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MSP C

BOEING 747

MODEL 747-51

OPERATIONS MANUAL

NORTHWEST AIRLINES, INC.

PUBLISHED BY THE BOEING COMPANY, COMMERCIAL AIRPLANE DIVISION, RENTON, WASHINGTON U.S.A.

BOEING DOCUMENT NO. D6-30151 – 51 AUGUST 15, 1969

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Operations Manual Bulletins for each type airplane are issued by the Boeing Company as the need arises. They are used to transmit information of a nature requiring issuance earlier than the next formal revision to the Operations Manual. When the next formal revision is issued, it will include a replacement Operations Manual Bulletin Record listing all Bulletins issued to date and the status of each as follows:

IN EFFECT – Identifies that the bulletin contains current and pertinent information which is not otherwise covered in the Operations Manual. Bulletin should remain in manual.

INCORPORATED – Identifies that appropriate information has been incorporated into this Operations Manual. Bulletin may be removed from manual. Additional information regarding the disposition of Bulletins will be contained in the Highlights of the Revision Record Transmittal Sheet.

CANCELLED – Bulletin no longer in effect; should be removed from Manual.

N/A – Not Applicable identifies bulletins that were issued for this type airplane which are not applicable to the particular model covered by this Operations Manual.

NOTE: Bulletins are numbered in sequence as they are issued. Occasionally, a bulletin may not pertain to some airplane models. In such cases, each manual holder will be so advised and requested to enter N/A in the Bulletin Status column for that bulletin number. This will provide a full accountability of all bulletins issued.

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71-1	1-1-71	Incorporated		71-19	2-23-71	Cancelled	
-2	1-8-71	Incorporated		-20	2-25-71	N/A	
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The 747 OPERATIONS MANUAL is designed for "on the line" operations by trained flight crewmembers. All of the procedures are based on a thorough analysis of the crew activity required to operate the airplane. The intent of the manual is to provide for the primary requirement of the flight crew – ready retrieval of the correct procedure. Additional information concerning the procedures may be acquired by reference to documents that treat the airplane in greater depth.

The manual is divided into Limitations, Procedures (Emergency, Abnormal, and Normal), Airplane General, Systems, Warnings, and Performance (Inflight and Dispatch) chapters as follows:

CHAPTER 1 – LIMITATIONS

This chapter contains a summary of all significant FAA certification limitations and Boeing Recommended limitations not included in a specific procedure.

The FAA Limitations restrict operation of the airplane in accordance with the airworthiness certificate and are legally binding on the flight crew. The Boeing Recommended Limitations, reflect manufacturer's warranties or recommendations to increase service life of the airplane or airplane equipment.

CHAPTERS 2, 3 and 4 – PROCEDURES (EMERGENCY, ABNORMAL and NORMAL)

The majority of the airplane operating procedures are contained within these chapters. However, procedures that are not related to a phase of flight, and procedures that are performed a number of times, are contained within the Normal Operations section of the applicable systems chapter. These chapters include the checklists and the amplified procedures.

Included in these chapters are the EMERGENCY, ABNORMAL and NORMAL checklists. An optional checklist presentation which combines the EMERGENCY-ABNORMAL procedure checklists with the applicable NORMAL procedure checklists is included. This type of checklist reduces the requirement for multiple checklists to complete a single procedure. The checklists are designed so that they may be reprinted on cardstock for ready reference in the cockpit.

Also included in these chapters are the recommended flight patterns to support the applicable procedures.

The Emergency Procedures are those where immediate and precise action on the part of the crew in a foreseeable but unusual situation will substantially reduce the possibility of personnel injury or loss of life.

The Abnormal Procedures are those "irregularities" that require the use of a checklist.

The Normal Procedures include checks and operation of the airplane and systems that are oriented to a particular phase of flight – for example, establishing airplane electrical power during the AFTER START procedure.

Performance of the Normal Procedures will be within the recall of the flight crew as a result of training and experience. However, reference will be made to the NORMAL CHECKLIST to confirm that essential steps have been accomplished. An amplification of each portion follows the appropriate phase of flight procedure.

CHAPTER 5 – AIRPLANE GENERAL

This chapter contains such items as illustrated instrument panels, information related to equipment and furnishings, etc.

CHAPTERS 6 thru 21 – SYSTEMS

Each of the systems chapters is subdivided into five sections. The first two sections – Normal Operations and Alternate Operations – are procedural in nature. The three remaining sections – Controls and Indicators, Schematics, and Supplementary Information (narrative) – contain only descriptive material required to support the procedures. Specifically, these sections contain the following:

- Normal Operations are procedures that are not directly related to a specific phase of flight, such as use of engine anti-ice.
- Alternate Operations are procedures that are designed to cope with "irregularities" that are not included on the Abnormal Checklist, but are available for reference, as needed. These are situations such as engine hot start, hydraulic system overheat, etc.
- Controls and Indicators show panel information as to the function of various switches, indicators, and lights.
- Schematics provide additional descriptive information to support the procedures.
- Supplementary Information contains brief system description and specific details that experience with the 747 has proven essential to the flight crew's performance of procedures.

CHAPTER 22 – WARNINGS

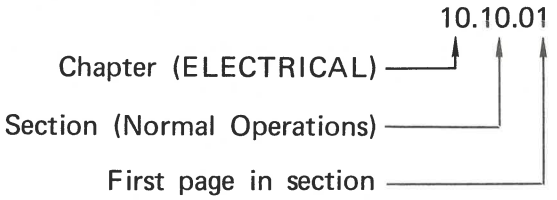
This chapter contains a summary of aural, tactile (perceived by feel) and the more critical visual warnings in the cockpit, for ready review by the flight crew.

CHAPTERS 23 and 24 – PERFORMANCE (INFLIGHT and DISPATCH)

Inflight Performance contains operational performance data to enable the flight crew to accurately determine the most efficient takeoff, flight and landing airplane performance under all conditions.

Dispatch Performance contains operational data, enabling the crew to derive information for flight planning, altitude selection, speed capability, holding, etc.

The Decimal Numbering System used in this Manual for page identification is suitable for computer usage and will allow individual operators to rearrange the contents if desired. An example of the numbering system is as follows:



This publication will be revised periodically to expand or provide information not available at time of printing.

NOTICE

Due to airplane changes and publications scheduling, it may be apparent that some differences between the Operations Manual and the FAA Approved Airplane Flight Manual could occur. In the event of a difference, the FAA Approved Airplane Flight Manual shall always prevail.

REVISION RECORD

Formal Operations Manual Revisions are issued periodically by the Boeing Company to provide current procedures and information not previously furnished. The formal revision will also incorporate appropriate information from previously issued Operations Manual Bulletins. When bulletins are incorporated in this manner, the Highlights of the formal revision will describe the change and the new Bulletin Record will reflect the resultant status of the bulletin.

All formal revisions will be accompanied by a new Revision Record and a Transmittal Sheet containing the revision number, date, highlights, and filing instructions. Also, a new Log of Pages will provide a complete list of currently effective pages in the manual. The record below should be completed by the person filing the revision material.

Pages containing revised material will show a revision bar in the margin of the page opposite the changed text or illustration. Relocated or rearranged text or illustrations will be indicated by a revision bar adjacent to the page number or code and date.

ORIGINAL BOOK DATE AUG 15/69

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Loading		TAB
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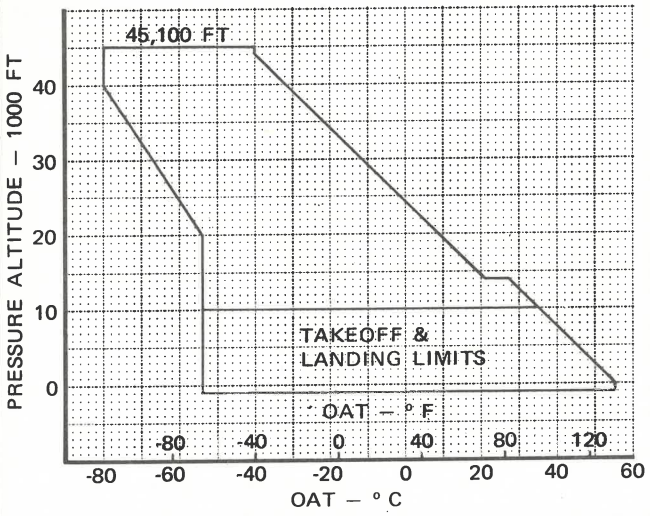
GENERAL

(AFM) For passenger operation, during taxi, T.O., & landing:
- One attendant required at each overwing exit or as placarded.
- Emergency escape system: AUTOMATIC and girt bar engaged.
- Passengers use of upper deck area as placarded. Crew compartment escape slide in forward locked position.

OPERATIONAL

(AFM) Operating Envelope



(AFM) Max T.O. & landing tailwind: 10 KTS
Max demonstrated T.O. & landing crosswind:
30 KTS manual
23 KTS autoland

(AFM) Max speeds: observe V_{MO} pointer & gear and flap placards.
Turbulent air penetration: 280-290 KIAS/ .82-.85M

LANDING GEAR EXTENDED

Additional or more restrictive limitations for dispatch with landing gear extended.

(AFM) See Chap. 23 and 24 for performance decrements.
(AFM) Max. Operating Altitude: 30,000 feet
(AFM) Max airspeed: 270 KIAS
Turbulent air penetration: 240 KIAS
(AFM) Extended overwater operation prohitited

GROSS WEIGHT & C.G.

(AFM) C.G. limits: Observe approved weight and balance system and fuel management per chap 4, 15 & 24

(AFM) Max taxi wt: 713,000 lbs (323,411 kgs) or as limited by approved weight & balance system.

(AFM) Max brake release wt:
710,000 lbs (322,056 kgs)
Reduce as a function of the fuel density.
Use FULL reserve tank fuel weight (gage) for determinating reduction.

For FULL reserve tank wt. lbs (kgs)		Reduce Max brake release wt. by: lbs	(kgs)
3250 (1475) and up	–	0	(0)
3200 (1450)	–	1700	(1000)
3150 (1425)	–	3300	(1600)
3100 (1400)	–	5000	(2400)
3050 (1375)	–	6600	(3200)
3000 (1360)	–	8300	(3700)

May be further restricted by field length limits, climb limits, tire speed limits, brake energy limits, or obstacle clearance, enroute and landing requirements.

(AFM) Max landing wt: 564,000 lbs (255,825 kgs)
May be further restricted by field length limits or climb limits.

(AFM) Max zero fuel wt: 526,500 lbs (238,816 kgs)

SPARE ENGINE

Additional or more restrictive limitations for operation with spare engine installed.

(AFM) Max taxi wt.
(AFM) Max brake release wt.
(AFM) Max landing wt.
→ Reduce by 20,000 lbs (9,072 kgs) May be further restricted by spare engine performance decrements.

(AFM) Max operating altitude: 35,200 ft.
(AFM) Max speed: 290 knots IAS

(AFM) Operation in icing conditions not permitted unless equipped with deflector dome.

AIR CONDITIONING & PRESSURIZATION

(AFM) Max cabin differential: 9.4 psi
(AFM) Max cabin differential for T.O. & landing: cabin 140 ft below field pressure altitude.
(AFM) T.O. with packs off — See Chapter 4
— Not above 110° F (44° C) ambient temperature.
(AFM) T.O. with APU & pack No. 2 operating — See Chapter 4

APU

(AFM) Ground use only unless modified.
(AFM) Inflight use (placard installed)
(AFM) — Below 15,000 feet
(AFM) — Not permitted in icing conditions
(AFM) — No inflight starts
(AFM) — APU electrical power not to be used
(AFM) EGT Starting: 900° C
(AFM) Maximum: 720° C (two minutes)
(AFM) Continuous: 670° C
Starter: 1 minute ON, 5 minutes OFF
3 starts per hour.

ELECTRICAL

AC volts: 115 ± 5 Volts
AC freq: 400 ± 5 HZ
Generator load:
(AFM) Isolated: 54 KW (81 KW for 5 min)
3 or 4 generators paralleled: 51 KW each
2 generators paralleled: 81 KW total
DC volts (battery and TR): 25 to 30 Volts
Max TR load: 75 AMPS continuous
93 AMPS 30 minutes
113 AMPS 5 minutes
Auxiliary (APU or external) 250 AMPS

FLIGHT CONTROLS

(AFM) Flap extension, max altitude: 20,000 ft.
Do not operate speed brakes in flight with flaps extended.
(AFM) Max G.W. Flaps 25 or 30: 570,000 lbs. (258,547 kgs.)
(AFM) Do not ARM speed brakes at temperatures below -45° F (-43° C)

FUEL

(AFM) Loading & usage: See Chapters 4, 15 & 23
(AFM) Center tank fuel: load only with full mains and reserves unless considered as payload.
(AFM) Max temp: 54.5° C (JP4: 43° C)
(AFM) Min temp: fuel freeze point + 3° C
(AFM) Max fuel qty, tanks 1 & 4: 30,000 lbs. (13,605 kgs.)
(AFM) Fuel reserve: retain in main wing tanks
(AFM) Min fuel qty tanks 1 & 4: See chart page 01.10.03

ICE & RAIN PROTECTION

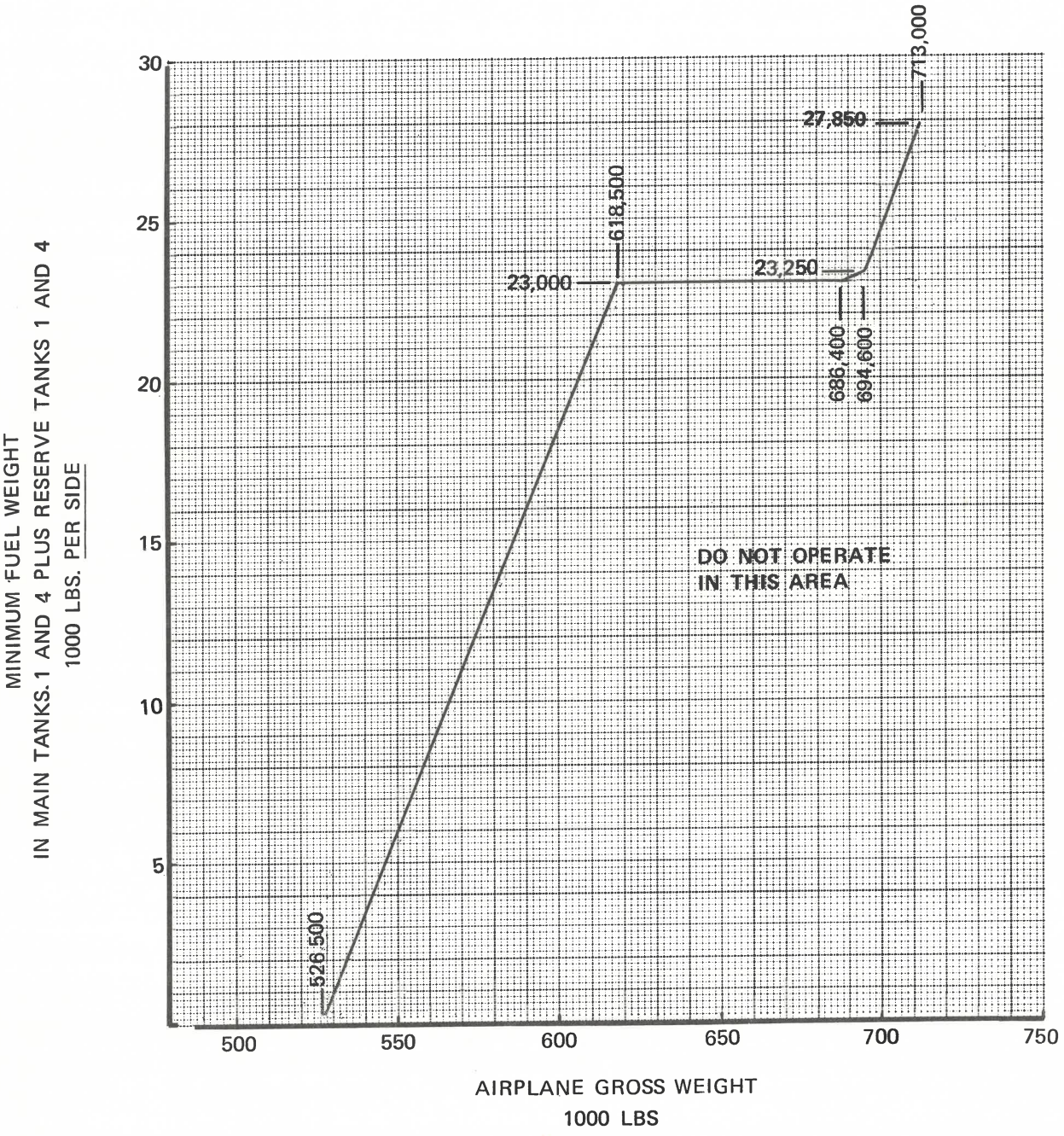
(AFM) Engine TAI must be on when icing conditions exist or are anticipated during ground operation, takeoff and flight.
Max temp for TAI operation: 10° C (50° F) ambient on ground or TAT inflight.
For anti-ice with inoperative engines:
3 engines: max 2 packs on
2 engines: max 1 pack on
(AFM) Window heat ON for all flight operations.

LANDING GEAR

(AFM) Antiskid off for taxi & at end of landing run or refused takeoff.
(AFM) Body gear steering deactivated for takeoff and landing.
One or two brakes deactivated: See Chapter 24 for performance decrements.

POWER PLANT (JT9D-3A ENGINE)

(AFM) Ignition: On for T.O. and landing and with throttle bar engaged.
(AFM) Throttle bar: engaged as placarded.
(AFM) Reverse Thrust: ground operation only
(AFM) Max N1 RPM: 101.4%
(AFM) Max N2 RPM: 100.6%
(AFM) Max EGT
(AFM) T.O.: 846° C (5 min)
(AFM) Continuous: 816° C
(AFM) Starting: 593° C
(AFM) Acceleration: 846° C
(AFM) Oil pressure: Maximum — upper red radial
Minimum — lower red radial
(AFM) Oil temp: Max continuous — Green band
(AFM) Max 20 minutes — Yellow arc
Starter: Max re-engage — 30% N2 RPM
Max operation — 15 minutes continuous
(AFM) Max EPR — See Chapter 23



FUEL REQUIREMENTS – MAIN & RESERVE TANKS 1 AND 4

CHAPTER 2

EMERGENCY PROCEDURES

Any crewmember detecting an existing or impending emergency condition will immediately inform the Captain and reset any aural warning. With an engine fire condition the crewmember will identify the engine number and the captain will verify.

On the Captain's command the appropriate crewmember(s) will perform, without reference to the checklist, the items contained within the boxed portion of the checklist.

The F/E will then read the complete checklist and the appropriate crewmember(s) will respond as indicated in the prefatory statement on each amplified checklist. The appropriate crewmember(s) will acknowledge procedural or advisory items identified in the checklist by a dot.

Upon completion of the checklist the F/E will announce "_____ Checklist complete."

These procedures assume that circuit breakers will be checked and lights tested at any time in a particular procedure if appropriate.

FLIGHT PATTERNS

Flight patterns applicable to emergency procedures are included to present the recommended flight pattern and sequence for airplane configuration changes.

EMERGENCY CHECKLIST

BOEING 747-151

ENGINE FIRE

Severe Damage or Separation

Thrust Lever . . . . . .CLOSE
Start Lever . . . . . CUTOFF
Engine Fire Switch . . . . . .PULL
IF FIRE SWITCH REMAINS ILLUMINATED:
Fire Bottle . . . . . DISCHARGE

AFTER 30 SECONDS, IF FIRE SWITCH REMAINS ILLUMINATED:

Other Fire Bottle . . . . . DISCHARGE

IF FIRE CONTINUES:

- Do not lower flaps or use speed brakes unless emergency landing is imminent.

Landing Gear. . . . . .UP & OFF
Flaps . . . . . UP, NO LIGHTS
Airspeed. . . . . 280 KIAS MIN

APU FIRE

APU Fire Switch . . . . . .PULL
Fire Bottle . . . . . .DISCHARGE

WHEEL WELL FIRE

Landing Gear and Doors . . . . .DOWN & OPEN

LOWER FWD CARGO FIRE

Compartment Selector . . . . . FWD
Fire Bottle No. 1 . . . . . DISCHARGE

Airplane Altitude . . . . . MEA, 14,000 FT, OR BELOW
Air Conditioning Packs . . . . . .MAX ONE ON
Zone 1 Recirculating Fan. . . . . .CHECK OFF
Pressurization Mode . . . . . MAN
Cabin Altitude. . . . . EQUAL TO AIRPLANE
Outflow Valves . . . . . .MINIMUM OPEN

AFTER ONE HOUR

Fire Bottle No. 2 . . . . . .DISCHARGE

LOWER AFT CARGO FIRE

Compartment Selector . . . . . AFT
Fire Bottle No. 1 . . . . . DISCHARGE

Airplane Altitude . . . . . 23,000 FT.
Cabin Altitude . . . . . 10,000 FT.
Air Conditioning Packs . . . . . .MAX ONE ON
Equipment Cooling Valve . . . . . SMOKE

AFTER ONE HOUR

Fire Bottle No. 2 . . . . . .DISCHARGE

EMERGENCY CHECKLIST

BOEING 747-151

ELECTRICAL SMOKE OR FIRE

Oxygen Mask and Regulators (if required) . . . . . ON, 100%
Crew Communications . . . . . ESTABLISH
Smoke Goggles (if required) . . . . . ON
Cabin Altitude (max 10,000 Ft, if required) . . . . INCREASE
Pressurization Rate Switch (if required) . . . . . INCREASE

IF SMOKE SOURCE CAN BE LOCATED:

Electrical Power (Affected Equipment) . . . . . REMOVE

IF SMOKE SOURCE CANNOT BE LOCATED:

Galley Power . . . . . OFF
Gasper and Recirculating Fans . . . . . OFF

IF SMOKE CONTINUES:

Circuit Breaker Panels . . . . . CHECK

IF SMOKE CONTINUES:

DC Bus Isolation Relays . . . . . OPEN
Bus Tie Breakers . . . . . TRIP
Pilots' Panels . . . . . CHECK
Flight Engineer's Panel . . . . . CHECK

IF SMOKE CONTINUES:

All Unnecessary Equipment . . . . . OFF

- Land at nearest suitable airport.
- Main busses or radio and flight instrument busses may be de-energized on an individual one at a time basis.

COCKPIT SMOKE EVACUATION

Oxygen Masks and Regulators (if required) . . . . . ON, 100%
Crew Communications . . . . . ESTABLISH
Smoke Goggles (if required) . . . . . ON
Cabin Altitude (max 10,000 ft) . . . . INCREASE
Pressurization Rate Switch (if required) . . . . . INCREASE
Bleed Air Valves . . . . . OPEN
Isolation Valves . . . . . OPEN
Pack Valves . . . . . OPEN

IF SMOKE PERSISTS OR IS SEVERE:

Smoke Evacuation Port . . . . . OPEN

IF UNPRESSURIZED:

Crew Escape Hatch (below 200 KIAS) . . . OPEN

LOSS OF ALL GENERATORS

Battery . . . . . CHECK ON
Standby Power . . . . . ON

Fuel Crossfeed Valves . . . . . OPEN

IF ENGINE START REQUIRED:

Start Levers . . . . . CUTOFF
Airplane Altitude . . . . . BELOW 30,000 FT.
Airspeed . . . . . MIN 250 KIAS
Standby Ignition . . . . . IGN 1 OR IGN 2
Start Levers . . . . . IDLE

IF ENGINES ARE RUNNING:

Split System and Bus Tie Breakers . . . . . TRIP
DC Bus Isolation Switches . . . . . OPEN
Generator Fields . . . . . CLOSE
Essential Power . . . . . ESTABLISH
Generator Breakers . . . . . CLOSE
DC Bus Isolation Switches . . . . . CLOSE

3 GENERATORS INOPERATIVE

All Unnecessary Equipment . . . . . OFF
Split System And Bus Tie Breakers . . . . CLOSE

EMERGENCY CHECKLIST

BOEING 747-151

TWO HYDRAULIC SYSTEMS INOPERATIVE

- Complete SINGLE HYDRAULIC SYSTEM LEAK OR LOSS Checklist.
- With two hydraulic systems inoperative, land at the nearest suitable airport.
- Set airspeed bugs at V_{REF} + 20 for landing.
- Crosswind limit is 20 knots.
- With loss of systems 1 and 4 open reserve brake source before landing.
- Use flaps 25 for landing.

TWO ENGINES INOPERATIVE

- Complete ENGINE FIRE or ENGINE FAILURE/SHUTDOWN Checklists.
- Complete 1 or 2 GENERATORS INOPERATIVE Checklist.

Air Conditioning Packs . . . . . .MAX ONE ON
Fuel Jettison (if required) . . . . . COMPLETE
Airspeed Bugs . . . . . V_{Ref} +5
Complete NORMAL DESCENT-APPROACH Checklist.
Two Engine Inoperative Go-Around Procedure . . . . . .REVIEW
Flaps . . . . . .25-25, BLUE LIGHT
Rudder Trim (prior to touchdown) . . . . ZERO

- Complete NORMAL LANDING Checklist.

TWO ENGINES INOPERATIVE GO-AROUND REVIEW

Thrust . . . . . GO-AROUND
Flaps . . . . . RETRACT TO FLAPS 1 ON SCHEDULE

- DO NOT ATTEMPT TO GO-AROUND AFTER THE LANDING GEAR IS EXTENDED.

PARTIAL MAIN GEAR LANDING

- Complete ALTERNATE LANDING GEAR EXTENSION Checklist.

IF BODY GEAR NOT EXTENDED: (Land on available gear)

Aural Warn Circuit Breaker (P-6) . . . . . .PULL

- If neither body gear is extended the airplane may tip tail down when on the ground.
- Complete NORMAL DESCENT-APPROACH and LANDING Checklists.
- Do not activate Body Gear Steering.

IF ONE WING GEAR NOT EXTENDED: (Retract both wing gear)

Gear Lever . . . . . .DOWN
Hydraulic System 1 . . . . . .DEPRESSURIZE
Gear Lever . . . . . .UP
Gear Lever . . . . . .OFF
Hydraulic System 1 . . . . . .PRESSURIZE
Hydraulic System 4 . . . . . .DEPRESSURIZE
Gear Lever . . . . . DOWN, IN
Body & Nose Gear . . .DOWN, GREEN LIGHTS
Normal Brake Source . . . . . SEC SYS 1
Aural Warn CB (P-6) . . . . . .PULL
Trailing Edge Flaps. . . . . ALT EXT

- Complete NORMAL DESCENT-APPROACH and LANDING Checklists.

INADVERTANT REVERSE THRUST IN FLIGHT

WITH REVERSER LIGHT ON AND:

No Yaw or Loss of Airspeed . . . . . .OPERATE NORMALLY
With Yaw and/or Loss of Airspeed (reverse lever down) . . . SHUT DOWN AFFECTED ENGINE

- Buffeting may be reduced by decreasing airspeed.
- Set airspeed bugs at V_{REF} + 20 for landing.
- Use flaps 25 for landing.

EMERGENCY CHECKLIST

BOEING 747-151

RAPID DEPRESSURIZATION

Oxygen Masks & Regulators . . . . . ON, 100%
Crew Communications . . . . . ESTABLISH
Isolation Valve (either) . . . . . CLOSE
Pack Valves . . . . . OPEN
Outflow Valves . . . . . CLOSE
Emergency Descent
(if required) . . . . . INITIATE

Passenger Oxygen (if required) . . . . . ON
Cabin Signs . . . . . ON
PA Announcement . . . . . IF REQUIRED

EMERGENCY DESCENT

Ignition . . . . . FLIGHT START
Thrust Levers . . . . . CLOSE
Speed Brakes . . . . . FLIGHT DETENT
Landing Gear (on placard speed) . . . . . DOWN
Autopilot . . . . . DISENGAGE
Descent . . . . . INITIATE
Target Speed . . . . . M.82 OR 320 KIAS

PREPARATION FOR PASSENGER EVACUATION (LAND)

- Advise Flight Attendant(s)/Passengers Intent to Evacuate
- Notify Flight Attendant(s) of any condition that may affect evacuation.

Tower/Ground Crew . . . . . NOTIFY
Parking Brakes . . . . . SET
Outflow Valves . . . . . OPEN
Speed Brake Lever . . . . . DOWN
Start Levers . . . . . CUTOFF
Engine Fire Switches . . . . . PULL
Fire Bottles . . . . . DISCHARGE
Emergency Lights . . . . . ON
Flight Attendant(s)/Passengers . . . . NOTIFIED
APU Fire Switch . . . . . PULL
Fire Bottle . . . . . DISCHARGE
Battery . . . . . OFF

- Crew and Passengers Evacuate Airplane

PREPARATION FOR DITCHING

- Advise Crew Intent to Ditch.
- Send Distress Signals.
- Review Ditching Procedure, Brief Crew and Brief Passengers.
- Jettison Fuel.
- Depressurize Cabin.
- Pull Ditching Handle at No. 3 Doors and Place Mode Selector Handles for other Doors in MANUAL.

Landing Data . . . . . BUGS SET
Pack Valves . . . . . CLOSE
Outflow Valves . . . . . CLOSE
Equipment Cooling Valve . . . . . DITCH
Battery . . . . . ON
Vest, Harness, and Belt . . . . . SECURE
Landing Gear . . . . . UP
Aural Warn CB, (P-6) . . . . . PULL
Cabin Signs . . . . . ON
Emergency Lights . . . . . ON
F/E Gives Checklist to F/O and Assumes Ditching Station.

Flaps . . . . . 30-30, BLUE LIGHT
PA Announcement . . . . . ACCOMPLISH
Start Levers . . . . . CUTOFF
Engine Fire Switches . . . . . PULL
Fire Bottles . . . . . DISCHARGE

- Crew and Passengers Evacuate Airplane

OVERWEIGHT LANDING

- Avoid bank angles greater than 30° when using normal landing flaps.

CONTROLLABILITY WITH ALL ENGINES WINDMILLING

- Min airspeed 160 KIAS or maneuvering speed for flap setting which ever is greater.
- DO NOT ATTEMPT TO OPERATE FLAPS OR LANDING GEAR.

ENGINE FIRE

SEVERE DAMAGE OR SEPARATION

The F/E will read the challenge and response within the boxed portion of the checklist, and the appropriate crewmember(s) will reply with the required responses.

He will then proceed to the remaining items and read the challenge and response. The appropriate crewmember(s) will take the required action and give the verbal response.

Items contained under clean-up are performed by the F/E.

Thrust Lever.....CLOSE	C
Start Lever.....CUTOFF	C

Positioning start lever to CUTOFF shuts off fuel to the engine at the fuel shutoff valve. Check the ENG VALVE light illuminates bright (in transit), then dim (valve closed).

Engine Fire Switch.....PULL	F/E

Pull the engine fire switch on Captain's command.

IF ENGINE FIRE SWITCH REMAINS ILLUMINATED:

Fire Bottle.....DISCHARGE	F/E

Press either BTL PUSH switch on Captain's command and hold until DISCHARGE light illuminates.

NOTE: The engine fire switch will remain illuminated until fire is extinguished and temperature has decreased.

AFTER 30 SECONDS, IF ENGINE FIRE SWITCH REMAINS ILLUMINATED:

Other Fire Bottle.....DISCHARGE F/E

Press other BTL PUSH switch on Captain's command and hold until DISCHARGE light illuminates.

(Procedure continued on next page.)

ENGINE FIRE, SEVERE DAMAGE OR SEPARATION (CONT)

IF THE FIRE CONTINUES:
Do not lower flaps or use speed brakes unless emergency landing is imminent.

Landing Gear.....UP & OFF C
Check gear lever OFF, DOOR OPEN and GEAR lights extinguished.

Flaps.....UP, NO LIGHTS C
Check flap lever in FLAP UP position, flap position indicators UP and LE FLAPS lights extinguished.

Airspeed.....280 KIAS MIN C
Accelerate, if necessary. Do not exceed Vmo.

Clean-Up:
- Check generator FIELD OFF light illuminated; if not, place generator field switch to TRIP.
- Place engine fuel shutoff switch to CLOSE.
- Place bleed air valve switch to close.
- Place engine driven hydraulic pump switch to SUPPLY OFF.
- Place engine ignition switch to OFF.
- Place nacelle anti-ice switch to OFF.

NOTE: See Chapter 1 and 23 for anti-ice limitations and engine out performance.

APU FIRE

The F/E will read the challenge and response within the boxed portion of the checklist, and take the required action.

APU Fire Switch.....PULL	F/E

Pulling the fire switch shuts down the APU and arms the APU fire extinguisher.

NOTE: APU will normally shut down automatically when fire detection system is activated.

Fire Bottle.....DISCHARGE	F/E

Press BTL PUSH switch and hold until DISCHARGE light illuminates.

NOTE: The APU fire warning lights will remain illuminated until fire is extinguished and temperature has decreased.

Place APU bleed air switch to CLOSE.

WHEEL WELL FIRE

The F/E will verify that the boxed item has been accomplished.

Landing Gear & Doors.....DOWN & OPEN	F/O-F/E

Check placard speeds, and on Captain's command, place landing gear lever to DN; check for normal gear sequence and that GEAR DOWN light illuminates.

Place gear lever UP momentarily, then OFF when DOOR OPEN light illuminates; check that DOOR OPEN and GEAR DOWN lights remain illuminated.

Press either PRIM or ALT door switch on landing gear annunciator module and check that all wing and body gear DOOR OPEN lights are illuminated.

Check Wheel Well Fire Detection System:

After WHEEL WELL fire warning light is extinguished the Captain will press the wheel well fire test switch; check that the WHEEL WELL and master FIRE warning lights illuminate and the fire warning bell sounds.

If the wheel well fire detection system does not respond to the test, or if WHEEL WELL fire warning light remains illuminated, land at the nearest suitable airfield.

If WHEEL WELL fire warning light extinguishes and the system responds to test, allow 20 minutes for brake cooling then retract landing gear (if desired).

LOWER FWD CARGO FIRE

Upon completion of the boxed items, the F/E will read the checklist and verify each item has been accomplished. He will then read and accomplish the remaining items as appropriate.

Compartment Selector.....FWD	F/E

Place compartment select switch to FWD. Selects compartment for extinguisher discharge and operates equipment cooling system in the SMOKE mode.

Fire Bottle No. 1.....DISCHARGE	F/E

Press BTL 1 PUSH switch and hold until DISCHARGE light illuminates.

NOTE: The cargo fire warning lights will remain illuminated until fire is extinguished and smoke has dissipated.

Airplane Altitude.....MEA, 14,000 FT OR BELOW C
Descend if required to MEA, 14,000 ft. or below. Descending will reduce cabin differential pressure and resultant cargo compartment ventilation.

Air Conditioning Packs.....MAX ONE ON F/E
One pack operation reduces air flow in cabin and area surrounding the cargo compartment.

Zone 1 Recirculating Fan.....CHECK OFF F/E
For early airplanes this fan draws air from the lower cargo area.

Pressurization Mode.....MAN F/E
Place pressurization mode switch to MAN.

Cabin Altitude.....EQUAL TO AIRPLANE F/E
Operate outflow valve manual control switches to increase cabin altitude to airplane altitude.

Outflow Valves.....MINIMUM OPEN F/E
Position outflow valves at minimum open as required to maintain equal cabin and airplane altitudes.

NOTE: With valves maintained at a minimum open position, the airflow surrounding the cargo compartment will be reduced, the door seals will remain compressed and negative relief valves will remain closed.

Clean-Up:
Place equipment cooling valve control switch to SMOKE.

AFTER ONE HOUR:
Fire Bottle No. 2.....DISCHARGE F/E
Press BTL 2 PUSH switch and hold until DISCHARGE light illuminates.

NOTE: To maintain maximum concentration and effectiveness of the extinguishing agent in the FWD cargo compartment requires depressurization of the airplane.

LOWER AFT CARGO FIRE

Upon completion of the boxed items, the F/E will read the checklist and verify each item has been accomplished. He will then read and accomplish the remaining items as appropriate.

Compartment Selector.....AFT	F/E

Place compartmnt select switch to AFT. Selects compartment for extinguisher discharge and shuts off aft cargo heat airflow.

Fire Bottle No. 1.....DISCHARGE	F/E

Press BTL 1 PUSH switch and hold until DISCHARGE light illuminates.

NOTE: The cargo fire warning lights will remain illuminated until fire is extinguished and smoke has dissipated.

Airplane Altitude.....23,000 FT.	C

Descend if required to and maintain 23,000 ft. altitude. Descending will reduce cabin differential pressure and resultant cargo compartment ventilation.

Cabin Altitude.....10000 FT.	F/E

Raise cabin altitude to 10,000 ft. if below.

Air Conditioning Packs.....MAX ONE ON	F/E

One pack operation reduces airflow in cabin and area surrounding the cargo compartment.

Equipment Cooling Valve.....SMOKE	F/E

Venting of the equipment cooling air overboard reduces airflow in the cabin and between lower FWD and AFT cargo compartments.

Clean-Up:
- Place aft cargo heat switch to OFF.

AFTER ONE HOUR:

Fire Bottle No. 2.....DISCHARGE	F/E

Press BTL 2 PUSH switch and hold until DISCHARGE light illuminates.

NOTE: To maintain an effective concentration of the extinguishing agent in the AFT cargo compartment requires that the cabin differential pressure be reduced.

ELECTRICAL SMOKE OR FIRE

The F/E will read the challenge and response items and the appropriate crewmember(s) will take the required action and give the verbal response.

Oxygen Masks and Regulators (if required).....ON, 100% ALL
Crew Communication.....ESTABLISH ALL
Smoke Goggles (if required).....ON ALL
Cabin Altitude (Max 10,000 FT, if required).....INCREASE F/E
If smoke is severe, raise cabin altitude, but do not exceed 10,000 feet.
Pressurization Rate Switch (if required).....INCREASE F/E
Increase cabin rate of change, if necessary, to evacuate smoke.

IF SMOKE SOURCE CAN BE LOCATED:
Electrical Power (affected equipment).....REMOVE F/E
Check indications of failure location and take appropriate action to remove electrical power from the faulty system.

IF SMOKE SOURCE CANNOT BE LOCATED:
Galley Power.....OFF F/E
Gasper and Recirculating Fans.....OFF F/E

IF SMOKE CONTINUES:
Circuit Breaker Panels.....CHECK F/E
Check through viewing ports for smoke and check circuit breaker status.

IF SMOKE CONTINUES:
DC Bus Isolation Relays.....OPEN F/E
Check DC volt meters and ammeters for abnormal indications.
Bus Tie Breakers.....TRIP F/E
Check KW/KVAR, frequency and volt meters for abnormal indications.
Pilots' Panels.....CHECK C-F/O
Complete scan of instruments for abnormal indications.
Flight Engineer's Panels.....CHECK F/E
Complete scan of instruments for abnormal indications.

IF SMOKE CONTINUES:
All Unnecessary Equipment.....OFF F/E
Any circuits that the flight crew deems are not required for the safe conduct of the flight should be de-energized. The crew should be aware of the consequences of any circuit deactivation prior to the circuit being opened.

Land at nearest suitable airport.

(Procedure continued on next page.)

ELECTRICAL SMOKE OR FIRE (CONT)

NOTE: At flight crew's discretion, main busses or radio and flight instrument busses may be de-energized on an individual one-at-a-time basis.

- To de-energize radio and flight instrument busses use following procedure:

  Pull RADIO BUS 2 (AC) C/B on lower P-6 panel and RADIO BUS 2 (DC) C/B on lower outboard P-6 panel.

  If smoke continues after approximately 5 minutes maximum, reset RADIO BUS 2 circuit breakers.

  NOTE: Wait until flags have retracted on First Officer's instruments before continuing.

  Pull ESS RADIO BUS (AC) C/B on lower P-6 panel and ESS RADIO BUS (DC) C/B on lower outboard P-6 panel.

- Generator breakers may be tripped to de-energize main busses. Change essential power source prior to tripping No. 4 generator breaker.

COCKPIT SMOKE EVACUATION

The F/E will read the challenge and response for the first three items and the appropriate crewmembers will take the required action and give the verbal response. He will then read and accomplish the remaining items on the checklist.

Oxygen Masks and Regulators (if required)	ON, 100%	ALL
Crew Communication	ESTABLISH	ALL
Smoke Goggles (if required)	ON	ALL
Cabin Altitude (max 10,000 ft.)	INCREASE	F/E

If smoke is severe, rotate cabin altitude selector to raise cabin altitude, but do not exceed 10,000 feet.

Pressurization Rate Switch (if required)	INCREASE	F/E

Increase cabin rate of change, if necessary, to evacuate smoke.

Bleed Air Valves	OPEN	F/E

Check that all bleed air VALVE CLOSED lights are extinguished.

Isolation Valves	OPEN	F/E
Pack Valves	OPEN	F/E

IF SMOKE PERSISTS OR IS SEVERE:

Smoke Evacuation Port	OPEN	F/E

Move smoke evacuation port lever to aft position to open port.

IF UNPRESSURIZED:

Crew Escape Hatch (below 200 KIAS)	OPEN	F/E

Rotate overhead escape hatch lock handle as indicated by arrows and pull door inward. Considerable force may be required to release door.

NOTE: Noise level increases significantly at airspeeds above 250 KIAS.

LOSS OF ALL GENERATORS

The F/E will verify that the boxed items have been accomplished. He will read the applicable challenge and response items and the appropriate crewmember(s) will take the required action and give the verbal response. He will then restore normal electrical power within the limitations imposed by system malfunction(s).

Battery.....CHECK ON	F/E

Check battery switch in ON (guarded) position.

Standby Power.....ON	F/E

Place standby power switch to ON and check that light illuminates.

Fuel Crossfeed Valves.....OPEN	F/E

IF ENGINE START REQUIRED:
(ALL 4 ENGINES NOT OPERATING)

NOTE: NO engine, N1 or EGT response to thrust lever movement.

Start Levers.....CUTOFF	C
Airplane Altitude.....BELOW 30,000 FT.	C

To improve start capability initiate start below 30,000 feet altitude.

Airspeed.....MIN 250 KIAS	C

Initiate start above 250 KIAS.

Standby Ignition.....IGN 1 OR IGN 2	F/E

NOTE: Captain's heading information will be lost while standby ignition is used.

Start Levers.....IDLE	C

Check start levers in IDLE position.

LOSS OF ALL GENERATORS (CONT)

IF ENGINES ARE RUNNING:

Split System and Bus Tie Breakers. . . . . .TRIP F/E
Check that split system breaker OPEN light and BUS TIE OPEN lights illuminate.

DC Bus Isolation Switches. . . . . .OPEN F/E
Isolate DC busses to prevent possible overload when power is reestablished.

Generator Fields . . . . . CLOSE F/E
Check FIELD OFF lights extinguished.

Verify normal voltage and frequency of reactivated generators utilizing AC meters switches.

Essential Power. . . . . ESTABLISH F/E
If generator No. 4 output is normal, place No. 4 generator breaker switch to CLOSE and check GEN OPEN and ESS BUS OFF lights extinguished.

If generator No. 4 output is <u>not</u> normal or if it will not go on the line, place the essential power switch to an alternate operating generator (preferred selection sequence 3, 1, 2) and check ESS BUS OFF light extinguished.

If essential power cannot be established after one additional generator source has been selected, the essential power bus may be shorted. Place essential power switch OFF and reclose tripped generator field(s).

<u>NOTE</u>: See ESS BUS OFF LIGHTS ILLUMINATED, Alternate Operation, Chapter 10, for additional procedural information.

Generator Breakers . . . . . CLOSE F/E
Remove galleys and recirculating fans from bus and place the generator breaker switches of all normally operating generators to CLOSE and check GEN OPEN lights extinguished.

If generator other than No. 4 is supplying essential power, close that generator breaker last.

At flight crew's discretion, split system and bus tie breakers may be closed.

DC Bus Isolation Switches. . . . . CLOSE F/E

3 GENERATORS INOPERATIVE

The F/E will read the challenge and response and take the required action.

All Unnecessary Equipment. . . . . OFF F/E
All unnecessary equipment in addition to high load items included in the abnormal checklist for 1 OR 2 GENERATORS INOPERATIVE.

Split System and Bus Tie Breakers. . . . . CLOSE F/E
Check that split system breaker OPEN light and BUS TIE OPEN lights extinguish.

Monitor KW/KVAR indicator to ensure generator load is with in limit.

Land at nearest suitable airport.

TWO HYDRAULIC SYSTEMS INOPERATIVE

Complete SINGLE HYDRAULIC SYSTEM LEAK OR LOSS checklist for individual systems.

With two hydraulic systems inoperative land at nearest suitable airport.

NOTES: Set airspeed bugs at VREF + 20 for landing.

With loss of two hydraulic systems, crosswind limit is 20 knots.

With loss of systems 1 and 4 open reserve brake source before landing.

Use flaps 25 for landing.

TWO ENGINES INOPERATIVE

The F/E will read the challenge and response and the appropriate crewmember(s) will take the required action and give the verbal response.

Complete ENGINE FIRE or ENGINE FAILURE/SHUTDOWN checklist.

Complete 1 OR 2 GENERATOR(S) INOPERATIVE checklist.

Air Conditioning Packs.....MAX ONE ON F/E
Engine performance limits bleed air available. Operate one air conditioning pack only.

Fuel Jettision (if required).....COMPLETE ALL
If required complete fuel jettison abnormal procedure.

Airspeed Bugs.....VREF + 5 ALL
Captain and F/O will set airspeed bugs for threshold speed and F/E will verify settings.

Complete NORMAL DESCENT-APPROACH checklist.

Two Engine Inoperative Go-Around Procedure.....REVIEW ALL

Flaps.....25-25, BLUE LIGHT F/O

Rudder Trim (prior to touchdown).....ZERO F/O

Complete NORMAL LANDING checklist.

TWO ENGINES INOPERATIVE GO-AROUND REVIEW:

Thrust.....GO-AROUND
Apply go-around thrust.

Flaps.....RETRACT TO FLAPS 1 ON SCHEDULE

CAUTION: DO NOT ATTEMPT TO GO AROUND AFTER THE LANDING GEAR IS EXTENDED.

PARTIAL MAIN GEAR LANDING

The F/E will read the challenge and response and the appropriate crewmember(s) will take the required action and give the verbal response.

Complete ALTERNATE LANDING GEAR EXTENSION checklist.

IF BODY GEAR NOT EXTENDED:
(Land on available gear.)
Aural Warning Power CB (P-6 panel).....PULL F/E
Pull aural warning circuit breaker to deactivate landing gear warnings.
- If neither body gear is extended, the airplane may tip tail down when on the ground. Retaining most of the available fuel in main tanks 2 and 3 without exceeding maximum landing weight will reduce the possibility of tipping tail down. For the tail down condition the upper deck, Door 1 and Door 2 escape slides would be unusable.
- Complete NORMAL DESCENT-APPROACH and LANDING checklists.
- Do not activate body gear steering.

IF ONE WING GEAR NOT EXTENDED:
(With hydraulic system 4 operative retract both wing gears)
Gear Lever.....DOWN F/O
Check landing gear lever in DOWN detent.
Hydraulic System 1.....DEPRESSURIZE F/E
Place engine driven hydraulic pump switch to DEPR and air driven hydraulic pump switch to OFF. Check low pressure lights illuminated.
Gear Lever.....UP F/O
Place landing gear lever in UP position to retract wing gear. Check flight engineer's landing gear annunciators for WING DOWN and WING DR OPEN lights extinguished.
Gear Lever.....OFF F/O
Hydraulic System 1.....PRESSURIZE F/E
Place engine pump switch to NORMAL and air pump to AUTO. Check low pressure lights extinguished.
Hydraulic System 4.....DEPRESSURIZE F/E
Place engine pump switch to DEPR and air pump switch to OFF. Check low pressure lights illuminated.
Gear Lever.....DOWN, IN C-F/O
Body & Nose Gear.....DOWN, GREEN LIGHTS C-F/E
Check body and nose gear down annunciator lights illuminated.

(Procedure continued on next page.)

PARTIAL MAIN GEAR LANDING (CONT)

Normal Brake Source.....SEC SYS 1 F/E
Check SEC SYSTEM 1 light illuminated and brake LOW PRESS lights extinguished.

Aural Warning Power CB (P-6 panel).....PULL F/E
Pull aural warning circuit breaker to deactivate landing gear warnings.

Trailing Edge Flaps.....ALT EXT F/O
Complete ALTERNATE TRAILING EDGE FLAP OPERATION checklist. Complete NORMAL DESCENT-APPROACH and LANDING checklists.

INADVERTENT REVERSE THRUST IN FLIGHT

The F/E will read the appropriate challenge and response item and the appropriate crewmember(s) will take required action and give verbal response.

WITH REVERSER LIGHT ON AND:

No Yaw or Loss of Airspeed.....OPERATE NORMALLY ALL
The thrust reversers are in retracted position; with no airplane yaw or loss in airspeed continue normal flight operations.

With Yaw and/or Loss of Airspeed
(reverse lever down).....SHUT DOWN AFFECTED ENGINE ALL
With airplane yaw or loss of airspeed a thrust reverser probably is in the extended position. Complete INFLIGHT ENGINE FAILURE/SHUTDOWN checklist.

NOTE: Buffeting may be reduced by decreasing the airspeed.
The flaps may be extended to further reduce airspeed.
Set airspeed bugs at VREF + 20 for landing.
Use flaps 25 for landing.
Complete NORMAL DESCENT-APPROACH and LANDING checklists.

RAPID DEPRESSURIZATION

The F/E will verify that each boxed item has been accomplished.

He then proceeds to the remaining items and reads the challenge and response. The appropriate crewmember(s) will take the required action and give the verbal response.

Oxygen Masks and Regulators.....ON, 100%	ALL
Crew Communications.....ESTABLISH	ALL
Isolation Valve (either).....CLOSE	F/E

Check duct pressure indicator L and R needles for normal indication and check for wing overheat indications. With a L or R duct low pressure indication, complete DUCT PRESSURE LOW procedure.

Pack Valves.....OPEN	F/E

Check that all pack valves are open to insure maximum available air is entering the cabin.

Outflow Valves.....CLOSE	F/E

Check that both outflow valves indicate close. Close valves manually if necessary.

Emergency Descent (if required).....INITIATE	C

If the above procedure fails to gain control of cabin altitude, initiate emergency descent procedure.

Passenger Oxygen (if required).....ON F/E

If cabin altitude exceeds 14,000 ft, check that oxygen ON light is illuminated. If not illuminated, place passenger oxygen switch to ON.

Cabin Signs.....ON C

Check that NO SMOKING and FASTEN SEAT BELTS ON lights are illuminated.

PA Announcement.....IF REQUIRED F/O

AFTER CABIN ALTITUDE DESCENDS TO 10,000 FEET OR BELOW:
Crewmembers remove and stow their oxygen masks.

F/E will advise the cabin attendant to reset passenger oxygen system (if required).
- When cabin attendant reports passenger oxygen system reset the F/E checks that passenger oxygen ON light is extinguished.

EMERGENCY DESCENT

The F/E will verify that each boxed item has been accomplished.

NOTE: The following procedure assumes structural integrity of the airplane. If structural integrity is in doubt, limit speed as much as possible. Reduce rate of descent if necessary and avoid high maneuvering loads.

Ignition.....FLIGHT START	F/E
Thrust Levers.....CLOSE	C

Place throttle bar in retracted position (if extended).

Speed Brakes.....FLIGHT DETENT	C
Landing Gear (on placard speed).....DOWN	C

Check placard speed, and on Captain's command position landing gear lever to DN; check for normal gear sequence and that GEAR DOWN light illuminates.

Autopilot.....DISENGAGE	C
Descent.....INITIATE	C
Target Speed.....M.82 OR 320 KIAS	C

Accelerate to Mach .82 or 320 knots, whichever is lower, and maintain during descent.

Establish level flight at 14,000 feet or MEA whichever is higher: Place speed brake lever in DOWN detent. Check placard speed and retract landing gear.

Place engine ignition switches to OFF when flight conditions permit.

Place oxygen diluter levers to NORMAL if cabin altitude is 14,000 feet or below.

PREPARATION FOR PASSENGER EVACUATION (LAND)

The F/E will read the challenge and response and the appropriate crewmember(s) will take the required action and give the verbal response.

Advise Flight Attendant(s)/Passengers Intent to Evacuate:
Captain will advise flight attendants and passenger as necessary to prepare for and if required initiate evacuation.

Notify Flight Attendant(s) of any conditions that may affect evacuation.
Flight Attendant(s) should be informed of any existing conditions such as high winds, irregular ground conditions and/or structural damage areas that could affect deployment or alter status of the escape slides.

Tower/Ground Crew	NOTIFY	F/O
Notify tower and/or ground crew of abnormal airplane condition and of intention to evacuate.		
Parking Brakes	SET	C
Outflow Valves	OPEN	F/E
Place pressurization mode switch to MAN and open outflow valves using manual control switches.		
Speed Brake Lever	DOWN	C
Start Levers	CUTOFF	C
Engine Fire Switches	PULL	F/E
Fire Bottles	DISCHARGE	F/E
On Captain's command pull all engine fires switches and press either BTL PUSH switch on each engine and hold until DISCHARGE lights illuminate.		
Emergency Lights	ON	F/O
Flight Attendant(s)/Passengers	NOTIFIED	C
Verify that evacuation, if required, is underway.		
APU Fire Switch	PULL	F/E
If APU is operating, shut down APU with fire switch.		
Fire Bottle	DISCHARGE	F/E
Press BTL PUSH switch and hold until DISCHARGE light illuminates.		
Battery	OFF	F/E

PREPARATION FOR PASSENGER EVACUATION (LAND) (CONT)

Crew and Passengers Evacuate Airplane

Captain's Duties:

- Proceed to cabin, evaluate escape potentials and direct the evacuation of passengers. When all possible assistance has been rendered, leave airplane and direct passengers away from area.

F/O's Duties:

- Supervise evacuation of the forward cabin area. When all possible assistance has been rendered, leave airplane and assist in directing passengers away from area.

F/E's Duties:

- Supervise evacuation of the mid-cabin area. When all possible assistance has been rendered, leave airplane and assist in directing passengers away from area.

PREPARATION FOR DITCHING

The F/E will read the challenge and response and the appropriate crewmember(s) will take the required action and give the verbal response.

After the F/E assumes his ditching station, the F/O will complete the checklist.

Advise Crew Intent to Ditch:
Captain will advise crew to prepare for ditching.

Send Distress Signals:
On Captain's command the F/O will set ATC transponder to 7700 and report identification, position, altitude, ground speed, true course, description of emergency, intentions and request assistance.

Review Ditching Procedure, Brief Crew, and Brief Passengers:
The Captain will review ditching procedures, brief crew and passengers and assign duties to extra crewmembers and able-bodied men.

Jettison Fuel:
On Captain's command the F/E will jettison fuel to desired ditching weight.

Depressurize Cabin:
The F/E will increase cabin altitude (below 10,000 feet) at a rate which will allow complete depressurization.

Pull Ditching Handle at No. 3 Doors and place Mode Selector Handles for all other Doors in MANUAL:
The F/E will advise the cabin attendant to pull the ditching deactivation handle at the No. 3 doors and place mode selector handles for other doors in MANUAL.

Landing Data.....BUGS SET ALL
Captain and F/O will set airspeed bugs and F/E will verify settings.

Pack Valves.....CLOSE F/E
After airplane is depressurized, place all pack valves to close.

Outflow Valves.....CLOSE F/E
Place mode switch to MAN and close outflow valves using manual control switches.

Equipment Cooling Valve.....DITCH F/E
Place equipment cooling valve control switch to DITCH.

PREPARATION FOR DITCHING (CONT)

Battery.....ON F/E
Vest, Harness, and Belt.....SECURE ALL
Landing Gear.....UP C
Check gear lever OFF, DOOR OPEN and GEAR lights extinguished.
Aural Warning Power CB (P-6 panel).....PULL F/E
Deactivates landing gear warning horn.
Cabin Signs.....ON F/O
Check that FASTEN SEAT BELTS and NO SMOKING ON lights are illuminated.
Emergency Lights.....ON F/O

F/E Gives Checklist to F/O and Assumes Ditching Station:
On Captain's command, the F/E will go to the cabin attendant's seat closest to No. 3 right exit.

Flaps.....30-30, BLUE LIGHT F/O
Check flaps in selected position and blue LE FLAPS light illuminated.
PA Announcement.....ACCOMPLISH F/O
Advise cabin crew and passengers to prepare for impact.
Start Levers.....CUTOFF F/O
On Captain's command, the F/O will place all start levers to CUTOFF.
Engine Fire Switches.....PULL F/O
Fire Bottles.....DISCHARGE F/O
After impact, the F/O will pull all engine fire switches, press all BTL PUSH switches and hold until DISCHARGE lights illuminate.

Crew and Passengers Evacuate Airplane

Captain's Duties:
- Proceed to cabin and direct evacuation through No. 3 doors first, then any doors above water. When all possible evacuation efforts have been rendered, board a raft.

F/O's Duties:
- Supervise evacuation of the upper deck. Normal evacuation route is via the main deck.
- After upper deck has been evacuated, proceed to forward cabin and direct evacuation. When all possible evacuation efforts have been rendered, board a raft.

F/E's Duties:
- Direct opening of No. 3 doors, actuation of ramps, launching of rafts, and evacuation. When all possible evacuation efforts have been rendered, board a raft.

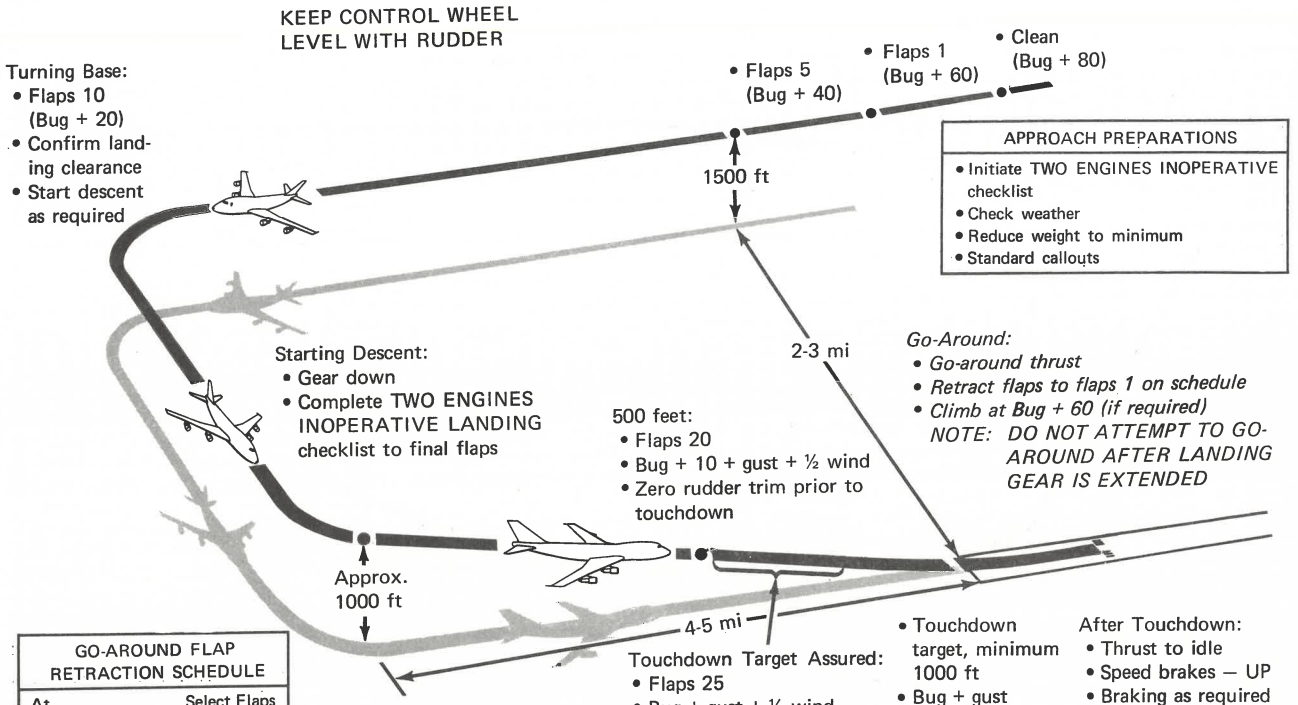
OVERWEIGHT LANDING

For approach and landing - at gross weights above maximum landing weight with landing flaps avoid bank angles greater than 30 degrees.

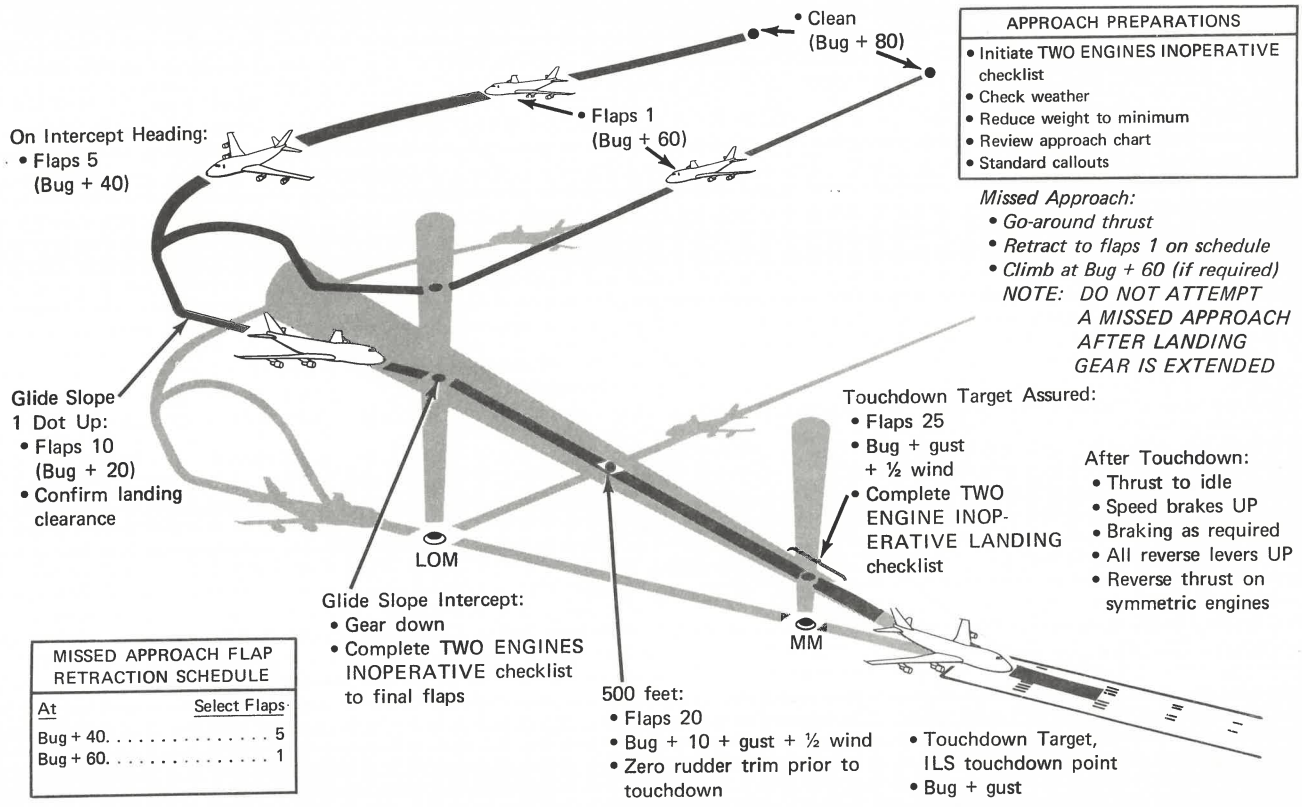
CONTROLLABILITY WITH ALL ENGINES WINDMILLING

To provide necessary hydraulic power for flight controls maintain airspeed above 160 KIAS or maneuvering speed for the existing flap setting whichever is greater.

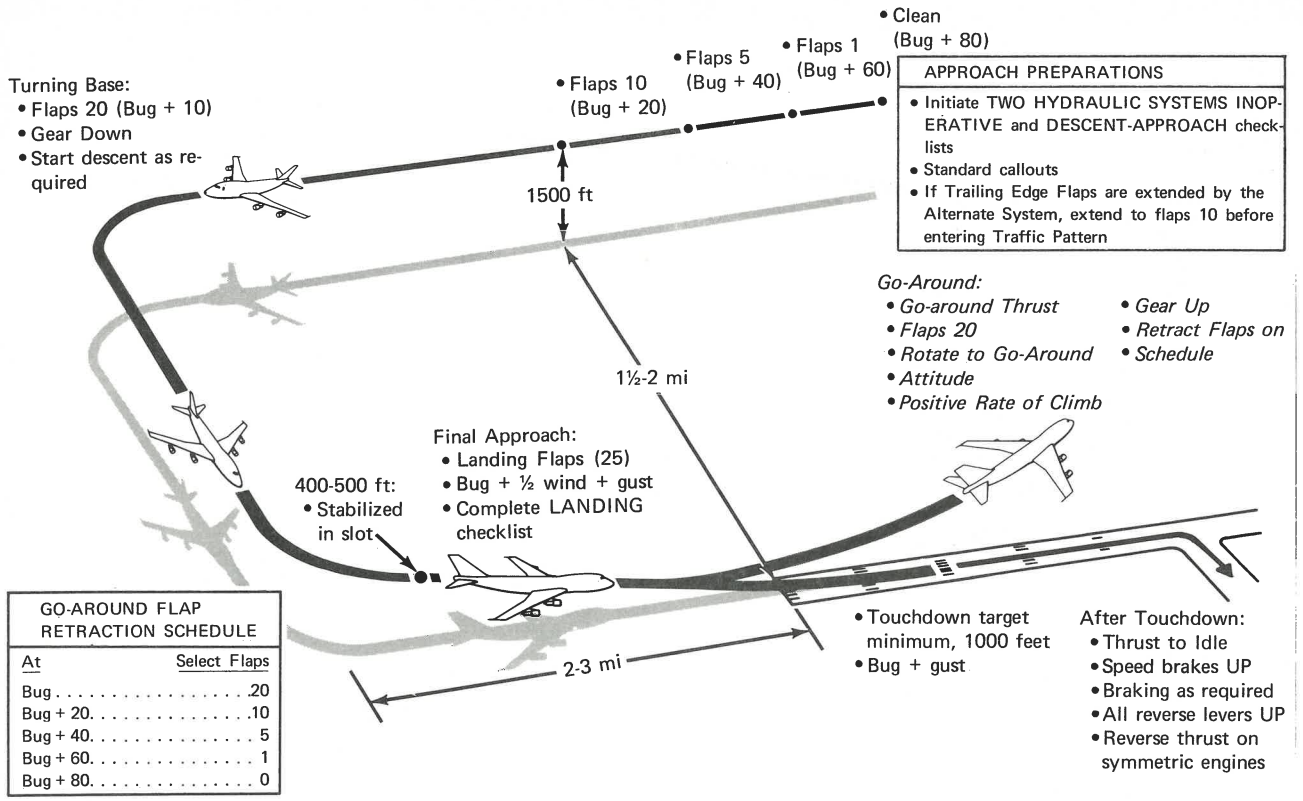
CAUTION: DO NOT ATTEMPT TO OPERATE THE FLAPS OR LANDING GEAR.



TWO ENGINES INOPERATIVE LANDING



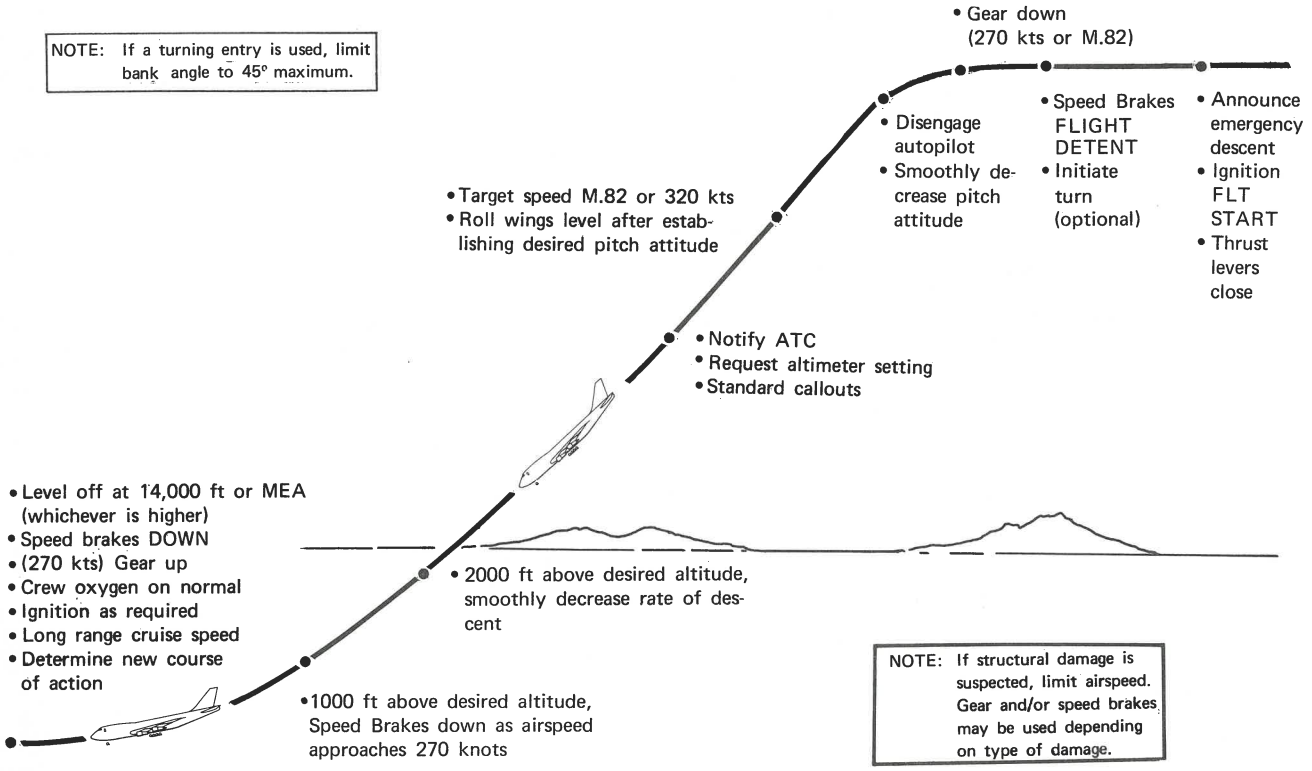
ILS TWO ENGINES INOPERATIVE



GO-AROUND FLAP RETRACTION SCHEDULE

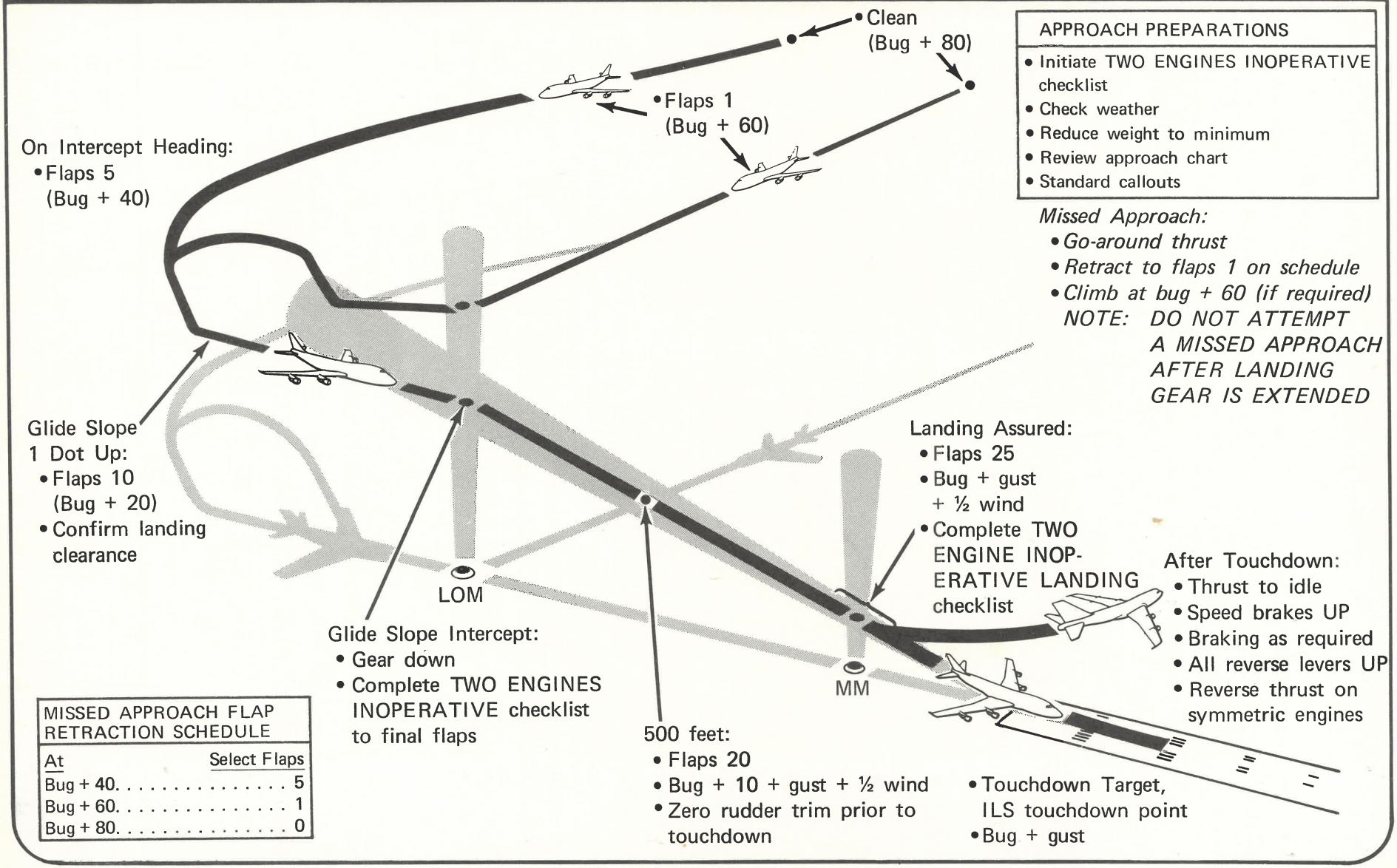
At	Select Flaps
Bug	20
Bug + 20	10
Bug + 40	5
Bug + 60	1
Bug + 80	0

TWO HYDRAULIC SYSTEMS INOPERATIVE LANDING



EMERGENCY DESCENT
(STRUCTURAL INTEGRITY SATISFACTORY)

747 ILS TWO ENGINES INOPERATIVE



APPROACH PREPARATIONS
• Initiate TWO ENGINES INOPERATIVE checklist
• Check weather
• Reduce weight to minimum
• Review approach chart
• Standard callouts

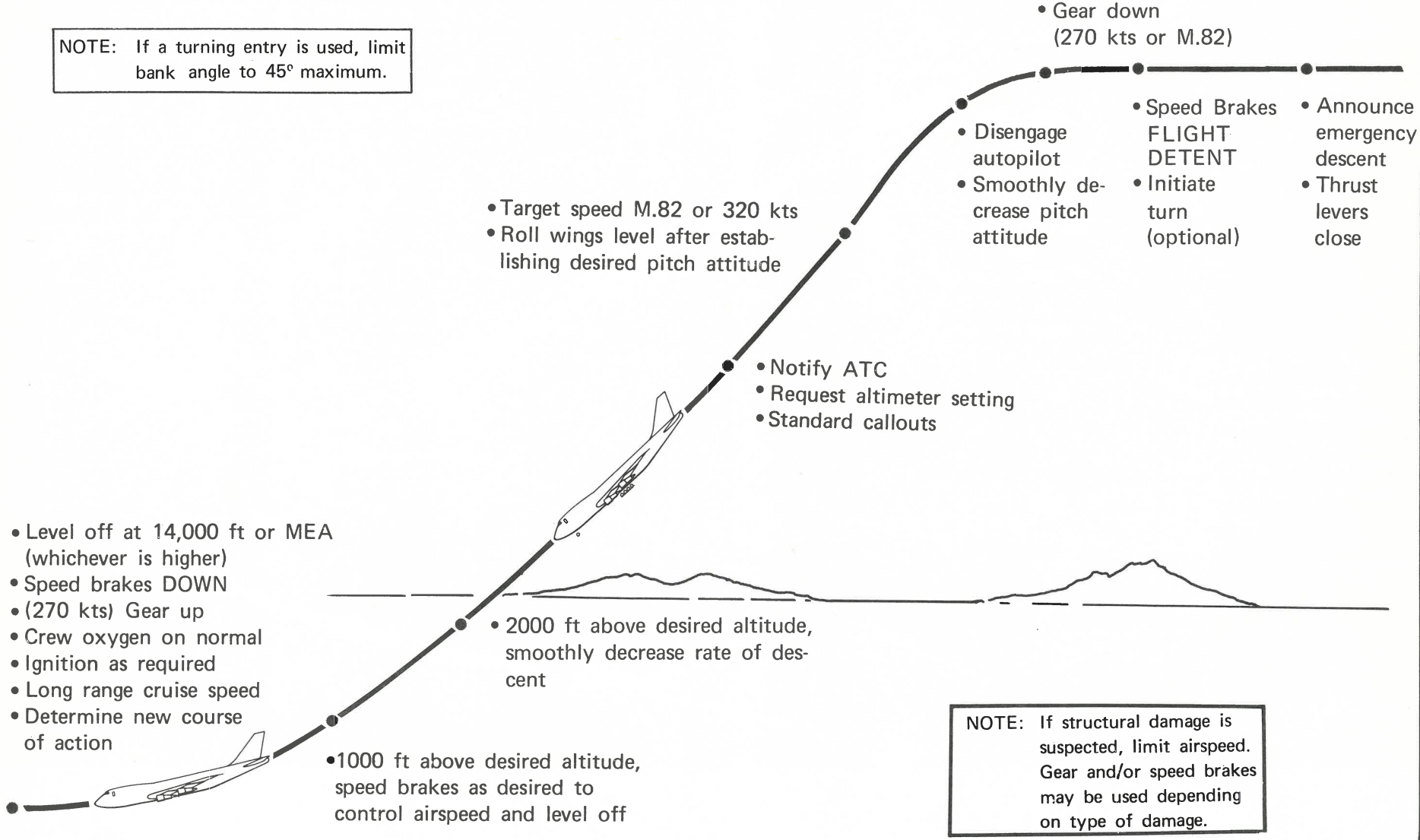
Missed Approach:
- *Go-around thrust*
- *Retract to flaps 1 on schedule*
- *Climb at bug + 60 (if required)*

NOTE: DO NOT ATTEMPT A MISSED APPROACH AFTER LANDING GEAR IS EXTENDED

MISSED APPROACH FLAP RETRACTION SCHEDULE	
At	Select Flaps
Bug + 40	5
Bug + 60	1
Bug + 80	0

747 EMERGENCY DESCENT
STRUCTURAL INTEGRITY SATISFACTORY

NOTE: If a turning entry is used, limit bank angle to 45° maximum.



NOTE: If structural damage is suspected, limit airspeed. Gear and/or speed brakes may be used depending on type of damage.

CHAPTER 3

ABNORMAL PROCEDURES

Any crewmember upon detecting an abnormal condition will inform the Captain who will call for the appropriate checklist. The checklist pages are tabbed and identified to facilitate use. The upper case on the tab identifies the subject matter on the face page and the lower case that on the reverse page.

The F/E will read the checklist items. For the challenge and response items the appropriate crewmember(s) will take the required action and give the verbal response; for the procedural and advisory items the appropriate crewmember(s) will acknowledge. The procedural and advisory items are identified in the checklist by a dot.

Upon completion of the checklist the F/E will announce "_____ _____ Checklist complete."

These procedures assume that circuit breakers will be checked and lights tested at any time in a particular procedure if appropriate.

FLIGHT PATTERNS

The included flight patterns applicable to abnormal procedures present the recommended flight profiles and sequence for airplane configuration changes.

COMBINED EMERGENCY - ABNORMAL CHECKLISTS

A set of plates suitable for use as a combined EMERGENCY - ABNORMAL checklist are included as a separate section. This checklist presentation provides the crewmembers with all the emergency and abnormal procedure checklists including the applicable normal procedure checklists in one package. The function of the combined checklist is to reduce the need of multiple checklists for accomplishing a single procedure.

ABNORMAL CHECKLIST

PACK(S) TRIP

Pack Selector Switch. . . . . PRESS
ACM Outlet and Compressor Discharge Temperatures . . . . . MONITOR
Bypass, Inlet and Exit Door Indications . . . . . .CHECK

IF DOOR AND BYPASS VALVE POSITIONS AND PACK TEMPERATURES ARE NORMAL:
Pack Reset Switch . . . . . PRESS

IF PACK FAILS TO RESET, RETRIPS, OR DOOR AND BYPASS VALVE POSITIONS NOT NORMAL:
Pack Control Switch . . . . . MAN
Turbine Bypass Valve . POSITION MID RANGE
Exit and Inlet Doors . . . . CHECK FULL COOL
- If exit and inlet doors not in full COOL position discontinue procedure for the affected pack. Close pack valve and position inlet door to full heat.

Pack Reset Switch . . . . . PRESS
Manual Temperature Switch. . . AS REQUIRED
Pack Control Switch . . . . . AUTO

IF PACK STILL FAILS TO RESET & PACK OPERATION IS REQUIRED:
Pack Valve CB (P-12 panel) . . . . . .PULL
- PACK TRIP PROTECTION IS DEACTIVATED:

Pack Control Switch . . . . . AUTO/MAN

- RESET PACK TRIP PROTECTION:

Pack Reset CB (P-12 panel) . . . . . .PULL
Master Dim and Test Switch. . . . . .TEST
Pack Reset CB (P-12 panel) . . . . . .RESET
- If pack trip light extinguishes reset PACK VALVE CB and use AUTO pack control.

AIR CONDITIONING SMOKE

Oxygen Masks and Regulators (if required) . . . . . .ON, 100%
Crew Communication . . . . . ESTABLISH
Smoke Goggles (if required) . . . . . .ON

IF APU OPERATING:
Pack Valve 2 . . . . . .CLOSE
- Shutdown APU and restore air conditioning in accordance with normal procedure for in-flight use of the APU.

Cabin Altitude (max 10,000 ft). . . . INCREASE
Pressurization Rate Switch (if required). . . . . INCREASE
Gasper and Recirculating Fans . . . . . .OFF
Upper Deck Heat . . . . . .OFF
Pack Valve (overheated pack) . . . . . .CLOSE
IF SMOKE CONTINUES:
Bleed Air Valves 1 and 2 . . . . . .CLOSE
Pack Valve 1 . . . . . .CLOSE
IF SMOKE CONTINUES:
Bleed Air and Pack Valves . . . . . .OPEN
Bleed Air Valves 3 and 4 . . . . . .CLOSE
Pack Valve 3 . . . . . .CLOSE
IF SMOKE CONTINUES:
Bleed Air and Pack Valves . . . . . .OPEN
Pack Valve 2 . . . . . .CLOSE

AUTOMATIC PRESSURIZATION CONTROL FAILURE

IF AUTO FAIL LIGHT ILLUMINATED:
Pressurization Mode Switch . . MOMENTARILY TO MAN THEN AUTO

IF AUTO PRESSURIZATION SYSTEM DOES NOT OPERATE NORMALLY:
Pressurization Mode Switch . . . . . MAN
Outflow Valve Manual Control Switches. . . .AS REQUIRED

LOSS OF EQUIPMENT COOLING

Blower Selector . . . . . ALTERNATE
No Airflow Light . . . . . .RESET

IF NO AIRFLOW LIGHT REMAINS ILLUMINATED OR RE ILLUMINATES:
Equipment Cooling Valve . . . . . SMOKE
TR Unit Loads . . . . . MAX 54 AMPS
- Continue flight with no airflow light illuminated.

ABNORMAL CHECKLIST

HIGH OR RISING CSD OIL TEMPERATURE

Generator Breaker . . . . . TRIP
CSD PRESS Light . . . . . CHECK
Generator Frequency . . . . . CHECK
CSD Oil Temperature . . . . . .DECREASING
IF ABNORMAL INDICATIONS PERSIST:
CSD. . . . . .DISCONNECT

1 OR 2 GENERATOR(S) INOPERATIVE

Split System and Bus Tie Breakers. . . . .CLOSE
Electrical Loads . . . . . .WITHIN LIMITS

- High Load Items:
  - Galley Power
  - Recirculating Fans
  - Upper Deck Heat
  - Passenger Entertainment
  - Gasper Fan
  - Passenger Cabin Lights
  - Ovrd/Jett Pumps
  - Window Heat
  - Boost Pumps (1 per engine required)

INFLIGHT ENGINE FAILURE/SHUTDOWN

Thrust Lever . . . . . .CLOSE
Start Lever . . . . . .CUTOFF
Generator Breaker . . . . . TRIPPED
Fuel Shutoff Valve . . . . . .CLOSE
Bleed Air Valve . . . . . .CLOSE
Engine Ignition . . . . . .OFF
Nacelle Anti-Ice . . . . . .OFF
Fuel Control Unit Cooling . . . . .3 MIN/30 MIN

INFLIGHT STARTING

Engine Condition and Start Envelope. . .CHECK
Fire Switch . . . . . IN
Thrust Lever . . . . . .CLOSE
Start Lever . . . . . .CUTOFF
Fuel Shutoff Valve . . . . . .OPEN
Fuel Pressure. . . . . .AVAILABLE
Bleed Air Valve . . . . . .OPEN
Engine Ignition:
(windmilling start) . . . . . FLT START
(crossbleed start) . . . . . .GND START
Start Lever . . . . . .RICH/IDLE
Engine Instruments. . . . . .STABILIZED
Start Lever . . . . . IDLE
Engine Ignition . . . . . AS REQUIRED
Electrical and Hydraulic Power . . . . .RESTORE

ASYMMETRICAL/SPLIT TRAILING EDGE FLAPS

Airspeed Bugs (landing). . . . . .V_{REF} +20
Leading Edge Flaps (as necessary) . . . . . EXTEND/RETRACT
Operating Trailing Edge Flaps. 30

- DO NOT USE ALTERNATE TRAILING EDGE FLAP SYSTEM

ONE OR MORE LEADING EDGE FLAPS INOP

- Complete ALTERNATE LEADING EDGE FLAP OPERATION checklist.

If one or more leading edge flaps still inop:

Airspeed Bugs (landing) . . . . . V_{REF} +20
Trailing Edge Flaps 25-25

ALTERNATE TRAILING EDGE FLAP OPERATION

Trailing Edge Flaps. . . . . ARM
EXTENSION:
Flap Lever . . . . . LANDING FLAPS

- Observe placard limit speed of 160 KIAS while extending flaps from 25 to 30 positions.

Alternate Flap Extension. . . . . COMPLETE
RETRACTION:
Flap Lever . . . . . UP DETENT
Alternate Flap Retraction . . . . . COMPLETE
Trailing Edge Flaps. . . . . .OFF

ALTERNATE LEADING EDGE FLAP OPERATION

Leading Edge Flaps . . . . . ARM
Alternate Extension/Retraction. . . .COMPLETE

- Leave alternate leading edge flap switches in ARM and the selected UP or DOWN position to prevent inadvertent pneumatic operation.

SINGLE HYDRAULIC SYSTEM LEAK OR LOSS

Air Pump . . . . . .OFF
Engine Pump. . . . . DEPRESSURIZE
IF LEAK CONTINUES:
Engine Pump. . . . . SUPPLY OFF
FOLLOW APPLICABLE PROCEDURE AS REQUIRED:

System 1
Auto Speed Brake CB (P12) . . . . . .PULL

- Check ground safety relay light. If illuminated use alternate procedure for Ground Safety Relay Light Illuminated in Flight, page 18.20.04.

Trailing Edge Flaps. . . . . ALT EXT
Nose Gear. . . . . ALT EXT
Body Gear. . . . . ALT EXT

- Nose and body gear steering inop.
- SEC SYS 1 brake source inop.
- Left outboard elevator inop.

System 2
Autopilot "B" . . . . . .OFF

- Stabilizer trim rate reduced.
- Spoilers inop. as placarded.
- Reserve brakes inop.

System 3
Autopilot "A". . . . . .OFF

- Stabilizer trim rate reduced.
- Spoilers inop. as placarded.

System 4
Auto Speed Brake CB (P12) . . . . . .PULL

- Check ground safety relay light. If illuminated use alternate procedure for Ground Safety Relay Light Illuminated in Flight, page 18.20.04.

Trailing Edge Flaps . . . . . ALT EXT
Wing Gear. . . . . ALT EXT
Brake Pressure Indicator . . . . . .CHECK
WITH BRAKE PRESSURE NORMAL:
Normal Brake Source . . . . . SEC SYS 1
WITH LOSS OF BRAKE PRESSURE:
Reserve Brake Valve . . . . . .OPEN

- Spoilers inop. as placarded.
- Right outboard elevator inop.

DUCT PRESSURE LOW

Isolation Valves . . . . . .CLOSE

IF BOTH DUCT PRESSURES RETURN TO NORMAL:
No. 2 Pack Valve . . . . . .CLOSE

IF ONE DUCT PRESSURE REMAINS LOW:
Isolation Valve (normal side). . . . . .OPEN
Bleed Air Valves (low side). . . . . .CLOSE
Pack Valve (low side). . . . . .CLOSE

- Use ALTERNATE LEADING EDGE FLAP OPERATION checklist. Initiate L.E. Extension/Retraction with T.E. flaps UP.

WING OVERHEAT

Isolation Valve (affected side). . . . . CLOSE
Bleed Air Valves (affected side). . . . . CLOSE

IF OVERHEAT LIGHT EXTINGUISHES:
- Use ALTERNATE LEADING EDGE FLAP OPERATION checklist. Initiate L.E. Extension/Retraction with T.E. flaps UP.

IF OVERHEAT CONTINUES AFTER 5 MINUTES AND FLIGHT CONDITIONS PERMIT:
Engine Thrust Settings (affected side). REDUCE ONE ENGINE AT A TIME TO IDLE FOR 5 MINUTES

IF OVERHEAT IS ISOLATED TO ONE ENGINE STRUT AREA:
- Restore pneumatic pressure to remainder of system.

IF OVERHEAT CANNOT BE ISOLATED:
- Leave isolation and bleed air valves closed. Reducing thrust settings will lower any possibility of strut damage.
- Use ALTERNATE LEADING EDGE FLAP OPERATION checklist. Initiate L.E. Extension/Retraction with T.E. flaps UP.

FUEL JETTISON

Fuel Feed . . . . . .TANK TO ENGINE
Crossfeed Valves. . . . . .CLOSE
Override/Jettison Pumps . . . . . .ON
Jettison Pumps . . . . . .ON
Center Wing Jettison Valves . . . . . .OPEN
Jettison Nozzle Valves. . . . . .OPEN

WHEN INBD MAIN TANK FUEL QUANTITY EQUALS OUTBD MAIN PLUS RESERVE OR G.W. BELOW 580,000 LBS:

Jettison Transfer Valves. . . . . .OPEN
Reserve Valves (Below 580,000 lbs G.W.) .OPEN
Fuel Quantity . . . . . MONITOR

TO STOP FUEL JETTISON:
- Repeat above steps (except for reserve valves) placing switches in opposite position.

MINIMUM FUEL GO-AROUND

WHEN A GO-AROUND IS MADE WITH MINIMUM FUEL IN ANY MAIN TANK:
All Main Tank Boost Pumps . . . . . .ON
All Crossfeed Valves . . . . . .OPEN
- Avoid nose high attitude.

ONE/TWO BOOST PUMPS IN ONE TANK OR INBD CROSSFEED VALVE INOP

WITH OUTBD MAIN TANK BOOST PUMPS INOP:
Jettison Transfer Valve (affected tank). . .OPEN
- Fuel transfer capability limited to standpipe level.

WITH INBD MAIN TANK BOOST PUMP/PUMPS OR INBD CROSSFEED VALVE INOP:
Jettison Pumps (affected tank) . . . . . .ON
Center Wing Jettison Valve . . . . . .OPEN
Fuel Crossfeed Valves . . . . . AS REQUIRED
- Fuel available with jettison pumps, limited to standpipe level.

ALTERNATE LANDING GEAR EXTENSION

Gear Lever . . . . . .OFF
Alternate Gear Extend
Switch(es) . . . . . .HOLD IN EXT
5-10 SECONDS
THEN ARM
Gear Lever . . . . . .DN

- Observe V_{LO} placard.
- Affected gear doors will remain open.

JAMMED STABILIZER LANDING

- Maintain in-trim airspeed.
- Set airspeed bugs at V_{REF} + 20 for landing.
- Use flaps 25 for landing.
- Complete NORMAL DESCENT-APPROACH and LANDING Checklists.

PACK(S) TRIP

Pack Selector Switch.....PRESS F/E
Select pack to be monitored.
ACM Outlet and Compressor Discharge Temperatures.....MONITOR F/E
Over temperature condition exists when ACM outlet temperature exceeds 185°F or compressor discharge temperature exceeds 425°F.
Bypass, Inlet and Exit Door Indications.....CHECK F/E
After a pack trip (in automatic control) the turbine bypass valve should indicate mid range to full heat, the inlet door full cool and the exit door mid range.

IF DOOR AND BYPASS VALVE POSITIONS AND PACK TEMPERATURES ARE NORMAL:
Pack Reset Switch.....PRESS F/E
Check pack operating and indications normal.

IF PACK FAILS TO RESET, RETRIPS OR DOOR AND BYPASS VALVE POSITIONS ARE NOT NORMAL:
Pack Control Switch.....MAN F/E
Turbine Bypass Valve.....POSITION MID RANGE F/E
Actuate manual temperature switch as required.
Exit and Inlet Doors.....CHECK FULL COOL F/E

NOTE: If either inlet or exit door is not in the full cool position discontinue procedure for the affected pack. Close pack valve and position inlet door if possible to full heat.

Pack Reset Switch.....PRESS F/E
Check pack operating and indications normal.
Manual Temperature Switch.....AS REQUIRED F/E
Actuate manual temperature switch to balance affected pack ACM outlet temperature with normal operating packs. Changes in airspeed and altitude will affect pack temperatures.
Pack Control Switch.....AUTO F/E
Use AUTO mode if operation is satisfactory.

IF PACK STILL FAILS TO RESET & PACK OPERATION IS REQUIRED:
Pack Valve CB (P-12 panel).....PULL F/E
Pulling Pack Valve circuit breaker will open the pack valve.

CAUTION: PACK TRIP PROTECTION IS DEACTIVATED.

Pack Control Switch.....AUTO/MAN F/E
Operate in AUTO or MAN as required.

-RESET PACK TRIP PROTECTION:
Pack Reset CB (P-12 panel).....PULL F/E
Master Dim and Test Switch.....TEST F/E
Pack Reset CB (P-12 panel).....RESET F/E
-If pack trip light extinguishes reset pack valve circuit breaker and use AUTO pack control.

AIR CONDITIONING SMOKE

Oxygen Masks and Regulators (if required).....ON, 100% ALL
Crew Communication.....ESTABLISH ALL
Smoke Goggles (if required).....ON ALL

IF APU OPERATING:
Pack Valve 2.....CLOSE F/E

NOTE: -Shutdown APU and restore air conditioning and pressurization in accordance with normal procedure for inflight use of APU.
-If desired activate and check pack No. 2 as source of smoke.

Cabin Altitude (max 10,000 ft).....INCREASE F/E
Check outflow valves move toward open.
Pressurization Rate Switch (if required).....INCREASE F/E
Increase cabin rate of change, if necessary, to evacuate smoke.
Gasper and Recirculating Fans.....OFF F/E
Upper Deck Heat.....OFF F/E
Pack Valve (overheated pack).....CLOSE F/E
If abnormal temperatures are noted in any pack, position the respective pack valve switch to the closed position. Check for decreasing temperature. If the smoke stops, the procedure is complete.

IF SMOKE CONTINUES:
Deactivate the left engine bleed air system and No. 1 pack.
Bleed Air Valves 1 and 2.....CLOSE F/E
Pack Valve 1.....CLOSE F/E

IF SMOKE CONTINUES:
Re-establish left engine bleed air system and No. 1 pack and deactivate the right engine bleed air system and No. 3 pack.
Bleed Air Valves 1 and 2.....OPEN F/E
Pack Valve 1.....OPEN F/E
Bleed Air Valves 3 and 4.....CLOSE F/E
Pack Valve 3.....CLOSE F/E

IF SMOKE CONTINUES:
Re-establish right engine bleed air system and No. 3 pack and deactivate No. 2 pack.
Bleed Air Valves 3 and 4.....OPEN F/E
Pack Valve 3.....OPEN F/E
Pack Valve 2.....CLOSE F/E

AUTOMATIC PRESSURIZATION CONTROL FAILURE

IF AUTO FAIL WARNING LIGHT ILLUMINATED:
The pressurization controller will hold existing cabin altitude. Cabin rate of climb will modulate holding cabin altitude within approximately 200 feet.
Pressurization Mode Switch.....MOMENTARILY TO MAN THEN AUTO
Positioning switch momentarily MAN will extinguish the AUTO FAIL warning light and reset AUTO pressurization control mode.

IF AUTO PRESSURIZATION SYSTEM DOES NOT OPERATE NORMALLY:
Pressurization Mode Switch.....MAN
Outflow Valve Manual Control Switches.....AS REQUIRED
Position outflow valves as required to maintain desired cabin altitude.

LOSS OF EQUIPMENT COOLING
(NO AIRFLOW light illuminated)

With NO AIRFLOW light illuminated equipment cooling system will automatically operate in the SMOKE mode with airflow being maintained by cabin differential pressure.

Blower Selector.....ALTERNATE F/E
No Airflow Light.....RESET F/E
NO AIRFLOW light should extinguish if detector has cooled (NO AIRFLOW light illuminated more than 30 seconds).

IF NO AIRFLOW LIGHT REMAINS ILLUMINATED OR REILLUMINATES:
Equipment Cooling Valve Control Switch.....SMOKE F/E
TR Unit Loads.....MAX 54 AMPS F/E
Press DC meter switches and check individual TR unit loads are less than 54 AMPS.

Continue flight with no airflow light illuminated.

HIGH OR RISING CSD OIL TEMPERATURE

Generator Breaker.....TRIP F/E
Check that GEN OPEN light illuminates.

CSD PRESS Light.....CHECK F/E
Check CSD PRESS light extinguished. If illuminated use CSD OIL LOW PRESSURE LIGHT ILLUMINATED alternate operation procedure.

Generator Frequency.....CHECK F/E
Press appropriate GEN switch; check that generator frequency is steady and within limits.

CSD Oil Temperature.....DECREASING F/E
Check that OUT and RISE indications are decreasing.

IF ABNORMAL INDICATIONS PERSIST:
If oil temperature does not decrease, or continues to increase, disconnect generator.

CSD.....DISCONNECT F/E

1 OR 2 GENERATOR(S) INOPERATIVE

Split System and Bus Tie Breaker(s).....CLOSE F/E
Check that split system breaker OPEN light and BUS TIE OPEN lights are extinguished.

Electrical Loads.....WITHIN LIMITS F/E
Monitor KW/KVAR indications to ensure loads are within limits of available generators. If loads are excessive, reduce as necessary in following order:

HIGH LOAD ITEMS:
Galley Power
Recirculating Fans
Upper Deck Heat
Passenger Entertainment
Gasper Fan
Passenger Cabin Lights
Ovrd/Jett Pumps
Window Heat
Boost Pumps (One boost pump per operating engine required for normal operation.)

INFLIGHT ENGINE FAILURE/SHUTDOWN

Thrust Lever.....CLOSE C

Leave throttle bar engaged (if engaged).

If conditions permit, allow engine to cool for three minutes before continuing engine shutdown.

Start Lever.....CUTOFF C

Check that ENG VALVE light illuminates bright (in transit), then dims (valve closed).

Generator Breaker.....TRIPPED F/E

If affected GEN OPEN light is not illuminated, place generator breaker switch to TRIP; check that GEN OPEN light illuminates.

Fuel Shutoff Valve.....CLOSE F/E

Place fuel shutoff switch to CLOSE.

Bleed Air Valve.....CLOSE F/E

Check VALVE CLOSED light illuminated.

Engine Ignition.....OFF F/E

Nacelle Anti-Ice.....OFF F/O

Check that NACELLE VALVE OPEN and STATOR VALVE OPEN lights are extinguished.

Fuel Control Unit cooling.....3 MIN/30 MIN F/E

If shutdown engine is windmilling faster than 25% N2, fuel control unit should be cooled for 3 minutes at 30-minute intervals using the following procedure:

Engine Ignition.....OFF
Fuel Shutoff Valve.....OPEN
Fuel Pressure.....AVAILABLE
Start Lever.....IDLE

AFTER THREE MINUTES:

Start Lever.....CUTOFF
Fuel Shutoff Valve.....CLOSE
Boost Pump Switches.....AS REQUIRED

NOTE: See Chapter 1 for anti-ice limitations and Chapter 23 for engine out performance.

INFLIGHT STARTING

Engine Condition and Start Envelope.....CHECK C-F/E
Use inflight start envelope to determine conditions for inflight start and check that engine indications are in agreement with reference limitations.

Fire Switch.....IN F/E

Thrust Lever.....CLOSE C
Disengage throttle bar (if engaged).

Start Lever.....CUTOFF C

Fuel Shutoff Valve.....OPEN F/E

Fuel Pressure.....AVAILABLE F/E
Fuel can be supplied from the respective main tank boost pump or through the crossfeed manifold.

Bleed Air Valve.....OPEN F/E
Position bleed air switch to open position.

Engine Ignition (windmilling start).....FLT START C-F/E
(cross bleed start).....GRD START C-F/E
For windmilling start place start lever to rich/idle and observe starting EGT limit of 593°C.

For crossbleed start place start lever to rich/idle at 20-24% N2 RPM. Observe starting EGT limit of 593°C and starter cutout at 46% N2 RPM.

Start Lever.....RICH/IDLE C

NOTE: Start should be initiated when EGT is 100°C or below.

Position start lever to IDLE. If EGT is 0°C or below, position start lever to RICH.

Check that ENG VALVE light illuminates bright (in-transit), then extinguishes (valve open).

Engine Instruments.....STABILIZED ALL
Check that all indications are normal.

Start Lever.....IDLE C
If RICH start is used, position start lever to IDLE.

Engine Ignition.....AS REQUIRED F/E
Place engine ignition to OFF when flight conditions permit.

Electrical and Hydraulic Power.....RESTORE F/E
Press appropriate AC meters selector switch and check that generator voltage and frequency are normal. Place generator breaker switch to CLOSE; check that GEN OPEN light extinguishes.

Check that appropriate hydraulic pump low PRESS light extinguishes.

ASYMMETRICAL/SPLIT TRAILING EDGE FLAPS

Airspeed Bugs (for landing).....VREF + 20 ALL
Captain and F/O will set airspeed bugs and F/E will verify settings.

Leading Edge Flaps (as necessary).....EXTEND/RETRACT F/O
Check position of leading edge flaps on LE flap indicator and inform Captain of flap position indications.

If necessary, place leading edge alternate flap arm switch to ARM and extend or retract the leading edge flaps using directional switches.

Operating Trailing Edge Flaps.....30 C-F/O
On Captain's command, position flap lever to flaps 30 and check flap indicators for proper response.

CAUTION: DO NOT USE ALTERNATE TRAILING EDGE FLAP SYSTEM.

NOTE: When selecting landing flaps with inboard flaps inoperative, a nuisance stick shaker may occur.

ONE OR MORE LEADING EDGE FLAPS INOP

Complete ALTERNATE LEADING EDGE FLAP OPERATION checklist.

IF ONE OR MORE LEADING EDGE FLAPS STILL INOPERATIVE:

Airspeed Bugs (for landing).....VREF + 20 ALL
Captain and F/O will set airspeed bugs and F/E will verify settings.

Trailing Edge Flaps.....25-25 C-F/O
On Captain's command, position flap lever to 25, check flap indicators for proper response.

ALTERNATE TRAILING EDGE FLAP OPERATION

Trailing Edge Alternate Flap Arm Switch.....ARM F/O

EXTENSION:
Flap Lever.....LANDING FLAPS F/O
Position flap lever to desired landing setting.

NOTE: Observe placard limit speed of 160 KIAS while extending flaps from 25 to 30 positions.

Alternate Flap Extension.....COMPLETE F/O
Place INBD and OUTBD trailing edge directional switches to DOWN.
Check LE FLAPS lights for normal indications.

NOTE: Flap load relief system will be inoperative. FLAP LD RELIEF light will illuminate and remain illuminated with the flap lever at 30 until the airspeed is substantially below placard limits.

RETRACTION:
Flap Lever.....UP DETENT F/O
Alternate Flap Retraction.....COMPLETE F/O
Place INBD and OUTBD trailing edge directional switches to UP.

Check LE FLAPS lights for normal indications.
Trailing Edge Alternate Flap Arm Switch.....OFF F/O

ALTERNATE LEADING EDGE FLAP OPERATION

Leading Edge Flaps.....ARM F/O
Place leading edge alternate flaps arm switch to ARM.
Alternate Extension/Retraction.....COMPLETE F/O
Place leading edge directional switches in desired direction.

Check LE FLAPS lights for normal indications.

NOTE: Leave leading edge alternate flaps arm switch in ARM and the directional switches in the UP or DOWN position to prevent inadvertent pneumatic operation.

For this condition leading edge flaps will not automatically retract when thrust reversers are used.

SINGLE HYDRAULIC SYSTEM LEAK OR LOSS

Air Pump.....OFF F/E
Check RUN light extinguished.
Engine Pump.....DEPRESSURIZE F/E
Check that engine pump low PRESS light illuminates and hydraulic quantity indicator remains steady.

IF LEAK CONTINUES:
Engine Pump.....SUPPLY OFF F/E

FOLLOW APPLICABLE PROCEDURE AS REQUIRED:

System 1:
Auto Speed Brake C.B (P-12).....PULL F/E
Use speed brake lever for manual operation of ground spoilers.

NOTE: Check ground safety relay light. If illuminated use alternate procedure page 18.20.04 for Ground Safety Relay Light Illuminated Inflight.

Trailing Edge Flaps.....ALTERNATE EXTENSION F/O
Nose Gear.....ALTERNATE EXTENSION F/O
Body Gear.....ALTERNATE EXTENSION F/O
- Nose and body gear steering will be inoperative.
- SEC SYS 1 brake source inoperative.
- Left outboard elevator inoperative.

System 2:
Autopilot "B".....OFF C
Hydraulic input to Autopilot "B" not available.
- Stabilizer trim rate reduced.
- Spoilers inoperative as placarded.
- Reserve brakes inoperative.

System 3:
Autopilot "A".....OFF C
Hydraulic input to Autopilot "A" not available.
- Stabilizer trim rate reduced.
- Spoilers inoperative as placarded.

(Procedure continued on next page.)

System 4:

Auto Speed Brake C.B (P-12).....PULL F/E

Use speed brake lever for manual operation of ground spoilers.

NOTE: Check ground safety relay light. If illuminated use alternate procedure page 18.20.04 for Ground Safety Relay Light Illuminated Inflight.

Trailing Edge Flaps.....ALTERNATE EXTENSION F/O

Wing Gear.....ALTERNATE EXTENSION F/O

Brake Pressure Indicator.....CHECK F/E

WITH BRAKE PRESSURE NORMAL (pressure holding):

Normal Brake Source.....SEC SYS 1 F/E

Check SEC SYSTEM 1 light illuminated and brake LOW PRESS lights extinguished.

WITH LOSS OF BRAKE PRESSURE (precharge pressure):

Reserve Brake Valve.....OPEN C

Place reserve brake switch to OPEN before landing.
Check reserve brake valve OPEN light illuminated and brake LOW PRESS lights extinguished.

- Spoilers inoperative as placarded.
- Right outboard elevator inoperative.

DUCT PRESSURE LOW

Isolation Valves.....CLOSE F/E
Place both isolation valve switches to the close position.

IF BOTH DUCT PRESSURES RETURN TO NORMAL:
Leak is in the cross body pneumatic duct.
No. 2 Pack Valve.....CLOSE F/E
Operate with the isolation valves closed. The No. 2 pack and aft cargo heat will be inoperative.

IF ONE DUCT PRESSURE REMAINS LOW:
Leak is in the wing pneumatic duct with the low pressure indication.
Isolation Valve (normal side).....OPEN F/E
Bleed Air Valves (low side).....CLOSE F/E
Check that VALVE CLOSED lights illuminate.
Pack Valve (low side).....CLOSE F/E
Pneumatic leading edge extension, air conditioning pack, air driven hydraulic pumps and wing anti-ice on the affected side will be inoperative.

Use ALTERNATE LEADING EDGE FLAP OPERATION checklist. Initiate leading edge flap extension or retraction with trailing edge flaps in retracted position.

WING OVERHEAT

Isolation Valve (affected side).....CLOSE F/E
Bleed Air Valves (affected side).....CLOSE F/E
Check associated VALVE CLOSED lights illuminate.

With pneumatic duct leak in the wing area, the WING OVHT light should extinguish when leading edge area cools (at least 5 minutes).

IF OVERHEAT LIGHT EXTINGUISHES:
(Leak is in the wing duct.)
- Use ALTERNATE LEADING EDGE FLAP OPERATION checklist.
- Air conditioning pack air driven hydraulic pumps and wing anti-ice on the affected side will be inoperative.

IF OVERHEAT CONTINUES AFTER 5 MINUTES AND FLIGHT CONDITIONS PERMIT:
Engine Thrust Settings (affected side).....REDUCE ONE ENGINE AT A TIME TO IDLE FOR 5 MINUTES

IF OVERHEAT IS ISOLATED TO ONE ENGINE STRUT AREA:
Restore pneumatic pressure to remainder of system.

IF OVERHEAT CANNOT BE ISOLATED:
Leave isolation and bleed air valves closed.

NOTE: Reducing thrust settings will lower any possibility of strut damage.

Use ALTERNATE LEADING EDGE FLAP OPERATION checklist. Initiate leading edge flap extension or retraction with trailing edge flaps in retracted position.

FUEL JETTISON

Fuel Feed.....TANK TO ENGINE F/E
Establish tank to engine fuel configuration. Place all main tank boost pump switches ON. Check that low PRESS lights are extinguished.

Crossfeed Valves.....CLOSE F/E
Check that CROSSFEED VALVE lights illuminate (in transit), then extinguish (valves closed).

Override/Jettison Pumps.....ON F/E
For fuel jettison from center wing tank, place override/jettison pump switches ON. Check that low PRESS lights extinguish.

Jettison Pumps.....ON F/E
For fuel jettison from main wing tanks, place outboard and inboard No. 2 and No. 3 main fuel jettison pump switches ON. Check that low PRESS lights illuminate momentarily, then extinguish.

Center Wing Jettison Valves.....OPEN F/E
For fuel jettison from center wing tank, place center wing jettison valve switches to OPEN. Check that lights illuminate (in transit), then extinguish (valves open).

Jettison Nozzle Valves.....OPEN F/E
Check that VALVE lights illuminate (in transit), then extinguish (valves open).

Use fuel quantity indicators to monitor pump operation.

NOTE: When jettisoning fuel at altitude, jettison pump low PRESS light(s) may illuminate.

WHEN INBD MAIN TANK FUEL QUANTITY EQUALS OUTBD MAIN TANK PLUS RESERVE OR AIRPLANE GROSS WEIGHT BELOW 580,000 LBS:

Jettison Transfer Valves.....OPEN F/E
Place jettison transfer valve switches to OPEN. Check VALVE light illuminates (in transit) then extinguishes (valve open).

Reserve Valves (below 580,000 lbs gross weight).....OPEN F/E
Place reserve valve switches to open if required to transfer fuel into the No. 1 and No. 4 main tanks; check that RES VALVE lights illuminate (in transit) then extinguish (valve open).

Fuel Quantity.....MONITOR F/E
Monitor fuel quantity indications for all tanks and use jettison pump switches and jettison transfer valves as required to maintain fuel balance.

TO STOP FUEL JETTISON:
Repeat above steps placing switches in opposite position except leave reserve valves open. Check that all lights reflect the appropriate condition. Close fuel jettison module cover and resume fuel management.

MINIMUM FUEL GO-AROUND

WHEN A GO-AROUND IS MADE WITH MINIMUM FUEL IN ANY MAIN TANK:

All Main Tank Boost Pumps.....ON F/E
If low PRESS lights illuminate, do not turn boost pump switches OFF.

All Crossfeed Valves.....OPEN F/E
Check that CROSSFEED VALVE lights illuminate (in transit), then extinguish (valve open).

Avoid Nose High Attitude.
Apply engine thrust slowly and avoid high body angles. If fuel boost pump low PRESS lights illuminate, lower nose of airplane.

