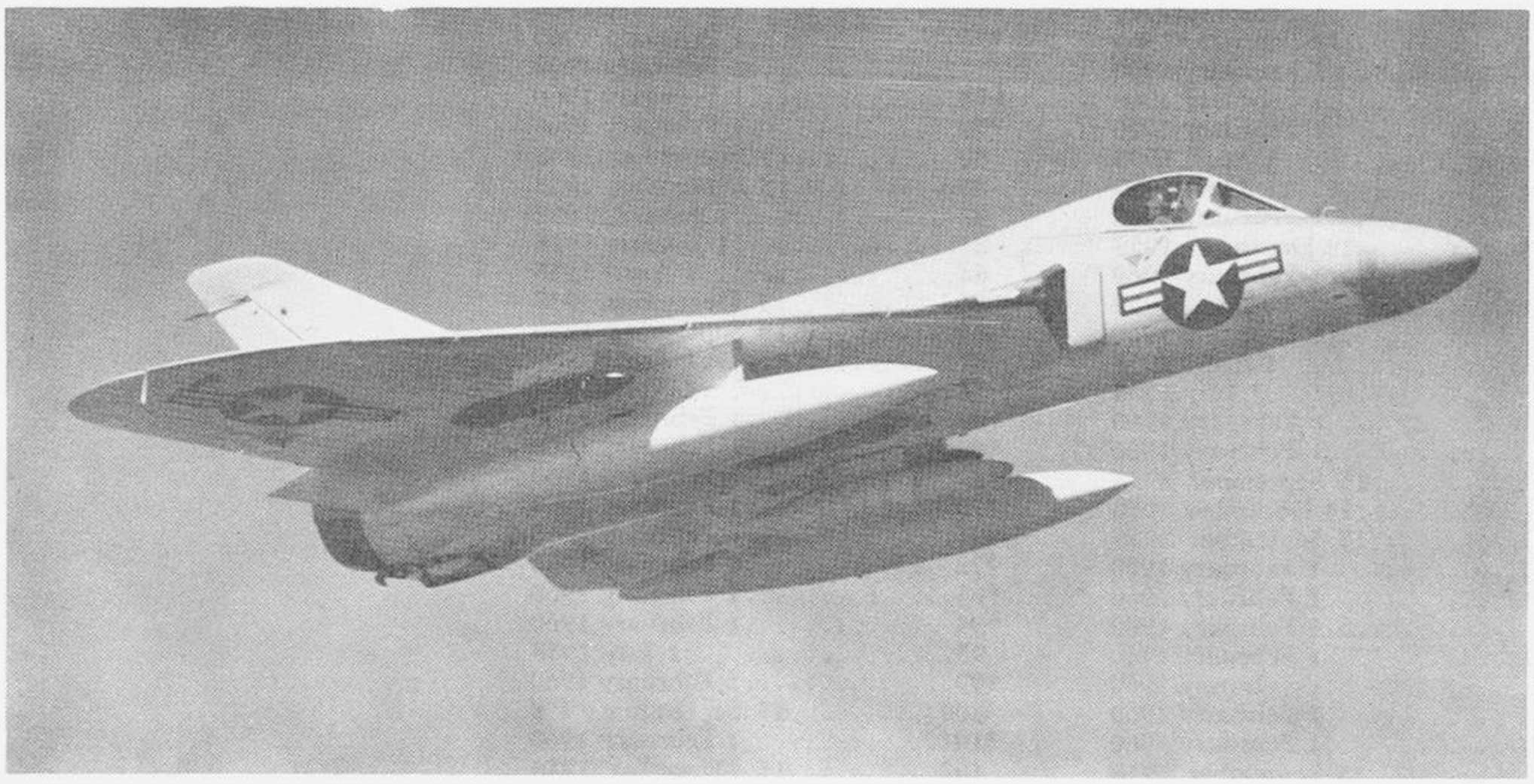
AN 01-40FBA-1
NAVWEPS 01-40FBA-1

Flight Handbook

NAVY MODEL

F4D-1

AIRCRAFT



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AND THE CHIEF OF THE BUREAU OF NAVAL WEAPONS

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INTERIM REVISION SUMMARY

The following Interim Revisions have been either canceled or incorporated in this Flight Handbook:

Canceled or Previously Incorporated	*Incorporated in This Revision on Pages Indicated*
Nos. 1 through 26, 28	No. 27 . . . . . Page 13 No. 29 . . . . . Page 54

INTERIM REVISIONS OUTSTANDING: (to be maintained by custodian of Flight Handbook)

Number	*Date*	*Purpose*

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The following Interim Revisions have been either canceled or incorporated in this Flight Handbook:

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Nos. 1 through 7	No. 8.....Pages 7, 9, 10, 11, 12, 20

INTERIM REVISIONS OUTSTANDING: (to be maintained by custodian of Flight Handbook)

Number	*Date*	*Purpose*

AN 01-40FBA-1A
14 JUNE 1957

FLIGHT HANDBOOK INTERIM REVISION No. 9

Navy Model F4D-1 Aircraft

PUBLISHED BY DIRECTION OF THE CHIEF OF THE BUREAU OF AERONAUTICS

Of paramount interest to pilots. To be read by all pilots operating these aircraft

1. CANCELLATION. None.

2. PURPOSE. To modify the flight restrictions while carrying external auxiliary fuel tanks.

3. The following changes are made to the Confidential Supplemental Flight Handbook Navy Model F4D-1 Aircraft, AN 01-40FBA-1A of 15 December 1956, revised 15 March 1957, including Interim Revision Number 8:

Section V, page 9, paragraph entitled STORES, as modified by Interim Revision Number 8, add new sub-paragraph ".8" under subparagraph ".d" as follows:

".8. At altitudes below 25,000 feet, external fuel tanks shall not be jettisoned at indicated Mach numbers greater than 0.90."

END

AN 01-40FBA-1A
27 AUGUST 1957

FLIGHT HANDBOOK INTERIM REVISION No. 11

Navy Model F4D-1 Aircraft

PUBLISHED BY DIRECTION OF THE CHIEF OF THE BUREAU OF AERONAUTICS

Of paramount interest to pilots. To be read by all pilots operating these aircraft

1. CANCELLATION. None.

2. PURPOSE. To promulgate flight information concerning the TRANSONIC TRIM COMPENSATION SYSTEM, effective on Model F4D-1 Airplanes BuNo. 134919 and subsequent.

3. The following changes are made to the Confidential Supplement, AN 01-40FBA-1A of 15 December 1956, revised 15 March 1957, to the Flight Handbook for Navy Model F4D-1 Aircraft:

(a) Section VI, page 17. Paragraph entitled HIGH SPEED FLIGHT, in the bottom line add the following sentences after the sentence ending "level flight (see figure 6-3A)":

With the transonic trim change compensator operating, this trim change is eliminated at altitudes between 40,000 and 45,000 feet and is reduced at other altitudes. Below 25,000 feet the compensator has negligible effect on the trim change characteristics.

(b) Section VI, page 19. Under the heading HIGH SPEED FLIGHT add the following to the CAUTION:

It is most critical at 25,000 feet altitude and below where excessive "g" loadings can result in severe structural damage to the aircraft.

(c) Section VI, page 19. Under the heading HIGH SPEED FLIGHT in the second sentence of the last paragraph, change to read as follows:

Between an indicated MACH number of 0.890 and 1.200,

(d) Section VI, page 20. Under the heading FLIGHT WITH EXTERNAL STORES, item "b", add "With the Transonic Trim Change Compensation System inoperative" at the beginning of the paragraph and at the end insert the following:

With the transonic trim change system operative and with Aero 1A drop tanks carried, the trim change characteristics of the airplane are compensated for at all altitudes up to 45,000 feet. The compensation is somewhat less effective with abrupt changes in altitude or abrupt decelerations. The maximum response rate of the actuators which control elevon motion is fixed and is not rapid enough to meet rapid trim change requirements. This is because the actuators are programmed to preclude structural damage to the aircraft in the event of a "run-away" malfunction.

END

AN 01-40FBA-1
9 March 1960

FLIGHT HANDBOOK INTERIM REVISION No. 30

Navy Model F4D-1 Aircraft

PUBLISHED BY DIRECTION OF THE CHIEF OF THE BUREAU OF AERONAUTICS

Of paramount interest to pilots. To be read by all pilots operating these aircraft

1. CANCELLATION: None.

2. PURPOSE. To promulgate information concerning description of the fuel transfer pump pressure indicator light and its operating characteristics, effective on F4D-1 airplanes BuNo 134744 and subsequent.

3. The following change is made to AN 01-40FBA-1, Flight Handbook, Navy Model F4D-1 Aircraft of 1 November 1957, revised 1 April 1959; and is to remain outstanding against AN 01-40FBA-1, Flight Handbook Navy Model F4D-1 Aircraft of 1 November 1957, revised 1 February 1960, when received:

Section I, page 14A, after the paragraph entitled BOOST PUMP FAILURE WARNING LIGHT, add the following:

FUEL TRANSFER PUMP PRESSURE LIGHT. A fuel transfer pump pressure indicator light (26, figure 1-4, sheet 2) is provided on the instrument panel. This light indicates the operating status of the main tanks to sump compartments fuel transfer pumps. The indicator light will illuminate upon failure of either transfer pump.

Note

Due to operating characteristics of the system, the fuel transfer pump pressure light may illuminate during certain phases of flight even though the pumps are fully operational. This is caused by very high fuel flow rates at high power settings reducing transfer fuel pressure to a point where

the light illuminates; or, by unporting of the transfer pumps during high angles of attack and a low fuel state during landing approach. Illumination of the light during these operating conditions need not be cause for concern on the part of the pilot, or reason to "down" the airplane because of incorrectly interpreted transfer pump pressure light indications.

END

NAVWEPS 01-40FBA-1
2 September 1960

FLIGHT HANDBOOK INTERIM REVISION NO. 31

Navy Model F4D-1 Aircraft

PUBLISHED BY DIRECTION OF THE CHIEF OF THE BUREAU OF NAVAL WEAPONS

Of paramount interest to pilots. To be read by all pilots operating these aircraft

1. CANCELLATION. None

2. PURPOSE. To promulgate information concerning the installation and operation of the Martin-Baker MK-P5 Ejection Seat, effective on Model F4D-1 airplanes BuNo. 134 744 and subsequent after incorporation of F4D Aircraft Service Change No. 164.

3. The following change is made to AN 01-40FBA-1 Flight Handbook, Navy Model F4D-1 Aircraft dated 1 November 1957, revised 1 February 1960:

(a) Section I, page 3, add the following: Airplanes BuNo. 130740-130750; 134744 and subsequent prior to service change.

(b) Section I, page 37, add the following superscript after "ball lever" in the first sentence of the last paragraph: (3)

(c) Section I, page 37, delete footnote effectivities and substitute the following footnotes:

(1) Airplanes BuNo. 130740-130750 prior to service change.
(2) Airplanes BuNo. 134744 and subsequent; 130740-130750 after service change.
(3) Airplanes BuNo. 130740-130750 only.

(d) Section I, page 38, after the title of the paragraph following the WARNING, add the following superscript: (1).

(e) Section I, page 38, after the paragraph entitled CANOPY REMOVER GROUND SAFETY PINS add the following:

CANOPY INITIATOR SAFETY PINS. (2) Two safety pins attached to a red flag comprised of a total of six safety pins (3, 5, figure 1-13C) are used to safety the canopy initiators while on the

ground. These pins are located, one on the initiator on the port side of the cockpit, and the other on the initiator on the aft side of the ejection gun. A red flag connecting these two pins, plus four other pins (refer to MARTIN-BAKER EJECTION SEAT), serves to prevent an oversight in removing the pins before flight.

(f) Section I, page 38, after the title PILOT'S EJECTION SEAT, add the following superscript: (1).

(g) Section I, page 38, in the paragraph entitled PILOT'S EJECTION SEAT, delete the third and fourth sentences and substitute the following:

Prior to Service Change No. 29 the seat is armed upon canopy jettisoning. After service change, the seat is armed by pulling the face curtain past the interlock position after the canopy has been jettisoned.

(h) Section I, page 38, after PILOT'S EJECTION SEAT, delete the second paragraph and substitute the following:

The firing mechanism of the NAMC Type II personnel ejection seat catapult contains a plunger which indicates visually whether or not a cartridge is installed. The plunger is spring-loaded downward and projects from the catapult cap to reveal the word "LOADED" if a cartridge is in place.

(i) Section I, page 38, delete the footnote effectivities and substitute the following:

(1) Airplanes BuNo. 130740-130750 only.
(2) Airplanes BuNo. 134744-and subsequent.

(j) Section I, page 38, before the last paragraph, entitled AUXILIARY EQUIPMENT, insert the following:

MARTIN-BAKER EJECTION SEAT (2)

The Martin-Baker Automatic Ejection Seat, MK-P5, provides a means of escape from high speed aircraft at most altitudes and speeds within the range of the aircraft. Safe ejection for all pilots regardless of weight, may be accomplished within an altitude/speed envelope of 50 feet from 120 knots IAS to 370 knots IAS, and 200 feet from 370 knots IAS to maximum velocity, in a level or climbing upright attitude.

The seat employs a duplex drogue system consisting of a small

controller and a main stabilizer drogue. These drogues provide progressive deceleration and stabilization of the seat to place it in an attitude convenient for seat and pilot separation. Tension imposed by the drogues on the parachute and shroud lines provide uniform, gradual blossoming of the canopy. This prevents squidding and insures safe separation of the seat and its occupant. The seat is further equipped with a barostatic control and "G" switch, which delay parachute opening during high altitude and/or high speed ejection. The primary ejection control is the face curtain handle. A secondary means of initiating the ejection sequence is provided by a firing handle mounted on the front of the seat bucket. The seat has automatic leg restraint equipment to insure that the pilot's legs are held securely during ejection, and automatic leg release equipment to release the pilot's legs after ejection.

SEAT EQUIPMENT

EJECTION GUN. The ejection gun mounted on the back of the seat, provides power for the ejection of the seat and occupant from the airplane. It is comprised of three tubes which extend under power from one primary and two auxiliary cartridges. This gives the seat a final velocity of 83 feet per second. Ejection gun firing is preceded by pulling of the face curtain or secondary handle and jettisoning of the canopy.

DROGUE GUN. The drogue gun, (4, Figure 1-13C) propels a piston which extracts the controller drogue from stowage in the top of the seat and deploys the stabilizer drogue. The drogues develop freely without becoming entangled with the seat during rapid ascent due to incorporation of an escapement mechanism that allows 1/2 second interval between ejection gun firing and drogue firing.

TIME DELAY MECHANISM. The time delay mechanism (TDM) (top right side of the seat) prevents the main parachute from being opened by the drogue until the seat is stabilized, decelerated, and below a pre-set altitude. A TDM trip rod tied to the airplane structure starts the TDM operation. Below 10,000 feet altitude and at speeds low enough to prevent actuation of the "G" switch, the TDM escapement mechanism runs for 1.5 seconds, then releases the drogues from the scissor shackle and unlocks the seat harness.

At altitudes above 10,000 feet, a barostatic control engages the escapement mechanism, preventing the TDM from running until an altitude of 10,000 feet is reached.

During high speed ejection at 10,000 feet or below, where deceleration exceeds 3 to 4-1/2 "G", a "G" switch engages the escapement mechanism of the TDM, preventing operation until the deceleration load has been reduced. In the event of high speed ejection, the delay in the deployment of the main parachute after ejection is the time the "G" switch remains actuated plus the TDM running time for a total of approximately 3 seconds or less.

SCISSOR SHACKLE. The scissor shackle, (top of the seat) when opened by descent of the shackle release plunger of the TDM, allows the drogues to withdraw the main parachute. This, in addition to release of the shoulder harness and leg restraint straps, permits pilot and seat separation.

GUILLOTINE-AUTOMATIC DROGUE SYSTEM RELEASE. The guillotine (upper left side of the seat) is fired by pulling the EMERGENCY HARNESS RELEASE handle (15, figure 1-13A). Gases from the guillotine cartridge cause the piston and blade assembly of the guillotine to sever the parachute withdrawal line from the automatic drogue system.

SEAT CONTROLS

FACE CURTAIN. The face curtain, (1, figure 1-13A) is the primary control for initiating seat ejection. Face curtain tension of approximately 60 lbs. on the primary cable triggers the canopy initiator cartridge behind the seat. Further face curtain and cable travel is prevented until the interconnect mechanism sear is removed as the canopy removal sequence progresses.

SECONDARY EJECTION HANDLE. The secondary ejection handle, (14, figure 1-13A) is utilized in the event that high acceleration forces or damage to the primary firing control should render it's use impossible. Pulling the secondary ejection handle accomplishes results identical to the primary firing control with the exception that the face curtain is not utilized.

WARNING

Do not resort to this method of ejection unless absolutely necessary. Be sure to keep the spine erect and the head back when using the secondary ejection handle.

INERTIA REEL LEVER. The inertia reel lever, (7, figure 1-13A) manually controls the shoulder harness, allowing the occupant to lean forward. The lever is moved aft to "recycle" center for "free movement" and forward to "lock". In the "free movement" position, forces in excess of "2.5 Gs" will cause the inertia reel to lock. The inertia reel is spring loaded to take up slack in the shoulder harness when the occupant returns to an upright position in the seat.

LEG LINE RELEASE LEVER. The leg line release lever, (8, figure 1-13A) releases the leg restraint lines (11, figure 1-13A) from engagement with the seat to permit manual removal of the lines from the garter loops.

SNUBBING RELEASE RING. The snubbing release rings, (10, figure 1-13A), allow freedom of leg movement when the rings are pulled.

WARNING

Prior to flight, pull snubbing release rings independently to permit release of leg restraint lines, and at the same time apply full rudder to the left and right to assure complete freedom of leg movement.

EMERGENCY HARNESS RELEASE HANDLE. The EMERGENCY HARNESS RELEASE handle (15, figure 1-13A) releases all harnesses, allowing pilot and seat separation. Depressing the red button (16, figure 1-13A) on the front of the handle and pulling "up" and "aft" fires the guillotine, cutting the parachute withdrawal line. It also releases the harness fittings and leg line locks, which in turn free the "blue" and "white" leg restraint lines from the front of the seat so they may pass thru the garter loops as the pilot separates from the seat.

SEAT ADJUSTMENT. The seat actuator is electrically powered by the 28-volt d-c primary bus. Raising and lowering of the seat is controlled by the SEAT switch (13, figure 1-5) which has "UP" "DOWN" and "OFF" position. The seat has a total travel of approximately 4.5 inches.

OPERATION

Pulling the face curtain or alternate ejection handle initiates the following seat ejection sequence (see figure 1-13B):

a. The canopy initiator is fired and the expanding gases remove the exactor pin from the canopy remover, thus firing the canopy remover. This jettisons the canopy.

b. A cable attached to the jettisoned canopy withdraws a sear from the interconnect mechanism, permitting the further travel of the face curtain which withdraws the ejection gun sear, firing the primary cartridge. This cable also actuates the emergency IFF.

c. Expanding gas from the firing of the primary cartridge causes the inner and intermediate tubes to rise. Initial movement of these tubes cams the seat latch out of engagement, thus disengaging the seat from the outer barrel. After 14 inches of travel a port is uncovered permitting ignition of the lower auxiliary cartridge. After 17 additional inches of travel the upper auxiliary cartridge is ignited, giving the seat a final velocity of 83 feet per second.

d. The leg restraint lines tighten as the seat rises, drawing the pilot's legs aft to the front of the seat bucket and locking them in place until they are released by completion of the TDM cycle. At the same time the emergency oxygen release is pulled free from the seat pan, activating the emergency oxygen supply.

e. Initial seat movement up the guide rails causes the TDM and drogue gun trip rods to pull the drogue gun and TDM sears, rendering both systems operative. After 1/2 second the drogue gun fires, extracting the controller and stabilizer drogues.

f. The TDM prevents the main parachute from opening until the seat has been stabilized, decelerated and lowered to the preset altitude by the drogue parachutes.

g. 1.5 seconds after altitude and deceleration conditions have been met, the TDM shackle release plunger permits the scissor shackle to open, allowing the drogues to withdraw the main parachute. At the same time the leg restraint mechanism and harness are released, permitting pilot and seat separation. The drogues also withdraw pins on the parachute link line, disconnecting the face curtain and parachute retaining straps.

Key to figure 1-13A

1. Face curtain handle (primary ejection control).
2. Parachute ripcord.
3. Parachute ripcord D ring.
4. Rocket - Jet fitting (4).
5. Oxygen hose (2).
6. Seat belt.
7. Inertia reel lever.
8. Leg restraint line release lever.
9. Emergency oxygen supply "green ring".
10. Leg restraint line snubbing release ring.
11. Leg restraint line.
12. Secondary ejection handle safety lever.
13. Emergency oxygen supply pressure gage.
14. Secondary ejection handle.
15. Emergency harness release handle.
16. Emergency harness release handle safety button.
17. Kidney pad.
18. Parachute pack.

(k) Section II, page 41, delete 5-6 COCKPIT AREA with steps "a" through "g", and substitute the following:

5-6 CANOPY AND EJECTION SEAT

a. Early airplanes (4):

1.	Canopy	General condition
2.	Pressure relief door	Closed, condition
3.	Canopy air pressure seal	Condition
4.	Canopy bungee air pressure	Canopy stays open
5.	Canopy jettison safety pins	Removed
6.	Seat ejection safety pin	In place
7.	Ejection catapult indicating cap	"LOADED"

b. Later airplanes (5):

1.	Canopy	General condition
2.	Pressure relief door	Closed, condition
3.	Canopy air pressure seal	Condition
4.	Canopy bungee air pressure	Canopy stays open
5.	Drogue gun sear safety pin	Removed
6.	Guillotine cartridge sear safety pin	Removed
7.	Canopy initiator safety pin (left side of cockpit)	Removed

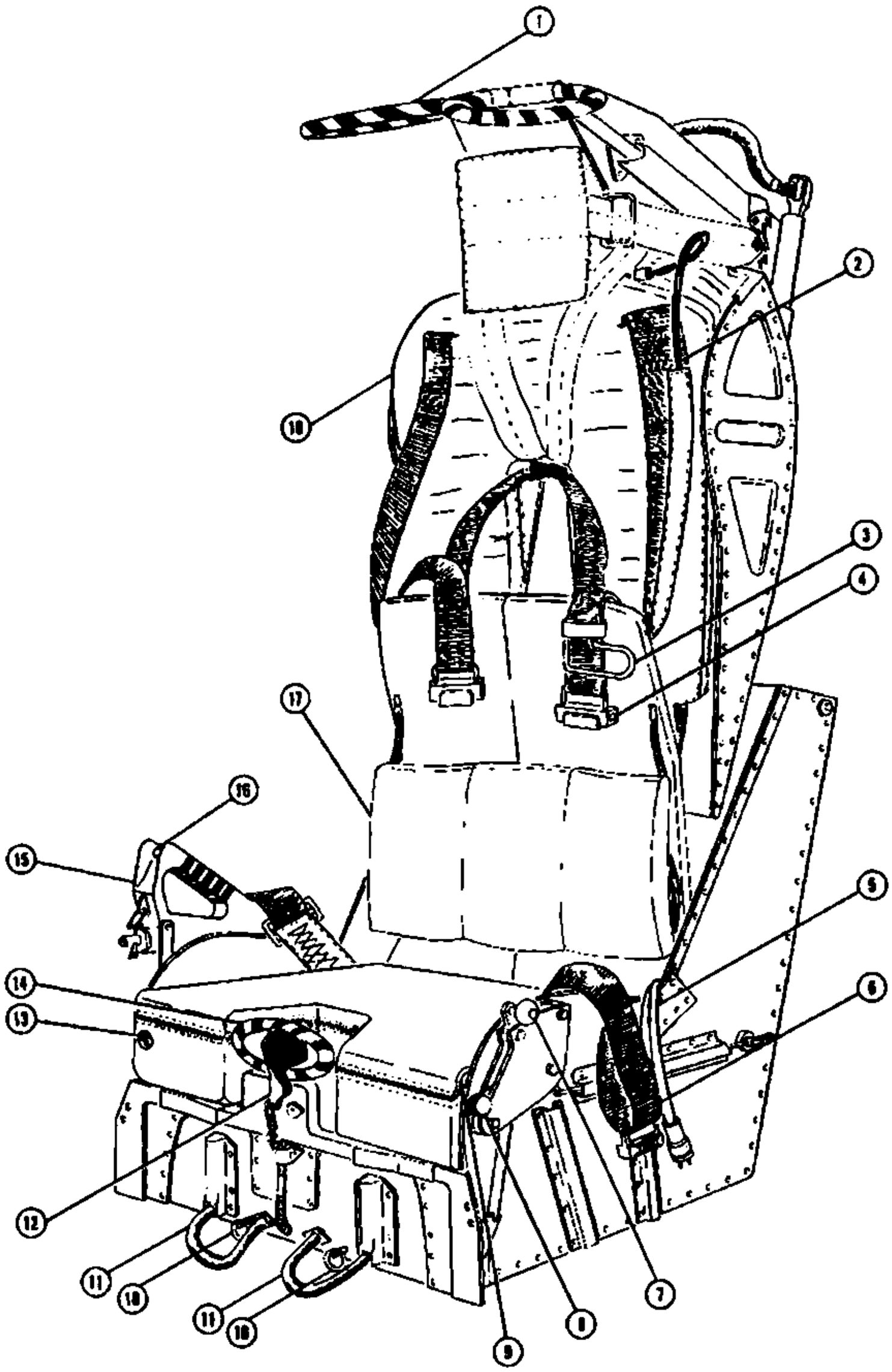


Figure 1-13A. Martin-Baker Ejection Seat

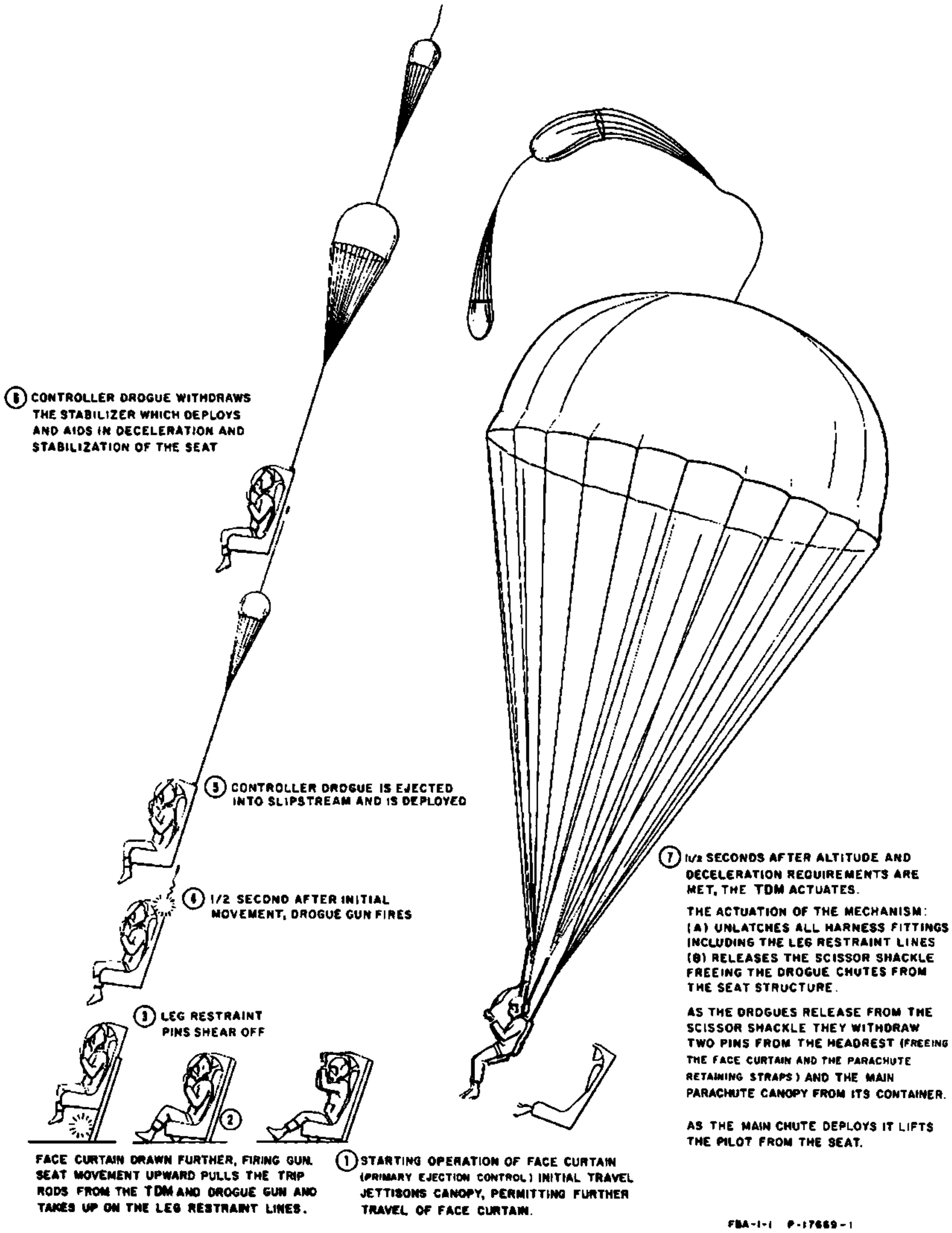


Figure 1-13B. Ejection Sequence

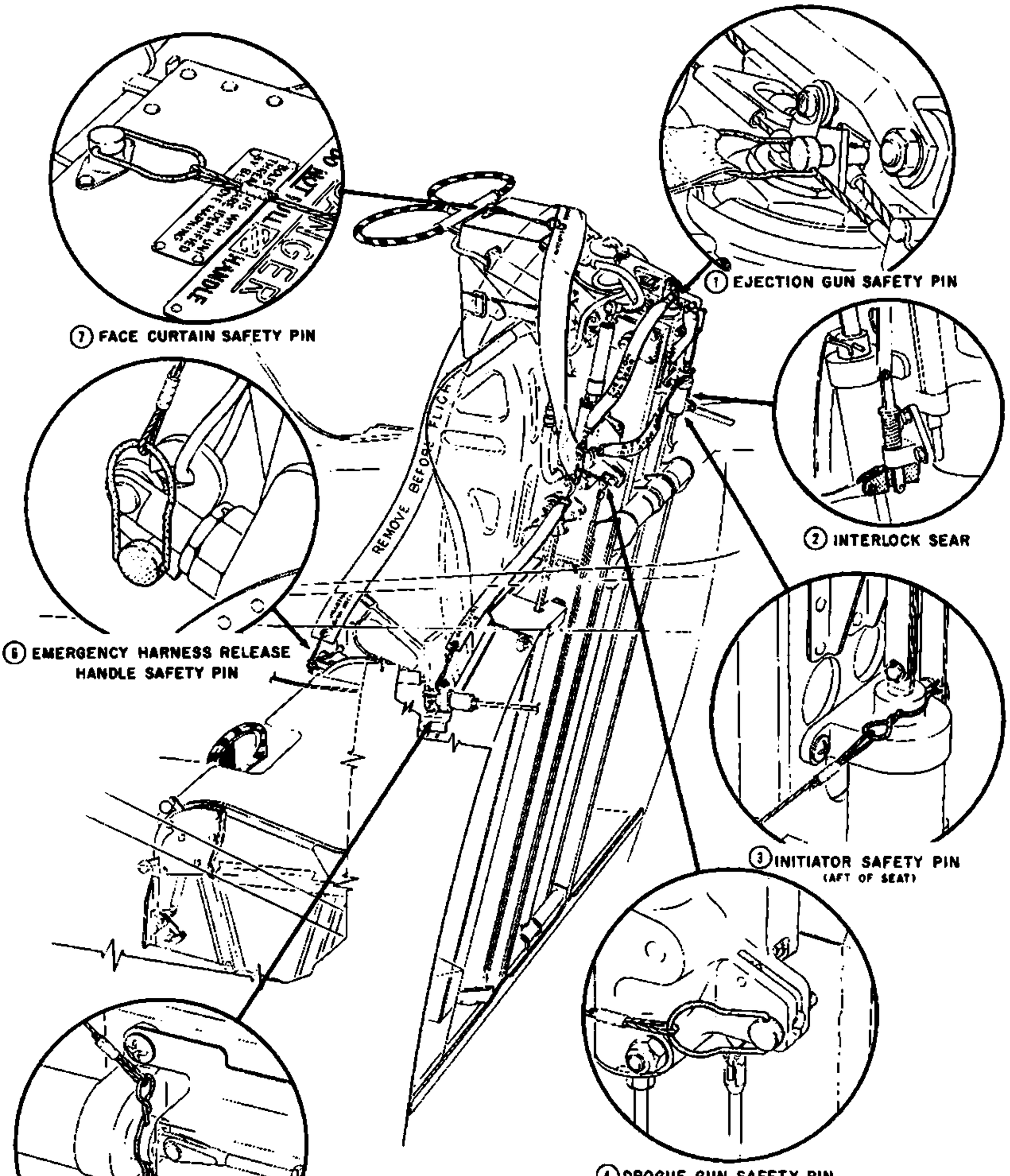


Figure 1-13C. Safety Pin Locations

8. Canopy initiator safety pin (aft side of ejection gun).....Removed
9. Face curtain safety pin..... In place
10. Ejection gun sear safety pin..... In place
11. Check that the face curtain and secondary firing cables are attached to the ejection gun sear and are secured to the interlock assembly.
12. Check that the interlock sear (2, figure 1-13C) is in place.
13. Check that the drogue gun and TDM trip rods are attached to the bulkhead.
14. Check that the emergency oxygen release lanyard is attached to the left hand console.

(l) Section II, page 41, after INTERIOR CHECK (ALL FLIGHTS), delete items "a" and "b" and substitute the following:

a. Early airplanes (4):

1. Safety belt and shoulder harness.....Fastened
2. All personal service lines.....Connected

b. Later airplanes (5):

1. Fasten leg restraint garters just below the knees, but above the calf; with the white garter on the left leg and the blue garter on the right leg. The metal loops face aft.

Note

This applies only if the garters are not integral with the suit.

2. Release leg restraint lines from locks, if secured; then check that the leg restraint line release lever is in the locked (down) position.
3. Pass blue and white leg restraint lines through respective garter loops and snap line terminals into locks on front of seat.
4. Pull and hold snubbing release rings and extend the legs alternately to obtain sufficient slack in the leg restraint lines to permit full rudder and brake pedal travel.
5. Hook up four "Rocket-Jet" harness fittings.
6. Check shoulder harness inertia reel operation.
7. Adjust kidney pad for maximum comfort.
8. Connect all personal service lines.
9. Rotate the safety lever on the secondary ejection handle 90° to starboard.

10. Have the plane captain remove the safety pins from the face curtain handle and the ejection gun sear.
11. Count six safety pins and stow the safety pin harness on the starboard side of the aft bulkhead.

(m) Section II, page 41, add the following footnotes:

(4) Airplanes BuNo. 130740-130750.
(5) Airplanes BuNo. 134744 and subsequent.

(n) Section II, page 52, after BEFORE LEAVING THE AIRPLANE, delete items "f" and "g" and substitute the following:

f. Place the secondary ejection handle safety lever to the safe (vertical) position. (3)
g. Have the plane captain install the safety pins in the face curtain handle and the ejection gun sear. (3)
h. Disconnect all personal service lines. (3)
i. Disconnect "Rocket-Jet" harness fittings. (3)
j. Release leg restraint lines by pulling up on leg line release lever and remove the lines from the garter loops. (3)
k. Remove leg restraint garters and stow in cockpit. (3)

Note

This applies only if the garters are not integral to the suit.

l. Disembark from the airplane.
m. Have the four remaining safety pins installed. (3)
n. Have canopy jettison safety pins installed. (4)
o. Check that wheels are chocked.
p. If gusty wind conditions prevail, have the airplane moored. (See figure 2-5)

(o) Section II, page 52, add the following footnotes:

(3) Airplanes BuNo. 134744 and subsequent.
(4) Airplanes BuNo. 130740-130750.

(p) Section III, page 60, underneath the illustration add the following:

Airplanes BuNo. 130740-130750.

(q) Section III, page 61, after the WARNING add the following:

BAIL-OUT

EARLY AIRPLANES (1)

a. If possible, slow the airplane and trim for straight and level flight.
b. SPEEDBRAKE switch......"CLOSE"
c. Jettison canopy by one of the following:
   1. EMER CANOPY JETT "D" handle..... Pull
   2. EMERGENCY CANOPY REMOVER lever.... Pull
   3. Interior manual canopy handle..... "OPEN"
d. Emergency oxygen supply ring..... Pull
e. Manually release the lap belt and shoulder harness.
f. Bail-out in accordance with squadron doctrine.
g. Manually pull parachute ripcord "D" ring if terrain requires parachute opening prior to the pre-set altitude.

LATER AIRPLANES (2) (3)

a. If possible, slow the airplane and trim for straight and level flight.
b. SPEEDBRAKE switch ....."CLOSE"
c. Jettison canopy by one of the following:
   1. EMER CANOPY JETT "D" handle..... Pull
   2. Interior manual canopy handle....."OPEN"
d. Emergency oxygen supply ring..... Pull
e. EMERGENCY HARNESS RELEASE handle..... Pull
f. Bail-out in accordance with squadron doctrine.
g. Manually pull parachute ripcord "D" ring below 10,000 feet or as terrain requires.

(r) Section III, page 61, in the last paragraph, delete the third sentence and substitute the following:

Therefore, an ejection should be attempted if above 50 feet at 120 KIAS and 200 feet at 370 KIAS in most airplanes, (2) (3) or 800 feet in some airplanes. (1)

(s) Section III, page 62, at the end of the first WARNING, add the following superscript: (3).

(t) Section III, page 62, delete both notes in their entirety.

(u) Section III, page 62, in the left-hand column delete step "h" and substitute the following:

h. OXYGEN control....."ON"

(v) Section III, page 62, in the right-hand column, delete step "1" and substitute the following:

1. In early airplanes, (3) perform the following:
   1. Unfasten lap belt and shoulder harness latch manually.
   2. Check that personal equipment does not foul when arising from the seat.

   In later airplanes (4) perform the following:
   1. Pull the EMERGENCY HARNESS RELEASE handle.
   2. Disconnect the two upper "Rocket-Jet" harness fittings.
   3. Check that personal equipment does not foul when arising from the seat.

(w) Section III, page 62, at the end of the fourth **WARNING**, add the following superscript: (3)

(x) Section III, page 62, delete the first sentence in the last paragraph and substitute the following:

In the event the airplane sinks with the canopy still closed, actuate the EMERGENCY CANOPY REMOVER lever (3), or the EMER CANOPY JETT "D" handle (3) (4) to jettison the canopy.

(y) Section III, page 62, delete footnote effectivities (3) and (4) and substitute the following:

(3) Airplanes BuNo. 130740-130750.
(4) Airplanes BuNo. 134744 and subsequent.

(z) Section III, page 63, after the title, **EJECTION**, add the following:

(EARLY AIRPLANES) (2)

(aa) Section III, page 63, after the third **WARNING**, add the following:

EJECTION (LATER AIRPLANES) (3)

If time permits, the following procedure is recommended; however, if immediate ejection is necessary, simply grasp the face curtain handle and pull down:

a. Slow the airplane as much as possible.
b. Descend to at least 10,000 feet if terrain permits.
c. IFF..... ....."EMERGENCY"
d. Use radio distress procedure on guard channel.
e. NORMAL-RAM switch....."RAM"

f. Shoulder harness.....Tight and locked
g. Ascertain that all personal gear is properly utilized.
h. Sit erect with head firmly against the headrest.
i. Grasp the face curtain handle and pull smartly until the seat ejects.
j. If the canopy fails to jettison, pull the EMER CANOPY JETT "D" ring or manually actuate the canopy latch handle to "OPEN".

WARNING

Hold on to the face curtain handle with one hand if step "j" is required, otherwise the face curtain may blow back and become inaccessible. After the canopy has jettisoned, pull the face curtain or secondary ejection handle. Do not use secondary ejection handle unless absolutely necessary.

k. After ejection, if the TDM controlled scissor shackle fails to release the drogues from the seat and deploy the main parachute, proceed as follows:

1. EMERGENCY HARNESS RELEASE HANDLE.....Pull
2. Wriggle and kick free of the seat.
3. Pull the manual parachute ripcord "D" ring.

(ab) Section III, page 63, add the following footnote effectivities:

(2) Airplanes BuNo. 130740-130750.
(3) Airplanes BuNo. 134744 and subsequent.

- END -

NAVWEPS 01-40FBA-1
25 January 1961

FLIGHT HANDBOOK INTERIM REVISION NO. 32

Navy Model F4D-1 Aircraft

PUBLISHED BY DIRECTION OF THE CHIEF OF THE BUREAU OF NAVAL WEAPONS

Of paramount interest to pilots. To be read by all pilots operating these aircraft

1. CANCELLATION. None

2. PURPOSE. To promulgate information concerning the pre-flight check of the link line connector in the parachute withdrawal line in Martin-Baker MK-P5 Ejection Seat equipped airplanes.

3. The following change is made to NAVWEPS 01-40FBA-1, Flight Handbook, Navy Model F4D-1 Aircraft, dated 1 November 1957, revised 1 February 1960, as revised by F4D-1 Interim Revision No. 31, dated 2 September 1960:

Section II, page 41, paragraph 5-6 CANOPY AND EJECTION SEAT, sub-paragraph b., add the following:

15. Check that the link line connector between the drogue link line and the parachute withdrawal line is connected and secure. (The link line connector is generally obscured from view under the left-hand parachute retaining strap).

WARNING

The link line connector must be secured, or the drogues cannot deploy the main canopy when the TDM releases the scissor shackle. While actuation of the manual parachute ripcord will still deploy the main parachute, successful parachute deployment in low-level ejection is unlikely.

-END-

TABLE OF CONTENTS

IMPORTANT

In order to gain the maximum benefits from this handbook, it is imperative that you read this page carefully.

FOREWORD

This handbook is written as a text for initial study and frequent reference by the pilot, in order that he may gain a thorough knowledge of the equipment he is expected to operate. Complete information is given, where required, on structure, installations, controls, equipment, and fundamental operating procedures. It is not the objective of this handbook to teach the pilot how to fly the aircraft, but to provide him with information regarding behavior and procedure unique to the equipment. Thorough investigation of the material presented in this handbook is essential to the attainment of flying proficiency in the subject aircraft.

The handbook is divided into nine sections and an appendix. Sections I, II, and III are closely interrelated and contain complete information relative to flying the aircraft. Section I contains a complete description of the aircraft, its systems, controls and instruments. Emergency equipment which is not a part of an auxiliary system is also described. Section II contains information and procedure for normal operation of the aircraft from the time it is approached until it is left parked after completing one non-tactical flight under ordinary conditions. Section III describes the procedure to be followed in meeting any emergency that could reasonably be expected to be encountered, except those in connection with auxiliary equipment. Section IV contains the description and procedure for operation of all auxiliary equipment which does not actually contribute to flight but enables the aircraft to perform certain specialized functions. Section V discusses limitations and restrictions that must be observed during normal operation of the aircraft. Section VI is compiled to acquaint the pilot with the control response and general maneuverability of the aircraft that he may expect during flight. Both advantageous and disadvantageous flight characteristics are discussed. Sections V and VI are currently classified Confidential and are published in a supplemental handbook, AN 01-40FBA-1A. Section VII contains instructions for management of the various systems of the aircraft under all conditions of aircraft operation. Section VIII does not apply to single place aircraft. Section IX sets forth the proper technique and procedure to be used under instrument flight conditions and all-weather operation. The Appendix contains all operating data charts necessary for preflight and inflight mission planning and explanatory text on how to use the data presented. All data classified Confidential are contained in AN 01-40FBA-1A, Supplement to AN 01-40FBA-1 Flight Handbook, Navy Model F4D-1 Aircraft. An alphabetical index by subject material is provided in the back of the handbook.

To make the text as specific as possible, the nomenclature used in the handbook to identify controls and other equipment is identical wherever practicable to that nomenclature used on the aircraft itself. Such nomenclature is capitalized. Also capitalized and enclosed in quotation marks are the control positions as they are identified in the aircraft. For example, 'The EMERGENCY TRIM control has three positions, "OFF," "NOSE UP," and "NOSE DOWN." '

A system of footnotes is employed in the text of this publication for the purpose of referencing specific airplane configuration or installation effectivities. Aircraft which have been modified subsequent to delivery by Field Modification, Post Delivery Modification, or Service Change, are all classed under the general heading of Service Change in the footnotes for the sake of convenience.

Information in this handbook will be kept current by frequent revision. Since a delay in the dissemination of revision material due to production, reproduction, and distribution considerations is to be expected, *it is imperative that flight crews stay abreast of technical orders and directives pertinent to new flight restrictions or techniques involved in operating the aircraft.*

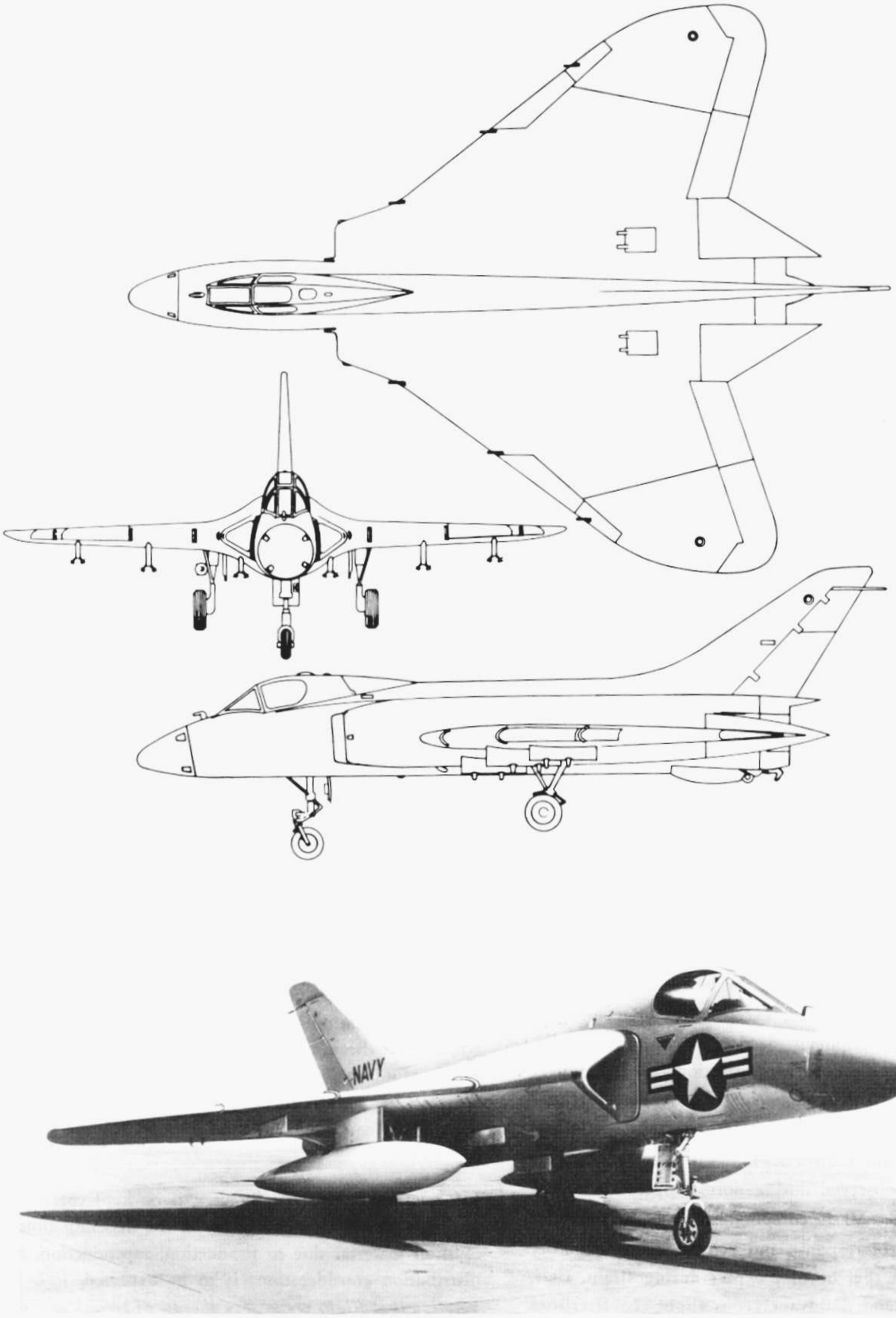


Figure 1-1. Model F4D-1 Airplane

SECTION I

DESCRIPTION

THE AIRCRAFT

The Navy Model F4D-1 is manufactured by the Douglas Aircraft Company, Inc., El Segundo Division. The aircraft is a single place, single engine, jet propelled, high performance, interceptor landplane. Propulsion is provided by a Pratt and Whitney J57-P-8 Series gas turbine engine with afterburner. The aircraft can operate from either a land base or a carrier with equal facility, having provisions for catapulted take-off and arrested landing. The tailless design of the aircraft incorporates an unconventional control surface arrangement consisting of elevons, pitch trimmer, servo rudder, rudder and slats. A tail bumper wheel is provided in addition to a conventional tricycle landing gear to protect the tail cone during landings at the high angle of attack required by the tailless configuration. Armament consists of four rocket pylons, each capable of carrying rocket packages containing either seven or nineteen 2¾-inch folding fin stabilized rockets, and four 20-mm cannon. An alternate armament installation may be installed consisting of four air-to-air guided missiles. For general arrangement of the aircraft, see figure 1–2.

DIMENSIONS. The principal dimensions are as follows:

a. Length	45 ft. 8¼ in.
b. Span (wings extended)	33 ft. 6 in.
c. Span (wings folded)	25 ft. 6 in.
d. Height (over tail, wings extended)	12 ft. 11⅞ in.
e. Height (over tail, wings folded)	12 ft. 11⅞ in.
f. Height (maximum during folding)	12 ft. 11⅞ in.
g. Tread	11 ft. 6 in.
h. Sweepback of wing leading edges	52½ degrees
i. Wing area	557 sq. ft.

ENGINE

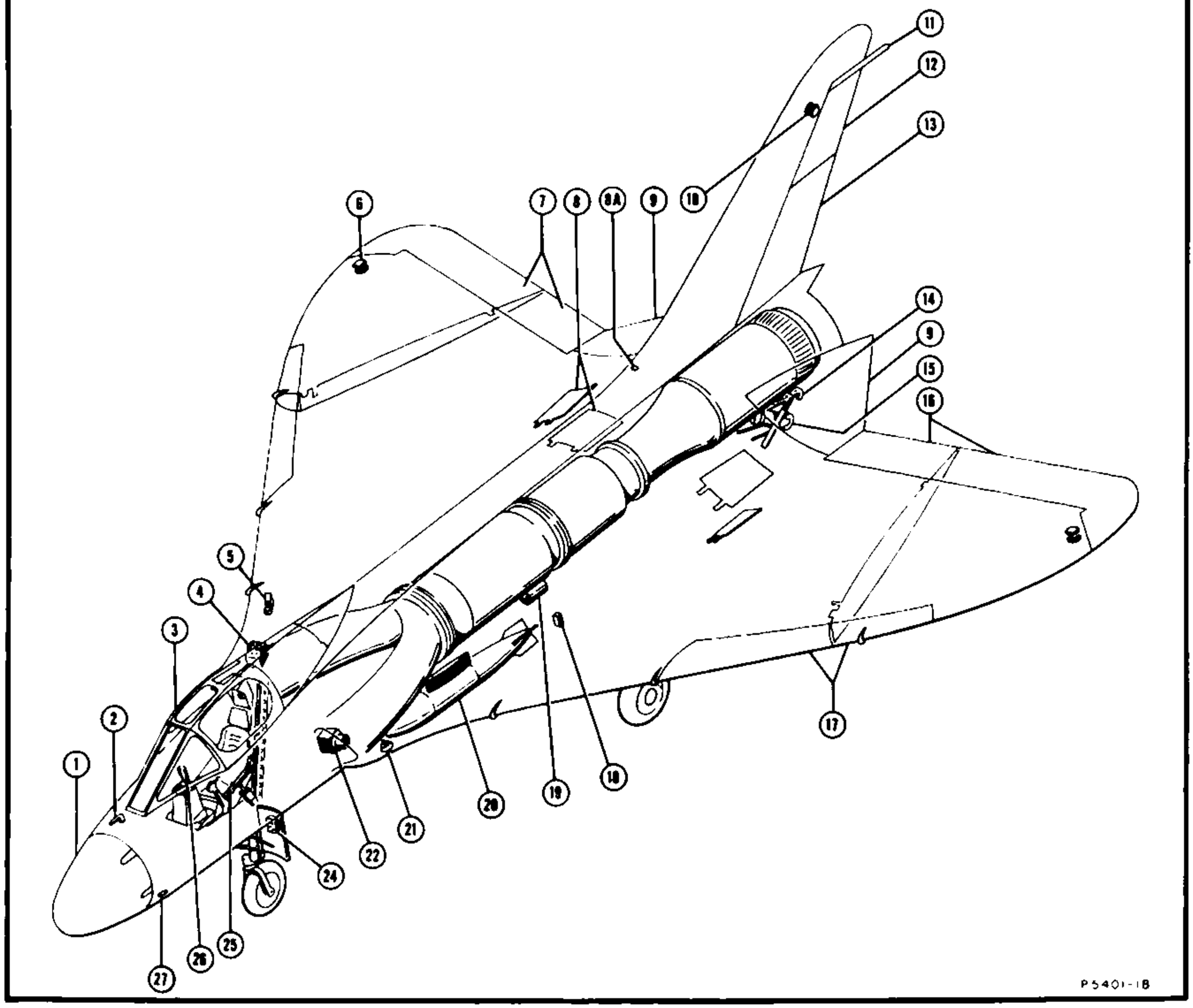
A Pratt and Whitney J57-P-8, J57-P-8A or J57-P-8B engine is installed in these airplanes. The essential difference between the -8 and the -8A engines is that the -8 has a flap-type exhaust nozzle while the -8A has an iris-type nozzle. The -8B incorporates changes which improve the reliability of afterburner light-off and increase engine afterburner performance at altitude.

The Pratt and Whitney J57-P-8 Series "Turbo-Wasp" is a continuous-flow, gas turbine engine consisting of two multi-stage, axial flow compressors, eight combustion chambers, and a split, three-stage turbine assembly. The engine is composed of three main sections: the compressor section, the accessory section, and the combustion chamber, turbine, and exhaust section. The compressor section consists of a low pressure, nine-stage unit driven by the second and third stages of the turbine assembly, and a high pressure, seven-stage unit driven by the first stage of the turbine assembly. The combustion chamber, turbine and exhaust section houses the eight combustion chambers which are inter-connected by cross-over tubes to allow flame passage and continuous burning in all chambers, the three-stage turbine which drives the compressor units, and the exhaust duct which channels the exhaust gases out of the engine. The main accessory section is located beneath the engine at the point of smallest diameter, and contains those supplementary units necessary for proper operation of the engine. Power to drive the accessories is taken from the high pressure compressor unit by means of an accessory drive shaft.

AFTERBURNER. An afterburner is attached to the turbine case of the engine to provide thrust augmentation. An inner liner in the afterburner is perforated at the forward end to allow engine exhaust gases to pass through for cooling purposes. A two-position exhaust nozzle is attached to the exhaust duct of the afterburner, and is actuated by compressor discharge pressure. The afterburner incorporates a separate fuel control and igniter system.

FUEL CONTROL SYSTEM

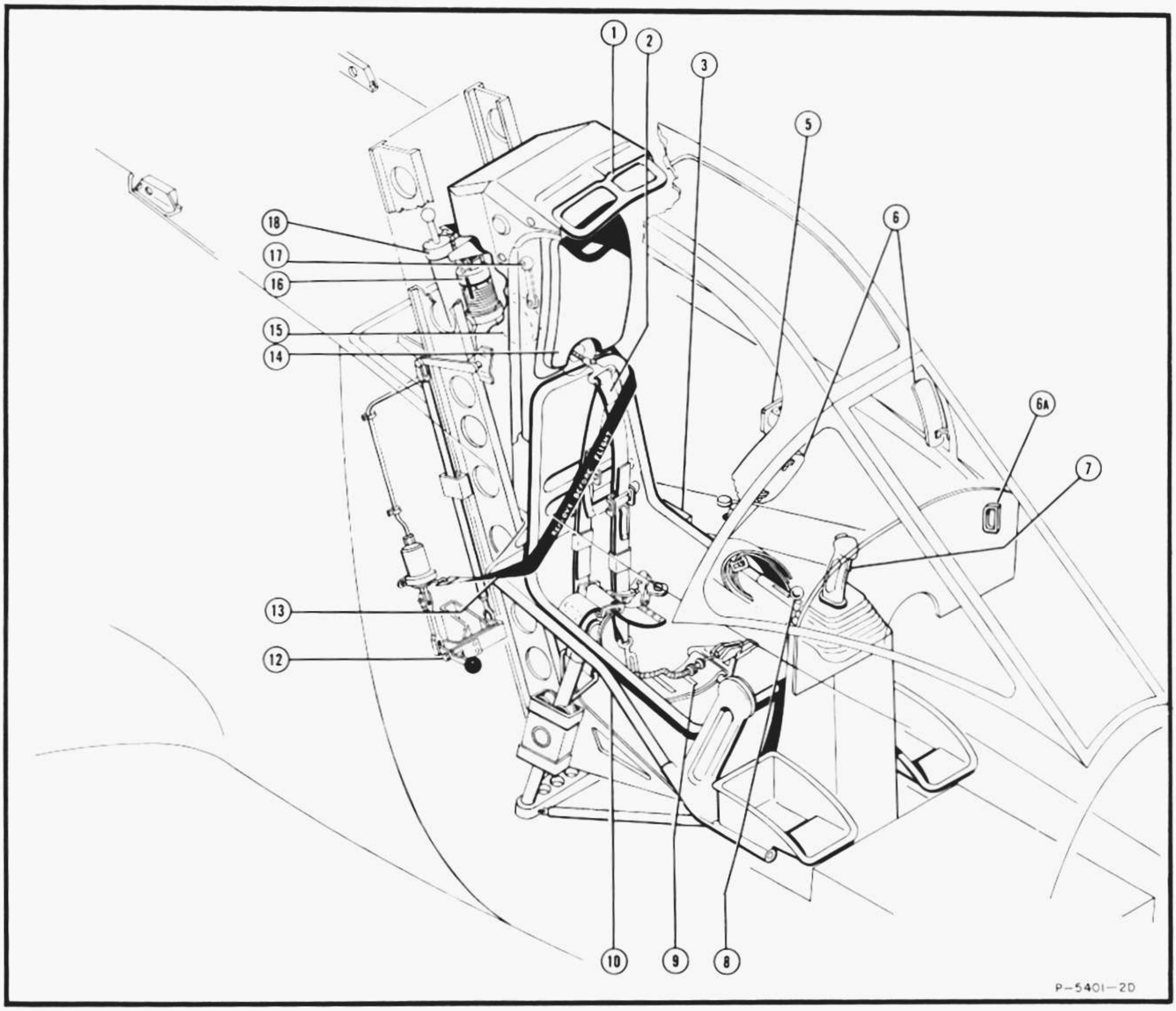
ENGINE FUEL CONTROL. The basic engine fuel control system consists of a three-stage combination fuel pump, pump stage emergency transfer valve, and a fuel control unit. The combination fuel pump has a centrifugal boost stage, supplying two separate gear-type pump stages, one providing pressure for the engine, the other for the afterburner. The emergency transfer valve assembly senses pressure drop due to failure of the engine gear stage and diverts sufficient fuel flow from the afterburner gear stage to the engine fuel control unit to meet engine operating requirements. The engine fuel control unit meters fuel in proportion to throttle position, correcting automatically for engine speed, compressor inlet temperature, and compressor discharge pressure. Included in the engine fuel control unit is a compressor discharge pressure limiter which reduces fuel flow when pressure exceeds specified limits, and a minimum flow regulator which prevents lean "blowout" during rapid deceleration by preventing the reduction of fuel flow to an amount that is insufficient to sustain combustion. A manual fuel system is incorporated into the fuel control unit as a safety feature in the event of fuel control malfunction.



1. Radome
2. Pitot tube
3. Cockpit enclosure
4. Battery
5. External power receptacles
6. Wing navigation lights
7. Starboard elevon
8. Speed brakes
8A. Liquid oxygen filler[1]
9. Pitch trimmer
10. Fin navigation lights
11. Fuel vent
12. Servo rudder
13. Rudder
14. Arresting hook
15. Tail bumper
16. Port elevon
17. Slats
18. Jack pad container
19. DC generator
20. Radio NAVPAC
21. Gaseous oxygen filler[2]
22. AC generator
23. Deleted
24. Approach light unit
25. Ejection seat
26. Control stick
27. Static vent

[1] Airplanes BuNo. 134919 and subsequent. BuNo. 134744-134918 by service change.
[2] Airplanes BuNo. 130740-130750; BuNo. 134744-134918 before service change.

Figure 1-2. General Arrangement (Sheet 1)



1. Ejection seat face curtain handle
2. Shoulder harness
3. D-500 disconnect
4. Deleted
5. Standby compass
6. Rear view mirrors
6A. Emergency canopy jettison handle
7. Control stick
8. Shoulder harness lock lever
9. Automatic release safety belt
10. Ejection seat
11. Deleted
12. Emergency canopy remover handle
13. Canopy jettison safety pins and warning flag
14. Headrest
15. Inertia reel
16. Yellow torque stripe
17. Headrest adjust handle
18. Canopy remover

Figure 1-2. General Arrangement (Sheet 2)

The manual system is selected by the pilot through a switch in the cockpit. When thus selected, a solenoid on the fuel control unit isolates the automatic fuel metering system, and all fuel metering is then done manually by a throttling valve mechanically linked to the throttle. This valve also acts as a fuel shut-off valve during engine shut-down.

CAUTION

If fuel control malfunction is suspected during take-off, the manual fuel system should be turned on and the thrust setting should be reduced as required to prevent overspeeding and overtemperaturing of the engine.

FUEL SYSTEM SELECTOR SWITCH. The FUEL SYSTEM selector switch (21, figure 1–3) located on the left console, permits the selection of either the normal or the manual fuel system. In the "NORMAL" position, the engine is automatically controlled by speed, temperature, and pressure sensing devices to obtain and hold the selected thrust settings. When placed in "MANUAL," a solenoid isolates the automatic fuel metering system, and allows the pilot to manually control fuel metering by use of the throttle which is mechanically linked to a throttling valve in the fuel control unit.

CAUTION

When operating on the manual fuel system, the throttle must be moved smoothly to prevent "lean-out," "rich-out," or overtemperaturing of the engine.

AFTERBURNER FUEL CONTROL. The afterburner fuel control system becomes separate from the engine fuel control system at a point in the combination fuel pump. In addition to the fuel pump, the system includes an afterburner fuel control unit, an igniter control, fuel nozzles, and an exhaust nozzle control unit. When the throttle engages the afterburner detent a switch is depressed, causing fuel to be delivered by the afterburner gear stage to the afterburner fuel control which meters fuel to the fuel nozzles as a function of compressor discharge pressure. The afterburner igniter is actuated by fuel pressure from the fuel control unit, and injects a stream of fuel into the engine upstream of the turbine where it ignites and passes into the afterburner to ignite fuel from the fuel nozzles. The exhaust nozzle control is actuated by fuel pressure from the combination fuel pump. Fuel pressure in the nozzle control moves a piston, porting compressor discharge pressure to the exhaust nozzle actuating cylinders, causing the nozzle to open or close.

