MARTIN

T.O. 1C-121(E)D-1SS-15

SAFETY SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

EC-121D AND TC-121C

AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. 1C-121(E)D-1 AND REPLACES SAFETY SUPPLEMENT T.O. 1C-121(E)D-1SS-7, DATED 22 NOVEMBER 1965. The supplement and attached flyleaf Safety Supplement Status page will be filed with the basic manual by personnel responsible for maintaining the publication in current status.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AFFECTED AF PERSONNEL.

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23 NOVEMBER 1966

1. PURPOSE.

To provide aircrews with expanded procedures if landing gear fails to extend.

2. INSTRUCTIONS.

The paragraphs under Landing Gear System Malfunction Procedures Failure to Extend are changed to read:

Failure to Extend.

After the landing gear is extended, if any of the landing gear warning devices indicate an unsafe condition of the gear, it should be considered that the gear is unsafe for landing and not that there is a malfunction of the warning system, unless definitely proven otherwise. These warnings are: glowing of the gear unlocked warning light, unlocked indication of any of the gears on the landing gear position indicator, and the sounding of the landing gear warning horn (activated by the throttles and/or the wing flap lever). The following procedures are based upon the assumption that normal hydraulic system pressure is available; however, certain portions of these procedures will still apply if only the emergency extension system is operating. The procedures apply to malfunctioning nose or main gear unless specified otherwise.

a. Determine whether the affected gear is still on the uplock or is down but not locked.

NOTE

The landing gear position indicator will indentify the malfunctioning landing gear(s). The approximate position of the affected gear(s) can then be determined by crew inspection. This can be done with the drift sight for any gear or from the cabin for main gear and from the lower forward compartment for the nose gear. Control tower operators may also provide visual assistance in determining the position of the malfunctioning gear.

b. If the affected gear is up and locked:

(1) Operate the landing gear lever up and down several times. Wait for the normally operating gears to complete each cycle.

(2) Malfunctioning main gear only – Place the landing gear lever DOWN and then NEUTRAL (after the operating gears are down and locked). Moving the lever to DOWN removes the wedge from the uplock jaws; moving it to NEUTRAL removes hydraulic pressure from the landing gear system. The gear then hangs from the uplock jaws. Cycle the wing flaps from 0 to 100% and back several times, allowing them to stop at either extreme before recycling. Relative span-wise motion may relieve binding in the uplock jaws, working them loose and allowing the gear to free fall. If unsuccessful, execute a series of pushovers and pullups (observing aircraft structural limitations). Wing flaps may be recycled during these maneuvers. The resulting vertical forces will cause a hammering action by the uplock lug against the guide and the jaws of the uplock since there is no hydraulic pressure applied to the actuating cylinder.

(3) Repeat paragraph (2) above with the gear lever DOWN if the gear cannot be dislodged from the uplock. The forces developed by those actions may be helpful in freeing a binding wedge in the uplock.

(4) Retract the operating gears and try extending by means of the emergency extension system, using recommended procedures (No. 3 and 4 emergency shutoff levers HYDRAULIC OIL OFF). Pump maximum pressure with the handpump.

(5) Repeat the above procedures as necessary. Place the gear lever DOWN when a successful extension is accomplished and leave it in that position for the remainder of the flight.

c. If the affected gear is down but not locked:

(1) Operate the landing gear lever up and down several times. Wait for the operating gears to complete each cycle.

(2) Make alternate pushovers and pullups while using normal system pressure to hold gear down. Use maximum handpump pressure if normal system pressure is not available.

(3) Attempt to extend gear by means of the emergency extension system using recommended procedures (No. 3 and 4 emergency shutoff levers HYDRAULIC OIL OFF). Pump maximum pressure with the handpump.

(4) Repeat the preceding steps as necessary.

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CURRENT FLIGHT MANUAL	DATE	CHANGED
T.O. 1C-121(E)D-1	15 Oct 64	31 Jan 66

CURRENT FLIGHT CREW CHECKLIST	DATE	CHANGED
T.O. 1C-121(E)D-1CL-1	15 Oct 64	30 Sep 66
-2	15 Oct 64	31 Jan 66
-3	15 Oct 64	31 Jan 66
-4	15 Oct 64	Original
-5	15 Oct 64	Original
-6	15 Oct 64	Original
-7	15 Oct 64	31 Jan 66
-8	31 Jan 66	Original

CURRENT SAFETY SUPPLEMENTS

NO.	DATE	SHORT TITLE
- 8	21 Dec 65	Radio Operator'sChecklist
- 9	21 Dec 65	Engine Fire During Ground Operation
-10	23 Feb 66	Landing Gear Malfunction
-13	20 Jun 66	Ditching
-14	12 Oct 66	Emergency Landing Gear Extension
-15	23 Nov 66	Landing Gear Fails to Extend

REPLACED OR RESCINDED SAFETY SUPPLEMENTS

- 7	Replaced by -15

END

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T.O. 1C-121(E)D-1SS-14

SAFETY SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

EC-121D & TC-121C

AIRCRAFT

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12 OCTOBER 1966

NOTE

This supplement affects the Pilots checklist and is incorporated in change to the checklist, dated 30 Sep 66.

1. PURPOSE.

To revise the Pilots Emergency Landing Gear Extension Checklist.

2. INSTRUCTIONS.

The Emergency Landing Gear Extension Checklist is changed as follows:

EMERGENCY LANDING GEAR EXTENSION CHECKLIST

PILOTS

1. No. 3 and No. 4 emergency shutoff	HYD OIL OFF	CP
2. Landing gear lever	DOWN	CP

AF SMAMA OCT 66, 1400

3. Emergency fuel dump lever	L.G. EMER EXT	CP
4. Emergency hand pump selector	EMER GEAR (aft)	CP
5. Emergency hand pump	OPERATE	CP
6. Landing gear position indicator	GEAR DOWN AND LOCKED	P, CP
7. Emergency hand pump selector	EMER BRAKES	CP

WARNING

Do not reactivate the secondary hydraulic system after the gear is down and locked if the landing gear selector valve is malfunctioning or if it cannot be determined that the landing gear selector valve is in the DOWN position.

8. Emergency extension	CHECKED	P

Check fluid level and have replenished.

END

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REPLACED OR RESCINDED SAFETY SUPPLEMENTS

-11	20 Jun 66	Replaced by -13
-12		Rescinded

T.O. 1C-121(E)D-1S-15

OPERATIONAL SUPPLEMENT

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14 OCTOBER 1966

1. PURPOSE.

To provide new information to the Appendix of the Flight Manual.

2. INSTRUCTIONS.

Under Engine Operating Data, figure A2-9 Maximum Cruise Power is changed to read: Maximum allowable CHT 215°C. Limit MAP 43.0 in Hq (low blower) 44.0 in Hq (high blower, 10% lean) and 45.0 in Hq (high blower, 15% lean). No time limit.

NOTE

If there is any engine instability at 15% lean, use 10% lean.

AF SMAMA OCT 66, 1400

FLIGHT MANUAL AND OPERATIONAL SUPPLEMENT STATUS

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-8	31 Jan 66	Original

CURRENT OPERATIONAL SUPPLEMENTS

NO.	DATE	SHORT TITLE
-10	31 Jan 66	618T-1HF
-11	8 Apr 66	Fuel System Check
-13	5 Jul 66	Low High Blower Change
-14	30 Sep 66	
-15	14 Oct 66	

REPLACED OR RESCINDED OPERATIONAL SUPPLEMENTS

-12	22 Jul 66	Replaced by -14

END

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T.O. 1C-121(E)D-1S-14

OPERATIONAL SUPPLEMENT

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EC-121D & TC-121C

AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. 1C-121(E)D-1 AND REPLACES OPERATIONAL SUPPLEMENT T.O. 1C-121(E)D-1S-12, DATED 22 JULY 1966, WITH CHANGES TO THE TEXT. The supplement and attached flyleaf Operational Supplement Status page will be filed with the basic manual by personnel responsible for maintaining the publication in current status.

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30 SEPTEMBER 1966

1. PURPOSE.

To provide aircrews with new information to Section II, III and V of the Flight Manual.

2. INSTRUCTIONS.

a. In Section II under DESCENT CHECKLIST–PILOTS, add item 12:

12. Windshield wash – AS REQUIRED.

b. In Section III, under the paragraph LANDING WITH ONE OR MORE ENGINES INOPERATIVE, change the third sentence to read:

Landing with only one engine inoperative will not seriously affect the normal characteristics of the aircraft; therefore, normal flap settings and airspeeds should be utilized.

c. The sentence starting in line 26 is changed to read:

AF SMAMA OCT 66, 1400

The airspeed during final approach should be 140 knots until landing is assured, no more than 60% flaps should be used.

d. Under GO-AROUND TWO ENGINES OPERATING CONTROL BOOST ON, item b. should read:

Airspeed – 130 knots (minimum).

e. In Section V under INSTRUMENT MARKINGS, figure 5-1 (Sheet 1 of 3) Cylinder Head temperature should read:

Blue 145° – 215°C AUTO/MANUAL LEAN PERMITTED.

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-14	30 Sep 66	

REPLACED OR RESCINDED OPERATIONAL SUPPLEMENTS

-12	22 Jul 66	Replaced by -14

END

T.O. 1C-121(E)D-1S-13

OPERATIONAL SUPPLEMENT

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5 JULY 1966

1. PURPOSE.

To provide new information to Section II of the flight manual.

2. INSTRUCTIONS.

Under CLIMB, the CAUTION is changed to read as follows:

CAUTION

Particular attention must be paid to engine oil pressure indications when the supercharger control levers are moved from LOW to HIGH. If oil pressure fluctuation is noted and the supercharger is still in low ratio after resuming power, an internal engine failure may be imminent. Return the lever to LOW and feather the propeller if abnormal oil pressure and/or temperature are observed. If the supercharger will not shift and no oil pressure fluctuation is noted, return the control lever to LOW and leave it in that position for the remainder of the flight.

END

AF SMAMA JUL 66, 1600

T.O. 1C-121(E)D-1SS-13

SAFETY SUPPLEMENT

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AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. 1C-121(E)D-1 AND REPLACES SAFETY SUPPLEMENT T.O. 1C-121(E)D-1SS-11, DATED 28 FEBRUARY 1966 WITH CHANGE TO THE TEXT. Reference to this supplement will be made on the title page by personnel responsible for maintaining the publication in current status.

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20 JUNE 1966

NOTE

This safety supplement provides a corrected change to the checklist. Attach the page provided by figure 1 of this supplement over the existing page in the checklist. Reference to this supplement should be made on the title page of the checklist.

1. PURPOSE.

To provide new DITCHING PROCEDURES to Section III, of the flight manual.

2. INSTRUCTIONS.

a. Change the paragraph DITCHING to read as follows:

DITCHING

Ditching is a term used to describe an emergency landing of an aircraft on water. A successful aircraft ditching is dependent on sea conditions and wind, aircraft type, and skill and technique of the pilot. Most of the AEW & C flights are conducted over water and it is essential that pilots know how to evaluate sea conditions in order to execute a pattern and touchdown suited for the existing weather and sea conditions. The aircraft may be damaged by impact and all efforts must be directed toward a prompt and orderly abandonment. (See Figure 3-11). Each crew member should be thoroughly familiar with his duties as well as the duties of all other crew members, so that in event of injury to one, another crew member may assume his duties. Responsibility for each piece of equipment to be removed from the aircraft should be assigned to various regular crew members. Periodic drills will insure orderly operation when an emergency occurs and will familiarize flight personnel with the location of all emergency equipment. A description of each crew members's duties and other helpful information are outlined in the Ditching, Crash Landing, Bailout Chart in this section. Ditching information contained in this section has been condensed from AFM 64-6, Aircraft Emergency Procedures Over Water, and each aircrew member should review this manual for further amplification of ditching procedures.

b. SPECIAL PROCEDURES, change the paragraph to read:

SPECIAL PROCEDURES

Selection of Ditching Heading.

The greatest danger to an aircraft during ditching is that rapid deceleration, extensive damage, and injury to personnel may be experienced upon contact with the water. These dangers can be minimized by selecting the optimum ditching heading. Selection of the ditching heading may well determine the difference between survival and disaster. Factors to consider in heading selection are as follows:

a. EFFECT OF SWELLS.: A swell is a condition of the surface which has been caused by a distant disturbance. The individual swell appears to be regular and smooth with considerable distance between the rounded crests. The primary swell is the swell system having the greatest height from trough to crest. Secondary swells are those systems having less height than the primary swell system. Swell direction is the direction *from* which a swell is moving. This direction is not necessarily the result of the wind present at the scene. Wave or chop is the condition of the surface caused by local winds. It is characterized by its irregularity, short distance between crests, whitecaps and breaking motion. It is not sufficient to land into the wind without regard for sea conditions. This procedure has proved disastrous in the past. Many ditchings plus hundreds of open sea seaplane landings have proved that the swell systems must be taken into consideration. The best touchdown conditions are obtained with a minimum relative speed existing between the aircraft and the swells. If the aircraft is landed into the swell, it has a good chance of being swamped or thrown into the air out of control by the oncoming swell. If the aircraft is landed down swell with touchdown just beyond the crest, the aircraft may come to rest short of the next crest; but shorter swell lengths ordinarily prevent this heading, except when conditions warrant landing down a secondary swell system. The best ditching heading is parallel to the primary swell system. It makes little difference whether touchdown is on top of the crest or in the trough, although it is preferable, if possible, to land on the top or backface of the system (see Figure 3). Most sea conditions involve two or more swell systems running in different directions. A difficult situation occurs when two swell systems are at right angles. If a pilot parallels one swell system, he must land into or down the other system. In this case, down swell to both systems may be advisable. When landing down a secondary swell and parallel to the primary, attempt to touch down on the backside, not on the face of the swell.

b. EFFECT OF WAVES OR CHOP: Local winds create waves that ride on top of the underlying swell systems. Moderate waves alone caused by wind can be discounted as a danger to ditching.

c. EFFECT OF WIND: The best condition for ditching is one which permits landing parallel to a single swell system and into the wind. This situation seldom exists. Some crosswind is usually present and must be accepted in order to land parallel to the major swell. There is a ample reason, based on theoretical considerations and on a limited number of actual ditchings in high winds, to believe that low wing land planes can accept a higher crosswind component than seaplanes. If the swell system is formidable, it is considered advisable in landplanes to accept more crosswind to avoid landing directly into the swell. The following rules apply to seaplane operations in the open sea and can be used as an aid in selecting a ditching heading:

(1) WINDS FROM 0-25 KNOTS. Ignore the crosswind component and land parallel to the primary swell. If a pronounced secondary swell exists, it may be desirable to land down the secondary system and accept some tailwind component.

(2) WINDS BETWEEN 25-35 KNOTS. It may be necessary to select an intermediate heading, neither parallel to the swell (since the crosswind may prove too much to handle) nor into the wind (because the ground speed reduction, due to headwind, will not compensate for the disadvantage of landing into the swell). A heading at an angle into the greater crosswind component should be accepted in order to more closely parallel the swell.

(3) WINDS OVER 35 KNOTS. Generally, with winds of this force, the landing will be made into the wind regardless of the swell. Ground speed will be materially reduced. However, if the swell is so formidable as to make a successful ditching into it doubtful, it may be advisable to land at an angle, or parallel, to the swell-accepting crosswinds of great force.

The simplest method of estimating the wind direction and velocity is to examine the wind streaks on the water. These appear as long streaks up and down wind. Some persons may have difficulty determining wind direction after seeing the streaks on the water. Whitecaps fall forward with the wind, but are overrun by the waves, thus producing the illusion that the foam is sliding backward. Knowing this and by observing the wind streaks, the wind direction is easily determined. Wind velocity can be estimated by noting the appearance of the whitecaps, foam and wind streaks.

	APPROX WIND VELOCITY	
SURFACE CONDITION	KNOTS	MPH
Few White Crests	8-17	10-20
Many White Crests	17-26	20-30
Streaks of Foam from Crests	26-35	30-40
Spray Blown from Tops of Waves	35-43	40-50

SELECTION OF TOUCHDOWN POINT

On final approach, look ahead and observe the surface of the sea. There may be shadows and whitecaps - signs of high seas. Touchdown in these areas is to be avoided. Look for a relatively smooth area where the shadows and whitecaps are not so numerous and try to touchdown on the near edge.

SEA EVALUATION

The pilot should begin analyzing the surface from as high an altitude as the surface can be seen, 2,000 feet or more if possible. The primary swell will be recognized first. Determine its direction and then look for secondary systems. As altitude is decreased and the aircraft turned through 360 degrees, surface appearance will change and the direction and size of the different swell systems should be remembered. Once primary and secondary systems are recognized, the analysis may be checked by flying on various headings just above the water. When flying into any system, the sea appears to be steep, fast, and rough. When flying down or parallel to the system, the sea seems much more calm. Estimate the direction and velocity of the wind. Using these factors, select the best ditching heading.

SEA EVALUATION MINIMUM TIME

1. Determine direction of primary swell.
2. Determine direction of secondary swell if time permits.
3. Estimate direction and velocity of wind.
4. Using these factors, select ditching heading.

DITCHING TECHNIQUE

The pilot's task is essentially to set the aircraft down on a proper heading in the right spot at the best combination of attitude and speed. The desired aircraft configuration is flaps 100% with landing gear retracted and fuel dump completed. Touchdown should be at the lowest speed and rate of descent which permit safe control and optimum nose up attitude on impact. When pre-ditching preparations are complete, the pilot should turn to the ditching heading and commence letdown. The aircraft should be dragged low over the water and slowed down until 10 knots above a stall. At this point, power should be added to overcome the additional drag caused by the nose up attitude. When a smooth stretch of water appears ahead, cut power, and touchdown as close to a stalling speed as possible. Care must be taken not to drop the aircraft from too high an attitude or to balloon due to excessive speed. At night or over smooth, glassy water, it is easy to misjudge altitude. Under these conditions, carry enough power to maintain 9–12 degrees nose up attitude and 7–10 knots above stall speed until contact is made with the water. If power is available on one side only, a little power should be used to flatten the approach; however, the engine should not be used to such an extent that the aircraft cannot be turned against the good engines right down to the stall with a margin of rudder movement available. If power is available on one side only, a slightly higher than normal glide approach should be used. This will insure good control and some margin of speed after leveling off without the use of excess power. If no power is available, a greater than normal approach speed should be used down to flare out. This speed margin will allow the glide to be broken early and more gradually, thereby giving the pilot time and distance to feel for the surface. In most cases, drift caused by crosswind can be ignored; the forces acting on the aircraft after touchdown are of such magnitude that drift will only be a secondary consideration. If the aircraft is under good control, the "crab" may be kicked out with rudder just prior to impact. Lower radome and flaps on most aircraft may be expected to carry away on initial impact. If the flaps do withstand impact, some diving tendencies may result. The importance of flaps in slowing down the aircraft on approach make their use mandatory. If the aircraft is landed wing low, a waterloop may result, thus increasing the possibility of structural failure to the after fuselage. Prior to ditching, the aircraft should be made as light as possible by dumping fuel.

WARNING

Keep flight station windows closed because the aircraft has a tendency to nose under as it loses forward speed on water. All openings, with the exception of the overwing emergency escape hatches, will be kept closed.

DITCHING PROCEDURE BY SELF ILLUMINATION (Figure 2).

If an aircraft is forced to ditch at night, the pilot must be prepared to select a suitable ditching heading based on surface conditions received during the mission weather briefing or information obtained from other sources. Many ships at sea, including Ocean Station Vessels, send frequent weather reports. This information may sometimes be obtained through the air-ground station, which requests it from the Rescue Coordination Center. A pilot will often have an estimate of the best ditching heading from observation made during daylight. Additional aid in ditching may be obtained from the use of parachute flares. It is advisable to utilize both flares simultaneously for ditching. After selecting a ditching heading, the following procedures are recommended for a single aircraft ditching by self illumination (see Figure 2):

a. Make all preparations for ditching. Use DITCHING CHECKLIST.

b. Fly the reciprocal of the selected ditching heading. Descend, rate as required, to 2,000 feet.

CAUTION

Initiate the recovery from an emergency rapid descent, if applicable, at 3,000 feet and level off at 2,000 feet to establish the proper ditching pattern configuration.

c. Flaps 60 percent and establish desired pattern approach speed (140 to 150 knots). (Make all turns standard rate 3 degrees per second.)

d. Turn 40 degrees right (descent to 2,000 feet may be accomplished on 40 degree teardrop leg).

e. Drop both flares from 2,000 feet and begin descent of 1,000 feet per minute. MAP approximately 22 in Hg or as required. (Power settings based on aircraft gross weight of 110,000 lbs, four engines operating.)

f. Maintain 40 degree teardrop leg for 45 seconds.

g. Turn 220 degrees left or until the flare is dead ahead. Water and flare should be clearly visible throughout the last 180° of turn, weather permitting.

h. Do not descend below 500 feet indicated altitude until established inbound. Adjust rate of descent and/or power as required. (Last 90 degrees of turn will require additional power for a level turn.)

i. When established inbound, lower flaps to 100 percent; descend and flare prior to touchdown. The illumination flare will be approximately one minute ahead.

WARNING

If the flares are not visible at the point where the aircraft reaches 500 feet on the ditching heading, convert to a power-attitude approach. Begin descent of 200 feet per minute and an airspeed of 7–10 knots above stall with flaps 100 percent. This approach should be maintained until the aircraft makes contact with the water or visual contact is established for ditching.

j. Ditch straight ahead using the light of the flare and set power, as required, to reduce airspeed to 7–10 knots above stall. *Do not over shoot.* The best touchdown point is several hundred yards short of the flare. Avoid flying into the water at a high rate of descent due to faulty depth perception or altimeter setting.

DITCHING WITH VERY LOW CEILING AND VISIBILITY.

The effectiveness of parachute flares with low ceilings and reduced visibility is only fair, but still better than no illumination at all. If the flares are dropped from an altitude of 2000 feet, they will ignite at 1700 feet and 3 minutes later go out at 100 feet. Even with a low ceiling, the flares would be visible during the final portion of the approach.

IF FLARES ARE NOT AVAILABLE FOR DITCHING OR LOW VISIBILITY PROHIBITS THEIR USE, A POWER APPROACH SHOULD BE MADE. When using the self illumination pattern and the flares are not visible at the point where the aircraft reaches 500 feet on the ditching heading, convert to the power approach and continue straight ahead. Set up a power altitude combination for a rate of descent of 200 feet per minute and an airspeed 7–10 knots above stall with flaps down. This approach should be maintained until the aircraft makes contact with the water or visual contact is established for ditching.

ALTITUDE DETERMINATION.

The pressure altimeter may be several hundred feet in error. The radio and radar altimeter should be used throughout the descent as a check against the pressure altimeter. Near the water, or with a high rate of descent, the radio altimeter is generally more reliable. The APN–1/–22 altimeter should have the altitude limit switch set to 50 feet. When the red light comes on, the pilot can expect contact momentarily.

c. Figure 3–9 of the basic manual is changed by Figures 2 and 3 of this Safety Supplement.

d. On page 3–70, DITCHING/CRASH LANDING/BAILOUT; Duties Before Impact, under Ditching column, change item 3 to read as follows:

3. Order fuel to be dumped (if applicable).

e. In same column, delete item 8.

(Cut out and insert in checklist)

T.O. 1C-121(E)D-1CL-1

DITCHING (PILOT).

Before Impact.

1. Bell & announcement — 6 RINGS, EMER & INTENTIONS.
2. Set course for nearest land or vessel.
3. Fuel (if no fire) — DUMP.
4. Cabin — DEPRESSURIZE.
5. Copilot to don survival equip., adj & fasten harness.
6. Pilot don survival equip.
7. Pilot adj & fasten shoulder harness.

Ditching Imminent.

1. Flares — JETTISON.
2. PA & interph (copilot) — GIVE WARNING.
3. Radio opr screw down key.
4. Flaps — 100%. at 500 ft inb on dtch Hg.
5. Bell (copilot) — ON (30 sec. prior to impact).
6. Power — AS DESIRED.

After Impact.

1. All personnel — EVACUATED.
2. Take flashlight, dinghy & evacuate acft.
3. Assume command of left raft.

Exit.

1. Use left emer exit.

E-10

Chg'd 28 Feb 66, reflects 1SS-13

Figure 1

DITCHING PATTERN WITH SELF-ILLUMINATION (FLARES)

Prepare for ditching.

1.

Fly the reciprocal of ditching heading Descend, rate as required, to 2000 feet.

2.

3. Flaps 60%, airspeed (140–150 kts). RPM 2600. (Make all turns standard rate 3° per second.

Turn 40° right (Descent to 2000 feet may be accomplished on 40 teardrop leg.)

4.

5. Drop both flares. Begin 1000 ft/min rate of descent. MAP approximately 22" Hg or as required. (Power setting based on acft gross weight of 110,000 lbs, 4 engines operating.)

Maintain 40° teardrop leg for 45 seconds.

6.

10. Slow acft to 7–10 kts above stall - engage water prior to passing flare.

Turn 220° left or until flare is dead ahead. Water and flare should be clearly visible throughout the last 180° of turn, weather permitting.

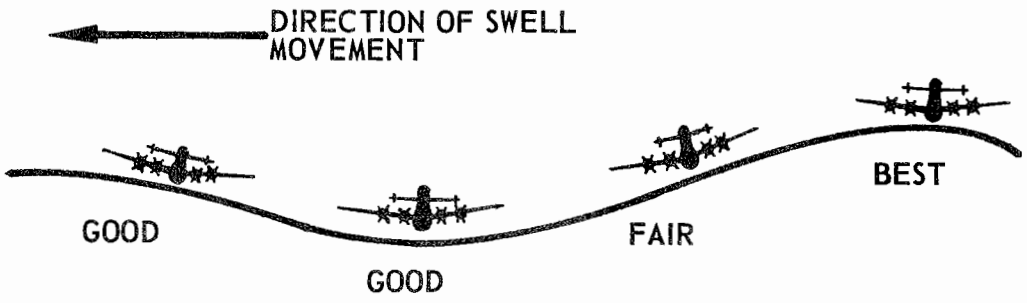
7.

9. When established inbound, lower 100% flaps. Descend and flare prior to touchdown. The illumination flare will be approximately 1 minute ahead.

8. Do not descend below 500 feet indicated until established inbound. Adjust rate of descent and/or power, as required. (Last 90° of turn will probably require additional power for a level turn.)

FIGURE 2

LANDING PARALLEL TO THE MAJOR SWELL



LANDING ON THE FACE AND BACK

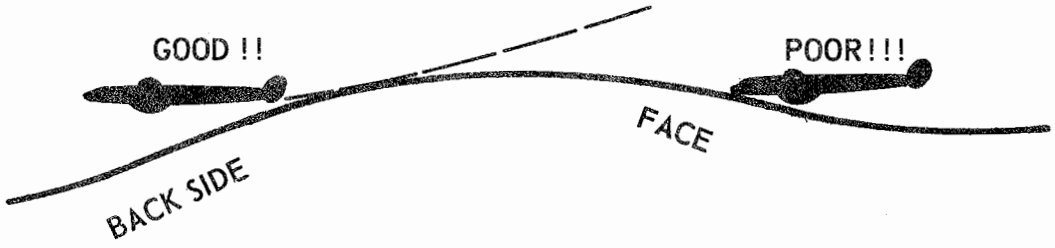


FIGURE 3

END

T.O. 1C-121(E)D-1S-11

OPERATIONAL SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

EC-121D & TC-121C

AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. 1C-121(E)D-1. Reference to this supplement will be made on the title page of the basic manual.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AFFECTED AF PERSONNEL.

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8 APRIL 1966

NOTE

This supplement provides a corrected change to the checklist. Attach the checklist pages provided by figures 1 thru 6 of this supplement over the corresponding existing pages in the checklist. Reference to this supplement should be made on the title page of the checklist.

1. PURPOSE.

To reduce the time the fuel system is under pressure from the fuel booster pumps during preflight.

2. INSTRUCTIONS.

a. After Interior Inspection, First Engineer, complete FUEL SYSTEM CHECK as follows:

FIRST ENGINEER

FUEL SYSTEM CHECK

1. Mixtures – AUTO RICH.

2. Tip tank fuel pump switches – ON.
3. Tank No. 6 fuel pump switches – LOW, if tank No. 6 contains fuel.
4. Tank selector levers, No. 1, 2A, 3A and 4 – ON, check for LOW and HIGH fuel pump operation. 12 psi on LOW and 27 psi on HIGH or bus voltage.
5. Tank selector levers No. 2 and No. 3 – ON, check for LOW and HIGH fuel pump operation.
6. No. 1, 2, 2A, 3A, 3 and 4 fuel pump switches – OFF.
7. Tank selector levers – OFF.
8. Fuel pump switches – ON, fuel pressure should not register, turn switches OFF.
9. Fuel tank selector levers No. 1, 2, 3 and 4 ON.
10. Tank No. 5 fuel pump switch – On LOW.
11. Tank No. 5 and crossfeed levers – OPEN, note fuel pressure for all engines.
12. Tank No. 5 fuel pump switch – On HIGH.
13. No. 1 emergency shutoff lever OFF check – Completed.
    a. Move slowly to full OFF, check fuel pressure drop and warning light on at approximately 19 psi.
    b. Note lever between hydraulic oil OFF and fuel OFF position.
14. No. 1 emergency shutoff lever ON check – Completed.
    a. Move slowly to full ON, check fuel pressure rise and warning light OFF at approximately 19 psi.
    b. Note lever between hydraulic oil OFF and fuel OFF position.
15. Repeat items 13 and 14 for engines No. 2, 3 and 4 emergency shut off levers.

NOTE

If lever operation is stiff, do not force movement. Notify maintenance personnel.

16. Tanks No. 1, 2, 2A, 3A, 3, and 4 fuel pump switches – LOW.
17. Keep fuel system pressurized and mixtures in AUTO RICH until exterior fuel system check is completed.

b. Under EQUIPMENT OPERATIONAL CHECK add new coordinated item:

18. Fuel system check – completed.
    a. No. 1, 2, 2A, 3A, 3, 4, 5 and 6 fuel pumps switches and mixtures – OFF.
    b. Tank 5 and cross-feed levers – CLOSED.

c. Under EQUIPMENT OPERATIONAL CHECK add note after item 15:

SECOND ENGINEER

NOTE

Assure that fuel system is pressurized and mixtures AUTO RICH prior to exterior fuel system check to make certain that any fuel leaks will be noticeable.

16. Tip tank, wing panels, outboard nacelle, inboard nacelle, and wheel well – check for fumes leaks and noisy fuel pump bearings. Use same procedure on opposite wing.
17. Electronic inverter – On MAIN and checked.
18. Refrigerator – Check operation.
19. Fuel system check – completed.
20. Tip tank pumps (EC–121D) – ON.

d. Under TOP OF WING INSPECTION add new item 14:

14. Tip tank pumps (EC–121D) – OFF.

e. Under EXTERIOR INSPECTION BY PILOT, delete so much of paragraph that reads:

"Assure that fuel system is pressurized and mixtures AUTO RICH prior to exterior check to make certain that any fuel leaks will be noticeable."

T.O. 1C-121(E)D-1S-7

OPERATIONAL SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

EC-121D & TC-121C

AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. 1C-121(E)D-1. Reference to this supplement will be made on the title page of the basic manual by personnel responsible for maintaining the publication in current status.

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25 FEBRUARY 1966

1. PURPOSE.

To provide new information to Section IV of the Flight Manual.

2. INSTRUCTIONS.

Under COMMUNICATIONS AND ASSOCIATED ELECTRONICS SYSTEM (EC-121D) add the following:

VHF 101 COMMUNICATIONS SYSTEM (EC-121D)

The VHF 101 radio is a short range set for air-to-air or air-to-ground voice communications. The set includes an antenna, transmitter, receiver and control panel. The frequency range of the transmitter is from 116 to 149.95 MCS in 50 KCS steps. The set has two modes of operation, SCS (Single Channel Simplex) or DCS (Double Channel Simplex)/Operation of the system is from 28 volt DC radio circuits.

AF SMAMA FEB 66, 1400

POWER SWITCH

This switch controls system power.

FREQUENCY SELECTOR KNOBS

The frequency of the set is manually selected by use of these knobs. One knob sets MCS and the other sets KCS in 50 KCS steps.

SCS-DCS SWITCH

This switch with SCS-DCS positions, selects single channel or double channel simplex mode of operation. When this switch is in the SCS position, the transmitter and receiver operate at the frequency selected on the control panel. The DCS position is functional at receiver frequencies (as selected on control panel) of 118.00 to 120.95 MCS and 127.00 to 129.95 MCS. In these frequency ranges, the transmitter operates at a frequency 6 MCS above the receiver frequency. At all other control panel selections the transmitter will tune to the same frequency as that selected on the control panel regardless of the switch position. In any case, the receiver is disabled while the transmitter is operating since the set has only one antenna.

VOLUME AND SQUELCH CONTROL

The volume control adjusts the volume level going to the interphone. The squelch circuit shuts off the receiver audio amplifier below a preset signal level to prevent annoying noise in the headset or loudspeaker. The squelch control adjusts the signal sensitivity level at which time this cut-off occurs.

END

T. O. 1C-121(E)D-1SS-10

SAFETY SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

EC-121D & TC-121C

AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T. O. 1C-121(E)D-1, AND REPLACES SAFETY SUPPLEMENT T. O. 1C-121(E)-1SS-4, DATED 15 JULY 1965, WITH CHANGES TO THE TEXT. Reference to this supplement will be made on the title page by personnel responsible for maintaining the publication in current status.

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23 FEBRUARY 1966

1. PURPOSE.

   To provide new information to Section III of the Flight Manual.

2. INSTRUCTIONS.

   On page 3-35, under the paragraph LANDING GEAR MALFUNCTION PROCEDURES – Failure to Retract, is changed to read:

   Failure to Retract.

   a. If all gears unlock, but do not retract, when the gear handle is placed in the UP position:

   (1) Check secondary hydraulic system pressure and reservoir quantity. If the loss of pressure and/or quantity was not caused by a leak in the landing gear system, the landing gear may be retracted when the pressure is restored.

   (2) Check the position of the emergency hand pump selector valve. If the valve is in the LANDING GEAR position, move it to the BRAKE position and retract the gear.

AF SMAMA FEB 66, 1400

b. If the nose gear does not retract or gives an unsafe indication when the gear handle is placed in the UP position, inspect the gear and the wheel-well doors through the forward baggage compartment door.

(1) If the nose gear is in the uplock and there is no apparent damage to either the gear or the wheel-well doors, place the gear handle to neutral. If the gear stays in the uplock, the flight may be continued. Extend the gear only when necessary for landing.

(2) Check the position of the nose gear shutoff valve.

WARNING

The landing gear handle must be placed to neutral before attempting to open the nose gear shutoff valve. The crew member who is operating the shutoff valve must be safety-strapped to the aircraft structure.

c. If a main gear fails to retract or indicates UNSAFE when the landing gear handle is placed in the UP position, inspect the gear through the driftmeter.

(1) If the wheel-well doors are damaged as noted by the wheels being visible while the doors are not, leave the gear handle in the UP position and dump fuel if required. The gear will then be extended if possible.

(2) If the affected gear is not in the wheel-well, leave the gear handle in the UP position and dump fuel if required. The gear will then be extended if possible.

(3) If the affected gear is in the wheel-well, place the gear handle to neutral. Continue the flight if the gear does not fall out of the uplock. If the gear free-falls, dump fuel if required. The gear handle will then be placed in the DOWN position.

WARNING

Do not recycle the landing gear if the cause of the failure to retract is unknown or if damage to the wheel-well doors is apparent.

(4) Inspect the gear for possible damage to tires, hydraulic lines, etc.

NOTE

Fuel can be dumped safely with the gear extended if required. Cross reference all landing gear malfunctions with the indicator, warning lights and horn.

END

T.O. 1C-121(E)D-1S-10

OPERATIONAL SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

EC-121D & TC-121C

AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. 1C-121(E)D-1 AND REPLACES OPERATIONAL SUPPLEMENT T.O. 1C-121(E)D-1S-4 DATED 25 MARCH 1965, WITH CHANGES TO THE TEXT. Reference to this supplement will be made on the title page of the basic manual by personnel responsible for maintaining the publication in current status.

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31 JANUARY 1966

1. PURPOSE.

To provide new information to Section IV after paragraph 618 S-1 HF TRANSMITTER/RECEIVERS for those EC-121D aircraft modified by T.O. 1C-121-750 and T.O. 1C-121-750C.

2. GENERAL.

Two 618 T-1 HF transceivers (1 and 13, figure 4-21) sets designated commands and liaison, provide voice communications through SSB (single sideband) transmitting and receiving facilities. There are 28000 channels in the frequency range of 2.0 to 30.0 mc. The frequency selector control units 714E are located at the pilot's overhead control panel (12, figure 1-8, sheet 1 of 2) and the radio operator's station (4 figure 4-21). A four position switch allows the operator to select USB (upper sideband), LSB (lower sideband), AM or OFF positions. Frequencies are selected by operation of the selector knobs and are read directly. The system operates on dc and ac power.

END

AF SMAMA FEB 66, 1500

T.O. 1C-121(E)D-1SS-9

SAFETY SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

EC-121D & TC-121C

AIRCRAFT

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21 DECEMBER 1965

NOTE

This supplement provides a corrected change to the checklist. Attach the checklist pages provided by this supplement over the corresponding existing pages in the checklist. Reference to this supplement should be made on the title page of the checklist.

1. PURPOSE.

To revise ENGINE FIRE DURING START AND/OR GROUND OPERATION in Section III of the Flight Manual.

2. INSTRUCTIONS.

ENGINE FIRE DURING START AND/OR GROUND OPERATION is to read as follows:

Anytime an engine fire occurs during starting or ground operation and external fire fighting equipment is available, both engines on that side of the aircraft where the fire exists will be shut down simultaneously. An accepted deviation to this procedure will be when only two engines are operating on one side of the aircraft and cart power has been disconnected. When this occurs, the engine not on fire must remain in operation until the tower has been notified.

Caution should be exercised in using the aircraft fire extinguishing system for zone 1 fires due to different capabilities of the HRD and CO2 systems.

Pilots		Flight Engineer	
The first 2 items in *BOLD PRINT* will be accomplished prior to reading the checklist.		The first *4* items in *BOLD PRINT* will be accomplished prior to reading the checklist.	
1. BRAKE SELECTOR EMER.	P, CP	1. DISCONTINUE PRIMING AND/OR MOVE MIXTURE TO IDLE CUT OFF FOR APPLICABLE ENGINE.	
2. NOTIFY TOWER AND CREW	CP	2. CONTINUE CRANKING TO DRAW FIRE THROUGH ENGINE (FIRE DURING START ONLY). IF FIRE CONTINUES OR SPREADS, STOP CRANKING.	
		3. EMER SHUTOFF LEVER (Applicable engine)	OFF
		4. SMOTHER FIRE BY USE OF AIRCRAFT FIRE EXTINGUISHER SYSTEM AND/OR EXTERNAL EXTINGUISHER IF AVAILABLE.	
3. All mixture levers OFF	P	5. All mixture levers	OFF

WARNING

Do not cut mixtures until tower has been notified, if ground power has been disconnected.

4. All ignition switches OFF	P	6. Fuel pump switches	OFF
5. Evacuate aircraft	P	7. Battery or cart switch	OFF

NOTE

One long ring of the alarm bell on ground, signifies crew emergency evacuation.

WARNING

When all D.C. power is turned OFF, the fire detection system (CO2) will be inoperative and the fire may persist.

CAUTION

Do not attempt to restart engine until cause of fire has been determined and corrected.

T.O. 1C-121(E)D-1SS-8

SAFETY SUPPLEMENT
FLIGHT MANUAL

USAF SERIES

EC-121D & TC-121C

AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. 1C-121(E)D-1. Reference to this publication will be made on the title page of the basic manual by personnel responsible for maintaining the publication in current status.

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21 DECEMBER 1965

NOTE

This safety supplement provides a corrected change to the checklist. Reference to this supplement should be made on the title page of the checklist.

1. PURPOSE.

To provide a change to the RADIO OPERATOR'S CHECKLIST in Section VIII of the Flight Manual.

2. INSTRUCTIONS.

Under RADIO OPERATOR'S -- EMERGENCY PROCEDURES, Fuel Dumping, is changed to read as follows:

FUEL DUMPING

1. HF transmitter -- OFF.

After Dumping:

1. HF transmitter AS NECESSARY.

FLIGHT MANUAL

USAF SERIES

EC-121D

AND

TC-121C

SAFETY SUPPLEMENTS

To 1C-121(E)D - 15S-7 11/22/65
" 15S-8 12/21/65
" 15S-9 12/21/65
" 15S-10 2/23/66
" 15S-12 8/25/66
" 15S-13 6/20/66

OPERATIONAL SUPPLEMENTS

To 1C-121(E)D - 15-10 1/31/66
AIRCRAFT
" 15-7 2/25/66
" 15-11 4/8/66
" 15-12 7/22/66
15-13

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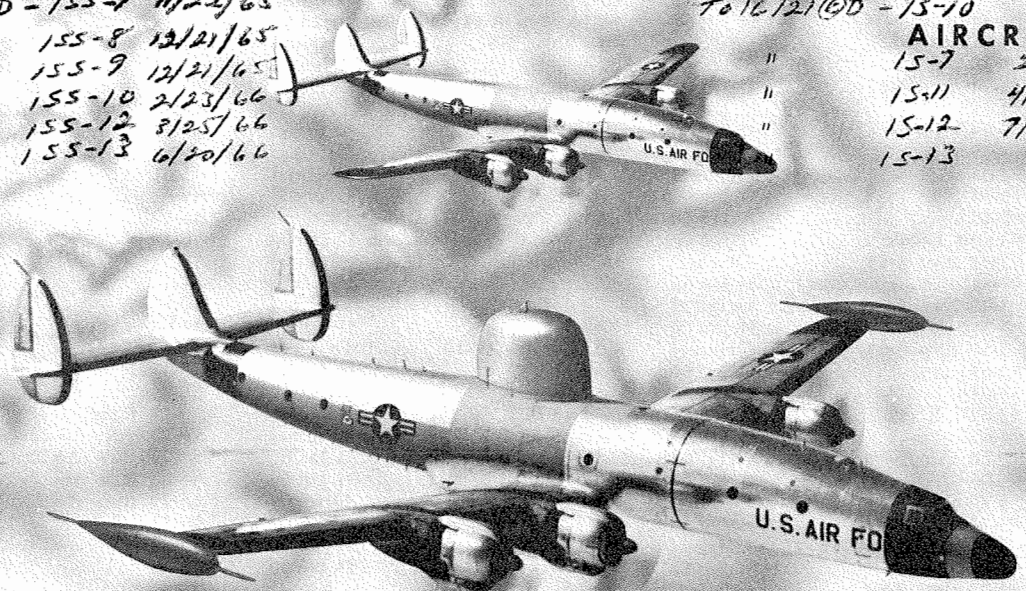

Commanders are responsible for bringing this manual to the attention of all personnel cleared for operation of subject aircraft.

See Weekly Index T.O. 0-1-1-3A for current status of Operational and Safety Supplements.

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Insert changed pages into basic publication. Destroy superseded pages.

AF SMAMA JUL 66, 1500

15 OCTOBER 1964
CHANGED 31 JANUARY 1966

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TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 728, CONSISTING OF THE FOLLOWING:

Page No.	*Issue*
*Title	31 Jan 66
*A	31 Jan 66
i	Original
*ii	31 Jan 66
*iii	31 Jan 66
iv	Original
1-1 thru 1-11	Original
*1-12	31 Jan 66
1-13 thru 1-22	Original
*1-23 thru 1-25	31 Jan 66
1-26 thru 1-85	Original
1-86 Blank	Original
2-1 thru 2-10	Original
*2-10A	31 Jan 66
*2-10B Blank	31 Jan 66
*2-11	31 Jan 66
2-12 thru 2-34	Original
*2-35	31 Jan 66
2-36 thru 2-46	Original
*2-47 thru 2-54	31 Jan 66
3-1 thru 3-22	Original
3-23	30 Apr 65
3-24 thru 3-34	Original
*3-34A	31 Jan 66
*3-34B Blank	31 Jan 66
*3-35	31 Jan 66
3-36 thru 3-39	Original
*3-40	31 Jan 66
*3-40A	31 Jan 66
*3-40B Blank	31 Jan 66
3-41 thru 3-43	Original
*3-44	31 Jan 66
3-45 thru 3-53	Original
*3-54	31 Jan 66
3-55 thru 3-63	Original
*3-64	31 Jan 66
*3-64A	31 Jan 66
*3-64B Blank	31 Jan 66
*3-65	31 Jan 66
3-66 thru 3-69	Original
*3-70	31 Jan 66
3-71 thru 3-73	Original
*3-74	31 Jan 66
3-75	Original
*3-76	31 Jan 66
3-77 thru 3-88	Original
4-1 thru 4-31	Original
*4-32	31 Jan 66
4-33 thru 4-36	Original
*4-37	31 Jan 66
4-38 thru 4-42	Original
*4-43	31 Jan 66
4-44 thru 4-47	Original
*4-48	31 Jan 66
*4-48A	31 Jan 66
*4-48B Blank	31 Jan 66
4-49 thru 4-51	Original
*4-52	31 Jan 66
*4-52A	31 Jan 66
*4-52B Blank	31 Jan 66
4-53 thru 4-92	Original
*4-93	31 Jan 66
4-94 thru 4-128	Original
5-1	Original
*5-2	31 Jan 66
5-3 thru 5-7	Original
*5-8 thru 5-10	31 Jan 66
5-11 thru 5-18	Original
6-1 thru 6-6	Original
*6-7	31 Jan 66
6-8 thru 6-11	Original
6-12 Blank	Original
7-1 thru 7-9	Original
*7-10	31 Jan 66
*7-10A	31 Jan 66
*7-10B Blank	31 Jan 66
7-11 thru 7-41	Original
7-42 Blank	Original
8-1 thru 8-9	Original
*8-10 thru 8-14	31 Jan 66
9-1 thru 9-3	Original
*9-4	31 Jan 66
9-5 thru 9-11	Original
9-12	30 Apr 65
9-13	Original
9-14 Blank	Original
A-1	Original
A-2 Blank	Original
A1-1 thru A1-20	Original
*A2-1	31 Jan 66
*A2-2	31 Jan 66
*A2-3	31 Jan 66
A2-4	Original
*A2-5	31 Jan 66
A2-6 thru A2-10	Original
*A2-11	31 Jan 66
A2-12	Original
*A2-13 thru A2-15	31 Jan 66
A2-16	Original
*A2-17	31 Jan 66
*A2-18	31 Jan 66
A2-19	Original
A2-20 Blank	Original
*A3-1	31 Jan 66
*A3-2	31 Jan 66
A3-3	Original
A3-4	Original
*A3-5 thru A3-7	31 Jan 66
A3-8	Original
*A3-9 thru A3-15	31 Jan 66
A3-16 thru A3-23	Original
*A3-24	31 Jan 66
A3-25	Original
A3-26	Original
*A3-27	31 Jan 66
A3-28 thru A3-38	Original
A4-1	30 Apr 65
A4-2 thru A4-35	Original
A4-36 Blank	Original
A5-1	30 Apr 65
*A5-2	31 Jan 66
A5-3	Original
A5-4	Original
A5-5	30 Apr 65
*A5-6 thru A5-9	31 Jan 66
A5-10	Original
A5-11	Original
*A5-12	31 Jan 66
A5-13	Original
A5-14	30 Apr 65
A5-15	30 Apr 65
*A5-16	31 Jan 66
A5-17	30 Apr 65
A5-18	30 Apr 65
*A5-19	31 Jan 66
A5-20 thru A5-25	30 Apr 65
*A5-26 thru A5-29	31 Jan 66
A5-30 thru A5-33	30 Apr 65
*A5-34 thru A5-36	31 Jan 66
A5-37 thru A5-39	30 Apr 65
*A5-40 thru A5-45	31 Jan 66
A5-46	30 Apr 65
*A5-47 thru A5-57	31 Jan 66
A5-58	30 Apr 65
A5-59	30 Apr 65
*A5-60	31 Jan 66
*A5-61	31 Jan 66
A5-62	30 Apr 65
*A6-1	31 Jan 66
*A6-2	31 Jan 66
A6-3	Original
A6-4	Original
*A6-5	31 Jan 66
A6-6	Original
A6-7	Original
*A6-8	31 Jan 66
A6-9 thru A6-14	Original
*A6-15 thru A6-18	31 Jan 66
A6-19 thru A6-22	Original
*A6-23 thru A6-25	31 Jan 66
A6-26 thru A6-28	Original
*A6-29 thru A6-32	31 Jan 66
A6-33	Original
A6-34	Original
*A6-35	31 Jan 66
*A6-36	31 Jan 66
A6-37	Original
*A6-38 thru A6-43	31 Jan 66
A6-44	Original
*A6-45	31 Jan 66
*A6-46	31 Jan 66
A6-47 thru A6-49	Original
A6-50 Blank	Original
A7-1 thru A7-7	Original
A7-8 Blank	Original
A8-1 thru A8-5	Original
A8-6 Blank	Original
*Index-1 thru Index-9/Index-10	31 Jan 66

CURRENT FLIGHT CREW CHECKLISTS

1C-121(E)D-1CL-1	15 Oct 1964	Changed 31 Jan 66	1C-121(E)D-1CL-5	15 Oct 1964	
1C-121(E)D-1CL-2	15 Oct 1964	Changed 31 Jan 66	1C-121(E)D-1CL-6	15 Oct 1964	
1C-121(E)D-1CL-3	15 Oct 1964		1C-121(E)D-1CL-7	15 Oct 1964	Changed 31 Jan 66
1C-121(E)D-1CL-4	15 Oct 1964		1C-121(E)D-1CL-8	31 Jan 1966	

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TABLE OF CONTENTS

SECTION	I	Description	1-1
SECTION	II	Normal Procedures	2-1
SECTION	III	Emergency Procedures	3-1
SECTION	IV	Auxiliary Equipment	4-1
SECTION	V	Operating Limitations	5-1
SECTION	VI	Flight Characteristics	6-1
SECTION	VII	Systems Operation	7-1
SECTION	VIII	Crew Duties	8-1
SECTION	IX	All-Weather Operation	9-1
APPENDIX		Performance Data	A-1
ALPHABETICAL INDEX			X-1

Know it before you go!

--or--

You'll go before you know it!

SCOPE. This manual contains the information necessary for safe and efficient operation of the EC-121D/TC-121C. These instructions provide you with a general knowledge of the airplane, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and therefore basic flight principles are avoided.

SOUND JUDGMENT. Instructions in this manual are for a crew inexperienced in the operation of this airplane. This manual provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc., may require modification of the procedures.

PERMISSIBLE OPERATIONS. The Flight Manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations (such as asymmetrical loading) are prohibited unless specifically covered herein. Clearance must be obtained from AFSC before any questionable operation is attempted which is not specifically permitted in this manual.

STANDARDIZATION AND ARRANGEMENT. Standardization assures that the scope and arrangement of all Flight Manuals are identical. The manual is divided into ten fairly independent sections to simplify reading it straight through or using it as a reference manual. The first three sections must be read thoroughly and fully understood before attempting to fly the airplane. The remaining sections provide important information for safe and efficient mission accomplishment.

SAFETY SUPPLEMENTS. Information involving safety will be promptly forwarded to you by Safety Supplements. Supplements covering loss of life will get to you in 48 hours by TWX, and those concerning serious damage to equipment within 10 days by mail. The current status of each Safety Supplement affecting your airplane can be determined by referring to the Weekly Index of Safety Supplements (T.O. 0-1-1-3A). The title page of the Flight Manual and the title block of each Safety Supplement should also be checked to determine the effect they may have on existing supplements. You must remain constantly aware of the status of all supplements—current supplements must be complied with, but there is no point in restricting your operation by complying with a replaced or rescinded supplement.

CHECKLISTS. The Flight Manual contains only amplified checklists. Condensed (abbreviated) checklists have been issued as separate technical orders—see the back of the title page for T.O. number and date of your latest checklist. Line items in the Flight Manual and checklists are identical with respect to arrangement and item number. Whenever a Safety Supplement affects the condensed (abbreviated) checklist, write-in the applicable change on the affected checklist page. As soon as possible, a new checklist page, incorporating the supplement will be issued. This will keep hand-written entries of Safety Supplement information in your checklist to a minimum. A scroll type checklist may be provided by the using command; however, use of the scroll checklist does not preclude use of the normal checklist binder which must be carried by the pilot.

HOW TO GET PERSONAL COPIES. Each flight crew member is entitled to personal copies of the Flight Manual, Safety Supplements, and Checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your supply personnel—it is their job to fulfill your Technical Order requests. Basically, you must order the required quantities on the Publication Requirement Table (T.O. 0-3-1). Technical Orders 00-5-1 and 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately upon receipt.

FLIGHT MANUAL AND CHECKLIST BINDERS. Loose leaf binders and sectionalized tabs are available for use with your manual. These are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1). Binders are also available for carrying your condensed (abbreviated) checklist. These binders contain plastic envelopes into which individual checklist pages are inserted. They are available in three capacities and are obtained through normal Air Force supply under the following stock list numbers: 7510-766-4268,

-4269, and -4270 for 15, 25, and 40 envelope binders respectively. Check with your supply personnel for assistance in securing these items.

WARNINGS, CAUTIONS, AND NOTES. The following definitions apply to "Warnings," "Cautions," and "Notes" found throughout the manual.

WARNING — Operating procedures, techniques, etc., which will result in personal injury or loss of life if not carefully followed.

CAUTION — Operating procedures, techniques, etc., which will result in damage to equipment if not carefully followed.

Note — An operating procedure, technique, etc., which is considered essential to emphasize.

YOUR RESPONSIBILITY – TO LET US KNOW. Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments and questions regarding this manual or any phase of the Flight Manual Program are welcomed. AF Form 847 will be used for recommending changes to the Flight Manual in accordance with instruction in AFR 60-9 and T.O. 00-5-1. These will be forwarded through command headquarters to SMAMA, McClellan AFB, California, ATTN: SMNSTT. AF Forms 847 are routed to SMNSTT for control purposes. Technical content of the Flight Manual is the responsibility of the Flight Manual Manager (SMNEOH) and all comments and questions transmitted by means other than the AF Form 847 will be submitted directly to the Flight Manual Manager, SMAMA, McClellan AFB, California, Attn: SMNEOH.

OPERATIONAL AND SAFETY SUPPLEMENT SUMMARY

Supplements you receive will be in order and if you find one missing, check the Cargo Aircraft Index of Safety Supplements, T.O. 0-1-1-3A, to see if it was issued and if it is still in effect. The Supplement may have been replaced or rescinded before you received your copy. If it is still active, see your Publication Distribution Officer for your copy. Please note that a Supplement number is used only once.

SUPPLEMENTS IN THIS CHANGE

This change incorporates Supplements T.O. 1C-121(E)D-1SS-2 through T.O. 1C-121(E)D-1SS-6 and T.O. 1C-121(E)D-1S-2 through T.O. 1C-121(E)D-1S-6, T.O. 1C-121(E)D-1S-8 and T.O. 1C-121(E)D-1S-9.

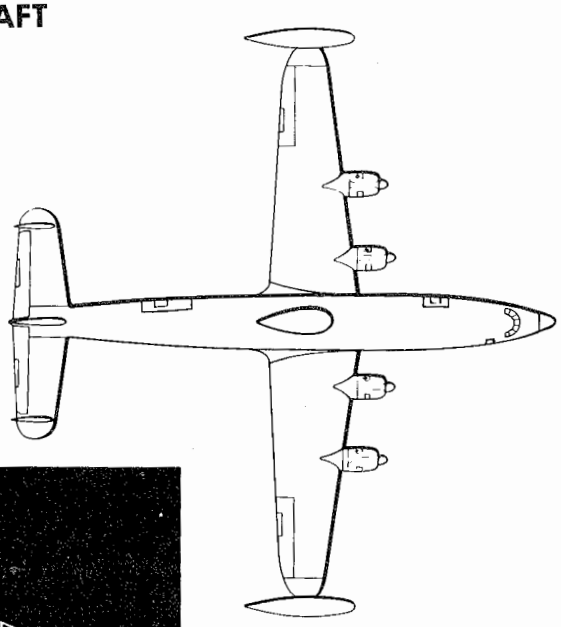
SUPPLEMENT SUMMARY

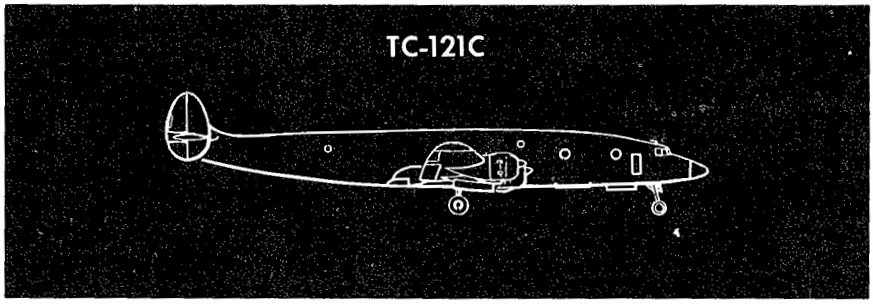
This portion will be filled in upon receipt of new Supplements. Refer to T.O. 0-1-1-3A for latest information if questions arise. Supplements outstanding at time of preparation of this page have been listed below for your convenience.

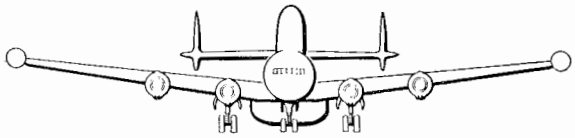
NUMBER	*DATE*	*SHORT TITLE*	*DISPOSITION*
1SS-10	23 February 1966	Landing Gear Malfunction	Outstanding
1SS-11	28 February 1966	Ditching	Outstanding
1SS-12	25 March 1966	Ditching/Crash Landing	Outstanding
1S-10	31 January 1966	618T-1HF	Outstanding
1S-11	8 April 1966	Fuel System Check	Outstanding

THE AIRCRAFT

EC 121D AND TC 121C







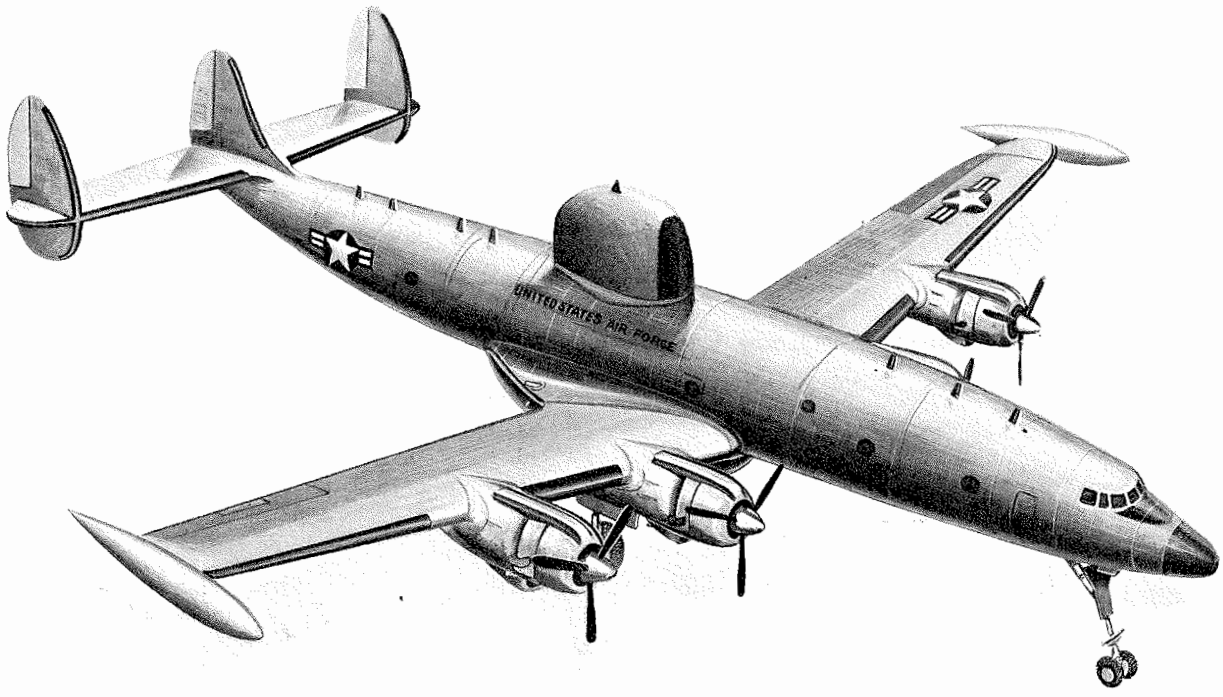


Figure 1-1

Section I – DESCRIPTION

TABLE OF CONTENTS

	Page
THE AIRCRAFT	1-1
ENGINES	1-2
PROPELLERS	1-20
OIL SYSTEM	1-28
FUEL SYSTEM	1-31
ELECTRICAL SYSTEM	1-40
HYDRAULIC SYSTEM	1-54
FLIGHT CONTROL SYSTEM	1-60
WING FLAPS	1-63
LANDING GEAR SYSTEM	1-65
NOSE GEAR STEERING SYSTEM	1-70
BRAKE SYSTEM	1-70
INSTRUMENTS	1-75
PITOT STATIC SYSTEM	1-77
EMERGENCY EQUIPMENT	1-77
MISCELLANEOUS EMERGENCY EQUIPMENT	1-81
ENTRANCE DOORS	1-83
CREW SEATS	1-83
AUXILIARY EQUIPMENT	1-85

THE AIRCRAFT.

The EC-121D and TC-121C airplanes are four-engine low wing monoplanes. (See figure 1-1.) The EC-121D is designed for patrol operation, as a special search and airborne early warning aircraft. The TC-121C is used for EC-121D transition.

Note

TC-121C airplanes, USAF Serials 51-3836 through 51-3841 and 51-3843 through 51-3845 were formerly designated RC-121C. The special search and airborne early warning equipment including extended radomes, has been removed from these airplanes.

Distinguishing external features are three vertical fins and rudders, dual-wheel tricycle landing gear, and on EC-121D airplanes the extended radomes which house the radar antennas. Both the EC-121D and TC-121C are powered by turbo-compound R3350-93 engines. (See figure 1-2 for Main Difference Table.) Each engine is equipped with a three-blade, full-feathering, reversible-pitch Hamilton Standard hydromatic propeller. The flight controls incorporate hydraulic boosters to assist in the movement of the control surfaces, and an automatic pilot is provided for automatic control of the aircraft. The semi-monocoque fuselage is sealed for pressurization between the forward and aft pressure bulkheads. Lightning diverters are installed on the nose, wing tip tanks and empennage to minimize the possibility of injury or damage to personnel or equipment resulting from lightning strikes or static electricity discharges.

GENERAL ARRANGEMENT.

The forward bulkhead separates the flight station from the nose radome; the aft bulkhead is the rear wall of the cabin. All doors in the lower sides and bottom of the fuselage have additional sealing to minimize water leakage in the event of ditching. The interior of the fuselage is divided by the station 260 bulkhead into the flight station and the cabin. One cargo loading door, with an integral personnel door, is located on the left side aft of the wing. A crew door is located on the right side immediately forward of the station 260 bulkhead. (See figure 1-3.)

Crew Stations.

The active crew stations include the following: pilot, copilot, flight engineer, navigator and radio operator. (See figure 1-4 and figure 1-6 for typical stations.) In addition the EC-121D has the following stations: senior weapons controller, duty weapons controller, 3 search radar operators, surveillance supervisor, plotter, scanner-recorder, height finder operator, and 2 radar technicians. Additional crew and relief members are assigned in accordance with the mission involved.

MAIN DIFFERENCE TABLE

	EC-121D	TC-121C	C-121A	C-121C	VC-121E	C-121G
INTERIOR	SPECIAL RADAR EQUIPMENT	CONVERTIBLE PASSENGER AND CARGO	CONVERTIBLE PASSENGER CARGO AND LITTER	CONVERTIBLE PASSENGER, CARGO AND LITTER	EXECUTIVE	CONVERTIBLE PASSENGER, CARGO AND LITTER
LENGTH	116' 2"	116' 2"	97' 4"	116' 2"	116' 2"	116' 2"
ENGINES	WRIGHT TURBO-COMPOUND R3350-93	WRIGHT TURBO-COMPOUND R3350-93	WRIGHT CYCLONE R-3350-75	WRIGHT TURBO-COMPOUND R3350-93	WRIGHT TURBO-COMPOUND MODIFIED 972 TC18DA-1	WRIGHT TURBO-COMPOUND R3350-93
WINDOWS (FUSELAGE)	ROUND	ROUND	ROUND	SQUARE	SQUARE	ROUND
RADOMES	NOSE AND FUSELAGE	NOSE	NOSE	NOSE	NOSE	NOSE
WING TIP TANKS	YES	NO	NO	NO	NO	NO

F75-F-1-121

Figure 1-2

Lavatory.

A lavatory is installed in the forward cabin on the left side. A galley is installed on the right side aft of the forward cabin.

AIRCRAFT DIMENSIONS.

The over-all dimensions of the aircraft are as follows:

Length ..... 116' 2"
Height (to top of fins) ..... 24' 9"
Height (to top of radome) ..... 26' 11.6"
Wing Span (without tip tanks) ..... 123' 0"
Wing Span (with tip tanks) ..... 123' 6"

GROSS WEIGHTS.

This aircraft is in the 130,000 to 152,500 lb. gross weight category. Refer to Section V for weight limitations.

ENGINES.

The four engines installed on the aircraft are turbo-compound, 18-cylinder, air-cooled R3350-93 engines. The total horsepower output of each engine is increased by the installation of three power recovery turbines, each of which is driven by the combined exhaust from six of the eighteen cylinders. Turbine energy is geared back to the engine crankshaft through a fluid coupling. Turbine speed is proportional to engine speed and requires no control. Each engine also incorporates a fuel injection system, a two-speed supercharger and a low-tension ignition system.

THROTTLE LEVERS.

One set of four throttle levers is located on the pilots' center control stand (5, figure 1-11) and another set of four throttle levers is located on the flight engineer's control quadrant (5, figure 1-14). The corresponding levers are mechanically interconnected to the carburetor butterfly shafts by cable, pulley and linkage systems.

The throttle levers also are electrically (dc) connected to the propeller automatic feathering arming circuit and landing gear warning horn circuit.

Reverse Pitch Throttle Levers.

The pilots' throttle levers incorporate an additional set of four reverse pitch throttle levers (4, figure 1-11) hinged on the main throttle arms. The reverse levers normally are folded forward and below the main throttle knobs so that they do not interfere with normal throttle operation. The reverse pitch throttle levers are connected by a linkage mechanism to the same cable system as the main throttle levers. A spring-loaded mechanical lock prevents inadvertent movement of the reverse throttle while in flight. The lock normally is released by a 28-volt dc reverse actuator controlled by landing gear microswitches. It can be released manually by depressing the reverse lock override lever (flag) (7, figure 1-11) located on the center control stand. When the main throttle levers are retarded to the full aft position, the reverse pitch throttle levers may be lifted upward and pulled aft, provided the reverse throttle lock has been released. This action energizes the propeller governor solenoid valves which release the low pitch stop levers of the propellers, thus turning the blades to the fixed reverse pitch stop position. As the reverse pitch throttle levers are moved aft the engine throttle valves are opened to increase power. The maximum travel of the carburetor butterfly valve is limited in the reverse range to approximately METO power.

FUEL MASTER CONTROL CARBURETOR.

Each engine utilizes a direct fuel injection system which consists of a carburetor (master control unit), two injection pumps and a fuel injection nozzle for each cylinder. The carburetor unit senses the amount of air passing through it and meters the correct proportion of fuel from the fuel pressure chamber of the carburetor to the two injection pumps that are mounted on each side of the rear crankcase section of each engine. Each injection pump is geared to the engine and contains nine plungers which time and distribute the metered fuel to the cylinder combustion chambers. A flow divider is installed to insure measured distribution to the injection pumps. Spring-loaded poppet valves in the fuel injection nozzles, one of which is located in each cylinder head, are opened by the pressure of the fuel and the nozzle sprays the fuel into combustion chamber.

Carburetor Alternate Fuel Source.

An alternate fuel source is provided within the fuel master control (carburetor) to supply a positive increase in fuel flow when the normal metering differential pressure is partially or totally lost, such as might occur during icing conditions. The alternate fuel source functions as a standby and not as a replacement for the normal alternate air, pre-heat and alcohol procedures recommended for combating ice.

Carburetor Alternate Fuel Source Switches. Four circuit-breaker type switches are located on the Main Junction Box (MJB) No. 2 switch panel (figure 1-29). The carburetor alternate fuel source switches have EMERGENCY (up) and NORMAL (down) positions. Moving a switch to the EMERGENCY position energizes a dc solenoid which opens a valve to allow fuel pressure to supplant air measuring forces in the selected master control.

ALTERNATE AND RAM AIR INDUCTION SYSTEM.

A ram-type induction scoop for directing air to the carburetor (figure 1-5) is located in the top of all modified nacelles. The duct directs either ram air from the front of the cowl or alternate air which has passed up into the duct from under the cowl. This permits selection of the alternate air source during icing conditions. A variable position door is also located in this duct ahead of the carburetor to mix hot air from behind the cylinders with the induction air.

Carburetor Alternate Air Switches.

Four toggle switches, located on the left side of the flight engineer's lower switch panel (1, figure 1-14) are used to select either ram or alternate air for each carburetor. Each switch has two positions; RAM (up) and ALTERNATE (down). In the RAM (normal) position, an electric (dc) reversible motor opens the forward ram air scoop and simultaneously closes the aft door in the induction duct. This allows ram air to pass directly to the carburetor. In the ALTERNATE position, the electrically-operated motor closes the forward ram air opening and simultaneously opens the aft door, admitting sheltered air to the carburetor.

Carburetor Air Switches.

Four toggle-type switches (1, figure 1-14) are located on the left side of the flight engineer's lower switch panel. Each switch has three positions, OFF, COLD, and HOT, and is spring-loaded from HOT to OFF. Holding the switch in the HOT position electrically actuates (dc) a

EC-121D. TYPICAL GENERAL ARRANGEMENT

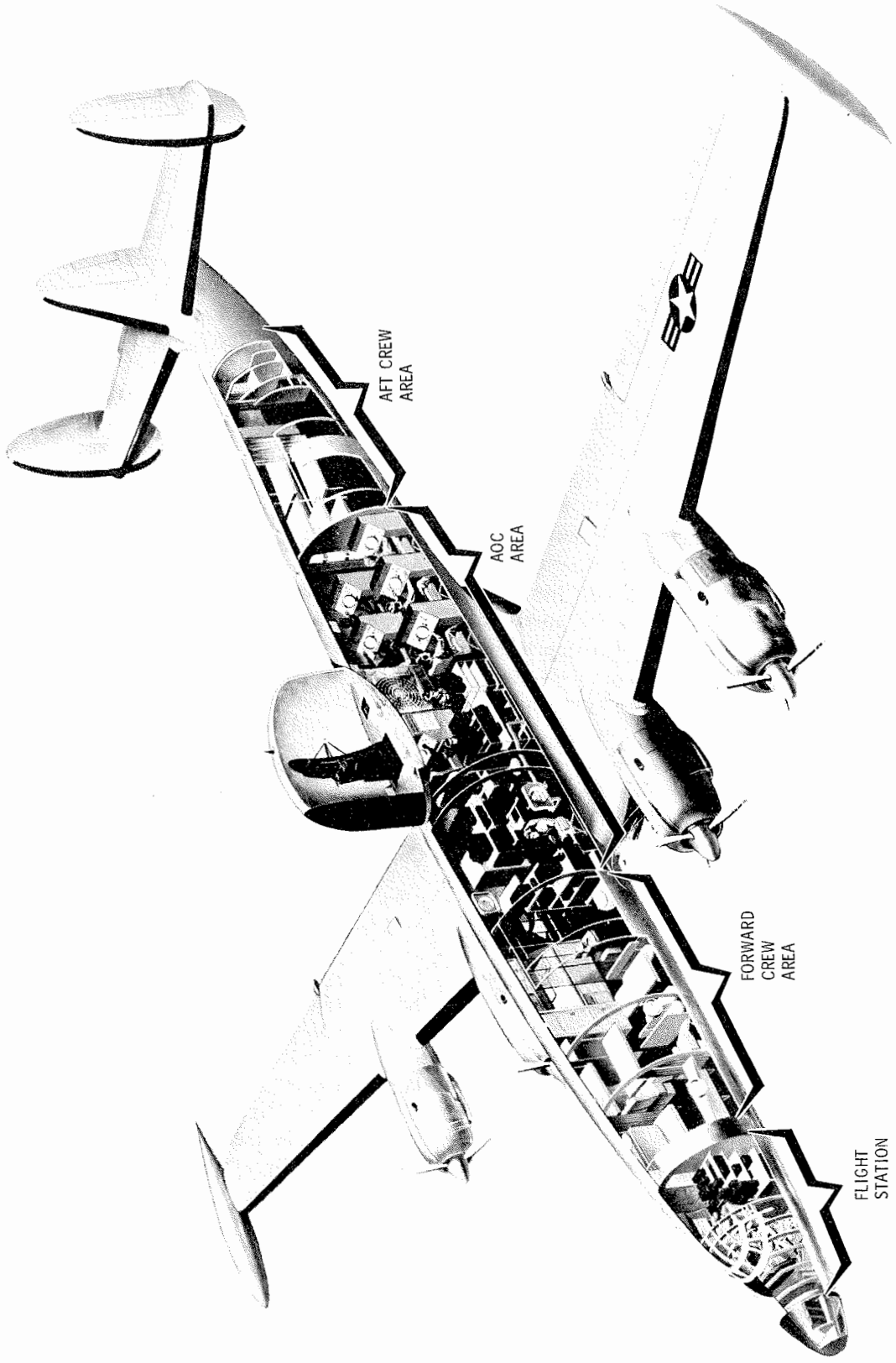


Figure 1-3 (Sheet 1 of 2)

TC-121C. TYPICAL GENERAL ARRANGEMENT

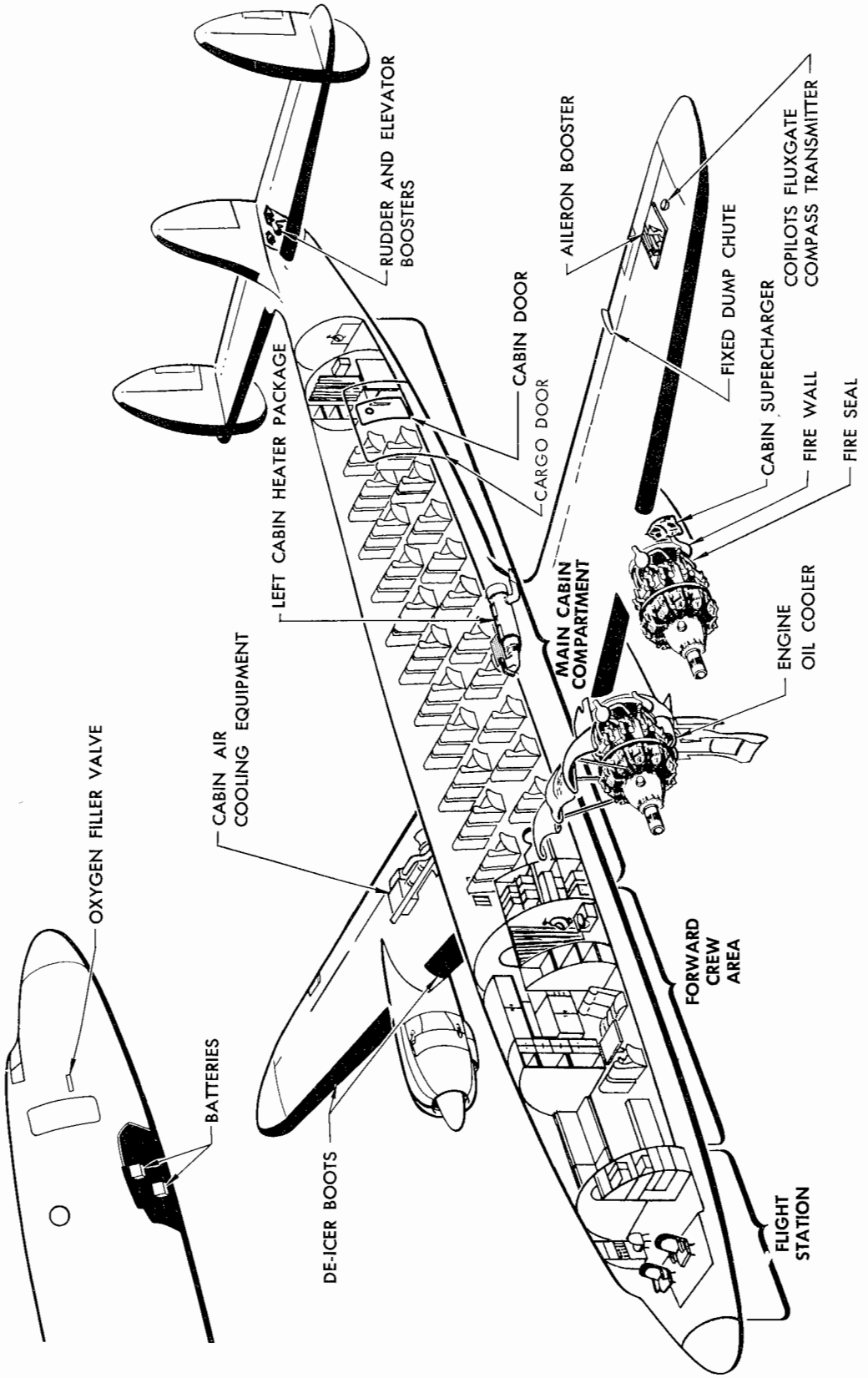


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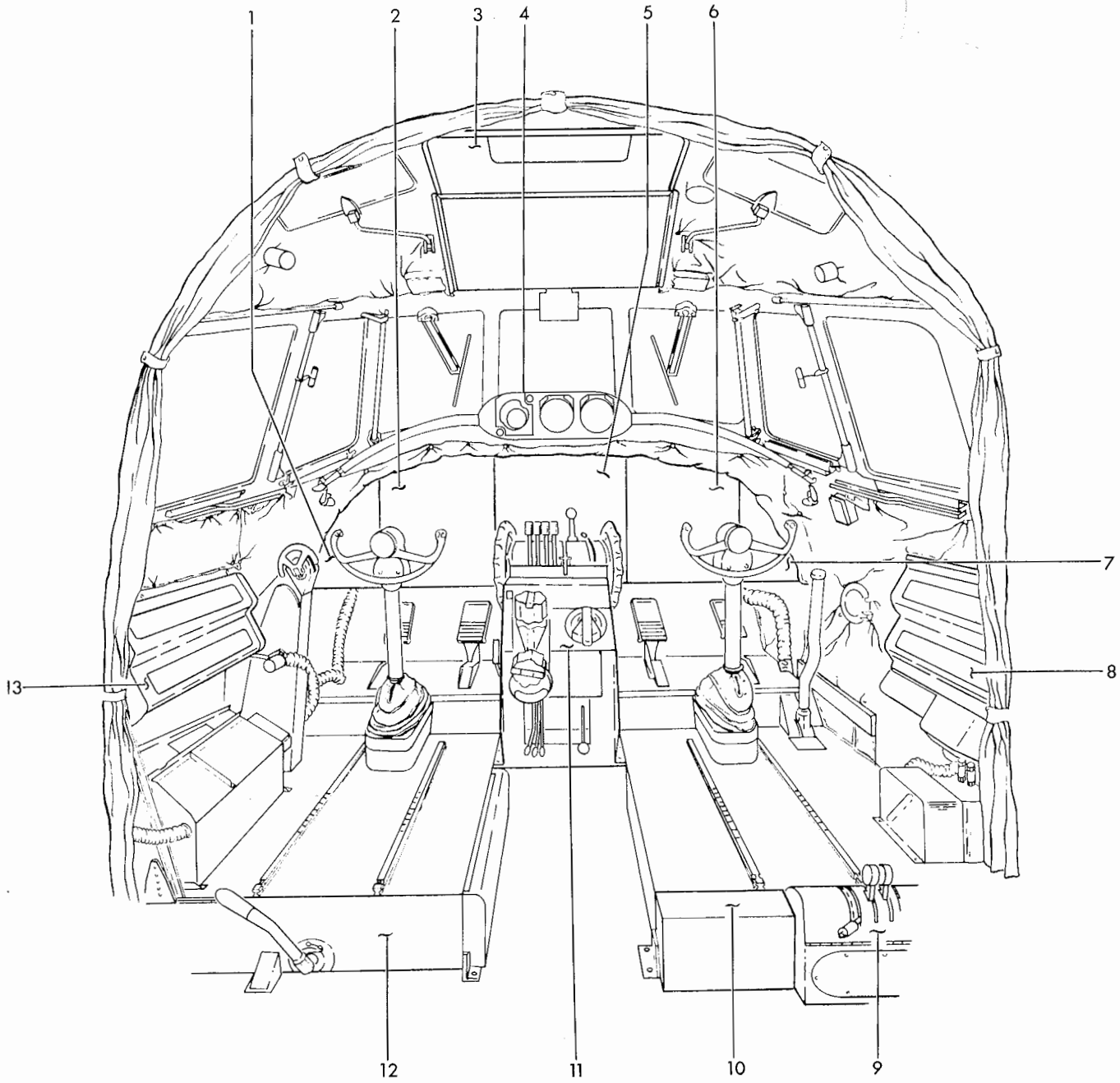
Figure 1-3 (Sheet 2 of 2)

TYPICAL PILOTS' STATION



1 PILOT'S AUXILIARY INSTRUMENT PANEL
2 PILOT'S INSTRUMENT PANEL
3 PILOTS' OVERHEAD PANEL
4 GLARE SHIELD AND GLARE SHIELD INSTRUMENT PANEL
5 PILOTS' CENTER INSTRUMENT PANEL
6 COPILOT'S INSTRUMENT PANEL
7 COPILOT'S AUXILIARY INSTRUMENT PANEL
8 COPILOT'S SIDE PANEL
9 FLIGHT ENGINEER'S AUXILIARY CONTROL QUADRANT
10 IGNITION ANALYZER CONTROL PANEL
11 CENTER CONTROL STAND
12 HYDRAULIC RESERVOIR REPLENISHING CONTROLS PANEL
13 PILOT'S SIDE PANEL

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Figure 1-4

ENGINE AIR INDUCTION SYSTEM

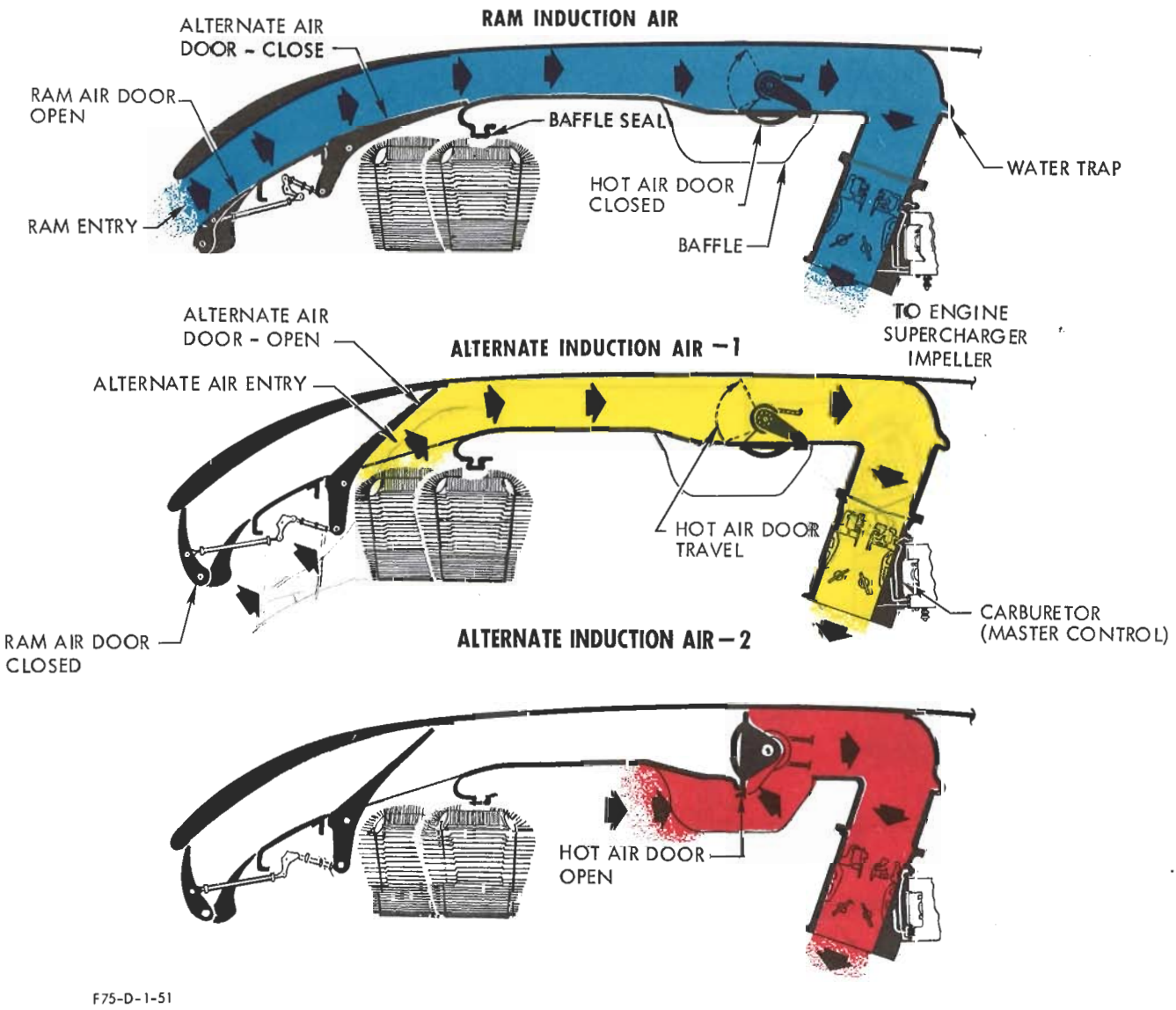


Figure 1-5

rotary valve in the carburetor air intake scoop, permitting hot air from behind the engine cylinders to enter the carburetor. Moving the switch to the COLD position rotates the valve to permit unheated air to enter the carburetor. The valve may be stopped in any position by moving the switch to OFF. Limit switches stop the valve automatically when it reaches either the full hot or full cold position.

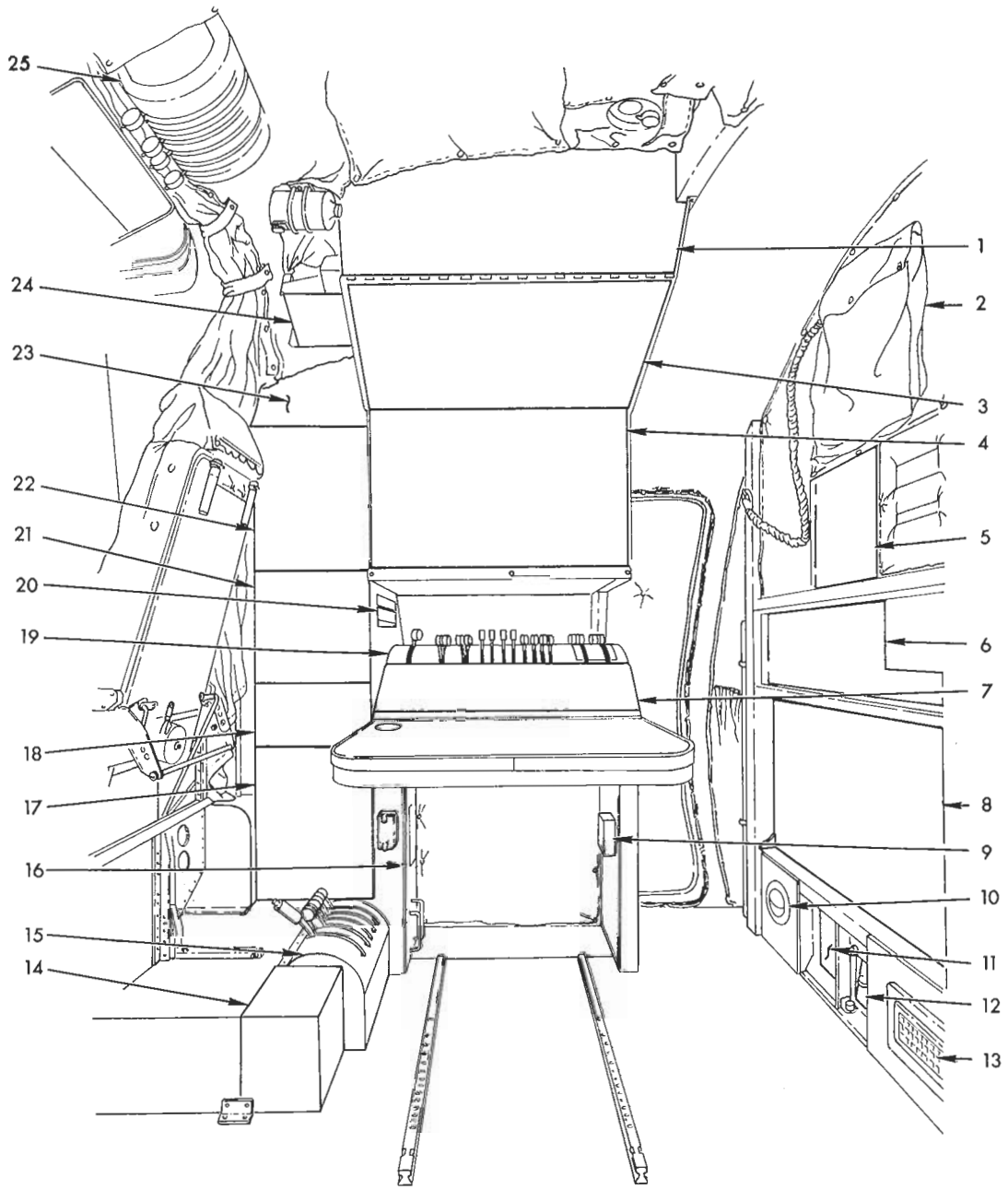
Mixture Levers.

Four mixture levers (9, figure 1-14) are located on the flight engineer's control quadrant and are mechanically linked to the carburetor mixture control valves. The mixture control quadrant is marked OFF, AUTO LEAN and AUTO RICH but incorporates continuously serrated detent plates to permit setting the control at intermediate positions for best power and economy. See MANUAL LEANING in Section VII for procedures.

Carburetor Air Temperature Indicators.

Two dual carburetor air temperature indicators (11, figure 1-16), located on the lower left side of the flight engineer's upper panel, register the induction air temperature at the carburetor throat by means of dc temperature resistance bulbs. The indicators are calibrated in degrees Centigrade.

TYPICAL FLIGHT ENGINEERS' STATION



1	UPPER SWITCH PANEL	10	CREW DOOR LIGHT	18	MJB NO. 2A PANEL
2	DITCHING ROPE AND CONTAINER	11	DITCHING VALVE RELEASE HANDLE	19	FLIGHT ENGINEER'S CONTROL QUADRANT
3	UPPER INSTRUMENT PANEL	12	CABIN HEATER FIRE EXTINGUISHING CONTROL PANEL	20	UPPER MJB 212 PANEL
4	LOWER INSTRUMENT PANEL	13	STATION 260 AIR OUTLET	21	MJB NO. 2 PANEL
5	ENGINE FIRE EXTINGUISHER CONTROL PANEL	14	IGNITION ANALYZER CONTROL PANEL	22	MJB NO. 1 PANEL
6	STATION 260 UPPER SWITCH PANEL	15	FLIGHT ENGINEER'S AUXILIARY CONTROL QUADRANT	23	UPPER MJB PANEL
7	LOWER SWITCH PANEL	16	LOWER MJB 212 PANEL	24	RADIO SELECTOR BOX
8	AIR CONDITIONING CONTROL PANEL	17	MJB NO. 3 PANEL	25	EMERGENCY SHUT-OFF LEVERS AND QUADRANT
9	STATION 238 CIRCUIT BREAKER PANEL				

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Figure 1-6

SUPERCHARGERS.

Each engine incorporates a single stage, two speed supercharger that is mechanically controlled at the flight engineer's station.

Engine Supercharger and Cabin Supercharger Disconnect Levers.

Four engine supercharger levers (7, figure 1-14) are located at the center of the flight engineer's control quadrant. All of the levers have HIGH and LOW positions. The two outboard levers also have a third position, which mechanically disconnect the cabin pressurization supercharger drive shafts from the engines. The cabin superchargers can be disconnected by compressing a spring-loaded lock mounted adjacent to the outboard levers and pushing the levers through and beyond LOW.

ENGINE COWL FLAPS.

Engine temperature is controlled by air exit flaps one on each side of each engine nacelle. Flap position is controlled by two dc electrical actuators in each engine nacelle that are interconnected by a flexible shaft. One actuator in each nacelle incorporates a position transmitter which registers a flap position indication at the flight engineer's station.

Cowl Flap Switches.

The four paddle-type cowl flap switches (15, figure 1-14), located on the left side of the flight engineer's lower switch panel, have three positions: OPEN, CLOSE and center (Off) position which holds the flaps in the last preset position. The switches are spring-loaded to Off from the CLOSE position. The OPEN position is a steady-on position. Either OPEN or CLOSE position provides dc electrical power to the cowl flap actuators in each nacelle. Limit switches are installed to automatically stop the cowl flaps at the full OPEN or the full CLOSED position.

Cowl Flap Position Indicators.

Two dual cowl flap position indicators (19, figure 1-15) are located on the flight engineer's lower instrument panel and are marked from 0 to 100%. These indicators are actuated by magnasyn transmitters attached to the right actuator in each engine nacelle and are powered by 26-volt, 400 cycle ac.

Cylinder Head Temperature Indicators and Selector.

Two dual cylinder head temperature indicators (21, figure 1-15) and a two-position selector switch (20, figure 1-15) are located on the flight engineer's lower instrument panel. A resistance bulb in cylinders 1 and 18 of each engine electrically transmits cylinder head temperature to the indicators, which are calibrated in degrees Centigrade. The selector switch has A and B positions. The A position selects cylinder 1 on each engine and position B selects cylinder 18 on each engine.

IGNITION SYSTEM.

Each engine utilizes a low-tension dual ignition system. The low-tension magneto installed on the rear accessory section produces a low-voltage spark for the right and left distributors located on the nose section case. The right distributor directs low voltage to high tension coils that fire the front plugs in each cylinder. The left distributor directs low voltage to high-tension coils that fire the rear plugs in each cylinder. A high-tension coil is provided for each plug and is attached to a cylinder rockerbox cover. An induction vibrator is also employed to provide the hot-spark that is required during cold starts and low starting speeds which are below the coming-in speed of the magneto. The induction vibrator discharges through the right distributor. Aircraft are equipped with distributors that incorporate manual spark control circuits. Refer to Section VII for a description of the use of the manual spark control.

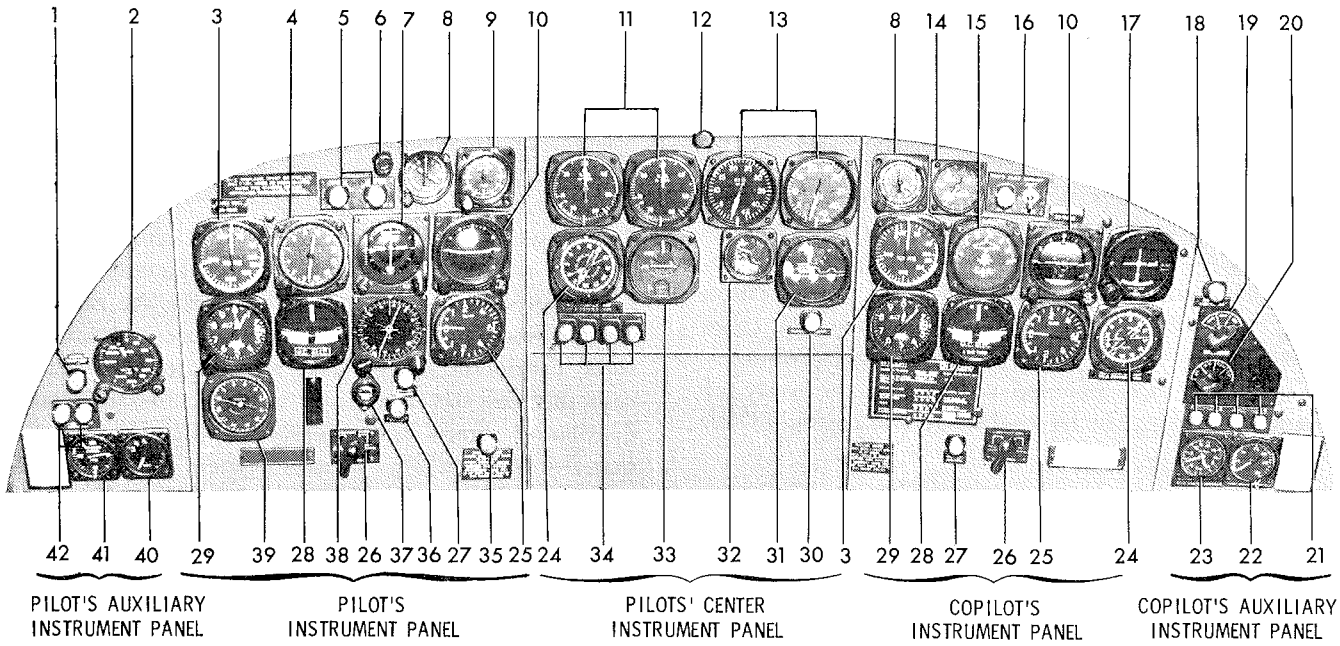
Ignition Switches.

Four ignition switches (3, figure 1-8) are located on the pilots' overhead panel. As the switches are rotated in a clockwise direction the positions are OFF, R, L, and BOTH. When the ignition switch is placed in the R position, the circuit to the left distributor is grounded and the circuit to the right distributor, which fires the front plugs in each cylinder, is ungrounded. The L position grounds the right distributor circuit and ungrounds the left distributor circuit which fires the rear plugs in each cylinder. The BOTH position ungrounds the circuits to both the left and the right distributors and the OFF position grounds both circuits.

Master Spark Control Switch.

A single spark control switch, located on the flight engineer's lower switch panel (14, figure 1-14) controls the ignition timing for the four engines simultaneously. A movable guard covers the switch and opens downward. The two positions are placarded RETARD (up) and ADVANCE (down). When the guard is closed, the switch is moved to the RETARD position.

EC-121D. TYPICAL PILOTS' INSTRUMENT PANELS

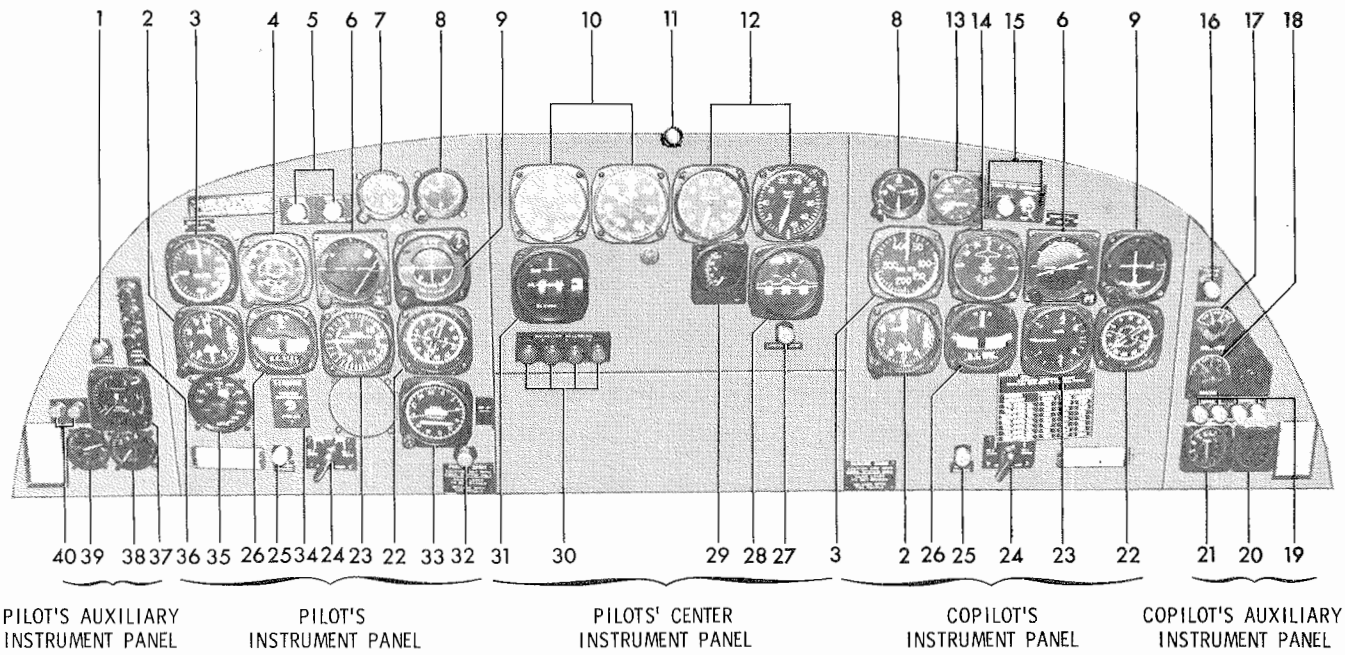


1 AUTOMATIC FEATHERING ARMED LIGHT
2 RADAR ALTIMETER INDICATOR
3 AIRSPEED INDICATOR
4 CGRS HEADING INDICATOR
5 LOCALIZER AND GLIDE SLOPE-INOPERATIVE WARNING LIGHTS
6 MARKER BEACON LIGHT
7 ATTITUDE DIRECTOR INDICATOR (ADI)
8 CLOCK - 8 DAY
9 CLOCK - ELAPSED TIME
10 ATTITUDE INDICATOR
11 MANIFOLD PRESSURE INDICATORS
12 MASTER FIRE WARNING LIGHT
13 TACHOMETERS
14 WING FLAP ASYMMETRY INDICATOR
15 FLUXGATE HEADING INDICATOR
16 WING FLAP SHUT-OFF VALVE TEST SWITCH AND WARNING LIGHT
17 COURSE INDICATOR
18 RADOME WARNING LIGHT
19 POSITION LIGHTS BRILLIANCE CONTROL
20 EXTERIOR LIGHTS MASTER SWITCH
21 HYDRAULIC PUMP LOW PRESSURE WARNING LIGHTS
22 EMERGENCY BRAKE PRESSURE INDICATOR
23 HYDRAULIC SYSTEMS PRESSURE INDICATOR
24 RADIO MAGNETIC INDICATOR (RMI)
25 VERTICAL VELOCITY INDICATOR
26 STATIC SELECTOR
27 TURN AND SLIP POWER FAILURE WARNING LIGHT
28 TURN AND SLIP INDICATOR
29 ALTIMETER
30 LANDING GEAR WARNING LIGHT
31 LANDING GEAR AND WING FLAP POSITION INDICATOR
32 OUTSIDE AIR TEMPERATURE INDICATOR
33 THREE AXIS TRIM INDICATOR
34 REVERSE PITCH INDICATOR LIGHTS
35 PARKING BRAKE INDICATOR LIGHT
36 VERTICAL GYRO CAGED LIGHT
37 VERTICAL GYRO MONITOR
38 HORIZONTAL SITUATION INDICATOR (HSI)
39 PILOT'S UHF ID-91 INDICATOR
40 VACUUM INDICATOR
41 DEICER PRESSURE INDICATOR
42 DEICER PUMP WARNING LIGHTS

F75-F-1-7(1)

Figure 1-7 (Sheet 1 of 2)

TC-121C. TYPICAL PILOTS' INSTRUMENT PANELS

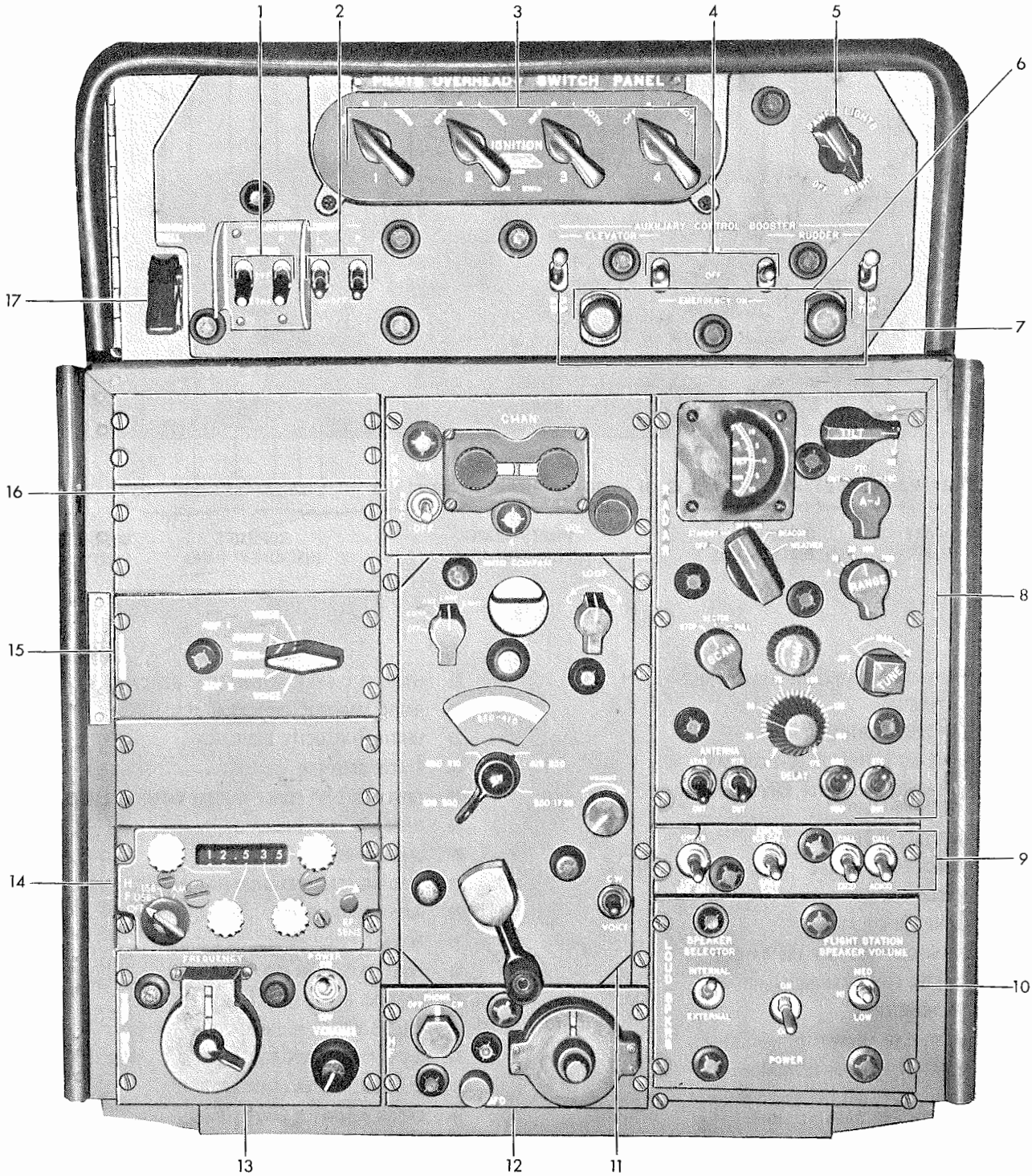


1 AUTOMATIC FEATHERING ARMED LIGHT
2 ALTIMETER
3 AIRSPEED INDICATOR
4 HEADING INDICATOR (G-2 COMPASS)
5 LOCALIZER AND GLIDE SLOPE-INOPERATIVE WARNING LIGHTS
6 ATTITUDE INDICATOR
7 CLOCK-ELAPSED TIME
8 CLOCK-8 DAY
9 COURSE INDICATOR
10 MANIFOLD PRESSURE INDICATORS
11 MASTER FIRE WARNING LIGHT
12 TACHOMETERS
13 WING FLAP ASYMMETRY INDICATOR
14 FLUXGATE HEADING INDICATOR
15 WING FLAP SHUT-OFF VALVE TEST SWITCH AND WARNING LIGHT
16 RADOME WARNING LIGHT
17 POSITION LIGHTS BRILLIANCE CONTROL
18 EXTERIOR LIGHTS MASTER SWITCH
19 HYDRAULIC PUMP LOW PRESSURE WARNING LIGHTS
20 EMERGENCY BRAKE PRESSURE INDICATOR
21 HYDRAULIC SYSTEMS PRESSURE INDICATOR
22 RADIO MAGNETIC INDICATOR (RMI)
23 VERTICAL VELOCITY INDICATOR
24 STATIC SELECTOR
25 TURN AND SLIP POWER FAILURE WARNING LIGHT
26 TURN AND SLIP INDICATOR
27 LANDING GEAR WARNING LIGHT
28 LANDING GEAR AND WING FLAP POSITION INDICATOR
29 OUTSIDE AIR TEMPERATURE INDICATOR
30 REVERSE PITCH INDICATOR LIGHTS
31 THREE AXIS TRIM INDICATOR
32 PARKING BRAKE INDICATOR LIGHT
33 PILOT'S UHF ID 91 INDICATOR
34 G-2 COMPASS CONTROLLED/FREE D.G. SWITCH
35 RADAR ALTIMETER LIMIT SWITCH
36 RADAR ALTIMETER LIMIT LIGHTS
37 RADAR ALTIMETER INDICATOR
38 VACUUM INDICATOR
39 DEICER PRESSURE INDICATOR
40 DEICER PUMP WARNING LIGHTS

F75-F-1-7(2)

Figure 1-7 (Sheet 2 of 2)

TYPICAL PILOT'S OVERHEAD PANEL

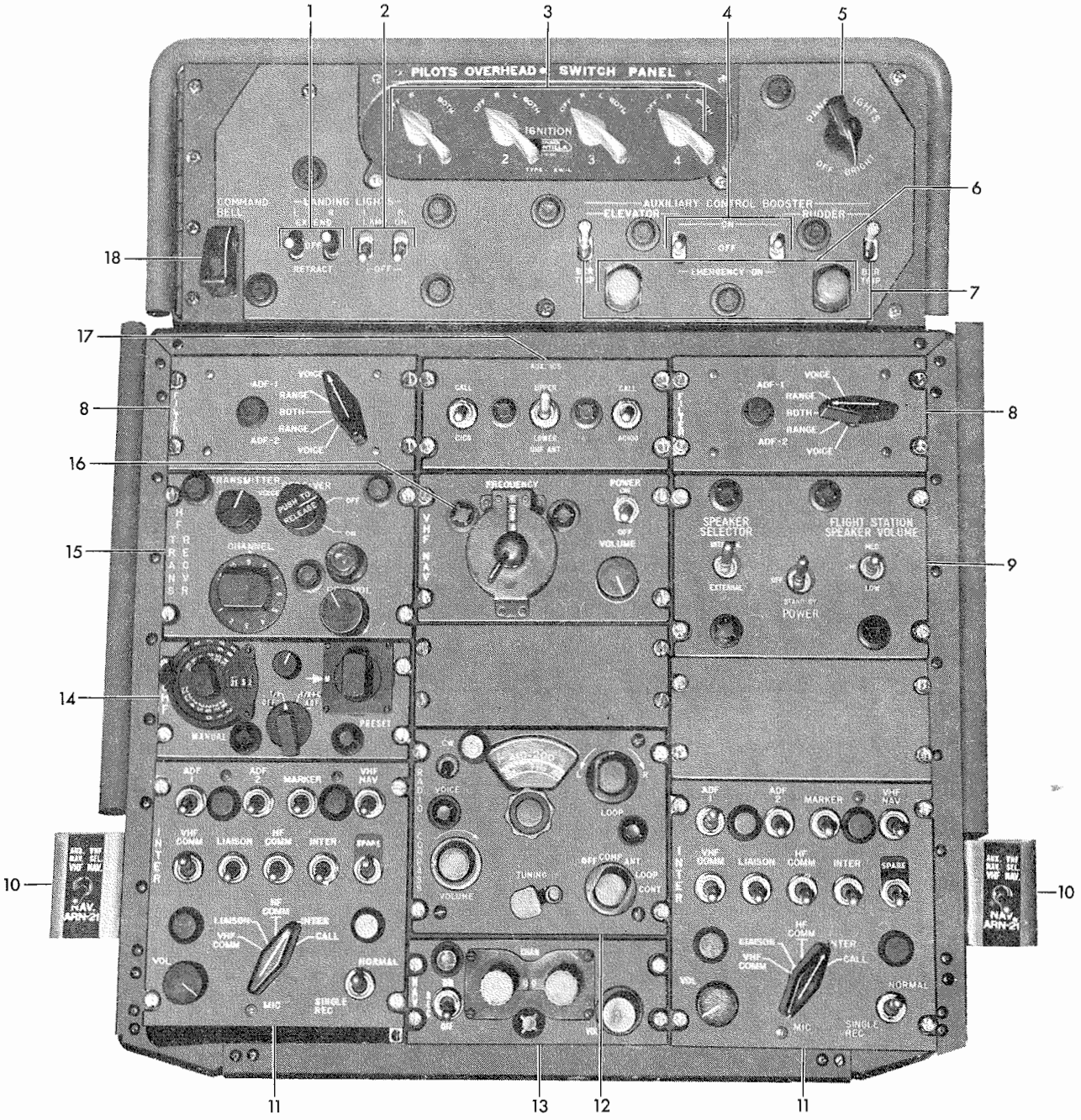


1 LANDING LIGHT EXTEND-RETRACT SWITCH
2 LANDING LIGHT SWITCHES
3 IGNITION SWITCHES
4 ELEVATOR AND RUDDER AUXILIARY BOOSTER SWITCHES
5 PANEL LIGHT RHEOSTAT
6 ELEVATOR AND RUDDER AUXILIARY BOOSTER INDICATOR LIGHTS
7 ELEVATOR AND RUDDER AUXILIARY BOOSTER CIRCUIT BREAKERS
8 AN/APS-42 RADAR CONTROL PANEL
9 AUXILIARY INTERCOM CONTROL PANEL
10 P.A. CONTROL PANEL
11 AN/ARN-6 RADIO COMPASS
12 714E-2 COMMAND CONTROL PANEL
13 AN/ARN-14 VOR RECEIVER CONTROL PANEL
14 AN/ARC-27 UHF CONTROL PANEL
15 RANGE FILTER SWITCH
16 AN/ARN-21 TACAN CONTROL PANEL
17 COMMAND BELL SWITCH

F75-F2-1-201(1)

Figure 1-8 (Sheet 1 of 2)

TC-121C. TYPICAL PILOTS' OVERHEAD PANEL



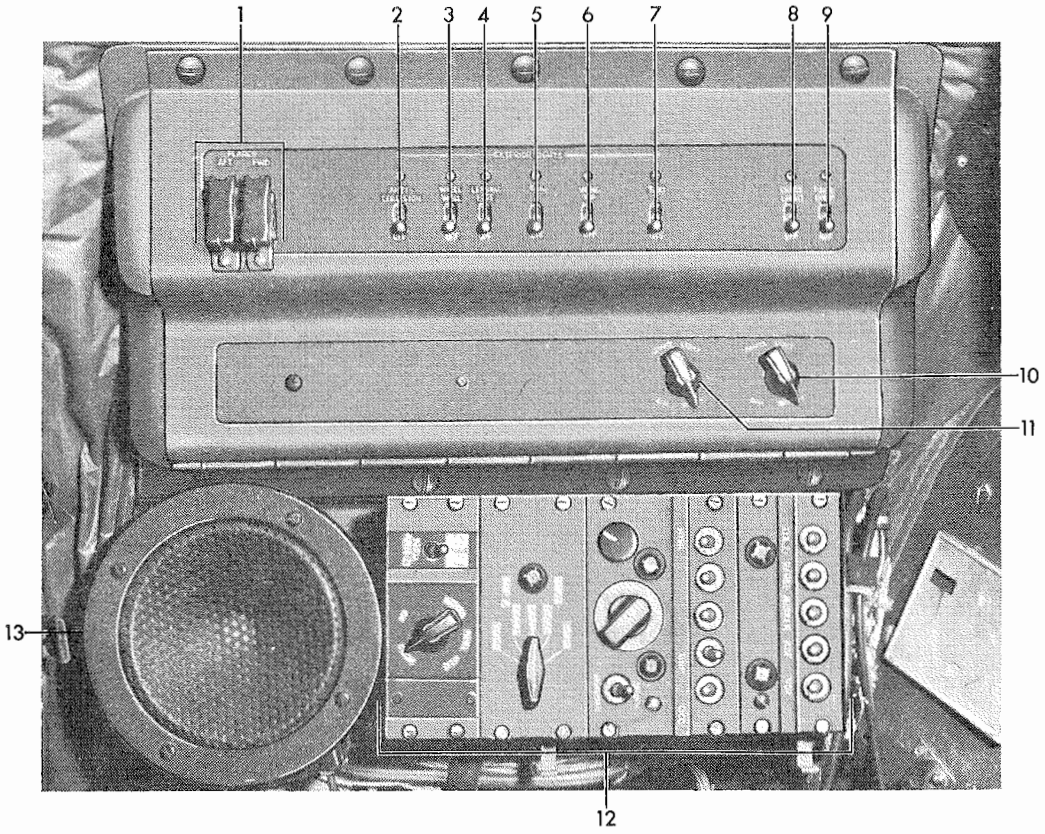
1 LANDING LIGHT EXTEND – RETRACT SWITCHES
2 LANDING LIGHT OFF-ON SWITCHES
3 IGNITION SWITCHES
4 ELEVATOR AND RUDDER AUXILIARY BOOSTER SWITCHES
5 PANEL LIGHT RHEOSTAT
6 ELEVATOR AND RUDDER AUXILIARY BOOSTER INDICATOR LIGHTS
7 ELEVATOR AND RUDDER AUXILIARY BOOSTER CIRCUIT BREAKERS
8 ADF RANGE FILTER SELECTOR
9 P.A. CONTROL PANEL
10 VHF NAV/ARN-21 NAV SELECTOR SWITCH
11 C-633/AIC-8 INTERPHONE CONTROL PANEL
12 AN/ARN-6 RADIO COMPASS CONTROL PANEL
13 AN/ARN-21 TACAN CONTROL PANEL
14 AN/ARC-27 UHF CONTROL PANEL
15 AN/ART-13, AN/ARR-15 TRANSMITTER/RECEIVER CONTROL PANEL
16 AN/ARN-14 VOR RECEIVER CONTROL PANEL
17 AUXILIARY ICS CONTROL PANEL
18 COMMAND BELL SWITCH

F75-E-1-201 (2)

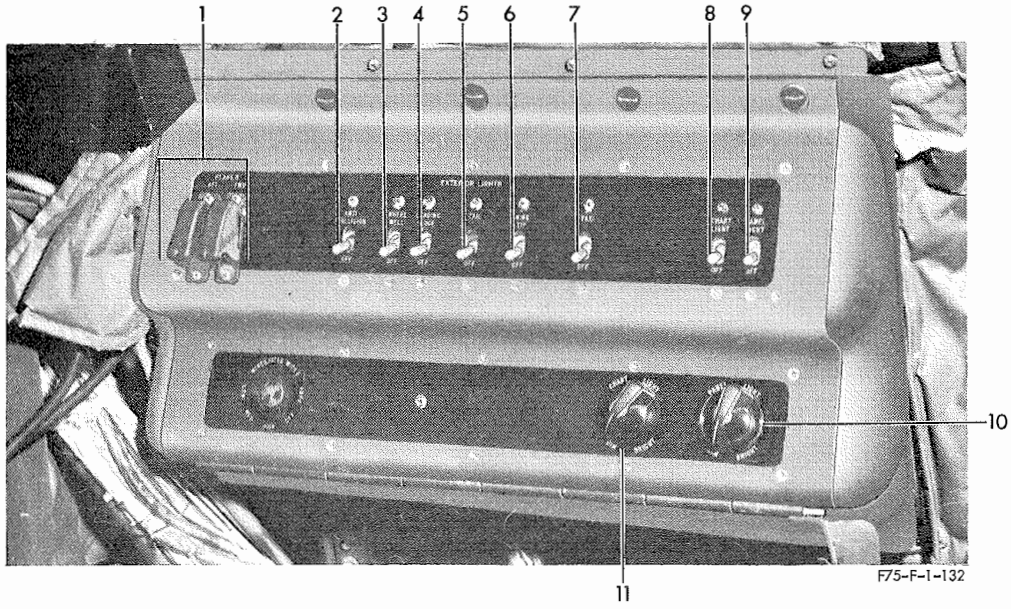
Figure 1-8 (Sheet 2 of 2)

PILOT'S SIDE PANEL

EC-121D



TC-121C



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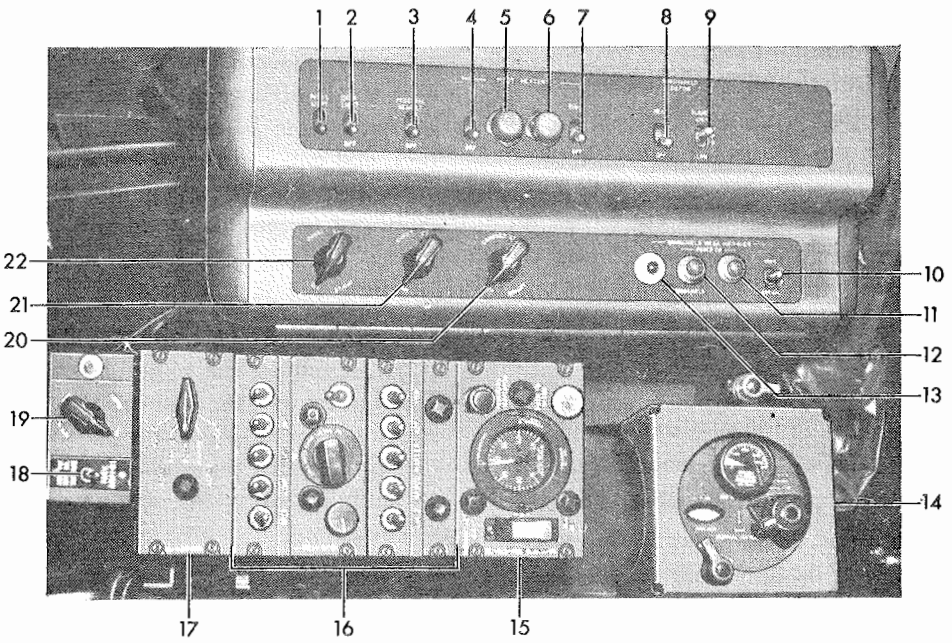
1 FLARE RELEASE SWITCHES
2 ANTI-COLLISION LIGHT SWITCH
3 WHEEL WELL LIGHT SWITCH
4 LEADING EDGE LIGHTS SWITCH
5 TAIL LIGHT SWITCH
6 WING TIP LIGHTS SWITCH
7 TAXI LIGHT SWITCH
8 CHART LIGHT SWITCH
9 PANEL LIGHT SWITCH
10 PANEL LIGHT RHEOSTAT
11 CHART LIGHT RHEOSTAT
12 RADIO AND ICS PANEL
13 LOUDSPEAKER LS-184

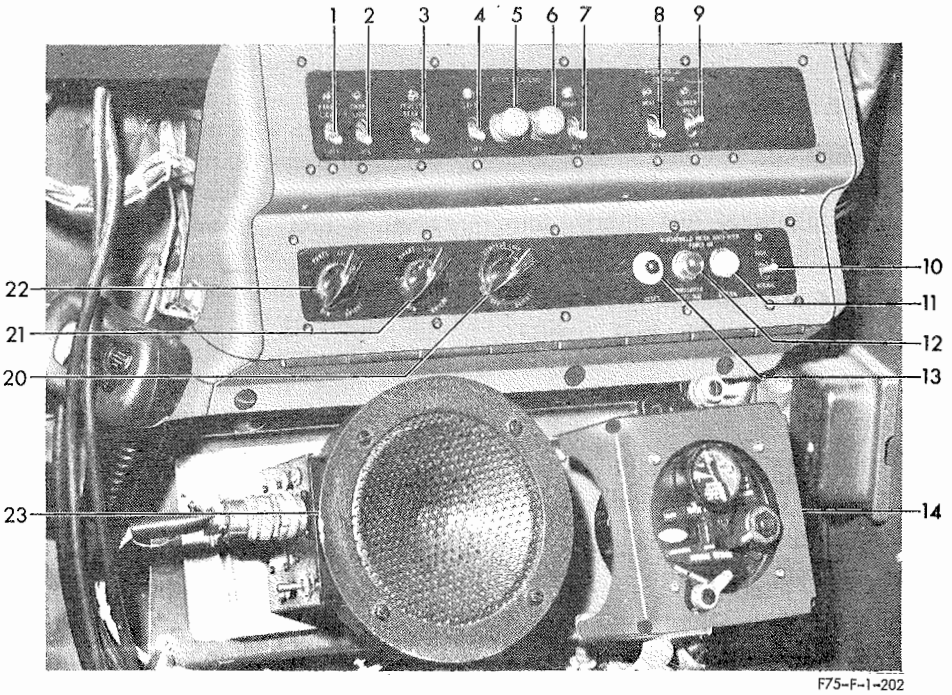
Figure 1-9

COPILOT'S SIDE PANEL

EC-121D



TC-121C



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1 PANEL LIGHT SWITCH
2 CHART LIGHT SWITCH
3 PEDESTAL REAR LIGHT SWITCH
4 LEFT PITOT HEATER SWITCH
5 LEFT PITOT HEATER INDICATOR LIGHT
6 RIGHT PITOT HEATER INDICATOR LIGHT
7 RIGHT PITOT HEATER SWITCH
8 WINDSHIELD DEFOG HEATER SWITCH
9 WINDSHIELD DEFOG BLOWER SWITCH
10 NESA SYSTEM SWITCH
11 NESA SYSTEM POWER-ON LIGHT
12 NESA CYCLING LIGHT
13 NESA RESET SWITCH
14 OXYGEN REGULATOR
15 RADAR PRESSURIZATION CONTROL AND INDICATOR
16 COPILOT'S ICS PANEL
17 RANGE FILTER SWITCH PANEL
18 VHF, NAV AND ARN-21 SELECTOR SWITCH
19 INPH PANEL LIGHT RHEOSTAT
20 COMPASS LIGHT RHEOSTAT
21 CHART LIGHT RHEOSTAT
22 PANEL LIGHT RHEOSTAT
23 LOUDSPEAKER LS-184

Figure 1-10

Spark Control Switches.

Four circuit breaker type switches (4, figure 1-17) are located on the flight engineer's upper switch panel. These switches have two positions placarded NORMAL (up) and RETARD (down). The spark control circuit will not be complete unless these switches are in the NORMAL position. If the circuit of any engine is shorted the circuit breaker for that engine will automatically snap to the RETARD position. The circuit for any engine can be interrupted by manually placing the switch for that engine in the RETARD position.

PRIMING SYSTEM.

Fuel for priming is supplied by the auxiliary fuel pumps through the solenoid priming valve, mounted on the housing of each carburetor pressure chamber. The solenoid valve is actuated by direct current through a momentary-contact switch. Priming fuel is discharged from the fuel inlet chamber directly to the engine blower section.

Engine Primer Switch.

A single priming switch (16, figure 1-29), located on the MJB No. 2 switch panel, is a momentary-contact push button which electrically operates a solenoid primer valve on the carburetor to discharge fuel directly into the engine blower section. Selection of the solenoid primer valve and the engine to be primed is controlled by the engine starter selector switch. The fuel auxiliary boost switches also must be on.

STARTING SYSTEM.

Each engine is equipped with a direct cranking dc electric starter mounted on the engine accessory section. The starter incorporates a disc-type clutch which will slip when the engine offers abnormal resistance to cranking during starting, such as that caused by a hydraulic lock.

Engine Starter Switches.

Two switches for the starting system are located on the MJB No. 2 switch panel. One switch is the engine starter selector (13, figure 1-29). It is a rotary-type switch with five positions; engine 1, 2, OFF, 3, and 4. The other switch is a momentary-contact type push button (14, figure 1-29) which energizes the selected engine starter.

ENGINE INDICATORS.

Tachometer Indicators.

Engine rotational speed is transmitted by tachometer generators mounted on the rear case of each engine to four dual self energized electric indicators. Two are located on the pilots' instrument panel (12, 13, figure 1-7), and two are located on the flight engineer's lower instrument panel (16, figure 1-15). The indicators are calibrated to read in revolutions per minute.

Manifold Pressure Indicators.

Two dual manifold pressure indicators (10, 11, figure 1-7), located on the pilots' instrument panel, and two dual indicators (18, figure 1-15), located on the flight engineer's lower instrument panel register the air induction pressures in the engine manifolds. The instruments are calibrated in inches of mercury and are operated by ac power.

Torquemeters (BMEP Indicators).

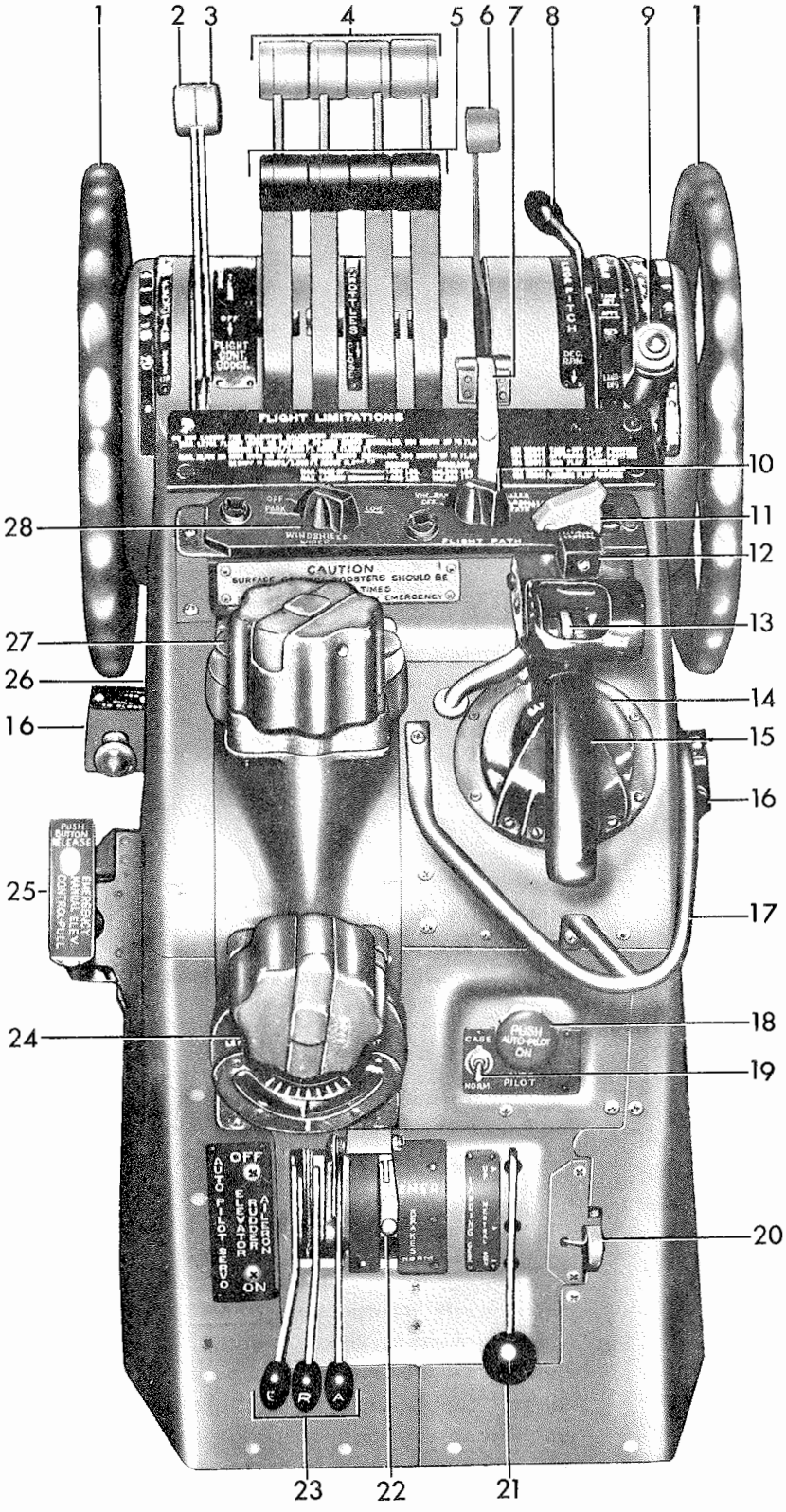
Two dual ac-operated torquemeter indicators (4, figure 1-15), located on the flight engineer's lower instrument panel, measure the torque at the propeller shaft. The indicators are calibrated in BMEP.

Torquemeter Line Heater Switches. Four switch-type circuit breakers (8, figure 1-17) are located on the flight engineer's upper switch panel and are placarded ENG 1, ENG. 2, ENG. 3, and ENG. 4. (On some aircraft these switches are placarded INOPERATIVE because internal torquemeter lines are provided and heater switches are not required.) These switches supply dc electrical power to the heating element in each of the external torquemeter lines. In the event a short circuit occurs in the line heater, the switch-type circuit breaker will open, interrupting the dc electrical current to the heating element.

Oil Pressure Indicators.

Two dual oil pressure indicators (9, figure 1-15) are located on the right side of the flight engineer's lower instrument panel and register pressure in pounds per square inch. The oil pressure transmitters are located in the accessory section on the transmitter panel in each engine nacelle. Immediately below the oil pressure indicators are the four oil low-pressure warning lights (10, figure 1-15) which glow when the pressures drop to 55 ($\pm$5) psi. Because of the tolerance of the pressure transmitters ($\pm$5 psi), the lights are intentionally set to come on at an oil pressure that is lower than the minimum marking of the oil pressure gage. This setting precludes low oil pressure indications which are not actually below the minimum inflight oil pressure of 65 psi.

TYPICAL PILOTS' CENTER CONTROL STAND



1 ELEVATOR TRIM TAB CONTROL WHEELS

2 RUDDER BOOSTER CONTROL LEVER

3 AILERON BOOSTER CONTROL LEVER

4 REVERSE PITCH THROTTLE LEVERS

5 THROTTLE LEVERS

6 THROTTLE LOCK LEVER (NOT INSTALLED ON TC-121C AIRCRAFT)

7 REVERSE LOCK OVERRIDE LEVER

8 PROPELLER MASTER LEVER

9 WING FLAP LEVER

10 FLIGHT PATH SELECTOR

11 FLIGHT PATH DIRECTION FINDER

12 AUTOMATIC PILOT ALTITUDE CONTROL

13 AUTOMATIC PILOT PITCH TRIM CONTROL

14 AUTOMATIC PILOT BANK TRIM CONTROL

15 AUTOMATIC PILOT PISTOL GRIP TURN CONTROL

16 VENTILATION DAMPER CONTROL

17 LANDING GEAR SOLENOID LOCK RELEASE (HIDDEN)

18 AUTOMATIC PILOT CLUTCH SWITCH

19 AUTOMATIC PILOT FLUX GATE CAGING SWITCH

20 LANDING GEAR LEVER RELEASE TRIGGER

21 LANDING GEAR LEVER

22 BRAKE SELECTOR VALVE LEVER

23 AUTOMATIC PILOT SERVO DISCONNECT LEVERS

24 ALIERON TRIM TAB

25 EMERGENCY ELEVATOR BOOSTER SHIFT CONTROL

26 LANDING GEAR WARNING HORN RELEASE (HIDDEN)

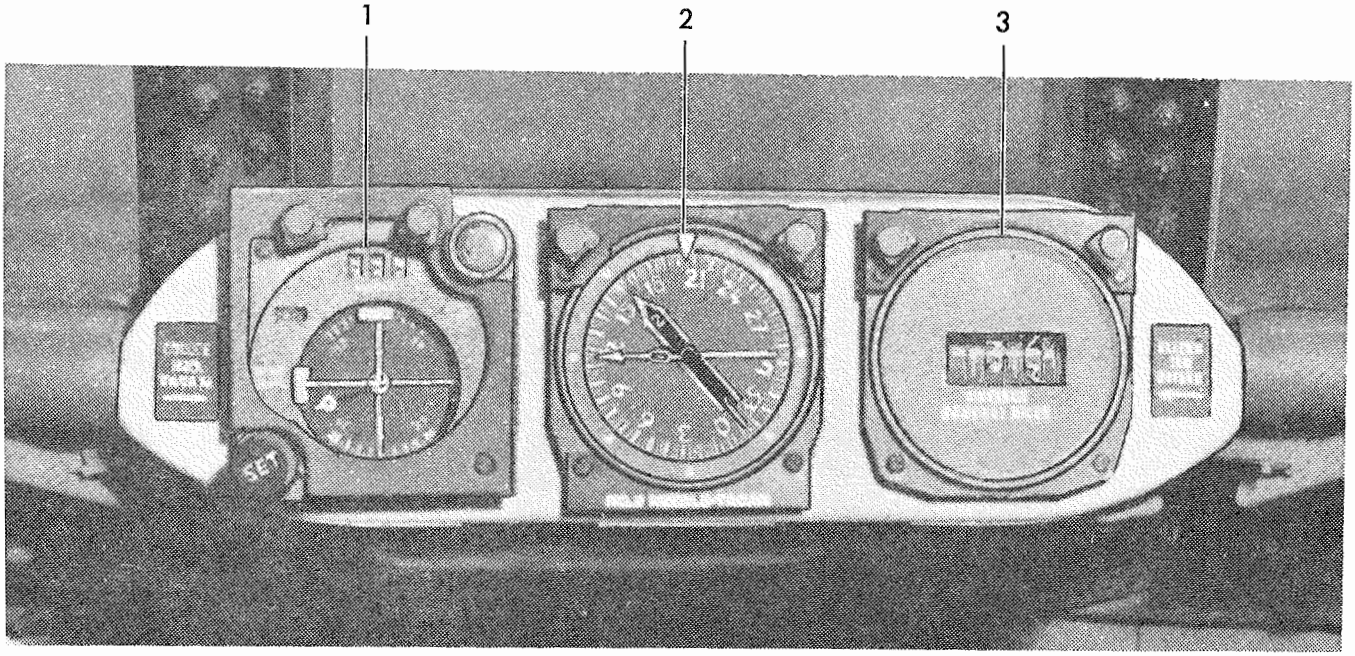
27 RUDDER TRIM TAB

28 WINDSHIELD WIPER CONTROL

F75-E-1-4A

Figure 1-11

PILOTS' GLARE SHIELD PANEL



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1. ID-249 COURSE INDICATOR 2. ID-250 RADIO MAGNETIC INDICATOR 3. ID-310 RANGE INDICATOR

Figure 1-12

Oil Temperature Indicators.

Four dual oil temperature indicators are located on the flight engineer's upper and lower instrument panels and are calibrated in degrees Centigrade. Two of these indicators (4, figure 1-16) register the oil outlet temperature of the four engines by bulbs located in the oil-out line housing fittings near the engine oil sump cases. The other two indicators (8, figure 1-15) register the oil inlet temperatures of the four engines after the oil has passed through the oil cooler system and supply tanks. The oil-in temperature bulbs are located in the engine oil-in lines, Zone 3. Signals are transmitted electrically from the bulb transmitters to the panel indicators.

Fuel Pressure Indicators.

Two dual fuel pressure indicators (11, figure 1-15) are located on the engineer's lower instrument panel and provide an indication of fuel pressure at the carburetors.

Fuel Low-Pressure Warning Lights.

Four fuel low-pressure warning lights (12, figure 1-15) are located on the flight engineer's lower instrument panel below the fuel pressure indicators. They glow red when the fuel pressure measured at the carburetors drops to the allowable minimum (approximately 19 psi).

Fuel Flow Indicators.

Two dual fuel flow indicators (2, figure 1-15) are located on the flight engineer's lower instrument panel. They indicate the rate of fuel flow to the engine in pounds per hour.

IGNITION ANALYZER.

This aircraft incorporates a Sperry ignition analyzer which provides a visual means of detecting, locating and identifying engine ignition abnormalities. The analyzer can be used on the ground or during flight and will reveal ignition malfunctions at high altitude that normally are not evident on the ground. Data is presented in the form of patterns on the face of the cathode ray tube indicator mounted on the flight engineer's table. The characteristic ignition patterns of each engine may be examined singularly for individual

ENGINE ANALYZER CONTROLS

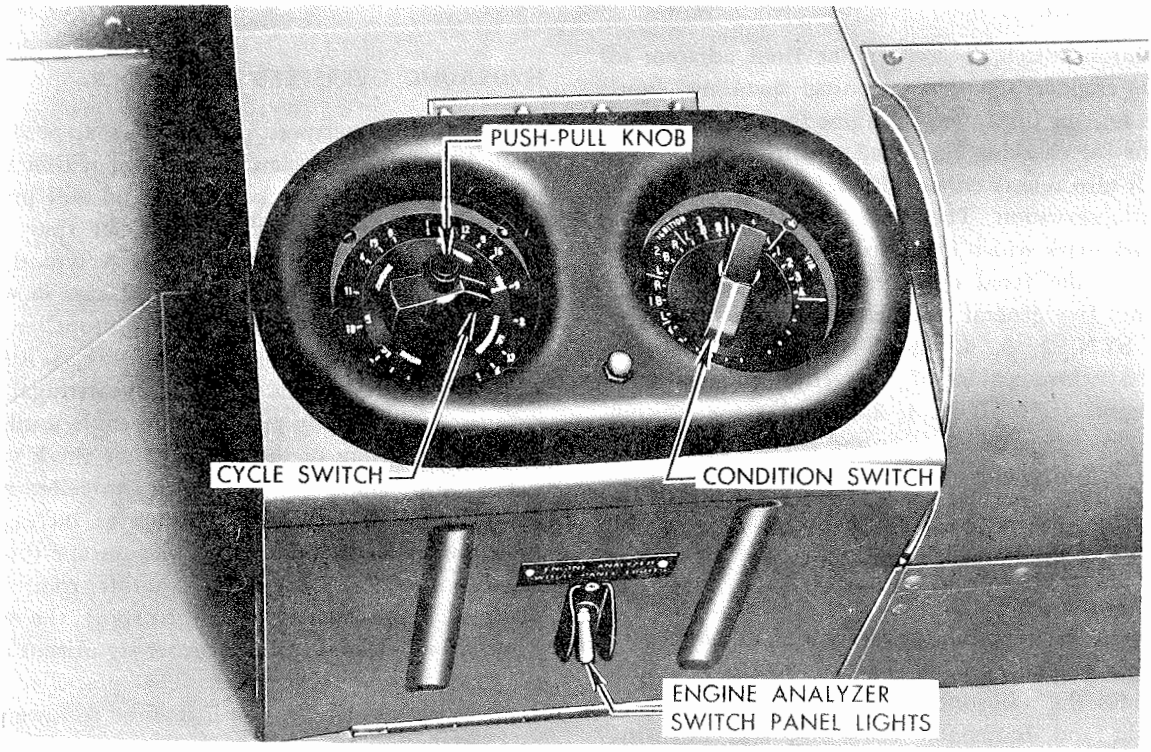


Figure 1-13

cylinders or simultaneously for all cylinders. Any ignition malfunction during engine operation will alter the characteristic pattern and change its contour. Each engine pattern can be identified with the number of the cylinder, spark plug, or magneto associated with the malfunction. The power supply amplifier, located on the forward radio rack operates on ac power and contains the electronic circuits that provide necessary voltages to operate the cathode ray tube indicator. The synchronizing generator is driven by the engine auxiliary tachometer drive at one-half engine speed, and provides 3-phase voltage for timing the patterns to the angular position of the engine crankshaft. This voltage initiates and produces the horizontal base sweep across the cathode ray tube of the indicator. Refer to Section VII for operating procedures.

Cycle Switch.

The cycle switch (figure 1-13), located on the floor adjacent to the flight engineer's auxiliary control quadrant, consists of a fixed index ring marked off with numbers that correspond to the number of cylinders of the engine in their firing order. The inner rotatable switch dial is marked with an index line and abbreviations at specific points which indicate events occurring during a complete engine cycle. The following abbreviated positions are inoperative on this unit because vibration pickups are not installed: I.O. (intake opens), E.C. (exhaust closes), I.C. (intake closes), E.O. (exhaust opens). The IGN (ignition position), however, is used. The center selector switch incorporates a push-pull knob that controls the sweep of the horizontal pattern on the cathode ray tube indicator. The IGN position is aligned with any cylinder designation on the fixed ring dial, and the operator may choose the pattern presentation. The number of patterns that will be seen is contingent upon the position of the push-pull knob. In the "pushed-in" position (fast sweep), two complete patterns will appear on the indicator, beginning with the ignition pattern of the cylinder on which the cycle switch is indexed, and will conclude with that of the next cylinder in firing order. In the "pulled-out" position (slow sweep), the

patterns of all cylinders will appear, beginning with that of the cylinder on which the IGN is indexed. Some typical patterns are illustrated in Section VII.

Condition Switch.

The condition switch, located on the floor adjacent to the flight engineer's auxiliary control quadrant, functions as a selector for a specific engine for either ignition analysis or for checking the speed synchronism between engines. It also selects either left, right, or both distributors for observation. The inner rotatable dial has a single index mark which is rotated to the desired indices engraved on the fixed outer ring. The fixed ring is divided into five general sections which are engraved as follows: SYN, 2, 3, 4, and VIB (inoperative) for checking synchronization of respective engines with No. 1 engine; IGNITION, 1, 2, 3, and 4 for ignition analysis of the respective engines and B (both), L (left) and R (right) magnetos.

Cathode Ray Tube Indicator and Controls.

The indicator assembly is a housing which encloses a 3-inch cathode ray tube. The assembly is mounted face-up in the flight engineer's table. The power supply amplifier provides the adjustments of the indicator such as focus, gain and horizontal centering, and intensity. However, when these controls are set, they should not require frequent readjustment.

PROPELLERS.

A Hamilton Standard hydromatic, three-bladed, full-feathering and reversible pitch propeller is installed on each engine. Each propeller incorporates a fluid deicing distribution system. A propeller control system is provided for constant speed, synchronization, individual selector controls, a master control for changing rpm of all engines simultaneously, manual and automatic feathering, and reversing. The constant speed, reversing and unreversing, feathering and unfeathering features of this propeller are controlled by a double acting governor mounted on the top of the nose case of each engine. The governor consists of an engine-driven gear-type pump which takes oil from the engine oil system and boosts the pressure to that required for operation of the propeller pitch changing mechanism located in the propeller dome. Other components of the governor consist of the following: A pilot valve actuated by spring-balanced flyweights which control the flow of oil to and from the propeller dome; a pressure-operated check valve which allows high pressure oil from an auxiliary (feathering) pump to add to the governor output when the propeller is being feathered and unfeathered, or reversed and unreversed; and a relief valve system which limits the output pressure of the governor pump, yet allows it to provide sufficient operating force to control the propeller under all conditions.

HYDRAULIC OVERSPEED PITCH LOCK.

The hydraulic overspeed pitch lock is a speed sensitive pitch lock. It is completely contained within the dome assembly, is completely automatic, and will prevent decrease pitch operation above a preset rpm (approximately 5-10% above takeoff rpm). A typical example of the action of the pitch lock is the case in which the control oil pressure supply to the propeller is interrupted but the engine remains operative. With no control oil pressure available, CTM (centrifugal twisting moment) will rapidly reduce blade angle until the rpm reaches the setting of the transfer tube check valve (between 2630 and 2740 rpm). The propeller may then be feathered or rpm will continue to increase slowly since the trapped, outboard oil must escape through the bleed hole. When the bleed shutoff rpm setting is reached (approximately 3110-3220 rpm), the dome will be effectively seated and no further significant reduction of blade angle will occur. The propeller may be feathered or the engine power reduced to lower the rpm to a satisfactory value. Engine operation may be continued at reduced power but still producing positive thrust. Once the pitch lock is triggered, rpm may be reduced to a very low value (approximately 1600 rpm) without unlocking since the trapped oil will supply the force necessary to hold the check valve and shutoff valve closed. In this situation, the pitch lock will reduce the possibility of engine damage, improve featherability, or allow continued operation at reduced power.

There are other circumstances where the pitch lock will prove beneficial. In all of these, the reduced rate of decrease pitch change above the transfer tube check valve rpm setting will allow more time for feathering to be initiated, allow more time for power and airspeed reduction, and will retard the increase of drag associated with windmilling propeller. When the bleed shutoff valve is also triggered, it will limit the ultimate overspeed to a lower rpm and will, therefore, reduce final drag, limit engine damage, improve featherability, and allow continued, reduced power operation.

FEATHERING SYSTEM.

During feathering, a dc electric motor-driven auxiliary (feathering) pump directs engine oil through the governor, which distributes and augments oil pressures

through the propeller shaft to the forward side of the dome piston. As the piston is forced aft, a slotted cam gear is rotated which, in turn, rotates each of the three blades so that the blades move up to the feathered positions. Displaced oil from the aft side of the piston is forced back through the propeller shaft to the propeller governor to be recirculated in the system as long as the propeller feathering button is in the depressed position.

UNFEATHERING SYSTEM.

During unfeathering, the motor-driven auxiliary (feathering) pump and the solenoid valve in the governor, directs oil pressure to position the governor pilot valve in the decrease pitch position. The oil flows through the decrease pitch passages to the aft side of the propeller dome piston. The piston is forced forward, turning the blades toward low pitch. The oil on the forward side of the piston is forced back through the propeller shaft to the intake side of the propeller governor.

REVERSING FEATURES.

When reverse thrust braking is used, the motor-driven auxiliary (feathering) pump and the solenoid valve in the governor are energized and send high pressure oil through the propeller shaft to the aft side of the dome piston, moving it forward until the piston sleeve contacts the low-pitch stop levers. As additional oil pressure builds up, force is exerted on the servo piston valve which becomes unseated and moves the wedge from under the low-pitch stop levers, which in turn retract, allowing the piston to move forward, rotating the cam gear and causing the blade angle to be decreased through zero pitch and into the reverse angle. Prior to reaching the reverse pitch stop, the feathering pump is shut off by the blade angle switch and power for the last few degrees of travel is supplied by pressure from the governor. The full reverse angle stop is a fixed pitch position, and the blade is held in that position by oil pressure from the governor pump.

UNREVERSING FEATURES.

When unreversing, high pressure oil from the motor-driven auxiliary (feathering) pump is directed to the forward side of the dome piston, forcing the blades to the positive angle. Unreversing will continue until the blade cam contacts a blade switch which stops the auxiliary (feathering) pump. This occurs when the blade angle reaches a point before the low-pitch stop setting, where the constant speed control takes over.

SYNCHRONIZING FEATURES.

The synchronizer unit provides a flexible means of controlling and synchronizing engine speed. Among the features provided are: Limited range synchronization with solenoid release, to allow full range synchronization by increments; speed adjustment of all engines throughout the entire operating range by a single master control lever; separate adjustment of each propeller governor by individual toggle switches; and positive positioning of all governors against the high-speed stops for takeoff. Provision is made for selecting either of two engines as a master speed reference (engine No. 1 and engine No. 2) and for switching the synchronizer on and off at will. Master lever control is retained even with the synchronizer function inoperative. Each propeller is under governor control at all times so that constant speed operation is retained in the event of the complete failure of the synchronizer system. The synchronizer unit is contained in a moisture-proof case to the right of the copilot's chair. Electrical connections are by individual plugs to insure correct connections. Incorporated in the synchronizer are 19 relays, three differential motor and combinations with solenoids to release the limited range feature, one reversible dc motor and commutator switch combination, one non-reversible dc motor and commutator switch combination, a mechanical-electrical switch operated by the master lever at the high-speed limit, and the required wiring for these units. Four fuses are incorporated for electrical protection, in addition to the manual circuit breakers, on the flight engineer's upper circuit breaker panel. Refer to Synchronizer Operation, Section VII.

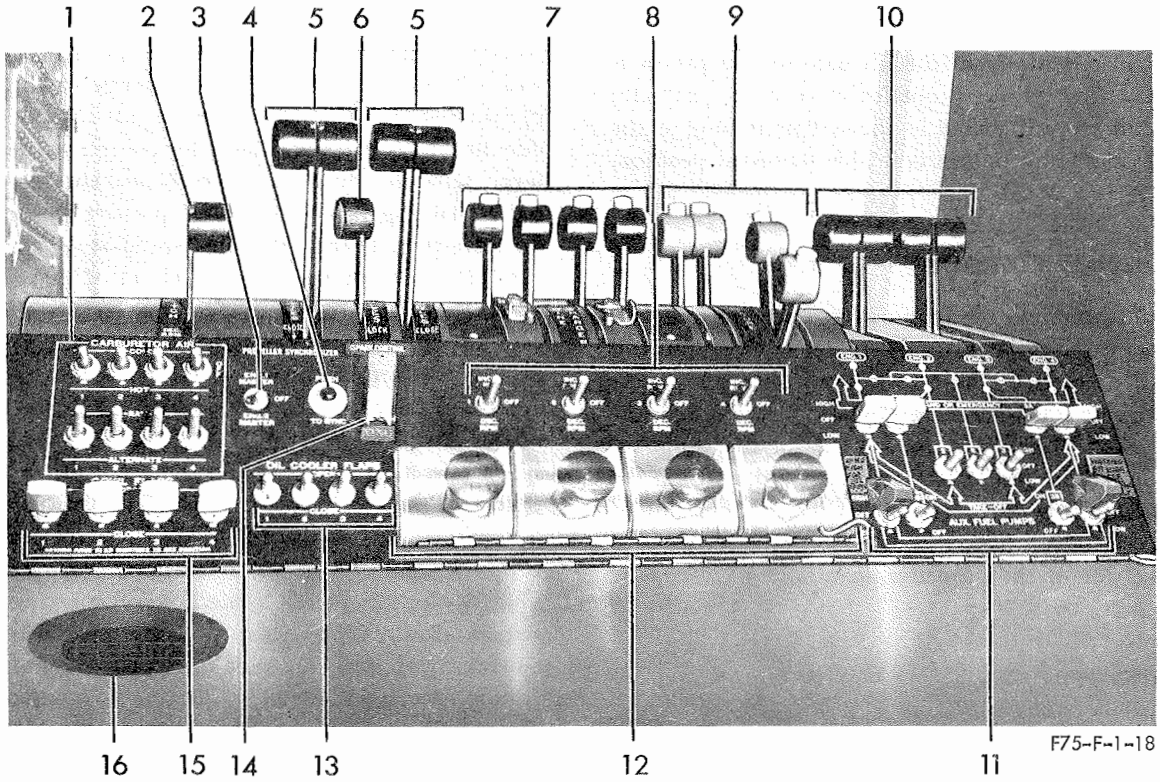
AUTOMATIC FEATHERING FEATURES.

The automatic feathering system will feather the propeller of an engine automatically if the BMEP drops to approximately 93-104 BMEP or less and remains there from 1½ to 2 seconds, provided the system is armed and the throttle is beyond the 49% position. This delay is introduced to prevent automatic feathering in the event of momentary power losses and to prevent automatic feathering if the throttle is advanced rapidly enough to close the throttle switch before the BMEP has risen above the setting of the torque pressure switch. A blocking relay will disconnect the entire automatic feathering system after one propeller has feathered automatically.

Propeller Master Levers.

Propeller master levers are located on the pilots' center control stand (8, figure 1-11), and on the flight engineer's control quadrant (2, figure 1-14). These levers

TYPICAL FLIGHT ENGINEER'S LOWER SWITCH PANEL



1 CARBURETOR AIR SWITCHES

2 PROPELLER MASTER LEVER

3 MASTER ENGINE SELECTOR SWITCH

4 SYNCHRONIZER BUTTON

5 THROTTLE LEVERS

6 THROTTLE LOCK - (NOT INSTALLED ON TC-121C AIRCRAFT)

7 ENGINE SUPERCHARGER CONTROL AND CABIN SUPERCHARGER DISCONNECT LEVERS

8 PROPELLER GOVERNOR SWITCHES

9 MIXTURE LEVERS

10 FUEL TANK SELECTOR LEVERS

11 AUXILIARY FUEL PUMP SWITCHES - (TIP TANK AND TANK NO. 6 SWITCHES NOT INSTALLED ON TC-121C AIRCRAFT)

12 PROPELLER FEATHERING BUTTONS & LIGHTS

13 OIL COOLER FLAPS SWITCHES

14 MASTER SPARK CONTROL SWITCH

15 COWL FLAPS SWITCHES

16 IGNITION ANALYZER INDICATOR

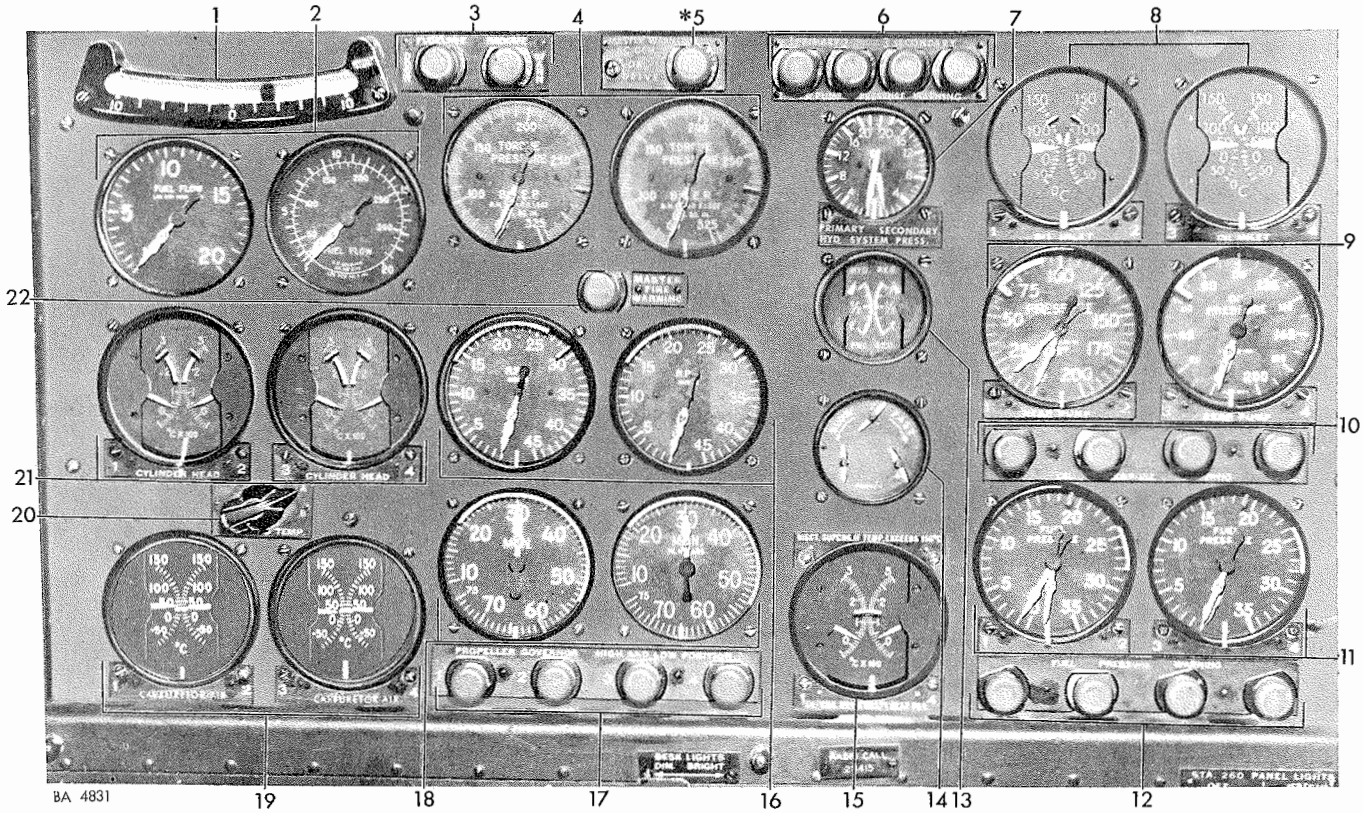
Figure 1-14

mechanically reset all four propeller governors simultaneously throughout the governing range and at approximately the take-off rpm position, sets the governors to maximum rpm and actuates the calibrate switch, which disconnects the synchronizer from the system. These two levers are mechanically linked with no over-riding feature for either the pilot or the flight engineer.

Propeller Governor Switches.

Four individual governor switches (8, figure 1-14) are located on the flight engineer's lower switch panel and are numbered from left to right. Each switch has three positions, INC. RPM, OFF, and DEC. RPM, and is spring-loaded to the OFF position. Holding the switch in either the INC. RPM or DEC. RPM position provides momentary dc electrical contact to the propeller governor to effect changes in pitch, as desired.

TYPICAL FLIGHT ENGINEER'S LOWER INSTRUMENT PANEL



1. INCLINOMETER
2. FUEL FLOW INDICATORS
3. DOOR WARNING LIGHTS
4. TORQUEMETERS (BMEP INDICATORS)
*5. AC GENERATOR MASTER WARNING LIGHT
6. HYDRAULIC PUMP LOW PRESSURE WARNING LIGHT
7. HYDRAULIC SYSTEM PRESSURE INDICATOR
8. OIL TEMPERATURE INDICATORS
9. OIL PRESSURE INDICATORS
10. OIL LOW-PRESSURE WARNING LIGHTS
11. FUEL PRESSURE INDICATORS
12. FUEL LOW-PRESSURE WARNING LIGHTS
13. HYDRAULIC FLUID QUANTITY INDICATOR
14. SYNCHROSCOPE
15. CABIN SUPERCHARGER DRIVE SHAFT REAR BEARING TEMPERATURE INDICATOR
16. TACHOMETER INDICATORS
17. PROPELLER GOVERNOR HIGH AND LOW PITCH POSITION INDICATOR LIGHTS
18. MANIFOLD PRESSURE INDICATORS
19. CARBURETOR AIR TEMPERATURE INDICATORS
20. CYLINDER HEAD TEMPERATURE SELECTOR SWITCH
21. CYLINDER HEAD TEMPERATURE INDICATORS
22. MASTER FIRE WARNING LIGHT

*AC generators removed on all TC-121C aircraft

F75-F2-1-10

Figure 1-15

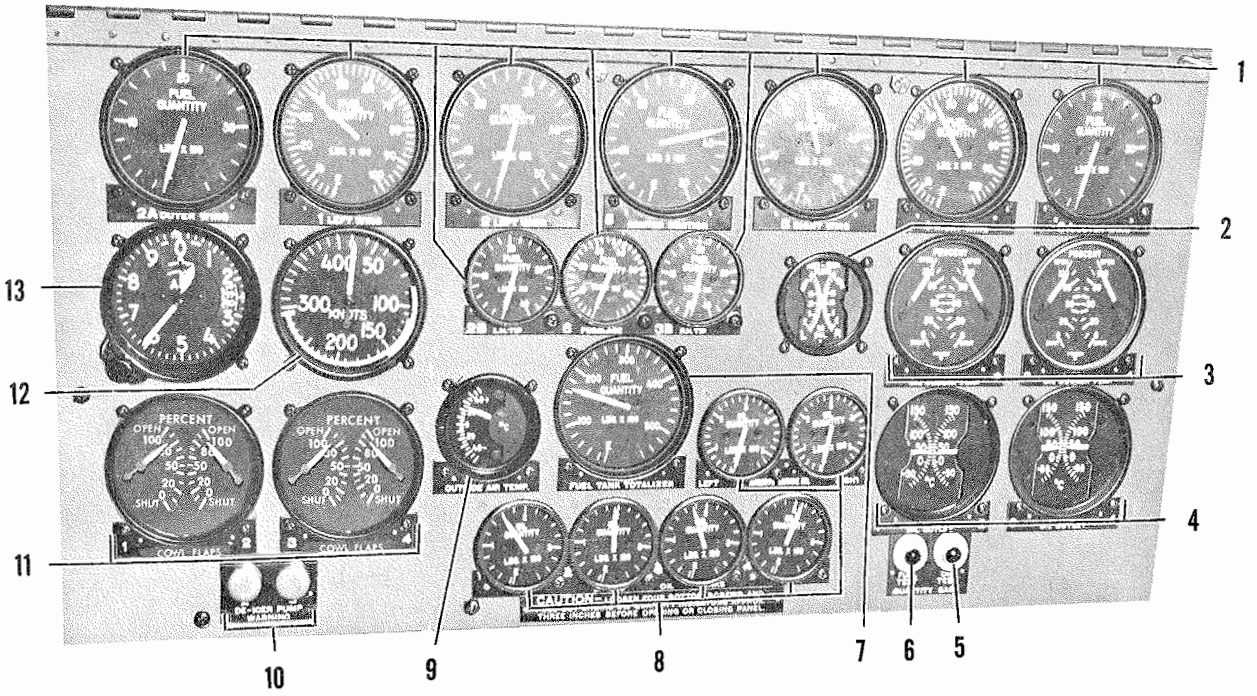
Master Engine Selector Switch.

A master engine selector switch (3, figure 1-14), located on the flight engineer's lower switch panel, selects the synchronization function and permits the selection of engine 1 or 2 as the master engine. It is a toggle-type switch that has three positions: ENG. 1 MASTER, OFF and ENG. 2 MASTER.

Feathering Buttons and Lights.

Four individual feathering buttons (12, figure 1-14) are located on the flight engineer's lower switch panel and are numbered from left to right. Each button is protected by a plastic cover to prevent inadvertent feathering. Each cover is marked PUSH FEATHER and PULL UNFEATHER. Pressure on the selected button energizes the auxiliary (feathering) pump, and a holding coil holds the button in during feathering operation. After the blades have reached the feathered position, the button must be pulled manually to the midway position to deenergize the circuit and stop the auxiliary (feathering) pump. The feathering button must be held out manually to unfeather a propeller; however, the unfeathering action can be terminated by releasing the feathering button. Operation of any feathering button to the feather or unfeather position will interrupt the automatic feathering circuit of the other three propellers

EC-121D. TYPICAL FLIGHT ENGINEER'S UPPER INSTRUMENT PANEL



1. FUEL QUANTITY INDICATORS
2. ALCOHOL ANTI-ICING TANK FLUID QUANTITY INDICATOR
3. OIL COOLER FLAP POSITION INDICATORS
4. OIL TEMPERATURE INDICATORS (OIL OUT)
5. OIL QUANTITY INDICATORS TEST SWITCH
6. FUEL QUANTITY INDICATORS TEST SWITCH
7. FUEL QUANTITY TOTALIZER INDICATOR
8. OIL QUANTITY INDICATORS
9. OUTSIDE AIR TEMPERATURE INDICATOR
10. VACUUM WARNING (DE-ICER PUMP) LIGHTS
11. COWL FLAP POSITION INDICATORS
12. AIRSPEED INDICATOR
13. ALTIMETER

F75-F2-1-21

Figure 1-16 (Sheet 1 of 2)

by energizing a feather interlock relay. A light is incorporated in each feathering button that glows when the auxiliary (feathering) pump circuit is energized.

Synchronize Button.

The synchronizer button (4, figure 1-14) is located on the flight engineer's lower switch panel. Pushing and releasing this button will automatically release a dc solenoid which will synchronize the propellers to the existing rpm indicated on the selected master engine tachometer, provided the deviation is less than 3% from the master. When the button is depressed, synchronization is disconnected and the range limitation feature is released so that it can re-center. Releasing the button reconnects the synchronization or makes the off-speed governors run up to 3% toward the master tachometer.

Auto Feathering Master Switch.

This is a guarded switch (16, figure 1-17) located on the flight engineer's upper switch panel. When this switch is placed in the ON position, a dc holding coil energizes the automatic feathering system. The automatic feathering system is completely armed when this switch is turned on and the throttles are advanced beyond the 49% position.

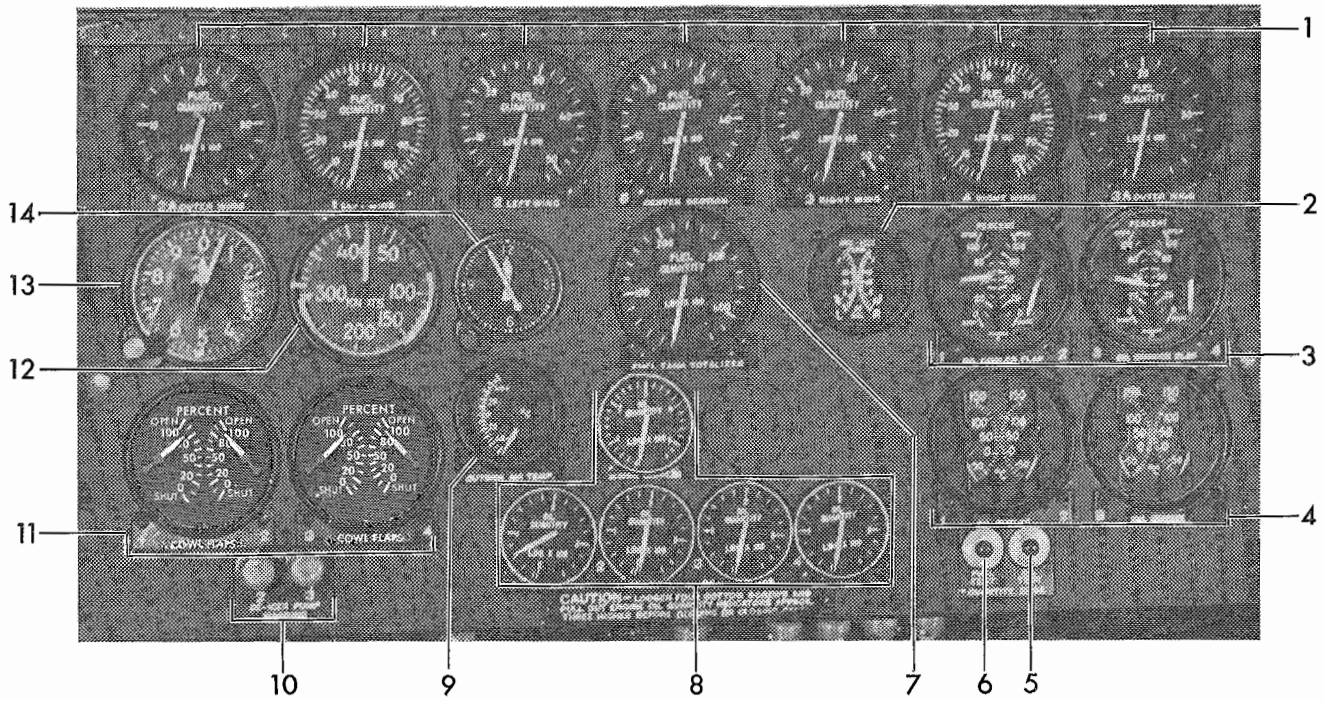
Auto Feathering Test Switches.

Four automatic feathering test switches (14, figure 1-17) are located on the flight engineer's upper switch panel. Each switch is protected by a guard which must be lifted before the system test can be made. The test switches bypass the throttle switches and make it possible to test the system by operating the engines at low power with the circuit simulating take-off power, provided the automatic feathering master switch is ON.

Reverse Lock Override Lever.

A guarded flag visible under a cover on the center control stand (7, figure 1-11) to the right of the No. 4 throttle lever, indicates when the reverse throttle levers are locked. This flag lever may be pushed down manually

TC-121C. TYPICAL FLIGHT ENGINEER'S UPPER INSTRUMENT PANEL



1 FUEL QUANTITY INDICATORS
2 ALCOHOL ANTI-ICING TANK FLUID QUANTITY INDICATOR
3 OIL COOLER FLAP POSITION INDICATORS
4 OIL TEMPERATURE INDICATORS (OIL OUT)
5 OIL QUANTITY INDICATORS TEST SWITCH
6 FUEL QUANTITY INDICATORS TEST SWITCH
7 FUEL QUANTITY TOTALIZER INDICATOR
8 OIL QUANTITY INDICATORS
9 OUTSIDE AIR TEMPERATURE INDICATOR
10 VACUUM WARNING (DE-ICER PUMP) LIGHTS
11 COWL FLAP POSITION INDICATORS
12 AIRSPEED INDICATOR
13 ALTIMETER
14 CLOCK

F75-F2-1-21(2)

Figure 1-16 (Sheet 2 of 2)

to release the reverse throttle lock. The reverse lock actuator is connected by cables to the reverse throttle locking bar which, when turned to the open position, lowers the flag lever and permits the reverse throttle levers to be pulled aft for reverse thrust. An automatic means of releasing the reverse throttle lock is also provided. A switch, mounted on each main landing gear fulcrum, releases the reverse throttle lock when the main gear shock struts pivot rearward as brakes are applied during a rejected take-off or as the wheels contact the runway during landing. As this contact is momentary, the action of this switch is maintained by means of a holding relay. These switches will permit use of the reverse thrust power with partial weight on the main gear, and the scissors switch on the left main gear permits the use of reverse thrust power when full weight is on the landing gear. The throttle reverse lock is reset when both outboard throttles are advanced beyond the 49% position and the aircraft weight on the left main landing gear is partially reduced.

Reverse Pitch Throttle Levers.

These levers control the reverse power range and are discussed under Throttles.

Reverse Pitch Indicator Lights.

Four dc operated reverse pitch indicator lights (30, 34, figure 1-7) are mounted on the pilots' center instrument panel. These lights are set to come on 5° before the reverse pitch stops are reached and to go out when unreversing is initiated.

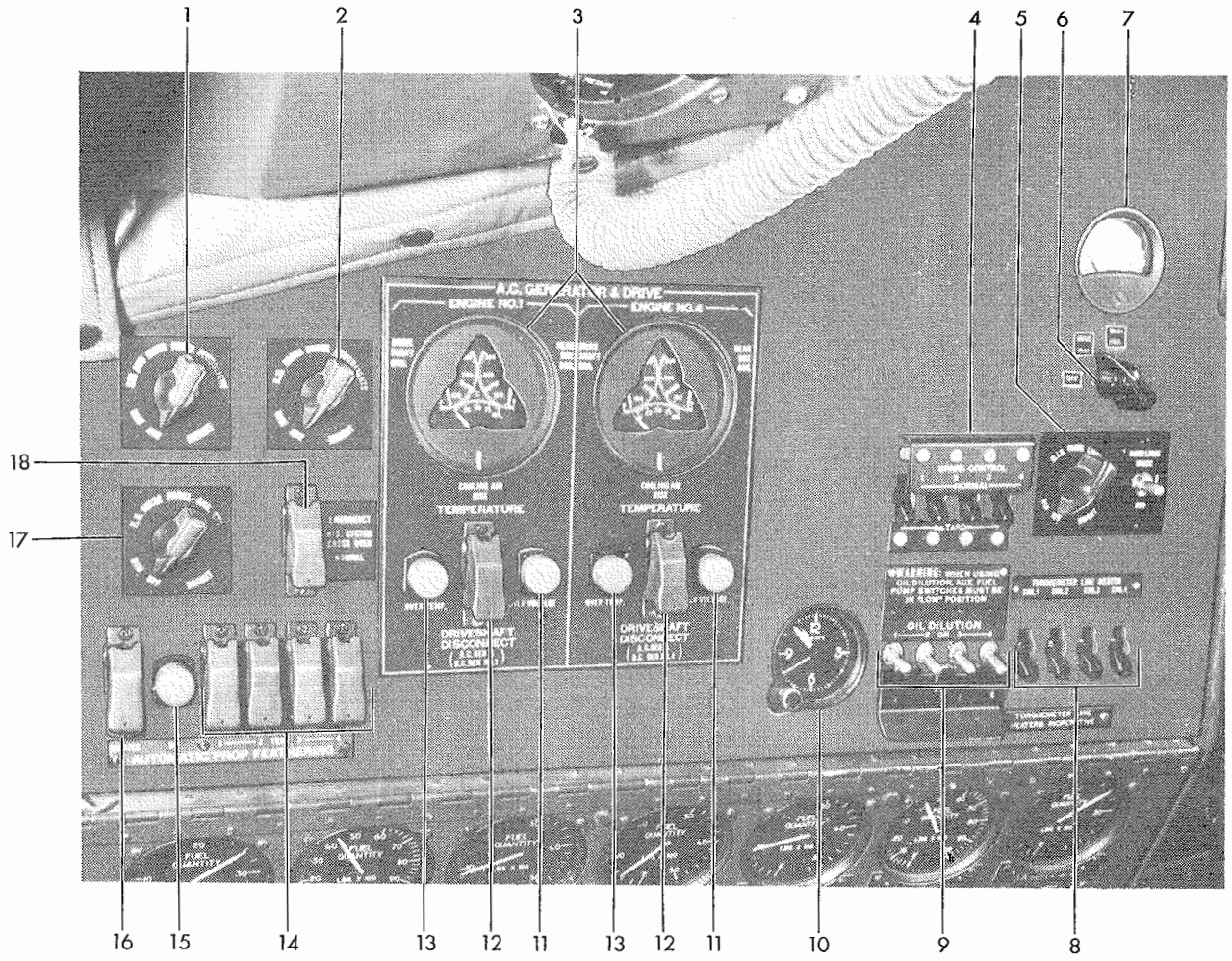
Propeller Governor High and Low Pitch Position Lights.

Four dc operated indicator lights (17, figure 1-15) are located on the flight engineer's lower instrument panel. These lights are set to glow whenever the propeller governors are operating at either the high or low rpm pitch limit setting.

Auto Feathering Armed Light.

Automatic feathering armed lights are installed on the flight engineer's upper switch panel (15, figure 1-17) and on the pilot's auxiliary instrument panel (1, figure 1-7). These lights are dc operated and are set to glow when the automatic feathering system master switch is ON. When the feathering is started automatically, the feathering button light will come on, and when the feathering button is pulled out, the feathering button light and the automatic propeller feathering armed light will go out.

TYPICAL FLIGHT ENGINEER'S UPPER SWITCH PANEL



1. STA 260 INST. PANEL FLOODLIGHT SWITCH
2. FLIGHT ENGINEER'S INSTR. PANEL FLOOD LIGHT SWITCH
*3. A.C. GENERATOR TEMPERATURE INDICATORS
4. SPARK CONTROL C.B. SWITCHES
5. FLIGHT ENGINEER'S STATION LIGHTS SWITCHES
6. INVERTERS FREQUENCY SELECTOR SWITCH
7. INVERTER FREQUENCY METER
8. TORQUEMETER LINE HEATER SWITCHES
9. OIL DILUTION SWITCHES
10. CLOCK
*11. A.C. GENERATOR OVER VOLTAGE WARNING LIGHTS
*12. A.C. GENERATOR DRIVE SHAFT DISCONNECT SWITCHES
*13. A.C. GENERATOR OVER TEMPERATURE WARNING LIGHTS
14. AUTO FEATHERING TEST SWITCHES
15. AUTO FEATHERING ARMED LIGHT
16. AUTO FEATHERING MASTER SWITCH
17. FLIGHT ENGINEER'S INSTRUMENT PANEL AUX. LIGHTS
18. HYDRAULIC SYSTEM CROSS OVER SWITCH

* AC generators removed on all TC-121C aircraft

Figure 1-17

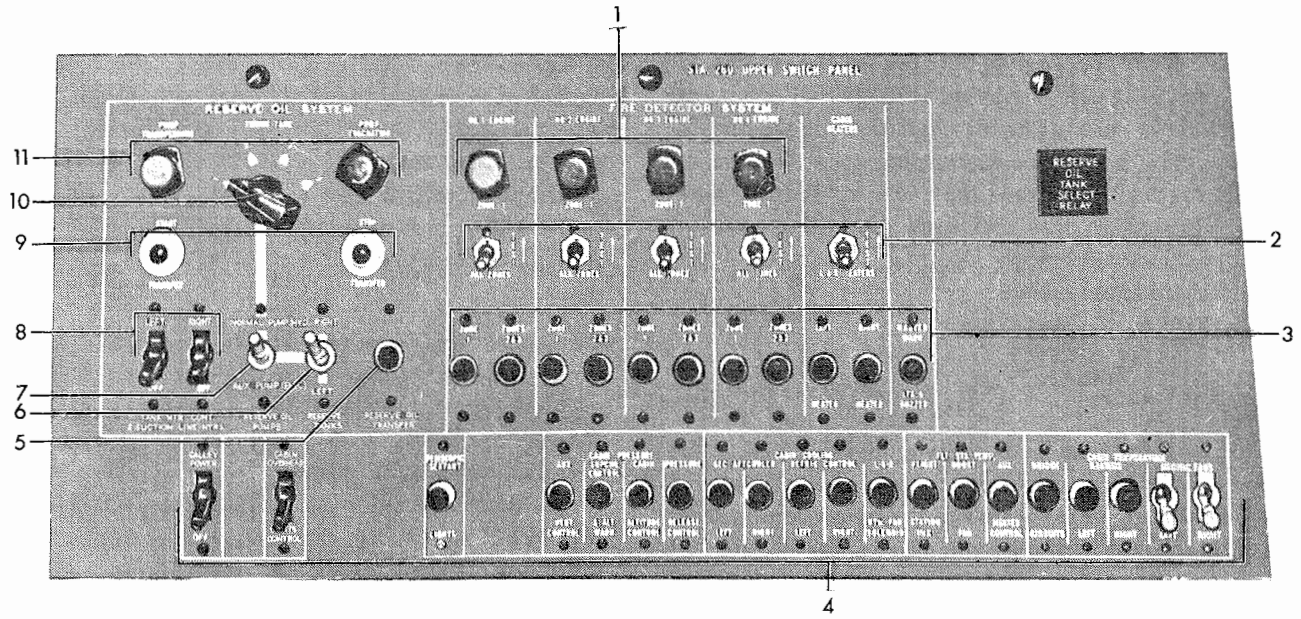
F57-E-1-54

Synchroscope.

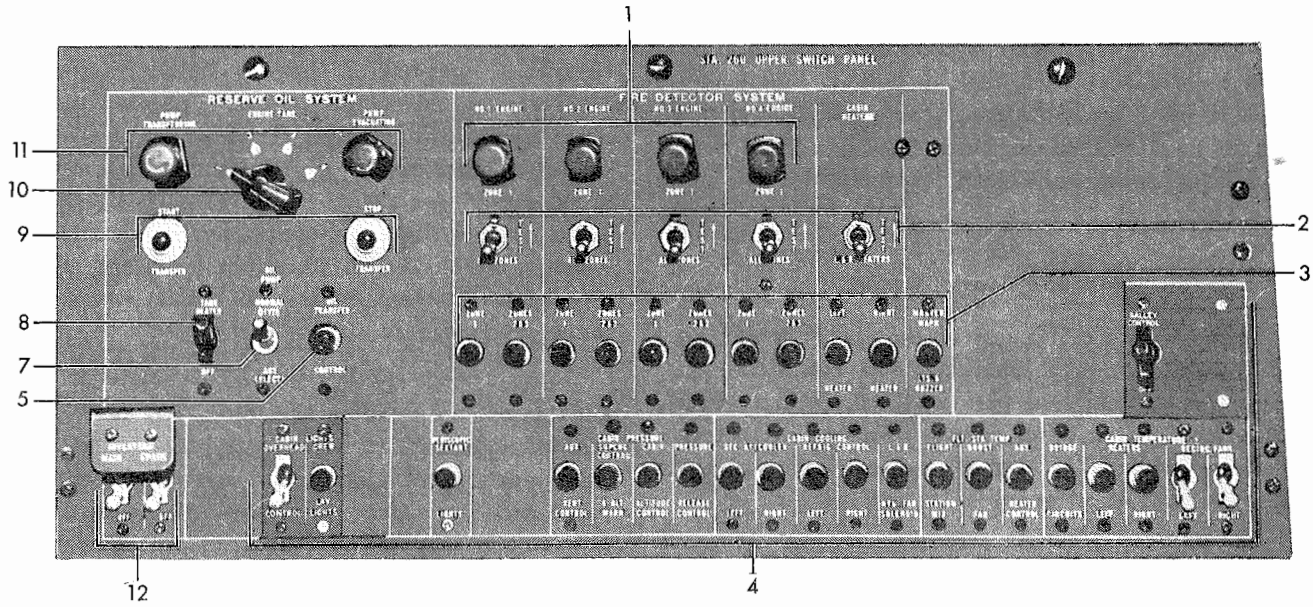
The synchroscope, located on the flight engineer's lower instrument panel (14, figure 1-15), provides indications for synchronizing the four propellers. It is an ac electrical differential motor-type indicator that shows the frequency differences between the tachometer generator output of engine 1, and the output of engine tachometer generators 2, 3, and 4. Since the frequency is proportional to the engine speed, the synchroscope provides a visual comparison of the engine speeds. The three needles on the face of the instrument indicate the rpm of engines 2, 3, and 4 relative to engine 1. They rotate either clockwise or counterclockwise, depending upon whether the engine speed is faster (clockwise) or slower (counterclockwise) than engine 1. When the speeds of engines 2, 3, and 4 are synchronized with engine 1, the needles will be stationary.

STATION 260 UPPER SWITCH PANEL

EC-121D



TC-121C



1 FIRE DETECTOR-ZONE WARNING LIGHTS
2 FIRE DETECTOR TEST SWITCHES
3 FIRE DETECTOR CIRCUIT BREAKERS
4 STATION 260 CIRCUIT BREAKERS
5 OIL TRANSFER CIRCUIT BREAKER
6 RESERVE OIL TANK SELECTOR SWITCH
7 RESERVE OIL PUMP SELECTOR SWITCH
8 RESERVE OIL TANK AND SUCTION LINE HEATER SWITCHES
9 START AND STOP TRANSFER BUTTONS
10 ENGINE OIL TANK SELECTOR SWITCH
11 PUMP TRANSFER AND PUMP EVACUATING INDICATOR LIGHTS
12 INVERTERS (MAIN-SPARE) CIRCUIT BREAKER SWITCHES

F75-F-1 -22

Figure 1-18

OIL SYSTEM.

ENGINE OIL SYSTEM.

Separate oil systems provide lubrication for each engine. Oil flows from the engine oil tank to the engine oil pressure pump which pumps oil through the engine oil passages. After circulating through the engine, the oil is returned by an engine scavenging pump to the oil radiator for cooling. From the radiator, the oil flows through the return line and back into the engine oil tank. Refer to the Servicing Diagram, (figure 1-47), for oil grades and specifications.

Engine Oil Tanks.

The oil tank for each outboard engine is located in the engine nacelle aft of the firewall, and the oil tank for each inboard engine is located in the center section leading edge, inboard of the engine nacelle. Each engine oil tank has a total volume of 54 gallons which includes an 11.5-gallon expansion and foaming space. The total oil content for each tank is 42.5 gallons and includes an oil reserve of 2.5 gallons (which cannot be used by the engine) for feathering of each propeller. External filling beyond the prescribed amount of filling of the expansion space is impossible because of the design and shape of the filler unit. A capacitance-type oil quantity indicating system is installed in each tank to indicate the amount of usable oil. Each tank also is provided with a dip stick, calibrated in U.S. gallons, encased in a foam-proof tube which is a part of the tank filler unit.

Oil Cooler Radiators and Control Valves.

An oil cooler unit is installed on the underside of each engine nacelle. Ram air enters a scoop, passes through the oil radiator and exits past an oil cooler flap which controls the amount of air necessary for cooling. A control valve, mounted on the oil radiator, automatically routes the flow of oil in one of the following ways:

1. Straight through the valve, bypassing the radiator.
2. Around the jacket of the oil cooler radiator.
3. Through the core of the radiator.

When the engine is started at low ambient temperature, the viscosity of the oil in the cooler prevents the flow of oil through the radiator. Oil pressure builds up in the control valve until the pressure opens the surge valve. When the surge valve is open, the oil cooler radiator is bypassed. As the temperature rises and the oil in the jacket of the radiator becomes more fluid, the pressure decreases and the surge valve closes. The bypass valve to the jacket is opened and as oil is circulated through the jacket, the oil in the core is heated and becomes more fluid until the rate of oil flow is increased and the pressure drops below the closing point of the bypass valve. When the bypass valve is completely closed, the oil is circulated directly through the core of the radiator, back into the control valve, and then out through the exit port to the oil tank return line. Under cruise conditions, oil temperature is further controlled by actuating the oil cooler flap which regulates the amount of air passing through the radiator.

Oil Cooler Flap Switches. The switches that operate the cooler flaps (13, figure 1-14) are located on the left side of the flight engineer's lower switch panel. These switches are spring-loaded from the OPEN and CLOSE positions to the OFF position. The cooler flap is moved to the desired position by holding the switch in either the OPEN or CLOSE position, and is stopped at any setting by releasing the switch.

Emergency Shut-off Levers. Movement of this lever to the fourth detent position will shut off engine oil. Refer to Emergency Equipment, this Section.

Oil Quantity Indicators and Test Switch. Four ac electrically operated oil quantity indicators (8, figure 1-16) are located on the lower side of the flight engineer's upper instrument panel. These indicators register the oil quantity of each engine tank, and are calibrated in pounds. A test switch button (5, figure 1-16) is installed on the flight engineer's upper instrument panel which, when depressed, allows the indicating needle to drop to zero; when released, the needle will return to the accurate quantity reading.

Oil Cooler Flap Position Indicators. Two dual oil flap position indicators (3, figure 1-16) are located on the right side of the flight engineer's upper instrument panel and are marked to register the position of the flaps in percentage of travel from the full open (100 per cent) position.

Oil Dilution.

Oil dilution is provided for each engine oil system and is controlled separately or collectively by switches located on the flight engineer's upper switch panel. The oil dilution solenoid valves are located aft of the firewall in each nacelle. Since the connections to the fuel lines are on the suction side of the engine-driven fuel pumps, the auxiliary fuel pumps must be operating while

RESERVE ENGINE OIL SYSTEM

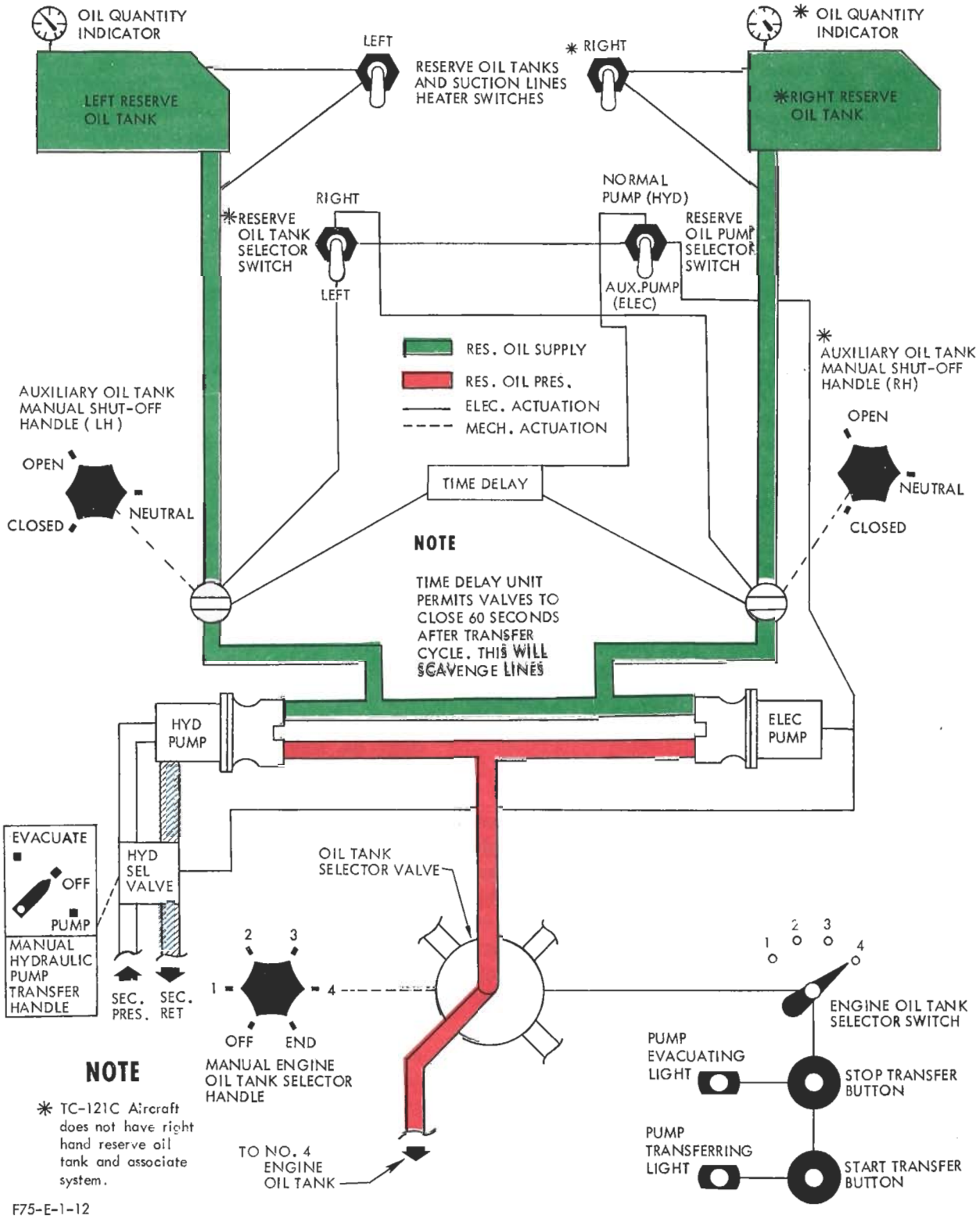


Figure 1-19

diluting. The fuel is delivered directly into the engine oil-in line.

Oil Dilution Switches. Four dc operated switches (9, figure 1-17) are located on the flight engineer's upper switch panel. They are spring-loaded to the OFF position. In the ON position, each switch opens a solenoid valve which admits fuel into the corresponding engine oil inlet line when the fuel boost pumps are on.

CAUTION

Oil dilution is not recommended. The engine oil tanks do not include hoppers.

RESERVE OIL SYSTEM.

A reserve oil system (figure 1-19) permits the selective addition of oil to each engine oil tank from two* reserve oil supply tanks. These supply tanks are insulated cell-type bladder tanks and have a usable fluid capacity of 67 gallons each. These cells are located in the outer bays of the center section aft of the front beam. The filler units are located in each wing-to-fuselage fillet and contain air vent shutoff valves and dip sticks calibrated in gallons. Each tank unit includes internal thermostatically controlled heating elements laced to the cell walls and suspended approximately one inch above the bottom of each cell. The thermostats are set to maintain an oil temperature of 70-100° F (21° to 38° C). Oil quantity transmitters are also provided in each tank.

Transfer Pumps.

The reserve oil system includes a dc electric motor-driven engine tank selector valve with a manual override control to preselect the engine tank that requires replenishing. One reversible electrically-operated pump and one reversible hydraulically-operated pump are installed in the forward cargo compartment just forward of the front wing beam. Either pump will transfer oil to an engine tank at the rate of 3 gallons per minute at an oil temperature of 70° F (21° C). The reversing feature of these pumps is for the purpose of evacuating the system lines after transfer operation in order to prevent the oil from congealing in the lines. Integral relief valves are provided in each pump for system protection. A float switch is installed to reverse the pump automatically for the evacuating operation which is set for 60 seconds duration. An additional oil float shutoff valve is also installed in each engine oil tank and is set to automatically close the inlet valve when the maximum filling level has been reached.

* One tank installed in TC-121 aircraft.

Auxiliary Transfer Panel.

In the event of electrical power failure, an auxiliary manual oil transfer control panel (figure 1-20) is provided for operation of the system which includes three manual override controls to actuate the hydraulically-driven oil pump and valves. This panel is located under the floor forward of the front wing beam. On EC-121D aircraft access to the panel is gained through a hatch on the floor between the emergency exits. On TC-121C aircraft access to the panel is gained through the forward cargo compartment access hatch. Refer to Section VII for sequence of operation of the auxiliary manual system.

Engine Oil Tank Selector Switch. This switch is located on the station 260 upper switch panel (10, figure 1-18) and has four positions: 1, 2, 3 and 4. This switch actuates a dc motor to select the engine oil tank that is to be supplied.

Start Transfer Button and Pump Transferring Light. The start transfer button is located on the station 260 upper switch panel (9, figure 1-18). This button is depressed to start the transfer operation. The pump transferring light (11, figure 1-18) glows as long as the system is transferring oil.

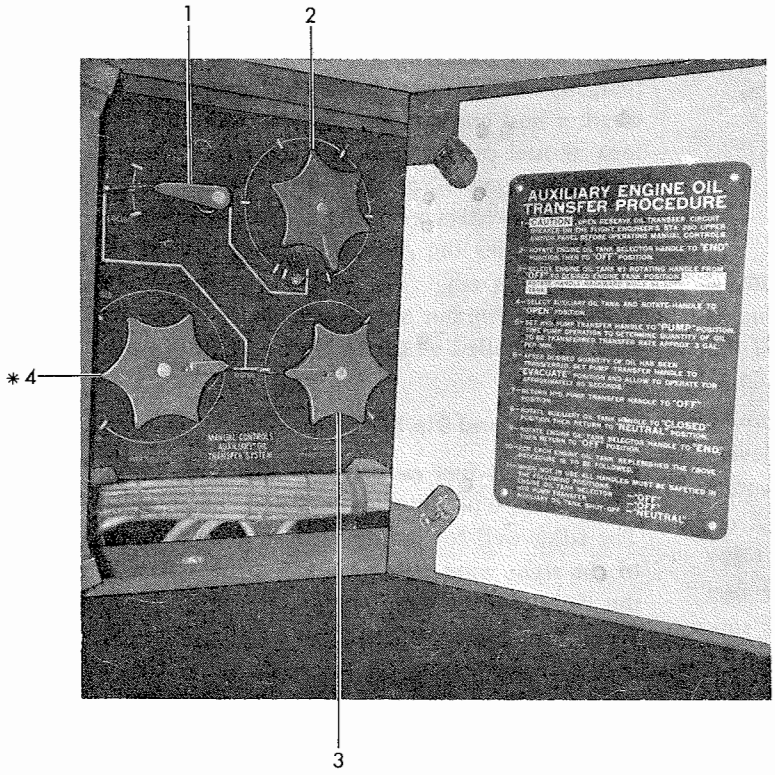
Reserve Oil Tank and Suction Line Heater Switch(es). Two switches* are located on the station 260 upper switch panel (8, figure 1-18) and have two positions: LEFT and OFF, and RIGHT and OFF. When these switches are placed in the LEFT and RIGHT (on) positions, the tank heating element will raise the oil temperature in the reserve oil tank(s) to the maximum set limit of the heating element thermostat (100° F). When the maximum limit has been reached, the thermostat will automatically shut off the heating element. As long as the switch is ON it will continue to cycle.

Stop Transfer Button and Pump Evacuating Light. The stop transfer button, located on the station 260 upper switch panel (9, figure 1-18), is depressed to stop the oil transfer operation. This switch overrides the tank float switch. The pump evacuating light (11, figure 1-18) indicates that the transfer operation has stopped and that the pump has reversed and is evacuating oil from the lines.

Reserve Oil Pump Selector Switch. This switch is located on the station 260 upper switch panel (7, figure 1-18) and has two positions: NORMAL PUMP (HYD.), and AUX. PUMP (ELEC.). It is used to select by a dc electric actuator either the electric or hydraulic transfer pump.