ONE/TWO BOOST PUMPS IN ONE TANK OR INBD CROSSFEED VALVE INOP

WITH OUTBD MAIN TANK BOOST PUMPS INOP:

Jettision Transfer Valve (affected tank).....OPEN F/E
Check jettison transfer VALVE light illuminates bright then extinguishes

Transfer fuel to adjacent INBD main tank as required for fuel usage.

Fuel transfer capability limited to standpipe level approximately 7000 lbs per tank remaining.

WITH INBD MAIN TANK BOOST PUMP/PUMPS OR INBD CROSSFEED VALVE INOP:

Jettison Pumps (affected tank).....ON F/E
Check jettison pump low PRESS light extinguished.

Center Wing Jettison Valve.....OPEN F/E
Open either center wing jettison valve and check appropriate VALVE light illuminates bright then extinguishes.

Fuel Crossfeed Valves.....AS REQUIRED F/E
The jettison pumps will override main tank fuel boost pumps.

Maintain fuel balance using jettison pumps in opposite inbd tank as required.

Fuel available with jettison pumps is limited to standpipes level approximately 7000 lbs per tank remaining.

ALTERNATE LANDING GEAR EXTENSION

Gear Lever.....OFF F/O
Place landing gear lever in OFF position. Extend affected gear first if desired.
Alternate Gear Extend Switch(es).....HOLD IN EXT 5-10 SECONDS THEN ARM F/O
Hold switch(es) in EXT position 5 to 10 seconds to initiate extension then leave in ARM position.
Gear Lever.....DN F/O
Check GEAR DOWN light illuminated.

NOTE: Affected gear doors will remain open. Observe Vlo placard.

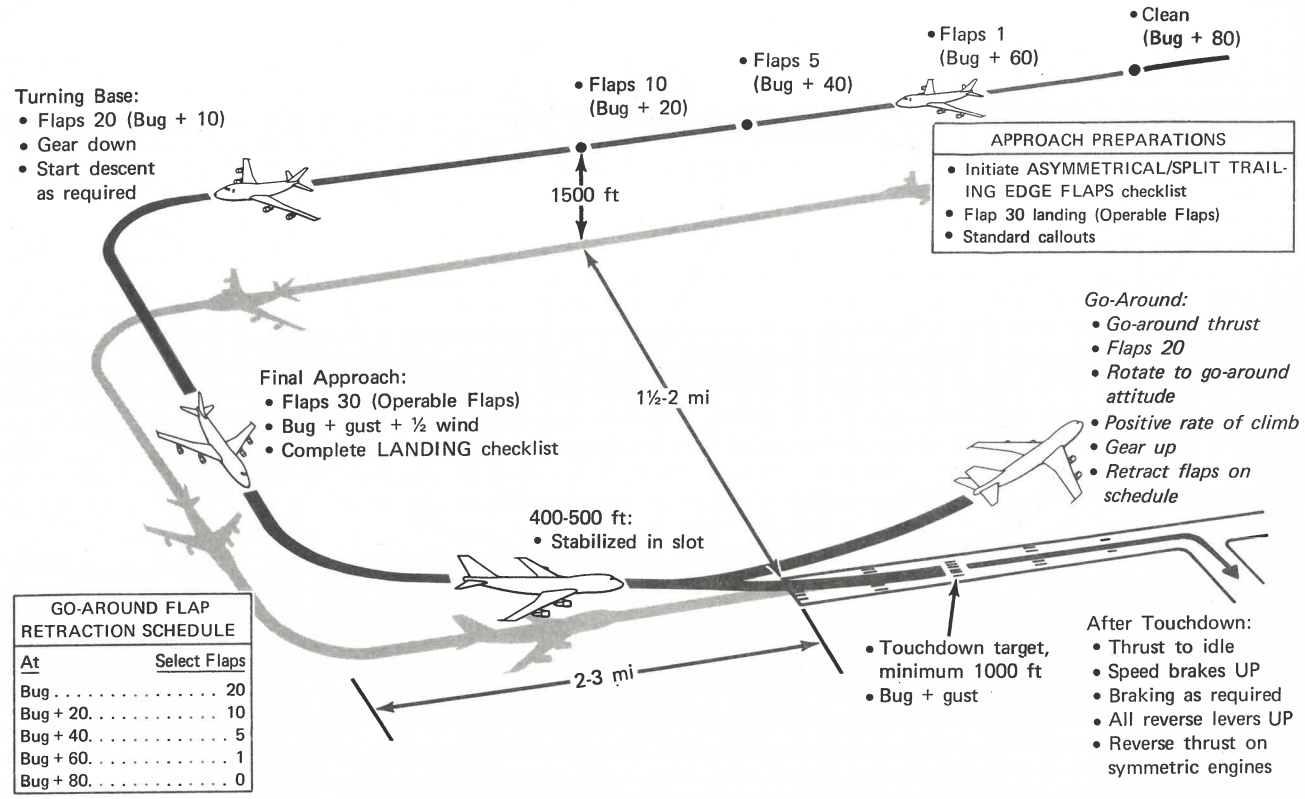
JAMMED STABILIZER LANDING

Maintain in-trim airspeed.

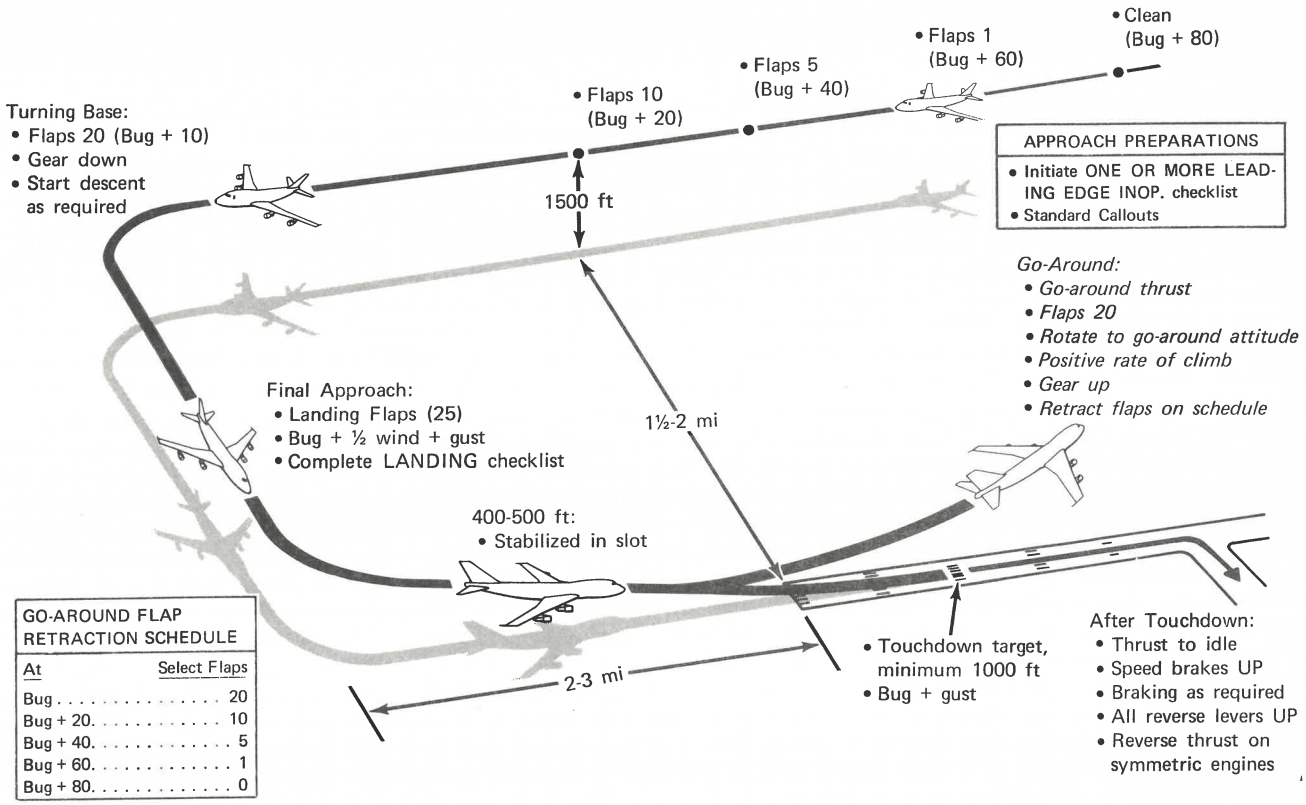
Set airspeed bugs at VREF + 20 for landing.

Use flaps 25 for landing.

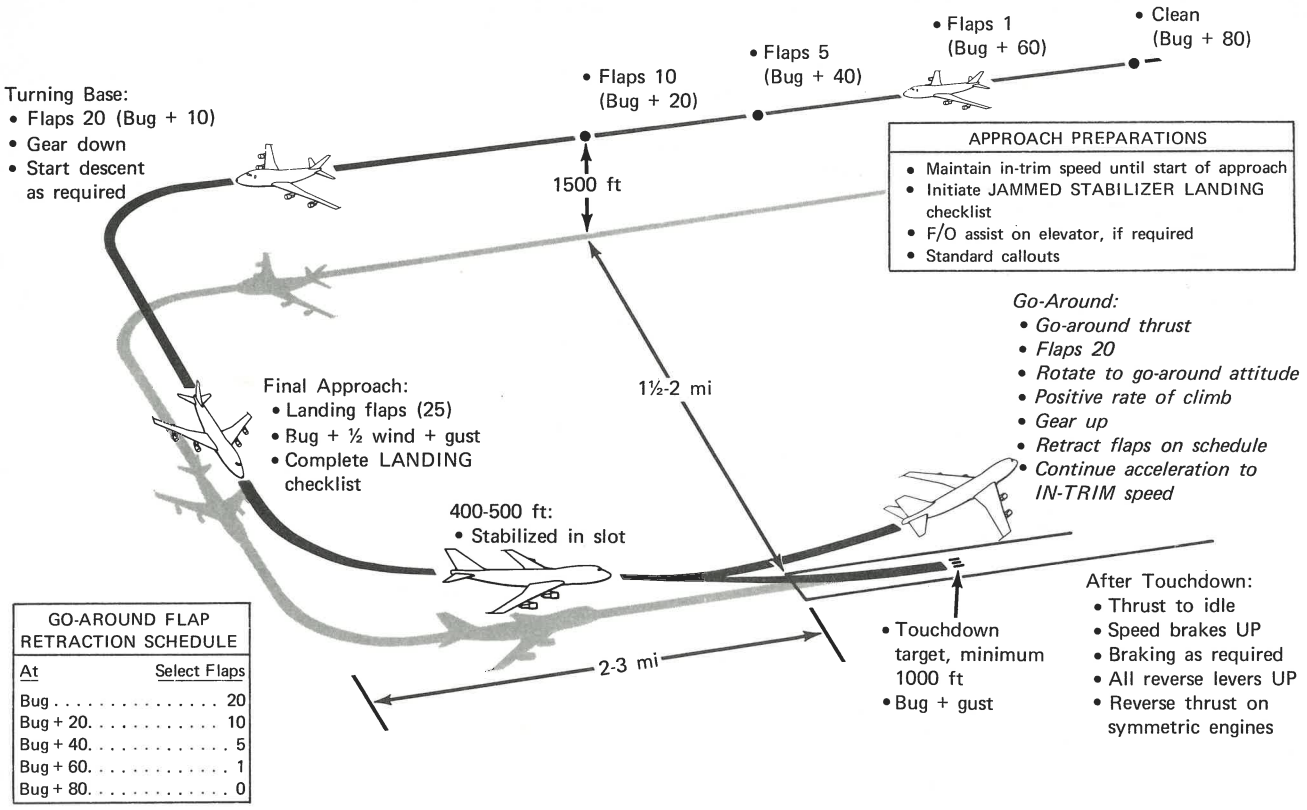
Complete NORMAL DESCENT-APPROACH and LANDING checklists.



LANDING — ASYMMETRICAL/SPLIT TRAILING EDGE FLAPS



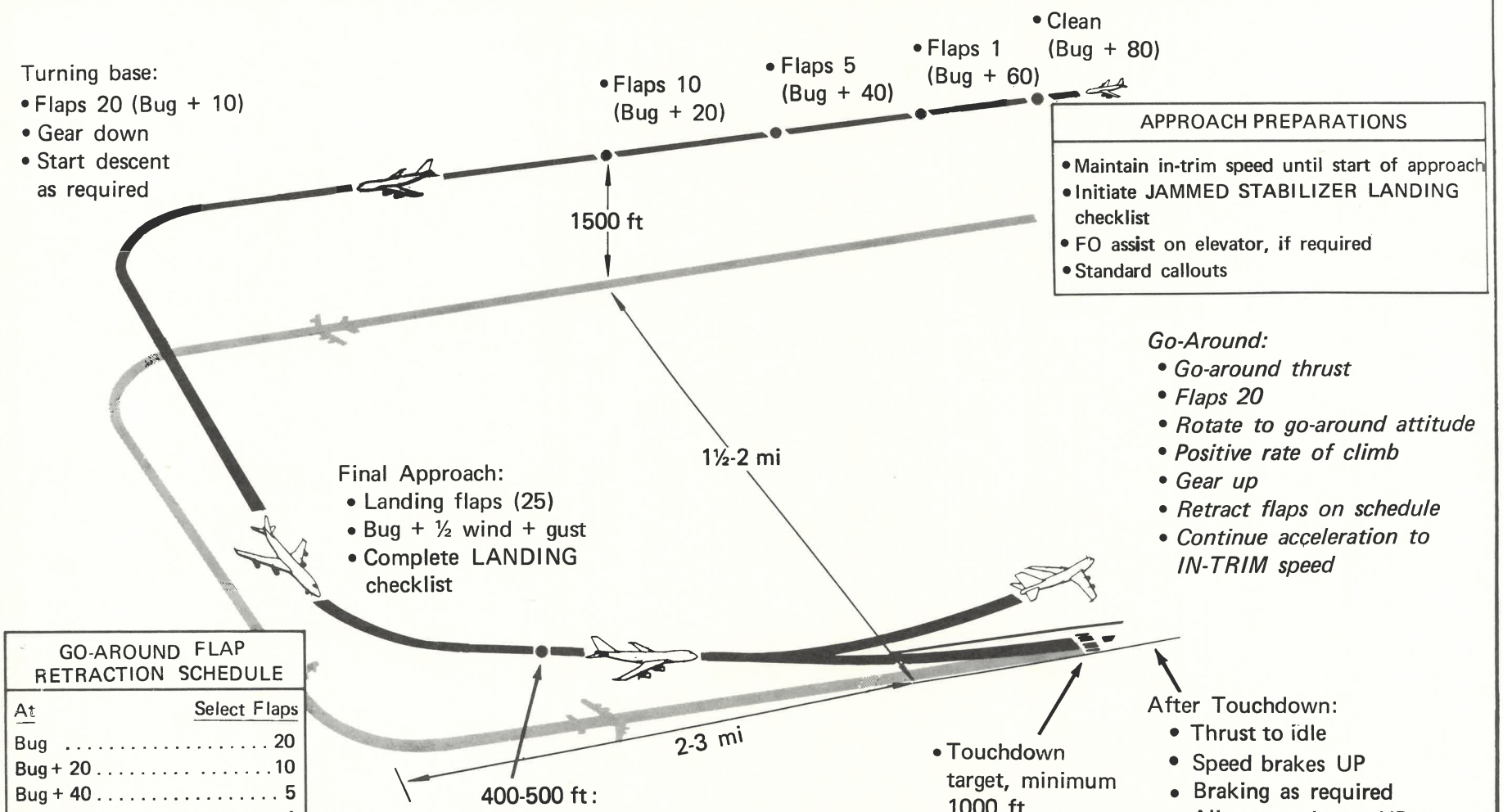
LANDING — ONE OR MORE LEADING EDGE FLAPS INOPERATIVE



GO-AROUND FLAP RETRACTION SCHEDULE	
At	Select Flaps
Bug	20
Bug + 20	10
Bug + 40	5
Bug + 60	1
Bug + 80	0

JAMMED STABILIZER LANDING

747 JAMMED STABILIZER LANDING



APPROACH PREPARATIONS
• Maintain in-trim speed until start of approach
• Initiate JAMMED STABILIZER LANDING checklist
• FO assist on elevator, if required
• Standard callouts

Go-Around:
- *Go-around thrust*
- *Flaps 20*
- *Rotate to go-around attitude*
- *Positive rate of climb*
- *Gear up*
- *Retract flaps on schedule*
- *Continue acceleration to IN-TRIM speed*

After Touchdown:
- Thrust to idle
- Speed brakes UP
- Braking as required
- All reverse levers UP
- Reverse thrust on symmetric engines

GO-AROUND FLAP RETRACTION SCHEDULE	
At	Select Flaps
Bug	20
Bug + 20	10
Bug + 40	5
Bug + 60	1
Bug + 80	0

ABNORMAL PROCEDURES
COMBINED EMERGENCY-ABNORMAL CHECKLIST

CUT ON DOTTED LINE

Engine and Fuel	**Engine Fire, Severe Damage or Separation** Engine Failure and Shutdown **Inadvertent Reverse Thrust In Flight** Inflight Start Fuel Jettison One/Two Boost Pumps in One Tank or Inbd Crossfeed Valve Inop
Electrical	**Electrical, Smoke or Fire** High or Rising CSD Oil Temperature 1 or 2 Generator(s) Inoperative **3 Generators Inoperative** **Loss of All Generators**
Hydraulic	Single Hydraulic System Leak or Loss **Two Hydraulic Systems Inoperative**
Flight Controls and Landing Gear	Asymmetrical/Split Trailing Edge Flaps One or More Leading Edge Flaps Inop Alternate Leading or Trailing Edge Flaps Alternate Landing Gear Extension **Controllability With All Engines Windmilling**
Pneumatics, Pressurization and Air Conditioning	**Rapid Depressurization** **Emergency Descent** Wing Overheat Duct Pressure Low Loss of Equipment Cooling Pack(s) Trip Auto Pressurization Control Failure
Fuselage Fires, Air Conditioning Smoke and Smoke Evacuation	**APU Fire** **Wheel Well Fire** **Lower Fwd Cargo Fire** **Lower Aft Cargo Fire** Air Conditioning Smoke **Cockpit Smoke Evacuation**
Abnormal Landings	**2 Engines Inoperative** **Overweight Landing** **Passenger Evacuation (Land)** **Ditching**
	Jammed Stabilizer Landing Minimum Fuel Go-Around **Partial Main Gear Landing**

CUT ON DOTTED LINE

ENGINE FIRE, SEVERE DAMAGE OR SEPARATION

Thrust Lever	CLOSE	C
Start Lever	CUTOFF	C
Engine Fire Switch	PULL	F/E

If fire switch remains illuminated:

Fire Bottle	DISCHARGE	F/E

After 30 seconds, if fire switch remains illuminated:

Other Fire Bottle	DISCHARGE	F/E

If fire continues:

Do not lower flaps or use speed brakes unless emergency landing is imminent.

Landing Gear	UP & OFF	C
Flaps	UP, NO LIGHTS	C
Airspeed	280 KIAS MIN	C

ENGINE FAILURE AND SHUTDOWN

Thrust Lever	CLOSE	C
Start Lever	CUTOFF	C
Generator Breaker	TRIPPED	F/E
Fuel Shutoff Valve	CLOSE	F/E
Bleed Air Valve	CLOSE	F/E
Engine Ignition	OFF	F/E
Nacelle Anti-Ice	OFF	F/O
Fuel Control Unit Cooling	3 MIN/30 MIN	F/E

INADVERTENT REVERSE THRUST IN FLIGHT

With reverser light on and:

No Yaw or Loss of Airspeed	OPERATE NORMALLY	ALL
With Yaw and/or Loss of Airspeed (Reverse Lever Down)	SHUT DOWN AFFECTED ENGINE	ALL

- *Buffeting may be reduced by decreasing airspeed.*
- *Set airspeed bugs at V_{REF} + 20 for landing.*
- *Use flaps 25 for landing.*

INFLIGHT START

Engine Condition and Start Envelope	CHECK	C, F/E
Fire Switch	IN	F/E
Thrust Lever	CLOSE	C
Start Lever	CUTOFF	C
Fuel Shutoff Valve	OPEN	F/E
Fuel Pressure	AVAILABLE	F/E
Bleed Air Valve	OPEN	F/E
Engine Ignition (Windmilling Start)	FLT START	C, F/E
(Crossbleed Start)	GRD START	C, F/E
Start Lever	RICH/IDLE	C
Engine Instruments	STABILIZED	ALL
Start Lever	IDLE	C
Engine Ignition	AS REQUIRED	F/E
Electrical and Hydraulic Power	RESTORE	F/E

FUEL JETTISON

Fuel Feed	TANK TO ENGINE	F/E
Fuel Crossfeed Valves	CLOSE	F/E
Override/Jettison Pumps	ON	F/E
Jettison Pumps	ON	F/E
Center Wing Jettison Valves	OPEN	F/E
Jettison Nozzle Valves	OPEN	F/E

WHEN INBD MAIN TANK FUEL QUANTITY EQUALS OUTBD MAIN PLUS RESERVE OR G.W. BELOW 580,000 LBS:

Jettison Transfer Valves	OPEN	F/E
Reserve Valves (Below 580,000 lbs G.W.)	OPEN	F/E
Fuel Quantity	MONITOR	F/E

To stop fuel jettison:

- *Repeat above steps (except reserve valves) placing switches in opposite position.*

ONE/TWO BOOST PUMPS IN ONE TANK OR INBD CROSSFEED VALVE INOP

With outbd main tank boost pumps inop:

Jettison Transfer Valve (affected tank)	OPEN	F/E

- *Fuel transfer capability limited to standpipe level.*

With inbd main tank boost pump/pumps or inbd crossfeed valve inop:

Jettison Pumps (affected tank)	ON	F/E
Center Wing Jettison Valve	OPEN	F/E
Fuel Crossfeed Valves	AS REQUIRED	F/E

- *Fuel available with jettison pumps, limited to standpipe level.*

ELECTRICAL SMOKE OR FIRE

Oxygen Mask and Regulators (if required)	ON, 100%	ALL
Crew Communications	ESTABLISH	ALL
Smoke Goggles (if required)	ON	ALL
Cabin Altitude (Max 10,000 Ft, if required)	INCREASE	F/E
Pressurization Rate (if required)	INCREASE	F/E
If smoke source can be located:		
Electrical Power (Affected Equipment)	REMOVE	ALL
If smoke source cannot be located:		
Galley Power	OFF	F/E
Gasper and Recirculating Fans	OFF	F/E
If smoke continues:		
Circuit Breaker Panels	CHECK	F/E
If smoke continues:		
DC Bus Isolation Relays	OPEN	F/E
Bus Tie Breakers	TRIP	F/E
Pilots' Panels	CHECK	C, F/O
Flight Engineer's Panel	CHECK	F/E
If smoke continues:		
All Unnecessary Equipment	OFF	ALL

- LAND AT NEAREST SUITABLE AIRPORT
- *Main busses or radio and flight instrument busses may be de-energized on an individual one at a time basis.*

HIGH OR RISING CSD OIL TEMPERATURE

Generator Breaker	TRIP	F/E
CSD PRESS Light	CHECK	F/E
Generator Frequency	CHECK	F/E
CSD Oil Temperature	DECREASING	F/E
If abnormal indications persist:		
CSD	DISCONNECT	F/E

1 OR 2 GENERATOR(S) INOPERATIVE

Split System and Bus Tie Breakers	CLOSE	F/E
Electrical Loads	WITHIN LIMITS	F/E

- *High Load Items:*
  - *Galley Power*
  - *Recirculating Fans*
  - *Upper Deck Heat*
  - *Passenger Entertainment*
  - *Gasper Fan*
  - *Passenger Cabin Lights*
  - *Ovrd/Jett Pumps*
  - *Window Heat*
  - *Boost Pumps (one per engine required)*

3 GENERATORS INOPERATIVE

All Unnecessary Equipment	OFF	ALL
Split System and Bus Tie Breakers	CLOSE	F/E

LOSS OF ALL GENERATORS

Battery	CHECK ON	F/E
Standby Power	ON	F/E
Fuel Crossfeed Valves	OPEN	F/E
If engine start required: (All engines inoperative)		
Start Levers	CUTOFF	C
Airplane Altitude	BELOW 30,000 FT	C
Airspeed	MIN 250 KIAS	C
Standby Ignition	IGN 1 OR IGN 2	F/E
Start Levers	IDLE	C
If engines are running:		
Split System and Bus Tie Breakers	TRIP	F/E
DC Bus Isolation Switches	OPEN	F/E
Generator Fields	CLOSE	F/E
Essential Power	ESTABLISH	F/E
Generator Breakers	CLOSE	F/E
DC Bus Isolation Switches	CLOSE	F/E

SINGLE HYDRAULIC SYSTEM LEAK OR LOSS

Air Pump . . . . . OFF F/E
Engine Pump. . . . . DEPRESSURIZE F/E

If leak continues:
Engine Pump. . . . . .SUPPLY OFF F/E

- *Complete applicable checklist items and note advisory items for the systems lost.*

System 1

Auto Speed Brake C B. (P-12) . . . . . PULL F/E

- *Check ground safety relay light (If illuminated use alternate procedure for Ground Safety Relay Light Illuminated in Flight).*
- *Nose and body gear steering inoperative.*
- *SEC SYS 1 brake source inoperative.*
- *Left outboard elevator inoperative.*
- *Alternate trailing edge flaps extension required.*
- *Alternate Nose and Body Gear extension required (max airspeed 270 KIAS).*
- *Manual operation of Speed Brakes required.*

System 2

Autopilot "B" . . . . . OFF C

- *Stabilizer trim rate reduced.*
- *Spoilers inoperative as placarded.*
- *Reserve brakes inoperative.*

System 3

Autopilot "A" . . . . . OFF C

- *Stabilizer trim rate reduced.*
- *Spoilers inoperative as placarded.*

System 4

Auto Speed Brake C B. (P-12) . . . . . PULL F/E

- *Check ground safety relay light (If illuminated use alternate procedure for Ground Safety Relay Light Illuminated in Flight).*
- *Spoilers inoperative as placarded.*
- *Right outboard elevator inoperative.*
- *Alternate Trailing Edge Flaps extension required.*
- *Alternate Wing Gear extension required (max airspeed 270 KIAS).*
- *PRIM SYS 4 brake source inoperative.*
- *Manual operation of Speed Brakes required.*

- *Complete (ONE OR TWO HYDRAULIC SYSTEM(S) INOPERATIVE) DESCENT-APPROACH and LANDING Checklists (next page).*

TWO HYDRAULIC SYSTEMS INOPERATIVE

- *Complete SINGLE HYDRAULIC SYSTEM LEAK OR LOSS Checklist.*
- *With two hydraulic systems inoperative, land at the nearest suitable airport.*
- *Set airspeed bugs at V_{REF} + 20 for landing.*
- *Use flaps 25 for landing.*
- *Crosswind limit is 20 knots.*

DESCENT-APPROACH
(ONE OR TWO HYDRAULIC SYSTEM(S) INOPERATIVE)

Pressurization	SET	F/E
Landing Data (Single System Loss) (Flaps 30)	V_{REF} BUGS SET	ALL
(Flaps 25)	V_{REF} +5 BUGS SET	ALL
(Two Systems Loss)	V_{REF} +20 BUGS SET	ALL
Fuel	SET FOR LANDING	F/E
Annunciator Panels	CHECKED	F/E
Altimeters	SET & X-CHECKED	ALL
Radio & Nav. Instruments	SET & X-CHECKED	C, F/O
Radio Altimeters	SET	C, F/O

Additional Items With System 1 or 4 Loss:

Alternate Trailing Edge Flaps	ARM	F/O
Flap Lever	LANDING FLAPS	F/O

- Flaps 25 max for 2 Hyd System Loss.
- Observe placard 160 KIAS while extending from 25 to 30 positions.

Alternate T. E. Flaps	EXTEND ON SCHEDULE	F/O
Landing Gear Lever	OFF	F/O
ALT Gear EXT Switches (Body & Nose for Sys 1 loss) (Wing for Sys 4 loss)	HOLD IN EXT 5-10 SECONDS THEN ARM	F/O

To select alternate brake hydraulic source for System 4 loss:

Brake Pressure Indicator	CHECK	C

With brake pressure normal:

Normal Brake Source	SEC SYS 1	F/E

Loss of brake pressure or loss of systems 1 and 4:

Reserve Brake Valve	OPEN	C
DESCENT-APPROACH Checklist	COMPLETE	F/E

LANDING

Ignition	FLT START	F/E
Cabin Signs	ON	F/O
Speed Brake	ARM	C
Landing Gear	DOWN, IN, GREEN LIGHT	C
Flaps	———, ———, BLUE LIGHT	C
Hydraulics (Operative Systems)	NORMAL	F/E
LANDING Checklist	COMPLETE	F/E

ASYMMETRICAL/SPLIT TRAILING EDGE FLAPS

If necessary to operate L.E. flaps:

Leading Edge Flaps	ARM	F/O
Alternate Extension/Retraction	COMPLETE	F/O

- *Leave alternate leading edge flaps arm switch in ARM and directional switches in UP or DOWN position to prevent inadvertent pneumatic operation.*

Operating Trailing Edge Flaps	30	C, F/O

- *Do not use alternate T.E. flap system.*
- *Set airspeed bugs at V_{REF} + 20 for landing.*
- *Use DESCENT-APPROACH and LANDING Checklist on this page.*

ONE OR MORE LEADING EDGE FLAPS INOP

- *Complete ALTERNATE LEADING EDGE FLAP OPERATION checklist.*

If one or more leading edge flaps still inop:

- *Set airspeed bugs at V_{REF} + 20 for landing.*
- *Use trailing edge flaps 25 for landing.*
- *Use DESCENT-APPROACH and LANDING Checklist on this page.*

DESCENT-APPROACH

Pressurization	SET	F/E
Landing Data	V_{REF} +20, BUGS SET	ALL
Fuel	SET FOR LANDING	F/E
Annunciator Panels	CHECKED	F/E
Altimeters	SET & X-CHECKED	ALL
Radios & Nav. Instruments	SET & X-CHECKED	C, F/O
Radio Altimeters	SET	C, F/O
DESCENT-APPROACH Checklist	COMPLETE	F/E

LANDING

Ignition	FLT START	F/E
Cabin Signs	ON	F/O
Speed Brake	ARM	C
Landing Gear	DOWN, IN, GREEN LIGHT	C
Flaps	——— ———	C
Hydraulics	NORMAL	F/E
LANDING Checklist	COMPLETE	F/E

ALTERNATE LEADING EDGE FLAPS

Leading Edge Flaps	ARM	F/O
Alternate Extension/Retraction	COMPLETE	F/O

- *Leave alternate leading edge flaps arm switch in ARM and directional switches UP or DOWN position to prevent inadvertent pneumatic operation.*

ALTERNATE TRAILING EDGE FLAPS

Trailing Edge Flaps	ARM	F/O
Extension:		
Flap Lever	LANDING FLAPS	F/O

- Observe placard 160 KIAS while extending from 25 to 30 positions.

Alternate Flap Extension	COMPLETE	F/O
Retraction:		
Flap Lever	UP DETENT	F/O
Alternate Flap Retraction	COMPLETE	F/O
Trailing Edge Flaps	OFF	F/O

ALTERNATE LANDING GEAR EXTENSION

Gear Lever	OFF	F/O
Alternate Gear Extend Switches	HOLD IN EXT 5-10 SECONDS THEN ARM	F/O
Gear Lever	DOWN	F/O

- *Maximum airspeed 270 KIAS, with doors open.*

CONTROLLABILITY WITH ALL ENGINES WINDMILLING

- *Minimum airspeed 160 KIAS or maneuvering speed for flap setting which ever is greater.*
- *Do not attempt to operate flaps or landing gear.*

RAPID DEPRESSURIZATION

Oxygen Masks & Regulators	ON, 100%	ALL
Crew Communications	ESTABLISH	ALL
Isolation Valve (either)	CLOSE	F/E
Pack Valves	OPEN	F/E
Outflow Valves	CLOSE	F/E
Emergency Descent (if required)	INITIATE	C
Passenger Oxygen (if required)	ON	F/E
Cabin Signs	ON	C
PA Announcement	IF REQUIRED	F/O

EMERGENCY DESCENT

Ignition	FLT START	F/E
Thrust Levers	CLOSE	C
Speed Brakes	FLIGHT DETENT	C
Landing Gear (On Placard Speed)	DOWN	C
Autopilot	DISENGAGE	C
Descent	INITIATE	C
Target Speed	M.82 OR 320 KIAS	C

WING OVERHEAT

Isolation Valve	CLOSE	F/E
Bleed Air Valves	CLOSE	F/E

If Overheat Light Extinguishes:
- Use ALTERNATE LEADING EDGE FLAP OPERATION checklist.

If overheat continues after 5 minutes and flight conditions permit:
Engine Thrust Settings (affected side). . .REDUCE ONE ENGINE AT A TIME TO IDLE FOR 5 MINUTES

If overheat is isolated to one engine strut area:
- Restore pneumatic pressure to remainder of system.

If overheat cannot be isolated:
- Leave isolation and bleed air valves closed.
- Reducing thrust settings will lower any possibility of strut damage.
- Use ALTERNATE LEADING EDGE FLAP OPERATION checklist. Initiate L.E. Extension/Retraction with T.E. flaps UP.
- Complete NORMAL DESCENT-APPROACH and LANDING checklists.

DUCT PRESSURE LOW

Isolation Valves	CLOSE	F/E

If both duct pressures return to normal:

No. 2 Pack Valve	CLOSE	F/E

If one duct pressure remains low:

Isolation Valve (normal side)	OPEN	F/E
Bleed Air Valves (low side)	CLOSE	F/E
Pack Valve (low side)	CLOSE	F/E

- Use ALTERNATE LEADING EDGE FLAP OPERATION checklist. Initiate L.E. Extension/Retraction with T.E. flaps UP.
- Complete NORMAL DESCENT-APPROACH and LANDING checklists.

LOSS OF EQUIPMENT COOLING

(NO AIRFLOW LIGHT ILLUMINATED)

Blower Selector	ALTERNATE	F/E
No Airflow Light	RESET	F/E

If no airflow light remains illuminated or reilluminates:

Equipment Cooling Valve	SMOKE	F/E
TR Unit Loads	MAX 54 AMPS	F/E

- *Continue flight with no airflow light illuminated.*

PACK(S) TRIP

Pack Selector Switch	PRESS	F/E
ACM Outlet and Compressor Discharge Temperatures	MONITOR	F/E
Bypass, Inlet and Exit Door Indications	CHECK	F/E

If door and bypass valve positions and pack temperatures are normal:

Pack Reset Switch	PRESS	F/E

If pack fails to reset, retrips, or door and bypass valve positions not normal:

Pack Control Switch	MAN	F/E
Turbine Bypass Valve	POSITION MID RANGE	F/E
Exit and Inlet Doors	CHECK FULL COOL	F/E

- *If exit and inlet doors not in full COOL position discontinue procedure for the affected pack. Close pack valve and position inlet door to full heat.*

Pack Reset Switch	PRESS	F/E
Manual Temperature Switch	AS REQUIRED	F/E
Pack Control Switch	AUTO	F/E

If pack still fails to reset & pack operation is required:

Pack Valve CB (P-12 panel)	PULL	F/E

- PACK TRIP PROTECTION IS DEACTIVATED:

Pack Control Switch	AUTO/MAN	F/E

- RESET PACK TRIP PROTECTION:

Pack Reset CB (P-12 panel)	PULL	F/E
Master Dim and Test Switch	TEST	F/E
Pack Reset CB (P-12 panel)	RESET	F/E

- *If pack trip light extinguishes reset PACK VALVE CB and use AUTO pack control.*

AUTO PRESSURIZATION CONTROL FAILURE

If auto fail warning light illuminated:

Pressurization Mode Switch	MOMENTARILY TO MAN THEN AUTO	F/E

If auto pressurization system does not operate normally:

Pressurization Mode Switch	MAN	F/E
Outflow Valve Manual Control Switches	AS REQUIRED	F/E

APU FIRE

APU Fire Switch	PULL	F/E
Fire Bottle	DISCHARGE	F/E

WHEEL WELL FIRE

Landing Gear and Doors	DOWN & OPEN	F/O, F/E

LOWER FWD CARGO FIRE

Compartment Selector	FWD	F/E
Fire Bottle No. 1	DISCHARGE	F/E
Airplane Altitude	MEA, 14,000 FT OR BELOW	C
Air Conditioning Packs	MAX ONE ON	F/E
Zone 1 Recirculating Fan	CHECK OFF	F/E
Pressurization Mode	MAN	F/E
Cabin Altitude	EQUAL TO AIRPLANE	F/E
Outflow Valves	MINIMUM OPEN	F/E
After one hour:		
Fire Bottle No. 2	DISCHARGE	F/E

LOWER AFT CARGO FIRE

Compartment Selector	AFT	F/E
Fire Bottle No. 1	DISCHARGE	F/E
Airplane Altitude	23,000 FT	C
Cabin Altitude	10,000 FT	F/E
Air Conditioning Packs	MAX ONE ON	F/E
Equipment Cooling Valve	SMOKE	F/E
After one hour:		
Fire Bottle No. 2	DISCHARGE	F/E

AIR CONDITIONING SMOKE

Oxygen Masks and Regulators (if required)	ON, 100%	ALL
Crew Communication	ESTABLISH	ALL
Smoke Goggles (if required)	ON	ALL
If APU operating:		
Pack Valve 2	CLOSE	F/E
• *Shutdown APU and restore air conditioning in accordance with normal procedure for inflight use of APU.*		
Cabin Altitude (Max 10,000 Ft)	INCREASE	F/E
Pressurization Rate (if required)	INCREASE	F/E
Gasper and Recirculating Fans	OFF	F/E
Upper Deck Heat	OFF	F/E
Pack Valve (overheated pack)	CLOSE	F/E
If smoke continues:		
Bleed Air Valves 1 and 2	CLOSE	F/E
Pack Valve 1	CLOSE	F/E
If smoke continues:		
Bleed Air and Pack Valves	OPEN	F/E
Bleed Air Valves 3 and 4	CLOSE	F/E
Pack Valve 3	CLOSE	F/E
If smoke continues:		
Bleed Air and Pack Valves	OPEN	F/E
Pack Valve 2	CLOSE	F/E

COCKPIT SMOKE EVACUATION

Oxygen Masks and Regulators (if required)	ON, 100%	ALL
Crew Communications	ESTABLISH	ALL
Smoke Goggles (if required)	ON	ALL
Cabin Altitude (Max 10,000 Ft)	INCREASE	F/E
Pressurization Rate (if required)	INCREASE	F/E
Bleed Air Valves	OPEN	F/E
Isolation Valves	OPEN	F/E
Pack Valves	OPEN	F/E
If smoke persists or is severe:		
Smoke Evacuation Port	OPEN	F/E
If unpressurized:		
Crew Escape Hatch (below 200 KIAS)	OPEN	F/E

2 ENGINES INOPERATIVE

- *Complete ENGINE FIRE or ENGINE FAILURE/ SHUTDOWN Checklist.*
- *Complete 1 or 2 GENERATORS INOPERATIVE Checklist.*

Air Conditioning Packs	MAX ONE ON	F/E
Fuel Jettison (if required)	COMPLETE	F/E

DESCENT-APPROACH

Pressurization	SET	F/E
Landing Data	V_{REF} +5 BUGS SET	ALL
Fuel	SET FOR LANDING	F/E
Annunciator Panels	CHECKED	F/E
Altimeters	SET & X-CHECKED	ALL
Radios & Nav. Instruments	SET & X-CHECKED	C, F/O
Radio Altimeters	SET	C, F/O
2 Engine Inoperative Go-Around Procedure	REVIEW	ALL
DESCENT-APPROACH Checklist	COMPLETE	F/E

LANDING

Ignition	FLT START	F/E
Cabin Signs	ON	F/O
Speed Brakes	ARM	C
Landing Gear	DOWN, IN, GREEN LIGHT	C
Flaps	25, 25, BLUE LIGHT	C
Hydraulics	NORMAL	F/E
Rudder Trim (prior to touchdown)	ZERO	F/O
LANDING Checklist	COMPLETE	F/E

2 ENGINES INOPERATIVE GO-AROUND REVIEW

Thrust	GO-AROUND
Flaps	RETRACT TO FLAPS 1 ON SCHEDULE

- *DO NOT ATTEMPT TO GO-AROUND AFTER THE LANDING GEAR IS EXTENDED.*

OVERWEIGHT LANDING

- *Avoid bank angles greater than 30° when using normal landing flaps.*

PASSENGER EVACUATION (LAND)

- *Advise Flight Attendant(s)/Passengers Intent to Evacuate*

Tower/Ground Crew	NOTIFY	F/O
Parking Brakes	SET	C
Outflow Valves	OPEN	F/E
Speed Brake Lever	DOWN	C
Start Levers	CUTOFF	C
Engine Fire Switches	PULL	F/E
Fire Bottles	DISCHARGE	F/E
Emergency Lights	ON	F/O
Flight Attendant(s)/Passengers	NOTIFIED	C
APU Fire Switch	PULL	F/E
Fire Bottle	DISCHARGE	F/E
Battery	OFF	F/E

- *Crew and Passengers Evacuate Airplane*

DITCHING

- *Advise Crew Intent to Ditch*
- *Send Distress Signals*
- *Reviewing Ditching Procedure, Brief Crew and Brief Passengers*
- *Jettison Fuel*
- *Depressurize Cabin*
- *Pull Ditching Handles at No. 3 Doors and Place Mode Selector Handles for other Doors in MANUAL*

Landing Data	BUGS SET	ALL
Pack Valves	CLOSE	F/E
Outflow Valves	CLOSE	F/E
Equipment Cooling Valve	DITCH	F/E
Battery	ON	F/E
Vest, Harness, and Belt	SECURE	ALL
Landing Gear	UP	C
Aural Warn CB, (P6)	PULL	F/E
Cabin Signs	ON	F/O
Emergency Lights	ON	F/O
F/E Gives Checklist to F/O and Assumes Ditching Station		F/E
Flaps	.30, 30, BLUE LIGHT	F/O
PA Announcement	ACCOMPLISH	F/O
Start Levers	CUTOFF	F/O
Engine Fire Switches	PULL	F/O
Fire Bottles	DISCHARGE	F/O

- *Crew and Passengers Evacuate Airplane*

JAMMED STABILIZER LANDING

- *Maintain in-trim airspeed.*
- *Set airspeed bugs at V_{REF} + 20 for landing.*
- *Use flaps 25 for landing.*
- *Complete NORMAL DESCENT-APPROACH and LANDING Checklists.*

MINIMUM FUEL GO-AROUND

When a go-around is made with minimum fuel in any main tank.

All Main Tank Boost Pumps	ON	F/E
All Crossfeed Valves	OPEN	F/E

- *Avoid nose high attitude.*

PARTIAL MAIN GEAR LANDING

- *Complete ALTERNATE LANDING GEAR EXTENSION checklist.*

If Body Gear Not Extended:
(Land on available Gear)

Aural Warn Circuit Breaker (P-6)	PULL	F/E

- *If neither body gear is extended the airplane may trip tail down when on the ground.*
- *Complete NORMAL DESCENT-APPROACH and LANDING Checklists.*
- *Do not activate Body Gear Steering.*

If One Wing Gear Not Extended:
(Retract both wing gear)

Gear Lever	DOWN	F/O
Hydraulic System 1	DEPRESSURIZE	F/E
Gear Lever	UP	F/O
Gear Lever	OFF	F/O
Hydraulic System 1	PRESSURIZE	F/E
Hydraulic System 4	DEPRESSURIZE	F/E
Gear Lever	DOWN, IN	C, F/O
Body & Nose Gear	DOWN, GREEN LIGHTS	C, F/E

- *Right Outboard Elevator Inoperative*
- *Spoilers Inoperative as Placarded*
- *Alternate Trailing Edge Flaps extension required.*
- *PRIM SYS 4 brake source inoperative.*

DESCENT-APPROACH

Pressurization	SET	F/E
Landing Data	BUGS SET	ALL
Fuel	SET FOR LANDING	F/E
Annunciator Panels	CHECKED	F/E
Altimeters	SET & X-CHECKED	ALL
Radio & Nav Instruments	SET & X-CHECKED	C, F/O
Radio Altimeters	SET	C, F/O
Aural Warn Circuit Breaker (P-6)	PULL	F/E
Alternate T.E. Flaps	ARM	F/O
Flap Lever	LANDING FLAPS	F/O

- Observe placard 160 KIAS while extending from 25 to 30 positions.

Alternate T.E. Flaps	EXTEND ON SCHEDULE	F/O
DESCENT-APPROACH Checklist	COMPLETE	F/E

LANDING

Ignition	FLT START	F/E
Cabin Signs	ON	F/O
Speed Brakes	ARM	C
Flaps	——, ——, BLUE LIGHT	C
Normal Brake Source	SEC SYS 1	F/E
Hydraulics (Operative Systems)	NORMAL	F/O
LANDING Checklist	COMPLETE	F/E

CHAPTER 4

NORMAL CHECKLIST

BOEING 747-151

BEFORE START

Cockpit Preparation Procedures . . . COMPLETE
Oxygen Mask & Quantity . . . . . CHECKED
Flight Control Power Switches . . . . . ON
Stall Warning . . . . . NORMAL
INS Mode . . . . . NAV
Emergency Lights . . . . . ARMED
Cabin Signs . . . . . ON
Window Heat . . . . . ON
Probe Heat . . . . . PITOTS ONLY
Radios, Clocks & Altimeters . . . . . SET
Airspeed . . . . . BUGS SET
EPR . . . . . BUGS SET

• For pushback only
No. 1 Air Pump . . . . . AUTO

Parking Brakes & Pressure . . . SET & NORMAL
Start Levers . . . . . CUTOFF
Gear Pins . . . . . REMOVED
Galley Power . . . . . OFF
Fuel . . . . . ——— LBS., SET FOR START
Pressurization . . . . . AUTO
Pack Valves . . . . . ONE OPEN
Air Pumps . . . . . OFF
Start Pressure . . . . . ——— PSI
Cargo Doors . . . . . BOTH CLOSED
Before Start Checklist . . . . . COMPLETE

AFTER START

Aileron & Rudder Trim . . . . . ZERO
Electrical . . . . . NO LIGHTS, ESSENTIAL NORMAL
Hydraulics . . . . . AUTO & NORMAL
Doors . . . . . CLOSED
Ground Equipment . . . . . CLEARED
After Start Checklist . . . . . COMPLETE

BEFORE TAKEOFF

Nacelle Anti-Ice . . . . . AS REQUIRED
Flight & Nav Instruments . . . . . ALIGNED, NO FLAGS
Flaps . . . . . ——— ——— BLUE LIGHT
Flight Controls . . . . . CHECKED
Stabilizer Trim . . . . . ——— UNITS SET
Galley Power . . . . . ON
APU . . . . . AS REQUIRED
Fuel . . . . . SET FOR TAKEOFF
Air Conditioning & Pressurization . . . . . SET & AUTO
Annunciator Lights . . . . . CHECKED
Ignition . . . . . FLIGHT START
Transponder . . . . . ON
Anti-Skid . . . . . ON
Body Gear Steering . . . . . DISARM
Before Takeoff Checklist . . . . . COMPLETE

AFTER TAKEOFF

Ignition . . . . . AS REQUIRED
Cabin Signs . . . . . AS REQUIRED
Landing Lights . . . . . OFF
Probe Heat . . . . . ON
Landing Gear . . . . . UP, NO LIGHTS & OFF
Flaps . . . . . UP & NO LIGHTS

Isolation Valves . . . . . BOTH OPEN
APU . . . . . SHUTDOWN
APU Bleed Air Switch . . . . . CLOSE
After Takeoff Checklist . . . . . COMPLETE

• Items below line required only if APU is used on takeoff.

NORMAL CHECKLIST

BOEING 747-151

DESCENT-APPROACH

Pressurization . . . . . SET
Landing Data . . . . . BUGS SET
Fuel. . . . . SET FOR LANDING
Annunciator Lights. . . . . CHECKED
Altimeters. . . . . SET & X-CHECKED
Radios & Nav
Instruments . . . . . SET & X-CHECKED
Radio Altimeters . . . . . SET
Descent-Approach Checklist. . . . . COMPLETE

LANDING

Ignition . . . . . FLIGHT START
Cabin Signs. . . . . ON
Speed Brakes. . . . . ARMED
Landing Gear . . . . DOWN, IN, GREEN LIGHT
Flaps . . . . . ——— ——— BLUE LIGHT
Hydraulics . . . . . NORMAL
Landing Checklist. . . . . COMPLETE

AFTER LANDING

Outflow Valves . . . . . OPEN
Galley Power. . . . . OFF
Electrical . . . . . ON APU
Ignition . . . . . OFF
Anti-Skid . . . . . OFF
Body Gear Steering . . . . . ARM
Speed Brakes. . . . . DOWN, DETENT
Flaps . . . . . UP, NO LIGHTS
Radar, Transponder, DME . . . . STANDBY/OFF
After Landing Checklist. . . . . COMPLETE

SHUTDOWN

Parking Brakes. . . . . SET
Start Levers . . . . . CUTOFF
Seat Belt. . . . . OFF
Window Heat . . . . . OFF
Probe Heat . . . . . OFF
Exterior Lights . . . . . AS REQUIRED
Air Conditioning . . . . . AS REQUIRED
Air Pumps. . . . . OFF
Reserve Fuel Transfer Switches. . . . . CLOSED
Oxygen Regulators. . . . . 100%, OFF

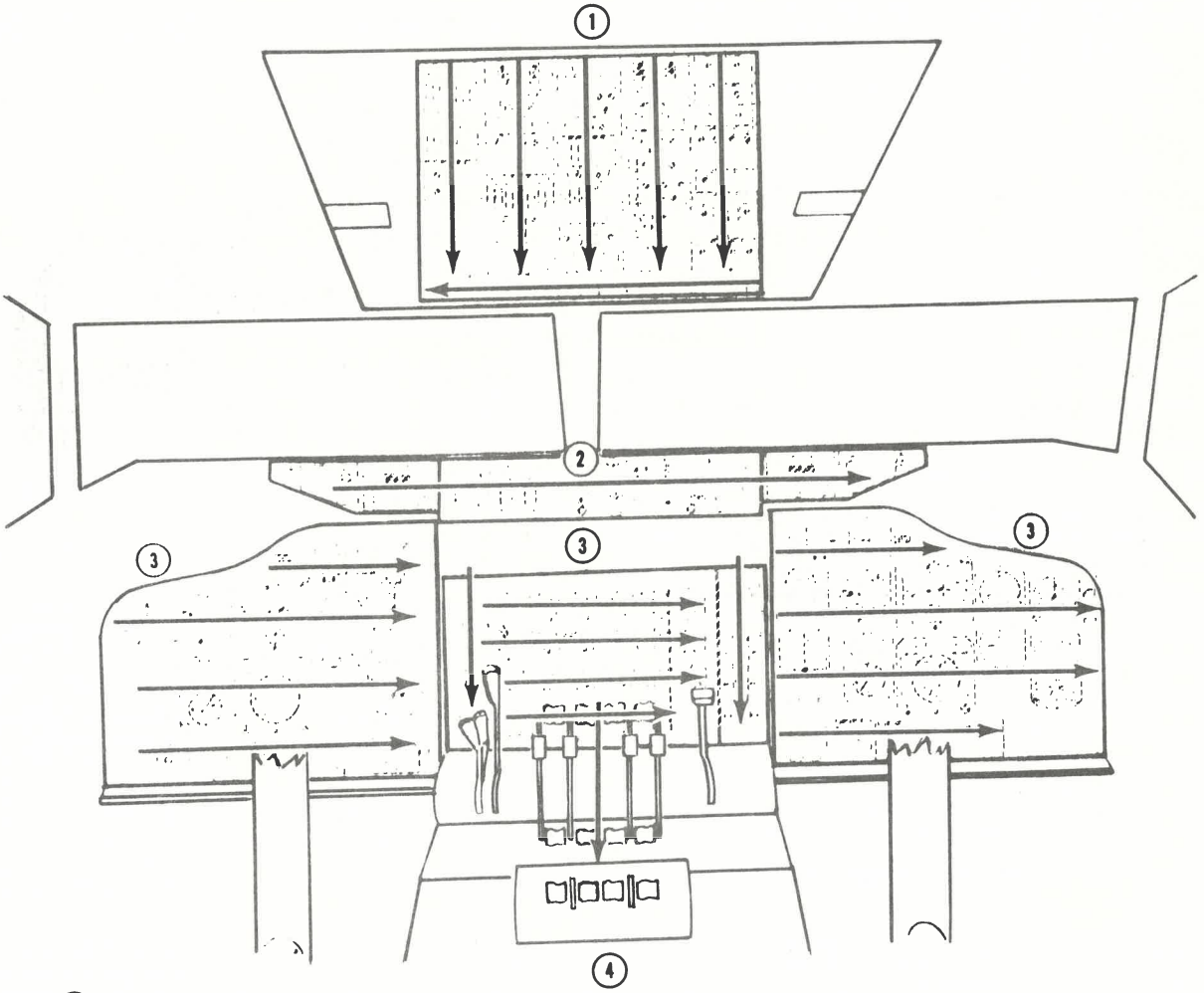
INS Mode . . . . . OFF
Emergency Lights. . . . . OFF
Oxygen Valve . . . . . CLOSED
APU . . . . . OFF
Battery. . . . . OFF
Shutdown Checklist . . . . . COMPLETE

•Items below line not required on through flights.

NORMAL PROCEDURES

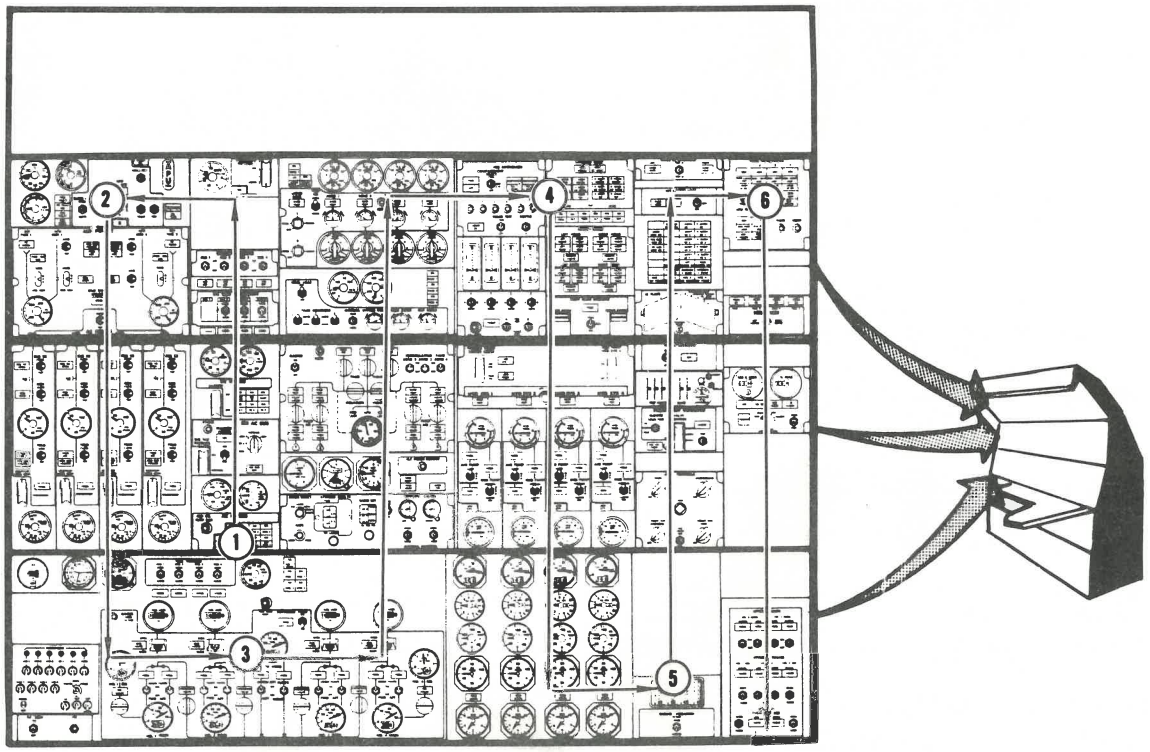
The following normal procedures are the recommended actions necessary to operate the airplane. Each phase of flight (PRE-FLIGHT, BEFORE START, etc) follows a standardized "scan" of the cockpit panels or equipment. Besides standardization, this "scan" (1) enables the flight crew to more readily memorize the required items, (2) ensures that all necessary actions have been taken, and (3) minimizes the time required.

Normal procedures for each phase of flight are performed by recall (memory). Following this, the challenge and response NORMAL CHECKLIST is read to ascertain that all safety items have been accomplished. Procedures not related to a specific phase of flight will be found in the appropriate systems chapter.



1. OVERHEAD PANEL
2. LIGHTSHIELD
3. INSTRUMENT PANELS
4. FORWARD ELECTRONIC, CONTROL STAND, AND AFT ELECTRONIC PANELS

PILOTS' PANEL "SCAN" SEQUENCE



The Flight Engineer's panel scan for all phases of flight is as shown.

F/E'S PANEL "SCAN" SEQUENCE

EXTERNAL SAFETY INSPECTION - F/E

This inspection is performed on each originating trip or crew change before entering the airplane to ascertain that no obviously unsafe conditions exist.

Chocks.....IN PLACE
Landing Gear Doors.....CHECK

WARNING: WHEN ANY GEAR DOOR IS OPEN CHECK THAT RESPECTIVE DOOR RELEASE HANDLE IS IN "DOORS OPEN" POSITION. IF HANDLE IS IN "DOORS CLOSED" POSITION AND DOORS ARE OPEN, PRESSURIZING NO. 1 OR 4 HYDRAULIC SYSTEMS WILL CLOSE DOORS AND CAN RESULT IN PERSONNEL INJURY.

APU Ground Control Panel...CHECK
Check fire control handle up.
APU Fuel
Line Shroud Drain.....CHECK
Check that there is no fuel leaking from the drain.
Flight Control
Surface Areas.....CLEAR
APU Exhaust Area.....CLEAR
APU Fire
Bottle Discharge Disc.....CHECK
Check disc intact.

COCKPIT SAFETY INSPECTION - F/E

This inspection is performed on each originating trip or crew change, only when electrical and/or pneumatic power is not applied to the airplane, to ascertain that they may be applied safely.

Windshield Wiper Switches....OFF
Alternate Flap Switches.....OFF
Landing Gear Lever.....DN & IN
Radar.....OFF
Transponder Mode Switch.....OFF
Galley Power Bus Switches....OFF
Upper Deck
Temperature Switches.....OFF
Electric & Air Driven
Hydraulic Pump Switches.....OFF
Fuel Jettison
Panel Cover.....CLOSED

PRELIMINARY COCKPIT PREPARATION - F/E

This inspection is performed to activate those components necessary to permit accomplishment of individual control cabin and exterior preparation procedures.

All asterisk (*) items are to be accomplished at transit stops when no crew change is involved.

F/E'S STATION

*Circuit Breakers.....CHECK
Standby Power Switch.....OFF
*Battery Switch.....ON
DC Meters Switch.....APU BATT
APU Master Switch.....ON
APU Fire
Warning and Squib.....CHECK
Check APU fire switch in, position indicator out of view, and APU fire bottle DISCHARGE light extinguished.

Hold the APU squib test switch to SQUIB TEST; check that SQUIB OK light illuminates.

NOTE: On earlier airplanes the squib will not test on battery power only.

Check APU fire detector switch in BOTH.

Hold the APU fire/fault test "A" switch to FIRE TEST; check that both master fire warning lights, APU fire detection light, and the APU fire switch illuminate and the fire warning bell sounds.

PRELIMINARY COCKPIT PREPARATION - F/E (CONT)

APU Fire Warning and Squib (Cont)

- Repeat procedure with the APU fire/fault test "B" switch.

Hold the APU fire/fault test "A" and "B" switches to FAULT TEST; check that "A" and "B" fire detection system fault lights illuminate.

APU Oil Quantity.....GREEN BAND

APU Bleed Air Switch.....CLOSE

APU.....START

Check GEN BRG FAILURE light extinguished.

APU or External Electrical Power.....ESTABLISH

Equipment Cooling.....CHECK

Check NO AIR FLOW light extinguished. If illuminated, push reset switch and check that light extinguishes.

INS Battery Parallel Switch.....NORMAL

Standby and Essential Power.....CHECK & NORMAL

Place standby power switch to ON. Check that standby power ON light illuminates and warning flags on N1 and EGT are out of view. Return standby power switch to OFF. Check that power ON light extinguishes.

Check essential power switch NORMAL and both ESS BUS OFF lights extinguished.

Main DC Power.....CHECK

Press all DC meters switches one at a time; check DC voltage and amperage meters (25-30 volts and positive amps indication).

DC Bus Isolation Switches..CLOSE

Check all isolation relay OPEN lights extinguished.

Air Conditioning and Pneumatic Systems...CHECK & SET

Place the APU bleed air switch to OPEN.

Check that duct isolation valve switches are open and duct pressure is normal on both L and R indicators.

Place No. 1 recirculating fan switch OFF (if installed) and Nos. 2, 3 and 4 switches ON.

Check all pack control switches in AUTO.

NOTE: If pack switches are placed from MAN to AUTO, wait 30 seconds before placing pack valve switches to open.

Check zone temperature switches in AUTO and check that at least one trim air indicator does not indicate full HEAT. Check OVERHEAT lights extinguished.

Place trim air switch to OPEN and gasper fan switch as desired.

Press No. 1 pack selector switch; check bypass valve in mid or full HEAT position and inlet and exit doors in full COOL position.

Place No. 1 pack valve switch to open and check PACK TRIP light extinguished.

Repeat the above two steps for No. 2 and No. 3 packs.

Check that all pack ACM and compressor discharge temperatures show normal pack operation.

Place upper deck heat switches as desired.

PRELIMINARY COCKPIT PREPARATION - F/E (CONT)

PILOTS' STATION

*Forward and Overhead Panel Indicating Lights.....TEST
Check all pilots' indicator lights illuminated except flight director/autopilot approach display lights, marker beacon and INS modules.
*Radio Master Bus Switches.....ON
INS Systems.....ALIGN & LOAD

NOTE: The airplane must not be towed or taxied during INS alignment.

Place each INS mode selector switch to ALIGN.

Adjust dim switch on each INS data selector switch to desired intensity; check that INSERT switch is illuminated and FROM-TO indicates 12 on each module.

Test INS Circuits Status:
- Press TEST switch; check that all INS lights (except keyboard & CLEAR lights) illuminate, figure eight (8) appears in all digit positions of both data indicators, directional letters (NS) appear in the left indicator, directional letters (EW) appear in the right indicator, and FROM-TO indicates 88. Also check that INS ready/navigate and battery lights on their respective INS mode selector modules illuminate.
  - Repeat test on each module.

Check INS Malfunctions:
- Red WARN light on each control display module and red BAT light on each mode selector module should be extinguished. A ten second period of illumination of the amber BAT light on the control display modules during align mode indicates that battery power is operating normally.

Load INS Field Position Data:
- Place data selector switch to POS.
- Press keyboard switch for north (N2) or south (8S) latitude as required.
- Press keyboard switches in sequence for present position latitude and check correct latitude in left data indicator.
- Press INSERT switch and check that present latitude remains in left data indicator.
- Press keyboard switch for east (6E) or west (W4) longitude as required.
- Press keyboard switches in sequence for present position longitude and check correct longitude in right data indicator.
- Press INSERT switch and check insert light extinguishes and new present position data, latitude and longitude, appear in left and right data indicators.
  - Repeat for each INS module.

Insert INS Performance Index:
- Place data selector switch to DSRTK/STS.
- The left data indicator will display 225° until waypoints have been loaded.

PRELIMINARY COCKPIT PREPARATION - F/E (CONT)

INS Systems (Cont)

- The far right digit of the right data indicator will show a "5" if a post-flight-present-position-up-date has been accomplished by the previous crew. The far right digit of the right data indicator will show a "4" if a post-flight-present-position-up-date has not been accomplished by the previous crew.

- If desired performance index is not displayed, press keyboard switch for desired performance index.
- Press INSERT switch and check INSERT light extinguishes and desired performance number appears in right-hand digit of right data indicator.
  - Repeat for each INS module.

*Stall Warning.....TEST & NORM
Place switch to TEST; check that PWR OFF light extinguishes, test indicator disc rotates, and stick shaker vibrates.

Release switch; check that PWR OFF light illuminates, indicator disc and stick shaker action stops.

*Mach/Airspeed Warning.....TEST
Place switch to TEST; check that clacker sounds.

*Over Rotation Warning.....TEST
Place switch to TEST; check that stick shaker vibrates.

Wheel Well Fire Detector....TEST
Press test switch; check that WHEEL WELL fire detection light and master FIRE warning lights illuminate and fire warning bell sounds.

Cockpit Voice Recorder.....TEST
Press test switch; check that meter needle fluctuates in green band.

Emergency Lights.....OFF
Check UNARMED light illuminated.

*No Smoking, Fasten Seat Belts and Exit Lights.....ON
Check that ON lights illuminate.

Wing Anti-Ice Switch.....GRD TEST & OFF
Hold switch to GRD TEST; check that left and right wing anti-ice VALVE lights illuminate (in transit), then extinguish (valves open).

Release switch to OFF; check that VALVE lights illuminate (in transit), then extinguish (valves closed).

Window Heat.....CHECK & OFF
Place window heat switches ON.

Press POWER LIGHTS switch; check that all window heat POWER lights illuminate. If POWER lights L1 and R1 do not illuminate, momentarily press the POWER TEST switch and check that POWER TEST and POWER lights L1 and R1 illuminate.

Press OVHT TEST switch; check that POWER lights L1 and R1 extinguish and WINDOW 1 OVHT annunciator light (on F/E door annunciator module) illuminates.

PRELIMINARY COCKPIT PREPARATION - F/E (CONT)

Window Heat (Cont)

Place window heat switches left 1 and right 1 to OVRD (if installed); check that window heat POWER lights L1 and R1 illuminate.

Place all window heat switches OFF.

Probe Heat.....CHECK & OFF
Place both probe heat switches ON.

Individually press aux pitots, temp probes and main pitots switches and check for indication on both meters.

Place both probe heat switches OFF.

Wing and Navigation Lights Switches.....ON

Engine Instruments.....NORMAL
Check that power failure flags are not visible and maximum indication lights are extinguished.

*Annunciator Lights.....CHECK
Lights must correspond to systems status.

Total Air/Static Air Temperatures.....CHECK
Check that failure warning flags are not visible and temperatures are comparable.

Takeoff Warning Horn.....CHECK
With flaps or stabilizer set out of takeoff range, body gear not centered or speed brake lever out of down detent advance No. 3 thrust lever until warning horn sounds.

TAT/EPRL System.....CHECK
Check warning flags out of view. Press each mode selector switch in conjunction with test switch; check that ON portion of switches illuminate and that placarded test value for the selected mode appears in the EPRL window (Captain's panel).

F/E'S STATION

Crew Oxygen Control Valve...OPEN
Check that pressure is within green band.

*F/E Panel Indicator Lights.....TEST
Check that all indicator lights illuminate.

*Galley Power Bus Switches.....ON
Check TRIP OFF lights extinguished. Check that electrical load limits are not exceeded.

*Crew and Passenger Oxygen...CHECK & NORM
Check crew and passenger oxygen pressure adequate for flight, passenger oxygen switch NORM (guarded) and ON light extinguished.

*AC Electrical System.....SET FOR START
Check all GEN OPEN lights illuminated, KW load meters indicate zero, FIELD OFF lights extinguished, GEN BRG FAILURE lights extinguished, CSD oil low PRESS lights illuminated, CSD disconnect switch guards down and safetied, and CSD oil temperature indications normal.

TAT Indicator.....CHECK
Check that failure warning flag is not visible and temperature is comparable to Captain's indicator.

F/E Clock.....SET

Fuel System.....CHECK & SET
Press the fuel quantity test switch; check that all fuel quantity indicator needles and digital indicators move toward zero.

PRELIMINARY COCKPIT PREPARATION - F/E (CONT)

Fuel System (Cont)

Release test switch; check that all indicators return to original indication.

Check total fuel weight indicator to insure that requested fuel is on board.

Place all forward boost pump and left override/jettison pump switces ON; check that all forward boost pump and left override/jettison pump low PRESS lights extinguish and all aft boost pump and right override/jettison pump low PRESS lights remain illuminated.

NOTE: If APU is operating and No. 2 main aft boost pump switch is OFF, its low PRESS light will remain extinguished.

Place all forward boost pump and left override/jettison pump switches OFF; check that all boost pump and override/jettison pump low PRESS lights illuminate.
- Repeat procedure for all aft boost pumps and right override/jettison pumps.

Place each reserve fuel transfer switch to open; check that RES VALVE lights illuminate (in transit), then extinguish (valves open).

Place each reserve fuel transfer switch to close; check that RES VALVE lights illuminate (in transit), then extinguish (valves closed).

Place each fuel crossfeed switch to open; check that CROSSFEED VALVE lights illuminate (in transit), then extinguish (valves open).

Place No. 2 and 3 crossfeed switches to close; check that CROSSFEED VALVE lights illuminate (in transit), then extinguish (valves closed).

Check that engine fuel shutoff switches are OPEN (guarded) and ENG VALVE lights are illuminated.

Check fuel heat switches in CLOSE position.

Place scavenge pump switch ON; check that scavenge pump low PRESS light extinguishes. (Light may illuminate momentarily.)

Place scavenge pump switch OFF.

Press NO. 1 MAIN fuel temperature indicator switch; check that ON light illuminates. Check fuel temperature appropriate for prevailing conditions.

Cabin Altitude Control Module.....CHECK & SET

*Set pressurization rate selector to the index.

*Set flight/cabin altitude indicator to 1000 ft above cruise on FLT scale.

*Set 29.92 on BARO SET indicator and cabin altimeter.

Check pressurization mode switch in AUTO.

PRELIMINARY COCKPIT PREPARATION - F/E (CONT)

Cabin Altitude Control Module (Cont)

Press and hold rate limit test switch. Check that outflow valve indicators move toward the closed position and the AUTO FAIL light illuminates.

Place pressurization mode switch to MAN. Check that outflow valve movement stops and AUTO FAIL light extinguishes.

Place pressurization mode switch to AUTO then release rate limit test switch. Check that AUTO FAIL light illuminates and that outflow valve indicators move toward the open position.

Reset system by placing pressurization mode switch to MAN. Check that AUTO FAIL light extinguishes.

Place pressurization mode switch to AUTO.

* Pneumatic Systems....CHECK & SET
Place all engine bleed air switches in open position. Check all VALVE CLOSED lights illuminated, all HIGH STAGE, PRESS RELIEF and OVERHEAT lights extinguished.

Air Conditioning.....CHECK
Check that all pack ACM and compressor discharge temperatures are comparable and in the normal range.

Lower Cargo Fire Protection.....CHECK
Check compartment select switch OFF, bottle 1 and 2 DISCHARGE lights extinguished and discharge switch guards down.

Press FWD 1 detector test switch; check that FWD and LWR CARGO fire warning lights and master FIRE warning lights illuminate and fire warning bell sounds.
- Repeat procedure with FWD 2 detector test switch.

Press AFT 3 detector test switch; check that AFT and LWR CARGO fire warning lights and master FIRE warning lights illuminate and fire warning bell sounds.
- Repeat procedure with AFT 4, 5 and 6 detector test switches.

Place squib test switch to FWD; check that SQUIB OK light illuminates when squib test bottle switch is placed to BOTTLE 1 and BOTTLE 2 position.
- Repeat procedure with squib test switch in AFT position.

Engine Fire Detection and Nacelle Temperature Indication.....TEST
Check all engine fire switches in, position indicators out of view, and all fire bottle DISCHARGE lights extinguished.

Check all nacelle fire detector switches in BOTH.

Place "A" switch to FIRE TEST and "B" switch to FAULT TEST; check that all nacelle temperature indications are in the red band and that the FAULT, master FIRE warning lights and engine fire switches illuminate and the fire warning bell sounds.

PRELIMINARY COCKPIT PREPARATION - F/E (CONT)

Engine Fire Detection and Nacelle Temperature Indication (Cont)

Release test switches; check that fire and fault indications cease.

Repeat procedure with "A" switch to FAULT TEST and "B" switch to FIRE TEST.

Landing Gear Annunciator Module.....CHECK

Press gear and tilt PRIM landing gear annunciator switches; check that appropriate annunciator lights illuminate.

Press door PRIM landing gear annunciator switch; check that annunciator lights agree with door positions noted during the exterior safety inspection.

- Repeat procedure using ALT landing gear annunciator switches.

Body Gear Steering.....CHECK

Check body gear steering PRESS light and left and right body UNLOCKED lights extinguished.

* Hydraulic System.....SET

Check normal brake source select switch in PRIM SYS 4 (guarded) position, SEC SYS 1 light extinguished, brake LOW PRESS light and brake source LOW PRESS light (forward electronic's panel) are illuminated.

Press hydraulic quantity test switch; check that all hydraulic quantity indicator needles drive toward zero and return to original setting when switch is released. Check that all HYD QTY indicators are within the green band and hydraulic LOW QTY lights are extinguished. Check all hydraulic system OVERHEAT lights extinguished.

Check all engine driven hydraulic pump switches NORMAL and all hydraulic low PRESS lights illuminated.

Engine Instruments.....NORMAL

Check that power failure flags are not visible.

*Oil System.....CHECK

Check oil pressures zero, oil temperatures normal, oil quantities adequate for flight, FILTER BYPASS lights extinguished and engine breather indications zero.

Engine Vibration Indicators.....ZERO

Equipment Cooling System.....CHECK & NORM

Check blower switch NORM, NO AIR FLOW light extinguished and equipment cooling valve switch NORM (guarded).

Hold smoke detector test switch to TEST; check that SMOKE detector light illuminates. Release switch and check that SMOKE detector light extinguishes.

PRELIMINARY COCKPIT PREPARATION - F/E (CONT)

Flight Recorder.....CHECK
Place flight recorder switch ON; check that OFF light extinguishes.

Set trip number and date in encoder.

Place flight recorder switch OFF; check that OFF light illuminates.

Leading Edge Flap Indicator Module.....CHECK
Check that leading edge flap position lights agree with leading edge flap positions.

Door Annunciator Module....CHECK
Lights must correspond to system status. (Not necessary to check status of doors at this time.)

Aft Cargo Heat System.....TEST & OFF
Place cargo heat switch to TEST; check that ON light illuminates and OVERHEAT light is extinguished.

Wing Leading Edge Overheat System.....TEST
Hold wing leading edge overheat switch to TEST A; check that WING OVHT lights illuminate.
- Repeat procedure with switch in TEST B position.

Generator Annunciator Module.....CHECK
Press READ switch; check that all lights remain extinguished.

Squib Circuits.....TEST & OFF
Hold squib test switch to LEFT BOTTLE; check that all SQUIB OK lights illuminate.
- Repeat procedure for RIGHT BOTTLE position.

Weight and Balance System....OFF

F/E Life Vest.....STOWED

F/E Smoke Goggles.....STOWED

*Oxygen Mask, Hose and Regulator.....CHECKED, ON, 100%

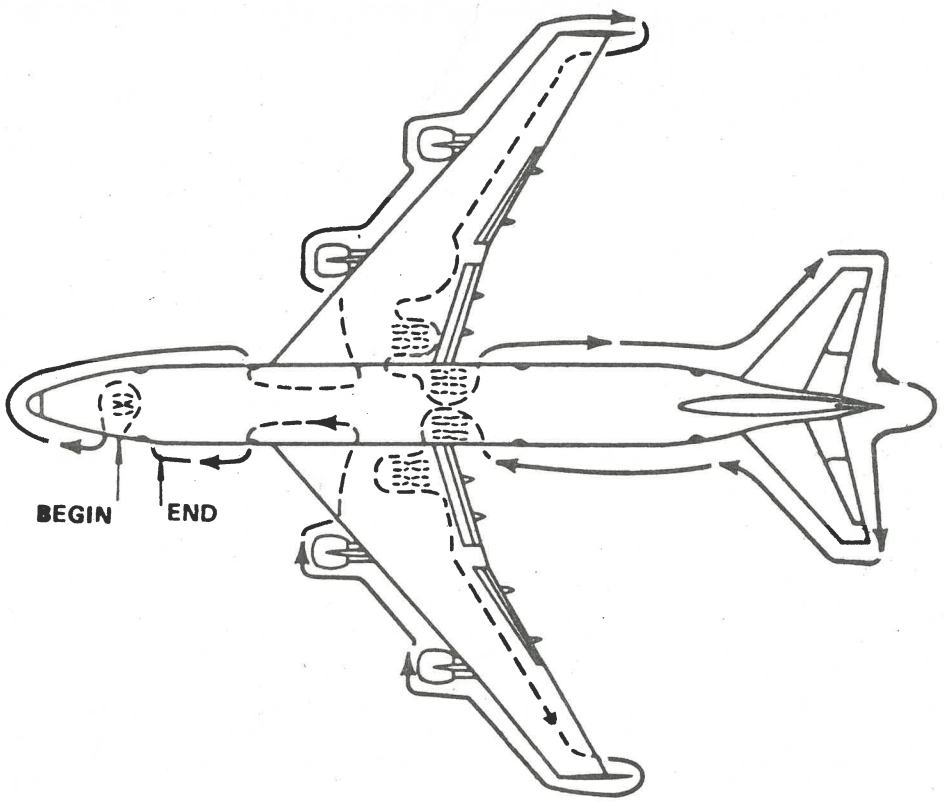
Windshield Washing Fluid...CHECK
Check that sight gage level is above refill mark.

Windshield Rain Repellent.....CHECK
Check that sight gage level is above refill mark, pressure indicator within green band and shutoff valve handle in vertical position.

*Crew Emergency Hatch.....CHECK
Check hatch closed and locked. Check escape devices stowed.

Cockpit Emergency Equipment.....CHECK
The following equipment must be properly stowed and serviceable:
- Portable CO2 fire extinguisher (seal intact).
- Asbestos gloves.
- Portable oxygen bottle (pressure within limits) hose and mask attached.
- Crash axe.
- First aid kit (seal intact).
- Signal lamp.

*Crew Service Door Escape Slide.....CHECK
Check that slide pack is intact, locked in DEPLOYMENT position, shear plunger ENGAGED in floor track and safety pin removed.



* EXTERIOR INSPECTION - F/E

This inspection is performed in final preparation for flight to check acceptable condition of the airplane. (Acceptable Condition: One that, as a result of cursory visual inspection, does not, in the opinion of the flight engineer, require a further in-depth inspection or investigation.)

Nose Gear and Wheel Well...CHECK
Check tires for acceptable condition.

Shock strut inner cylinder visible and no leakage.

Nose wheel steering ground pin removed.

Upper and lower steering linkage connected, apex pin locked in place.

Runway turnoff lights in acceptable condition.

Nose gear and wheel well area free of fluid leaks and in acceptable condition.

Ground lock pin removed. (Check both sides.)

Nose Section.....CHECK
Probes and sensors in place and covers removed.

Windshield wiper stop visible.

Airplane skin and radome in acceptable condition.

Right Forward Fuselage.....CHECK
Crew, passenger and cargo doors that are not in use closed and door handles recessed.

Static ports uncovered.

Oxygen bottle discharge disc intact (right side only).

EXTERIOR INSPECTION - F/E (CONT)

Right Forward Fuselage (Cont)

Wing illumination light illuminated.

Landing light lens clean and unbroken.

Radio antenna in acceptable condition.

Pack inlet and exit doors full open.

Fuselage skin in acceptable condition, no evidence of fluid leaks and all panels closed and fastened.

Right Wing and Engines 3 and 4.....CHECK

Inboard wing undersurfaces and leading edge flaps in acceptable condition, no evidence of fluid leaks and all panels closed and fastened.

No. 3 engine strut in acceptable condition, access panels closed, latches secured and no evidence of fluid leaks.

Temperature sensing probe in acceptable condition.

Exhaust section in acceptable condition and unobstructed.

Thrust reverser sleeves fully forward.

Fan air exit, auxiliary air inlet doors and inlet cowl in acceptable condition.

Inlet pressure sensing probe in acceptable condition.

Fire bottle discharge discs intact.

Engine cowling latches secured, access panels closed and no evidence of excessive fluid accumulation under nacelle.

Mid wing undersurface and leading edge flaps in acceptable condition, no evidence of fluid leaks and all panels closed and fastened.

- No. 4 engine inspection same as No. 3.

Outboard wing undersurface and leading edge flaps in acceptable condition, no evidence of fluid leaks and all panels closed and fastened.

Fuel vent outlet unobstructed.

Navigation light lens unbroken and light illuminated.

HF antenna tuner access door in wing tip latched and probe in acceptable condition.

Fuel jettison nozzle unobstructed and no fuel leakage.

Static dissipators in place.

Inboard and outboard ailerons and trailing edge flaps in acceptable condition.

EXTERIOR INSPECTION - F/E (CONT)

Right Wing Gear.....CHECK
Check tires for acceptable condition.

Shock strut inner cylinder visible.

Gear and wheel well area, free of fluid leaks and in acceptable condition.

Ground lock pin removed.

Right Body Gear.....CHECK
Inspection same as wing gear. Check steering assemblies for leaks or damage.

Right Aft Fuselage.....CHECK
Outflow valves full open, unobstructed.

Passenger and cargo doors that are not in use closed and door handles recessed.

Latching indicator pin on emergency slide door (aft of No. 3 door) out of view.

Fuselage skin in acceptable condition, no evidence of fluid leaks and all panels closed and fastened.

Empennage and Control Surfaces.....CHECK
Check all fixed and movable control surfaces in acceptable condition, no evidence of fluid leaks and panels closed and fastened.

Left and right navigation light lens unbroken and lights illuminated.

Wing spoilers retracted.

Static dissipators in place.

Horizontal stabilizer in neutral position.

Left Aft Fuselage.....CHECK
Inspection same as right aft fuselage.

Left Body Gear.....CHECK
Inspection same as right body gear.

Left Wing Gear.....CHECK
Inspection same as right wing gear.

Left Wing and Engines 1 and 2.....CHECK
Inspection same as right wing and engines 3 and 4.

Left Forward Fuselage.....CHECK
Inspection same as right forward fuselage.

Both cabin pressure relief valve doors closed.

FINAL COCKPIT PREPARATION - F/E

This inspection is performed in final preparation for flight to prepare the F/E panel and related components prior to initiating the Before Start checklist.

*Weight and Balance System.....ON
Check that POWER light illuminates.

*F/E Light Controls.....SET
Adjust panel, background, map and circuit breaker panel lights to desired intensity.

*F/E Communications.....SET
Set interphone for engine start and set all other communications as desired.

*Interphone.....CHECK
If interphone communication with ground station cannot be established, switch to service interphone as an alternate source.

*Galley Power Bus Switches....OFF

*Fuel Load.....CHECK
Crosscheck distribution, individual fuel quantity indicators and total fuel weight indicator with weight manifest.

Press fuel used reset switch until all fuel used indicators move to zero.

*Fuel Boost Pumps....ALL MAINS ON

*Crossfeed Valve Switches.....SET
Check No. 1 and 4 crossfeed valve switches open and No. 2 and 3 crossfeed valve switches closed. All take-offs must be made using main tank to engine fuel feed.

*Pack Valve Switches...TWO CLOSED
Place two pack valve switches to the closed position to reduce pneumatic load for engine start. Place upper deck heat switches OFF.

*Normal Brake System...PRESSURIZE
Place hydraulic system 4 electric pump switch ON; check hydraulic pressure within green band.

NOTE: Obtain ground crew clearance before pressurizing hydraulic system 4.

*Weight and Balance System.....CHECK
After warmup, place system check switch to INST; check that NO GO light illuminates until indicators drive to preset values, then GO light illuminates.

Place check switch to CHAN; check that GO light illuminates and NO GO light remains extinguished.

Place system check switch to ATT; check that GO light illuminates and NO GO light remains extinguished.

Place system check switch to ALARM; check that CG ALARM light illuminates.

Place system check switch to OPR; check that CG ALARM light extinguishes.

Hold CG read/standby switch to READ; lbs x 1000 and % MAC is displayed on gross weight and CG indicators. In wind conditions hold read/standby switch to READ when average wind effect is determined on wind effect indicator.

FINAL COCKPIT PREPARATION - F/E
(CONT)

*Gross Weight/Total
Fuel Indicator.....SET
Crosscheck computed gross weight with weight and balance indicator and set computed gross weight in total weight indicator.

Press fuel quantity test switch; check that gross weight follows change in fuel quantity.

*Weight and Balance System....OFF
Check that POWER light extinguishes.

*Takeoff Data.....COMPUTE
Compute V1, VR, V2 speeds, EPR, stabilizer trim setting and initial climb attitude.

COCKPIT PREPARATION - C & F/O

This inspection is performed by the Captain and First Officer prior to initiating the Before Start checklist in order to configure their panels and related components for flight.

Life Vest.....STOWED
Smoke Goggles.....STOWED
*Oxygen.....CHECK, ON 100%
Static Source Selectors...NORMAL
Flight Control
Power Switches.....ON
Check VALVE CLOSED lights extinguished.
Yaw Dampers.....ENGAGED
*Anti-Skid.....OFF
Check ANTI-SKID annunciator light illuminated.
Body Gear
Steering.....ARM
Ignition Switches.....OFF
Check VALVE OPEN lights extinguished.
Standby Ignition.....NORM
Instrument
Transfer Switches.....SET
Check NAV DEV, INS, COMPASS, COMP/STAB and ATTITUDE switches in NORM and FLT DIR COMPUTER CAPT and F/O switches are in A/1 and B/2 positions respectively; check instrument transfer lights extinguished.
INS Mode Switches.....ALIGN
Emergency Lights.....ARMED
Check UNARMED light extinguished.
Cabin Interphone.....CHECK
Initiate conference call and check station response.
Cabin Signs.....ON
Check that NO SMOKING, FASTEN SEAT BELT and EXIT ON lights are illuminated.
Alternate Gear
Extension Switches.....OFF
*Compasses.....SLAVED
If synchronization indicator is not aligned, place DG/SLAVED switch to DG momentarily and return it to SLAVED. If the synchronization indicator is still not aligned use SET HDG switch to align indicator.
*Selcal.....SET
Place selcal switches as desired.
Marker Beacon.....AS DESIRED
Alternate Flap Switches.....OFF
Wing Anti-Ice.....OFF
*Window Heat.....ON
*Probe Heat.....PITOTS ONLY
Nacelle Anti-Ice.....OFF
*Cockpit Lights....SET AS DESIRED
*Radio/INS Switch.....RADIO
*Autopilot Mode
Selector Panel....CHECK AND SET
Place flight director switch ON. Check autothrottle switch not engaged (light extinguished), and set autothrottle speed if desired. Check autopilot engage switches OFF. Set desired course and heading; place course transfer switch in DUAL and navigation mode switch in HDG. Check back beam switch not engaged (B/B light extinguished). Check speed mode switch OFF. Check altitude mode switch OFF and ALT HOLD and ALT SEL lights extinguished. Set selected altitude if desired.
Central Instrument
Warning System.....TEST
Press and hold INST WARNING switch; check that Captain's and F/O's CIWS ATT, HDG and MON annunciators illuminate steady and INSTRUMENT WARN annunciators flash red. Release test switch; check that ATT, HDG and MON lights extinguish and INSTRUMENT WARN lights remain illuminated.

Press Captain's and F/O's INSTRUMENT WARN lights; check that INSTRUMENT WARN lights extinguish.

COCKPIT PREPARATION - C & F/O (CONT)

Autothrottle and
Autopilot Lights...EXTINGUISHED
Flight Director/Autopilot Approach Progress Display....TEST
Press flight director annunciator panel; check that flight director and autopilot lights, AUTOPILOT, and AUTOTHROT warning lights illuminate amber.

Press autopilot annunciator panel; check that flight director and autopilot annunciator lights illuminate green and AUTOPILOT and AUTOTHROT warning lights illuminate red.

Marker
Beacon Lights.....PRESS-TO-TEST
Clocks.....CHECKED & SET
Flight Director.....TEST & SET
Check that command bars are in view and FD flags retracted from view.

Press and hold ADI test switch. Check that ADI indicates approximately 20° right bank, 10° pitch up, GYRO warning flag appears, ATT light illuminates and INSTRUMENT WARN light flashes.

Release test switch; check that ADI indications return to normal, GYRO flag retracts from view and ATT light extinguishes. Press INSTRUMENT WARN light; check that light extinguishes.

* Set flight director for takeoff if desired.

*Altimeters.....SET & CROSS-CHECK
Set current barometric pressure and check that altitude indication corresponds to field elevation.

Radio Altimeter.....TEST
Check warning flag retracted and altitude pointer zero.

Rotate DH SET control to set DH bug to approximately 20 feet; check that DH light on ADI illuminates.

Press PUSH-TO-TEST switch; check that altitude pointer indicates approximately 30 feet, DH light extinguishes, warning flag appears and aural warning sounds. Release test switch; check that all indicators return to pretest position.

Rotate DH SET control to set DH bug to zero. Check DH light extinguishes.

*RMI.....SET
Set VOR/ADF switches for departure.

*HSI.....CHECK
Check HSI flags indicate RAD and MAG. Check that selected courses and headings agree with HSI pointers.

IVSI.....CHECKED & ZERO

*Standby
Horizon Indicator.....CHECK
Check failure warning flag out of view, gyro erect, and airplane symbol properly positioned.

Altitude Alert.....SET
Check altitude alert and failure indicator lights extinguished. Set tone volume control and light intensity as desired. Set current barometric pressure and set selected altitude if desired.

*Flap Indicators.....CHECK
Check flap indicators in agreement with flap lever position.

COCKPIT PREPARATION - C & F/O (CONT)

Rudder Ratio.....TEST
Press rudder ratio test switch; check that RUDDER RATIO annunciator light illuminates.

Landing Gear Lever.....DN & IN
Check GEAR DOWN light illuminated and DOOR OPEN and red GEAR lights extinguished.

True Airspeed Indicator....CHECK
Check warning flag out of view and TAS less than 200 knots.

Brake Pressure.....NORMAL
Check brake indicator pressure is not less than system pressure.

INS .....CHECK & SET
Place data selector on each INS to DSRTK/STS. Check actual performance index in the right data displays, and that mode selector unit READY NAV lights are illuminated.

Place each INS data selector to POS. Check correct present position latitude and longitude data loaded.

*Place each data selector switch to WAYPT. Check that both data indicators display all zeroes, with N in left indicator and E in right indicator (on through flights the previously loaded waypoint will appear). If remote loading of all units is desired press REMOTE switch on each control display unit; check that each REMOTE switch light illuminates.

*Place waypoint selector to 1 on each control display unit.

*Press switch for north (N2) or south (8S) latitude as appropriate. Check INSERT switch illuminates. Press numbered switches in sequence for waypoint latitude. Check correct latitude in left data indicator. Press INSERT switch; check that insert light extinguishes.

*Press switch for west (W4) or east (6E) longitude as appropriate. Check INSERT switch illuminates. Press numbered switches in sequence for waypoint longitude. Check correct longitude in right indicator. Press INSERT switch; check that insert light extinguishes.

*Place waypoint selector to position 2 through 9 for each successive waypoint required. Repeat waypoint loading procedure for each additional waypoint. If remote loading has been used, press each REMOTE switch to extinguish REMOTE lights. If more than nine waypoints are required, remaining waypoints will be loaded in place of first waypoints as they are overflown.

Place each mode selector to NAV; check that all READY NAV lights extinguish.

Place each control display unit auto/manual switch to AUTO to establish automatic navigation leg switching.

COCKPIT PREPARATION - C & F/O (CONT)

*VHF NAV/DME Receivers.....SET AS REQUIRED
*ADF Radios.....SET AS REQUIRED
Radar.....SET & STANDBY
Place function switch to STBY. Place antenna tilt to zero, gain control to AUTO and system switch as desired.
Reserve Brake Switch.....CLOSED
Check reserve brake valve OPEN light extinguished.
*Speed Brake Lever....DOWN DETENT
*Reverse, Thrust and Start Levers....DOWN, CLOSED & CUTOFF
Check all reverse indicator lights extinguished.
*Parking Brake.....SET
Check PARK BRAKE light and ANTI-SKID HYD light illuminated.
*VHF Comm Radios.....SET AS REQUIRED
*Interphone.....SET
Set interphone for engine start.
*HF Radios.....SET AS REQUIRED
*Transponder.....SET
Place mode switch to STBY and code selector to "A"; check ALT RPTG switch OFF, TEST switch in MON, TFR switch as desired and departure code set.
*Control Stand & Center Forward Panel Lights.....SET AS DESIRED
*Takeoff Data...SET & CROSS-CHECK
Set airspeed reference bugs for V1, VR, V2 speeds. Set ambient air temperature in TAT/EPRL module and press TOD mode switch. Check that ON light illuminates, TOD appears in mode window and EPR limit readout appears in EPRL window. Check that computed and readout EPR's are comparable and set EPR bugs.

AMPLIFIED BEFORE START CHECKLIST

The F/O will read the checklist and the appropriate crew member(s) will reply with the proper response.

Cockpit Preparation Procedures.....COMPLETE ALL

Oxygen Mask & Quantity.....CHECKED ALL

Flight Control Power Switches.....ON C
Check VALVE CLOSED lights extinguished.

Stall Warning.....NORMAL F/O
Check PWR OFF light illuminated.

INS Mode.....NAV C
All INS modules.

Emergency Lights.....ARMED C

Cabin Signs.....ON C
Check that NO SMOKING and FASTEN SEAT BELTS and EXIT ON lights are illuminated.

Window Heat.....ON F/O

Probe Heat.....PITOTS ONLY F/O
Check MAIN PITOTS light illuminated.

Radios, Clocks & Altimeters.....SET ALL
Individual radios, clocks and altimeters set and crosschecked.

Airspeed.....BUGS SET ALL
Check that V1, VR, V2 bug settings correspond to data on takeoff card.

EPR.....BUGS SET ALL

If pushback is desired at this time and ground clearance has been obtained:
No. 1 Air Driven Hydraulic Pump.....AUTO F/E

Parking Brakes & Pressure.....SET & NORMAL C
Check brake indicator pressure is not less than system pressure, PARK BRAKE and ANTISKID HYD lights illuminated.

Start Levers.....CUTOFF C

Gear Pins.....REMOVED C
Verify that all gear pins have been removed by ground personnel.

AMPLIFIED BEFORE START CHECKLIST (Cont)

Galley Power . . . . . OFF F/E
Check all galley power bus switches OFF.

Fuel . . . . . ____ LBS., SET FOR START F/E
Confirm that fuel load corresponds to dispatch fuel requirements and fuel system is set for start.

Pressurization . . . . . AUTO F/E

Pack Valves. . . . . ONE OPEN F/E
Check two pack valve switches in the closed position and upper deck heat switches OFF.

Air Pumps. . . . . OFF F/E

Start Pressure . . . . . ____ PSI F/E

Cargo Doors. . . . . BOTH CLOSED F/E

Before Start Checklist . . . . . COMPLETE F/O

ENGINE START PROCEDURE

NOTES: 1. Cold Engine - EGT 0°C or below.
Warm Engine - EGT above 0°C to 100°C.
If EGT is above 100°C, motor the engine to reduce EGT to Warm Engine range.
2. See Chapter 21, Power Plant, for the following procedures:
(a) Starting in High Tailwinds (Normal Operations).
(b) Low Duct Pressure Starts (Alternate Operations).
(c) Aborted Starts (Alternate Operations).

CAPTAIN	FIRST OFFICER	FLIGHT ENGINEER
	Report "Before Start Checklist complete."	Place hydraulic system 4 electric pump switch OFF.* Check brake pressure.
Obtain ground crew acknowledgement that inlet and exhaust areas are clear and place beacon switch ON. Call Start No. ———.		
Check N2 rotation.		Call "Turning No. ———." Hold ignition switch to GRD START. Check start VALVE OPEN light illuminates and minimum duct pressure 30 psi.** Check increasing engine oil pressure indication.
	Call "15%" N2 for a Cold Engine or "Max motoring" for a Warm Engine.	
Place start lever to RICH at 15% N2 for a Cold Engine or IDLE at max motoring*** N2 for a Warm Engine.		
Check normal fuel flow indication. Immediately after indication of EGT rise, some indication of N1 rotation should be observed or the start should be aborted.		
Check EGT indicator for normal temperature rise and N2 for normal acceleration. Continue to monitor until EGT peaks, then decreases. If EGT climbs rapidly through 500%C and/or N2 acceleration is sluggish, discontinue the start to prevent reaching 593° C.		
	Call "46%" N2.	Release ignition switch. Check start VALVE OPEN light extinguished and call "Starter cutout." Check CSD PRESS light extinguished.
Check N1, EGT and fuel flow for normal indications and ENG OIL PRESS light extinguished. If RICH start was used, place start lever IDLE.		Check oil pressure and temperature indications normal. Check hydraulic system 4 electric pump switch OFF.****
Repeat procedure to start remaining engines on Captain's command.		

* On earlier airplanes until modified.
** Less 1 psi per thousand feet of pressure altitude.
*** Use RICH if ambient temperature is below 32°F (0°C) and EGT 0°C.
**** On later airplanes.

AFTER START PROCEDURE

After the engines have been started and have stabilized, the following tasks are performed in order to ensure proper operation of the aircraft systems. All ground equipment is disconnected, both cargo doors are closed and the airplane is prepared for taxi.

Airplane
Electrical Power.....ESTABLISH
Press GEN 1 AC meters switch; check for proper voltage and frequency.
- Repeat procedure for GEN's 2, 3 and 4.

Place No. 4 generator breaker switch to CLOSE; check that No. 2 aux power source (APU or external) switch returns to OFF and No. 4 GEN OPEN light extinguishes.

Place No. 3 generator breaker switch to CLOSE; check that GEN OPEN light extinguishes.

Place No. 2 generator breaker switch to CLOSE; check that No. 1 aux power source (APU or external) switch returns to OFF and No. 2 GEN OPEN light extinguishes.

Place No. 1 generator breaker switch to CLOSE; check that GEN OPEN light extinguishes.

Place split system breaker switch to CLOSE; check that split system breaker OPEN light extinguishes.

Check that generator load does not exceed 51 KW per generator. A slight load oscillation between paralleled generators at ground idle N2 RPM is a normal CSD characteristic.

Galley Power Bus Switches.....ON
Check TRIP OFF lights extinguished.

APU Bleed Air
Switch.....AS REQUIRED
If APU will not be used for takeoff, place APU bleed air switch to CLOSE; check decrease in APU EGT.

Isolation Valves.....AS REQUIRED
Place isolation valves to the closed position if the APU will be used on takeoff.

Air Conditioning
System.....ACTIVATE
Place all pack valve switches open and upper deck heat switches as desired.

Hydraulic System.....CHECK & SET
Place all air driven hydraulic pump switches to AUTO. Check all low PRESS lights extinguished.

Check each system hydraulic pressure indicator within green band.

Check that LOW QTY lights are extinguished and all hydraulic quantity indicators are within green band.

AFTER START PROCEDURE (CONT)

Flight Recorder.....ON
Check that OFF light extinguishes.

Press repeat switch; check that trip/date encoder light illuminates.

Doors.....CLOSED
Check all door annunciator lights extinguished.

Aft Cargo Heat.....NORMAL
Check that OVERHEAT light is extinguished and ON lights illuminate if heat is required.

Ground Equipment.....DISCONNECT
After electrical, air conditioning, hydraulic and annunciator panels are satisfactory for taxi, the F/E will advise the Captain, "Ready for disconnect."

Captain will advise ground crew, "Remove all ground equipment."

Stabilizer Trim.....CHECK
Hold stabilizer trim switches nose down; observe stabilizer trim indicator movement and BRAKE REL lights illuminate.

Release stabilizer trim switches; check that BRAKE REL lights extinguish and stabilizer movement stops.

Hold stabilizer trim levers nose up, observe stabilizer trim indicator movement.

Set stabilizer trim for takeoff.

Aileron Trim.....ZERO
Check "0" position of aileron trim indicator on control wheel is aligned with the pointer on the control column.

Rudder Trim.....ZERO
Check rudder pedals and UPR and LWR rudder indices centered.

Exterior Lights.....AS REQUIRED

Cockpit Door.....LOCKED

NOTE: Push back may also be accomplished at this time if desired.

Taxi Clearance.....AS REQUIRED

All Clear Signal.....OBTAIN

AMPLIFIED AFTER START CHECKLIST

The F/O will read the checklist and the appropriate crew member(s) will reply with the proper response.

Aileron & Rudder Trim. . . . . .ZERO F/O
Check aileron and rudder trim at zero.

Electrical . . . . . NO LIGHTS, ESSENTIAL NORMAL F/E

Hydraulics . . . . . AUTO & NORMAL F/E
Check all air driven hydraulic pump switches AUTO, all engine driven hydraulic pump switches NORMAL, low PRESS and LOW QTY lights extinguished and pressures within green band.

Doors. . . . . .CLOSED F/E
Check all door annunciator lights extinguished.

Ground Equipment . . . . . CLEARED C
Verify that all external equipment has been removed by ground personel.

After Start Checklist. . . . . .COMPLETE F/O

TAXI-OUT PROCEDURE

After receiving taxi clearance and prior to initiating the Before Takeoff checklist, the following tasks are accomplished to insure proper configuration of the airplane for takeoff.

Parking Brake.....RELEASE
Check PARK BRAKE and ANTI-SKID HYD lights extinguished.

Flaps.....___ ___ BLUE LIGHT
Place flap lever to the required takeoff flap setting. Check that amber LE FLAP light extinguishes, blue LE FLAP light illuminates, and flap position indicators agree with flap lever position.

Nacelle Anti-Ice.....AS REQUIRED
If icing conditions are anticipated or exist, place nacelle anti-ice switches ON; check that NACELLE VALVE OPEN & STATOR VALVE OPEN lights illuminate.

Flight Instruments...ALIGNED, NO FLAGS
Compare indication of all attitude indicators, HSI's, RMI's, and standby compass during turns. Check rudder indices movement in opposite direction for yaw damper operation.

Flight Controls.....CHECK
On Captain's command, the F/O will:
- Rotate the control wheel full left; check that control position indicator shows left outboard aileron full up, left spoilers extended, right spoilers retracted and right outboard ailerons full down.
- Reverse control wheel; check that indicated aileron and spoiler positions are reversed.
- Pull control column full aft; check that control position indicator shows outboard elevators full up.
- Push control column full forward; check that control position indicator shows outboard elevators full down.
- While Captain holds tiller in vertical position, F/O will smoothly push full left rudder pedal and check that control position indicator shows both rudders move full left.
- Smoothly push full right rudder; check that control position indicator shows both rudders move full right.
- Check rudder ratio light extinguished.

NOTE: Rudder check should not be performed while turning.

INS.....CHECK
Place one data selector to TK/GS to assist Captain in determining taxi speed.

Place other data selectors to POS and check present position change.

APU.....AS REQUIRED
If APU will not be used for takeoff, shut down APU; check APU DOOR light illuminates (door in transit) then extinguishes (door closed).

Pressurization.....AUTO
Check that outflow valve indicators show open position and cabin altitude is not greater than 140 ft below field pressure altitude (.07 psi differential pressure).

Air Conditioning.....CHECK
Check that all pack ACM outlet and compressor discharge temperatures are normal.

Engine Operation.....MONITOR
Check oil quantity adequate for flight, oil temperatures and pressures within green band and FILTER BYPASS lights extinguished.
- Check engine breather pressure is below 7.5 psig.

Hydraulic Systems.....NORMAL
Check hydraulic systems pressures, quantities and temperatures normal.

Weight.....CORRECT
Confirm takeoff gross weight. Correct takeoff data card and gross weight digital readouts as required.

Fuel Heat.....AS REQUIRED

PA Announcement.....IF REQUIRED
Advise cabin attendants and passengers to prepare for takeoff.

Annunciator Lights.....CHECKED

Ignition Switches...FLIGHT START

AMPLIFIED BEFORE TAKEOFF CHECKLIST

After leaving the gate and prior to taking the runway the Captain will call for the Before Takeoff Checklist. The F/E will read the checklist and the appropriate crew member(s) will reply with the proper response.

Nacelle Anti-Ice . . . . . AS REQUIRED F/O

Flight and Nav Instruments . . . . . ALIGNED, NO FLAGS C-F/O
All flight instruments crosschecked and no warning flags. Radios set for departure.

Flaps. . . . . ____ ____ BLUE LIGHT C-F/O

Flight Controls. . . . . CHECKED F/O

Stabilizer Trim. . . . . ____ UNITS SET F/O
Check stabilizer trim setting corresponds to takeoff data card.

Galley Power . . . . . .ON F/E

APU. . . . . AS REQUIRED F/E

Fuel . . . . . SET FOR TAKEOFF F/E
Check crossfeed valve switches in appropriate position and appropriate low PRESS lights extinguished.

Air Conditioning and Pressurization. . . . . .SET & AUTO F/E

Annunciator Lights . . . . . CHECKED F/E

Ignition . . . . . .FLIGHT START F/E

Transponder. . . . . .ON F/O
Place transponder switch to ON upon taking runway.

Anti-Skid. . . . . .ON C
Place anti-skid switch ON after taking the runway; check ANTI-SKID light extinguished.

Body Gear Steering . . . . . .DISARM C
Place body gear steering switch to DISARM after taking the runway.

Before Takeoff Checklist . . . . . .COMPLETE F/E

TAKEOFF PROCEDURE

After completing the Before Takeoff Checklist and when cleared for takeoff, the flight crew will perform their respective tasks to accomplish the takeoff.

PILOT FLYING	PILOT NOT FLYING	FLIGHT ENGINEER
Place anti-skid switch ON and body gear steering switch to DISARM upon taking the runway.	Place transponder switch to ON upon taking the runway.	Check body gear steering locked.
Advance thrust levers to approximately 1.1 EPR, then set takeoff thrust.	Maintain light forward pressure on control column and wings level.	Make final EPR adjustment between 40 and 80 knots. Check N2 RPM. Monitor all forward engine instruments and annunciator panel lights during takeoff.
Maintain directional control.	Call "V1, VR, V2" and "Positive rate of climb."	
After positive rate of climb, call "Gear UP."	Place gear lever UP; check for normal indications.	
	Place gear lever OFF after all gear lights extinguish.	
At desired altitude and speed, call for flap retraction, observing flap retraction schedule.	Place flap lever to desired setting. Check for proper flap indications.	Check EGT, OIL TEMP and PRESS normal, engine breather pressure below 7.5. Check N1 and N2.

REJECTED TAKEOFF PROCEDURE

Simultaneously apply maximum braking and retard thrust levers to idle. Apply full reverse thrust on symmetrical engines. Maintain directional control. When taxi speed is reached, place anti-skid switch OFF; check ANTI-SKID light illuminated. Place body gear steering switch to ARM.	Check speed brake lever in UP detent. Call tower and announce, "Rejected takeoff." Maintain wings level.	

NO A/C PACK TAKEOFF PROCEDURE

If a No Air Conditioning Pack Takeoff is to be made, the F/E will, in addition to his normal tasks, use the following procedure for the takeoff:

Use normal air conditioning during taxi.

Prior to taking the runway:
Upper Deck Heat Switches.....OFF
Place switches OFF just prior to taking the runway.
Pack Valve Switches.....CLOSE
Place all pack valve switches to the closed position upon taking the runway and just prior to the application of thrust.

After takeoff:
Normal Air
Conditioning.....RESTORE
Place <u>one</u> pack valve switch to the open position at not less than 400 ft above field elevation and prior to reaching 2000 ft. If engine failure occurs, do not open pack valve until obstacle clearance height has been reached.

When cabin rate-of-climb stabilizes, place second pack valve switch to open position.

Use same procedure for third pack.

Place upper deck heat switches ON as required.
Thrust Setting.....ADJUST
Adjust thrust as required for existing bleed air conditions.

<u>NOTE</u>: If a one A/C pack takeoff is made follow the above procedure; turn remaining packs on (one at a time) at not less than 400 ft above field elevation.

TAKEOFF PROCEDURE USING APU FOR AIR CONDITIONING

After engine start:
Isolation
Valve Switches.....BOTH CLOSED
Place both isolation valve switches to the closed position after engine start and prior to taxi. Leave APU bleed air switch OPEN.

Prior to taking the runway:
Upper Deck Heat Switches.....OFF
Nos. 1 and 3
Pack Valve Switches.....CLOSE

After takeoff:
Normal
Air Conditioning.....RESTORE
Place <u>one</u> pack valve switch to the open position at not less than 400 ft above field elevation. If engine failure occurs, do not open pack valve switch until obstacle clearance height has been reached.

When cabin rate-of-climb stabilizes, place other pack valve switch to the open position.
Isolation
Valve Switches.....BOTH OPEN
APU.....SHUTDOWN
Shutdown the APU <u>immediately</u> after opening the isolation valves. Check APU DOOR light illuminates (door in transit) then extinguishes (door closed).
APU Bleed Air Switch.....CLOSE
Upper Deck
Heat Switches.....AS DESIRED
Thrust Setting.....ADJUST

<u>NOTE</u>: APU DOOR light will illuminate (10-15 seconds) at liftoff as APU door moves to inflight position.

AFTER TAKEOFF PROCEDURE

PILOT FLYING	PILOT NOT FLYING	FLIGHT ENGINEER
Call "Climb EPR."	Press CLB on TAT/EPRL mode selector; check that ON light illuminates and CLB appears in window.	
	Reset EPR bugs.	Set climb EPR.
Call "Landing lights off."	Place landing light switches OFF.	
	Flight conditions permitting, press No Smoking and Fasten Seat Belts switches; check that ON lights extinguish.	
Establish autopilot control.	Place probe heat switches to ON.	
Establish autospeed control.		Place ignition switches as required.
		Verify that checklist items have been accomplished and announce "After Takeoff Checklist complete."

AMPLIFIED AFTER TAKEOFF CHECKLIST

After takeoff the F/E will verify that the following actions have been completed and announce to the Captain: "After Takeoff Checklist complete."

Ignition	AS REQUIRED	F/E
Cabin Signs	AS REQUIRED	F/E
Landing Lights	OFF	F/E
Probe Heat	ON	F/E
Landing Gear	UP, NO LIGHTS & OFF	F/E
Flaps	UP & NO LIGHTS	F/E
Isolation Valves	BOTH OPEN	F/E
APU	SHUTDOWN	F/E
APU Bleed Air Switch	CLOSE	F/E
After Takeoff Checklist	COMPLETE	F/E

• Items below line required only if APU is used on takeoff.

CLIMB PROCEDURE

Upon completion of After Takeoff Procedure, the flight crew will perform their respective actions to configure airplane for climb to cruise altitude.

Air Conditioning and Pressurization.....CHECK

Check that all air conditioning lights are extinguished, ACM outlet temperature is between 35-160°F and compressor discharge temperature does not exceed 425°F.

Check cabin altitude moving in proper direction, cabin vertical speed indicating the rate set on the rate selector and cabin differential pressure increasing.

Do not exceed 8.9 PSI differential pressure.

Fuel Management.....AS REQUIRED

Main tanks 1 and 4 greater than 23,100 lbs per side:

Climb and cruise using main tank to engine fuel feed until fuel quantity in main tanks 1 and 4 is between 22,000 lbs and 21,000 lbs per side.

With center tank fuel available:

When the fuel quantity in main tanks 1 and 4 is between 22,000 lbs and 21,000 lbs per side, continue flight using center tank to all engines fuel feed until center tank fuel is consumed.

- Place both center wing override/jettison pump switches ON; check override/jettison low PRESS lights extinguished.
- Place No. 2 and 3 crossfeed valve switches to open; check that CROSSFEED VALVE lights illuminate (in transit), then extinguish (valves open).
- Place No. 1 and 4 main tank boost pump switches OFF; check that respective low PRESS lights illuminate.

When override/jettison low PRESS lights illuminate, place override/jettison pump switches OFF.

Place scavenge pump switch ON; check that scavenge pump low PRESS light extinguishes.

- Remaining center tank fuel will transfer to No. 2 main tank.
- When scavenge pump low PRESS light illuminates steadily, place scavenge pump switch OFF; check that low PRESS light extinguishes.

Fuel Management (Cont)

Continue flight using main tanks 2 and 3 to all engines fuel feed until the fuel quantity in main tanks 2 and 3 equals the quantity in main tanks 1 and 4 plus adjacent reserves. Continue flight using main tank to engine fuel feed.

- Place No. 1 and 4 main tank boost pump switches to ON; check that respective low PRESS lights extinguish.
- Position No. 2, 3 and 4 fuel crossfeed valve switches to close; check that CROSSFEED VALVE lights illuminate (in transit), then extinguish (valves closed).