MAIN PUMP FAILURE WARNING LIGHT. The MAIN PUMP FAILURE warning light (23, figure 1–4) located on the right side of the instrument panel, indicates failure of the engine stage of the combination fuel pump. The illumination of this light will be the only indication of the failure of the engine stage of the pump since transfer to the afterburner stage is automatically accomplished by the pump-stage emergency transfer valve.

ENGINE CONTROLS

THROTTLE. The throttle (8, figure 1–3) located on the left-hand console, is used to select thrust conditions for which the fuel control meters fuel to the engine. The throttle has an "OFF" position in which the fuel shut-off valve is closed, depriving the engine of all fuel; an "IGNITE" position, which is entered by moving the throttle outboard from "OFF," thus closing a switch which actuates the ignition system; an "IDLE" position, guarded by a stop device to prevent the throttle from being inadvertently moved to "OFF"; and a transitional range from idle rpm to maximum rpm. On later airplanes,[2] when the throttle is set at any position from idle stop to within a few degrees forward of the stop, the afterburner nozzle is open to reduce thrust while maintaining sufficiently high rpm for increased electrical power output. Forward and outboard of "IDLE" is the afterburner stop device. (Refer to AFTERBURNER CONTROL for description of throttle operation for afterburning.) Military thrust is obtained with the throttle full forward against the take-off stop gate. On the throttle grip are located the radio microphone button, the speed brake switch, and the armament fire control system gyro UNCAGE button.

FRICTION LEVER. The friction lever (23, figure 1–3), located on the inboard side of the left hand console, is used to regulate the amount of force desired to manipulate the throttle. When the lever is fully engaged, approximately fifty pounds of force is required to move the throttle.

CATAPULT HAND GRIP. A catapult hand grip (12, figure 1–3) is located forward of the throttle and is

(1) Airplanes BuNo. 139030 and subsequent.
(2) Airplanes BuNo. 134744 and subsequent.

used to prevent retardation of the throttle during catapult launchings. When not in use, the catapult handgrip may be retracted into the console structure.

MASTER ENGINE SWITCH. The MASTER ENGINE switch (7, figure 1–5) has two positions: "ON" and "OFF." When placed in the "ON" position, d-c electrical power is made available to the engine electrical circuits, the main compartment crossfeed valve(1), for opening the fuel shut-off valves, and—if a-c power is available—to the electric fuel pumps. When moved to "OFF," all power to the engine electrical circuits is discontinued.

TAILPIPE TEMPERATURE INDICATOR. The tailpipe temperature indicator (17, figure 1–4), located on the instrument panel, indicates the temperature of the exhaust gases immediately downstream of the turbine assembly in degrees centigrade.

TACHOMETER. A tachometer (16, figure 1–4) located on the instrument panel indicates speed of the high pressure compressor rotor as a percentage of 9,976 rpm.

PRESSURE RATIO INDICATOR.(1) A pressure ratio indicator (15A, figure 1–4), located on the lower left-hand side of the instrument panel, is provided to indicate the ratio of tailpipe (Pt7) pressure to ambient air pressure forward of the intake duct (Pt0) as a means of checking take-off thrust at military power. The instrument is calibrated from 1.2 to 3.4. A knob on the lower left-hand side of the instrument operates a counter dial and simultaneously moves an index pointer which travels along the perimeter of the instrument face. Turn the knob until the minimum acceptable take-off pressure ratio is displayed on the counter dial. (Refer to figure 2–3A, Military Power Pressure Ratio chart, to determine the minimum acceptable take-off pressure ratio.) When the throttle is advanced to military power, a needle on the dial should coincide with, or exceed, the setting of the index pointer to indicate that satisfactory take-off thrust is available. The indicator can also be used at all altitudes to determine whether a successful afterburner light-off has been accomplished.

PITOT AND ENGINE ANTI-ICING SWITCH. A two-position switch, labeled PITOT & ENGINE ANTI-ICING (11, figure 1–5) is located outboard on the right console. Placing the switch to "ON" causes a valve to be actuated which allows hot air from the compressor section to flow to the engine inlet area, preventing the formation of ice on the inlet guide vanes. In this position the switch also energizes the electrical heating elements in the pitot head, yaw sensing probe and angle of attack sensing probe. When the switch is moved to "OFF," electrical shutoff valves in the hot air lines close, stopping the flow of air to the engine inlet area and the pitot heat and sensing probe heat are simultaneously turned off.

AFTERBURNER CONTROL. Operation of the afterburner is controlled electrically by outboard movement of the throttle near military. Between the military stop and afterburner stop there is approximately 4 to 5% RPM modulation. To utilize the afterburner, the throttle must be moved outboard forward of the stop, actuating the afterburner switch, at the same time engaging the afterburner detent which holds the throttle in the outboard position. The afterburner may be used for take-off, climb, or bursts of combat speed and should normally be engaged by first attaining military thrust and then moving the throttle to the afterburner detent. A mechanical shut-off is incorporated in the throttle linkage, providing afterburner fuel shut-off if the normal electrical control should fail. The mechanical shut-off is actuated when the throttle is retracted 3/16 inches AFT of the afterburner stop.

WARNING

With failure of the afterburner nozzle to open, indicated by excessive exhaust gas temperature and pressure ratio indication, discontinue afterburning immediately.

CAUTION

Do not attempt to check operation of the afterburner on the ground unless the airplane is securely tied down or on the takeoff roll.

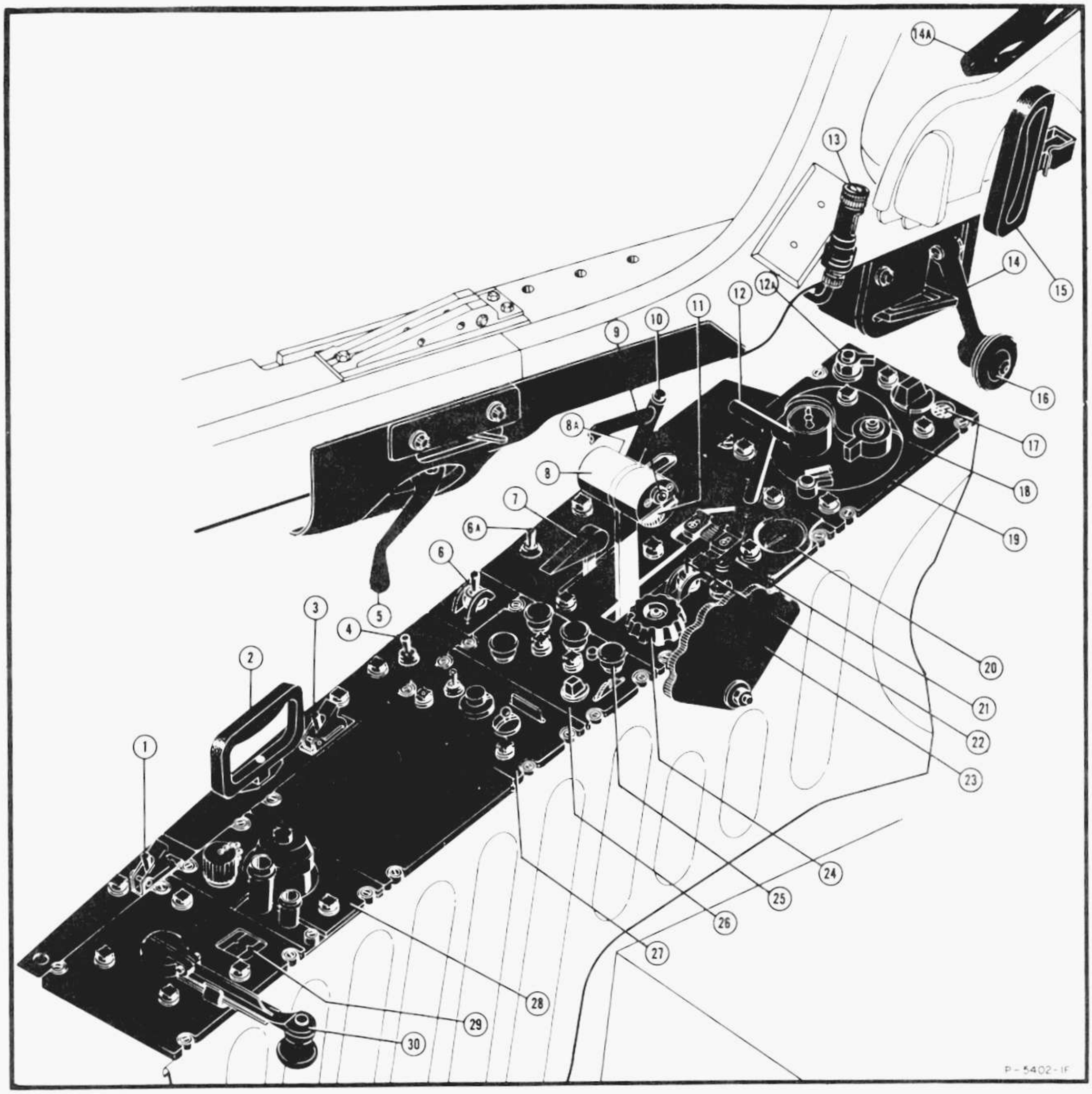
"POP-OPEN" NOZZLE.(1) On later airplanes the afterburner nozzle is utilized to permit higher rpm settings in the idle range. In these airplanes, sufficient a-c generator current is thus provided for operation of the Aero 13F fire control system during standstill and taxi. Whenever the throttle is retarded to within a few degrees of the idle stop, a switch which controls the movement of a pneumatic cylinder actuator is actuated, causing the afterburner nozzle to "pop open." The nozzle remains in this position between the approximate rpm settings of 64% and 74%, reducing the thrust normally developed at these rpm's. Beyond this rpm range the nozzle closes until normal afterburner operation is desired. In the event of throttle linkage failure, the spring-loaded switch in the quadrant will return the "pop-open" nozzle to the closed position; however, excessive braking action will be required and may make it necessary for the engine to be shut-down to avoid blown tires or overrunning the landing area.

Note

A slight detent is felt at the point where switch operation opens the afterburner nozzle; however, this should not be confused with the idle stop.

IGNITION. The ignition switch is incorporated in the throttle lever assembly. This is a momentary-contact limit switch and is actuated by outboard movement of the throttle lever when the throttle is in the "OFF" position. The ignition switch completes a circuit from the primary d-c electrical bus, through the engine master

(1) Airplanes BuNo. 134853 and subsequent; BuNo. 134744–134852 by service change.

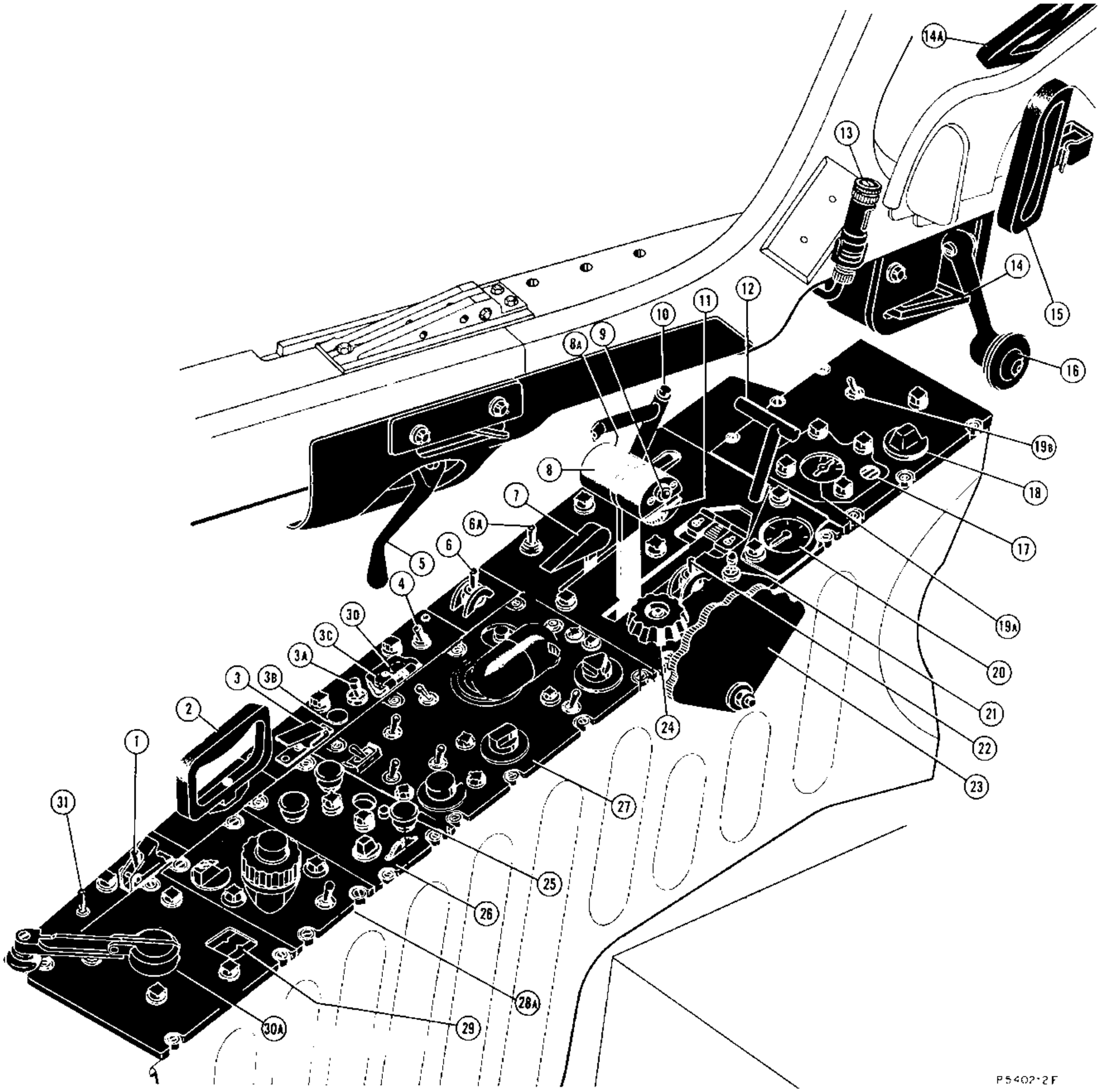


1. Tow target switch
2. Emergency stores jettison handle
3. Center stores jettison switch
3A. Transonic trim switch[1]
3B. Onset adjust[1]
3C. Altitude bypass button[1]
3D. Ground test button[1]
4. Gyro horizon power switch[2] or flight instrument power switch[3]
5. Canopy latch handle
6. Pitch trim motor circuit breaker
6A. Exterior lights master power switch
7. Emergency pitch trimmer control
8. Throttle
8A. Sight unit gyro uncage button
9. Microphone switch
10. Rudder gust lock
11. Speedbrake switch
12. Catapult hand grip
12A. Oxygen supply shut-off
13. Instrument floodlight
14. Landing gear control safety latch
14A. Emergency landing gear release

[1] Airplanes BuNo. 134744 and subsequent.
[2] Airplanes BuNo. 130740-130744, 130746-130750.
[3] Airplanes BuNo. 130745, 134744 and subsequent.

Airplanes BuNo. 130740–130750

Figure 1-3. Cockpit—Left-Hand Side (Sheet 1)

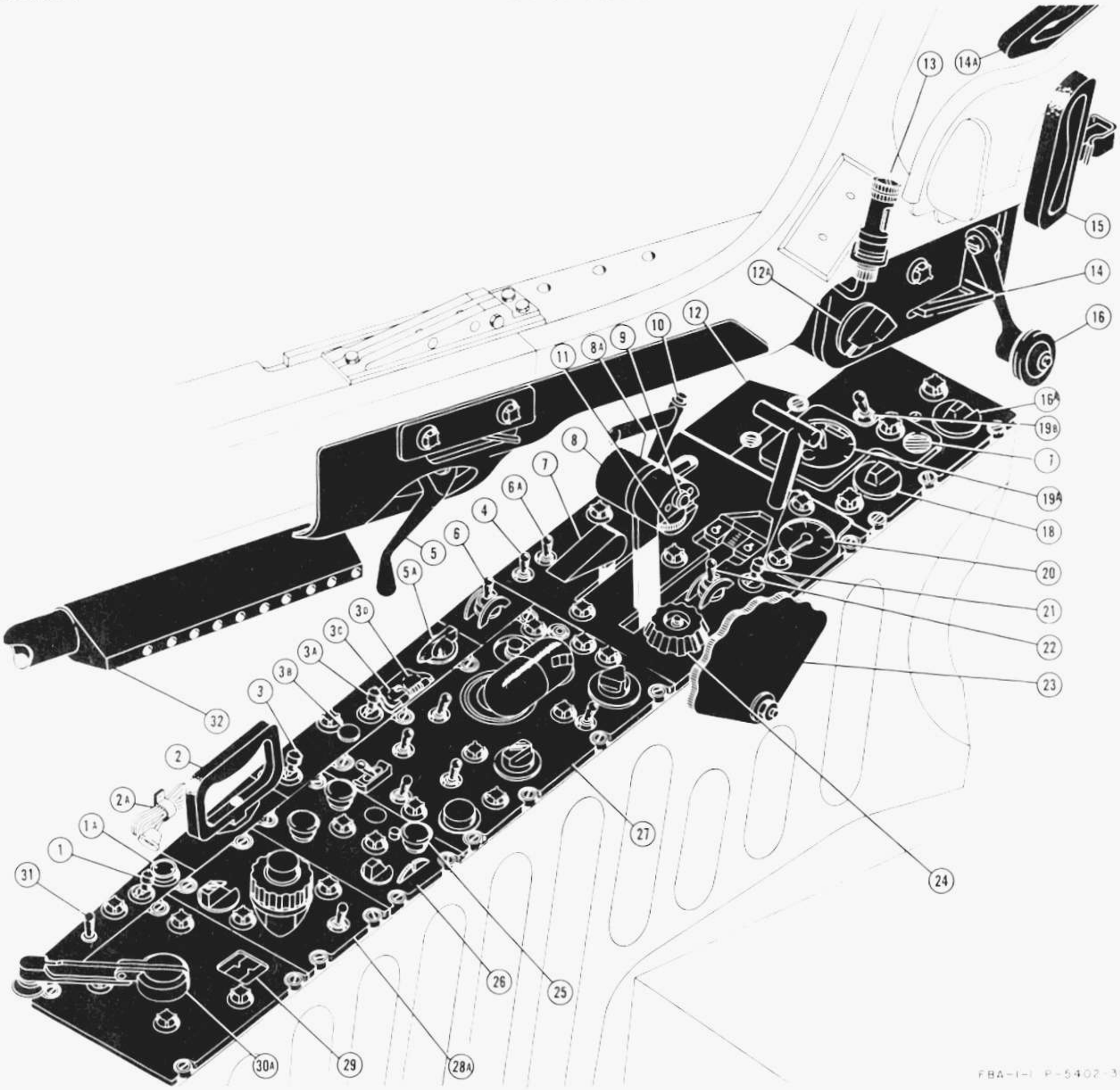


15. Emergency canopy jettison
16. Landing gear control lever
17. Wheels position indicator
18. Wheels position selector knob
19. Oxygen regulator panel(1)
19A. Liquid oxygen indicator(2)
19B. Liquid oxygen "ON"–"OFF" control
20. Cabin pressure altimeter
21. Fuel system selector switch
22. Yaw damper and auto pilot switch
23. Throttle friction control lever
24. Rudder trim control knob
25. Yaw damper control button
26. Auto control panel
26. Auto control panel(3)
27. Radar control panel(3)
28. Oxygen and anti-blackout control panel
28A. Anti-blackout and pressure suit ventilation control panel(3)
29. MACS indicator window
30. MACS control crank(1)
30A. MACS control crank(2)
31. Taxi light switch
32. Cockpit diffuser(4)

(1) Airplanes BuNo. 130740-130750.
(2) Airplanes BuNo. 134744 and subsequent.
(3) Positions interchanged on airplanes BuNo. 139148 and subsequent; BuNo. 134744-134973, 139030-139147 after service change.
(4) Airplanes BuNo. 139030 and subsequent.

Airplanes BuNo. 134744–134973, 139030–139177 prior to service change

Figure 1-3. Cockpit—Left-Hand Side (Sheet 2)

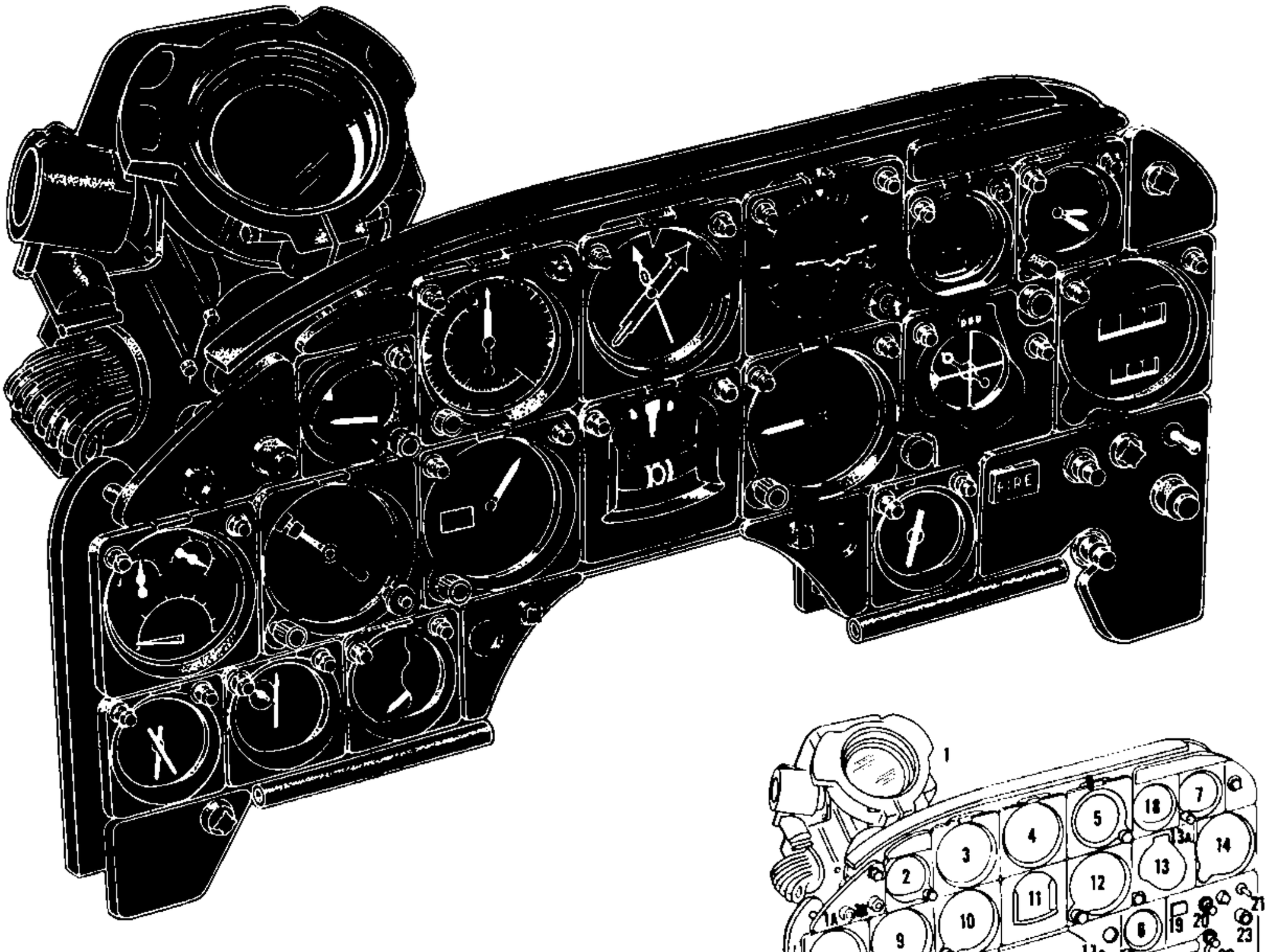


1. Tow target switch
1A. Face mask heater receptacle
2. Emergency stores jettison handle
2A. Face plate heater cord (stowed position)
3. Center stores jettison switch
3A. Transonic trim compensator switch
3B. TCC onset adjust
3C. Altitude bypass button
3D. Ground test button
4. Flight instrument power switch
5. Canopy latch handle
5A. Face mask heater rheostat
6. Pitch trim motor circuit breaker
6A. Exterior lights master power switch
7. Emergency pitch trimmer control
8. Throttle
8A. Sight unit gyro uncage button
9. Microphone button
10. Rudder gust lock
11. Speedbrake switch
12. Catapult hand grip
12A. Approach indexer dimming knob(1)
13. Instrument floodlight
14. Landing gear control safety latch
14A. Emergency landing gear release
15. Emergency canopy jettison
16. Landing gear control lever
16A. Missiles and marker beacon audio(1)
17. Wheels position indicator
18. Wheels position selector knob
19A. Liquid oxygen indicator
19B. Liquid oxygen "ON"—"OFF" control
20. Cabin pressure altimeter
21. Fuel system selector switch
22. Yaw damper and auto pilot switch
23. Throttle friction control lever
24. Rudder trim control knob
25. Yaw damper control button
26. Auto control panel
27. Radar control panel
28. Deleted
28A. Anti-blackout and pressure suit ventilation control panel
29. MACS indicator window
30A. MACS control crank
31. Taxi light switch
32. Cockpit diffuser

(1) Airplanes BuNo. 134744-134973, 139030-139207 after service change.

Airplanes BuNo. 139178 and subsequent

Figure 1-3. Cockpit—Left-Hand Side (Sheet 3)

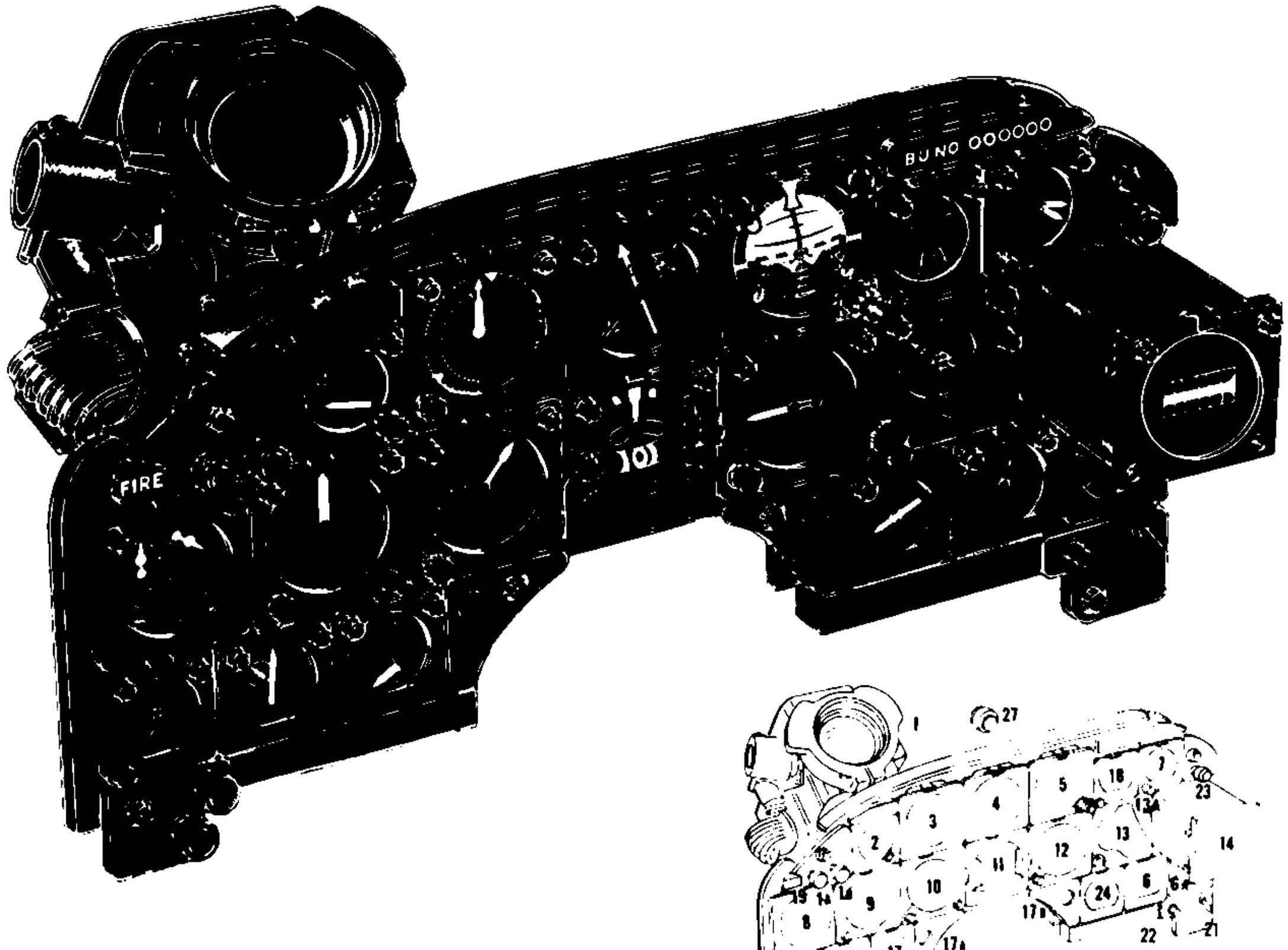


FBA-1-1 P5403-IG

1. Sight unit Mk 11 Mod 1
1A. Inverter failure warning light
1B. Boost pump failure warning light
2. Angle of attack indicator
3. Airspeed indicator
4. ID-250/ARN course indicator
5. Gyro horizon indicator
6. Fuel quantity indicator
7. Clock
8. Trim position and mechanical advantage indicator
9. ID-257/APN-22 height indicator
10. Pressure altimeter
11. Turn and bank indicator
12. Rate of climb indicator
13. ID-249/ARN course indicator
13A. Marker beacon indicator
14. ID-310/ARN range indicator
15. Oil and fuel pressure indicator
16. Tachometer
17. Tail pipe temperature indicator
17A. Elevon hydraulic pressure indicator
17B. Utility hydraulic pressure indicator
18. ARN/ARC-27A (UHF) remote channel indicator
19. Fire warning light
20. Fire warning test button
21. Drop tank transfer switch
22. Fuel quantity test button
23. Main pump failure warning light

Airplanes BuNo. 130740–130750

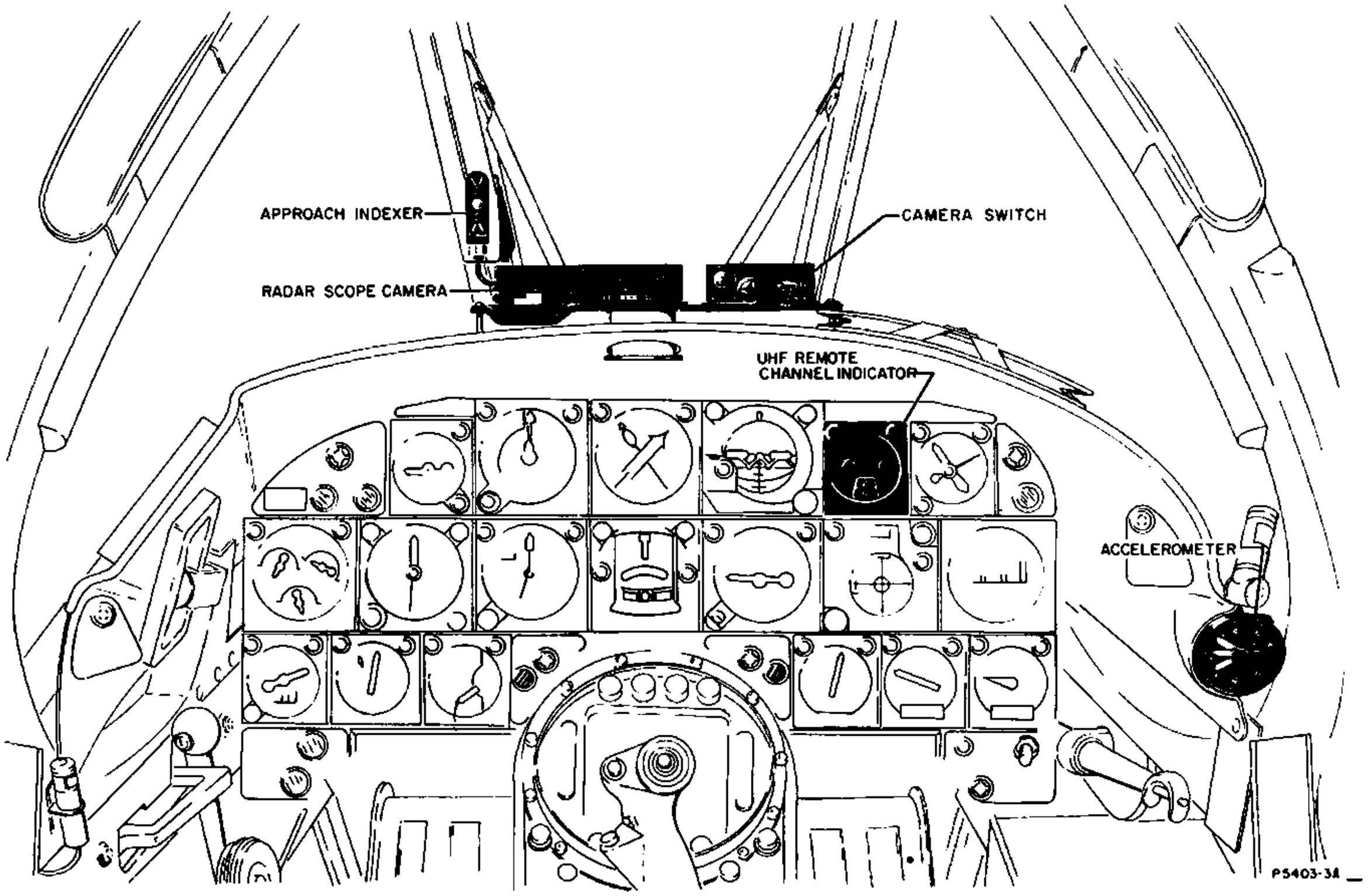
Figure 1-4. Instrument Panel (Sheet 1)



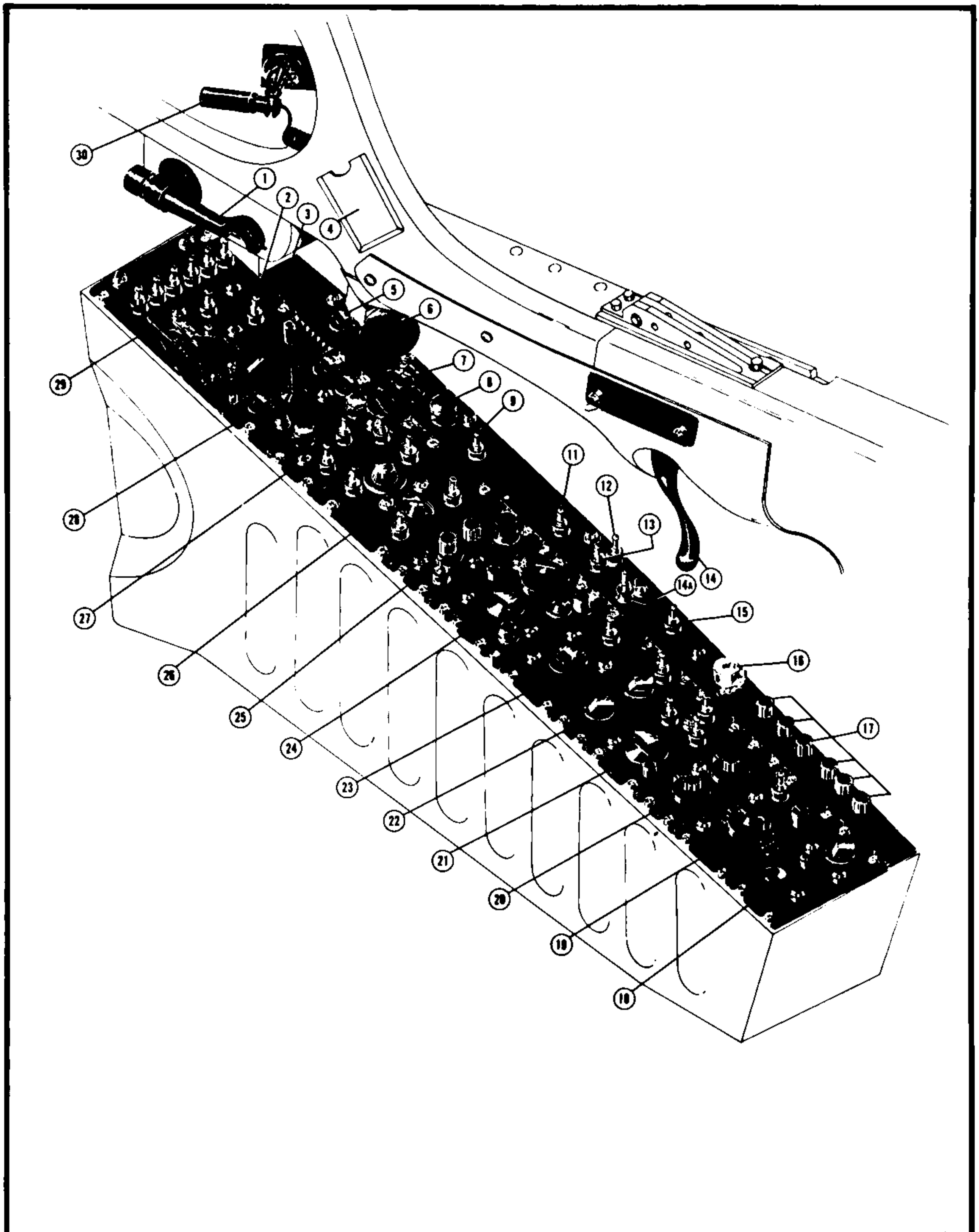
P5403-21

1. Sight unit Mk 11 Mod 1
1A. Inverter failure warning light
1B. Boost pump failure warning light
2. Angle of attack indicator
3. Airspeed indicator
4. ID-250/ARN course indicator
5. Gyro horizon indicator
6. Fuel quantity indicator (main tanks)
6A. Fuel quantity indicator (drop tanks)
7. Clock
8. Trim position and mechanical advantage indicator
9. ID-257/APN-22 height indicator
10. Pressure altimeter
11. Turn and bank indicator
12. Rate of climb indicator
13. ID-249/ARN course indicator or ID-351/ARN
13A. Marker beacon indicator
14. ID-310/ARN range indicator
15. Deleted
15A. Pressure ratio indicator
16. Tachometer
17. Tailpipe temperature indicator
17A. Elevon hydraulic pressure indicator
17B. Utility hydraulic pressure indicator
18. ARN/ARC-27A (UHF) remote channel indicator
19. Fire warning light
20. Deleted
21. Drop tank transfer switch
22. Fuel quantity test button
23. Main pump failure warning light
24. Fuel flowmeter
25. Oil pump failure warning light
26. Fuel transfer pump failure warning light
27. On target indicator

Airplanes BuNo. 134744 and subsequent prior to service change.
Figure 1-4. Instrument Panel (Sheet 2)



Airplanes BuNo. 134744 and subsequent after service change
Figure 1-4. Instrument Panel (Sheet 3)



Airplanes BuNo. 130740–130744, 130746–130750
Figure 1-5. Cockpit—Right-Hand Side (Sheet 1)

Key to Figure 1-5 (Sheet 1)

1. Arresting hook control
2. Wing pin lock lever
3. Wing fold control lever
4. Compass correction card
5. Marker beacon audio control
6. Sight unit reticle masking control
7. Master engine switch
8. Starter button
9. Cross feed fuel valve switch
10. Deleted
11. Pitot and engine anti-icing switch
12. Pedals adjust switch
13. Seat adjust switch
14. Canopy latch handle

14A. Exterior lights switch (dim-bright)(1) or,
Navigation lights switch (dim-off-bright)(2)

15. Exterior lights switch (steady-flash)(1) or,
Formation lights switch (dim-off-bright)(2)
16. Utility receptacle(1) or,
Fuselage lights switch (dim-off-bright)(2)
17. Interior lights fuses
18. Gyrosyn compass control
19. C-760B/A omni-range control panel
20. C-1272/APA 89 control
21. C-1159/APX-6B IFF control
22. Interior lights control panel
23. Air conditioning and pressurization control
24. C-2459/ARC-27A UHF radio set control
25. C-866/ARN-21 omni-bearing and distance radio control
26. Mk 35 Mod 2 control panel (Mk 16 Mod 11 fire control system)
27. Electrical power control panel
28. AP (auto control maneuver) panel
29. Armament control panel
30. Instrument floodlight

switch, to the two igniters located in separate combustion chambers of the engine. A timing mechanism limits ignition to a period of thirty seconds.

STARTER. A pneumatic starter is mounted on the engine accessory section, and is capable of accelerating the engine to the desired starting speed when connected to an external gas turbine ground power unit. The push-pull type STARTER button (8, figure 1–5) is located outboard on the right-hand console. Depressing this button opens an air valve in the starter, allowing high pressure air from the external unit to actuate the starter. When the engine reaches a speed of approximately 50% rpm, the starter is automatically disengaged and the button pops up. The starter may be disengaged manually by pulling up on the STARTER button at any time.

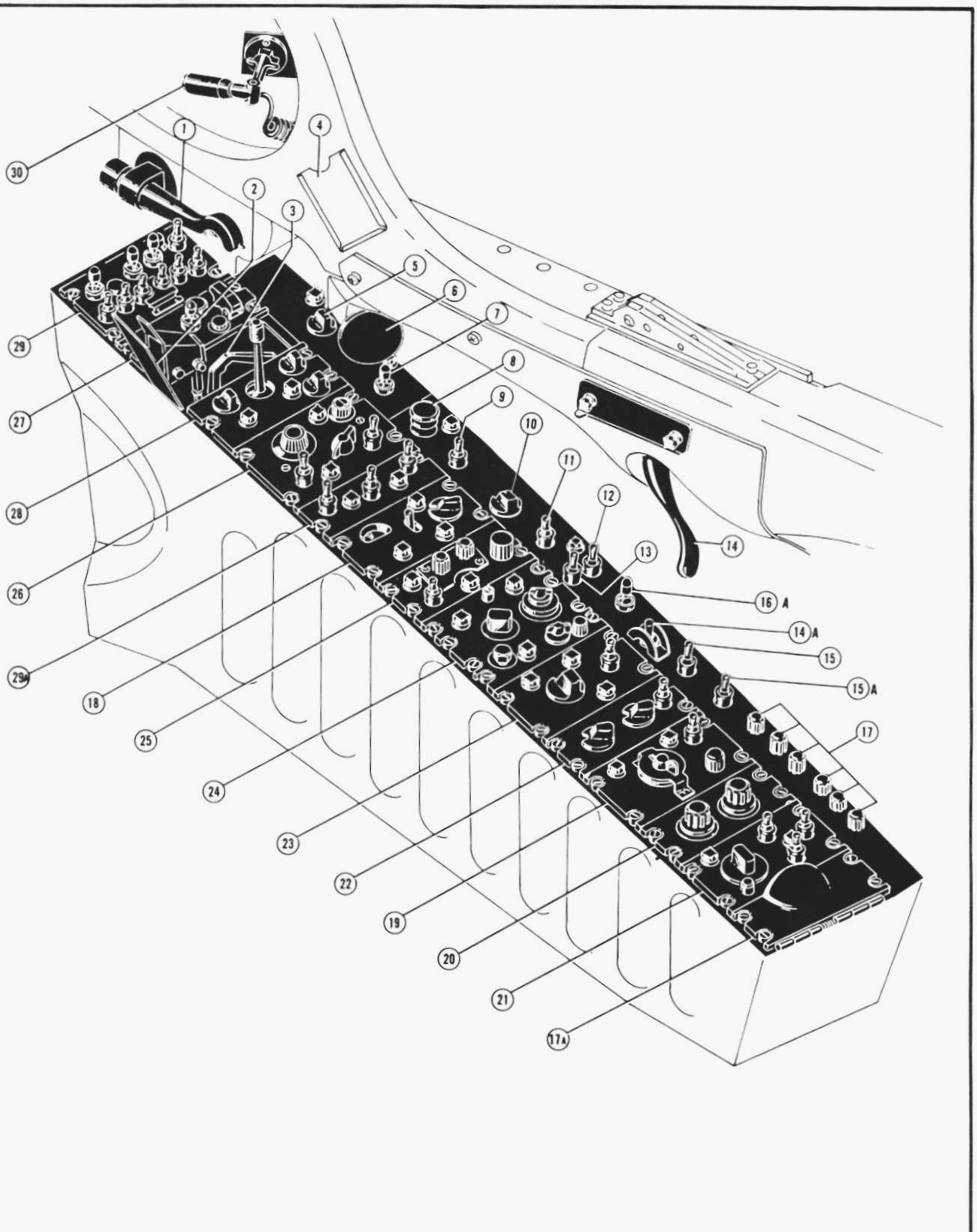
OIL SYSTEM

An oil tank is located on the upper left quadrant of the engine near the compressor. The tank has a total capacity of 5.5 U. S. gallons, of which 3.0 gallons are usable, with 1.0 gallon as reserve oil, and 1.5 gallons remaining in the system when the engine is not operating. Expansion space for 1.6 gallons is provided. A pressure pump forces oil to all main engine bearings, and six scavenging pumps return the oil to the tank after passing it through a cooling system. On early airplanes(3) pump pressure is indicated electrically on a combination fuel and oil pressure indicator (15, figure 1–4). A transmitter connected to the oil pump discharge line sends a synchro signal representing oil pressure to the oil pressure side of the indicator. A pressure relief valve is installed in the oil system which maintains a pressure differential of 45 ±5 psi between the pressure oil branch of the engine lubrication system and the bearing compartments breather pressurizing system. Oil pressure should register 40-50 psi (30 psi minimum) during all phases of engine operation. The instrument is powered by 26 volt a-c power. Later airplanes(4) have no fuel and oil pressure indicator, but are equipped with an OIL PRESSURE FAILURE warning light (25, figure 1–4) that illuminates whenever malfunction of the oil pump occurs or when the pressure falls below the safe level of 30 psi. Also, the light can be expected to illuminate intermittently whenever the aircraft is subjected to zero or negative g conditions. This occurs as a result of reduced pressure rise through the oil pressure pump due to unporting, or unfavorable pump inlet conditions. The warning light operates on 28 volt d-c current. See figure 1–14 for oil grade and specification.

FUEL SYSTEM

The fuel supply is contained in two 320-gallon bladder-type fuel cells which are buried in the wing roots, one on each side, adjacent to the fuselage. Two 300 U. S. gallon capacity drop tanks may be carried on the wings. Transfer of fuel from the drop tanks to the main tanks is accomplished by compressor bleed air pressure, and is controlled by a switch in the cockpit. Float valves in the main fuel tanks automatically discontinue fuel transfer when the main tanks are full. An electric transfer pump in the forward part of each main fuel tank maintains a constant supply of fuel to an electric boost pump located in the sump compartment in the rear section of each main fuel tank. An inverted-flight electrical fuel pump in the sump compartment of the right-hand main fuel tank insures the engine of a fuel supply when the aircraft is inverted. All electrical fuel pumps are energized by the MASTER ENGINE switch in the cockpit. Two electrical shut-off valves and the main compartment crossfeed valve are also operated by the MASTER ENGINE switch. A CROSS FEED FUEL VALVE switch is provided for utilizing the sump

(1) Before service change.
(2) After service change.
(3) Airplanes BuNo. 130740-130750.
(4) Airplanes BuNo. 134744 and subsequent.



Airplanes BuNo. 130745, 134744–134973

Figure 1-5. Cockpit—Right-Hand Side (Sheet 2)

Key to Figure 1-5 (Sheet 2)

1. Arresting hook control
2. Wing pin lock lever
3. Wing fold control lever
4. Compass correction card
5. Marker beacon audio control
6. Sight unit reticle masking control
7. Master engine switch
8. Starter button
9. Cross feed fuel valve switch
10. Drop tank quantity selector switch
11. Pitot and engine anti-icing switch
12. Pedals adjust switch
13. Seat adjust switch
14. Canopy latch handle

14A. Exterior lights switch (dim-bright)(1) or, Navigation lights switch (dim-off-bright)(2)

15. Exterior lights switch (steady-flash)(1) or, Formation lights switch (dim-off-bright)(2)

15A. Fuselage lights switch (dim-off-bright)

16. Deleted

16A. Defrost-ram air selector switch

17. Interior lights fuses

17A. Spare lamps container

18. Gyrosyn compass control
19. C-760B/A omni-range control panel
20. C-1272/APA 89 control
21. C-1159/APX-6B IFF control
22. Interior lights control panel
23. Air conditioning and pressurization control
24. C-2459/ARC-27A UHF radio set control
25. C-866/ARN-21 or C-1763/ARN-21 Omni-bearing and distance radio control
26. Mk 46 Mod 0 control panel (Mk 16 Mod 11 fire control system)
27. Electrical power control panel
28. Auto control maneuver panel
29. Armament control panel

29A. Aero 13F armament selector panel

30. Instrument floodlight

compartment crossfeed line in the event of boost pump failure. A system of vents maintains a maximum pressure differential between internal and external tank pressures. See figure 1–14 for fuel grades and specifications.

SUMP CROSSFEED FUEL VALVE SWITCH. A CROSSFEED FUEL VALVE switch(3) (9, figure 1–5), located on the right hand console, has "CLOSE" and "OPEN" positions for operation of the sump crossfeed valve. The switch should remain in the "CLOSE" position at all times except as follows: Place the switch in the "OPEN" position whenever the fuel boost pump warning light comes on; or, upon reaching 5000 feet on landing descent. This action will assure a constant fuel supply in case of a boost pump failure in the landing pattern.

Note: Some early airplanes, BuNo's 134745, 134748, 134754, 134759, 134763, 134821, 134830, 130740 through 130744 and 130746 through 130750, do not have the dual crossfeed, so in addition to the above direction, should also have the crossfeed switch positioned to "OPEN" upon reaching a fuel state of 2000 pounds. Extended periods of nose down attitude should be avoided after opening the crossfeed valve. Later airplanes(4) are provided with immediate, automatic sump tank crossfeed operation should either boost pump fail.

DROP TANK TRANSFER SWITCH. A DROP TANK transfer switch (21, figure 1–4) located on the lower right-hand corner of the instrument panel, controls transfer of fuel and has two positions, "OFF" and "TRANSFER." When on "TRANSFER," a compressor bleed air shut-off valve is opened, and fuel is forced from the drop tanks to the main tanks if space is available. If the main tanks are full, float valves close the transfer lines.

DROP TANK JETTISON CONTROLS. Refer to paragraph entitled TO JETTISON EXTERNAL STORES, section IV, for a discussion of controls for releasing external stores.

FUEL QUANTITY INDICATOR. The fuel quantity indicator (6, figure 1–4) on the instrument panel, indicates total quantity of fuel, in pounds, that remains in the main fuel tanks. Later airplanes(3) are also equipped with a drop tank quantity indicator (6A, figure 1–4) and a DROP TANK FUEL QUAN selector knob (10, figure 1–5). Associated with the fuel quantity indicators, is the FUEL QUAN TEST button (22, figure 1–4). Depressing this button causes the pointer on the fuel quantity indicator to move toward the zero reading of the dial. Upon release of the button the pointer should return to the previous indication if functioning properly.

Note

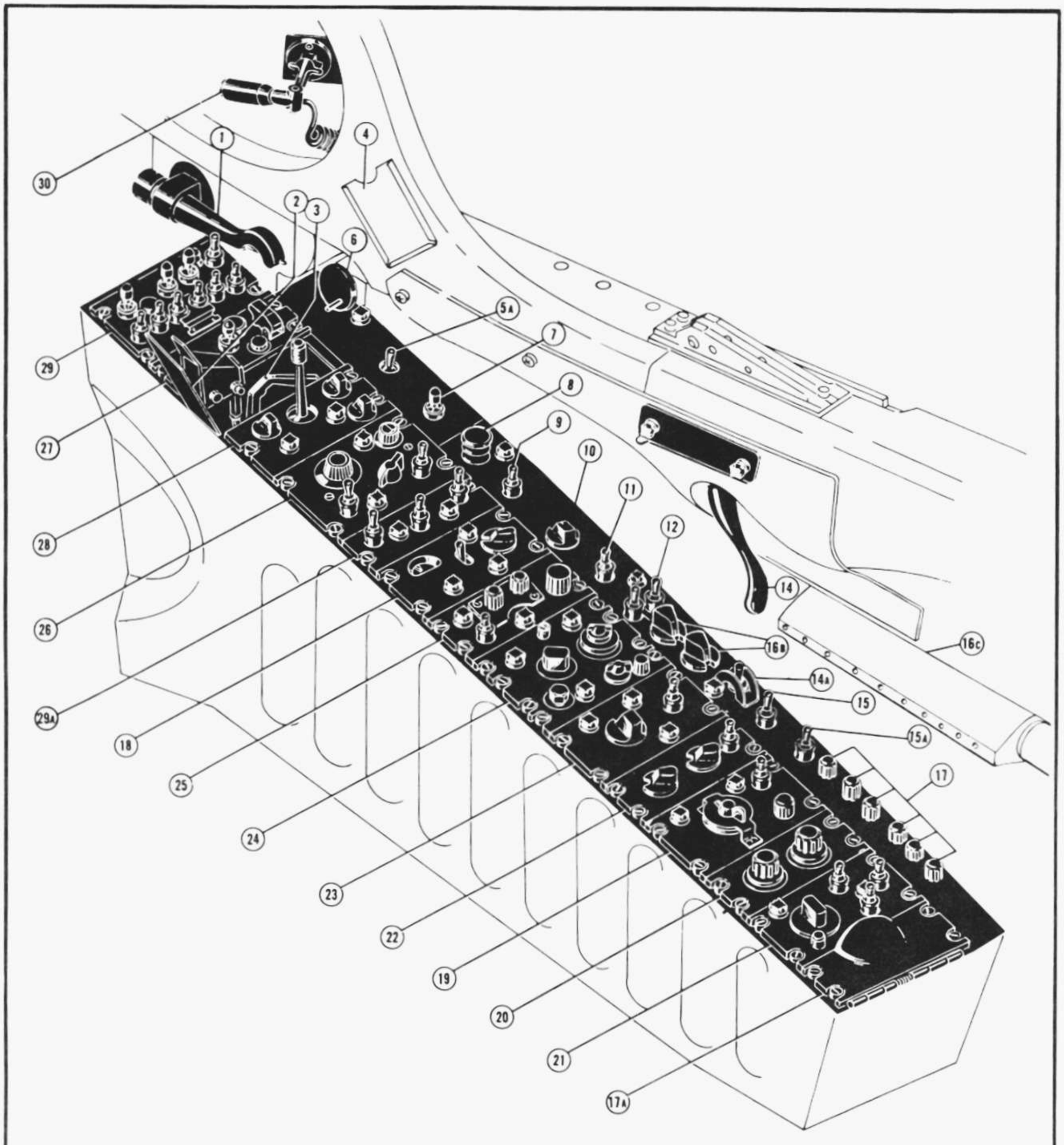
- Fuel varies in weight, depending on its temperature, and the indication of fuel quantity in pounds will vary when the tanks are full if standard conditions do not exist.
- For best accuracy in reading the fuel quantity gage, the aircraft should be in nearly normal attitude for level flight, or approximately 5° nose up.

(1) Prior to service change.

(2) After service change.

(3) Airplanes BuNo. 134744 and subsequent.

(4) Airplanes BuNo. 134919 and subsequent.



Airplanes BuNo. 139090 and subsequent
Figure 1-5. Cockpit—Right-Hand Side (Sheet 3)

←

Key to Figure 1-5 (Sheet 3)

1. Arresting hook control
2. Wing pin lock lever
3. Wing fold control lever
4. Compass correction card
5. Moved to left-hand console, oxygen panel[2]
   Missiles and marker beacon audio control
5A. Missile automatic stepping switch[2]
6. Sight unit reticle masking control
7. Master engine switch
8. Starter button
9. Cross feed fuel valve switch
10. Drop tank quantity selector switch
11. Pitot and engine anti-icing switch
12. Pedals adjust switch
13. Seat adjust switch
14. Canopy latch handle
14A. Exterior lights switch (dim-bright)[1] or,
   Navigation lights switch (dim-off-bright)[2]
15. Exterior lights switch (steady-flash)[1] or,
   Formation lights switch (dim-off-bright)[2]
15A. Fuselage lights switch
16. Deleted
16A. Deleted
16B. Windshield and canopy defrost knobs
16C. Cockpit diffuser
17. Interior lights fuses
17A. Spare lamps container
18. Gyrosyn compass control
19. C-760B/A omni-range control panel
20. C-1272/APA 89 control
21. C-1159/APX-6B IFF control
22. Interior lights control panel
23. Air conditioning and pressurization control
24. C-2459/ARC-27A UHF radio set control
25. C-866/ARN-21 or C-1763/ARN-21 omni-bearing and distance radio control
26. Mk 46 Mod 0 control panel (Mk 16 Mod 11 fire control system)
27. Electrical power control panel
28. Auto control maneuver panel
29. Armament control panel
29A. Aero 13F armament selector panel
30. Instrument floodlight

The location and construction of the fuel boost pump inlets will cause usable fuel quantity to vary with different conditions of flight. With fuel boost pumps operating normally, all but approximately 6 gallons of fuel will be removed from the cells. If the fuel boost pumps become inoperative, approximately 20 gallons of fuel will be unusable during power approach in the landing configuration. This value will vary somewhat depending on the attitude of the airplane. (See Fuel Quantity Data, figure 1–6.)

FUEL BOOST PRESSURE INDICATOR. On early airplanes[6] the fuel boost pressure is indicated electrically on a combination fuel and oil pressure indicator (15, figure 1–4) calibrated in psi. Fuel boost pressure is taken from the inlet side of the engine fuel pump and should register 20-50 psi on the gage during stable engine operations. The instrument is powered by 26 volt a-c power.

BOOST PUMP FAILURE WARNING LIGHT. A press-to-test warning light, designated BOOST PUMP FAILURE, is located on the instrument panel (1B, figure 1–4). The light will glow when one or both fuel boost pumps fail.

FUEL FLOWMETER. A fuel flowmeter (24, figure 1–4), installed on the instrument panel of later airplanes[3] indicates the rate of fuel flow to the engine in pounds per hour. In establishing cruise control this indicator becomes valuable as an aid to the pilot in determining optimum flow requirements. The flowmeter indicates fuel flow to the engine only and does not have provisions for indicating fuel flow to the afterburner when in operation.

FIRE WARNING SYSTEM

The airplane is equipped with a fire warning system which functions automatically in the event a fire or overheat condition occurs in the engine or afterburner compartments. A 28-volt d-c circuit red FIRE warning light (19, figure 1–4) is located on the instrument panel. In the event a fire occurs in the engine compartment, the light will illuminate through a perforated block installed on the panel, and the word FIRE will be indicated to the pilot. A momentary contact FIRE WARNING TEST button is located on the instrument panel (20, figure 1–4) adjacent to the FIRE warning light. In later airplanes[3], the test switch is incorporated in the light socket so that when the light (or switch) is depressed, a 28-volt d-c circuit is closed which causes the FIRE warning light to illuminate. This indicates that the circuit is operative.

ELECTRICAL SYSTEM

The electrical system is supplied with d-c power by a 24-volt, 36-ampere-hour storage battery, and a 28-volt d-c generator rated at 200 amperes. A-c power is supplied by an air-driven, constant speed, 15 KVA, 400-cycle, 3 phase, 115/200 volt, a-c generator. A 250 VA inverter is installed in later airplanes[4] to provide an alternate source of a-c power for flight instruments. A 100 VA inverter is installed in certain earlier airplanes[5] as an alternate source of a-c power for the gyro horizon indicator only. Only one circuit breaker (pitch trim) is located in the cockpit in addition to six interior lights fuses. Two fuses are mounted in each wing leading edge to provide electrical protection for

(1) Prior to service change.
(2) After service change.
(3) Airplanes BuNo. 134744 and subsequent.
(4) Airplanes BuNo. 130745, 134744 and subsequent.
(5) Airplanes BuNo. 130740–130744, 130746–130750.
(6) Airplanes BuNo. 130740–130750.

missile installations. All other electrical system circuits are protected by fuses located in two junction panels on the left and right sides of the nose gear well.

D-C POWER DISTRIBUTION

D-C power is distributed by the primary, secondary and monitor buses as shown on the electrical diagram, figure 1–8, DC Power Supply.

PRIMARY BUS (EARLY AIRPLANES[1]). The primary bus is energized directly by an external power source, by the battery when either the "ON" or "EMER" position of the BAT switch is selected, or by the d-c generator when the DC GEN switch is "ON" and the generator is operating.

PRIMARY BUS (LATER AIRPLANES[2]). The primary bus is energized directly by an external power source, by the battery when the battery-generator switch is on either "BAT & GEN" or "BAT ONLY" position, and energized by the d-c generator when the switch is on "BAT & GEN" position, if the generator is operating.

SECONDARY BUS (EARLY AIRPLANES[3]). The secondary bus normally is energized only when the BAT and DC GEN switches are "ON" and the d-c generator is operating (engine speed above 65% rpm), or when the BAT switch is in the "EMER" position. The secondary bus can be energized on the ground when the BAT switch is in the "EMER" position, or through an external power source when the BAT switch is "OFF." In order to preserve the life of the battery, it should normally be operated on the ground only in the "OFF" position with external power.

SECONDARY BUS (LATER AIRPLANES[2]). The secondary bus normally is energized with the battery-generator switch in "BAT & GEN" position. However, in event of d-c generator failure this bus is energized only when the switch is on the "BAT ONLY" position. The secondary bus can be energized on the ground when the BAT switch is in the "BAT ONLY" position, or through an external power source when the BAT switch is "OFF." However, in order to preserve the life of the battery, it should normally be operated on the ground only in the "OFF" position with external power.

MONITOR BUS. The monitor bus, which is energized thru power from the secondary bus, is directly dependent on d-c generator operation. The monitor bus supplies power only to operate the left tank transfer fuel pump. This bus may be operated by external power.

D-C POWER CONTROLS AND INDICATOR

BATTERY SWITCH (EARLY AIRPLANES[3]). Battery power to the electrical equipment is controlled by the BAT switch on the electrical power panel (27, figure 1–5). Positions of the switch are "ON," "OFF" and "EMER." The BAT switch must be left turned "ON" at all times when the generator is operating to allow generator current to re-charge the battery. The "EMER" position supplies battery power to the primary and secondary buses in case of generator failure. (See figure 1–8, sheet 1.)

GENERATOR SWITCH (EARLY AIRPLANES[3]). Generator power to the electrical equipment junction panels and the battery is controlled by the DC GEN switch (27, figure 1–5). Positions of the switch are "ON" and "OFF." Placing the switch in the "ON" position when the engine is idling at or above 65% rpm will provide full d-c power as required.

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(1) Airplanes BuNo. 130740-130744, 130746-130750.
(2) Airplanes BuNo. 130745, 134798 and subsequent.
(3) Airplanes BuNo. 130741 through 130744, 130746 through 130750; BuNo. 134744 through 134797 prior to service change.

CAUTION

During ground operation if the forward engine access door is open, turn off the d-c generator (or operate at minimum load) to prevent damage from lack of air cooling.

BATTERY-GENERATOR SWITCH (LATER AIRPLANES[1]). In later airplanes a combined battery-generator switch replaces the two separate BAT and D-C GEN switches (27, figure 1-5). Positions of the switch are "BAT ONLY," "OFF," and "BAT & GEN." The "BAT & GEN" position should be selected at all times when the generator is operating to provide current for recharging the battery. The engine must be operating at 65% or more rpm to provide adequate d-c power for a full load on the system. In the "BAT ONLY" position, battery power will be supplied to both the primary and secondary buses in case of generator failure. With the switch in the "OFF" position, external power will energize the primary, secondary and monitor busses. (See figure 1-8).