* One switch installed in TC-121C aircraft.

MANUAL RESERVE OIL SYSTEM CONTROLS



1. HYDRAULIC PUMP TRANSFER HANDLE
2. ENGINE OIL TANK SELECTOR HANDLE
3. LEFT AUXILIARY OIL TANK SHUTOFF HANDLE
* 4. RIGHT AUXILIARY OIL TANK SHUTOFF HANDLE

* Not installed on TC-121C aircraft

F75-E-1-125

Figure 1-20

Reserve Oil Tank Selector Switch (EC-121D). This switch is located on the station 260 upper switch panel (6, figure 1-18) and has two positions: LEFT and RIGHT. It is used to select by a dc electric actuator, either the right or left reserve tank.

Engine Oil Tank Selector Handle. This handle is located on the auxiliary transfer panel (2, figure 1-20) and is used to override the motor-driven engine tank selector valve. When this handle is used it must be rotated from the OFF position through the four engine tank stops to the END position, back to OFF, and then to the desired engine tank number. The purpose for this procedure is to properly sequence the cam linkage arrangement to mechanically assure positive and correct tank selection.

Hydraulic Pump Transfer Handle. This handle is located (1, figure 1-20) under the cabin floor of the front wing beam and can be used to manually control the direction of rotation of the hydraulic pump that pumps the engine oil from the reserve oil tank. It has three positions: OFF, PUMP and EVACUATE.

Auxiliary Oil Tank Shut-off Handle(s). The manual auxiliary oil tank shut-off handle(s) (3, 4, figure 1-20) are located under the cabin floor forward of the front wing beam. These handle(s) are used to mechanically select either the right or left reserve oil tank (left only on TC-121C). They are labeled OPEN, NEUTRAL and CLOSED. Use of the handle(s) manually overrides the motor-driven shut-off valve(s). The NEUTRAL position restores electrical control. In the event the normal transfer panel (station 260 panel) is inoperative, the circuit breaker(s) must be pulled before operating the manual transfer panel.

Reserve Oil Quantity Indicator(s). The oil quantity indicator(s) are located on the flight engineer's upper instrument panel (8, figure 1-16). The indicator(s) register by ac transmitter(s), the oil quantity in pounds.

FUEL SYSTEM (EC-121D).

Fuel is carried in six integral wing tanks (Nos. 1, 2, 2A, 3, 3A, and 4), one bladder-type center section tank (No. 5), one fuselage tank (No. 6) and two wing tip

tanks (Nos. 2B and 3B). A fuel crossfeed system is installed to provide fuel flow from tanks 1, 2, 2A, 3 3A, 4, and 5 to any engine; check valves make it impossible to transfer fuel from one tank to another. (See figure 1-21.)

Note

The recommended fuel consumption sequence is given in Section VII.

Provisions are incorporated for dumping fuel from all tanks except tank No. 5. Submerged fuel boost pumps are installed in all tanks. Tanks 2A, 3A, 1, and 4 are provided with float valves that automatically open when the fuel level in these tanks reaches a predetermined level (approximately 150 gallons below the full level) allowing fuel to be pumped from tanks 2B, 3B, and 6 to replenish tanks 2A, 3A, 1, and 4. For fuel tank capacities refer to Fuel Quantity Data Table (figure 1-22) and refer to Servicing Diagram (figure 1-47) for fuel grades and specifications. Fuel for cabin heaters is supplied from engines 2 and 3 feed lines.

A surge box that traps fuel when the attitude of the aircraft is other than straight and level is located in the inboard, aft corner of each integral wing tank. From the surge box, fuel flows to an electric motor-driven, submerged, auxiliary fuel pump located in the aft, inboard corner of each tank. The auxiliary fuel pump for tank 5 is located in the right, outboard cell of that tank. Tank 6 has two submerged fuel pumps. Each pump is remotely controlled from the flight engineer's lower switch panel and pumps fuel, under pressure, to tanks 1 and 4. There are five tank selector valves in the system; the three, serving tanks 1, 5 and 4, are two-way valves; the other two, serving tanks 2A and 2, and 3A and 3, are three-way valves. From the selector valves fuel flows through micronic filters to the four two-way cable-operated crossfeed valves. When the crossfeed valves are closed, fuel will flow directly to the engine associated with each tank after passing through one of the four cable-operated emergency shut-off valves, engine-driven fuel pumps, fuel-flow transmitters and carburetors. A thermal relief valve is located in the crossfeed line to relieve pressure resulting from expansion when the crossfeed valves are closed. An additional thermal relief valve is incorporated downstream of each emergency shut-off valve to relieve pressure in the fuel lines caused by fuel expansion when the emergency shut-off valves are closed. Water drain valves are located at low points in the system.

FUEL TANKS (EC-121D).

Tanks 1, 2, 3, and 4 are located in the inner wing panels. Tanks 2A and 3A are in the outer wing panels. A center section tank, No. 5, is located between the front and rear wing beams. It is lined with a bladder type cell that, once it has been filled with gasoline, will tend to weather and crack if left dry. Although all but 11 gallons of fuel can be used, it is advisable, for cell preservation, to leave 50 gallons in the tank if it is not to be used for ten days or longer. Tank 6 is located in the fuselage under the cabin floor, immediately aft of the wing trailing edge. The wing tip tanks 2B and 3B are not jettisonable but are detachable. A different wing tip must be installed when the tip tanks are removed.

Filler Wells and Dip Sticks.

Each integral fuel tank has a filler well located in the upper surface of the wing and must be filled separately. The filler well for tank 5 is located in the upper surface of the right wing fillet. Tank 6 filler well is located on the right side of the fuselage, aft of the wing trailing edge. Two plastic fuel measuring dip sticks are stowed in the flight station on the station 260 bulkhead near the crew door. One dip stick is calibrated for use in tanks 1, 2, 3, 4, 5, 2A and 3A. The other dip stick is calibrated for tanks 6, 2B and 3B. These dip sticks are used in the tank filler wells and, because of wing dihedral, will not record low fuel levels.

Vapor Return Lines.

The vapor return lines from engines 1 and 2 are routed to fuel tank 1 and the lines from engines 3 and 4 are routed to tank 4. A check valve in each vapor return line allows vapor flow only to the tank.

Fuel Tank Vents.

Fuel is vented from each wing tank through vent lines to a common flush-type vent in the lower surface of the outer wing panels. Separate overboard lines are teed into the vent lines which incorporate pressure and suction relief valves to prevent any possibility of excessive pressure existing in the tanks if icing should close the flush-type vent. The vent line from tank 5 extends to the flush vent on the left wing. A suction relief inlet for this tank is located beneath the fuselage, and the pressure relief scarf-type vent is located inboard of the left wing tank scarfed vents. Tank 6 vents from a small mast several feet aft of the lower radome on the fuselage centerline and incorporates a suction relief valve at the high point of the vent line. Each tip tank has its own vent system including the sniffle valve, float shut-off valve, flush ram scoop and scarfed-type overboard line.

EC-121D. FUEL SYSTEM

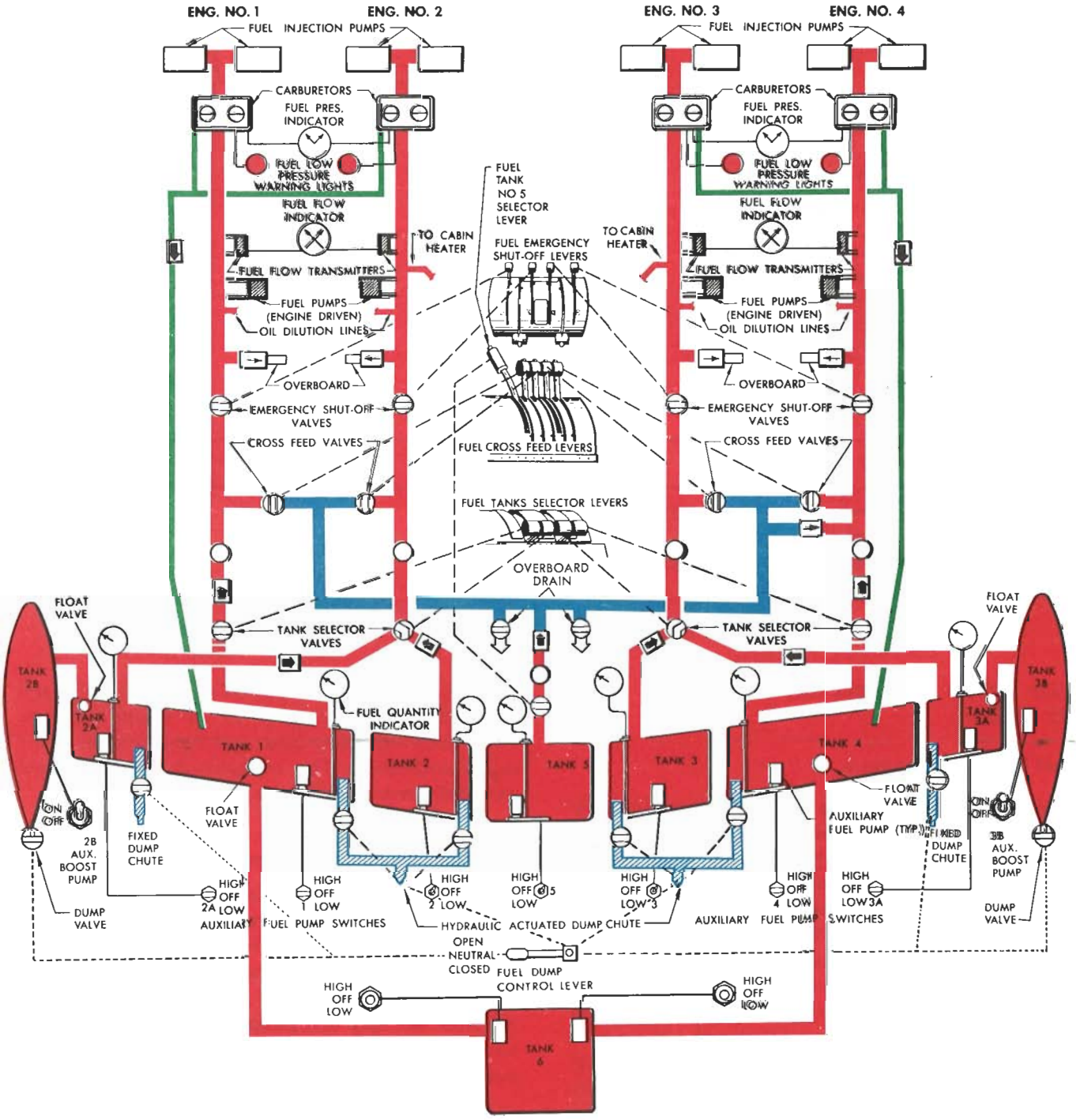


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Figure 1-21

EC-121D. FUEL QUANTITY TABLE

TANK	USABLE FUEL		FULLY SERVICED		FUEL THAT CAN BE READ ON DIP STICK	USABLE FUEL REMAINING AFTER DUMPING			
NO.	Lbs.	Gal.	Lbs.	Gal.	Gallons	(1)Lbs.	Gal.	(2)Lbs.	Gal.
2B	3600	600	3606	601	25 to 600	144	24	144	24
2A	3390	565	3420	570	300 to 565	894	149	894	149
1	9330	1555	9396	1566	700 to 1555	870	145	870	145
2	4740	790	4836	806	300 to 790	804	134	732	122
5	4380	730	4446	741	350 to 730	4380	730	4380	730
6	6000	1000	6138	1023	450 to 1000	——	——	——	——
3	4740	790	4836	806	300 to 790	804	134	732	122
4	9330	1555	9396	1566	700 to 1555	870	145	870	145
3A	3390	565	3420	570	300 to 565	894	149	894	149
3B	3600	600	3606	601	25 to 600	144	24	144	24
TOTAL	52,500	8,750	53,100	8,850		9,804	1,634	9,660	1,610

NOTE: Pound of fuel based upon weight of 6.0 lbs/gal.

(1) USAF Serials 52-3411 through 52-3424.

(2) USAF Serials 52-3425, 53-533 and subsequent.

Figure 1-22

FUEL SYSTEM CONTROLS AND INDICATORS (EC-121D).

Fuel Tank Selector Levers.

There are five fuel tank selector levers that mechanically control the opening and closing of the fuel tank shut-off valves. Four of these levers (10, figure 1-14) are located on the flight engineer's control quadrant. The two outside levers of these four, have positions, ON and OFF, and control tanks 1 and 4. The inside levers have three positions. The left inside lever is placarded OFF, No. 2, and No. 2A. The right inside lever is placarded OFF, No. 3 and No. 3A. Either of the two tanks placarded on each inside lever quadrant may be selected, but not both at the same time. The lever for the center section fuel tank (tank 5) is located on the flight engineer's auxiliary control quadrant (1, figure 1-23), inboard of the fuel crossfeed levers. This is a two-position lever, OPEN and CLOSED, that mechanically controls the tank shut-off valves from tank 5 to the crossfeed line.

Fuel Crossfeed Levers.

Four, two-position fuel crossfeed levers (2, figure 1-23), are located on the flight engineer's auxiliary control quadrant. They are placarded OPEN and CLOSED and are numbered to correspond to the engine positions. These levers are used to direct fuel from the tanks to any engine combination. They mechanically operate the fuel crossfeed valves through control cables.

Auxiliary Fuel Pump Switches.

Eleven auxiliary fuel pump control switches (11, figure 1-14) are located on the right side of the flight engineer's lower switch panel. These switches are arranged on the panel according to the fuel tank locations. The switches for tanks 2B and 3B are labeled ON and OFF. All other auxiliary fuel pump switches have three positions: HIGH, OFF and LOW. The HIGH and LOW positions control the d.c. pump operating speeds.

CAUTION

The switches for tanks 6R and 6L should not be placed in HIGH position except during fuel dumping operations. In the event of a float valve malfunction in tanks 1 or 4, the HIGH position will deliver pressure to tanks 1 and 4 in excess of their design strength.

Emergency Shutoff Levers.

Moving these levers to the third detent position, shuts off the fuel. Refer to Emergency Equipment, this section.

Fuel Quantity Indicators and Test Switch.

Eleven ac capacitance-type fuel quantity indicators (1, figure 1-16) are located on the flight engineer's upper instrument panel. Individual indicators for the ten fuel tanks are provided and a totalizer indicator is provided to indicate the sum total of fuel in all tanks. These indicators show the weight of fuel in the tanks in pounds. There is a pushbutton fuel quantity test switch (6, figure 1-16) located on the flight engineer's upper instrument panel. When pushed in, it disconnects the electrical circuit from the fuel quantity indicators and the needles should move toward the empty position. When released, the needles should return to the original readings. This provides a check that will show whether the indicators are sticking or giving erroneous readings.

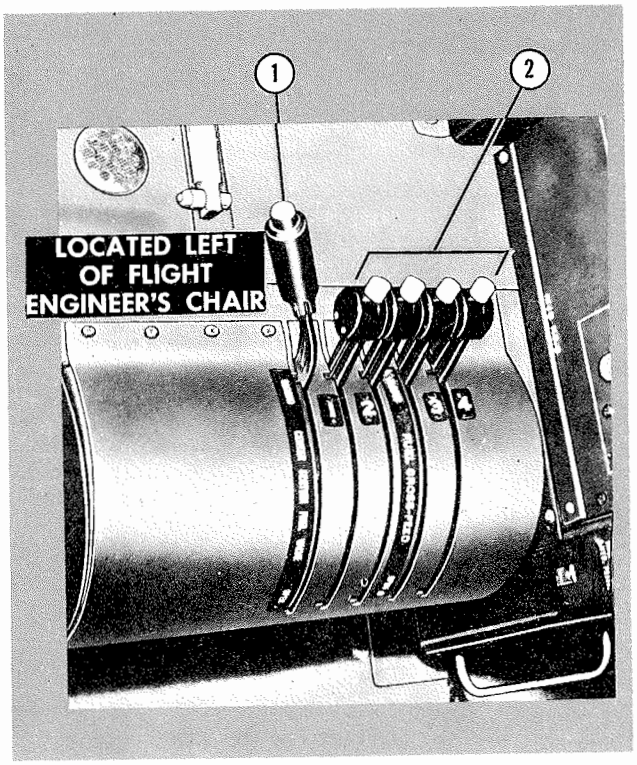
FUEL DUMP SYSTEM (EC-121D).

Fuel from tank 6 may be pumped to tanks 1 and 4 from which fuel may be dumped. Fuel may be dumped simultaneously from all integral wing tanks and tanks 2B and 3B by movement of a single dump control lever (figure 1-24) located under the station 260 step. Fuel from tanks 1, 2, 3 and 4 flows through two retractable dump chutes, one located in each inboard engine nacelle tailcone. Each of these tanks has an independent valve that is opened or closed mechanically by means of a linkage system connected to the dump chute hydraulic actuating cylinder. Fuel from tanks 2A and 3A flows through two fixed dump chutes located at the trailing edge of each outer wing panel. Tanks 2B and 3B each have a fixed dump chute. The dump valves for tanks 2A, 3A, 2B, and 3B are hydraulically operated. Standpipes are installed in fuel tanks 2A, 1, 4, and 3A to limit the amount of fuel that can be dumped from these tanks. There are no provisions for dumping fuel from tank 5.

On USAF Serials 52-3411 through 52-3424, the usable fuel remaining after dumping is as follows: Tanks 2B and 3B, 24 gallons each; Tanks 2A and 3A, 149 gallons each; Tanks 1 and 4, 145 gallons each; Tanks 2 and 3, 134 gallons each. Refer to figure 1-22.

On USAF Serials 52-3425, 53-533 and subsequent, the fuel remaining in tanks 2 and 3 after dumping is 122 gallons each. Refer to figure 1-22.

FLIGHT ENGINEER'S AUXILIARY CONTROL QUADRANT



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1 TANK NO. 5 FUEL SELECTOR LEVER
2 FUEL CROSS FEED LEVER

Figure 1-23

Fuel Dump Control Lever (Sta 260).

The fuel dump control lever (figure 1-24) is located in the flight station step at station 260, and is accessible through a hinged door. The lever is placarded OPEN, NEUTRAL and CLOSED. When the lever is in the OPEN position, secondary hydraulic system pressure operates actuating cylinders which open the dump valves for tanks 2A, 2B, 3B, and 3A, and extend the dump chutes for tanks 1, 2, 3, and 4. When the lever is in the NEUTRAL position, secondary hydraulic system pressure is relieved from the actuating cylinders. The CLOSED position of the lever reverses the direction of hydraulic fluid flow to the actuating cylinders which retract the dump chutes for tanks 1, 2, 3, and 4 and close the dump valves for tanks 2A, 3A, 2B, and 3B. Gravity provides the force for dumping.

FUEL DUMP CONTROL LEVER (STATION 260)

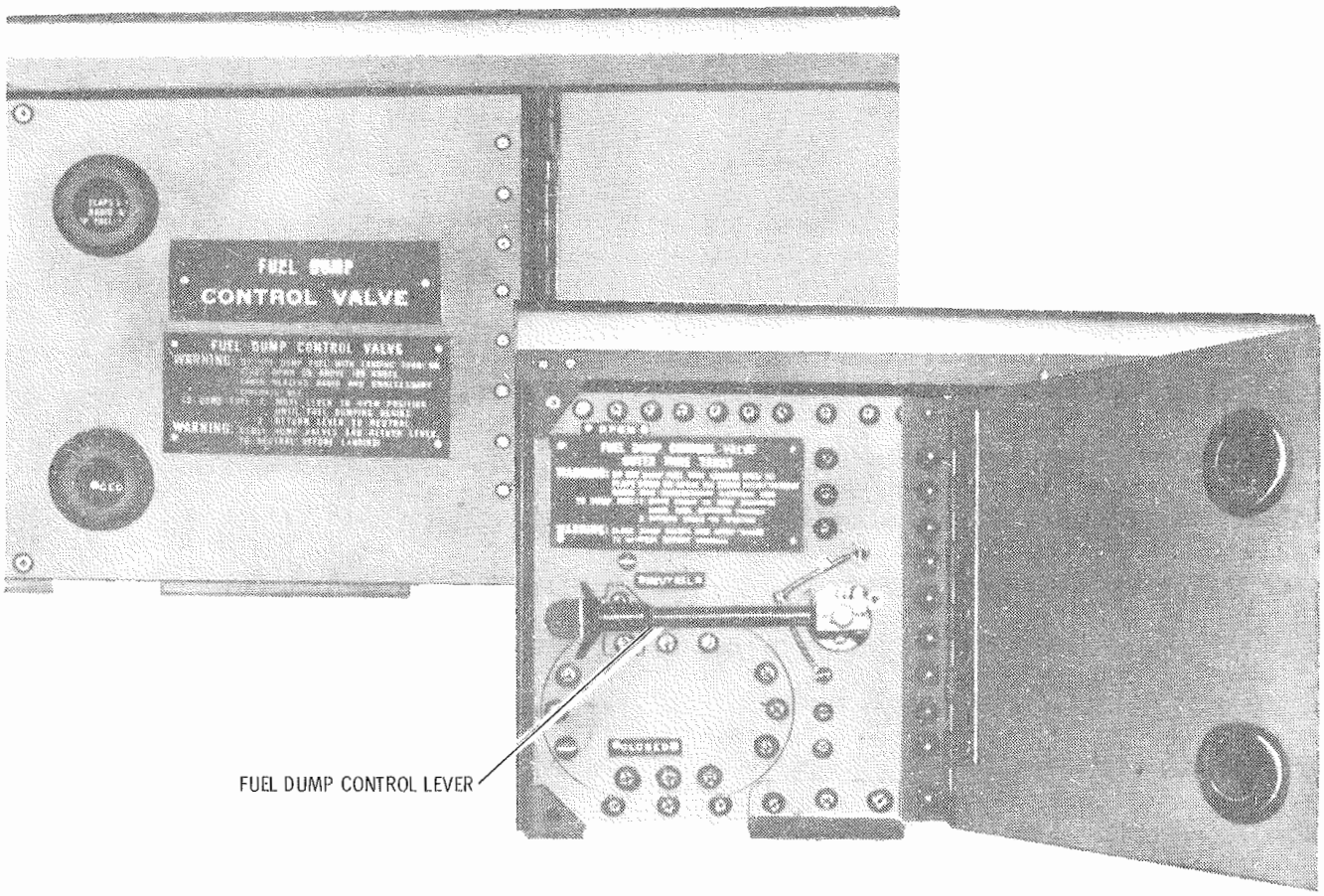

Figure 1-24

Fuel Dump Lever (Emergency).

In the event secondary hydraulic system pressure is not available, fuel may be dumped by the use of the emergency hydraulic system. An emergency fuel dump selector lever (figure 1-33) is located near the floor at the right of the copilot's seat. This lever has two positions: L. G. EMER. EXT. and FUEL DUMP. When the lever is in the FUEL DUMP position and the handpump selector lever is in the aft (EMER GEAR) position, the handpump can be used to supply hydraulic pressure for the dumping operation, provided fuel dump lever at station 260 is positioned properly. In the event secondary hydraulic system pressure is not available, fuel may be dumped without the use of the emergency hydraulic system by use of the hydraulic system crossover switch. Refer to Hydraulic System Crossover Valve, this section.

FUEL SYSTEM (TC-121C).

Fuel is supplied to the engines from six separate integral wing tanks and a removable, bladder-type center section tank. All of the tanks are interconnected by a crossfeed line which allows fuel to be supplied from any tank to any engine.

Note

The recommended fuel consumption sequence is given in Section VII.

Check valves make it impossible to transfer fuel from one tank to another. Provisions are incorporated for dumping fuel from the integral wing tanks. (See figure 1-26.) For fuel tank capacities refer to the Fuel Quantity Table (figure 1-25) and Servicing Diagram (figure 1-47) for fuel grades and specifications. A surge box that traps fuel when the attitude of the aircraft is other than straight and level is located in the inboard, aft corner of each integral wing tank. From the surge box the fuel flows to an electric motor-driven, submerged, auxiliary fuel pump located in the aft, inboard center of each tank. The auxiliary fuel pump for tank 5 is located in the right, outboard cell of the tank. Each pump is remotely controlled from the flight engineer's lower switch panel and pump fuel under pressure

TC-121C. FUEL QUANTITY TABLE

TANK	USABLE FUEL		FULLY SERVICED		FUEL THAT CAN BE READ ON DIP STICK	USABLE FUEL REMAINING AFTER DUMPING	
NO.	Lbs.	Gal.	Lbs.	Gal.	Gallons	Lbs.	Gal.
2A	3390	565	3420	570	300 to 565	894	149
1	9330	1555	9396	1566	700 to 1555	870	145
2	4740	790	4836	806	300 to 790	804	134
5	4380	730	4446	741	350 to 730	4380	730
3	4740	790	4836	806	300 to 790	804	134
4	9330	1555	9396	1566	700 to 1555	870	145
3A	3390	565	3420	570	300 to 565	894	149
TOTAL	39,300	6550	39,750	6625		9,516	1,586

NOTE: Pounds of fuel based upon weight of 6.0 lbs/gal.

Figure 1-25

to the engine-driven fuel pumps in the nacelles. Fuel is forced from the auxiliary fuel pumps through check valves. There are five tank selector valves in the system. The three valves that serve tanks 1, 5 and 4 are two-way valves; the two valves serving tanks 2A and 2, and 3A and 3, are three-way valves. From the selector valves fuel flows through micronic filters to the four, two-way cable-operated crossfeed valves. When the crossfeed valves are closed, fuel will flow directly to the engine associated with each tank after it has passed through the cable-operated emergency shut-off valve, engine-driven fuel pump, fuel-flow transmitter, and carburetor. A thermal relief valve is located in the cross-feed line to relieve pressure resulting from expansion when the cross-feed valves are closed. An additional thermal relief valve is incorporated downstream of each emergency shut-off valve to relieve pressure in the fuel lines caused by fuel expansion when the emergency shut-off valves are closed. Water drain valves are located at the low points in the system.

FUEL TANKS (TC-121C).

Tanks 1, 2, 3, and 4 are located in the inner wing panels. Tanks 2A and 3A are in the outer wing panels. A center section tank, No. 5, is located between the front and rear wing beams. It is lined with a bladder type cell that, once it has been filled with gasoline, will tend to weather and crack if left dry. Although all but 11 gallons of fuel can be used, it is advisable, for cell preservation, to leave 50 gallons in the tank if it is not to be used for ten days or longer.

Filler Wells and Dip Stick.

Each integral fuel tank has a filler well located in the upper surface of the wing and each tank must be filled separately. The filler well for tank 5 is located in the upper surface of the right wing fillet.

The fuel measuring dip stick is stowed in the flight station on the station 260 bulkhead near the crew door. The dip stick is calibrated for tanks 1, 2, 3, 4, 2A, 3A and 5. This dip stick is used in the tank filler wells, and because of the wing dihedral, will not record low fuel levels.

Vapor Return Lines.

The vapor return lines from engines 1 and 2 are routed to fuel tank 1 and the lines from engines 3 and 4 are routed to tank 4. A check valve in each vapor return line allows vapor flow only to the tank.

Fuel Tank Vents.

Fuel is vented from each wing tank through vent lines to a common flush-type vent in the lower surface of the outer wing panels. Separate overboard lines are teed into the vent lines which incorporate pressure and suction relief valves to prevent excessive pressure from

TC-121C. FUEL SYSTEM

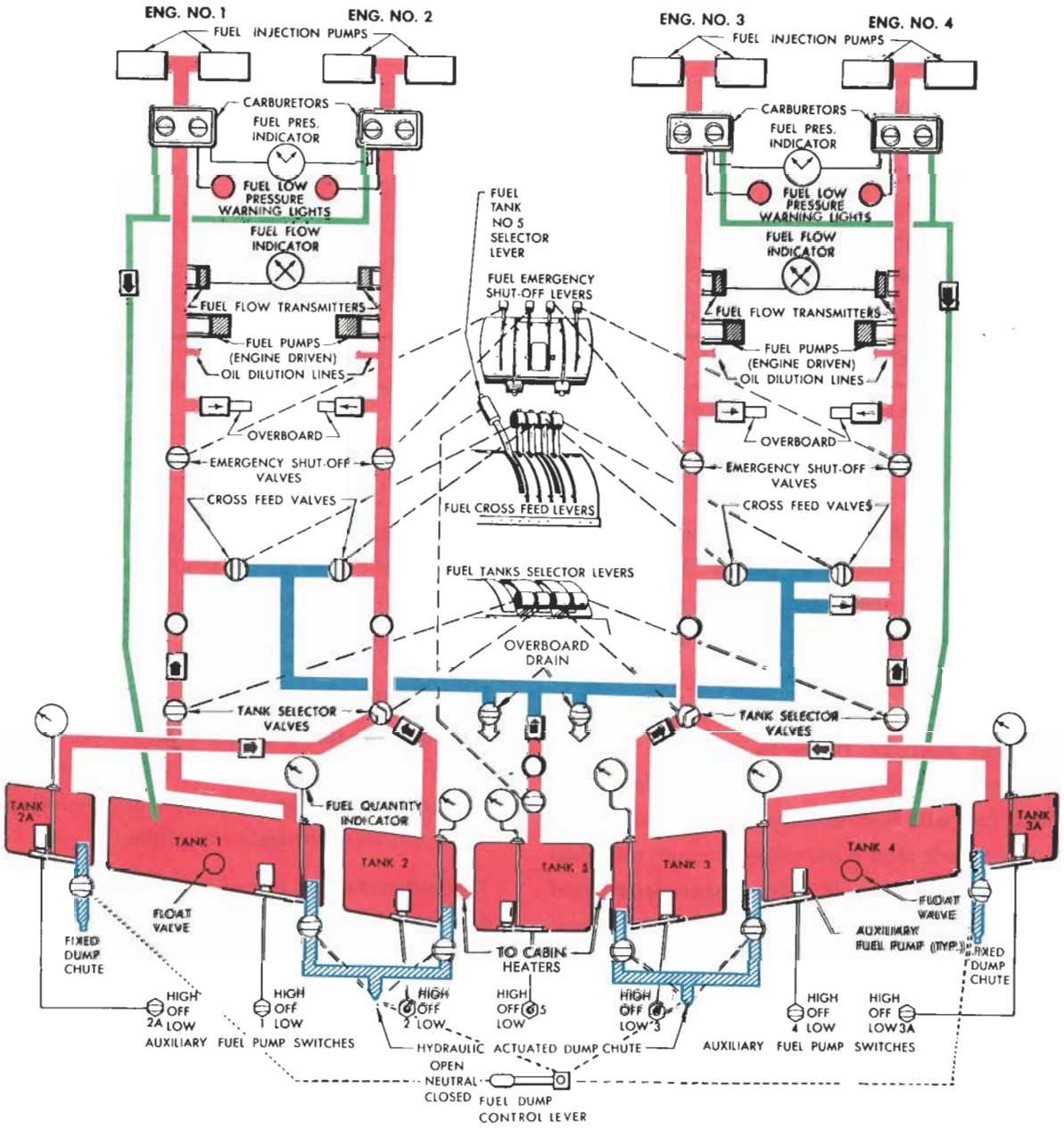

Figure 1-26

building up in the tanks if the flush-type vent is closed by ice. The vent line from tank 5 extends to the flush vent on the left wing. A suction relief inlet for this tank is located beneath the fuselage, and the pressure relief scarf-type vent is located inboard of the left wing tank scarfed vents.

FUEL SYSTEM CONTROLS AND INDICATORS (TC-121C).

Fuel Tank Selector Levers.

There are five fuel tank selector levers that control the opening and closing of the fuel tank shutoff valves. Four of these levers (10, figure 1-14) are located on the flight engineer's control quadrant. The two outside levers of these four have two positions (ON and OFF) and control tanks 1 and 4. The inside levers have three positions. The left inside lever is placarded OFF, No. 2, and No. 2A. The right inside lever is placarded OFF, No. 3 and No. 3A. Either of the two tanks placarded on each inside lever quadrant may be selected, but not both at the same time. The lever for the center section fuel tank (tank 5) is located on the flight engineer's auxiliary control quadrant (1, figure 1-23), inboard of the fuel crossfeed levers. This is a two-position lever, (OPEN and CLOSED) that controls the flow of fuel from tank 5 to the crossfeed line.

Fuel Crossfeed Levers.

Four, two-position fuel crossfeed levers (2, figure 1-23), are located on the flight engineer's auxiliary control quadrant. They are placarded OPEN and CLOSED and are numbered to correspond to the engine positions. These levers are used to direct fuel from the tanks to any engine combination. They mechanically operate the fuel crossfeed valves through control cables.

Auxiliary Fuel Pump Switches.

Seven auxiliary fuel pump switches (11, figure 1-14) are located on the right side of the flight engineer's lower switch panel. These switches are arranged on the panel according to the fuel tank locations. They have three positions: HIGH, LOW, and OFF. The HIGH or LOW positions control the pump operating speed.

Emergency Shutoff Levers.

Moving these levers to the third detent position, shuts off the fuel. Refer to Emergency Equipment, this section.

Fuel Quantity Indicators and Test Switch.

Eight ac capacitance-type fuel quantity indicators (1, figure 1-16) are located on the flight engineer's upper instrument panel. Individual indicators for the seven fuel tanks are provided and a totalizer indicator is provided to indicate the sum total of fuel in all tanks. These indicators show the weight of fuel in the tanks in pounds. There is a pushbutton fuel quantity test switch (6, figure 1-16) located on the flight engineer's upper instrument panel. When pushed in, it disconnects the electrical circuit from the fuel quantity indicators and the needles should move toward the empty position. When released, the needles should return to the original readings. This provides a check that will show whether the indicators are sticking or giving erroneous readings.

Fuel Pressure Indicators.

Two dual fuel pressure indicators (11, figure 1-15) are located on the engineer's lower instrument panel and provide an indication of the fuel pressure at the carburetors.

Fuel Low-Pressure Warning Lights.

Four fuel low-pressure warning lights (12, figure 1-15) are located on the flight engineer's lower instrument panel below the fuel pressure indicators. These glow red when fuel pressure, measured at the carburetors, drops to the minimum allowable.

Fuel Flow Indicators.

Two dual fuel flow indicators (2, figure 1-15) are located on the flight engineer's lower instrument panel. They indicate the rate of fuel flow to the engine in pounds-per-hour.

FUEL DUMP SYSTEM (TC-121C).

Fuel may be dumped from all integral wing tanks simultaneously by movement of a single dump control lever (figure 1-24), located under the station 260 step. Fuel from tanks 1, 2, 3, and 4 flows through two retractable dump chutes, one located in each inboard engine nacelle tail-cone. Each of these tanks has an independent valve that is opened or closed mechanically through a linkage system connected to the dump chute hydraulic actuating cylinder. Fuel from tanks 2A and 3A flows through two fixed dump chutes located at the trailing edge of each outer wing panel. The dump valves for tanks 2A and 3A are hydraulically opened and closed by movement of the same control lever at the station 260 step. Standpipes are installed in fuel tanks 2A, 1, 4, and 3A to limit the amount of fuel that can be dumped. Refer to the Fuel Quantity Table, figure 1-25. Tank 5 cannot be dumped.

Fuel Dump Control Lever (Sta. 260).

The fuel dump control lever (figure 1-24) is located in the flight station step at station 260, and is accessible

through a hinged door. The lever is placarded OPEN, NEUTRAL and CLOSED. When the lever is in the OPEN position, secondary hydraulic system pressure operates actuating cylinders which open the dump valves for tanks 2A and 3A, and extend the dump chutes for tanks 1, 2, 3, and 4. When the lever is in the NEUTRAL position, secondary hydraulic system pressure is relieved from the actuating cylinders. The CLOSED position of the lever reverses the direction of hydraulic fluid flow to the actuating cylinders which retract the dump chutes for tanks 1, 2, 3, and 4 and close the dump valves for tanks 2A and 3A. Gravity provides the force for dumping.

Fuel Dump Lever (Emergency).

In the event secondary hydraulic system pressure is not available, fuel may be dumped by the use of the emergency hydraulic system. An emergency dump selector lever (figure 1-33) is located near the floor at the right of the copilot's seat. This lever has two positions: L. G. EMER. EXT. and FUEL DUMP. When the lever is in the FUEL DUMP position and the handpump selector lever is in the aft (EMER. GEAR) position, the hand pump can be used to supply hydraulic pressure for the dumping operation, provided fuel dump lever at station 260 is positioned properly. In the event secondary hydraulic system pressure is not available, fuel may be dumped without the use of the emergency hydraulic system by use of the hydraulic system crossover switch. Refer to Hydraulic System Crossover Valve, this section.

ELECTRICAL SYSTEM (EC-121D).

Basic electrical power is furnished by two primary system, a 28-volt dc system and a 115/208-volt ac system. Six dc generators, two ac generators and five basic inverters provide power for the various electrical systems (refer to figure 1-28). Each inboard engine drives two dc generators and each outboard engine incorporates a driveshaft which drives a gear box on which one dc and one ac generator is mounted. These gear boxes can be disconnected from the engines. On most aircraft three battery cart receptacles are located left of the centerline on the fuselage underside, aft of the lower radome. This installation provides separate ground power facilities.

ELECTRICAL SYSTEM (TC-121C).

Basic electrical power is furnished by two primary systems, a 28-volt dc system and a 115/208-volt ac system. Six dc generators and four inverters provide power for the various electrical systems (see figure 1-28). Each inboard engine drives two dc generators and each outboard engine, one dc generator. On some aircraft battery cart receptacles are located left of the centerline on the fuselage underside, aft of the wing trailing edge.

DC ELECTRICAL SYSTEM.

All circuits are single wired, ground return except those forward of station 260 which carry steady current loads. These are two-wire installations to minimize deviation of the standby compass. Power is supplied by six engine-driven dc generators (1, 2, 2A, 3, 3A, and 4) and two 24-volt storage batteries installed in the nosewheel well. The dc generators can be controlled individually and connected for parallel operation. A differential reverse current relay and a voltage regulator are provided for each dc generator and its protective system. Regulators No. 1 and No. 2 are located just aft of the pilot's seat under the floor; No. 2A and No. 3A are just forward of the copilot's seat under the floor; No. 3 and No. 4 are just aft of the copilot's seat under the floor. The differential voltage reverse current relays are located in the forward underfloor compartment. Three ac motor-driven blowers provide cooling air for the voltage regulators.

Generator Switches.

Each dc generator is controlled by a three-position switch (5, figure 1-29) that is located on the main junction box (MJB) No. 1 switch panel. The switch has three positions: ON (up), OFF (center), and a RESET (down) position. Each switch is spring-loaded from the down to the OFF position. When a generator switch is placed in the ON position, output of the generator will be connected to the main dc bus provided load and special conditions are correct. The down position is a momentary contact position, which resets the field relay if it is tripped by overvoltage or by generator reversed polarity. If the relay was tripped by a feeder fault, it cannot be reset until the forward current relay, located in the forward cargo compartment, is reset. This must not be done until the fault is located and cleared. In the OFF position the generator is disconnected from the dc bus, but the field is not deenergized.

Generator Field Circuit Breakers.

Each generator is provided with a switch-type circuit breaker for emergency use. These circuit breakers (8, figure 1-29) are located on the MJB No. 1 switch panel and are guarded in the ON position. These circuit breakers should be placed in the OFF position only when necessary to deenergize the generators completely, as in an emergency landing or in the event that the protection system malfunctions. They should not be used

CIRCUIT BREAKER PANELS

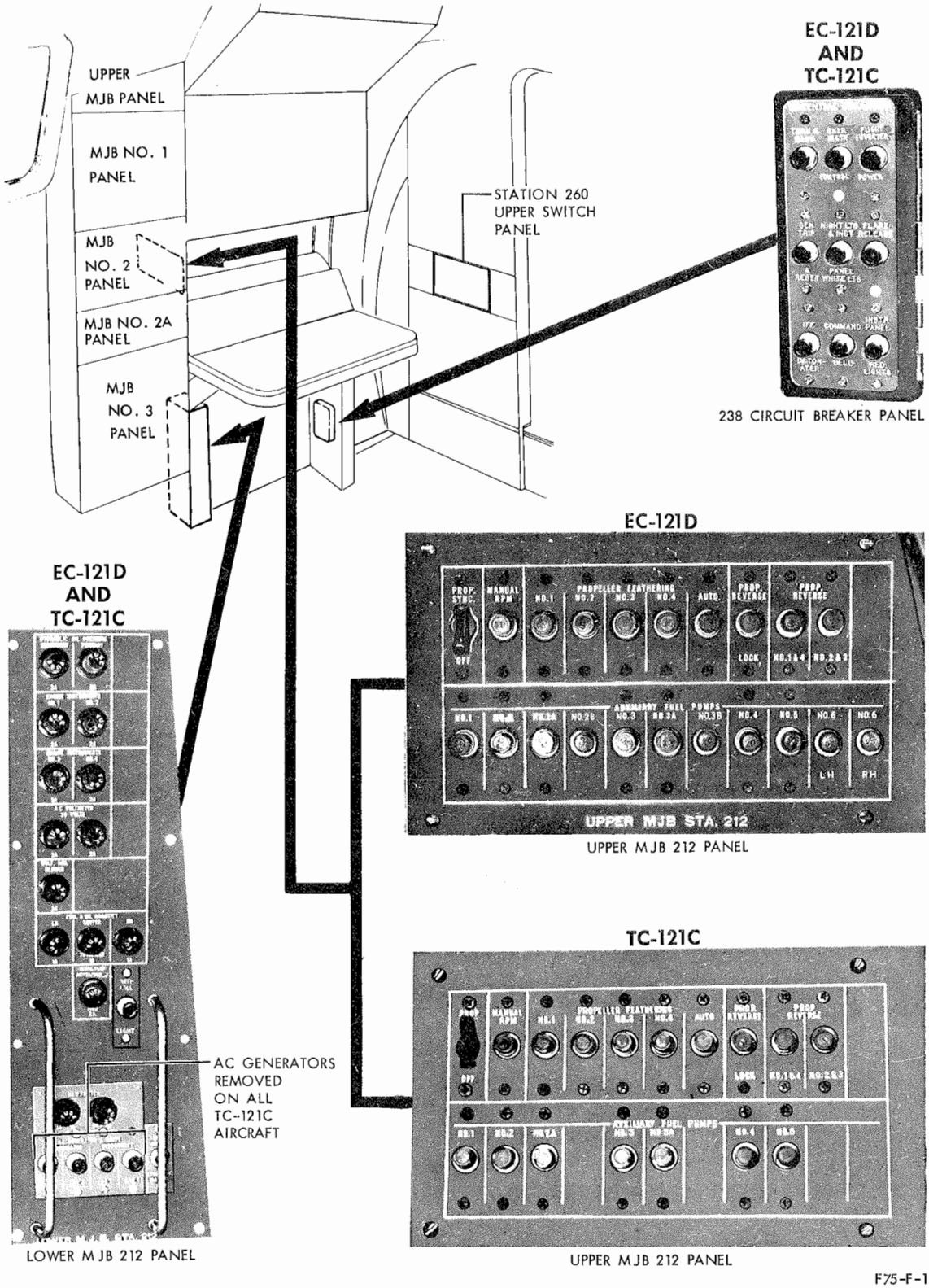

Figure 1-27

TYPICAL DC ELECTRICAL POWER SYSTEM

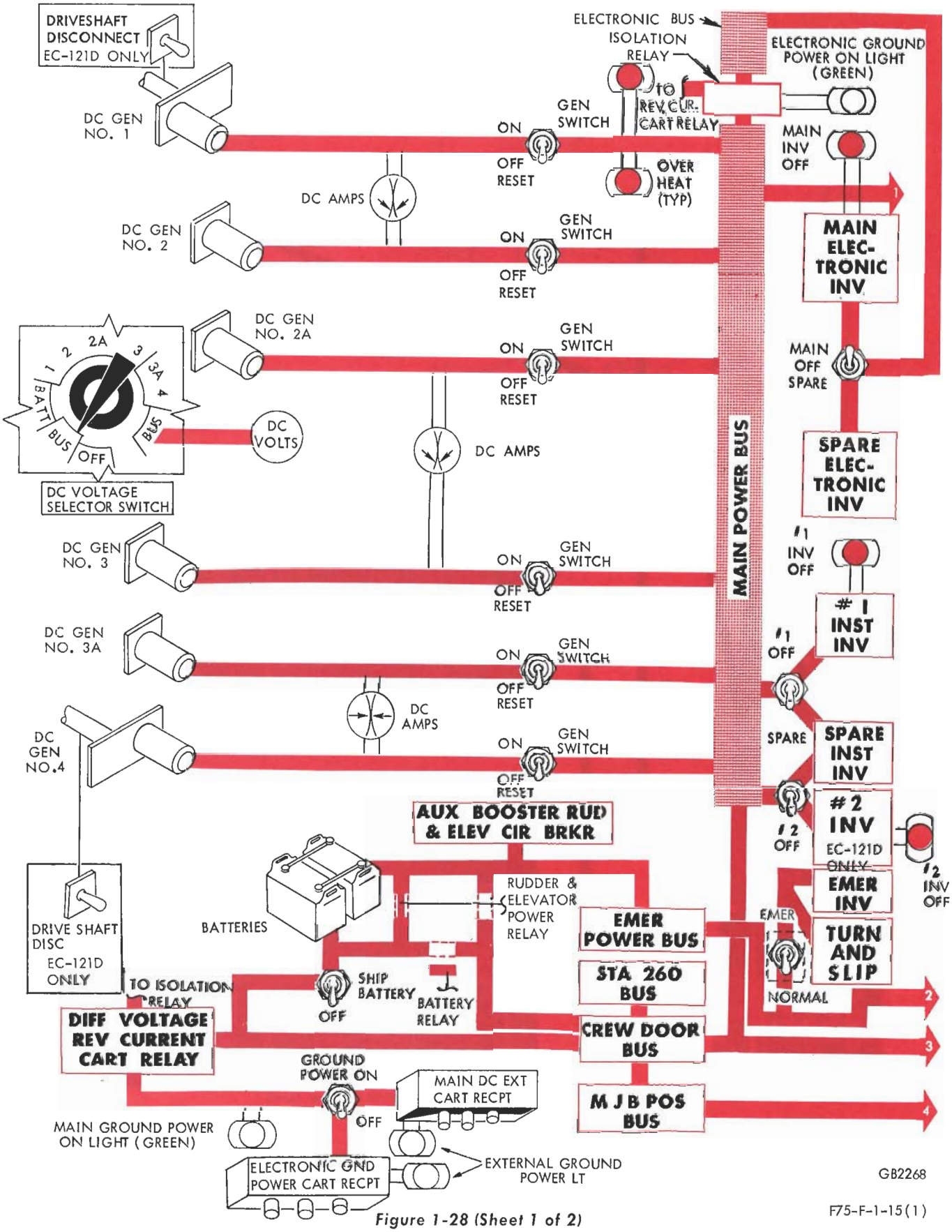

Figure 1-28 (Sheet 1 of 2)

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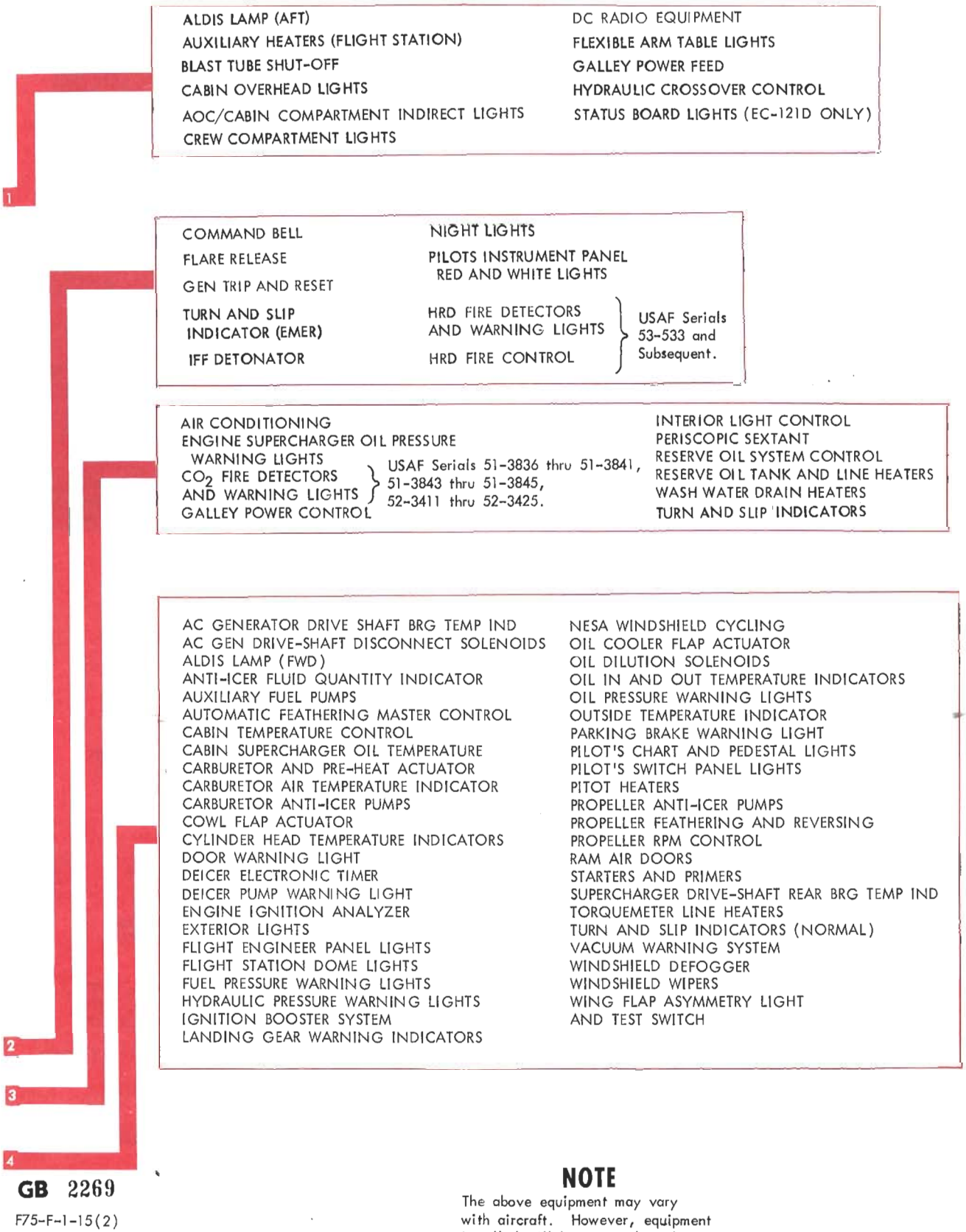
TYPICAL DC ELECTRICAL POWER SYSTEM



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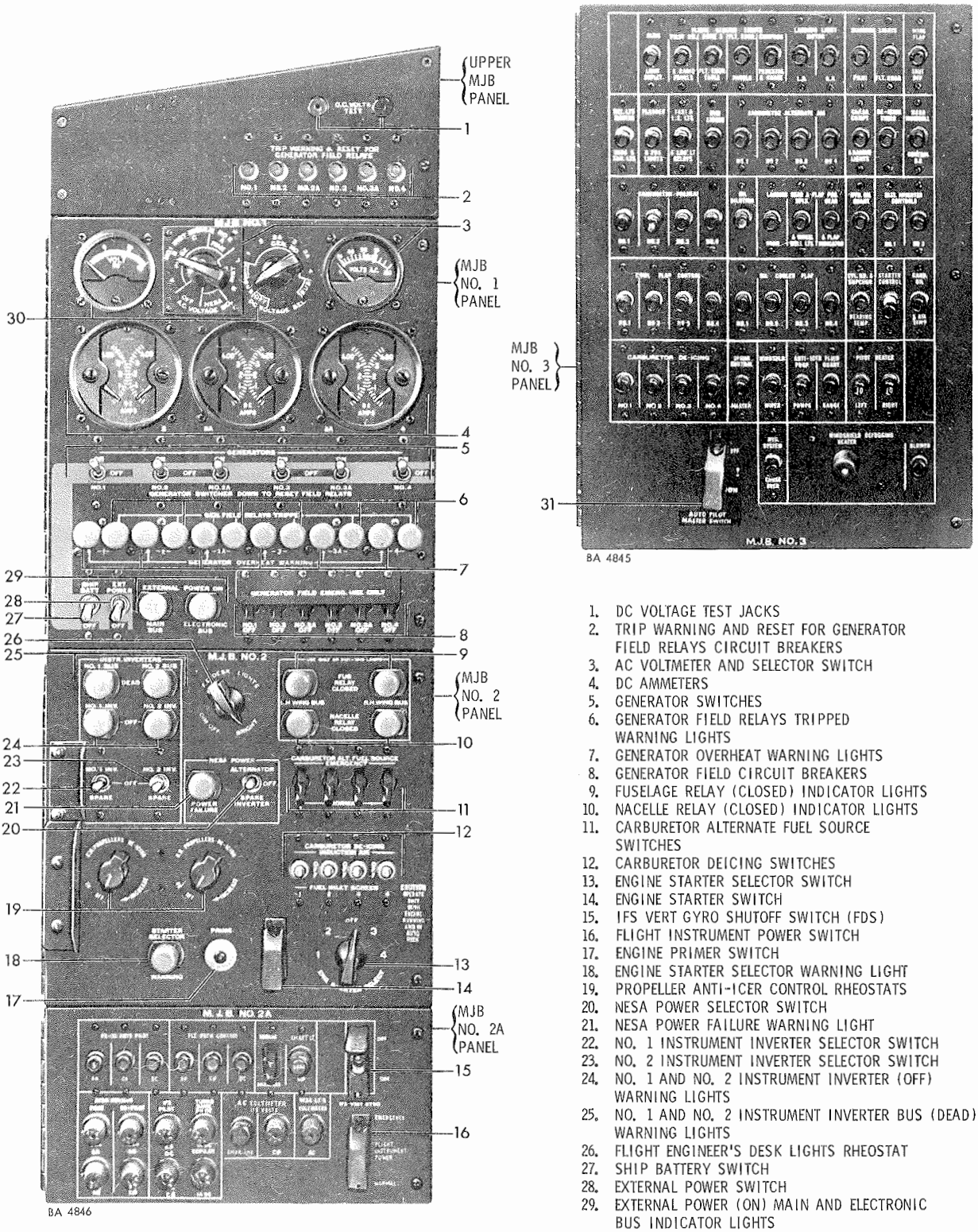
NOTE

The above equipment may vary with aircraft. However, equipment installed will be powered as shown

Figure 1-28 (Sheet 2 of 2)

EC-121D. TYPICAL MJB PANELS

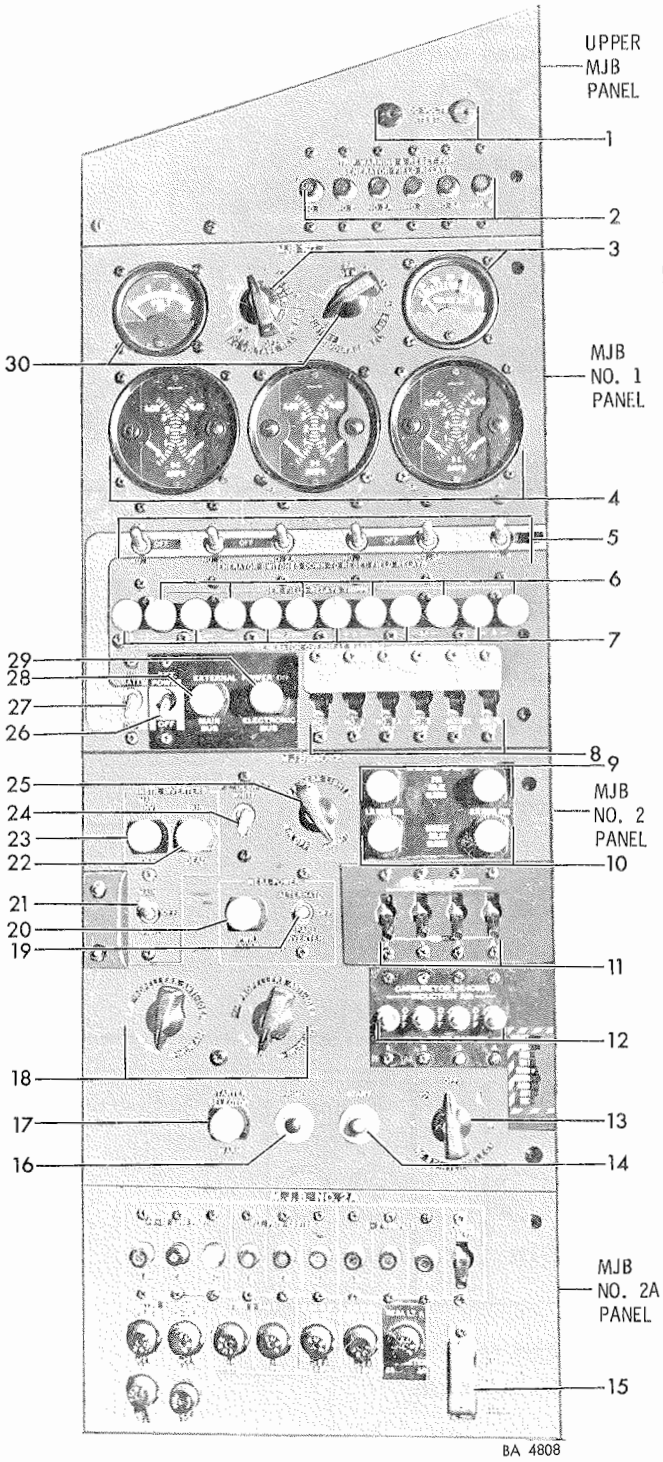


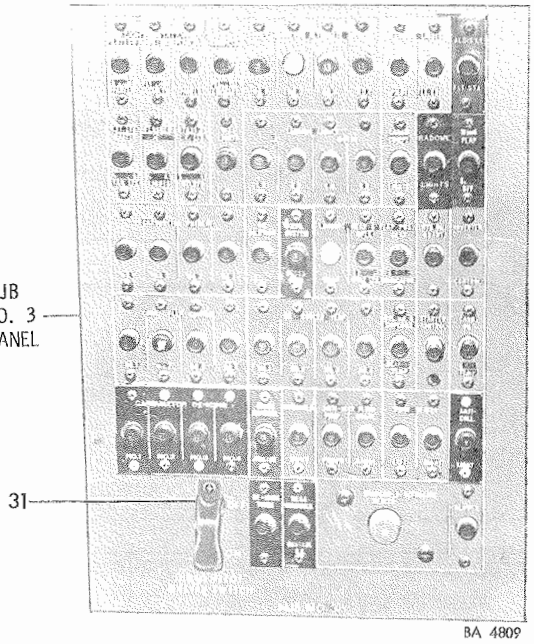
1. DC VOLTAGE TEST JACKS
2. TRIP WARNING AND RESET FOR GENERATOR FIELD RELAYS CIRCUIT BREAKERS
3. AC VOLTMETER AND SELECTOR SWITCH
4. DC AMMETERS
5. GENERATOR SWITCHES
6. GENERATOR FIELD RELAYS TRIPPED WARNING LIGHTS
7. GENERATOR OVERHEAT WARNING LIGHTS
8. GENERATOR FIELD CIRCUIT BREAKERS
9. FUSELAGE RELAY (CLOSED) INDICATOR LIGHTS
10. NACELLE RELAY (CLOSED) INDICATOR LIGHTS
11. CARBURETOR ALTERNATE FUEL SOURCE SWITCHES
12. CARBURETOR DEICING SWITCHES
13. ENGINE STARTER SELECTOR SWITCH
14. ENGINE STARTER SWITCH
15. IFS VERT GYRO SHUTOFF SWITCH (FDS)
16. FLIGHT INSTRUMENT POWER SWITCH
17. ENGINE PRIMER SWITCH
18. ENGINE STARTER SELECTOR WARNING LIGHT
19. PROPELLER ANTI-ICER CONTROL RHEOSTATS
20. NESA POWER SELECTOR SWITCH
21. NESA POWER FAILURE WARNING LIGHT
22. NO. 1 INSTRUMENT INVERTER SELECTOR SWITCH
23. NO. 2 INSTRUMENT INVERTER SELECTOR SWITCH
24. NO. 1 AND NO. 2 INSTRUMENT INVERTER (OFF) WARNING LIGHTS
25. NO. 1 AND NO. 2 INSTRUMENT INVERTER BUS (DEAD) WARNING LIGHTS
26. FLIGHT ENGINEER'S DESK LIGHTS RHEOSTAT
27. SHIP BATTERY SWITCH
28. EXTERNAL POWER SWITCH
29. EXTERNAL POWER (ON) MAIN AND ELECTRONIC BUS INDICATOR LIGHTS
30. DC VOLTMETER AND SELECTOR SWITCH
31. AUTOPILOT MASTER SWITCH

F75-F-1-6(1)

Figure 1-29 (Sheet 1 of 2)

TC-121C. TYPICAL MJB PANELS





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1. DC VOLTAGE TEST JACKS
2. TRIP WARNING & RESET FOR GENERATOR FIELD RELAYS CIRCUIT BREAKERS
3. AC VOLTMETER AND SELECTOR SWITCH
4. DC AMMETERS
5. GENERATOR SWITCHES
6. GENERATOR FIELD RELAYS TRIPPED WARNING LIGHTS
7. GENERATOR OVERHEAT WARNING LIGHTS
8. GENERATOR FIELD CIRCUIT BREAKERS
9. FUSELAGE RELAY (CLOSED) INDICATOR LIGHTS
10. NACELLE RELAY (CLOSED) INDICATOR LIGHTS
11. CARBURETOR ALTERNATE FUEL SOURCE SWITCHES
12. CARBURETOR DE-ICING SWITCHES
13. ENGINE STARTER SELECTOR SWITCH
14. ENGINE STARTER SWITCH
15. FLIGHT INSTRUMENT EMERGENCY POWER SWITCH
16. ENGINE PRIMER BUTTON
17. ENGINE STARTER SELECTOR WARNING LIGHT
18. PROPELLER ANTI-ICER CONTROL RHEOSTATS
19. NESA INVERTER SELECTOR SWITCH
20. NESA INVERTER FAILURE WARNING LIGHT
21. INSTRUMENT INVERTER SELECTOR SWITCH
22. INSTRUMENT INVERTER BUS (DEAD) WARNING LIGHT
23. INSTRUMENT INVERTER (OFF) WARNING LIGHT
24. FLIGHT ENGINEER'S DESK LIGHTS COLOR SELECTOR SWITCH
25. FLIGHT ENGINEER'S DESK LIGHTS RHEOSTAT
26. EXTERNAL POWER SWITCH
27. SHIP BATTERY SWITCH
28. EXTERNAL POWER (ON) MAIN BUS INDICATOR LIGHT
29. EXTERNAL POWER (ON) ELECTRONIC BUS INDICATOR LIGHT
30. DC VOLTMETER AND SELECTOR SWITCH
31. AUTOPILOT MASTER SWITCH

Figure 1-29 (Sheet 2 of 2)

EC-121D. REMOTE CIRCUIT BREAKER PANELS

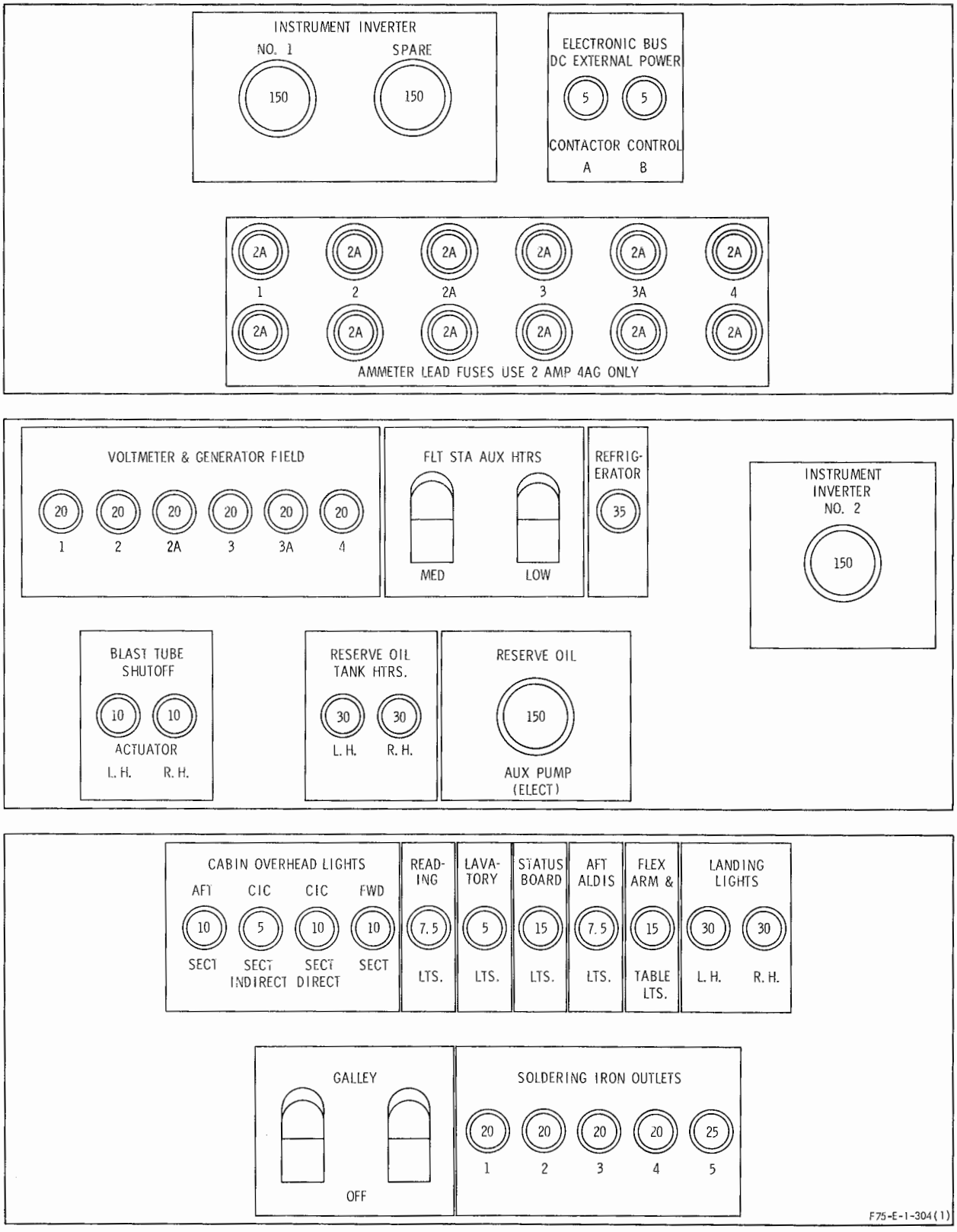
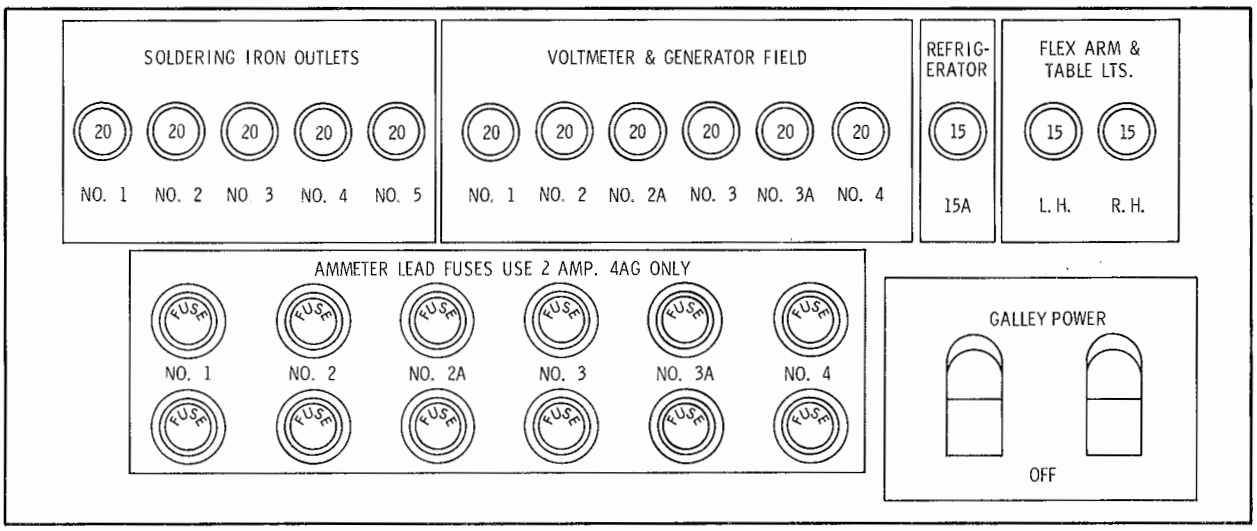


Figure 1-30 (Sheet 1 of 2)

TC-121C. REMOTE CIRCUIT BREAKER PANELS



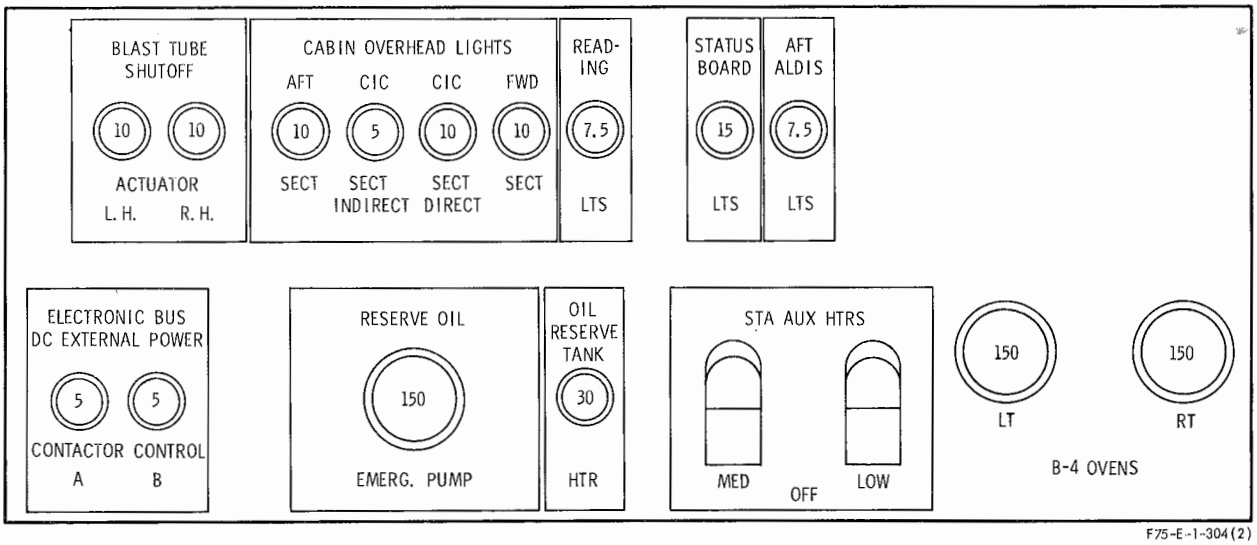


Figure 1-30 (Sheet 2 of 2)

as generator switches and should be opened or closed only when the associated generator switch is in the OFF position.

Ship Battery Switch.

A two-position switch (27, figure 1-29), with SHIP BATTERY (up) and OFF (down) positions, is located on the MJB No. 1 switch panel. Moving the switch to the SHIP BATTERY position connects the aircraft batteries to the main dc bus.

External Power Switch.

This switch (26, figure 1-29) is located on the MJB No. 1 switch panel and has EXT POWER (up) and OFF (down) positions. In the EXT POWER position, the short prong of the cart receptacle closes the cart relay, and power from the cart is connected to the main dc bus. A cart relay is installed in the cart power circuit to provide automatic protection for reversed polarity, differential voltage and reversed current.

CAUTION

It is possible to have the EXT POWER switch and the ship battery switch ON at the same time when charging the aircraft batteries from a ground power supply in an emergency. *Extreme care should be exercised to prevent battery explosions, boiling dry, acids dripping from vents, fire from resulting short circuits, etc.* The two switches should never be ON at the same time for longer than the few seconds necessary to switch from the aircraft batteries to cart system or vice versa.

Generator Field Relays Tripped Warning Lights.

A red warning light (6, figure 1-29), which is set to glow when a generator field relay has been tripped is located on the MJB No. 1 switch panel. If a generator is tripped by a feeder fault, the light will stay on when the generator switch is placed in the (down) RESET position. If the cause was overvoltage or reverse polarity, the light will go out. If the cause of the trip persists, the light will immediately come on again and stay on even if the switch is held down.

Generator Overheat Warning Lights.

Beneath each generator switch and beside each field relay warning light is a red generator overheat warning light (7, figure 1-29). Overheating of a generator that causes one of these lights to glow may be caused by an electrical overload or failure of the generator. If the overheat condition is caused by an electrical overload on the system, the generator should not be shut off until the electrical load has been reduced because it is likely that the resulting increased load on the generators will cause them to overheat also.

Relay Closed Indicator Lights.

Two amber and two red indicator lights (10, figure 1-29) are located on the MJB No. 2 switch panel. They function as warning devices to indicate improper operation of relays connected to the wing buses. An amber fuselage relay indicator light and a red nacelle relay closed indicator light are provided for the left and right wing buses of the aircraft. These indicator lights are connected in such a manner that when an amber light is bright, the sectionalizing relay is closed and the wing bus is energized. When the relays are open, both the amber and the red lights should be dim and have equal brilliance. If, after one of the sectionalizing relays has operated, the amber light does not return to original brilliance, the sectionalizing relay has not opened. This does not represent any direct hazard to flight, but the condition should be corrected at the earliest opportunity. If the red light becomes brighter after propeller feathering, unfeathering, reversing, or unreversing is completed, the propeller feathering pump relay has remained closed. Subsequent operation of cowl flaps, engine starters, or propeller feathering, unfeathering, reversing or unreversing on that side of the aircraft will energize the feathering pump of the propeller whose previous operation caused the red light to burn brighter.

WARNING

- If the propeller nacelle relay remains closed in flight, notify the pilot immediately.
- If this condition occurs while the aircraft is on the ground, it must be rectified before flight.

If, after engine starter or cowl flap operation, one of the red lights becomes brighter, operation of the same engine starter or cowl flap will occur if engine starters, cowl flaps, or propeller feathering, unfeathering, reversing, or unreversing electrical circuits on the same side of the aircraft are energized.

Note

If this condition occurs on the ground, notify the ground crew.

DC Voltmeter and Selector Switch.

A dc voltmeter located on the MJB No. 1 switch panel, indicates the output of the generators, batteries and bus voltage. A ten-position switch (30, figure 1-29), located on the MJB No. 1 switch panel, provides selections of generators 1, 2, 2A, 3, 3A, 4, BAT., two BUS. positions, and OFF. Parallel operation of the generators and batteries necessitates that each be disconnected individually from the bus to indicate its potential.

Ground Power Indicator Lights.

Two ground power indicator lights (29, figure 1-29), one of which indicates ground power available to the main dc bus and the other to the electronic dc bus, are located on the MJB No. 1 switch panel. An isolation relay prevents ground power from being applied to the dc electronic bus only. Two white indicator lights are located adjacent to the ground power receptacle and will glow whenever the ground power supply is connected to the respective dc bus.

DC Ammeters.

Three dual ammeters (4, figure 1-29) are installed in the MJB No. 1 switch panel. The ammeters indicate the direct load on each generator.

AC ELECTRICAL SYSTEM (EC-121D).

The basic ac electrical power system (figure 1-31) includes five 115/208-volt, three-phase inverters, and two a.c. generators. One inverter provides power for the basic aircraft loads; one provides power for the APS-42, TACAN* and ILS Glide Slope*; and one acts as a standby. Another inverter supplies power for the electronic loads and one is a standby. The two standby inverters are provided with automatic and manual transfer to their standby loads. One additional 115-volt, three-phase inverter operates as an emergency standby for the ac flight instruments. This inverter is powered directly from the emergency dc bus when in operation. On ARC-85 modified aircraft two additional 115/208-volt, 3-phase inverters are installed.

Instrument Inverter Switches and Warning Lights (EC-121D).

Two instrument inverter switches (22, 23, figure 1-29) are located on the MJB No. 2 switch panel and are placarded No. 1 INV and SPARE, No. 2 INV and SPARE. Warning lights are installed above these switches. One will light when the switch is off or when ac power from the main inverter is interrupted. The other light will come on when electrical power is not being supplied to the ac bus. When a main inverter fails, a change-over relay will automatically transfer the instrument load to the spare inverter.

* Some aircraft.

Electronic Inverter Switch (EC-121D).

An electronic inverter power switch is located at the radar technician's station on the fixed frequency inverter control panel (11, figure 4-35) and placarded MAIN, OFF, and SPARE. Two warning lights are installed above this switch. One will glow when the inverter switch is OFF or when ac power from the main inverter is interrupted. The other light will glow when electrical power is not being supplied to the ac bus. When the main inverter fails, a changeover relay will automatically transfer the electronic load to the spare inverter.

Nesa Power Selector Switch (EC-121D).

This switch (20, figure 1-29) is located on the MJB No. 2 switch panel. It permits selection of the ac generators or the spare inverter as a power source for the Nesa system. When the switch is in the ALTERNATOR position, Nesa power is supplied by the ac generators. If one ac generator is not operative, ac power may be transferred from the other ac generator. If neither ac generator is available, the spare inverter can be selected by moving the switch to the SPARE INVERTER position. The OFF position provides disconnect when Nesa power is not required. A power failure warning light adjacent to the switch will glow when ac power is not available from either ac generator or the spare inverter.

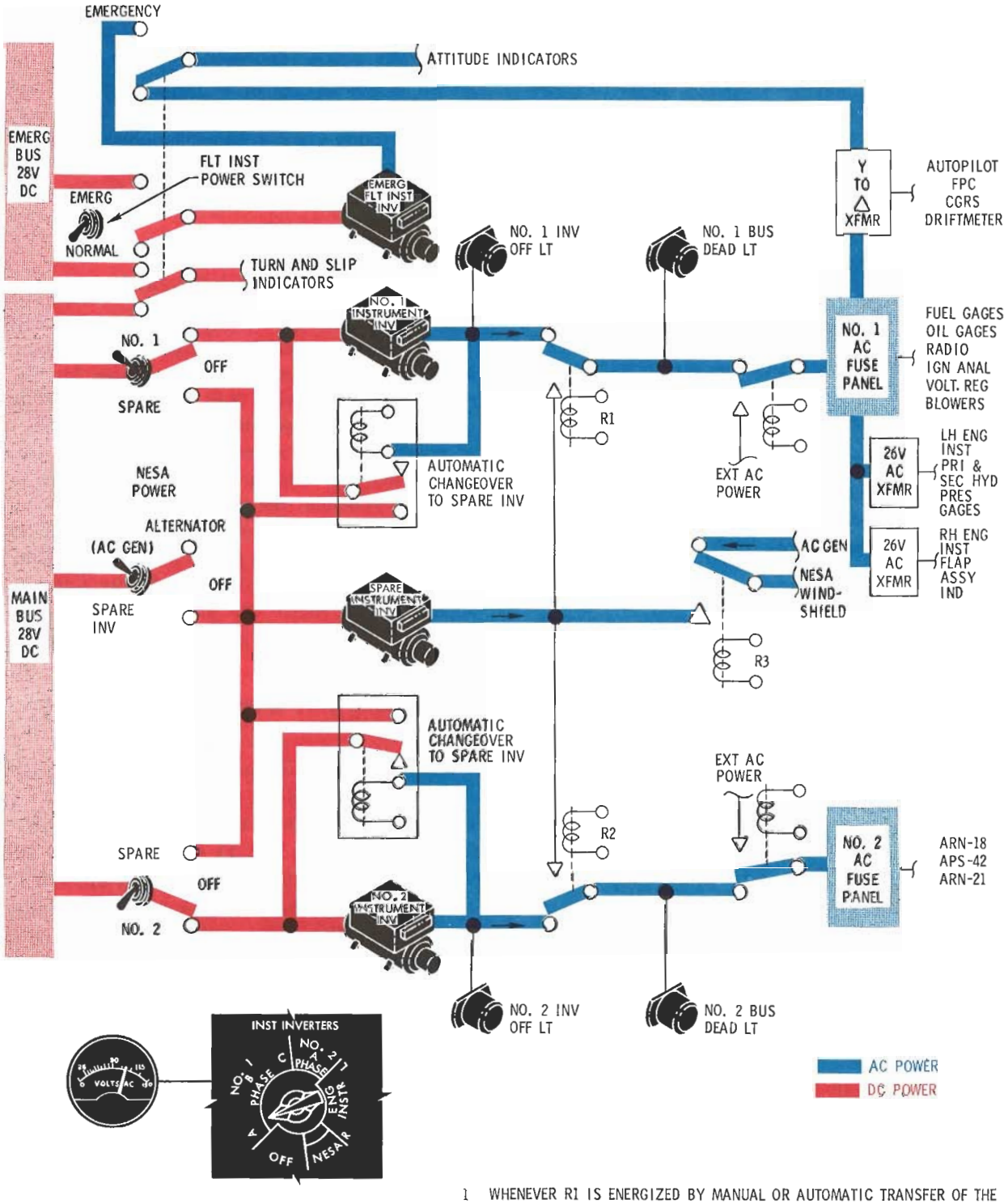
AC Generator Drive Shaft Disconnect Switches (EC-121D).

Two ac generator disconnect switches (12, figure 1-17) are located on the flight engineer's upper switch panel, and are placarded DRIVESHAFT DISCONNECT (AC GEN. & DC GEN. NO. 1) for engine 1 and DRIVESHAFT DISCONNECT (AC GEN. & DC GEN. NO. 4) for engine 4. These switches are protected by a red guard cover. When either switch is actuated, the driveshaft is mechanically disconnected from the engine by a dc solenoid.

Flight Instrument Power Switch (EC-121D).

This switch (16, figure 1-29) is located on the MJB 2A switch panel and has NORMAL and EMERGENCY positions. When the switch is in the NORMAL position, power for the attitude indicators is supplied by the ac bus. When the switch is placed in the EMERGENCY position, power for the attitude indicators is obtained from the emergency flight instrument inverter which operates directly from the emergency dc bus. This switch also transfers the turn and slip indicators to the emergency bus.

EC-121D. AC ELECTRICAL POWER SYSTEM



1 WHENEVER R1 IS ENERGIZED BY MANUAL OR AUTOMATIC TRANSFER OF THE NO. 1 LOADS TO THE SPARE INVERTER, R2 AND R3 CANNOT BE ENERGIZED.
2 WHENEVER R2 IS ENERGIZED BY MANUAL OR AUTOMATIC TRANSFER OF THE NO. 2 LOADS TO THE SPARE INVERTER, R1 AND R3 CANNOT BE ENERGIZED.
3 WHENEVER EITHER R1 OR R2 IS ENERGIZED BY MANUAL OR AUTOMATIC SWITCHING, R3 (IF ENERGIZED) WILL BE DE-ENERGIZED.

F75-E-1-16(1)

Figure 1-31 (Sheet 1 of 3)

EC-121D. AC ELECTRICAL POWER SYSTEM

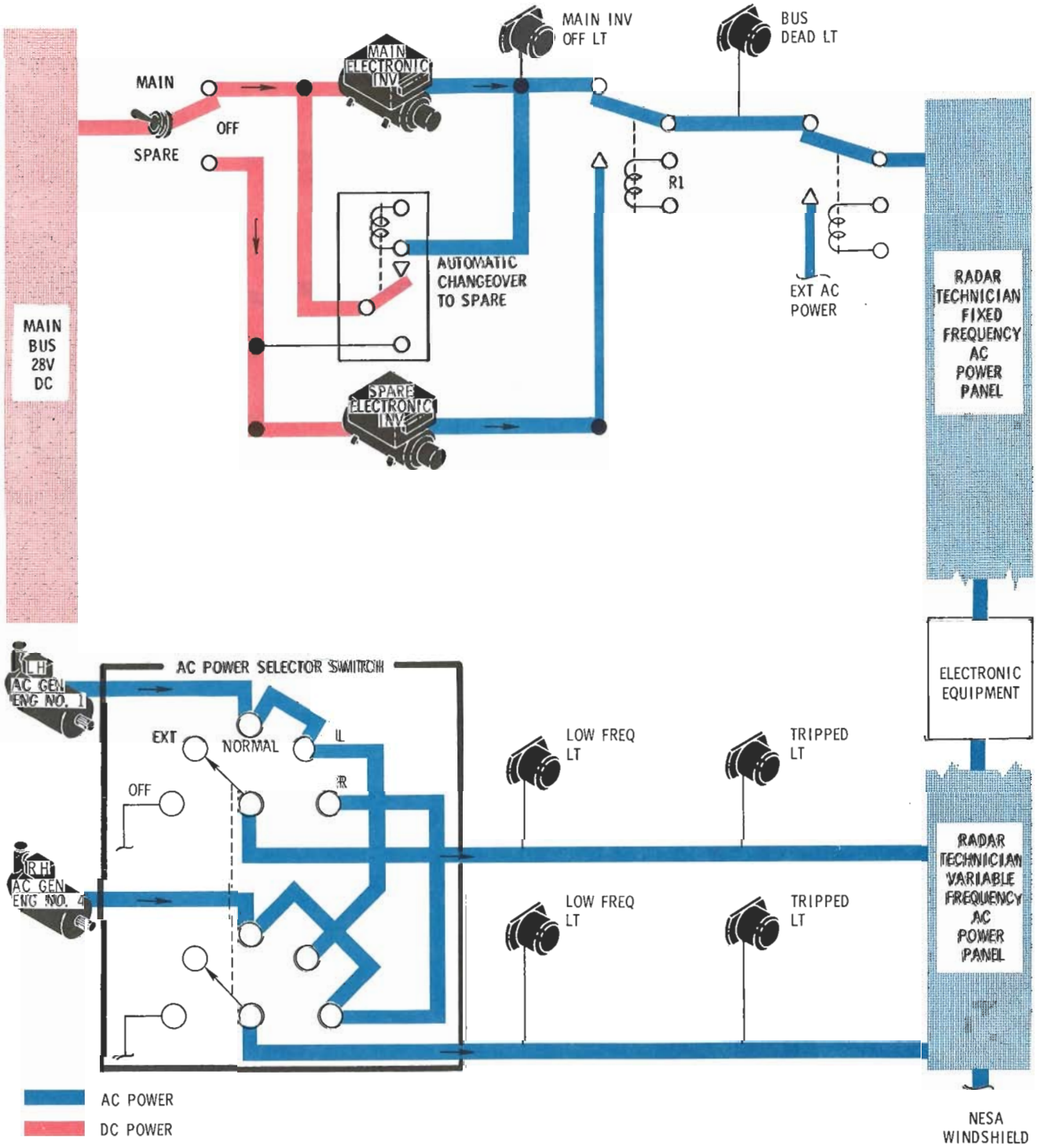
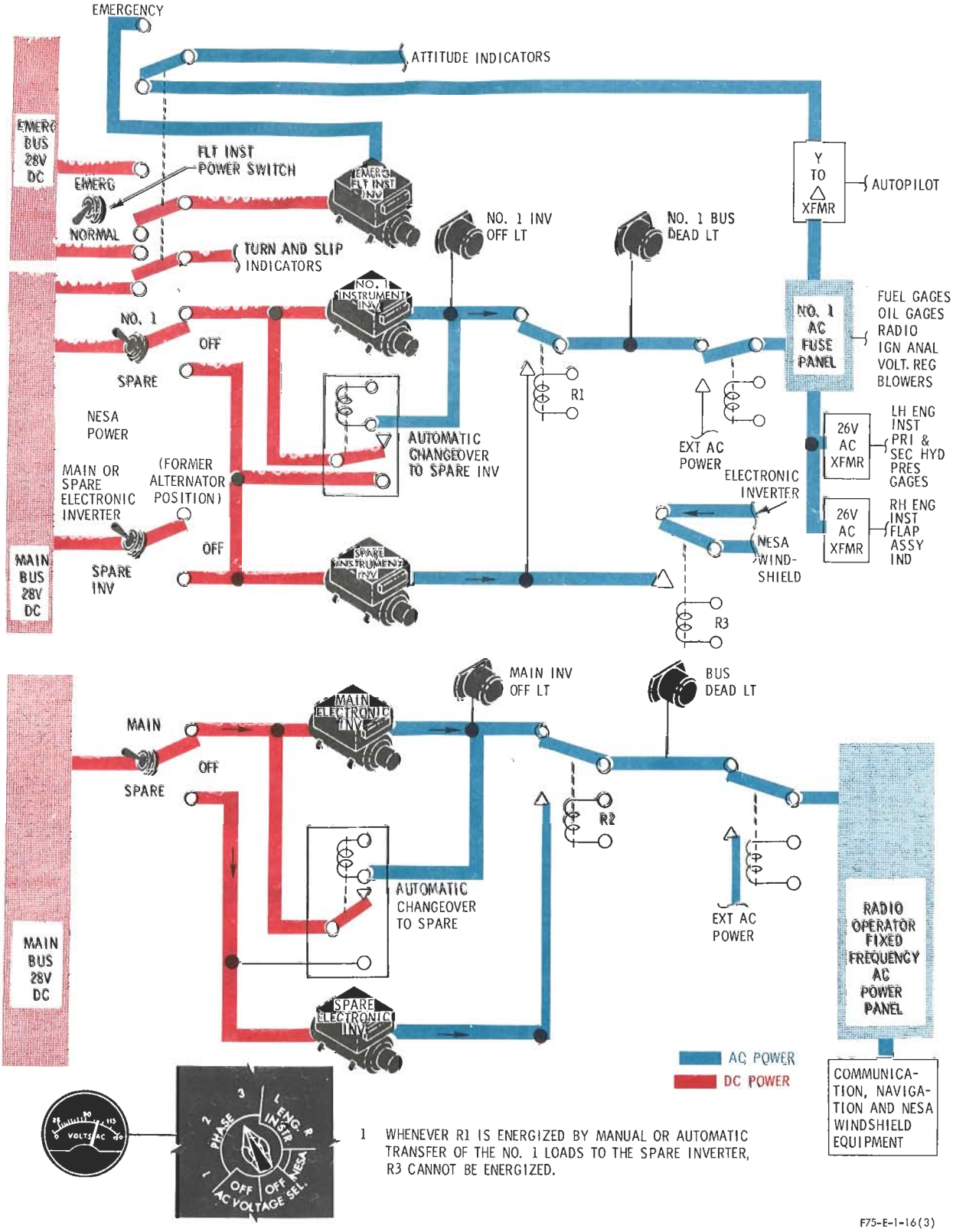


Figure 1-31 (Sheet 2 of 3)

TC-121C. AC ELECTRICAL POWER SYSTEM



1 WHENEVER R1 IS ENERGIZED BY MANUAL OR AUTOMATIC TRANSFER OF THE NO. 1 LOADS TO THE SPARE INVERTER, R3 CANNOT BE ENERGIZED.

F75-E-1-16(3)

Figure 1-31 (Sheet 3 of 3)

AC Generator Over Temperature and Over Voltage Warning Lights (EC-121D).

Two warning lights (11, 13, figure 1-17) are located adjacent to each ac generator disconnect switch. One, placarded OVER TEMP will glow when the gear box over temperature reaches 100°C or; when the drive shaft bearing reaches 150°C, or when the cooling air rise reaches 50°C. The other is placarded OVER VOLTAGE. In addition a single master AC GEN. OR DRIVE warning light (5, figure 1-15) is installed on the flight engineer's lower instrument panel. Above each switch is a single gage (3, figure 1-17) with three halfmoon dials, indicating DRIVESHAFT BRG. temperature, GEAR BOX BRG. temperature, and COOLING AIR RISE which measures the rise in cooling air to the generator.

AC Voltmeter and Selector Switch (EC-121D).

An ac voltmeter and a selector switch (3, figure 1-29) are located on the MJB No. 1 switch panel. The selector switch selects any phase of the three-phase, 115-volt ac bus, the Nesa power supply, or the output voltage from the left and right 26-volt, single-phase engine instrument transformers. The selector switch also has an OFF position.

AC ELECTRICAL POWER SYSTEM (TC-121C).

The basic ac electrical power system (figure 1-31) includes four 115/208-volt, three-phase inverters. One inverter provides power for the basic aircraft loads and one is a standby. Another inverter supplies power for most of the communication and electronic loads and one is a standby. The two standby inverters are provided with automatic and manual transfer to their standby loads. One additional 115-volt, three-phase inverter operates as an emergency standby for the ac flight instruments. This inverter is powered directly from the emergency dc bus when in operation.

Instrument Inverter Switch and Warning Lights (TC-121C).

An instrument inverter switch (21, figure 1-29) placarded MAIN, OFF, SPARE is located on the MJB No. 2 switch panel. Two warning lights are installed above this switch. One will glow when the switch is off or when ac power from the main inverter is interrupted. The other light will glow when electrical power is not being supplied to the ac bus. When the main inverter fails, a change-over relay will automatically transfer the instrument load to the spare inverter. In this case, the warning light will glow but will go out when the inverter power is restored.

Electronic Inverter Switch (TC-121C).

An electronic inverter power switch placarded MAIN, OFF, SPARE, is located at the radio operator's station on the fixed frequency inverter control panel (figure 4-47). Two warning lights are installed above this switch. One will glow when the inverter switch is off or when ac power from the main inverter is interrupted. The other light will glow when electrical power is not being supplied to the ac bus. When the main inverter fails, a change-over relay will automatically transfer the communication and electronic loads to the spare inverter. The electronic inverter supplies ac power for operation of the Nesa windshield anticing system and must be on before the Nesa system can be operated.

Nesa Inverter Selector Switch (TC-121C).

This switch (19, figure 1-29) is located on the MJB No. 2 switch panel. It permits selection of the electronic inverter or the spare inverter as a power source for the Nesa system. When the Nesa inverter selector switch is in the UP position, Nesa power is supplied by the electronic inverter. If the electronic inverter is not available, the spare inverter can be selected by moving the switch to the SPARE (UP) position. The OFF position provides disconnect when Nesa power is not required. A power failure warning light adjacent to the switch will glow when ac power is not available from either the electronic or the spare inverter.

Flight Instrument Emergency Power Switch (TC-121C).

This switch (15, figure 1-29) is located on MJB No. 2A switch panel and has NORMAL and EMERGENCY positions. When the switch is in the NORMAL position, power for the attitude indicators is supplied by the ac bus. When the switch is placed in the EMERGENCY position, power for the attitude indicators is obtained from the emergency flight instrument inverter which operates directly from the emergency dc bus. This switch also transfers the turn and slip indicators to the emergency bus.

AC Voltmeter Selector Switch.

An ac voltmeter and a selector switch (3, figure 1-29) are located on the MJB No. 1 switch panel. The selector switch selects any phase of the three-phase, 115-volt ac bus, the Nesa power supply, or the output voltage from the left and right 26-volt, single-phase engine instrument transformers. The selector switch also has an OFF position.

HYDRAULIC SYSTEM.

(See figure 1-32.)

Four variable-displacement hydraulic pumps, one driven by each engine, provide operating power up to 1700 psi for the various hydraulically operated unit. Hydraulic power is divided into two systems — primary and secondary — each of which obtains fluid from the main hydraulic reservoir, located in the left center section leading edge. The reservoir is divided vertically into two compartments up to approximately ⅔ its height and is pressurized with air by means of an aspirator. As hydraulic fluid passes through the aspirator at normal pressure, air is bled into the return system downstream from the aspirator orifice, thereby providing pressure in the reservoir. The reservoir partition separates secondary system fluid from the primary system fluid and each system draws fluid from its respective compartment. The hydraulic system incorporates pressure operated by-pass valves. Loss of fluid pressure at any by-pass valve will permit tension of an internal spring in the valve to position a poppet valve so that return fluid is directed to the compartment of the reservoir which is supplying fluid. The primary and secondary hydraulic power systems are interconnected by means of a crossover valve which allows the secondary system to supply power to the primary system in the event of partial or total loss of primary system pressure. The primary system also will supply pressure to the secondary system by means of the hydraulic system crossover valve. A separate emergency hand pump power system, with its own reservoir, provides pressure for emergency braking, emergency landing gear extension and emergency fuel dumping.

HYDRAULIC SYSTEM CROSSOVER VALVE.

An electric motor-driven crossover valve is installed in the hydraulic system to connect the primary and secondary systems in the event of failure of either system. Should a loss of system pressure occur in either the primary or secondary system, pressure from either system may be used by opening the crossover valve. Opening this valve allows primary system pressure to feed secondary services as well as the booster systems, or will allow the secondary system pressure to feed the booster systems as well as secondary services. However, operation time of some of the secondary system units may be slower. Booster return bypass valves automatically direct return hydraulic fluid from the primary and secondary systems to their respective side of the main hydraulic reservoir during normal operation. In the event of system pressure loss of either the primary or secondary system, the booster return bypass valves will continue to direct return hydraulic fluid to its respective side of the main reservoir until the crossover valve is opened. The operating system will then supply pressure for both systems and the return hydraulic fluid will be directed automatically by the booster return bypass valves to the reservoir of the system supplying the pressure.

WARNING

Before opening the crossover valve in the event of loss of system pressure from either the primary or secondary system, it should first be determined that opening the valve will not result in loss of the remaining system pressure fluid.

PRIMARY HYDRAULIC SYSTEM.

The primary hydraulic system supplies pressure to operate the surface control boosters and left wing secondary heat exchanger fan motor. The hydraulic pumps on engines 1 and 2 furnish the volume and pressure required for operation of the primary system. Return lines from all primary units are manifolded into the common return line through the main primary filter to the primary return port of the main hydraulic reservoir.

SECONDARY HYDRAULIC SYSTEM

The secondary hydraulic system supplies pressure to operate the landing gear, brakes, nose wheel steering, aspirator, wing flaps, fuel dump system, oil pump for the reserve oil system, and the right wing secondary heat exchanger fan motor. Pressure for the secondary system is supplied by the pumps on engines 3 and 4. Return lines from all of the secondary system units are manifolded into a common line through the main secondary filter to the secondary return port of the main hydraulic reservoir.

RESTRICTION CONTROL VALVE.

A restriction control valve is installed in the secondary system pressure manifold to operate as a flow control valve if the hydraulic system pressure drops to a preset

RC-121D. HYDRAULIC POWER SYSTEM

EMERGENCY POWER
WHEEL BRAKES
NOSE GEAR STEERING
LANDING GEAR ACTUATION
ENGINE OIL TRANSFER SYSTEM
FUEL DUMP ACTUATION
SECONDARY HEAT EXCHANGER FAN MOTORS
FLIGHT CONTROLS BOOSTER ACTUATION
WING FLAP SYSTEM

CODE
PRIMARY PRESSURE
SECONDARY PRESSURE
EMERGENCY PRESSURE
EMERG. SUPPLY
PRIMARY RETURN
SECONDARY RETURN
PUMP SUCTION
ASPIRATOR AND SUCTION BRAKE RETURN
ACTUATING PRESSURE
DRAIN
CHECK VALVE

★ INSTALLED ONLY ON U.S.A.F. SERIALS 54-2304 THROUGH 54-2308, 55-118 THROUGH 55-139

★★ NOT INSTALLED ON U.S.A.F. SERIALS 54-2306 THROUGH 54-2308, 55-119 THROUGH 55-121 55-131 THROUGH 55-139.

FB 2746

Figure 1-32 (Sheet 1 of 3)

RC-121D. HYDRAULIC POWER SYSTEM

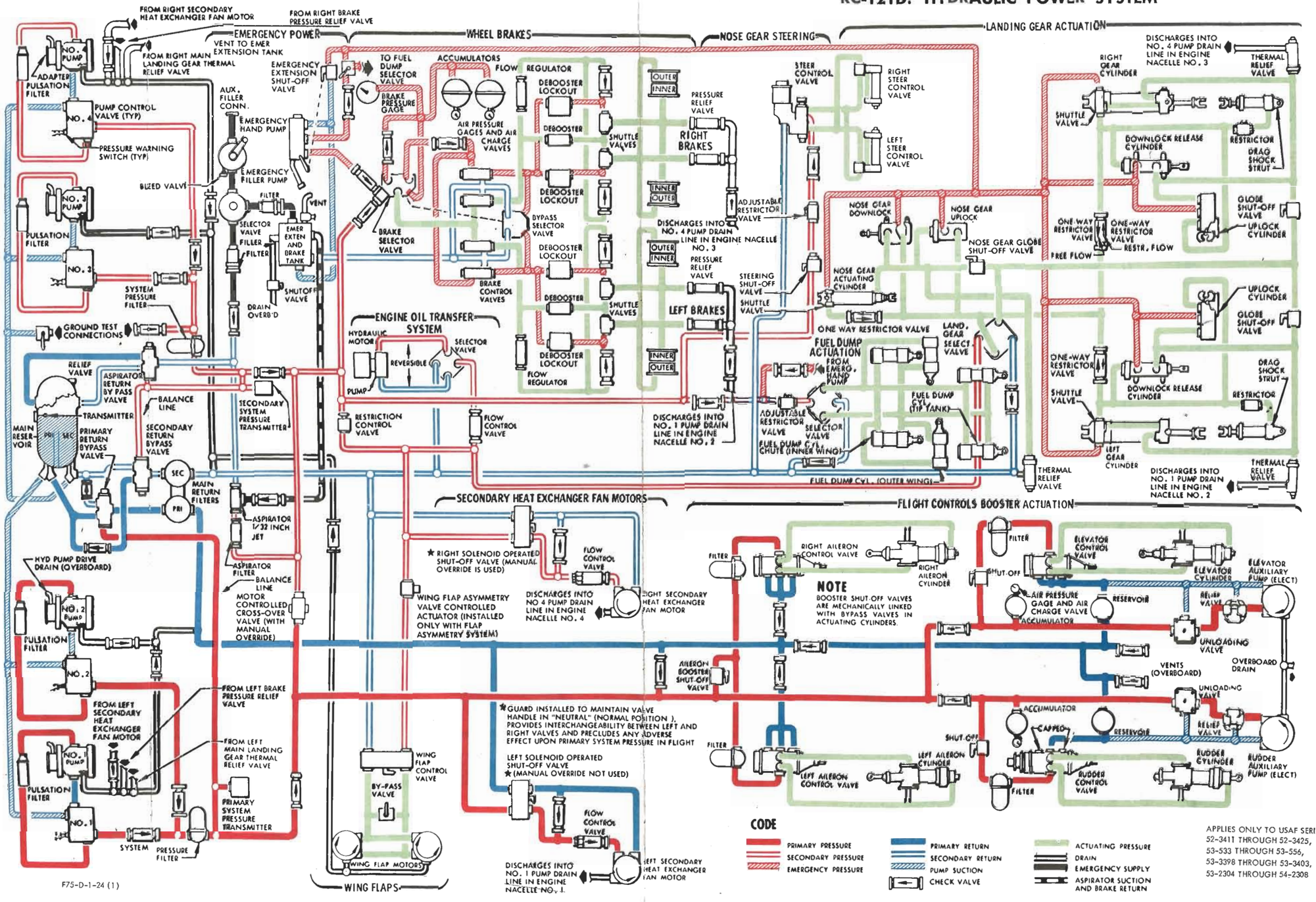


Figure 1-32 (Sheet 2 of 3)

value. Extension of the landing gear and wing flaps may be slower than normal because the restriction control valve will give priority to the pressure requirements of the flight control boosters when one of the systems is providing hydraulic pressure for both systems through the hydraulic crossover valve. Brakes, nose steering and fuel dumping are not affected.

EMERGENCY HAND PUMP POWER SYSTEM.

The emergency hand pump power system (figure 1-32) consists of a separate fluid reservoir (emergency extension tank), located forward of the pilot's rudder pedals, and a combined hand pump and selector valve. The system provides an auxiliary source of fluid and pressure, independent of the normal hydraulic system, for emergency braking, landing gear extension, and fuel dumping in the event of normal system failure. A separate and independent set of lines, connected to the downside of the landing gear actuating cylinders, is used during emergency gear extension. During emergency braking, fluid is directed to the brake selector valve. (Refer to Brake System, this section.) Other components of the emergency hand pump system include provisions for replenishing the system with fluid. These components consist of a hand wobble pump with a capped inlet line (to be attached to a portable fluid container) and an outlet line that connects the wobble pump to a filler selector valve which directs replenishing fluid to the emergency extension tank or to the main system hydraulic reservoir. If neither primary nor secondary system pressure is available, the emergency hand pump power system may be used.

PUMP CONTROL VALVE.

A multiple-function pump control valve is installed with each engine-driven hydraulic pump. It acts as a manual emergency shut-off valve, a thermal relief valve, a pressure relief valve and a pressure switch. The manual shut-off valve consists of a cam-operated poppet valve acting against a suction inlet port of the control valve. The thermal relief valve automatically bypasses the hydraulic fluid from the pressure side to the suction side of the control valve when the fluid pressure, because of high temperature, reaches the high limit. The pressure relief valve operates automatically when system pressure reaches the maximum limit by allowing a valve piston to open which diverts fluid to the suction side of the control valve. The pressure switch consists of a spring-loaded piston which actuates an electric switch that closes the circuit to the indicator light located in the flight station, when the hydraulic pressure drops to the minimum limit.

Emergency Hand Pump Selector Lever.

The emergency hand pump and selector lever (figure 1-33) are located on the flight station floor, outboard of the copilot's seat. The selector lever has two positions, EMER. BRAKES and EMER. GEAR. When the lever is in the EMER. BRAKES position, the hand pump may be used to direct fluid and pressure to the brake selector valve located in the normal brake system. (Refer to Brake System, this section.) When the selector lever is placed in the EMER. GEAR position, the hand pump lever may be used to supply pressure through an independent system of lines to the downside of the landing gear actuating cylinders or the emergency fuel dumping. If this lever is left in the EMER. GEAR position, the landing gear cannot be retracted by the normal system.

Emergency Shut-Off Valve Levers.

The emergency shut-off levers are located on a control quadrant in the ceiling of the flight station. There is one lever for each engine, and each lever has four notched positions on the quadrant. The second stop position, as the lever is moved from the full forward position, mechanically shuts off the hydraulic oil supply to the engine-driven pump at the pump control valve. The emergency shut-off levers and the pump control valves are mechanically connected by a cable and pulley system.

Hydraulic Reservoir Filler Pump.

A wobble pump (5, figure 1-34) is located on the flight station floor offset behind the pilot's seat. This pump is used to transfer hydraulic fluid from a portable container to the emergency or main reservoir through a selector valve.

Hydraulic Reservoir Filler Selector.

This selector lever (2, figure 1-34) labeled OFF, EMER. RES., and MAIN, operates mechanically and is located near the hydraulic reservoir filler pump. The EMER. RES. position permits hydraulic fluid to be transferred from the portable container to the emergency reservoir. The MAIN position provides a means of replenishing the normal reservoirs.

Hydraulic System Crossover Switch.

The hydraulic system crossover switch (18, figure 1-17) is installed at the flight engineer's station and has two

SIMPLIFIED HYDRAULIC SYSTEM DIAGRAM

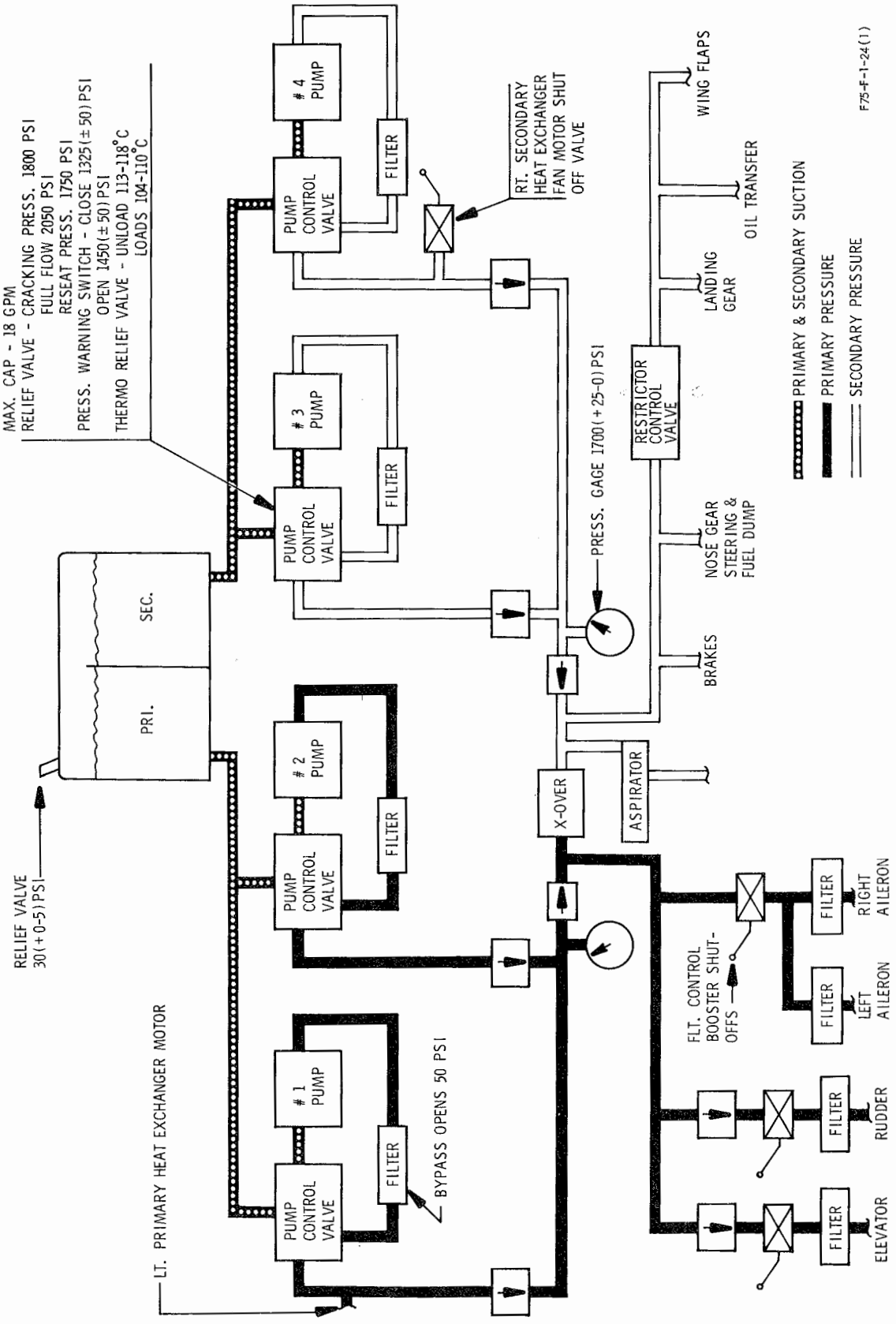


Figure 1-32 (Sheet 1 of 3)

EC-121D. HYDRAULIC POWER SYSTEM

USAF Serials 55-118, 55-121, 55-122, 55-124, 55-127, 55-133, 55-135, 55-137 through 55-139, 54-2304, 54-2306, 54-2307 and airplanes incorporating T.O. 1C-121-629.

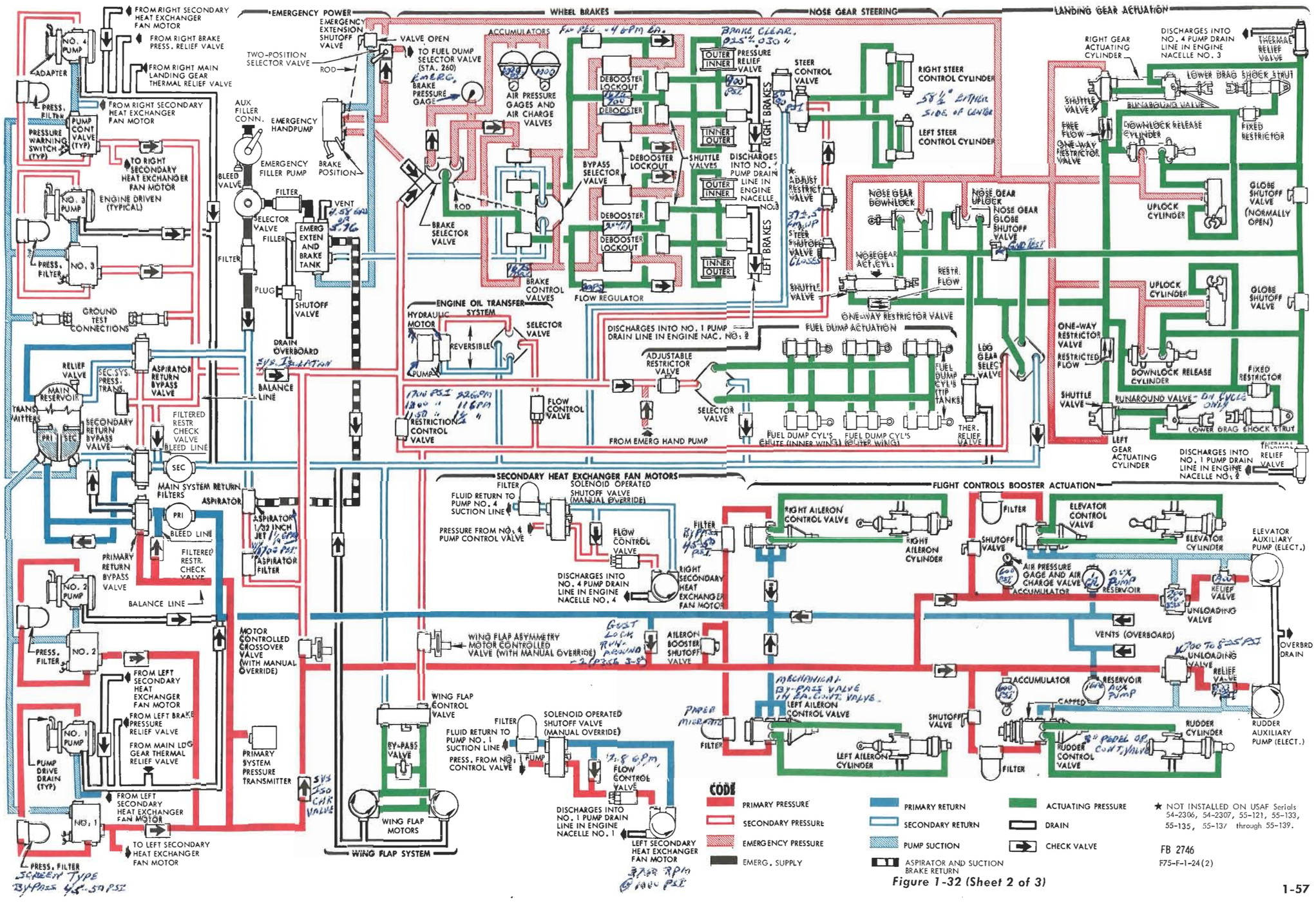


Figure 1-32 (Sheet 2 of 3)

TYPICAL HYDRAULIC POWER SYSTEM

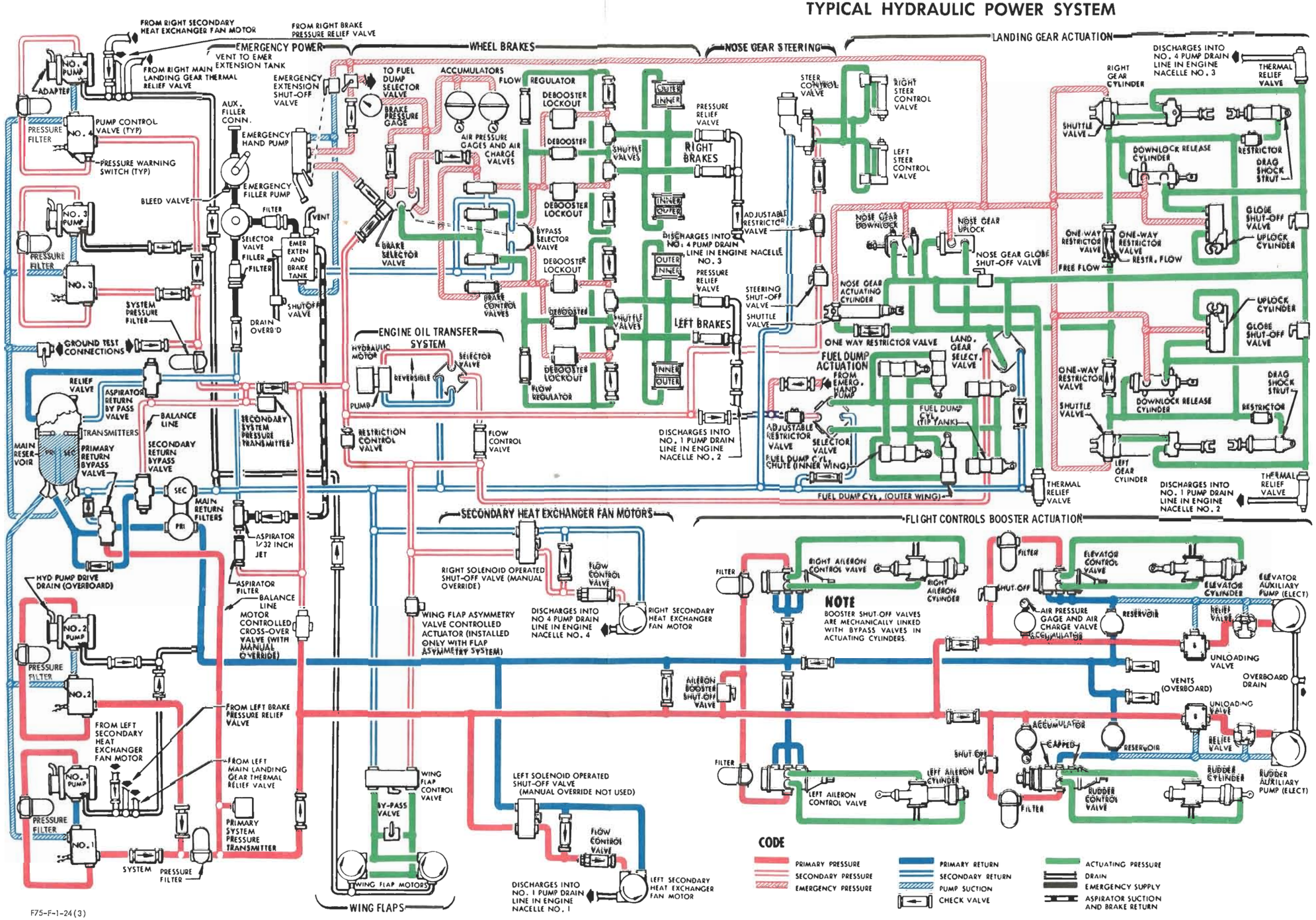


Figure 1-32 (Sheet 3 of 3)

EMERGENCY HYDRAULIC SYSTEM (FUEL DUMP)

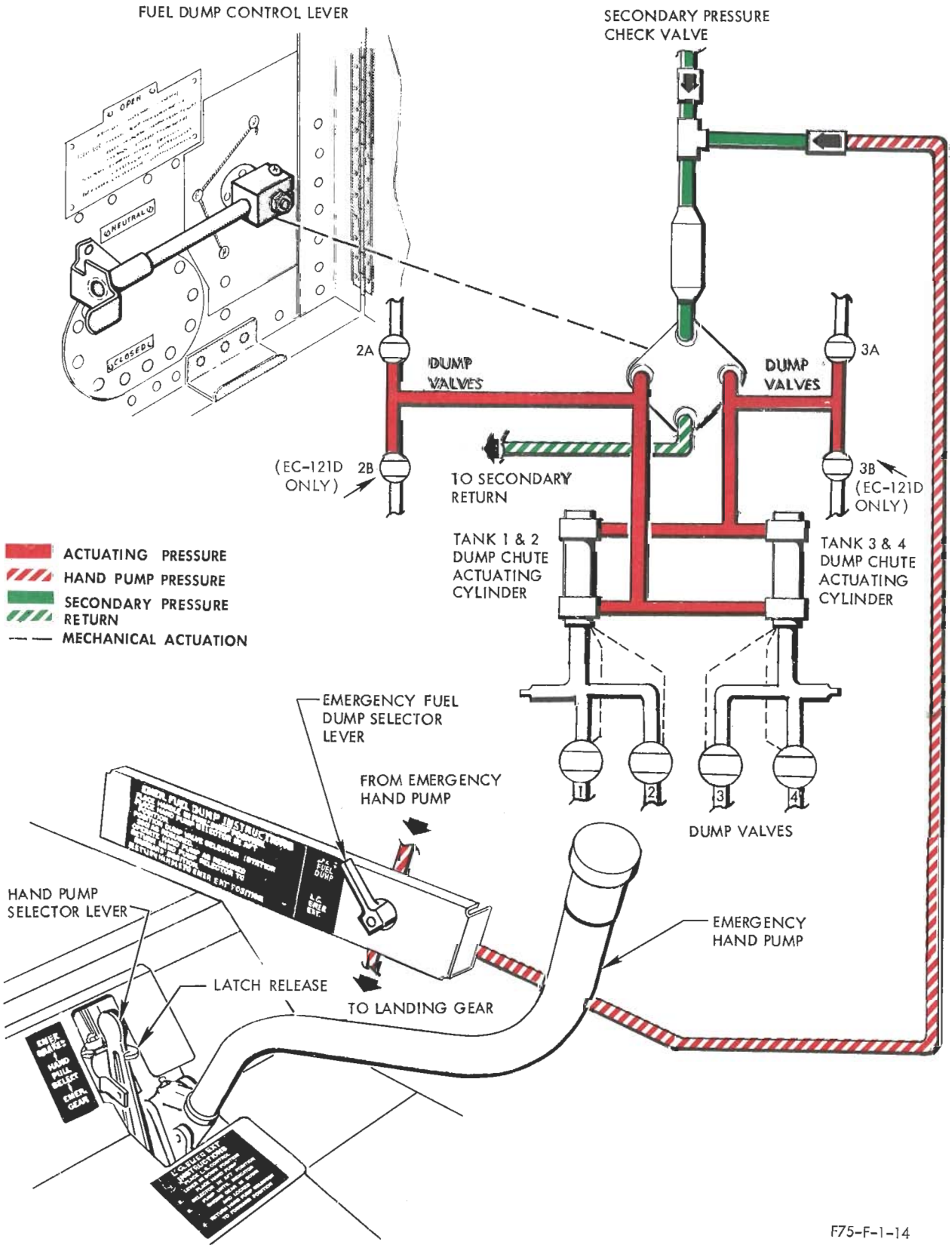
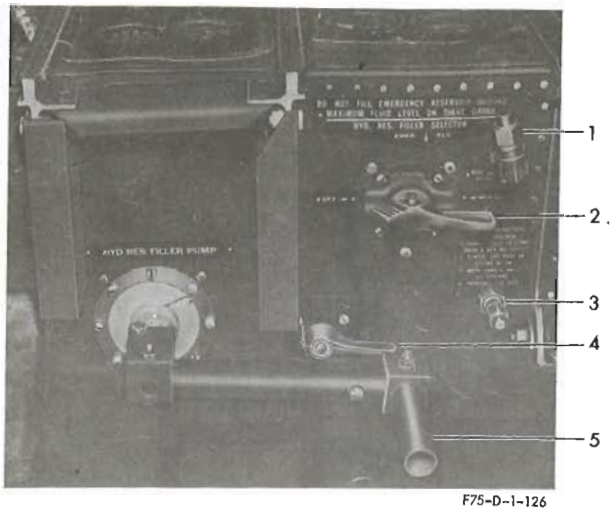


Figure 1-33

TYPICAL HYDRAULIC RESERVOIR FILLER CONTROLS



1 HOSE CONNECTION FILLER PUMP

2 HYDRAULIC RESERVOIR FILLER SELECTOR

3 PUMP BLEED VALVE

4 CABIN PRESSURE REGULATOR VACUUM SHUT-OFF LEVER

5 HYDRAULIC RESERVOIR FILLER PUMP

Figure 1-34

positions, NORMAL and EMERGENCY. The NORMAL position is the closed position. When the switch is in the EMERGENCY position, a dc motor rotates the valve and the primary and secondary hydraulic systems are interconnected.

Hydraulic System Crossover Manual Control Lever.

A manual hydraulic system crossover valve lever is part of the hydraulic system crossover valve unit and is installed in the rear of the forward cargo compartment, aft of the manual auxiliary oil control panel. Access to the unit is made through the forward cargo compartment hatch. On some aircraft the control lever can be operated through an access plate in the cargo floor.

Hydraulic Fluid Quantity Indicator.

The main hydraulic fluid quantity indicator is located on the flight engineer's lower instrument panel (13, figure 1-15). This is a dual dc operated indicator actuated by two Liquidometer transmitters, one in the primary side of the main hydraulic reservoir and one in the secondary side. The dials are calibrated in quarters from empty to full. When the fluid quantity exceeds 7/8 capacity, the indicators will equalize.

Hydraulic System Pressure Indicators.

Two dual hydraulic oil pressure indicators are installed, one on the copilot's auxiliary instrument panel (21, 23, figure 1-7) and one on the flight engineer's lower instrument panel (7, figure 1-15). These indicators are calibrated in psi. One needle in each instrument indicates the hydraulic pressure in the primary system and the other needle indicates the pressure in the secondary system. Each indicator is electrically (ac) connected to a pressure transmitter located in the pressure lines of each system.

Hydraulic Pump Low-Pressure Warning Lights.

Four pump low-pressure warning lights are installed on the flight engineer's lower instrument panel (6, figure 1-15) and on the copilot's auxiliary instrument panel (19, 21, figure 1-7). These lights are numbered from left to right and are electrically (dc) connected to the pressure side of their respective pump control valves. When the pump pressure decreases to the low limit (1325 $\pm$50), the pump control valve pressure switch will close the circuit to the respective light on each panel.

Emergency Extension Hydraulic Reservoir Sight Gage.

A sight gage, mounted on the emergency extension reservoir, is visible from the pilot's seat between the rudder pedals and is marked at MAX & MIN fluid levels.

FLIGHT CONTROL SYSTEM.

(See figure 1-35.)

The elevators, rudders and ailerons are actuated by cable and pulley systems which incorporate tension regulators that automatically maintain constant tension in the cable systems. Each outboard rudder, each elevator and each aileron is provided with a cable-operated trim tab that is controlled from the flight station. Hydraulic booster units are built into the elevator, rudder and aileron cable systems to assist the pilot in moving the control surfaces. The characteristic control "feel" is retained throughout movement of all controls. The elevator and the rudder booster systems incorporate a complete electrical power unit that will provide an auxiliary source of hydraulic power to the booster assemblies in the event of primary or secondary hydraulic system failure. Electrical power is obtained from the emergency dc bus. There is no source of auxiliary hydraulic power for the aileron booster system.

FLIGHT CONTROL HYDRAULIC SYSTEM

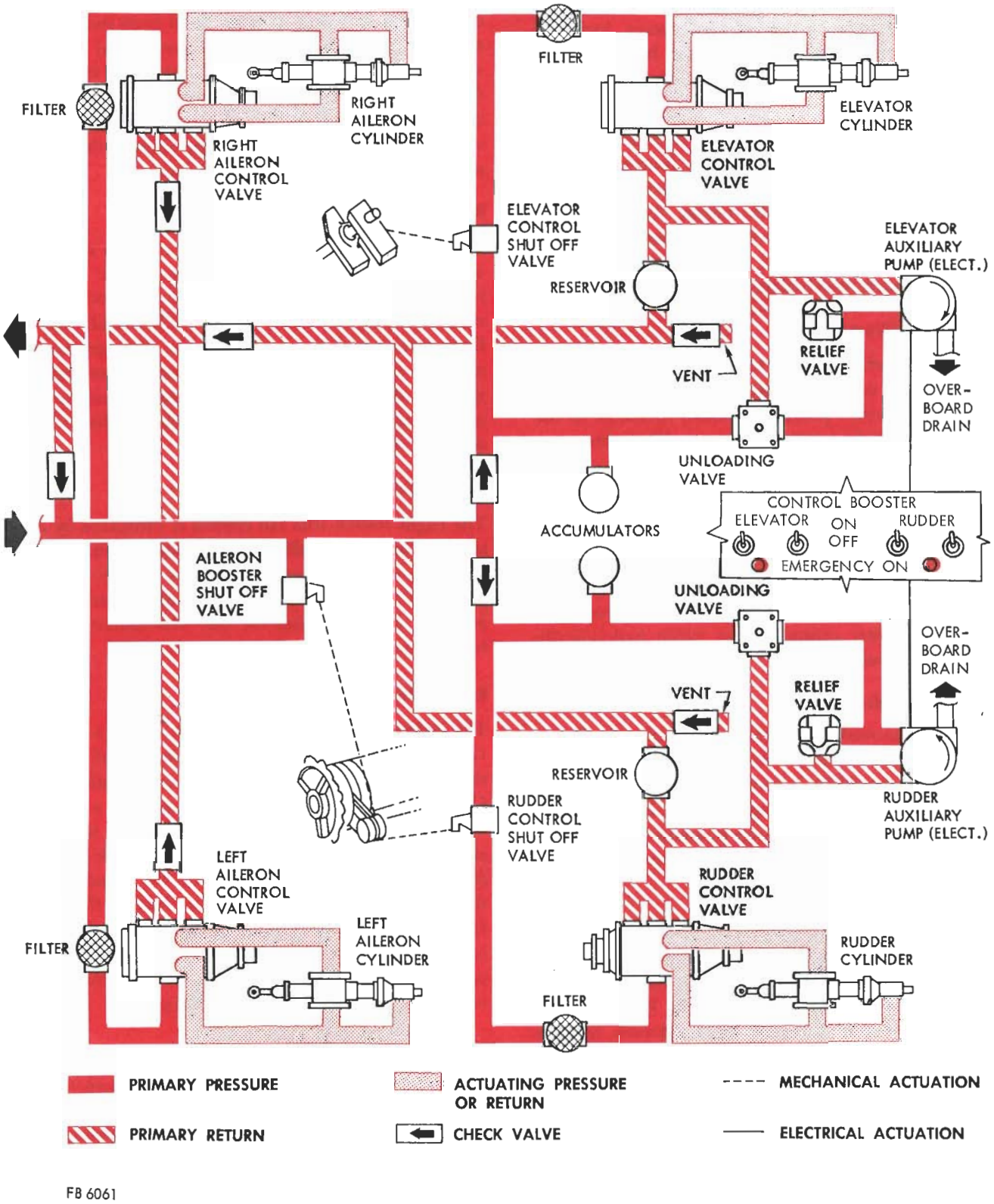


Figure 1-35

FLIGHT CONTROL BOOSTERS.

Hydraulic pressure for the flight control boosters normally is supplied by the primary hydraulic system. In the event of failure of the primary system, hydraulic pressure from the secondary system can be supplied to the flight control boosters through the hydraulic crossover valve.

Each booster assembly includes a hydraulic actuating cylinder which applies the force and a four-way control valve which regulates the speed and direction of movement of the actuating cylinder piston. Any movement of the rudder pedals or control wheel opens the control valve, or valves, which direct hydraulic pressure to the actuating cylinder, or cylinders.

SURFACE CONTROL LOCK.

The effect of surface control locks is achieved by engaging the flight control boosters while the aircraft is parked. The boosters provide sufficient resistance in the system to absorb the impact loads caused by gusts.

AILERON CONTROL SYSTEM.

The aileron control system consists of a cable and pulley system that connects the pilots' control wheels to the ailerons and aileron booster assemblies located in the wing forward of each aileron. As the control wheel is rotated, push rods mechanically force the ailerons and the aileron booster control valves which hydraulically boost control wheel action.

Aileron Trim Tabs.

A trim tab is located in the trailing edge of each aileron and is controlled mechanically through a cable system. Movement of the cables is converted by a tab actuating unit, located in the outer wing structure, into rod linkage servo-action. The rod linkage is connected to the tab and passes through the aileron to the aileron tab actuating unit.

Aileron Trim Tab Handcrank and Indicators.

The aileron trim tab handcrank (24, figure 1-11) is located on the center control stand and is rotated to actuate a cable system to each aileron tab. Internal stops limit the number of turns of the handcrank in each direction from the neutral position. Tab position is shown by a needle forward of the handle and by a dial indicator below the handcrank. The needle on the lower dial gives the most sensitive indication and moves from the neutral position toward either the LEFT or RIGHT extremities as the handcrank is rotated.

Aileron Booster Control Lever.

The aileron booster control lever (3, figure 1-11) is located on the center control stand to the left of the throttle controls. When the booster control lever is pulled to the OFF (aft) position, a cable system actuates a hydraulic shut-off valve and opens a bypass valve in each aileron actuating cylinder. Fluid from the hydraulic system is then shut off from the boosters, and the bypass valves in each cylinder allow the fluid to flow freely from one end of the cylinder to the other as the ailerons are moved. When the boosters are shut off, control wheel forces are transmitted to the ailerons through the mechanical system of cables and linkage.

RUDDER CONTROL SYSTEM.

The rudder pedals are connected by cable to a quadrant assembly, located in the aft fuselage section. The quadrant assembly is connected by push-pull rods to each rudder. The center rudder on EC-121D aircraft only is a fixed surface and is not controllable. Linkage also connects the cable quadrant to the rudder booster assembly, which is different in mechanical arrangement from the aileron and elevator booster assemblies in that it incorporates a trail center valve.

Rudder Trim Tabs.

The flight station trim tab control is connected by cable to each outboard rudder tab actuating unit. The tab actuating units are connected to the tabs by adjustable link rods which screw forward and aft by action of the actuator, thus deflecting the tab. The rudder trim tabs have no servo action.

Rudder Booster Control Lever.

The rudder booster control lever (2, figure 1-11) is located on the center control stand to the left of the throttles. When the booster control lever is pulled to the OFF (aft) position, a control cable actuates a hydraulic shut-off valve and opens a bypass valve in the rudder actuating cylinder. Fluid from the hydraulic system is then shut off from the booster, and the bypass valve in the cylinder opens and allows the fluid to flow freely from one end of the cylinder to the other as the rudder is moved. When the rudder booster is shut-off, rudder pedal forces are transmitted to the rudders through the mechanical system of cables and linkage.

Rudder Auxiliary Booster Switch.

The rudder auxiliary booster switch (4, figure 1-8), located on the pilots' overhead panel, has three positions, ON, OFF and EMERGENCY ON. It is spring-loaded to OFF from the EMERGENCY ON position. When the switch is moved to the ON position, the electrically operated hydraulic pump is energized which supplies auxiliary hydraulic power to the rudder booster in the event normal hydraulic power is not available. When the switch is held in the EMERGENCY ON position,

electrical power is supplied directly to the auxiliary motor from the dc bus, or if that bus is dead, directly from the aircraft batteries without the protection of circuit breakers.

Rudder Tab Handcrank and Indicator.

The rudder tab handcrank (27, figure 1-11) is located on the center control stand and is rotated to drive a drum in the control unit. This drum is connected by cables to a similar drum in each of the two tab-actuating units located in the outboard rudders. Internal stops limit the number of turns of the handcrank in each direction from the neutral position. Tab position is shown by a dial indicator forward of the handcrank. The needle on the dial moves from the neutral position toward either the LEFT or RIGHT extremities as the handcrank is rotated.

Rudder Auxiliary Booster Indicator Light.

The rudder auxiliary booster indicator light (6, figure 1-8) is located on the pilot's overhead panel adjacent to the rudder auxiliary booster switch. The indicator light glows amber whenever the auxiliary boost pump is in operation.

ELEVATOR CONTROL SYSTEM.

The control columns are connected by cable to an elevator walking beam which is connected by a linkage system to the elevators. Direct linkage connects the elevators and the hydraulic booster assembly. The booster assembly is similar to the aileron booster in principle of operation. An actuating cylinder, a control valve and connecting linkage are the essential parts of the booster assembly. Elevator booster operation can also be provided by an auxiliary dc electrically driven hydraulic pump which supplies hydraulic power to the booster unit in the event of normal hydraulic system failure. An emergency elevator booster shift control is provided to shut off the booster and to alter the leverage ratio between the flight station controls and the booster mechanism.

Elevator Trim Tab Control Wheels and Indicator.

The elevator trim tabs may be controlled manually by control wheels (1, figure 1-11) located on each side of the pilots' center control stand. They are interconnected by a shaft which drives a drum pulley. A control cable connects the drum pulley in the stand with the tab actuating units. The control wheel is rotated forward for nose-down and aft for nose-up trim. A dial needle indicator, driven by the drum shaft by means of gears, is mounted inboard of the wheels on the control stand and indicates the relative position of the tabs.

Emergency Elevator Booster Shift Control.

The elevator booster shift control (25, figure 1-11) is located on the left side of the center control stand and consists of a shaft with a push-button lock on the handle grip. Normally, the control is in the forward and downward position for boost ON. It is pulled upward and aft for boost OFF. In the event of elevator booster system failure, the elevators may be actuated manually by use of the emergency elevator booster shift control. When this shift lever is pulled upward, it shuts off and bypasses the normal and the auxiliary booster systems and alters the leverage ratio between the control columns and the elevator. This provides the pilots with sufficient mechanical advantage to actuate the elevators manually during the boost-off operations. The amount of elevator travel in relation to control column movement is reduced approximately 3 to 1, and there is approximately 1½ inches of free movement in the control column before elevator movement is affected.

Elevator Auxiliary Booster Switch.

The auxiliary booster toggle switch, located on the pilots' overhead panel (4, figure 1-8), has three positions, ON, OFF and EMERGENCY ON. It is spring-loaded to OFF from the EMERGENCY ON position. When the switch is placed in the ON position, the electrically-driven auxiliary hydraulic motor is energized and supplies hydraulic power to the booster. In the event of electrical system failure, the switch can be held in the EMERGENCY ON position to energize the auxiliary booster. The electrical circuit to the EMERGENCY ON position is direct from the aircraft batteries and is not protected by circuit breakers.

CAUTION

The rudder and elevator boost levers must be ON before the auxiliary boost system is effective.

WING FLAPS.

The wing flaps are Fowler-type, and flap motion during extension is a combination of an aft and a downward tilting movement. There are ten flap sections (five in each wing) located in the inner wing panels. The flap control unit consists of a hydraulic selector valve and a follow-up mechanism that controls two hydraulically-driven flap motors which supply the driving force for the wing flaps. The control unit also allows pre-positioning of the flaps and changing of the flap movement at any time without completing a selected cycle. The two hydraulic motors are located on the rear wing beam in

WING FLAP MOTOR HYDRAULIC SYSTEM

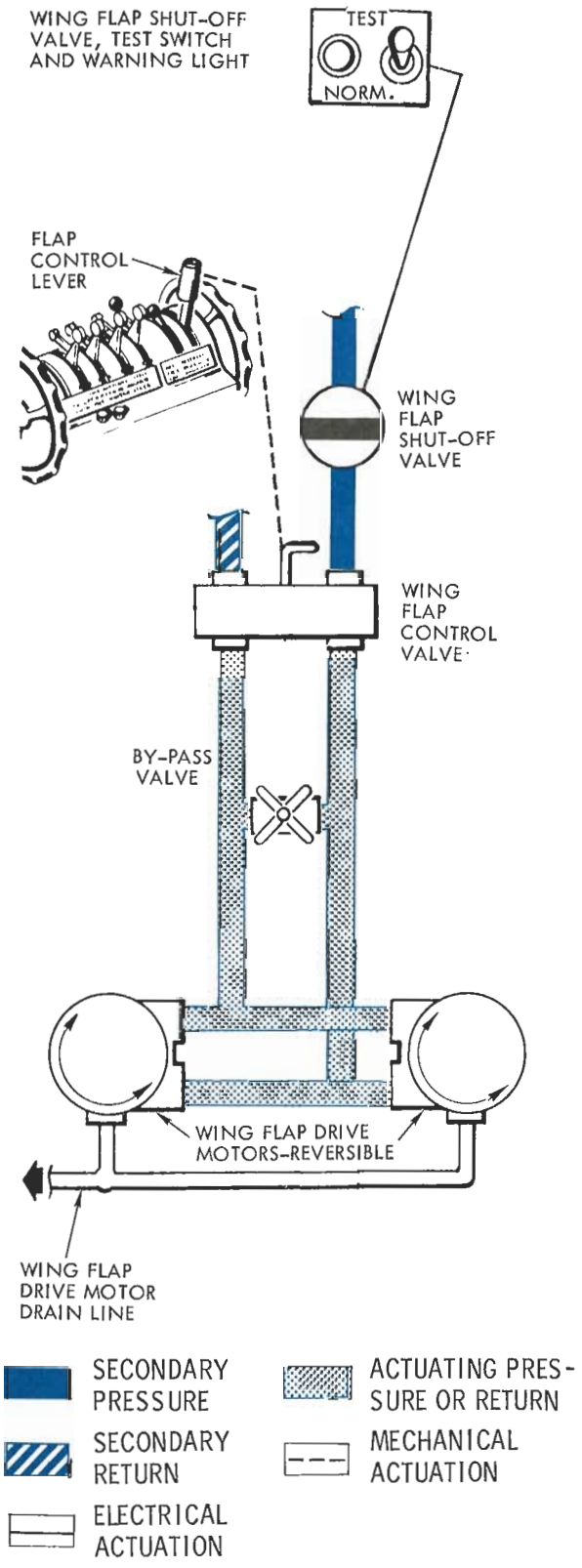


Figure 1-36

the center section and normally are powered by the secondary hydraulic system. Output of the hydraulic motors is transmitted by a main drive shaft to drive shafts that extend into each inner wing panel to operate separate intermediate drive units. There are twelve intermediate drive units bolted to carriage track ribs and to brackets on the wing rear beam. The intermediate drive units turn sprockets that are connected by chains and cables to the wing flap carriages. The carriages are attached to the wing flap sections and roll on tracks riveted to adjacent wing ribs. Spring units take up the slack on the loose side of the chains to prevent jamming. In the event that the wing flaps fail to operate by normal means, the flaps may be extended to retracted manually. Access to the shaft-and-gear mechanism is through the flap emergency access door, centrally located in the main cabin floor.

WING FLAP ASYMMETRY PROTECTION SYSTEM.

The wing flap asymmetry protection system consists of cam-operated switches mounted on the wing flap gear box drive located on each extreme outboard flap mechanism. These switches are adjusted so that an open circuit exists during normal operation of the wing flaps. Should an asymmetrical wing flap condition occur, the open circuit is closed by the failure in rotation of the opposite cam driven switch. This completed electrical circuit then trips a mechanical latching relay, which in turn energizes an asymmetrical wing flap warning light and closes a dc electric motor-driven hydraulic shut-off valve. This valve shuts off hydraulic pressure to the wing flap motors and stops travel of the wing flaps.

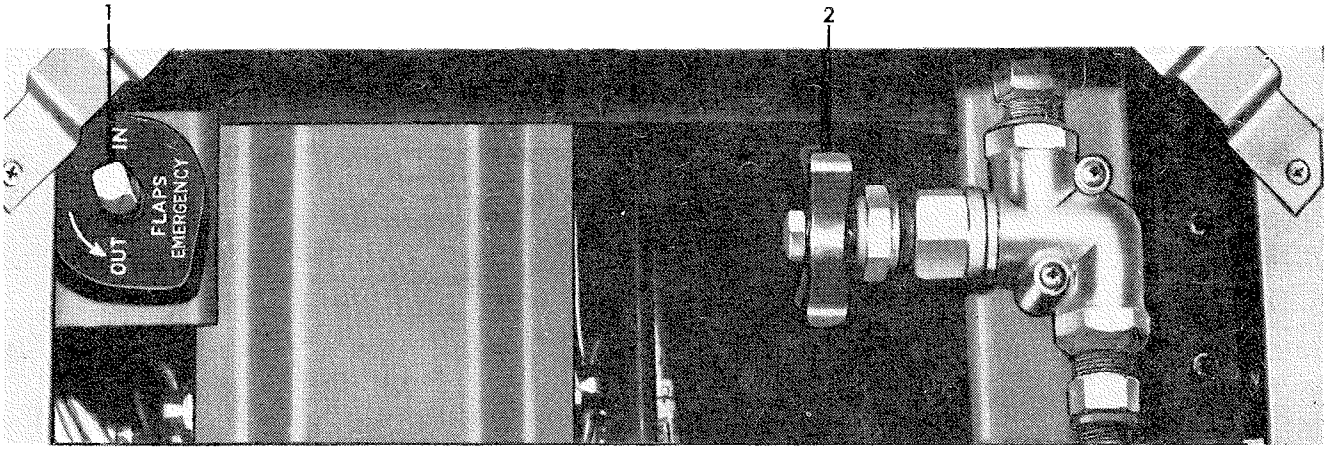
Wing Flap Shut-off Valve Test Switch and Warning Light.

A two-position wing flap shut-off valve test switch (15, 16, figure 1-7) and an asymmetrical wing flap warning light are located on the copilot's instrument panel. The test switch is spring-loaded from the TEST to the NORMAL position. The test switch provides a means of testing the asymmetrical wing flap warning light and the operation of the hydraulic shut-off valve without energizing the dc latching relay. With the switch in the TEST position, the warning light is energized and the shut-off valve is closed. With the test switch in the NORMAL position, the warning light will be out and the shut-off valve open.

Wing Flap Lever.

The wing flap lever (9, figure 1-11) is located on the top, right side of the center control stand. There are four placarded positions on the quadrant: TAKE-OFF, APPROACH, 80%, and LANDING. When the lever is full forward, the flaps are retracted or are in the up

EC-121D. WING FLAP EMERGENCY EXTENSION CONTROLS



1 WING FLAP EMERGENCY OPERATION DRIVE

2 WING FLAP MOTOR BY-PASS VALVE

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Figure 1-37 (Sheet 1 of 2)

position. Moving the flap lever progressively aft permits the following flap extensions:

TAKEOFF	(60% extension)
APPROACH	(66% extension)
80%	(80% extension)
LANDING	(100% extension)

Note

There is no detent at the APPROACH position; however, the lever will remain at that position.

A switch is installed on USAF serial 52-3425 and subsequent aircraft in the wing flap follow-up mechanism and is wired to the landing gear warning horn. This switch is wired in parallel with the landing gear warning horn throttle switches and will energize the warning horn circuit when the wing flap selector lever is placed in the 66% through 100% positions and the landing gear is not down and locked.

Emergency Extension Handcrank.

The emergency extension handcrank is strapped on the aft side of the bulkhead opposite the galley. It fits onto the emergency extension crank square drive socket located below the wing flap emergency extension access door.

Wing Flap Motor Bypass Valve.

The wing flap motor bypass valve (2, figure 1-37) permits hydraulic fluid to circulate through the hydraulic flap motor preventing a hydraulic lock during emergency wing flap extension. Turning the control valve counterclockwise opens the valve. (Refer to Section III for emergency procedures.)

Wing Flap and Landing Gear Position Indicator.

The wing flap and landing gear position indicator (28, 31, figure 1-7) is dc operated and is located on the pilots' center instrument panel. The upper portion of the indicator shows flap position by illustrating a flap in the UP, DOWN, or intermediate positions. The DOWN position corresponds to 100% extension. The lower portion of the indicator shows landing gear position.

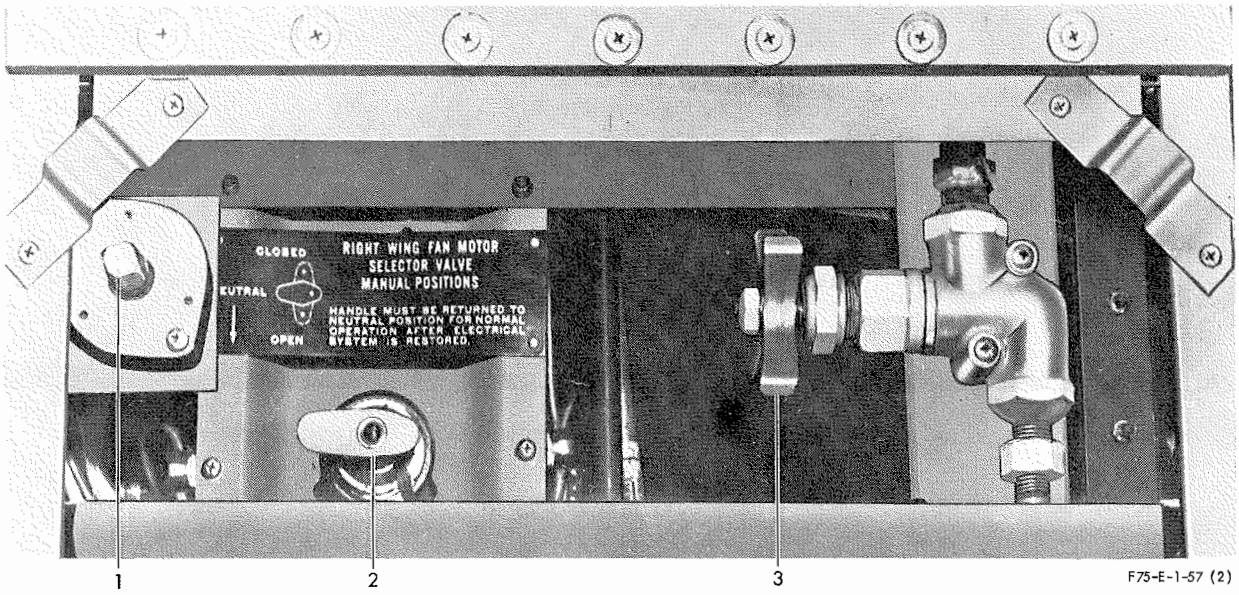
Wing Flap Asymmetry Indicator.

The wing flap asymmetry indicator (13, 14, figure 1-7) is operated by 26-volt ac current and is located on the copilot's instrument panel adjacent to the wing flap shutoff valve test switch. It is a dual indicator, placarded UP and DOWN, showing the position of each wing flap.

LANDING GEAR SYSTEM.

The aircraft is equipped with a fully retractable, tricycle landing gear. When the gear retracts, the nose gear pivots aft into the underside of the fuselage, and the main gears pivot forward into the nacelle wheel wells. Landing gear doors, which are mechanically operated by the gear oleo pneumatic shock struts, lie flush with the airplane contour when the gears are retracted. The secondary hydraulic system provides hydraulic pressure to operate the uplocks, downlocks and actuating cylinders which extend and retract the landing gear. The nose and main gears have oleo pneumatic shock struts which utilize air and hydraulic fluid to give controlled resistance to taxiing, takeoff and landing shocks. Dual wheels are mounted on each landing gear shock strut. The nose gear wheels are cambered 12 degrees to help

TC-121C. WING FLAP EMERGENCY EXTENSION CONTROLS



1 WING FLAP EMERGENCY OPERATION DRIVE

2 RIGHT WING FAN MOTOR SELECTOR VALVE

3 WING FLAP MOTOR BY-PASS VALVE

Figure 1-37 (Sheet 2 of 2)

forward castering. A centering saddle cam is built into the nose gear shock strut to align the gear when there is no weight on it. Scissor links keep the landing gear shock strut pistons and cylinders in alignment. For ground handling, the nose gear scissor link may be quickly disconnected by removing the center pivot bolt.

LANDING GEAR HYDRAULIC SYSTEM.

(See figure 1-38.)

A cable-actuated hydraulic selector valve, located in the aft end of the forward cargo compartment, directs secondary hydraulic system pressure to either the retracting or extending end of the landing gear actuating cylinders and to the uplocks or downlocks. The main gear actuating cylinders, which are located on each upper drag strut assembly, have a run-around valve which allows hydraulic fluid to pass from one side of the actuating cylinder pistons to the other without returning the fluid to the hydraulic reservoir when the gears extend, thereby reducing operating time. The right wing secondary heat exchanger fan motor receives hydraulic fluid from the secondary hydraulic system. On later aircraft, USAF Serials 55-118 and subsequent, the right heat exchanger fan motor receives pressure directly from the No. 4 engine-driven hydraulic pump. Normally, the motor is shut off by a main gear scissors switch when the right strut is extended during takeoff. In the event of failure of this switch, landing gear operating time may be increased because the flow of fluid to the fan motor will tend to starve the landing gear system.

EMERGENCY LANDING GEAR EXTENSION.

In the event that the secondary hydraulic system does not supply sufficient pressure, the landing gear can be extended by means of a hand pump system. Hydraulic fluid for the hand pump is taken from an emergency extension hydraulic reservoir and is directed to the uplocks, gear actuating cylinders, and downlocks through separate hydraulic lines. No emergency means is provided for gear retraction. The hydraulic system crossover valve provides means of extending and retracting the landing gear in the event normal secondary hydraulic system pressure is not available. (Refer to Hydraulic System Crossover Valve, this section.)

MAIN GEAR DRAG STRUTS.

The main gear drag strut assembly consists of an upper and lower drag strut. The upper strut is composed of two rigid triangular forgings, which are bolted together with pivot points at each end. The lower drag strut is a hydraulic cylinder that absorbs forward and aft shock loads of landing and taxiing by the combined action of

LANDING GEAR HYDRAULIC SYSTEM

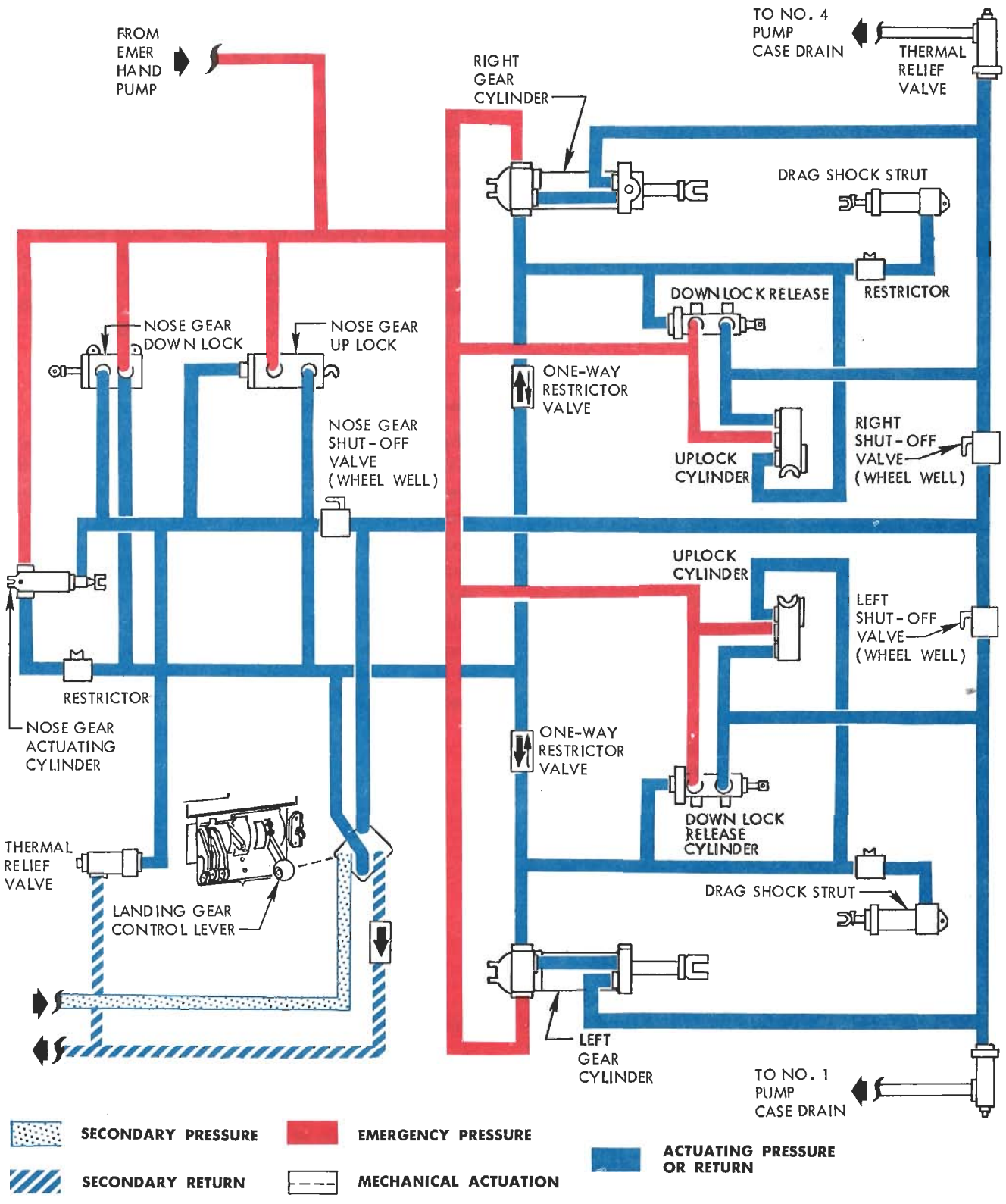


Figure 1-38

an internal spring and a metering orifice. There is no circulation of fluid through the lower drag strut, but when the landing gear lever is in the DOWN position, pressure from the secondary hydraulic system is used to maintain hydraulic fluid in the lower drag strut.

UPLOCKS.

The main gear uplocks are mechanically latched to the landing gears which trip the uplock triggers when they are completely retracted. The locks are released by hydraulic pressure and are held open by springs and pressure as the gear extends. The nose gear uplock operation is similar to that of the main gear. The gears cannot be released from the uplocks by maneuvering loads.

DOWNLOCKS.

When each main gear is in the down position, a downlock strut prevents the drag strut from folding. One end of the downlock strut connects to the pivot that connects the upper and lower drag struts, and the other end hooks over a lock shaft mounted in the wheel well. A spring-loaded latch in the hook prevents disengagement except by operation of a hydraulic downlock release cylinder. The nose gear downlock is a mechanical cam that locks the drag strut in the extended position. The gear connot retract until the cam is released by the nose gear downlock release hydraulic cylinder.

GEAR PINS.

When the aircraft is parked, ground safety pins must be inserted through the downlock mechanism (figure 1-39). These pins will prevent accidental folding of the gears should inadvertent downlock release occur because of mispositioning of the landing gear lever when secondary hydraulic system pressure is available. These pins cannot be removed if hydraulic pressure is directed to the upside of the cylinders.

Landing Gear Lever and Solenoid Lock Release.

The landing gear lever (21, figure 1-11) is located on the right aft face of the center control stand and actuates the landing gear selector valve by control cables. It has three positions, UP, DOWN and NEUTRAL. The lever is moved to the UP position to retract the landing gear and to the DOWN position to extend it. There is a detent in the NEUTRAL position (midway between the UP and DOWN positions). The landing gear lever must be pulled out to move it toward the UP position. The release trigger to the right of the lever must be held toward the lever to move it past the NEUTRAL position and into the UP position. After the landing gear has been retracted, the lever should be moved to the NEUTRAL position to decrease the possibility of leaks occurring in the landing gear system during flight by shutting off unnecessary hydraulic pressure. The uplocks and downlocks are automatically positioned by hydraulic pressure. The uplocks hold the gear in the retracted position. When the landing gear is extended, the landing gear lever must left in the DOWN position so that hydraulic pressure in the actuating cylinders will supplement the downlocks. A solenoid lock prevents accidental movement of the lever to the UP position when the weight of the aircraft is on the gear. The solenoid lock is operated by a dc series circuit through both main gear scissors switches. The solenoid lock may be released manually by depressing the landing gear lock solenoid lock release which is accessible through a hole in the right side of the center control stand.

Emergency Hand Pump and Selector Lever.

The emergency hand pump and selector lever (figure 1-33) are located on the flight station floor outboard of the copilot's seat. The selector lever has two positions, EMER BRAKE and EMER GEAR. When the selector lever is in the EMER GEAR (aft) position, the hand pump may be used to supply pressure through independent emergency extension lines to the uplocks, actuating cylinders and downlocks, provided the landing gear lever is in the DOWN position to permit return fluid to flow to the reservoir. The selector lever is spring-latched to the EMER BRAKE (forward) position.

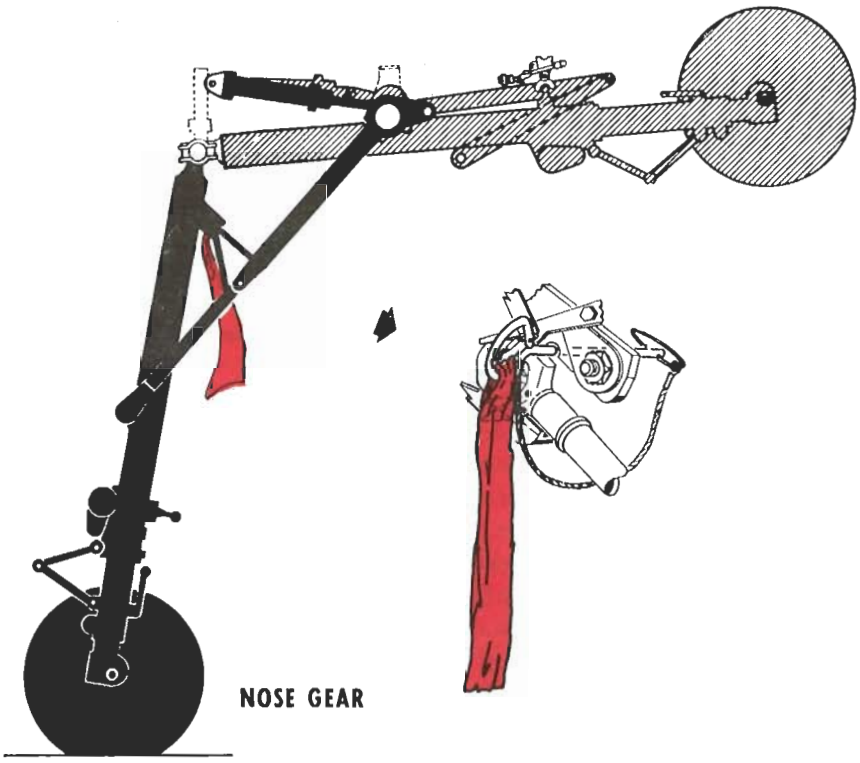
Note

If the emergency hand pump selector lever is in the EMER GEAR position and normal hydraulic pressure is available, it may not be possible to retract the landing gear since hydraulic pressure cannot return from the down side of the landing gear actuating cylinders.

Landing Gear Position Indicators.

A combination landing gear and wing flaps position indicator (28, 31, figure 1-7) is located on the pilot's center instrument panel. This indicator shows, individually, the position of all three wheels. When the word UP appears in an indicator window, the landing gear is up and locked. When the picture of a wheel appears, the gear is down and locked. When a red and white flag appears, the gear is somewhere between the two positions or the aircraft dc electrical system is inoperative.

LANDING GEAR SAFETY PINS



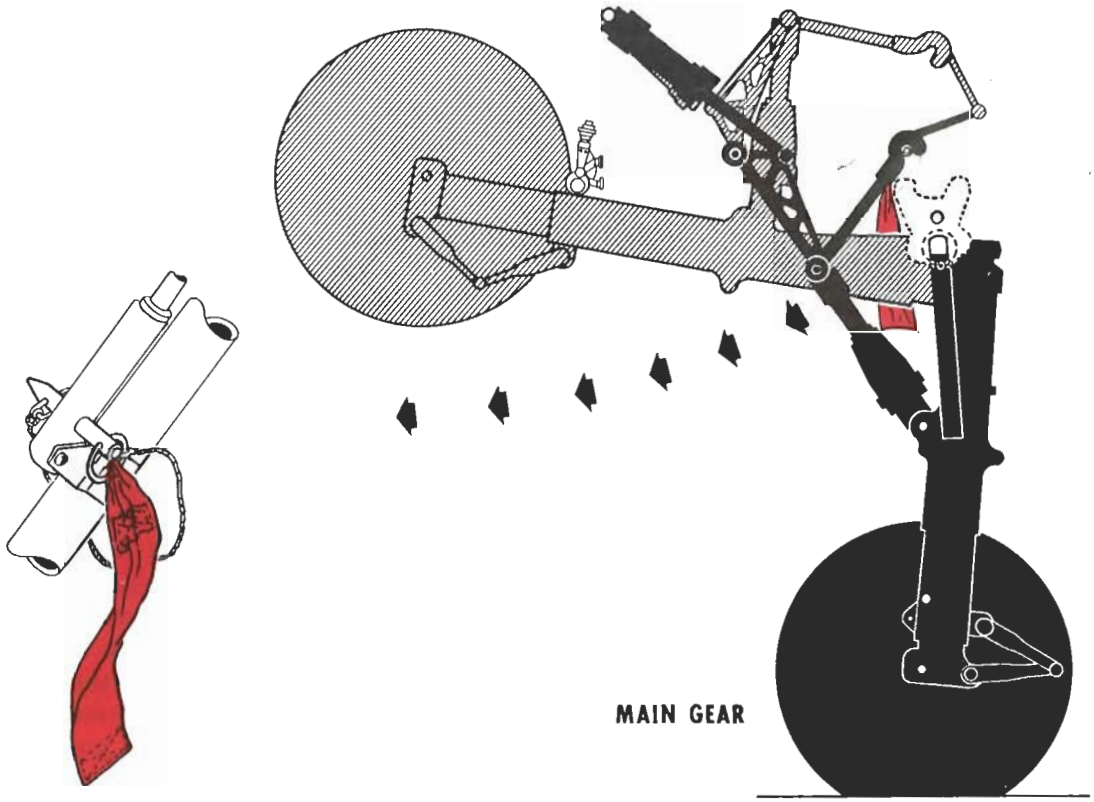


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Figure 1-39

NOSE GEAR HYDRAULIC STEERING SYSTEM

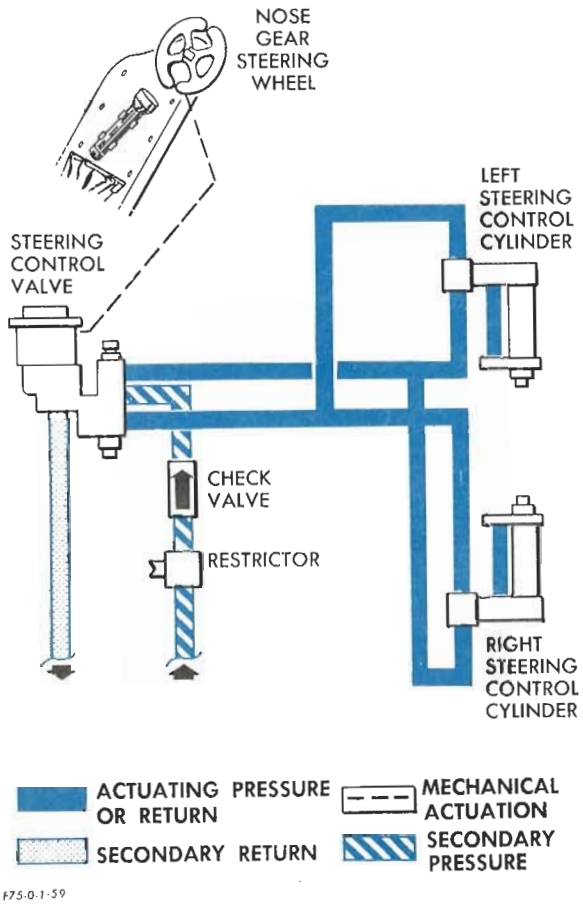


Figure 1-40

Landing Gear Warning Light.

This light (27, 30, figure 1-7) is located near the landing gear position indicator. The dc light glows (red) whenever the landing gear is in an unlocked or an unsymmetrical position. It goes out when all gears are in the full retracted position or the extended and locked position. The "push-to-test" feature of this light is not operative when the gears are down and locked.

Landing Gear Warning Horn and Release Lever.

A landing gear warning horn is operated by four throttle switches connected in parallel, and the unlock contacts of the downlock switches are also connected in parallel. This horn will sound if one or more of the throttles is retarded beyond a critical setting and all gears are not down and locked. The landing gear warning horn can be silenced either by locking the landing gear down, by advancing the throttles, or by raising the horn release lever, located on the left side of the center control stand. If the horn has been silenced by the release lever, the dc circuit will be reset when the throttles are advanced. On USAF Serials 52-3425 and subsequent, a switch is installed in the wing flap follow-up mechanism and is wired in parallel with the landing gear warning horn throttle switches. (Refer to Wing Flap Lever, this Section.)

NOSE GEAR STEERING SYSTEM.

When the nose gear is extended it can be turned by the small control wheel located on the left side of the pilot's station. Turning the control wheel operates the control cables which actuate the steering control valve. This valve directs secondary hydraulic system pressure to the left or the right steering control actuating cylinder to turn the nose gear. (Refer to figure 1-40.) The control wheel must be held to keep the nose gear turned and, when the wheel is released, the nose gear will return to the neutral (central) position. Approximately 1½ turns of the control wheel will deflect the nose gear approximately 58½ degrees, either side of center. When the nose gear is turned that amount, the inside main gear shock strut will turn on a radius of 12 feet. Oscillations are dampened by orifices in the steering control actuating cylinders that restrict the flow of hydraulic fluid; these cylinders serve as shimmy dampers when the nose gear is in the neutral position. The control wheel folds along its diameter so that it will clear full forward and aft movement of the pilot's control column. A shut-off valve in the hydraulic line is linked to the nose gear strut to shut off hydraulic pressure to the steering control valve when the nose gear is approximately 37 degrees from the fully retracted position.

BRAKE SYSTEM.

(See figure 1-41.)

Each of the four main landing gear wheels is equipped with an inner and an outer hydraulically powered brake. These brakes are actuated by the pilot's and copilot's toe pedals which, when depressed, meter hydraulic fluid through either the normal brake system or the emergency brake system. The two systems employ separate valving and plumbing between the brake selector valve and the shuttle valves. The normal brake system is operated by secondary hydraulic system pressure. The emergency brake system also is operated by secondary hydraulic system pressure and, in addition, may be operated by accumulator pressure. If neither secondary hydraulic system pressure nor accumulator pressure is available, and if time permits, the emergency brake system may

BRAKE SYSTEM

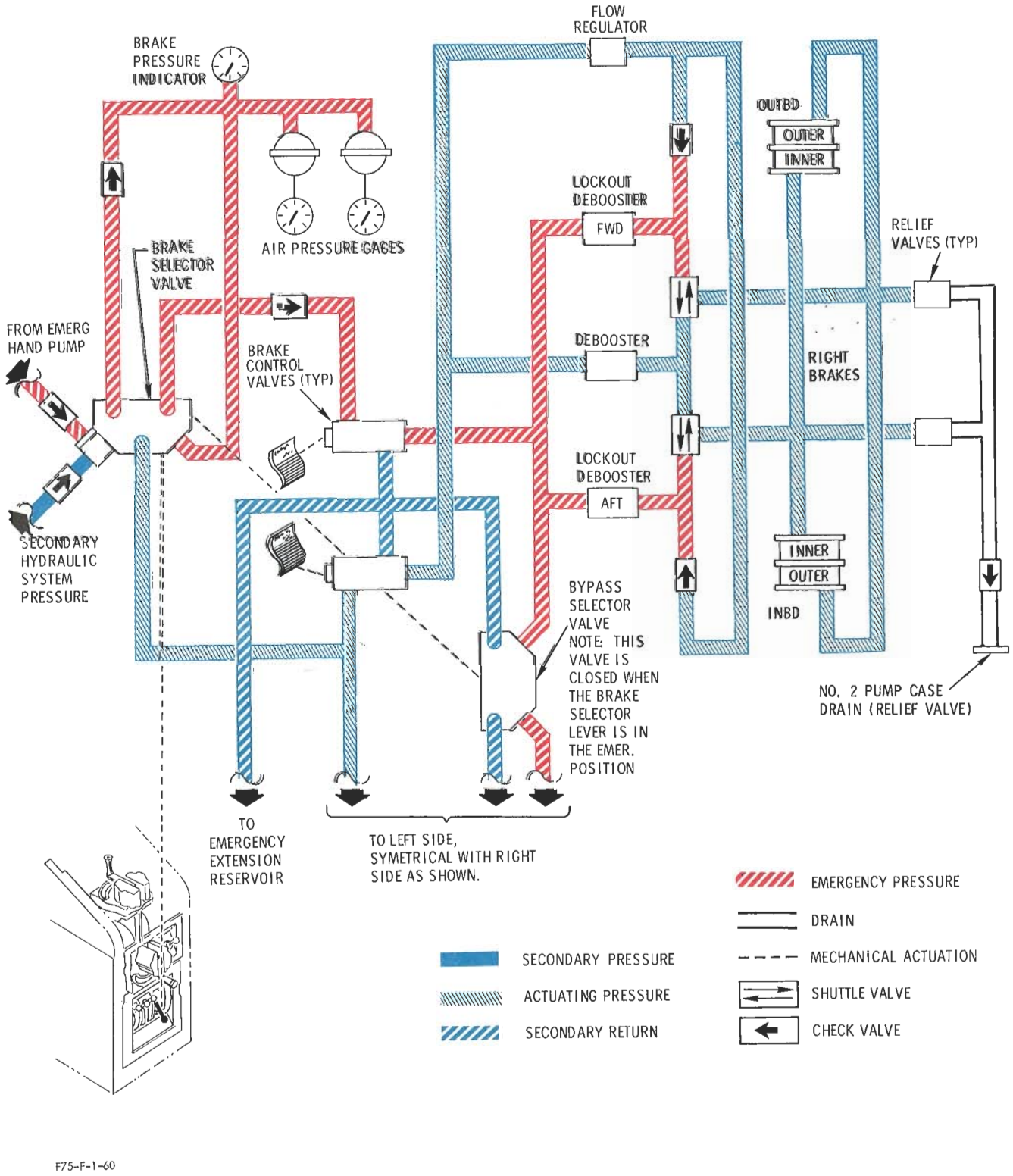


Figure 1-41

be operated by pressure supplied by the emergency hand pump. The hydraulic system crossover valve may permit normal operation of the brake system. The aircraft is equipped with an emergency brake lockout debooster bleed system which bleeds fluid from the normal brake system into the emergency brake system plumbing, downstream of the lockout deboosters, whenever the brakes are applied with the brake selector in the NORM position. The plumbing of this system precludes effective use of the emergency hand pump to operate the brakes with the brake selector in the NORM position. When the brake pedals are released, the excess hydraulic fluid returns from the brake control valves to the emergency extension reservoir.

NORMAL BRAKE SYSTEM.

The normal brake system is selected by placing the brake selector in the NORM position. When the toe pedals are depressed, pressure from the secondary hydraulic system is transmitted through the brake selector valve and through the normal side of the dual brake control valves to the deboosters. From the deboosters, pressure, reduced for optimum braking action, is transmitted through the shuttle valves to the brakes. Brake relief valves are installed, one in the outboard brake and one in the inboard brake common lines, to provide protection against excessive pressures in the common pressure lines that may damage the brakes.

EMERGENCY BRAKE SYSTEM.

The emergency brake system is selected by placing the brake selector in the EMER position. When the toe pedals are depressed, secondary hydraulic system pressure, accumulator pressure, or pressure supplied by the emergency hand pump is transmitted through the emergency porting of the brake selector valve and through the emergency side of the dual brake control valves to the lockout deboosters. From the lockout deboosters, pressure, reduced to the optimum for braking action, is transmitted through the shuttle valves to the brakes. There are two lockout deboosters for each pair of wheels. They differ from the deboosters in the normal brake system in that they isolate the low pressure section of the brake system from the high pressure hydraulic system. Each lockout debooster controls one of the dual brakes on each wheel, thus insuring hydraulic pressure to one brake on each wheel in the event of a leak downstream from the other lockout debooster. With secondary hydraulic system pressure available, brake operation with the brake selector in the EMER position is similar to operation with the brake selector in the NORM position except that secondary hydraulic system pressure is directed to the brakes through the emergency system valving and plumbing instead of through the normal brake system. Without secondary hydraulic system pressure, but with accumulator pressure, brake operation with the brake selector in the EMER position is also similar to operation with the brake selector in the NORM position, except that accumulator pressure, instead of secondary hydraulic system pressure, is directed to the brakes through the emergency system valving and plumbing, and the number of brake applications is limited by the pressure store din the accumulators as indicated by the emergency brake pressure gage. When the accumulators are the sole source of pressure, some pressure should be maintained in the accumulators during braking by operating the emergency hand pump with the brake selector in the EMER position.

In the event that neither the primary nor the secondary hydraulic systems is available, the emergency hand pump system may be used. If the two main hydraulic power sources fail, hydraulic pressure to operate the brakes can be built up with the emergency hand pump with the brake selector in the EMER position. In this configuration, pressure from the emergency hand pump is directed to the brakes through the emergency brake system valving and plumbing. This procedure should be used as a last resort because of the time required to build up pressure manually.

Brake Pedals.

The brakes are controlled by the toe portion of the rudder pedals, which are connected to the brake control valves. The pilot's and copilot's brake pedals are interconnected by cables. Slack take-up springs are installed on each cable to take up the slack when the brake pedals are applied. The linkage is so arranged that the toe pedals can be depressed 5° before pressure is fed to the brakes. As the pedals are depressed beyond 5°, the pressure increases. The rudder pedals are hinged, and geometry of the linkage is such that pedal movement for rudder control does not actuate the brake valve unless the pedals are tilted forward by toe pressure.

Parking Brake Handle.

There are two parking brake handles, (figure 1-42) one on each side of the center control stand. They are both connected to a lever at the rear of the control stand. With the parking brake handle in the lowered position, the parking brake is off. When raised after the toe pedals have been depressed, the mechanical linkage holds the brake valves in the open position. The parking brakes are released by depressing the toe pedals.

TYPICAL PARKING BRAKE LEVER AND VENTILATION DAMPER

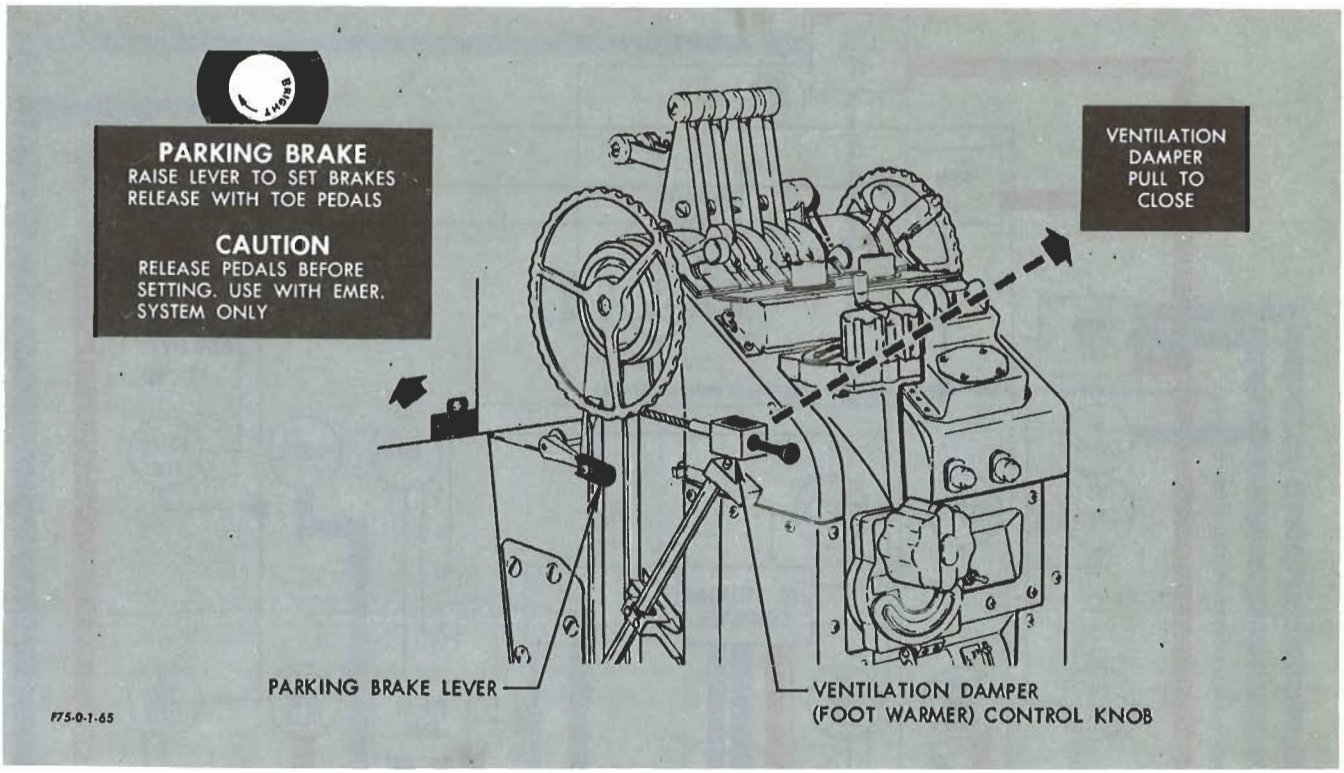


Figure 1-42

Brake Selector Valve Lever.

The brake selector valve lever (22, figure 1-11) is located on the aft face of the center control stand and has two positions, NORM (down) and EMER (up). This lever is mechanically connected to the brake selector valve which directs hydraulic pressure through the normal or emergency hydraulic brake lines. When the lever is in the NORM position and the brake pedals are depressed, secondary hydraulic system pressure is directed to the normal brake lines. When the lever is placed in the EMER position while secondary hydraulic system pressure is available, the brake accumulators are charged and hydraulic fluid flows through the emergency brake lines. If secondary hydraulic system pressure is not available, the hydraulic power necessary to operate the brakes is provided by the charged brake accumulators or by operating the emergency hand pump (which charges the brake accumulators when the brake selector lever is in the EMER position).

CAUTION

Do not shift the brake selector from NORM to EMER, or from EMER to NORM position with brake pedals depressed because pressure surges may damage the brake system.

When the engines are shut down, normal secondary system pressure drops; therefore, the EMER position must be selected to provide constant pressure to the brakes.

Emergency Hand Pump Selector Valve Lever.

The emergency hand pump selector valve lever (figure 1-33) is located near the base of the emergency hand pump to the right of the copilot's seat. The lever is placarded EMER BRAKES (forward) and EMER GEAR (aft). The lever normally is in the EMER BRAKES position, and must be in this position when the emergency hand pump is used to supply emergency brake pressure.

Parking Brake Indicator Light.

A parking brake indicator light (32, 35, figure 1-7) is located on the pilot's instrument panel and is operated by a microswitch that is actuated by the parking brake lever.

CAUTION

The parking brake warning light merely indicates that the parking brake handle is raised and does not indicate that the brakes are locked sufficiently to keep the aircraft from rolling.

EC-121D. FLIGHT INSTRUMENT ELECTRICAL POWER SYSTEM

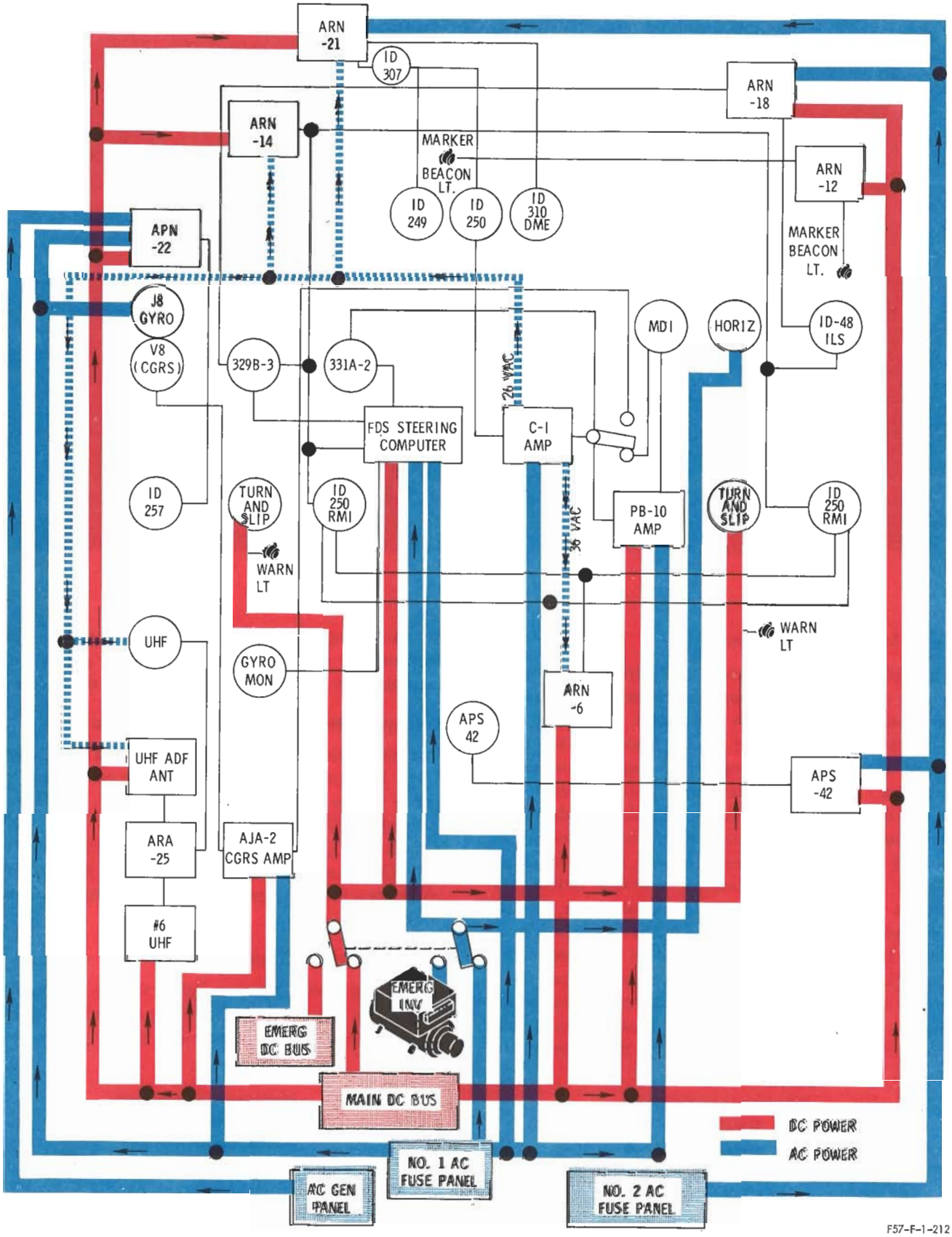


Figure 1-43

Emergency Brake Pressure Indicator.

The emergency brake pressure indicator (20, 22, figure 1-7), located on the copilot's auxiliary instrument panel, is a direct pressure instrument calibrated in psi and actuated by hydraulic pressure in the lines near the brake accumulators.

INSTRUMENTS.

Instruments are grouped on the pilot's, flight engineer's, and the navigator's instrument panels and on the air conditioning control panel. The instruments that are not discussed in the following paragraphs are those that are a part of a complete system and are discussed with the appropriate system.

ALTIMETERS.

On EC-121D aircraft seven sensitive altimeters are mounted in the aircraft. One is located on the air conditioning control panel; the other six are installed at the pilot's, copilot's, height finder's, senior weapons controller's flight engineer's upper and navigator's instrument panels. On TC-121C aircraft five sensitive altimeters are mounted in the aircraft. One is located on the air conditioning control panel; the other four are installed at the pilot's, copilot's, flight engineer's upper and navigator's instrument panels. The altimeters include an extended 10,000 foot pointer incorporating a notched disc warning indicator. At altitudes below 16,000 a striped section will appear through the notched disc. The modified altimeters improve the readability of the 10,000 foot pointer and provide a constant reminder when the aircraft altitude is less than 16,000 feet.

Note

It is possible to misset standard altimeters in USAF use by 10,000 feet. When the barometric set knob is continuously rotated after the baro scale is out of view, the numbers will reappear in the Kollsman window from the opposite side. If the correct altimeter setting is then established, the altimeter will read approximately 10,000 feet in error. As a preflight check, special attention should be given to the altimeter to assure that the 10,000 foot pointer is reading correctly.

The altimeters have a range of 50,000 feet altitude and a ground setting scale marked in inches of mercury.

AIRSPEED INDICATORS.

Airspeed indicator are mounted on the pilot's, copilot's, flight engineer's, and navigator's panels. On EC-121D aircraft an additional airspeed indicator is mounted on the senior weapons controller's panel. They are all calibrated in knots.

VERTICAL VELOCITY INDICATORS.

An instrument that indicates vertical speed, climb, or descent, is mounted on the pilot's and copilot's instrument panels (23, 25, figure 1-7) and on the air conditioning control panel. The vertical velocity indicator on the air conditioning control panel indicates only the equivalent cabin pressure rate of change. The other two indicators show the aircraft rate of climb or descent in feet per minute.

FLUXGATE HEADING INDICATOR.

The fluxgate heading indicator is located on the copilot's instrument panel (14, 15, figure 1-7) and indicates the magnetic heading of the aircraft. The azimuth dial is directly connected through gears and linkage to an induction motor which operates both directionally and proportionally to changes of the magnetic heading of the aircraft. The gyro fluxgate transmitter, mounted in the left outer wing, senses the aircraft heading changes, because of its change of position in the earth's magnetic field and transmits an electrical signal to the fluxgate heading indicator. The sensing signal of the fluxgate transmitter also originates a course signal impulse for the automatic pilot control. (Refer to Automatic Pilot Controls, Section IV.) Power for operation of the fluxgate heading indicator system is supplied by the aircraft ac and dc electrical system.

ATTITUDE INDICATOR.

An attitude indicator (6, 10, figure 1-7), powered by alternating current, is mounted on the pilot's and copilot's instrument panels. Each indicator is an electrically driven vertical seeking gyro, coupled with a bank pointer, and a horizon bar. A pitch trim knob on the instrument provides adjustment of the miniature aircraft to correspond to different pitch attitudes. Quick erection of the gyro is accomplished in this indicator by means of a mechanical caging device. The gyro must be caged immediately after power is applied to the indicator by pulling out the caging knob on the front bezel. The knob should be held in the extended position until the horizon bar and the bank pointer cease to oscillate, at which time they should indicate zero roll and pitch within approximately three degrees. The caging time will depend upon the position of the gyro; however, the longest time will be approximately ten seconds. Instantaneous erection may be obtained by holding the caging knob in the extended position when the power is turned on.

WARNING

Before take-off erect gyro in the right side up position. Failure to do so will give reverse indication on the pitch axis. Since the caging device cages the gyro to the true attitude of the aircraft and not to the true vertical, the indicator should not be caged in flight unless the aircraft is known to be in straight and level flight during the caging procedure.

The indicator is equipped with an attitude warning flag that is visible whenever the power supply is shut-off, whenever there is an improper-phase rotation, or whenever there is an open or short circuit in the instrument. The flap will disappear under normal circumstances, indicating that the power supply is on and is satisfactory.

WARNING

The pilot should not rely upon the indicator for flight indications if the attitude warning flag is visible in the face of the instrument.

TURN & SLIP INDICATOR.

A turn and slip indicator (26, 28, figure 1-7) is mounted on the pilot's and copilot's instrument panels. The indicators are powered by direct current. Power failure warning lights (25, 27, figure 1-7), that glow red when the electrical power is interrupted, are installed on the pilot's and copilot's instrument panels.

CGRS HEADING INDICATOR (EC-121D).

There are three Central Gyro Reference System (CGRS) heading indicators installed in the aircraft. They are located, one on the pilot's instrument panel, (4, figure 1-7) one on the navigator's instrument panel and one on the senior weapons controller's instrument panel. The CGRS heading indicator indicates the magnetic or directional gyro heading depending upon the mode of CGRS operation. It has a dial face calibrated from zero to 360 degrees. The dial face is set by a knob on the indicator. It has a single centrally pivoted pointer, and is actuated by electrical signals from the CGRS system.

COMPASS (G-2) (TC-121C).

The G-2 compass system provides an accurate, stabilized indication of the aircraft heading through 360 degrees of azimuth and operates on the combined principals of the gyroscope and the magnetic compass. The pilot's master heading indicator is located on the pilot's instrument panel (4, figure 1-7), and a compass repeater indicator is located on the navigator's instrument panel (1, figure 4-51). The indicator has two azimuth dials. The smaller of the two is mounted in the center of the instrument and is actuated by electrical impulse from a remote compass transmitter, located in the right outer wing. The large azimuth dial is actuated by an electrically operated gyro and is set by a knob on the indicator to correspond with the small dial. A G-2 COMPASS switch (34, figure 1-7) is mounted on the pilot's instrument panel and has two positions, COMPASS CONTROLLED and FREE D.G. When the switch is placed in the FREE D.G. position, the small dial is disconnected from the system, and the large dial may be set independently. The G-2 compass signal system utilizes ac electrical power for its operation, and the vacuum tubes in the set are heated by dc electrical power.

MAGNETIC COMPASS.

The magnetic compass is mounted above the center windshield panel. It contains a graduated card that reads in degrees and indicates the direction of flight with reference to magnetic north. A compass correction card is mounted on the pilot's and copilot's auxiliary instrument panels and each card shows compass deviation corrections.

FREE AIR TEMPERATURE INDICATOR.

An air temperature indicator is mounted on the pilot's, flight engineer's upper and the navigator's instrument panels. The indicators are energized by dc electrical resistance bulbs located in the right side of the nose wheel well.

CLOCKS.

Eight-day clocks with sweep second hands are installed on the pilot's, copilot's, flight engineer's, navigator's, radio operator's and on EC-121D aircraft the senior weapons controller's panel. In addition the pilot's and senior weapons controller's panels are provided with elapsed time clocks.

INCLINOMETERS.

On most EC-121D aircraft two inclinometers are installed, one on the flight engineer's lower instrument

panel (1, figure 1-15) and one at the height finder's station (1, figure 4-33). On TC-121C aircraft one is installed at the flight engineer's station. The instruments are ball-bank type and indicate the pitch attitude of the aircraft about the lateral axis.

PITOT-STATIC SYSTEM.

The pitot-static system includes the pitot system through which impact air pressure is transmitted to the airspeed indicators and the static system through which outside static air pressure is transmitted to the altimeters, airspeed indicators, vertical speed indicators, cabin differential pressure indicator, and altitude control of the automatic pilot (figure 1-44).

PITOT SYSTEM.

Two separate pitot systems are provided, each of which includes a pitot head installed on the lower fuselage nose. The left pitot head supplies impact air pressure for the pilot's, navigator's and on EC-121D aircraft senior weapons controller's airspeed indicators. The right pitot head supplies impact air pressure for the copilot's and the flight engineer's airspeed indicators.

STATIC SYSTEM.

Flush-type static openings on each side of the fuselage nose are the source of static air pressure. Two separate systems, first static and second static, are installed to provide separate and alternate static selection to both the pilot and copilot in an emergency. The selection of either system is controlled by the static selector valves (24, 26, figure 1-7) on the pilot's and copilot's instrument panels. Two separate sources are available to either the pilot's or copilot's instruments.

EMERGENCY EQUIPMENT.

The following equipment consists of fixed systems and loose equipment that contribute to safety of flight.

EMERGENCY SHUTOFF LEVERS.

Four emergency shutoff levers are located on the control quadrant aft of the pilot's overhead panel. These levers actuate valves that shut off hydraulic oil, fuel, generator blast air, and lubricating oil to the engines. Each lever has four notched positions on the control quadrant. The full forward position is ALL ON; the next position shuts off hydraulic oil; the third position shuts off fuel and generator blast air; the last and full aft position shuts off engine oil. However, oil is still available for feathering the propeller. These levers mechanically operate cam arrangements through cable and pulley systems, which in turn actuate the hydraulic,

PITOT STATIC SYSTEM

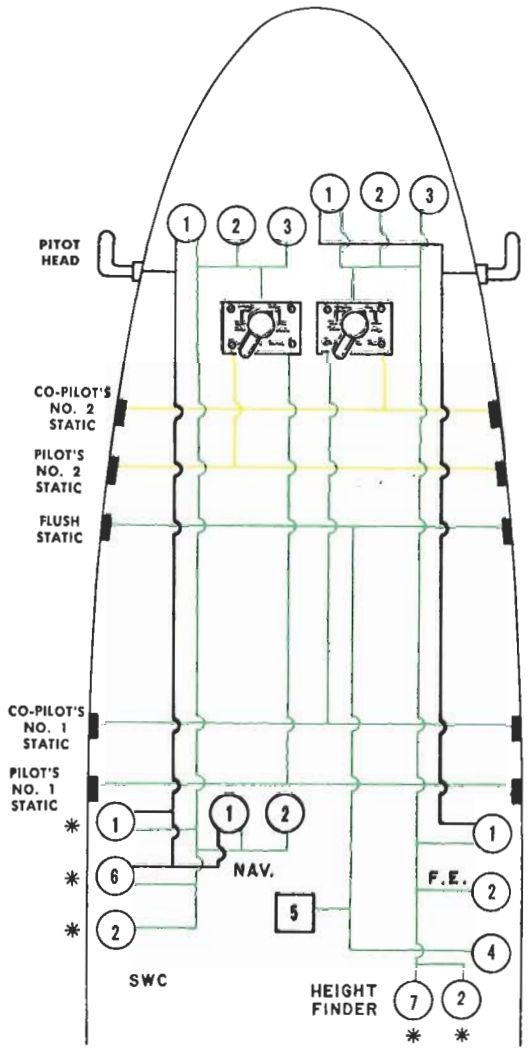


Figure 1-44

FIRE EXTINGUISHING SYSTEM (CO_2)

(USAF SERIALS 51-3836 THRU 51-3841, 51-3843 THRU 51-3845 AND 52-3411 THRU 52-3425)

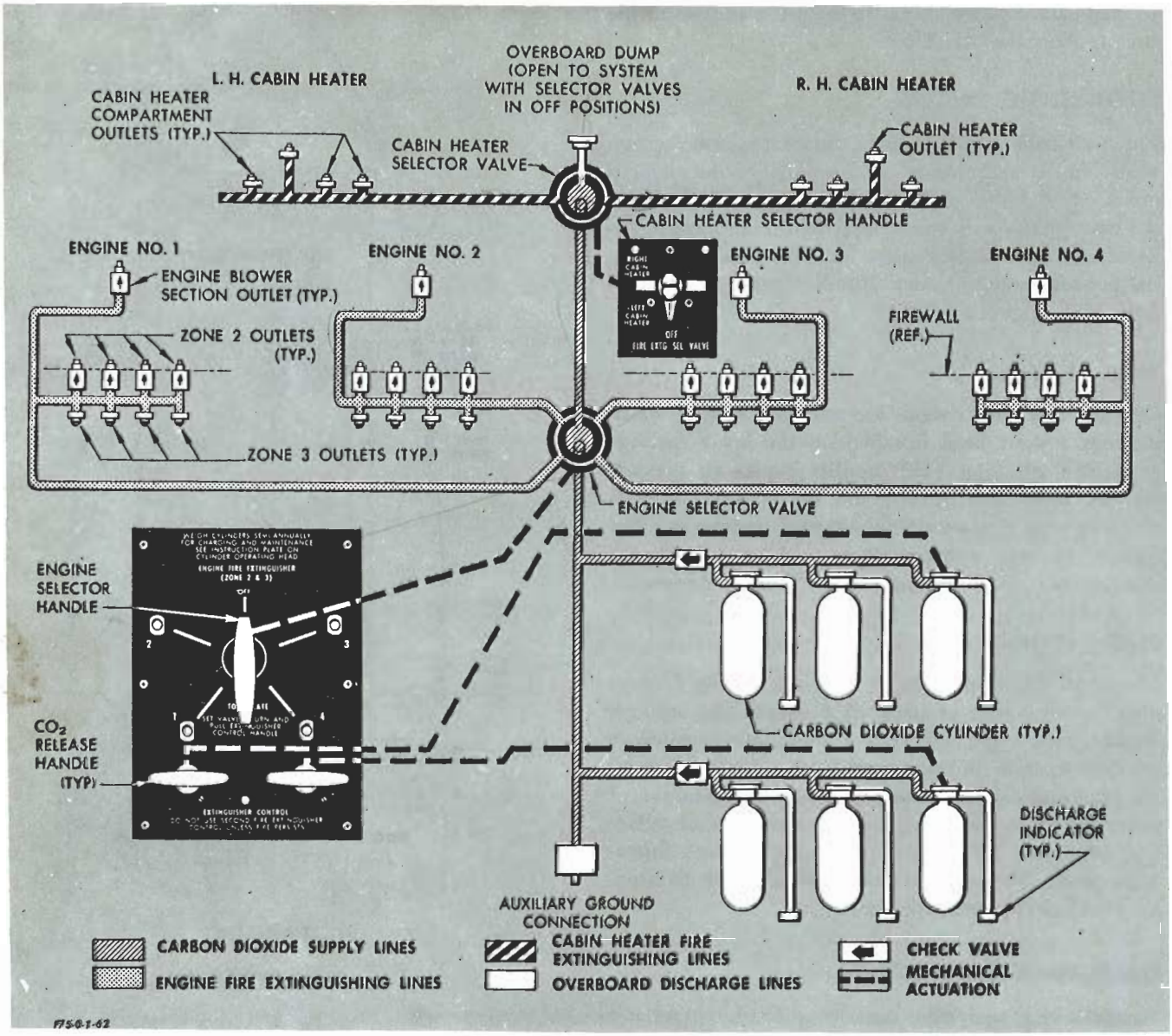


Figure 1-45

fuel, and oil shutoff valves. As the lever enters the third position on the quadrant, it trips a switch that energizes a small dc electrical actuator, mounted on the aft face of the firewall, that shuts off the blast air.