Main tanks 1 and 4 less than 23,100 lbs per side: Maintain takeoff fuel configuration until power is reduced from takeoff setting.

Continue flight using main tanks 2 and 3 to all engines fuel feed until the fuel quantity in main tanks 2 and 3 equals the quantity in main tanks 1 and 4 plus adjacent reserves. Continue flight using main tank to engine fuel feed.

Commence transfer of reserve tank fuel when:

- All center tank (except scavenge) fuel is used.
- Fuel quantity in main tanks 1 or 4 is less than 19,500 lbs per side.
- Airplane gross weight is 580,000 lbs or below.

NOTE: Reserve tanks must not be empty above 577,000 lbs gross weight.

Place No. 1 and 4 reserve fuel transfer switches to open; check that RES VALVE lights illuminate (in transit), then extinguish (valves open).

After reserve tank transfer is completed: Continue flight using main tank to engine fuel feed.

Leave reserve tank transfer valves open for remainder of flight.

Altimeters.....SET
At transition altitude, reset altimeters to 29.92 in. Hg. (1013 millibars).

If cruise altitude is above 35,000 ft:

Ignition Switches.....IGN 1 OR IGN 2
Place ignition switches to IGN 1 or IGN 2 above 35,000 ft.

Throttle Bar.....ENGAGE
Engage throttle bar above 35,000 ft. Push THROTTLE BAR light to extinguish light.

CRUISE PROCEDURE

Upon reaching cruise altitude, the flight crew will perform their respective actions to place airplane in cruise configuration.

Cruise Thrust.....SET
After level-off and when the airplane has accelerated slightly above desired cruise airspeed, press CRZ on the TAT/EPRL mode selector. Check that the ON light illuminates and CRZ appears in the window. Reset EPR bugs and set cruise thrust.

Fuel Management.....AS REQUIRED

Operating Systems.....MONITOR

- Check AC electrical system within limits.
- Check DC electrical system within limits.
- Check galley busses are powered.
- Check CSD operation normal.
- Check engine indications within limits.
- Periodically check engine vibration, both INLET and TURBINE positions.
- Check air conditioning, pressurization and pneumatic systems operation within limits.
- Check nacelle temperatures normal and engine fire detection FAULT light extinguished.
- Check equipment cooling system normal.
- Check aft cargo heat system operating normally.
- Check WING OVHT lights extinguished.
- Check all hydraulic systems operating normally.
- Check all annunciator panels for normal indications.

DESCENT - APPROACH PROCEDURE

After initiation of descent and prior to the landing procedure, the following tasks are accomplished by the appropriate crew members to insure proper configuration of the airplane for descent and for required navigation to the navigational facility serving the airport of landing.

If cruise altitude has been above 35,000 ft with throttle bar engaged:

Throttle Bar.....DISENGAGE
Disengage throttle bar at 35,000 ft.

Ignition Switches.....OFF
If flight conditions permit, place ignition switches OFF.

Pressurization.....SET
Place flight/cabin altitude indicator to destination field elevation. Check that cabin altitude is moving in proper direction, cabin vertical speed indicates rate set on rate selector and cabin differential pressure is decreasing.

Set field barometric pressure for destination airport.

Circuit Breakers.....CHECK

Annunciator Lights.....CHECK

Fuel Management.....SET FOR LANDING
Check all main tank fuel boost pump switches ON and all main tank boost pump low PRESS lights extinguished.

Check No. 1 fuel crossfeed switch open, No. 2, 3 and 4 crossfeed valve switches closed and all CROSSFEED VALVE lights extinguished.

Hydraulic Systems.....CHECK
Check all air driven pump switches in AUTO, pressures within green band, LOW QTY, low PRESS, OVERHEAT and HYD SYS PRESS lights extinguished.

Fasten Seat Belt.....ON
Check that ON light illuminates.

Altimeters.....SET & CROSS-CHECK
At transition altitude, set altimeters to current barometric setting.

Radio Altimeters.....SET
DH bugs set and cross-checked for approach.

Landing Data.....COMPUTE
Utilizing landing flap setting, airplane gross weight, destination temperature and elevation, determine reference speed. Press GA on the TAT/EPRL mode selector; check that ON light illuminates and GA appears in the window.

Airspeed and EPR Bugs.....SET & CROSS-CHECK

Radio and Navigation Instruments...SET & CROSS-CHECK
Place radio/INS switch to RADIO.

Set flight directors, autopilots and navigation instruments for approach.

Flaps.....EXTEND
Observe flap placard speeds and check speed brake lever in DOWN detent.

Check for correct flap indications.

AMPLIFIED DESCENT-APPROACH CHECKLIST

The F/E will read the checklist and the appropriate crew member(s) will reply with the proper response.

Pressurization	SET	F/E
Landing Data	BUGS SET	ALL
Fuel	SET FOR LANDING	F/E
Annunciator Lights	CHECKED	F/E
Altimeters	SET & X-CHECKED	ALL
Radios & Nav Instruments	SET & X-CHECKED	C-F/O
Radio Altimeters	SET	C-F/O
Descent-Approach Checklist	COMPLETE	F/E

LANDING PROCEDURE

Upon approaching the navigational facility serving the destination airport, the following tasks are accomplished to insure the proper configuration of the airplane for landing.

Ignition Switches.....FLT START

Flight and Navigation Instruments...SET & CROSS-CHECK
Prior to passing approach facility (OM, NDB or VOR) check all flight instruments for agreement, radios tuned to correct frequencies, RMI selector switches set, and no warning flags.

Check flight director in proper mode and HSI set.

Speed Brakes.....ARMED
Check AUTO SPOILERS light extinguished.

No Smoking.....ON
Check that ON light illuminates.

Landing Gear.....DN
Check for normal extension indications.

Flaps.....EXTEND FOR LANDING
On earlier airplanes Nos. 2, 3 and 4 air driven hydraulic pump RUN lights illuminate at flaps 25 and 30.

Glide Slope Capture.....CHECK
On glide slope intercept, check that Captain and F/O flight director/autopilot approach progress display illuminates properly.

Hydraulics.....NORMAL
Check pressures in green band, OVERHEAT, PRESS and LOW QTY lights extinguished.

AMPLIFIED LANDING CHECKLIST

Prior to landing, the pilot flying will call for the Landing Checklist; the F/E will read the checklist and the appropriate crew member(s) will respond. When practical the F/E will verify all responses by inspection of the unit or system concerned.

Ignition Switches. . . . . .FLIGHT START F/E

Cabin Signs. . . . . .ON F/O
Check that FASTEN SEAT BELTS and NO SMOKING ON lights are illuminated.

Speedbrakes. . . . . ARMED C
Check AUTO SPOILERS light extinguished.

Landing Gear . . . . . DOWN, IN, GREEN LIGHT C
Check gear lever DN and in, GEAR DOWN light illuminated, DOOR OPEN and GEAR lights extinguished.

Flaps. . . . . ____ ____ BLUE LIGHT C
Check flaps in selected position and blue LE FLAP light illuminated.

Hydraulics . . . . . .NORMAL F/E

Landing Checklist. . . . . .COMPLETE F/E

GO-AROUND PROCEDURE

In the event of a missed approach or other circumstances necessitating a go-around with the airplane in the landing configuration, the following procedures will be accomplished:

Thrust.....GO-AROUND
Apply go-around thrust. If appropriate, check for proper indication of AUTOTHROT and AUTOPILOT lights, flight director and annunciator.

Rotate.....GO-AROUND ATTITUDE
Rotate to go-around attitude as thrust levers are advanced; maintain at least approach speed.

Flaps.....RETRACT
PF calls for "Flaps 20 and go-around thrust." PNF makes flap selection and F/E adjusts go-around thrust.

Check engine instruments and flap position indication.

Continue with flap retraction at proper altitude and flap retraction speed schedule.

Landing Gear.....UP
PF checks for positive rate of climb and calls "Gear up." PNF places gear lever UP; check for normal gear retraction.

Flight Director.....AS DESIRED

Speed Brakes.....DOWN DETENT
Place speed brake lever to the DOWN detent after go-around has been accomplished.

NOTE: The speed brake lever may be left in the ARMED position if another approach is to be made.

LANDING ROLL PROCEDURE

After touchdown and during landing roll, the following tasks are accomplished to insure proper systems response for normal deceleration.

Autopilot.....DISENGAGE
When appropriate, disengage autopilot.

Autothrottle.....DISENGAGE
When appropriate, disengage autothrottle. Check thrust levers in idle thrust position.

Speed Brakes.....CHECK
F/E checks that the speed brake lever is in the UP detent.

Reverse Thrust.....AS REQUIRED
F/E checks that REV UNLOCK and FULL REV lights indicate normal operation and that N1 and EGT limits are not exceeded.

Brakes.....AS REQUIRED
F/E checks HYD BRAKE pressure in green band and ANTI-SKID light extinguished.

Anti-Skid.....OFF
When taxi speed is reached, place anti-skid switch OFF; check ANTI-SKID light illuminated.

Body Gear Steering.....ARM
When taxi speed is reached, place body gear steering switch to ARM.

AFTER LANDING PROCEDURE

When clear of the active runway, the following tasks are accomplished to configure the aircraft for parking:

Speed Brakes.....DOWN
Check spoiler indices move to retracted position.
Landing Lights.....AS REQUIRED
Runway Turnoff Lights.....AS REQUIRED
Flaps.....RETRACT
Check that flap position indicators indicate UP and LE FLAPS annunciator lights are extinguished.
Stabilizer Trim.....NEUTRAL
Trim stabilizer to 3 units.
Radar, Transponder, DME.....STBY/OFF
Place radar and transponder to STBY for through flights or OFF for terminating flights. Place DME switch to STBY.
Ignition Switches.....OFF
Galley Power Bus Switches....OFF
If needed, re-establish galley power when on APU or external power.
APU Master Switch.....ON
Check that APU DOOR light illuminates (in transit), then extinguishes (door open).
Outflow Valves.....CHECK OPEN
Air Conditioning Packs.....CHECK
Check that inlet and exit doors indicate full cool.
Hydraulic Systems.....NORMAL
Check all amber lights extinguished, hydraulic quantity, pressure and temperature indications normal.
APU.....START
Electrical Power.....ON APU
Gate Assignment (if necessary).....OBTAIN
Select ground control or company frequency, as applicable, to obtain the assigned gate position.

AMPLIFIED AFTER LANDING CHECKLIST

When clear of the active runway the Captain will call for the After Landing Checklist. The F/E will read and verify that the Checklist is complete.

Outflow Valves	.OPEN	F/E
Galley Power	OFF	F/E
Electrical	.ON APU	F/E
Ignition	OFF	F/E
Anti-Skid	OFF	F/E
Body Gear Steering	ARM	F/E
Speed Brakes	.DOWN, DETENT	F/E
Flaps	UP, NO LIGHTS	F/E
Radar, Transponder, DME	.STBY/OFF	F/E
After Landing Checklist	.COMPLETE	F/E

PARKING PROCEDURE

After the airplane has come to a complete stop the flight crew will perform their respective tasks to park and secure the airplane.

Parking Brakes.....SET
Check that PARK BRAKE and ANTI-SKID HYD lights are illuminated.
External Power (if required).....CONNECTED
Transfer electrical power to external source.
APU Bleed Air Switch.....OPEN
Bleed Air Valves.....CLOSED
Place all engine bleed air valve switches to the closed position; check that VALVE CLOSED lights illuminate.
Air Driven Hydraulic Pumps...OFF
Check that RUN lights extinguish and low PRESS lights illuminate.
Start Levers.....CUTOFF
Check fuel flow decreases.
INS Update.....AS REQUIRED
Update present position as desired.

Place each INS mode switch to OFF on terminating flights.
Voice Recorder.....ERASED
Press and hold ERASE switch for approximately five seconds.
Emergency Lights.....ARMED/OFF
Place switch OFF on terminating flights. Check that UNARMED light illuminates.
Fasten Seat Belts.....OFF
Check that ON light extinguishes.
Exit Lights.....ON
Check that ON light illuminates.
Cockpit Door.....UNLOCK
Windshields.....WASHED
Window Heat Switches.....OFF
Place window heat switches OFF. Check that POWER lights extinguish.
Wing Anti-Ice Switch.....OFF
Check that VALVE lights are extinguished.
Probe Heat Switches.....OFF
Nacelle Anti-Ice Switches....OFF
Exterior Lights.....AS REQUIRED
Dome Lights.....AS REQUIRED
Thrust Levers.....CHECK
Check thrust levers for freedom of movement.
Boost Pump Switches.....OFF
Check that low PRESS lights are illuminated.
Reserve Fuel Transfer Switches.....CLOSED
Check that RES VALVE lights illuminate (in transit) then extinguish (valve closed).
Air Conditioning.....AS REQUIRED
Place packs, recirculating fans, gasper air, upper deck heat and trim air switches off when no longer required.
Flight Recorder.....OFF
Check that OFF light illuminates.
Aft Cargo Heat.....OFF
Check that ON light extinguishes.
Cockpit Lights.....AS REQUIRED
Oxygen.....100% & OFF
- - - - - - - - - - - - - - - - -
Crew Oxygen Control Valve.....CLOSE
APU.....SHUTDOWN
When air conditioning and/or electrical power no longer required. Place APU bleed air switch to CLOSE before shutting down APU.
Battery Switch.....OFF

NOTE: Items below line not required on through flights.

AMPLIFIED SHUTDOWN CHECKLIST

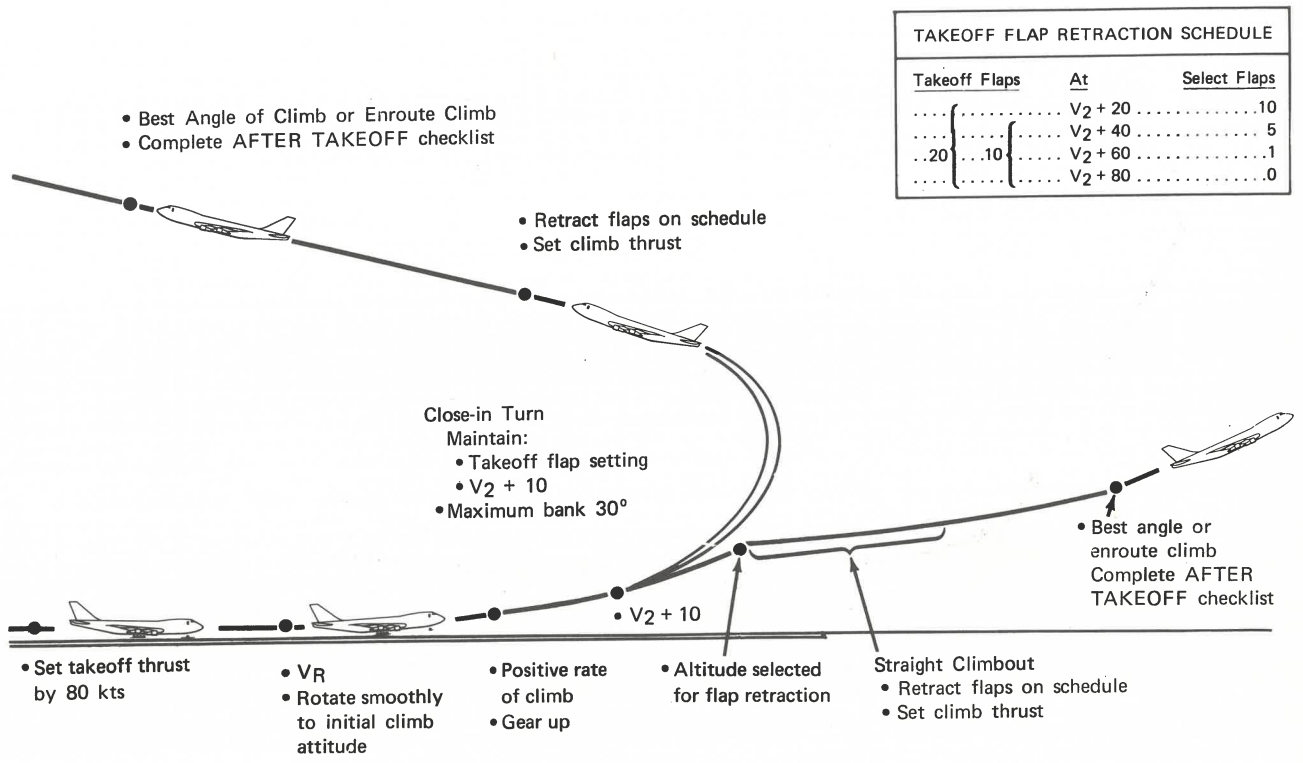
After parking, and prior to leaving the airplane, the Captain will call for the Shutdown Checklist. The F/O will read the checklist and the appropriate crew member(s) will reply with the proper response.

Parking Brakes	SET	C
Start Levers	CUTOFF	C
Seat Belt	OFF	C
Window Heat	OFF	F/O
Probe Heat	OFF	F/O
Exterior Lights	AS REQUIRED	F/O
Air Conditioning	AS REQUIRED	F/E
Air Pumps	OFF	F/E
Reserve Fuel Transfer Switches	CLOSED	F/E
Oxygen Regulators	100%, OFF	ALL

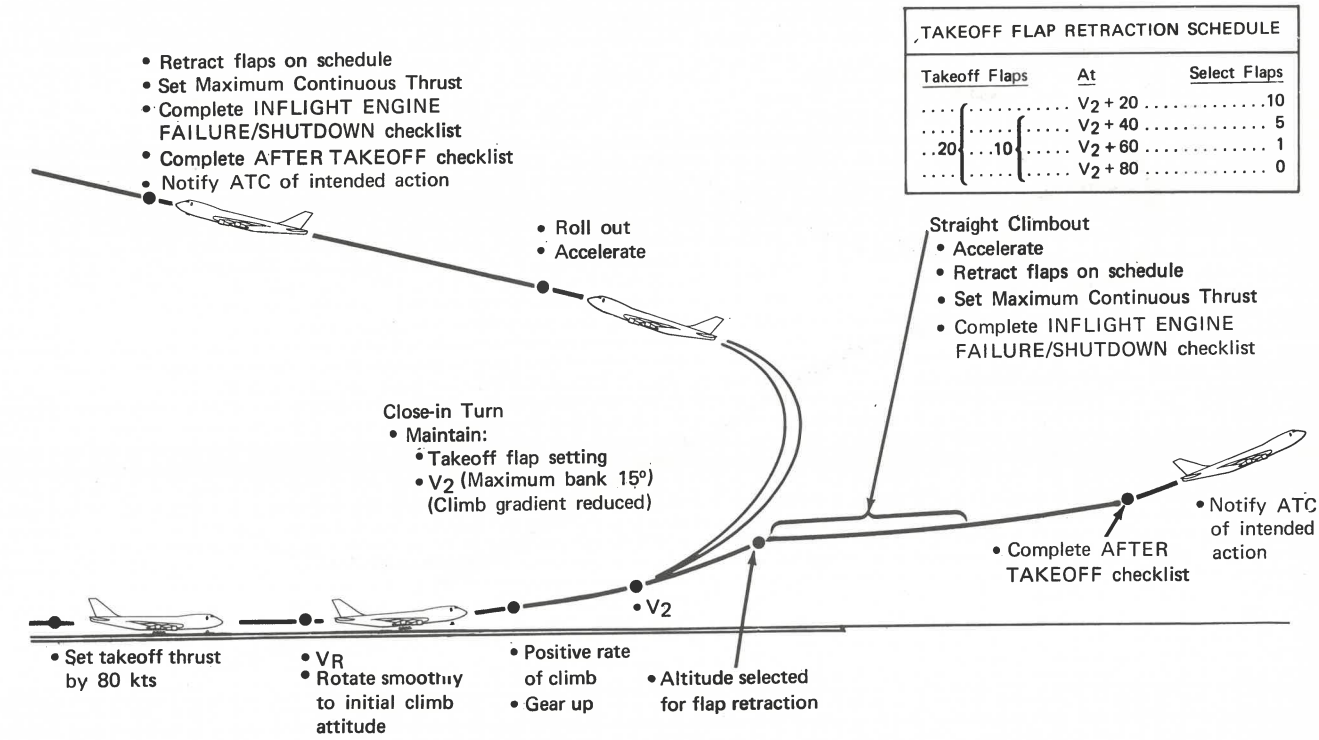
- -

INS Mode	OFF	C
Emergency Lights	OFF	C
Oxygen Valve	CLOSED	F/E
APU	OFF	F/E
Battery	OFF	F/E
Shutdown Checklist	COMPLETE	F/O

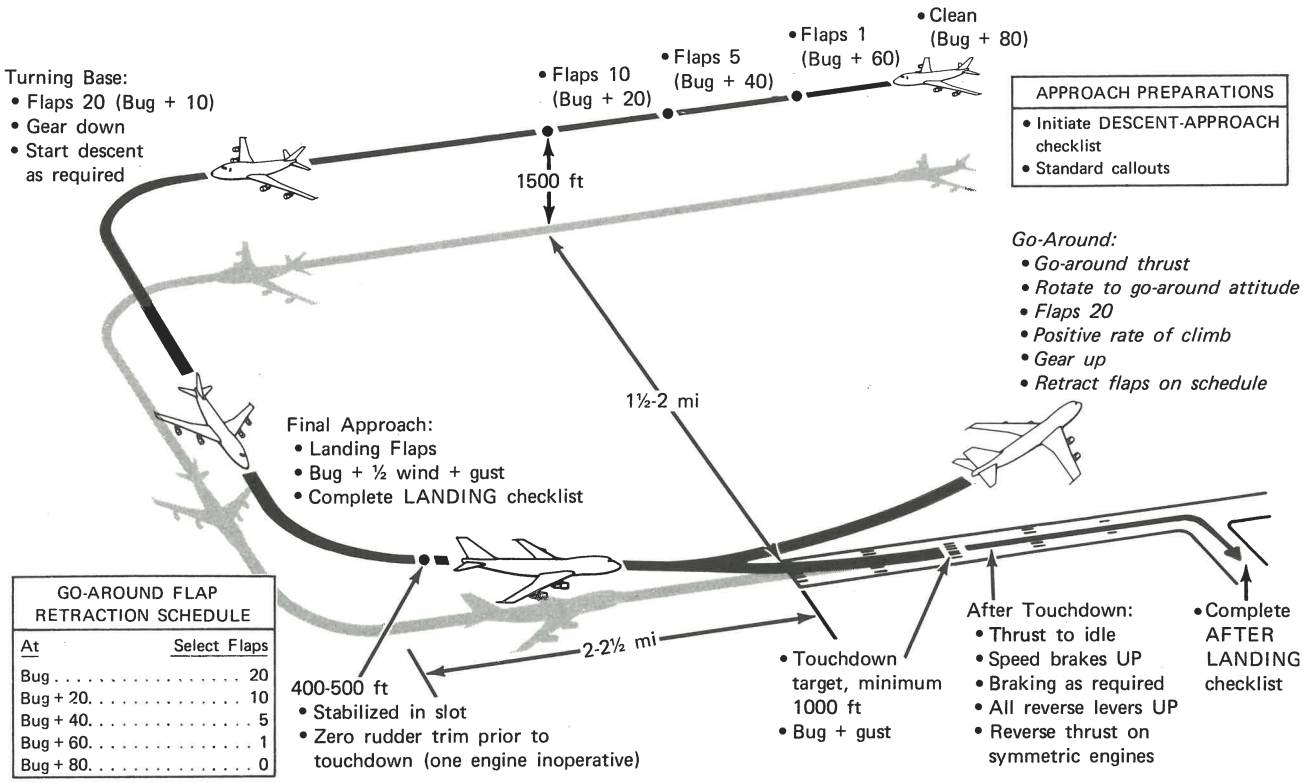
NOTE: Items below line not required on through flights.



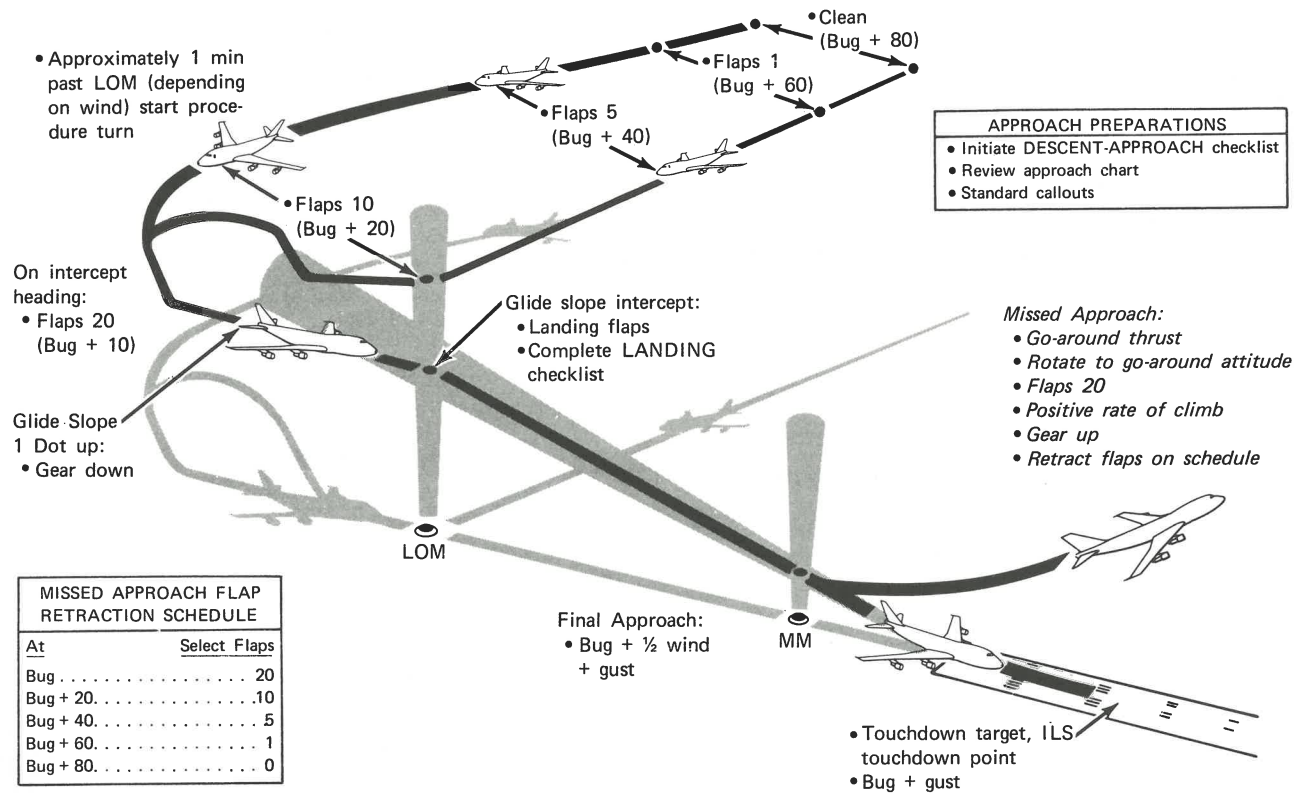
NORMAL TAKEOFF



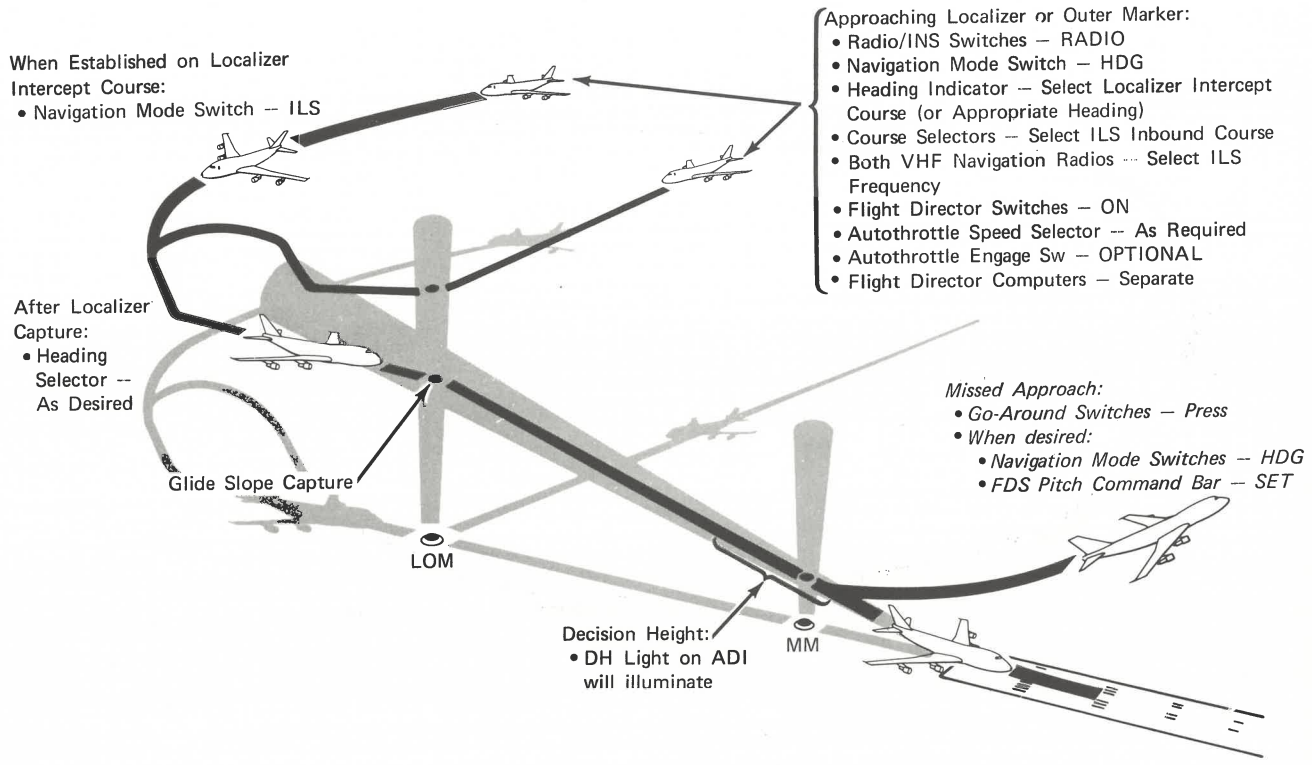
TAKEOFF ENGINE FAILURE AFTER V_1



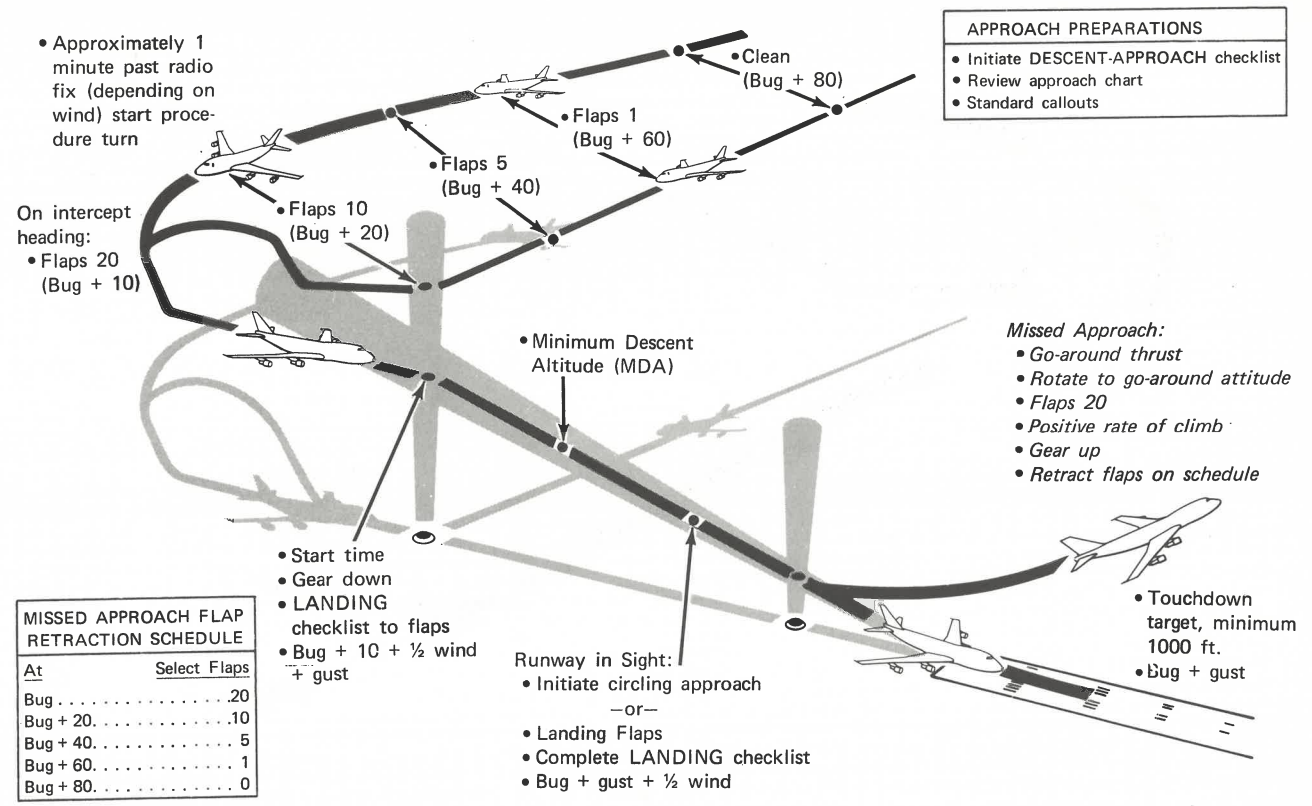
NORMAL LANDING
(INCLUDING ONE ENGINE INOPERATIVE)



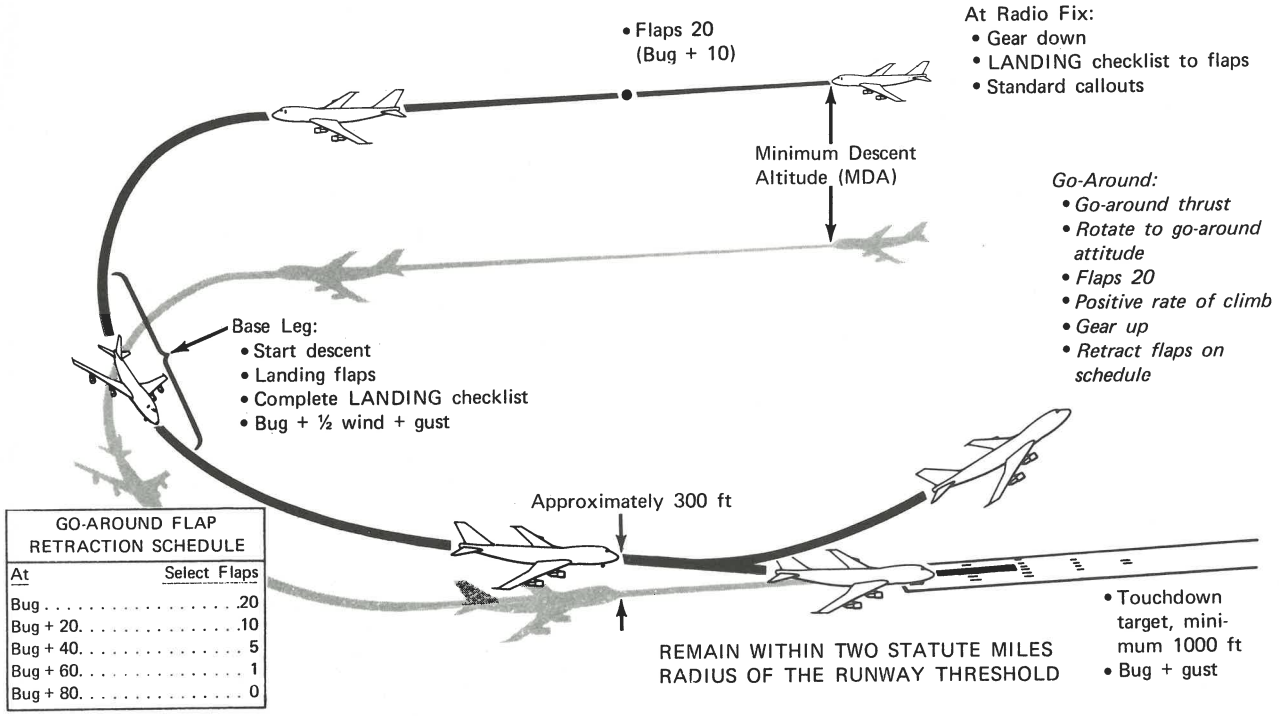
ILS



ILS FLIGHT DIRECTOR

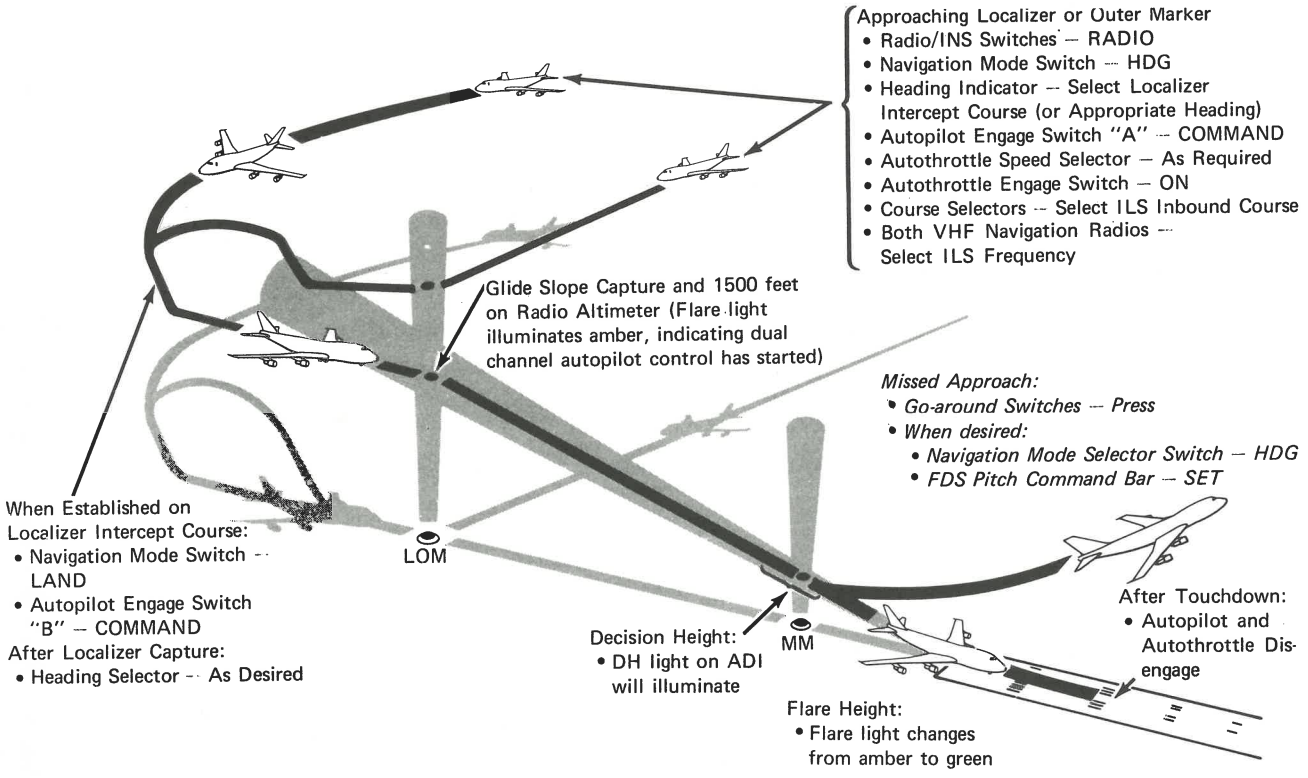


VOR-LOC-ADF-ASR



GO-AROUND FLAP RETRACTION SCHEDULE	
At	Select Flaps
Bug	20
Bug + 20	10
Bug + 40	5
Bug + 60	1
Bug + 80	0

CIRCLING
(INSTRUMENT APPROACH COMPLETE MAINTAIN VISUAL CONTACT)



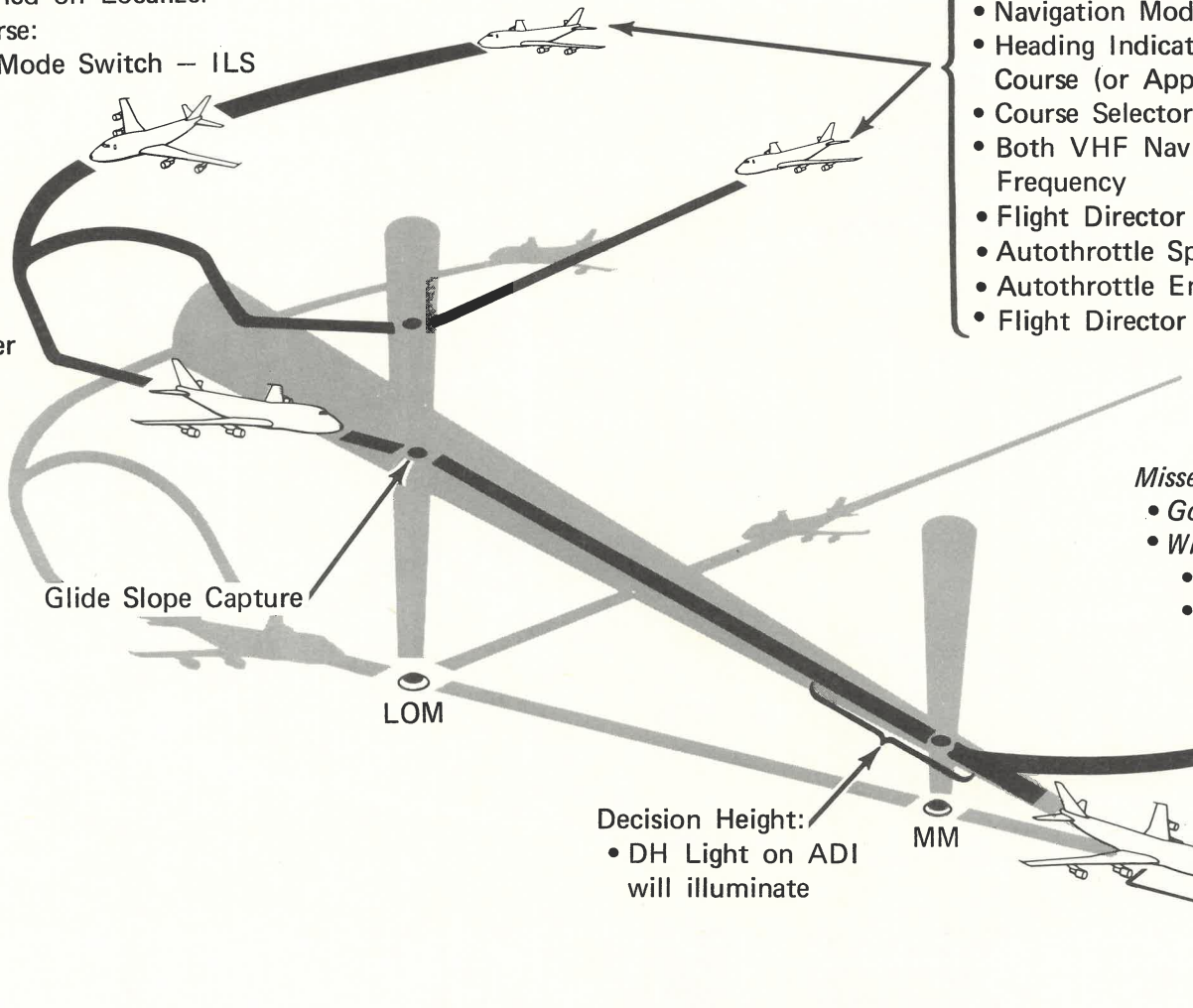
AUTOLAND

747 ILS FLIGHT DIRECTOR

Approaching Localizer or Outer Marker:
- Radio/INS Switches – RADIO
- Navigation Mode Switch – HDG
- Heading Indicator – Select Localizer Intercept Course (or Appropriate Heading)
- Course Selectors – Select ILS Inbound Course
- Both VHF Navigation Frequencies – Select ILS Frequency
- Flight Director Switches – ON
- Autothrottle Speed Selector – As Required
- Autothrottle Engage Sw – ON (Cat II Approach)
- Flight Director Computers – Separate

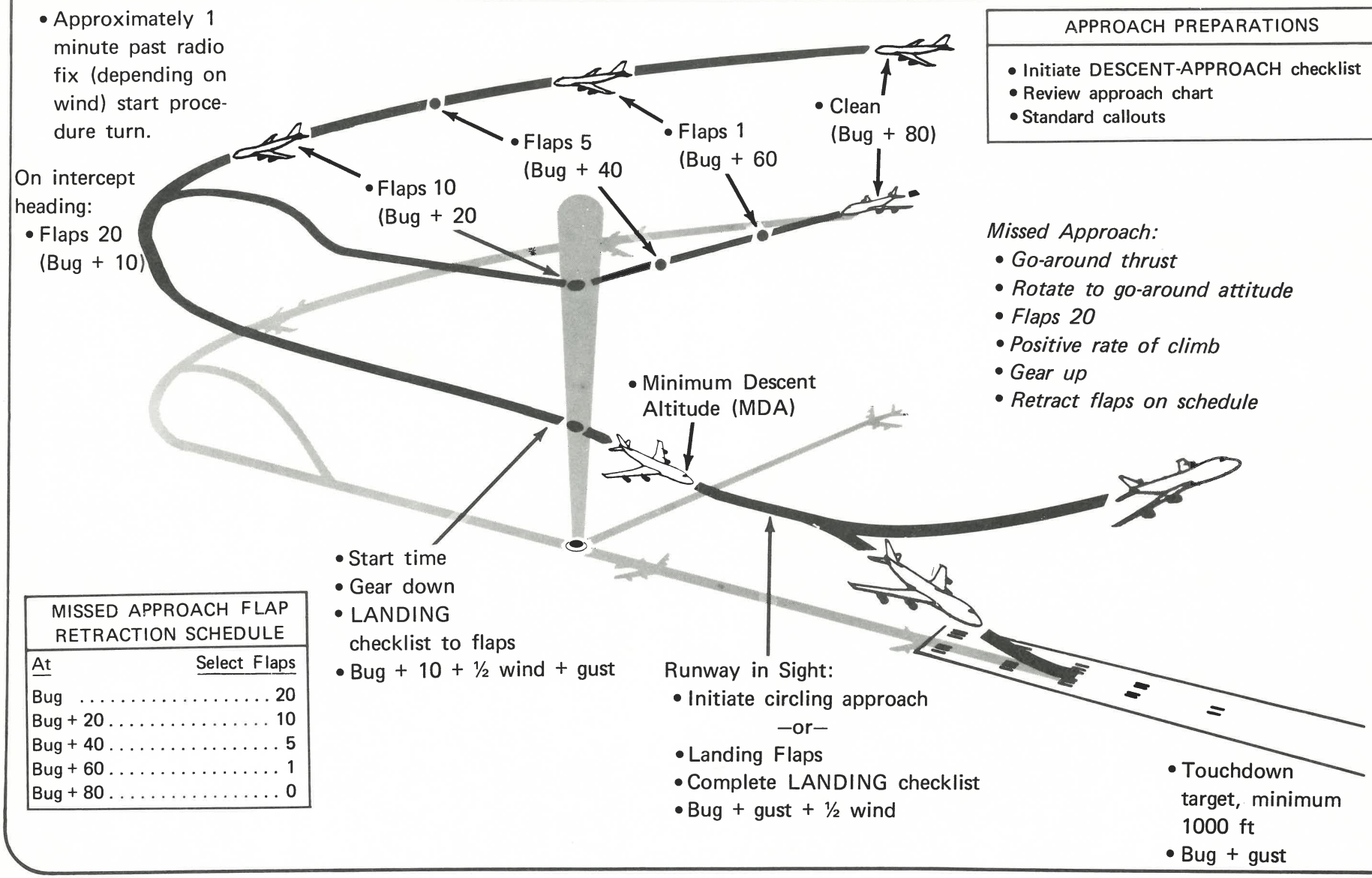
When Established on Localizer Intercept Course:
- Navigation Mode Switch – ILS

After Localizer Capture:
- Heading Selector – As Desired



Missed Approach:
- *Go-Around Switches – Press*
- *When desired:*
  - *Navigation Mode Switches – HDG*
  - *FDS Pitch Command Bar – SET*

747 VOR-LOC-ADF-ASR



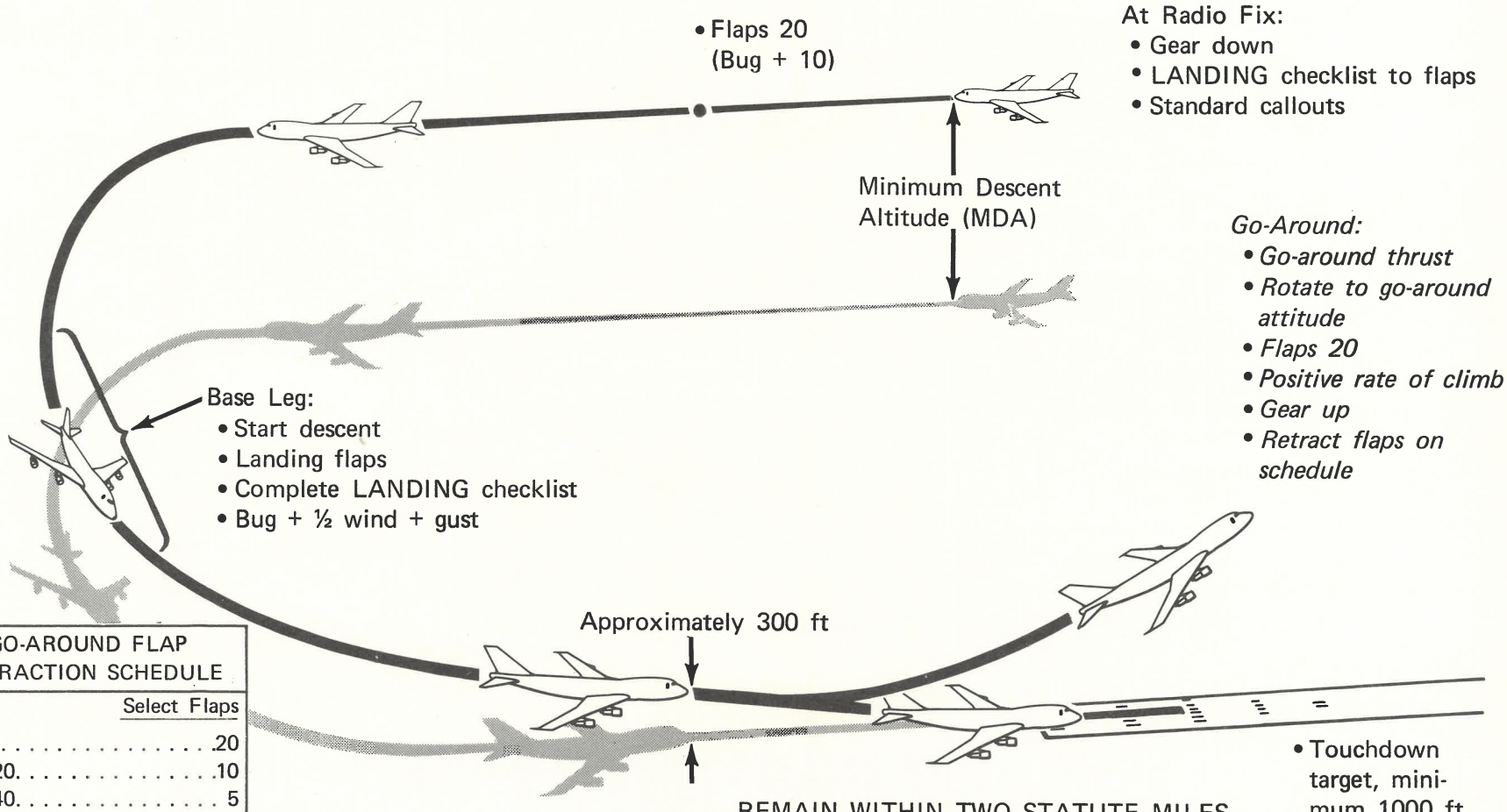
APPROACH PREPARATIONS
• Initiate DESCENT-APPROACH checklist • Review approach chart • Standard callouts

Missed Approach:
- *Go-around thrust*
- *Rotate to go-around attitude*
- *Flaps 20*
- *Positive rate of climb*
- *Gear up*
- *Retract flaps on schedule*

MISSED APPROACH FLAP RETRACTION SCHEDULE	
At	Select Flaps
Bug	20
Bug + 20	10
Bug + 40	5
Bug + 60	1
Bug + 80	0

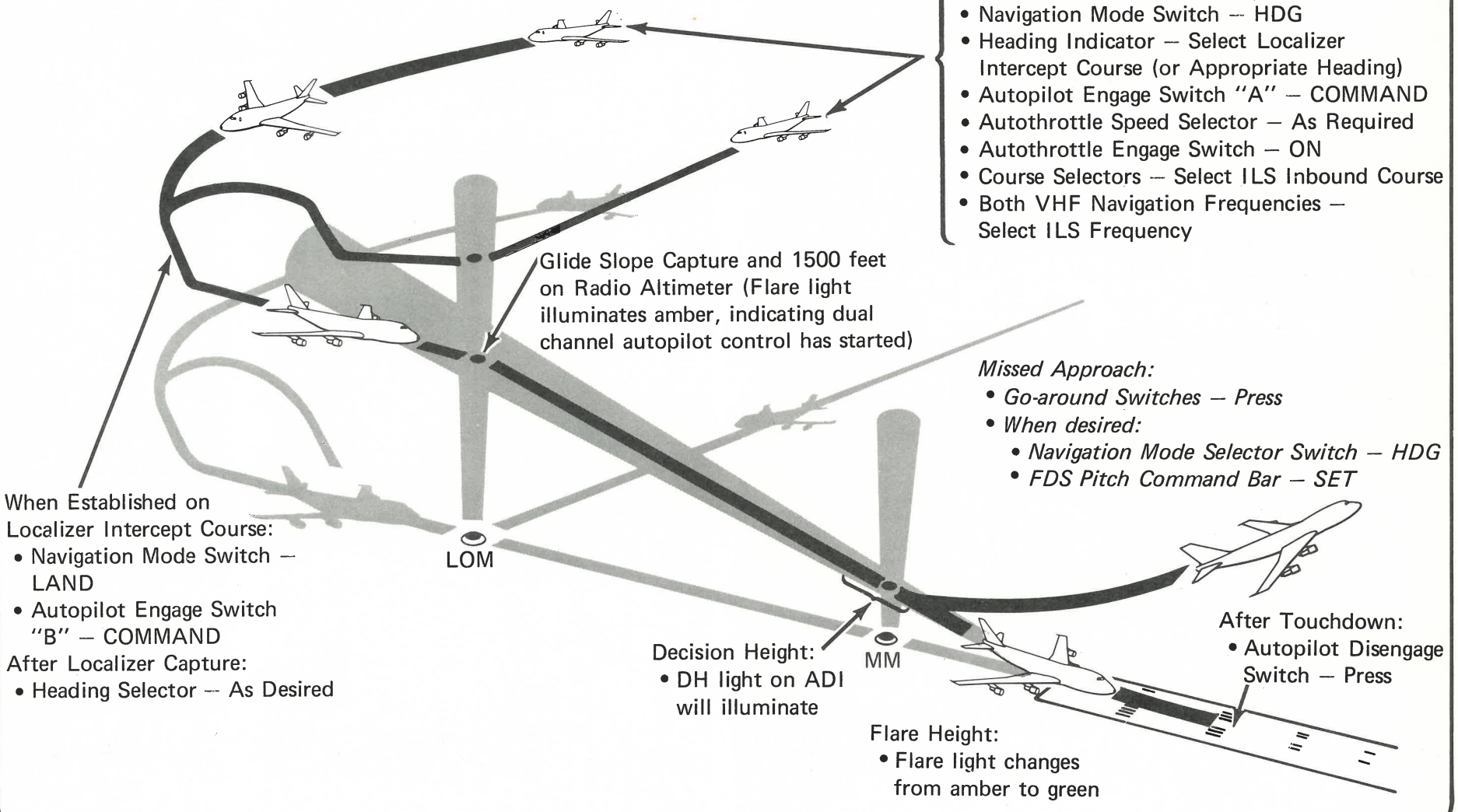
747 CIRCLING

INSTRUMENT APPROACH COMPLETE MAINTAIN VISUAL CONTACT



GO-AROUND FLAP RETRACTION SCHEDULE	
At	Select Flaps
Bug	20
Bug + 20	10
Bug + 40	5
Bug + 60	1
Bug + 80	0

747 AUTOLAND



COLD WEATHER OPERATION

Operating the airplane in cold weather conditions may present additional problems as a result of the low temperatures. The majority of cold weather operating difficulties are encountered on the ground. The following instructions are intended to supplement or amplify the normal procedures and should be observed where applicable.

PRELIMINARY COCKPIT PREPARATIONS

The operation of the APU is adversely affected by ice accumulations in the inlet areas and by ingestion of ice or foreign materials. Higher than normal EGT indications with a reduction in duct pressure are an indication of inlet area icing. The condition of the APU battery and operation of the battery heater is more critical during cold weather.

When operating APU during icing conditions, the APU bleed air switch should be in the OPEN position. Bleed air for APU anti-icing is supplied from the pneumatic duct downstream of the APU bleed air valve.

NOTE: Flight operation with the APU door open is not permitted in icing conditions.

To heat airplane use all packs whenever possible. Turn zone 1 recirculating fan OFF when packs are operating.

CAUTION: DO NOT REMOVE ELECTRICAL POWER WITH PACKS OPERATING. CONTROLLERS AND PROTECTIVE CIRCUITS ARE INOPERATIVE.

EXTERIOR INSPECTION

Although removal of surface snow, ice or frost is normally a maintenance function, the flight crew should be especially alert during preflight preparation to areas where conditions could change and affect normal system operations. Supplemental preflight checks should include the following:

- Airplane exterior surface free of frost, ice or snow. Takeoff with light coating of frost up to 1/8 inch on the lower surfaces of the wing will not affect takeoff performance.
- APU door, air conditioning inlet and exit doors, outflow valves, landing gear doors, and movable control surfaces free of impacted snow and unobstructed.
- Engine inlet cowling and auxiliary air inlet doors free of ice. Engine N1 rotor free to rotate.

ENGINE START

Normal procedures for engine starting are applicable for cold weather operations. For engine start after prolonged cold soak periods at subzero temperatures idle engine for two minutes before changing thrust lever position. Initial oil pressures may be above normal. Engine manufacture does not specify a minimum oil temperature during takeoff for the JT9D engine. The oil pressure must be in the normal range.

CAUTION: IF THERE IS NO INDICATION OF OIL PRESSURE AFTER 30 SECONDS OF ENGINE OPERATION SHUT DOWN THE ENGINE.

AFTER ENGINE START

In cold weather operation the electrical generators may be slow to produce stabilized power. CSD should operate normally and power should stabilize within one minute.

Place nacelle anti-ice switches ON after engine start when visible moisture such as fog, rain or wet snow is present with static air temperature below +8°C (46°F) Engine ignition should be turned on prior to activating nacelle anti-ice.

NOTE: Normally adequate anti-ice is available providing the NACELLE and STATOR VALVE OPEN lights indicate proper system operation. However, it may be required to advance the thrust slightly to provide sufficient bleed pressure to open the nacelle valve and/or illuminate the NACELLE VALVE OPEN light(s).

If severe icing conditions are present during prolonged ground operation, periodic engine run-up to as high a thrust setting as practical (45% N1 desired) may be performed to minimize the possibility of ice build-up. This run-up need not be made more frequently than 10 minute intervals for a duration of 10 to 15 seconds.

Subsequent takeoff should be preceded by a static run-up to as high a power level as practical (minimum 45% N1) for 10 to 15 seconds and stable engine operation observed prior to brake release.

TAXI

Maintain a greater separation distance than normal when operating on ice or snow covered areas. Pieces of ice, packed snow or slush can cause damage to the airplane, ramp facilities, personnel or other airplanes. Use all engines at minimum thrust necessary to initiate airplane movement.

When taxiing on a slick taxiway particularly in strong crosswind conditions avoid using large tiller inputs for sideslip correction. The body gear steering may aggravate a skid condition.

Avoid taxiing with the flaps extended when slush conditions exist. Snow or slush thrown up by the main gear may accumulate in the flap slot areas. With large accumulations of ice or packed snow flap damage could occur during subsequent retraction.

NOTE: If the flaps are left up during taxi to avoid slush and ice, the BEFORE TAKEOFF checklist will not be complete until flaps are in takeoff position and the flight control check completed.

CAUTION: WHEN OPERATING THE WING FLAPS DURING LOW TEMPERATURES, THE FLAP POSITION INDICATORS SHOULD BE CLOSELY OBSERVED FOR POSITIVE MOVEMENT. IF THE FLAPS SHOULD STOP, THE FLAP CONTROL LEVER SHOULD BE PLACED IMMEDIATELY IN THE SAME POSITION AS INDICATED.

BEFORE TAKEOFF

If icing conditions are anticipated during taxi, takeoff roll, or immediately after takeoff, the nacelle anti-icing system should be ON. When tank fuel temperature is between 0°C and -40°C, turn fuel heat switches to ON for 1 minute before takeoff. Below -40°C operate fuel heat on a 2-minute cycle. Fuel heat should be OFF for takeoff.

Wing anti-ice system is more effective as a deicer and is not effective with leading edge flaps extended.

NOTE: Do not switch wing anti-ice on for takeoff or until leading edge flaps are in retracted position.

TAKEOFF

Experience on precipitation covered runways has shown that, wet snow, standing water and ice can adversely effect takeoff performance. Slush and standing water will increase drag on the landing gear. Precipitation in any form will affect stopping capability. The airplane limit gross weight for a particular runway and V1 may be reduced to account for the runway condition. Lowering V1 will increase the available stopping distance.

Takeoff and accelerate-stop distances and V1 speeds in the FAA Approved Airplane Flight Manual are based on smooth, dry, hard surfaced runways. See Section 24.30 to determine the effects of snow or slush on FAR field lengths.

Normal takeoff procedures should be used when taking off from precipitation covered runways.

If the decision is made to stop the takeoff and the runway is slick, raise the speed brakes, use maximum allowable symmetrical reverse thrust, and maximum braking. Rudder is effective for directional control, down to 50 knots. With the brake pedals fully depressed and not modulated, the antiskid system will operate to provide the minimum distance stop for the existing condition of the runway.

CAUTION: AT TEMPERATURES BELOW -43°C (-45°F) ARMING OF THE TAKEOFF WARNING SYSTEM CANNOT BE ASSURED AT T.O. EPR.

To accomplish the takeoff configuration check at these low temperatures, momentarily advance fully then retard the No. 3 thrust lever. The horn will sound if takeoff configuration is not within established limits.

CLIMB

If icing conditions are anticipated subsequent to takeoff, the use of anti-icing may be delayed until needed. Activate nacelle anti-ice before penetration of icing conditions to prevent ice buildup.

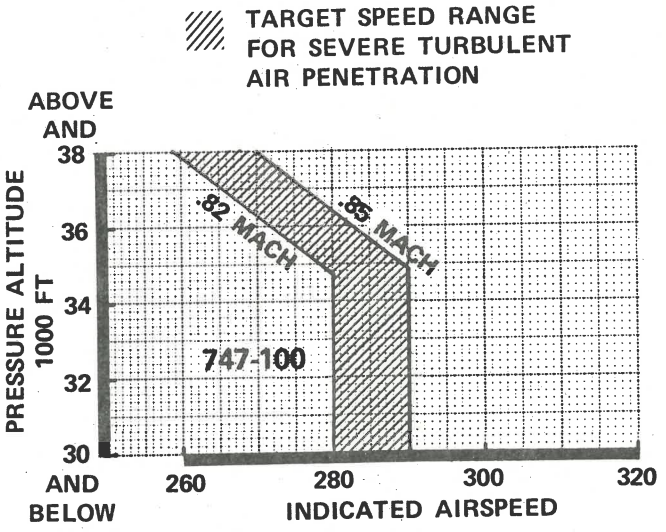
The recommended use of the wing anti-ice system is to remove ice after an appreciable amount has formed. A slight performance loss will result when wing anti-ice system is ON.

CRUISE

Monitor fuel tank temperature as required. The type of fuels available for use have a wide range of freeze point temperatures generally between -36 and -72°F. When fuel with a restrictive freeze point is used be aware of the limitation on tank fuel temperature of freeze point +3°C. If fuel temperature approaches limit, decrease altitude or divert to warmer air. Increasing Mach number will tend to increase the resultant fuel temperature obtained after extended periods of cold soak.

SEVERE TURBULENT AIR PENETRATION

The following graph shows the recommended target airspeed range for severe turbulent air penetration:



Target airspeed should be within the range of 280-290 KIAS or Mach .82-.85, whichever is lower. Target N1 settings for turbulent penetration speeds are in Chapter 23, Section 23.10.54A. Engine ignition should be on.

DESCENT AND APPROACH

When descending through visible moisture adjust thrust levers as required to insure adequate bleed air for nacelle anti-ice system operation. If icing is unexpectedly encountered, turn nacelle anti-ice on for one engine at a time. The ingestion of ice accumulation may result in engine instability.

If icing is encountered turn wing anti-ice ON as necessary to deice wing and before extending leading edge flaps. The wing anti-ice system is not effective with flaps extended and should be turned OFF.

CAUTION: AT TEMPERATURES BELOW -43°C (-45°F) DO NOT ARM THE AUTO SPEED BRAKES. MOVEMENT OF THRUST LEVERS FOR A GO AROUND MAY NOT ACTUATE SPEED BRAKE RETRACTION SWITCHES.

LANDING

Braking effectiveness will be significantly reduced on wet, slush covered or icy runways. To obtain optimum braking from the 747 anti-skid system:

- Smoothly apply full brake pressure.
- Do not attempt to modulate.
- Hold constant brake pressure until speed has been reduced to a safe taxi speed.

On initial brake application the anti-skid system modulates the applied brake pressure to determine the skid threshold. On detecting a wheel deceleration, impending skid, the anti-skid system releases brake pressure sufficient to avoid skid. Three or four releases will occur in the process of determining the optimum brake pressure for the existing runway conditions. When the brake pedals are modulated or re-adjusted for additional or less braking this process is repeated. Braking effectiveness during readjustment period is reduced.

On slick surfaces the optimum applied brake pressure is appreciably reduced. The effect of the initial releases is more pronounced. The varying runway surface conditions associated with ice and snow will result in additional anti-skid system brake releases. These combined with the reduced optimum brake pressure will significantly increase stopping distances. Modulating the brake pedals will only aggravate the conditions.

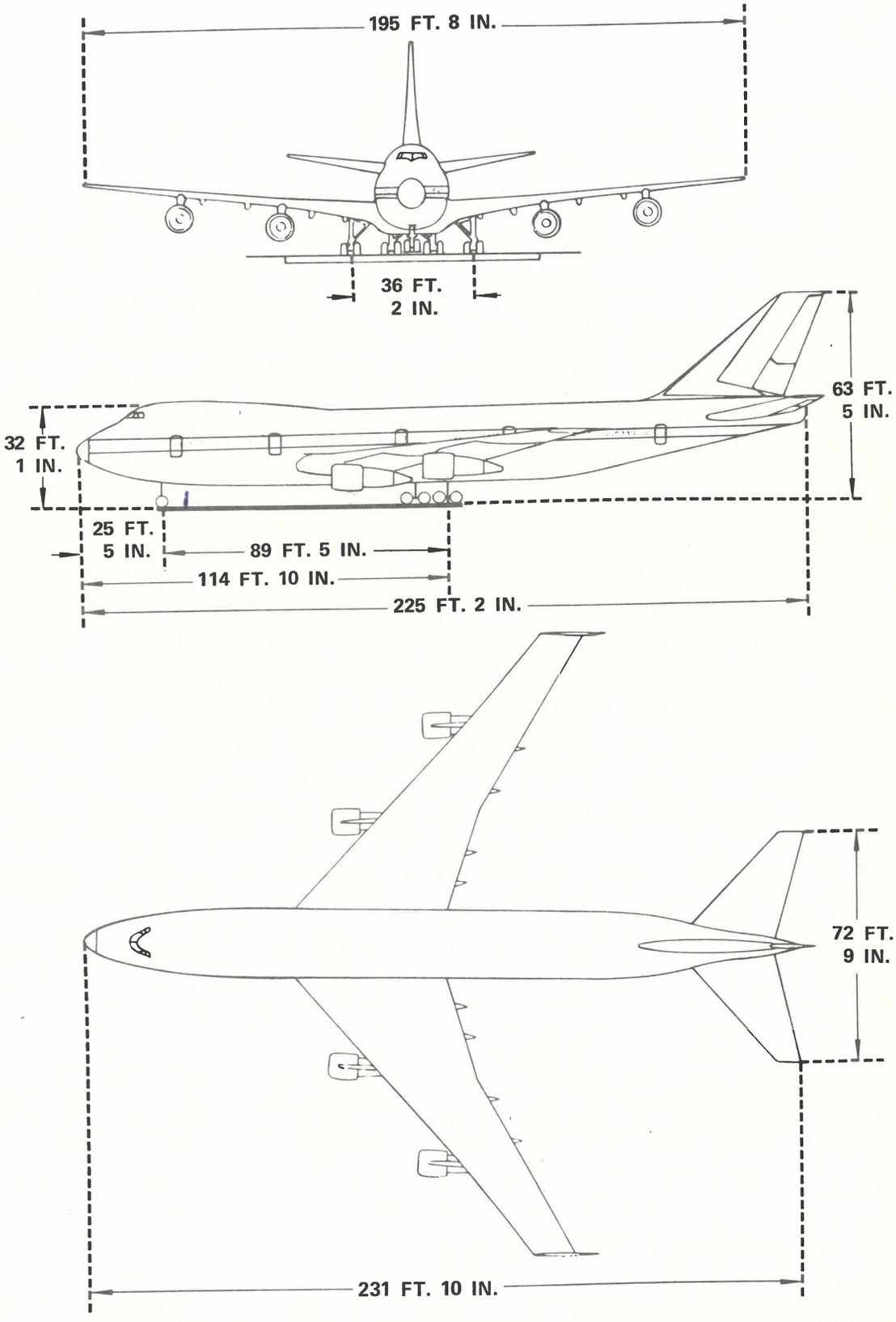
At slower speeds especially on slick surfaces, the effect of the anti-skid system brake releases are even more pronounced. For these conditions the anti-skid system is still effective and should not be turned OFF until a safe taxi speed is reached.

AFTER LANDING

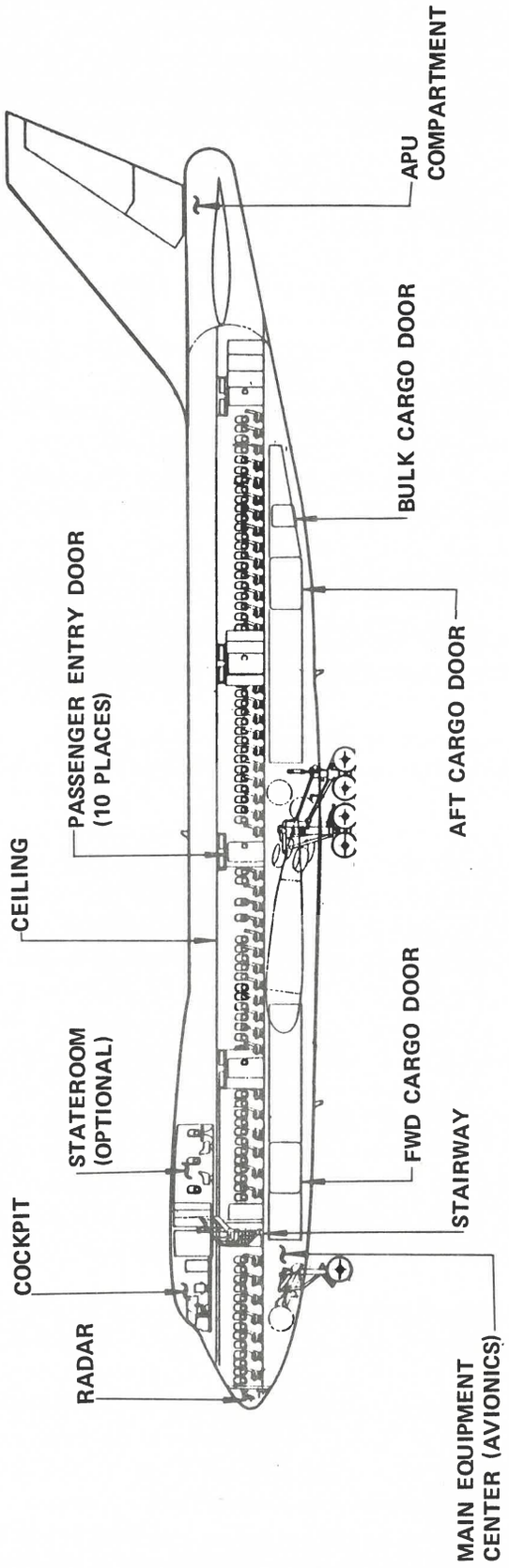
If icing conditions exist or were encountered during approach, or if slush or wet snow is on the runway, do not retract flaps beyond 25 for taxi. A visual inspection should be accomplished to determine that the flaps and flap areas are clear of ice, snow, or slush before further retraction of the flaps.

If icing conditions exist do not start APU until just prior to engine shutdown when APU bleed air may be used.

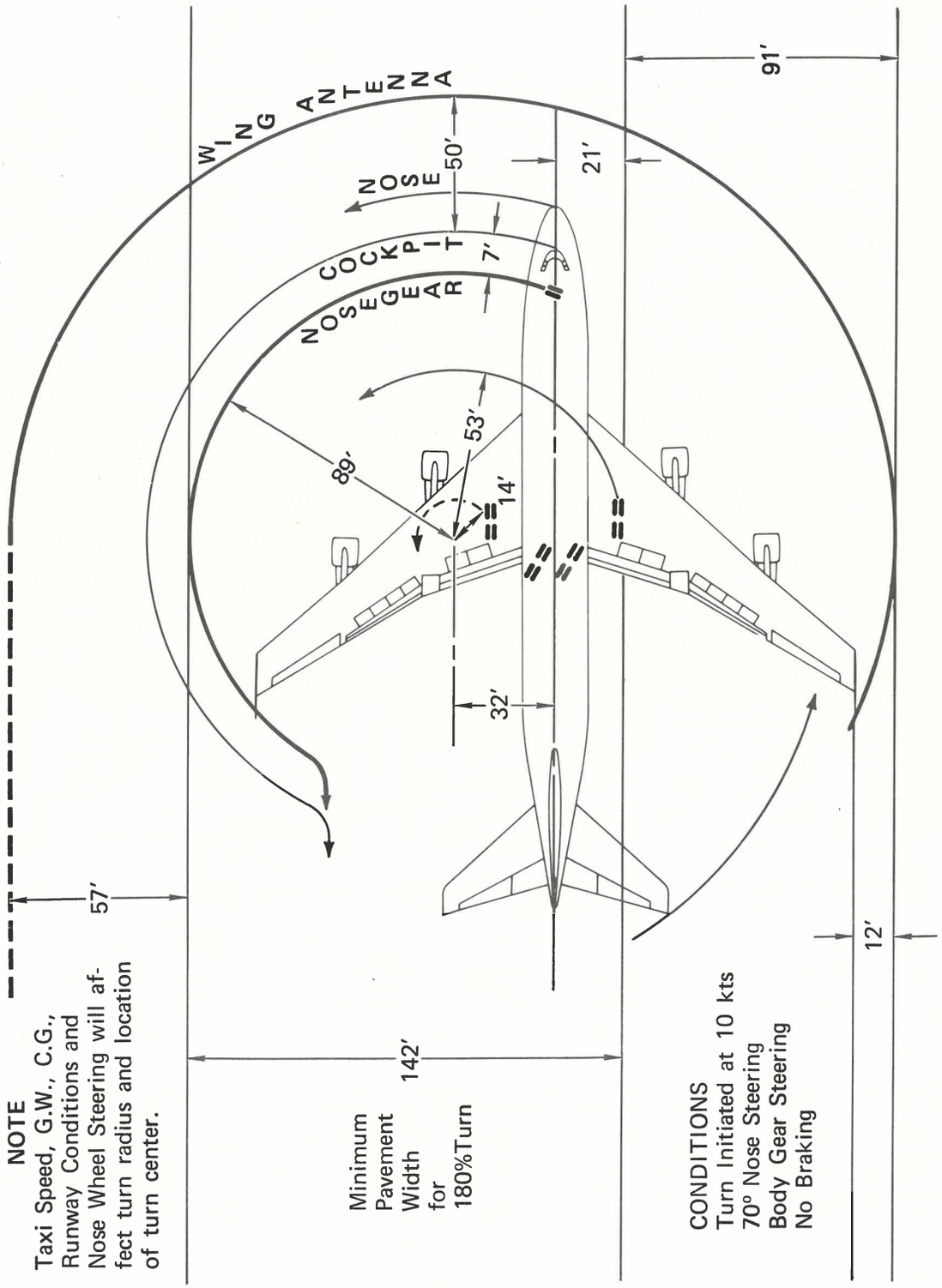
CHAPTER 5



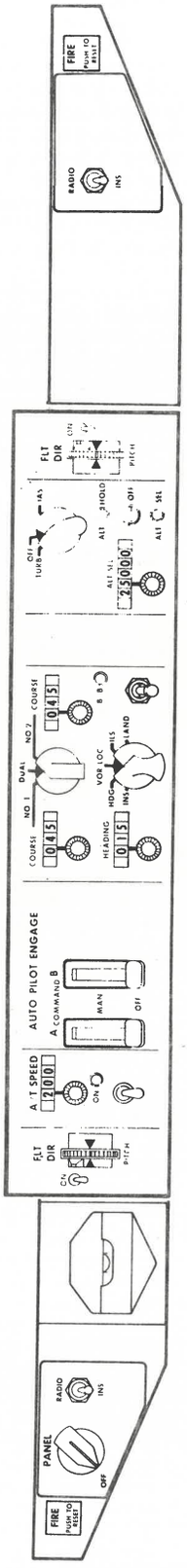
PRINCIPAL DIMENSIONS



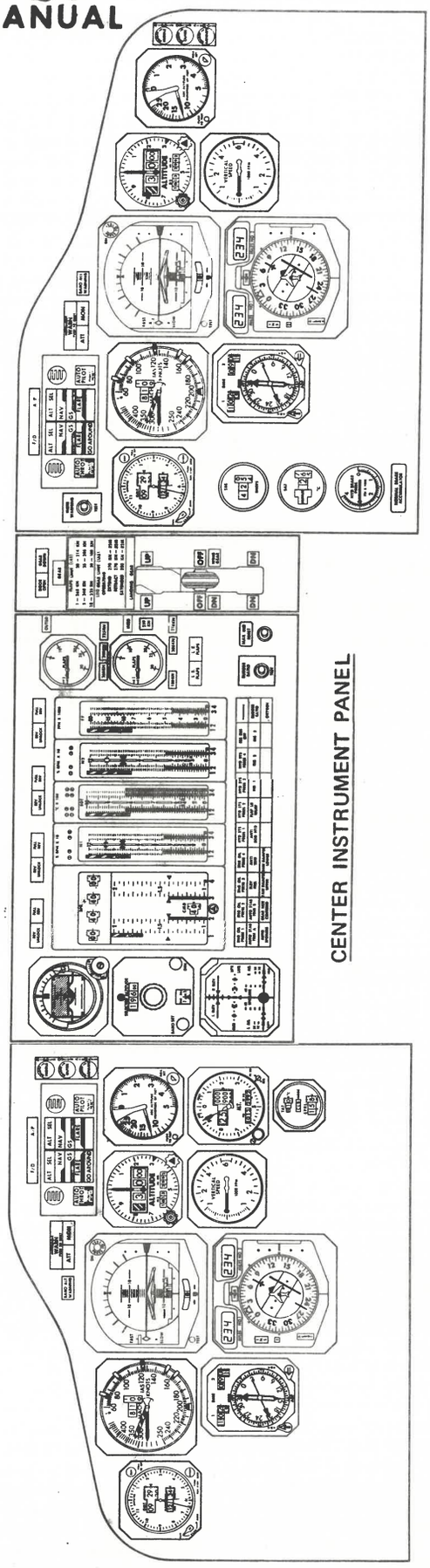
AIRPLANE DECK STRUCTURE



TURNING RADIUS



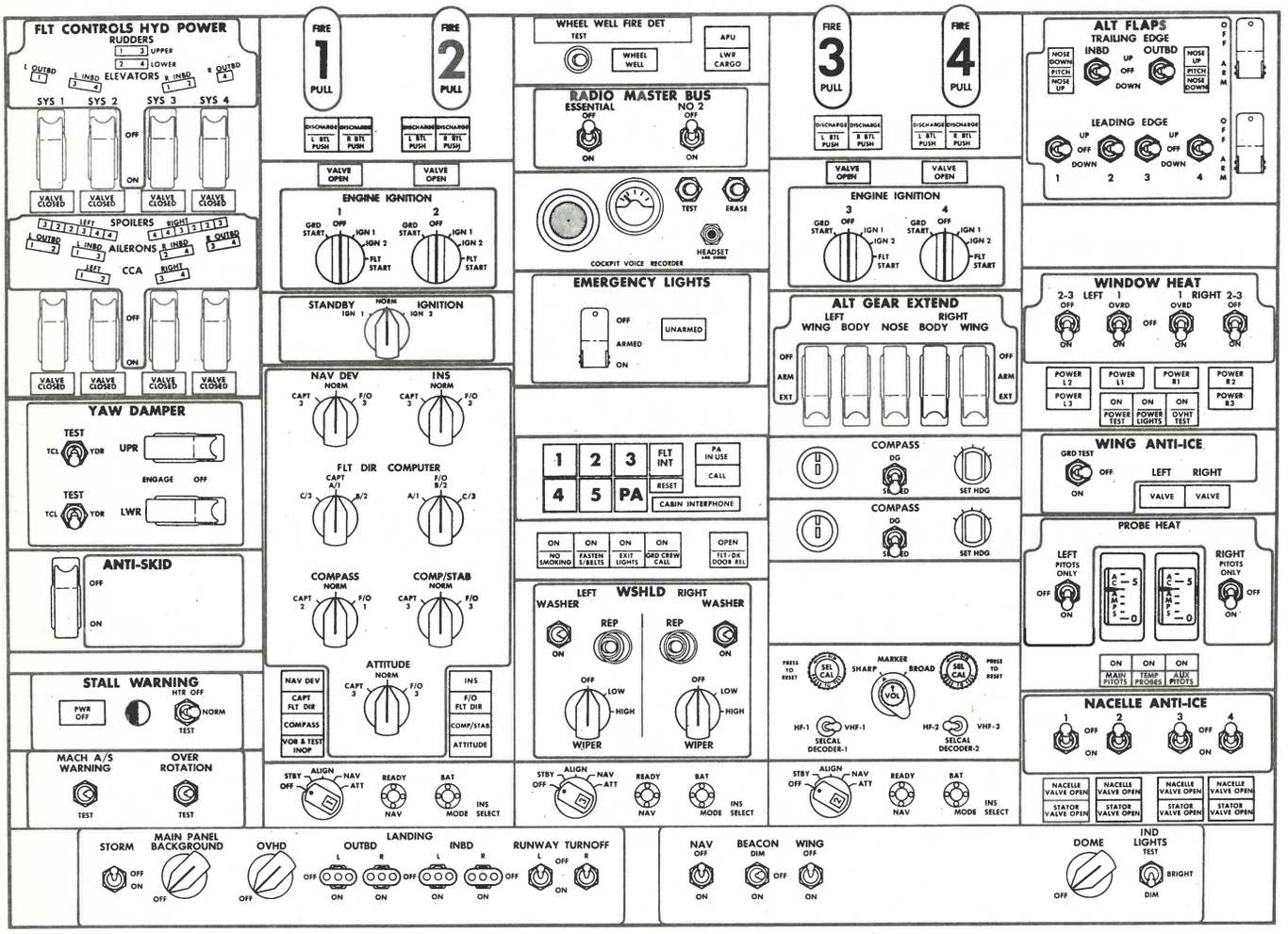
PILOTS' LIGHT SHIELD



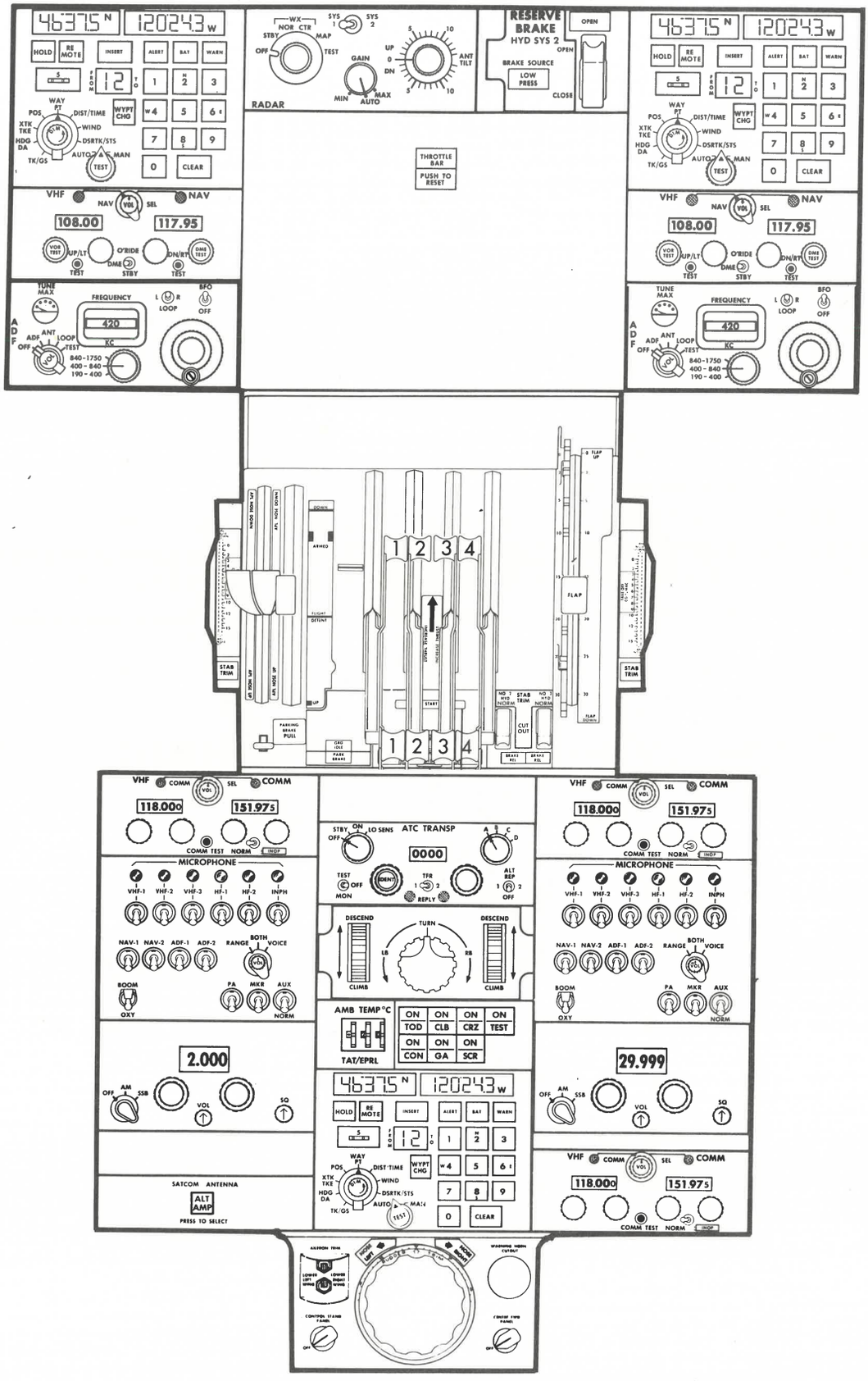
FIRST OFFICER'S INSTRUMENT PANEL

CENTER INSTRUMENT PANEL

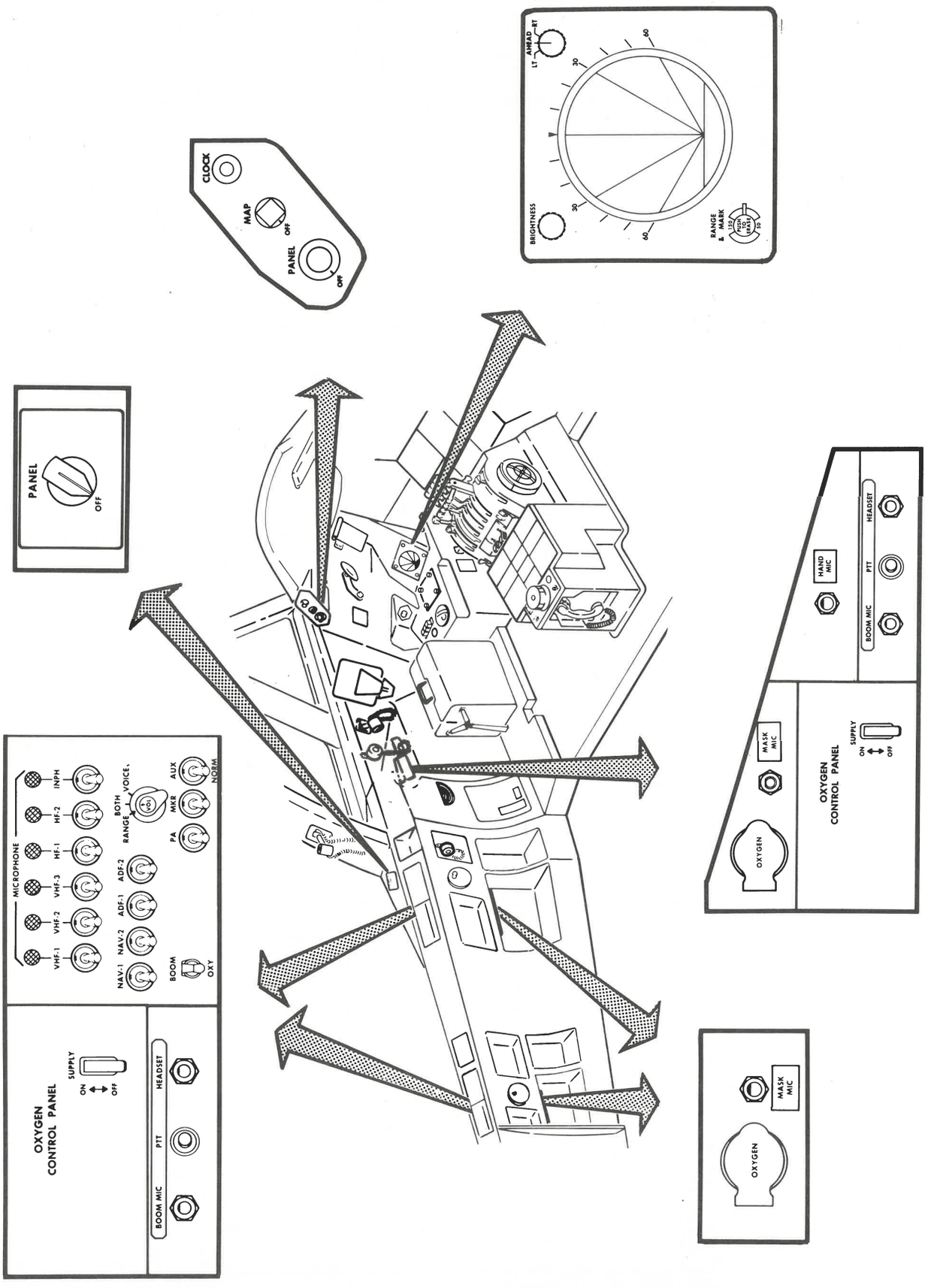
CAPTAIN'S INSTRUMENT PANEL



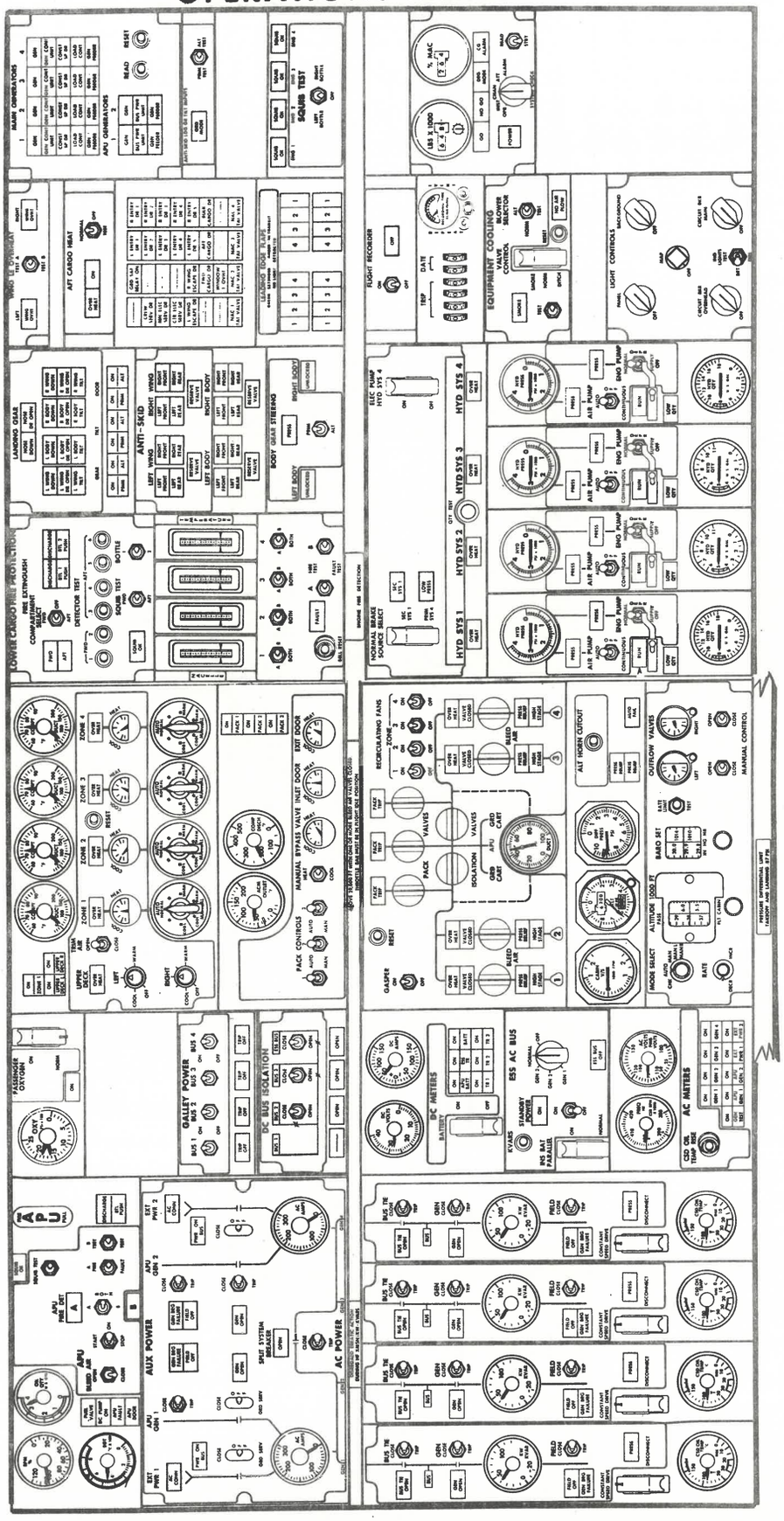
PILOTS' OVERHEAD PANEL



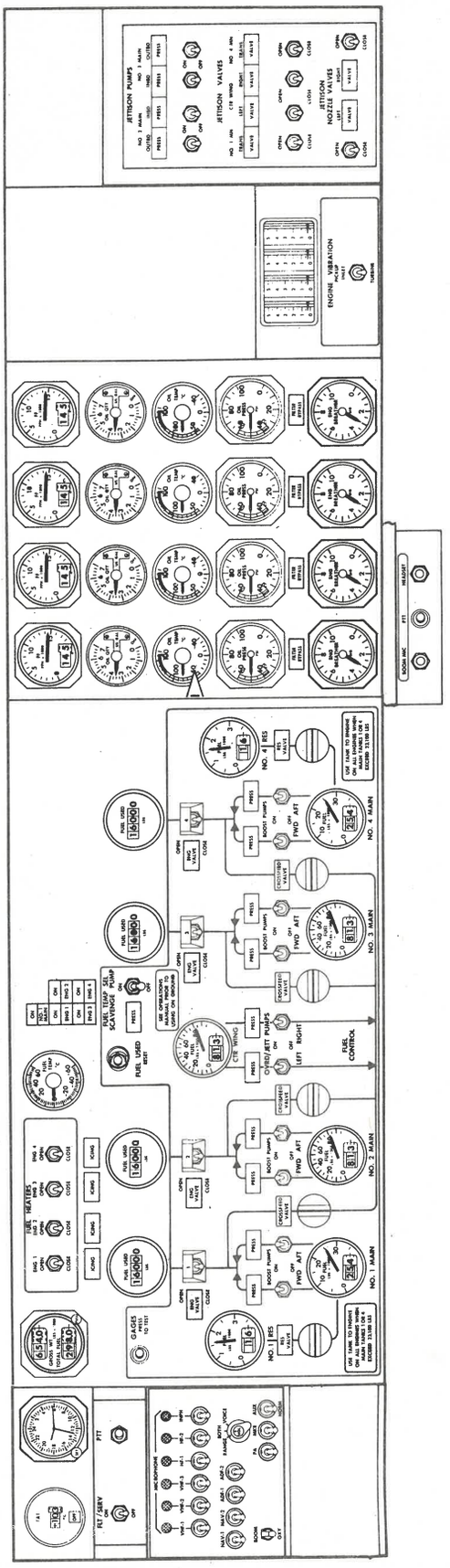
PILOTS' CONTROL STAND



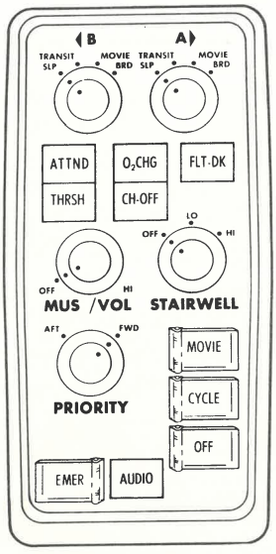
PILOTS' AUXILIARY AND OBSERVERS' PANELS



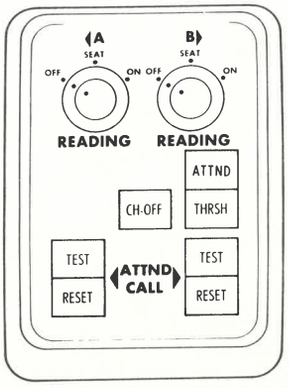
FLIGHT ENGINEER'S INSTRUMENT PANELS – UPPER



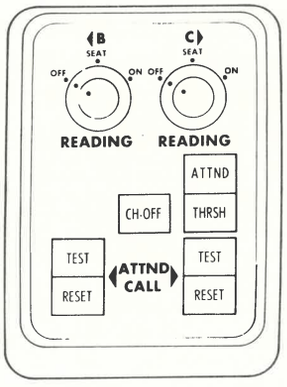
FLIGHT ENGINEER'S INSTRUMENT PANELS — LOWER



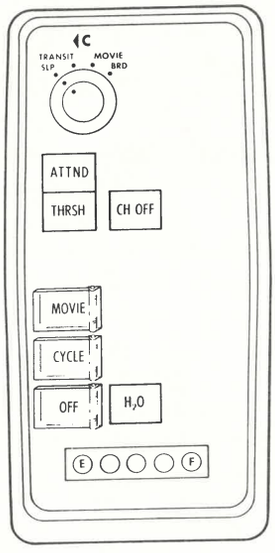
STATION 1L



STATION 1R



STATION 2R



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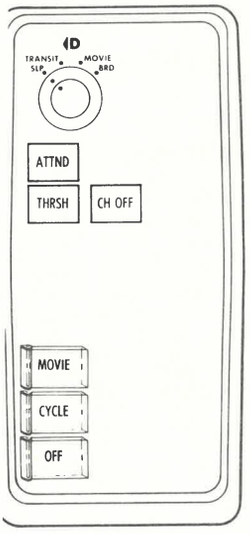
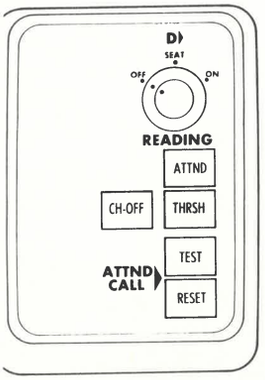
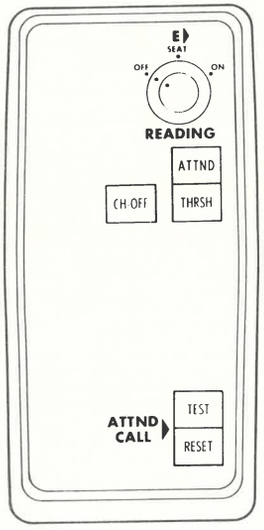


STATION 3L



STATION 3R



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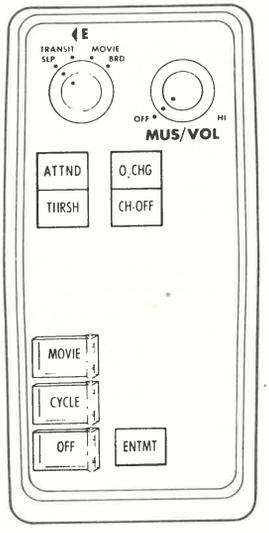
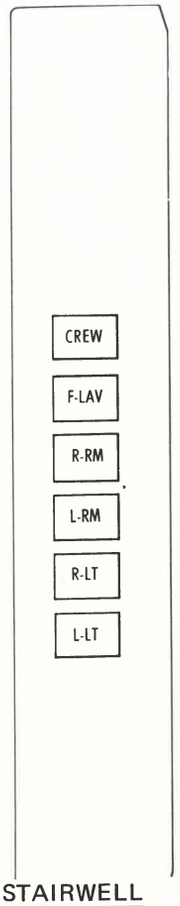
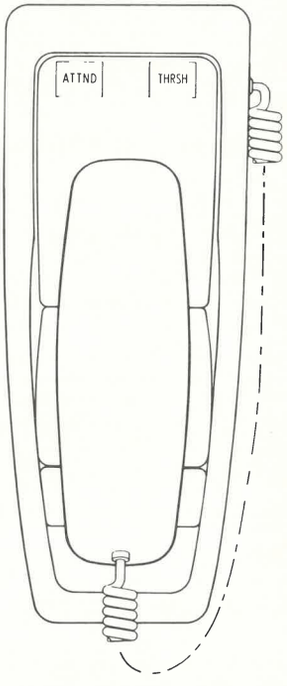


STATION 4R



STAIRWELL ATTENDANT'S STATION



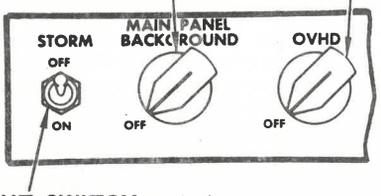
STATION 5 – L AND R

MAIN PANEL BACK-GROUND LIGHT SWITCH

Controls intensity of Captain, F/O and center panel background lights.

OVERHEAD LIGHT SWITCH

Controls intensity of Pilots' overhead panel edge lighting.

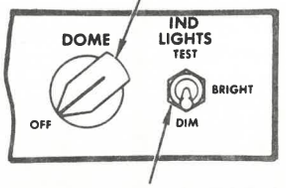


STORM LIGHT SWITCH

ON – Overrides background lighting switches to provide full intensity and turns on the dome lights.

DOME LIGHT SWITCH

Controls intensity of Captain and F/O dome lights.



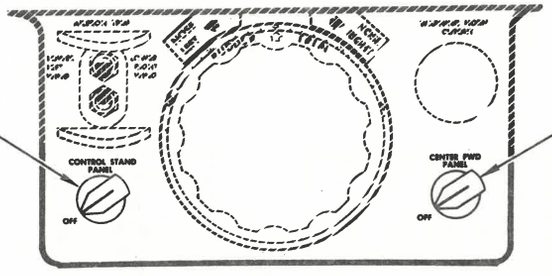
PILOTS' OVERHEAD PANEL

MASTER INDICATOR LIGHTS DIM AND TEST SWITCH

TEST – Tests all indicator lights on pilots' panels except approach progress display, marker beacon and INS modules. Intensity set as desired by DIM or BRIGHT.

CONTROL STAND PANEL LIGHT SWITCH

Controls intensity of lights on pilots' control stand, forward and aft electronic panels.



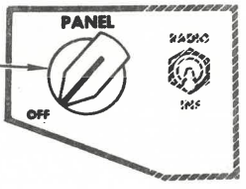
PILOTS' CONTROL STAND

CENTER FORWARD PANEL LIGHT SWITCH

Controls intensity of edge lighting on pilots' center panel.

PILOTS' LIGHTSHIELD LIGHT SWITCH

Controls intensity of edge lighting on lightshield.



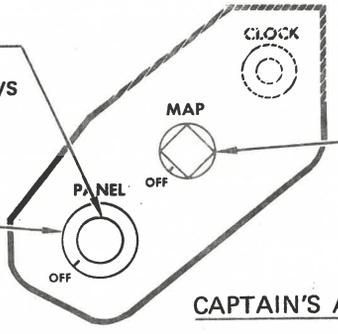
PILOTS' LIGHTSHIELD

DIGITAL LIGHT SWITCH

Controls intensity of digital displays on Captain's and F/O's instrument panels respectively.

PANEL LIGHT SWITCH

Controls intensity of edge lighting on Captain's and F/O's instrument panels respectively.



MAP LIGHT SWITCH

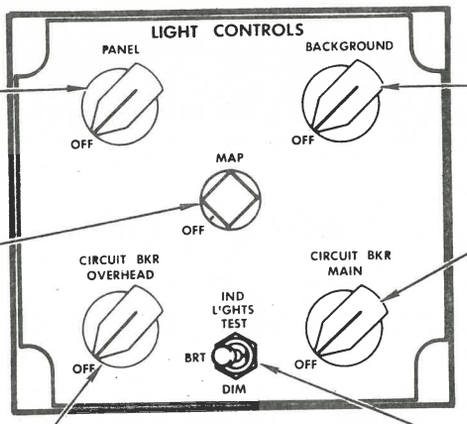
Pull out and rotate for variable intensity. Light located in ceiling.

CAPTAIN'S AND F/O'S AUXILIARY PANELS

COCKPIT LIGHTING CONTROLS

PANEL LIGHT SWITCH
Controls intensity of edge lighting of F/E's panel.

MAP LIGHT SWITCH
Controls intensity of spotlight above F/E's panel.



F/E'S AUXILIARY PANEL

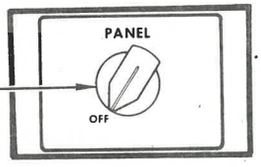
BACKGROUND LIGHTS SWITCH
Controls intensity of F/E panel background lights.

MAIN CIRCUIT BREAKER PANEL LIGHT SWITCH
Controls intensity of edge lighting for P6 circuit breaker panel.

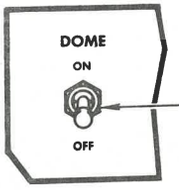
OVERHEAD CIRCUIT BREAKER PANEL LIGHT SWITCH
Controls intensity of edge lighting for P7 and P12 circuit breaker panels.

MASTER INDICATOR LIGHTS DIM AND TEST SWITCH
TEST – Tests all indicator lights on F/E's panel. Intensity set as desired by DIM or BRIGHT.

OBSERVERS' PANEL LIGHT SWITCH
Controls intensity of edge lighting on both observers' panels.

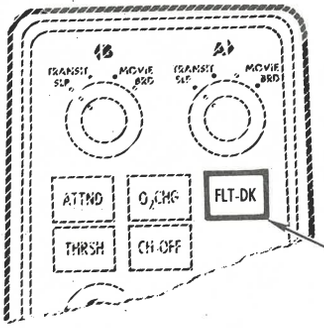


FIRST OBSERVER'S PANEL

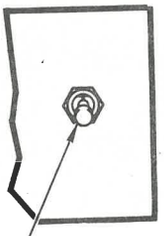


P6 PANEL – LOWER RIGHT

FLIGHT ENGINEER'S DOME LIGHT SWITCH



CABIN ATTENDANTS PANEL – STA. 1L



EXTERIOR MAIN EQUIPMENT CENTER HATCH & CREW SERVICE DOOR

FLIGHT DECK ENTRY LIGHTS SWITCHES
With external power established any switch illuminates/extinguishes entry lights consisting of spiral stairwell lights and E/E compartment light.

COCKPIT LIGHTING CONTROLS

ALL LAVATORIES

RETURN TO SEAT

LOUNGE

RETURN TO SEAT
FASTEN SEAT BELT

PASSENGER CABIN PSU'S AND LOUNGE

NO SMOKING

PASSENGER CABIN PSU'S

FASTEN SEAT BELT

PASSENGER CABIN DOORS AND CREW SERVICE DOOR

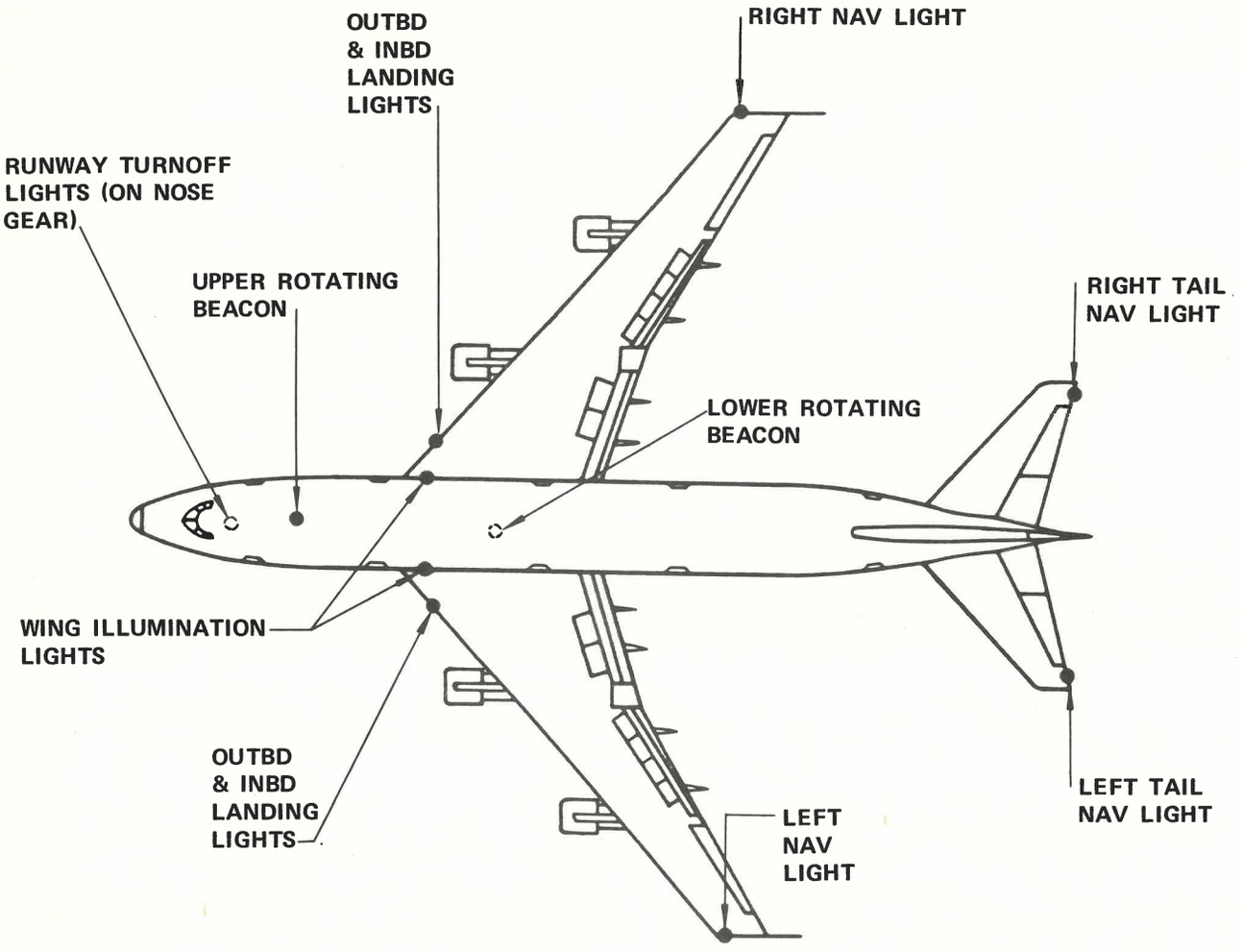
EXIT

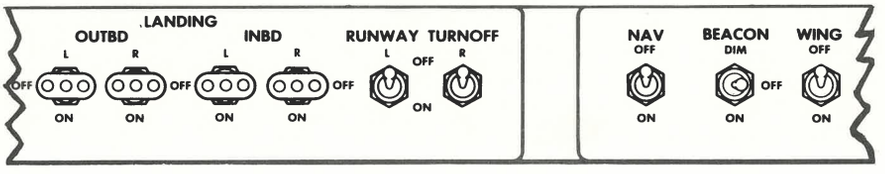
Press to operate switch. Switch is on when ON light is illuminated.