CAUTION

Should complete loss of D-C power be experienced, the pilot should check the possibility of having inadvertently operated the BAT & GEN switch to the "OFF" position.

GENERATOR WARNING LIGHT. A DC GEN warning light on the electrical power panel (27, figure 1-5)

[1] Airplanes BuNo. 130745, 134798 and subsequent; BuNo. 134744-134797 by service change.

FUEL QUANTITY DATA

GALLONS

TANKS	TOTAL VOLUME	EXPANSION SPACE	UNUSABLE FUEL BOOST PUMPS OPERATING			UNUSABLE FUEL (4) BOOST PUMPS NOT OPERATING		
			(1)	(2)	(3)	(1)	(2)	(3)
L H CENTER WING FUEL CELL	331.5	11.5	2.7	15.1	21	10	42	48
R H CENTER WING FUEL CELL	331.5	11.5	2.7	15.1	21	10	42	48
L H CENTER WING DROP TANK (EXTERNAL AUXILIARY)	300	NEGLIGIBLE				NOT APPLICABLE		
	150							
R H CENTER WING DROP TANK (EXTERNAL AUXILIARY)	300							
	150							

(1) POWER APPROACH IN LANDING CONFIGURATION.

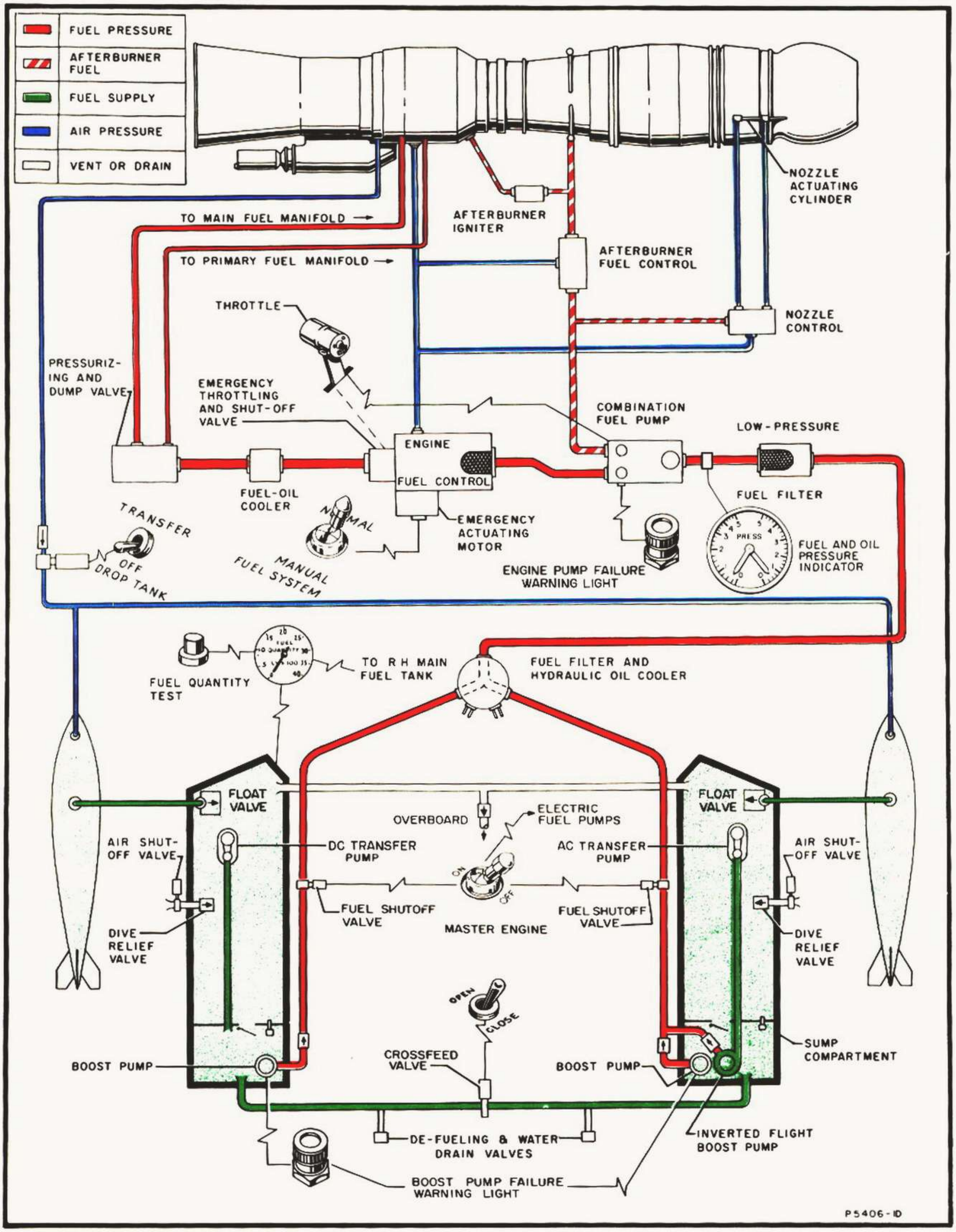
(2) STRAIGHT AND LEVEL FLIGHT.

(3) BEST GLIDE RATIO IN LANDING CONFIGURATION AT IDLE POWER.

(4) APPROXIMATE AMOUNT OF UNUSABLE FUEL AT THE NOTED FLIGHT CONDITION. (FUEL STARVATION WILL OCCUR WITH A MUCH HIGHER TOTAL OF FUEL REMAINING IF THE AIRCRAFT IS MANEUVERED IN SUCH A MANNER AS TO UNPORT THE PUMPS AND CAUSE ENTRAPMENT OF AIR IN THE SUPPLY LINES, THEREBY INTERRUPTING THE SUCTION FEED.)

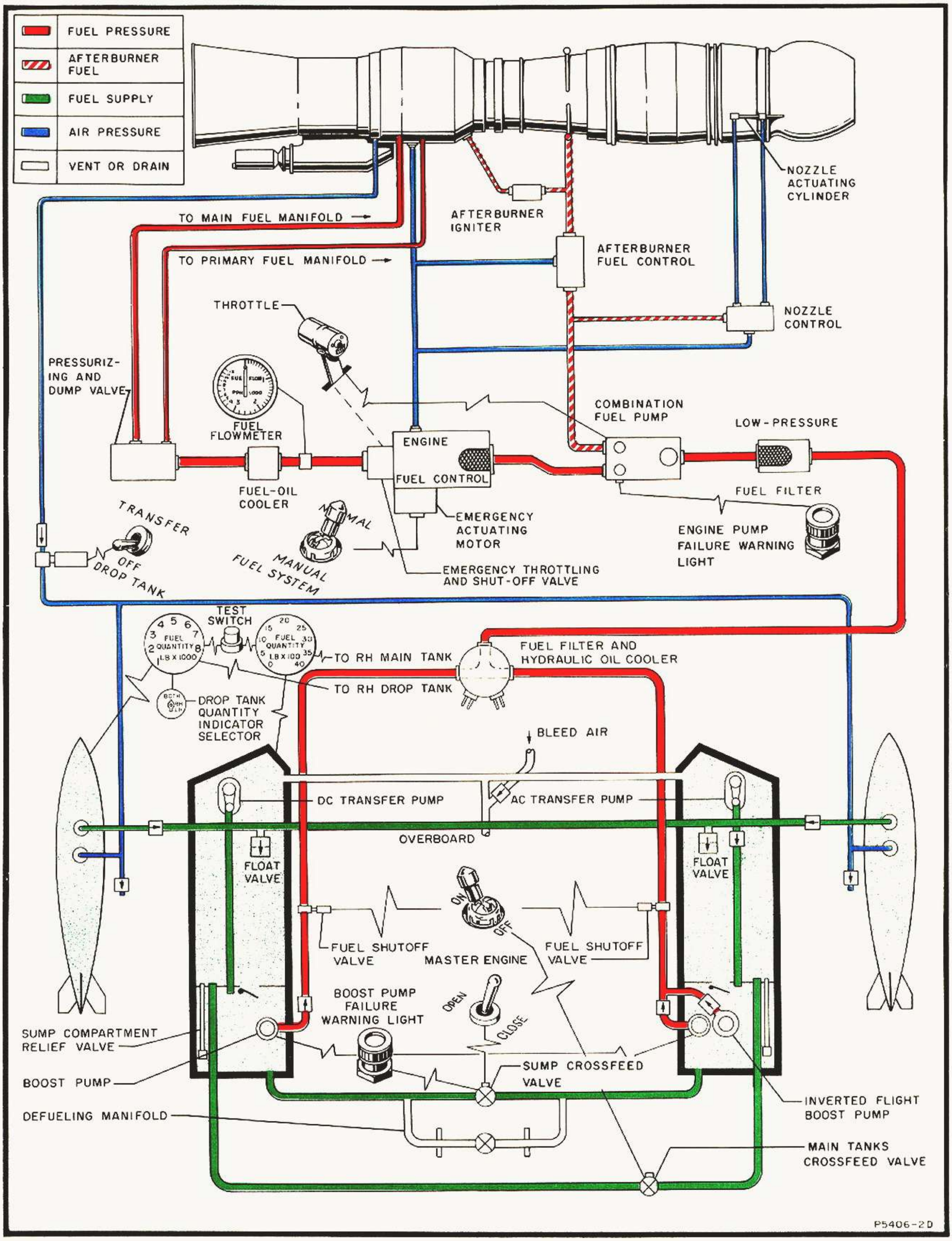
P-5405-1B

Figure 1-6. Fuel Quantity Data



Airplanes BuNo. 130740–130750; BuNo. 134744–134852 prior to service change

Figure 1-7. Fuel System (Sheet 1)



Airplanes BuNo. 134853 and subsequent; BuNo. 134744–134852 after service change
Figure 1-7. Fuel System (Sheet 2)

is installed on the right-hand console. The light illuminates to indicate d-c generator power failure; also, the light remains on as long as external power is supplied to the airplane and the BAT & GEN switch is "OFF."

CAUTION

In early aircraft(1) the a-c electrical system becomes inoperative upon depletion of the battery following failure of the d-c generator.

PITCH TRIM MOTOR CIRCUIT BREAKER. A manual reset circuit breaker (6, figure 1–3 is installed to permit re-setting d-c power to the pitch trimmers in the event of overload or other malfunction.

A-C POWER DISTRIBUTION

A-C power is distributed to the electrical system by the two electrical equipment junction panels. (See figure 1–9.)

A-C POWER CONTROLS AND INDICATOR

GENERATOR SWITCH (EARLY AIRPLANES(1)). A-C power to the electrical system is controlled by the AC GEN switch on the electrical power panel (27, figure 1–5). The switch has two positions, "ON," and "OFF." Placing the switch in the "ON" position energizes the a-c electrical system when external a-c and d-c power is connected to the airplane or when the a-c generator is operating and d-c electrical power is available from the d-c generator or battery.

A-C GENERATOR FIELD SWITCH (EARLY AIRPLANES(1)). The AC GEN FIELD switch on the electrical power panel (27, figure 1–5) is provided to disable the a-c generator in the event of an emergency. Positions of the switch are "ON" and "OFF." The AC GEN FIELD switch should be "ON" at all times during normal operations.

GENERATOR SWITCH (LATER AIRPLANES(2)). A-C power to the electrical system is controlled by the A-C PWR switch on the electrical power panel (27, figure 1–5). Placing the switch in the "ON" position energizes the a-c electrical system when the a-c generator is operating. The AC PWR switch should remain in the "ON" position unless a serious malfunction or fire is suspected in the a-c electrical system. In this event the switch should be placed at "EMER OFF."

Note

To recover a-c power after the A-C PWR switch has been placed in the "EMER OFF" position, the d-c power switch must first be placed in the "OFF" position. The A-C PWR switch is then returned to the "ON" position and the d-c power switch is returned to the "BAT & GEN" position. (Refer to section III for information covering emergencies.)

EXTERNAL POWER SWITCH. Later airplanes(2) are equipped with a ground operated a-c power control switch adjacent to the external power receptacle. With this switch "EXTERNAL" power or "INTERNAL" power may be selected to energize the a-c electrical system. The switch must be placed in the "INTERNAL" position by the ground crew after the engine is operating before the a-c generator can energize the a-c electrical system.

GENERATOR WARNING LIGHT. An AC GEN PRESS-TO-TEST red warning light on the electrical power panel (27, figure 1–5) is installed on the right-hand console. The AC GEN warning light will illuminate due to generator exciter field being opened resulting from overvoltage in the A or B phases,(2) complete a-c generator failure, failure of any of the three generator phases, or generator stoppage due to the air drive control cutting out as a result of generator overspeeding. If the generator failure indicated is caused by failure of one phase of the generator only, a-c electrical equipment connected to the remaining two phases will remain operative.

Note

When external a-c and d-c power are being supplied to the electrical systems, the AC GEN warning light will be on until the a-c external power is removed, even though the a-c generator is operating. Make certain that the warning light is out after external power is removed. If the AC GEN warning light remains on, ascertain that the external power switch is at "INTERNAL" and then reset the a-c generator by turning the BAT & GEN switch "OFF" and then back to "BAT & GEN."

GYRO HORIZON POWER SWITCH (SOME AIRPLANES(3)). On some airplanes a d-c powered standby inverter is provided to supply emergency 115-volt a-c power to the gyro horizon. In case of a-c generator failure, the GYRO HORIZON POWER switch (4, figure 1–3) should be placed on "EMER" position.

FLIGHT INSTRUMENT POWER SWITCH (LATER AIRPLANES(2)). A three-position FLT INST POWER switch (4, figure 1–3) is installed to control the distribution of a-c power, furnished by a d-c powered inverter, for essential equipment. The three positions of the switch are; "NORMAL," "INVERTER," and "GENERATOR." When the FLT INST POWER switch is in the "NORMAL" position, inverter power is furnished to the gyro horizon and the fuel quantity indicating system. With the switch placed at "GENERATOR," the gyro horizon and fuel quantity indicating system will be powered by the a-c generator. In the

(1) Airplanes BuNo. 130741–134744, 130746–130750; BuNo. 134744–134797 prior to service change.
(2) Airplanes BuNo. 130745, 134798 and subsequent; BuNo. 134744–134797 after service change.
(3) Airplanes BuNo. 130743, 130746, 130747, 130750.

event of a-c generator failure, placing the FLT INST POWER switch at "INVERTER" accomplishes the following: powers the gyro horizon, fuel quantity indicating system, S-2 gyrosyn compass, fuel pressure indicator, oil pressure indicator, fuel flow indicator, AN/ARN-14 omni-range receiver, and the AN/ARA-25 UHF direction finder; de-energizes the auto control and yaw damper systems; removes 26 volt a-c rotor excitation from the vertical gyro and AN/ARN-21 omnibearing-distance radio (TACAN); provides emergency power for TCC (return to neutral) and air conditioning manual cold operation.

INVERTER FAILURE WARNING LIGHT.[1] A press-to-test INVERTER PWR FAILURE warning light (1A, figure 1–4), located on the upper left-hand corner of the instrument panel, illuminates upon failure of the d-c powered inverter with the FLT INST POWER switch in either "NORMAL" or "INVERTER."

HYDRAULIC POWER SUPPLY SYSTEM

Two hydraulic systems with separate hydraulic pumps and reservoirs are provided; a 3000 psi utility system, and a 3000 psi elevon system. Both hydraulic systems are powered by variable displacement engine driven pumps. Two airless, pressurized hydraulic reservoirs supply the pumps with hydraulic fluid. A hand pump (12, figure 1–14) is incorporated in the hydraulic system for use in ground handling. The hydraulic system is shown schematically in figure 1–10.

UTILITY HYDRAULIC SYSTEM

The utility hydraulic system supplies pressure for extending and retracting the landing gear, folding and spreading the wings, opening and closing the speed brakes, retracting the arresting hook, retracting the tail bumper, operating the power boost brakes, and one-half of the tandem power cylinders of the tandem elevon actuator installations. A HYDRAULIC PRESSURE UTILITY indicator, located on the instrument panel (17B, figure 1–4), reads "PRESS" when the utility hydraulic system is functioning normally. A cross-hatched warning signal reads "OUT" when utility hydraulic pressure is below 800 psi.

ELEVON HYDRAULIC SYSTEM

The elevon hydraulic system supplies pressure to operate the servo rudder and one-half of the tandem power cylinders of the tandem elevon actuator installations. A HYDRAULIC PRESSURE ELEVON indicator, located on the instrument panel (17A, figure 1–4), reads "PRESS" when the elevon hydraulic system is functioning normally. A cross-hatched warning signal reads "OUT" when elevon hydraulic pressure is below 800 psi.

FLIGHT CONTROL SYSTEM

The flight control surface arrangement is unconventional. The control surfaces consist of elevons, rudder, servo rudder, trimmers, and slats. The elevons (7, 16, figure 1–2) perform both the longitudinal and lateral control functions normally accomplished by elevators and ailerons. Directional control is accomplished by a conventional rudder (13, figure 1–2) and a servo rudder (12, figure 1–2). The pitch trimmers (9, figure 1–2) provide longitudinal trim during take-off, landing, and all speed conditions. Wing slats (17, figure 1–2) are installed to improve stability during slow flight. A conventional control stick and rudder pedals operate the control surfaces.

ELEVON CONTROL

The elevon surfaces are divided into two parts to permit folding the wings. The inboard and outboard portion of each elevon act as one surface at all times. The port and starboard elevons act together symmetrically for longitudinal control (elevator function) and differentially for lateral control (aileron function). The elevons are actuated by hydraulically powered tandem elevon actuator installations located in the wing fold joint forward of the elevon surfaces. Operation of the elevon actuators is controlled by the control stick. Each tandem elevon actuator installation is comprised of two integral power cylinders and pistons joined by a common piston rod. Each half of the power cylinders has a separate hydraulic power source. In the event of a failure of either the elevon hydraulic system or the utility hydraulic system, complete control is maintained in the transonic and subsonic speed ranges. Control in the supersonic speed range is limited when one hydraulic system is inoperative. If both hydraulic systems fail, emergency manual control of the elevons by direct mechanical linkage from the control stick is provided. The hydraulic power to the elevons may be disengaged by pulling the ELEVON POWER RELEASE handle (figure 1–12) after which the airplane must be controlled manually.

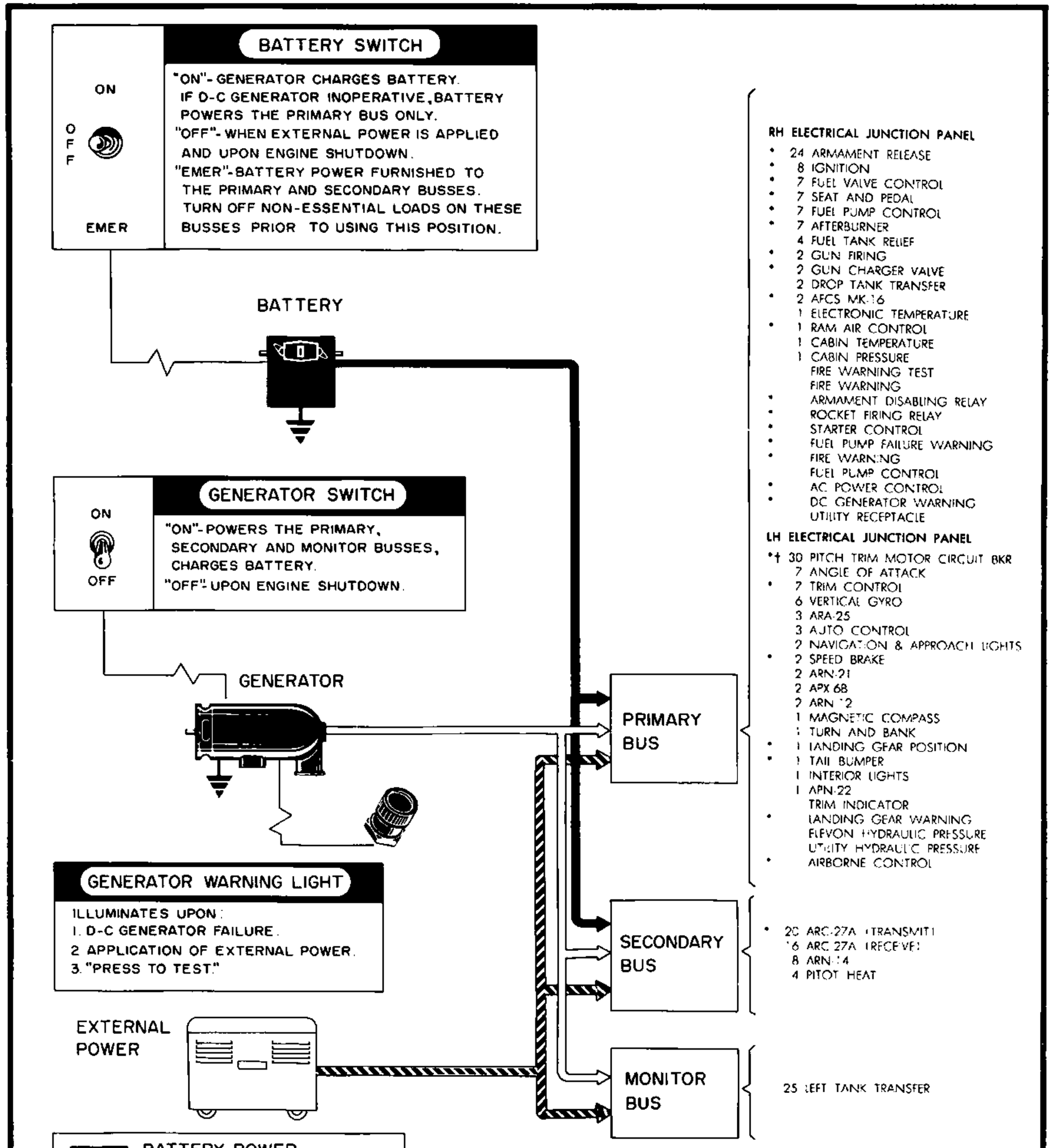
WARNING

Do not pull ELEVON POWER RELEASE handle unless both hydraulic power systems are inoperative, the elevons are uncontrollable, or engine seizure occurs. The resulting manual control of the airplane is marginal and is not recommended for use at high airspeed. When using manual control the stick should be extended, and it is recommended that an MAC ratio of 2:1 be selected. (Refer to MANUAL FLIGHT CONTROL, section VI of the Confidential Supplement, and section VII of the Flight Handbook.)

Note

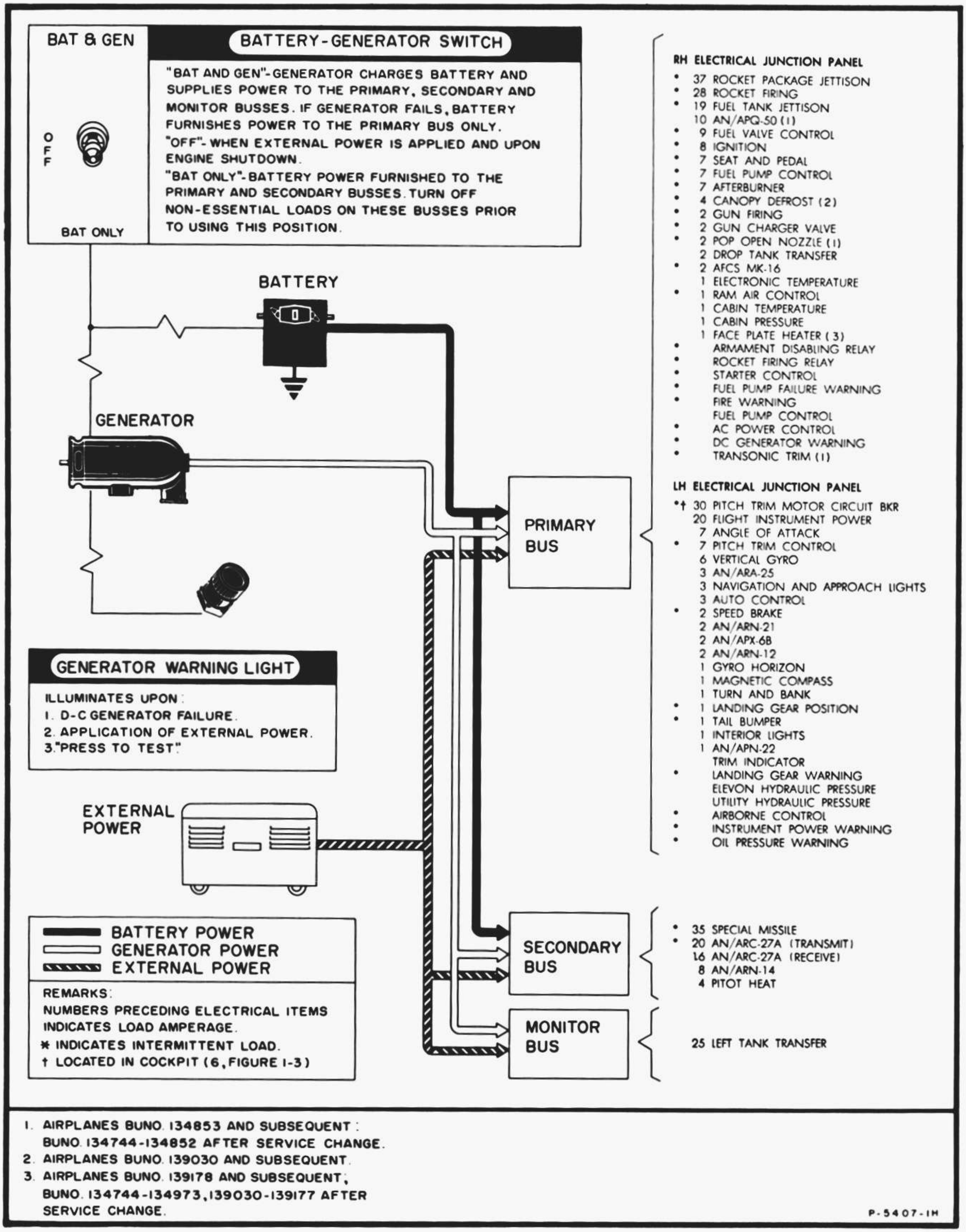
- Transonic trim system malfunctions are *not* cause to pull the ELEVON POWER RELEASE handle. (Refer to TRANSONIC TRIM CONTROL, this section.)

[1] Airplanes BuNo. 130745, 134798 and subsequent; BuNo. 134744–134797 by service change.



Airplanes BuNo. 130740–130744, 130746–130750; BuNo. 134744–134797 before service change

Figure 1-8. DC Power Supply (Sheet 1)



Airplanes BuNo. 130745, 130744 and subsequent
Figure 1-8. DC Power Supply (Sheet 2)

- The ELEVON POWER RELEASE cannot be reset in flight after it has been disengaged.
- The control stick may be extended by depressing the release latch at the base of the control stick grip, providing additional mechanical advantage for manual control.

TRANSONIC TRIM CHANGE COMPENSATOR (TCC) CONTROL.[1] A transonic trim change compensation system is installed in later airplanes to provide automatic elevon motion as may be required during stages of flight through the transonic range. When transonic speeds are approached, signals are transmitted from the transonic trim amplifier to the series servo actuators which act to offset the effects of the aerodynamic forces encountered and provide longitudinal static stability.

Control of the transonic trim compensation system is achieved through a manually operated TRANS TRIM switch (3A, figure 1–3) located outboard of the left-hand console. When "ON," the three position switch activates the mechanical and electrical components of the system in preparation for flight conducted within the transonic region. Impulses transmitted from the amplifiers effect the mechanical operation of the series servo actuators controlling the movement of the elevons to give elevon deflection programmed as a function of altitude and mach number. An interlock automatically turns the system off in the event the elevons become unsynchronized. When this happens, the pilot should immediately neutralize the roll and place the TRANS TRIM switch to the spring-loaded "RETURN TO NEUTRAL" position and hold for approximately 10 seconds. This will enable the system to be reactivated by subsequently repositioning the switch to "ON." If a symmetrical malfunction occurs and airplane pitch results, immediately neutralize the pitch and hold the TRANS TRIM switch to the "RETURN TO NEUTRAL" position for approximately 10 seconds to bring the elevons back to their normal (subsonic) position and to relieve the system of all input signals. The system is de-energized by releasing the switch, allowing it to go to "OFF."

Note

- All TCC malfunctions can be adequately overcome by the pilot through the control stick.
- Identical control stick movement is required to overcome transonic trim system malfunctions whether in normal or manual control.

CAUTION

- Do not turn the TRANS TRIM switch from "OFF" to "ON" while in the trim change region.
- The TRANS TRIM switch should never be turned "OFF" during transonic flight without first using the "RETURN TO NEUTRAL" position.
- Do not hold the TRANS TRIM switch in the "RETURN TO NEUTRAL" position longer than necessary to remove all TCC system input signals. Prolonged operation in this position (over 5 minutes) may damage the actuator motors as a consequence of applying continued electrical power while the actuators have been driven to the mechanical stops.

Two buttons, labeled ALTITUDE BYPASS and GROUND TEST (3C and 3D, figure 1–3), are located on the left hand console for the purpose of checking the transonic trim system prior to flight. These buttons are guarded from inadvertent actuation by a spring-hinged cover.

Note

Turning the TRANS TRIM switch "ON" before starting the engine and conducting the ground test of the system just before taxi will insure sufficient warm-up time (2 minutes) and extend the service life of the equipment.

An optimum programming of the TCC system for maximum effectiveness in flight is possible by adjustment of the onset adjustment potentiometer by means of a specially designed screwdriver. Access to the onset adjust (3B, figure 1–3) is located aft of the TRANS TRIM switch, and adjustment of the system is dependent on criteria developed by squadron doctrine. The procedures for adjustment by designated personnel are to be found in the appropriate maintenance publication.

MECHANICAL ADVANTAGE CHANGER SYSTEM. The function of the mechanical advantage changer (MAC) system is to change the ratio of stick-to-elevon travel from one-to-one at slow speeds or high altitudes to as much as three-to-one at high speeds and low altitudes (see figure 1–11). The MAC automatically maintains a relatively constant stick-travel-to-control-response throughout the entire speed and altitude range, reduces control surface sensitivity at high speeds, protects the structural integrity of the wing under torsion by limiting elevon deflection at certain altitude and airspeed conditions, and reduces stick forces encountered during emergency manual elevon control. The MAC is automatically operated by an electric servo motor and cable system which positions a variable arm bell crank. Actuation of the MAC servo motor is programmed by an electronic amplifier receiving signals from Mach number and altitude sensing units. Both the servo motor and amplifier are powered by a-c electrical power.

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[1] Airplanes BuNo. 134853 and subsequent; BuNo. 134744–134852 after service change.

MECHANICAL ADVANTAGE CHANGER SYSTEM CONTROL. The MAC operates automatically when the EMER ELEVON MAC system crank (30, figure 1–3) is kept in the stowed position. In early aircraft, the crank must be stowed in the clip located on the panel; in later aircraft,(1) the crank, once removed from the slotted head containing the detent and switch for manual operation, is extended with the handle inserted face-down in a plastic cup. (This precludes interference with adjacent oxygen equipment.) This crank is provided for

(1) Airplanes BuNo. 134919 and subsequent; BuNo. 134744–134918 after service change.

emergency use in the event of electrical failure or as an alternate control if the pilot desires to select a particular mechanical advantage ratio manually. To operate the control, the EMER ELEVON MAC system crank is moved from its stowed position to its manual operating position. This action automatically disconnects the electrically operated automatic components of the MAC system. To change the mechanical advantage ratio, the crank is then rotated towards "INCREASE" or "DECREASE."

WARNING

The EMER ELEVON MACS crank must be in the stowed position in order to obtain automatic operation.

MECHANICAL ADVANTAGE CHANGER INDICATOR. An ELEVON MECHANICAL ADVANTAGE (MAC) indicator is situated on the instrument incorporating the trim position indicators (8, figure 1–4) in addition to the indicator located on the left-hand console adjacent to the MACS crank. The MACS indicator is calibrated from "T.O. & LAND" to "3" and shows the mechanical advantage ratio at all times. When the EMER ELEVON M.A.C. system crank is in use, the pilot may obtain the desired mechanical advantage ratio by turning the crank handle until the desired ratio appears on the indicator.

CAUTION

When entering low-altitude high-speed flight, check the MACS indicator for normal operation. If the MAC is not operating properly, the aircraft can become extremely sensitive to longitudinal control movement with resultant pilot induced oscillations that could possibly cause structural damage.

RUDDER CONTROL

Conventional rudder pedals mechanically operate the lower portion of the two section rudder through a cable system. No boost or power is supplied to the lower rudder. Both rudder pedals may be adjusted simultaneously by a momentary contact PEDALS switch (12, figure 1–5). Positions of the switch are "FWD" and "AFT."

YAW DAMPER CONTROL

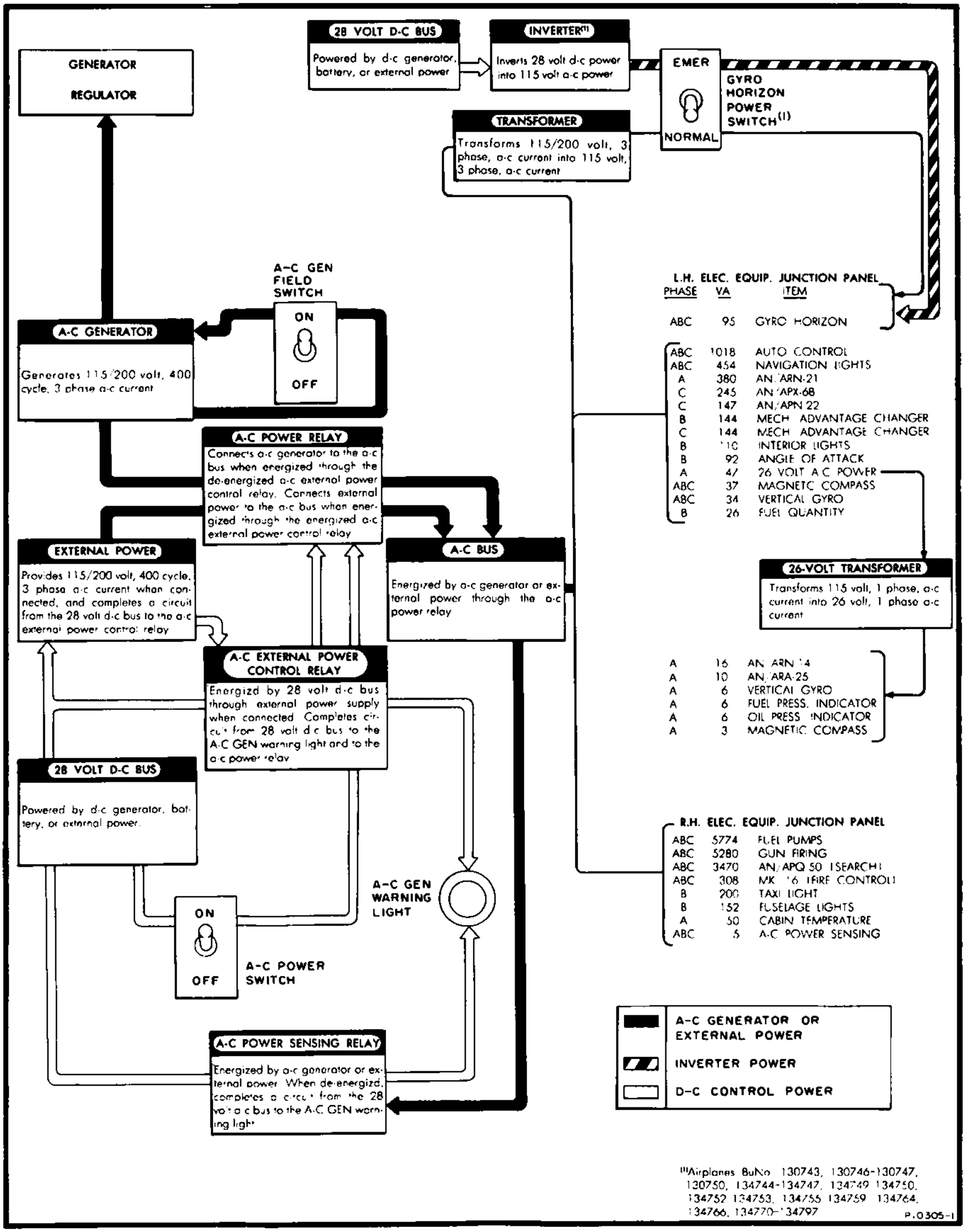
The upper portion of the two section rudder is a servo rudder and is used for yaw damping, rudder trim, low speed lateral interconnect and to supplement the lower rudder under all flight conditions. The servo rudder is hydraulically powered by elevon hydraulic system pressure reduced to 1000 psi and is controlled by a servo valve receiving signals from the servo rudder amplifier in the automatic control system. The servo rudder is slaved to movements of the mechanical rudder at all times within the limits of its restricted travel. The servo rudder is also coupled to lateral stick movement at speeds under 208 knots to assist in performing coordinated turns. Its travel is limited, however, to ±15° to limit effectiveness in case of "hard-over failures." Engagement of the yaw damper system is accomplished after take-off by depressing the push-pull type YAW DAMP control button (25, figure 1–3). If yaw damper malfunction occurs, the yaw damper mode can be turned off by pulling up the YAW DAMP control button. If some other mode of the servo rudder system should malfunction, the complete system can be deactivated by placing the YAW DAMPER & AUTO-PILOT switch (22, figure 1–3) to "EMER OFF." Switch positions are labeled "ON" and "EMER OFF." The yaw damper mode is automatically turned off during initial compression of the landing gear struts when effecting a landing. However, the servo rudder is slaved to the manual rudder as long as the YAW DAMPER & AUTO-PILOT switch is "ON" and electrical and hydraulic power is available. (Refer to D-1 AUTO CONTROL SYSTEM, section IV.)

CONTROL STICK

The control stick (see figure 1–12) is conventional in appearance and operation, although the combined lateral and longitudinal control with elevons requires a unique design in the control linkage. The control stick is mounted in a "stick mixer" housing containing differential gears which provide differential (aileron) motion of the elevons as well as symmetrical (elevator) action. Artificial feel springs are installed in the center pedestal to provide simulated control force to the stick. A bob weight is installed on the control stick mechanism in the "stick mixer" housing to obtain additional elevator feel. To obtain additional mechanical advantage when operating under emergency manual control, the control stick may be extended by depressing a release latch located at the base of the control stick grip and pulling upwards on the grip. The stick grip is provided with a lateral-longitudinal TRIM switch, a trigger switch, and two buttons, identified as "B" and "R." When on auto control, a force of from 5 to 10 pounds exerted on the stick grip will disengage the automatic feature and restore normal elevon control to the pilot.

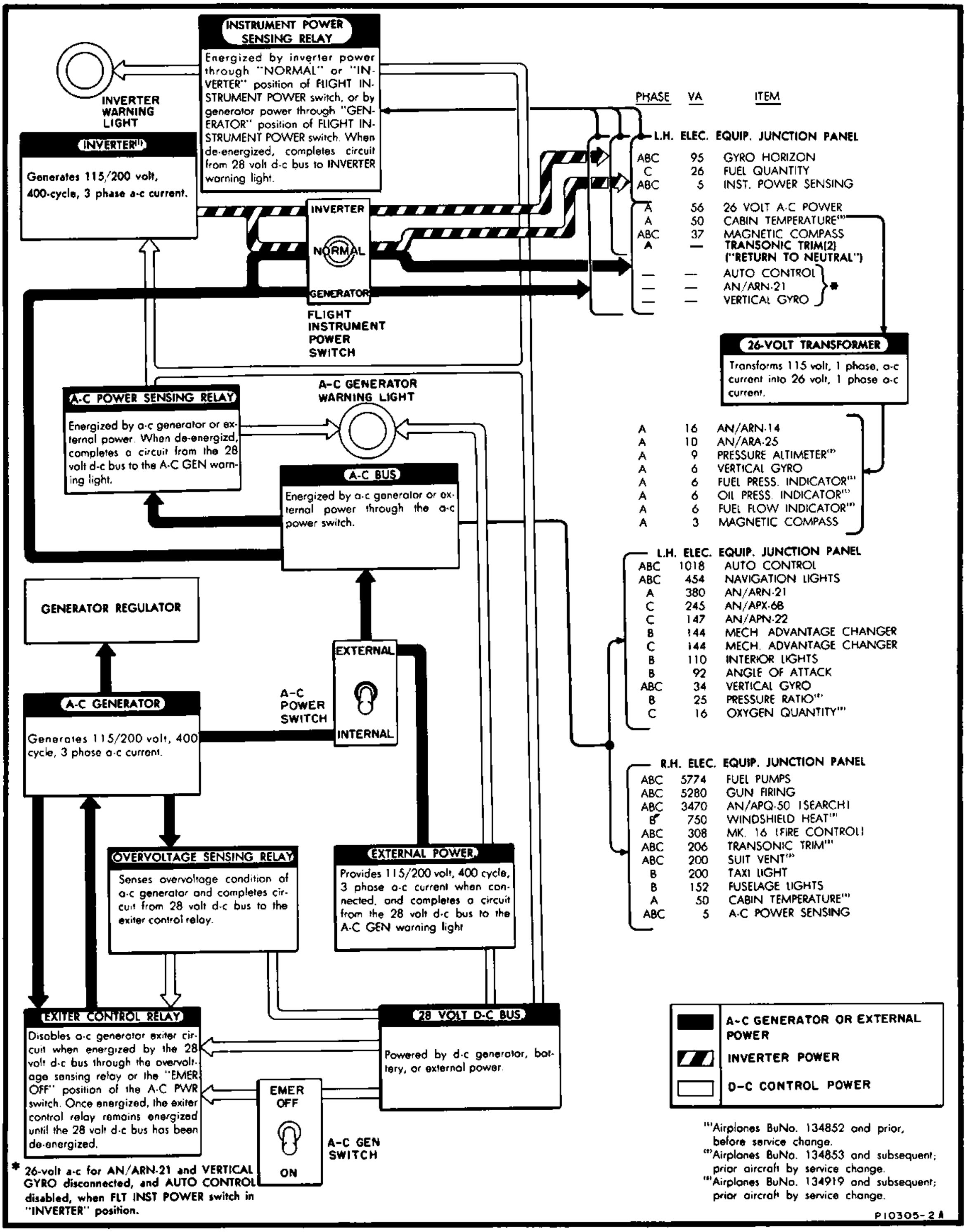
TRIM CONTROL SYSTEM

The trim control system provides trim about all three axes of the airplane. A pitch trimmer surface (9, figure 1–2, sheet 1) is installed on each wing trailing edge inboard of the elevons to trim the airplane longitudinally. The pitch trimmers are electrically powered by the 28-volt d-c electrical system and controlled by the TRIM switch (figure 1–12) on the control stick grip. Directional trim is accomplished by displacing the servo rudder through means of signals from the servo rudder amplifier to the rudder servo valve mechanism. Directional trim is electrically controlled by a RUDDER



Airplanes BuNo. 130741–130744, 130746–130750; BuNo. 134744–134797 prior to service change

Figure 1-9. AC Power Supply (Sheet 1)



Airplanes BuNo. 130745, 134744 and subsequent
Figure 1-9. AC Power Supply (Sheet 2)

TRIM control (24, figure 1–3)on the left-hand console, operating through the yaw damper system. Lateral trim is effected by physically moving the lateral stick feel spring in the center pedestal from its center or "neutral" position with an electric motor powered by 26-volt a-c electrical power. This movement provides a displaced "neutral" position for the control stick which in turn actuates the elevons to trim the airplane. Movement of the lateral stick feel spring is controlled electrically by the TRIM switch on the control stick.

PITCH TRIMMER CONTROL. The pitch trimmer travel is 1.5° below faired position to 28.5° above faired position. A limit switch, altitude bellows, and airspeed bellows arrangement limit pitch trimmer travel, when airspeed exceeds 208 knots, to a maximum deflection of approximately 8 degrees at sea level to approximately 20 degrees at 39,000 feet. Full deflection of the pitch trimmers may be accomplished when the airspeed falls below 186 knots at any altitude. Refer to Pitch Trimmer Deflection Chart, figure 1–13. The pitch trimmer is controlled by moving the control stick TRIM switch to the "NOSE UP" or "NOSE DOWN" position. An EMERGENCY TRIM control (7, figure 1–3) is provided for emergency operation of the pitch trimmers or to override the limit switch at airspeeds above 208 knots if the pilot desires to do so. Positions of the EMERGENCY TRIM control are "OFF," "NOSE UP," and "NOSE DOWN." A pitch trim motor circuit breaker (6, figure 1–3) is located on the left-hand console. The TRIM POSITION indicator (8, figure 1–4) on the instrument panel shows the position of the pitch trimmers at all times. The trim position indicator reads "NOSE UP" and "NOSE DOWN." The indicator is calibrated "0–6" for the 0°–30° travel of the pitch trimmer controls.

Note

Although the pitch trim position indicator is calibrated from "0" to "6" units in the "NOSE UP" range, actual pitch trimmer range (30° of travel) is achieved on the indicator when the pointer is at "5½." Therefore, other settings will be fractions of this number; 15° trim will be indicated as slightly less than "3," etc.

CAUTION

- Because the EMERGENCY TRIM control must be held over to maintain override of the trim control switch, it may be necessary to operate the pitch trim motor circuit breaker switch after achieving the desired trim.
- The airplane should not be maneuvered in an out of trim condition as the elevons and pitch trimmers will oppose each other, causing unnecessarily high wing loads.
- The Pitch Trimmer Deflection chart (figure 1–13) shows limits on trimmer deflection. The maximum trimmer deflection should be limited as shown in this figure when using the EMERGENCY TRIM control.

DIRECTIONAL TRIM CONTROL. To trim the airplane directionally, the rudder trim control, labelled NOSE (24, figure 1–3), is moved toward the "NOSE RIGHT" or "NOSE LEFT" position. No emergency rudder trim is provided. The TRIM POSITION indicator on the instrument panel reads "NOSE RIGHT" and "NOSE LEFT." The indicator is calibrated "0–4" both left and right of center.

Note

No rudder trim control is possible if the YAW DAMPER & AUTO-PILOT switch is in the "EMER OFF" position.

LATERAL TRIM CONTROL. To trim the airplane laterally, the control stick TRIM switch is moved to the "LWD" or "RWD" position. No emergency lateral trim control or lateral trim position indicator is provided. When manual flight control is required, both lateral load feel and lateral trim control are disconnected.

WING SLATS

Slats are installed in the leading edges of the wings to improve lateral and directional stability and control during landing and take-off. The slats are free floating and operate automatically in response to aerodynamic forces.

GUST LOCK CONTROL

A rudder GUST LOCK control (10, figure 1–3) is installed to lock the rudder control surface. The rudder is unlocked with the control in the vertical position. Moving the control to the horizontal position locks the rudder and prevents the engine power control from being moved to the take-off RPM range. A release button on the inboard end of the gust lock control must be depressed to move the control from one position to the other. The elevons are automatically centered and gust locked when the wings are folded.

WING FOLDING SYSTEM

The wings are folded and spread by hydraulic pressure from the utility hydraulic system. Hydraulically operated wing locking pins are safetied by a mechanically operated latch mechanism.

WING FOLDING CONTROL

The wing folding controls are located on the right-hand console. A door-type lever marked WING PIN LOCK (2, figure 1–5) operates the mechanical latch

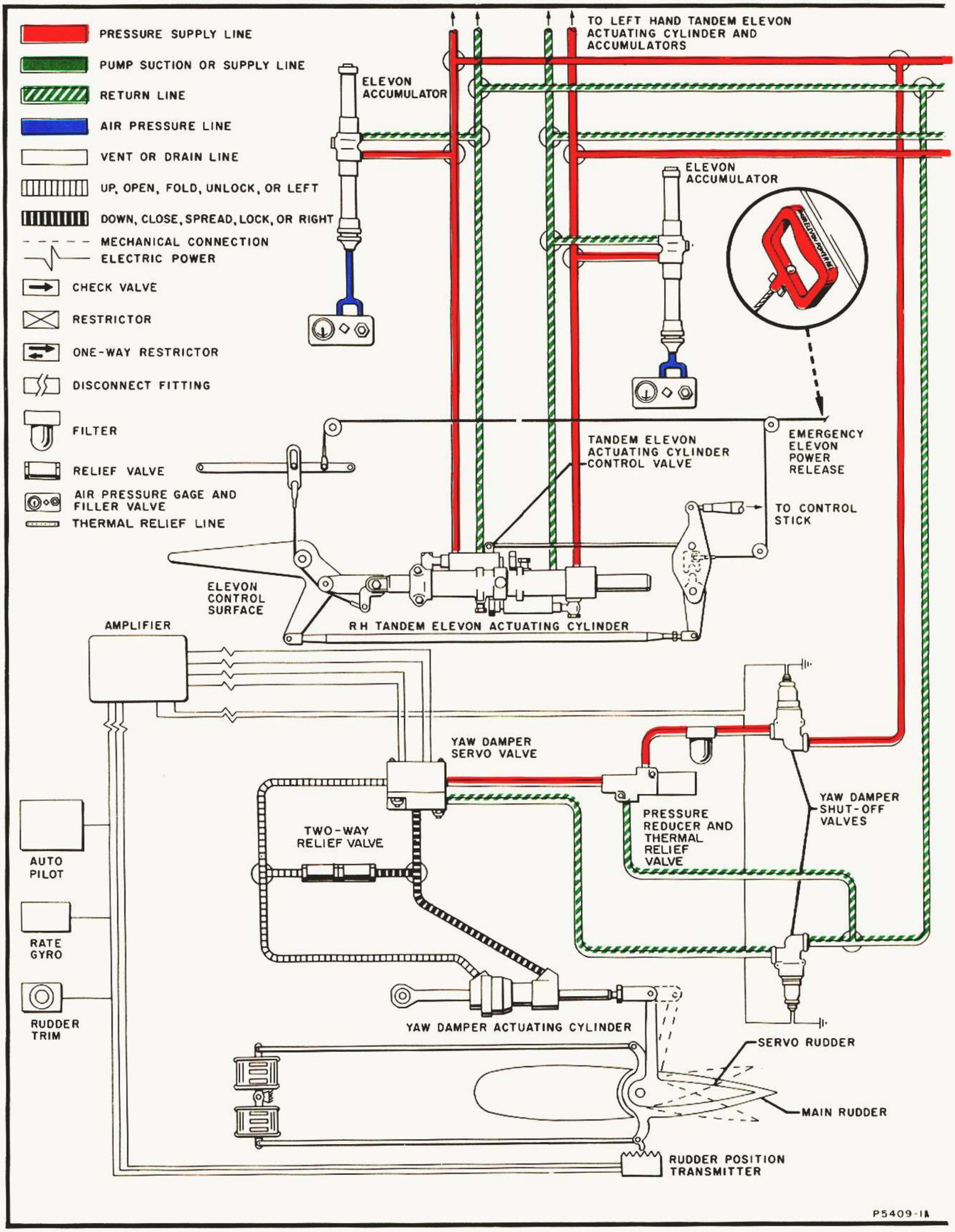


Figure 1-10. Hydraulic System (Sheet 1)

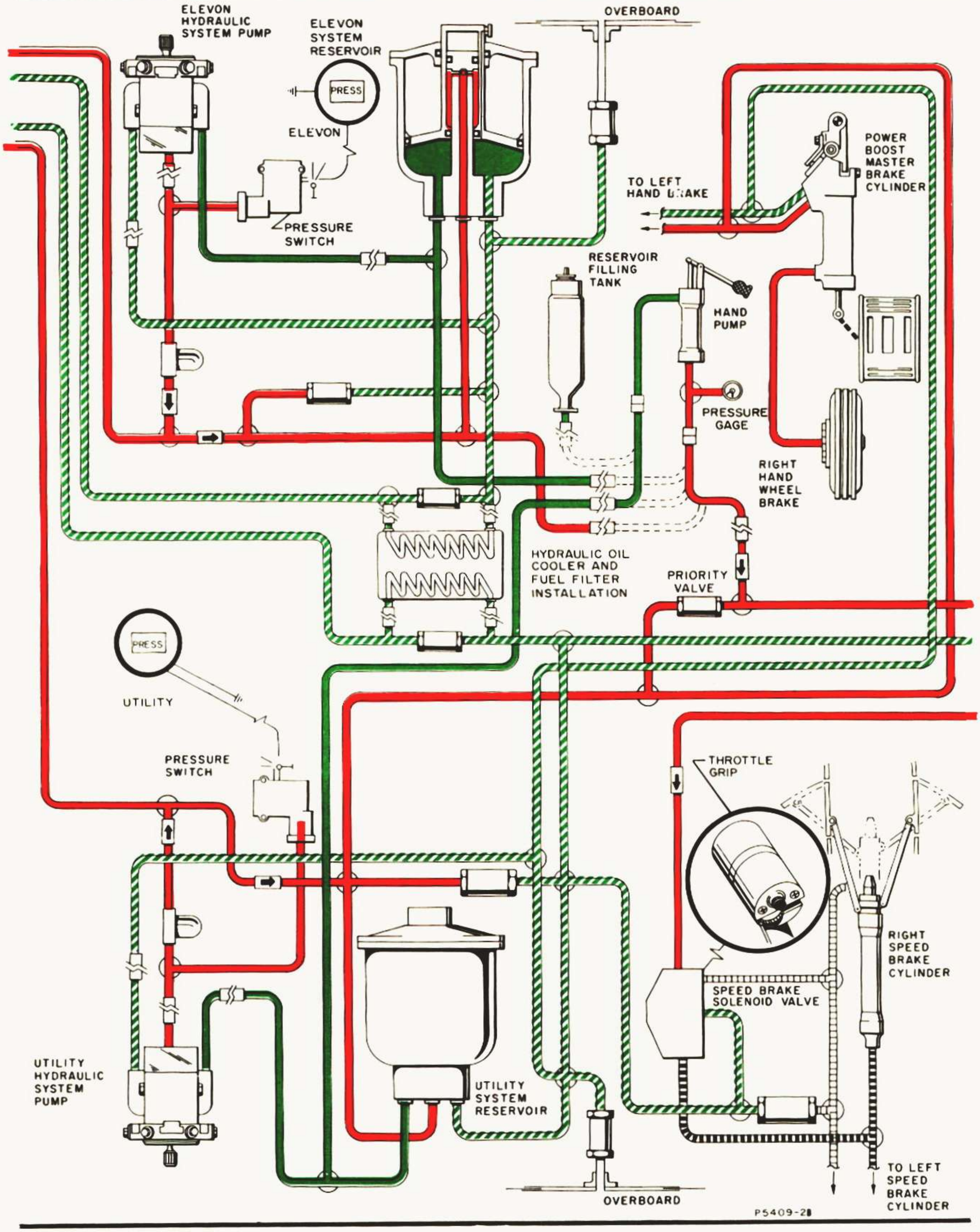


Figure 1-10. Hydraulic System (Sheet 2)

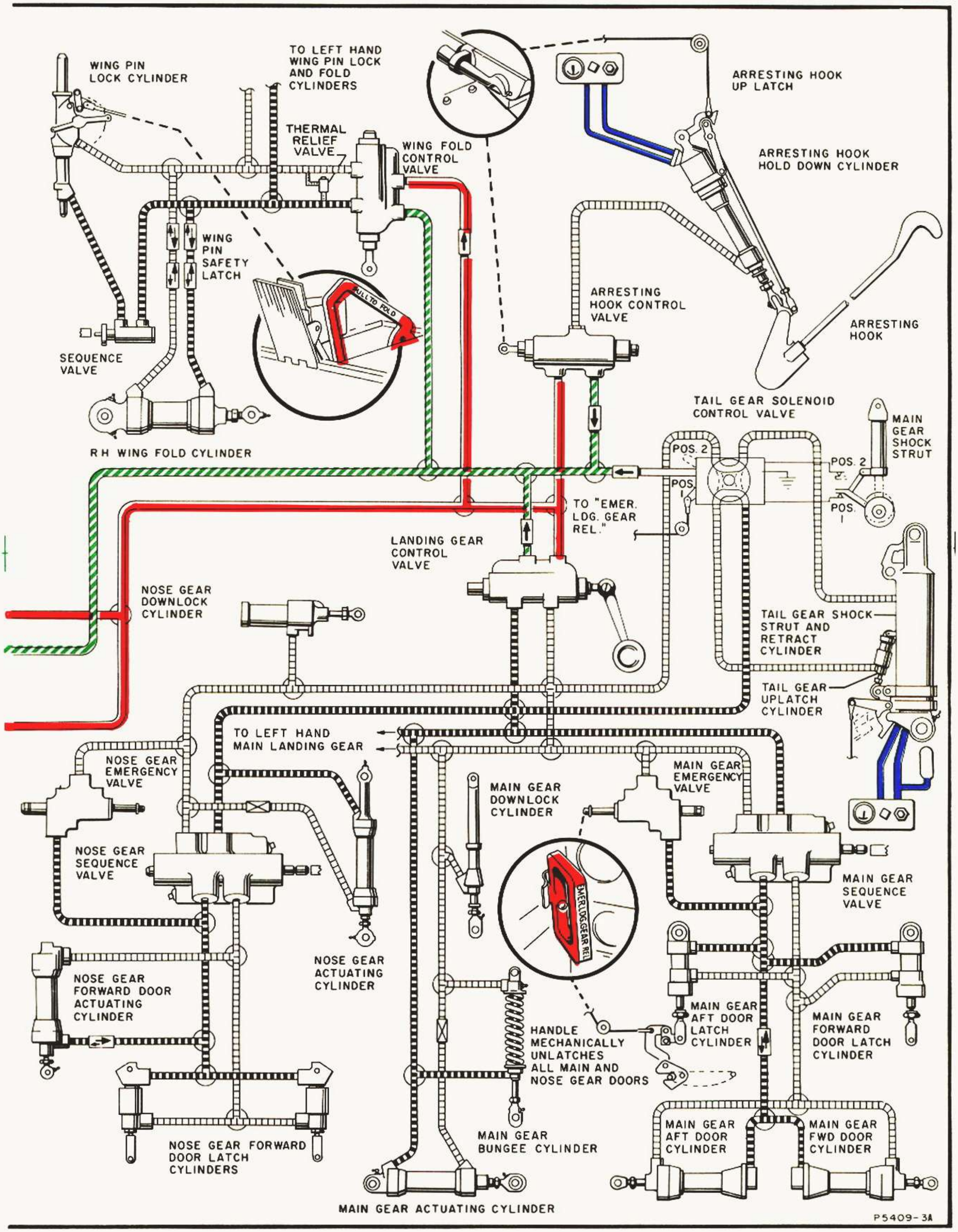


Figure 1-10. Hydraulic System (Sheet 3)

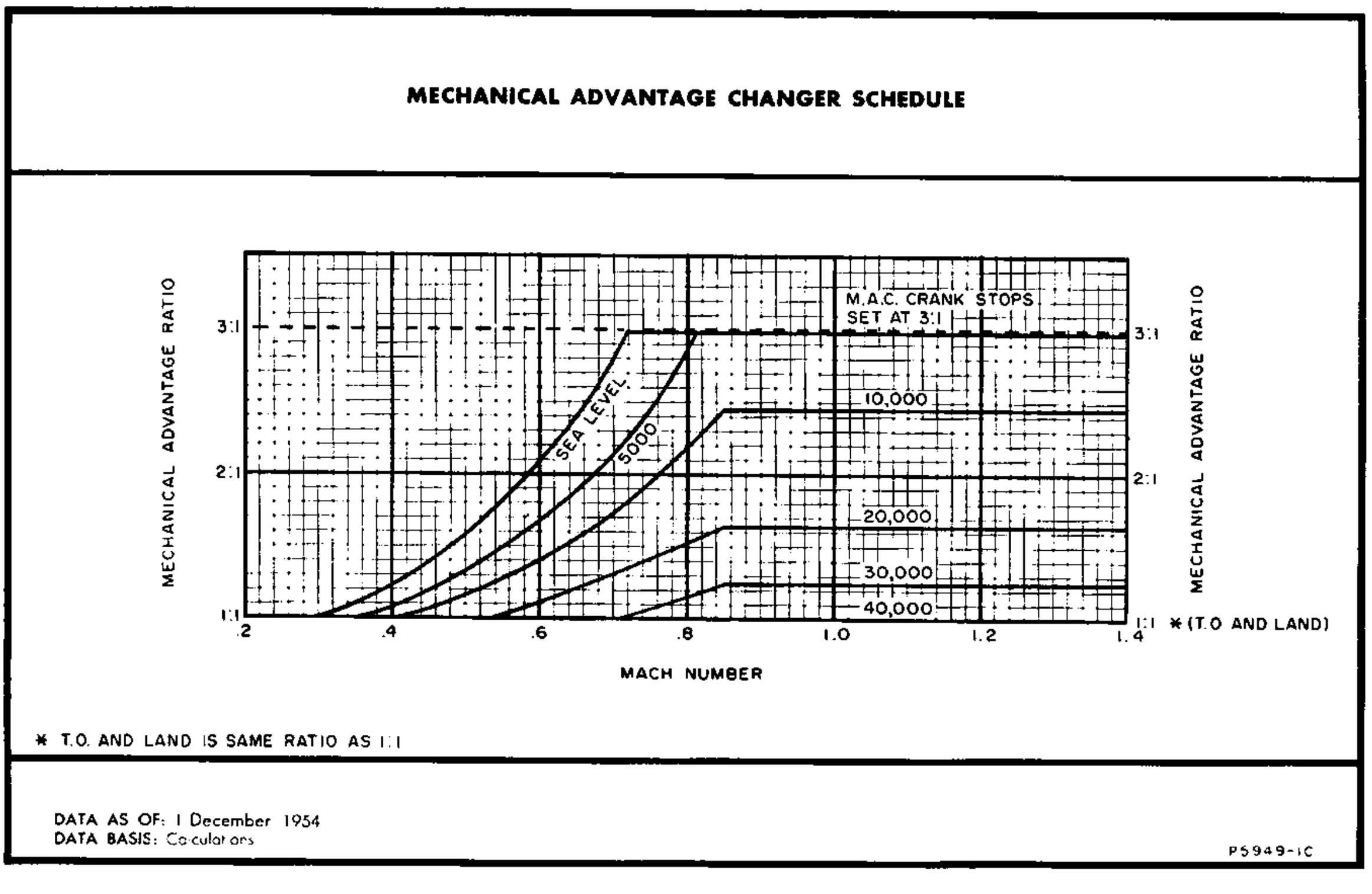


Figure 1-11. Mechanical Advantage Changer Schedule

which safeties the wing locking pins. A WING FOLD lever (3, figure 1–5) controlling the wing folding and locking pin operations is located in a recess under the wing pin lock lever. The wings are folded by raising the wing pin lock lever and then raising the exposed wing fold lever. To spread the wings, the wing fold lever is depressed, then a safety release on the wing pin lock lever is released, and the wing pin lock lever is moved to a position flush with the console after the wings are spread.

CAUTION

When parked in close proximity to obstructions, with wings folded, both levers should remain in the raised (fold) position. This is to preclude the possibility of inadvertently spreading the wings when the engine is started and hydraulic pressure is supplied to the wing folding control valves.