FIRE DETECTION SYSTEM.

Heat-sensitive fire detector switches are installed in each zone of all engine nacelles and in each cabin heater compartment. These switches close and complete the electric circuits to the fire warning buzzer if the temperature in any of these areas rises to the setting of the switches. The switches in zone 1 are set at approximately 316°C (600°F) and all other switches are set at approximately 232°C (450°F). On aircraft incorporating T.O. 1C-121-735 the switches in zone 1 are set at approximately 400°C (750°F). They reset themselves automatically after cooling below this temperature. Each circuit is a double loop with two-wire (ungrounded) detectors in parallel between the loops. There is one circuit for zone 1 and one circuit for zones 2 and 3 of each nacelle. There is also one circuit for each cabin heater installation. A resistor is connected in parallel with each individual area warning light and master relay coil, so that the system will not be rendered inoperative by a defective bulb or a master relay coil open circuit. If a short to ground occurs any place in the fire warning system, the circuit breaker will trip to prevent any false warning and neither the warning lights nor

the warning buzzer will operate. A short circuit within the detector switches will activate both buzzer and lights. There is one test switch for each nacelle and one for both of the heaters. These switches break both loops and connect them in series around the fire detector switches.

Master Fire Warning Lights and Buzzer.

A master fire warning light is located in the top center of the pilot's instrument panel (11, 12, figure 1-7) and on the flight engineer's lower instrument panel (22, figure 1-15). The fire warning buzzer is located on the bulkhead behind the copilot's seat. These lights and the buzzer are energized simultaneously by the dc electrical system and actuated when one or more fire detector switches close. Each warning light can be tested by pressing its cap.

Individual Area Fire Warning Lights.

Zone 2 and 3 fire warning lights (dc operated) are located adjacent to the engine fire extinguisher selector handle on the station 260 bulkhead. Zone 1 engine fire warning lights are located on the station 260 circuit breaker panel. Fire warning lights for the left and right cabin heater compartments are located adjacent to the cabin heater fire extinguisher selector handle near the floor on the station 260 bulkhead. Each of the warning lights may be pressed to test. The master warning lights on the flight engineer's lower instrument panel and on the pilot's center instrument panel will glow, and the fire warning buzzer will sound whenever one or more of the area warning lights are energized, either for test or by fire. If an open circuit exists in the master fire warning circuit, the zone warning lights will still glow.

FIRE EXTINGUISHING SYSTEM (CO_2).

(USAF Serials 51-3836 through 51-3841, 51-3843 through 51-3845 and 52-3411 through 52-3425).

A two-shot fire extinguishing system (figure 1-45) is installed to extinguish fires in engine zones 2 and 3 and cabin heater compartments. The fire extinguishing system consists of two separately controlled groups of three cylinders of carbon dioxide, operating heads, two selector valves, cable controls, and a distribution system. The carbon dioxide cylinders are mounted on the right side of the forward underfloor area. Gas is released from each group of three cylinders when the seal of the master cylinder is broken. Pulling one of the fire extinguisher control handles on the station 260 bulkhead mechanically breaks the seal of the master cylinder in the selected group, and the pressure released from the master cylinder actuates pistons that puncture the seals of the other two cylinders in that group. Once the gas charge in the master cylinder has been released, the charges in all of the cylinders in that group are released. A safety disc is provided in the head of each cylinder which will break and allow the cylinder to discharge if the pressure becomes too high because of overcharging or excessive heat. The safety discharge ports terminate in the right side of the fuselage forward of the wing and each is capped with a red celluloid seal. An auxiliary ground connection is located on the right wall of the nose wheel well to permit attachment of a ground CO_2 supply which is directed to the selector valves in the same manner as the aircraft CO_2 supply. However, the release must be accomplished by the ground operator. This auxiliary ground connection is installed to provide a greater CO_2 supply than the standard installation.

Engine Fire Extinguisher Selector Handle.

The handle (figure 1-45) located above the station 260 circuit breaker panel has 1, 2, 3, and 4 numbered positions that correspond to the engine numbers, and an OFF position. Turning the handle remotely operates by control cables a disc-type selector valve, and connects the pressure line to the line leading to the selected engine. Normally, the handle is left in the OFF position. Each selector valve port is piped to a distributing tube mounted on the aft face of the firewall in each nacelle. Nozzles are attached to the tube to direct the carbon dioxide gas forward through the firewall into zone 2, and aft of the firewall into zone 3. An additional line is routed forward through the firewall and carries the carbon dioxide forward to the engine where it is injected into the induction section. There are no provisions for releasing carbon dioxide into zone 1.

Cabin Heater Fire Extinguisher Selector Handle.

The handle, located on the station 260 bulkhead near the floor, has the following three positions: LEFT CABIN HEATER, RIGHT CABIN HEATER, and OFF. The engine fire extinguisher selector handle must be OFF for CO_2 to reach the cabin heater fire extinguisher selector valve.

Fire Extinguisher Control Handles.

Two fire extinguisher control handles are located on the station 260 bulkhead below the engine fire extinguisher selector handle. Each fire extinguisher control handle, when pulled, releases one of the two

FIRE EXTINGUISHING SYSTEM (HRD)

(USAF SERIALS 53-533 AND SUBSEQUENT)

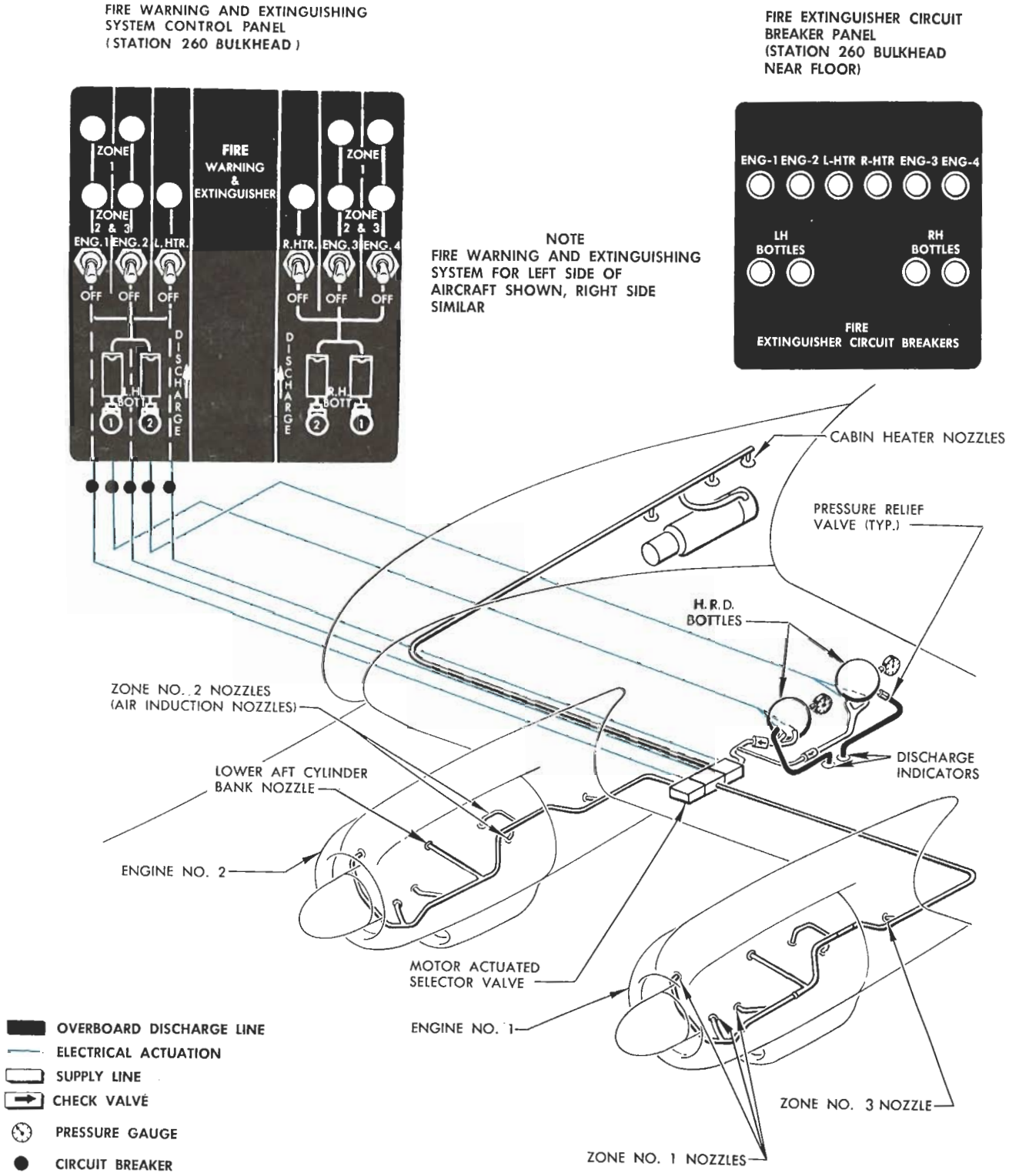


Figure 1-46

carbon dioxide charges available. If one charge, consisting of three bottles, is insufficient to smother the fire, the second shot may be released by turning and pulling the other handle. If either control handle is pulled when both selector handles are OFF, the CO_2 from the three bottles controlled by that handle will be discharged overboard.

HRD FIRE EXTINGUISHING SYSTEM (USAF Serials 53-533 and Subsequent).

A dc electrically operated two-shot high rate of discharge fire extinguishing system is installed in each wing to extinguish fires in engine zones No. 1, No. 2, No. 3 (engine induction system), and in the cabin heater compartments. The extinguishing equipment in each wing is a completely independent system. The fire extinguishing installation consists of four, separately controlled bottles of bromo-trifluoromethane. Two HRD bottles are mounted in each main gear wheel well. Gas is released from each bottle when the seal is broken. Placing one of the guarded discharge switches located on the station 260 bulkhead in the UP position electrically breaks the seal in the selected bottle. The selector switches provide independent selection of each engine and each cabin heater. Electric power for this system comes from the emergency d.c. bus and is them routed through the fire extinguisher circuit breaker panel located on the lower part of the 260 bulkhead.

Safety Valves.

A safety valve is provided in each bottle which will break and allow the bottle to discharge overboard if the pressure becomes too high because of overcharging or excessive heat. Two safety discharge ports terminate on the aft outboard side of each inboard nacelle, and each is capped with a red celluloid seal. If the bottle discharges the seal will break. A broken seal indicates that the system should be checked, the trouble corrected and the bottle replaced. Auxiliary ground connections that permit refilling of bottles are not provided in this system. Empty bottles are to be replaced with pre-filled bottles.

Engine Fire Extinguisher Selector Switches (HRD).

The selector switches (figure 1-46); located above the station 260 upper switch panel, are numbered ENG. 1, ENG. 2, ENG. 3, ENG. 4, representing the ON position. Each selector switch has an OFF position. Lifting the selector switches operates a remote, dc electric-motor-driven selector valve which connects the pressure line to the line leading to the selected engine. Normally, the switch is left in the OFF position. Each selector valve port is piped to a distributing tube routed to each engine. Nozzles are attached to the tubes to direct the agent simultaneously to zones No. 1, No. 2, and No. 3 Warning lights are located above the selector switches for the purpose of indicating fire in a particular engine and engine zone.

Cabin Heater Fire Extinguisher Selector Switch.

Two cabin heater fire extinguisher selector switches are mounted on the same panel with the engine selector switches, and have the following positions: L. HTR., R. HTR., and OFF. Warning lights are dc operated located above each switch for the purpose of indicating fire in each heater compartment.

Fire Extinguisher Control Switches.

Four, momentary-contact fire extinguisher control or discharge switches are located beneath the selector switches. Each discharge switch releases one bottle when the guard is raised and the switch turned on. If one charge, consisting of one bottle, is insufficient to smother the fire, the second bottle may be released by actuating the second guarded switch.

Individual Area Fire Warning Lights (HRD).

Fire warning lights (figure 1-46) for each nacelle are dc operated and cabin heater are located on the fire extinguisher electric control switch panel mounted on the station 260 bulkhead. These warning lights are arranged to indicate the presence of fire in each engine zone, 1, or 2 and 3, and each cabin heater. Each warning light may be pressed to test. The master warning lights on the flight engineer's lower instrument panel and on the pilot's center instrument panel will glow, and the fire warning buzzer will sound whenever one or more of the area warning lights is energized, either for test or by fire.

MISCELLANEOUS EMERGENCY EQUIPMENT.

(See figure 3-1.)

HAND FIRE EXTINGUISHERS (EC-121D).

Nine A-20 (bromocloromethane) type fire extinguishers are provided; one is clamped in supports on the left sidewall forward of station 260 in the flight station; one is clamped in the galley area right side at station 545; two are located forward of the radio operator clamped to station 545; one on the left sidewall at ACO No. 3 position; one is clamped to the forward side of the aft coat closet partition. Three extinguishers are located in the under floor area and are accessible through floor hatches. See figure 3-1.

HAND FIRE EXTINGUISHERS (TC-121C).

Eight A-20 (bromocloromethane) type fire extinguishers are provided: one is clamped to the flight engineer's chair; one is clamped in the galley area right side at station 545; two are located forward of the radio operator clamped to station 545; and (on some aircraft) one is clamped to the technician's table aft of the main cabin door. On other aircraft one is clamped to the forward side of the lavatory wall or on the left side wall forward of the main cabin door. Three extinguishers are located in the under floor area and are accessible through floor hatches. See figure 3-1.

WARNING

Prolonged exposure (5 minutes or more) to high concentrations (pronounced irritation of eye and nose) of Bromochloromethane (CB) or its decomposition products should be avoided. CB is an anesthetic agent of moderate intensity. It is safer to use than previous fire extinguishing agents (carbon tetrachloride, methylbromide). However, especially in confined spaces, adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

FIRE AXES.

On most aircraft three fire axes are provided, one on the left of station 260 bulkhead, one aft of station 545, forward of the radio operator, and one on the aft side of the aft coat closet partition. On some TC-121C aircraft the one at the technician's bench is not installed.

EMERGENCY LIGHTS.

Three dry-battery operated emergency lights, with integral switches, are installed. One is located on the ceiling of the flight station, and the other two are located on the cabin overhead duct opposite the navigator's station and the aft cabin door. These lights may be used to illuminate the doors or escape area during an emergency.

PARACHUTES (EC-121D).

Provisions for stowing parachutes are provided in the main cabin.

LADDER AND ESCAPE ROPES.

One telescoping metal ladder is installed on the left side at the aft personnel door.

WARNING

When the ladder is extended for use, be certain to check that the latching lugs are in place.

Four escape ropes are installed as follows: One over the upper station 260 switch panel, one over each emergency exit window, and one over the forward edge of the aft personnel door. (Refer to emergency equipment diagram, figure 3-1).

DITCHING PANELS.

On EC-121D aircraft ditching panels of metal-faced honeycomb construction are provided for five crewmembers at the following positions: aft face of the ACO Nos. 1, 2, and 4 consoles (one for each person), and two aft of the tables and benches in the aft crew quarters. On TC-121C aircraft three ditching webs are installed, one in the ceiling aft of the 260 station and two in the ceiling aft of the main cabin door. (For other ditching stations, refer to Section III.)

FIRST AID KITS.

Two first aid kits are located as follows: one on the flight station left sidewall, aft of the pilot's seat, and one on the aft face of the station 545 bulkhead.

LIFE RAFTS.

Two 20-man life rafts are installed. One is located in each inner wing panel, aft and outboard of the inner engine nacelles. A life raft release handle, (figure 3-8), is located in the window frames of the emergency exits over the wings. These handles are accessible after the windows have been removed. Pulling these handles automatically inflates the rafts and ejects them into the water. The rafts may also be released by pulling the handles in the wing life raft wells. On TC-121C aircraft additional rafts can be carried in the cabin area if necessary.

Life Raft Radio Transmitter.

One life raft radio transmitter (AN/CRT-3) is located on the floor beneath the right side emergency exit window.

EMERGENCY ALARM BELL AND COMMAND BELL SWITCH.

Two emergency alarm bells are installed, one on the forward AOC/cabin compartment bulkhead and one on the aft AOC/cabin compartment ceiling near the aft cabin door. The command bell switch is located on the pilots overhead switch panel and is guarded in the open position. When the guard is raised and the switch is closed, the command bells sound a warning. The electrical circuit is energized by the emergency dc bus.

PYROTECHNIC EQUIPMENT.

A pyrotechnic pistol and a container for carrying twelve rounds of ammunition are clipped to the partition forward of the radio operator's or navigator's station. A pressure trap mount is provided for firing the pyrotechnic pistol during pressurized flight and is located in the ceiling of the fuselage aft of the navigator's station.

WARNING

The pistol should be inserted into the pressure trap mount prior to loading it with the cartridge. This procedure will preclude accidental firing of the pistol inside the aircraft.

Flares.

Two flares may be installed in separate chutes located in the aft fuselage aft of the pressure bulkhead. Each flare is provided with a parachute which allows it to descend at the rate of approximately 360 feet per minute. Burning time of the flare is approximately three minutes and the light output is 300,000 to 400,000 candlepower. The release and triggering provisions consist of release switches, cover latch, lanyard and dc operated solenoids. When the release switches are actuated, the solenoid triggers the latch and the flare drops through the flare chute.

Note

The cover plate is a thin sheet of aluminum alloy and is pushed out by the weight of the falling flare.

The flare will not ignite, nor will the parachute be ejected if the release switch is inadvertently closed when the aircraft is on the ground, because the lanyard is long enough to permit the flare to drop to the ground without tripping the parachute release and flare ignition mechanism. In flight the flare falls a considerable distance below the aircraft before the parachute is ejected and the flare is ignited.

Flare Release Switches.

Flare release switches are located near the top and aft end of the pilot's side panel (1, figure 1-9). Guards cover the flare release switches and are safetied in the closed position. The circuit breaker is located on the station 238 circuit breaker panel.

Note

- Flares should be released at or near approach speeds to provide maximum illumination time.
- Flares have been successfully ejected up to and including 217 knots indicated airspeed.

ENTRANCE DOORS.

CREW DOOR.

The crew door is located on the right side forward of station 260. The door is opened from the outside by turning the exterior latch handle and pushing inward, then lifting upward. The door is opened from the inside by turning the interior latch handle, and pulling the door inwards then lifting upward. (Refer to Section IV for the rear entrance door).

CREW SEATS.

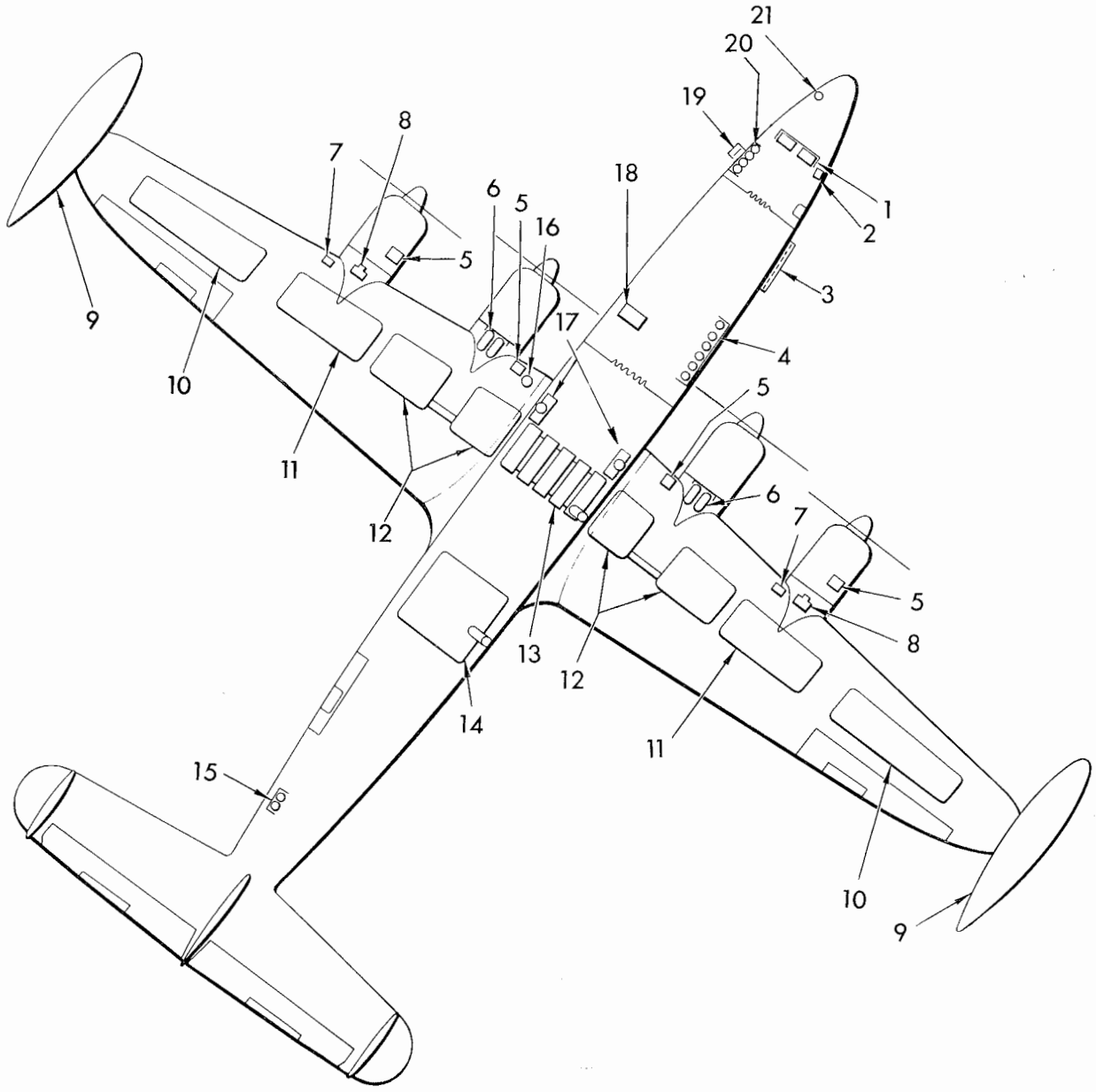
PILOTS' SEATS.

The pilot's and copilot's seats are track-mounted to provide fore-and-aft positioning. A small pin is attached to the seat for inserting in the track as an extra safety measure to prevent the seat from inadvertently slipping during take-off and landing. They have tilting backs, and are adjustable for height. Each seat is equipped with folding arm rests, a removable head rest and a shoulder harness connected to an inertia reel. The inertia reels are mounted on the backs of the seats.

Pilots' Seat Controls.

Levers for tilting the backs and for adjusting the height of the pilot's seats are located on the outboard side of each seat. The handles for releasing the seats for fore-

TYPICAL SERVICING DIAGRAM



F75-F-1-32(1)

Figure 1-47 (Sheet 1 of 2)

SERVICING DIAGRAM

REF	PART	NO. OF POINTS	REPLENISH WITH	NATO
1	Batteries	2	Distilled water	
2	Oxygen filler valve	1		
3	Indicators, CO_2 overboard safety discharge	6	Celluloid seal	
4	CO_2 cylinders, fixed fire extinguishing system	6	Carbon dioxide	
5	Engine oil tanks	4	Grade 1100 (Above 35°F) MIL-L-6082	O-117
6	HRD system			
7	Deicing fluid tank	2	MIL-A-6091	
8	Cabin supercharger oil tank	2	Aeroshell 1AC	
	Cabin supercharger drive shaft disconnect housing	2	Aeroshell 1AC (or SAE 10W)	
9	Fuel tanks 2B and 3B (EC-121D only)	1 each	Grade 115/145* MIL-G-5572	F-22
10	Fuel tanks 2A and 3A	1 each	Grade 115/145* MIL-G-5572	F-22
11	Fuel tanks 1 and 4	1 each	Grade 115/145* MIL-G-5572	F-22
12	Fuel tanks 2 and 3	1 each	Grade 115/145* MIL-G-5572	F-22
13	Fuel tank No. 5	1	Grade 115/145* MIL-G-5572	F-22
14	Fuel tank 6 (EC-121D only)	1	Grade 115/145* MIL-G-5572	F-22
15	Flares	2	Flares and aluminum seal	
16	Main hydraulic reservoir	1	MIL-H-5606	H-515
17	Reserve engine oil tank (TC-121C does not have right tank)	2 each	Grade 1100 MIL-L-6082	O-117
18	Water tank	1	Water	
19	Indicator, oxygen overboard discharge	1		
20	Oxygen system supply cylinders	4	Oxygen MIL-O-27210	
21	Emergency hydraulic reservoir	1	MIL-H-5606	H-515

F75-F-1-32(2)

*Grade 100/130 fuel may be used as an alternate.

Figure 1-47 (Sheet 2 of 2)

and-aft movement and for locking them in position are located on the inboard sides near the floor. Height adjustment is accomplished by overcoming the up-spring action when the control lever is lifted to release the position lock. The inertia reel control lever is located on the inboard side of the each seat near the forward end of the cushion. It has detents in two positions; LOCKED and UNLOCKED. In the LOCKED position, the inertia reel holds the shoulder harness so that the pilot cannot lean forward. In the UNLOCKED position the harness will not restrict movement but is set for inertia action. When set for inertia action, the reel automatically restrains the shoulder harness when the aircraft encounters an impact force of from 2 to 3 G's. When the reel is locked by impact force it must be released by moving the control lever to the LOCKED position, then to the UNLOCKED position.

FLIGHT ENGINEER'S CHAIR.

The flight engineer's chair is mounted on a track and arranged to swivel and lock in the aft facing position. Vertical and tilting adjustments are not provided. A special removable ditching headrest is provided.

SAFETY BELTS.

Lap type safety belts are provided for all crew seats, seat-bunks, and fixed bunks. Fittings are installed to permit the seat-bunk belts to be used as bunk safety belts.

AUXILIARY EQUIPMENT.

Auxiliary equipment, such as the air conditioning, communication, electronic, lighting, oxygen, automatic pilot, and navigation are discussed in Section IV of this handbook.

Section II—NORMAL PROCEDURES

TABLE OF CONTENTS

	Page
PREPARATION FOR FLIGHT	2-1
AMPLIFIED AND ABBREVIATED CHECKLISTS	2-2
ENGINEER'S PREFLIGHT CHECKLISTS	2-2
PILOT'S BEFORE INTERIOR INSPECTION	2-9
PILOTS INTERIOR INSPECTION	2-9
EXTERIOR INSPECTION	2-11
BEFORE STARTING ENGINES CHECKLIST	2-11
STARTING ENGINES CHECKLIST	2-14
ENGINE GROUND OPERATION	2-17
BEFORE TAXI CHECKLIST	2-17
TAXIING	2-18
ENGINE RUNUP CHECKLIST	2-21
BEFORE TAKEOFF CHECKLIST	2-27
LINEUP CHECKLIST	2-29
TAKEOFF CHECKLIST	2-30
AFTER TAKEOFF CHECKLIST	2-33
CLIMB	2-34
CRUISE	2-35
DESCENT	2-36
BEFORE LANDING CHECKLIST	2-38
LANDING PROCEDURES	2-38
AFTER LANDING CHECKLIST	2-44
ENGINE SHUTDOWN CHECKLIST	2-45
BEFORE LEAVING THE AIRCRAFT CHECKLIST	2-46

PREPARATION FOR FLIGHT.

A check should be made of the takeoff and anticipated landing gross weights, and that the grades and weight of fuel, oil, and special equipment carried is suited to the mission to be performed.

FLIGHT RESTRICTIONS.

Refer to Section V for the information concerning Operating Limitations.

FLIGHT PLANNING.

Flight Planning and cruise control information for the complete flight regime is presented in the Appendix. It is recommended that operational charts be prepared from this basic information, favoring reduced power operation whenever possible. Use a Power Schedule derived from the Nautical Miles Per Pound of Fuel charts, reducing power for every 3000 lbs. reduction in airplane gross weight, whenever practical.

TAKEOFF AND LANDING DATA.

The takeoff and landing data must be computed and checked during determination of the data necessary for the proposed mission. The takeoff and landing chart will be reviewed and available for ready reference. Refer to part 8 of the Appendix for an illustration of a takeoff and landing data card and sample problem.

WEIGHT AND BALANCE.

It is the responsibility of the pilot in command to ascertain that the aircraft is properly loaded and balanced and that the center of gravity limits are not exceeded. To obtain further loading information, refer to the Operating Limitations in Section V and to the Handbook of Weight and Balance, AN 1-1B-40. A balance computer is supplied which is to be used in conjunction with the weight handbook for computing proper loadings. Be certain that the basic weight being used applies to the aircraft assigned for the flight. It is possible that the aircraft has undergone modifications that may affect the basic weight.

CHECKLISTS.

It will be the responsibility of the pilot to conduct an exterior visual inspection as outlined (see figure 2-1 for recommended inspection route), and to ensure that a PREFLIGHT or THRU FLIGHT inspection as required

by the *Handbook of Inspection Requirements, T.O. 1C-121(R)D-6,* has been performed. It also will be the responsibility of the pilot to insure that each crewmember has accomplished his individual inspection requirement as outlined in Section II and Section VIII of this manual.

Note

The air crew visual inspection procedures outlined in this section are predicated on the assumption that maintenance personnel have completed all of the requirements of the *Handbook of Inspection Requirements, T.O. 1C-121(R)D-6,* for PREFLIGHT or THRU FLIGHT; therefore, duplicate inspections and operational checks of systems by air crew members have been eliminated, except for certain items required in the interest of FLYING SAFETY. PREFLIGHT or THRU FLIGHT inspections will be accomplished by the flight crew, at stations where maintenance personnel are not available, in accordance with T.O. 1C-121(R)D-6.

CREW ENTRANCE.

Crew entrance normally is gained through the rear cabin door.

AMPLIFIED AND ABBREVIATED CHECKLISTS.

This manual now contains only amplified checklists. These checklists are presented in two column form, one column lists pilot items and the other flight engineer items.

Note

Abbreviated checklists, one for each crewmember, have been issued as separate Technical Orders. For the T.O. number and date of the check list applicable to the EC-121D/TC-121C, refer to the Flight Manual "A" page under "Current Flight Crew Checklist."

It is intended that, insofar as possible, the flight crew will perform each phase of action in conjunction with direct reference to a checklist. However, it would be both impractical and unsafe to require use of a checklist during actual landing, takeoff, touch-and-go landings, or certain emergency situations. Accordingly, there are two categories of checklists identified as follows:

a. Mandatory Checklists—these cover phases of action that shall be performed in conjunction with direct reference to the appropriate checklist.

b. Non-Mandatory Checklists—these cover phases of action which cannot be performed safely in conjunction with direct reference to a checklist. The flight crew is required to review these checklists before entering the indicated phase of action or to use them for cleanup purposes after an emergency procedure has been completed.

The following procedures will be accomplished by the pilots, or flight engineer, as indicated. For those items that have been accomplished during the interior inspection, it is necessary only that the control or indicator concerned be pointed to or touched and that a verbal reply be made by the crewmember. Any command may be countermanded by the pilot at any time.

When the pilot, copilot and engineer are ready for the checklist, the pilot will call for the appropriate checklist and this will be the signal for the copilot and flight engineer to begin. Items designated by a circled number indicate that coordination is required between the pilot or copilot and the flight engineer.

Note

If using alternate grade fuel, consult alternate fuel grade operating limit data in Section V.

ENGINEER'S PREFLIGHT CHECKLISTS

The following checklists are predicated on the fact that there will usually be two flight engineers conducting the preflight inspection. The two flight engineers should coordinate their actions when outside check is required of an item operated from the cockpit. For example, see coordinated items listed on the Equipment Operational Check.

First Engineer

INTERIOR INSPECTION.

1. Magneto switches—OFF.

Second Engineer

CURSORY INSPECTION.

1. Fire extinguisher—Checked and available.

ENGINEER'S PREFLIGHT CHECKLISTS—Continued

First Engineer

2. Landing gear lever—Checked down.

3. Form 781—Checked.

4. Refrigerator—ON.

5. Battery condition—Checked.

   a. Battery switch—OFF.

   b. External power switch—OFF.

   c. Elevator and rudder auxiliary booster switches—ON.

Note

Battery voltage should reach the maximum drop in approximately 3 seconds.

   d. External power switch—ON.

Note

Battery voltage should increase to approximately 24 volts.

   e. Elevator and rudder auxiliary booster switches—EMERGENCY ON, then OFF.

6. Battery relay—Checked.

   a. Battery switch—ON.

Note

When battery switch is ON, and external power switch is ON, battery voltage should read approximately the same as bus voltage. A minimum of 18 volts is required to close the battery relay.

   b. Battery switch—OFF.

7. Inverter system—Checked.

   a. No. 1 instrument inverter—On MAIN, check frequency and voltage.

   b. No. 2 instrument inverter—On MAIN, check voltage.

Second Engineer

2. Electrical load on APU—Checked.

WARNING

Be sure lower radome has been checked for fumes.

3. Static ground—Connected.

4. Chocks—In place.

5. Gear pins—Installed.

6. Brakes—Visually checked.

7. Batteries—Connected.

8. Pitot covers—Removed.

9. Area—Clear.

ENGINEER'S PREFLIGHT CHECKLISTS—Continued

First Engineer

c. NESA power switch—On SPARE, check voltage.

d. No. 1 instrument inverter—On SPARE, check lights, frequency and voltage.

e. No. 2 instrument inverter—On SPARE, check zero voltage and No. 2 dead bus.

f. No. 1 instrument inverter—On MAIN, check for proper indications. (No. 2 should go to SPARE.)

g. No. 2 instrument inverter—On MAIN, check for proper indications.

h. NESA power switch—OFF.

i. Emergency flight instrument inverter — On EMERGENCY, check frequency, then NORMAL.

EQUIPMENT OPERATIONAL CHECK.

(1.) ICS—Checked.

(2.) Cowl flaps—Full CLOSED, then OPEN.

(3.) Ram air doors—CLOSED, then OPEN.

(4.) Oil cooler flaps—Full CLOSED, then OPEN.

(5.) Propeller deicer alcohol — Check operation and quantity.

(6.) Heat exchanger scoops and exit doors—Full OPEN, then CLOSED.

(7.) Pitot heat—ON, then OFF.

8. Exterior light master switch — FLASH and BRIGHT.

9. Parking brake—Set.

(10.) Taxi lights—ON, then OFF.

(11.) Anti-collision light—ON, then OFF.

Note

Anti-collision light operation on the ground should be kept to a minimum. Excessive heat on the ground shortens bulb life. Also during ground emergencies the operating light could confuse rescue operations since emergency ground vehicles use a similar light.

Second Engineer

EQUIPMENT OPERATIONAL CHECK.

(1.) Ground ICS cord—Installed and checked.

(2.) Cowl flaps—Full CLOSED, then OPEN.

(3.) Ram air doors—CLOSED, then OPEN.

(4.) Oil cooler doors—Full CLOSED, then OPEN.

(5.) Propeller deicer alcohol—Checked.

(6.) Heat exchanger scoops and exit doors—Full OPEN, then CLOSED.

(7.) Pitot heat—Checked.

(8.) Taxi lights—Checked.

(9.) Anti-collision light—Checked.

ENGINEER'S PREFLIGHT CHECKLISTS—Continued

First Engineer

(12.) Landing lights—EXTEND and ON, RETRACT and OFF.

(13.) Wing tip and tail lights — On FLASH, then STEADY.

(14.) Wheel well lights—ON.

(15.) Leading edge lights—Turn ON, then as required.

(16.) Position lights—ON.

(17.) Control surfaces—Check climbing left turn, then descending right turn with auxiliary control boost ON.

WARNING

Clear area around tail of aircraft, and make sure tail cone is clear of personnel before operating elevator and rudder.

Flight Station Inspection.

Oxygen System Area:

1. Emergency hydraulic extension tank—Check fluid level.

2. Hydraulic tank replenishing system—Checked.

3. Fixed oxygen bottles—Check service and flight crew valve OPEN.

4. Oxygen regulator—Checked.

5. Portable fire extinguisher—Checked.

6. Fire axe—Stowed.

MJB Panel Area:

1. Switches and circuit breakers—As required.

2. Generators—ON.

Second Engineer

(10.) Landing lights — EXTENDED and ON, RETRACTED and OFF.

(11.) Wing tip and tail lights—Checked.

(12.) Wheel well lights—Checked.

(13.) Leading edge lights—Checked.

(14.) Position lights—Checked.

(15.) Control surfaces—Check climbing left turn, then descending right turn.

16. Electronic inverter—On MAIN and checked.

17. Refrigerator—Check operation.

18. Tip tank pumps (EC-121D)—ON.

Top of Wing Inspection.

1. All fuel tanks—Check quantity and assure caps are secure.

2. Engine oil tanks—Check quantity and assure caps and cover are secure.

3. Wing nacelles and turbines—General conditions, security of hood, condition of bucket wheel and absence of tools or foreign items.

4. Cowling—Check for locked indication and that cowl flaps are latched and secure.

5. Deicer boots—Condition.

6. Tip tanks pumps (EC-121D)—Check operation, listen for noisy bearings.

7. Aileron hinges—Condition.

ENGINEER'S PREFLIGHT CHECKLISTS—Continued

First Engineer

3. Warning and indicator lights — Operation and proper indication.

4. Carburetor alternate fuel switches—NORMAL.

5. Master control deicer switches—OFF.

6. Engine starter selector—OFF.

7. FDS vertical gyro switch (EC-121D)—ON.

8. Automatic pilot master switch (EC-121D)—ON.

9. Ignition analyzer light—Checked.

10. Lower MJB 212 panel—Checked.

11. Upper MJB 212 panel—Checked.

Upper Switch Panel:

1. Switches and circuit breakers—As required.

2. Warning and indicator lights—Operation and proper indication.

3. Hydraulic crossover switch—NORMAL.

Center and Lower Instrument Panel:

1. Instruments—Condition and proper indications.

2. Warning and indicator lights—Condition and proper indication.

3. Fuel and oil quantity push-to-test—Checked.

Engineer's Quadrant:

1. Master RPM control—Full DECREASE, then full INCREASE.

2. Throttles—Full OPEN, then CLOSED.

3. Blowers—HIGH, then LOW and locked.

4. Spare bulbs and fuses—Checked.

Second Engineer

8. Deicer fluid tank—Check tank cap and cover for security.

9. Life raft hatches—Check that latches are secured and safetied.

10. Upper radome (EC-121D)—General condition.

11. Reserve oil tank—Check quantity and secure cap and cover.

12. Main hydraulic reservoir—Check cover for security.

13. Dipsticks—Stowed.

INTERIOR INSPECTION.

Forward Baggage Compartment:

1. Forward compartment door—Secured.

2. Cabin pressurization units—Checked for condition.

3. Inverters—Check condition and security.

a. No. 1 and No. 2 instrument inverter and electronic inverter change over relays—Check operation.

4. Aircraft CO_2 fire extinguisher bottles—Check for evidence of being discharged and general condition (if applicable).

5. Portable fire extinguisher—Checked.

6. Electrical wiring, circuit breakers and fuses—Condition, note supply of spare current limiters.

7. Electrical units—Condition and security.

8. Hydraulic panel area—Evidence of hydraulic leaks.

9. Manual oil transfer system (TC-121C)—Condition and positioning.

10. Hydraulic crossover valve (TC-121C)—Condition and operation.

11. General inspection of area, including all exposed cables—Checked.

ENGINEER'S PREFLIGHT CHECKLISTS—Continued

First Engineer

Fuel System Check:

1. Mixtures—AUTO RICH.

2. Tip tank fuel pump switches—ON.

3. Tank No. 6 fuel pump switches—LOW, if tank No. 6 contains fuel.

4. Tank selector levers, No. 1, 2A, 3A and 4—ON, check for LOW and HIGH fuel pump operation. 12 psi on LOW and 27 psi on HIGH or bus voltage.

5. Tank selector levers No. 2 and No. 3—ON, check for LOW and HIGH fuel pump operation.

6. No. 1, 2, 2A, 3A, 3 and 4 fuel pump switches—OFF.

7. Tank selector levers—OFF.

8. Fuel pump switches—ON, fuel pressure should not register, turn switches OFF.

9. Fuel tank selector levers No. 1, 2, 3, and 4—ON.

10. Tank No. 5 fuel pump switch—On LOW.

11. Tank No. 5 and crossfeed levers—OPEN, note fuel pressure for all engines.

12. Tank No. 5 fuel pump switch—On HIGH.

13. No. 1 emergency shutoff lever OFF check—Completed.

a. Move slowly to full OFF, check fuel pressure drop and warning light on at approximately 19 psi.

b. Note lever between hydraulic oil OFF and fuel OFF position.

14. No. 1 emergency shutoff lever ON check—Completed.

a. Move slowly to full ON, check fuel pressure rise and warning light off at approximately 19 psi.

b. Note lever between hydraulic oil OFF and fuel OFF position.

15. Repeat items 13 and 14 for engines No. 2, 3 and 4 emergency shutoff levers.

Second Engineer

Forward Lavatory:

1. Water supply and fittings—Quantity and leakage.

2. Cabinet—Check for adequate supply of spare hydraulic fluid (10 gallons) and hose.

Radar/Cabin Compartment:

1. Emergency flap crank—Check for adapter and security.

2. Portable oxygen bottles—Checked.

3. Pyrotechnic pistol and cartridges — Aboard and stowed.

4. CGRS (EC-121D)—Erected.

5. Portable fire extinguishers (3)—Checked.

6. Manual oil transfer system (EC-121D)—Condition and positioning.

7. Hydraulic crossover valve (EC-121D)—Condition and operation.

8. Electronic inverter—On MAIN.

9. Inverter bypass system (EC-121D)—ON.

10. Wing flap emergency extension bypass valve—CLOSED.

11. Right secondary heat exchanger hydraulic valve—NEUTRAL (if installed).

12. Upper radome hatches and latches (EC-121D)—Installed and secure.

Lower Center Compartment:

1. Lower radome hatch (EC-121D)—Installed and secure.

2. Flap drive motors—Condition and leakage.

3. Wing flap asymmetry shutoff valve—Checked for leakage.

4. Hydraulic lines and fittings—Checked for leakage.

5. Electrical cables—Condition and security.

ENGINEER'S PREFLIGHT CHECKLISTS—Continued

First Engineer

Note

If lever operation is stiff, do not force movement. Notify maintenance personnel.

16. Tanks No. 1, 2A, 2, 3, 3A and 4 fuel pumps switches—LOW.

17. Keep fuel system pressurized and mixtures in AUTO RICH until exterior preflight is completed.

Engineer's Lower Switch Panel:

1. Propeller governor control switches—Checked and OFF.

2. Spark control switch—RETARD.

3. Feathering buttons—Condition.

238 Circuit Breaker Panel:

1. Circuit breakers—As required.

Station 260 Area:

1. Crash axe—Installed and secured.

2. Escape rope—Attached and stowed.

3. Fire extinguisher selectors (engine and heaters)—OFF.

4. Fire warning system—Operation.

5. Circuit breakers and switches—As required.

6. Cabin spare bulb locker—Full.

7. Pressurization and air conditioning panel—Checked and set.

8. Ditching valve T handle—Checked and safetied.

9. HRD circuit breaker panel—Checked.

10. Fuel dump control lever—NEUTRAL and safetied.

11. Pitot covers—Stowed.

12. Engineer's headrest—Installed.

13. Seat belts—Checked.

14. Log, takeoff data, and forms—Completed.

Second Engineer

6. Evidence of fuel vapors/leaks—Checked.

7. General condition of area—Checked.

8. Portable fire extinguisher—Checked.

Aft Baggage Compartment:

1. Evidence of fuel vapor/leaks—Checked.

2. Auxiliary vent exit—Proper position.

3. General condition of area—Checked.

4. Portable fire extinguisher—Checked.

Aft Cabin Area:

1. Escape rope—Attached and stowed.

2. Night lights—Check operation.

3. Rear main entrance door—Condition and operation.

4. Hydraulic bypass valve for cargo door control—OPEN.

5. Portable oxygen bottle—Checked.

6. Portable fire extinguisher—Checked.

7. Fire axe—Stowed.

8. Ladder—Condition and stowed.

9. General condition of area—Checked.

Tail Cone Area:

1. Emergency cabin pressure valve—Check condition and operation (solenoid warm with electrical power ON).

2. Cabin negative pressure relief valve—Check condition and freedom.

3. Flare chutes—Check condition.

4. Auxiliary booster accumulator—Check condition and pressure.

5. Servos and controls—Check condition.

6. Hydraulic lines and fittings—Check condition.

7. Aft bulkhead door—Condition and security.

PILOTS' BEFORE INTERIOR INSPECTION.

1. Chocks—In place.
2. Gear pins—Installed.
3. Area free of obstructions—Checked.

PILOTS' INTERIOR INSPECTION.

Pilot Position:

1. Form 781—Checked.
2. Ignition switches—OFF.
3. Gear lever—DOWN.
4. Brake selector—EMERGENCY.
5. Parking brake (1100 psi minimum)—Set.
6. Seat adjustments—Checked.
7. Headset—Checked.
8. Oxygen regulator—Checked.
9. Radio and ICS panel lights—Checked.
10. Chart lights—Checked and set.
11. Side panel lights—Checked and set.
12. Instrument panel lights—Checked and set.
13. Instrument panel—Check FDS, all instruments and indicators for condition, indication and set as required.
14. Warning lights—Push-to-test.
15. Trim tabs—Checked and centered.
16. Windshield wipers—PARKED.
17. Elevator booster shift lever (after neutralizing the control column)—Checked and OFF.

WARNING

Clear area around tail of aircraft and make sure tail cone is clear of personnel before operating elevator and rudder.

CAUTION

Shifting the elevator boost shift lever when the control column is full forward may jam the boost assembly; therefore the control column must be neutralized before the elevator boost shift lever is moved.

18. Aileron and rudder booster levers—Checked and OFF.
19. Automatic pilot—Check operation.
    a. Automatic pilot servo disconnect levers—ON.
    b. Control surface and trim tabs—Neutralized.
    c. Automatic pilot—Engage.
    d. Pitch and trim controller—Move control surface with controller.
    e. All disconnect levers—Checked.
    f. Altitude control switch—ON.
    g. Automatic pilot—Attempt to engage (should not engage).
    h. Altitude control switch—OFF.
    i. Automatic pilot servo disconnect levers—OFF.
20. Flight path control switches—Checked and OFF.
21. Elevator booster shift lever—ON.
22. Aileron and rudder booster levers—ON.
23. Auxiliary control boost switches—Check elevator and rudder operation with switches in both ON and EMERGENCY ON position.

WARNING

Clear area around tail of aircraft and make sure tail cone is clear of personnel before operating elevator and rudder.

24. Overhead panel lights—Checked and set.

EXTERIOR INSPECTION DIAGRAM

A AFT FUSELAGE UNDERSIDE
1. SKIN CONDITION — CHECK
2. LOWER RADOME — CONDITION, MOUNTING BOLTS, VENTS OPEN AND FREE OF FUEL
3. RADOME INTERIOR FOR LEAKS, FOREIGN ARTICLES AND GENERAL CONDITION (IF APPLICABLE)

B WING TRAILING EDGE
1. WING FLAPS, AILERON, TRIM TABS AND STATIC WICKS — GENERAL CONDTION
2. FUEL DUMP CHUTES — CONDITION
3. TRAILING EDGE OF SKIN — CONDITION

C FLAP RETRACTION AREA
1. FLAP TRACK, CARRIAGE ASSEMBLY, MOUNTING BOLTS, CHAIN AND CABLES — CHECK
2. AFT ROLLERS AND END OF TRACK FOR PROPER SPACING — CHECK

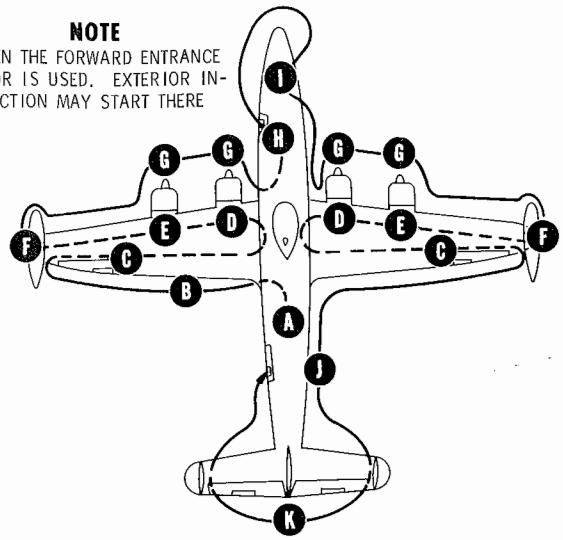
D INBOARD ENGINE NACELLE AND MAIN GEAR
1. RADOME CONDITION AND MOUNTING BOLTS — CHECK
2. FLUID LEAKS — CHECK
3. ACCESS PANELS — SECURE
4. AUXILIARY VENT INTAKE — CLEAR
5. OIL COOLER SCOOP — CONDITION
6. ENGINE NACELLE AND SHIELDING — CONDITION
7. BREATHER LINES — CLEAR
8. DRAIN LINES — CHECK FOR EXCESSIVE LEAKS
9. EXHAUST SYSTEM — CONDITION AND SECURE
10. ENGINE COWLING, COWL FLAPS, STAY RODS — CONDITION AND SECURE
11. OIL COOLER (AFT SIDE) — CONDITION
12. GEAR DOORS — CONDITION AND SECURE
13. DOOR CARRIAGE HOOK — FULL OPEN
14. GEAR UP-LOCK — OPEN
15. HYDRAULIC SHUT-OFF STAR VALVE — OPEN AND SAFETIED
16. LANDING GEAR PINS — INSTALLED AND NOT BINDING
17. FUEL LEAKS AND FUMES — CHECK
18. DEBOOSTER AND LOCK-OUT DEBOOSTERS — INDICATION AND LEAKS
19. HRD FIRE EXTINGUISHER — NOTE PRESSURE
20. ACTUATING CYLINDER — CONDITION AND LEAKAGE
21. DRAG SHOCK STRUT — INFLATION AND LEAKAGE
22. MAIN GEAR STRUT — INFLATION AND LEAKAGE
23. STATIC GROUND — CONTACT
24. TIRES — INFLATION AND CONDITION
25. BRAKES AND HYDRAULIC LINES, BRAKE DRUMS AND SPRINGS — LEAKS AND CONDITION
26. FUEL DUMP CHUTE — CONDITION
27. HRD FIRE EXTINGUISHER BLOW - OUT DISC -- INTACT

E INNER WING PANEL AND OUTBOARD NACELLE
1. SKIN CONDITION — CHECK
2. FUEL TANK SURFACES — CHECK FOR LEAKS
3. CABIN SUPERCHARGER ACCESS DOORS AND SCOOP — SECURE
4. HEAT EXCHANGER SCOOPS — CLEAR
5. OIL COOLER SCOOP — CONDITION
6. BREATHER LINES — CLEAR
7. DRAIN LINES — CHECK FOR EXCESSIVE LEAKS
8. EXHAUST SYSTEM — CONDITION AND SECURE
9. ENGINE COWLING, COWL FLAPS AND STAY RODS — CONDITION AND SECURE
10. OIL COOLER (AFT SIDE) — CONDITION

F OUTER WING PANEL
1. ACCESS PANELS — SECURE
2. SKIN CONDITION AND SURFACE — CHECK FOR LEAKS
3. LIGHTS — LENS INTACT AND CONDITION
4. (EC-121D) TIP TANKS — CONDITION AND LEAKS
5. DEICER BOOTS — CONDITION AND LEAKS

G PROPELLER AND FORWARD NACELLE
1. PROPELLER BLADES — CHECK FOR NICKS, POSITIVE PITCH AND BOOTS
2. PROPELLER DOME AND FAIRING — SECURE AND LEAKS
3. CARBURETOR SCOOPS — CLEAN
4. INSIDE COWLING LATCHES AND STAY RODS — SECURE
5. DEICER BOOTS — CONDITION

NOTE
WHEN THE FORWARD ENTRANCE DOOR IS USED. EXTERIOR INSPECTION MAY START THERE



WARNING

IF THERE IS ANY EVIDENCE OF FUEL LEAKS OR VAPORS IN THE LOWER RADOME, OR LEAKS WHICH MIGHT ENTER THE LOWER RADOME, DO NOT ATTEMPT FLIGHT.

H FORWARD FUSELAGE AREA
1. FUSELAGE AND GENERAL CONDITION — CHECK
2. DRIFTMETER — CONDITION
3. FORWARD WATER FILLER — SECURE
4. FORWARD LATRINE DRAIN COVER — SECURE
5. STATIC PORTS — CLEAR
6. DITCHING VALVES — OPEN
7. HYDRAULIC OVERBOARD DRAIN — CHECKED
8. OXYGEN DISCHARGE DISC — INTACT
9. FORWARD ANTENNAS — GENERAL CONDITION
10. NOSE RADOME — GENERAL CONDITION
11. PITOT COVERS — REMOVED
12. OXYGEN FILLER COVER — SECURE

I NOSE GEAR AND WHEEL WELL
1. NOSE WHEEL TIRES — GENERAL CONDITION
2. NOSE WHEEL STRUT — INFLATION AND GENERAL CONDITION
3. TAXI LIGHTS — LENS INTACT AND CONDITION
4. NOSE WHEEL STEERING — LEAKS AND GENERAL CONDITION
5. NOSE GEAR SCISSORS PIN — SECURE
6. LANDING GEAR PIN — INSTALLED AND NOT BINDING
7. ACTUATING CYLINDERS AND LINES — CONDITION
8. UP-LOCK — OPEN
9. BATTERIES, DRAIN AND SUMP JARS — SECURE AND CONDITION
10. HYDRAULIC SHUT-OFF STAR VALVE — SAFETIED AND OPEN
11. LOWER CARGO DOOR — LATCH SECURE AND CONDITION
12. NOSE WHEEL WELL DOORS — CONDITION
13. CO_2 DISCHARGE DISC — INTACT (IF APPLICABLE)

J AFT FUSELAGE AREA
1. (EC-121D) NO. 6 TANK FILLER COVER — INTACT
2. FUSELAGE SKIN — GENERAL CONDITION
3. ANTENNAS — CONDITION
4. AUXILIARY VENT EXIT VALVE — CONDITION
5. FLARE CHUTE COVERS — INTACT

K TAIL CONE AREA
1. DEICER BOOTS — CONDITION
2. STABILIZER, CONTROL SURFACE, TRIM TABS AND STATIC WICKS — GENERAL CONDITION
3. TAIL CONE — GENERAL CONDITION
4. CONTROL BOOSTER DRAIN — LEAKAGE

F75-F-2-137

Figure 2-1

Copilot Position:

1. Seat adjustments—Checked.
2. Headset—Checked.
3. Radio and ICS panel lights—Checked.
4. Oxygen regulator—Checked.
5. Windshield defogger—Checked then OFF.
6. Pedestal light switch—Checked and set.
7. Chart lights—Checked and set.
8. Side panel lights—Checked and set.
9. Compass light—Checked and set.
10. Emergency fuel dump lever—LG EMER EXT position.
11. Handpump selector—Check for freedom of movement and that levers in EMERGENCY BRAKE (forward) position and latched.
12. Instrument panel lights—Checked and set.
13. Instrument panel—Check all instruments and indicators for condition, indication and set as required.
14. Warning light—Push-to-test.

Forward Cabin Area:

1. Windows—Condition and cleanliness.
2. Furnishing and interior—General cleanliness.
3. G file—Check for completeness.
4. Galley area—Condition and cleanliness.

Radar/Cabin Compartment:

1. Circuit breakers and switches at radio operator's station—As required.

a. To be accomplished by the radio operator when a crewmember.

2. Circuit breakers and switches at radar technician's station (EC-121D)—As required.

Note

Assure that all CGRS circuit breakers are ON.

EXTERIOR INSPECTION BY PILOT.

A visual inspection should be conducted by the pilot or flight engineer. The identifying letters on figure 2-1 indicate the area to be checked. The numbered subjects are the points to be checked in those areas. Assure that fuel system is pressurized and mixtures AUTO RICH prior to exterior check to make certain that any fuel leaks will be noticeable.

PASSENGER BRIEFING.

Prior to takeoff the pilot or his representative will brief passengers on the following items as applicable to the mission being flown.

1. Aircraft commander's name.

2. Destination, route, ETE, weather, and flight altitude.

3. Seats, safety belts and movement in aircraft. Passengers will be briefed to remain seated with safety belts fastened during taxi operations, take-off, turbulent air, landing, and at other times when directed by the pilot or other crew members.

4. Smoking. Smoking will be at the discretion of the pilot. It will not be permitted until after take-off and will be discontinued during letdown for landing. At no time will smoking be allowed on the ground within 50 feet of the aircraft.

5. Use of Galley area. On "D" and "H" model aircraft, liquid and food are not allowed aft of the galley.

6. Location of lavatory equipment.

7. Location of air sickness bags and first aid kits.

8. Electronic devices. Passengers having electrical or electronic devices shall not use them during flight. (This does not include hearing aids.)

9. Opening the doors. Doors will not be opened in the air or on the ground by anyone except an authorized crewmember.

10. Use of parachutes (if applicable). Passengers will be fitted with a parachute and the utilization procedures will be explained.

11. Emergency procedures.

a. Brief on the emergency signals, exists, and passenger position for crash landing or ditching.

b. Brief on the location and use of survival and emergency equipment.

c. If fumes, smoke or fire is observed, notify a crew member and move away from affected, area, then remain seated if possible.

12. Questions.

BEFORE STARTING ENGINES CHECKLIST

	Pilots		*Flight Engineer*	
1.	UHF radio Set to tower frequency and checked	ON & CHECKED P	1. Circuit breakers and switches	SET
2.	Landing gear lever	DOWN CP	2. Ground power	ON (Note ground power light(s) and cart switch ON. Check bus voltage.)
3.	Ignition switches	OFF CP	3. Battery voltage	_____VOLTS (return selector switch to BUS position.)
4.	Circuit breakers and switches	SET P, CP	4. Generator switches	ON

BEFORE STARTING ENGINES CHECKLIST—Continued

Pilots

5.	Emergency fuel dump lever	LG EMER EXT	CP
6.	Handpump selector lever	EMER BRAKES	CP
7.	Brake selector lever	EMER	P
8.	Parking brakes	SET	P

Pilot depresses brake pedals, sets parking brake, and notes light ON.

9.	Emergency brake pressure	CHECKED	CP

Copilot notes pressure to ensure that pressure was not depleted when parking brake was set. A minimum of 1100 psi is required.

10.	Aileron and rudder booster levers	CHECKED AND ON	P
11.	Elevator booster shift lever	CHECKED AND ON	P

CAUTION

During ground operation do not shift elevator boost unless control column is in neutral position.

12.	Auxiliary booster switches	CHECKED AND OFF	P

Note

The elevator and rudder booster levers must be ON to utilize the auxiliary boost system.

Flight Engineer

5.	No. 1 instrument inverter switch	MAIN
6.	No. 2 instrument inverter switch (EC-121D)	OFF
7.	Flight instruments power switch	EMERGENCY, THEN NORMAL

Note

This switch should be moved slowly so that the flag operation may be observed on the attitude indicators.

8.	Propeller and carburetor deicer switches	OFF
9.	Carburetor alternate fuel switches	NORMAL
10.	Tank 5 and fuel cross-feed levers	CLOSED
11.	Emergency shutoff levers	ALL ON
12.	Vacuum shutoff levers	OPEN
13.	Cowl flaps	OPEN
14.	Oil cooler flaps	AS REQUIRED

Position of oil cooler flaps will be dictated by outside air temperature.

15.	Alternate air switches	RAM

Alternate may be used if takeoff will be in icing conditions.

16.	Carburetor air switches	COLD
17.	Master engine selector switch	ENG 1 OR ENG 2
18.	Manual spark control switches	RETARD

Check spark control master switch and individual control switches in the RETARD position.

CAUTION

The manual spark control override switch must be placed in the RETARD position for all ground operation.

BEFORE STARTING CHECKLIST—Continued

Pilots

13. Deicer and Nesa window switches	OFF	P, CP

Pilot checks deicer OFF, boot cycling switch to be OFF. Copilot checks pitot heaters and Nesa switches OFF. Pilot states "OFF left" and copilot states "OFF right."

14. Deicer air pump selector valve switches	VACUUM	P
15. Oxygen and masks	ON AND CHECKED	P, CP
16. Crew briefing	STARTING ENGINES	CP

Notify crew over PA "starting engines."

17. Jumpmaster's report	HEAD COUNT, LOADING RAMP CLEAR AND DOOR CLOSED	CP
(18.) Engineer's Before Starting Engines checklist	COMPLETED	

Flight Engineer

19. Master propeller lever	FULL INC RPM

Check indicator lights ON

20. Engine supercharger levers	LOW AND LOCKED IN DETENT
21. Fuel tank selector levers	ON (takeoff tanks)

Note

Select tanks 1, 2, 3, and 4. If tanks 2 and 3 contain less than a dippable amount of fuel, select 1, 2A, 3A and 4.

22. Mixture levers	OFF
23. Auxiliary fuel pump	OFF
24. Hydraulic reservoirs and reserve quantity	FULL AND CHECKED
25. Engine oil and reserve oil quantity	CHECKED
26. Deicer fluid	CHECKED
27. Fuel quantity	CHECKED
28. Hydraulic system crossover switch	NORMAL
29. Air conditioning panel	POSITION A AND PANEL SET

Note

Paddle switches should be adjusted so that refrigeration is not called for until after engines are started. This prevents secondary heat exchanger fans from making a heavy demand on the hydraulic system until after the accumulators have been charged and system pressure has built up. Set cabin altitude selector to 1500 feet above field elevation, rate-of-change as desired (approximately 300 ft/min) and position auxiliary vent knob to position A to prevent fumes from entering cabin during engine starting, reversing, or ground heating. All test and emergency switches in normal position.

30. Takeoff and landing data	PASS TO PILOT
(31.) Engineer's Before Starting Engines checklist	COMPLETED

STARTING ENGINES.

Before starting, the engines must be turned over a minimum of 6 blades with the starter, while the ignition switch is off, to check for a liquid lock which could seriously damage the engine. If a liquid lock exists, the lower cylinder spark plugs must be removed and the propeller again rotated to remove the oil from the cylinders.

CAUTION

The propellers should not be moved by hand and must never be moved opposite to normal engine rotation.

Note

Engine starting sequence is 3, 4, 2, 1. To obtain faster cranking speeds when starting without external power, minimize the electrical load.

Cold Engines.

With a cold engine, use AUTO RICH prior to activating the ignition switch (optimum point depends upon engine temperature). If the engine does not fire within two revolutions after ignition, or if the engine loads up, move the mixture control to the OFF position momentarily. The primer may be substituted for the mixture when starting cold engines and may be applied in a similar manner until the engine is running smoothly at 800 to 1000 rpm. At that time place mixture control to AUTO RICH and release the primer when a drop in rpm is noted.

Warm or Hot Engine.

With a warm or hot engine, leave mixture in OFF until the engine fires, or two revolutions after ignition, then advance the mixture control to the AUTO RICH position. If the engine fails to fire within a short period in AUTO RICH, return the mixture control to the OFF position.

STARTING ENGINES CHECKLIST

Pilots *Flight Engineer*

The engine starting sequence is 3, 4, 2, 1. They are started in this order to provide immediate secondary hydraulic pressure. After obtaining the all clear signal, complete starting procedure as follows:

(1.) Start engines	STARTING ENGINES	P

Observe the area, and when ready for engine start, command the flight engineer to start engines. Stand by to turn on ignition upon request from engineer.

(1.) Start engines	STARTING ENGINES
2. Area	CLEAR

Check with ground crew.

3. Start No. 3 engine	START

a. Auxiliary fuel pump switch—Set No. 3 to LOW.

b. Mixture lever—OFF.

c. Throttle lever—Set to approximately 1200 rpm.

STARTING ENGINES CHECKLIST—Continued

Pilots

Flight Engineer

d. Engine start selector switch—Set to No. 3 engine.

Note

Visually check position of the extinguisher selector. To prevent excessive use of motor control valve, do not select engine on the HRD system. CO_2 selector will be in the OFF position to provide standardization between the two systems.

e. Starter switch—Engage.

f. Ignition switch—BOTH.

Pilot stands by, then turns No. 3 to BOTH.

Note

The ignition switch should be turned ON after the propeller has turned 6 blades.

g. Mixture lever—As required.

Note

Avoid throttle movement until engine is running smoothly. Do not exceed 1400 rpm on start. If engine does not fire within a short period, after the ignition switch is activated, place mixture control in OFF momentarily to prevent afterburning. If engine fails to start within 30 seconds, discontinue starting attempt and allow starter to cool approximately 2 minutes before repeating starting procedure.

h. Engine oil pressure—Check for rise.

CAUTION

If oil pressure does not register within 10 seconds or reach 40 psi within 20 seconds, shut down engine. Check for rise in cabin supercharger oil pressure.

STARTING ENGINES CHECKLIST—Continued

Pilots			*Flight Engineer*	
			Note Warm engines at 1000 to 1400 rpm until a 6 degree rise is indicated on the oil temperature gage.	
			4. Auxiliary fuel pump	OFF
(2.) Crossover operation	CHECKED	P	(5.) Crossover operation	CHECKED

Note

Check crossover after No. 3 engine is started and secondary hydraulic pressure is normal. Upon request from the pilot, the flight engineer places the hydraulic crossover switch in the EMERGENCY position. The aileron control should then be moved through a complete cycle to ensure proper operation of the crossover valve. After the switch is returned to NORMAL position recheck for high flight control forces to determine that the crossover valve has closed.

3. Wing flaps	UP	CP	6. No. 4 engine	START
			Use same procedure as for No. 3 engine.	
			CAUTION When an alternator and/or cabin supercharger is inoperative, as noted in Form 781, or becomes inoperative after engine start, set affected engine rpm at 1400 and operate the disconnect mechanism. Check zero volts and amps on the alternator and dc generator, zero oil pressure and needle spread on cabin supercharger.	
4. Wing flap shutoff valve	CHECKED	CP	7. Engine No. 3 and No. 4	1200 RPM
Test by starting flap retraction and actuating the wing flap asymmetry shutoff switch. Note that the flaps stop retracting. Release test switch and note that retraction continues.			8. Battery switch	ON
			9. Cart switch	OFF
			10. External power and landing gear pins	REMOVED
			Coordinate with ground crew.	
			11. Engines No. 2 and No. 1	START
			Use same procedure as for No. 3 or No. 4 engines.	
			12. Starter selector	OFF

STARTING ENGINES CHECKLIST—Continued

Pilots			*Flight Engineer*	
(5.) Fire warning system	CHECKED	CP	(13.) Fire warning system	CHECKED
Check pilot's warning light and buzzer. Test switch is actuated by flight engineer.			Actuate any fire warning test switch and check for light and buzzer operation.	
(6.) Engineer's Starting Engines checklist	COMPLETED	CP	(14.) Engineer's Starting Engines checklist	COMPLETED

ENGINE GROUND OPERATION.

Operate the engine at 1000-1400 rpm until the oil inlet temperature has risen at least 6° C above the prestarting temperature and the oil pressure is stabilized.

BEFORE TAXI CHECKLIST

After all four engines are started, the pilot will call for the Before Taxi checklist.

Pilots			*Flight Engineer*	
1. Vacuum system pressure	CHECKED (4 to 7.5 in. Hg)	P	1. Ignition analyzer	ON
2. Engine and flight instruments	CHECKED AND SET	P, CP	2. Carburetor deicer (Switches ON until rpm drops. Do not exceed 10 seconds, then OFF.)	CHECKED
Note Gyros should be erect, attitude indicators uncaged, compasses, clocks, and altimeters set.			3. Carburetor air switches	CHECKED AND COLD
3. Hydraulic pressure	CHECKED	CP	Check for heat rise, then position to COLD.	
4. Taxi clearance	RECEIVED	CP	**CAUTION** Do not check carburetor deicing and heat at the same time because fire or faulty indication may occur.	
5. Emergency ICS, PA system and alarm bell	CHECKED	P	4. Engine instruments	NORMAL
Using the emergency ICS and PA systems, the pilot notifies the crew to standby for alarm bell check, then turns alarm bell on and receives operational check from crewmembers.			5. Oil tank heaters	ON
6. IFF/SIF controls	STDBY	P	6. Mechanic's (ICS) switch	OFF
7. Central gyro reference system light (EC-121D)	FAST OR NORMAL ERECT LIGHT ON	CP		
(8.) Landing gear pins, pitot covers and ground crew headset	ABOARD	CP	(7.) Landing gear pins, pitot covers and ground crew headset	ABOARD

BEFORE TAXI CHECKLIST—Continued

Pilots			*Flight Engineer*	
			8. Recirculating fan switches	ON
			The recirculating fans should be on for all ground operation except propeller reversing checks.	
9. Engineer's Before Taxi checklist	COMPLETED	CP	9. Engineer's Before Taxi checklist	COMPLETED
10. Wheel chocks	REMOVED	P		
Retard inboard throttles prior to signal for chock removal.				
11. Exterior lights	SET	P, CP		
Exterior lights switch FLASH, anti-collison light OFF, wheel well lights OFF, etc. as required.				

TAXIING.

Pilot instructs flight engineer on required throttle settings for taxiing, or advises that he will handle throttles. Pilot releases brakes and call for taxiing checklist when clear of congested area.

As the pilot releases the brakes and the aircraft moves forward, he will smoothly depress the brake pedals and check for proper brake operation. Pilot will state to copilot "Brake check on EMERGENCY." When well clear of parking or congested area, pilot will state to copilot "Brakes switch to NORMAL." Copilot moves brake selector to normal and replies "Brakes on NORMAL." Pilot then checks normal brakes and states "Brakes check on NORMAL." Copilot notes secondary system hydraulic pressure and states "Secondary pressure checks."

CAUTION

- EMER. BRAKES selector lever must not be shifted while brake pedals are depressed. Damage to the system may result.
- Avoid taxiing for extended periods of time in the EMER. BRAKES position or operating the wing flaps while in that position. It is possible to deplete available emergency system pressure and in the event of a secondary hydraulic failure be without brakes.

If low power is required for taxiing, it is preferable to retard the throttles of the inboard and advance the throttles of the outboard engines to assure adequate generator output and ground refrigeration, if the latter is required.

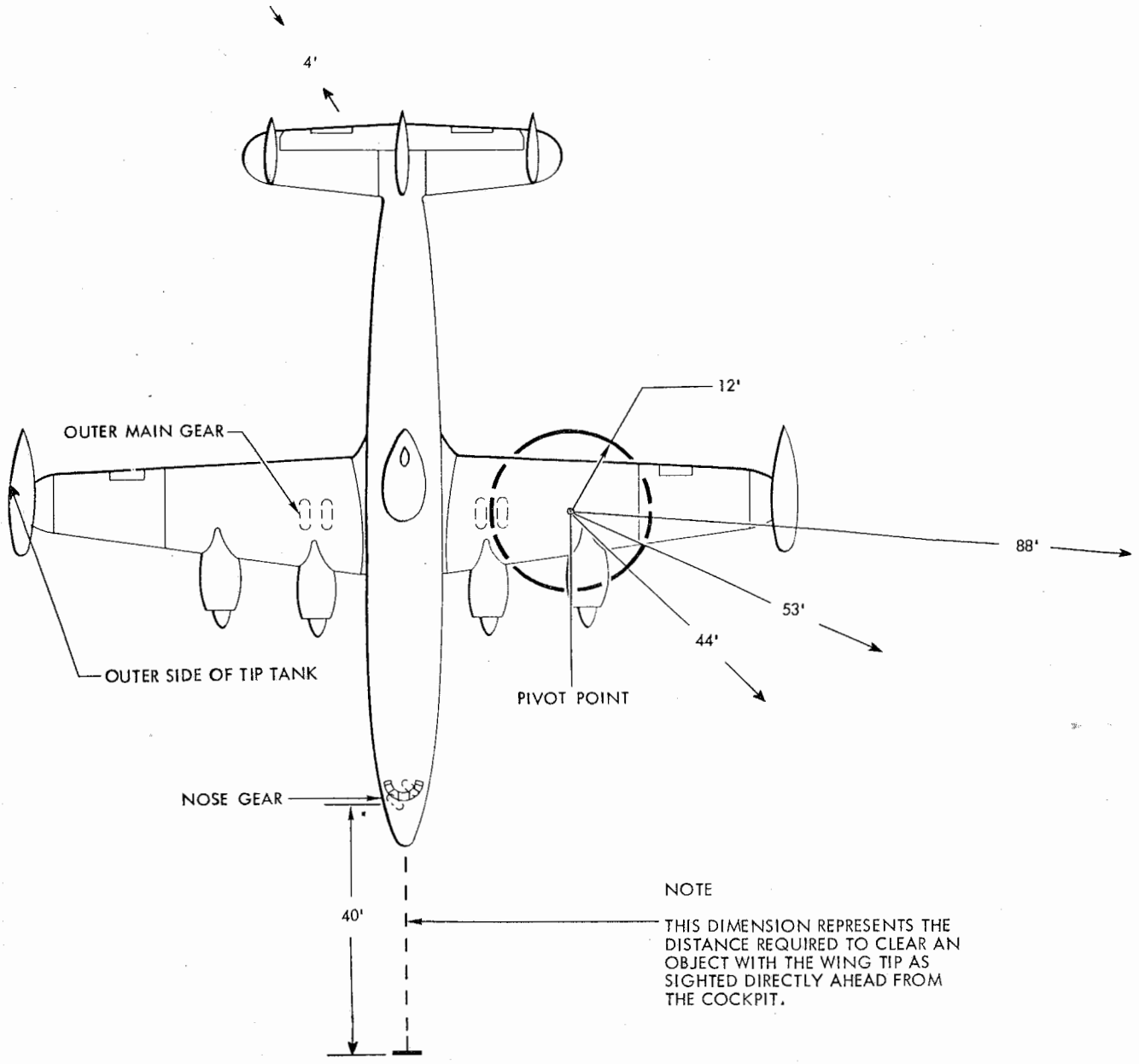
Brakes should be used sparingly and applied gently. If taxi speed is too high, use brakes to slow aircraft to a near stop and then allow speed to build up again. This will permit adequate brake cooling. If taxi speed persists in building up, reduce power as necessary. Care should be exercised to avoid dragging the brakes which causes excessive brake temperatures and results in failures of brake expander tubes.

During taxiing operations the pilot and copilot will not perform checklists, tune radios, or be engaged in any duties that may divert attention from taxiing the aircraft until it is well clear of the parking and/or congested area.

At night the Aldis lamp may be utilized by the copilot if required for taxiing. The landing lights set at a 45-degree angle may be used in lieu of the taxi lights to prevent blinding ground personnel during parking and wing walking operation.

When taxiing with full tip tanks, caution should be exercised when a dip or a bump is to be traversed. Reduced speed and contact the dip or bump with both gears simultaneously.

EC-121D/TC-121C. TURNING RADIUS



VERTICAL CLEARANCES

VERTICAL STABILIZER TIP	24 FT. 10 IN.
TIP TANK	15 FT. (APPROX)
FUSELAGE	5 FT. 0 IN.
FUSELAGE (RADOME)	— 16 IN.
PROPELLER INBOARD	1 FT. 8 IN.
PROPELLER OUTBOARD	3 FT. 7 IN.

F75-D-2-34

Figure 2-2

Sharp turns at high speed impose excessive forces on the inside nosewheel tire, strut components and aircraft structure. Side loads imposed during a high-speed turn may be sufficient to pull the inside tire off the wheel.

Stopping the Aircraft.

Use a power-on stop when engine runup is to be accomplished and a power-off stop at station arrival, or whenever it is desirable to stop with the engines idling. The action of the hydraulic drag struts installed on the main gears can induce a rocking motion of the aircraft during either a power-on or a power-off stop unless proper braking techniques are employed.

To make a power-on stop, ease the aircraft to a normal stop while applying approximately 1700 rpm to all four engines. This is ample power to prevent the aircraft from rocking rearward. If it is necessary to hold before takeoff, and it is desired to reduce power to idle rpm, release the brakes as the throttles are closed and allow the main wheels to move forward; then reapply the brakes.

To make a power-off stop, apply the brakes in a normal manner, but release and reapply them as the aircraft stops. This will allow the main wheels to move forward and prevent the aircraft from rocking rearward. If it is desired to runup after a power-off stop, allow the aircraft to roll forward slightly and make a power-on stop as described above.

The aircraft should be parked with the nosewheel straight to avoid side loads and strains on the nose wheel and struts. If the nosewheel is deflected in either direction, apply power until the aircraft starts rolling before using nosewheel steering.

TAXI CHECKLIST

Pilots

1. Brake system	CHECKED	P
2. Turn indicators, compasses and attitude indicators	CHECKED	CP

Note

Pilot will make a left turn during taxi and the copilot will check indicators, compasses and attitude indicators for proper indication. Copilot will recheck indicators when the procedure is repeated for right turn.

3. Nesa system	ON	CP
4. Pitot heaters	ON	CP
(5.) Engineer's Taxi checklist	COMPLETED TO PROPELLER REVERSING	CP
(6.) Propeller reversing	CHECKED	P

Flight Engineer

1. Air conditioning panel	CHECK AND SET

Note

Position auxiliary vent knob to CLOSED; move paddle switch to full COOLER position; note that all primary and secondary scoop door indicator lights come on; check for rise in supercharger duct discharge pressure; check for decrease in refrigeration discharge duct temperature; leave paddle switches in full COOLER position after scoop door lights are on to allow mixing valve to go to full cold position. Refrigeration may be used during taxiing and engine runup if required. Before takeoff, however, auxiliary vent control knob should be in position A, paddle switches in full WARMER position until doors are closed and indicator lights are out, and then returned to STEADY position.

2. Nesa power switch	SPARE INVERTER
3. No. 2 inverter (EC-121D)	ON
(4.) Engineer's Taxi checklist	COMPLETED TO PROPELLER REVERSING
(5.) Propeller reversing	CHECKED

TAXI CHECKLIST—Continued

Pilots

Note

- Reverse two engines at a time. (Engines No. 2 and 3, then No. 1 and 4.)
- Very little power (approximately 1000 rpm) should be applied in reverse range and then only for a short duration to minimize the blowing of dust and pebbles into propellers. Reversing at low speeds also has an adverse effect on engine cooling.
- Use of reverse thrust is not recommended to back the aircraft.

a. Reverse throttle levers—Reverse range. P

b. Reverse pitch indicator lights—Check on. P

Note

Feathering button lights should go off when the reverse pitch lights come on. If the lights fail to come on, the engineer will notify the pilot.

c. Reverse throttle levers—Forward range. P

d. Reverse pitch indicator lights—Check out. P

Flight Engineer

a. Recirculating fans—OFF.

b. Aux vent knob—Position A.

c. Engines not being reversed — Maintain 1000 rpm.

d. Feathering button lights—On, then off during reversing.

e. Feathering button lights—On, then off during unreversing.

ENGINE RUNUP CHECKLIST

Pilots

Flight Engineer

Note

- Make a power-on stop smoothly and keep nosewheel straight so that severe side loads will not be imposed on tires and struts. Head the aircraft into the wind.
- The ignition analyzer should be ON during all engine checks to aid in determining the location and extent of possible malfunction. The pilot will advise the flight engineer when ready for runup.
- An engine oil inlet temperature of at least 40° C is required for runup and oil inlet temperature of 60° C is desired to accomplish a satisfactory auto feathering check.

1. Parking brake SET P

2. Deicer boots CHECKED AND OFF P

a. Cycle selector switch—Check NORMAL operation and pressures (20-24 psi).

1. Propellers CHECKED

a. Master propeller lever—INC RPM.

b. Throttle levers—Set for 1700 rpm.

c. Propeller governor switches—Toggle to full DEC RPM.

ENGINE RUNUP CHECKLIST—Continued

Pilots

Note

With the cycle selector switch ON, note vacuum and pressure readings and electric timer indicator lights.

b. Cycle selector switch—Off (Note pressure drop).

3.	Radios	CHECKED AND SET	CP

a. Command transmitter—Set.

b. ADF—Check ANT, LOOP and COMP.

c. VOR receiver—Checked and set.

d. Tacan—Checked and set.

4.	Flight director system (EC-121D)	CHECKED ON HEADING FUNCTION	P
5.	Takeoff and landing data	REVIEWED	P, CP
6.	CGRS (EC-121D)	NORM ERECT LIGHT ON	CP
7.	Departure clearance	RECEIVED	CP

Flight Engineer

Note

Hold the governor switches in the DEC RPM position until the limit light comes on and the rpm stabilizes at 1350, plus or minus 25 rpm.

d. Propeller governor switches—Move toward INC RPM position and note limit lights OFF.

e. Master propeller lever—Move toward DEC INC position and note limit lights on. Return lever to full INC RPM and note limits lights on.

f. Master propeller lever—Full DEC RPM position and note limit lights go out and then come on again, denoting low limit. The rpm should stabilize at 1350.

Note

The low limit lights going off at this time can be attributed to synchronizer action where the slave governor settings are lower than the master governor setting.

g. Master propeller lever—Set 1600 rpm on master engine.

h. Synchronizer button—Push and note that slave engines synchronize with master.

Note

Reduce master engine to 1000 rpm with throttle and note that slave engines do not drop below 1425 rpm. Press synchronizer button and note rpm drop of slave engines. Open master engine throttle to 1600 rpm and note that slave engines follow. Press synchronizer button for across-the-board synchronization at 1600 rpm. Select No. 2 engine as the master and repeat the synchronization checks.

i. Master propeller lever—Full INC RPM.

2.	Auto feathering	CHECKED

a. Throttles—Set at minimum of 110 BMEP, then retard to 105 BMEP.

b. Auto feathering test switch—ON.

c. Master switch—ON.

d. Note that none of the propellers feather.

ENGINE RUNUP CHECKLIST—Continued

Pilots *Flight Engineer*

Note

If a feathering button light comes on, indicating that a propeller is feathering, reject the feathering cycle and investigate.

e. Master switch—OFF.

f. Throttles—Retard to 90 BMEP.

g. Master switch—ON.

Note

One propeller should begin to feather after a two-second time delay. Reject the feathering cycle by pulling feathering button to neutral.

h. Auto feathering test switch—OFF on propeller that has started feathering cycle.

Note

When the auto feathering master switch is reset, another propeller should start to feather. Repeat the procedures on remaining propellers. After all propellers have been checked, without resetting the master switch, turn on all four test switches. The auto feathering armed light should be out and no feathering should occur. When auto feathering is not operative, a manual feathering check will be accomplished.

i. Auto feathering test switches—OFF.

j. Master switch — REARM, no prop should feather, then OFF.

3. Alternate fuel CHECKED

a. Engine speed—Set to 1600 rpm or more.

b. Alternate fuel switches—EMERGENCY.

Note

If these switches are left in EMERGENCY too long, an excessively rich mixture may result.

ENGINE RUNUP CHECKLIST—Continued

Pilots *Flight Engineer*

c. Fuel flow—Check for increase.

d. Alternate fuel switches—NORMAL.

4. Fuel inlet screen deicing system — CHECKED

a. Fuel inlet screen switches—Hold ON.

b. Fuel flows—Check for decrease.

c. Fuel inlet screen switches—OFF.

5. Manual spark — CHECKED AND RETARD

Note

The manual spark must be in RETARD position for all of the following conditions: Max power, METO power, climb power, abnormal or emergency power, starting and ground operation. ADVANCE spark is to be used only during cruise power or descent and will be selected prior to manual leaning. All checks should be made with the master switch armed and the individual circuit-breaker type switches used for each engine check to prevent excessive operation of the advance spark relays.

With Ignition Analyzer in Operation.

a. Master propeller lever—Full INC RPM.

b. Mixture levers—AUTO RICH.

c. Throttles—1600 rpm.

d. Spark control switches—RETARD.

e. Analyzer condition switch—BOTH (on No. 1 cylinder, fast sweep).

f. Master spark control switch—ADVANCE.

g. Spark control switches—NORMAL.

h. Spark control switches—RETARD.

i. Repeat procedure for No. 2 cylinder.

Note

Observe patterns on analyzer scope as the spark control switch is placed from NORMAL to

ENGINE RUNUP CHECKLIST—Continued

Pilots *Flight Engineer*

Note

RETARD. Required spark advance is 5° plus-or-minus 1° as measured on No. 1 and 2 cylinders. If the advance limits are exceeded, or if the out-of-synchronization, as shown on No. 1 and 2 cylinders, exceeds 2°, the discrepancies should be noted in the Form 781. Repeat procedures on remaining engines.

With Ignition Analyzer Inoperative.

a. Throttles—2000 rpm.

b. Mixture levers—Manually lean until rpm drops to 1950.

c. Master spark control switch—ADVANCE.

d. Ignition switch—Select left.

e. Spark control switches—Advanced and retard.

Note

When checking the manual spark in either the LEFT or RIGHT position, there should be a definite rise in rpm or BMEP (25 rpm and 2 to 4 BMEP) when switching from RETARD to ADVANCE position. If no change in rpm or BMEP occurs, it is impossible to determine whether the manual spark is locked in the ADVANCE or RETARD position; therefore, this malfunction must be corrected before takeoff. If the advance mechanism fails in flight, place spark in RETARD and continue flight.

f. Repeat procedure from item d. for right distributor.

g. Ignition switch—BOTH.

h. Master spark control switch—RETARD.

6. Engine superchargers—CHECKED AND LOW.

a. Throttle levers—Set to 1600 rpm.

b. Engine supercharger levers—No. 1, 2, 3, and 4 shift to HIGH. Note engine oil pressure indication.

c. Throttles—Set to 30 in. MAP on engines No. 1 and 4.

ENGINE RUNUP CHECKLIST—Continued

			Pilots	*Flight Engineer*
				Note Check engine instruments and 260 panel for possible malfunctions in cabin superchargers. If the engine oil pressure drops or fluctuates as rpm is increased, extend the warm-up period.
				d. Engine supercharger levers—Shift No. 1 and 4 to LOW.
				CAUTION Do not shift to HIGH ratio more than once in any five minute period.
(8.)	Magnetos	CHECKED	P	(7.) Magnetos CHECKED
				a. Throttles—Set engines 1 and 4 to field barometric pressure and note rpm and BMEP.
				Note Symmetrical engines should turn within 100 rpm of each other at the magneto check power setting. A difference of more than 100 rpm should be investigated before flight. A dead cylinder, propeller low pitch stop setting off, exhaust turbine malfunction, fuel metering, and failure to park headed into the wind are some of the causes for rpm differences. This is in addition to accountability to cabin superchargers and alternators on engines 1 and 4. The pilot's and flight engineer's tachometers should be cross-checked.
				b. Ignition switch—L and note rpm and BMEP change.
				c. Ignition switch—Return to BOTH and allow rpm to stabilize.
				CAUTION When rpm drop exceeds 150, or excessive roughness is encountered, retard throttle to IDLE before returning magneto switch to BOTH.
				d. Ignition switch—Repeat procedure for R position.

ENGINE RUNUP CHECKLIST—Continued

Pilots

Flight Engineer

e. Repeat procedure on engines 2 and 3, Supercharger to LOW and magneto CHECK.

Note

- Atmospheric conditions and ignition timing will influence the readings obtained. With a 20-25 degree ignition timing, a drop of 100 rpm or less on one magneto is satisfactory provided no engine roughness is encountered. The use of BMEP as a measure of power loss is recommended to substantiate the rpm variation. A drop of 10 BMEP is considered equivalent to a drop of 100 rpm.
- In cases of known richer than normal carburetion and/or the presence of high atmospheric absolute humidity which effectively richens the fuel air ratio, the following is recommended, if the above limits are exceeded:

a. Throttle—Set to field barometric pressure.

b. Mixture levers—Lean to best power (max BMEP) and enrich to a 2 BMEP drop.

c. Magnetos—Check as before.

Note

If the above limits continue to be exceeded, the conditions should be investigated.

8. Generators — CHECKED AND ON

a. Throttles—1500 rpm and check amperage and voltage for even distribution of load.

Note

If departure is delayed, the pilot should instruct the engineer to set 150 BMEP for one minute after every 15 minutes of ground operation to minimize plug fouling.

(9.) Engineer's Runup checklist	COMPLETED.	CP	(9.) Engineer's Runup checklist	COMPLETED.

BEFORE TAKEOFF CHECKLIST

Pilots

Flight Engineer

1. Radar altimeter	SET TO 50′	P	1. Door warning lights	LIGHTS OUT
			2. Alternate air switches	RAM

BEFORE TAKEOFF CHECKLIST—Continued

Pilots

WARNING

The AN/APN-22, AN/APN-1 and SCR-718 radio altimeters are unreliable in areas covered by large depths of snow and ice such as encountered over polar regions. An apparent terrain clearance 1600 feet greater than actual clearance has been recorded. Do not rely on your APN-22, APN-1 or SCR-718 radio equipment to provide terrain clearance when flying over areas covered by a large depth of snow and ice.

2.	Flight director system (EC-121D)	AS REQUIRED	P
3.	Doors and windows	CLOSED AND LOCKED	P, CP
4.	Trim tabs	SET	P
5.	Autopilot switch	OFF	P
6.	Static selector levers	NO. 2 POSITION	P, CP

Note

Due to the unpredictable error in the No. 1 static system during the takeoff ground run, No. 2 position will be used for takeoff.

7.	Seat belt, shoulder harness and seat pin	SET AND LOCKED	P, CP
8.	Crew briefing	COMPLETED	P

Note

Pilot will advise copilot and engineer of any special instructions needed, or special circumstances to be encountered on takeoff. If none, he will advise that the takeoff will be standard. (For standard takeoff procedures, refer to Takeoff Checklist, this Section.)

Flight Engineer

Note

Alternate air may be used (refer to Appendix.)

3.	Carburetor air switches	COLD
4.	Auto feathering	AS REQUIRED
5.	Seat belt and seat, check pilot's seat pins in place	SET AND LOCKED
6.	Oil cooler flaps	SET (normally 40%)

BEFORE TAKEOFF CHECKLIST—Continued

Pilots			*Flight Engineer*	
9. Flight controls Checked for freedom of movement	FREE	P		
(10.) Engineer's Before Takeoff checklist	COMPLETED	CP	(7.) Engineer's Before Takeoff checklist	COMPLETED

LINEUP CHECKLIST

Pilots			*Flight Engineer*	
1. Auxiliary control booster switches	ON	CP	1. Pressure and temperatures	NORMAL
2. Wing flap lever	60%	CP	2. Air conditioning panel	SET
3. Anti-collision and exterior light switches	AS REQUIRED	P, CP	a. Auxiliary vent knob position A, cooling doors closed.	
			3. Recirculating fans	OFF

Note

Anti-collision light operation on the ground should be kept to a minimum. Excessive heat on the ground shortens bulb life. Also, during ground emergencies, the operating light could confuse rescue operations since emergency ground vehicles use a similar light.

(4.) Propeller controls	FULL INCREASE	CP	(4.) Propeller controls	FULL INCREASE
a. Master lever and toggle switches—Full increase rpm.			a. Master lever and toggle switches full increase rpm.	
(5.) Auxiliary fuel pump switches (takeoff tanks)	HIGH	CP	(5.) Auxiliary fuel pump switches (takeoff tanks)	HIGH
6. Takeoff clearance	RECEIVED	CP		
(7.) Mixture levers	AUTO RICH	CP	(6.) Mixture levers	AUTO RICH
8. IFF/SIF controls	AS REQUIRED	P		
			Note Cylinder head temperatures should be below 200° C and oil temperatures above 40° C.	
(9.) Engineer's Lineup checklist	COMPLETED	CP	(7.) Engineer's Lineup checklist	COMPLETED

TAKEOFF CHECKLIST

	Pilots		*Flight Engineer*	
Pilot aligns the aircraft with the runway.				
1. Brakes	RELEASED	P		
(2.) Cowl flaps	SET (30%)	P	(1.) Cowl flaps	SET (30%)
3. Throttles	35 IN.	P		
(4.) Max Power	SET	P	(2.) Max Power	SET

Note

- As the brakes are released and after the aircraft starts to roll, the pilot calls for "Cowl flaps" and smoothly advances the throttles to approximately 35 in. The flight engineer sets the cowl flaps to 30% and states "Cowl flaps set." The pilot then calls for Max Power. The flight engineer acknowledges Max Power and smoothly advances the throttles to Max Power. Power application from idle to Max Power should take approximately 12 to 15 seconds.

- If an unsafe condition is noted by a pilot or flight engineer prior to reaching refusal speed, he will call "REJECT." The pilot will close the throttles and, if necessary, reverse. The copilot will ensure that the propeller reversing flap is pushed in, and will hold the yoke forward to minimize buffeting and to increase the effectiveness of nose wheel steering.

- The refusal speeds and refusal distance charts are based on the techniques of applying Max Power before brakes are released. This procedure should be used when takeoff performance is critical because of high gross weights, short runways, or power deviations.

5. Nose wheel steering	RELEASED AT 70 KNOTS	P

Note

At 70 knots, the pilot releases the nose wheel steering and maintains directional control with the rudders.

6. Yoke and reverse flag	STANDBY	CP
7. Back pressure on yoke 10 knots below V_2 airspeed	APPLIED	P

Note

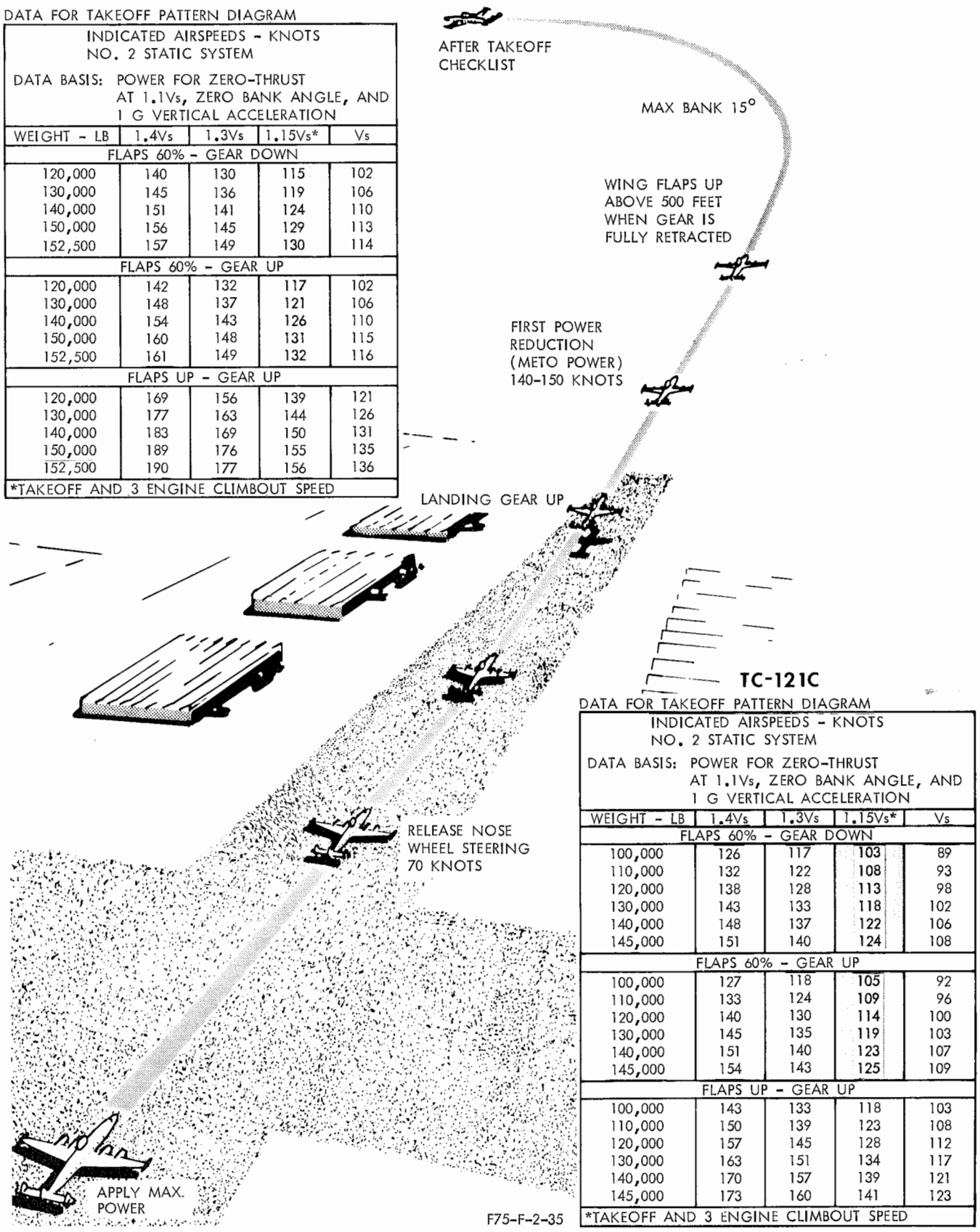
Apply slight back pressure on the yoke to relieve the weight from the nose wheel.

TAKEOFF PATTERN

EC-121D

DATA FOR TAKEOFF PATTERN DIAGRAM

INDICATED AIRSPEEDS - KNOTS NO. 2 STATIC SYSTEM DATA BASIS: POWER FOR ZERO-THRUST AT 1.1Vs, ZERO BANK ANGLE, AND 1 G VERTICAL ACCELERATION				
WEIGHT - LB	1.4Vs	1.3Vs	1.15Vs*	Vs
FLAPS 60% - GEAR DOWN				
120,000	140	130	115	102
130,000	145	136	119	106
140,000	151	141	124	110
150,000	156	145	129	113
152,500	157	149	130	114
FLAPS 60% - GEAR UP				
120,000	142	132	117	102
130,000	148	137	121	106
140,000	154	143	126	110
150,000	160	148	131	115
152,500	161	149	132	116
FLAPS UP - GEAR UP				
120,000	169	156	139	121
130,000	177	163	144	126
140,000	183	169	150	131
150,000	189	176	155	135
152,500	190	177	156	136
*TAKEOFF AND 3 ENGINE CLIMBOUT SPEED				



TC-121C

DATA FOR TAKEOFF PATTERN DIAGRAM

INDICATED AIRSPEEDS - KNOTS NO. 2 STATIC SYSTEM DATA BASIS: POWER FOR ZERO-THRUST AT 1.1Vs, ZERO BANK ANGLE, AND 1 G VERTICAL ACCELERATION				
WEIGHT - LB	1.4Vs	1.3Vs	1.15Vs*	Vs
FLAPS 60% - GEAR DOWN				
100,000	126	117	103	89
110,000	132	122	108	93
120,000	138	128	113	98
130,000	143	133	118	102
140,000	148	137	122	106
145,000	151	140	124	108
FLAPS 60% - GEAR UP				
100,000	127	118	105	92
110,000	133	124	109	96
120,000	140	130	114	100
130,000	145	135	119	103
140,000	151	140	123	107
145,000	154	143	125	109
FLAPS UP - GEAR UP				
100,000	143	133	118	103
110,000	150	139	123	108
120,000	157	145	128	112
130,000	163	151	134	117
140,000	170	157	139	121
145,000	173	160	141	123
*TAKEOFF AND 3 ENGINE CLIMBOUT SPEED				

Figure 2-3

TAKEOFF CHECKLIST—Continued

Pilots			Flight Engineer	
8. V_1 and/or V_2	____KN	CP		

The copilot will call out "V_1" (the maximum refusal speed) and V_2 (the takeoff and 3-engine climbout speed). Omit V_1 speed call if V_1 and V_2 are the same.

9. Fly off	V_2 SPEED	P		

The aircraft should be airborne at V_2 airspeed.

10. Landing gear lever	UP	P, CP		

Maintain a constant climbing attitude. After becoming airborne, do not lower the nose to gain speed. When well established in the climb, the pilot will call for gear up and give the closed-fist, thumb-up signal. After night takeoff, wait for red light on radio altimeter to go out before retracting the landing gear.

CAUTION

Do not apply the brakes to stop wheel rotation during gear retraction. Application of brakes will cause unnecessary stress on the gear structure.

Note

Gear retraction time is approximately 14 seconds.

The copilot will acknowledge the gear up command and move the landing gear lever to the UP position.

Note

If the gear lever will not go past the NEUTRAL position, insert a finger through the hole in the right side of the pedestal and push the solenoid pin out of the way.

(11.) METO power	SET	P	(3.) METO power	SET	

When the airplane reaches a safe distance above the ground, with an airspeed of 140 knots and a positive rate of climb established, the pilot will call for METO Power which the flight engineer will acknowledge and set.

TAKEOFF CHECKLIST—Continued

Pilots *Flight Engineer*

Note

The flight engineer will then move the aux vent knob to CLOSE and set the paddle switches to the desired cabin temperature.

WET OR SLIPPERY RUNWAY TAKEOFF.

Copilot must hold the yoke forward to prevent nosewheel skipping and to increase the effectiveness of nosewheel steering.

CROSSWIND TAKEOFF PROCEDURES.

The procedures for crosswind takeoffs which are different or in addition to normal takeoff are as follows:

a. During the initial takeoff run, allow the aircraft to accelerate to takeoff speed in the three point position.

b. Hold upwind wing down with aileron, as necessary.

c. Hold the yoke forward until takeoff speed is attained. Make a definite pull-off at takeoff speed, and crab into wind in order to make good a track in alignment with the runway.

AFTER TAKEOFF CHECKLIST

Pilots

1. Landing gear lever	NEUTRAL	CP
2. Wing flaps	UP	P, CP

When the gear is up, airspeed is at least 140 knots, and 500 feet altitude has been obtained, the flaps should be retracted. The copilot will ensure that the flaps are fully retracted before removing his hand from the flap lever. Flap retraction time is approximately 15 seconds. Maintain constant attitude and allow airspeed to increase to enroute climb speed (170 knots) as the flaps retract.

3. Landing lights	OFF AND RETRACTED	CP
4. Auxiliary control booster switches	OFF	CP
5. Static selectors levers	POSITION NO. 1	P, CP
6. Fumes check	COMPLETED	CP

Flight Engineer

Note

The ignition analyzer should be operating and frequent checks made during the climb. Maintain maximum allowable BMEP throughout the climb and take advantage of BMEP increase with altitude.

1. Auxiliary fuel pump switches	LOW
2. Auto feathering switch	OFF
3. Pressures and temperatures	CHECKED

Note

Monitor instruments closely during climb and maintain cleanest configuration possible without exceeding engine operating limits. Manual leaning to reduce high fuel flow is permissible only if calibration cards are installed.

4. Air conditioning	CHECKED

Position paddle switches for desired cabin temperature.

AFTER TAKEOFF CHECKLIST—Continued

Pilots			*Flight Engineer*	
			5. Recirculating fans	ON
			6. Overwing check	COMPLETED
			7. Nesa power switch	ALTERNATOR (up)
			8. Cabin altitude	AS REQUIRED
(7.) Engineer's After Takeoff checklist	COMPLETED	CP	(9.) Engineer's After Takeoff checklist	COMPLETED

Note

When METO power is set, the flight engineer or a designated crewmember will inspect the over-wing area for engine condition, and fuel siphoning. All crewmembers check cabin for fumes.

CLIMB.

The engine superchargers should be shifted from LOW to HIGH when the power allowed and available in high ratio exceeds that in low ratio, but do not shift below 10,000 feet pressure altitude. The flight engineer will notify the pilot when the shift is required and the pilot will notify the crew. The aircraft should be leveled and airspeed not allowed to decrease below 170 knots. Reduce power on all engines to 20 in. Hg and 1600 rpm, shift superchargers in pairs (engines 1 and 4, 2 and 3) to HIGH, then resume required power.

CAUTION

See Ops. Sup. 15-13 (Sept 66)

Power reduction and subsequent re-application will be handled in an expeditious manner but not so quickly that harmful engine deceleration or acceleration forces are encountered. If failure to shift to HIGH is indicated during shift or after power resumption, immediately move the lever of the affected supercharger to LOW. Continue flight in LOW.

INTERMEDIATE CLIMB CHECKLIST

Pilots			*Flight Engineer*	
			1. Mixture levers	AUTO RICH
			2. Manual spark switch	RETARD
			3. Climb power	SET
			4. Cowl and oil cooler flaps	SET
			5. Cabin altitude	AS REQUIRED
(1.) Engineer's Intermediate Climb checklist	COMPLETED	CP	(6.) Engineer's Intermediate Climb checklist	COMPLETED

CRUISE.

Cruise powers, above maximum cruise in the best economy range should not be used except in an emergency. Mixture will remain in AUTO RICH, the cleanest possible configuration established, and pressures and temperatures stabilized before manual leaning. Power settings should not be greater than those required for recommended long range cruise except when icing or emergency conditions are encountered.

Headwinds of more than 50 knots will require correction in power to make good the most ground nautical miles per pound of fuel. During airway flying, pilots should monitor the weather sequence broadcasts from radio range stations to keep informed of the existing weather trend along the route being flown. On over-water flights, obtain the weather broadcasts periodically on designated frequencies. Turbulence should be avoided as much as practicable. Continuous radar surveillance should be maintained during instrument conditions in order to circumnavigate thunderstorm areas.

Upon reaching the desired cruising altitude, level off and maintain climb power until cruise speed is obtained. The pilot will then call for cruise power which the flight engineer will acknowledge and set. Refer to Appendix for cruise control data, to Section VII for information regarding manual leaning, systems operation, and fuel systems management, and to Section IV for pressurization system operation.

The pilot should inspect logs, charts, and the weather periodically so that he is well informed on the current status of the aircraft and the mission.

Frequently check the automatic pilot heading against the magnetic compass. You could end up going in the wrong direction because of a malfunctioning flux gate compass.

Whenever power conditions are changed, or whenever the automatic pilot seems to cause the aircraft to porpoise during cruise, turn the automatic pilot off and retrim the aircraft; carefully reset and re-engage the automatic pilot.

During cruise flight, crewmembers should mentally review the procedures for coping with various emergencies that might be encountered.

CRUISE CHECKLIST

Pilots

Flight Engineer

1. Cowl flaps — SET
2. Oil cooler flaps — SET
3. Manual spark switch — AS REQUIRED

Refer to Section VII for manual spark operating procedures.

4. Mixtures — 10% LEAN

Refer to Section VII for the Manual Leaning procedure and CHT Comparison Fuel-Air-Distribution.

5. Fuel tank selector levers — AS DESIRED

Shift fuel tanks and/or crossfeeds as necessary in accordance with recommended usage outlined in Section VII. After the aircraft is established in the cruise configuration, the second engineer will proceed aft and inspect the cabin for security of cargo and/or comfort of passengers. When the last item on the checklist has been accomplished, state: CRUISE CHECKLIST COMPLETED.

The pilot acknowledges:

CRUISE CHECKLIST COMPLETED.

DESCENT.

The pilot should notify the crew prior to starting a descent. Prior to reducing power the flight engineer should scan the ignition analyzer for engine malfunction and note discrepancies in the Form 781. Descent should be planned at a sufficient distance from destination so as to reach the desired altitude at the proper time without the use of flaps. Standard power settings for descent is 1800 rpm and 120 BMEP. If a high rate of descent is desired, a power setting of 1700 rpm and approximately 110 BMEP will usually allow 1000 feet-per-minute rate of descent without exceeding placarded airspeeds. When leaving an altitude requiring high-blower operation and descending to an altitude in the low-blower range, the shift from HIGH to LOW will be made upon reaching an altitude that can be maintained in LOW. During normal descent 1-inch Hg should be maintained for each 100 rpm. Under normal descent conditions, the mixtures may be left in manual lean position. Even if power is reduced while maintaining the fixed manual lean position, there will be little change in mixture strength. The pressurization controls should be adjusted to insure a comfortable rate of depressurization (usually 300 feet-per-minute) so that the cabin altitude will reach 1000 to 1500 feet above the pressure altitude of the field by the time the aircraft reaches that level.

The flight engineer should refill by transfer all engine oil tanks to a minimum of 220 pounds so that it will be necessary to service only the auxiliary oil tanks upon completion of the flight.

DESCENT CHECKLIST

Pilots

1. Crew briefing	COMPLETED	P

Note

The pilot will brief the copilot on the approach procedure to be used. The copilot will call out minimum altitudes, abnormal airspeeds, etc. The pilot will advise the flight engineer when he is taking over throttle operation. Prior to entering the traffic pattern, slow the aircraft to 170 knots and request Descent checklist.

Note

Before landing, the pilot should assure that all crew members are seated with seat belts fastened. Shoulder harnesses should be worn if unusual conditions make it advisable.

2. Automatic pilot	AS REQUIRED	P
3. Altimeters and radar altimeters	SET	P, CP

Note

Set landing minimums on radar altimeter and use as cross reference.

Flight Engineer

1. Fuel tank selectors	LANDING TANKS ON

Note

During training or frequent landings, tanks 1, 2, 3 and 4 may be used to prevent undesirable fuel loading.

2. Tank No. 5 and fuel crossfeed levers	CLOSED
3. Carburetor alternate fuel source switches	NORMAL
4. Cowl and oil cooler flaps	SET
5. Carburetor alternate air switches	SET
6. Carburetor air switches	SET

Note

Normally, the carburetor air switches should be in the COLD and RAM position. However, if icing conditions are present on the final approach use ALTERNATE air and apply heat as required. Do not exceed 30° C CAT when heat is applied.

DESCENT CHECKLIST—Continued

Pilots			Flight Engineer	
4. Auxiliary control booster switches	ON	CP		
			CAUTION Sudden removal of carburetor heat may dislodge ice from in front of the preheat door. This could cause a dangerous loss of power at low altitudes. In the event of a go-around, carburetor air temperature should be monitored so as not to exceed 30° C.	
			7. Manual spark	RETARD
			Note The ignition analyzer should be on to check operation of the manual spark.	
			8. Engine superchargers	LOW
			9. Cabin altitude	SET FOR LANDING
(5.) Seat belt, shoulder harness, pins and seat	SET AND LOCKED	P, CP	(10.) Seat belt and seat	ADJUSTED AND LOCKED
			Check pilots' seat pins in place.	
(6.) Engineer's Descent checklist	COMPLETED TO MIXTURES	CP	(11.) Engineer's Descent checklist	COMPLETED TO MIXTURES
(7.) Mixture levers	AUTO RICH	CP	(12.) Mixture levers	AUTO RICH
			Note Always move the mixture levers one at a time to preclude loss of all engines should the levers inadvertently be placed in the OFF position instead of AUTO-RICH.	
(8.) Hydraulic system crossover switch	AS REQUIRED	P	(13.) Hydraulic system crossover switch	AS REQUIRED
(9.) RPM 2400	RPM 2400 SET	P	(14.) RPM 2400	RPM 2400 SET
10. Wing flaps 60%	60% SET	CP		
(11.) Landing weight	_____ POUNDS	CP	(15.) Landing weight	_____ POUNDS
			Note The flight engineer will estimate the landing gross weight and CG from the log form. From this information the pilot will determine the minimum approach and flare-out speeds. Compute the minimum landing runway length required if this is critical.	

12. WINDSHIELDS WASHED - AS REQUIRED. (IAW OS 15-12 22 JULY 66 & OS 15-14 30 SEPT 66)

BEFORE LANDING CHECKLIST

	Pilots			*Flight Engineer*	
1.	Landing lights and windshield wipers	AS REQUIRED	P, CP		
2.	Deicer boots (pneumatic control)	OFF	P		
(3.)	RPM 2600	RPM 2600 SET	P	(1.) RPM 2600	RPM 2600 SET
4.	Landing gear	DOWN AND LOCKED	CP	2. Auxiliary fuel pump switches	HIGH (landing tanks)
	Pilot will visually check the gear position indicator for a down-and-locked indication.			3. Cowl and oil cooler flaps	SET
5.	Brakes	CHECKED AND ON NORM	CP	4. Propeller circuit breakers	CHECKED
	Note After the landing gear is down and locked, move the brake selector lever to EMER position. This charges the accumulators. Depress pedals and note emergency pressure gage for a drop then buildup of pressure. This checks the emergency brake system. Place the brake selector in NORM position and depress the brake pedals for about 5 seconds. This procedure not only checks the normal brake system, but also replenishes the fluid in the lockout deboosters in the emergency brake system.			5. Air-conditioning panel	SET
(6.)	Engineer's Before Landing checklist	COMPLETED	CP	(6.) Engineer's Before Landing checklist	COMPLETED

LANDING PROCEDURES.

CAUTION

Until T.C.T.O. 1C-121(R)D-550B is incorporated (providing kits and instructions for reinforcement of the APS-95 antenna supporting structure) every effort shall be made to touch down as smoothly as possible during landing.

Note

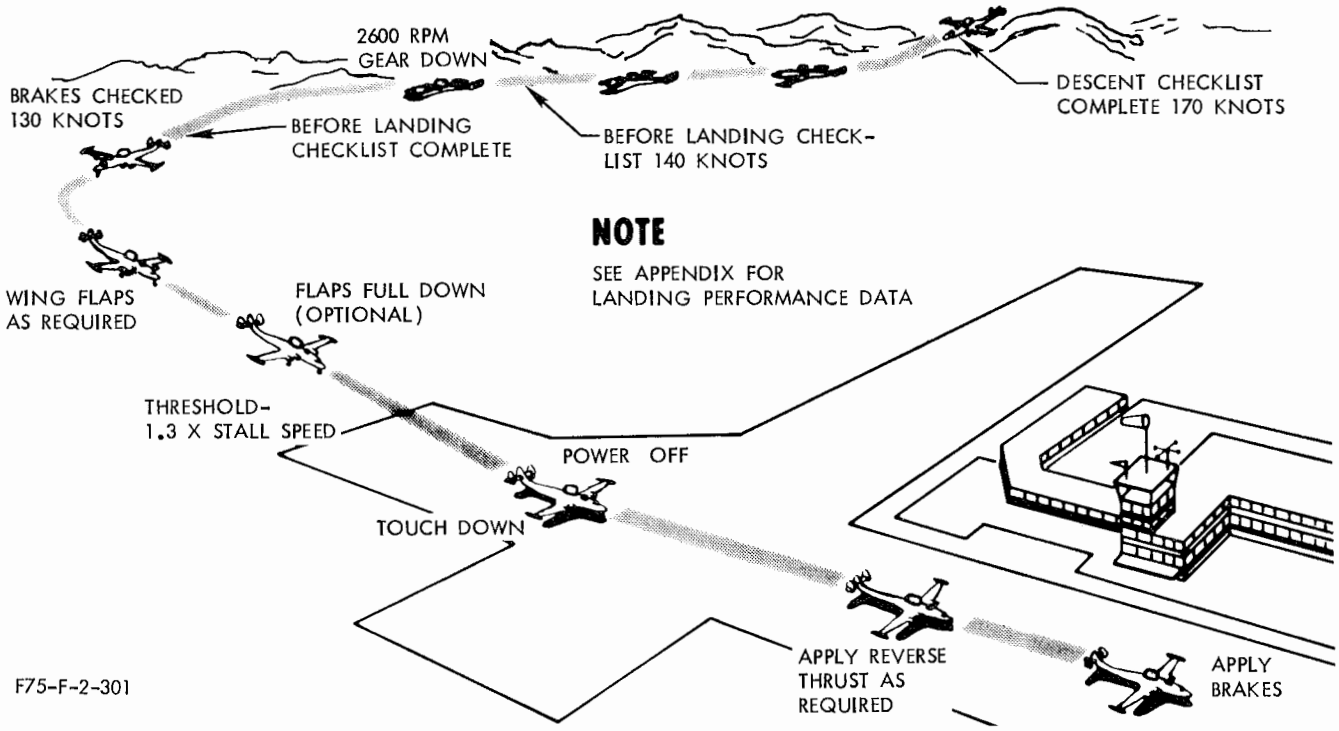
Every approach and landing should be planned as though propeller reversing is not available.

After the wing flaps have been extended to the 60% position and the downwind portion of the traffic pattern has been entered, airspeed should be 140 knots, which is the recommended airspeed for level flight in the traffic pattern. Downwind leg altitude is 1000 to 1200 feet above terrain, or as applicable to local airport traffic regulations.

Under normal conditions the pilot will always advise the flight engineer when he desires to set his own power during let down and landing, or at any time that he deems it advisable. Standard procedure is for the pilot to call for fixed power settings, such as maximum power, METO climb power, or cruise power.

On downwind leg, flight engineer will close all scoop doors, set cowl flaps as desired, and oil cooler flaps as required to maintain 70° C to 85° C oil-in temperature. Over the boundary, turn off cabin heaters, recirculating and flight station fans, and turn auxiliary vent knob to position A. The pilot will handle the

LANDING PATTERN



DATA FOR LANDING PATTERN DIAGRAM

EC-121D

INDICATED AIRSPEEDS - KNOTS
NO. 1 STATIC SYSTEM

DATA BASIS: POWER FOR ZERO-THRUST AT 1.1Vs, ZERO BANK ANGLE, AND 1 G VERTICAL ACCELERATION

WEIGHT - LB	1.3Vs*	1.2Vs	1.1Vs**	Vs
FLAPS UP - GEAR UP				
90,000	140	130	120	110
100,000	147	136	125	115
110,000	153	143	132	120
122,000	162	150	138	126
FLAPS 60% - GEAR UP				
90,000	117	109	101	92
100,000	123	114	105	97
110,000	130	120	110	101
122,000	136	126	116	106
FLAPS 60% - GEAR DOWN				
90,000	115	106	98	89
100,000	121	112	102	93
110,000	127	118	108	98
122,000	134	124	113	103
FLAPS 80% - GEAR DOWN				
90,000	110	102	93	85
100,000	116	107	98	90
110,000	122	112	103	94
122,000	128	119	109	99
FLAPS 100% - GEAR DOWN				
90,000	108	100	92	84
100,000	114	105	97	88
110,000	120	110	101	92
122,000	126	117	107	97

* NORMAL THRESHOLD SPEED
** NORMAL TOUCHDOWN SPEED

TC-121C

INDICATED AIRSPEEDS - KNOTS
NO. 1 STATIC SYSTEM

DATA BASIS: POWER FOR ZERO-THRUST AT 1.1Vs, ZERO BANK ANGLE, AND 1 G VERTICAL ACCELERATION

WEIGHT - LB	1.3Vs*	1.2Vs	1.1Vs**	Vs
FLAPS UP - GEAR UP				
90,000	131	121	111	101
100,000	138	127	117	107
110,000	144	134	123	112
122,000	151	140	128	117
FLAPS 60% - GEAR UP				
90,000	116	107	98	90
100,000	122	112	103	94
110,000	127	118	108	99
122,000	134	124	114	104
FLAPS 60% - GEAR DOWN				
90,000	115	106	97	89
100,000	121	112	102	93
110,000	127	117	107	98
122,000	133	123	113	103
FLAPS 80% - GEAR DOWN				
90,000	105	97	90	81
100,000	110	102	94	85
110,000	116	107	98	89
122,000	122	112	103	94
FLAPS 100% - GEAR DOWN				
90,000	102	94	86	78
100,000	108	99	91	82
110,000	113	104	95	86
122,000	119	110	100	91

* NORMAL THRESHOLD SPEED
** NORMAL TOUCHDOWN SPEED

Figure 2-4

throttles during the final approach and landing, unless he considers it advisable to have the copilot or flight engineer handle them. Example: If the copilot is to handle the throttles, the pilot will state "Copilot throttles." The copilot will acknowledge "Copilot throttles." Power changes will be requested as follows: "Manifold two-eight, manifold three-zero, etc."

Landing on Wet or Slippery Runways.

When landing on wet runways, apply the brakes lightly and intermittently during the initial phase of the landing run. After most of the weight is on the landing gear, more brake pedal may be used, but the applications must continue to be intermittent. Flaps shall be raised as soon as the wheels are solidly on the ground. It should be remembered that braking efficiency increases as weight on the wheels increases. Furthermore, as the weight on the landing gear increases the tires tend to flatten out and force the water out from under them, thereby greatly increasing their traction. Reversing also helps to put a load on the main wheels. (Refer to RCR chart, figure A3-20, in the Appendix.)

Crosswind Landings.

Except in an emergency, 30 knots is the maximum allowable perpendicular component. In making a crosswind landing, the following variations must be taken into consideration:

a. Direction and velocity of the wind.

b. Condition and length of the runway.

c. Crosswind component.

d. Gustiness of the wind.

The three approved methods of making a crosswind approach are:

a. Lower the upwind wing.

b. Crab into the wind.

c. Combination of the first two methods.

Landings in crosswind conditions require careful attention and skillful handling on the part of the pilot. Make the approach slightly longer and lower than usual. This will aid in establishing a definite ground track in line with the runway center line. Maintain a safe margin of speed. Extend wing flaps as desired. In strong or gusty crosswinds it may be desirable to use less than 100 per cent flaps. Remove crab just before contact with the runway. Pilots must be careful not to overcontrol on the rudder when straightening out from the heading used to correct for drift. Land airplane on the main wheels first. It is preferable to set the aircraft down on the upwind gear rather than allowing it to strike the runway in a crab. Place the nose wheel on the runway and exert forward pressure on the yoke. Keep sufficient aileron rolled in to hold the upwind wing down.

Note

The high dihedral angle in the wing exposes the upwind wing to lifting which introduces the possibility of dragging the opposite wing during a crosswind landing. Prior to landing, the copilot should be instructed to hold the ailerons during the roll out so that the upwind wing will not be lifted by the wind. Flaps should be raised as soon as the wheels are on the ground.

Refer to the Appendix for crosswind components.

No Flap Landings.

When making a no-flap landing and approach, the airspeed downwind should be maintained at 150 knots. The power required for this airspeed for normal landing weights is approximately 25 in. Hg MAP. At the desired point of the downwind leg call for the Before Landing Checklist. Make the turn to base leg so that the final approach will be longer than normal. Speed throughout the base leg and on the long final should be maintained at 135 to 145 knots, depending upon gross weight. Flare at 130 knots, using power as necessary. Do not allow the aircraft to float. Fly it on and commence reversing as soon as possible while the speed is high.

Short Field Landings.

The following procedure shall be used for short field landings:

a. The approach speed will be 1.3 times the stalling speed.

b. Make the approach lower with power on, using 100 percent wing flaps.

c. Aim for a spot slightly short of the runway so that the flare out will carry the aircraft over the end of the runway. This will result in a touchdown within

the first available part of the runway instead of somewhere within the first third, as in a normal landing.

d. Get the nosewheel on the runway and apply reverse thrust as soon as possible.

e. To obtain maximum braking, first apply reverse thrust (this increases weight on the wheels), then apply brakes by partly depressing the brake pedals and gradually increasing braking pressure up to the maximum possible without sliding the tires.

f. For landing distance over a fifty foot obstacle, refer to the Appendix.

Heavy Landing.

a. In the event an overgross landing is *necessary*, make a power-on approach at an airspeed of 1.3 times the stall speed.

b. Make a power-on landing.

c. During the landing roll use reverse thrust and brakes to decelerate.

LANDING PROCEDURES

Pilots ***Flight Engineer***

a. Airspeed—130 knots. P

Start a descending turn onto the base leg and reduce airspeed to 130 knots. Taper final approach airspeed from 130 knots to 1.3 times the stall speed when over the threshold. Airspeed should be maintained at 130 knots until the desired amount of wing flaps are extended for landing. Beware of getting low and slow on the final approach. When adding power to prevent such a situation, don't be stingy. It's better to add too much than too little.

b. Wing Flaps lever—As required. P, CP

c. Threshold speed—As required. P

d. Flare and landing—15 to 17 in. P

A gradual reduction of the power after initial flare-out should be made at a rate commensurate with airspeed and gross weight. Better landings usually can be made if a little power is left on until touchdown. Gear warning horn may be inoperative with throttles advanced. Power normally should never be all the way off until flare is completed. Be alert for rapid settling of the aircraft during flareout. The touchdown should be made in a slightly nose-high attitude.

e. Power—Off. P

After touchdown, remove all power and ease the nosewheel to the runway as soon as possible without allowing it to strike too hard. When the nosewheel touches, place

LANDING PROCEDURES—Continued

Pilots

the left hand on the nosewheel steering wheel and the right hand on the reversing throttles. Remember that the rudder is a more effective means of directional control than nosewheel steering at speeds above approximately 70 knots. Premature use of nosewheel steering may cause it to skid sideways.

f. Nosewheel—Lowered to runway. P

g. Yoke and reverse flag—Standby. CP

h. Nosewheel steering—Hand on wheel. P

i. Propeller reversing—Applied (optional). P

Note

The flight engineer will monitor engine instruments and mixture controls during reversing and unreversing to prevent loss of engines. Loading up of engines may cause one to die during the reversing and unreversing cycle. The copilot will report when the reverse lights come on.

Note

Reversing is most effective at speeds above 80 knots and should, therefore, be initiated as soon as possible after the nosewheel touches the runway. Pull reversing throttles on for a small amount of power until the lights come on; then apply power evenly and positively. Don't be too slow applying reverse power or an engine may die. Under normal circumstances, applying reverse power to about 1200 to 1500 rpm will be sufficient. This will give approximately 60 percent of full braking effectiveness, provided the power is applied at relatively high groundspeed. Full reversing may be utilized if circumstances require maximum braking. After aircraft has decelerated to 50 knots, move the throttle out of reverse to forward thrust with a positive action. This procedure will prevent engine overheating at the lower speeds.

WARNING

If a propeller fails to go into reverse, (usually indicated by a failure of reversing light to come on), forward thrust will be applied when the reverse throttle is pulled back. If difficulty is encountered in maintaining directional control during the reversing period because of the reversing system, move the throttles to forward thrust idle immediately.

Flight Engineer

After reversing cycle is initiated and the feathering button lights come on, accomplish the following:

a. Cowl flaps—OPEN.

b. Propeller master lever—Full INC RPM.

c. Oil cooler flaps—OPEN.

During reversing, the engineer will monitor the feathering button lights. If one should fail to light, he will use the term "NO LIGHT ON No.____." If a propeller will not come out of reverse and there is sufficient rpm to provide normal electrical power, depress the feathering button. If this does not bring the propeller out of reverse, apply full decrease rpm while slowly opening the throttle until the governor setting is exceeded. At this point rpm will rise rapidly and then fall. Open the throttle further to assure that the propeller is in forward pitch.

After reversing is completed, accomplish the following (if required):

a. Auxiliary fuel pumps—Off.

b. Recirculating fan switches—On.

c. Flight station fan switch—On.

LANDING PROCEDURES—Continued

Pilots		Flight Engineer
j. Propeller unreversing	As required	P
k. Brakes	As required	P

The copilot will note the hydraulic system and brake accumulator gage readings immediately after the first brake application upon landing and be prepared to operate the hand pump immediately for brake pressure. In the event of loss of braking, or of secondary system pressure or fluid, the brake selector lever should be placed to EMER. immediately so that accumulator pressure and the lockout feature of emergency brakes can be utilized. Additional pressure should be supplied with the hand pump.

GO-AROUND.

When the decision is made to make a go-around, the following steps will be performed:

a. The pilot will call for the flight engineer to set METO POWER or MAX. POWER if required.

b. The pilot will call for the copilot to retract the wing flaps to the 60% position.

c. At least V_2 airspeed will be maintained after the flaps have been retracted to the 60% position.

d. The pilot will call for gear up only after the flaps are set at 60% and after it is certain that the aircraft will not settle to the runway. The copilot will acknowledge the order for gear up and place the landing gear lever in the UP position.

Note

- The flaps are retracted to 60% position before raising the gear because flap drag is greater than gear drag when the flaps are extended beyond 60%. If the gear and flaps are retracted simultaneously, both are slowed in retraction time because of the large demand placed on the hydraulic system.
- If maximum climb performance is required, climb at V_2 airspeed during aircraft clean-up.

e. After the landing gear has retracted, the flaps may be fully retracted or left in the 60% position, depending upon the course of action the pilot decides to take.

Note

If the pilot decides to remain in the traffic pattern for another approach and landing or another instrument approach, more stable flight characteristics will be realized if the flaps are left at 60% while flying the pattern at 140 knots. If the pilot decides to proceed enroute the flaps may be fully retracted. Allow airspeed to increase to enroute-climb speed (170 knots) as the flaps retract and complete After Takeoff checklist.

TOUCH AND GO LANDINGS.

Touch and go landings are feasible in this aircraft and may be accomplished when authorized or directed by the major command concerned. Since actions must be executed while rolling on the runway, it is recomended that a well qualified pilot occupy one of the pilot positions during this maneuver. The procedure for touch and go landings is:

Before Landing.

a. The landing approach will be accomplished as if a full stop landing were to be made.

b. The pilot will brief the copilot to neutralize the elevator trim tab and retract the wing flaps to 60% after touchdown and on command of the pilot.

On the Runway.

a. After touchdown, the nosewheel will be lowered to the runway in the normal manner prior to any application of power.

b. Pilot calls for wing flaps to 60%. The copilot places the wing flap selector handle in the 60% position.

c. Pilot calls for elevator trim neutral. The copilot neutralizes elevator trim.

d. Pilot advances the throttles smoothly toward METO power as soon as the wing flaps start retracting and directs the flight engineer to set METO power.

e. Continue takeoff using normal procedures.

After Takeoff.

a. Normal After Takeoff procedures apply unless an emergency is simulated. (For emergency procedures, refer to Section III.)

AFTER LANDING CHECKLIST

	Pilots	
1. IFF/SIF controls	OFF	P

Turn IFF OFF as soon after landing as possible. This will eliminate signals from taxiing or parked aircraft which would otherwise block the controller's scope and interfere with the control of airborne aircraft.

2. Wing flaps	AS REQUIRED	CP

Note

Wing flaps may be left in the 60% position if another takeoff is to be made. They also may be left down if the aircraft is to be parked. Flaps must be retracted if a post flight check is to be performed.

CAUTION

When landing on gravel runways, it is possible for rocks and gravel to be carried into the wing flap well and jam the flap mechanism upon retraction. If this occurs, the flaps should be left in whatever position was used for landing until the flap tracks and chains can be inspected and cleaned. Further ground operation shall be at minimum power to prevent damage to aircraft.

3. Auxiliary control boosters	OFF	CP
4. Pitot heaters	OFF	CP
5. Nesa windshield	OFF	CP

	Flight Engineer
1. Propellers	CHECKED, FULL INCREASE
2. Cowl and oil cooler flaps	CHECKED, OPEN
3. Fuel pumps	CHECKED, OFF
4. Nesa power	OFF

Note

This checklist is to be read after the aircraft is clear of the active runway.

AFTER LANDING CHECKLIST—Continued

	Pilots			Flight Engineer	
6.	Anti-collision light	OFF	P		
7.	Exterior lights master switch	FLASH (if applicable)	CP		
8.	Wheel well lights	ON	P		
9.	Unnecessary radios	OFF	CP		
(10.)	Engineer's After Landing checklist	COMPLETED	CP	(5.) Engineer's After Landing checklist	COMPLETED

Note

If any engine malfunction was evident during descent and the ignition analyzer was not in operation, a magneto check should be made prior to engine shutdown. The Engineer Engine Runup procedure outlined in this section should be accomplished. Note all discrepancies on the Form 781. Engines will be idled at 1000 rpm or above for 30 seconds immediately prior to engine shutdown to allow for scavenging of crankcase oil to reduce the possibility of hydraulic or liquid lock. Taxi time may be counted as a portion of this period.

ENGINE SHUTDOWN CHECKLIST

	Pilots			Flight Engineer	
1.	Brake selector lever	EMERGENCY	P, CP	1. Magneto ground	CHECKED

With the throttle closed, the ignition switch should be placed to OFF momentarily to check for possible open circuit.

CAUTION

- Brake selection should be accomplished prior to entering a congested area. If the aircraft is stopped and the brake selector lever is inadvertently left in the NORM position, release the brakes, move the lever to EMER, and reapply the brakes. Never move the selector lever with brakes on.
- Avoid taxiing for extended periods of time in the EMER BRAKES position or operating the wing flaps while in that position. It is possible to deplete available emergency system pressure and in the event of a secondary hydraulic failure be without brakes.

2.	Wing flaps	100%	CP
3.	Parking brakes	SET	P

Note

Illumination of the parking brakes light is not a definite indication that the parking brakes are set because the parking brakes lever merely operates a microswitch which closes the circuit to the light. Brake hydraulic pressure must be up before the parking brakes will hold. The parking brakes can be set with the brake

ENGINE SHUT DOWN CHECKLIST—Continued

Pilots			*Flight Engineer*	
Note selector lever in NORMAL provided the engines are running and normal hydraulic system pressure is up. If the parking brakes are set after the engines are shut down, the brake selector must be in the EMER. position. The parking brakes are released by applying toe pressure to the rudder pedals. The parking brakes light should go out after the brakes are released.				
(4.) Mixture levers	OFF	P	(2.) Mixture levers	OFF
5. Ignition switches	OFF	P	3. Unnecessary switches	OFF (except generators)
After engines are stopped.				
6. All unnecessary switches	OFF	P, CP	4. Gear pins and pitot covers	INSTALLED
			Note At intermediate bases, the gear pins will be installed by the flight engineer.	
7. Instrument panel lights	OFF	P, CP		
(8.) Engineer's Engine Shutdown checklist	COMPLETED	P	(5.) Engineer's Engine Shutdown checklist	COMPLETED

BEFORE LEAVING THE AIRCRAFT CHECKLIST

Pilots			*Flight Engineer*	
1. Wheel chocks	IN PLACE	CP	1. Postflight walk-around	COMPLETED
2. Parking brakes	OFF	P	2. Carburetor air switches	AS REQUIRED
3. Windows	CLOSED	P, CP	3. Cowl and oil cooler flaps switches	AS REQUIRED
4. IFF/SIF codes	REMOVED	P	4. Battery switch	OFF
			5. Night lights	OFF
			6. Doors	CLOSED

CAUTION

In addition to established requirements for reporting any system defects, unusual and excessive operations, the flight crew will also make entries in Form 781 to indicate when any limits in the Flight Manual have been exceeded.

ALERT PROCEDURES.

PREFLIGHT.

Accomplish the Before Interior Inspection, Interior Inspection, Exterior Inspection and Before Starting Engines Cheklists as set forth in the normal checklist.

COCKING.

Checklist items have been rearranged so that all items that can be checked or pre-set ahead of time will be accomplished prior to the FLUSH order. To cock the aircraft the flight crew will accomplish the additional Preflight, Starting Engines, Engine Warmup, Engine Shutdown and Pre-starting Engines Checklists. When these checklists have been accomplished the aircraft is cocked for a FLUSH departure.

FLUSH.

When the FLUSH order is received the flight crew will accomplish the Starting Engines, Before Taxi, Taxi, and Before Takeoff and Lineup Checklists. The pilot will insure that the aircraft is clear of congested area prior to accomplishing the Taxi and Before Takeoff and Lineup Checklists. When clear of individual aircraft rows the aircraft may be taxiied at a fairly brisk speed (5-10 mph) if aircraft/vehicle traffic and pedestrian traffic permits. When clear of the congested area and on open taxi lanes, your taxi speed is governed only by other airdrome aircraft/vehicle traffic and safe spacing between FLUSH aircraft.

CAUTION

Slow down before making sharp turns. THE NOSE GEAR WILL NOT WITHSTAND HEAVY SIDE LOADS.

TAKEOFF.

After the Before Takeoff and Lineup Checklists have been accomplished, return to the normal checklist beginning with "TAKEOFF CHECKLIST."

TAXI BACK.

If a FLUSH is practiced where a takeoff is not accomplished, the aircrew will cock or uncock the aircraft as directed. If the aircraft is to return to the alert status, the pilot and flight engineer will accomplish their cocking checklists with the exception of the Engine Warmup Checklist.

UNCOCKING.

To uncock the aircraft the pilots and flight engineer will accomplish the After Landing, Engine Shutdown and Before Leaving the Aircraft checklists. All aircraft will be uncocked when the alert is terminated unless directed otherwise.

Ground Crewmen And Second Flight Engineer Flush Duties:

Two ground crewmen with the assistance of the second flight engineer are required to support the alert plan when the FLUSH order is received. The ground crewmen will be identified as the right wing and left wing ground crewmen. Upon receipt of the FLUSH ORDER crew duties are as follows:

Right Wing Ground Crewmen:

Proceed as rapidly as possible to the fire extinguisher at the right wing tip, check area clear and stand fire guard for Nr 3 and Nr 4 engines. After Nr 3 and Nr 4 engines have been started, pull the right wheel chock, disconnect ground power and move MD-3 to parking spot if MD-3 is used. (DO NOT WAIT FOR SIGNAL FROM AIRCRAFT COMMANDER.)

Left Wing Ground Crewman:

Proceed as rapidly as possible to the right main gear and pull the main gear pin, then proceed rapidly to the left main gear and pull the left gear pin if you arrive before the second engineer, give pin(s) to the second engineer and remove and park the crew stand after the second engineer boards the aircraft. Proceed to the fire extinguisher at the left wing tip, clear area and stand fire guard for Nr 1 and Nr 2 engines. After engines Nr 1 and Nr 2 engines have been started pull left wheel chock (DO NOT WAIT FOR SIGNAL FROM AIRCRAFT COMMANDER.) Proceed to a point ahead of the left wing tip, check area clear and give clear to taxi signal.

Second Engineer:

Proceed as rapidly as possible and pull the nose gear pin, then proceed rapidly to the left main gear and pull the pin if you arrive before the left wing ground crewman, receive pin(s) from left ground crewman. Get aboard and close the rear door, proceed to the cockpit and notify the copilot that the landing gear pins are aboard.

WARNING

DO NOT WALK THROUGH THE PROPELLER ARC.

If more or less than two ground crewmen are available for alert duties the aircraft commander will brief the ground crew of their specific duties. Ground crew checklists are outlined in Section VIII of this manual.

SECOND FLIGHT ENGINEER FLUSH DUTIES.

When the FLUSH ORDER is received the second engineer must accomplish his duties as rapidly as safety permits. (DO NOT WAIT FOR SIGNAL FROM AIRCRAFT COMMANDER.)

1. Nose gear pin—Removed.

WARNING

DO NOT WALK THROUGH PROPELLER ARC.

2. Left main gear pin—Removed, if you arrive before left ground crewman.

3. Receive pin(s) from left wing crewman, and get aboard aircraft.

4. Rear entrance door—Closed.

5. Landing gear pins—Aboard (notify copilot).

PREFLIGHT CHECKLIST

Pilots	*Flight Engineers*
REFER TO: T.O. 1C-121(E)D-1CL-1	REFER TO: T.O. 1C-121(E)D-1CL-2

BEFORE STARTING ENGINES CHECKLIST

Pilots	*Flight Engineers*
REFER TO: T.O. 1C-121(E)D-1CL-1	REFER TO: T.O. 1C-121(E)D-1CL-2

STARTING ENGINES CHECKLIST

Pilots	*Flight Engineers*
REFER TO: T.O. 1C-121(E)D-1CL-1	REFER TO: T.O. 1C-121(E)D-1CL-2

COCKING CHECKLISTS
ADDITIONAL PREFLIGHT CHECKLIST

Pilots			*Flight Engineers*
1. Navigational radios	TUNED & SET TO DESIRED STATIONS THEN OFF	P	
2. IFF/SIF	STANDBY	P	
3. Central gyro reference system light (EC-121D)	NORMAL ERECT LIGHT ON	CP	

ADDITIONAL PREFLIGHT CHECKLIST—Continued

	Pilots		Flight Engineers
4. Exterior lights	SET	P, CP	
5. Radar altimeter	SET TO 50′	P	
6. Flight director system (EC-121D)	HEADING FUNCTION SET	P	
7. Forward crew door and windows	CLIMATIC	P, CP, FE	
8. Trim tabs	SET	P	
9. Auto pilot	OFF	P	
10. Static selector levers	NR 2 POSITION	P, CP	
11. Crew takeoff briefing	COMPLETED	P, CP, FE	
12. Takeoff and landing data	REVIEWED	P, CP	

ENGINE WARMUP CHECKLIST

	Pilots		Flight Engineers
(1.) Landing gear pins, pitot covers and ground crew headset	ABOARD	CP	(1.) Landing gear pins, pitot covers and ground crew headset — ABOARD
2. Wing flap lever	60%	CP	2. Mechanic's (ICS) switch — OFF
3. Vacuum system pressure	CHECKED (4 to 4.75″ Hg)	P	3. Ignition analyzer switch — ON
4. Emergency ICS, PA system and alarm bell	CHECKED	P	4. Carburetor deicer (Switches ON until rpm drops. Do not exceed 10 seconds, then OFF.) — CHECKED

ENGINE WARMUP CHECKLIST—Continued

Pilots			*Flight Engineers*	
			5. Alternate fuel	CHECKED
			Note If these switches are left in EMERGENCY too long, an excessively rich mixture may result.	
			6. Fuel inlet screen deicing system	CHECKED
			7. Carburetor air	CHECKED & COLD
			CAUTION Do not check carburetor deicing and heat at the same time because fire or faulty indication may occur.	
			8. Engine instruments	NORMAL
			9. Air conditioning	CHECK AND SET
(5.) Propeller reversing	CHECKED	P	(10.) Propeller reversing	CHECKED
6. Deicer boots	CHECKED AND OFF	P	11. Propeller and ignition system	CHECKED
7. Engine and flight instruments	CHECKED AND SET	P, CP	a. Master propeller lever—INC RPM.	
8. Flight controls	FREE	P	b. Throttle levers—Set engines 1 and 4 to 1500 RPM.	
			c. Check manual feather, INC and DEC on master lever and manual toggle switches.	
			d. Check each spark plug using ignition analyzer.	
			e. Repeat procedures on engines 2 and 3.	

ENGINE WARMUP CHECKLIST—Continued

Pilots			Flight Engineers	
			12. Manual Spark	CHECKED AND RETARD
(9.) Engineer's Warmup Checklist	COMPLETED	CP	(13.) Engineer's Warmup Checklist	COMPLETED

ENGINE SHUTDOWN CHECKLIST

Pilots			Flight Engineers	
1. Brake selector lever	EMER	P, CP		
2. Parking brakes	SET	P		
3. Wing flap lever	60%	CP		
(4.) Ground power	REINSTALLED	CP	(1.) Ground power	REINSTALLED
(5.) Mixture levers	OFF	P	(2.) Mixture levers	OFF
6. Ignition switches	OFF	P	3. Landing gear pins	REINSTALLED
(7.) Engineer's Engine Shutdown Checklist	COMPLETED	P	(4.) Engineer's Engine Shutdown Checklist	COMPLETED

PRE-STARTING ENGINES CHECKLIST

Pilots		Flight Engineers	
		1. Nesa power switch	SPARE INVERTER
		2. Engine start selector switch	SET TO NR 3 ENGINE
		3. Nr 2 inverter (EC-121D)	ON
		4. Ignition analyzer condition switch	SET TO NR 3 ENGINE
		5. Alternate air switches	RAM

PRESTARTING ENGINES CHECKLIST—Continued

Pilots		*Flight Engineers*
6. Carburetor air switches		COLD
7. Oil cooler flaps		CLOSED
8. Mixture levers (Off on hot engines)		AUTO RICH
9. Master propeller lever		FULL INC RPM
10. Auxiliary fuel pump switches (takeoff tanks)		HIGH
11. Oil tank heaters		ON

Note

Aircraft is now "COCKED" for "FLUSH" departure.

STARTING ENGINES CHECKLIST

Pilots			*Flight Engineers*	
1. FLUSH order	RECEIVED			
(2.) Start engines	STARTING ENGINES	P, CP	(1.) Start engines	STARTING ENGINES
			2. Area	CLEAR
			3. Start Nr 3 engine	START
			4. Ignition analyzer	ON
			5. Nr 4 engine	START
			6. Engines Nr 3 & 4	1200 RPM
			7. Battery switch	ON
			8. Cart switch	OFF
			9. External power and landing gear pins	REMOVED
			10. Engines Nr 2 & 1	START

WARNING

Make sure area is clear prior to starting engines.

When ready for engine start, command the flight engineer to start engines. The first pilot will clear the right side of the aircraft, insure that a fire guard is posted and give the flight engineer a six blade count on Nr 3 and Nr 4 engines, the aircraft commander will clear the left side of the aircraft, insure that a fire guard is posted and give the flight engineer a six blade count on Nr 2 and Nr 1 engines. Stand by to turn on ignition upon request from the engineer.

STARTING ENGINES CHECKLIST—Continued

	Pilots			Flight Engineers	
3.	Taxi clearance	RECEIVED	CP	11. Starter selector	OFF
	Note A blanket taxi clearance will normally be given to all aircraft. Roger the transmission. If you connot establish contact with the tower do not taxi.				
4.	Seat belt, harness and seat	SET AND LOCKED	P,CP		
5.	Forward crew door and windows	CLOSED	P,CP,FE		
(6.)	Engineer's Starting Engines checklist	COMPLETED	CP	(12.) Engineer's Starting Engines checklist	COMPLETED

BEFORE TAXI CHECKLIST

	Pilots			Flight Engineers	
1.	Hydraulic pressure	CHECKED	CP		
(2.)	Landing gear pins, pitot covers and ground crew headset	ABOARD	CP	(1.) Landing gear pins, pitot covers and ground crew headset	ABOARD
(3.)	Engineer's Before Taxi Checklist	COMPLETED	CP	(2.) Engineer's Before Taxi Checklist	COMPLETED
4.	Wheel chocks	REMOVED	P		
5.	Area clear to taxi	CLEAR	P,CP		

TAXI CHECKLIST

	Pilots			Flight Engineers
1.	Brake system	CHECKED	P	
2.	Turn indicators, compasses and altitude indicators	CHECKED	CP	
	Note Check one direction only.			

TAXI CHECKLIST—Continued

	Pilots		Flight Engineers
3. Radios	ON	CP	
4. Nesa system	ON	CP	
5. Pitot heaters	ON	CP	
6. IFF/SIF	AS REQUIRED	P	

BEFORE TAKEOFF AND LINEUP CHECKLIST

	Pilots		Flight Engineer	
1. Anti-collision light	ON	P	1. Door warning lights	LIGHTS OUT
2. Auxiliary control booster switches	ON	CP	2. Seat belt and seat, check pilot's seat pins in place	SET AND LOCKED
3. Wing flap lever	CHECK 60%	CP		
4. Takeoff clearance	RECEIVED	CP		
(5.) Engineer's Before Takeoff and Lineup Checklist	COMPLETED	P	(3.) Engineer's Before Takeoff and Lineup Checklist	COMPLETED

Section III—EMERGENCY PROCEDURES

TABLE OF CONTENTS

	Page
INTRODUCTION	3-1
ENGINE FAILURE	3-2
FLIGHT CHARACTERISTICS UNDER PARTIAL POWER CONDITIONS	3-2
ENGINE FAILURE UNDER SPECIFIC CONDITIONS	3-3
FAILURE OF TWO ENGINES	3-8
UNFEATHERING AND RESTART DURING FLIGHT CHECKLIST	3-11
FUEL PRESSURE DROP—ENGINE OPERATING NORMALLY	3-12
LANDING WITH ONE OR MORE ENGINES INOPERATIVE	3-13
GO-AROUND WITH ONE OR MORE ENGINES INOPERATIVE	3-15
BOOST OUT LANDINGS	3-16
PRACTICE MANEUVERS WITH ONE OR MORE ENGINES INOPERATIVE	3-16
PROPELLER FAILURE	3-17
FIRE	3-22
EXPLOSIVE DECOMPRESSION	3-30
EMERGENCY DESCENT PROCEDURES	3-31
TAKEOFF AND LANDING EMERGENCIES	3-32
EMERGENCY JETTISONING	3-38
FUEL DUMPING CHECKLIST	3-40
AIRCRAFT SYSTEMS FAILURE	3-42
TURNING BOOSTERS ON IN FLIGHT	3-51
EMERGENCY LANDING GEAR EXTENSION CHECKLIST	3-54
WING FLAP MALFUNCTION	3-55
EMERGENCY WING FLAP EXTENSION CHECKLIST	3-57
EMERGENCY BRAKE OPERATION	3-58
EMERGENCY ENTRANCE	3-60
DITCHING	3-60
CRASH LANDING	3-63
BAILOUT	3-68

INTRODUCTION.

A complete knowledge of the procedures set forth in this section will enable the flight crew to cope with various emergencies that may be encountered during take-off, flight and landing. Crewmembers must have a thorough knowledge of all emergency procedures. Each emergency procedure presents a different problem which can be solved only through specific remedial action. Good judgment, precision and teamwork are essential. These can only be developed through frequent simulated emergencies and emergency drills. After it has been determined that an emergency exists, communications should be established immediately with surface craft or stations. These stations should be advised in as much detail as possible the aircraft position, nature of emergency, the aircraft commander's intentions and any other pertinent information.

Upon detecting a malfunction, the flight engineer will notify the pilot of the type of malfunction and the location. The pilot, when detecting a malfunction, will call for an engineer's report, advising the flight engineer of the location of the suspected malfunction. The flight engineer replies what the malfunction is (Loss of Power No.____ Engine, Fire Warning Light No.____, Left Cabin Heater Fire, etc.). The pilot commands, "Pilot's Power Execute Emergency Procedure." The flight engineer acknowledges, "Pilot's Power Executing Emergency Procedure." If higher power settings are required the flight engineer sets mixtures to auto rich, manual spark master switch to retard and proceeds with required procedure. The copilot sets rpm as required by pilot. Prior to increasing rpm over 2500 the copilot will coordinate with the flight engineer to assure that the manual spark is in retard and the mixtures are in AUTO RICH. Coordination between the pilot and flight engineer is required for rpm change when the synchronizer is inoperative.

Note

- When the pilot commands EXECUTE EMERGENCY PROCEDURE, the copilot and flight engineer initiate whatever immediate action is required of each, followed by accomplishment of the appropriate checklist as soon as feasible. A separate command for the checklist will not be necessary unless the pilot notices the check-

list has not been accomplished. Steps appearing in **BOLD FACE** type on the checklist are mandatory memory and immediate action items which must be accomplished prior to reading the checklist. For those instances not requiring rapid and immediate action (such as unfeathering, preplanned engine shutdown and preplanned fuel dumping), procedures will be accomplished by reference to the appropriate checklist.

- When the flight engineer's checklist is complete, he will report to the copilot "Engineer's Emergency checklist complete." When checklists are complete and the flight engineer is ready to assume responsibility of handling the power he will advise the pilot, "Engineer ready to assume power." If pilot is ready to relinquish power, he will acknowledge and reply, "Engineer's Power."

During transition flying, when emergencies are being practiced and an actual emergency has not occurred, the commands of execution will be preceded by the word Simulate. Simulated engine failure and engine fire procedure will be used when aircraft altitude is less than 3000 feet above terrain. When altitude is 3000 feet or above, the actual emergency procedures for engine failure may be accomplished. Simulated feather (zero thrust) power setting at 4000 feet and 140 knots is 20" MAP and 2000 RPM.

ENGINE FAILURE.

The corrective action required after an engine failure consists of shutting down the failed engine, feathering the propeller, and retrimming the aircraft to continue flight. The longer the delay between the detection of a malfunction and the actual feathering the more severe the damage to the engine will be.

Feather the propeller and stop the engine when:

a. An extreme or abnormal engine vibration occurs.

b. An excessive or uncontrollable power loss occurs.

c. A sudden or uncontrollable rise in oil temperature occurs.

d. A sudden or uncontrollable drop in oil pressure occurs.

e. A sudden and uncontrollable rise of cylinder head temperature occurs.

f. A heavy discharge of oil is seen to emit from the engine breather or exhaust system.

g. In the event of turbine malfunction, which is usually evidenced by discharge of smoke, heavy orange flame and sparks from or around the exhaust flight hood.

h. A loss of BMEP occurs (refer to Section VII).

i. Two or more cylinders are inoperative or when symptoms of impending mechanical failure exist in any one cylinder (two shorted secondary patterns or two low resistance patterns in one cylinder).

j. Any other condition that indicates feathering is advisable.

When continued operation of an engine evidencing any of the foregoing conditions of malfunction is considered imperative in the interest of safety of the aircraft and crew, such operation shall be performed at the discretion of the pilot. If these conditions exist, it is recommended that operation of the engine be conducted with caution and at the minimum power consistent with requirements.

FLIGHT CHARACTERISTICS UNDER PARTIAL POWER CONDITIONS.

Flight characteristics of this aircraft with either inboard engine inoperative remain unchanged and rapid trim changes are not required. With either outboard engine inoperative, a slight yawing of the aircraft may be noticeable to the pilot and rudder trim may be required. The BMEP indicators should quickly indicate to the flight engineer which engine has failed. The aircraft is fully controllable with the loss of any one engine, but as a precaution, the wing flaps should not be extended to the full position during final approach until the landing is assured.

MINIMUM CONTROL SPEED.

Minimum control speed is that speed required to provide sufficient control to enable the airplane to fly a straight path over the ground when an outboard engine has failed. This minimum control speed is based on take-off configuration, propeller on dead engine windmilling in low pitch, maximum power on remaining

three engines, wing flaps 60% position, landing gear either retracted or extended, and no more than 5 degrees of bank angle away from the failed engine.

The minimum control speed for the EC-121D is 97 knots IAS using the No. 2 static system. The minimum control speed for the TC-121C is 84 knots IAS using the No. 2 static system.

SAFE ENGINE-OUT SPEED.

The safe one-engine-out speed is defined as that speed which permits an aircraft at the maximum recommended gross weight to climb 100 fpm on a sea-level standard day in the clean configuration, propeller feathered on the inoperative engine, and maximum power on the remaining engines. For the EC-121D, these speeds are lower than takeoff speeds and vary from 128 knots IAS at 152,500 lb to 102 knots IAS at 130,000 lb.

ONE-ENGINE OUT PERFORMANCE.

The following tabulations presents the normal one-engine inoperative climbout sequence. Performance is based on standard day, sea-level conditions with the propeller feathered on the inoperative engine. Power schedules are for the inboard engine(s) and are defined as 277 and 254 BMEP for Maximum and METO power respectively.

EC-121D

140,000 Lbs Gross Weight

Power and Configuration	*Three Engine Climb Speed (No. 2 Static)*	*Take-Off Rate of Climb Available*
Max. Power Gear Down Flaps Take-Off	124 knots IAS	70′/min.
Max. Power Gear Up Flaps Take-Off	126 knots IAS	325′/min.
METO Power Gear Up Flaps Take-Off	126 knots IAS	20′/min.
METO Power Gear Up Flaps Up	155 knots IAS	380′/min.

TC-121C

130,000 Lbs Gross Weight

Power and Configuration	*Three Engine Climb Speed (No. 2 Static)*	*Take-Off Rate of Climb Available*
Max. Power Gear Down Flaps Take-Off	118 knots IAS	530′/min.
Max. Power Gear Up Flaps Take-Off	118 knots IAS	800′/min.
METO Power Gear Up Flaps Take-Off	118 knots IAS	415′/min.
METO Power Gear Up Flaps Up	160 knots IAS	640′/min.

When operating at heavy gross weights, it may be necessary to alter this sequence. For maximum climb performance, a drag reduction should be completed (gear and flaps up) prior to a power reduction. Moreover, terrain should be such that a reduction to climb performance can be tolerated during the acceleration to the three-engine climb speed (155 knots IAS). Refer to the Appendix Part 4, Climb, for specific effects of weight, configuration, speed, altitude and power.

ENGINE FAILURE UNDER SPECIFIC CONDITIONS.

ENGINE FAILURE DURING TAKEOFF.

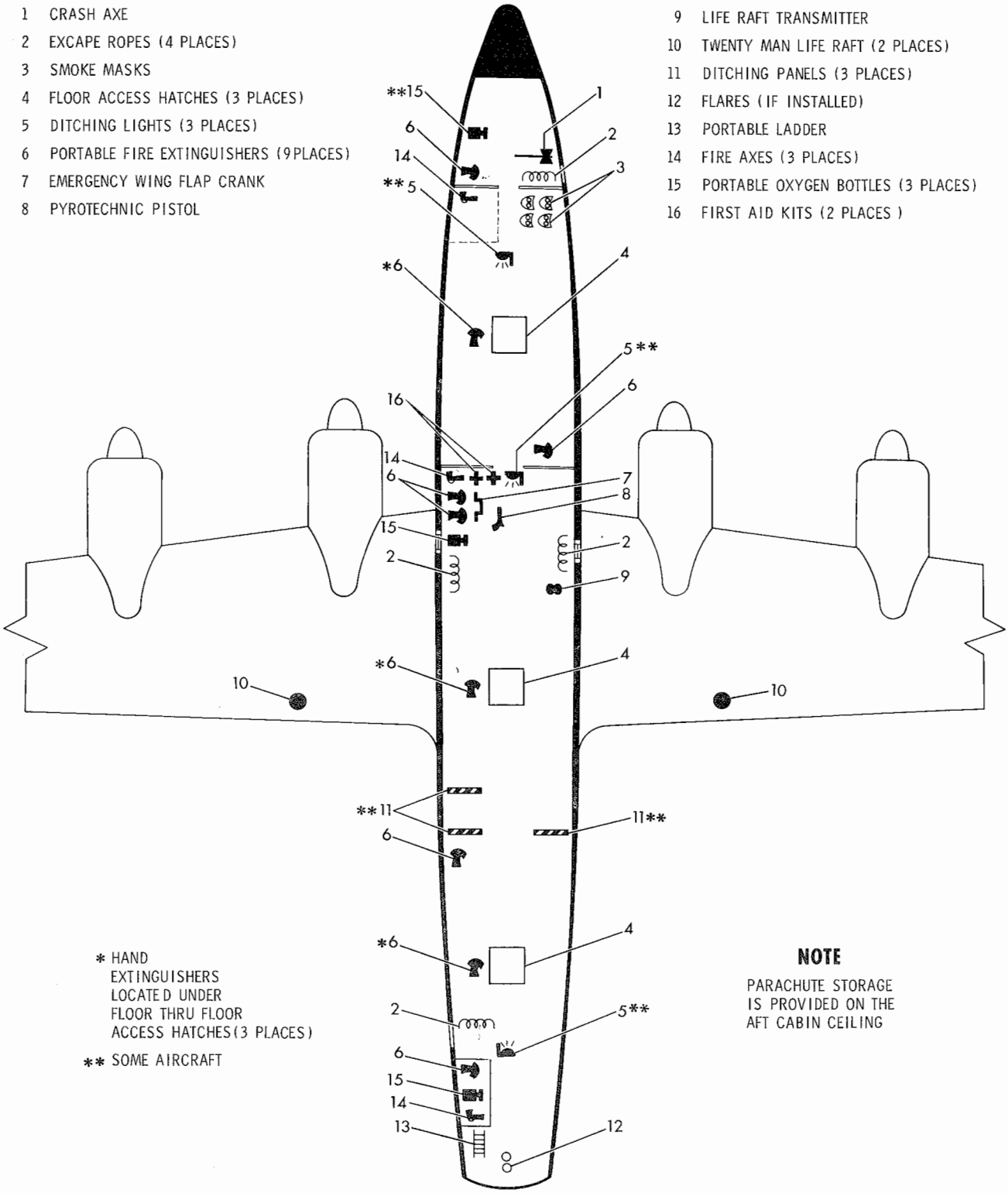
If engine failure occurs before airplane leaves the ground:

a. REJECT TAKEOFF PROCEDURE.

Refer to REJECT TAKEOFF PROCEDURE under TAKEOFF AND LANDING EMERGENCIES in this section.

EC-121D. EMERGENCY EQUIPMENT LOCATIONS (TYPICAL)

1 CRASH AXE
2 EXCAPE ROPES (4 PLACES)
3 SMOKE MASKS
4 FLOOR ACCESS HATCHES (3 PLACES)
5 DITCHING LIGHTS (3 PLACES)
6 PORTABLE FIRE EXTINGUISHERS (9PLACES)
7 EMERGENCY WING FLAP CRANK
8 PYROTECHNIC PISTOL
9 LIFE RAFT TRANSMITTER
10 TWENTY MAN LIFE RAFT (2 PLACES)
11 DITCHING PANELS (3 PLACES)
12 FLARES (IF INSTALLED)
13 PORTABLE LADDER
14 FIRE AXES (3 PLACES)
15 PORTABLE OXYGEN BOTTLES (3 PLACES)
16 FIRST AID KITS (2 PLACES)



* HAND EXTINGUISHERS LOCATED UNDER FLOOR THRU FLOOR ACCESS HATCHES(3 PLACES)

** SOME AIRCRAFT

NOTE

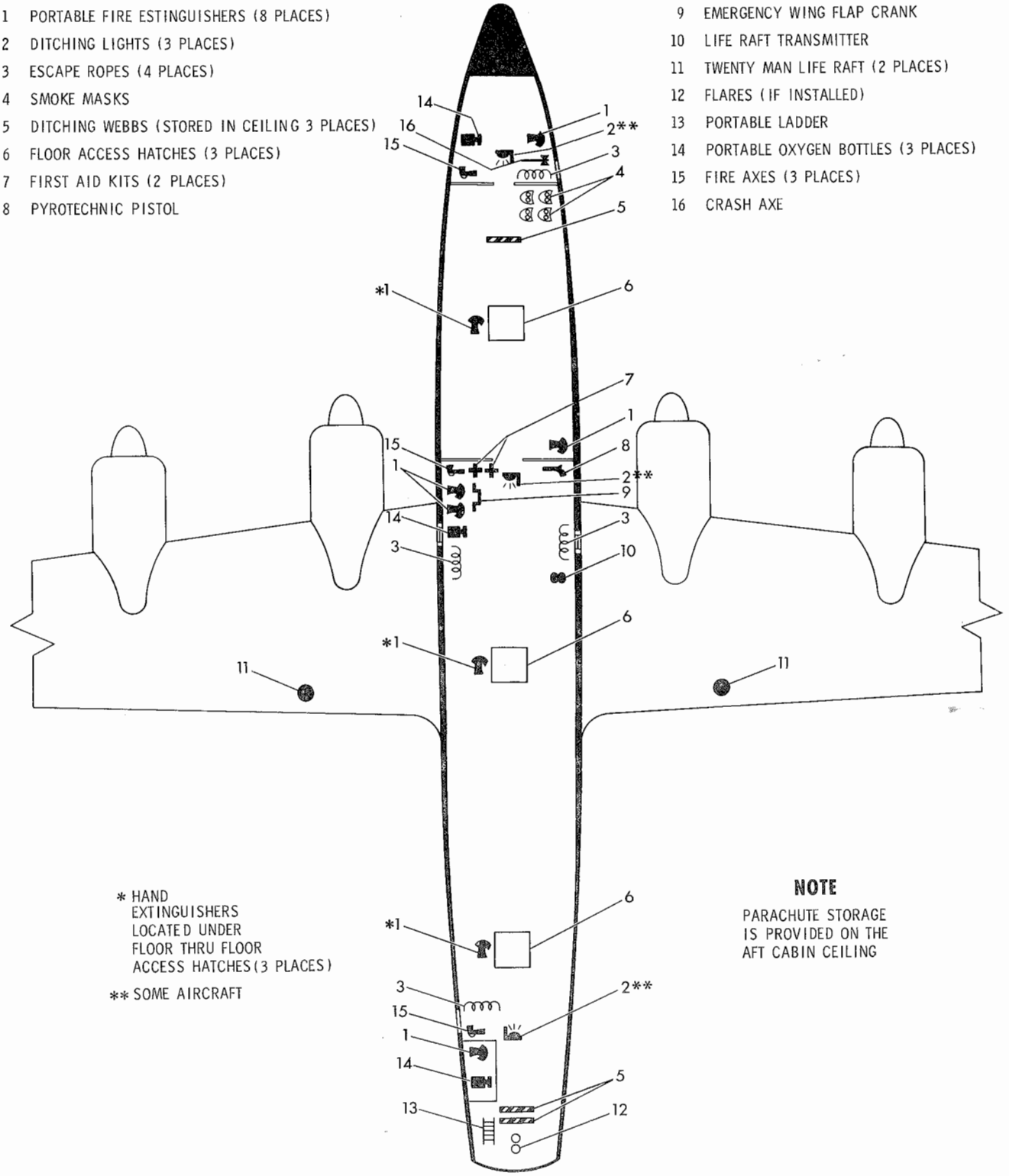
PARACHUTE STORAGE IS PROVIDED ON THE AFT CABIN CEILING

F75-F-3-142(1)

Figure 3-1 (Sheet 1 of 2)

TC-121C. EMERGENCY EQUIPMENT LOCATIONS (TYPICAL)

*1 PORTABLE FIRE ESTINGUISHERS (8 PLACES)
2 DITCHING LIGHTS (3 PLACES)
3 ESCAPE ROPES (4 PLACES)
4 SMOKE MASKS
5 DITCHING WEBBS (STORED IN CEILING 3 PLACES)
6 FLOOR ACCESS HATCHES (3 PLACES)
7 FIRST AID KITS (2 PLACES)
8 PYROTECHNIC PISTOL
9 EMERGENCY WING FLAP CRANK
10 LIFE RAFT TRANSMITTER
11 TWENTY MAN LIFE RAFT (2 PLACES)
12 FLARES (IF INSTALLED)
13 PORTABLE LADDER
14 PORTABLE OXYGEN BOTTLES (3 PLACES)
15 FIRE AXES (3 PLACES)
16 CRASH AXE



* HAND EXTINGUISHERS LOCATED UNDER FLOOR THRU FLOOR ACCESS HATCHES (3 PLACES)

** SOME AIRCRAFT

NOTE

PARACHUTE STORAGE IS PROVIDED ON THE AFT CABIN CEILING

F75-F-3-142(2)

Figure 3-1 (Sheet 2 of 2)

ENGINE FAILURE AND/OR FIRE DURING FLIGHT CHECKLIST

Pilots

The first 2 items in bold print will be accomplished prior to reading the checklist.

1. POWER	**AS REQUIRED**	**P, CP**
2. GEAR AND FLAPS	**AS REQUIRED**	**P, CP**

CAUTION

If the emergency occurs while in cruise with the mixtures in MANUAL LEAN it will be necessary to ensure that the engineer has moved the mixtures to AUTO RICH and the manual spark to RETARD prior to increasing rpm above 2400. An inoperative master lever will require rpm change by the flight engineer.

Note

On EC-121D aircraft, when feasible, notify the radar technician prior to feathering outboard engine or disconnecting the ac generator, due to the possibility of overloading the remaining ac generator.

Flight Engineer

The first 9 items in bold print will be accomplished prior to reading the checklist.

1. THROTTLE LEVER	**CLOSED**
2. FEATHERING BUTTON	**PUSHED**
3. MIXTURE LEVER (Inoperative engine)	**OFF**
4. MIXTURE LEVERS (Operating engines)	**AUTO RICH**
5. EMERGENCY SHUTOFF LEVER (After rpm is zero)	**FULL OFF**

Note

Hydraulic fluid, fuel, blast air, and engine oil OFF. Return to third detent (Hydraulic fluid, fuel, blast air OFF) when it has been determined there is no fire.

6. ENGINE FIRE EXTINGUISHER SELECTOR	**SET**
7. FIRE EXTINGUISHER	**DISCHARGED (if fire exists)**

WARNING

Do not release second charge until it is definitely determined that first charge did not smother the fire.

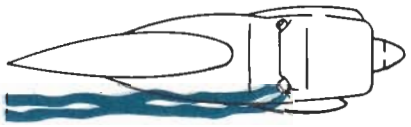
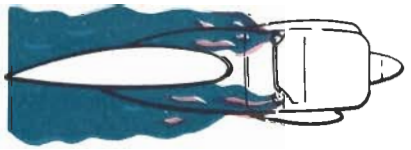
8. COWL FLAPS	**OPEN (FIRE) 10% SET (FAILURE)**
9. FEATHERING BUTTON	**NEUTRAL**

Note

Visually check propeller after feathering operation and at frequent intervals thereafter to see that propeller remains feathered.

10. Manual spark switch	RETARD

ENGINE FIRE AND SMOKE CHART

CAUSE	ACTION	
SMOKE: POWER RECOVERY TURBINE BEARING FAILURE. EXHAUST VALVE OPEN. HOLE IN PISTON.	SHUT DOWN ENGINE.	 BLUE-GREY SMOKE FROM ONE EXHAUST ONLY
SMOKE: OIL LEAKING ONTO EXHAUST STACKS AND VAPORIZING. NOT A DANGEROUS CONDITION PROVIDING OIL LEAK IS NOT EXCESSIVE. NO INSTRUMENT INDICATIONS EXCEPT FOR POSSIBLE DROP IN OIL QUANTITY.	NORMALLY, NO ACTION IS NECESSARY UNLESS FIRE DEVELOPS. IF FIRE OCCURS, FOLLOW EMERGENCY ENGINE FIRE PROCEDURE.	THIN WISPS OF BLUSH-GREY SMOKE FROM EXHAUST AND COWL FLAP AREA
SMOKE: ON GROUND AT IDLING SPEEDS, INDICATES MIXTURE TOO RICH. IN FLIGHT, USUALLY AT HIGH POWER SETTINGS, THIS CAN OCCUR AND INDICATES TOO RICH MIXTURE. ENGINE WILL TEND TO DIE ON GROUND. IN FLIGHT, CHECK FUEL FLOW.	ON GROUND, MANUALLY LEAN. IN FLIGHT, LEAN MIXTURE ACCORDING TO THE APPROVED MANUAL LEANING PROCEDURE.	GREY-BLACK SMOKE COMING FROM EXHAUST
SMOKE: DAMAGED OR WORN-OUT PISTON RINGS PERMITTING CYLINDER TO PUMP OIL. AT NIGHT, THIS CONDITION APPEARS AS FIRE, HOWEVER, IT IS ONLY HOT OIL BURNING IN EXHAUST STACK AND EXHAUST STREAM. NO INSTRUMENT INDICATIONS ON THE GROUND. IN FLIGHT, MONITOR OIL CONSUMPTION.	MONITOR CONDITION AND RECORD IN FORM 781.	BLACK SMOKE COMING FROM EXHAUST
SMOKE AND FIRE: FIRE CAUSED BY OIL LEAK IN ACCESSORY SECTION. FIRE DETECTOR LIGHTS FOR ZONE 2 AND 3 WILL COME ON IF FIRE OCCURS.	FOLLOW EMERGENCY ENGINE FIRE PROCEDURE.	BLACK SMOKE COMING FROM ACCESSORY SECTION
SMOKE AND FIRE: FUEL FIRE IN ACCESSORY SECTION GENERALLY CAUSED BY BROKEN FUEL LINE. LOW FUEL PRESSURE MAY BE INDICATED. FIRE WARNING LIGHTS, ZONE 2 AND 3, WILL COME ON.	FOLLOW EMERGENCY ENGINE SHUTDOWN PROCEDURE. PREPARE TO ABANDON AIRCRAFT IF FIRE DOES NOT GO OUT.	BLACK SMOKE WITH ORANGE-YELLOW COMING FROM ACCESSORY SECTION
SMOKE AND FIRE: DETONATION FOULED SPARK PLUGS, OR FOULED FUEL INJECTION NOZZLE. IF DETONATION CONTINUES, ENGINE FAILURE MAY BE IMMINENT.	ENRICH MIXTURE. INCREASE COWL FLAP SETTING IF CHT IS HIGH; IF ENGINE CONTINUES TO BE ROUGH AND LOW ON POWER, SHUT DOWN ACCORDING TO APPROVED SHUTDOWN PROCEDURE.	 BLUE-BLACK SMOKE WITH FLASHES OF ORANGE COMING FROM EXHAUST

F75-F-3-36

Figure 3-2

ENGINE FAILURE AND/OR FIRE DURING FLIGHT CHECKLIST—Continued

Pilots			*Flight Engineer*	
			11. Fuel tank selector levers (operating engines)	TANK TO ENGINE
			12. Fuel tank selector lever (inoperative engine)	OFF
			13. Fuel pump switch	OFF
			14. Tank 5 and fuel cross-feed levers	CLOSED
			15. Propeller deicer switches	OFF
			16. Generator switch(es)	OFF
			17. Propeller switch	FULL DECREASE RPM
			18. Master engine selector switch	AS REQUIRED
			19. Oil cooler flap	22% SET
			20. Cowl flaps	10% SET (if no fire)
			21. Engine fire extinguisher selector	OFF
			22. Tank 5 and fuel cross-feed levers	AS REQUIRED
			23. Emergency shutoff lever (if no fire)	3rd DETENT (oil on)
(3.) Ignition switch	OFF	P	(24.) Ignition switch	OFF
(4.) Engineer's Engine Failure or Engine Fire checklist	COMPLETED	CP	(25.) Enginer's Engine Failure or Engine Fire checklist	COMPLETED

FAILURE OF TWO ENGINES.

Because of the manner in which associated systems are integrated between the engines, the effect of losing various combinations of engines must be understood and anticipated. In all combinations of two engine failures, cabin superchargers must be disconnected and generator loading must be kept to a minimum. All non-essential electrical units must be shutoff to keep loading within the range of available generator output and to obtain maximum available BHP from the operating engines.

ENGINES NO. 1 AND NO. 4 INOPERATIVE

Pilots

Note

To operate deicer boots the deicer air pump selector valve switches must be placed in the DEICER PRESS position.

Flight Engineer

Note

A descent to a safe altitude is necessary if engines Nos. 1 and 4 are inoperative because pressurization is not available.

a.	Failed engines	Shut down and feather
b.	Paddle switches	WARMER
c.	Nesa power switch	SPARE
d.	Auxiliary vent knob	As required

Note

The hydraulic pump driven by No. 3 engine will supply hydraulic pressure for those units normally operated by the secondary system. The restriction control valve may slow the operation of the wing flaps and the landing gear while giving priority to the other systems. The hydraulic pump driven by No. 2 engine will supply hydraulic pressure for the operation of the flight control boosters. DC generators No. 1 and 4 and the two ac generators will be inoperative.

ENGINES NO. 2 AND NO. 3 INOPERATIVE

Pilots

Flight Engineer

a.	Failed engines	Shutdown and feather
b.	Cabin superchargers	Disconnected
c.	Paddle switches	WARMER
d.	Electrical load	Monitor
e.	Auxiliary vent knob	As required

Note

With engines 2 and 3 inoperative, the vacuum system will not operate and suction for the deicer boots will not be available. The hydraulic pump driven by engine No. 4 will supply hydraulic pressure for those units normally operated by the secondary system. The restriction control valve may slow operation of the wing flaps and landing gear while giving priority to the other systems. The hydraulic pump driven by engine No. 1 will supply hydraulic pressure for the operation of the flight control boosters. DC generators No. 2, 2A, 3, and 3A will be inoperative.

ENGINES NO. 3 AND NO. 4 INOPERATIVE

Pilots	*Flight Engineer*
a. Failed engines	Shutdown and feather
b. Hydraulic system crossover switch	EMERGENCY
c. Engine No. 1 cabin supercharger	Disconnected
d. Paddle switches	WARMER
e. Electrical load	Monitor

Note

With engines 3 and 4 inoperative, secondary hydraulic pressure will not be available. However, the units normally operated by the secondary system will be operated by hydraulic pressure supplied by the primary system through the crossover valve. The ac generator and dc generators No. 3, 3A and 4 will be inoperative.

ENGINES NO. 1 AND NO. 2 INOPERATIVE

Pilots	*Flight Engineer*
a. Hydraulic system crossover switch	EMERGENCY
b. Failed engines	Shutdown and feather
c. Engine No. 4 cabin supercharger	Disconnected
d. Paddle switches	WARMER
e. Electrical load	Monitor

Note

With engines 1 and 2 inoperative, primary hydraulic system pressure wil not be available. However, the surface control boosters will be operated by hydraulic pressure supplied by the secondary hydraulic system through the crossover valve. The ac generator and dc generators No. 1, 2, and 2A will be inoperative.

ENGINES NO. 1 AND NO. 3 OR NO. 2 AND NO. 4 INOPERATIVE

Pilots	*Flight Engineer*
a. Failed engines	Shutdown and feather
b. Cabin supercharger (operating engine)	Disconnected
c. Paddle switches	WARMER
d. Electrical load	Monitor

ENGINES NO. 1 AND NO. 3 OR NO. 2 AND NO. 4 INOPERATIVE—Continued

Note

With either of these two combinations of inoperative engines, hydraulic power will be available but flow will be reduced. One air pressure pump and one suction pump in the wing and empennage deicing system will be inoperative.

UNFEATHERING AND RESTART DURING FLIGHT CHECKLIST

Pilots			*Flight Engineer*	
			1. Ignition switch	OFF
			2. Emergency shutoff lever	ALL ON POSITION
(1.) Airspeed	140-155 KNOTS	P	(3.) Airspeed Request pilot to slow aircraft to 140-155 knots.	140-155 KNOTS
			4. Throttle lever	CLOSED
			5. Fire extinguisher selector	SET
			6. Engine supercharger lever	LOW
			7. Mixture lever	OFF
			8. Manual spark switch	RETARD
			9. Propeller switch	FULL DECREASE RPM
			10. Starter switch	ENGAGE
			Note The observer will notify the flight engineer when the propeller has turned six blades. If a liquid lock is evident, make no further attempt to start.	
			11. Fuel tank selector lever	ON
			12. Fuel pump switch	LOW
(2.) Ignition switch	BOTH	P	(13.) Ignition switch	BOTH
			14. Feathering button	PULL INTERMITTENTLY

CAUTION

The propeller should be under observation by some crewmember while being unfeathered.

UNFEATHERING AND RESTART DURING FLIGHT CHECKLIST—Continued

Pilots			*Flight Engineer*	
			15. Mixture lever (At 500-600 rpm)	AUTO RICH

Note

- After the propeller is governing, advance the throttle gradually until power is indicated on the BMEP gage. When engine oil-in temperature has risen and oil pressure has stabilized, gradually increase rpm and power to correspond with the other engines.
- On engines equipped with reverse flow torquemeters the BMEP will not read correctly until a minimum of 60°C oil-in temperature is reached.

			16. Generator switch	ON
			17. Cowl and oil cooler flaps	AS REQUIRED
			18. Fire extinguisher selector	OFF
(3.) Engineer's Unfeathering and Restart checklist	COMPLETED	CP	(19.) Engineer's Unfeathering and Restart checklist	COMPLETED

FUEL PRESSURE DROP—ENGINE OPERATING NORMALLY.

During Ground Operation.

If the fuel pressure drops below the operating limits, but the engine continues to operate normally, stop the aircraft, stand by to release fire extinguishing agent to the affected engine, and shut down immediately. Investigate and correct the cause before takeoff.

During Flight.

If fuel pressure drops below normal operating limits but the engine continues to operate normally, the cause may be fuel line leakage, primer solenoid leakage, oil dilution leakage, engine-driven fuel pump bypass valve leakage, clogged pressure line, or instrument failure. The action to be taken depends upon the circumstances existing at the time. Such factors as known aircraft condition, power requirements, and flight conditions must be considered. All factors being equal, any one of the following procedures are recommended.

a. Shut down the engine immediately by means of mixture control, not by retarding throttle, if power from the affected engine is not necessary to sustain flight or to reach a safe destination.

b. Continue to operate the engine normally. This may be done if it can be unquestionably determined that the indicated pressure drop has not resulted from a fuel leak.

c. Keep the affected engine in operation at or above normal cruising speed while maintaining a constant

watch for fire. This can be done if it cannot be determined that a leak exists and the engine power is required either to sustain flight or to 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 (not by retarding the throttle) and accomplish a three-engine landing unless the added power is absolutely essential to effect a safe landing. Do not reduce airspeed until the affected engine is shut down. This procedure is based on the fact that the cooling effect of the airflow over the engine and nacelle will frequently keep a fire from starting, even though a fuel leak exists, until aircraft speed is reduced sufficiently as during landing.

LANDING WITH ONE OR MORE ENGINES INOPERATIVE.

The following notes and procedures are in addition to the normal landing procedures. It is assumed that the landing area is within landing range and that feathering procedure checklists have been completed. Landing with only one engine inoperative will not seriously affect the normal flight characteristics of the aircraft. When landing with one engine out, the hydraulic crossover valve should be opened to provide immediate hydraulic pressure if another engine on the same side fails during the approach. However, with engine No. 3 or No. 4 inoperative, the reduction in output to the secondary hydraulic system may cause the landing gear and wing flap operation to be slower than normal. After landing, the wing flaps should not be raised until after full use of nosewheel steering and full use of the brakes is not critical. When landing with any two engines feathered, the windmilling drag is reduced by one-half and deceleration with closed throttles is less than normal. Hence, excessive speed on approach should be anticipated and avoided. However, a slightly high final approach with low power is considered good practice. With two engines operating at METO power, the propellers feathered on the inoperative engines, and the aircraft not exceeding recommended landing weights, the wing flaps may be lowered to 60% without loss of altitude up to approximately 2,500 feet. The airspeed during final approach should be ~~130~~ 140 knots ~~at maximum landing weight, and~~ until the landing is assured, no more than 60% flaps should be used. The rate of descent with the gear extended and the wing flaps in 60% position will be approximately 500 feet per minute.

THEREFORE NORMAL FLAP SETTINGS & AIRSPEEDS SHOULD BE UTILIZED.

LANDING WITH ENGINES NO. 1 AND NO. 2 INOPERATIVE

Pilots			Flight Engineer	
(a.) Hydraulic system crossover switch	EMERGENCY	P	(a.) Hydraulic system crossover switch	EMERGENCY
			b. Paddle switches	WARMER

Note

With engines 1 and 2 inoperative, primary hydraulic system pressure will not be available. However, the surface control boosters will be operated by hydraulic pressure supplied by the secondary system through the crossover valve. The ac generator and dc generators No. 1, 2, and 2A will be inoperative.

CAUTION

Use propeller reversing with caution because of possible control difficulties.

LANDING WITH ENGINES NO. 2 AND NO. 3 INOPERATIVE

Pilots *Flight Engineer*

a. Paddle switches WARMER

Note

With engines No. 2 and 3 inoperative, the vacuum system will not operate and suction for the deicer boots will not be available. The hydraulic pump diven by engine No. 4 will supply pressure for those units normally operated by the secondary system. The restriction control valve may slow operation of the wing flaps and landing gear while giving priority to the other systems. The hydraulic pump driven by engine No. 1 will supply hydraulic pressure for operation of the flight control boosters. Monitor dc electrical load. Only generators No. 1 and 4 are available to supply dc power.

LANDING WITH ENGINES NO. 3 AND NO. 4 INOPERATIVE

Pilots

CAUTION

Use propeller reversing with caution because of possible control difficulties.

Flight Engineer

Note

Actuating the hydraulic system crossover switch will provide normal operation of those units normally supplied by the secondary system.

a. Hydraulic system crossover switch EMERGENCY

b. Paddle switches WARMER

LANDING WITH ENGINES NO. 1 AND NO. 4 INOPERATIVE

Pilots *Flight Engineer*

Note

The hydraulic pump driven by engine No. 3 will supply hydraulic pressure for those units normally operated by the secondary system. The restriction control valve may slow operation of the wing flaps and landing gear while giving priority to the other systems. The hydraulic pump driven by engine No. 2 will supply hydraulic pressure for operation of the flight control boosters. DC generators No. 1 and 4 and the two ac generators will be inoperative.

a. Paddle switches WARMER

GO-AROUND WITH ONE OR MORE ENGINES INOPERATIVE.

Note

The following is based on EC-121D performance. TC-121C performance is somewhat better.

Go-Around, Three Engines Operating, Flight Control Boosters On.

A go-around at not more than the recommended landing weight of 110,000 lbs, with landing gear down and 100% flaps, can be accomplished if altitude is more than 100 feet and the indicated airspeed is more than 113 knots. If engines No. 3 and 4 are inoperative, operation of the gear and flaps will be slower. Procedure will be the same as four engine procedure.

Go-Around, Two Engines Operating, Flight Control Boosters On.

In general, a two-engine go-around is not recommended. It can be accomplished however if gross weight is not above designed landing weight of 110,000 lbs, with landing gear down and 100% flaps, if altitude is not less than 400 feet and airspeed is not less than 130 knots. If engines No. 1 and 2 are inoperative, the hydraulic system crossover valve must be open for boost-on operation.

If engines No. 3 and 4 are inoperative, the hydraulic system crossover valve must be open to extend and retract the landing gear and wing flaps.

GO-AROUND TWO ENGINES OPERATING CONTROL BOOST ON

	Pilots		*Flight Engineer*	
a.	Throttle levers	Power as required. P	Throttle levers	Adjust power as required
b.	Airspeed	130 knots (Minimum) P		
c.	Landing gear lever	UP CP		
d.	Wing flap lever	UP (raise flaps slowly) CP		
e.	Airspeed	Accelerate to 152 knots P		

CAUTION

At 152 knots the sea level rate of climb is approximately 400 ft/min. at designed landing weight (110,000 lbs.), wing flaps up and

GO-AROUND TWO ENGINES OPERATING CONTROL BOOST ON—Continued

Pilots *Flight Engineer*

CAUTION

landing gear retracted. Below 152 knots the rate of climb drops off rapidly and at 130 knots the rate of climb is essentially zero. It takes several minutes (depending on whether altitude loss is permissible, turbulence, etc.) to accelerate from 130 to 152 knots. Therefore, terrain clearance must be considered. (Refer to Appendix, Part IV for emergency climb data.)

BOOST OUT LANDINGS.

In the event an actual emergency go-around is required during practice with boost-out, do not shift the elevator boost lever to ON position. The aileron and rudder boost levers however, should be moved to ON. Ample elevator control is available for go-around provided excessive elevator trim has not been used during approach and the cg limit is within the recommended boost-out range of 23 to 30% of MAC.

PRACTICE MANEUVERS WITH ONE OR MORE ENGINES INOPERATIVE.

Note

It should be understood that during practice maneuvers the simulation of engine failures and various systems failures require thorough knowledge of resulting conditions. Therefore, cognizance of military regulations and other sections of this manual is essential. Practice maneuvers involving more than one engine inoperative should be accomplished by feathering only one engine and simulating zero thrust with the second engine (set 20 inches Hg and 2000 rpm). Practice maneuvers involving the actual feathering of one engine and the throttling (zero thrust) of an additional engine should be confined to altitudes which comply with military regulations. The following information is based on a gross weight of 110,000 pounds.

PRACTICE MANEUVERS WITH ONE OR MORE ENGINES INOPERATIVE

Pilots *Flight Engineer*

CAUTION

Turns should not exceed 45 degrees of bank during simulated two engine failure because of undue control forces. During training, when emergencies are being practiced and an actual

PRACTICE MANEUVERS WITH ONE OR MORE ENGINES INOPERATIVE—Continued

	Pilots		*Flight Engineer*	
	CAUTION emergency has not occurred, the commands of execution will be preceded by the word SIMULATE. It is much easier for the instructor pilot to countermand this order in case of an actual emergency than it is to correct actual commands of execution which have already been given.			
a. First engine	Shut down and feather		a. First engine	Shut down and feather.
b. Second engine	Simulate engine failure by producing zero thrust (2000 rpm and 20″ Hg. MAP.)	P	b. Second engine	Simulate engine failure by producing zero thrust (2000 rpm and 20″ Hg. MAP.)
c. Power	As required	P		

WARNING

During practice maneuvers, the simulated failure of more than two engines is prohibited. There are no restrictions on combinations of two engine failures.

PROPELLER FAILURE.

PROCEDURE IN THE EVENT OF A VIBRATION FROM AN ENGINE OR PROPELLER.

If a vibration and shaking of the aircraft occurs and is apparently caused by an engine or propeller, attempt to reduce it and isolate the cause in the following manner:

a. Automatic pilot—OFF.

b. The engineer monitors instruments. If no malfunction is indicated, proceed as follows:

(1) Engine power and rpm—Reduce as much as possible.

(2) If the vibration ceases, advance the rpm and power on one engine at a time until the trouble is located. If necessary, feather the propeller of the engine causing the trouble.

RUNAWAY PROPELLER DURING TAKEOFF.

An overspeeding propeller is a condition during which rpm goes beyond maximum normal range but is controllable by governor action. A runaway propeller is a condition during which rpm goes beyond maximum normal range and is *not* controllable by governor action. Overspeeds are most likely to occur during operations that require the master propeller pitch lever to be in the calibrate position. In this position, the propeller governors are called for full increase rpm, as is indicated by the limit lights. However, if a propeller should start to exceed 2900 rpm while the governor is not calling for full increase rpm and the limit light is not on (that is, while METO power is set during the takeoff procedure), a runaway condition is indicated.

a. In the event of an overspeed during takeoff, toggle back and throttle back as necessary. If the rpm cannot

be reduced with the toggle switch, reduce power and maintain a minimum safe airspeed. If overspeeding persists with toggling and reduction of power, feather the propeller and shut down the affected engine.

b. In the event of a runaway propeller during takeoff, use the following procedure:

(1) If airborne when advised of a runaway propeller, climb aircraft at takeoff speed.

Note

- During critical stages of flight such as takeoff, feathering the runaway propeller must be weighed against the loss of power of that engine which could adversely affect the performance of the aircraft. Circumstances may warrant consideration of continued operation of the affected engine at reduced power, which may be possible if the propeller has pitch-locked at a sufficiently high blade angle. (Refer to HYDRAULIC OVERSPEED PITCH-LOCK, Section I.)
- Engine rpm has to be allowed to increase to the range 3110 to 3220 in order to ensure a locked-out condition. If the throttle is reduced to prevent a propeller from pitch-locking, the blades will rotate to a full low-pitch position and very little forward thrust can be obtained.

(2) When clear of obstructions with the aircraft well under control, the pilot directs the flight engineer to feather the malfunctioning propeller. (Feather the propeller before allowing the aircraft to accelerate beyond takeoff speed.)

Note

Most runaway propellers experienced have occurred as the result of loss of governing action which, in turn, allows the propellers to go toward a low blade angle. There has been no reported instance of a propeller running away in flat pitch. As a matter of fact, it is practically impossible for the propeller on this airplane to go into flat pitch as a result of loss of governing control. Therefore, some positive thrust can still be obtained from a runaway propeller during takeoff. Furthermore, if the BMEP is reduced sufficiently, engine limits will not be exceeded. If a propeller sticks in full low pitch during takeoff at sea level, a MAP of about 25.5 inches will not produce more than about 2900 rpm if the airspeed is not allowed to exceed 122 knots. (If the runaway occurs after METO power is set, the airspeed will be 140 knots or more.) In this case the flight engineer should immediately retard the throttle to about 20 in. MAP and recommend feathering. In addition the pilot should immediately pull the nose up to takeoff speed. The zero-thrust point with the propeller in full low pitch is approximately 20 in. MAP. Therefore, if a runaway occurs before an excessive amount of forward speed is gained, retarding the throttle to between 25.5 and 20 in. MAP will allow some positive thrust to be retained without exceeding engine limits.

(3) Complete the Engine Failure Or Fire checklist, if practicable, and land as soon as possible.

RUNAWAY PROPELLER AT ALTITUDE.

Runaway propellers result from the following causes:

a. Centrifugal twisting moments on the blades of a revolving propeller continually attempt to drive the blades toward the low pitch stops. Governing action counteracts these forces. When a failure causes the loss of this governing counter action, the blades move from a governed pitch to a low pitch, resulting in an increased rpm.

b. Lack of propeller oil or mechanical failure of the propeller pumping system will cause failure of governing action and a resulting runaway.

c. High internal leakage within the high pitch line may cause a runaway propeller; it may also hamper feathering action.

The symptoms of an impending or actual runaway propeller and actions to be taken are as follows:

a. The audible sound increases rapidly as the rpm goes beyond the usual governing range. This occurs because as the rpm increases more and more of the propeller blades, from the tips inward, enter the speed-of-sound range.

b. Continued operation of the affected engine at reduced power may be possible if the propeller will pitch-lock at a sufficiently high blade angle. (Refer to Hydraulic Overspeed Pitchlock, Section I.) Engine rpm must be allowed to increase to the range 3110-3220 rpm in order to insure a locked-out condition. If the throttle

is reduced to prevent a propeller from pitch locking, the blades will rotate to a full low pitch position and very little forward thrust can be obtained.

c. When the decision is made to secure and shutdown the affected engine, throttle back immediately, pull nose up, and slow down to the minimum safe airspeed for the gross weight. Use flaps up to 60 percent if necessary.

d. On pilot's command, engineer will feather immediately.

Note

With each decrease of 10 knots IAS, altitude remaining constant, the windmilling rpm will be decreased by approximately 200 rpm.

(1) Feathering must be attempted immediately. At high runaway rpm, the centrifugal twisting force may be so great that feathering oil pressure is insufficient to increase the blade pitch toward the feather position.

e. Mixture—OFF.

Note

Actions in steps c, d, and e should be accomplished almost simultaneously.

f. Open the throttle. This will decrease windmill speed if the propeller fails to feather. High blower will increase this braking effect (however, do not try to shift blowers to HIGH at runaway rpm). An open throttle in low blower may only decrease the rpm by 50, but under the circumstances any decrease will help.

CAUTION

Do not try to shift blowers to HIGH at runaway rpm.

g. If the propeller feathers, complete the Engine Failure or Fire checklist.

h. If the propeller will not feather or pitchlock, do the following:

(1) Order passengers removed from danger area and reduce the cabin differential pressure.

(2) Continue to maintain the minimum safe airspeed for the gross weight. Flaps may be used up to 60 percent maximum.

(3) Complete the Engine Failure or Fire checklist.

(4) Descend to a lower altitude.

Note

The higher the altitude, the higher the windmill rpm. With a constant IAS the windmilling rpm will be decreased by approximately 50 for each 1000-foot decrease in altitude. Therefore, it is desirable to start a descent as soon as possible if the propeller will not feather.

(5) As the windmill rpm is decreased by reducing airspeed, opening throttle, and decreasing altitude, again attempt to feather.

i. Occasionally a propeller fails to feather because of an electrical fault. Therefore, when attempting to feather, check the following:

(1) Check for a light in the feathering button.

If the light is on while the button is depressed, it is a positive indication of current being delivered to the feathering pump motor.

(2) If a light does not show and the feathering switch holding coil is not energized, check the circuit breakers on the upper 212 panel.

(3) If the cowl flaps also fail to operate, then the current limiter may have failed. This could be caused by a welded starter relay or a faulty limiter. (Operation of the cowl flaps cannot cause a current limiter to fail because the cowl flap circuit has a separate protection which is set at a lower value.)

j. If rpm cannot be controlled, reduce airspeed to within limits.

k. After all emergency procedures have been completed, select a cruising altitude that will allow the optimum three-engine range.

WARNING

In flight, do not unfeather a propeller which has been feathered because of a runaway.

RUNAWAY PROPELLER DURING TAKEOFF CHECKLIST

Pilots

The first 3 items in bold print will be accomplished prior to reading the checklist.

1. AIRSPEED	**MAINTAIN SAFE VALUE**	**P**
2. THROTTLE LEVER	**AS REQUIRED**	**P**
3. FEATHERING BUTTON	**PUSHED (if pitch lock does not engage)**	**P**

Flight Engineer

The first 3 items in bold print will be accomplished prior to reading the checklist.

1. PROPELLER SWITCH	**DEC RPM**
2. THROTTLE LEVER	**AS REQUIRED**
3. FEATHERING BUTTON	**PUSHED (if pitchlock does not engage)**

WARNING

If propeller operation is erratic when the toggle switch is actuated, a control circuit malfunction is indicated. Do not actuate the switch again. Leave rpm at last setting if it is within an acceptable range for continued flight operation. If rpm is not within an acceptable range, the engine must be feathered.

RUNAWAY PROPELLER IN FLIGHT CHECKLIST

Pilots

The item in bold print will be accomplished prior to reading the checklist.

1. AIRSPEED	**MAINTAIN SAFE VALUE**	**P**

a. At the first indication of a runaway propeller immediately throttle back, pull up nose, and slow down to the minimum safe airspeed for the gross weight. Use flaps up to 60% if necessary.

Note

- With each decrease of ten knots IAS, altitude remaining constant, the windmilling rpm will be decreased by approximately 200 rpm.
- With propeller synchronizer circuit breaker off pilots propeller control lever will be inoperative and flight engineer must set rpm manually.

Flight Engineer

The first 3 items in bold print will be accomplished prior to reading the checklist.

Note

Turn off synchronizer circuit breaker if propeller cannot be controlled with manual toggle switch.

1. THROTTLE LEVER	**RETARD**
2. PROPELLER SWITCH	**DEC RPM**

WARNING

If propeller operation is erratic when the toggle switch is actuated, a control circuit malfunction is indicated. Do not actuate the switch again. Leave rpm at last setting if it is within an acceptable range for continued flight operation. If rpm is not within an acceptable range, the engine must be feathered.

RUNAWAY PROPELLER IN FLIGHT CHECKLIST—Continued

Pilots	*Flight Engineer*
3. FEATHERING BUTTON	PUSHED (if overspeeding cannot be controlled with toggle switch)

Note

If overspeeding cannot be controlled, move personnel away from the area of propeller plane rotation and descend to a safe altitude.

FAILURE TO UNREVERSE

Pilots

Flight Engineer

Note

Failure to unreverse is commonly due to a malfunctioning relay in the propeller control circuit. A propeller that fails to unreverse normally can be taken out of reverse by one of two methods. The following is the preferred method:

a. Throttle lever	Close
b. Feathering button	Push
c. Feathering button	Pull out (when the propeller is in normal governing range)

Note

The above procedure will cause the feathering pump to take the propeller out of reverse and start it toward the feathered position; however, if an inoperative feathering pump is indicated by non-operation of the feathering pump light, use the following alternate method:

FAILURE TO UNREVERSE—ALTERNATE METHOD

Pilots

Flight Engineer

a. Propeller switch	Full DEC RPM
b. Throttle lever	Open to approximately 1500 rpm

FAILURE TO UNREVERSE—ALTERNATE METHOD—Continued

Pilots *Flight Engineer*

Note

Obtain approximately 1500 rpm and reduce throttle opening while propeller goes through flat pitch.

c. Propeller switch — INC RPM (after propeller comes out of reverse range)

INADVERTENT REVERSING IN FLIGHT CHECKLIST

Pilots *Flight Engineer*

The 3 items in bold print will be accomplished prior to reading the checklist.

1. THROTTLE LEVER — CLOSED

2. PROPELLER REVERSE CIRCUIT BREAKER — PULL OUT

3. FEATHERING BUTTON — PUSHED (complete engine shut down)

FIRE.