Press to unlock cockpit door. Door is unlocked when OPEN light is illuminated.

PILOTS' OVERHEAD PANEL

PASSENGER SIGN CONTROLS





PILOTS' OVERHEAD PANEL

EXTERIOR LIGHTS LOCATION

EXTERIOR LIGHTING

LIGHTING SUPPLEMENTARY INFORMATION

COCKPIT

Cockpit illumination is provided by background, panel, overhead flood, and spot lighting.

Background lights illuminate both pilots' and center instrument panels and the F/E's panels. Controls are rotary switches which increase the intensity of incandescent lights with clockwise rotation. Further rotation, after reaching full intensity, extinguishes the incandescent lights and illuminates fluorescent lights. Placing the storm light switch to ON overrides the main control switches to provide full intensity lighting. Additional incandescent lamps powered by the battery bus will illuminate whenever normal background lighting power fails.

Variable intensity rotary switches control edge lighting for the following panels: Captain, F/O and center panels, overhead, control stand, main and overhead circuit breaker panels, lightshield, F/E and observer's panels.

General area lighting is provided by variable and fixed intensity incandescent dome lights. The Captain, F/O and F/E lights will illuminate to full intensity with the storm light switch in the ON position. In event of loss of normal dome light power, the Captain and F/O dome lights will automatically illuminate off battery bus power.

Flight deck entry light switches at the crew service door, cabin attendant's station 1L and the main electronic equipment hatch illuminate the spiral stairwell lights and the E/E compartment lights to provide limited access lighting when external power is established.

Overhead variable intensity map lights with individual controls are provided for the Captain, F/O and F/E. A detachable utility light is provided for each crew member and observer. The standby compass has a light switch at the top of the compass housing.

Both pilots and F/E have a test and intensity control for their respective indicator lights (except for the approach progress display, marker beacon and INS modules.). In the TEST position, all indicator lights are simultaneously tested at full intensity.

PASSENGER CABIN LIGHTS

The passenger signs (NO SMOKING, FASTEN SEAT BELTS and RETURN TO SEAT) are operated by pushbutton switches on the pilots' overhead panel.

Passenger cabin lights include the following: ceiling lights, cove lights, window lights, night illumination lights and lounge lights. The passenger cabin lights are distributed over zones with the controls located at the appropriate cabin attendants' panels. Lounge lights are controlled at the lounge attendants' panel. The spiral stairs are illuminated by both dome and tread lights. Individual reading lights are controlled by the passenger at the PSU.

Passenger loading lights include threshold, manifest, door entry and aisle crossover lights. All are controlled at the cabin attendants' panels. Coat compartments have individual light controls at the compartment and stowage compartments have door operated lights.

EXTERIOR LIGHTS

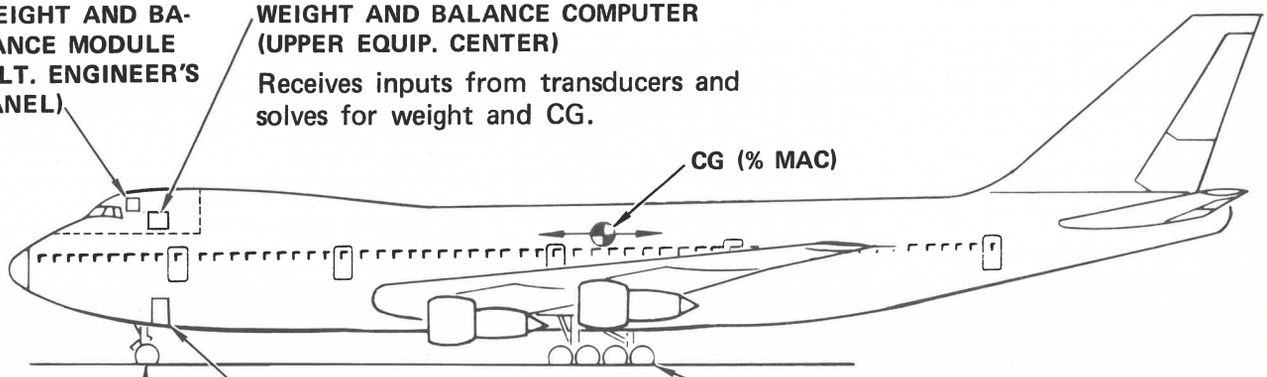
Exterior lights include the landing, runway turnoff, navigation, beacon, and wing illumination lights. Controls are located on the pilots' overhead panel.

WEIGHT AND BALANCE MODULE (FLT. ENGINEER'S PANEL)

WEIGHT AND BALANCE COMPUTER (UPPER EQUIP. CENTER)

Receives inputs from transducers and solves for weight and CG.

CG (% MAC)



NOSE GEAR TRANSDUCERS (2)

One for each wheel assembly.

ATTITUDE SENSOR

Determines pitch attitude from true horizontal and gives correction signal for CG to computer.

MAIN GEAR TRANSDUCERS (16)

One for each wheel assembly.

AIRPLANE WEIGHT AND BALANCE SYSTEM COMPONENT LOCATIONS

GROSS WEIGHT INDICATOR

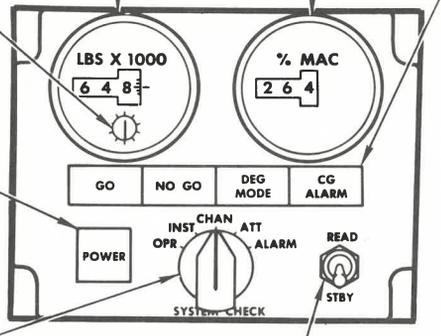
CENTER OF GRAVITY INDICATOR

WIND EFFECT INDICATOR

Used in conjunction with READ switch to determine zero or minimum wind condition.

CG POWER SWITCH

Push to apply or remove power to system. Switch illuminates when ON.



F/E PANEL

CG SYSTEM CHECK SWITCH

OPR – Normal position.

INST – Checks indicators. NO GO light illuminates until indicators drive to 765,000 lbs. (± 2000) and 07.5% (± .3). GO light then illuminates.

CHAN – Checks inputs from all channels. GO or NO GO light illuminates.

ATT – Checks attitude sensor. GO or NO GO light illuminates.

ALARM – Checks alarm circuit. CG ALARM light illuminates.

CG SYSTEM ANNUNCIATOR LIGHTS

GO (Green) – Indicates that the system being checked is operational. Functions only with SYSTEM CHECK switch in INST, CHAN and ATT position.

NO GO (Amber) – Indicates that the system being checked is not operational with SYSTEM CHECK switch in same positions as above.

DEG MODE (Amber) – Indicates that a substitute channel is being utilized.

CG ALARM (Amber) – Indicates that MAC is greater than preset maximum.

READ/STANDBY SWITCH

STBY – Spring loaded to this position. GROSS WEIGHT and CG indicators retain last reading.

READ – Hold until indicators stabilize and take readings. When released to STBY, readings remain.

WEIGHT AND BALANCE MODULE

WEIGHT AND BALANCE CONTROLS AND INDICATORS

WEIGHT AND BALANCE SUPPLEMENTARY INFORMATION

GENERAL DESCRIPTION

The weight and balance system utilizes a strain gage system to provide a direct readout of the airplane total weight and center of gravity during ground operation.

The system consists of a strain gage transducer mounted on each landing gear axle (18 total), an attitude sensor located in the main equipment center, a computer located in the cockpit, and an indicator/control panel at the F/E's station. The transducers measure only vertical loads. The output of all transducers in each main landing gear truck are combined into a single channel for the computer. The nose gear has two channels into the computer. The attitude sensor provides a slope CG correction to the computer for ramp slope or airplane attitude. The computer sums the individual axle weights to provide the airplane gross weight in pounds and calculates CG in units of percentage of mean aerodynamic chord (MAC).

WEIGHT AND BALANCE MODULE

The weight and balance module contains the gross weight and CG readouts in digital form. The POWER switch turns the system on or off. The SYSTEM CHECK switch allows the instruments, channels, attitude sensor and alarm circuit to be tested. A series of lights define the system status.

The gross weight indicator has a graduated, uncalibrated dial for determining the wind effect. By observing the dial to determine the average wind, and using the read/standby switch to take a reading at that time, the wind error can be reduced or eliminated.

WEIGHT AND BALANCE COMPUTER

The weight and balance computer is located on the bottom shelf of the E-11 equipment rack. If, while checking the system in the CHAN position, a NO GO condition exists, a test switch on the computer allows each channel to be tested and the defective channel isolated. Using the appropriate OVERRIDE switch on the computer, the corresponding opposite channel may be substituted for the defective channel. This results in a slightly degraded operational system, since an uneven left-right weight distribution is possible. For example, if the left wing truck channel is defective, the right wing truck channel output is applied to replace that channel. After the appropriate substitution is made, the GO and DEG MODE lights will be illuminated.

CHAPTER 6

CROSS REFERENCE

FOR	REFER TO	CHAPTER
Lower Cargo Compartments Fire Protection	FIRE PROTECTION	12
Pneumatic Power	PNEUMATICS	20
Bleed Air Overheat	PNEUMATICS	20

USING GROUND PRECONDITIONED AIR

The passenger cabin and cockpit may be air conditioned by attaching a preconditioned air source to the ground service connections. Supply goes directly into the conditioned air manifold for distribution to the cabins.

ONE PACK OPERATION

Recirculating Fans.....ON
Gasper Fan.....ON
If cabin altitude cannot be maintained below 10,000 feet, direct cabin attendant to close valve control at No. 4 right entry door.
Upper Deck
Temperature Switches.....OFF

ZONE OVERHEAT LIGHT ILLUMINATED

Trim Air Indicator.....CHECK
Check that indicator has driven to the full cool position.

WITH TRIM AIR INDICATORS IN FULL COOL:
Duct Temperature.....MONITOR
Duct temperatures should decrease.
Zone Overheat
Reset Switch (duct temperature below 158°F (70°C)...PRESS
Check that OVERHEAT light extinguishes and the duct temperature stabilizes.

IF TRIM AIR INDICATORS FAIL TO DRIVE TO FULL COOL OR IF DUCT TEMPERATURE DOES NOT REMAIN IN NORMAL RANGE:
Zone Temperature Switch...MANUAL
Manually reposition trim air valve to maintain desired duct and compartment temperatures.

IF TRIM AIR INDICATOR REMAINS IN HEAT:
Trim Air Switch.....CLOSE

TRIM AIR VALVE (MASTER) CLOSED

(Duct temperatures not indicating addition of trim air with trim air indicators showing requirement for heat.)

Trim Air Switch.....CLOSED
Place switch in agreement with the failed master trim air valve.
All Zone
Temperature Switches.....MANUAL
Remove any zone temperature controller from controlling the packs.

NOTE: To prevent possible pack trips, remain in MANUAL position at least 5 seconds.

One Passenger Zone
Temperature Switch.....AUTO
Select the <u>one</u> zone of zones 2, 3 or 4 that has the coolest compartment temperature and place <u>only</u> that temperature switch to AUTO. This will put that zone in control of all packs. Pack ACM OUTLET, DUCT and COMPT temperatures should increase.

UPPER DECK OVERHEAT LIGHT ILLUMINATED

Upper Deck Temperature
Switches.....OFF, ONE AT A TIME
The OVERHEAT light will extinguish when the overheated side (L or R) is turned off, and the system will be reset.

NOTE: Upper deck heat may be turned back on when duct temperatures have lowered.

EQUIPMENT COOLING SMOKE LIGHT ILLUMINATED

With illumination of SMOKE detector light, equipment cooling air will be automatically vented overboard.

Equipment Cooling
Valve Switch.....SMOKE
Place switch in agreement with system operation.

NOTE: With the equipment cooling air being vented overboard, SMOKE detector light should extinguish.

AFT CARGO OVERHEAT LIGHT ILLUMINATED

Check that the heat ON lights have extinguished indicating heated air supply has been shut off. If the aft cargo heat switch is left in normal the system will cycle at a higher temperature (OVERHEAT/ON lights cycle alternately).

IF AFT CARGO HEAT NOT REQUIRED:
Aft Cargo Heat Switch.....OFF
OVERHEAT light will extinguish when the compartment has cooled.

NOTE: OVERHEAT light may illuminate during ground operations when ambient temperatures are high.

NON OPERATING PACK TRIP (ON THE GROUND)

This can be caused by internal heat soak of the ACM due possibly to a trim air check valve failure, or external heat soak from duct joint leakage in the air conditioning bay.

IF THE PACK TRIP LIGHT HAS BEEN ILLUMINATED LESS THAN ONE MINUTE:
Pack Valve CB
(P-12 panel).....PULL
This will deactivate pack trip protection. The pack valve will open starting the ACM to operate, even though the ACM outlet temperature circuit is sensing an overheat due to leakage of bleed air from the other pack.
Pack Valve Switch.....OPEN
Pack Valve Reset Switch....PRESS
If the ACM outlet temperature sensor has cooled sufficiently, the PACK TRIP light will extinguish.
Pack Valve CB (P-12).....RESET
Automatic trip protection will be reset.

CAUTION: IF A NON-OPERATING PACK THAT HAS TRIPPED DUE TO HEATSOAK REMAINS TRIPPED FOR MORE THAN ONE MINUTE, THE PACK SHOULD NOT BE RESET USING THIS PROCEDURE AS IT MAY DAMAGE THE ACM BECAUSE OF EXCESSIVE HEATSOAK.

With a non-operating pack that has been tripped more than one minute, do not start the pack until it has been cooled in flight to the point where it can be reset using the normal reset procedure.

TRIM AIR INDICATORS FULL HEAT (PRIOR TO PACK OPERATION)

This is caused by one of the pack valves failing to close completely. The trim air valves will remain activated along with the zone temperature controllers. If the airplane zones begin to cool down, the zone temperature controllers will drive the trim air valves to full heat since no bleed air is available. If the pack valves are opened under these conditions, the zones may become too warm before the system regains normal control.

Zone Temperature Switches.....MANUAL; COOL
Drive the four trim air indicators to full cool. Going to MANUAL also resets the zone temperature controllers to command the temperature of the duct rather than full heat.
Pack Valve Switches.....OPEN
Zone Temperature Switches...AUTO

MANUAL PACK OPERATION

STARTING
Pack Valve Switch...CHECK CLOSED
Pack Selector Switch.....SELECT PACK TO BE OPERATED IN MANUAL
Pack Controls Switch.....MAN
Check that the bypass valve and inlet door position indicators maintain their position, and the exit door position indicator moves to full COOL.
Manual Temperature Switch.....ADJUST
Place the switch to COOL or HEAT in order that the inlet door position indicator reads full COOL and the bypass valve position indicator reads 1/4 out of COOL (on the ground) or mid range (in the air).
Pack Valve Switch.....OPEN
Allow approximately two minutes for the pack to stabilize.

NOTE: ACM outlet temperature of the pack in manual must not be allowed to go below the red line as there is no automatic protection to prevent freezing.

OPERATION
Manual Temperature Switch.....ADJUST
Sequence the bypass valve position indicator to agree with the other bypass valve position indicators operating in AUTO. This will give an ACM outlet temperature approximately the same as the other packs.
All Indicators.....MONITOR
It is necessary to anticipate the effects of changing ambient temperature, airspeed, and altitude and adjust the inlet door and/or the bypass valve accordingly.

SWITCHING FROM MAN TO AUTO
Pack Controls Switch.....AUTO
A time delay of approximately 18 seconds will elapse before any indication is noticeable. The bypass valve, inlet and exit doors will then move to automatic preposition. The ACM outlet temperature will react accordingly until the automatic function can correct to the desired temperature by repositioning the bypass valve, inlet and exit doors in the normal sequence for AUTO operation.

BYPASS, INLET OR EXIT DOORS NOT IN PREPOSITION

This is probably the result of a pack valve not closing completely on shutdown, since this is the signal that causes the bypass, inlet and exit doors to drive to preposition.

Trim Air Indicators.....CHECK

Check that the trim air indicators have not driven to full heat. (See TRIM AIR INDICATORS FULL HEAT procedure.)

Use MANUAL PACK OPERATION to start the affected pack. Adjust the ACM temperature to agree with the packs operating in AUTO.

Pack Controls Switch.....AUTO

PRESSURIZATION SYSTEM - MAN L OR MAN R MODE OPERATION

With one outflow valve not operating with AUTO mode selected:

Pressurization Mode Switch.....SELECT MANUAL POSITION FOR MALFUNCTIONING VALVE L OR R

With the selection of MAN L or MAN R as appropriate, the pressurization system will continue to operate in AUTO mode and the malfunctioning valve will be in manual control.

Outflow Valve Position Indicators.....MONITOR

Monitor AUTO controlled outflow valve position to avoid full open or closed positions.

Outflow Valve Manual Control Switch.....REPOSITION AS NECESSARY

Reposition manually controlled valve as necessary to keep AUTO controlled valve from reaching full open or closed position.

PRESSURIZATION SYSTEM - MAN MODE OPERATION

NOTE: For MAN mode operation, the outflow valve manual control switches are used to reposition the outflow valves.

The Flight/Cabin Altitude Indicator can be used to determine nominal cabin altitude for cruise.

GROUND OPERATIONS -

Outflow Valve Manual Control Switches.....LEAVE FULL OPEN

To keep doors operable for any emergency evacuation, airplane should not be pressurized on the ground.

TAKEOFF AND CLIMB -

Outflow Valve Manual Control Switches...POSITION TOWARDS CLOSE

Reposition both outflow valves towards the close position to obtain desired cabin rate of climb. Small corrections can be made by repositioning one valve at a time.

CRUISE -
Outflow Valve Manual
Control Switches...POSITION FOR ZERO CABIN VERTICAL SPEED

Monitor cabin vertical speed indicator repositioning outflow valves to maintain desired cabin altitude.

DESCENT & LANDING -
Outflow Valve Manual
Control Switches....AS REQUIRED

Reposition outflow valves to maintain desired cabin rate of descent. The valves should be in the full open position on landing.

NOTE: To maintain control of the cabin vertical speed the cabin altitude must be below the airplane altitude.

PACK TRIP LIGHT (Amber)

Flight/Ground:
When illuminated (automatic or manual pack temperature control) the pack valve has automatically closed due to a high ACM outlet, compressor discharge temperature; or improper sequencing of bypass valve and inlet and/or exit doors.

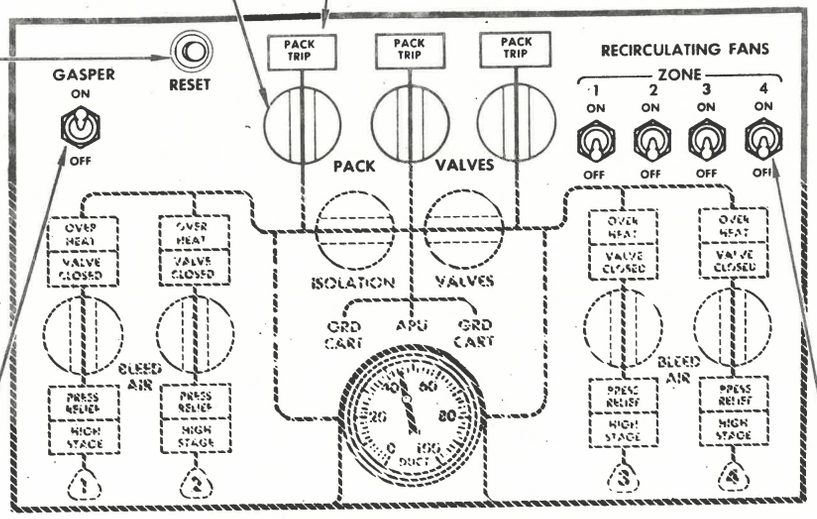
- In automatic pack control the bypass valve, inlet and exit doors will be in preposition nominal for restart.
- In manual pack control the bypass valve and inlet door remain in their last position. In manual operation the exit door remains in the full COOL position.

PACK VALVE SWITCH

Controls airflow to air conditioning pack. Pack valve will automatically close if duct pressure falls below 8 to 12 psi or a pack overheat trip occurs.

PACK TRIP RESET SWITCH [1]

Pressing this switch, following a pack trip, will reopen the pack valve and the pack will restart provided the temperature has dropped below trip level.



GASPER FAN SWITCH

- Provides additional ventilating air at each passenger or crew outlet.
- Temperature is the same as the ACM outlet.
- Also provides cooling air for passengers entertainment equipment.

RECIRCULATING FAN SWITCHES [2]

Recirculate conditioned air. No. 1 is for the cockpit; No. 2, 3 & 4 for the passenger cabin.

[1] On early airplanes, if more than one pack has tripped it will be necessary to use the master dim and test switch (see ABNORMAL PROCEDURES) in order to start a pack that has returned to normal. On later airplanes, pressing the reset switch will restart any pack that has returned to normal.

[2] On early airplanes there is no No. 1 recirculating fan switch, however the No. 1 fan is installed, but operates only when all three pack valves are closed on the ground. On airplanes with the switch the fan operates anytime the switch is ON. On early airplanes the fan draws air from the forward cargo compartment. On later airplanes the fan draws air from the conditioned air manifold.

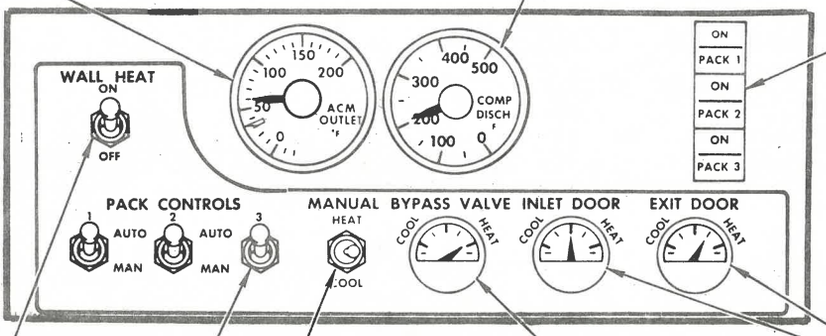
PACK INLET CONTROL

AIR CYCLE MACHINE OUTLET TEMPERATURE INDICATOR

Indicates pack outlet temperature to the conditioned air manifold. Normally ACM outlets should read similar. Normal range 35-160° F (2° -71° C). Pack trips at 185° F (85° C).

COMPRESSOR DISCHARGE TEMPERATURE INDICATOR

Will reflect higher temperatures as the cooling requirement increases. Pack trips at 425° F (218° C).



PACK SELECTOR SWITCH

Selects the pack to be monitored by all indicators and permits manual control when corresponding pack control switch is in manual.

FLIGHT ENGINEER PANEL

WALL HEAT SWITCH (IF INSTALLED)

Inoperative.

PACK CONTROL SWITCH

AUTO – Normal operation.

MAN – Removes pack from automatic control; freezes position of bypass valve and inlet door (until manually toggled); and puts the exit door in cool (fixed position).

NOTE: There is a delay in indicator response of about 18 seconds when switching from MAN to AUTO control, or following application of electrical power to the system.

MANUAL TEMPERATURE SWITCH

Used to control ACM outlet temperature with pack control switch in MAN. Appropriate pack selector switch must be ON to arm manual temperature switch.

CAUTION: Operating the ACM outlet temperature below 35° F (2° C) will cause icing of the water separator and moisture in the air conditioning system.

TURBINE BYPASS VALVE POSITION INDICATOR

Reflects the demand on the pack for heating or cooling.

ON THE GROUND – Temperature control is provided by this valve.

IN FLIGHT – This valve modulates in sequence with the inlet and exit doors to control ACM outlet temperature.

INLET AND EXIT DOOR POSITION INDICATORS

IN FLIGHT – Temperature control is provided primarily by these doors. They will both move toward cool or heat as cabin temperatures require.

ON THE GROUND – Both doors are driven to the full cool position when pack control switch is in auto.

PACK TEMPERATURE CONTROL

UPPER DECK OVERHEAT LIGHT (Amber)

- Indicates (1) low airflow across electric heater resulting in surface overheat of heater, or (2) high ACM outlet temperature resulting in duct overheat when supplemental electric heat is added.
- Deactivates heater until reset at lower temperatures.

ZONE 1 AND UPPER DECK L AND R SELECTOR SWITCHES

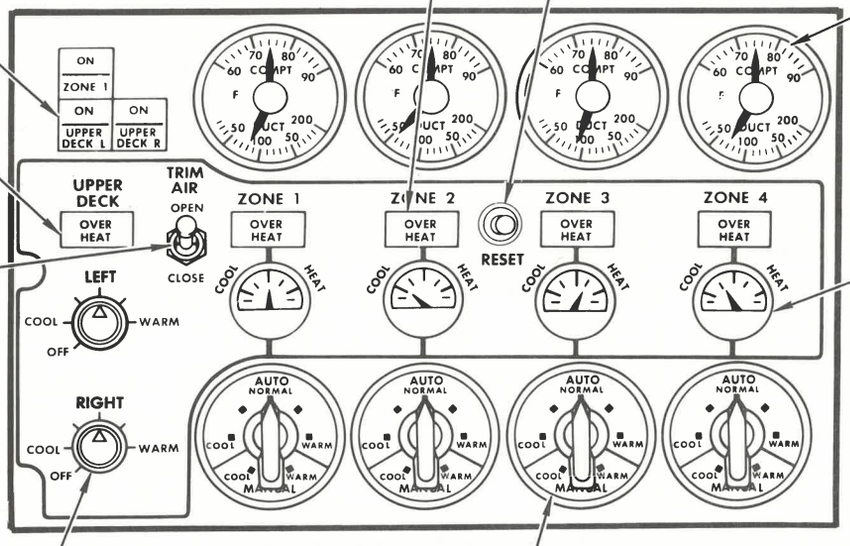
Provides selection for temperature readouts on zone 1 indicator.

ZONE OVERHEAT LIGHTS (Amber)

Illuminates when duct temperature reaches 185° F (85° C). Trim air indicator will move to full cool position when operating in auto zone temperature mode but will not reposition automatically in manual zone temperature mode.

ZONE OVERHEAT RESET SWITCH

Extinguishes OVERHEAT light and permits reset of auto or manual control when temperature drops below 160° F (71° C). Also used to reset upper deck overheat.



ZONE COMPARTMENT/DUCT TEMPERATURE INDICATORS

Continuous temperature readouts for zones 2, 3 & 4.

TRIM AIR INDICATORS

Display relative position of trim air valves.

FLIGHT ENGINEER PANEL

TRIM AIR SWITCH

OPEN – Controls master trim air valve. Supplies trim air to all trim air valves.

CLOSE – All trim air is shut off by master trim air valve.

UPPER DECK TEMPERATURE SWITCHES

OFF-COOL – Arms electric heater.

COOL-WARM – Sets upper deck thermostat control from 65° F (18° C) to 85° F (29° C).

NOTE: Should not be turned on unless at least two packs are operating to ensure adequate airflow past the heater and prevent OVERHEAT trip.

ZONE TEMPERATURE SWITCHES

AUTO – Automatic temperature control as desired. The zone that requires the coldest temperature will control the output of all packs that are operating in auto. Hot trim air will be added to the conditioned air to the remaining zones.

MANUAL – Manually positions the trim air valve. If all zones are operated in manual mode and the packs in auto the ACM outlet temperature will be 35° F (2° C).

ZONE AND UPPER DECK TEMPERATURE CONTROL

VALVE CONTROL SWITCH

NORM (On Ground) – Air is discharged overboard as well as ducted into the forward cargo compartment for heating.

NORM (In Flight) – During initial climb increasing differential pressure will close the flow control valve to stop overboard discharge and all airflow will be routed into the forward cargo compartment for heating.

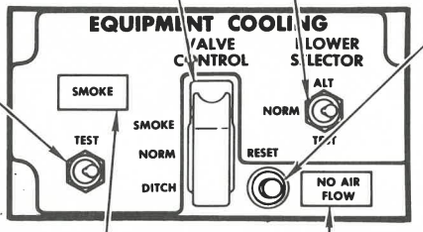
SMOKE – All air dumped overboard.

DITCH – Closes both overboard valves to prevent water entry upon ditching.

BLOWER SELECTOR SWITCH

Selects either of two main equipment rack blowers to provide equipment cooling airflow in the lower electronics compartment. TEST position turns off operating main equipment rack blower to check the NO AIRFLOW detection system; light illuminates. Flight deck equipment cooling blower continues to operate during TEST.

FLIGHT ENGINEER PANEL



SMOKE DETECTOR TEST SWITCH

TEST – Checks the smoke detection system, SMOKE light illuminates.

NO AIRFLOW RESET SWITCH

Resets the equipment cooling NO AIRFLOW detection system; light will extinguish when temperature sensor cools (approx 30 seconds after airflow has been restored).

SMOKE DETECTOR LIGHT (Amber)

Illuminates when equipment cooling smoke is detected in the flight deck or main equipment rack ducting. All equipment cooling air is automatically discharged overboard and heated air supply is shut off to the forward cargo compartment.

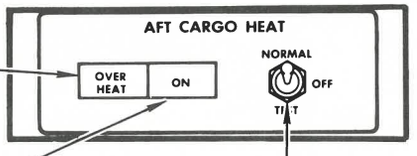
NOTE: On the ground the flight deck blower will continue to discharge air into the forward cargo compartment even though the overboard dump valve is open.

NO AIRFLOW LIGHT (Amber)

When illuminated, indicates less than normal airflow in the flight deck or main equipment rack systems and equipment overheat condition may result. Ground crew call horn will sound continuously if light illuminates on ground. In flight the system will automatically go to the SMOKE mode and cooling airflow is maintained by cabin pressure differential.

AFT CARGO OVERHEAT LIGHT (Amber)

Indicates override valve closed due to overheat.



FLIGHT ENGINEER PANEL

AFT CARGO HEAT ON LIGHT (Green)

Illuminated during heating cycle. Light will cycle when system is operating normally.

AFT CARGO HEAT SWITCH

Controls heated air supply directly off the main pneumatic duct to the aft cargo compartment.

NORMAL – Heat ON light illuminates during heat cycles. Air temperature controlled by thermostat in compartment.

TEST – Checks that heated air can be supplied to the aft cargo compartment. Heat ON light illuminates.

EQUIPMENT COOLING AND AFT CARGO HEAT

PRESSURIZATION MODE SWITCH

CHK – Moving flight cabin altitude selector above field elevation drives both outflow valves open. Moving the selector below field elevation will drive the valves closed.

AUTO – Prevents pressurization on the ground, outflow valves open. In flight outflow valves will modulate to control cabin climb or descent to the desired altitude.

MAN – Both outflow valves controlled manually.

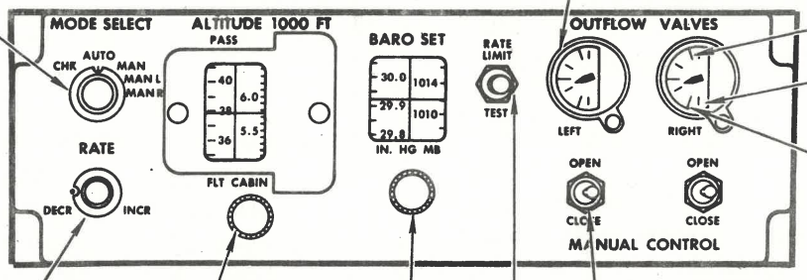
MAN L – Left outflow valve controlled manually, right outflow valve and remainder of system controlled automatically.

MAN R – Right outflow valve controlled manually, left outflow valve and remainder of system controlled automatically.

OUTFLOW VALVE POSITION INDICATORS

Indicates outflow valve position.

FLIGHT ENGINEER PANEL



FULL OPEN

ELECTRICAL POWER OFF

FULL CLOSED

FLIGHT/CABIN ALTITUDE SELECTOR

BAROMETRIC SETTING SELECTOR

OUTFLOW VALVE MANUAL CONTROL SWITCH

Operates only in the manual modes. (Momentary toggle).

PRESSURIZATION RATE SWITCH

Index mark provides for 500 fpm climb and 300 fpm descent. Range of control for climb nominal 150-2500 fpm; descent 100-1500 fpm.

RATE LIMIT TEST SWITCH

Pressing switch initiates an excessive pressurization rate of change signal.

With AUTO pressurization mode selected.

– AUTO FAIL light will illuminate.

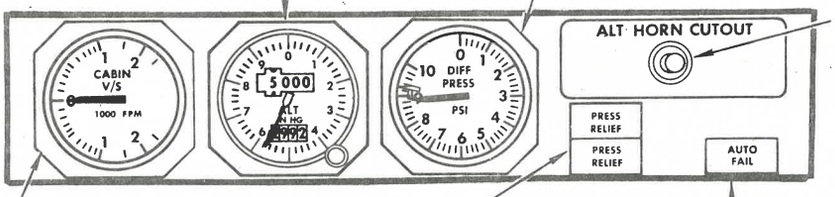
– Outflow valves will initially move in the direction to reduce cabin vertical speed.

CABIN ALTITUDE INDICATOR

Displays cabin altitude with sweep-hand as well as a digital counter display. Digital counter moves in 1000 foot increments only.

CABIN DIFFERENTIAL PRESSURE INDICATOR

Displays differential pressure between cabin and ambient. Normal maximum in automatic control mode is 8.9 psi.



ALTITUDE WARNING HORN CUTOUT SWITCH

FLIGHT ENGINEER PANEL

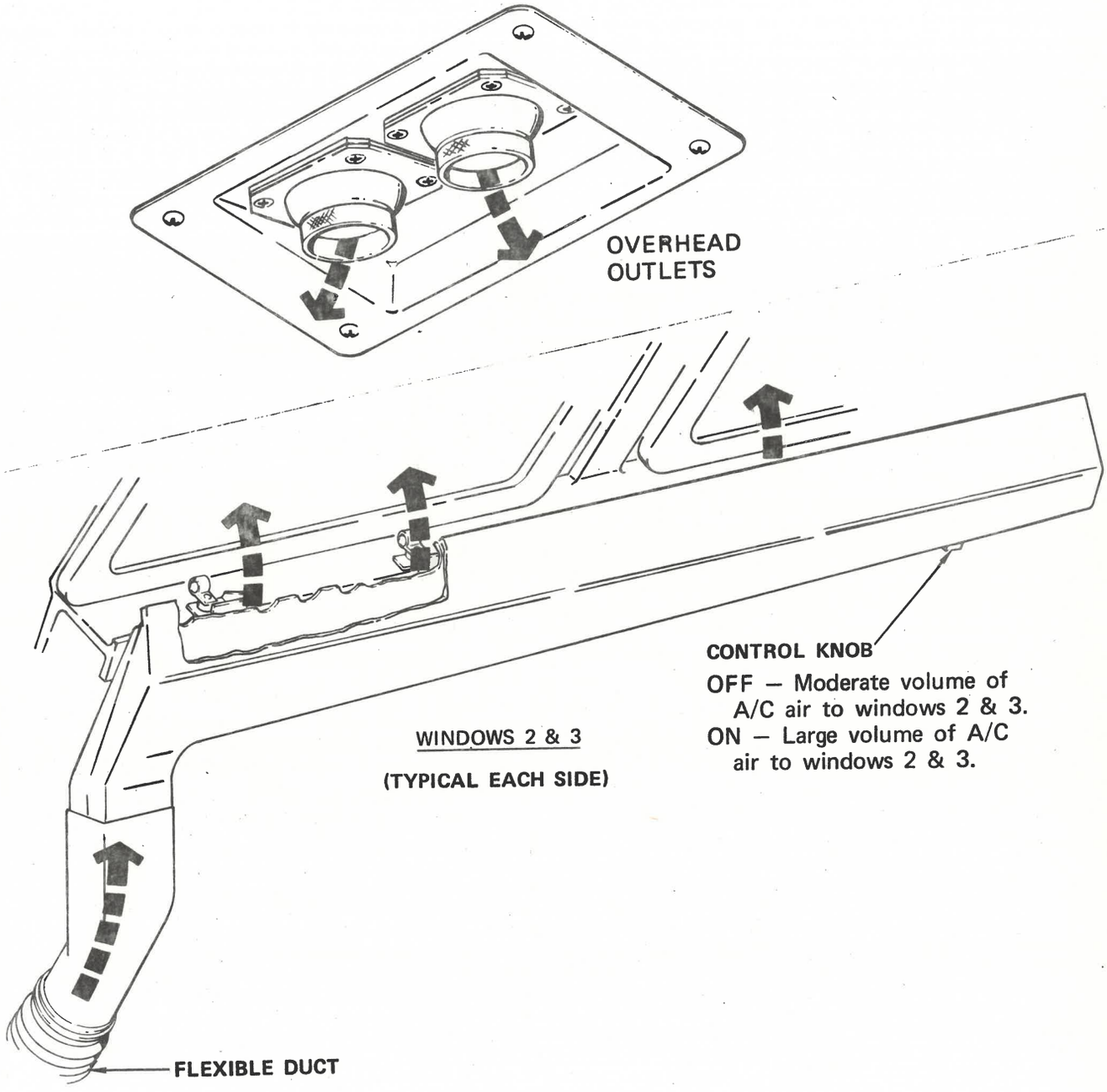
CABIN VERTICAL SPEED INDICATOR

PRESSURE RELIEF VALVE OPEN LIGHTS (Amber)

Illuminates when corresponding pressure relief valve opens. Normal cabin differential is being exceeded.

AUTO FAIL WARNING LIGHT (Amber)

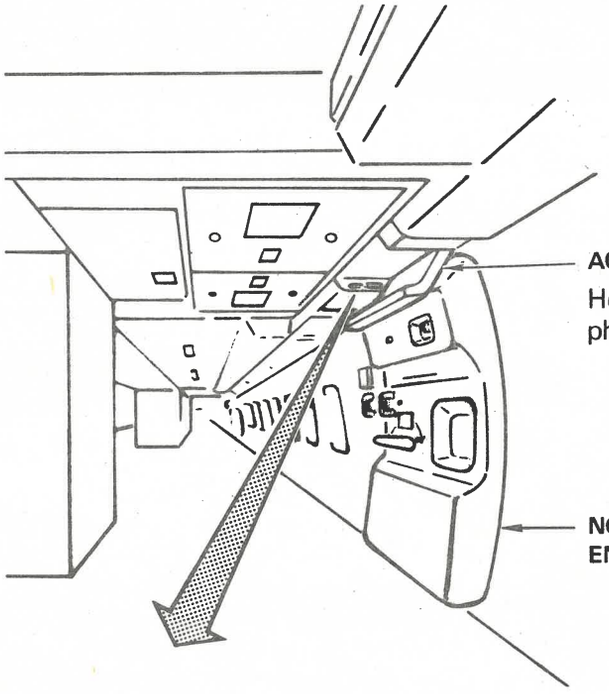
- Illuminates to indicate an AUTO pressurization control failure resulting in an excessive cabin pressurization rate condition.
- Cabin altitude will modulate about the existing cabin altitude at the time the warning light illuminated.
- Moving the pressurization mode switch to MAN will extinguish the light and reset the pressurization controller.

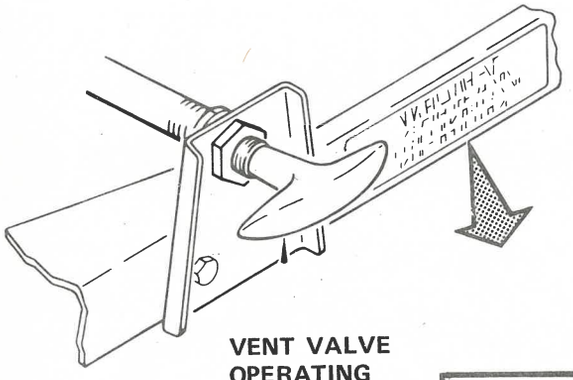


WINDSHIELD/FOOT AIR CONTROLS

WINDSHIELD – Distributes A/C air to No. 1 windows.
FOOT-AIR – Distributes A/C air around pilots' rudder pedals.

PILOTS' A/C AIR DISTRIBUTION



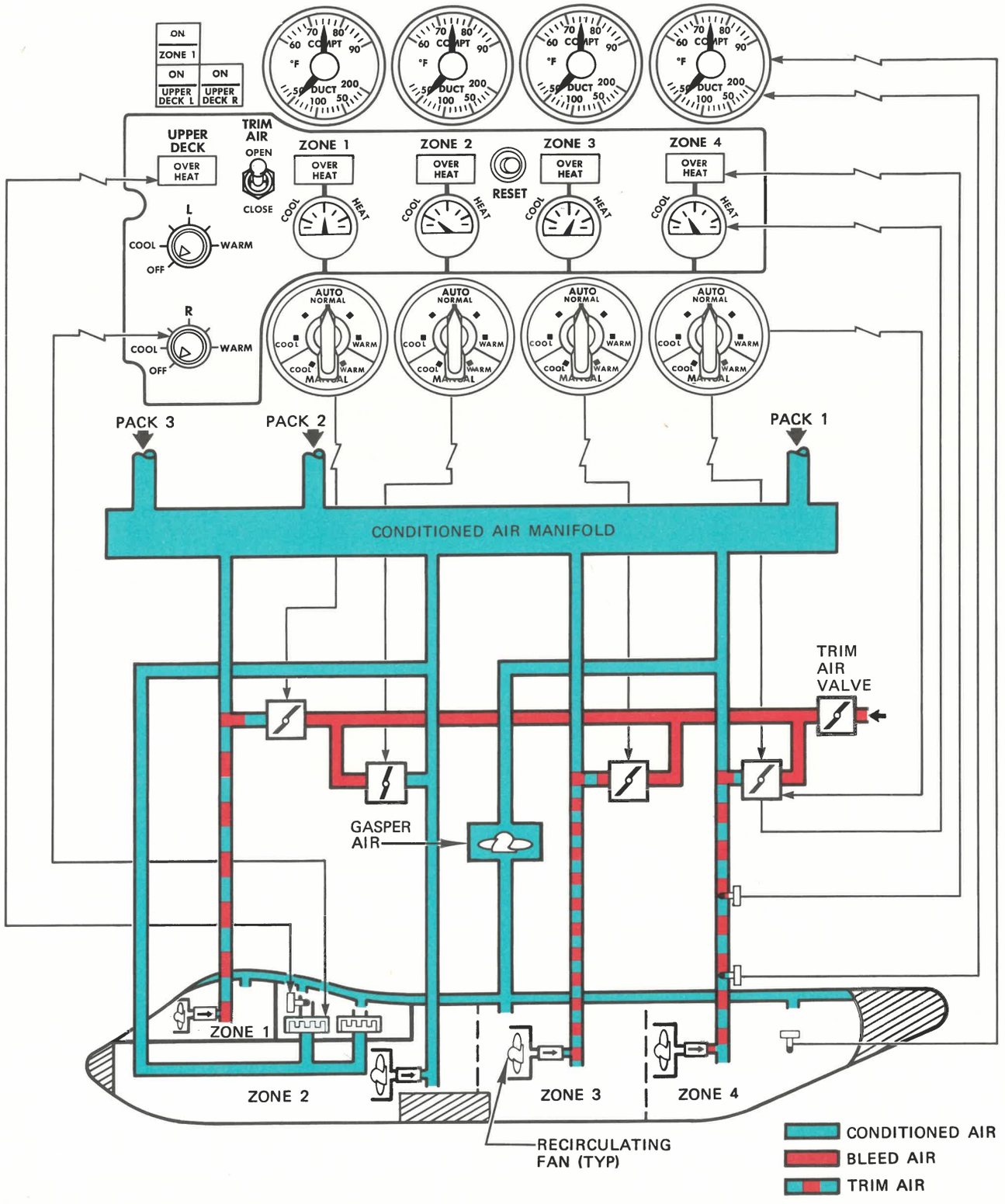


VENT CONTROL	
LOW	: UNLOCK, PULL AND LOCK.
NORMAL	: UNLOCK, PUSH AND LOCK.
TO LOCK	: ¼ TURN CLOCKWISE–OPPOSITE TO UNLOCK

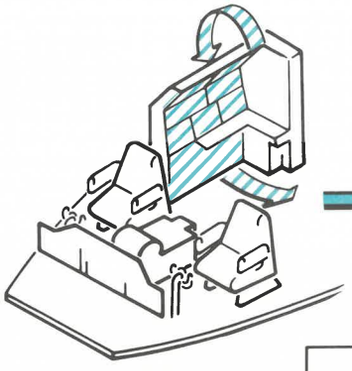
LAVATORY AND GALLEY VENT COMPONENTS LOCATION

AIR CONDITIONING SCHEMATIC

CONDITION: ZONE 2 IN CONTROL OF PACKS



AIR CONDITIONING TRIM AIR



FLIGHT DECK COOLING

EXHAUST AIR

CABIN AMBIENT

OVERBOARD

DUMP VALVE (CLOSED EXCEPT IN SMOKE MODE)

FLIGHT DECK BLOWER (ON EXCEPT SMOKE MODE IN FLIGHT)

HEAT TO FWD CARGO WHEN DUMP VALVE CLOSED

CHECK VALVE

EQUIPMENT COOLING

VALVE CONTROL

BLOWER SELECTOR

SMOKE

SMOKE

NORM

DITCH

TEST

RESET

ALT

NORM

TEST

ON

ON

OFF

NO AIR FLOW

FLIGHT AND GROUND

SMOKE – ALL EXHAUST OVERBOARD.
NOTE: ON THE GROUND THE FLIGHT DECK BLOWER WILL CONTINUE TO EXHAUST AIR INTO THE FORWARD CARGO COMPARTMENT.

NORM – OVERBOARD DUMP CLOSED – FLOW CONTROL VALVE CLOSES AFTER TAKEOFF.

DITCH – BOTH OVERBOARD EXHAUST VALVES CLOSED.

NO AIRFLOW (OR SMOKE) ACTIVATES SMOKE MODE AUTOMATICALLY

NO AIRFLOW CREW CALL HORN (GRD ONLY)

MAIN EQUIP CENTER

SMOKE DETECTION

AIR FLOW DETECTION

MAIN BLOWERS

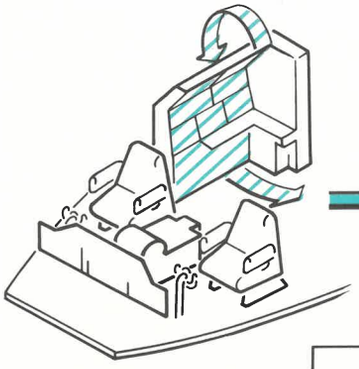
CARGO COMPARTMENT VALVE (OPEN EXCEPT IN SMOKE MODE)

HEAT TO FWD CARGO

FLOW CONTROL VALVE

OVERBOARD

MAIN EQUIPMENT COOLING



FLIGHT DECK COOLING

EXHAUST AIR

CABIN AMBIENT

OVERBOARD

DUMP VALVE (CLOSED EXCEPT IN SMOKE MODE)

FLIGHT DECK BLOWER (ON EXCEPT SMOKE MODE IN FLIGHT)

HEAT TO FWD CARGO WHEN DUMP VALVE CLOSED

CHECK VALVE

EQUIPMENT COOLING

VALVE CONTROL

BLOWER SELECTOR

SMOKE

TEST

SMOKE

NORM

DITCH

RESET

ALT

NORM

TEST

ON

ON

OFF

NO AIR FLOW

FLIGHT AND GROUND

1 SMOKE – ALL EXHAUST OVERBOARD

NORM – OVERBOARD DUMP CLOSED, FLOW CONTROL VALVE CLOSES AFTER TAKEOFF

DITCH – BOTH OVERBOARD EXHAUST VALVES CLOSED

NO AIRFLOW (OR SMOKE) ACTIVATES SMOKE MODE AUTOMATICALLY

NO AIRFLOW CREW CALL HORN (GRD ONLY)

MAIN EQUIP CENTER

SMOKE DETECTION

AIR FLOW DETECTION

MAIN BLOWERS

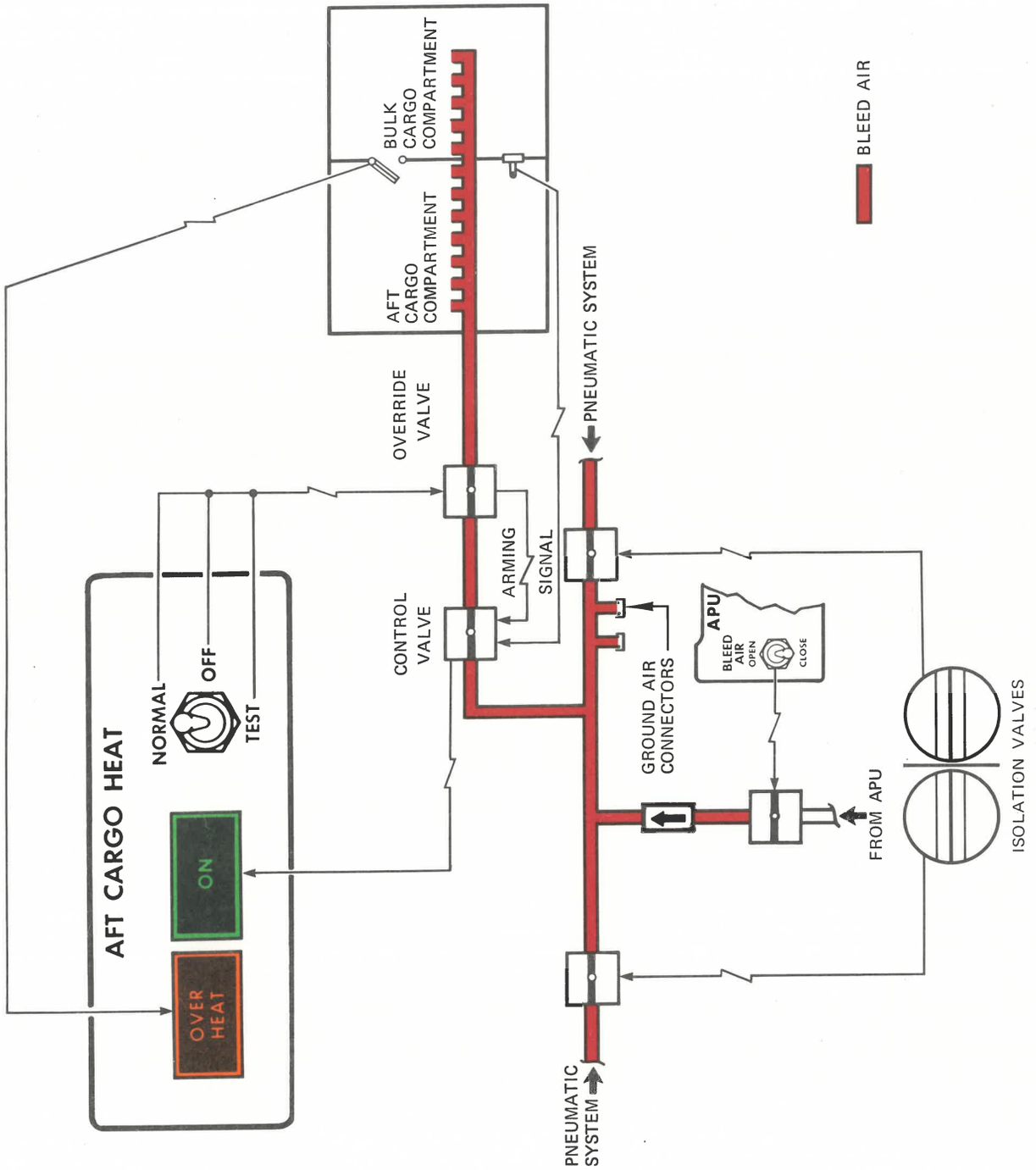
CARGO COMPARTMENT VALVE (OPEN EXCEPT IN SMOKE MODE)

HEAT TO FWD CARGO

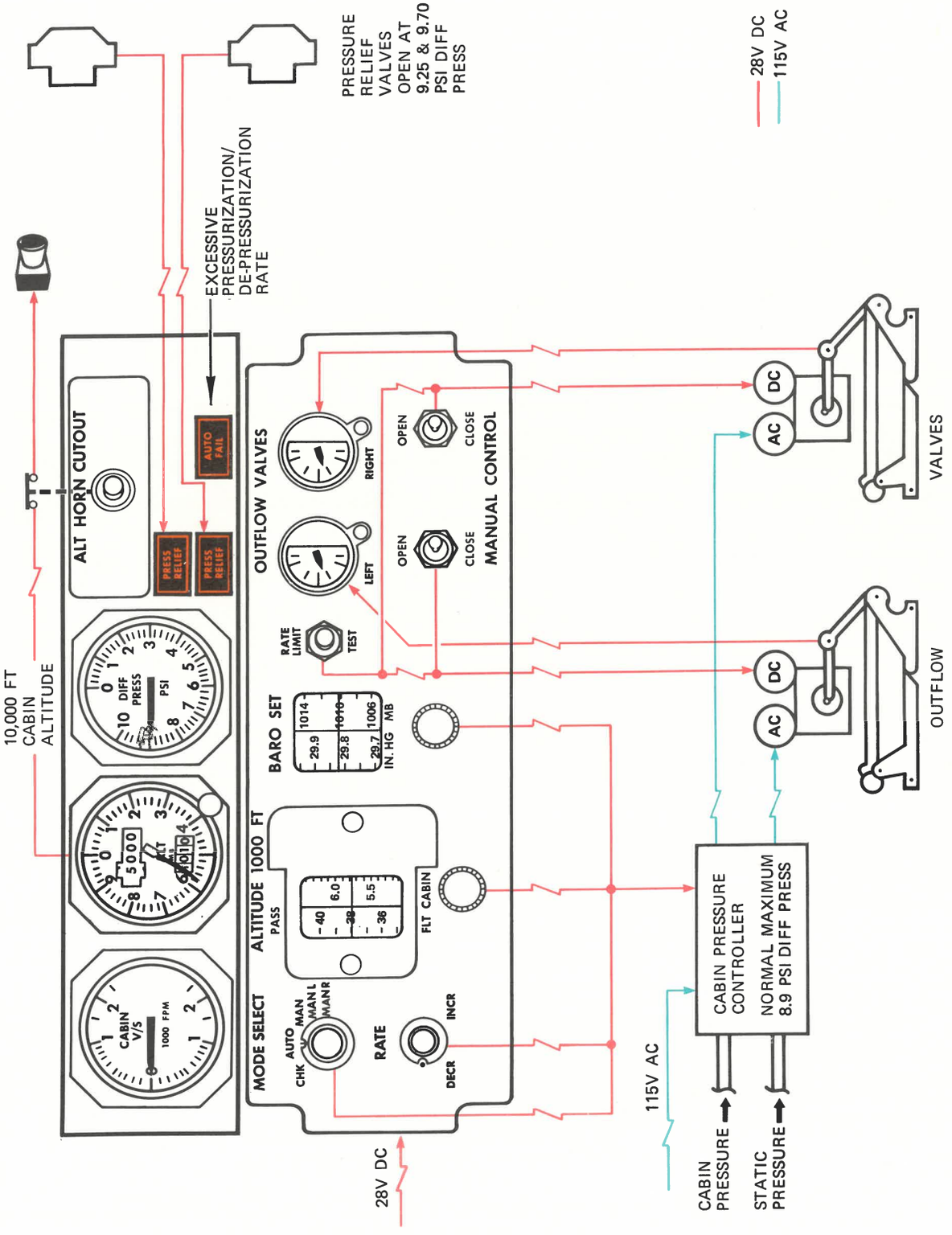
FLOW CONTROL VALVE

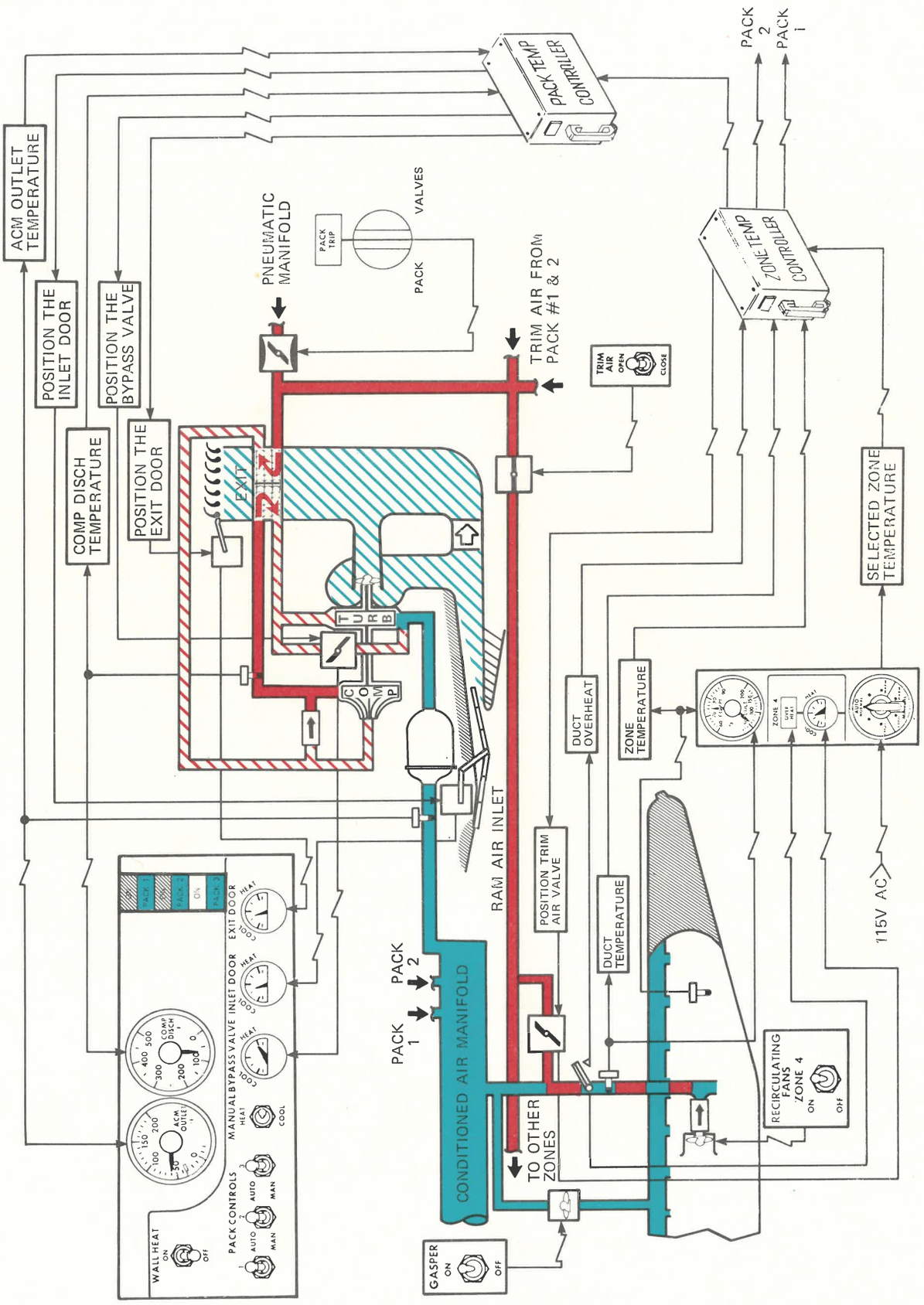
OVERBOARD

MAIN EQUIPMENT COOLING



AFT CARGO COMPARTMENT HEAT


PRESSURE RELIEF VALVES OPEN AT 9.25 & 9.70 PSI DIFF PRESS
28V DC
115V AC
EXCESSIVE PRESSURIZATION/ DE-PRESSURIZATION RATE
10,000 FT CABIN ALTITUDE
ALT HORN CUTOUT
AUTO FAIL
PRESS RELIEF
PRESS RELIEF
OUTFLOW VALVES
RIGHT
LEFT
OPEN
CLOSE
OPEN
CLOSE
MANUAL CONTROL
RATE LIMIT
TEST
BARO SET
IN. HG
MB
ALTITUDE 1000 FT
PASS
FLT CABIN
MODE SELECT
AUTO
CHK
MAN L
MAN R
RATE
INCR
DECR
DC
AC
VALVES
DC
AC
OUTFLOW
CABIN PRESSURE CONTROLLER
NORMAL MAXIMUM 8.9 PSI DIFF PRESS
115V AC
28V DC
CABIN PRESSURE
STATIC PRESSURE



ZONE TEMPERATURE CONTROL

PRESSURIZATION SYSTEM DESCRIPTION

The pressurization controller maintains the desired cabin pressure by varying the position of the outflow valves. Cruise cabin altitude setting can be selected prior to take off. Cabin will climb to and descend from cruise altitude at the rate selected by the pressurization rate switch. Minor changes in cruise altitude will not affect cabin altitude, when the flight altitude selector has been set above the actual airplane cruise altitude. At touchdown the outflow valves will move to full open. If the cabin is pressurized at touchdown, the outflow valves will modulate towards full open, depressurizing the cabin at the rate set on the pressurization rate switch.

During AUTO operation the outflow valve positions should be in agreement. The system will operate in AUTO with a malfunctioning valve. By selecting the appropriate position MAN L or MAN R the malfunctioning valve can be driven by the manual control switch. AUTO operation can be maintained as long as the operating valve is not allowed to reach the full open or full closed positions.

The pressurization system has an auto fail feature which monitors for conditions of excessive rates of change in cabin altitude. With the AUTO FAIL warning light illuminated the cabin will hold the altitude at the time warning was initiated. Cabin altitude will modulate about this altitude until MAN mode is selected. On early airplanes HF transmissions have resulted in AUTO FAIL warning light illuminating.

AIR CONDITIONING SYSTEM DESCRIPTION

The primary source of air for the system is taken from engine bleeds. With engines inoperative air may be supplied by APU or external air carts. Air is directed from the pneumatic manifold to three air conditioning packs; the output from the packs enters a common conditioned air manifold. From this manifold air is ducted to the four zones of the pressurized area of the airplane. The temperature of the air delivered by the packs is determined by the zone requiring the coolest air input.

Conditioned air temperature is achieved by cooling the engine bleed air by means of heat exchangers and when required, regulating the flow of air through the ACM. Individual zone temperature requirements are satisfied by adding trim air directly from the pneumatic manifold. The zone controlling the pack output will not be trimmed. Upper deck air supply is tapped off zone 2 downstream of the conditioned air manifold; warmth is added as required by electric heaters in the ducting. Gasper air is taken off zone 4 ducting prior to addition of trim air. The gasper fan provides a positive supply of conditioned air to all zones. Recirculating fans in zones 1, 2, 3, & 4 increase ventilation rates.

AUTO PACK OPERATION

The AUTO mode of operation is recommended for all ground or flight operations. MAN operation should be used only if operation in AUTO cannot be maintained. Three packs should be utilized whenever possible.

When establishing electrical power to the A/C system, there is a delay of approximately 18 seconds before pack controllers will respond. The same time delay will occur when pack control switch is placed from MAN to AUTO.

Pack valves are electrically controlled, pneumatically operated and will open if not electrically powered when pneumatic manifold is pressurized. On later airplanes the valve will remain closed without electric power except at altitudes above approximately 7,000 feet.

Pack ACM outlet temperature is controlled by the positions of the pack BYPASS VALVE, INLET DOOR and the EXIT DOOR. ACM outlet temperature, BYPASS VALVE, INLET and EXIT DOOR positions should be approximately the same for all operating packs. Pack controllers will position BYPASS VALVE, INLET and EXIT DOORS in a fixed sequence. When operating on the ground both INLET and EXIT DOORS will remain in the full COOL position. The BYPASS VALVE will modulate as required to maintain the necessary ACM outlet temperature. In flight, INLET and EXIT DOORS and the BYPASS VALVE are all sequenced as air conditioning requirements change. With an increase in cooling requirements INLET and EXIT DOORS will modulate as required to full COOL. With the doors in full COOL the BYPASS VALVE will modulate to increasing cooling. The reverse sequence is followed when less cooling is required.

On later airplanes with the drag reduction configuration the maximum COOL (door open) positions inflight are reduced. The inlet door will operate from full HEAT to approximately 20% from the full COOL position while the exit door operates only 30% of total travel from the full HEAT position. Doors will open to full COOL position when operating on the ground. Except for the change in maximum inflight door open positions the sequence of operation of the bypass valve and inlet and exit doors will be the same.

The BYPASS VALVE, INLET and EXIT DOORS will automatically move to a preset position (PREPOSITION) when a pack is shut down. The shutdown may result from moving the pack valve switch to closed position, duct pressure dropping below 8 to 12 psi or a pack trip. The inflight or on ground prepositions are shown on the following page.

The air conditioning packs will automatically shut down (pack valves closed) for conditions of excessive ACM outlet temperature, excessive compressor discharge temperature or improper sequencing of BYPASS VALVE and INLET DOOR and/or EXIT DOOR. Valve and exit door positions for an out of sequence trip are shown on the following page.

MANUAL PACK OPERATION

With pack control switch in MAN the ACM outlet temperature is controlled by the manual temperature switch. The appropriate pack selector switch must be ON to use the manual temperature switch for control. To maintain a constant ACM outlet temperature frequent adjustments are required to compensate for changes in ambient temperature, airspeed and altitude. These adjustments should be anticipated.

In MAN operation the EXIT DOOR will drive to and remain in the full COOL position. The manual temperature switch controls only the positions of the INLET DOOR and BYPASS VALVE With an increase in cooling requirements the INLET DOOR can be moved as required to full COOL The BYPASS VALVE can be moved as required to full COOL For less cooling the BYPASS VALVE and INLET DOOR will operate in reverse order. The ACM outlet temperature must be maintained above 35°F (2°C) to prevent freezing in water separator.

With a pack shut down for any reason the BYPASS VALVE and INLET DOOR will remain in the position at time of shut down.

When switching from MAN to AUTO mode, a time delay of approximately 18 seconds will occur before any change is noticeable. The BYPASS VALVE, INLET and EXIT DOORS will first move towards the auto operation preposition. Then the controller will position the BYPASS VALVE, INLET and EXIT DOORS as necessary for the existing conditions.

PREPOSITION

	BYPASS VALVE	INLET DOOR	EXIT DOOR
AUTO OPERATION – ON GROUND			
AUTO OPERATION – INFLIGHT			

MAN OPERATION – ON GROUND OR INFLIGHT

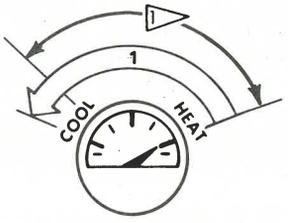
BYPASS VALVE and DOORS will remain in position at shutdown.

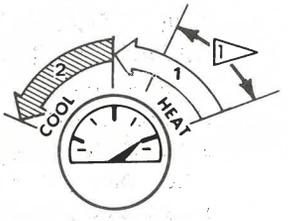
In MAN operation EXIT DOOR will remain in full COOL position.

BYPASS VALVE, INLET and EXIT DOOR SEQUENCING

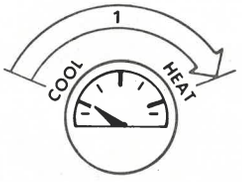
AUTO OPERATION – INFLIGHT

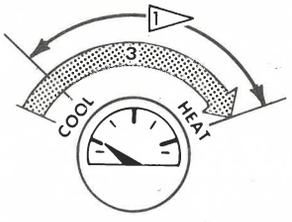
COOLING

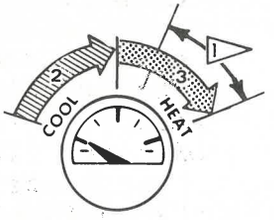




HEATING







1 Door operating range for airplanes with drag reduction configuration.

AUTO OPERATION – ON GROUND

Only the BYPASS VALVE will operate. INLET and EXIT doors will remain in full COOL position.

MAN OPERATION – ON GROUND OR INFLIGHT

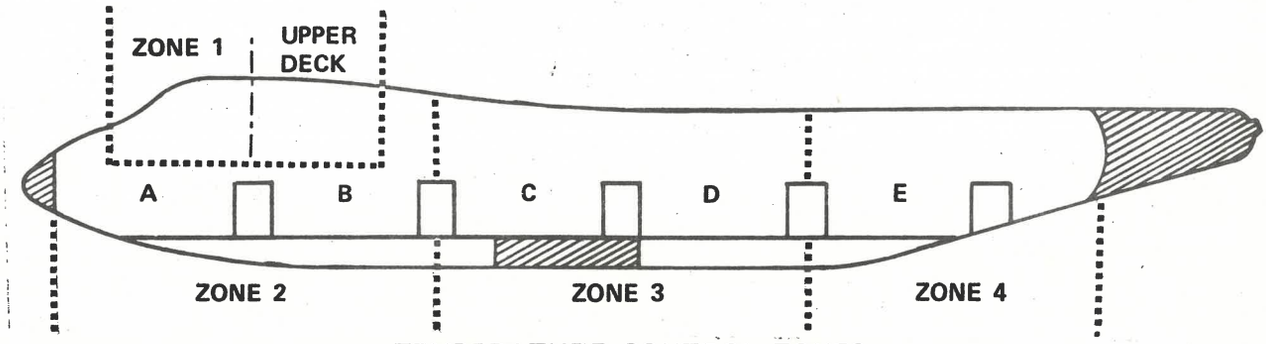
INLET DOOR and BYPASS VALVE will move in the sequence shown for auto operation when MAN operation is used. The EXIT DOOR will remain in the full COOL position.

PACK TRIP – OUT OF SEQUENCE – RANGE

BYPASS VALVE position near full COOL with INLET DOOR and/or EXIT DOOR near full HEAT.

BYPASS VALVE, INLET AND EXIT DOOR INDICATORS

TYPICAL PASSENGER COMPARTMENT LOCATIONS



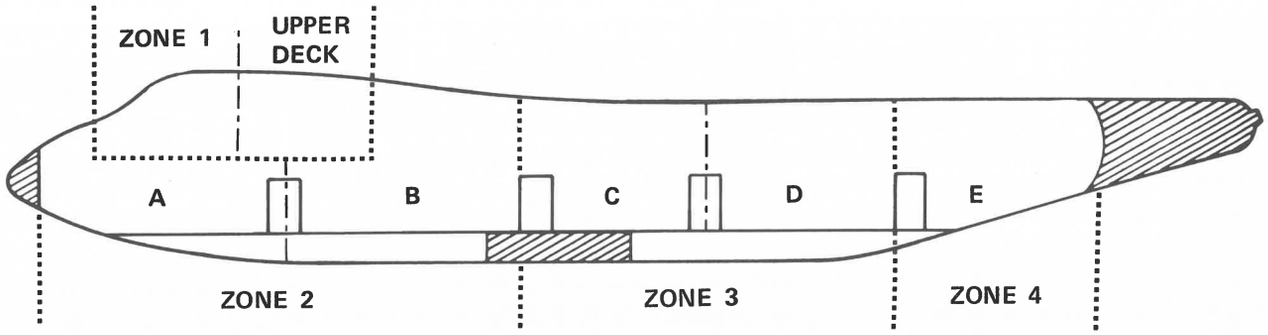
TEMPERATURE CONTROL ZONES

ZONE TEMPERATURE CONTROL

The function of the zone temperature control system is to maintain desired temperature in all zones. The temperature of the conditioned air entering each zone will vary with the requirements. The heating or cooling requirements will vary with the existing compartment temperatures, size of the zone, passenger loading and electrically operated equipment in use. The zone controller for the zone with the coolest air requirements will determine the ACM outlet temperature for all packs.

Trim air is added to the conditioned air to satisfy the higher temperature requirements for the other zones. The Trim Air Indicator for the zone controlling the packs will indicate full COOL. The remaining Trim Air and Duct Temperature Indicators will reflect the amount of trim air being added. The quantity of trim air available is sufficient to maintain a desired temperature in all control zones. When additional cooling is selected for zone 1 and zone 1 is controlling the packs, cockpit A/C air distribution should be in the normal open positions. Reducing cockpit air ventilation for the above condition may result in the trim air available not being sufficient to meet the increased heating requirements for all the other zones.

The Trim Air Controllers should be operated in the AUTO position except where defined in the ALTERNATE OPERATIONS for zone overheat or master trim air valve failure conditions. With all zone temperature controllers positioned in MANUAL and packs operating in AUTO the ACM outlet temperature will drive to and remain at 35°F (2°C).



Zones 2, 3 and 4 are frequently subdivided into passenger compartments A to E as shown.

The operation of the control system is intended to be fully automatic. Pack control and zone control is one integral system only when both are operated in AUTO mode. Manual control is provided for use as a back-up to handle abnormal conditions and improper functioning components.

The zone control system is designed to maintain approximately the same temperature in all zones with different heat loads in each zone such as the number of passengers and electrical equipment in use. The zone control system is not designed to maintain different temperatures from one zone to another. The temperature of one zone will affect the temperature of the adjacent zone, and the recirculating fan system is common to all zones.

The trim air system is a supplemental heat source and will provide up to 30° F increase in zone supply duct temperature over the zone requiring the coolest supply air.

The operator should not lose sight of the fact that this is a large airplane with an immense volume, consequently, a noticeable temperature change will take up to two or three times as long as other airplanes.

The trim air valve supplying the zone trim air modulating valves also modulates to reduce undesirable air noise in the passenger cabin. It will modulate toward close as the requirement for trim air decreases. Failure of this valve in the full closed or near closed position is indicated by duct temperatures that do not correspond with the respective trim air indicators. The trim air indicators, for all but the controlling zone, will eventually move to the full heat position because the system doesn't know it is not getting the supplemental heat it demands. The procedure for "Trim Valve Closed" should be utilized to maintain a mean desired compartment temperature through the airplane.

It may be desirable to place all zone temperature switches momentarily to MAN and then back to AUTO in order to prevent the ACM outlet temperature from going too high. This will result in a quicker stabilization of ACM outlet and zone duct temperatures.

If all trim air valve indicators are in the full heat position prior to pack operation, do not start any pack until all zone temperature selector switches have been momentarily positioned from AUTO to MANUAL and returned to AUTO. Initiate start of any pack within 15 seconds.

During one pack operation, if the pack being used is No. 1 or 2 and the zone 3 trim air indicator moves past midrange towards HEAT, the upper deck zone may become excessively warm.

ZONE TEMPERATURE CONTROL

CHAPTER 7

CROSS REFERENCE

FOR	REFER TO	CHAPTER
Flight Controls	FLIGHT CONTROLS	13
Flight Instruments	FLIGHT INSTRUMENTS	14
Inertial Navigation System	NAVIGATION	19
VHF Navigation System	NAVIGATION	19
Instrument Switching	NAVIGATION	19

AUTOPILOT "A" (SINGLE CHANNEL)

Procedures with autopilot "B" are identical using the First Officer's controls.

MANUAL OPERATION

TO ENGAGE AUTOPILOT:
Autopilot Engage
Switch "A".....MAN

Pitch
Autopilot will maintain pitch attitude at time of engagement (pitch attitude hold).

Roll
Autopilot will roll to wings level and maintain heading (heading hold).

TO STEER THE AIRPLANE:
In Pitch and/or Roll
Maneuver the airplane using the pitch and/or turn controls on the autopilot manual control module.

TO OPERATE WITH THE NAVIGATION MODE SWITCH:
There are no autopilot controlled navigation modes available in MAN.

TO OPERATE WITH THE ALTITUDE MODE SWITCH:
Only altitude hold mode is available in MAN.

(ALT HOLD MODE)
Altitude Mode Switch....ALT HOLD
The altitude light will illuminate. The autopilot will control pitch to maintain the barometric altitude at the time of engagement.

TO OPERATE WITH THE SPEED MODE SWITCH:
Only turbulence mode is available in MAN.

(TURB MODE)
Speed Mode Switch.....TURB
The altitude mode switch will trip to OFF if engaged, since two pitch modes cannot command the autopilot at the same time, and the last pitch mode selected has priority.

Autopilot response rates will be reduced. The stabilizer will not automatically trim, although the AUTO STAB TRIM light is still operative. The autopilot will return to its original pitch and roll attitude if displaced by turbulence. However, heading hold will be inoperative, so that the autopilot will not return to its original heading if displaced by turbulence, but will remain wings level.

Placing the autopilot engage switch to COMMAND will trip the speed mode switch to OFF.

COMMAND OPERATION

TO OPERATE WITH THE NAVIGATION MODE SWITCH:
When the autopilot engage switch is in COMMAND, moving the turn control (on the autopilot manual control module) out of detent will trip the autopilot engage switch to MAN.

(HDG MODE)
Preset Roll Information
Navigation Mode Switch.....HDG
Heading Indicator.....SET
Rotate the heading selector to the desired heading.

Engage Autopilot
Autopilot Engage Switch "A".....COMMAND
The autopilot will roll to and maintain the selected heading.

(VOR/LOC MODE)
The autopilot cannot make a back beam approach in COMMAND. Use the MAN or OFF position and follow the flight director or HSI.

Preset Roll Information
Course Transfer Switch.....DUAL OR NO. 1
RADIO/INS Switch.....RADIO
No. 1 Course Indicator.....SET
Rotate the course selector to the desired course for VOR operation; to the inbound front course of the ILS for LOC operation.
No. 1 VHF Navigation Frequency Indicator.....SET
Use the frequency selectors to set the desired VOR or LOC frequency.
Heading Indicator.....SET
Rotate the heading selector to the desired intercept heading.
Navigation Mode Switch...VOR/LOC

Engage Autopilot
Autopilot Engage Switch "A".....COMMAND
The autopilot will roll to the selected heading. The autopilot will maintain the selected heading until the VOR or LOC course capture point is reached, at which time the autopilot will roll to and maintain the selected course.

(ILS MODE)
Preset Roll Information
Preset roll procedures are the same as for a localizer in VOR/LOC mode.
Course Transfer Switch.....CHECK DUAL
Switch will automatically trip to DUAL when ILS position is selected.

Engage Autopilot
Autopilot Engage Switch "A".....COMMAND
The autopilot will respond to preset heading if not within the capture zone of the localizer, and maintain pitch attitude until glide slope capture.

Localizer capture must occur before the autopilot will capture the glide slope.

Roll intercept procedures are the same as in VOR/LOC mode.

Set Pitch Information
Set the altitude and/or speed mode switches to intercept the glide slope. See "TO OPERATE WITH ALTITUDE OR SPEED MODE SWITCHES."

The autopilot will capture the glide slope from above or below. Entering the glide slope capture zone, the autopilot will pitch to capture the glide slope. The altitude and/or speed mode switches will automatically trip to OFF.

To Go Around From An ILS (Or LAND) Approach:
See FLIGHT DIRECTOR.

(INS MODE)
Preset Roll Information
Captain's RADIO/INS Switch...INS
No. 1 INS Control
Module.....CHECK, SET
Check that the from/to indicator shows the desired number sequence to the next waypoint; set the data selector to XTK/TKE.
Navigation Mode Switch.....INS

Engage Autopilot
Autopilot Engage
Switch "A".....COMMAND
Autopilot will be referenced to the heading (magnetic) selected on the Autopilot/Flight Director mode select panel on the light shield.

To Intercept the INS Track
Intercept Heading.....ESTABLISH
Rotate heading selector to desired intercept heading. The autopilot will continue to respond to this magnetic heading until capturing the INS track.

The capture zone of the INS track begins at approximately 7-1/2 miles cross track distance (XTK) or 2 dots on the HSI. At this point, the NAV light on the approach progress display illuminates green.

TO OPERATE WITH THE ALTITUDE MODE SWITCH:

(ALT HOLD MODE)
Operation is the same as in MAN, except that the altitude mode switch will trip to OFF when the glide slope becomes captured in ILS or LAND mode.

(ALT SEL MODE)
Preset Pitch Information
Selected Altitude
Indicator.....SET
Rotate the altitude selector to the desired altitude.

Engage Autopilot
Autopilot Engage
Switch.....COMMAND
The autopilot will maintain the pitch attitude at the time of engagement.
Altitude Mode Switch.....ALT SEL
The autopilot will still maintain the pitch attitude at the time ALT SEL was selected if not within the "capture" zone of the selected altitude. IAS speed mode may be used to establish the pitch of the airplane enabling capture of the selected altitude.

Entering the selected altitude capture zone, the autopilot will pitch to capture the selected altitude and will trip the speed mode switch to OFF.

TO OPERATE WITH THE SPEED MODE SWITCH:

(IAS MODE)
Engage Autopilot
Autopilot Engage
Switch "A".....COMMAND
The autopilot will maintain the pitch attitude at the time the autopilot is engaged.
Speed Mode Switch.....IAS
The autopilot will vary pitch to maintain the airspeed at the time IAS was selected.

TO OPERATE USING NAVIGATION, ALTITUDE AND SPEED MODE SWITCHES SIMULTANEOUSLY:

- Select the navigation mode.
- Engage the autopilot to COMMAND.
  This will trip the speed and altitude mode switches to OFF.
- Select the desired altitude and/or speed modes.

AUTOPILOT "A" & "B" (DUAL CHANNEL)

Both autopilot engage switches will engage only in the LAND mode.

(LAND MODE)

Preset Roll Information

Both RADIO/INS Switches....RADIO

Both Course Indicators.....SET
Rotate both course selectors to the same inbound front course of the ILS.

Both VHF Navigation
Frequency Indicators.....SET
Use frequency selectors to set same ILS frequency on both radios.

Navigation Mode Switch.....LAND
The AUTOPILOT warning lights will flash amber until second autopilot engage switch is placed to COMMAND.

Course Transfer
Switch.....CHECK DUAL
The switch will automatically trip to DUAL when LAND mode is selected.

NOTE: If the autopilot is maneuvering the airplane when the LAND mode is selected or when the second autopilot engage switch is placed to COMMAND, the AUTOPILOT warning light may illuminate steady red. The warning light may be cleared by cycling the navigation mode switch to ILS then back to LAND. The second engage switch will be disengaged by the cycling action and must be re-engaged.

Engage Autopilot

Both Autopilot
Engage Switches.....COMMAND
Place both "A" and "B" switches to COMMAND. The first switch engaged will control the autopilot, and operation is single channel. The switches cannot be engaged simultaneously. The flashing amber AUTOPILOT warning lights will extinguish.

Autopilot response and intercept procedures are the same as in ILS mode.

After glide slope capture, as the autopilot descends through 1500 feet on the radio altimeter, the FLARE lights will illuminate amber indicating automatic flare is armed, and dual channel autopilot control has started.

Landing
At decision height on the radio altimeter, the decision height light will illuminate. At flare height on the radio altimeter, the FLARE lights will change to green and the autopilot will flare.

Throttle Retard
If autothrottles are used, the thrust levers will retard to the aft limit starting at 30 feet radio altitude.

After Landing
Autopilot Disengage Switch (pilot's control wheel)...PRESS
Both engage switches will trip to the OFF position.

Go-Around
Go-around procedures are the same as in the ILS mode.

FLIGHT DIRECTOR

All modes available to the autopilot, except turbulence (TURB), are also provided for the flight director. The procedures are the same to allow simultaneous operation of the flight director and autopilot. Flight director commands may also be followed using the primary flight controls, or, with the autopilot in MAN, using the turn and pitch controls on the manual control module.

Two control modes are exclusively flight director modes: Back beam and go-around.

(BACK BEAM MODE)
Captain's Flight Director Switch.....ON
Procedures with first officer's flight director are identical, using corresponding controls.
Course Transfer Switch.....DUAL OR NO. 1
RADIO/INS Switch.....RADIO
No. 1 Course Indicator.....SET
Rotate the course selector to the inbound front course of the ILS.
No. 1 VHF Navigation Frequency Indicator.....SET
Use frequency selector to set the localizer frequency.
Navigation Mode Switch...VOR/LOC
Back Beam Switch.....B/B
B/B light will illuminate. The ADI will present correctly oriented displays for roll control. No pitch information is provided.

(GO AROUND MODE)
Go Around Switches.....PRESS
After glide slope capture in ILS or LAND mode, actuation of the switches on the No. 2 and No. 3 thrust levers will activate the go-around mode.

The flight director (ADI) will command a predetermined wings-level pitch attitude. The flight director will remain in this mode until the navigation mode switch is moved to any other position

YAW DAMPER

Upper Yaw Damper.....TEST

Check UPR yaw damper engage switch in ENGAGE position (guarded).

Hold UPR yaw damper test switch to YDR; check that upper rudder indicator (flight controls position indicator) moves right then slowly returns to neutral and the Captain's rate of turn indicator moves left. Release switch and check that upper rudder indicator moves left then slowly returns to neutral, and the Captain's rate of turn indicator returns to neutral.

Hold UPR yaw damper test switch to TCL; check that upper rudder indicator and Captain's rate of turn indicator do not move.

Lower Yaw Damper.....TEST

Repeat above test with LWR yaw damper test switch in the YDR and TCL positions, observing the lower rudder indicator and the First Officer's rate of turn indicator.

NOTE: If the flaps are not fully retracted when the yaw damper test switch is moved to the TCL position, the rudder indicator will move to the left and return to neutral. When the switch is released, the rudder indicator will move right and return to neutral. The rate of turn indicators will not respond during the TCL test.

AUTOPILOT

AUTO STAB TRIM LIGHT ILLUMINATED (A OR B)

Autopilot.....DISENGAGE
Hold control column in its present position and press autopilot disengage switch. Check that AUTO STAB TRIM light extinguishes.

CAUTION: A SUDDEN PITCH CHANGE CAN BE EXPECTED AS THE AUTOPILOT ELEVATOR INPUTS ARE REMOVED. THE MINIMUM CHANGE OCCURS WHEN THE CONTROL COLUMN IS HELD IN POSITION AS THE AUTOPILOT IS DISENGAGED.

Stab Trim.....TRIM
Trim the airplane using the stab trim switches on the control wheel.
Autopilot.....ENGAGE
Engage other channel of autopilot and check AUTO STAB TRIM light extinguished.

NOTE: If the AUTO STAB TRIM light illuminates, disengage autopilot and fly airplane manually.

AUTOTHROTTLE

AUTOTHROTTLE MALFUNCTION

Autothrottle Light...ILLUMINATED

IF AMBER, SPEED ERROR IN EXCESS OF 10 KTS:
Airspeed.....CHECK
Check that indicated airspeed and autothrottle operation, including engine EPR limits, are acceptable. If unsatisfactory place A/T SPEED switch to OFF.

CAUTION: ENGINE EPR LIMITS CAN BE EXCEEDED UNDER CERTAIN CONDITIONS.

IF FLASHING RED, AUTOTHROTTLE IS DISENGAGED:
A/T Speed Switch.....OFF
Check that engage light is extinguished.
Autothrottle Warning Light.....PRESS
Check that both AUTOTHROT warning lights extinguish. If desired, the autothrottles may be re-engaged.

IF STEADY RED, SELF-TEST SWITCH ON AUTOTHROTTLE COMPUTER NOT IN OFF POSITION:
A/T Self Test Switch.....OFF

YAW DAMPER LIGHT ILLUMINATED (UPPER OR LOWER)

Yaw Damper Engage Switch (Upper or Lower).....OFF

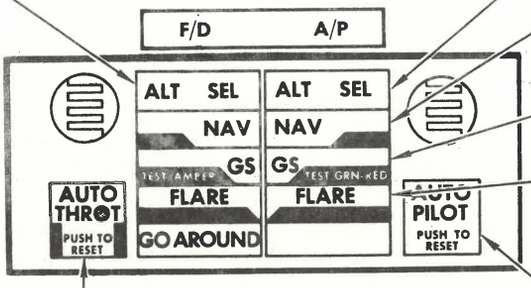
FLIGHT DIRECTOR APPROACH PROGRESS DISPLAY

ALT SEL
NAV
GS
FLARE

} Same light functions as in autopilot operation.

NOTE: All the above lights illuminate when corresponding autopilot light comes on, if flight director switch is on.

GO-AROUND – Flight director operation only. Illuminates green when system is activated by pushing either of the go-around switches on number 2 or 3 thrust levers.



AUTOPILOT APPROACH PROGRESS DISPLAY

ALT SEL – Amber when altitude mode select switch is placed to ALT SEL; Green when selected altitude is captured.

NAV – Amber when navigation mode switch is in INS, VOR LOC, ILS, or LAND position and prior to capture; Green after capture.

GS – Amber when navigation mode switch is in ILS or LAND position and prior to capture; Green after capture.

FLARE – Amber when navigation mode switch is in LAND position and all dual channel approach conditions are met; Green at flare point as determined by radio altitude.

AUTOTHROTTLE WARNING LIGHT

STEADY AMBER – Airspeed error greater than 10 knots.

STEADY RED – Self-test switch not in OFF position.

FLASHING RED (Momentary) – System disengaged. Flashes only as long as thrust lever disengage switch is held depressed.

Will flash continuously for fault disengagement or for disengagement by A/T switch action on mode selector panel. Reset by pushing light cap or by pushing any one of the four thrust lever switches (autothrottle or go around).

AUTOPILOT WARNING LIGHT

FLASHING AMBER – System in LAND mode, but second A/P engage switch not in command.

STEADY RED – Warning indicating an invalid signal from a subsystem; also may indicate a camout condition.

FLASHING RED (Momentary) – System disengaged. Flashes (and aural warning sounds) only as long as disengage switch on control wheel is held depressed.

Will flash continuously for fault disengagement. Reset by single push on control wheel switch or by pushing light cap.

TESTS:

- Pushing F/D side of display will illuminate all amber lights; pushing A/P side will illuminate all red and green lights.
- Pushing autopilot warning light will illuminate light flashing red and cause aural warning to sound.
- Pushing autothrottle warning light will illuminate light flashing red.

AUTOPILOT/FLIGHT DIRECTOR APPROACH PROGRESS DISPLAY

FLIGHT DIRECTOR SWITCH (CAPTAIN)

Controls output of autopilot-flight director computer to Captain's attitude director indicator (ADI).

FLIGHT DIRECTOR PITCH CONTROL WHEEL

Provides pitch trim signal outputs to pitch command bar on the ADI.

AUTOTHROTTLE ENGAGE SWITCH

When switch is ON the adjacent light is illuminated and the throttles are automatically referenced to the airspeed set by the autothrottle speed selector.

AUTOTHROTTLE SPEED SELECTOR

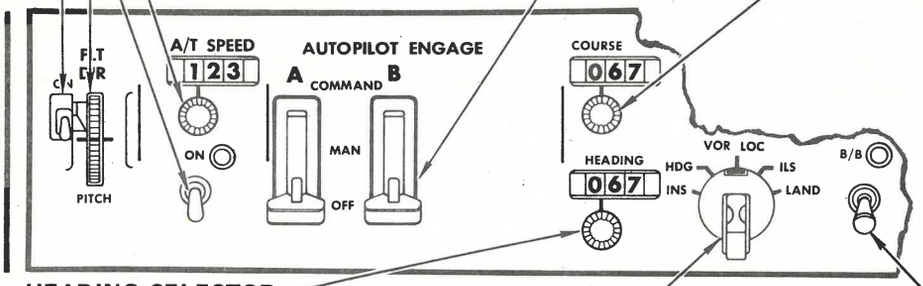
Rotation of the selector sets the desired autothrottle airspeed on the adjacent digital indicator.

AUTOPILOT ENGAGE SWITCHES

Permit selection of A or B autopilot for MANUAL or COMMAND operation, or permit selection of both A and B for COMMAND operation after specific interlock conditions have been satisfied.

COURSE SELECTOR #1

Rotation of the selector sets the desired course on the digital display and sets the course pointer on the Captain's HSI. Course signals from the No. 1 navigation radio go to the autopilot/flight director computers, as determined by the position of the course transfer switch.



HEADING SELECTOR

Provides heading select signals to the HSI's and heading error signals to the autopilot and flight director computers.

BACK BEAM SWITCH

For use with back course of a localizer (B/B light on).

NAVIGATION MODE SWITCH

INS – Used to couple the INS system to the autopilot/flight director system. Capture of the INS track starts at 7.5 nautical miles from the track.

HDG – Autopilot or flight director coupled to a selected heading reference, as set by the heading selector.

VOR LOC – Either VOR or localizer signals will arm the autopilot and/or flight director for roll control, depending on the selected frequency. Prior to course capture, control is referenced to the selected heading. Actual capture begins at a radio beam deviation angle which varies with the intercept angle.

ILS – Selection of the ILS position will arm the autopilot (single channel only) and/or the flight director. Capture of the localizer course is a function of beam displacement and intercept angle so that close-in performance of large intercept angles is possible. Prior to course capture, control is referenced to the selected heading. Glide slope intercept can be made from above or below glide slope. Course transfer switch moves to DUAL position when ILS is selected.

LAND – For dual channel autoland operation with flare mode. Dual channel operation requires airplane to be on a localizer and glide slope beam below 1500 feet radio altitude, and both (A and B) autopilot engage switches to be in the COMMAND position. Course transfer switch moves to DUAL position when LAND is selected.

AUTOPILOT/FLIGHT DIRECTOR MODE SELECTOR PANEL
(Sheet 1 of 2)

SPEED MODE SWITCH

TURB – Used for turbulence penetration with autopilot in MAN only. Provides reduced gain commands. Not effective with navigation mode switch in ILS or LAND. FD roll commands in compatible modes are retained. Automatic stabilizer trim is not effective.

IAS – Provides for automatic pitch axis control referenced to the indicated air speed existing at the time of engagement.

FLIGHT DIRECTOR SWITCH (FIRST OFFICER)

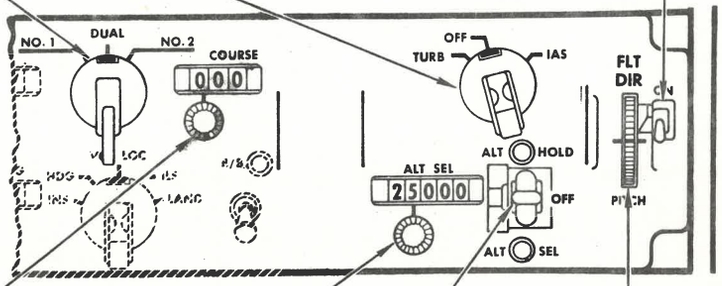
(First Officer's ADI)

COURSE TRANSFER SWITCH

NO. 1 – Autopilot/Flight Director computers A, B, and C are referenced to NO. 1 VHF Nav radio.

NO. 2 – Autopilot/Flight Director computers A, B, and C are referenced to NO. 2 VHF Nav radio.

DUAL – Autopilot/Flight Director computers A and C are referenced to NO. 1 VHF Nav radio. Computer B is referenced to NO. 2 VHF Nav radio. Will move to DUAL automatically when ILS or LAND mode is selected.



COURSE SELECTOR #2

(No. 2 Navigation Radio)

ALTITUDE SELECTOR

Rotation of control sets the desired altitude in the indicator for altitude select altitude reference.

FLIGHT DIRECTOR TRIM CONTROL WHEEL

(First Officer's ADI)

ALTITUDE MODE SWITCH

ALT HOLD – (ALT HOLD light on) Provides for airplane to maintain the barometric altitude reference existing at the time of selection. Can be selected with navigation mode switch in any position, but cannot be engaged after glide slope capture. Speed mode switch will trip to OFF when ALT HOLD is selected.

ALT SEL – (ALT SEL light on) Provides for intercept and capture of a selected altitude. Capture can begin within 1200 feet of altitude. Flight path may be set up by using pitch wheel control or indicated air speed mode. Speed mode switch will return to OFF when altitude is captured.

ATTITUDE HORIZON (HORIZON BAR)

Sphere display, showing attitude in pitch and roll axes, referenced to the appropriate attitude system (INS).

BANK ANGLE SCALE

Displays bank angle of airplane in response to attitude signals from the inertial navigation system.

COMMAND BARS

Display computed pitch and roll attitude which airplane must assume to make good a desired course or track or to maintain a computed degree of pitch.

AUTOTHROTTLE FAST-SLOW INDICATOR AND SCALE

Indicates amount of airspeed error during autothrottle operation.

GYRO WARNING FLAG

In view when instrument power fails or when attitude signal is not valid.

TEST SWITCH

When depressed, the attitude sphere will indicate a 20° right bank and a 10° pitch up attitude. GYRO flag will be in view.

FIXED AIRPLANE REFERENCE

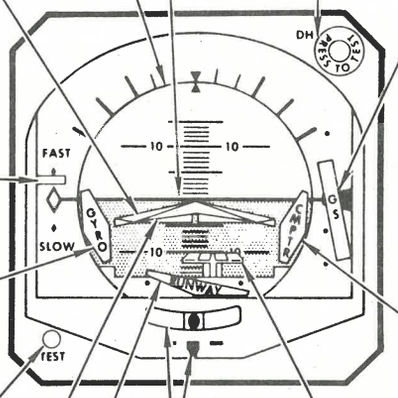
Fixed symbol, rear view of airplane. Attitude reference when related to horizon and bank angle scales.

DECISION HEIGHT (DH) LIGHT

Illuminates when the altitude pointer on the radio altimeter descends to or below the altitude at which the DH pointer is set. Can be tested by pressing.

GLIDE SLOPE POINTER AND SCALE

Displays vertical position relative to glide slope. GS flag covers display when signal not valid. Pointer out of view when ILS frequency not tuned or RADIO INS switch in INS.



COMPUTER WARNING FLAG

In view when power fails to associated flight director computer or when pitch and roll signals to the command bars are not valid.

TURN AND BANK INDICATORS

LOCALIZER WARNING FLAG

In view if signal to the localizer course deviation indicator is not valid; also in view if the radio altitude signal is not valid.

LOCALIZER COURSE DEVIATION INDICATOR AND RISING RUNWAY SYMBOL

Displays both localizer deviation and radio altitude. Lateral movement shows displacement from oncourse. Vertical movement shows radio altitude from 200' down to touchdown (symbol rises to meet fixed airplane reference). Indicator biased out of view when Back Beam selected or ILS frequency not tuned.

(FLIGHT DIRECTOR)
ATTITUDE DIRECTOR INDICATOR

HEADING POINTER

In radio operation, shows selected heading as set by heading selector. In INS operation, shows actual track.

NAVIGATION WARNING FLAG

In view when radio input or INS input is lost when operating on the corresponding navigation system.

INS MILEAGE INDICATORS (2)

Show mileage-to-go to next INS waypoint.

RAD/INS INDICATOR

Shows RAD when radio navigation system is being used; shows INS when inertial navigation system is being used.

DATA SOURCE INDICATOR

Shows the source (system 1, 2 or 3) of data from either the INS or the radio navigation systems.

INS ALERT LIGHT

Illuminates when airplane is within two minutes of a waypoint while navigating along an INS track. ALERT light on INS control/display unit appears at same time. Both lights flash when waypoint is passed with INS in MAN mode.

FIXED AIRPLANE REFERENCE

AZIMUTH CARD

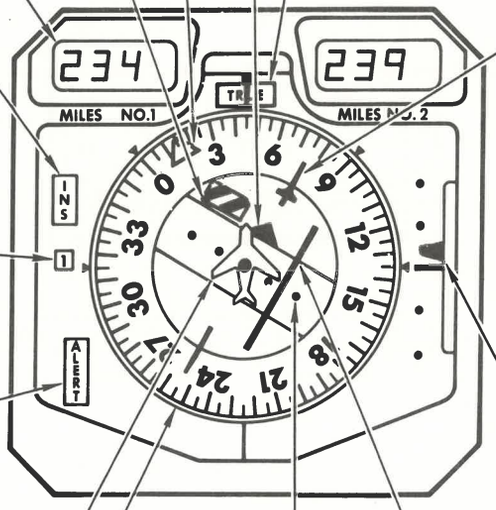
Displays airplane heading (read against lubber line). In INS operation, referenced to true north; in RADIO operation, referenced to magnetic north.

TO-FROM INDICATOR

In radio operation, shows direction of VOR station relative to airplane heading. In INS operation, points "to" when approaching waypoint with AUTO/MAN switch in AUTO or MAN; will point "from" only with switch in MAN.

HEADING REFERENCE

Shows TRUE when RADIO/INS switch in INS; shows MAG when switch in RADIO. HEADING warning flag in view when heading reference is not valid.



DESIRED TRACK/COURSE POINTER

In INS operation, displays desired track; in radio operation, moves in response to rotation of course selector (on mode selector panel) to desired position on azimuth card.

GLIDE SLOPE POINTER & SCALE

Displays vertical position relative to glide slope. GS flag covers display when signal not valid. Pointer out of view when ILS frequency not tuned or when GS flag in view. On later airplanes, pointer out of view when RADIO/INS switch in INS.

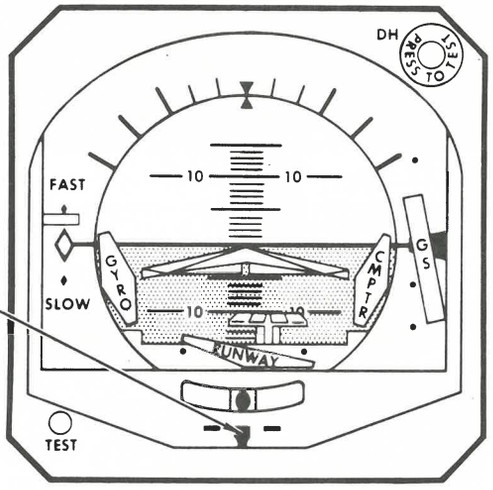
COURSE/TRACK DEVIATION TRACK SCALE

Shows deviation in degrees during radio operation; 2 dots — 10 degrees on VOR, 2½ degrees on ILS. Shows crosstrack distance in miles during INS operation; 2 dots — 7½ miles.

CROSS TRACK DISTANCE/ COURSE BAR

Moveable center portion of desired track/course pointer. Shows both angular and lateral displacement from VOR or ILS course (radio operation) or shows cross track distance (INS operation).

HORIZONTAL SITUATION INDICATOR

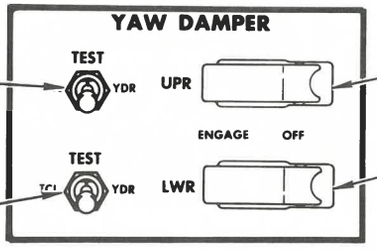


CAPTAIN'S PANEL

RATE-OF-TURN INDICATOR

Out of view when power is lost to upper yaw damper.

UPPER YAW DAMPER AND TURN COORDINATOR TEST SWITCH



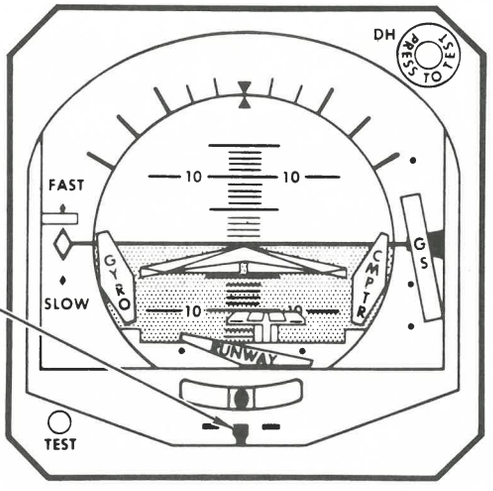
OVERHEAD PANEL

LOWER YAW DAMPER AND TURN COORDINATOR TEST SWITCH

UPPER YAW DAMPER ENGAGE SWITCH

LOWER YAW DAMPER ENGAGE SWITCH

NOTE: Interlocks prevent tests from being performed in flight.

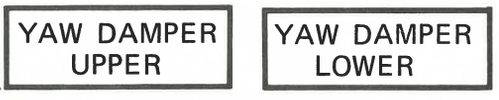


FIRST OFFICER'S PANEL

RATE-OF-TURN INDICATOR

Out of view when power is lost to lower yaw damper.

PILOTS' CENTER PANEL



YAW DAMPER LIGHTS (Amber)

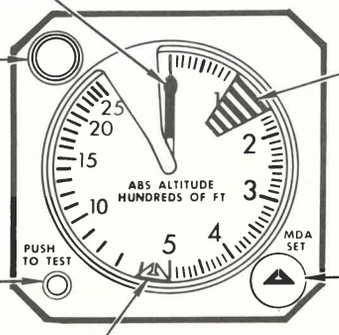
Illuminate when flap switching signals (which result from "flaps up" or "flaps down" movement) fail to be transmitted to the yaw damper computer. Indicates that corresponding turn coordinator function may be working in a "flaps up" condition or may not be working in a "flaps down" condition. (See SUPPLEMENTARY INFORMATION).

ALTITUDE POINTER

Reflects actual height above terrain up to 2500'.

DH LIGHT

Illuminates when the altitude pointer descends to or below the altitude at which the DH



WARNING FLAG

In view when – Power is off, test switch is pushed, or invalid signal is present.

TEST SWITCH

When pushed, altitude pointer drives to 30' feet and warning flag appears.

DH SELECTOR

Rotation causes DH pointer to move across face of instrument.

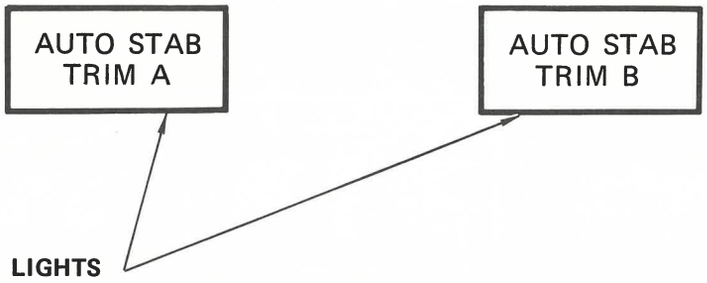
DECISION HEIGHT (DH) POINTER

Moves in response to movement of DH selector.

PILOTS' PANELS

LOW RANGE RADIO ALTIMETER

PILOTS' CENTER PANEL

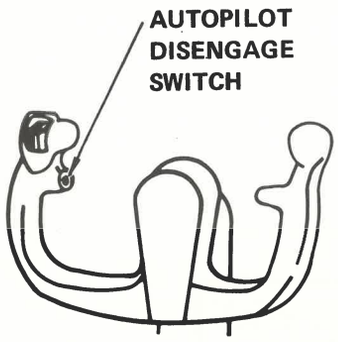


STABILIZER TRIM LIGHTS

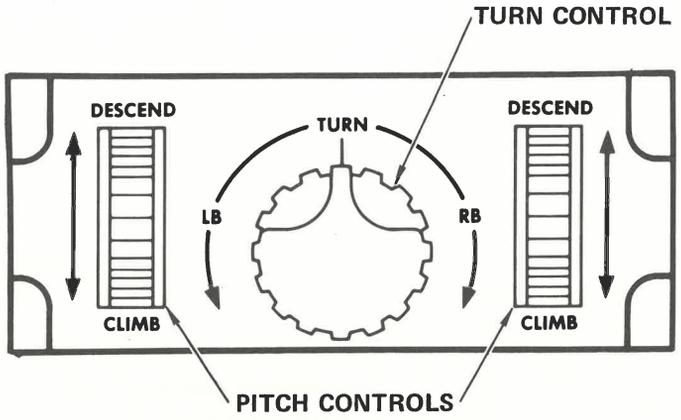
Lights function only when autopilot(s) engaged (AUTO STAB TRIM A – autopilot A; AUTO STAB TRIM B – autopilot B)

- Illuminated when corresponding automatic stabilizer trim unit fails or when an out-of-trim condition is sustained for approximately 12 seconds.
- In dual autopilot operation (LAND mode), both stab trim units are available for trimming; the stab trim unit associated with the first autopilot engaged does the trimming. If the trimming unit fails, that light comes on, and the other unit automatically assumes the trimming function (fail operational).

AUTOMATIC STABILIZER TRIM LIGHTS

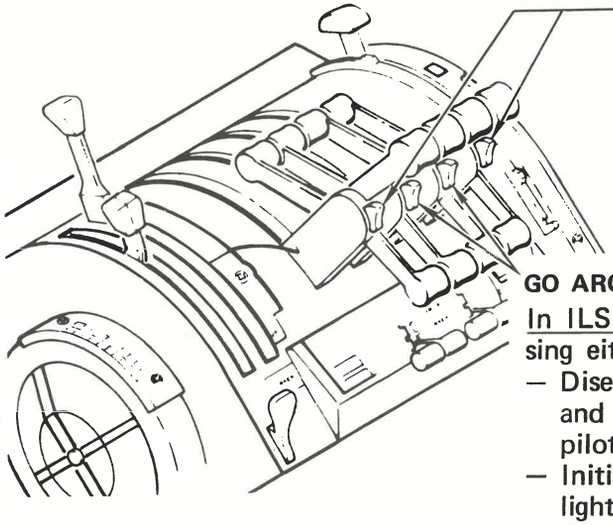


PILOTS' CONTROL WHEEL



AFT ELECTRONICS PANEL

AUTOPILOT MANUAL CONTROL MODULE



THRUST LEVERS

AUTOTHROTTLE DISENGAGE SWITCHES (1 & 4 THRUST LEVERS)

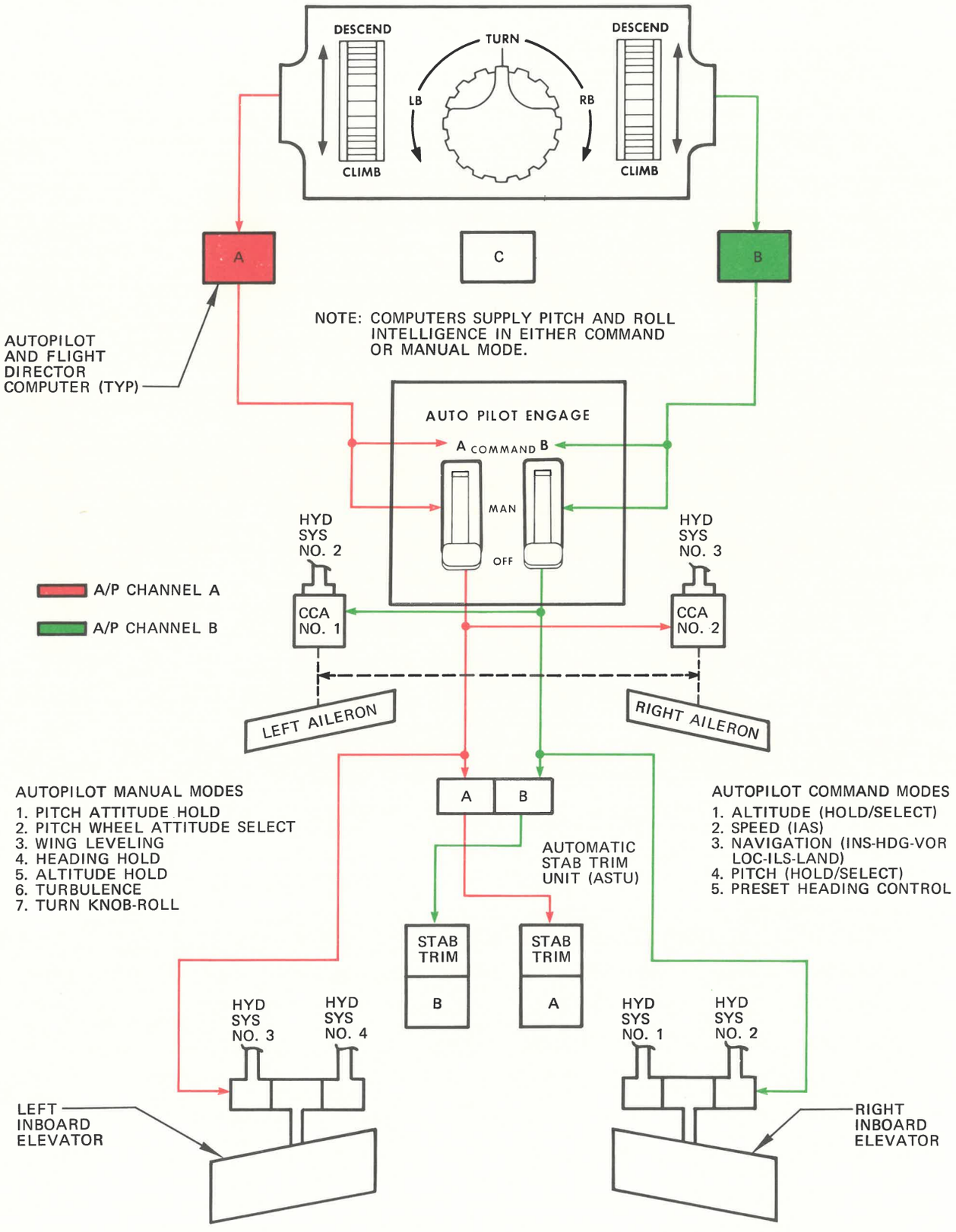
Depressing either switch will disengage the autothrottle only.