WING PIN LOCK INDICATORS

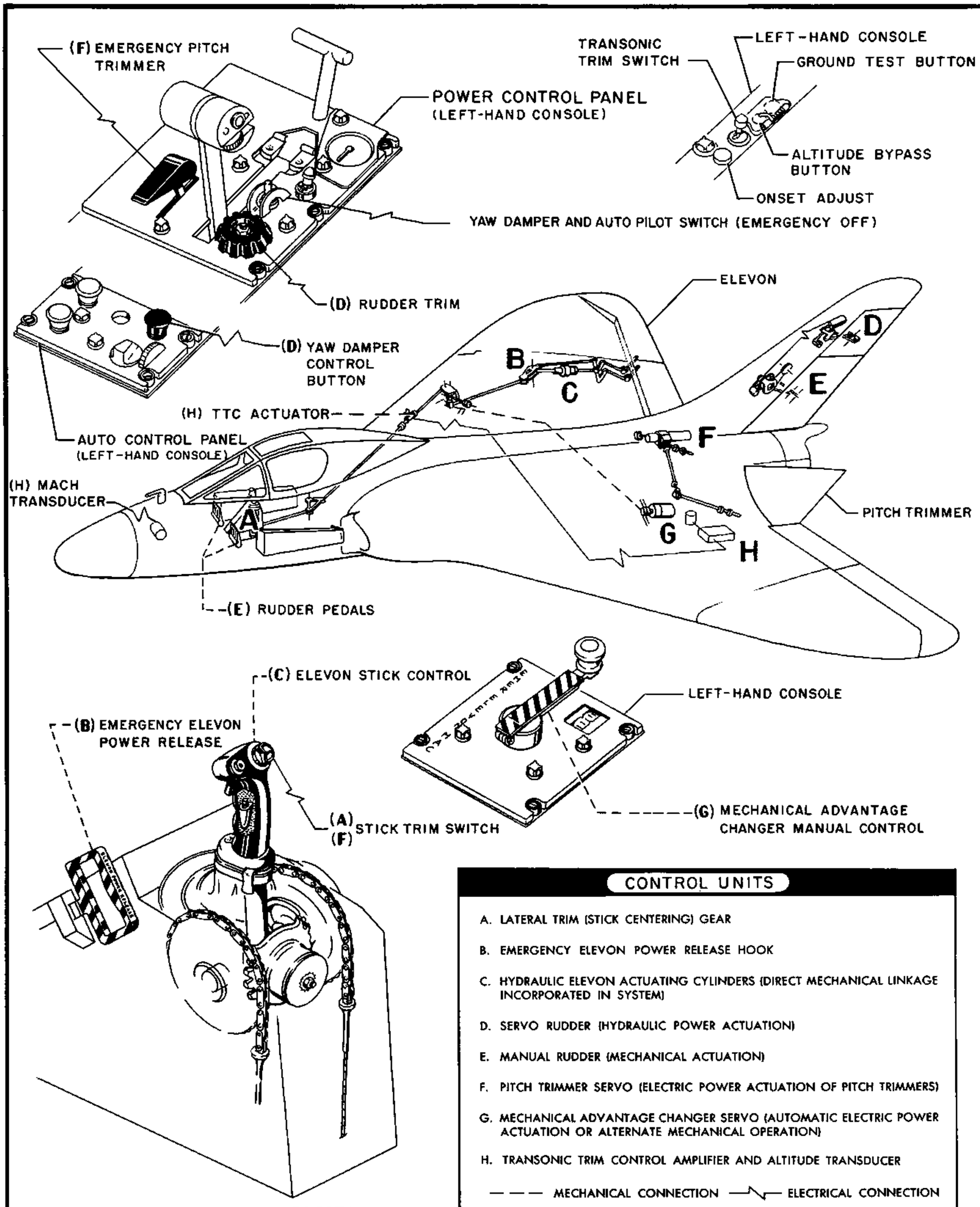
Two red "warning flag" indicators are located inboard of the wing fold joints, just aft of the slats. The indicators extend above the wing surface when the wings are folded or unlocked, and are flush with the wing surface when the wings are spread, locked, and safetied.

SPEED BRAKES

Four speed brakes are installed on the aircraft, one on the upper and lower surface of each wing. The speed brakes are actuated by the utility hydraulic system and controlled by a two position SPEEDBRAKE switch (11, figure 1–3) mounted on the throttle grip. To open the speed brakes the switch is moved aft to the "OPEN" position; to close them, the switch is moved forward to the "CLOSE" position. The speed brakes may be actuated at any speed. A blow-back feature is incorporated allowing the speed brakes to begin to blow-back at approximately 450 knots.

CAUTION

Use of the speed brakes during the final approach to a landing should be avoided, because of their effect on pitch trim with resulting difficulty in maintaining the proper landing attitude. Refer to SPEED BRAKES, section VI of the Confidential Supplement.



CONTROL UNITS

A. LATERAL TRIM (STICK CENTERING) GEAR

B. EMERGENCY ELEVON POWER RELEASE HOOK

C. HYDRAULIC ELEVON ACTUATING CYLINDERS (DIRECT MECHANICAL LINKAGE INCORPORATED IN SYSTEM)

D. SERVO RUDDER (HYDRAULIC POWER ACTUATION)

E. MANUAL RUDDER (MECHANICAL ACTUATION)

F. PITCH TRIMMER SERVO (ELECTRIC POWER ACTUATION OF PITCH TRIMMERS)

G. MECHANICAL ADVANTAGE CHANGER SERVO (AUTOMATIC ELECTRIC POWER ACTUATION OR ALTERNATE MECHANICAL OPERATION)

H. TRANSONIC TRIM CONTROL AMPLIFIER AND ALTITUDE TRANSDUCER

— — — MECHANICAL CONNECTION —⁄\— ELECTRICAL CONNECTION

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Figure 1-12. Flight Controls

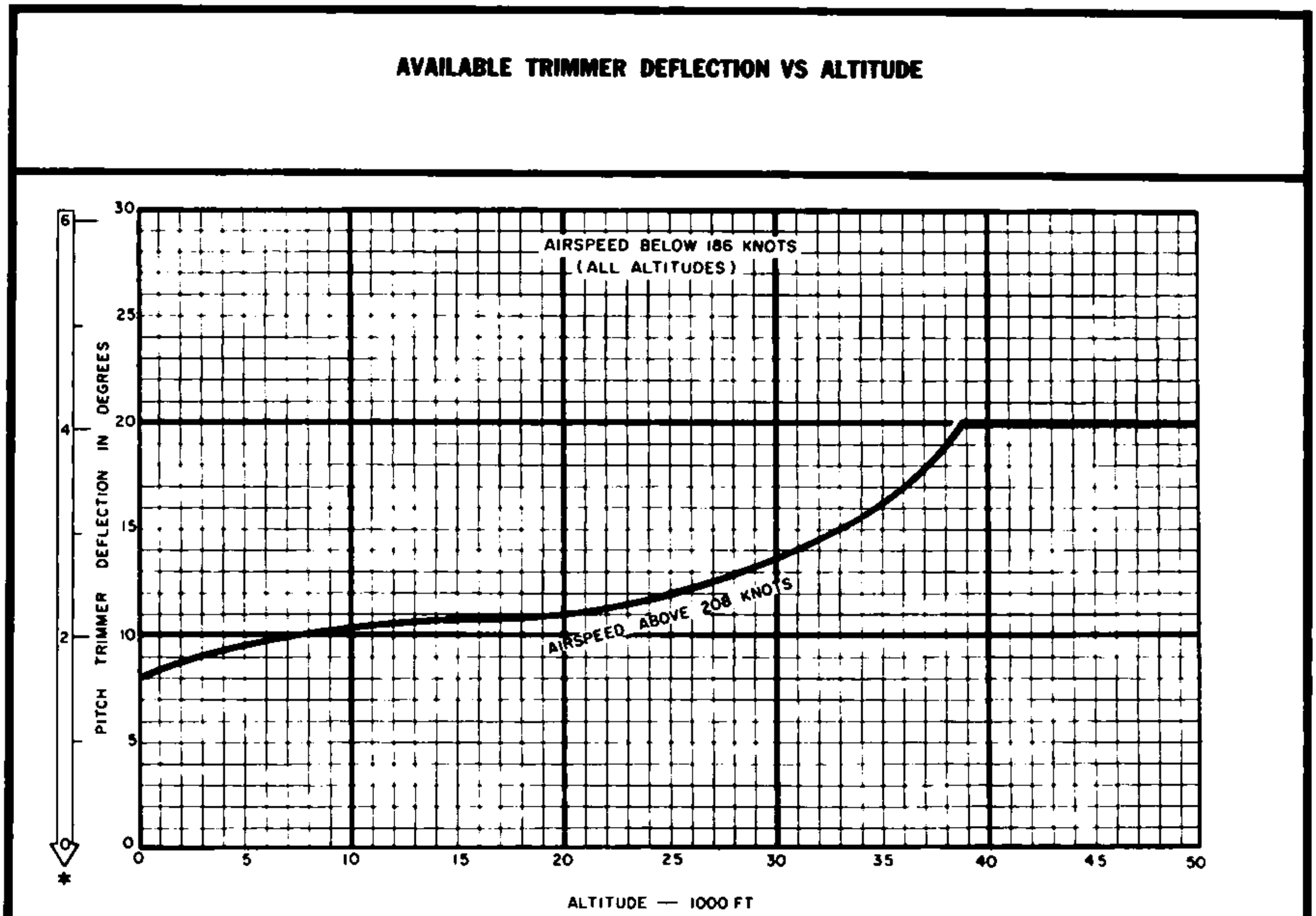

Figure 1-13. Pitch Trimmer Deflection

LANDING GEAR SYSTEM

The aircraft is equipped with a tricycle landing gear and tail bumper gear. The main gear retracts forward into the wings and the nose gear retracts forward into the fuselage. The tail bumper gear retracts upward into the tail cone assembly. A tail bumper gear sequencing switch automatically retracts the tail bumper when the weight of the aircraft is on the main gear landing struts. A timed relay mechanism is installed to delay tail bumper retraction 10-15 seconds after the main gear has contacted the ground, thereby lessening possible wear to the tail hook. This delay mechanism is inoperative with the tail hook extended. The landing gear and wheel well doors are actuated by the utility hydraulic system. The tail bumper gear is extended pneumatically and retracted hydraulically. All landing gear well doors are closed and latched with the gear in the down position except one small door at each landing gear strut. Emergency extension of the landing gear is accomplished through a mechanical release and the effects of gravitational and aerodynamic forces.

LANDING GEAR CONTROL

The landing gear may be extended or retracted by moving the landing gear control (16, figure 1–3) to "WHEELS UP" or "WHEELS DOWN." When the landing gear control is placed in the "WHEELS UP" position, a red light in the control handle will illuminate until all four units of the landing gear are up and locked. When the landing gear control is placed in the "WHEELS DOWN" position, the red light will illuminate until the tail bumper is extended and all three units of the main gear are down and locked. A solenoid-operated safety latch (14, figure 1–3) is provided to prevent inadvertent retraction of the landing gear when the aircraft is on the ground.

EMERGENCY LANDING GEAR EXTENSION CONTROL

In the event of utility system hydraulic failure the landing gear may be extended by pulling the EMER LDG GR REL handle (14A, figure 1–3). When this handle is pulled, two actions take place which combine to free-fall the gear to the down and locked position: the first four inches of handle travel opens an emergency bypass valve in the landing gear hydraulic system, and full travel of the handle releases the landing gear door mechanical latches. Once the mechanical latches have been released, the handle need only be held out far enough to allow the emergency bypass valve to remain open. Operation of this handle for a period of 7 seconds or more is recommended to allow the gear to extend and lock down. This action may be repeated as many times as necessary and will not affect any gear which is already down and locked. The tail bumper gear is extended pneumatically when the emergency landing gear release handle is operated.

WARNING

- The landing gear controls lever *must* be in the "WHEELS DOWN" position when operating the emergency control.

LANDING GEAR POSITION INDICATOR

A WHEELS position indicator (17, figure 1–3) is installed on the left-hand console. The indicator consists of an indicator window and a five-position rotary switch. The switch positions are labeled "N" for the nose gear, "L" for the left main gear, "R" for the right main gear, "T" for the tail bumper, and "ALL" for all four gear components simultaneously. When the landing gear is locked up, the word "UP" appears in the indicator window. When the landing gear is locked down, a miniature wheel is visible. If any unit of the landing gear is not locked in either position, a cross-hatched warning signal will be visible. By selecting each of the rotary switch positions in turn, the pilot may determine which of the four gear components is not locked.

Note

If the d-c electrical power to the indicator fails, the cross-hatched warning signal will appear at all five switch positions.

ARRESTING GEAR

The aircraft is equipped with a hydraulically retractable arresting hook. The utility hydraulic system powers the arresting hook retracting mechanism. The hook is extended when the arresting hook control (1, figure 1–5) is moved to the "HOOK DOWN" position, releasing a mechanical up-latch and pneumatically extending the hook. To retract the hook, the control is moved to the "HOOK UP" position. A red warning light is incorporated into the arresting hook control which will illuminate when the control is moved to the "HOOK DOWN" position and will remain on until the hook reaches the full down position.

BRAKE SYSTEM

A hydraulic power boost brake system is provided. The brakes are operated by toe pressure on the rudder pedals. In the event of utility hydraulic system failure, sufficient pressure for braking can be obtained by exerting approximately twice the normal toe pressure on the rudder pedals.

INSTRUMENTS

The aircraft is equipped with all instruments necessary for all weather flying, operation of the power plant, navigation, and monitoring emergency and auxiliary equipment. In addition, the aircraft is equipped with a trim position indicator, an angle of attack indicator, and a mechanical advantage changer system indicator. Pitot pressure is supplied by an electrically heated pitot pressure tube located on the top of the fuselage forward of the windshield. Static pressure is supplied by two static ports, one on each side of the fuselage above and forward of the nose gear door.

FLIGHT INSTRUMENTS

The flight instruments consist of an airspeed indicator, pressure altimeter, and rate of climb indicator, operated by pitot and static pressure; and a four minute turn and bank indicator, gyro horizon indicator, angle of attack indicator, and trim position indicator, powered by electrical current. A description of the trim position indicator may be found under PITCH TRIMMER CONTROL and DIRECTIONAL TRIM CONTROL, section I.

AIR SPEED INDICATOR. A combination airspeed indicator and Mach meter (3, figure 1–4) is mounted on the instrument panel. The airspeed portion of the dial is fixed in position and is calibrated from 80 to 650 knots. The Mach meter scale is a rotating disc, marked from 0.50 to 2.20, turning beneath the airspeed dial. Both airspeed and corresponding Mach number are indicated simultaneously by a single needle pointer. On the Mach number disc is a movable index which is used to set the limiting Mach number of the aircraft by depressing and turning a PUSH MACH LIMIT knob on the lower left corner of the instrument case. On the edge of the airspeed dial is an airspeed index pointer which is adjustable through a range of 80 to 145 knots by turning the PUSH MACH LIMIT knob. The airspeed index pointer is used as a reference point to indicate the minimum safe airspeed for a particular gross weight during approach and landing or slow speed flight.

ANGLE OF ATTACK INDICATOR. The ANGLE OF ATTACK indicator (2, figure 1–4) shows the angle between the longitudinal axis of the airplane and the relative wind accurately at speeds above 90 knots IAS. The instrument is electrically controlled by a computer and an angle of attack sensing probe projecting into the airstream on the right-hand side of the fuselage nose section. The indicator is calibrated "0–30" to represent a range of −6.5° to +20.8° true angle of attack. An adjustable lubber mark on the indicator dial may be positioned by turning the lubber mark adjustment knob on the front of the indicator, providing the pilot with a reference for landing attitude and other operations. For other components of the angle of attack system refer to ANGLE OF ATTACK APPROACH INDEXER LIGHT, section I, and LIGHTING EQUIPMENT, APPROACH LIGHT, section IV.

ANGLE OF ATTACK APPROACH INDEXER LIGHT.[3] The angle of attack approach indexer light is mounted at the left side of the center windshield. The unit consists of three vertically-mounted lights. The top light is depicted as a chevron pointing downward, the center light a circle, and the lower light a chevron pointing upward. The approach indexer can be pivoted to parallel the pilot's line of sight. The light intensity for the unit is controlled by an APPROACH INDEXER dimming adjustment knob, which is located aft of the landing gear handle. When operating at low angles of attack, only the lower light of the indexer will be on and the external approach light will be red. As the angle of attack increases and approaches the optimum, both the lower and center lights of the indexer will be on, and the external approach light will change to amber. When the optimum angle of attack is reached, only the center light of the indexer will be on, and the external approach light will remain amber. As the angle of attack is increased above the optimum, both the center and the upper lights of the indexer will be on; and as the limits of the optimum angle of attack are passed, the center light will go out and the external approach light will change to green. Whenever the center light of the approach indexer is on, the external approach light will be amber, and the airplane will be within the optimum angle of attack limits. The approach indexer is operated by 28 volt d-c power.

ALTIMETER. The pressure altimeter (10, figure 1–4, sheet 2) indicates the altitude of the airplane above sea level to a height of 80,000 feet. The face is marked in increments of 100 feet. Each complete revolution of the pointer indicates a change in altitude of 1000 feet. On the left of the instrument face are two counters; an inner counter, which registers altitude in thousands of feet, and an outer counter, which registers altitude in ten thousands of feet. At the extreme right side of the face of the instrument is a barometric pressure dial. The dial is marked from 28.10 to 31.00 inches of mercury. The dial may be adjusted to correct for variations in sea level barometric pressure by rotating a knob on the lower left of the instrument case.

GYRO HORIZON INDICATOR (LATER AIRPLANES[1]). These airplanes are equipped with a Model 978 remote reference gyro horizon indicator which normally receives a-c power from a 250 VA inverter. The spherical background of the instrument is intended to give the pilot a pictorial presentation of the attitude of his airplane. Approximately two minutes are required for erection of the vertical gyro, after which the red warning flag, labeled "OFF," will lift out of view, indicating the instrument is ready for use. The instrument provides an accurate indication of all attitudes and is capable of indicating pitch rates up to 180 degrees per second and roll rates of 275 degrees per second. A knob on the lower right corner of the instrument controls a potentiometer which provides a pitch signal for positioning the horizon line to coincide with the attitude of the airplane under varying trim conditions.

In the event of failure of the inverter, the power load of the gyro horizon may be transferred to the a-c generator by placing the FLT INST POWER switch[3] (4, figure 1–3), located on the left-hand console, in the "GENERATOR" position. Electrical failure or instrument malfunction is indicated by the appearance of the red warning flag.

GYRO HORIZON INDICATOR (EARLY AIRPLANES[2]). These airplanes are equipped with a Model H-6, a-c powered gyro horizon indicator. The instrument has a very low "turn error" at high speeds and steep bank angles. It is "self erecting" and a "quick erect" mechanism is provided for airplane with short warm-up periods. To mechanically erect the gyro after starting the engine the "PULL TO CAGE" knob is pulled until the horizon bar stops oscillating. After a maximum of three minutes the instrument will settle sufficiently for instrument flight. The instrument is free to rotate 360 degrees in a roll and will swing 180 degrees and erect itself immediately in maneuvers in which the airplane passes a vertical nose attitude. In the event of electrical failure or instrument malfunction, a warning

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(1) Airplanes BuNo. 134798 and subsequent; BuNo. 134744–134797 by service change.

(2) Airplanes BuNo. 130741–130750; BuNo. 134744–134797 prior to service change.

(3) Airplanes BuNo. 134744 and subsequent after service change.

flag labeled "OFF" will appear on the face of the instrument.

Some early aircraft[1] are equipped with a 100 VA d-c inverter, which functions to supply emergency a-c power to the H-6 gyro-horizon only. A GYRO HORIZON POWER switch (4, figure 1–3), located outboard of the left-hand console is provided to energize the stand-by inverter. During normal operation of the a-c electrical system the switch remains at "NORM." In case of a-c generator failure, the switch should be placed at the "EMER" position.

CAUTION

Since the caging device cages the Model H-6 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 in straight and level flight during the caging procedure.

[1] Airplanes BuNo. 130743, 130746–130747, 130750; BuNo. 134744–134747, 134749–134750, 134752–134753, 134755–134758, 134764, 134766, and 134770–134797 prior to service change.

RATE-OF-CLIMB INDICATOR. A conventional rate-of-climb indicator (12, figure 1–4) is installed on the instrument panel.

TURN AND BANK INDICATOR. A conventional needle-and-ball turn and bank indicator (11, figure 1–4) is provided for basic instrument flight. The instrument is driven by d-c electrical current.

ENGINE INSTRUMENTS

For descriptions of the engine instruments, see applicable paragraphs under ENGINE, FUEL CONTROL SYSTEM, and ENGINE CONTROLS.

OTHER INSTRUMENTS

CLOCK. The standard clock (7, figure 1–4) is operated by an internal spring powered mechanism requiring periodic winding by means of the knob in the lower left corner of the instrument.

ACCELEROMETER. The accelerometer (18, figure 1–4) provides an indication of the g forces applied to the airplane both during and after maneuvers. (However, any momentary vertical accelerations—such as those which occur when stores are jettisoned from ejector racks—cause the accelerometer to overshoot. In such instances the resultant reading on the accelerometer is meaningless, since this instrument will function properly only when the reaction is applied over a period of time and in the absence of abrupt vertical shock.) The instrument uses three pointers: a free pointer, which indicates the g load being applied at any given moment; a pointer which indicates the greatest positive g load applied to the airplane during any given period; and a pointer which indicates the greatest negative g load applied to the airplane during any given period. The last two pointers hold their maximum indication until reset to their base position by use of the knob on the lower left of the instrument. The dial is calibrated from minus 5 to plus 10 g units.

Also available to the pilot is a cabin pressure altimeter (20, figure 1–3), mechanical advantage changer system indicator, landing gear position indicator, two hydraulic pressure indicators, oxygen cylinder pressure indicator, and oxygen flow indicator. For descriptions of the mechanical advantage changer system, landing gear position indicator, and hydraulic pressure indicators, see applicable paragraphs of section I. For description of the oxygen flow and pressure indicators, refer to applicable paragraphs of OXYGEN SYSTEM, section IV.

NAVIGATION INSTRUMENTS

S-2 GYROSYN COMPASS

The S-2 Gyrosyn Compass provides a visual indication of the heading of the airplane. The compass system consists of an amplifier, compass controller, flux valve, and a directional indicator which is the rotating compass card of the ID-250/ARN MAGNETIC COURSE INDICATOR. (The latter is a repeater instrument used selectively for magnetic or "FREE GYRO" headings.) The compass controlled gyroscope requires about three minutes for leveling and slaving to the magnetic flux valve after a-c and d-c electrical current is turned on. The COMPASS CONTROLLER (18, figure 1–5) is located on the right-hand console and consists of a SYNC SIGNAL indicator, a SLAVED GYRO-FREE GYRO switch, and a SET HEADING FREE GYRO knob. In the "SLAVED GYRO" position of the switch, the gyroscope is automatically slaved to the position of the magnetic flux valve and, once correctly set, will indicate the actual magnetic heading of the aircraft on the repeater compass card (4, figure 1–4). If incorrectly set, the gyroscope automatically precesses toward the correct magnetic heading at a slaving rate of approximately ninety degrees per minute during the first two to three minutes after a-c and d-c electrical power is supplied to the system. This "fast slaving rate" is thereafter reduced to approximately three degrees per minute for any subsequent deviations between the gyroscope and the flux valve.

With the switch on the "FREE GYRO" position, the gyroscope is not slaved to the flux valve and operates as a free directional gyro. During this operating condition, the repeater compass indicator shows the position of the directional gyroscope and no indication of the magnetic heading of the aircraft is available except by reference to the standby compass mounted on the canopy above the glareshield. Also, in the "FREE GYRO" condition, the gyroscope may be manually rotated to the desired setting on the compass card at the rate of ninety degrees per minute, using the SET HEADING FREE GYRO knob. With the SET HEADING FREE GYRO knob in the "INC" position the dial on the course indicator will move upscale and the SYNC SIGNAL indicator will move to the right. With the SET HEADING FREE GYRO knob in the "DEC" position the dial on the course indicator will move downscale and the SYNC SIGNAL indicator will move to the left.

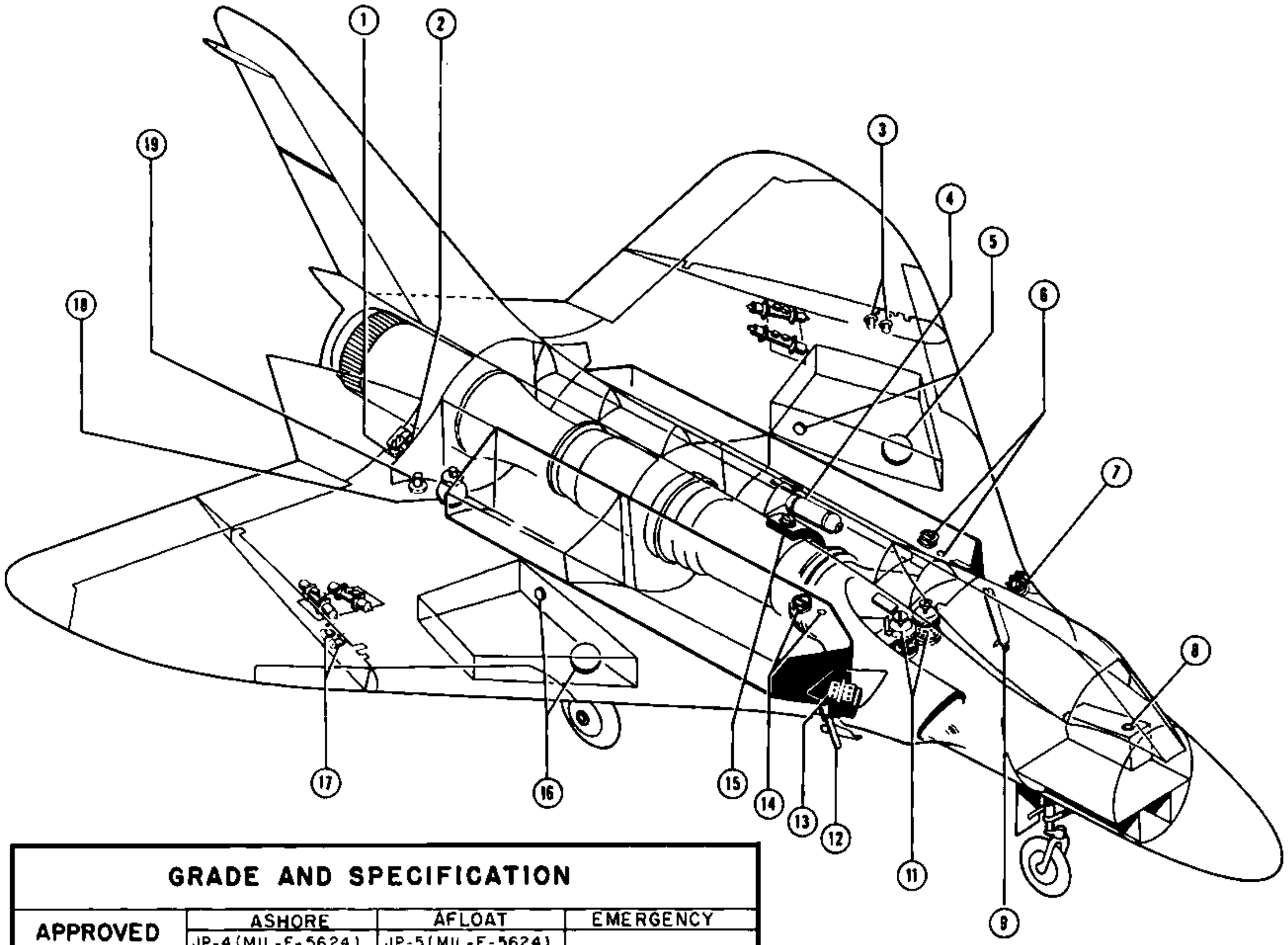
When the SLAVED GYRO-FREE GYRO switch is in the "SLAVED GYRO" position the SET HEADING FREE GYRO knob is inoperative.

Note

- During carrier take-offs, use of the "FREE GYRO" may be required to prevent error resulting from shipboard magnetic disturbance affecting the compass.
- The instrument is unreliable as a magnetic compass in polar regions where the dip of the earth's magnetic field is in excess of 85 degrees.

STANDBY COMPASS

A standard magnetic standby compass (5, figure 1–2, sheet 2) is mounted on the inside of the canopy bow. The compass is visible to the pilot when the canopy is closed and may be used in the event of failure of the S-2 gyrosyn compass.



GRADE AND SPECIFICATION			
	ASHORE	AFLOAT	EMERGENCY
APPROVED FUEL	JP-4 (MIL-F-5624) JP-3 (MIL-F-5624)	JP-5 (MIL-F-5624)	AVGAS
OIL		MIL-L-7808 (PWA-521A)	
HYDRAULIC FLUID		MIL-O-5606-2 (RED)	

F-541 1G

1. Arresting hook pressure gage and filler valve
2. Tail bumper pressure gage and filler valve
3. Elevon accumulator pressure gages and filler valves
4. Gaseous oxygen tank(1)
5. Gun charger air pressure gage and filler valve
6. Fuel cell filler cap and nozzle grounding receptacle
7. Gaseous oxygen filler valve
8. Oxygen pressure(1) or quantity(2) gage
9. Enclosure bungee cylinder and filler valve
10. Deleted
11. Elevon and utility hydraulic system reservoirs
12. Hydraulic hand pump and pressure gage
13. Battery
14. Fuel cell filler cap and nozzle grounding receptacle
15. Oil tank filler cap
16. Gun charger air pressure gage and filler valve
17. Elevon accumulator pressure gages and filler valves
18. Liquid oxygen converter(2)
19. Liquid oxygen filler valve(2)

(1) Airplanes BuNo. 130740-130750; BuNo. 134744-134918 before service change.
(2) Airplanes BuNo. 134919 and subsequent. BuNo. 134744-134918 by service change.

Figure 1-14. Servicing Points

CANOPY

A manually operated canopy encloses the cockpit. The canopy opens upward, pivoting on shear hinges installed at a point on the fuselage stiffeners immediately aft of the cockpit. The canopy is limited to 45 degrees travel and counterbalanced at desired intermediate points throughout the arc of travel by a compressed air bungee cylinder. An inflatable rubber seal is installed on the canopy to assure air-tight pressurization of the cockpit. A canopy pressure relief valve is installed on top of the canopy behind the pilot's head which will allow water to spill into the cockpit when ditching to balance the internal and external pressure and permit jettisoning of the canopy underwater. This valve is essentially a door, that is hinged to the canopy and which is normally in the closed position. However, a force of 11 +3 −2 pounds will open it and keep it open as long as pressure persists.

WARNING

The canopy is not designed to be opened during flight. Release of the canopy latches while the airplane is airborne or with headwind conditions in excess of 60 knots during ground operations will result in loss of the canopy, and likely contact with and structure damage to the vertical stabilizer.

CANOPY CONTROLS. The canopy is locked in the closed position by two latches (5, figure 1–3; 14, figure 1–5) installed on the cockpit rails 8 inches aft of the juncture of the canopy and the windshield bow. The latches interconnected by cables, operate on torque shafts and provide means of locking or unlocking the canopy from the closed position from either outside or within the cockpit. The interior latch handles are located beneath the cockpit rail and move upward to a lateral position and pull aft to unlatch the canopy. The exterior latches pull forward on a horizontal plane to open the canopy. Reverse operation of either the interior or exterior latches will lock the canopy when in the closed position. Manual operation of only one latch handle is required to lock or unlock the canopy when the interconnecting cable system is functioning. The interior latch handle has three positions: "OPEN," "LATCH," and "LOCK." When the canopy is closed, moving the latch handle to the "OPEN" position will unlatch the canopy latch hook allowing the air bungee cylinder and booster spring (9, figure 1–14) to automatically open the canopy.

CAUTION

Do not open canopy until after cabin pressurization has been turned off.

Note

The latch handle is spring loaded and should return from the "OPEN" position to the "LATCH" position when released.

The canopy will automatically latch on closing when the latch handle is in the "LATCH" position. Snapping the latch handle to the "LOCK" position will lock the canopy hook in the latched position.

CAUTION

The canopy will not latch on closing when the latch handle is in either the "OPEN" position or the "LOCK" position.

Note

A physical check of the canopy latching by pushing up on it is required to obtain positive proof that the canopy is locked.

Mechanical linkage incorporates the canopy latch cable system into the canopy remover system, affecting release of the canopy latches in the first half-inch of movement when the canopy remover is fired. In early airplanes[1] a cable connection linking the canopy with the seat catapult firing mechanism removes the safety pin and arms the catapult gun for subsequent seat ejection after the canopy is jettisoned. In later airplanes[2] the seat catapult and firing linkage has been modified so that the canopy can be jettisoned without arming the ejection seat. With this configuration, the safety pin is removed from the seat catapult firing mechanism by a cable when the face curtain handle is pulled during the ejection sequence.

Note

There is no danger of ejecting through the canopy since the face curtain handle will not remove the seat-arming safety pin until the canopy leaves the airplane.

Canopy jettison can be accomplished by pulling the "D" handle marked EMER CANOPY JETT (15, figure 1–3) on the left of the instrument panel, or the ball lever labeled EMERGENCY CANOPY REMOVER (12, figure 1–2, sheet 2) installed to the right of the seat on the canted bulkhead. This action fires an explosive gas generating cartridge which in turn detonates the canopy remover. The canopy is blown away from the airplane, shearing away at the hinged section. (See 18, figure 1–2, sheet 2, for view of canopy remover.)

Note

The canopy remover is capable of blowing the canopy clear of the airplane during a ground emergency condition with the airplane at rest.

[1] Airplanes prior to BuNo. 134919 prior to service change.
[2] Airplanes BuNo. 134919 and subsequent; prior airplanes by service change.

Another method for jettisoning the canopy is by pulling the face curtain to the interlock position. This will fire the canopy remover through an interconnecting linkage from the seat ejection system.

WARNING

Canopy jettisoning by means of face curtain extension is *not* recommended except during the ejection sequence, since no positive stops are provided which would prevent inadvertent seat ejection if tension is maintained on the face curtain after the canopy has jettisoned.

CANOPY REMOVER GROUND SAFETY PINS. Two safety pins (13, figure 1–2, sheet 2) are installed in the cockpit whenever the airplane is on the ground to prevent accidental jettisoning of the canopy. These pins are located one on the initiator assembly next to the EMERGENCY CANOPY REMOVER handle and the other on the canopy remover piston aft of the seat. A red flag connecting the two pins is crossed over the front of the seat to prevent an oversight in removing the pins before flight.

PILOT'S EJECTION SEAT

The seat (10, figure 1–2, sheet 2) is of the ejectable type mounted on tracks and a catapult assembly. A simplified control method allows the pilot to jettison the cockpit canopy and eject the seat in one operation in an emergency. In early airplanes[1] the seat is armed upon jettisoning of the canopy. In later airplanes[2] jettisoning of the canopy will not arm the seat. In this later configuration the seat is armed by travel of the face curtain during the ejection sequence, and after the canopy has left the aircraft. (Refer to CANOPY CONTROLS, section I.) The seat will accommodate seat and back pads, a PK-2 pararaft kit, and a seat-type parachute equipped with a barometric opener incorporating a 3-second time delay. Seat adjustment is controlled electrically by the SEAT switch (13, figure 1–5) on the right-hand console. With the switch in the "UP" position, the seat moves upward and forward, and in the "DOWN" position, the seat moves downward and aft. The seat headrest is adjustable fore and aft by operating the control lever (17, figure 1–2, sheet 2) on the right-hand side of the head rest.

A yellow torque stripe (16, figure 1–2, sheet 2) is located on the top, right side of the catapult cylinder. This stripe extends in an unbroken line from the screw-on cap to a portion of the threads to indicate proper installation and adjustment.

An inspection should also be made to determine that the seat is held down securely by the seat-retaining dogs. The retaining dogs are not visible beneath the seat and it will be necessary to have the assistance of the ground crew to make this check. With one person stationed at each side of the cockpit, lifting pressure can be exerted on the seat to test the installation.

FACE CURTAIN. The face curtain contained in the seat headrest is the main control for actuating canopy jettisoning and the seat ejection mechanism. The curtain is wound on rollers and when extended by pulling the handle grip (1, figure 1–2, sheet 2) at the front of the headrest, it actuates the canopy remover and the seat catapult. During ejection, the face curtain protects the pilot from strong wind pressure and helps proper positioning of the head, neck and backbone.

EMERGENCY HANDLE. If the cockpit canopy fails to jettison by extending the face curtain, the ejection mechanism will not operate. In this event, the EMER CANOPY JETT handle or the EMERGENCY CANOPY REMOVER ball lever can be pulled to jettison the canopy.

SHOULDER HARNESS CONTROL. The shoulder harness take-up mechanism can be controlled manually by the SHOULDER HARNESS lock (8, figure 1–2, sheet 2) on the left-hand side of the seat. The manual control is moved forward to "LOCK" and aft to "UNLOCK." During seat ejection or sudden deceleration of the airplane the inertia reel (15, figure 1–2, sheet 2) automatically locks the shoulder harness. When once locked and a force has been applied to the shoulder harness, the inertia reel will not release when the harness is merely slacked off, regardless of the position of the manual control. This is due to the "stay lock" feature of the inertia reel. Only when the control is moved into "UNLOCK" position with the harness slacked off will the mechanism release.

AUTOMATIC RELEASE SAFETY BELT. During seat ejection the pilot is released from his seat harness by an automatic belt disconnect mechanism. The mechanism consists of an actuator unit with a built-in ¾-second delay, a static cable assembly, a release cable assembly, a cartridge, and the cartridge actuated release on the lap belt. The actuator assembly which holds the cartridge is fitted to the pilot's seat. The release cable assembly is connected between the actuator unit and the safety belt release. When the seat is ejected the static cable attached from the actuating unit to the right-hand side of the seat track is pulled. This actuation fires the cartridge with a ¾-second delay and the release cable releases the lap belt. This frees the pilot from the seat at a safe distance from the airplane. If the cartridge is inadvertently fired, the actuating unit assembly will be distorted by powder pressure. In this event, the belt assembly will be removed and replaced by a new belt assembly.

AUXILIARY EQUIPMENT

Refer to section IV for description and operation of auxiliary equipment such as cabin air conditioning and pressurizing system, communication and associated electronic equipment, lighting equipment, oxygen system, etc.

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[1] Airplanes BuNo. 134918 and prior, before service change.
[2] Airplanes BuNo. 134919 and subsequent. Prior airplanes after service change.

SECTION II
NORMAL PROCEDURES

BEFORE ENTERING THE AIRPLANE

FLIGHT RESTRICTIONS

Refer to Section V, Operating Limitations for airplane operating limitations and flight restrictions.

CRUISE CONTROL

To determine the fuel, power settings, and airspeeds required to accomplish an assigned mission, refer to Appendix I.

WEIGHT AND BALANCE

Check gross weight and center of gravity for take-off and anticipated loading for landing. Refer to Section V for weight limitations to be observed. Loading data are furnished in the Handbook of Weight and Balance Data, AN 01-1B-40. It is necessary to file a Weight and Balance Clearance Form F prior to flight whenever the airplane is loaded in a manner for which no previous valid Form F has been filed.

CHECK LISTS

The airplane is provided with TAKEOFF and LANDING check lists, displayed on the instrument panel (see figure 2–2).

EXTERIOR INSPECTION

Consult the Naval Aircraft Flight Record form (yellow sheet) to determine the engineering status of the airplane and that it has been serviced with fuel, oil, oxygen, hydraulic fluid, and compressed air as required for the mission.

Conduct an inspection of the exterior of the airplane as follows (see figure 2–1):

1–2 FUSELAGE

a. Nose wheel tire	Properly inflated, no slippage
b. Nose wheel strut	Proper extension, no leakage
c. Nose wheel downlock pin	Removed
d. Nose wheel fairing doors	Secure
e. Approach light	Condition and security
f. Static vent (left side)	Free of obstructions
g. L.H. electrical equipment junction panel access door	Secure
h. Radome	Condition and security
i. Angle of yaw probe and cover	Condition and removed
j. Pitot tube and sensing probe covers	Removed
k. R.H. electrical equipment junction panel access door	Secure
l. Angle of attack probe and cover	Condition and removed
m. Static vent (right side)	Free of obstructions

2–3 R.H. WING AND LANDING GEAR

a. Engine air intake plug	Removed
b. Intake duct	Free of foreign objects
c. External starting units standing by, hose and electrical plugs	Plugged in
d. External power switch	"EXTERNAL"
e. Main wheel tire	Properly inflated, no slippage
f. Main wheel strut	Proper extension, no leakage
g. Main wheel downlock pin	Removed
h. Main wheel doors	Secure
i. All access doors and covers	Secure
j. External a-c and d-c electrical power	Standing by
k. External stores if carried	Secure
l. Slats	General condition, operation, security
m. Jury strut	Removed
n. Elevon accumulator pressure gages (wing fold joint)	1000 ± 100 psi
o. Elevons, pitch trimmer, speed brake (lower)	General condition, security, bonding

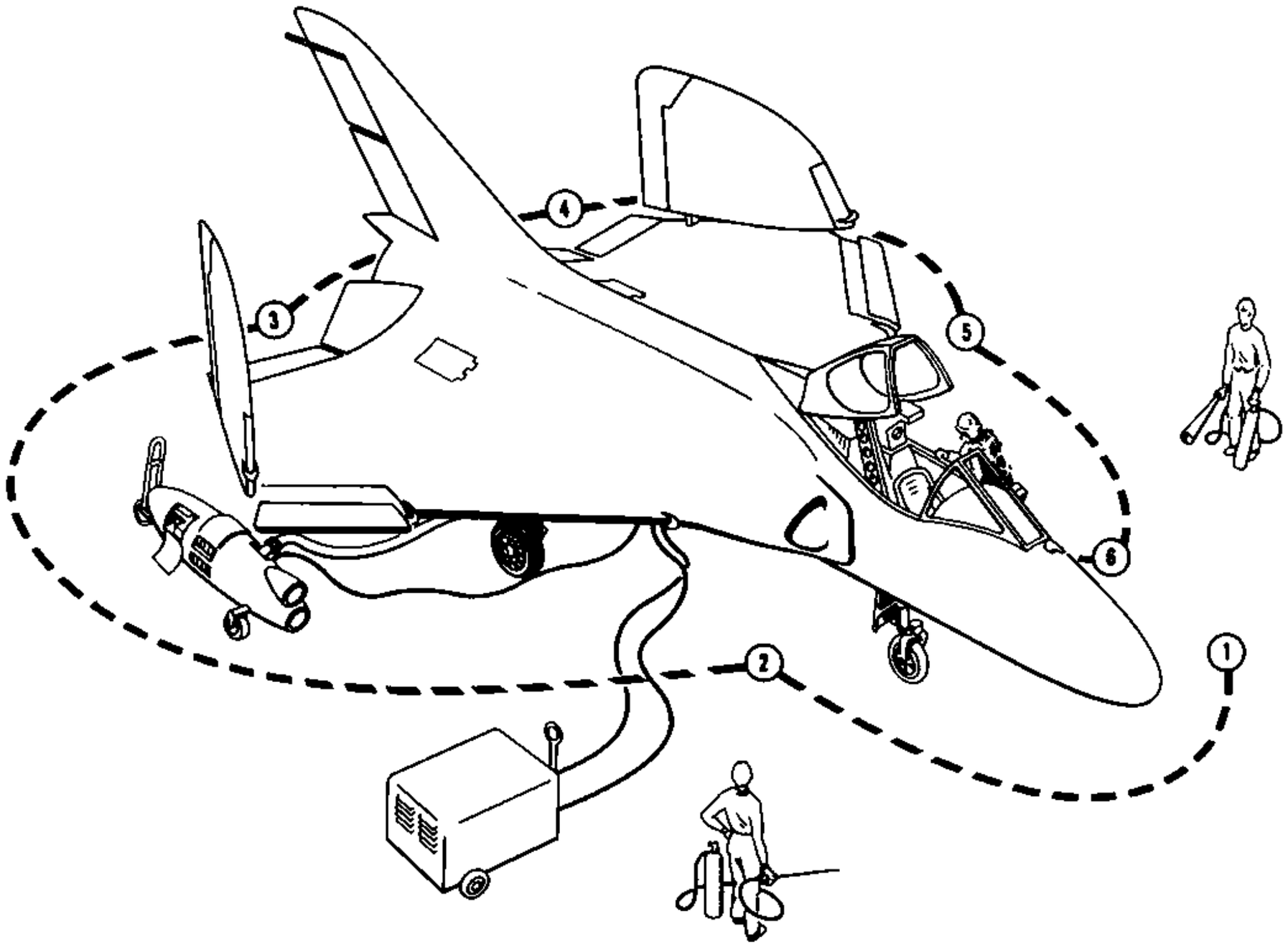

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Figure 2-1. Exterior Inspection

p. Liquid oxygen filler valve door . . . . . Secured
q. Tail bumper pressure gage[1] . . . 225 $^{+25}_{-0}$ psi
r. Arresting hook pressure gage[1] . . . . . 475 $^{+25}_{-0}$ psi
s. All access doors and covers[1] . . Secure
t. Speed brake (upper)[1] . . . . . General condition, security
u. Fuel cell filler cap[1] . . . . . Secure

3–4 TAIL SECTION

a. Tail pipe plug . . . . . Removed
b. Tail pipe . . . . . Cracks, fuel deposits
c. Arresting hook . . . . . Up and secure
d. Tail bumper . . . . . Up and secure
e. Rudder and servo rudder . . . . . General condition, security, bonding

4–5 L.H. WING AND LANDING GEAR

a. Elevons, pitch trimmer, speed brake (lower) . . . . . General condition, security, bonding
b. Speed brake (upper)[1] . . . . . General condition, security
c. Elevon accumulator pressure gages (wing fold joint) . . . . . 1000 ± 100 psi
d. Jury strut . . . . . Removed
e. Slats . . . . . General condition, operation, security
f. External stores if carried . . . . . Secure
g. NAVPAC and rack . . . . . Secure
h. All access doors and covers . . . . Secure
i. Main wheel doors . . . . . Secure
j. Main wheel downlock pin . . . . . Removed
k. Main wheel strut . . . . . Proper extension, no leakage
l. Main wheel tire . . . . . Proper inflation, no slippage
m. Engine air intake plug . . . . . Removed
n. Intake duct . . . . . Free of foreign objects

[1] Items located on upper surface of wing.

o. All access doors and covers(1) . . Secure
p. Fuel cell filler cap(1) . . . . . Secure
q. Fire extinguisher . . . . . Manned approximately ten feet from engine

5-6 COCKPIT AREA

a. Canopy . . . . . General condition
b. Pressure relief door . . . . . Closed, condition
c. Seat ejection safety pin . . . . . In place
d. Canopy jettison safety pins . . . . Removed
e. Enclosure bungee air pressure gage . . . . . 1700 psi
f. Torque stripe on ejection seat . . Aligned
g. Canopy air pressure seal . . . . . Condition

ENTRANCE

Entrance to the airplane is effected on the left side, using the ladder provided by the ground crew to gain access to the cockpit. After entering the airplane have the ground crew remove the ladder before starting the engine due to its proximity to the engine air intake ducts.

ON ENTERING THE AIRPLANE

INTERIOR CHECK (ALL FLIGHTS)

Upon entering the airplane check or accomplish the following:

a. Safety belt and shoulder harness . . . . . Fastened
b. Make oxygen and radio, and anti-blackout hose connections
c. MASTER armament switch . . . . "OFF"
d. BAT GEN switch(3) . . . . . "OFF"
BAT switch(2) . . . . . "OFF" and
D-C GEN switch . . . . . "ON"
A-C GEN switch . . . . . "ON" or
A-C GEN field switch . . . . . "ON"
e. MASTER ENGINE switch . . . . "OFF"
f. Landing gear handle . . . . . "WHEELS DOWN"
g. Throttle . . . . . "OFF"
h. MAC control crank . . . . . Crank to "3:1" & stow
i. MAC indicator window . . . . . Checked
j. TAXI light switch . . . . . "OFF"
k. TOW TARGET switch . . . . . "OFF"
l. Anti-blackout & pressure suit panel . . . . . As desired
m. Emergency stores jettison handle . . . . . Stowed & Safetied
n. CENTER STORES jettison handle . . . . . "OFF"

WARNING

Inadvertent jettisoning of external stores will occur upon application of internal or external power unless the handle is completely seated in the stowed position.

o. AUTO CONTROL panel . . . . . Knobs centered
p. TCC switch . . . . . "ON"
q. Radar CONTROL panel . . . . . "OFF" and set as desired
r. FLT. INST POWER switch(3) . . "NORMAL"
s. GYRO HORIZON POWER switch(2) . . . . . "NORMAL"
t. PITCH TRIM MOTOR CIRCUIT BREAKER switch . . . "ON"
u. Exterior lights master power switch . . . . . As desired
v. Rudder trim control knob . . . . . Centered
w. Throttle friction control lever . . . . . As desired
x. YAW DAMPER AND AUTO PILOT switch . . . . . "ON"
y. FUEL SYSTEM switch . . . . . "NORMAL"
z. Rudder gust lock . . . . . Checked

aa. Direct the ground crew to energize the external electrical power supply.

ab. WHEELS position selectors . . "ALL"
ac. WHEELS position indicator . . "WHEELS DOWN"
ad. OXYGEN SYSTEM . . . . . Checked
ae. Missiles and Marker beacon audio . . . . . "OFF"
af. Approach indexer dimming knob . . . . . As desired
ag. Emergency canopy jettison . . . . Set & Safetied
ah. Emergency landing gear release . . . . . Set & Safetied
ai. FUEL TRANSFER PUMP PRESSURE light . . . . . Illuminated
aj. OIL PRESSURE FAILURE warning light . . . . . Illuminated
ak. BOOST PUMP FAILURE warning light . . . . . Illuminated
al. Inverter light . . . . . "ON"
am. FIRE WARNING TEST circuit . . . . . Test
an. Altimeter . . . . . Set
ao. PRESSURE RATIO indicator . . . . . Set
ap. Clock . . . . . Set
aq. MAIN PUMP FAILURE warning light . . . . . Illuminated
ar. FUEL QUANTITY TEST switch . . . . . Press for Test
as. D-C warning light . . . . . Illuminated
at. A-C warning light . . . . . Illuminated

(1) Items located on upper surface of wing.
(2) Airplanes BuNo. 130741–130744, 130746–130750.
(3) Airplanes BuNo. 130745, 134744 and subsequent.

au. Arresting hook control ..... "HOOK UP"
av. WING PIN lock lever ..... Position in relation to wings
aw. WING FOLD control lever ... Position in relation to wings
ax. MARKER BEACON audio control ..... "OFF"
ay. AP (auto pilot maneuver) panel ..... Check
az. Missile automatic stepping switch ..... "OFF"
ba. STARTER button ..... Up
bb. AERO 13F Armament selector panel ..... "OFF"
bc. CROSSFEED FUEL VALVE switch ..... "CLOSED"
bd. S-2 gyrosyn compass ..... Set to "SLAVED" or "FREE"
be. DROP TANK quantity selector switch ..... Check quantity
bf. TACAN ..... Set and "OFF"
bg. PITOT & ENGINE ANTI-ICING switch ..... "OFF"
bh. UHF ARC-27 radio ..... Set & "OFF"
bi. SEAT position ..... As desired
bj. PEDAL position ..... As desired
bk. Interior and Exterior lights ... As desired
bl. AIR CONDITIONING control ..... "70°"
bm. CABIN PRESSURE switch ... "NORMAL"
bn. OMNI ..... Set & "OFF"
bo. APA 89 control ..... Set
bp. IFF ..... "OFF"

Note

In an emergency, with no external power available, the engine may be started using airplane battery power, in which case the EXTERNAL POWER switch(1) is placed in "INTERNAL," and the BAT-GEN switch to "BAT-GEN," or in earlier airplanes, the BAT switch to "ON."

INTERIOR CHECK (NIGHT FLIGHTS)

In addition to the above, check the operation of all interior and exterior lights.

(1) Airplanes BuNo. 134744 and subsequent.

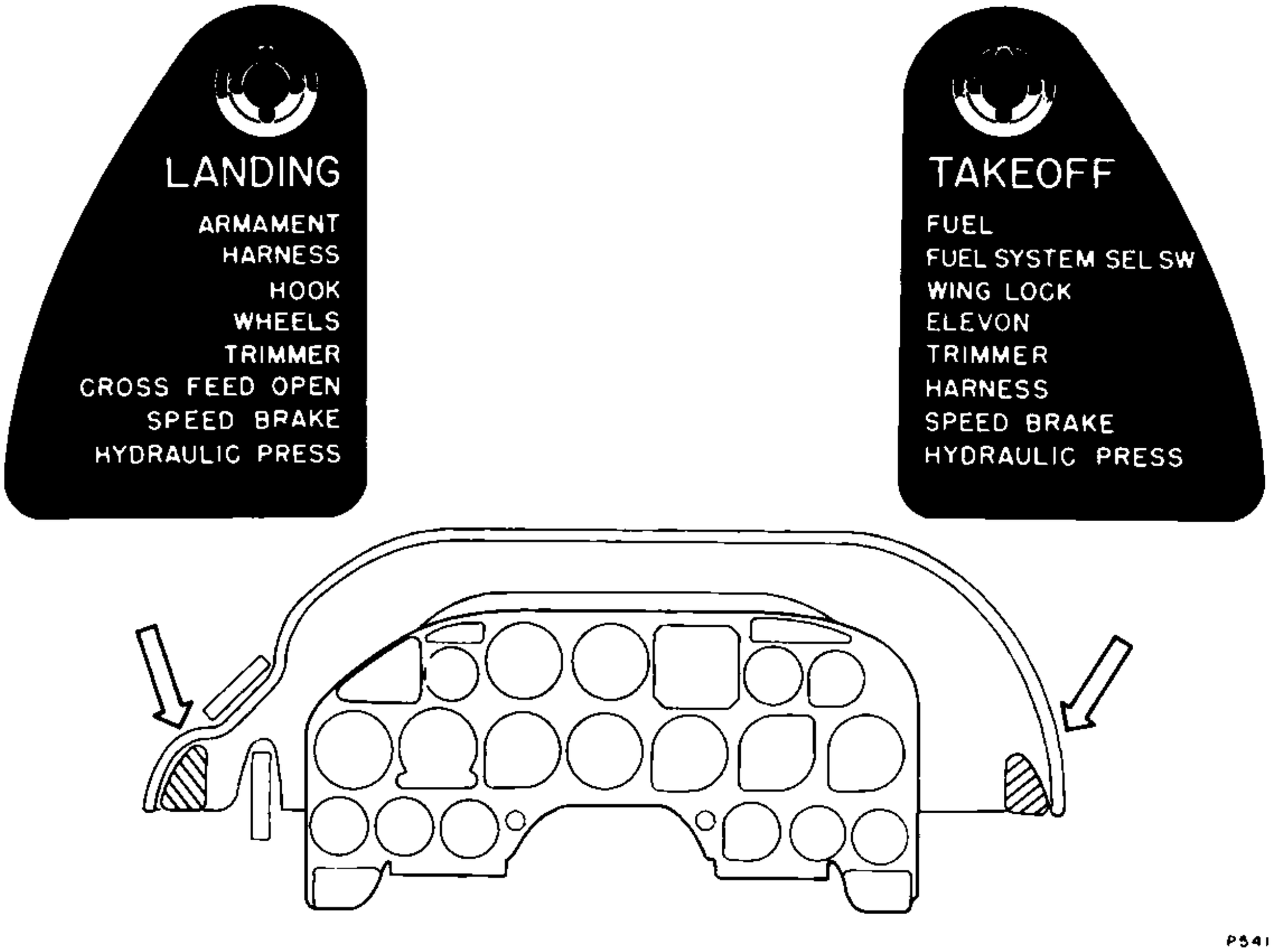


Figure 2-2. Check-Off List

BEFORE STARTING THE ENGINE

CAUTION

Do not start the engine with external compressed air starting units which provide air at pressure in excess of 50 psia on a NACA standard day (sea level) or at temperatures in excess of 350°F. Use the following ground units for starting: BuAer Model C-4 Gas Turbine Compressor, USAF Models MA-1 or MA-1A.

Where parking and exhaust areas permit, it is desirable to point the airplane into the wind. Before starting the engine, check to see that the air inlet duct screens have been removed, that the gas turbine ground power unit is plugged into the airplane, and that no personnel or equipment are within the danger areas in front of the engine intake ducts or behind the exhaust duct. See figure 2–3 for danger areas.

STARTING THE ENGINE

Pilot-controlled starts are recommended. Electrical connection from the airplane starter circuit external receptacle (5, figure 1–2, sheet 1) to the gas turbine ground power unit is to be made prior to starting, to insure automatic shutoff of the air supply at the correct starter cutout speed. Hand signals or ground-controlled starts are not recommended for initiation and/or shutoff of the ground air supply. Time delay inherent in this method will result in overspeed of the starter causing failure or damage.

CAUTION

Failure of a starter due to overspeed could be hazardous to operating personnel. If automatic shutoff of the air supply cannot be achieved due to malfunction of equipment, the starter air supply must be manually shut off at a speed not to exceed 50% engine rpm. The control valve in the gas turbine ground power unit will *not* shut off the air supply automatically unless the unit is connected electrically to the airplane starting circuit.

The following procedure should be employed when starting the engine while on the ground:

a. Throttle ..... "OFF"

b. MASTER ENGINE switch .... "ON"

c. FUEL SYSTEM selector switch . "NORMAL"

d. STARTER button ..... Depress

e. Throttle ..... "IGNITE" when tachometer indicates 12–16% rpm, then to "IDLE"

Note

- Observe MAIN PUMP FAILURE warning light on right side of instrument panel while starting engine. Light should go out before engine accelerates to starting rpm.

The engine should start within 20 seconds after the throttle is moved to "IDLE," and then should accelerate to approximately 64 to 67% rpm, (55 to 57% rpm without the pop-open nozzle). The exhaust temperature must not exceed 630°C during acceleration to idle rpm, after which it should stabilize at, or below, 340°C. The OIL PRESSURE FAILURE warning light(1) and BOOST PUMP FAILURE warning light(1) should be out. Some airplanes(2) should read 40 to 50 psi (30 psi minimum) oil pressure on the fuel and oil pressure indicator. After the engine has reached idle rpm and is operating satisfactorily, place the BAT switch to "ON" in earlier airplanes or BAT-GEN switch to "BAT-GEN" in later airplanes. Direct the ground crew to place the external power switch to "INTERNAL"(1) and disconnect all external power sources.

Note

During starting, when the engine reaches a speed of approximately 50% rpm, the STARTER button should pop up. If it does not, the button must be pulled up to disengage the starter.

HOT START. A hot start is any start during which the exhaust gas temperature exceeds 630°C. When a hot start is experienced, the following procedure should be followed:

a. Throttle ..... "OFF"

b. MASTER ENGINE switch .... "OFF"

c. STARTER button ..... Pull up, if starter is not disengaged.

d. When engine stops, investigate to locate the difficulty.

ABORTED START. An aborted start is one in which the engine does not start within 20 seconds after movement of the throttle to "IDLE," as evidenced by no rise in exhaust gas temperature, and no increase in engine rpm. When an aborted start occurs, follow the procedure outlined for hot starts.

(1) Airplanes BuNo. 134744 and subsequent.
(2) Airplanes BuNo. 130740–130750.

FALSE START. If, after moving the throttle to "IDLE," the engine starts but does not accelerate to idle rpm, a false start has occurred, and the procedure as stipulated for hot starts should be followed.

CLEARING THE ENGINE

When an abnormal start has occurred, or when it is suspected that fuel has accumulated in the engine, a period of at least thirty seconds should be allowed for dispersion of accumulated fuel. After which; proceed as follows:

a. Throttle ..... "OFF"
b. MASTER ENGINE switch.... "OFF"
c. STARTER button ..... Depress
d. Allow starter to crank for 10 to 20 seconds.
e. STARTER button ..... Pull up

CAUTION

After two abnormal starts the front engine sump must be drained if the oil level is more than three gallons low on the dip stick.

ENGINE GROUND OPERATION

Because of abnormally high idle rpm with a resultant high fuel consumption, ground operation should be limited to as short a period as possible.

CAUTION

- For any sustained engine operation on ground (not including normal starting, taxiing and idling before take-off), all engine access doors must be open. Engine operation with doors open will be limited to cycles of five minutes at high rpm followed by a minimum of three minutes at idle.
- During any ground operation when the forward engine access door is open, turn off the d-c generator (or operate at minimum load) to prevent damage to the generator through lack of air cooling.
- Engine operation with access doors closed is limited to three minutes at high rpm and, before subsequent operation at high rpm with the doors closed, the engine must be shutdown for cooling. (Refer to the paragraph in this section entitled STOPPING THE ENGINE.)

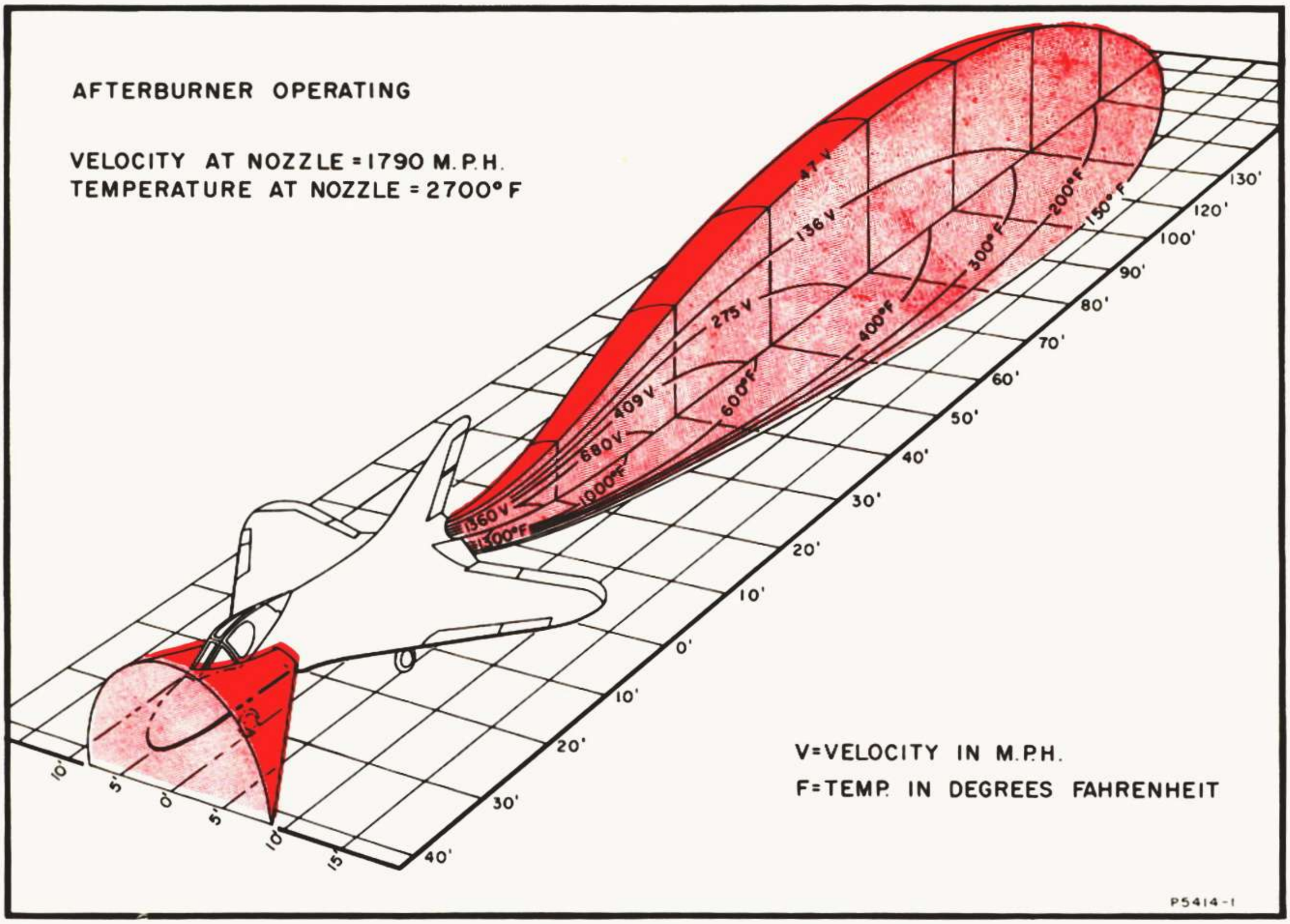


Figure 2-3. Danger Areas

GROUND TESTS

ELECTRICAL SYSTEM

With the engine running at idle rpm and external electrical power disconnected, perform or check the following:

a. DC GEN warning light.....Out

b. AC GEN warning light.....Out

c. Normal "PRESS" indications of the hydraulic pressure indicators verifies the presence of d-c power.

d. Normal fuel boost pressure will indicate that the fuel boost pumps are operating, verifying the presence of a-c current.