ENGINE FIRE.

Judgment and precision are more important than speed when putting out an engine fire. Closing a wrong valve could cause more trouble than a few seconds delay in controlling the fire. The procedures vary for fires which occur during and after starting, and in flight.

ENGINE FIRE DURING START AND/OR GROUND OPERATION CHECKLIST

REVISED See TO-1C-121(E)D-155-9 21 DEC 65

Pilots *Flight Engineer*

The first 2 items in bold print will be accomplished prior to reading the checklist.

1. BRAKE SELECTOR — EMER. — P, CP

2. NOTIFY TOWER AND CREW — P

The first 5 items in bold print will be accomplished prior to reading the checklist.

1. DISCONTINUE PRIMING AND/OR MOVE MIXTURE TO IDLE CUT OFF FOR APPLICABLE ENGINE.

2. CONTINUE CRANKING TO DRAW FIRE THROUGH ENGINE (FIRE DURING START ONLY). IF FIRE CONTINUES OR SPREADS, STOP CRANKING.

ENGINE FIRE DURING START AND/OR GROUND OPERATION CHECKLIST—Continued

Pilots			*Flight Engineer*	
3. All mixture levers	OFF	P	3. **ALL MIXTURE LEVERS**	**OFF**

REVISED
ISS-9
21 DEC 65

WARNING

Do not cut mixtures until tower has been notified.

4. All ignition switches	OFF	P, CP	4. **EMER SHUTOFF LEVERS**	**FULL OFF**
5. Evacuate aircraft		P	5. **SMOTHER FIRE BY USE OF AIRCRAFT FIRE EXTINGUISHER SYSTEM AND EXTERNAL EXTINGUISHER (IF AVAILABLE).**	
			6. Fuel tank selector levers	OFF
			7. Fuel pump switches	OFF
			8. Battery switch	OFF

Note

One long ring of the alarm bell on the ground signified crew emergency evacuation.

CAUTION

Do not attempt to restart engine until cause of the fire has been determined and corrected.

ENGINE FIRE DURING FLIGHT

Refer to Engine Failure and/or Fire During Flight Checklist, this section.

FUSELAGE FIRE.

Cabin Fire.

Any time smoke is noticed or a fire occurs in the aircraft, the flight crew and personnel combating the fire should breathe 100% oxygen, the recirculating fans shut off, and a passageway between the cabin and flight station kept open. These steps will protect the flight crew and help to prevent the fire from spreading. If smoke should become dense, follow the Smoke Removal procedure given in this section. If an open fire occurs in the cabin or flight station, it may be controlled by smothering it with one of the portable fire extinguishers. If smoke or fire originates beneath the floor, attempt to isolate the cause and shut off any fluids that may be feeding it. Then proceed as follows:

CAUTION

Because the under-floor areas are not equipped with fire detectors nor fixed fire extinguishers, the hand extinguishers must be used. Use extreme caution when opening floor hatches.

ELECTRICAL FIRE.

Electrical Fire Detection and Extinguishing.

It is recommended that when smoke or the odor of burning insulation is detected in the aircraft, the follow-

ing detection procedure be used to locate the defective equipment. On EC-121D aircraft, instruct each AOC crew member to open the shrouds enclosing respective electronic equipment racks and inspect. Instruct that underfloor area be inspected through the viewing windows and, if necessary, remove floor hatches and inspect. On AAD missions the flight engineer will be responsible for extinguishing fires forward of the 545 bulkhead. The radar technician will be responsible for detecting and extinguishing fires aft of the 545 bulkhead.

Note

When smoke or fumes first become apparent, the radar technician should be notified so that the blower switches on the radar technician's panel may be turned off. Engineer should turn off recirculating and flight station fan switches.

WARNING

Search for the affected or faulty equipment should be confined to a visual inspection since fumes may be toxic.

Short Circuit Fire.

Fires resulting from an active short circuit cannot be extinguished until the circuit involved is dead. It is essential, therefore, to locate the fire and interrupt any circuits which may be involved as quickly as possible. If it is necessary to shut off the electrical system, the generator field circuit breakers should be opened to prevent the generators from developing any electrical potential.

CAUTION

The generator switches must be OFF and the field circuit breakers opened to prevent the generators from developing any electrical potential.

CABIN AND/OR ELECTRICAL FIRE CHECKLIST

Pilots

The first 2 items in bold print will be accomplished prior to reading the checklist.

1. AUTOPILOT	**OFF**	**P**
2. RADAR BLOWER FAN SWITCHES (EC-121D) Notify radar technician	**OFF**	**CP**
3. AC Generators (EC-121D) Notify radar technician	TRIPPED	CP
4. Radio call	CREW & GROUND STATION NOTIFIED	CP
5. Aux. control booster switches & aileron shut-off lever	AS REQUIRED	P, CP

Flight Engineer

The first 2 items in bold print will be accomplished prior to reading the checklist.

1. RECIRCULATING AND FLIGHT STATION FAN SWITCHES	**OFF**

WARNING

If the fire or source of smoke is located in the underfloor area, use extreme care when opening floor hatches and use 100% oxygen for protection against smoke and fumes. The cabin recirculating fans may draw some of the smoke into the cabin. It is very important, therefore, to shut off the recirculating fans immediately to minimize smoke accumulation in the cabin and to reduce the possibility of fanning the fire.

2. FLIGHT STATION MIXING VALVE SWITCH	**COOL**

CABIN AND/OR ELECTRICAL FIRE CHECKLIST—Continued

Pilots

Note

Auxiliary boost will still be available for rudder and elevators and should be turned ON if the hydraulic system has been turned OFF. Aileron boost should be bypassed to reduce forces. The auxiliary boost motors will deplete the batteries very rapidly and, since the batteries may be the only power available for operation of the propellers, radio, instruments, etc., auxiliary boost should be turned OFF as soon as safety permits. To reduce control forces, the rudder should be bypassed and the emergency manual elevator control pulled out and locked.

Flight Engineer

Note

If fire is minor in nature and there is a negligible accumulation of fumes, complete steps 12, 13, and 14.

3. Aux vent knob — POSITION B

Note

Position B on the aux vent knob dumps the cabin superchargers and puts them in minimum flow, opens the cabin safety relief and dump valve, partially opens the aux vent inlet and exit valves, and closes the recirculation dampers. Although this configuration reduces the ventilation, some ventilation nevertheless is supplied that will aid in keeping the cabin and flight station clear.

4. Fuel tank selector levers — TANK TO ENGINE

5. Tank 5 and crossfeed levers — CLOSED

6. All emergency shut-off levers (Inform pilot prior to bypassing pumps) — HYD OIL OFF

Note

If it is definitely known that the hydraulic systems are not involved in the fire, step 6 may be omitted.

7. Flight instrument power switch — EMERGENCY

Note

On EC-121D aircraft monitor ac generator over-voltage and over temperature warning lights. If either light is on or if the master ac generator warning light is on, disconnect the affected generator by means of the driveshaft disconnect switch. If neither of these lights gives indication of malfunction, then proceed as follows:

(6.) RPM	INCREASE AS REQUIRED	P	(8.) RPM	INCREASE AS REQUIRED

CABIN AND/OR ELECTRICAL FIRE CHECKLIST—Continued

Pilots			*Flight Engineer*	
			9. Battery switch	OFF
(7.) All dc generators	OFF	P	(10.) All dc generator switches	OFF
8. Descend	As required	P	11. All generator circuit breakers	OFF

CAUTION

When the battery switch and all dc generator switches are OFF, the fire detection system (CO_2) and propeller feathering systems will be inoperative. On EC-121D aircraft the ac generator driveshaft disconnect also will be inoperative.

12. Affected equipment	DISCONNECT
13. Combat fire	AS REQUIRED

WARNING

Prolonged exposure (5 minutes or more) to high concentrations (pronounced irritation of eye and nose) of Bromochloromethane (CB) or its decomposition products should be avoided. CB is an anesthetic agent of moderate intensity. It is safer to use than previous fire extinguishing agents (carbon tetrachloride, methylbromide). However, especially in confined spaces, adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

(9.) Engineers Cabin and/or Electrical Fire checklist	COMPLETED	P	(14.) Engineers Cabin and/or Electrical Fire checklist	COMPLETED

CAUTION

Conservation of battery power for necessary flight instruments, radio communication, and auxiliary booster operation for landing is of vital importance.

TO RESTORE UNAFFECTED CIRCUITS

Pilots			*Flight Engineer*	
(a.) Electrical load	Reduce to minimum	P	(a.) Electrical load	Reduce to minimum
b. AC generator switches (EC-121D)	Reset	P	b. DC generator field circuit breakers	ON (one at a time)
Pilot must coordinate with radar technician.			c. DC generator switches	ON (one at a time)

TO RESTORE UNAFFECTED CIRCUITS—Continued

Pilots *Flight Engineer*

CAUTION

Before turning the battery and generator switches ON, it is imperative that the source of trouble be located and the affected circuit isolated from the main bus.

d. Battery switch ON

CABIN HEATER FIRE CHECKLIST

Pilots *Flight Engineer*

If a fire occurs in the cabin heaters or cabin heater compartments, the fire detectors will energize the warning lights and the fire can be extinguished with the integral fire extinguishing system.

The first 6 items in bold print will be accomplished prior to reading the checklist.

1.	**CABIN HEATER SWITCHES**	**OFF**
2.	**RECIRCULATION AND FLIGHT STATION FAN SWITCHES**	**OFF**
3.	**FLIGHT STATION MIXING VALVE SWITCH**	**COOL**
4.	**ENGINE FIRE SELECTOR**	**OFF**
5.	**CABIN HEATER FIRE SELECTOR**	**SET**
6.	**FIRE EXTINGUISHER**	**DISCHARGE**

WARNING

Do not release the second charge until it is certain that the first charge did not smother the fire.

After the Fire is Out

7.	Cabin heater fire selector	OFF

(1.)	Engineer's Cabin Heater Fire checklist	COMPLETED	CP	(8.) Engineer's Cabin Heater Fire checklist	COMPLETED

SMOKE/FUME REMOVAL CHECKLIST

Pilots			*Flight Engineer*	
			1. Recirculation and flight station fan switches	OFF
			2. Flight station mixing valve switch	COOL
			3. Aux vent knob	FULL OPEN, THEN TO POSITION A

WARNING

Sound judgment is required when measuring the relative danger involved in fanning the fire with fresh air and subjecting the crew to high altitude as against the alternate danger of asphyxiation. If immediate smoke removal is felt to be necessary, the following procedure may be initiated.

1. Notify flight crew	100% OXYGEN	P		
2. Airspeed	REDUCED TO 175 KNOTS	P		
3. Rapid descent	AS REQUIRED	P		

Note

Position A of the aux vent knob supplies no ventilating air to the flight station and cabin through the normal ventilating system; therefore, position A should be used only when windows may be opened for ventilation.

			4. Cabin supercharger	DISCONNECTED (if required)

Cabin superchargers have been known to discharge fumes into the cabin.

(4.) Engineer's Smoke Removal checklist	COMPLETED	CP	(5.) Engineer's Smoke Removal checklist	COMPLETED
5. Emergency exits	OPEN	CP		

Note

If, *after cabin has been depressurized*, it is not possible to open an emergency exit, break window by using an axe or heavy object. Personnel should stay clear of the opening.

6. Pilots' windows	AS REQUIRED	P, CP		

WARNING

Never open a vent or window in the flight station before there is an opening in the cabin over the wing. Pressure outside of the flight station is low; an open vent in this area will suck air forward into the flight station. By first opening a vent over the wing where the pressure is even lower, air from the flight station will be sucked aft and out over the wing.

BRAKE FIRE CHECKLIST

Pilots

The first 8 items in bold print will be accomplished prior to reading the checklist.

Flight Engineer

The first 2 items in bold print will be accomplished prior to reading the checklist.

When frequent landings are made or when excessive brake usage is required, it is possible to overheat the brake system and cause a fire. To avoid the possibility of retracting the gear with hot brakes, it is desirable to obtain a visual brake check before takeoff. At the first indication or report of a brake fire, the pilot states: "BRAKE FIRE, EXECUTING EMERGENCY PROCEDURE."

1. BRAKE SELECTOR LEVER	**EMER**	**P**
2. STOP AIRCRAFT		**P**
3. WING FLAP LEVER (to facilitate evacuation)	**100% FLAPS**	**CP**
4. GROUND FIRE-FIGHTING EQUIPMENT	**REQUESTED**	**CP**
5. NOSEWHEEL	**TURNED FULL THROW TOWARD BURNING OR SMOKING WHEEL**	**P**
6. BRAKE ON BURNING WHEEL	**RELEASED, OPPOSITE BRAKE ON, PARKING BRAKE SET**	**P**
7. RPM ON ENGINE OVER BURNING WHEEL	**2600 RPM**	**P**

Increase rpm to 2600 or as required to attempt to extinguish fire.

8. ALL ENGINES (except engine over burning wheel)	**SHUT DOWN**	**P**

If ground fire equipment is available, shut down engine over burning wheel and evacuate crewmembers.

If Ground Fire-Fighting Equipment is Not Available, Proceed as Follows:

9. RPM on engine over burning wheel	MAINTAINED	P

Maintain sufficient rpm to keep fire clear of nacelle.

1. THROTTLE LEVERS (except engine over burning wheel)	**CLOSED**
2. MIXTURE LEVERS (except engine over burning wheel which will be placed in RICH)	**OFF (at pilot's command)**

BRAKE FIRE CHECKLIST—Continued

Pilots			*Flight Engineer*	
10. Unnecessary crewmembers	EVACUATED AND CLEAR OF AIRCRAFT	P		

Evacuate passengers using available exits, normally those on side opposite fire. Direct all passengers to a safe distance from the aircraft. It is preferable to stay well ahead or behind the aircraft. If a wheel explodes due to rapid cooling the fragments tend to fly out sideways from the wheel. (A tire may also explode from the heat of the fire.)

WARNING

Do not use CO_2 directly on the wheel as this may cause it to shatter.

Upon Arrival of Fire-Fighting Equipment Proceed as Follows:

11. Engine over burning wheel	SHUT DOWN	P	3. Throttle lever on engine over burning wheel	CLOSED
			4. Mixture lever on engine over burning wheel	OFF
			5. Emergency shutoff lever	FULL OFF
			6. Fuel tank selector lever	OFF
			7. CO_2 engine fire selector	SET
(12.) HRD/CO_2	DISCHARGED	P	(8.) HRD/CO_2	DISCHARGED
(13.) Engineer's Brake Fire checklist	COMPLETED	CP	(9.) Engineer's Brake Fire checklist	COMPLETED

EXPLOSIVE DECOMPRESSION.

When an explosive decompression occurs, the cabin pressure is reduced to the outside pressure in less than a second. The fog caused by explosive decompression should not be confused with smoke. Any explosive decompression affects all crewmembers and can be extremely dangerous if occurring at high altitude. Rush of air from lungs, a momentary dazed sensation that passes immediately, possible gas pains, and anoxia if oxygen equipment is not immediately available are some of the effects accompanying explosive decompression. Maintaining a safe pressure differential, and having oxygen equipment immediately available are precautions that should be observed in pressurized compartments. If an explosive decompression occurs, the pilot should try to ascertain the cause of the trouble and if it cannot be

fixed in flight he should decide whether to continue on the mission or to descend to a safe altitude immediately.

EMERGENCY DESCENT PROCEDURES.

Emergency rapid descents from high altitudes may be made in either the clean configuration or with landing gear down and wing flaps extended. Descent in the clean configuration can be made at speeds up to placarded limits. Refer to Section V for operating limitations.

EMERGENCY DESCENT WITH GEAR AND FLAPS EXTENDED.

Descent with gear DOWN and flaps in 60% position may be made at speeds up to the landing gear extended placarded limits; similarly, descent with landing gear DOWN and the flaps in LANDING position may be made at speeds up to the wing flap extended placarded limits. With landing gear and flaps extended the angle of descent will be greater than when descending in a clean configuration, but the rate of descent is lower because of the lower airspeed necessitated by the landing gear extended or the wing flaps extended limits.

EMERGENCY DESCENT CHECKLIST

Pilots

Note

If proximity of the landing area, rough air, or the possibility of structural damage indicates the advisability of descending at low airspeed, rapid loss of altitude can be achieved at relaitvely low airspeeds with the landing gear down and the wing flaps extended. This configuration will also permit smoke removal during descent, if necessary.

1.	Automatic pilot	OFF	P
2.	Throttle levers	RETARD	P, CP
3.	Wing flap lever	AS REQUIRED	P, CP
4.	Landing gear lever	AS REQUIRED	P, CP
(5.)	Engineer's Emergency Descent checklist	COMPLETED	CP

Flight Engineer

The first (3) items in bold print will be accomplished prior to reading the checklist.

1.	**ENGINE SUPERCHARGER LEVER**	**LOW**
2.	**MIXTURE LEVERS**	**AUTO RICH**
3.	**MANUAL SPARK SWITCH**	**RETARD**
4.	Propeller switches	RPM 2600 SET
5.	Cowl and oil cooler flaps	100% OPEN (during descent with flaps & gear down) AS REQUIRED (during clean descent)
6.	Aux vent knob (if necessary)	FULL OPEN, THEN POSITION A
(7.)	Engineer's Emergency Descent checklist	COMPLETED

TAKEOFF AND LANDING EMERGENCIES.

ABORT TAKEOFF PROCEDURE.

If an engine fails or a fire is detected during takeoff, and adequate runway is left in which to stop the aircraft with wheel brakes and propeller reversing, close the throttles and stop.

CAUTION

The primary problem faced in an emergency occurring prior to refusal speed is to stop the aircraft within the confines of the available runway. Hence, all operating engines should be utilized as necessary during the reversal procedures. An engine which is on fire can be effectively utilized for this purpose. Once the aircraft is stopped the engine fire procedure can be implimented.

If the automatic feathering is turned on, the propeller should feather automatically for engine failures when the BMEP falls to the auto feathering range. The following procedure should be accomplished if engine failure or fire is encountered before reaching refusal speed:

Note

The flight engineer will advise the pilot of any serious malfunction immediately during takeoff run using the term "REJECT."

a.	Throttle levers	Close
b.	Reverse throttle levers	Reverse range
c.	Stop aircraft with brakes	
d.	Execute appropriate emergency checklist	

ENGINE FAILURE OR FIRE DURING TAKEOFF.

If engine fails, or a fire is detected after reaching V_1 speed and there is not sufficient runway to stop the aircraft, the takeoff should be continued. If maximum performance climb is required, climb at V_2 speed until starting wing flaps up. If the automatic feathering system has been turned on, the propeller should feather automatically when the BMEP falls to the auto feathering range. Engine failures or power losses occurring during critical gross weight takeoffs may result in insufficient power available to keep aircraft airborne if the engine is feathered prematurely. It is therefore recommended that under these circumstances the engine continue to be operated until the BMEP falls to the auto feathering range, or until sufficient altitude and airspeeds are obtained for safe operation with the remaining engine power available. Engine Failure or Fire procedure will be initiated upon pilot's command. After the gear is up the pilot will call for METO power if a power reduction is feasible. Climb will be continued until desired altitude is reached. If an engine fails or an engine fire is detected, shut down the inoperative engine as described in the following procedure. If the flight can be continued, refer to Appendix for cruise control with one or more engines inoperative. The minimum control speed in the air with one outboard engine inoperative, the propeller windmilling in low pitch, maximum power on the remaining three engines, the wing flaps at 60% position, and with the landing gear either retracted or extended, is 97 knots IAS, for the EC-121D aircraft and 84 knots for the TC-121C aircraft.

LANDING GEAR TIRE FAILURE.

a. If a tire is blown during takeoff and the remaining runway is sufficient to stop the aircraft, close the throttles and maintain directional control by using brakes and nosewheel steering. Use reverse thrust as necessary. If the remaining runway is not sufficient to accomplish a safe stop, continue the takeoff, but do not retract the landing gear, since the blown tire may jam the gear in the wheel well.

b. If the nosewheel tires are flat at time of landing, keep those wheels off the ground as long as possible, with aft cg at 30 per cent. (Moving 400 pounds from the center cabin area to the rear cabin area will shift the cg approximately one per cent.) Use a minimum of braking.

c. If one or both tires are flat on one main gear, drop the nose gear 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.

d. If both tires are flat on one main gear as a result of striking some object on the runway, damage in addition to the flat tires, may have occurred. For example, a hydraulic hose may have been torn loose, a wheel may have been broken, or the landing gear itself may have been damaged.

A forward cg will place more weight on the nose wheel and provide positive steering after touchdown. Make a normal approach and landing. After touchdown, the aircraft will tend to swerve in the direction of the blown tires; therefore, land the aircraft on the side of the runway away from the blown tires to allow space for possible swerve during deceleration. Use aileron to ease weight on the blown tires. When the aircraft has slowed, reverse thrust may be used on the outboard engine opposite the side of the blown tires to aid in maintaining directional control. Do not apply brakes to the wheels with the blown tires during the landing roll nor attempt to taxi after the aircraft has stopped.

LANDING ON SOFT GROUND OR UNPREPARED RUNWAYS.

If it is necessary to land on soft ground or on unprepared runway, the landing should be made with the landing gear retracted.

LANDING WITHOUT LANDING GEAR FULLY EXTENDED.

SEE -1557 22 NOV 65 FOR ADDITIONAL INFORMATION

Landing With Partially Extended Landing Gear.

In the event that a landing gear malfunction cannot be corrected and neither the main or nose landing gear will fully extend nor retract and a landing is to be attempted, proceed with the following gear-up landing procedures:

a. Notify crew of intention to make an emergency landing.

b. Request assistance required (crash equipment, foam, etc.).

c. Reduce gross weight of aircraft by dumping fuel.

d. If possible, move center of gravity to approximately 25 to 30 percent MAC.

e. Secure or stow loose equipment.

f. Open all doors; remove and stow securely all emergency exit covers.

Note

Leave cabin heaters off.

g. Order flight attendant to see that all passengers' seat belts are fastened (if applicable).

h. Flight control auxiliary booster switches—ON.

i. Shut down Engines No. 2 and No. 3 when advised by the pilot.

j. Ignition of shutdown engines No. 2 and No. 3—OFF.

k. All auxiliary fuel boost pumps—OFF.

l. Wing flaps—Extend to LAND (100%) position as soon as it is certain landing area can be reached.

m. Give order to brace, 30 seconds before contact.

n. Mixture control levers—Engines No. 1 and No. 4—OFF.

o. Fuel tank selector levers—OFF.

p. Ignition switches—OFF.

q. All electrical power (batteries, generators, and generator field circuit breakers)—OFF as soon as possible after ground contact.

r. Hold nose fairly high for landing.

s. Emergency shutoff levers, all engines—Full OFF position.

t. Evacuate aircraft promptly.

Note

Steps n, o, p, and q should be accomplished simultaneously just prior to contact with the ground so that engines No. 1 and No. 4 can be kept running up to the last possible moment to provide hydraulic power for flight control boosters.

Landing With Main Landing Gear Only—Nose Gear Retracted.

Nose gear component failure can cause a condition where the main gear comes down and locks, but the nose gear remains in an unsafe condition. The following procedure will allow the aircraft to be landed in this configuration with minimum damage.

a. Reduce landing weight by burning or dumping excess fuel.

WARNING

If the nose gear is to be inspected through the nosewheel well access door, turn off all electrical equipment in the compartment. With the access door open, leaking hydraulic fluid can spray back into the lower compartment.

b. Make a flat approach using 60 percent flaps.

c. Place brake selector in EMERGENCY.

d. After touchdown, shut down engines No. 2 and No. 3.

CAUTION

Minimum damage should occur by shutting down the engines with the mixture controls. Feathering may result in the engines being torn loose from the mounts when the stopped propellers strike the runway.

e. As the speed decreases, lower the nose to the runway as gently as possible before elevator control is lost.

Note

When the nose is lowered through a level attitude increased control force can be expected due to a negative angle of attack.

f. After stopping the aircraft using brakes, shut down engines No. 1 and No. 4.

g. Secure all switches and controls, and evacuate promptly.

Landing With Main Landing Gear Retracted—Nose Gear Extended.

a. Retract nose gear and follow Landing Without Landing Gear Fully Extended procedures.

Landing With One Main Landing Gear Not Extended.

a. Retract all landing gear and follow Landing Without Landing Gear Fully Extended procedures.

LANDING GEAR SYSTEM MALFUNCTION PROCEDURES.

Failure to Extend.

After the landing gear is extended, if any of the landing gear warning devices indicate an unsafe condition of the gear, it should be considered that the gear is unsafe for landing and not that there is a malfunction of the warning system, unless definitely proven otherwise. These warnings are: glowing of the gear unlocked warning light, unlocked indication of any of the gear down and locked lights or indicators, and the sounding of the landing gear warning horn. The following procedures are based upon the assumption that normal hydraulic system pressure is available; however, certain portions of these procedures will still apply if only the emergency extension system is operating. The procedures apply to malfunctioning nose or main gear unless specified otherwise.

a. Determine whether the affected gear is still on the uplock, or is down but not locked.

Note

The down and locked indicators will identify the malfunctioning landing gear. The approximate position of the gear can then be determined by crew inspection. This can be done with the drift sight for any gear, or from the cabin for main gear and from the lower forward baggage compartment door or by making a pass by the control tower and asking the operators to check gear position.

b. If affected gear is up and locked:

(1) Operate the landing gear lever UP and DOWN several times. Wait for the gear to complete each cycle.

(2) Malfunctioning main gear only—With the landing gear lever DOWN, fully extend and retract the wing flaps several times. Wait for the flaps to complete each cycle. Operation of the flaps causes relative spanwise motion between the uplock sleeve and the uplock jaws and may be effective in releasing the uplock. Airspeed limitations with flaps extended must be observed.

(3) Retract gear and try extending it by means of the emergency extension system, using recommended procedures (No. 3 and 4 pumps OFF). Pump maximum pressure with the handpump.

(4) Malfunctioning main gear only—Turn No. 3 and 4 pumps back on and operate the wing flaps through several full cycles while holding maximum hand pump pressure.

(5) Make alternate push-overs and pullups while holding maximum hydraulic pressure with hand pump and normal system. Use caution to avoid exceeding aircraft structural limitations.

(6) Repeat the preceding steps as necessary. Past experience with cases of this type has shown that repeated cycling of the gear will usually result in a successful gear extension.

c. If affected gear is down but not locked:

(1) Operate landing gear lever UP and DOWN several times. Wait for the gear to complete each cycle.

(2) Make alternate push-overs and pullups while using normal system pressure to hold gear down. Use maximum handpump pressure if normal system pressure is not available.

(3) Extend gear with emergency extension system using recommended procedures, and pump maximum pressure with the handpump.

(4) Repeat the preceding steps as necessary.

FOR "FAILURE TO EXTEND" PROCEDURES, REFER TO TO — 1S5-15 DTO. 23 NOV. 66 - FOUND IN FRONT OF MANUAL.

c. If affected gear is down but not locked:

(1) Operate landing gear lever UP and DOWN several times. Wait for the gear to complete each cycle.

(2) Make alternate push-overs and pullups while using normal system pressure to hold gear down. Use maximum handpump pressure if normal system pressure is not available.

(3) Extend gear with emergency extension system using recommended procedures, and pump maximum pressure with the handpump.

(4) Repeat the preceding steps as necessary.

Failure to Retract.

a. If all gears unlock but do not retract:

(1) Check secondary pressure and quantity.

(2) Check position of emergency handpump selector valve. (Should be in BRAKE position.)

b. If nose gear fails to retract:

(1) Inspect nose gear through forward baggage door.

(2) Check nose gear shutoff valve.

(3) Recycle DOWN and then UP (if gear and doors appear normal).

(4) If the gear and/or doors are damaged, extend gear if possible.

c. If main gear fails to retract:

(1) Inspect gear.

(2) Recycle DOWN and then UP (if gear and doors appear normal).

(3) If the gear and/or doors are damaged, extend gear if possible.

CAUTION

Do not recycle landing gear if doors or gear are damaged on initial retraction attempt. If required, dump fuel before extending gear.

Note

Cross reference all gear malfunctions with indicator and warning light.

EMERGENCY NOSE GEAR EXTENSION.

In cases of emergency, such as failure in the emergency hydraulic line to the main gear accompanied by some other malfunction which prevents the extension of the nose gear with the normal hydraulic system pressure, emergency pressure can be concentrated in the nose gear line by capping off the emergency line to the main gears. If the main gears can be extended and locked successfully by free fall, the main gears can be isolated from the emergency gear extension system, and emergency pressure directed to the nose gear with the emergency extension procedure.

a. The emergency main gear extension line may be reached through the forward cargo compartment by removing the forward section of the compartment lining on the left side to expose the hydraulic plumbing. The emergency line to the main gears is marked L.G. EMERG EXT.

Landing With a Gear Fully Extended But Not Locked.

If the procedures above fail to lock the gear down and a landing must be made, it is still possible to land safely while holding the gear in the extended position by hydraulic pressure. To maintain sufficient pressure, it is essential to keep engines operating at an adequate rpm and to refrain from actuating other hydraulically operated units that might cause pressure to drop in the landing gear hydraulic lines. Specifically, the following procedure is recommended:

a. Place brake selector lever in EMER.

b. Turn refrigerator cooling fan switches OFF; paddle switches to WARMER until secondary scoop lights are out.

c. If certain that both hydraulic systems are operating normally, place hydraulic crossover shutoff switch in EMER (open).

d. Make a normal landing, or slightly flatter than normal, if runway length is adequate; however, it must be remembered that use of propeller reverse should be avoided, and that the aircraft, therefore, will require more landing distance than normal. Do not make an extremely slow, nose-high landing as the impact forces, if the plane should drop in a stalled condition, could tend to collapse the gear.

e. Do not use propeller reversing.

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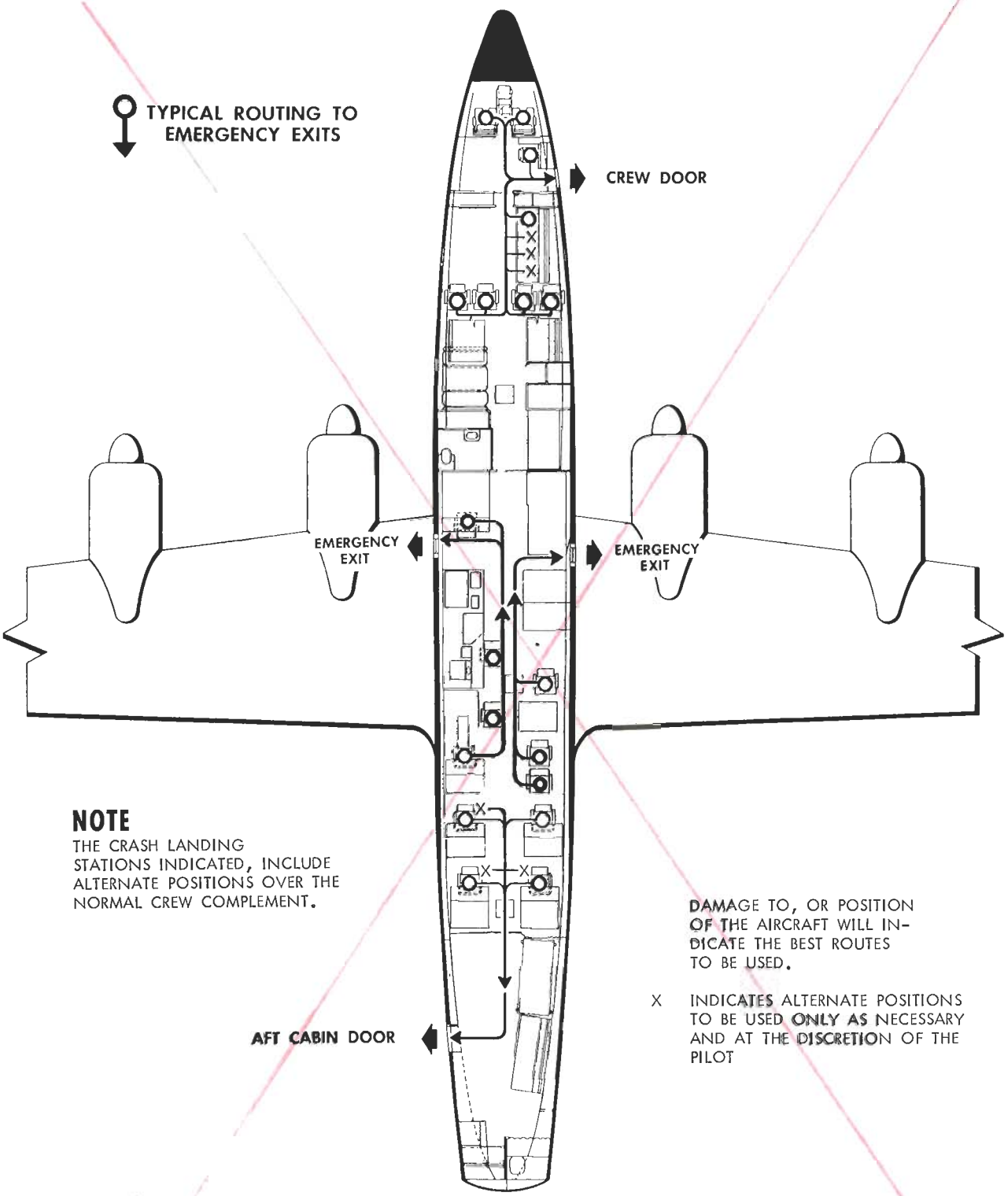
EC-121D. EMERGENCY ESCAPE ROUTES—LAND


TYPICAL ROUTING TO EMERGENCY EXITS
CREW DOOR
EMERGENCY EXIT
EMERGENCY EXIT
AFT CABIN DOOR
X
X
X

SEE 1SSUD 23 FEB 66 FOR ADDITIONAL WARNINGS + NOTES

Failure to Retract.

a. If all gears unlock but do not retract:

(1) Check secondary pressure and quantity.

(2) Check position of emergency handpump selector valve. (Should be in BRAKE position.)

(3) Inspect gear.

CAUTION

Do not recycle landing gear if doors or gear are damaged on initial retraction attempt. If required, dump fuel before extending gear.

4. Recycle gear down and make no further attempts to retract gear if gear is down and locked.

Note

Cross reference all gear malfunctions with indicator and warning lights.

b. If nose gear fails to retract:

(1) Inspect nose gear through forward baggage door.

(2) Check nose gear shutoff valve.

(3) Recycle DOWN and then UP (if gear and doors appear normal).

(4) If the gear and/or doors are damaged, extend gear if possible.

c. If main gear fails to retract:

(1) Inspect gear.

(2) Recycle DOWN and then UP (if gear and doors appear normal).

(3) If the gear and/or doors are damaged, extend gear if possible.

CAUTION

Do not recycle landing gear if doors or gear are damaged on initial retraction attempt. If required, dump fuel before extending gear.

Note

Cross reference all gear malfunctions with indicator and warning light.

EMERGENCY NOSE GEAR EXTENSION.

In cases of emergency, such as failure in the emergency hydraulic line to the main gear accompanied by some other malfunction which prevents the extension of the nose gear with the normal hydraulic system pressure, emergency pressure can be concentrated in the nose gear line by capping off the emergency line to the main gears. If the main gears can be extended and locked successfully by free fall, the main gears can be isolated from the emergency gear extension system, and emergency pressure directed to the nose gear with the emergency extension procedure.

a. The emergency main gear extension line may be reached through the forward cargo compartment by removing the forward section of the compartment lining on the left side to expose the hydraulic plumbing. The emergency line to the main gears is marked L.G. EMERG EXT.

Landing With a Gear Fully Extended But Not Locked.

If the procedures above fail to lock the gear down and a landing must be made, it is still possible to land safely while holding the gear in the extended position by hydraulic pressure. To maintain sufficient pressure, it is essential to keep engines operating at an adequate rpm and to refrain from actuating other hydraulically operated units that might cause pressure to drop in the landing gear hydraulic lines. Specifically, the following procedure is recommended:

a. Place brake selector lever in EMER.

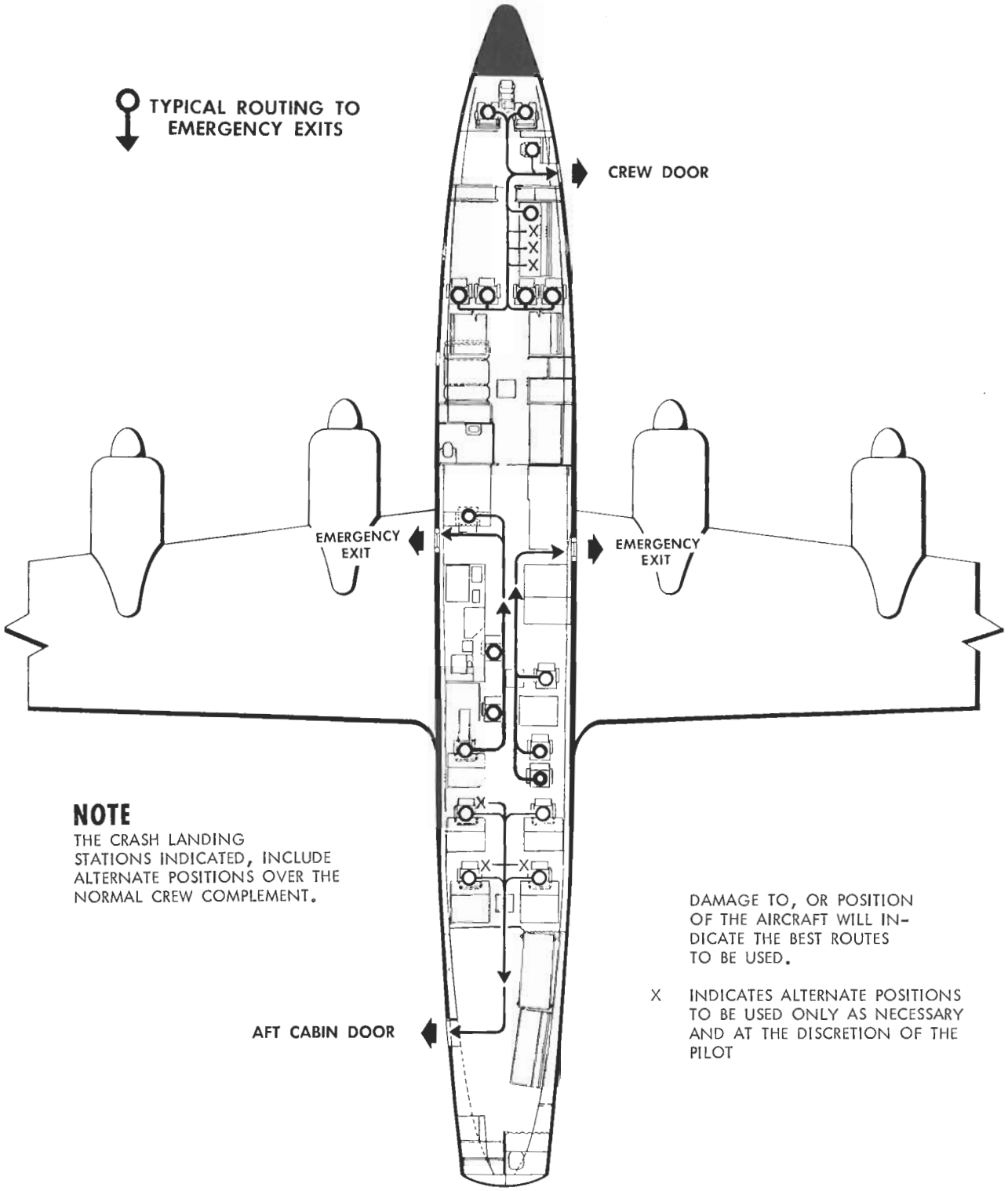
b. Turn refrigerator cooling fan switches OFF; paddle switches to WARMER until secondary scoop lights are out.

c. If certain that both hydraulic systems are operating normally, place hydraulic crossover shutoff switch in EMER (open).

d. Make a normal landing, or slightly flatter than normal, if runway length is adequate; however, it must be remembered that use of propeller reverse should be avoided, and that the aircraft, therefore, will require more landing distance than normal. Do not make an extremely slow, nose-high landing as the impact forces, if the plane should drop in a stalled condition, could tend to collapse the gear.

e. Do not use propeller reversing.

EC-121D. EMERGENCY ESCAPE ROUTES—LAND



NOTE

THE CRASH LANDING STATIONS INDICATED, INCLUDE ALTERNATE POSITIONS OVER THE NORMAL CREW COMPLEMENT.

DAMAGE TO, OR POSITION OF THE AIRCRAFT WILL INDICATE THE BEST ROUTES TO BE USED.

X INDICATES ALTERNATE POSITIONS TO BE USED ONLY AS NECESSARY AND AT THE DISCRETION OF THE PILOT

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Figure 3-3 (Sheet 1 of 2)

TC-121C. EMERGENCY ESCAPE ROUTES—LAND (TYPICAL)

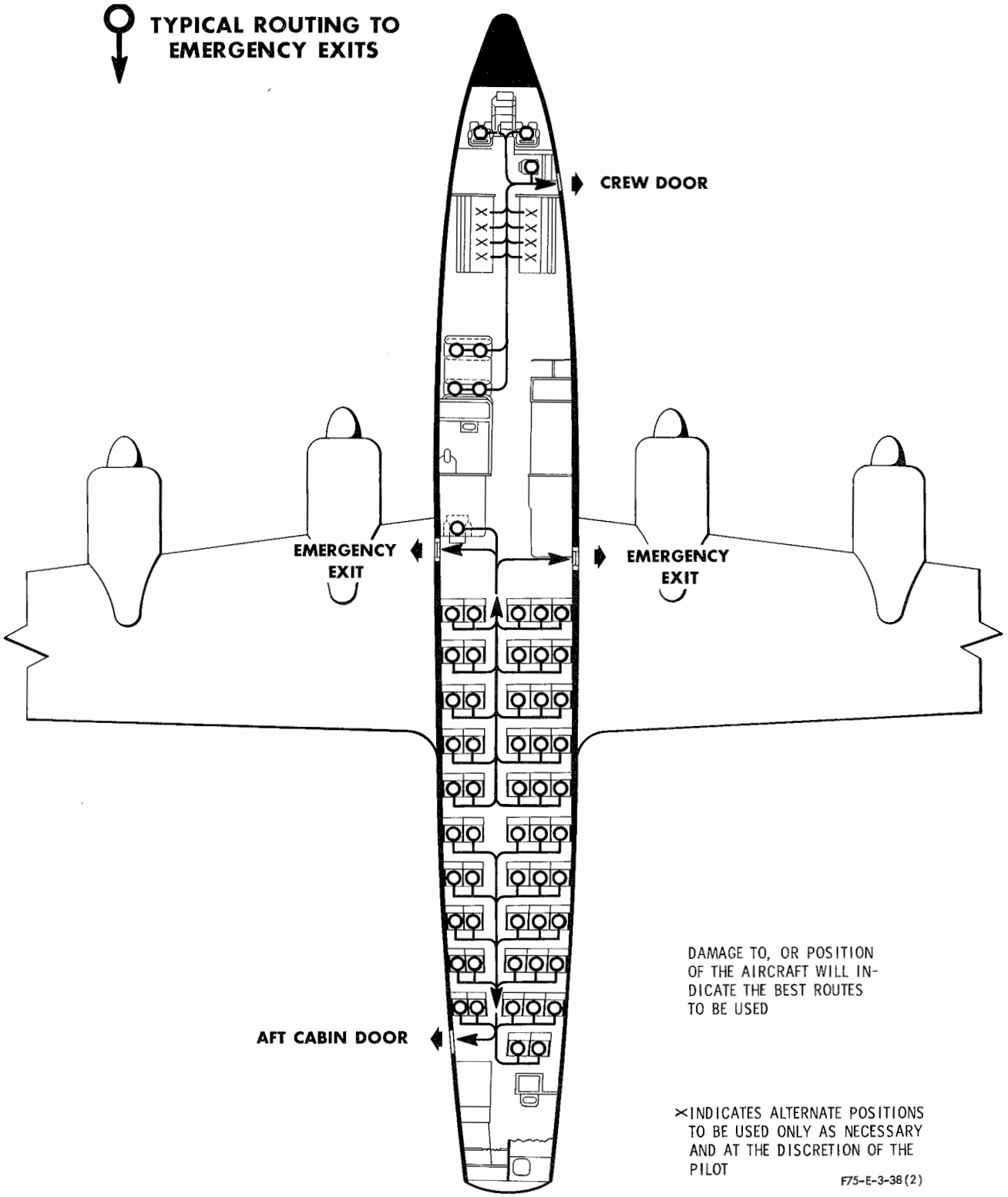

Figure 3-3 (Sheet 2 of 2)

Note

Because of the geometry of the main gear, the forward motion of the aircraft being opposed by the wheel brakes will tend to hold the gear extended. This may not be true if propeller reversing is used for braking.

f. Do not use nosewheel steering unless unable to steer the aircraft by differential wheel braking. Do not turn off the runway.

g. Do not raise the flaps. Operation of the flaps will reduce hydraulic pressure which may allow the gear to collapse.

h. Maintain 1,000 to 1,200 rpm on all four engines and gradually apply the brakes. Just before the aircraft comes to a complete stop, release the brakes momentarily to allow the lower drag shock to retract and then bring the aircraft to a smooth stop. Hold position with the brakes.

Note

An rpm of 1,000 to 1,200 will give full hydraulic pressure as long as no hydraulic system units are operated. This is considerably more pressure than is required to keep the gear extended. Also, at this rpm the lower drag shock strut normally will remain retracted as the aircraft stops. It is recognized that at times the airplane will rock backward as it stops in spite of the pilot's best efforts to stop with the lower drag shock struts retracted; however, this condition is not critical as long as full hydraulic pressure is maintained and rpm is in the recommended range. Stopping with the drag shock struts retracted is recommended since it facilitates ground action in making the gear safe as explained below.

(1) The hydraulic force imposed by the landing gear hydraulic cylinder acts to pull the downlock hook onto the shaft. If the lower drag shock strut is extended the tension in the drag shock strut opposes the force exerted by the landing gear hydraulic cylinder and tends to raise the downlock hook off the shaft. This may make it difficult or impossible to move the latch to the locked position in order to insert the ground safety pin.

(2) If the shock strut is broken, the landing gear hydraulic cylinder will extend until it bottoms, which will put the upper and lower drag struts in an over-center (stable) condition. If the lower drag shock strut is extended, the tension produced opposes the force exerted by the landing gear hydraulic cylinder. This tends to pull the upper and lower drag struts back into a straight line, or on-center position, and makes it more difficult to insert bracing to hold the gear extended.

i. Have the landing gear safety pins inserted. It may be necessary to move the downlock latch to the locked position manually. If a main gear downlock or downlock latching mechanism is damaged, thus preventing the insertion of the safety pin or rendering its insertion ineffective, block the nosewheels and jack the aircraft with a wing jack. Blocking the nosewheels will prevent the airplane from rocking off the jack when engine power is reduced should the lower drag shock struts retract at that time.

WARNING

Ground personnel should be alerted to the possibility of the landing gear collapsing while the ground safety pins are being inserted or while the aircraft is being jacked. It may be considered desirable to back a heavy truck under the wing box beam; however, to be of any help, the truck must have sufficient bearing area and strength to support the aircraft. Use of small equipment is not recommended since it will not protect personnel and will increase the damage to the aircraft if the gear does collapse.

j. Do not reduce engine rpm until either the landing gear is safely locked down or the aircraft is on jacks. When safe to do so, reduce rpm gradually to idle prior to cutting engines. Do not move the aircraft until the landing gear is safely locked.

EMERGENCY JETTISONING.

JETTISONING OF BAGGAGE AND/OR CARGO (TC-121C).

If it becomes necessary to reduce weight in filght, consideration should be given to the peculiarities of the cargo load and to time available for load reduction.

Careful consideration should be given to the following:

a. Jettisoning the heaviest cargo that can be pushed out of the passenger door which would reduce weight in less time as opposed to jettisoning lighter items because of better accessibility and ease of handling.

EMERGENCY EXIT OPERATION

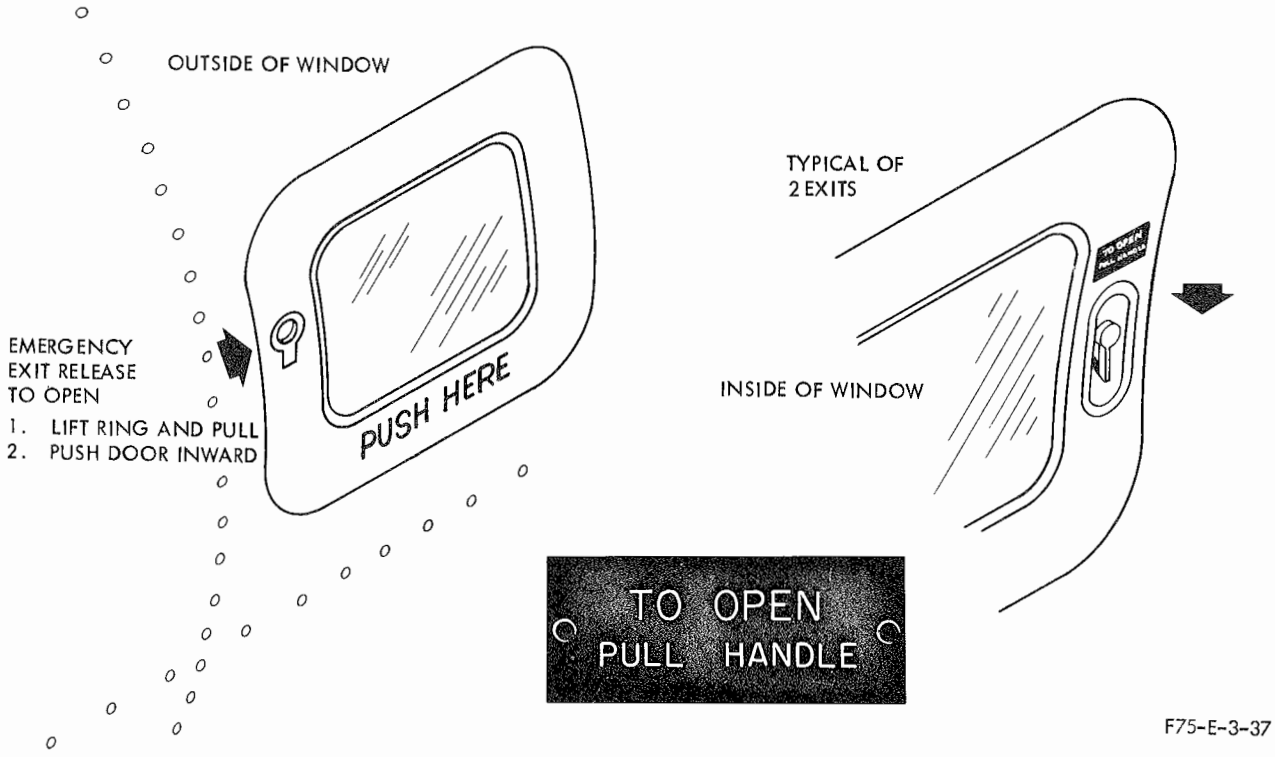

Figure 3-4

b. Maintaining the airplane center of gravity within limits to preclude inadvertent loss of altitude.

c. If carrying passengers, all unneeded baggage, seats, gear and radio equipment may be jettisoned, but if possibility of ditching exists, seats should be retained.

An object pushed from the passenger door, when operating under the conditions set forth in the following table, will clear the horizontal tail by:

5 LBS. PER CUBIC FOOT CARGO DENSITY

Operating Speed Flaps Up	*Airplane Operating Weight*	*Clear Horizontal Tail*
180 knots IAS	120,000 lbs.	* 6.0 ft.
180 knots IAS	130,000 lbs.	* 5.75 ft.
180 knots IAS	140,000 lbs.	* 5.50 ft.

* At a given airplane weight a reduction in speed, increase in object weight density, or operating with extended wing flaps will increase this clearance.

Proceed as follows:

a. Depressurize, and at 1" Hg turn auxiliary ventilation control knob to position A.

b. Airspeed—150 to 160 knots.

c. Wing flaps—may be used to change the longitudinal axis of the aircraft to facilitate movement of the cargo fore or aft for jettisoning.

d. Passenger entrance door—OPEN.

WARNING

- Crewmember who is jettisoning cargo must be safety-strapped to aircraft structure so that maximum length of strap will prevent his falling through the opening.
- The cargo doors must never be opened in flight.

FUEL DUMPING CHECKLIST

Pilots			*Flight Engineer*	
1. Alert entire crew	ACCOMPLISHED	P	1. Cabin heater switches	OFF
2. Radar equipment (EC-121D)	ON STANDBY	CP	2. Tank 5 and fuel crossfeed levers	CLOSED
Notify Radar Technician				
3. HF Radio	OFF	CP		
4. Wing flap lever	UP	CP		
5. Landing gear lever	UP	CP		
6. Airspeed (140 min-190 max)	155-165 KNOTS DESIRED	P		
7. Exterior light master switch	STEADY	CP		
(8.) Start dumping	DUMP VALVE OPEN	P	(3.) Start dumping	DUMP VALVE OPEN

Note

The maximum permissible airspeed during fuel dumping is 190 knots; the minimum 140 knots. However, since airspeed will build up as fuel is dumped, it is desirable to start dumping at a speed of 155 knots. The aircraft should be flown straight with wings level to avoid the possibility of flight through fuel vapors. Engine powers should be kept constant. Shallow turns, climb and descent are permissible.

When fuel starts to dump, move fuel dump lever to NEUTRAL.

			4. Fuel pumps 6L and 6R switches (EC-121D)	AS REQUIRED
(9.) Stop dumping	DUMP VALVE CLOSED	P	(5.) Stop dumping	DUMP VALVE CLOSED

CAUTION

On EC-121D aircraft auxiliary booster pumps 6L and 6R should never be in the HIGH position except during fuel dumping operations. Refer to Fuel Dump rates, figure 3-7.

When valves are closed, move fuel dump lever to NEUTRAL.

			6. Fuel pumps 6L and 6R switches (EC-121D)	OFF
(10.) Engineer's Fuel Dumping checklist	COMPLETED	CP	(7.) Engineer's Fuel Dumping checklist	COMPLETED

Note

If a fuel dump system malfunction is encountered, attempt to use the Emergency Fuel Dumping procedure.

EMERGENCY FUEL DUMPING CHECKLIST

Pilots	*Flight Engineer*
	WARNING
	Dumping fuel when a fire is involved is not recommended and should only be accomplished as a last resort at the pilot's discretion.
1. Accomplish steps No. 1 through No. 8 of Fuel Dumping checklist.	P 1. Accomplish steps No. 1 through No. 4 of Fuel Dumping checklist.

FUEL DUMPING PROCEDURE

FUEL DUMP CONTROL LEVER —**OPEN** UNTIL FUEL STARTS TO DUMP; THEN **NEUTRAL**

FUEL DUMP CONTROL LEVER —**CLOSED** UNTIL VALVES HAVE CLOSED; THEN **NEUTRAL**

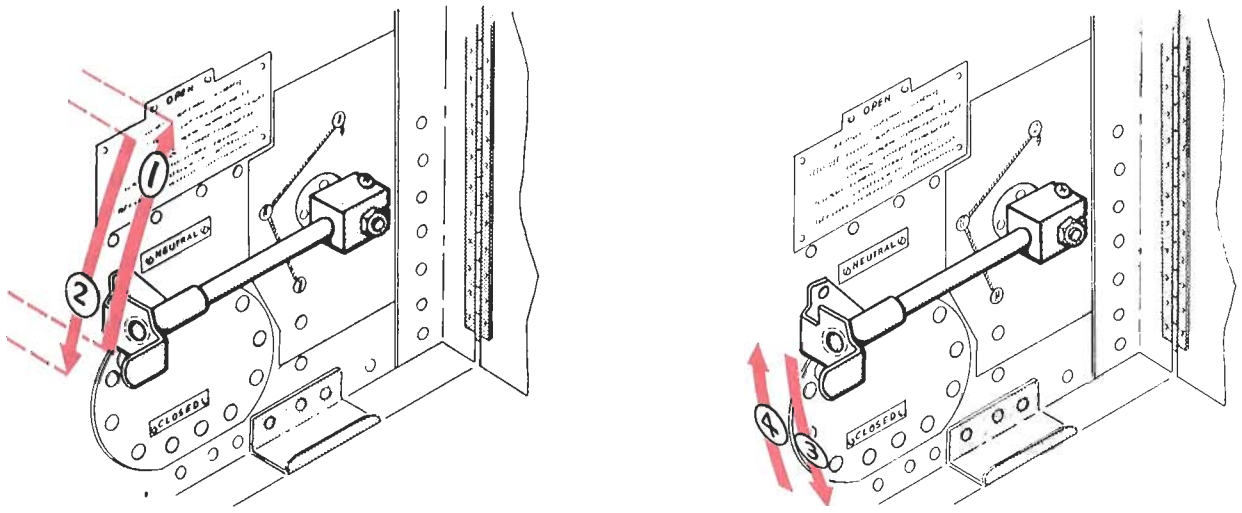

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Figure 3-5

EMERGENCY FUEL DUMPING CHECKLIST—Continued

	Pilots		*Flight Engineer*	
2. Emergency fuel dump lever	FUEL DUMP	CP		
3. Handpump selector lever	EMER GEAR	CP		
4. Handpump	OPERATE	CP		
After fuel dumping:				
(5.) Stop dumping procedure	DUMP VALVE CLOSED	P, CP	(2.) Stop dumping procedure	DUMP VALVE CLOSED
6. Handpump	OPERATE	CP	3. Fuel pumps 6L and 6R switches (EC-121D)	OFF
7. Emergency fuel dump lever	L.G. EMER. EXT.	CP		
8. Handpump selector	EMER. BRAKES	CP		
9. Emergency extension tank	RESERVICED AS REQUIRED	P		
(10.) Engineer's Emergency Fuel Dumping checklist	COMPLETED.	CP	(4.) Engineer's Emergency Fuel Dumping checklist	COMPLETED.

AIRCRAFT SYSTEMS FAILURE.

ELECTRICAL POWER SYSTEM FAILURES.

It is extremely difficult to anticipate all of the possible failures and plan corrective action for each individual failure. A broad analysis of the situation indicates that electrical failures fall into three possible categories as follows:

Loss of Primary Power Source.

If a field relay circuit breaker switch trips, reset and check for overload. If the field relay trips again, do not reset until the source of trouble is located and corrected. To provide further feeder protection, open the field circuit breakers.

Generator Malfunction or Failure.

In the event that the ammeter starts to fluctuate and generator voltage is erratic, or a generator overheat light comes on indicating a possible generator failure, immediate corrective action must be taken as outlined in the following steps:

a. Check operating generator loads to determine that ratings will not be exceeded.

b. Proceed as follows:

(1) If the generator ammeter is fluctuating and the generator voltage is erratic but the generator overheat light is not on—generator switch off.

(2) On EC-121D aircraft, if an inboard engine generator ammeter is fluctuating, the generator voltage is erratic and the generator overheat light comes on and remains on, feather the engine if no greater emergency exists. If this situation occurs with an outboard engine generator the driveshaft should be disconnected.

(3) On TC-121C aircraft if the generator ammeter is fluctuating and the generator voltage is erratic and the generator overheat light comes on and remains on—feather the engine (if no greater emergency exists).

(4) If the generator overheat light comes on and remains on and if the generator voltage and field relay trip lights are normal, the overheat indication could be caused by a blocked generator cooling air duct or a shorted warning light circuit—generator switch off.

(5) If the generator overheat and field relay trip lights are both on, feather the engine unless a greater emergency exists. On EC-121D aircraft, if this situation occurs on an outboard engine generator the driveshaft should be disconnected.

LOSS OF ALL GENERATORS CHECKLIST

Pilots — *Flight Engineer*

The first 2 items in bold print will be accomplished prior to reading the checklist.

1.	**SHIP BATTERY SWITCH**	**OFF**
2.	**FLIGHT INSTRUMENT SWITCH**	**EMERGENCY**
3.	Generator switches	OFF
4.	All non-essential dc currents	OFF

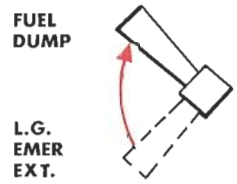
Note

If fuel requirements are not critical, engine rpm should be increased before battery power is depleted to a value that will permit ample power for a go-around. Battery switch may be switched on momentarily for rpm changes.

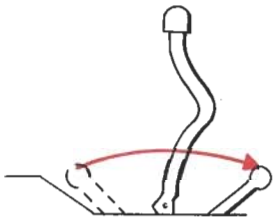
FUEL DUMPING EMERGENCY HANDPUMP OPERATION

TO DUMP

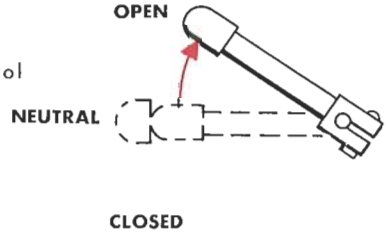
1. Emergency fuel dump lever—**FUEL DUMP** position.



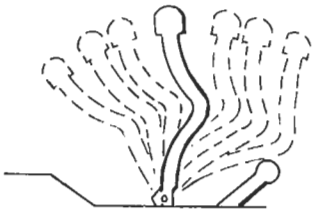
2. Emergency hand pump selector lever—**EMER. GEAR** (aft position).



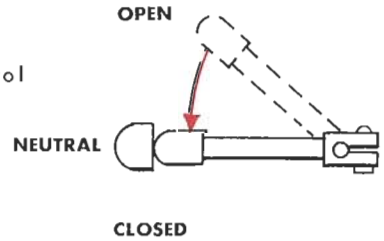
3. Fuel dump control valve lever (sta. 260)— **OPEN.**



4. Emergency hand pump—Operate until fuel starts to dump.



5. Fuel dump control valve lever (sta. 260)— **NEUTRAL.**



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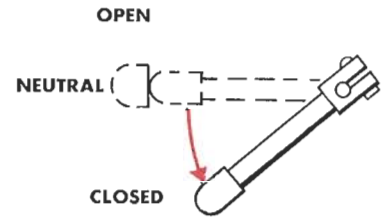
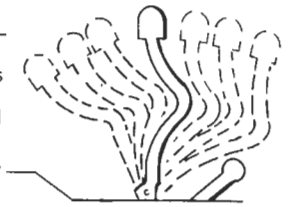
AFTER DUMPING

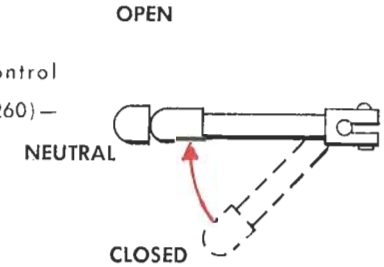
6. Fuel dump control valve lever —**CLOSED.**



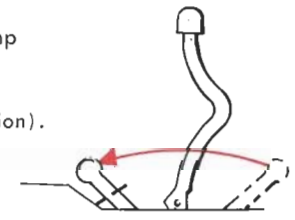
7. Emergency hand pump—Operate until dump valves are closed and the inboard dump chutes are retracted.



8. Fuel dump control valve lever (sta. 260)— **NEUTRAL.**



9. Emergency hand pump selector lever—**EMER. BRAKES** (forward position).



10. Emergency fuel dump lever—**L. G. EMER. EXT.** position.

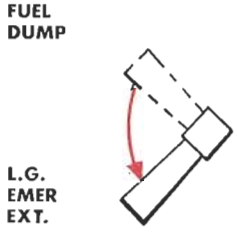


Figure 3-6

EC-121D. FUEL DUMPING FOR WEIGHT REDUCTION

BEFORE DUMPING FUEL

1. ALL ELECTRONIC EQUIPMENT IN STANDBY
2. WING FLAPS UP
3. LANDING GEAR RETRACTED
4. INDICATED AIRSPEED (IAS) OF 155 – 165 KNOTS
   DO NOT EXCEED 190 KNOTS IAS
   OR LESS THAN 140 KNOTS IAS

LANDING GR WT LB	MAX ALLOWABLE IN TIP TANKS GAL/TANK	DUMPING DURATION MINUTES
122,000	300	3.9 *
110,000	200	5.4 *

* 601 GAL/TANK (FULL) INITIALLY

CONDITIONS:

ONE US GALLON = 6.0 POUNDS
INDICATED AIRSPEED (IAS) 190 KNOTS
FUSELAGE TANK FUEL NOT DUMPABLE
BASED ON RECOMMENDED FUEL MANAGEMENT

EXAMPLE:

GROSS WEIGHT – 142,500 LB
FUEL WEIGHT – 45,000 LB (INCLUDING FUSELAGE TANK FUEL)
DUMPING DURATION – 9 MINUTES
FUEL ABOARD AFTER DUMPING – 12,500 LB
GROSS WEIGHT AFTER DUMPING – 110,000 LB

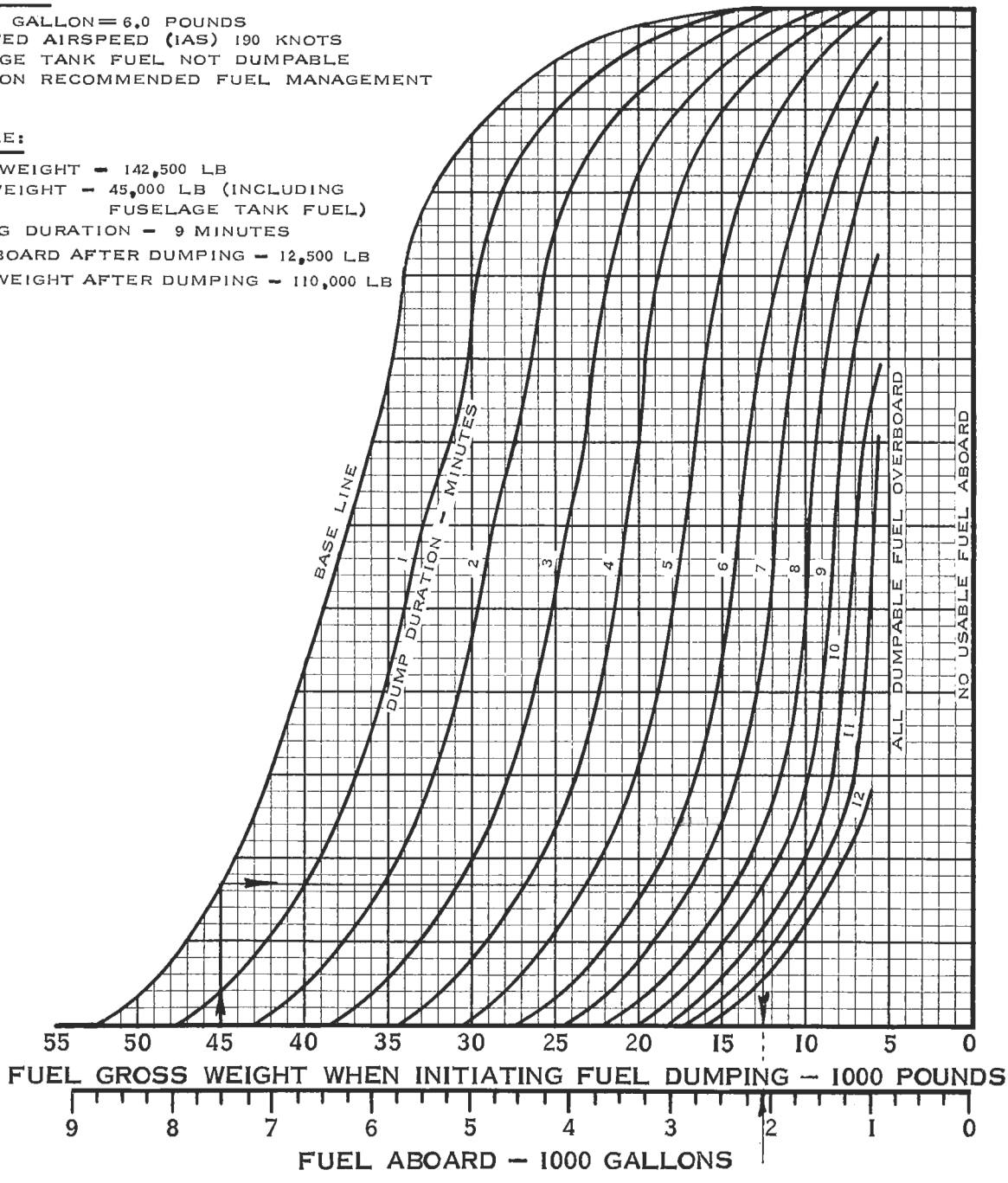


Figure 3-7 (Sheet 1 of 2)

TC-121C. FUEL DUMPING FOR WEIGHT REDUCTION

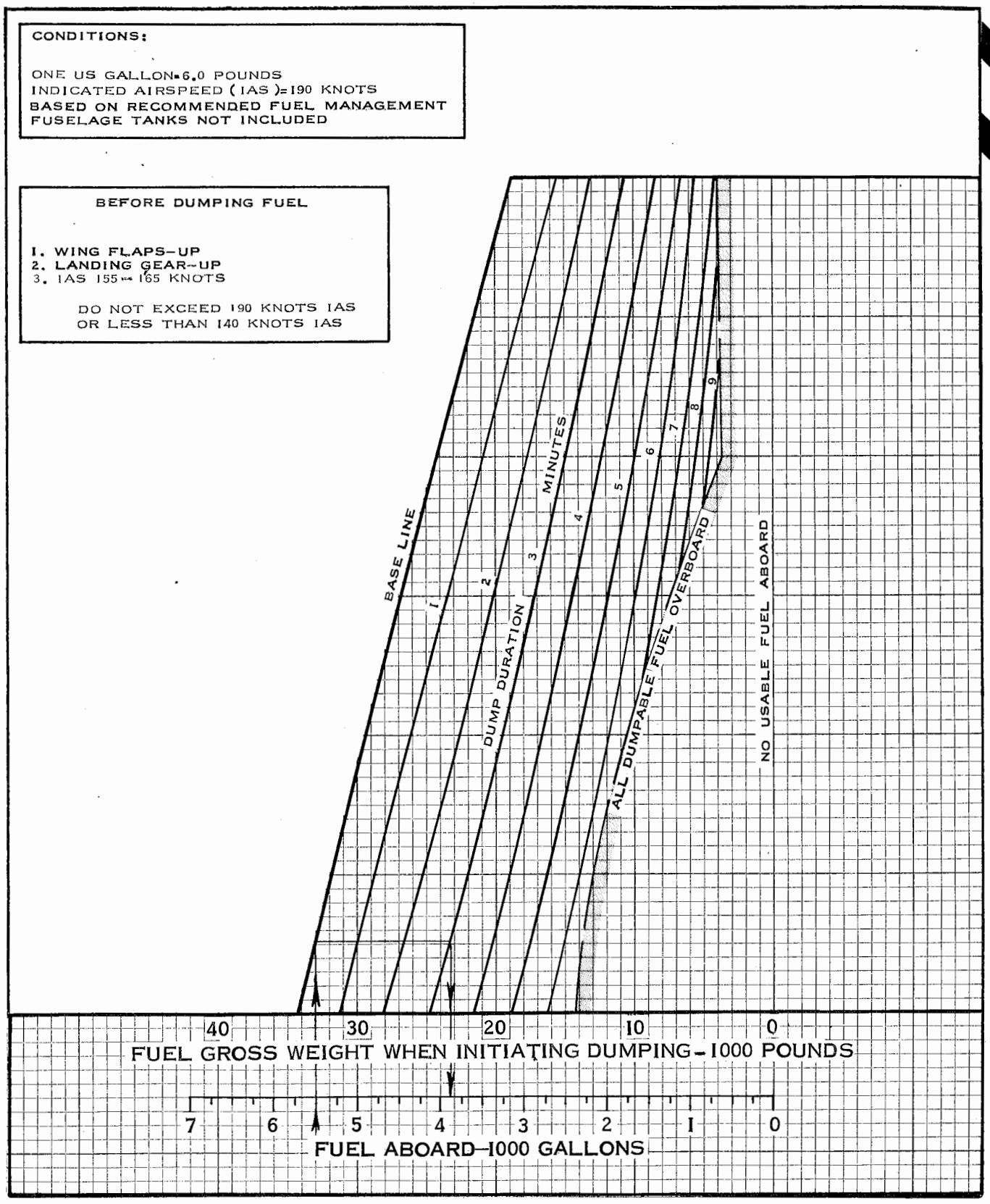


Figure 3-7 (Sheet 2 of 2)

Equipment and Distribution System Faults.

If one or more items of electrical or electronic equipment should fail, isolate the faulty item by opening the fuse or circuit breaker. Faults on the distribution system should clear through the action of circuit breakers, fuses, limiters, and generator protection systems. They may result in smoke and require some emergency corrective action. Refer to ELECTRICAL FIRE. Faults on the bus or complete loss of dc system from other causes are unlikely.

WARNING

In event the replacement of a current limiter is required, the dc electrical system must be deactivated.

AC Generator Drive-Shaft Disconnect (EC-121D).

When the over-voltage warning light glows, the flight engineer should have the AOC crew monitor the electrical load and reduce it as necessary to relieve the situation. Reset the tripped generator. If the generator trips again do not reset until the fault has been corrected. If the over-temperature warning light glows have the AOC crew remove part of the associated ac generator load. If the temperature cannot be lowered sufficiently, trip the generator from the bus. If this action does not lower the temperatures to within tolerance, disconnect the drive shaft to the associated generator.

Note

- If the ac generator drive shaft is disconnected, it cannot be reconnected in flight.
- Since each gear box drives one ac generator and one dc generator, both will be disconnected and monitoring of the dc loads will be required.
- If generator fails to disconnect, check dc circuit breaker on lower MJB 212 panel.

AUTOMATIC PILOT-EMERGENCY OPERATING PROCEDURES.

When using the automatic pilot, the pilot or copilot must be in his seat, with his safety belt fastened so that if any malfunction occurs, he can recover immediately.

Automatic Pilot Failures.

Automatic pilot failures generally will be indicated by continuous hard-over signals or oscillating signals. The continuous hard-over type of malfunction can result from shorting or grounding of certain circuits, and/or the failure of certain tubes. The result will be that the automatic pilot servo will develop full torque on one of the surfaces (not necessarily full deflection) and the maneuver that results will depend upon the speed, cg position, gross weight, and to a certain extent upon the type of failure that has occurred, as it is possible to get erroneous signals that do not develop full torque from the servo unit.

Elevator Hard Nose Down.

Should the automatic pilot malfunction give an elevator hard nose-down signal, the aircraft will pitch over quite rapidly to almost zero G, which is the critical condition. In combination with turbulence, this hard nose-down signal may produce an acceleration below zero G's which could unseat the pilot. Therefore, the pilot must have his safety belt fastened at all times.

Aileron Hard-over.

Another type of failure is an aileron hard-over signal which produces a smooth movement at the ailerons and the aircraft will roll at a maximum rate of about six degrees per second. This is so smooth that it is quite possible that the pilot will not detect the motion at night or when on instruments, unless he is actually observing the gyro horizon or the control wheel at the time. It is possible that the aircraft can reach a very steep angle of bank before the pilot detects the motion, particularly if the air is slightly turbulent, making the pilot relatively insensitive to the small acceleration produced by the aileron roll.

Oscillating Signals.

Oscillating signals can occur due to a failure in the automatic pilot follow-up circuit and will be evident by the oscillating movement of the controls. Should the automatic pilot malfunction, it should be disengaged immediately by one of the following methods:

a. Operate either the pilot's or copilot's clutch disconnect switch.

b. Pull out the clutch switch.

c. Move the servo disconnect levers to OFF (up) position.

d. Move the flux gate caging switch to the ON (up) position and then release.

If a malfunction occurs, the pilot must restrain the controls while disconnecting the automatic pilot to prevent a sudden jerk when it disengages. The automatic pilot will be automatically disengaged by any momentary interruption of either ac or dc current.

Note

The automatic pilot may be overpowered; however, the control forces required will be higher than when the automatic pilot is disengaged.

HYDRAULIC PUMP FAILURE.

Continuous or repeated flashing of a pump low pressure warning light, which is not caused by operating a system component at low engine rpm and where there is no loss of fluid, indicates cavitation of the pump or internal pump failure. Place a load on the defective pump by operation of the brakes or flight controls to restore normal operation. If the defective pump does not return to normal operation turn off the good pump on the affected system and place a load on the defective pump again. If the pump will not prime and resume normal operating pressure it is defective. Turn the good pump back on. Leave the defective pump off and continue normal operation. Under most circumstances it is not advisable to open the emergency crossover valve after suspected pump failure. Contamination of the entire system may result. One pump inoperative in the primary system will not affect normal control booster operation of the flight controls. Loss of one pump in the secondary system will only restrict the flow and slow the operation of the landing gear, nose wheel steering, wing flaps and oil transfer. However, if the pilot faces severe weather conditions he may decide to use the crossover valve to provide better response to flight controls under heavy air load conditions or to provide positive steering and brakes during the landing roll.

CAUTION

Do not move the hydraulic system crossover switch to the EMERGENCY position until it has been determined that a complete loss of the remaining hydraulic system pressure will not occur.

HYDRAULIC SYSTEM CONTAMINATION.

The major cause of hydraulic system contamination is internal hydraulic pump failure. By not bypassing the affected pump soon enough after failure, fine and large metal particles from the defective pump may clog or crush the pump filter. When the pump filter is clogged or crushed the filter bypass will open at 50 psi, allowing contaminated fluid to enter either the primary or secondary system if the overhead emergency shutoff of the affected pump is still in the FULL ON position. BY OPENING THE EMERGENCY CROSSOVER THE ENTIRE HYDRAULIC SYSTEM WILL BE CONTAMINATED.

The possibility of contamination can be minimized by expedient troubleshooting to determine if the pump is defective before metal particles crush or clog the pump filter. When a pump is found to be defective, move the emergency overhead shutoff lever to the HYD OIL OFF position. The overhead shutoff lever actuates the pump control shutoff valve which bypasses and restricts fluid from entering the pressure system.

TROUBLESHOOTING THE HYDRAULIC SYSTEM.

Each hydraulic pump has a capacity of 22 gallons per minute at 1650 psi. Since the entire hydraulic system holds only 54 gallons of fluid it can be readily seen that prompt corrective action is essential when a loss of fluid quantity is observed in the primary or secondary system. If too much fluid has been lost the system cannot be restored. Therefore, if a loss of quantity is observed with or without a serious loss of pressure or pump low pressure warning light indication, both hydraulic pumps on the affected system should be shut down immediately. Move the emergency shutoff levers to the HYD OIL OFF position, then troubleshoot the affected system.

FAILURE OF PRIMARY HYDRAULIC SYSTEM.

In the event of loss of primary system fluid quantity or pressure, the following four steps must be accomplished in a minimum of time to avoid excessive loss of hydraulic fluid:

a. Autopilot	OFF	P
b. Emergency Shutoff Levers No. 1 & No. 2	HYD OIL OFF	P
c. Auxiliary Boost	ON	CP
d. Aileron Boost Lever	OFF	P

The pilot must then shut off the automatic pilot and tell the engineer to place the No. 1 and 2 shutoff levers in the HYD OIL OFF position. The pilot must have the copilot turn the auxiliary boost on and then the pilot must pull the aileron boost lever off.

WARNING

Do not move the emergency shutoff levers beyond the first detent. Engine failure may result.

e. If the elevator or rudder auxiliary boost system has a leak the affected control will stiffen up as the hydraulic system loses pressure. Shut off the defective control boost, reservice the hydraulic system and return to normal operation.

f. If the elevator and rudder auxiliary boost system holds pressure and operates normally, check the baggage compartments and tail section for leaks. If a leak is located in the hydraulic plumbing or components refer to the hydraulic system diagram to see if the leak can be isolated. If no leak is found, continue troubleshooting as indicated below.

g. Reservice the main hydraulic reservoir to three-fourths full.

h. Turn on number two hydraulic pump. The inboard pump is the lowest pump in the system and less likely to cavitate due to air in the lines. It isn't unusual for the quantity to drop rapidly to approximately one-half full before stabilizing due to air in the system. If the quantity drops below one-half, shut off the number two pump and reservice the reservoir to three-fourths full.

Note

If considerable fluid has been lost it is extremely difficult to determine if the drop in quantity is due to a hydraulic leak or due to air in the lines returning to the reservoir. Under these conditions it is advisable to check the number two pump again. If the quantity drops below one-half a second time, reservice the reservoir to three-fourths full and check the number one pump for leaks.

If the number one pump holds pressure and quantity then it has been established that the leak is in the number two pump. Reservice and resume normal operation.

CAUTION

Do not allow hydraulic reservoir quantity to drop below one-fourth full. Loss of the system may result.

i. If the number two pump holds pressure and quantity the leak is either in the number one pump or the aileron boost system. Since pump failures are more common check the aileron boost first.

CAUTION

Slow aircraft to 155 knots or below prior to turning on the aileron boost lever.

j. If the aileron boost system leaks, shut it off, turn the number one pump back on and continue operation with the aileron boost off.

If the pressure and quantity holds with the aileron boost on it may be assumed that the number one hydraulic pump is inoperative. Leave the number one pump off and resume normal operation. Do not use crossover unless weather or runway conditions require it.

k. If both number one and number two pumps fail to hold pressure, either both pumps are defective or there is a leak in a line common to both pumps. The aircraft may be flown with the auxiliary boost system on and the aileron boost shut off, or if conditions warrant, use of the emergency crossover may be attempted.

WARNING

If the emergency crossover valve is opened and the primary hydraulic system is contaminated with metal particles from a pump failure, the secondary hydraulic system will become contaminated. Loss of the secondary system may result.

l. If the emergency crossover must be used for landing, the landing gear should be lowered and the wing flaps lowered to 60% prior to opening the crossover. Shut off the number three and number four hydraulic pumps. Turn on the number three hydraulic pump. Observe secondary system quantity and pressure. (The primary system pressure will continue to read zero.) If the secondary quantity and pressure holds, turn the number four hydraulic pump back on. All primary system units can now be operated by the secondary system.

If the leak in the primary system is below the primary isolation check valve, the secondary system will not hold pressure and secondary hydraulic fluid will be lost through the leak. Return the crossover valve to NORMAL.

FAILURE OF SECONDARY HYDRAULIC SYSTEM.

In the event of loss of secondary system fluid quantity or pressure proceed as follows:

a. During Ground Operation: Tell the engineer to place the No. 3 & 4 emergency shutoff levers in the HYD OIL OFF position. Tell the copilot to place the emergency brake selector lever in the EMERGENCY BRAKE position. Stop the aircraft. Insert landing gear pins. Do not taxi the aircraft.

b. During Flight: Place No. 3 & 4 emergency shutoff levers in the HYD OIL OFF position.

WARNING

Do not move the emergency shutoff levers beyond the first detent. Engine failure may result.

c. Reservice the main hydraulic reservoir to three-fourths full. Check the emergency extension reservoir. Set aside three gallons of fluid in the event the emergency extension reservoir requires reservicing if the emergency system must be used.

d. All operating units should be shut off. If the hydraulic failure occurred during the operation of one of these units the leak is probably in the unit. For example: If a failure occurs during landing gear retraction the landing gear up line is probably leaking. Place landing gear selector lever in the neutral position.

e. Check each baggage compartment for leaks. Considerable plumbing and several of the selector valves are located in these areas. Refer to hydraulic system diagram to see if the leak can be isolated. If the wing flap motor or associated plumbing below the wing flap shutoff valve is leaking the leak can be isolated. Hold the wing flap shutoff valve test switch in the TEST position and pull out the wing flap shutoff circuit breaker (MJB-3 panel). Then release test switch.

Note

Wing flaps must be extended manually if the wing flap shutoff valve is closed. Refer to Emergency Wing Flap Extension checklist.

f. Turn on number three hydraulic pump since it is the lowest pump in the system. If the hydraulic quantity drops below one-half full, shut off the number three pump and reservice the reservoir to three-fourths full.

Note

If considerable fluid has been lost it is extremely difficult to determine if the drop in quantity is due to a hydraulic leak or due to air in the lines returning to the reservoir. Under either condition it is advisable to check the number three pump again. If the quantity drops below one-half a second time, reservice the reservoir to three-fourths full and check the number four pump for leaks.

If the number four pump holds pressure and quantity then it has been established that the leak is in the number three pump. Reservice and resume normal operation.

CAUTION

Do not allow hydraulic reservoir quantity to drop below one-fourth full. Loss of the system may result.

g. If the number three pump holds pressure and quantity the leak is either in the number four pump or the secondary plumbing operating units. Since all secondary units will operate on one pump it is not advisable to risk the loss of more fluid by checking number four pump.

h. If there is no leakage of fluid with pressure on the system and all operating units are shut off, the leak may be further isolated by operating units one at a time. Frequently, if the location of the leak can be determined and isolated, the remainder of the hydraulic system may continue to be operated normally.

i. If both number three and number four pumps fail to hold pressure either both pumps are defective or there is a leak in a line common to both pumps. The use of emergency crossover is not recommended unless nose wheel steering is essential because of weather or runway conditions.

WARNING

If the emergency crossover valve is opened and the secondary hydraulic system is contaminated with metal particles from a pump failure the primary hydraulic system will become contaminated. Loss of the primary system may result.

j. If the emergency crossover must be used for landing, shut off one of the primary hydraulic pumps prior to placing the emergency crossover valve switch in the EMERGENCY position. Observe primary system quantity and pressure. (The secondary system pressure will continue to read zero.) If the primary quantity and pressure hold, return both primary pumps to normal operation. All secondary units can now be operated by the primary system.

If the leak in the secondary system is below the secondary isolation check valve the primary system will not hold pressure and primary hydraulic fluid will be lost through the leak. Return the crossover valve to NORMAL.

k. If pressure cannot be restored to the secondary system by the engine driven pumps the emergency hand pump must be used to dump fuel, extend the landing gear and to provide pressure for brakes. The emergency extension reservoir, located between the pilot's rudder pedals, should be full prior to operation of the hand pump and will require reservicing after the landing gear is extended. The wing flaps may be extended by means of the hand crank. The nose gear steering will be inoperative. The right secondary heat exchanger fan motor will not operate. The reserve oil transfer system can be operated by placing the oil pump switch in the AUX (ELEC) position.

Note

Brakes will be available only if the brake accumulators are charged and the brake selector is in the EMER position. If the accumulators are discharged the brakes must be powered by the hand pump with the hand pump selector lever in the EMER BRAKES position and the brake selector lever in the EMER position.

FAILURE OF PRIMARY HYDRAULIC SYSTEM

Pilots

The first 4 items in bold print will be accomplished prior to reading the checklist.

1. **AUTOPILOT**	**OFF**	**P**
(2.) **EMERGENCY SHUTOFF LEVERS NO. 1 AND NO. 2**	**HYD OIL OFF**	**P**
3. **AUX CONTROL BOOSTER SWITCHES**	**ON**	**CP**
4. **AILERON BOOSTER SHUTOFF LEVER**	**OFF**	**P**

Note

If both auxiliary control boosters operate normally, continue to operate on auxiliary boost while trouble shooting the primary system. Loss of one auxiliary control booster indicates leak area.

Flight Engineer

The first item in bold print will be accomplished prior to reading the checklist.

(1.) **EMERGENCY SHUTOFF LEVERS NO. 1 AND NO. 2**	**HYD OIL OFF**
2. Troubleshoot	

FAILURE OF PRIMARY HYDRAULIC SYSTEM IN FLIGHT CHECKLIST—Continued

Pilots			*Flight Engineer*	
(5.) Crossover valve switch	OPEN (if location of leak permits)	P	(3.) Crossover valve switch	OPEN (if location of leak permits)

WARNING

Do not move the hydraulic system crossover switch to the EMERGENCY position until it has been determined that a complete loss of the remaining fluid will not occur.

BOOST-OFF LANDING.

When a boost-off landing is necessary, aircraft loading should be arranged to give a gear-down cg of 23% to 30% MAC. The forward cg position is limited by inability to flare for landing because of reduced elevator travel (elevator shift lever pulled out to EMER. position). The aft cg position is limited by the possibility of experiencing insufficient down elevator in case it is necessary to use full power at low airspeeds in rough air. Approach at 140 to 145 knots EAS for normal landing weights. The aircraft should be maintained in trim during the approach to eliminate excessive elevator control forces. A longer final approach with power for a low rate of descent is recommended to reduce the amount of attitude change during the landing flare. A small amount of power should be maintained until the aircraft touches down. Reverse thrust rather than brakes should be used for deceleration during the initial portion of the landing rollout. The copilot should standby to hold the controls during reversing to prevent excessive buffeting.

Rudder and/or differential power may be used for directional control. Turns may be made with the rudder, ailerons or differential power. Ailerons and/or differential power may be used to raise the wings.

Although the above procedure is recommended, boost-off landings may be made using 60% wing flaps, if desired. When using wing flaps the above technique is recommended except that the approach speed should be 135 knots EAS instead of 140 to 145 knots EAS. The use of 60% wing flaps, which permits lower approach and touchdown speeds, is important only if reverse thrust is not available.

Note

Should troubleshooting disclose that actuating the hydraulic system crossover switch would result in complete loss of the secondary hydraulic system, the aircraft must be operated, at the pilot's discretion, with either the rudder and elevator auxiliary booster switches ON and the aileron booster lever OFF, or all boosters OFF.

TURNING BOOSTERS ON IN FLIGHT.

CAUTION

Once the boosters have been turned off, they should not be turned on again unless it is definitely known that the cause of the malfunction no longer exists.

If the decision is made to turn the boosters on, use the following procedure:

a. Airspeed—130 to 155 knots.

Note

With the airspeed in this range, an abrupt control surface deflection is not likely to cause a serious change in attitude, and consequently will not subject the aircraft structure to as large loads as would be the case at higher speeds.

b. Altitude—As required.

Note

Maintain sufficient altitude to permit recovery from any inadvertent attitude change.

c. Automatic pilot—OFF.

Note

Trim the aircraft longitudinally, laterally, and directionally for hands-off, straight and level flight. Even though the aircraft is trimmed for hands-off flight with boost off, it is possible that a boost control valve may be slightly open, and when the boost is turned on, may cause an abrupt change in control surface position. For this reason, airspeed should be held within the range noted in step a.

CAUTION

Do not apply any force to the rudders, elevators, or ailerons, but merely hold the controls lightly. This is important because the application of pressure to any of the controls will open the booster control valve which, when boost is turned on, will result in large deflection of the control surface.

d. Boost control levers—ON (move slowly).

Note

Positioning the control levers slowly has the effect of turning on hydraulic pressure slowly, which, if a booster control valve is slightly open, will preclude the possibility of an abrupt surface control deflection. In the event there is some misrigging between the aileron booster units, turning the aileron booster on may cause the aircraft to rock laterally.

SHIFTING FLIGHT CONTROL SYSTEMS FROM BOOST-ON TO BOOST-OFF.

The need to shift a boosted surface control system from boost-on to boost-off could be created by a loss of hydraulic pressure or by a discrepancy in the mechanical portion of the affected booster system.

Most control system difficulties should be recognizable by one or more of the following conditions:

a. Aircraft does not respond to pilot force on flight controls.

b. Flight controls seem to be immovable or require abnormally high force.

c. Aircraft starts nosing up or down, rolling or yawing and application of pilot force on the flight controls to correct or stop the condition is ineffective. (If the changing attitude is being caused by an automatic pilot malfunction, corrective action on the flight control *will be* effective, since malfunctions of the automatic pilot can be overpowered.)

d. Application of trim tab has no effect on trimming the aircraft. If this is a *tab system problem* the airplane will respond to pilot force on the primary control.

An important consideration in shifting a boosted control system to boost-off is the position of the trim tabs which should be at or near normal trim position prior to shifting. If the trim tabs are displaced several degrees out-of-trim (by pilot or the automatic pilot), the airplane may be expected to lurch when the transition to boost-off operation is made. If time does not permit retrimming prior to shifting to boost-off, the next best thing to do is to retrim as soon as possible after achieving boost-off operation.

Although the procedure of shifting to boost-off usually will not help if the control system is rigidly jammed by a foreign object or other serious interference, it is recommended that the shift to boost-off be made regardless because it is possible that the problem will be overcome by doing so.

EMERGENCY CONTROL BOOST SHUTOFF CHECKLIST

Pilots

The first 8 items in bold print will be accomplished prior to reading the checklist.

1. AUTOMATIC PILOT DISCONNECT LEVERS	**OFF**	**P**
2. TRIM TAB	**NEUTRAL IF TIME PERMITS**	**P**

If time does not permit, retrim airplane after booster shift is accomplished.

Flight Engineer

The first item in bold print will be accomplished prior to reading the checklist.

EMERGENCY CONTROL BOOST SHUTOFF CHECKLIST—Continued

Pilots

Flight Engineer

WARNING

A sudden and pronounced lurch of the airplane should be anticipated as the shift is made if the tab setting is more than 2 or 3 degrees from the normal trim position.

Note

If the pilot or automatic pilot has unsuccessfully attempted to counteract an attitude change by moving the tabs, the tabs can be out-of-trim by several degrees. That is why it is important to check the setting of the tab and to return it to a normal trim setting before or immediately after shifting, preferably before.

3. AFFECTED CONTROL BOOST	PULL OFF	

WARNING

When shifting the elevator system to boost-off, a force on the control column will increase the force required to pull the shift handle. A heavy force could make it difficult to pull the shift handle. *Do not apply force on the elevator control column during operation of the elevator shift handle.*

If unable to shift affected system for any reason (such as malfunction of shift mechanism):

4. OPERATIVE CONTROL BOOST SYSTEMS	PULL OFF	P
(5.) EMERGENCY SHUTOFF LEVERS NO. 1 AND NO. 2	HYD OIL OFF	P
6. AUX BOOST	OFF	CP
7. AFFECTED CONTROL BOOST	PULL OFF	P

(1.) EMERGENCY SHUTOFF LEVERS NO. 1 AND NO. 2 — HYD OIL OFF

WARNING

If the shift cannot be completed, leave primary hydraulic pressure off for the remainder of the flight.

EMERGENCY CONTROL BOOST SHUTOFF CHECKLIST—Continued

Pilots *Flight Engineer*

8. Auxiliary boost or primary hydraulic pressure—As required.

Note

- Auxiliary boost or primary pressure can be re-established provided it does not supply pressure to the malfunctioning control system.
- If the shift is completed on the malfunctioning system, re-established airplane hydraulic pressure and return the other two control systems to boost-on operation.

9. Operative boost systems—ON.

SPECIAL CASE FOR *NOT* SHIFTING TO BOOST-OFF:

If any primary control (elevator, rudder or aileron) should become free, that is, flight control moves freely with no effect on aircraft attitude, the following is recommended:

a. Leave automatic pilot ON if already on.

b. Turn automatic pilot ON if not on.

c. Do *not* shift to boost-off.

d. Land airplane with automatic pilot by using automatic pilot controller and/or tabs.

EMERGENCY LANDING GEAR EXTENSION CHECKLIST

CHANGED 155-14 12 OCT 66 (SEE FRONT OF MANUAL)

Pilots *Flight Engineer*

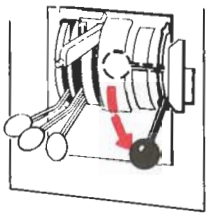
1.	Landing gear lever	DOWN	CP
2.	Emergency fuel dump lever	L. G. EMER. EXT	CP
3.	Emergency hand-pump selector	**EMER GEAR** (aft)	CP
4.	Emergency hand-pump	**OPERATE**	CP

Operate hand pump until landing gear is down and locked.

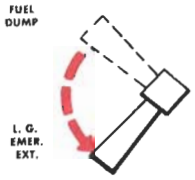
5.	Landing gear position indicator	GEAR DOWN AND LOCKED	P, CP

EMERGENCY GEAR EXTENSION

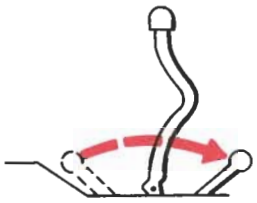
1. LANDING GEAR CONTROL LEVER — **DOWN.**



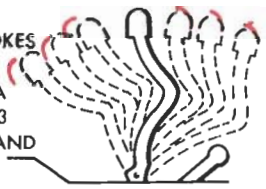
2. EMERGENCY FUEL DUMP LEVER — **L.G. EMER. EXT.**



3. EMERGENCY HAND PUMP SELECTOR LEVER — **EMER. GEAR** (AFT).



4. USE FULL STROKES OF THE HAND PUMP. ABOUT 245 FULL STROKES OF THE HAND PUMP ARE REQUIRED OVER A PERIOD OF 2 1/2 TO 3 MINUTES TO EXTEND AND LOCK ALL GEARS.



5. LANDING GEAR POSITION INDICATOR — CHECK FOR GEAR DOWN AND LOCKED.

6. EMERGENCY HAND PUMP SELECTOR LEVER — RETURN TO **EMER. BRAKES** (FORWARD) POSITION.

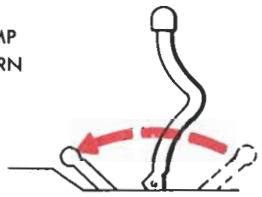


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Figure 3-8

EMERGENCY LANDING GEAR EXTENSION CHECKLIST—Continued

SEE NOTE FACING PAGE

	Pilots		Flight Engineer
6.	Emergency hand-pump selector	EMER BRAKES (forward)	CP
7.	Emergency extension reservoir	CHECKED	P

Check fluid level and have replenished.

WING FLAP MALFUNCTION.

The aircraft is equipped with an asymmetric flap shutoff system which normally prevents wing flap malfunctioning by stopping all flap movement any time the flaps split approximately 1¾ inches. However, a malfunction within the asymmetric shutoff itself or an electrical power failure will render the asymmetric shutoff inoperative and split flaps could result. Furthermore, the automatic shutoff will operate only if the torque tube breaks or otherwise becomes separated. Therefore, if the drive chains or cables to individual flap sections should fail, these sections would become fixed whereas the other flap panels with intact drive mechanisms would continue to operate.

Note

If drive chains break while the flaps are above 60%, aerodynamic forces may cause the failed section to further extend to some fixed position between 60% and 80%. It is possible to have a partial asymmetric flap condition with no indication in the cockpit except a rolling tendency. For this reason, the flaps should not normally be raised after takeoff until an altitude of 500 feet is attained, and the copilot should keep his hand on the flap control lever whenever the flaps are operated until the flaps stop at the selected position. The procedure to follow is outlined below:

Asymmetric wing flaps will be indicated by a rolling motion of the aircraft (not created by the ailerons as evidenced by displacement of the yoke) following any movement of the wing flap selector handle. The roll will be away from the extended flap. The time required for the wing flaps to extend to the 60% position is approximately fifteen seconds. This allows a reasonable reaction time for detection of the malfunction, and initiation of corrective action before loss of control of the aircraft occurs.

Wind tunnel analysis indicates that it is possible to control the aircraft at speeds below 165 knots with an asymmetric wing flap deflection of 60%. With the wing flap on one side extended to the 100% position and the other retracted, it will be impossible to control the aircraft laterally at any speed.

In the event of a wing flap malfunction, immediate action must be taken to stop the flaps as quickly as possible after the roll is noticed.

Procedure: At the first indication of a wing flap malfunction, pilot commands "Wing Flap Failure, Stop the Flaps." Copilot acknowledges, "Stopping the Flaps," and positions the flap handle to the position shown on the wing flap position indicator. Pilot reduces airspeed to 165 knots and, if possible, maintains a level flight attitude. Copilot advises pilot when flap travel has been stopped. If the electrical system is operative, flap travel may also be stopped by actuating the asymmetry test switch. The flap selector handle may then be positioned to the position shown on the wing flap position indicator. After being advised that flap travel has been stopped, the pilot will prepare to land the aircraft as soon as possible.

WARNING

After the flaps have been stopped by means of movement of the flap handle, further movement of the flap handle in the wrong direction will cause additional asymmetric flap travel which may result in total loss of control of the aircraft.

Successful landings have been made with all wing flaps on one side at 60% and all the wing flaps on the opposite side retracted. Asymmetrical travel in excess of 60% will permit only partial control of the aircraft.

If the asymmetric condition is critical, it is recommended that the secondary hydraulic system be shut off and the flaps hand cranked to symmetrical condition.

WARNING

Reposition the flap control lever to hydraulic neutral prior to repressurizing the secondary system.

Emergency Wing Flap Operation.

The wing flaps may be extended or retracted manually in the event of failure of the secondary hydraulic system. However, movement of the wing flaps is very slow when powered by the handcrank. About 360 counterclockwise turns will lower the wing flaps 60%.

For this reason, normal extension beyond the 60% position in flight is not recommended, and manual retraction is not considered, although it is possible.

WARNING

Do not move flap lever or otherwise use secondary hydraulic system during manual operation of flaps.

EMERGENCY WING FLAP EXTENSION CHECKLIST

Pilots			*Flight Engineer*	
			1. Emergency shutoff levers (No. 3 and No. 4)	HYD OIL OFF

Note

When the emergency shutoff levers for engines 3 and 4 are placed in the HYD OIL OFF position, the secondary hydraulic system will be inoperative. Actuating the hydraulic system crossover switch will permit use of primary hydraulic system pressure for normal wing flap operation.

WARNING

Do not attempt to operate any other equipment on the secondary hydraulic system while operating the flaps manually. If the hydraulic flap motor becomes activated while the hand crank is engaged, action will be fast enough to whirl the handcrank rapidly and may cause serious injury to personnel.

(1.) Airspeed	170 KNOTS OR LESS	P	(2.) Airspeed	170 KNOTS OR LESS	
(2.) Wing flap lever	60-70%	CP	(3.) Wing flap lever	60-70%	

CAUTION

Placing the wing flap lever in this position permits the flap control valve to remain open to bypass the fluid, thus keeping hand crank torque to a minimum.

4. Flap motor bypass valve	OPEN
5. Wing flap handcrank	CRANK TO 60% (360 turns counterclockwise)

WARNING

Never engage handcrank unless the emergency shutoff levers for engines 3 and 4 are in the HYD OIL OFF position, the crossover valve is closed and the secondary system is zero. Do not engage handcrank unless the flap motor bypass valve is OPEN.

6. Wing flaps	VISUALLY CHECKED

EMERGENCY WING FLAP EXTENSION CHECKLIST—Continued

Pilots			Flight Engineer	
			7. Flap motor bypass valve	CLOSED
(3.) Wing flap lever	60%	CP	(8.) Wing flap lever	60%
			9. Emergency shutoff levers	AS REQUIRED
(4.) Engineer's Emergency Wing Flap Extension checklist	COMPLETED	CP	(10.) Engineer's Emergency Wing Flap Extension checklist	COMPLETED

EMERGENCY BRAKE OPERATION.

Note

- When the brake accumulators are charged normally, approximately ten applications are available. Brake selector lever must be in EMER before the accumulator can be charged.
- If, after touchdown, a brake emergency occurs in which little or no braking action can be developed by any of the following emergency procedures, propeller reversing is available for aerodynamic braking. However, reversing should be used judiciously if the secondary hydraulic system is inoperative because nose wheel steering will not be available. If the accumulator pressure has been depleted, hold brake pedals down and use emergency hand pump.

EMERGENCY BRAKE FAILURE (GROUND OPERATION) CHECKLIST

Note

This checklist will be used when a sudden loss of pressure occurs during the landing roll or during taxi.

Pilots			Flight Engineer	
The first 4 items in bold print will be accomplished prior to reading the checklist.			**The first item in bold print will be accomplished prior to reading the checklist.**	
Note If there is no braking action with the brake selector lever in NORM position, do the following:				
1. BRAKE SELECTOR LEVER	**EMER**	**CP**	**1. MIXTURE LEVERS**	**RICH**
2. EMERGENCY HANDPUMP	**AS REQUIRED**	**CP**		
3. PROPELLER REVERSING	**AS REQUIRED**	**CP**		
(4.) **HYDRAULIC CROSSOVER SWITCH**	**AS REQUIRED**	**P**	(2.) Hydraulic crossover switch	As required

EMERGENCY BRAKE OPERATION PRIOR TO LANDING CHECKLIST

	Pilots		*Flight Engineer*	
	Note Accomplish the following after the gear has been extended and locked by means of the emergency system.			
1.	Emergency handpump selector lever	EMER. BRAKES	CP	
2.	Brake selector valve	EMER.	CP	
3.	Emergency brake pressure (minimum 1250 psi)	CHECKED	CP	
	Note If pressure is down, use handpump until positive pressure rise is obtained and maintain pressure until landing is completed.			
4.	Handpump	STAND-BY (maintain 1250 psi)	CP	
	Note Avoid pumping the toe pedals because this will reduce the number of useful brake applications.			
1.				Emergency extension reservoir fluid — CHECKED

OPERATING PROCEDURES WITH HYDRAULIC ACCESS DOOR UNLATCHED.

In the event the hydraulic oil tank access door latches should inadvertently be left open or should come open in flight, severe buffeting will result. The aft portion of the door is in a region of reduced pressure which causes the door to lift under certain flight conditions. This lifting causes a discontinuity over the upper wing surface and creates a turbulence in the wing-to-fuselage fillet area. The condition under which this buffeting occurs is a function of angle of attack of the wing and is, therefore, related to airspeed and the weight of the aircraft. Extension of the wing flaps changes the air flow over the wing in such a way that the critical airspeed for buffeting with the access door unlatched is reduced. With 60% flaps, no buffeting should be experienced in the normal speed range. It is possible that during landings at landing gross weights some buffeting may occur at approximately touchdown speed.

The following procedures are recommended:

a. If buffeting is first noticed when the wing flaps are retracted after takeoff, it is possible that the access door has come open. In this event, re-extend the flaps to 60%.

b. If buffeting is experienced during flight, increase airspeed, if possible, to a point at which buffeting does not occur. The following critical speeds were determined from flight tests with gear and flaps UP:

80,000 Pounds	150-160 Knots
100,000 Pounds	165-180 Knots
120,000 Pounds	180-200 Knots

CAUTION

This should be done only if it is necessary to continue cruising flight for a protracted period. *It should not be done during conditions of turbulent air.*

c. If it is necessary or desirable for other reasons to maintain lower airspeed, extend the wing flaps as far as is necessary to stop the buffeting (usually approximately 60%).

d. Land at the nearest suitable airport and secure the access door.

e. If buffeting is experienced during landing, maintain airspeed above that at which buffeting occurs.

FLIGHT CREW GENERAL EMERGENCY PROCEDURES AND EQUIPMENT.

All flight crews will familiarize themselves with the emergency procedures as outlined for each crew position in the different types of emergency situations. Individual crewmember Emergency Procedures checklist will be prepared and posted at or near the appropriate crew position or duty station. Upon entering the aircraft, each crewmember and passenger will locate his ditching and crash landing position and inspect it for proper installation. He will also inspect the safety belt, head rest and/or applicable support surfaces. He will inspect his own emergency equipment and stow it at his ditching and crash landing position or duty station.

EMERGENCY ENTRANCE.

If it is necessary to enter the aircraft to rescue trapped personnel, open the emergency exits or the aft cabin door, all of which are operable from the inside and outside. Otherwise it is necessary to chop through the fuselage at the marked cut-in areas.

DITCHING. — CHANGED BY 155-13 30 JUNE 66

Ditching is the term used to describe an emergency landing and abandonment of an aircraft on water. Extensive tests have been made with models to determine the probable stresses which would develop under such conditions. Since the aircraft may be damaged by impact all efforts must be directed toward a prompt and orderly abandonment of the aircraft. (Refer to figure 3-11.) It is essential that each crew member be thoroughly familiar with ditching procedures, and with his duties as well as duties of all other crewmembers, so that in event of injury to one, another crewmember may assume his duties. Responsibility for each piece of equipment to be removed from the aircraft should be assigned to various regular crewmembers. Periodic drills will insure orderly operation when an emergency occurs, and will familiarize flight personnel with the location of all emergency equipment. A description of each crewmember's duties and other helpful information are outlined on the Ditching/Crash Landing/Bailout Chart in this section.

PREPARATION.

If the following techniques are used in the preparation for ditching, the possibility of a successful ditching will be greatly increased. When ditching is probable, the pilot will notify the crew by six short rings of the alarm bell followed by an announcement over the P.A. system. The announcement will include the pilot's intentions and the estimated time of ditching. The pilot will at this time set course for the nearest land or surface vessel.

Note

On EC-121D aircraft, with the Emergency ICS switch on, only transmissions from the pilot's position can be made. These transmissions will be read over both the interphone system and P.A. system. If the emergency ICS switch is used it is imperative that the pilot turn the emergency ICS switch OFF upon completion of initial notification, as all communication equipment is disabled when emergency ICS is ON.

All crewmembers will accomplish duties as outlined on the chart in this section. The additional crewmembers and/or passengers will perform such duties as directed. If time permits the anti-exposure suit should be donned.

Note

Do not attempt to open emergency exits until the cabin is depressurized, except under extreme circumstances. If it is necessary to dump pressure in a hurry and in order to get emergency exits opened, break window and stay clear of opening. The overwing emergency exits should be opened prior to touchdown.

When ditching is imminent (at least 3 minutes prior to touchdown if possible) the pilot will notify the crew by an announcement over the PA system. All crewmembers will assume ditching positions.

WARNING

Do not inflate life vests inside the aircraft. Be certain that all crewmembers are so instructed. In the event of rapid submersion, an inflated life vest will make it impossible for the wearer to dive to the exit level to escape from the sinking aircraft.

At least thirty (30) seconds prior to impact, the pilot will notify the crew with one long ring of the alarm bell. All crewmembers and passengers will brace for impact and remain in position until the aircraft comes to a stop.

SPECIAL PROCEDURES. SEE 155-13 20 JUN 66

The desired ditching configuration is: wing flaps—100% and landing gear retracted. If possible, ditch while power is still available. If ditching without power, plan to touchdown in a nose-high attitude. Surface stations and ships should be informed of the existence of the emergency as soon as it arises. This should be done even if it is not certain that the aircraft will have to be ditched. It is difficult to judge height above the water when the sea is calm. At night, landing lights may make the estimation of distance above water even more difficult. The pilot will determine surface wind direction and velocity so as to make contact near the crest and parallel to the swell unless there is a crosswind of 30 MPH or more. If crosswind exceeds 30 MPH, ditching will be made into the wind on the up-slope of the swell near the crest. Descend at a minimum safe rate in a flattened approach attitude. If the aircraft bounces from the first impact, the aircraft should be kept in a nose-up attitude. Wave motion is indicative of wind direction, but swells do not necessarily move with the wind. Conditions of water surface are indicative of wind speed. The following table may be helpful:

Surface Condition	*Approx. Wind Velocity*	
	Knots	*MPH*
Few white crests	8–17	10–20
Many white crests	17–26	20–30
Streaks of foam from crests	26–35	30–40
Spray blown from tops of waves	35–43	40–50

WARNING

Keep flight station windows closed because the aircraft has a tendency to nose under as it loses forward speed on water. All openings, with the exception of the over-wing emergency escape hatches, will be kept closed.

Additional aid in ditching may be obtained from the use of parachute flares. It is advisable to utilize both flares simultaneously for ditching. After selecting a ditching heading, the following procedures are recommended for single aircraft ditching by self-illumination: (See figure 3-9.)

a. Make all preparations for ditching. Complete cockpit check.

b. Take up a heading 90-degrees less than that of the selected ditching heading. Lower flaps and slow to desired pattern approach speed. Descend to 2500 feet.

c. Drop flares from 2500 feet. (2000 feet minimum may be used if unable to maintain 2500.)

d. After flare drop, begin descent of 1500 feet-per-minute. Maintain heading for 10 seconds.

e. Turn 90 degrees left; continue descent at 1500 feet-per-minute.

f. Roll out of turn, and hold heading for 30 seconds. Continue rate-of-descent of 1500 feet-per-minute. This 30-second leg is the reciprocal of the ditching heading—similar to the downwind leg in an airport pattern.

g. Turn 180-degrees to left. Decrease rate-of-descent so as to roll out of the turn on final at 200 feet. (Immediately after entering the 180-degree turn, the surface of the water can be seen, and the remainder of the approach can be made by visual reference.)

h. When entering final approach, the flare will be 40 seconds ahead. Ditch straight ahead using the light of the flare. *DO NOT OVERSHOOT*. A rapid descent in the early stages of the approach allows a slow rate-of-descent when near the water. This should prevent flying into the water at a high rate-of-descent due to faulty depth perception or altimeter setting. (Make turns standard rate 3°/second.)

ABANDONMENT.

Unless the bottom has been seriously damaged, leakage should be slow, and the aircraft should float long

REVISED - BY TO 1C121(ED)-155-13 (SEE NEXT PAGES)

DITCHING PROCEDURE WITH SELF ILLUMINATION (FLARES)

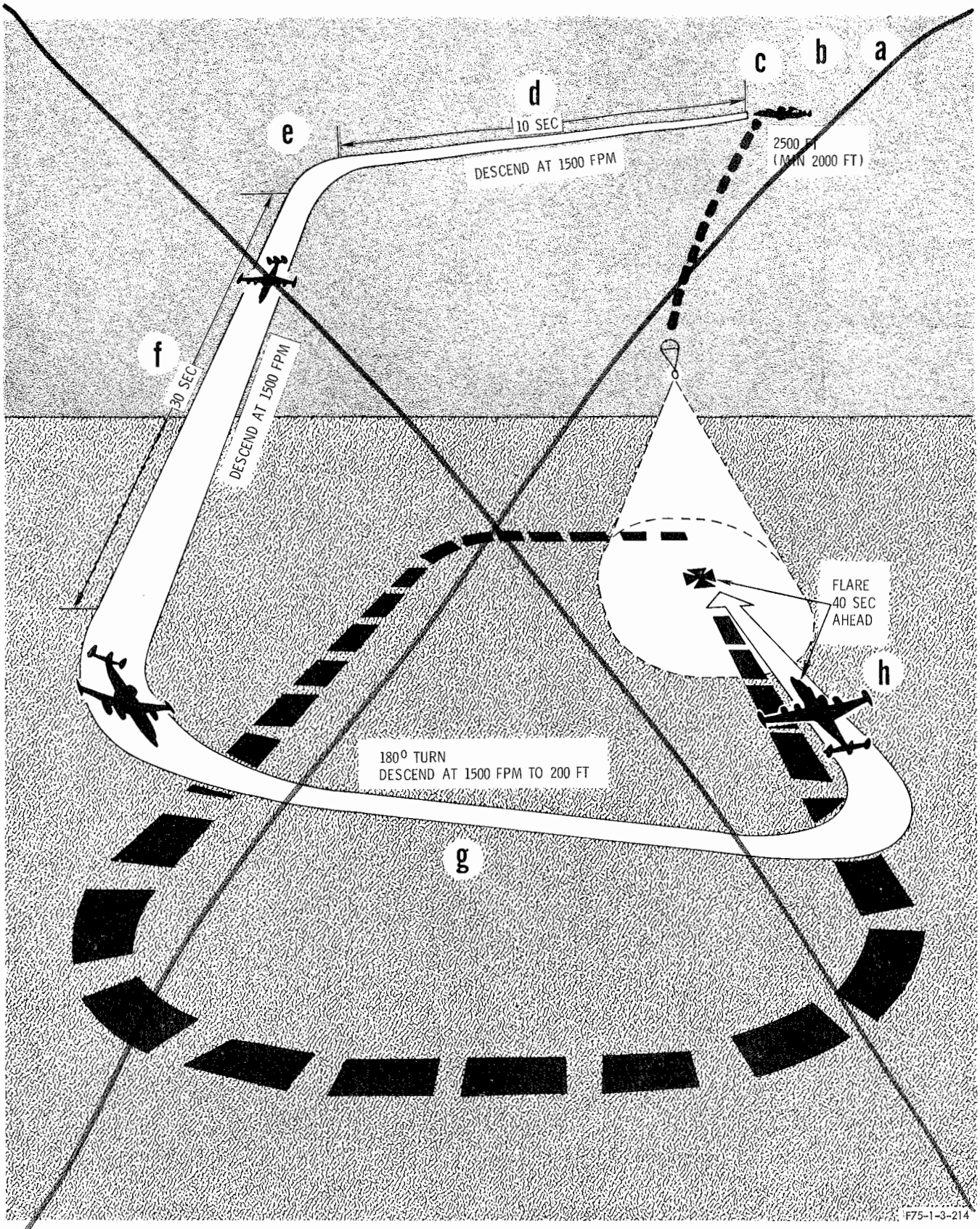


Figure 3-9

DITCHING PATTERN WITH SELF-ILLUMINATION (FLARES)

1. Prepare for ditching.

2. Fly the reciprocal of ditching heading Descend, rate as required, to 2000 feet.

3. Flaps 60%, airspeed (140–150 kts). RPM 2600. (Make all turns standard rate 3° per second.

4. Turn 40° right (Descent to 2000 feet may be accomplished on 40 teardrop leg.)

5. Drop both flares. Begin 1000 ft/min rate of descent. MAP approximately 22" Hg or as required. (Power setting based on acft gross weight of 110,000 lbs, 4 engines operating.)

6. Maintain 40° teardrop leg for 45 seconds.

7. Turn 220° left or until flare is dead ahead. Water and flare should be clearly visible throughout the last 180° of turn, weather permitting.

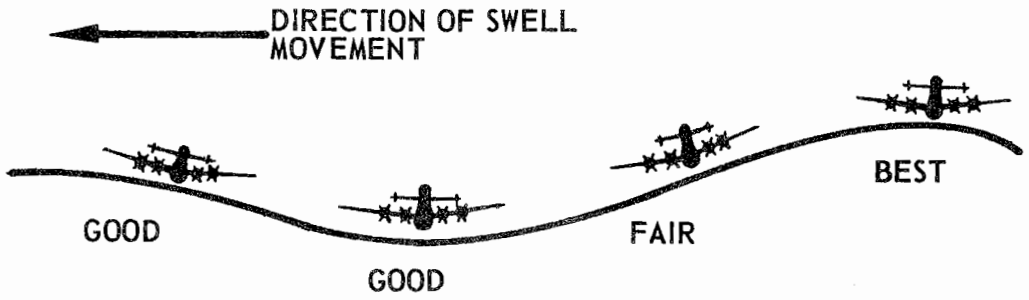
8. Do not descend below 500 feet indicated until established inbound. Adjust rate of descent and/or power, as required. (Last 90° of turn will probably require additional power for a level turn.)

9. When established inbound, lower 100% flaps. Descend and flare prior to touchdown. The illumination flare will be approximately 1 minute ahead.

10. Slow acft to 7–10 kts above stall - engage water prior to passing flare.

FIGURE 2

LANDING PARALLEL TO THE MAJOR SWELL



LANDING ON THE FACE AND BACK

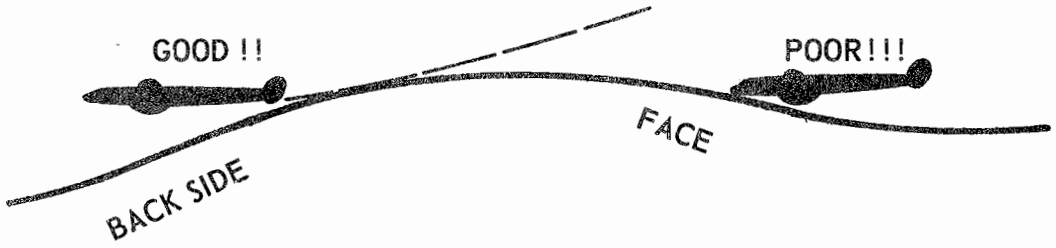


FIGURE 3

END

enough to evacuate all flight personnel safely. Evacuation must be conducted in an orderly manner as shown in figure 3-11. After the life rafts have been loaded, and if it appears safe to do so, salvage any additional equipment and valuables which can be transported without jeopardizing the comfort and safety of the crew members and passengers aboard life rafts. Any coats and blankets which can be carried into the life rafts will provide welcomed protection. Space limitations will indicate how much extra equipment can be taken.

AFTER DITCHING.

The forward crew door and the aft cabin door provide the easiest means of exit; however, the window exits must be used to board the wing life rafts. These exits are convenient for exacuation, because the wings provide a pier from which the rafts may be boarded. Emergency supplies should be distributed among the rafts and tied down in the center of the rafts to prevent them from being lost in case the raft should capsize. After all crewmembers and passengers have been evacuated, move the rafts out from under any part of the aircraft which might strike them as it sinks. Rope the rafts together so that they will not drift apart or become separated and complicate rescue. Remain in the vicinity of the aircraft as long as it remains afloat.

WARNING

Do not open any doors if their sills are below water. Use emergency exits.

CRASH LANDING.

The techniques and procedures relative to crash landing must be formulated with periodic drills to insure orderly operation and to increase the chance for survival after a crash landing. A well disciplined and informed crew will greatly aid in the proper preparation and final result of a successful crash landing with minimum personal injury and loss of life. In an emergency it is possible to land this aircraft with gear retracted without serious damage. With the exception of those procedures which are obviously peculiar to ditching, the procedures for a crash landing are very similar to those recommended for ditching. A crash landing immediately after take-off, however, would reduce the preparatory time considerably.

PREPARATION.

The following procedures should be utilized for adequate crash landing preparation. When a crash landing is probable, the pilot will notify the crew and passengers by six (6) short rings of the alarm bell followed by an announcement over the PA system. The announcement will include the pilot's intentions and time remaining.

Note

On EC-121D aircraft, with the Emergency ICS switch ON, only transmissions from the pilot's position can be made. These transmissions will be read over both the interphone system and PA system. If the emergency ICS switch is used it is imperative that the pilot turn the emergency ICS switch OFF upon completion of initial notification as all communication equipment is disabled when emergency ICS is ON.

In the case of crash landing on takeoff, the pilot will notify the crew and passengers by one (1) long, sustained ring on the alarm bell followed by an announcement over the PA system, if time permits. At this time, all crewmembers and passengers will remain in position and brace for impact. In preparation for crash landings other than on takeoff, all crewmembers will accomplish duties as outlined in the Ditching/Crash Landing/Bail-out chart. The additional crewmembers and passengers will perform such duties as directed. When crash landing is imminent (at least 3 minutes prior to touchdown, if possible) the pilot will notify the crew and passengers by an announcement over the PA system. At this time, all crewmembers and passengers will assume crash landing positions. At least thirty (30) seconds prior to impact, the pilot will notify the crew and passengers with one (1) long ring of alarm bell. All crewmembers and passengers will brace for impact and remain in position until the aircraft comes to a stop.

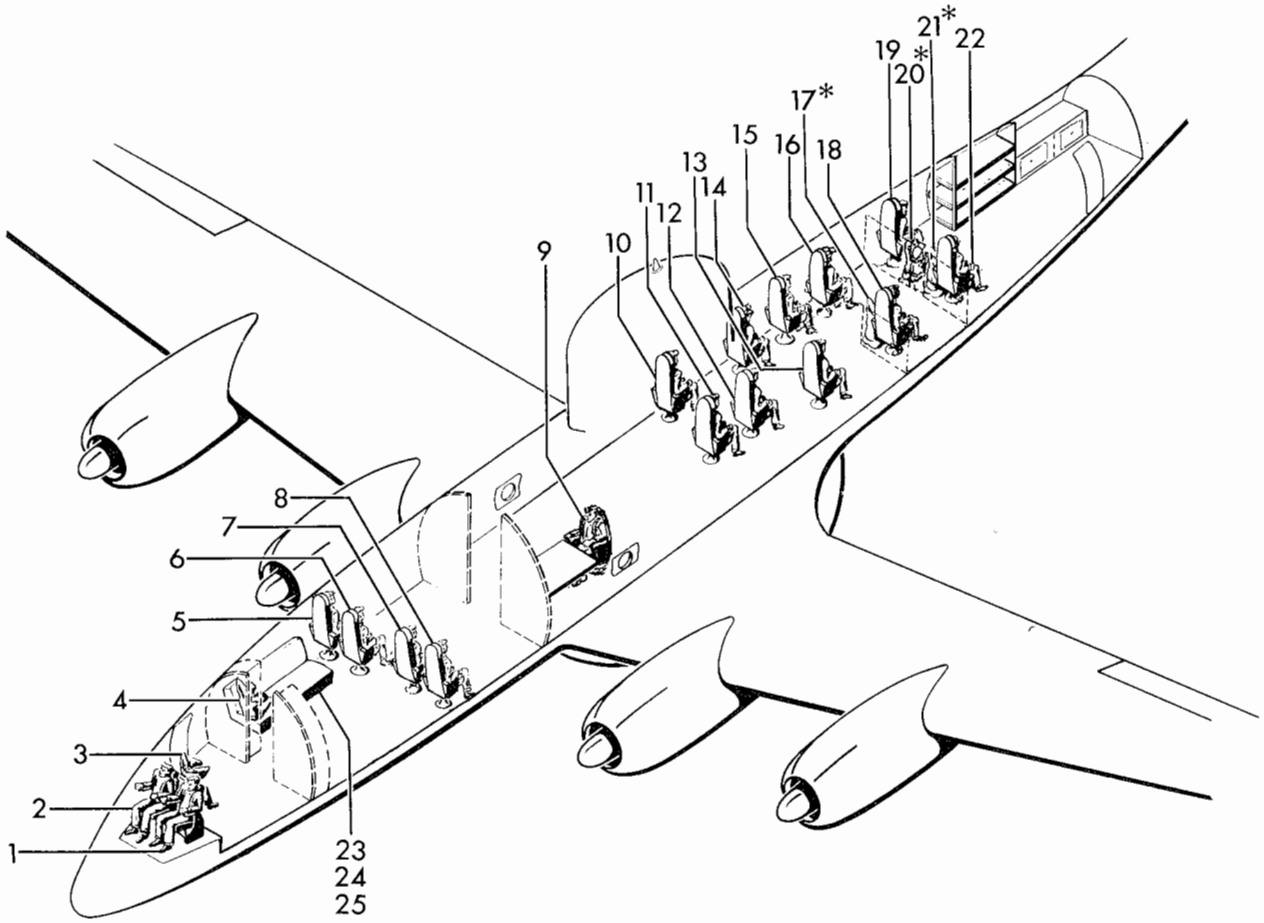
Note

Do not attempt to open emergency exits until the cabin is depressurized except under extreme circumstances. If it is necessary to dump pressure in a hurry and in order to get emergency overwing exits open, break window and stay clear of opening. The emergency exits should be opened prior to touchdown.

ABANDONMENT.

Since the aircraft may be damaged by impact, all efforts must be directed toward a prompt and orderly abandonment of the aircraft. Escape routes are shown on figure 3-3. It is essential that each crewmember be thoroughly familiar with crash landing procedures and duties of all other crewmembers; in the event of injury to one, his

EC-121D. DITCHING AND CRASH LANDING POSITIONS



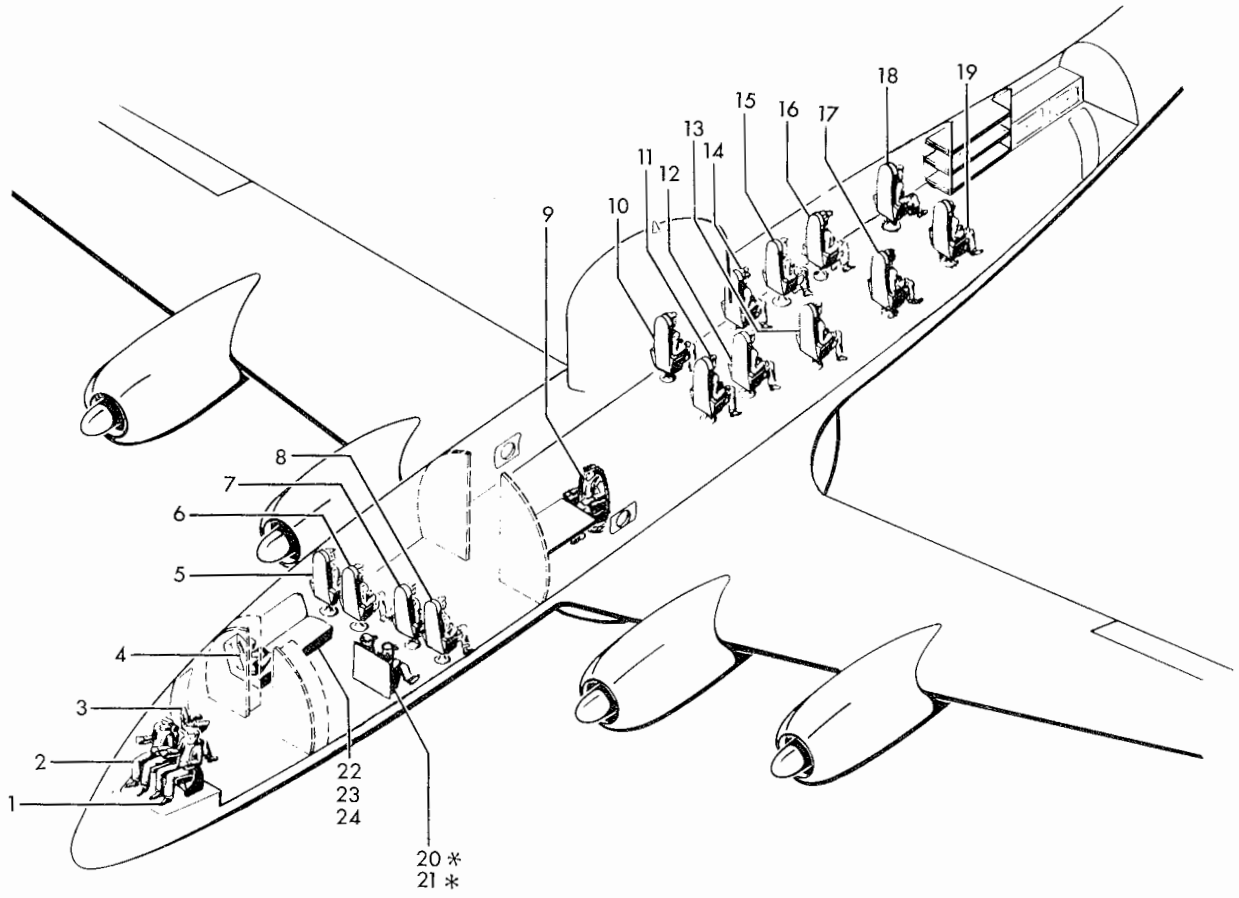
F75-F-3-69(1)

1	PILOT
2	COPILOT
3	FLIGHT ENGINEER
4	FLIGHT ENGINEER
5	RADIO OPERATOR
6	NAVIGATOR
7	NAVIGATOR
8	RELIEF CREW
9	RADIO OPERATOR
10	RADAR TECHNICIAN
11	RADAR TECHNICIAN
12	SENIOR WEAPON'S CONTROLLER
13	DUTY WEAPON'S CONTROLLER
14	PLOTTER
15	TELLER/DUALEX
16	SEARCH RADAR OPERATOR
*17	RELIEF CREW (SOME AIRCRAFT)
18	SEARCH RADAR OPERATOR
19	SEARCH RADAR OPERATOR
*20	RELIEF CREW } SOME AIRCRAFT
*21	RELIEF CREW }
22	SEARCH RADAR OPERATOR
23	} ALTERNATE POSITIONS TO BE
24	} USED ONLY AS NECESSARY
25	} AND AT DESCRETION OF PILOT

Figure 3-10 (Sheet 1 of 3)

EC-121D. DITCHING AND CRASH LANDING POSITIONS

(Aircraft Modified By T.O. 1C-121-767)

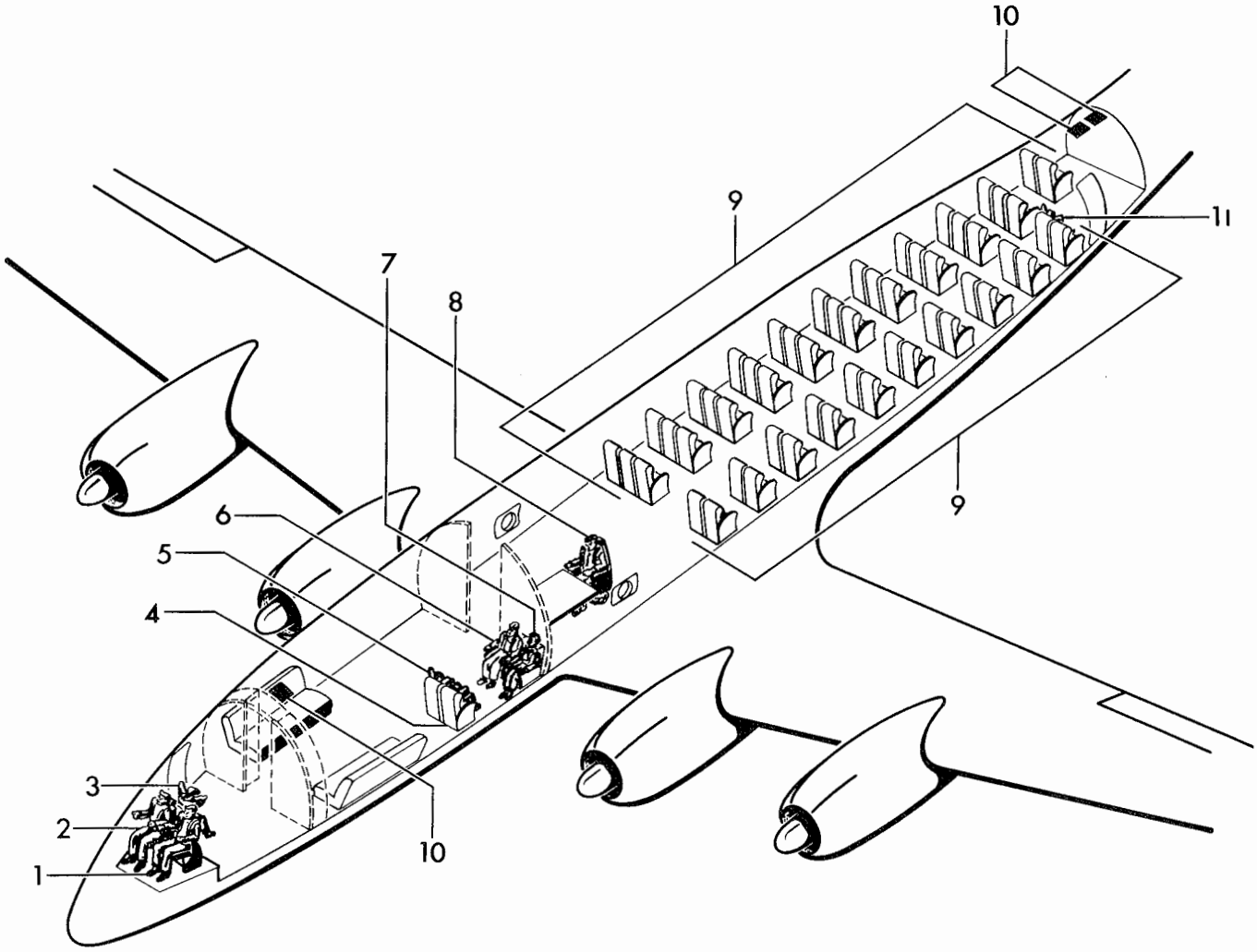


1	PILOT
2	COPILOT
3	FLIGHT ENGINEER
4	FLIGHT ENGINEER
5	RADIO OPERATOR
6	NAVIGATOR
7	NAVIGATOR
8	RELIEF CREW
9	RADIO OPERATOR
10	RADAR TECHNICIAN
11	RADAR TECHNICIAN
12	SENIOR WEAPONS CONTROLLER
13	DUTY WEAPONS CONTROLLER
14	PLOTTER
15	TELLER/DUALEX
16	SEARCH RADAR OPERATOR
17	SEARCH RADAR OPERATOR
18	SEARCH RADAR OPERATOR
19	SEARCH RADAR OPERATOR
*20	RELIEF CREW } SOME AIRCRAFT
*21	RELIEF CREW }
22	} ALTERNATE POSITIONS TO BE
23	} USED ONLY AS NECESSARY
24	} AND AT DESCRETION OF PILOT

F75-F 2-3-69(3)

Figure 3-10 (Sheet 2 of 3)

TC-121C. DITCHING AND CRASH LANDING POSITIONS



F75-E-3-69 (2)

1 PILOT
2 COPILOT
3 FLIGHT ENGINEER
4 RELIEF CREW
5 RELIEF CREW
6 NAVIGATOR
7 RELIEF CREW
8 RADIO OPERATOR
9 PASSENGER AND/OR CREW
10 CRASH LANDING WEBBINGS (3 PLACES IN CEILING)
11 FLIGHT ENGINEER

Figure 3-10 (Sheet 3 of 3)

EC-121D. EMERGENCY ESCAPE ROUTES—WATER

NOTE

STATIONS MARKED ● INDICATE THAT CREW MEMBER EXITS THROUGH LEFT EMERGENCY EXIT WINDOW AND BOARDS LEFT WING LIFE RAFT.

STATIONS MARKED ○ INDICATE THAT CREW MEMBER EXITS THROUGH RIGHT EMERGENCY EXIT WINDOW AND BOARDS RIGHT WING LIFE RAFT.

STATION MARKED X INDICATE POSITIONS TO BE USED ONLY AS NECESSARY AND AT THE DISCRETION OF THE PILOT

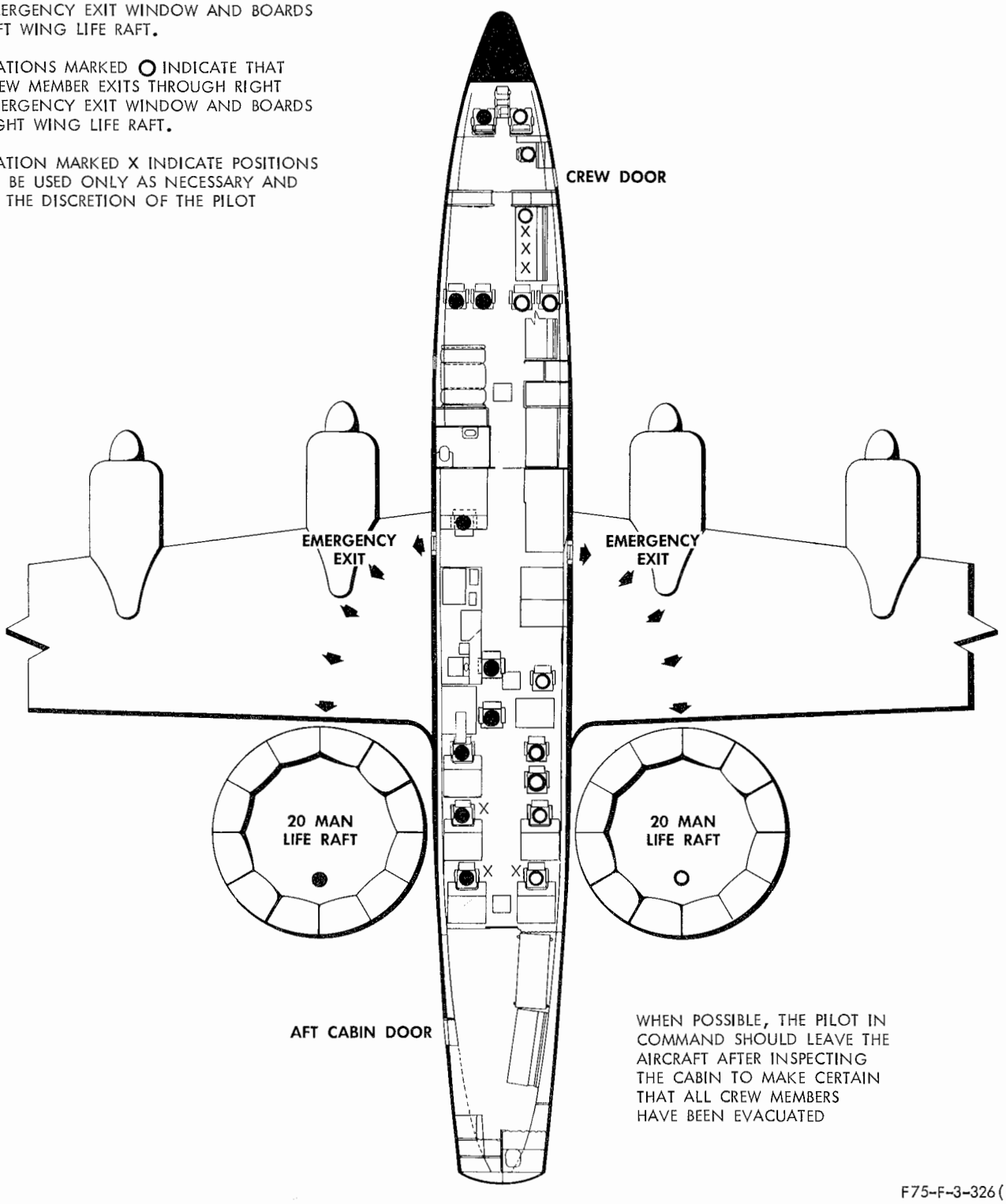


Figure 3-11 (Sheet 1 of 2)

TC-121C. EMERGENCY ESCAPE ROUTES—WATER

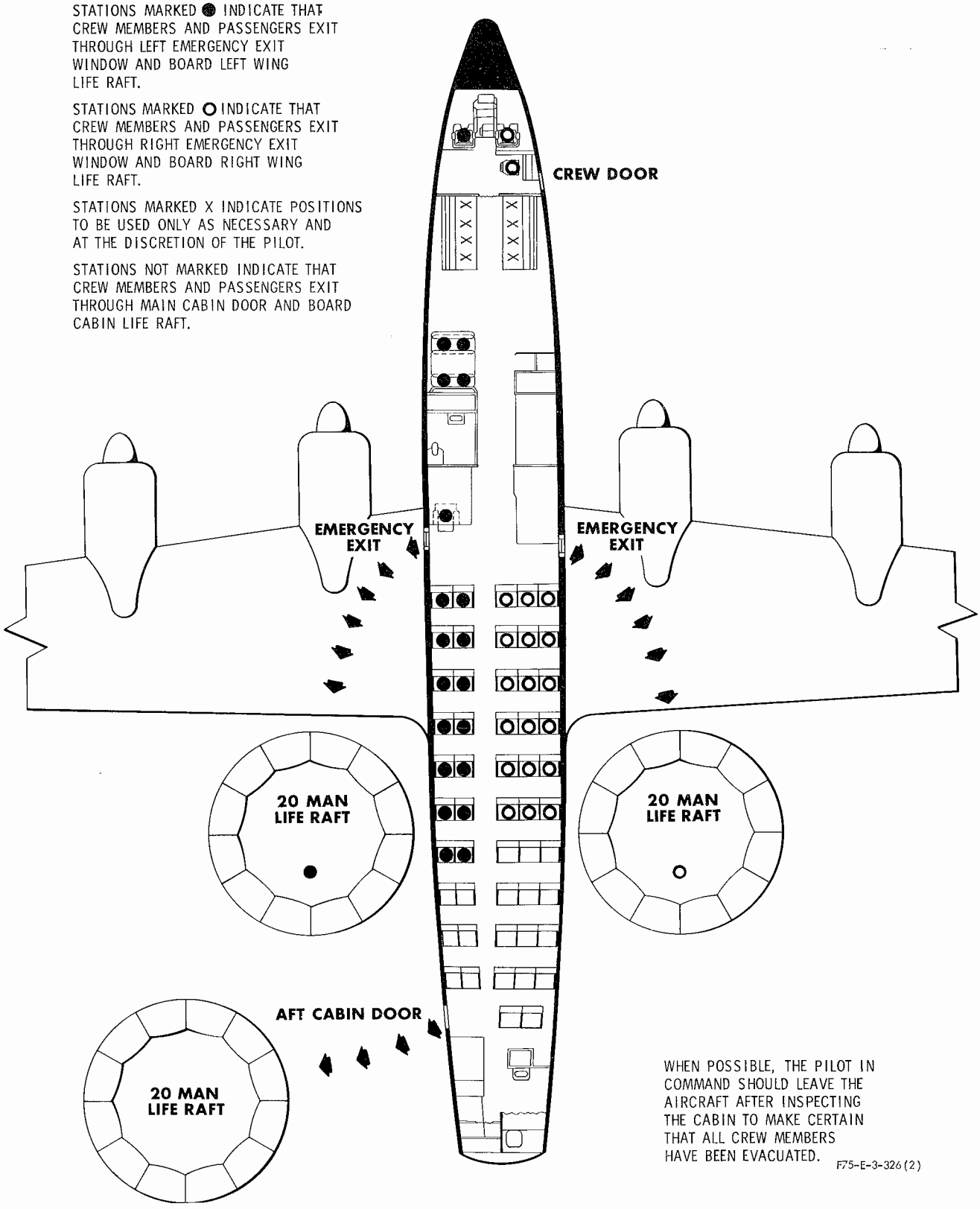
NOTE

STATIONS MARKED ● INDICATE THAT CREW MEMBERS AND PASSENGERS EXIT THROUGH LEFT EMERGENCY EXIT WINDOW AND BOARD LEFT WING LIFE RAFT.

STATIONS MARKED O INDICATE THAT CREW MEMBERS AND PASSENGERS EXIT THROUGH RIGHT EMERGENCY EXIT WINDOW AND BOARD RIGHT WING LIFE RAFT.

STATIONS MARKED X INDICATE POSITIONS TO BE USED ONLY AS NECESSARY AND AT THE DISCRETION OF THE PILOT.

STATIONS NOT MARKED INDICATE THAT CREW MEMBERS AND PASSENGERS EXIT THROUGH MAIN CABIN DOOR AND BOARD CABIN LIFE RAFT.



WHEN POSSIBLE, THE PILOT IN COMMAND SHOULD LEAVE THE AIRCRAFT AFTER INSPECTING THE CABIN TO MAKE CERTAIN THAT ALL CREW MEMBERS HAVE BEEN EVACUATED.

F75-E-3-326(2)

Figure 3-11 (Sheet 2 of 2)

EXTERIOR LIFE RAFT RELEASE

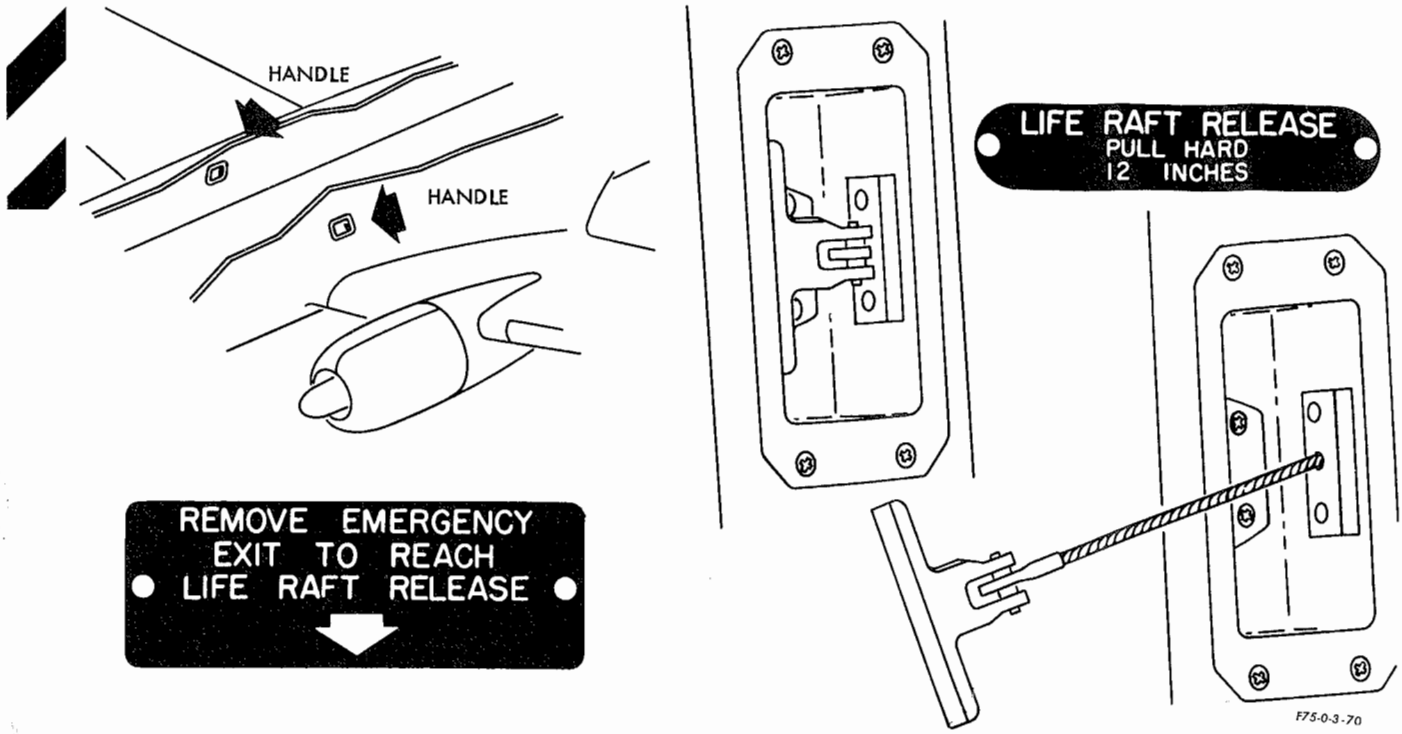


Figure 3-12

duties may be assumed by another crewmember. Responsibility for each piece of equipment to be removed from the aircraft is as outlined in Ditching/Crash Landing/Bailout chart and as otherwise directed.

AFTER CRASH LANDING.

After all crewmembers and passengers have vacated the aircraft, a check for extent of injuries, etc., should be made. Also, if it is determined feasible, all equipment that is considered of any use in rescue and/or survival should be removed from the aircraft. Remain in the vicinity of the aircraft, if possible, in order to aid being located by rescue facilities.

BAILOUT.

The decision to bail out rather than ditch or crash land will be determined by many varying factors. Primarily in the interest of survival over water, ditching should be considered over bailout. However, to avoid possible serious injury whenever the terrain is unknown or unsuited for a crash landing, more consideration should be given to bailout. A high degree of crew discipline must be maintained at all times during bailout preparation and execution.

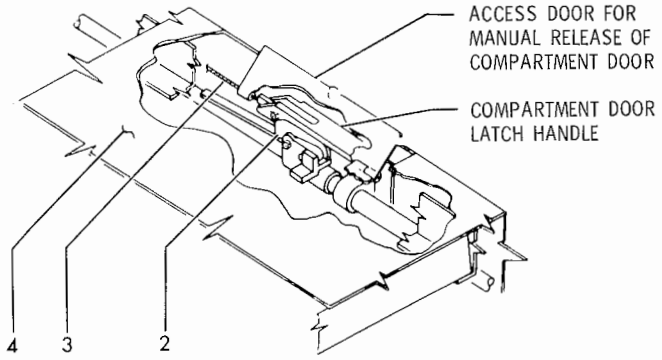
PREPARATION.

When the decision is made to abandon the aircraft while in flight, the pilot will notify the crew by three (3) short rings of the alarm bell followed by an announcement over the PA system which will include whether the aircraft is over land or over water and the time remaining, if possible. The information regarding overland or overwater bailout will be the deciding factor in what emergency and survival equipment the crew will be required to don at this time. If an overwater bailout is anticipated, crewmembers must also don the life preserver and dinghy in addition to normal overland bailout equipment.

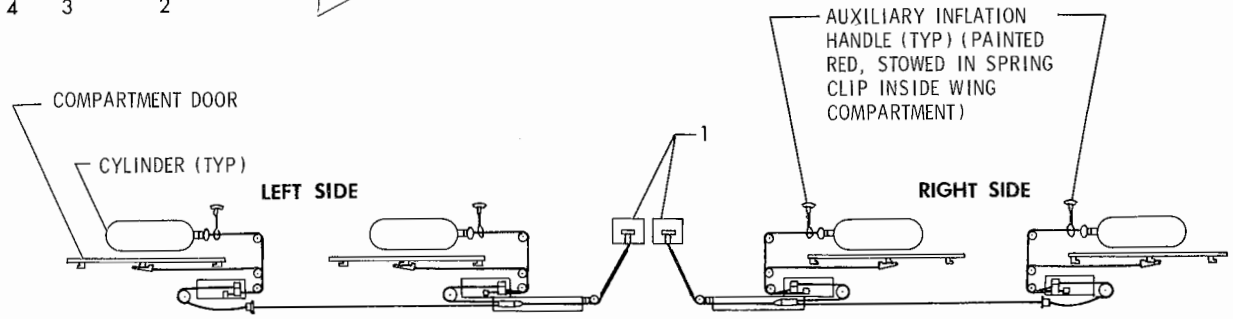
Note

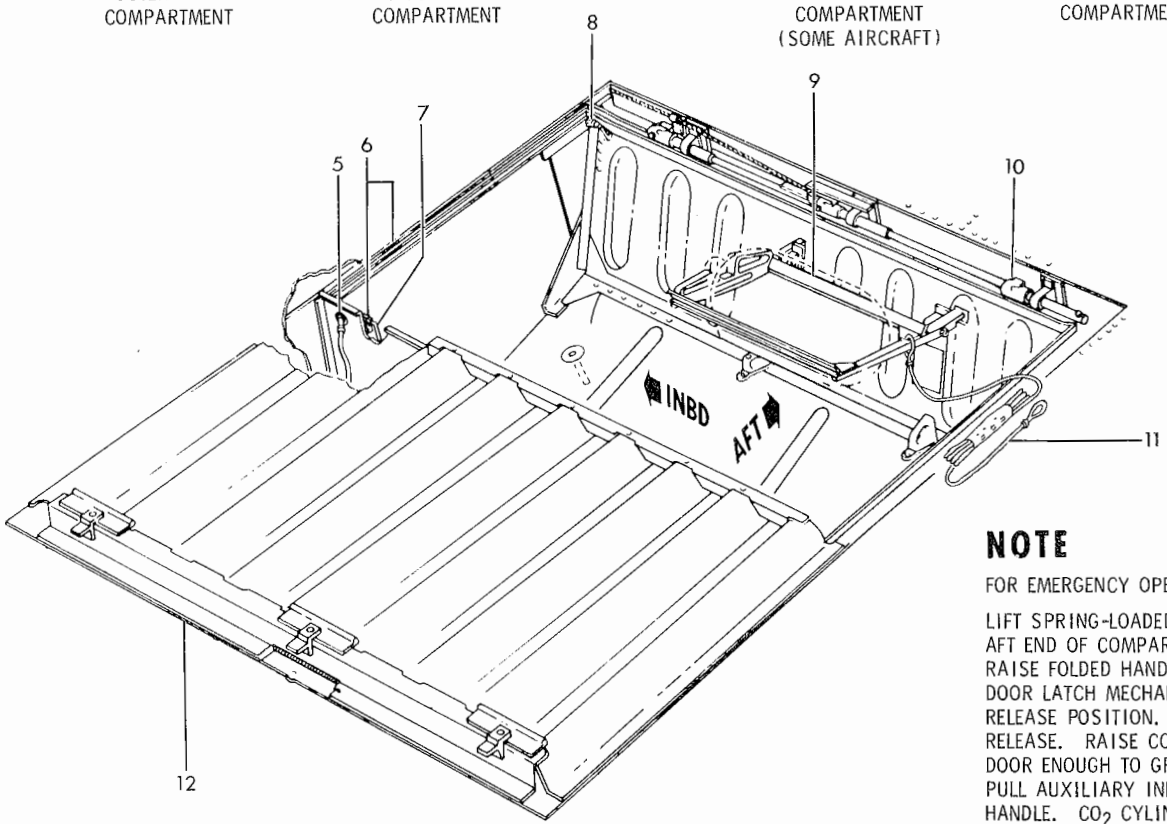
On EC-121D aircraft, with the Emergency ICS switch ON, only transmissions from the pilot's position can be made. These transmissions will be read over both the interphone system and PA system. If the Emergency ICS switch is used it is imperative that the pilot turn the Emergency ICS switch OFF upon completion of initial notification, as all communications equipment except the pilot's is disabled when Emergency ICS is ON.

LIFE RAFT RELEASE



1.	EMERG. EXIT WINDOW RELEASE HANDLES	7.	DRAIN TROUGH
2.	SAFETY LATCH	8.	CYLINDER CABLE CONDUIT
3.	DOOR RELEASE CABLE	9.	CYLINDER SUPPORT
4.	TRAILING EDGE (WING)	10.	DOOR LATCH
5.	COMPARTMENT DRAIN TUBE	11.	LANYARD
6.	COMPARTMENT SEAL	12.	COMPARTMENT DOOR





NOTE

FOR EMERGENCY OPERATION:

LIFT SPRING-LOADED COVER AT AFT END OF COMPARTMENT DOOR, RAISE FOLDED HANDLE AND SLIDE DOOR LATCH MECHANISM TO RELEASE POSITION. DOOR MUST RELEASE. RAISE COMPARTMENT DOOR ENOUGH TO GRASP AND PULL AUXILIARY INFLATION HANDLE. CO_2 CYLINDER MUST DISCHARGE AND RELEASE LIFE RAFT.

Figure 3-13

All crewmembers will accomplish duties as outlined in the Ditching/Crash Landing/Bailout chart. The additional crew members and/or passengers will perform such duties as directed. Care must be taken to provide a clear passageway to all exits. Although it is not necessary to stow all loose equipment, it must be kept clear of all exit routes of evacuating crewmembers. The pilot will designate a jumpmaster on all missions. Normally the jumpmaster on AAD missions will be the duty weapons controller or crewmember acting in this capacity and a member of the flight crew on other missions. The jumpmaster duties are as follows:

a. Proceed to rear compartment and establish interphone communication with the pilot.

b. Insure that all personnel in the aft cabin are alerted.

c. Open rear entrance door.

d. Stand by for bailout signal.

e. Upon bailout signal, order crew to bail out.

f. Notify pilot when all personnel have evacuated the aircraft.

g. Bail out.

All equipment that may be used after bailout and will not render any additional hardship or possible injury during the process of bailout, i.e., flare pistols and flares, first aid kits, etc., should be evacuated by designated crewmembers or as directed. After crewmembers complete preparation duties they will remain at takeoff/landing stations until the signal to bailout is given.

ABANDONMENT.

The pilot will notify the crew to bail out by one (1) long ring of the alarm bell. Crewmembers will proceed to the rear crew entrance door in an orderly manner and bail out. If too many crewmembers congregate in the rear of the aircraft, the flight characteristics will be adversely affected. The jumpmaster will insure all crewmembers bail out in an orderly and expeditious manner and report to pilot on interphone when all crewmembers have evacuated the aircraft. The pilot will reduce airspeed if possible. If over land, the pilot will turn the aircraft and head for an uninhabited area in a slightly nose-down attitude. If over water, the pilot will place the aircarft in a slightly nose-down attitude and execute and 360 degree turn to the left until all crewmembers have abandoned the aircraft.

DITCHING/CRASH LANDING/BAILOUT

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Pilot	**DITCHING**		
STATION 1	1. Give alarm bell warning (6 short rings) followed by an announcement on PA system of emergency condition and intentions.	1. Check aircraft for evacuation of personnel.	1. Left Emergency Exit.
	2. Set course for nearest land or surface vessel (information furnished by navigator and/or Senior Weapons Controller).	2. Take flashlight, dinghy and evacuate aircraft.	
	3. Order fuel to be dumped (if applicable).	3. Assume command of left life raft.	
	4. Order engineer to depressurize cabin.		
	5. Order copilot to don necessary survival equipment, adjust and fasten shoulder harness.		
	6. Don necessary survival equipment.		
	7. Adjust and fasten shoulder harness.		
	~~8. Order electronic equipment not needed OFF.~~ DELETED 15543		

CONTINUED

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Pilot	**DITCHING—Continued**		
STATION 1	WHEN DITCHING IS IMMINENT (AT LEAST THREE MINUTES PRIOR TO IMPACT).		
	1. Jettison flares.		
	WARNING Do not jettison flares while dumping fuel.		
	2. Order copilot to give warning on PA and interphone.		
	3. Order radio operator to screw down key.		
	4. Order flap lever 100% landing position.		
	5. Order copilot to turn on alarm bell thirty (30) seconds prior to impact.		
	6. Power (if available) as desired to point of contact.		
Pilot	**CRASH LANDING**		
STATION 1	1. Give alarm bell warning (6 short rings) followed by announcement on PA system of emergency condition and intentions.	1. Check aircraft for evacuation of personnel.	1. Nearest Available Exit.
	2. Order fuel to be dumped (if applicable).	2. Take flashlight and evacuate aircraft.	
	3. Order engineer to depressurize cabin.		
	4. Don necessary survival equipment.		
	5. Adjust and fasten shoulder harness.		
	6. Order electronic equipment not needed—OFF.		

CONTINUED

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Pilot	**CRASH LANDING—Continued**		
STATION 1	WHEN CRASH LANDING IS IMMINENT (AT LEAST THREE MINUTES PRIOR TO IMPACT): 1. Order copilot to give warning on PA and interphone. 2. Order radio operator to screw down key. 3. Order flap lever 100% landing position. 4. Order copilot to turn on alarm bell thirty (30) seconds prior to impact. 5. Power (if available) as desired to point of contact.		
Pilot	**BAILOUT**		
	1. Give alarm bell warning (3 short rings) followed by announcement on PA system of emergency condition and intentions. 2. Don parachute and necessary survival equipment while copilot manages aircraft. 3. Order engineer to depressurize cabin. 4. Reduce airspeed if possible. 5. Aircraft, slightly nose down trim. 6. Give bailout signal (one long ring on alarm bell). 7. Automatic pilot may be engaged to maintain course and stability for crew abandonment. 8. When jumpmaster advises that all personnel have abandoned the aircraft, put aircraft on autopilot and evacuate aircraft.		1. Rear Entrance Door.

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Copilot	**DITCHING**		
STATION 2	1. Execute specific orders from pilot.	1. Confirm that the life rafts have been released.	1. Right Emergency Exit.
	2. Send emergency message with UHF on guard channel.	2. Take flashlight, dinghy, and evacuate aircraft.	
	3. Secure all loose equipment in flight station.	3. Assume command of right life raft.	
	4. Don necessary survival equipment and place pilot's survival equipment advantageous to his station.		
	5. Adjust and fasten shoulder harness.		
	WHEN DITCHING IS IMMINENT (AT LEAST THREE MINUTES PRIOR TO IMPACT):		
	1. Give PA and interphone warning on order from pilot.		
	2. Assist pilot as required.		
	3. Flap lever—100% landing position (on order from pilot).		
	4. Landing gear lever—Up.		
	5. Turn on alarm bell (on order from pilot).		
Copilot	**CRASH LANDING**		
STATION 2	1. Execute specific orders from pilot.	1. Take flashlight, first aid kit and evacuate aircraft.	1. Nearest Available Exit.
	2. Send emergency message with UHF on guard channel.		
	3. Secure all loose equipment in flight station.		
	4. Don necessary survival equipment.		
	5. Adjust and fasten shoulder harness.		

CONTINUED

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Copilot	**CRASH LANDING—Continued**		
STATION 2	WHEN CRASH LANDING IS IMMINENT (AT LEAST THREE MINUTES PRIOR TO IMPACT): 1. Give PA and interphone warning on order from pilot. 2. Assist pilot as required. 3. Flap lever—100% landing position (on order from pilot). 4. Landing gear lever—Up. 5. Turn on alarm bell (on order from pilot).		
Copilot	**BAILOUT**		
	1. Executes specific orders from pilot. 2. Send emergency message with UHF on guard channel. 3. Don parachute and necessary survival equipment. 4. Remain at station. 5. Evacuate aircraft upon bailout signal.		1. Rear Entrance Door.
Duty Flight Engineer	**DITCHING**		
STATION 3	1. Heaters and recirculating fan switches—OFF. 2. Dump fuel on pilot's order. 3. Depressurize cabin on pilot's order. **Note** Reduce fuel load to the lowest practical minimum before ditching. Empty, or nearly empty, fuel tanks will provide extra buoyancy.	1. Discharge engine fire extinguisher bottles (HRD aircraft).	1. Right Emergency Exit.

CONTINUED

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Duty Flight Engineer	**DITCHING—Continued**		
STATION 3	**WARNING** Make certain that fuel dump valves are closed before making contact with the water, and close all openings below waterline. This includes cabin door, flight station door, and auxiliary ventilation intakes and exits.	2. Take flashlight, dinghy and evacuate aircraft. (Before leaving flight station assure the seat is far enough forward on the track to enable pilot and copilot to pass).	
	4. Pull ditching valve release handle and close auxiliary ventilation valves (Position A). 5. Turn paddle switches to WARMER (lights out). 6. Don necessary survival equipment. 7. Pass loose gear aft for jettisoning. 8. All unnecessary switches OFF. 9. Turn emergency ditching and night lights ON.		
	WHEN DITCHING IS IMMINENT (AT LEAST THREE MINUTES PRIOR TO IMPACT): 1. Open all selector valves for HRD fire extinguisher system. 2. Battery switch—Off. 3. Turn seat aft, install headrest (if applicable) and fasten safety belt. 4. Brace for impact.		
Duty Flight Engineer	**CRASH LANDING**		
STATION 3	1. Heater and recirculation fan switches—OFF.	1. Mixture levers all engines—OFF.	1. Nearest Exit Available.

CONTINUED

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Duty Flight Engineer	**CRASH LANDING—Continued**		
STATION 3	2. Dump fuel (on pilot's order).	2. Fuel tank selectors—OFF.	
	3. Depressurize cabin (on pilot's order).	3. All electrical power (generators)—OFF (as soon as possible after contact with ground).	
	4. Don necessary survival equipment.	4. Discharge engine fire extinguisher bottles (HRD aircraft).	
	5. Auxiliary fuel pump switches—OFF.	5. Take flashlight, fire axe and evacuate aircraft. (Before leaving flight station assure the seat is far enough forward on the track to enable pilot and copilot to pass.)	
	6. Open forward crew entrance door and lock in position.		
	7. Turn emergency and nights lights—ON.		
	WHEN CRASH LANDING IS IMMINENT (AT LEAST THREE MINUTES PRIOR TO IMPACT):		
	1. Open all selector valves for HRD fire extinguisher system.		
	2. Battery switch—OFF.		
	3. Turn seat aft, install headrest (if applicable) and fasten safety belt.		
	4. Brace for impact.		
Duty Flight Engineer	**BAILOUT**		
	1. Execute specific orders from pilot.		1. Rear Entrance Door.

CONTINUED

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Duty Flight Engineer	**BAILOUT—Continued**		
	2. Depressurize cabin (on pilot's order). 3. Push seat forward. 4. Don parachute and necessary survival equipment. 5. Remain at station. 6. Evacuate aircraft upon bailout signal.		
Off-Duty Flight Engineer	**DITCHING**		
EC-121D STATION 4 TC-121C STATION 11	1. Assist duty engineer as necessary. 2. Don necessary survival equipment. 3. Check immediate area for loose equipment; stow all loose equipment. WHEN DITCHING IS IMMINENT: 1. Assume assigned ditching position. 2. Brace for impact.	EC-121D 1. Take flashlight, dinghy, additional equipment as directed and evacuate aircraft. TC-121C Take flashlight and additional equipment as directed. Supervise and assist in launching and loading cabin life raft on left side and evacuate aircraft.	EC-121D 1. Right Emergency Exit. TC-121C Rear Entrance Door.
Off-Duty Flight Engineer	**CRASH LANDING**		
EC-121D STATION 4 TC-121D STATION 11	1. Assist duty engineer as necessary. 2. Don necessary survival equipment. 3. Check immediate area for loose equipment; stow all loose equipment. WHEN CRASH LANDING IS IMMINENT: 1. Lash open rear door. 2. Assume assigned crash landing position. 3. Brace for impact.	EC-121D 1. Take flashlight, additional equipment as directed and evacuate aircraft. TC-121C Take flashlight and additional equipment as directed. Supervise and assist passenger evacuation and evacuate aircraft.	EC-121D 1. Nearest Emergency Exit. TC-121C Rear Entrance Door.

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Off-Duty Flight Engineer	**BAILOUT**		
	1. Assist in preparing aircraft for bailout as directed. 2. Don parachute and necessary survival equipment. 3. Remain at assigned position. 4. Upon bailout signal proceed to rear exit and bail out.		1. Rear Entrance Door.
Duty Navigator	**DITCHING**		
STATION 7	1. Acknowledge warning announcement and pilot's intentions. 2. Give pilot heading and distance to nearest land or surface vessel. 3. Establish poistion and pass information to pilot, radio operator and senior weapons controller. Include position, time, course, speed, altitude and additional information as time permits. 4. Prepare kit with necessary plotting equipment, charts, and aeronautical publications. 5. Stow kit and periscopic sextant forward of radio rack. 6. Don necessary survival equipment. 7. Remove right emergency escape hatch and stow in forward latrine. WHEN DITCHING IS IMMINENT: 1. Assume ditching position. 2. Brace for impact.	1. Take flashlight, navigation kit, periscopic sextant, dinghy and evacuate aircraft.	1. Right Emergency Exit.

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Duty Navigator	**CRASH LANDING**		
STATION 7	1. Acknowledge warning announcement and pilot's intentions.	1. Take flashlight, navigation kit, periscopic sextant an evacuate aircraft.	1. Nearest Available Exit.
	2. Establish position and pass information to pilot, radio operator and senior weapons controller. Include position, time, course, speed, altitude and additional information as time permits.		
	3. Prepare kit with necessary plotting equipment, charts and aeronautical publications.		
	4. Stow kit and periscopic sextant forward of radio rack.		
	5. Don necessary survival equipment.		
	6. Remove right emergency escape hatch and stow in forward latrine.		
	WHEN CRASH LANDING IS IMMINENT:		
	1. Assume crash landing position.		
	2. Brace for impact.		
Duty Navigator	**BAILOUT**		
	1. Acknowledge warning announcement and pilot's intentions.		1. Rear Entrance Door.
	2. Establish position and pass information to pilot, radio operator and senior weapons controller. Include position, time, course, speed, altitude and additional information as time permits.		
	3. Don parachute and necessary survival equipment.		
	4. Remain at station.		
	5. Upon bailout signal proceed to rear exit, and bail out.		

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Off-Duty Navigator	**DITCHING**		
STATION 6	1. Stow all loose equipment at navigator station, including seat in forward latrine. 2. Turn on emergency light. 3. Don necessary survival equipment. 4. Direct preparation of galley and forward crew compartment for ditching. WHEN DITCHING IS IMMINENT: 1. Assume ditching position. 2. Brace for impact.	1. Direct removal of food, water, and first aid kits using personnel ditching in galley positions. 2. Distribute supplies to crew members departing from both exits. 3. Take flashlight, Very pistol and flares, dinghy and evacuate aircraft.	1. Left Emergency Exit.
Off-Duty Navigator	**CRASH LANDING**		
STATION 6	1. Stow all loose equipment at navigator station, including seat, in forward latrine. 2. Turn on emergency light. 3. Don necessary survival equipment. 4. Direct preparation of galley and forward crew compartment for crash landing. WHEN CRASH LANDING IS IMMINENT: 1. Assume crash landing position. 2. Brace for impact.	1. Direct removal of food, water, and first aid kits, using personnel crash landing in galley positions. Distribute supplies to crew members departing from both exits. 2. Take flashlight, Very pistol and flares and evacuate aircraft.	1. Nearest Available Exit.

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Off-Duty Navigator	**BAILOUT**		
	1. Don parachute and necessary survival equipment.		1. Rear Entrance Door.
	2. Remain at takeoff station.		
	3. Upon bailout signal proceed to rear exit and bail out.		
Duty Radio Operator	**DITCHING**		
EC-121D STATION 9	1. Acknowledge warning annuoncement and pilot's intentions.	1. Slide radio seat forward and clear of hatch opening.	1. Left Emergency Exit.
TC-121C STATION 8	2. Turn IFF/SIF to EMERGENCY.	2. Pull left life raft release handle.	
	3. Send emergency message to appropriate ground station (information supplied by navigator).	3. Throw free end of ditching rope out on left wing.	
	4. Don necessary survival equipment.	4. Take flashlight, first aid kit, dinghy and evacuate aircraft.	
	5. Stow all loose equipment. Remove left emergency escape hatch and stow it in forward latrine.	5. Take end of ditching rope and attach to gas cap D-ring.	
	6. Continue sending emergency message.	6. Stow equipment in raft and position it for boarding, holding it free of any torn metal to avoid puncture.	
	WHEN DITCHING IS IMMINENT: 1. Screw down key. 2. Assume ditching position. 3. Brace for impact.		

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Duty Radio Operator	**CRASH LANDING**		
EC-121D STATION 9 TC-121C STATION 8	1. Acknowledge warning announcement and pilot's intentions. 2. Turn IFF/SIF to EMERGENCY. 3. Send emergency message to appropriate ground station (information supplied by navigator). 4. Don necessary survival equipment. 5. Stow all loose equipment. 6. Remove left emergency escape hatch and stow it in forward latrine. 7. Continue sending emergency message. WHEN CRASH LANDING IS IMMINENT: 1. Screw down key. 2. Assume crash landing position. 3. Brace for impact.	1. Slide radio seat forward and clear of hatch opening. 2. Pull left life raft release handle. 3. Throw free end of ditching rope out on left wing. 4. Take flashlight and evacuate aircraft.	1. Nearest Available Exit.
Duty Radio Operator	**BAILOUT**		
	1. Acknowledge warning announcement and pilot's intentions. 2. Turn IFF/SIF to EMERGENCY. 3. Send emergency message to appropriate ground station. 4. Don parachute and necessary survival equipment. 5. Procure CRT-3 (Gibson Girl). 6. Screw down key.		1. Rear Entrance Door.

CONTINUED

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
Duty Radio Operator	**BAILOUT—Continued**		
	7. Remain at station. 8. Upon bailout signal proceed to rear exit. 9. Fasten CRT-3 parachute lanyard to escape rope lanyard bracket and throw out CRT-3. 10. Bail out.		
EC-121D Senior Weapons Controller (or Radar Crew Chief)	**DITCHING**		
STATION 12	1. Acknowledge warning announcement and pilot's intentions. 2. Advise pilot of heading and range to nearest land and/or surface vessel, as determined by radar equipment. 3. Send emergency message on UHF frequency 364.2 or any other UHF tactical frequency assigned. 4. Don necessary survival equipment. Supervise the following: 5. Cabin and emergency lights to BRIGHT. 6. Electronic equipment not needed OFF when ordered by pilot. 7. Stow all of loose equipment. 8. Curtain removal and distribution for use as blankets. WHEN DITCHING IS IMMINENT: 1. Insure that AOC crew members are in ditching positions. 2. Notify pilot that AOC compartment is ready. 3. Assume ditching position. 4. Lights to DIM at night. 5. Brace for impact.	1. Supervise evacuation of personnel from AOC section. 2. Take flashlight dinghy and evacuate aircraft.	1. Left Emergency Exit.

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
EC-121D Senior Weapons Controller (or Radar Crew Chief)	**CRASH LANDING**		
STATION 12	1. Acknowledge warning announcement and pilot's intentions. 2. Send emergency message on UHF frequency 364.2 or any other UHF tactical frequency assigned. 3. Don necessary survival equipment. Supervise the following: 4. Cabin and emergency lights to BRIGHT. 5. Electronic equipment not needed—OFF (when ordered by pilot). 6. Stow all loose equipment. 7. Curtain removal and distribution for use as blankets. 8. Escape hatches open. 9. Rear exit door lashed open. WHEN CRASH LANDING IS IMMINENT: 1. Assume crash landing position. 2. Notify pilot that AOC compartment is ready. 3. Lights to DIM at night. 4. Brace for impact.	1. Supervise evacuation of personnel from AOC section. 2. Take flashlight and evacuate aircraft.	1. Left Emergency Exit.
EC-121D Senior Weapons Controller (or Radar Crew Chief)	**BAILOUT**		
	1. Acknowledge warning announcement and pilot's intentions. 2. Send emergency message on UHF frequency 364.2 or any other UHF tactical frequency assigned. 3. Don parachute and necessary survival equipment.		1. Rear Entrance Door.

CONTINUED

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
EC-121D Senior Weapons Controller (or Radar Crew Chief)	**BAILOUT—Continued**		
	4. Remain at station. 5. Upon bailout signal proceed to rear exit and bail out.		
EC-121D First Radar Technician	**DITCHING**		
STATION 10	1. Turn cabin lights on BRIGHT. 2. Stow all loose equipment. 3. Turn OFF electronic equipment on left side of aircraft upon notification from senior weapons controller. **Note** Leave ac generators ON. 4. Don necessary survival equipment. WHEN DITCHING IS IMMINENT: 1. Dim cabin lights at night. 2. Assume ditching position with seat faced aft. 3. Brace for impact.	1. Push radar technician chair full forward against table. 2. Take flashlight, dinghy and evacuate aircraft. 3. Assist duty radio operator with left life raft.	1. Left Emergency Exit.
EC-121D First Radar Technician	**CRASH LANDING**		
STATION 10	1. Turn cabin lights on BRIGHT. 2. Stow all loose equipment.	1. Push radar technician chair full forward against table.	1. Left Emergency Exit.

CONTINUED

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
EC-121D First Radar Technician	**CRASH LANDING—Continued**		
STATION 10	3. Turn off electronic equipment on left side of aircraft upon notification from Senior Weapons Controller.		
	Note Leave ac generators ON.	2. Take flashlight and evacuate aircraft.	
	4. Don necessary survival equipment.		
	WHEN CRASH LANDING IS IMMINENT:	3. Assist duty radio operator with left life raft.	
	1. Dim cabin lights at night.		
	2. Assume crash landing position with seat faced aft.		
	3. Brace for impact.		
EC-121D First Radar Technician	**BAILOUT**		
	1. Turn cabin lights on BRIGHT.		1. Rear Entrance Door.
	2. Push radar technician chair full forward against table.		
	3. Don parachute and necessary survival equipment.		
	4. Remain at station.		
	5. Upon bailout signal proceed to rear exit and bail out.		
EC-121D Second Radar Technician	**DITCHING**		
STATION 11	1. Stow all loose equipment.	1. Pull right life raft release handle.	1. Right Emergency Exit.

CONTINUED

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
EC-121D Second Radar Technician	**DITCHING—Continued**		
STATION 11	2. Turn off electronic equipment on right side of aircraft upon notification from senior weapons controller.	2. Throw free end of ditching rope out on right wing. Attach rope to gas cap D-ring.	
	3. Don necessary survival equipment.	3. Take flashlight, dinghy and evacuate aircraft.	
	WHEN DITCHING IS IMMINENT:		
	1. Assume ditching position.	4. Position right raft for boarding, holding it free of any torn metal to avoid puncture.	
	2. Brace for impact.		
EC-121D Second Radar Technician	**CRASH LANDING**		
STATION 11	1. Stow all loose equipment.	1. Pull right life raft release handle.	1. Right Emergency Exit.
	2. Turn off electronic equipment on right side of aircraft upon notification from senior weapons controller.	2. Throw free end of ditching rope out on right wing.	
	3. Don necessary survival equipment.	3. Take flashlight and evacuate aircraft.	
	WHEN CRASH LANDING IS IMMINENT:		
	1. Assume crash landing position.		
	2. Brace for impact.		
EC-121D Second Radar Technician	**BAILOUT**		
	1. Don parachute and necessary survival equipment.		1. Rear Entrance Door.
	2. Remain at station.		
	3. Upon bailout signal proceed to rear exit and bail out.		

Crewmember Position	*Duties Before Impact*	*Duties After Impact*	*Exit*
EC-121D Radar Operators	**DITCHING**		
ASSIGNED DITCHING STATION	1. Assist in preparing aircraft for ditching as desired. 2. Don necessary survival equipment. 3. Check immediate area for loose equipment; stow all loose equipment. WHEN DITCHING IS IMMINENT: 1. Assume assigned ditching position. 2. Brace for impact.	1. Take flashlight, dinghy, additional equipment as directed and evacuate aircraft. (Radar operator at ACO #5 will take CRT-3 out right emergency exit.)	1. Emergency exit on same side of aircraft as ditching position.
EC-121D Radar Operators	**CRASH LANDING**		
ASSIGNED CRASH LANDING STATION	1. Assist in preparing aircraft for crash landing as directed. 2. Don necessary survival equipment. 3. Check immediate area for loose equipment; stow all loose equipment. WHEN CRASH LANDING IS IMMINENT: 1. Assume assigned crash landing position. 2. Brace for impact.	1. Take flashlight, additional equipment as directed and evacuate aircraft.	1. Emergency exit on same side of aircraft as crash landing position.
EC-121D Radar Operators	**BAILOUT**		
	1. Assist in preparing aircraft for bailout as directed. 2. Don parachute and necessary survival equipment. 3. Remain at assigned position. 4. Upon bailout signal proceed to rear exit and bail out.		1. Rear Entrance Door.

Section IV—AUXILIARY EQUIPMENT

TABLE OF CONTENTS

	Page
AIR CONDITIONING SYSTEM	4-1
ANTI-ICING, DEICING AND DEFOGGING SYSTEMS	4-21
COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT EC-121D	4-30
COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT TC-121C	4-76
LIGHTING SYSTEM	4-93
OXYGEN SYSTEM EC-121D	4-96
OXYGEN SYSTEM TC-121C	4-100
FLIGHT DIRECTOR SYSTEM	4-104
AUTOMATIC PILOT	4-112
AUTOMATIC FLIGHT PATH CONTROL SYSTEM	4-116
FUSELAGE FURNISHINGS AND MISCELLANEOUS EQUIPMENT	4-119

AIR CONDITIONING SYSTEM.

The heating, ventilating, cooling and pressurization system on this aircraft are so united and controlled that they will be considered as one system.

HEATING.

Heated air for the cabin is supplied by two 125,000 btu combustion heaters located in each wing fillet. Each heater package, or assembly, contains its own ignition system and individual units for supplying the combustion fuel/air mixture. Fuel is supplied to the heaters from the No. 2 and No. 3 engine fuel systems. On USAF Serials 52-3411—54-2308, fuel is supplied from No. 1 and No. 4 tanks. On TC-121C aircraft fuel is supplied from No. 2 and No. 3 fuel tanks. The heaters, during auxiliary ventilation operation, heat outside ram air. During pressurized operation, recirculated cabin air from the recirculation fans is heated. The recirculated air is picked up by the fans through the recirculation check valves from the area around the outside of the aft cargo compartment liner. A mixture of heated and unheated air from the output side of the heaters is then mixed with fresh air from the cabin superchargers before entering the cabin distribution system. Heated air for the flight station may be recirculated cabin air, or by positioning the flight station mix valve, a mixture of fresh air and recirculated air or all fresh air. If the air is not as warm as desired, it can be further heated by operation of the pilots' electric auxiliary heater.

AUXILIARY VENTILATION.

Ambient air for auxiliary ventilation is provided by circulating ram air from inlets in the leading edges of the left and right wing center sections. The ram air is directed from the inlets to the cabin recirculating fans, then to the cabin distributing system. The air from the cabin is exhausted overboard through the auxiliary ventilation exit valve and the cabin safety relief and dump valve. Ventilation on the ground is furnished by the recirculation fans drawing air through the auxiliary ventilation inlet valves and distributing it to the cabin in the same manner as during flight operation.

REFRIGERATION.

Cooled or refrigerated air is supplied to the cabin and flight station from equipment in both wing panels. Partial cooling may be accomplished by positioning the cabin air mixing and selector valve toward the cool position which forces supercharged air to pass through the primary heat exchanger before reaching the fuselage. Heat transfer from the supercharged air within the tubes is made to the cooling ram air around the tubes. The cooling ram air is carried away through the exit door in the upper surface of the wing panel. Modulation of the amount of cooling is then determined by the position of the primary heat exchanger ram air scoop. Full cooling and refrigeration may be accomplished by positioning the cabin air mixing and selector toward the cool position which forces air to be refrigerated to pass through

CABIN PRESSURIZATION VS. ALTITUDE

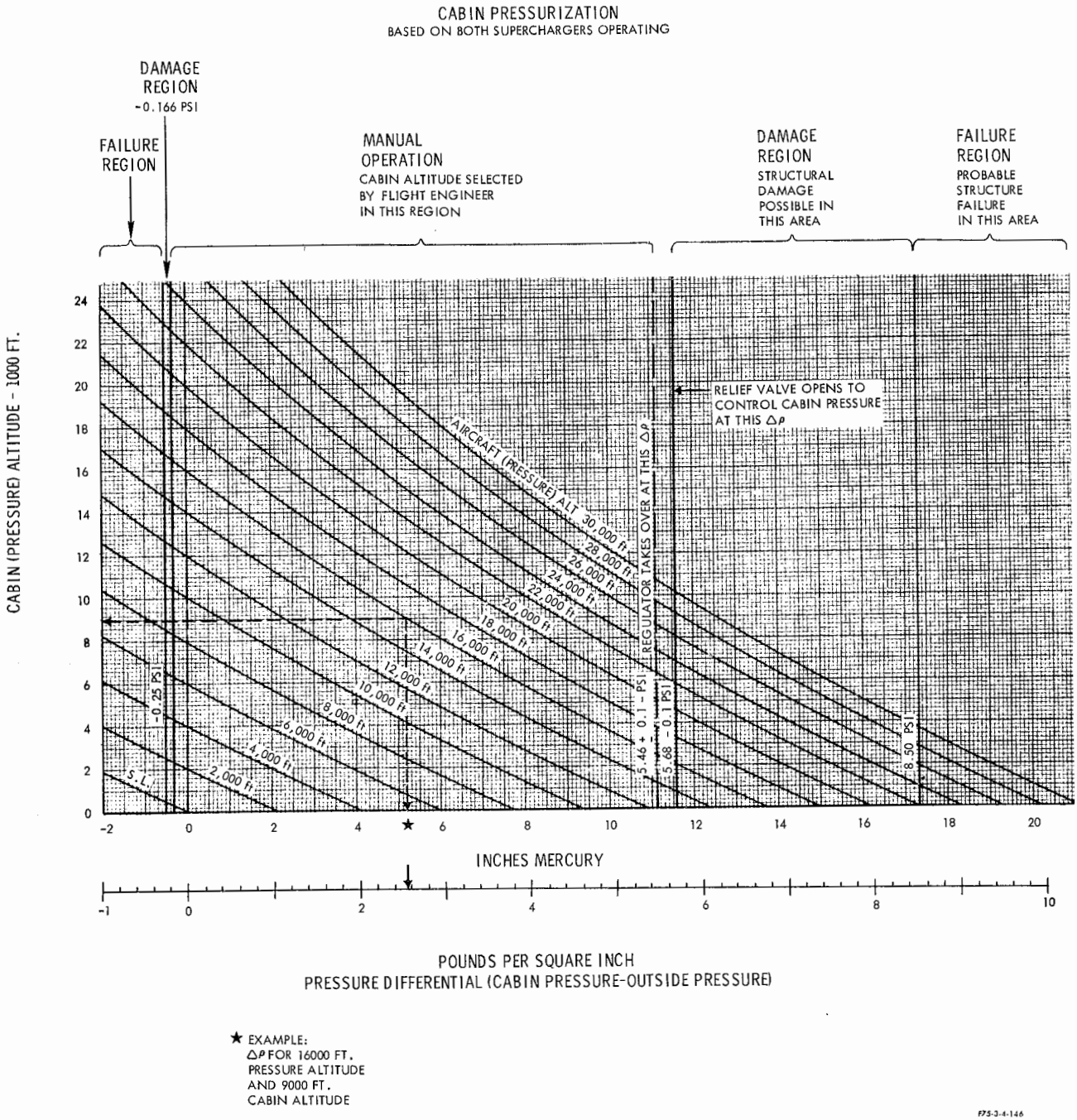


Figure 4-1

the primary heat exchanger as in cooling. From the outlet side of the primary heat exchanger, the air flows into the compressor turbine of the cooling unit. From this turbine, the air passes through the secondary heat exchanger, then back into the expansion turbine of the cooling unit. From this turbine the air flows through the water separator to the air mixing and selector valve which directs it into the fuselage duct. Duct temperature,

just downstream of the air mixing and selector valve, is continuously registered on a temperature indicator. This permits the controls to be positioned for a desired discharge temperature within the capacity of the equipment.

PRESSURIZATION.

Ambient air is ducted from inlets just aft of the leading edge of the wings to the cabin superchargers, which are located in the outboard nacelles. It is then compressed and passed through the refrigeration and cooling equipment located in the wings (the path through this equipment is dependent upon cabin temperature selection and position of the cabin air mixing valve) and then introduced into the fuselage structure to pressurize and ventilate this area when the auxiliary ventilation system is closed. A cabin pressure equivalent to that at sea level may be maintained up to an altitude of 12,300 feet. Any further increase in altitude will cause a proportional decrease in cabin pressure. At 25,000 foot altitude, the cabin pressure can be maintained at a pressure equivalent to 10,600 feet. The amount and rate at which the cabin air is exhausted overboard to maintain selected cabin pressure are determined by the auxiliary pressure regulator valves, the master pressure regulator valve, the altitude selector and the rate-of-change selector. The auxiliary pressure regulator valves automatically meter the outflow of cabin air in response to variable pneumatic control forces from the master pressure regulator control valve. This valve varies the pneumatic control forces in response to the manually selected positions of the altitude and rate-of-change selectors. These instruments provide for remote positioning of the isobaric section of the valve, permitting selective automatic operation up to a pressure differential of 10.92 inches mercury (5.36 psi). If the range of the isobaric section is exceeded, the differential section of the valve provides for non-selective automatic operation up to a maximum pressure differential of 11.32 inches mercury (5.46 psi). A cabin pressure safety relief and dump valve is installed on the aft pressure bulkhead. The valve acts as a pressure safety relief valve and a pressure dump valve. A vacuum or negative pressure relief valve is also installed on the aft pressure bulkhead, adjacent to the cabin pressure safety relief and dump valve. This valve is hinge-mounted from the top to permit it to swing inward if outside pressure is greater than inside pressure. In addition the outflow valves act as negative relief valves.

CABIN HEATER SWITCHES (LEFT AND RIGHT).

The cabin heater switches (4, figure 4-4) are two position switches labeled ON and OFF. The ON position permits operation of the cabin heaters provided the recirculating fan switches are ON; the cabin temperature selector switch is set above a specified temperature; and the number 2 and number 3 engine fuel pumps, or the auxiliary boost pumps are operating (except aircraft 51-3836 thru 51-3841, 51-3843 thru 51-3845 and 52-3411 thru 54-2308). This automatic type electrical system is protected by several cabin temperature circuit breakers located on the upper 260 panel. Power for the various heater components is routed through the 260 bus and the main dc bus.

CABIN HEATER TEMPERATURE CONTROL OVERRIDE SWITCHES (LEFT AND RIGHT).

These two-position guarded switches (5, figure 4-4) are labeled OVERRIDE and NORMAL (guarded). The OVERRIDE position of each switch provides for higher heater output if the cabin temperature control rheostat fails to supply sufficient cabin heat. A bridge circuit breaker, located on the 260 upper switch panel, protects this phase of the cabin heater system. Electric power is routed through the 260 dc bus.

CABIN HEATER COMBUSTION AIR BLOWER SWITCH.

This two-position switch (38, figure 4-4) is labeled OVERRIDE and NORMAL. The OVERRIDE position permits operation of both combustion air blowers, which supply air for combustion in the cabin heaters, when ram air is insufficient because of ice accumulation in the aux. vent inlets. In the NORMAL position, the combustion air blower is inoperative unless the cabin heating system is operating on the ground and aux. vent is in position A or beyond. The blower will be then turned on automatically through a pressure switch. This phase of the cabin heater electrical system is protected by the recirculating fan circuit breakers located on the 260 upper switch panel. Electric power for the combustion air blower switch is routed through the 260 dc bus and the main dc bus.

CABIN HEATER EMERGENCY IGNITION SWITCHES (LEFT AND RIGHT).

These two-position guarded switches (34, figure 4-4) are labeled EMERGENCY and NORMAL (guarded). The EMERGENCY position permits selection of an alternate set of ignition points if the first set of ignition points malfunctions. The NORMAL position selects the first set of ignition points. The cabin heater circuit breakers, located on the 260 upper switch panel, protects the emergency ignition switches.

RECIRCULATING FAN SWITCHES (LEFT AND RIGHT).

The recirculating fan switches (39, figure 4-4) are two-position switches labeled ON and OFF. The ON position permits operation of the electric fans, which circulate hot or cold air throughout the cabin. The fans are

AIR CONDITIONING SYSTEM

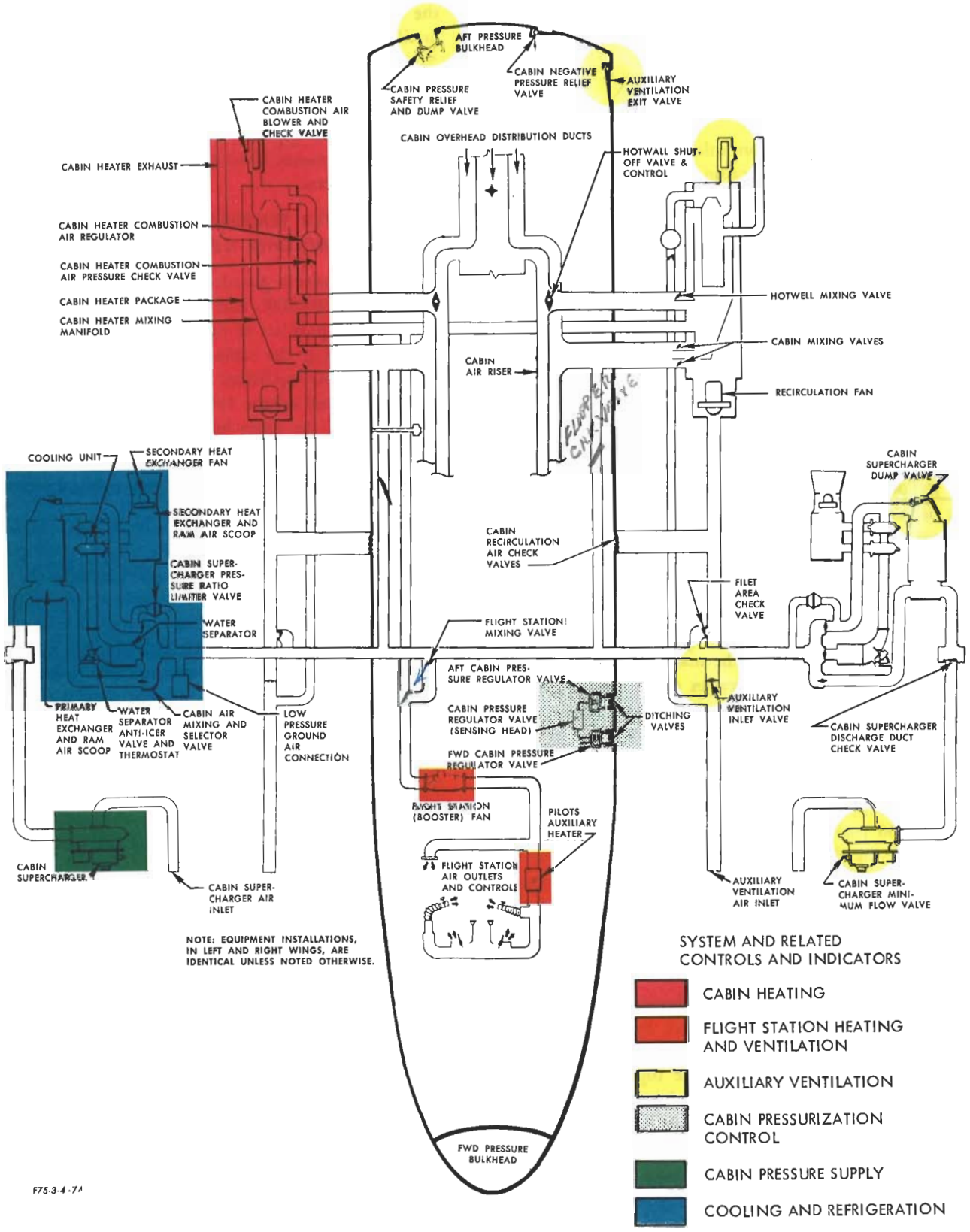


Figure 4-2

located on the forward end of each heater. Recirculating fan circuit breakers, located on the 260 upper switch panel, protect this system. Electric power for these switches is routed through the 260 dc bus.

CABIN TEMPERATURE SELECTOR SWITCH.

This switch (25, figure 4-4) is a rheostat type switch and is labeled 1 through 10 with the word DECREASE pointing to the low number. The 1 through 10 positions are relative and permit selection of various cabin temperatures, provided the heater switches and recirculating fan switches are ON. Cabin thermistors are provided to automatically control selected temperatures. A bridge circuit breaker, located on the 260 upper switch panel, protects this phase of the cabin heater electrical system. Electrical power is routed through the 260 dc bus.

PILOTS' AUX HEATER SWITCH.

The pilots' auxiliary heater switch (35, figure 4-4) is a four-position dual wafer-type switch located on the 260 instrument panel. The four positions are: OFF, all circuits open; LOW, 1 kw heater output energized; MEDIUM, 2 kw heater output energized; HIGH, 1 kw and 2 kw (3 kw total) heater output energized. LOW, MEDIUM and HIGH switch positions arm the overheat warning light, thermal switches, and overheat lockout relay circuits which prevents excessive heater temperatures. The pilots' heater vent should be in the open position during heater operation to preclude actuating overheat lockout relay. Operating power is drawn from the main dc bus bar (fwd cargo comp.), and the 260 dc positive bus which is activated by the flight station fan switch.

FLIGHT STATION FAN SWITCH.

The flight station fan switch (37, figure 4-4) is an electrically actuated, two-position, ON and OFF switch that arms the pilots' auxiliary heater and controls the flight station fan. When on, air circulation in the flight station is increased and heat from the pilots' auxiliary heater is dissipated. Circuit protection is afforded by the booster fan circuit breaker (260 switch panel), and operating power is drawn from the 260 dc positive bus.

FLIGHT STATION MIXING VALVE SWITCH.

This control is a three-position switch (36, figure 4-4) labeled WARM (up), STEADY (center), and COOL (down). The WARM and COOL position actuates the flight station mixing valve. The mixing valve moves to provide a mixture of recirculated cabin air and fresh supercharger discharge air during pressurized operation. During auxiliary vent. operation, the mixing valve moves to provide a mixture of fresh auxiliary vent air, and heated fresh air (if desired) from the cabin heaters. The mixing valve ceases to change position when the switch is returned to the STEADY position. Note that the full-warm position supplies no fresh air, but recirculated heated air only. This circuit is afforded protection by the flight station mix circuit breaker (260 switch panel). Power is drawn from the 260 dc positive bus.

CABIN AIR PADDLE SWITCHES (LEFT AND RIGHT).

The three-position paddle switches (27, figure 4-4) are labeled WARMER (up), STEADY (center) and COOLER (down). The WARMER and COOLER positions electrically energize a cam arrangement which allows a continuous cam-travel to the full-cool or full-warm positions, as selected, unless interrupted by the paddle switches being positioned to STEADY for a desired intermediate air temperature. These cams in turn control, electrically, the operation of the cabin air mixing and selector valves, the primary and secondary heat exchanger scoops, and the primary heat exchanger exit door, which provide air of the selected temperature to the cabin. All circuits involved are protected by the left and right refrigeration control circuit breakers, the left and right secondary aft cooler circuit breakers, the left and right fan solenoid circuit breaker, and draw power from the crew door bus. All circuit breakers are located on the 260 switch panel.

REFRIGERATOR COOLING FAN SWITCHES (LEFT AND RIGHT).