GO AROUND SWITCHES (2 & 3 THRUST LEVERS)

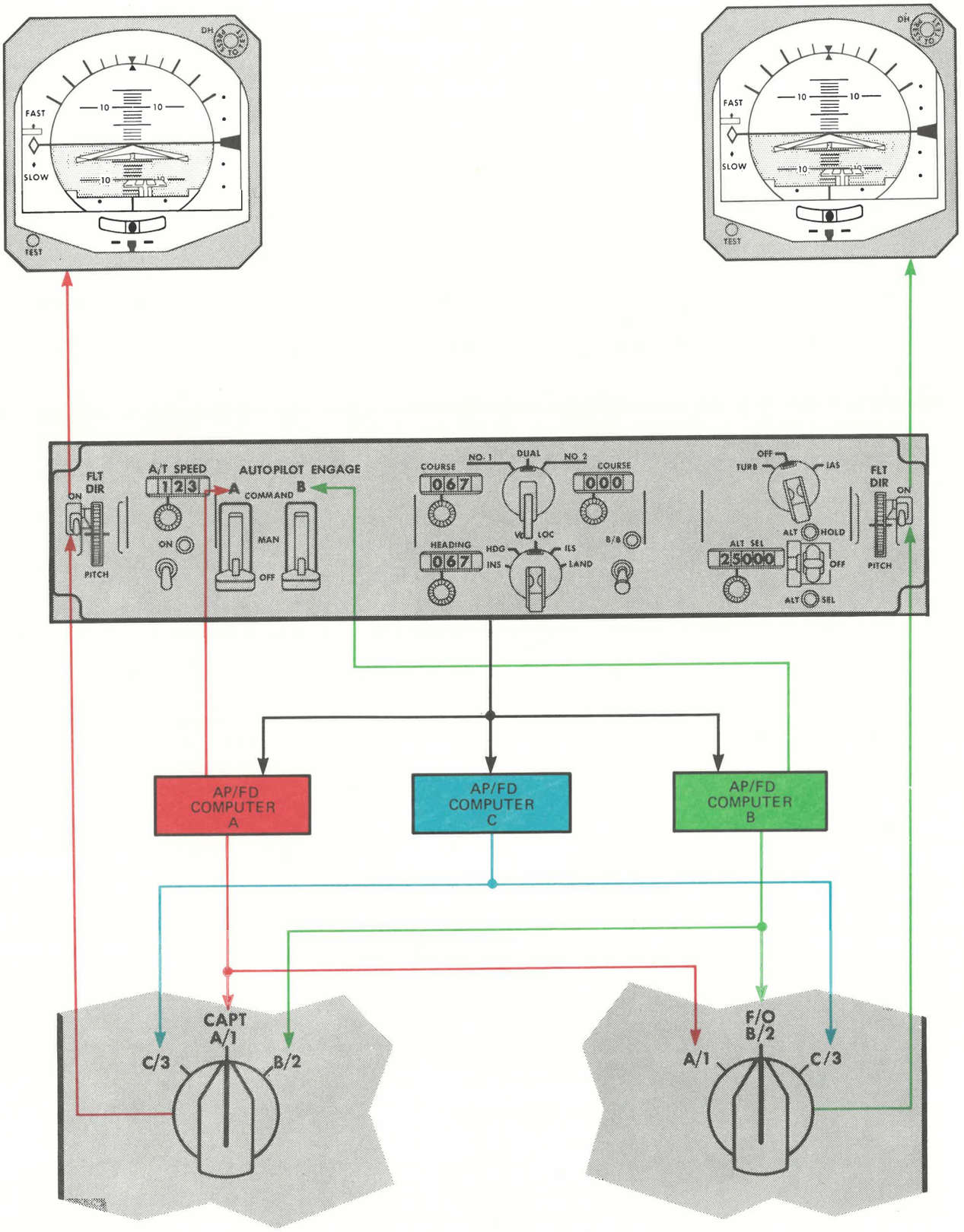
In ILS or LAND mode (after glide slope capture), depressing either switch will:

- Disengage the autopilot and autothrottle. (AUTOPILOT and AUTOTHROT warning lights flash red and autopilot wailer sounds.)
- Initiate flight director go-around mode. (GO AROUND lights illuminate green.)
- Cause flight director (ADI) to display a wings-level, predetermined pitch up command.

MISCELLANEOUS AUTOPILOT CONTROLS



AUTOPILOT SIGNAL FLOW



AUTOPILOT FLIGHT DIRECTOR UTILIZATION

AUTOPILOT WARNING LIGHTS (AND WAILER)

FLASHING RED (AND WAILER)	FLASHING AMBER	STEADY RED	COMMAND TO MAN
SINGLE CHANNEL **WARNING – (DISENGAGE) CAUSED BY ANY ONE OR MORE OF THE FOLLOWING CONDITIONS:** 1. Loss of attitude signal. 2. Loss of computer voltage. 3. Use of electric trim.* 4. Actuation of Go-Around switches. 5. Actuation of control wheel disengage switch. (SEE FLASHING AMBER) **DUAL CHANNEL (LAND)** **CAUSED BY ANY ONE OR MORE OF THE FOLLOWING CONDITIONS:** 1. Through 5. (Same as above). 6. Localizer frequency not selected. 7. Turn control out of detent (one channel to OFF, one to MAN). *Use of manual trim levers will not cause disengage.	**SINGLE CHANNEL** **CAUTION – (NO DISENGAGE) CAUSED BY THE FOLLOWING CONDITION:** Navigation mode switch in "LAND", but only one autopilot engage switch in "command" (above 150'). If the second channel has not been engaged by the time the airplane is at 150' (radio altitude), the engaged channel will be disengaged.	**SINGLE CHANNEL** **WARNING – (NO DISENGAGE) CAUSED BY ANY ONE OR MORE OF THE FOLLOWING CONDITIONS:** 1. Faulty IAS signal. 2. Faulty Glide Slope signal. 3. Faulty VOR or Localizer signal. 4. Faulty INS signal. 5. Faulty Heading signal. 6. Faulty Altitude signal. **DUAL CHANNEL (LAND)** **WARNING – (NO DISENGAGE) CAUSED BY ANY ONE OR MORE OF THE FOLLOWING CONDITIONS:** 1. Cam-out. 2. Faulty radio altimeter signal. 3. Faulty Glide Slope signal. 4. Faulty localizer signal.	**SINGLE CHANNEL** **CAUSED BY ANY ONE OR MORE OF THE FOLLOWING CONDITIONS:** 1. Pitch mode switch moved to "TURB". 2. Back beam switch moved to "B/B". 3. Turn control moved out of detent. 4. Localizer frequency not selected (ILS). 5. Change in position of COMP/STAB or NAV DEV switch.

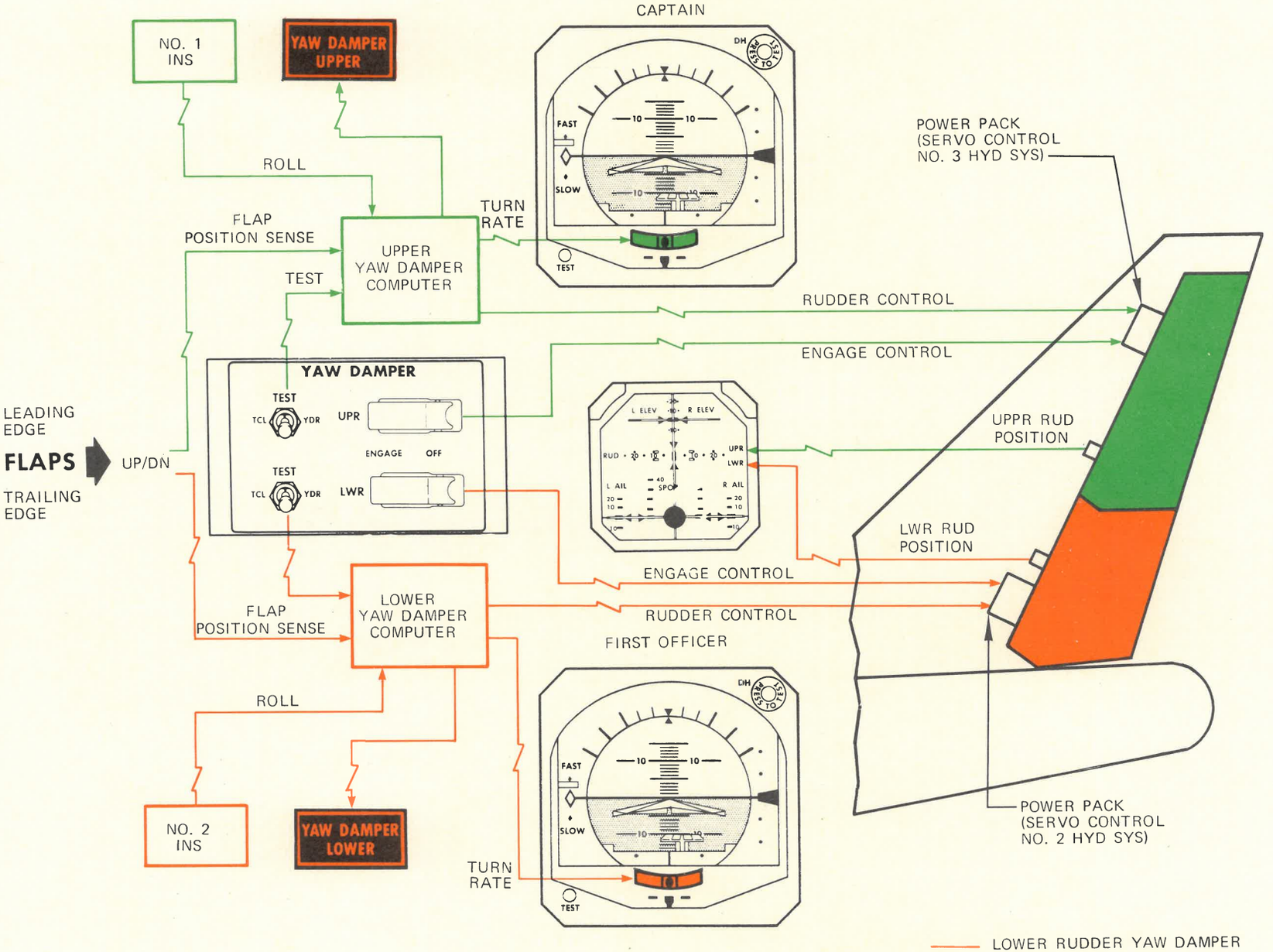
YAW DAMPER/TURN COORDINATOR

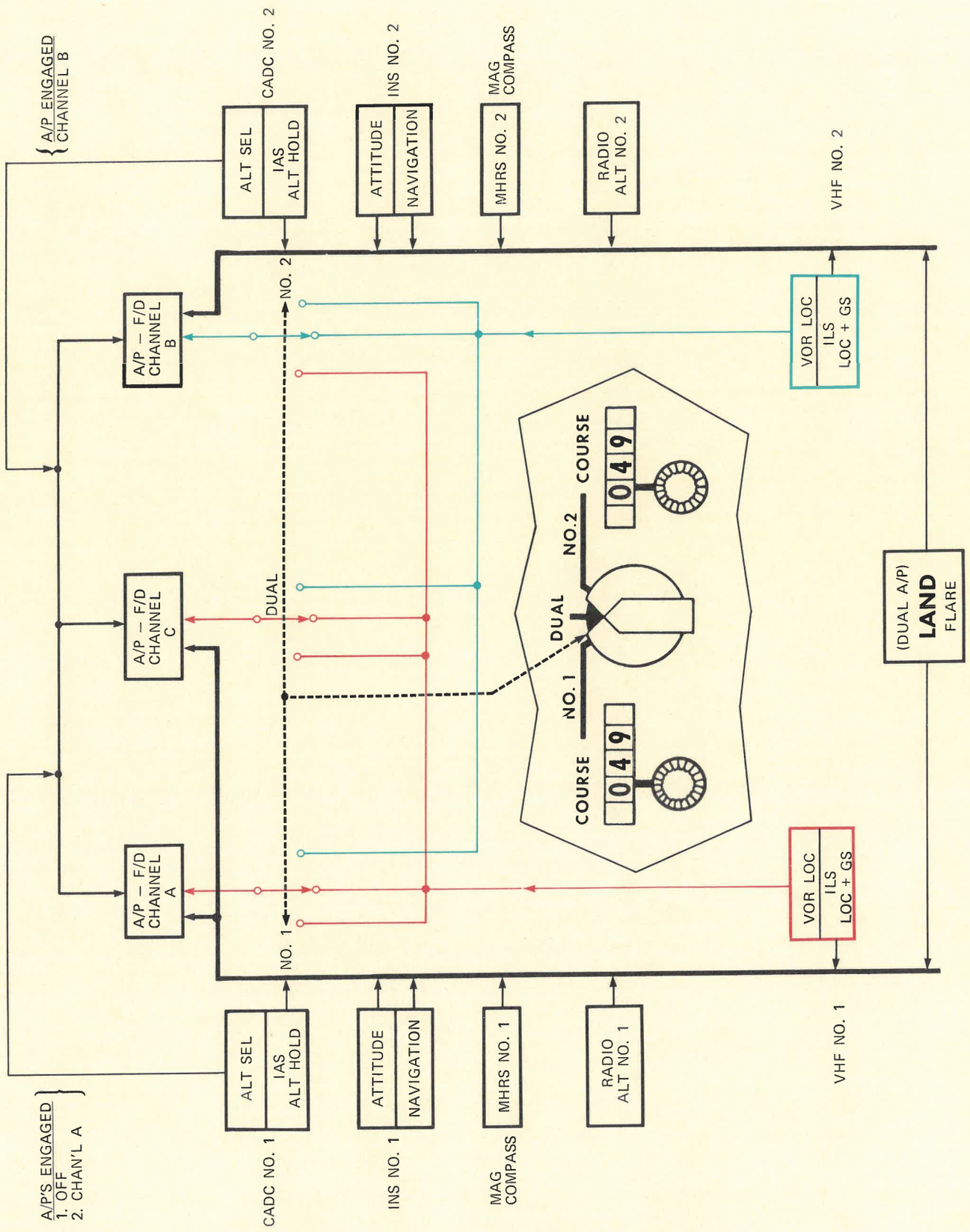
Two independent yaw dampers are provided for the 747 yaw axis stability augmentation system, one for each of the rudders, upper and lower.

In addition to augmenting the yaw axis stability, the yaw damper system has an added feature designed to improve airplane response to turning maneuvers in "flaps down" configuration. This system is called the "turn coordinator" and deflects the rudders at a rate proportional to the roll rate, to improve the roll control response. In "flaps up" configuration, the roll rate signals are removed.

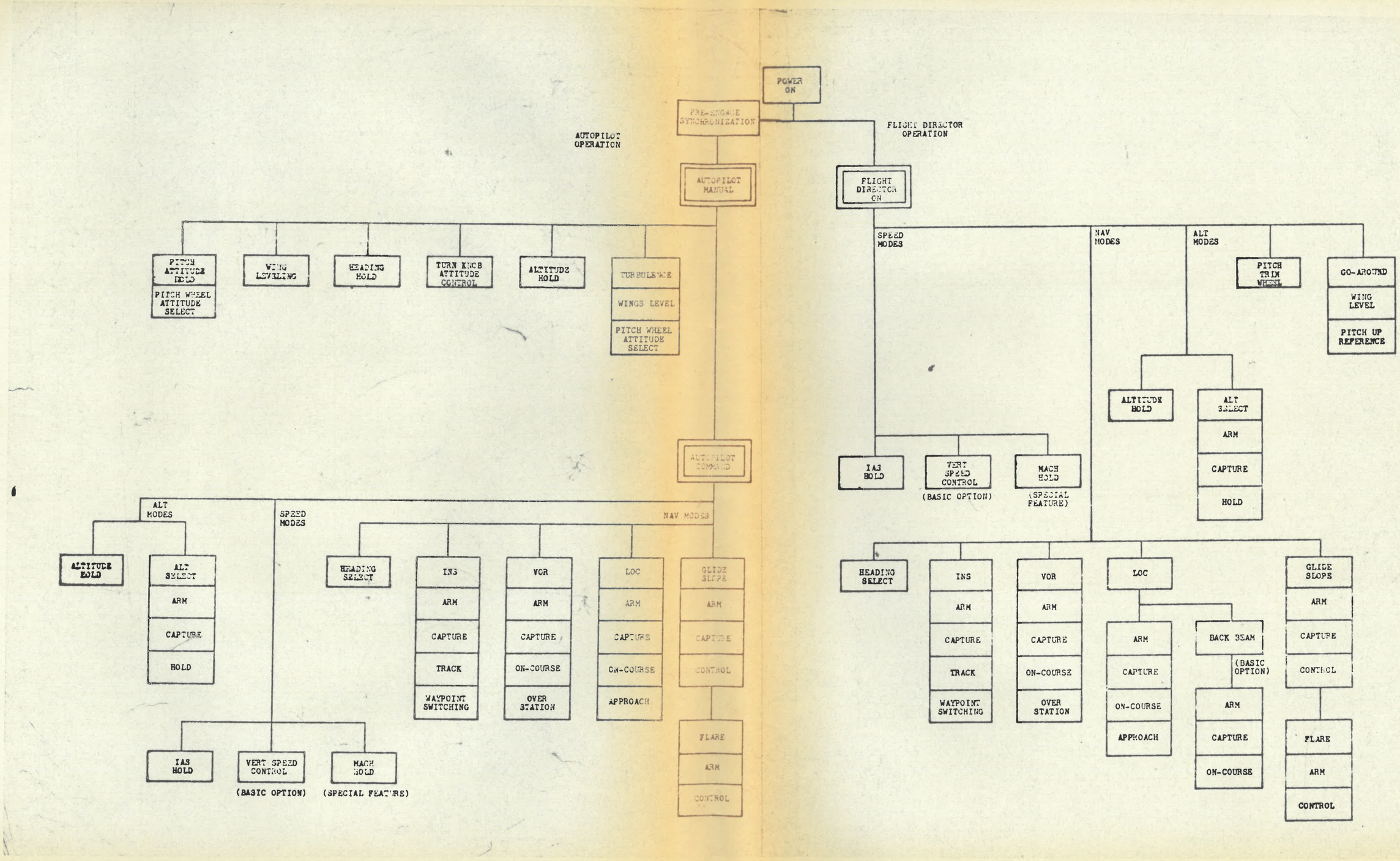
A monitoring circuit senses the "flaps up" or "flaps down" condition. Failure of flap switching signals to the yaw damper/turn coordinator computer is detected and displayed to the pilots by illumination of the amber yaw damper light.

YAW DAMPER SYSTEM





AUTOPILOT-FLIGHT DIRECTOR INPUTS


POWER ON
PRE-ENGAGE SYNCHRONIZATION
AUTOPILOT OPERATION
AUTOPILOT MANUAL
PITCH ATTITUDE HOLD
PITCH WHEEL ATTITUDE SELECT
WING LEVELING
HEADING HOLD
TURN KNOB ATTITUDE CONTROL
ALTITUDE HOLD
TURBULENCE
WINGS LEVEL
PITCH WHEEL ATTITUDE SELECT
AUTOPILOT COMMAND
ALT MODES
ALTITUDE HOLD
ALT SELECT
ARM
CAPTURE
HOLD
SPEED MODES
IAS HOLD
VERT SPEED CONTROL
(BASIC OPTION)
MACH HOLD
(SPECIAL FEATURE)
NAV MODES
HEADING SELECT
INS
ARM
CAPTURE
TRACK
WAYPOINT SWITCHING
VOR
ARM
CAPTURE
ON-COURSE
OVER STATION
LOC
ARM
CAPTURE
ON-COURSE
APPROACH
GLIDE SLOPE
ARM
CAPTURE
CONTROL
FLARE
ARM
CONTROL
FLIGHT DIRECTOR OPERATION
FLIGHT DIRECTOR ON
SPEED MODES
IAS HOLD
VERT SPEED CONTROL
(BASIC OPTION)
MACH HOLD
(SPECIAL FEATURE)
NAV MODES
HEADING SELECT
INS
ARM
CAPTURE
TRACK
WAYPOINT SWITCHING
VOR
ARM
CAPTURE
ON-COURSE
OVER STATION
LOC
ARM
CAPTURE
ON-COURSE
APPROACH
BACK BEAM
(BASIC OPTION)
ARM
CAPTURE
ON-COURSE
GLIDE SLOPE
ARM
CAPTURE
CONTROL
FLARE
ARM
CONTROL
ALT MODES
ALTITUDE HOLD
ALT SELECT
ARM
CAPTURE
HOLD
PITCH TRIM WHEEL
GO-AROUND
WING LEVEL
PITCH UP REFERENCE

CHAPTER 8

CROSS REFERENCE

FOR	REFER TO	CHAPTER
Main/APU Generator Fault Annunciator	ELECTRICAL	10
APU Electrical Controls	ELECTRICAL	10
External Power Controls	ELECTRICAL	10
APU Fire Protection	FIRE PROTECTION	12
APU Fire Test	NORMAL PROCEDURES	4
Takeoff Procedure Using APU Air Conditioning	NORMAL PROCEDURES	4
Pneumatic System Operation	PNEUMATICS	20

APU START

Battery Switch.....ON
- Fire detection circuits are engaged.
- APU battery is connected to APU bus.
- APU oil quantity indicator is operative.

DC Meter Switch.....APU BATT
APU Master Switch.....ON
- APU FUEL VALVE light illuminates, and then extinguishes when APU Fuel Shutoff Valve is fully open.
- APU DOOR light illuminates, and then extinguishes when air inlet door reaches full open position.
- DC PUMP ON light will illuminate if AC power is not available.
- If AC power is available the low PRESS light of the aft fuel boost pump in #2 main tank will extinguish.

NOTE: If APU is to be utilized after landing do not position APU Master Switch to ON until completion of landing roll.

APU Oil Quantity...IN GREEN BAND
APU Bleed Air Switch.....CLOSE
APU Master Switch.....START
Momentarily position to START and then release.

NOTE: The START position is deactivated until the APU Door has fully opened and the APU Door light is extinguished.

EGT and RPM.....MONITOR
After ignition (at 7% RPM) EGT will increase rapidly and may indicate in the red band momentarily during start, but should stabilize in the green band at 100% RPM.

DC Voltage.....CHECK
At 50% RPM the APU starter will disengage with a resulting increase of APU voltage to a nominal indication (24V).

NOTE: Failure of the voltage to return to a nominal indication before 100% RPM is reached indicates that the starter has not disengaged and the APU should be shut down.

APU SHUTDOWN

APU Bleed Air Switch.....CLOSE
Observe APU EGT decreases and stabilizes.

APU Master Switch.....STOP
- FAULT light illuminates.
- RPM and EGT decreases.
- APU DOOR light illuminates at 50% RPM.
- FAULT light and APU DOOR light extinguish, verifying that APU Door is fully closed.

NOTE: Failure of the FAULT light to illuminate when the APU Master Switch is positioned to STOP indicates a malfunctioning of the overspeed protection circuitry. However the APU will shut down due to fuel starvation and the APU Fuel Valve and Door and associated lights will function normally.

AUTO SHUTDOWN DUE TO INTERNAL FAULT

After auto shutdown the FAULT light at the Flight Engineer's station will remain on until the master switch is placed in the STOP position. Placing the master switch to STOP resets the system.

CAUTION: IF APU IS SHUT DOWN DUE TO ACTION OF THE AUTO SHUTDOWN SYSTEM, AN APU MALFUNCTION IS INDICATED. MAINTENANCE SHOULD BE REQUESTED PRIOR TO ATTEMPTING ANOTHER START.

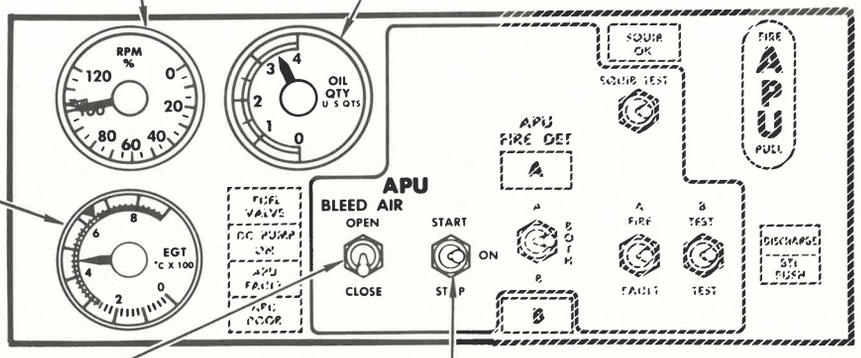
APU RPM INDICATOR

Indicates APU engine speed in percent rpm.

OIL QUANTITY INDICATOR

Indicates APU oil quantity by increments. Operative whenever battery bus is powered.

F/E UPPER PANEL



EGT INDICATOR

The index mark (brown) on the EGT Indicator is for maintenance use in instrument calibration.

BLEED AIR SWITCH

OPEN – APU provides bleed air to pneumatic manifold.

CLOSE – Bleed air valve closed.

APU MASTER SWITCH

START – Held momentarily, spring loads to ON upon release. Initiates starter motor cranking.

ON – Opens APU door. Opens APU fuel valve. Starts AC or DC fuel pump.

STOP – Signals 110% switch for shutdown. Position to STOP after auto shut down to reset circuits for another start.

APU MODULE

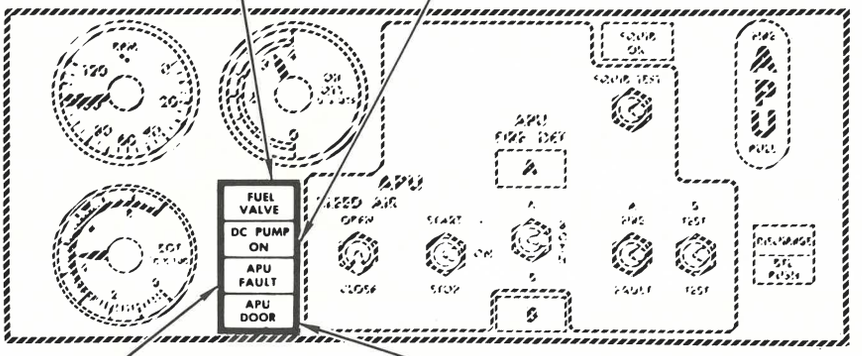
APU FUEL SHUTOFF VALVE LIGHT (Blue)

EXTINGUISHED – APU fuel shutoff valve open or closed.
ILLUMINATED – Valve in transit.

DC PUMP ON LIGHT (Green)

ILLUMINATED – APU DC fuel pump operating.

F/E UPPER PANEL



FAULT LIGHT (Amber)

ILLUMINATED – APU has shut down due to:

- Low oil pressure
  Low oil pressure shutdown locked out of operation during start until APU reaches 95% rpm.
- High oil temperature
- Cooling air valve fails to open
- High EGT
  EGT reaches maximum allowable for rpm range.
- Overspeed, 110% rpm
- Duct failure overheat
- Excessive pressure drop across APU inlet screen.
- Loss of control power
  Air inlet temperature
  Compressor discharge pressure
  EGT information
  Speed input signal
- Normal shutdown

APU DOOR LIGHT (Blue)

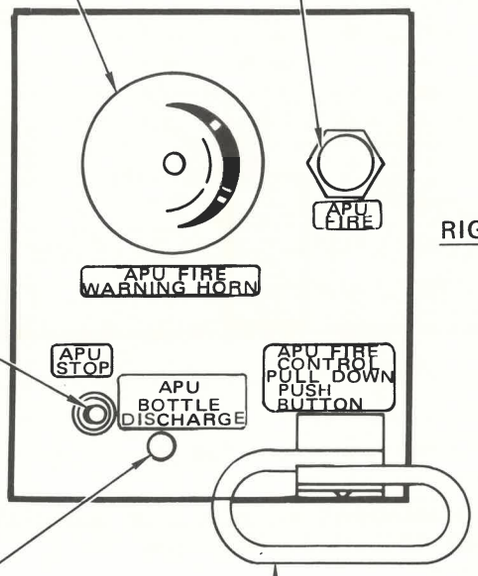
EXTINGUISHED – APU air inlet door open or closed.
ILLUMINATED – APU air inlet door in transit to open when APU master switch is positioned ON or door in transit to closed after master switch is positioned to STOP and APU RPM is 50%.

APU MODULE

ANNUNCIATOR LIGHTS

APU REMOTE FIRE WARNING HORN
Sounds upon receiving fire signal. Silenced when fire switch in wheel well or on flight engineer's panel is pulled or fire is extinguished. Also sounds during fire test. Deactivated when gear is retracted.

APU REMOTE FIRE LIGHT (Red)
Illuminates upon receiving fire signal. Goes out when fire is extinguished. Also illuminates during fire test.



RIGHT BODY WHEEL WELL

APU REMOTE STOP SWITCH
Press momentarily to stop APU.

APU BOTTLE DISCHARGE SWITCH
Pull fire switch to arm: Press to discharge fire bottle.

REMOTE FIRE CONTROL SWITCH
Pull to shutdown APU and arm fire extinguisher discharge circuit.

APU REMOTE CONTROL MODULE

REMOTE CONTROL MODULE

GENERAL

The auxiliary power unit (APU) is a self-contained gas turbine engine. It is installed in the tail cone of the airplane, isolated from flight critical structure and control surfaces by a firewall. The APU provides electrical and pneumatic power for systems operation on the ground.

FUEL SYSTEM

Fuel is normally supplied to the APU from the airplane No. 2 main tank. Fuel can be supplied from any tank through the crossfeed system. In the event that AC power is not available, a DC operated pump, controlled by the APU master switch, will supply fuel from No. 2 main tank to the APU. With AC power available, the No. 2 aft main boost pump will operate automatically. The DC pump is shut down by a pressure switch actuated by the No. 2 aft main boost pump.

OIL SYSTEM

The APU oil system is a self-contained system consisting of independent supply, pumps, regulator, cooler, filters and indicator. A quantity indicator is provided on the APU module.

ELECTRICAL SYSTEM

The APU drives two generators identical to the engine driven generators at constant speed. The APU generators are capable of supplying the entire electrical load of the airplane.

BLEED AIR SYSTEM

The APU provides bleed air to the airplane pneumatic manifold for operation of pneumatic components. When electrical load and bleed air extraction combine to raise EGT above normal operating temperature, the load control valve will modulate toward the closed position to restrict bleed air extraction. When large amounts of pneumatic power are required, as during engine start, electrical loads should be reduced.

APU BATTERY

A separate 24-volt battery is provided for APU starting. The main airplane battery switch must be on to operate the APU.

The APU battery is provided with a separate battery charger which is disconnected during APU starter engagement.

REMOTE STOP SWITCH

The remote stop switch is mounted on the APU remote control panel located in the right main wheel well. Momentarily pressing the switch will shut down the APU.

NOTE: The APU FAULT light will not illuminate when the remote stop switch is used for shut down.

STARTING SEQUENCE

7% - APU fuel solenoid valve opens and ignition starts.

50% - Starter cutout. DC ammeter becomes operative. DC voltmeter normal.

95% - Ignition cutout. APU starts governing. Load enabling switch closes. Bleed air valve can be opened and generators can be connected to the sync bus. Hour-meter starts recording.

100% - Normal operation with APU governing ± 1.25% RPM.

AUTO SHUTDOWN

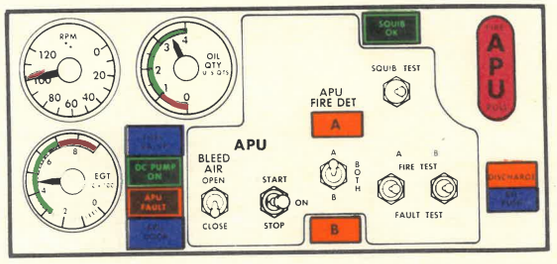
The auto shutdown circuits will cause APU shutdown by closing the APU fuel shutoff valve, fuel solenoid valve, and deactivating ignition (if operating). The following causes of auto shutdown represent those conditions which are readily monitored:

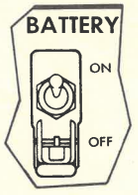
- Overspeed (110% RPM).
- Fire signal (either from the fire detection system or by operation of one of the fire switches).
- High EGT (when EGT reaches maximum allowable for the RPM range).

PULSATING EGT INDICATION

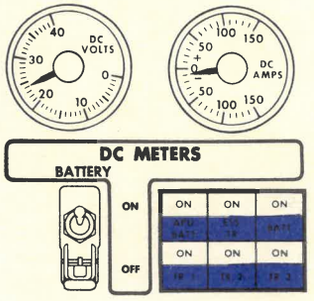
The electronic turbine control monitors each of the two EGT thermocouple harness circuits of the APU. If one of the two circuits is open or is presenting a significantly lower temperature the fault will be shown on the APU EGT indicator. The EGT reading will pulse every 2-1/2 seconds from a stabilized (valid) reading to a reading approximately 100°C above or below the stabilized reading. This will not cause an automatic shutdown and the APU is operative if this condition exists. However corrective maintenance action should be requested as soon as practicable to replace the faulty thermocouple harness.

APU START PROCEDURE





BATTERY SWITCH ON



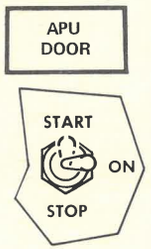
SELECT
APU BAT ON DC METERS

MASTER SWITCH TO ON

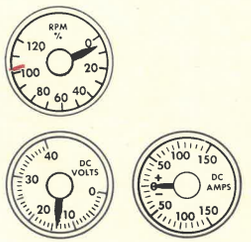
QUANTITY ABOVE (1) QUART

BLEED AIR SWITCH CLOSE

GEN OPEN LIGHTS ON
FUEL VALVE LIGHT ON
THEN OFF
DC PUMP LIGHT ON
APU DOOR LIGHT ON

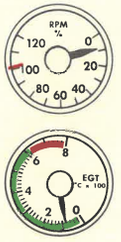


APU DOOR LIGHT OFF
MASTER SWITCH TO START-ON

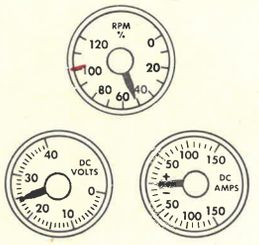


DC METERS

RPM INCREASE
DC VOLTS LOW
DC AMPS ZERO

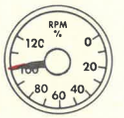


AT 7% RPM
EGT RISE



DC METERS

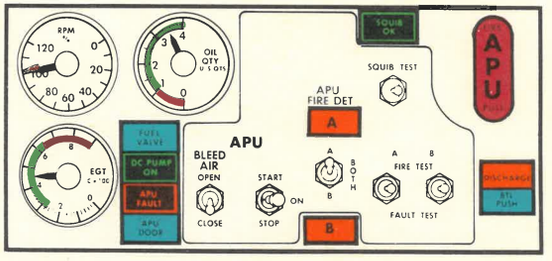
AT 50% RPM
DC VOLTS NORMAL



SPEED ABOVE 95%

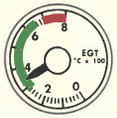
START COMPLETE

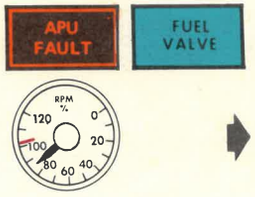
APU STOP PROCEDURE

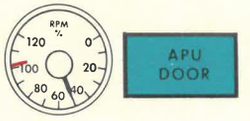


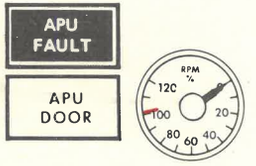
PLACE

BLEED AIR SWITCH TO CLOSE









OBSERVE

EGT DECREASE TO IDLE TEMP

PLACE

MASTER SWITCH TO STOP

FAULT LIGHT ON
FUEL VALVE LIGHT BRIGHT-OFF
RPM DECREASE

AT 50% RPM
APU DOOR LIGHT ON

RPM ZERO
APU DOOR LIGHT OFF
FAULT LIGHT OFF

SHUTDOWN COMPLETE

CHAPTER 9

CROSS REFERENCE

FOR	REFER TO	CHAPTER
Additional Communication Use	NORMAL PROCEDURES	4
Navigation Aids	NAVIGATION	19

TO ESTABLISH VHF COMMUNICATION:

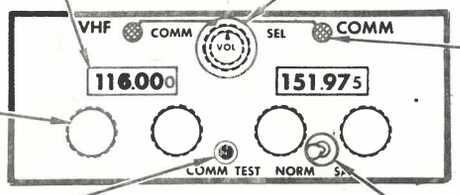
Radio Master Switches.....ON
VHF Mode Selector.....NORMAL
Frequency Selectors.....SET
Transfer Switch.....DESIRED FREQUENCY
Frequency Transfer Light...ILLUMINATED
Transmit Select Switch.....PUSH
VHF-1, 2, or 3 may be selected.
Receive Switch.....ON
Volume Controls (2).....SET
Push-to-Talk Switch.....PUSH
Use appropriate switch to transmit. (Hand mike; or if using oxygen mask/boom mike the control wheel or auxiliary panel PTT switch may be used.)

TO ESTABLISH HF COMMUNICATION:

Radio Master Switches.....ON
HF Mode Switch.....AM OR SSB
Frequency Selectors.....SET
Transmit Select Switch.....PUSH
HF-1 or 2 may be selected.
Receive Switch.....ON
Volume Controls (2).....SET
Push-to-Talk Switch.....PUSH
Use appropriate switch to transmit. (Hand mike; or if using oxygen mask/boom mike the control wheel or auxiliary panel PTT switch may be used.)

FREQUENCY INDICATOR (2)
Displays frequency from 116.0 to 151.97 MHz, as set by the frequency selectors.

FREQUENCY TRANSFER SWITCH
Permits selection of either left or right-hand displayed frequencies. Integral volume switch.



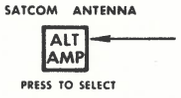
FREQUENCY TRANSFER LIGHT (2-Green)
Illuminates to show which frequency has been selected by transfer switch.

FREQUENCY SELECTOR (2 Each)
Rotation of selectors changes displayed frequency.

COMM TEST SWITCH
When pressed receiver noise may be heard indicating receiver operating.

AFT ELECTRONICS PANEL

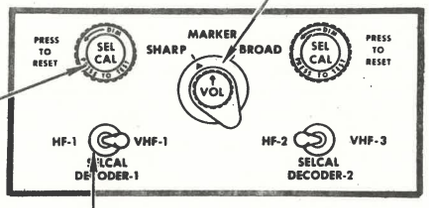
MODE SELECTOR
NORM – Provides operation with standard power and with the VHF antenna.
SAT – (Provisions only)



Provisions only

OVERHEAD PANEL

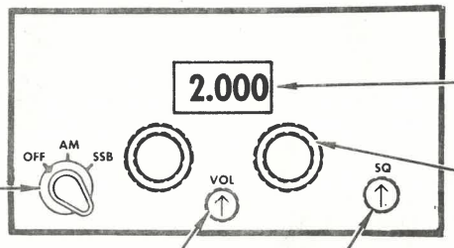
MARKER BEACON CONTROL
Sensitivity adjustment for beacon identification.
SHARP – Decreased sensitivity to more sharply define marker beacon fix.
BROAD – Increased sensitivity to ensure reception.



SELCAL LIGHT (2-Amber)
Blinking light and single hi-lo chime alerts pilots to incoming call on communication radio selected. Pressing SELCAL light will extinguish light and reset selcal.

SELCAL SELECTORS (2)
Selects communication radios to monitor incoming calls. Ground station must transmit selcal signal on SSB to alert airplane monitoring SSB. VHF 2 cannot be selected.

AFT ELECTRONICS PANEL



FREQUENCY INDICATOR
Range from 2 to 30 MHz.

MODE SWITCH
SSB – Single side band. Same as upper side band. Provides peak power for extra long range transmissions. Station being "worked" must also have SSB capability.
AM – Amplitude modulation.

FREQUENCY SELECTOR (4)
Rotation of each of the 4 selectors changes the corresponding number.

VOLUME SWITCH

SQUELCH SWITCH
Rotation clockwise decreases power level required by incoming HF transmission in order to "break in". Eliminates background noise except when station breaks in.

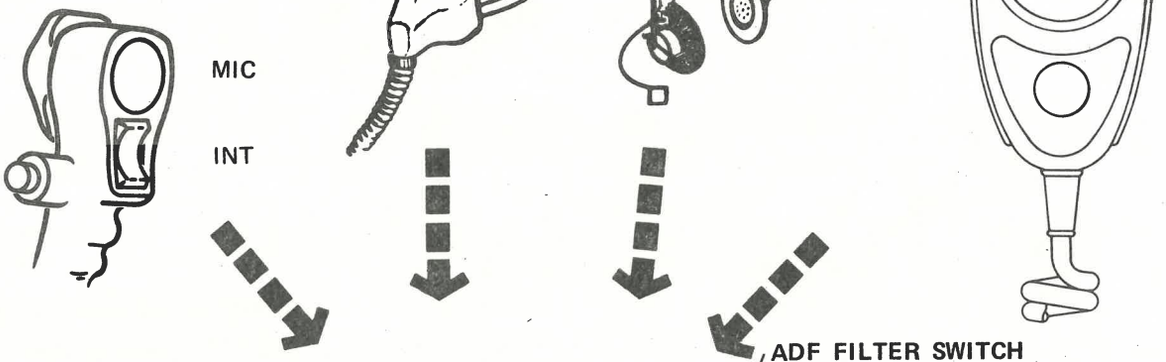
CONTROL WHEEL PTT SWITCH

MIC – Keys lighted mic selector.
INT – Allows pilot to talk over interphone without pressing INPH transmit switch.

OXYGEN MASK MICROPHONE

BOOM MICROPHONE (PROVISIONS ONLY)

HAND MICROPHONE



INPUTS

TRANSMIT SWITCH (6)

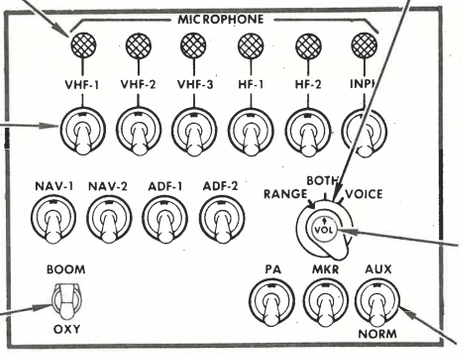
Press in to select transmitter; depressed switch will illuminate. Only one switch may be depressed at any time.

RECEIVE SWITCH (12)

Switch up to monitor receiver. Volume control is on individual radio modules. Any number of receivers may be monitored at the same time.

BOOM/OXY SWITCH

BOOM – Select when using boom microphone.
OXY – Select when using oxygen mask microphone.
– Switch is guarded to OXY position.



ADF FILTER SWITCH

VOICE – Range signals are filtered out when selected. Allows only voice to be heard.
BOTH – Both range signals and voice can be heard.
RANGE – Voice is filtered out when selected. Allows only range signals to be heard.

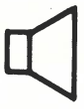
INTERPHONE VOLUME CONTROL

AMPLIFIER SWITCH

Selects isolation amplifier in audio selector panel. Loss of the amplifier selected will cause that audio selector panel only to lose audio. Switch to auxiliary amplifier.

OUTPUTS

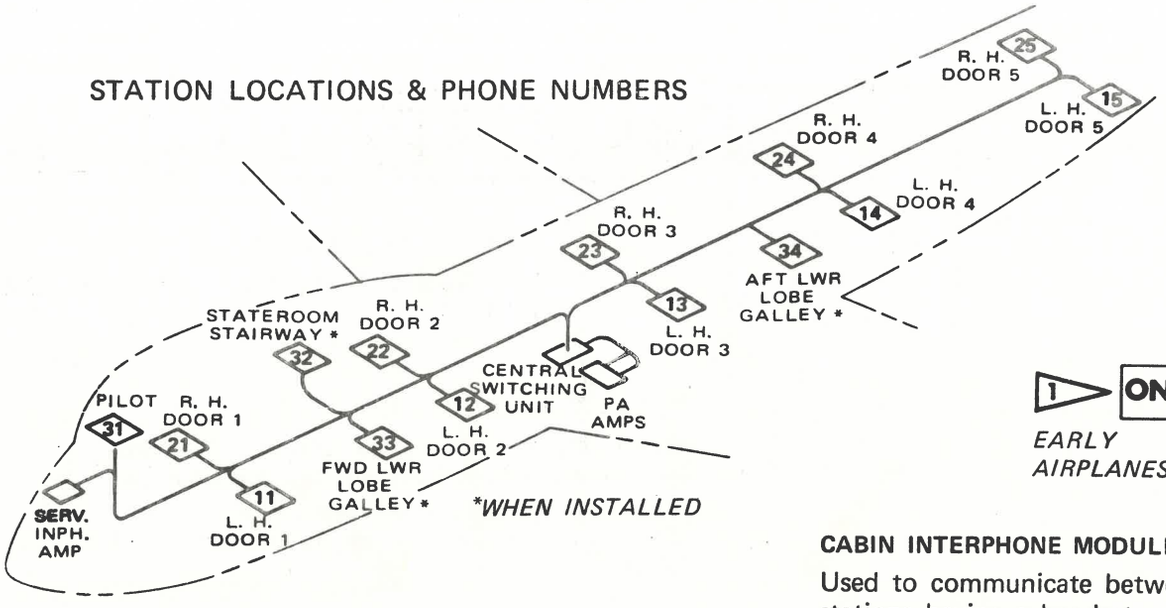
HEADSET



COCKPIT LOUDSPEAKER

AUDIO SELECTOR PANEL

STATION LOCATIONS & PHONE NUMBERS

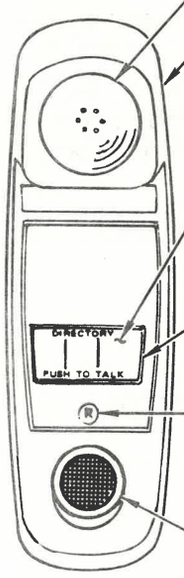


EARLY AIRPLANES

CABIN INTERPHONE MODULE

Used to communicate between stations having a handset.

PILOTS' CONTROL STAND



EARPHONE

PILOTS' HANDSET

Used to talk to attendants and to make PA announcements.

DIRECTORY

Lists numbers of attendants and PA inputs.

PUSH TO TALK SWITCH

Hold down to speak.

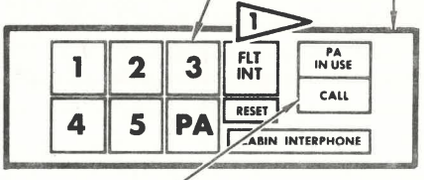
RESET SWITCH

Push to cancel call. Same as placing handset on hook.

MICROPHONE

NUMBERED SWITCHES (5)

- Used to call stations. For example, to call right hand door #3, push "2", then "3".
- All stations may be called simultaneously by selecting "55".



CALL LIGHT

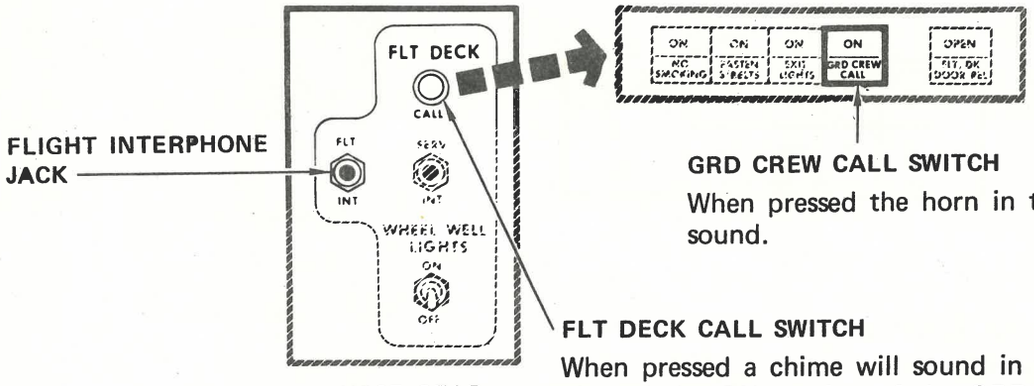
- Illuminates steady for normal call (31) from cabin attendant.
- Illuminates flashing for priority call (PP or 55) from cabin attendant.
- Single chime sounds for both types of calls.
- Light extinguishes when pilots' handset is lifted off hook.

PILOTS' HANDSET

To Call Attendant (Using Handset) – This is the primary way of talking to the cabin attendants. It is not necessary to press the FLT INT (ON) switch when using the handset.

- Remove handset from hook; listen for tone. Lack of tone indicates the system trunklines are busy. Tone must be present to call attendants even on priority (55) call.
- Press station numbers. HI-LO chime will sound once and pink call light will illuminate steady at station called.
- Press push to talk switch to speak. Release when listening. If station called is talking to another attendant, there will be no call light or chime; however, pilot will "break into" their conversation and talk to both attendants. If attendant is making a PA announcement, attendant will be able to hear pilot, but must press reset switch to cancel PA and talk to pilot.

CABIN INTERPHONE (USING HANDSET)



PILOTS
OVERHEAD PANEL

FLIGHT INTERPHONE JACK

NOSE GEAR

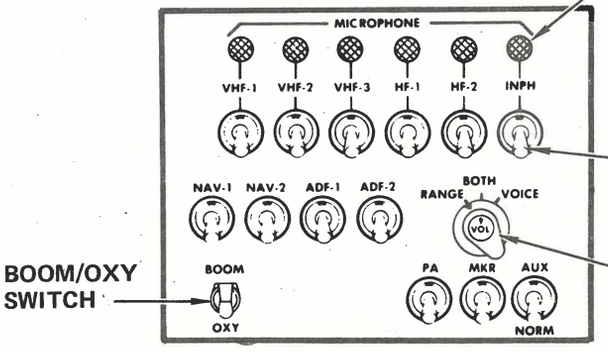
GRD CREW CALL SWITCH

When pressed the horn in the nose wheel will sound.

FLT DECK CALL SWITCH

When pressed a chime will sound in the cockpit and the ON portion of the GRD CREW CALL switch on the pilots' overhead panel will illuminate and remain illuminated for 30 seconds.

FLIGHT/GROUND CREW CALL SYSTEM



INPH TRANSMIT SWITCH (FLIGHT INTERPHONE)

Used to communicate between stations having an audio selector panel plus the FLT INT jack at the nose gear.

INPH RECEIVE SWITCH (FLIGHT INTERPHONE)

INPH VOLUME CONTROL SWITCH

BOOM/OXY SWITCH

AUDIO SELECTOR PANEL

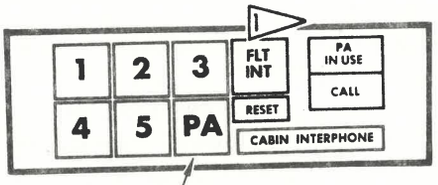
To Talk On Flight Interphone:

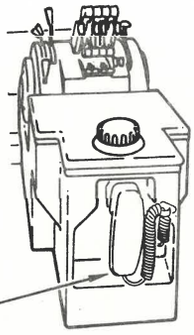
– Press INPH TRANSMIT SWITCH. Use hand microphone. If using oxygen mask or boom microphone, place BOOM/OXY switch to desired position. Press PTT switch to talk.
– Pilots can also talk on flight interphone by pressing the PTT switch on the pilots' control wheels.

To Listen To Flight Interphone:

Press the INPH receive switch up.

PILOTS' OVERHEAD PANEL





CONTROL STAND

PASSENGER ADDRESS

With Handset:

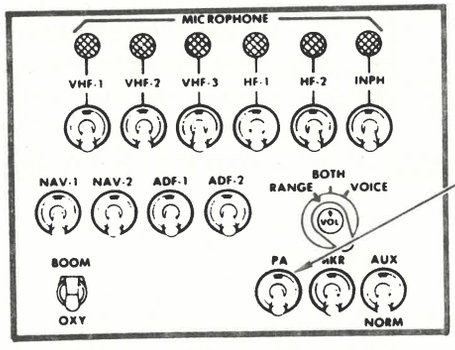
– Lift handset off of hook. Listen for dial tone.
The dial tone must be present before the PA switch can be used.
If the PA is being used by another station, the PA IN USE light will illuminate.

– Push PA switch twice.
The PA light will illuminate indicating the pilots are connected to the priority side of the PA, and will override any cabin attendant making a PA announcement.

NOTE: If pilots use 43 with the handset from the cockpit, they will not override cabin attendants making a PA announcement.

– Press the handset push-to-talk switch to transmit.
The PA light will extinguish when the handset is placed back on the hook or the handset reset switch is pressed.

EARLY AIRPLANES



Used to monitor PA announcements in passenger cabin.

AUDIO SELECTOR PANEL

NOTE: Only the control stand handset can be used to make PA announcements from the cockpit.

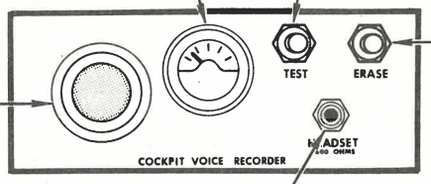
INDICATOR

Fluctuates during normal recorder operation and when test switch is pushed.

TEST SWITCH

When test switch is pushed needle on indicator will deflect to center of scale, and test tone may be heard with headset plugged in headset jack.

PILOTS' OVERHEAD PANEL



ERASE SWITCH

Hold switch in for several seconds to erase all four channels. Airplane must be on ground with parking brake set and AC power available.

MICROPHONE

Picks up cockpit area conversation on one channel.

NOTE: Captain's, First Officer's and Flight Engineer's microphone inputs are recorded on three other channels.

HEADSET JACK

Headset may be plugged into jack to monitor tone transmission during test.

NOTE: With the essential radio master switch ON, the voice recorder runs through a complete cycle approximately every 30 minutes. It then begins a new cycle – erasing the old recording and recording the new. If an "incident" occurs, consideration should be given to deactivating the voice recorder, if desired, to preserve the recording.

FLT/SERV SWITCH (SERVICE INTERPHONE)

Service interphone is used to communicate between stations having a service jack. The FLT/SERV switch connects service interphone to flight interphone. To use service interphone from the cockpit, it must be connected to flight interphone.

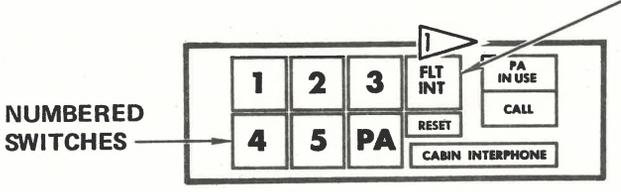
FLIGHT ENGINEER'S PANEL

To Connect Flight and Service Interphones:
Place the FLT/SERV switch ON. Use normal flight interphone procedures to talk to outside service jacks.

To Disconnect Flight and Service Interphones:
Place the FLT/SERV switch OFF.

FLT/INT SWITCH

Used to connect flight and cabin interphones. Allows the flight crew to talk with cabin attendants using microphones and earphones other than the handset.

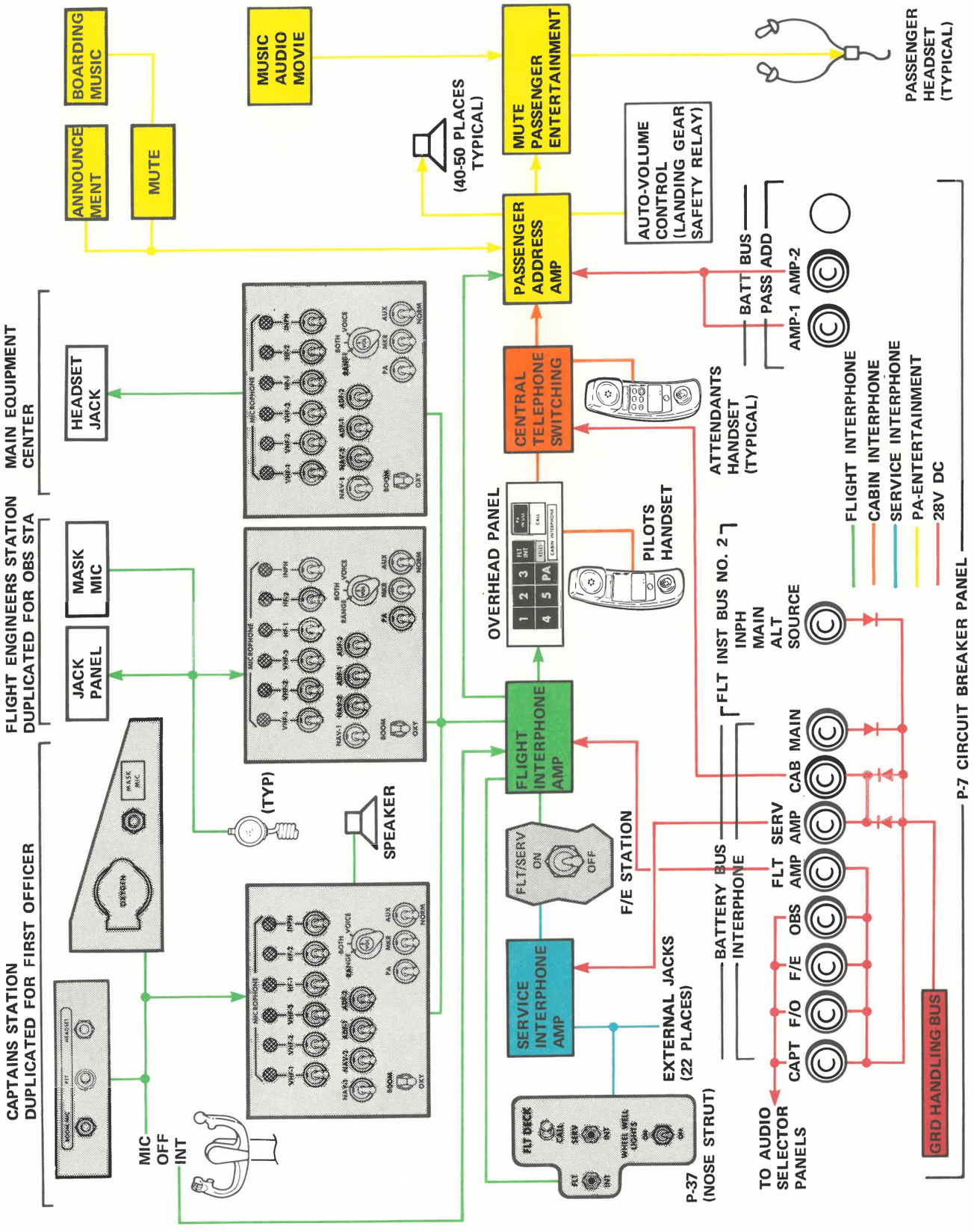


To Connect Flight and Cabin Interphones:
Press the FLT/INT switch. FLT/INT light illuminates. Use normal flight interphone procedures with the hand, boom or oxygen mask microphones. Use the normal cabin interphone procedure of selecting two numbered switches for the desired station.

To Disconnect Flight and Cabin Interphone:
Press the FLT/INT switch again. FLT/INT light extinguishes.

NOTE: Always press the FLT/INT switch again to extinguish the FLT/INT light when the conversation is ended. Leaving the light illuminated is the same as leaving the handset off the hook and will cause the cabin attendant to receive a busy signal.

EARLY AIRPLANES



INTERPHONE & PASSENGER ADDRESS SYSTEM

VHF COMMUNICATIONS

There are three complete VHF communication systems, each with a separate antenna. When the satellite communications (SATCOM) system is installed, two of these units may be connected to the SATCOM system.

HF COMMUNICATIONS

There are two complete HF communication systems, each with a separate receiving antenna, although only one may be keyed at a time. Each unit is capable of single side band and amplitude modulation operation.

AUDIO SELECTOR PANEL

Serves as a selector for internal or external transmission and reception at each cockpit position.

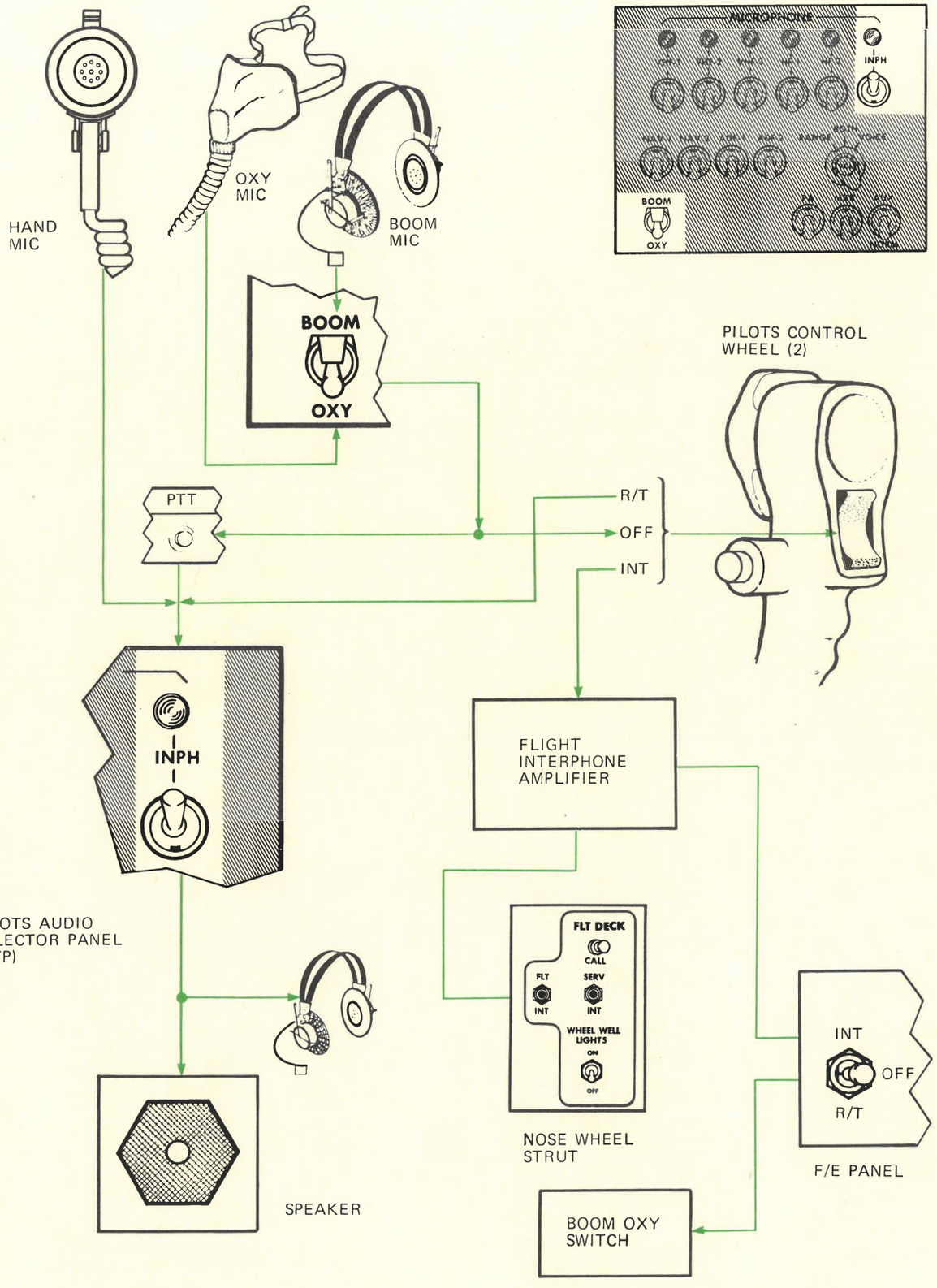
INTERPHONE

There are three interphone systems: flight, service, and cabin. Flight interphone may be connected to service and/or cabin. However service interphone, by itself, cannot be connected to cabin.

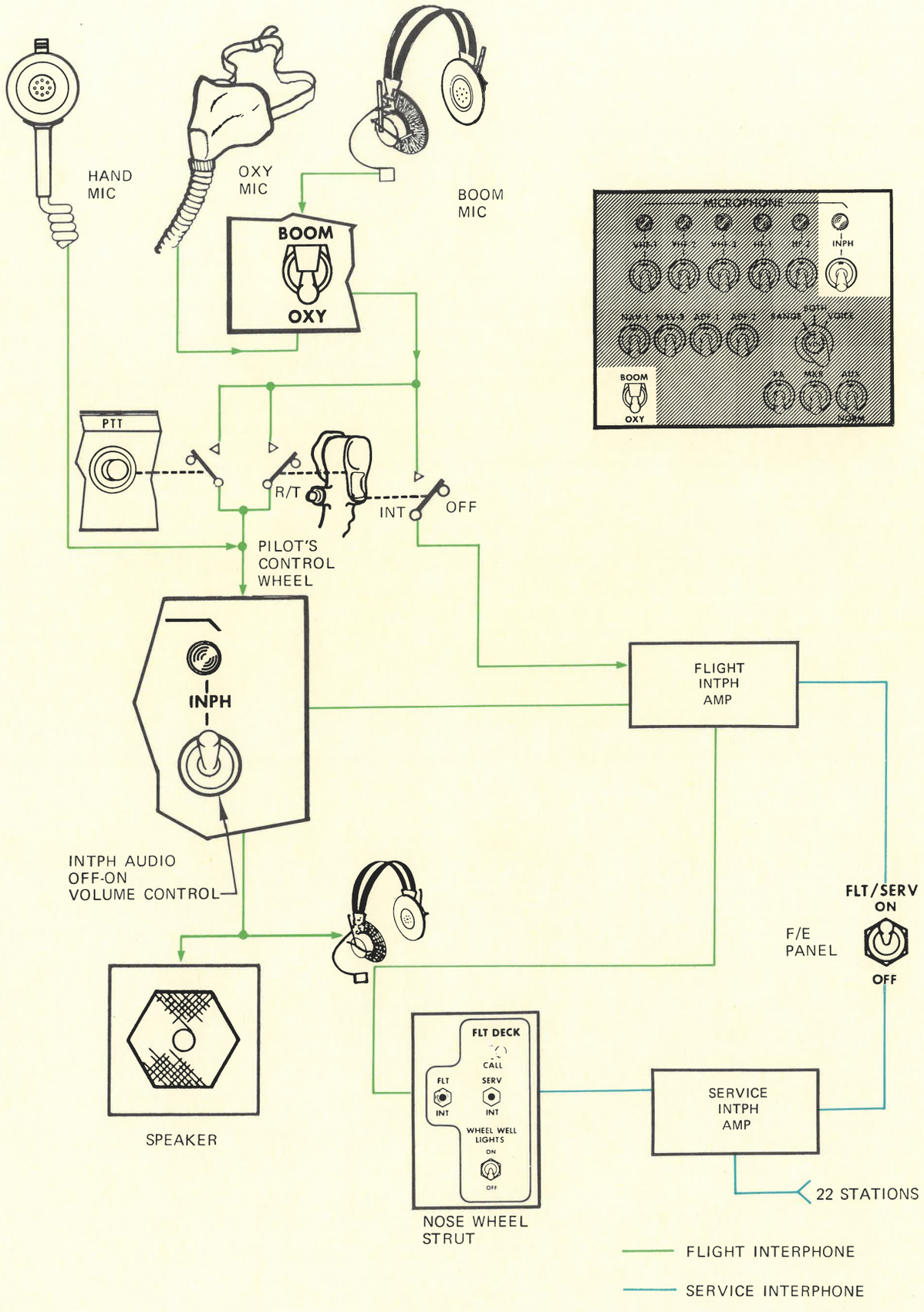
FLIGHT INTERPHONE: For cockpit stations exclusive intercommunication. An additional station (nose gear) is on this circuit for control of ground crew.

SERVICE INTERPHONE: This system provides for communication between all external service jacks.

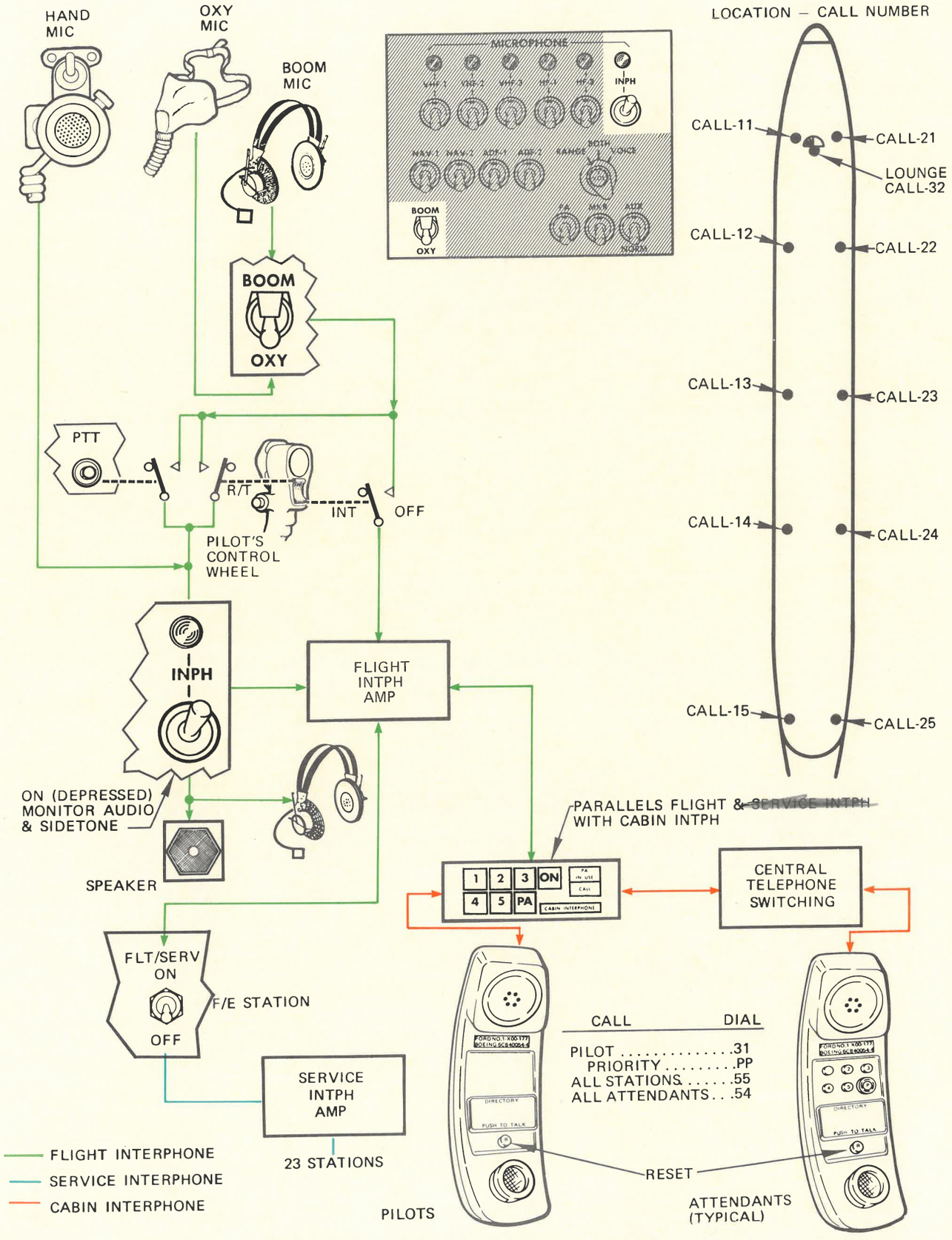
CABIN INTERPHONE: This system allows telephone-type communication between the cockpit (with handset) and passenger cabin attendant stations, between separate attendant stations, and provides the primary means for making passenger address announcements. In addition, the system may be connected to the flight interphone system permitting cockpit-to-attendant's station(s) (with hand, boom or oxygen mask mike) communication.



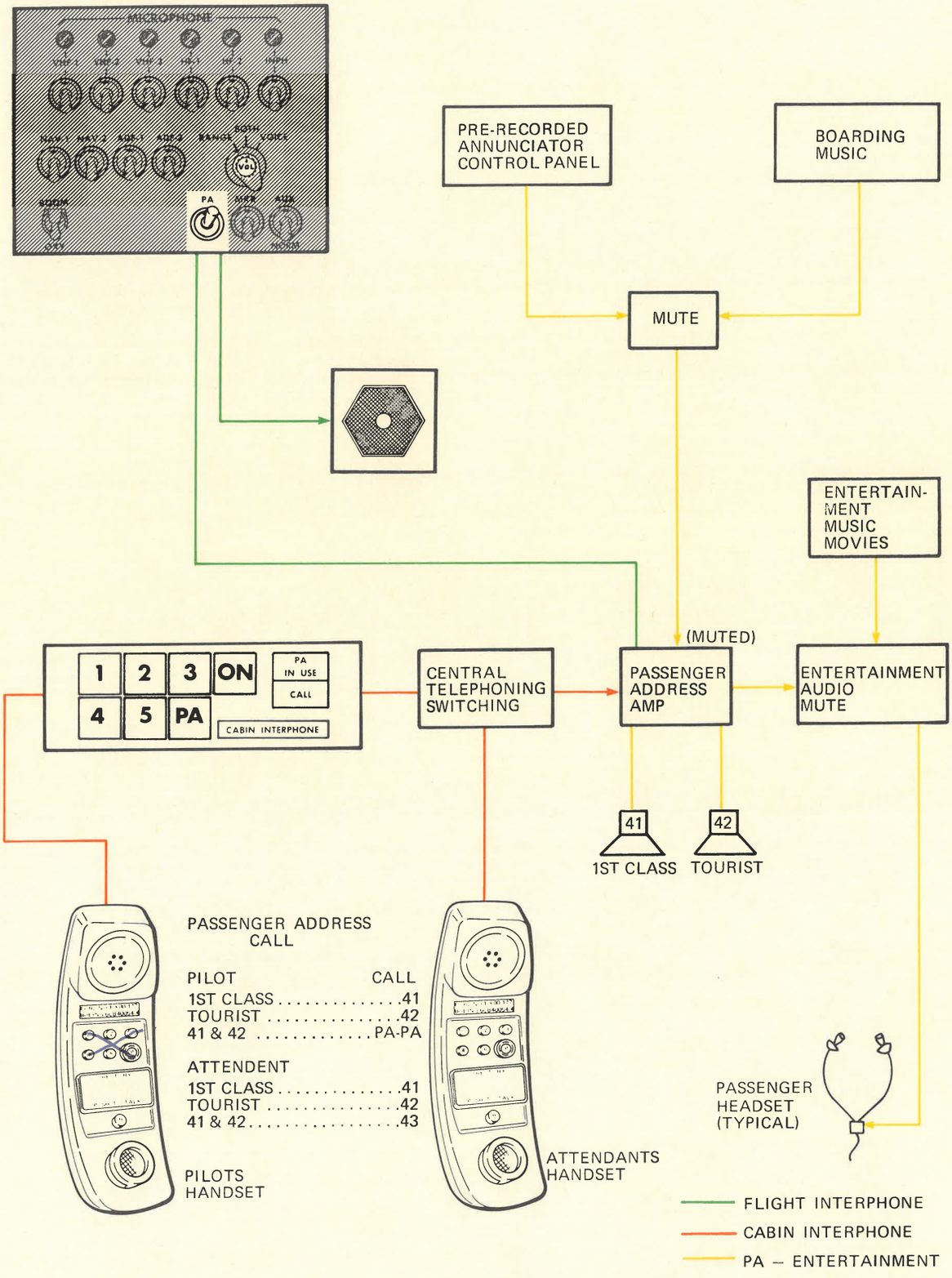
FLIGHT INTERPHONE



FLIGHT & SERVICE INTERPHONE PARALLELED



CABIN INTERPHONE OPERATION



PASSENGER ADDRESS SYSTEM

FOR TRAINING PURPOSES ONLY - UNOFFICIAL — P.L. Boeing

SYMBOLS: T - Station call is initiated from.
R - Station(s) being called or receiving call.
O - System idle - no previous calls made.

TEST STEP NO.	CALL MODE ESTABLISHED BEFORE PERFORMING TEST	CALL STATIONS AND MODES CHECKED: ATTENDANT'S STATION #1	OTHER ATTND'S STATION	P. A. CALL	ATTENDANT'S ALL CALL	PILOT ALERT CALL	ALL CALL	PILOT'S STATION	DIALING SIGNAL	PROPER SYSTEM RESPONSE
1	O	R						T	11	Chime sounds once, lamp glows, call is completed.
2	O			R				T	43	Pilot is connected to P.A. and may make announcement.
3	O						R	T	55	All attnd's chimes sound once, lamps pulsate, call is completed to all attnd. station.
4	O	T		R					43	Attnd. is connected to P.A. and may make announcement. Pilot's P.A. in use light comes on when Pilot's handset is off hook and Cab. Interphone switch is off (overhead).
5	O	T			R				54	Only attnd's chimes sound once and lamps glos, call is completed to all attnd's sta.
6	O	T				R			pp	Chime sounds once, lamp pulsates, call is completed.
7	O	T					R		55	All chimes sound once, lamps pulsate, call is completed to all stations.
8	O	T						R	31	Chime sounds once, call lamp glows, call is completed.
9	O	T	R						12	Chime sounds once, lamp glows, call is completed.
10	9	R						T	11	Chime and light do not respond, three way party call is connected.
11	1	R	T						11	Dial tone sounds in callers handset, call is not completed.
12	1		T					R	31	Dial tone sounds in caller's handset, call is not completed.
13	4	R						T	11	Dial tone sounds in pilot's handset, call is not completed.
14	4						R	T	55	Chimes sound once, lamps pulsate, call is completed to all attnd. stations except one connected to P.A. which becomes connected after pressing reset.
15	4		T	R					43	Dial tone sounds in caller's handset, call is not completed.
16	2	T						R	31	Chime sounds once, lamp glows but audio connection is not completed until pilot's reset is pressed.
17	1		T		R				54	All attnd's chimes sound on and lights glow; except sta. on line with pilot. Party line is connected with all stations including pilot.
18	8		T			R			pp	Pilot's chime sounds once, call lamp, pulstates, but audio is not connected nor previous call until Pilot's reset button is pushed.
19	2	T				R			pp	Pilot's chime sounds, light pulsates, connection to P.A. is not interrupted and audio connection is not made until Pilot's reset button is pushed.
20	4			R				T	PA PA	Attendant is immediately disconnected from P.A. and Pilot is connected and may make announcement.
21	9		R					T	13	First call is not interrupted. Calleddstation's chime sounds, lamp glows, private call is connected.
22	9 & 21		T R						14	Initial calls are not interrupted. Called station's chime sounds once, lamp glows, private call is connected.

CHAPTER 10

CROSS REFERENCE

FOR	REFER TO	CHAPTER
Equipment Cooling	AIR CONDITIONING AND PRESSURIZATION	6
Lighting	AIRPLANE GENERAL	5
Emergency Lighting	EMERGENCY EQUIPMENT	11
APU Operation	AUXILIARY POWER UNIT	8

ESTABLISH EXTERNAL POWER

External Power AC CONN
Lights.....ILLUMINATED
Lights indicate that external power is connected to the airplane and power is within prescribed limits. Ground handling busses will be powered by external power 1.

AC Meters.....CHECK
Select EXT PWR 1 then EXT PWR 2. Check voltage and frequency.

External Power 1 Breaker
Switch.....CLOSE
External PWR ON BUS light will illuminate, indicating external power is connected to sync bus. If BTB and SSB open lights are extinguished, airplane main busses will be powered.

Auxiliary Power Ammeter.....CHECK
Check maximum continuous amperage is not exceeded.

External Power 2 Breaker
Switch.....CLOSE
External PWR ON BUS light will illuminate. Check split system breaker OPEN light illuminated. Split system breaker will automatically trip.

ESTABLISH APU POWER

APU "FIELD OFF"
Lights.....BOTH EXTINGUISHED

AC Meters.....CHECK
Select APU GEN 1 then APU GEN 2. Check voltage and frequency within limits.

APU Generator 1 Breaker Switch...CLOSE
APU generator 1 GEN OPEN light will extinguish. If BTB and SSB open lights are extinguished, airplane main busses will be powered. No. 2 aft main tank fuel boost pump low PRESS light and APU "DC PUMP ON" light will both extinguish, indicating operation of the No. 2 aft AC fuel boost pump.

Auxiliary Power Ammeter.....CHECK
Check maximum continuous amperage is not exceeded.

APU Generator 2 Breaker Switch...CLOSE
Check GEN OPEN light extinguished and split system breaker OPEN light illuminated. Split system breaker will automatically trip.

BUS TIE BREAKER OPEN LIGHT ILLUMINATED

Check KW/KVAR indications of affected generator(s) are within limits.

NOTE: If the difference between KW meter readings or between KVAR meter readings for paralleled generators exceeds 5 KW's or 5 KVAR'S a maintenance log entry should be made. If the difference exceeds 10 KW's or 10 KVAR's, the generators should be operated isolated, and a maintenance log entry made.

AC Meters Switch.....PRESS
Press appropriate switch and verify frequency and voltage.

IF FREQUENCY OR VOLTAGE LOW OR ERRATIC:
CSD Disconnect Switch.....DISCONNECT
Bus Tie Breaker Switch.....CLOSE
Check BUS TIE OPEN light is extinguished. Accomplish GENERATOR INOPERATIVE CHECKLIST. SEE CSD DISCONNECT.

IF FREQUENCY AND VOLTAGE NORMAL:
Bus Tie Breaker Switch.....CLOSE
Bus Tie Breaker Open Light.....EXTINGUISHED
Split System Breaker Open Light...CHECK EXTINGUISHED

NOTE: If the malfunctions should trip both bus tie breakers on one side, the split system breaker will also trip.

IF BUS TIE BREAKER OPEN LIGHT REMAINS ILLUMINATED:
Consider breaker defective and leave open.

Annunciator Read Switch....PRESS
Enter in maintenance log any annunciator light indication.

GENERATOR FIELD OFF AND GEN OPEN BREAKER LIGHTS ILLUMINATED

Check all BUS TIE OPEN and split system breaker OPEN lights are extinguished.

Electrical Loads.....MONITOR
Verify that KW/KVAR indications are within limits.
AC Meter Switch and Generator Test Switch.....PRESS
Check CSD rpm (8000 ± 400 rpm) on the AC frequency meter.

IF CSD RPM IS NORMAL, RE-ESTABLISH THE GENERATOR FIELD:
Generator Field Switch.....CLOSE
Check generator FIELD OFF light is extinguished. Observe on AC meters that frequency and voltage are within limits.

IF GENERATOR "FIELD OFF" LIGHT WILL NOT EXTINGUISH OR IF FREQUENCY AND VOLTAGE NOT WITHIN LIMITS:
CSD Disconnect Switch.....DISCONNECT
Accomplish the GENERATOR INOPERATIVE CHECKLIST. SEE CSD DISCONNECT.

IF FREQUENCY AND VOLTAGE WITHIN LIMITS:
Reconnect the generator to its bus.
Generator Breaker Switch...CLOSE
Check generator breaker GEN OPEN and generator FIELD OFF lights stay extinguished.

GENERATOR BREAKER OPEN LIGHT ILLUMINATED

CHECK KW LOAD IS WITHIN LIMITS:
Appropriate AC
Meter Switch.....PRESS
Check that frequency and voltage indications are stable and within limits. If within limits reestablish the generator to its bus.
Generator Breaker Switch...CLOSE
Check generator breaker GEN OPEN light is extinguished.

IF FREQUENCY AND VOLTAGE LOW OR ERRATIC, OR GENERATOR BREAKER OPEN LIGHT ILLUMINATES AGAIN:
CSD Disconnect
Switch.....DISCONNECT
Check BUS TIE OPEN breaker light is extinguished. ACCOMPLISH GENERATOR INOPERATIVE CHECKLIST. See CSD DISCONNECT

FAILED TR UNIT, DC AMMETER READS ZERO (FAILURE NOT DUE TO OVERHEAT)

Check DC bus isolation switches closed and DC isolation relay OPEN light is extinguished.
Check that failed TR circuit breaker is set.

NOTE: If failed TR circuit breaker is open, check that remaining TR readings are less than 75 amps. If more, monitor electrical loads.

If failure was due to overheat caused by loss of equipment cooling, restrict TR loads to 54 amps. See LOSS OF EQUIPMENT COOLING, CHAPTER 3.

ESS BUS OFF LIGHT ILLUMINATED

Standby Power Switch.....ON
Check standby power power ON light illuminated.
Essential Power
Switch.....SELECT AN OPERATING GENERATOR
Preferred selection: 3, 1, 2.
ESS BUS OFF Light...EXTINGUISHED
If ESS BUS OFF light remains illuminated after first selection, verify loss of essential bus power by observing engine oil temperature and ESS TR amps indication.

If ESS TR amps output is zero and oil temperature indications are approximately -30°C, rotate essential power switch to OFF

If ESS TR amps output and oil temperature indications are normal, continue essential operation as selected.

CSD OIL LOW PRESSURE LIGHT ILLUMINATED

Verify associated engine N2 indication is in the normal range.

IF N2 INDICATION NORMAL:
CSD Disconnect
Switch.....DISCONNECT

CAUTION: DO NOT ACTIVATE CSD DISCONNECT SWITCH WHEN ENGINE SPEED IS BELOW MINIMUM GROUND IDLE SPEED. CSD MAY BE DAMAGED AS A RESULT OF AN INCOMPLETE DISCONNECT.

CSD DISCONNECT

CSD Disconnect
Switch.....DISCONNECT
Lift constant speed drive switch guard and momentarily place switch to disconnect.

CSD Oil Low Pressure Light.....CHECK ILLUMINATED

NOTE: Once disconnected, CSD can only be reset on the ground.

Appropriate AC Meter Switch and GEN TEST Switch.....PRESS
Check CSD rpm and pmg voltages read zero to verify that CSD has disconnected.

VERIFY THAT TIE BUSSES PARALLELED:
Check that BUS TIE OPEN lights and split system breaker OPEN light are extinguished. Monitor electrical loads.

IF CSD DOES NOT DISCONNECT:
Generator Field Switch.....TRIP
Continue normal operation of the engine. Accomplish GENERATOR INOPERATIVE CHECKLIST.

GENERATOR BREAKER WILL NOT CLOSE WHEN ATTEMPTING TO PARALLEL

Appropriate AC Meter Switch.....PRESS
Check voltage and frequency within limits.
Bus Tie Breaker Switch.....TRIP
Check BUS TIE OPEN light illuminated.
Generator Breaker Switch...CLOSE
Check GEN OPEN light extinguished.
Bus Tie Breaker Switch.....CLOSE
Check BUS TIE OPEN light extinguished.

APU OR EXTERNAL POWER WILL NOT CONNECT TO SYNC BUS

Split System Breaker Switch.....TRIP
Appropriate Generator Breaker Switches.....TRIP
Check for GEN OPEN lights.
Appropriate Auxiliary Power Breaker Switch.....CLOSE
Observe that the related GEN OPEN light extinguishes or the PWR ON BUS light illuminates.

APU OR EXTERNAL POWER WILL NOT DISCONNECT AUTOMATICALLY WHEN ATTEMPTING TO CONNECT AN ENGINE GENERATOR

Appropriate Auxiliary Power Breaker Switch.....TRIP
Check that the related GEN OPEN light illuminates or the PWR ON BUS light extinguishes.
Engine Generator Breaker Switch.....CLOSE
Check GEN OPEN light extinguished.

CAUTION: IF THE ABOVE PROCEDURE IS NOT EFFECTIVE, SHUT DOWN THE APU OR EXTERNAL POWER AND INVESTIGATE. DO NOT ATTEMPT TO CLOSE THE SPLIT SYSTEM BREAKER; SERIOUS DAMAGE COULD RESULT.

GEN BRG FAILURE LIGHT(S) ILLUMINATED

NOTE: Generator(s) may be operated only 5 minutes under full load with a faulty bearing and up to 15 hours under no load.

Generator Field Switch(s)...TRIP
Check 'FIELD OFF' and GEN OPEN lights illuminated.
Accomplish GENERATOR(S) INOPERATIVE CHECKLIST.

KW OSCILLATION BETWEEN PARALLELED GENERATORS (LOAD SHUFFLING)

NOTE: A slight load oscillation (±5KW) between paralleled generators at ground idle N2 rpm is a normal CSD characteristic.

IF KW INDICATORS OSCILLATING MORE THAN ±5KW:

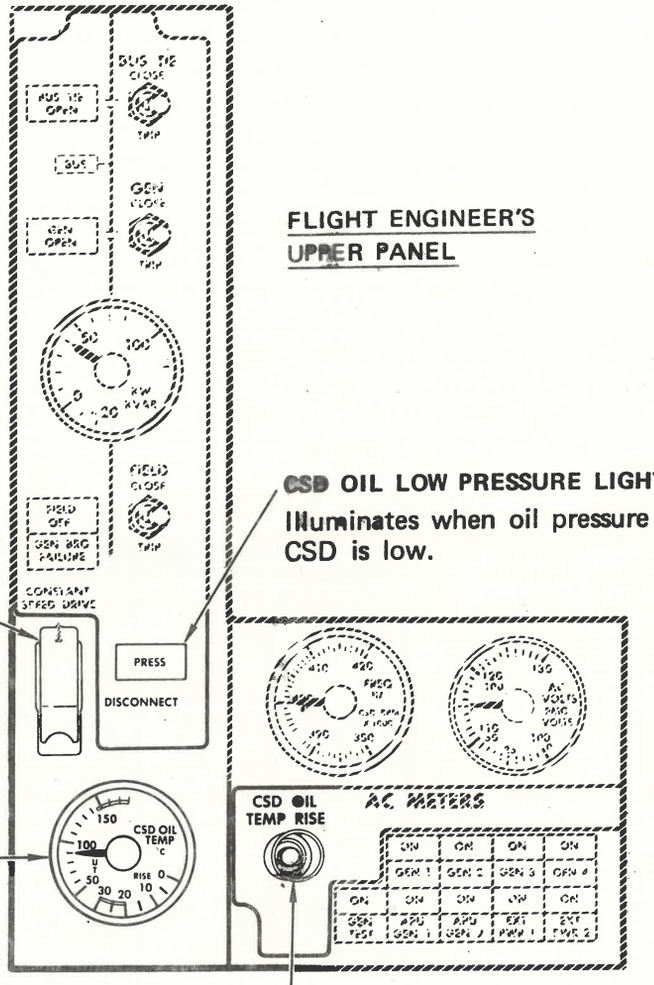
Bus Tie Breaker Switch.....TRIP
Trip and reclose each generator bus-tie breaker until oscillation stops on paralleled generators, then leave affected generator(s) bus-tie breaker open.

KW Meters.....CHECK
Check that generators are within limits. To reduce loads, see 1 or 2 GENERATOR INOPERATIVE CHECKLIST, Chapter 3.

Frequency and Voltage.....CHECK
Press appropriate AC meters switch to check frequency and voltage within limits.

IF FREQUENCY AND/OR VOLTAGE HIGH, LOW, OR ERRATIC:
Accomplish GENERATOR INOPERATIVE CHECKLIST. See CSD DISCONNECT.

IF FREQUENCY AND VOLTAGE NORMAL:
Leave generator bus-tie breaker switch open (TRIP) to prevent KW oscillation on paralleled generators.



FLIGHT ENGINEER'S
UPPER PANEL

CSD OIL LOW PRESSURE LIGHT (Amber)

Illuminates when oil pressure within CSD is low.

CSD DISCONNECT SWITCH

GUARD DOWN – Normal operation.

DISCONNECT – Mechanically disconnects CSD from engine. Reset only on ground. Generator breaker trips.

CSD OIL TEMPERATURE INDICATOR

Normally reads temperature of oil leaving CSD (OIL OUT). With CSD oil temperature rise switch pressed, indicator reads oil temperature rise through CSD.

CSD OIL TEMPERATURE RISE SWITCH

When pressed causes indicator to read CSD rise temperature.

AC POWER MODULE

CONSTANT SPEED DRIVE CONTROLS

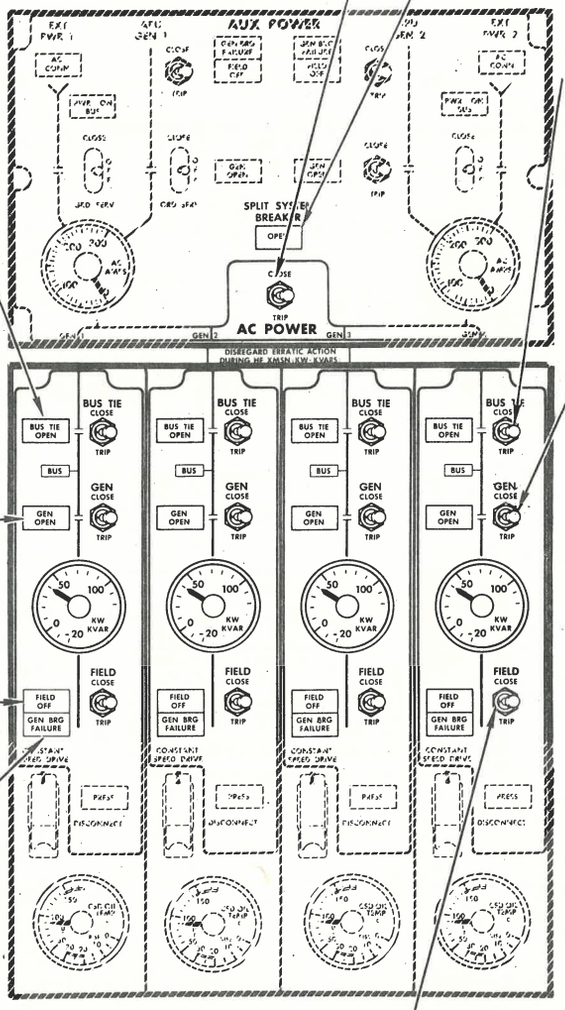
SPLIT SYSTEM BREAKER SWITCH

TRIP – Opens circuit dividing electrical system into separate two-generator parallel systems. Will trip automatically to isolate one-half of sync bus from sync bus faults. Will also trip automatically when two like auxiliary generators are used to power the sync bus. The SSB may be tripped manually if desired.

SPLIT SYSTEM BREAKER OPEN LIGHT (Green)

ILLUMINATED – Indicates split system breaker open.

F/E UPPER PANEL



BUS TIE BREAKER OPEN LIGHT (Amber)

ILLUMINATED – Generator disconnected from sync bus.

BUS TIE BREAKER SWITCH

TRIP – Disconnects AC bus from sync bus. Trips automatically due to electrical faults. Recloses automatically after generator breaker trips.

GENERATOR BREAKER OPEN LIGHT (Amber)

ILLUMINATED – Generator disconnected from its AC bus.

GENERATOR BREAKER SWITCH

TRIP – Generator disconnected from its AC bus. Trips due to CSD disconnect, engine shutdown, CSD or electrical faults, APU or external power breaker closed.

CLOSE – Connects generator to its respective bus. TRips external or APU power if connected to sync bus.

GENERATOR FIELD OFF LIGHT (Amber)

ILLUMINATED – Indicates generator field deactivated.

GENERATOR BEARING FAILURE LIGHT (Amber)

ILLUMINATED – Indicates impending generator bearing failure.

GENERATOR FIELD SWITCH

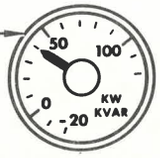
TRIP – Deactivates generator field and trips generator breaker. Trips automatically due to electrical faults and when fire switch is pulled.

AC POWER MODULE

GENERATOR CONTROLS

KW/KVAR METER

Normally reads KW output of the generator. Reads KVAR while KVAR switch is depressed.



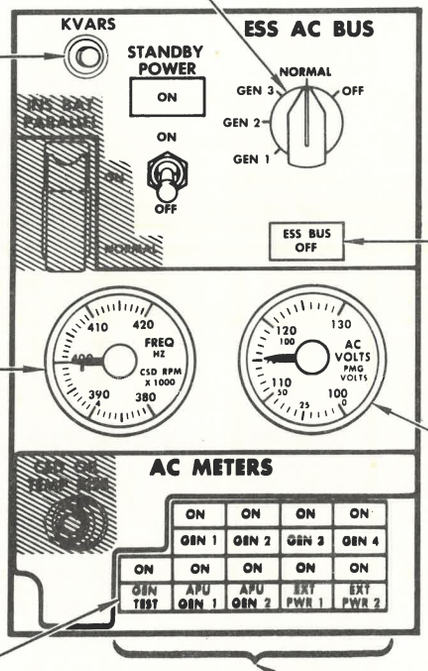
ESSENTIAL POWER SWITCH

Selects power source for the essential AC bus. External or APU can supply the essential AC power if connected to the sync bus when generator 4 bus tie breaker is closed and essential AC bus switch is selected to NORMAL.

KVAR SWITCH

Press to read KVAR on all KW/KVAR meters.

F/E UPPER PANEL



ESS BUSS OFF

PILOTS' CENTER PANEL

ESSENTIAL BUS OFF LIGHT (Red)

ILLUMINATED – Indicates that the essential AC bus is not powered.

FREQUENCY METER

Indicates frequency (H_z) output of the selected generator and CSD RPM when test switch pressed.

AC VOLTMETER

Indicates voltage output of the selected generator and PMG when test switch pressed.

GENERATOR TEST SWITCH

Press in conjunction with selected engine driven or APU generator AC meter switch to read permanent magnet voltage (PMG) on the AC voltmeter and CSD rpm on the frequency meter. If an APU generator is selected, CSD rpm will read zero.

AC METERS SWITCHES (Blue)

Press to select generator readout on AC voltage and frequency meters. On light will illuminate in depressed switch.

ELECTRICAL CONTROL MODULE

AC POWER INDICATORS

DC VOLTMETER

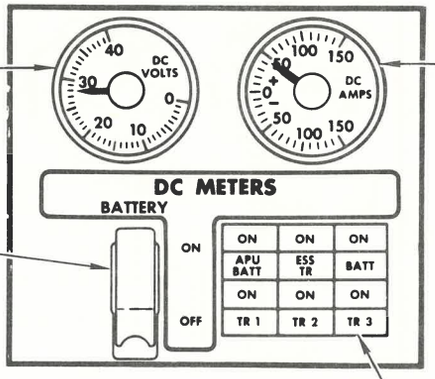
Indicates voltage at the selected DC bus.

BATTERY SWITCH

ON – Battery serves as back up to supply battery bus, DC standby bus and static inverter in event of essential power failure.

OFF

– Battery isolated from all loads except hot battery bus.
– Battery will continue to receive charge.
– APU will automatically shut down.



F/E UPPER PANEL

DC METERS MODULE

DC AMMETER

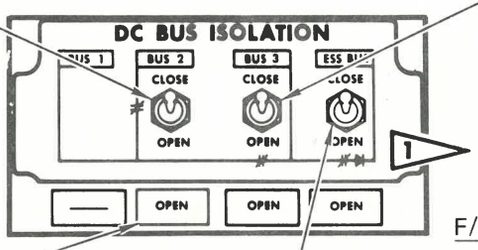
Indicates DC current output of selected source.

DC METERS SWITCHES (Blue)

Press to read voltage and amperage on DC meters. On light will illuminate in depressed switch.

DC BUS 2 ISOLATION SWITCH

OPEN – Bus isolated.
CLOSE – Bus paralleled with DC busses 1 and 3.



DC BUS 3 ISOLATION SWITCH

OPEN – DC bus 3 and essential DC bus isolated from busses 1 and 2.
CLOSE – Bus 3 paralleled with DC bus 1 and 2.

F/E UPPER PANEL

DC BUS ISOLATION RELAY OPEN LIGHT (Green)

DC BUS ISOLATION MODULE

DC ESSENTIAL BUS ISOLATION SWITCH

OPEN – Essential DC bus isolated.
CLOSE – Essential DC bus can receive power from busses 1, 2 and 3. Cannot provide power to busses 1, 2 or 3.

1 *AIRPLANES, S/N's 19778 THRU 19786 AND 20356*

DC VOLTMETER

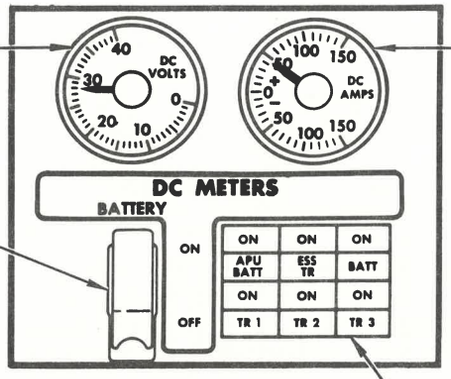
Indicates voltage at the selected DC bus.

BATTERY SWITCH

ON – Battery serves as back up to supply battery bus, DC standby bus and static inverter in event of essential power failure.

OFF

– Battery isolated from all loads except hot battery bus.
– Battery will continue to receive charge.
– APU will automatically shut down.



DC METERS MODULE

F/E UPPER PANEL

DC AMMETER

Indicates DC current output of selected source.

DC METERS SWITCHES (Blue)

Press to read voltage and amperage on DC meters. On light will illuminate in depressed switch.

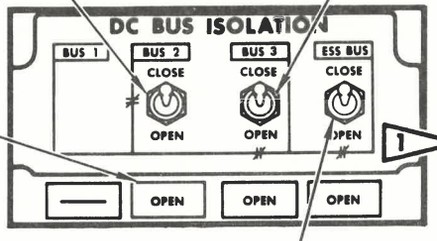
DC BUS 2 ISOLATION SWITCH

OPEN – Bus isolated.

CLOSE – Bus 2 paralleled with DC busses 1, 3, and essential if other isolation switches are closed.

DC BUS ISOLATION RELAY OPEN LIGHTS (Green)

Illuminate when corresponding isolation switch is placed to the OPEN position. Bus 3 OPEN light illuminates automatically (no switch action) when essential power switch is moved to the 3, 2, or 1 position.



DC BUS ISOLATION MODULE

F/E UPPER PANEL

DC BUS 3 ISOLATION SWITCH

OPEN – DC bus 3 and essential DC bus isolated from busses 1 and 2. Relay opens automatically and light illuminates when essential power switch is moved to the 3, 2, or 1 position (switch does not move).

CLOSE – Bus 3 paralleled with DC busses 1, 2, and essential if other isolation switches are closed.

DC ESSENTIAL BUS ISOLATION SWITCH

OPEN – Essential DC bus isolated.

CLOSE – Essential DC bus paralleled with DC busses 1, 2, and 3, if other isolation switches are closed.

1 *AIRPLANES S/N'S 19787 AND 20357 AND ON.*

DC POWER CONTROLS AND INDICATORS

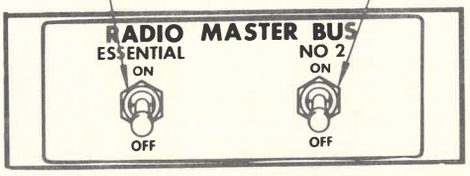
ESSENTIAL RADIO BUS SWITCH

ON – Connects essential radio busses to the airplane AC and DC essential busses.

NO. 2 RADIO BUS SWITCH

ON – Connects No. 2 radio busses to No. 2 AC and DC busses.

PILOTS' OVERHEAD PANEL



RADIO MASTER BUS
MODULE

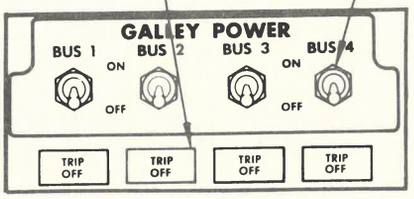
GALLEY POWER TRIP OFF LIGHTS (Amber)

ILLUMINATED – The galley power bus has been automatically disconnected from its airplane bus.

GALLEY POWER BUS SWITCHES

ON – Galley power bus is connected to its airplane bus.

F/E UPPER PANEL



GALLEY POWER
MODULE

RADIO MASTER AND GALLEY POWER CONTROLS

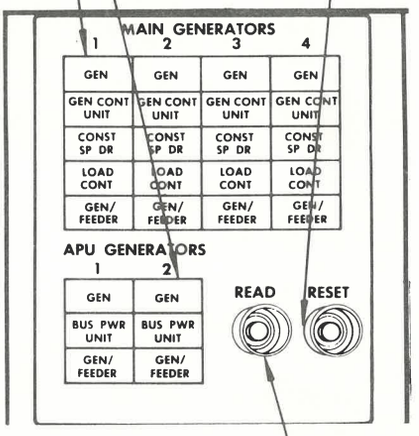
ANNUNCIATOR LIGHTS

Provides a readout of main and APU generator faults. Fault circuitry will deliver a signal to the annunciator module. The associated annunciator light will illuminate only while the read switch is pressed.

ANNUNCIATOR RESET SWITCH

Press simultaneously with read switch. If the fault has been corrected, the circuitry will be cleared of the fault signal.

F/E UPPER PANEL



ANNUNCIATOR READ SWITCH

Press for annunciator reading. Anticipate a time delay in fault readout. If a fault signal is present at the module, the appropriate light will illuminate. The light will extinguish when the switch is released.

GENERATOR ANNUNCIATOR MODULE

MAIN/APU GENERATOR FAULT ANNUNCIATOR

EXTERNAL POWER ON BUS LIGHT (green)

ILLUMINATED – External power breaker switch closed, power on sync bus.

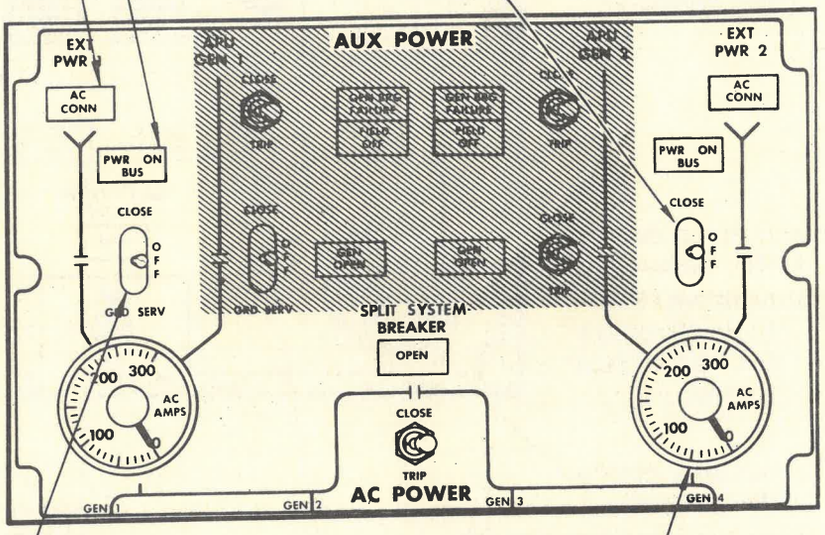
EXTERNAL POWER CONNECTED LIGHT (White)

ILLUMINATED – External power unit connected to airplane. Ground handling busses will be powered by external power 1 only.

EXTERNAL POWER 2 BREAKER SWITCH

OFF – External power 2 is disconnected from sync bus.

CLOSE – External power 2 is connected to sync bus. Split system breaker will automatically trip if external power 1 is also on sync bus. Generator breaker will not close if the SSB fails to trip.



F/E UPPER PANEL

AUXILIARY POWER AMMETER

Indicates current output of the auxiliary generator powering the sync bus.

AUXILIARY POWER MODULE

EXTERNAL POWER 1 BREAKER SWITCH

OFF – External power on ground handling busses only.

GRD SERV – Ground handling and ground service busses powered.

CLOSE – External power 1 is connected to sync bus. If split system breaker and all bus tie breakers are closed and essential power switch is in NORMAL, the entire electrical system will be powered.

EXTERNAL POWER CONTROLS

APU GENERATOR FIELD SWITCH

CLOSE – Field energized. Ground handling busses powered by No. 1 APU generator if external power not connected. Does not trip on APU shutdown.

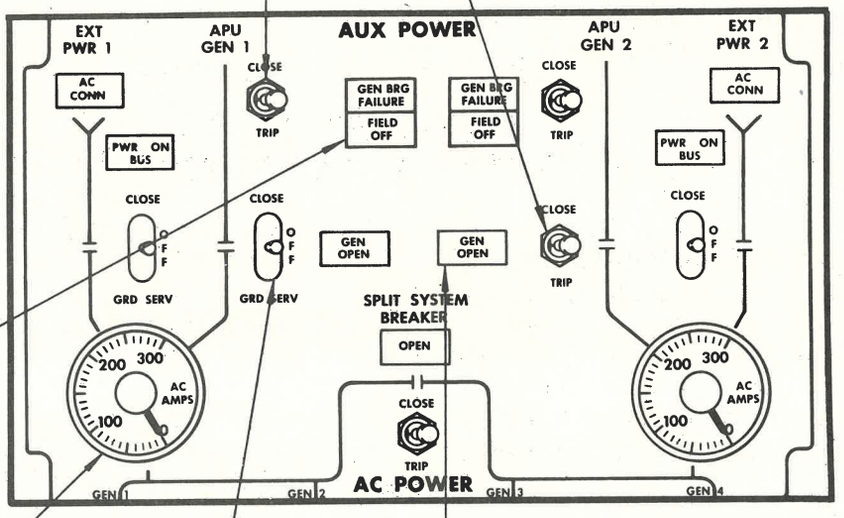
TRIP – Field not energized, generator is deactivated. Automatically tripped due to generator faults.

APU GENERATOR 2 BREAKER SWITCH

CLOSE – APU GEN 2 connected to sync bus.

TRIP – APU GEN 2 disconnected from sync bus. Automatically trips on APU shutdown or when external or airplane power is connected to the bus.

FLIGHT ENGINEER'S UPPER PANEL



APU FIELD OFF LIGHT (Amber)

ILLUMINATED – Indicates generator field is deactivated.

AUXILIARY POWER AMMETER

Indicates current output of the auxiliary generator powering the sync bus.

APU GENERATOR 1 BREAKER SWITCH

OFF – APU GEN 1 disconnected from the sync bus.

GRD SERV – Ground handling and ground service busses powered.

CLOSE – APU GEN 1 connected to sync bus. If split system breaker and all bus tie breakers are closed and essential power switch is in NORMAL, the entire electrical system will be powered.

APU GENERATOR BREAKER OPEN LIGHT (Amber)

ILLUMINATED – Indicates generator breaker tripped and generator is disconnected from sync bus. Generator breakers can not be closed unless generator output is within frequency and voltage tolerance.

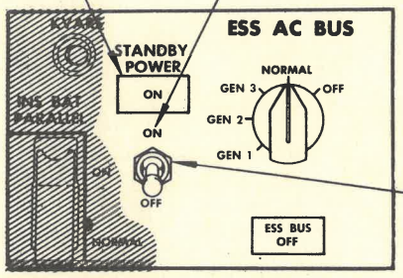
AUXILIARY POWER MODULE

APU ELECTRICAL CONTROLS

STANDBY POWER ON LIGHT (Green)

ILLUMINATED – Indicates the static inverter is operating.

ON – Essential AC and essential DC busses disconnected from standby AC and standby DC busses, respectively. Static inverter is turned on by battery bus power and will power the standby AC bus. Standby DC bus is powered by the battery bus. (Battery switch must be ON.)



OFF – Static inverter is deactivated.