HYDRAULIC SYSTEM

To check operation of the hydraulic system accomplish or check the following:

a. ELEVON HYDRAULIC PRESSURE indicator ......"PRESS"

b. UTILITY HYDRAULIC PRESSURE indicator ....."PRESS"

c. Operate the wing fold control through one cycle.

d. Operate the elevons to check for smooth, rapid response to control movements.

Note

The wings must be spread and locked to operate the elevons as the elevons are automatically gust-locked when the wings are folded.

e. Operate the rudder pedals and determine that the servo rudder is slaved to the mechanical rudder.

Note

The arresting hook should be inspected for proper operation, prior to flight, by ground personnel. Care should be taken to prevent unnecessary wear on the hook, which could result from repeated contacts with a hard surface such as concrete paving.

MECHANICAL ADVANTAGE CHANGER SYSTEM

a. Manually crank system to 3:1.

b. Place EMER ELEVON MAC crank in stowed position.

c. Check that system automatically schedules to "T.O. & LAND."

TRANSONIC TRIM COMPENSATION SYSTEM

a. Press the GROUND TEST button and hold down. The elevons should not move.

b. Press and hold down both the GROUND TEST and ALTITUDE BYPASS buttons. An approximate 8 degree up travel of the elevons should be noted.

c. Release the buttons and check that the elevons fair by comparing horn balance to wing fairing.

TAXIING INSTRUCTIONS

When taxiing, the wheel brakes must be used to steer the airplane since the rudder is not effective at taxi speeds. To accelerate from a standstill, advance the throttle to an intermediate thrust setting above idle rpm. When the aircraft is moving at the desired taxi speed, retard the throttle to idle. Idle rpm will be sufficient for normal taxi speed under most conditions, and should require slight braking action to prevent acceleration.

BEFORE TAKE-OFF

CAUTION

Since full throttle operation above 90% (and especially with afterburner) will cause slippage on any surface, this check can only be accomplished while starting the take-off roll unless the airplane is tied down.

PRE-FLIGHT ENGINE CHECK

After starting, allow the engine to run at idle rpm until the instrument readings have stabilized, then make the following checks:

a. Throttle	"IDLE"
b. FUEL SYSTEM selector switch	"NORMAL"
c. Tachometer	55 to 57% rpm (64 to 67% rpm[1] with pop-open nozzle)
d. Exhaust gas temperature	340°C maximum
e. OIL PRESSURE FAILURE warning light[1]	Off
f. Oil pressure[2]	40 to 50 psi
g. Fuel boost pressure[2]	19 to 50 psi
h. BOOST PUMP FAILURE warning light	Off
i. MAIN PUMP FAILURE warning light	Off
j. DC GEN warning light	Off
k. AC GEN warning light	Off

MANUAL FUEL SYSTEM CHECK

CAUTION

The aircraft must be securely tied down for ground run-up to military rpm.

a. Throttle	"IDLE"
b. FUEL SYSTEM selector switch	"MANUAL"
c. Tachometer 1. (allow to decrease to lowest rpm) 2. T_{t7}	47 to 69 percent rpm (with external A-C power connected)
d. Fuel flowmeter[1]	Approximately 800 pph minimum
e. Throttle	Slowly advance to military rpm
f. Tachometer	91 to 96% rpm
g. Fuel flowmeter[1]	Approximately 6200 to 7200 pph (less 150 pph for each 1000 feet of field elevation)
h. Exhaust gas temperature	620°C maximum
i. Pressure ratio indicator[1]	1.92 units (minimum) (99°F ambient air, maximum)

CAUTION

Extreme care must be taken not to over-temperature the engine when using manual fuel system.

j. Throttle	"IDLE"
k. FUEL SYSTEM selector switch	"NORMAL"

ENGINE POWER CHECK

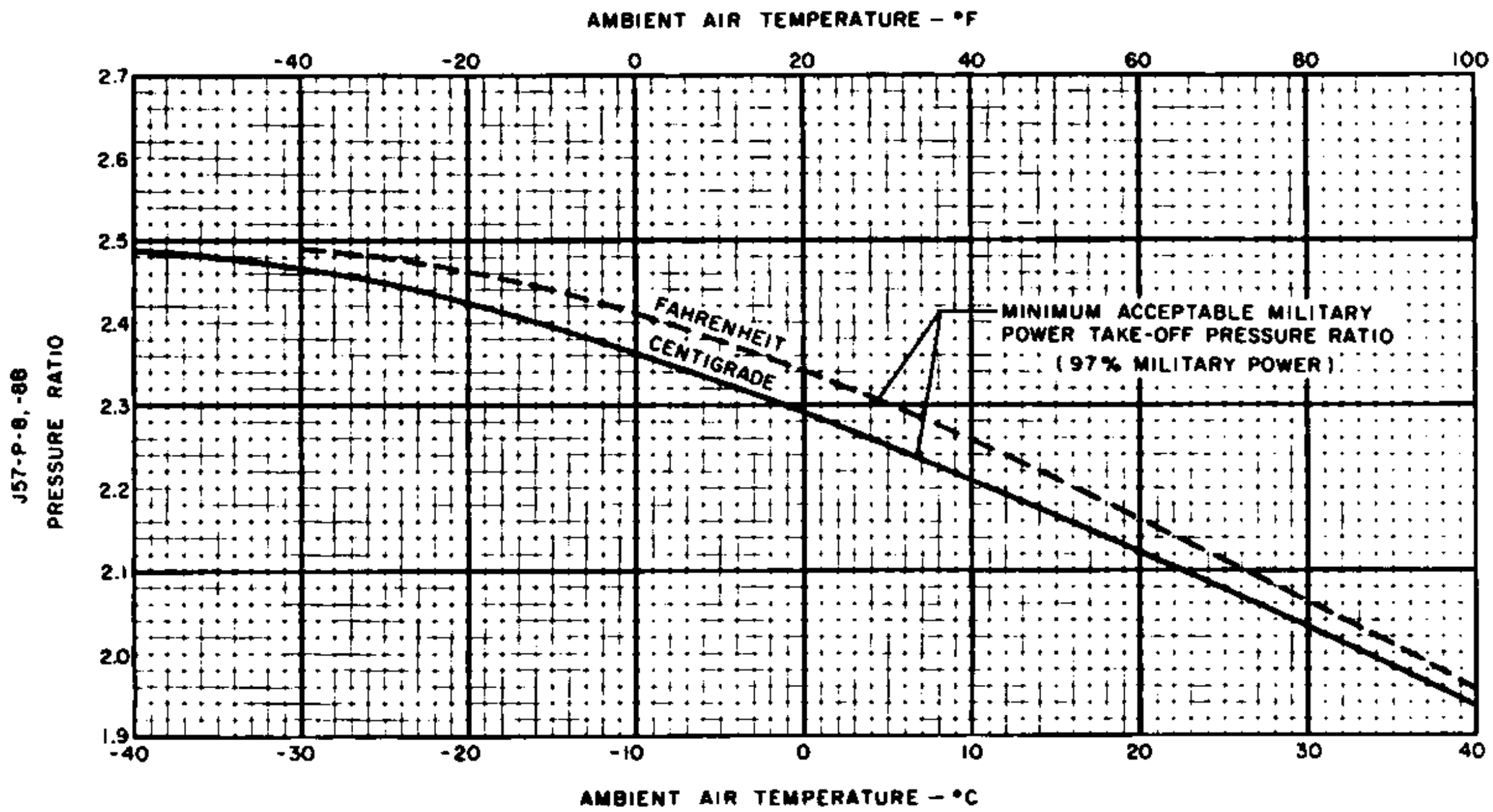
a. Throttle	"IDLE"
b. FUEL SYSTEM selector switch	"NORMAL"
c. Throttle	Advance to military position, observing tachometer red line limitation (102.2%)
d. Pressure ratio indicator[1]	Minimum acceptable take-off pressure ratio
e. Tachometer	93 to 98% rpm
f. Exhaust gas temperature	620°C maximum

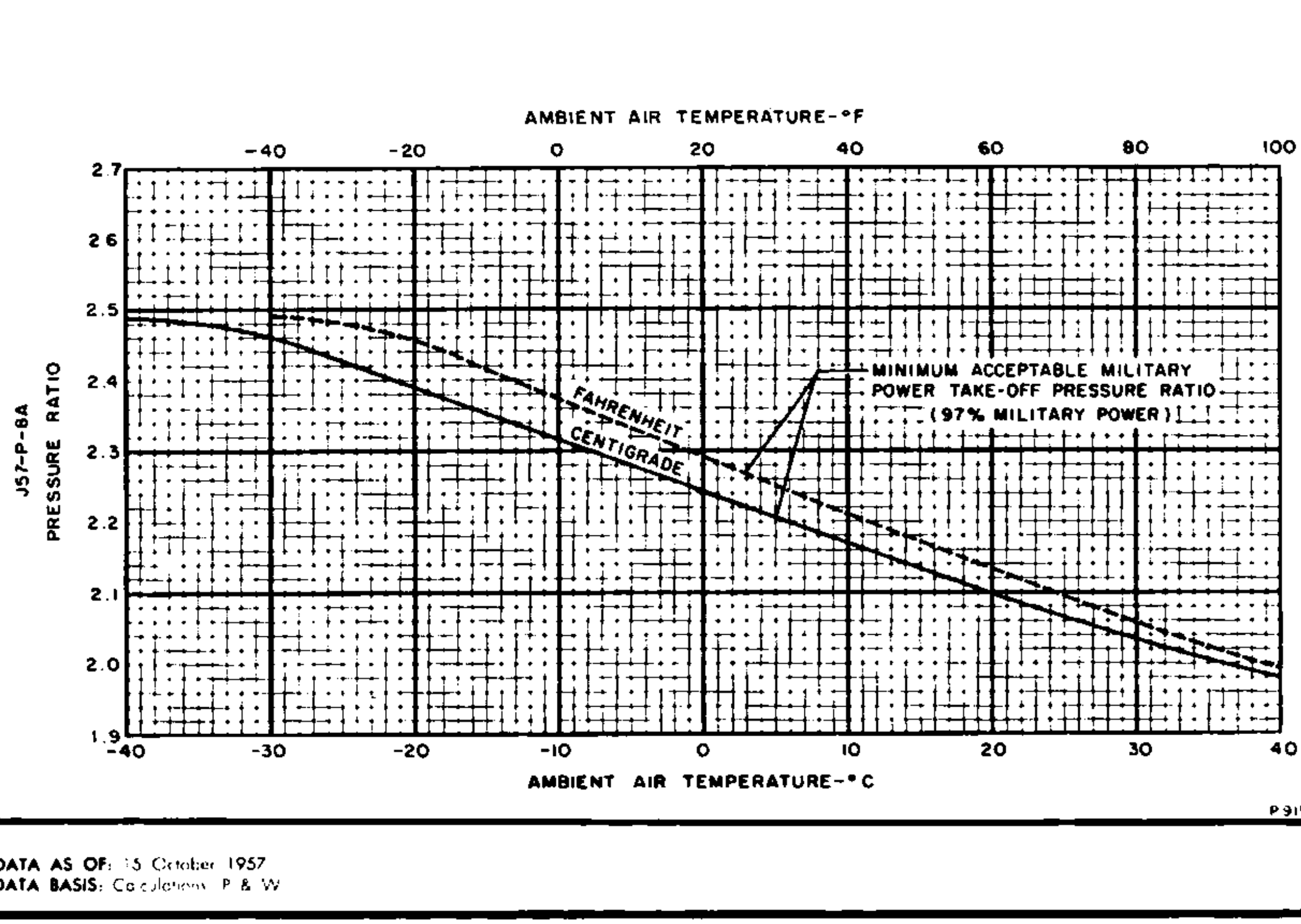
[1] Airplanes BuNo. 134744 and subsequent.
[2] Airplanes BuNo. 130741–130750.

MILITARY POWER PRESSURE RATIO

P17 P-O

MODEL: F4D-1





DATA AS OF: 15 October 1957
DATA BASIS: Calculations P & W

Figure 2-3A. Military Power Pressure Ratio

g. OIL PRESSURE FAILURE warning light[1] ..... Off, or

h. Oil pressure[2] ..... 40 to 50 psi

i. BOOST PUMP FAILURE warning light[1] ..... Off or

j. Fuel boost pressure[2] ..... 19 to 50 psi

k. Main PUMP FAILURE warning light ..... Off

l. DC GEN warning light ..... Off

m. AC GEN warning light ..... Off

CAUTION

A one per cent variation in rpm results in approximately five per cent variation in thrust. A "thrust overshoot" is not unusual at higher thrust settings, such as on take-off. During acceleration, or overshoot period, a maximum exhaust gas temperature of 670°C is allowed. Temperature must return to normal within two minutes or damage to the engine will be sustained. (Refer to Table I, section V of the Confidential Supplement.)

AFTERBURNER CHECK

With the engine operating at military rpm, or at a maximum of 3% under military rpm, check afterburner operation. This check must be performed during the take-off run and therefore demands rapid observation of the most critical instruments within a limited time.

a. Throttle ..... Outboard to engage the afterburner detent and start the afterburner

b. Tachometer ..... No appreciable change

c. Exhaust gas temperature ..... 630°C maximum

d. OIL PRESSURE FAILURE warning light[1] ..... Off, or

Oil pressure[2] ..... 40 to 50 psi

e. Boost pump failure warning light[1] ..... Off, or

Fuel boost pressure[2] ..... 3 psi minimum

[1] Airplanes BuNo. 134744 and subsequent.
[2] Airplanes BuNo. 130741–130750.

CAUTION

If after starting the afterburner, the exhaust nozzle fails to open, as evidenced by a rapid rise in exhaust gas temperature, pressure ratio indication and a decrease of approximately 4% rpm, immediately shut off the afterburner.

SHUTTING OFF AFTERBURNER. To shut off the afterburner, pull the throttle inboard. If not successful, reduce throttle setting to less than 80% rpm.

Note

After operating the afterburner on the ground, the engine should be allowed to run at idle rpm for as long as two minutes to allow fuel drainage.

PRE-FLIGHT AIRPLANE CHECK

AIRFIELD CHECK

a. Actuate P/S canopy actuating handles simultaneously to the fully locked position.

b. Safety belt and shoulder harness ..... Tightened and "LOCK"

c. Wings ..... Spread

d. Speed brakes ..... Closed

e. Rudder trim ..... "O"

f. Lateral trim ..... Neutral

g. Pitch trimmers ..... "3" units up (15°)

h. Gyro horizon ..... Set

i. Radar POWER switch ..... "STBY"

Note

Moisture will form in the radar compartment during ascents and descents from altitude, thereby causing damage to the gear, unless the gear is operating or the switch is on "STBY."

j. Check controls for freedom of movement and response.

k. Throttle friction control ..... As desired

l. During take-off run, check all instruments for indication within required operating limitations.

CARRIER CATAPULT CHECK

In addition to the airfield check, perform the following:

a. Apply recommended trim tab settings for various loading conditions using military thrust as indicated below:

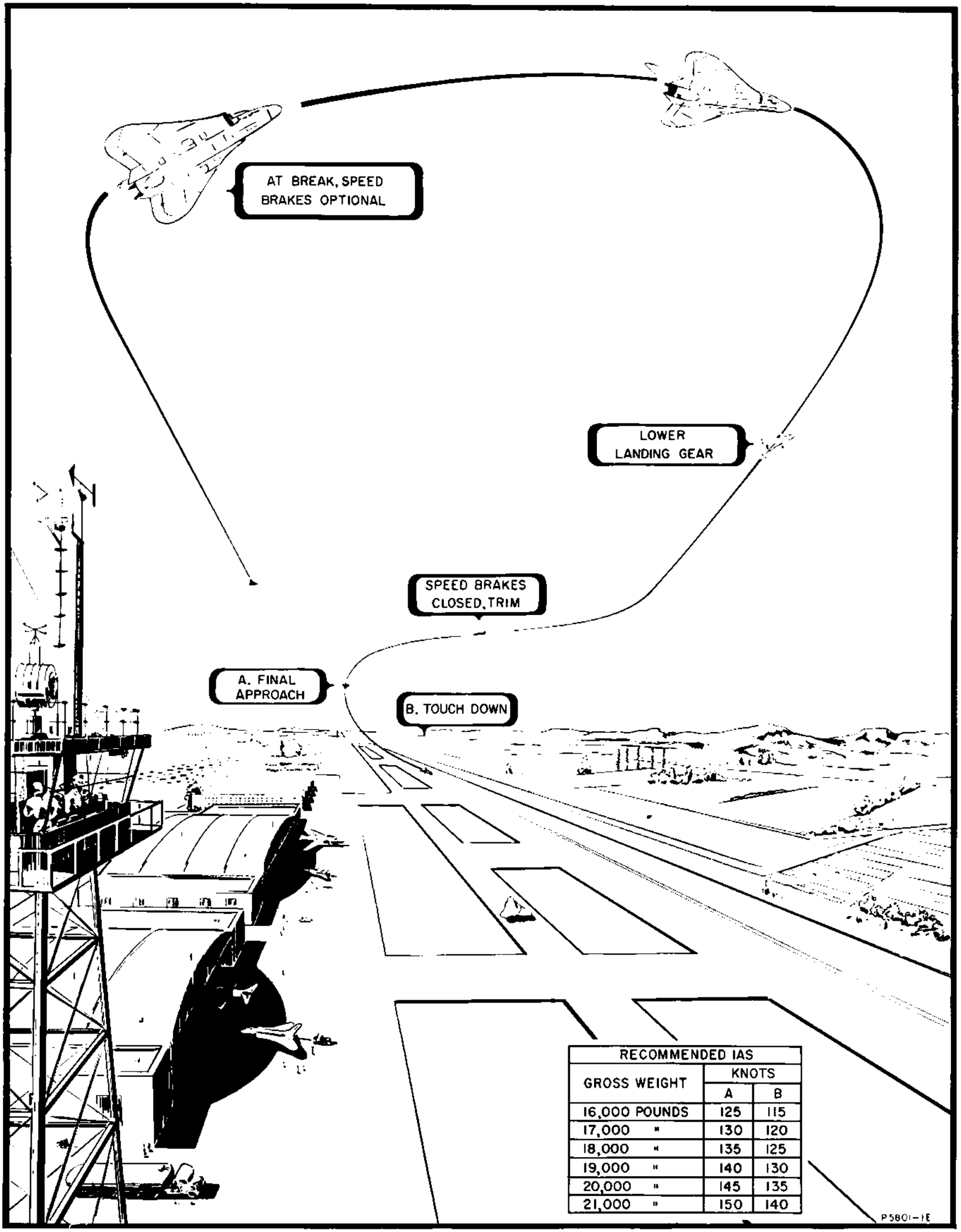
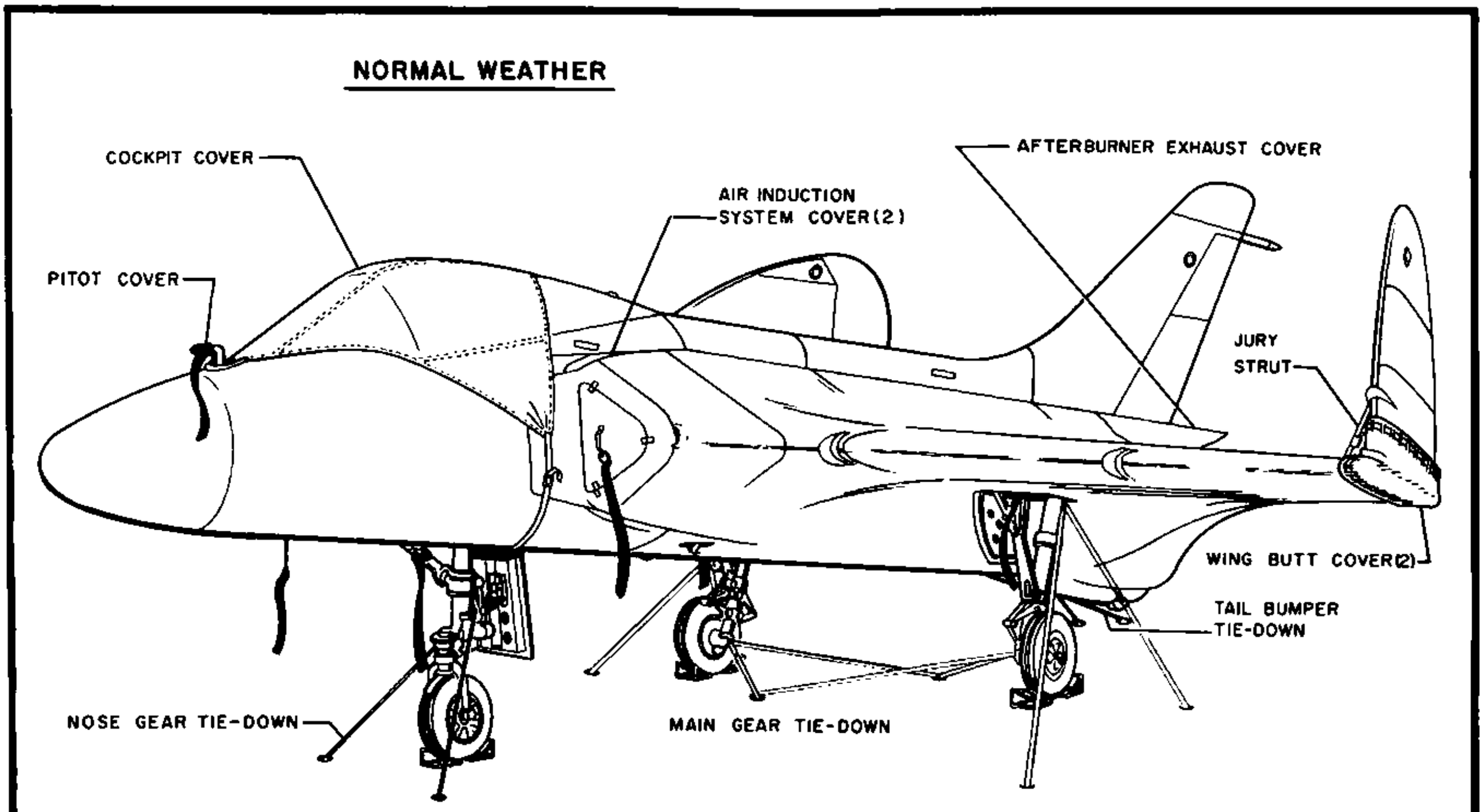


Figure 2-4. Landing Pattern



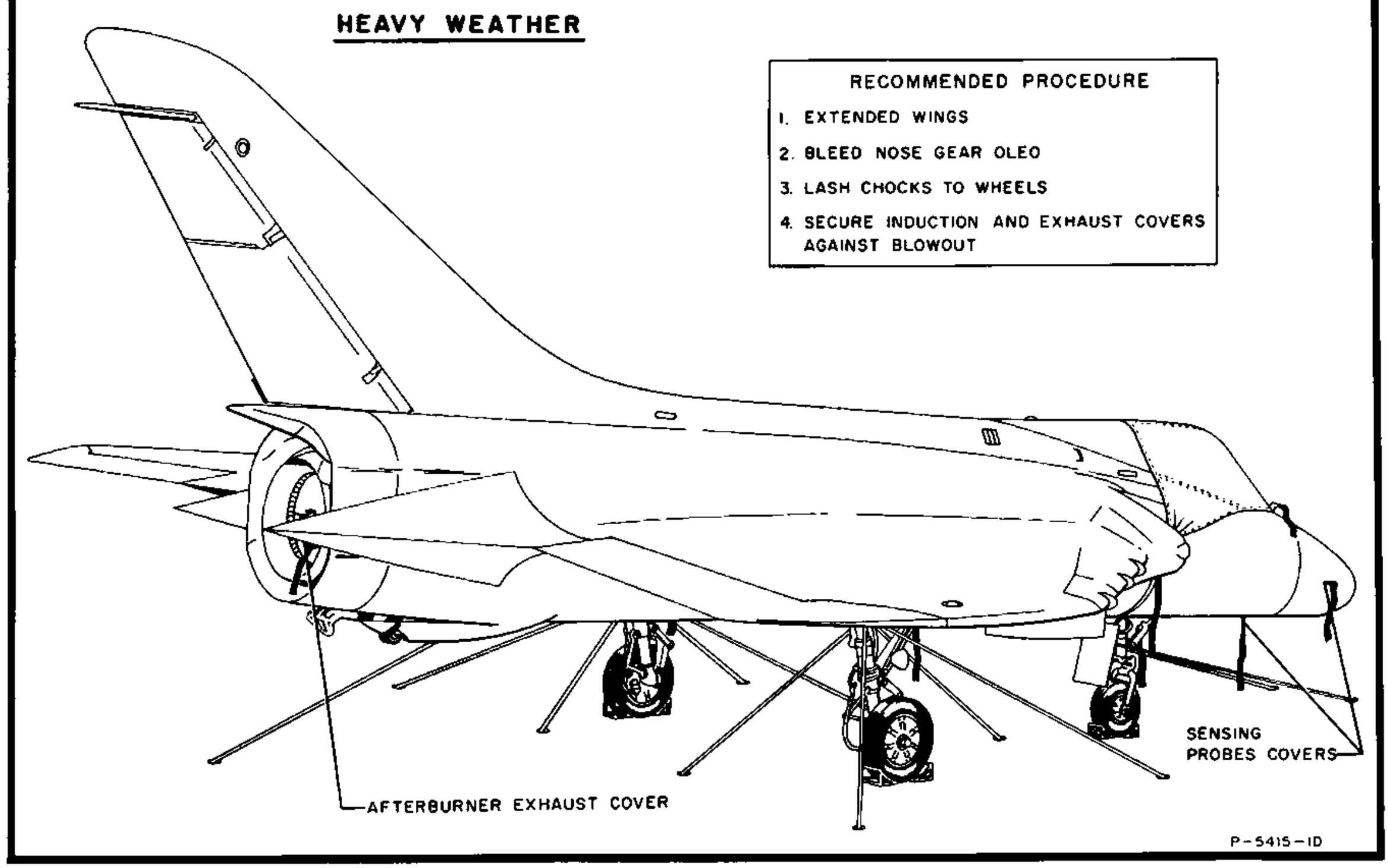


Figure 2-5. Mooring

Configuration	*Longitudinal Trim (MK NU)*	*Lateral Trim*	*Directional Trim (MK)*	*Expected End Airspeed (K)*
Clean, full fuel	5.0	Centered	0	125
2-300 gal external tanks, full fuel	5.0	Centered	0	148
2-300 gal external tanks, 4 Aero 6A rocket packages, full fuel	5.2	Centered	0	148

b. Raise catapult hand grip.

c. Place back and head firmly against back pad and headrest.

d. Place feet against rudder pedals with legs stiff.

e. Brace right arm.

f. Advance throttle and grasp catapult handgrip.

g. Check pressure ratio indicator.[3]

TAKE-OFF

AIRFIELD

The airplane is inherently stable and has no unusual take-off characteristics except that the nose wheel should not be lifted from the runway during the take-off run. Due to the configuration of the airplane, lifting the nose wheel from the runway will result in greatly increased drag which will lengthen the take-off run prohibitively. The airplane can be steered by gentle use of the brakes until rudder control becomes effective at approximately 50 knots IAS. The pitch trimmers should be set at 15° nose up to obtain the performance tabulated in Appendix I. Typical take-off speed is 129 knots IAS at 20,000 pounds gross weight. At take-off speed the airplane should be lifted gently from the ground. Since the airplane has no flaps or other controllable high-lift devices, no differentiation in take-off technique is possible for minimum run or obstacle clearance type take-offs.

CARRIER

The correct pilot technique for shipboard steam catapult launches utilizing military thrust is to hold the stick in the neutral position until clear of the catapult, with the trimmers at the recommended position for the airplane loading condition and end airspeed anticipated (refer to CARRIER CATAPULT CHECK). Slightly less nose-up trim should be used when making afterburner launches due to the rapid acceleration after leaving the catapult. Full nose-up trim should be used only when launching at minimum end airspeeds using military or afterburner thrust. The airplane will settle slightly after leaving the bow, even at speeds well above the minimums, as a result of the time required to rotate to the attitude required for level flight. The recommended trim settings allows the pilot to launch with the stick in the neutral position; however, shortly after the airplane achieves its rotation and commences to climb, forward stick is required, and it is necessary to reduce the nose-up trim by a considerable amount.

AFTER TAKE-OFF

a. Retract the landing gear as soon as the point is reached beyond which a safe landing cannot be made on the runway or any level area available immediately beyond the runway. When operating with afterburner bring the gear up immediately after the wheels have left the runway.

WARNING

Initiate gear retraction prior to attaining 220 KIAS. Retraction time is approximately 12 seconds. During retraction on take-off, it is permissible to attain 300 KIAS (one g flight) before deceleration is required to prevent damage to the gear. In the event of landing gear malfunction, maintain airspeed below 220 KIAS when attempting to recycle the gear.

b. Re-trim the aircraft as necessary.

c. YAW DAMP button . . . . . Depress

d. DROP TANK transfer switch . . "TRANSFER"

e. DEFROST-NORMAL-RAM switch[1] . . . . . "DEFROST" or "NORMAL"

f. NORMAL-RAM switch[2] to "NORMAL." Defrost system on, if desired.

g. AIR CONDITIONING knob . . . As desired

CLIMB

The airplane should be accelerated to climbing speed as soon as possible after take-off to obtain maximum performance. The airplane can be trimmed to produce the climb performance stated in Appendix I and has no unusual climb characteristics. For rockets and no external tanks, using military thrust at 20,000 pounds gross weight, the climb should be started at 300 knots IAS at sea level. When using afterburner, the initial climb should be performed at maximum climbing airspeed but not in excess of 500 knots while under 10,000 feet altitude. This is to preclude the possibility of overstressing the airplane due to trim change in the transonic range.

FLIGHT CHARACTERISTICS

For information regarding flight characteristics refer to section VI of the Confidential Supplement.

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[1] Airplanes BuNo. 134744–134973.
[2] Airplanes BuNo. 139030 and subsequent.
[3] Airplanes BuNo. 134744 and subsequent.

SYSTEMS OPERATION

For information regarding systems operation refer to section VII.

DESCENT

Make the appropriate descent as dictated by local weather conditions, airfield position, fuel remaining, and squadron procedures. Speed brakes may be used to reduce speed in the descent but full brake deflection is not available above approximately 450 knots IAS. Maximum range descent is obtained with the throttle at "IDLE," speed brakes closed and descending at approximately 200 knots IAS. (See Appendix I for effect of airplane weight and altitude on descent performance, including rate of descent, fuel used, distance covered, and time in the descent.)

CAUTION

The air conditioning and engine anti-icing systems will be inoperative at "IDLE" power. (Refer to DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT, section IV.)

Even when range is not a factor, an IDLE thrust descent is desirable to effect a fuel saving. Speed must be limited in dives as given in section V of the Confidential Supplement under AIRSPEED LIMITATIONS.

PRE-TRAFFIC PATTERN CHECK LIST

a. Safety belt and shoulder harness ..... Tightened and "LOCK"

b. PITCH TRIM MOTOR CIRCUIT BREAKER ..... Check "ON"

c. Speed brakes ..... As desired

d. MASTER armament switch ..... "OFF"

e. DROP TANK TRANSFER switch ..... "OFF"

f. Auto control ..... Disengage

g. Pitch trim ..... As required

h. AP TURN knob ..... Centered

i. CROSSFEED switch ..... "OPEN"(1)

j. YAW DAMPER & AUTO PILOT switch ..... "EMER OFF" on airplanes not incorporating service change 89.

(1) Airplanes BuNo. 134852 and prior.

TRAFFIC PATTERN CHECK LIST

Refer to section V of the Confidential Supplement for landing gross weight and C.G. limitations.

a. Arresting hook ..... "HOOK DOWN" for carrier landings

b. Landing gear control ..... "WHEELS DOWN"

WARNING

Do not extend landing gear above 220 KIAS.

c. Speed brakes ..... As desired

d. Pitch trim ..... As required

e. MAC ..... Proper scheduling or manually crank to "T.O. & LAND"

LANDING

CAUTION

If trim can not be adjusted, maintain approach airspeed ten knots above airspeed recommended in figure 2–4.

AIRFIELD

Make a normal approach with a final approach speed of approximately 130 knots IAS and touchdown at 120 knots IAS for a gross weight of 17,000 pounds. These recommended airspeeds provide an added safety margin for airfield operation, the approach airspeed and the touchdown airspeed being approximately 25% and 15% above the stalling speed, respectively. Recommended airspeeds for other gross weights can be found in figures 2–4 and 6–1A. Refer to Appendix I for landing data for various gross weights and speeds. Refer to section III for information concerning landing emergencies.

CAUTION

Opening the speed brakes on the final approach and landing is not recommended since the operation may affect pitch trim and alter aircraft attitude. (Also, drag coefficient of the

aircraft at landing attitudes is so high that the additional drag provided by the speed brakes will have little effect in reducing speed.) If the speed brakes are being used, however, during the final approach, it is recommended that they not be closed prior to the landing, since adverse pitch trim effects will again occur.

In order to effect a minimum stopping distance roll-out after touchdown, it is recommended that the speed brakes be actuated immediately upon making contact with the deck. Then, as brake pressure is increased additional aft stick should be applied slowly until full aft stick and maximum braking without skidding have been achieved. The nose will fall through and the nose wheel will contact the runway. The remainder of the roll-out should be made with full aft stick in order that the main gear contact pressure remains at its highest.

CAUTION

At touchdown, care should be exercised to prevent "floating off" because of extreme aft stick movement or rotation to such an angle as to grind the tail bumper wheel.

CARRIER

The approach speeds for arrested landings are approximately the same as for field landings. A plot of recommended final approach speeds versus gross weights is shown in section VI (figure 6–1A) of the Confidential Supplement. The angle of attack during the approach is of prime importance, and airspeed and thrust settings should be regulated so as to maintain between 22½ and 24 units angle of attack if high sink rates are to be avoided.

WARNING

If airspeed is allowed to fall below recommended values and the airplane is in the stall warning region, it will be necessary to use full thrust, and perhaps afterburning, to maintain altitude. Refer to section VI of the Confidential Supplement for slow flight characteristics.

The angled deck carrier pattern for LSO approaches is similar to that used for mirror approaches. The distance abeam is about 3000 yards. The turn off the downwind leg is started abeam of the stern of the ship and approximately 25° of bank is used through the first 90° of the turn. The turn is shallowed out during the remainder of the approach until the glide path is entered. Normally, the ship's wake is crossed just prior to entering the glide path.

This attitude on the glide path is held until deck contact. The landing should not be flared because the tail bumper will strike the deck and result in a rapid nose-down pitch and attendant high nose gear loads.

The angled deck carrier pattern utilizing the mirror approach is similar to that flown in the regular LSO approach with respect to distance abeam, time to turn off the downwind leg, and angle of bank. The pattern is flown at 500 feet until the airplane is in the straightaway and on the glide path. The optimum approach speed at 19,000 pounds gross weight is 137 knots CAS at the 90° position and 132 knots CAS on the glide path. Care should be taken to reduce the speed during the last stages of the turn into the straightaway as it is difficult to complete a proper approach once the airspeed has been allowed to build up on the glide path. Very little landing technique is required when making mirror approaches. If flown on glide path all the way to touchdown, the airplane will make a satisfactory tail low landing.

CAUTION

- On days when the wind is light and little turbulence exists, the pilot will probably fly through the carrier's stack wash during the latter stages of the approach. If this occurs at a slow approach speed consistent with the ambient conditions, a critical situation could easily develop. Therefore, throttle should not be reduced during the last stages of any approach to an angled deck carrier as the combination of reduced throttle and stack wash turbulence may result in a dangerous high sink condition.

- Carrier landings on angled deck ships should be made with particular attention to achieving a good line-up and avoiding landings with right to left drift. Because of this right to left drift, coupled with the increased runout of angled deck arresting gears, it is possible that the airplane could come to rest in the port catwalk even though a pendant is engaged.

- On angled deck carriers a burble effect, present under all wind conditions, produces a definite tendency for the right wing to drop as the airplane approaches and passes the round-down at the forward end of the landing area.

HEAVY WEIGHT

Approach and landing with the aircraft heavily loaded must be made at proportionately higher airspeeds. When Aircraft Service Changes 101 and 107 are both incorporated, the aircraft is restricted to 21,000 pounds gross weight for field landings and 19,700 pounds for arrested landings. Consumption of surplus fuel or jettisoning of external stores is necessary if the aircraft exceeds this weight.

CROSS WIND

The aircraft possesses no unusual characteristics during cross wind landings. Normal tricycle landing gear cross wind landing techniques may be used.

TOUCH AND GO

When practicing "touch and go" landings and take-offs, the airplane should be re-trimmed for take-off immediately upon making contact with the landing area and military power applied steadily but without abruptness. Keep the weight of the aircraft on the ground to preclude the strut extension switch from actuating the tail bumper "DOWN." Once the aircraft has regained sufficient flying speed lift-off with positive aft stick motion, taking care not to bounce the main gear back on to the deck.

WAVE-OFF

The wave-off characteristics are satisfactory at speeds as low as 115–117 knots IAS at about 17,500 pound airplane gross weight, using military thrust. At these speeds, small rates of sink can be readily checked and a rate of climb easily established; as the engine accelerates from approach rpm (approximately 85%) to military thrust in about 2.5 seconds. Afterburner is not normally necessary for wave-offs, although in extreme cases its use presents a definite advantage despite the momentary loss of thrust during light-off. The wave-off technique consists of applying full throttle, closing speed brakes, if used, climbing straight ahead until clear of the ship, turning to clear the deck of slip stream and then retracting the landing gear if desired. The wave-off must be taken at a greater distance from the ship when making a mirror approach than when making an LSO approach because of the sink rate already established on the glide path.

WARNING

If use of the afterburner is necessary to recover from a critical condition such as low airspeed during a wave-off, the pilot must be cognizant of the fact that fuel consumption will be exceedingly high (600 pounds per minute). *Do not operate the afterburner longer than is absolutely necessary* to regain safe flying speed. Approximately two seconds interval should be expected between the time of afterburner application and thrust increase.

POST-FLIGHT ENGINE CHECK

Prior to stopping the engine, all instruments should be checked for proper indications. Any discrepancies noted must be referred to the proper personnel, and entries of such discrepancies must be inserted on the proper forms.

STOPPING THE ENGINE

An engine which has been operated at 85% rpm or below for five minutes will be sufficiently cool to permit an immediate shutdown. In any instance where the engine has been operated above 85% rpm for a period exceeding one minute during the last five minutes prior to shut-down, it is recommended that it be operated below 85% rpm for a period of five minutes in order to prevent seizure of the rotor. After ensuring that the engine has been allowed to cool sufficiently, accelerate to 75–80% rpm for 15 to 20 seconds to scavage the oil sumps and lubricate engine bearings, and then:

a. Throttle ..... "OFF"

b. PITOT & ENGINE ANTI-ICING switch ..... "OFF"

c. DROP TANK transfer switch ..... "OFF"

d. MASTER ENGINE switch.... "OFF"

e. Check that the engine decelerates freely, and that no rubbing of the blades is heard.

BEFORE LEAVING THE AIRCRAFT

a. BAT-GEN switch(1) ..... "OFF" or

b. DC GEN switch(2) ..... "OFF" and BAT switch(2) ..... "OFF"

c. All radio switches ..... "OFF"

d. Engage rudder gust lock.

e. EMER ELEVON MAC crank ..... Manual position

f. Chock wheels.

g. If gusty wind conditions prevail, moor the aircraft. (See figure 2-5.)

(1) Airplanes BuNo. 130745, 134798 and subsequent; BuNo. 134744–134797 after service change.
(2) Airplanes BuNo. 130741–130744, 130746–130750; BuNo. 134744–134797 prior to service change.

SECTION III

EMERGENCY OPERATING PROCEDURES

ENGINE FAILURE

Indications of impending engine failure will usually be in the form of unstable engine operation, and can be recognized by any of the following symptoms:

a. Erratic increase in exhaust gas temperature.

b. Fluctuation of engine rpm.

c. Compressor pulsation.

d. Loss of thrust and pressure ratio indications.

e. Lack of response to changes in throttle settings.

WARNING

Continued operation in an unstable engine operating condition is dangerous.

Upon encountering unstable engine operation, proceed as follows:

a. Immediately reduce thrust setting.

b. Reduce altitude and increase airspeed.

c. Place FUEL SYSTEM selector switch to "MANUAL."

d. Place CROSS FEED FUEL VALVE switch to "OPEN."

If necessary because of excessive instability, shut off the engine.

PROCEDURE ON ENCOUNTERING ENGINE FAILURE

When engine failure occurs, quickly retard the throttle. The engine may run at some reduced thrust setting if the throttle is retarded to a point at which the engine is "caught" before a flame-out occurs. If the loss of thrust cannot be prevented by this action, proceed as follows:

a. Throttle ..... "OFF"

b. Check for indication of fire. Refer to paragraph entitled FIRE in this section.

WARNING

If fire is present or suspected, no attempt should be made to restart the engine and the MASTER ENGINE switch should be turned "OFF."

AIR STARTING PROCEDURE. Successful air starts may be accomplished as high as 45,000 feet within an engine windmilling range of from 12 to 36% rpm. An indicated airspeed above 180 knots will give consistent air starts up to an altitude of 35,000 feet. It is recommended that the higher rpm value be used to give more consistent starts. (See Flight Relight Regions, figure 7–1, section VII.)

a. Throttle ..... "OFF"

Note

- If an inflight shutdown is performed because the engine is not receiving fuel, place the throttle in the "IDLE" position until fuel flow is reestablished (to purge the fuel control unit of air) then move it to the "OFF" position for thirty seconds to disperse accumulated fuel from the engine. A normal relight can then be made.
- The airplane should be maintained in a nose high attitude in order to assure gravity flow of fuel from the forward section of the fuel cells into the sumps. This procedure will insure fuel immersion of the boost pumps and thus the continuity of suction feed.

b. BAT-GEN switch(1) ..... "BAT & GEN"
or
BAT switch(2) ..... "ON"

c. GYRO HORIZON POWER switch(3) ..... "EMER"
or
FLT INST POWER switch(1) .. "INVERTER"

Note

For a list of instruments and indicators which will be operative during flame-out, refer to applicable paragraphs under ELECTRICAL SYSTEM, section I.

(1) Airplanes BuNo. 130745, 134744 and subsequent.
(2) Airplanes BuNo. 130740–130744, 130746–130750.
(3) Airplanes BuNo. 130743, 130746, 130747, 130750.

d. FUEL SYSTEM selector switch. "NORMAL" ("MANUAL" if fuel control malfunctioning is suspected)

e. Tachometer ..... 12 to 36% rpm

f. Throttle ..... "IGNITE" then to "IDLE"

(When using JP-5 fuel and with the FUEL SYSTEM switch set at "MANUAL," use the following procedure regardless of altitude:

Throttle ..... "IGNITE" momentarily, then adjust to obtain a fuel flow of 650 to 700 pph.)

g. Engine should start and accelerate to idle rpm within 40 seconds.

Note

- The tachometer should be regarded as the primary instrument to determine if an air start has been accomplished.
- Idle rpm will increase with altitude, therefore an idle speed of as high as 80% rpm will not be unusual for high altitudes.

h. Move the throttle to the desired setting after the engine speed has stabilized.

CAUTION

- In the event that a successful start is not accomplished, retard the throttle to "OFF," and wait at least 30 seconds before attempting another start to insure fuel drainage and completion of the ignition cycle.
- Avoid subjecting the airplane to negative g forces during flameout operation, as the boost pumps are inoperative during this condition and the engine is drawing fuel by suction feed. A negative g condition can unport the fuel boost pumps, and under these circumstances result in entrapment of air in the fuel supply line. Such an occurrence will preclude the possibility of effecting a relight at any altitude.

If several relight attempts are unsuccessful, a malfunction of the ignition timer may be the cause. In this event proceed as follows:

a. Place the throttle to "IDLE."

b. By means of a finger tip, actuate the ignition switch in the throttle quadrant and hold down for a period of approximately 30 seconds, or until a relight is obtained.

A relight preceded by either a-c generator failure or fuel boost pump failure, or both, will not succeed if negative g forces are exerted prior to the start; air will be entrapped in the fuel lines. If this difficulty is encountered, proceed as follows:

a. Throttle — open half-way, omitting ignition, and hold 15 seconds to clear air entrapment.

b. Wait 30 seconds before the next relight attempt.

c. Remain in a nose high attitude during relight to keep the fuel siphoning out of the sumps.

d. Observe rpm vice tpt as relight indication.

AIR STARTING—HIGH ALTITUDE. The following procedure has been used with considerable success to obtain flight relights at altitudes above the "Possible Start Region" on the Flight Relight Chart (figure 7-1) and is recommended for use in the event of a flameout at high altitude. As quickly as possible after the high altitude flameout is observed, in order to utilize maximum available rpm, proceed as follows:

a. Throttle — Move to "IGNITE" momentarily and then to "IDLE."

(When using JP-5 fuel and with the FUEL SYSTEM switch set at "MANUAL," use the following procedure regardless of altitude:

Throttle ..... "IGNITE" momentarily, then adjust to obtain a fuel flow of 650 to 700 pph.)

b. Observe exhaust gas temperature gage. If over temperaturing occurs, discontinue relight and place throttle "OFF."

Note

- If a start cannot be obtained within 40 seconds, descend to a lower altitude. Do not attempt another start for at least 30 seconds.
- When moving the throttle to "OFF," avoid accidental engagement of the "IGNITE" detent which will interrupt the 30-second interval.

c. If a successful start is obtained, advance throttle to desired thrust setting.

Note

Low energy compressor "chugs" will occur during air starts above 30,000 feet, but will not prevent satisfactory engine acceleration to "IDLE."

ENGINE FAILURE UNDER SPECIFIC CONDITIONS

ENGINE FAILURE DURING TAKE-OFF. If the engine fails during take-off, but before becoming airborne:

a. Throttle ..... "OFF"

b. MASTER ENGINE switch ..... "OFF"

c. Apply wheel brakes as necessary to stop the airplane.

d. Open speed brakes for added braking effect.

If the engine fails after becoming airborne, *land straight ahead*. Perform as many of the following operations as possible.

a. Throttle ..... "OFF"

b. Jettison external stores.

CAUTION

Refer to section V of the Confidential Supplement for limitations on jettisoning external stores.

c. Landing gear control ..... "WHEELS DOWN"

d. MASTER ENGINE switch .... "OFF"

ENGINE FAILURE DURING FLIGHT. If the engine fails during flight, attempt an air start as prescribed under AIR STARTING PROCEDURE. If an air start is not possible, maintain the recommended speed for maximum distance as shown under MAXIMUM GLIDE. Should the engine fail during night operations, it is left to the discretion of the pilot whether to attempt a landing or abandon the aircraft.

MAXIMUM GLIDE. Maximum range gliding speeds for various gross weights with the engine inoperative are as follows:

GROSS WEIGHT	IAS—KNOTS
16,000 pounds	195
18,000 "	205
20,000 "	215
22,000 "	225
24,000 "	235

FLAMEOUT LANDING PROCEDURE

Prior to making a forced landing accomplish as many of the following as possible.

a. Throttle ..... "OFF"

b. MASTER ENGINE switch ..... "OFF"

c. Safety belt and shoulder harness ..... Tightened and "LOCK"

d. YAW DAMPER & AUTO PILOT switch ..... "EMER OFF"

e. EMER ELEVON MAC crank ... Crank to "2" position

f. Generator switches ..... "OFF"

g. Nonessential electrical equipment ..... "OFF"

CAUTION

Save battery power for the pitch trimmers by limiting operation of all radio and essential electrical equipment.

h. BAT-GEN switch[2] ..... "BAT ONLY" or

BAT switch[1] ..... "EMER"

[1] Airplanes BuNo. 130740–130744, 130746–130750; BuNo. 134744–134797 prior to service change.

[2] Airplanes BuNo. 130745, 134798 and subsequent; BuNo. 134744–134797 after service change.

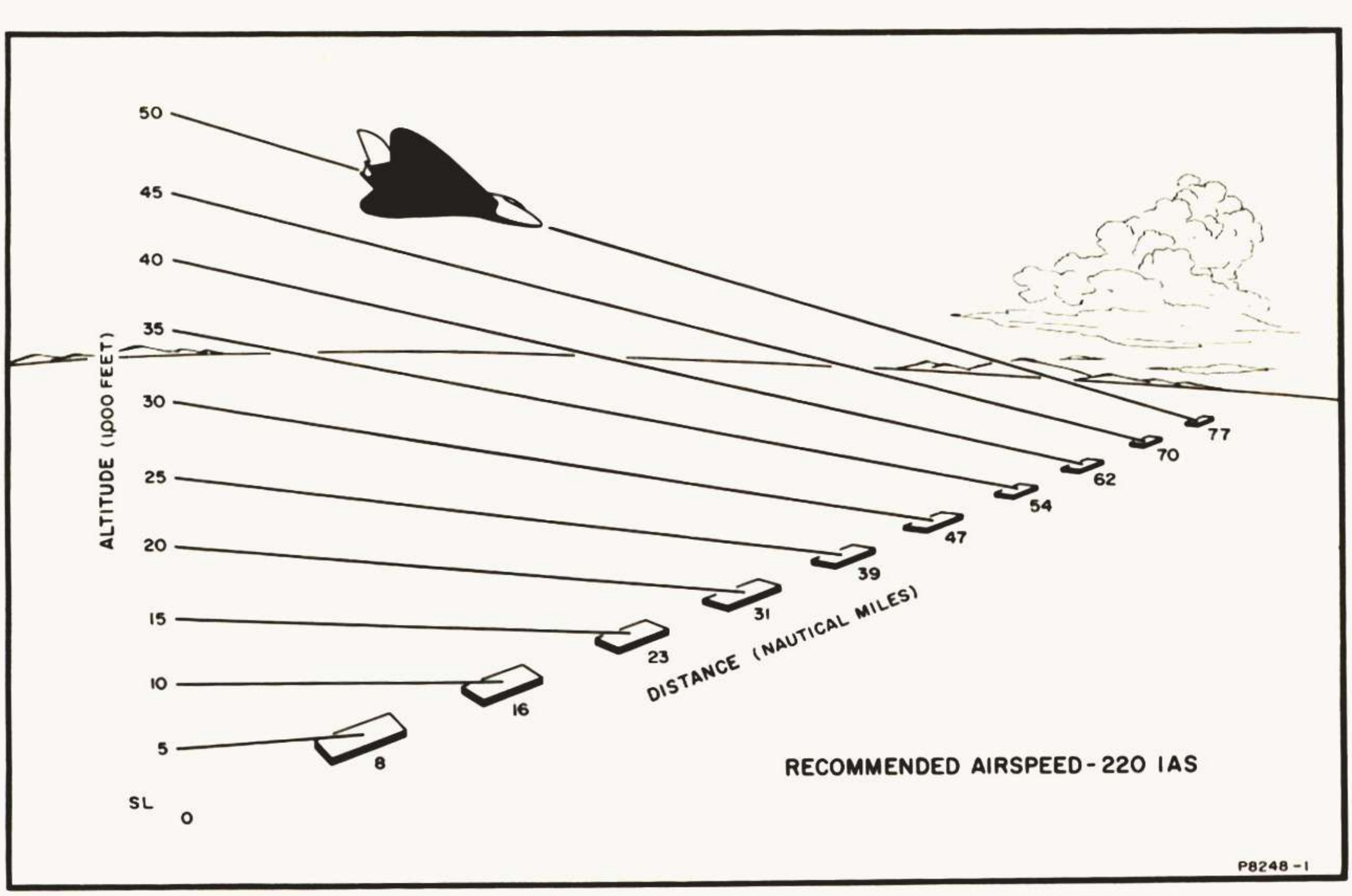

Figure 3-1. Flameout Gliding Range

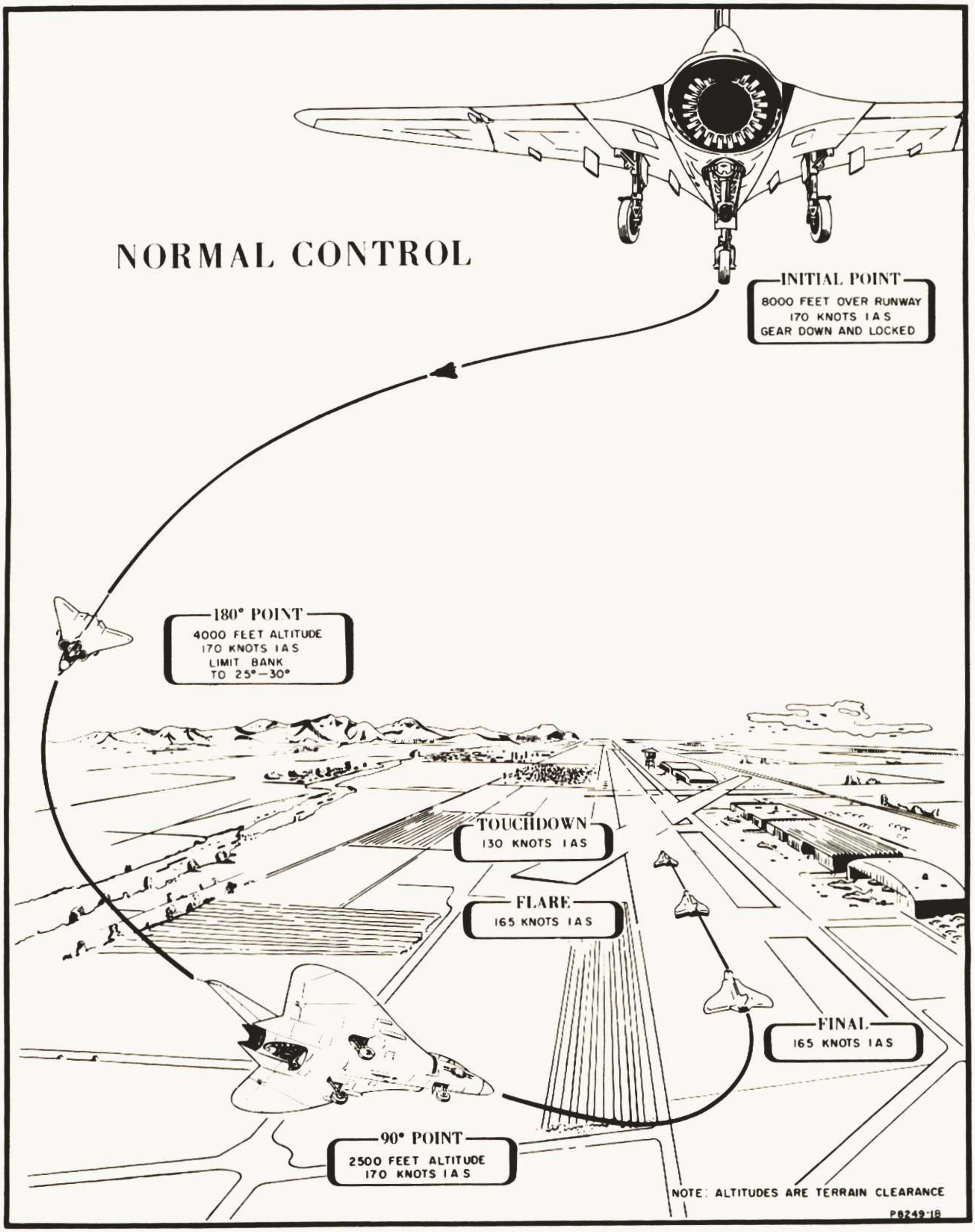

Figure 3-2. Flameout Landing (Sheet 1)

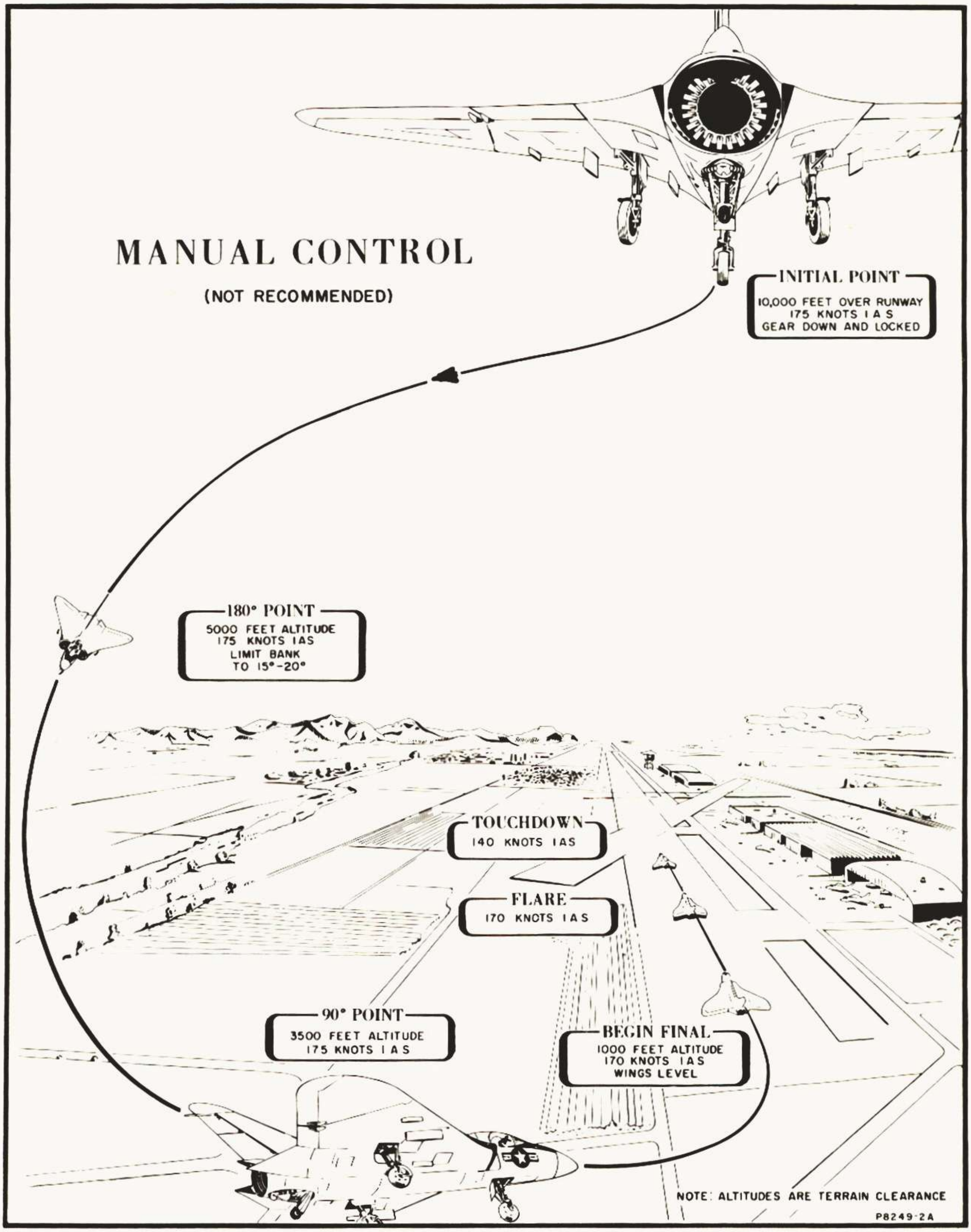

Figure 3-2. Flameout Landing (Sheet 2)

WARNING

The radio equipment and pitch trimmers become inoperative if the battery switch is turned off. (Refer to the paragraph in this section entitled D-C GENERATOR FAILURE for d-c power control procedure during flameouts.)

i. Control stick.....Extend

j. Jettison external stores.....At discretion

CAUTION

Refer to section V of the Confidential Supplement, OPERATING LIMITATIONS, for limitations on jettisoning external stores.

k. Landing gear control.....“WHEELS DOWN”

CAUTION

An engine windmilling rpm of 15 percent or more normally will supply sufficient hydraulic pressure to operate the flight controls during the descent and flare out. However, if at least 20 percent rpm cannot be maintained, a normal control landing should not be attempted. Depletion of hydraulic pressure is indicated by an increase in force necessary to maintain a constant stick movement. A hesitation in stick movement will permit hydraulic pressure to build up sufficiently for further control deflections.

FLAMEOUT LANDING TECHNIQUE (NORMAL CONTROL)

When the pilot is committed to a flameout landing, altitude must be sufficient to permit a far steeper glide than required in normal approaches (see figure 3–2).

The following procedure is recommended when altitude allows the pilot to maneuver to the desired position over the runway:

a. Lower the landing gear when certain that the initial point over the runway can be made.

b. Initial point in pattern should be at 8,000 feet over the intended point of landing and on the same heading as the landing will be made.

c. Maintain 170 knots IAS during letdown.

d. Downwind leg should be extended according to wind drift. Altitude at point abeam of the intended point of landing should be approximately 4,000 feet.

e. Angle of bank should not exceed 30 degrees.

f. Altitude on base leg should be approximately 2,500 feet after completing initial turn from the abeam position.

g. Final approach and flare should be made at not less than 165 knots IAS with the flare started at approximately 200 feet above the ground.

h. Touchdown should be made at not less than 130 knots IAS and as soon as possible after flare-out.

WARNING

- If the approach speed is allowed to fall below the recommended value, the rate of descent will increase so rapidly that undershooting will become probable. A high rate of descent will also make it difficult to execute a proper flareout.
- If the airplane is in a banked attitude during the flare, or just prior to the flare, it will have a higher rate of descent, which will make it more difficult to execute a proper flare-out.
- Sideslips should not be made to lose altitude more rapidly as this causes a reduction in windmilling engine rpm, which will cause a reduction in control boost power at slow speeds, resulting in a more rapid starvation of the system.

SIMULATED FLAMEOUT APPROACH. The procedure for simulated flameout approaches is the same as recommended for normal control approaches, except as follows:

a. Throttle set at 80 percent rpm.

b. Speed brakes extended.

c. Landings shall not be made with more than 2000 pounds of fuel.

d. Speed brakes shall remain extended until the airplane is on the runway.

FLAMEOUT LANDING TECHNIQUE (MANUAL CONTROL) (Not Recommended)

Flameout descents and landings, during which rpm is not sufficient to maintain hydraulic pressure and the ELEVON POWER RELEASE handle must be actuated, are considerably more difficult to accomplish due to high stick force gradients.

Note

A mild pitch down may occur upon actuation of the ELEVON POWER RELEASE handle.