The cooling fan switches (21, figure 4-4) have two positons which are labeled NORM and OFF, and are for ground operation of refrigerated air system only. On some modified aircraft, these switches are spring-loaded in the ON position.

In the NORM position, the hydraulically driven cooling air fans, which are located on the aft sides of the secondary heat exchanger, operate and supply cooling air for the secondary heat exchanger when actuated by the landing gear scissor switch. Note that this setting is for all normal operations. The circuit is protected by the left and right fan solenoid circuit breaker, located on the 260 upper switch panel, and the fan switches draw power from the crew door bus.

REFRIGERATOR OVERRIDE SWITCHES (LEFT AND RIGHT).

These guarded switches (23, figure 4-4) have two positions: NORM and EMER. In the EMER position, these switches bypass the sequence switches in the cabin air mixing and selector valve actuator, disconnecting the primary heat exchanger scoop from the cabin air mixing

AIR CONDITIONING DUCTING

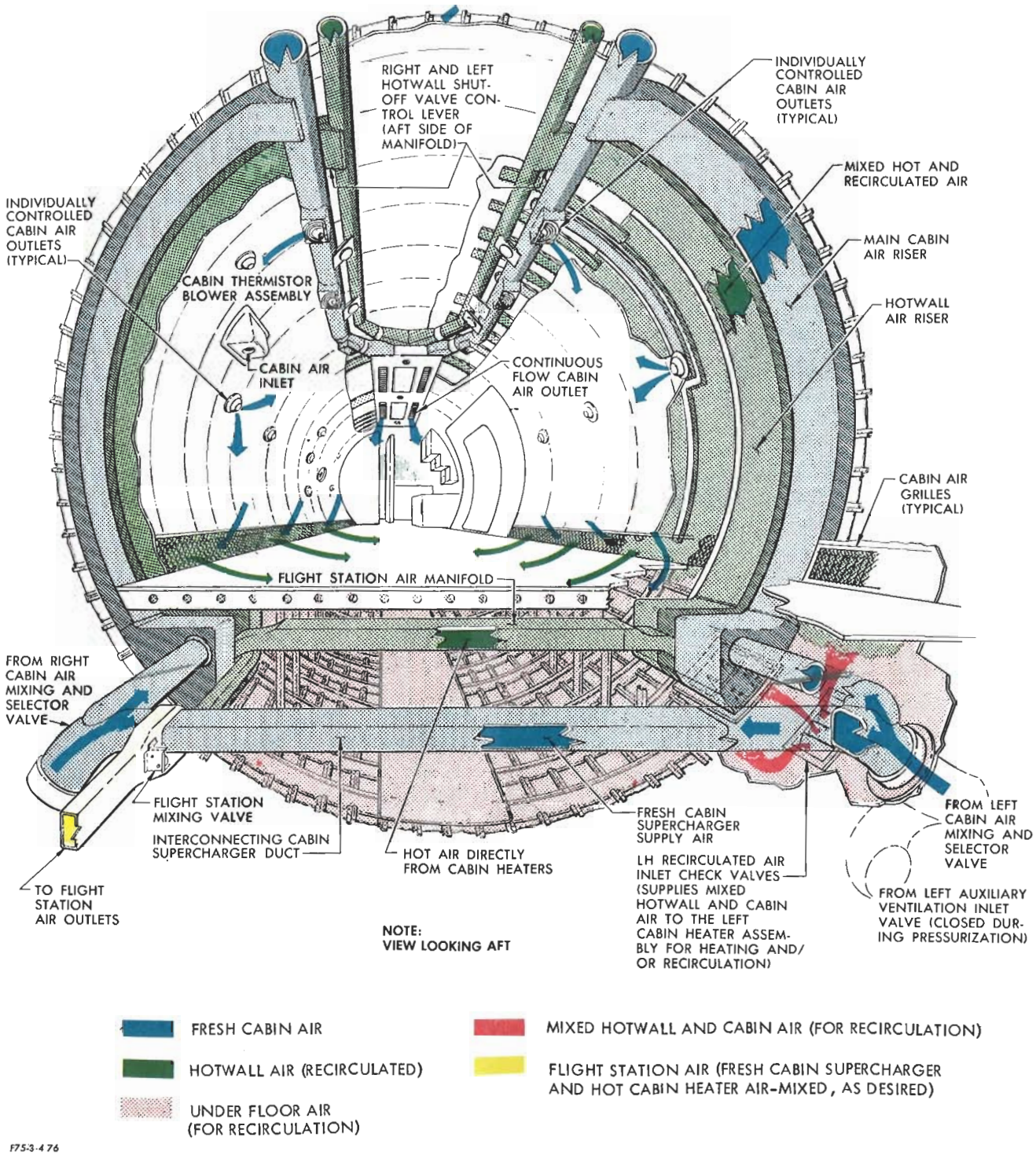


Figure 4-3 (Sheet 1 of 2)

AIR CONDITIONING DUCTING

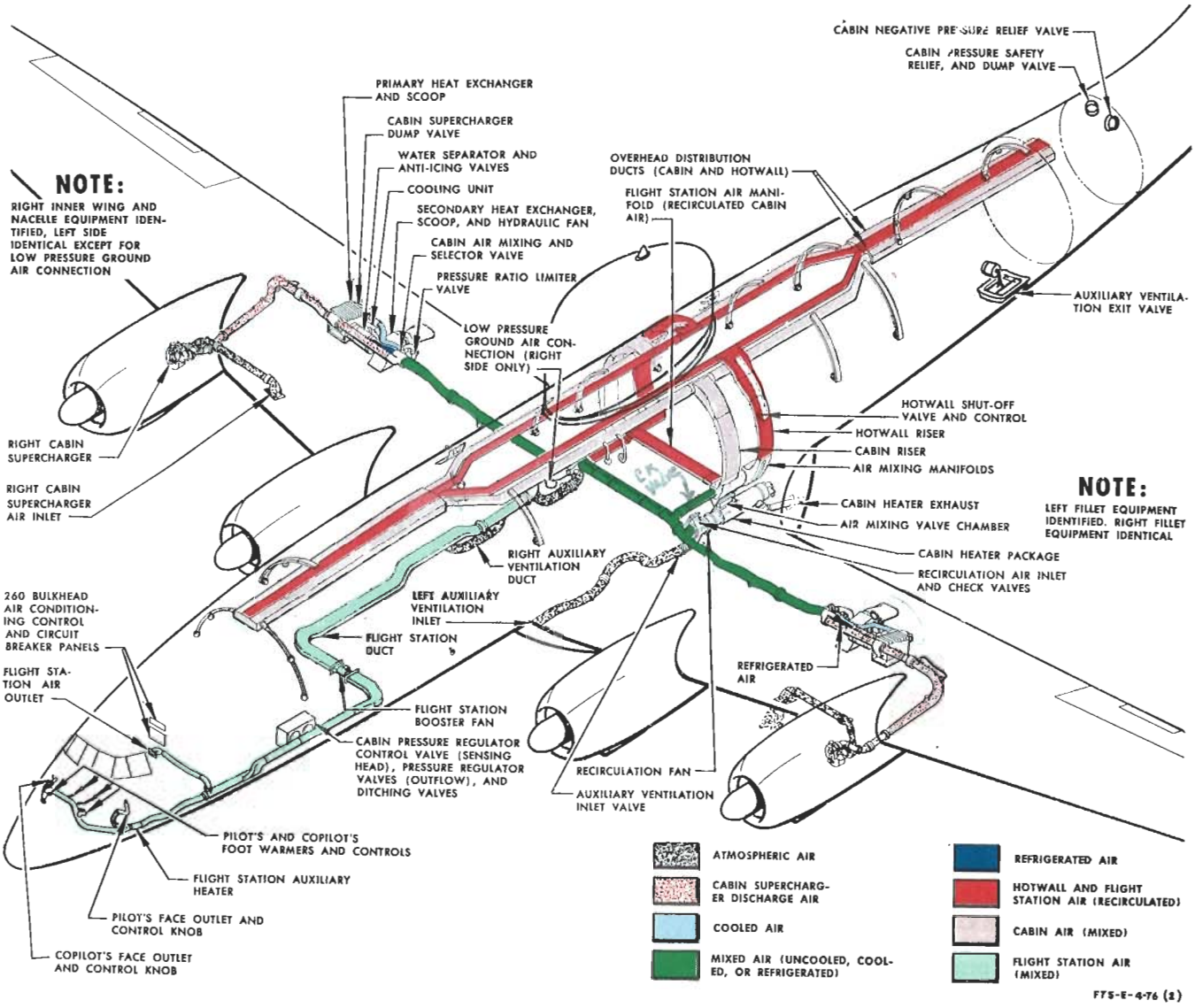


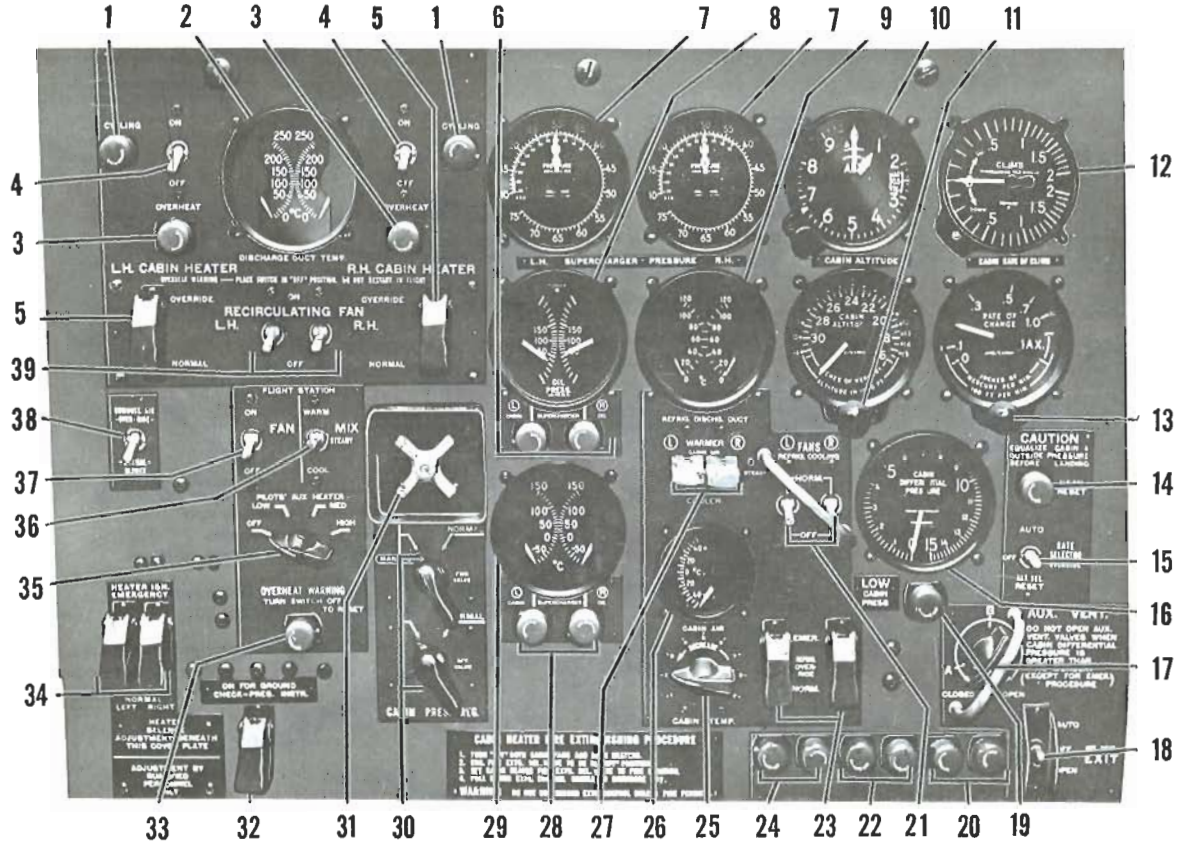
Figure 4-3 (Sheet 2 of 2)

valve control cycle. This allows the cabin air mixing and selector valve to be positioned in the event that the primary heat exchanger scoop is malfunctioning.

AUXILIARY VENTILATION CONTROL SWITCH.

The auxiliary ventilation control knob switch (17, figure 4-4) is a rheostat switch circularly labeled CLOSED, A, B, and OPEN. This switch is mechanically interconnected with the supercharger control and altitude warning switch (which also completes an electrical circuit to the combustion air blowers); the pressurization control switch; and is electrically connected to micropositioners, which, in turn, control the left and right auxiliary ventilation inlets, and the auxiliary ventilation exit. The switch in the "A" position dumps the cabin supercharger discharge air and places the supercharger air setting to minimum flow; arms the combustion air blowers circuit, (they will operate if the cabin heater control calls for heat); arms thermistor blowers and opens the vacuum-controlled cabin safety relief and dump valve (with inboard engines operating to supply system vacuum). Clockwise movement of the auxiliary ventilation control knob switch past the A position progressively opens the

AIR CONDITIONING CONTROL PANEL



1. CABIN HEATER CYCLING LIGHTS (L & R)
2. CABIN HEATER DISCHARGE DUCT TEMPERATURE INDICATOR
3. CABIN HEATER OVERHEAT WARNING LIGHTS (L & R)
4. CABIN HEATER SWITCHES (L & R)
5. CABIN HEATER TEMPERATURE OVERRIDE SWITCHES (L & R)
6. CABIN SUPERCHARGER LOW OIL PRESSURE WARNING LIGHTS (L & R)
7. CABIN SUPERCHARGER DIFFERENTIAL AIR PRESSURE INDICATORS (L & R)
8. CABIN SUPERCHARGER OIL PRESSURE INDICATOR
9. REFRIGERATION DISCHARGE DUCT TEMPERATURE INDICATOR
10. CABIN ALTITUDE INDICATOR
11. CABIN ALTITUDE SELECTOR KNOB
12. CABIN VERTICAL VELOCITY INDICATOR
13. CABIN RATE OF CHANGE SELECTOR KNOB
14. CABIN ALTITUDE SELECTOR RESET LIGHT
15. RATE SELECTOR OVERRIDE SWITCH
16. CABIN DIFFERENTIAL PRESSURE INDICATOR
17. AUXILIARY VENT. KNOB
18. AUXILIARY VENT. EXIT SWITCH
19. LOW CABIN PRESSURE WARNING LIGHT
20. SECONDARY HEAT EXCHANGER SCOOP OPEN LIGHTS (L & R)
21. REFRIGERATOR COOLING FAN SWITCHES (L & R)
22. PRIMARY HEAT EXCHANGER EXIT OPEN LIGHTS (L & R)
23. REFRIGERATOR OVERRIDE SWITCHES (L & R)
24. PRIMARY HEAT EXCHANGER SCOOP OPEN LIGHTS (L & R)
25. CABIN TEMPERATURE SELECTOR SWITCH
26. CABIN AIR TEMPERATURE INDICATOR
27. CABIN AIR PADDLE SWITCHES (L & R)
28. CABIN SUPERCHARGER HIGH OIL TEMPERATURE WARNING LIGHTS (L & R)
29. CABIN SUPERCHARGER OIL TEMPERATURE INDICATOR
30. CABIN PRESSURE REGULATOR SELECTOR VALVE (FWD. & AFT)
31. CABIN PRESSURE REGULATOR CONTROL VALVE
32. GROUND CHECK SWITCH
33. PILOTS' AUXILIARY HEATER OVERHEAT WARNING LIGHT
34. CABIN HEATER EMERGENCY IGNITION SWITCHES
35. PILOTS' AUXILIARY HEATER SWITCH
36. FLIGHT STATION MIXING VALVE CONTROL SWITCH
37. FLIGHT STATION FAN SWITCH
38. CABIN HEATER COMBUSTION AIR BLOWER SWITCH
39. RECIRCULATING FAN SWITCHES (L & R)

F75-D-4-83

Figure 4-4

auxiliary ventilation inlet and exit valves by energizing the micropositioners, however, the inlet valves open 10% prior to the initial opening of the exit valves. Any degree of opening of the auxiliary ventilation inlet and exit valves is obtainable according to the positioning of the switch. Position B of the switch provides moderate cabin and flight station ventilation without excessive air circulation. The OPEN position of the switch provides maximum auxiliary ventilation (the auxiliary ventilation inlets and exit are fully open). The CLOSED position of the switch provides cabin supercharger discharge air to the fuselage, according to flow requirements; closes the

cabin safety relief and dump valve; deenergizes the combustion air blower; and closes the auxiliary ventilation inlet valves and exit valve. All circuits are protected by the auxiliary ventilation control circuit breaker, the supercharger control and altitude warning circuit breaker, the cabin altitude control circuit breaker, and the pressure release control circuit breaker. All circuit breakers are located on the 260 upper switch panel. Power is derived from the 260 dc bus.

AUXILIARY VENTILATION EXIT VALVE OVERRIDE SWITCH.

The auxiliary ventilation exit valve override switch (18, figure 4-4) is a three-position switch labeled AUTO (up), OFF (center), and OPEN (down). The normal position is AUTO (up) which allows control of the auxiliary ventilation exit and inlets by the auxiliary ventilation control knob switch. In the OFF position, the auxiliary ventilation exit door is removed from the circuit, thereby preventing movement from the last selected position. The OPEN position of the override switch bypasses the auxiliary ventilation exit micropositioner, and actuates the exit to the full-open position.

CABIN ALTITUDE SELECTOR.

The cabin altitude selector knob (11, figure 4-4) operates a needle type indicator mounted on a dial that is calibrated both in inches-of-mercury and in thousands-of-feet. The knob (and needle) is mechanically connected to a potentiometer in such a manner that selection of an altitude on the dial mechanically positions the arm of the potentiometer so that each selected altitude is equal to a certain resistance value on the potentiometer. An isobaric changer potentiometer is connected to the selector potentiometer relay coil so that when an altitude is selected, and the selector potentiometer moves to put the circuit in an unbalanced condition, the micropositioner moves the isobaric changer potentiometer, which actuates the isobaric spring tension-motor to correspond to the altitude selected, resulting in an increase or decrease in the sensing head valve release pressure, until the circuit is again in balance. This circuit is protected by the cabin altitude control circuit breaker, located on the 260 switch panel, and draws power from the 260 dc bus.

CABIN PRESSURE RATE-OF-CHANGE SELECTOR.

The cabin rate-of-change selector knob (13, figure 4-4) operates a needle-type indicator mounted on a dial that is calibrated both in inches-of-mercury per minute, and in hundreds-of-feet per minute. The knob (and needle) is mechanically connected to a moveable brush making electrical contact with a plastic cylinder having a wedge-shaped contact inlay in its outer surface. This contact completes the cricuit to the sensing head valve. A constant-speed electric motor causes the contact-cylinder to revolve, resulting in the interruption of this circuit. Rate-of-change in cabin pressure varies directly with the width of the contact-inlay which is determined by selection on the instrument (and, as a result, on the moveable brush). This circuit is protected by the cabin altitude control circuit breaker, located on the 260 switch panel, and draws power from the 260 dc bus.

RATE SELECTOR OVERRIDE SWITCH AND ALTITUDE SELECTOR RESET LIGHT.

The rate selector override switch (15, figure 4-4) is a three-position dual switch labeled AUTO (up), OFF (center), and ALT. SEL. RESET (down). AUTO is the position for all normal flight conditions. The OFF position will stop the changer assembly at the existing condition, and ALT. SEL. RESET position will bypass the cabin rate-of-change selector for an approximate 2500 ft. rate of change. The reset light (14, figure 4-4) will glow when the switch is in the ALT. SEL. RESET position until the cabin altitude selector setting has been obtained. This switch and light are part of the cabin rate-of-change selector circuit.

CABIN PRESSURE REGULATOR SELECTOR VALVES (FWD AND AFT).

The two fwd. and aft cabin pressure regulator selector valves (30, figure 4-4) are mechanically operated two-position valves labeled NORMAL and MANUAL. The NORMAL positions permit control of the cabin pressure outflow valves by the cabin altitude selector. The MANUAL positions permit direct manual control of the cabin pressure outflow valves by the emergency cabin pressure regulator control valve (located directly above the regulator selector valves).

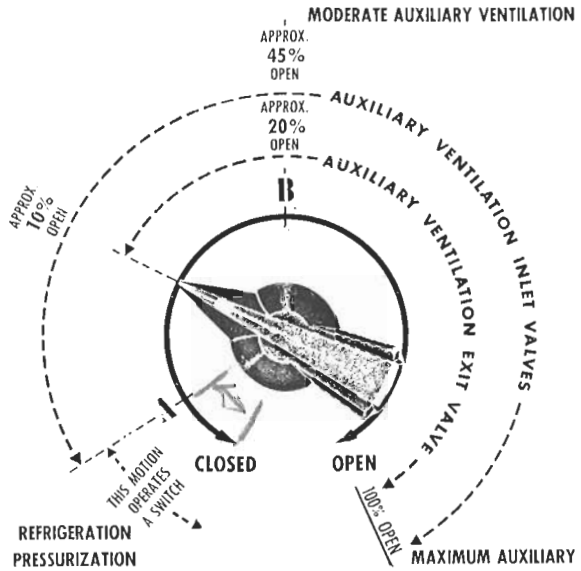
CABIN PRESSURE REGULATOR CONTROL VALVE.

The cabin pressure regulator control valve (31, figure 4-4), labeled DEPRESSURIZE (with an arrow pointing left), is a needle-valve that meters a source of true ambient air pressure to the cabin pressure outflow valves. The clockwise movement of this valve handle will cause the cabin to pressurize, and counterclockwise movement will cause the cabin to depressurize. The valve is effective only when the cabin pressure regulator selector is in the MANUAL position.

GROUND CHECK TEST SWITCH.

This switch (32, figure 4-4) is guarded and is labeled ON FOR GROUND CHECK-PRES. INSTR. In the ON position it permits pressurization tests on the ground by removing the vacuum source from the cabin pressure

AUXILIARY VENT CONTROL KNOB



The auxiliary ventilation control knob is a rheostat-type switch placarded CLOSED, A, B, and OPEN. In the A position the aux. vent. control knob dumps the cabin superchargers and puts them on minimum flow; completes an electrical circuit to the combustion air blowers (they will operate if the cabin thermostatic controls call for heat); and opens the vaccum-controlled cabin safety, relief and dump valve (if the inboard engines are operating to supply vaccum to the system).

Clockwise movement of the aux. vent. control knob, past the A position, progressively opens the auxiliary ventilation inlet and exit valves. When the inlet valves are 10% open (approximately the 10:00 o'clock position on the control knob) the aux. vent. exit valve starts to open. The last 90% travel of the control knob completes the opening of both inlet and exit valves. Any degree of OPEN is obtainable by positioning the control knob.

The position B of the aux. vent. control system is a recommended position for moderate cabin and flight station ventilation without excessive air circulation. The OPEN position provides maximum auxiliary ventilation (the aux. vent. inlets and exit are fully open). In the CLOSED position the cabin superchargers are supplying air to the fuselage according to flow requirements; the cabin safety, relief and dump valve is closed; the combustion air blower is de-energized; and the aux. vent. inlets and exit valves are closed.

F75-E-4-84

Figure 4-5

safety relief valve and outflow valves which allows them to close. The OFF position is for all other operating conditions.

HOTWALL SHUT-OFF VALVES (LEFT AND RIGHT).

A hotwall shut-off valve is located in each hotwall cabin air riser approximately six feet above the cabin floor. These valves are labeled OPEN and SHUT. The OPEN position is for all normal operations. The CLOSED position is for maximum ground refrigeration or when operating in-flight with the failure of one cabin heater at low ambient air temperatures.

CABIN SUPERCHARGERS DRIVE SHAFT DISCONNECT LEVERS.

The cabin superchargers drive shaft disconnect levers (7, figure 1-14) (same as No. 1 and No. 4 engine supercharger control levers), are labeled EMERGENCY CABIN SUPCHGR. DISCONNECT with an arrow pointing outboard and are located on the flight engineer's control quadrant. The full outboard, or quadrant-stop, position is the drive shaft disconnect position. The spring-loaded gate-lever is provided to prevent inadvertent disconnection of the supercharger drive shaft when operating the supercharger levers.

Note

The cabin supercharger drive shafts cannot be reconnected in flight.

DITCHING VALVE RELEASE HANDLE.

The ditching valve release handle (figure 4-10), located behind a door under the air conditioning control panel,

AUXILIARY VENT CONTROL OPERATION

FUSELAGE FIRE PROCEDURE

The cabin superchargers are dumped and put on minimum flow; the cabin safety, relief and dump valve is opened; and the auxiliary ventilation inlet and exit valves are closed.

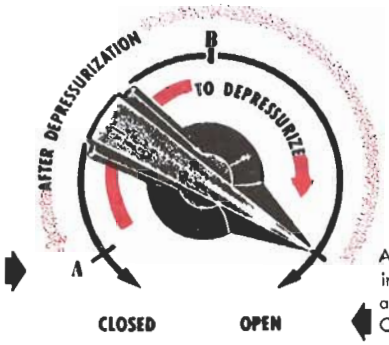
Auxiliary ventilation inlet valves are approximately 45% open; the auxiliary ventilation exit valve is approximately 20% open; the air recirculation check valves are closed.

Depressurization, without excessive air circulation that might fan a fire, is accomplished by placing the auxiliary ventilation control knob in the "B" position.

★ If the cabin is not occupied and oxygen is available for crew members, the aux vent knob is to be placed in the A position (after depressurization) to minimize air circulation. If the cabin is occupied, the auxiliary ventilation control knob is to be left in the "B" position as it affords moderate auxiliary ventilation.

SMOKE REMOVAL

After depressurization, the auxiliary ventilation control knob is placed at position "A" so that the auxiliary ventilation system is closed and will not circulate smoke through the cabin or flight station.

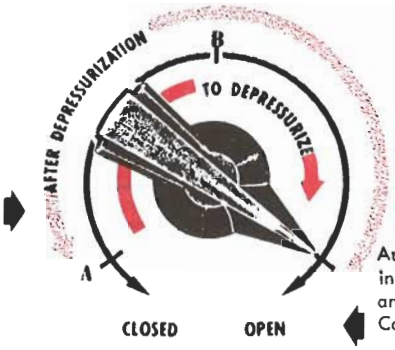


Aux vent. inlet valves and exit valve-- Completely OPEN

Auxiliary ventilation inlet valves and exit valve are closed; the cabin superchargers are dumped and put on minimum flow; the cabin safety, relief and dump valve is open.

EMERGENCY DEPRESSURIZATION

Auxiliary ventilation inlet valves and exit valve are closed; the cabin superchargers are dumped and put on minimum flow; the cabin safety, relief and dump valve is open.



Aux vent. inlet valves and exit valve-- Completely OPEN

After depressurization, the auxiliary ventilation control knob is placed at position "A" so that the auxiliary ventilation system will be closed and will not partially pressurize the airplane. Partial pressurization could interfere with the opening of windows and doors.

F75-E-4-87

Figure 4-6

HEATING SYSTEM

NOTE

- FUEL IS SUPPLIED TO THE HEATERS FROM THE NO. 2 AND NO. 3 ENGINE FUEL PUMPS.
- ON SERIALS 52-3411 THRU 54-2308, FUEL IS SUPPLIED FROM FUEL TANKS 1 AND 4.
- ON SERIALS 51-3836 THRU 51-3841, 51-3843 THRU 51-3845 FUEL IS SUPPLIED FROM FUEL TANKS NO. 2 AND NO. 3.

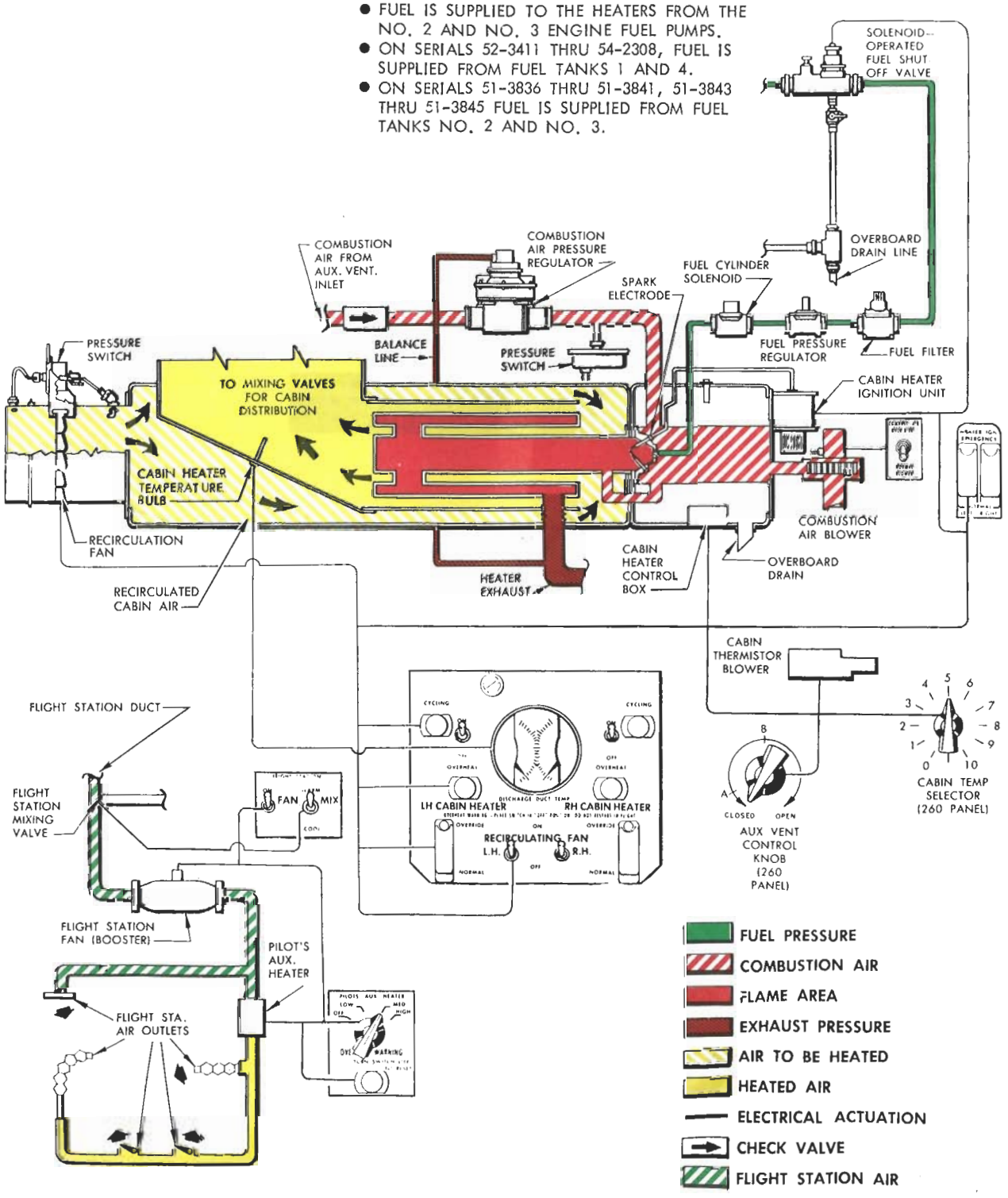


Figure 4-7

is a T-handle that, when pulled, releases the spring-loaded ditching valve located in the discharge manifold of each cabin air outflow valve. This prevents water from entering the fuselage through the outflow valves. These valves cannot be reset in flight.

CABIN HEATER CYCLING LIGHTS (LEFT AND RIGHT).

The cabin heater cycling lights (1, figure 4-4) flicker amber whenever cabin heaters are being operated.

CABIN HEATER DISCHARGE DUCT TEMPERATURE INDICATOR.

The discharge duct temperature indicator (2, figure 4-4) is a dual gage providing a continuous indication of cabin discharge air temperatures in degrees of centigrade.

CABIN HEATER OVERHEAT WARNING LIGHTS (LEFT AND RIGHT).

The cabin heater overheat warning lights (3, figure 4-4) glow red whenever the cabin heaters reach an unsafe temperature (180°C). When one of these lights glows, it also indicates that the cabin heater is in a locked-out (off) condition.

PILOTS' AUXILIARY HEATER OVERHEAT WARNING LIGHT.

The pilots' auxiliary heater warning light (33, figure 4-4) glows red whenever the pilots' auxiliary heater temperature exceeds a safe value. When this light glows, it also indicates that the heater is in a lock-out condition.

CABIN SUPERCHARGER DIFFERENTIAL AIR PRESSURE INDICATORS (LEFT AND RIGHT).

The direct reading cabin supercharger differential air pressure indicators (7, figure 4-4) provide a continuous indication of the pressure differential, in inches-of-mercury (absolute), existing between the inlet and outlet ducts of the cabin superchargers.

CABIN SUPERCHARGER OIL TEMPERATURE INDICATOR.

The cabin supercharger oil temperature indicator (29, figure 4-4) is a dual dc operated indicator providing the oil-in temperature of the cabin superchargers in degrees Centigrade.

CABIN SUPERCHARGER HIGH OIL TEMPERATURE WARNING LIGHTS (LEFT AND RIGHT).

The dc operated cabin supercharger high oil temperature warning lights (28, figure 4-4) glow red whenever the oil-in temperature exceeds a safe (107°C) value. When one of these lights glows, the associated cabin supercharger should be disconnected, if confirmed by reading on the temperature indicator.

HEAT EXCHANGER HYDRAULIC SYSTEM

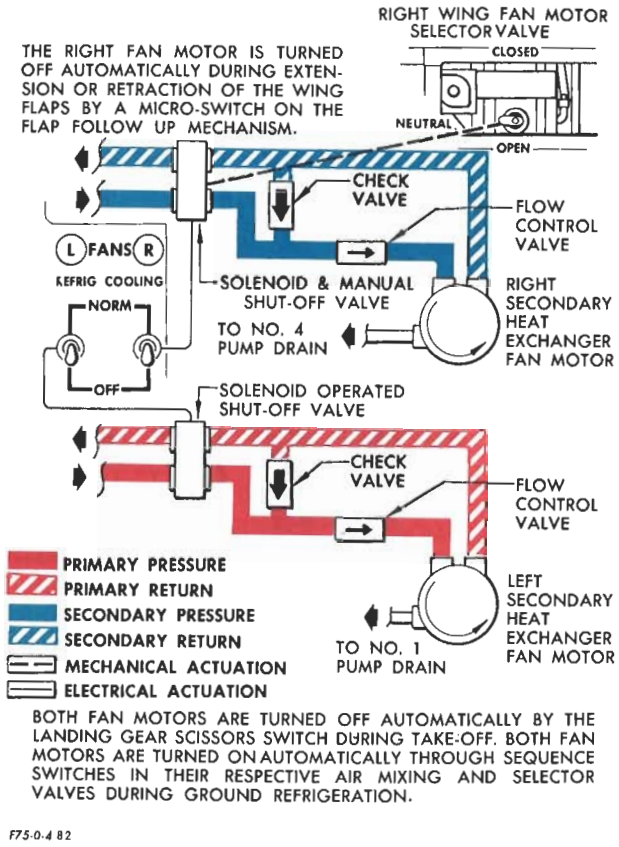


Figure 4-8

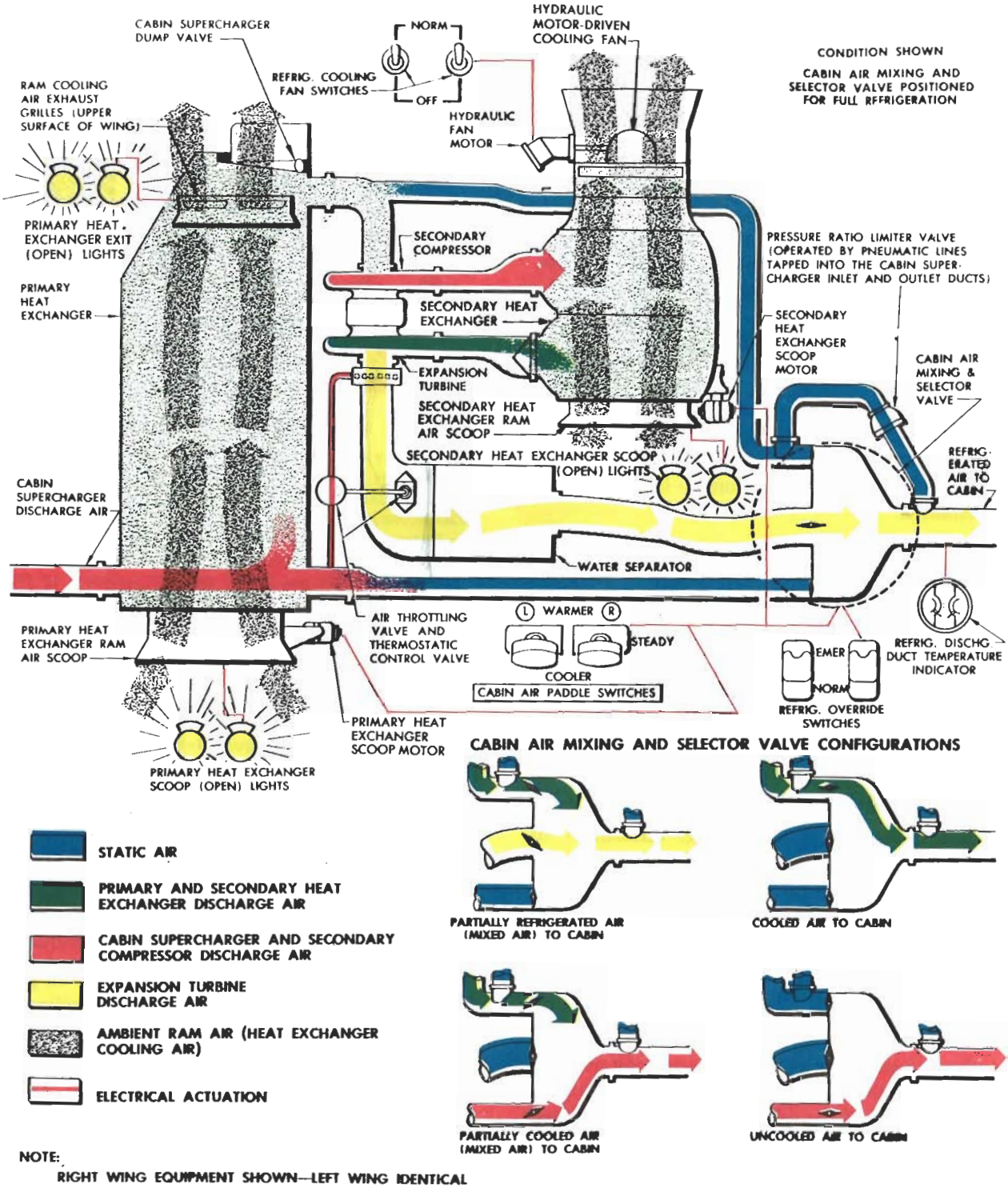
CABIN SUPERCHARGER OIL PRESSURE INDICATOR.

The 26 volts ac operated cabin supercharger oil pressure indicator (8, figure 4-4) is a dual gage providing a continuous indication of the cabin supercharger oil-in pressure in pounds per square inch.

CABIN SUPERCHARGER LOW OIL PRESSURE WARNING LIGHTS (LEFT AND RIGHT).

The dc operated cabin supercharger low oil pressure warning lights (6, figure 4-4) glow red whenever the oil pressure is below a safe value (35 ±5 psi). The affected cabin supercharger should be disconnected when the light glows and if confirmed by the oil pressure indicator.

CABIN AIR COOLING SYSTEM



NOTE:
RIGHT WING EQUIPMENT SHOWN—LEFT WING IDENTICAL

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Figure 4-9

CABIN DIFFERENTIAL PRESSURE INDICATOR.

The cabin differential pressure indicator (16, figure 4-4) provides a continuous indication, in inches-of-mercury, of the differential pressure between cabin and atmospheric pressure.

LOW CABIN PRESSURE WARNING LIGHT.

The low cabin pressure warning light (19, figure 4-4) glows red whenever the cabin altitude is 10,300 feet or above.

CABIN ALTITUDE INDICATOR.

The cabin altitude indicator (10, figure 4-4) provides a continuous indication of the equivalent cabin pressure altitude in feet.

CABIN VERTICAL VELOCITY INDICATOR.

The cabin vertical velocity indicator (12, figure 4-4) provides a continuous indication of changes in the cabin pressure. The cabin rate of ascent and descent is indicated in feet per minute.

ALTITUDE SELECTOR RESET INDICATOR LIGHT.

Refer to rate selector override switch under Air Conditioning Controls.

CABIN SUPERCHARGER DRIVE SHAFT REAR BEARING TEMPERATURE INDICATOR.

The cabin supercharger drive shaft rear bearing temperatures are sensed by dc electrical resistance-type bulbs connected to the rear bearing temperature indicator (15, figure 1-15) located in the flight engineer's lower instrument panel. This indicator is a dual gage.

CABIN AIR TEMPERATURE INDICATOR.

The dc operated cabin air temperature indicator (26, figure 4-4) provides a continuous indication of cabin air temperature. It is calibrated in degrees Centigrade.

REFRIGERATION DISCHARGE DUCT TEMPERATURE INDICATOR.

The dc operated refrigeration discharge duct temperature indicator (9, figure 4-4) is a dual gage providing a continuous indication of the inner wing duct air temperature downstream of the cabin air mixing and selector valve. This instrument indicates the duct temperature of refrigerated, cooled, or uncooled air to the cabin distribution system.

CAUTION

The water eliminator tubes may be damaged by freezing if duct temperature drops below 2°C. The refrigeration should be turned off if duct temperature cannot be maintained at 2°C or above.

DITCHING VALVE RELEASE HANDLE

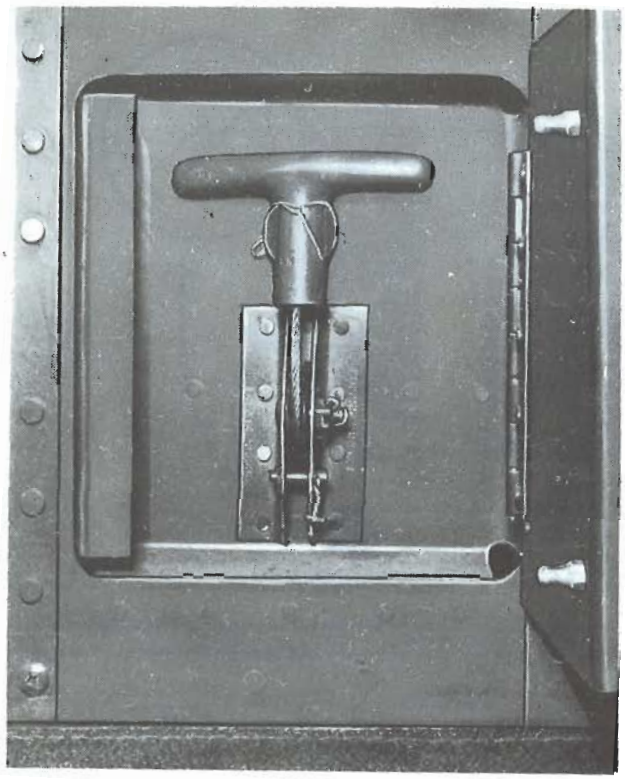

Figure 4-10

PRIMARY HEAT EXCHANGER SCOOP OPEN LIGHTS (LEFT AND RIGHT).

The primary heat exchanger scoop open lights (24, figure 4-4) glow amber whenever the scoops begin to open, thus enabling the operator to modulate the position of the scoop (during flight) from CLOSED to 66% open.

PRIMARY HEAT EXCHANGER EXIT OPEN LIGHTS (LEFT AND RIGHT).

The primary heat exchanger exit door lights (22, figure 4-4) glow amber whenever the exit doors are open. Inasmuch as the exit doors are indirectly connected to the primary heat exchanger scoops, the exit doors will not begin to open or the lights to come on until the primary scoops reach the OPEN position.

SECONDARY HEAT EXCHANGER SCOOP OPEN LIGHTS (LEFT AND RIGHT).

The secondary heat exchanger scoop open lights (20, figure 4-4) glow amber whenever the secondary heat exchanger scoops are in the full open position.

PRESSURIZATION CONTROL—AUTOMATIC TO MANUAL

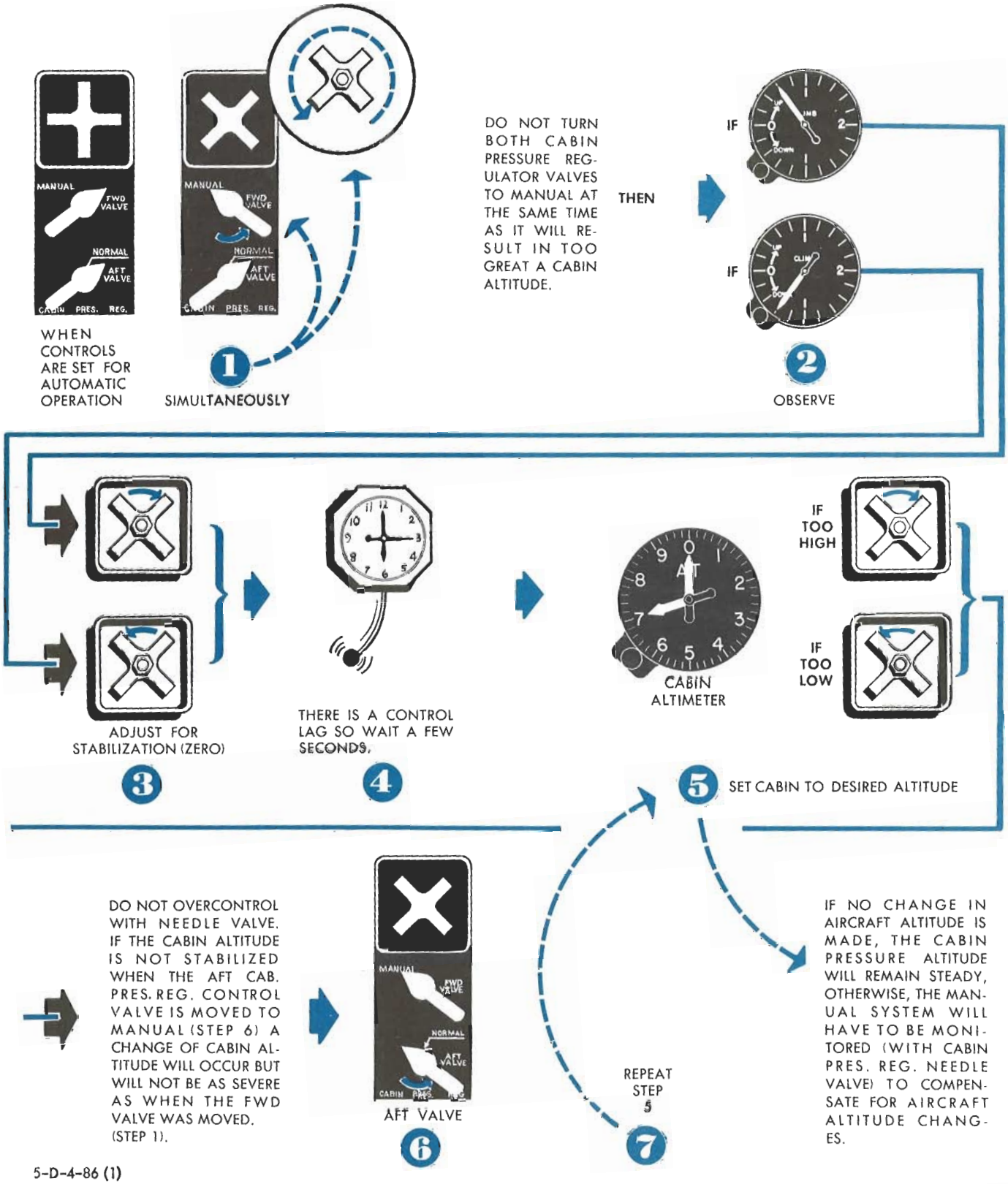

Figure 4-11 (Sheet 1 of 2)

PRESSURIZATION CONTROL—MANUAL TO AUTOMATIC

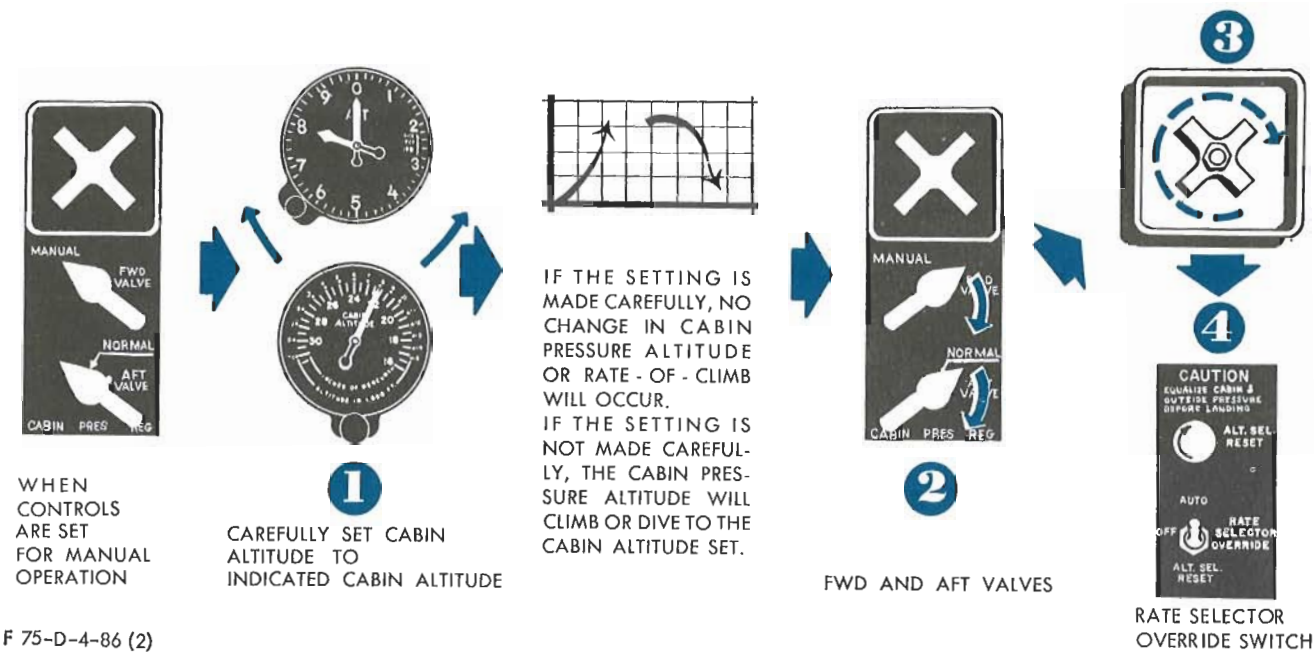

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Figure 4-11 (Sheet 2 of 2)

NORMAL OPERATING PROCEDURES.

Ground Truck Heating or Cooling.

The flight compartment and cabin areas may be heated or cooled on the ground without engines operating by performing the following steps:

1. Attach low-pressure truck to the ground-air connection.
2. Attach electrical ground power cart.
3. Recirculating fan switches—ON.
4. Aux. vent. control knob—POSITION A.
5. Cabin heater switches—OFF.
6. Flight station air outlets—OPEN.
7. Flight station fan switch—ON.
8. Flight station mixing valve—COOL.
9. If additional flight compartment heat is required:
   a. Pilots' aux. heater—Position to heat required.

Heating and Cooling During Ground Operation.

The flight compartment and cabin areas may be heated or cooled on the ground during engine operation by performing the following steps:

1. Recirculating fan switches—ON.
2. Flight station fan—As desired.
3. All windows and doors—Closed.

If ground heating is required:

1. Aux. vent. control knob—Position A.
2. Cabin air paddle switches—WARMER.
3. If additional heat is required:
   a. Cabin heater temperature selector—As required.
   b. Cabin heater switches—ON.
4. If additional flight compartment heat is required:
   a. Flight station mix valve—WARM.
   b. Flight station fan switch—ON.
   c. Pilots' aux. heater—Position to heat required.

If ground cooling or refrigeration is required:

Note

Before the engines are started, the superchargers are in low ratio. When the engines are started and supercharger oil pressure builds up,

they shift to high ratio. This occurs at approximately 900 rpm. As rpm is increased above 1400-1500 for engine run-up the superchargers will shift to low ratio. After run-up, the engine rpm must be reduced to approximately 900 in order for the superchargers to shift back to high ratio. In high ratio, approximately 1200 rpm will provide adequate ground refrigeration. If necessary during taxiing, idle inboard engines to prevent high taxi speed.

1. Altitude selector—Set 1000-1500 feet above field elevation.
2. Aux. vent. control knob—CLOSED.
3. Cabin air paddle switches—COOLER.
4. Flight station mixing valve—Position as required.

CAUTION

The refrigerator cooling fan switches must be in the NORMAL position during ground refrigeration.

Heating and Cooling During Flight.

The flight compartment and cabin areas may be heated or cooled during flight as follows:

1. Recirculating fan switches—ON.

If heating is required:

1. Cabin air paddle switches—WARMER.
2. Cabin temperature selector — Set to temperature required.
3. Cabin heater switches—ON.

If additional flight compartment heat is required:

1. Flight station mix valve—WARM.
2. Flight station fan switch—ON.
3. Pilots' aux. heater—Position to heat required.

If cooling or refrigeration is required:

1. Cabin air paddle switches—COOLER as required.

If additional flight compartment cooling is required:

1. Flight station fan switch—ON.
2. Flight station mix valve—COOL.

Note

If only partial refrigeration is required while using both superchargers, an increase of 1 to 3 knots can be realized if the desired cabin temperature is maintained with one supercharger.

Auxiliary Ventilation During Ground Operation.

The flight compartment and cabin areas may be ventilated on the ground during engine operation by performing the following steps:

1. Aux. vent. control knob—OPEN.
2. Aux. vent. exit valve switch—AUTO.
3. Altitude selector—Set to 1000-1500 feet above field elevation.
4. Rate-selector-override switch—AUTO.
5. Cabin pressure regulator valves—NORMAL.
6. Cabin pressure regulator needle valve—Closed.
7. Recirculating fan switches—ON.
8. Flight station fan—As required.
9. All windows and doors—Closed.

Auxiliary Ventilation During Flight.

The flight compartment and cabin areas may be ventilated during flight as follows:

1. Before takeoff.
   a. Recirculating fans—ON.
   b. Aux. vent. control knob—OPEN.
   c. Altitude selector—Set to 1000-1500 feet above field elevation.
2. During flight.
   a. Aux. vent. exit switch—OPEN.
   b. Aux. vent. control knob—As required to maintain adequate ventilation.
   c. Flight station mix valve—As desired.
   d. Flight station fans—ON.
3. Before landing.
   a. Aux. vent. exit valve switch—OPEN.
   b. Recirculating fan switches—OFF.
   c. Aux. vent. control knob—Position A.

Pressurization Control.

The flight compartment and cabin areas may be pressurized for flight operation by performing the following steps:

1. Before starting engines.
   a. Ground test switch—OFF (down).
   b. Cabin altimeter—Set 29.92" Hg and correlate with other aircraft altimeters.
   c. Cabin altitude selector—Set to 1000-1500 feet above field altitude.
   d. Rate selector override switch—ALT. SEL. RESET until cabin altitude selector reset light goes out, then move switch to AUTO position.

e. Aux. vent. control knob—Position A.

f. Aux. vent. exit valve switch—AUTO.

g. Cabin air paddle switches—As required.

h. Rate-of-change selector—300 feet per minute.

i. Cabin pressure regulator valves—NORMAL.

j. Cabin pressure regulator needle valve—1½ turns open.

2. During engine operation (before taxiing).

a. Recirculating fans switches—ON.

b. Flight station fan switch—ON.

c. All windows and doors—Closed.

d. Aux. vent. control knob—AS REQUIRED.

3. During climb.

a. Cabin altitude selector—During climb select desired cabin altitude.

4. Descent.

a. At the start of descent, reset cabin altitude selector to 1000-1500 feet above field altitude. Control rate-of-change as aircraft descends.

Note

If, during descent, it appears that the altitudes will not meet at approximately 1500 feet above the field, increase or decrease the cabin rate-of-change setting, as required.

5. Before landing.

a. Cabin heater switches—OFF.

b. Recirculating fan switches—OFF.

c. Aux. vent. control knob—Position A for propeller reversing.

d. Cabin heater paddle switches—WARM.

Note

Refer to paragraphs on heating, cooling and refrigeration for procedure to be followed to maintain required cabin and flight station temperatures.

EMERGENCY OPERATING PROCEDURES.

Cabin Heater Malfunction.

If the heater does not operate properly, as indicated by the cycling lights not glowing or by low cabin temperature, accomplish the following:

CAUTION

If cycling light glows but duct temperature does not increase, turn heater off.

1. Check the recirculating fans and circuit breakers. Be sure they are ON.

2. Turn the cabin temperature selector to a higher setting (toward 10). If heaters still do not cycle, place the emergency override switches on OVERRIDE.

3. Switch to alternate ignition points by placing the cabin heater emergency ignition switches on EMERGENCY.

4. Place combustion air blower on OVERRIDE.

5. Each cabin heater is protected by a Fenwal overheat switch. Should both the cycling controls fail or some other unit malfunction, causing the heater to overheat, the Fenwal switch will shut off the heater and electrically lock it off at an indicated temperature of approximately 180°C. Occasionally, under extreme conditions of air flow, a rapid rise of the combustion chamber temperature may also cause a heater to lock "off" with an indicated temperature that does not seem excessive.

6. To re-energize heater circuit, place heater switch to OFF position, then return switch to the ON position. If the Fenwal switch has cooled, the heater will start.

CAUTION

If the heater circuit locks OFF twice in succession, it should not be reset until the cause has been determined.

Pilots' Aux. Heater Inoperative.

When the pilots' aux. heater overheat warning light comes ON, the heater is in a lockout (off) condition. The heater may be reset:

1. Pilots' aux heater switch—OFF.

Note

Allow time for heater to cool.

2. Pilots' aux. heater switch—ON as required.

CAUTION

The face and foot air outlets should be partially or fully open to assure adequate air flow over the pilots' heater elements or the heater will lock-out again.

Emergency Depressurization.

(See figure 4-6.)

1. Place the aux. vent. control knob in the full OPEN position. Return the knob to position A as soon as the cabin differential pressure is one inch of mercury. The aux. vent. control knob must be returned to position A to prevent partial pressurization of the cabin by the auxiliary ventilation system, which is sufficient to interfere with the opening of windows and doors.

CAUTION

Electrical power must be available for emergency depressurization with the aux. vent. control knob.

2. Cabin heater switches—OFF.

3. Recirculating fan switches—OFF.

4. Pilots' aux. heater switch—OFF.

5. Flight station fan switch—OFF.

6. Descend to a low, safe altitude.

Pressurization With One Cabin Supercharger Inoperative.

In the event it becomes necessary to maintain cabin pressurization on one cabin supercharger, it should be understood that operation with cabin pressurized at full differential from the output of one cabin supercharger is marginal and is dependent upon the cabin differential required and the rate of leakage from the cabin through normal deterioration of seals with service use. Therefore, if operation with only one cabin supercharger connected, and full differential is required, it is recommended that the following steps be performed.

1. Galley venturi—Closed.

2. Radio rack venturi—Closed, if it is still impossible to maintain desired cabin pressure.

CAUTION

If difficulty is experienced in maintaining cabin pressure up to the maximum differential with both venturi tubes closed, descend to a cruising altitude where the cabin altitude can be maintained at 10,000 feet or less.

Cabin Supercharger Drive Shaft Disconnect.

CAUTION

If the cabin supercharger driveshaft bearing temperature starts rising rapidly and continues to rise beyond 125° C, the cabin supercharger should be disconnected before a temperature of 150° C is exceeded. If cabin supercharger fails to disconnect, reduce rpm to 1800 and repeat procedure.

1. Release hook-type lock on No. 1 and/or No. 4 engine supercharger control lever.

2. Move control lever past the LOW position to the end of its travel.

3. Return lever to desired engine supercharger position.

CAUTION

Do not make more than one shift from LOW to HIGH within a five minute interval or the engine may be damaged.

When the cabin supercharger drive shaft is completely disconnected, one or more of the following indications will be noted:

1. A drop in cabin supercharger oil temperature (this may require several minutes).

2. Oil pressure warning light, if not already on, will come on as soon as the drive shaft is disengaged from the engine.

3. No pressure differential on the dual pressure gage.

4. No oil pressure on the oil pressure indicator.

CAUTION

The propeller of the affected engine should be feathered immediately if the cabin supercharger does not disconnect.

ANTI-ICING, DEICING AND DEFOGGING SYSTEMS.

Anti-icing or deicing facilities are provided for the leading edges of the wing, empennage, radomes, windshield, carburetors, propellers, and pitot heads. Defogging facilities are provided for the four aft windshield panels and the cabin windows. The pilot's and copilot's forward windshield panels are equipped with wipers.

WING, EMPENNAGE AND RADOME DEICING SYSTEM.

Ice may be removed after it has formed on the leading edges of the wing, empennage and on EC-121D aircraft all external radomes by electronic-timed, pneumatic inflation and deflation of rubber boots cemented to those surfaces. Pressure and vacuum for the pneumatic system are supplied by four engine-driven air pumps. (See figure 4-12.)

Deicer Boots.

The deicer boots are made in segments designed for and firmly bonded to the leading edges of the wing, empennage and radomes. Each segment incorporates two separate systems of tubes with independent connections to their respective distributor valves except those segments attached to the tips of the stabilizer and to the fins, each of which has one system of cells. The boots are surfaced with a conductive coating to prevent the accumulation of static electricity, which when discharged, would interfere with radio reception.

Deicer System Pumps.

Four rotary, four-vane, positive displacement type, engine-driven air pumps, one mounted on each engine, supply air pressure and vacuum for the pneumatic deicer system. The two outboard pumps supply pressure; the two inboard pumps supply vacuum for normal operation, but can be used as pressure sources in an emergency. Air for the pneumatic system is drawn from the cabin supercharger air ducts, and cooling air for the pumps is drawn from the oil cooler scoop ahead of the radiator.

Suction Pumps.

The two inboard pumps supply suction for the deicer boot, the cabin pressure regulator valves, and the cabin pressure safety relief and dump valve. Normally, the output from the pressure side of the two pumps which supply vacuum is by-passed around the air regulator and filter, and is vented overboard. In an emergency, the vacuum pumps may be used as a source of pressure.

Pressure Pumps.

Pneumatic pressure from the two outboard pumps is directed through oil separators to pressure regulators and filters. Solenoid valves in the regulators maintain approximately 22 pounds per square inch at the outlet ports, discharging excess air overboard. Relief valves between the pumps and regulators protect the regulators from pressure surges of approximately 24 pounds per square inch or above. Check valves downstream from the oil separators prevent loss of system pressure in the event of failure of either pump. From the regulators, the compressed air passes to the main pressure line. Branches from the main pressure line extend to the distributor valves from which pressure is delivered to the deicer boot segments in metered pulsations.

Distributor Valves.

The solenoid-operated manifold deicer distributor valves deliver alternate pressure and vacuum to the deicer boot segments. Each valve has five ports; two inlets, two outlets, and one overboard vent. The outlet ports serve individual boot tube systems. Air pressure is supplied through one of the inlet ports and dumped through the overboard vent. Vacuum is applied through the other inlet port. When the solenoid is energized, air pressure flow through the outlet port to the associated boot segment. When the solenoid is deenergized pressure is relieved overboard until the pressure drops to approximately one inch of mercury, then four inches of mercury suction is applied through the vacuum port to evacuate the tubes and flatten the boot segment against the leading edge surface.

Deicer Boot Cycle Selector Switch.

The dc electronic timer is controlled by a 3-position switch (3, figure 4-13) located on the timer control panel, and is placarded EXTENDED CYCLE, NORMAL CYCLE, and OFF. When the switch is placed in either EXTENDED CYCLE or NORMAL CYCLE position, the system will warm up within 20 seconds, and the cycling lights will flash in sequence with the inflation-deflation cadence of the deicer boot segments. In NORMAL CYCLE position, the inflation cycle requires 90 seconds on the EC-121D, and 60 seconds on the TC-121C; in the EXTENDED CYCLE position, it requires 135 seconds on the EC-121D, and 90 seconds on the TC-121C. The selector switch may be turned OFF at any stage of cycling sequence, and a stepper relay will return the electronic timer to its starting position. The timer is designed for continuous duty in flight, and receives its power from the MJB positive bus.

EC-121D. PNEUMATIC DEICING SYSTEM

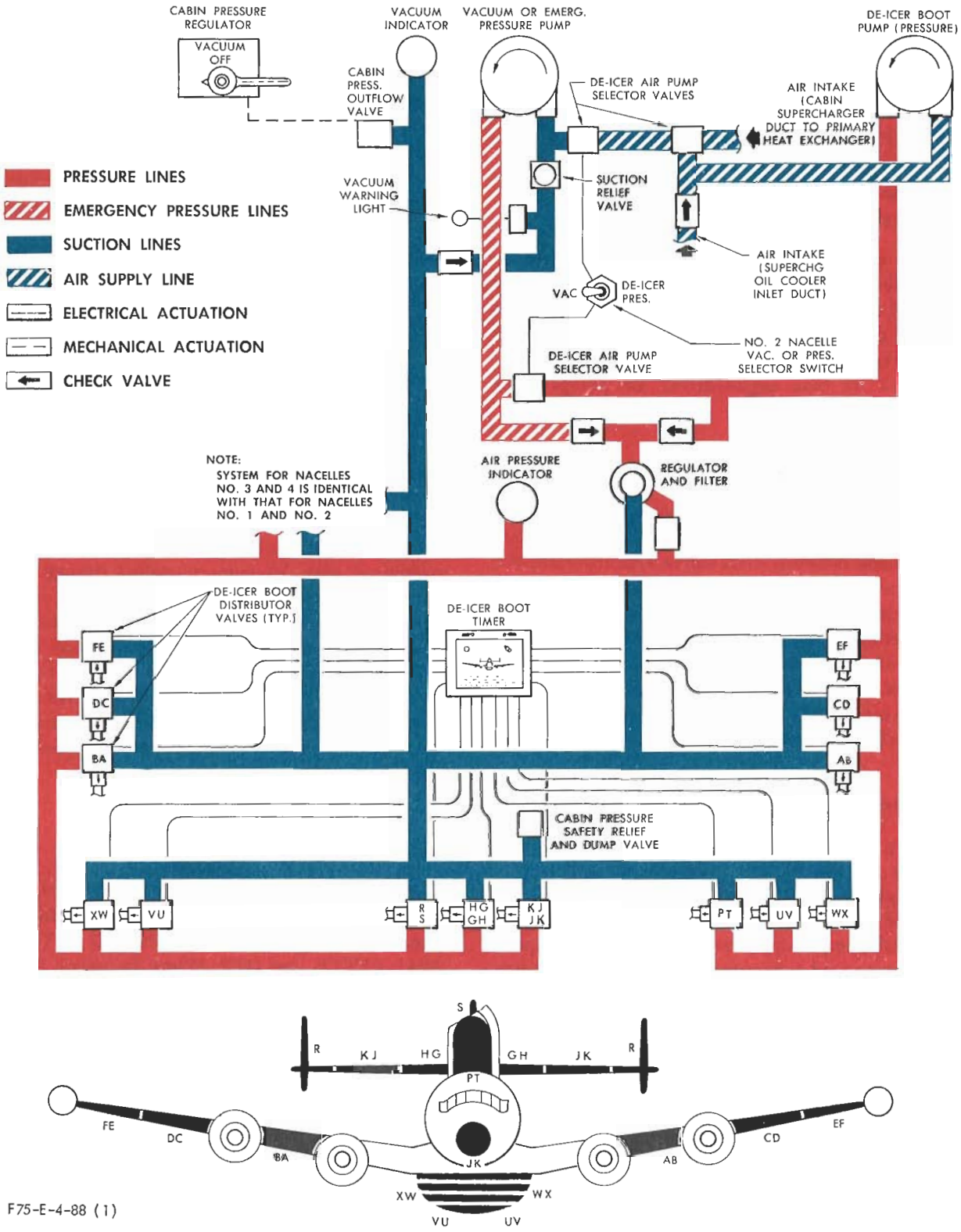

Figure 4-12 (Sheet 1 of 2)

TC-121C. PNEUMATIC DEICING SYSTEM

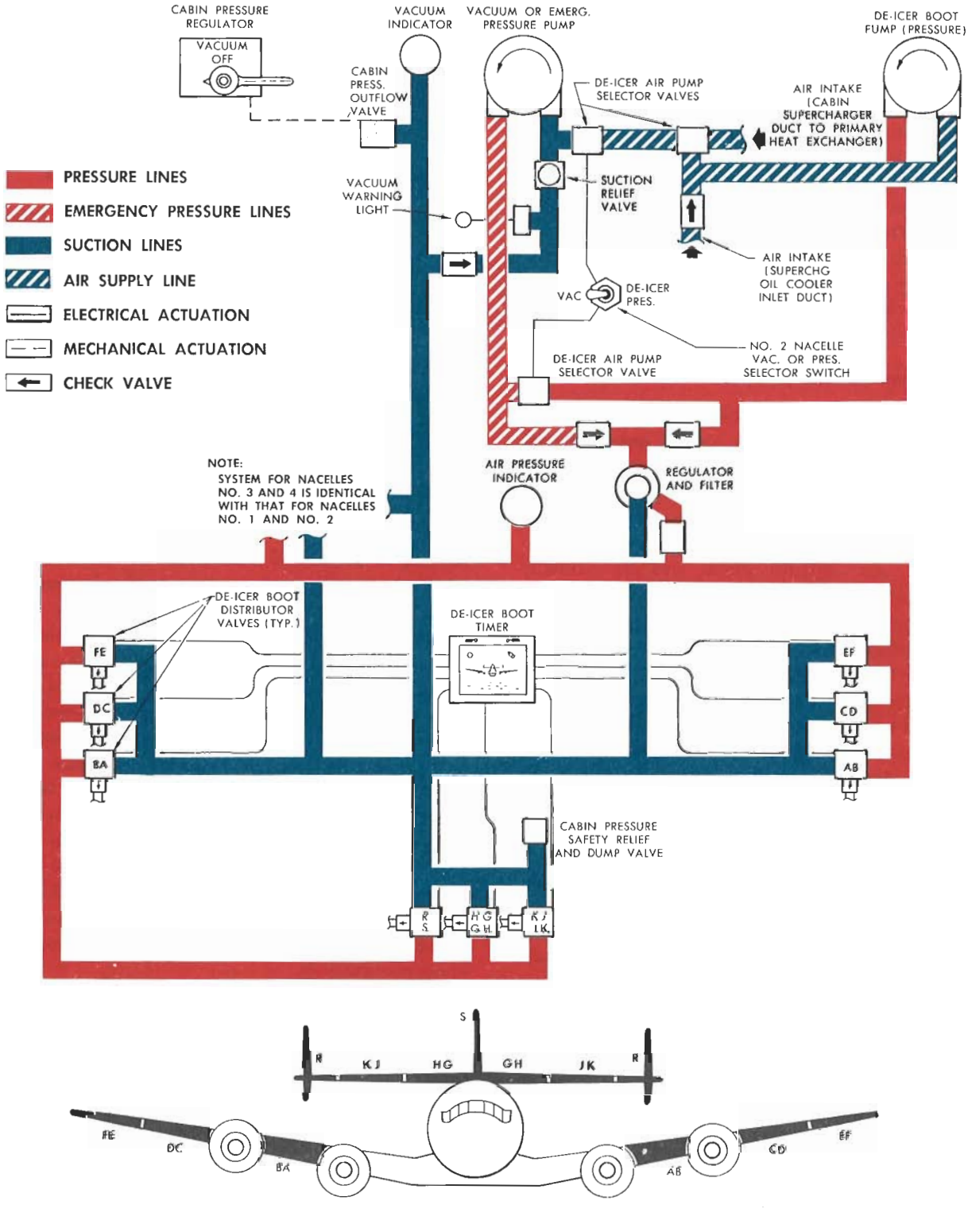

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Figure 4-12 (Sheet 2 of 2)

Deicer Boot Segment Switches and Cycling Lights.

Most of the aircraft have nine 3-position switches (5, figure 4-13), located on the control panel between the two rows of cycling lights which permit out-of-sequence inflation of any individual boot segment. These switches are placarded with the identification letters of the inflation tube groups they control. A schematic diagram etched on the face of the control panel shows the corresponding location of each tube group. When any individual switch is moved to either of its on positions, the adjacent cycling light will flash to show that the individual circuit is closed and the selected boot tube group is inflated. When more than one switch is closed, the one to the left will control, and until it is released, the switches to the right of it will be inoperative. Energizing the individual boot segment switches does not affect the cadence of the inflation-deflation cycle.

Deicer Air Pump Selector Switches.

Two 2-position toggle switches (4, figure 4-13), located forward of the electronic timer control panel, operate the deicer pump selector valves which permit the use of either or both of the vacuum pumps as sources of deicer boot pressure. The valves are positioned by electric motors mounted on the valves. The switches are placarded VAC. and DEICER PRES. and are normally positioned VAC. In this position, the valves dump the pressure output overboard. When the switches are positioned at DEICER PRES., air is vented to the vacuum line upstream from the pump, and the output is routed around the overboard dump into the deicer boot pressure system. In this switch position, the vacuum system is isolated from the pump. Either or both vacuum pumps may be used to supply deicer boot pressure.

Cabin Pressure Regulator Vacuum Shutoff Lever.

A cabin pressure regulator vacuum shutoff lever (4, figure 1-34) is located on the offset in the flight station floor behind the pilots' seat. This lever controls the valve that shuts off the suction to the cabin outflow valves. In the event the outflow valves solenoid malfunctions and holds the outflow valves open, the lever should be moved to the closed position.

Deicer Pressure Indicator.

One direct reading pressure gage (figure 1-7) is mounted on the pilot's auxiliary instrument panel. It registers the pressure in pounds per square inch available in the deicer pressure system.

Vacuum Indicator.

Adjacent to the deicer pressure gage (figure 1-7) is the vacuum gage which registers the vacuum in the system in inches of mercury.

Vacuum Warning Lights.

A warning light for each vacuum pump is located on the pilot's auxiliary panel (figure 1-7) above the deicer pressure gage and on the flight engineer's upper instrument panel (10, figure 1-16). They are energized by vacuum warning units in the vacuum lines upstream of the suction relief valves and glow whenever the vacuum drops below 4 inches of mercury.

Pneumatic Deicer Indicator and Cycling Lights.

When the deicer boot cycle selector switch is placed in either NORMAL or EXTENDED CYCLE position, a dc operated indicator light (1, figure 4-13) in the upper left corner of the timer control panel will glow. This light may be dimmed or brightened by turning its cover. The double bank of lights at the bottom of the control panel are the cycling lights which indicate the progress of the pressure vacuum cycle through the deicer boot segments.

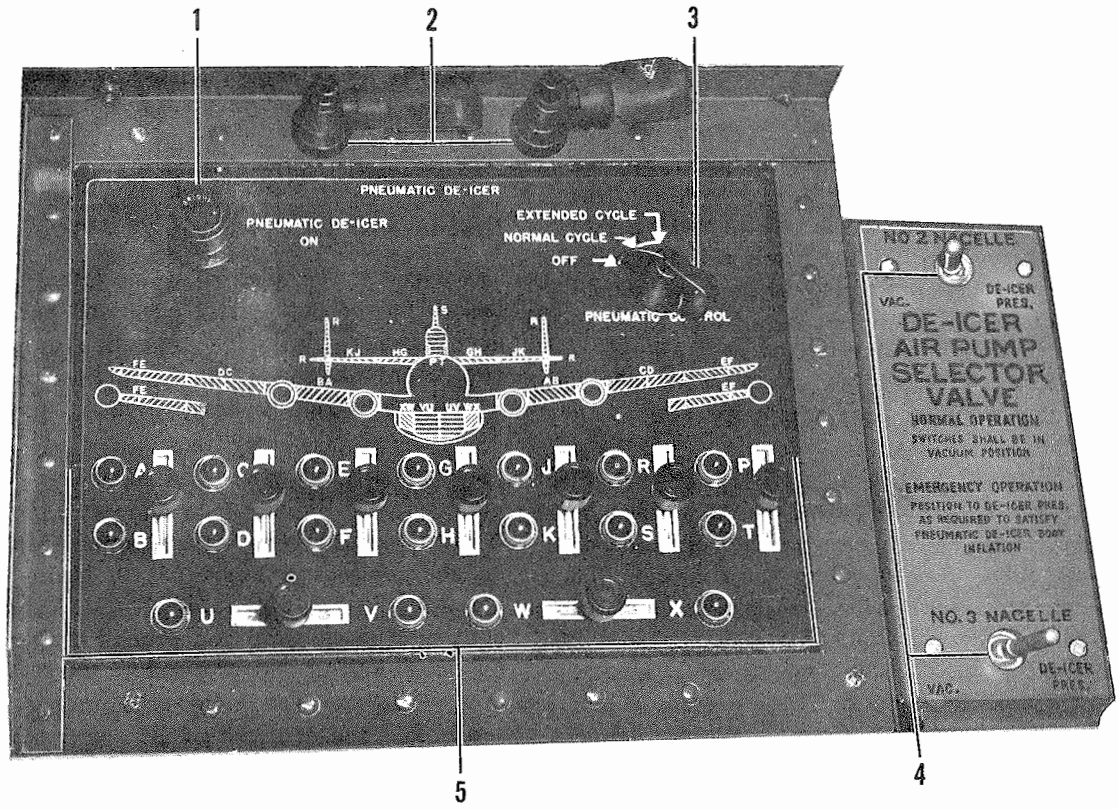
NORMAL OPERATING PROCEDURE FOR DEICER BOOTS.

Ice may be eliminated more effectively from the leading edges of the wing and empennage if it is permitted to build up to between ⅜ inch and ¾ inch in thickness before the deicer boots are turned on. A thin film of ice may be flexible, but when it thickens, the expansion and contraction of the boots will crack it and permit it to be blown off. When icing conditions are encountered, permit the ice to accumulate on the leading edges until it is between ⅜ inch and ¾ inch thick. Then place the system in operation by moving the deicer boot cycle selector switch to NORMAL CYCLE. Allow the boots to operate for one or at the most two cycles and then turn them off until ⅜ to ¾ inch of ice builds up again. The time between cycles will vary with the rate of build-up. More effective ice removal has been experienced by using this procedure and not operating the boots continuously.

CAUTION

- Air from the cabin superchargers is directed to the pressure pumps to lower the operating pressure ratio of the pumps. If continuous operation of the boots is necessary, cabin altitude must be maintained at or below 10,000 feet.
- Wing and empennage deicers must be turned OFF prior to landing.

TYPICAL DEICER BOOT TIMER



1. PNEUMATIC DE-ICER ON LIGHT
2. PANEL LIGHTS
3 DE-ICER BOOT CYCLE SELECTOR SWITCH
4. DE-ICER VACUUM PUMP SELECTOR VALVE SWITCHES
5. DE-ICER BOOT SEGMENT SWITCHES AND CYCLING LIGHTS

F75-D-4-89

Figure 4-13

EMERGENCY OPERATING PROCEDURES.

Deicer Pump Failure.

Te deicer air pump selector switches permit the use of either of the vacuum pumps as a pressure source if one of the pressure pumps fail. Deicing may be accomplished as follows:

1. Deicer air pump selector valve switches—No. 2 NACELLE—VAC. and No. 3 NACELLE—DEICER PRES.

Note

- The positions of the deicer air pump selector valve switches may be reversed at the discretion of the pilot.
- If both pressure pumps have failed and inadequate pressure is available with only one pump, switch both vacuum pumps from VAC. to DE-ICER PRES. Return to VAC. when need for pressure no longer exists, or when vacuum is required.

2. Deicer boot cycle selector switch (pneumatic control)—EXTENDED CYCLE.

Note

In the event of uneven icing, or in case ice fails to come off any boot segment, move the appropriate segment switch up or down as required.

ELECTRICAL WINDSHIELD ANTI-ICING SYSTEM (EC-121D).

The three center windshield panels can be warmed by electrically generated heat to prevent the formation of ice on the exterior surfaces. Current for heating the windshield glass is normally supplied by alternator power. A three-phase inverter driven by power from the main dc bus is installed as a source for auxiliary power in the event of alternator failure. Normal power provides adequate heat in the windshield panels to handle most conditions where anti-icing is required and to maintain the temperature of the vinyl layer within the range in which it possesses its maximum resistance to shattering due to impact. Normal power will also assist the defogging air system in keeping the inner windshield surfaces free of fog.

ELECTRICAL WINDSHIELD ANTI-ICING SYSTEM (TC-121C).

The three center windshield panels can be warmed by electrically generated heat to prevent the formation of ice on the exterior surfaces. Current for heating the windshield glass is supplied by a three-phase inverter driven by power from the main dc bus. Normal power provides adequate heat in the windshield panels to handle most conditions where anti-icing is required and to maintain the temperature of the vinyl layer within the range in which it possesses its maximum resistance to shattering due to impact. Normal power will also assist the defogging air system in keeping the inner windshield surfaces free of fog.

Panels.

The electrically heated panels are a laminated product consisting of a ¼ inch layer of vinyl plastic between two sheets of glass. The outside sheet is 3/16 inch thick; the inside sheet is ⅜ inch thick, and is structurally designed to contain maximum cabin differential pressure in the event of fracture or delamination of the outer sheet of glass. The inner surface of the outside layer of glass is coated with a transparent conductive coating which generates heat when electric current is passed through it. Bus bars, imbedded in the top and bottom of the panels, distribute electric current to the conductive coating. Thermistors, one imbedded in the vinyl layer of each panel, connected in parallel, control the application of power to the panels. The cycling of alternating current through the three windshield panels is accomplished by a wheatstone bridge control energized by direct current from the MJB bus. The resistance variation of the thermistors with temperature, provides the bridge unbalance necessary to produce the cycling action that automatically controls the temperature of the windshield panels.

Nesa Power Selector Switch (EC-121D).

The Nesa power selector switch (19, figure 1-29) is located on the MJB No. 2 panel and permits selection of either the ALTERNATOR or SPARE INVERTER as a power source for the electrically heated windshield anti-icing system.

Nesa Inverter Selector Switch (TC-121C).

The Nesa power selector switch (19, figure 1-29) is located on the MJB No. 2 panel and permits selection of the electronic inverter (up position) or spare inverter (down position) as a power source for the electrically heated windshield anti-icing system.

Nesa System Switch.

A three-position Nesa system power switch is located on the copilot's side panel (10, figure 1-10). It is placarded HIGH, OFF, and NORMAL; in the HIGH position a more rapid and greater temperature rise in the outer sheet of glass is possible. The NORMAL position is recommended for routine use in all conditions and provides 40% of the HIGH power output.

Nesa Reset Switch.

The spring-loaded, push-button Nesa reset switch, located near the Nesa system switch on the copilot's switch panel (13, figure 1-10), performs two functions. First, it permits restart of heating as soon as the thermistors cool as much as 3° C. Second, it initiates the start of cycling when the windshield is so cold (approximately −40° C, that high thermistor resistance prevents application of heating current.

Nesa System Power-On Light.

This light, located adjacent to the Nesa system switch (11, figure 1-10), is illuminated whenever power for the system is available.

Nesa Cycling Light.

The Nesa cycling light located adjacent to the system power-on-lights, glows whenever the conductive material in the windshield panels is energized and goes off when current to the panels is interrupted by the cycling circuit. In flight at low OAT, the cycling light stays on contin-

uously with NORMAL power. This indicates marginal ability of normal power to supply sufficient heat to start the cycling operation.

NORMAL OPERATING PROCEDURES.

The use of windshield heat is recommended at all times. The electric windshield heating system should be placed in operation as follows:

1. Nesa power switch—ALTERNATOR (up position).

Note

On TC-121C aircraft the electronic inverter switch must be on before power will be available in the up position.

2. Nesa system switch—NORMAL.

Note

If the Nesa cycling light does not come on, heating has not started because the thermistor is too cold. To initiate heating, maintain occasionally interrupted pressure on the reset switch until release of pressure does not cause the cycling light to go off.

HIGH POWER OPERATION.

It is recommended that HIGH power be used under the following conditions:

1. When ice begins to form on the windshield panels when using NORMAL power.

2. At 10,000 feet altitude, during descent into areas where birds are numerous.

3. When icing is anticipated at outside temperatures near the low end of the icing range $-25°$ C to $0°$ C.

4. At 10,000 feet altitude during descent into areas of high temperature—high humidity conditions.

Note

To maintain windshield heat for defogging in high temperature, high humidity conditions, maintain pressure on the Nesa reset switch until the cycling light comes on. This will raise the lower limit within $3°$ C of the upper limit.

5. A three minute warm up period in LOW is required prior to selecting HIGH.

CAUTION

If HIGH power is used without prior warming of the panels with NORMAL power, the resultant thermal shock may cause local delamination of the outer layer of glass from the vinyl plastic core or in the cracking of the outer layer of glass. If visibility is not impaired, cracking of the outer layer of glass is not an emergency condition, since the inner layer is structurally capable of containing the maximum cabin pressure differential.

EMERGENCY OPERATING PROCEDURES.

In the event of failure of the normal Nesa power proceed as follows:

1. Nesa power switch—SPARE INVERTER.

CAUTION

In the event of sparking or arcing in the electric windshield panels leave, or change, the power setting to NORMAL. Make only such changes in operation of the aircraft as are required by reduced vision through the damaged panel.

ALCOHOL DEICING SYSTEMS.

The alcohol deicing systems provide the means for removing ice from the carburetors, and propellers. With the exception of the alcohol tanks, the systems are independent. (Refer to figure 4-14.)

Tanks.

One 20-gallon alcohol tank is mounted in the aft end of each outboard engine nacelle. The filler wells are located in the upper surface of the wing and are equipped with drains leading overboard. The carburetors and propellers are supplied from the tank located on their respective sides of the aircraft.

Pumps.

Three dc electrically driven deicing pumps are mounted in each outboard engine nacelle. One pump in each nacelle delivers alcohol to both propellers on its side of the aircraft. The inboard and outboard carburetors on each side of the aircraft are individually supplied by the other two pumps in each nacelle. The pumps are similar except for their rated delivery capacities.

Each of the two pumps serving the propellers delivers a minimum of 5 gallons per hour (2.5 gallons per propeller) in the full INCREASE position, and each of the four pumps serving the carburetors is capable of delivering a maximum of 26 gallons per hour at 51 pounds per square inch.

Alcohol Tank Fluid Quantity Indicator.

Each alcohol tank is equipped with a dc electrically operated Liquidometer-type, fluid quantity transmitter which registers alcohol quantity in gallons on a dual indicator mounted on the flight engineer's upper instrument panel (2, figure 1-16).

CARBURETOR ALCOHOL DEICING SYSTEM.

Alcohol may be used to dislodge ice after it has formed in the carburetors. The carburetor alcohol deicing system delivers alcohol to the carburetors through three dual outlets in each throat, each positioned to provide adequate coverage of the critical carburetor icing area. Provisions are made to add alcohol to the fuel line upstream of the carburetor.

Carburetor Deicing Switches.

The four carburetor deicing system alcohol pumps are individually controlled by four 3-position switches (figure 1-29) spring-loaded to the OFF position. In the up position, placarded INDUCTION AIR, alcohol is pumped directly into the carburetor throat. In the down position, placarded FUEL INLET SCREEN, alcohol is pumped into the fuel line upstream of the carburetor. These switches are mounted on the MJB No. 2 switch panel.

NORMAL OPERATING PROCEDURES.

When alcohol injection is necessary to combat carburetor icing, momentary application (from 3 to 5 seconds) is usually sufficient. If more alcohol is necessary to control heavy or continued icing, it should be injected intermittently. Refer to Section VII, Carburetor Icing, for further discussion of this procedure.

1. Close the appropriate switch or switches momentarily, and release.

2. Repeat, if necessary, until engine power is stabilized.

CAUTION

Operate these switches in FUEL INLET SCREEN position only when the engines are operating and mixtures are in AUTO RICH. Improper operation may damage the carburetor diaphragms.

PROPELLER ALCOHOL DEICING SYSTEM.

One of the two outlets of each propeller deicing pump supplies the outboard propeller, and the other supplies the inboard propeller. Alcohol is delivered by the pumps to the propeller slinger rings. Centrifugal force propels the alcohol to the outside of the slinger ring and through feeder tubes to the grooved boots mounted on the leading edges of the propeller blades. The regulator check valve in the alcohol line prevents the alcohol from escaping except when the pumps are operating.

Propeller Deicing Switches.

The regulator check valves and the alcohol pumps are controlled by two rheostat switches (figure 1-29) located on the MJB No. 2 switch panel. One switch controls alcohol delivery to the two left propellers, the other controls delivery to the two right propellers. The switches are labeled OFF, ON and, at the extreme clockwise limit of the arc, INCREASE. The ON position energizes the pumps; the positions clockwise from ON control the delivery rate of the alcohol.

NORMAL OPERATING PROCEDURES.

To start the propeller alcohol deicing system:

1. Turn propeller deicer thermostats clockwise to full INCREASE, then back to the position which will give the desired delivery rate.

2. Increase or decrease the alcohol delivery rate as may be required by icing conditions.

3. To stop the propeller deicing system, turn the rheostat switches counterclockwise to OFF.

PITOT HEAD DEICING SYSTEM.

Electrically energized resistance elements mounted inside the two pitot heads provide heat to prevent the accumulation of moisture or the formation of ice in the impact tubes. The heating elements operate from the dc electrical system and are energized, as required, through the pitot heat switches.

Pitot Head Switches and Indicator Lights.

A two-position toggle switch (4, 7, figure 1-10) for each pitot heater is mounted on the copilot's side panel. These two switches are placarded LEFT or RIGHT, and OFF. The heaters are dc energized when the switches are in the up position. Two indicator lights (5, 6, figure 1-10), mounted between the switches, glow when the pitot heaters are energized and operating normally. The lights will go out if an open circuit occurs. Pitot heaters should be turned on during taxi to allow sufficient time for them to reach operating temperature before takeoff.

ALCOHOL DEICING SYSTEM

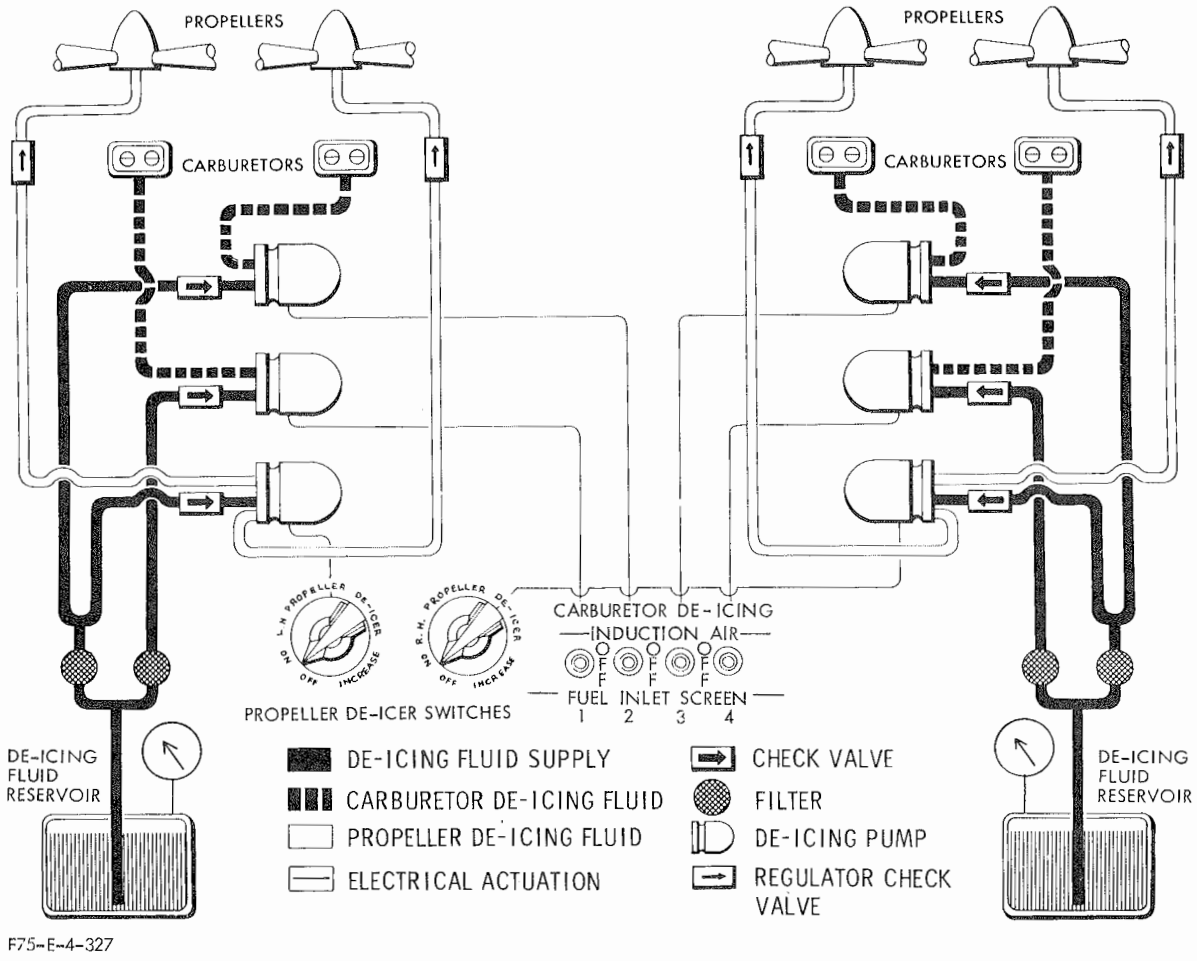


Figure 4-14

Note

Under severe icing conditions ice may bridge over the pitot heads on those aircraft not incorporating the higher capacity heaters. This will result in an erroneous or no airspeed indication.

CAUTION

Pitot heaters must be turned OFF when the aircraft is on the ground to avoid burning ground personnel and to prevent damage to the pitot heads when covered.

WINDOW DEFOGGING SYSTEM.

The two aft windshield panels on each side of the flight station, which are not Nesa glass, are equipped with distributor manifolds (figure 4-15) through which heated air may be directed against the inner surface of the panels to prevent fogging. A dc electrically energized heater-blower assembly, mounted forward of the pilot's instrument panels, supplies warm air for the system. The heater is protected by a special low-melting alloy link which will open the relay circuit if the heater becomes overheated. In addition, the heater circuit is protected by a push-to-reset circuit breaker on the MJB No. 3 circuit breaker panel. The blower circuit is protected by a push-pull circuit breaker. The circuit is

WINDSHIELD ANTI-ICING AND DEFOGGING

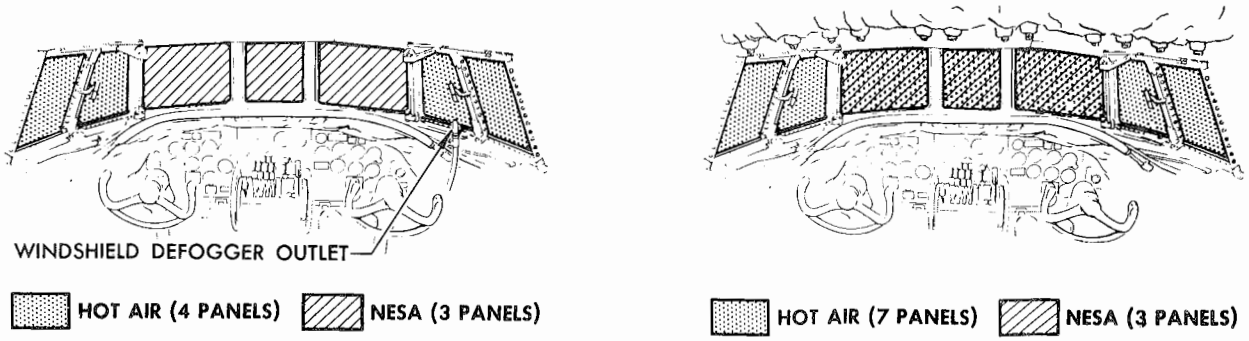


Figure 4-15

designed so that the heater will function only when the blower is operating. However, the blower may be operated without the heater. The space between the inner and outer panes of the cabin windows is ventilated by warm air from the air conditioning system of the aircraft to prevent fogging and icing. Operation is automatic, and air circulates between the double window panes whenever the air conditioning system is operating. On USAF serials 52-3425 and subsequent, an overhead ducting is provided to supply heated air for all windshield panels from two 28 volt dc operated heater assemblies, one located behind the flight engineer's upper switch panel and one on the left hand side wall ceiling.

Windshield Defogger Blower Switch.

A three-position toggle switch on the copilot's switch panel (9, figure 1-10) controls the dc blower and arms the heater circuit so that the heater may be turned on if required. The blower switch is placarded HIGH, OFF, and LOW.

Windshield Defogger Heater Switch.

A two-position, HEAT and OFF, windshield defogging heater switch (8, figure 1-10) is located on the copilot's side panel.

Windshield Spot Defogger.

For spot defogging of any windshield areas, a flexible hose has been provided which can be attached to the pilot's foot or face air duct outlets, and warm air from the air conditioning system of the aircraft can be directed against the windshield. When not in use, the hose is coiled and stowed in a canvas sling attached to the flight station canopy.

NORMAL OPERATING PROCEDURES.

When fogging occurs on the windshield panels, place the system in operation as follows:

1. To start, move the blower switch to HIGH or LOW, as required.

2. If heat is necessary, move the heater switch to HEAT.

3. When defogging is no longer necessary, heater switch—OFF. After 30 seconds, blower switch—OFF.

CAUTION

Leave the windshield defogging blower switch on at least 30 seconds after turning off heater switch or residual heat in the heater may open the heater fusible links.

COMMUNICATIONS AND ASSOCIATED ELECTRONIC SYSTEM (EC-121D).

See TO 1C-121(E)D-1S-7 (as revised) for additional

Note

The following text will refer to certain stations, positions, switch labeling and crew members in nomenclature other than that placarded. The following comparison list will indicate the altered terminology.

Combat Information Center (CIC)	Airborne Operations Center (AOC)
Combat Information Center Officer (CICO)	Senior Weapons Controller (SWC)
Assistant Combat Information Center Officer (ACICO)	Duty Weapons Controller (DWC)
Radar Operator	Radar Technician
Air Control Officer (ACO) Talker	Search Radar Operator (SRO) Scanner Recorder
Plotter Poster	Plotter Teller-Dualex

Communication and electronic equipment consists of radio and interphone equipment that provides aircraft to aircraft communication, aircraft to ground communication, interphone communication between flight crew members and AOC crew members, navigation equipment for guidance and blind landings, and various specialized functions in connection with radar sets for search and identification operations in connection with the aircraft's function as an AOC aircraft. This is in addition to other electronic equipment such as automatic pilot, electronic fuel gage timers, etc., which are described in other sections of this manual. Equipment described is grouped in broad classifications of power distribution system, antenna, intercommunication, navigational, radar search, identification, and other specialized equipment. A functional breakdown of the equipment in the aircraft is listed in the Table of Communications and Associated Electronic Equipment (figure 4-16) and operation of the primary controls is listed in the FLIGHT CREW and AOC CREW Electronic Facilities Table (figure 4-17, 4-18).

AOC EQUIPMENT COOLING SYSTEM (EC-121D).

The AOC equipment cooling system consists of two separate ducting systems and two 28-volt powered blowers. The forward system draws heated air from under the shrouds surrounding the equipment at the radio operator's station, navigator's station, radar technician's station and the senior weapon controller's station. The aft system draws the heated air from inside of the AN/APA-56 consoles at the five search radar operators' stations and at the height finder's station. The heated air from both systems is ducted into the under floor area for cooling.

AOC Equipment Cooling System Switch and Blower Warning Lights.

The switch for operating the AOC equipment cooling system is located at the radar technician's station (figure 4-34) and is placarded ON-OFF. Two blower inoperative warning lights are installed adjacent to this switch. The forward warning light is labeled EQUIP RACKS and will illuminate when the forward blower becomes inoperative. The aft warning light is labeled APA-56 CONSOLES and will illuminate when the aft blower becomes inoperative.

WARNING

If either blower inoperative warning light illuminates the affected equipment should be monitored to avoid overheating.

POWER DISTRIBUTION SYSTEM (EC-121D).

Power for communications and other electronics equipment is obtained from the 28-volt dc bus, three fixed-frequency 115-volt, 3-phase, 400-cycle inverter systems which feed their respective ac buses and two variable-frequency 115-volt, 3-phase 380-1000 cycle ac generators which feed two 3-phase ac buses. The fixed-frequency inverters are installed for electronic equipment having 390 to 410 cycle ac requirements. The No. 1 and No. 2 instrument inverters are used as individual main inverters and share a common spare inverter. The electronic inverter has a separate spare inverter. Change over for the three inverters to their respective spare inverter is automatic or may be accomplished manually. The variable-frequency ac generators are installed on an engine driven gearbox in each outboard nacelle and supply ac power to either or both ac buses. Direct and alternate current power is supplied to the radio and associated equipment through circuit breakers on the radio operator's circuit breaker panel. The direct current bus in the radio operator's circuit breaker panel is supplied through two 130 amp current limiters at the main direct current bus in the forward lower compartment. Direct and alternating current power is supplied to the AEW Radar and associated equipment through circuit breakers on the radar technician's primary power panel. Direct current power is supplied to the radar technician direct current bus through one 150 amp current limiter at the main direct current bus. On aircraft with split dc bus modification, a 150 amp circuit breaker is installed on the electronic bus to supply dc power to the radar technician's primary power panel. Circuit breakers for the electronic

EC-121D. TABLE OF COMMUNICATIONS AND ASSOCIATED ELECTRONICS EQUIPMENT

Type	*Designation*	*Function*	*Range*	*Location of Controls*
COMMUNICATIONS				
Flight crew interphone system	AN/AIC-10	Inter-crew communication, audio distribution, microphone function	Crew stations within aircraft and mechanics' stations	Pilot's, copilot's, radio operator's, navigator's, engineer's stations. Forward and aft baggage compartment, galley, jumpmaster station, lower center compartment and lower radome, and tail cone bulkhead.
AOC crew interphone system	LOCKHEED	Intercommunication between AOC crew stations separate from flt. crew ICS	AOC crew stations within aircraft	Each AOC station.
Public address system	LAC	All crew stations	Crew stations within the aircraft	SWC and pilot.
VHF transceiver	VHF-101	Short range two-way voice communications	Line of sight	SRO No. 2
UHF transmitter-receiver	AN/ARC-27	Short-range, two-way voice communication	Line of sight	Pilot's, radio operator's, SRO No. 1 thru No. 5 stations
UHF transmitter-receiver	AN/ARC-85	Short-range, two-way voice communication	Line of sight	SRO No. 2 and No. 3
HF liaison receiver	AN/ARR-15A	Reception of voice, CW or MCW communication	1,000 miles	Radio operator's station
HF liaison transmitter/receiver	618 S-1 or 618 T-1	Voice, CW transmission	250 to 2,000 miles	Radio operator's station
HF command transmitter/receiver	618 S-1 or 618-T	Voice, CW transmission	250 to 2,000 miles	Pilot's station
Emergency trans.	AN/CRT-3	Emerg. CW and MCW transmission on 500 and 8364 kcs.	100-1500 miles	
Navigation receiver	AN/ARN-14A	Reception of VOR, VAR and localizer signals	Line of sight	Pilot's station

Figure 4-16 (Sheet 1 of 3)

EC-121D. TABLE OF COMMUNICATIONS AND ASSOCIATED ELECTRONICS EQUIPMENT

Type	*Designation*	*Function*	*Range*	*Location of Controls*
NAVIGATION				
TACAN	AN/ARN-21	Reception of VOR signals, gives bearings and distances information	195 nautical miles	Pilots' station
Loran receiver	AN/APN-70	Reception of long-range radio navigation signals	Day—700 miles Night—1400 miles	Navigator's station
Radar Altimeter	AN/APN-22	Indicates altitude above terrain	10,000 feet over land 20,000 feet over water	Pilots' and navigator's stations
Radar Altimeter (High Alt)	SCR-718D	Indicates altitude above terrain	40,000 feet	Navigator's station
Marker beacon receiver	AN/ARN-12	Reception of location marker and marker beacon signals		Pilots' station
Radio Compass	AN/ARN-6	Reception of voice or code signals for direction finding and bearings	300 miles	Pilots' and navigator's stations
Glide Slope Receiver	AN/ARN-18	Reception of glide slope signals from ILS stations	Line of sight	Pilots' station
UHF Direction Finder	AN/ARA-25	Reception of UHF signals for direction finding and homing	Line of sight	Pilots' station
Navigation Radar	AN/APS-42	Navigation aid, anti-collision warning and search	200 miles	Pilots' station
AOC SPECIALIZED EQUIPMENT				
Identification Set	AN/APX-25	Reception and transmission of identification signals	Line of sight	Radio operator's station

Figure 4-16 (Sheet 2 of 3)

EC-121D. TABLE OF COMMUNICATIONS AND ASSOCIATED ELECTRONICS EQUIPMENT

Type	*Designation*	*Function*	*Range*	*Location of Controls*
AOC SPECIALIZED EQUIPMENT (Continued)				
Coder	KY-95 and coder group control C-1128	Provides coded IFF transmissions	Line of sight	Radio operator's station and fwd. radio rack
Recognition Set	AN/APX-7 or AN/APX-49	Transmits interrogations and receives identification signals	Line of sight	SWC station, radar tech, navigator and all SRO and camera PPI stations
Ground Position Indicator	AN/APA-57C	Gives continuous indication of aircraft's ground position		Navigator's station
Search Radar	AN/APS-95	High power, long-range search radar		Radar technician's station
Height Finding Radar	AN/APS-45 or AN/APS-103	Obtains alt. of targets detected		Height finder's station and SRO No. 1—No. 5
Control Indicator	AN/APA-159	PPI, video information		SRO No. 1 thru No. 5 stations
Camera Scope	IP-230	Recording camera indicator		AOC area (aft of nav.)
Recording Camera	O-15	Photograph indicator display		DWC

Figure 4-16 (Sheet 3 of 3)

inverters and the radar vent blower motors are also located on the electronic bus. The radar technician's primary power panel contains two switch type circuit breakers that supply dc power to the AOC interphone system and phase C variable frequency alternating current power to the radio operator's circuit breaker panel, from the alternating current generators, respectively. Fixed-frequency alternating current power, from the instrument inverters, is supplied to the radio operator's circuit breaker panel and the radar technician's primary power panel through fuses in the instrument inverter fuse panels, in the forward lower compartment. Fixed frequency alternating current power, from the electronic inverters, is supplied directly to the fixed-frequency circuit breakers on the radar technician's primary power panel, from the electronic inverters in the forward lower compartment. Three-phase variable frequency alternating current power is supplied to the radar technician's primary power panel from the two three-phase variable frequency alternating current generator buses. The buses are located directly forward of the radar technician's primary power panel.

AC Power Selector Switch.

This is a five-position rotary-type switch that is located on the radar technician's ac power panel (15, figure 4-35). It is placarded as follows: OFF, EXT, NORM, L and R. the switch is used to select a source of ac power which can be either one, or both, of the engine-driven ac generators or an external power cart (200/115-v,

EC-121D. FLIGHT CREW ELECTRONICS FACILITIES TABLE

	PRIMARY* CONTROL				TRANSMITTING FACILITIES				RECEIVING FACILITIES				INDICATORS			
	PILOT	COPILOT	RADIO OP.	NAVIGATOR	PILOT	COPILOT	FLT. ENGR.	RADIO OP. NAVIGATOR	PILOT	COPILOT	FLT. ENGR.	RADIO OP. NAVIGATOR	PILOT	COPILOT	NAVIGATOR	RADIO OP.
AN/APX-25 SIF			x													
AN/APX-7 IFF																
AN/APS-95 Search Radar															x	
AN/APA-57C Grd. Pos. Indicator				x											x	
AN/ARN-6 ADF Receiver	x	x		x					x	x		x x	x	x	x	
618-S Command	x	x			x	x	x	x x	x	x	x	x x				
618-S (Liaison) or 618-T			x		x	x	x	x x	x	x	x	x x				
AN/ARR-15A			x						x	x		x x				
AN/ARC-27 UHF #6 (Pilots)	x	x			x	x	x		x	x	x					
AN/ARC-27 UHF #7 (Relay)			x		x	x	x	x x	x	x	x	x x				
AN/ARC-27 UHF #8 (Relay)			x		x	x	x	x x	x	x	x	x x				
AN/ARN-12 Marker Beacon									x	x		x x	x	x		
AN/APN-22 Radar Altimeter	x			x									x			x
AN/APN-70 Loran Receiver				x											x	
AN/AIC-10 Flt. Crew ICS: H-78 Mic. Hdst. Boom					x	x	x	x x	x	x	x	x x				
C-826 Control Panel									x	x		x x				
C-824 Control Panel					x	x	x	x x	x	x	x	x x				
F-90 Range Filter									x	x		x				
M-34 H.H. Microphone					x	x		x x								
C-823 Control																
LS-184 Loud Speaker									x	x		x x				
AN/ARN-18 Glide Slope Recr.	x	x											x	x		
AN/ARN-14A VOR Receiver	x	x							x	x		x x	x	x	x	
AN/ARN-21 TACAN	x	x							x	x			x	x	x	
P. A. System	x	x			x	x			x	x	x	x x				
AN/ARA-25 Direction Finder	x												x			

x Indicates one facility is provided.

* Includes tuning, frequency selection, on/off, etc.

Figure 4-17

EC-121D. AOC CREW ELECTRONICS FACILITIES TABLE

	PRIMARY* CONTROL								TRANSMITTING FACILITIES (No Freq. Sel.)											RECEIVING FACILITIES (No Freq. Sel.)										
	SWC	RADAR TECH.	DWC	SRO #2	SRO #3	SRO #4	SRO #5	HT. FINDER OP.	POSTER	SWC	DWC	SRO #2	SRO #3	SRO #4	SRO #5	POSTER	PLOTTER	SCANNER-RECORDER (TALKER)	RADAR TECH.	SCANNER-RECORDER (TALKER)	SWC	DWC	SRO #2	SRO #3	SRO #4	SRO #5	POSTER	RADAR TECH.	PLOTTER
AN/APS-95 Radar		x																	x			†	†	†	†	†			
AN/APS-45 Ht. Finder or AN/APX-103								x														†	†	†	†	†			
AN/APX-7 IFF or AN/APX-49		x										x	x	x	x	x			x			x	†	†	†	†	†			x
618S-1 Command										x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
618S-1 or 618T Liaison										x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
AN/ARR-15A Liaison																				x	x	x	x	x	x	x	x	x	x	x
AN/ARC-27 or AN/ARC-85 UHF #1		x								x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
AN/ARC-27 or AN/ARC-85 UHF #2			x							x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
AN/ARC-27 UHF #3				x						x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
AN/ARC-27 UHF #4					x					x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
AN/ARC-27 UHF #5						x				x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x

x Indicates one facility is provided.

* Includes tuning, frequency selection, on/off, etc.

† Via APA-56 System.

Figure 4-18 (Sheet 1 of 2)

EC-121D. AOC CREW ELECTRONICS FACILITIES TABLE (Cont'd)

	PRIMARY* CONTROL		TRANSMITTING FACILITIES (No Freq. Sel.)											RECEIVING FACILITIES (No Freq. Sel.)										
	SWC POSTER	SRO #2	SWC	DWC	SRO #2	SRO #3	SRO #4	SRO #5	POSTER	HT. FINDER OP.	PLOTTER	SCANNER-RECORDER (TALKER)	RADAR TECH.	SCANNER-RECORDER (TALKER)	SWC	DWC	SRO #2	SRO #3	SRO #4	SRO #5	TELLER	HT. FINDER OP.	PLOTTER	RADAR TECH.
AOC ICS System:																								
ICS Control Panel			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H-78 or H-46 Headset and boom mic assembly			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
LAC P.A. System	x		x	x										x	x	x	x	x	x	x	x	x	x	x
C-824 Control Panel (No audio or interphone facilities)	x																							
VHF-101		x			x												x							

x Indicates one facility is provided.

* Includes tuning, frequency selection, on/off, etc.

Figure 4-18 (Sheet 2 of 2)

400 cps). When the switch is in the EXT position, the external power source is connected to the aircraft's variable-frequency ac busses. With this switch in the NORM position the left alternator supplies ac power to the search radar and the right alternator supplies ac power to the height finder and APA-56 system. The L and R positions are used only when one or the other alternator becomes inoperative.

External Cart AC Power Selector Switch.

This is a three-position toggle switch that is located on the radar technician's ac power panel (16, figure 4-35). It is placarded as follows: INVERTER, CART and RESET CART. The switch provides a means of bypassing the aircraft's inverters when the aircraft is on the ground and an external source of ac power is used. This circuit arrangement precludes unnecessary operation of the inverters during ground checks of aircraft equipment

and/or electrical systems. The switch is spring-loaded to the CART (center) position from the RESET CART position. After an external source of ac power is connected to the external receptacle, the inverters are bypassed and the external power source connected to the aircraft's circuits when the switch is held momentarily in the RESET CART position and released (provided the ac power selector switch also is in the EXT position). The RESET CART position also is used to reset external power if failure of this source is experienced and the circuit has automatically reverted to the inverters. The INVERTER position is used to connect the aircraft's inverters to the ac busses; this is the normal, in-flight position of the switch.

Note

The inverter selector switches must each be in the MAIN position if the circuits normally supplied by the inverters are to be supplied by the external power source. The bypass circuit breakers on the radar technician's panel must be closed.

AC Power Indicator Lights.

Four ac power indicator lights are located on the radar technician's ac power panel (17 thru 20, figure 4-35) and are placarded as follows: LOW FREQUENCY, HIGH FREQUENCY, PHASE REVERSAL and EXTERNAL POWER ON. If the LOW FREQUENCY or the HIGH FREQUENCY or the PHASE REVERSE light glows, incompatible external power is indicated and the system is on inverter power. Illumination of the EXTERNAL POWER ON light indicates that the external source of power is connected to the ship's circuits.

VOLTAGE REGULATION (EC-121D).

Variable frequency voltage regulation is provided and frequency-sensing relays automatically deenergize the buses when the frequency of the output voltage drops below 380 cycles per second. Additional protection for the variable-frequency system is provided by overvoltage and fault protection relays. Direct current voltage regulation is supplied by a carbon pile type voltage regulator for each direct current generator, located beneath the floor at the flight station.

EXTERNAL POWER RECEPTACLE (EC-121D).

The external ac power receptacle circuit is protected against frequencies below 380 cycles and against reverse phase-sequences by means of low-frequency and phase-sensing relays.

JUNCTION BOXES (EC-121D).

These boxes are defined as follows: Forward radio junction box, main radio junction box, radio operator's auxiliary junction box, CIC interphone junction box, main radar junction box and APA-56 junction box, and external power.

Forward Radio Junction Box.

The forward radio junction box contains the IFF IP relay, two relays and two capacitors for use with automatic approach equipment, emergency ICS-PA relay, CICO call relay, pilots ICS disconnect relay, VOR relay, signal attenuating resistors for use with the VOR, ADF, and C-1 equipment, audio resistor panel, ICS switch, instrument fuses for VOR, ADF, ARA-25 and ARN-21 and VOR test receptacle. This box is located on the flight deck, left side behind pilot.

Main Radio Junction Box.

The main radio junction box contains two 618S-1 radio noise filters, an HF muting relay, three ARC-27 radio noise filters and two signal attenuating resistors used with the ID-250/ARN indicators. This box also contains the ac and dc circuit breakers for the radio and interphone equipment and is located under the radio operator's table on the aft side of the main radio rack. Extending aft along the aisle side of the table is the box containing the radio equipment circuit breakers. This box is connected to the main radio junction box and is similarly identified. The circuit breaker panel is on the aft side of this box. This circuit breaker panel is supplemented with the radio operator's auxiliary junction box, which contains circuit breakers for the IFS, teletype, ARN-21 and APS-42. This panel is located to left of the radio operator's position against the bulkhead.

Main Radar Junction Box.

The main radar junction box is located directly behind the radar technician's primary power panel.

CIC Interphone Junction Box.

The CIC interphone junction box contains the emergency ICS relays, CICO flight crew call override relay, APS-45 magnetron blower relay, dynamotor switch-type circuit

breakers, pilot's emergency ICS switch-type circuit breaker and the top-mounted fuse panel containing the fuses in the individual AOC interphone circuits. This box is located adjacent to the plotters station.

AN/APA-56 Junction Box.

The APA-56 junction box provides common connections for heading information to the APA-159 indicator system. This box is located underneath the Senior Weapons Controller's table.

RADIO HEAT EXHAUST DUCT SYSTEM (EC-121D).

The heat generated by the electronic equipment in the forward radio rack is exhausted through a venturi in the skin of the fuselage, outboard of the rack.

Radio Heat Exhaust Button.

Exhausting is controlled by a pull-type button, containing a center-mounted, push-type release mechanism, mounted on the second shelf of the forward radio rack (figure 4-20). This button is connected by a sheathed wire to a bell crank which actuates a butterfly valve in the throat of the venturi.

ANTENNA SYSTEM (EC-121D).

The antenna system is installed as shown on figure 4-29.

INTERCOMMUNICATION SYSTEMS (EC-121D).

Two separate interphone systems and a public address system are installed in the aircraft. The two interphone systems are designated as FLIGHT CREW and the AOC CREW. The flight crew interphone system also includes service and radio facilities with the flight crew and mechanics' stations connected by a conventional push-to-talk system with call facilities. The flight crew interphone system receives and distributes audio signals for each of the stations connected to the system. The AOC crew interphone system is separate from the flight crew interphone system and basically provides separate channel communication between any two AOC crew stations. Any AOC crew member may signal any other AOC crew member, and a AOC crew member may accept or reject, at his option, any call from any station. The only signal which all AOC stations are forced to accept is pilot's transmission when the public address system is used for emergency announcements by the pilot. The public address system(LAC)is controlled by the SWC with emergency override provision for the pilot.

FLIGHT CREW INTERCOMMUNICATION SYSTEM AN/AIC-10 (EC-121D).

This equipment provides voice and signal communication at all altitudes. It incorporates four facilities: intercommunication within the aircraft; communication beyond the aircraft by means of radio equipment; monitoring of received radio signals, including simultaneous monitoring of a number of radio receivers; a call facility for use in establishing communication between stations of the aircraft intercom system. Intercommunication stations are provided at the following locations: pilot, copilot, navigator, radio operator and flight engineer. The mechanics' interphone stations comprise the forward lower compartment, the inboard engine nacelles, nose gear compartment, aft external power receptacle (on aircraft with split dc bus only), galley, lower center compartment, lower radome, aft crew compartment and tail cone. Each station includes a J-16 jack box. The mechanics' station circuits are wired through external terminal strips so that all circuits to these stations may be disconnected from the system by throwing a toggle switch located on the forward radio junction box, directly behind the pilot's station. However, the two mechanics' stations located in the galley and aft crew compartments cannot be disconnected. Primary power for operating this equipment is supplied from the main dc bus through the main radio junction box at 28 volts. The system is powered when the dc bus is energized.

RADIO SELECTOR BOXES (EC-121D).

(See figure 1-9.)

The selector boxes provide a means of selecting the audio output of any one of several receivers and interphone communications, and a means of connecting the microphone to a desired transmitter.

Selector Box Control Panel C-824.

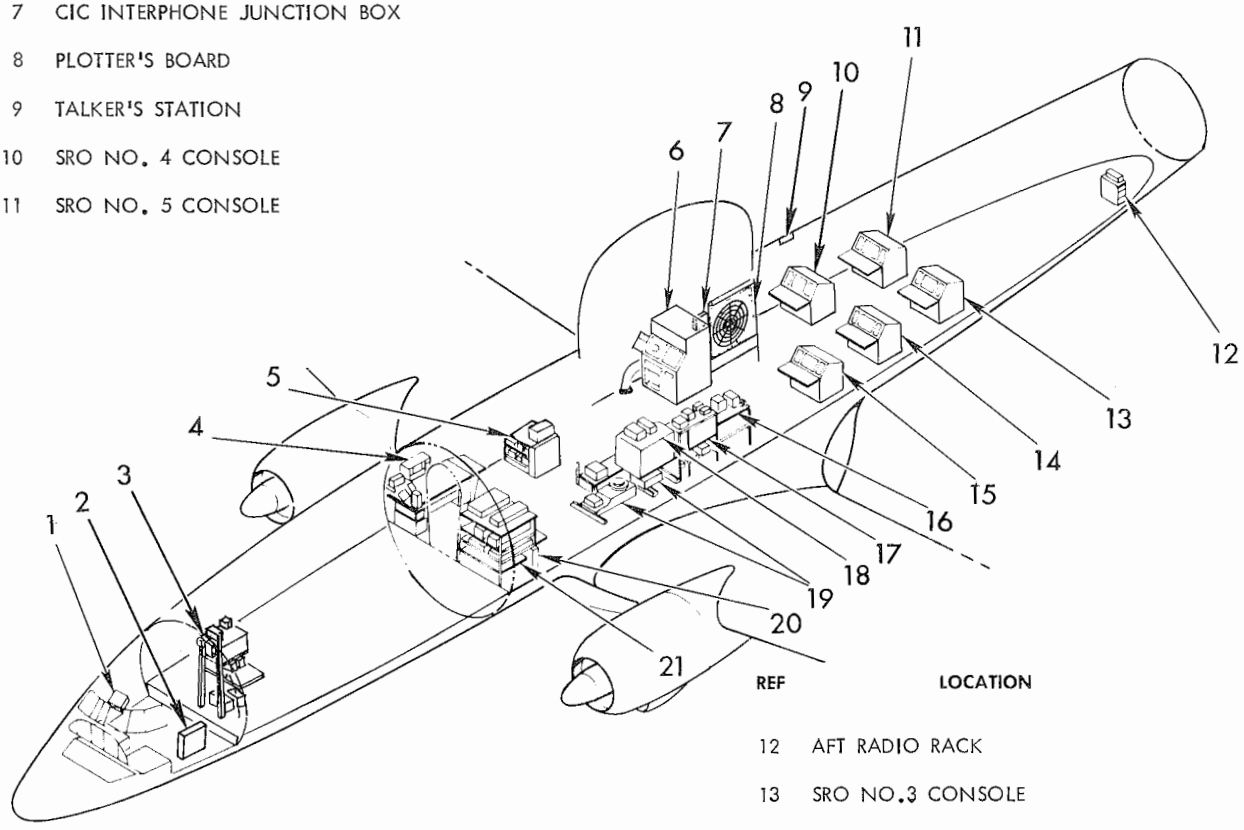
The pilot, copilot, navigator, radio operator, and flight engineer stations are equipped with this control panel.

Channel Selector Switch.

This switch is located at the lower center of the panel and is a rotary type switch. The switch provides six possible positions which control the mode of transmission and reception. The CALL position is used to alert any or all stations in the intercommunications system except the pilot. The microphone selector switch is spring-loaded to rotate to INTER position from the CALL position when the switch is released. The INTER

EC-121D. ELECTRONICS EQUIPMENT LOCATIONS

REF	LOCATION
1	PILOT'S OVERHEAD RADIO CONTROL PANEL
2	FORWARD RADIO JUNCTION BOX
3	FORWARD RADIO RACK
4	NAVIGATOR'S RADIO RACK
5	AN/APA-56 AND SEARCH RADAR EQUIPMENT RACK
6	HEIGHT FINDER CONSOLE
7	CIC INTERPHONE JUNCTION BOX
8	PLOTTER'S BOARD
9	TALKER'S STATION
10	SRO NO. 4 CONSOLE
11	SRO NO. 5 CONSOLE



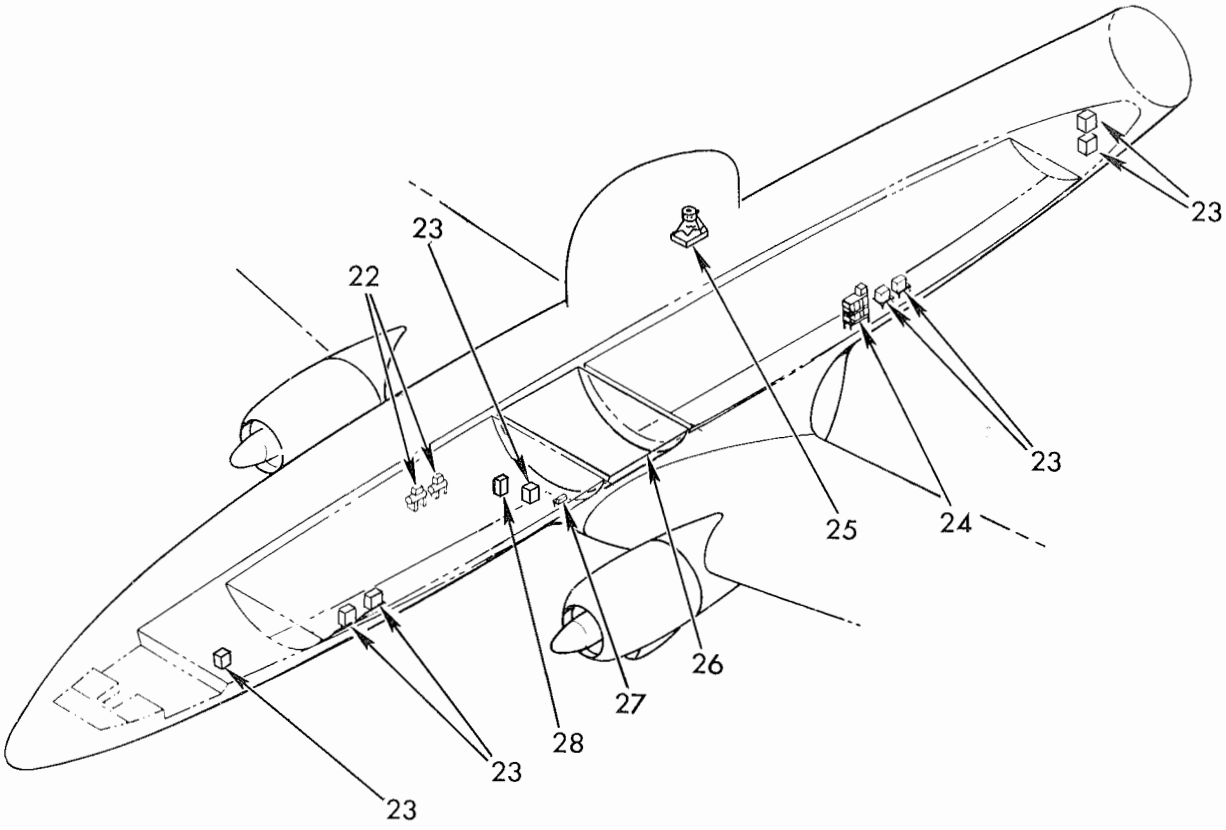
REF	LOCATION
12	AFT RADIO RACK
13	SRO NO.3 CONSOLE
14	SRO NO. 2 CONSOLE
15	SRO NO. 1 CONSOLE
16	SENIOR WEAPONS CONTROLLER EQUIPMENT RACK
17	RADAR TECHNICIAN EQUIPMENT RACK
18	AC GENERATOR CONTROL EQUIPMENT
19	SEARCH RADAR EQUIPMENT
20	RADIO OPERATOR'S JUNCTION BOX
21	RADIO OPERATOR'S EQUIPMENT RACK

F75-F-4-103(1)

Figure 4-19 (Sheet 1 of 2)

EC-121D. ELECTRONICS EQUIPMENT LOCATIONS

	REF	LOCATION
(cont)	22	ELECTRONIC INVERTERS (2)
	23	AN/ARC-27 UHF RADIO SETS
	24	AOC INTERPHONE AMPLIFIERS
	25	CGRS GYRO PLATFORM

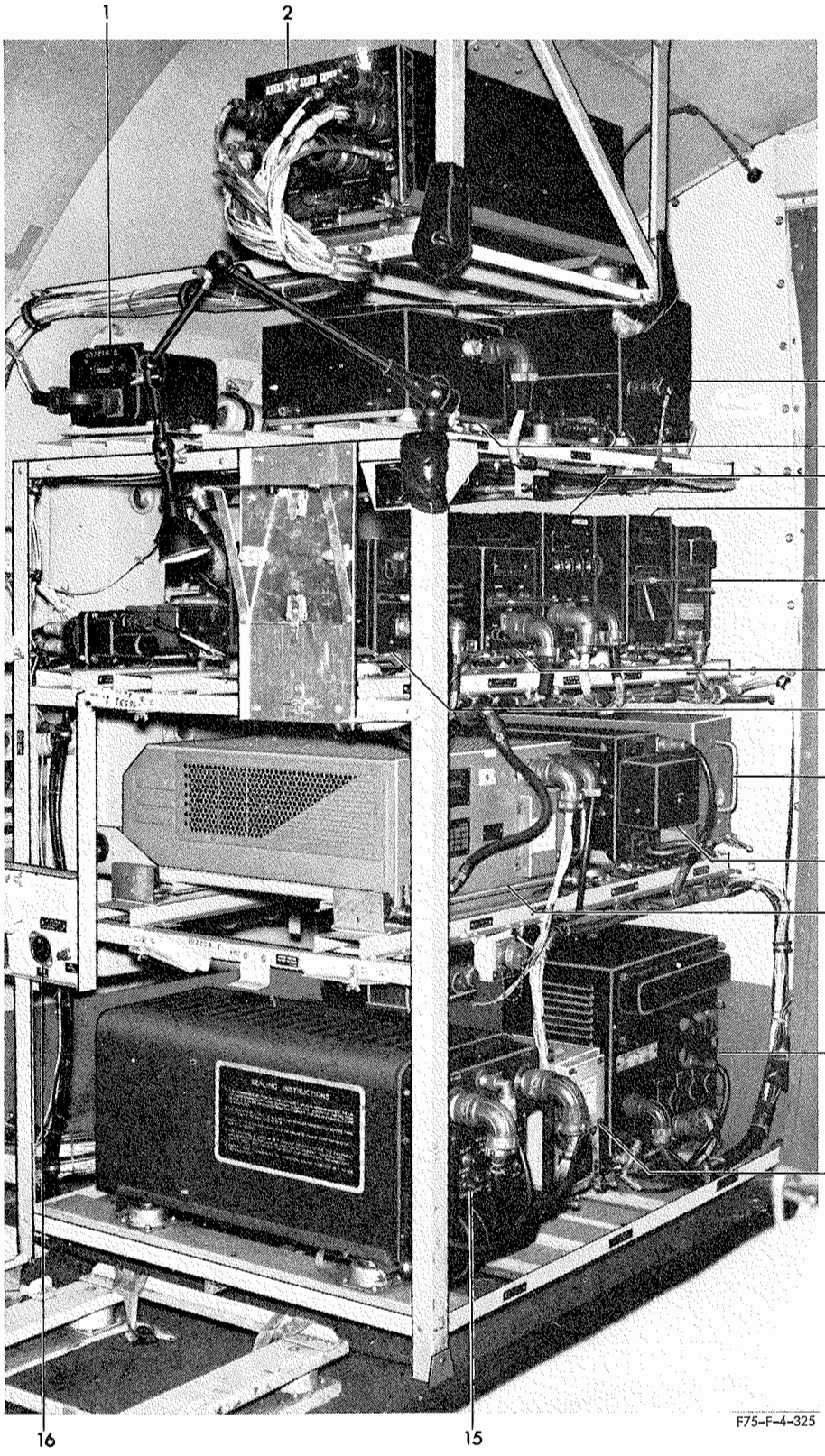


REF	LOCATION
26	ELECTRONIC EQUIPMENT COMPARTMENT
27	SEARCH RADAR TRANSMITTER COOLING EQUIPMENT
28	DC EXTERNAL POWER JUNCTION BOX

F75-F-4-103(2)

Figure 4-19 (Sheet 2 of 2)

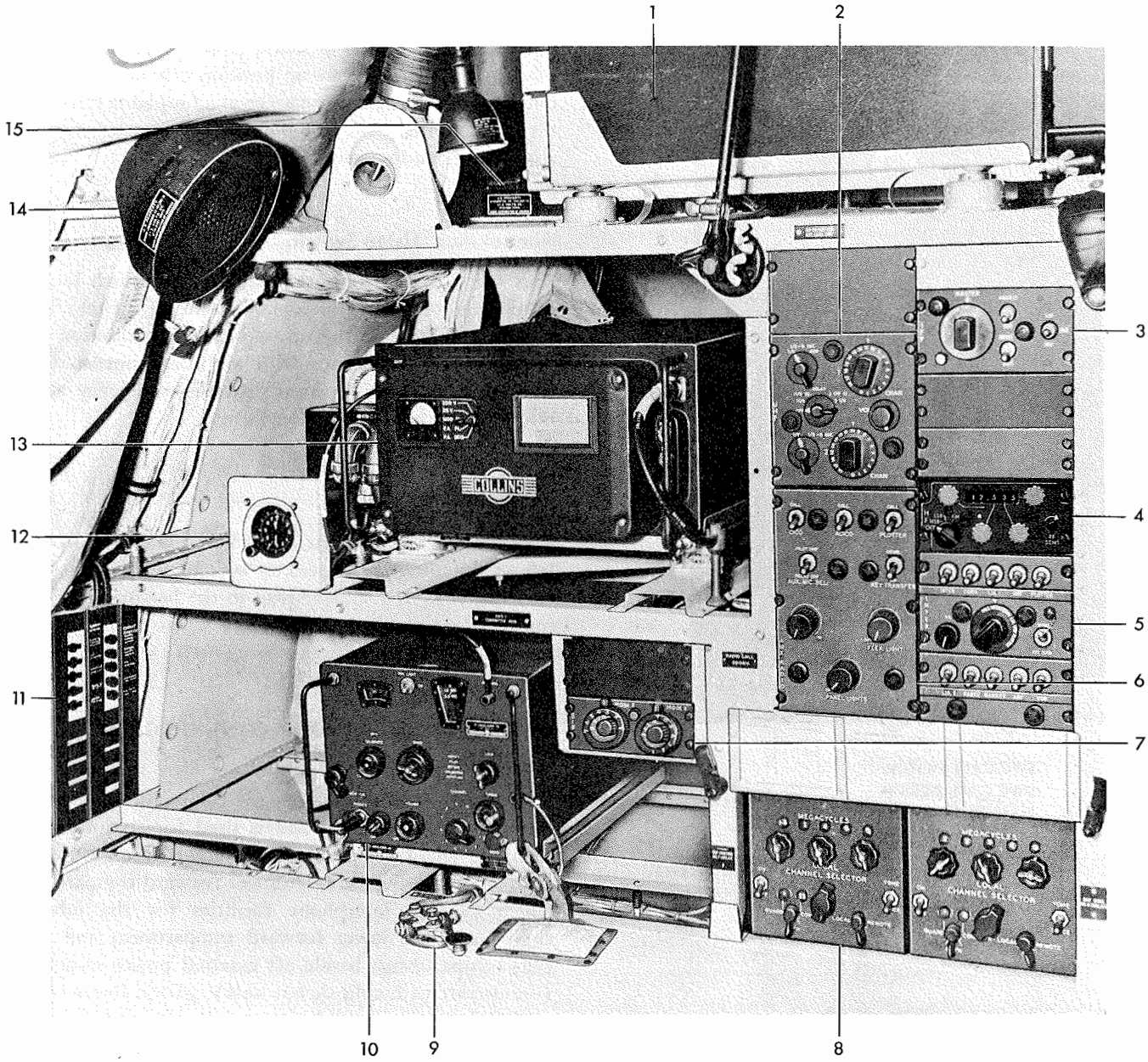
EC-121D. TYPICAL FORWARD RADIO RACK



1 THROTTLE SERVO AMPLIFIER (AUTOPILOT)
2 SN-59A/APS-42 SYNCHRONIZER
3 ENGINE ANALYZER AMPLIFIER
4 C-1 COMPASS AMPLIFIER
5 KY 95/APX-25 IFF/SIF CODER
6 DY-66/ARN-14 VOR DYNAMOTOR
7 R-322/ARN-18 GLIDE SLOPE RECEIVER
8 AM-608/ARA-25 UHF/DF AMPLIFIER
9 R-122/ARN-12 MARKER BEACON RECEIVER
10 MI-36 PUBLIC ADDRESS AMPLIFIER
11 R-541/ARN-14 VOR RECEIVER
12 AMPLIFIER AND SIGNAL GENERATOR (AUTOPILOT)
13 AN/APX-25 TRANSPONDER
14 FLIGHT PATH COMPUTER
15 RT-178/ARC-27 UHF TRANSCEIVER
16 IFF TEST PROBE AND CABLE

Figure 4-20

TYPICAL RADIO OPERATOR'S STATION

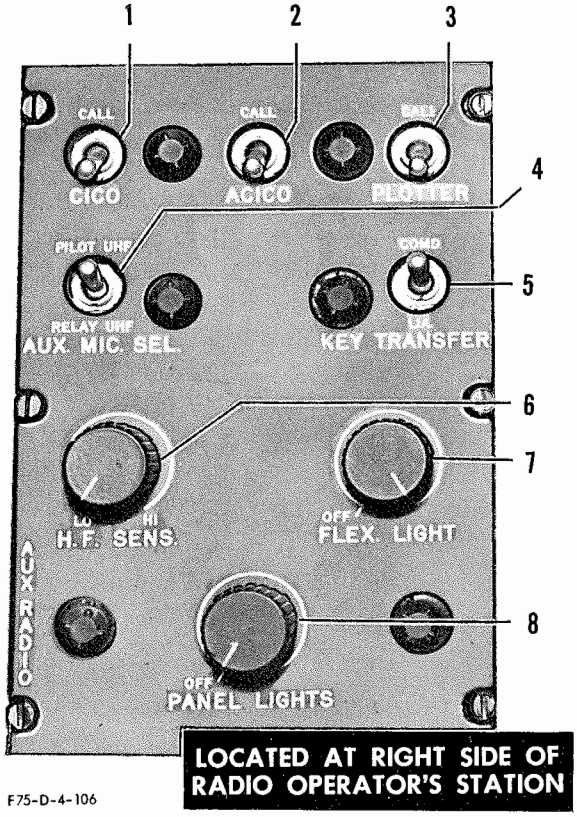


1 618T-1 HF TRANS-RECEIVER (COMMAND)
2 C-853/ARC-27 UHF CONTROL PANEL
3 IFF CONTROL PANEL
4 714E-2 LIAISON CONTROL PANEL
5 RADIO AND ICS CONTROL PANEL
6 ICS PANEL
7 C-1128/APX-25 CONTROL PANEL
8 C-626/ARC-27 MASTER CONTROL UNIT
9 KEY
10 AN/ARR-15 RECEIVER
11 AUXILIARY CIRCUIT BREAKER PANEL
12 CLOCK
13 618-1 OR 618T-1 HF TRANS-RECEIVER (LIAISON)
14 LOUDSPEAKER LS-184
15 DY-76/AIC-10 DYNAMOTOR

F75-F2-4-138

Figure 4-21

EC-121D. RADIO OPERATOR'S ICS PANEL



1 SWC CALL SWITCH
2 DWC CALL SWITCH
3 PLOTTER CALL SWITCH
4 UHF MICROPHONE SELECTOR SWITCH
5 KEY TRANSFER SWITCH
6 HIGH FREQUENCY SENSITIVITY (NOT IN USE)
7 FLEX. LIGHT RHEOSTAT
8 PANEL LIGHTS RHEOSTAT

Figure 4-22

position is used for interphone communication between the various stations in the aircraft. The remaining four positions are labeled according to the function provided at the various stations. The COMM position directs transmission through one of the 618-S transmitters. The LIA position utilizes the alternate 618-S or 618-T transmitter. The UHF position directs transmission through the ARC-27 equipment. When microphone output is to be directed through a radio transmitter, it is necessary to set up the desired frequency on the control panel for the individual radio.

Monitoring Switches.

Five toggle switches are arranged horizontally across the top of the panel (12, figure 1-9). These switches control the choice of additional aural reception coming through the headphones. Placing any switch in the down position cuts off audible sound from the related circuit. Placing any switch in the up position connects the audio output from the related receiver or interphone circuit to the headphones. Any combination of circuits may be monitored simultaneously.

Normal-Aux. Listen Switch.

This switch is a two-position toggle type switch located to the right of the microphone selector switch. This switch is safetied in the up or NORMAL position and provides communications with all interphone stations. The AUX LISTEN position provides emergency audio reception in case of amplifier failure.

Volume Control.

The volume control, placarded VOL, is located to the left of the microphone selector switch and regulates the audio level of the signal heard in the headphones. This control does not regulate volume when CALL facility or AUX LISTEN position is being used.

MECHANICS' INTERPHONE CONTROL C-823 (EC-121D).

This panel provides facilities for communication on the interphone circuit only, and is used for stations other than the flight crew. There are eight or nine C-823's located as follows: three in lower forward compartment which provide interphone facilities for the inboard engine nacelles, lower forward compartment and nose gear compartment; beside aft external power receptacle (on aircraft with split dc bus only); galley; lower center compartment; lower radome; two in aft crew compartment for that compartment and the tail cone.

Call Button.

This button is protected by a cover which must be unscrewed in order to press the button. Pressing the CALL button interrupts all communications in the system including radio reception except at the pilots' station and is designed for initiating a call only.

Normal Aux. Listen Switch.

This switch is a two-position toggle switch located on the right side of the panel. It functions the same as outlined under C-824.

Volume Control.

The volume control is located below the normal aux listen switch on the right side of the panel, and functions the same as outlined under C-824.

AN/AIC-10 Operation.

To put into operation:

1. Aircraft power supply—On.
2. Circuit breakers—On.

To turn equipment off—Normal:

1. Equipment turns off when power supply is removed or turned to OFF.

To turn equipment off—Emergency:

1. Trip the circuit breakers in the radio junction box.

AOC INTERCOMMUNICATION SYSTEM (EC-121D).

The AOC intercommunication system provides interphone facilities for the SWC, DWC, SRO 2, 3, 4, 5, height finder, radar technician, scanner recorder and teller. In addition to interphone facilities the system also provides radio facilities for the AOC crew members except the height finder. AOC crew members may use all radio and ICS equipment available to them without changing connections to their respective headsets and microphones. The system comprises 11 identical AOC-ICS control units. A master interphone junction box, three dynamotors with radio noise filters, two operating and one standby. Each station has a control box and amplifier. The system is capable of communicating with any individual position, any combination of these positions, or all of these positions. Five independent two-way conversations may be conducted without interference. The pilot's position is provided with a switch to activate call-lights at the SWC and DWC positions. Through switches at the latter stations, the pilot can communicate with the SWC and DWC, and it is possible for the pilot to hear all conversations conducted by the SWC. The radio operator's and navigator's positions are provided with switches to activate call-lights at the SWC, DWC, and plotter's positions.

AOC Operation.

To put into operation:

1. Aircraft power supply—On.
2. Circuit breakers—On.

EC-121D. TYPICAL RADIO OPERATOR'S CIRCUIT BREAKER PANEL

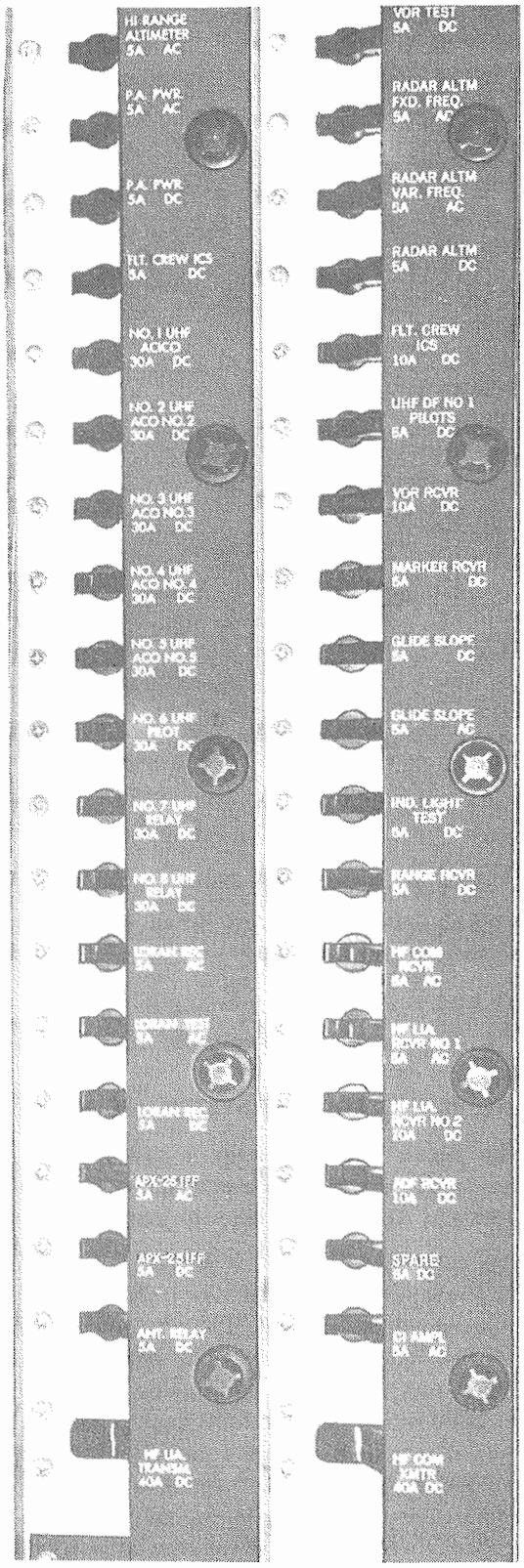


Figure 4-23

EC-121D. CIC JUNCTION BOX

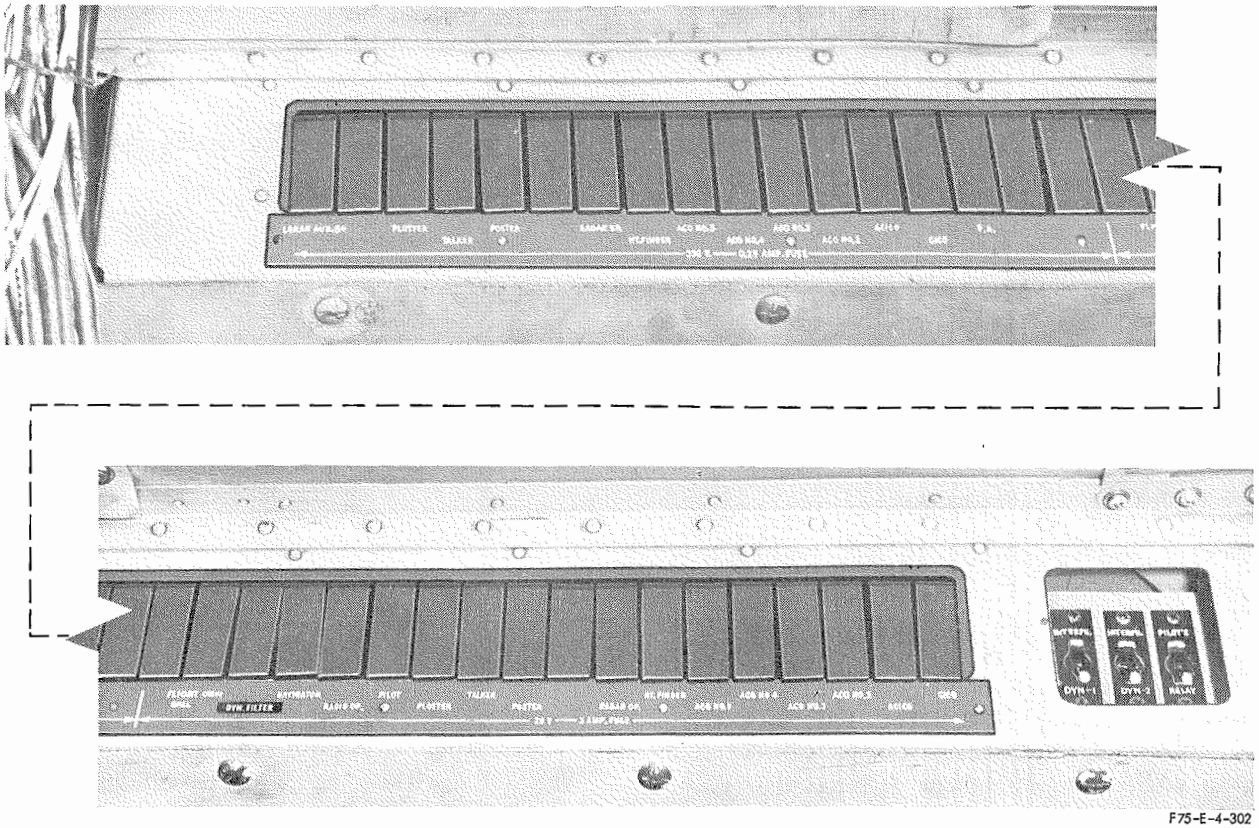


Figure 4-24

To turn equipment off—Normal:

1. Equipment turns off when power supply is removed or turned to OFF.

To turn equipment off—Emergency:

1. Trip circuit breakers in the AOC junction box.

LAC PUBLIC ADDRESS SYSTEM (EC-121D).

The public address system is operated by ac and dc power. The system provides announcements to the flight crew and AOC personnel or to ground personnel.

The pilot, copilot, senior weapons controller and the duty weapons controller may make public address announcements by priority. The pilot and the copilot have priority operation of the public address system, with the senior weapons controller having normal control for announcements to the AOC crew. The duty weapons controller also has normal control of the system when selected by the senior weapons controller. The public address system has 12 loudspeakers, one in the flight station, three in the forward crew area, five in the AOC area, two in the aft crew area and one in the nose wheel well.

PA Operation.

To put in operation:

1. Aircraft dc power supply—On.
2. PA circuit breakers—On.
3. Main instrument inverter—On.

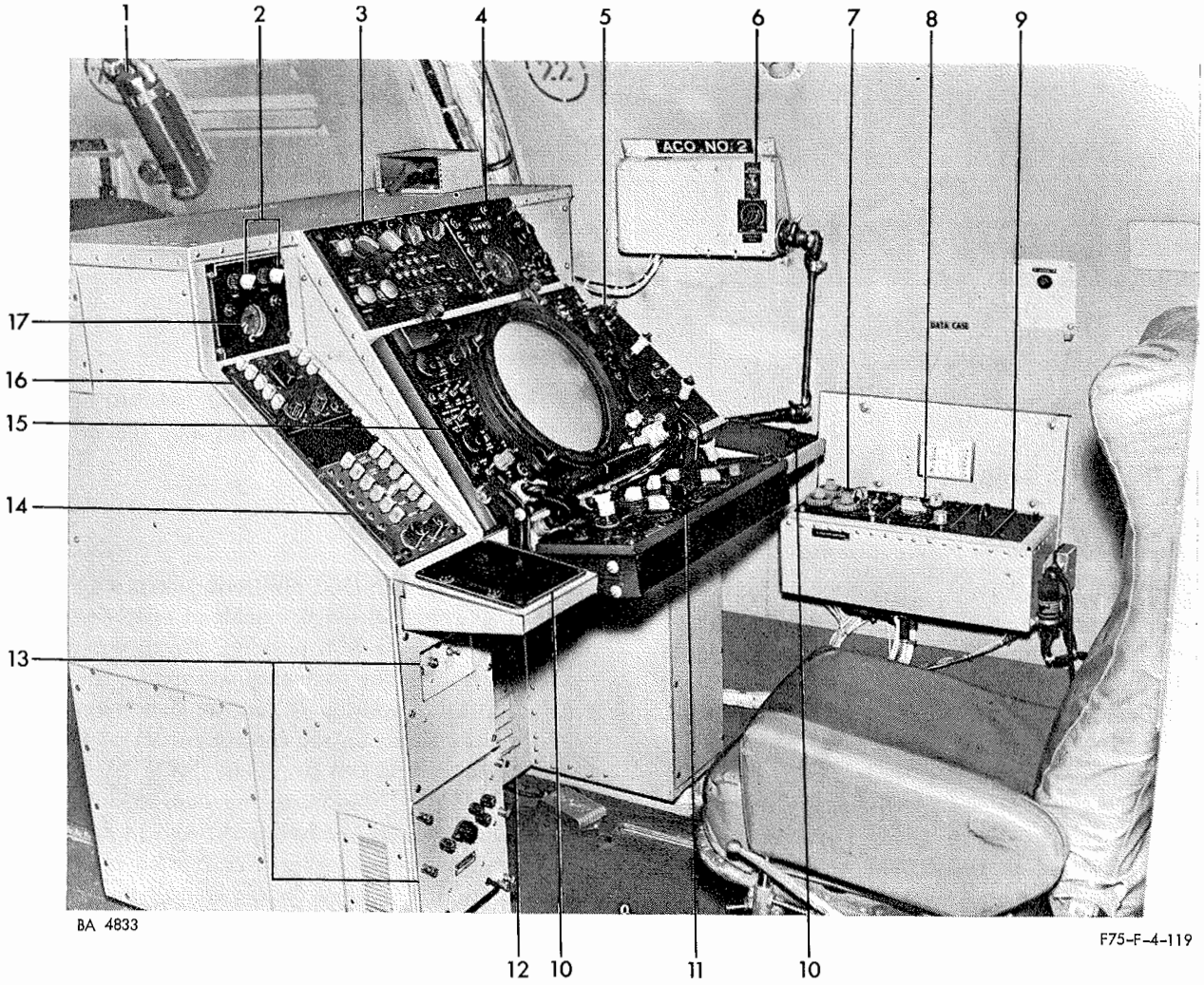
To turn this equipment off:

1. PA circuit breakers—Off.

Pilots' Public Address Control Panel.

The pilot's public address control panel is located on the pilots' overhead panel (10, figure 1-8). The panel includes one two-position (ON and OFF) power switch, one three-position (LOW, HIGH and MED.) flight station speaker volume switch and one two-position (INTERNAL and EXTERNAL) speaker selector switch. When the power switch is in the ON position the pilot or copilot may transmit through the PA system. The volume control switch controls the volume to the loudspeaker in the flight station. The speaker selector switch allows the pilot or copilot to transmit to the ground crew

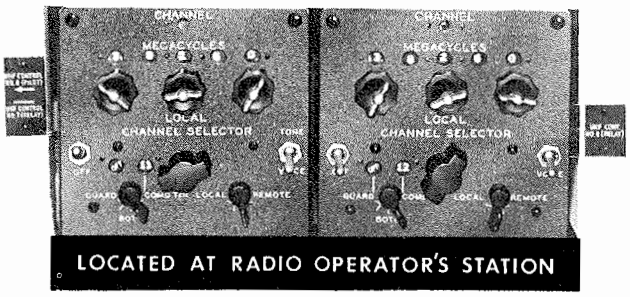
EC-121D. TYPICAL SEARCH RADAR OPERATOR'S STATION



1. HAND FIRE EXTINGUISHER
2. C-4817/APA-159 DESK AND PANEL DIMMER RHEOSTATS
3. RHI (RANGE HEIGHT INDICATOR) ASSIGNMENT PANEL
4. C-4815/APA-159 INDICATOR CONTROL PANEL
5. CP-738/APA-159 TARGET-INTERCEPT COMPUTER PANEL
6. UHF ANTENNA SELECTOR SWITCH
7. C-2167/APX-49 DECODER CONTROL (MODE 2/3)
8. AN/ARC-85 UHF TRANSCEIVER CONTROL PANEL
9. PANEL LIGHTS RHEOSTAT
10. WRITING SURFACES (2)
11. C-4814/APA-159 COMPUTER CONTROL PANEL
12. PP-2297/APS-95 POWER SUPPLY
13. PP-3820/APA-159 POWER SUPPLY PANEL
14. ICS CONTROL PANEL
15. C-628/ARC-27 UHF RADIO CONTROL PANEL
16. IP-719/APA-159 AZIMUTH-RANGE INDICATOR PANEL
17. CLOCK (24 HOUR)

Figure 4-25

EC-121D. C-626/ARC-27 MASTER CONTROL PANEL



F75-F-4-111

Figure 4-26

by placing the switch in the external position and by placing the switch in the internal position the pilot or copilot may transmit to flight crew and the AOC crew.

Senior Weapons Controller Public Address Control Panel.

The senior weapons controller control panel is located on the SWC intercommunication control panel (figure 4-28). The panel includes four separate two-position speaker switches (FLIGHT DECK, FWD, AOC AREA and AFT). These switches permit the SWC or the DWC to transmit to any one station individually or collectively. The microphone selector switch is a three-position type switch (OFF, CICO, ACICO). When this switch is placed in the OFF position the system can only be operated by the pilot or copilot. When the selector is placed in the CICO position the system can be operated by the SWC or the pilot or copilot. When the microphone selector is placed in the ACICO position by the SWC the DWC has control of the system. Regardless of what position the selector is in, the pilots have priority to operate the system.

Pilots' Emergency Interphone and Public Address Operation.

In an emergency, the pilots' microphone transmissions may be connected to all of the interphone stations in the airplane and to the public address system, interrupting all other interphone and public address operations. Emergency interphone operation is conducted by the pilot placing the EMERG. ICS CALL-CREW CALL switch on the pilots' emergency interphone control panel (9, figure 1-8) in the EMERG. ICS CALL position.

VHF 101 COMMUNICATIONS SYSTEM. (EC-121D Aircraft Incorporating T.O. 1C-121(E)D-501.)

The VHF 101 radio is a short range set for air-to-air or air-to-ground voice communications. The set includes an antenna, transmitter, receiver, and control panel located at the ACO No. 2 station. The frequency range of the transmitter is from 116 to 149.95 MCS in 50 KCS steps. The set has two modes of operation, SCS (Single Channel Simplex) or DCS (Double Channel Simplex). Operation of the system is from 28 volt dc radio circuits.

VHF 101 CONTROL PANEL.

Power Switch.

This switch controls system power.

Frequency Selector Knobs.

The frequency of the set is manually selected by use of these knobs. One knob sets MCS and the other sets KCS in 50 KCS steps.

SCS-DCS Switch.

This switch with SCS-DCS positions, selects single channel or double channel simplex mode of operation. When this switch is in the SCS position, the transmitter and receiver operate at the frequency selected on the control panel. The DCS position is functional at receiver frequencies (as selected on the control panel) of 118.00 to 120.95 MCS and 127.00 to 129.95 MCS. In these frequency ranges, the transmitter operates at a frequency 6 MCS above the receiver frequency. At all other control panel selections the transmitter will tune to the same frequency as that selected on the control panel regardless of the switch position. In any case, the receiver is disabled while the transmitter is operating since the set has only one antenna.

Volume and Squelch Control.

The volume control adjusts the volume level going to the interphone. The squelch circuit shuts off the receiver audio amplifier below a preset signal level to prevent annoying noise in the headset or loud speaker. The squelch control adjusts the signal sensitivity level at which this cut-off occurs.

AN/ARC-27 UHF TRANSMITTER-RECEIVER SETS (EC-121D).

(See 2, 8, figure 4-21 and figure 4-26.)

Eight AN/ARC-27 transmitter-receiver sets are installed in the aircraft and operate on 28-volts dc power from the radio operator's junction box. These sets provide short range communications between aircraft and between the aircraft and ground station. No. 1 through 5 AN/ARC-27 sets are for exclusive use of the AOC crew

members. UHF modification (T.O. 1C-121(R)-573) has made it possible for the pilot to have use of set 6, 7, or 8. To make this possible the PILOT UHF, RELAY UHF AUX. MIC. SEL switch on radio operator's AUX radio panel (4, figure 4-22) must be positioned correctly. With this switch in PILOT (UHF) or up position the pilot, copilot and flight engineer only, have use of No. 6 UHF set. The radio operator and navigator can use No. 7 or 8 (depending on selection of C-853 panel) for normal communication or relay operation. With the switch in the RELAY UHF AUX. MIC. SEL. or down position all flight crew members can use sets No. 7 or 8 depending on the C-853 setting. On modified aircraft any one of 1750 frequencies can be selected.

AN/ARC-27 Operation.

To put into operation:

1. Aircraft power supply—On.
2. Local-remote switch—REMOTE.
3. Function selector switch—T/R or T/R & G REC.
4. Tone voice switch—VOICE.
5. Microphone selector switch—UHF.
6. Rotate the channel selector switch on the UHF panel to the desired channel; allow a minimum of one minute for the set to warm up.
7. Adjust volume control on the UHF control panel and the ICS control panel for desired output.

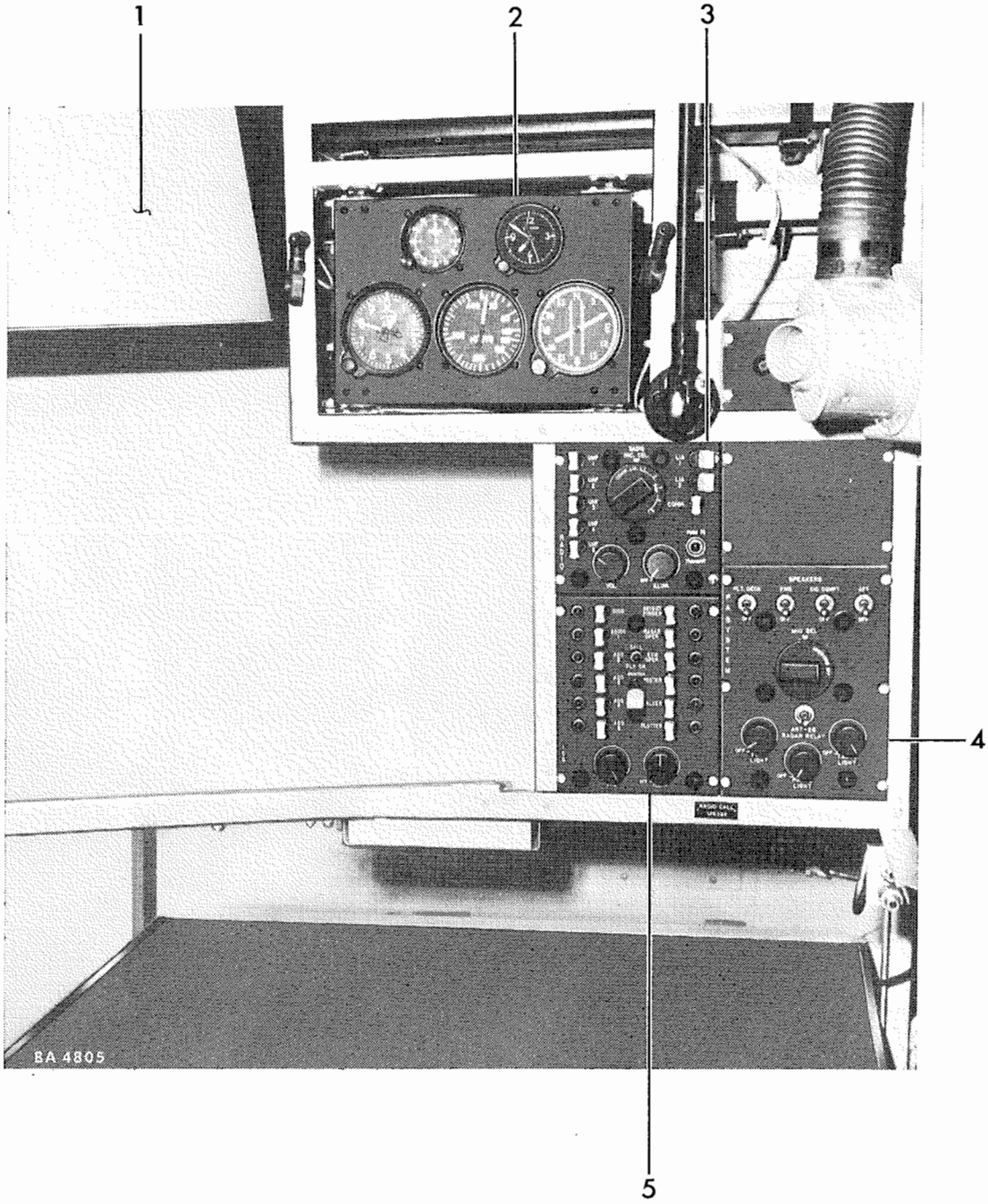
Note

No transmission will be made on emergency (distress) frequency channels except for emergency purposes in order to prevent transmission of messages that could be construed as actual emergency messages.

AN/ARC-85 UHF TRANSMITTER/RECEIVER.

One of the AN/ARC-85 (UHF No. 3) transmitter-receivers provides for UHF voice communications from all positions except the height finder station in the AOC compartment (figure 4-33). A radio set control at the SRO 3 station controls operation of this AN/ARC-85. The other AN/ARC-85 (UHF No. 2) provides for voice communication to the ground station or other aircraft from all positions, except the height finder station in

EC-121D. TYPICAL SENIOR WEAPONS CONTROLLER'S STATION



1. DISPLAY BOARD
2. INSTRUMENT PANEL
3. RADIO PANEL
4. PUBLIC ADDRESS SYSTEM CONTROL
5. INTER COMMUNICATION CONTROL PANEL

F75F-4-116

Figure 4-27

EC-121D. SENIOR WEAPONS CONTROLLER'S ICS PANEL

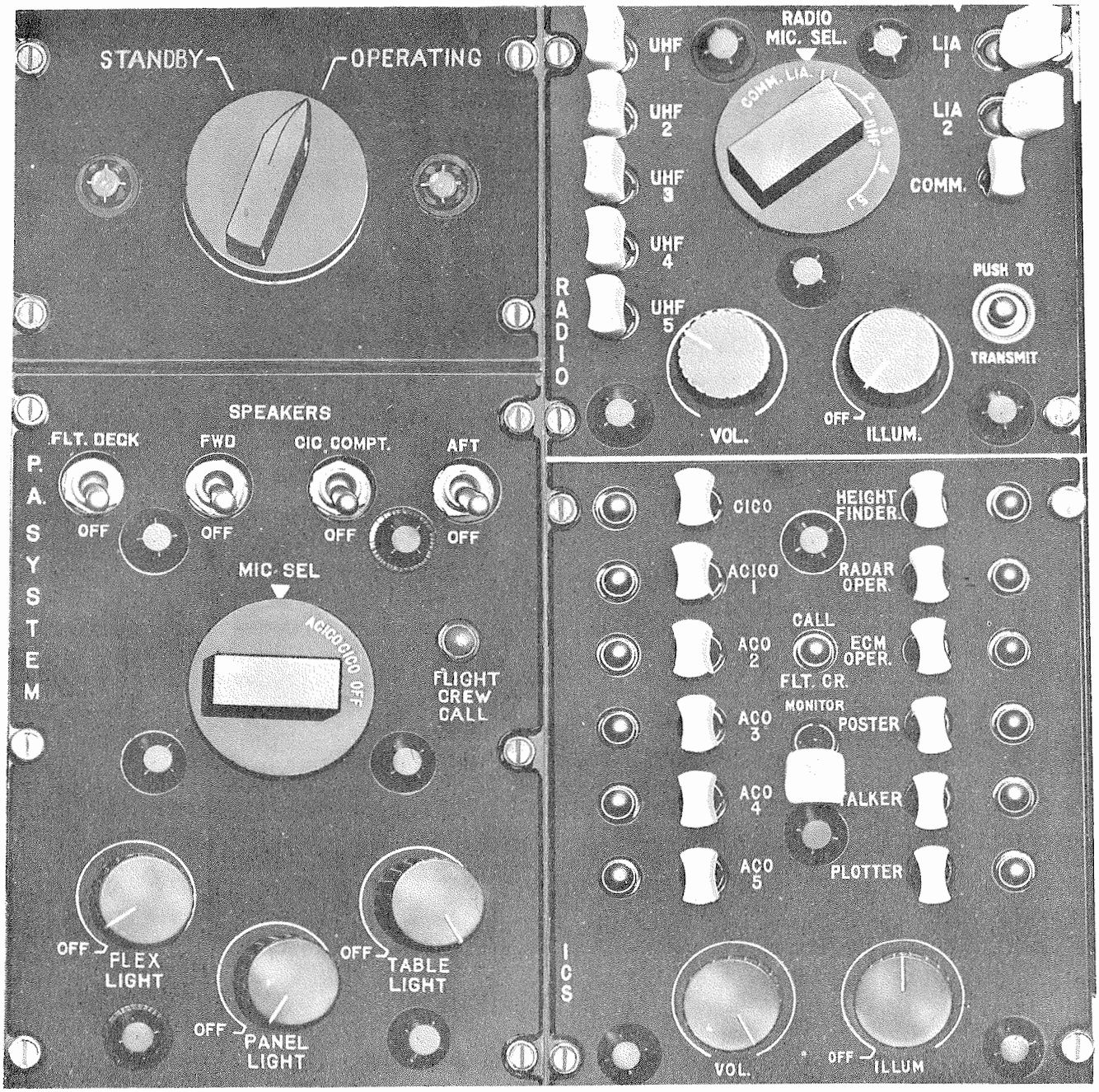


Figure 4-28

the AOC compartment. Radio set control at the SRO 2 station controls operation of this AN/ARC-85. Both AN/ARC-85's receive ac and dc power through the radio technician's circuit breaker panel.

AN/ARC-85 Operation.

1. Operate power switch (AN/ARC-85) to the ON position.

EC-121D. TYPICAL ANTENNA LOCATION DIAGRAM

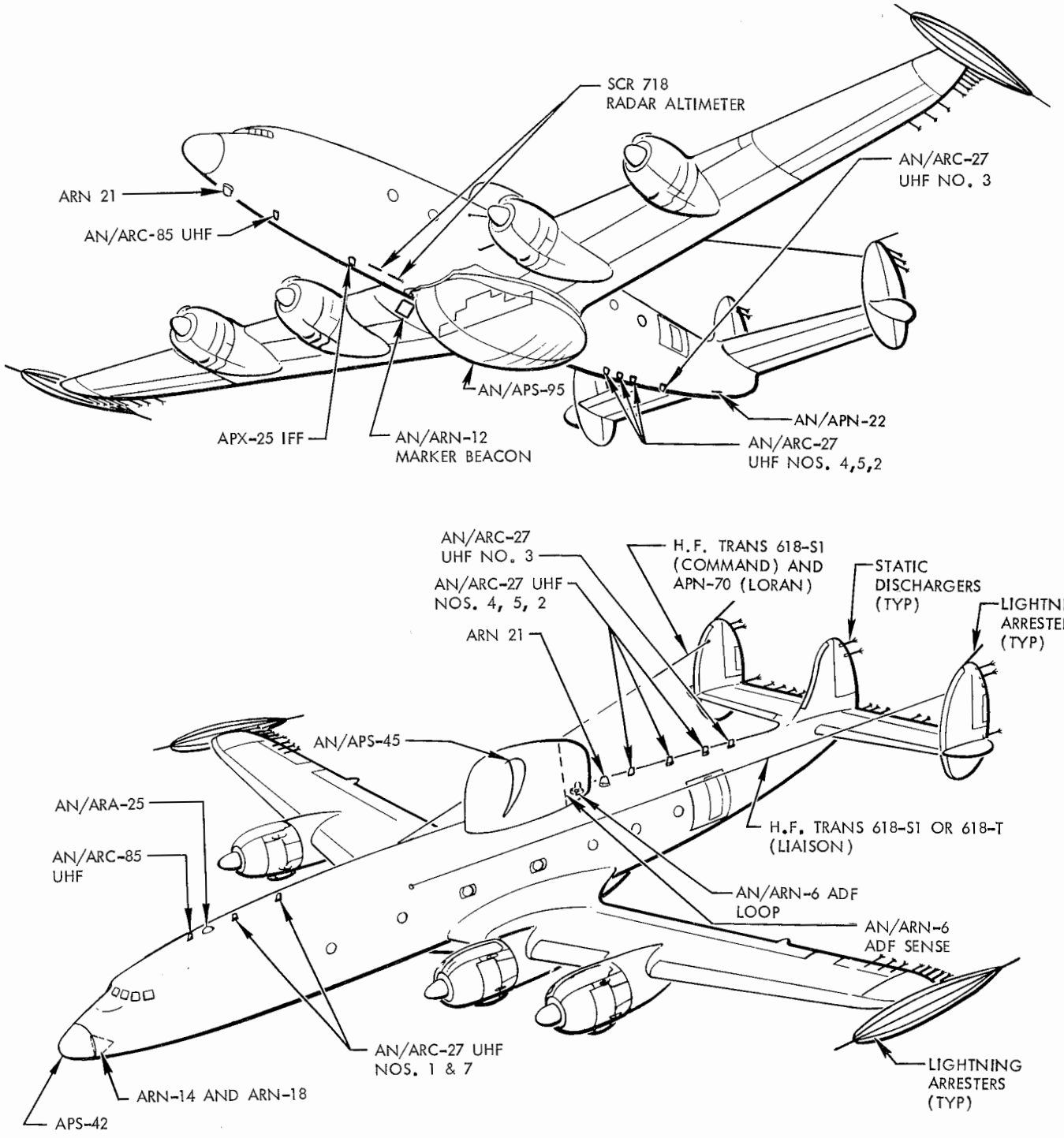


Figure 4-29

2. Move guard receiver switch (radio set control) to BOTH or MAIN position.

3. Move function switch to the PRESET position.

4. Turn preset channel selector switch to the desired channel and allow a 1-minute warm up time.

5. Adjust volume control as required.

To turn equipment off:

1. Operate power switch to the OFF position.

AN/ARR-15A HF RADIO RECEIVER (EC-121D).

The AN/ARR-15A is operated from the radio operator's station (10, figure 4-21). The equipment provides long-range code and voice reception with ground stations and other aircraft. This receiver is powered by dc bus.

AN/ARR-15A Operation.

To put into operation:

1. Aircraft power supply—On.

2. Power ON and OFF switch—ON.

3. CW-MCW-CAL switch—Select desired type of reception.

4. Receiver toggle switch on intercommunication control panel—LIA No. 2.

5. After the set has warmed up (approximately 30 seconds), advance the volume control knob until a slight background noise is heard.

6. Set the band switch to the frequency desired.

To turn equipment off:

1. Power ON-OFF switch—OFF.

618 S-1 HF TRANSMITTER/RECEIVERS (EC-121D).

Two 618S-1 HF transmitter/receivers (1, 13, figure 4-21) sets designated command and liaison, provide both transmitting and receiving facilities up to 144 crystal control channels in the frequency range of 2.0 to 25.0 mc. The transmitter/receivers are located on the radio operator's station. The transmitter/receivers use two 180L-3 tuning units which automatically make all antenna tuning adjustments when the desired channel is selected. The command transmitter/receiver is operated by the pilots by remote controls (12, figure 1-8) on the pilot overhead panel. The liaison transmitter/receiver is operated by the radio operator by remote controls on the radio operator's HF control panel (4, figure 4-21). The system operates on dc and ac power.

618 S-1 Operation.

To put into operation:

1. Aircraft dc and ac power supply—ON.

2. Power OFF-PHONE-CW switch—PHONE or CW.

3. Allow the system to warm up (approximately 30 seconds).

4. Set the band switch to the frequency desired.

Note

No transmissions will be made on emergency (distress) frequency channels except for emergency purposes in order to prevent transmission of messages that could be construed as actual emergency messages.

To turn equipment off:

1. Power OFF-PHONE-CW switch—OFF.

618T-1 HF TRANSMITTER RECEIVER (EC-121D).

Aircraft incorporating T.O. 1C-121-750, replaces the 618S-1 HF transmitter receiver with the 618T-1 HF transceiver. This unit is a SSB (single side band) transceiver for long range voice or AM communication. It increases the operational range and is more compatible with the SAGE seward extensions, picket vessels, SAGE Long Range Radar System, and normal air to ground communications. The set operates in the 2.0-29.999 frequency range, thus providing 28,000 channels tuned in one KC increments. The set uses both ac and dc power.

714E-2/618T CONTROL PANELS. (Figure 4-29A.)

The 714E-2/618T control panels are located at the radio operator's station (4, figure 4-21) and on the pilot's overhead panel (12, figure 1-8, sheet 1 of 2). The panel contains the following:

Function Selector Switch.

The rotary function selector switch has four positions, OFF, USB, LSB, and AM. It is used to energize the equipment and select the type of operation.

Frequency Indicator Window.

The frequency indicator window displays the frequency from 2.0-29.999 as selected by the four frequency selector knobs.

Frequency Selector Knobs.

The four frequency selector knobs are used to select any of the 28,000 operating frequencies.

RF Sensitivity Dial.

The RF sensitivity dial provides adjustment of the RF gain.

AN/ARN-14A NAVIGATION RECEIVER (EC-121D).

The VHF omni-directional navigation system is operated from the pilots' overhead control panel (13, figure 1-8). The navigation information is visual and is observed on indicator units at the pilot's, copilot's and navigator's stations. Power is supplied to the equipment from the aircraft 28-volt dc system, 26-volt ac for the indicators from the C-1 amplifier.

AN/ARN-14A Operation.

To put into operation:

1. Aircraft power supply, ac and dc—On.

2. Power switch on pilots' overhead VHF NAV control panel—ON.

3. Receiver toggle switch VOR or NAV on intercommunication control panel—On.

4. Rotate the channel selector switch on the VHF NAV control panel to the desired channel.

5. Adjust the volume control on VHF NAV control panel and intercommunication control box for the desired output.

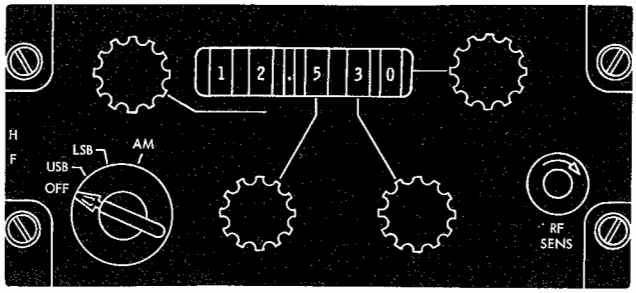
To turn equipment off:

1. Power switch on pilots' overhead VHF NAV control panel—OFF.

AN/ARN-21 TACAN SYSTEM (EC-121D).

The AN/ARN-21 is airborne equipment designed to operate in conjunction with a surface navigation beacon;

714E/G187 CONTROL PANEL



F75-F-4-300

Figure 4-59A

it provides the pilots with continuous indications of distance and bearing for any selected surface beacon located within a line of sight up to 195 nautical miles. This system is operated from the pilots' overhead control panel (16, figure 1-8). The bearing and distance information are displayed on two separate indicators (2 and 3, figure 1-12) the ID-250/ARN-14 radio magnetic indicator and the ID-310/ARN-21 range indicator. Audio selector switches (18, figure 1-10) are located beneath the pilot's and copilot's side panel. The audio output is available for the pilot and copilot only. Power is supplied to the equipment from the 28-volt dc system and from the 115-volt ac inverter system.

Audio Selector Switch.

Two audio selector switches, one on the pilot's auxiliary side panel and one located with the radio controls below the copilot's side panel, select either the ARN-21 audio or the VHF NAV audio. These switches are placarded VHF NAV and NAV ARN-21.

Function Switch.

The OFF, REC, T/R switch is a three-position toggle switch. The down or OFF position deenergizes all AN/ARN-21 equipment. The center or REC position, places only the receiver portion of the receiver-transmitter into operation. When the switch is in this position only bearing information is furnished. When the switch is in the up or T/R position the AN/ARN-21 interrogates and receives a signal which produces both distance and bearing information on the respective indicators.

Channel Selector.

The CHAN selector consists of two rotary switches with knobs and dial skirts for selecting the desired navigation beacon channel. The left-hand knob selects the tens and hundreds figures of the beacon channel number and the right hand knob selects the units figures of the beacon channel number. Combinations of dial settings may be made from 00 to 129. However, the equipment only operates on 01 to 126, a total of 126 channels.

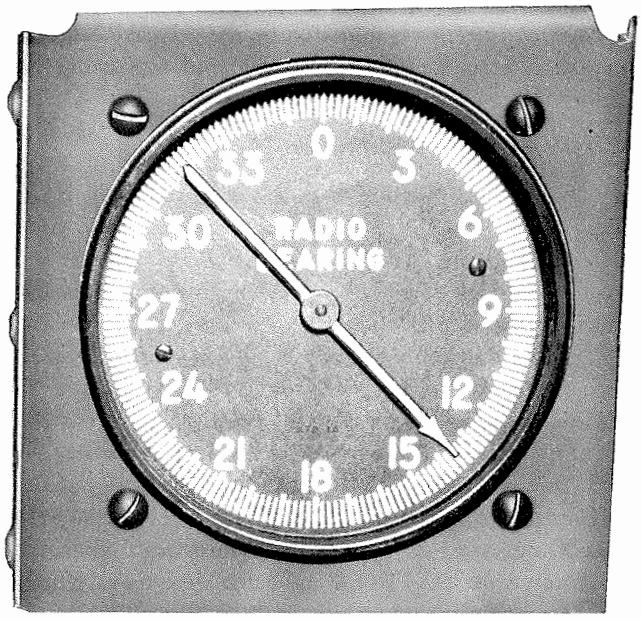
CAUTION

No attempt should be made at any time, to set the CHAN dial below channel 01 or above channel 126.

Volume Control.

This volume control is used to adjust the volume of an audio identification signal received from the beacon. The identification signal, audible in the pilots' headphones when they are connected to the regularly used audio jack, consists of a two or three letter tone signal in International Morse Code.

EC-121D. TACAN INDICATOR ID307/ARN



F75-D-4-211

Figure 4-30

ID-310/ARN Range Indicator.

The ID-310/ARN indicator is installed in the pilots' glare shield panel (3, figure 1-12) and has a single window through which distance is indicated in nautical miles between the aircraft and the surface beacon. The numerals in the window are electronically controlled by the receiver-transmitter range circuits, and serve to display the results computed electronically by these circuits. While the indicator is "searching" for the correct range, the rapidly rotating numbers are partially covered by a red flag which warns the pilots against reading incorrect distance indications.

ID307/ARN Azimuth Indicator.

The ID307/ARN indicator is installed on the radio operator's equipment rack facing the navigator and has a dial face calibrated from 0 to 360 degrees (figure 4-30). This indicator has a single centrally pivoted pointer, electronically controlled by the RT220/ARN-21 azimuth circuits, which indicates the magnetic bearing from the aircraft to the Tacan beacon to which the AN/ARN-21 is tuned. The ID307 must be operative as it provides heading sensitive bearing information for the ID249 and ID250 indicators.

ID-250/ARN Radio Magnetic Indicator.

The radio magnetic indicator (ID-250/ARN) is installed on the pilots' glare shield panel (2, figure 1-12). The number two needle is operated by the AN/ARN-21; the number one needle is not connected and will swing free.

ID-249/ARN Course Indicator.

The ID-249/ARN course indicator is mounted on the pilots' glare shield panel (1, figure 1-12). The course indicator combines the functions of a cross-pointer indicator, an aircraft relative heading indicator, a bearing selector and a marker beacon indicator. The bearing selector knob establishes any magnetic course in whole degrees measured "to" or "from" a Tacan station. The vertical pointer indicates lateral position deviation from the course set in the window on top of the instrument or from an "on course" runway localizer signal. The magnetic heading information is derived from the PB-10 Flux Gate compass system. The horizontal pointer is inoperative. A TO-FROM indicator designates whether the Tacan bearing selected is "to" or "from" the station.

If either the reference or the variable signal strength for a Tacan receiver falls below a safe level, a red flag moves in front of the corresponding cross pointers.

AN/APN-70 LORAN RECEIVER (EC-121D).

This (AN/APN-70) equipment is operated from the navigator's station and is used for long-range navigation (2, 10, figure 4-37). Power is supplied to the equipment from the aircraft's 115-volt ac system, "C" phase. The Loran circuit breakers are located on the radio operator's circuit breaker panel.

AN/APN-70 Operation.

To put into operation:

1. Aircraft power supply, ac—ON.

2. Rotate the master-XZ gain control clockwise until the panel lettering is illuminated. Allow five minutes for the set to warm up.

To turn equipment off:

1. Turn the master-XZ gain control to POWER OFF and see that panel lettering light is out. Also see that the pattern on the indicator screen has disappeared.

CU308/U ANTENNA COUPLER (EC-121D).

This coupler provides facilities for the AN/APN-70 Loran receiver, AN/ARR-15A HF receiver and 618S-1 HF command transceiver to share the right overhead long wire antenna. The AN/APN-70 and AN/ARR-15A are connected to the CU308/U at connector posts nomenclatured LORAN and COMM respectively. The antenna input to the CU308/U is obtained from the 618S-1 HF command automatic tuner, 180L-3. The CU308/U is located against the bulkhead forward of the navigator's equipment rack. Power is supplied to the equipment from the aircraft dc system through the LORAN DC circuit breaker on the radio operator's circuit breaker panel. Also 120 volts dc is supplied to the COMM and AUX posts on the CU308/U through the LORAN AUX B fuse located on the CIC junction box.

AN/APX-25 RADAR IDENTIFICATION TRANSPONDER (EC-121D).

The purpose of the AN/APX-25 is to identify the aircraft as friendly when correctly challenged by a friendly shore, shipboard and airborne radar, and to permit surface tracking and control of aircraft in which it is installed. The AN/APX-25 control panel is located at the radio operator's station (3, figure 4-21). Power is supplied to the equipment from the aircraft 28-volt dc system and from the 115-volt ac generator system.

KY95/APX-25 CODER (EC-121D).

Coder KY95 is an airborne electronic set which operates in conjunction with the AN/APX-25 radar identification set to provide coded electronic recognition known as SIF (7, figure 4-21). The primary purpose of the coder, when used with the AN/APX-25, is to identify the aircraft in which it is installed as friendly, when correctly challenged by an interrogator-responder associated with friendly radars that are ground based, or airborne.

AN/APN-22 RADAR ALTIMETER (EC-121D).

The AN/APN-22 radar altimeter is designated as a low altitude altimeter (0 to approx. 20,000 ft.) and is operated from the pilots' station (2, figure 1-7) and the navigator's station (5, figure 4-37). The equipment gives a visual indication of the aircraft altitude with respect to the terrain beneath. Power is supplied to the equipment through circuit breakers on the radio operator's circuit breaker panel from the aircraft 28-volt dc system and from the 115-volt ac generator and inverter system. Fusing for the AN/APN-22 is located at the rear of the mounting rack for AM-291/APN-22 in the aft crew compartment.

AN/APN-22 Operation.

To put into operation:

1. Aircraft power supply ac and dc—On.

2. ON-LIMIT control knob on front of indicator—ON.

To turn equipment off:

1. ON-LIMIT control knob on front of indicator at both pilots' and navigator's station—OFF.

WARNING

The AN/APN-22 radar altimeter is unreliable in areas covered by large depths of snow and ice such as encountered over polar regions. An apparent terrain clearance 1600 feet greater than actual clearance has been recorded. Do not rely on your APN-22 equipment to provide terrain clearance when flying over areas covered by a large depth of snow and ice.

SCR-718 RADAR ALTIMETER (EC-121D).

The SCR-718 radar altimeter is designated a high altitude altimeter (0 to approx. 40,000 ft.). The indicator (4, figure 4-37) is operated from the navigator's station. The equipment indicates the aircraft altitude with respect to the terrain beneath. The measurement is graphically exhibited by the appearance of a lobe on the face of the cathode-ray indicator tube. Power is supplied to the equipment from the 115-volt ac inverter system. A circuit breaker for the altimeter is located on the radio operator's circuit breaker panel, and the fuse is located on the BC-788C receiver-transmitter.

SCR-718 Operation.

To put into operation:

1. Aircraft power supply, ac—On.

2. OFF-ON REC. GAIN switch—ON and turn clockwise to adjust height of lobes.

To turn equipment off:

1. OFF-ON REC. GAIN switch—OFF.

WARNING

The SCR-718 radar altimeter is unreliable in areas covered by large depths of snow and ice such as encountered over polar regions. An apparent terrain clearance 1600 feet greater than actual clearance has been recorded. Do not rely on your SCR-718 equipment to provide terrain clearance when flying over areas covered by large depths of snow and ice.

AN/ARN-12 MARKER BEACON RECEIVER (EC-121D).

The 28-volt dc (AN/ARN-12) marker beacon receiver (figure 4-20) has no controls but comes on automatically when power is supplied to the dc bus. Marker beacon indicator lights are located on the pilots' instrument panel. An aural signal will be heard at the pilots' and navigator's stations when the aircraft is within the radiation pattern of a 75-megacycle marker beacon transmitter and the Marker switch on the intercommunication control panel is ON.

AN/ARN-6 AUTOMATIC RADIO COMPASS (EC-121D).

The (AN/ARN-6) automatic radio compass may be operated by either pilot or by the navigator. The pilots' automatic radio compass controls are located on the pilots' overhead control panel (11, figure 1-8) and the navigator's controls are located at his station (7, figure 4-37). Receiving facilities also are provided for the radio operator. An indicating instrument is installed at each pilot's station and at the navigator's station. Power is supplied to the equipment from the aircraft 28-volt dc system, and 36-volts ac to the indicators through the C-1 amplifier.

AN/ARN-6 Operation.

To put into operation:

1. Aircraft power supply, dc and ac—On.

2. Receiver toggle switch on intercommunication control panel—ADF.

3. Function switch on automatic compass control panel—COMP, ANT, or LOOP, as desired.

To turn equipment off:

1. Function switch on automatic compass control panel—OFF.

2. Receiver toggle switch on intercommunication control panel—OFF.

AN/ARN-18 GLIDE SLOPE RECEIVER (EC-121D).

The glide slope receiver R-322/ARN-18 is installed in the forward radio rack (figure 4-20). The receiver is connected to a glide slope antenna located in the nose radome. The receiver detects 90/150 cps tone modulated

EC-121D. NAVIGATOR'S CGRS CONTROL PANEL

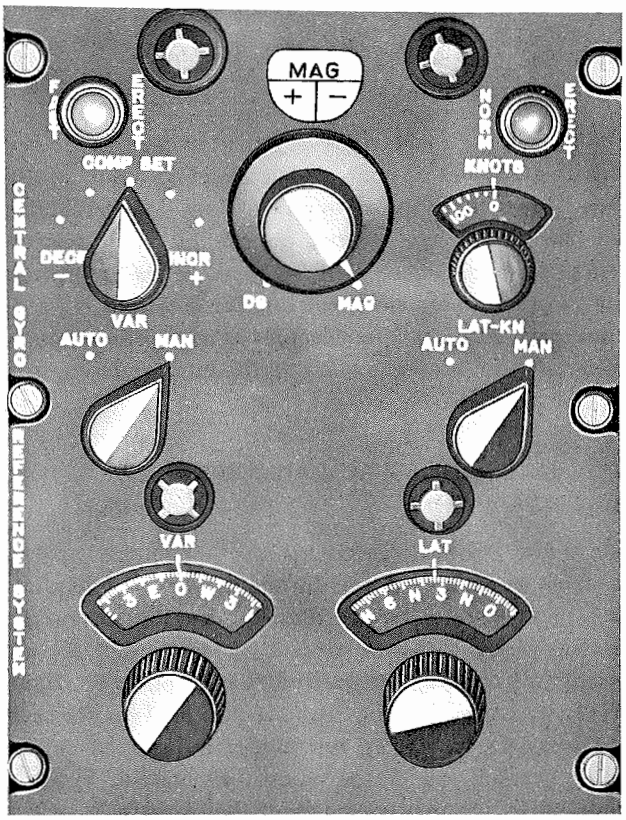


Figure 4-31

signals in the UHF range between 329.3 to 335 mc. Power is supplied to the equipment from the aircraft's 28-volt dc system and from the No. 2 inverter.

AN/ARA-25(UHF) DIRECTION FINDER (EC-121D).

The (AN/ARA-25) direction finder is used in conjunction with the No. 6 AN/ARC-27 UHF set. Placing the function switch of the pilots' AN/ARC-27 control to ADF connects the direction finder antenna relay, and places the AN/ARA-25 amplifier in operation. Relative bearings of the received signals are displayed on the ID-91/ARN-6 indicator on the pilots' left instrument panel and at the DWC and SRO No. 2 positions. Power is supplied to the equipment from the aircraft's 28-volt dc system, and 26-volts ac to the indicators through the C-1 amplifier.

Note

No transmission will be made on emergency (distress) frequency channels except for emergency purposes in order to prevent transmission of messages that could be construed as actual emergency messages.

EC-121D. CGRS AMPLIFIER

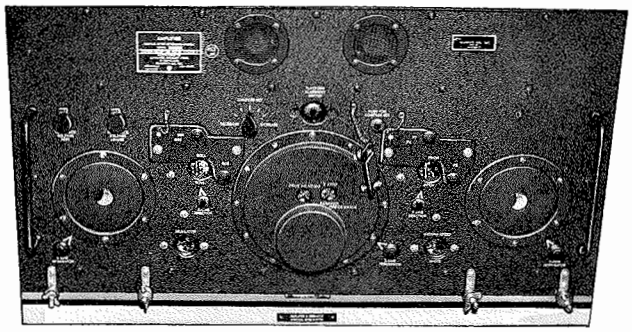


Figure 4-32

AN/CRT-3 EMERGENCY TRANSMITTER (EC-121D).

The AN/CRT-3 emergency transmitter automatically transmits on 500 and 8364 kcs. Operating power is furnished by the hand operated generator inside of the transmitter cabinet. Operating instructions are inscribed on the equipment for use in emergency.

Note

Be sure to crank the transmitter long enough for the tubes to warm up. Always rotate the crank at approximately 80 rpm.

CENTRAL GYRO REFERENCE SYSTEM (EC-121D).

The central gyro reference system is an airborne flight attitude control and reference system, designed for continuous duty in long-range aircraft operating over any area of the earth. It provides simultaneouly accurate attitude data in azimuth, pitch, and roll. Heading information is magnetic, directional gyro, or true, as determined by the selected mode of operation. Magnetic or directional gyro heading is supplied to the V-8 repeaters located at the pilot, navigator and CICO positions. Magnetic, directional gyro or true heading is supplied to the AN/APA-57, AN/APS-45 and search radar systems. The CGRS is supplied 115-volt ac power from the main instrument inverter. 28-volt dc is supplied from the aircraft dc system. Circuit breakers for the CGRS are located on the radar technician's power panel.

CAUTION

There are no electrical or mechanical caging devices within the gyro assembly; therefore, the ac and dc circuit breakers should be on and the main instrument inverter turned on during all periods of engine run-up, taxi, and flight. This will supply electrical power to the gyro motors and prevent damage from mechanical shock. Aircraft should not be moved during the period 10 minutes to one hour after shutdown; damage may result.

CGRS Operation.

To put into operation:

1. Knot dial—Zero.
2. Lat-Kin selector switch—MAN.
3. VAR dial—Zero.
4. LAT dial—Local latitude.
5. VAR selector switch—MAN.
6. DG-MAG selector—MAG.
7. DC power—On.
8. Main instrument and electronic inverters—On.
9. AJA-2 CGRS circuit breakers and phase A heading circuit breaker—On.

Note

Allow ten minutes for system to reach normal operating conditions. At temperatures below 0° C, the ac circuit breakers should be turned on fifteen minutes before the dc circuit breakers to provide adequate warm-up of the equipment.

10. X-AXIS integrator—Press.
11. Y-AXIS integrator—Press.

Note

Corresponding dials should rotate at the rate of approximately fourteen white sectors in fifteen seconds.

12. Platform alignment switch—Press.

Note

Z-AXIS dial should rotate and come to rest at zero degrees.

CAUTION

Platform alignment switch is not for inflight operation. Do not press while in flight.

13. COMPT. SET knob—Rotate (max rotation).

Note

True heading dial on servo-amplifier should rotate at the rate of approximately four rpm.

14. Knot dial—Set (desired speed).

Note

Check ground speed dial on servo-amplifier, should indicate this same speed.

15. VAR selector—MAN.
16. VAR dial—Set (desired heading).

Note

Check the true heading dial on servo-amplifier for corresponding change. Cross check true heading dial with magnetic compass. Difference between the two readings should equal preselected variation.

17. Z-AXIS—Press.

Note

Check the smallest dial in the Z-AXIS window which rotates at a minimum rate of six black or white sections past a reference point in one minute.

CAUTION

After switching inverters, or when switching from ground to the aircraft's inverters, the system operation should be checked as follows:

1. Check compass section of the system by observing the annunciator on the control panel. If it is not centered, rotate COMP SET knob or positions as indicated by the annunciaator. Release when annunciator on control panel is aligned.

2. Check verticality of the platform by observing the dial marked ROLL and dials marked PITCH. These

dials should indicate approximately the attitude of the aircraft. If the dials do not indicate properly, repeat the erection cycle by switching the dc circuit breakers OFF for five minutes and then to the ON position. The FAST ERECT light must be on prior to taxi and the NORMAL ERECT light must be on prior to takeoff.

Note

In order to prevent a dc voltage drop sufficient to cause the CGRS system to recycle, it is imperative that both outboard engines be running before switching from ground power to the aircraft's dc power. A positive load must be indicated on the ammeters for both generators before switching is accomplished. On aircraft that has two dc buses, both buses must be checked before switching.

Test Equipment.

The OS-4/AP test scope is located behind the IP-230/APA-56. The TS-147/UP test set has been installed on the floor forward of the left hand airline seats or on top of the APS-45 console.

AN/APS-45 HEIGHT FINDER (EC-121D).

The AN/APS-45 (7, 12, figure 4-33) is an airborne height finding radar set designed to locate airborne targets and to provide accurate altitude information on targets with respect to the altitude of the observer's aircraft. It is used in conjunction with the AN/APA-159 Indicator Group and supplies height information to each of the five IP-229 consoles individually upon request, through a request priority system. The RHI request priority assignment panel is located at the DWC position. The AN/APS-45 operates in the X-band frequency range and is designed for AEW use. The primary power required is obtained from the radar technician's primary power panel through a circuit breaker protection system. The primary source of heading information for north stabilization of the set is obtained from the AN/AJA-2 CGRS.

AN/APS-45 Operation.

To put into operation:

1. Input voltages on OA-295/APS-45 control panel —Monitor.
2. Master and standby switches—ON.
3. Magnetron blower operation—Check.
4. Pressure lights—Out.
5. PP-705 voltages—Check.
6. When ready lights come on, start button—Press.
7. Xtal currents—Check.
8. Transmitter current—Raise to a maximum of 38 ma.
9. All operational controls—Check for proper action.
10. Receiver, scope display—Tune and set up.
11. MDS and power output—Check.

To turn equipment off:

1. AFC-Manual switch—MANUAL.
2. Stop button—Push.
3. Gain and intensity controls—Full CCW.
4. Standby and master switches—OFF.

AN/APS-103 HEIGHT FINDING RADAR (SOME AIRCRAFT).