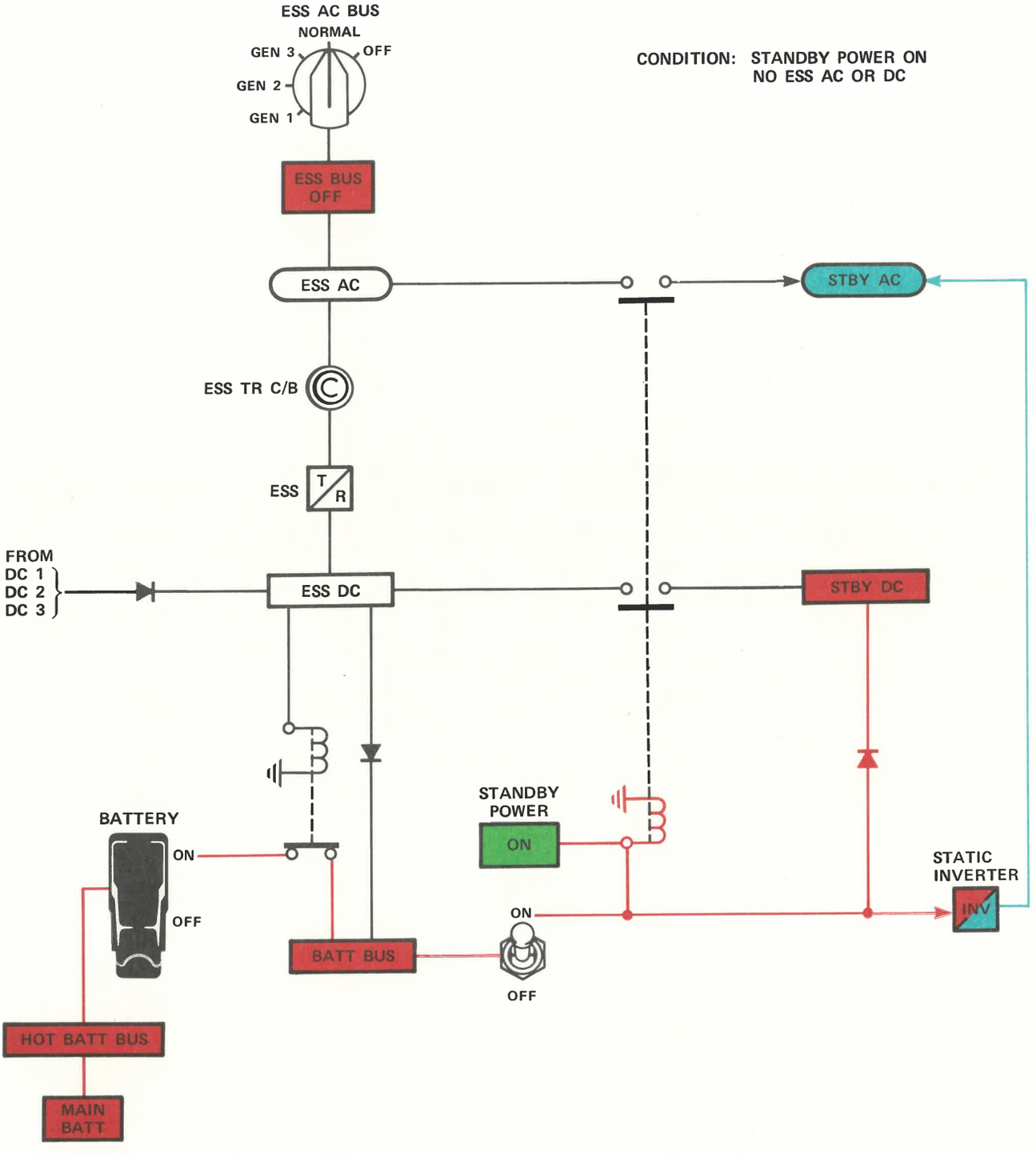
F/E UPPER PANEL

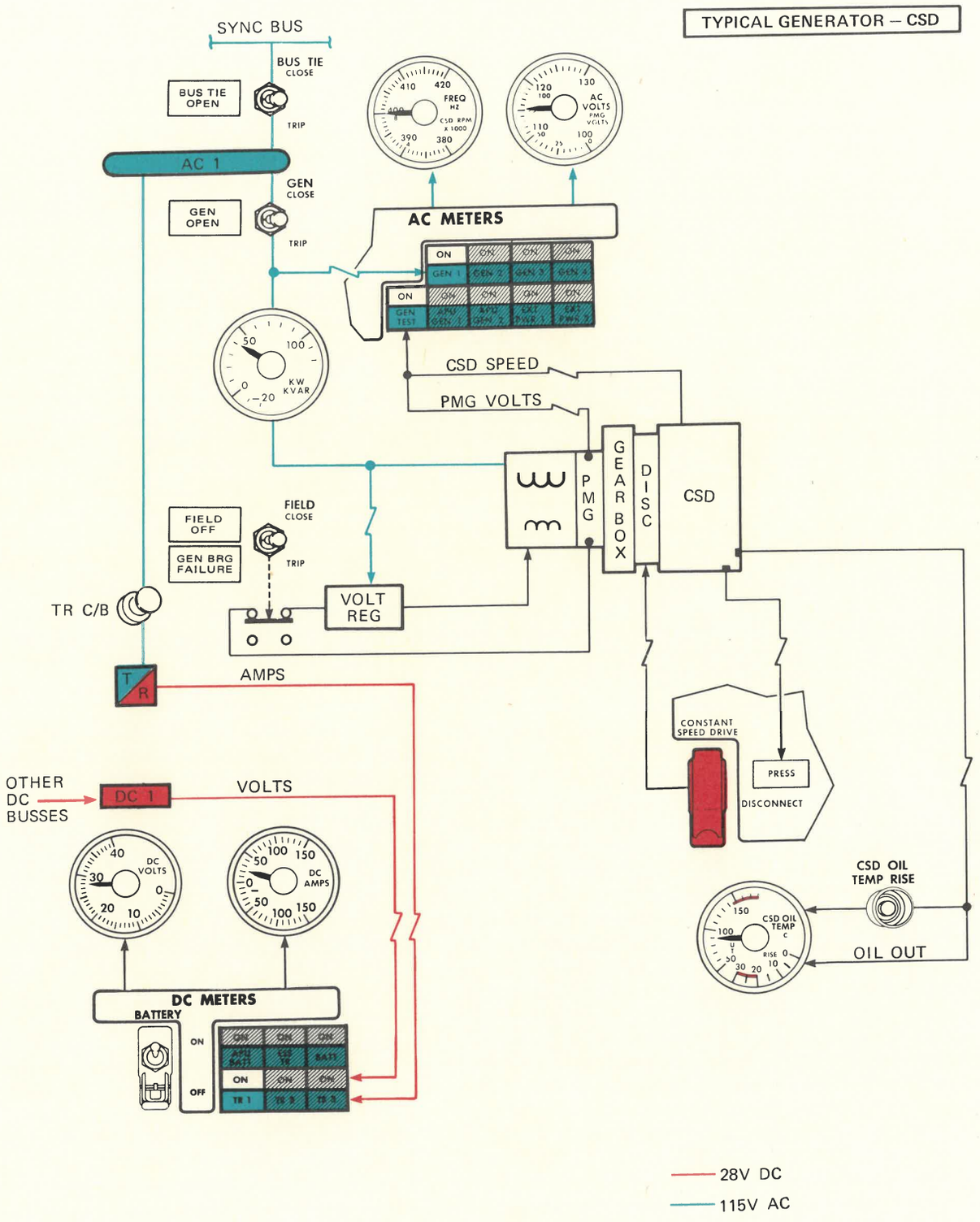
STANDBY POWER SWITCH

STANDBY POWER CONTROLS

ELECTRICAL SCHEMATIC

ELECTRICAL POWER SYSTEM


ESS AC BUS
NORMAL
GEN 3
OFF
GEN 2
GEN 1
ESS BUS OFF
CONDITION: STANDBY POWER ON
NO ESS AC OR DC
ESS AC
STBY AC
ESS TR C/B
ESS
T
R
FROM
DC 1
DC 2
DC 3
ESS DC
STBY DC
STANDBY
POWER
ON
BATTERY
ON
OFF
STATIC
INVERTER
INV
ON
BATT BUS
OFF
HOT BATT BUS
MAIN
BATT
115V AC
28V DC


TYPICAL GENERATOR – CSD
SYNC BUS
BUS TIE CLOSE
BUS TIE OPEN
TRIP
AC 1
GEN CLOSE
GEN OPEN
TRIP
FREQ HZ
CSD RPM x 1000
AC VOLTS
PMG VOLTS
AC METERS
ON
GEN 1
GEN 2
GEN 3
GEN 4
GEN TEST
KW KVAR
CSD SPEED
PMG VOLTS
PMG
GEAR BOX
DISC
CSD
FIELD CLOSE
FIELD OFF
GEN BRG FAILURE
TRIP
VOLT REG
TR C/B
T
R
AMPS
CONSTANT SPEED DRIVE
PRESS
DISCONNECT
CSD OIL TEMP RISE
CSD OIL TEMP
RISE
OIL OUT
OTHER DC BUSSES
DC 1
VOLTS
DC VOLTS
DC AMPS
DC METERS
BATTERY
ON
OFF
BATT
TR 1
28V DC
115V AC

AC POWER SYSTEM

Primary AC power for the airplane is supplied by four engine driven generators, controlled and monitored from the control cabin.

GENERATORS

The generators are rated 60 KVA (57 KW), 115V, 400 Hz (hertz, cycles per second). They are identical to and interchangeable with the APU generators.

CONSTANT SPEED DRIVE

Each engine driven generator is connected to its engine through a CSD. The CSD maintains a constant generator speed throughout the normal variable operating range of the engine. This provides a constant generator frequency output. Each CSD is a complete self-contained unit consisting of oil supply, cooler, instrumentation, and disconnect. The integral disconnect device provides for complete mechanical isolation of the CSD and generator in the event of a malfunction.

CONTROLS

Generators are activated by closing the associated generator field switches. Power for the main busses is obtained by closing the generator breaker switches, which connect generator output to the individual AC busses. The main AC busses are connected to the synchronous bus loop by bus tie breakers for parallel operation. The synchronous (sync) bus is provided with a split system breaker which allows physical division of the generator system into two sync busses. The generators can be paralleled in any combination, any generator or combination of generators can power the busses of a dead generator, or a bus or busses may be operated isolated. System protection is provided to prevent generator connection to the sync bus until power and phasing requirements are satisfied, and to prevent the paralleling of unlike power sources.

KW/KVAR INDICATORS

Combination KW/KVAR indicators indicate the real and reactive loads produced by the engine driven generators:

KW - The measure of real power delivered. Balanced indications among all generators indicates normal functioning of the load controllers and CSD's. One higher than the others indicates that the generator is contributing more than an equal share of the load and should be isolated to supply only its own bus loads.

KVAR - An indication of the amount of reactive load on the generator. Balanced readings are insurance that voltage regulators are functioning properly. The system is automatically protected from out-of-tolerance conditions.

ESSENTIAL AC BUS

The 115V AC essential bus normally is powered from 115V AC bus No. 4. It may also be powered from the other three generators by using the essential power selector switch. The essential AC bus will still receive power from selected generators 1, 2 or 3 with the generator breakers open. Generator breaker No. 4 must be closed to power the essential AC bus from main generator No. 4.

GENERATOR BEARING FAILURE DETECTION LIGHTS
Illumination of a generator bearing failure light indicates that excessive generator bearing clearance exists in the associated main airplane or APU generator. Operating time remaining on the generator will be proportional to generator load and observance of generator bearing failure operating limitations.

DC POWER SYSTEM

Primary DC power is supplied to the DC busses from the 115V AC busses through transformer-rectifier (T-R) units. Secondary DC power is supplied by two batteries.

TRANSFORMER-RECTIFIERS
Five T-R units supply DC power to DC busses 1, 2, 3 and essential DC bus, and to the 28V DC ground handling bus.

DC BUS ISOLATION
Isolation relays are installed to provide for isolation of a DC bus or busses as desired. DC busses 1, 2 and 3 are operated in parallel. The essential transformer-rectifier powers the essential DC bus and is isolated by a diode. In the event of an essential T-R failure, the essential bus would then be paralleled with busses 1, 2 and 3 through the diode. The essential bus cannot supply power to busses 1, 2 or 3 due to the blocking effect of the diode.

On later airplanes (S/N 19787 and 20357 and on) the blocking diode is removed. This permits the essential bus to supply power to the other busses, if required. In addition, DC bus 3 and essential DC bus are automatically isolated from DC bus 1 and DC bus 2 when the essential AC power selector is moved from the NORMAL to the 3, 1, or 2 position. This causes the DC bus 3 isolation relay to open and the corresponding OPEN light to illuminate.

BATTERY POWER
Two 24V, 34 ampere hour batteries supply DC power. The batteries are identical and interchangeable. Because of its location in an unpressurized area in the aft fuselage, the APU battery is provided with an electrically heated blanket to prevent freezing.

BATTERY CHARGER
Independent battery chargers maintain the charge in the two batteries at all times that the 115V AC ground service bus is powered. The battery chargers are capable of charging a completely discharged battery to a full charge in one hour. Initial charge will produce a large positive deflection of the needle in the DC ammeter which will decrease as the battery approaches a full charge. After the battery reaches full charge, the charger will maintain a constant potential mode of sufficient amplitude to sustain the state of charge.

Integral to the batteries is a thermal switch to protect the battery from overheating during charging. The thermal switch will disconnect the battery from the charger when overheat is sensed.

STANDBY BUSSES

The standby AC and DC busses are normally supplied by the essential AC and DC busses. In the event of complete AC power failure, the main airplane battery will supply the standby DC bus directly and the standby AC bus through the static inverter when the standby power switch is placed in the on position.

GALLEY POWER BUSSES

The galley busses are supplied power from the main airplane AC busses. The galley feeder circuit protection system is designed to trip off the galleys and illuminate appropriate galley TRIP OFF lights when:

- The current demand from an APU generator or an external power source exceeds a safe value.
- There is an electrical fault in the feeder circuit.
- The galley feeder current exceeds a safe value.

The protective system is reset by cycling the appropriate galley power switches.

RADIO AND FLIGHT INSTRUMENT BUSSES

The essential radios and flight instruments are powered from the essential AC and DC busses and the No. 2 radios from No. 2 AC and DC busses. The flight instruments are tied directly to the bus and are not switchable. Radios are powered when the radio master switches are on and AC/DC power is available from the respective bus. The power source for essential radio and flight instruments is determined by the position of the essential power selector switch.

AUXILIARY POWER SYSTEM

The auxiliary power system consists of the APU and external power units.

EXTERNAL POWER

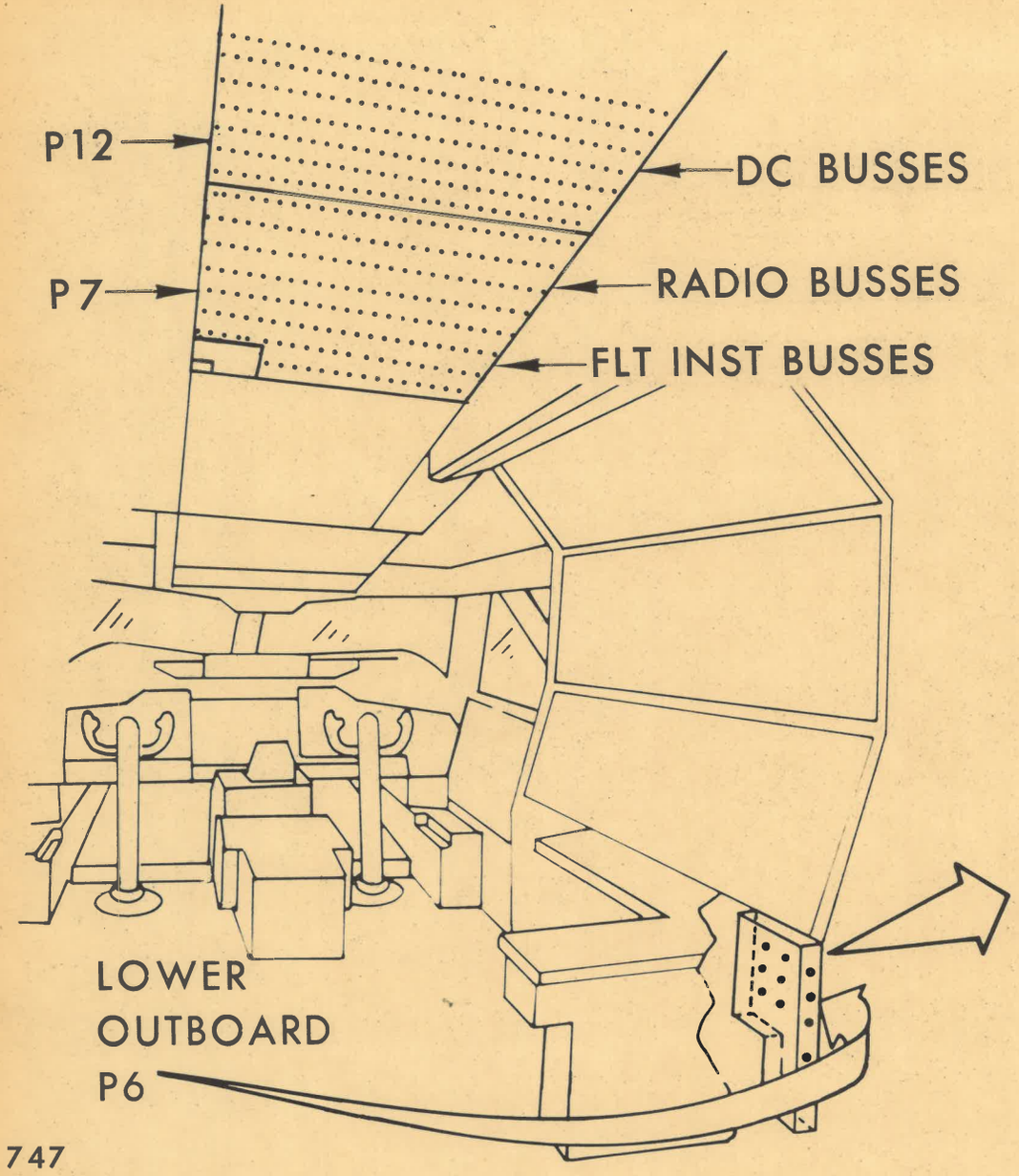
Two external power receptacles are located in the lower nose section on the right side of the fuselage. Connecting external power to the sync bus will trip the APU or airplane generator breakers if those units are powering the sync bus at the time. The paralleling of two external power generators is prevented by the split system breaker.

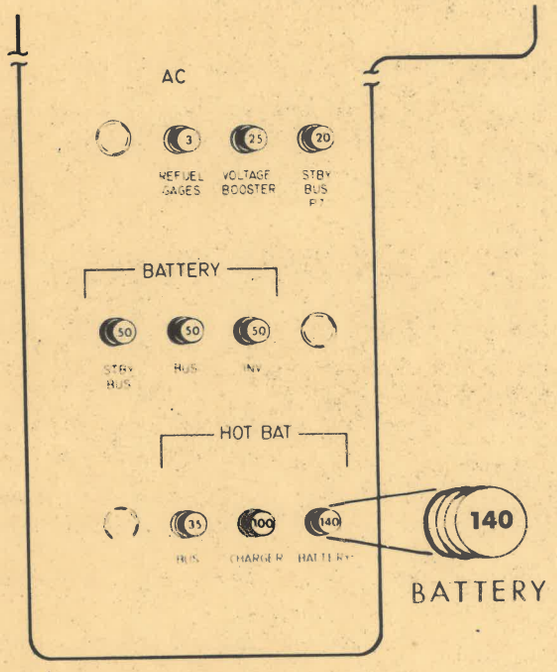
EXTERNAL POWER T-R
A T-R unit is provided to convert AC from the 115V AC ground handling bus to DC to power the 28V DC ground handling bus.

APU POWER
One APU driving two AC generators provides auxiliary power for ground operation of electrical and pneumatic systems when the airplane engines are not running. The generators are identical to and interchangeable with the engine driven generators. They are rated at 90 KVA due to superior cooling. The paralleling of two APU generators is prevented by the split system breaker. If external power is connected to the sync bus when APU generator power is applied, the external power breakers will trip; however, external power will retain priority over the ground handling relay and will power the ground handling busses.

NOTE: If the airplane is to be powered by only one external power unit or one APU generator, use number one in both cases. Neither number two external power unit nor number two APU generator can power the ground handling busses.

CIRCUIT BREAKER PANELS

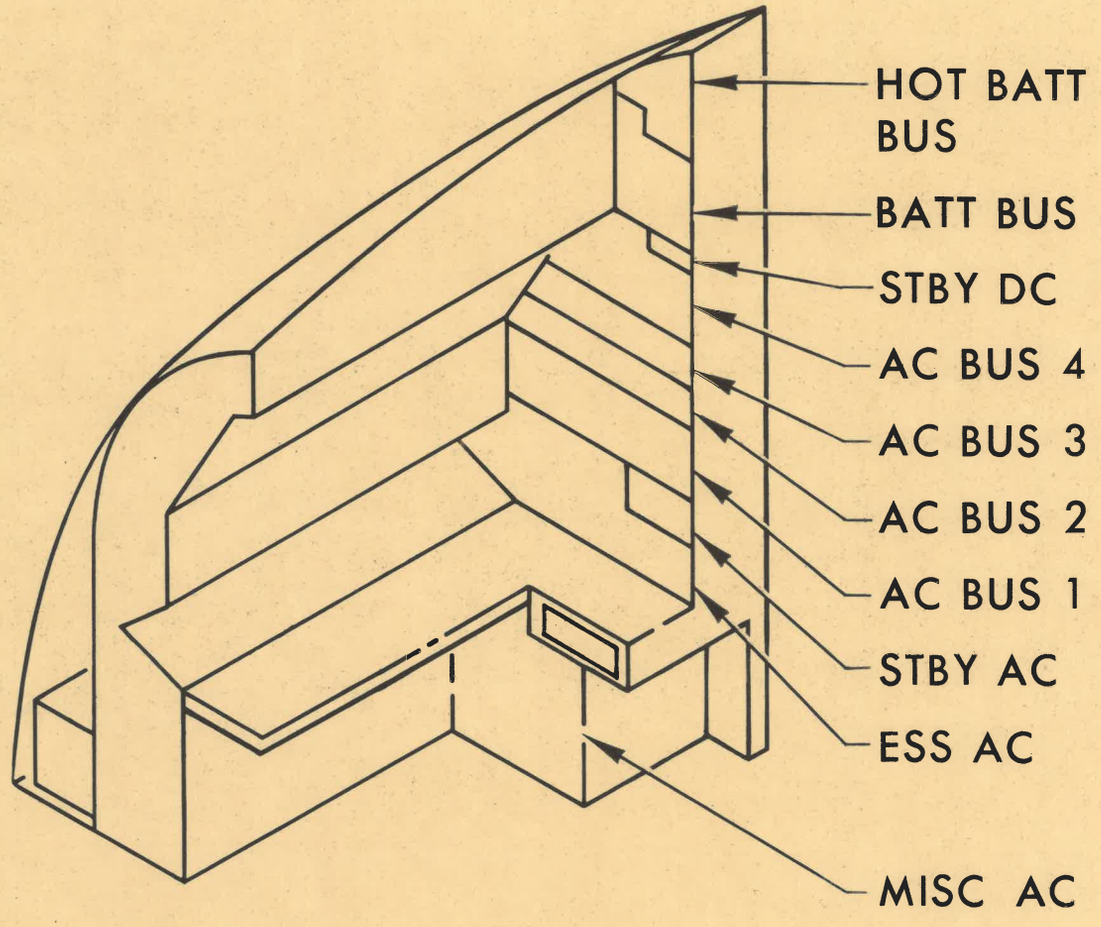




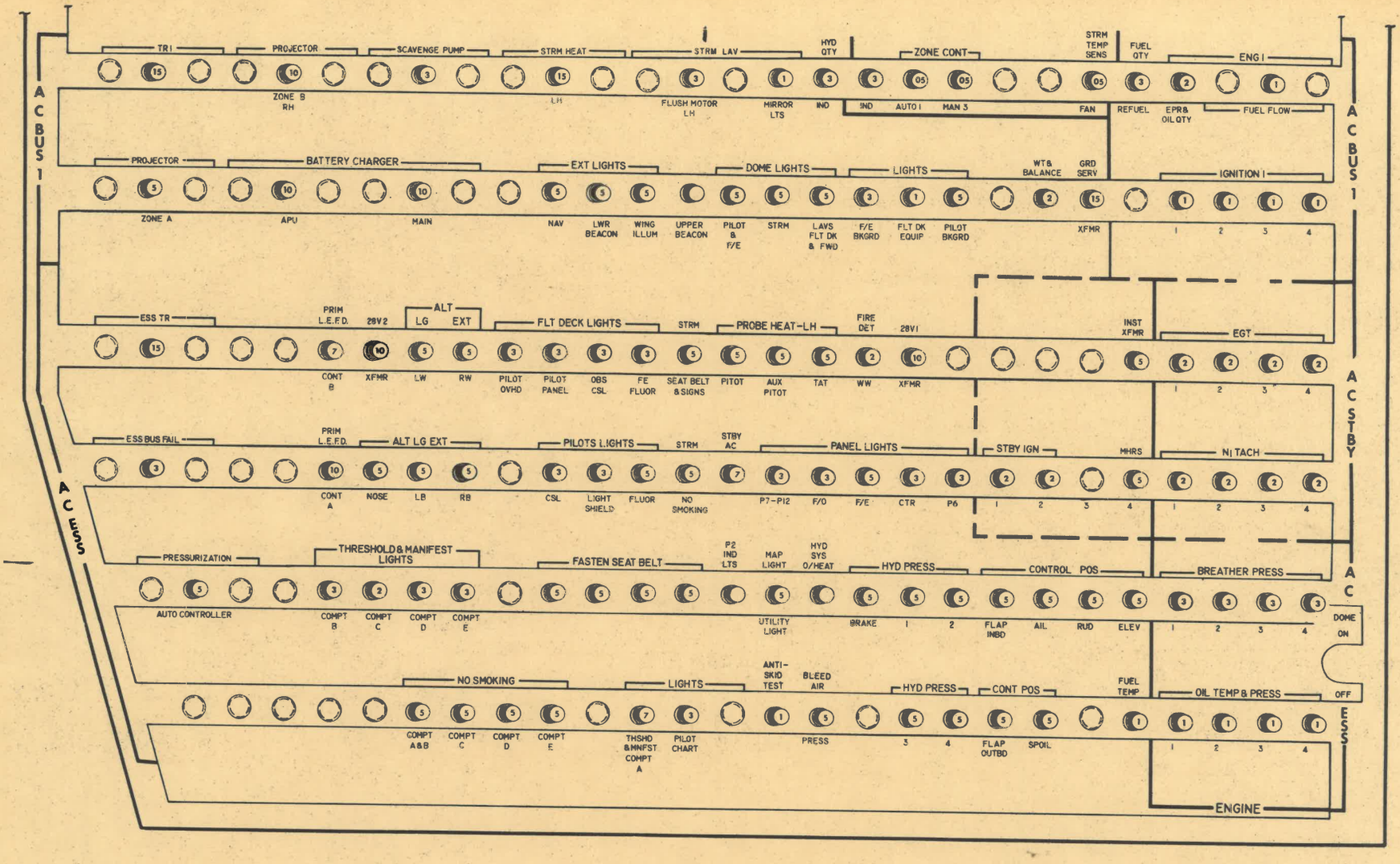
747

10-16A

P12
P7
DC BUSSES
RADIO BUSSES
FLT INST BUSSES
LOWER
OUTBOARD
P6

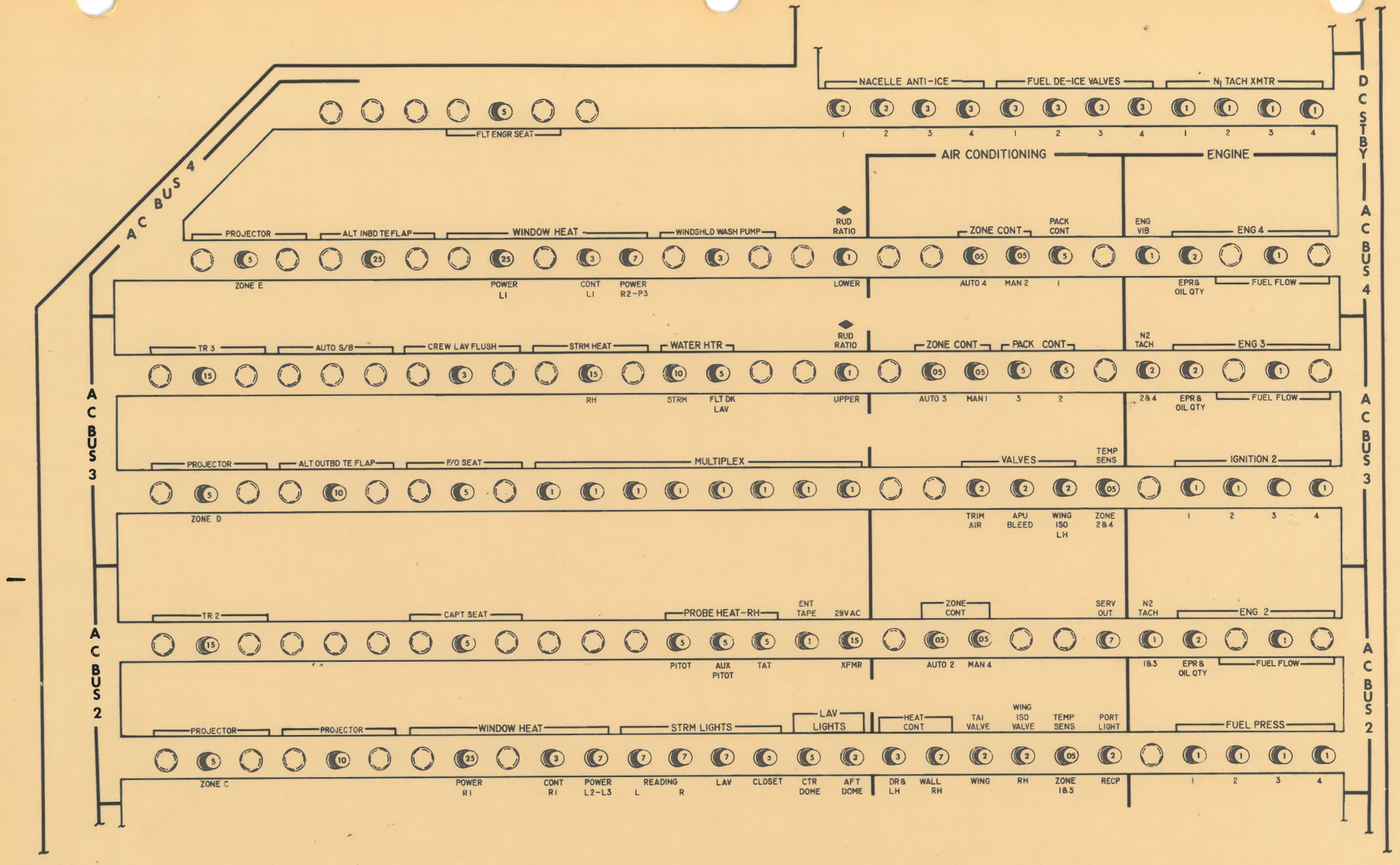


P6 CIRCUIT BREAKER PANELS



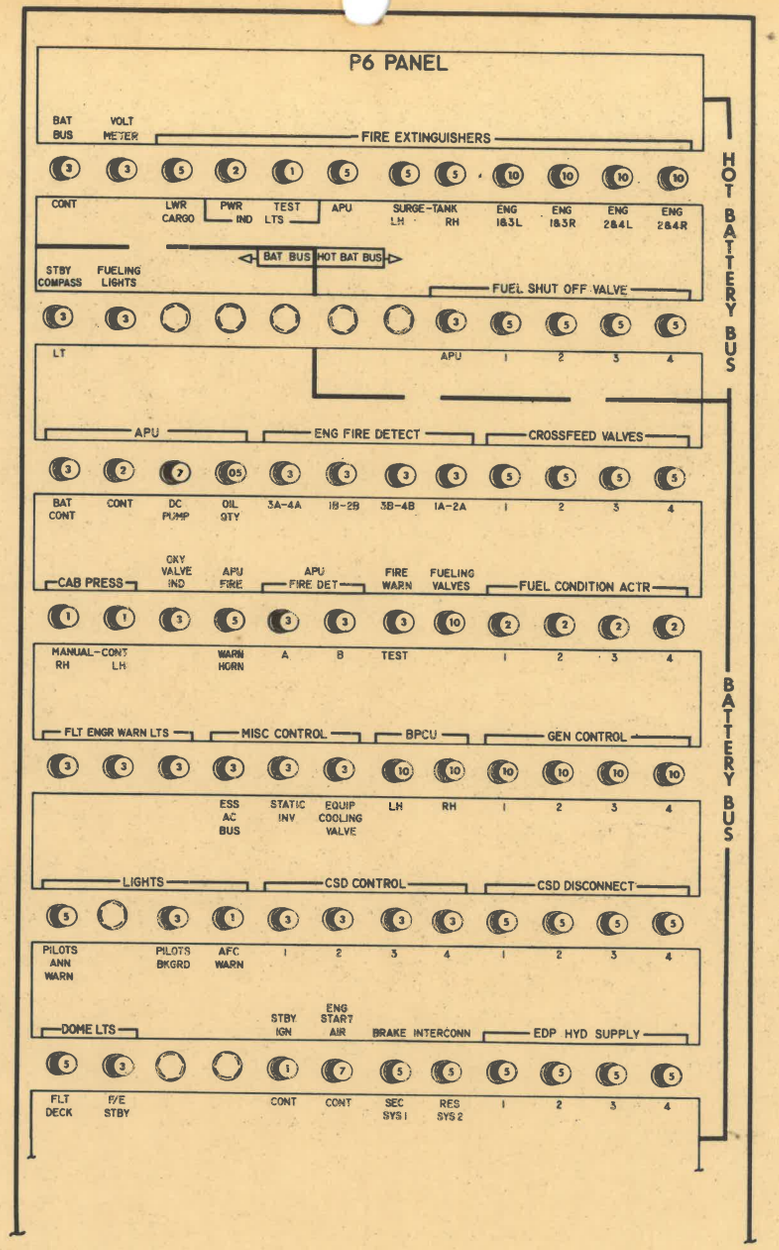
CIRCUIT BREAKER PANEL P6 - LOWER

24-6 S3



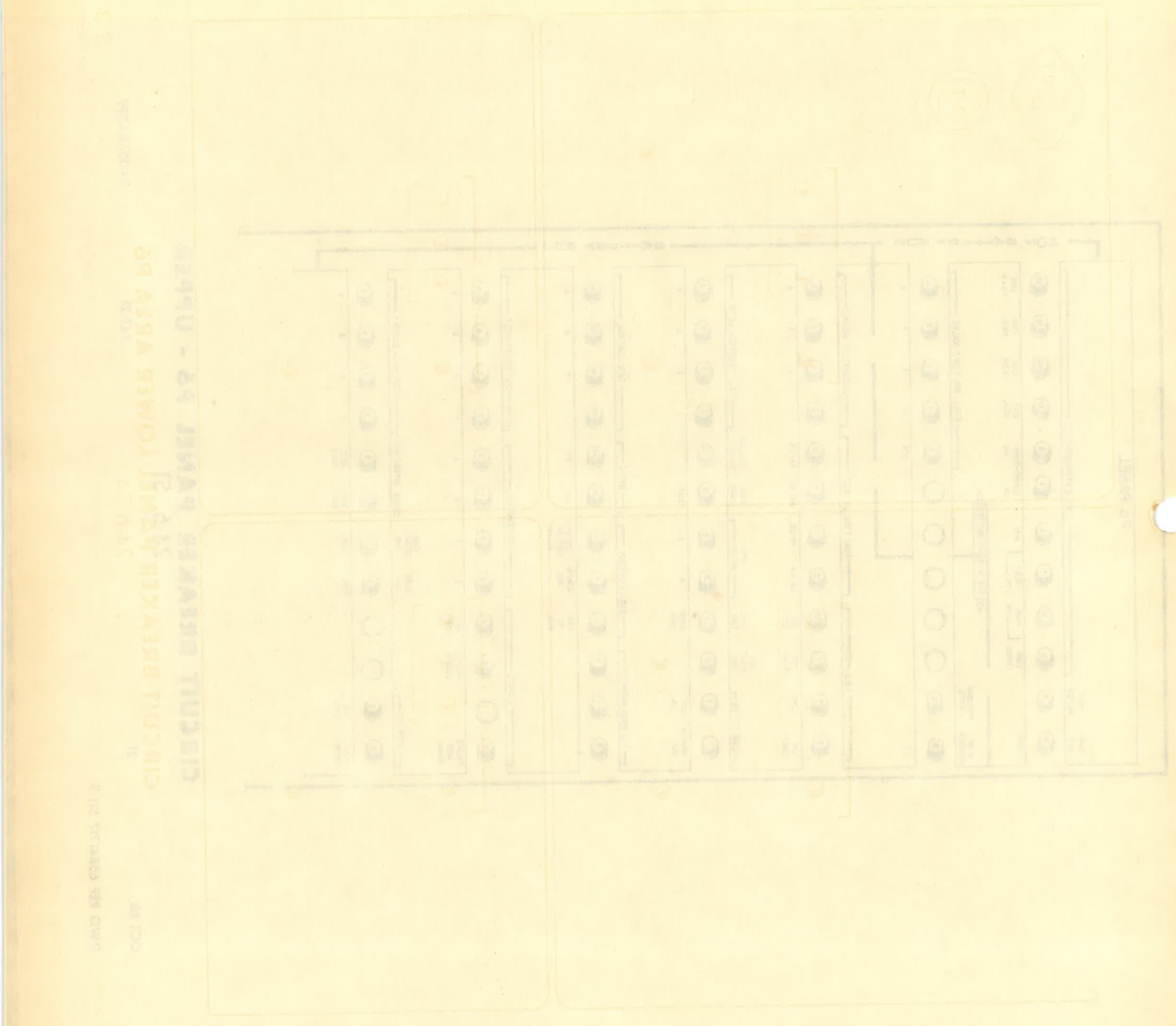
CIRCUIT BREAKER PANEL P6 - CENTER

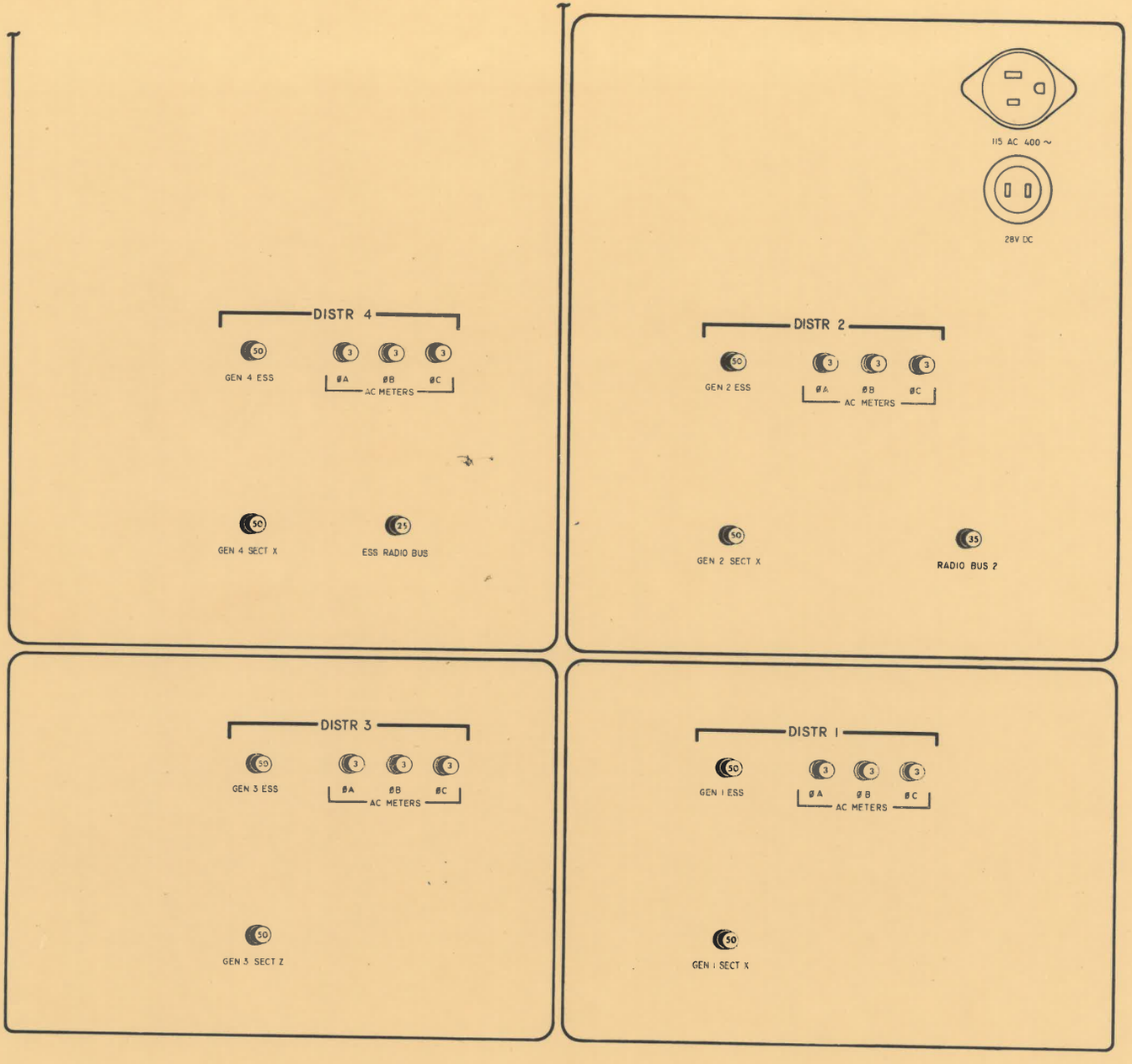
24-6 S2



CIRCUIT BREAKER PANEL P6 - UPPER

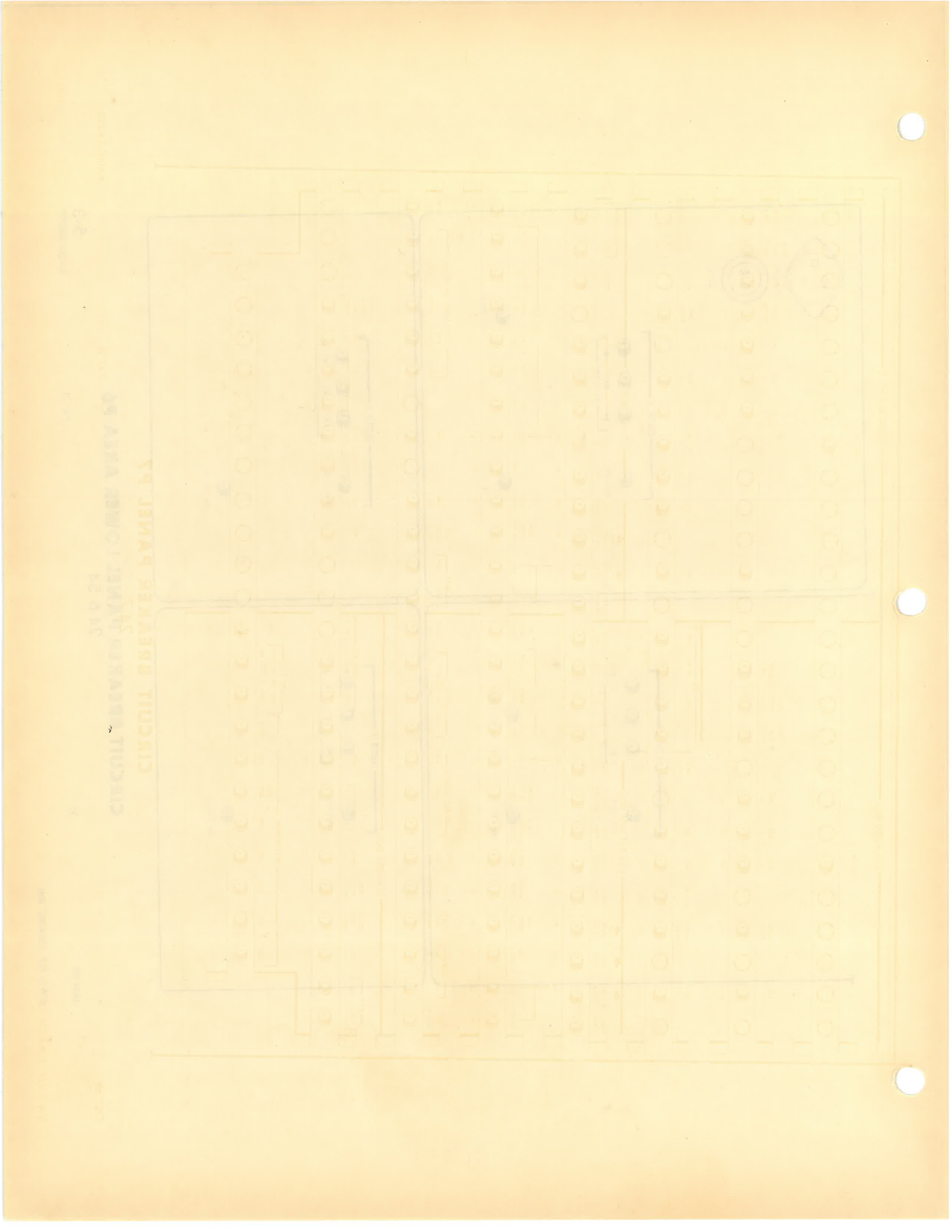
24-6 S1

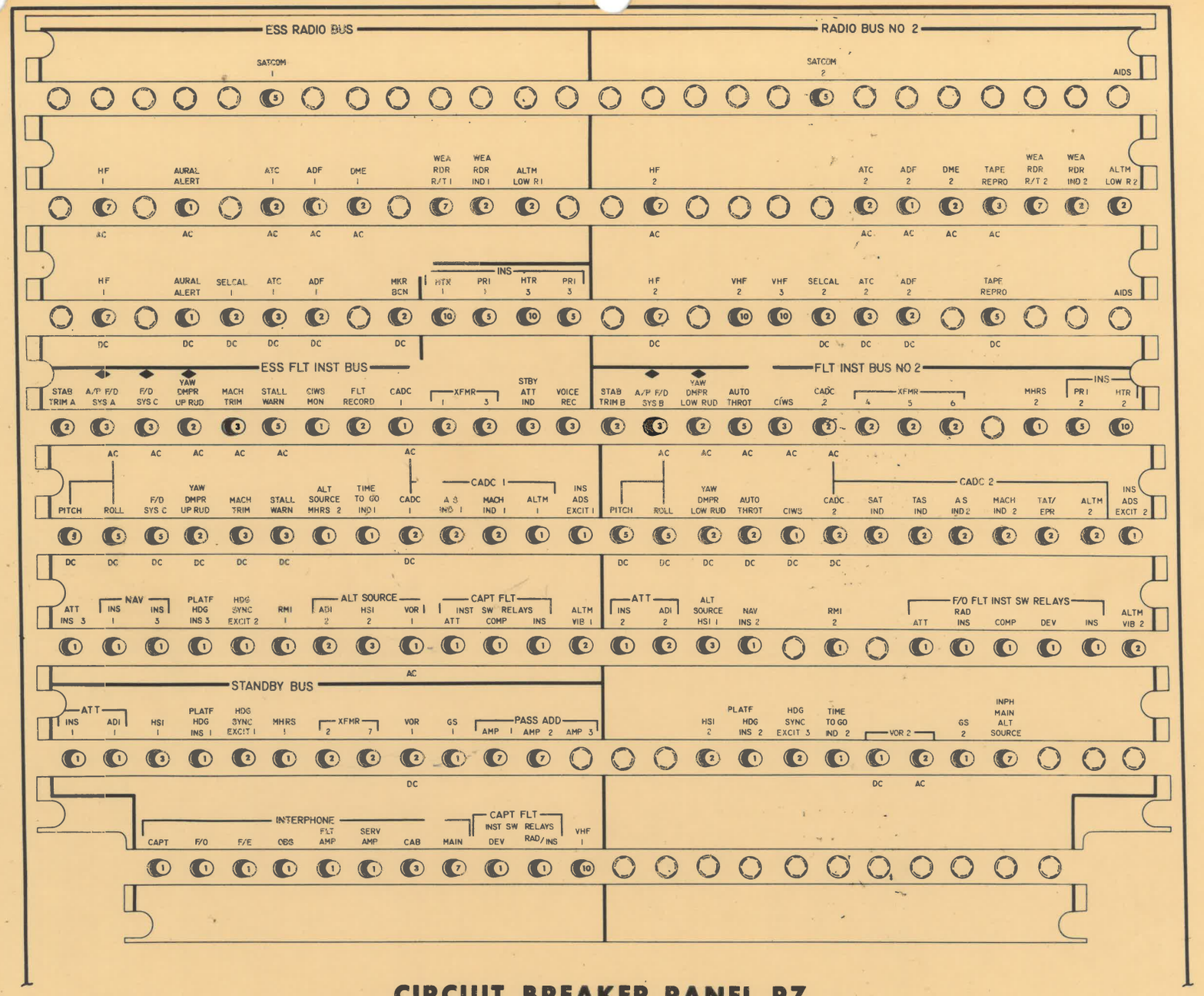




CIRCUIT BREAKER PANEL LOWER AREA P6

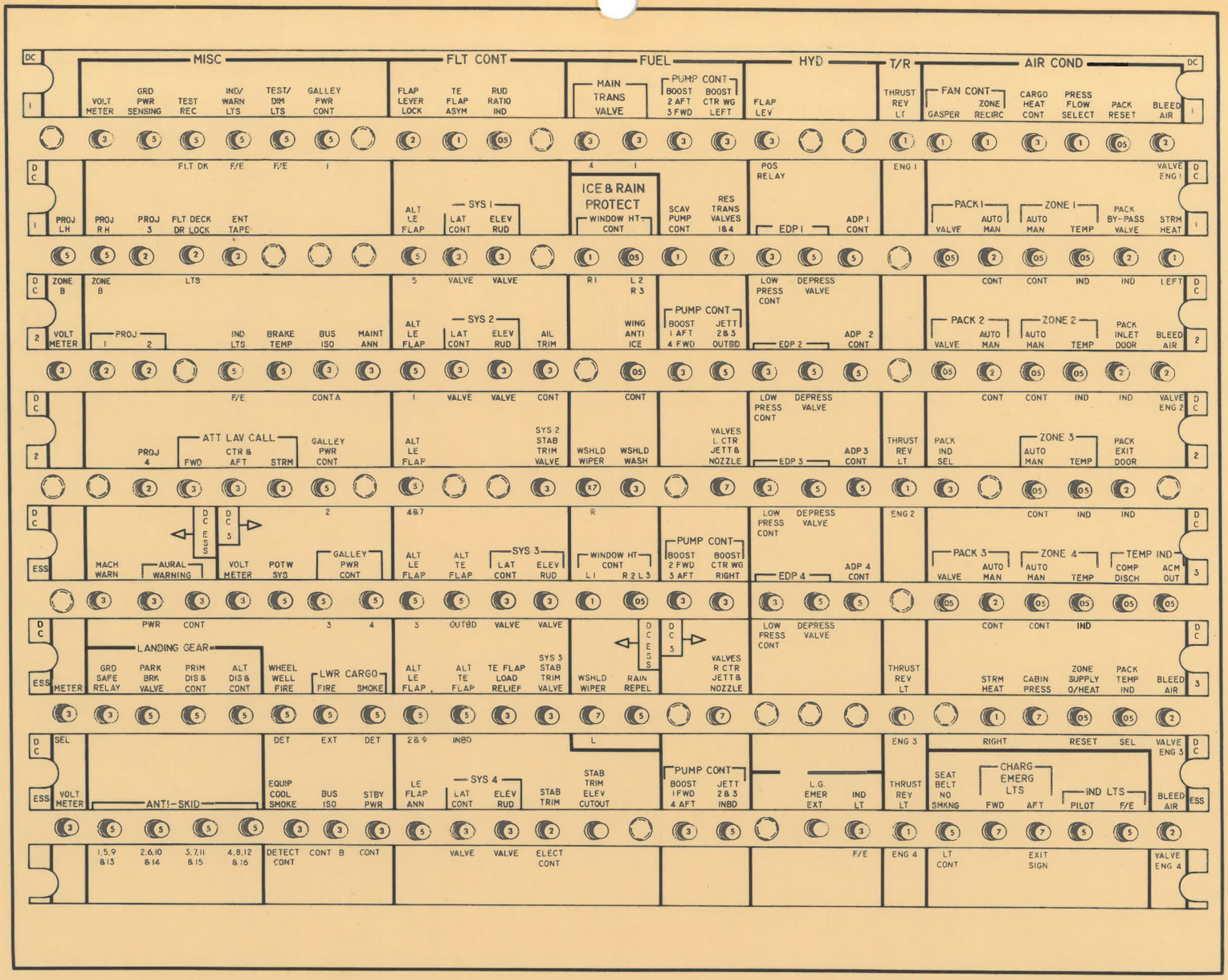
24-6 S4





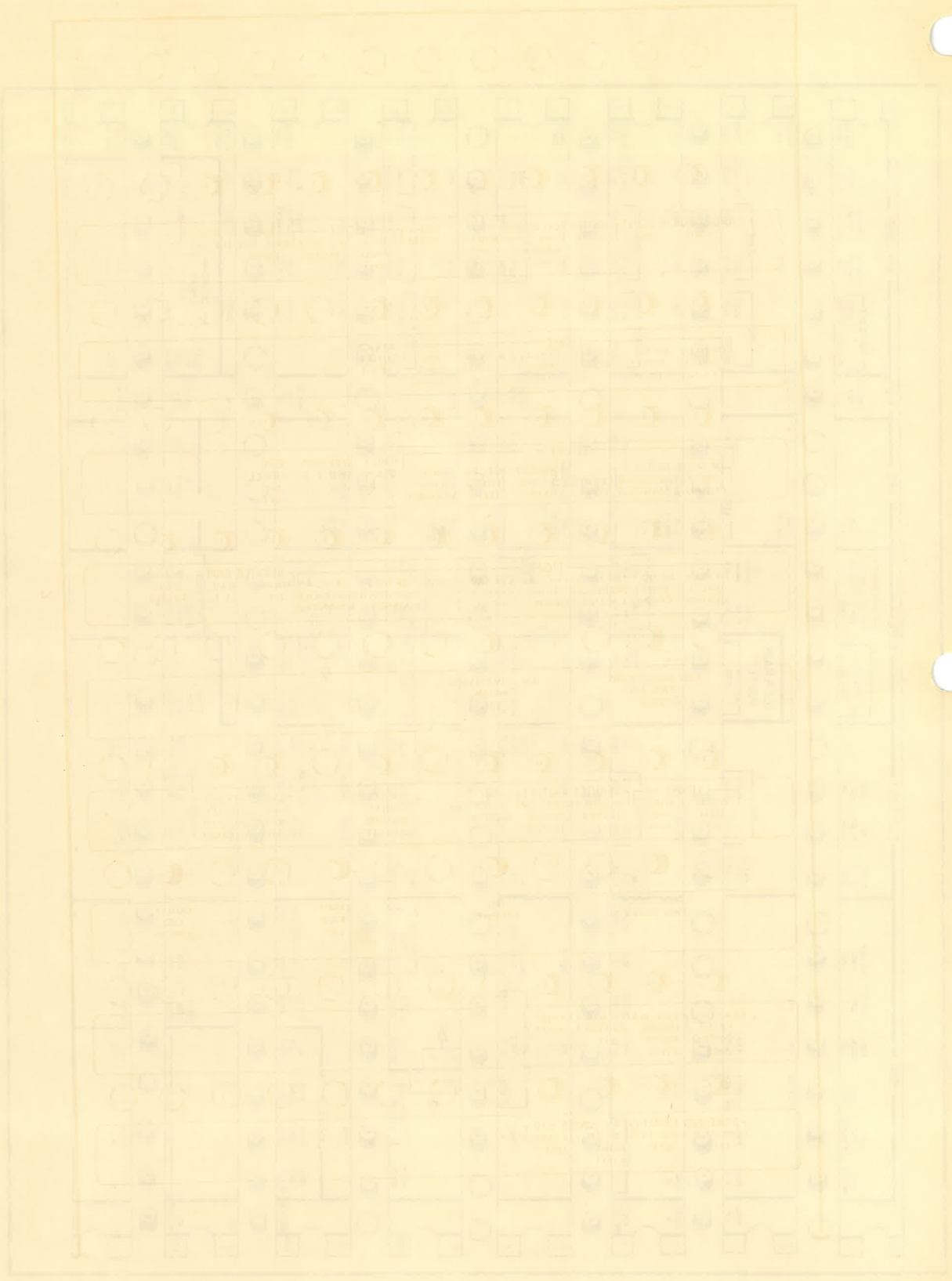
CIRCUIT BREAKER PANEL P7

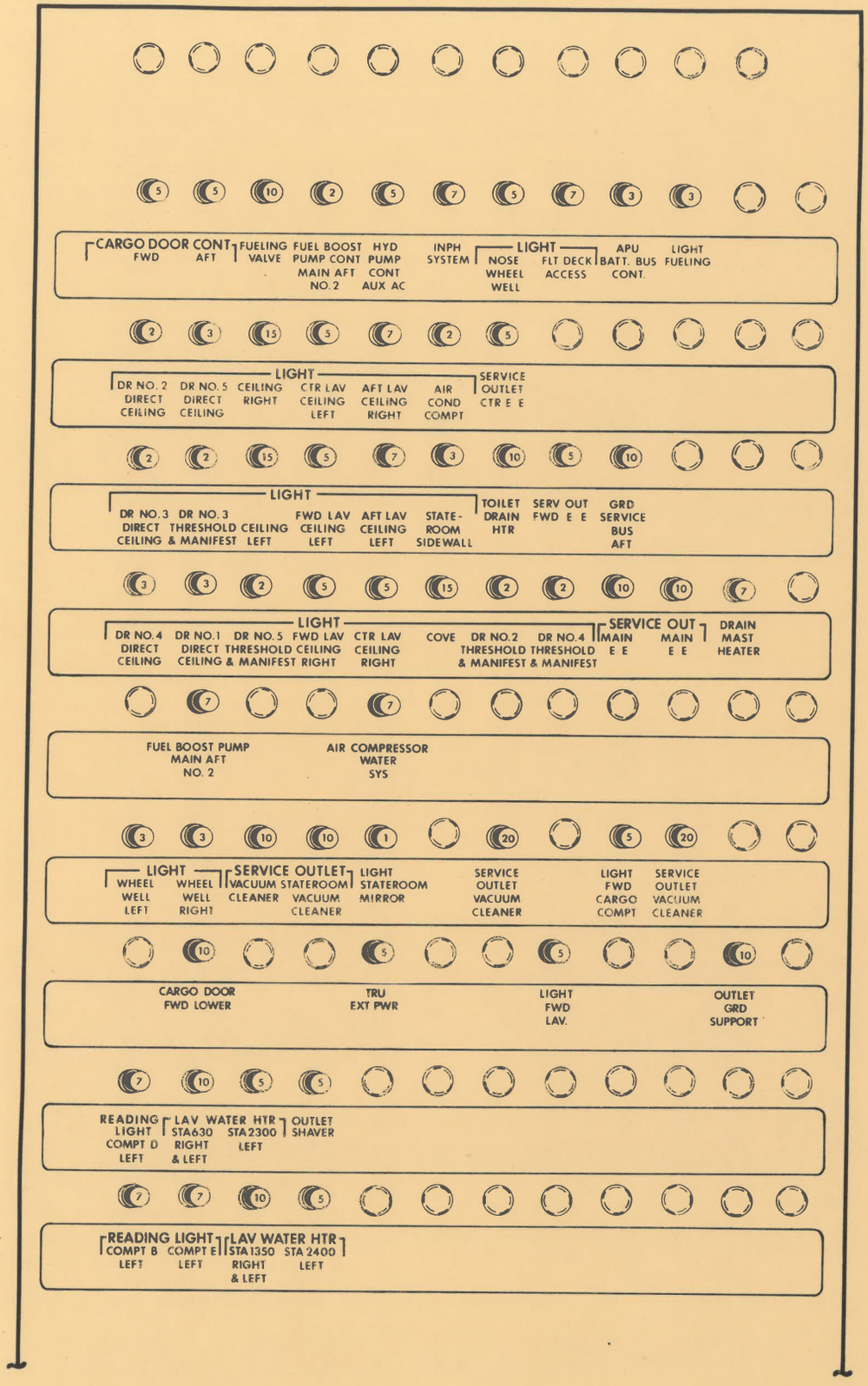
24-7



CIRCUIT BREAKER PANEL P12

24-12





CIRCUIT BREAKER PANEL P14 - UPPER

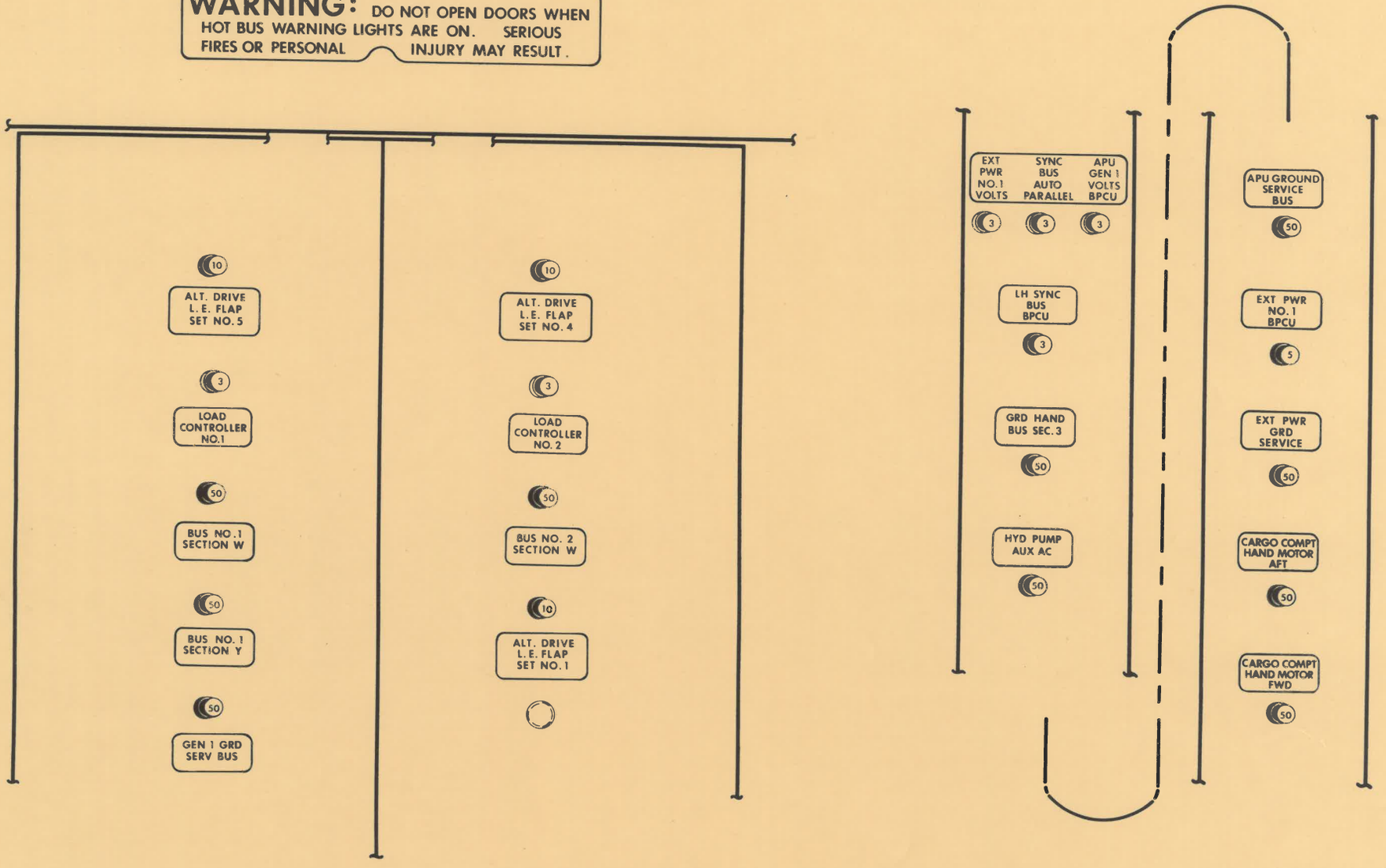
24-14 S1

GENERATOR 1

P14 MAIN POWER CENTER

GENERATOR 2

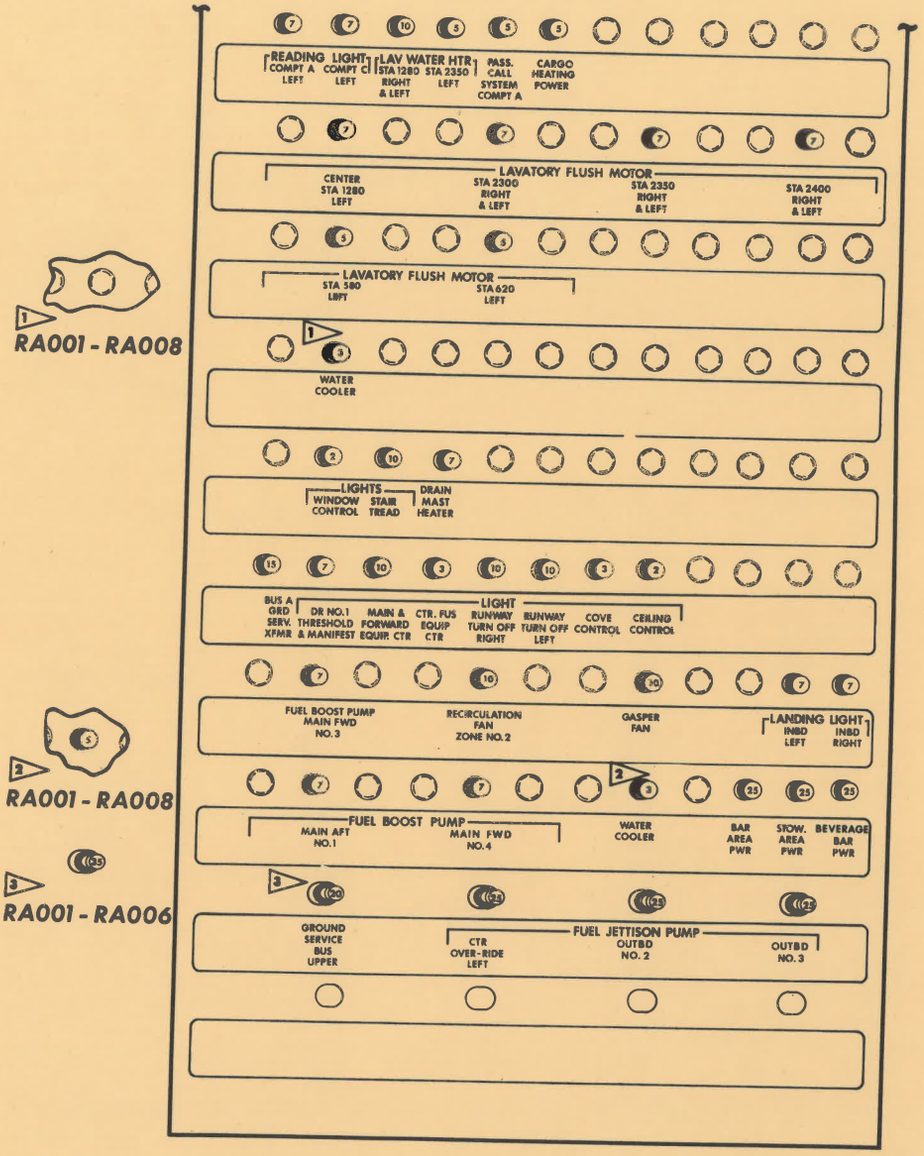
WARNING: DO NOT OPEN DOORS WHEN HOT BUS WARNING LIGHTS ARE ON. SERIOUS FIRES OR PERSONAL INJURY MAY RESULT.



CIRCUIT BREAKER PANEL MAIN POWER CENTER P14

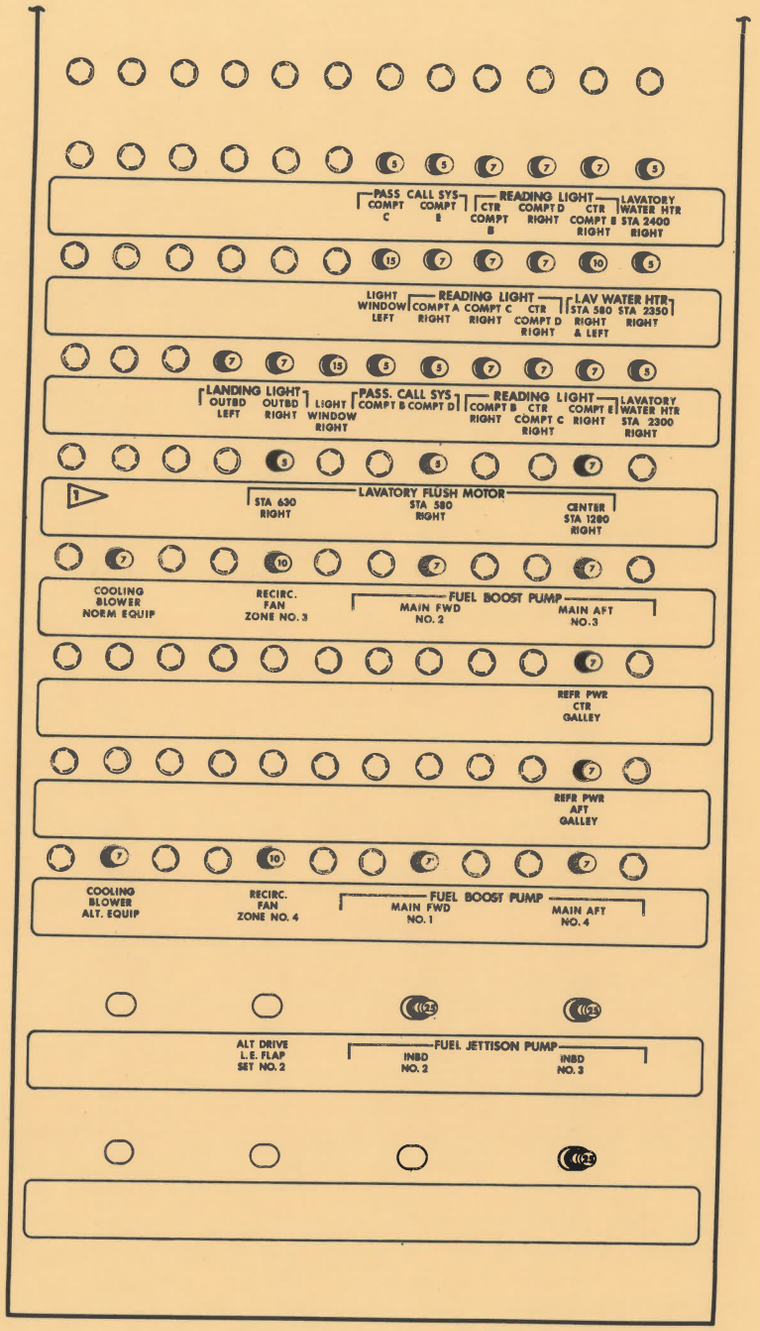
24-14 S3

DWG REF: 65B40719 SH 5



CIRCUIT BREAKER PANEL P14 - LOWER

24-14 S2



WATER COOLER
RA001 - RA008

747-21

24-15 S1

21

CIRCUIT BREAKER PANEL P15
24-15 S1

JAN 69

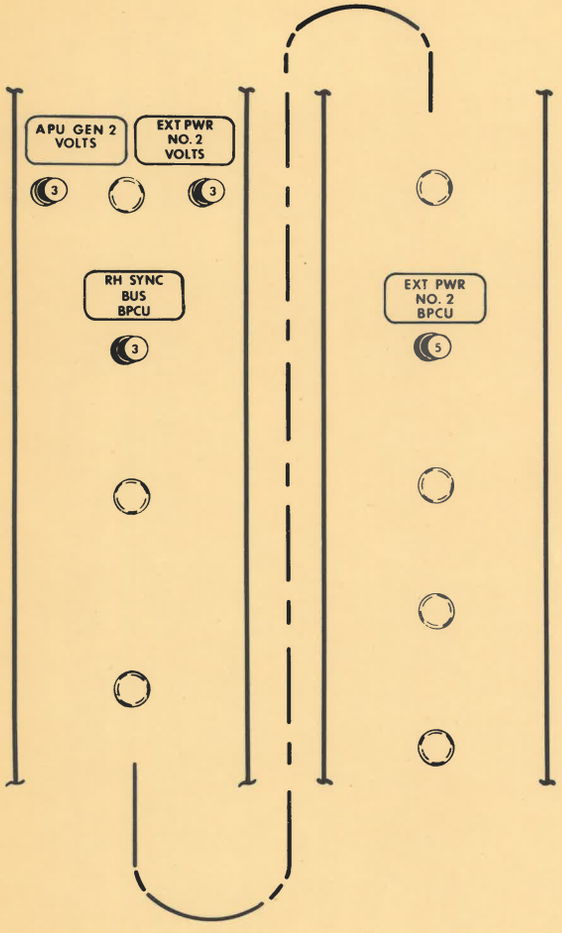
DWG REF: 65B40778 SH 3

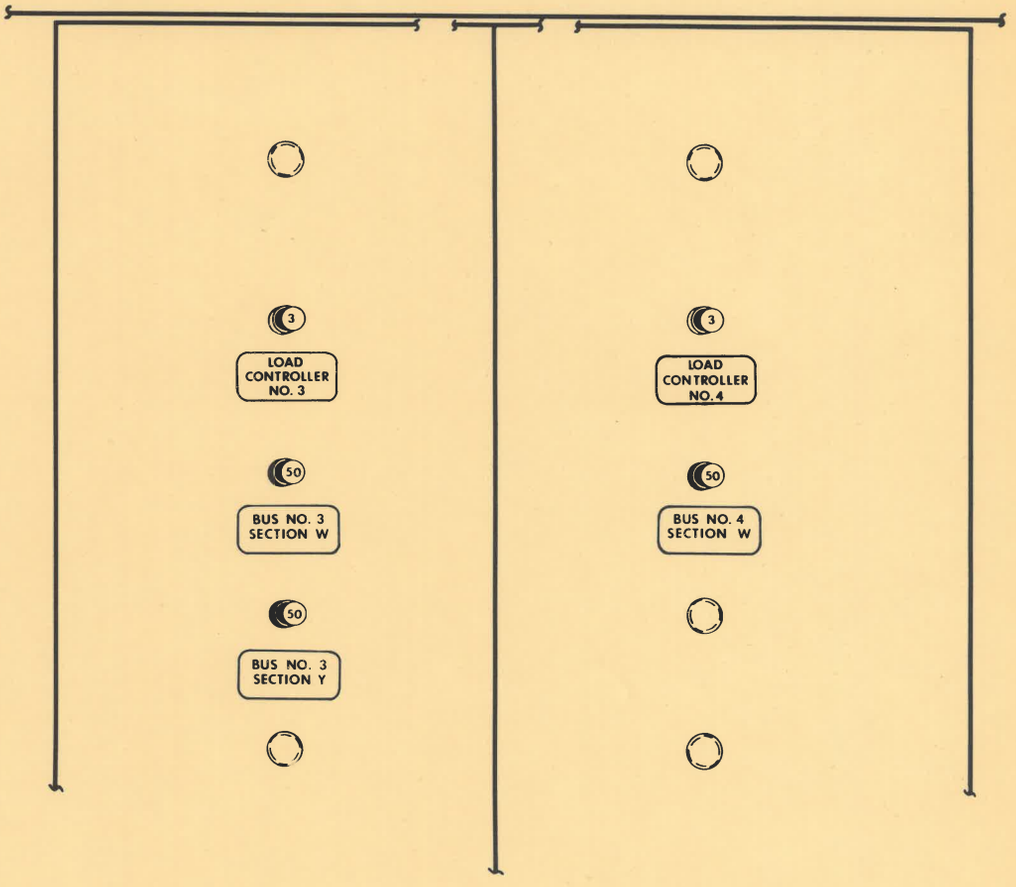
GENERATOR 3

P15 MAIN POWER CENTER

GENERATOR 4

WARNING: DO NOT OPEN DOORS WHEN HOT BUS WARNING LIGHTS ARE ON. SERIOUS FIRES OR PERSONAL INJURY MAY RESULT.





CIRCUIT BREAKER PANEL MAIN POWER CENTER P15

24-15 S2

DWG REF: 65B40719 SH 5

CHAPTER 11

OXYGEN SYSTEM

SYSTEM CHECK, FLIGHT CREW

Crew Oxygen Control Valve...OPEN
Oxygen Mask, Hose and Regulator.....CHECK
Oxygen Supply Lever.....ON
Oxygen Diluter Control.....100%
Oxygen Emergency Control.....EMERGENCY
Hold mask away from face and note oxygen flow under pressure.
Oxygen Supply Lever.....OFF
Oxygen Emergency Control.....NORMAL
Adjust mask to face, inhale and note mask pulls to face.
Oxygen Diluter Control....DILUTE
Inhale and exhale cabin air through the diluter. Inhalation should be relatively difficult due to restricted flow.
Oxygen Supply Lever.....ON
Inhale and exhale unrestricted.
Oxygen Diluter Control 100%
Inhale and exhale unrestricted.
Oxygen Emergency Control.....EMERGENCY
Oxygen delivered under pressure.
Oxygen Emergency Control.....NORMAL
Boom/Oxy Switch.....OXY
INPH Transmit Switch.....PRESS
INPH Receive Switch.....ON
Volume Control.....ADJUST
PTT Switch.....PRESS
Interphone System.....CHECK
Transmissions should be audible through cockpit speaker.
Oxygen Mask.....STOW

SYSTEM USE, FLIGHT CREW

Oxygen Mask.....ON
Diluter Lever.....AS REQUIRED
Lever will normally be left in 100% position unless circumstances dictate use of diluted flow.

SYSTEM USE, PASSENGERS & ATTENDANTS

Oxygen System.....ACTIVATED
Individual oxygen masks are automatically released from passenger service units when cabin altitude is at or above 14,000 feet.

NOTE: When passenger oxygen system is activated all cabin and upper deck lights will be illuminated automatically.

Oxygen Masks.....ON
Pulling the mask down over the face will allow a constant flow of oxygen into the mask.

CAUTION: OXYGEN WILL CONTINUE TO FLOW THROUGH THE MASKS UNTIL SHUT OFF AT THE PASSENGER SERVICE UNITS OR BY THE MANUAL RESET HANDLE. "NO SMOKING" SHOULD BE STRICTLY OBSERVED.

PORTABLE OXYGEN

Portable oxygen cylinder assemblies are positioned in the cockpit and cabin for use if required. Instructions for use are affixed to the cylinders.

EXITS

- The ten main entry doors and the crew service door may be used as emergency exits.
- An inward opening overhead hatch in the cockpit may be used in an emergency. The installation includes five self-contained inertia reel descent devices.

EVACUATION SLIDES

PASSENGER DOORS (1, 2, 4, 5 - L & R)

With the mode selector handle of the emergency evacuation system in the AUTOMATIC position, rotation of the interior door handle will actuate the emergency power system for the door which will position the door to the full open position. The escape slide will automatically deploy and inflate when the door is fully opened.

NOTE: If the slide does not inflate automatically pulling the inflation handle on the hinged end of the door will inflate the slide.

In a ditching situation deployment of the escape slide(s) would not be desirable and the mode select handle(s) should be positioned to MANUAL for ditching.

PASSENGER DOORS (3 - L & R)

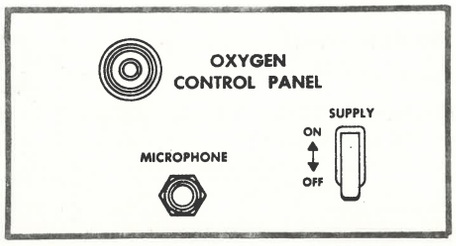
Operation of the #3 door utilizing the interior door handle with the system in AUTOMATIC will actuate the emergency power system for the door and position the door to the full open position. The door-mounted escape ramp and the fairing mounted, off-wing escape slide will be automatically deployed. An off-wing deployment indicator will be visible to the cabin attendant at the #3 door when the off-wing escape slide is properly deployed.

NOTE: If the ramp does not inflate automatically pulling the inflation handle on the hinged end of the door will inflate the ramp.

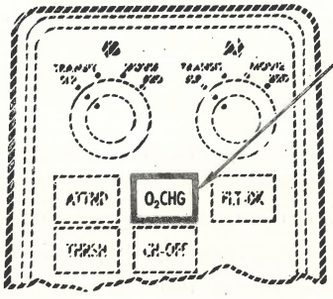
If the off-wing escape slide does not inflate automatically pulling the manual deployment handle (on sidewall adjacent to the door) will inflate the slide.

In a ditching situation deployment of the off-wing escape slide would not be desirable, but use of the ramp for access to life rafts would. This configuration is attained with the system in AUTOMATIC, but with the ditching deactivation handles (on sidewall adjacent to door) activated. This will remove the off-wing escape slide from the automatic sequencing.

The ditching deactivation handle should also be used in the event of a wheels-up landing. The proper deployment of the off-wing escape slide(s) and/or the escape slide from the #4 door(s) will not be attained in this landing configuration.



OXYGEN CONTROL PANEL



CABIN ATTENDANTS' PANELS – STATIONS 1L AND 4L

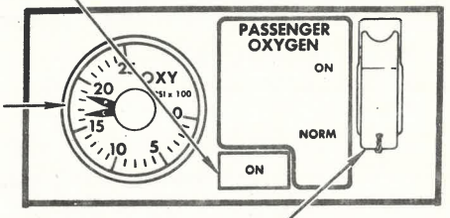
PASSENGER OXYGEN INDICATOR LIGHT (Amber)
(Red) – Cabin Attendants')

ILLUMINATED – System activated.

OXYGEN

PILOTS' CENTER PANEL

F/E PANEL



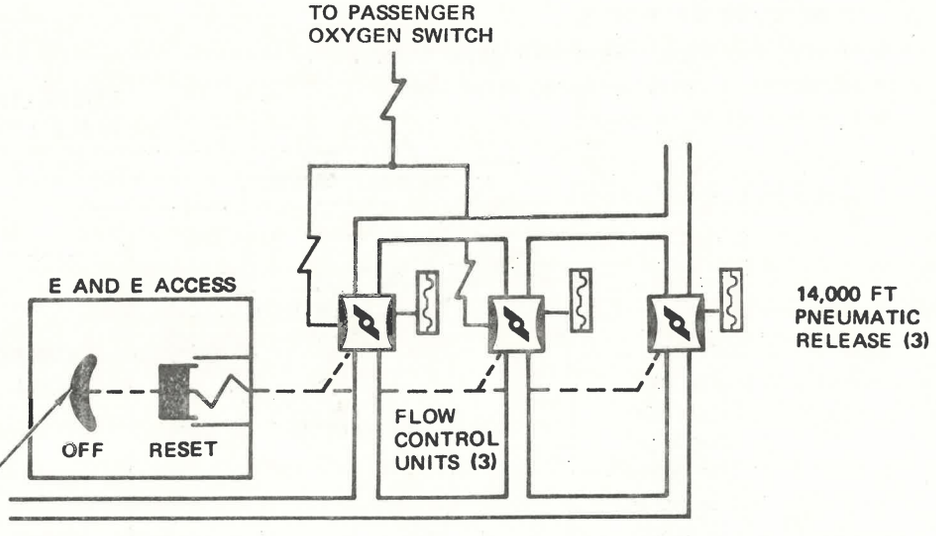
OXYGEN PRESSURE INDICATOR

Crew (C) and passenger (P) oxygen systems.

PASSENGER OXYGEN SWITCH

NORM – System automatically activated when cabin altitude is at or above 14,000 feet.

ON – Electrical activation of two flow control units. Masks will drop regardless of cabin altitude.



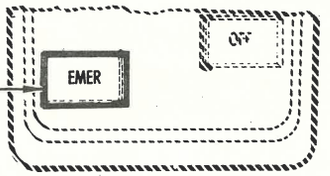
MANUAL RESET HANDLE

To reset passenger oxygen system push aft to RESET position, hold for approximately 5 seconds and then reposition to OFF.

OXYGEN SYSTEM

EMERGENCY LIGHTS SWITCH (Red)
(Clear Plastic Guard)

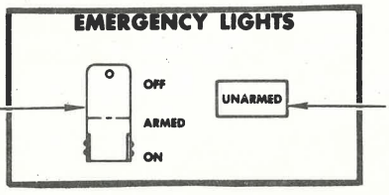
Illuminates lights regardless of position of pilots' EMERGENCY LIGHTS switch.



CABIN ATTENDANT'S PANEL
STATION NO. 1 LEFT

EMERGENCY LIGHTS SWITCH

Primary emergency light control for aisle lights, door and overwing lights and exit lights.
OFF – Emergency lights out.
ARMED – Lights extinguished but will illuminate when power is lost to the essential DC bus.
ON – Emergency lights illuminated.



PILOTS' OVERHEAD PANEL

EMERGENCY LIGHTS UNARMED LIGHT (Amber)

Light illuminated with 28V DC essential bus powered and EMERGENCY LIGHTS switch in OFF or ON position or No. 1 Left Cabin Attendant's switch activated.

LUMINESCENT EXIT SIGN

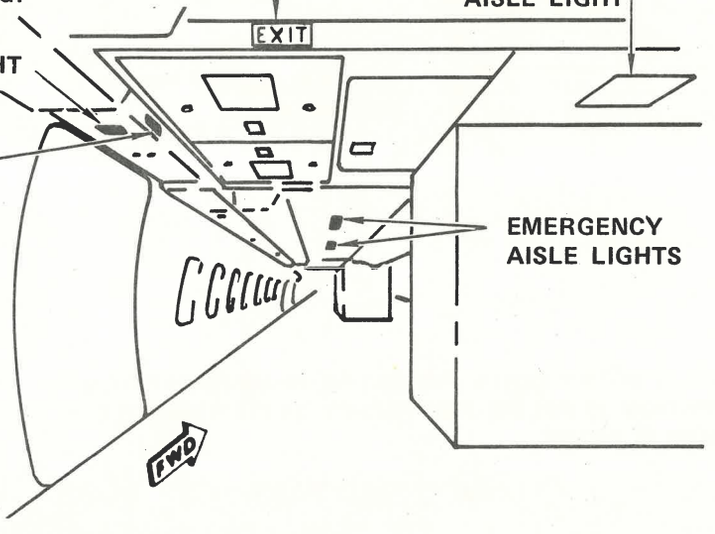
Activated by light. Sign will glow for approximately twenty minutes after light source has been removed.

EMERGENCY CROSS AISLE LIGHT

EMERGENCY DOOR LIGHT

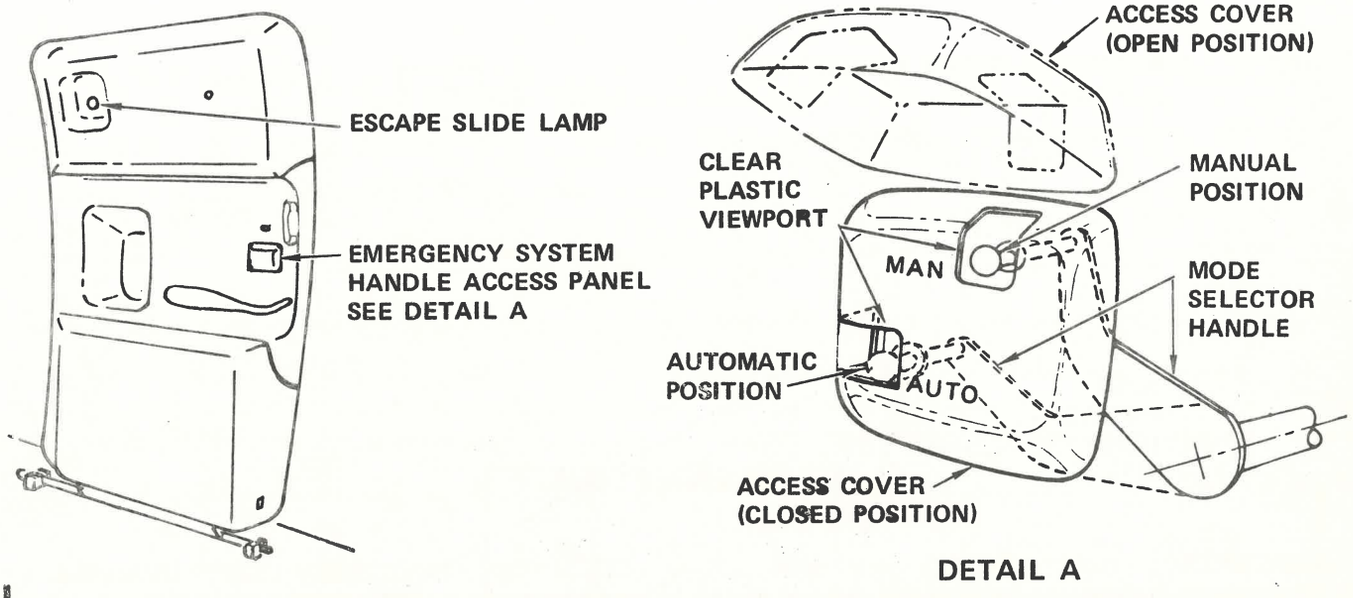
EXIT LIGHT

Equipped with four lamps. Two lamps controlled by EXIT LIGHTS switch for normal passenger deplaneing operations. The other two lamps are powered by self contained nicad batteries and are controlled by EMERGENCY LIGHTS switches.

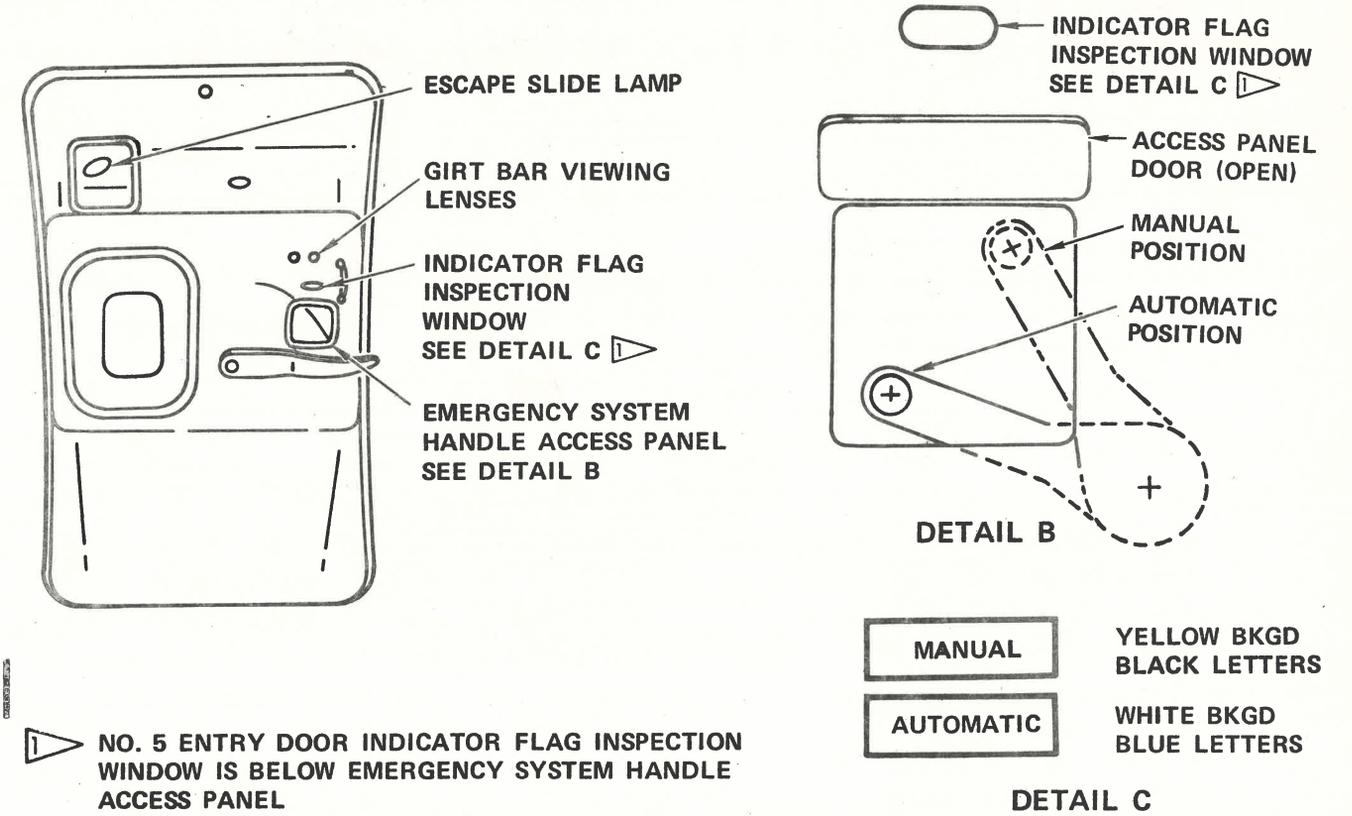


EMERGENCY AISLE LIGHTS

EMERGENCY LIGHTS



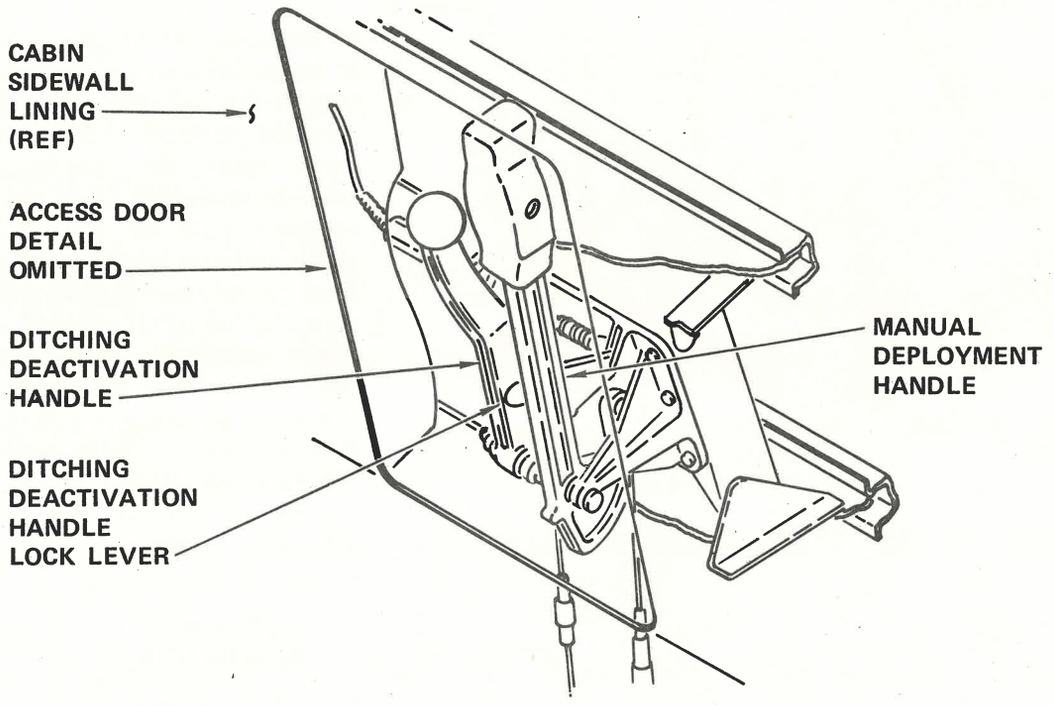
MODIFIED PASSENGER DOOR – INTERIOR VIEW



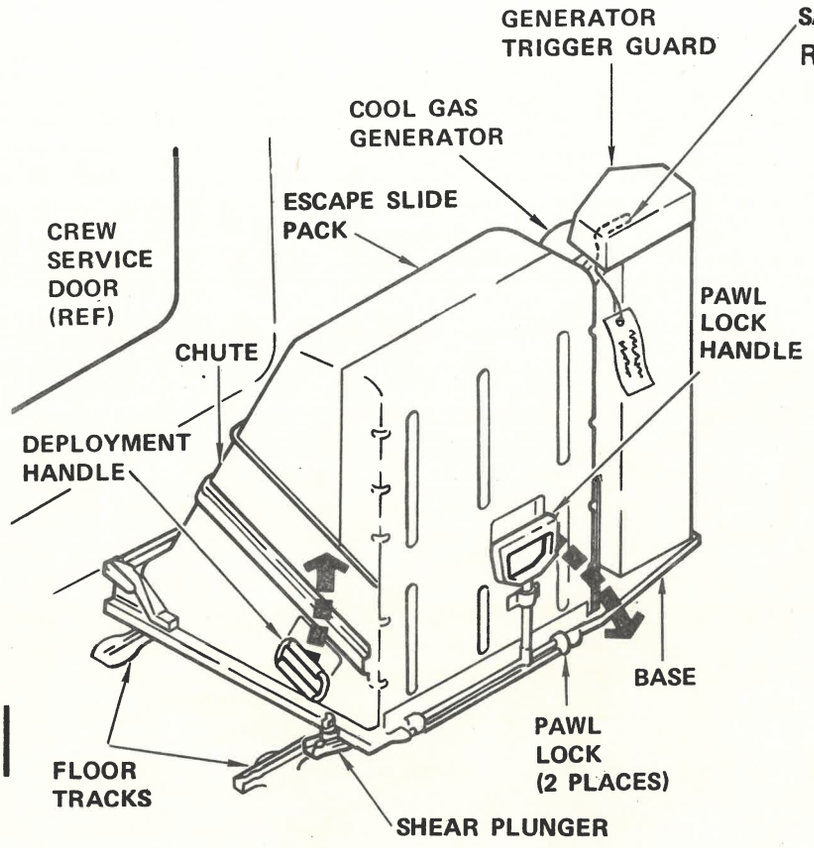
1 NO. 5 ENTRY DOOR INDICATOR FLAG INSPECTION WINDOW IS BELOW EMERGENCY SYSTEM HANDLE ACCESS PANEL

UNMODIFIED PASSENGER DOOR – INTERIOR VIEW

PASSENGER DOOR – INTERIOR VIEW



OFF-WING ESCAPE SLIDE MANUAL CONTROLS (#3 DOORS ONLY)



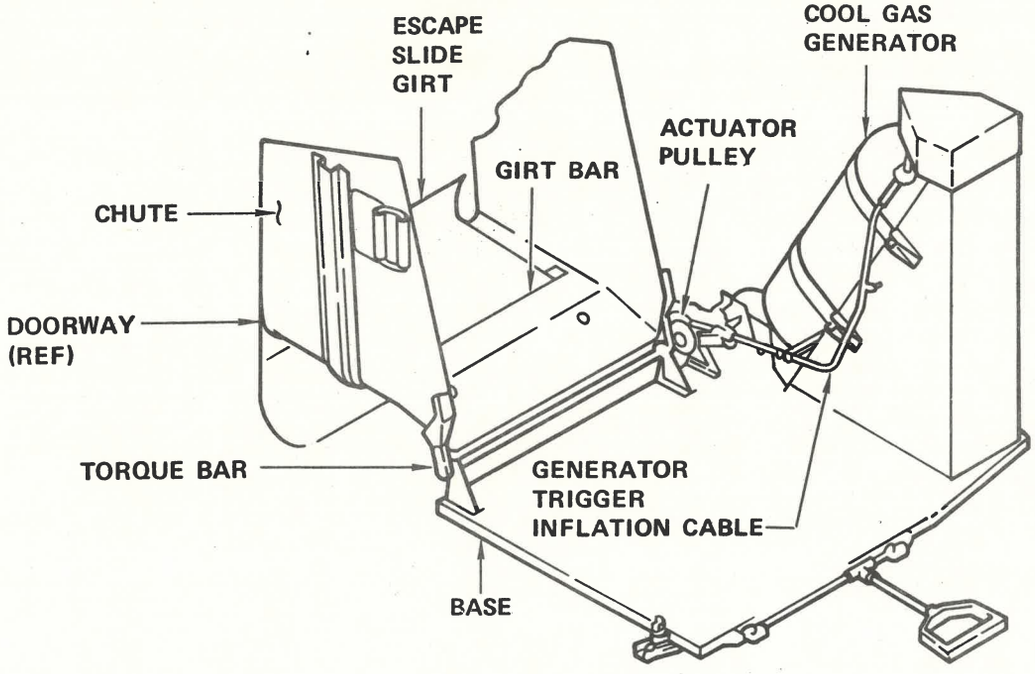
ESCAPE SLIDE IN DEPLOYMENT READINESS POSITION

SAFETY PIN AND STREAMER

Remove when slide is positioned.

The escape slide for the crew service door is mounted on tracks immediately inboard of the door. The assembly has two maintained positions. Aft (clear of door opening) and forward (immediately inboard of door opening).

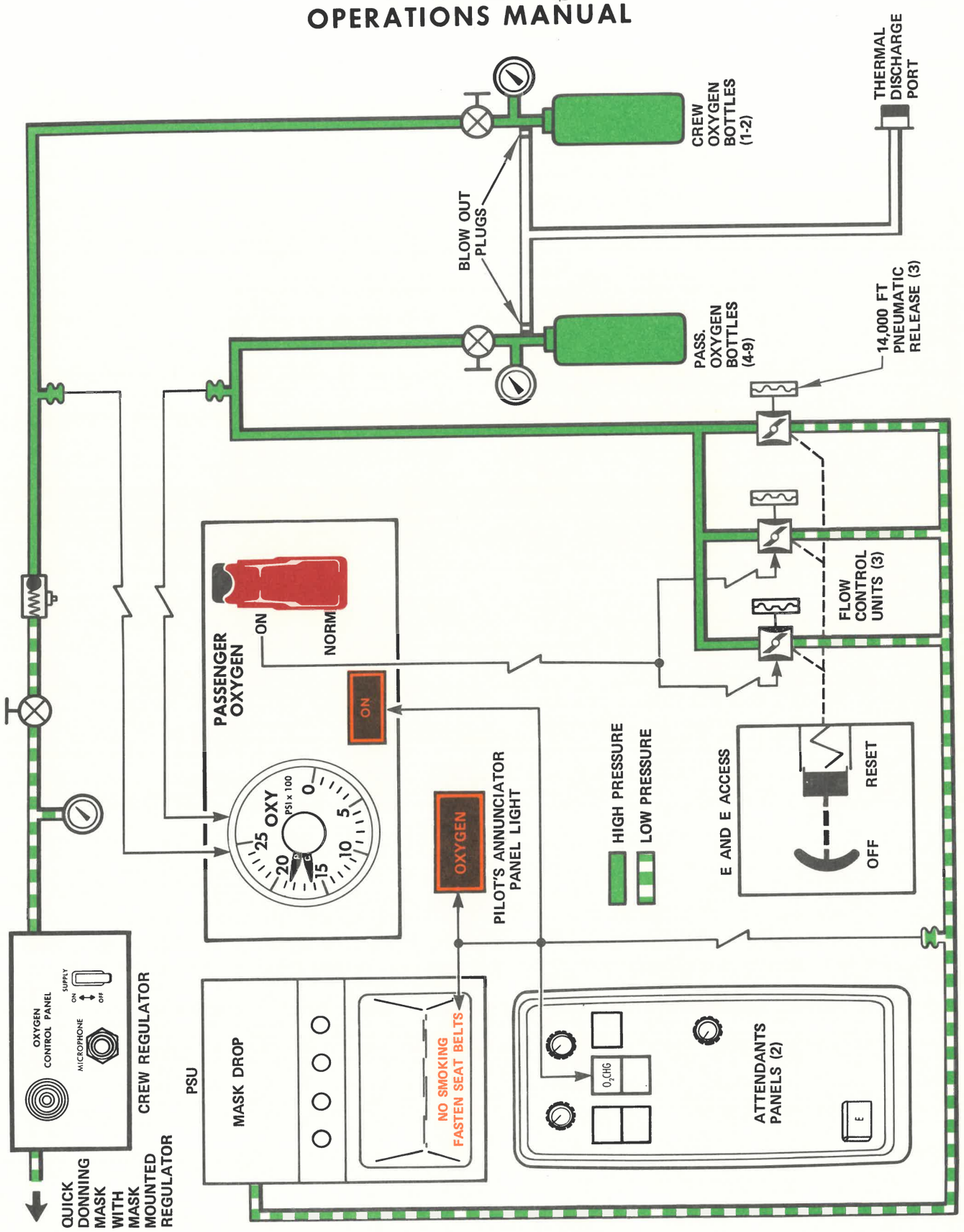
If the crew service door escape slide is to be utilized in an emergency evacuation the assembly must be in the forward position and the generator trigger safety pin removed. With the crew service door open the pawl lock handle is rotated to clear the pawl locks and the deployment handle is used to rotate the slide assembly through the door opening. Subsequent movement of the escape slide pack free of the chute will activate the cool gas generator which will inflate the slide. If the slide does not inflate automatically the generator can be activated by depressing the generator trigger manually.



ESCAPE SLIDE DEPLOYED

ESCAPE SLIDE-CREW SERVICE DOOR

EMERGENCY EQUIPMENT SCHEMATIC



OXYGEN SYSTEM

EVACUATION SLIDES

PASSENGER DOORS (UNMODIFIED)

The emergency evacuation system mechanism is positioned to AUTOMATIC when the door is closed from the outside. Conversely, when the door is opened from the outside, the mechanism is automatically positioned to MANUAL and the slide will not deploy. If the door has been closed from the inside, the system must be manually set to AUTOMATIC to provide for automatic deployment. If the door is to be opened from the inside and slide deployment is not desired, the system must be set to MANUAL. The mode selector handle should not be repositioned (from MANUAL to AUTOMATIC or AUTOMATIC to MANUAL) unless the door is fully closed.

The position of the girt bar lock, engaged (AUTOMATIC) - disengaged (MANUAL), can be verified through the viewing lenses above the indicator flag inspection window (below inspection window on door #5). With the system in AUTOMATIC the girt bar locks should be engaged and a bright orange light will be viewed. With the system in MANUAL the girt bar locks should not be engaged and the orange light will not appear.

CAUTION: WITH THE MODE SELECTOR HANDLE OF THE EMERGENCY EVACUATION SYSTEM IN THE AUTOMATIC POSITION THE EMERGENCY POWER SYSTEM WILL POSITION THE DOOR(S) TO FULL OPEN WHEN THE INTERIOR DOOR HANDLE IS PLACED IN THE COCKED POSITION.

EVACUATION SLIDES

PASSENGER DOORS (MODIFIED)

On later airplanes, and on earlier airplanes when service bulletin(s) are incorporated the operation of the passenger doors and evacuation slides is as follows:

When the mode selector handle is in the AUTOMATIC position and the interior door handle is moved toward the OPEN position the emergency power system will position the door to full open and the slide (and ramp in the case of the #3 door) will automatically deploy. If the door is to be opened from the interior and slide deployment is not desired the mode selector handle must be in the MANUAL position.

If the mode selector handle is in the AUTOMATIC position and the door is opened utilizing the exterior door handle the mode selector handle will be mechanically positioned to MANUAL and the door can be opened without slide deployment.

When the door is closed utilizing either the exterior or interior door handles the mode selector handle will remain in MANUAL and must be positioned to AUTOMATIC by cabin personnel to provide for automatic sequencing if required.

The mode selector handle should not be repositioned (from MANUAL to AUTOMATIC or AUTOMATIC to MANUAL) unless the door is fully closed.

RAFTS

Stowage provisions for twenty-one 25-man life rafts are provided in overhead compartments adjacent to each passenger door.

EMERGENCY LIGHTING

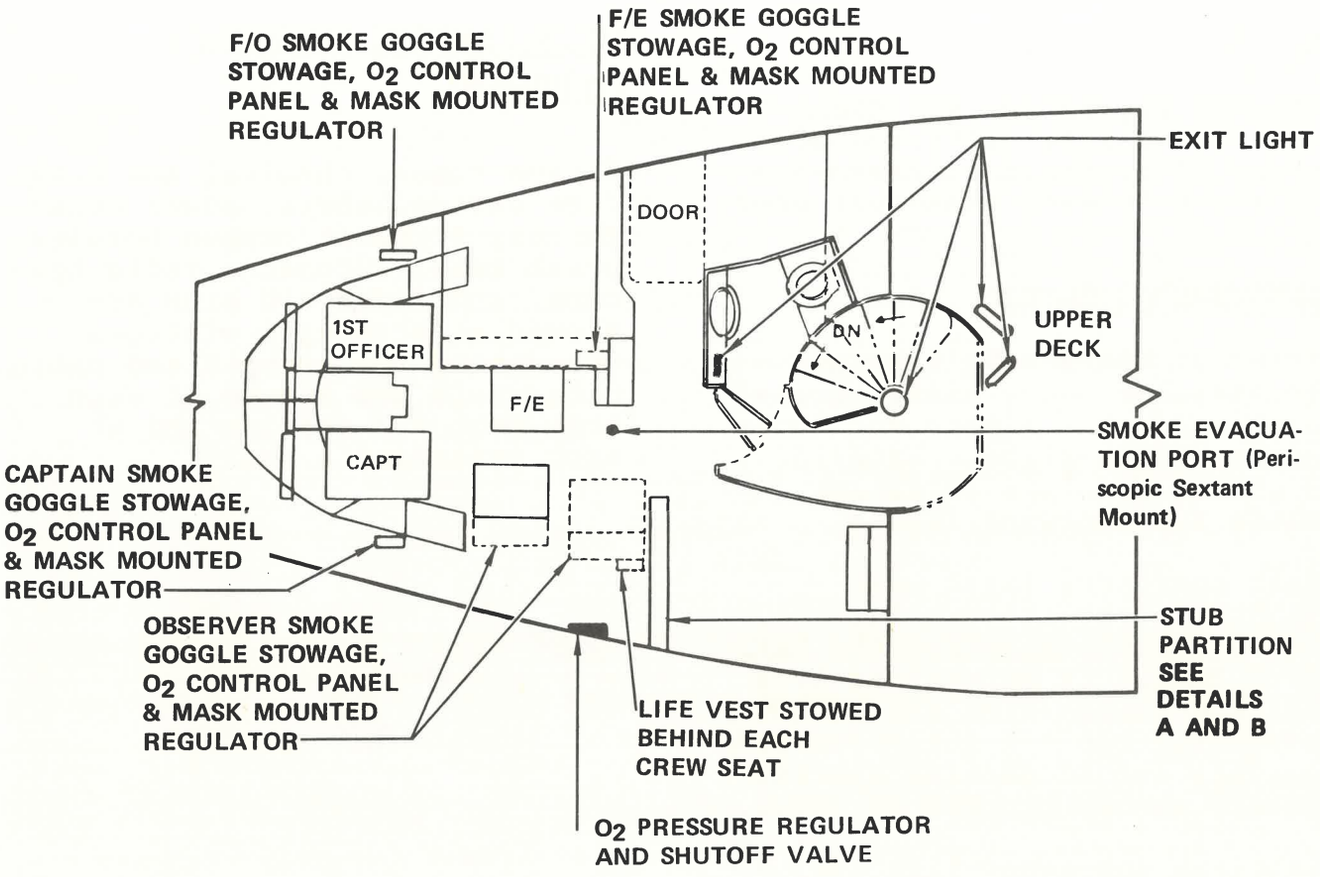
Interior emergency lighting consists of door, aisle, cross-aisle and exit lights and luminescent exit signs. Exterior lighting consists of escape slide and overwing lights.

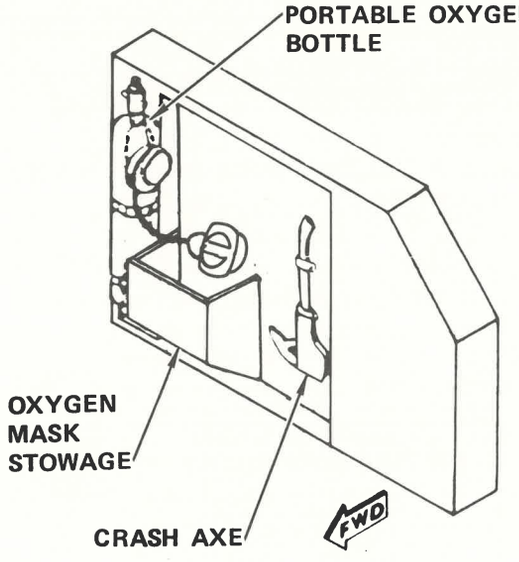
Each emergency light unit is powered by its own battery. Under normal operation the battery charge is maintained by a trickle charge from the 28V DC essential bus. A fully charged battery should provide approximately twenty minutes of power.

External emergency lighting is designed to illuminate all escape slides, ramps and overwing areas. Emergency lights for doors 1, 2, 4 and 5 are mounted on the door. Door 3, which opens over the wing, has one light flush mounted in the door sill to illuminate the escape ramp. Four flush-mounted fuselage lights illuminate the over-flap escape slide. The crew service door escape slide is illuminated by two flush-mounted door sill lights.

MISCELLANEOUS EMERGENCY EQUIPMENT

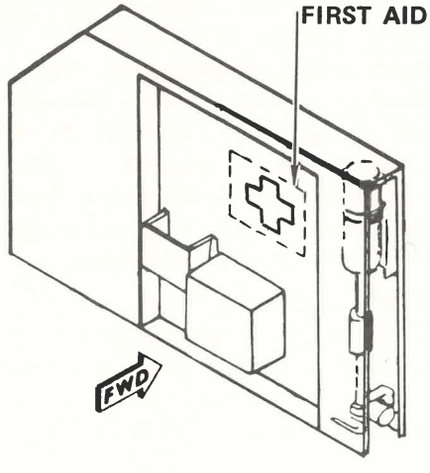
Escape ropes, chemical and water fire extinguishers, power megaphones, portable oxygen bottles, crash axes, automatic radio beacons, and first aid kits are stowed at strategic stations throughout the cockpit and cabin. Life vests are stowed at each crew member's station and at each passenger's seat.