Less angle of bank in turns and a longer final approach must be used (see figure 3–2). The following procedure is recommended when altitude allows the pilot to maneuver to the desired position over the runway:

a. Lower the landing gear when certain that the initial point over the runway can be made. Maintain wings level during gear actuation. The gear should lock down in approximately 20 seconds.

b. Initial point in pattern should be at 10,000 feet over the intended point of landing and on the landing heading.

c. Maintain 175 knots IAS during the letdown.

d. Downwind leg should be adjusted according to wind drift. Altitude at point abeam of the intended point of landing should be approximately 5000 feet.

e. Angle of bank should not exceed 20 degrees.

f. Altitude on base leg should be approximately 3500 feet after completing initial turn from the abeam position.

g. Final approach should be made at 175 knots IAS with the wings level.

h. 170 knots should be maintained until the flare is started. The flare should not be started until approximately 200 feet above the ground.

WARNING

A lightening of the control force may be encountered on the flare-out when in manual control. An excessively nose high attitude may result if aft stick pressure is not reduced.

i. Touchdown should be made at not less than 140 knots IAS and as soon as possible after flare-out.

WARNING

Twice the normal amount of toe pressure will be required to actuate the brakes for stopping.

FLAMEOUT GLIDING RANGE

The flameout gliding range of the aircraft is shown in figure 3-1. Recommended airspeeds are 220 knots IAS clean and 170 knots IAS landing gear extended. Both airspeeds are recommended with normal windmilling engine.

Note

- If the engine is not windmilling normally, the airspeed will have to be increased proportionately in order to supply sufficient hydraulic pressure to operate the controls for descent, flareout, and landing.
- An increase in airspeed above the recommended value will decrease the gliding distance of the aircraft.

AFTERBURNER FLAMEOUT

Afterburner flameout may occur because of compressor instability or fuel control malfunctioning, although such disturbances may not always be noticeable to the pilot. Flight test reports also indicate that afterburner flameout at extremely high altitudes may go unnoticed unless the pilot is vigilant in observing thrust characteristics of the engine. When installed, the pressure ratio gage will indicate a sudden ratio drop with afterburner flameout. Afterburner relights are difficult above 49,000 feet. Airspeed is an important factor in obtaining an afterburner relight at altitude. A minimum indicated airspeed of 220 knots should be maintained during an afterburner relight attempt at altitude. With afterburner flameout, proceed as follows:

a. Move throttle inboard to shut off afterburner.

b. Wait five seconds.

c. Move throttle outboard to turn on afterburner. Do not prolong the operation beyond five seconds.

d. If afterburner does not relight, decrease the angle of attack, and descend to a lower altitude while allowing the aircraft to pick up some speed. Repeat the relight procedure.

AFTERBURNER SHUT-OFF FAILURE. If afterburning should continue after the throttle is moved from the afterburner detent, failure of the electrical control is indicated. Actuate the mechanical afterburner fuel shut-off by retarding the throttle. If the controls have been properly rigged, shut-off should occur by the time the throttle has traveled 3/16 inch past the afterburner stop. Terminate the flight as soon as practicable.

CAUTION

Plan landing approach for low throttle setting to avoid re-lighting afterburner.

FIRE

ENGINE FIRE

ON THE GROUND. If an engine fire should occur while on the ground, immediately perform the following:

a. Throttle ..... "OFF"

b. Make certain that the starter has a source of power.

Note

Use of CO_2 is generally to be avoided, if possible, since application of the cold gas can be detrimental to a heated engine. Slow burning carbon deposits, for instance, may be controlled without the use of CO_2 if engine rotation is maintained to prevent "hot-spots." When it becomes necessary to use CO_2, engine rotation must be maintained for proper dispersion of the extinguishing agent.

c. STARTER button ..... Depress

Allow the starter to crank until fire has disappeared if control is established quickly. If fire persists for a considerable length of time, indicating a fuel leak, the engine should be rotated with the external starting unit until fire is brought under control. CO_2 should be applied to the engine inlet duct.

CAUTION

Cold CO_2 must not be applied to hot turbine blades through exhaust exit.

DURING FLIGHT. When indications of fire occur during flight, make certain that a fire actually exists, then proceed as follows:

a. Throttle ..... "OFF"

b. MASTER ENGINE switch ..... "OFF"

Note

D-c power is required to actuate the valves in the fuel system controlled by the MASTER ENGINE switch. Therefore, insure that battery power is on before actuating MASTER ENGINE switch.

The pilot must use his own discretion in deciding whether to attempt a landing or whether to abandon the aircraft.

FUSELAGE FIRE

ON THE GROUND. If fire in the fuselage occurs, the most likely location would be in the engine compartment, unless the trouble is of electrical origin (refer to ELECTRICAL FIRE). Fire-fighting equipment should include a javelin-type fire extinguisher for easy access to the engine compartment. Observe the following procedure:

a. Throttle ..... "OFF"

b. MASTER ENGINE switch ..... "OFF"

c. Exit from airplane.

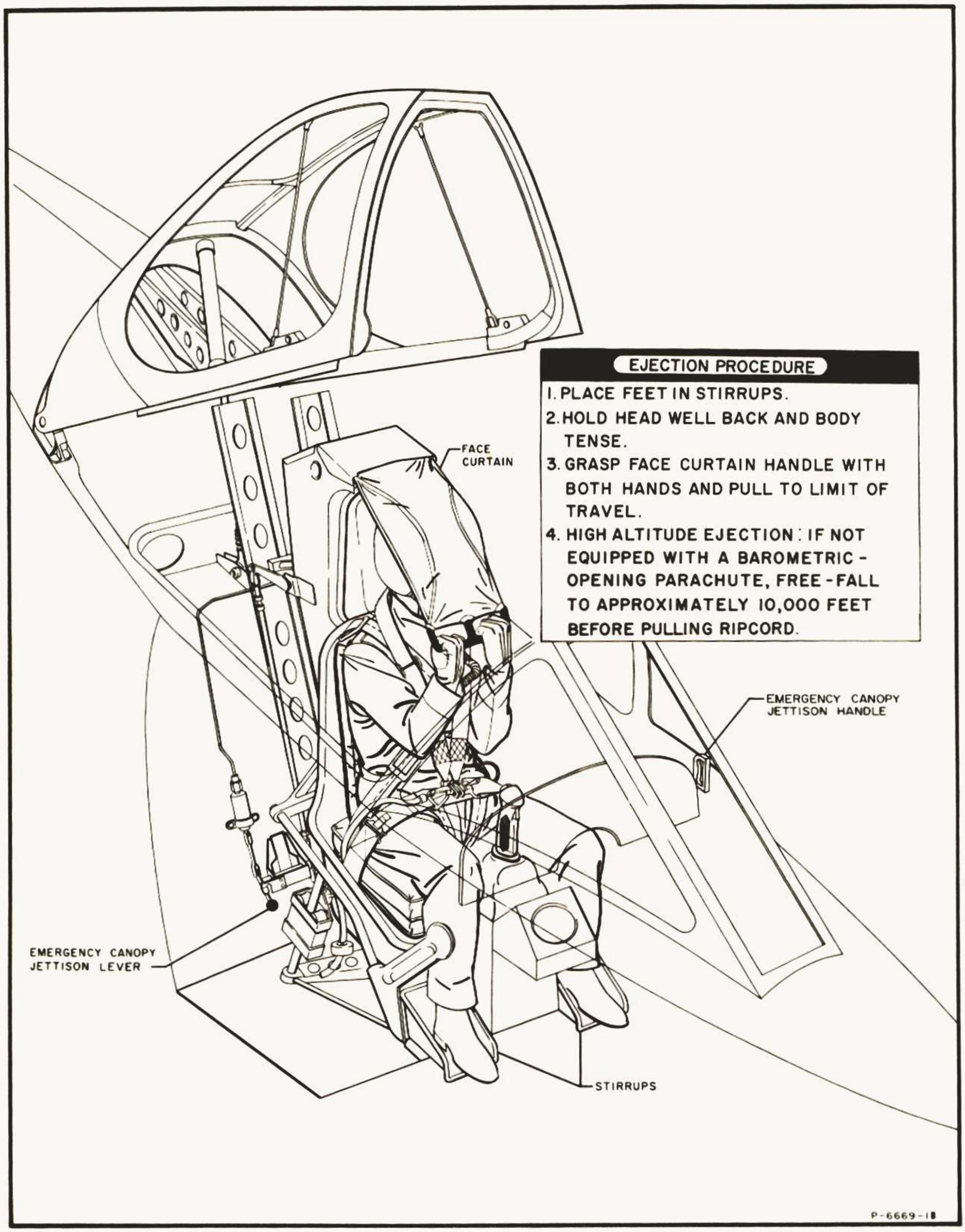

Figure 3-3. Seat Ejection

DURING FLIGHT. Since no fire fighting equipment is available in flight, there is little the pilot can do to combat a fuselage fire, and, as always, the decision to abandon the airplane is left to the pilot. There is a possibility that the fuselage fire could be electrical in origin. In such event, follow the procedure as stated in the paragraph, ELECTRICAL FIRE.

WING FIRE

When a fire occurs in the wing, jettison all combustible external stores.

ELECTRICAL FIRE

IN THE AIR. In the event of an electrical fire, turn off all electrical switches, except the generator switches and the MASTER ENGINE switch. Turn on the switches again, one by one, and watch for signs of fire. If the source of the fire can be isolated in this manner, leave the defective circuit off. If the origin of the fire can not be determined, leave all switches off, and land as soon as possible.

ON THE GROUND. If indications of electrical fire are present, observe the following procedure:

a. Throttle ..... "OFF"

b. MASTER ENGINE switch ..... "OFF"

c. Turn off all electrical power switches.

d. Exit from airplane.

SMOKE ELIMINATION

In early airplanes,(1) to dissipate smoke or fumes in the cockpit, turn the AIR CONDITIONING control knob to "OFF." In some airplanes,(2) position the DEFROST-NORMAL-RAM switch, or in later airplanes(3) the NORMAL-RAM switch, to "RAM." This action stops the flow of pressurized air from the compressor section, dumps the air in the cockpit, and allows ram air to enter. Upon detecting smoke or fumes, the pilot should immediately turn his oxygen regulator(1) to "100% OXYGEN" and the safety pressure lever "ON."

WARNING

Do not turn the AIR CONDITIONING control to "OFF" above 43,000 feet.

LANDING EMERGENCIES (EXCEPT DITCHING)

Landing jet airplanes on unprepared terrain is usually extremely hazardous. Provided sufficient altitude is available, ejection is preferable to attempting an emergency landing on any surface other than a runway. If a malfunction occurs during low level flight, it may be possible to convert excess airspeed into enough altitude to permit a safe ejection. In the event that landing on unprepared terrain is unavoidable, the landing gear control should be placed in the "WHEELS DOWN" position. The landing gear will probably be carried away, but will absorb many impact forces that would otherwise be taken by the fuselage and cockpit area. Also, the energy absorption of the nose gear will reduce the vertical deceleration as the nose rotates downward, thus reducing the hazard of spinal injury to the pilot. Emergency landings should be made at, or slightly above, recommended approach and landing speeds. Landings at lower speeds should never be attempted, due to the accompanying high angles of attack and subsequent high rates of sink and loss of control. If the landing emergency consists of the failure of one or more gear to extend, lower the gear by following the EMERGENCY LANDING GEAR EXTENSION procedure in this section. In the event the gear is damaged and fails to lock down, place the landing gear control handle in the "WHEELS UP" position to allow the gear to collapse upon landing. For landing emergencies with no thrust, refer to the paragraph on FLAMEOUT LANDING TECHNIQUE.

EMERGENCY ENTRANCE

Entrance into the airplane may be accomplished by operating the external canopy control. If the canopy control handle interconnecting cable system has been damaged or shot away, it will be necessary to pull the handles on each side of the canopy. If the airplane has overturned and the canopy cannot be opened, break the transparent panels or use axes or other cutting tools to gain entrance.

DITCHING

A ditching at sea is much more hazardous than an ejection and should *not* be attempted if ejection is feasible, since the airplane may sink in only a matter of seconds after water contact. Because all emergency survival gear is carried by the pilot, even a successful ditching lends no advantage over an ejection. Therefore, an ejection should be attempted if above 800 feet terrain clearance (refer to EJECTION); whereas, ditching may become necessary at lower altitudes during a landing approach, a weak catapult shot, or an engine failure after take-off. If the malfunction occurs near the deck, a "zoom" to convert excess airspeed into altitude may climb the airplane to an altitude where ejection can be accomplished in a normal manner.

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(1) Airplanes BuNo. 130740-130750.
(2) Airplanes BuNo. 134744-134973.
(3) Airplanes BuNo. 139030 and subsequent.

WARNING

Assure that proper auto parachute opener arming cable end fitting is used, i.e., a fitting compatible with the lap belt.

Time permitting, accomplish as many of the following as possible in preparation for ditching:

a. Landing gear ..... "UP"

b. Safety belt and shoulder harness. Tightened and "LOCK"

WARNING

Shoulder harness should be tight to prevent the pilot's head from striking the control stick.

c. Jettison all external stores except the fuel tanks, if empty.

d. Speed brakes ..... "CLOSE"

e. Arresting hook "DOWN" for drag and to feel for initial contact with the water.

f. MASTER ENGINE switch ...."OFF"

g. BAT–GEN switch(2) ....."OFF" or
BAT switch(1) ....."OFF"

h. Oxygen to "100%" with SAFETY PRESSURE lever(3) ....."ON"

Note

Should the aircraft sink before exit from the cockpit has been accomplished, it is possible to survive underwater by using the installed gaseous oxygen equipment(3). Pressure breathing oxygen mask and the positive pressure diluter demand regulator are suitable underwater breathing devices when the regulator is set at "100%" and the SAFETY PRESSURE lever is "ON."

i. Jettison the canopy at pilot's discretion during some point in the approach or after touchdown.

Note

In later aircraft(4) jettisoning the canopy will not arm the ejection seat.

(1) Airplanes BuNo. 130740–130744, 130746–130750; BuNo. 134744–134797 prior to service change.
(2) Airplanes BuNo. 130745, 134798 and subsequent; BuNo. 134744–134797 after service change.
(3) Airplanes BuNo. 134918 and prior before service change.
(4) Airplanes BuNo. 134919 and subsequent. Prior airplanes by service change.
(5) Airplanes prior to BuNo. 139030.
(6) Airplanes BuNo. 139030 and subsequent. Prior airplanes by service change.

j. Plan the approach so as to be heading parallel to any uniform swell pattern and touchdown along wave crest or just after crest passes. If the wind is as high as 20 to 25 knots or the water surface is irregular, make the approach into the wind and touch down on the falling side of a wave.

k. Make a normal approach and touch down in a nose high attitude.

WARNING

If the aircraft is ditched in a near level attitude, it may dive violently soon after contact.

l. Check that personal equipment will not foul and remove oxygen mask when leaving the cockpit.

WARNING

When the lap belt is released manually, check that the auto parachute opener arming cable is free of the belt.

m. Abandon aircraft immediately after it stops.

The following is an abbreviated check-off list for ditching:

a. Check gear, speed brakes and arresting hook.

b. Tighten belt and harness.

c. Jettison external stores.

d. MASTER ENGINE and d-c power switches "OFF."

e. Check oxygen.

f. Jettison canopy at pilot's discretion.

g. Plan approach and make nose high landing.

h. Abandon aircraft.

In the event the aircraft sinks with the canopy still attached, actuate the EMERGENCY CANOPY REMOVER handle or the "D" handle to jettison the canopy and abandon the aircraft as soon as possible. On early aircraft(5) the canopy seal is provided with a regulator that automatically deflates when the engine stops. This reduces the differential pressures encountered beneath the water and will allow jettisoning of the canopy to depths of fifteen feet. Later aircraft(6) have a canopy relief valve installed on top of the canopy behind the pilot's head which will allow water to spill into the cockpit to balance the internal and external pressure and permit the canopy to be jettisoned at depths greater than 15 feet.

EJECTION

Ejection is considered feasible from an altitude of 800 feet terrain clearance if the airplane is in a climb or level flight and equipped with an automatic lap belt and automatic parachute opener. If the aircraft is in a dive, ejection must be initiated at a much higher altitude. Any airspeed up to 485 knots IAS will allow adequate aircraft clearance; however, due to the possibility of wind blast damage to personal gear, it is advisable to slow the aircraft as much as possible prior to ejection. Also, if time and circumstances permit, descend to about 10,000 feet and trim the aircraft for straight and level flight. If below 800 feet terrain clearance an ejection should not be attempted, and the aircraft should be landed straight ahead; however, a "zoom" to convert excess airspeed into altitude may climb the aircraft high enough to allow the pilot to utilize ejection.

If time permits, the following procedure is recommended; however, if immediate ejection is necessary, simply grasp the face curtain handle and pull down (figure 3–3).

a. Throttle back and open the speed brakes to slow the aircraft as much as possible.

b. Descend to a lower altitude—preferably to around 10,000 feet—and trim the aircraft for straight and level flight.

c. IFF to ..... "EMERGENCY"

d. Follow radio distress procedure.

e. Depressurize the cockpit by placing the air conditioning control to ..... "RAM"

f. Shoulder harness ..... Tightened and "LOCK"

g. Ascertain that all personal gear (goggles, gloves, etc.) is properly utilized.

h. Place feet in stirrups.

i. Sit erect with spine straight and head firmly against headrest.

j. Pull the "green apple" to actuate the emergency (bail-out) oxygen supply.

WARNING

When wearing a non-pressure suit, disconnect the MC-3A connector from the tee block[1] immediately before or after pulling the "green apple."

k. Grasp the face curtain handle with both hands and pull down smartly until the seat fires. The canopy will be jettisoned when the face curtain has traveled to a position over the pilot's helmet, and the seat catapult will fire when the curtain passes his nose or chin.

Note

A safety interlock feature prevents the firing of the seat catapult before the canopy is jettisoned.

l. Should the canopy fail to blow off when the face curtain handle is pulled, hold onto the handle with either hand and actuate the EMERGENCY CANOPY REMOVER handle or the "D" handle, or manually open the canopy by actuating the canopy latch handle. The canopy should shear off when opened into the airstream.

WARNING

Do not allow the face curtain to blow back and become inaccessible.

m. After the seat has left the aircraft, the safety belt automatic release will unlatch the safety belt and shoulder harness. Fall free of the seat by rolling forward.

Note

If the lap belt fails to open automatically, it can be manually opened by pulling the lap belt latch handle.

n. The barometric-opening parachute deploys automatically at the preset altitude of 10,000 feet. If ejection occurs below this preset altitude and the chute doesn't open automatically within 3 seconds after seat separation, manually open the chute by pulling the "D" ring.

The manual ripcord will override the automatic barometric ripcord release.

WARNING

- If high speed ejection is made, allow time for slowing down before manually opening the parachute to preclude the possibility of tearing panels in the chute.
- If high altitude ejection is made, free fall to approximately 10,000 feet before manually opening the parachute.

AIRCRAFT SYSTEMS

FUEL CONTROL SYSTEM

DURING TAKE-OFF. If the fuel control system fails during take-off, place the FUEL SYSTEM selector switch on "MANUAL." The flight should be terminated as soon as practicable.

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[1] Airplanes BuNo. 134919 and subsequent; BuNo. 134744–134918 by service change.

CAUTION

The throttle should be retarded as necessary to prevent excessive exhaust gas temperatures.

DURING FLIGHT. Should fuel control system failure be suspected during flight, as indicated by unstable engine operation, set throttle on "IDLE," place the FUEL SYSTEM selector switch to "MANUAL," and advance the throttle slowly and smoothly to the desired thrust setting.

CAUTION

Except in extreme emergencies, as on take-off, the throttle should be retarded to "IDLE" before moving the FUEL SYSTEM selector switch to the "MANUAL" position. While operating on the manual fuel control system at any altitude, the throttle must be moved slowly and smoothly to prevent overtemperaturing and overspeeding of the engine. Do not return the FUEL SYSTEM selector switch to "NORMAL" for the duration of the flight. To do so may cause a flameout. (During pilot training and check out, it is permissible only after retarding the throttle to 80% rpm, or less.) Terminate flight as soon as practicable.

ENGINE DRIVEN FUEL PUMP FAILURE

ENGINE STAGE. The MAIN PUMP FAILURE warning light glows, automatic transfer to the afterburner stage occurs, and full fuel requirements are provided for the engine, with partial flow to the afterburner at low altitudes. At all but the lower altitudes, both engine and afterburner will receive full fuel requirements.

AFTERBURNER STAGE. No afterburning will be possible, but full fuel flow to the engine will be provided.

CENTRIFUGAL BOOST STAGE. Little or no effect on engine and afterburner operation will be experienced unless the fuel boost pumps fail also, then there will be some loss of thrust, especially on initial climbout, but no flame-out should result.

FUEL BOOST PUMP FAILURE

Failure of one or both boost pumps will be indicated by illumination of the BOOST PUMP FAILURE warning light located on the left side of the instrument panel. There may be a small drop in fuel pressure, depending upon engine operating speed and ambient conditions. At sea level while using military thrust without afterburning, normal pressure is from 26 to 40 psi. A loss of one boost pump might result in a pressure drop to a reading of approximately 17 psi and failure of both pumps would be evidenced by a complete loss of pressure indication on the gage. When boost pump failure occurs, observe the following emergency procedures:

a. Airplane attitude ..... Nose up, maintain lg

b. CROSS FEED FUEL VALVE switch . . OPEN

c. Avoid sudden power setting changes.

With boost pump failure, afterburning should not be attempted, particularly at low altitudes, because of the excessive fuel requirement. Otherwise normal fuel flow may be obtained as long as one or both transfer pumps are operating, and it is possible to maintain flight for all operations at high altitude when such action is required by an *emergency* situation. Normally, however, the pilot should avoid high thrust settings in the nose low attitude. For a more thorough discussion on the subject, refer to FUEL BOOST PUMPS, section VII.

WARNING

- When boost pump failure occurs, terminate the flight as soon as practicable. It is recommended that descent be accomplished quickly and that a nose low attitude be avoided.
- Avoid subjecting the airplane to negative g forces, as this flight condition can unport the boost pumps and result in entrapment of air in the engine fuel supply line. Such an occurrence will result in a flameout and preclude the possibility of a relight at any altitude. (For an indication of usable fuel with boost pumps inoperative, see figure 1–6, Fuel Quantity Data.)
- During a wave-off from a carrier approach, do not attempt use of the afterburner if either or both boost pumps are inoperative except when contact with the deck would otherwise be unavoidable (refer to WAVE-OFF, section II).

OIL SYSTEM

Upon indication of oil system failure by a drop in oil pressure below the minimum of 30 psi or by the illumination of the OIL PRESSURE FAILURE warning light[1] (25, figure 1–4), the engine should be operated at the lowest practicable thrust setting, and a landing effected as soon as possible.

Note

The OIL PRESSURE FAILURE warning light may illuminate intermittently whenever the airplane is subjected to zero or negative g conditions. Under these circumstances no remedial action is required of the pilot, other than correcting g load.

ELECTRICAL POWER SYSTEM

D-C GENERATOR FAILURE (EARLY AIRPLANES[2]). Failure of the d-c generator is indicated

[1] Airplanes BuNo. 134744 and subsequent.
[2] Airplanes BuNo. 130740–130744, 130746–130750.

by the DC GEN warning light. When generator failure occurs, place the DC GEN switch to "OFF." Turn off all non-essential d-c electrical equipment to prevent unnecessary depletion of battery power and place BAT switch on "EMER." Battery power should last at least half an hour if heavy loads (such as UHF equipment) are not placed on the system.

CAUTION

- Due to the large power requirement of the pitch trimmers, use of all other electrical equipment should be kept at an absolute minimum. It is recommended that the flight be terminated as soon as practicable in order to assure having pitch trimmer control available for approach and landing.
- A-C power is lost upon depletion of battery following d-c generator failure in some early airplanes(1)

If necessary to operate equipment on the secondary bus, first turn off non-essential equipment and place the BAT switch to "BAT ONLY" position. (See figure 1–8 for list of equipment controlled by the secondary bus.) On "BAT ONLY" position, the only inoperable d-c equipment is the left-hand fuel transfer pump on the monitor bus which is de-energized when the d-c generator fails. In the event engine rpm drops below 65 percent (such as would occur with too slow an airspeed after engine flameout), the d-c generator will become inoperative. If engine rpm cannot be maintained at or above 65 percent, the battery switch must be placed on "BAT ONLY" in order to supply electrical power to the UHF radio, omni and pitot heater.

D-C GENERATOR FAILURE (LATER AIRPLANES(2)).

When generator failure occurs, the battery-generator switch may be left in the "BAT & GEN" position until necessary to recover secondary bus power. To regain use of the secondary bus, first turn off non-essential equipment and place the switch on "BAT ONLY." (See figure 1–8 for list of equipment controlled by the secondary bus.)

CAUTION

Should complete loss of D-C power be experienced, the pilot should check the possibility of having inadvertently operated the BAT & GEN switch to the "OFF" position.

A-C GENERATOR FAILURE

Failure of the a-c generator is indicated by the AC GEN warning light. However, this may reveal only an interruption in a-c power caused by one of the following:

a. An over-voltage condition.

b. External power disconnected before the a-c generator is operating or before "INTERNAL" power is selected.

c. Turning the a-c power switch to the "EMER OFF" position.

To restore power, if such is the case, make certain the a-c power switch is "ON." Next, turn the d-c power "OFF" momentarily, and then reset to "BAT & GEN." When experiencing generator failure, check the operation of a-c operated equipment to determine if only one or all three generator phases are inoperative (see figure 1–9).

Note

Upon loss of a-c power to operate the air conditioning control unit, cockpit temperature will remain fairly constant depending on variations in power and altitude. Cockpit temperatures may be decreased by holding the AIR CONDITIONING control switch in the spring-loaded MANUAL COLD position; however, the MANUAL HOT position will be inoperative.

A-C GENERATOR FAILURE. If complete loss of a-c power is experienced, observe the following procedure:

a. Airplane attitude	Nose up, maintain 1 g
b. Throttle	Reduce power; avoid rapid power setting changes.
c. CROSS FEED FUEL VALVE switch	"OPEN"
d. YAW DAMPER & AUTO-PILOT switch	"EMER OFF"
e. GYRO HORIZON POWER switch(3)	"EMER" or,
FLT INST POWER switch(2)	"INVERTER"

Note

If exterior lights are desired, the EXTERIOR LIGHTS master switch must be "ON," and the EXTERIOR LIGHTS and FUS LTS switches must be placed to "DIM."

f. EMER ELEVON MAC crank . . 2:1

g. Land as soon as possible.

h. Do not use afterburner during wave-off.

CAUTION

In the event of complete loss of a-c power in early airplanes,(4) the only instruments available for directional reference are the turn and

(1) Airplanes BuNo. 130740–130744, 130746–130750.
(2) Airplanes BuNo. 130745, 134744 and subsequent.
(3) Airplanes BuNo. 130743, 130746, 130747, 130750; BuNo. 134744–134747, 134749, 134750, 134752, 134753, 134755–134758, 134764, 134766, and 134770–134797 prior to service change.
(4) Airplanes BuNo. 130741, 130742, 130744, 130745, 130748, 130749, 134748, 134751, 134754, 134759–134763, 134765, 134767–134769.

bank indicator and the stand-by compass, making night or instrument flying hazardous.

WARNING

Maintain a nose high attitude and no less than 1 g in order to prevent possible flameout, which would result from unporting the boost pumps. (For an indication of usable fuel with an a-c generator failure—boost pumps inoperative—see figure 1-6, Fuel Quantity Data.)

FLIGHT CONTROL SYSTEM

EMERGENCY ELEVON POWER RELEASE. If either the elevon or utility hydraulic power systems fail during supersonic flight, terminate any accelerated maneuver and reduce speed. The faulty hydraulic power system fluid will be automatically by-passed and the operative system will continue to furnish adequate pressure for control movement. If both the elevon and utility hydraulic power systems fail, if engine seizure occurs, or if the elevons are uncontrollable, then the elevon power system will have to be disconnected. However, it should first be determined that the unusual behavior of the airplane is not caused by a malfunction of one of the other control systems—such as the yaw damper, auto control, transonic trim or MAC. If the problem is not alleviated after having turned off the switches that control these systems, then it will be necessary to go into manual control. (For discussion of the manual controls system, refer to MANUAL FLIGHT CONTROL, section VI of the Confidential Supplement and section VII of the Flight Handbook.) This is accomplished as follows:

a. Reduce speed.

b. Crank EMER ELEVON MAC to ratio of 2:1.

c. Extend control stick.

d. Trim the airplane for slight nose-up trim.

e. At an IAS between 200-300 knots pull the ELEVON POWER RELEASE handle out briskly and completely at least twice. This insures that both hooks completely disconnect.

WARNING

When on manual control, airspeed should not be permitted to go below 130 knots. Control forces lighten at this airspeed, and an abrupt up elevon deflection and an excessively nose high attitude may result from elevon surface overbalance.

CAUTION

- Do not disconnect the elevon power system when the airplane is not in a trimmed condition, or when disconnecting has not been determined mandatory.
- Upon actuation of the emergency elevon power release handle, a mild to moderate pitch down of 5 to 10 degrees is apparent. Be prepared to re-trim the airplane.

Note

- With the elevon hydraulic system inoperative, no rudder trim control is available. With both hydraulic systems inoperative, lateral trim control is ineffective. Handling of the airplane while on "manual" can be greatly assisted by using the pitch trimmers for longitudinal control and using rudder action for lateral control.
- The ELEVON POWER RELEASE cannot be reset in flight after it has been disengaged.

EMERGENCY MECHANICAL ADVANTAGE CHANGER CONTROL. In the event of a-c electrical power failure to the MAC amplifier and servo motor, the MAC is operated as follows:

a. Move the EMER ELEVON MAC system crank to the operating position.

b. Turn the crank toward "INCREASE" (clockwise) or "DECREASE" (counter-clockwise) as required.

c. Observe the mechanical advantage ratio on the MAC indicator located on the instrument panel.

EMERGENCY SERVO RUDDER OPERATION

If yaw damper malfunction occurs, the yaw damper mode can be turned off by pulling up the YAW DAMP control button. If some other mode of the servo rudder system should malfunction, place the YAW DAMPER & AUTO-PILOT switch to "EMER OFF." This will deactivate all modes of the servo rudder system. In the event of an a-c electrical power failure, hydraulic pressure to the servo rudder power cylinder is discontinued automatically. However, if the automatic feature should fail, placing the YAW DAMPER & AUTO-PILOT switch to "EMER OFF" will also discontinue hydraulic pressure to the cylinder.

Note

With the yaw damper control turned off, the rudder trim control is inoperative.

CAUTION

When the yaw damper is inoperative, avoid making abrupt turns with a high rate of roll

during slow flight. Such a maneuver will produce an adverse yaw characteristic, causing the nose of the aircraft to lift and thereby creating a dangerous attitude. (Refer to SERVO RUDDER, section VI of the Confidential Supplement.)

EMERGENCY PITCH TRIMMER CONTROL. If the control stick TRIM switch fails to operate the pitch trimmers, move the EMERGENCY TRIM control to "NOSE UP" or "NOSE DOWN." If this procedure fails to actuate the pitch trimmers, reset the PITCH TRIM MOTOR CIRCUIT BREAKER and repeat the procedure.

Note

If a condition should occur in which the pitch trimmers will not hold a desired setting when operated with the EMERGENCY TRIM control, make the desired trim adjustment and then turn off the PITCH TRIM MOTOR CIRCUIT BREAKER.

CAUTION

Do not exceed the pitch trimmer deflection angles shown on the Pitch Trimmer Deflection Chart (figure 1-13).

EMERGENCY TRANSONIC TRIM CONTROL. If a malfunction of the automatic transonic trim compensation system is evidenced during transonic flight, immediately apply stick forces as required to counteract trim change effects. At the same time, hold the TRANS TRIM switch at "RETURN TO NEUTRAL" until the elevons have returned to their neutral position as indicated by stick forces. This will require up to 10 seconds, depending upon the degree of transonic trim prevalent at the time of failure. Then, place the TRANS TRIM switch "OFF" and continue flight without trim change compensation or land as desired.

CAUTION

- Do not hold the TRANS TRIM switch in the "RETURN TO NEUTRAL" position longer than necessary to relieve the surface of signals.
- Do not pull the ELEVON POWER RELEASE handle for transonic trim system malfunctions.

LANDING GEAR SYSTEM

EMERGENCY LANDING GEAR EXTENSION. In event of utility hydraulic power system failure, the landing gear can be extended by the following procedure:

a. Place the landing gear control handle in the "WHEELS DOWN" position.

b. Pull the EMER LDG GR RELEASE handle firmly and hold for 7 seconds.

c. If the gear does not free-fall to the down and locked position, repeat step b as often as required.

LANDING GEAR SAFETY SOLENOID. If the solenoid operated safety catch to prevent inadvertent retraction of the landing gear on the ground fails to retract after take-off, manually depress the catch and move the landing gear control to "WHEELS UP."

BRAKE SYSTEM

EMERGENCY BRAKE OPERATION. Failure of the utility hydraulic power supply will cause loss of pressure in the power boost brake system. To operate the brakes, approximately twice the normal toe pressure must be exerted. Make allowance for a longer landing roll.

SECTION IV

DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT

AIR CONDITIONING SYSTEMS

Two separate air conditioning systems are provided, one being used in conjunction with a pressurization system for cabin air conditioning and the other serving only as a cooling system for the electronics compartments. The latter system is completely automatic when d-c electrical power is supplied and therefore requires no attention from the pilot. In later aircraft[1] a heat exchanger has been added for windshield and canopy defrost purposes.

GROUND COOLING (LATER AIRCRAFT[2]). An external air hose inlet is provided in later aircraft to permit ground cooling of the electronic equipment by means of a mobile air conditioning unit.

CABIN AIR CONDITIONING AND PRESSURIZING SYSTEM

Cockpit pressurization, heating, cooling, ventilation, and windshield de-fogging is accomplished by an interconnected air conditioning and pressurizing system (see figure 4–1). Hot compressed air is bled from the engine compressor section and passed through a refrigeration unit. The cold air produced is mixed proportionately with hot air from the engine compressor section which by-passes the refrigeration unit. This mixed air provides heating or cooling as required. The cockpit is pressurized by the action of a pressure regulator which meters release of the compressed, conditioned air from the cockpit. Cabin differential pressures of 5 psi or 3.3 psi may be selected by the pilot. A portion of the conditioned air is passed over the windshield[3] to prevent fogging. If air passing over the windshield becomes hot enough to threaten safety of the windshield, an automatic temperature limit switch actuates a windshield de-fogging air shut-off valve. The windshield de-fogging air shut-off valve automatically returns to the open position when the conditioned air temperature is reduced to a safe value. An automatic regulator controllable by the pilot maintains constant cockpit temperature. In some aircraft[4], the pilot has control over the distribution of conditioned air either to warm his feet or for purposes of canopy defrost. In later aircraft[1] a heat exchanger has been added for windshield and canopy defrost purposes. Because of this independent defrost system, the cockpit refrigeration unit now supplies pressurized, conditioned air only to the footwarmer and cockpit diffusers.

AIR CONDITIONING CONTROL

In early aircraft[3] an AIR CONDITIONING knob (23, figure 1–5) on the right-hand console controls the cockpit air temperature. The knob is provided with an "OFF" position, a "MANUAL COLD" position, an automatic range calibrated from "40°-100°" F. and a "MANUAL HOT" position. A neutral detent is located between the automatic range and the "MANUAL HOT" position. To manually decrease cockpit temperature, it is necessary to hold the knob in the spring-loaded "MANUAL COLD" position. Temperatures selected in the "40°-100°" F. range are automatically maintained. To manually increase cockpit temperature, ensure that the control knob is in the "MANUAL HOT" detent and not in the adjacent neutral detent. The knob must be depressed to move it in or out of the "OFF" position. When the knob is placed in the "OFF" position, the cabin is depressurized and emergency ram air ventilation is provided.

In some aircraft[4], the AIR CONDITIONING knob serves only to select desired temperature settings. The knob cannot be turned "OFF," as that feature is blocked out. Instead, a DEFROST-NORMAL-RAM air selector switch (16A, figure 1–5), located outboard of the air conditioning panel on the right-hand console, turns the system on or off. Placing the switch in "DEFROST" opens the canopy defrost valve, allowing hot air to be ducted out the vents situated flush against the canopy panels for canopy defrost; the footwarmer valve also closes, shutting off conditioned air at the pilot's feet. In the "NORMAL" position, the switch closes the canopy valve for canopy defrost and opens the footwarmer valve providing heat from the forward section of the cabin floor. The "RAM" position of the switch shuts off the air conditioning system, depressurizes the cabin and admits ambient ram air from the air scoop outboard of the right-hand engine intake.

In later aircraft[1] the DEFROST-NORMAL-RAM air selector switch has been replaced by a NORMAL-RAM switch (figure 4–1A), and an independent defrost sys-

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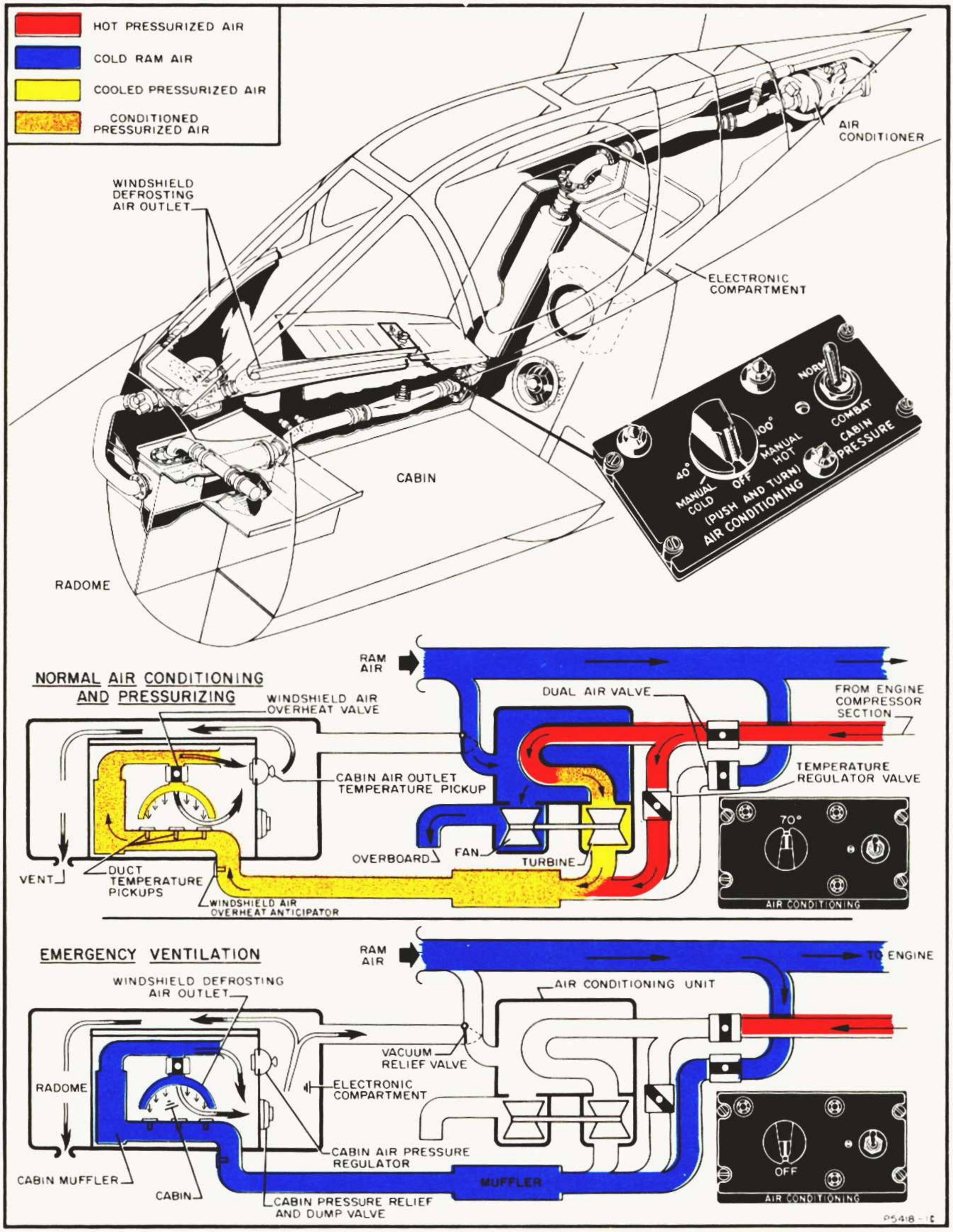
[1] Airplanes BuNo. 139030 and subsequent.

[2] Airplanes BuNo. 134745, 134748, 134751, 134754, 134762–134763, 134765–134766, 134819, 134853 and subsequent; BuNo. 134744, 134746–134747, 134749–134750, 134752–134753, 134755–134761, 134764, 134767–134818, 134820–134852 by service change.

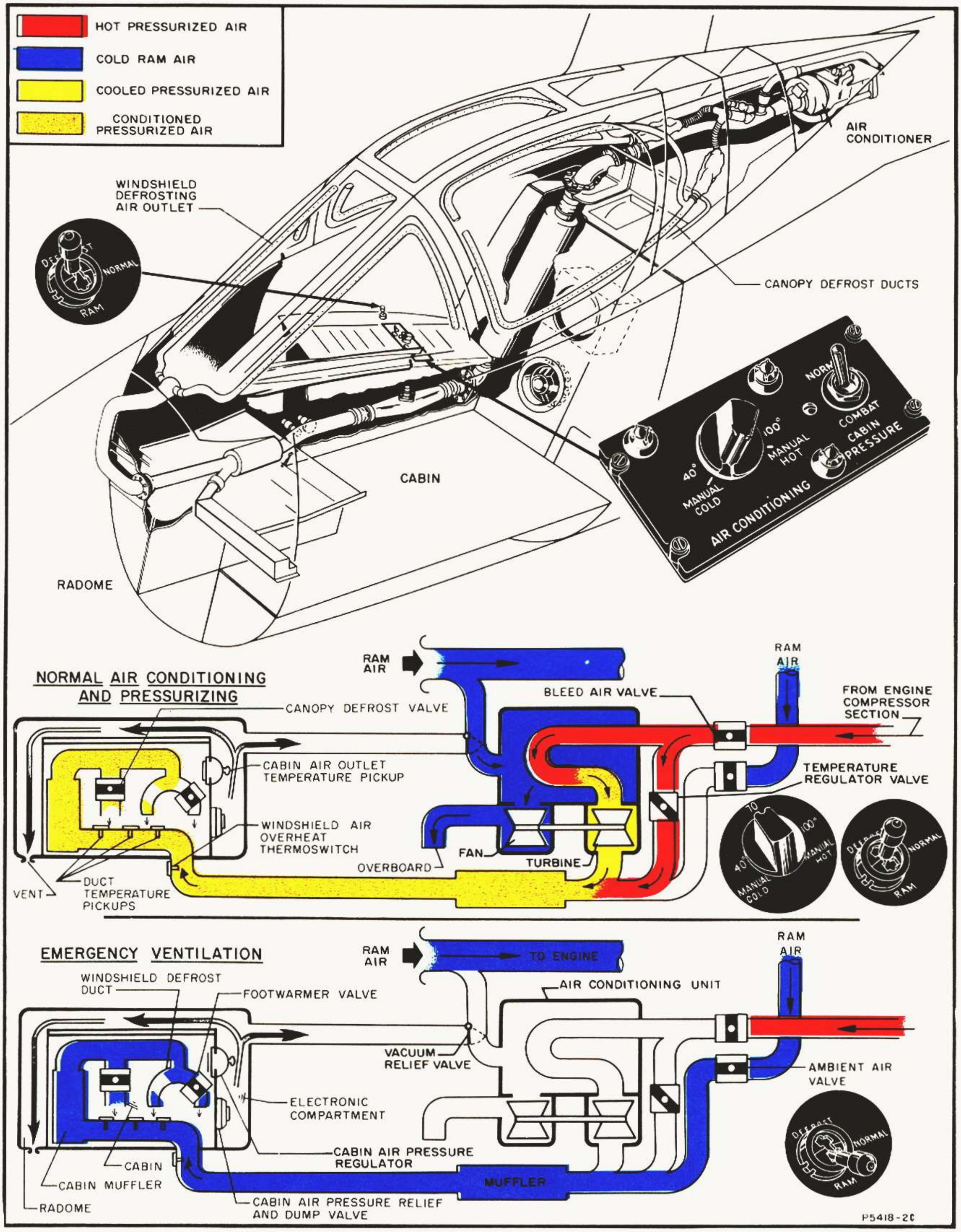
[3] Airplanes prior to BuNo. 134853 prior to service change.

[4] Airplanes BuNo. 134853–134973. Prior aircraft by service change.



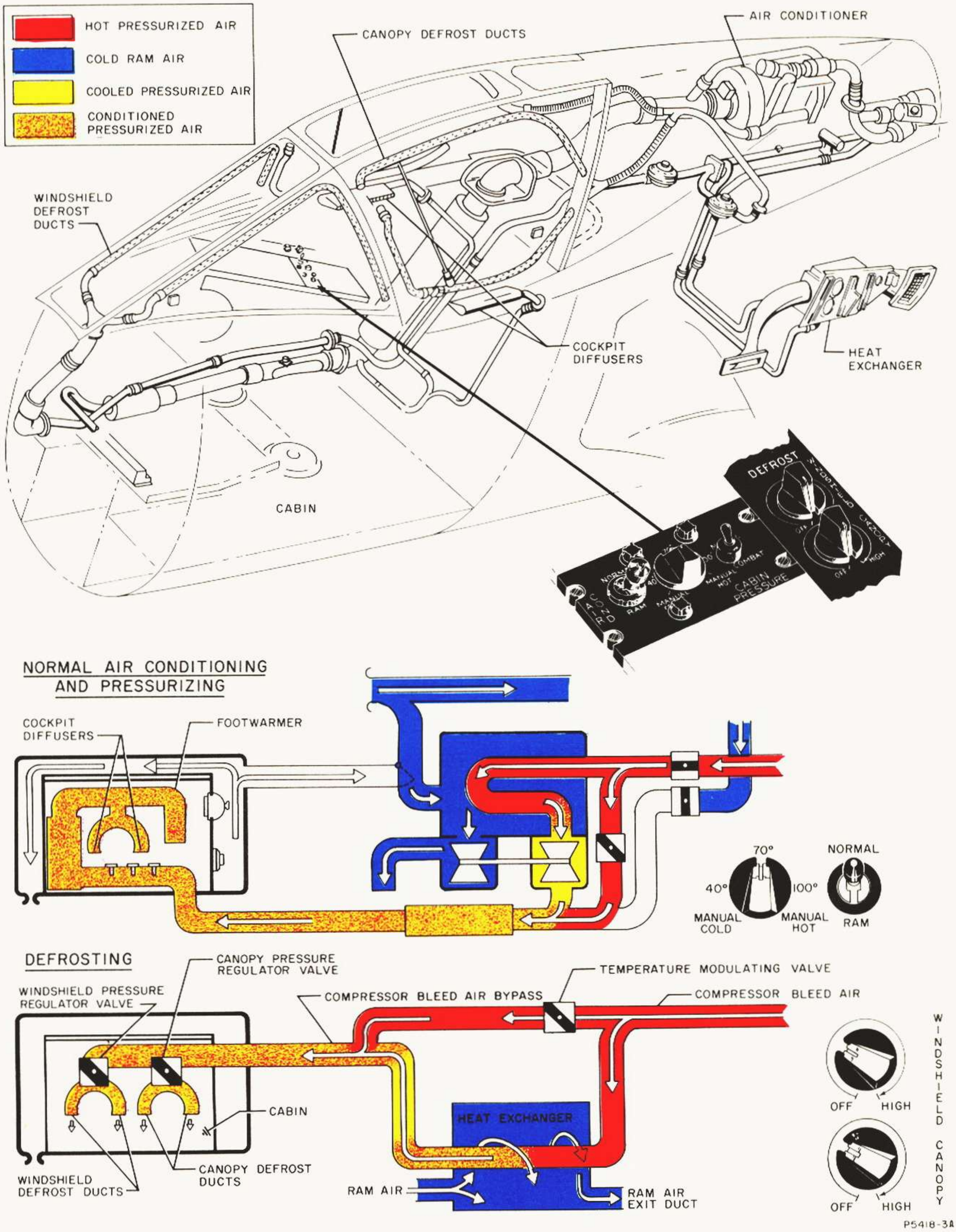
Airplanes BuNo. 130740–130750; BuNo. 134744–134852 prior to service change

Figure 4-1. Air Conditioning and Pressurization System (Sheet 1)



Airplanes BuNo. 134853–134973; BuNo. 134744–134852 after service change

Figure 4-1. Air Conditioning and Pressurization System (Sheet 2)



Airplanes BuNo. 139030 and subsequent

Figure 4-1. Air Conditioning and Pressurization System (Sheet 3)

tem has been added which incorporates the use of separate WINDSHIELD and CANOPY defrost knobs.

CABIN PRESSURE CONTROL

A CABIN PRESSURE switch (23, figure 1–5) is provided on the right-hand console. In the "NORMAL" position this switch sets the cabin pressure regulator to maintain atmospheric altitude to 5,000 feet, 5,000 feet cabin altitude from 5,000 feet to 18,000 feet flight altitude, and a cabin differential pressure of 5 ± .15 psi greater than atmospheric pressure at flight altitudes above 18,000 feet. With the switch in the "COMBAT" position, a 3.3 ± .15 psi pressure differential is maintained at flight altitudes above 13,000 feet. (See figure 4–2.)

NORMAL OPERATION

BEFORE TAKE-OFF. Before take-off, perform the following:

a. Place the DEFROST-NORMAL-RAM[1] switch at "NORMAL" or "DEFROST" as desired.

b. Place the NORMAL-RAM switch[2] to "NORMAL" and turn on the defrost system (if desired).

c. Place AIR CONDITIONING knob at "70°."

d. Place CABIN PRESSURE switch at "NORMAL" or "COMBAT" as desired.

DURING FLIGHT. Rotate AIR CONDITIONING switch to a setting which provides maximum comfort.

WARNING

Care must be taken not to press downward on the control knob while selecting the "MANUAL HOT" position. This action would allow the switch to be inadvertently rotated into the "OFF" position in some airplanes[3] thus depressurizing the cockpit. Depressurizing the cockpit above 43,000 feet pressure altitude would cause the limits of the oxygen regulator to be exceeded; as well as causing discomfort to the pilot because of decompressioning effect.

CAUTION

In early airplanes,[3] if a rapid descent from high altitude is anticipated, place the AIR CONDITIONING switch in the "MANUAL HOT" position to prevent windshield fogging.

AFTER FLIGHT. Place AIR CONDITIONING switch in "OFF" position or the DEFROST-NORMAL-RAM or NORMAL-RAM switch to "RAM."

EMERGENCY OPERATION

AIR CONDITIONING UNIT. If the air conditioning unit fails, cabin temperature will become excessively high and operation of the "MANUAL COLD" control will be ineffective. In this event, place the AIR CONDITIONING switch in the "OFF" position or the DEFROST-NORMAL-RAM or NORMAL-RAM switch in "RAM."

PRESSURE SUIT VENTILATION. On later airplanes,[4] provisions are installed which permit the ventilation of a full pressure suit. Conditioned air, circulated throughout the cockpit, is vented to the full pressure suit by an electrically driven pump located beneath the pilot's seat. The pump is activated by a two-position switch on the anti-blackout and pressure suit ventilation control panel. The flow of air is manually regulated through a rotating knob on the panel that positions the vent-flow valve to provide proper ventilation during all stages of flight.

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[1] Airplanes BuNo. 134853–134973; prior airplanes by service change.

[2] Airplanes BuNo. 139030 and subsequent.

[3] Airplanes prior to BuNo. 134853, before service change.

[4] Airplanes BuNo. 134919 and subsequent, BuNo. 134744–134918 after service change.

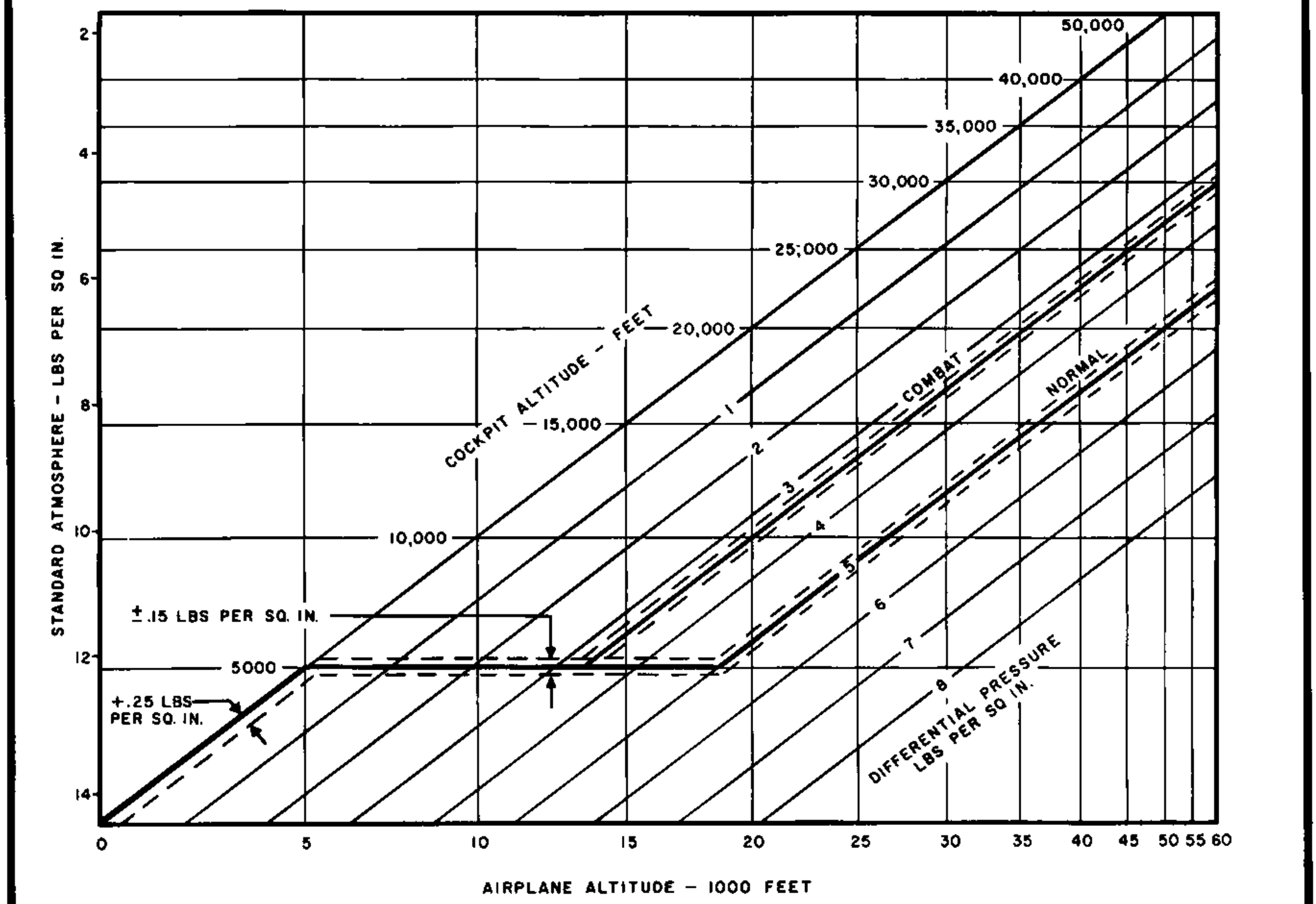


Figure 4-2. Cockpit and Airplane Altitude Comparison

WINDSHIELD AND CANOPY DEFROST SYSTEM

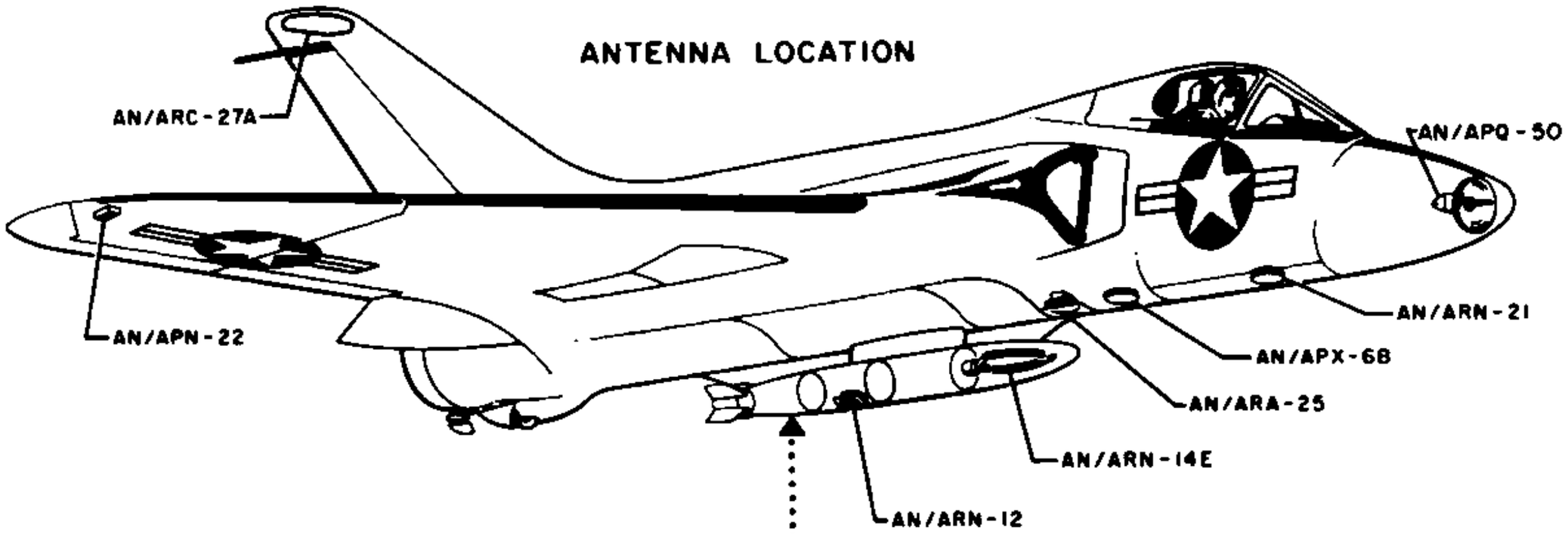
Later aircraft[1] are equipped with an independent windshield and canopy defrost system. This system incorporates a heat exchanger through which hot compressor bleed air is cooled by engine intake ram air. Compressor bleed air flows through a separate line which bypasses the heat exchanger. This air mixes with the cooled air from the heat exchanger to furnish hot (265°F) air for windshield and canopy defrost. Two defrost knobs (figure 4–1A) are located outboard on the right hand console and are labeled WINDSHIELD and CANOPY.

[1] Airplanes BuNo. 139030 and subsequent.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

AIRCRAFT INSTALLATIONS

TYPE	DESIGNATION	FUNCTION	RANGE	LOCATION OF CONTROLS
COMMUNICATION				
UHF RADIO	AN/ARC-27A	SHORT RANGE - TWO WAY VOICE COMMUNICATION	LINE-OF-SIGHT	RIGHT-HAND CONSOLE
NAVIGATION				
OMNI-BEARING (1) DISTANCE RADIO	AN/ARN-21	PROVIDES BEARING AND DISTANCE TO A SELECTED BEAM	LINE-OF-SIGHT TO 200 MILES	RIGHT-HAND CONSOLE
UHF HOMING ADAPTER	AN/ARA-25	PROVIDES MEANS OF HOMING ON UHF TRANSMISSIONS	LINE-OF-SIGHT	RIGHT-HAND CONSOLE
IFF RADAR	AN/APX-68	TRANSMISSION & RECEPTION OF IDENTIFICATION SIGNALS	LINE-OF-SIGHT	RIGHT-HAND CONSOLE
IFF RADAR	KY-81/APA-89	VIDEO RESPONDER	LINE-OF-SIGHT	RIGHT-HAND CONSOLE
ORDNANCE				
FIRE CONTROL	MK 16	VISUAL FIRE CONTROL SYSTEM	2000 YARDS	RIGHT-HAND CONSOLE
RANGE RADAR (2)	AN/APQ-50	SEARCH AND TRACKING	200 NAUTICAL MILES	LEFT-HAND CONSOLE



NAVIGATIONAL PACKAGE

TYPE	DESIGNATION	FUNCTION	RANGE	LOCATION OF CONTROLS
OMNI-RANGE RECEIVER	AN/ARN-14E	VOR, VAR & LOCALIZER SIGNALS	LINE-OF-SIGHT	RIGHT-HAND CONSOLE
MARKER BEACON RECEIVER	AN/ARN-12	RECEPTION OF LOCATION MARKER BEACON SIGNALS FROM INSTRUMENT APPROACH STATIONS	WITHIN BOUNDARIES OF FAN MARKER OR Z MARKER	RIGHT-HAND CONSOLE (TONE CONTROL ONLY)

(1) INSTALLATION PROVISIONS ONLY
(2) BUNO 134853 AND SUBSEQUENT

P-5420-1E

DATA AS OF: 1 July 1956

Figure 4-3. Communication and Associated Electronic Equipment

Turning the knobs clockwise from "OFF" to the required setting controls the flow of hot air for defrost purposes. For normal operation, the knobs should be rotated just slightly from the "OFF" position in order to keep the hot air flow over the windshield and canopy at a low level. If the knobs are set too high, the subsequent increase of hot air flow will lead to an increase in the temperature of the upper portion of the cockpit. This action could eventually affect the normal operation of the cockpit refrigeration unit since the temperature sensing element, located in the upper part of the cockpit behind the pilot's seat, will respond to the increased temperature by shutting off the supply of conditioned, warm air. Cold air will then be introduced into the cockpit and result in discomfort to the pilot in that the upper part of his body will be hot and the lower part cold. More important, however, is that under these circumstances there is a probability that the meeting of hot air from the heat exchanger and the cold air from the cockpit refrigeration unit will produce fog in the cockpit, thereby obscuring the instruments from the pilot's view. Therefore, it is recommended that the WINDSHIELD and CANOPY defrost knobs be set to the position which will supply the minimum amount of hot air required for adequate defrosting. This will provide maximum comfort and minimum temperature differential between feet and head. Setting the knobs to permit a slight airflow at all times, or at least when icing conditions are anticipated, will expedite dissipation of ice or prevent it from forming. Temperature sensing elements on the windshield and canopy are used to shut off the supply of hot air if the temperature reaches a point that threatens to crack the glass.

CAUTION

In the event of a-c power failure, the pilot does not have protection of the temperature sensing elements to prevent thermoshock to the glass. However, he can stop the flow of hot air to the glass by placing the defrost knobs in the "OFF" position.

Nesa glass,[1] which contains electrical heating elements, is installed in the center windshield panel. The pilot has no control of these elements, which are energized as long as d-c power is available. A constant temperature of 100° ± 10°F is maintained throughout the glass for defrost when the B phase of the a-c power supply is energized. The temperature is regulated to remain within limits by an automatic temperature-sensing unit. Allow a period of approximately three minutes for warm-up after the power is turned on before checking to see that the inside panel of the windshield feels warm to the hand.

[1] Airplanes BuNo. 134853 and subsequent; BuNo. 134744–134852 by service change.

ANTI-ICING SYSTEM

ENGINE

Ice formation in the engine air inlet section is prevented by an integral power plant system which utilizes high pressure, hot bleed air from the compressor section. Air bled from both sides of the compressor discharge is piped forward through two external lines and distributed through the inlet guide vanes from which it is ported into the engine inlet airstream.

ANTI-ICING CONTROL. Electrical control of the anti-icing system is accomplished by operating the PITOT & ENGINE ANTI-ICING switch (11, figure 1–5) located on the outboard side of the right-hand console. This switch directs power to an anti-icing valve and regulator mechanism on each external line.