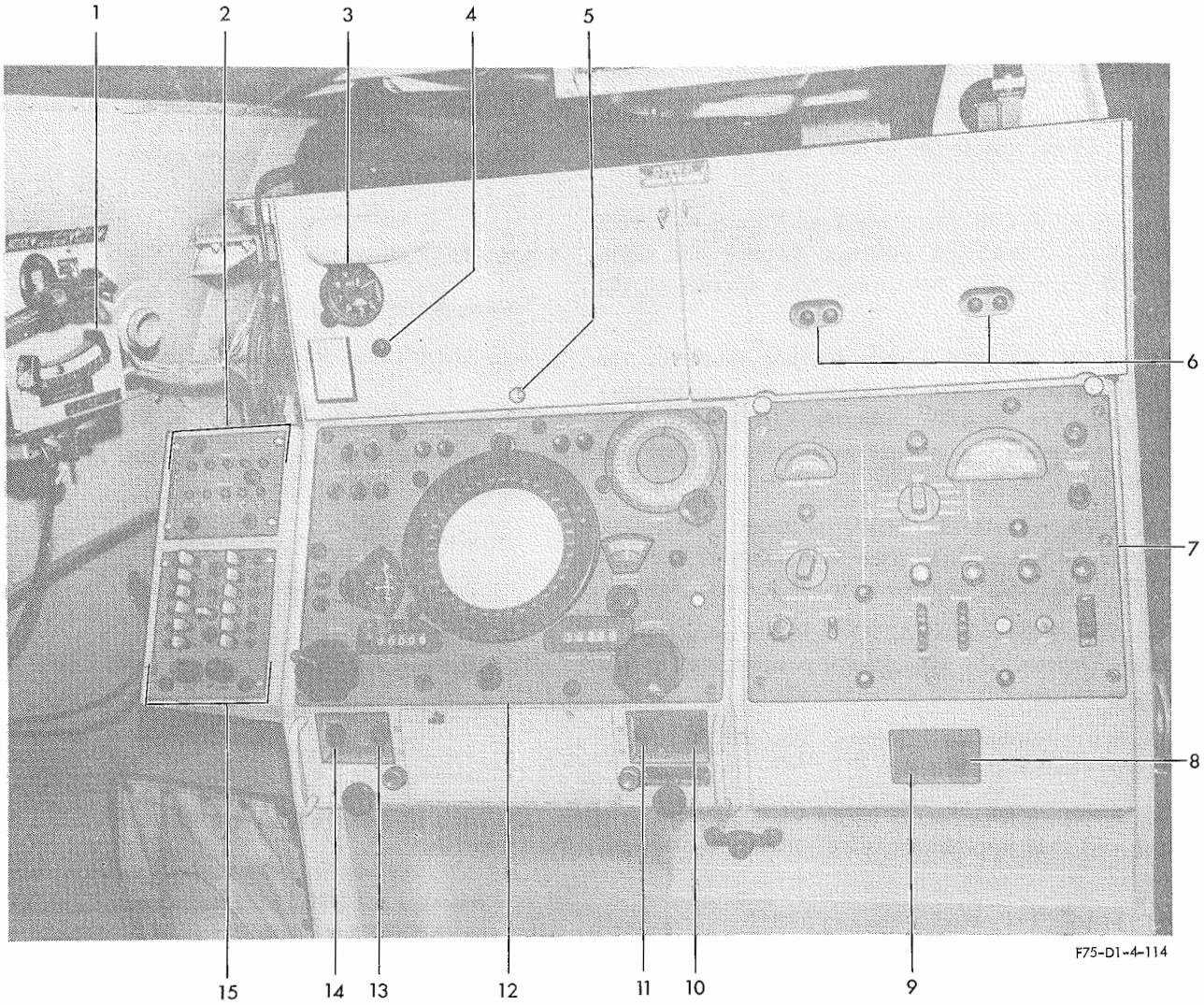
The AN/APS-103 height finding radar is an airborne radar set designed to locate airborne targets and to provide accurate altitude information on targets with respect to the ground. The AN/APS-103 is used in conjunction with the AN/APA-159 indicator group to supply height information to APA-159 system. The primary power required is obtained through circuit breakers on the radar technician's circuit breaker panels. True bearing data for north stabilization is obtained from CGRS.

AN/APS-103 Operation.

1. Master and standby circuit breakers—OFF.
2. MANUAL-AFC switch—MANUAL position.
3. ELEVATION control—Rotate to 0.
4. Video gain control—Set at center of range.
5. RCVR gain control—Set at center of range.
6. Open SF6 gas cylinder valve. Typical pressure for various temperatures are as follows:

425 psig	90° F
310 psig	70° F
295 psig	50° F
190 psig	30° F
130 psig	0° F
78 psig	−30° F

EC-121D. TYPICAL HEIGHT FINDER'S STATION



1 INCLINOMETER
2 ALTITUDE REQUESTER REPEATER
3 ALTIMETER
4 ALTIMETER LIGHT
5 TILT INDICATOR
6 POWER SUPPLY INDICATING LIGHT
7 AN/APS-45 CONTROL PANEL
8 PANEL LIGHT INTENSITY CONTROL
9 RCVR TEST OUTLET
10 PANEL LIGHT INTENSITY CONTROL
11 VIDEO-GAIN CONTROL
12 AN/APS-45 INDICATOR CONTROL PANEL
13 VERTICAL CONTROL
14 HORIZONTAL CONTROL
15 ICS CONTROL PANEL

Figure 4-33

7. SF6 gas regulator control—Turn CW until delivery pressure (small gage) indicates 45 psig. After 30 seconds, proceed to step 8.

8. SF6 gas regulator control—Turn CCW (until tension on the control handle is relieved). When the gage reads the recommended pressure, slowly turn control clockwise to maintain this pressure.

Recommended pressure versus altitude follows:

Sea Level	30 psig
5,000 ft.	34 psig
10,000 ft.	36 psig
15,000 ft.	37 psig
20,000 ft.	38 psig
25,000 ft.	40 psig

9. Set meter switch in sequence to VAR FREQ PHASE A, VAR FREQ PHASE B, VAR FREQ PHASE C, CONST FREQ PHASE A, CONST FREQ PHASE B, CONST FREQ PHASE C. The control panel meter must indicate within the limits of the white block marked AC LINE.

10. Meter switch—Set to DC. The control panel must indicate within the limits of the white block marked DC LINE.

11. MASTER-OFF circuit breaker—Turn to MASTER position. The MASTER indicator (white) will light. After 45 seconds the PPI sweep trace appears on the indicator.

12. STANDBY-OFF circuit breaker—Turn to the STANDBY position. The STANDBY indicator (amber) will light. The READY indicator (green) will light after approximately 5 minutes to indicate equipment is warmed up.

13. ANT AZIMUTH MAN pushbutton—Depress. The antenna will position itself in azimuth as indicated by PPI presentation and the azimuth position dial.

14. ANTENNA ELEVATION SCAN MAN pushbutton—Depress. The antenna will position itself in elevation as indicated by the elevation control.

15. Start pushbutton—Depress. The MOD PLATE indicator (red) will light.

16. Meter switch—Set to MAG CUR position. The meter will read approximately 18 on the 0 to 100 ma scale.

17. MAG CUR switch—Press to RAISE position until meter indicates 57 ma. The READY indicator (green) will extinguish.

18. Meter switch—Set to MOD CUR position. The meter will indicate approximately 300 on the 0-0500 ma scale.

19. Crystal selector switch—Set in sequence to each of the six positions. CRYSTAL CURRENT meter will indicate between 0.3 and 0.7 ma in each position.

20. MANUAL-AFC switch—Set to AFC position, then to MANUAL. The crystal current should be approximately the same in both positions.

To turn equipment off:

1. Video gain control—Rotate fully CCW.
2. MANUAL-AFC switch—MANUAL.
3. Stop pushbutton—Depress.
4. STANDBY-OFF circuit breaker—OFF.
5. MASTER-OFF circuit breaker—OFF.

AN/APX-7 RADAR RECOGNITION SET (EC-121D).

This equipment functions as the IFF airborne interrogator-responder. The primary purpose of this equipment is to identify aircraft. Controls are located at the radar technician station (9, figure 4-34). Power is supplied to the equipment from the aircraft 28-volt dc system and the ac generators. Circuit breakers are located on the radar technician's primary power panel.

AN/APX-7 Operation.

To put into operation:

1. Aircraft ac and dc power—ON.
2. C-1040 power switch—ON.
3. Test meter readings—Check after time out period has elapsed.
4. Gain control—Set for proper returns.
5. Pulse counter—Set as required.

To turn equipment off:

1. C-1040 power switch—OFF.

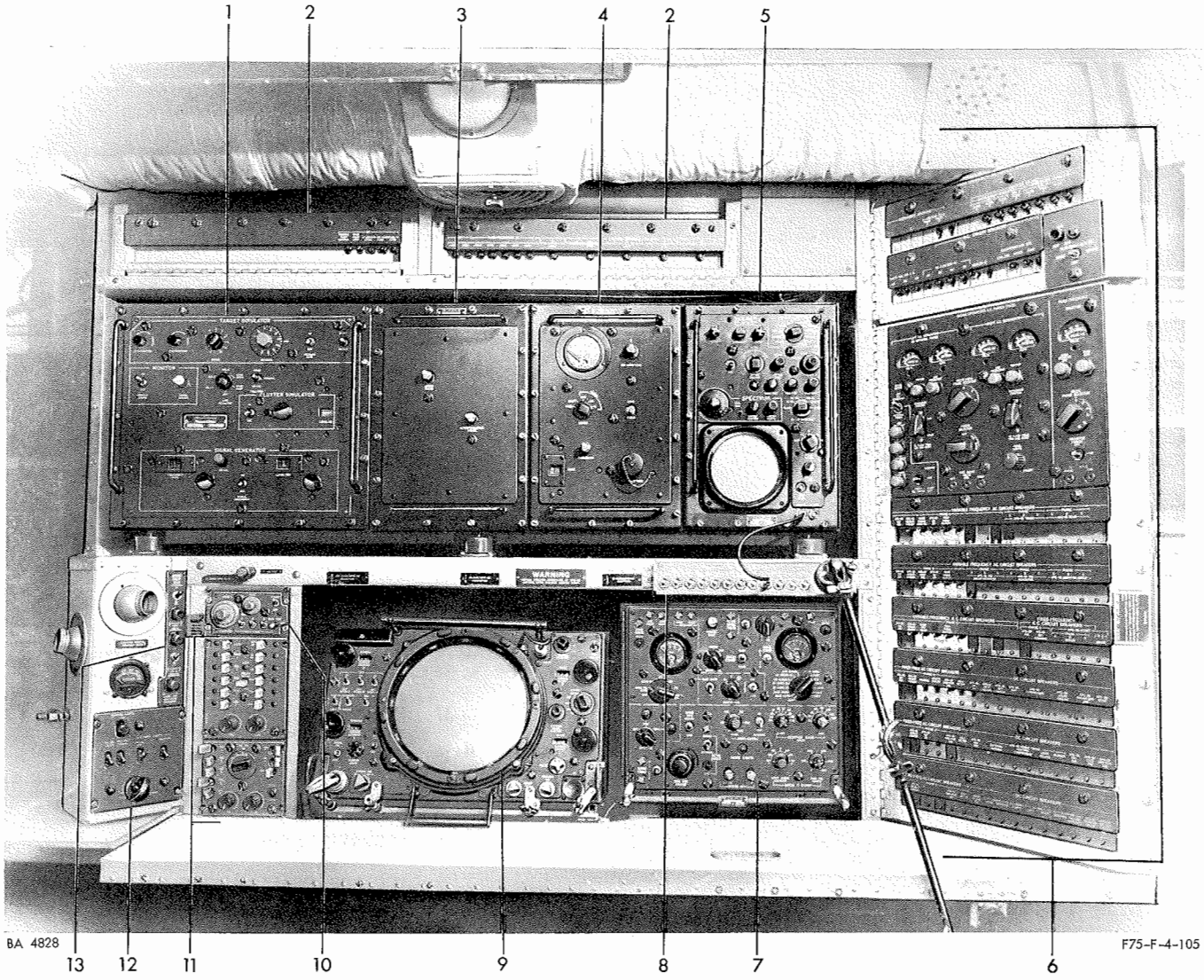
AN/APX-49 INTERROGATOR SET.

The AN/APX-49 interrogator set provides identification friend or foe (IFF) of targets detected and displayed by the AN/APS-95 search radar. A decoder control for mode 1 at the radar technician's station, and a decoder control for modes 2 and 3, located at ACO stations 1, 2, 3, 4, and 5, control operation of the AN/APX-49. Operating power is 28-volt dc, 115-volt ac variable frequency and 115-volt fixed frequency obtained through circuit breakers on the radar technician's circuit breaker panel.

AN/APX-49 Operation.

1. Relay mode switches—OFF position.
2. Gain control—Fully CCW.
3. CHALL switch—OFF position.
4. OUTPUT IFF-MIX-RADAR switch—MIX position.
5. OUTPUT DECODED-RAW VID switch—DECODED.

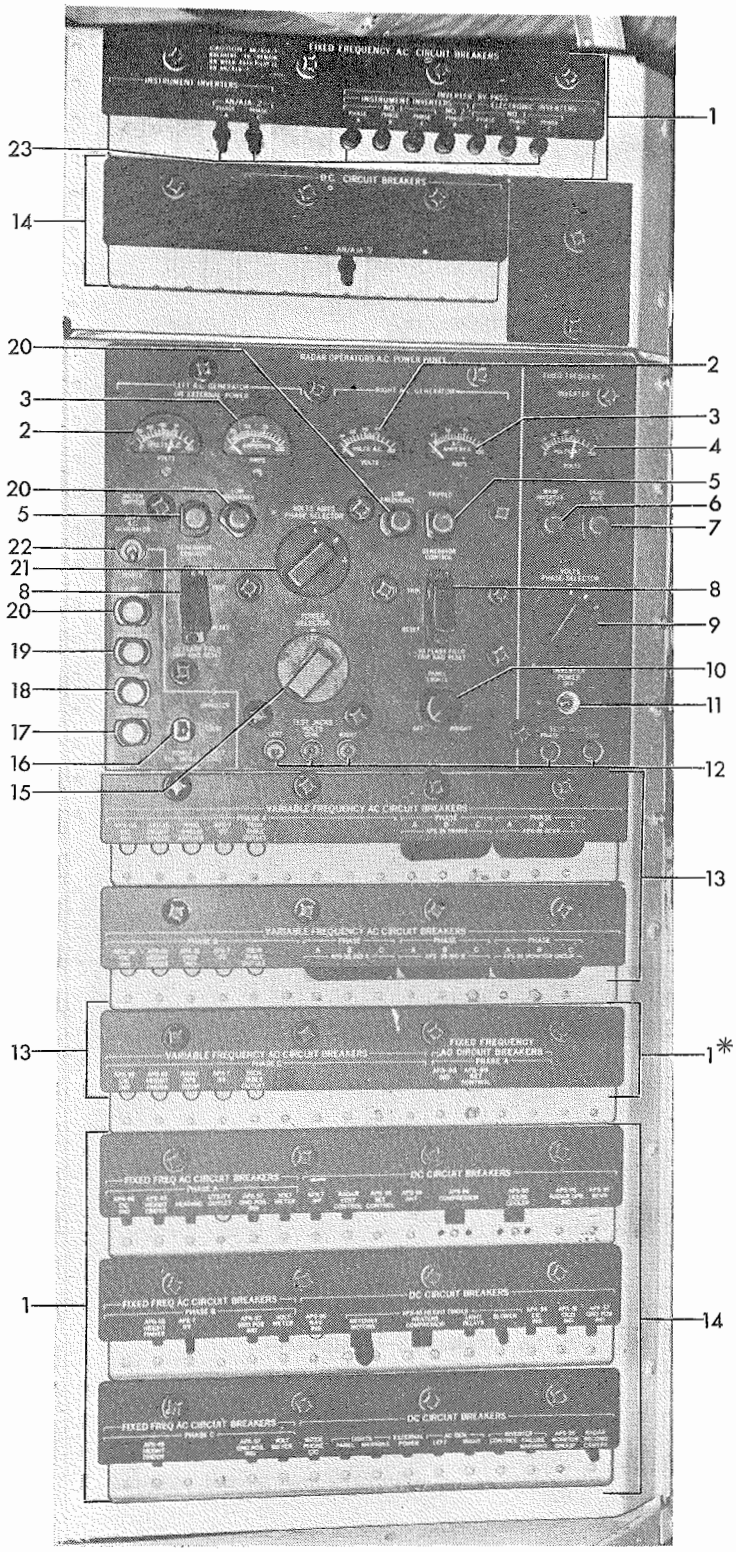
EC-121D. TYPICAL RADAR TECHNICIAN'S STATION



1. SM-190/APS-95 TARGET SIMULATOR TEST EQUIPMENT
2. RADAR TECHNICIAN AUXILIARY CIRCUIT BREAKER PANELS
3. CM-144/APS-95 TEST EQUIPMENT
4. ID-788/APS-95 COHO/STALO TEST PANEL
5. IP-512/APS-95 OSCILLOSCOPE TEST PANEL
6. AC POWER AND CIRCUIT BREAKER PANEL
7. C-2566/APS-95 RADAR SET CONTROL
8. APS-95 TEST JACK STRIP PANEL
9. IP-462/APS-95 INDICATOR
10. C-2186/APX-49 DECODER CONTROL
11. RADIO AND ICS PANEL
12. LIGHTING CONTROL PANEL
13. RADAR EQUIPMENT VENT BLOWER PANEL

Figure 4-34

EC-121D. TYPICAL RADAR TECHNICIAN'S AC POWER PANEL



1 FIXED FREQUENCY AC CIRCUIT BREAKERS
2 VOLTMETERS
3 AMMETERS
4 FIXED FREQUENCY VOLTMETER
5 TRIPPED WARNING LIGHTS
6 MAIN INVERTER OFF WARNING LIGHT
7 DEAD BUS WARNING LIGHT
8 GENERATOR CONTROL SWITCHES
9 VOLT PHASE SELECTOR SWITCH
10 PANEL LIGHT RHEOSTAT
11 INVERTER POWER SWITCH
12 TEST JACKS
13 VARIABLE FREQUENCY AC CIRCUIT BREAKERS
14 DC CIRCUIT BREAKERS
15 AC POWER SELECTOR SWITCH
16 EXTERNAL CART AC POWER SEL. SWITCH
17 EXTERNAL POWER LIGHT
18 HF WARNING LIGHT
19 PHASE REVERSED WARNING LIGHT
20 LF WARNING LIGHTS
21 VOLT AMPS PHASE SELECTOR
22 METER SWITCH
23 INVERTER BYPASS & AJA-2 CIRCUIT BREAKERS

* APS-95 INSTALLATION ONLY

F75-D1-4-107

Figure 4-35

6. Three AN/APX-49 circuit breakers on the radar technician's circuit breaker panel—Verify in the ON position.

7. Power switch—POWER position.

Allow a 5-minute warmup period before operating equipment.

Note

Lighted panel lamps on the decoder control do not indicate that power is applied to the AN/APX-49. These lamps are energized by the aircraft lighting system.

To turn equipment off:

1. Power switch—OFF.

AN/APA-57C GROUND POSITION INDICATOR (EC-121D).

The ground position indicator AN/APA-57C (9, 11, figure 4-37) is an airborne computer used to ground stabilize the search radar indicators. The AN/APA-57C combines values of airspeed and wind data, resolved into rectangular coordinates to obtain ground displacement of the aircraft from an initial reference point. Magnetic, true or directional gyro heading from the CGRS and true airspeed from the airspeed transmitter T-349/APA-57C are fed into the computer indicator CP-132/APA-57C. The airspeed vector is resolved into N-S and E-W components by the computer indicator and transmitted to control C-1061/APA-57C. N-S and E-W components of wind are manually set into the control and combined with the airspeed components by velocity servos. The resultant ground track outputs are converted into ground displacement coordinates by positioning servos which drive indicating counters and data potentiometers. The counters provide a direct indication of the relative position of the aircraft from an initial ground reference in terms of N-S and E-W components. The potentiometers supply dc output voltage for ground stabilization of the radar displays. Power for the equipment is supplied by the aircraft 28-volt dc system and the 115-volt ac electronic inverters system. Circuit breakers are located on the radar technician's power panel and fuses are located on the C-1061.

AN/APA-57C Operation.

To put into operation:

1. Electronic inverter and aircraft dc power supply—On.

EC-121D. RADAR TECHNICIAN'S ICS PANEL

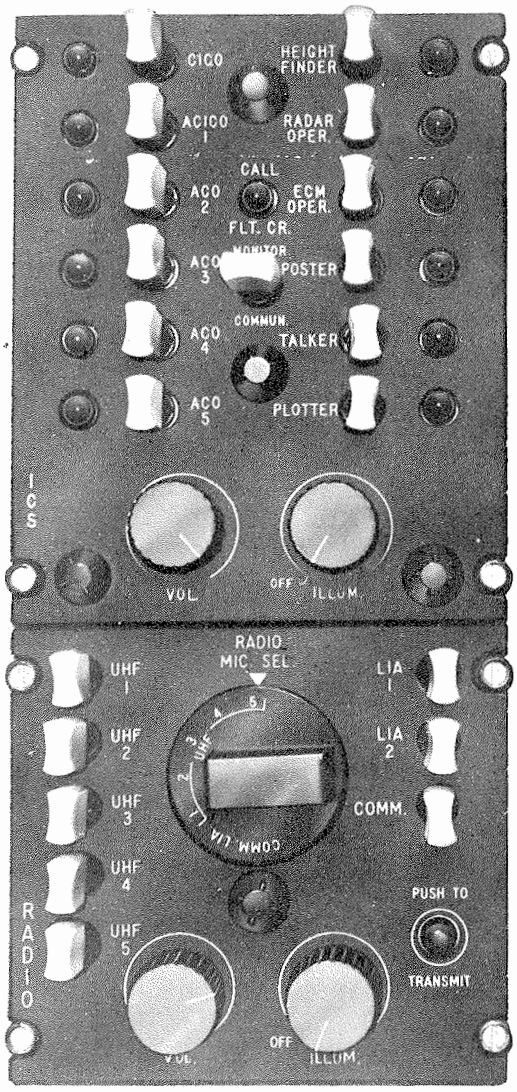


Figure 4-36

2. Power switch on C-1061—On.

3. Standby-operating switch located at CICO position—OPERATING.

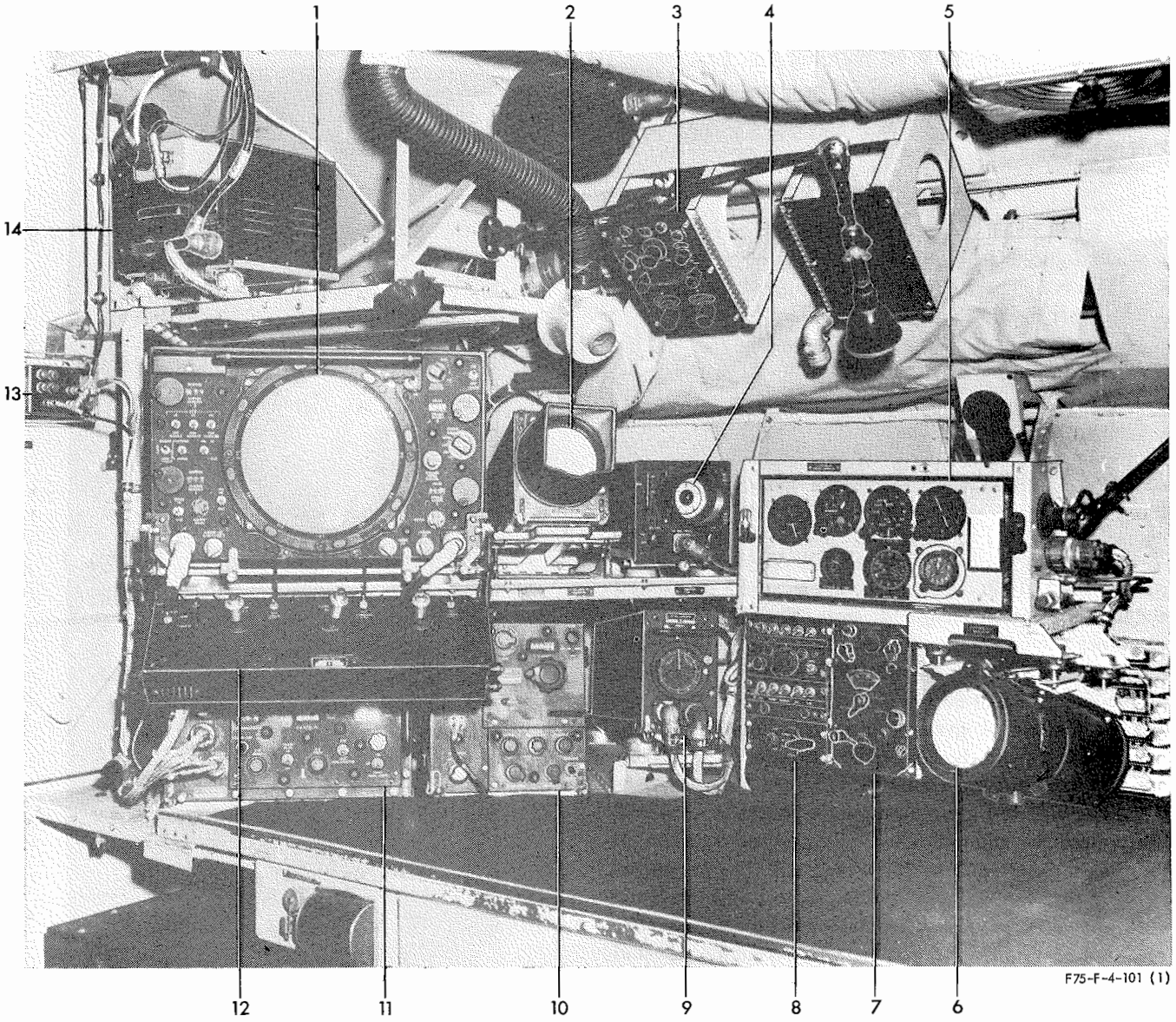
4. Standby-normal switch on C-1061—NORMAL.

5. Wind direction switches on C-1061, N-S and E-W. Set the direction from which winds originate.

6. Wind controls on C-1061—Insert components of wind velocity in coordinate form.

7. Panel lights switch on C-1061—As desired.

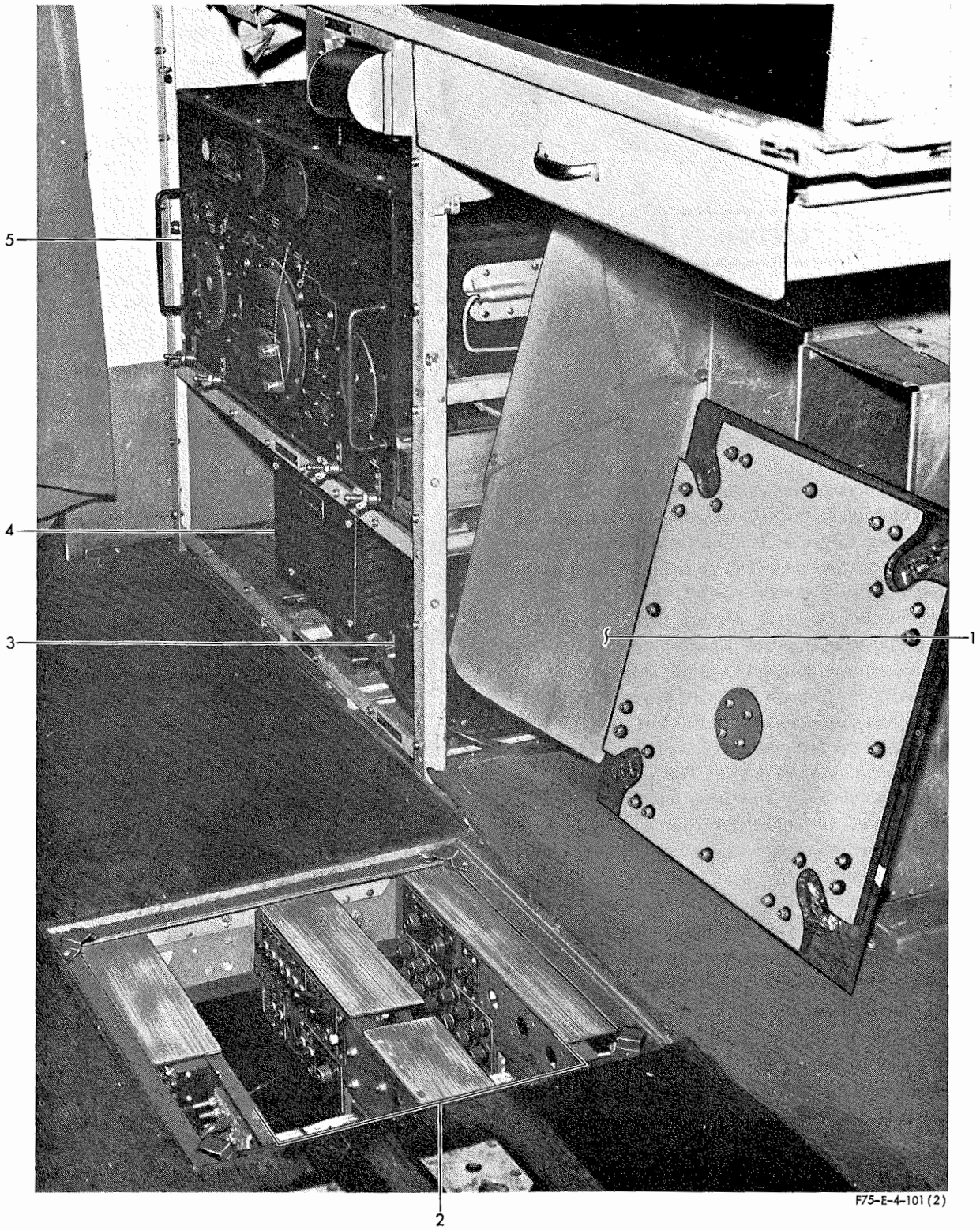
EC-121D. NAVIGATOR'S STATION



1 IP-462/APS-95 INDICATOR
2 IP-58/APN-70 LORAN INDICATOR
3 CGRS CONTROL PANEL
4 RADAR ALTIMETER SCR-718
5 NAVIGATOR'S INSTRUMENT PANEL
6 IP-217/APS-42A INDICATOR
7 ARN-6 CONTROL PANEL
8 RADIO AND ICS PANEL
9 CP-132/APA-57C
10 R-277/APN-70 LORAN RECEIVER
11 C-1061/APA-57C CONTROL
12 C-2826/APS-95 CONTROL
13 CU 308/U ANTENNA
14 180L-3 AUTO TUNING UNIT

Figure 4-37 (Sheet 1 of 2)

EC-121D. NAVIGATOR'S STATION



1 CV-279 TACAN MIXER (HIDDEN)
2 REMOTE CIRCUIT BREAKER PANELS (REFER TO SECTION I FOR INDIVIDUAL PANELS)
3 VOLTAGE REGULATOR FOR CU-308
4 RT-220/ARN-21 TACAN TRANSMITTER
5 CGRS AMPLIFIER

Figure 4-37 (Sheet 2 of 2)

8. Reset knobs, N-S and E-W on C-1061—Set INITIAL and CORRECT. Fix counters to obtain proper displacement from selected ground reference point.

9. Counter limit indicator on C-1061—A red light indicates the approach of any fix counter to within five miles of the limit stops. The light also operates when the standby-normal switch on the C-1061 is in the STANDBY position.

CAUTION

Do not attempt to turn fix counters or wind controls beyond the fixed stops.

10. Variation control on CP 132—Set at 000°.

AN/APS-95 SEARCH RADAR (EC-121D).

The AN/APS-95 radar set (figure 4-34 and 4-37) is an airborne, ultra-high frequency, search radar designed for airborne moving target indication (AMTI) with plan-position indicator displays (PPI) covering a radial range of 250 radar miles (500,000 yards). Integration is accomplished in the EC-121D aircraft with the existing Airborne Early Warning and Control (AEW and C) and navigational equipment including: Height Finding Radar AN/APS-45; Control Indicator Group AN/APA-159; Radar Recognition Set AN/APX-7 or AN/APX-49; Central Gyro Reference System AN/AJA-2; and Ground Position Indicator AN/APA-57C. The radar set transmits and receives through a rotating antenna located in the lower radome. Search information is presented on the plan-position indicator display at the navigator, radar technician, and search radar operator (SRO) stations. Each indicator displays the radar video, moving target video, and heading marker signals from the radar receiver as well as other video signals, such as the IFF. Independently controlled electronic cursors with range strobes are provided for use in azimuth and range measurements. Power is supplied to the equipment from the aircraft's 28-volt dc system and from the 115-volt ac inverter system and ac generators. Circuit breakers are located on the radar technician's primary power panel.

AN/APS-95 CONTROLS (EC-121D).

Because of the numerous controls and the complexity of this equipment, reference should be made to T.O. 12P6-2APS95-1 for control functions and switch position.

AN/APS-95 Operation (EC-121D).

CAUTION

- During taxiing, low taxi speeds are recommended and care shall be taken to avoid rough taxi strips and chuck holes which would cause undue stress on the antenna supporting structure.
- Intentional stalls are prohibited.
- During landing, every effort shall be made to touchdown as smoothly as possible.
- Do not attempt to operate the set unless thoroughly familiar with the functions of all operating controls and procedures. Faulty operation or damage to the equipment may result from misuse.

WARNING

This equipment employs voltages that are dangerous to life. Covers and connectors are not to be removed from any unit that is in operation. All standard safety practices must be followed.

To put into operation:

1. Monitor radar technician's power panel input voltages to radar set control, C-2566/APS-95.

2. SYNC SEL switch—NORM.

3. System switch—STBY.

4. Equipment vent blower—On.

5. Check overload lights—AIR PRES (20 lbs.—Check meter), MOD OVHT, and COOLANT TEMP and flow lights—OUT.

6. AC METER switch—Check phases and 400 cycle REF. positions. Set to RCVR FIL position.

7. DC selector switch—Check 28-volts.

8. Check RCVR overload light—OUT.

9. Dummy load light—ON, switch in DUMMY LOAD position.

10. Dummy load blower light—TEST.

11. AC selector switch—MAG FIL CURR position.

12. Standby timer light—OUT.

Note

The standby timer Light will remain on for 20 minutes after set is actuated or will require a 2 minute additional period for each minute the set is turned off.

13. Check that radar technician's indicator power switch is ON. (Azimuth-Range indicator panel, IP-462/APS-95).

14. Dummy load switch—ANT position (inflight operation only).

15. System switch—OPR position (Green oper. light —ON).

16. DC Meter—Check MAG CURR and MOD CURR reading.

17. AC Meter—Check MAG FIL CURR.

18. RCVR Tune selector switch—AFC position (light OUT).

19. MAG CURRENT Switch—MAG CURR Position (raise).

20. RCVR INPUT Switch—NORMAL position.

21. RCVR INPUT ANT button—Depress button.

22. RPM antenna speed switch—Set 2, 4, or 5 rpm.

23. Antenna rotation switch—CW or CCW position.

Note

Antenna rotation will be discontinued when the rotation switch is turned to STOP position or the system switch turned OFF.

CAUTION

It is necessary that the antenna rotation switch be moved to the STOP position prior to changing the direction of antenna rotation. Otherwise, damage to equipment may result.

24. Check presentation on radar technician's azimuth range indicator, IP-462/APS-95.

25. Adjust IP-462/APS-95 indicator controls (Intensity, Focus, Master Gain, etc.) for best presentation.

Ground operation:

WARNING

- Do not operate radar equipment in ANT position during ground operation unless adequate precautions are taken.
- Aircraft must be moved to isolated area because of radiation hazard.
- Radiation signs will be posted to warn personnel to keep away.
- Outside radome door must be open to provide ventilation to radome housing.

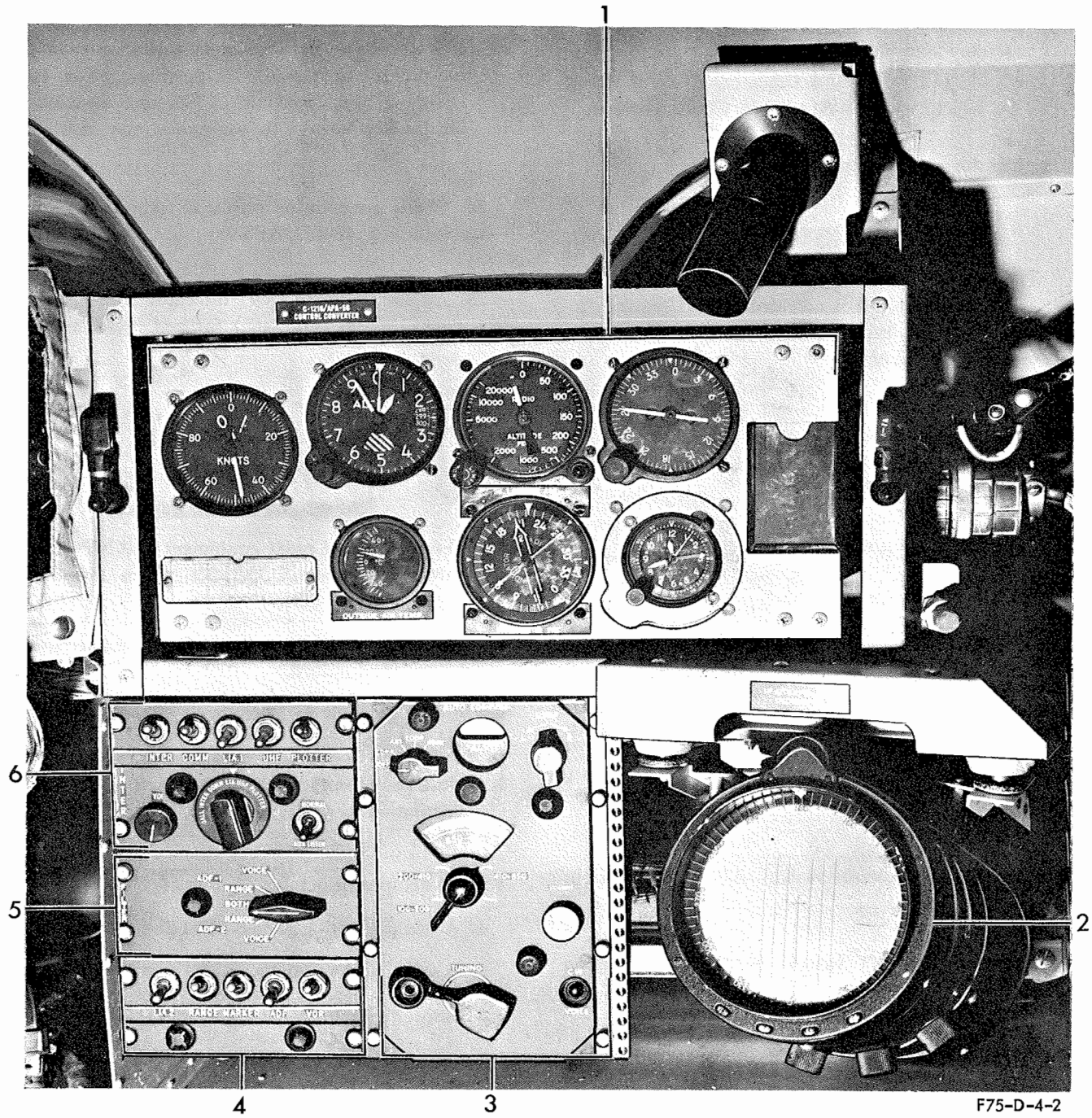
To turn equipment off:

1. Antenna rotation switch—STOP.
2. System switch—OFF.
3. Blower switches—All OFF.

AN/APA-89 CODER GROUP (PROVISIONS ONLY) (EC-121D).

Coder Group AN/APA-89 is an airborne electronic set which operates in conjunction with the AN/APX-25 radar identification set to provide coded electronic recognition known as IFF. The primary purpose of the coder group, when used with the AN/APX-25, is to identify the airplane in which it is installed as friendly, when correctly challenged by an interrogator-responder associated with friendly radars that are ground based, or airborne.

EC-121D. TYPICAL NAVIGATOR'S INSTRUMENT PANEL



1 FLIGHT INSTRUMENT PANEL
2 IP-217/APS-42A OR IP-35/APS-42 INDICATOR
3 AN/ARN-6 RADIO COMPASS REMOTE UNIT
4 AUXILIARY RADIO SELECTOR PANEL
5 RANGE FILTER SWITCH PANEL
6 RADIO AND ICS CONTROL PANEL

Figure 4-38

AN/APA-159 CONTROL INDICATOR GROUP (EC-121D).

The control indicator group, AN/APA-159 system includes the following components: five azimuth and range indicators, one camera scope IP-230/APA-56, one signal distributor J-294/APA-56, one relay assembly RE-144/APA-56, and one voltage regulator CN-212/APA-56. The operation of control indicator group AN/APA-159 is accomplished primarily from the five azimuth

range indicator AN/APA-159 consoles. Each console requires one operator, and each of the five may be operated independently. Although several auxiliary functions are performed from some of the other units, the consoles are the center of operations. At these consoles the search area is combed for targets, and these targets plotted and tracked when they are discovered. Control of intercepter operations may also be affected from the consoles, depending upon the type of tactical operation being performed. Circuit breakers are located on the radar technician's auxiliary circuit breaker panel. Power for the equipment is supplied from the aircraft's 28-volt dc system and from the 115-volt ac inverter system and 115-volt ac generators.

Azimuth and Range (Repeat) Indicator, IP-230/APA-56.

The IP-230/APA-56 presents video information on a 5-inch, centered PPI display. By use of a 35mm camera and a periscope, the video information includes search video, beacon and mixed IFF video, range marks, and angle marks.

AN/APA-159 System Operation.

To put into operation:

1. VOLTAGE REGULATOR CN-212/APA-56.

a. Normal-off-emergency switch (radar technician) —NORMAL.

b. DC and synchro switch—DC and synchro.

c. Input-output switch—Input ϕA, ϕB, and ϕC, in turn. (Panel meter should read between 105 and 125 at each position).

d. Input-output switch—Output ϕA. (Panel meter should read 115. Adjust with voltage adjust control as necessary).

e. Input-output switch—Output ϕB. (Panel meter should read 115. Adjust with voltage adjust control as necessary).

f. Input-output switch—Output ϕC. (Panel meter should read 115. Adjust with voltage adjust control as necessary).

2. SIGNAL DISTRIBUTOR J-294/APA-56.

a. Power switch (radar technician)—ON.

b. Meter switch— +220, −220. (Panel meter should read 220 each position).

3. AZIMUTH AND RANGE INDICATOR IP-230/APA-56.

a. Power switch (radar technician)—ON.

b. Intensity control—CW until sweep just appears.

c. Intensity control—CCW until sweep is barely visible.

d. Range marks selector switch—10.

e. Video control—CW for desired intensity.

f. Focus control—Adjust for sharpest sweep line.

g. Range selector switch—50, 100, and 250 in turn. (Sweep should fill tube face at all ranges. 10 mile range marks visible).

4. AZIMUTH AND RANGE INDICATOR AN/APA-159.

Console Adjustments

a. Power switch (radar technician)—ON.

b. Panel lights—Set as desired.

c. All other control knobs—CCW and all switches —OFF.

d. Computer mode switch—SEARCH position.

e. Range selector switch—250 miles.

f. Spare switch—IN.

g. Sweep intensity and focus control—Adjust trace until barely visible and sharply defined.

h. Range mark switch—10 mile markers, adjust master gain control until markers are barely visible.

i. Focus control—Adjust until range marks are sharply defined.

j. Range marks—OUT, master gain CCW readjust sweep intensity until sweep is barely visible.

k. Cursor selector switch—No. 1 and 2 position.

l. Cursor intensity—Adjust to desired brilliance.

m. Cursor No. 1 strobe intensity—Adjust to desired brilliance.

n. Cursor No. 2 strobe intensity—Adjust to desired brilliance.

Alignment Checks

a. APA-57—OUT.

b. Computer mode switch—SEARCH position.

c. Combined slew switch—IN.

d. Cursor No. 1 slew switch—OUT.

e. Range switch—250 miles.

f. Combined slew control—Center sweep under etch mark.

g. Range marks—On 50 mile markers.

h. Cursor bearing control No. 1—Rotate until cursor No. 1 is aligned with 0° mark on compass rose. Read bearing in cursor No. 1 bearing window.

i. Range strobe intensity control No. 1—Rotate until range strobe is superimposed on 50 mile range marker. Read range in No. 1 stobe range window. Repeat for 100, 150, and 200 mile ranges.

j. Repeat steps h and i for 90°, 180° and 270°.

k. Report any error in excess of 1 nautical mile or 1% of the range and any azimuth error in excess of ±2°.

Computer Checks

a. Range selector switch—150 miles.

b. Range mark switch—50 mile markers.

c. Computer mode switch—INTERCEPT position.

d. Target cursor—Rotate to 270° azimuth.

e. Intercept cursor—Rotate to 90° azimuth.

f. Speed dials—Set at 600 knots.

g. Target cursor origin—Place on 50 mile marker (left of etch mark) with cursor through center of 270° marker.

h. Interceptor cursor origin—Place on 50 mile range marker (right of etch mark) with cursor through center of 90° marker.

i. As the sweep passes through cursor origin, press reset button.

j. Record time to nearest second.

k. When tracking strobe reaches 100 mile range marker, record time.

l. Elapsed time check—Should be 5 minutes ±5 seconds.

m. Report any error in computer speed to crew chief.

Ground Stabilization

a. Range mark switch—OUT.

b. Range selector—250 nautical miles.

c. Computer mode selector—SEARCH position.

d. Cursor No. 1 slew switch—IN.

e. Cursor No. 1 slew control—Place cursor No. 1 origin on station center point.

f. Select video presentation.

g. Readjust sweep intensity and master gain control for optimum presentation of MDS signal.

h. APA-57—Designated fix.

Off Centering

a. Rotate cursor No. 1 to reciprocal of azimuth desired.

b. Set range strobe on cursor No. 1 at desired range.

c. With combined slew control, move range strobe on cursor No. 1 under etch mark.

d. You are now off centered. Station center point is at the origin of cursor No. 1, use grease pencil to mark this position.

Height Request

a. Search mode.

b. Cursor No. 1 slew switch—OUT.

Note

Cursor No. 1 slew switch must be out to engage the HRI.

c. Rotate azimuth crank cursor No. 2 to bisect target blip.

d. Rotate range crank cursor No. 2 until range strobe is 10 miles short of target blip.

e. Press height request button on priority panel 1A10.

f. Read transmitted altitude in window on C-4815 readout panel.

g. Cursor No. 1 slew switch—IN.

Speed and Course Checks

a. Place computer mode switch in INTERCEPT mode.

b. Place target cursor origin on target blip, and press reset button as the trace passes through target.

c. After any elapsed time, place target cursor through target blip by rotating bearing dial. Read track from arrow on bearing dial.

d. Rotate target speed dial until tracking strobe is on target. Read target ground speed from speed dial window.

e. If more than one target speed is desired, intercept side of panel may be used the same way as target side.

CAUTION

When using intercept side of panel, the interceptor bearing correction dial must read 0°.

f. Once step c has been accomplished, scope may be returned to SEARCH mode of operation without disturbing speed problem. Longer elapsed time will give a more accurate speed check.

To turn equipment off:

1. AZIMUTH AND RANGE INDICATOR APA-159.

a. Turn all control knobs full CCW and all video switches off.

b. Power switch (radar technician)—OFF.

2. AZIMUTH AND RANGE INDICATOR IP-230/APA-56.

a. Intensity controls—Full CCW.

b. DC and synchro switch (radar technician)—OFF.

c. All video and function switches—OFF.

3. SIGNAL DISTRIBUTOR J-294/APA-56.

a. Power switch—OFF.

4. VOLTAGE REGULATOR CN-212/APA-56.

a. Normal-off-emergency switch—OFF.

b. DC and synchro switch (radar technician)—OFF.

AN/APS-42 NAVIGATION RADAR (EC-121D).

This radar set is designed for use as a navigational aid, as an anti-collision warning device, and as a search instrument. Either a pencil-beam pattern or a cosecant-squared beam may be formed by the reflector. The antenna, which is located in the nose of the aircraft, is pitch-and-roll stabilized so that it maintains an essentially constant inclination in adverse flying conditions. The nose radome is unpressurized. However, pressurization is provided for some components within the radome. Two indicators may be used at one time. One is located at the navigator's station (6, figure 4-37) and the other on the pedestal floor between the pilot and copilot (figure 4-39) in accordance with operational requirements. The radar uses both ac and dc power. Circuit breakers are located on the radio operator's auxiliary panel. The ac power is furnished by the No. 2 instrument inverter. The control unit contains all of the operating controls for the radar as well as the tilt indicator. The control unit is located on the pilots' overhead panel.

Function Switch.

The function switch energizes the equipment, and selects SEARCH, BEACON, or WEATHER operation.

Note

Insure antenna is scanning prior to placing function switch from STANDBY to SEARCH or SEARCH to STANDBY.

Obs-Map Switch.

This switch operates the beam-pattern change motor in the antenna assembly. The OBS position provides the pencil beam and the MAP position provides the cosecant-squared beam.

Antenna HTR Switch.

Antenna AS-428A/APS-42 does not employ heaters, as satisfactory operation is obtained without their use. However, Radar Set Control C-818A/APS-42 has a HTR position in order to satisfy the interchangeability requirements. When antenna AS-428A/APS-42 is used the HTR position of the switch is not connected. This switch should be left in the OFF position at all times. When starting antenna AS-428A/APS-42 at low ambient temperatures, turn the scan switch to FULL and the range switch from OFF to STANDBY. Wait at least five minutes before selecting any combination giving a fast scan rate or sector scan. If ambient temperature is below −20° C, wait ten minutes before changing scan rate.

Scan Switch.

The scan switch controls the rotation of the antenna. The FULL position rotates the antenna 240 degrees in azimuth centered along the airplane longitudinal axis and the SECTOR position rotates the antenna 120 degrees. The apex of the sector is automatically offset on SECTOR position for all ranges except the 200 mile position, thus giving a larger size sweep on the scope.

Range Switch.

This switch has 5, 10, 30, 100, 200 mile and TD positions and is used to select the minimum operating range of the equipment.

Gain Control.

The gain switch adjusts the sensitivity of the radar set and should be adjusted to the point at which the target has the clearest presentation.

EC-121D. PILOTS' AN/APS-42 INDICATOR

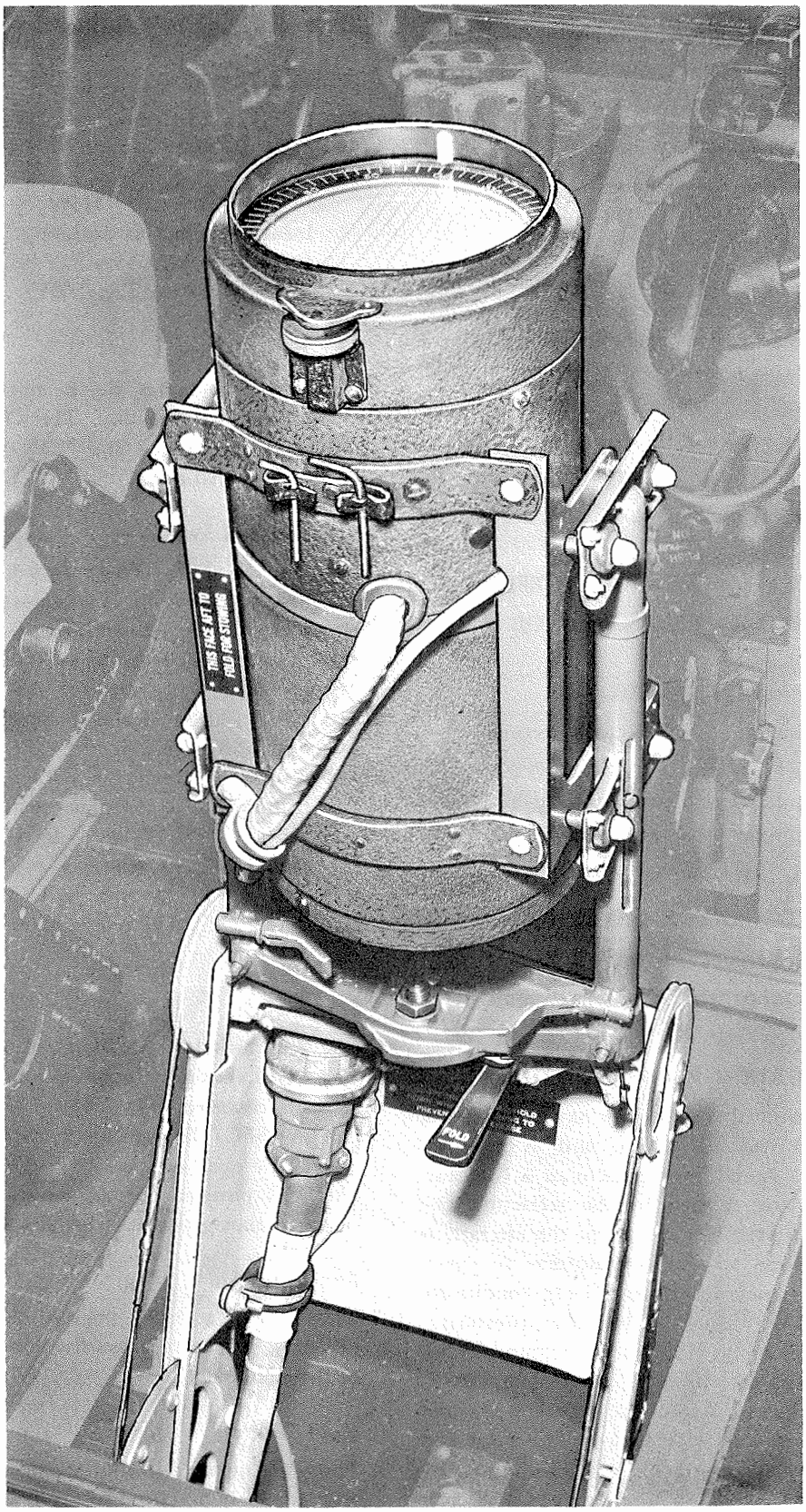


Figure 4-39

Tune Switch.

This switch has AFC and MAN positions. When the switch is in the MAN position the switch must be turned until the targets come in clear. Normally the switch is left in the AFC (Automatic Frequency Control) position and the tuning is automatic.

A-J Switch.

This switch has OUT, FTC, and IAGC positions. In the OUT position the FTC (Fast Time Constant) and IAGC (Instantaneous Automatic Gain Control) circuits in the receiver are inoperative. In the FTC position, the FTC circuit is operative, reducing clutter and sharpening up targets as presented on the PPI. In the IAGC position, both the FTC and IAGC circuits are operative. Clutter is practically eliminated and all targets are sharpened.

STC. Switch.

This switch has OUT and ON positions. In the OUT position of the STC (Sensitivity Time Control) switch, the STC circuits are inoperative, with the receiver gain functioning normally. In the ON position, the STC circuits are operative, thereby reducing the intensity of presentation of targets and clutter effective in the first 3 to 4 miles of range.

Antenna Stab. Switch.

This switch has STAB and OUT positions. When the switch is in the STAB (normal) position, the radar antenna is stabilized by gyros to compensate for pitch and roll of the aircraft so that the target will not be lost.

Delay Switch.

This switch provides a movable range spot, variable between 5 and 175 miles, on the first five positions of the range switch. On the sixth or TD position of the range switch, the movable range spot becomes the start of the 30 mile expanded sweep. The 30 mile expanded sweep can be started between 5 and 175 miles from the aircraft by means of the delay control. These indicators have the following five adjustments: edge light dimmer, focus control, cursor knob, video gain control and an intensity control.

Edge Lights Control.

This control is used to adjust the illumination of the indicator lights to the desired brilliance.

Focus Control.

The focus control is used to obtain a clear presentation.

Cursor Control.

This knob turns the cursor that is calibrated in degrees so that bearings to targets can be determined.

Video Gain Control.

This control is used in conjunction with the gain switch on the control unit. Turn the gain control on the control unit to zero and then adjust the video gain control until the range marks are observed. Then adjust gain control on the control unit until the target is clear.

Intensity Control.

This control is used to adjust brilliancy of the trace.

AN/APS-42 Operation.

Note

CCW denotes counterclockwise; CW denotes clockwise.

Before Operation Checks:

Pilot and navigator indicators.

1. Intensity control—CCW to OFF.
2. Focus control—CCW to OFF.
3. Edge lights control—CCW to OFF.
4. Cursor control—Zero.

Radar set control panel.

5. Antenna HTR switch—OUT.
6. Function switch—OFF.
7. Scan switch—STOP.
8. Gain control—CCW to OFF.
9. A-J switch—OUT.
10. STC switch—OUT.
11. Antenna STAB switch—OUT.
12. OBS-MAP switch—OUT.
13. Tilt control—CENTER.
14. Range switch—10 MILES.
15. Delay switch—175 MILES.
16. Tune switch—AFC.
17. Pressurization indicator—28-31″ Hg.

Turn On Procedure:

During cold weather operation turn Scan switch to FULL and Range switch to 100 MILES before turning the Function switch from OFF to STANDBY. Wait at least five minutes (ten minutes if below −20° C) before selecting a fast scan rate or Section scan.

Radar set control panel.

1. Function switch—STANDBY.

Note

Normal operation begins after a three minute time delay cycle. This cycle is completed when the sweep appears on the indicator screens.

Pilot and navigator azimuth and range indicator.

2. Intensity control—Check sweep (plainly visible).

3. Focus control—Check sweep (sharp and clear).

4. Intensity control—Turn CCW until sweep just visible.

5. Edge light control—As desired.

Radar set control panel.

6. Scan switch—FULL (240°) for general coverage. SECTOR (120°) for specific objects ahead of aircraft.

7. Function switch—SEARCH.

8. Gain control—CW for clearest viewing and definition.

9. A-J switch (if required)—FTC (reduces sea return or heavy masses of objects). LAGC (further sharpening of display) readjust GAIN control if required.

10. STC switch (if required)—STC (reduces intensity of nearby objects, ground clutter and sea return).

11. Antenna STAB switch—STAB.

12. OBS-MAP switch—OBS (pencil beam for longer range or object at same altitude) MAP (for terrain). Use zero TILT and STAB when utilizing MAP.

13. Tilt control—UP or DOWN as required (OBS position).

14. Lights control—As required for cursor and range marker lights.

15. Range switch—As required.

Note

- Range marks are as follows:

Range	Number of Marks	Distance in miles between marks
5 miles	2.3	2
10	5	2
30	6	5
100	4	25
200	8	25
TD	6	5 (variable)

- Readjust TILT after changing range if in OBS position.

16. Tune switch—MAN (check whether manual tuning is sharper than AFC).

Beacon Operation.

Radar set control panel.

1. Function switch—BEACON.

2. Range switch—200 miles or lesser range if desired. TD position may be used for amplified view. Do not use TD continuously; this overloads the beacon transmitter.

3. Antenna STAB switch—STAB.

4. Scan switch—SECTOR or FULL.

5. Gain control—Best return.

6. Tilt control—Best return.

Pilot and navigator azimuth and range indicator.

7. Edge lights control—Best viewing position.

Weather Operation.

Radar set control panel.

1. Function switch—WEATHER.

2. Range switch—As desired. Use TD position to observe particular formations.

3. Scan switch—SECTOR or FULL.

4. OBS-MAP switch—OBS.

5. Tilt control—Start with ZERO. Then adjust slightly for clearest presentation.

Note

TD position will provide an amplified and more complete analysis of weather formation.

Standby Operation.

Place Function switch to STANDBY. There is no transmission or reception when in STANDBY position.

To turn equipment off:

Radar set control panel.

1. Function switch—STANDBY.
2. Scan switch—STOP, 180°.

Note

Position antenna 180° from dead ahead through intermittent operation of the SCAN switch.

3. Tilt control—FULL UP (minimum pick-up position).
4. Gain control—CCW.
5. Delay switch—CCW to 175.
6. A-J switch—OUT.
7. Range switch—10 MILES.
8. Tune switch—AFC.
9. All toggle switches—DOWN.

Pilot and navigator azimuth and range indicator.

10. Intensity control—CCW to OFF.
11. Focus control—CCW to OFF.
12. Edge lights control—CCW to OFF.

Radar set control panel.

13. Function switch—OFF.

Note

Pressurize wave guide system to 40" Hg. Return switch to AUTOMATIC (down) position. This prevents wet air from entering wave guide system (through undetected leak) as requirement cools off.

AN/APS-42 RADAR PRESSURIZATION SYSTEM (EC-121D).

The radar pressurization system is designed to maintain an air pressure approximately equal to that of the atmosphere at sea level in the AN/APS-42 radar transmitter-receiver and associated wave guides. A pressure switch automatically energizes the air compressor when the line pressure drops below 28 inches of mercury (absolute) and stops the air compressor at about 32 inches. A check valve at the air compressor outlet retains pressure in the line after the compressor is stopped. This system is capable of pressurization, at any altitude within the limits of the aircraft. However, the cabin superchargers are able to maintain sea level pressure within the pressurized sections of the aircraft, thence through lines to the radar, up to an altitude of 12,000 feet. If cabin pressure is maintained at a value below 2,000 feet the radar pressurization system usually will not operate; therefore, if this system should fail it may be possible to pressurize the cabin sufficiently to continue use of the radar. The radar pressurization controls and indicators are mounted on a panel located on the copilot's side panel.

CAUTION

Do not operate radar when radar pressure indicator shows pressure below 26 inches of mercury.

A silica gel dehydrator, located in the flight station, is installed in the radar pressurization lines to remove moisture from the cabin air that is used to pressurize the radar components.

Radar Pressurization Switch.

This switch has three positions: NORMAL, ON, OFF and is spring-loaded from the momentary ON to the OFF position. In the NORMAL position, the pressure switch controls the air compressor. When the switch is held in the momentary ON position, the pressure switch is bypassed and the compressor is energized.

Bleed Button.

This button is used to bleed pressure from the lines so that the pressure indicator can be calibrated.

Radar Pressure Indicator.

This indicator shows the air pressure in the radar pressurization lines.

Radar Pressure Indicator Light.

This indicator glows when the radar pressurization pump is operating.

Calibration of Radar Pressure Indicator.

1. Turn radar pressurization switch OFF.

2. Turn the dial shield to point the calibration arrow at approximately sea level pressure (29.92 on the instrument).

3. Depress the bleed button and hold until any existing pressure differential is equalized. The pressure gage should then indicate the barometric pressure of the station at which the aircraft is located. If this barometric pressure is unknown, the average reading of the supercharger pressure ratio indicators may be used as the true barometric reading while the aircraft is on the ground.

AIR SITUATION PLOTTING BOARD (EC-121D).

An edge-lighted vertical-plot air situation plotting board is located forward of the right hand SRO consoles. Two operators will care for the display board and post information to allow SRO operators to view air situations as they develop. A two position ON-OFF switch on the forward edge of the board controls the board lighting. Circuit breakers for the plotting board are located on the remote circuit breaker panel.

COMMUNICATIONS AND ASSOCIATED ELECTRONIC SYSTEMS (TC-121C).

Communication and electronic equipment consists of radio and interphone equipment that provides aircraft to aircraft communication, aircraft to ground communication, interphone communication between flight crew members, navigation equipment for guidance and blind landings. (This is in addition to other electronic equipment such as automatic pilot, electronic fuel gage timers, etc., which are described in other sections of this manual.) A functional breakdown of the equipment in the aircraft is listed on the Table of Communications and Associated Electronic Equipment (figure 4-40).

POWER DISTRIBUTION SYSTEM (TC-121C).

Power for radio and other electronic equipment is obtained from the 28-volt dc bus and two 115/208-volt, 3-phase 400-cycle inverter systems which furnish fixed-frequency alternating current. There are four fixed-frequency inverters installed: the main and spare electronic inverters and the main and spare instrument inverters. The electronic inverters supply ac power primarily for navigational equipment. The instrument inverters supply ac power primarily for the flight and engine instruments. These inverters supply ac power for equipment having 390 to 410 cycle ac requirements. The changeover to the spare inverter in each inverter system can be accomplished manually or automatically. Direct and alternating current power is supplied to the radio equipment through circuit breakers on the radio operator's circuit breaker panel. The direct current bus in the radio operator's circuit breaker panel is supplied through two, 130-amp current limiters at the main direct current power bus in the forward lower compartment. Fixed frequency alternating current power is supplied to the radio operator's circuit breaker panel from the three phases of the instrument inverters. Fixed-frequency, alternating current power is supplied through fuses in the alternating current fuse panel in the forward lower compartment.

External Power Receptacles.

Two external dc power receptacles, one for the main bus and one for the electronic bus, are located left of the centerline on the fuselage under side, aft of the wing trailing edge.

Junction Boxes.

Two main junction boxes are employed. These boxes are defined as follows: forward radio junction box and main radio junction box. The forward radio junction box contains the auxiliary IFF relay, public address system relays, signal attenuating resistors for the VOR, ADF, and C-1 equipment, an audio resistor panel, an ICS switch and VOR test receptacle. This box is located on the forward side of the rack and covers the upper half of the rack. The main radio junction box contains two HF muting relays, three AN/ARC-27 radio noise filters, and two signal attenuating resistors for the IP-250/ARN indicators. This box also contains ac and dc circuit breakers for the radio and interphone equipment. The box is located under the radio operator's table on the aft side of the main radio rack. Extending aft along the aisle side of the table is the box containing the radio equipment circuit breakers. This box is connected to the main radio box and is similarly identified. The circuit breaker panel is on the aft side of this box.

RADIO HEAT EXHAUST DUCT SYSTEM (TC-121C).

The heat generated by the electronic equipment in the forward radio rack is exhausted through a venturi in the skin of the fuselage, outboard of the rack.

Radio Rack Heat Exhaust Vent Control.

Exhaust of radio rack heat is controlled by a center-mounted, push-pull type release mechanism mounted on the second shelf of the flight station radio rack (6, figure 4-43). This control is connected by a sheathed wire

to a bell crank which actuates a butterfly valve in the throat of the venturi.

ANTENNA SYSTEM (TC-121C).

The antenna system is installed as shown on figure 4-48.

INTERCOMMUNICATION SYSTEMS, AN/AIC-8 (TC-121C).

An interphone system and a public address system are installed in the aircraft. The interphone system is designated as FLIGHT CREW. The flight crew interphone system also includes service and radio facilities with the flight crew and mechanics' stations connected by a conventional push-to-talk system with call facilities. The flight crew interphone system receives and distributes audio signals for each of the stations connected to the system. The LAC public address system is controlled by the pilot.

RADIO SELECTOR BOXES (TC-121C).

(See figure 1-8).

The selector boxes provide a means of selecting the audio output of any one of several receivers and interphone communications, and a means of connecting the microphone to a desired transmitter.

Selector Box Control Panel.

The pilot, copilot, navigator, radio operator, and flight engineer stations are equipped with this panel which contains the following controls:

Microphone Selector Switch. This rotary-type switch is located at the lower center of the panel and provides six possible modes of transmission. The CALL position is used to alert any or all stations in the intercommunications system. The microphone selector switch is spring-loaded to rotate to INTER position from the CALL position when the switch is released. The INTER position is used for interphone communication between the various stations in the aircraft. The remaining four positions are labeled according to the function provided at the various stations. The HF COMM position directs transmission through the command AN/ART-13 transmitters.

The LIAISON position utilizes the liaison AN/ART-13 transmitter. The UHF position directs transmission through the AN/ARC-27 equipment. When microphone output is to be directed through a radio transmitter, it is necessary to set up the desired frequency on the control panel for the individual radio.

Monitoring Switches. Five toggle switches are arranged horizontally across the top of the panel. These switches control the choice of aural reception coming through the headphones. Placing any switch in the down position cuts off audible sound from the related circuit. Placing any switch in the up position connects the audio output from the related receiver or interphone circuit to the headphones. Any combination of circuits may be monitored simultaneously.

Normal-Aux. Listen Switch. This switch is a toggle-type switch located to the right of the microphone selector switch. In the NORMAL position simultaneous reception of all receivers is possible. In the SINGLE REC. position priority reception may be set.

Volume Control. The VOL control is located to the left of the microphone selector switch and regulates the audio level of the signal head in the headphones. This control does not regulate volume when CALL facility is being used.

FLIGHT CREW INTERCOMMUNICATION SYSTEM (TC-121C).

This equipment provides voice and signal communication at all altitudes. It incorporates four facilities: intercommunication within the aircraft communication beyond the aircraft by means of radio equipment; monitoring of received radio signals, including simultaneous monitoring of a number of radio receivers; a call facility for use in establishing communication between stations of the aircraft intercom system. Intercommunication stations are provided at the following locations: pilot, copilot, flight engineer, navigator and radio operator. The mechanics' interphone system is comprised of the following stations: forward lower compartment, aft lower compartment, the four engine nacelles, nose gear compartment, and tail cone. Each station includes a jack box. The mechanics' stations circuits are wired through external terminal strips so that all circuits to these stations may be disconnected from the system by throwing a toggle switch located on the forward radio junction box, directly behind the pilot's station. Primary power for operating this equipment is supplied from the main dc bus through the radio junction box at 28-volts. The system is energized when the dc bus is energized.

AN/AIC-8 Operation.

To put into operation:

1. Aircraft power supply—On.
2. Circuit breakers—On.

TC-121C. TABLE OF COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT

Type	Designation	Function	Range	Location of Controls
COMMUNICATIONS				
Interphone System	AN/AIC-8	Inter-crew communication, audio distribution, microphone function	Crew stations within aircraft	Pilot's, radio operator's, flight engineer's, navigator's stations.
Public Address System	LAC	All crew stations and mechanics	All crew stations and mechanics	Pilots
UHF transmitter-receiver	AN/ARC-27	Short-range, two-way voice communication	Line of sight	Pilot's, radio operator's stations.
HF liaison receivers	AN/ARR-15A	Reception of voice, CW or MCW communication		Radio operator's station.
HF command receiver	AN/ARR-15A	Reception of voice, CW or MCW communication		Pilot's, radio operator's station.
HF liaison transmitter	AN-ART-13A	Voice, CW or MCW transmission.	250 to 2,000 miles.	Radio operator's station.
HF command transmitter	AN/ART-13A	Voice CW or MCW transmission	250 to 2,000 miles.	Pilot's, radio operator's station.
NAVIGATION				
Omni and ILS	AN/ARN-14A	Reception of VOR, and localizer signals.	300 miles.	Pilot's station.
TACAN System	AN/ARN-21	Reception of VOR signals gives bearings and distance information.	195 nautical miles.	Pilot's station.
Loran receiver	AN/APN-9	Reception of long-range radio navigation signals	Day—700 miles. Night—1,400 miles.	Navigator's station.
Loran receiver	AN/APN-70	Reception of long-range radio navigation signals		Navigator's station.
Radar identification transponder	AN/APX-25	Transmission of identification signals.	Line of sight.	Radio operator's station.

Figure 4-40 (Sheet 1 of 2)

TC-121C. TABLE OF COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT (Continued)

Type	Designation	Function	Range	Location of Controls
Radio altimeter (low alt)	AN/APN-1	Indicates altitude above terrain.	4,000 feet.	Pilot's station.
Radar altimeter (high alt)	SCR/718C	Indicates altitude above terrain.	40,000 feet.	Navigator's station.
Marker Beacon	AN/ARN-12	Reception of marker beacon signals.	Line of sight.	Pilot's station.
Radio Compass	AN/ARN-6	Reception of voice or code signals for direction finding and bearings.	100 to 300 miles.	Pilot's and navigator's station.
Glide Slope receiver	AN/ARN-18	Reception of glide slope signals from ILS stations.	30 miles.	Pilot's station.
UHF direction finder	AN/ARA-25	UHF reception of signals and homing.	Line of sight.	Pilot's station.
MISCELLANEOUS				
Frequency meter	LM-14	Frequency measuring equipment.		Radio operator's station.
EMERGENCY				
Radio transmitter	AN/CRT-3	Transmission of emergency CW signals		On equipment.

Figure 4-40 (Sheet 2 of 2)

To turn equipment off: (Normal)

1. Equipment turns off when power supply is removed or turned OFF.

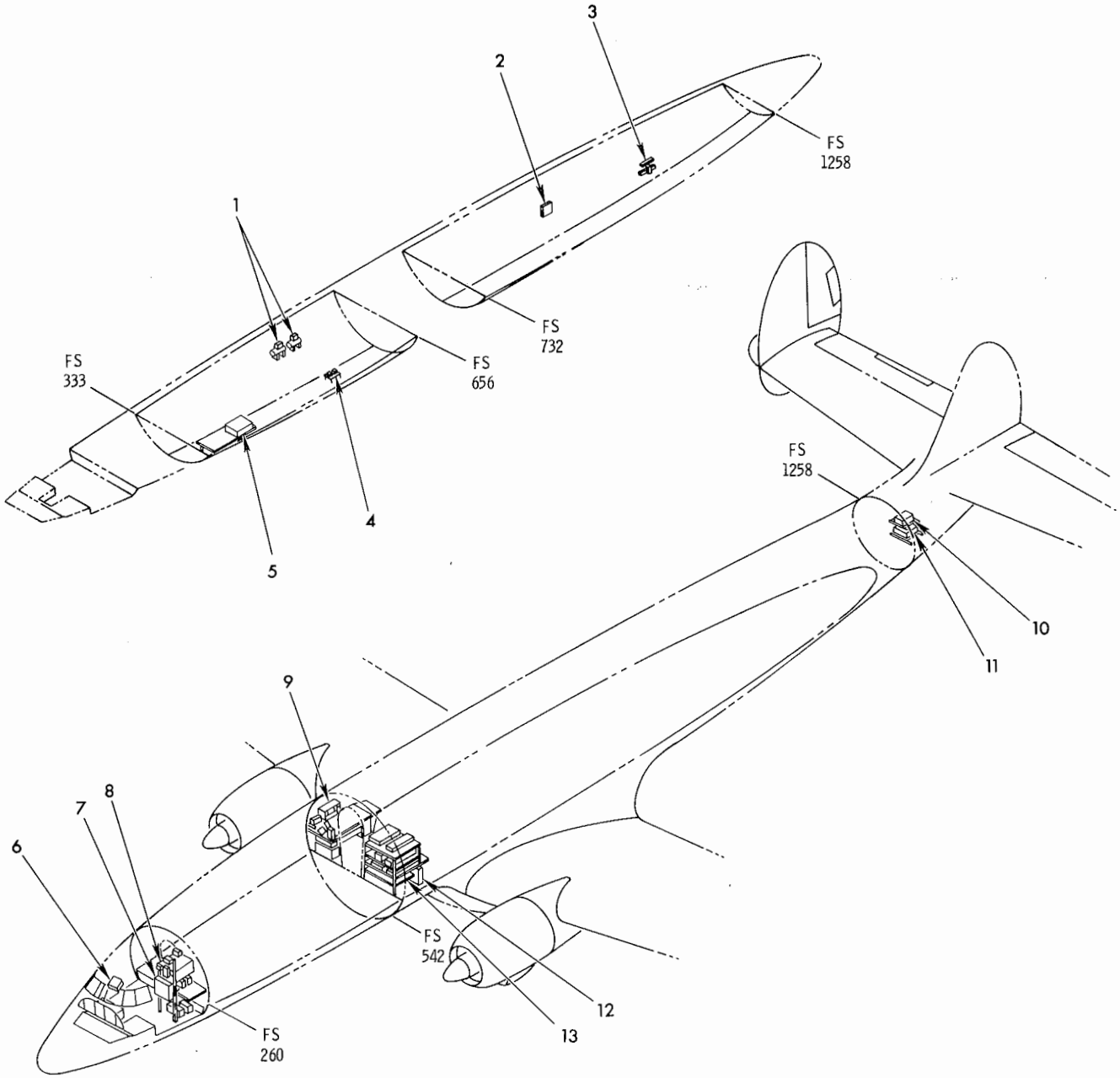
To turn equipment off: (Emergency)

1. Trip the circuit breakers in the radio junction box.

LAC PUBLIC ADDRESS SYSTEM (TC-121C).

The public address system is operated by dc power. The system is used to make general announcements to the flight crew or to ground personnel. The pilots have priority operation of the public address system. The public address system has 4 loudspeakers: three in the flight station and one in the nose wheel well.

TC-121C. ELECTRONIC EQUIPMENT LOCATIONS



1 ELECTRONIC INVERTERS
2 AFT LOWER COMPARTMENT CIRCUIT BREAKER
3 TRAILING WIRE ANTENNA EQUIPMENT
4 DY-17/ART-13 DYNAMOTORS (2)
5 AN/ARC-27 UHF RADIO SET
6 PILOT'S OVERHEAD RADIO CONTROL PANEL
7 FORWARD RADIO JUNCTION BOX
8 FLIGHT STATION RADIO RACK
9 NAVIGATOR'S EQUIPMENT RACK
10 SCR-718 RADAR ALTIMETER
11 AN/APN-1 RADIO ALTIMETER
12 MAIN RADIO JUNCTION BOX
13 RADIO OPERATOR'S EQUIPMENT RACK

F75-F-4-305

Figure 4-41

PA Operation.

To put into operation:

1. Aircraft dc power supply—On.
2. PA circuit breakers—On.

To turn equipment off:

1. PA circuit breakers—Off.

Pilot's Public Address Control Panel.

The pilot's public address control panel is located on the pilots' overhead or side panel. The panel includes one two-position (ON and OFF) power switch, one three-position (LOW, HIGH and MED.) flight station speaker volume switch and one two-position (INTERNAL and EXTERNAL) speaker selector switch. When the power switch is in the ON position the pilot or copilot may transmit through the PA system. The volume control switch controls the volume to the loudspeakers. The speaker selector switch allows the pilot or copilot to transmit to the ground crew when it is in the EXTERNAL position; when the switch is in the INTERNAL position the pilot or copilot may transmit to the flight crew.

AN/ARC-27 UHF TRANSMITTER RECEIVER SETS (TC-121C).

(See figures 4-44 and 4-46).

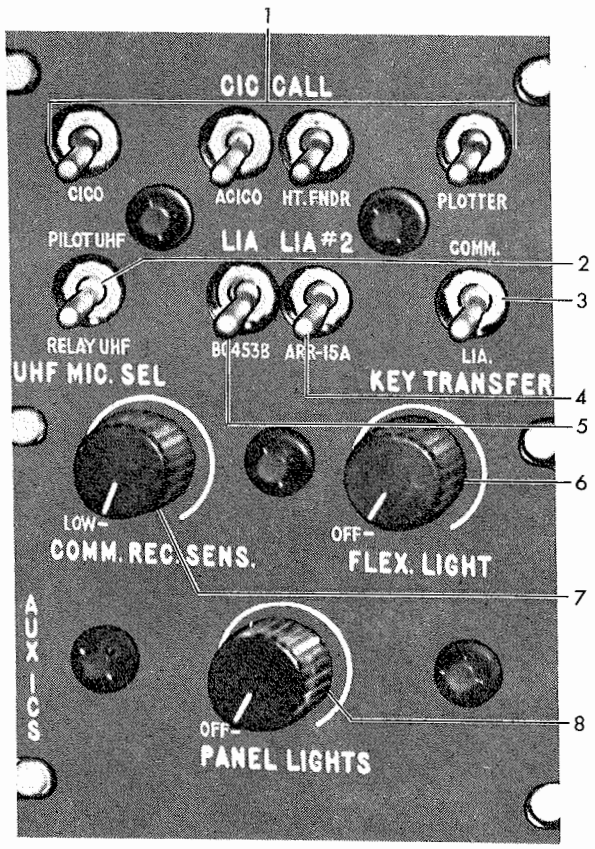
Three AN/ARC-27 transmitter-receiver sets are installed in the aircraft and operate on 28-volt dc power from the radio operator's junction box. These sets provide short range communication between aircraft and between the aircraft and ground stations. The No. 6 AN/ARC-27 transceiver is available to the pilot. Controls for this transceiver are located on the pilot's overhead radio control panel (14, figure 1-8). If the pilot's AN/ARC-27 UHF set becomes inoperative or if conditions warrant the use of a back-up transceiver, the No. 7 or No. 8 AN/ARC-27 UHF sets are available to the pilot upon request. However, it is not possible to transmit on two separate frequencies simultaneously when using the No. 7 or No. 8 UHF sets because it is not possible to select both sets at the same time. The radio operator will set up the transceiver, channel, and volume as requested by the pilot. On modified aircraft any one of 1750 frequencies can be selected.

AN/ARC-27 Operation.

To put into operation:

1. Aircraft power supply—On.

TC-121C. RADIO OPERATOR'S AUXILIARY ICS PANEL



1 INOPERATIVE
2 UHF MICROPHONE SELECTOR SWITCH
3 KEY TRANSFER SWITCH
4 AN/ARR-15A LIASON RECEIVER SELECTOR SWITCH
5 INOPERATIVE
6 FLEX LIGHT RHEOSTAT
7 COMMAND RECEIVER SENSITIVITY RHEOSTAT
8 PANEL LIGHTS RHEOSTAT

Figure 4-42

2. Function selector switch—T/R or T/R & G REC.

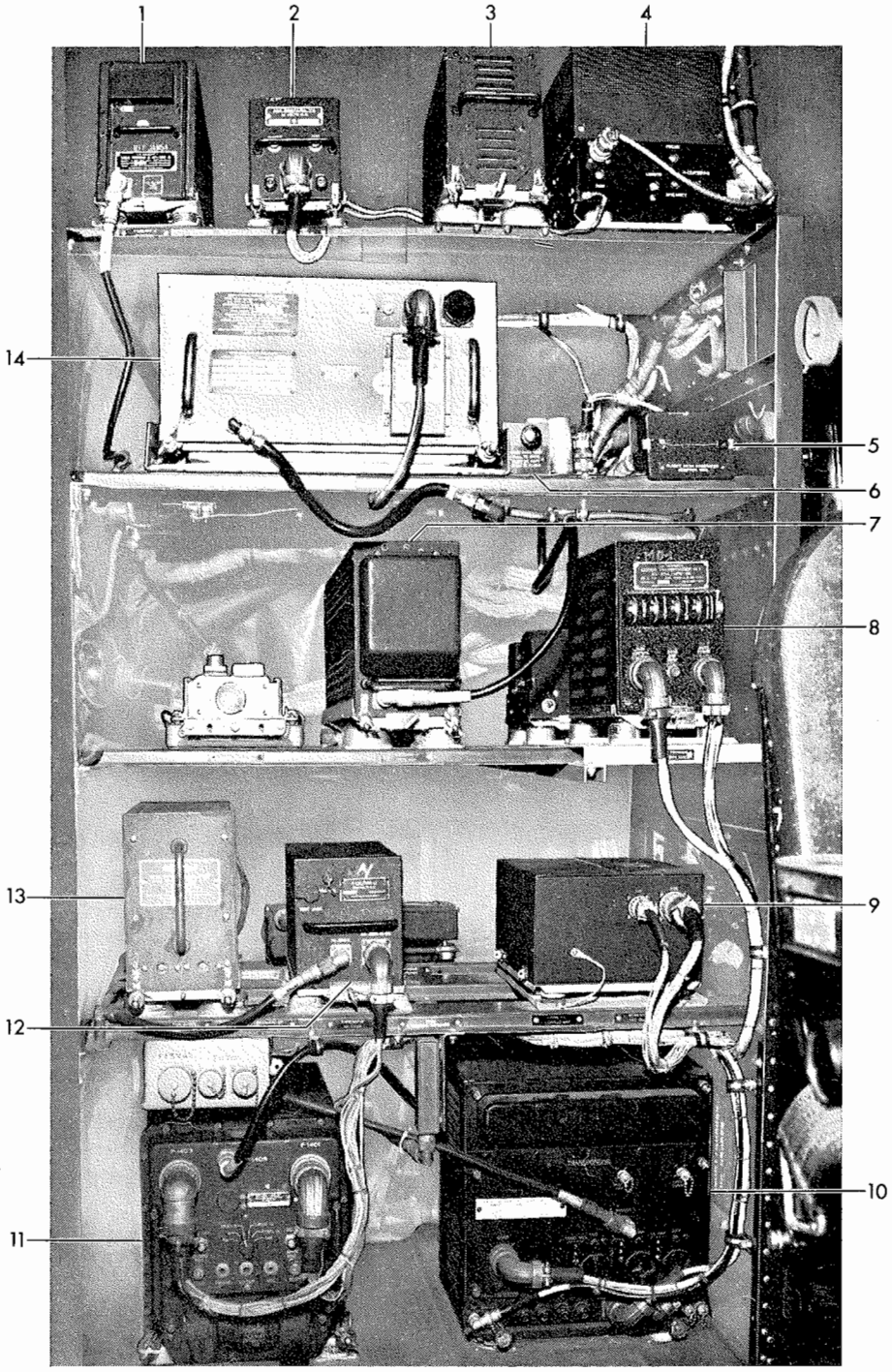
3. Receiver monitoring switch (on ICS selector control panel)—VHF command for No. 6. (For No. 7 & 8—Spare toggle switch up.)

4. Microphone selector switch—UHF command.

5. Channel selector switch (UHF panel)—Rotate to the desired channel; allow approximately 2 minutes for the set to warm up.

6. Volume controls (UHF control panel and ICS control panel)—Adjust for desired output.

TC-121C. TYPICAL FLIGHT STATION RADIO RACK

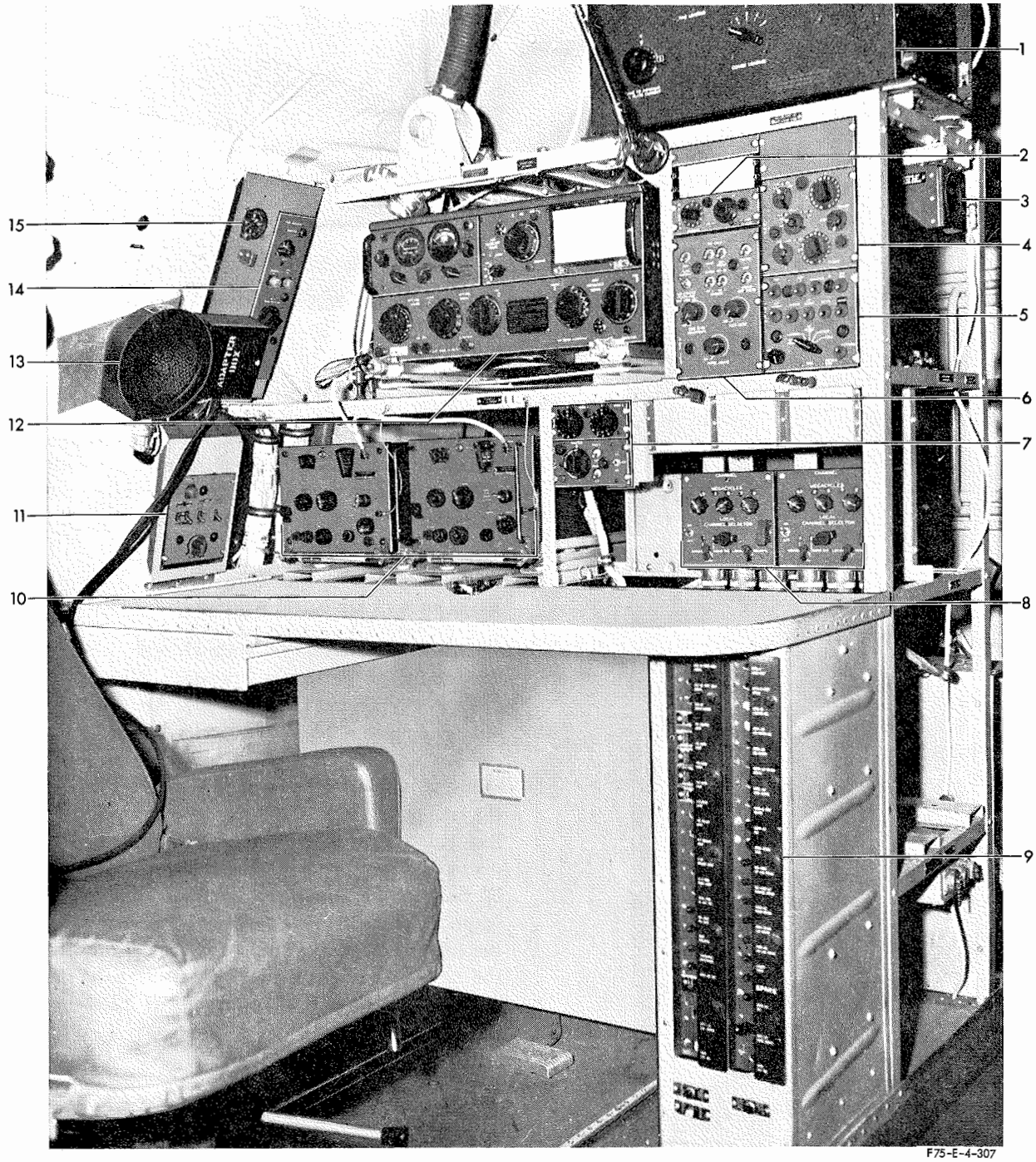


1 R-322/ARN-18 GLIDE SLOPE RECEIVER
2 AM-608/ARA-25 UHF/DF AMPLIFIER
3 DY-66/ARN-14 VOR DYNAMOTOR
4 ENGINE ANALYZER AMPLIFIER
5 FLIGHT PATH COMPUTER ADAPTER BOX
6 RADIO RACK VENT
7 R-252/ARN-14 VOR RECEIVER
8 KY-95/APX-25 IFF CODER
9 C-1 COMPASS AMPLIFIER
10 APX-6 TRANSPONDER
11 RT-178/ARC 27 UHF TRANSCEIVER
12 R 122/ARN 12 MARKER BEACON RECEIVER
13 MI 36 PUBLIC ADDRESS AMPLIFIER
14 AMPLIFIER AND SIGNAL GENERATOR (AUTOPILOT)

F75-E-4-319

Figure 4-43

TC-121C. TYPICAL RADIO OPERATOR'S STATION



1 CU-32/ART-13 ANTENNA LOADING COIL
2 AN/ARR-15 RECEIVER CONTROL PANEL
3 ID 307/ARN AZIMUTH INDICATOR (TACAN)
4 C-853/ARC 27 UHF CONTROL PANEL
5 C-633/AIC-8 INTERPHONE CONTROL PANEL
6 AUXILIARY ICS CONTROL PANEL
7 IFF-SIF CONTROL PANELS
8 C-626/ARC-27 MASTER CONTROL UNIT
9 RADIO CIRCUIT BREAKER PANEL
10 AN/ARN-15HF RECEIVERS
11 CABIN CARGO, RADOME AND FLEX LIGHTS CONTROL PANEL
12 AN/ART-13 LIAISON TRANSMITTER
13 LOUD SPEAKER LS-184
14 ELECTRONIC INVERTER CONTROL PANEL
15 CLOCK

Figure 4-44

TC-121C. TYPICAL RADIO OPERATOR'S CIRCUIT BREAKER PANELS

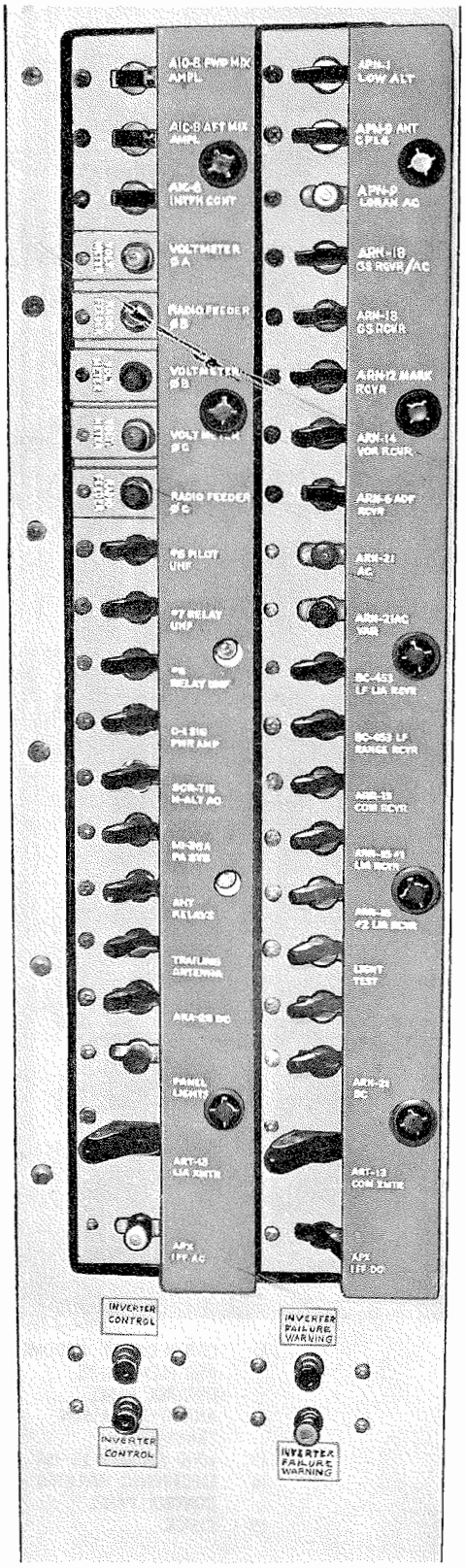


Figure 4-45

TC-121C. C-626/ARC-27 MASTER CONTROL PANEL

F75-E-4-311

Figure 4-46

Note

No transmission will be made on emergency (distress) frequency channels except for emergency purposes in order to prevent transmission of messages that could be construed as actual emergency messages.

AN/ARR-15A HF Radio Receivers.

The three AN/ARR-15A multi-channel, preset receivers are located at the radio operator's (figure 4-44) and navigator's stations (figure 4-50). Any one of ten preset channels can be automatically selected by a rotary channel selector located on the face of the receiver. The receivers will provide voice, CW or MCW reception in the frequency range of 1.5 to 18.5 megacycles. The No. 1 and No. 2 liaison receivers are controlled by the radio operator, while the command receiver may be controlled by both pilots and radio operator. The pilot's, flight engineer, navigator and radio operator may receiver over the command receiver and the No. 1 liaison receiver, but the radio operator is the only member of the flight crew who has receiving facilities on the No. 2 liaison receiver.

AN/ARR-15A Operation.

To put into operation:

1. Aircraft power supply—On.
2. Power switch—ON.
3. CW-MCW-CAL switch—Select desired type of reception.
4. Receiver monitor switch (on ICS selector control panel)—HF.
5. Volume control—After the set has warmed up, approximately 30 seconds, advance the volume control until a slight back-ground noise is heard.

6. Band switch—Set the frequency desired.

To turn equipment off:

1. Power switch—OFF.

AN/ART-13A TRANSMITTERS (TC-121C).

The AN/ART-13A liaison transmitter is located at the radio operator's station (figure 4-44) and selection of the transmitting frequency can only be made by the radio operator. Eleven channels can be preset for automatic selection thereafter. The set will operate in the freqeuncy range of 2,000 to 18,000 kilocycles and 200 to 1,500 kilocycles when using type O-17/ART-13A low frequency oscillator unit. The AN/ART-13A command transmitter unit is located at the navigator's station. The liaison transmitter and two receivers use the left long wire antenna; the command transmitter and receiver use the right long wire antenna.

AN/ART-13A Operation.

To put into operation:

1. Aircraft dc power supply—On.

2. Emission switch—Voice, CW or MCW.

3. Allow the system to warm up (approximately 30 seconds).

Note

No transmisison will be made on emergency (distress) frequency channels except for emergency purposes in order to prevent transmission of messages that could be construed as actual emergency messages.

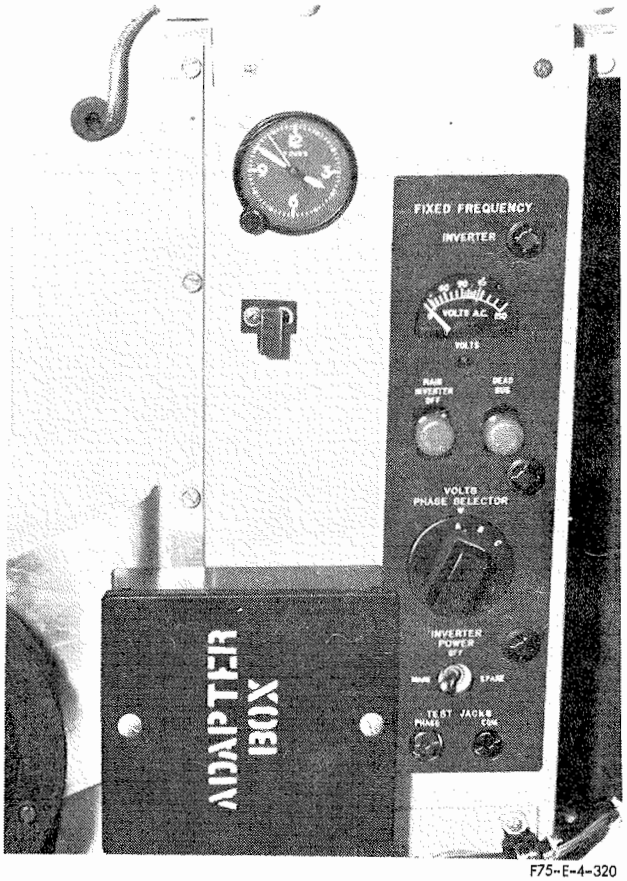
To turn equipment off:

1. Emission switch—OFF.

AN/ARN-14A NAVIGATION RECEIVER (TC-121C).

The VHF omni-directional navigational system is operated from the pilots' overhead control panel (16, figure 1-8). The navigation information is visual and is observed on indicator units at the pilot, copilot and navigator's station. Power is supplied to the equipment from the aircraft 28-volt dc system, 26-volt ac for the indicators from the C-1 amplifier and from the 115-volt ac inverter system.

TC-121C. ELECTRONIC INVERTER CONTROL PANEL



F75-E-4-320

Figure 4-47

AN/ARN-14A Operation.

To put into operation:

1. Aircraft power supply, ac and dc—ON.

2. Power switch (on pilots' overhead VHF NAV control panel)—ON.

3. Receiver monitor switch (VOR on ICS control panel)—ON.

4. Channel selector switch (on the VHF NAV control panel)—Rotate to the desired channel.

5. Volume control (on VHF NAV control panel and ICS control panel)—Adjust for the desired output.

To turn equipment off:

1. Power switch (on pilots' overhead VHF NAV control panel)—OFF.

TC-121C. ANTENNA DIAGRAM

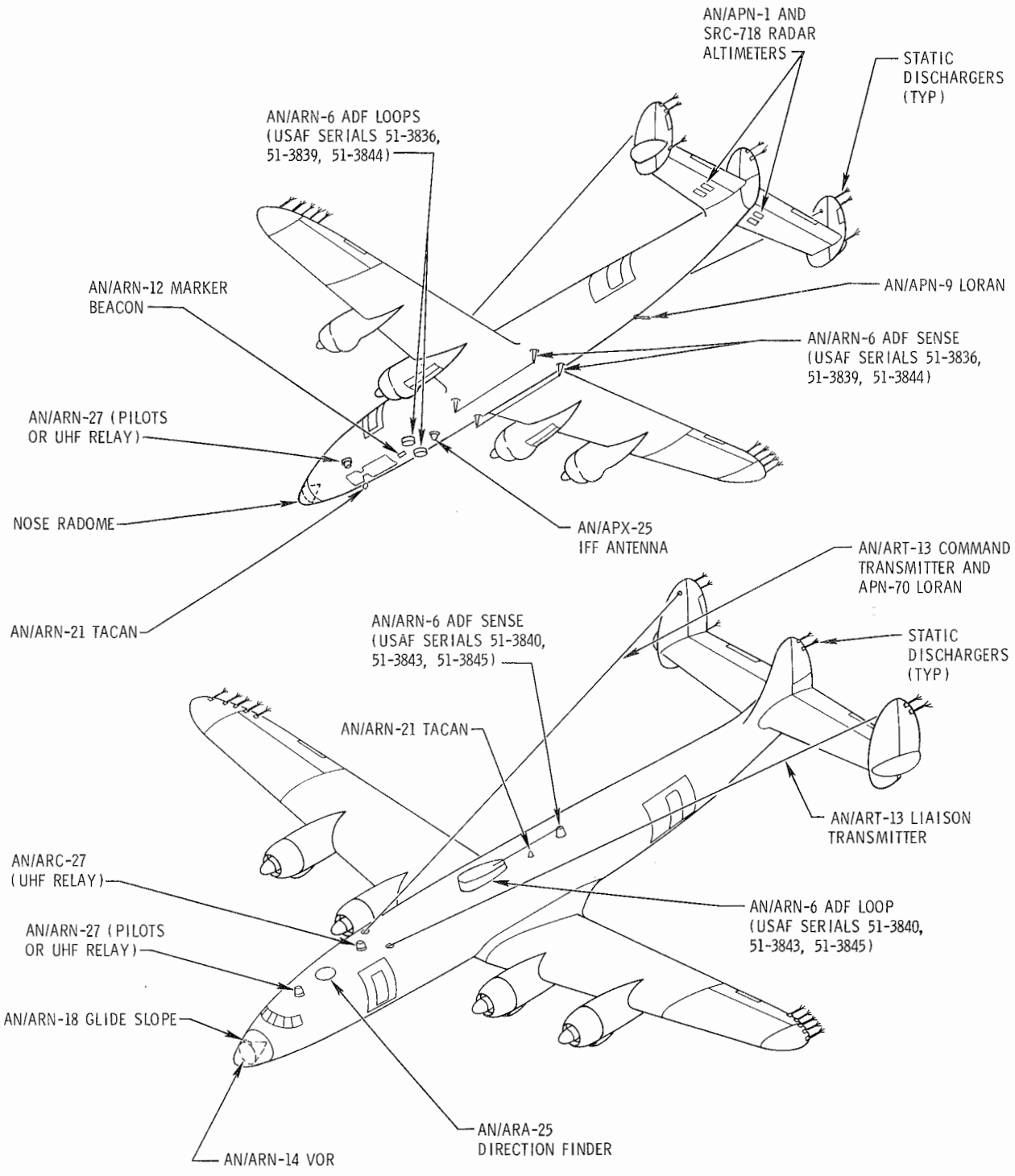


Figure 4-48

AN/ARN-21 TACAN SYSTEM (TC-121C).

The AN/ARN-21 is airborne equipment designed to operate in conjunction with a surface navigation beacon; it provides the pilots with continuous indications of distance and bearing for any selected surface beacon located within a line of sight up to 195 nautical miles. This system is operated from the pilots' overhead control panel (13, figure 1-8). The bearing and distance information are displayed on two separate indicators (2, 3, figure 1-12), the ID-250/ARN-14 radio magnetic indicator and the ID-310/ARN-21 range indicator. Audio selector switches are located on the pilots' overhead radio control panel. The audio output is available for the pilot and copilot only. Power is supplied to the equipment from the 28-volt dc system and from the 115-volt ac inverter system.

Audio Selector Switch.

Two audio selector switches, one on the left side and one on the right side of the pilots overhead radio control panel, select either the ARN-21 audio or the VHF NAV audio. These switches are placarded AUX. VHF, NAV. SEL., VHF NAV. and NAV ARN-21.

Function Switch.

The OFF, REC, T/R switch is a three-position toggle switch. The down or OFF position deenergizes all AN/ARN-21 equipment. The center or REC position, places only the receiver portion of the receiver-transmitter into operation. When the switch is in this position only bearing information is furnished. When the switch is in the up or T/R position the AN/ARN-21 interrogates and receives a signal which produces both distance and bearing information on the respective indicators.

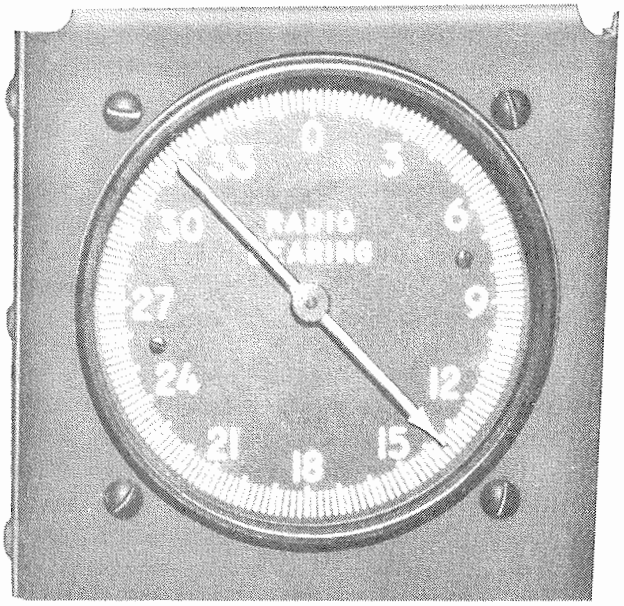
Channel Selector.

The CHAN. selector consists of two rotary switches with knobs and dial skirts for selecting the desired navigation beacon channel. The left-hand knob selects the tens and hundreds figures of the beacon channel number and the right hand knob selects the units figures of the beacon channel number. Combinations of dial settings may be made from 00 to 129. However, the equipment only operates on 01 to 126, a total of 126 channels.

CAUTION

No attempt should be made at any time, to set the CHAN dial below channel 01 or above channel 126.

TC-121C. TACAN INDICATOR ID307/ARN



F75-E-4-309

Figure 4-49

Volume Control.

This volume control is used to adjust the volume of an audio identification signal received from the beacon. The identification signal, audible in the pilots' headphones when they are connected to the regularly used audio jack, consists of a two or three letter tone signal in International Morse Code.

ID-310/ARN Range Indicator.

The ID-310/ARN indicator is installed in the pilots' glare shield panel (3, figure 1-12) and has a single window through which distance is indicated in nautical miles between the aircraft and the surface beacon. The numerals in the window are electronically controlled by the receiver-transmitter range circuits, and serve to display the results computed electronically by these circuits. While the indicator is "searching" for the correct range, the rapidly rotating numbers are partially covered by a red flag which warns the pilots against reading incorrect distance indications.

ID307/ARN Azimuth Indicator (TC-121C).

The ID-307/ARN indicator (figure 4-49) is installed on the radio operator's equipment rack facing the navigator and has a dial face calibrated from 0 to 360 degrees. This indicator has a single centrally pivoted pointer,

electronically controlled by the RT220/ARN-21 azimuth circuits, which indicates the magnetic bearing from the aircraft to the TACAN beacon to which the AN/ARN-21 is tuned. The ID307 must be operative as it provides heading sensitive bearing information for the ID-249 and ID-250 indicators (1, 2, figure 1-12).

ID-250/ARN Radio Magnetic Indicator. The radio magnetic indicator (ID-250/ARN) is installed on the pilots' glare shield panel (2, figure 1-12). The number two needle is operated by the AN/ARN-21; the number one needle is not connected and will swing free.

ID-249/ARN Course Indicator. The ID-249/ARN course indicator is mounted on the pilots' glare shield panel (1, figure 1-12). The course indicator combines the functions of a cross-pointer indicator, an aircraft relative heading indicator, a bearing selector and a marker beacon indicator. The bearing selector knob establishes any magnetic course in whole degrees measured "*to*" or "*from*" a TACAN station. The vertical pointer indicates lateral position deviation from the course set in the window on top of the instrument or from an on course runway localizer signal. The magnetic heading information is derived from the PB-10 fluxgate compass system. The horizontal pointer is inoperative. A TO-FROM indicator designates whether the TACAN bearing selected is *to* or *from* the station.

If either the reference or the variable signal strength for a TACAN receiver falls below a safe level, a red flag moves in front of the corresponding cross pointers.

AN/APN-9 LORAN RECEIVER (TC-121C).

The AN/APN-9 Loran equipment provides a means of determining the geographic location of the aircraft. The equipment consists of a receiver-indicator unit located in the navigator's station (figure 4-50). The receiver is connected to the trailing wire antenna. The receiver-indicator unit receives, amplifies, and displays Loran signals on the face of a cathode-ray tube. The power supply requirements are 115-volts ac at 360 to 1200 cycles.

AN/ARN-9 Operation.

To put into operation:

1. Aircraft power supply, ac and dc—ON.
2. Receiver gain control—ON.
3. Function switch—As desired.

To turn equipment off:

1. Receiver gain control—OFF.

AN/APN-70 LORAN RECEIVER (TC-121C). (If installed).

This (AN/APN-70) equipment is operated from the navigator's station and is used for long-range navigation. Power is supplied to the equipment from the aircraft's 115-volt ac system, "C" phase. The Loran circuit breakers are located on the radio operator's circuit breaker panel.

AN/APN-70 Operation.

To put into operation:

1. Aircraft power supply, ac—On.
2. Rotate the master-XZ gain control clockwise until the panel lettering is illuminated. Allow five minutes for the set to warm up.

To turn equipment off:

1. Turn the master-XZ gain control to POWER OFF and see that panel lettering light is out. Also see that the pattern on the indicator screen has disappeared.

CU308/U ANTENNA COUPLER (TC-121C). (If installed).

This coupler provides facilities for the AN/APN-70 Loran receiver, AN/ARR-15A HF receiver and AN/ART-13A command transmitter to share the right overhead long wire antenna. The AN/APN-70 and AN/ARR-15A are connected to the CU308/U at connector posts nomenclatured LORAN and COMM respectively. The antenna input to the CU308/U is obtained from the AN/ART-13A. The CU308/U is located against the bulkhead forward of the navigator's equipment rack. Power is supplied to the equipment from the aircraft dc system through the APN-9 antenna coupler circuit breaker on the radio operator's circuit breaker panel.

AN/APX-25 RADAR IDENTIFICATION TRANSPONDER (TC-121C).

The purpose of the AN/APX-25 is to identify the aircraft as friendly when correctly challenged by friendly shore, shipboard and airborne radars, and to permit surface tracking and control of aircraft in which it is installed. The AN/APX-25 control panel is located at the radio operator station (figure 4-44). Power is supplied to the equipment from the aircraft 28-volt dc system and from the 115-volt inverter system.

KY95/APX-25 CODER (TC-121C).

Coder KY95 is an airborne electronic set which operates in conjunction with the AN/APX-25 radar identification set to provide coded electronic recognition known as SIF (figure 4-44). The primary purpose of the coder, when used with the AN/APX-25, is to identify the aircraft in which it is installed as friendly, when correctly challenged by an interrogator-responder associated with friendly radars that are ground based, or airborne.

AN/APN-1 RADIO ALTIMETER (TC-121C).

The AN/APN-1 radio altimeter gives indication of the aircraft altitude above the terrain and is operated from the pilot station. The altimeter is useful in determining altitude under adverse weather conditions, particularly when barometric conditions are not available. It is also used to make approaches at night or in adverse weather.

CAUTION

Indications of the AN/APN-1 radio altimeter are unreliable when the AN/ARC-27 transmitter is operating. They are also unreliable when emergency elevator boost switches are on in early serial airplanes.

On-Off Switch.

The ON-OFF switch, located on the radio altimeter indicator is used to turn the equipment on and off. When this switch is turned on it disables the SCR-718 radio altimeter.

Range Switch.

The range switch, located on the radio altimeter indicator (37, figure 1-7) is used to set the instrument in accordance with altitude at which the aircraft is flying. The altimeter can be set to give indications in either of two ranges: Low range, 0-400 feet and high range, 400-4,000 feet.

CAUTION

The HIGH range of the AN/APN-1 altimeter cannot be relied upon below 500 feet over water and 600 feet over land. Below these altitudes, when on the HIGH range, the indicator will usually read high and may fail to read below 400 feet no matter how close to the terrain the airplane may actually be flying. Therefore, when flying under conditions of poor visibility, the AN/APN-1 indicator should always be on LOW range.

Limit Switch.

The limit switch is located on the pilot's instrument panel (35, figure 1-7). The switch operates in conjunction with the indicator light and the range switch. The setting of the limit switch determines the altitude at which the indicating light will function. The switch is calibrated in increments of 25 from 25 to 300 feet for low range operation and denotes increments of 250 feet from 250 to 3,000 feet for high range operation.

Radio Altimeter Indicator.

The radio altimeter indicator is located on the pilot's auxiliary instrument panel (37, figure 1-7). The numerals 1, 2, 3, and 4 are read as hundreds of feet when operating in the low range. The numerals 10, 20, 30, and 40 appearing in high range are also read as hundreds of feet.

Altitude Limit Warning Lights.

The altitude limit warning lights, located on the pilot's auxiliary instrument panel (36, figure 1-7), will glow when the aircraft is flying below the altitude set on the limit switch.

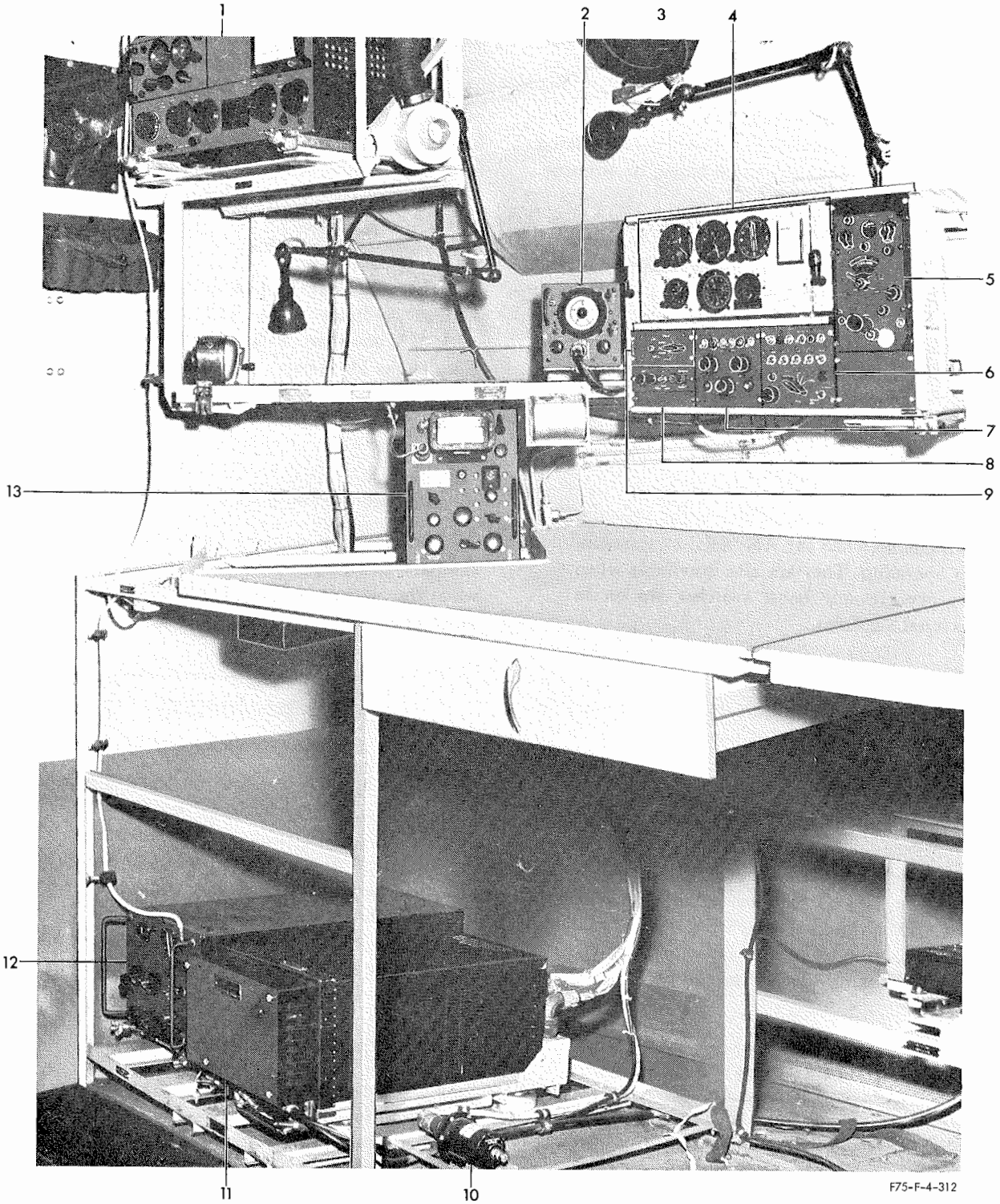
WARNING

The AN/APN-1 radio altimeter is unreliable in areas covered by large depths of snow and ice such as encountered over polar regions. An apparent terrain clearance 1,600 feet greater than actual clearance has been recorded. Do not rely on your APN-1 equipment to provide terrain clearance when flying over areas covered by a large depth of snow and ice.

SCR-718 RADAR ALTIMETER (TC-121C).

The SCR-718 radar altimeter is designated a high altitude altimeter (0 to approx. 40,000 ft.). The indicator is operated from the navigator's station (2, figure 4-50). The equipment indicates the aircraft altitude with respect to the terrain beneath. The measurement is graphically exhibited by the appearance of a lobe on the face of the cathode-ray indicator tube. Power is supplied to the equipment from the 115-volt ac inverter system. A circuit breaker for the altimeter is located on the radio operator's circuit breaker panel (figure 4-45), and the fuse is located on the BC-788C receiver-transmitter.

TC-121C. TYPICAL NAVIGATOR'S STATION



1. T-47/ART-13A COMMAND TRANSMITTER
2. RADAR ALTIMETER SCR-718
3. LOUDSPEAKER LS-184
4. NAVIGATOR'S INSTRUMENT PANEL
5. AN/ARN-6 RADIO COMPASS CONTROL PANEL
6. C-633/AIC-8 INTERPHONE CONTROL PANEL
7. AUXILIARY ICS CONTROL PANEL
8. TRAILING ANTENNA CONTROL PANEL
9. ADF RANGE FILTER SWITCH
10. CV-279/ARN-21 TACAN MIXER
11. RT 220/ARN-21 TACAN TRANSMITTER
12. AN/ARR-15 COMMAND RECEIVER
13. AN/APN-9 LORAN RECEIVER

Figure 4-50

Note

The AN/APN-1 is electrically interlocked with the SCR-718 and has priority over the SCR-718.

SCR-718 Operation.

To put into operation:

1. Aircraft power supply, ac—On.

2. OFF-ON REC Gain switch—ON and turn clockwise to adjust height of lobes.

WARNING

The SCR-718 radar altimeter is unreliable in areas covered by large depths of snow and ice such as encountered over polar regions. An apparent terrain clearance of 1,600 feet greater than actual clearance has been recorded. Do not rely on your SCR-718 equipment to provide terrain clearance when flying over areas covered by large depth of snow and ice.

To turn equipment off:

1. OFF-ON REC Gain switch—OFF.

AN/ARN-12 MARKER BEACON RECEIVER (TC-121C).

The 28-volt dc (AN/ARN-12) marker beacon receiver (12, figure 4-43) has no controls but comes on automatically when power is supplied to the dc bus. Marker beacon indicator lights are located on the pilots' instrument panel. An aural signal will be heard at the pilots' and navigator's stations when the aircraft is within the radiation pattern of a 75-megacycle marker beacon transmitter and the MARKER switch on the intercommunication control panel is ON.

AN/ARN-6 AUTOMATIC RADIO COMPASS (TC-121C).

The (AN/ARN-6) automatic radio compass may be operated by either pilot or by the navigator. The pilots' automatic radio compass controls are located on the pilots' overhead control panel (12, figure 1-8) and the navigator's controls are located at his station (5, figure 4-50). Receiving facilities also are provided for the radio operator. An indicating instrument is installed at each pilot's station and at the navigator's station. Power is supplied to the equipment from the aircraft 28-volt dc system, and 36-volts ac to the indicators from the C-1 amplifier.

AN/ARN-6 Operation.

To put into operation:

1. Aircraft power supply, dc and ac—On.

2. Receiver toggle switch on intercommunication control panel—ADF.

3. Function switch on automatic compass control panel—COMP, ANT, or LOOP, as desired.

To turn equipment off.

1. Function switch on automatic compass control panel—OFF.

2. Receiver toggle switch on intercommunication control panel—OFF.

AN/ARN-18 GLIDE SLOPE RECEIVER (TC-121C).

The glide slope receiver R-322/ARN-18 is installed in the flight station radio rack (1, figure 4-43). The receiver is connected to a glide slope antenna located in the nose radome. The receiver detects 90/150 cps tone modulated signals in the UHF range between 329.3 to 335 mc. Power is supplied to the equipment from the aircraft's 28-volt dc system and from the 115-volt ac system.

AN/ARA-25 (UHF) DIRECTION FINDER (TC-121C).

The (AN/ARA-25) direction finder is used in conjunction with the No. 6 AN/ARC-27 UHF set. Placing the function switch of the pilots' AN/ARC-27 control to ADF connects the direction finder antenna relay, and places the AN/ARA-25 amplifier in operation. Relative bearings of the received signals are displayed on the ID-91/ARN-6 indicator on the pilots' left instrument panel (33, figure 1-7). Power is supplied to the equipment from the aircraft's 28-volt dc system, and 26-volts ac to the indicators through the C-1 amplifier.

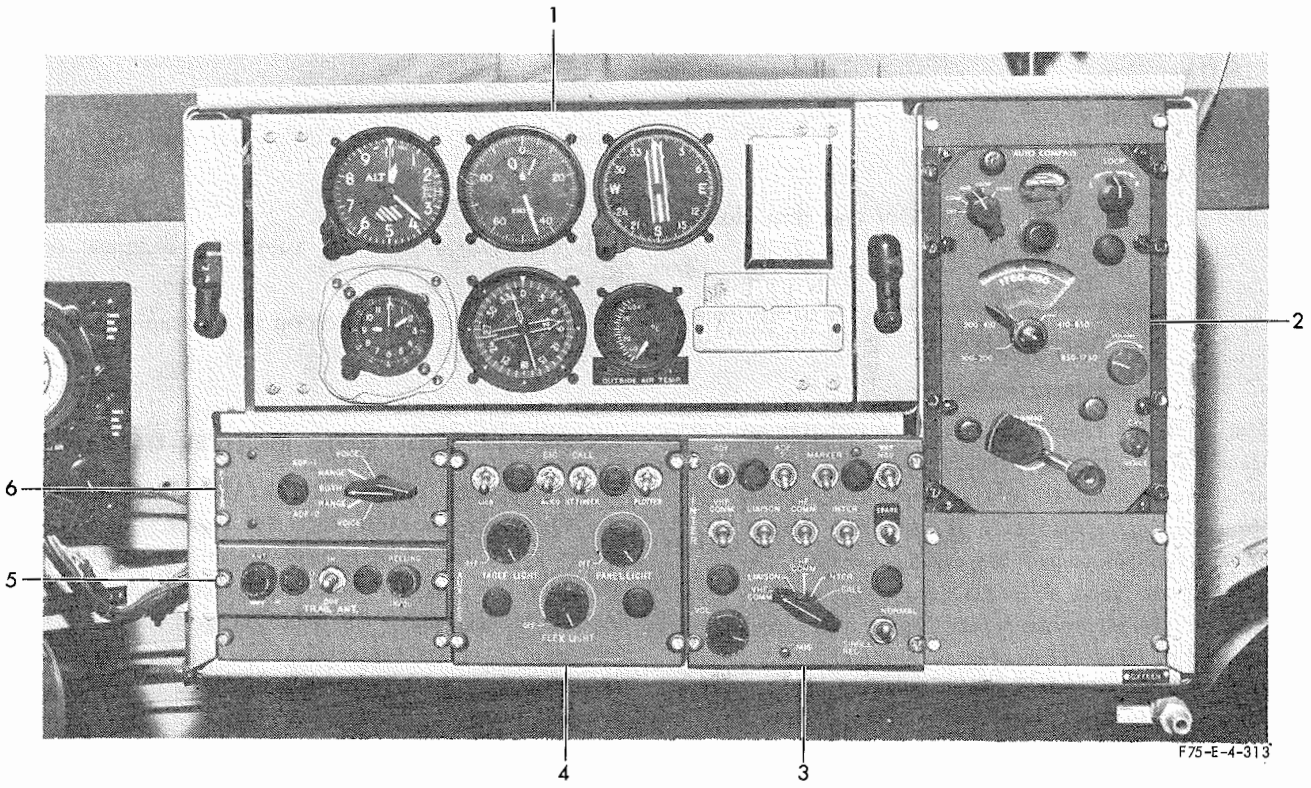
Note

No transmission will be made on emergency (distress) frequency channels except for emergency purposes in order to prevent transmission of messages that could be construed as actual emergency messages.

AN/CRT-3 EMERGENCY TRANSMITTER (TC-121C).

The AN/CRT-3 emergency transmitter automatically transmits on 500 and 8364 kcs. Operating power is furnished by the hand operated generator inside of the transmitter cabinet. Operating instructions are inscribed on the equipment for use in emergency.

TC-121C. TYPICAL NAVIGATOR'S INSTRUMENT PANEL



1 FLIGHT INSTRUMENT PANEL
2 AN/ARN-6 RADIO COMPASS (REMOTE) CONTROL PANEL
3 C-633/AIC-8 INTERPHONE CONTROL PANEL
4 AUXILIARY ICS CONTROL PANEL
5 TRAILING WIRE ANTENNA CONTROL PANEL
6 ADF RANGE FILTER SELECTOR

Figure 4-51

Note

Be sure to crank the transmitter long enough for the tubes to warm up. Always rotate the crank at approximately 80 rpm.

C-1 COMPASS SIGNAL POWER AMPLIFIER (TC-121C).

The C-1 amplifier is installed in the forward radio rack. This unit is an electrical device containing a power amplifier, servo motor, synchro transmitters and receiver which function together to reinforce the output signal voltage (magnetic heading) from the master direction indicator (MDI). The three-phase signal from the MDI supplies magnetic heading voltages to the synchros actuating the compass cards in the RMI's and the relative heading in the pilot's ID-249/ARN course indicator. The amplifier in the C-1 unit receives 115-volt, 400 cycle, ac power through a 5-ampere, switch-type circuit breaker in the main radio junction box.

LM-14 FREQUENCY METER (TC-121C).

An LM-14 crystal frequency meter is installed on the radio rack and provides a means of measuring and adjusting the frequency of installed transmitters and receivers in the range of 125 to 20,000 kilocycles with

extreme accuracy. The unit is supported on a shock-mounted base. A coil is attached to the RF-CPLG terminal connection on the front panel of the unit providing a radio-frequency coupling with the associated radio equipment in the aircraft. A calibration book is stowed in a small compartment below the unit.

LIGHTING SYSTEM.

All lights are dc operated unless otherwise indicated.

EXTERIOR LIGHTS.

The exterior light include the landing lights, taxi lights, leading edge lights, fuselage lights, wing tip, tail lights, wheel well lights and anti-collision lights. All of these lights are operated by the dc electrical system, and the control systems incorporate the necessary switches and relays. Circuit breakers, protecting the external light circuits, are located on the MJB No. 3 panel except for the anti-collision light. The anti-collision light circuit breaker is located on the lower 212 panel.

Anti-Collision Lights.

The rotating anti-collision light is installed, on the top of the center vertical fin.

Note

The rotating anti-collision light should be turned OFF during flight through conditions of reduced visibility where the pilot could experience vertigo as a result of the rotating reflections of the light against the clouds. In addition, the light would be ineffective as an anti-collision light during these conditions since it could not be observed by pilots of other aircraft.

Exterior Lights Master Switch.

Primary control of all exterior lights is provided by a master switch located on the copilot's auxiliary instrument panel (18, 20, figure 1-7). The master switch has three positions: OFF, FLASH, and STEADY. When this switch is in any position but OFF, the master relay closes to supply dc power for steady operation of the leading edge lights, the taxi lights, and the landing lights. The STEADY and FLASH positions control the operation of the position lights.

Position Lights Brilliance Switch.

A switch located on the copilot's auxiliary instrument panel (17, 19, figure 1-7) with DIM, MED., BRT, labeled positions may be used to control the intensity of the position lights.

Wing Tip Lights Switch.

A switch (6, figure 1-9) on the pilot's side panel, labeled WING TIP LTS., OFF turns these lights on.

Tail Lights Switch.

A switch (5, figure 1-9) on the pilot's side panel, labeled TAIL LIGHTS, OFF, is installed to turn on the white tail lights.

Landing Lights Switch.

Two 600-watt landing lights are installed in the lower surface of each outer wing panel and are controlled by switches on the pilots' overhead panel. A switch for each light (2, figure 1-8), labeled LAMP ON and OFF, turns the light on or off. Another switch (1, figure 1-8) for each light, labeled EXTEND, OFF and RETRACT, controls the motors which extend or retract the light independent of the exterior light master switch. It is possible to turn the lights on while they are extended, retracted, or in any intermediate position, provided the exterior master switch is ON.

CAUTION

Do not leave landing lights on for more than 30 seconds without an airblast on the lens as the heat produced by the filament is sufficient to crack the lens.

Taxi Lights Switch.

A switch (7, figure 1-9) on the pilot's side panel with TAXI LIGHTS and OFF labeled positions may be used to control the two white taxi lights mounted on the nose landing gear.

Leading Edge Lights Switch.

A switch (4, figure 1-9) located on the pilot's side panel has LEADING EDGE LTS. and OFF positions and controls the two white lights mounted on each side of the fuselage. These lights are used to illuminate the wing leading edge for detection of ice, etc.

Anti-Collision Light Switch.

The anti-collision light switch is located on the pilot's side panel (2, figure 1-9) and is placarded ANTI-COLLISION and OFF.

Wheel Well Lights Switch.

The wheel well lights switch (3, figure 1-9) on the pilot's side panel, labeled WHEEL WELL, may be used to illuminate the well area.

INTERIOR LIGHTS.

Interior lighting provides general illumination for the cabin, flight station, cargo compartments and illumination for the controls and control panels provided for the flight crew and radar crew. The cabin overhead lights consist of three sets, individually controlled. They are the forward crew compartment lights, the AOC compartment direct lights, and the aft crew compartment lights. Night lights are provided and consist of two amber and two white lights located in the cabin. Twenty status board white lights are also provided. Lavatory lights, crew compartment reading lights, and AOC compartment indirect green lights are provided. A white, flexible arm light is installed at each operator's station, at the technician's table, and near the driftmeter.

Cabin Lights Control Switches.

Three switches, placarded BRIGHT, OFF, and DIM control the cabin lights. One of the switches controlling the forward crew compartment lights is located above the flight station door on the cabin side and a switch controlling the aft cabin lights is located on the switch panel aft of the cabin door. On EC-121D aircraft another switch controlling the AOC compartment lights is located on the radar technician's switch panel. On TC-121C aircraft the cabin light switches are located on the radio operator's switch panel.

Night Lights Switches.

The night lights are controlled by two ON and OFF switches. One switch is located on the cabin side of the partition above the flight station-to-cabin door and the other switch is located on the switch panel aft of the main crew entrance.

Status Board Light Switches.

A rheostat controlling the lights on the left and right status board is located adjacent to each status board.

Lavatory Lights Switches.

A switch controlling the forward lavatory light is located adjacent to the cabin doorway and a switch controlling the aft lavatory lights is located adjacent to the doorway in the aft lavatory compartment.

Crew Reading and Galley Light Switches.

These switches are located on the light panel.

AOC/Cabin Compartment Indirect Lights Switch.

A switch controlling the indirect lights is located on the radar technicians switch panel or (on TC-121C aircraft) on the radio operator's switch panel.

Flex Light Switches.

A rheostat is installed at each operator's station to control the illumination of the flex arm light in that station.

Pilots' Instrument Panel Lights Rheostat.

Direct red and direct white lighting is provided for the pilots' instrument panels and glare shield. The rheostats controlling these lights are located under the glare shield on copilot's side and are labeled PILOT'S RED, EMERGENCY WHITE, and COPILOT'S RED and GLARE SHIELD.

Flight Station Dome Light and Switch.

A combination red-white dome light is provided in the flight station for general illumination. The switch (5, figure 1-17) for controlling this light is located on the flight engineer's upper switch panel and is labeled DOME LIGHT and is placarded WHITE—OFF and RED.

Pilots' Switch Panels Lights Switches.

A switch (9, figure 1-9) and (1, figure 1-10), located on each pilot's side panel, labeled PANEL LIGHT, OFF, controls the respective switch panel lights. A rheostat type switch (10, figure 1-9) and (22, figure 1-10), located directly below the panel light switch, controls the intensity of these lights. The switch is labeled PANEL LIGHT, DIM, BRIGHT.

Chart Lights and Switches.

The chart light switches are located on each pilots side panel (8, figure 1-9) and (2, figure 1-10). They are placarded CHART LIGHT and OFF. Also on these panels are the chart light rheostats (11, figure 1-9) and

EC-121D/TC-121C. EXTERIOR LIGHT ARRANGEMENT

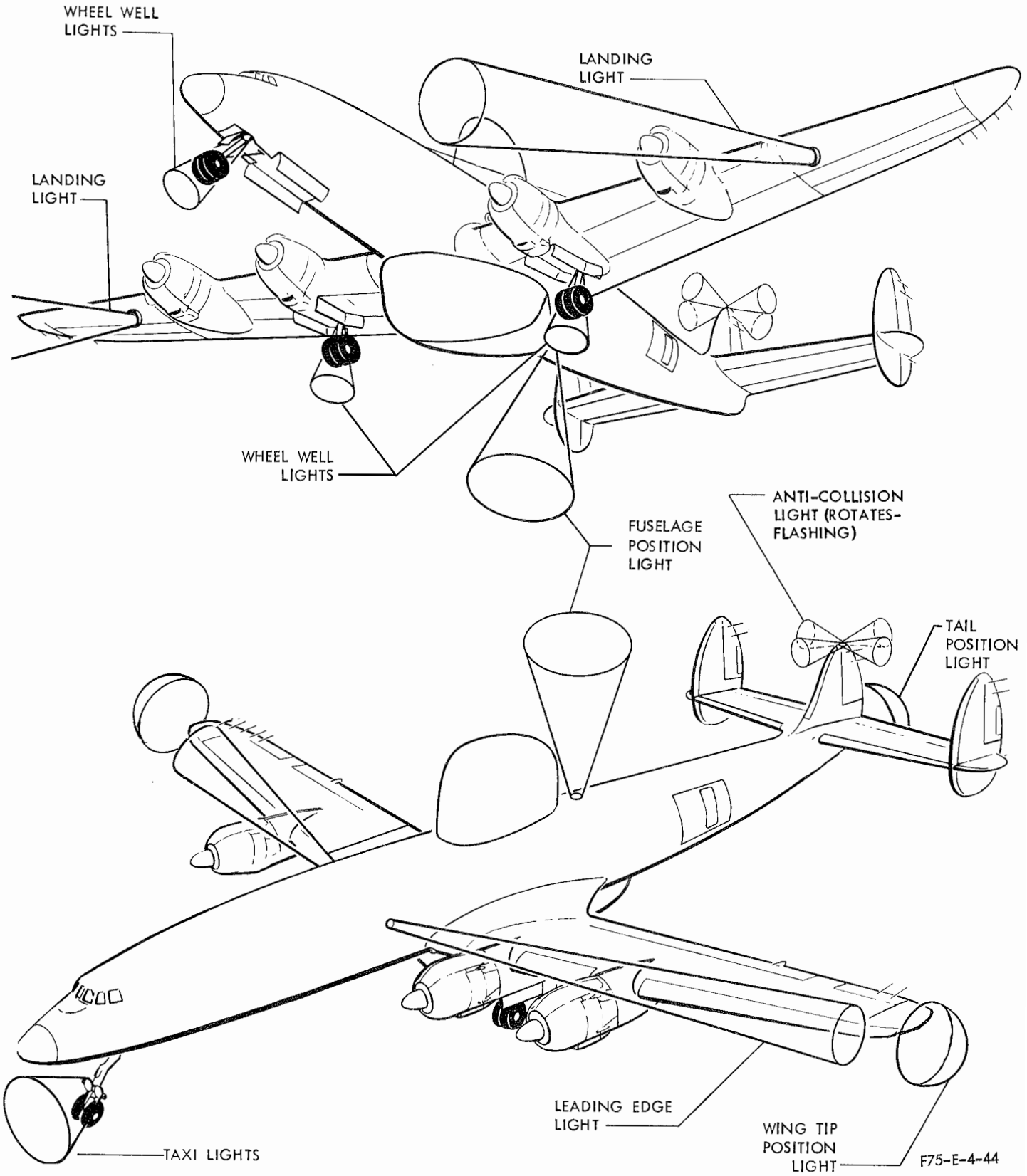


Figure 4-52

(21, figure 1-10) which controls the intensity of illumination desired. The rheostats are placarded DIM and BRIGHT. The lights are located over and slightly behind each pilot. Each light has a removable red lens and both chart lights may be removed from their bases to be used as a hand light.

Pedestal Light Switch.

A light controlled by a two-position toggle switch (3, figure 1-10) on the copilot's side panel, labeled PEDESTAL REAR LT., illuminates the area between the pilots' seats, aft of the center control stand.

Compass Light Switch.

A rheostat (20, figure 1-10) located on the copilot's side panel labeled COMPASS LIGHT, DIM, OFF, BRIGHT, may be used to turn on the light in the standby compass and to control its intensity.

Pilots' Radio Remote Control Panel Lights Switches.

The pilot's and copilot's radio remote control panels are illuminated by small red floodlights installed directly above each box. The lights contain integral switches that can be rotated in either direction to turn on or off.

Pilots' Overhead Panel Lights Switch.

Red edge lighting is provided for the pilots' overhead panel. The control switch (5, figure 1-8) is located on the right side of the overhead switch panel and has OFF and BRIGHT positions.

Deicer Control Panel Lights Switches.

The pneumatic deicer panel, located to the left of the pilot, is illuminated by direct red incandescent floodlights (2, figure 4-13) with integral switches.

Cargo and Tail Section Inspection Lights Switch.

A switch, located on the radar technician's switch panel on the EC-121D, and on the radio operator's switch panel on the TC-121C, labeled CARGO LIGHTS and RADOME LIGHTS, controls the five overhead lights in the forward and aft cargo compartments and radome lights. These lights are automatically energized when the cargo compartment door is opened, regardless of the position of the inspection lights switch. The cargo door switch also actuates the door warning light located on the flight engineer's lower instrument panel.

Flight Engineer's Instrument Panels Floodlights Switch.

A switch (2, figure 1-17), located on the flight engineer's upper switch panel, may be used to illuminate the flight engineer's instrument panels with either red or white floodlights. The switch is labeled F. E. INSTR. PANEL FLOODLIGHT.

Flight Engineer's Instrument Panel Auxiliary Light Switch.

A rheostat (17, figure 1-17), located on the flight engineer's upper switch panel, controls the small incandescent lights installed in a glare shield below the instrument panels. The switch is labeled F.E. INSTR. PANEL AUX. LTS. and has DIM, OFF, and BRIGHT positions.

Station 260 Instrument Panel Floodlight Switch.

A switch (1, figure 1-17), installed on the flight engineer's upper switch panel, controls the floodlight that illuminates the station 260 panel. This switch is labeled STA. 260 INSTR. PANEL FLOODLIGHT.

Station 260 Instrument Panel Light Switch.

A rheostat installed under the flight engineer's lower instrument panel, controls illumination of the station 260 panel. This switch is labeled STA. 260 PANEL LIGHTS.

Flight Engineer's Desk Lights and Switches.

The flight engineer's desk lights are controlled by one rheostat located on the MJB No. 2 panel (26, figure 1-29). This rheostat controls the intensity of illumination desired. There are four lights under the flight engineer's lower instrument panel, two are red and two are white. The selector switch for these lights (5, figure 1-17) is placarded RED and WHITE.

Master Junction Box Panel Lights Switch.

A switch (5, figure 1-17), located on the flight engineer's upper switch panel on EC-121D aircraft, and on the MJB No. 2 panel on TC-121C aircraft, with positions labeled DIM, OFF, and BRIGHT, controls the lights that illuminate the MJB panels.

OXYGEN SYSTEM (EC-121D).

The oxygen system (figure 4-53) consists of a fixed system available to all crew stations and portable bottles to supplement the fixed system. All oxygen containers are charged with the gaseous type.

FIXED OXYGEN SYSTEM (EC-121D).

A high pressure gaseous oxygen system that supplies 29 cabin crew members and three flight station crew

EC-121D. OXYGEN SYSTEM

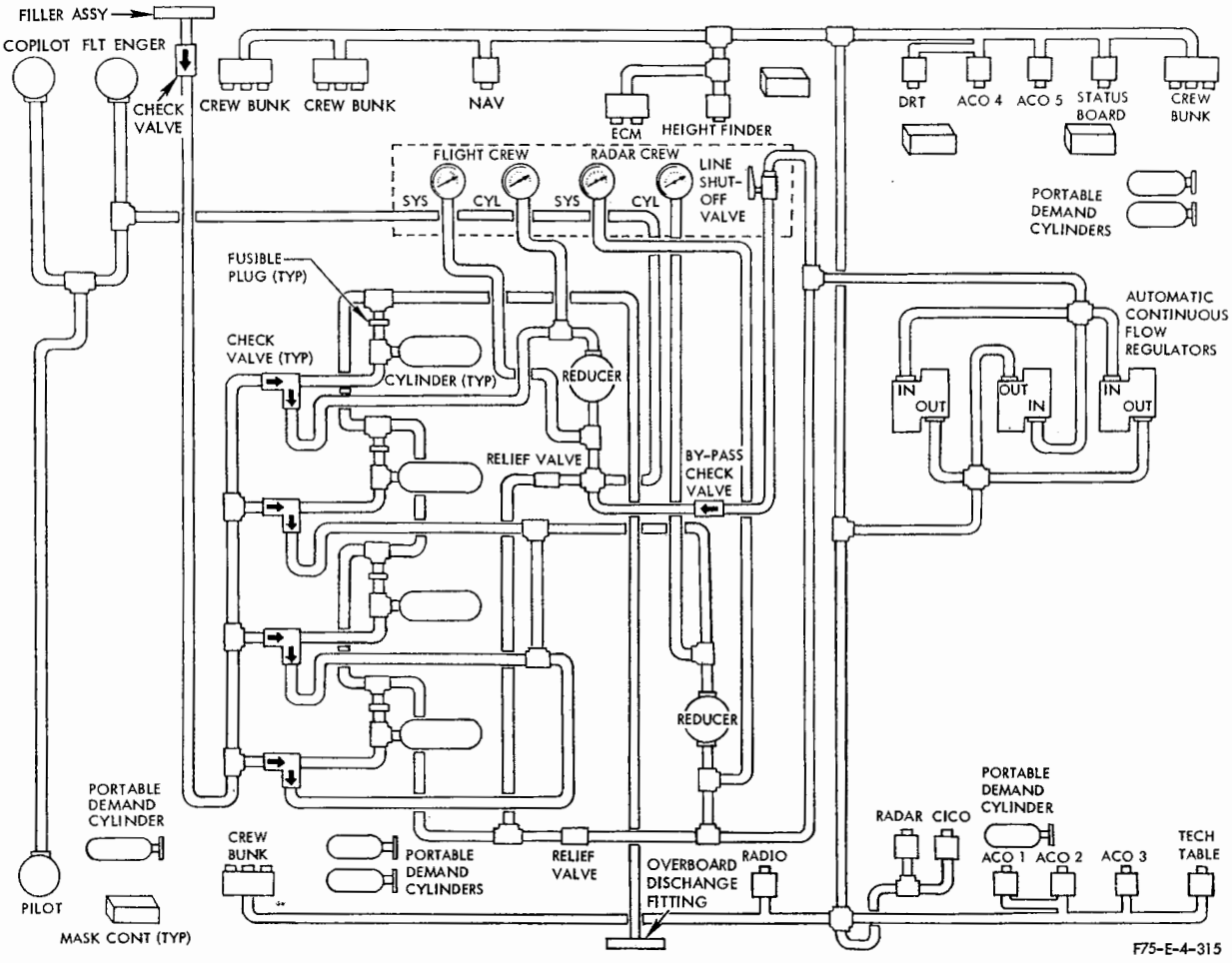


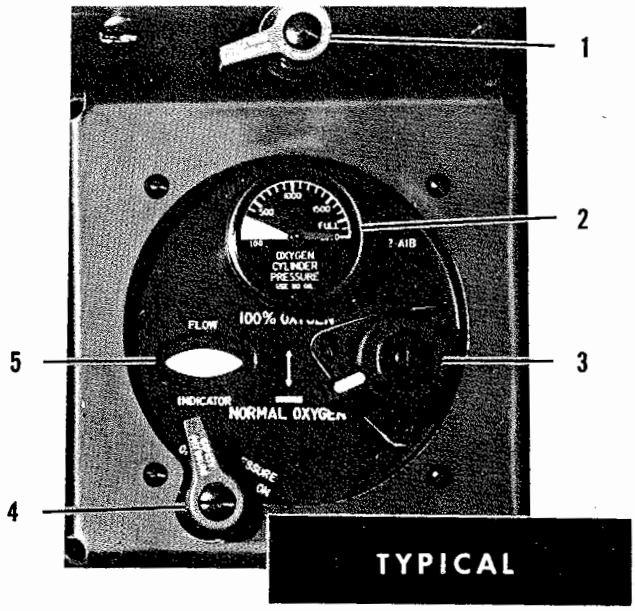
Figure 4-53

members is installed in the aircraft. The system is supplied from four high pressure oxygen cylinders located aft of the pilot's station. Three of the oxygen cylinders are plumbed together to supply the radar crew. These cylinders may also be used to supply the flight crew by means of a line shutoff valve (crew valve) and bypass check valve which are plumbed between the radar supply line and flight crew pressure reducer. The fourth cylinder supplies only the flight crew. The oxygen cylinders are recharged through a filler assembly located forward of the crew door. Refer to EC-121D oxygen duration chart, (figure 4-56). Oxygen is routed from the three radar crew cylinders to a high pressure cylinder gage, pressure reducer, and low pressure system gage. From the pressure reducer, the line is "teed" to a relief valve. One end of the "T" is plumbed to the flight station supply line. The other end of the "T" is plumbed to three automatic, continuous flow regulators and then to the radar crew manifolds. Oxygen from the flight station cylinder is routed in a similar manner to the pilot's, copilot's, and flight engineer's diluter demand regulators. The relief valves, from the radar crew system and flight station system, are plumbed together and join the oxygen cylinder's overboard discharge line which discharges through a flush fuselage skin fitting immediately aft of the main cylinders. The relief valves discharge the oxygen overboard in the event of pressure reducer regulator failure. Each oxygen supply cylinder is equipped with a retainer safety disc that includes a fusible metal plug which will melt at 100°C to discharge the oxygen overboard.

Note

As an airplane ascends to high altitudes, where the temperature is normally quite low, the oxygen cylinders become chilled. As the cylinders

DILUTER DEMAND OXYGEN REGULATOR



1. Oxygen supply lever
2. Regulator pressure gage
3. Air valve lever
4. Safety pressure lever
5. Flow indicator

F75-D-4-94

Figure 4-54

grow colder, the oxygen gage pressure is reduced, sometimes rather rapidly. With a 100°F decrease in temperature in the cylinders, the gage pressure can be expected to drop 20%. This rapid fall in pressure is occasionally a cause for unnecessary alarm. All the oxygen is still there, and as the airplane descends to warmer altitudes, the pressure will tend to rise again, so that the rate of oxygen usage may appear to be slower than normal. A rapid fall in oxygen pressure while the airplane is in level flight, or while it is descending, is not ordinarily due to falling temperature, of course. When this happens, leakage or loss of oxygen must be suspected.

PORTABLE OXYGEN SYSTEM (EC-121D).

Provisions for three individual portable oxygen cylinders are supplied; one in the flight station and two in the main cabin. Each cylinder is equipped with a diluter demand oxygen regulator with an oxygen flow indicator, a carrying strap, breathing tube with quick disconnect coupling, a clothing clamp, a shutoff valve, and cylinder pressure gage; see figure 4-54. The oxygen regulator will reduce the cylinder pressure to approximately 65 psi if the pressure reducer should fail. Refer to oxygen duration chart, figure 4-56.

Oxygen Cylinder Shutoff Valve.

Each of the four main oxygen supply cylinders, clamped to the left side of the flight station behind the pilot's seat, are equipped with a poppet-type shutoff valve. The shutoff valves control the flow of oxygen to the system and should be off when the aircraft is parked.

Radar-Flight Crew Shutoff Valve.

A crew valve (figure 4-55) is located on the oxygen control panel above the oxygen cylinders. When this valve is opened, the flight station oxygen is supplied from three radar crew cylinders to all radar crew stations.

Air Valve Control Lever.

The air valve control lever (3, figure 4-54), mounted on the oxygen regulator, can be set to NORMAL OXYGEN or 100% OXYGEN. In the NORMAL OXYGEN position, a mixture of air and oxygen is delivered to the mask as required. In the 100% OXYGEN position, undiluted oxygen is delivered to the mask.

Oxygen Supply Control Lever.

The oxygen supply control lever (1, figure 4-54) mounted on the oxygen regulator is used to open or close the incoming oxygen supply line that is connected to the regulator. The oxygen supply lever should be left in the OFF position when oxygen is not being used.

Safety Pressure Control Lever.

When the safety pressure control lever, mounted on the oxygen regulator (4, figure 4-54), is in the ON position, it allows a slight pressure to be built up inside the mask. This prevents outside air from being drawn into the mask when inhaling.

High Pressure Gages.

One high pressure gage for the radar crew oxygen system and one for the flight crew oxygen system (figure 4-55) are located on the oxygen control panel above the oxygen cylinders. Each gage is calibrated from 0 to 3000 psi and registers 1800 psi at 21°C when fully charged.

EC-121D. OXYGEN SYSTEM CONTROL PANEL

Figure 4-55

Low Pressure Gages.

Two low pressure oxygen gages (figure 4-55) are located adjacent to the high pressure gages, downstream of the flight station and radar crew system pressure reducers.

Flow Indicators.

Each diluter demand regulator incorporates an oxygen flow indicator (5, figure 4-54). The flow of oxygen through the demand valve is indicated by the oscillation of a plate under the glass of the flow indicator.

NORMAL OPERATING PROCEDURES (EC-121D).

Note

Blow gently into end of the oxygen regulator hose as during normal exhalation. If there is a resistance to blowing the system is satisfactory. Little or no resistance will indicate a faulty demand diaphragm or diluter air valve.

1. Oxygen supply cylinder shutoff valves — Open slowly.

2. Oxygen supply control lever—ON.

3. High and low pressure gages—Check for proper pressures.

4. Air valve control lever—NORMAL OXYGEN.

5. Smoke masks—Check.

6. Flow indicator—Check.

EC-121D. OXYGEN DURATION CHART

FLIGHT CREW OXYGEN DURATION

HOURS FOR 3 FLIGHT CREW MEMBERS, 1 LAC 654114 OXYGEN CYLINDER

CABIN ALTITUDE IN FEET	GAGE PRESSURE — PSI 1800	1500	1200	900	600	300
25,000	1.4 .8	1.1 .6	.8 .5	.5 .3	.3 .2	EMERGENCY
20,000	2.3 .6	1.8 .5	1.4 .4	.9 .2	.5 .1	DESCEND BELOW 10,000 FEET
15,000	2.8 .5	2.3 .4	1.7 .3	1.1 .2	.6 .1	
10,000	3.0 .4	2.4 .3	1.8 .2	1.2 .2	.6 .1	
HOURS FOR 3 FLIGHT CREW MEMBERS, 4 LAC 654114 OXYGEN CYLINDERS						
5,000	1.2	.9	.6	.5	.26	EMERGENCY

BLACK FIGURES INDICATE DILUTER DEMAND LEVER "NORMAL OXYGEN."

RED FIGURES INDICATE DILUTER DEMAND LEVER "100% OXYGEN."

CABIN CREW OXYGEN DURATION

HOURS FOR 30 CREW MEMBERS, 3 LAC 654114 OXYGEN CYLINDERS

CABIN ALTITUDE IN FEET	GAGE PRESSURE — PSI 1800	1500	1200	900	600	300
25,000	.85	.62	.46	.31	.16	
20,000	.92	.77	.54	.38	.16	
15,000	1.23	1.0	.77	.46	.23	EMERGENCY
10,000	1.84	1.46	1.1	.69	.38	

ABOVE FIGURES BASED UPON "CONTINUOUS-FLOW OXYGEN."

F75-E-4-95

Figure 4-56

7. Flight crew shutoff valve—Off, unless it is desired to supply the flight station from the radar crew system, then—Open.

EMERGENCY OPERATING PROCEDURES (EC-121D).

1. Should symptoms of hypoxia occur or the regulator fail, turn the safety pressure control lever clockwise to the ON position and descend to an altitude not requiring oxygen.

2. Whenever excessive carbon monoxide or other noxious or irritating gas is present or suspected, then, regardless of altitude, put on oxygen mask and set the air valve control lever to the 100% OXYGEN position until danger is past.

OXYGEN SYSTEM (TC-121C).

The oxygen system (figure 4-57) consists of a fixed system available to the pilot, copilot, and flight engineer, and portable bottles to supplement the fixed system. All oxygen containers are charged with the gaseous type.

FIXED OXYGEN SYSTEM (TC-121C).

A high pressure gaseous oxygen system that supplies the three flight station crew members is installed in the aircraft. The system is supplied from four high pressure oxygen cylinders located aft of the pilot's station. Three of the oxygen cylinders, formerly radar crew oxygen, are plumbed together. These cylinders are used to supply the flight crew by means of a line shutoff valve (crew valve) and bypass check valve. The fourth cylinder supplies the flight crew direct. The oxygen cylinders are recharged through a filler assembly located forward of the crew door. Refer to TC-121C oxygen duration chart, figure 4-59. Oxygen is routed from the three cylinders to a high pressure cylinder gage, pressure reducer, and low pressure system gage. From the pressure reducer, the line is "teed" to a relief valve. One end of the "T" is plumbed to the flight station supply line. The other end

TC-121C. OXYGEN SYSTEM

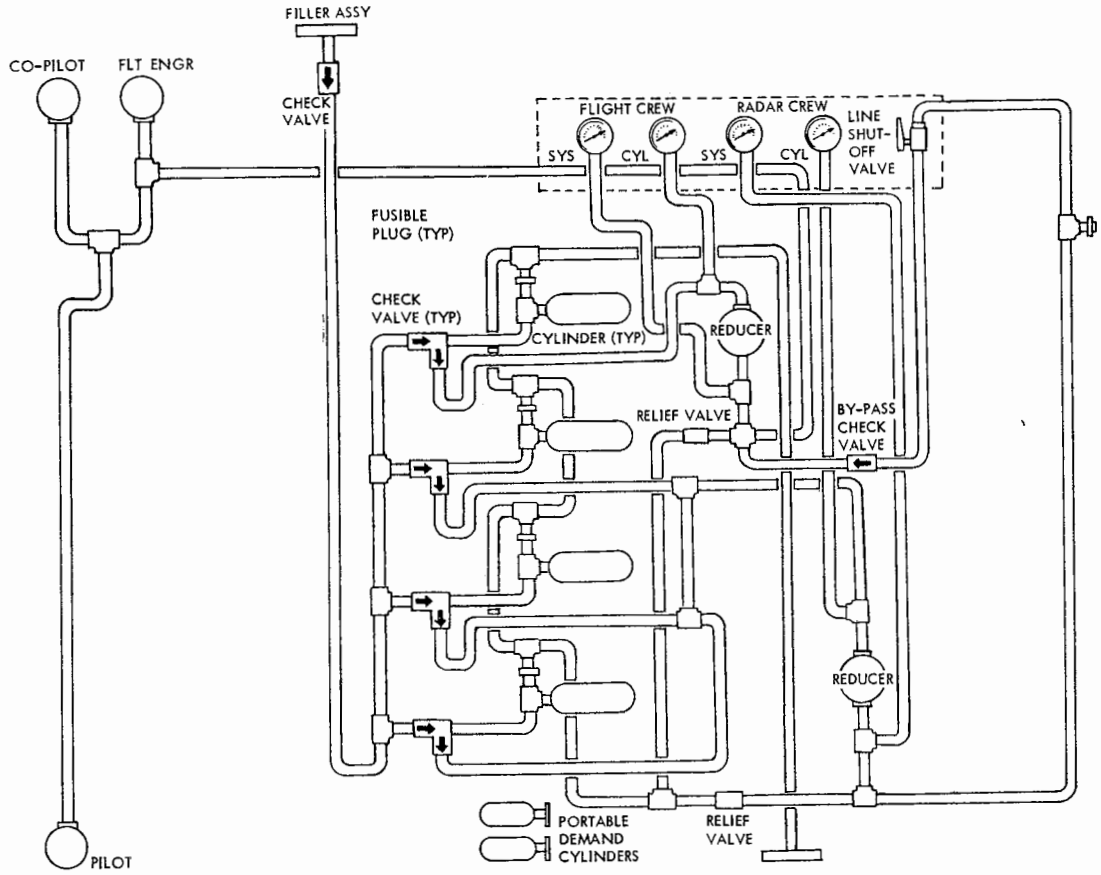


Figure 4-57

of the "T" is capped off. Oxygen from the fourth cylinder is routed in a similar manner to the pilot's, copilot's, and flight engineer's diluter demand regulators. The relief valves are plumbed together and join the oxygen cylinder's overboard discharge line which discharges through a flush fuselage skin fitting immediately aft of the main cylinders. The relief valves discharge the oxygen overboard in the event of pressure reducer regulator failure. Each oxygen supply cylinder is equipped with a retainer safety disc that includes a fusible metal plug which will melt at 100°C to discharge the oxygen overboard.

Note

As an airplane ascends to high altitudes, where the temperature is normally quite low, the oxygen cylinders become chilled. As the cylinders grow colder, the oxygen gage pressure is reduced, sometimes rather rapidly. With a 100°F decrease in temperature in the cylinders, the gage pressure can be expected to drop 20%. This rapid fall in pressure is occasionally a cause for unnecessary alarm. All the oxygen is still there, and as the airplane descends to warmer altitudes, the pressure will tend to rise again, so that the rate of oxygen usage may appear to be slower than normal. A rapid fall in oxygen pressure while the airplane is in level flight, or while it is descending, is not ordinarily due to falling temperature, of course. When this happens, leakage or loss of oxygen must be suspected.

PORTABLE OXYGEN SYSTEM (TC-121C). (USAF Serials 51-3836, 51-3839, 51-3844).

Provisions for three individual portable oxygen cylinders are supplied. One is in the flight station aft of the pilot's seat, one is forward of the radio operator's station and the other aft of the main cabin door. Each cylinder

TC-121C. OXYGEN SYSTEM CONTROLS

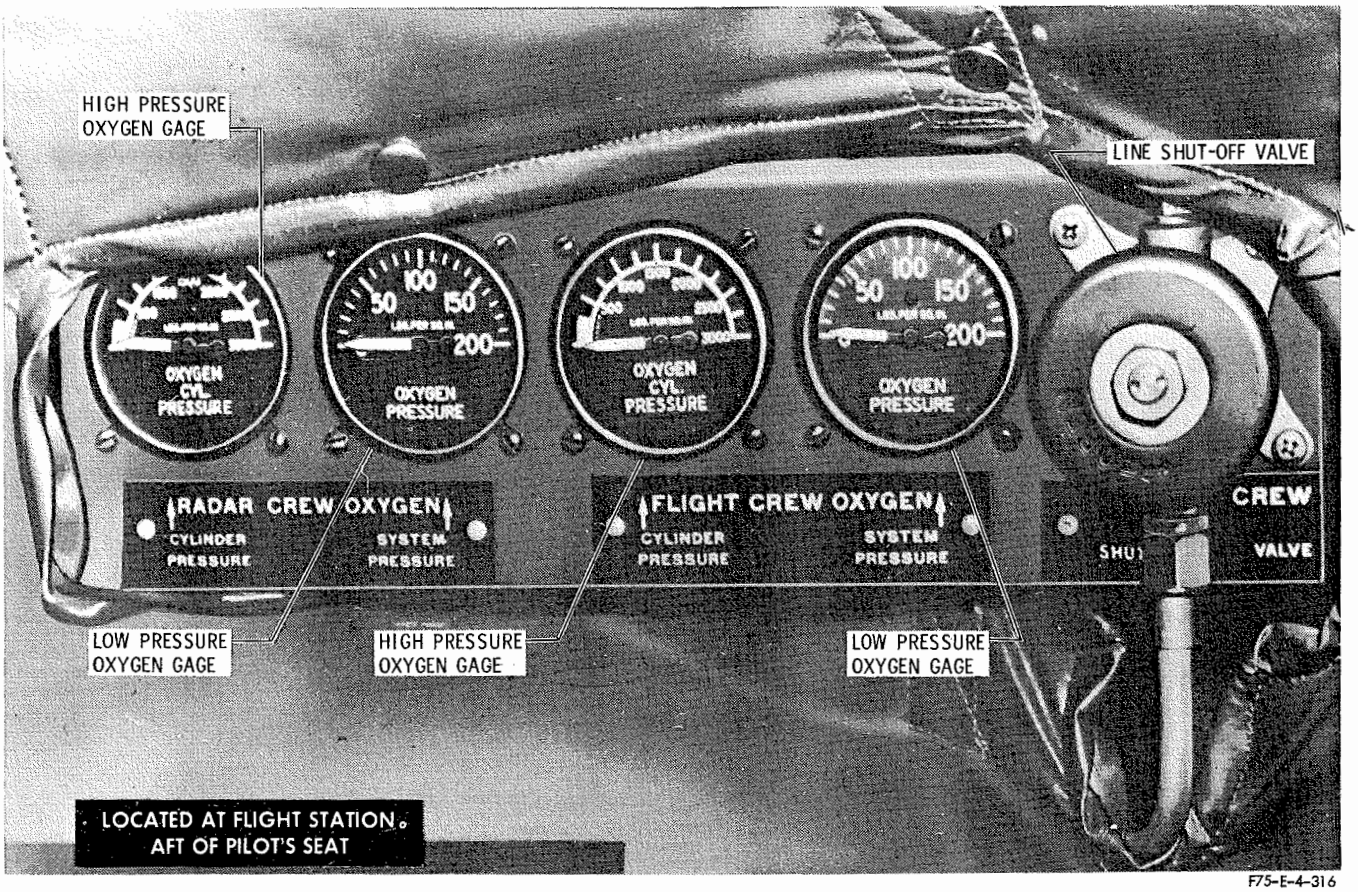


Figure 4-58

is equipped with a diluter demand oxygen regulator with an oxygen flow indicator, a carrying strap, breathing tube with quick disconnect coupling, a clothing clamp, a shutoff valve and cylinder pressure gage. The oxygen regulator will reduce the pressure to approximately 65 psi if the pressure reducer should fail.

PORTABLE OXYGEN SYSTEM (TC-121C). (USAF Serials 51-3840, 51-3843, 51-3845).

Provisions for two individual portable oxygen cylinders are supplied. These cylinders are located on the front face of the forward lavatory partition. Each cylinder is equipped with a diluter demand oxygen regulator with an oxygen flow indicator, a carrying strap, breathing tube with quick disconnect coupling, a clothing clamp, a shutoff valve and cylinder pressure gage. The oxygen regulator will reduce the pressure to approximately 65 psi if the pressure reducer should fail.

Oxygen Cylinder Shutoff Valves.

Each of the four main oxygen supply cylinders clamped to the forward radio rack behind the pilot's seat is equipped with a poppet-type shutoff valve. The shutoff valves control the flow of oxygen to the system and should be off when oxygen is not being used.

Flight Crew Shutoff Valve.

A flight crew shutoff valve (figure 4-58) is located on the oxygen control panel above the oxygen cylinders. When this valve is opened, oxygen is available to the flight station from all four oxygen cylinders.

Air Valve Control Lever.

The air valve control lever (3, figure 4-54) mounted on the oxygen regulator, can be set to NORMAL OXYGEN or 100% OXYGEN. In the NORMAL OXYGEN position, a mixture of air and oxygen is delivered to the

TC-121C. OXYGEN DURATION CHART

FLIGHT CREW OXYGEN DURATION

HOURS FOR 3 FLIGHT CREW MEMBERS, 1 LAC 654114 OXYGEN CYLINDER

CABIN ALTITUDE IN FEET	GAGE PRESSURE — PSI 1800		1500		1200		900		600		300
25,000	1.4	.8	1.1	.6	.8	.5	.5	.3	.3	.2	EMERGENCY
20,000	2.3	.6	1.8	.5	1.4	.4	.9	.2	.5	.1	DESCEND BELOW 10,000 FEET
15,000	2.8	.5	2.3	.4	1.7	.3	1.1	.2	.6	.1	
10,000	3.0	.4	2.4	.3	1.8	.2	1.2	.2	.6	.1	
5,000		.3		.2		.1		.1		.06	

BLACK FIGURES INDICATE DILUTER DEMAND LEVER "NORMAL OXYGEN"

RED FIGURES INDICATE DILUTER DEMAND LEVER "100% OXYGEN"

FLIGHT CREW OXYGEN DURATION

HOURS FOR 3 FLIGHT CREW MEMBERS, 3 LAC 654114 OXYGEN CYLINDERS

CABIN ALTITUDE IN FEET	GAGE PRESSURE — PSI 1800		1500		1200		900		600		300
25,000	4.2	2.4	3.3	1.8	2.4	1.5	1.5	.9	.9	.6	EMERGENCY
20,000	6.9	1.8	5.4	1.5	4.2	1.2	2.7	.6	1.5	.3	
15,000	8.4	1.5	6.9	1.2	5.1	.9	3.3	.6	1.8	.3	
10,000	9.0	1.2	7.2	.9	5.4	.6	3.6	.6	1.8	.3	
5,000		.9		.7		.5		.4		.2	

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Figure 4-59

mask as required. In the 100% OXYGEN position, undiluted oxygen is delivered to the mask.

Oxygen Supply Control Lever.

The oxygen supply control lever (1, figure 4-54) mounted on the oxygen regulator is used to open or close the incoming oxygen supply line that is connected to the regulator. The oxygen supply lever should be left in the OFF position when oxygen is not being used.

Safety Pressure Control Lever.

When the safety pressure control lever, mounted on the oxygen regulator (4, figure 4-54) is in the ON position, it allows a slight pressure to be built up inside the mask. This prevents outside air from being drawn into the mask when inhaling.

High Pressure Gages.

One high pressure gage for the three bottle system (formerly radar crew oxygen) and one for the one bottle system (flight crew oxygen) (figure 4-58) are located on the oxygen control panel above the oxygen cylinders. Each gage is calibrated from 0 to 3000 psi and registers 1800 psi at 21° C when fully charged.

Low Pressure Gages.

Two low pressure oxygen gages (figure 4-58) are located adjacent to the high pressure gages. These gages are calibrated from 0 to 200 psi and indicate system pressure. Normal pressure is 65 psi.

Flow Indicators.

Each diluter demand regulator incorporates an oxygen

flow indicator (5, figure 4-54). The flow of oxygen through the demand valve is indicated by the oscillation of a plate under the glass of the flow indicator.

NORMAL OPERATING PROCEDURES (TC-121C).

Blow gently into end of the oxygen regulator hose as during normal exhalation. If there is a resistance to blowing the system is satisfactory. Little or no resistance will indicate a faulty demand diaphragm or diluter air valve.

1. Oxygen supply cylinder shutoff valves — Open slowly.
2. Oxygen supply control lever—ON.
3. High and low pressure gages—Check for proper pressures.
4. Air valve control lever—NORMAL OXYGEN.
5. Smoke masks—Check.
6. Flow indicator—Check.
7. Flight crew shutoff valve—Off, unless it is desired to supply the flight station from the three cylinder crew system, then—Open.

EMERGENCY OPERATING PROCEDURES (TC-121C).

1. Should symptoms of hypoxia occur or the regulator fail, turn the safety pressure control lever clockwise to the ON position and descend to an altitude not requiring oxygen.
2. Whenever excessive carbon monoxide or other noxious or irritating gas is present or suspected, then, regardless of altitude, put on oxygen mask and set the air valve control lever to the 100% OXYGEN position until danger is past.

FLIGHT DIRECTOR SYSTEM (EC-121D).

(Figure 4-60).

The flight director system (FDS) gives the pilot a pictorial presentation (on only two navigation instruments) of all the information needed to:

1. Make ILS approaches.
2. Fly VOR courses.
3. Fly compass headings.
4. Maintain proper pitch and roll attitudes.

The major components of the flight director system are the attitude director indicator (ADI), the horizontal situation indicator (HSI), the gyro vertical monitor and caging indicator light, the vertical gyro and the steering computer. The first four components are mounted on the pilots' instrument panel and the last two components are mounted in the radio operator's station. Coupled with the system are the AN/ARN-14A navigation receiver and the AN/ARN-18 glide slope receiver.

The flight director system is operated by ac and dc power. AC power is supplied by the inverters and dc power is supplied from the main dc bus.

ATTITUDE DIRECTOR INDICATOR (ADI) (EC-121D).

The attitude director indicator (ADI) is the pilot's source of steering information, pitch and roll reference and aircraft displacement from the glide slope. Warnings are provided by the GS and LOC flags. These flags indicate that adequate signals are being received for proper operation of the system by swinging upward to a masked position.

A function selector knob, placarded HDG/ILS, and a pitch trim knob are located on the ADI. The ADI includes the following indicators: bank steering bar, pitch steering bar, glide slope indicator, horizon bar and bank pointer, and glide slope and localizer warning flag.

Bank Steering Bar.

Steering information is presented by the upright bank steering bar. Steering indications are computed from three basic signals and their rates of changes:

1. The VOR receiver gives course deviation when the function selector knob is in the ILS position.
2. The compass gives heading error.
3. The vertical gyro gives bank information.

These signals are sent to the steering computer and the lateral guidance signal output of the computer is used to operate the bank steering bar. Turns are always made toward the bank steering bar to correct a deviation error. The bank steering bar centers when the aircraft is holding a selected heading or when the bank angle has been correctly adjusted to turn to the heading. A bank angle of 20 to 25 degrees is the normal maximum amount needed to bring the bank steering bar to center. If a steeper bank entry is made the bank steering bar will move past center on its return and will signal the pilot to ease his bank. Holding the bank steering bar centered, will result in a smooth roll-out from the turn. In the ILS function, the bank steering bar responds to a synthetic heading signal based on the rate at which the

localizer deviation signal changes. Centering the bank steering bar on an ILS approach results in the alignment of the aircraft track with the localizer course, thereby correcting for crosswind.

Pitch Steering Bar.

The pitch steering bar, symbolizing the wings and the vertical stabilizer of the aircraft, moves up or down from center references as the pitch of the aircraft changes. The pitch signal is produced by the vertical gyro. The pitch trim knob enables the pilot to adjust the position of the pitch steering bar to compensate for changes from the normal pitch attitude of the aircraft during flight. When the ILS-HDG function selector knob is in the ILS position, the pilot cannot adjust the normal pitch attitude indication. It is determined by a pre-set approach trim control located in the steering computer. The pitch range of the pitch steering bar in the ILS and HDG function is indexed on the face of the ADI ±27°.

Glide Slope Indicator.

Displacement of the aircraft above or below the glide slope is indicated by the glide slope indicator and a vertical scale at the left of the ADI face. The same scale is used as a pitch steering bar reference. The glide slope indicator responds to the glide slope course deviation signal output of the glide slope receiver. The pilot flies the aircraft to align the pitch steering bar with the glide slope pointer. When the pitch steering bar is matched to the guide slope indicator at the center scale, the aircraft is in the correct approach attitude and holding on the glide path.

Horizon Bar and Bank Pointer.

The horizon bar and bank pointer are connected and therefore operate together. They are similar to a conventional artificial horizon both in appearance and action. The position of the horizon bar may be compared to the vertical scale marks at the side of the ADI. The bank pointer may be compared to a scale of ±10, ±20, ±30, and ±60 degrees at the top of the case. Thus the two indicators show both direction of roll and bank angle. The bank range of the ADI is ±100 degrees. The bank signal is produced by the vertical gyro.

HORIZONTAL SITUATION INDICATOR (HSI) (EC-121D).

The horizontal situation indicator functions as a compass repeater and is used for directional reference. In addition, it supplies properly oriented pictorial presentation of the aircraft heading and displacement with respect to a VOR or ILS course. The HSI includes the following: compass card, heading marker and heading set knob, course arrow, course deviation indicators, course set knob, and To-from indicator.

Compass Card.

The compass card repeats the indication of the aircraft's stabilized magnetic compass and displays the aircraft's heading continuously at the stationary lubber line.

Heading Marker and Heading Set Knob.

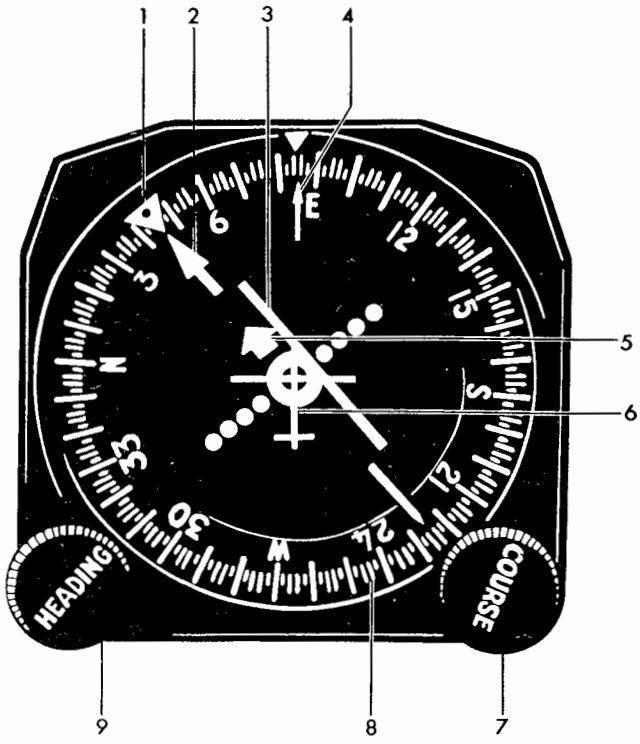
To aid in flying on a selected heading, a heading marker is provided. The heading marker is set to a desired heading on the compass card by turning the heading set knob. After the heading marker is set, it rotates with the compass card, and shows the amount and direction of heading error as a displacement between the marker and the lubber line. This heading error is relayed through the steering computer to the bank steering bar of the DI. The bank steering bar deviates from center indicating the required correction.

Course Arrow, Course Deviation Indicator, and Course Set Knob.

The central area of the HSI face is called the deviation indicator section. It includes the course arrow and the course deviation indicator. All parts of the deviation indicator section rotate as a unit, turning with the compass card as the aircraft's heading changes. An aircraft symbol is etched on the cover glass of the HSI and shows the position of the actual aircraft by its relation to the deviation indicator section. The course arrow and course deviation indicator are used in conjunction with the VOR receiver. After the correct channel for an omnirange station is chosen, a desired course or radial of the chosen station is selected by rotating the course set knob to adjust the position of the course arrow on the compass card. The course arrow is the reference marker for the course deviation indicator. Since the course deviation indicator is bidirectional in its movement, rotating with the deviation indicator section as well as moving across the face of the instrument, it indicates both displacement from the selected course and direction to the course with respect to the actual aircraft heading. The pilot then may select the heading required by adjusting the heading marker. If the aircraft is making good a selected course, the course deviation indicator is aligned with the course arrow. Each dot of the course deviation index is equal to 2° of deviation change.

EC-121D. FLIGHT DIRECTOR SYSTEM

HORIZONTAL SITUATION INDICATOR (HSI)

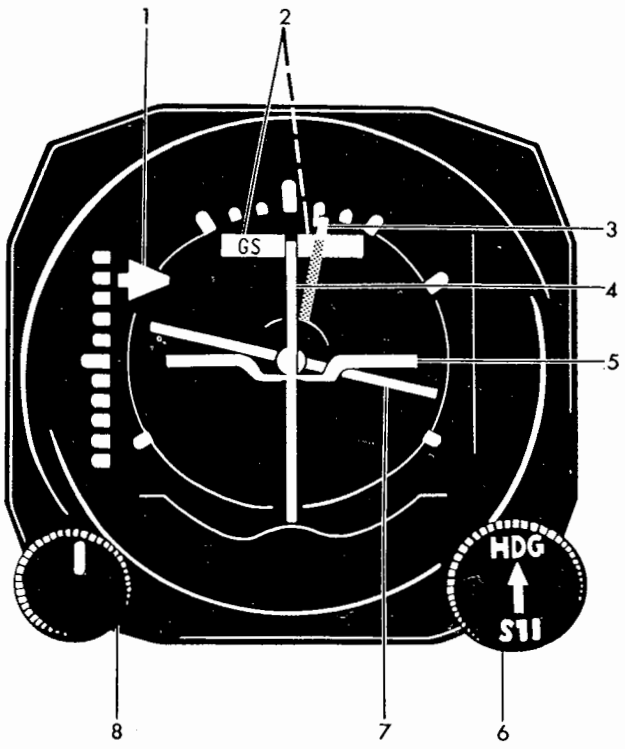


1. HEADING MARKER
2. COURSE ARROW
3. COURSE DEVIATION INDICATOR
4. LUBBER LINE
5. TO-FROM INDICATOR
6. AIRCRAFT SYMBOL
7. COURSE SET KNOB
8. COMPASS CARD
9. HEADING SET KNOB

The Horizontal Situation Indicator combines compass heading and radio position indications to form a plan view or map-like display of the aircraft with respect to a selected course. The Course Deviation Indicator simulates the selected course while other indications show the direction of the omni-range station and the position of the aircraft. The picture is equal to that which would be presented if the selected course were marked on the ground with the shadow of the aircraft moving along or toward it and the To-From Indicator pointing out the direction of the VOR station. The Horizontal Situation Indicator contains two meter movements in a standard three- or five- inch instrument case.

F75-F-4-200(1)

ATTITUDE DIRECTOR INDICATOR (ADI)



1. GLIDE SLOPE INDICATOR
2. WARNING FLAGS
3. BANK POINTER
4. BANK STEERING BAR
5. PITCH STEERING BAR
6. FUNCTION SELECTOR KNOB
7. HORIZON BAR
8. PITCH TRIM KNOB

The Attitude Director Indicator is a primary attitude and steering instrument. It is a forward view instrument with glide slope position and computed steering information superimposed on a pitch-and-roll reference. Steering information for precise ILS let-down and cross-country flying is given by the Bank Steering Bar. Other indications show pitch and bank attitude, give vertical guidance on the glide slope, and show when external signals are present. The Attitude Director Indicator contains six meter movements in a standard three-inch instrument case. Resistance and sensitivity characteristics of all meter movements are standard.

Figure 4-60 (Sheet 1 of 4)

EC-121D. FLIGHT DIRECTOR SYSTEM

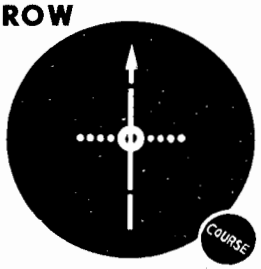
HORIZONTAL SITUATION INDICATOR (HSI)

COMPASS CARD

Driven by the aircraft compass system, the Compass Card rotates as aircraft heading changes. It always shows heading of aircraft beneath Lubber Line at top of instrument.

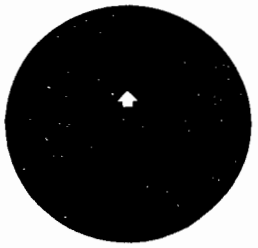
COURSE DEVIATION INDICATOR AND ARROW

Course Deviation Indicator simulates selected course. Deflection represents deviation from selected course, measured against the standard five-dot scale. Course Arrow indicates selected VOR radial or localizer inbound track. Knob at lower right sets Course Arrow to any desired course. Course Deviation Indicator and Arrow ride with Compass Card as aircraft heading changes.



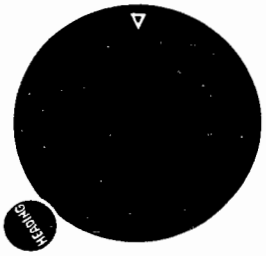
TO—FROM INDICATOR

To-From omni-range indication is provided by a large arrow which appears beneath Course Deviation Indicator on appropriate side of center. To-From Indicator is not displayed when FDS is working on localizer or VAR signals.



HEADING MARKER

Knob at lower left turns Heading Marker to magnetic heading desired. Marker rides with Compass Card as aircraft heading changes. Heading error is shown in degrees by displacement of marker from Lubber Line.



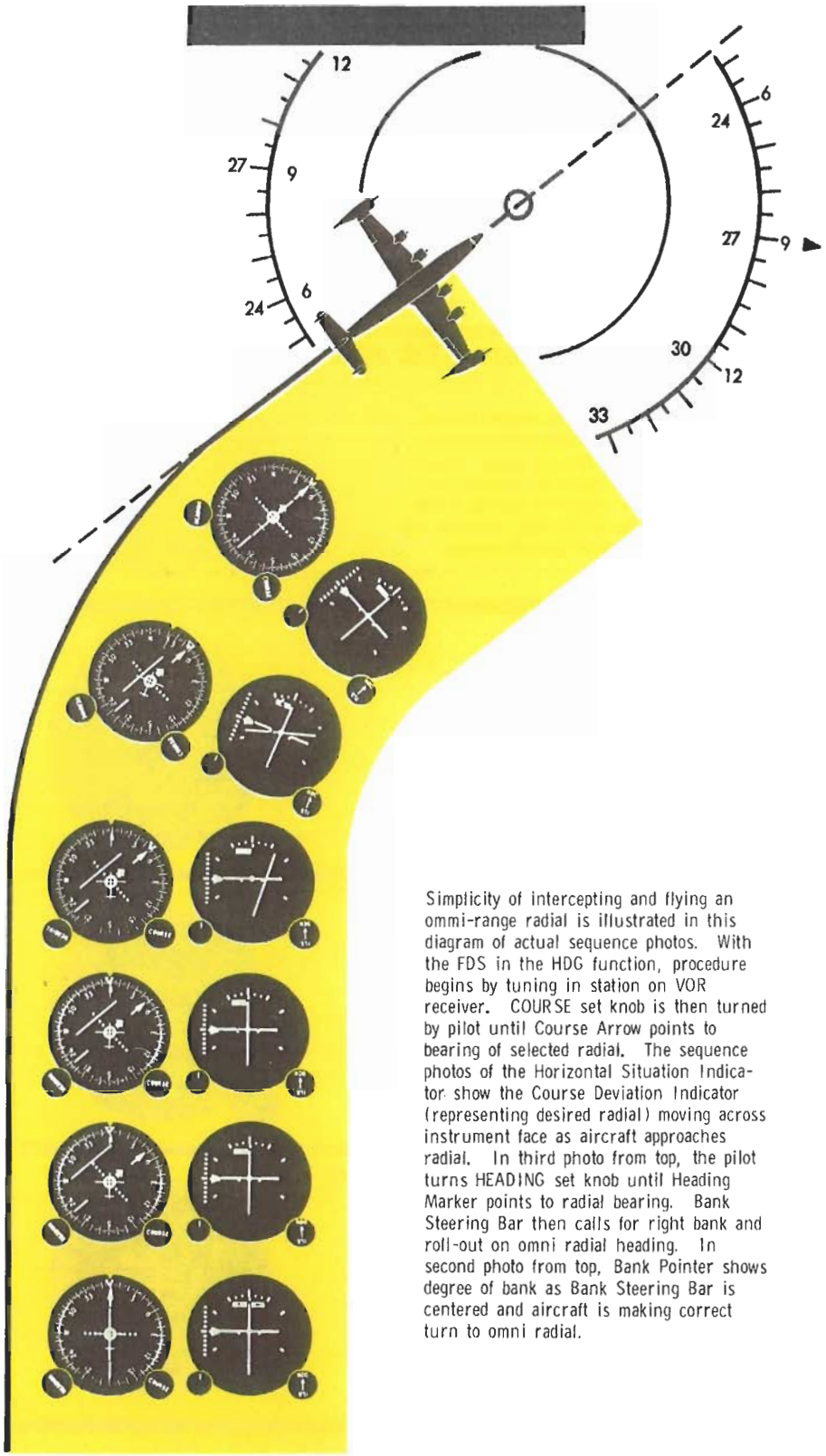
AIRCRAFT SYMBOL AND LUBBER LINE

Etches on instrument's glass, the Aircraft Symbol simulates aircraft. Lubber Line indicates aircraft heading. Picture is comparable to shadow of aircraft on ground. When Aircraft Symbol is pointed toward Course Deviation Indicator, aircraft is approaching selected course.

F75-F-4-200(2)

Figure 4-60 (Sheet 2 of 4)

EC-121D. FLIGHT DIRECTOR SYSTEM



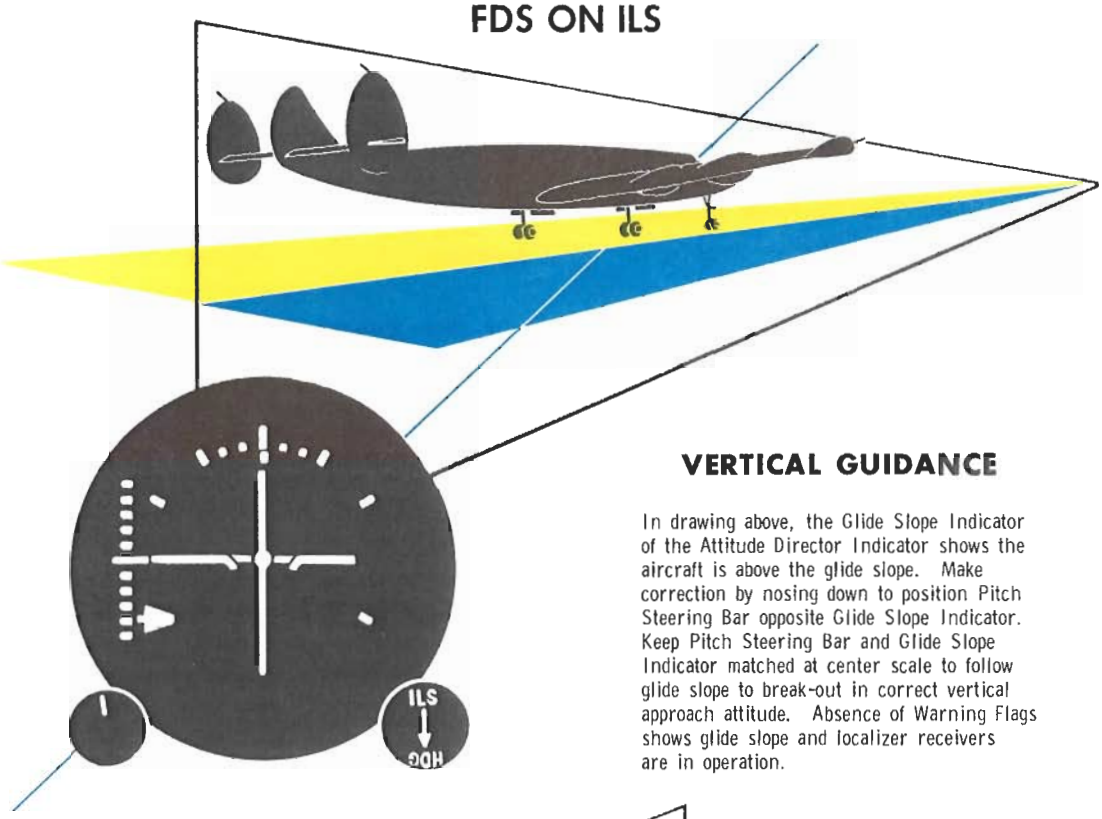
Simplicity of intercepting and flying an ommi-range radial is illustrated in this diagram of actual sequence photos. With the FDS in the HDG function, procedure begins by tuning in station on VOR receiver. COURSE set knob is then turned by pilot until Course Arrow points to bearing of selected radial. The sequence photos of the Horizontal Situation Indicator show the Course Deviation Indicator (representing desired radial) moving across instrument face as aircraft approaches radial. In third photo from top, the pilot turns HEADING set knob until Heading Marker points to radial bearing. Bank Steering Bar then calls for right bank and roll-out on omni radial heading. In second photo from top, Bank Pointer shows degree of bank as Bank Steering Bar is centered and aircraft is making correct turn to omni radial.

F75-F-4-200(3)

Figure 4-60 (Sheet 3 of 4)

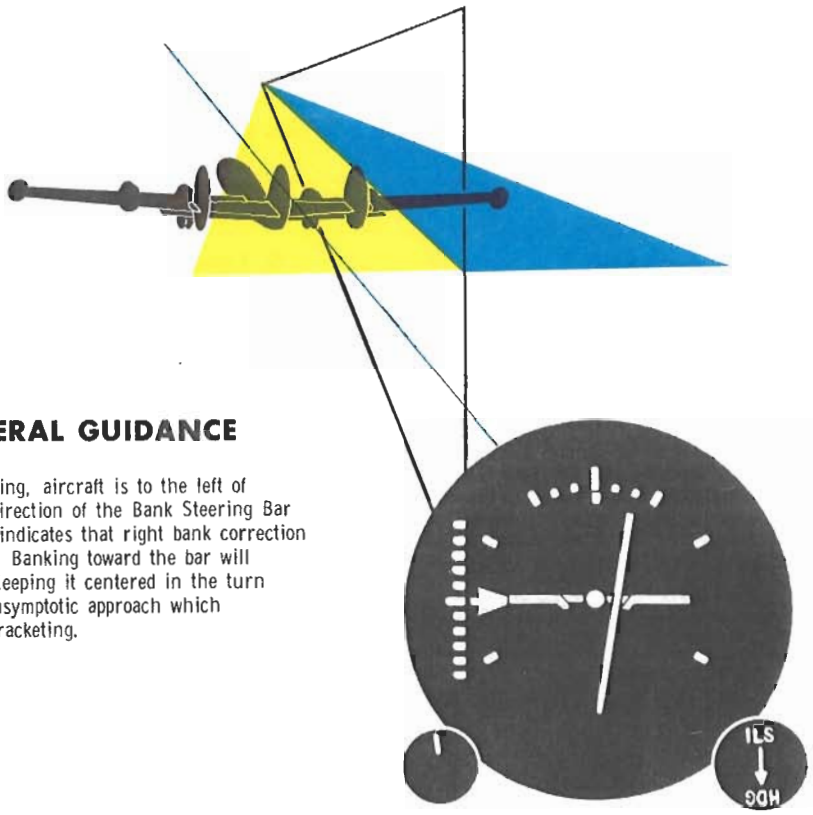
EC-121D. FLIGHT DIRECTOR SYSTEM

FDS ON ILS



VERTICAL GUIDANCE

In drawing above, the Glide Slope Indicator of the Attitude Director Indicator shows the aircraft is above the glide slope. Make correction by nosing down to position Pitch Steering Bar opposite Glide Slope Indicator. Keep Pitch Steering Bar and Glide Slope Indicator matched at center scale to follow glide slope to break-out in correct vertical approach attitude. Absence of Warning Flags shows glide slope and localizer receivers are in operation.



LATERAL GUIDANCE

In this drawing, aircraft is to the left of localizer. Direction of the Bank Steering Bar to the right indicates that right bank correction is required. Banking toward the bar will center it. Keeping it centered in the turn insures an asymptotic approach which eliminates bracketing.

F75-F-4-200(4)

Figure 4-60 (Sheet 4 of 4)

To-From Indicator.

The To-From indicator is also included in the deviation indicator section of the HSI. The VOR receiver, operating on omnirange channels, produces the signal to operate the To-From indicator. This indicator removes all ambiguity from the position picture. It indicates which end of the course bar (including the course arrow) points toward the station. Reversal of indications show passage over the station. The To-From indicator is masked when tuned to an ILS station.

VERTICAL GYRO MONITOR (EC-121D).

The vertical gyro monitor indicates applications of power to the vertical gyro rotor and torque motors. It also shows when the rotor has reached operating speed and is fully erected. When the rotor reaches operating speed, the pointer drops back to the center scale from SLO position of the scale. When full erection of the rotor is reached, the pointer flickers and holds within the center scale, the green area bordered by yellow fluorescent lines. Torque motor operation to maintain the rotor's erection causes the pointer to flicker, with initial motion toward the SLO portion of the scale. Power failure immediately drops the pointer to OFF. The vertical gyro cage light tells the pilot when the vertical gyro is caged or uncaged. When the light is on, the gyro is caged, indicating a loss of either ac or dc power coming through the fuses on the MJB #2A panel. When the gyro is caged, the horizon and pitch bars are inoperative and the steering pointer is unreliable.

FDS PREFLIGHT CHECKS (EC-121D).

1. Compass card of HSI should repeat heading of stabilized magnetic compass.

2. Set function selector knob to HDG.

(a) Rotate heading set knob to place heading marker at lubber line.

(b) Bank steering bar should center.

(c) Rotate heading marker to right; bank steering bar should deflect right.

(d) Rotate heading marker to left; bank steering bar should deflect left.

(e) Rotate pitch trim knob on ADI to center pitch steering bar.

3. Set function selector knob to ILS.

(a) Rotate heading set knob to place heading marker at lubber line.

(b) Bank steering bar should center.

(c) Rotate heading marker to right; bank steering bar should deflect right then slowly return to center.

(d) Rotate heading marker to left; bank steering bar should deflect left and then slowly return to center.

(e) Rotating pitch trim knob on ADI should have no effect.

4. Note gyro monitor and indicator light.

(a) Gyro monitor pointer should be approximately midscale reading.

(b) Gyro indicator light should be OUT.

(c) PUSH-TO-TEST gyro indicator light should operate.

5. Course selector check.

(a) Set function selector knob to HDG.

(b) NAV receiver ON and tuned to local VOR channel.

(c) Rotate course set knob to center course deviation indicator.

(d) Rotate course set knob to displace course deviation indicator.

(e) LOC flag on ADI should be masked.

6. Localizer and glide slope check.

(a) Tune NAV receiver to localizer channel.

(b) LOC flag should be masked.

(c) Glide slope flag should be masked.

(d) Course deviation indicator on HSI should be displaced.

(e) Set function selector knob to ILS.

(f) Bank steering bar should deflect and hold.

7. Check that function selector knob is in HDG position before takeoff.

NORMAL OPERATING PROCEDURE (EC-121D).

Flying Magnetic Headings.

1. Function selector knob—HDG.

2. Heading marker—Set to selected course.

3. Bank steering bar—Centered.

Flying Omni-Courses.

1. Function selector knob—HDG.

2. VOR receiver—Set.

Note

LOC flag warning swings upward to masked position.

3. Course arrow—Set to selected course.

4. Heading marker—Set to heading that will approach or hold selected course.

5. Bank steering bar—Centered.

6. HSI—Cross-check for oriented picture of position relative to omniradial: compare position of course deviation indicator, course arrow, and aircraft symbol.

Note

To-From indicator establishes direction and indicates, by reversal, station passage.

7. Plot omnirange stations, if necessary, by setting the VOR receiver to proper channels and adjusting the course set knob to align the course deviation indicator with course arrow.

Flying ILS Approaches.

1. Heading marker—Adjust to heading which will intercept localizer course at desired location.

2. Bank steering bar—Centered.

3. VOR and glide slope receivers—Set.

Note

GS and LOC flag warnings move to masked position.

4. Course arrow—Set to inbound localizer course.

Note

Course deviation indicator now represents the localizer course.

5. When course is intercepted, fly outbound localizer course and complete procedure turn.

Note

- Course deviation indicator and aircraft symbol provide constant position-picture with reference to localizer beam. Actual headings are displayed under the lubber line.
- If bank steering bar is to be used, heading marker must be advanced through a series of headings which make good the requirements of the procedure turn. Advance the heading marker into the turn, less than 90 degrees at a time, during the turn around.
- If the pilot does not desire to make adjustments to the heading marker during a procedure turn, he may match the heading marker to the course arrow which is set to the inbound course and ignore the heading marker and bank steering bar until the turn is completed.

6. Heading marker—Set to same heading as head of course arrow.

7. Function selector knob—ILS, when the course deviation indicator moves from the full four dot deflection to a three dot deflection.

8. Fly by reference to the bank steering bar and the altimeter until the glide slope indicator is centered.

9. Adjust power settings or pitch attitude as necessary to match the glide slope indicator and pitch steering bar.

Note

In unusual circumstances such as downwind approaches or extreme cg location, it is difficult to hold the two pointers together at the center of the scale. Fly the pitch steering bar to maintain the glide slope indicator centered.

Missed Approach.

1. Function selector knob—HDG.

Note

An immediate change to the HDG function is required to remove the synthetic heading signal response of the bank steering bar and to remove the pre-set approach trim of the pitch steering bar.

2. Heading marker—Set and fly by reference to the bank steering bar.

AUTOMATIC PILOT.

The PB-10 automatic pilot installed in the aircraft is an electrically operated system that requires alternating current, which is supplied by the main instrument inverter and direct current, which is supplied by the main bus. The automatic pilot establishes references for automatic control of the aircraft. Whenever there are any deviations in the attitude of the aircraft from these flight references, the system senses these deviations electronically and operates the rudders, ailerons, and elevators through the normal flight control system, accordingly.

AUTOMATIC PILOT COMPONENTS.

Fundamentally, the automatic pilot is made up of nine components. Of these the gyro fluxgate transmitter, the amplifier signal generator, the three main servos, and the elevator trim tab servo, comprise the working units of the system. The remaining three components, the master direction indicator, the three-axis trim indicator, and the controller provide indications and operating controls for the pilots. In addition, switches are provided to control the various functions of the equipment. An elevator trim tab servo eliminates the need for manual nose up or nose down trimming when the automatic pilot is being used because the elevator trim tab servo is controlled directly by the elevator servo signal. When the elevator servo is required to sustain a force for a period of time to hold an elevator position, the elevator trim tab servo will be automatically actuated and will position the trim tab to provide aero-dynamic balance. The manual trim tab wheel will move very slowly and the tab position indicator will show the position of the tab.

Safety Circuit.

A safety circuit in the amplifier causes disengagement of the automatic pilot servo clutches in case of ac power failure likely to affect the operation of the gyros. The automatic pilot clutches are also automatically disengaged in case of dc failure.

Circuit Breakers.

Three circuit breakers (figure 1-29), two labeled PB-10 AUTO PILOT Aϕ and Cϕ, and one labeled dc, are located on the MJB No. 2A panel. When these circuit breakers are pushed in, both alternating and direct current are directed to the system.

Servo Disconnect Levers.

These three levers (10, figure 4-61), located on the lower aft side of the center control stand, operate mechanical clutches in each of the servos. Raising any one lever completely disengages the corresponding servo pulley from the servo drive shaft so that the pulley is free to turn with cable control movement. The servo disconnect levers also operate interlock switches at the beginning of their travel which interrupt the dc power to the clutch switch and prohibit its engagement before the actual mechanical engagement.

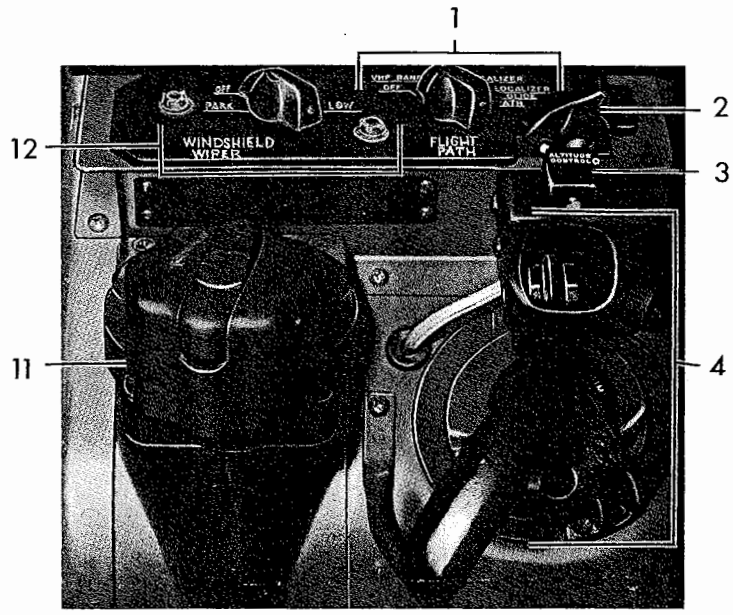
Fluxgate Caging Switch.

This momentary contact switch (6, figure 4-61), located on the center control stand and to the left of the clutch switch, provides a means for expediting the erection of the gyro in the gyro fluxgate transmitter and the automatic pilot vertical flight gyro. When the caging switch is placed in the CAGE (up) position and then released, the caging motors are energized to drive and lock the gimbal rings of the gyros so that the gyros are caged; then the gyros are automatically released (uncaged) and the caging motors are stopped. The caging circuit to the automatic pilot and fluxgate compass also includes an interlock so that in case the caging switch is closed, whiie the automatic pilot is engaged, the clutch switch holding solenoid is deenergized. This releases the clutch switch, allowing it to pop out, disengaging the automatic pilot.