DETAIL A

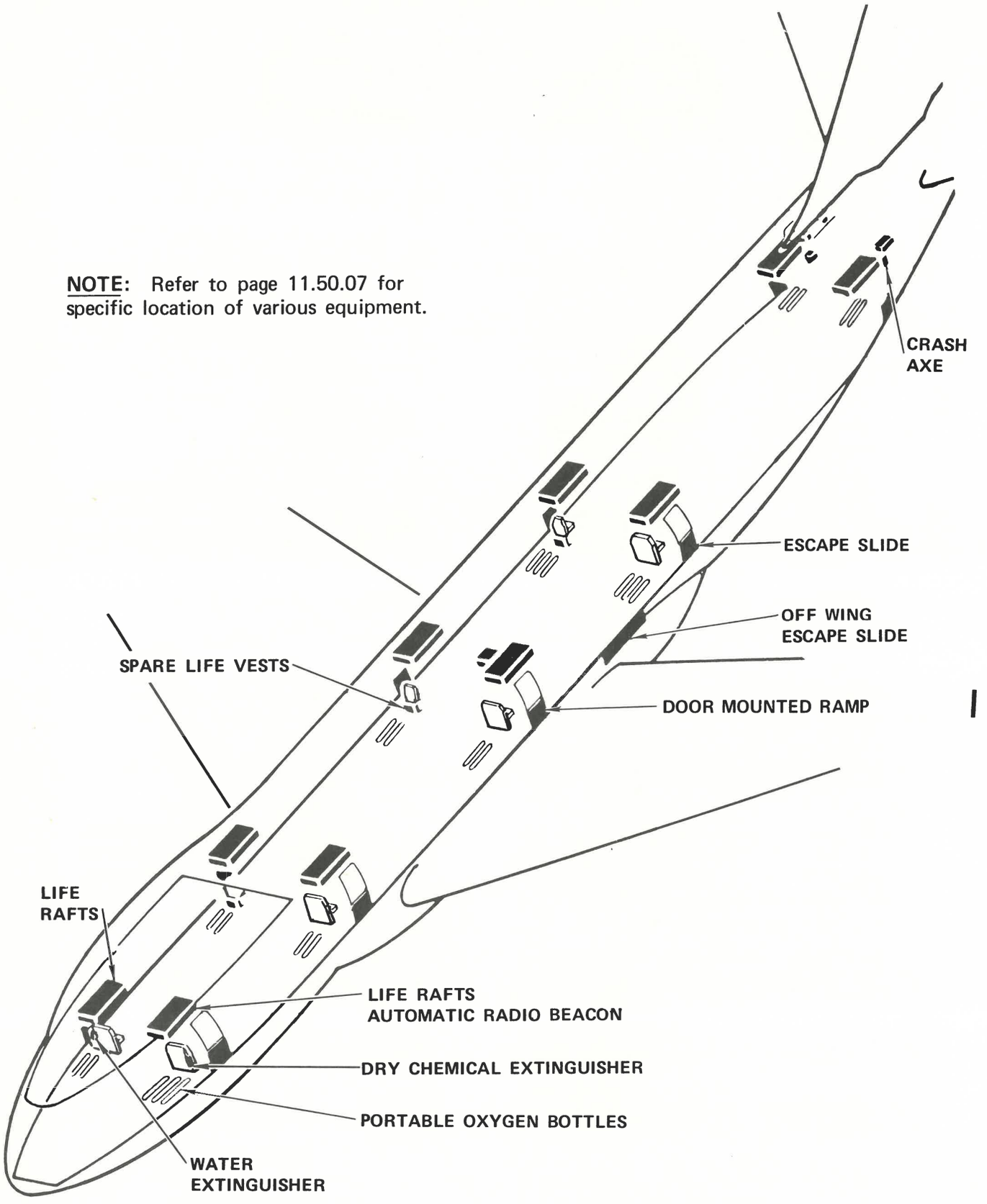
STUB PARTITION
(FWD SIDE)



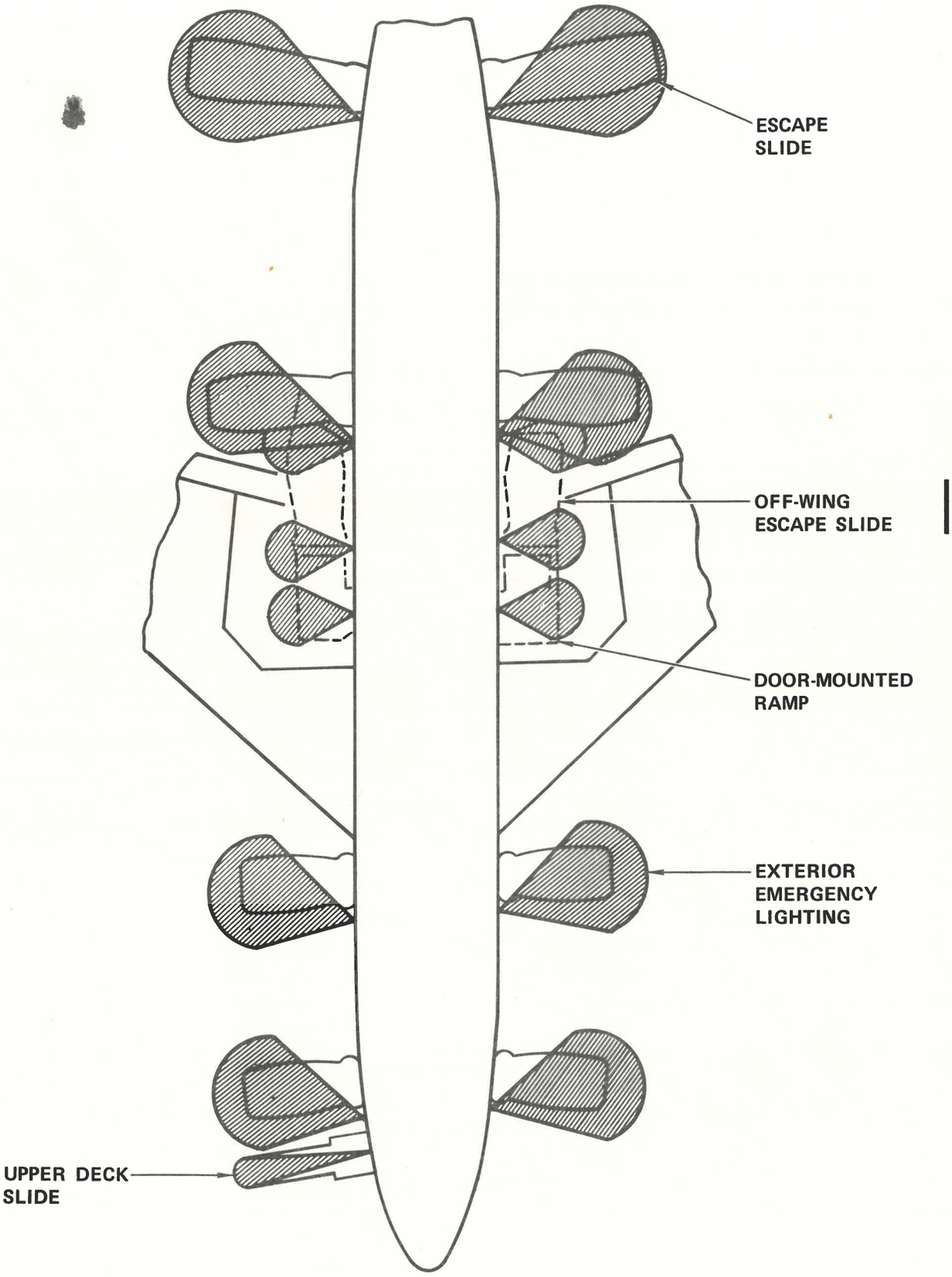
DETAIL B

STUB PARTITION
(AFT SIDE)

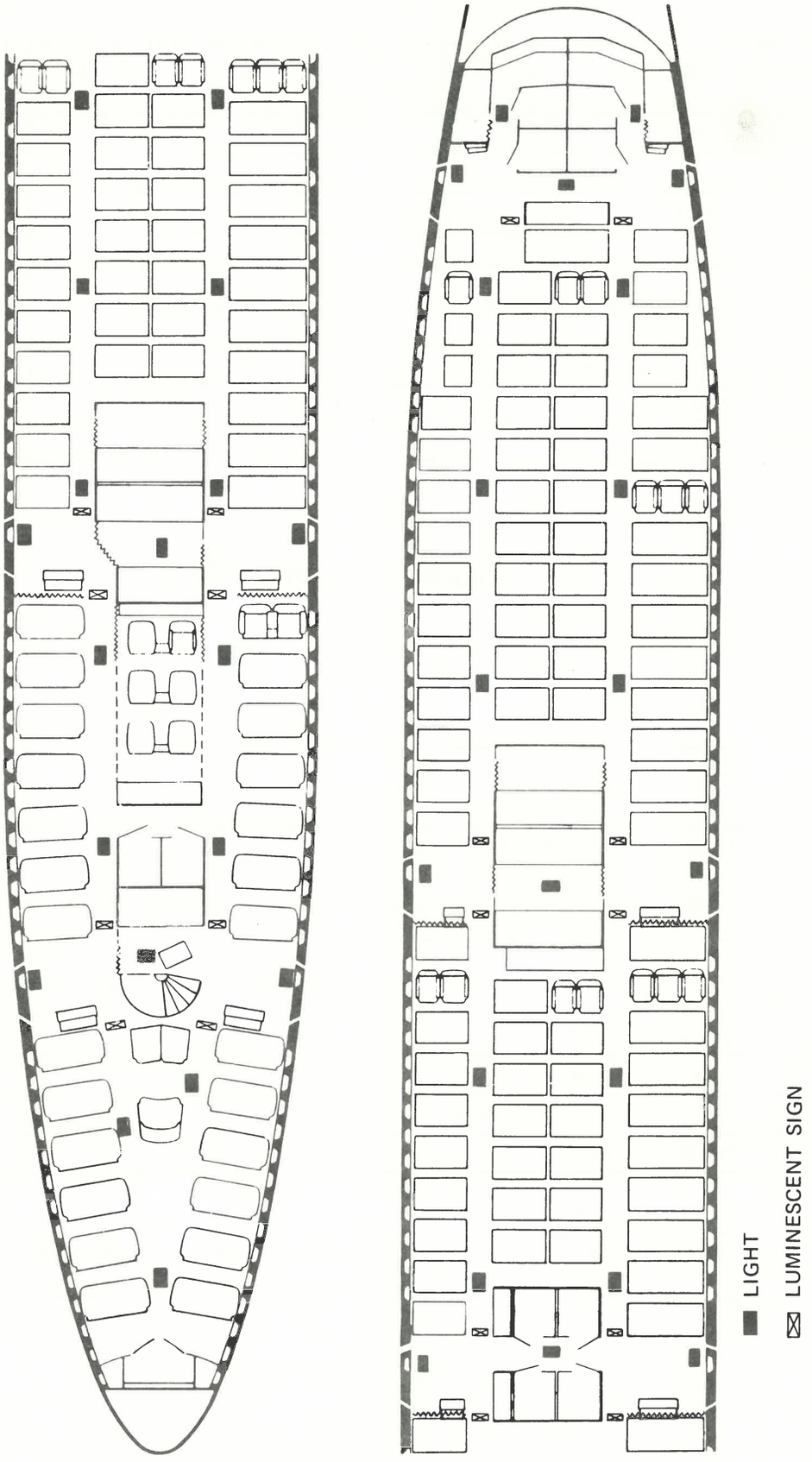
EMERGENCY EQUIPMENT – COCKPIT



EMERGENCY EQUIPMENT – PASSENGER CABIN



EXTERIOR EMERGENCY LIGHTS & ESCAPE SLIDES



FIXED EMERGENCY LIGHTING – PASSENGER CABIN

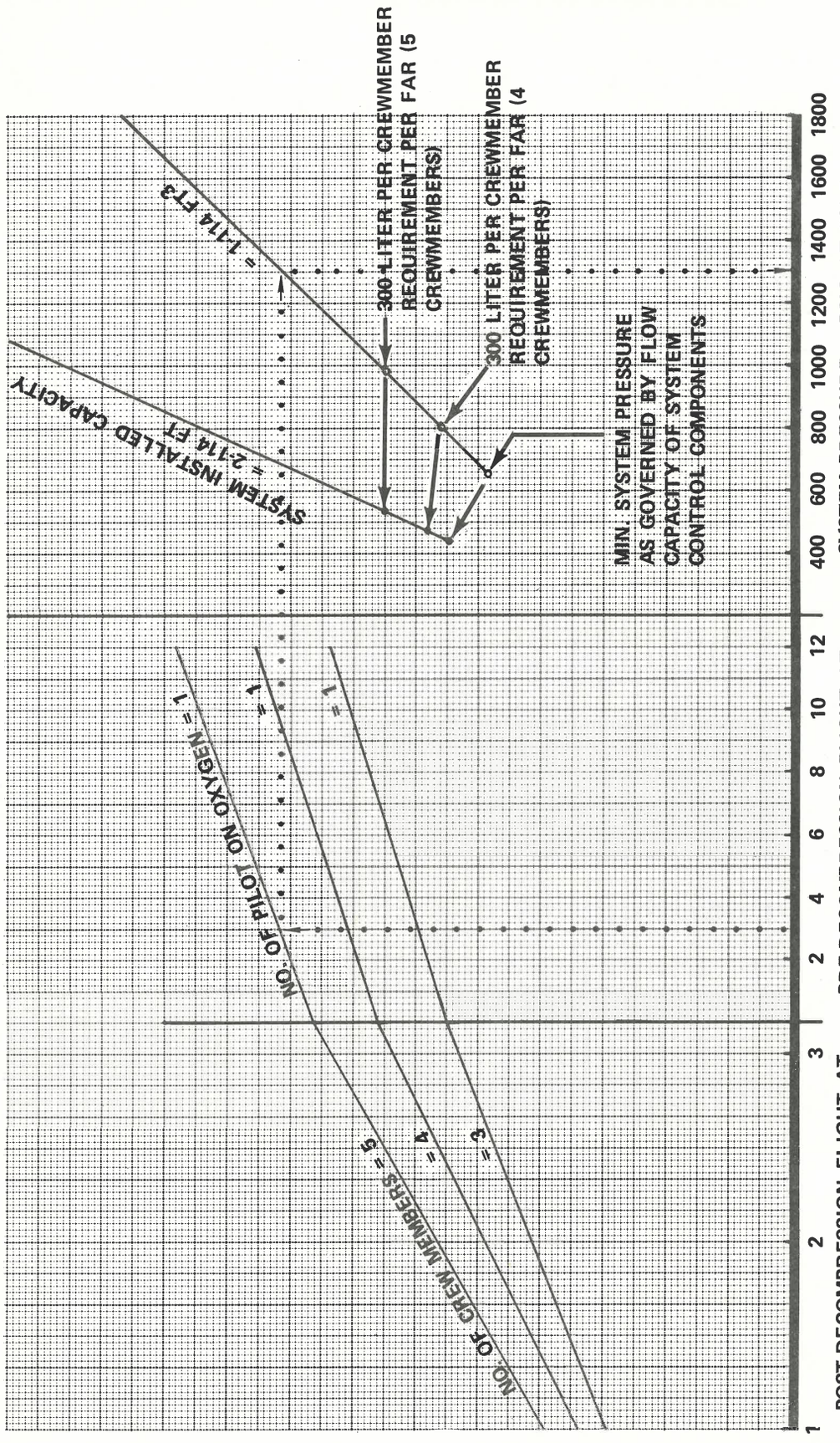
EMERGENCY EQUIPMENT	CREW STA	STUB PART.	P6 PANEL	SERV DOOR	STOW AREA	STAIR-WELL	LOUNGE AREA
SMOKE GOGGLES	5						
LIFE VESTS	5						8
O2 BOTTLES & MASK		1				1	
FIRST AID KIT		1					
CRASH AXE		1					
ESCAPE REELS (CEILING)			5				
CO2 BOTTLE			1				
ASBESTOS GLOVES			1 pr				
INFLATABLE SLIDE				1			
H2O BOTTLE							1

COCKPIT AND UPPER DECK

EMERGENCY EQUIPMENT	DOOR 1		DOOR 2		DOOR 3		DOOR 4		DOOR 5	
	LH	RH	LH	RH	LH	RH	LH	RH	LH	RH
O2 BOTTLES (UNDER OUTBD PASSENGER SEAT)	3	2	2	2	2	2	3	3	2	2
CHEM EXT (OUTBD OF ATTENDANTS SEAT BUSTLE)	1		1				1			
H2O EXT (OUTBD OF ATTENDANTS SEAT BUSTLE)		1						1		
H2O EXT (OUTBD OF ATTENDANTS SEAT)										1
MEGAPHONE (IN OVERHEAD SIDE STOWAGE BIN)	1						1			1
FIRST AID KIT (IN CLOSET)	1									1
CRASH AXE (IN CLOSET)									1	
SPARE LIFE VESTS (UNDER ATTENDANTS SEAT)				10		10		10		10
INFLATABLE SLIDE (ON DOOR)	1	1	1	1			1	1	1	1
INFLATABLE RAMP AND OFF-WING ESCAPE SLIDE					1	1				
ESCAPE ROPE (DOOR TO WING)					1	1				
ATTENDANTS LIFE VEST (UNDERSEAT STOWAGE)	2	2	2	1	2	2	2	1	1	1
LIFE RAFT PROV. (OVERHEAD)	2	2	2	2	3	2	2	2	2	2
AUTO. RADIO BEACON (IN RAFT COMPARTMENT)	1					1	1			1

PASSENGER CABIN

EMERGENCY EQUIPMENT AND LOCATION

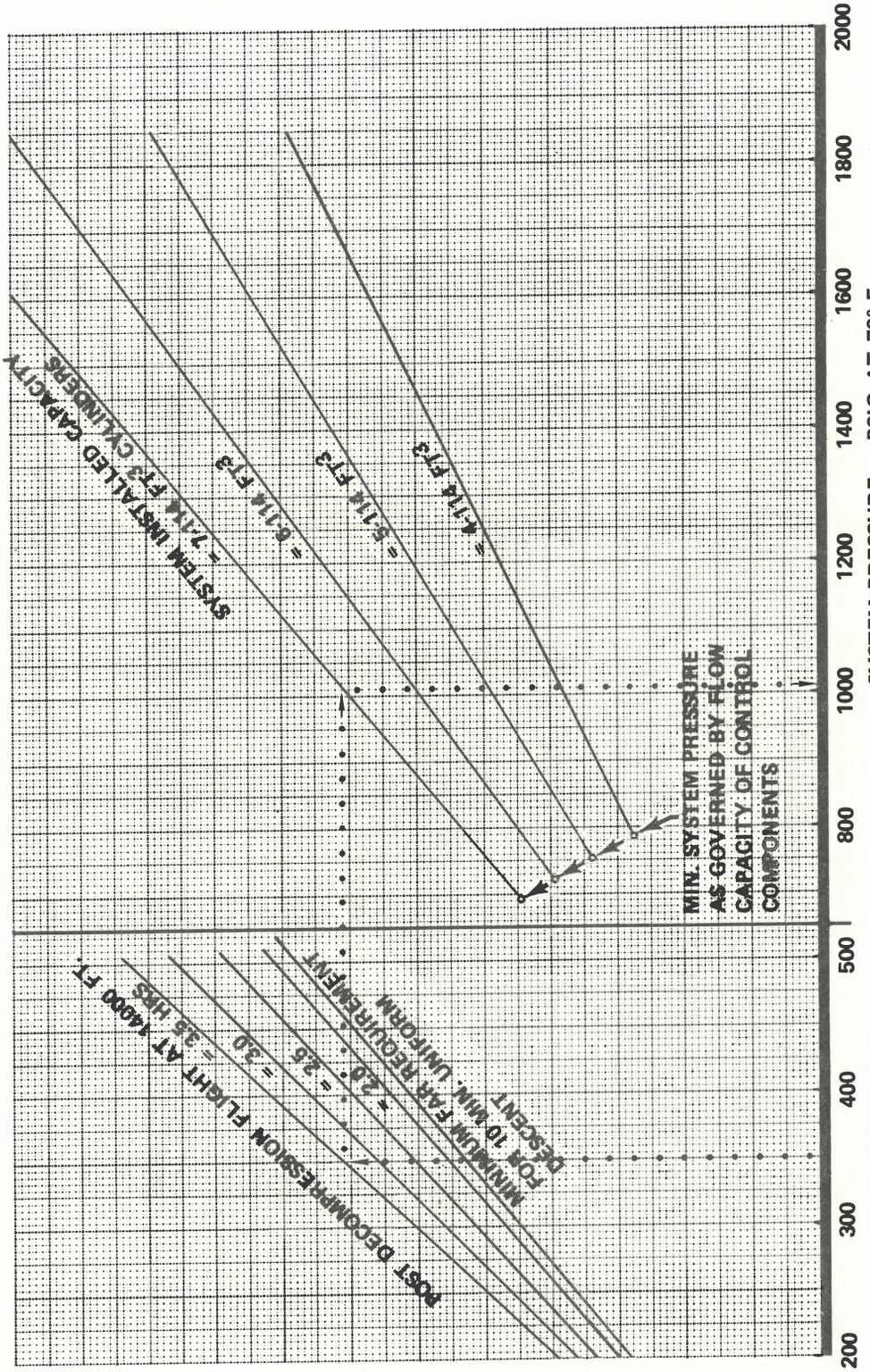


BASED ON

1. ONE PILOT ON OXYGEN DURING NORMAL FLIGHT AT 8000 FT CABIN ALTITUDE.
2. EMERGENCY DESCENT TO 14,000 FT AFTER DECOMPRESSION. ALL FLIGHT CREW MEMBERS ON O_2.
3. POST-DESCENT FLIGHT AT 14,000 FT. ALL FLIGHT CREW MEMBERS ON O_2.
4. ALL DILUTER DEMAND O_2 REGULATORS AT NORMAL SETTING.

EXAMPLE: ONE (1) 114 CU FT O_2 CYLINDER INSTALLED.
THREE HOURS WITH CABIN ALTITUDE AT 8000' (ONE PILOT ON OXYGEN).
FIVE CREW MEMBERS ON OXYGEN FOR DESCENT & FOR 3 HOURS & 15 MINUTES AT 14,000'.
O_2 REQUIREMENT: 1300 PSI.

FLIGHT CREW OXYGEN PRESSURE REQUIREMENTS – EMERGENCY DESCENT



BASED ON

1. EMERGENCY DESCENT TO 14,000 FT, ALL OCCUPANTS ON OXYGEN
2. 10 MIN. REQUIRED TO DEACTIVATE 90% OF O_2 OUTLETS AT 14,000 FT
3. 10% OCCUPANTS ON O_2 FOR REMAINDER OF FLIGHT

EXAMPLE: SEVEN (7) 114 CU FT CYLINDERS INSTALLED
350 CABIN OCCUPANTS
3 HOURS & 30 MINUTE POST-DECOMPRESSION FLIGHT AT 14,000 FT
O_2 REQUIREMENT: 1010 PSI

PASSENGER OXYGEN PRESSURE REQUIREMENTS – EMERGENCY DESCENT

The following information should clarify the procedures for slide and ramp deployment from the No. 3 doors.

Closure of the No. 3 door will place a locking pin through the manual override lever. The ditching lever is not locked. Should it be tampered with in flight by a curious passenger, the cabin attendant need only return the lever to the normal position.

Normal Operation

Should an emergency evacuation be necessary, the cabin attendant need only open the door and both ramp and off-wing slide will deploy.

Abnormal Operation

If the ramp does not deploy, the attendant must unsnap the canvas flap on the door and pull the T handle to fire the bottle and deploy the ramp.
If the off-wing slide does not deploy, the attendant must pull the manual override lever to deploy the slide.

Ditching

Prior to ditching, the ditching lever must be pulled inboard. After ditching, the opening of the door will deploy the ramp but not the slide.
If the ramp is not deployed, the attendant must then unsnap the canvas flap on the door and pull the T handle to deploy the ramp.

CHAPTER 12

CROSS REFERENCE		
FOR	REFER TO	CHAPTER
Equipment Cooling Smoke Detection	AIR CONDITIONING AND PRESSURIZATION	6

RUDDER RATIO LIGHT ILLUMINATED

Illumination of the RUDDER RATIO light indicates a malfunction of the rudder ratio changer. Avoid large or abrupt rudder control inputs at high indicated airspeeds. Crosswind landing capability is reduced to 20 knots.

AUTO SPOILERS LIGHT ILLUMINATED

When illuminated, ground auto spoiler system is inoperative. Do not ARM auto spoiler system; use speed brake lever for controlling ground spoilers.

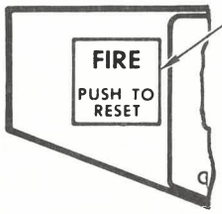
UNSCHEDULED STABILIZER TRIM

Stabilizer Hydraulic Shutoff Switches.....CUTOUT
Autopilot.....DISENGAGE

To operate stabilizer:
Manual Stabilizer Trim Levers...MOVE IN DIRECTION OF DESIRED TRIM
Stabilizer Hydraulic Shutoff Switch.....PLACE EITHER ONE TO NORM POSITION WHILE TRIMMING

NOTE: Moving control column or a manual stabilizer trim lever in opposition to unscheduled trim will stop stabilizer movement.

PILOTS' LIGHTSHIELD



MASTER FIRE WARNING LIGHTS (Red) (CAPTAIN'S AND FIRST OFFICER'S)

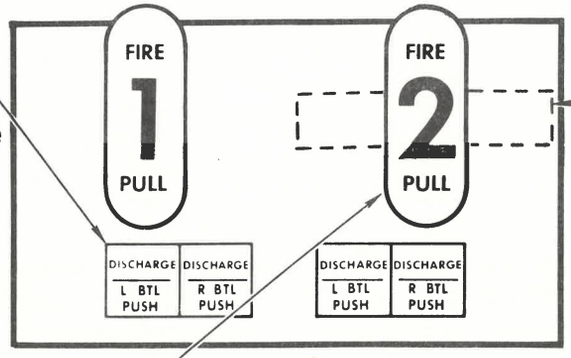
Illuminate and fire warning bell sounds for a fire condition, or during test, for the following areas:
- Engine nacelles.
- Main landing gear wheel wells.
- APU.
- Lower forward and aft cargo compartments.

Push to extinguish master fire warning lights, silence fire warning bell and reset warning circuits.

ENGINE FIRE EXTINGUISHER DISCHARGE SWITCHES

With engine fire switch pulled, press to discharge indicated fire extinguisher bottle.
Switch illuminates amber and remains illuminated to indicate extinguisher bottle discharged.

PILOTS' OVERHEAD PANEL



FIRE SWITCH FLAG

When fire switch is pulled yellow flag rotates into view and locks switch in pulled position.

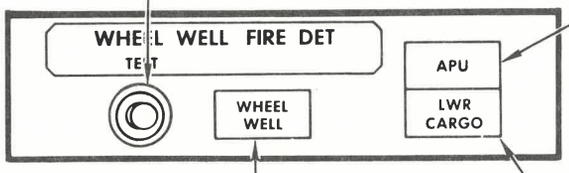
ENGINE FIRE SWITCHES (Red)

Illuminate for a nacelle fire condition or during test. With detectors operating fire switches will remain illuminated as long as fire condition exists.
Pulling switch:
- Arms fire extinguisher.
- Closes fuel shutoff valve.
- Depressurizes engine driven hydraulic pump and shuts off hydraulic fluid supply.
- Trips generator field after a time delay.
- Close bleed air valve.

WHEEL WELL FIRE DETECTION TEST SWITCH

Checks wheel well fire detector circuits. Master fire warning lights and wheel well fire warning light will illuminate and fire warning bell will sound while switch is pressed.

PILOTS' OVERHEAD PANEL



APU FIRE WARNING LIGHT (Red)

Illuminates for an APU fire condition or during test. Without a detector failure, light remains illuminated as long as fire condition exists.

WHEEL WELL FIRE WARNING LIGHT (Red)

Illuminates for a wheel well fire condition or during test. Without a detector failure, light remains illuminated as long as fire condition exists.

LOWER CARGO FIRE WARNING LIGHT (Red)

Illuminates for either a FWD or AFT lower cargo fire condition or during test. Remains illuminated as long as smoke condition exists.

NACELLE TEMPERATURE INDICATORS

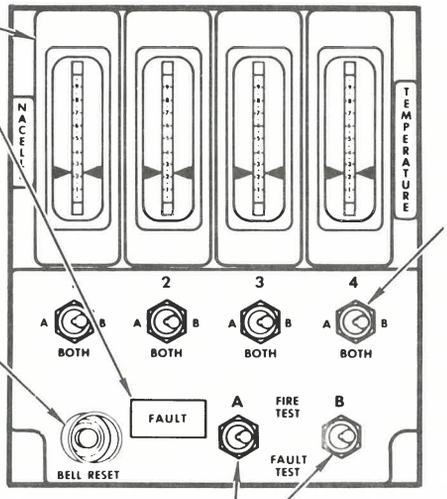
- Indicate relative temperature levels in the engine nacelle area. Normal indication will be in the green band; overheat in the amber band; fire in the red band.
- With a fire condition existing and fire warnings initiated, a detector short will cause the warnings from that detector to be locked on. For this condition the nacelle fire detector fault light remains extinguished and the nacelle temperature indicator will not move.
- A single detector electrical open will not affect fire warnings or temperature indications.

NACELLE FIRE DETECTOR FAULT LIGHT (Amber)

Illuminates to indicate a detector fault.
Illuminates during fault test to indicate detector is operational.

FIRE BELL RESET SWITCH

Press to extinguish master fire warning lights, silence fire warning bell and reset warning circuits.



FLIGHT ENGINEER'S PANEL

NACELLE FIRE DETECTOR SWITCHES

BOTH – Either A or B detectors will initiate a fire warning.
A or B – Only selected detector will initiate a fire warning. Both nacelle temperature indicators will operate regardless of switch position.

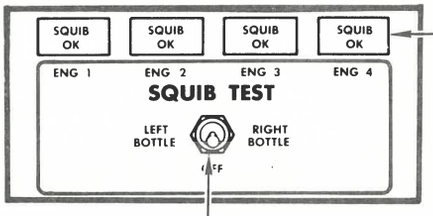
NACELLE FIRE/FAULT TEST SWITCHES

FIRE TEST – Introduces a simulated fire signal.
- Nacelle temperature indicators move to red band.
- Engine fire switches illuminate.
- Master fire warning lights illuminate and fire warning bell sounds. Releasing switch extinguishes lights, silences fire warning bell and resets warning circuits.

FAULT TEST – For operational detector the nacelle fire test fault light will illuminate and nacelle temperature indicators will indicate in red band.

NOTE: With a detector electrical open there will be no response to either the FIRE TEST or FAULT TEST.

FLIGHT ENGINEER'S PANEL



SQUIB OK LIGHTS (Green)

Illuminate to indicate operative extinguisher circuit.

SQUIB TEST SWITCH

Selects bottle for squib test.

NACELLE FIRE PROTECTION

APU FIRE SWITCH (Red)

– Illuminates for an APU fire condition or during test. Pilots' APU fire warning light and master fire warning lights will illuminate and fire warning bell will sound. APU remote fire warning horn will sound and APU remote fire light will illuminate.
– Pulling fire switch shuts down APU and arms APU fire extinguisher circuit.
– Without a detector failure switch remains illuminated as long as fire condition exists.

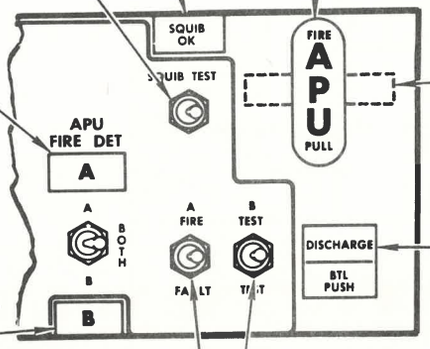
SQUIB TEST SWITCH

When energized tests fire extinguisher squib circuit. SQUIB OK light illuminates when squib is operational.

SQUIB OK LIGHT (Green)

APU FIRE DETECTOR SWITCH

BOTH – Either A or B detectors will initiate a fire warning.
A or B – Only selected detector will initiate a fire warning.



FIRE SWITCH FLAG

When fire switch is pulled yellow flag rotates into view and locks switch in pulled position.

APU EXTINGUISHER DISCHARGE SWITCH (Amber)

With APU fire switch pulled, press to discharge fire extinguisher.
Switch illuminates and remains illuminated to indicate fire extinguisher discharged.

APU FIRE DETECTOR FAULT LIGHTS (Amber)

Illuminate to indicate detector inoperative.
Illuminate during fault test to indicate detector is operational.

FLIGHT ENGINEER'S PANEL

APU FIRE/FAULT TEST SWITCHES

FIRE TEST – Introduces a simulated fire signal in the detector system. Master fire warning lights, APU fire warning light and APU fire switch will illuminate and fire warning bell will sound. The APU remote fire warning horn will sound and APU remote fire warning light will illuminate.
FAULT TEST – Illumination of the APU fire detection system fault light indicates circuit is operational.

NOTE: With a detector electrical open there will be no response to either test.

APU REMOTE FIRE WARNING HORN

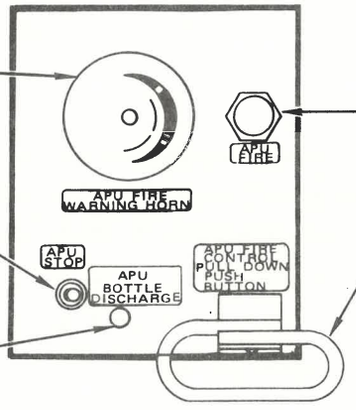
Sounds for an APU fire condition or during test.

APU REMOTE STOP SWITCH

Press momentarily to stop APU.

APU REMOTE BOTTLE DISCHARGE SWITCH

With APU remote fire control switch pulled, press to discharge fire extinguisher.



APU REMOTE FIRE LIGHT (Red)

Illuminates for APU fire condition or during test.

APU REMOTE FIRE CONTROL SWITCH

When pulled shuts down APU and arms APU fire extinguisher circuit.

APU REMOTE CONTROL MODULE
(R.H. BODY GEAR WHEEL WELL)

APU FIRE PROTECTION

LOWER CARGO FIRE WARNING LIGHTS (Red)

Illuminates for a fire condition in the indicated lower cargo compartment or during test. Pilots' lower cargo fire warning and master fire warning lights will illuminate and warning bell will sound.

Remains illuminated as long as fire condition exists.

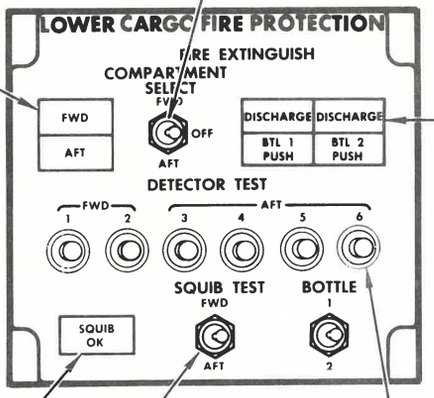
LOWER CARGO COMPARTMENT SELECT SWITCH

Selects cargo compartment for extinguisher discharge.

In FWD position equipment cooling airflow into the forward cargo compartment is shut off. (Functions the same as the SMOKE position on the equipment cooling valve control switch.)

In AFT position aft cargo heat airflow into the aft compartment is shut off.

FLIGHT ENGINEER'S PANEL



LOWER CARGO EXTINGUISHER DISCHARGE SWITCHES (Amber)

Press BTL 1 or BTL 2 to discharge fire extinguisher bottle into selected compartment. DISCH light illuminates to indicate corresponding fire extinguisher bottle discharged. BTL 1 DISCH light illuminates when overpressure relief occurs at either bottle.

SQUIB OK LIGHT (Green)

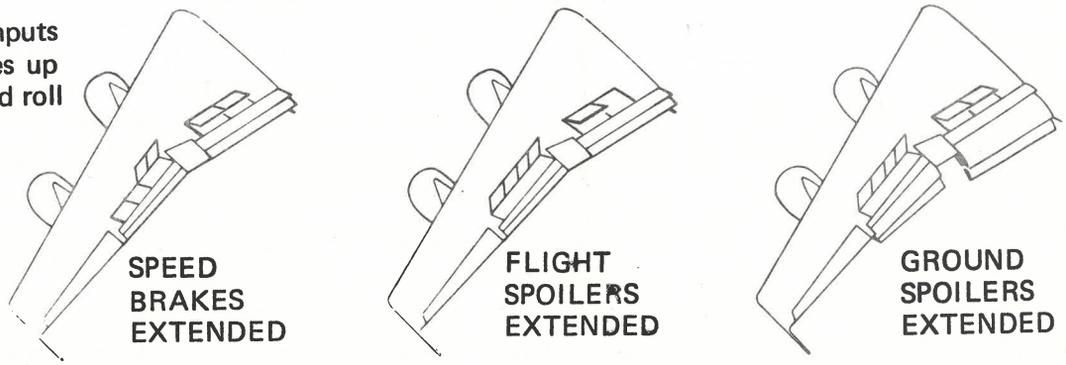
SQUIB TEST SWITCHES

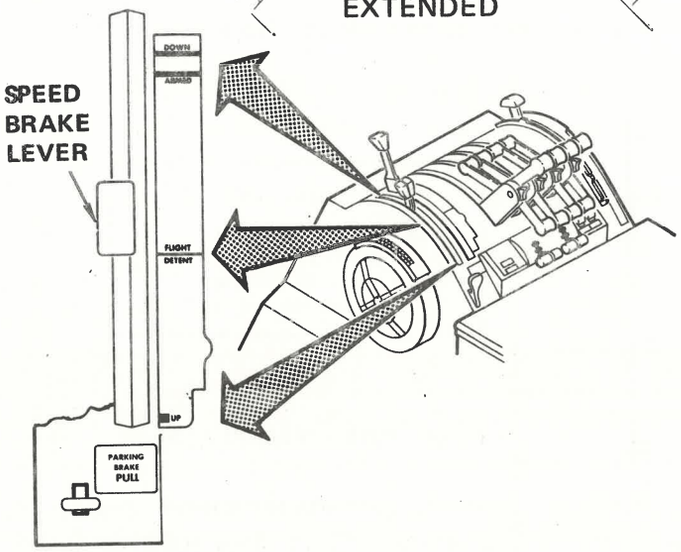
Tests the FWD and AFT squibs for both extinguisher bottles. SQUIB OK light will illuminate if squib is operational.

LOWER CARGO DETECTOR TEST SWITCHES

Simulates a fire condition at the individual detectors. Respective lower cargo fire warning light, pilots' lower cargo fire warning light and master fire warning lights will illuminate and fire warning bell will sound while switch is pressed.

Control wheel inputs with speed brakes up result in increased roll rates.





AUTO SPOILERS LIGHT (Amber)

Illuminates to indicate auto ground spoiler system is inoperative.

NOTE: Auto ground spoiler system will not operate unless both PRIM and ALT landing gear TILT annunciator systems indicate airplane is on the ground.

SPEED BRAKE LEVER

DOWN (Detent) – The speed brake lever will automatically move to the UP position extending the ground spoilers during a (not armed) landing or refused takeoff if:
- Both the No. 1 and 3 thrust levers are retarded,
- The landing gear are on the ground and,
- Either No. 2 or 4 reverse thrust levers are actuated to the reverser interlock position.

ARMED – The speed brake lever will automatically move to the UP position extending the ground spoilers, if:
- Both the No. 1 and 3 thrust levers are retarded with the landing gear on ground.

NOTE: For a landing gear on ground signal at least two main landing gear, one on each side of the airplane, must be in the "not tilted" position. On later airplanes for a landing gear on ground signal hydraulic system 1 or 4 must be pressurized and the corresponding main gear must also indicate "not tilted."

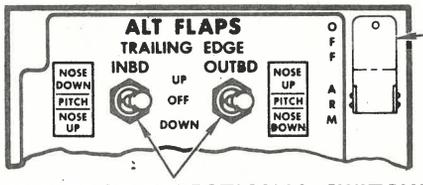
FLIGHT DETENT – Movement or travel of the speed brake lever for inflight use is limited by a solenoid actuated stop. Use of the speed brakes will reduce wing lift and slow down the airplane.

NOTE: The inboard spoiler travel is limited to prevent tail buffet. To minimize pitch up the outboard spoilers are not utilized as speed brakes.

UP – Placing the speed brake lever in UP detent raises all the spoilers on each wing. This reduces wing lift after touchdown causing brakes to be more effective. With the speed brake lever in the UP position, advancing either the No. 1 or 3 thrust lever will automatically move the lever to the DOWN detent retracting the ground spoilers.

NOTE: The automatic ground spoiler function of the speed brake lever can be manually overridden at any time.

TRAILING EDGE FLAPS



TRAILING EDGE ALTERNATE FLAP ARM SWITCH

ARM – Bypasses hydraulic flap motors during alternate extension and arms trailing edge directional switches.

TRAILING EDGE DIRECTIONAL SWITCHES

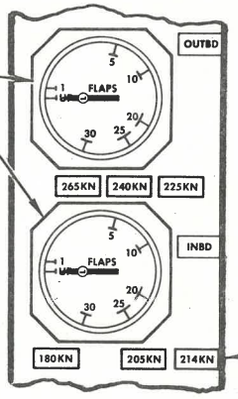
- Control inboard and outboard electric flap motors. Switches will hold in any position.
- No asymmetry protection is provided for during electrical extension.
- Placards indicate direction of airplane pitch if only one switch is used.

NOTE: The flap load relief system will be inoperative when using alternate flaps.

FLAP POSITION INDICATORS

Flap asymmetry protection is provided by the flap position indicating systems. The left and right outboard flap indications are compared for asymmetry and the left and right inboard flaps are compared for asymmetry.

- Asymmetric flaps will not operate hydraulically.
- A power failure in the flap indicating system will not affect hydraulic flap operation except that asymmetry protection will be inoperative.



FLAPS LIMIT (IAS)

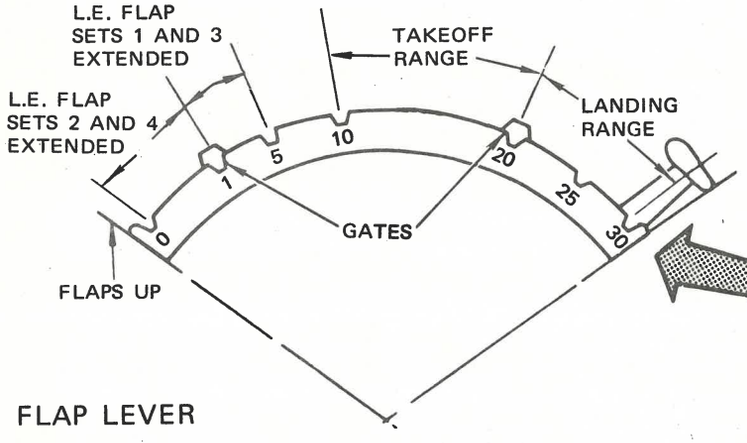
1-265 KN	20-214 KN
5-240 KN	25-205 KN
10-225 KN	30-180 KN
	(30-160 KN ALT DR)

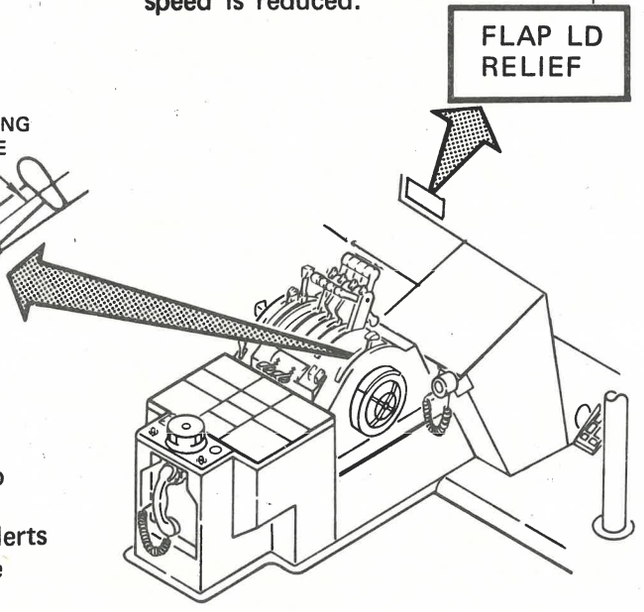
FLAP LIMIT SPEED PLACARDS

FLAP LOAD RELIEF LIGHT (Amber)

- Operates only with flaps 30 selected.
- Illuminates to indicate airspeed is approaching flap placard.

NOTE: When light is illuminated flaps will automatically retract to the 25 position and hold until airspeed is reduced.

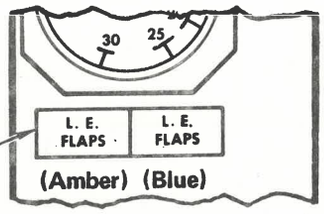




FLAP LEVER

The 20 gate is provided as a mechanical means to alert pilot retracting flaps that airspeed should be initially checked during go-around. The 1 gate alerts the pilot to check airspeed prior to retracting the remaining set of leading edge flaps.

TRAILING EDGE FLAPS

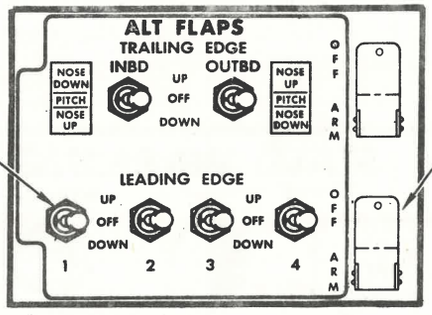


POSITION LIGHTS

FLAPS 0 – Lights out; all leading edge flaps retracted.
FLAPS 1 – Amber illuminates until leading edge flap sets 2 and 4 are extended. Blue illuminates and amber extinguished when leading edge flap sets 2 and 4 are extended.
FLAPS 5 – Amber illuminates and blue extinguishes until LE flaps sets 1 and 3 are extended. Blue illuminates and amber extinguishes when all leading edge flaps are extended.

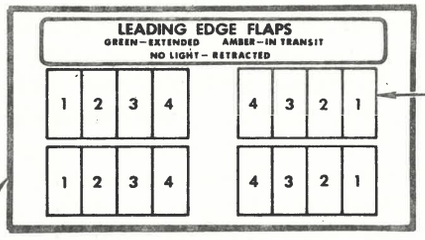
LEADING EDGE DIRECTIONAL SWITCHES

WHEN ARMED:
UP or DOWN – Extends or retracts leading edge flaps.
– Overrides pneumatic leading edge flap extension system.



LEADING EDGE ALTERNATE FLAPS ARM SWITCH

ARM – Arms leading edge directional switches.



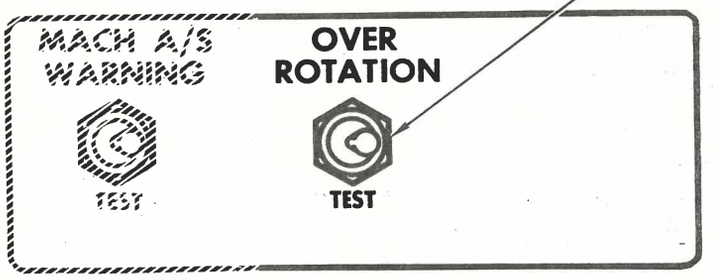
LEADING EDGE FLAP LIGHTS

– Lights extinguished for LE flaps retracted.
– Amber lights illuminate for LE flaps in transit.
– Green lights illuminate for LE flaps extended.

LEADING EDGE FLAPS MODULE

– Normally sets 2 and 4 extended when the outboard trailing edge flaps reach 1. Sets 1 and 3 extend when the inboard trailing edge flaps extend beyond 1.
– Leading edge devices are normally powered pneumatically.
– The leading edge devices will retract when all four reverse thrust levers are moved to the reverse thrust position.

NOTE: On later airplanes, there is a 5 second delay before the leading edges will extend when coming out of reverse thrust position.



OVER ROTATION TEST SWITCH

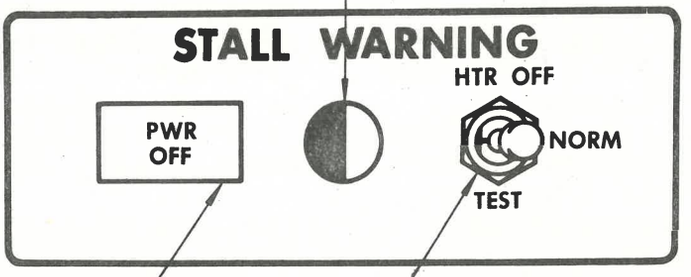
TEST – System is operational if control column shakes when switch is held.

NOTE: System alerts pilot to overrotation during takeoff as sensed by INS system attitude.

– System is deactivated inflight when a body landing gear is in the TILT position.

TEST INDICATOR

Rotates during test to indicate reliable inputs from stall warning sensor and flap position transmitter.



POWER OFF LIGHT (Amber)

– For normal operation the light will be extinguished except when using APU or external power.

– Light will extinguish during test when using APU or external power.

– Light will illuminate to indicate a sensor heater failure or a system power failure.

STALL WARNING SWITCH

HTR OFF (For maintenance) – Deactivates heater when airplane generators are supplying power to stall warning system.

– Initiates a landing gear "inflight" signal to STALL WARNING and OVER-ROTATION systems.

NORMAL – System is operational with PWR OFF light extinguished and nose gear strut extended (takeoff position).

– With APU or external power sensor heater is not powered.

TEST – With APU or external power:

1. PWR OFF light extinguishes,
2. Indicator spins,
3. Control columns shake.

– With airplane power:

1. PWR OFF light remains extinguished,
2. Indicator spins.
3. Control columns shake.

STALL WARNING AND OVER-ROTATION

NORMAL POWER SOURCES

All flight controls are powered by four independent hydraulic systems. There is no mechanical (manual) reversion due to (1) the large control forces that would be required, and (2) system redundancies: duplication of control surfaces and power sources.

Hydraulic systems 2 and 3 are primarily used to power flight controls. The redundancy is such that even if both systems 2 and 3 are inoperative, all of the primary flight controls (ailerons, elevators and rudders) can still be operated with hydraulic systems 1 and 4.

CONTROL RESPONSE

The flight controls are designed so that airplane response to control inputs is relatively the same regardless of speed, CG or gross weight. Control system feel forces are generated artificially in all axes.

Effectiveness of the roll and yaw controls, and pilot feel of the pitch controls, is accomplished as follows:

ROLL (AILERONS AND SPOILERS)
At low speeds, with the flaps extended, inboard and outboard ailerons as well as flight spoilers are utilized. As flaps are retracted above position 1, the outboard ailerons are electrically "locked out." Flight spoilers operate only when the control wheel is moved beyond 8°. As speed increases, flight spoilers "blow down" until the speed is such that only the inboard ailerons are effective.

YAW (RUDDERS)
As airplane speed increases, rudder movement is decreased by ratio changers that sense airspeed through the auxiliary pitot-static system.

PITCH (ELEVATORS AND STABILIZER)
As airplane speed increases and/or as airplane CG shifts aft, the elevator artificial feel force is increased. This is accomplished by the feel computer, which is biased by auxiliary pitot-static and stabilizer position.

SIGNAL CHAIN
Mechanical and electrical inputs from the cockpit controls position control valves which determine hydraulic input to power units as follows:
Ailerons, Elevators, Rudders and CCA's - Dual hydraulic source actuators.
Spoilers - Single hydraulic source actuators.
Stabilizer - Dual hydraulic motors.
Trailing Edge Flaps - Single hydraulic motors for inboard and outboard flaps.

Response of the control surface closes the hydraulic valves through a follow-up mechanism leaving the surface deflected proportional to the cockpit control displacement.

TRAILING EDGE FLAPS

The inboard flaps are powered by hydraulic system 1; the outboards are powered by hydraulic system 4. Electrical power is provided as an alternate method to operate flaps. Flap asymmetry protection is provided for the normal hydraulic extension system. The affected hydraulic flap drive will automatically shut down when an asymmetry condition exists on the inboard flaps or on the outboard flaps. The asymmetry condition is sensed by the flap position indicating system. The loss of electrical power to the flap indicating system will not affect hydraulic flap operation except that flap asymmetry protection will be inoperative.

The flap protection system will shut off hydraulic trailing edge flap power when the flaps move without the flap lever being repositioned. The protection system is armed when in either a flaps up or a takeoff flap configuration (flap lever and flaps in agreement).

Flap asymmetry or flap protection circuits and the alternate extension arm switch will deactivate the hydraulic extension system.

LEADING EDGE FLAPS

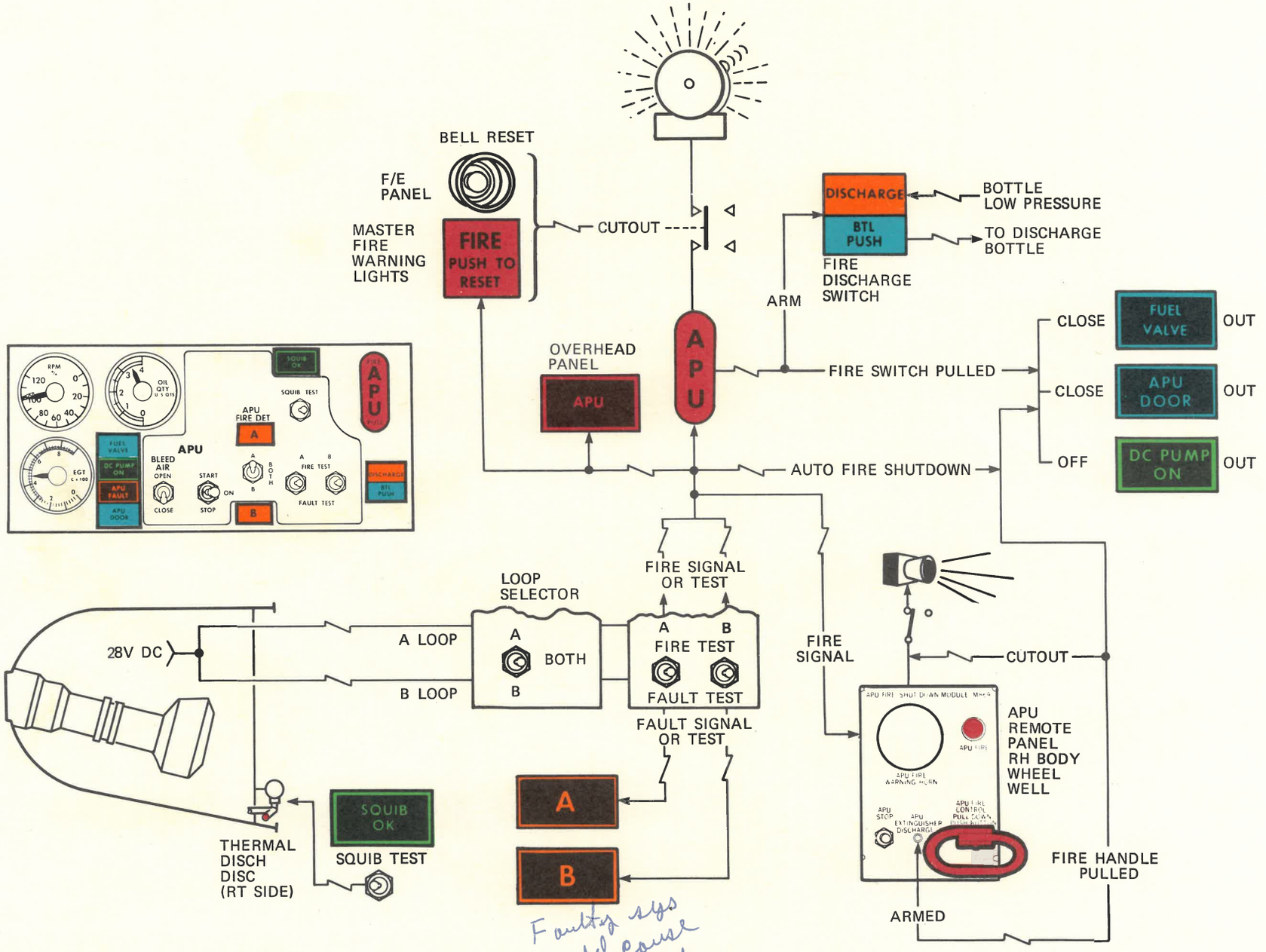
The leading edge flaps are normally powered by the pneumatic system. Leading edge flap groups 2 and 4 are programmed by the outboard flaps. Leading edge flap groups 1 and 3 are programmed by the inboard flaps. Extension or retraction using the alternate electrical system will override the pneumatic operation. The leading edge directional switches must be left in the UP or DOWN position and the leading edge alternate flaps arm switch in the ARM position to deactivate the pneumatic system.

OVER-ROTATION AND STALL WARNING

The control column shaker will be activated during takeoff when the rate or angle of rotation is excessive. The warning is deactivated when the main landing gear leaves the runway.

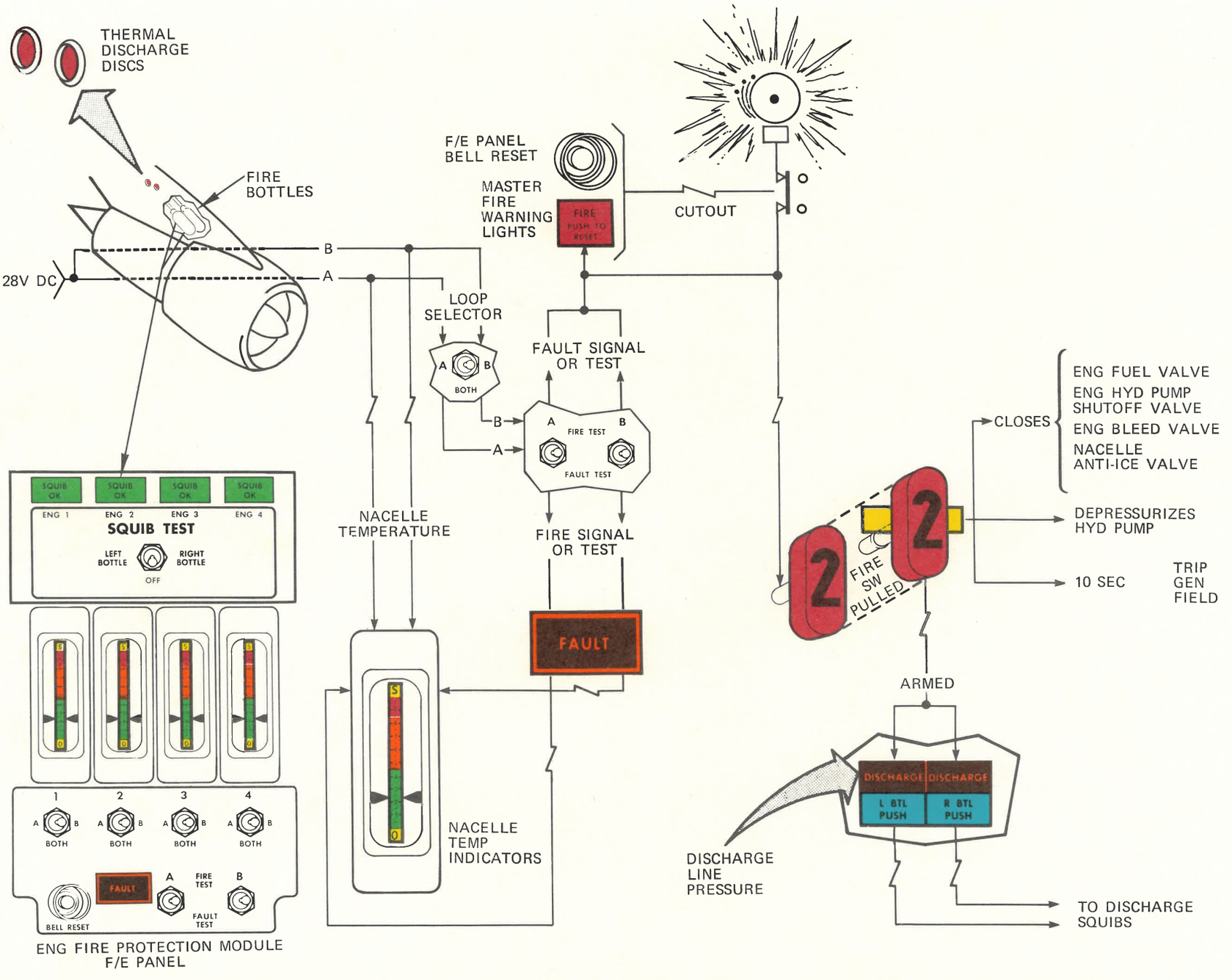
The stall warning (column shaker) is active inflight once the nose gear leaves the runway. Stall warning speed schedule is changed as a function of the left inboard flap position.

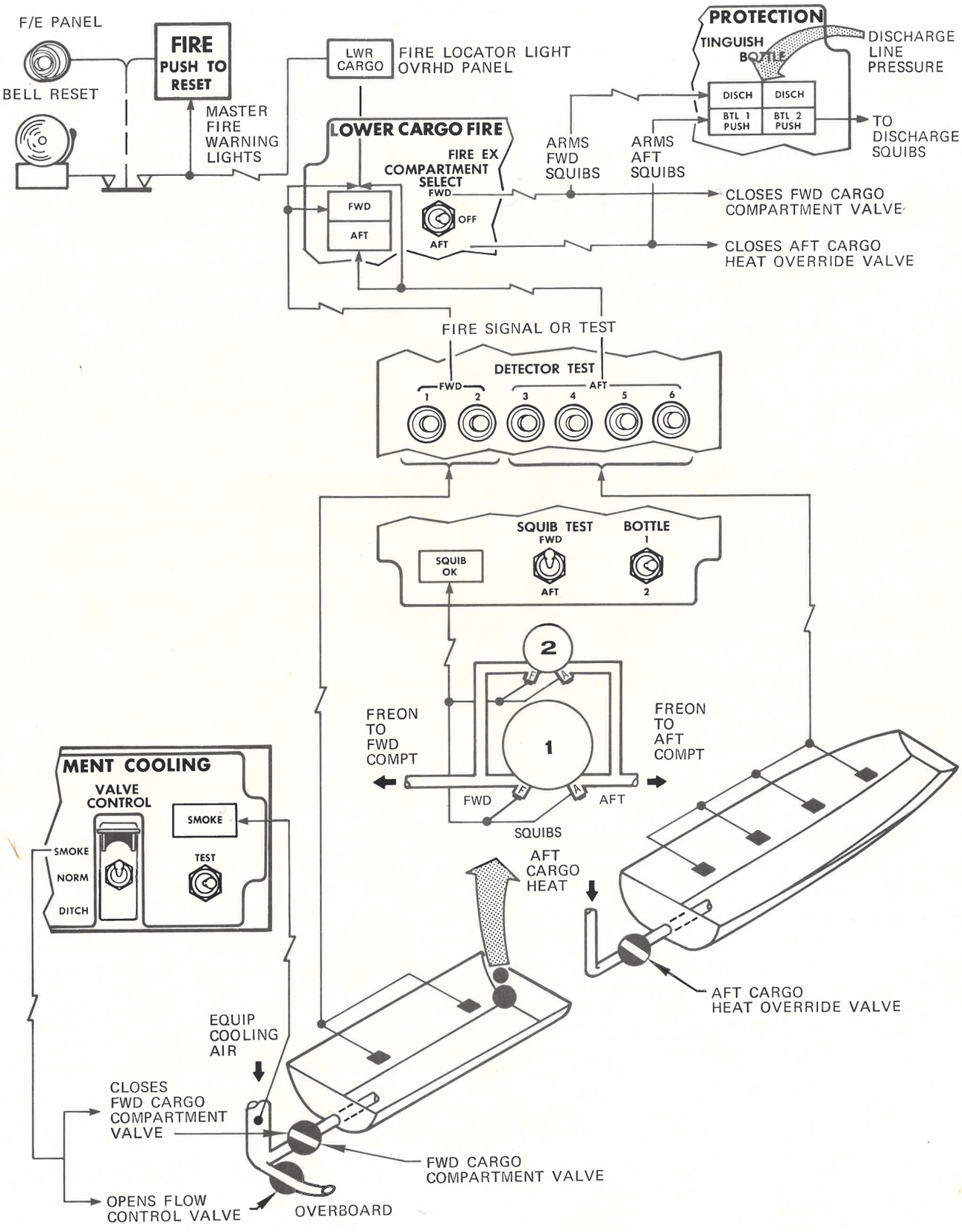
APU FIRE PROTECTION



Faulty sys could cause the APU to shut down

ENGINE FIRE PROTECTION





LOWER CARGO FIRE PROTECTION

13 FLIGHT CONTROLS

RUDDER RATIO LIGHT ILLUMINATED

Illumination of the RUDDER RATIO light indicates a malfunction of the rudder ratio changer. Avoid large or abrupt rudder control inputs at high indicated airspeeds. Crosswind landing capability is reduced to 20 knots.

AUTO SPOILERS LIGHT ILLUMINATED

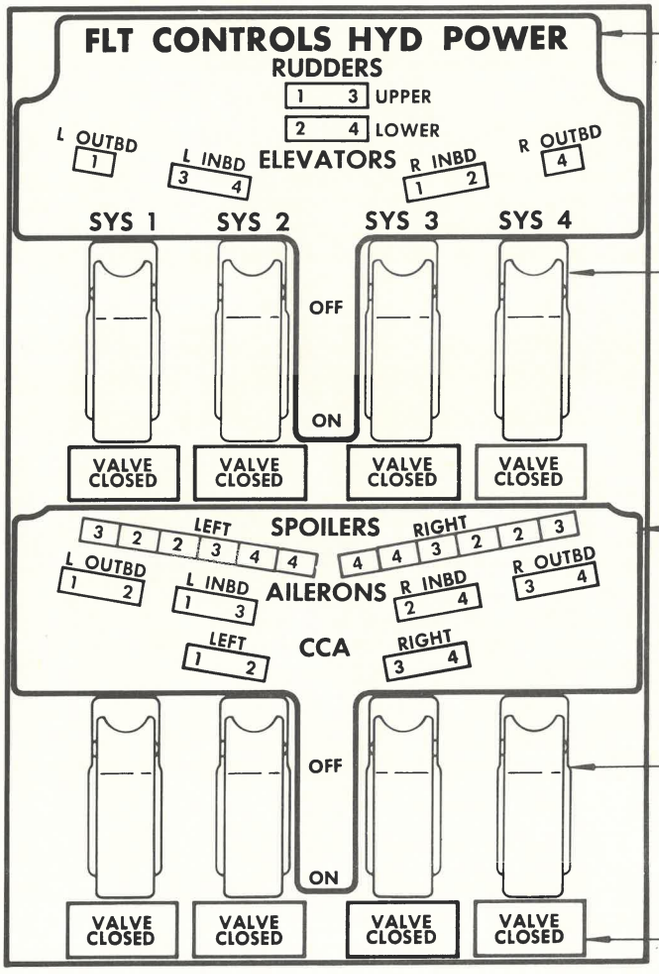
When illuminated, ground auto spoiler system is inoperative, use speed brake lever for controlling ground spoilers.

UNSCHEDULED STABILIZER TRIM

Stabilizer Hydraulic
Shutoff Switches.....CUTOUT
Autopilot.....DISENGAGE

To operate stabilizer:
Manual Stabilizer Trim
Levers.....MOVE IN DIRECTION
OF DESIRED TRIM
Stabilizer Hydraulic Shutoff
Switch.....PLACE EITHER ONE
TO NORM POSITION
WHILE TRIMMING

NOTE: Moving control column or a manual stabilizer trim lever in opposition to unscheduled trim will stop stabilizer movement.



EMPENNAGE LIGHT PLATE

Placarded to indicate hydraulic power source to control surfaces.

HYDRAULIC POWER SWITCHES

Control system hydraulic pressure to rudder and elevator actuators.

LATERAL CONTROL LIGHT PLATE

Placarded to indicate hydraulic power source to control surfaces.

HYDRAULIC POWER SWITCHES

Control system hydraulic pressure to spoiler, aileron and CCA actuators.

VALVE CLOSED LIGHTS (Amber)

Illuminate when hydraulic shut off valves are not in the fully open position.

HYDRAULIC POWER MODULE

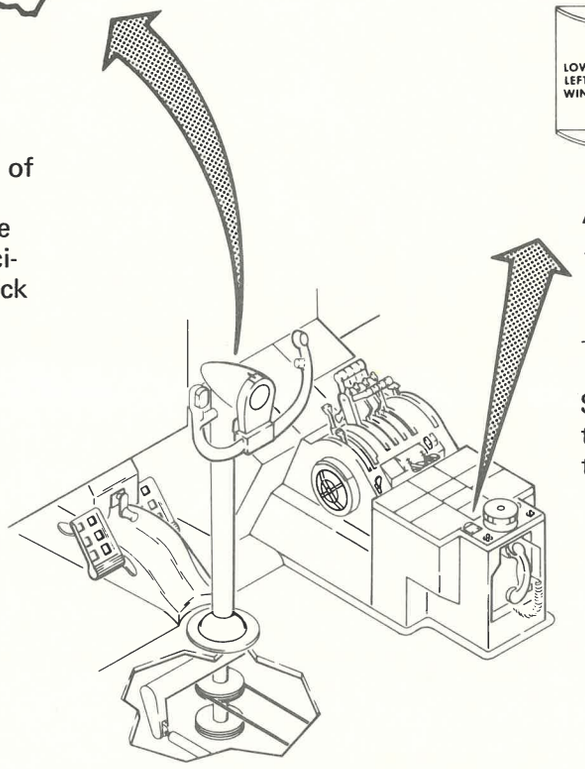
AILERON TRIM INDICATOR

- Indicator shows number of units of aileron trim.
- Trimming more than one unit will cause the associated flight spoilers to pick up.

AILERON TRIM SWITCHES

- Electrically repositions control system neutral position.
- Control wheels will be displaced from neutral.

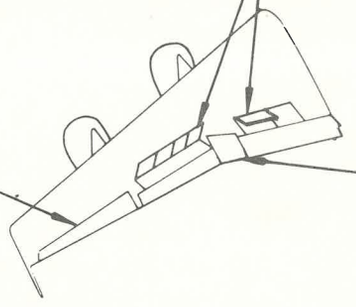
Switches must be operated together. The upper arms the lower switch.



CONTROL WHEELS

- Operate ailerons and flight spoilers on each wing.
- In event of a jam, one control wheel will operate independently of the other through a lost motion device.

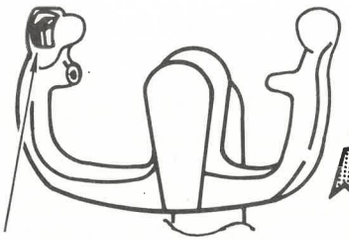
FLIGHT SPOILERS (SHOWN EXTENDED)
Flight spoilers extend to supplement ailerons for roll control.



OUTBOARD AILERON
Locked out when flaps are retracted above position 1.

INBOARD AILERON

AILERONS AND FLIGHT SPOILERS



STABILIZER TRIM SWITCHES

Two-part switch on each control wheel.

- One part arms control modules.
- Other part electrically opens control module valves to release brake and to power stabilizer hydraulic motors.

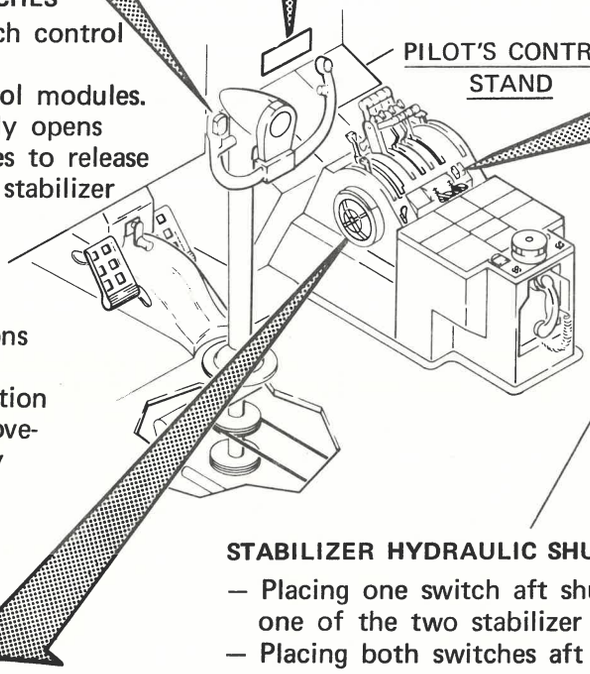
CONTROL COLUMNS

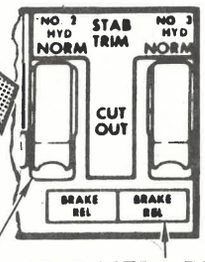
- Hydraulically positions elevators.
- Movement in opposition to stabilizer trim movement will electrically shut off trim.

ELEVATOR FEEL LIGHT (Amber)

On indicates loss of one of two redundant feel computers. Control forces not changed if failure occurs; however, maintenance is required.

NOTE: Elevator feel light will illuminate when feel system is powered by only one hydraulic system.





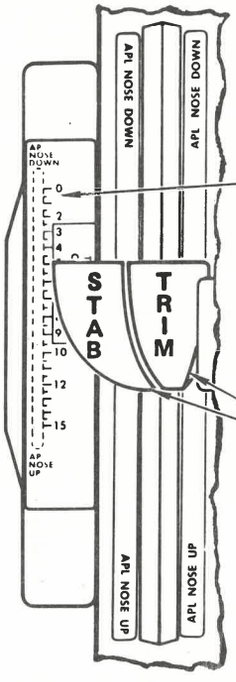
STABILIZER BRAKE RELEASE LIGHTS (Amber)

On when trimming. Indicates brakes are released permitting stabilizer to be trimmed.

STABILIZER HYDRAULIC SHUTOFF SWITCHES

- Placing one switch aft shuts off hydraulic pressure to one of the two stabilizer control modules.
- Placing both switches aft disables stabilizer trim.

NOTE: Trim rate varies with the airspeed and the number of control modules operating. Reduced trim rates for autopilot are obtained by operating one stabilizer control module.



STABILIZER TRIM INDICATORS

- Provides visual indication of stabilizer position.
- Indicates allowable takeoff range (green band).

NOTE:
- Trim range is the same when utilizing stabilizer trim switches and autopilot.
- An increased trim range is available when utilizing the stabilizer manual trim levers.

STABILIZER MANUAL TRIM LEVERS

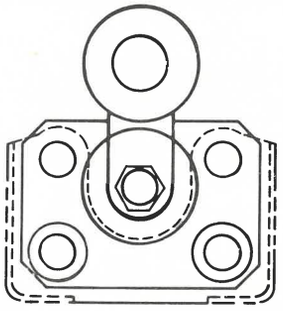
- When both levers are displaced from neutral, mechanically operates the stabilizer control modules. Levers will return to neutral when released.
- One lever arms, the other opens control modules valves to release brake and to power stabilizer hydraulic motors.

NOTE: Manual trim levers will override electric trim control of the stabilizer trim switches and autopilot. Autopilot will not disengage when manual trim levers are used.

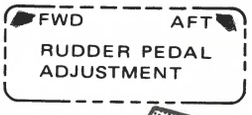
RUDDER PEDAL ADJUSTMENT
Moves rudder pedals fore and aft for individual pilot adjustment. No effect on rudder control surfaces.

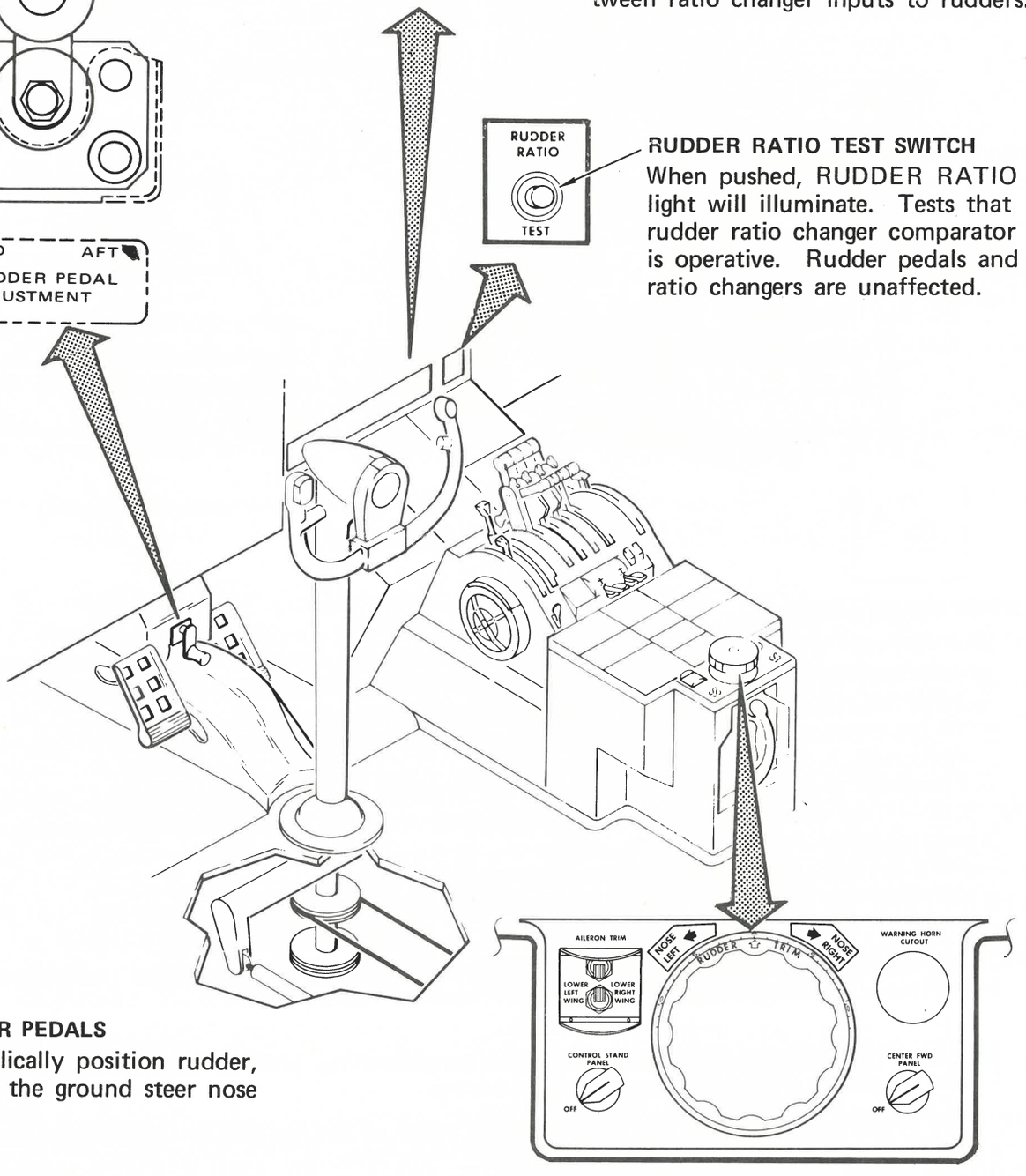
RUDDER RATIO

RUDDER RATIO LIGHT (Amber)
Monitors the two rudder ratio changers. Ratio changers reduce travel of rudders (for structural safety) with increase in speed. Light illuminated indicates significant difference between ratio changer inputs to rudders.



RUDDER RATIO TEST SWITCH
When pushed, RUDDER RATIO light will illuminate. Tests that rudder ratio changer comparator is operative. Rudder pedals and ratio changers are unaffected.



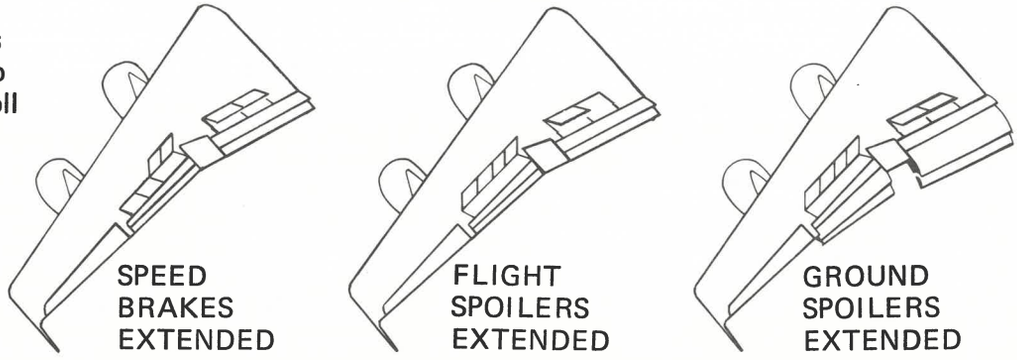


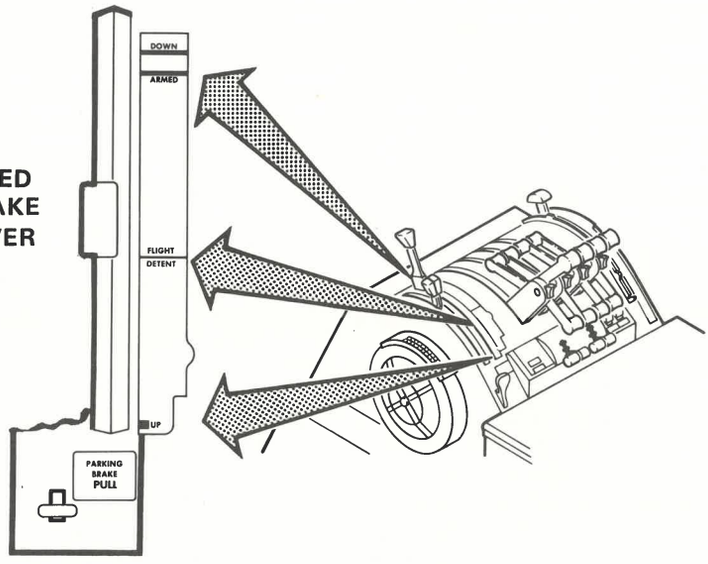
RUDDER PEDALS
Hydraulically position rudder, and on the ground steer nose wheel.

RUDDER TRIM WHEEL
- Mechanically repositions control system neutral position.
- Rudder pedals will be displaced from neutral.

RUDDERS

Control wheel inputs with speed brakes up result in increased roll rates.





AUTO SPOILERS LIGHT (Amber)

Illuminates to indicate auto ground spoiler system is inoperative.

NOTE: Auto ground spoiler system will not operate without both PRIM and ALT landing gear TILT annunciator systems operative.

SPEED BRAKE LEVER

DOWN (Detent) – The speed brake lever will automatically move to the UP position extending the ground spoilers during a (not armed) landing or refused takeoff if:
- Both the No. 1 and 3 thrust levers are retarded, and
- At least two main landing gear, one on each side of the airplane, are in the "not tilt" position, and
- Either No. 2 or 4 reverse thrust levers are actuated to the reverser interlock position.

ARMED – The speed brake lever will automatically move to the UP position extending the ground spoilers, if:
- Both the No. 1 and 3 thrust levers are retarded, and
- At least two main landing gear, one on each side of the airplane, are in the "not fully tilted" position.

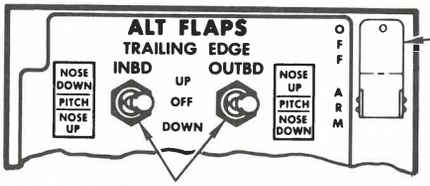
FLIGHT DETENT – Movement or travel of the speed brake lever for inflight use is limited by a solenoid actuated stop. Use of the speed brakes will reduce wing lift and slow down the airplane.

NOTE: The inboard spoiler travel is limited to prevent tail buffet. To minimize pitch up the outboard spoilers are not utilized as speed brakes.

UP – Placing the speed brake lever in UP detent raises all the spoilers on each wing. This reduces wing lift after touchdown causing brakes to be more effective. With the speed brake lever in the UP position, advancing either the No. 1 or 3 thrust lever will automatically move the lever to the DOWN detent retracting the ground spoilers.

NOTE: The automatic ground spoiler function of the speed brake lever can be manually overridden at any time.

SPEED BRAKES AND GROUND SPOILERS



TRAILING EDGE ALTERNATE FLAP ARM SWITCH

ARM – Bypasses hydraulic flap motors during alternate extension and arms trailing edge directional switches.

TRAILING EDGE DIRECTIONAL SWITCHES

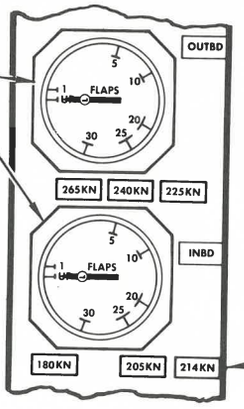
- Control inboard and outboard electric flap motors. Switches will hold in any position.
- No asymmetry protection is provided for during electrical extension.
- Placards indicate direction of airplane pitch if only one switch is used.

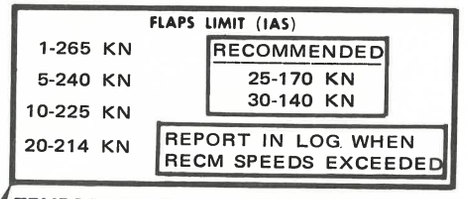
NOTE: The flap load relief system will be inoperative when using alternate flaps.
- On early airplanes extension of outboard flaps is limited to 25 position.

FLAP POSITION INDICATORS

Flap asymmetry protection is provided by the flap position indicating systems. The left and right outboard flap indications are compared for asymmetry and the left and right inboard flaps are compared for asymmetry.

- Asymmetric flaps will not operate hydraulically.
- On airplanes S/N's 19778 thru 19787, the flaps will not operate hydraulically with a failure in the flap indicating system.
- On later airplanes, a power failure in the flap indicating system will not affect hydraulic flap operation except that asymmetry protection will be inoperative.





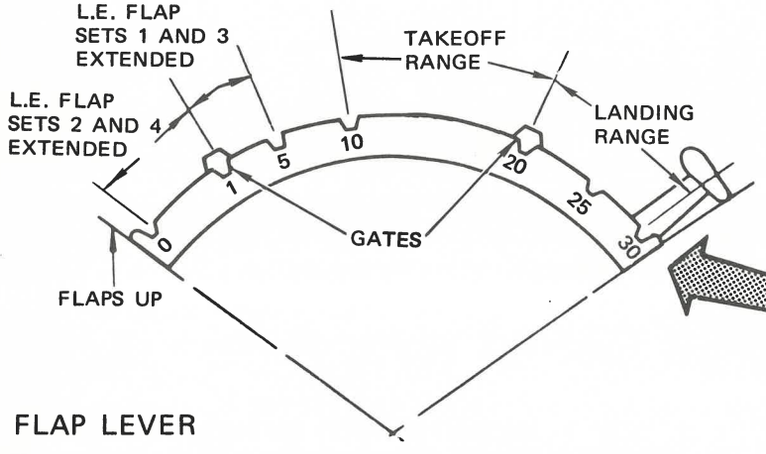
TEMPORARY FLAP LIMIT PLACARD FOR AIRPLANES S/Ns 19778 thru 19787.

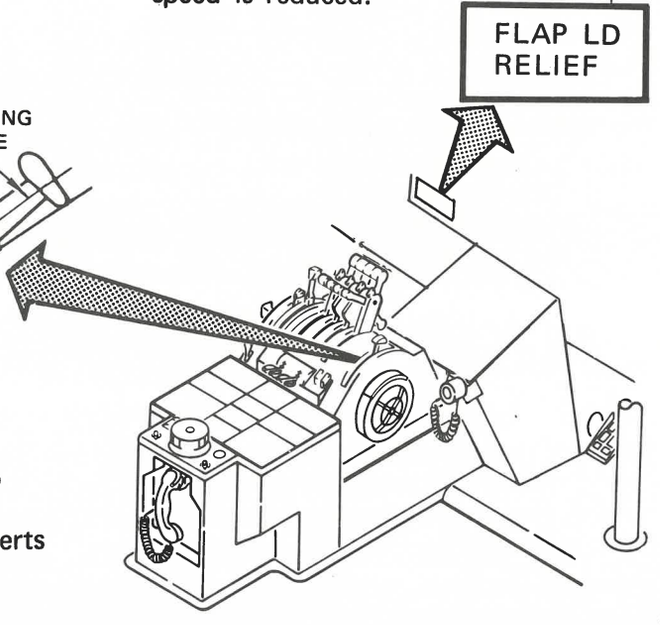
FLAP LIMIT SPEED PLACARDS

FLAP LOAD RELIEF LIGHT (Amber)

- Operates only with flaps 30 selected.
- Illuminates to indicate airspeed is approaching flap placard.

NOTE: When light is illuminated flaps will automatically retract to the 25 position and hold until airspeed is reduced.

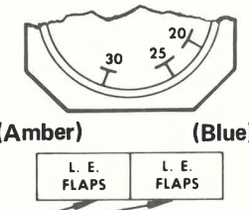




FLAP LEVER

The 20 gate is provided as a mechanical means to alert pilot retracting flaps that airspeed should be initially checked during go-around. The 1 gate alerts the pilot to check airspeed prior to retracting the remaining set of leading edge flaps.

TRAILING EDGE FLAPS



POSITION LIGHTS

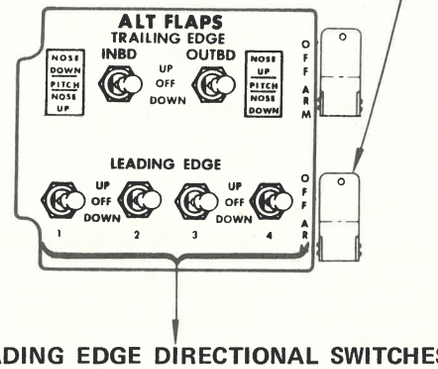
FLAPS 0 – Lights out; all leading edge flaps retracted.

FLAPS 1 – Amber illuminates until leading edge flap sets 2 and 4 are extended.
Blue illuminates and amber extinguished when leading edge flap sets 2 and 4 are extended.

FLAPS 5 – Amber illuminates and blue extinguishes until LE flaps sets 1 and 3 are extended.
Blue illuminates and amber extinguishes when all leading edge flaps are extended.

LEADING EDGE ALTERNATE FLAPS ARM SWITCH

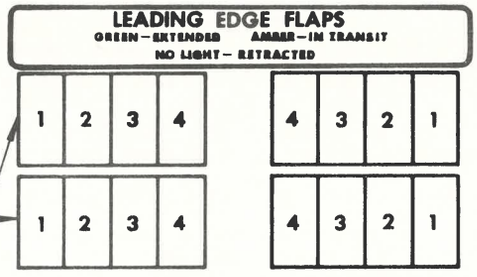
ARM – Arms leading edge directional switches.



LEADING EDGE DIRECTIONAL SWITCHES

WHEN ARMED:

UP or DOWN – Extends or retracts leading edge flaps.
– Overrides pneumatic leading edge flap extension system.

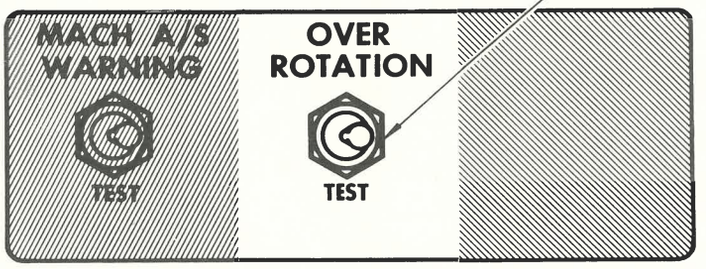


LEADING EDGE FLAP LIGHTS

– Lights extinguished for LE flaps retracted.
– Amber lights illuminate for LE flaps in transit.
– Green lights illuminate for LE flaps extended.

LEADING EDGE FLAPS MODULE

– Normally sets 2 and 4 extended when the outboard trailing edge flaps reach 1. Sets 1 and 3 extend when the inboard trailing edge flaps extend beyond 1.
– Leading edge devices are normally powered pneumatically.
– The leading edge devices will retract when all four reverse thrust levers are moved to the reverse thrust position.



OVER ROTATION TEST SWITCH

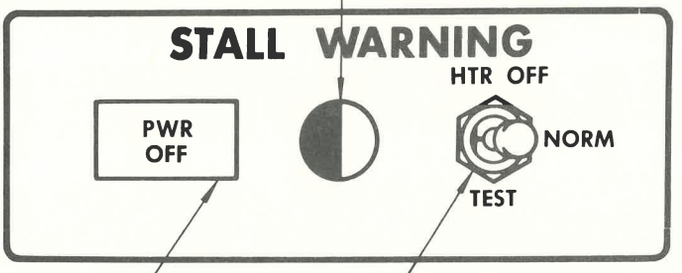
TEST – System is operational if control column shakes when switch is held.

NOTE: System alerts pilot to overrotation during takeoff as sensed by INS system attitude.

– System is deactivated inflight when a body landing gear is in the TILT position.

TEST INDICATOR

Rotates during test to indicate reliable inputs from stall warning sensor and flap position transmitter.



POWER OFF LIGHT (Amber)

– For normal operation the light will be extinguished except when using APU or external power.

– Light will extinguish during test when using APU or external power.

– Light will illuminate to indicate a sensor heater failure or a system power failure.

STALL WARNING SWITCH

HTR OFF (For maintenance) – Deactivates heater when airplane generators are supplying power to stall warning system.

– Initiates a landing gear "inflight" signal to STALL WARNING and OVER-ROTATION systems.

NORMAL – System is operational with PWR OFF light extinguished and nose gear strut extended (takeoff position).

– With APU or external power sensor heater is not powered.

TEST – With APU or external power:

1. PWR OFF light extinguishes,
2. Indicator spins,
3. Control columns shake.

– With airplane power:

1. PWR OFF light remains extinguished,
2. Indicator spins.
3. Control columns shake.

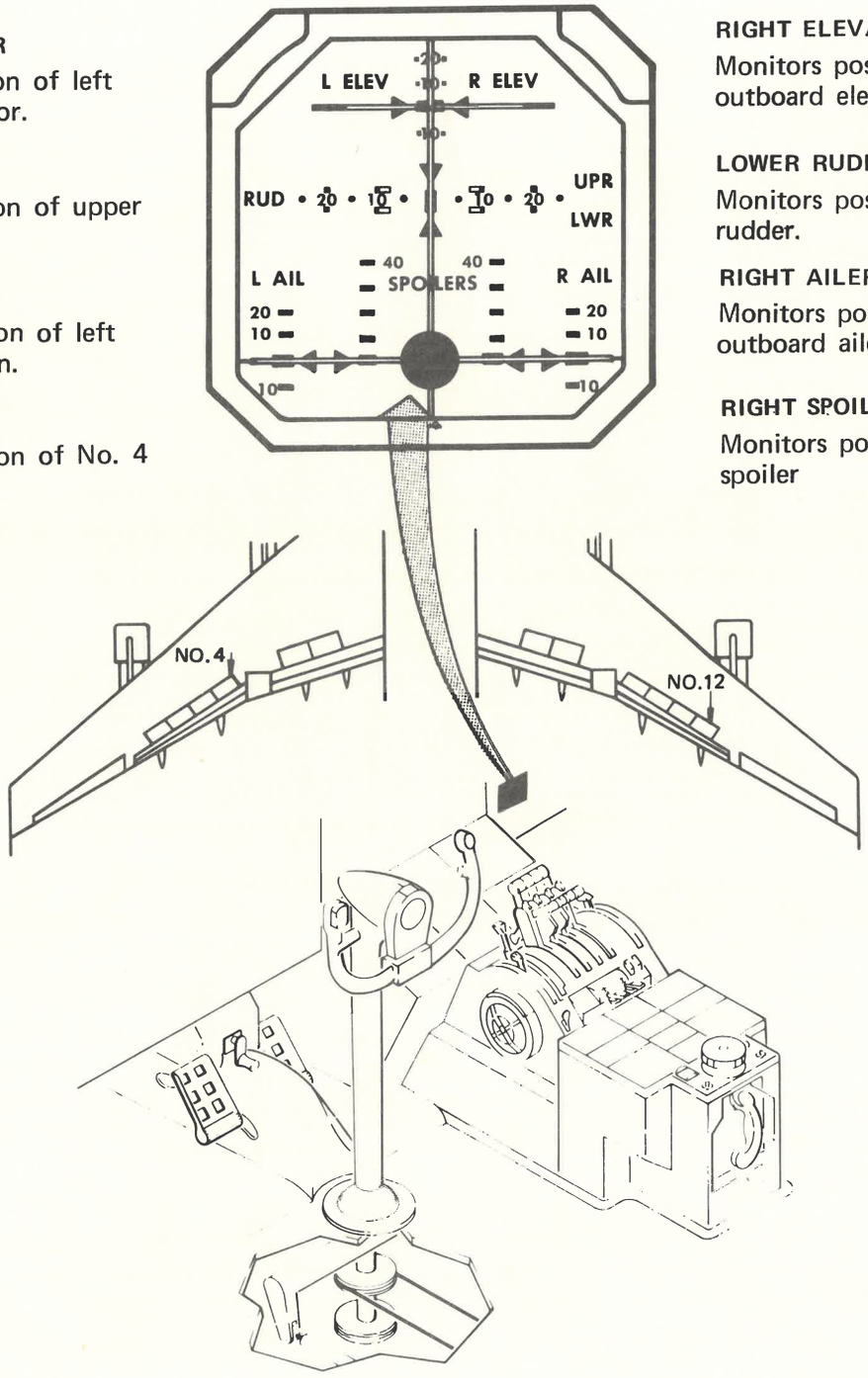
STALL WARNING AND OVER-ROTATION

LEFT ELEVATOR
Monitors position of left outboard elevator.

UPPER RUDDER
Monitors position of upper rudder.

LEFT AILERON
Monitors position of left outboard aileron.

LEFT SPOILERS
Monitors position of No. 4 spoiler



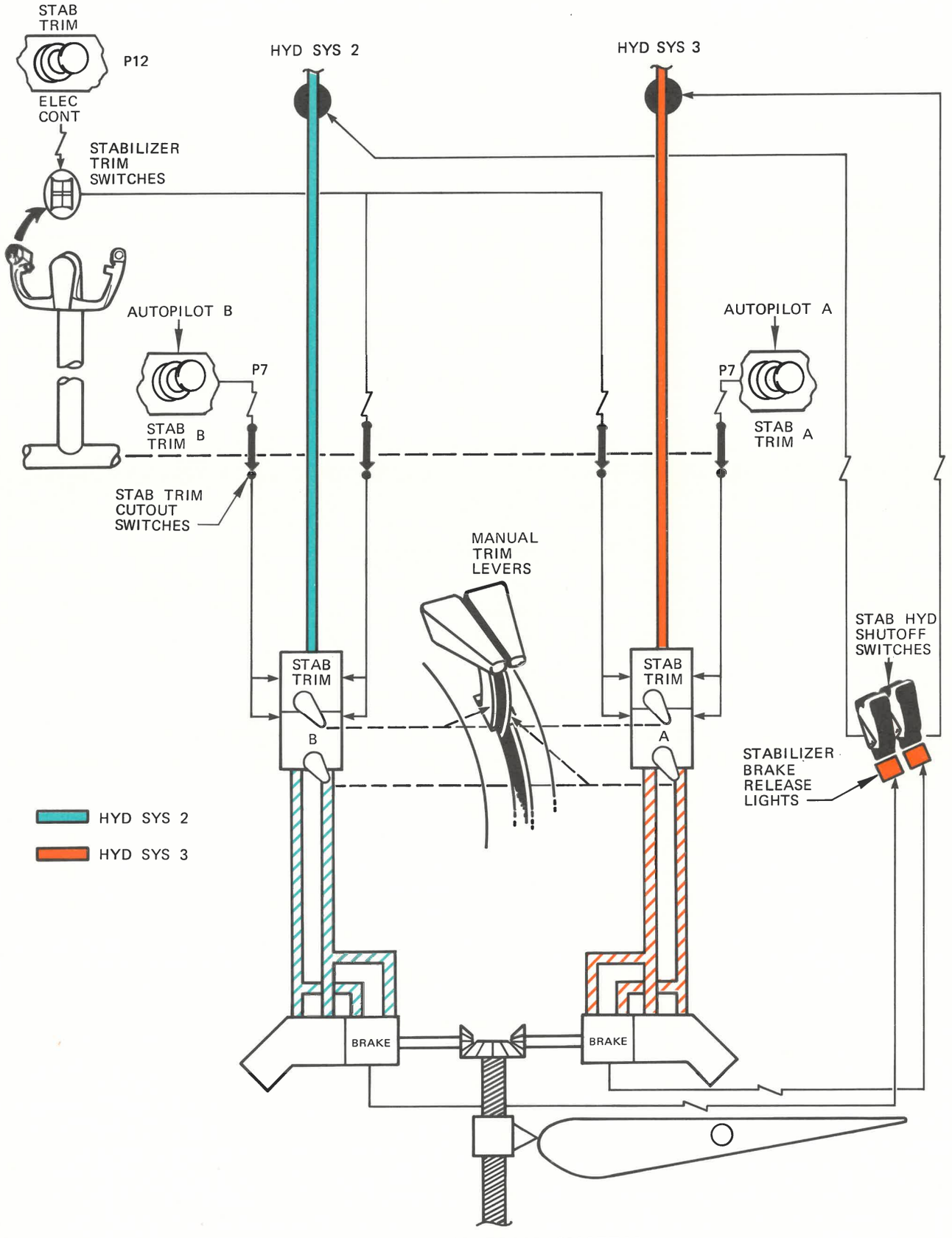
RIGHT ELEVATOR
Monitors position of right outboard elevator.

LOWER RUDDER
Monitors position of lower rudder.

RIGHT AILERON
Monitors position of right outboard aileron.

RIGHT SPOILERS
Monitors position of No. 12 spoiler

POSITION INDICATOR



STABILIZER TRIM SYSTEM

NORMAL POWER SOURCES

All flight controls are powered by four independent hydraulic systems. There is no mechanical (manual) reversion due to (1) the large control forces that would be required, and (2) system redundancies: duplication of control surfaces and power sources.

Hydraulic systems 2 and 3 are primarily used to power flight controls. The redundancy is such that even if both systems 2 and 3 are inoperative, all of the primary flight controls (ailerons, elevators and rudders) can still be operated with hydraulic systems 1 and 4.

CONTROL RESPONSE

The flight controls are designed so that airplane response to control inputs is relatively the same regardless of speed, CG or gross weight. Control system feel forces are generated artificially in all axes.

Effectiveness of the roll and yaw controls, and pilot feel of the pitch controls, is accomplished as follows:

ROLL (AILERONS AND SPOILERS)
At low speeds, with the flaps extended, inboard and outboard ailerons as well as flight spoilers are utilized. As flaps are retracted above position 1, the outboard ailerons are electrically "locked out." Flight spoilers operate only when the control wheel is moved beyond 8°. As speed increases, flight spoilers "blow down" until the speed is such that only the inboard ailerons are effective.

YAW (RUDDERS)
As airplane speed increases, rudder movement is decreased by ratio changers that sense airspeed through the auxiliary pitot-static system.

PITCH (ELEVATORS AND STABILIZER)
As airplane speed increases and/or as airplane CG shifts aft, the elevator artificial feel force is increased. This is accomplished by the feel computer, which is biased by auxiliary pitot-static and stabilizer position.

SIGNAL CHAIN
Mechanical and electrical inputs from the cockpit controls position control valves which determine hydraulic input to power units as follows:
Ailerons, Elevators, Rudders and CCA's - Dual hydraulic source actuators.
Spoilers - Single hydraulic source actuators.
Stabilizer - Dual hydraulic motors.
Trailing Edge Flaps - Single hydraulic motors for inboard and outboard flaps.

Response of the control surface closes the hydraulic valves through a follow-up mechanism leaving the surface deflected proportional to the cockpit control displacement.

TRAILING EDGE FLAPS

The inboard flaps are powered by hydraulic system 1; the outboards are powered by hydraulic system 4. Electrical power is provided as an alternate method to operate flaps. Flap asymmetry protection is provided for the normal hydraulic extension system. The affected hydraulic flap drive will automatically shut down when an asymmetry condition exists on the inboard flaps or on the outboard flaps. The asymmetry condition is sensed by the flap position indicating system. On early airplanes, a failure or loss of electrical power in the flap indicating system will result in an asymmetry shut down of the affected flaps. On later airplanes the loss of electrical power to the flap indicating system will not affect hydraulic flap operation except that flap asymmetry protection will be inoperative.

The flap protection system will shut off hydraulic trailing edge flap power when the flaps move without the flap lever being repositioned. The protection system is armed when in either a flaps up or a takeoff flap configuration (flap lever and flaps in agreement).

Flap asymmetry or flap protection circuits and the alternate extension arm switch will deactivate the hydraulic extension system.

LEADING EDGE FLAPS

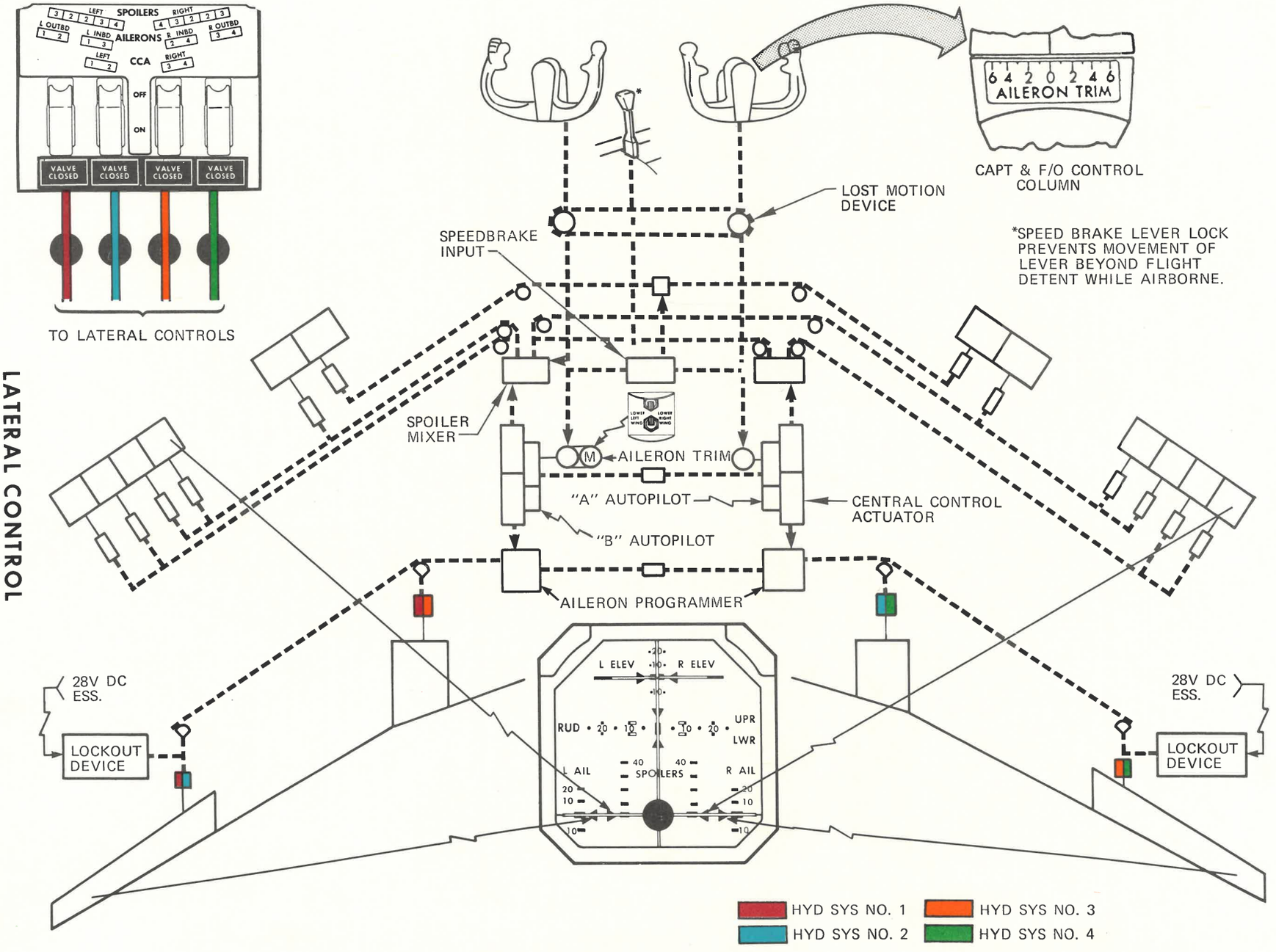
The leading edge flaps are normally powered by the pneumatic system. Leading edge flap groups 2 and 4 are programmed by the outboard flaps. Leading edge flap groups 1 and 3 are programmed by the inboard flaps. Extension or retraction using the alternate electrical system will override the pneumatic operation. The leading edge directional switches must be left in the UP or DOWN position and the leading edge alternate flaps arm switch in the ARM position to deactivate the pneumatic system.