CAUTION

- The engine anti-icing system is designed to *prevent* ice formation, and safe operation requires that the pilot anticipate the possibility of ice formation whenever dangerous conditions exist.
- When icing conditions are encountered, the airplane must be operated at a thrust level and Mach number equivalent to or above maximum range cruise flight conditions. Operation below this thrust level may not supply sufficient heat to keep the engine inlet guide vanes clear of ice.

PITOT AND SENSING PROBE

Electrical heating is provided for the pitot tube, yaw sensing probe and angle of attack sensing probe. When the PITOT & ENGINE ANTI-ICING switch is turned "ON," these circuits are energized in conjunction with engine anti-icing.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

The communication and associated electronic equipment installed in the airplane consists of five categories. Each is listed in figure 4–3.

MICROPHONE AND HEADSET JACK

The microphone and headset jack is incorporated into the oxygen supply tube and comprises a component of the personnel gear adapter (28, figure 1–3). The connection is located on the left-hand console adjacent to the seat.

MICROPHONE BUTTON

The microphone button (9, figure 1–3) is located on the throttle grip and (for use when operating the Aero 13F fire control system) on the radar control handle. With the UHF receiver-transmitter in operation, the microphone button is depressed to transmit.

UHF RADIO EQUIPMENT

The AN/ARC-27A radio equipment provides two-way voice communication with other aircraft or surface facilities. Transmission and reception are on the same frequency and through the same antenna. Remote tuning of the RT-178/ARC-27A transmitter-receiver is achieved through the UHF radio control panel.

UHF RADIO CONTROL PANEL. Radio control panel, C-2459/ARC-27A, identified as UHF and located on the right-hand console (24, figure 1–5) provides

the pilot with 20 preset channels, 1750 manual channels or the guard channel, all of which are selected from the 1750 available frequency channels in the range of 225 to 400 megacycles. The channel selector (CHAN) provides selection of #1 through #20 preset channels, the guard channel (G) or the manual position (M). In the manual position (M), the three concentric dials (frequency selectors) on the right side of the panel, control the equipment frequency directly. The outer dial sets the first two digits of the frequency, the center dial sets the third digit and the inner dial sets the digit to the right of the decimal point.

The frequency of preset channels is normally set by maintenance personnel. However, the procedure is as follows:

1. Set the channel selector (CHAN) to the desired preset channel number.

2. Set the three concentric dials (frequency selectors) to the desired frequency.

3. Turn the preset button (PUSH TO SET CHAN) in the direction shown by the arrow (next to word UNLOCK) until a stop is felt, then push button into panel until another stop is felt.

A standard function switch provides for a mode of operation as follows:

Setting	*Function*
"OFF"	Set inoperative
"T/R"	Transmitter and main receiver in operation. Guard receiver in standby. ADF in standby.
"T/R+G"	Transmitter and main receiver in operation. Guard receiver in operation. ADF in standby.
"ADF"	Transmitter in standby. Guard receiver in standby. ADF in operation thru main receiver.

NAVIGATIONAL PACKAGE (NAVPAC)

VHF navigation equipment is provided by the installation of an external unit referred to as the NAVPAC (20, figure 1–2, sheet 1). This unit, designed for ready installation or removal to conform with existing operational conditions, contains omni-range radio receiving set ARN-14E and marker beacon receiving set ARN-12 with antennas installed in the fore and aft sections of the NAVPAC. A spring loaded momentary contact CENTER STORES switch (3, figure 1–3) installed on the left-hand console provides for emergency jettisoning of the unit. A quick-disconnect fin assembly is fitted to the aft end of the NAVPAC.

CAUTION

The fin assembly must be removed before opening the forward engine access door.

RADIO RECEIVING SET AN/ARN-14E

PURPOSE OF THE EQUIPMENT. The AN/ARN-14E is designed to receive all VHF omni-range, tone localizer and voice facilities in the 108-136 megacycle spectrum and to enable the pilot to home, track to and from the station on pre-determined courses, monitor voice transmissions, perform procedure turns and to make low-approaches to fields equipped with omni-range facilities.

CONTROL PANEL C-760B/A. Control panel C-760-B/A is identified as VHF-NAV and is installed on the right-hand console (19, figure 1–5). This panel contains a power "ON-OFF" switch, VOLUME control and a frequency control incorporating a concentric dial and tuning knob. Rotation of the knurled section of the concentric dial selects frequencies in the 108-136 megacycle spectrum and operation of the center tuning knob of the dial selects the one-tenth megacycle to the right of the decimal point. The frequency selected is indicated in the windows of the frequency control unit and are read downward.

COURSE INDICATOR ID-249A. Course indicator ID-249A (13, figure 1–4) incorporates a vertical bar and a horizontal bar. The indicator is controlled by radio-receiver ARN-14E (and ARN-21 when installed). The vertical bar moves laterally to give directional guidance to the selected facility. The horizontal bar is not operative in this airplane. The two bars remain parallel to their rest positions and are always at right angles to each other. A course window in the instrument indicates the course that is set into the instrument and a "TO-FROM" flag appearing in a second window indicates whether the airplane is heading toward or away from the station. The desired course is set into the instrument by the SET control. A relative heading indicator consisting of a pointer with a white circle on the outer end is also provided on the face of the instrument. The end of the pointer moves around the inside edge of the circular face of the instrument to indicate the angle between the heading of the airplane and the course set into the COURSE window. Travel of the pointer is calibrated to 45 degrees each side of center, top and bottom, to facilitate approaching the desired track at definite angles and for establishing wind correction angles. A marker beacon light of the PRESS-TO-TEST type and a "DIM" control is incorporated into the upper right-hand corner of the instrument.

Note

The ID-249A indicator is used alternately with the ARN-21 radio, and, if both sets are placed in operation at the same time, the pointer will give priority to the AN/ARN-21 signal.

COURSE INDICATOR ID-250/ARN. Magnetic directional information is provided by the number 2 pointer of the ID-250/ARN indicator (4, figure 1–4). The visual indicator provides magnetic bearing to the selected station when the AN/ARN-14E or AN/ARN-21 radio is operating.

Note

The number 2 pointer of the ID-250/ARN indicator is used alternately with the AN/

ARN-21 radio and, if both sets are placed in operation at the same time, the pointer will give priority to the AN/ARN—21 signal.

OPERATION OF AN/ARN-14E. Operation of radio receiving set AN/ARN-14E is as follows:

a. Select frequency on the concentric dial and tuning knob on VHF-NAV control panel.

b. Select desired course to be indicated on course indicator ID-249A/ARN by rotation of SET control incorporated on the lower left-hand corner of the instrument.

c. Move POWER switch on VHF-NAV control panel to the "ON" position.

d. Secure audio station identification.

e. Adjust volume by rotating the VOLUME control.

MARKER BEACON RECEIVING SET

The R-122/ARN-12 marker beacon receiving set is an airborne navigational aid. The function of the receiver is to receive signals transmitted by a ground beacon facility on a fixed frequency of 75 megacycles and to deliver an aural tone and a visual indication of the received signal to the pilot. The equipment is automatically energized and ready for functioning whenever d-c power is supplied to the airplane electrical system. A knob identified as MISSILES & MARKER BEACON AUDIO (5, figure 1–5) and located on the forward right-hand console, provides volume control from "OFF" to "LOUD." Use of this knob makes it possible to control volume of aural marker beacon signals during simultaneous reception with other radio equipment. The aural tone may be turned off when not desired. Refer to section IV of the Confidential Supplement for other functions of this knob.

MARKER BEACON INDICATOR. The AN/ARN-12 marker beacon indicator is an amber press-to-test light located on the instrument panel (13A, figure 1–4). The function of the marker beacon indicator is to present a visual indication to the pilot of a signal received from a marker beacon transmitter.

AUTOMATIC DIRECTION FINDING EQUIPMENT

AN/ARA-25

The AN/ARA-25 automatic direction finding equipment operates in conjunction with the AN/ARC-27A UHF radio communications system to provide a continuous relative directional indication of the source of signals in the 225-400 megacycle band. Approximate source indication in degrees of relative bearing is provided by the single-bar pointer of the ID-250/ARN course indicator (4, figure 1–4) for homing or direction finding purposes.

COURSE INDICATOR ID-250/ARN. A circular scale calibrated in 2 degree increments is provided in the face of the instrument to indicate the magnetic heading of the airplane. The rotatable scale is controlled by the S-2 gyrosyn compass and the magnetic heading is read underneath the fixed scale at the top of the instrument. Two pointers are incorporated into the instrument. Pointer number 1, a single barred pointer, is connected to radio receiving set AN/ARA-25 and provides for UHF homing or direction finding as desired. Pointer number 2, a double barred pointer, is connected to radio receiving set AN/ARN-14E or AN/ARN-21 and provides supplementary homing or direction finding information when the VHF-NAV control panel C-760B/A or C866 is turned "ON."

OPERATION OF THE AN/ARA-25. The AN/ARA-25 is placed in operation with the function selector switch labeled "OFF-T/R-T/R+G-ADF."

a. Rotate the function selector switch on the UHF radio control panel C-2459/ARC-27A to the "ADF" position. (Allow a 3-minute warm-up period if the control is moved from the "OFF" position.)

b. Select the desired frequency with the CHAN control.

c. Observe the direction of the signal source (relative bearing) as indicated on the azimuth scale under the single-bar pointer of the course indicator for direction finding; or, turn the airplane until the narrow end of the single-bar pointer is under the lubber line of the ID-250/ARN course indicator.

Note

SLAVED GYRO-FREE GYRO switch must be on "SLAVED GYRO."

CAUTION

Because ADF readings may be subject to an error of ±20 degrees, this equipment should not be considered reliable for navigational purposes.

AN/ARN-21 RADIO[1] (TACAN)

Radio set AN/ARN-21 is airborne equipment which operates in conjunction with a selected surface navigation beacon and provides continuous direction and distance information to the pilot. Pulse signals are transmitted and received from the beacon by radio RT-220/ARN-21 where time lapses are converted into distance measurement readings on the ID-310/ARN range indicator (14, figure 1–4). Visual indication of magnetic bearing to the beacon is provided by the number 2 pointer of the ID-250/ARN course indicator. The set also incorporates the use of the ID-249/ARN course indicator to provide "fly left" and "fly right" instructions as well as "TO-FROM" information concerning

[1] Airplanes BuNo. 134853 and subsequent; BuNo. 134744–134852 by service change.

airplane heading with relation to the beacon. Beacon identification tone signals are received through the regular headset.

Note

Because of the fact that the ID-249/ARN and ID-250/ARN indicators are common to both the AN/ARN-14E radio and the AN/ARN-21 radio, means are provided for the selection of proper receiver-indicator combinations to meet specific navigational requirements. An electrically operated rotary type switch will automatically connect the indicators to the respective set when the power switch on either the C-866/ARN-21 or C-760A/ARN-14E control panel is turned on. If both radio sets are turned on at the same time, the switch will act to give priority in the operation of the AN/ARN-21 equipment.

CONTROL PANEL C-866/ARN-21. The C-866/ARN-21 control panel (25, figure 1–5) is identified as NAV and located on the right-hand console. Operating controls include the power switch with "OFF-REC-T/R" positions, two CHAN (channel selector) knobs and a VOL (volume) control. The left CHAN knob sets the tens and hundreds figures of the channel number in the dial; the right CHAN knob sets the units figures.

OPERATION OF AN/ARN-21. A warm-up period of 90 seconds is required after the power switch is turned from the "OFF" position. There is no delay when switching from "REC" to "T/R." Observe the following procedure for operating the AN/ARN-21 radio:

a. Power switch ..... "REC" or "T/R"

b. CHAN selector ..... Set channel number in dial

Identify the beacon by verifying the tone signal received in the headset thru VOL control. When operating on "REC" check the number 2 pointer of the ID-250/ARN indicator for magnetic bearing to the beacon and the vertical cross-bar on the ID-249A/ARN indicator for course deviations. In "T/R" also check the ID-310/ARN indicator and observe that the red flag disappears behind the meter face to obtain accurate slant range distance readings in nautical miles.

RADAR IFF SYSTEM

AN/APX-6B

The AN/APX-6B identification set provides the airplane with a means of identifying itself when correctly challenged by surface or airborne radar equipment. The system also permits surface tracking of the airplane in which it is installed.

IFF CONTROL PANEL C-1159/APX-6B. The IFF control panel C-1159/APX-6B (21, figure 1–5) is installed in the right-hand console and is identified as IFF. The unit contains a rotary selector switch identified as MASTER with five designated positions: "OFF," "STDBY," "LOW," "NORM" and "EMERGENCY."

OPERATION OF THE AN/APX-6B. The system is energized when the MASTER switch on the IFF control panel is set to any position other than "OFF." A push button below and to the left of the function selector switch controls the operation of the "EMERGENCY" setting of the function switch. Depressing the button is required before the "EMERGENCY" position can be entered. This prevents inadvertent movement of the control to the "EMERGENCY" position. The function selector switch identified by the "OFF," "STDBY," "LOW," "NORM," "EMERGENCY" positions is operated as follows:

Setting	*Function*
"OFF"	Set is inoperative.
"STDBY"	Set is ready for operation but the transponder-receiver is not sensitized and no replies can be transmitted.
"LOW"	Transponder-receiver operates at reduced sensitivity and replies will be transmitted upon receipt of strong interrogation signals ordinarily from nearby interrogator-responsors.
"NORM"	Transponder-receiver is given full sensitivity and the transponder operates with maximum performance. Transmitted power from the transponder is the same for both the "LOW" and "NORM" positions of this switch.
"EMERGENCY"	Emergency replies are transmitted upon receipt of any IFF interrogation regardless of the mode of interrogation or the settings of MODE toggle-switches on the control panel.

Note

It is necessary to press the dial stop while turning the switch to the "EMERGENCY" setting which is the next detent position set counterclockwise from "NORM."

AN/APA-89

Provisions are made for installation of AN/APA-89 equipment which includes the C-1272/APA-89 control panel (20, figure 1–5).

RADAR RANGING EQUIPMENT

AN/APQ-50

Later airplanes[1] are equipped with AN/APQ-50 radar. Information received by this radar can be adapted to fire control functions at the selection of the pilot. A RADAR control panel is installed in the left hand console (27, figure 1–3, sheet 2) of airplanes equipped with the AN/APQ-50 radar. For information concerning the operation of the AN/APQ-50 radar refer to section IV of the Flight Handbook Confidential Supplement, AN 01-40FBA-1A.

RADAR ALTIMETER

The AN/APN-22 radar altimeter is designed to provide reliable height indications over the terrain from 0–10,000 feet over land and 0–20,000 feet over water. The accuracy of indication is plus or minus 2 feet from 0–40 feet and plus or minus 10% percent of the indicated altitude from 40–10,000 feet.

HEIGHT INDICATOR ID-257/APN-22. The height indicator (9, figure 1–4) is located on the pilot's instrument panel and indicates the true altitude of the airplane above the terrain on a single-turn type instrument. The altitude pointer advances lineally over the calibrated range of the instrument from 0–200 feet and proportionately from 200–20,000 feet. The ON-LIMIT switch located at the lower left-hand corner of the instrument is the only manual operating control on the indicator. This switch incorporates the OFF-ON control and is also used to select the limit altitude by adjustment of a "bug-pointer" on the outside of the calibrated scale.

LIMIT INDICATOR LIGHT. An altitude limit indicator light is incorporated in the instrument. When illuminated this light provides a visual indication of flight at or below a pre-set altitude. As long as the airplane remains above this altitude, the light will remain off. Another altitude limit indicator light is provided for use with the AFCS Aero 13F and is located in the lower left hand corner of the AN/APQ-50 radar scope[1]. When at or below the pre-set altitude, the light will blink (when the CONSOLES switch is in "OFF") or emit a steady glow (when the CONSOLES switch is in any position other than "OFF").

DROP-OUT. The "drop-out" altitude (altitude at which the signal becomes too weak to operate the radar altimeter) is above 10,000 feet over land, and above 10,000 feet altitude when flying over water. When drop-out occurs the instrument is temporarily disabled, moving the indicator needle behind a mask to prevent reference to the instrument when signals are too weak for reliable indication.

OPERATION OF THE AN/APN-22 RADAR ALTIMETER

a. Turn the ON-LIMIT switch on the height indicator in a clockwise direction.

b. Allow approximately 3 minutes for the equipment to start operating.

c. Set the bug-pointer to the desired altitude by rotation of the ON-LIMIT switch.

d. To turn off the AN/APN-22 radar altimeter, turn the ON-LIMIT switch in a counterclockwise direction to its fullest extent.

LIGHTING EQUIPMENT

EXTERIOR LIGHTS

The exterior lights consist of navigation, fuselage, formation, approach and taxi lights. Circuits energized by 115-volt a-c power or 28 volt d-c power are utilized to operate the exterior lights whenever the appropriate switches are turned on. Power for the exterior lights is controlled by a two position[2] or a three position[3] EXTERIOR LIGHTS master switch (6A, figure 1–3) which is located on the left-hand console outboard of the emergency pitch trimmer control. The one exception being that the approach lights will operate with this master switch "OFF"; however, the lights will be dimmed when the switch is "ON,"[2] or at "STEADY" or "FLASH."[3]

NAVIGATION LIGHTS. Navigation lights (6, 10. figure 1–2, sheet 1) are installed on the top and bottom of each wing tip and on each side of the vertical stabilizer. After the EXTERIOR LIGHTS master switch has been turned "ON," the navigation lights are further controlled by a DIM-BRIGHT switch and an EXTERIOR LIGHTS STEADY-FLASH switch (14A and 15, figure 1–5). The latter two switches are located in tandem outboard on the right-hand console. When the lights are on "BRIGHT," they receive power from three phases of the a-c power supply. When selected "DIM," 28 volt d-c power is furnished to the lights.

On later airplanes[3] the "ON" position of the EXTERIOR LIGHTS master switch has been deleted. The EXTERIOR LIGHTS master switch must be turned to "STEADY" or "FLASH," after which the navigation lights can be controlled by operating the NAV LIGHTS DIM-OFF-BRIGHT switch (14A, figure 1–5), which is located outboard on the right-hand console.

APPROACH LIGHT.[1] An intricate approach light system is installed, consisting of an angle of attack sensing probe, a combined computer unit, an ANGLE of ATTACK indicator, and a three colored external approach (Grimes) light unit. The sensing probe, located on the right side and aft of the radome, freely torques in response to the relative wind. Signals transmitted from the probe to the airstream direction combined computer

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[1] Airplanes BuNo. 134745, 134751, 134766, 134853 and subsequent; BuNo. 134744, 134746, 134747, 134749–134753, 134755–134761, 134764, 134767–134852 by service change.

[2] Airplanes BuNo. 130740–130750; BuNo. 134744 and subsequent before service change.

[3] Airplanes BuNo. 134744 and subsequent after service change.

unit effect the readings on the ANGLE of ATTACK indicator and control illumination of the colored lights. The external approach light unit viewed by the Landing Signal Officer is located on the aft nose wheel well door, and automatically operates when the aircraft is airborne with landing gear down and locked and the tail hook extended. The three colored lights in the unit go out when the gear lever is pulled up or when the "squat" switch is activated upon touch-down. They glow bright for daytime usage, but become dim automatically whenever the EXTERIOR LIGHTS master switch is turned on for night flying.

Note

The hook by-pass switch may be utilized for FCLP landings.

Flight attitude of the aircraft is visually indicated to the LSO as follows:

a. Amber light — Optimum approach angle of attack.

b. Red light — Angle of attack is too low.

c. Green light — Angle of attack is too high.

APPROACH LIGHT.[2] There is a prism type approach light (24, figure 1 2, sheet 1) located on the aft nose wheel well door which is visible when the door is in the open position. Operation of the light is controlled by switches on the nose gear, main landing gear, and arresting hook struts. For carrier landings, the approach light operates as follows:

WHEELS	HOOK	APPROACH LIGHT
Not locked down	Any position	Off
Locked down	Not down	Off
Locked down	Down	On

A hook by-pass switch is located in the right-hand wheel well adjacent to the external d-c power receptacle to allow operation of the light for night field carrier landing practice.

Note

When the hook by-pass switch has been depressed, the approach light will continue to operate whenever the wheels are locked down regardless of hook position. The hook by-pass circuit remains operative until the aircraft d-c electrical system is shut off, at which time it will reset itself for normal operation. If field carrier practice landings are made and it is desired to reset the hook by-pass circuit for normal operation without stopping to turn off the d-c electrical system, it may be accomplished by operating the arresting hook through one cycle during flight.

FUSELAGE LIGHTS[1]. Two white fuselage lights are installed on the aircraft. One light is located on top of the canopy just forward of the hinge point, and the other light is on the underside of the fuselage on the forward engine access door. These lights may be operated only after the EXTERIOR LIGHTS master switch has been turned on. Then the FUSELAGE LIGHT switch (15A, figure 1 5), located on the right-hand outboard console, must be toggled from "OFF" to "DIM" or "BRIGHT." When in the "BRIGHT" position, the lights receive their power from the phase B bus of the a-c power supply. When at "DIM," power is from the 28 volt d-c supply. The flash-steady feature is used in conjunction with the selection made while operating the navigation lights,[4] or the EXTERIOR LIGHTS master switch.[3]

FORMATION LIGHTS. Bar formation lights, amber in color, are positioned on the aircraft so as to facilitate visual reference during night flights. There are four lights, one on each side below the canopy fairing and one on each side of the dorsal forward of the vertical stabilizer. The formation lights are on whenever the EXTERIOR LIGHTS switch is at "ON," and thereby receive power from the 28 volt d-c supply.

After service change,[3] the four lights will be located one on each side below the canopy fairing and one half way up each side of the vertical stabilizer. On these airplanes, after the EXTERIOR LIGHTS master switch has been placed to "FLASH" or "STEADY," the formation lights can be controlled by operating the FORM LIGHTS switch (15, figure 1–5), which is located on the right-hand console. The positions of the switch are "DIM," "OFF" and "BRIGHT." The lights are powered by the 28 volt d-c supply in both the "DIM" and "BRIGHT" positions.

TAXI LIGHT[1]. The taxi light is attached to the right main gear and may be utilized during periods when the gear is extended. After the EXTERIOR LIGHTS master switch has been turned on, a toggle switch (31, figure 1–3), located on the left-hand console, serves to connect the electrical bus supplying B phase a-c power to operate the taxi light when the switch is turned "ON."

INTERIOR LIGHTS

The interior lights consist of instrument lights, console lights, and floodlights. The instruments are illuminated by red lighting emanating from behind the instrument masks. The consoles are illuminated by indirect red lighting from numerous light sources behind the consoles which transmit light through acrylic plastic panels. The instrument and console lights are powered by the a-c electrical system. Four floodlights are also provided

(1) Airplanes BuNo. 134830, 134853 and subsequent; prior airplanes by service change.
(2) Airplanes BuNo. 130740–130750, 134744–134829, 134831–134852 before service change.
(3) Airplanes BuNo. 134744 and subsequent after service change.
(4) Airplanes BuNo. 130740–130750; BuNo. 134744 and subsequent before service change.

for illumination of the instrument panel and consoles. One floodlight is mounted on each side of the cockpit near the glareshield (13, figure 1–3, and 30, figure 1–5). One floodlight is mounted on the bulkhead above the aft end of each console. All floodlights are powered by the d-c electrical system and controlled by switches on the interior lights control panel. The two forward floodlights have an adjustable cover for directing the light beam and the right forward floodlight can be detached for use as an extension light.

An INTERIOR LIGHTS FUSES panel (17, figure 1–5) on the right-hand console contains fuses for FLIGHT INSTRS, OTHER INSTRS and CONSOLES lights.

GASEOUS OXYGEN DURATION

CABIN ALTITUDE FEET	AIR VALVE	GAGE PRESSURE – P.S.I.								
		1800	1600	1400	1200	1000	800	600	400	300 & BELOW
43,000	NORMAL	7.6	6.6	5.6	4.5	3.5	2.5	1.5	0.5	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	100% OXYGEN	7.6	6.6	5.6	4.5	3.5	2.5	1.5	0.5	
40,000	NORMAL	7.1	6.1	5.2	4.2	3.3	2.3	1.4	0.5	
	100% OXYGEN	7.1	6.1	5.2	4.2	3.3	2.3	1.4	0.5	
35,000	NORMAL	5.4	4.6	3.9	3.2	2.5	1.8	1.1	0.3	
	100% OXYGEN	5.4	4.6	3.9	3.2	2.5	1.8	1.1	0.3	
30,000	NORMAL	3.8	3.3	2.8	2.3	1.8	1.3	0.7	0.2	
	100% OXYGEN	3.8	3.3	2.8	2.3	1.8	1.3	0.7	0.2	
25,000	NORMAL	4.6	3.9	3.3	2.7	2.1	1.5	0.9	0.3	
	100% OXYGEN	2.7	2.4	2.0	1.6	1.3	0.9	0.5	0.2	
20,000	NORMAL	5.9	5.1	4.3	3.5	2.7	1.9	1.2	0.4	
	100% OXYGEN	2.0	1.8	1.5	1.2	0.9	0.7	0.4	0.1	
15,000	NORMAL	6.4	5.5	4.7	3.8	3.0	2.1	1.3	0.4	
	100% OXYGEN	1.4	1.3	1.1	0.9	0.7	0.5	0.3	0.1	
10,000	NORMAL	5.6	4.9	4.1	3.4	2.6	1.9	1.1	0.4	
	100% OXYGEN	1.0	0.9	0.7	0.6	0.5	0.3	0.2	—	
SEA LEVEL	NORMAL	4.3	3.7	3.1	2.6	2.0	1.4	0.8	0.3	
	100% OXYGEN	0.6	0.6	0.5	0.4	0.3	0.2	0.1	—	

REMARKS:

(1) Data based on one 514 cubic inch cylinder.
(2) Chart is based on 23.7 liters per minute breathing rate at pressures and temperatures existing in the lungs.
(3) Upper figures in each box indicate AIR VALVE knob set at "NORMAL".
(4) Lower figures in each box indicate AIR VALVE knob set at "100% OXYGEN"

DATA AS OF: 7 April 1954
DATA BASIS: Calculations

P5419-1A

Figure 4-4. Oxygen Duration (Sheet 1)

INTERIOR LIGHTS CONTROL. The INT LTS control (22, figure 1–5) operates the instrument, console, and flood lights. Turning the INST switch clockwise from the "OFF" position toward "BRIGHT" turns on the instrument lights and regulates their intensity. Turning on the instrument lights also operates a warning light dimming relay which automatically dims all cockpit warning lights for night flying. To operate the console lights, the CONSOLES switch is turned clockwise from the "OFF" position toward "BRIGHT" until the desired intensity is obtained. To operate the instrument floodlights the FLOOD switch is placed at "BRIGHT," "DIM," or "MEDIUM" as desired. The floodlights switch will not operate unless the console lights switch is turned on.

EMERGENCY OPERATION

If the a-c electrical power to the instrument and console lights fails, turn the FLOOD switch to "BRIGHT," "DIM," or "MEDIUM." If the d-c electrical generator

LIQUID OXYGEN DURATION

2½ LITER SYSTEM

MAN HOURS REMAINING

CABIN PRESSURE ALTITUDE —FEET—	TANK FILLED TO CAPACITY	GAGE READING "F"	"3/4"	"1/2"	"1/4"
40,000 UP ▶	15.1	12.1	9.1	6.0	3.0
35,000 ▶	9.2	7.4	5.5	3.7	1.8
30,000 ▶	6.8	5.7	4.1	2.7	1.3
25,000 ▶	5.1	4.1	3.1	2.0	1.0
20,000 ▶	4.0	3.2	2.4	1.6	0.8
15,000 ▶	3.2	2.5	1.9	1.3	0.6
10,000 ▶	2.5	2.0	1.5	1.0	0.5
5000 ▶	2.1	1.6	1.2	0.8	0.4
SEA LEVEL ▶	1.7	1.4	1.0	0.7	0.1

P-9528-1A

REMARKS:
(1) Based on 800 liters of gaseous oxygen per liter of liquid oxygen
(2) Data assume the use of a properly fitted mask.

DATA AS OF: 15 October 1957

DATA BASIS: Specification MIL-I-19326(Aer) taken from NAVAER 03-50-517

Figure 4-4. Oxygen Duration (Sheet 2)

fails, the floodlights will automatically draw current directly from the battery.

OXYGEN SYSTEM (GASEOUS[1])

The aircraft is equipped with an automatic positive pressure diluter demand regulator (19, figure 1-3). Oxygen is supplied to the regulator by an 1800 psi, 514 cubic inch capacity cylinder located in the dorsal fin between the cockpit and vertical stabilizer. The oxygen system filler valve (21, figure 1-2) is located on the bottom of the left engine air intake duct. The oxygen regulator automatically mixes varying quantities of air and oxygen in ratios proportionate to the altitude, and delivers the quantity demanded upon inhalation. Above 35,000 feet the regulator automatically supplies oxygen under positive pressure. An OXYGEN CYLINDER PRESSURE gage shows oxygen system pressure at all times when the regulator is turned on. An OXYGEN FLOW INDICATOR is provided, which "blinks" when oxygen is being supplied by demand.

Note

An A13-A type oxygen mask should be used with the automatic positive pressure diluter demand regulator.

CAUTION

Do not exceed 43,000 feet cabin pressure altitude except during operational emergencies.

[1] Airplanes BuNo. 130740-130750; BuNo. 134744-134918 before service change.

LIQUID OXYGEN DURATION

5 LITER SYSTEM

MAN HOURS REMAINING

CABIN PRESSURE ALTITUDE —FEET—	GAGE READING (LITERS) "5"	"4"	"3"	"2"	"1"	"0.5"
40,000 UP ▶	30.3	24.2	18.2	12.1	6.0	3.0
35,000 ▶	18.5	14.8	11.1	7.4	3.7	1.8
30,000 ▶	13.6	10.9	8.2	5.4	2.7	1.4
25,000 ▶	10.2	8.2	6.2	4.1	2.0	1.0
20,000 ▶	8.0	6.4	4.8	3.2	1.6	0.8
15,000 ▶	6.4	5.1	3.8	2.6	1.3	0.6
10,000 ▶	5.0	4.0	3.0	2.0	1.0	0.5
5000 ▶	4.2	3.3	2.5	1.6	0.8	0.4
SEA LEVEL ▶	3.5	2.8	2.1	1.4	0.7	0.3

PS6564-3C

REMARKS:
(1) Based on 800 liters of gaseous oxygen per liter of liquid oxygen.
(2) Data assume the use of a properly fitted mask.

DATA AS OF: 15 October 1957

DATA BASIS: Specification MIL-I-19326(Aer) taken from NAVAER 03-50-517

Figure 4-4. Oxygen Duration (Sheet 3)

OXYGEN SUPPLY SHUT-OFF VALVE. An oxygen supply shut-off valve (12A, figure 1-3) is provided on the oxygen regulator. Positions of the valve are "ON" and "OFF."

AIR VALVE KNOB. The air valve knob of the oxygen regulator has two positions, "NORMAL OXYGEN" and "100% OXYGEN." In the "NORMAL OXYGEN" position, the regulator supplies diluted oxygen in quantities proportionate to the altitude upon demand, up to 30,000 feet. Above 30,000 feet the regulator automatically supplies 100% oxygen under pressure. In the "100% OXYGEN" position, the regulator supplies 100% oxygen regardless of altitude.

SAFETY PRESSURE LEVER. The regulator is equipped with a manual SAFETY PRESSURE lever. If the automatic pressure breathing feature of the regulator fails, or if pressure breathing is desired below 30,000 feet, the manual safety pressure lever is turned clockwise to the "ON" position. Positions of the lever are "ON" and "OFF."

WARNING

The SAFETY PRESSURE lever must be "OFF" when the oxygen mask is not in use, as the oxygen supply will be exhausted into the cockpit and upon contact with oil or grease may cause an explosion.

NORMAL OPERATION

PRE-FLIGHT CHECK. Before a flight which will require the use of the oxygen system, the following procedure should be followed:

a. Turn oxygen supply shut-off valve "ON".

b. Check oxygen system pressure. The oxygen pressure gage should read 1800 psi ± 50 psi if the cylinder is fully charged.

c. Test the breathing tube, couplings, regulator diaphragm and diluter check valve for leakage by inserting a spare mask tube quick disconnect fitting (AN6043) into the open end of the disconnect. Blow into the open end until the flow indicator face opens. Seal the end of the disconnect fitting with the tongue If the flow indicator face closes within 5 seconds, leakage is excessive. If leakage exists, check the couplings, outlet elbow and breathing tube clamps for tightness.

d. Put on a type A-13A or MS22001 mask. Check the fit of the mask by placing the thumb over the end of the disconnect fitting and inhaling lightly. If there is no leakage the mask will adhere tightly to the face and definite resistance to inhalation will be encountered. If the mask leaks, tighten the mask suspension straps and repeat the check. DO NOT USE A MASK THAT LEAKS. Check the mask inhalation check valve for leakage by inhaling, closing off the breathing tube, and then exhaling. Excessive resistance to exhalation indicates that the inhalation check valves are leaking and should be replaced.

e. Fully engage the mating portions of the coupling to connect the mask to the personnel gear adapter. The force required to disconnect the coupling should not be less than 10 pounds.

f. Check the operation of the regulator by breathing several times with the air valve in both the "NORMAL" and "100% OXYGEN" positions. Check the operation of the SAFETY PRESSURE valve for a positive flow of oxygen with the lever in the "ON" position then return the lever to the "OFF" position. Observe the OXYGEN FLOW INDICATOR to confirm the positive flow of oxygen to the mask.

DURING FLIGHT REQUIRING OXYGEN. During a flight which requires that oxygen be used, observe the following procedure:

a. Set the air valve knob at "NORMAL" for normal flight operations.

b. Set the air valve knob at "100% OXYGEN" for all take-offs, letdowns, and landings.

c. Frequently check the oxygen system pressure.

d. Frequently check the OXYGEN FLOW INDICATOR.

Note

At cockpit pressure altitudes above 30,000 feet when the regulator is delivering automatic positive pressure, the OXYGEN FLOW INDICATOR will remain in the open position. In this case, proper operation of the regulator can be determined by "feeling" the positive pressure against the face.

e. Frequently check the mask fit for leaks.

f. Frequently check the engagement of the disconnect coupling.

AFTER FLIGHT REQUIRING OXYGEN. After flights using oxygen turn the oxygen supply shut-off valve "OFF."

EMERGENCY OPERATION

ANOXIA. Should symptoms of anoxia occur, immediately operate the SAFETY PRESSURE lever. If the regulator is inoperative and a constant pressure is not obtained by use of the safety pressure lever, disconnect the breathing tube, activate the oxygen bailout equipment, and descend below 10,000 feet.

NOXIOUS GASES. Whenever noxious or irritating gases are present, or if carbon monoxide is suspected, set the AIR VALVE knob at "100% OXYGEN" regardless of altitude, until danger is past or flight is completed.

WARNING

Do not use oxygen system when oxygen cylinder pressure is below 300 psi except in an emergency.

OXYGEN SYSTEM (LIQUID[1])

The liquid oxygen system is comprised of an oxygen storage tank, filler valve, check valves, relief valves, evaporator, shut-off control valve, positive pressure demand regulator, quantity indicator, and associated piping and fittings. Basically, liquid oxygen stored in an insulated tank flows through an evaporator where it is converted to gaseous oxygen and delivered to the oxygen regulator at a pressure of 70 ± 5 psi.

OXYGEN SUPPLY

The liquid oxygen supply is stored in a tank (18, figure 1–14) located inboard and aft of the lower, right speed brake well. The filler valve (19, figure 1–14) may be reached through a small access door for servicing. The tank contains 2½ liters of liquid oxygen in early airplanes,[2] and 5 liters of liquid oxygen in late airplanes.[3] The tank is an insulated, vacuum sealed storage bottle which keeps the liquid oxygen in a liquid state by maintaining it at −265°F at a system pressure of 70 ± 5 psi. Evaporation loss is constant even when the system is not in use, and since evaporation of liquid oxygen creates pressure, this loss is used to pressurize the system. By venting excess pressure overboard through relief valves, pressure is maintained at 70 ± 5 psi.

[1] Airplanes BuNo. 134919 and subsequent. BuNo. 134744–134918 by service change.

[2] Airplanes BuNo. 134919–134960, before service change.

[3] Airplanes BuNo. 134961 and subsequent; BuNo. 134744–134960 after service change.

CAUTION

If the liquid oxygen quantity is depleted and the aircraft remains on the ground for over two hours with the oxygen system open to the surrounding atmosphere, there is danger of system contamination. In this event, the pilot should ascertain that the oxygen system has been purged per instructions in applicable publications.

OXYGEN EQUIPMENT

OXYGEN CONTROL. The OXYGEN SUPPLY control (19B, figure 1–3) located on the left-hand console has two positions, "ON" and "OFF." Placing the control at "ON" opens the oxygen shut-off valve and permits gaseous oxygen to be delivered to the oxygen regulator through the D-500 composite gear disconnect and the oxygen supply tube.

OXYGEN QUANTITY INDICATOR (2½ LITER(1)). An oxygen quantity indicator is provided on the OXYGEN panel (19A, figure 1–3), located on the left-hand console. The gage is graduated "FULL," "¾," "½," "¼," and "0," to reflect the number of liters of liquid oxygen remaining in the storage tank. The oxygen quantity indicating system is powered by 115-volt a-c current.

OXYGEN QUANTITY INDICATOR (5 LITER(2)). An oxygen quantity indicator is provided on the OXYGEN panel (19A, figure 1–3), located on the left-hand console. The gage is graduated "5" (full), "4," "3," "2," "1," and "0" (empty), to reflect the number of liters of oxygen remaining in the storage tank. The quantity gage is electrically operated and has a small "OFF" window to indicate that the gage is not operating when electrical power is lost. Also provided on the gage is a red LOW LEVEL warning light which illuminates when the liquid oxygen quantity falls below one-half liter. The oxygen quantity indicating system is powered by C-phase 115-volt a-c current.

PERSONNEL GEAR. The personnel oxygen equipment consists of the following: D-500 composite gear disconnect; miniature, positive pressure, demand type oxygen regulator; tee-block manifold assembly; MC-3A connector; SP-1A seat pan containing an H-2 emergency oxygen bottle; A-13A oxygen mask; and associated hoses and fittings.

The D-500 composite gear disconnect (figure 4–4A) provides in one unit the means to connect the pilot to the airplane's oxygen, anti-g system, radio and microphone, altitude sensing, and pressure suit ventilation connections. The altitude sensing and pressure suit ventilation connections are used only with the full pressure suit. Normally, the ventilation part will be capped and the altitude sensing part will be vented to cabin air. The lower half (male portion) of the D-500 disconnect is attached to the left side of the pilot's ejection seat. The upper half (female portion) of the D-500 disconnect is attached to the pilot's parachute harness by means of webbing and buckles. This arrangement separates the two halves of the D-500 disconnect when the pilot separates from the seat following ejection. The two halves of the D-500 disconnect must be connected by the pilot when he straps in. To do this, he need merely align the upper half with the lower half and press down to seat the fittings and engage the lock. To unlock and disconnect the D-500, the spring-loaded lock release is squeezed and the upper half lifted from the lower half.

The miniature, positive pressure, demand type oxygen regulator receives gaseous oxygen at 70 ± 5 psi from the airplane's liquid oxygen system through the OXYGEN SUPPLY shut-off valve and D-500 disconnect. The regulator delivers 100% oxygen under positive pressure at all altitudes to the pilot's A-13A oxygen mask through the tee-block manifold assembly and MC-3A connector.

The tee-block manifold assembly (figure 4–4A) is a "T" shaped, air tight chamber which serves as a junction for personnel oxygen equipment. The tee-block is securely fastened to the parachute harness. Three ports comprise the assembly; one port connects to the oxygen regulator, one port to the MC-3A connector, and the remaining port to the emergency oxygen bottle used in conjunction with the partial-pressure suit. This last port will be capped during non-pressure suit flight.

The MC-3A connector is part of the oxygen mask breathing assembly, and serves to connect the A-13A breathing mask to the oxygen regulator through the tee-block assembly. The MC-3A connector also incorporates a fitting to which an emergency oxygen supply line may be connected. This fitting receives a bayonet type connector from the H-2 emergency oxygen supply bottle in the pilot's SP-1A seat pan. A valve, installed in the end of the connector, serves to impede or provide resistance to breathing when the connector is disconnected from the tee-block assembly, in order to warn the pilot of such disconnection.

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(1) Airplanes BuNo. 134919–134960 prior to service change.
(2) Airplanes BuNo. 134961 and subsequent. BuNo. 134744–134960 after service change.

CAUTION

The MC-3A connector replaces the Erie connector, which does not have the "resistance to breathing" feature. Should the pilot be equipped with an Erie connector, he should make frequent checks during flight to ascertain that the connector is secure in the tee-block.

The SP-1A seat pan assembly contains the H-2 emergency oxygen bottle. The bottle is charged to 1800 psi. This oxygen supply may be checked by noting the reading of a pressure gage which is visible on top of the forward right-hand corner of the seat cushion. Oxygen is supplied from the emergency oxygen bottle when the green ball hanging from the front right-hand corner of the seat cushion is pulled. The ball, attached to a cable, releases a plunger on the pressure reducer of the emergency oxygen bottle and permits oxygen to flow to the A-13A oxygen mask through the bayonet fitting on the MC-3A connector. The green ball must be pulled manually to obtain emergency oxygen. At lower altitudes, the flow rates of oxygen from the H-2 bottle is insufficient in volume for pilot requirements. At high altitudes with lower ambient pressure, the flow rate may be excessive. Since there is a closed system from the regulator to the A-13A mask, or SPD-21 helmet, suffocation may occur from use of the H-2 bottle with the MC-3A attached to the tee-block. When an A-13A mask is used, the MC-3A must be disconnected from the tee-block, either prior to actuation of the H-2 bottle, or immediately after. Disconnecting the MC-3A from the tee-block permits ambient air to mix with the emergency oxygen flow and satisfy the pilot's volumetric requirements.

WARNING

When wearing a non-pressure suit, manually disconnect the MC-3A connector from the tee-block manifold assembly immediately before or after actuation of the emergency oxygen supply.

The A-13A oxygen breathing mask is connected to the MC-3A connector by a flexible rubber hose. The A-13A oxygen mask used with the positive pressure system must be properly fitted to the pilot's face for best results. Relatively small leaks around the mask are cumulative in effect and result in considerable oxygen loss over long periods of operation.

NORMAL OPERATION

BEFORE FLIGHT. Before each flight requiring oxygen, the oxygen system and personnel gear may be checked as follows:

a. Check general condition of D-500, hose, regulator, mask, and fittings.

b. Inspect the mask exhalation valve for foreign matter (sand, grit, lint, etc.).

c. Inspect the mask inhalation valves to see that each valve body is properly seated in the mask.

d. Inspect the inhalation valves for foreign matter and proper mounting of plastic covers. The arrow scribed in the cover must point down.

e. With the OXYGEN SUPPLY control turned "OFF," connect the D-500 disconnect.

f. Inspect the inside of the tee-block manifold assembly for foreign material, then connect the MC-3A connector.

g. Place the mask on the face and exhale. Exhalation should be possible without difficulty or resistance if the exhalation valve is unseating properly.

h. Under the same conditions, inhale. Inhalation should be impossible and will confirm that the exhalation valve is seating properly.

i. With the mask in place, turn the OXYGEN SUPPLY control to "ON." Inhalation should be very easy to accomplish if the regulator is functioning and delivering oxygen at a slight positive pressure. Exhalation should also be possible without difficulty. If exhalation is difficult, there is inhalation valve leakage.

j. Check oxygen supply and security of all hose couplings and radio connections.

DURING FLIGHT. The following should be checked frequently while on oxygen during flight:

a. Oxygen supply.

b. Oxygen mask for secure fit.

c. Security of oxygen disconnect couplings.

CAUTION

Loss of radio communication may indicate separation of the D-500 disconnect couplings. Check this connection before making any other check of communications equipment.

AFTER FLIGHT. Following each flight during which oxygen has been used, perform the following:

a. OXYGEN SUPPLY control . . . . . "OFF"

b. Disconnect the oxygen supply connections as necessary to exit the aircraft.

c. Report any oxygen system discrepancies and see that they are corrected.

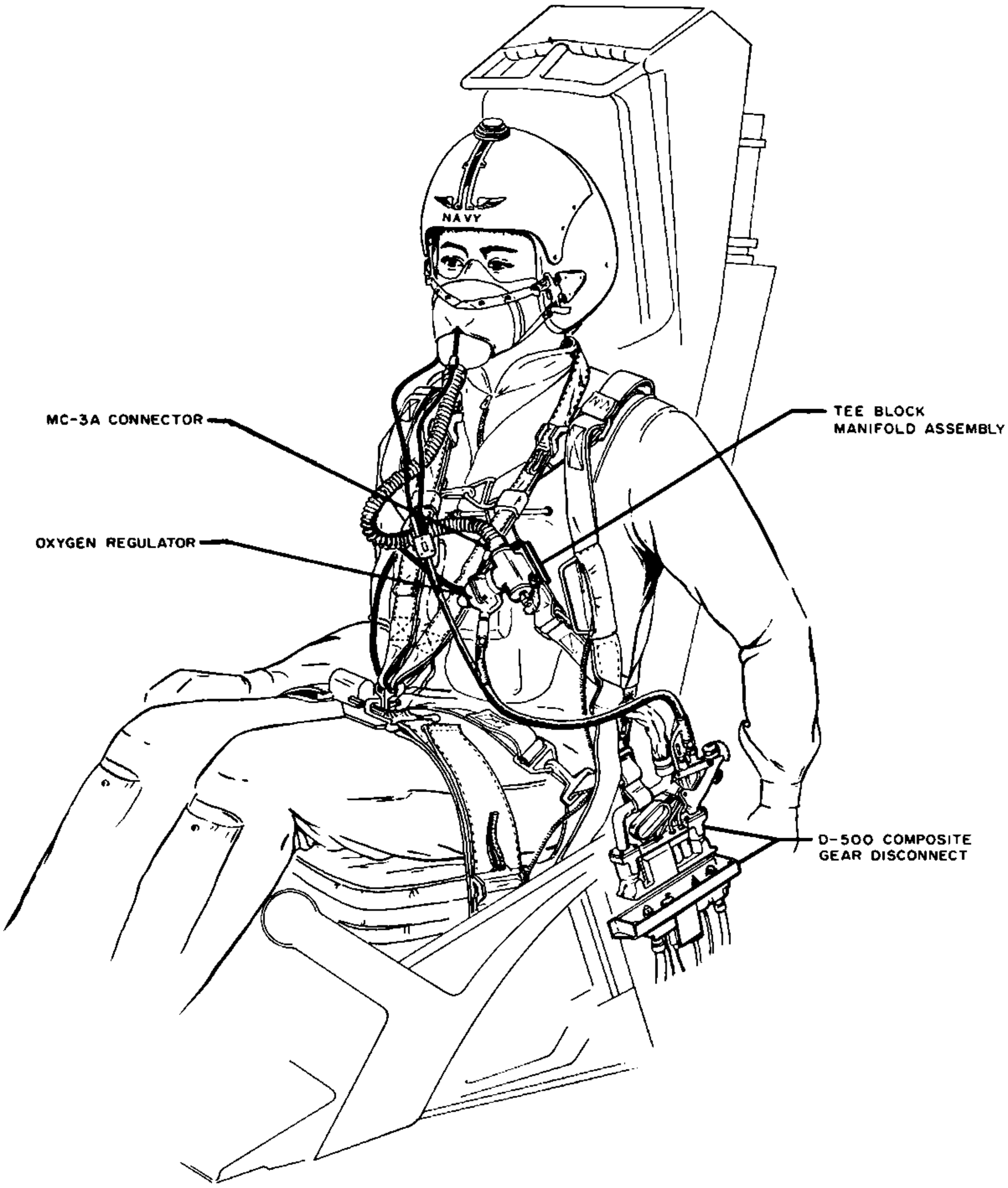

Figure 4-4A. Personnel Gear

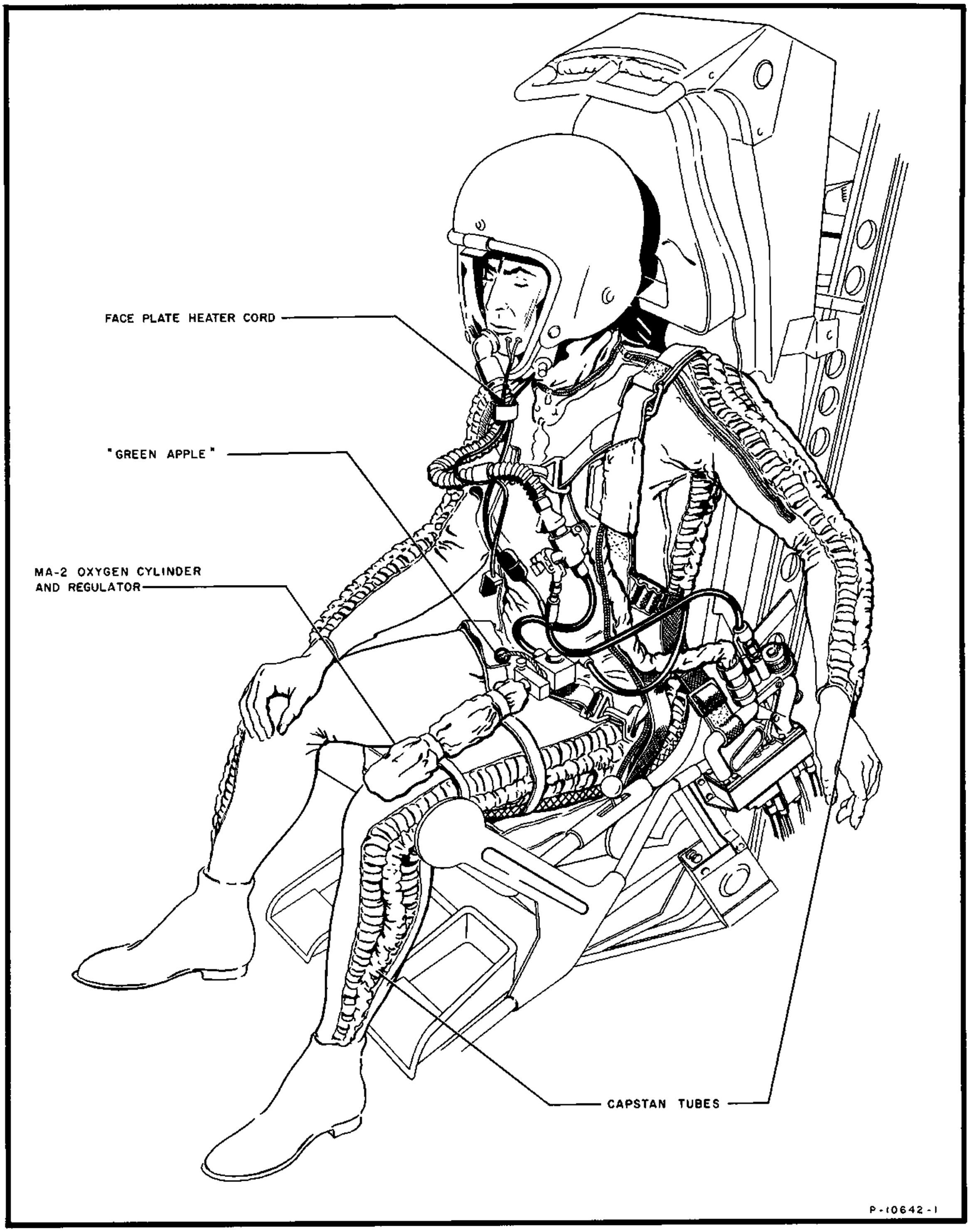

Figure 4-4B. Partial Pressure Suit

EMERGENCY OPERATION

In the event of oxygen system failure or depletion of airplane supply while wearing an A-13A mask, disconnect the MC-3A connector from the tee block and immediately activate the emergency H-2 oxygen supply by pulling the green apple at the right front of the SP-1A seat cushion and descend to a lower altitude where supplementary oxygen is not required.

When wearing the SPD-21 partial pressure suit helmet, activate the MA-2 cylinder and regulator assembly by pulling the green apple on the assembly and descend to a lower altitude.

PARTIAL PRESSURE SUIT

Later airplanes[1] are equipped for use with the partial pressure suit (figure 4–4B). The suit is a close fitting garment of porous inelastic nylon fabric. Capstan tubes lead across the back and down the outer sides of the arms and legs and are attached to the suit by means of crossing tapes. When the capstans are inflated, the tapes are shortened and the suit becomes skin tight, thereby applying mechanical pressure to the surface of the body. The ratio of capstan pressure to mechanical pressure is 5:1. Thus, in order to obtain 1 psi effective counterpressure with the suit, a pressure of 5 psi must be applied to the capstans. When wearing this suit the personnel equipment used with non-pressure suit flight is utilized: D-500 composite gear disconnect, oxygen breathing regulator, tee block manifold assembly and MC-3A connector (refer to the paragraph in this section entitled PERSONNEL GEAR). In addition, an MA-2 oxygen cylinder and regulator is used in place of the H-2 emergency oxygen bottle, and an SPD-21 partial pressure suit helmet replaces the non-pressure suit helmet.

WARNING

Do not connect the H-2 emergency oxygen bottle to the MC-3A connector for partial pressure suit flight, as this will cause possible over-pressurization at the helmet.

The MA-2 oxygen cylinder and regulator, attached at the upper left leg of the suit, furnishes oxygen to the capstan tubes and to the pilot's oxygen hose whenever manual or automatic actuation of the cylinder takes place. Manual actuation of the MA-2 cylinder and regulator should be initiated whenever emergency oxygen is required, or whenever automatic actuation does not occur at ambient pressure above 43,500 feet altitude. To operate the equipment manually, pull the "green apple" located at the cylinder. Automatic actuation is controlled by an aneroid assembly and is preset to a cabin altitude of 42,250 ± 1250 feet. A pressure gage is visible between the cylinder and the regulator and should be checked prior to flight for a reading of 1950 ± 50 psi. The emergency oxygen regulator assembly reduces the incoming oxygen pressure from the cylinder to those pressures usable in the pilot's suit and mask. The regulator is basically of the pressure-demand type and maintains a 5:1 ratio between suit and mask-helmet pressure. The ratio remains constant regardless of altitude. Two hoses lead from the regulator: one connects at the tee block to supply breathing oxygen; the other connects to the capstan hose at the left side of the suit for suit pressurization. Oxygen flow to the SPD-21 helmet is dependent on the pilot's breathing cycle. Oxygen is furnished to the pilot upon inhalation and ceases upon exhalation. The MA-2 cylinder supplies oxygen for approximately ten minutes operation.

The SPD-21 partial pressure suit helmet consists of the shell and a face plate. A rubber liner is worn under the helmet. The base of the liner fits on top of the pilot's shoulders and under the partial pressure suit. From the neck up, the liner covers all but the pilot's face. Located at the face plate is the oxygen hose, exhalation valve and the face plate heater cord. The latter connects to a cord which is plugged in at the FACE MASK HTR RECP (1A, figure 1–3) on the left hand console. When the cord is not in use, it can be stowed in a clip (2A, figure 1–3) which is located outboard of, and above, the left hand console. A rheostat (5A, figure 1–2), which controls the temperature of the face plate for defogging purposes, is also located on the left hand console and is labeled FACE MASK HEAT.

For complete information regarding the partial pressure suit, refer to Bureau of Aeronautics Aviation Clothing and Survival Equipment Bulletin 12-57.

D-1 AUTO CONTROL SYSTEM

The D-1 Auto Control System is an electro-mechanical flight control system designed specifically for the airplane. Use of the system allows the pilot to direct his attention mainly to tactical problems. This is made possible by such features as automatic pitch trim, automatic yaw damping in controlled (or normal) flight and automatically coordinated turns at any airspeed. The auto control system can be used to maintain level flight, constant barometric altitude, an established compass heading, a selected bank angle, climbs and dives, and logical combinations of the foregoing maneuvers.

AUTO CONTROL (AUTOPILOT) CONTROLS. The shaded features in figure 4-5 illustrate the switches and controls necessary to operate the auto control system. They include the following: An A.P. EMERG DISENGAGE lever,[2] or an AUTO CONT engaging lever[3]

[1] Airplanes BuNo. 139178 and subsequent; BuNo. 134744–134973, 139030–139177 after service change.
[2] Airplanes BuNo. 134919 and subsequent; BuNo. 134744–134747, 134749–134753, 134755–134761, 134764, 134766–134918 after service change.
[3] Airplanes BuNo. 130740–130750; BuNo. 134744–134747, 134749–134753, 134755–134761, 134764, 134766–134918 before service change.

mounted on the left side of the control pedestal, an AP CONT panel on the right hand console, and AUTO CONT panel and manual rudder trim knob on the left hand console, and a YAW DAMPER & AUTO-PILOT switch mounted to the right of the throttle.

The AP CONT panel (28 figure 1-5) consists of the following: a maneuver stick to provide control of the airplane in the roll and pitch axes while the auto control system is engaged, an AIL GAIN knob and an ELEV GAIN knob to control the sensitivity of the maneuver stick, and a TURN knob for setting the angle of bank desired to execute a turn. With the YAW DAMPER button or the AUTO CONT button depressed, rudder action to effect a coordinated turn which may be initiated by the pilot control stick, the maneuver control, or the TURN control, is accomplished automatically through an aileron-rudder interconnect synchro. Coordinated rudder action is not effective at air speeds in excess of approximately 230 knots. Automatic pitch trim adjustments are effected soon after the maneuver stick is displaced from the neutral position. As the trim adjusts to a new attitude the maneuver stick should gradually be returned to the neutral position.

The AUTO CONT panel (26, figure 1–3), used in conjunction with the AP CONT panel, consists of the following: a push-pull type AUTO CONT engaging button[1], used as the primary method of engaging the auto control system; a PITCH level wheel and a HEADING knob for minor trim adjustments in pitch and heading while auto control system is engaged; a push-pull type CLIMB button,[2] which will maintain the airplane at the attitude at which it is trimmed (either climb, dive or level flight) when depressed; a push-pull type ALTITUDE button, which will maintain the airplane at a constant barometric altitude when depressed, and a YAW DAMP control button, which will engage the yaw damping feature of the auto control system when depressed. (Depressing the YAW DAMP control button to engage the yaw damping feature is necessary only when the auto control is disengaged.)

Note

In later airplanes[3] the CLIMB button has been removed and the function of this button has been incorporated into the AUTO CONT engaging button[1]. Engaging the auto control automatically provides a pitch reference which will maintain the airplane at the attitude at which it is trimmed.

The yaw damping feature may be considered an independent system. Utilized as such, it provides yaw damping action and coordinated turns during normal controlled flight. The yaw damping feature will function without depressing the YAW DAMP control button, however, when the auto control system is engaged. (Refer to YAW DAMPER CONTROL, section I.)

The AUTO CONT engaging lever[4] is spring-loaded to the aft position. A button type release switch on the end of the lever will unlatch the lever from either the aft (disengaged) or forward (engaged) position when depressed. The YAW DAMPER & AUTO-PILOT switch is normally left in the "ON" position and is placed in the "EMER OFF" position only when complete electrical and mechanical disconnect of either yaw damper alone or the complete system is required. The directional gyro of the S-2 gyrosyn compass is coupled to the auto control system whenever the auto control system is energized. (Refer to S-2 GYROSYN COMPASS, section I.) A strut actuated switch in the left landing gear strut scissor link will prevent auto control engagement prior to take-off and will disengage the system, including yaw damper, upon landing.

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(1) Airplanes BuNo. 134919 and subsequent. BuNo. 134744–134747, 134749–134753, 134755–134761, 134764, 134766–134918 after service change.

(2) Airplanes BuNo. 134973 and prior, before service change.

(3) Airplanes BuNo. 134970, 139030 and subsequent; BuNo. 134745, 134747–134748, 134750–134752, 134754–134773, 134775–134831, 134833–134969, 134971–134973 by service change.

(4) Airplanes BuNo. 130740–130750; BuNo. 134744–134747, 134749–134753, 134755–134761, 134764, 134766–134918 before service change.

NORMAL OPERATION

PRE-FLIGHT

a. YAW DAMPER & AUTO-PILOT switch ..... "ON"

b. S-2 COMPASS CONTROLLER gyrosyn ..... "SLAVED GYRO" or "FREE GYRO" as desired

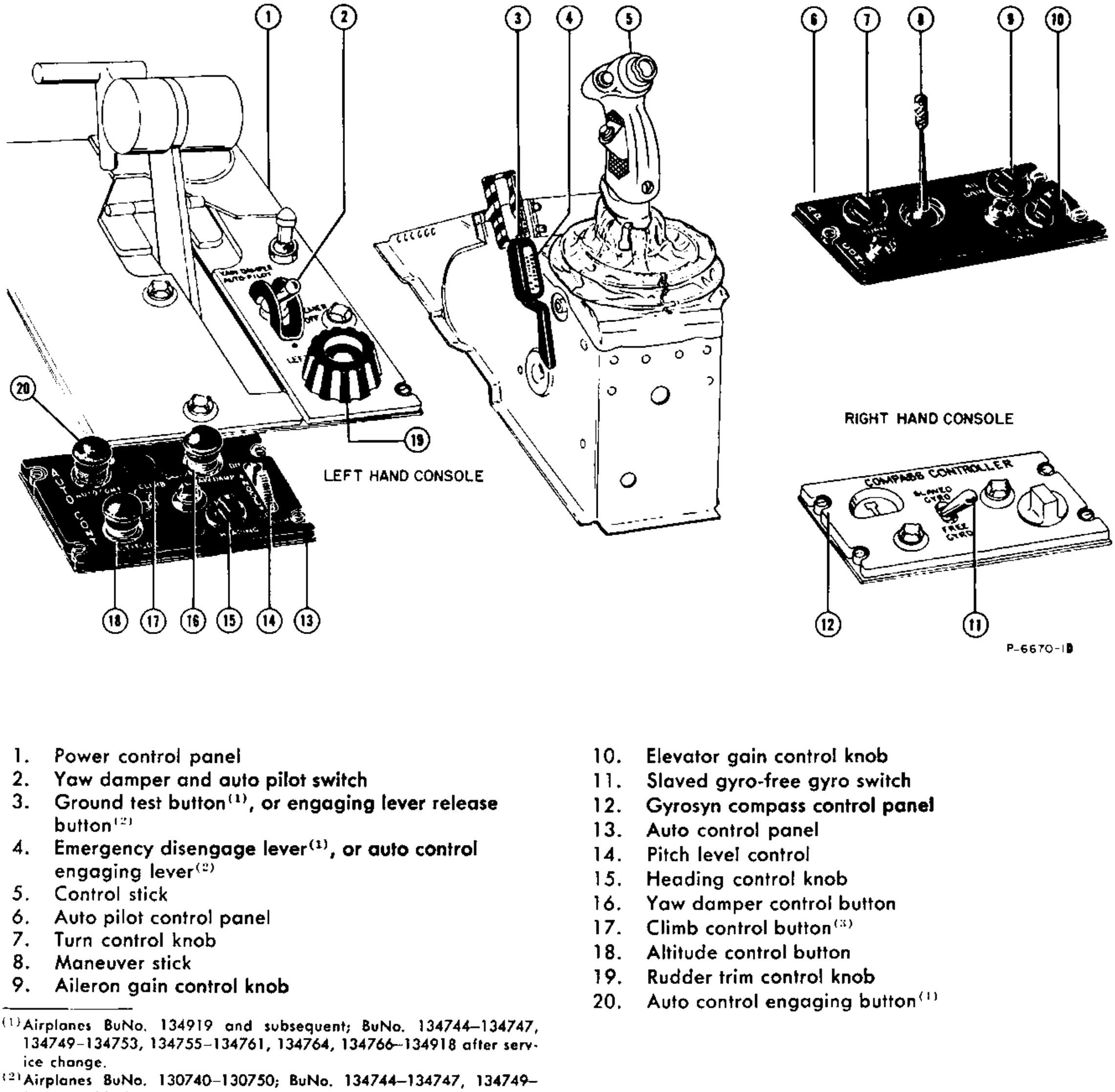
c. A.P. EMERG DISENGAGE lever[1] ..... Normal (forward position)

or

AUTO CONT engaging lever[2] ..... Disengaged (aft position)

Note

Place the YAW DAMPER & AUTO-PILOT switch in "EMER OFF" any time that hydraulic power is unavailable for more than 5 minutes while electrical power is being applied.