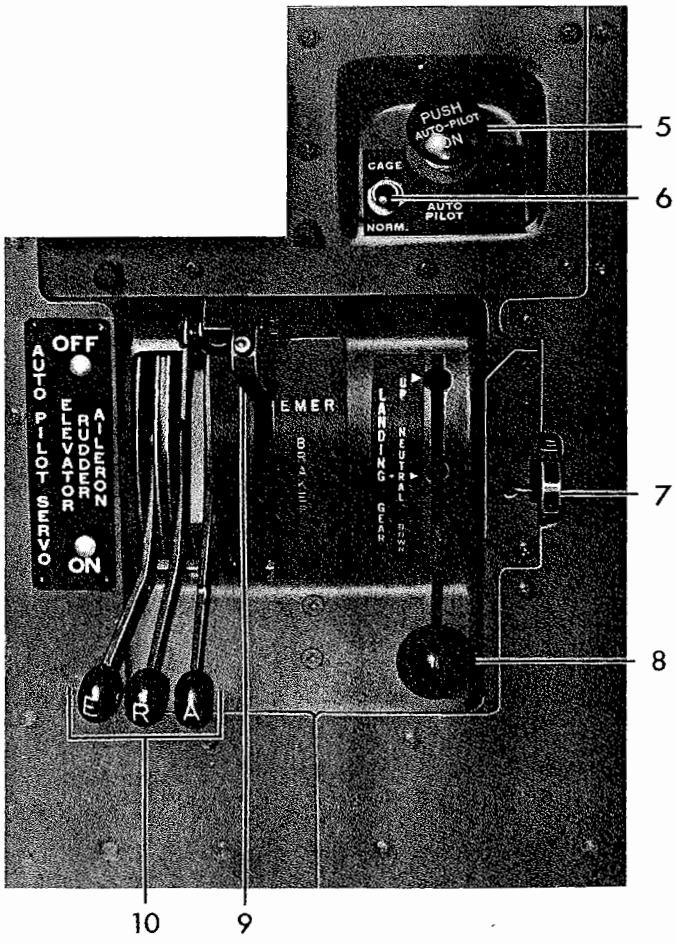
Clutch Switch.

This switch (5, figure 4-61), is located on the center control stand, directly above the caging switch, and when pressed in, operates an electric clutch in each of the servos and the direction indicator to engage the automatic pilot, provided ac and dc power have been on approximately two minutes; servo disconnect levers are in the ON position; altitude control switch is OFF and gyros are uncaged. A clutch time delay relay prevents engagement of the clutch for approximately two minutes after the automatic pilot is turned on. The delay set in by the relay allows time for the amplifier tubes to warm up, the gyros to reach operating speed, and the servos to turn to cancel the net channel signal before the automatic pilot takes control of the aircraft. During this delay period, the clutch switch, when pressed, will not hold and will not operate the servo clutches. The trim tab functions with the automatic pilot clutch switch. With the clutch switch out and the automatic pilot not engaged, a clutch inside the trim tab servo disengages to free the servo. A pulley friction release, mounted on the servo shaft, permits overpowering the trim tab servo.

AUTOMATIC PILOT CONTROLS



1. FLIGHT PATH SELECTION SWITCH
2. FLIGHT PATH DIRECTION SELECTION SWITCH
3. ALTITUDE CONTROL SWITCH
4. AUTO-PILOT CONTROLS
5. AUTO-PILOT CLUTCH SWITCH
6. AUTO-PILOT FLUX-GATE CAGING SWITCH
7. LANDING GEAR LEVER RELEASE TRIGGER
8. LANDING GEAR LEVER
9. BRAKE SELECTOR LEVER
10. AUTO-PILOT SERVO DISCONNECT LEVERS
11. RUDDER TRIM TAB HANDCRANK
12. WINDSHIELD WIPER CONTROL



F75-D-4-96

Figure 4-61

Altitude Control Switch.

This switch (3, figure 4-61), which is mounted above the turn controller energizes a clutch which connects the altitude control autosyn to its sensing aneroid. Any deviation from the altitude at which this clutch is engaged will cause a signal to be generated for automatic control of the elevator, which will hold the aircraft at any pressure altitude up to 30,000 feet, provided airspeed and altitude are stabilized at the time it is turned on. Regardless of the amount the aircraft is displaced in altitude, the maximum pitch change that the unit can set in to return the aircraft to its original altitude is ±8°. The switch is electrically interlocked with the clutch switch to prevent engagement of the automatic pilot while the altitude control switch is ON. Also, when the altitude control switch is ON, a guard covers the pitch trim wheel, making it inaccessible.

Maneuvering Controls.

The maneuvering controls (4, figure 4-61) mounted on the center control stand are used to make coordinated turns, climbs, descent, climbing turns, or descending turns with the automatic pilot. The three controls and their functions are:

1. The pistol grip turn controller incorporates two cut-out switches; one operated automatically whenever the handle is displaced 4 degrees maximum in either direction from the center position and the other operated manually by a trigger switch on the pistol grip. The switches are normally closed and are connected in series with the clutch solenoid in the master direction indicator. When either switch is opened, the course autosyn is disengaged, thus allowing the selection of a new heading by use of the turn controller. If neither of these switches is opened while maneuvering the aircraft with the turn controller, the aircraft will return to its original heading when the turn controller is returned to the detent.

2. The bank trim wheel is dc operated and may be used to adjust bank attitude after squeezing the pistol grip trigger switch. (See paragraph on CRUISE procedure.)

3. The pitch trim wheel is dc operated and may be used to bias the elevator channel for any desired angle of climb or descent. This control is not accessible with the altitude control switch ON.

Pilot's Clutch Disconnect Switches.

These switches, mounted on the outboard hand grip of each pilot's control wheel, provide a means for disengaging the automatic pilot. When pressed, either of these switches will electrically disconnect the automatic pilot system and the clutch switch will pop out. When this occurs, the clutches in the servos and in the direction indicator are disengaged, preventing automatic control from being applied to the aircraft control surfaces.

Fluxgate Sensitivity Control.

This control, located on the lower right corner of the automatic pilot amplifier-signal generator, under a removeable cover, is used for adjusting fluxgate compass sensitivity. For latitudes approximating that of the Continental United States, this adjustment can be full counterclockwise. For those latitudes nearer the poles where the horizontal component of the earth's flux is weaker, increased sensitivity will probably be preferred. A setting which is too high results in oscillation of the master direction indicator and of the aileron servo. Sluggish movement of the direction indicator occurs when the setting is too low.

Fluxgate Compass Master Direction Indicator.

The fluxgate compass master direction indicator (14, 15, figure 1-7), located on the copilot's instrument panel, indicates the magnetic heading of the aircraft whether the automatic pilot is engaged or disengaged. The dial is directly connected through gears and linkages to an induction motor which operates both directionally and proportionally to changes of the magnetic heading of the aircraft. When the heading changes, the gyro fluxgate transmitter, mounted in the wing, electrically senses this change due to its change of position in the earth's magnetic field, and transmits a signal to the fluxgate direction indicator. This signal serves two purposes; it is used to drive the dial of the fluxgate direction indicator, and to originate a course signal for automatic control. The course signal is then transmitted to the amplifier where it is amplified and modified to become a working signal with the characteristics necessary for application of power to the servo motor. When this working signal energizes the servo motor, which is tied to the aileron control system of the aircraft, it drives in the proper direction to apply corrective force for holding the aircraft on a desired magnetic heading.

Three-Axis Trim Indicator.

The three-axis trim indicator (31, 33, figure 1-7) is dc operated and is mounted on the pilot's center instrument panel. It is connected across all three amplifier channels and indicates trim condition in all three axes. A sustained displacement of the indicator hand indicates a servo is putting out torque and the direction indicated. This out-of-trim condition requires manual correction before engaging the automatic pilot by use of the trim tab control in the same direction.

NORMAL OPERATING PROCEDURES.

To Engage the Automatic Pilot for Ground Check:

1. Circuit breakers—In.

2. Servo disconnect levers—ON.

3. Gyros—Cage (after the inverter has been operating at least two minutes). Allow about 30 seconds for completion of the caging cycle.

4. Check three-axis trim indicator.

5. Altitude control switch—OFF.

6. Clutch switch—PRESS.

Ground Check.

The forces tabulated below refer to: Elevator force applied on the center of the control wheel hub; aileron force applied at the rim of the control wheel; and rudder force applied on the rudder pedals.

	Stall
Elevator	33# (±7)
Rudder	65# (±15)
Aileron	16# (±3)

To determine that the values of the above stall forces are approximately correct:

1. With the engines running and with boost on, operate the surface control several times.

2. Neutralize (center) surface controls.

3. Engage the automatic pilot.

4. By use of the pitch trim wheel and turn controller, move the surface controls each way.

5. Operate the turn controller and determine that the rotation of the control wheel can be stopped with moderate effect of one hand.

6. Operate the pitch trim wheel forward and aft and determine that the control column movement can be stopped with moderate effect of one hand.

7. Operate the turn controller and determine that the rudder motion can be stopped with moderate effort. (The rudder will move only a few inches.)

To check the overpowering forces, proceed as follows:

1. With the pitch trim wheel and turn controller in the neutral position, operate each of the surface controls against the power of the automatic pilot.

2. Using two hands on the wheel, the pilot should be able to turn or move it forward and aft.

3. By applying considerable effort on the rudders the pilot should be able to move the pedal each way.

Note

The above checks can be performed in flight as well as on the ground.

The above checks give the pilot an approximation of the forces that the automatic pilot can produce. If it requires maximum effort with two hands to stall the elevator, the pilot is sure that the automatic pilot is capable of producing excessive force. If the pilot can overpower the ailerons easily with one hand, he knows that the aileron servo is not putting out sufficient force.

Note

Wind blowing directly on the tail may affect the required force on the controls.

Before Take-off.

1. Pilot's clutch disconnect switch—Press.

2. Servo disconnect levers—OFF.

Climb.

1. After climb power is set, the aircraft should be trimmed before the automatic pilot is used.

2. Altitude control—OFF.

CAUTION

Altitude control may be used to level the aircraft off at cruising altitude due to the addition of an altitude integrator mechanism. It must be remembered that the aircraft will return to the original rate of climb if altitude control is turned off before the automatic pilot is disconnected and the aircraft retrimmed for level flight.

3. Servo disconnect levers—ON.

4. Center three-axis trim.

5. Clutch switch—Push.

Cruise.

When the desired cruising altitude has been attained, proceed as follows:

1. Disengage the automatic pilot.

2. Trim the aircraft manually for straight and level cruising flight at the desired altitude with desired cruising power.

3. Set the automatic pilot trim wheels to neutral.

4. Check that the altitude control is OFF.

5. Engage the automatic pilot.

6. Altitude control—ON, if desired.

7. For normal changes in trim, such as power changes or changing weight due to fuel consumption, the altitude integrator mechanism will automatically retrim the pitch axis of the aircraft. When sustained displacements of the indicators on the three axis trim indicator occur, the pilot may adjust manual trim without disengaging the automatic pilot or altitude control.

8. The automatic pilot now has control of all three axes of the aircraft. With the altitude control OFF, the aircraft's attitude can be changed by operation of the maneuvering controls. It is possible to adjust bank attitude by squeezing the trigger switch and using the bank trim wheel. However, since the inclusion of the directional signal in the aileron channel the bank trim wheel is of no practical use. The automatic pilot should be engaged with the aircraft trimmed for wing level flight. Normal changes in trim are compensated for automatically through the action of the heading integrator mechanism. Rotating the pitch trim wheel aft (toward the pistol grip) will move the elevator to raise the nose. Any desired angle of descent may be obtained by rotating the pitch trim wheel forward. To make a coordinated turn, move the turn controller in the direction it is desired to turn. This operation gives the proper amount of up-elevator to maintain altitude and the correct amount of aileron and rudder for coordinated turn. When the turn controller is rotated to make greater changes in heading, a switch is automatically tripped to disconnect the automatic pilot from the fluxgate compass so that when the handle is returned to the central detent position, the aircraft will maintain the new heading. If very slight changes in heading are desired, squeeze the trigger switch under the pistol grip, which cuts out compass heading signals, and rotate the turn controller a small amount in the desired direction, and then return it to the detent. The aircraft will hold the new course.

Descent.

1. Automatic pilot—Disengage, if desired.

2. Altitude control—OFF.

Note

Through alternate use of the pitch trim wheel and the altitude control switch, the pilot has a convenient method of letting down in a holding pattern. With the use of the pitch trim wheel, a rate of descent may be established to the newly assigned altitude. Altitude control would then be reengaged upon reaching the new holding altitude. Integration corrects the altitude error caused by over-shooting the engaged altitude. When letdown to the next holding level is directed, the pilot disengages altitude control and the memory feedback automatically returns the aircraft to the former descent altitude. Descent at a uniform rate may thus be made in a series of steps. Once the desired rate is established, the pilot engages the altitude control to hold altitude, and disengages to descend at a uniform rate.

3. Pilot's (or copilot's) clutch switch—Press.

4. Servo disconnect levers—OFF.

EMERGENCY OPERATING PROCEDURES.

Refer to Section III.

AUTOMATIC FLIGHT PATH CONTROL SYSTEM (EC-121D).

The automatic flight path control (FPC) system is a combination of an electronic computer and the PB-10A autopilot. Its primary power source is from the MJB dc bus and ac from the instrument inverter system. The FPC system enables the aircraft to automatically follow a fixed flight path determined by signals from ILS, VOR, and VAR radio ranges.

COMPONENTS (EC-121D).

The FPC system consists of the following equipment:

Flight path computer

Throttle servo amplifier

Throttle servo unit

Autosyn transmitter

Geneva actuator

Throttle clutch assembly

The flight path computer permits navigation and all-weather instrument landing approach of the aircraft by automatic radio control. The computer takes the same information sent to the ILS deviation indicator and converts it into information for the automatic pilot and throttle servo unit. Provisions are made in the computer to prevent any sudden, large correction and to allow smooth, non-oscillating approaches to the center of the beam. The throttle servo amplifier amplifies the error signal from the computer and determines the direction and amount of correction of the throttle servo motor. The throttle servo unit controls the throttles to provide proper operation of the aircraft on the glide slope. The autosyn transmitter attached to the No. 1 throttle is pre-set by maintenance personnel to a null at a pre-determined power setting.

When an error signal is picked up from the ILS deviation indicator which shows the aircraft to be either above or below the glide slope the computer sends a signal to the elevators through the automatic pilot, and at the same time a proportionate amount of signal is sent to the throttle servo unit. A rate generator, incorporated in the throttle servo unit, serves as a damper to provide stable approach to the required throttle setting. The geneva actuator is used to engage and disengage the throttle clutch. An interlock switch couples the computer to the automatic pilot and throttle servo unit when the throttle clutch is engaged. If manual operation of the throttles is desired, the throttle lock lever (6, figure 1-11) may be unlocked. The throttle clutch assembly is a multiple disc clutch which couples the four throttles together and to the throttle servo motor whenever the flight path selector switch is placed in the LOCALIZER & GLIDE PATH poistion. This clutch can be manually overridden either by the pilot or the flight engineer.

CAUTION

If No. 1 propeller is feathered, align the No. 1 throttle with the other throttles before placing the flight path selector switch in the LOCALIZER & GLIDE PATH position to prevent an improper power setting.

Flight Path Selector Switch.

This switch (1, figure 4-61) is mounted on the center control stand and is placarded with the following positions: OFF, VHF RANGE, LOCALIZER, and LOCALIZER & GLIDE PATH. This switch is used to select the mode of operation. If the FPC is disconnected, (autopilot disconnect or controller moved from detent), this switch must be returned to the OFF position and then back to the desired mode. When the flight path selector switch is in the VHF RANGE or the LOCALIZER position, the signals from the computer are sent to the ailerons and rudders, through the automatic pilot, to track the radio beam. When the flight path selector switch is in the LOCALIZER & GLIDE PATH position, signals are also sent to the automatic pilot for elevator control and to the throttle servo unit for throttle control to maintain the glide slope and airspeed. As the glide slope is intercepted and the flight path selector switch is put in the LOCALIZER & GLIDE PATH position, the aircraft will nose down and the throttles will move until the autosyn transmitter on the No. 1 engine reaches the null position with the aircraft on the glide slope.

CAUTION

If No. 1 propeller is feathered, align the No. 1 throttle with the other throttles before placing the flight path selector switch in the LOCALIZER & GLIDE PATH position to prevent an improper power setting.

Flight Path Direction Selector Switch.

This switch (2, figure 4-61) is mounted adjacent to the flight path selector switch. It is used when flying the localizer beam. It has two positions, BLUE RIGHT and BLUE LEFT, and is guarded in the BLUE RIGHT position. To fly the outbound leg of an ILS station the guard must be lifted and the switch placed in the BLUE LEFT position.

Pilots' Clutch Disconnect Switches.

A switch, mounted on each pilot's control wheel, provides instantaneous release of the automatic pilot, and therefore the FPC. It may be used as a quick return to manual operation if desired.

Localizer Glide Slope Inoperative Warning Lights.

Warning lights, one for the localizer, and one for the glide slope are located on the pilot's instrument panel. The two lights for the localizer and the glide slope will come on with the flight path selector switch in the corresponding position whenever there are certain malfunctions in the flight path computer, or if the turn control or automatic pilot interlocks are operated. If either of

these lights comes on, that section of the computer is automatically disconnected from the automatic pilot and it is necessary to resequence the flight path selector switch. If light comes on again place flight path selector in OFF and fly manually.

FPC PREFLIGHT CHECKS (EC-121D).

1. Follow standard procedure for preflight of automatic pilot. When caging cycle is actuated note that the MDI, RMI's and compass card of the HSI all show a slight movement and then stabilize.

2. Automatic pilot engaged, tune ARN-14 to nearest VOR station; select radial that will center course deviation indicator on the HSI.

Note

Localizer OFF flag will not be visible.

3. Turn flight path selector switch to VHF RANGE function, note no localizer warning light.

4. Select radial that will cause displacement of course deviation indicator to fly right, there should be control surface movement for right turn. Center course deviation indicator; controls should return to neutral. Select radial that will cause displacement of course deviation indicator to fly left; there should be a control surface movement for left turn. Center course deviation indicator; controls should return to normal.

Note

When controls are fully displaced, movement back toward center may be noticed. This is a normal reaction.

5. Move controller handle out of detent. You should get a localizer warning light (flight path control system disengaged automatic pilot control only). Center controller handle light will not go out.

6. Re-sequence flight path selector switch (move to OFF then back to VHF RANGE). Localizer warning light should go out.

7. Tune ARN-14 to station localizer frequency. Switch flight path selector switch to LOCALIZER function. Controls should move in a direction to fly into displaced course deviation indicator.

8. Move automatic pilot controller handle out of detent. You should get a localizer warning light (flight path control disengaged, automatic pilot control only). Center controller handle; light will not go out.

9. Re-sequence flight path selector switch (move to OFF then back to LOCALIZER). Localizer warning light will go out and controls will again move to fly into the course deviation indicator.

10. While holding throttles move flight path selector switch from LOCALIZER to LOCALIZER & GLIDE PATH. Throttle lock will drive to lock position automatically and pressure will be felt to move the throttles to increase power.

11. Throttle override check—Move throttles; advance and retard; resistance must be felt.

12. With copilot or flight engineer still holding throttles, move controller out of detent. Throttle lock will drive off, throttles will remain in same setting and both localizer and glide slope warning lights will glow.

Note

Warning lights are extinguished by moving flight path selector switch to OFF position. If switch is re-sequenced back to LOCALIZER & GLIDE PATH position to check warning lights, throttles must again be held.

13. Warning light push to test check:

Flight Path Selector Switch Position	*Push to Test*	
	Localizer	*Glide Path*
OFF	No light	No light
VHF RANGE	Light	No light
LOCALIZER	Light	No light
LOCALIZER & GLIDE SLOPE	Light	Light

NORMAL OPERATION (EC-121D).

Operation of the FPC is divided into two general types of problems; navigating a range and instrument landing approach.

Range Flying.

After the aircraft is airborne and the automatic pilot is engaged, proceed as follows:

1. Aircraft receiver—Tuned to desired station.

2. Omni bearing selector—Turn to desired radial (optional).

3. ILS indicator—In making the range orientation, the aircraft is maneuvered by means of the controller turn handle. Follow the standard operating procedure to place the aircraft on the selected radial. With the course deviation indicator centered, and the aircraft within 15° of the radial, wait approximately 1½ minutes, then turn the flight path selector switch from OFF to VHF RANGE. To avoid a rough reaction, do not initiate a switch resequence on range position when the wings are not level. When the aircraft is in a turn, with a wing down, the turn is commanded by the range signal; moving the switch to OFF in the resequencing drops out the range signal. If the signal is appreciable, the maneuver may be abrupt. If the aircraft drifts off the radial, the computer will add directional correction to put the aircraft back on the radial. If it continues to drift the computer corrections will eventually establish a crab angle to track the radial. If a heading change of more than 15° from the intercept heading is required, the aircraft will not track the radial and it will be necessary to reset the range control on the new heading by turning the flight path selector switch to OFF and then back to VHF RANGE. The aircraft will then fly back to the radial and track it. Control on range is stabilized by the data smoother circuit in the flight path computer which smoothes out the radio signal by averaging it with the compass heading. Therefore, a sustained displacement of the course deviation indicator may be noticed for a period of time in areas of an unstable or warped radial. If a change of heading is desired over the station, the pilot should initiate a turn, using the automatic pilot controller, to intercept the new radial. Place the flight path selector to the OFF position, hold the course deviation indicator at center for 1½ minutes, then re-engage the VHF RANGE mode. To fly cross-country by means of FPC all that is necessary is to switch back to automatic pilot, select another station heading, retune the aircraft receiver and repeat the foregoing steps.

Instrument Landing Approach.

Follow the standard operating procedure in making localizer orientation while flying manually or with the automatic pilot. If the procedure turn is made so that the localizer can be intercepted between 2 and 3 minutes beyond the outer marker at an angle of 45 degrees or less, the flight path selector switch can be moved to the LOCALIZER position when the course deviation indicator leaves the stop. If the localizer is intercepted at less than 2 minutes from the outer marker, fly to and align the aircraft in the center of the localizer course before moving the flight path selector to LOCALIZER position to eliminate over bracketing.

WARNING

Because this system has a throttle position feed-back which is not a function of airspeed, a displacement from the glide slope beam center caused by gusts may result in a loss of airspeed that could be dangerous if not monitored.

Proceed on localizer for the glide slope intercept. When the glide slope pointer centers, position the flight path selector switch to LOCALIZER GLIDE PATH position. Follow procedures outlined in authorized letdown chart. If the glide slope is captured before the recommended time the computer will prematurely reduce the bank limit due to the action of time constants which are built into the computer to compensate for beam convergence. On glide slope, the pilot should monitor the airspeed indicator. Airspeed adjustments are made by changing angle of attack of aircraft through the pitch trim wheel of the automatic pilot controller. To increase airspeed, roll the pitch trim wheel forward. As the aircraft goes below the glide slope the resulting up-elevator signal will increase the throttle setting to put the aircraft back on the glide slope and thereby increase the airspeed. Rolling the pitch trim wheel back will have an opposite effect. No adjustment to the autosyn transmitter preset null is made in flight since this is an installation or maintenance adjustment.

CAUTION

The flight path control system is incapable of maintaining or returning the aircraft to the localizer center during an automatic approach with No. 3 engine at zero thrust and simulating No. 4 engine failure on the glide slope.

FUSELAGE FURNISHINGS AND MISCELLANEOUS EQUIPMENT.

NAVIGATOR'S EQUIPMENT.

The navigator's station is located on the right forward side of the cabin and is equipped with a chair, table, instrument panel, fabric pocket for miscellaneous data,

EC-121D. INTERIOR ARRANGEMENT

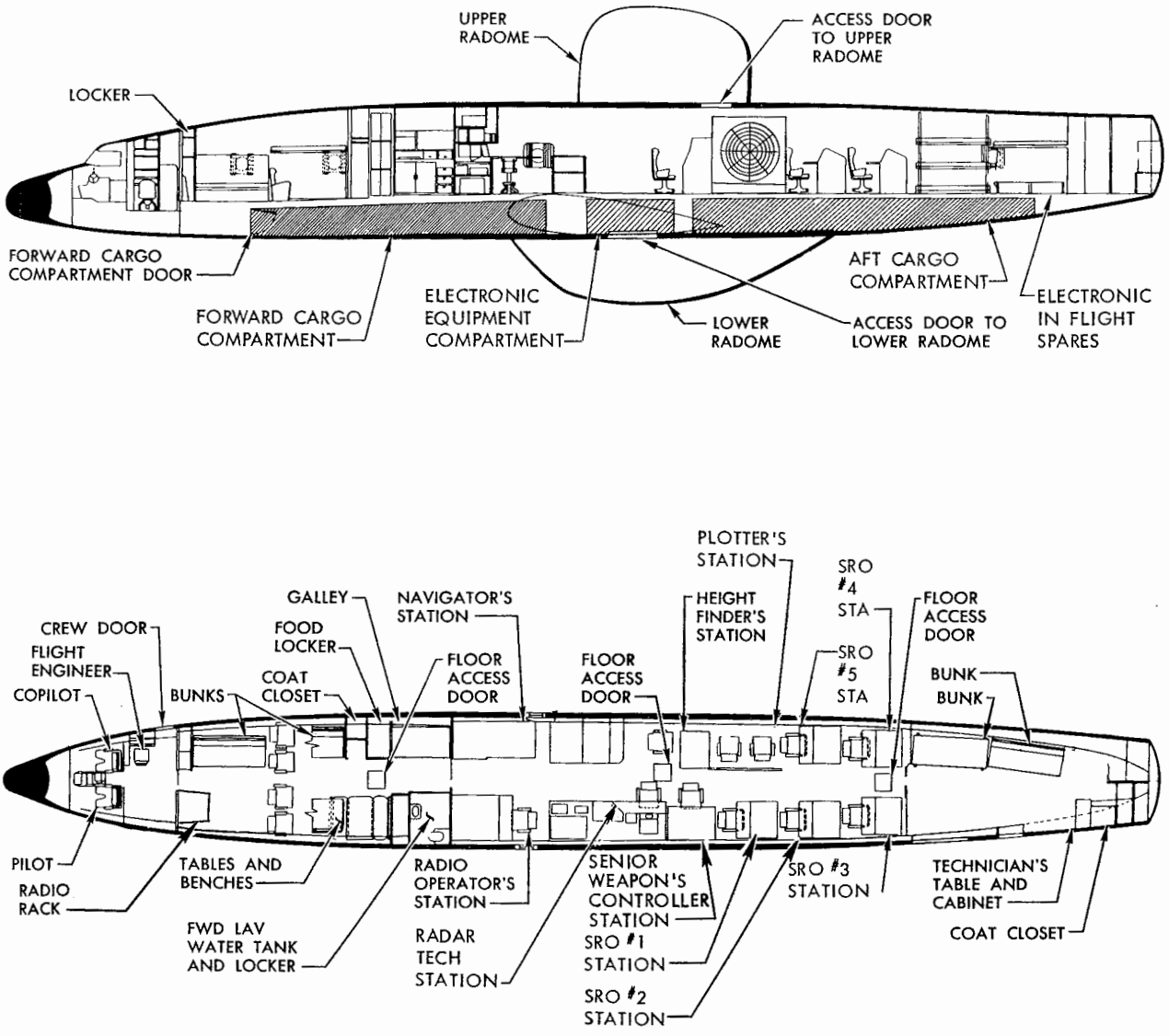


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Figure 4-62 (Sheet 1 of 2)

TC-121C. TYPICAL INTERIOR ARRANGEMENT

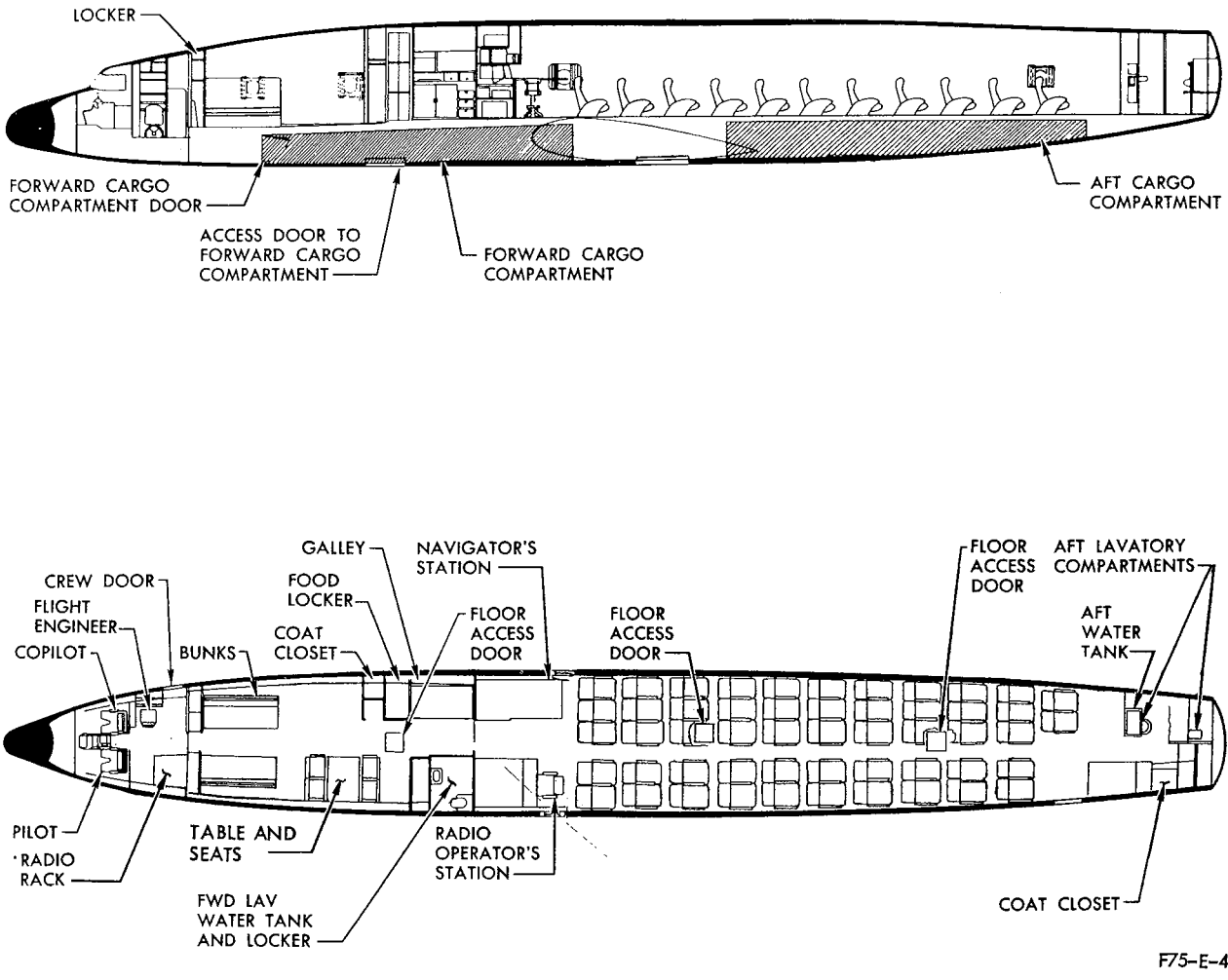

Figure 4-62 (Sheet 2 of 2)

PILOTS' WINDOW OPERATION

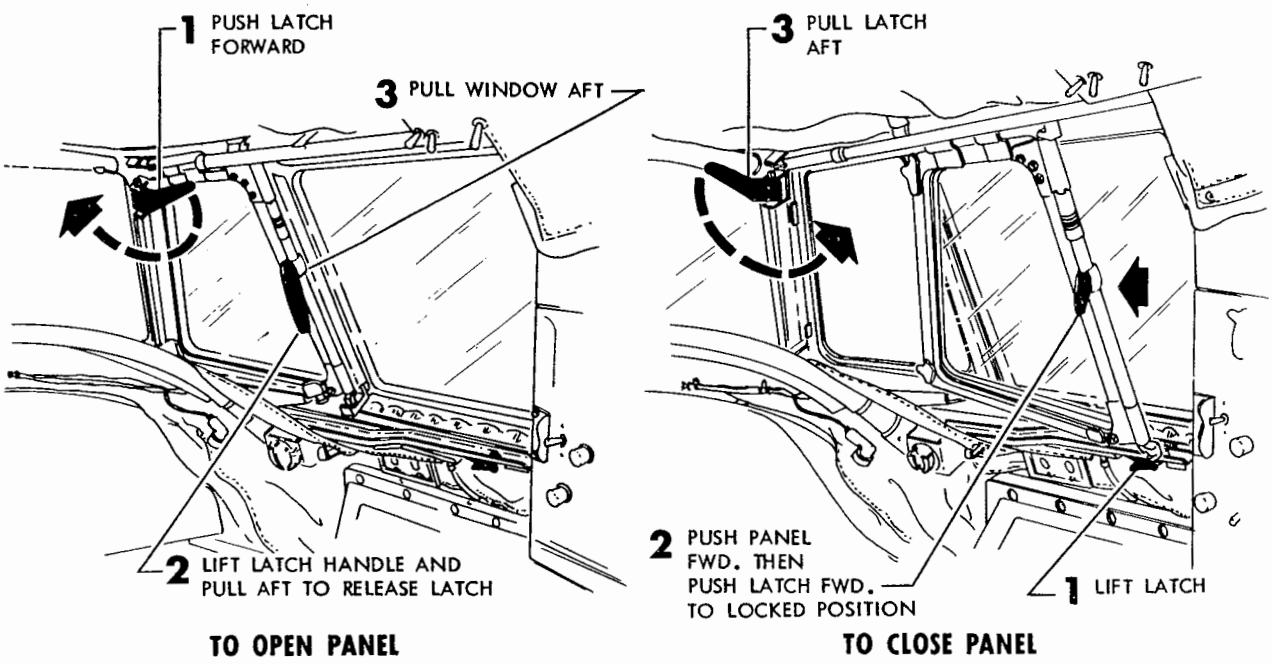

Figure 4-63

book locker, binoculars and case, periscopic sextant with case, sextant mount, and (if installed) a driftmeter and tube.

Driftmeter.

A gyro-stabilized driftmeter is installed to aid the navigator in determining terrestrial bearings of objects relative to the heading of the aircraft, ground speed, and wind velocity. The driftmeter is mounted on the floor of the navigator's station. A switch mounted on the lower gyro housing controls the gyro erection system. A rheostat installed on top of the upper gyro housing controls illumination of the reticle optical system. A lever, mounted on the filter housing marked SHADE GLASS, controls a shade glass filter. By operation of the lever, the shade glass may be interposed in the optical system to reduce the intensity of light when the ground image is too bright. A one-power eyepiece and a three-power eyepiece are secured in an ocular housing. The eyepieces are equipped with rubber guard buffers and the unused eyepiece is stowed in a holder on the side of the driftmeter. The driftmeter telescope tube extends downward through the fuselage floor and projects through a hole in the lower fuselage skin. A red warning light labeled "DO NOT USE" indicates when the gyro is caged. The power supply for the driftmeter is provided by the instrument inverter system and is protected by two fuses located on the lower 212 panel. Alignment for the driftmeter may be checked by sighting on the nose wheel door actuating arm roller. This bearing should read 005°.

CAUTION

The driftmeter should be caged at all times when not in use. Set the driftmeter at 270° for takeoff, landing and ground operations to prevent damage to the outer lens.

WINDSHIELD WIPERS.

Electric windshield wipers are provided for the pilot's and copilot's forward windshield panels. Both wipers are driven through a flexible shaft by a dc electric motor mounted on the flight station canopy above the MJB switch panels.

CAUTION

Do not operate windshield wipers on dry glass.

CABIN DOOR OPERATION

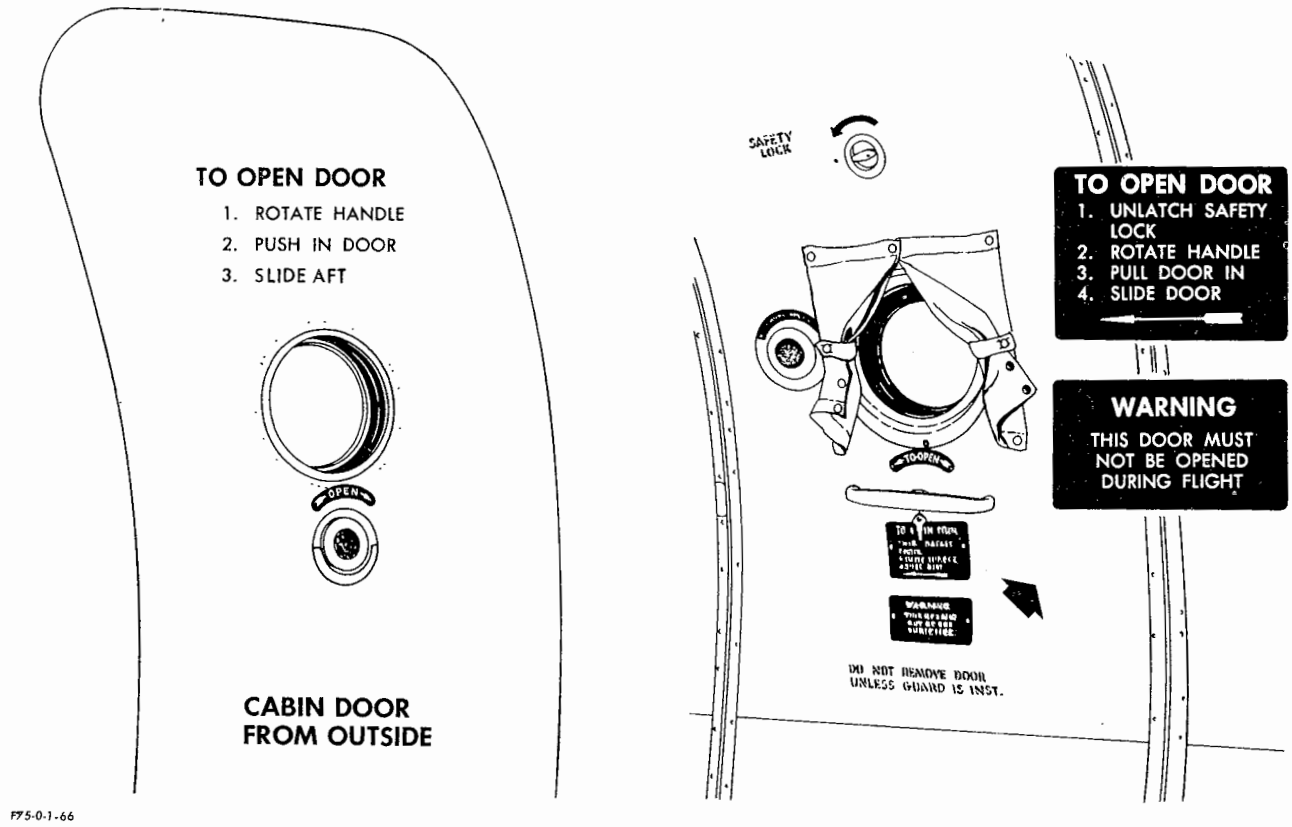

Figure 4-64

Windshield Wiper Switch.

The windshield wipers are controlled by a rheostat located on the pilots' pedestal (28, figure 1-11). The rheostat type switch is labeled PARK, OFF, HIGH, MED. and LOW. Clockwise movement starts the motor at high speed. Counterclockwise movement reduces speed as desired. The PARK position stops the wiper blades and positions them at the sides of the windshield panels so that they will not obstruct vision.

PERISCOPIC SEXTANT.

A periscopic sextant is provided which, through a periscopic optical system, enables the navigator to make observations from within the fuselage by projecting the periscope outside of the aircraft. To accommodate the sextant, a mount is installed at the navigators station. When the mount is installed, it is aligned with the aircraft longitudinal axis. Mount alignment may be checked by sighting the antenna connection on the left vertical stabilizer. With 000° set in the azimuth counter, this bearing should read 162.4. Illumination for the sextant is provided by the aircraft dc power supply and is controlled by an on-off switch on the mount. The circuit breaker for the sextant power supply is located on the upper 260 switch panel at the flight engineer's station.

MISCELLANEOUS EQUIPMENT.

Cabin/Cargo Door.

The aft cabin door in the left side of the fuselage (figure 4-64) is hinged at the top and operated by a hydraulic mechanism consisting of a hydraulic fluid reservoir, hand pump bypass control valve, and door actuating cylinder. The cargo door is opened as follows:

1. Remove table (if installed).
2. Door latches—Release.

TC-121C. CARGO LOADING & DIMENSIONAL LIMITS

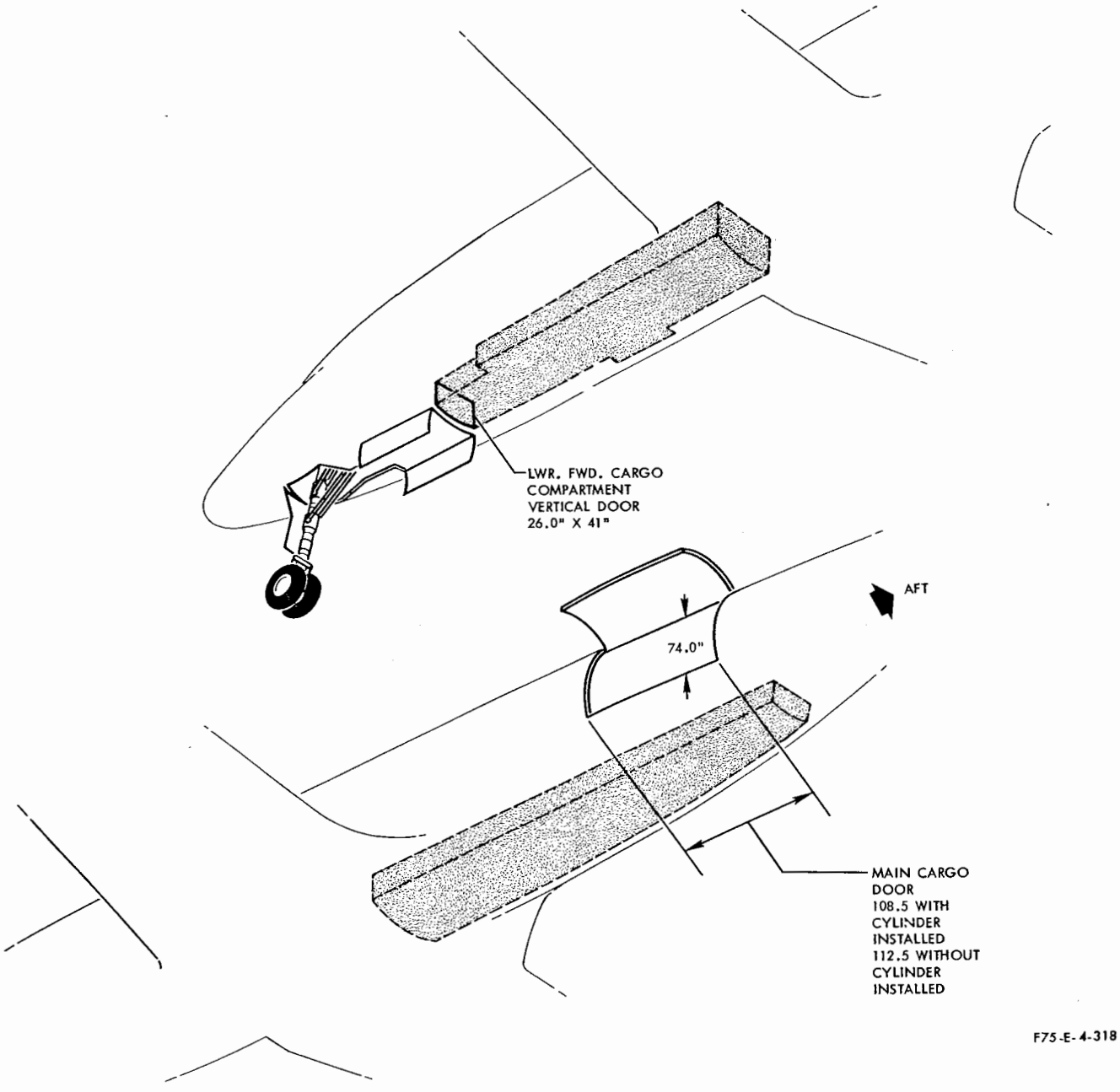

Figure 4-65

3. Hydraulic bypass valve—Close, by turning clockwise.

4. Pump handpump until cylinder is fully extended.

The cargo door is closed as follows:

1. Hydraulic bypass valve—Open slowly, by turning counterclockwise, to control rate of downward movement.

2. Cargo door latches—Engage.

CAUTION

Leave the bypass valve open, except when the cargo door is being raised, to preclude pressure build-ups resulting from thermal expansion.

CARGO TIE-DOWN DEVICES (TC-121C.)

On some TC-121C aircraft cargo tie-downs are provided in the floor and spaced to provide approximately a 20 by 20-inch grid tie-down pattern. Refer to 1C-121C-9 for cargo loading and tie-down instructions.

Upper Radome Access Door (EC-121D).

The upper radome access door is located on the centerline of the fuselage above the height finder's table. This door provides access for service and maintenance of the equipment installed in the upper radome and also forms a pressure seal between the main compartment and the radome chamber, which is not pressurized in flight. A warning light switch, installed in the door frame at the forward right latch, gives indication by a red warning light (3, figure 1-15) located on the flight engineer's lower instrument panel when the door is not closed or latched. Some aircraft cannot be pressurized when these warning lights are on. A similar switch installation stops rotation of the height finder antenna when the access door is not closed and locked.

Lower Radome Access Door (EC-121D).

The lower fuselage-to-radome access door is located on the centerline below the upper radome door. This door provides limited access to the radome and forms a pressure seal between the aft lower compartment and the radome chamber, which is not pressurized during flight. In the event the access door is not closed and locked, vent holes in the radome assembly tend to provide pressure equalization. A warning light switch, installed in the door frame, actuates a red warning light (3, figure 1-15) located on the flight engineer's lower instrument panel when the door is not closed and locked. A similar switch installation stops rotation of the antenna when the door is not closed and locked.

Table and Bench Installations (EC-121D).

One table and two benches are installed in the crew compartment. Each bench is provided with airfoam seat and back cushions.

Navigator's Seat.

The navigator's seat is a tubular framed stool adjustable through a vertical range of approximately 11 inches and is provided with a padded back rest. The stool is secured to the floor with quick detachable latches.

AOC Crew Chairs (EC-121D).

The AOC crew (except SWC, radar technician) and the radio operator's chairs are mounted on slide rails and are provided with adjustable and removable arm rests, reclinable posture cushioned back, turnable throughout 360 degrees, and adjustable vertically. The chairs for SRO operators are mounted on slide rails and are arranged to swivel and lock in suitable positions. Each chair may be removed from its fixed supports.

Relief Crew Seat/Bunks (EC-121D).

Three relief crew seat-bunks are located in the forward cabin on the right side. These seat-bunks are arranged to seat four side by side and are convertible without modification into upper and lower bunks. Two additional overhead bunks are installed, one on each side in the forward cabin, and one three-tier fixed bunk is located on the right side in the rear cabin. In addition, two aft facing double seats are located under the overhead bunks in the forward cabin. On early aircraft, four relief crew seat-bunks are provided as follows: one on the right side rear cabin, one on the left side forward cabin, and two on the right side forward cabin. These seat-bunks are arranged to seat four side-by-side and are convertible without modification into upper and lower bunks.

Curtains.

A drape-type curtain covers the flight station doorway, and the partition separating the AOC/cabin compart-

TYPICAL GALLEY

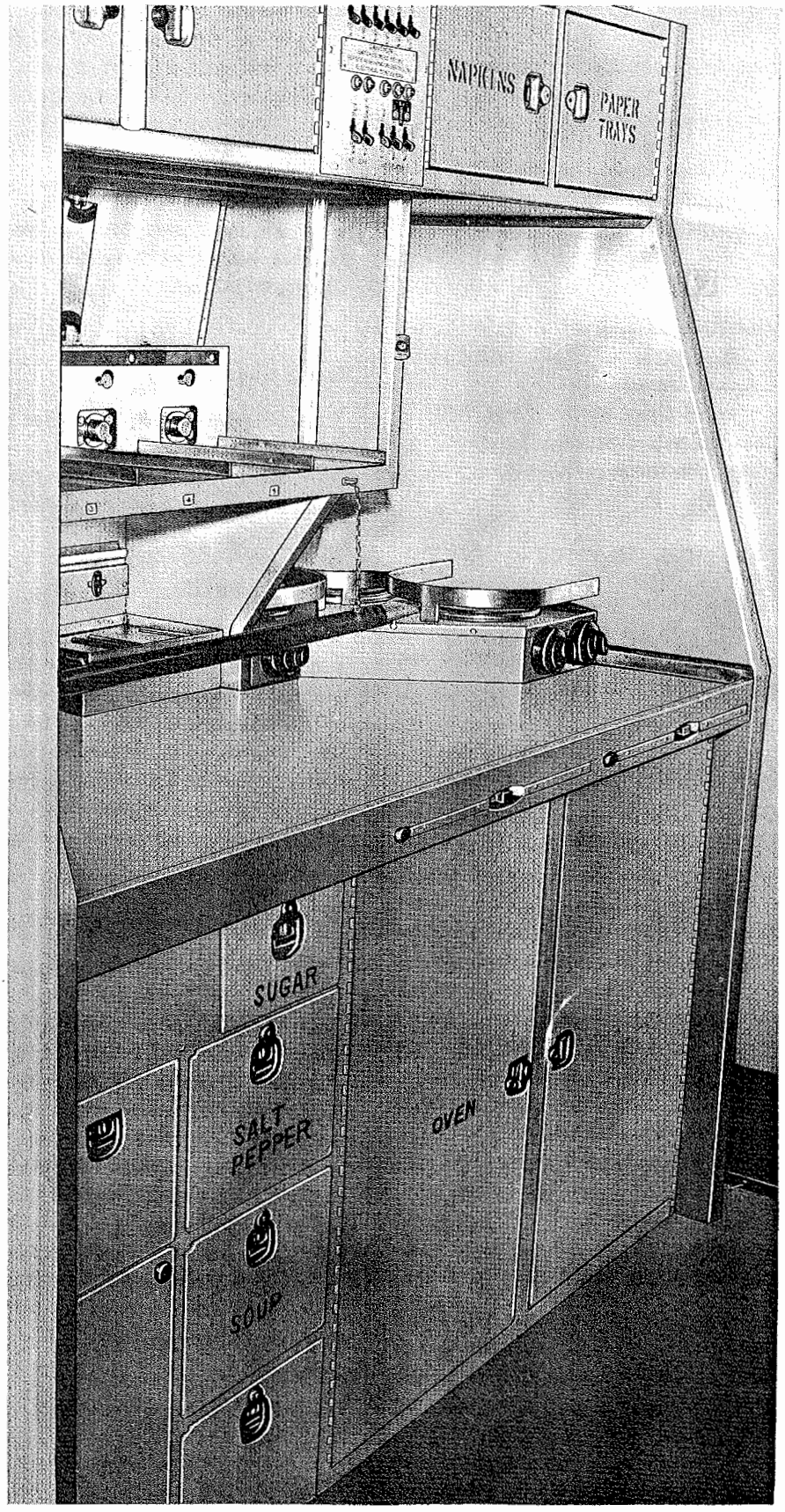

Figure 4-66

ment from the forward lavatory-galley area. The AOC/cabin compartment is separated from the aft crew compartment by a curtain with a draw curtain doorway in the middle. Crew compartment bunk curtains and window curtains are provided.

Station 260 Locker.

A small locker is located on the aft, right side of the 260 bulkhead.

Passenger Carrying Equipment (TC-121C).

The aircraft can be equipped for carrying passengers. See figure 4-62 for passenger transport configuration.

Passenger Seats (TC-121C).

Seat attachment fittings are provided for aft facing seats. The seats may be removed and folded for stowing. A trigger catch located on the aft end of each arm rest permits the seat back to be erected from the folded position. A recline control installed on the aft end of the seat position brace, under the forward part of the arm rest, permits the seat back to be reclined. The seat fittings are designed so that the seats, except in the extreme right forward row may also be installed facing forward. Ash trays are provided in the arm rest of each seat.

GALLEY.

The galley (figure 4-66) is installed on the right side forward of the AOC/cabin area. The galley provides complete facilities for the preparation of meals. Two storage compartments with double doors are installed in the upper part of the galley, on either side of the galley switch panel. Directly below the upper compartments six heated liquid containers are installed, each with a two gallon capacity. Each of these containers have provisions for installation of a dry ice cup. Each container is held in position by an individual locking device and to remove these containers, the handle directly in front of the desired container to be removed is turned in the down position. This releases the lock and the container then can be pulled out. The heater switches for the liquid containers are located on the upper row of the galley switch panel (figure 4-67) and are placarded ON-OFF.

CAUTION

These switches must be in the OFF position before removing or installing the liquid containers.

A sink is installed on the forward end of the galley working surface. The sink is provided with a water faucet, overdrain and a flush perforated top for use when the sink is not required. Water for this sink is supplied from the forward water tank. Two one-quart hot cup receptacles are installed in the center, above the working surface. The switches (figure 4-67) that control the hot cup are located on the forward end of the lower row of switches on the galley switch panel; they are placarded ON-OFF. Three hot plate assemblies are installed in the aft outboard corner of the galley. The master switch that controls the hot-plates is located in the middle of the lower row of switches on the galley switch panel and is placarded ON-OFF. Individual switches for the hot-plates are located on the hotplate assemblies and are placarded OFF-LOW-MED-HIGH. A waste container is mounted directly below the sink; it is readily removable for emptying and cleaning. Four storage drawers are installed on the inboard face of the galley just aft of the waste container. Two heating ovens are installed aft of the storage drawers. The control switches (figure 4-67) for these ovens are located at the aft end of the lower row of switches on the galley switch panel; they are labeled OVEN LEFT and RIGHT and are placarded ON-OFF. Two pull out boards are located above the two ovens. Identical locks are provided on all compartment doors and drawers. Provisions are incorporated in all drawers and work boards to prevent their being accidentally pulled all of the way out. The galley is powered by 28-volt dc current.

Galley Exhaust.

The galley area may be vented through a sonic venturi which is installed in the upper aft corner. A manual control lever is located on the aft side of the venturi; to open the venturi, place the lever in the down position. The opening is protected by a metal slotted shroud.

Food Locker.

A refrigerator is installed immediately forward of the galley. A thermostat located inside the refrigerator,

TYPICAL GALLEY ELECTRICAL CONTROL PANEL

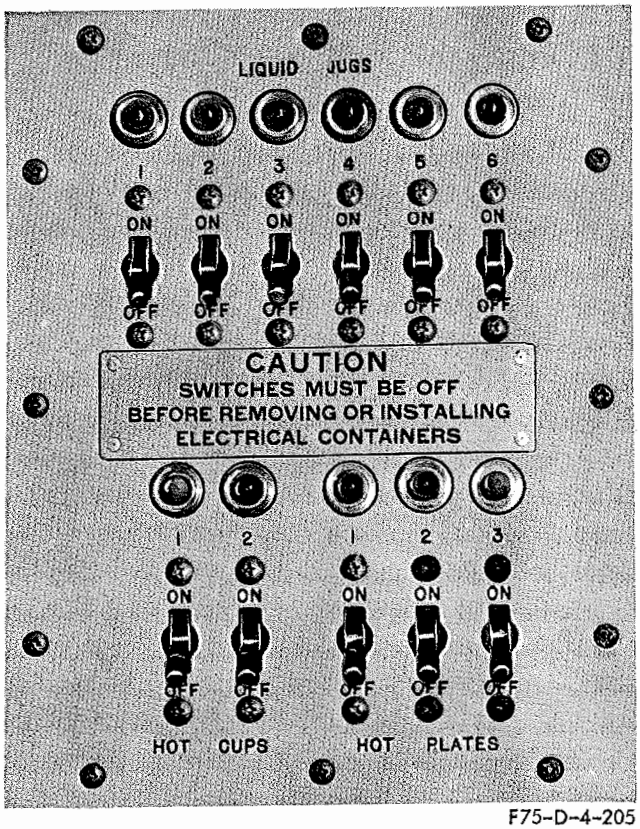

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Figure 4-67

automatically controls the inside temperature while in use. The refrigerator is powered by a 28-volt dc bus.

FORWARD LAVATORY AND LOCKER.

The forward lavatory and locker compartment are located on the left side forward of the AOC/cabin area. Entrance to the lavatory is through a doorway opening into the center aisle of the aircraft; entrance into the locker is through the lavatory. The lavatory contains a urinal and toilet assembly located on the forward face of the AOC/cabin partition. A wash basin, soap dispenser,

WATER FILLER VALVE

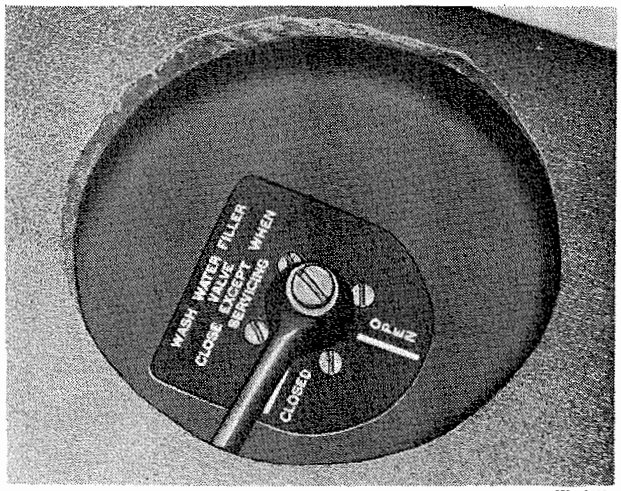

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Figure 4-68

waste container, towel holder, mirror, paper cup holder, and an ash tray are included on the aft face of the forward partition of the lavatory. The door into the locker area is on the outboard side of this partition. The locker contains three shelves for storage of equipment and the water supply tank for the lavatory and the galley. The inboard partition of the locker may be removed for convenient access to the water plumbing system.

WATER SYSTEM.

The water system is gravity fed. The system consists of a supply tank, a wash basin, a drain and filler valve (figure 4-68), a tank shutoff valve, an external ground filler connection, a heated overboard drain, and the necessary piping to form an integral system. The galley supply and drain lines are plumbed into the forward system. The capacity of the tank is approximately 40 gallons. The inboard partition of the water tank cabinet includes a sight gauge for determining the water level.

Section V—OPERATING LIMITATIONS

TABLE OF CONTENTS

	Page
INTRODUCTION	5-1
MINIMUM CREW REQUIREMENTS	5-1
INSTRUMENT MARKING	5-1
ENGINE LIMITATIONS	5-1
PROPELLER LIMITATIONS	5-5
CARBURETOR TEMPERATURE LIMITATIONS	5-5
AIRSPEED LIMITATIONS	5-5
PROHIBITED MANEUVERS	5-5
CENTER OF GRAVITY LIMITATIONS	5-5
CABIN PRESSURIZATION LIMITATIONS	5-5
CONSOLIDATED LIMITATIONS LIST	5-6
FUEL LOADING AND USAGE LIMITATIONS	5-7
WEIGHT LIMITATIONS	5-7

INTRODUCTION.

The limitations imposed on the aircraft must be observed during normal operation. Cognizance must be taken of the instrument markings since they represent limitations that are not necessarily repeated in the text. Further explanation of the instrument markings is covered in the text under pertinent headings.

MINIMUM CREW REQUIREMENTS.

The minimum crew requirements for this aircraft are the pilot, copilot, and flight engineer. Additional crew members may be added at the discretion of the pilot in command.

INSTRUMENT MARKINGS.

The limits and interpretation of the markings on the aircraft instruments are shown on figure 5-1.

ENGINE LIMITATIONS.

In addition to the instrument marking limitations indicated on figure 5-1 and Engine Operating Curves (figure 5-2), the following limitations must be observed:

CAUTION

Do not make more than one blower shift into high ratio within a five-minute interval. Reduce engine speed to 1600 rpm and MAP to 20 in. HG before shifting from LOW to HIGH blower.

1. Operation at speeds between 3050 and 3120 rpm represents limited overspeed which must be followed by inspection in accordance with established procedure.

2. An overspeed of over 3120 rpm but not over 3300 rpm is permitted on a one time basis and requires that the engine be inspected. If the engine encounters operation in this 3120 to 3300 rpm range for a second time, it must be removed for overhaul.

3. Overspeeds in excess of 3300 rpm require engine removal.

Note

All operations at speeds above 3050 rpm must be recorded in the Form 781 by the pilot, stating specific overspeed rpm or range.

OVERBOOST LIMITATIONS.

Blower Position	*MAP in Hg*	*Duration in Seconds*	*RPM Range at Which Limits Apply*
LOW	1	60	Above 2600 rpm
	5	15	2401 to 2600 rpm
		No Limits	2400 rpm and below
HIGH	2	15	At 2600 rpm
	3	15	Below 2600 rpm

INSTRUMENT MARKINGS

BASED ON MIL-G-5572
FUEL GRADE 115/145

NOTE MAXIMUM CONTINUOUS LIMIT FOR SEA LEVEL-LOW BLOWER-AUTO RICH IS 52 IN. HG MAXIMUM LIMIT FOR 10,000 FT HIGH BLOWER IS 49.5 IN. HG

TACHOMETER

- 1600-2500 RPM AUTO/MANUAL LEAN PERMITTED (LOW BLOWER)
- 1800-2500 RPM AUTO/MANUAL LEAN PERMITTED (HIGH BLOWER)
- 2500-2650 RPM AUTO RICH REQUIRED
- 2900 RPM MAXIMUM

MANIFOLD PRESSURE

- 20-43 IN. HG AUTO/MANUAL LEAN PERMITTED (LO BLOWER) (MAX OF 45 IN. HG PERMITTED IN HIGH BLOWER AT 15% MANUAL LEAN)
- 43-52 IN. HG AUTO RICH REQUIRED
- 59.5 IN. HG MAXIMUM

BMEP

- 277 BMEP MAXIMUM

CYLINDER HEAD

- 145° - ~~230~~ 215 C AUTO/MANUAL LEAN PERMITTED
- 230° - 245° C AUTO RICH REQUIRED
- 260° C MAXIMUM

CARBURETOR AIR

- 30° C MAXIMUM - LOW BLOWER (WITH HEAT APPLIED)
- 22° C MAXIMUM - HIGH BLOWER (WITH HEAT APPLIED)
- +15° TO +30° C NORMAL OPERATION
- -10° TO +15° C DANGER OF ICE

OIL INLET

- 70°-85°C CONTINUOUS OPERATION
- 40° C MINIMUM
- 104° C MAXIMUM

ENGINE OIL PRESSURE (REAR PUMPS)

- 65-90 PSI CONTINUOUS OPERATION
- 65 PSI MINIMUM FOR FLIGHT
- 100 PSI MAXIMUM

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FUEL PRESSURE

- 24-28 PSI NORMAL
- 19 PSI MINIMUM FOR FLIGHT
- 35 PSI MAXIMUM

AC GENERATOR TEMPERATURE

- 150° C MAXIMUM REAR BEARING TEMP
- 160° C (FIVE MIN. MAX.) MAXIMUM (LYC) CSD OIL TEMPERATURE
- 50° C MAXIMUM COOLING AIR RISE

Figure 5-1 (Sheet 1 of 3)

INSTRUMENT MARKINGS

CABIN SUPERCHARGER OIL PRESSURE

- 70-80 PSI NORMAL 1000 RPM
- 60 PSI MINIMUM
- 125 PSI MAXIMUM

CABIN SUPERCHARGER OIL TEMP

- 49° - 77° C NORMAL
- 107° C MAXIMUM (LIGHT ON)

CABIN SUPERCHARGER DRIVE SHAFT

- 150° C MAXIMUM

CABIN DIFFERENTIAL PRESSURE

- 10.92 IN. HG MAXIMUM FOR NORMAL OPERATION
  11.4 IN. HG SAFETY RELIEF AND DUMP VALVE CRACKING PRESSURE

CABIN HEATER TEMP

- 50° - 140° C NORMAL CYCLING
- 170° C MAXIMUM CYCLING AND OVERRIDE CYCLING TEMP
  180° C LOCKOUT AND OVERHEAT LIGHT ON

REFRIGERATOR DISCHARGE DUCT TEMPERATURE

- 2° C MINIMUM

F75-F-5-120(2)

Figure 5-1 (Sheet 2 of 3)

INSTRUMENT MARKINGS

AIR SPEED

- 295 KNOTS MAXIMUM PERMISSIBLE AIRSPEED
- 155 KNOTS MAXIMUM-WING FLAPS 100% EXTENDED (LANDING GEAR - 165 KNOTS)

HYDRAULIC QUANTITY

FULL	7.1 GALS
RESERVICE	1/2 FULL
MINIMUM	1/4 FULL

(EQUALIZER HOLE IN BAFFLE AT 7/8 FULL)

HYDRAULIC PRESSURE

- 1650-1800 PSI NORMAL
- 1850 PSI MAXIMUM

EMERGENCY BRAKE

- 1100 PSI MINIMUM
- 1650-1800 PSI NORMAL
- 1850 PSI MAXIMUM

VACUUM

- 7-7.5 IN. HG NORMAL
- 4.0 IN. HG WARNING LIGHT ON

DEICING PRESSURE

- 20-24 PSI NORMAL
- 26 PSI MAXIMUM

F75-F-5-120(3)

Figure 5-1 (Sheet 3 of 3)

1. When the maximum allowable manifold pressure for any applicable power is exceeded by more than the listed MAP values, an engine overboost inspection is required, regardless of overboost duration.

2. When the maximum allowable manifold pressure for any applicable power is exceeded for a time period in excess of the listed durations, an engine overboost inspection is required.

3. All overboosts in excess of the limits should be recorded in Form 781.

4. Engines overboosted beyond the limits need not be rejected to overhaul unless the required inspection reveals sufficient overboost damage.

5. The statement *no limit—2400 rpm and below* means that full throttle will normally be reached before cylinder pressures become sufficiently high to cause damage to the average engine in this rpm range. Therefor, overboost limitations are not applicable.

PROPELLER LIMITATIONS.

There are no restricted operating speeds within the normal operating region for aircraft equipped with the Hamilton Standard 43H60/6959-0 propellers. However the aircraft will be headed into the wind during static run-up tests when engine speeds exceed 2600 rpm. The propellers must not be unfeathered at flight speeds in excess of 155 knots. Do not reverse the propellers in flight.

CARBURETOR TEMPERATURE LIMITATIONS.

When the carburetor air temperature gage read 30°C the air intake temperature at the carburetor deck may be 38°C. Therefore, it is recommended that the carburetor air temperature not exceed 30°C as read on the carburetor air temperature gage.

CAUTION

If carburetor heat is used during HIGH blower operation, CAT must not exceed 22°C and spark must be in RETARD.

AIRSPEED LIMITATIONS.

The maximum permissible indicated airspeeds are as follows:

Maximum propeller unfeathering	155 knots
Maximum turning boost on	155 knots
In smooth air—	
at 15,000 feet or below	295 knots
at 20,000 feet	270 knots
at 25,000 feet	240 knots
With landing gear extended	165 knots
With flaps extended	
60%	190 knots
66%	175 knots
80%	175 knots
100%	155 knots
With landing light extended	165 knots
For fuel dumping (permitted only when landing gear and wing flaps are retracted).	190 knots

For turbulent air penetration speeds, refer to Section IX.

PROHIBITED MANEUVERS.

Inflight maneuvers are restricted as follows:

1. The angle of bank shall not exceed 60 degrees.

2. The flight controls shall not be moved abruptly.

3. Slipping or skidding shall be avoided at indicated airspeed in excess of 180 knots. At indicated airspeeds below 180 knots, slipping or skidding is permitted as required.

FLIGHT CONTROL PRECAUTIONS.

Although the control forces for patrol and transport aircraft are heavier than in some other types, it is still possible to apply severe structural loads by a rapid and violent application, sudden release or reversal of forces on any of the three control systems. It is within the pilot's physical power to cause failure of some components of the airframe structure, particularly when flying at high speeds. A rapid release or reversal of rudder force can result in heavy loads on the vertical fins and aft fuselage and should be avoided.

CENTER OF GRAVITY LIMITATIONS.

The forward center of gravity limit is variable depending upon the aircraft gross weight. The aft cg limit is a constant 32% with gear down at all gross weights. Raising the landing gear, will move the cg forward approximately 1%. Refer to Handbook of Weight Limitations, AN 1-1B-40.

CABIN PRESSURIZATION LIMITATIONS.

Cabin pressurization is not permitted during takeoff and landing. In the event of emergency during takeoff and landing, cabin pressurization would interfere with opening of doors and emergency exits. See figure 4-1.

CONSOLIDATED LIMITATIONS LIST

Weights—MAC—Max. Speed.

EC-121D takeoff weight capability	2.50 G — 145,000	2.25 G — 152,500
TC-121C takeoff weight capability	2.50 G — 135,400	2.25 G — 145,000
EC-121D zero fuel weight capability	2.50 G — 99,000	2.25 G — 105,000
TC-121C zero fuel weight capability	2.50 G — 105,000	2.25 G — 110,000
Landing weight capability	600 fpm sinking speed — 110,000	420 fpm sinking speed — 122,000
MAC limits		18-32%
MAC limits for BOOST-OUT landing		desired 23-30%
Max speed for gear extension		165 knots
Max speed for 60% flaps		190 knots
Max speed for 66% flaps		175 knots
Max speed for 80% flaps		175 knots
Max speed for 100% flaps		155 knots
Max speed for landing light extension		165 knots
Max speed for unfeathering		155 knots
Max speed for engaging control boosters		155 knots
Max speed for opening escape hatches		175 knots
Speeds for flight with hydraulic tank access door unlatched		80,000 pounds 150-160 knots
		100,000 pounds 165-180 knots
		120,000 pounds 180-200 knots
Speed for fuel dumping		155-165 knots
Speed for turbulence penetration		60 knots above stall speed (clean configuration)
Maneuvering speed 60% flaps		140 knots
Max speed at 15,000 ft or below		295 knots

Tank Quantities.

Engine oil tanks	Volume 54 gal—fill to 42.5 gal each
Engine reserve oil tank	67 gallons
Cabin supercharger oil system	2 gal each
Hydraulic system	54 gallons
Hydraulic reservoir	Capacity 10.1—fill to 7.1 gallons
Emergency extension tank	3.2 gallons
Alcohol tanks	20 gal each
Wash water fwd	40 gallons

Electrical.

Battery voltage and capacity	24-volts 34-amps/hr /each
Generators	28-volt 300-amp/each—overload 400-amp/each for 15 min.
(EC-121D) alternators	115-volt variable freq./each
DC system voltage	28 (± .5) volts
AC system voltage	115-volt 400 cycle

Hydraulic.

Hydraulic system pressure	normal 1650-1800 psi
Auxiliary boost system pressure	normal 700-825 psi
Hydraulic pump capacity	22 g.p.m. at 1650 psi
Hydraulic warning light limit	1325 (± 50) psi
Minimum pressure for setting parking brake	1100 psi
Air charge in brake accumulator	1000 psi each

Engine Oil.

Engine oil system pressure	normal 65-90 psi, min. 65 psi, max. 100 psi
Engine oil temperature	normal 70°-85°C, max. 104°C
Engine oil warning light limit	55 psi (± 5)

Fuel.

Fuel system pressure	normal 24-28 psi, min 19 psi, max 35 psi
Aux fuel pump (static)	high boost 27-29 psi, low boost 12 psi min.
Fuel system low pressure warning lights	19 psi

Anti-icing.

Propeller anti-icing system pump capacity (full increase setting) at least ..... 5 gal/hr/pump
Propeller anti-icer rate of flow (full increase setting) at least ..... 2.5 gal/hr/prop
Carburetor anti-icer rate of flow ..... 26 gal/hr/pump

Oxygen System Pressure ..... fill to 1800 psi

Elevator Control Surface Travel ..... boost on 40° up 20° down, boost off 16° up 6° down

Cabin Supercharger.

Cabin supercharger capacity ..... 70 lb/min/supercharger/S.L.
Cabin supercharger oil pressure ..... normal 70-80 psi, min 60 psi, max 125 psi
Cabin supercharger oil pressure warning lights ..... on 30-35 psi, off 35-40 psi
Cabin supercharger oil temperature ..... max 107° C
Cabin supercharger oil temperature warning lights ..... on 107° C
Maximum regulated cabin regulator differential pressure ..... 10.92 inches of Hg
Cabin altitude warning lights ..... 10,000 (± 500) feet

FUEL LOADING AND USAGE LIMITATIONS.

Tanks 1, 2, 3, and 4, tank-to-engine, with auxiliary fuel boost pumps for these tanks on HIGH, normally will be used for takeoff. During flight, lateral balance must be maintained within limits set forth in this section. Minimum fuel quantity restrictions applicable because of structural limitations are shown on figure 5-3. Use of the normal fuel loading and fuel management procedures given in Section VII will result in compliance with the minimum fuel quantity restrictions. Under some circumstances, such as training operations, it may be desirable to deviate from normal fuel loadings. Optional fuel loading and usage procedures suited to the particular situation are permitted in such cases, provided structural minimum fuel restrictions for individual tanks shown in figure 5-3 are observed. In the event circumstances, such as training operations, require deviations from normal fuel loading, and tanks 2 and 3 do not contain the minimum of 150 gallons each, then tanks 2A and 3A may be used for takeoff. In either event, tanks used for takeoff must contain the minimum of 150 gallons each. On EC-121D aircraft because of structural wing strain, during landing, the maximum permissible fuel in the tip tanks 2B and 3B are as follows:

At landing gross weight of 122,000 lb—300 gal each (Reduced limit sinking speed—420 fpm)

At landing gross weight of 110,000 lb—200 gal each (Design limit sinking speed—600 fpm)

LATERAL UNBALANCE OF FUEL LOAD.

The following table presents the maximum safe fuel differential between opposite tanks. Lateral unbalance may cause abnormal control deflection therefore, producing asymmetrical airload conditions.

TANK	MAXIMUM DIFFERENTIAL	
	Flight or Landing	Takeoff
2A & 3A or 1 & 4 or 2 & 3	3,390# (565 gals) 5,400# (900 gals) 4,740# (790 gals)	1,200# (200 gals) 1,800# (300 gals) 4,740# (790 gals)
EC-121D only 2B & 3B	2,700# (450 gals) (for flight only) 300# (50 gals) (For landing)	1,200# (200 gals)

WEIGHT LIMITATIONS.

The following weight limits have been provided to show operational capabilities and restrictions which must be served due to structural and performance considerations. Their proper use will assure maximum utilization of the aircraft as well as extended life of its structural components. Overloading or improper weight distribution results in penalties in performance and can result in structural damage or failure. Factors which govern weight limitations, as applied to this aircraft, are discussed in the succeeding paragraphs.

Note

- Maximum zero fuel weight is defined as the maximum airplane gross weight with zero usable fuel in any tank. Refer to minimum permissible fuel restrictions for individual tanks during flight. (figure 5-3).

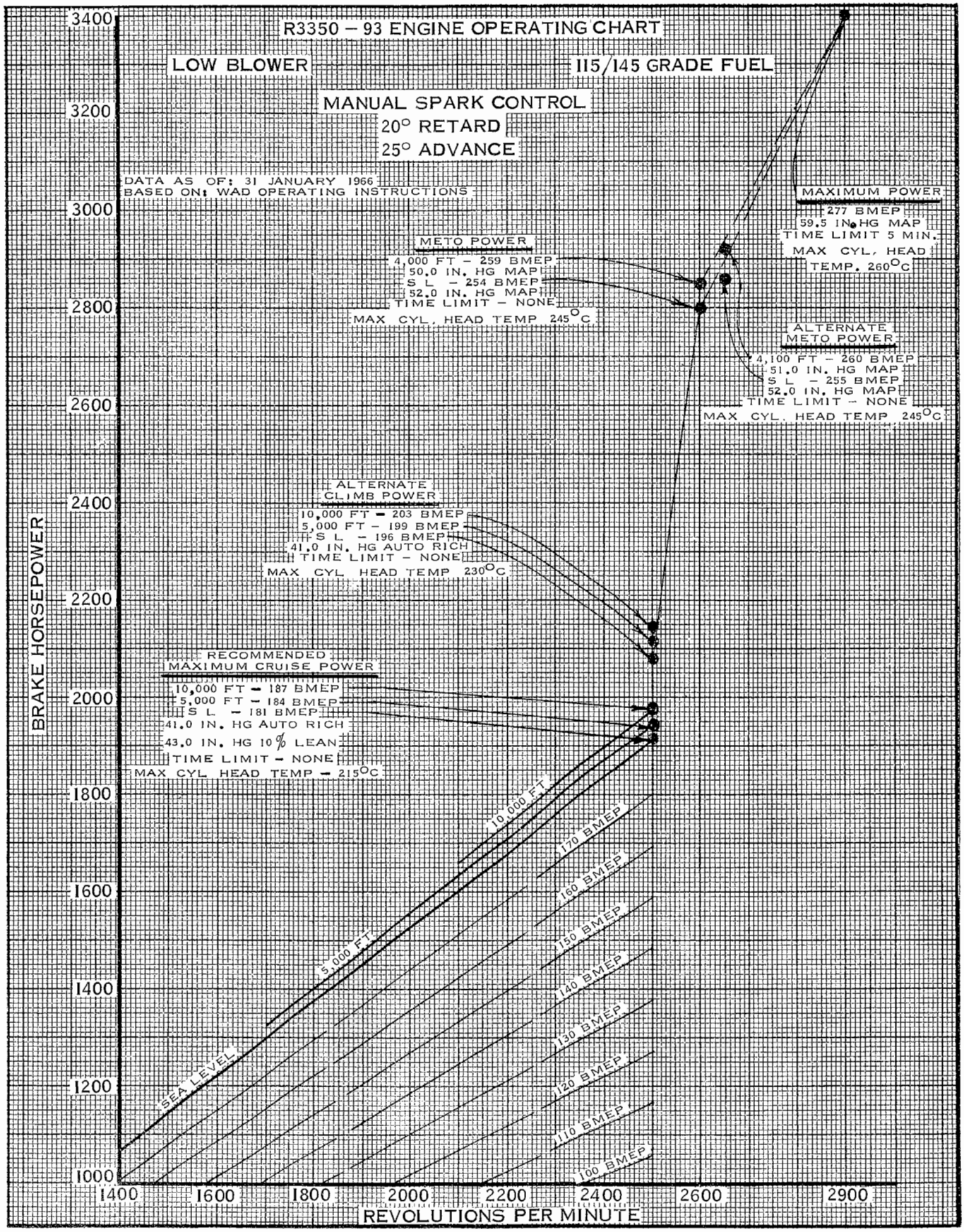


Figure 5-2 (Sheet 1 of 3)

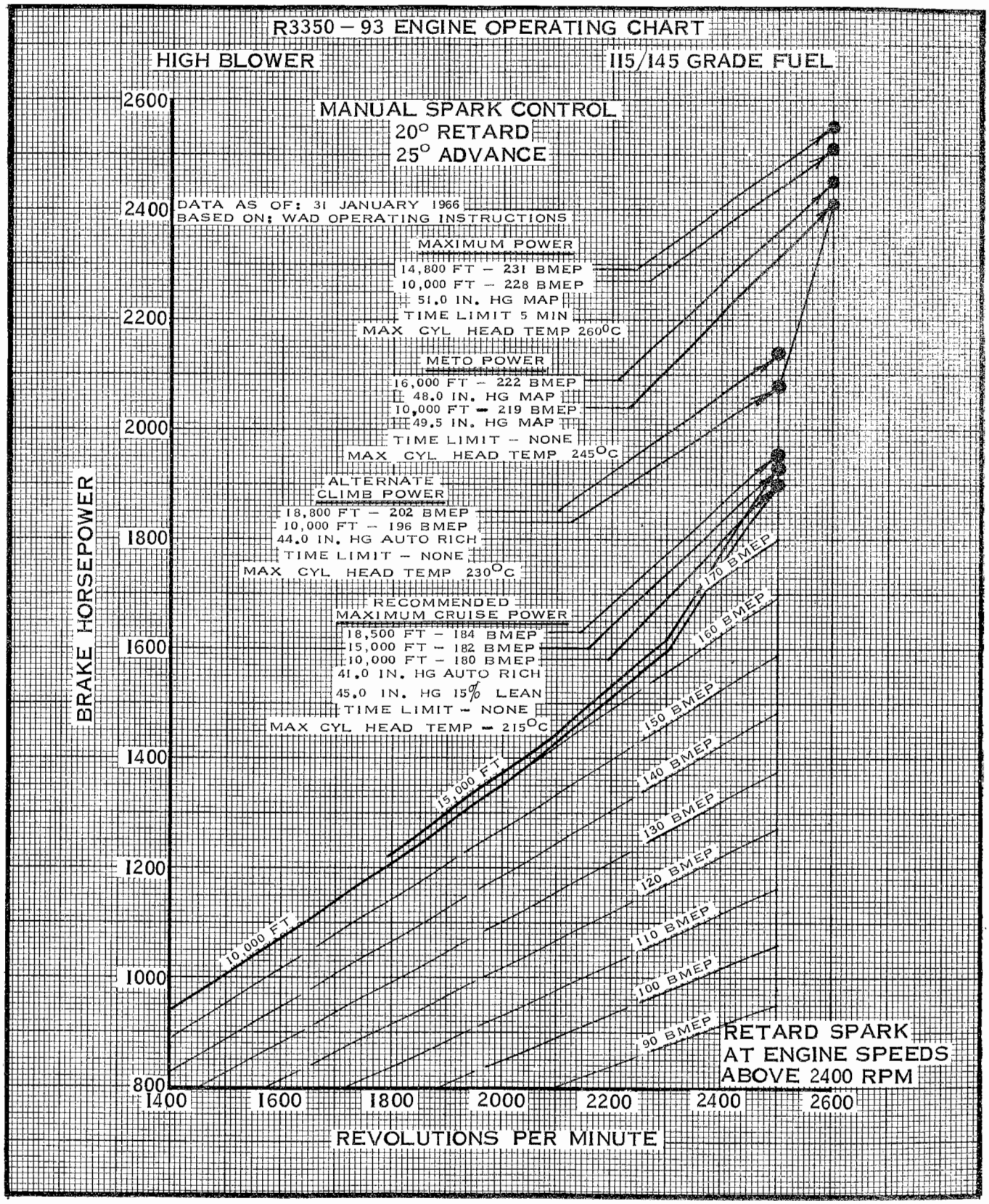


Figure 5-2 (Sheet 2 of 3)

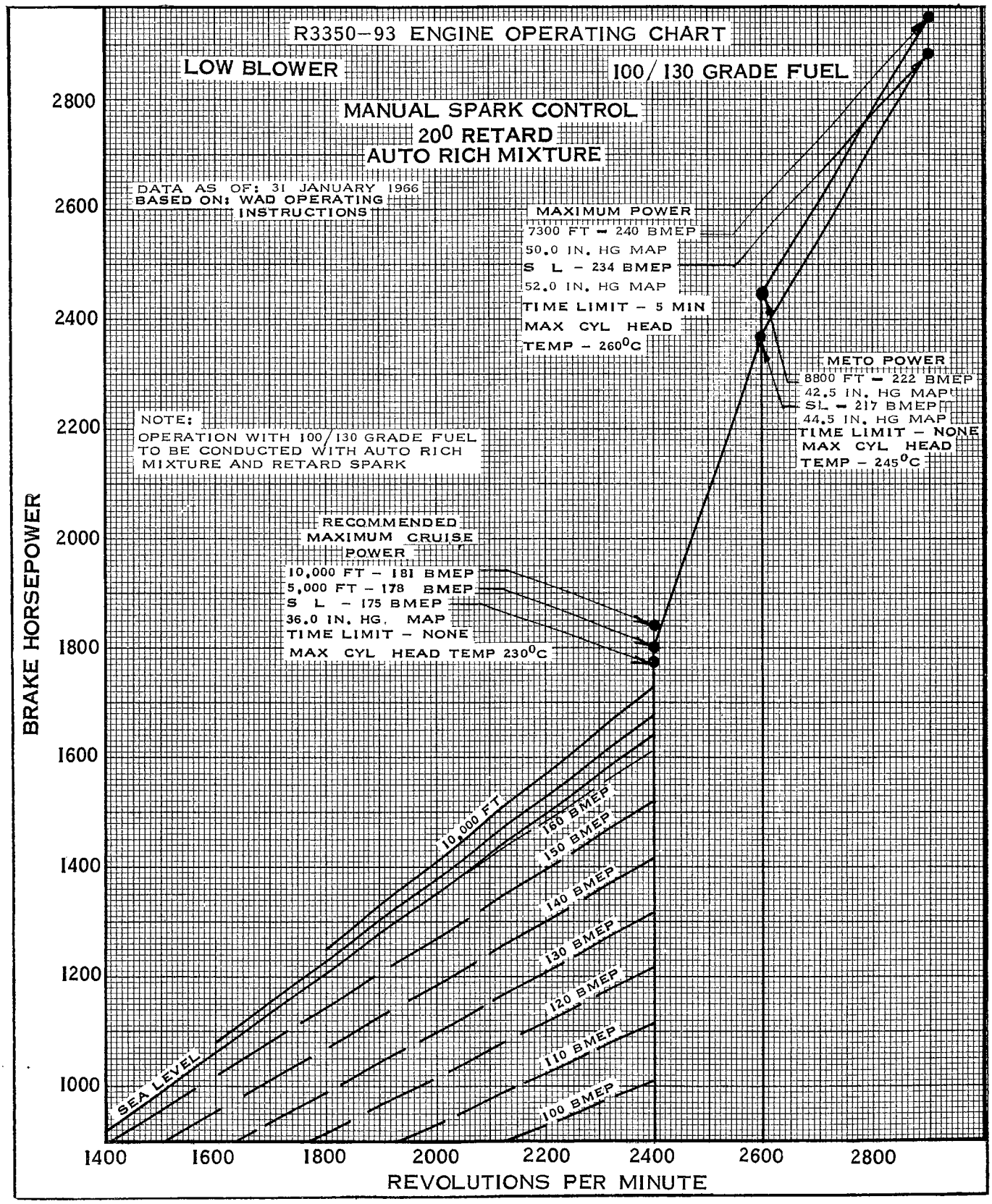


Figure 5-2 (Sheet 3 of 3)

- The most critical wing loading condition occurs with maximum weight in the fuselage and minimum fuel in the wing. By proper fuel management the fuselage fuel, except for takeoff and climb, is burned before the wing fuel has been reduced to the most critical combination of gross weight and inertia relief. Therefore, fuel in tanks 5 and 6 is not the same as payload since it should be consumed before the critical weight condition is reached.

WEIGHTS AND LOADS.

The total weight an aircraft must sustain is composed of the basic operating weight of the aircraft plus the crew, fuel, oil, cargo and any additional equipment. Additional loads are frequently imposed on the structure during flight which result from operation in turbulent air or from maneuvering of the aircraft. These loads have been considered in the design of the aircraft and will not exceed the limit strength of the structure in normal operation. However, if these loads were imposed with the aircraft in an overweight condition, the limit strength of the supportting structure might be exceeded and damage or failure could result. The maximum weight which the aircraft can safely carry is dependent upon distribution of the weight throughout the aircraft, its capacity to sustain airloads in accelerated flight, and its available performance under the existing flight conditions. Fuel and cargo must be carried in accordance with recommended procedures if maximum structural capability is to be maintained.

LOAD FACTORS.

A load factor is the ratio of the load imposed on the aircraft (when accelerated in any direction) relative to the weight of the aircraft. The load factor is indicative of the magnitude of the forces acting on the aircraft due to such accelerations, and may occur because of sudden changes in air currents or by manipulation of the controls or due to loads imposed during ground handling. The load resulting from these forces is expressed in terms of "G" and is the ratio of forces acting on the structure to the airplane weight. For example, if a 110,000 pound aircraft underwent an acceleration of 3.0 G at some given moment, the wing would have to sustain approximately three times the load on the wings in 1 G level flight, or 330,000 pounds.

MARGIN OF SAFETY.

The margin of safety of an airplane part in a given design condition is defined as the amount by which its strength exceeds its design loading in that condition. In actual operation of the aircraft, the margin of safety becomes the difference between the load carried by the airplane structure at a particular instant and the load at which structural damage would occur.

EXPLANATION OF WEIGHT LIMITATIONS CHART.

The gross weight limitation chart (figure 5-4) is intended to represent graphically the weight carrying capabilities of all aircraft. Through the use of the chart, flight planning is aided by recognizing the weight limitations within which the airplane can conduct a specific mission.

Note

Although the chart indicates the limitations applicable to a specific loading of the aircraft, the authority for operating the aircraft at a given gross weight remains the responsibility of the commander.

GROSS WEIGHTS.

The data in this chart is referenced to a basic operating weight, exclusive of fuel and cargo, of 85,000 pounds for EC-121D aircraft and 75,000 lb for TC-121C aircraft. This value is an arbitrary weight which approximates the aircraft basic weight shown on Chart C of T.O. 1-1B-40, Handbook of Weight and Balance Data, plus standard crew and full oil capacities. Individual aircraft weights vary because of differences in equipment weights. Therefore, it may be necessary to adjust the chart for variations in basic operating weight before use for a specific aircraft.

The basic operating weight is represented on the chart by the intersection of the vertical and horizontal axes where the fuel load and cargo load are zero. The terms *cargo or payload* are used to indicate extra crew members, baggage, or other removable items. The diagonal gross-weight lines show combinations of fuel-load and cargo-load that can be used to make up a given permissible gross weight. The allowable design load factor varies along these weight lines. Constant load factor lines appear as near horizontal lines in the chart. They are valid only when the *FUEL AND CARGO ARE LOADED TO RECOMMENDED PROCEDURE.* They separate the chart in three distinct areas as follows: Safe area (green), Cautious area (yellow) and Damage area (red). Listed, furthermore, are normal takeoff, landing gross weights where performance or structural considerations may limit operations.

EC-121D. MINIMUM PERMISSIBLE FUEL RESTRICTIONS FOR INDIVIDUAL TANKS DURING FLIGHT WITH TIP TANKS INSTALLED

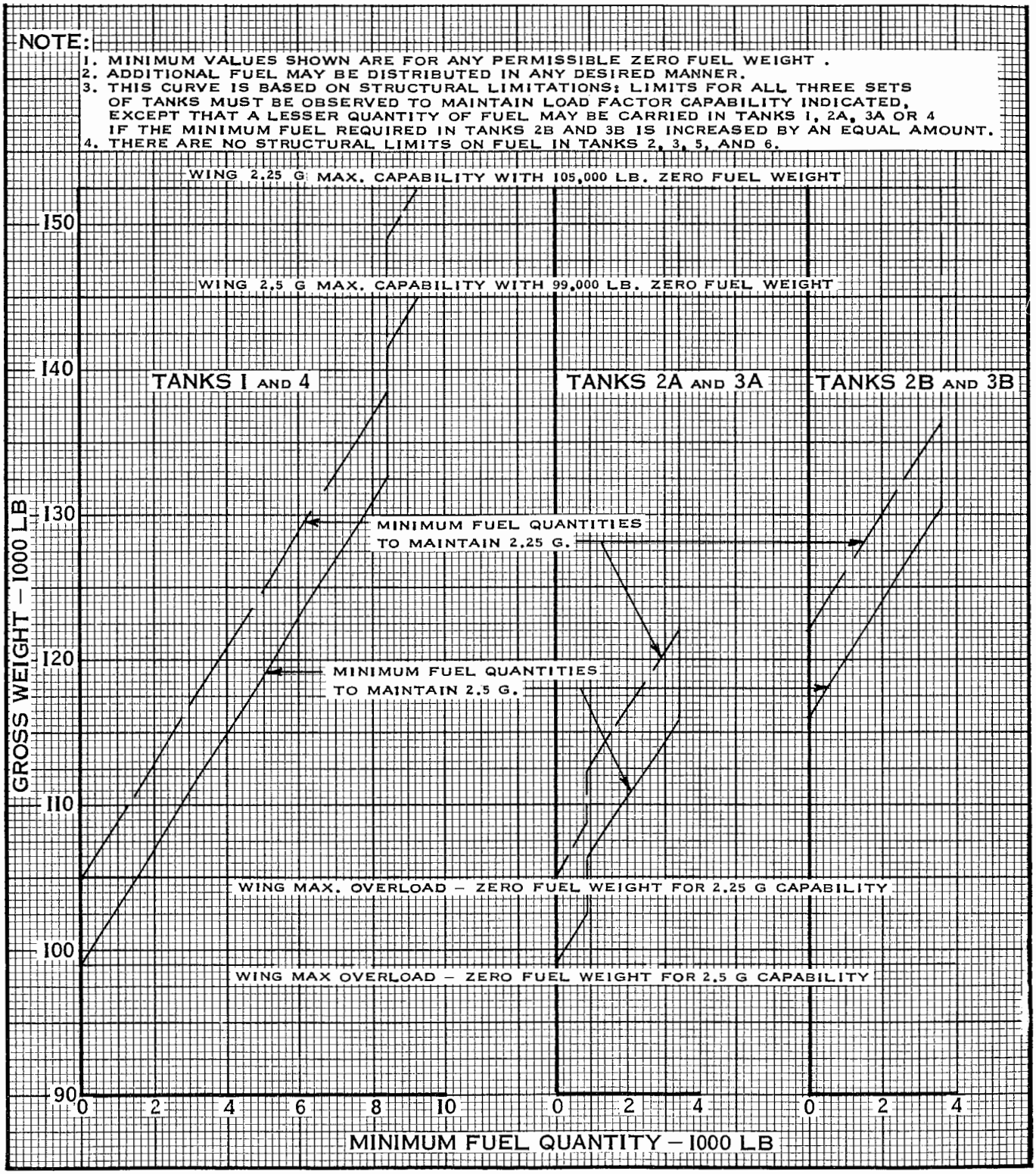


Figure 5-3 (Sheet 1 of 2)

TC-121C. MINIMUM PERMISSIBLE FUEL RESTRICTIONS FOR INDIVIDUAL TANKS DURING FLIGHT

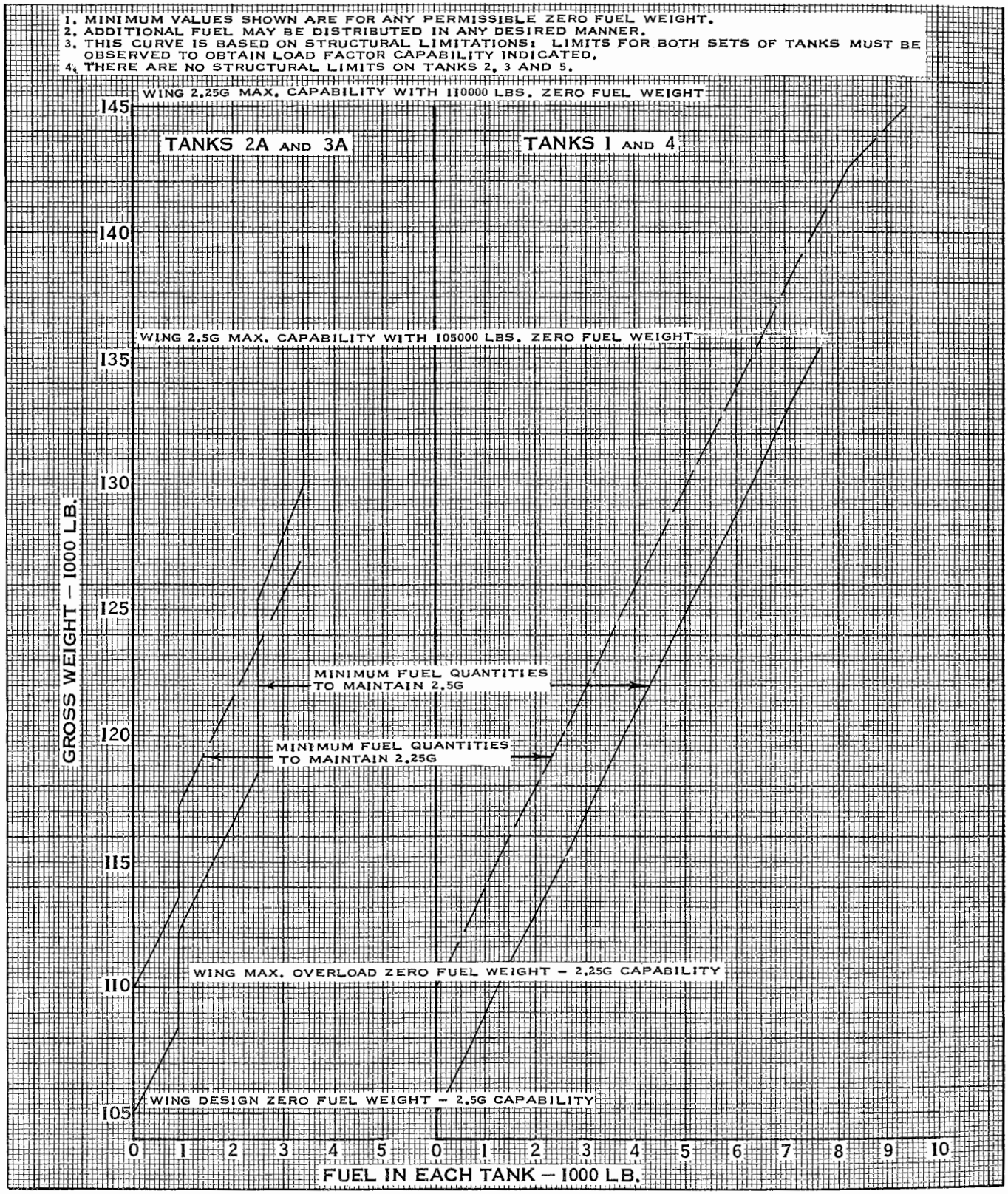


Figure 5-3 (Sheet 2 of 2)

DESIGN LOAD FACTORS.

The design load factor is 2.5 G for the design zero fuel weight. The aircraft normally will be loaded and flown so that maneuvering loads, gust loads or a combination of both will not cause load factors in excess of 2.5 G to be experienced in the green area. The aircraft has strength capabilities in flight such that it can support limit loads due to a 2.5 G maneuver without detrimental deformation, and such that any deformation which might occur will not interfere with safe operation of the airplane. The structure is also designed to ultimate loads obtained by applying a 1.5 factor of safety to limit loads, and is capable of supporting ultimate loads without failure of the primary structure.

WING FUEL LOAD.

The ability of the wing to safely withstand the imposed airloads is dependent on the weight of the fuel present in the wings, and the distribution of the fuel in the wings along the span. Therefore, it is important to adhere to fuel loading and consumption schedules recommended in Section VII.

WING LIMITATIONS.

Lines showing wing strength in terms of aircraft flight load factors for combinations of fuel and payload are shown for 2.0, 2.25 and 2.5 G. If the aircraft utilizes combinations of payload and fuel which reduce the allowable load factor to less than 2.5 G it should be flown with caution, especially when making turns and pull-outs and when operating in turbulent air. In addition to the instructions noted under the paragraph titled LOADING NOT RECOMMENDED, *the aircraft should never be loaded with any combination of payload and fuel which reduces the load factor below 2.0 G as shown in figure 5-4 because of the probability of structural damage to the wing.*

LANDING GEAR AND BRAKING LIMITATIONS.

The aircraft design landing weight is 110,000 pounds for a sinking speed of 600 feet per minute. The overload design landing weight is 122,000 pounds with a limit sinking speed of 420 feet per minute at touchdown. The landing gear and associated structure are of required strength for normal taxiing and ground handling at take-off weights up to 130,000 pounds. Increased care should be exercised in taxiing, braking, turning and other ground handling operations at heavier weights. It should be possible to make at least 100 normal stops without reverse thrust from 110,000 pound landing weight without brake difficulty provided brakes are cooled properly on the ground or in the air between landings. Brake wear at heavier landing weight will be increased unless the assistance of reverse thrust is used properly. The brakes are capable of bringing the aircraft to an emergency stop from normal takeoff speed at a weight of 135,400 pounds without assistance of reverse propeller thrust. It should also be possible to make one emergency stop at overload operating weights up to 152,000 pounds. However, full reverse thrust should be used during such a stop, especially at altitudes above sea level, to reduce the energy which would otherwise be absorbed by the brakes. Full application of brakes should be delayed, if possible, until speed has been reduced to that for design takeoff weight. The critical braking condition for take-off would be reached at about 155,000 lb using full reverse thrust on two engines or partial reverse thrust on three engines.

PERFORMANCE LIMITATIONS.

Structural limitations rather than performance requirements generally limit the weight carrying capabilities of a four-engine airplane. The most severe of the normal performance requirements is met at a weight of 150,200 lbs. for the EC-121D and 159,300 lbs. for the TC-121C. The airplane will takeoff and climb fifty feet within a distance of 10,000 feet at sea level on a hot day at that weight. Higher weights are listed on the Weight Limitations curve (figure 5-4) for less severe performance requirements. However, this chart is to be used only as a guide with respect to performance available. Refer to the appendix for detailed performance information. Local operating conditions may limit allowable weights more severely than is indicated by the weight limitations chart.

CONFIGURATION AND PERFORMANCE.

The configuration of the airplane may impose a penalty on performance. An increase in drag from that for the cruise configuration results in a decrease in the rate of climb available, increases power required and may require a readjustment of the permissible operating gross weight. As with power losses, increases in drag are most critical at take-off when the landing gear is extended, the cowl flaps are open and the wing flaps are 60% extended. The effect of the drag produced is indicated on the weight limitations chart by the gross weights at which minimum performance requirements are met with various airplane configurations.

RECOMMENDED LOADING AREA.

The green areas of the chart represent the loading conditions that present no particular problem in regard to

strength or performance of the aircraft. Operation of the aircraft at weights outside of this recommended loading area should be avoided.

CAUTIONARY LOADING AREA.

The yellow area on the chart represents loading of progressively decreasing margin of safety as the red area is approached. An aircraft may reasonably be expected to encounter a load factor of 2.5 G at times because of either maneuvering or turbulence. Also, performance may become critical in the upper region of this area depending upon airplane configuration and atmospheric condition. Careful adherence to rough air penetration speeds is recommended when operating at weights in the cautionary range. In a particular emergency, landing at weights in excess of normal landing weights are practicable on the condition that the pilot exercise ordinary care and precaution during the approach and landing. The glide path should be planned for decremental power changes from the start of the final approach to the landing. Rapid power changes should be held to a minimum during the approach and a small amount of engine power should be kept in reserve until after the landing flare. Every effort should be made to achieve minimum rate of descent on landing.

LOADING NOT RECOMMENDED.

Note

Whenever flights are conducted at weights shown on the red area of the chart, entry of this fact in Form 781 is required.

The red area represents loadings which are not recommended because of the reduced margin of safety available from the standpoint of both performance and structural limitations. Under conditions of extreme emergency (when a reduction in normal requirements for safety of flight may be tolerable), the commander will determine if the degree of risk warrants operation of the aircraft at gross weights appearing in the red zone.

SAMPLE USE OF WEIGHT LIMITATIONS CHART.

Example 1.

Assume a mission requires a 4,000 pound payload and a 39,000 pound fuel load (including the reserve allowance). Calculate the gross weight to be:

Basic operating weight	85,760 lb
Payload	4,000 lb
Fuel load	39,000 lb
	128,760 lb

The Weight Limitations Curve can only be used directly for a basic operating weight of 85,000 pounds since its constructions is based on this value. Any other value, as in the example, must be adjusted to 85,000 pounds before entering the curve. This step can be accomplished by subtracting 85,000 pounds from the basic operating weight for the problem and adding this difference to the problem payload value. The solution then would be as follows:

Example 1 Basic Operating Weight	85,760 lb
Curve Basic Operating Weight	85,000 lb
Difference	760 lb

The problem payload now becomes 4,000 plus 760 or 4760 pounds.

Recalculate the loaded gross weight:

Adjusted Operating Weight	85,000 lb
Payload & Weight Adjustment	4,760 lb
Fuel Load	39,000 lb
	128,760 lb

Enter the weight limitations curve at 0, which now represents the basic operating weight of 85,000 pounds, and proceed horizontally to the fuel load line 39,000 pounds. Move vertically along this line to 4,760 pounds payload. Find the loaded gross weight on the diagonal lines by interpolation to be 128,760 pounds; which checks the initial calculation. This initial operating point falls in the green area and the planned landing weight, with reserve fuel included, is less than 110,000 pounds.

Example 2.

Use a fuel load of 52,500 pounds, assume that the basic operating weight was found to be 90,500 pounds due to the addition of equipment. Also assume that mission requirements increase the payload to 9,000 pounds.

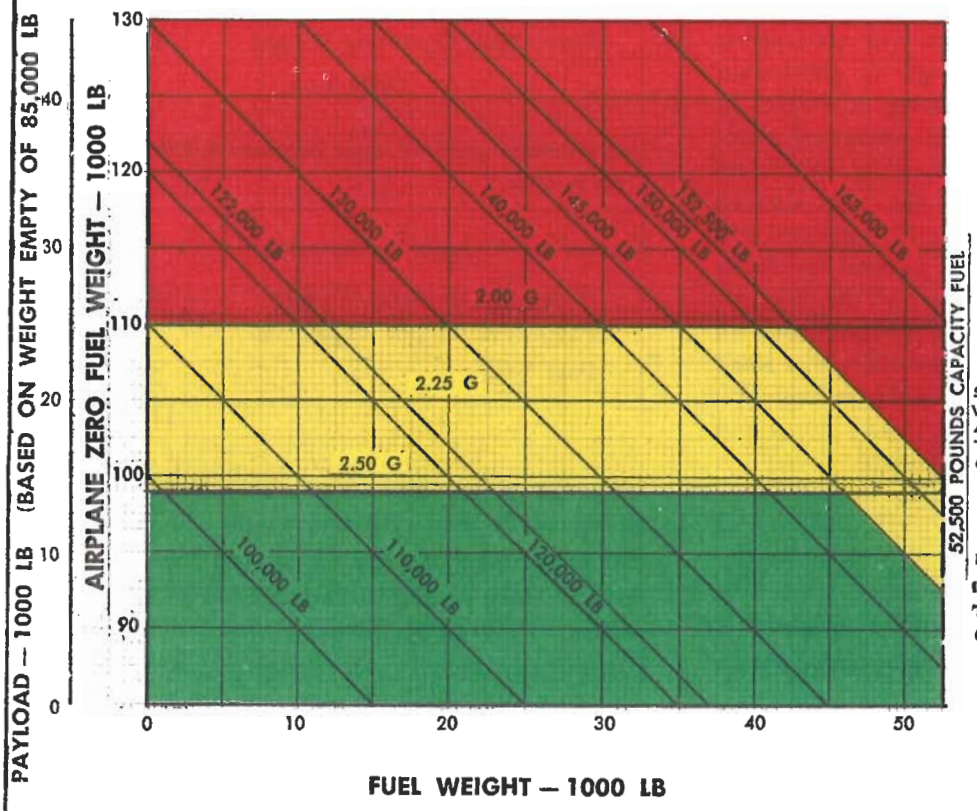
The following conditions are now present:

Basic Operating Weight	90,500 lb
Payload	9,000 lb
Fuel Load	52,500 lb
Total	152,000 lb

As in Example 1, the basic operating weight for the problem must be adjusted to 85,000 pounds before entering the weight limitations curve. This adjustment

EC-121D. GROSS WEIGHT LIMITATIONS

TIP TANKS INSTALLED



85,000 POUNDS
BASIC OPERATING WEIGHT

110,000 POUNDS
DESIGN LANDING WEIGHT WITH 600 FPM LIMIT CONTACT SINKING SPEED.

122,000 POUNDS
OVERLOAD LANDING WEIGHT WITH 420 FPM LIMIT CONTACT SINKING SPEED.

149,900 POUNDS
LIMITING GROSS WEIGHT FOR 100 FPM RATE OF CLIMB AT SEA LEVEL ON A HOT DAY WITH ONE ENGINE INOPERATIVE AND PROPELLER FEATHERED, TAKE – OFF (60%) FLAPS AND GEAR UP.

150,200 POUNDS
LIMITING GROSS WEIGHT FOR 10,000 FT DISTANCE TO TAKE OFF AND CLIMB 50 FT ON A HOT DAY AT S L.

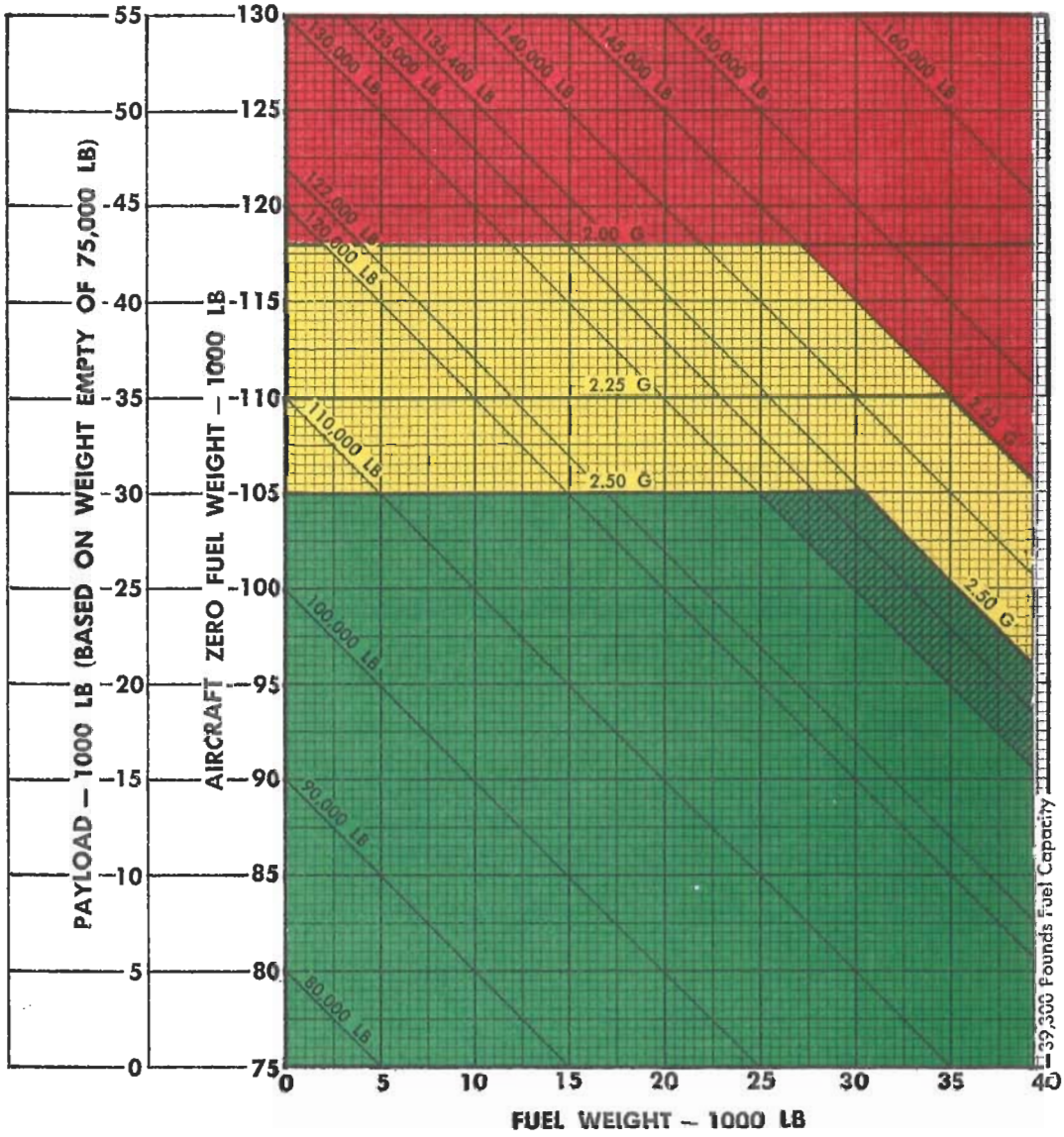
152,500 POUNDS
MAXIMUM OVERLOAD GROSS WEIGHT

NOTE:

1. CAREFUL ADHERENCE TO ROUGH AIR PENETRATION SPEEDS IS RECOMMENDED WHEN OPERATING AIRPLANE AT WEIGHTS IN THE CAUTIONARY RANGE.
2. SINKING SPEEDS LESS THAN 420 FEET PER MINUTE ARE REQUIRED IN THE UPPER PART OF THE CAUTIONARY RANGE WHERE ZERO FUEL WEIGHTS SHOWN WILL LEAD TO LANDING WEIGHTS IN EXCESS OF 122,000 POUNDS.
3. INCREASED CARE SHOULD BE EXERCISED IN TAXIING, BRAKING, TURNING AND OTHER GROUND HANDLING OPERATIONS AT GROSS WEIGHTS IN EXCESS OF 130,000 POUNDS.
4. REFER TO APPENDIX FOR DETAILED PERFORMANCE INFORMATION.

Figure 5-4 (Sheet 1 of 2)

TC-121C. GROSS WEIGHT LIMITATIONS



Increased care should be exercised in taxiing, braking, turning, and other ground handling operations at gross weights in excess of 130,000 lb.

NOTES:

1. Careful adherence to rough air penetration speeds is recommended when operating at weights in the cautionary range.
2. Sinking speeds less than 7 fps are required in the upper part of the cautionary range where zero fuel weights shown will lead to landing weights in excess of 122,000 lb.
3. Refer to appendix for detailed performance information.

75,000 POUNDS
Basic operating weight.

110,000 POUNDS
Design landing weight with contact sinking speed limit of 600 fpm.

122,000 POUNDS
Overload landing weight with contact sinking speed limit of 420 fpm.

145,000 POUNDS
Maximum overload gross weight.

Figure 5-4 (Sheet 2 of 2)

is made, as before, by adding the difference of the two basic operating weights to the payload value.

Example 2 Basic Operating Weight	90,500 lb
Adjusted Basic Operating Weight	85,000 lb
Difference	5,500 lb
Actual Payload	9,000 lb
Difference Between Basic Operating Weights	5,500 lb
New Payload Value	14,500 lb

Enter the curve as in the previous example with the fuel load, 52,500 pounds, and the new payload value, 14,500 pounds. Read the loaded gross weight to be 152,000 pounds which checks the initial calculation. The point falls in the caution area, 1000 pounds above the 2.5 G line. If overweight operations are not permissible, the mission requirements must be reexamined since at least 500 pounds of payload along with 500 pounds of fuel must be removed in order to move to the green area. If 500 pounds of fuel cannot be spared, then 1000 pounds of payload must be removed to operate in the green area.

If operation in the green area is obtained by a removal of 500 pounds of payload and 500 pounds of fuel it will be of importance to note that if the fuel remaining at the end of the flight is less than 8,500 pounds the 2.5 G line moves under the operating point. Therefore, unless the landing weight is to be between 108,000 lb and 110,000 lb the payload should be limited to 8,500 pounds (9000—500) for this mission.

The appendix should be checked for detailed performance data to determine whether further limitations should be imposed.

SECTION VI—FLIGHT CHARACTERISTICS

TABLE OF CONTENTS

	Page
FLIGHT CHARACTERISTICS	6-1
STALL CHARACTERISTICS	6-1
SPIN CHARACTERISTICS	6-4
FLIGHT CONTROLS	6-4
LEVEL FLIGHT CHARACTERISTICS	6-5
MANEUVERING FLIGHT	6-11

FLIGHT CHARACTERISTICS.

This aircraft exhibits no flight characteristics that would tend to place the pilot in a difficult situation. It has been flown during various weather conditions including thunderstorms, gusty crosswind landings, and severe icing. General performance and flight characteristics under such conditions have been described as good by operating service personnel. Its handling qualities are normal in every respect. Control response under typical flight conditions and with asymmetrical power is considered excellent.

Note

The information contained in this section is based on experience gained from flight and service tests accomplished on previous civilian and military models of Constellation aircraft.

STALL CHARACTERISTICS.

The stall characteristics of this aircraft, with any combination of wing flap or landing gear positions, are excellent and the stall is preceded by adequate warning in the form of mild buffeting. There is no abnormal tendency for a wing to drop and aileron and rudder controls are effective up to and into the actual stall through both power-on and power-off stalls. With a forward center of gravity, the control forces that are necessary to slow the aircraft down to the stall speed will be fairly heavy and will increase as the speed is reduced. At the stall, a pronounced nose-down pitch will occur; however, if the center of gravity is moved near the aft limit, the forces that are necessary to accomplish the stall will be greatly reduced and this nose-down pitching tendency at the stall will also be reduced. With increased power, the stall occurs at a more pronounced nose-up attitude, at a lower speed, with a slight increase in rolling tendency and a reduction in stall warning. The stall speeds for angles of bank are given on figure 6-1. Values shown are reliable for the flight conditions noted. However, indicated airspeed may vary from equivalent airspeed values shown at the actual stall. Readings will depend on individual IAS instrument calibrations, system in use, rate of speed reduction, power setting, and other factors which affect the indication or the stall speed. Therefore this chart should be used primarily as a basis for establishing minimum desired flight speed margins above stall speed to be observed in normal operations.

ACCELERATED STALLS.

Accelerated stalls are similar to the level flight unaccelerated stalls, except that the warning margin, normally 3 to 5 knots above the stall, is somewhat reduced. During progressive stalls (one stall immediately following another), no change occurs in the stall characteristics with each succeeding stall. However, if only a partial recovery is effected between stalls, a considerable increase in rolling tendency and buffeting will result.

Note

Flight in the stall area where severe airframe buffet occurs may possibly cause some fuel system leaks. Therefore, practice stalls performed for the purpose of indoctrination demonstrations should not be carried into the stall area, but be limited to approach-to-stall speeds. This will provide adequate demonstration of buffet characteristics, and reduce possibility of damage to the airframe or component equipment.

The technique for recovering from stalls of any nature is to move the control column forward and apply whatever aileron and rudder control and power that is necessary to keep the wings level.

WARNING

A critical flight condition is a combination of high power, low speed and a nose up attitude. When applying power, make certain that airspeed increases as power is applied, and maintain a minimum attitude change because of undue control forces and controlability.

SPIN CHARACTERISTICS.

WARNING

Intentional spins with this aircraft are prohibited.

No spin tests have been conducted with Constellation aircraft; however, in the event of an inadvertent spin, it is believed that a normal spin recovery method, consisting of the application of opposite rudder followed by the forward movement of the wheel, would accomplish recovery. However, it is recommended that the control column not be pushed forward of its neutral position, as excessive build-up in speed might result. Avoid excessive back pressure on the wheel during the pull-out after recovery.

FLIGHT CONTROLS.

In order to perform their primary mission efficiently, aircraft in the patrol and transport categories are designed to withstand lower load factors than some other types, such as attack bombers and fighters which require greater maneuverability. To reduce the possibility of inadvertently applying structural loads greater than those for which they are designed, transports have a very high degree of stability. Because of this stability, the control forces necessary to perform maneuvers are somewhat greater than those required on other types.

Trim Devices.

All control systems are equipped with conventional mechanically-operated trim tabs.

NORMAL OPERATION.

The aileron, elevator, and rudder control systems are conventional in every way except that they are partially powered by means of hydraulic booster units. Since these booster units do not completely accomplish the movement of the surfaces but merely assist in this movement, "feel" of the controls is retained by the pilot. To maintain this feeling and to prevent overcontrolling, the booster units are designed to provide low boost ratios for small control force applications, and to increase boost ratios as the applied control force is increased.

BOOST-OUT OPERATION.

The possibility of the booster units becoming inoperative is rather remote since the boosters are operable with either the primary or secondary hydraulic system inoperative. If both of these systems fail, the auxiliary booster systems will still provide hydraulic pressure to the rudder and elevator booster units. In the event that a situation should arise which would result in all booster units being inoperative, the aircraft will still be adequately controllable, provided that the center of gravity is between 23-30% MAC. The control forces will, of course, be quite heavy, and the emergency elevator booster shift control should be pulled out to reduce the forces on the control wheel. This reduction in force is accomplished by a change in mechanical ratio and results in a corresponding reduction in the available elevator travel.

Flight Control Precautions.

Although the control forces for transport aircraft are, in general, heavier than in some other types, it is still possible to apply severe structural loads by a rapid and violent application, sudden release, or reversal of force on any of the three control systems. It is within the pilot's physical power to cause failure of some components of the airframe structure, particularly when flying

at high speeds. A rapid release or reversal of rudder force can result in heavy loads on the vertical fins and aft fuselage, and should, therefore, be avoided.

BOOST-ON OPERATION.

Boosters should never be turned on at high speeds, or at any speed, if the aircraft is out of trim. This will result in a rapid and severe application or release of forces on any system in which the boost is turned either off or on. In an emergency, the boost may be turned off at any airspeed. If conditions permit, however, the speed should be maintained between 130 and 155 knots during the change-over. Normal cruising speed schedules may be re-established with boost off; however, an increase in control forces required may be expected. If the automatic pilot is engaged during boost-off operation the flight crew should monitor airplane attitude continually and more carefully than during normal operation, particularly during flight through turbulent areas. If gusts cause deviation from the trimmed attitude, the autopilot might become stalled due to increased air loads on the controls, so that action by the crew may be required to effect recovery.

Cross Wind Effect.

Cross wind landing characteristics are excellent; however, airspeeds above 115 knots may be desirable in the approach if gusty conditions exist in order to maintain desired margins of aileron control response rate.

INFLIGHT CONTROL TECHNIQUE.

Pilots should strive for proper rudder-aileron coordination. This is particularly important in recoveries from highly banked conditions at slow speeds. If an attempt is made to roll out of such a highly banked condition, using ailerons only, the low wing may not come up immediately and the aircraft will tend to scoop out toward the low side. This could be extremely hazardous at low altitudes.

LEVEL FLIGHT CHARACTERISTICS.

Extensive flight tests of civilian and military versions of Super Constellation aircraft similar to the EC-121D indicate that it will be stable throughout its speed range. It can be flown from its maximum placard speed to the stall speeds without reversals or abnormal variations of control force. However, as is true of most aircraft, excellent piloting technique and smooth air are required in order to maintain steady flight speeds when power is reduced to settings recommended for holding and maximum endurance.

Figure 6-2 illustrates some typical speed/power characteristics at normal and slow flight speeds discussed in the following paragraphs.

SLOW FLYING.

There are two major differences between operating at slow and normal flight speeds. The most noticeable is the different ratio of speed change to power change. The aircraft becomes much more sensitive to small power changes as speed is reduced. A power adjustment which might normally result in a two or three knot speed change at high speed cruise conditions can result in a ten to fifteen knot speed range in calm air at endurance speeds. The effects of turbulence are also much greater, and the speed change takes place over a longer period of time. Successive gusts, encountered before intermediate recovery is affected, might result in excessive slowing of the airplane. Therefore, the pilot should exercise a more positive degree of control than would be considered normal for higher speed operation.

MINIMUM SPEED OPERATION.

This leads to the second difference between normal and slow speed operation. There is a possibility of the airplane flying on the back side of the power curve. An airplane may be longitudinally stable throughout its speed range, as the EC-121D is, and still experience what might seem to be airspeed instability in the slow speed area of operation. This is a situation which can occur at low flight speeds with any airplane having a favorable lift, drag ratio and reasonable stall speeds. It is referred to either as *flying on the back side of the power curve* or *operating in the reverse command region.* It happens when airspeed is reduced to less than the speed for minimum power required for level flight, most often when power settings in use are just sufficient to maintain holding or endurance speeds.

POWER REQUIREMENTS.

The power required for flight increases with decreasing speed after the minimum power point has been passed. The airplane can then accelerate to a greater speed

EC-121D. BASIC SPEED—POWER CHARACTERISTICS
NORMAL OPERATION

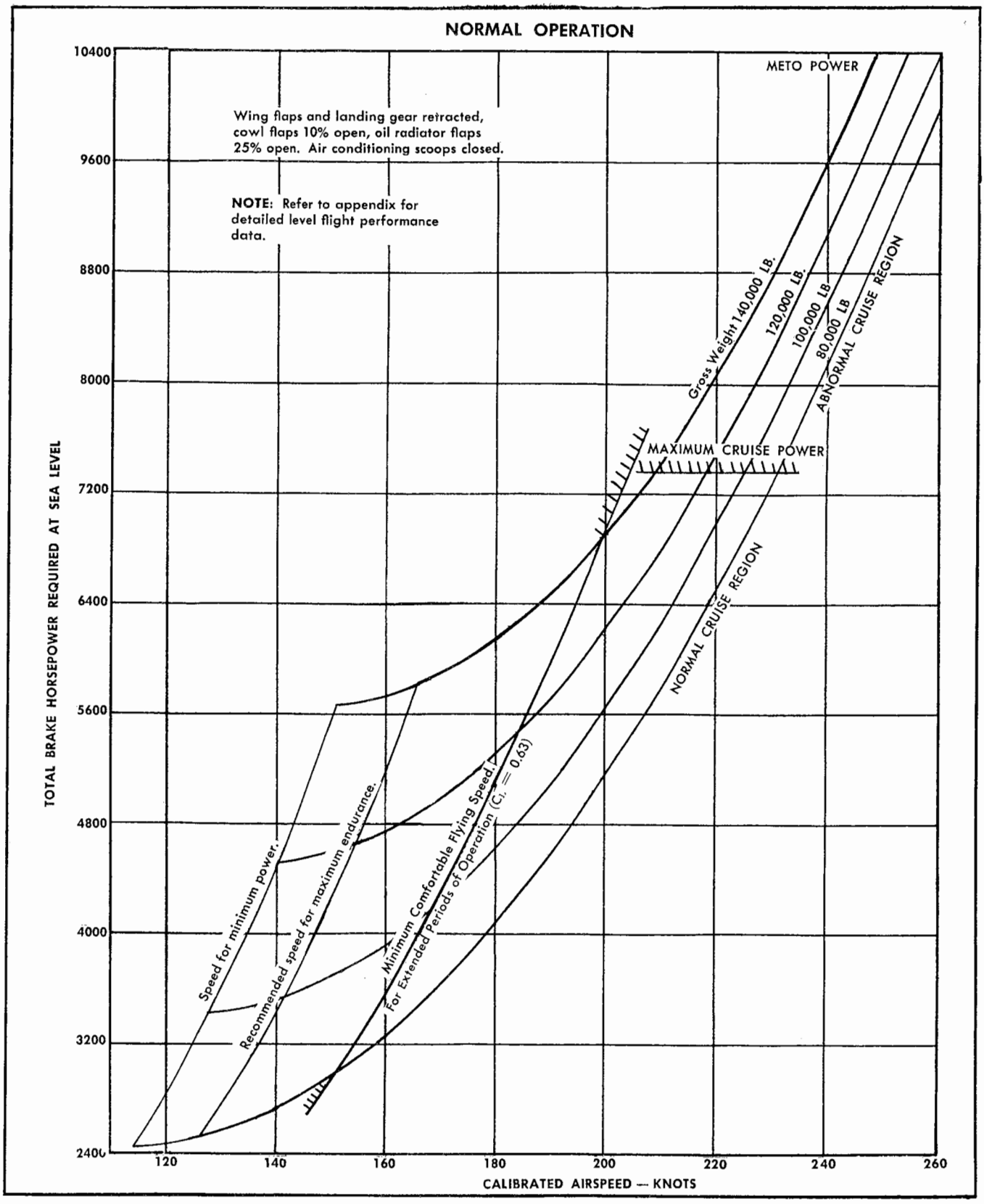


Figure 6-2 (Sheet 1 of 4)

TC-121C. BASIC SPEED—POWER CHARACTERISTICS

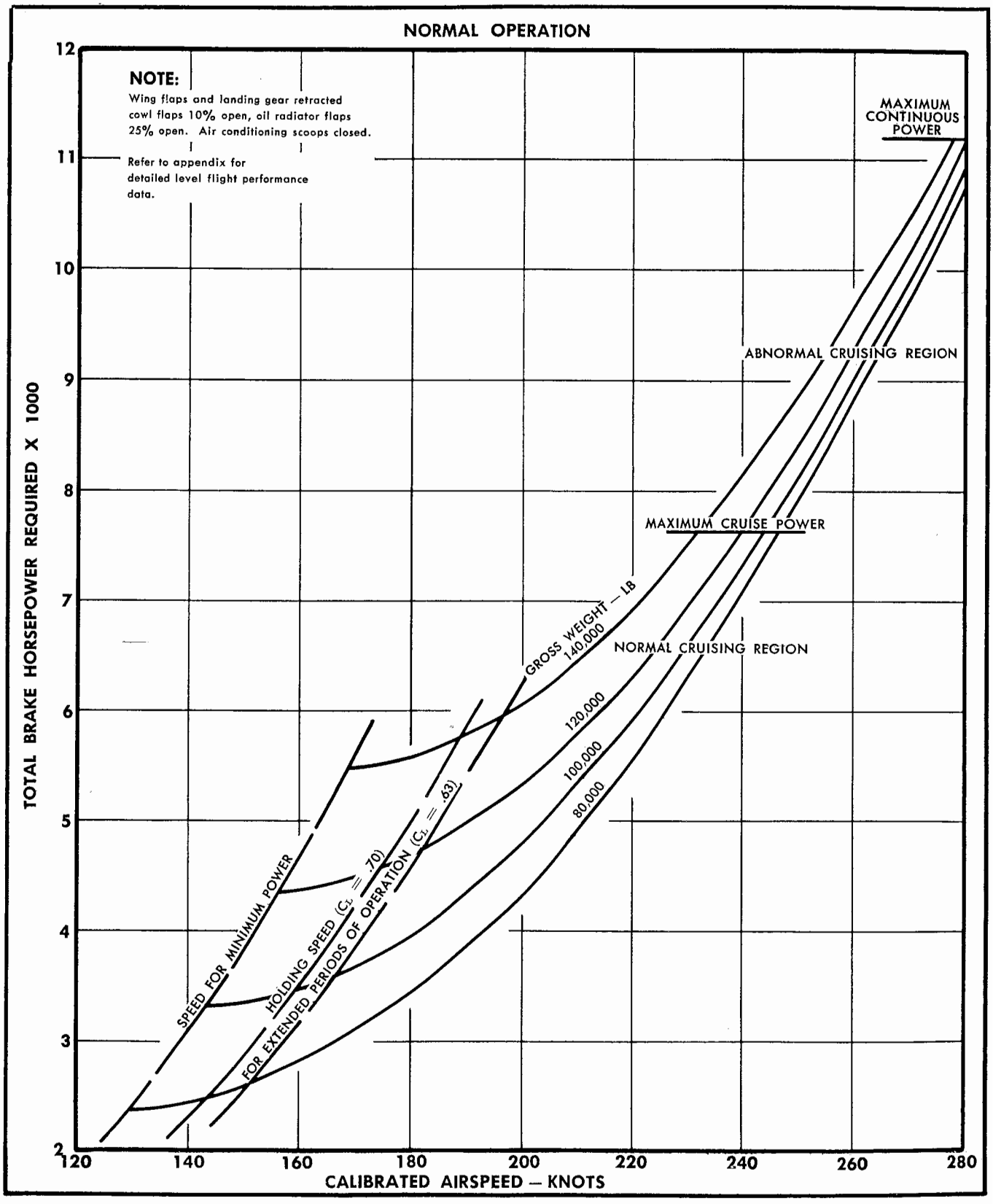


Figure 6-2 (Sheet 2 of 4)

EC-121D/TC-121C. BASIC SPEED—POWER CHARACTERISTICS
NORMAL OPERATION

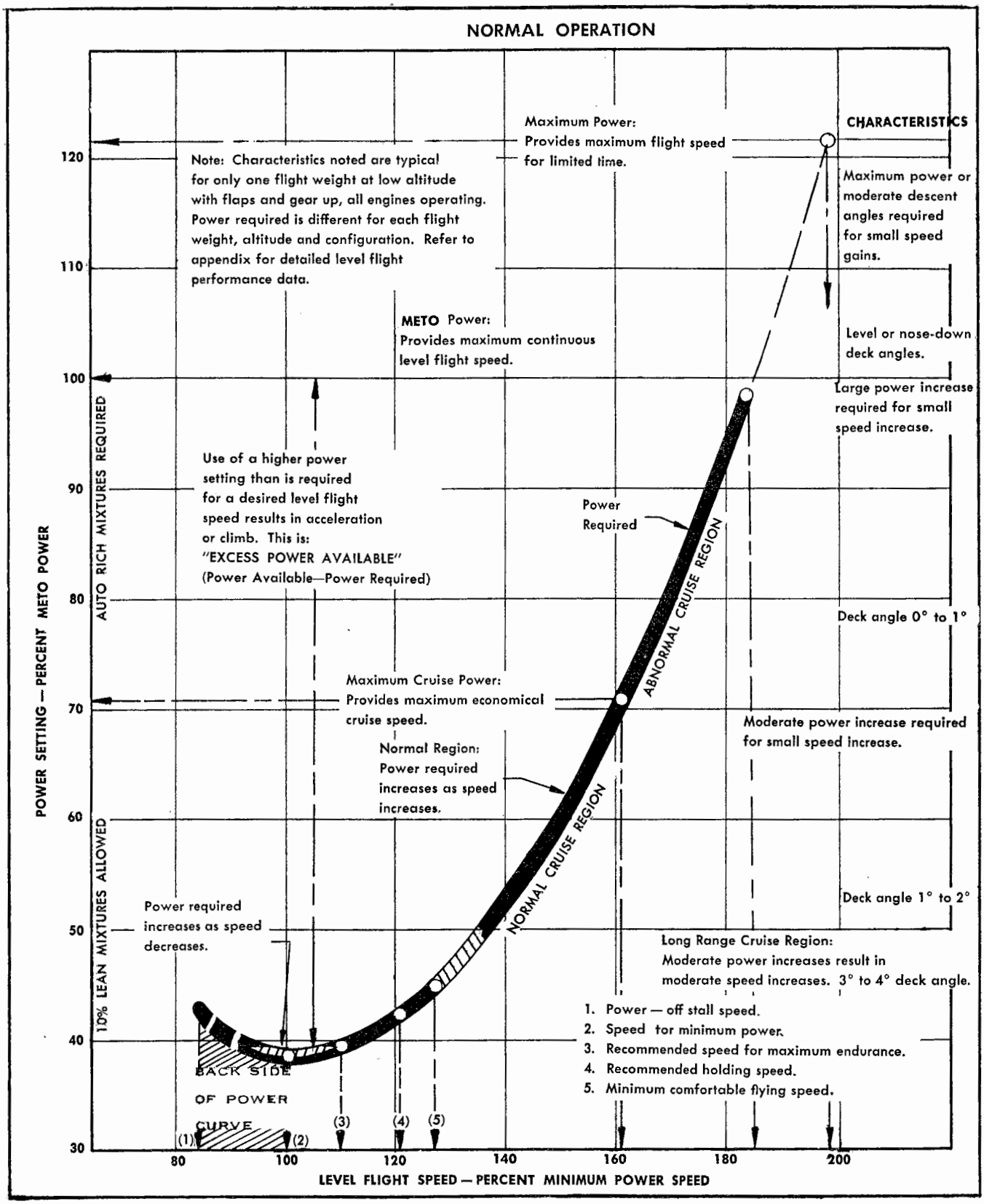


Figure 6-2 (Sheet 3 of 4)

EC-121D/TC-121C. BASIC SPEED—POWER CHARACTERISTICS
SLOW SPEED OPERATION

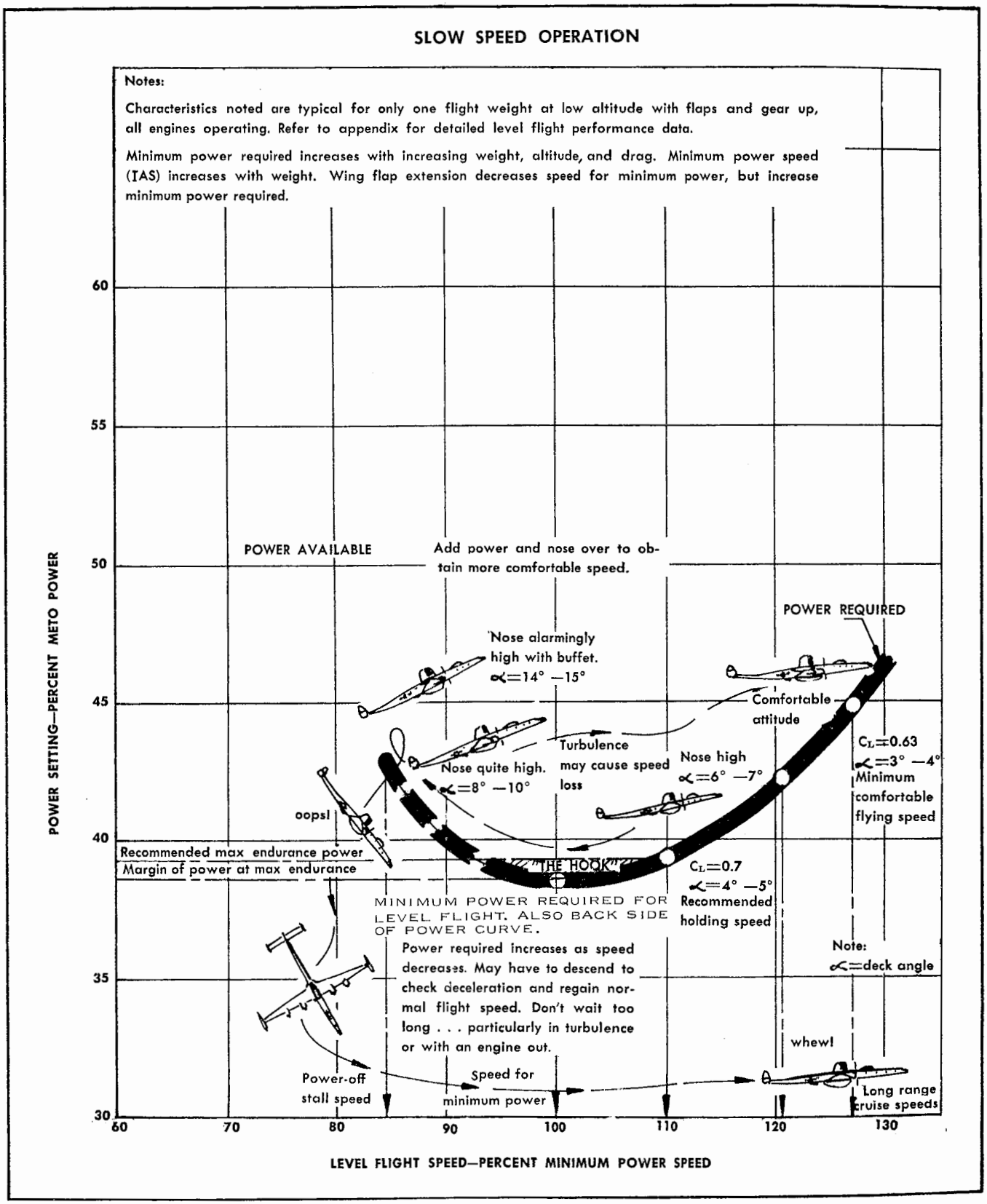


Figure 6-2 (Sheet 4 of 4)

without loss of altitude only if a positive margin of power exists; that is, if power required at reduced speed does not exceed the power setting in use. If a positive margin does not exist, the airplane will tend to recover trim speed by descending and accelerating unless adversely affected by turbulence. Recovery can also be affected by increasing power at constant altitude provided speed loss has not progressed to the point where insufficient power is available to check deceleration. The fastest recovery can be made, of course, by combined descent and addition of power. The only danger involved lies in not recognizing that the aircraft is flying "on the back side of the power curve" as it occurs, and attempting to maintain altitude without increasing power. Deceleration may then continue until the lowering airspeed and high deck angle are noticed, pre-stall buffet is felt, or the aircraft enters a stall.

SPEED REQUIREMENTS.

Recommended speeds for maximum endurance shown on the miles per pound curves in the Appendix are approximately 110% of the speeds for minimum power or absolute maximum endurance. This provides a margin of excess power for acceleration if speed reduction due to turbulence should occur, thus allowing normal operations to be conducted at endurance cruising schedules. AEW aircraft might enter the reverse command region more frequently than transport type aircraft since holding or maximum endurance speed schedules are used more often. In addition, mission requirements might be such that operation at low speeds in a turbulent area may be required. Use of slightly higher than scheduled power settings should forestall large speed losses in mild or moderate turbulence, and ample power is available from the four engines to check large decelerations. The characteristic effects of "flying around the hook" should be known and recognizable however. Inadvertent entry into a "reverse command region" during an emergency might affect airplane performance so as to affect flight safety.

WEIGHT CONSIDERATIONS.

An example might be illustrated by considering an airplane operating at heavy weight with two engines inoperative, at an altitude just less than its rated power ceiling. It can maintain altitude and expect an increase in performance as fuel is consumed and weight decreased. If turbulence slows the airplane beyond the minimum power speed however, power required for flight might become more than available. The pilot must then sacrifice altitude by descending rapidly enough to increase speed to the original value, check the deceleration by use of maximum power, or both. Continued operation at the reduced speed might result in slower but continuous loss of much more altitude than would be required to accelerate to the original speed.

EFFECT OF WING FLAPS.

Operation with flaps extended decreases the speed for minimum power to some extent. However, the value of minimum power associated with the decreased speed is always greater than that for the clean configuration at its corresponding minimum power speed.

CRUISING FLIGHT.

The basic mission of this type aircraft involves long periods of operation at cruise power settings. It is for such conditions that the aircraft was designed and is most effective. Patience and skill on the part of the flight crews will result in optimum aircraft performance. Adequate data are presented in the Appendix to permit preparation of a wide variety of flight plans. It is suggested that the pilot consider use of the following techniques however, as a means to obtain maximum performance from the aircraft.

1. Maintain climb power after leveling off until the desired cruise speed is reached when entering a cruise condition from a climb speed which is less than that desired for level flight, and then reduce to the desired cruising power. Airspeed will tend to increase thereafter as fuel is consumed if cruising power is held constant. The increase in speed relative to the decrease in weight is lessened as light weights are approached.

2. Flight characteristics in turbulent air are favorable although, as would be expected, the average airspeed will tend to be less than for the same power setting in calm air. Some loss of range results. If range is the primary consideration, the pilot will find that a slight increase in power will result in a more stable speed. The increase should be determined for the specific conditions existing by inspection of fuel economy data in the Appendix. No change of power setting should normally be necessary if maximum endurance is the primary consideration. Duration is a function of total fuel flow rather than average airspeed. However, power may have to be increased at the expense of fuel flow in turbulence if the average airspeed tends to become less than 90% of the value recommended for maximum endurance.

HIGH SPEED FLIGHT.

In general, high speed flight will be normal in all respects; that is, no compressibility effects will be noted at speeds up to the placarded dive speed.

MANEUVERING FLIGHT.

The maneuvering flight characteristics are normal with the exception that on the EC-121D it is necessary to maintain pressure on the bottom rudder to sustain a coordinated turn.

DIVING.

Generally it is not necessary to observe any special precautions when diving, other than to observe the limit speeds and structural load factors described in Section V of this manual. Under these conditions, no high-speed compressibility affects will be encountered. The aircraft should be retrimmed manually with speed changes in the normal manner. When recovering from a dive attitude, the aircraft should be pulled out manually without changing trim. The pilot should not use excessive or rapid application of control forces in the recovery to avoid possible structural damage to the aircraft.

Section VII—SYSTEMS OPERATION

TABLE OF CONTENTS

	Page
ENGINE OPERATION	7-1
IGNITION ANALYZER	7-10
ENGINE OIL TANK REPLENISHING	7-24
FUEL SYSTEM	7-30
FILLING MAIN OR EMERGENCY HYDRAULIC RESERVOIR IN FLIGHT	7-33
USE OF LANDING WHEEL BRAKES	7-33
SYNCHRONIZER OPERATION	7-37
FLIGHT INSTRUMENT AND NAVIGATIONAL AIDS TROUBLE SHOOTING PROCEDURES	7-38

ENGINE OPERATION.

CARBURETOR ICING.

Whenever there is visible moisture in the air, such as rain, snow, sleet, clouds, super-cooled precipitation, etc., the flight crew should be alert for indications of carburetor icing which can be detected by close attention to fuel flow and BMEP. With the fuel injection engine, the occurence of throat ice or refrigeration ice is very rare. Furthermore, precipitation particles of large density are removed by inertia separation at the induction scoop entrance. Icing in this installation, therefore, is the result of very fine particles of ice in the impact tube system of the carburetor, and is most likely to occur when visible moisture is present and the free air temperature is below 10°C. The most likely causes of engine instability during precipitation conditions are:

1. Ice crystals or water droplets entering the impact tube system and physically restricting the passages. This results in excessive leanness and usually causes a sudden and radical power loss.

2. Ice crystals or fine snow becoming lodged in the automatic mixture control unit needle aperture. This also results in excessive leanness and usually causes a sudden and radical power loss. This particular condition is most critical at higher altitudes and at very low free air temperatures when carburetor heat is being used.

3. Accumulation of moisture in passage or bleeds (with heat on) and subsequent freezing and blocking of bleeds after removal of heat.

4. Accumulation of ice on various parts of the master control.

Power losses can also occur because of the following:

1. Richness due to mixture control bleed restriction which is a relatively rare occurrence. This condition usually results in a more gradual loss of power than occurs with the above conditions.

2. Leanness or richness due to a head of water in the air passages.

A power loss due to a manifold pressure loss, which is usually gradual, is probably caused by a reduction of airflow because of screen and surface icing, either in the air scoop or carburetor. This condition may be encountered in freezing rain, heavy snow, ice, or when an extremely cold aircraft is exposed to moisture conditions during descent. The prevention and/or correction of this type of icing is the same as for other icing conditions previously described. The following methods have been shown to be effective under all normal conditions where ice is likely to be encountered at altitudes below 20,000 feet and at temperatures between 10 and −25C.

At altitudes above 20,000 feet, extremely high carburetor air temperatures may cause excessive leaning of the mixture and result in engine instability. If such a condition occurs, the mixture should be enriched and/or carburetor heat reduced. It also may be necessary to use alcohol more frequently. At ambient temperatures below −25°C, the amount of visible moisture in the air is extremely small and is not likely to cause icing trouble; however, the temperature inside of clouds may be considerably different from the temperature outside the clouds. Therefore, it should be anticipated that icing conditions will be prevalent when entering a condition of visible moisture, and preventative measures should be taken.

Air-Side Icing.

The application of carburetor heat and alternate fuel source is not permissible during takeoff. Carburetor heat may be used before takeoff to insure that any ice accumulation has been dislodged, but the switch must be in the COLD position and the carburetor temperature normal before takeoff. The alternate fuel source switch must also be in the NORMAL position before takeoff. After the first power reduction is made, carburetor heat may be applied to maintain a minimum temperature indication of 20 to 30° C. Temperature stratification at the carburetor deck when using carburetor heat causes the carburetor air temperature gage to read 30°C when the actual average air intake temperature at the carburetor is 38°C. *Therefore, it is recommended that the carburetor air temperature not exceed 30°C, as read on the carburetor air temperature gage.* Anticipation of impending icing conditions is of primary importance in avoiding fuel metering disturbances. Visible moisture in the air with free air temperature below 10°C may be an indication of impending fuel flow disturbance. Intermittent fluctuations of fuel flow and BMEP, or gradual decrease or increase in fuel flow under these conditions, usually indicate a fuel metering disturbance which may be followed by a loss of power.

Note

If fuel flow indicates that the mixture is excessively rich, which has happened upon very rare occasions, manually lean with the mixture control to maintain smooth operation, then apply pre-heat to remedy.

The first step in preventing a fuel metering disturbance caused by carburetor ice is to use the alternate air source.

The effectiveness of the under cowl air source in preventing moisture from entering the induction system may be increased by opening the cowl flaps from the normal cruise setting. A possible explanation for this is that by opening the cowl flaps the air flow velocity through the cowling is increased and, therefore, moisture particles are more likely to continue straight through the cowling instead of following the air into the undercowl opening. *Cowl flap openings beyond faired (30%) position are not recommended because openings beyond this position may reduce the available carburetor heat.*

While it is recommended that the alternate air source be used to combat induction system ice, there are some conditions where it may be desirable to apply heat with the door in the ram position. If icing conditions are anticipated, or if any atmospheric condition is encountered which could cause a radical metering disturbance, the following procedures should be followed:

1. Mixture levers—AUTO RICH.
2. Alternate air switches—ALTERNATE.
3. Manual spark switch—As required.
4. Cowl flaps switches—OPEN (20-30%).
5. Carburetor heat switches—Raise temperature to maximum 30°C for LOW blower and 22°C for HIGH blower.

Note

In event of BMEP or fuel flow loss during icing conditions, position carburetor heat switch to FULL HOT position. If engine power is restored, regulate pre-heat control so as not to exceed limits stated above.

6. Reset cruise power, and monitor fuel flow and BMEP for evidence of instability.
7. Continue to monitor all instruments to detect indications of icing.
8. Leave carburetor heat on for approximately five minutes after passing through icing conditions to insure that ice is melted; then remove heat slowly in small increments, one engine at a time.
9. Reset cruise power and mixture.

When a metering disturbance (caused by atmospheric conditions) occurs suddenly and unexpectedly apply the same procedure as outlined above with special attention to "resetting power and fuel flows" plus:

1. Carburetor alcohol—As required to stabilize power (3 to 5 seconds maximum).

In the event that the foregoing procedures are not effective in relieving the metering difficulties, the following procedures should be accomplished on one engine at a time:

1. Mixture levers—AUTO RICH.

2. Throttle levers—Reduce manifold pressure to 25" Hg.

3. Alternate fuel switch—EMERGENCY.

4. Reset power—Advance throttle to desired BMEP. Manually lean mixture to best power and readjust throttle to maintain desired BMEP.

5. Carburetor heat switch—Adjust (on one engine at a time) to maintain temperature within limits. Refer to Section V for limitations.

6. Return to normal metering and power adjustment as soon as deemed advisable, doing so on one engine at a time.

If it is absolutely necessary to continue operation in level flight with the alternate fuel source, lean mixture and simultaneously open throttle to maintain constant BMEP until manifold pressure is three inches Hg above value noted at best power. If aircraft altitude is changed, the mixture will have to be reset. When using the alternate fuel source, the following cautions should be observed:

CAUTION

- Monitor fuel flow and power indications closely to detect changing conditions. Power changes may require resetting the mixture control.
- The alternate fuel source does not depend upon airflow; therefore, fuel flow, BMEP, and manifold pressure should be monitored carefully. The alternate fuel source should not be used without the prescribed amount of pre-heat because a dangerous build-up of ice can occur without the usual fuel flow effects. Increasing throttle requirements to maintain manifold pressure usually indicates ice build-up, and increased pre-heat should always be used under these conditions to insure airflow to the engine.
- In the event of total loss of metering differential pressure, the alternate fuel source will supply sufficient fuel flow to allow power settings up to and including maximum cruise power, provided the mixture control is in the AUTO RICH position.

Deactivating the Alternate Fuel Source.

1. Mixture lever—AUTO LEAN and simultaneously move alternate fuel source switch to NORMAL.

Note

Monitor fuel flow when deactivating the carburetor alternate fuel system.

2. Leave carburetor heat on for approximately five minutes after passing through icing conditions to insure that ice is melted; then remove heat slowly in small increments one engine at a time.

3. Reset cruise power and mixture.

During Descent.

It is possible that conditions conducive to carburetor icing will be aggravated by lower power, lean mixture, and part throttle operation, especially during long steep descents. If trouble is encountered under these circumstances, the icing condition should be controlled by use of alternate air and/or carburetor heat.

The use of carburetor heat has been effective under all normal conditions where ice is likely to be encountered at altitudes below 20,000 ft. and at temperatures between +10 and −25°C.

At ambient temperatures below −25°C the amount of visible moisture in the air is extremely small and is not likely to cause induction system icing trouble; however, the temperature inside of clouds may be considerably different from the temperature outside of clouds. Therefore, it should be anticipated that icing conditions will be prevalent when entering a condition of visible moisture, and preventative measures should be taken.

Generally speaking, it may be better not to change an established configuration while in icing conditions as long as no difficulties are encountered, whether or not any anti-icing technique is used. In any event, do not switch to RAM air until it is determined that ice has not accumulated on the scoop door while in ALTERNATE. Air supply may be restricted and result in a power loss.

Fuel-Side Icing.

Because of the similarity of induction-side and fuel-side icing indications, and the possible damaging consequences of improper use of the fuel-side alcohol deicing system, it is recommended that the following factors be evaluated before actuating this system:

1. Determine that extremely cold ambient temperatures are being encountered. (Tests and operational experience indicate that fuel-side icing difficulties should not be encountered at ambient temperatures above approximately −12°C.)

2. Take every precaution to ascertain that the metering disturbance is not of the induction-side type, i.e., by applying normal induction system deicing measures attempt to alleviate disturbance before actuating the fuel-side alcohol deicing system.

3. A 2 to 3 psi drop in engine fuel pressure is a definite and predictable characteristic of an iced bypass type master control inlet screen. Positive identification of this symptom, associated with persistent metering disturbances, is by far the most reliable indication of carburetor fuel-side icing.

It cannot be emphasized too strongly that improper, or untimely use of the fuel-side deicing system can result in engine operational difficulties as severe as carburetor icing itself. Therefore, the following cautions should be observed and strictly adhered to:

CAUTION

- DO NOT actuate system until factors listed above have been analyzed.
- DO NOT actuate carburetor deicing system when engine is operating in lean mixture. Severe combustion instability may result.
- DO NOT actuate system with mixture control in OFF or with engine stopped, since this may cause damage to diaphragms in certain fuel system components.
- DO NOT inject fuel-side alcohol for periods in excess of 15 seconds. Tests have shown that longer bursts are no more effective, are wasteful of the alcohol supply, and are capable of imposing marginal fuel-air-ratios.

If it is definitely ascertained that fuel-side icing is being encountered, the following deicing procedure may be instituted, one engine at a time if more than one engine is affected.

1. Mixture lever—AUTO RICH.

2. Manual spark control—As required.

3. Alcohol injection switch—Hold to FUEL INLET SCREEN position for period of 10 seconds (do not exceed 15 seconds). Proper operation will be indicated by a drop in fuel flow of approximately 200 lbs/hr. A resumption of normal fuel pressure is an indication that ice has been successfully removed.

If the above procedure does not remedy the suspected carburetor fuel-side icing problem, the mixture control lever may be moved back and forth several times between AUTO-RICH and AUTO-LEAN to impose maximum control pressures on the master control diaphragm. This will assist the alcohol in freeing an iced regulating poppet.

Note

The carburetor fuel-side alcohol injection system is designed to function as a restorative, rather than a preventative, device. By proper fuel system maintenance and operation, the likelihood of experiencing fuel-side icing is slight.

Although it has not been flight tested under actual icing conditions, the fuel-side deicing system has been demonstrated on a full scale fuel system mockup to be capable of clearing the carburetor of major accumulations of ice under severe icing conditions for periods of one to two hours. Indiscriminate or excessive injection of alcohol through this system will deplete the available alcohol supply, which should be reserved for induction system and/or propeller deicing. Engine damage is also possible.

MANUAL LEANING.

(When using maximum cruise BMEP or below).

Manual leaning with the mixture control is to be used to obtain best economy fuel flows and cylinder cooling in accordance with the procedures outlined as follows:

1. Mixture lever—AUTO RICH.
2. Propeller switch—Set desired cruise rpm.
3. BMEP—As desired.
4. Manual spark control switch—As desired.
5. Lean manually with mixture lever until BMEP:
   a. Rises to the maximum.

Note

The rise normally is 1 to 5 BMEP. If the BMEP rise is more than 5 the master control is metering rich. Rich master control is not detrimental to engine operation. However, it can cause a power loss at the limiting MAP when operating at higher powers.

b. Shows no rise and begins to drop.

Note

Determine if the master control is metering lean by returning the mixture lever to the AUTO RICH position and operate the primer intermittently. If there is a BMEP increase, the master control is metering lean. Subsequent operation should be in AUTO RICH until the discrepancy is corrected. Lean mixtures can be detrimental to engine life during high power operation.

6. Throttle levers—Reset to desired BMEP.

7. Lean manually with the mixture lever for 10% BMEP drop.

Note

If the cruise engine speed is above 2200 rpm and after leaning the position of the mixture control is forward of the AUTO LEAN detent, place the mixture control in AUTO LEAN detent and observe the percent power drop. *If not more than 15% power drop occurs, the engine remains stable and CHT spread limits are not exceeded; operate the engine in this manner.* If more than 15% power drop and/or instability occurs, return mixture to AUTO RICH until the discrepancy can be corrected. At 2200 rpm and below, the position of the mixture control after leaning is of no consequence.

This procedure has the advantage of cooling the engine by means of lower combustion and exhaust temperature due to the excess air which absorbs some of the heat of combustion, resulting in optimum cylinder, tubing, nozzle box, and exhaust system durability. When operating below 14,000 feet altitude and carburetor heat is required, it is preferable to use low blower and lean to 7% mixture than to use high blower at 10% lean. If momentary applications of high power are required, use RICH mixture and increase rpm as necessary. This will provide cooler combustion temperatures with less cowl flap drag and lower overall fuel consumption.

An occasional need to maintain cruise power in low blower at altitudes above the 10% lean critical altitude is recognized. On such occasions it is permissible to use the same procedure leaning to 7% BMEP drop provided rpm is 2400. The critical altitude increase is approximately 700 feet and fuel consumption increases.

The use of mixtures richer than 7% BMEP drop at cruise power in level flight should be avoided since this results in temperatures which have an adverse effect on the engine durability. The use of mixtures leaner than 10% BMEP drop should be avoided also since any abnormal distribution of fuel or air to the cylinders can result in serious cylinder to cylinder power differences which are aggravated by extremely lean operation.

If engine condition does not permit stable operation when leaned to 10% BMEP drop, it is recommended that AUTO RICH be used until the engine condition can be corrected. Stability is defined as no visual roughness or no indication of power fluctuation in excess of 5 BMEP.

Under normal conditions when operating with either an AUTO RICH or a 10% BMEP drop mixture, it is recommended that all engines be operated within a maximum of 2 inches of MAP of each other. Appropriate compensation should be made.

8. Throttle lever—Reset to desired rpm.

9. Recheck manual lean mixture setting following any change in cruise altitude greater than 2000 feet.

MANUAL SPARK CONTROL OPERATION.

The manual spark control provides the flight engineer with a positive control of engine ignition timing. The spark control switch shall be placed in the RETARD position for all starting, ground operation, takeoffs, climbs, approaches and landings, and whenever the engines are operating above a certain rpm. Refer to Engine Operating Curves in Section V for limitations concerning use of the manual spark.

CAUTION

The manual spark control must be in the RETARD position for takeoff and for all engine operation above 2500 rpm in LOW blower or above 2400 rpm in HIGH blower. Operation above these rpm with advanced spark may result in engine damage, particularly with AUTO LEAN mixture.

Spark Advance With Ignition Analyzer Operative.

1. Establish stabilized cruise power with mixture in AUTO RICH.

2. Select BOTH position for No. 1 engine on engine analyzer selector switch.

3. Place master spark control switch in ADVANCE and the spark control switch for the No. 1 engine in RETARD.

4. Move No. 1 engine spark control switch to NORMAL and note that analyzer pattern shifts to the left.

5. Repeat on other engines.

Note

If one pattern fails to shift to the left, that spark advance relay is inoperative. Select LEFT on analyzer selector switch and check. If pattern shifts, the right relay is inoperative.

Spark Advance Check With Ignition Analyzer Inoperative.

Proper operation of the manual spark advance relays may be checked as follows:

1. Establish a cruising power (lean mixture) in stabilized flight and clear air.

2. Move the master spark control switch to the ADVANCE position.

Note

There should be a definite increase in BMEP when the spark is advanced. If no increase occurs, the spark advance relays are not operating.

ENGINE OIL-IN, OIL-OUT TEMPERATURES.

The oil-out temperature indicator is useful in the detection of incipient master rod bearing failures. It should be realized that the normal spread between oil-in and oil-out temperatures will be affected by a number of factors, among which are oil-in temperature, engine power, ambient temperature and possibly oil tank quantity. The important item is not the stable temperature spread, but rather a rapid and uncontrollable change in this relationship.

The following information should be evaluated and adhered to on all oil temperature indications other than normal:

a. A rapid rise in oil-out and oil-in temperature, with a widening of the normal spread between these temperatures, is indicative of internal engine failure.

b. Narrowing of the spread between oil-in and oil-out temperature during a rise of both is indicative of oil cooler malfunctioning.

c. A sudden rise to maximum of either temperature, with no change in the other, is indicative of a fault in the temperature indicating system.

ENGINE SUPERCHARGER SHIFT.

If a climb to high cruising altitudes is made and an engine supercharger shift is required to maintain adequate climb power, shift to HIGH ratio position in the following manner:

1. Reduce manifold pressure to 20" Hg. or less.

2. Reduce engine speed to 1600 rpm.

3. Shift supercharger lever to HIGH position. (Make all shifts as smoothly and as rapidly as possible.)

4. After manifold pressure increases, indicating shift has been made, reset throttles and rpm to obtain the required climb power.

ABNORMAL BMEP INDICATION.

If the overhaul modifications to the torque cell support brackets have been made, the possibility of a propeller decoupling in the event of a torque cell failure is greatly reduced. However, these modifications do not relieve the flight crew of their responsibility to trouble shoot and evaluate a malfunctioning or abnormal BMEP indication.

1. In the event of a complete loss of BMEP, the pilot should use his own good judgment prior to making the decision to feather.

2. Sudden changes in BMEP from normal indication to zero, either clockwise or counter-clockwise is not cause for immediate feathering. Stand by to retard throttle quickly; turn on auto feather test switch of affected engine; turn on master auto-feather switch and stand by for automatic feathering of the affected engine. If the feathering button is energized, retard throttle quickly and continue feathering procedure. If feathering button is not energized within two to three seconds, turn auto-feather switches off. Observe closely for any other malfunction and continue the mission. An engine run-up will be made after the next landing for analysis of trouble. Record all engine instrument indications for the benefit of maintenance personnel.

3. A BMEP drop to zero, preceded by an unaccountable, progressive BMEP spread, will justify immediate feathering. Attempt to account for the BMEP spread by setting the affected engine and its symmetrical engine at identical rpm, MAP, and best power mixture. Note BMEP spread. Check analyzer patterns for indication of a non-productive cylinder. Check for power recovery turbine failure as follows: During daytime flight, visually inspect turbines for unusual discharge of smoke from or around exhaust flight hood. During night flight, visually inspect turbines for heavy discharge of orange sparks. If BMEP spread cannot be accounted for, feather engine when BMEP spread exceeds 20 BMEP. An engine that operates to 20 BMEP below the other engines at the same throttle setting, should be watched carefully for any signs of increase in torque deviation, or other indications of engine malfunction.

An engine that apparently malfunctions in this manner should be submitted to maintenance for inspection and correction. In all instances of low BMEP indications, possible instrument error should also be investigated prior to any extensive torquemeter system malfunction investigation.

4. An indicated BMEP rise to off-scale is an occasional flight occurence. This is not to be considered as a cause for feathering. Continue mission, maintaining identical rpm, MAP and fuel flow with its symmetrical engine. Monitor cylinder head temperatures closely and adjust mixture accordingly.

5. In all instances, suitable correction should be allowed for instrument calibration correction and cabin supercharger and alternator power demands.

SPARK PLUG CLEAN OUT PROCEDURE.

1. Throttle levers—1000 rpm.

2. Mixture levers—Lean to 25 rpm below the idle best power position. Maintain this power setting for a period of five minutes, then recheck for plug fouling.

150 BMEP Operation.

In order to prevent excessive build-up of carbon deposits on the spark plugs during prolonged ground operation, the following procedure is recommended as a supplement to the procedure outlined above:

1. Cowl flaps—OPEN.

2. Mixture levers—AUTO RICH.

3. Propeller switches—Full INC. RPM.

4. Throttle levers—As required for 150 BMEP.

Note
Do not use alcohol.

Operate the engines at this power setting for one minute after each fifteen minutes of ground operation. Cylinder head temperatures should be maintained below 200°C, if possible, so as not to exceed take-off temperature.

PROGRESSIVE POWER CLEANOUT PROCEDURE.

In event the spark plug clean out procedure fails to satisfactorily clean the affected spark plugs, the flight engineer will proceed as follows:

1. Mixture levers—AUTO RICH.

2. Propeller switches—Full INC. RPM.

3. Throttle levers—1600 rpm.

From the 1600 rpm position, gradually increase power in 200 rpm increments. At each 200 rpm increment, allow power instruments to stabilize. Check for fouled plugs with ignition analyzer. When fouled plugs are detected, power should be reduced until the plug commences firing. This is determined by the analyzer pattern. Allow the plug to fire for fifteen seconds then increase power to the next 200 rpm increment.

Note

This progressive power clean-out procedure is based on the fact that a plug must be firing in order to clean lead and carbon deposits. Spark plugs will often fire properly at low power settings, yet will break down at higher settings. A decrease in power, slightly below the breakdown point, will allow the plug to fire and clear deposits. During low power spark plug cleanout procedure, and 150 BMEP cleanout operation, the cylinder head temperatures should be maintained below 200°C. For progressive power cleanout procedures, CHT should be maintained below 260°C.

FOULED PLUG PROCEDURE.

Ground Operation:

When the analyzer indicates two fouled plugs in the same cylinder the following procedure will be used in an attempt to recover the cylinder.

1. Set engine at barometric manifold pressure with mixture in AUTO RICH.

2. Apply steady prime.

3. Advance throttle gradually to 2600 rpm.

4. Observe affected cylinder spark plugs on analyzer as power is advanced.

5. When any activity is noted on either pattern, release primer immediately and reduce power to barometric manifold pressure.

6. Recheck all spark plugs on affected engine at 150 BMEP.

Note

If one minute of operation at 2600 rpm with steady prime does not restore the cylinder, shut down the engine and return to maintenance.

Inflight Operation:

During extended periods of low power cruise, spark plug fouling may occur which can result in a dead cylinder. This condition is indicated by a low resistance pattern on the ignition analyzer. Whenever such spark plug fouling patterns are observed on the analyzer, during extended low power cruise, the following procedure will be accomplished.

1. Move mixture to AUTO RICH position.

2. Advance power slowly (1" Hg MAP per 5 sec) to 1540 BHP.

This power setting will produce a core nose temperature of sufficient amplitude to effect satisfactory cleanout.

3. As soon as analyzer pattern indicates optimum plug firing—Return to cruise power and manually lean affected engine.

ENGINE MALFUNCTION ANALYSIS.

When a spread of over 100 rpm on symmetrical engines is encountered at field barometric pressure, the following procedure will be initiated to determine the cause:

a. Determine that all engines are fully warmed up, and all pressures and temperatures normal.

b. If the aircraft is not headed into the wind, turn aircraft into the wind and repeat barometric check.

Note

If the aircraft is not headed directly into the wind, unstable readings and possible rpm spread may be encountered.

c. Perform standard magneto check noting rpm, BMEP, and fuel flow. A drop of 100 rpm while operating on one magneto is permissible, provided no engine roughness is encountered. If magneto check is unsatisfactory, a cross reference with the pilot's tachometer and the ignition analyzer will be made.

d. If ignition system is satisfactory, a cruise power performance check will be made as follows:

1. Mixture levers—AUTO RICH.

2. Propeller switches—Full INC. RPM.

3. Master spark control switch—RETARD.

4. Throttle levers—Advance to 2200 rpm for symmetrical engines.

5. Propeller switches—Toggle to 2100 rpm.

6. Throttle levers—Advance to obtain 169 BMEP.

7. Mixture levers—Manually lean to best power and reset throttle to 169 BMEP and compare manifold pressures.

Note

If the BMEP increase between AUTO RICH and best power is more than 3 BMEP, the master control is metering too rich. If no increase occurs place the mixture lever in AUTO RICH, engage the engine primer intermittently and if any increase of BMEP occurs the master control is metering too lean. If master control is metering too lean, corrective action is required.

8. Mixture levers—Continue leaning to 152 BMEP.

9. Throttle levers—Advance to obtain 169 BMEP.

Note

Under normal conditions, with either best power or at 10% lean, all engines should be within 2" Hg MAP, or 5 BMEP. If these limits are exceeded, specific performance checks should be made. Suitable allowances should be made in above checks for accessory power variations.

10. Check for engine instability.

If the above checks reveal no engine malfunction, but indicate a probable incorrect propeller blade pitch setting, make a maximum power check with brakes set. If correct rpm, MAP, and BMEP is obtained the engine may be considered acceptable for flight.

Note

Once the propeller is off the low-pitch stop, the propeller governor will maintain proper blade pitch.

SPECIFIC PERFORMANCE CHECKS.

Fuel System Checks.

1. Primer check for fuel injection troubles (flight).

a. Note the exact fuel flow and MAP and BMEP at 10% manual lean mixture on engine to be checked.

b. While still operating at 10% manual lean mixture, add prime fuel flow to engine to be checked and hold.

c. Manually lean mixture back to the original 10% lean fuel flow reading of the engine to be checked.

d. Note new BMEP reading.

e. If this reading is higher than the engine's original reading, there is trouble with the fuel injection system causing imperfect distribution, either cylinder to cylinder, or row to row.

f. While holding steady prime, return mixture to AUTO RICH then release primer.

g. Reset cruising mixture and make appropriate entry in Form 781.

Note

The primer on a fuel injection engine is a valuable tool with which to troubleshoot the engine for fuel enjection troubles. With it, fuel is injected directly into the induction system at a rate of 160 to 200 lbs. per hour. This fuel goes directly into the induction system, and by manual leaning, to the original fuel flow, the engine is running partially on fuel injection and partially on carburetion. Malfunctioning fuel injection system components, or leaks, can therefore be detected by its use. Partial fuel injection line leaks can be detected by the use of in-flight primer check. However, it can be readily seen that a leak of sufficient magnitude to cause a cylinder to be inoperative throughout the mixture range cannot be brought back in by the in-flight primer check.

Primer Check (Ground Run)

a. Obtain a minimum of 150° CHT.

b. Run engine at 1200 rpm with propeller control set to full increase rpm and mixture control AUTO RICH.

c. Hold steady prime on engine, and place mixture control in OFF.

d. Adjust throttle slowly until highest rpm and lowest MAP are reached.

e. Check and note exact rpm and fuel flow at this setting.

f. Move mixture control to AUTO LEAN and release the primer.

g. Obtain the same fuel flow as noted in step e with the mixture control.

h. Check rpm. If it is within 25 rpm of that noted in step e the fuel injection system is functioning properly. If more than a 25 rpm deviation occurs, this is an indication of a malfunction such as a fuel injection line or seal leak, poor synchronization, fuel pump diaphragm leak, etc.

Because the engine may be operated on the ground as a full carburetion engine, fuel injection line leaks of a magnitude which cannot be detected with the in-flight check can be detected.

Cylinder Head Temperature Comparison—Fuel Air Distribution.

a. Improper fuel-air distribution between the front and rear row cylinders can adversely affect combustion chamber component service life. The following procedure, using row to row cylinder head temperatures as a guide, may be used to check the distribution characteristics of the direct injection engine.

b. Set the following conditions:

(1) *Low Blower*
2400 RPM
180 BMEP
10% lean mixture
Advance spark
15% cowl flap angle
175 knots airspeed (minimum)
Pressure altitude 6000 to 10,000 feet

(2) *High Blower*
2400 RPM
175 BMEP
10% lean mixture
Advance spark
15% cowl flap angle
175 knots airspeed (minimum)
Pressure altitude 14,000 to 18,000 feet

c. Exercise care to obtain stabilized CHT readings at stabilized airspeed, heading and altitude. The following constitute limits of allowable CHT spreads:

	Low Blower	*High Blower*
Rear Row Hot	25°C	30°C
Front Row Hot	15°C	10°C

d. At the above 10% lean conditions, the CHT spread normally experienced is approximately 10°C rear row hot in low blower and 15°C rear row hot in high blower. The CHT spread in auto-rich mixtures will normally be small and can be either front or rear row hot. As a result, a small crossover in the hot indicated CHT is common when leaning from auto-rich to 10% lean.

e. If cylinder head temperature spreads fall outside the applicable limits, apply the applicable condition outlined in paragraph 2b. If CHT spread is excessive, open the cowl flaps to 30%. If the rear CHT now cools off, the CHT spread limits are not exceeded; no discrepancy is indicated. If limits are exceeded with cowl flaps set at 30%, reset cowl flaps to 15%. CHT MAP and fuel flow data should be obtained and plotted for auto-rich, best power, 5, 10 and 15% lean. This information should then be turned over to the appropriate maintenance personnel for investigation and corrective action when aircraft returns to its main base.

f. This check is normally accomplished at 10% lean mixture; however, if the rear row CHT does not cool off somewhat when leaning from best power to 10% lean, accomplish the check at 15% lean. The same spread limits apply. If the rear row CHT still does not cool off, a discrepancy is indicated and should be investigated upon return to home base. If rear row CHT now cools off, the CHT spread limits are not exceeded, no discrepancy is indicated.

g. If the normal low blower flight altitude is lower than 6000 feet, this check may be performed at lower altitudes provided that rechecks are performed at the same altitude after maintenance has been performed to correct the discrepancy.

Magneto Output Check.

Warm up the engine until the cylinder head is 125°C or more; with throttle closed, the engine should idle at approximately 600 rpm. Move the mixture control into idle cut-off; (OFF) then, when the engine slows down to 300 rpm, move the mixture control back to AUTO RICH. The engine should return smoothly to 600 rpm. Make this check with the ignition switch on right (R) and then on left (L). Then engine should be capable of performing this test on either side of the ignition switch, if the magnetos and breaker points are in good condition. This test should not be made until the engine is warm and temperatures are stabilized.

IGNITION ANALYZER.

The ignition analyzer operates on the principle that the voltages in the magneto primary vary with the condition of the ignition circuits. Since these voltages change in value very rapidly, a cathode ray tube is used to show the variations. The vertical displacement of the electron beam is proportionate to the voltage in the magneto primary. The electron beam is moved horizontally across the tube in a set time relationship with the degrees of crankshaft rotation so that a graph can be seen of the voltage changes "plotted" with respect to crankshaft rotation. When a normally operating ignition system

fires a fuel-air charge in a normally operating cylinder, a normal pattern occurs. Normal operation implies normal cylinder head temperature, compression ratio, mixture, ignition circuit, and spark plug gap, because all these factors affect the total resistance characteristics of the ignition system. A malfunctioning ignition system or abnormal cylinder conditions will affect the pattern, and therefore certain engine and ignition malfunctions can be detected by analyzing the ignition patterns.

Normal Patterns.

Figure 7-1 shows a normal ignition analyzer pattern. The letter headings in the discussion following correspond to the letter positions on figure 7-1.

A. Breaker Point Opening Time. At this time a rapidly rising voltage is induced in the magneto coil. The primary current flows to the distributor and the primary

NORMAL IGNITION PATTERN EXPLANATION

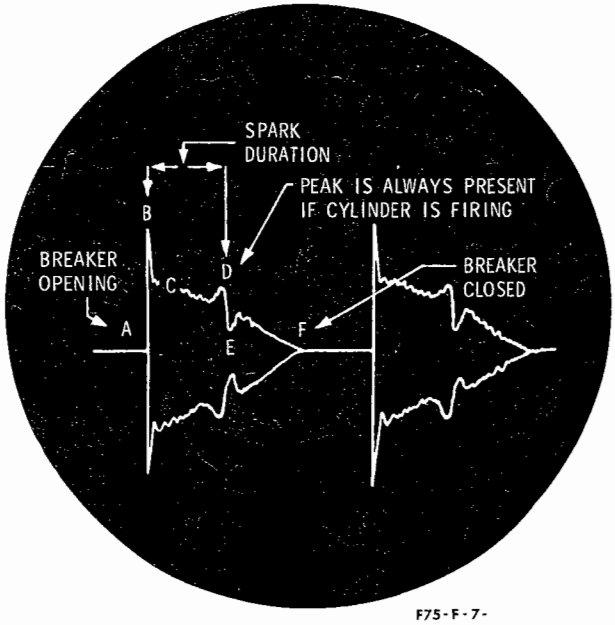


Figure 7-1

IGNITION MALFUNCTION PATTERN EXPLANATION

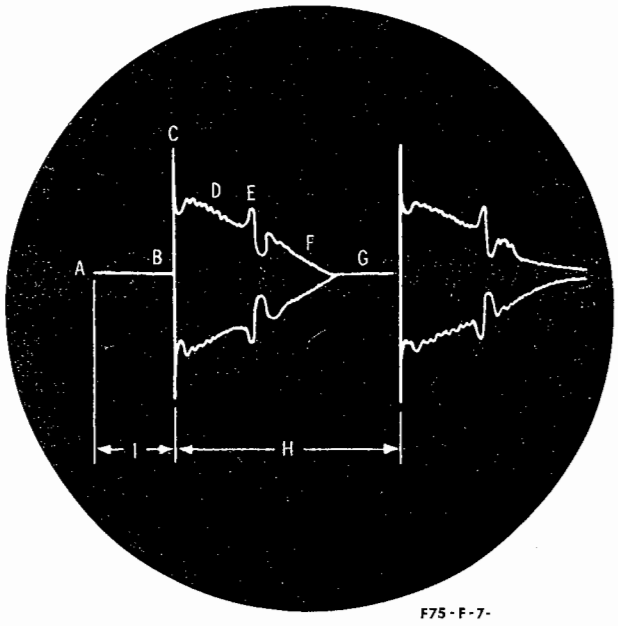


Figure 7-2

side of the high tension coil. A high tension voltage is thereby induced in the secondary winding of sufficient value to break down the spark plug gap. This voltage is represented by the first excursion line A to B.

B. Spark Plug Firing Time. At the instant of spark plug firing, the gap between the electrodes becomes ionized, lowering the resistance and requiring less voltage. This voltage decrease is represented by line B to C.

C to D. Spark Activity Period. This is best described as the thermal time delay necessary for the flame front to propagate. With the plug gap ionized, the voltage requirements are lowered and the activity traced is the continued spark plug firing.

D. Combustion Indication Hook. This portion of the pattern is associated with combustion phenomena. The height and position of the combustion hook at D are determined by combustion mixtures and cylinder condition. A stable or stationary hook indicates good combustion characteristics.

E. End of Spark Plug Firing Time (Hook). The line D to E represents the time the spark is dispelled. The remainder of the energy is then dissipated through the capacitance in the harness leads etc., represented by the sloping line E to F.

F. Breaker Point Closing Time. The duration of point opening or point dwell is the horizontal distance between points A and F. The breaker point closing event is not visible on all cylinders due to pattern overlap resulting from distributor cam compensation.

Effect of Ignition Malfunctions on Normal Pattern.

The letter headings in the discussion following correspond to the letter positions of figure 7-2.

A. Lead line. The appearance of the lead line is affected as follows:

1. Residual voltage in primary circuit determines slope.
2. Distributor brush arcing causes hash on line (see figure 7-3, sheet 8).
3. Flux reversal in magneto generator causes every other pattern to have crossover.

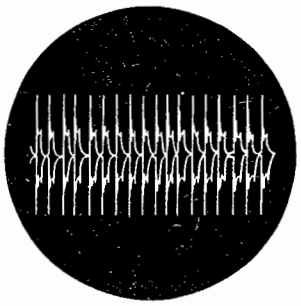
Note

Position on the scope is affected by position control.

IGNITION ANALYZER PATTERNS

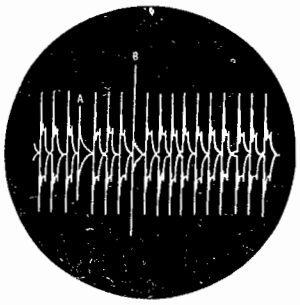
NORMAL PATTERN—SLOW SWEEP

THE PICTURE OBSERVED ON SLOW SWEEP PRESENTS THE PATTERN OF 18 PLUGS FIRED BY ONE DISTRIBUTOR IN ONE COMPLETE ENGINE CYCLE, OR 720 CRANKSHAFT DEGREES. THE NORMAL POLARITY REVERSAL OF CONSECUTIVE FIRING OF ONE MAGNETO IS INDICATED BY PATTERNS APPEARING ALTERNATELY ABOVE AND BELOW THE TRACE LINE. IT WILL BE NOTED THAT BECAUSE OF THE MAGNETO ARRANGEMENT FOR THIS ENGINE, SUCCESSIVE FIRINGS OF THE SAME SPARK PLUG ARE ALTERNATELY POSITIVE AND NEGATIVE.



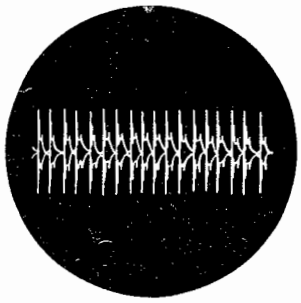
MALFUNCTION PATTERN—SLOW SWEEP

MALFUNCTION PATTERNS SUCH AS AN OPEN SECONDARY (B) (HIGH TENSION) CIRCUIT CAN BE IDENTIFIED AS MUCH HIGHER THAN NORMAL PATTERN, A SHORTED HIGH TENSION CIRCUIT (SHORTED SECONDARY) (A) APPEARS AS A PATTERN SLIGHTLY LOWER IN HEIGHT THAN A NORMAL PATTERN WITH COMPLETE LACK OF COMBUSTION HOOK CHARACTERISTICS. AN OPEN SECONDARY, A SHORTED SECONDARY, AND SIXTEEN NORMAL PATTERNS ARE SHOWN.



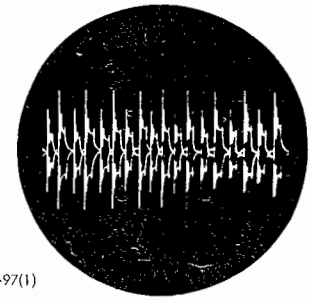
MALFUNCTION PATTERN—SLOW SWEEP
LOW MAGNETO VOLTAGE OUTPUT

GENERAL OVERALL LOW AMPLITUDE OF NORMAL IGNITION PATTERNS INDICATE LOW MAGNETO VOLTAGE OUTPUT. IF ALTERNATE CYLINDERS INDICATE LOW AMPLITUDE IT CAN BE ATTRIBUTED TO THE MAGNETS. PROBABLE CAUSES: 1. WEAK MAGNETO MAGNETS. 2. DAMAGED COIL WINDINGS. 3. IMPROPER SETTING OF E GAP TIMING.



MALFUNCTION PATTERN—SLOW SWEEP
WEAK MAGNET IN MAGNETO OR UNBALANCED ISOLATING RESISTOR VALUES

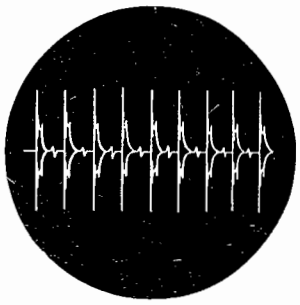
EVERY OTHER PATTERN HAS A DECREASED AMPLITUDE DUE TO: 1. A WEAK MAGNET IN THE MAGNETO GENERATOR, THIS WILL BE NOTICEABLE ON BOTH THE LEFT AND THE RIGHT MAGNETO. 2. UNBALANCED ISOLATING RESISTOR VALUES. THIS WILL BE NOTICEABLE ON EITHER LEFT OR RIGHT DISTRIBUTOR.



F75-F-7-97(1)

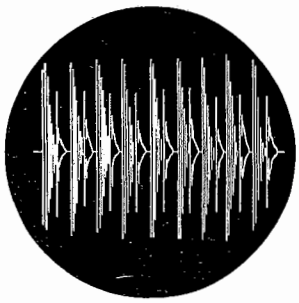
Figure 7-3 (Sheet 1 of 10)

IGNITION ANALYZER PATTERNS



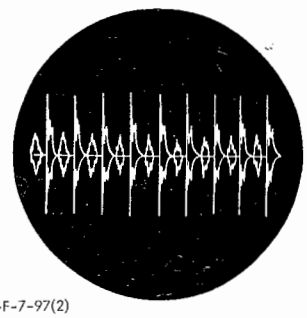
MALFUNCTION PATTERN—SLOW SWEEP
SHORTED PRIMARY CIRCUIT (MAGNETO TO DISTRIBUTOR)

A COMPLETELY SHORTED PRIMARY CIRCUIT IN GROUNDING SYSTEM OR BETWEEN THE MAGNETO AND THE DISTRIBUTOR WILL BE SEEN. NINE VERY SMALL PIPS WHICH ARE INDUCTIVE PICK-UP FROM THE OTHER (UNAFFECTED) DISTRIBUTOR ARE SOMETIMES VISIBLE. ALL SPARK PLUGS FIRED BY THE AFFECTED DISTRIBUTOR WILL DISPLAY THIS PATTERN. THE NINE ADDITIONAL PATTERNS APPEARING AT THE LEFT ARE FROM THE OTHER (UNAFFECTED) DISTRIBUTOR AND ARE VISIBLE BECAUSE OF THE ANALYZER TIE-IN TO THE MAGNETO GROUNDING SYSTEM (P LEAD). PROBABLE CAUSES:
1. BREAKER POINTS NOT OPENING. 2. GROUNDED PRIMARY COIL OR CONDENSER.
3. GROUND BETWEEN MAGNETO GENERATOR AND THE DISTRIBUTOR.



MALFUNCTION PATTERN—SLOW SWEEP
OPEN PRIMARY (DISTRIBUTOR BRUSH)

EVERY OTHER PATTERN HAS A VERY HIGH AMPLITUDE AND A COIL-SPRING EFFECT. PROBABLE CAUSES: 1. BROKEN DISTRIBUTOR BRUSH. 2. BROKEN DISTRIBUTOR BRUSH SPRING. 3. OPEN BETWEEN BREAKER POINTS AND THE SEGMENT PLATE.



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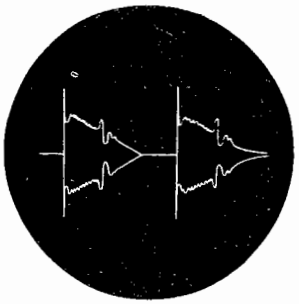
MALFUNCTION PATTERN—SLOW SWEEP
OPEN PRIMARY CIRCUIT (MAGNETO TO DISTRIBUTOR)

THIS PATTERN CAN BEST BE DESCRIBED AS NINE PIPS SUPERIMPOSED ON A DISTORTED SINE WAVE. THE PIPS OCCUR AT APPROXIMATELY THE BREAKER POINT CLOSING POINTS OF THE AFFECTED DISTRIBUTOR. THE SINE WAVE VOLTAGE VARIATION IS THE NORMAL VOLTAGE VARIATION INDUCED IN THE PRIMARY COIL BY THE MAGNET ROTOR. THE NINE NORMAL PATTERNS ARE FOR THE UNAFFECTED POINTS, BUT ARE GENERALLY DISTORTED BECAUSE OF THE MALFUNCTION PRESENT ON THE ONE MAGNETO. PROBABLE CAUSES: BROKEN DISTRIBUTOR BRUSH OR BRUSH SPRING, OR ANY OPEN IN THE PRIMARY CIRCUIT BETWEEN THE BREAKER POINTS AND THE SEGMENT PLATE.

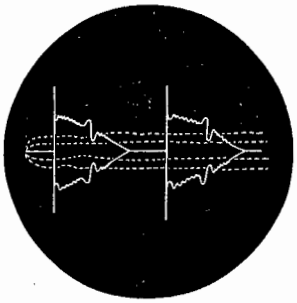
Figure 7-3 (Sheet 2 of 10)

IGNITION ANALYZER PATTERNS



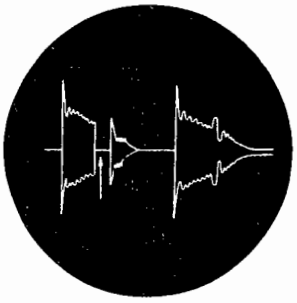
NORMAL PATTERN—FAST SWEEP

THE TWO PATTERNS THAT APPEAR IN FAST SWEEP ARE FOR THE CYLINDER SELECTED BY THE CYCLE SWITCH AND FOR THE NEXT CYLINDER FIRED BY THE SELECTED DISTRIBUTOR. THE PATTERN AT THE LEFT END IS THE CYLINDER SELECTED BY THE CYCLE SWITCH. BOTH PATTERNS APPEAR ABOVE AND BELOW THE TRACE LINE AS SUCCESSIVE FIRINGS OF THE SAME SPARK PLUG.



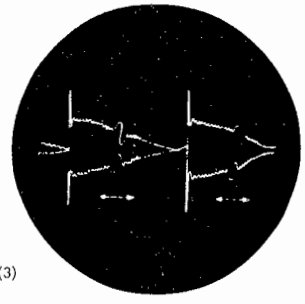
NORMAL PATTERN—FAST SWEEP
HORIZONTAL TRACE LINES

A PHENOMENON QUITE OFTEN NOTICED ESPECIALLY AT NIGHT ARE WAVY TRACE LINES RUNNING HORIZONTALLY THE FULL LENGTH OF THE SCOPE WHICH ARE REPRESENTED BY DOTTED LINES IN THE SKETCH. THESE LINES WILL BE MORE NOTICEABLE AT NIGHT TIME OR WHEN THE ANALYZER INTENSITY IS ADJUSTED TOO HIGH. THESE LINES WILL ALWAYS BE PRESENT BUT AT TIMES THEY ARE NOT AS NOTICEABLE AS AT OTHER TIMES. THEY ARE CAUSED BY FREE ELECTRONS BEING THROWN OFF FROM THE ENDS OF THE SECOND PATTERN THAT IS SOMETIMES EVIDENT AT THE LEFT SIDE OF THE SCREEN AND BEING TRIGGERED ACROSS THE SCREEN BY THE SYNCHRONIZING GENERATOR IMPULSES.



NORMAL PATTERN—FAST SWEEP
BOOSTER POINT FEED BACK

THIS PATTERN WILL BE NOTICED ON AUTOMATIC SPARK ADVANCE DISTRIBUTORS. CAUSE: THE GROUNDED CONDITION MARKED BY THE ARROW IS THE MOMENTARY PERIOD WHEN THE BOOSTER BREAKER POINTS ARE CLOSED DURING THE SAME PERIOD THE PRIMARY BREAKER POINTS THAT ARE FIRING THE SPARK PLUG ARE OPENED. THIS CONDITION CAUSES A MOMENTARY GROUND OF VARIOUS TIME DURATIONS. THE ACTIVITY FOLLOWING THIS CONDITION WILL TAKE MANY WAVEFORM VARIATIONS. THIS IS AN ACCEPTABLE CONDITION AND DOES NOT AFFECT ENGINE OPERATIONS.



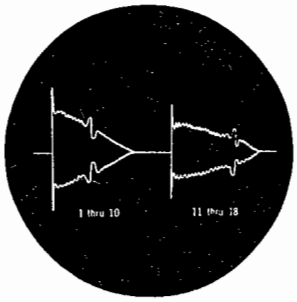
NORMAL PATTERN—FAST SWEEP
LEAN MIXTURE

THE COMBUSTION HOOK DANCES BACK AND FORTH AS INDICATED BY THE ARROWS. THE HOOK ALSO INCREASES AND DECREASES IN HEIGHT FROM NORMAL. PROBABLE CAUSE: NORMAL INSTABILITY OF COMBUSTION WHEN OPERATING WITH EXTREMELY LEAN MIXTURES. NOTE: IF LOCALIZED TO ONE CYLINDER OR TO ONE ROW OF CYLINDERS, IT MIGHT INDICATE FUEL DISTRIBUTION FAULTS.

F75-F-7-97(3)

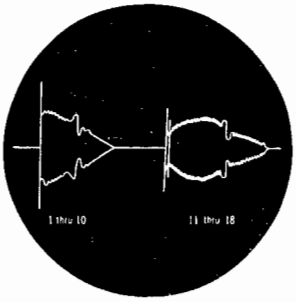
Figure 7-3 (Sheet 3 of 10)

IGNITION ANALYZER PATTERNS



NORMAL PATTERN—FAST SWEEP
IGNITION ADVANCED

CYLINDERS WHICH ARE COMPENSATED TO FIRE EARLY (11 THROUGH 18) WILL HAVE LOWER INITIAL AMPLITUDE AND LONGER, FLATTENED ACTIVITY PERIOD DUE TO POINTS OPENING FROM 0^0 UP TO 4^0 BEFORE DESIGN E-GAP IN RETARD AND FROM 5^0 UP TO 9^0 BEFORE E-GAP IN ADVANCE. CYLINDERS WHICH ARE UNCOMPENSATED OR COMPENSATED TO FIRE LATE (CYLS. 1 THROUGH 10) WILL BE OBSERVED TO HAVE NORMAL AMPLITUDE DUE TO POINTS OPENING AT DESIGN E-GAP UP TO 4^0 LATE IN RETARD AND ONLY FROM 1^0 UP TO 5^0 EARLY IN ADVANCE. THE DIFFERENCE IN PATTERNS IS MORE PRONOUNCED IN THE ADVANCED CONDITION.

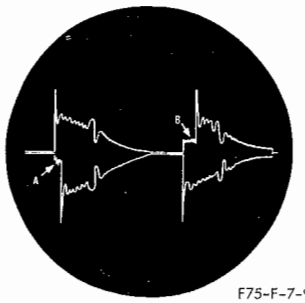


NORMAL PATTERN—FAST SWEEP
IGNITION ADVANCED

THIS IS AN EXAGGERATED CONDITION OF THE PATTERN ABOVE. IT SHOWS UP MORE FREQUENTLY ON CYLINDERS 11 THRU 18 WITH 14 BEING THE MOST OUTSTANDING. CAUSE: MAGNETO GENERATOR TIMED LATE WITH RESPECT TO BREAKER POINTS.

NORMAL PATTERN—FAST SWEEP
DRIVE TRAIN VARIATIONS

THIS CONDITION WILL BE RECOGNIZED BY A HORIZONTAL JITTER OR HUNTING BETWEEN THE POSITIVE AND NEGATIVE VOLTAGE RISES OF THE SAME PATTERN. THIS PATTERN IS THE RESULT OF ANGULAR HUNTING OF THE DISTRIBUTOR DRIVE TRAIN WITH RESPECT TO THE SYNCHRONIZING GENERATOR DRIVE. THIS IS CONSIDERED A NORMAL CHARACTERISTIC WHICH WILL BE FOUND TO VARY WITH THE INDIVIDUAL ENGINE.



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NORMAL PATTERN—FAST SWEEP
BREAKER ARC

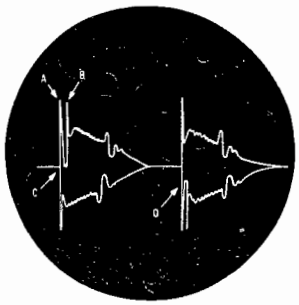
THIS CONDITION WILL BE RECOGNIZED BY INTERMITTENT ARCING OF A SHORT DURATION, SKIPPING ABOUT AT RANDOM FROM ONE PATTERN TO ANOTHER EVERY FEW SECONDS. THIS ARCING SEEMS TO HAVE NO PREFERENCE TO POSITIVE OR NEGATIVE IMPULSES OR POSITION (NOTE A AND B ABOVE). THE WRIGHT AERONAUTICAL DIVISION CONSIDERS THIS RANDOM ARCING OF SHORT DURATION TO BE AN ACCEPTABLE CONDITION AND SHOULD NOT BE CONSIDERED AS DETRIMENTAL TO ENGINE OPERATION UNTIL THE PHENOMENON BECOMES STEADY ON THE AFFECTED PAIR OR PAIRS OF BREAKER POINTS (SEE SHEET 7 NO. 2 PATTERN).

Figure 7-3 (Sheet 4 of 10)

IGNITION ANALYZER PATTERNS

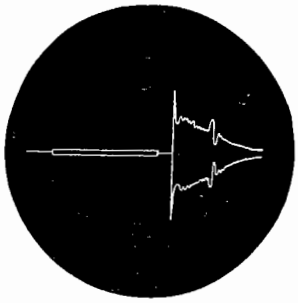
NORMAL PATTERN—FAST SWEEP
ABORTED PRIMARY INTERRUPTION

THE REPRESENTED PATTERNS RESULT FROM ANY CAUSE WHICH INTERFERS WITH CLEAN AND SMOOTH INTERRUPTION OF THE PRIMARY CURRENT. OF THE THREE MOST COMMON CAUSES OF THIS CONDITION, ONE IS NORMAL AND THE OTHER TWO HARMFUL. THESE PATTERNS MAY BE RECOGNIZED BY THE RISE OF AN INITIAL EXCURSION (A) WHICH PRECEDES THE ACTUAL EXCURSION (B). THIS INITIAL OR FALSE PEAK MAY RETURN TO THE BASE LINE AS SHOWN AT (C) OR MAY IN SOME CASES BE BRIDGED TO THE ACTUAL EXCURSION BY A HORIZONTAL LINE WHICH IS SOMETIMES JAGGED IN APPEARANCE (D). PROBABLE CAUSES: 1. NORMAL—DRIVE TRAIN VARIATIONS (SEE SHEET 4 NO. 3 PATTERN). 2. HARMFUL—SPARK ADVANCE RELAY CHATTER (SEE SHEET 9 NO. 3 PATTERN). MAY BE SEEN INTERMITTENTLY ON ANY PATTERN AT ANY SPEED. USUALLY MOST PREVALENT AT HIGH RPM. OPERATE THE SPARK ADVANCE RELAY. IF TROUBLE DISAPPEARS RELAY PROBABLY DEFECTIVE. 3. HARMFUL—BREAKER CAM FOLLOWER BOUNCE (SEE SHEET 8 NO. 3 PATTERN). MOST OFTEN SEEN AT HIGH RPM. USUALLY CONFINED TO CERTAIN CAM LOBES (INDIVIDUAL CYLINDER PATTERN ONLY). NORMALLY DOES NOT SKIP AROUND. CAUSED BY IMPROPERLY ASSEMBLED BREAKER ASSEMBLY.



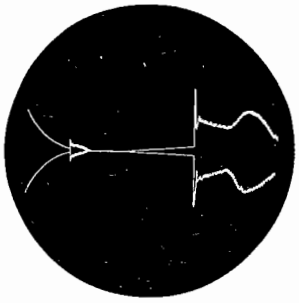
MALFUNCTION PATTERN—FAST SWEEP
SHORTED PRIMARY (DISTRIBUTOR TO COIL)

A SHORTED PRIMARY CIRCUIT BETWEEN THE DISTRIBUTOR AND CYLINDER MOUNTED COIL PRODUCES NO PATTERN FOR THE CYCLE SWITCH SELECTED SPARK PLUG POSITION; ONLY A SPLIT HORIZONTAL TRACE LINE WILL APPEAR. THE PATTERN WILL BE SEEN ONLY ON THE SELECTED CYLINDER POSITION, BUT THE PATTERN FOR THE NEXT CYLINDER TO BE FIRED BY THE SELECTED DISTRIBUTOR WILL GENERALLY BE DISTORTED BECAUSE OF THE REACTION OF THIS MALFUNCTION ON THE SYSTEM. PROBABLE CAUSES: A GROUND IN THE PRIMARY LEAD FROM THE DISTRIBUTOR TO THE CYLINDER MOUNTED COIL OR A SHORT IN THE PRIMARY WINDING OF THIS COIL.



MALFUNCTION PATTERN—FAST SWEEP
OPEN PRIMARY (MAGNETO GENERATOR TO BREAKER POINTS)

EVERY OTHER PATTERN IS DIMINUTIVE WITH PATTERNS OF THE OTHER COIL HAVING A SUPER-IMPOSED HUMP IN THEM. PROBABLE CAUSES: 1. OPEN COIL IN MAGNETO GENERATOR. 2. A BROKEN SPRING IN THE DISTRIBUTOR HAT. 3. ANY OPEN BETWEEN THE MAGNETO AND BREAKER POINTS. 4. BROKEN DISTRIBUTOR BRUSH.



MALFUNCTION PATTERN—FAST SWEEP
FOULED PLUG—SECONDARY CIRCUIT BREAKDOWN

THE MOST CHARACTERISTIC DIFFERENCE NOTICED ABOUT THIS PATTERN, IS ITS CUPID'S BOW APPEARANCE. THE INITIAL PEAK VOLTAGE AMPLITUDE IS SLIGHTLY HIGHER THAN NORMAL. THIS EXCURSION HOWEVER, INSTEAD OF ABRUPTLY DROPPING AS IN A NORMAL PATTERN, INDICATES A SLIGHT OSCILLATION AND SLOPES DOWNWARD TO A POINT NEAR THE BASELINE, THEN SUDDENLY PROGRESSES TO THE RIGHT IN A LONG SLOPING TAIL UNTIL BREAKER POINT CLOSING. THERE IS NO INDICATION OF A HOOK. PROBABLE CAUSES: 1. LEADED, CARBON FOULED, OR OIL FOULED SPARK PLUG. 2. CRACKED PLUG CERAMIC. 3. DIRTY OR CRACKED CIGARETTE, OR ANY BREAKDOWN OF THE SECONDARY CIRCUIT. (MOST FREQUENTLY SEEN AT HIGH POWER SETTING WHEN BREAKDOWN IS MORE LIKELY TO OCCUR.) MOST LIKELY TO OCCUR AFTER EXTENDED GROUND RUNS. IN MOST CASES, SPARK PLUG CLEAN-OUT PROCEDURE WILL BRING THE PLUG BACK IN.

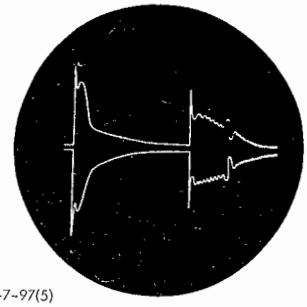


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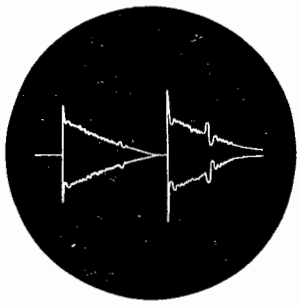
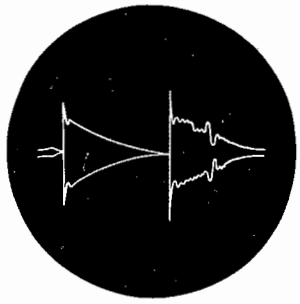
Figure 7-3 (Sheet 5 of 10)

IGNITION ANALYZER PATTERNS



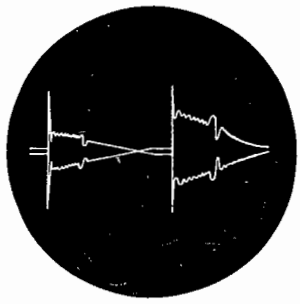
MALFUNCTION PATTERN—FASTSWEEP LOW RESISTANCE SECONDARY

THE INITIAL PEAK VOLTAGE AMPLITUDES ARE LESS THAN NORMAL. THERE MAY BE SOME OSCILLATION IN THE SLOPING PORTION, BUT THEY WILL BE SMALL IN AMPLITUDE AND OF A VERY MILD NATURE. THE SMALL OSCILLATION AT THE END OF THE PATTERN INDICATES THAT A SMALL OR INTERMITTENT SPARK EXISTS DURING THE BREAKER POINT OPENING PERIOD. THE ACTIVE PORTION OF THE PATTERN TENDS TO BECOME LONGER HORIZONTALLY THAN THE NORMAL PATTERNS. PROBABLE CAUSES: 1. NARROW SPARK PLUG GAP. 2. PLUG FOULING (LEAD CARBON OIL). 3. LOSS OF COMPRESSION. 4. SHORTED SECONDARY CIRCUIT. NOTE: IF THIS PATTERN APPEARS ON BOTH PLUGS OF ONE CYLINDER IT MAY MEAN A MECHANICAL FAILURE.



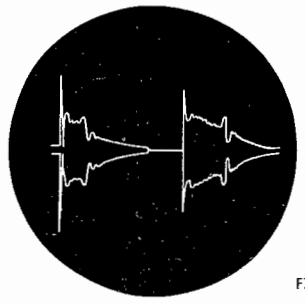
MALFUNCTION PATTERN—FAST SWEEP SHORTED SECONDARY

THE INITIAL PEAK VOLTAGE AMPLITUDE IS LESS THAN NORMAL. THIS EXCURSION DROPS SLIGHTLY THEN IMMEDIATELY EXTENDS IN A LONG SLOPE TO THE ZERO BASE LINE. THE LONG SLOPING LINE APPEARS STEADY AND WITHOUT OSCILLATION, SINCE THE CIRCUIT IS NOT DISSIPATING ENERGY IN THE PRESENCE OF COMBUSTION IONIZATION. PROBABLE CAUSES: 1. NARROW SPARK PLUG GAP. 2. PLUG FOULING (LEAD CARBON OIL). 3. LOSS OF COMPRESSION. 4. SHORTED SECONDARY CIRCUIT. 5. PEENED SPARK PLUG ELECTRODES. NOTE: IF THIS PATTERN APPEARS ON BOTH PLUGS OF ONE CYLINDER IT MAY MEAN A MECHANICAL FAILURE.



MALFUNCTION PATTERN—FAST SWEEP TWO DISTRIBUTOR SEGMENTS SHORTED TOGETHER

THE ACTIVITY PORTION OF THIS PATTERN IS EXTREMELY SMALL BECAUSE THE RATE OF ENERGY DISSIPATION IS DOUBLED BY THE TWO PARALLEL PATHS. THIS PATTERN WILL APPEAR ON TWO ALTERNATE FIRING IMPULSES SUCH AS 1 AND 5, 12 AND 16, ETC. PROBABLE CAUSE: TWO DISTRIBUTOR SEGMENTS SHORTED TOGETHER (CARBON DUST).



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MALFUNCTION PATTERN—FAST SWEEP HIGH RESISTANCE SECONDARY CIRCUIT (FIRST STAGE)

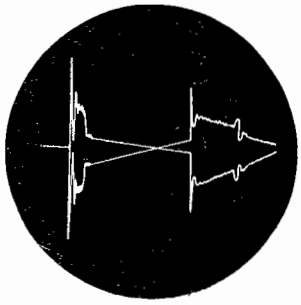
THE INITIAL HIGH PEAK VOLTAGE IS HIGHER THAN NORMAL AND THIS FIRST EXCURSION RETURNS NEARER TO THE TRACE LINE. THE NEXT PORTION OF THE PATTERN, UP TO THE ABRUPT NEGATIVE SLOPE, IS QUITE NARROW AND APPEARS SQUARED OFF. THE REMAINDER OF THE PATTERN APPEARS QUITE NORMAL. PROBABLE CAUSES: 1. MISSING CIGARETTE SPRING. 2. HIGH RESISTANCE WITHIN THE PLUG. 3. LARGE SPARK PLUG GAP. 4. DIRTY SPARK PLUG CONTACT BUTTON. 5. ANY GAP IN THE SECONDARY CIRCUIT.

Figure 7-3 (Sheet 6 of 10)

IGNITION ANALYZER PATTERNS

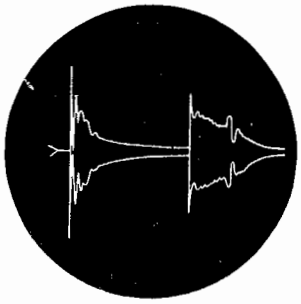
MALFUNCTION PATTERN—FAST SWEEP
HIGH RESISTANCE SECONDARY CIRCUIT (SECOND STAGE)

THE INITIAL HIGH PEAK VOLTAGE IS HIGHER THAN NORMAL AND THE FIRST EXCURSION RETURNS NEARER TO THE TRACE LINE. THE NEXT PORTION OF THE PATTERN REPRESENTS A VERY SHORT ACTIVITY PERIOD, IS QUITE NARROW AND APPEARS SQUARED OFF. BOTH AMPLITUDE AND ACTIVITY PERIODS ARE VERY STABLE. PROBABLE CAUSES: 1. MISSING CIGARETTE SPRING. 2. HIGH RESISTANCE WITHIN THE PLUG. 3. LARGE SPARK PLUG GAP. 4. DIRTY SPARK PLUG CONTACT BUTTON. 5. ANY GAP IN THE SECONDARY CIRCUIT.



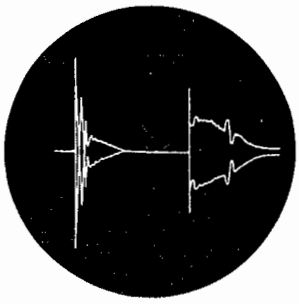
MALFUNCTION PATTERN—FAST SWEEP
HIGH RESISTANCE SECONDARY CIRCUIT (THIRD STAGE)

THE INITIAL HIGH PEAK VOLTAGE IS HIGHER THAN NORMAL AND THIS FIRST EXCURSION RETURNS TO A POINT AT THE BASE LINE AND SOMETIMES BEYOND IT. THE NEXT PORTION OF THE PATTERN IS EXTREMELY NARROW, FOLLOWED BY THE ABRUPT NEGATIVE SLOPE, SMALL OSCILLATION AND NORMAL SLOPING TAIL. PROBABLE CAUSES: 1. MISSING CIGARETTE SPRING. 2. HIGH RESISTANCE WITHIN THE PLUG. 3. LARGE SPARK PLUG GAP. 4. DIRTY SPARK PLUG CONTACT BUTTON. 5. ANY GAP IN THE SECONDARY CIRCUIT.



MALFUNCTION PATTERN—FAST SWEEP
OPEN SECONDARY CIRCUIT

THE INITIAL HIGH PEAK VOLTAGE IS HIGHER THAN NORMAL AND THIS FIRST EXCURSION RETURNS TO A POINT AT THE BASE LINE AND SOMEWHAT BEYOND IT. THE NEXT PORTION OF THE PATTERN IS EXTREMELY NARROW, FOLLOWED BY THE ABRUPT NEGATIVE SLOPE, SMALL OSCILLATION AND NORMAL SLOPING TAIL. PROBABLE CAUSES: 1. ABNORMALLY LARGE PLUG GAP. 2. AN OPEN WITHIN THE SPARK PLUG. 3. DISCONNECTED HIGH TENSION LEAD. 4. ANY OPEN IN THE HIGH TENSION CIRCUIT. NOTE: WHEN HIGH TENSION LEAD IS DISCONNECTED AND THE EXPOSED TERMINAL IS CLOSE ENOUGH TO A CONNECTOR FOR A SPARK TO JUMP BETWEEN THE TWO, PATTERN WILL APPEAR MORE NORMAL OR WILL BE INTERMITTENT.



MALFUNCTION PATTERN—FAST SWEEP
OPEN PRIMARY (DISTRIBUTOR TO COIL)

THIS PATTERN PRODUCES A VERY HIGH INITIAL PEAK VOLTAGE. THIS PEAK IS HIGHER THAN ANY OTHER PATTERN, EXTENDING BEYOND THE LIMITS OF THE SCREEN. THIS EXCURSION IS FOLLOWED BY OSCILLATIONS OF LOW FREQUENCY, CENTERED ON THE BASE LINE AND EXTENDING IN A LONG LINE PARALLEL WITH THE HORIZONTAL TRACE UNTIL BREAKER POINTS CLOSE. PROBABLE CAUSE: AN OPEN IN THE LEAD FROM THE DISTRIBUTOR TO THE CYLINDER MOUNTED COIL OR IN THE PRIMARY WINDING OF THIS COIL.

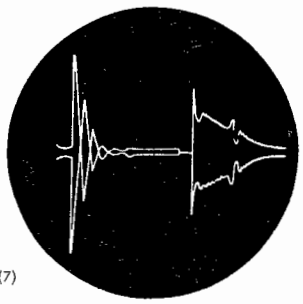


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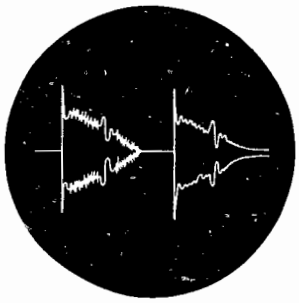
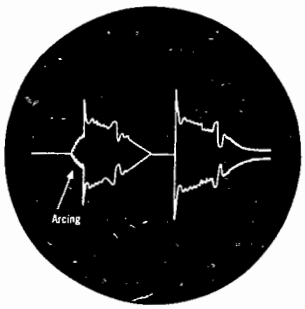
Figure 7-3 (Sheet 7 of 10)

IGNITION ANALYZER PATTERNS



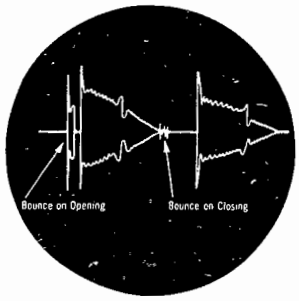
MALFUNCTION PATTERN—FAST SWEEP
ARCING DISTRIBUTOR BRUSH

THE PATTERN APPEARS NORMAL EXCEPT FOR THE PRESENCE OF SMALL JAGGED VARIATIONS APPEARING THROUGHOUT THE PATTERN FROM THE FIRST EXCURSION TO BREAKER POINT CLOSING. EARLY BRUSH ARCING APPEARS ON ONLY ONE OR A FEW POSITIONS. SEVERITY MAY VARY, BUT THE CONDITION IS ESPECIALLY NOTICEABLE AT ALTITUDE. THE MOST FREQUENT OCCURRENCE IS ON THE OUTER SEGMENT RING OR OUTER SLIP RING. PROBABLE CAUSES: 1. BURNED OR DIRTY DISTRIBUTOR SEGMENTS. 2. CONCAVE SEGMENT SURFACE CAUSING BRUSH TO HOP. 3. WEAK BRUSH SPRING. 4. FEATHERED SEGMENT EDGE. 5. EXCESSIVE DISTRIBUTOR VIBRATION MAY CAUSE THE BRUSHES TO ARC.



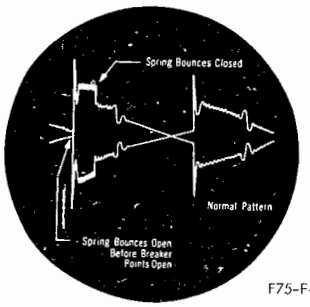
MALFUNCTION PATTERN—FAST SWEEP
ARCING BREAKER POINTS

AN EARLY STAGE OF ARCING BREAKER POINTS APPEARS AS A BRIGHT SPOT JUST AFTER BREAKER POINT OPENING INDICATED BY ARROW; A MORE SEVERE CONDITION IS ILLUSTRATED. THE ARC IS MAINTAINED UNTIL THE POINTS HAVE OPENED SUFFICIENTLY TO EXTINGUISH THE ARC, AT WHICH TIME PRIMARY COIL CURRENT FLOW CEASES, INDUCING A SURGE OF ENERGY INTO THE HIGH TENSION COIL. THE ACTIVITY IN THE HIGH TENSION COIL THEN BECOMES VISIBLE ON THE INDICATOR. SINCE A LARGE PERCENTAGE OF THE PRIMARY COIL ENERGY WAS DISSIPATED DURING ARCING, THE AMPLITUDE OF THE PATTERN IS NOT AS LARGE AS NORMAL. THE OSCILLATION AND DANCING HOOK INDICATES THAT THE SPARK PLUGS ARE BEING FIRED. ALL SPARK PLUGS FIRED BY THE AFFECTED BREAKER POINTS DISPLAY THIS PATTERN. PROBABLE CAUSES: 1. OIL ON BREAKER POINTS. 2. DEFECTIVE PRIMARY CONDENSER. 3. FOREIGN MATTER ON POINTS.



MALFUNCTION PATTERN—FAST SWEEP
BREAKER POINT BOUNCE

THIS PATTERN RESEMBLES THAT FOR MAGNETO BREAKER POINT MISTIMING. THE MARKED DIFFERENCE, HOWEVER, IS THE SHORT TRACE LINE SEPARATING THE TWO INITIAL HIGH AMPLITUDE OSCILLATIONS AND THE APPEARANCE OF THE PATTERN WITH THE CONDITION SWITCH SET FOR ONLY A SINGLE MAGNETO POSITION. BREAKER POINT BOUNCE MAY OCCUR BOTH BEFORE THE NORMAL BREAKER POINT OPENING AND AFTER THE NORMAL BREAKER POINT CLOSING. PROBABLE CAUSES: A WEAK BREAKER POINT SPRING OR DAMAGED CAM WITH ROUGH SPOTS ON IT. A WEAK SPRING SHOULD CAUSE BOUNCE ON ALL SPARK PLUG POSITIONS OF THE AFFECTED MAGNETO WHILE FOR A DAMAGED CAM THE BOUNCE SHOULD OCCUR ON ONLY ONE SPARK PLUG POSITION. NOTE: OCCASIONAL BOUNCE NOT SERIOUS UNLESS SPARK DISCHARGE AFFECTED.



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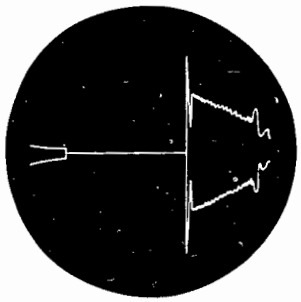
MALFUNCTION PATTERN—FAST SWEEP
HIGH TENSION LEAD SPRING BOUNCE

JUMP IN AMPLITUDE OF PATTERN APPEARS WHEN SPRING BOUNCES OPEN CAUSING A SERIES GAP IN SECONDARY CIRCUIT. CAUSE: TOO SHORT OR TOO WEAK CIGARETTE SPRING ON HIGH TENSION LEAD. NOTE: IF THIS TYPE OF PATTERN APPEARS ON SEVERAL OR MORE CYLINDERS, IT MAY BE DUE TO IGNITION MISTIMING.

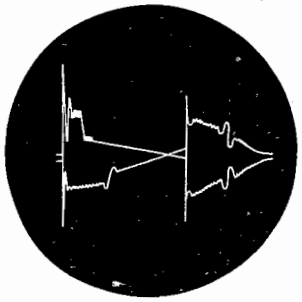
Figure 7-3 (Sheet 8 of 10)

IGNITION ANALYZER PATTERNS



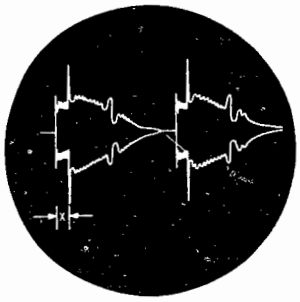
MALFUNCTION PATTERN— FAST SWEEP
OPEN MAGNETO GROUNDING CIRCUIT

EVERY OTHER PATTERN IS MISSING WITH THE NEXT ALTERNATE PATTERNS APPEARING MUCH HIGHER THAN NORMAL. CAUSE: AN OPEN GROUNDING LEAD BETWEEN THE MAGNETO AND THE MAG. SWITCH OR POSSIBLY AN OPEN ISOLATING RESISTOR IN THE ANALYZER IGNITION CIRCUIT.



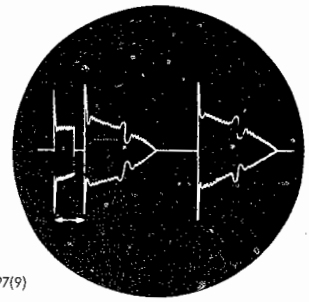
MALFUNCTION PATTERN—FAST SWEEP
RECTIFIER EFFECT OF UNEVEN SPARK PLUG EROSION

HALF OF THE PATTERN APPEARS AS A HIGH RESISTANCE SECONDARY WHILE THE OTHER HALF APPEARS TO BE NORMAL. PROBABLE CAUSE: THIS PATTERN IS CAUSED BY THE RECTIFIER EFFECT OF A SPARK PLUG WHICH HAS ITS CENTER ELECTRODE ERODED INTO A ROUND END AND ITS GROUND ELECTRODES ERODED TO A SHARP POINT. SINCE IT IS HARDER FOR A SPARK TO LEAVE A ROUND OBJECT THAN IT IS A SHARP OBJECT, IT TAKES MORE VOLTAGE TO PUSH THE ARC ACROSS FROM THE CENTER ELECTRODE THAN IT DOES IN THE OPPOSITE DIRECTION.



MALFUNCTION PATTERN—FAST SWEEP
BREAKER POINT NON SYNCHRONIZATION

NOTE: THIS CHECK IS MADE WITH THE CONDITION SWITCH SET ON BOTH. THE DISTANCE X CAN BE MEASURED TO DETERMINE THE NUMBER OF DEGREES OF UNSYNCHRONIZATION. IF ALL CYLINDERS SHOW APPROXIMATELY THE SAME AMOUNT OF UNSYNCHRONIZATION, THE TROUBLE LIES IN DISTRIBUTOR TO ENGINE TIMING. IF HOWEVER, ONLY THE ODD OR ONLY THE EVEN CYLINDERS SHOW UNSYNCHRONIZATION THEN THE INTERNAL DIST. TIMING IS AT FAULT. IF AN UNSYNCHRONIZATION OF 5^0 (5/32") APPEARS FOR ONLY THE ADVANCE OR RETARD POSITION, THE ADVANCE MECHANISM OF ONE DISTRIBUTOR IS MALFUNCTIONING.



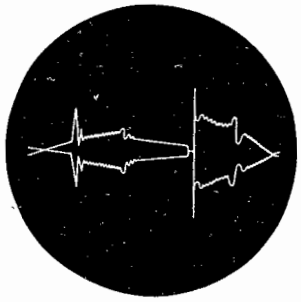
MALFUNCTION PATTERN—FAST SWEEP
DISTRIBUTOR ADVANCE RELAY CHATTERING (MANUAL ADVANCE ONLY)

PATTERN SHIFTS BACK AND FORTH AND APPEARS TO BE FIRING AT BOTH ADVANCED AND RETARDED POSITION. IT MAY OCCUR ON ONE, TWO OR ANY NUMBER OF CYLINDERS, DEPENDING UPON VIBRATION CHARACTERISTICS OF THE ENGINE AT SOME PARTICULAR ENGINE POWER SETTING. PROBABLE CAUSE: BY THE POINTS OF THE ADVANCE RELAY CHATTERING AND MAKING INTERMITTENT CONTACT AND THUS INTERMITTENTLY REGROUNDING THE RETARD POINTS. NOTE: EASILY MISTAKEN FOR BREAKER POINT BOUNCE.

F75-F-7-97(9)

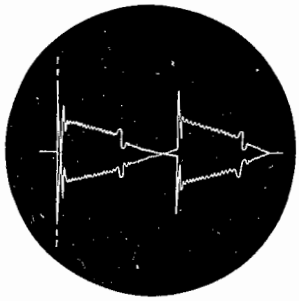
Figure 7-3 (Sheet 9 of 10)

IGNITION ANALYZER PATTERNS



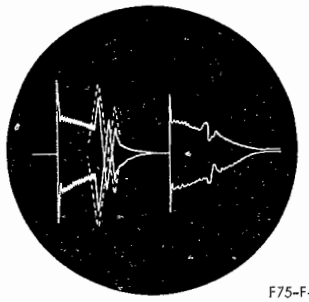
MALFUNCTION PATTERN—FAST SWEEP
LATE DISTRIBUTOR FINGER TIMING

THIS MALFUNCTION APPEARS AS A LOW AMPLITUDE PATTERN WITH A SLANTED INITIAL RISE SOMETIMES LOOPING LIKE AN OPEN PRIMARY. ACTIVITY PERIOD BUILDS UP IN AMPLITUDE AS IT PROGRESSES. APPEARS ON CYLINDERS 13 AND 14 FIRST, SINCE THEY ARE COMPENSATED THE EARLIEST. PROBABLE CAUSES: DISTRIBUTOR INTERNAL MISTIMING, DAMAGED DISTRIBUTOR CAP POSITIONING PIN LOCATING SLOT.



MALFUNCTION PATTERN—FAST SWEEP
CHIPPED DISTRIBUTOR SEGMENT

THE PATTERN PRESENTATION IS CAUSED BY THE MOMENTARY "OPEN PRIMARY" WHEN THE BRUSH BOUNCES, AT THE SAME TIME THE POINTS OPEN. THEN THE BRUSH RETURNS TO THE SEGMENT, REESTABLISHING THE CIRCUIT, AND A NORMAL SECONDARY DISCHARGE OCCURS. IN THE ADVANCED STATE OF PITTING, THERE IS FREQUENTLY A NEARLY COMPLETE "OPEN PRIMARY" PATTERN, APPARENTLY SUPERIMPOSED ON A NORMAL PATTERN, AS THE CONDITION VARIES FROM CYCLE TO CYCLE. PROBABLE CAUSES: LATE FINGER TIMING CAUSES ARCING AT LEADING EDGE OF SEGMENTS LEADING TO PITTING OF THOSE SEGMENTS.



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MALFUNCTION PATTERN—FAST SWEEP
NO COMBUSTION (IGNITION WITHOUT COMBUSTION)

THIS PATTERN HAS A SAWTOOTH APPEARANCE. THE AMPLITUDE OF THE SAWTEETH WILL INCREASE WITH INCREASING RPM. THE SAWTEETH MAY APPEAR MAINLY IN THE VICINITY OF THE 2ND HIGH FREQUENCY OSCILLATION POSITION IN THE PATTERN. PROBABLE CAUSE: FAULTY FUEL NOZZLE, FAULTY INJECTION PUMP, A LEAK IN A FUEL LINE, OR ANY MALFUNCTION CAUSING LOSS OF FUEL MIXTURES AND RESULTING IN NO COMBUSTION.

Figure 7-3 (Sheet 10 of 10)

B. Breaker Point Opening. Breaker point arcing causes a step to appear (see figure 7-3, sheets 4 through 8). The position of the breaker point opening is affected by:

1. Breaker point bounce (see figure 7-3, sheet 8).
2. Breaker point timing.
3. Synchronizing generator timing.
4. Cam and/or cam compensation.
5. Drive train variations (see figure 7-3, sheet 4).
6. Aborted primary interruptions (see figure 7-3, sheet 5).

C. Spark Plug Firing Time. The initial amplitude of the pattern at spark plug firing time is affected by the following factors:

1. Spark plug gap (see figure 7-3, sheet 6).
2. Secondary circuit open or short (see figure 7-3, sheets 6 and 7).
3. Primary circuit open or short (either intermittent or steady) (See figure 7-3, sheets 5 through 7).
4. Magneto generator or distributor timing (see figure 7-3, sheets 4 through 10).
5. Strength of magnets in magneto generator (see figure 7-3, sheet 1).
6. Amount of pressure in cylinder.

D. Spark Activity. The appearance of the pattern during spark activity is affected by:

1. Amount of turbulence in cylinder.
2. Distributor brush arcing (see figure 7-3, sheet 8).
3. High tension lead contact spring bounce (see figure 7-3, sheet 8).
4. Rate of energy dissipation (determines slope of the pattern).

E. (Hook). Point Where Spark Goes Out

1. Unstable dancing hook indicates lean mixture operation (see figure 7-3, sheet 3).
2. Unstable high amplitude hook intermittently displaced to left of normal position indicates no combustion (see figure 7-3, sheet 10).

F. Tail End. The appearance of the pattern between the points where the spark goes out and the breaker point closes is affected by:

1. Distributor brush arcing (see figure 7-3, sheet 8).
2. Rate of energy dissipation in the primary circuit.

G. Breaker Point Close. The position of the breaker point close is affected by:

1. Breaker point dwell.
2. Breaker point bounce (see figure 7-3, sheet 8).

H. Distance Between Two Patterns. The distance between two patterns is determined by the number of crankshaft degrees between two consecutive firing impulses (cam compensation causes this to vary from cylinder to cylinder).

I. Distance Between First Pattern and Initiation of Trace. The distance between the first pattern and the initiation of the trace is determined by the following factors:

1. Synchronizing generator timing.
2. Distributor timing.
3. Manual spark advance position.
4. Cam and/or cam compensation.

Note

Due to the open dwell used in this system (22 magneto degrees or 44 crankshaft degrees) the breaker point closing event is rarely visible, because No. 2 points will have opened prior to the closing of the No. 1 points. Split tail patterns are normal and are related to this effect.

Any change of total circuit resistance, which includes spark plug gap resistance, will affect the voltage requirements of the system. If the resistance is high, the voltage required will be high; if the resistance is low, the voltage required will be low. Extreme conditions will be indicated by patterns for open and short circuit conditions.

Synchronizing Generator Timing Check in Flight—Ignition Pattern Method.

The following procedure represents a simple means of checking synchronizer generator timing to the correct cylinder in flight or during ground runup. It depends upon the fact that the interval between ignition of successive cylinders varies because of magneto cam compensation. For each engine-magneto combination, the distance between patterns will be a maximum for No. 14 cylinder (approximately 1½ inches) and a minimum for No. 5 cylinder (approximately 1$\frac{1}{16}$ inches).

1. Set condition switch to desired engine on left or right distributor.

2. Set selector switch to No. 14 cylinder with push-pull button in FAST SWEEP.

3. Measure distance (it should be approximately 1½ inches).

4. Set selector switch to No. 5 cylinder.

5. Measure distance (it should be approximately 1$\frac{1}{16}$ inches).

With a little practice the operator should be able to determine in a very short time if the synchronizing generator is timed with reference to the correct cylinder.

OPERATING PROCEDURE.

Note

It is recommended that an ignition analysis be made during taxiing and during ground runup magneto check. A troubleshooting check with the ignition analyzer should be made during the climb to cruising altitude, and at least once an hour during cruising flight.

1. Turn on the amplifier power supply and allow it and the cathode ray tube to warm up.

2. Set the index on the inner dial of the condition switch to the L index (near the number 1) beneath the general caption IGNITION on the fixed ring.

3. Set the index labeled IGN on the inner dial of the cycle switch against the number 1 on the fixed ring. This setting, supplementing that of the condition switch, will present the pattern of No. 1 cylinder left magneto of No. 1 engine on the indicator, followed by the pattern of No. 12 cylinder, next in firing order.

Note

With the push-pull knob in the pulled-out position, in the above condition, the indicator will portray all the ignition patterns associated with the left magneto beginning with No. 1 cylinder. When the spark plug is fired on the negative pulse of the magneto, the major portion of the pattern will appear below the zero line, and when fired on the positive pulse, the major portion will appear above the zero line. This condition is apparent at low rpm only.

4. Push the push-pull knob in and set the dial index of the condition switch to B, near the numeral 1 beneath the general caption IGNITION. Maintain IGN against 1 on the cycle switch. The pattern on the indicator will portray the functioning of both magnetos and both spark plugs for cylinders 1 and 12. This setting is used for checking magneto synchronization.

5. For study of the individual ignition patterns or all of the ignition patterns of engines No. 2, 3, or 4, the same settings of the cycle switch as for engine No. 1 are used, but the condition switch must be switched to L, B, and R adjacent to the numerals 2, 3, and 4 respectively.

6. For an engine speed synchronization check, set the dial index of the condition switch against the index 2 under the caption SYN on the fixed ring. This setting establishes the electrical connection for the comparison of speed of engine No. 2 to that of engine No. 1. The push-pull knob should be in the pushed-in position. To compare the speeds of engines No. 3 and 4 to engine No. 1, set the dial index on the condition switch to 3 and 4 within the captioned SYN segment of the outer ring.

Note

When using the analyzer to synchronize the engine speed with an inoperative tachometer generator, a false on-speed condition can occur. Under certain rpm spreads, (approximately 200 rpm) it may be noted that the analyzer indicates synchronization of a selected engine with No. 1 engine. This is a false condition and can be recognized by the distortion or splitting of the patterns on the scope. Reference should be made to other basic instruments, i.e., fuel flow, MAP, BMEP to aid in synchronization of effected engine. When making the engine synchronization check, the position of the cycle switch is of no importance.

ENGINE OIL TANK REPLENISHING.

NORMAL IN-FLIGHT ENGINE OIL TANK REPLENISHING PROCEDURE.

Operational procedures for adding oil to the engine oil tanks are as follows:

Note

During interior flight station check, the reserve oil transfer circuit breaker should be pushed in and the reserve oil tank heater switches turned ON.

1. (EC-121D) Reserve oil tank selector switch—RIGHT or LEFT, as desired.

2. Rotate engine tank selector switch to tank requiring replenishing.

Note

In the event of hydraulic transfer pump failure, place pump selector switch to AUX. (ELECT.) position.

3. Place pump selector switch to NORMAL (HYD.) position.

4. Press the start transfer button and check pump transferring light.

Note

When the engine tank maximum quantity limit has been reached, the transferring operation will automatically stop, the pump transferring light will go out, and the pump evacuating light will glow for 60 seconds, indicating that the pump has reversed to evacuate the lines. In the event that the engine tank is to be replenished but not filled to the maximum limit, press the stop transfer button when the fluid quantity reaches the desired amount.

EMERGENCY ENGINE OIL TANK REPLENISHING PROCEDURE.

A manual reserve oil transfer procedure is provided for operation of the system in the event of electrical power failure. The sequence of steps is as follows:

CAUTION

Open the reserve oil system circuit breaker on the station 260 upper switch panel before operating the manual controls.

1. Rotate engine oil tank selector to END position, then return to OFF position.

2. Select engine oil tank by rotating the handle from OFF to the desired engine tank position. Do not rotate handle backward while selecting engine tank.

3. Rotate auxiliary oil tank handle to OPEN position.

4. Set hydraulic pump transfer handle to PUMP position. Time pump operation to determine quantity of oil to be transferred. Transfer rate is approximately 3 gallons per minute.

5. After the desired quantity of oil has been transferred, set pump transfer handle to EVACUATE position and allow pump to operate for approximately 60 seconds.

6. Return hydraulic pump transfer handle to OFF position.

7. Rotate auxiliary oil tank handle to CLOSED position, then return to NEUTRAL position.

8. Rotate engine oil tank selector handle to END position, then return to OFF.

Note

For each engine oil tank replenished, the above procedure is to be followed.

EC-121D. RECOMMENDED OPERATIONAL FUEL LOADING

For Normal Operation With Tip Tanks Installed

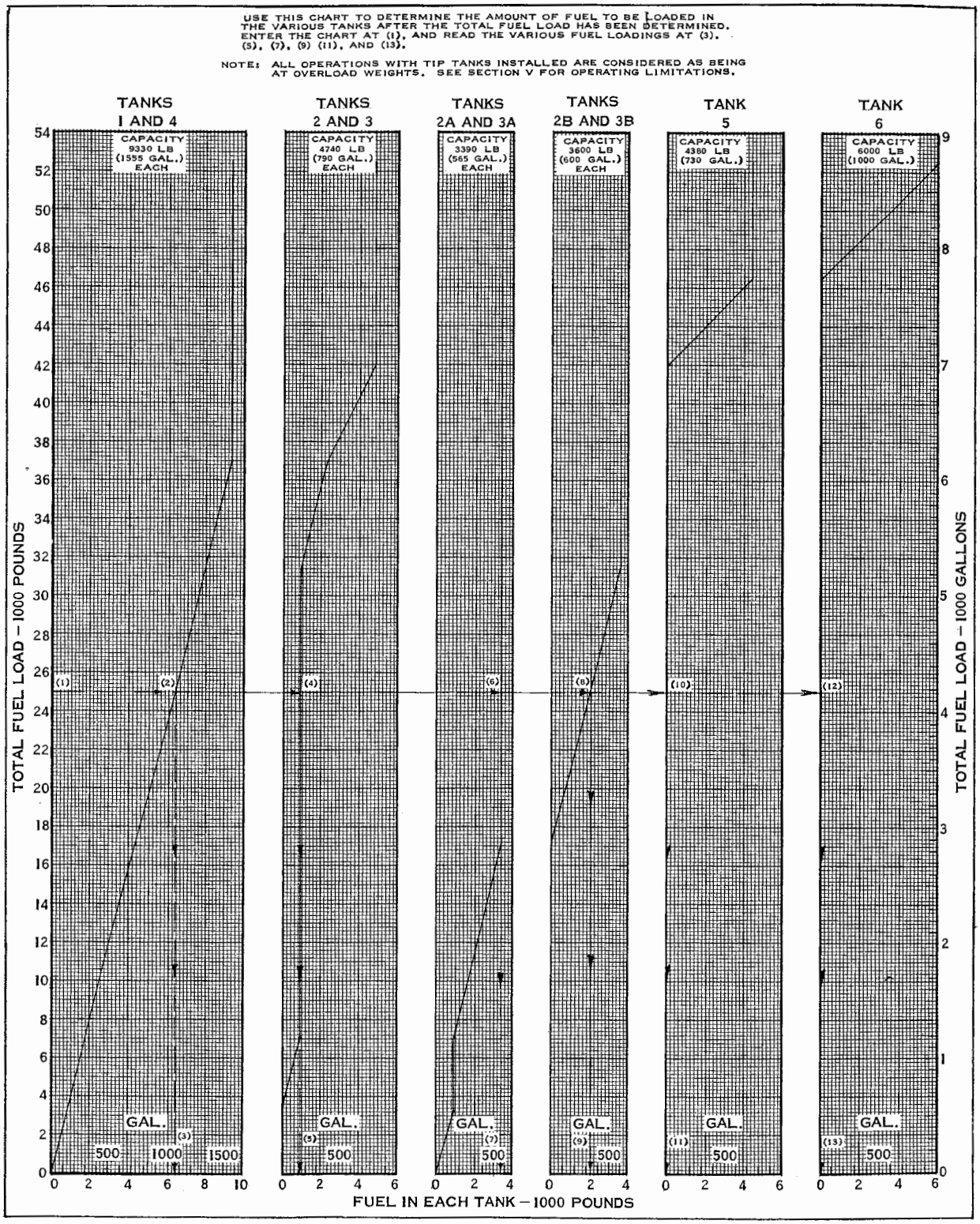


Figure 7-4 (Sheet 1 of 5)

EC-121D. RECOMMENDED FUEL LOADING TABLE
WING TIP TANKS ON

TOTAL FUEL GALLONS	QUANTITY PER TANK — GALLONS					
	2B & 3B	2A & 3A	1 & 4	2 & 3	5	6
2000	0	350	500	150	0	0
2200	0	400	550	150	0	0
2400	0	450	600	150	0	0
2600	0	500	650	150	0	0
2800	0	550	700	150	0	0
2860	0	565*	715	150	0	0
3000	35	565*	750	150	0	0
3200	85	565*	800	150	0	0
3400	135	565*	850	150	0	0
3600	185	565*	900	150	0	0
3800	235	565*	950	150	0	0
4000	285	565*	1000	150	0	0
4200	335	565*	1050	150	0	0
4400	385	565*	1100	150	0	0
4600	435	565*	1150	150	0	0
4800	485	565*	1200	150	0	0
5000	535	565*	1250	150	0	0
5200	585	565*	1300	150	0	0
5260	600*	565*	1315	150	0	0
5400	600*	565*	1350	185	0	0
5600	600*	565*	1400	235	0	0
5800	600*	565*	1450	285	0	0
6000	600*	565*	1500	335	0	0
6200	600*	565*	1550	385	0	0
6220	600*	565*	1555*	390	0	0
6400	600*	565*	1555*	480	0	0
6600	600*	565*	1555*	580	0	0
6800	600*	565*	1555*	680	0	0
7000	600*	565*	1555*	780	0	0
7020	600*	565*	1555*	790*	0	0
7200	600*	565*	1555*	790*	180	0
7400	600*	565*	1555*	790*	380	0
7600	600*	565*	1555*	790*	580	0
7750	600*	565*	1555*	790*	730*	0
7800	600*	565*	1555*	790*	730*	50
8000	600*	565*	1555*	790*	730*	250
8200	600*	565*	1555*	790*	730*	450
8400	600*	565*	1555*	790*	730*	650
8600	600*	565*	1555*	790*	730*	850
8750	600*	565*	1555*	790*	730*	1000*

* Tanks full.

Figure 7-4 (Sheet 2 of 5)

TC-121C. RECOMMENDED OPERATIONAL FUEL LOADING

For Normal Operation

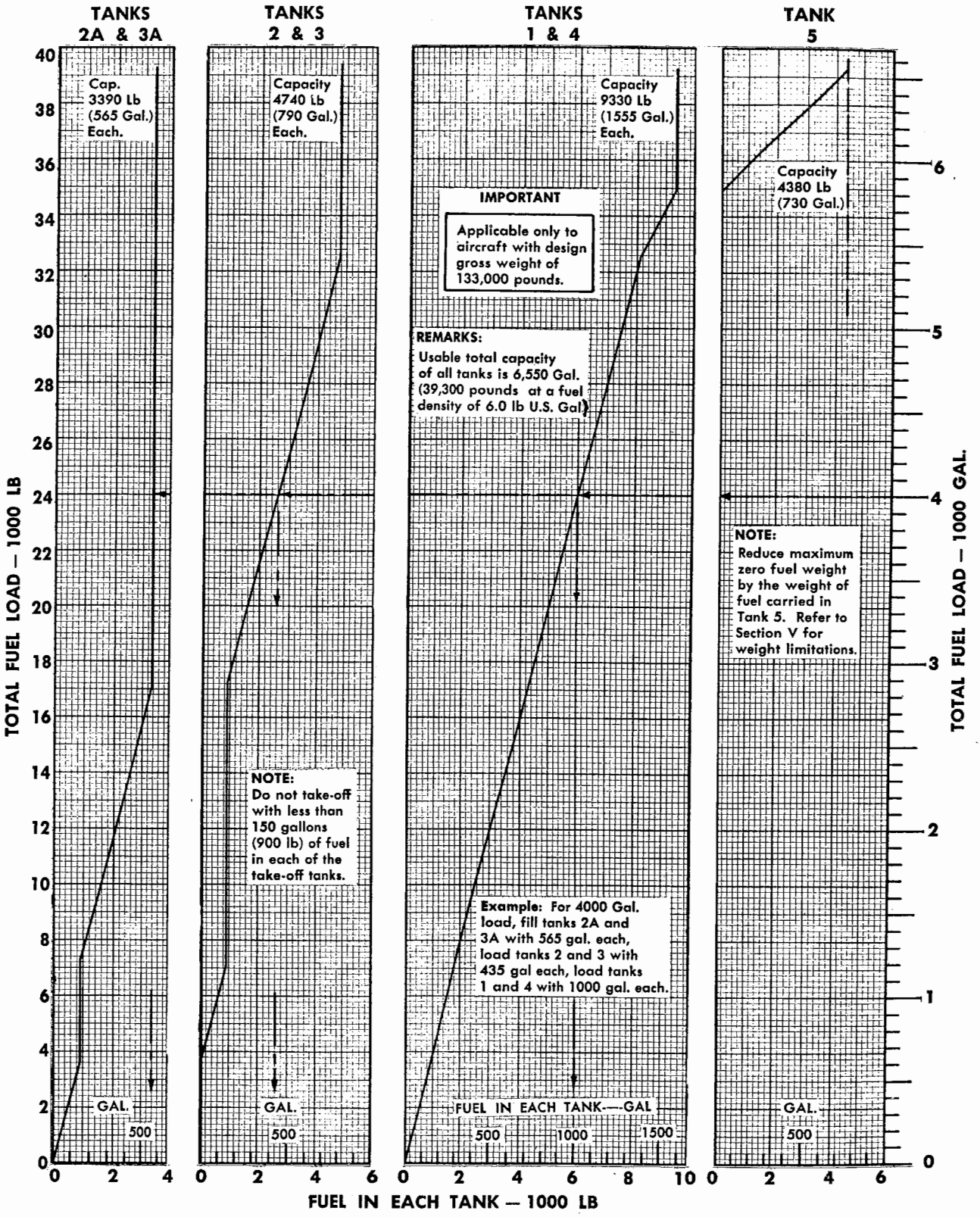


Figure 7-4 (Sheet 3 of 5)

TC-121C. RECOMMENDED FUEL LOADING TABLE

TOTAL FUEL GALLONS	QUANTITY PER TANK — GALLONS			
	1 & 4	2 & 3	2A & 3A	5
1000	250	100	150	0
1200	300	150	150	0
1400	350	150	200	0
1600	400	150	250	0
1800	450	150	300	0
2000	500	150	350	0
2200	550	150	400	0
2400	600	150	450	0
2600	650	150	500	0
2800	700	150	550	0
2860* (2A & 3A)	715	150	565*	0
3000	750	185	565*	0
3200	800	235	565*	0
3400	850	285	565*	0
3600	900	335	565*	0
3800	950	385	565*	0
4000	1000	435	565*	0
4200	1050	485	565*	0
4400	1100	535	565*	0
4600	1150	585	565*	0
4800	1200	635	565*	0
5000	1250	685	565*	0
5200	1300	735	565*	0
5400	1350	785	565*	0
5420* (2 & 3)	1355	790*	565*	0
5600	1445	790*	565*	0
5800	1545	790*	565*	0
5820* (1 & 4)	1555*	790*	565*	00
6000	1555*	790*	565*	160
6200	1555*	790*	565*	380
6400	1555*	790*	565*	580
6550* (ALL)	1555*	790*	565*	730*

* Tanks full.

Figure 7-4 (Sheet 4 of 5)

TC-121C. OPTIONAL FUEL LOADING

(Optional Fuel System Management procedures must be used for fuel weights less than 13,560 lb. See Figure 7-6, Sheet 3).

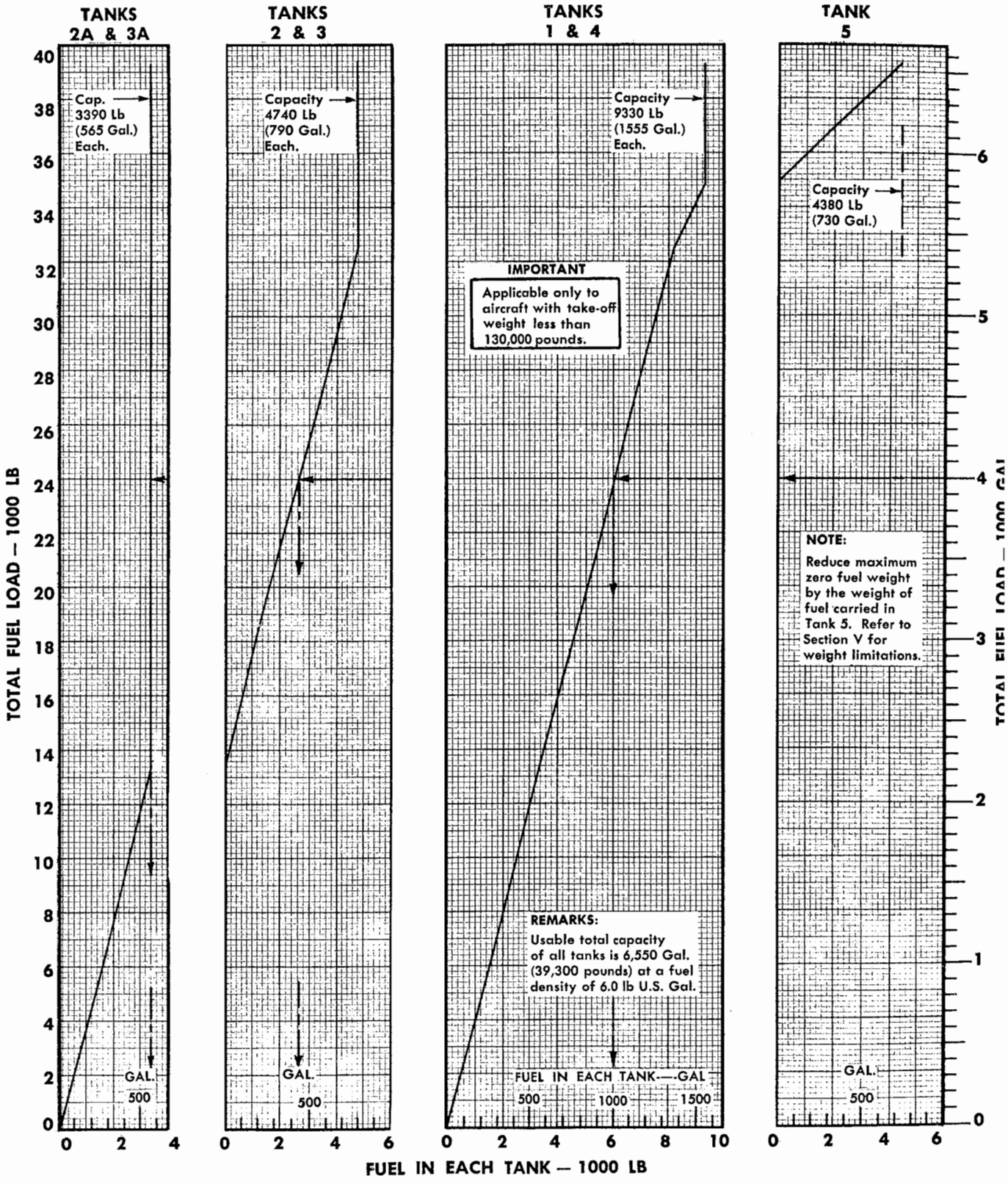


Figure 7-4 (Sheet 5 of 5)

9. When not in use, the handles must be in the following position:

a. Engine oil tank selector—OFF.

b. Hydraulic pump transfer—OFF.

c. Auxiliary oil tank shutoff—NEUTRAL.

FUEL SYSTEM.

FUEL SYSTEM MANAGEMENT.

For normal long range operation, all takeoffs are to be made with tanks 1, 2, 3 and 4 supplying fuel to respective engines. All landings are to be made on tanks 1, 2A, 3A and 4. Use of the recommended fuel loading chart for normal operation, (figure 7-4) results in optimum fuel distribution. Minimum wing stresses will result when this loading schedule is used in conjunction with the recommended fuel usage procedure. Minimum fuel load restrictions shown in Section V should be observed if deviations from the normal loading usage procedure are necessary. Improper fuel distribution due to unusual loading or usage procedures can, under some circumstances, result in the inability of the wing to withstand design load factors. See figure 7-4 for the proper fuel consumption sequence for various fuel quantities when the recommended operational fuel loading is followed. Use the tables by entering the column corresponding to gallons of fuel on board the aircraft at takeoff and completing the fuel usage procedures in numerical sequence as shown on the left side of the table. The various routes of fuel flow from the fuel tanks to the engines are also shown on the samples (figure 7-6).

Refueling.

During refueling operations, the following precautionary measures must be taken:

1. Assure the aircraft is grounded.

2. A crewmember must be assigned who will prevent smoking in the aircraft or in the vicinity until refueling is completed.

3. Loading ramps or stairways must be in position at the entrances and the doors must be kept open.

4. During daytime refueling, the cart battery and the ship battery switches must be turned OFF.

5. During night refueling, the ship battery switch may be left on to provide cabin lighting. The exterior lights switch may either be turned OFF or left at the STEADY position, if required by the airport. All radio equipment, inverters, motors, and similar electrical equipment must be off. No switches are to be operated after refueling is started.

6. The auxiliary ground power source must be shut down and moved clear of the aircraft unless it is explosion-proof.

Fuel Stabilizing Time.[1]

A fuel stabilizing time is required before accurate fuel quantity indications can be obtained for tanks 2 and 3. Below the 350-gallon level, fuel must stabilize through a ⅝-inch diameter tube. Above the 350-gallon level it stabilizes through a 3-inch diameter tube.

During that time, dip stick and fuel quantity indicator readings will be high. The following chart shows the approximate time required for fuel to stabilize between the two sections of the tank:

FUEL LOAD (Gallons)	TIME (Minutes)
100	27
200	27
300	27
350	4
400	2½
450	1½
Full	1½

Auxiliary Fuel Pumps.

Each fuel tank contains an electrically-operated, submerged fuel booster pump. These pumps supply relatively vapor-free fuel under pressure to the engine-driven fuel pumps so that engine operation is not affected by vapor and entrained air. The HIGH positions are used during takeoff and landing, and to supply fuel under

[1]Applicable to AF Serials 51-3836 thru 51-3841, 51-3843 thru 51-3845 and 52-3411 thru 52-3424 only. Later aircraft incorporate a 4-inch diameter tube between the low level sections of the tanks which eliminates the stabilization time requirement for accurate fuel quantity readings for these tanks.

FUEL DENSITY VS. FUEL TEMPERATURE

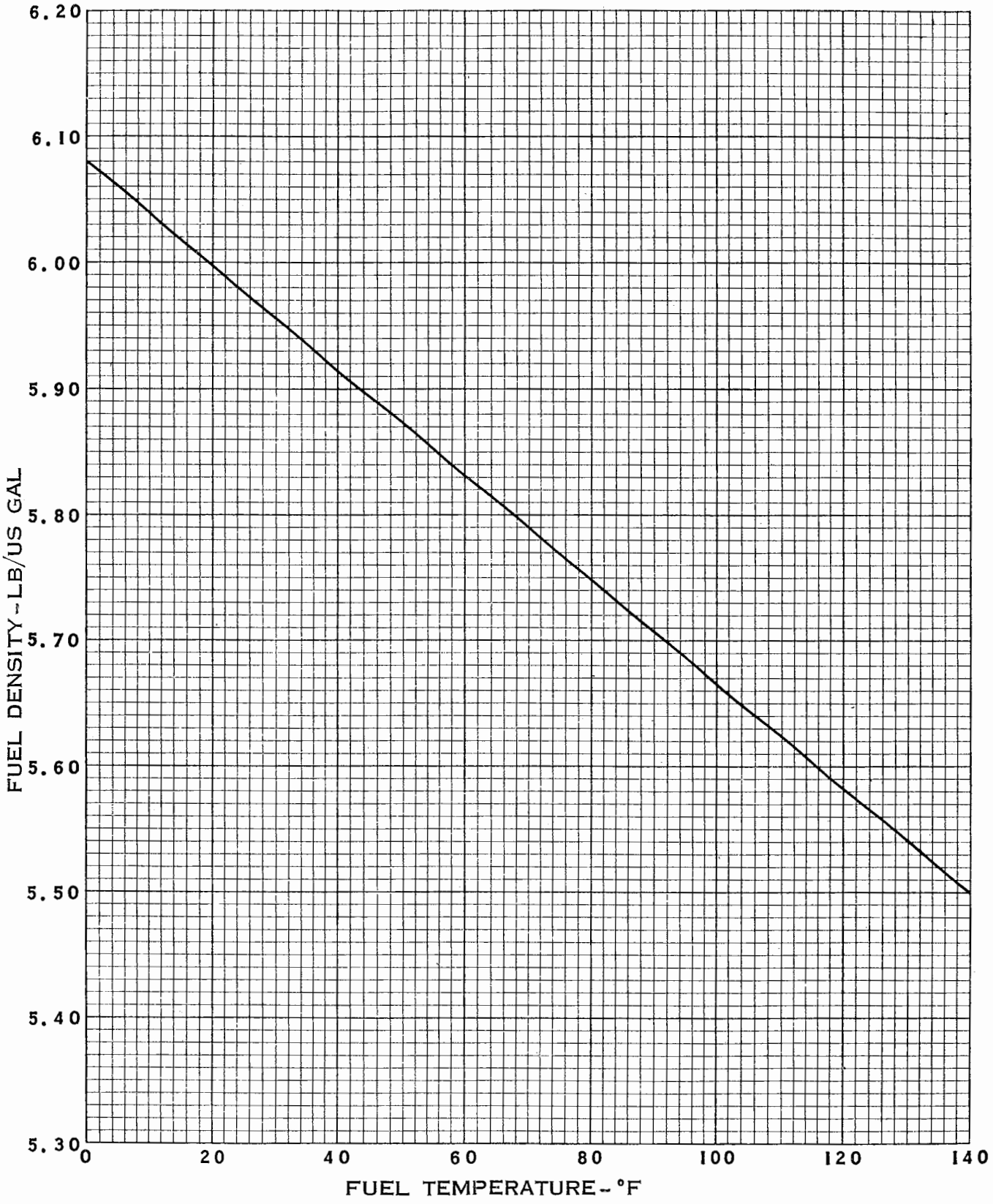


Figure 7-5

pressure in the event of engine-driven fuel pump failures; or where the LOW position cannot maintain sufficient pressure. The LOW positions are used during climb, cruise, and descent.

Crossfeed Operation.

When going to crossfeed operation, it is recommended that the fuel booster pump of the tank to supply the fuel be turned to HIGH. After crossfeed operation has been established, the fuel booster pump of this tank will be returned to the LOW position provided fuel pressure is maintained within limits.

CAUTION

On EC-121D aircraft do not place the switches for tanks 6R and 6L in HIGH position except during fuel dumping. In the event of a float valve malfunction in tanks 1 and 4, the HIGH position will deliver pressure to tanks 1 and 4 in excess of their design limitations.

FUEL LEAKS.

Inspecting and Recording Leaks:

Careful inspection in a well-lighted area is of prime importance. It is particularly important to inspect carefully for seeps and leaks in confined areas such as forward of the front spar, aft of the rear spar, and in the nacelles. Care and judgment will ensure that old stains, and leaks that have been fixed, are not recorded. If there is doubt as to whether a stain actually indicates the presence of a leak, the stain should be wiped off and the area observed for a time to see if fuel reappears.

CAUTION

Leaks in certain areas can be potential fire hazards. Give special attention to areas in the vicinity of the nacelles, wing-to-fuselage fillets and navigation lights in the wing-tip tanks. Also inspect places where vapor from fuel leaks may be trapped, such as in the nacelles or wing-to-fuselage fillets where the heaters are situated.

Types of Leaks:

1. Stain: The mildest kind of leak is the stain. This is a discoloration around fasteners or seams caused by very slow fuel seepage which dries as it meets the open air. A stain should be wiped off, and if it does not reappear within one hour, it should merely be recorded and periodically inspected.

2. Seep: A seep is a heavy stain which, when wiped off with a rag, reappears within one hour. This type of leak should be inspected frequently for increased activity.

3. Heavy Seep: Seepage that increases to the point where it reappears immediately after being wiped off is defined as a heavy seep.

4. Dripping Leak: This is a continuous fuel leak which wets a limited area and then drips off the aircraft.

5. Running Leak: This is a continuous running of fuel caused by a definite break in the sealant and the source is usually easy to locate.

Types of Leaks and Recommended Action:

The following table may used as a guide to determine the remedial action required when any type of leak occurs in various locations in the wing.

FUEL LEAK LOCATION	*ACTION REQUIRED*				
	Stain	*Seep*	*Heavy Seep*	*Dripping Leak*	*Running Leak*
Open areas, upper and lower surfaces	A	A	B	D	D
Face of forward beam (except inside nacelles)	A	B	B	D	D
Face of rear beam (except inside nacelles)	A	B	B	D	D
Inside nacelles, including beam faces, but excluding corrugations in top of wheel well.	A	B	B	D	D
Between WS 450.5 and 480	A	B	B	D	D
Internal leakage between tanks	A	A	A	D	D

FUEL LEAK LOCATION	*ACTION REQUIRED*				
	Stain	*Seep*	*Heavy Seep*	*Dripping Leak*	*Running Leak*
Under-deicer boots on wing outer section leading edge	C	C	C	D	D
Corrugations in top of wheel well	A	B	B	D	D
Center section cell drain tubes	—	—	—	E-1	D
Corrugation drain outlet tubes	—	—	—	E-1	D
Corrugation drain at WS 80	—	—	—	E-3	D
Cabin heater solenoid and filter drains	—	—	—	E-2	D
Fuel sump (remote control) drains	—	—	—	E-2	D
Fuel booster pump drains	—	—	—	E-3	D
Fuel dump valves, heater areas, fuel pressure lines and fittings	D	D	D	D	D
Wing-tip tank surfaces	A	B	B	D	D
Inside lower radome	A	D	D	D	D
Inside-wing-to-fuselage fillets	D	D	D	D	D

A Clean surface, and inspect frequently to ensure that leak does not increase.

B Make a temporary repair as described in paragraph 2–78, Structural Repair Manual, and repair at next scheduled inspection period or when airplane is grounded for other maintenance.

C Repairs to fuel leaks under de-icer boots can only be made by peeling back that portion of the boot covering the affected area. Good judgment must be used to determine whether leakage is of sufficient magnitude to require immediate repair. Replace de-icer boot according to instructions in Maintenance Manual.

D Make a permanent repair as described in the Structural Repair Manual.

E Maximum leakage is permitted as indicated below. Determine leak source and repair at next scheduled inspection, or when aircraft is grounded for other maintenance.

1. 50 drops per minute.
2. 25 drops per minute.
3. 10 drops per minute.

FILLING MAIN OR EMERGENCY HYDRAULIC RESERVOIR IN FLIGHT.

Emergency hydraulic fluid may be used to replenish either the main hydraulic reservoir or the emergency extension and brake reservoir by the following method.

1. Attach the emergency fluid hose to the capped line.

2. Set hydraulic reservoir selector to reservoir to be replenished.

3. Operate hydraulic reservoir filler wobble pump handle.

Note

If fluid fails to flow, the pump requires bleeding. Proceed as follows:

a. Pump bleed valve—OPEN.

b. Disperse air in the pump, by operating handle until fluid flows from the bleed port.

c. Pump bleed valve—CLOSED.

USE OF LANDING WHEEL BRAKES.

In order that brakes can be used as little and as lightly as possible, take full advantage of the length of the runway utilizing aerodynamic braking to stop the airplane. To minimize brake wear, the following precautions shall be observed insofar as is practicable:

BRAKE OPERATION AT TOUCHDOWN.

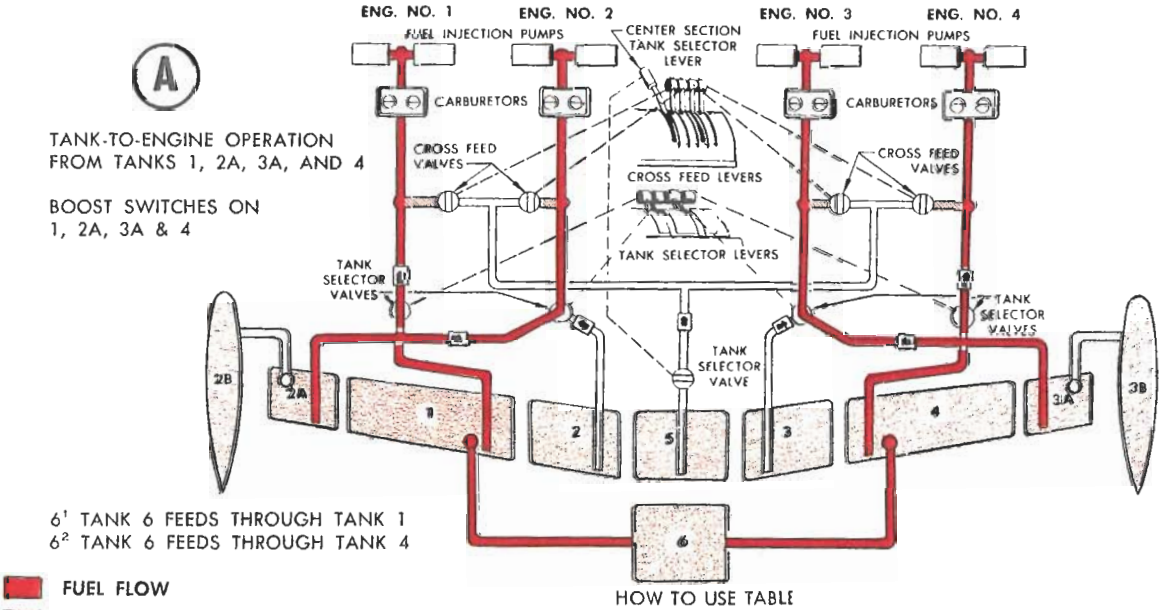
Use extreme care when applying brakes immediately after touchdown, or at any time there is considerable lift on the wings, to prevent skidding the tires. Heavy brake pressure will lock the wheels more easily immediately after touchdown than when the same pressure is applied after the full weight of the airplane is on the tires. A wheel once locked in this manner immediately after touchdown will not become unlocked as load increases, as long as brake pressure is maintained. Brakes can stop the wheels from turning, but stopping the airplane is dependent on the frictional force between the tires and the runway. As the load on the tires increases, the frictional force increases giving better braking action. During a skid, the frictional force is reduced thus requiring more distance to stop.

EC-121D. FUEL SYSTEM MANAGEMENT

TIP TANKS ON

SEQUENCE	INITIAL FUEL IN GALS: 8750 TO 8480	8480	8480 TO 7750	7750 TO 7020	7020 TO 6220	6220 TO 5260	5260 TO 2860	2860 TO 1200	FUEL TANK	ENGINE 1	2	3	4	FUEL USAGE PROCEDURES
1	1	1	1	1	1	1	1	1	TAKE-OFF AND CLIMB	1	2	3	4	TAKE-OFF AND CLIMB, USING NOT MORE THAN 150 GALS./1 TANK
2									EMPTY FUSELAGE TANKS	6[1]	5	5	6[2]	UNTIL TANK 5 IS EMPTY
	2									6	5	5	6	UNTIL TANKS 5 & 6 ARE EMPTY
		2								6	5	5	6	UNTIL TANK 6 IS EMPTY
3										6	2	3	6	UNTIL TANK 6 IS EMPTY
		3	2							5	2	3	5	UNTIL TANK 5 IS EMPTY
4	3	4	3	2					CROSS FEED	2	2	3	4	UNTIL TANK 1 = TANKS 2 + 2A + 2B
5	4	5	4	3						1	2	3	3	UNTIL TANK 4 = TANKS 3 + 3A + 3B
6	5	6	5	4	2				CRUISE	1	2	3	4	UNTIL TANKS 2 & 3 ARE EMPTY
7	6	7	6	5	3	2				1	2B	3B	4	UNTIL TANKS 2B & 3B ARE EMPTY
8	7	8	7	6	4	3	2		END FLIGHT AND LAND	1	2A	3A	4	REMAINDER OF FLIGHT AND LANDING

The cross-feed operation is shown immediately after fuel in tank 5 is exhausted, which is the most critical time from structural considerations. However, it may be done at any operationally desirable time after the fuel in tank 5 has been used, provided it is complete by the time that tanks 2 and 3 become empty.
This fuel management procedure affords optimum utilization of wing strength.



HOW TO USE TABLE

(a) ENTER THE INITIAL FUEL COLUMN AT LEFT AND TOP CORRESPONDING TO FUEL LOAD AND READ DOWN TO NO. 1.
(b) READ THE PROCEDURE AT THE RIGHT OF NO. 1 (FUEL TANK) AND ADJUST THE FUEL FEED AS SHOWN.
(c) CONTINUE FEED UNTIL INSTRUCTIONS OF THE FUEL USAGE COLUMN ARE COMPLETED.
(d) RETURN TO ORIGINALLY SELECTED VERTICAL COLUMN AND COMPLETE FUEL USAGE PROCEDURE IN NUMERICAL SEQUENCE AS SHOWN.

F75-E-7-206(1)

Figure 7-6 (Sheet 1 of 3)

TC-121C. FUEL SYSTEM MANAGEMENT

HOW TO USE CHART:

a. Enter the column at the left top corresponding to the fuel load and read down the column to the number one.
b. Read the procedure at the right of number one and adjust fuel feed as shown.
c. Continue feed until instructions of the note are completed.
d. Return to originally selected vertical column and complete the fuel usage procedures in numerical sequence as shown.

FUEL USAGE SEQUENCE FOR TOTAL FUEL LOAD (GAL) AT TAKE-OFF					RECOMMENDED FUEL USAGE PROCEDURES
5420 OR LESS	5420 TO 5820	5820 TO 6220	6220 (600 IN TANK 5)	OVER 6220	**Caution: Must Be Used If Take-Off Gross Weight Is 130,000 Lbs. or Greater** **IMPORTANT: Do Not Take Off With Less Than 150 Gallons (900 Lb.) of Fuel In Each of The Take-off Tanks** (Refer to Figure 7-4, Sheet 3 for fuel loading)
1	1				Feed tank to engine from tanks 1, 2, 3, and 4 until tanks 2 and 3 are empty.*
		1	1	1	Feed tank to engine from tanks 1, 2, 3, and 4 until cruise altitude is reached.
				2	Switch engines 1 and 4 to operate through crossfeed valves from tank 5 until 1/2 the excess over 400 gal. is used out of tank 5.
		2	2	3	Switch engines 2 and 3 to operate through crossfeed valves from tank 5 until that tank is empty.
		3	3	4	Switch all engines to tank-to-engine feed from tanks 1, 2, 3, and 4 until tanks 2 and 3 are empty.*
	2*	4*			Switch engine 2 to operate from tank 1, and engine 3 to operate from tank 3a until the quantities of fuel in tanks 1 and 2a are equal.
	3	5			Switch engine 3 to operate from tank 4 and engine 2 to operate from tank 2a until the quantities of fuel in tanks 3a and 4 are equal.
2	4	6	4	5	Switch engines 2 and 3 to operate from tanks 2a and 3a until end of flight and landing. (Refer to (B) Fig. 7-6).

SEQUENCE

*Momentarily switch engines 2 and 3 to operate from tanks 2a and 3a if crossfeed is to be established after tanks 2 and 3 are empty. (Refer to (B) Fig. 7-6).

(B)

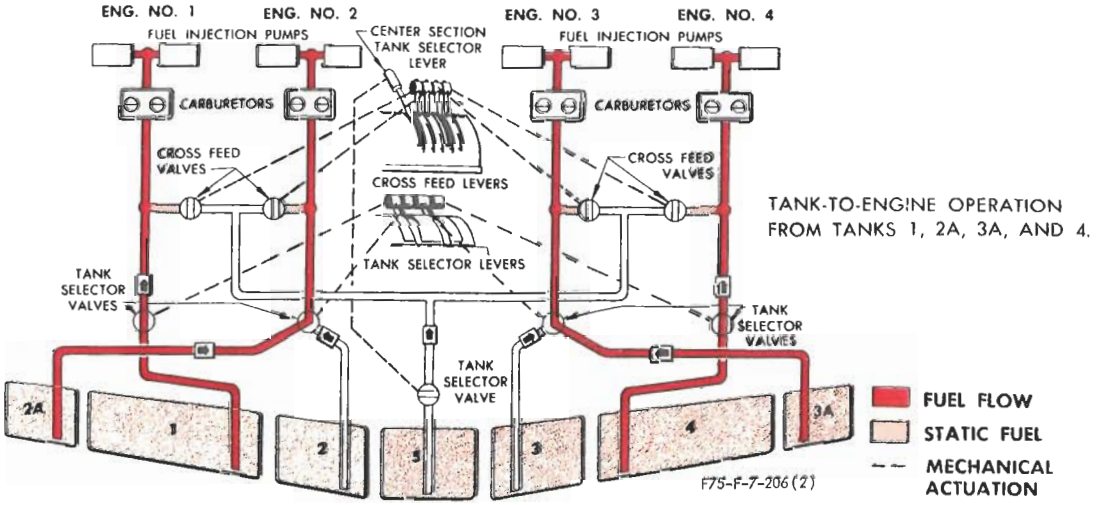
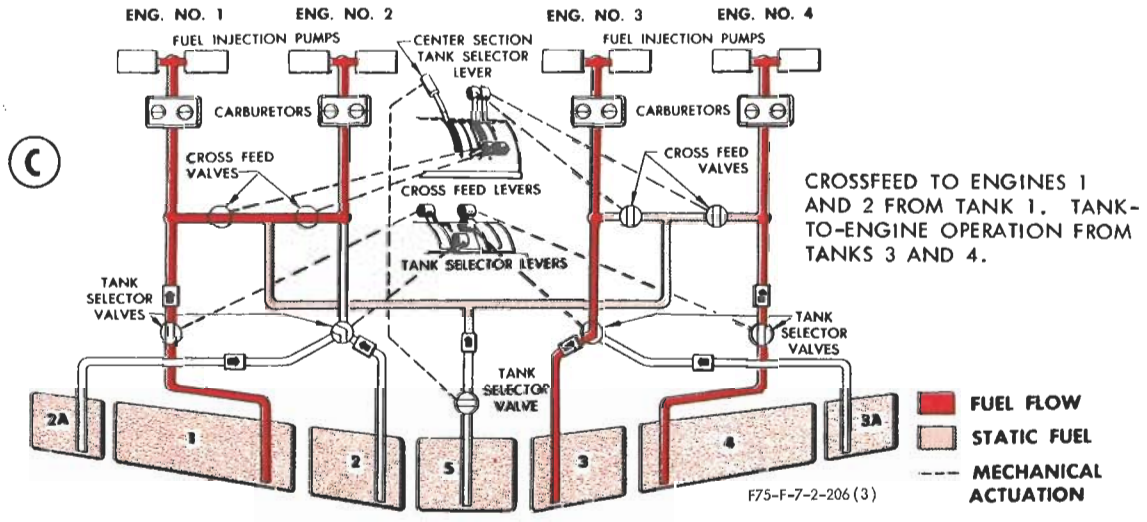


Figure 7-6 (Sheet 2 of 3)

TC-121C. FUEL SYSTEM MANAGEMENT

FUEL USAGE SEQUENCE FOR TOTAL FUEL LOAD (GAL) AT TAKE-OFF					OPTIONAL FUEL USAGE PROCEDURES **Caution: May Be Used Only If Take-Off Gross Weight Is Less Than 130,000 Lbs. And Zero Fuel Weight Is 105,000 Lbs. Or Less** **IMPORTANT:** DO NOT TAKE OFF WITH LESS THAN 150 GALLONS (900 LB.) OF FUEL IN EACH OF THE TAKE-OFF TANKS. (Refer to Figure 7-4, Sheet 5 for fuel loading)
2260 OR LESS	2260 TO 5420	5420 TO 5820	5820 TO 6220	OVER 6220	SEQUENCE
1	↓	↓	↓	↓	Feed tank-to-engine from tanks 1, 2A, 3A, and 4 during the entire flight. (Refer to (B) Fig. 7-6).
	1	1	1	1	Take-off and climb on tank-to-engine operation from tanks 1, 2A, 3A and 4. Continue this feed until not more than 150 gal. have been used from each of these tanks (Refer to (B) Fig. 7-6).
			2	2	Switch engines 2 and 3 to operate through crossfeed valves from tank 5 until that tank is empty.
		2	3		Switch engine 3 to tank 3 direct. Switch engines 1 and 2 to operate through crossfeed valves from tank 1 until the excess fuel in tank 1 over the total in tanks 2 and 2A is consumed. (Refer to (C) Fig. 7-6).
		3	4		Switch engines 1 and 2 to feed direct from tanks 1 and 2. Switch engines 3 and 4 to operate through crossfeed valves from tank 4 until the excess of fuel in tank 4 over totals in tanks 3 and 3A is consumed.
				3	Switch engine 3 to tank 3 direct. Switch engines 1 and 2 to operate through crossfeed valves from tank 2 until sum total of fuel in tanks 2 and 2A is equal to that in tank 1.
				4	Switch engines 1 and 2 to tank to engine operation from tanks 1 and 2. Switch engines 3 and 4 to operate through crossfeed valves from tank 3 until the sum total of fuel in tanks 3A and 3 is equal to that in tank 4.
	2	4	5	5	Switch all engines to tank-to-engine feed from tanks 1, 2, 3, and 4 until tanks 2 and 3 are emptied.
	3	5	6	6	Switch engines 2 and 3 to tanks 2A and 3A. (Refer to (B) Fig. 7-6).



(C) CROSSFEED TO ENGINES 1 AND 2 FROM TANK 1. TANK-TO-ENGINE OPERATION FROM TANKS 3 AND 4.

Figure 7-6 (Sheet 3 of 3)

MINIMUM ROLL LANDINGS.

If maximum wheel braking is required, lift should be decreased as much as possible by lowering the nose gear and raising the flaps before applying brakes. This procedure will improve braking action since the load on the tires will be increased thus increasing the frictional force between the tires and the runway. Reverse pitch propellers should be used whenever possible in lieu of wheel braking.

OPTIMUM BRAKING ACTION.

After touchdown when the nosewheel has contacted the runway, a single smooth application of the brakes with constantly increasing pedal pressure will result in optimum braking. This procedure will provide the shortest stopping distance possible from braking action.

BRAKE COOLING.

During a series of successive landings, a minimum of 15 minutes should elapse between landings where the landing gear remains in the slip stream, and a minimum of 30 minutes between landings with the landing gear retracted, to allow adequate cooling time between brake applications. This time restriction is not applicable to touch-and-go type landings when no brake application is involved. The brakes should not be dragged while taxiing, and should be used as little as possible for turning the aircraft on the ground. At the first indication of brake malfunction, or if brakes are suspected to be in an overheated condition after excessive use, the aircraft should be maneuvered off the active runway and stopped. The aircraft should not be taxied into a crowded parking area and the parking brakes should not be set. Overheated wheels and brakes will be cooled before the aircraft is subsequently towed or taxied. Peak temperatures in the wheel and brake assembly are not attained until some time after a maximum braking operation is completed (the time required may vary from 5 to 60 minutes). In extreme cases heat build-up can cause the wheel and tire to fail with explosive force or be destroyed by fire if proper cooling is not effected. Taxiing at low speeds to obtain air cooling of overheated brakes will not reduce temperatures adequately and can actually cause additional heat build-up.

Note

The time required to reach peak temperatures is dependent upon various factors such as the severity of the maximum braking operation, wheel and brake assembly installation in different aircraft, etc.

SYNCHRONIZER OPERATION.

With the stepmotor electric-head system, the governor speed setting is controlled by the operation of a commutator switch which energizes the multiple-field stepmotor in the head, and changes the adjustment of the speeder spring by a gear train and track. These commutating switches are driven by three-phase differential motors which are driven by the airplane engines. The output of the propeller synchronizer generator on the master engine is fed into the fields of each of the three differential motors, and the output of each of the propeller synchronizer "slave" generators, is fed into the armature of a corresponding differential motor. Thus, the frequency of the voltage from each of the slave generators is continually compared with that of the master propeller synchronizer generator, through the medium of the differential motor and its associated commutating switch. This rotation produces a change in the setting of the governor speeder spring, through operation of the stepmotor head, and direction of change is such that speed of the slave engine (as characterized by the frequency of the propeller synchronizer generator output) is altered until synchronism with master engine results. A mechanical device on the connection between each differential motor and commutator switch limits the synchronization within three percent of the master engine speed. However, a decrease in speed or even failure of the master engine cannot drag the speed of the slave engine down more than three percent.

Individual adjustment of governor speed setting is obtained through the use of double-throw toggle switches at the flight engineers lower switch panel. Operation of each toggle switch disconnects the differential motor commutator switch from the stepmotor head, and substitutes commutator switches driven by the non-reversible dc motor. Reversal of the stepmotor rotation by the toggle switch results from the reversal of two of the three leads to the stepmotor.

The dc motor drives four commutator switches, one for each stepmotor head. Any toggle switch, by relay action, connects its head to its commutator switch and starts the motor so that any number of heads may be adjusted simultaneously. The toggle switches override both the synchronizer and the master lever control. Master lever control of all units simultaneously is achieved through the adjustment of a cable control to the synchronizer box. The master control consists of an off-seeking, reversible followup element which is driven through a clutch by the reversible dc motor and commutator switch combination. Movement of the master element towards INCREASE or DECREASE speed position, energizes the motor which will drive the followup element in the proper direction so that the mechanism will resume the OFF position. At the same time, relays disconnect all stepmotor heads from the differential motor commutator switches and connect them to the commutator switch driven by the reversible motor energizing all four governor head stepmotors to adjust the speed setting in the direction of and proportional to the master element movement. Synchronization is momentarily cut-out during the brief initial movement and followup period. When the master control is advanced to takeoff rpm position, all governors are set to their positive high-speed stops regardless of their initial settings and the synchronizing features are cut-out so failure of the master engine on takeoff would have no effect upon the slave engine. When the resynchronize pushbutton is pressed and released it will allow each slave engine stepmotor head to move three percent of the speed of the slave governor toward synchronization with the master engine. It may be necessary to press the pushbutton several times to get synchronization, if any engine is operating outside the three percent range. It is usually more convenient to approach synchronization by means of the individual toggle switches on each engine before using the resynchronize button.

FLIGHT INSTRUMENT AND NAVIGATIONAL AIDS TROUBLE SHOOTING PROCEDURES.

INVERTER FAILURES.

There are five inverters on the TC-121C and six inverters on the EC-121D. All of these inverters have inverter control circuit breakers to protect the control circuits (5 amp rating). They also have inverter power circuit breakers to protect the dc motor that drives the ac generator of the inverter system (30 amp rating for the emergency inverter and 150 amp rating for the others). When troubleshooting all EC-121D/TC-121C inverter systems, check the inverter control and power circuit breakers; loss of either one will cause inverter failure. You will note an apparent discrepancy between the TC-121C and EC-121D instrument inverter placards. In the TC-121C the placard reads MAIN INV while in the EC-121D the placard reads NO. 1 INV. Either the term "main inverter" or "number one inverter" may be used during trouble shooting procedures.

ATTITUDE GYRO FAILURE.

1. Check copilots attitude gyro (indicator). If it is operating replace pilot's attitude gyro fuse located on the MJB 2A circuit breaker panel. If both attitude gyros (indicators) are inoperative proceed as follows:

a. Switch to spare inverter.

b. If spare inverter is inoperative, switch to emergency inverter.

c. If emergency inverter is inoperative, check emergency inverter control and power circuit breakers located on the 238 circuit breaker panel.

d. If both attitude gyros are still inoperative, check the four attitude gyro fuses located on the MJB 2A circuit breaker panel.

2. Troubleshooting procedures for the main (number one) and spare inverter:

a. Check the inverter control circuit breaker located on the MJB 3 circuit breaker panel.

b. Check the inverter power circuit breakers.

EC-121D—Located on the remote circuit breaker panel.

TC-121C—Located on the 260 circuit breaker panel.

c. Check the number one ac transfer fuse panel located in the forward baggage compartment (TC-121C) labeled 115-VOLT AC TRANSFER fuse). See T.O. 1C-121(R)D-2 for detailed diagram of inverter fuses and relay fuse.

CAUTION

This is a HOT FUSE panel. Do not troubleshoot unless an actual emergency situation dictates.

3. After inverter power is restored:

a. Flight instrument power switch (emergency inverter)—Switch to NORMAL (off).

b. Instrument inverter switch — Switch from SPARE back to MAIN (NO. 1) position.

Note

This sequence enables you to check the spare inverter before returning back to the main inverter. Watch for reappearance of flags on the attitude indicators.

TURN-AND-SLIP INDICATOR FAILURE.

1. Replace pilot's or copilot's turn and bank fuse located on the MJB 2A circuit breaker panel.

2. Check the turn and bank indicator circuit breaker located on the 238 circuit breaker panel (when operating with the emergency inverter on EMERGENCY position).

CGRS V-8 INDICATOR FAILURE (EC-121D).

1. Check the following items located on the radar technician's ac power panel.

a. Phase A heading circuit breaker (required on some aircraft).

b. Electronic inverter power (required on some aircraft). Switch to spare inverter. If spare inverter is inoperative, check the electronic inverter power circuit breakers located on the dc external power control box. This box is located in the rear of the forward baggage compartment.

2. Check the CGRS amplifier located under the navigator's table. Check verticality of the CGRS platform by observing roll and pitch dials. These dials should indicate approximate aircraft attitude. If the platform is not erect check CGRS power sources (dc power and number one instrument inverter). If interruption of power has occurred repeat the erection cycle. The aircraft must be flown straight and level during this period (13 to 15 minutes). (Refer to CGRS Operation, Section IV.)

Note

The radar technician can perform limited maintenance (replace some tubes) on the CGRS amplifier.

G-2 COMPASS MASTER HEADING INDICATOR FAILURE (TC-121C).

1. Check G-2 compass circuit breakers (located on MJB 2A circuit breaker panel).

2. Check G-2 compass muses located in G-2 compass amplifier box. This box is located on the radio rack behind the pilot's head.

CAUTION

This is a HOT FUSE panel. Do not troubleshoot unless actual emergency situation dictates.

FLUXGATE SYSTEM/RMI CARDS FAILURE.

1. Check the master direction indicator (MDI) located on the copilot's instrument panel. If the MDI is inoperative, check the PB-10 amplifier circuit breakers located on the MJB 2A circuit breaker panel. If still inoperative, check automatic pilot switch located on MJB 3 circuit breaker panel.

2. If the MDI is operating, proceed as follows:

a. EC-121C and TC-121C: Check the C-1 amplifier. To accomplish this check, place the radio compass in LOOP position and rotate the ADF needle. If the ADF needle will not rotate the C-1 amplifier is inoperative. Reset the C-1 amplifier circuit breaker located on the radio operator's circuit breaker panel. If still inoperative, check the C-1 amplifier fuse located in the number one ac transfer fuse panel (TC-121C; labeled 115-VOLT AC TRANSFER fuse). This panel is located in the forward baggage compartment.

CAUTION

This is a HOT FUSE panel. Do not troubleshoot unless actual emergency situation dictates.

b. TC-121C: Check the electronic inverter power. If inoperative, switch to spare inverter. If still inoperative check the electronic inverter control circuit breaker located on the radio operator's circuit breaker panel and the electronic inverter power circuit breakers located on the dc external power control box. This box is located in the rear of the forward baggage compartment.

c. EC-121D: Check the VOR fuse located on the forward radio junction box.

VOR RECEIVER FAILURE.

1. Check ARN-14 ON/OFF switch.

2. Check the VOR receiver circuit breaker located on the radio operator's circuit breaker panel.

3. EC-121D: Check the VOR fuse located on the forward radio junction box. Failure of this fuse will make the RMI cards unreliable and will render the number two needle inoperative.

ADF RECEIVER FAILURE.

1. Check the ARN-6 function switch for control of the receiver and assure the function switch is in the COMPASS position.

2. Check the ADF receiver circuit breaker located on the radio operator's circuit breaker panel.

3. EC-121D: Check the ADF fuse located on the forward radio junction box. Failure of this fuse will render the number one needle inoperative in ADF or LOOP position.

TACAN FAILURE.

1. Check the TACAN switch position on T/R.

2. Check inverter power.

a. EC-121D: Number two inverter. If inoperative, switch to spare inverter. If still inoperative, check the number two inverter control circuit breaker located on the MJB 3 circuit breaker panel, and the number two and spare inverter power circuit breakers located on the remote circuit breaker panel.

b. TC-121C: Electronic inverter. If inoperative, troubleshoot as indicated in Fluxgate System/RMI Cards Failure check (2b).

3. EC-121D: Check the TACAN fuse located on the forward radio junction box.

4. Check the TACAN circuit breakers.

a. EC-121D—Located on the radio operator's auxiliary circuit breaker panel.

b. TC-121C—Located on the radio operator's circuit breaker panel.

ILS RECEIVER FAILURE.

1. Check with airport tower to determine if ILS localizer/glide slope is operating normally.

2. Check ILS receiver circuit breakers located on the radio operator's circuit breaker panel.

3. Check ILS receiver ac electrical power.

a. TC-121C: Electronic inverter. If inoperative, troubleshoot as indicated in Fluxgate System/RMI Cards Failure check (2b).

b. EC-121D: Number two inverter. If inoperative, troubleshoot as indicated in Tacan Failure check (2a).

AC ENGINE INSTRUMENT FAILURE.

Check the appropriate engine instrument fuse (one for each engine) located on the lower MJB 212 panel. If two engines on the same side are affected, check the appropriate fuse in the number one (main) ac transfer fuse panel located in the forward baggage compartment.

CAUTION

This is a HOT FUSE panel. Do not troubleshoot unless emergency situation dictates.

FDS TROUBLESHOOTING.

1. Check position of IFS VERT GYRO switch (located on MJB 2A circuit breaker panel).

2. Check ac or dc circuit breakers—Open (located on the radio operator's auxiliary circuit breaker panel).

a. Bank steering bar will be inoperative.

b. Pitch steering bar will precess during turns on both ILS and HDG function.

3. DC fuse failure indications (located on the MJB 2A circuit breaker panel):

a. Gyro cage light will come on.

b. FDS vertical gyro indicator will stay in green range.

c. Pitch steering bar will be inoperative.

d. Bank steering bar will be unreliable.

e. Horizon bar will be inoperative.

f. Compass card will be unreliable.

4. AC fuse failure indications (located on the MJB 2A circuit breaker panel):

a. Gyro cage light will come on.

b. FDS vertical gyro indicator will drop out of green range.

c. Bank steering bar will be inoperative.

d. Pitch steering bar will be inoperative.

e. Horizon bar will be inoperative.

f. Compass card will be inoperative.

5. If the dc fuse located on the MJB 2A circuit breaker panel has failed and cannot be replaced, turn OFF the IFS VERT GYRO switch or pull the ac fuse located on the MJB 2A circuit breaker panel. This will stop compass card rotation and render the bank steering bar inoperative.

a. When the ARN-14 receiver is tuned to a VOR station, set the head of the course arrow to the desired radial (normal operation with the exception that compass card will not be orientated).

b. When tuned to an ILS station set the head of the course arrow to the top of the instrument and use for azimuth indications. The glide slope indication will be taken from the glide slope indicator. (Azimuth and glide slope indications are relative positions of the aircraft and appropriate corrections will have to be made on supporting instruments. Procedure will be similar to an approach using the ID-249.)

LOCATIONS OF ADDITIONAL CIRCUIT BREAKERS AND FUSES.

1. APN-22 circuit breaker—Radio operator's circuit breaker panel.

2. Wing flap fuse—Lower 212 circuit breaker panel.

3. Wing flaps shutoff circuit breaker—MJB 3 circuit breaker panel.

4. Gear and flap circuit breaker—MJB 3 circuit breaker panel.

5. Gear up-lock circuit breaker—MJB 3 circuit breaker panel.

Section VIII—CREW DUTIES

TABLE OF CONTENTS

	Page
PILOT	8-1
COPILOT	8-1
FLIGHT ENGINEER	8-1
NAVIGATOR	8-1
RADIO OPERATOR	8-5
SENIOR WEAPONS CONTROLLER AND/OR RADAR CREW CHIEF	8-7
SEARCH RADAR OPERATOR	8-9
FIRST AND SECOND RADAR TECHNICIAN	8-10

INTRODUCTION.

The successful completion of an assigned mission is dependent upon crew coordination as well as the proficiency and training of each crew member. The duties are divided among the crew members on the premise that AEW and C aircraft function with maximum efficiency as a result of flight crew cooperation. Adherence to the following items will establish the basic requirements of crew coordination, and aid in blending the skill and abilities of the individual crew members into an efficient team. Standard phraseology should be used during all flight operations and those terms selected must be clear and familiar to flight crew members. Unnecessary conversation between crew members should be avoided during certain phases of the flight such as takeoff, approaches, landings, and *especially during emergencies*. Communications at these times should be limited to pertinent orders and responses. Commands must be clear to preclude the necessity of repeating a command or an acknowledgment. Misunderstanding a command may result in confusion and could induce a hazard to safe flight.

PILOT.

The pilot is responsible for the progress and completion of a successful flight. He is vested with the authority to carry out this responsibility, and is in command of assigned crew members from the time they report for duty until termination of such assignment. The pilot's orders should receive prompt compliance; however, other crew members shall bring to his attention such information and factors of importance which could have a direct bearing on his ultimate decision in instances which involve safety in flight.

Your normal and emergency abbreviated checklists are now contained in T.O. 1C-121(E)D-(CL)1-1.

COPILOT.

The copilot is second in command and shall assist the pilot at such times the pilot in command deems necessary.

Your normal and emergency abbreviated checklists are now contained in T.O. 1C-121(E)D-(CL)1-1.

FLIGHT ENGINEER.

The flight engineer is directly responsible to the pilot in command. The amplified checklist for the flight engineer is covered in detail in Sections II and III.

Your normal and emergency abbreviated checklists are now contained in T.O. 1C-121(E)D-(CL)1-2.

NAVIGATOR—NORMAL PROCEDURES.

The navigator is responsible for all matters pertaining to navigation and radar stabilization. He will perform the following preflight inspection of navigation equipment and report the condition to the pilot.

MISSION PLANNING.

1. Mission requirements—CHECKED AND UNDERSTOOD.

2. Weather—CHECKED AND RECORDED WINDS.

3. Navigation kit—CHECKED AND COMPLETED.

4. Time hack—OBTAINED.

5. Flight plan—COMPLETED.

PREFLIGHT.

1. B-6 driftmeter lens (exterior)—CLEAN.

2. Radar technician's spare tubes for APN-70—CHECKED.

3. Form 781—CHECKED.

4. Flight engineer's electrical power check—COMPLETED.

5. Radar technician's ac power panel—CHECKED.

   a. External power—ON.

   b. Inverter switches—ON.

   c. Four CGRS circuit breakers—ON.

CAUTION

When starting the CGRS in cold weather, leave dc circuit breakers off for 15 minutes if outside temperature is below 0°C.

6. CICO position—CHECKED.

   a. GPI Standby/Operate switch—OPERATE.

7. Navigator's aux ICS panel—CHECKED.

   a. CICO, ACICO, PLOTTER lights—FLASH.

8. Interphone, PA speaker—CHECKED.

Note

Items 9 through 13 are turned on for required warmup periods prior to operational checks.

9. APA-57 (C-1061)—ON.

   a. Power switch—ON.

   b. Standby/Normal switch—STANDBY (allow 5 minutes for warmup).

10. APN-70 LORAN—ON.

11. SCR-718 radar altimeter—ON (½ max gain).

12. ARN-6—ON.

13. Driftmeter—CAGED AND ON.

14. CGRS control panel—Set.

   a. DG/MAG—DG.

   b. LAT-Kn Auto/Manual—MANUAL.

   c. Knots—Set 0.

   d. Var Auto/Manual—MANUAL.

   e. Variation—Set 0.

   f. Latitude—Local latitude.

15. Sextant alignment (in mount)—CHECKED.

   a. Lights—Checked.

   b. Internal alignment—Checked.

   c. External alignment—Checked.

   (1) Read 162½/197½ on antenna connectors on left and right vertical stabilizer or

   (2) Read 097½/262½ on center of left and right tip tank filler caps.

16. APA-57 (C-1061) drift check—OBSERVED AND SET.

   a. Position counters—150 on all 4 counters.

   b. Wind counters—0.

   c. Standby/Normal switch—NORMAL (for 5 min, no motion of counter).

17. APN-70—LORAN calibration and operation—CHECKED.

   a. Power switch—ON.

b. Signals on function 1—Checked.

c. Local/Distant switch—Checked.

Check for signal strength and buzz of ant. coupler CU-308 only.

Note

Antenna coupler CU-308A and CU-308B will not buzz. Observe Loran scope while a radio transmitter is keyed.

d. Pulse drift—Checked on function 3, ADC OFF.

e. Insure pulse locks on left edge of tract—Checked on function 3, ADC ON.

f. Indicator limits—CHECKED. Check W & Y counters, Upper—23530 (± 4) ms, Lower—98375 (± 4) ms.

g. Pip alignment—Checked and noted.

Check on function 5 on several even 100 readings near 3000 or 4000 (± 2) ms tolerance (apply indicated correction as necessary to fix readings).

h. Drop out—Checked. Check functions 2, 4, or 5 on the following channels:

2H7—13025	2H3—13225
2H6—13075	2H2—13275
2H5—13125	2H1—13325
2H4—13175	2H0—13375

Note

Any error noted should remain constant for all channels (± 10 ms tolerance).

i. Power switch—OFF.

18. APA-57 (C-1061)—CHECKED.

a. Standby/Normal switch—STANDBY.

b. Position reset knobs to limits and check for no physical binding. Limit lights should come on at approximately 5 and 295. Return all position counters to 150.

CAUTION

Do not force position counters past limits.

c. Wind counters—180N and 180E.

d. Standby/Normal switch—NORMAL.

After 10 minutes all position counters to read 120 (± 3) miles.

19. SCR-718 radar altimeter—CHECKED.

a. Circle/size control—Adjust.

b. OFF/ON rec gain control—Adjust pulse (approximately ¼ in. high).

c. Zero adjust—Checked (X1-X10).

d. OFF/ON rec gain control—OFF.

20. Automatic pilot (fluxgate caging)—CHECKED.

a. Automatic pilot cage switch—CAGE momentarily (check RMI reaction).

21. ARN-6 radio compass—CHECKED.

a. Tuning dial and band switch—ANT. pos. Tune to local station.

b. Function switch—COMPASS pos #1 (Needle of RMI should point to station).

c. L-R switch—LOOP pos. Check for proper rotation of #1 needle.

22. B-6 Driftmeter—CHECKED.

a. Lights—Checked.

b. Focus control—Adjusted.

c. Caging control—UNCAGE (if gyro tumbles, check fuses).

d. Horizontal align—Read 005° on nose gear door actuating cam. (Compute correction if required.)

e. Caging control—CAGED.

f. Azimuth—270°.

23. APA-57 (C-1061) (after 10 min.)—CHECKED.

a. Standby/Normal switch—STANDBY.

b. Wind counters—180S AND 180W.

c. Position counters—120 on all 4.

d. Standby/Normal switch—NORMAL. After 10 min all position counters to read 150 (± 3) miles.

24. Central gyro reference system (CGRS)—CHECKED.

a. Control panel—Checked.

(1) Fast erect light—ON.

(2) Ground speed dial—Set 200 knots (check dial on servo-amplifier follows. Return to zero).

(3) MAG/DG switch—MAG.

(4) Annunciator window and L-R switch—Align compass by centering annunciator. Compare with RMI.

b. Servo-amplifier (CGRS)—Checked.

(1) Platform alignment—Rotate Z axis dial to 0.

(2) X-Y integrator—Dial to move CCW one white sector/sec.

(3) X-Y erection—Smallest dial in 2 axis window to move CCW 6 lines/min.

(4) Roll indicator—0°.

(5) Pitch indicator—Approximately 3° nose down.

(6) Compass set and L-R switch—Turn "TH" indicator through 360°, stopping at each 30° and comparing V-8CP-132 for proper following.

25. Personal equipment—CHECKED.

a. Life preserver (LPUR)—Safety threads secure, inspection due date not expired.

b. Anti-exposure suit (R1A)—Last inspection date within 60 days, check seal.

26. Pressure altimeter set at 29.92—CHECKED.

27. All electrical equipment (except CGRS)—OFF.

28. Preflight report to pilot—PREFLIGHT COMPLETED.

BEFORE TAKEOFF.

1. CGRS—SET.

a. Control panel—Checked.

(1) Normal erect light—ON.

(2) Ground speed dial—Set 200 knots.

(3) Latitude dial—Set station latitude.

2. B-6 driftmeter—CAGED AND STOWED AT 270°.

3. Periscopic sextant and stand—STOWED.

4. Navigation equipment and stool—STOWED.

5. Flight plans (navigator's and pilot's)—CHECKED.

6. IFF/SIF settings—CHECKED.

7. All electrical navigation equipment (except CGRS) —OFF.

BEFORE LANDING.

1. APA-57 (C-1061)—SET AND OFF.

a. Standby/Normal switch—STANDBY.

b. All position counters—Set at 150.

c. All wind counters—Set at zero.

2. B-6 driftmeter—CAGED & STOWED AT 270°.

3. Periscopic sextant and stand—STOWED.

4. Navigation equipment and stool—STOWED.

5. All electrical navigation equipment (except CGRS) —OFF.

POST FLIGHT.

1. Navigation equipment malfunction(s)—ENTERED IN FORM 781.

2. HO 249 tables—RETURNED TO NAVIGATOR DRAWER.

3. Flight time (day, night and total)—RECORDED.

4. Maintenance debriefing—ATTENDED.

5. Periscopic sextant, personal and survival equipment —PLACED ON CART.

6. Weather and crew debriefing—COMPLETED (as required).

7. Navigator's log and forms—TURNED IN.

8. Crew personal and survival equipment—TURNED N.

NAVIGATOR—EMERGENCY PROCEDURES.

ELECTRICAL FIRE.

1. Electrical equipment—OFF.

2. Standby to assist.

DITCHING/CRASH LANDING/BAILOUT.

a. Navigator's amplifier ditching/crash landing/bailout checklists are contained in Section III.

FUEL DUMPING.

1. Radios and electrical equipment—OFF.

After Dumping.

1. Radios and electrical equipment—AS NECESSARY.

RADIO OPERATOR—NORMAL PROCEDURES.

The primary duty of the radio operator is to operate and check the radio equipment to assure the maintenance of communications throughout the mission. The following is a checklist for this position. Although these duties are the primary responsibility of the first radio operator, he may delegate any of these duties to the second radio operator.

MISSION PLANNING.

1. Pertinent NOTAMS and information file—CHECKED.

2. Tool kit—COMPLETE.

Refer to local directives for required items.

3. Radio operator's kit—COMPLETE.

Refer to local directives for required items.

4. Briefing—AS REQUIRED.

VISUAL PREFLIGHT—EXTERIOR.

1. Antennas, antenna masts and insulators—CHECKED.

Check all antennas, antenna masts and insulators for proper tension and mounting.

2. Loop and radome condition—CHECKED.

Check loops and radomes for abrasions, chipped areas and cleanliness.

3. Static discharge wicks—CHECKED.

Check for installation and proper length.

4. Condition of mechanics ICS control boxes—CHECKED.

VISUAL PREFLIGHT—INTERIOR.

All equipment visual checks shall include cabling, antenna connection, fuses, alignment and security.

1. (EC-121D) Jumpmaster station—CHECKED.

Check the C-823 and C-823 tailcone, headset, MIC, UHF No. 2 and No. 3, AM-291, RE-120's and harmonic suppressors.

2. (EC-121D) Aft lower baggage compartment—CHECKED.

Check the UHF No. 4 and No. 5, LAC ICS amplifiers, RE-120's and harmonic suppressors.

3. (EC-121D) AOC compartment—CHECKED.

Check LAC ICS dynamotors, CIC junction box fuses, AM-203, R101-PD-5/ARN-6.

4. Radio operator station equipment—INSTALLED.

Check installation of all equipment including seat, seat tracks and lock.

5. Navigator's station radio equipment—INSTALLED.

Check all applicable radio equipment (including CRT-3 stowage, inspection and repack dates).

6. Forward lower baggage compartment—CHECKED.

Check UHF No. 1 and No. 8, C-823's and all other applicable equipment.

7. Form 781 and G file—CHECKED.

8. Forward radio rack equipment—CHECKED.

9. Forward radio junction box, fuses and circuit breakers—CHECKED.

10. Proper aircraft power—CHECKED.

OPERATIONAL PREFLIGHT.

1. Radio operator's station circuit breakers (all applicable circuit breakers)—ON.

2. Radar technician's station circuit breakers (all applicable breakers)—ON.

3. Auxiliary junction box circuit breakers (all applicable breakers)—ON.

4. CIC interphone junction box circuit breakers (all applicable breakers)—ON.

5. Electronic inverter switch (if applicable)—ON.

6. UHF No. 6 control box switches (if applicable)—ON AND REMOTE.

Check that control box dials are locked and for proper channelization.

7. Liaison No. 2—ON AND SET TO TIME HACK.

8. Liaison HF—ON.

9. Flight station radios and equipment—CHECKED.

a. Mechanics ICS switch—ON.

b. Pilots' radio equipment—ALL ON.

c. Headset and mics—Checked.

d. Pilot's and engineer's flight crew ICS system—Operational.

e. PA and emergency ICS system—Operational.

f. Auxiliary interphone control panel—Checked.

g. Liaison HF remote operation—Checked.

h. Radio compass (all bands, all functions, alignment, indicators, bearings and filters)—Operational.

i. Command HF—Operational.

j. ILS equipment (audio output, bearings, course selector, indicators, and marker-beacon light)—Operational.

k. FDS—Operational.

l. Radar altimeter—Operational.

m. UHF No. 6 (2-way communications, antenna relay, ADF operation and channelization cards) — Checked.

n. Tacan equipment (audio output, bearings, course selector, indicators, and audio selector switches)—Operational.

o. All clocks—Set.

p. Aldis lamp—Checked.

10. Flight station operational preflight—COMPLETED.

Upon completion of preflight properly stow all headsets and mics. Place all other equipment on normal frequencies. Turn off all equipment except UHF No. 6 and PA system.

Note

The UHF No. 6 and PA system will remain ON for use in case of ground emergencies.

11. Galley headset, mic and interphone—CHECKED.

12. Liaison HF (2-way communication) — OPERATIONAL.

13. Hand key operation and adjustment—CHECKED.

14. Auxiliary interphone control panel and flex lights —ALL CONTROLS CHECKED.

15. Radio operator's flight crew ICS system—OPERATIONAL.

16. UHF No. 7 and No. 8 control box switches—ON AND REMOTE.

Check 2-way communication, relay operation, control box dials locked and proper channelization and channelization cards.

17. IFF/SIF—OPERATIONAL (if applicable).

18. ARR-15 controls and channelization—CHECKED.

19. Clock—SET.

20. Radio operator's station operational preflight—COMPLETED.

Upon completion of preflight stow headset and mic. Turn all equipment off.

21. Navigator's radio equipment (coordinate with navigator)—PREFLIGHT COMPLETED.

Insure proper operation of flight crew ICS, auxiliary interphone control panel, ARN-6 compass and filter operation.

22. (EC-121D) AOC compartment radio equipment (coordinate with senior weapons controller or crew chief)—PREFLIGHT COMPLETED.

Insure proper operation of AOC ICS, CIC PA controls, UHF No. 1 through 5, and associated antenna relays.

23. (EC-121D) Jumpmaster station headset, mic and interphone—CHECKED.

AFTER PREFLIGHT.

1. Form 781—ALL DISCREPANCIES NOTED.

2. Maintenance personnel — DISCREPANCIES REPORTED.

3. Preflight report to pilot—PREFLIGHT COMPLETED.

Advise pilot that preflight is complete and of any discrepancies noted. Keep pilot posted on progress of clearing discrepancies.

4. Personal equipment—FITTED, CHECKED AND STOWED.

PRIOR TO TAXI.

1. Overwing hatches—CLOSED.

2. Interphone, PA and alarm bell—CHECKED AND REPORTED.

3. (EC-121D) CGRS fast erect light and gyro—CHECKED AND REPORTED.

4. IFF/SIF controls—STANDBY.

DURING TAXI.

1. Tower communications—MONITORED.

2. Radio log—INITIATED.

3. Safety belt—FASTENED.

4. Applicable personal equipment—DONNED.

IN FLIGHT.

1. IFF/SIF controls—ON AND SET AS REQUIRED.

2. Over wing check (after take-off)—COMPLETED AND REPORTED.

Make overwing check report to the pilot after take-off and hourly during the flight.

3. Radio log—MAINTAINED.

4. All applicable equipment—ON AND SET.

5. All necessary messages—TRANSMITTED.

6. Quality of communications—MAINTAINED.

Coordinate with other crew members to insure that they have the desired quality of communications.

AFTER LANDING.

1. IFF/SIF cotnrols—OFF (codes removed).

Note

Turn off as soon after landing as possible. This will eliminate signals from taxiing or parked aircraft which would otherwise block the controller's scope and interfere with the control of airborne aircraft. IFF codes removed.

POSTFLIGHT.

1. All radio equipment and circuit breakers—OFF.

2. All loose equipment (headset, mic, safety belt, etc.)—STOWED.

3. Form 781—COMPLETED.

4. Kits, logs, forms and reports—TURNED IN.

RADIO OPERATOR—EMERGENCY PROCEDURES.

ELECTRICAL FIRE.

1. Electrical equipment—OFF.

2. Standby to assist.

DITCHING/CRASH LANDING/BAILOUT.

a. Radio operator's amplified ditching/crash landing/bailout checklists are contained in Section III.

FUEL DUMPING.

1. ~~Radios and electrical equipment—OFF~~.
H.F. TRANSMITTER — OFF

After Dumping:

~~1. Radios and electrical equipment—AS NECESSARY~~.
H.F. TRANSMITTER AS NECESSARY.

SENIOR WEAPONS CONTROLLER AND/OR RADAR CREW CHIEF—NORMAL PROCEDURES.

The senior weapons controller is responsible for the efficient operation of the airborne operation center and that the radar crew complies with all instructions and directives. He will be positioned at ACO No. 1. The radar crew chief is responsible to the senior weapons controller for efficient operation of the airborne operation center. He will be normally positioned at CICO.

SENIOR WEAPONS CONTROLLER.

MISSION PLANNING.

1. CDIF—REVIEWED.

2. Senior controller/ICT classified kit checked out—COMPLETED.

3. Detailed radar crew briefing—COMPLETED.

4. General crew briefing—COMPLETED.

PREFLIGHT.

1. Radar/communications system—OPERATIONAL.

2. Preflight report to pilot—COMPLETED.

3. Radar crew survival equipment—FITTED AND STOWED.

4. Assume ditching position—COMPLETED.

IN FLIGHT.

After takeoff and enroute to station.

1. Radar equipment turn on—COMPLETED.

2. Radar and radio listening watch—ESTABLISHED.

3. Air situation (from aircraft on station — OBTAINED.

4. All crew positions manned prior to assumption of station—COMPLETED.

ON STATION.

1. Operation directives—COMPLIED WITH.

a. Conduct operation in accordance with existing directives.

2. Air situation passed to relieving aircraft—COMPLETED.

INBOUND FROM STATION.

1. Radar and radio listening watch—ESTABLISHED.

2. All unnecessary equipment—OFF.

3. All radar equipment (as directed)—OFF.

4. Assume ditching position—COMPLETED.

POSTFLIGHT.

1. Form 781 write ups—COMPLETED.

2. Classified logs, forms and kits—TURNED IN.

3. Mission summary—PHONED TO COC.

4. Debriefing (bring up pertinent data) — COMPLETED.

RADAR CREW CHIEF.

MISSION PLANNING.

1. CDIF—REVIEWED.

2. Unclassified kit checkout—COMPLETED.

3. Aircraft on station information—RECORDED.

4. Radar crew duties—ASSIGNED.

5. Ditching positions—ASSIGNED.

6. Detailed radar briefing—COMPLETED.

7. General crew briefing—ATTENDED.

PREFLIGHT.

1. Radar/communication system—OPERATIONAL.

2. Intercommunication system check (all AOC positions)—COMPLETED.

3. UHF sets channelized to appropriate frequencies—COMPLETED.

4. UHF radio check on each set—COMPLETED.

5. Additional operations—COMPLETED.

a. Obtain WWV time hack—Completed.

b. Set all clocks in the AOC compartment—Completed.

c. 0-15 scope cameras—Checked.

d. Data card—Filled out.

e. Film magazine—Installed.

6. Preflight report to SWC—COMPLETED.

7. PA and alarm bell check—ACKNOWLEDGED.

8. All loose equipment—STOWED.

9. All radar crew members in ditching positions—CHECKED.

10. Advise COC of block time—COMPLETED.

IN FLIGHT.

After Takeoff And Enroute To Station.

1. Advise COC of takeoff time—COMPLETED.

2. Advise DC/NOC (SAGE) of station assumption and pass all data—COMPLETED.

3. Scope alignment check—COMPLETED.

4. Height finder alignment check—COMPLETED.

5. Post status boards—COMPLETED.

6. UHF radio checks (all sets)—COMPLETED.

7. IFF check (with aircraft on station) — COMPLETED.

8. Air situation (from aircraft on station) — OBTAINED.

9. Crew position manned prior to assumption of station—COMPLETED.

ON STATION.

1. Operation directive—COMPLIED WITH (conduct operation in accordance with existing directives).

2. Heading marker check—COMPLETED.

3. Air situation—PASSED TO RELIEVING AIRCRAFT.

4. Departure time and required information—PASSED TO GROUND FACILITY.

INBOUND FROM STATION.

1. Radar and radio listening watch—ESTABLISHED.

2. All loose equipment—SECURED AND STOWED.

3. All radar crew members in ditching positions—CHECKED.

4. Advise COC of landing time—COMPLETED.

POSTFLIGHT.

1. Unclassified kits, logs, forms and reports—TURNED IN.

2. Debriefing (bring up pertinent data) — COMPLETED.

SENIOR WEAPONS CONTROLLER AND/OR RADAR CREW CHIEF—EMERGENCY PROCEDURES.

CABIN FIRE.

Supervise the following:

1. Radar blower fan switches—OFF.

2. Portable fire extinguishers—AS NECESSARY.

ELECTRICAL FIRE.

Supervise the following:

1. Radar blower fan switches—OFF.

2. AC generator circuit breakers—TRIPPED.

3. Portable fire extinguishers—AS NECESSARY.

SMOKE/FUME REMOVAL.

Supervise the following:

1. Emergency exits—OPEN.

DITCHING/CRASH LANDING/BAILOUT.

a. Senior weapons controller amplified ditching/crash landing/bailout checklists are contained in Section III.

FUEL DUMPING.

Supervise the following:

1. Radar equipment controls—OFF.

2. Radio equipment—OFF.

After Dumping:

1. Radar equipment—AS NECESSARY.

SEARCH RADAR OPERATOR—NORMAL PROCEDURES.

The search radar operator is responsible for the efficient operation of surveillance equipment as directed by the radar crew chief.

MISSION PLANNING.

Prior to briefing.

1. Report to squadron operations.
2. Assist radar crew chief as directed.

Briefing.

1. Detailed radar briefing—ATTENDED.
2. General crew briefing—ATTENDED.

PREFLIGHT.

1. Duties as prescribed by the radar crew chief—COMPLETED.

a. Report preflight discrepancies to radar crew chief.

2. Survival equipment—CHECKED AND STOWED.
3. All loose equipment—STOWED.
4. Assume ditching position—COMPLETED.

IN FLIGHT.

1. Duties as prescribed by the radar crew chief—COMPLETED.
2. Assume ditching position—COMPLETED.

POSTFLIGHT.

1. Head sets and seat belts—STOWED.
2. Assist crew chief as directed—COMPLETED.
3. Survival equipment stowed or removed—COMPLETED.
4. Debriefing—ATTENDED.

SEARCH RADAR OPERATOR—EMERGENCY PROCEDURES.

CABIN FIRE.

1. Portable fire extinguishers — ASSIST AS REQUIRED.

ELECTRICAL FIRE.

1. Portable fire extinguishers — ASSIST AS REQUIRED.

SMOKE/FUME REMOVAL.

1. Standby to assist.

DITCHING/CRASH LANDING/BAILOUT.

a. Search radar operators amplified ditching/crash landing/bailout checklists are contained in Section III.

FUEL DUMPING.

1. Radio equipment—OFF.

After Dumping:

1. Radio equipment—AS NECESSARY.

FIRST AND SECOND RADAR TECHNICIANS—NORMAL PROCEDURES.

The primary duty of the radar technicians is to maintain all airborne early warning radar equipment in operating conditions throughout the mission. Although these duties are the primary responsibility of the first radar technician, he may delegate any of these duties to the second radar technician. The aircraft commander and senior weapons controller will be notified of equipment status, changes of status and problems encountered immediately upon determining the condition. One radar technician will remain in the radar compartment at all times when the radar equipment is operating. Duties further include performing the following checklist:

MISSION PLANNING.

1. Equipment, reports and history—CHECKED.
2. Tools—CHECKED.
3. Briefing—AS REQUIRED.

PREFLIGHT.

1. Form 781, all sections—CHECKED.
2. APS-95 antenna circuit breaker—OFF.
3. Lower radome—CHECKED.
   a. Antenna condition—CHECKED.
   b. Radome interior—CHECKED.
   c. Antenna parallel to wings—CHECKED.

4. Electronic inverter (frequency and voltage) — CHECKED.

5. Inverter bypass on (frequency and voltage) — CHECKED.

6. CGRS—POWER ON.

7. APA-57—POWER ON.

8. HD-517 Hydraulic Pump—CHECKED.
   a. Radar-Purge switch to—RADAR.
   b. Hydraulic fluid level on gage—FULL OFF.
   c. Pump drain cavity—BLEED.

9. HD-370 Coolant Pump—CHECKED.
   a. Coolant leaks—CHECKED.
   b. Security of cables and mounts—CHECKED.

10. HD-336 Air Compressor—CHECKED.
   a. Air valve safetied open—CHECKED.
   b. Security of cables and mounts—CHECKED.

11. APS-95 and APS-45 dehydrator crystals — CHECKED.
   a. Air bypass valve at 90 degrees—CHECKED.

12. Button on coolant filter tank down—CHECKED.
   a. Coolant level on filter tank—FULL.

13. Magnetron oil level—CHECKED.

14. Equipment cabling and mounts—CHECKED.

15. APS-95 shorting bar—CHECKED.

16. CGRS Amplifier—CHECKED.
   a. Platform aligned—CHECKED.
   b. Integrators—CHECKED.
   c. Two gain switching—CHECKED.
   d. Z-Axis precession—CHECKED.
   e. Annunciator null—CHECKED.
   f. Magnetic slaving (2 deg/min)—CHECKED.

17. All V-8 indicators (heading at cardinal points)—CHECKED.

18. Ground speed servo—CHECKED.

19. APA-57—CHECKED.

20. Counter Rotation (both directions)—CHECKED.

21. Counter Rotation with no wind—CHECKED.

22. CP-132 Heading each 30 Degrees—CHECKED.

23. Test Equipment Operation and Calibration Due Date—CHECKED.

24. PSM-6 Operation—CHECKED.

25. Inflight Bin Inventory—CHECKED.

26. Loose Equipment—CHECKED.

27. Survival Equipment—CHECK.

28. Report to Senior Director—PREFLIGHT COMPLETE.

ENGINE RUNUP.

1. Alternator Voltage—CHECKED.

2. Trip-Reset Switches—CHECKED.

3. AC Power Panel Push to Test Lights—CHECKED.

4. Electronic Inverter Voltage and Frequency — CHECKED.

TAKEOFF.

1. AC Power Selector Switch—NORMAL.

INFLIGHT.

1. AC Power Panel Voltage and Frequency — CHECKED.

2. Electronic Equipment—ON.

3. Auxiliary Vent Blowers—ON.

4. APS-95 Magnetron Filament Rise—MONITORED.

5. Meter Readings at APS-95 RSC—CHECKED.

6. Meter Readings at APS-45 Console—CHECKED.

7. CGRS Operation—CHECKED.

HEIGHT FINDER SYSTEM.

1. Push to Test Lights—CHECKED.
2. Transmitter Operation—CHECKED.
3. AFC Operation—CHECKED.
4. Crystal Current—CHECKED.
5. Transmitter Frequency—CHECKED.
6. Transmitter Power—CHECKED.
7. Receiver MDS—CHECKED.
   a. MDS in AFC Operation—CHECKED.
   b. MDS in Manual Operation—CHECKED.
8. Scope Presentation—CHECKED.
   a. Circularity—CHECKED.
   b. Range Marks—CHECKED.
   c. Height Mark Accuracy—CHECKED.
   d. Antenna Elevation Scans—CHECKED.
   e. Antenna Azimuth Rotation—CHECKED.

IFF SYSTEM.

1. Meter Readings and Video—CHECKED.

APS-95 SYSTEM.

1. Magnetron Filaments—CHECKED.
2. Warning Lights—OUT.
3. Air Pressure—CHECKED.
4. Transmitter Operation—CHECKED.
5. Transmitter Power—CHECKED.
6. TR Tube Leakage—CHECKED.
   a. Duplexer Leakage With and Without Limiter—CHECKED.
   b. Monoplexer Leakage With and Without Limiter—CHECKED.
7. Spectrum—CHECKED.
8. VSWR—CHECKED.
9. AFC and Manual Tuning w/Ringing Pulses—CHECKED.
10. Servo Tuned Stub Operation—CHECKED.
11. Stalo Unlock Points—CHECKED.
12. Noise Figure—CHECKED.
13. MDS (Normal)—CHECKED.
14. MDS (AMTI)—CHECKED.
15. MDS (Difference)—CHECKED.
16. Video Alignment—CHECKED.
17. AMTI Operation—CHECKED.
18. IP-462 Alignment—CHECKED.
19. Antenna Rotation—CHECKED.

INDICATOR SYSTEM.

1. CN-212 Voltages—CHECKED.
2. IP-230 Video and Set for Camera Operation—CHECKED.
3. APA-159 Scope Presentation—CHECKED.
   a. Sweep and Cursor Alignment—CHECKED.
   b. GPI Alignment—CHECKED.
   c. Heading Alignment—CHECKED.
   d. Remote Operation—CHECKED.

ALTERNATORS.

1. All Three Phases—CHECKED.

ON STATION.

1. Initial Equipment Check—COMPLETED.
2. Systems Check (every two hours)—COMPLETED.

Note

When making the noise figure and TR tube leakage check, the radar video is lost to the Indicator System. Before performing these checks, coordinate with the Senior Director.

DEPARTING STATION.

1. Off Station Checks (Complete Systems)—COMPLETED.
2. Form 781 Entries—COMPLETED.
3. Equipment Off When Directed (Ant Parallel to Wings)—COMPLETED.
4. Loose Equipment—STOWED.

AFTER LANDING.

1. AC Power Selector Switch—OFF.
2. Electric Inverter—OFF.
3. Auxiliary Vent Blowers—OFF.

ENGINE SHUT DOWN.

1. CGRS Circuit Breakers—OFF.

BEFORE LEAVING AIRCRAFT.

1. Policing of Station—COMPLETED.
2. Technician's Chair—FULL FORWARD.

FIRST RADAR TECHNICIAN—EMERGENCY PROCEDURES.

CABIN FIRE.

1. Radar equipment off or standby switch—AS REQUIRED.
2. Radar blower fan switches—OFF.
3. Portable fire extinguishers—AS NECESSARY.

ELECTRICAL FIRE.

1. Radar equipment off or standby switch—AS REQUIRED.
2. Radar blower fan switches—OFF.
3. AC generator switches—TRIPPED.
4. Portable fire extinguishers—AS NECESSARY.

SMOKE/FUME REMOVAL.

1. Emergency exits—OPEN.

DITCHING/CRASH LANDING/BAILOUT.

a. First radar technician's amplified ditching/crash landing/bailout checklists are contained in Section III.

FUEL DUMPING.

1. Radar equipment—OFF.

After Dumping:

1. Radar equipment—AS NECESSARY.

SECOND RADAR TECHNICIAN—EMERGENCY PROCEDURES.

CABIN FIRE.

1. Assist first radar technician—AS DIRECTED.
2. Portable fire extinguishers—AS REQUIRED.

ELECTRICAL FIRE.

1. Assist first radar technician—AS DIRECTED.
2. Portable fire extinguishers—AS REQUIRED.

SMOKE/FUME REMOVAL.

1. Assist first radar technician—AS DIRECTED.

DITCHING/CRASH LANDING/BAILOUT.

a. Second radar technician's amplified ditching/crash landing/bailout checklists are contained in Section III.

FUEL DUMPING.

1. Radar equipment—OFF.

After Dumping:

1. Radar equipment—AS NECESSARY.

LE
Procedures. tion VIII

When the FLUSH ORDER is receive
men must accomplish their duties as rapidly as
permits. (DO NOT WAIT FOR SIGNAL FROM AIR-
CRAFT COMMANDER.)

Right Wing Ground Crewman:

1. Proceed to right wing tip.
2. Area—Clear.
3. Stand fire guard of Nr 3 and Nr 4 engines.
4. Right wheel chock—Removed.
5. Ground power—Disconnected (Move MD-3 to parking spot if MD-3 is used).

SMOKE/FUME REMOVAL.

1. Standby to assist.

ASH LANDING/BAILOUT.

3. Crew Stand — Removed, after second engine ditching/crash boards the aircraft.
4. Area—Clear.
5. Stand fire guard for Nr 2 and Nr 1 engines.
6. Left wheel chock—Removed.
7. Proceed to a point ahead of the left wing tip.
8. Area—Clear to taxi.
9. Taxi signal—Clear to taxi.

SEE T.O. 1C-121(E)D-15-3, 15 FEB. 1965, CONCERNING NEW "ICING" TERMINOLOGY!

Section IX—ALL WEATHER OPERATION

TABLE OF CONTENTS

	Page
INSTRUMENT FLIGHT PROCEDURES	9-1
APPROACH PROCEDURES	9-3
FLIGHT THROUGH ICE AND RAIN	9-4
FLIGHT THROUGH TURBULENCE AND THUNDERSTORMS	9-4
COLD WEATHER OPERATION	9-8
HOT WEATHER PROCEDURES	9-13

INSTRUMENT FLIGHT PROCEDURES.

Except when repetition is necessary for emphasis, clarity, or continuity of thought, this section contains only those procedures that differ from normal operating instructions covered in Section II.

The aircraft has good stability and flight characteristics that make possible long range flights under sustained instrument operation with minimum pilot fatigue. Each pilot's instrument panel is arranged with a complete set of flight instruments, and an automatic pilot is incorporated in the flight control system to relieve the pilot of manual control. Instrument lighting and radio remote controls are provided within easy reach of either pilot.

INSTRUMENT TAKEOFF.

1. Check directional flight instruments during taxiing turns.

2. Adjust instrument lighting as required.

3. Align aircraft with the center line of the runway, straighten nose wheel, and hold with toe brakes.

4. Recheck radar altimeter and set limit switch to 50 feet.

5. Set miniature aircraft of attitude indicator on horizon bar.

INSTRUMENT CRUISING FLIGHT.

It is recommended that the pitot heaters be kept ON at all times during instrument operation to minimize the accumulation of moisture in the pitot heads. Frequent checks of the carburetor air temperature indicator should be made, and carburetor heat applied as required. The automatic pilot may be engaged to relieve the pilot during extended instrument operation.

DESCENT.

Descent from maximum high altitude cruising levels under instrument conditions should be initiated at a controllable rate. Cylinder head temperatures should be kept sufficiently warm to supply carburetor heat. If airways approach clearance requires extended holding procedures the aircraft should be trimmed and power settings adjusted to the best fuel economy range. An adjusted fuel consumption rate also should be established so that maximum holding time can be determined, and allowances be made for proceeding to an alternate airport.

HOLDING PROCEDURE.

If it is necessary to hold, request an expected approach time and set up power necessary to maintain 140 knots, flaps extended to 60%. If fuel is critical, set up maximum endurance power, flaps up. If icing and turbulence are encountered during holding procedure, flaps should be retracted, aircraft deck angle set at 3° or less and airspeed increased to maintain this deck angle. If ice is suspected in the wing flap wells, do not raise the flaps beyond the 10% position. Since the Descent checklist requires going to landing tanks, do not accomplish the checklist until cleared for the approach so that the fuel which may be in the other tanks can be used.

INSTRUMENT APPROACHES.

The general qualities and capabilities of the aircraft during instrument approaches are considered to be excellent and no special technique is required. Instrument letdowns from holding patterns normally do not require extensive retrimming of the aircraft to establish the approach speed. Letdown from cruising altitudes without holding procedures can be made in the clean configuration, or with the gear and flaps extended. Pilot's discretion is important in determining the particular choice of action when icing or turbulence is anticipated. If an accurate ETA to the radio fix is known and no delay is expected, or approach clearance has already been granted, approximately 3 minutes prior to ETA, the Descent checklist should be accomplished. The aircraft should be slowed to 140 knots, 60% flaps extended and the rpm increased to 2400. If ETA is not known the Descent checklist will not be accomplished until position is established, close in or over the cone. The radar altimeter will be set for minimum altitude for instrument approach. The pilot will maintain 140 knots during holding and procedure turns, and 130 knots will be maintained during final approach and descent with gear and flaps extended. After holding, and when over high cone, outer marker (ILS), or radio fix (GCA) and starting approach, the Descent checklist will be accomplished. At the start of the descent to the low cone after completing procedure turn, or when turning onto final approach for ILS or GCA approach, pilot calls for Before Landing checklist. The final aircraft configuration and final approach airspeed will be established prior to intercepting ILS and GCA glide slopes.

Upon completion of the Before Landing checklist the copilot will advise the pilot. The copilot can maintain airspeed during descent with throttles at the pilot's request. When clear of all clouds and when over the field boundary, the pilot should reduce airspeed from 130 knots to 1.3 x stall speed.

Ensure against getting too low and slow at any point.

Pilots should acquaint themselves with all suitable alternate airfields within range of their usual landing field.

It is permissible to use the automatic pilot during extended holding.

Careful study of the current, authorized approach plate for each station is mandatory prior to the approach. Minimum altitudes, courses, times on various headings, and missed approach procedure should be fixed in the pilot's mind.

The copilot will advise the pilot if aircraft goes below a minimum altitude and/or airspeed deviates 10 knots or more from normal.

The Descent checklist should be accomplished, and the aircraft prepared for the instrument approach prior to crossing the high cone, or radio fix, when holding is not required.

Turns during an instrument approach should be standard except when correcting for wind drift as in holding, or when making small corrections during final approach.

When the aircraft completes the turn onto final approach, and the landing gear has been lowered, the airspeed should be slowed to 130 knots. When the aircraft intercepts the glide slope, only a small change in MAP will be necessary to establish proper rate of descent.

To maintain a glide slope, any adjustments to the rate of descent must be immediate and positive. When airspeed is off more than 5 knots and altitude is off more than 50 feet, a return to the glide slope can best be accomplished by altering the attitude of the aircraft combined with a slight change in MAP. Normally, a 200 fpm variation from glide slope rate of descent will bring the aircraft back to the glide slope.

Heading corrections must be initiated promptly, but overcontrolling must be avoided. A good rule of thumb on final approach is not to exceed in angle of bank the number of degrees to be corrected in heading.

Although only one compass may be used as the primary indicator for directional control, (such as the CGRS on the pilot's side) the compass should be cross-checked. Thus malfunctioning of the primary compass can be detected immediately and primary shifted to another instrument.

Weather minimums for each station are contained in current publications. *You must adhere to these minimums.* Pilots are cautioned to allow for possible settling of the aircraft during a pull-up at minimums. Heavily loaded aircraft may settle as much as 100 feet before pull-up power takes affect. Both the pressure and the radar altimeters must be referred to constantly during the approach.

DO NOT DESCEND BELOW THE PRESCRIBED MINIMUMS.

During approaches with minimum weather conditions, it may be advisable not to change the wing flaps setting after breaking-out.

The failure of two engines will affect the manner in which some aircraft systems function because of the way in which they are integrated with various engines. For this reason, effects of losing more than one engine must be understood and anticipated when executing a two-engine instrument approach.

APPROACH PROCEDURES.

CIRCLING APPROACH PROCEDURES.

Refer to AFM 51-37, Instrument Flying, for correct circling approach procedures. The circling patterns described in this manual (AFM 51-37) will be used. Unless conditions dictate otherwise, left-hand circling approach pattern will be flown so that the pilot can keep the runway in sight at all times.

AUTOMATIC APPROACH.

The procedure for making an automatic approach is as follows:

1. Autopilot—ON.

2. Altitude Control—ON.

3. Descent checklist—Complete prior to outer marker.

4. Prior to reaching or when over the outer marker outbound, reduce airspeed to 140 knots. Execute procedure turn by use of the automatic pilot.

5. After completion of the procedure turn and on final approach heading, place the Flight Path Selector (approach selector) switch in the LOCALIZER position (the vertical needle of the cross-pointer indicator should be on or near the center position).

6. When inbound to outer marker, extend gear and complete Before Landing checklist. Reduce airspeed to 130 knots.

7. Monitor the glide slope by means of the horizontal bar of the cross-pointer indicator. When the horizontal bar reaches the center position, place the approach selector switch in the LOCALIZER & GLIDE PATH position.

Note

When the Flight Path Selector (approach selector) switch is placed in LOCALIZER & GLIDE PATH position, the automatic pilot altitude control switch is released.

8. When the runway is in sight, release the approach coupler and the automatic pilot by pressing the automatic pilot disconnect switch on control column and then make a normal landing.

LANDING.

1. When landing a heavily iced aircraft, approach and landing speeds should be considerably higher than normal, depending on the amount of icing.

WARNING

Stall warning may be totally absent due to ice on the wings.

Note

A slow touchdown is desirable, consistent with safe control. The brakes should be used as little as possible, and nosewheel steering used discriminately.

FOUR-ENGINE RANGE, ADF, AND VOR APPROACH (STRAIGHT-IN):

1. *High Cone to Procedure Turn*—140 knots, rpm 2400, flaps 60%, gear up.

2. *Procedure Turn to Low Cone*—140 knots, rpm 2600, flaps 60%, gear down. Slow to 130 knots after gear is down and Before Landing checklist completed.

THREE-ENGINE RANGE, ADF, AND VOR APPROACH (STRAIGHT-IN):

1. *High Cone to Low Cone*—Same as four-engine approach except 2600 rpm over high cone.

TWO-ENGINE RANGE, ADF, AND VOR APPROACH (STRAIGHT-IN):

1. *High Cone to Low Cone*—Maintain a minimum of 150 knots, rpm 2600, gear UP and flaps 60%.

2. *Low Cone*—Rpm 2900, airspeed 30% above stall speed. Maintain a minimum of 140 knots. Gear down and flaps to desired position when safe landing is assured. Neutralize rudder trim on final approach.

CIRCLING MANEUVERING CONFIGURATION.

The maneuvering configuration for all four-engine circling approaches is 2600 rpm, 60% flaps, airspeed 140 knots, gear down and Landing checklist completed.

FOUR ENGINE RANGE, ADF, AND VOR APPROACH (CIRCLING):

1. *High Cone to Low Cone*—Same as four engine range approach (straight-in), airspeed 140 knots.

2. *Low Cone to Field*—Maintain 140 knots until turning final to landing runway.

THREE ENGINE APPROACH (CIRCLING):

1. Same as four-engine approach (circling) except 2600 rpm over high cone.

TWO ENGINE RANGE APPROACH (CIRCLING):

1. *High Cone to Low Cone*—150 knots, rpm 2600, flaps and gear up.

2. *Low Cone*—Maintain 150 knots, rpm 2900, flaps and gear up while circling. When turning final to landing runway, extend gear. Slow aircraft and lower flaps as required when safe landing is assured.

FLIGHT THROUGH ICE AND RAIN.

Proper technique in the use of anti-icing and deicing equipment is essential when instrument flight is conducted through rain and icing conditions. The various types of icing encountered at low altitudes may present greatest problems while instrument approaches are being made. When visible moisture is encountered it is better not to close the cowl flaps because closing them disturbs the flow of air past the engine and moisture will accumulate more rapidly in the engine section. It is better to keep the cowl flaps in the faired position. No appreciable reduction in performance will be experienced when the de-icer boots are in operation. However, during flight through icing conditions the following conclusions should be understood.

(a) Flight in light icing conditions without the deicer boots in operation can be accomplished for short periods at airspeeds of 180 knots or better. No significant losses in airspeed will result for approximately 15 minutes. Operating the deicer boots and maintaining power settings will partially rectify speed losses, and an airspeed of approximately 155 knots can be maintained.

(b) If the deicer boot system is inoperative, it is unsafe to enter icing conditions of intensities greater than trace.

(c) The performance losses contributed by icing of the radomes are approximately two thirds of the total performance losses experienced by the aircraft in icing conditions.

(d) If the mission profile of 4½ degrees angle of attack is to be maintained, flight in icing conditions worse than trace should be avoided.

WARNING

Takeoff should not be attempted with ice accumulations on the wing surfaces, nor during heavy freezing rain conditions.

(e) Apply propeller deicing fluid and carburetor heat as required. Icing conditions and ice formation can vary in intensity. Ice can form during extensive cruising flight and have many different effects upon aircraft performance. Ice deposits increase the stall speed of the aircraft, which will occur at a smaller angle of attack. This means that increased dependence must be placed on the airspeed indicator, and landings must be at airspeeds made well above the normal landing speed. Efforts should be made to constantly maintain a smaller angle of attack during climb to minimize the development of ice deposits on the underside of the wing. During trace icing, the aircraft can be flown for long periods, provided the anti-icing and deicing equipment is handled properly. When icing reaches a light degree of intensity, the flight plan should be altered to avoid remaining in that condition. When icing is encountered, the wing and empennage deicers should not be operated until ice has formed on the boots. If the deicers are operated before entering the icing area, or if they are operated continuously, it is possible that a bridge of ice will form over the deicer boots, thereby rendering the inflation cycle ineffective.

FLIGHT THROUGH TURBULENCE AND THUNDERSTORMS.

Penetration of known thunderstorms should be avoided if possible; however, during instrument operation at night, such areas may be difficult to detect. Severe vertical air currents, heavy icing, and hail can be expected in thunderstorms, and all precautionary methods should be taken to prepare the aircraft prior to entering known thunderstorm areas. The automatic pilot may be engaged during light turbulence provided the altitude control is OFF. Maintain pitch attitude with the pitch control. A power setting should be made prior to entering a known thunderstorm area that will provide an airspeed of 60 knots above the stall speed for the weight, altitude, and

RANGE, ADF AND VOR PROCEDURES (STRAIGHT IN)

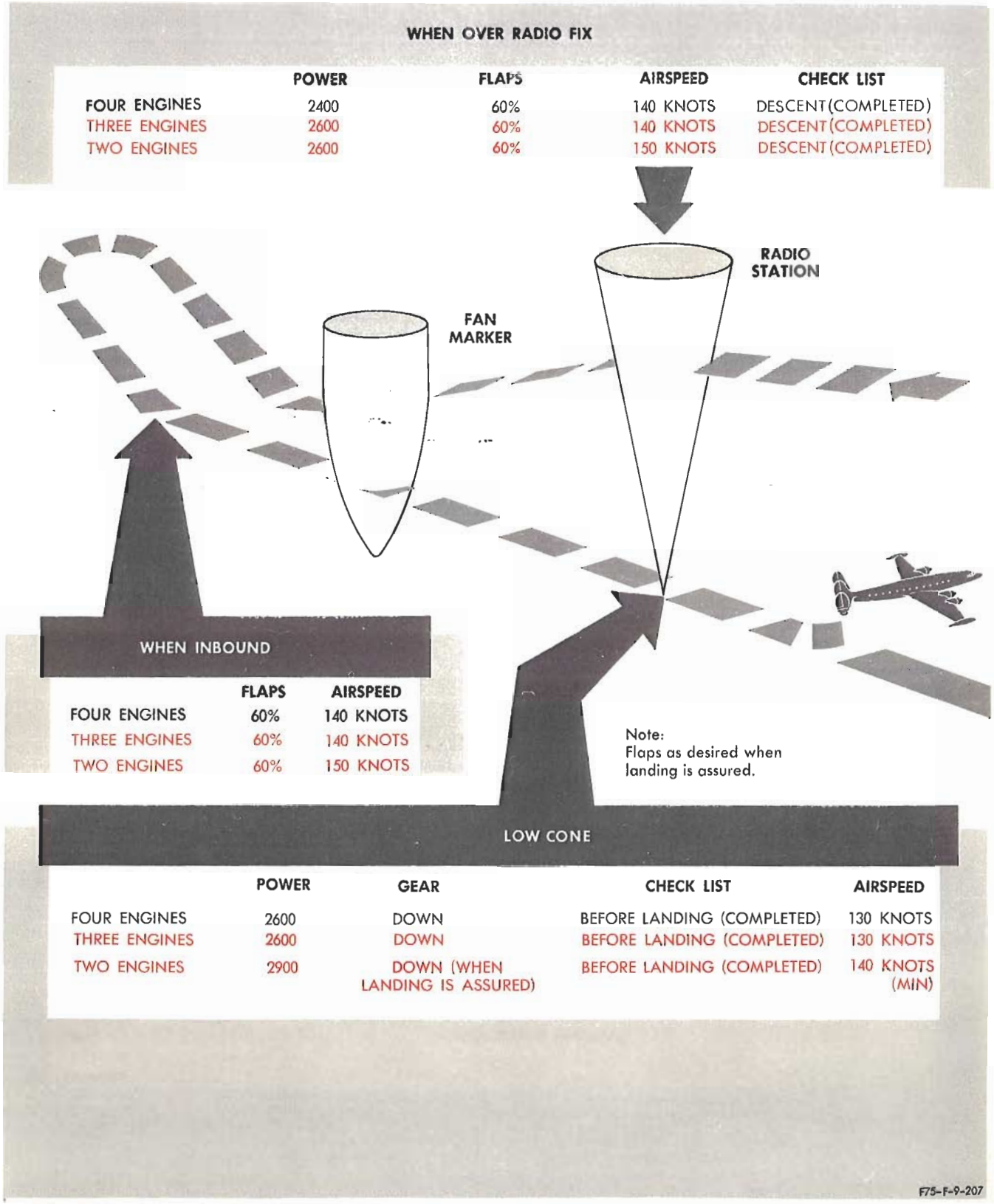
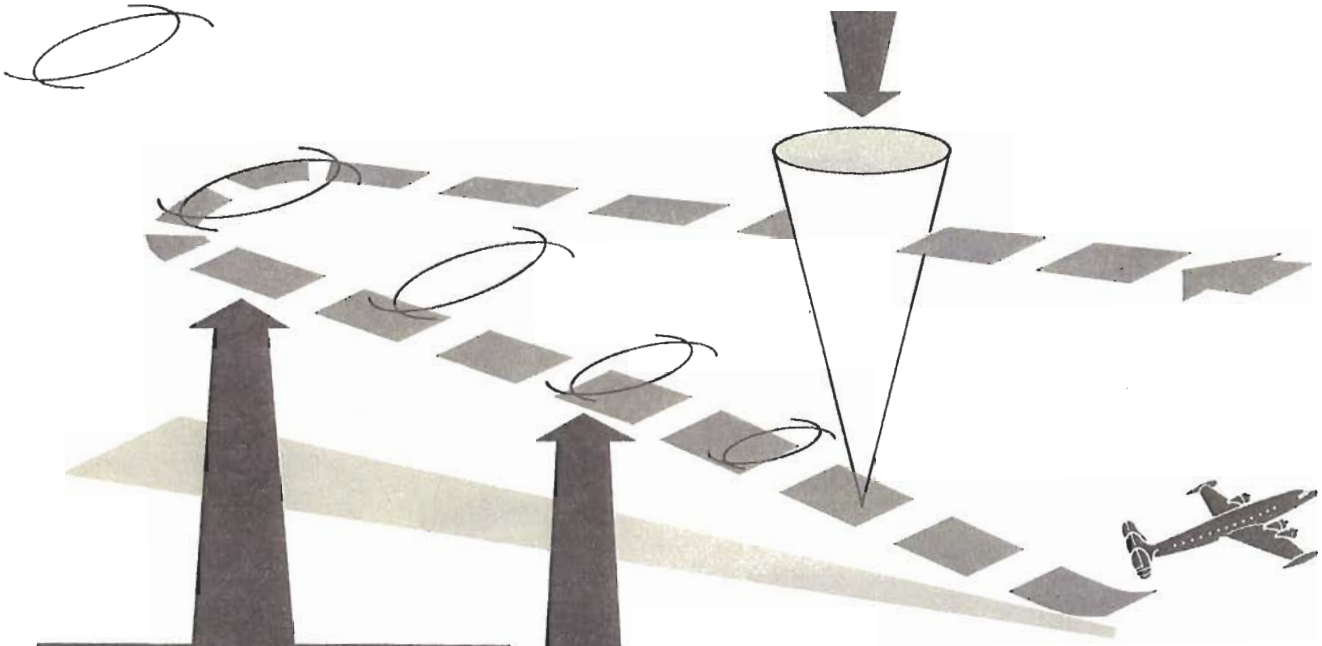


Figure 9-1

GCA PROCEDURES

WHEN OVER RADIO FIX

	POWER	FLAPS	AIRSPEED	CHECK LIST
FOUR ENGINES	2400	60%	140 KNOTS	DESCENT
THREE ENGINES	2600	60%	140 KNOTS	DESCENT
TWO ENGINES	2600	60%	150 KNOTS	DESCENT



WHEN INBOUND

	FLAPS	AIRSPEED
FOUR ENGINES	60%	140 KNOTS
THREE ENGINES	60%	140 KNOTS
TWO ENGINES	60%	150 KNOTS

Note:
Flaps as desired when landing is assured.

PRIOR TO INTERCEPTING GLIDE PATH

	POWER	GEAR	CHECK LIST	AIRSPEED
FOUR ENGINES	2600	DOWN	BEFORE LANDING (COMPLETED)	130 KNOTS
THREE ENGINES	2600	DOWN	BEFORE LANDING (COMPLETED)	130 KNOTS
TWO ENGINES	2900	DOWN (WHEN LANDING IS ASSURED)	BEFORE LANDING (COMPLETED)	140 KNOTS (MIN)

F75-F-9-209

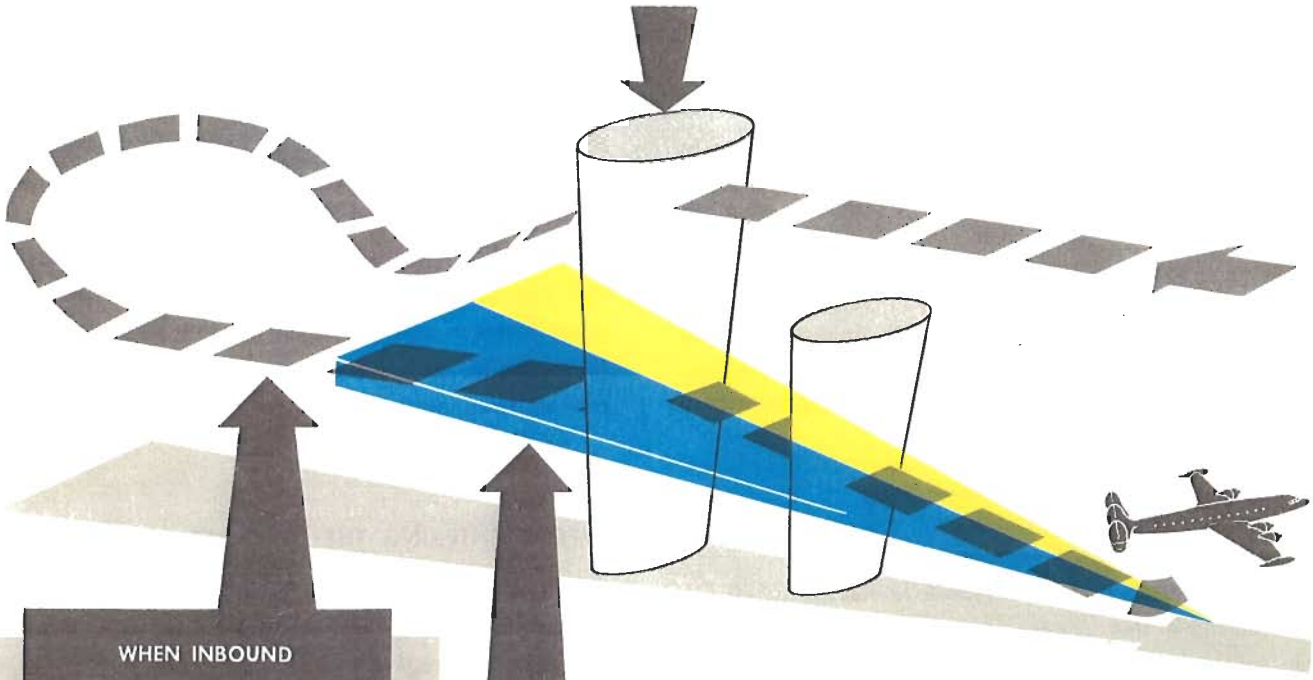
Note: The pilot will advise GCA of the rate of turn to be used throughout the procedure. Request a 10-second gear warning before intercepting glide path.

Figure 9-2

ILS PROCEDURES

WHEN OVER RADIO FIX

	POWER	FLAPS	AIRSPEED	CHECK LIST
FOUR ENGINES	2400	60%	140 KNOTS	DESCENT
THREE ENGINES	2600	60%	140 KNOTS	DESCENT
TWO ENGINES	2600	60%	150 KNOTS	DESCENT



WHEN INBOUND

	FLAPS	AIRSPEED
FOUR ENGINES	60%	140 KNOTS
THREE ENGINES	60%	140 KNOTS
TWO ENGINES	60%	150 KNOTS

Note:
Flaps as desired when landing is assured.

PRIOR TO INTERCEPTING GLIDE PATH

	POWER	GEAR	CHECK LIST	AIRSPEED
FOUR ENGINES	2600	DOWN	BEFORE LANDING (COMPLETED)	130 KNOTS
THREE ENGINES	2600	DOWN	BEFORE LANDING (COMPLETED)	130 KNOTS
TWO ENGINES	2900	DOWN (WHEN LANDING IS ASSURED)	BEFORE LANDING (COMPLETED)	140 KNOTS (MIN)

Figure 9-3

configuration being flown. Refer to the Stall Speed chart, figure 6-1.

The aircraft should be maintained in the clean configuration (gear and flaps retracted) during turbulent air conditions. The aircraft should be prepared prior to entry as follows:

1. Assure pitot heaters ON.

2. Check gyro instruments for proper setting.

3. Tighten all seat belts.

4. Turn off all radio equipment affected by static.

5. Turn on cockpit lights to minimize blinding by lightning.

PENETRATING THE THUNDERSTORM.

1. Maintain power and propeller pitch settings established before entry. Hold these and the attitude constant, and airspeed will be constant regardless of erratic airspeed indicator readings.

CAUTION

If the reduction of airspeed is carried to an extreme the danger of stalling because of gusts is increased. It is necessary therefore, that the optimum penetration speed be maintained at 60 knots above stall speed.

2. Attention should be devoted to flying the aircraft by reference to the attitude indicator. Maintain a level attitude.

3. The altimeter is unreliable in severe turbulence because of differential barometric pressures.

4. Use as little elevator control as possible in maintaining attitude in order to minimize the stresses imposed on the aircraft.

CAUTION

Heavy rain may partially block the pitot heads and cause erratic readings on the airspeed indicator so do not attempt to alter the aircraft attitude because of this.

COLD WEATHER OPERATION.

The following procedures are written as a supplement to the normal operating procedures outlined in Section II and the systems operations outlined in Section VII. These should be complied with when cold weather conditions are encountered. Procedures relative to wing icing conditions during flight are covered in the preceding portion of this section under instrument flight. The success of Arctic operations depends greatly on the preparations made during engine shutdown and post-flight procedures made prior to the next flight. Advance planning in the use of ground heating, wing and empennage covers, and other shelter facilities will help in assuring successful operations. If external heat will not be available for starting, or oil dilution cannot be accomplished, the oil should be drained into clean containers and stored in a sheltered location where the temperature will not be lower than freezing. Where warm storage space is not available, the oil must be heated until free-flowing and poured into the oil tanks immediately before starting engines.

BEFORE ENTERING THE AIRCRAFT.

Problems of congealed oil in the engine and attendant system of plumbing and accessories require considerable attention with regard to adequate preheating. Whenever outside air temperatures are low enough to warrant preheating engine oil systems, cabin supercharger units should also be preheated to ensure that initial torque load on the unit and shaft is held to a minimum. Engines which have been parked in warm hangars will accumulate considerable condensation within the cylinders when moved out on the ramp. They must be started as soon as possible to avoid starting difficulties from such condensation. Ascertain that auxiliary power is adequate for starting an engine at the first attempt so as to reduce time for condensation to form and avoid loading up effects.

Wings covered with frost or snow provide a good base for inflight ice formation. Ice, snow, and frost must be removed prior to takeoff. The same is also true of the tail group. Under extremely cold conditions, it will be impossible to drain water from the fuel sumps, since any water will have turned to ice in the bottom of the fuel

tanks. If the airplane is later flown into areas with above-freezing temperatures, the ice will thaw into water again. These above conditions indicate the need to check for water before entering very cold areas.

Whenever there is a possibility of ice in the fuel cross-feed system, the operation of each engine should be checked on this system. Particular attention should be given to the pitot tubes to assure that they are free from ice and the heating element is working satisfactorily. Check the entire landing gear assemblies for presence of chunks of frozen mud or ice, which might prevent satisfactory operation of switch and latches. Wing flap undersurfaces must be inspected since they may have been damaged by chunks of ice kicked up by the wheels.

It is suggested that when a shock strut is flat and there is evidence of excessive hydraulic leakage, the strut be partially warmed up with an air conditioner before reservicing.

Airplanes parked for more than twenty-four hours in sub-zero conditions will require, prior to takeoff, consideration of the fact that in extremely low outside air temperature, the gyro instruments will be very sluggish when they first start operating because low temperatures react on the bearings of these instruments and prohibit accurate indications. To determine which gyro has noisy bearings, turn the radio on interphone, place the mike against the face of each gyro one at a time with the mike button depressed and the headset on. This acts as a stethescope, and the instrument with noisy bearings will be easily detected. Usually in cases of this kind, use of the air conditioner should suffice to remedy the situation. (This also applies to the possible complications attendant to long flights in subzero weather conditions without cockpit heat.)

During engine warm-up in extreme cold weather, pilots should operate all flight control surfaces, control tabs, and flaps through two or three cycles to check freedom of movement. Shift to manual elevator control two or three times. Check the operation of the windshield and propeller anti-icers, windshield wiper, pitot heaters, de-icer boots. Note that static electricity is sometimes more prevalent in cold, crisp weather; be governed accordingly.

ON ENTERING THE AIRCRAFT.

1. Check that ground heating procedures as outlined in Section IV have been followed to ensure warming of cabin and flight station, radio and electrical equipment, and the instrument panels.

2. Ensure that engine protective shields, nacelle covers, and propeller blade covers are removed. This should be the last operation before starting engines.

STARTING ENGINES.

Flight crews are cautioned against the ineffectiveness of wheel chocks or blocks when runup is contemplated on icy surfaces. Sandbags are the best wheel chocks to use under this condition.

Use of minimum throttle position is most effective in cold weather starts, as Wright engines are not easily loaded up under these conditions. Primers should aid in getting better starts. Cold weather starts are sometimes aided by first turning the engine through with mixtures in FULL RICH prior to ignition, thus insuring presence of sufficient fuel in the cylinders. Unfortunately, however, should there be condensation present before an attempted start, this latter suggestion might merely aggravate the situation. The importance of doing everything to get the engine to fire on the first attempt is of utmost importance. After an engine has fired and indicates extreme instability, application of full carburetor heat in the initial stages of firing should help to vaporize fuel and even out power impulses. Carburetor heat will aid in heating the engine supercharger section, to make for a quicker pick-up after starting. Caution is advised against leaving full carburetor heat on after carburetor air temperature rises to approximately 30°C. The engine should be started with as low an rpm as possible to avoid undue stresses to the cabin supercharger unit and drive shafts, until engine oil temperatures have started to warm up. Due to possible extensive use of primers and possible leaking alcohol solenoids, cold weather engine starting may result in backfiring. This subjects the engine to considerable strain and may even result in blowing off carburetor air scoops. It is possible for power plants to ice up during runup. Therefore, whenever power plant malfunctioning is indicated during the runup period, every means must be used to eliminate the possibility of icing.

High oil pressures, if actually encountered, can split oil pressure lines and blow off hose connections. An indication of high oil pressure can be caused by faulty instrumentation which must be determined according to individual circumstance. Some cases of high BMEP have been encountered wherein the indication did not change, thus indicating congealing of oil in the BMEP line or frozen condensed moisture.

STARTING ENGINES.

1. Follow normal engine starting procedures outlined in Section II when the temperature is 10°F or above.

2. When the temperature is below 10°F use the following procedure:

a. Open the throttle approximately one-knob width.

b. Move the mixture to AUTO RICH when the propeller starts turning with the starter.

c. When the propeller has turned six blades, call for ignition switch ON.

d. Apply steady prime until the engine starts to fire; then release the primer.

e. If the engine does not fire within 10 seconds change from steady to intermittent prime.

Note

Discontinue cranking if the engine does not start firing within 30 seconds.

CAUTION

Close coordination with the ground crew is required when using the above procedure because fuel will run from the blower drain and increase the fire hazard.

3. Avoid priming when the engine is not turning. If the engine is primed prematurely, the gasoline will not vaporize but will run down into the lower cylinders and result in bent connecting rods and cracked cylinder heads when the piston contacts the cylinder full of fluid gasoline.

CAUTION

- If there is no oil pressure after 20 seconds of operation, immediately stop the engine and investigate.
- The oil pressure will be abnormally high immediately after starting. In extreme conditions the pressure will gradually drop from the high reading to approximately 20 psi. In either case rising oil temperature will correct the condition. Do not increase engine speed above 1200 rpm until oil pressure is normal.

ENGINE WARM UP.

1. Reserve oil system heater switch—ON.

2. Nesa power and pitot heater switches—ON.

3. Use ice-free area or firmly anchored wheel chocks for all engine run-up. Make sure no personnel, ground installations, or other aircraft are in the propeller wash.

4. Warm up engine. Do not make performance checks until oil temperature and pressure, and cylinder head temperatures are within desired limits. Do not check reversing until steps 1 through 5 of Engine Runup are completed.

5. If external power source is available, turn on electronic and radar equipment and check for proper antenna operation.

6. Check wing flap operation.

TAXIING.

1. Avoid sharp turns during taxiing. Use asymmetrical power for steering in icy areas and avoid excessive use of brakes.

Note

Avoid deep snow, mud, and slush covered areas as much as possible. Do not stop in deep snow. Watch for obstacles hidden by freshly fallen snow. Do not scrape lower radome on heavily crusted snow.

WARNING

In cold weather, make sure all instruments have warmed sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

ENGINE RUNUP.

Note

Prior to takeoff, the following cold weather operational procedures are recommended to flush the propeller and the auxiliary pump line

of oil that may have congealed while the airplane was idle. This is necessary so that bleeds, which are provided to keep the oil in the propeller and auxiliary pump line warm, will function properly in flight. The following check, prior to takeoff, should be conducted during engine runup after engine oil has reached the recommended operating temperature of 40°C.

1. Set the master propeller pitch lever to full INC RPM position, and adjust throttles to obtain approximately 1700 rpm.

2. Move master propeller pitch lever toward DEC RPM until minimum rpm position is obtained. RPM should drop to minimum rpm setting.

3. Set the master propeller pitch lever toward INC RPM until engine speed increases to the value established in step 1.

4. Repeat steps 2 and 3 (three or four times).

5. Readjust throttle setting if desired and conduct a feathering check. Push the feathering button for each engine individually and observe a drop of 200 to 300 rpm. Pull feathering button out to neutral. RPM should return to the initial setting. Complete standard runup contained in Section II.

6. Reverse and unreverse propellers.

7. Repeat step 5. If the rpm increases when the feathering button is depressed, the propeller is in reverse pitch. If this occurs, reduce power as necessary to prevent overspeeding and feather out to positive pitch range.

BEFORE TAKEOFF.

1. Follow normal operating procedures as outlined in Section II.

Note

If flight is to be made during precipitation, removal of wing and empennage covers may be delayed until just prior to takeoff.

2. Check all heating, anti-icing and deicing systems for proper operation.

3. Carburetor heat—OFF.

4. Recheck trim tabs and controls for freedom of operation.

TAKEOFF.

WARNING

Do not attempt to takeoff with ice or snow on the wings. Even loose snow may not blow off. Loss of lift and treacherous stalling characteristics may result.

1. During crosswind takeoff on icy runways, use asymmetrical power for directional control until rudder control becomes effective. It may be necessary to lift the nosewheel earlier than normal during the takeoff run to lessen the possibility of snow or icy slush being thrown into the nosewheel well .

WARNING

The use of asymmetrical power for directional control may lengthen the takeoff run.

ICING DURING FLIGHT.

Wing ice during cruise can become critical if the proper procedure is not followed. Since long range cruise involves flying only slightly faster than the speed for maximum L/D, any loss of airspeed due to wing ice will mean flying in an unstable speed range on the nautical mile per pound fuel chart. In other words, airspeed will vary over quite a range with changes in attitude caused by turbulence, crew movement, etc., even though a constant power setting is maintained. In this unstable speed range, the aircraft is quick to lose speed, but slow to recover it. The result is a further lowering of the average airspeed. This necessitates an increase in the angle of attack to maintain altitude. This increased angle of attack will allow ice to accumulate on the bottom of the leading edge where it can not be removed by the boots. This slows the aircraft still further and increases the stall speed considerably. If this cycle is allowed to continue, a very dangerous situation will quickly develop.

When encountering wing-ice in cruise, watch the angle of attack as shown by the inclinometer. It should not

be allowed to exceed 3°. If necessary, go to maximum cruise power for as long as is necessary to keep the angle of attack below the recommended maximum limit for operating in icing conditions. If unable to maintain an angle of attack of less than 3° with maximum cruise power, a change of altitude should be requested. Although it is usually impossible to see the empennage and radomes from the cockpit, it may be safely assumed that if ice is observed forming on the leading edge of the wing, a simultaneous action is taking place on the tail and radome surfaces. As ice forms on the vertical and horizontal stabilizers, an increased tendency to yaw will be noted.

Propeller icing may occur under the same conditions as surface icing. Propeller ice is especially dangerous because it decreases propeller efficiency by altering the blade profile and increasing the blade thickness. Refer to Section IV for alcohol maximum flow.

Failure of the airspeed indicator may result from freezing of the pitot head or the static line. Use pitot heater or alternate static source as necessary.

Refer to Carburetor Icing in Section VII, and Normal Operating Procedures For Deicer Boots in Section IV for information on these systems.

DESCENTS AND APPROACHES.

During descents and approaches, maintain power settings sufficient to prevent overcooling of the engines. Use carburetor heat (Refer to Section VII) and cowl flaps as necessary.

Note

While sufficient altitude remains for emergency procedure, it may be desirable to lower wheels and use partial flaps well in advance of the actual approach to check that they function correctly.

LANDING.

When landing a heavily iced aircraft, approach and landing speeds should be considerably higher than normal depending upon the amount of icing.

Note

A slow touchdown speed is desirable, consistent with safe control. The brakes should be used as little as possible, and nose wheel steering used discriminately.

WARNING

Stall warning buffet may be totally absent due to ice on wings.

CAUTION

When landing on snow or slush covered runways, use of reverse thrust can cause serious impairment of pilot's visibility. Turn on windshield wipers prior to using reverse thrust. During the landing rollout, snow and slush may be carried into the wing flap well and onto the top surface of the wing flaps. Upon retraction of the wing flaps, the packed snow may cause damage to the wing trailing edge and the flap mechanism. Under these circumstances, the flaps should not be retracted beyond the 30% extended position until the flap area and mechanism can be inspected and cleaned if necessary.

STOPPING OF ENGINES.

When parking on ice, after having taxiied through slush, or when the temperature alternates between freezing and thawing, roll the aircraft onto a layer of some type of protective material to prevent the tires from freezing to the surface.

Note

Oil dilution is not recommended.

BEFORE LEAVING THE AIRCRAFT.

1. Install all necesary protective covers if shelter for the aircraft is not available.

CAUTION

The protective covers should not be installed until the engines have cooled sufficiently to preclude the possibility of condensation forming inside.

2. Position ram/alternate air doors to alternate air position (CLOSED).

3. If a long layover is anticipated and if external heat will not be available for starting, or if oil dilution cannot be accomplished, the oil should be drained into clean containers and stored in a sheltered location where the temperature will not be lower than freezing.

4. If extremely low temperatures are expected, the aircraft batteries should be removed and stored in a warm location.

5. Release the brakes and chock the wheels. If the brakes are left on, the formation of ice may lock the wheels.

6. Drain water tanks if there is a possibility of freezing.

7. Drain oil tank sumps, Y drains, and fuel drains of condensate approximately 30 minutes after stopping engines.

8. Leave some aperture, such as a side window, partly open to help prevent the formation of frost on the inside of the windows.

9. Ensure that any snow, slush, or mud picked up in nosewheel well or nacelles, or on landing gear mechanism is cleaned off before it freezes.

HOT WEATHER PROCEDURES.

TROPIC OR DESERT OPERATION.

Before Entering the Aircraft.

1. During exterior and interior inspections, be particularly observant for corrosion, growth of fungi, or excessive accumulations of sand and dust.

2. If sand or dust is blowing, do not direct the removal of covers from engines, nacelles, propellers, and pitot tubes until just prior to starting engines.

On Entering the Aircraft.

Note

The instruments should be preheated prior to flight to eliminate possible fungus growths.

Engine Warm-Up.

1. Conduct ground operations in a minimum amount of time, and be careful not to overheat engines.

CAUTION

Longer takeoff runs are required than are necessary in ordinary temperatures.

2. Avoid taking off in the wake of another aircraft if ground is sandy or dusty.

Stopping Engines.

Follow normal operating procedures as outlined in Section II, except that cylinder head temperatures should be stabilized at the lowest temperature possible before shutdown.

Before Leaving Aircraft.

1. As soon as engines have cooled, install all protective covers.

2. If a sand or dust storm is anticipated, close all doors, windows, and hatches.

ALPHABETICAL INDEX

A

Abandonment 3-63
Abnormal BMEP Indication 7-6
Abort Takeoff Procedure 3-32
AC Electrical Power System—EC-121D 1-49, 1-50*
—TC-121C 1-53
AC Engine Instrument Failure 7-40
Accelerated Stalls 6-1
ADF and VOR Approach 9-3, 9-5*
ADF Receiver Failure 7-40
After Landing Checklist 2-44
After Takeoff Checklist 2-33
Aileron Control System 1-62
Air Conditioning System 4-1, 4-4*
—Control Panel 4-8*
—Ducting 4-6*
Air Cooling System, Cabin 4-14*
Air Situation Plotting Board (EC-121D) 4-76
Aircraft, The 1-1
Aircraft Configurations A1-1
Aircraft Dimensions 1-2
Aircraft Systems Failure 3-42
Airspeed Correction Charts A1-2, A1-6*
Airspeed Indicators 1-75
Airspeed Limitations 5-5
Alcohol Deicing Systems 4-27, 4-29*
Alert Procedures 2-47
Alternate and Ram Air Induction System 1-3
Alternate Climb Power Performance A4-2, A4-32*
Alternate Method—Failure to Unreverse 3-21
Alternate Meto Power Climb Performance A4-1, A4-9*, A4-28*
Altimeter Correction Charts A1-10*
Altimeters 1-75
Altitude vs Cabin Pressurization 4-2*
Amplified and Abbreviated Checklists 2-2
AN/AIC-8 TC-121C Intercommunication System 4-77
AN/AIC-10 EC-121D Intercommunication System 4-39
AN/APA-56 Junction Box 4-39
AN/APA-57C Ground Station Indicator (EC-121D) 4-63
AN/APA-89 Coder Group (EC-121D) 4-67
AN/APA-159 Control Indicator Group (EC-121D) 4-68
AN/APN-1 Radio Altimeter (TC-121C) 4-89
AN/APN-9 Loran Receiver (TC-121C) 4-88
AN/APN-22 Radar Altimeter (EC-121D) 4-54
AN/APN-70 Loran Receiver—EC-121D 4-54
—TC-121C 4-88
AN/APS-42 Indicator—EC-121D 4-71, 4-72*
AN/APS-45 Height Finder (EC-121D) 4-58
AN/APS-95 Search Radar (EC-121D) 4-66
AN/APS-103 Height Finding Radar 4-58
AN/APX-7 Radar Recognition Set (EC-121D) 4-60
AN/APX-25 Radar Identification Transponder
—EC-121D 4-54
—TC-121C 4-88
AN/APX-49 Interrogator Set 4-60
AN/ARN-6 Automatic Radio Compass
—EC-121D 4-55
—TC-121C 4-91
AN/ARA-25 UHF Direction Finder—EC-121D 4-56
—TC-121C 4-91
AN/ARC-27 UHF Transmitter-Receiver Sets (TC-121C) 4-81
AN/ARC-85 UHF Transmitter-Receiver 4-48A
AN/ARN-12 Marker Beacon Receiver
—EC-121D 4-55
—TC-121C 4-91
AN/ARN-14A Navigation Receiver—TC-121C 4-85
—EC-121D 4-52A
AN/ARN-18 Glide Slope Receiver—TC-121C 4-91
—EC-121D 4-55
AN/ARN-21 TACAN System—EC-121D 4-52A
—TC-121C 4-87
AN/ARR-15A HF Radio Receivers—EC-121D 4-52
—TC-121C 4-84
AN/CRT-3 Emergency Transmitter—EC-121D 4-56
—TC-121C 4-91
Antenna Coupler—EC-121D 4-54
—TC-121C 4-88
Antenna Location Diagram—EC-121D 4-51*
—TC-121C 4-86*
Antenna System—EC-121D 4-39
—TC-121C 4-77
Anti-Icing, Deicing, and Defogging Systems 4-21
Anti-Icing and Defogging, Windshield 4-30*
AOC Crew Chairs 4-125
AOC Crew Electronics Facilities Table 4-36*
AOC Equipment Cooling System 4-31
AOC Intercommunication System 4-45
Approaches, Instrument 9-2
Asymmetry Protection System, Wing Flap 1-64

PAGE NUMBERS WITH ASTERISK (*) DENOTE ILLUSTRATIONS

Attitude Director Indicator, EC-121D 4-104
Attitude Gyro Failure 7-38
Attitude Indicator 1-75
Automatic Approach 9-3
Automatic Feathering Features 1-21
Automatic Flight Path Control System (EC-121D) 4-116
Automatic Pilot 4-112
—Emergency Operating Procedures 3-46
—Controls 4-113*
Automatic Radio Compass—EC-121D 4-55
—TC-121C 4-91
Automatic to Manual Pressurization Control 4-16*
Auxiliary Equipment 1-85
Auxiliary Fuel Pumps 7-30
Auxiliary Vent Control 4-10*
Auxiliary Ventilation 4-1
Azimuth and Range Repeat Indicator 4-69

B

Bailout, Ditching, Crash Landing 3-68
Basic Speed, Power Characteristics 6-6
Before Entering the Aircraft 9-8
Before Landing Checklist 2-38
Before-Leaving-the-Aircraft Checklist 2-46
Before-Starting-Engine Checklist 2-11
Before-Takeoff Checklist 2-27
Before-Taxi Checklist 2-17
BMEP Operation 7-7
Boost-Off Landing 3-16, 3-51
Boost-On, Boost-Out Operation 6-4, 6-5
Brake Cooling 7-37
Brake Fire Checklist 3-29
Brake Operation at Touchdown 7-33
Brake System 1-70, 1-71*
Braking and Landing Gear Limitations 5-14

C

C-1 Compass Signal Power Amplifier (TC-121C) 4-92
C-626/ARC-27 Master Control Panel—EC-121D .4-48*
—TC-121C 4-84*
Cabin Air Cooling System 4-14*
Cabin Altitude Selector 4-9
Cabin or Electrical Fire Checklist 3-24
Cabin Door Operation 4-123*
Cabin Heater Emergency Operating Procedures ..4-19
Cabin Heater Fire Checklist 3-27
Cabin Pressure Control 4-9
Cabin Pressurization Limitations 5-5
Cabin Pressurization vs Altitude 4-2*
Cabin Supercharger Drive Shaft Disconnect .4-10, 4-20
Carburetor Alcohol Deicing System 4-28
Carburetor Icing 7-1
Carburetor Temperature Limitations 5-5
Cargo Loading and Dimensional Limits 4-124*
Cargo Tie-Down Devices 4-125
Cautionary Loading Area 5-15
Center-of-Gravity Limitations 5-5
Central Gyro Reference System (EC-121D) 4-56
—Heading Indicator 1-76
—V-8 Indicator Failure 7-39
Characteristics and Limits, Engine A2-1, A2-6*
Checklists—After Landing 2-44
—After Takeoff 2-33
—Before Landing 2-38
—Before Leaving the Aircraft 2-46
—Before Starting Engine 2-11, 2-48
—Before Takeoff 2-27, 2-54
—Before Taxi 2-17, 2-53
—Brake Fire 3-29
—Cabin or Electrical Fire 3-24
—Cabin Heater Fire 3-27
—Cocking 2-48
—Cruise 2-35
—Descent 2-36
—Emergency Brake Failure 3-58
—Emergency Brake Operation Prior to Landing 3-59
—Emergency Control Boost Shutoff 3-52
—Emergency Descent 3-31
—Emergency Fuel Dumping 3-40
—Emergency Landing Gear Extension 3-54
—Emergency Wing Flap Extension 3-57
—Engine Failure or Fire During Flight 3-6
—Engine Fire During Ground Operation 3-22
—Engine Runup 2-21
—Engine Shutdown 2-45, 2-51
—Engine Warmup 2-49
—Fuel Dumping 3-40
—Inadvertent Reversing in Flight 3-22
—Intermediate Climb 2-34
—Lineup 2-29, 2-54
—Loss of All Generators 3-42
—Preflight 2-48
—Prestarting Engines 2-51
—Runaway Propeller in Flight 3-20
—Runaway Propeller During Takeoff 3-20
—Smoke, Fume Removal 3-28
—Starting Engines 2-14, 2-48, 2-52
—Takeoff 2-30
—Taxi 2-20, 2-53
—Unfeathering and Restart During Flight 3-11
CIC Junction Box (EC-121D) 4-46*
Circling Approach Procedures 9-3
Circuit Breaker Panels 1-41*, 1-46*

PAGE NUMBERS WITH ASTERISK (*) DENOTE ILLUSTRATIONS

Cleanout Procedure, Spark Plug 7-7
Climb 2-34
Climb Performance
—Alternate Meto Power A4-1, A4-9*, A4-28*
—Emergency A4-1, A4-13*
—Maximum Cruise Power A4-2, A4-34*
—Meto Power A4-1, A4-3*, A4-22*
Clocks 1-76
Coder Group—EC-121D 4-67
—TC-121C 4-89
Cold Weather Operation 9-8
Communications and Associated Electronic Equipment Table 4-78*
Communications and Associated Electronic System—EC-121D 4-30
—TC-121C 4-76
Communications System, VHF-101 4-48
Compass, G-2 1-76
Composite Cruise Control Charts
—Four Engine A6-3*
—Three Engine A6-6*
—Two Engine A6-9*
Composite Cruising Charts, EC-121D A5-2, A5-15*
Compressibility Correction Charts A1-14*
Configuration and Performance 5-14
Consolidated Limitations List 5-6
Control Indicator Group, AN/APA-159 (EC-121D) 4-68
Control Panel, 714E/C187 ..... 4-52A*
Conversion, Temperature A1-2, A1-16*
Copilot Duties 8-1
Copilot's Side Panel 1-15*
Crash Landing, Bailout, Ditching 3-63
Crew Seats 1-83
Crossfeed Operation 7-32
Crosswind Takeoff Procedures 2-33
Cruise Checklist 2-35
Cruise Control, EC-121D A5-7
Cruise Control Charts, TC-121C
—Four Engine A6-3*
—Three Engine A6-6*
—Two Engine A6-9*
Cruise Performance, Long Range, TC-121C
—Four Engine A6-29*
—Three Engine A6-31*
—Two Engine A6-33*
Cruise Power Climb Performance, Maximum A4-2, A4-34*
Cruising Charts, EC-121D A5-2, A5-15*
Cruising Flight 6-10
CU308-U Antenna Coupler—EC-121D 4-54
—TC-121C 4-88
Curtains 4-125
Cylinder Head Temperature Comparison—Fuel Air Distribution 7-10

D

DC Electrical Power System 1-42*
DC Electrical System 1-40
Definitions and Symbols A1-3
Definitions, Takeoff Criteria A3-2
Defogging and Deicing Systems 4-21
Deicer Boot Timer 4-25*
Deicer Pump, Emergency Operating Procedures 4-25
Deicing and Defogging Systems, Anti-Icing 4-21
Deicing System, Alcohol 4-28, 4-29*
—Pitot Head 4-28
—Pneumatic 4-22*
Density Altitude A1-2, A1-18*
Descent Checklist 2-36
Descents and Approaches, Instrument 9-12
Design Load Factors 5-14
Diluter Demand Oxygen Regulator 4-98*
Dimensional and Cargo Loading Limits, TC-121C 4-124*
Direction Finder—EC-121D 4-56
—TC-121C 4-91
Distance and Time Prediction Charts, EC-121D A5-6, A5-41*
Ditching, Crash Landing, Bailout 3-60
Ditching 3-70
Ditching and Crash Landing Positions 3-64*, 3-64A*, 3-65*
Ditching Panels 1-82
Ditching Procedure with Self Illumination Flares 3-62*
Ditching Valve Release Handle 4-10, 4-15*
Diving 6-11
Drag Conversion Chart—EC-121D A5-1, A5-14*
—TC-121C A6-1

E

Electrical Fire 3-23
Electrical System, AC—EC-121D 1-49
—TC-121D 1-53, 1-50*
Electrical Power System, DC 1-42*
Electrical System 1-40
Electrical Windshield Anti-Icing System 4-26
Electronic Equipment Locations, TC-121C 4-80*
Electronic Inverter Control Panel, TC-121C 4-85*
Electronic System, Communications and Associated, EC-121D 4-30
—TC-121C 4-76
Electronics Equipment Locations 4-40*
Electronics Facilities Table—AOC Crew 4-36*
—Flight Crew 4-35*
Elevator Control System 1-63
Emergency Brake System 1-72
—Failure During Ground Operation Checklist 3-58

PAGE NUMBERS WITH ASTERISK (*) DENOTE ILLUSTRATIONS

—Operation Prior to Landing Checklist 3-59
Emergency Climb Performance A4-1, A4-13*
Emergency Control Boost Shutoff Checklist 3-52
Emergency Depressurization 4-20
Emergency Descent Procedures 3-31
Emergency Descents A7-1, A7-3*
Emergency Entrance 3-60
Emergency Equipment 1-77
Emergency Equipment Locations 3-4*
Emergency Escape Routes—Land 3-36*
—Water 3-66*
Emergency Exit Operation 3-39*
Emergency Extension Controls, Wing Flap 1-65*
Emergency Fuel Dumping Checklist 3-40A
Emergency Handpump Power System 1-55
Emergency Handpump Operation, Fuel Dumping 3-43*
Emergency Hydraulic System, Fuel Dump 1-59*
Emergency Jettisoning 3-38
Emergency Landing Gear Extension 1-66, 3-54
Emergency Lights 1-82
Emergency Nose Gear Extension 3-35
Emergency Oil Tank Replenishing Procedure 7-24
Emergency Operating Procedures
—Automatic Pilot 3-46, 4-116
—Cabin Heater 4-19
—Deicer Pump 4-25
Emergency Procedures—First Radar Technician 8-13
—Navigator 8-5
—Radio Operator 8-7
—Search Radar Operator 8-10
—Second Radar Technician 8-13
—Senior Weapons Controller and Radar Crew Chief 8-9
Emergency Procedures and Equipment, Flight Crew 3-60
Emergency Procedures Introduction 3-1
Emergency Shutoff Levers 1-77
Emergency Takeoff Performance A3-4
Emergency Transmitter 4-56, 4-91
Emergency Wing Flap Extension Checklist 3-57
Empennage, Wing, and Radome Deicing System 4-21
Engine Air Induction System 1-7*
Engine Analyzer Controls 1-19*
Engine Cowl Flaps 1-9
Engine Failure 3-2
Engine Failure or Fire During Flight 3-6
Engine Failure or Fire During Takeoff 3-3, 3-32
Engine Fire and Smoke Chart 3-7*
Engine Fire During Flight 3-23
Engine Fire During Ground Operation 3-22
Engine Ground Operation 2-17
Engine Indicators 1-16
Engine Instrument Failure 7-40
Engine Limitations 5-1
Engine Limits and Characteristics Charts A2-1, A2-6*
Engine Malfunction Analysis 7-8
Engine Oil-In Oil-Out Temperatures 7-6
Engine Oil System 1-28
Engine Oil Tank Replenishing 7-24
Engine Operating Curves 5-8*
Engine Operation 7-1
Engine Power Schedule Tables A2-3, A2-13*
Engine Runup Checklist 2-21
Engine Shutdown Checklist 2-45
Engine Supercharger Shift 7-6
Engine Warmup 9-10
Engineer's Preflight Checklists 2-2
Entrance Doors 1-82
Explosive Decompression 3-30
Exterior Inspection Diagram 2-10*
Exterior Life Raft Release 3-68*
Exterior Lights 4-93, 4-95*
External Power Receptacle 4-38

F

Failure of Primary Hydraulic System 3-47, 3-50
Failure of Secondary Hydraulic System 3-49
Failure of Two Engines 3-8
Failure to Unreverse 3-21
FDS Normal Operating Procedure (EC-121D) 4-110
FDS Troubleshooting 7-40
Feathering System 1-20
Filling Main or Emergency Hydraulic Reservoir in Flight 7-33
Fire Axes 1-82
Fire Detection System 1-78
Fire or Engine Failure During Flight 3-6
Fire Extinguishing System—CO_2 .....1-79, 1-78*
—HRD 1-80*
First Aid Kits 1-82
First and Second Radar Technicians, Normal Procedures 8-10
First Radar Technician, Emergency Procedures 8-13
Fixed Oxygen System—EC-121D 4-96
—TC-121C 4-100
Flight Characteristics 6-1
—Under Partial Power Conditions 3-2
Flight Control Boosters 1-62, 1-61*
Flight Control—Precautions 5-5
—System 1-60, 6-4
Flight Crew Electronics Facilities Table, EC-121D 4-35*
Flight Crew Emergency Procedures and Equipment 3-60
Flight Crew Intercommunication System

PAGE NUMBERS WITH ASTERISK (*) DENOTE ILLUSTRATIONS

—EC-121D 4-39
—TC-121C 4-77
Flight Director System 4-104, 4-106*
Flight Engineer Duties 8-1
Flight Engineer—Auxiliary Control Quadrant 1-35*
—Lower Instrument Panel 1-23*
—Lower Switch Panel 1-22*
—Upper Instrument Panel 1-24*
—Upper Switch Panel 1-26*
—Station 1-8*
Flight Instrument and Navigational Aids Trouble Shooting Procedures 7-38
Flight Instrument Electrical Power System 1-74*
Flight Planning 2-1
Flight Restrictions 2-1
Flight Station Radio Rack 4-82*
Flight Through Ice and Rain 9-4
Flight Through Turbulence and Thunderstorms ... 9-4
Flush Procedures 8-14
Fluxgate Heading Indicator 1-75
Fluxgate System RMI Cards Failure 7-39
Food Locker 4-127
Forward Lavatory and Locker 4-128
Forward Radio Rack 4-42*
Fouled Plug Procedure 7-8
Four Engine Range, ADF, and VOR Approach ... 9-3
Four Engine, TC-121C
—Composite Cruise Control Charts A6-3*
—Long Range Cruise Performance A6-29*
—Miles per Pound of Fuel Charts A6-10*
—Operating Tables A6-38*
FPC Normal Operation 4-118
Free Air Temperature Indicator 1-76
Frequency Meter, LM-14 4-92
Fuel Charts, Miles per Pound
—EC-121D A5-5, A5-22*
Fuel Charts, Miles per Pound, TC-121C
—Four Engine A6-10*
—Three Engine A6-19*
—Two Engine A6-26*
Fuel Density vs Fuel Temperature 7-31*
Fuel Dump System—EC-121D 1-35, 1-36*
—TC-121C 1-39
Fuel Dumping Checklist 3-40
Fuel Dumping Emergency Handpump Operation . 3-43*
Fuel Dumping for Weight Reduction 3-44*
Fuel Dumping Procedure 3-41*
Fuel Flow Charts A2-5, A2-16*
Fuel Leaks 7-32
Fuel Loading, Operational 7-25*, 7-27*
Fuel Loading and Usage Limitations 5-7
Fuel Loading Tables 7-26*, 7-28*
Fuel Master Control (Carburetor) 1-3
Fuel Pressure Drop 3-12
Fuel Quantity Table—EC-121D 1-34*
—TC-121C 1-37*
Fuel Stabilizing Time 7-30
Fuel System 7-30
Fuel System—EC-121D 1-31, 1-33*
—TC-121C 1-36, 1-38*
—Controls and Indicators 1-34, 1-39
—Management 7-34*
Fuel Temperature vs Fuel Density 7-31*
Fuselage Fire 3-23
Fuselage Furnishings and Miscellaneous Equipment 4-119

G

G-2 Compass Master Heading Indicator Failure .. 7-39
Galley 4-127, 4-126*
Galley Electrical Control Panel 4-128*
GCA Procedures 9-6*
General Arrangement 1-1, 1-4*
Glide Slope Receiver—EC-121D 4-55
—TC-121C 4-91
Go-Around With One or More Engines Inoperative 3-15
Gross Weight Limitations 5-16*
Gross Weights 1-2, 5-11
Ground Station Indicator, AN/APA-57C 4-63

H

Hand Fire Extinguishers 1-81
Hand Pump Power System, Emergency 1-55
Heat Exchanger Hydraulic System 4-13*
Heating 4-1
Heating System 4-12*
Height Finder, AN/APS-45 4-58
Height Finder's Station 4-59*
Height Finding Radar, AN/APS-103 4-58
HF Radio Receiver, AN/ARR-15A 4-52, 4-84
HF Transmitter-Receivers, 618 S-1 and 618T-1 4-52
High Speed Flight 6-11
Holding Cruise Performance—TC-121C A6-35*
Holding Procedure 9-1
Horizontal Situation Indicator 4-105
Hot Weather Procedures 9-13
Hydraulic Overspeed Pitch Lock 1-20
Hydraulic Power System 1-57*
Hydraulic Pump Failure 3-47
Hydraulic Reservoir Filler Controls 1-60*
Hydraulic Steering System, Nose Gear 1-70*
Hydraulic System 1-54
—Failure of Primary 3-47, 3-50
—Failure of Secondary 3-49
—Heat Exchanger 4-13*

PAGE NUMBERS WITH ASTERISK (*) DENOTE ILLUSTRATIONS

—Landing Gear 1-67*
—Wing Flap Motor 1-64*
—Contamination 3-47
—Simplified Diagram 1-56*

I

Icing During Flight 9-11
ID-249 ARN Course Indicator 4-54
ID-250 ARN Radio Magnetic Indicator 4-54
ID-310 ARN Range Indicator 4-53, 4-87
ID-307 ARN TACAN Indicator 4-53, 4-87*
Ignition Analyzer 1-18, 7-10, 7-12*
Ignition Malfunction Pattern Explanation 7-11*
Ignition System 1-9
ILS Procedures 9-7*
ILS Receiver Failure 7-40
Inadvertent Reversing in Flight Checklist 3-22
Inclinometers 1-76
In-Flight Control Technique 6-5
Instrument Approaches 9-2
Instrument Flight Procedures 9-1
Instrument Markings 5-1, 5-2*
Instrument Takeoff 9-1
Instruments 1-75
Intercommunication System—TC-121C 4-77
—EC-121D 4-39
Interior Arrangement, EC-121D 4-120*
Interior Lights 4-94
Intermediate Climb Checklist 2-34
Interrogator Set, AN/APX-49 4-60
IP-230/APA-56 Azimuth and Range Repeat-Indicator 4-69

J

Junction Boxes 4-38

K

KY95/APX-25 Coder—EC-121D 4-54
—TC-121C 4-89

L

LAC Public Address System 4-46
Ladder and Escape Ropes 1-82
Landing 9-12
Landing and Takeoff Data 2-1
Landing Distances, Normal A7-1, A7-4*
Landing and Takeoff Emergencies 3-32
Landing Gear and Braking Limitations 5-14
Landing Gear Extension, Emergency 1-66, 3-54
Landing Gear Hydraulic System 1-67*
Landing Gear Safety Pins 1-69*
Landing Gear System 1-65
—Malfunction Procedures 3-34
—Tire Failure 3-32
Landing on Soft Ground or Unprepared Runways 3-33
Landing Pattern 2-39*
Landing Performance, Maximum A7-1, A7-5*
Landing Procedures 2-38
Landing With One or More Engines Inoperative 3-13
Landing Without Landing Gear Fully Extended 3-33
Lateral Unbalance of Fuel Load 5-7
Lavatory and Locker, Forward 4-128
Left and Right Ground Crewman (Flush Procedures) 8-14
Level Flight Characteristics 6-5
Life Raft Release 3-68*
Life Rafts 1-82
Lighting System 4-93
Lineup Checklist 2-29
LM-14 Frequency Meter 4-92
Load Factors 5-11
Loading Not Recommended 5-15
Long Range Cruise Performance—TC-121C A6-29*, A6-31*, A6-33*
Loran Receiver—EC-121D 4-54
—TC-121C 4-88
Loss of All Generators 3-42
Lower Radome Access Door 4-125

M

Magnetic Compass 1-76
Main Difference Table 1-2*
Maneuvering Flight 6-11
Manifold Pressure Limits A2-2
Manual Leaning 7-4
Manual Reserve Oil System Controls 1-31*
Manual Spark Control Operation 7-5
Manual to Automatic Pressurization Control 4-17*
Margin of Safety 5-11
Marker Beacon Receiver, AN/ARN-12
—EC-121D 4-55
—TC-121C 4-91
Master Control Panel, C-626/ARC-27
—EC-121D 4-48*
—TC-121C 4-84*
Maximum Cruise Power Climb Performance A4-2, A4-34*
Maximum Landing Performance A7-1, A7-5*
Maximum Power Manifold Pressure Limits A2-2
Mechanic's Interphone Control C-823 4-44
Meto Power Climb Performance A4-1, A4-3*, A4-22*
Miles per Pound of Fuel Charts
—EC-121D A5-5, A5-22*
—TC-121C A6-2, A6-10*, A6-19*, A6-26*

PAGE NUMBERS WITH ASTERISK (*) DENOTE ILLUSTRATIONS

Minimum Control Speed 3-2
Minimum Crew Requirements 5-1
Minimum Permissible Fuel for Individual Tanks During Flight 5-12*
Minimum Roll Landings 7-37
Minimum Speed Operation 6-5
Mission Planning A8-1
MJB Panels 1-44*

N

Navigation Radar, AN/APS-42 4-71
Navigation Receiver, AN/ARN-14A—EC-121D .. 4-52
—TC-121C 4-85
Navigational Aids Trouble Shooting Procedures . 7-38
Navigator—CGRS Control Panel—EC-121D 4-56*
—Emergency Procedures 8-5
—Equipment 4-119
—Instrument Panel 4-68*, 4-92*
—Normal Procedures 8-1
—Seat 4-125
—Station 4-64*, 4-90*
Normal Brake System 1-72
Normal Ignition Pattern Explanation 7-11*
Normal Landing Distances A7-1, A7-4*
Normal Operating Procedure for Deicer Boots ... 4-24
Normal Operating Procedures, Automatic Pilot .. 4-115
Normal Procedures
—First and Second Radar Technicians 8-10
—Radio Operator 8-5
—Search Radar Operator 8-9
—Senior Weapons Controller and Radar Crew Chief 8-7
Normal Takeoff Performance ... A3-4, A3-17*, A3-30*
Nose Gear Hydraulic Steering System 1-70*

O

Oil System 1-28
One Engine Out Performance 3-3
Operating Procedures With Hydraulic Access Door Unlatched 3-59
Operating Tables, TC-121C
—Four Engine A6-38*
—Three Engine A6-44*
—Two Engine A6-47*
Optimum Braking Action 7-37
Optional Fuel Loading 7-29*
Overboost Limitations 5-1
Oxygen Duration Chart 4-100*
Oxygen Emergency Operating Procedures 4-100
Oxygen Normal Operating Procedures 4-99
Oxygen Regulator, Diluter Demand 4-98*
Oxygen System, EC-121D 4-96, 4-97*
—TC-121C 4-100, 4-101*
Oxygen System Control Panel 4-99*, 4-102*

P

Parachutes 1-82
Parking Brake Lever and Ventilation Damper ... 1-73*
Passenger Briefing 2-11
Passenger Carrying Equipment 4-127
Penetrating the Thunderstorm 9-8
Performance and Configuration 5-14
Performance Limitations 5-14
Periscopic Sextant 4-123
Pilot 8-1
Pilot's Side Panel 1-14*
Pilots' AN/APS-42 Indicator 4-72*
Pilots' Before-Interior Inspection 2-9
Pilots' Center Control Stand 1-17*
Pilots' Glare Shield Panel 1-18*
Pilots' Instrument Panels 1-10*
Pilots' Interior Inspection 2-9
Pilots' Overhead Panel 1-12*
Pilots' Station 1-6*
Pitot Head Deicing System 4-28
Pitot Static System 1-77
Plotting Board, Air Situation—EC-121D 4-76
Pneumatic Deicing System 4-22*
Portable Oxygen System 4-98, 4-101
Power-On Approach A7-2
Power Available, Standard Day A2-3, A2-11*
Power-Speed Characteristics, Basic 6-6
Power Distribution System—EC-121D 4-31
—TC-121C 4-76
Power Requirements 6-5
Practice Maneuvers With One or More Engines Inoperative 3-16
Prediction of Maximum Power for Takeoff A3-1, A3-9*, A3-27*
Preparation for Flight 2-1
Pressurization 4-3
Pressurization Control 4-16*
Pressurization With One Cabin Supercharger Inoperative 4-20
Primary Hydraulic System 1-54
Priming System 1-16
Prohibited Maneuvers 5-5
Propeller Failure 3-17
Propeller Limitations 5-5
Propellers 1-20
Psychrometric Chart A1-2, A1-20*
Pyrotechnic Equipment 1-83

R

Radar Altimeter 4-54, 4-89
Radar Crew Chief 8-8

PAGE NUMBERS WITH ASTERISK (*) DENOTE ILLUSTRATIONS

Radar Crew Chief, Senior Weapons Controller and
—Emergency Procedures 8-9
—Normal Procedures 8-7
Radar Identification Transponder, AN/APX-25 ..... 4-54, 4-88
Radar Pressurization System, AN/APS-42 4-75
Radar Recognition Set, AN/APX-7 4-60
Radar Technician's AC Power Panel 4-62*
Radar Technician's ICS Panel 4-63*
Radar Technician's Station 4-61*
Radio Altimeter, AN/APN-1 4-89
Radio Heat Exhaust Duct System 4-39, 4-76
Radio Operator
—Auxiliary ICS Panel 4-81*
—Circuit Breaker Panel 4-45*, 4-84*
—Emergency Procedures 8-7
—ICS Panel—EC-121D 4-44*
—Station 4-43*, 4-83*
Radio Selector Boxes 4-39, 4-77
Radome, Wing, and Empennage Deicing System .. 4-21
Ram Air Induction System 1-3
Range, ADF and VOR Procedures 9-5*
Recirculating Fan Switches 4-3
Recommended Fuel Loading Table 7-26*, 7-28*
Recommended Loading Area 5-14
Recommended Operational Fuel Loading .. 7-25*, 7-27*
Refrigeration 4-1
Refueling 7-30
Reject Takeoff Procedure 3-3
Relief Crew Seat Bunks 4-125
Remote Circuit Breaker Panels 1-46*
Reserve Engine Oil System 1-30, 1-29*
Restart and Unfeathering During Flight 3-11
Reverse Thrust A3-5, A3-25*
Reversing System 1-21
Rudder Control System 1-62
Runaway Propeller 3-17

S

Safe Engine-Out Speed 3-3
Safety Belts 1-85
SCR-718 Radar Altimeter 4-55, 4-89
Search Radar, AN/APS-95 4-66
Search Radar Operator
—Emergency Procedures 8-10
—Normal Procedures 8-9
—Station 4-47*
Second Radar Technician's Emergency Procedures 8-13
Secondary Hydraulic System 1-54
Senior Weapons Controller and Radar Crew Chief
—Emergency Procedures 8-9
—Normal Procedures 8-7
—ICS Panel 4-50*
—Station 4-49*
Servicing Diagram 1-84*
Shutoff Levers, Emergency 1-77
Simplified Hydraulic System Diagram 1-56*
Slow Flying 6-5
Smoke-Fume Removal Checklist 3-28
Spark Plug Cleanout Procedure 7-7
Specific Performance Checks 7-9
Speed Requirements 6-10
Spin Characteristics 6-4
Stall Characteristics 6-1
Stall Speed Curve 6-2*
Standard Day Power Available A2-3, A2-11*
Standard Atmosphere Table A1-17*
Starting Engines 9-9
Starting Engines Checklist 2-14
Starting System 1-16
Station 260 Upper Switch Panel 1-27*
Stopping of Engines 9-12
Superchargers 1-9
Symbols and Definitions A1-3
Synchronizer Operation 7-37
Synchronizing Features 1-21

T

Table and Bench Installations 4-125
Table of Communications and Associated Electronic Equipment—TC-121C 4-78*
—EC-121D 4-32*
TACAN Failure 7-40
TACAN Indicator ID-307 ARN 4-53*, 4-87*
TACAN System, AN/ARN-21 ..... 4-52, 4-87
Takeoff 9-11
Takeoff Criteria Definitions A3-2
Takeoff, Prediction of Maximum Power for A3-1, A3-9*, A3-27*
Takeoff and Landing Data 2-1
Takeoff and Landing Emergencies 3-32
Takeoff Checklist 2-30
Takeoff Pattern 2-31*
Takeoff Performance A3-4, A3-17*, A3-30*
Taxiing 2-18
Temperature Conversion A1-2, A1-16*
Three-Engine Range, ADF, and VOR Approach .. 9-3
Three-Engine Composite Cruise Control Charts A6-6*, A6-19*, A6-31*
Three-Engine Operating Tables A6-44*
Three-Engine Approach 9-4
Throttle Levers 1-2
Time and Distance Prediction Charts A5-6, A5-41*
Touch-and-Go Landings 2-43
Transmitters, AN/ART-13A 4-85

PAGE NUMBERS WITH ASTERISK (*) DENOTE ILLUSTRATIONS

Troubleshooting the Hydraulic System 3-47
Turn-and-Slip Indicator Failure 7-39
Turn-and-Slip Indicator 1-76
Turning Boosters On in Flight 3-51
Turning Radius 2-19*
Two-Engine Range, ADF, and VOR Approach 9-3
Two-Engine Charts—Cruise Control A6-9*
—Long Range Cruise Performance A6-33*
—Miles per Pound of Fuel Charts A6-26*
—Operating Tables A6-47*
—Circling Range Approach 9-4
—Failure of 3-8

U

UHF Transmitter-Receiver 4-48, 4-81
Unfeathering and Restart During Flight Checklist 3-11
Unfeathering System 1-21
Unreversing Features 1-21
Upper Radome Access Door 4-125
Use of Landing Wheel Brakes 7-33

V

Ventilation Damper and Parking Brake Lever 1-73*
Vertical Gyro Monitor 4-110
Vertical Velocity Indicators 1-75
VHF-101 Communications System 4-48
Voltage Regulation 4-38
VOR Approaches 9-3, 9-5*
VOR Receiver Failure 7-40

W

Water Filler Valve 4-128*
Water System 4-128
Weight and Balance 2-1
Weight Considerations 6-10
Weight Limitations 5-7
Weight Limitations Chart, Explanation 5-11
Weight Limitations Chart, Sample Use of 5-15
Weights and Loads 5-11
Wet or Slippery Runway Takeoff 2-33
Wind Component Chart A3-3, A3-16*
Window Defogging System 4-29
Windshield Anti-Icing and Defogging 4-26, 4-30*
Wing, Empennage, and Radome Deicing System .. 4-21
Wing Flap Asymmetry Protection System 1-64
Wing Flap Emergency Extension Controls 1-65*
Wing Flap Extension Checklist, Emergency 3-57
Wing Flap Malfunction 3-55
Wing Flap Motor Hydraulic System 1-64*
Wing Flaps 1-63
Wing Flaps, Effect 6-10
Wing Fuel Load 5-14
Wing Limitations 5-14

PAGE NUMBERS WITH ASTERISK (*) DENOTE ILLUSTRATIONS