1. Power control panel
2. Yaw damper and auto pilot switch
3. Ground test button[1], or engaging lever release button[2]
4. Emergency disengage lever[1], or auto control engaging lever[2]
5. Control stick
6. Auto pilot control panel
7. Turn control knob
8. Maneuver stick
9. Aileron gain control knob
10. Elevator gain control knob
11. Slaved gyro-free gyro switch
12. Gyrosyn compass control panel
13. Auto control panel
14. Pitch level control
15. Heading control knob
16. Yaw damper control button
17. Climb control button[3]
18. Altitude control button
19. Rudder trim control knob
20. Auto control engaging button[1]

[1] Airplanes BuNo. 134919 and subsequent; BuNo. 134744–134747, 134749–134753, 134755–134761, 134764, 134766–134918 after service change.

[2] Airplanes BuNo. 130740–130750; BuNo. 134744–134747, 134749–134753, 134755–134761, 134764, 134766–134918 before service change.

[3] Airplanes BuNo. 134973 and prior, before service change.

Figure 4-5. Auto Control System

AFTER TAKE-OFF.

After take-off, manually trim the airplane for the desired flight attitude. Depress the YAW DAMP control button if desired and if the remainder of the system is to remain disengaged.

Note

The MAC will be automatically reset at 2:1 when the auto control is engaged, unless already in excess of that, in which case it will stay in the higher reading.

ENGAGING AUTO CONTROL

a. TURN control knob ..... Centered

b. HEADING and PITCH level controls .... Centered

CAUTION

Be prepared to disengage the auto control system immediately upon engagement should a malfunction in the system cause extensive stick deflection upon engagement. The system may be disengaged using any method described in the subparagraph DISENGAGING AUTO CONTROL; however, the following is recommended: grasp the control stick lightly with a semi-restrained hold while moving the engaging lever forward. Should extensive deflection of the control stick occur, release the engaging lever, grasp the control stick more securely and return it to the neutral position. Do not, however, interpret a small stick deflection upon engagement as a malfunctioning system.

c. AUTO CONT engaging lever[1] ..... Depress switch on lever, rotate forward, engaging in a steady positive manner. Release switch and check lever in the latched forward position.

d. AUTO CONT engaging button[2] ..... Depress

e. Adjust trim ..... PITCH level wheel and HEADING control knob.

MANEUVERING. Adjust maneuver stick sensitivity with the AIL GAIN and ELEV GAIN control knobs.

a. Altering course ..... Move maneuver stick left or right or the TURN control knob L or R as desired and then center.

b. Changing pitch attitude (climb, dive or level flight) ..... Move maneuver stick, aft or forward, and hold until the desired attitude is attained. As the automatic trim action retrims the airplane, gradually neutralize the maneuver stick to the centered position.

c. Holding constant barometric altitude .. Trim straight and level, then depress ALTITUDE control button.

d. Loitering turns ..... Use TURN control knob. Adjust until the desired rate of turn is obtained.

Return to the centered position when turn is completed.

The CLIMB[3] and ALTITUDE control buttons can be pulled up or will pop up from the depressed position when the maneuver stick is operated or the auto control is disengaged.

DISENGAGING AUTO CONTROL. Any one of the following methods may be used to disengage the system. They are (listed in the order of use priority):

a. Control stick grip .... Exert 5 to 10 pound force in any direction.

b. AUTO CONT engaging button[2] ..... Pull up on button

c. YAW DAMPER & AUTO-PILOT switch ..... Place in the "EMER OFF" position.

d. AUTO CONT engaging lever release button[1] ..... Press button on top of the engage lever. The lever will spring to the disengage position. Use caution because the lever springs back sharply.

e. A.P. EMERG DISENGAGE lever[2] ... Force lever out of the forward latched position with approximately 35 pounds pull force.

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[1] Airplanes BuNo. 130740–130750; BuNo. 134744–134747, 134749–134753, 134755–134761, 134764, 134766–134918 before service change.

[2] Airplanes BuNo. 134919 and subsequent; BuNo. 134744–134747, 134749–134753, 134755–134761, 134764, 134766–134918 after service change.

[3] Airplanes BuNo. 134973 and prior, before service change.

f. Landing gear strut actuated switch . . . . . Actuated to disengage upon landing.

BEFORE LANDING.

a. AUTO CONT engaging button[1] . . . . . Disengage or

b. AUTO CONT engaging lever[2] . . . . . Disengage

CAUTION

Check AP TURN control knob in the centered position to protect against possible rudder transient upon touchdown if not centered and YAW DAMP button is engaged.

ARMAMENT EQUIPMENT

The airplane is designed to carry four 20-mm fixed guns and four external rocket packages. Various combinations of other stores such as fuel tanks, navigational equipment, auxiliary power unit, or tow target equipment are mounted externally. All external stores are jettisonable, empty or loaded.

ARMAMENT CONTROL PANEL (EARLY AIRPLANES[3]). Control of all armament is effected through an ARMAMENT control panel (29, figure 1–5 and figure 4–7) located at the forward end of the right-hand console. All armament control switches are located on this panel. However, weapons selection and rocket package selection must be made on the ground by actuating the weapons selector switch to "GUNS" or "ROCKETS" and the rocket package switch to "7-SHOT" or "19-SHOT." Both armament switches are located on the right-hand electrical equipment junction panel.

ARMAMENT CONTROL PANELS (LATER AIRPLANES[4]). On some airplanes there are two panels provided for armament operation, both located on the right-hand console. With this arrangement, the ARMT panel (29, figure 1–5 and figure 4–7) provides for operation of both guns and rockets on the same flight. The ACS Aero 13F panel (29A, figure 1–5) provides RANGE, COURSE, and ROCKET selector switches.

MASTER ARAMAMENT SWITCH. A MASTER armament switch controls the operation of all armament equipment. Unless the MASTER armament switch is "ON" no armament circuits can be energized. An armament safety switch actuated by the landing gear handle opens the armament circuit when the landing gear handle is moved to the "WHEELS DOWN" position. This safety feature can be by-passed for ground check of the armament system by momentarily closing an armament safety disabling switch located on the right-hand electrical equipment junction panel. Turning the BAT switch "OFF" will restore the armament safety circuit for normal operation.

ARMAMENT SELECTOR SWITCHES (EARLY AIRPLANES[3]). Six armament selector switches are installed in a row along the top of the ARMAMENT control panel. The desired armament operation is selected by these switches. Each switch has three positions, "READY," "OFF," and "JETT." With a fixed gun configuration the two outboard switches on each end of the row select gun operation. They are identified by GUNS OR ROCKETS, RIGHT, OUTBD-INBD, and GUNS OR ROCKETS, LEFT, OUTBD-INBD. In the rocket configuration the same switches are used to select rocket packages carried on racks at these stations. The two middle switches, identified by TANKS OR ROCKETS, select operation of the center stations, right and left, and control external stores carried at these stations. Upon completion of any operation controlled by one of the armament selector switches, return that armament selector switch to "OFF." This will de-energize the armament circuit to that station.

METHOD OF FIRE SWITCH. A METHOD OF FIRE switch[3], located in the center of the ARMAMENT control panel, has two positions: "MANUAL" and "AUTO." For manual operation of the armament equipment, set the METHOD OF FIRE switch to "MANUAL" position. The "AUTO" position is inoperative since the equipment does not incorporate an automatic fire control system.

COURSE SELECTOR SWITCH. The COURSE SEL switch[3] on the lower right-hand side of the ARMAMENT control panel has three positions, "OPTICAL TRACK," "PURSUIT," and "COLLISION." Set COURSE SEL switch to "OPTICAL TRACK" for manual operation of the armament equipment, "COLLISION" for lead collision, or "PURSUIT" for lead pursuit.

RANGE SELECTOR SWITCH. The RANGE SEL switch[3] located on the ARMAMENT control panel adjacent to the armament MASTER switch is used in the "MED" position for manual operation of the armament equipment. The "SHORT" and "LONG" positions are inoperative.

ARMAMENT SELECTOR SWITCHES (LATER AIRPLANES[4]). The ARMT panel contains the MASTER armament switch, two GUNS switches (INBD and OUTBD), a GUNS-STORES-TEST switch and test lamp, and a row of six switches with "READY," "OFF" and "DROP" positions for arming or dropping stores and tanks. The two switches on each end are labeled STORES (OUTBD and INBD) and the two center

(1) Airplanes BuNo. 134919 and subsequent; BuNo. 134744–134747, 134749–134753, 134755–134761, 134764, 134766–134918 by service change.

(2) Airplanes BuNo. 130740–130750; BuNo. 134744–134747, 134749–134753, 134755–134761, 134764, 134766–134918 before service change.

(3) Airplanes BuNo. 130740–130744, 130746–130750.

(4) Airplanes BuNo. 130745, 134744 and subsequent.

switches are identified as TANKS (L and R). Upon completion of any operation controlled by one of the armament selector switches, the respective switch for that operation should be turned to "OFF" to de-energize that station circuit.

GUNNERY EQUIPMENT

Four forward electrical impulse firing Mk 12 Mod 0, 20-mm guns are mounted in the wing, two on each side of the airplane just outboard of the center stores racks (see figure 4–6). A Mk 11 Mod 1 sight unit is provided. Ammunition is supplied to each gun by a linear chute containing sixty-five rounds. Links and cases are ejected out of the bottom surface of the wing through ejection chutes.[1] Gun gas purge doors, located forward and inboard of the ejection chutes, open while the guns are being fired. This action permits ram air to enter and clear the gun bays of explosive gun gases that may otherwise accumulate. Gases will escape through the ejection chutes. The armament selector switches are used to select the desired combination of guns. After firing the guns, return the armament selector switches to "OFF" as this causes the breechblock to be retracted to the safe position.

TO CHARGE THE GUNS. The guns are charged by an electrically operated, pneumatic gun charging system. Two pneumatic reservoirs capable of being pressurized to 3000 psi should be fully charged before each flight when guns are to be used. Gun charging is accomplished by:

a. BAT-GEN switch[2] ..... "BAT & GEN" or
   BAT switch[3] ..... "ON" and
   DC GEN switch[3] ..... "ON"
b. MASTER armament switch.. "ON"
c. GUNS selector switch[4][5] .. Switch from "SAFE" to "OFF" or
   GUNS selector switch[6] .... Switch to "OFF" and back to "READY"

TO FIRE THE GUNS

a. BAT-GEN switch[2] ..... "BAT & GEN" or
   BAT switch[3] ..... "ON" and
   DC GEN switch[3] ..... "ON"
b. AC GEN switch ..... "ON"
c. MASTER armament switch.. "ON"
d. METHOD OF FIRE switch[6] ..... "MANUAL"
e. COURSE SEL switch ..... "OPTICAL TRACK" "PURSUIT OR COLLISION"
f. RANGE SEL switch ..... "MED"
g. Sight unit ..... As required
h. GUNS selector switches .... Switch from "OFF" to "READY"
i. Trigger ..... Squeeze

WARNING

In the event a stoppage occurs during the firing of 20-mm guns, the gun charger shall not be operated in an attempt to clear the stoppage. Charging shall be accomplished only for the purpose of readying and safetying the guns.

ROCKET EQUIPMENT (EARLY AIRPLANES)

Four Aero 6 (7-shot) rocket packages are carried on Aero 14B-2 racks[7] at the inboard and outboard stations of each wing. Each rocket package contains 7 air-to-air, folding fin, stabilized rockets of 2.75 inches diameter. Aero 61B racks,[8] which carry the external fuel tanks, are installed at the center wing stations. However, provision is also made for the installation of Aero 14B-2 racks[9] at these stations, and—when installed—they can also carry Aero 6 rocket packages. Any single rocket package, or any combination of packages can be fired simultaneously by selecting the desired combination with the armament selector switches. Rocket packages are jettisonable in either the empty or loaded condition.

ROCKET EQUIPMENT (LATER AIRPLANES)

Later airplanes are equipped with Aero 20A[10] and Aero 7A[4][11] ejector racks. The Aero 20A racks supersede the Aero 14B-2 racks[7] at the inboard and outboard stations of each wing, however provisions are retained for use of the Aero 14B-2 racks at these stations. The Aero 20A ejector racks can carry either Aero 6 (7-shot) or Aero 7D (19-shot) rocket packages, while only the Aero 6 rocket packages are used with the Aero 14B-2 racks. The Aero 6 rocket packages contain seven air-to-air, folding fin, stabilized rockets of 2.75 inches diameter; the Aero 7D rocket packages contain nineteen of these rockets. An Aero 7A ejector rack is installed at the center station of each wing in lieu of either the Aero 61B[8] or Aero 14B-2[9] racks which

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(1) Airplanes BuNo. 134844 and subsequent.
(2) Airplanes BuNo. 130745, 143798 and subsequent; BuNo. 134744–134797 after service change.
(3) Airplanes BuNo. 130740–130744, 130746–130750; BuNo. 134744–134797 prior to service change.
(4) Airplanes BuNo. 134853 and subsequent.
(5) Airplanes BuNo. 130745, 134744–134852.
(6) Airplanes BuNo. 130741–130744, 130746–130750.
(7) Airplanes BuNo. 130740–130750; BuNo. 134744–134918 prior to service change.
(8) Airplanes BuNo. 130740–130744, 130746–130750; BuNo. 134744–134852 prior to service change.
(9) Airplanes BuNo. 130740–130750; BuNo. 134744–134818 prior to service change.
(10) Airplanes BuNo. 134919 and subsequent; BuNo. 134744–134918 after service change.
(11) Airplanes BuNo. 134744–134852 after service change.

were carried on earlier airplanes. The Aero 7A racks can carry the Aero 6 or Aero 7D rocket packages, but they normally carry the Aero 1A (300) external fuel tanks.

TO FIRE ROCKETS

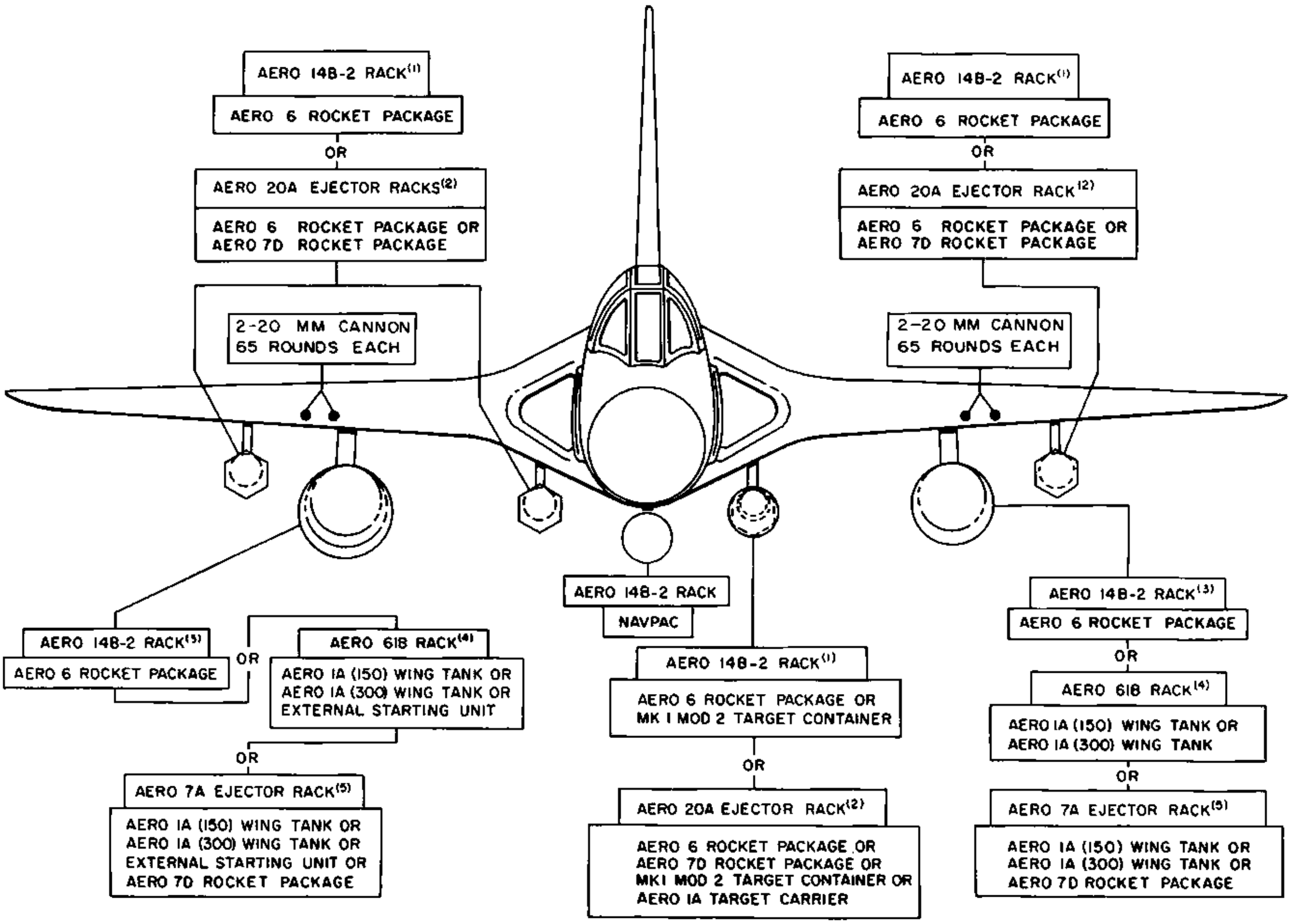
a. BAT-GEN switch(1) ..... "BAT & GEN" or
   BAT switch(2) ..... "ON" and
   DC GEN switch(2) ..... "ON"
b. MASTER armament switch ..... "ON"
c. METHOD OF FIRE switch(3) ..... "MANUAL"
d. ROCKETS switch(4) ..... Optional
e. COURSE SEL switch .... "OPTICAL TRACK" or "PURSUIT"
f. RANGE SEL switch.... "MED"(3) or Optional(1)
g. Sight unit ..... As required
h. Armament selector switches ..... "READY" as required
i. Rocket R button ..... Depress

This procedure will cause ripple fire of all rockets within the package at each station selected.

TO FIRE GUNS & ROCKETS SIMULTANEOUSLY.

Some airplanes have circuitry which provide for simultaneous firing of guns and rockets through the stores switches. These airplanes should have a guard indicating the gun switches to be inoperative. It is recommended

(1) Airplanes BuNo. 130745, 134798 and subsequent; BuNo. 134744–134797 after service change.
(2) Airplanes BuNo. 130740–130744, 130746–130750; BuNo. 134744–134797 prior to service change.
(3) Airplanes BuNo. 130740–130744, 130746–130750.
(4) Airplanes BuNo. 130745, 134744 and subsequent.
(5) Airplanes BuNo. 134744–134747, 134749–134753, 134755–134759, 134761, 134764, 134818 prior to service change.



(1) AIRPLANES BUNO. 130740-130750; BUNO. 134744-134918 PRIOR TO SERVICE CHANGE.
(2) AIRPLANES BUNO. 134919 AND SUBSEQUENT; BUNO. 134744-134918 AFTER SERVICE CHANGE.
(3) INSTALLATION PROVISIONS ONLY IN AIRPLANES BUNO. 130740-130750, 134744-134818.
(4) AIRPLANES BUNO. 130740-130744, 130746-130750; BUNO. 134744-134852 PRIOR TO SERVICE CHANGE.
(5) AIRPLANES BUNO. 130745, 134853 AND SUBSEQUENT; BUNO. 134744-134852 AFTER SERVICE CHANGE.

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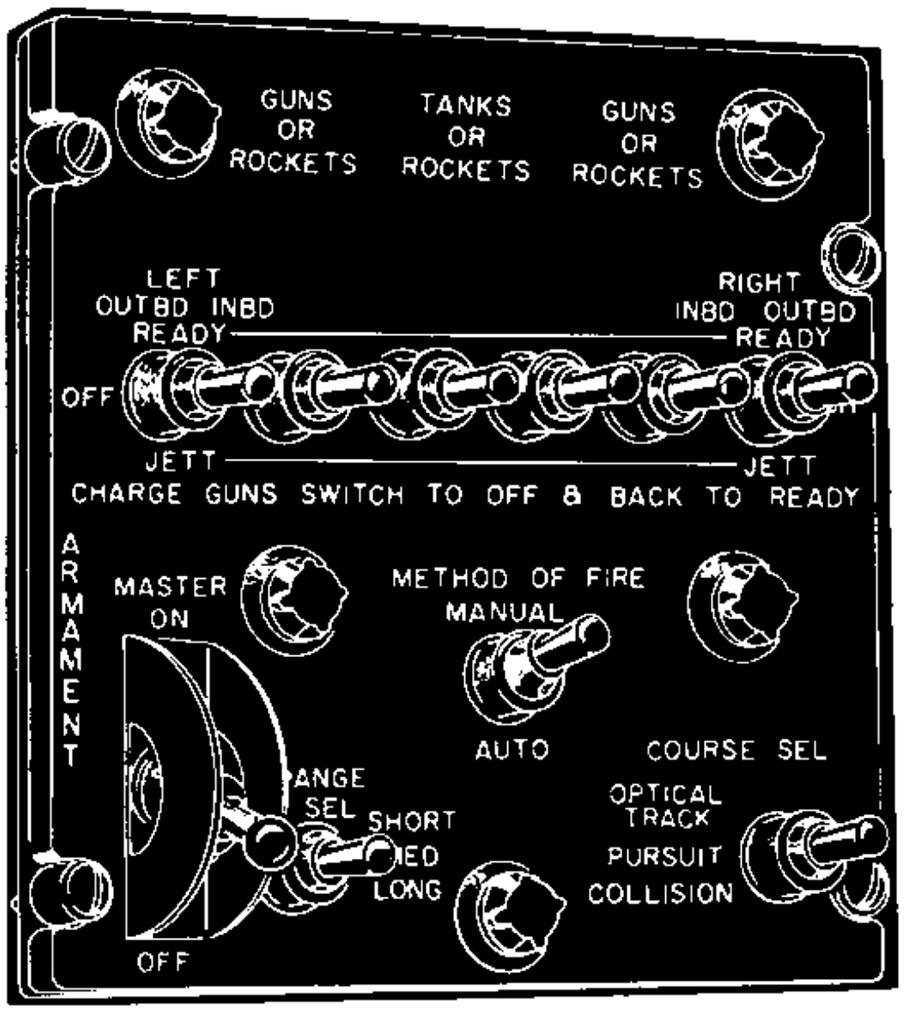
Figure 4-6. External Stores



P5422-1

Airplanes BuNo. 130740–130744, 130746–130750

Figure 4-7. Armament Control Panel (Sheet 1)

that aircraft thus provisioned be made to fire guns or rockets as follows:

a. BAT-GEN switch[3] ..... "BAT & GEN" or
BAT switch[2] ..... "ON" and
DC GEN switch[2] ..... "ON"
b. AC GEN switch ..... "ON"
c. COURSE SEL switch ..... "PURSUIT"
d. RANGE SEL switch ..... "MED"
e. STORES switches ..... "READY"
f. MASTER ARMAMENT switch ..... "ON"
g. Trigger ..... Squeeze

Note

The "OFF" position of the MASTER ARMAMENT switch is designated an interim "SAFE" position until post delivery modification allows for separate firing of the guns through operation of the gun switches.

TO JETTISON EXTERNAL STORES

Empty or loaded external stores may be jettisoned as follows:

a. BAT-GEN switch[3] ..... "BAT & GEN" or
BAT switch[2] ..... "ON" and
DC GEN switch[2] ..... "ON"
b. MASTER ARMAMENT switch ..... "ON"
c. METHOD OF FIRE switch[1] ..... "MANUAL"
d. Armament selector switches .....
"JETT"[4] (or "DROP"[5]) as required
e. Trigger[6] ..... Squeeze, or
Rocket R button[7] ..... Depress

CAUTION

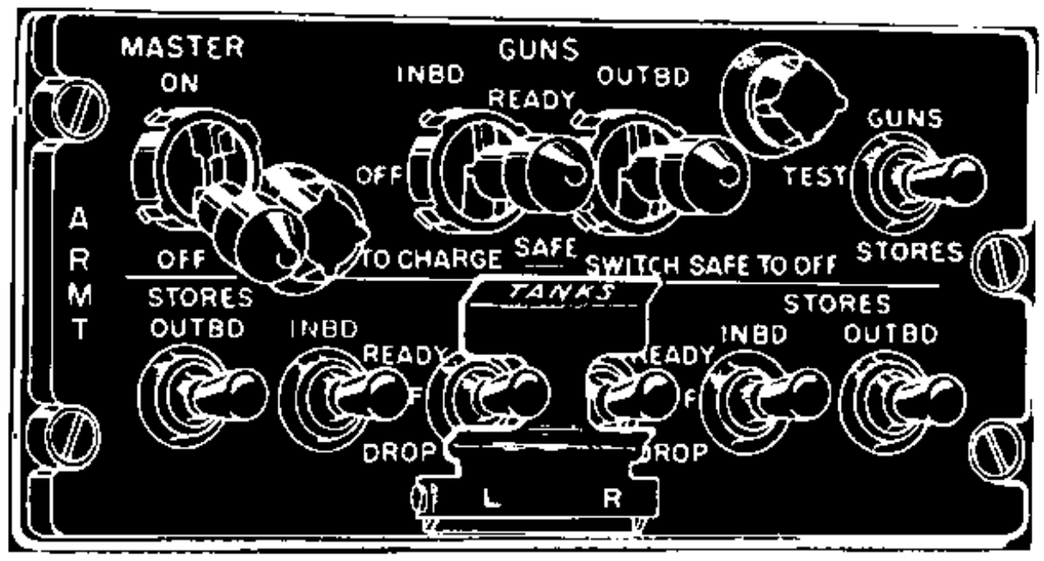
- Jettisoning of empty fuel tanks should be avoided in close formation flight, as tanks have been known to deflect outward and up from the airplane.
- For limitations on jettisoning external stores, refer to STORES, section V of the Confidential Supplement.

Note

- On early airplanes[1] the stores on the Aero 61B right and left center racks must be jettisoned by pulling the EMER BOMB RELEASE handle as no electrical jettisoning means are provided.
- For the effect that jettisoning of stores (from ejector racks) has on the accelerometer, refer to ACCELEROMETER, section I.

EMERGENCY EXTERNAL STORES JETTISONING.

An EMER BOMB RELEASE handle (2, figure 1–3) is provided for emergency jettisoning of external stores. Stores on all wing station racks can be jettisoned by



P5422-2C

Airplanes BuNo. 130745, 134744 and subsequent

Figure 4-7. Armament Control Panel (Sheet 2)

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(1) Airplanes BuNo. 130740–130744, 130746–130750; BuNo. 134744–134852 prior to service change.
(2) Airplanes BuNo. 130740–130744, 130746–130750; BuNo. 134744–134797 prior to service change.
(3) Airplanes BuNo. 130745, 134798 and subsequent; BuNo. 134744–134797 after service change.
(4) Airplanes BuNo. 130741–130744, 130746–130750.
(5) Airplanes BuNo. 130745, 134744 and subsequent.
(6) Airplanes BuNo. 134818 and prior.
(7) Airplanes BuNo. 134819 and subsequent.

pulling this handle out of its detent. This action closes electrical contacts and allows the battery to furnish power to the ejector charges in the racks. In the event of electrical failure in early aircraft[3], manual jettisoning of stores on the Aero 61B racks—center wing stations—can be accomplished mechanically by pulling the EMER BOMB RELEASE handle to the fully extended position.

Note

Actuation of this handle will jettison *all* wing station stores and there is no provision for individual station selection.

The NAVPAC, which is attached at the fuselage centerline rack (Aero 14B-2), is jettisoned by placing the CENTER STORES switch (3, figure 1–3) to the "JETTISON" position.

ARMAMENT CONTROL SYSTEM (ACS) AERO 13F[2]

Refer to section IV in AN 01-40FBA-1A, Confidential Supplement to Flight Handbook.

AIRCRAFT FIRE CONTROL SYSTEM (AFCS) MK 16 MOD 11

Refer to section IV in AN 01-40FBA-1A, Confidential Supplement to Flight Handbook.

MISSILE EQUIPMENT

Refer to section IV in AN 01-40FBA-1A, Confidential Supplement to Flight Handbook.

TOW TARGET EQUIPMENT

Sleeve type and banner type tow targets may be carried in Mk 1 Mod 2 target containers and Aero 1A target carriers on the left inboard station. The Mk 1 Mod 2 container can be carried only on the Aero 14B-2 rack, while the Aero 20A ejector rack can carry both the Mk 1 Mod 2 container and the Aero 1A target carrier. The components of the tow target installation include adapters to enable the containers to be mounted on the racks, an electrically actuated launching mechanism controlled by a TOW TARGET switch (1, figure 1–3) on the outboard side of the left-hand console, a stainless steel flex cable connected to the launching mechanism on one end and to the tow target release latch on the other, and the tow target release latch itself.

The TOW TARGET switch has two positions, "LAUNCH TARGET," and "OFF." To launch the tow target place the MASTER armament switch in the "ON" position then place the TOW TARGET switch in the "LAUNCH TARGET" position. This action completes the circuit to the launching mechanism to release the steel flex cable which has the nylon tow line of the target fastened to it. The cable then withdraws the target from its container and streams it behind the aircraft, the opposite end of the cable being attached to the aircraft at the release latch just aft of the arresting hook. The steel flex cable is routed from the launching mechanism to the release latch by way of a cable retainer mounted on the airplane in line with, and outboard of, the release latch to prevent the cable and target from fouling the arresting hook during launching.

Return the TOW TARGET switch to "OFF" after target is launched. The target, tow line, and steel flex cable are released from the aircraft by lowering the arresting hook. An arm attached to the arresting hook engages a latch lever as it moves down and releases the steel flex cable to which the tow target is fastened. The empty tow target container or carrier may be jettisoned in the same manner as other external stores if desired. (Refer to paragraph entitled, TO JETTISON EXTERNAL STORES.)

MISCELLANEOUS EQUIPMENT

ANTI-G EQUIPMENT. An anti-g air pressure valve and control is located aft of center on the left-hand console, marked ANTI-BLACKOUT VALVE (28, figure 1–3). The anti-g suit provides the pilot with protection against temporary impairment of senses caused by acceleration forces during maneuvering. The valve receives air from the pressure air system and meters it to the pilot's anti-g suit when a minimum force of approximately 1.75 g's is applied to the airplane. A HI and LO control allows for adjustment of the rate of inflation of the anti-g suit. In the LO range, the valve opens at 1.75 g and allows 1 psi of air pressure to pass to the suit for every increase of 1 g thereafter. In the HI range, the valve also opens at 1.75 g, but delivers 1.5 psi per g thereafter. A button is provided on top of the anti-g valve for manually inflating the anti-g suit on the ground with the engine running, or in straight and level flight. *Prior to each flight,* with the engine running and with the anti-g suit connected, depress this button several times to check the operation of the anti-g system. (If the valve has any tendency to stick or fails to return to the closed position, it should be replaced.) On long flights, this features makes it possible for the pilot to occasionally inflate the suit for body massage, thereby lessening fatigue.

Note

Too frequent use of this button will overheat the bladders in the anti-g suit.

REAR VIEW MIRRORS. Two rear view mirrors are provided, one on the right and one on the left of the windshield bow.

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[1] Airplanes BuNo. 134818 and prior.
[2] Airplanes BuNo. 134745, 134751, 134766, 134853 and subsequent; BuNo. 134744, 134746, 134747, 134749–134753, 134755–134761, 134764, 134767–134852 by service change.
[3] Airplanes BuNo. 130740–130744, 130746–130750; BuNo. 134744–134852 prior to service change.

SECTION V

OPERATING LIMITATIONS

See AN 01-40FBA-1A, Confidential
Supplement to Flight Handbook

SECTION VI

FLIGHT CHARACTERISTICS

See AN 01-40FBA-1A, Confidential
Supplement to Flight Handbook

SECTION V

OPERATING LIMITATIONS

See AN 01-40FBA-1A, Confidential
Supplement to Flight Handbook

SECTION VI

FLIGHT CHARACTERISTICS

See AN 01-40FBA-1A, Confidential
Supplement to Flight Handbook

SECTION VII

SYSTEMS OPERATION

ENGINE OPERATION

Exhaust gas temperature control within maximum limits is imperative for continued dependable engine operation. Temperatures are time limited for maximum and military thrust conditions while the temperature for normal rated (maximum continuous) or lower thrust permits continuous operation. The temperature limits (refer to Table I, Section V, of the Confidential Supplement) for cruising thrust below normal rated are limits which, if exceeded, will indicate malfunction of the fuel control or engine. The limits for normal rated are positive limits and should not be exceeded for any continuous operation. Retarding the throttle will maintain the exhaust gas temperature within limits when a tendency to overtemperature is observed.

Note

For a given throttle position, exhaust gas temperature will increase with altitude.

If overtemperaturing cannot be controlled, an immediate landing should be made using the minimum thrust to sustain flight.

ACCELERATION TEMPERATURE LIMIT. A maximum exhaust gas temperature of 670°C is permitted for acceleration and is time limited to two minutes. If temperatures above 670°C are experienced, a slower throttle movement should be used.

COMPRESSOR STALL

The occurrence of compressor stall, characterized by loud noise and sometimes concurrent vibration of considerable amplitude, can be somewhat alarming to the pilot when experienced for the first time. This may be accompanied by flames out the bleed valve duct and possibly even the intake duct. Intermittent compressor stall is indicated when one or a series of "bangs" is heard, at times the blasts seeming to emanate from a point directly behind the pilot. A "steady state" compressor stall, on the other hand, is recognized by strong vibration of the aircraft structure and a steady roar produced by many successive "bangs." A rapid increase in the exhaust gas temperature and a pronounced drop in rpm may accompany a steady stall. Compressor stalls have not, according to the engine manufacturer, proved damaging to the engine, but it is important to prevent the exhaust gas temperature from exceeding limits and thereby causing almost certain damage to the turbine section.

Compressor stall is actually a stalled condition of the compressor blades. Under certain conditions, local reductions in airflow through the compressors cause the compressor blades to operate at high effective angles of attack, and they momentarily stall much in the same manner as does an airplane wing at slow airspeed in turbulent air.

Compressor stalls may be caused by seriously disturbed compressor inlet airflow, high altitude conditions, and by abrupt and erratic throttle movements in conjunction with an improperly functioning fuel control. Although compressor stall can be the result of various conditions in combination, the following briefly outlines three general causes:

a. *Seriously disturbed compressor inlet airflow.* Excessive load factor at high altitude is the most usual cause of serious inlet airflow disturbance. This flight condition results in high angles of attack of the flow at the lower lip of the inlet ducts, and may cause separation of the internal flow at that point, as from the leading edge of a stalled wing. Icing of the inlet ducts or engine inlet guide vanes is another, though less probable, cause of airflow disturbance.

b. *High altitude conditions.* Low temperature and low density air cause the engine to operate with a reduced stall margin, since stalling of the compressor blade airfoils becomes more likely as the air becomes less dense.

c. *Improper functioning of the fuel control.* If the fuel flow to the main burner or afterburner is too high, the temperature and pressure in the burner and tailpipe will exceed normal operating conditions, thereby overloading the compressor by causing abnormal back pressure. Acceleration stalls out of idle are sometimes caused by too low a setting on the fuel control minimum flow regulator. Deceleration stalls are usually caused by bleed valve malfunctions.

d. *Supersonic flight.* Rapid throttle movement to reduce power when the airplane is supersonic may cause compressor stalls, therefore, snap decelerations should be avoided during supersonic flight.

RECOVERY FROM COMPRESSOR STALLS. The general procedure for compressor stall recovery, particularly when high altitude is a contributing factor to the stall, should be accomplished quickly:

a. Reduce thrust setting.
b. Reduce altitude.
c. Increase airspeed.

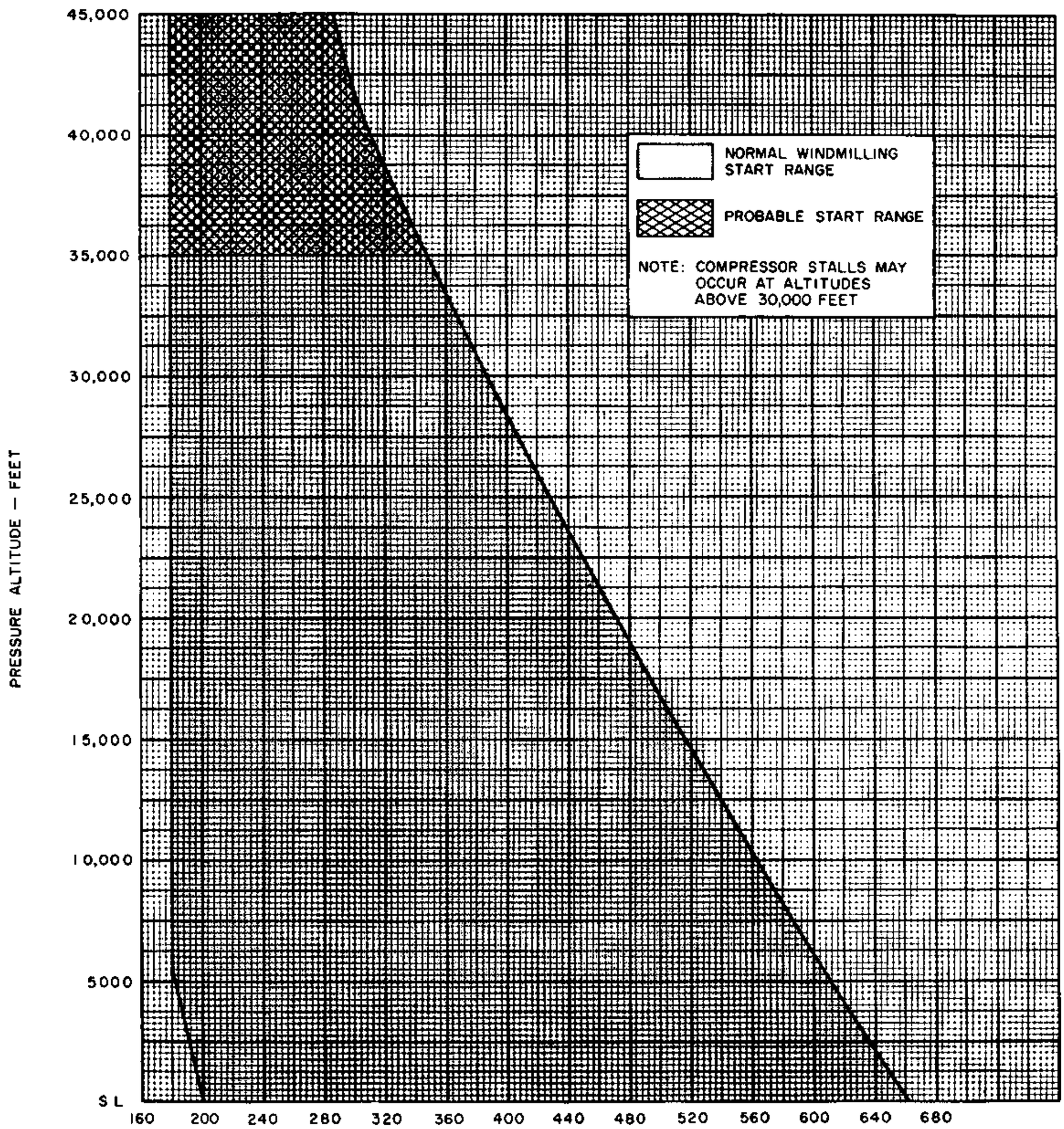
WARNING

Always observe exhaust gas temperature when compressor stall is experienced. Following corrective action, if temperature begins to climb

FLIGHT RELIGHT CHART

MODEL: F4D-1

ENGINE: J57-P-8, -8A, -8B



P-8286-1C

DATA AS OF: 4 June 1958
DATA BASIS: P&W Curve 28184 and Flight Test

FUEL GRADE: JP 4
FUEL DENSITY: 6.5 lb/gal

Figure 7-1. Flight Relight Regions

or does not return to required limits within a few seconds, cut engine and proceed in the same manner as required following a flameout. (Refer to AIR STARTING PROCEDURE, section III.)

Figure 7–1, Flight Relight Regions, shows a variable altitude-airspeed relationship to indicate the most favorable starting conditions within an engine windmilling range of from 12% to 36% rpm. Recent flight data shows that air starts can frequently be accomplished above 35,000 feet using the procedure described in AIR STARTING—HIGH ALTITUDE, section III.

The J57-P-8 and J57-P-8B engines may exhibit compressor stalls during high altitude air starts. These may vary from mild "choo choo" at 30,000 feet to low energy stalls as altitude is increased. They will likely occur in the OPTIMUM and POSSIBLE relight regions above 30,000 feet (see figure 7–1) in the rpm range of 35% to 75%. Relight time should not exceed 50 seconds at 45,000 feet and will decrease as altitude is reduced.

FLIGHT CONTROL SYSTEM

NORMAL FLIGHT CONTROL (WINDMILLING ENGINE)

A flamed-out engine windmilling at 15% will produce enough flow from the hydraulic pumps for a sustained rate of surface movement of approximately 4° per second. If this rate is exceeded, extremely high stick forces will result. While a 4° per second rate of surface movement is considerably below normal, it is still adequate for control. Pump pressure is unaffected, so complete control surface throw is obtainable. In this instance a disconnect should not be made. It is recommended, however, that the control stick be extended and the mechanical advantage changer be set to the 2:1 position in preparation for a disconnect should the rpm drop below 15%. Maneuvering should be gradual and situations that require large and rapid movement of the surfaces must be avoided. If windmilling RPM is maintained but controls freeze due to rapid and/or large deflections, a momentary relaxation of stick pressure will immediately recover control.

MANUAL FLIGHT CONTROL

A malfunction in the mechanical portion of the control system, such as a jam or bind, will not be alleviated by disconnecting the elevon power system. Disconnecting would actually aggravate the situation by adding to the surface load. In view of the difficulty in analyzing a control malfunction accurately, it is recommended that the steps listed under FLIGHT CONTROL SYSTEM in section III be followed to determine the necessity for going to manual. If the airplane still cannot be controlled, a disconnect should be made.

The manual control system offers an *emergency* means of controlling the airplane in the event of engine seizure, failure of the elevon and utility hydraulic systems, or if the elevons are uncontrollable. On manual control, pilot muscle power is substituted for hydraulic power; therefore, this mode of control is characterized by high stick forces and greatly reduced maneuverability. For example, with the airplane trimmed at 170 knots IAS and a MAC ratio of 2:1, it requires 100 pounds of stick force (approximately maximum pilot effort using one hand on the stick) to obtain 8° up elevons. These limitations dictate that manual control should not be used as long as the airplane can be adequately controlled in the powered system. Once the powered system is disconnected, the airplane must remain on manual control until the controls can be reset on the ground. The pitch trimmers should be utilized to augment longitudinal control and the rudder to assist lateral control. Airspeed should be maintained between 150 and 300 knots IAS. Disconnecting the power system when exerting a pull force on the stick should be avoided, because the mild nose down pitching transient associated with the disconnect will be difficult to control. If the pitch trimmers are inoperative, and a low trimmer angle exists, stick forces required to reduce speed and flare for the landing will be extremely high as compared to a trimmer failure at a slow, *trimmed* speed. With the trimmer surfaces faired, it requires approximately 100 pounds of stick force to flare the airplane for landing at 140 knots IAS and a MAC ratio of 2:1. Whereas, with pitch trimmers operative and the airplane trimmed for the approach, a force of only 20 to 25 pounds is required for the flare.

The landing approach should be relatively wide with a shallow angle of bank (20°) and a long straightway. Rate of sink should be kept to a minimum in order to keep stick forces as low as possible for the flare. The approach speeds are the same as for powered flight control, down to 130 knots. The speed should not go below 130 knots. Whereas increasing pull forces should be required to reduce the speed below the trim speed, at approximately 130 knots the back stick forces required to reduce the speed further become lighter and will reverse at speeds near the stall such that heavy forward stick force is required. If this condition occurs, power (if available) should be applied to increase airspeed. Flameout landings are not recommended using the manual system, since it is felt that the difficulties of high stick forces and the wider pattern should not be added to an already exacting task.

FUEL SYSTEM MANAGEMENT

FUEL CONTROL SYSTEM

In normal operation the fuel control system is automatic, metering fuel according to throttle setting while compensating for compressor inlet temperature, engine speed and compressor discharge pressure. The FUEL SYSTEM selector switch provides a means of shutting off automatic operation by isolating the fuel metering system, which allows the pilot to manually control fuel metering by the throttle.

TAKE-OFF FUEL CONTROL. The fuel control unit used on the J57-P-8 series engines does not have minimum-flow locks in the take-off position. During take-off, when fuel control unit failure is indicated, the "MANUAL" fuel system must be selected immediately. However, the throttle setting must be reduced before

reaching 6000 feet pressure altitude to avoid over temperaturing the engine. After selecting "MANUAL" do not return the FUEL SYSTEM selector switch to "NORMAL" for the duration of the flight as a flameout may result. Refer to section II for manual fuel system check.

FUEL SYSTEM NORMAL OPERATION

The fuel supply normally requires no attention other than checking the fuel quantity. When external fuel tanks are carried on the airplane, transfer of fuel to the main tanks is accomplished by turning on the fuel transfer switch. Compressor bleed air pressure forces fuel to the main tanks until float valves shut off the pressure.

Transferring fuel from either one or two external tanks is accomplished by a single transfer switch. A relief valve prevents possible excess pressure build-up in the main tanks, which can escape through the main tank vents only. To transfer fuel when either one or both tanks are loaded, use the following procedure:

a. Check quantity of fuel in main tanks.
b. CROSS FEED FUEL VALVE switch . . "CLOSED"
c. DROP TANK transfer switch . . . . . "TRANSFER"
d. When nearing completion of fuel transfer, level out if possible, to get all of the fuel from external tanks.

The DROP TANK transfer switch may be left on "TRANSFER" even though the main tanks are filled. As fuel is consumed, the float valve will open and allow transferring to continue. When external tanks are empty, turn the switch off.

For information on jettisoning of fuel tanks, refer to paragraph TO JETTISON EXTERNAL STORES, section IV.

FUEL BOOST PUMPS

The two fuel boost pumps are mounted internally in the aft sump sections of the main fuel tanks and will operate constantly whenever the MASTER ENGINE switch is "ON" and a-c power is available. When either boost pump fails, the BOOST PUMP FAILURE warning light will go on and a small drop in fuel pressure will be indicated on the fuel pressure gage[1]. Turning the CROSS FEED FUEL VALVE switch to "OPEN" will equalize the flow of fuel from both tank sumps. With only one boost pump inoperative, engine operation will generally not be subject to fuel starvation. However, operation of the afterburner at low altitudes should be avoided, since there is a possibility of afterburner flameout followed by engine flameout when fuel pressure is below normal. As a safety measure, it should also be noted that, with one boost pump inoperative, high thrust settings in a nose low attitude should be avoided at any altitude to offset the possibility of fuel starvation.

If both boost pumps are inoperative, complete loss of fuel pressure will be indicated on the fuel pressure gage.[1] (For an indication of usable fuel with boost pumps inoperative, see figure 1-6, Fuel Quantity Data.) Failure of both boost pumps would most likely be a result of a-c power failure, causing simultaneous failure of the right-hand tank transfer pump. Because of the reduced effectiveness of the fuel system under this condition, recommendations for limited thrust setting and flight operation should be observed when possible. However, it is important to understand that the design features of the fuel system are such that *all flight maneuvers and the use of maximum thrust with afterbrning are possible* with only the left-hand tank transfer pump operating. The one exception to normal engine operation which should be observed is that operation of the afterburner at low altitude be avoided.

Use of the aircraft for combat operations is therefore possible when fuel pressure is no longer indicated, but the pilot should maintain flight under such conditions only when an emergency requires such action. Under otherwise normal conditions of flight, the more conservative procedure should always be observed following failure of both boost pumps. This procedure is described as follows:

a. Aircraft attitude . . . . . Nose up, maintain 1g
b. CROSS FEED FUEL VALVE switch . . . "OPEN"
c. Avoid sudden power setting changes.
d. Terminate the flight as soon as practicable.
e. If extended flight is necessary, avoid maximum thrust conditions or use of afterburner, particularly in a nose low attitude. Gravity flow will supplement fuel pressure when the airplane is flown in a slightly nose high attitude.
f. When necessary to lose altitude, descend with a slightly nose high attitude at a low thrust setting to preclude the possibility of the transfer pump failing to maintain adequate fuel to the tank sump in the nose low attitude.

WARNING

With one or both boost pumps inoperative, do not attempt use of the afterburner during a wave-off except where the safety of flight is involved. Because of the excessive amount of fuel required at low altitude, afterburner flameout could result and may be followed by total engine flameout.

DURING FLIGHT. When safety of flight necessitates, transfer to the "MANUAL" fuel control system may be made at any thrust setting. At all other times the transfer should be made with the throttle in the "IDLE" position. The following procedure is recommended:

a. Throttle . . . . . "IDLE"
b. FUEL SYSTEM selector switch . . . . . "MANUAL"
c. Throttle . . . . . Move slowly to desired setting

Note

In case of procedural familiarization with the use of the manual fuel system, and with a properly functioning fuel control, the transfer back to "NORMAL" should be made with the throttle at the position which would give the approximate idle rpm for the existing altitude under "NORMAL" operation.

[1] Airplanes BuNo. 130741–130750; BuNo. 134744–134770, 134772–134852 prior to service change.

SECTION VIII
CREW DUTIES

(Not Applicable)

SECTION IX

ALL-WEATHER OPERATION

INTRODUCTION

A discussion on special techniques and procedures for operating the airplane in adverse weather necessarily includes for the sake of clarity, emphasis or continuity, some instructions found in other sections of this handbook. Normal operating instructions covered in Section II, however, will not be repeated here except for establishing the correct sequence of operations and to emphasize the importance of certain procedures. Any discussion concerning systems operation in relationship to all weather flying will be found in section VII.

NIGHT FLYING

For pre-flight preparations and take-off at night, refer to procedure described under INSTRUMENT FLIGHT PROCEDURES. In addition to performing this list of items, observe the following:

a. Prior to take-off, avoid use of bright light in cockpit to prevent loss of night vision.

b. Push up on the canopy to make certain that it has been securely latched and locked.

c. Check oxygen supply and oxygen mask fit.

INSTRUMENT FLIGHT PROCEDURES

This portion is not intended to provide information on general techniques of all weather flying, but certain characteristics and limitations of the airplane during instrument flight conditions are presented as a supplement to previous training and experience. Successful fulfillment of a mission under instrument flight conditions, especially in jets, requires careful pre-flight planning, current instrument proficiency on the part of the pilot, and adequate instrumentation for instrument take-off, orientation, approach and landing.

While designed to perform as a high-altitude interceptor at heights above the average instrument weather, the airplane is suitably equipped and capable of instrument flight operations. Control characteristics and stability are adequate for instrument flight and good instrumentation is provided.

The UHF receiver-transmitter provides static-free communication and works in conjunction with the UHF homing adapter receiver. Tacan or omni-range receivers are provided for navigation, orientation and letdown. Instrument flight is further aided by radar altimeter and automatic pilot.

INSTRUMENT TAKE-OFF

PRIOR TO TAKE-OFF. To reduce fuel consumption, the pre-take-off check should be completed as nearly as possible before starting the engine. This will include everything except the controls system and the engine check.

a. Connect external source of electrical power.

b. Check all communications and navigation equipment for correct operation.

c. Check interior lighting. Adjust the forward floodlights for use in reading instrument flight guides, maps, etc.

d. Check oxygen supply and oxygen mask fit.

e. Set the altimeter.

f. Turn on the radar altimeter and set for low range.

g. Adjust the gyro horizon.

h. Check all directional instruments while taxiing.

TAKE-OFF

a. When in take-off position, set the gyrosyn compass to the runway heading.

b. Check gyro horizon for correct operation.

c. Turn on PITOT HEAT & ENGINE ANTI-ICING switch.

d. Advance throttle, maintaining directional control with brakes until rudder control is effective (approximately 50 knots).

e. When take-off speed is reached, lift nose gently from ground to prevent an excessively high angle of attack.

f. When airplane clears ground, raise gear immediately.

INSTRUMENT CLIMB

a. Use standard or one-half standard rate climbing turns.

b. Retard throttle as required to prevent overtemperaturing the engine.

c. Avoid icing levels.

ICE, SNOW AND RAIN

Most kinds of precipitation encountered on the ground can create flight hazards when the temperature borders on freezing. Because of the rapidity with which icing conditions may occur, the responsibility of the pilot in making last minute checks on the exterior of his airplane cannot be overstressed. Take-offs should never be attempted when frost, ice-glaze or patches of wet snow adhere to the surfaces.

Note

The white and grey color of the aircraft finish may make it difficult to detect glaze ice formation on the wings.

CAUTION

Icing may form in the air intake ducts and on the duct rods forward of the engine under the same atmospheric conditions that causes ice to form on the wings. Indications of such ice formation in the ducts and on the rods will be an increase in tailpipe temperature and a loss in airspeed despite power remaining constant. Application of anti-icing heat will *not* alleviate this icing condition, since heat is applied aft of the rods. Therefore, to minimize the seriousness of icing, it is recommended that flight through areas of icing be accomplished as rapidly as possible.

RAIN REPELLENT

A rain repellent kit, stock number R83K710075, is available through normal supply channels for coating the *external* surfaces of the windshield and canopy. The function of the repellent is to increase visibility through windshields and canopies during rainstorms. The kit consists of a can of solvent cleaner, a tube of bonding paste, and a stick of repellent.

RAIN REPELLENT APPLICATION

a. Wash surface in accordance with existing instructions if excessively soiled.

b. Clean surface with kit-supplied cleaner. Use clean soft cloth, then dry surface.

c. Polish cleaned surface with a clean soft cloth.

d. Apply kit-supplied bonding paste very sparingly with a clean soft cloth, working it completely over the surface.

Note

Do not apply the bonding paste to a wet surface. A satisfactory bond will not be obtained.

e. Polish the surface with a clean soft cloth until all the black color disappears.

f. Apply the kit-supplied rain repellent by rubbing the side of the stick lightly over the surface.

Note

Do not apply rain repellent stick endwise. An excessive amount of film will be deposited.

g. Polish the surface with a clean soft cloth until the film is clear.

CAUTION

Do not apply rain repellent to the interior of the windshield or canopy.

ANTI-FOGGING COMPOUND

An anti-fogging compound, stock number R51-XAE101-1-8, is available through normal supply channels for coating the *interior* surfaces of the windshield and canopy. The function of the compound is to absorb the moisture and prevent fogging of the surfaces.

ANTI-FOGGING COMPOUND APPLICATION

a. Wash surface in accordance with existing instructions if excessively soiled.

b. Apply the anti-fogging compound to the interior of the windshield by means of the application unit.

c. Wipe the interior surface with a clean lintless cloth until the surface is clear.

CAUTION

- Do not permit compound to contact instrument panel finish.
- Do not permit compound to remain on windshield and canopy sealant.

Note

One application of compound is effective for a minimum of ten fogging and drying cycles or approximately seven hours of continuous fogging conditions.

FLIGHT IN TURBULENCE AND THUNDERSTORMS

PREPARATION. Whenever possible, thunderstorms should be by-passed, or if a storm area is extended over a wide front, it is usually advisable to fly above the weather. If it becomes necessary to penetrate a storm area, it is important to reduce airspeed to approximately 250 to 300 knots IAS, and if turbulence is extreme, airspeed should be kept to a minimum to avoid excessive gust loads on the structure. Vertical air currents in well-developed thunderstorms will sometimes alter the airplane's altitude several thousand feet, and airspeed will fluctuate considerably. Rather than attempt to fly at a constant altitude, the pilot should maintain the initial flight attitude which is commensurate with a safe airspeed. Wide fluctuations in airspeed usually of several seconds duration, can largely be ignored. When entering a storm area, proceed as follows:

a. Disengage auto-pilot.

b. Reduce airspeed to 250-300 knots IAS.

c. PITOT & ENGINE ANTI-ICING switch ..... "ON"

d. YAW DAMP control switch .... Pull up to disengage

e. Turn all cockpit lights on bright.

FLIGHT PROCEDURE. On approaching the storm, fly on a heading calculated to provide the quickest passage and at an altitude affording the least turbulence. Avoid known icing levels. Maintain the initial heading through the storm and correct for any deviation from flight plan after emerging from the weather.

COLD WEATHER OPERATIONS

In flight, low temperatures will be encountered in all regions when operating at extremely high altitudes. However, most cold weather difficulties exist on the deck or airfield, and safe operation demands diligent efforts of flight and ground crewmen alike. Safety of flight depends on thorough preparation and careful observation of weather by the pilot. Equally important are preflight inspections which must eliminate the added hazards of cold weather whenever the grounded airplane is exposed to ice, snow and frost.

BEFORE ENTERING THE AIRPLANE

Make a thorough check to see that the following items have been accomplished:

a. Protective covers and plugs removed.

b. Visually check engine intakes for evidence of ice.

c. Check fuel drains (defueling valves). If ice is present, heat should be applied for removal of condensation. Check fuel lines and shut-off valves.

d. All ice removed from fuel tank vents, static air sources, pitot tube, and angle of attack and yaw probes.

e. Shock struts properly inflated, and dirt and ice removed. Inspect limit switches and fairing door hinges, actuating cylinder and pistons, wheels.

f. Battery fully charged.

g. Control surfaces and hinges thoroughly checked.

h. Slat operation for smooth roller and track movement.

i. Check the entire airplane for freedom from frost, snow, and ice. Remove frost or snow by light brushing, ice by application of heat.

j. Make sure that wheels are chocked securely to prevent slippage.

CAUTION

- Do not chip ice from aircraft surfaces as damage will result.
- Check that water from ice removal does not refreeze, particularly on the control hinges.

ON ENTERING THE AIRPLANE

Inspect canopy seal to make sure no ice has accumulated to prevent proper seating.

BEFORE STARTING ENGINE

Check to see that compressor rotates freely by momentary starter application; engine heat on shutdown melts ice accumulated during the previous flight, and the moisture may refreeze on the lower sections of the low pressure compressor blades. Heat may be applied to melt ice, and the engine should be started as quickly as possible after the compressor is free.

STARTING AND WARM-UP

a. Use normal procedure for starting engine. If temperature is less than −35°C, run at IDLE for two minutes before take-off. Oil pressure may run high temporarily when temperature is low.

b. Inspect all instruments for proper operation.

c. Check all flight controls both visually and by feel for unrestricted movement.

d. Run through a complete cycle with rudder, pitch trimmer and speed brakes several times to assure correct operation.

e. Cabin heat and defrost on. Use engine anti-icing if required.

f. Use caution while running up on slippery surface, as chocks may slide.

TAXIING

a. If necessary to taxi on ice or snow, allow greater distance for braking action. Skidding may occur with temporary loss of control when sharp turns are made or when a crosswind exists. Hold taxi speed to a minimum when in proximity to other airplanes or obstructions.

b. Avoid taxiing through melted snow or slush caused by the jet blast of other airplanes, to prevent accumulation of ice on the airplane surfaces. Taxiing in deep snow is difficult and may cause freezing of brakes and gear after take-off.

c. Use caution when taxiing in the vicinity of other airplanes as the exhaust heat and blast from jets can blow melted ice and snow which will freeze on contact. Jet blast can impair visibility by blowing clouds of dry snow over a large area.

d. Minimize taxi time to conserve fuel and prevent fog accumulation from jet engine.

BEFORE TAKE-OFF

a. Turn air conditioning to "MANUAL HOT" temporarily if defrosting of windshield is required.

WARNING

Do not take off with frosted windshield, or with frost, snow, or ice formation on wings or control surfaces.

b. Pitot heat and engine anti-icing "ON," if necessary.

c. If surface of runway is too slippery for engine run-up, the power check must be made during early part of take-off.

TAKE-OFF

a. When starting the take-off run, advance the throttle rapidly and check engine instruments, afterburner operation.

b. After take-off from snow or slush-covered runways, operate the landing gear through several cycles to prevent freezing in the up position.

CAUTION

Do not apply brakes to stop wheels spinning after take-off as cold temperatures may freeze them in the "braked" position.

DURING FLIGHT

a. Flight characteristics of the airplane are not affected by cold weather, although colder than normal temperature increases air density and produces greater ram pressure. Engine thrust, therefore, must be reduced to establish the desired airspeed-altitude combination for maximum range.

b. If fogging of the cabin should occur in flight in airplanes not equipped with separate defrosting controls, use "MANUAL HOT" position of the air conditioning control and then reset the control to slightly higher setting than the previous one.

DESCENT

During rapid descent with low thrust settings, engine bleed air temperature may not supply sufficient heat for defrosting the windshield with normal air conditioning. Therefore, in airplanes not equipped with separate defrosting controls, place the air conditioning control in "MANUAL HOT" position to defrost.

CAUTION

If an idle descent from high altitude is contemplated, the "MANUAL HOT" position of the air conditioning control must be selected at least four minutes before letdown to prevent severe frosting of the canopy during the descent.

LANDING

When landing on snow or ice-covered runways, it is extremely important to avoid drift which will cause skidding and consequent loss of control. Maintain straight course down the runway, applying brakes evenly and lightly.

SHUTDOWN AND POSTFLIGHT

a. Use normal shutdown procedures.

b. See that wheels are chocked securely.

c. Have airplane serviced, fuel lines (defueling valves) drained.

d. Have covers and plugs installed without delay if airplane is to be moored outside. Make certain airplane is tied down securely.

e. Battery should be removed if airplane will not be flown for several days. At temperatures below −7°C, the battery should be removed from the airplane and stored in a heated area if the aircraft is not to be operated within the next four hours.

HOT WEATHER AND DESERT OPERATION

When high altitude flight requires the wearing of a close-fitting pressure suit, it is advisable to make a preflight check of the aircraft before getting into the suit. When wearing tight clothing, the pilot should take as little time as possible in getting the engine started if ground-connected air conditioning is not provided for the cockpit. Metal exposed to the sun can inflict severe burns, and contact with the skin should be avoided.

BEFORE STARTING ENGINE

a. Make visual inspection of airplane exterior, checking for system leakages, sand or dust accumulation, tire over-inflation, blistering, fungus or corrosion, and loose inspection plates.

b. See that all lock pins, protective covers and plugs, (including pitot head cover and yaw probe and angle of attack probe covers) are removed.

c. Make any other necessary ground checks prior to starting engine, such as servicing of oxygen and fuel tanks.

d. Make sure air conditioning system is turned on.

AFTER STARTING ENGINE

a. Make engine ground run-up as short as possible.

b. Acceleration to idle rpm will take longer than on a normal or cold day.

TAXIING AND TAKE-OFF

a. Avoid excessive use of brakes and watch exhaust temperatures closely.

b. Do not take off in blowing dust or sand, or in the wake of another aircraft on sandy or dusty fields.

c. Because of the lower density of air in hot weather, be prepared for slower acceleration, longer take-off distance, and reduced thrust at all throttle settings. TAS will be greater for the normal IAS and strict adherence to recommended IAS is essential to safe flight.

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