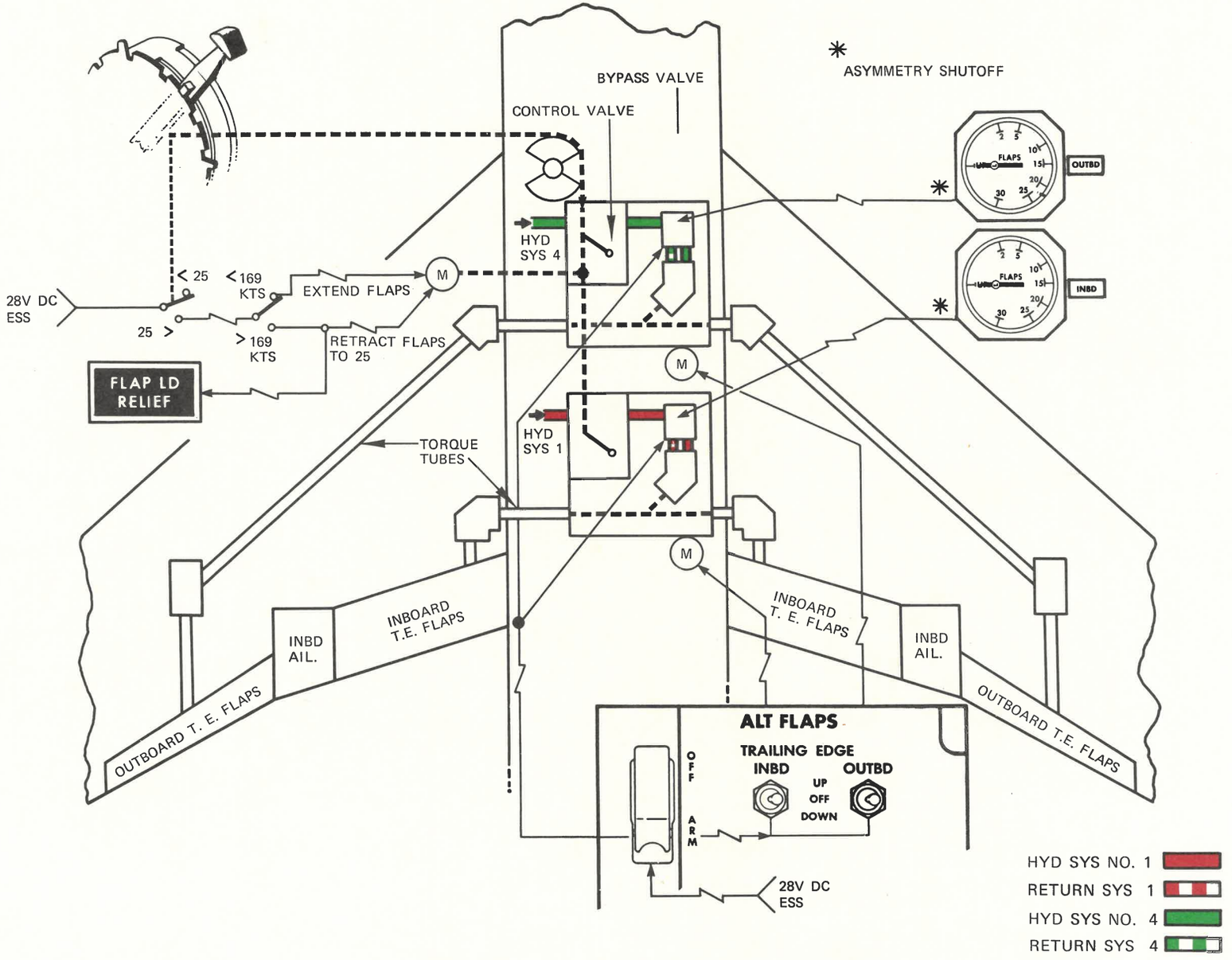
OVER-ROTATION AND STALL WARNING

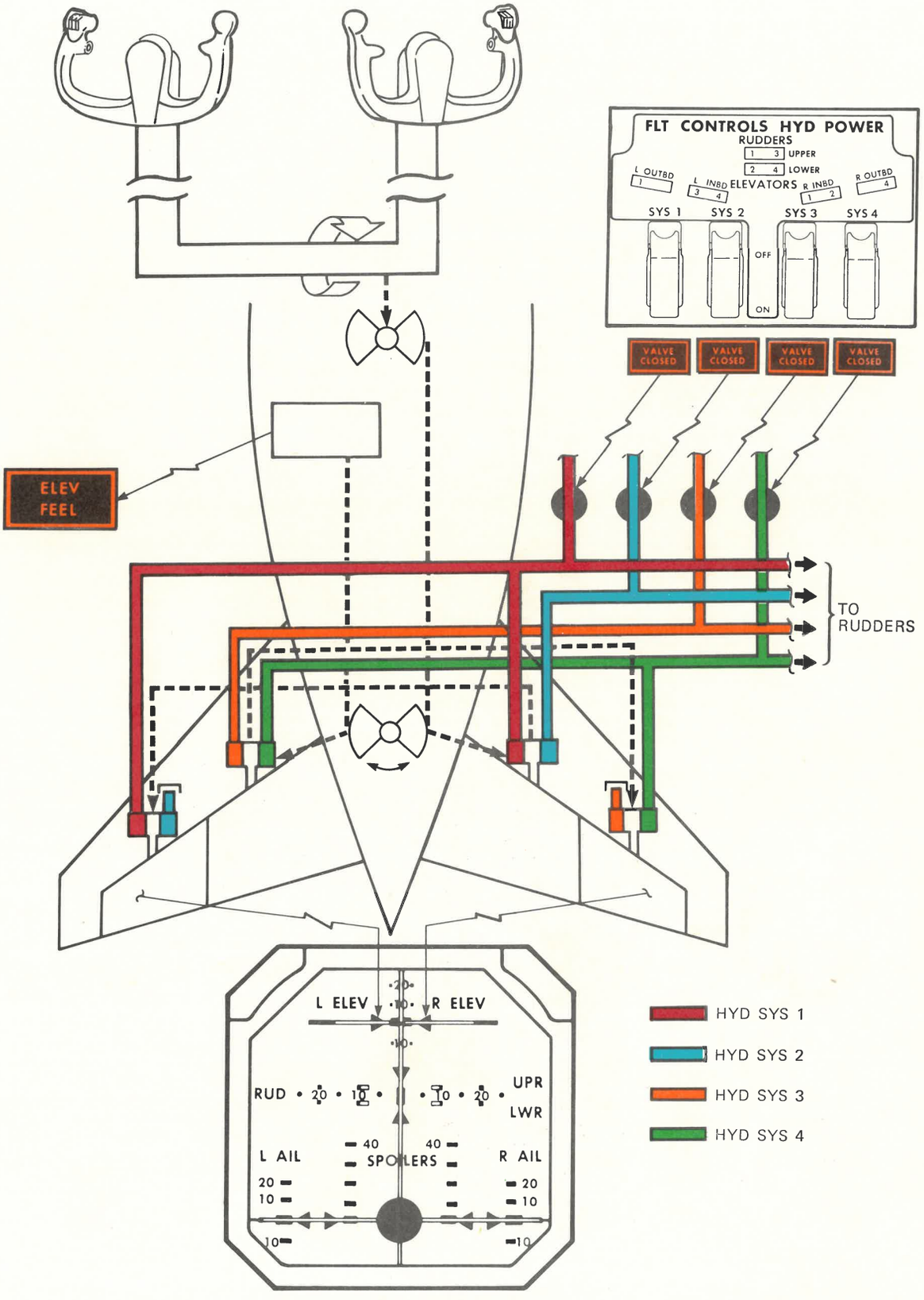
The control column shaker will be activated during takeoff when the rate or angle of rotation is excessive. The warning is deactivated when the main landing gear leaves the runway.

The stall warning (column shaker) is active inflight once the nose gear leaves the runway. Stall warning speed schedule is changed as a function of the left inboard flap position.

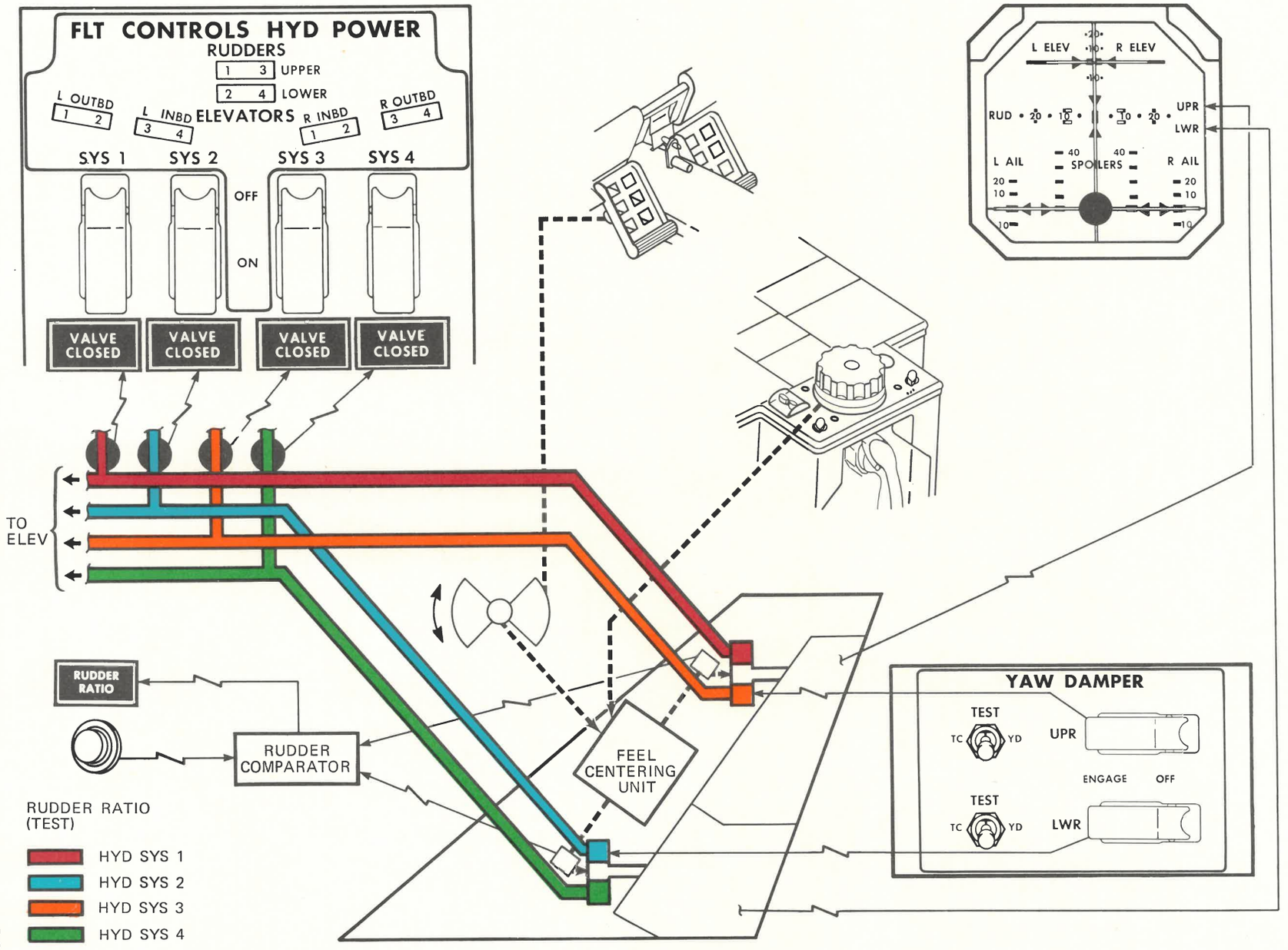
LATERAL CONTROL




ASYMMETRY SHUTOFF
BYPASS VALVE
CONTROL VALVE
OUTBD
INBD
FLAPS
HYD SYS 4
HYD SYS 1
28V DC ESS
< 25
< 169 KTS
EXTEND FLAPS
25 >
> 169 KTS
RETRACT FLAPS TO 25
FLAP LD RELIEF
TORQUE TUBES
M
INBOARD T.E. FLAPS
INBD AIL.
OUTBOARD T. E. FLAPS
ALT FLAPS
TRAILING EDGE
INBD
OUTBD
UP
OFF
DOWN
OFF
ARM
28V DC ESS
HYD SYS NO. 1
RETURN SYS 1
HYD SYS NO. 4
RETURN SYS 4



ELEVATOR SYSTEM


FLT CONTROLS HYD POWER
RUDDERS
1 3 UPPER
2 4 LOWER
L OUTBD 1 2
L INBD 3 4
ELEVATORS
R INBD 1 2
R OUTBD 3 4
SYS 1
SYS 2
SYS 3
SYS 4
OFF
ON
VALVE CLOSED
VALVE CLOSED
VALVE CLOSED
VALVE CLOSED
L ELEV
R ELEV
RUD
UPR
LWR
L AIL
SPOILERS
R AIL
TO ELEV
RUDDER RATIO
RUDDER COMPARATOR
FEEL CENTERING UNIT
YAW DAMPER
TEST
TC
YD
UPR
ENGAGE
OFF
TEST
TC
YD
LWR
RUDDER RATIO (TEST)
HYD SYS 1
HYD SYS 2
HYD SYS 3
HYD SYS 4

CHAPTER 14

CROSS REFERENCE

FOR	REFER TO	CHAPTER
Autothrottle	AUTOMATIC FLIGHT	7
Additional Instruments	AUTOMATIC FLIGHT	7
	NAVIGATION	19

MACH NUMBER INDICATOR

Displays computed mach number from central air data computer. Yellow flag covers digits when central air data computer or mach indicator fails.

MAXIMUM OPERATING AIRSPEED POINTER

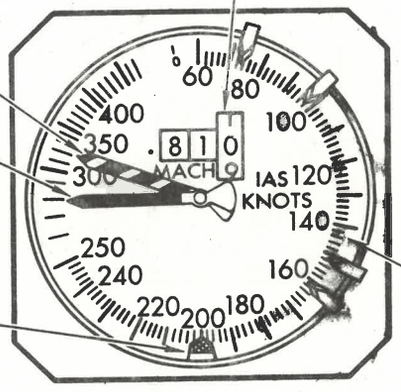
Displays V_{MO}.

INDICATED AIRSPEED POINTER

Displays indicated airspeed derived pneumatically from pitot-static pressures.

COMMAND AIRSPEED BUG

Set by autothrottle (A/T) speed selector.



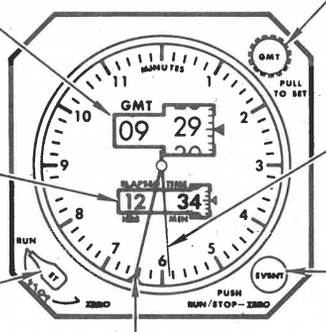
INDICATED AIRSPEED SCALE

Linear from 60 to 250 knots only.

PILOTS' PANELS

MACH/AIRSPEED INDICATOR

PILOTS' PANELS



GMT NUMERICAL DISPLAY

Displays Greenwich Mean Time in numerical form on 24-hour scale. Can be reset by the GMT START/SET CONTROL.

ELAPSED TIME INDICATOR

Displays elapsed time in numerical form up to 99 hours 59 minutes. Controlled by elapsed time switch.

ELAPSED TIME SWITCH

Will start, stop, and zero the elapsed time numerical indicator.

RUN – Starts recording elapsed time.

STOP – Records total elapsed time.

ZERO (Spring-loaded position) – Resets elapsed time to zero.

MINUTE HAND

Moves in response to event switch actuation. Hand moves around full scale in 12 minutes.

GMT START/SET CONTROL

Pull out and rotate to set the numerical GMT display. Push in to start.

SECOND HAND

Moves in response to event switch actuation. Hand moves around full scale in 60 seconds.

EVENT SWITCH

Minute hand and second hand rest at zero. Push to start event timing. Pushing a second time will cause hands to reset to zero. (Remote event switch labeled CLOCK on pilots' auxiliary panels serves same function. Event time can be started at CLOCK and stopped at remote switch, and vice versa.)

ELECTRONIC CLOCK

BOTH PILOTS' PANELS

10,000 FOOT WARNING FLAG
Displays diagonal stripe flag below 10,000 feet.

BAROMETRIC SETTING SELECTOR
Sets the barometric pressure on the millibar (MB) indicator and on the inches of mercury (IN HG) indicator.

1000 FOOT INDICATOR
Displays altitude in thousands of feet. Includes digital read-out capability within 50 feet.

REFERENCE ALTITUDE BUG

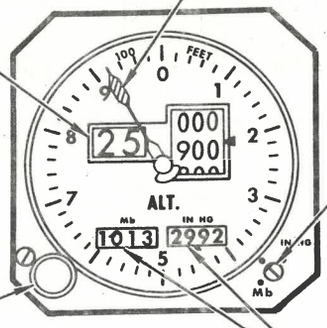
REFERENCE ALTITUDE SELECTOR
Sets reference altitude bug.

SERVO ALTIMETER

CAPTAIN'S PANEL ONLY

1000 FOOT INDICATOR
Displays altitude in thousands of feet. Includes digital read-out capability within 100 feet. Minus sign on red background will appear in 1st digit when below 10,000 feet.

BAROMETRIC SETTING SELECTOR
Sets the barometric pressure on the millibar (MB) indicator and on the inches of mercury (IN HG) indicator.



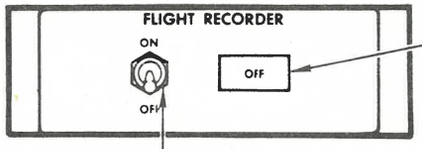
BAROMETRIC INDICATOR SELECTOR
Provides means to mask either or neither barometric setting indicators.

BAROMETRIC SETTING INDICATORS

STANDBY ALTIMETER (PNEUMATIC)

ALTIMETERS

FLIGHT ENGINEER
PANEL

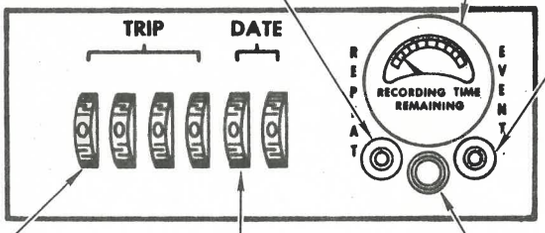


OFF LIGHT (Amber)
Illuminated at any time the recorder is not running.

FLIGHT RECORDER SWITCH
Turns the recorder on and off; however, if switch is left off the recorder will start when airplane leaves the ground and stop when airplane lands.

REPEAT SWITCH
When the switch is pushed, the trip and date information is encoded.

HOURS REMAINING INDICATOR
Shows the number of recording hours remaining on tape.

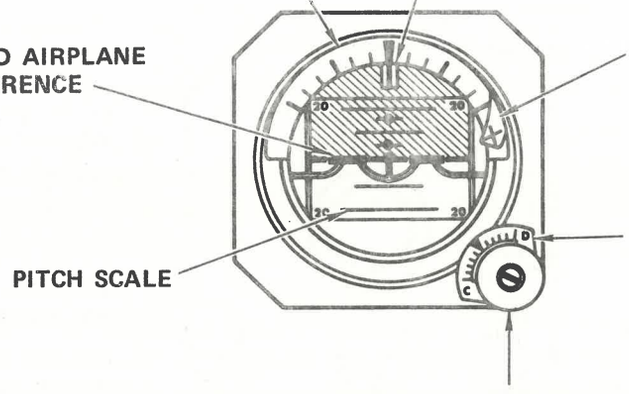


EVENT SWITCH
When switch is pushed, a marker is recorded on the tape, reflecting the time of an event or situation.

TRIP NUMBER SELECTOR
Rotate thumb wheels to set trip number.

DATE SELECTOR
Rotate thumb wheels to set date.

TRIP/DATE ENCODER LIGHT
Illuminated while the trip and date encoding is taking place.

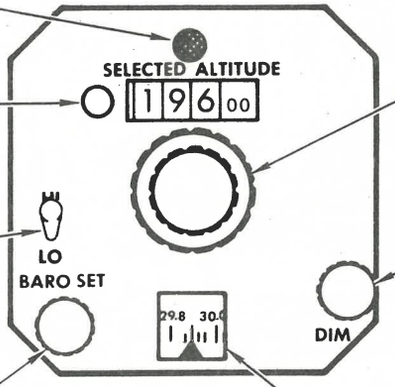


NOTE: Powered from the Battery Bus.

STANDBY HORIZON INDICATOR

ALTITUDE ALERT LIGHT (Blue)

- Illuminates when approaching (1000 feet above or below) selected altitude; remains illuminated until 500 feet above or below altitude.
- Extinguishes (and tone sounds) when 500 feet above or below selected altitude and remains extinguished while within that 500 feet above or below range.
- Illuminates (and tone sounds) when deviating 500 feet above or below selected altitude; remains illuminated until 1000 feet above or below at which time the light extinguishes and the light is automatically reset for subsequent altitude alerting.



ALTITUDE ALERT FAILURE INDICATOR (Red)

Monitors power to the altitude alert system.

ALTITUDE ALERT TONE VOLUME CONTROL

Allows selection of high or low volume.

ALTITUDE SELECT KNOB AND INDICATOR

Selects altitude up to 42,000 feet in 100-foot increments.

ALTITUDE ALERT LIGHT DIM KNOB

Turn to adjust brightness of altitude alert light.

BARO SET KNOB

BAROMETRIC SETTING INDICATOR

(Inches of mercury)

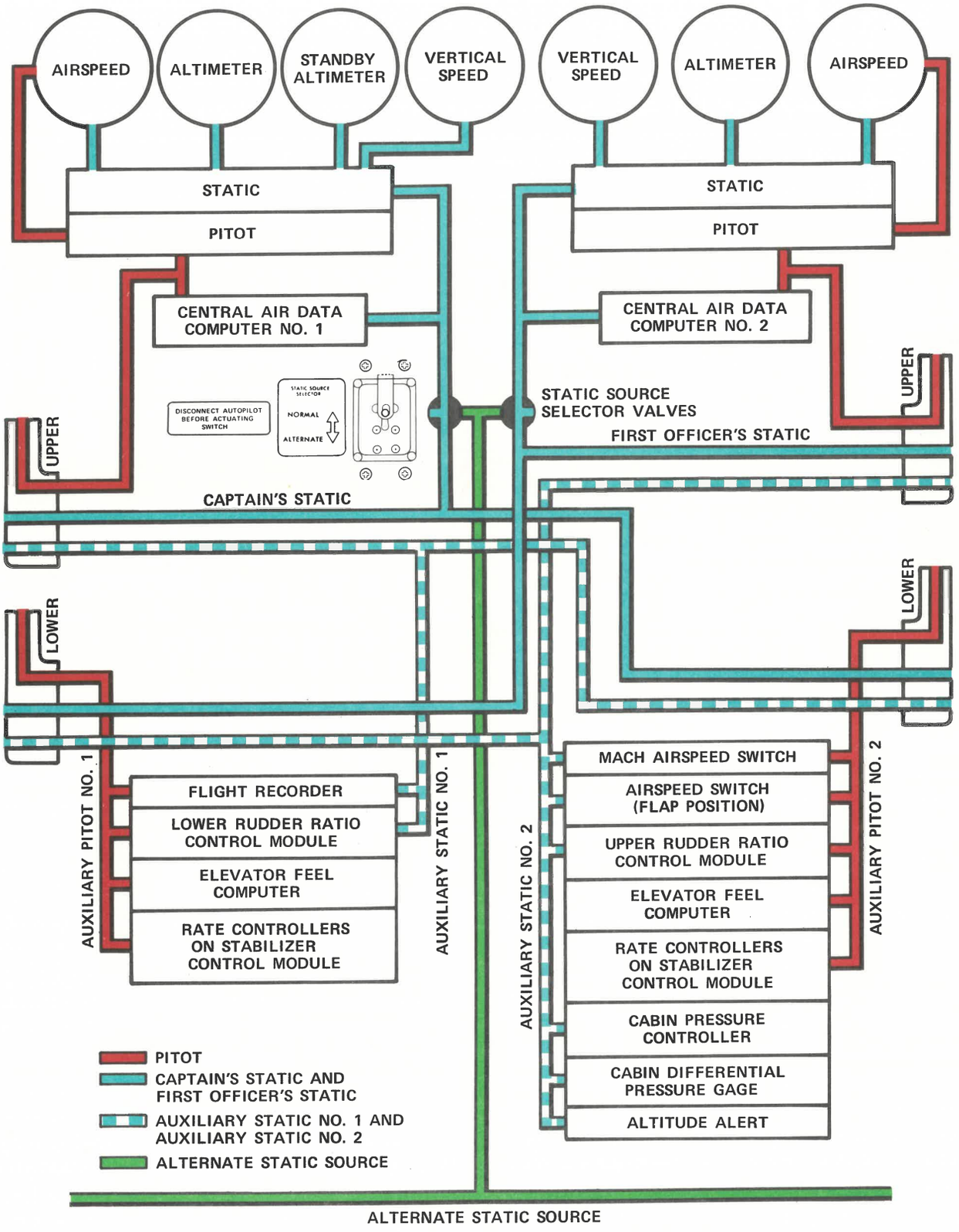
PILOT'S CENTER PANEL

PILOT'S PANELS

REMOTE ALTITUDE ALERT LIGHTS (BARO ALT WARNING)

Decaled INOP

ALTITUDE ALERT



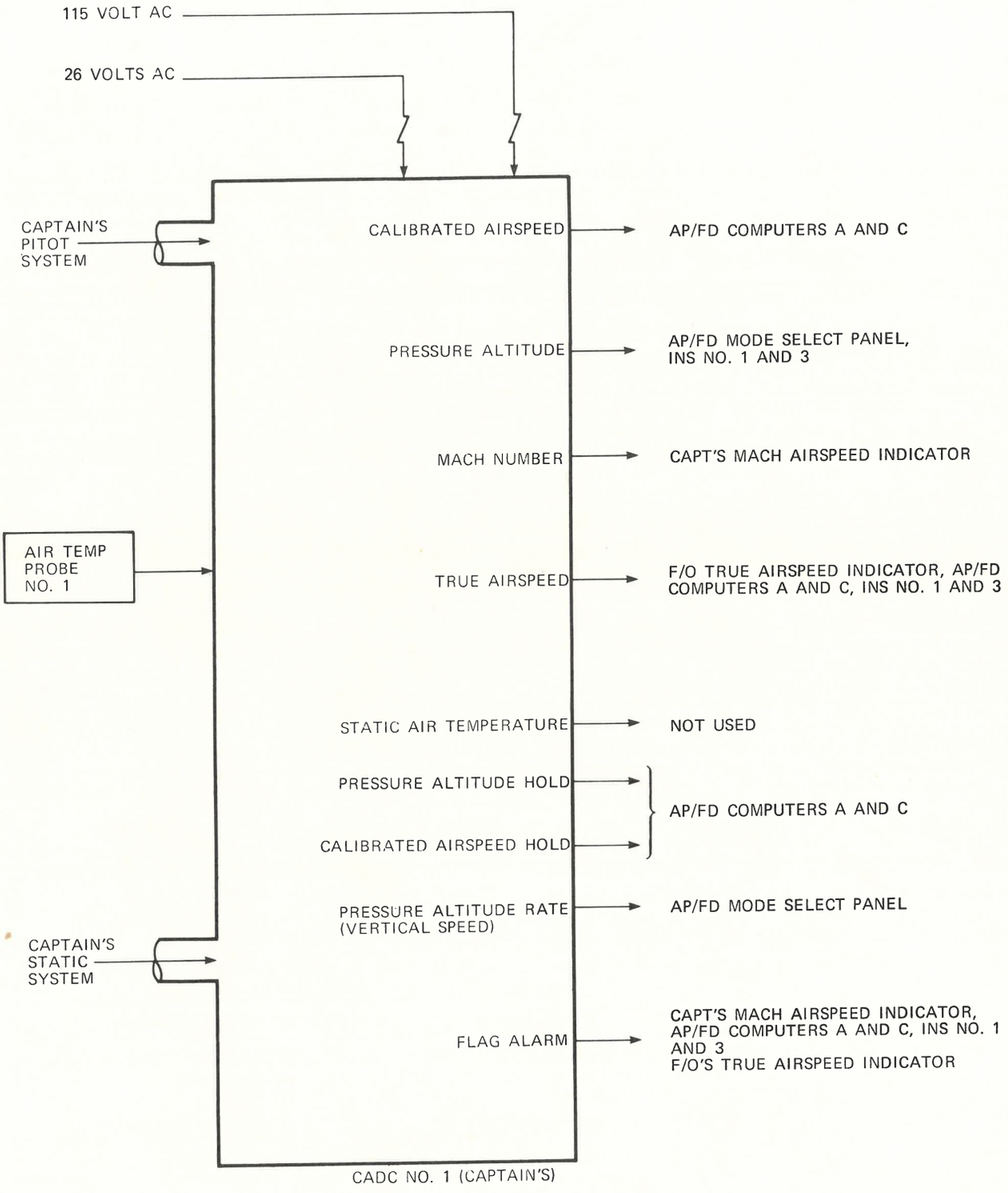
PITOT STATIC SYSTEM

CADC-1

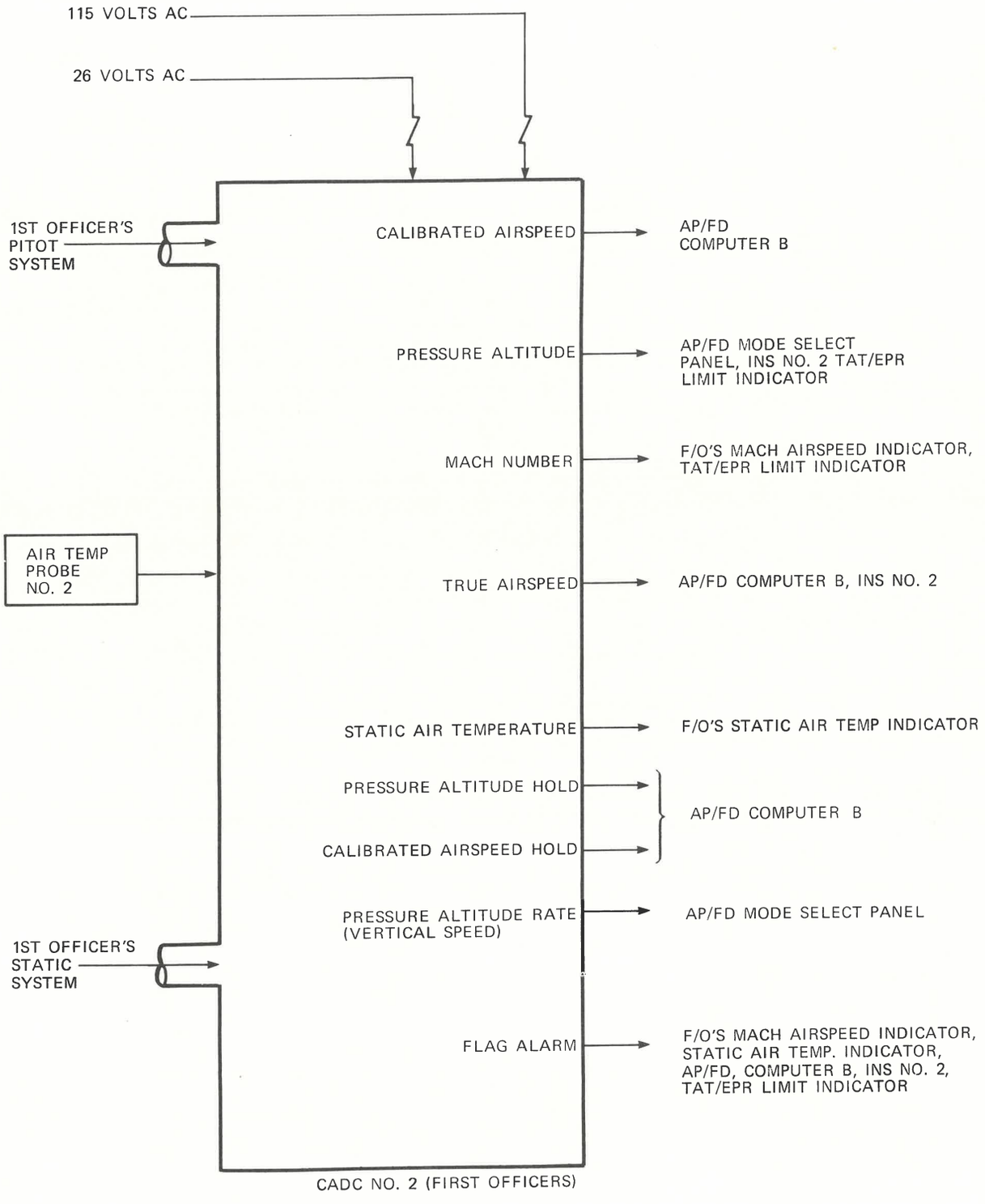
SUPPLIES:	TO:
Computed (Calibrated) Airspeed	AP/FD Computers A & C.
Pressure Altitude	AP/FD mode selector panel, INS-1 and -3, and ATC system No. 1.
Mach	Captain's Mach/airspeed indicator.
True Airspeed	TAS indicator, AP/FD Computers A & C, INS-1 and -3.
Pressure Altitude Hold	AP/FD Computers A & C.
Airspeed Hold	AP/FD Computers A & C.
Pressure Altitude Rate	AP/FD mode selector panel.
Flag Alarm Signals	Captain's Mach/airspeed indicator and altimeter, AP/FD Computers A & C, INS-1 and -3, and the true airspeed indicator.

CADC-2

SUPPLIES:	TO:
Computed (Calibrated) Airspeed	AP/FD Computer B.
Pressure Altitude	AP/FD mode selector panel, INS-2, and ATC system No. 2.
Mach	First Officer's Mach/airspeed indicator.
True Airspeed	AP/AD Computer B, and INS-2.
Static Air Temperature	SAT Indicator.
Pressure Altitude Hold	AP/A(Computer B.
Airspeed Hold	AP/FD Computer B.
Pressure Altitude Rate	AP/FD mode selector panel.
Flag Alarm Signals	First Officer's Mach/airspeed indicator and altimeter, AP/FD Computer B, INS-2, and the SAT indicator.



CENTRAL AIR DATA COMPUTER NO. 1



CENTRAL AIR DATA COMPUTER NO. 2

CHAPTER 15

CROSS REFERENCE

FOR	REFER TO	CHAPTER
Two Boost Pumps in One Tank or Inboard Crossfeed Valve Inop	ABNORMAL PROCEDURES	3
Normal Fuel Management	NORMAL PROCEDURES	4
Use of Fuel Heat	NORMAL OPERATIONS	21

ENGINE START, TAXI & TAKEOFF

ENGINE START - All engines shall be started using main tank to engine fuel feed.

TAXI - Taxi using main tank to engine for a minimum of four minutes. If extended ground operation is encountered and the fuel quantity in main tanks 1 and 4 is 24,600 LBS or less:

- With center tank fuel available; continue ground operation using center tank to all engines.
- With no center tank fuel available; continue ground operation using main tanks 2 and 3 to all engines until takeoff clearance is received or until fuel quantity in tanks 2 and 3 is equal to the fuel quantity in tanks 1 and 4, plus reserves.

TAKEOFF - Make all takeoffs using main tanks to engine fuel feed with No. 1 and No. 4 crossfeed valves open.

CLIMB/CRUISE - MORE THAN 23,100 LBS PER SIDE IN TANKS 1 AND 4

Continue tank to engine fuel feed until fuel quantity in tanks 1 and 4 is between 22,000 LBS and 21,000 LBS and then switch to center tank to all engines fuel feed, if available, or to main tanks 2 and 3 to all engines if center tank fuel is not available.

CENTER TANK FUEL AVAILABLE

If the center tank contains fuel in excess of any considered as payload switch to center tank to all engines fuel feed when the fuel quantity in tanks 1 and 4 is between 22,000 LBS and 21,000 LBS.

All Fuel Crossfeed Valves...OPEN
Main Tank Boost Pumps 2 & 3...ON
Override/Jettison Pumps.....ON
Main Tank Boost
Pumps 1 & 4.....OFF

When the payload fuel quantity in the center tank is reached or when override/jettison pump low pressure lights illuminate steadily switch to main tanks 2 and 3 to all engines fuel feed. Scavenge center tank fuel if appropriate.

Main Tank Boost Pumps 2 & 3...ON
All Fuel Crossfeed Valves...OPEN
Main Tank Boost
Pumps 1 & 4.....OFF
Override/Jettison Pumps.....OFF
Scavenge Pump
(if appropriate).....ON
Turn scavenge pump OFF when its low PRESS light illuminates steadily.

NOTE: If scavenge pump is inoperable approximately 2600 LBS of fuel will remain in the center tank.

Continue main tanks 2 and 3 to all engines fuel feed until fuel quantity in 2 and 3 is equal to that in tanks 1 and 4 plus reserve tanks 1 and 4 and then switch to main tank to engine fuel feed.

All Main Tank Boost Pumps.....ON
One Crossfeed Valve.....OPEN

RESERVE TANK TRANSFER

Place No. 1 and No. 4 reserve tank transfer valves to open when:
- Airplane gross weight is 580,000 LBS or less and
- All center tank fuel in excess of any considered as payload is consumed and
- Fuel quantity in main tanks 1 and 4 is 19,500 LBS or less each.

Leave transfer valves open for the remainder of the flight and close after parking.

CLIMB/CRUISE - LESS THAN 23,100 LBS PER SIDE IN TANKS 1 AND 4

After power reduction for climb switch to main tanks 2 and 3 to all engines fuel feed.
Main Tank Boost Pumps 2 & 3...ON
All Fuel Crossfeed Valves...OPEN
Main Tank Boost
Pumps 1 & 4.....OFF

When the fuel quantity in 2 and 3 is equal to that in tanks 1 and 4 plus reserve tanks 1 and 4 switch to main tank to engine fuel feed.
All Main Tank Boost Pumps.....ON
One Crossfeed Valve.....OPEN

Initiate reserve tank transfer as indicated above.

UNBALANCED FUEL

If an unbalanced fuel condition exists the following corrective procedures may be taken:
- Main tank 2 or 3 fuel quantity high when on main tank 2 and 3 to all engine fuel feed:
  Fuel Crossfeed Valve
  (Low Quantity Tank).....CLOSE
  When desired fuel quantity balance is attained:
  Fuel Crossfeed Valve
  (Low Quantity Tank).....OPEN
- One main tank fuel quantity high when on main tank to engine fuel feed:
  Fuel Crossfeed Valve
  (High Quantity Tank).....OPEN
  Fuel Crossfeed Valve
  (Opposite Tank).....OPEN
  Fuel Booster Pumps
  (Opposite Tank).....OFF
  Fuel Crossfeed Valves
  (Remaining Tanks).....CLOSE
  When desired fuel balance is attained, switch to normal main tank to engine fuel feed.

LANDING

All normal landings will be made on main tank to engine fuel feed with one crossfeed valve open.

ENGINE DRIVEN HYDRAULIC PUMP LOW PRESSURE LIGHT ILLUMINATED

Check F/E hydraulic power control module for hydraulic quantity indications and air driven hydraulic pump indications.

With low or decreasing hydraulic quantity indications see Chapter 3, SINGLE HYDRAULIC SYSTEM LEAK OR LOSS.

With normal quantity indications and the air driven hydraulic pump RUN light illuminated and air driven hydraulic pump low pressure light extinguished:
Engine Driven Hydraulic
Pump Switch.....DEPR

AIR DRIVEN HYDRAULIC PUMP LOW PRESSURE LIGHT ILLUMINATED
(With ADP switch in AUTO and pneumatic manifold pressurized.)

Hydraulic System Pressure and
Fluid Quantity.....CHECK

With low or decreasing hydraulic quantity indications see Chapter 3, SINGLE HYDRAULIC SYSTEM LEAK OR LOSS.

With low hydraulic system pressure:
Air Driven Hydraulic
Pump Switch.....CONTINUOUS

If ADP fails to operate:
Air Driven Hydraulic
Pump Switch.....OFF

HYDRAULIC SYSTEM OVERHEAT LIGHT ILLUMINATED

Engine Driven Hydraulic
Pump Switch.....DEPR
Air Driven Hydraulic
Pump Switch.....OFF

IF THE OVERHEAT LIGHT EXTINGUISHES:
Air Driven Hydraulic
Pump Switch.....AUTO

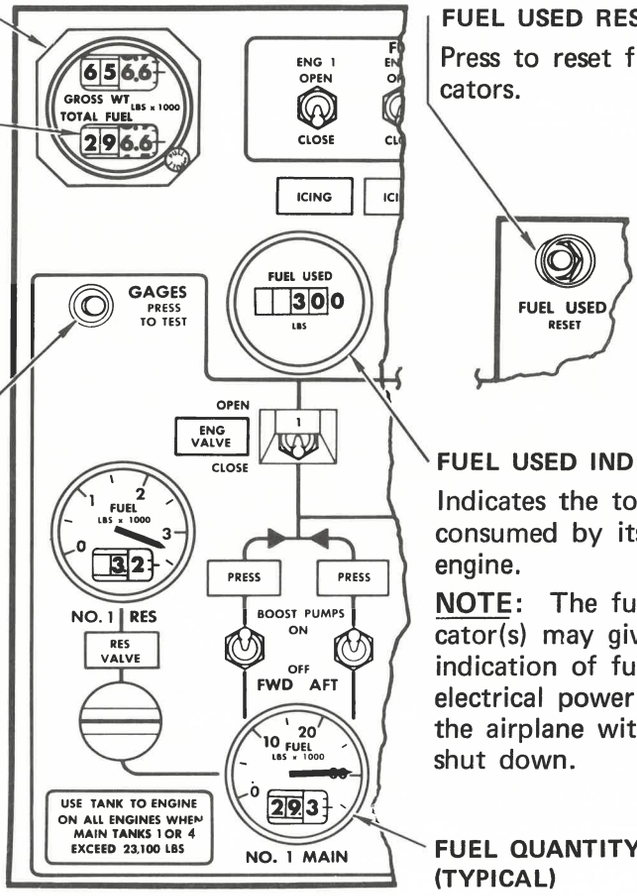
IF THE OVERHEAT LIGHT REMAINS ILLUMINATED:
Engine Driven Hydraulic
Pump Switch.....SUPPLY OFF

GROSS WEIGHT/TOTAL FUEL WEIGHT INDICATOR

The zero-fuel weight, is added to the indicated total fuel weight. Pull out the knob and set the total of these two figures into the gross weight window. Observe weight and balance "LBS X 1000" indicator in agreement.

TOTAL FUEL WINDOW

Reflects the total of the individual tank fuel indicators.
Both indicator readings decrease as fuel is consumed. Both decrease toward zero during the fuel quantity test.



FUEL USED RESET SWITCH

Press to reset fuel used indicators.

FUEL QUANTITY TEST SWITCH

Press to test fuel quantity indicators. Readings will decrease when switch is depressed and return to original readings when released.

FUEL USED INDICATOR

Indicates the total of fuel consumed by its associated engine.

NOTE: The fuel used indicator(s) may give an erroneous indication of fuel usage when electrical power is applied to the airplane with the engines shut down.

FUEL QUANTITY INDICATOR (TYPICAL)

F/E LOWER PANEL

FUEL SYSTEM MODULE

FUEL MEASURING

ENGINE FUEL SHUTOFF SWITCH

OPEN – Fuel available to the engine.

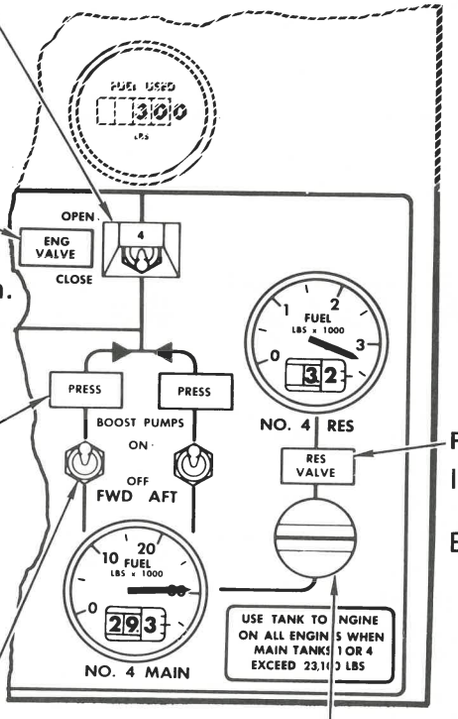
NOTE: If modified, the engine fuel valve will not open until the start lever is positioned to RICH or IDLE. The valve will close when the start lever is positioned to CUTOFF even though the fuel shutoff switch is in the OPEN position.

CLOSE – Engine isolated from all fuel supply. Valve will close upon actuation of the engine fire switch regardless of fuel shutoff switch or start lever position.

FUEL SHUTOFF VALVE LIGHT (White)

BRIGHT – Valve in transit.
DIM – Valve closed.
EXTINGUISHED – Valve open.

F/E LOWER PANEL



FUEL BOOST PUMP LOW PRESSURE LIGHT (Amber)

ILLUMINATED – When fuel pressure low or associated pump switch is in the OFF position.

RESERVE FUEL VALVE LIGHT (Blue)

ILLUMINATED – Transfer valve in transit.
EXTINGUISHED – Transfer valve fully open or closed.

FUEL BOOST PUMP SWITCH

Controls boost pump operation. Aft fuel boost pump in #2 main tank will operate whenever the 115V AC ground service bus is powered and the APU master switch is ON regardless of the position of the boost pump switch.

RESERVE TANK FUEL TRANSFER SWITCH

Reference line horizontal – transfer valve closed.
Reference line vertical – transfer valve open, reserve fuel gravity transfers into adjoining outboard main fuel tank.

FUEL SYSTEM MODULE

TANK-TO-ENGINE FUEL FEED

SCAVENGE PUMP LOW PRESSURE LIGHT (Amber)

Light may illuminate momentarily when pump is switched "ON".
Illuminates steady when scavenging is complete.

SCAVENGE PUMP SWITCH

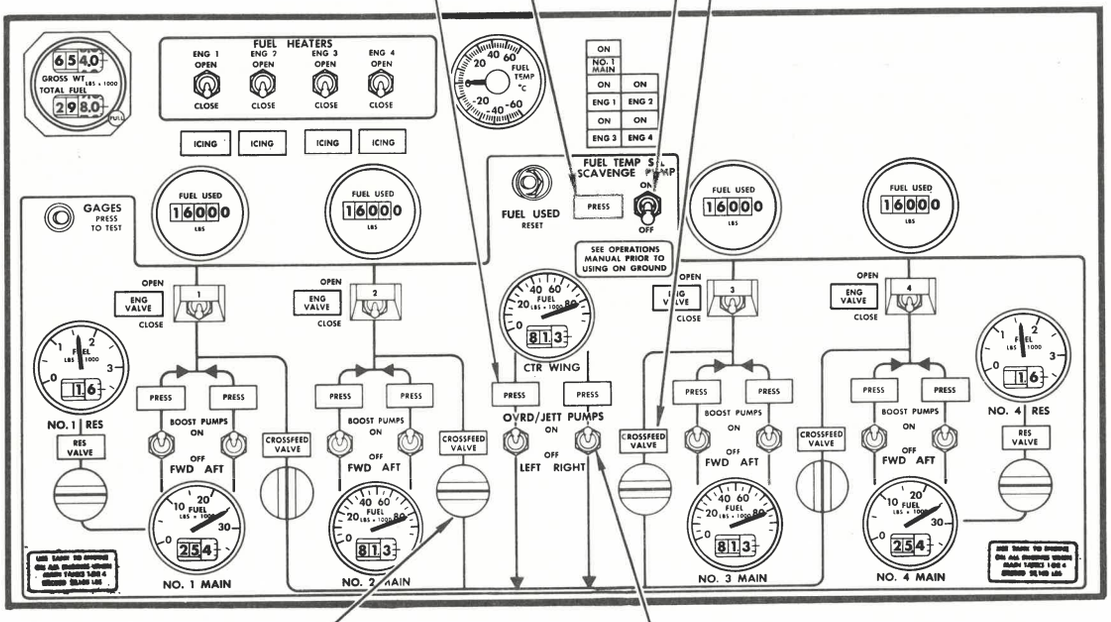
ON – Transfers residual center wing tank fuel from a position below the override/jettison pump intakes to the No. 2 main tank.

OVERRIDE/JETTISON PUMP LOW PRESSURE LIGHT (Amber)

ILLUMINATED – When fuel pressure low or associated pump switch is in the OFF position.

CROSSFEED VALVE LIGHT (Blue)

ILLUMINATED – Crossfeed valve in transit.
EXTINGUISHED – Crossfeed valve fully open or closed.



F/E LOWER PANEL

FUEL CROSSFEED SWITCH

Reference line horizontal – crossfeed valve closed, isolating associated engine and its fuel system from the crossfeed manifold.
Reference line vertical – crossfeed valve open, connecting engine fuel system to crossfeed manifold.

OVERRIDE/JETTISON PUMP SWITCH

ON – Operates override/jettison pump to supply fuel from center wing tank to the crossfeed manifold, and overrides boost pump output. Also used to jettison fuel from the center wing tank.

NOTE: Do not use center wing tank SCAVENGE PUMP on the ground when No. 2 MAIN tank is full.

FUEL SYSTEM MODULE

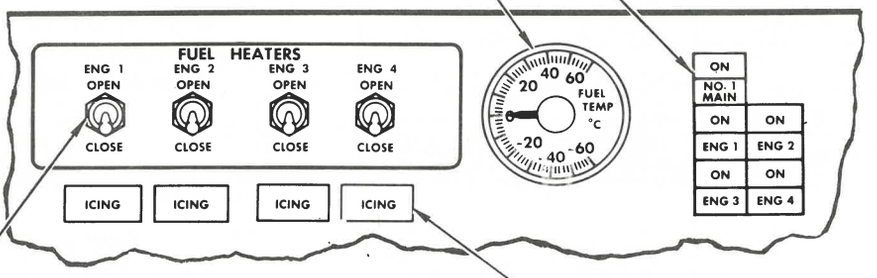
FUEL CROSSFEED

FUEL TEMPERATURE INDICATOR

Indicates fuel temperature in No. 1 main tank or fuel temperature downstream of the fuel heater, as selected by fuel temperature switches.

FUEL TEMPERATURE INDICATOR SWITCHES

Depress desired switch for readout on fuel temperature indicator. Depressed switch illuminates blue indicating circuit completed between the selected fuel temperature bulb and the indicator.



F/E LOWER PANEL

FUEL HEAT SWITCH

OPEN – Opens fuel heater valve, which permits flow of engine bleed air through fuel heater.

CLOSE – Closes fuel heater valve, to prevent flow of engine bleed air through fuel heater.

FUEL ICING LIGHT (Amber)

ILLUMINATED – Indicates fuel filter is approaching a bypass condition due to ice or foreign material.

FUEL SYSTEM
MODULE

JETTISON PUMP LOW PRESSURE LIGHTS (Amber)

Light may illuminate momentarily when pump switch placed to "ON". Illuminates steady when fuel is below standpipe level.

JETTISON PUMP SWITCHES

ON – Turns on jettison pumps in 2 and 3 main tanks.

CENTER WING JETTISON VALVE LIGHTS (Blue)

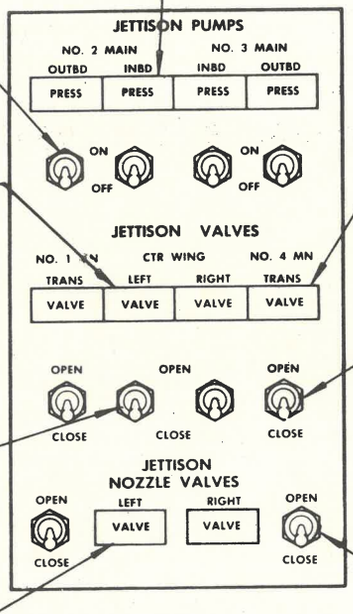
ILLUMINATED – Valve in transit.
EXTINGUISHED – Valve fully open or closed.

CENTER WING JETTISON VALVE SWITCHES

OPEN – Opens center wing jettison valve(s) to allow center wing tank fuel to enter jettison manifold.

JETTISON NOZZLE VALVE LIGHTS (Blue)

ILLUMINATED – Valve in transit.
EXTINGUISHED – Valve fully open or closed.



F/E LOWER PANEL

JETTISON TRANSFER VALVE LIGHTS (Blue)

ILLUMINATED – Transfer valve in transit.
EXTINGUISHED – Transfer valve fully open or closed.

JETTISON TRANSFER VALVE SWITCHES

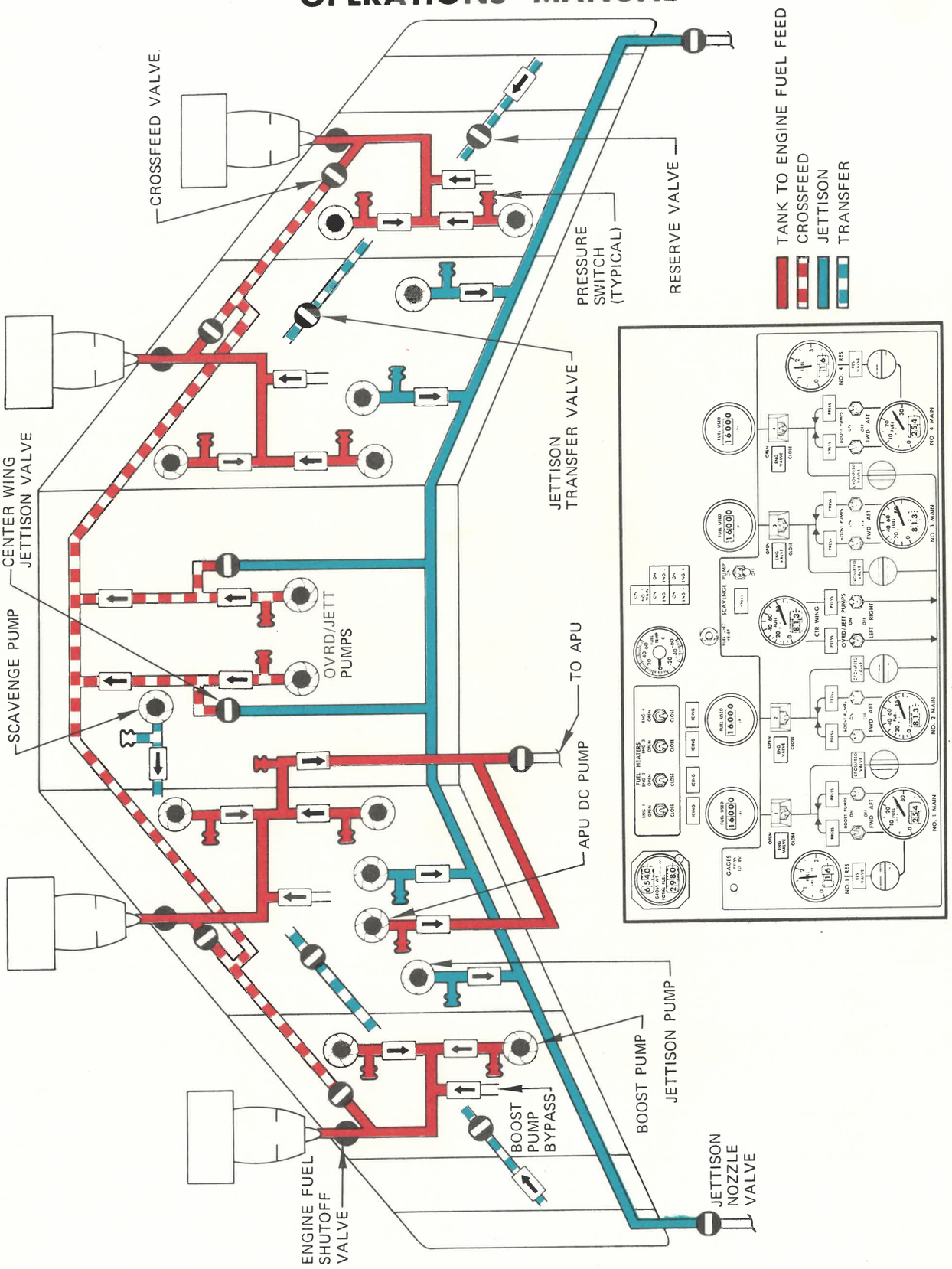
OPEN – Opens jettison transfer valve(s) to permit gravity flow of fuel from main tanks 1 and 4 to main tanks 2 and 3.

JETTISON NOZZLE VALVE SWITCHES

OPEN – Jettison nozzle valves at wing tips open for fuel jettison.

NOTE: The fuel jettison module cover will not close and latch unless all switches on the module are in the OFF or CLOSE position.

FUEL JETTISON
MODULE


CROSSFEED VALVE
RESERVE VALVE
PRESSURE SWITCH (TYPICAL)
TANK TO ENGINE FUEL FEED
CROSSFEED
JETTISON
TRANSFER
JETTISON TRANSFER VALVE
CENTER WING JETTISON VALVE
SCAVENGE PUMP
OVRD/JETT PUMPS
TO APU
APU DC PUMP
JETTISON PUMP
BOOST PUMP
BOOST PUMP BYPASS
ENGINE FUEL SHUTOFF VALVE
JETTISON NOZZLE VALVE

GENERAL

All fuel is contained within sealed wing areas, and delivered to the engine fuel system under positive pressure by AC driven boost pumps.

FUELING/DEFUELING
Rapid fueling and defueling is provided by two receptacles at each of two fueling stations, one in each wing. A volumetric shutoff system is used during fueling to automatically close the fueling valve in each fuel tank when the fuel reaches a preset volume. Overwing fill ports are provided for the main wing tanks only.

NOTE: Jettison valves and jettison pumps should not be operated during fueling operations when the fuel source is external to the airplane. Preflight procedures which would conflict with this caution must be delayed until external fuel pressure sources are disconnected.

FUEL QUANTITY MEASURING
The electronic fuel measuring equipment is a capacitance system. It reads the fuel by volume and acts upon the total fuel and gross weight indicator. The fuel quantity indicating system is also used in conjunction with the volumetric shutoff system to actuate fuel shutoff during fueling.

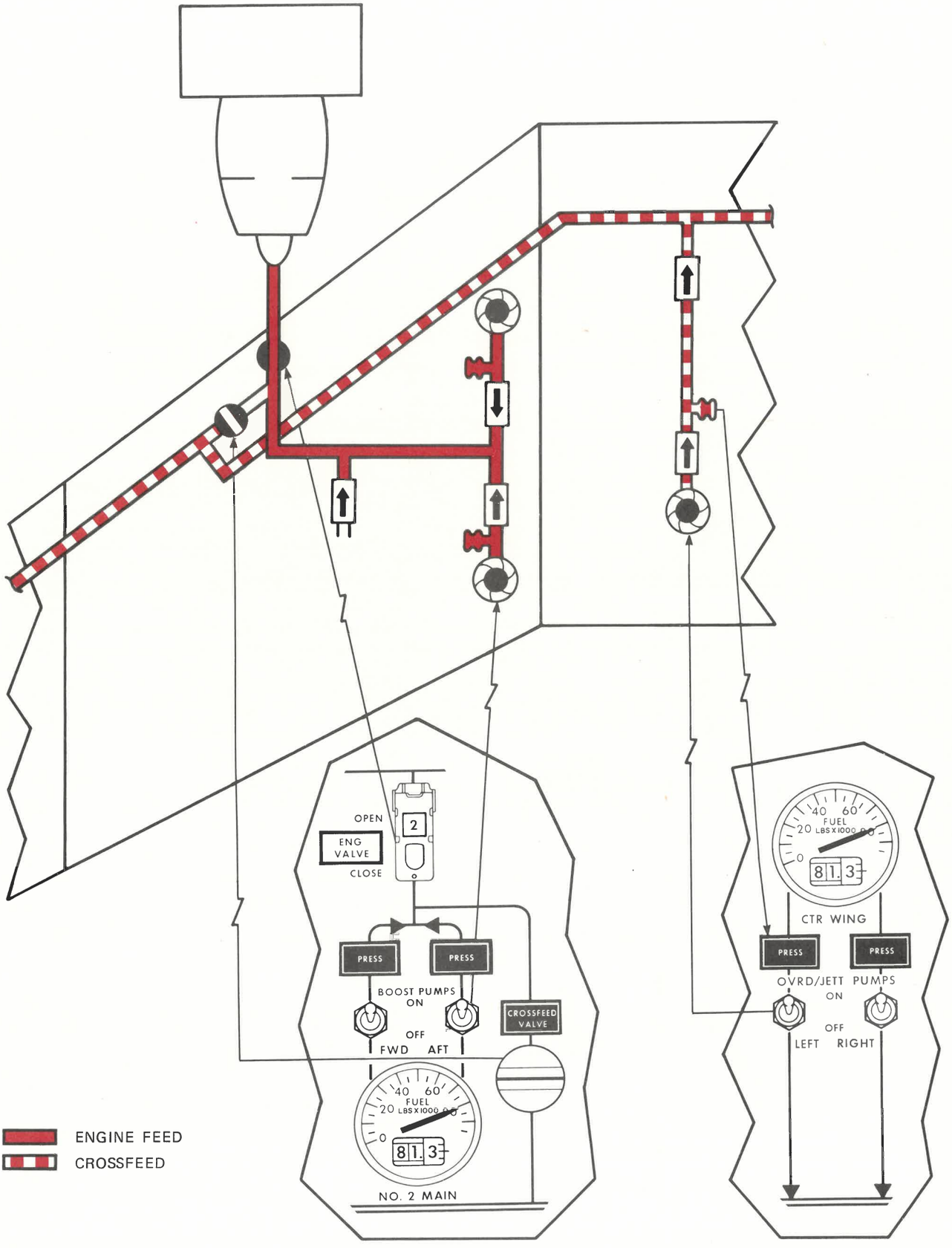
MEASURING STICKS
Measuring sticks mounted in the bottom of each tank provide a mechanical means of measuring fuel quantity in a tank. To obtain the reading, rotate the measuring stick 90° counterclockwise and pull out the stick. Gently push back in until the float magnet is felt to grab the stick magnet, then obtain reading at the flush wing reference plane.

FUEL TANK VENT SYSTEM
The fuel vent system provides positive venting of the fuel tanks to the atmosphere during all attitudes of the airplane. Fuel tank vent ports are positioned so that at least one port is open to the expansion area at all times. Fuel vent float valves located near the top of the fuel tanks prevent fuel from entering the vent system during airplane attitude changes. Vent outlets are located near the wing tips in the surge tank vent line.

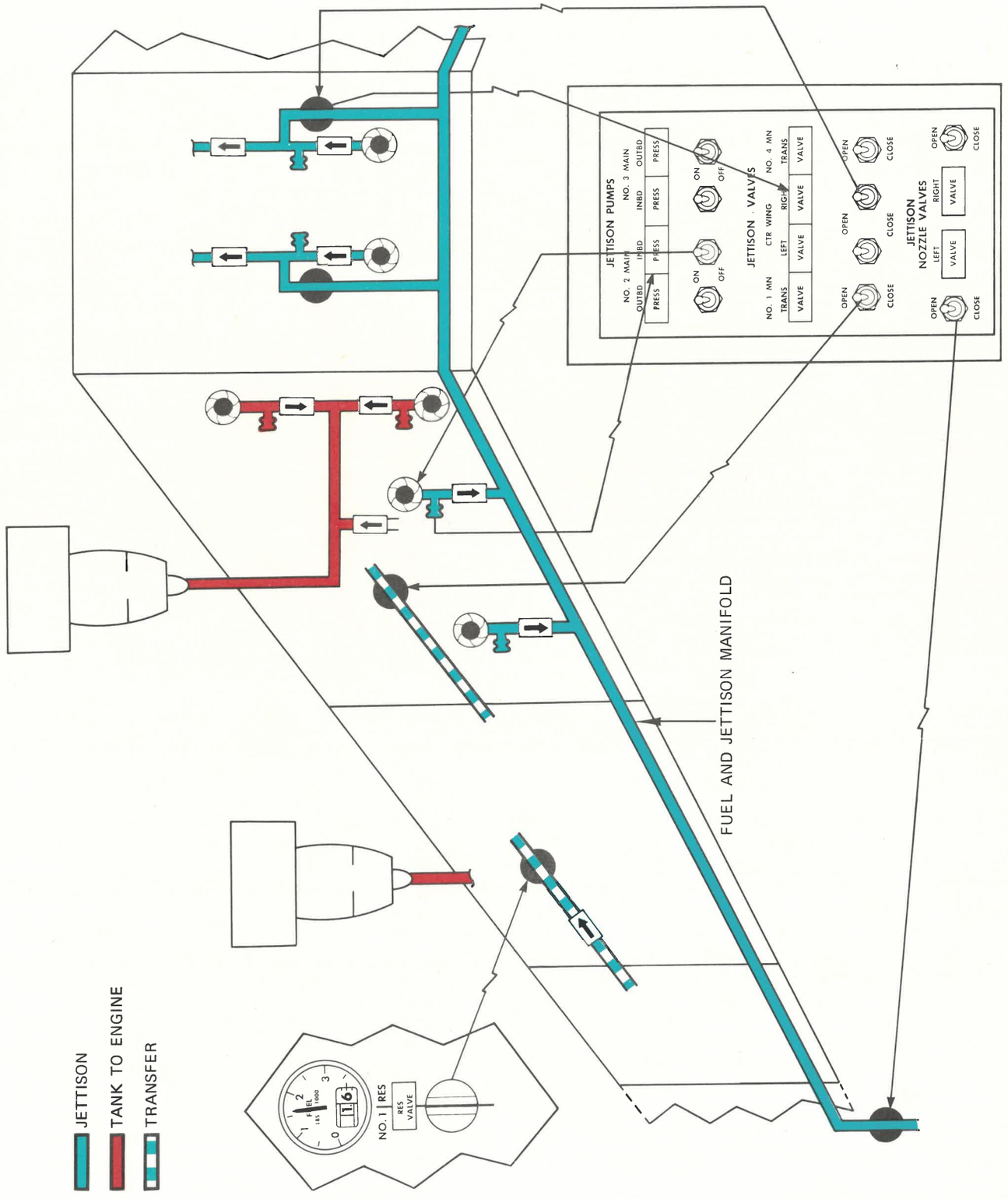
SURGE TANKS
A surge tank in each wing tip provides expansion chambers for excess fuel due to overfilling or thermal expansion. Surge tank fuel is drained back into the main inboard fuel tanks. Fuel may be vented overboard, dependent upon the quantity of fuel in the surge tank.

FUEL JETTISON
The fuel jettison system provides a means of rapid weight reduction in flight. Fuel may be jettisoned with gear and/or flaps extended.

UNJETTISONABLE FUEL
The jettison pumps incorporate standpipes which ensure a reserve fuel supply for emergency operation after jettison.



ENGINE FEED & CROSSFEED



FUEL JETTISON (ACTIVATED)

747 FUEL SYSTEM QUESTIONS

1. Is it possible to put any fuel load up to the GW limit and/or the max tank capacity limit in the aircraft?

   Yes. The fuel load sequence is as follows:
   1. Fill up the reserve tanks.
   2. When reserve tanks are full, fill the inboard and outbd tanks evenly until they reach 24,600 lb. each.
   3. Fill inbd tanks until completely full, leaving outbd at 24,600.
   4. When inbd tanks are filled, complete filling of outbd tanks.
   5. When all main tanks are full, start putting fuel into the CWT.

   As an example, let us take an aircraft at max zero fuel wt. of 526,500 and "fill it up." Assume the fuel weighs 6.5 lb/gal.

   1. Fill up reserves: 500 gal @ 6.5 lb/gal = 3,250 lb per tank for a total res tank load of 6,500 lb.
   2. Fill inbd and outbd equally until they reach 24,600 lb each. At this point, we have 24,600 x 4 + 6,500 = 104,900 lb of fuel.
   3. Fill inbd tanks until full. Since the inbds can each hold 12,240 gal @ 6.5 lb/gal, we can easily put the remaining 78,600 lbs in the inbd main tanks.

   Thus, we get the following loading

   Res 1 = 3,250 lb.
   Main 1 = 24,600
   Main 2 = 63,900

   Res 4 = 3,250 lb.
   Main 4 = 24,600
   Main 3 = 63,900

   Total fuel wt = 183,500 lbs.

2. Using the Boeing recommended fuel management procedures is it possible to violate the Fuel Usage Limitations?

   No. Following the Boeing recommended fuel management procedures (15.10.01 in the Ops Manual) it is impossible to exceed the fuel usage limitations.

3. Will there be any difficulty, as there was in the 707, in trying to fill the tanks with the plane not level while on the ground?

   No. The 707 utilized floats for the fueling shutoff signal. The 747 utilizes the fuel quantity indicators (which are attitude compensated instruments) for the fueling shutoff signal.

CHAPTER 16

CROSS REFERENCE

FOR	REFER TO	CHAPTER
Flight Control System Hydraulic Controls and Indicators	FLIGHT CONTROLS	13
Landing Gear System Hydraulic Controls and Indicators and Brake System Schematic	LANDING GEAR	18
Pneumatic Air Source for Air Driven Hydraulic Pump	PNEUMATICS	20

ENGINE DRIVEN HYDRAULIC PUMP LOW PRESSURE LIGHT ILLUMINATED

Check F/E hydraulic power control module for hydraulic quantity indications and air driven hydraulic pump indications.

With low or decreasing hydraulic quantity indications see Chapter 3, SINGLE HYDRAULIC SYSTEM LEAK OR LOSS.

With normal quantity indications and the air driven hydraulic pump RUN light illuminated and air driven hydraulic pump low pressure light extinguished:
Engine Driven Hydraulic
Pump Switch.....DEPR

AIR DRIVEN HYDRAULIC PUMP LOW PRESSURE LIGHT ILLUMINATED
(With ADP switch in AUTO and pneumatic manifold pressurized.)

Hydraulic System Pressure and
Fluid Quantity.....CHECK

With low or decreasing hydraulic quantity indications see Chapter 3, SINGLE HYDRAULIC SYSTEM LEAK OR LOSS.

With low hydraulic system pressure:
Air Driven Hydraulic
Pump Switch.....CONTINUOUS

If ADP fails to operate:
Air Driven Hydraulic
Pump Switch.....OFF

HYDRAULIC SYSTEM OVERHEAT LIGHT ILLUMINATED

Engine Driven Hydraulic
Pump Switch.....DEPR
Air Driven Hydraulic
Pump Switch.....OFF

IF THE OVERHEAT LIGHT EXTINGUISHES:
Air Driven Hydraulic
Pump Switch.....AUTO

HYDRAULIC SYSTEM LOW PRESSURE LIGHTS (Amber)

Illuminates when system pressure is low (regardless of pump switch positions). HYD SYS PRESS 4 light remains illuminated when using hydraulic system 4 electric pump.

HYD SYS PRESS 1	HYD SYS PRESS 2	HYD SYS PRESS 3	HYD SYS PRESS 4

PILOTS' CENTER PANEL

AIR DRIVEN HYDRAULIC PUMP LOW PRESSURE LIGHT (Amber)

Illuminates when:
- Air driven hydraulic pump switch is in the OFF position.
- Air driven hydraulic pump is operating and output pressure is low.
- ADP fails to operate (pneumatic drive malfunction).

AIR DRIVEN HYDRAULIC PUMP SWITCH

AUTO – Air driven pump operates automatically to maintain system pressure above approximately 2600 psi. Pump will operate continuously if engine driven hydraulic pump is not operating.

NOTE: On airplanes S/Ns 19778 thru 19786 only, system 2, 3 and 4 pumps operate continuously when flap lever is in the 25 or 30 positions.

OFF – Shuts off pneumatic supply to pump.

CONTINUOUS – Pump operates continuously.

AIR DRIVEN HYDRAULIC PUMP RUN LIGHT (Blue)

Illuminates when air pump is operating.

HYDRAULIC LOW QUANTITY LIGHT (Amber)

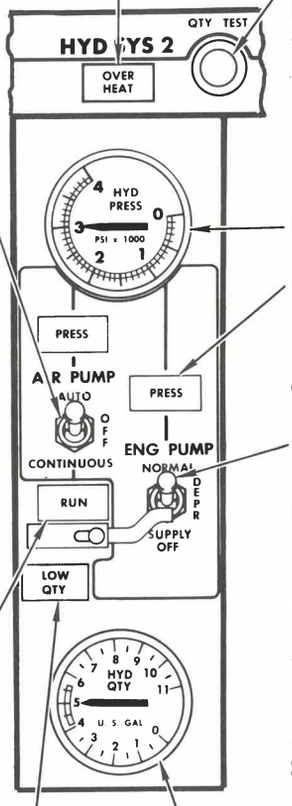
Illuminates when hydraulic quantity is low.

HYDRAULIC SYSTEM OVERHEAT LIGHT (Amber)

Illuminates when hydraulic fluid temperature is excessive.

QUANTITY TEST SWITCH

Press to check hydraulic quantity indicators.
Indicators are operational when indications move toward zero, then return to initial reading when switch is released.



HYDRAULIC PRESSURE INDICATOR

ENGINE DRIVEN HYDRAULIC PUMP LOW PRESSURE LIGHT (Amber)

Illuminates when engine pump output pressure is low.

ENGINE DRIVEN HYDRAULIC PUMP SWITCH

NORMAL – Hydraulic system pressurized when engine is operating.

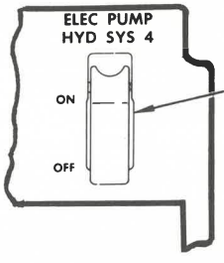
DEPR – Pump depressurized.

NOTE: Engine driven hydraulic pump low pressure light may not illuminate when air driven hydraulic pump is operating.

SUPPLY OFF (guarded) – Pump depressurized and engine pump fluid supply valve closed. (Guard shown not on early airplanes).

HYDRAULIC QUANTITY INDICATOR

FLIGHT ENGINEER'S PANEL



HYDRAULIC SYSTEM 4 ELECTRIC PUMP SWITCH

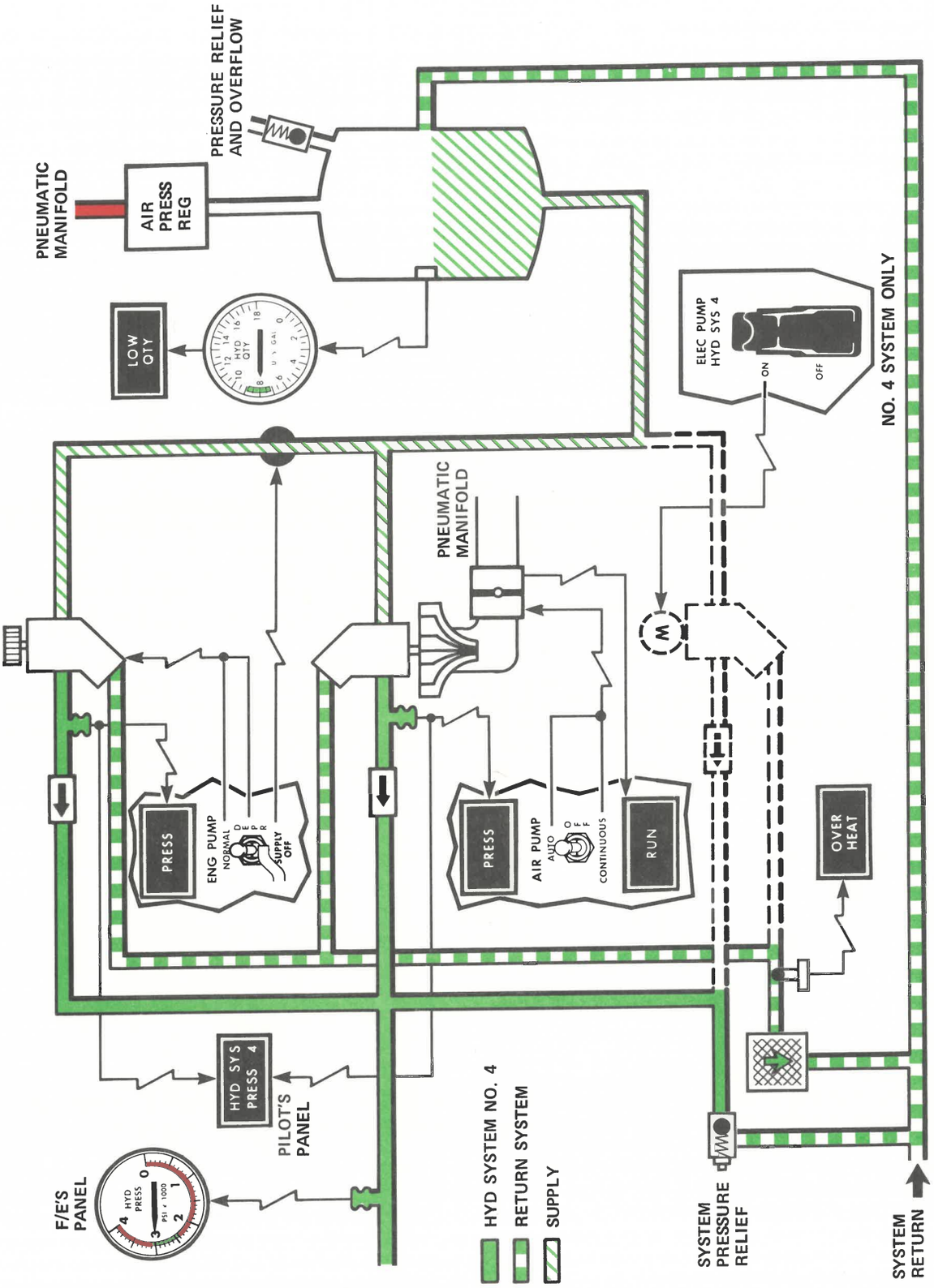
– Pressurizes hydraulic system 4.
– Pump can be operated only with APU or ground AC power.

NOTE: Pump should not be operated when system 4 engine or air driven hydraulic pumps are operating. On later airplanes switch will automatically move to OFF for this condition.

HYDRAULIC CONTROLS AND INDICATORS

HYDRAULIC POWER SCHEMATIC

HYDRAULIC POWER SYSTEM



HYDRAULIC POWER CONTROL & INDICATION

HYDRAULIC POWER SYSTEM

Hydraulic power is supplied by four independent systems. Each system incorporates an engine driven hydraulic pump and an air driven hydraulic pump. The pumps, reservoir and associated components are located at the engine and nacelle area. An electric driven hydraulic pump in system 4 is provided primarily for operation of the brake system during ground operations.

Hydraulic power is utilized for the operation of the flight control system including the trailing edge flaps and the stabilizer, and the landing gear system including braking and steering.

The four hydraulic systems provide power for the primary control surfaces. Each aileron, rudder, and inboard elevator surface is redundantly powered by two hydraulic systems and each of the three areas of control (roll, pitch and yaw) is powered by all four hydraulic systems.

Flight and ground spoilers are individually powered by one of three hydraulic systems. The inboard and outboard flaps are powered by two different hydraulic sources.

Trim movement and braking of the horizontal stabilizer is provided by two independent hydraulic motors and brakes, one pressurized from hydraulic system 2, the other from system 3.

A standby hydraulic system, which uses system 3 return fluid, provides standby power for the stabilizer. The pump is automatically powered by hydraulic system 1 when the pressure in system 3 is not sufficient for stabilizer operation.

Hydraulic systems 1 and 4 provide power for extending and retracting the landing gear and doors, for braking, and for steering. A separate reserve brake system is powered by system 2.

ENGINE DRIVEN HYDRAULIC PUMP

The engine driven hydraulic pump is a variable displacement type pump with the output pressure regulated to approximately 3000 psi. The pump is capable of operating at a reduced output with engines windmilling. The switch should be in the NORMAL position for all normal operations. Operation time in SUPPLY OFF position should be limited to two minutes to prevent pump damage. Operational time in SUPPLY OFF position should be entered in maintenance log.

AIR DRIVEN HYDRAULIC PUMP

The air driven hydraulic pump operates to supplement the engine driven hydraulic pump during high demand periods. The air pump is capable of supplying the normal system demands in the event of engine driven pump failure. The air pump is driven by bleed air from the pneumatic system; it can be supplied from engine or APU bleed air, or a ground air source. With the air driven hydraulic pump switch in the CONTINUOUS position, the air pump will run continuously whenever the pneumatic duct is pressurized. With the switch in the AUTO position, the pump will run as required to maintain a system pressure above 2600 psi. On early airplanes with switch in AUTO, the air driven hydraulic pumps for systems 2, 3 and 4 will operate continuously when flap lever is in the 25 or 30 positions.

The air pump has an overspeed trip circuit that will automatically close off the pneumatic supply to the air pump. This condition will be reflected by failure of the pump to operate normally in any switch position. Reset capability is not provided.

FLUID SUPPLY

Each system has an independent reservoir (no interconnect) with the capability of supplying fluid at all times. To prevent pump cavitation during high demand, the reservoirs are pressurized by air supplied from the pneumatic system.

The hydraulic quantity indication system is temperature compensated to account for fluid density changes during cold soak. Except for landing gear extension or retraction, hydraulic fluid quantity indication changes should be relatively small. Retraction of the landing gear will lower the quantity in the No. 4 reservoir approximately 2.5 gallons. The green band on the hydraulic quantity indicator is primarily for use during servicing.

Improper servicing can result in abnormal changes in quantity indication. Providing there is no low quantity indication, the system should operate normally.

HYDRAULIC FLUID SHUTOFF VALVES

A hydraulic fluid shutoff valve located in the nacelle area controls hydraulic fluid supply to the engine driven hydraulic pump. This valve will close when the engine fire switch is pulled or the flight engineer's engine driven hydraulic pump switch is moved to the SUPPLY OFF position.

HYDRAULIC FLUID COOLING

Heat exchangers are installed in the main fuel tanks to cool the pump case drain fluid before returning it to the reservoirs.

A hydraulic system should not be operated for extended periods on the ground when the associated fuel tank is near empty.

CHAPTER 17

CROSS REFERENCE

FOR	REFER TO	CHAPTER
Systems Utilizing Pitot Static and Temperature Probes	FLIGHT INSTRUMENTS	14

ENGINE ANTI-ICE

Engine anti-icing should be turned on during all ground or flight operations when icing conditions exist or are anticipated.

Engine
Ignition Switches.....FLT START
Nacelle
Anti-Ice Switches.....ON
Check NACELLE VALVE OPEN lights and STATOR VALVE OPEN lights illuminated.

When engine operation is stabilized and other flight conditions permitting:
Engine
Ignition Switches.....OFF

To turn engine anti-icing off:
Nacelle
Anti-Ice Switches.....OFF
Check NACELLE VALVE OPEN lights and STATOR VALVE OPEN lights extinguished.

USING ENGINE ANTI-ICE
Maintain at least 50% N1 RPM above 10,000 feet and at least 45% below 10,000 feet.

WING ANTI-ICE

Operate wing anti-ice system by turning it on following an icing encounter.

Wing Anti-Ice Switch.....ON
Check wing anti-ice VALVE lights illuminate then extinguish.

USING WING ANTI-ICE
Maintain at least 50% N1 RPM above 10,000 feet and at least 45% below 10,000 feet.

NOTE: If icing conditions exist turn wing anti-icing on before extending wing leading edge flaps. Anti-icing of leading edge flaps is not effective after they are extended.

RAIN REPELLENT

Rain repellent may be used any time rain intensity requires the use of windshield wipers. Apply repellent to one windshield at a time, allowing fluid to be spread and visibility to improve before applying to the other windshield.

NOTE: Do not use rain repellent on a dry windshield and if inadvertently applied do not use windshield wipers unless the windshield washer is activated first.

ARCING/DELAMINATED/SHATTERED OR CRACKED WINDOW

Affected Window
Heat Switch.....OFF
Windshield Air Control.....PULL
Applies conditioned air to the No. 1 windows for defogging.

NOTE: Rapid delamination and/or shattering of the outer glass ply does not affect structural integrity of the window. No airplane or cabin altitude change is necessary. Vision may be obstructed.

OVERHEAT LIGHT ILLUMINATED IN FLIGHT

Affected Window
Heat Switch.....CYCLE OFF-ON

IF OVERHEAT LIGHT ILLUMINATES AGAIN:
Affected Window
Heat Switch.....OVRD (IF INSTALLED) or OFF

IF OVERHEAT LIGHT ILLUMINATES IN OVERRIDE:
Affected Window
Heat Switch.....OFF
Windshield Air Control.....PULL

After landing with switch in OVRD:
Affected Window
Heat Switch.....OFF
Place affected window heat switch to OFF unless required for visibility.

NACELLE ANTI-ICE VALVE OPEN LIGHT FAILS TO ILLUMINATE

If valve fails to open avoid icing conditions. If failure occurs while in icing conditions buildup may occur at the nacelle. Damage to fan tip blades may be minimized if thrust reduction can be made prior to ice ingestion.

STATOR ANTI-ICE VALVE OPEN LIGHT FAILS TO ILLUMINATE

If valve fails to open avoid icing conditions if possible. If failure occurs in icing conditions maintain at least 70% N1 RPM when possible. During descent in prolonged icing conditions accelerate affected engine to 70% N1 periodically to clear residual ice from stator vanes.

NACELLE ANTI-ICE OVERPRESSURE LIGHT ILLUMINATES

If flight conditions permit reduce thrust to extinguish overpressure light (NAC TAI VALVE). Assure thrust reduction is short of HIGH STAGE light illumination.

NACELLE ANTI-ICE VALVE OPEN LIGHT FAILS TO EXTINGUISH

If the nacelle anti-ice valve remains open, no action is required unless the nacelle overpressure light (NAC TAI VALVE) illuminates.

STATOR ANTI-ICE VALVE OPEN
LIGHT FAILS TO EXTINGUISH

If stator anti-ice valve fails to close operate normally except use nacelle anti-ice system operating EPR limits for affected engine(s).

NOTE: Performance may be affected when dispatching with stator anti-ice valve open.

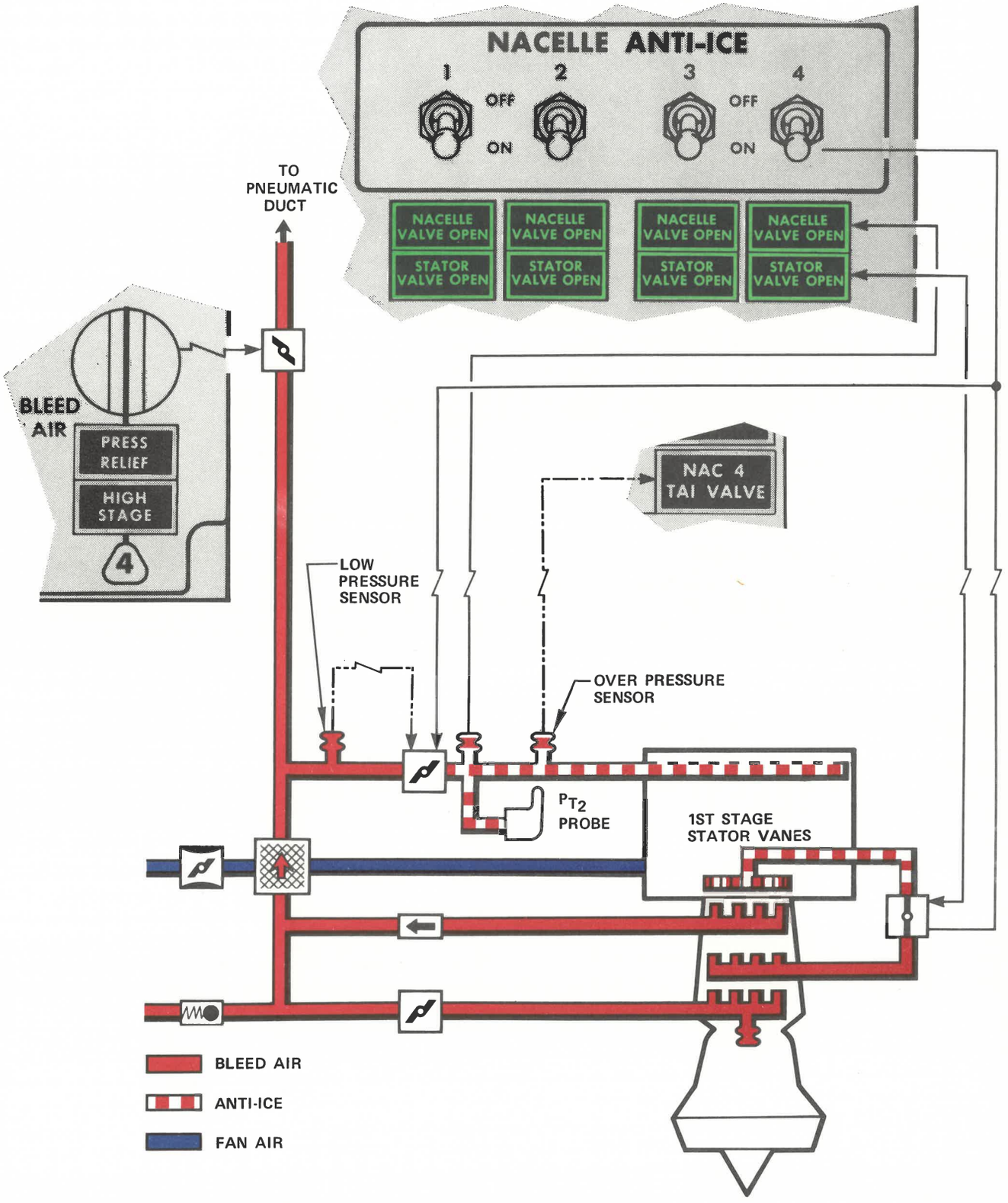
WING ANTI-ICE VALVE LIGHT
REMAINS ILLUMINATED WITH
WING ANTI-ICE SWITCHED ON

If anti-ice valve fails to open avoid icing conditions.

WING ANTI-ICE VALVE LIGHT
REMAINS ILLUMINATED AFTER
SWITCHING ANTI-ICE OFF

If wing anti-ice valve fails to close no action is required for inflight operation.

FOR GROUND OPERATIONS:
Duct Isolation Valve Switch
(affected wing).....CLOSE
Engine Bleed Air Valves
(both engines on
affected side).....CLOSE



NACELLE ANTI-ICE

ENGINE ANTI-ICE

The engine inlet cowl, the engine 1st stage stators and the Pt2 EPR probe are anti-iced by engine bleed air. The engine 1st stage stators are anti-iced by a separate engine bleed air source. Engine bleed air from the pneumatic system is routed to the inlet cowl and Pt2 EPR probe areas through the nacelle anti-ice valve which limits the maximum pressure of the bleed air. At low duct pressures the nacelle anti-ice valve will close and the NACELLE VALVE OPEN light will extinguish. In event of a valve malfunction allowing higher pressure air into a nacelle anti-ice system, the NAC TAI VALVE light will illuminate.

Icing of the Pt2 EPR probe will be indicated by abnormal EPR indications.

WING ANTI-ICE

The wing anti-ice system routes engine bleed air to the wing leading edge area. To prevent possible damage to the leading edge flaps anti-icing should be turned on prior to extending flaps. When turning the system off, the valve light should be monitored until extinguished.

The system is deactivated when airplane is on the ground by the landing gear tilt switches. A ground test switch position is provided to check valve operation on the ground. During the ground test, the valve will automatically close when wing leading edge temperatures become excessive.

WINDOW HEAT

The pilots' No. 1 windows are electrically heated using proportional heat controllers. When turning on window heat, electric current is applied to the windows taking approximately six minutes to obtain full heating. The controller will cut off power to the affected window when an overheat condition exists.

The pilots' No. 2 and No. 3 windows are electrically heated with a constant heating power. An overheat thermostat in each window will cut off power to that window when a window overheat condition exists.

The interior surface of the No. 1 windows will be slow to heat. Both the exterior and interior surfaces of the No. 2 and No. 3 windows will be slow to heat.

Conditioned air may be used for internal surface defogging. If operating at altitude after the loss of heat to a No. 1 window, anti-fog protection can be obtained by anticipating fogging during descent. For this condition cockpit conditioned air temperature can be increased to (27°C) (80°F), affected windshield air control opened and the respective foot-air control closed, approximately 1/2 hour in advance of expected fogging.

NOTE: On later windshields, an anti-static coating is applied to the outer windshield layer. With window heat voltage applied, a shock hazard exists for personnel contacting the windshield from the outside.

CHAPTER 18

CROSS REFERENCE

FOR	REFER TO	CHAPTER
Landing Gear Hydraulic Power	HYDRAULIC POWER	16

MANUAL NOSE GEAR EXTENSION

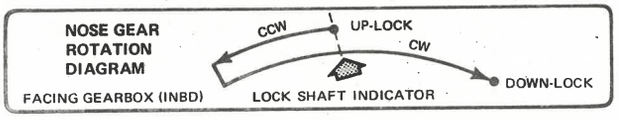
This method of extending the nose gear is provided for use in event that the nose gear fails to extend or does not lock in the down position, following alternate gear extension procedure.

Landing Gear Lever.....OFF

A crank, wrench, instruction placard, and the extension gearbox are located at the left side of the nose wheel well in the lower electronic compartment. Procedural steps for use of manual nose gear extension are contained on the facsimile of the actual instruction placard.

Landing Gear Lever.....DN
Check GEAR DOWN light illuminated.

N.L.G. MANUAL EXTENSION



ARROW IN GREEN ZONE INDICATES GEAR DOWN & LOCKED.

TO RELEASE GEAR – ARROW IN BLACK ZONE:

1. DISCONNECT ELECTRICAL PLUG.
2. REMOVE ELECTRICAL ACTUATOR & COVER PLATE.
3. INSERT CRANK IN LOWER DRIVE SOCKET.
4. ROTATE CRANK A MINIMUM OF 8 TURNS CCW.
5. CHECK GEAR DOWN & LOCKED – ARROW IN GREEN ZONE.

TO DOWN-LOCK GEAR:

1. PERFORM OPERATIONS 1, 2 & 3 ABOVE.
2. BREAK LOCKWIRE & REMOVE KNURLED KNOB.
3. REVERSE INDICATOR (RED END OUTB'D) & ROTATE CRANK CCW UNTIL INDICATOR ENGAGES SLOTTED SHAFT.
4. REPLACE & TIGHTEN KNOB.
5. NOTE POSITION OF LOCK SHAFT INDICATOR ARROW (SEE N.G. ROTATION DIAGRAM ABOVE):
   A. ARROW TO THE RIGHT OF THE UP-LOCK POSITION – ROTATE CRANK CW TO THE DOWN AND LOCKED POSITION.
   B. ARROW TO THE LEFT OF THE UP-LOCK POSITION – ROTATE CRANK CCW TO THE TRAVEL LIMIT, THEN ROTATE CRANK CW TO THE DOWN AND LOCKED POSITION.
6. CHECK GEAR DOWN AND LOCKED – ARROW IN GREEN ZONE.
7. CONTINUE APPLYING LOAD CW AND SECURE CRANK BY INSERTING PIN (WRENCH HANDLE) THROUGH MATCHING HOLES IN CRANK FLANGE AND GEARBOX.

CAUTION: RESTORE DOWN LOCKING INDICATOR TO NORMAL POSITION (RED END INB'D) BEFORE RETRACTING NOSE GEAR.

MANUAL NOSE GEAR DOOR RELEASE

(This facility not on early airplanes.)

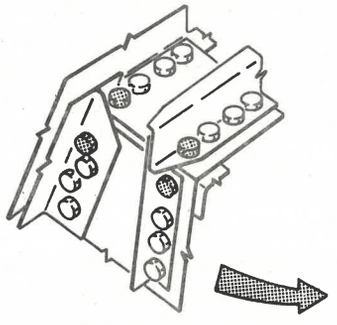
If during Manual Nose Gear Extension procedure TO RELEASE GEAR, the nose gear releases but the crank cannot be rotated the minimum of 8 turns as defined under item number 4.

NOTE: For this condition the nose gear lock shaft indicator will be positioned counterclockwise out of the up lock position. The increased noise levels associated with doors open will also be missing.

A wrench and instruction placard are located on the bulkhead forward of the nose gear manual extension facilities. Follow procedural steps for releasing nose gear door actuator fitting contained on the placard.

With doors released complete Manual Nose Gear Extension procedure.

NOSE GEAR DOOR ACTUATOR FITTING REMOVAL INSTRUCTIONS



- REMOVE INSULATION FROM TOP LEFT HAND FORWARD CORNER OF NOSE WHEEL WELL.
- REMOVE THE TWELVE BOLTS WITH UNPAINTED HEADS FIRST.
- REMOVE LAST FOUR BOLTS WITH RED HEADS IN DIAGONALLY OPPOSITE SEQUENCE.
- USE CAUTION WHEN REMOVING LAST FOUR BOLTS.

GEAR NOT CENTERED LIGHT ILLUMINATED
(Airplane not in a taxi turn)

Body Gear
Steering Switch....MOVE TO PRIM AND ALT POSITIONS

A respective gear is not centered and locked if a body gear steering UNLOCKED light illuminates during both PRIM and ALT checks.
- ON GROUND: DO NOT TAKE OFF.
- IN FLIGHT: DO NOT RETRACT GEAR.

A respective gear is centered and locked if UNLOCKED light remains extinguished during either PRIM or ALT checks.

LANDING GEAR LEVER WILL NOT MOVE TO UP POSITION

Indicator Light
Test Switch.....TEST
Check four tilt annunciator lights and two body gear steering lights illuminated.

Check GEAR NOT CENTERED light extinguished. If GEAR NOT CENTERED light is illuminated use GEAR NOT CENTERED LIGHT ILLUMINATED procedure prior to continuing following procedure.

Tilt Primary
Annunciator Switch.....PRESS
All four tilt annunciator lights should be extinguished.

Tilt Alternate
Annunciator Switch.....PRESS
All four tilt annunciator lights should be extinguished.

If both primary and alternate tilt annunciator lights or body gear steering UNLOCKED lights for any one gear fail to extinguish leave gear extended.

With an indication that all four main gears are tilted and one indication that each body gear is centered, the landing gear lever latch can be manually overridden.

Landing Gear
Lever Latch.....MOVE TO RIGHT
Landing Gear Lever.....UP

GEAR DOOR OPEN LIGHT REMAINS ILLUMINATED

Door Primary
Annunciator Switch.....PRESS
All five door open annunciator lights should be extinguished.
Door Alternate
Annunciator Switch.....PRESS
All five door open annunciator lights should be extinguished.

If a door open annunciator light illuminates during both primary and alternate checks, the V1o must be observed.

RED GEAR LIGHT REMAINS ILLUMINATED

(Thrust lever(s) not at idle setting)

FOLLOWING GEAR RETRACTION:

Gear Door Open
Light.....CHECK EXTINGUISHED
If illuminated, follow GEAR DOOR OPEN LIGHT REMAINS ILLUMINATED alternate procedure prior to completing this procedure.

Gear Primary
Annunciator Switch.....PRESS
Gear down annunciator lights should be extinguished.

Gear Alternate
Annunciator Switch.....PRESS
Gear down annunciator lights should be extinguished.

With all doors closed and all gear retracted (no gear down indications), the gear is retracted.

With any door open or any gear down indication observe Vlo placard.

NOTE: Landing gear warning horn may sound if flaps are not retracted.

FOLLOWING GEAR EXTENSION:

NOTE: The red gear light will remain illuminated if any gear annunciator lights fails to indicate landing gear down and locked.

Gear Primary
Annunciator Switch.....PRESS
All five gear down annunciator lights should illuminate.

Gear Alternate
Annunciator Switch.....PRESS
All five gear down annunciator lights should illuminate.

A respective gear is down and locked if the GEAR DOWN annunciator light illuminates during either check.

A respective gear is not down and locked if the GEAR DOWN annunciator light fails to illuminate during both checks.

ANTI-SKID LIGHT ILLUMINATED

Check F/E's anti-skid annunciator module for wheel or wheels affected.

Anti-Skid Switch.....LEAVE ON
Braking effectiveness could be reduced proportionally to the number of annunciator lights illuminated.

To minimize the possibility of tire blowout, use moderate braking action, consistent with runway conditions, for stopping.

ANTI-SKID HYDRAULIC LIGHT ILLUMINATED

If the anti-skid hydraulic light remains illuminated after parking brakes are released, operation of the braking system may be affected and the anti-skid system should be considered inoperative.

GROUND SAFETY RELAY LIGHT ILLUMINATED INFLIGHT

GRD SAFE RELAY Circuit Breaker (P12 panel).....PULL
Check ground safety relay light extinguished.

NOTE: - Engines will operate with ground idle setting. GRD IDLE light should illuminate with flaps in landing configuration.
- Speed brake lever stop at flight detent will not be active.

GRD SAFE RELAY Circuit Breaker.....PUSH IN BEFORE LANDING
Check ground safety relay light illuminated.

CAUTION: NO. 1 & 4 THRUST REVERSERS AND BODY GEAR STEERING WILL BE INOPERATIVE WITH "GRD SAFE RELAY" CIRCUIT BREAKER PULLED.

GEAR DOOR OPEN LIGHT (Red)

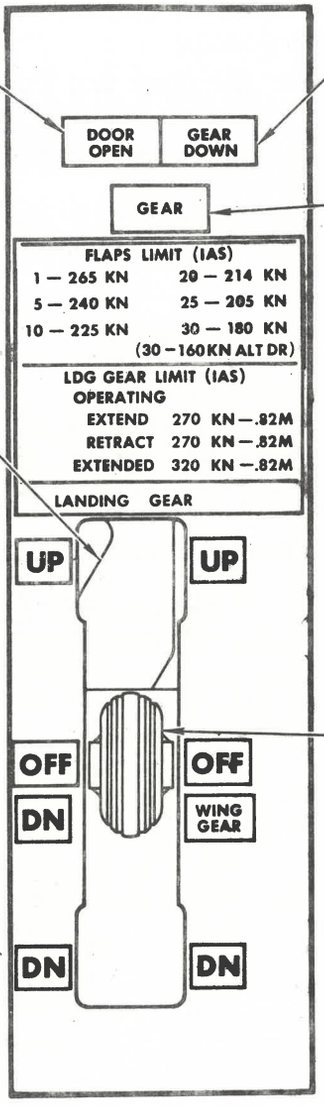
Illuminates with any one indication of a door open.

NOTE: A door can be considered closed if either the primary or the alternate annunciator lights indicate door closed.

LANDING GEAR LEVER LATCH

Locks landing gear lever out of UP position when airplane is on the ground. Automatically releases when body gears are centered and all primary or alternate tilt annunciator lights indicate airplane is in flight.

NOTE: The lever latch can be released manually by moving latch to the right to clear landing gear lever.



PILOTS' CENTER PANEL

GEAR DOWN LIGHT (Green)

Illuminates when landing gear is down and locked.

RED GEAR LIGHT

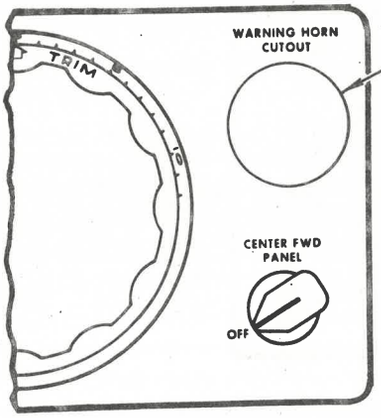
Illuminates for the following conditions:

- Landing gear not down and locked and any thrust lever retarded to IDLE.
- Landing gear in transit or not in agreement with the landing gear lever. Except light will not illuminate with gear and flaps up and landing gear lever in OFF position.
- Landing gear up with flaps in 25 or 30 position.

LANDING GEAR LEVER

OFF — Depressurizes landing gear hydraulic system.

DN WING GEAR — Extends wing gear only.



PILOTS' CONTROL STAND

WARNING HORN CUTOUT SWITCH

Push to silence and reset horn. With the landing gear not down and locked a steady horn will sound as follows:

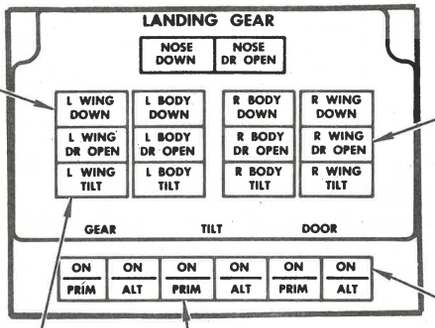
- With the flaps in a maneuvering detent (1 thru 20), any time a thrust lever is retarded to IDLE. The horn can be silenced (reset) with the warning horn cutout switch.
- With flaps 25 or 30 and thrust levers in any position, the warning horn cannot be silenced.

GEAR DOWN ANNUNCIATOR LIGHTS (Green)

Will illuminate when checked with gear down and locked.

NOTE:

- Pilots' gear down light will illuminate if all primary or all alternate gear down annunciator lights indicate gear down and locked.
- Pilots' red gear light will be illuminated with landing gear lever in DN position and any one primary or alternate gear down annunciator light indicates gear not down and locked.



FLIGHT ENGINEERS PANEL

DOOR ANNUNCIATOR LIGHTS (Amber)

Will illuminate when checked with door open.

PRIMARY ANNUNCIATOR SWITCHES

PRESS AND HOLD — The response of selected primary annunciator lights will be displayed.

TILT ANNUNCIATOR LIGHTS (Amber)

Will illuminate when checked with airplane on ground (gear not tilted).

NOTE: Airplane inflight (indicated by the tilt annunciator lights extinguished):

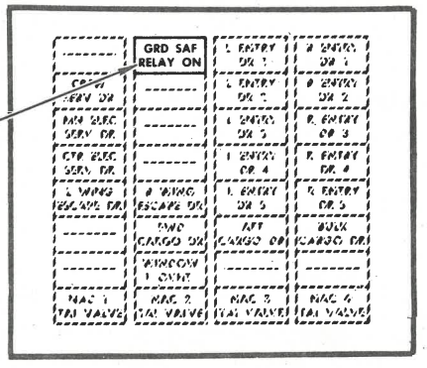
- Releases landing gear lever latch.
- Deactivates takeoff warning.
- De-energizes the ground safety relay.
- Activates anti-skid touchdown protection.
- Activates auto ground spoilers on landing.

ALTERNATE ANNUNCIATOR SWITCHES

PRESS AND HOLD — The response of selected alternate annunciator lights will be displayed.

GROUND SAFETY RELAY LIGHT (Green)

Illuminates when in the ground operations mode. (Tilt annunciator lights will indicate airplane on ground).



FLIGHT ENGINEER'S PANEL

LANDING GEAR ANNUNCIATOR MODULE

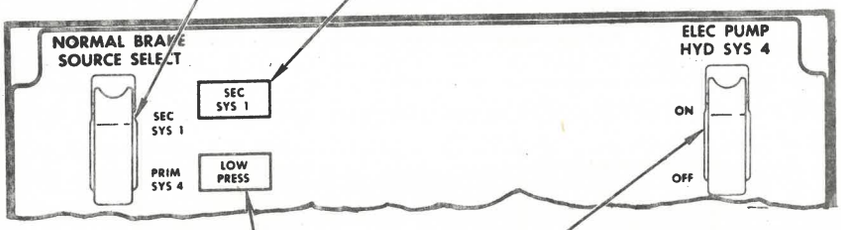
NORMAL BRAKE SOURCE SWITCH

Selects hydraulic power source for normal brake system.

HYDRAULIC SYSTEM 1 SELECT LIGHT (Green)

Illuminated when hydraulic system 1 is selected to pressurize brake system.

ENGINEER'S PANEL



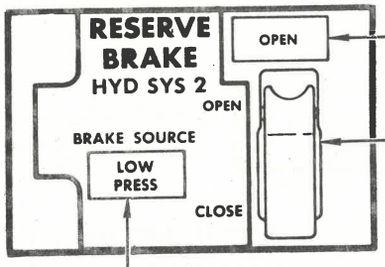
BRAKE LOW PRESSURE LIGHT (Amber)

- Illuminates when selected brake system pressure is low.
- Will remain illuminated when hydraulic system 4 electric pump is pressurizing brake system.

HYDRAULIC SYSTEM 4 ELECTRIC PUMP SWITCH

Primarily provided to power brakes during ground handling operations.
Switch will automatically move to OFF with loss of electrical power.

FORWARD ELECTRONICS PANEL



RESERVE BRAKE VALVE OPEN LIGHT (Green)

Illuminates when reserve brake valve is open.

RESERVE BRAKE SWITCH

Opens reserve brake valve pressurizing reserve brake system.

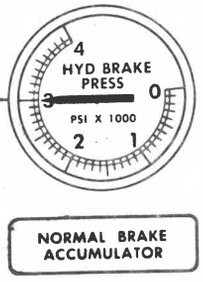
NOTE: Parking brakes will not hold with hydraulic system No. 2 depressurized.

BRAKE LOW PRESSURE LIGHT (Amber)

- Illuminates when selected brake system pressure is low.
- Will remain illuminated when hydraulic system 4 electric pump is pressurizing brake system.

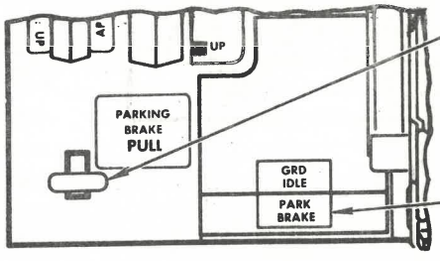
HYDRAULIC BRAKE PRESSURE INDICATOR

Indicates normal brake system pressure.
With no system pressure and parking brakes not set, indicates accumulator precharge pressure.



FIRST OFFICER'S PANEL

PILOTS' CONTROL STAND



PARKING BRAKE LEVER

To set brakes, move lever aft with brakes applied.
Apply brakes to release parking brakes.

PARKING BRAKE LIGHT (Red)

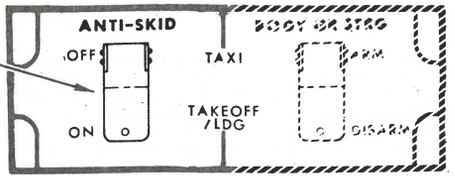
Illuminates when parking brakes are set.

BRAKE SYSTEM

ANTI-SKID SWITCH

OFF – All anti-skid annunciator lights will illuminate except the anti-skid hydraulic light.

ON – Anti-skid system is operative when any gear is extended.



PILOTS'
OVERHEAD PANEL

PILOTS' CENTER
PANEL

ANTI-SKID LIGHT (Amber)

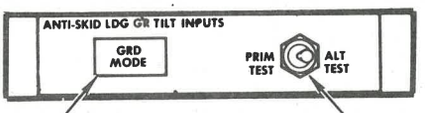
Illuminates to indicate electrical failure in the antiskid system.

NOTE: Anti-skid light and annunciators are deactivated when the landing gear is retracted.

ANTI-SKID HYDRAULIC LIGHT (Amber)

– When illuminated, parking brake valve is not in the full open position.
– Anti-skid system may be inoperative when valve is not fully open.

FLIGHT ENGINEER'S
PANEL



(PANEL INSTALLED ON LATER AIRPLANES ONLY)

ANTI-SKID GRD MODE LIGHT (Green)

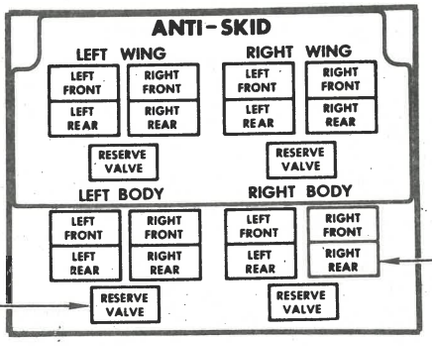
– If light illuminates during test anti-skid operation is normal.
– If light fails to illuminate switch anti-skid OFF for all taxi operations.

NOTE: Panel has no operational use with the present anti-skid system limitations.

ANTI-SKID GRD MODE TEST SWITCH

FOR GROUND TEST ONLY
Hold in PRIM or ALT positions to check landing gear on ground (not tilted) input to anti-skid system.

FLIGHT ENGINEER'S
PANEL



RESERVE VALVE ANNUNCIATOR LIGHTS (Amber)

Illuminate to indicate an electrical failure in reserve anti-skid valve.

ANTI-SKID ANNUNCIATOR LIGHTS (Amber)

Illuminate to indicate an anti-skid electrical failure for the indicated wheel.

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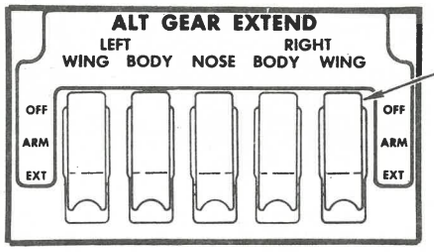
PILOTS' OVERHEAD PANEL



ALTERNATE GEAR EXTEND SWITCHES

EXT – Hold to initiate the landing gear extension cycle. Door annunciator light will illuminate indicating extension cycle has started.

ARM – Leave in ARM position to continue alternate extend cycle.

GEAR NOT CENTERED LIGHT (Amber)

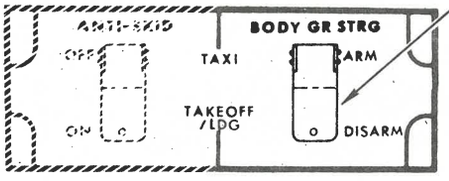
Illuminates for either a PRIM or ALT body gear unlocked indication.

NOTE: A warning horn will sound on advancing No. 3 thrust lever for take off and landing gear lever latch will not release with PRIM and ALT indication that body gear is not centered.

GEAR NOT CENTERED

PILOTS' CENTER PANEL

PILOTS' OVERHEAD PANEL



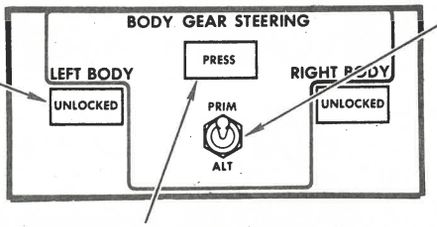
BODY GEAR STEERING SWITCH

DISARM position deactivates body gear steering for takeoff and landing.

NOTE: Body gear steering can also be deactivated by pulling Body Gear Steering Arm and Indicator CB on P-12 panel.

BODY GEAR STEERING UNLOCKED LIGHTS (Amber)

Illuminates for an unlocked indication for the selected PRIM or ALT systems.



BODY GEAR STEERING SWITCH

Monitors steering locked indications for selected PRIM or ALT systems.

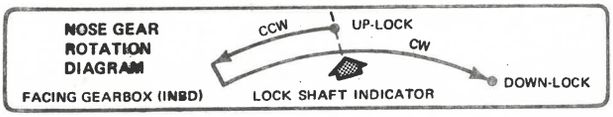
FLIGHT ENGINEER'S PANEL

BODY GEAR STEERING PRESSURE LIGHT (Amber)

Illuminates when body gear steering is powered and nose gear steering is being utilized.

NOTE: On some airplanes body gear steering will be deactivated at large rudder pedal deflections.

N.L.G. MANUAL EXTENSION



ARROW IN GREEN ZONE INDICATES GEAR DOWN & LOCKED.

TO RELEASE GEAR – ARROW IN BLACK ZONE:

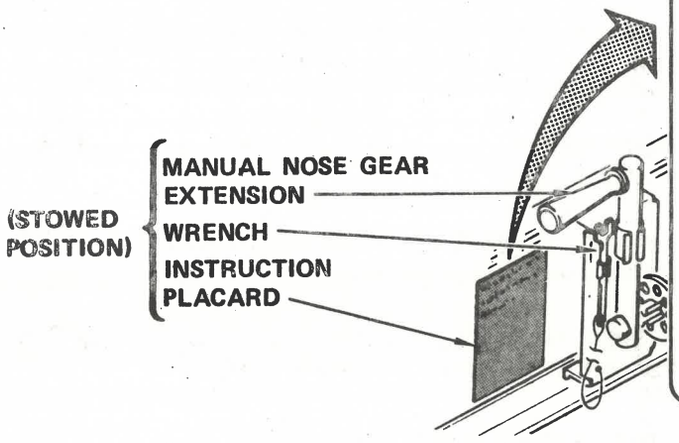
1. DISCONNECT ELECTRICAL PLUG.
2. REMOVE ELECTRICAL ACTUATOR & COVER PLATE.
3. INSERT CRANK IN LOWER DRIVE SOCKET.
4. ROTATE CRANK A MINIMUM OF 8 TURNS CCW.
5. CHECK GEAR DOWN & LOCKED – ARROW IN GREEN ZONE.

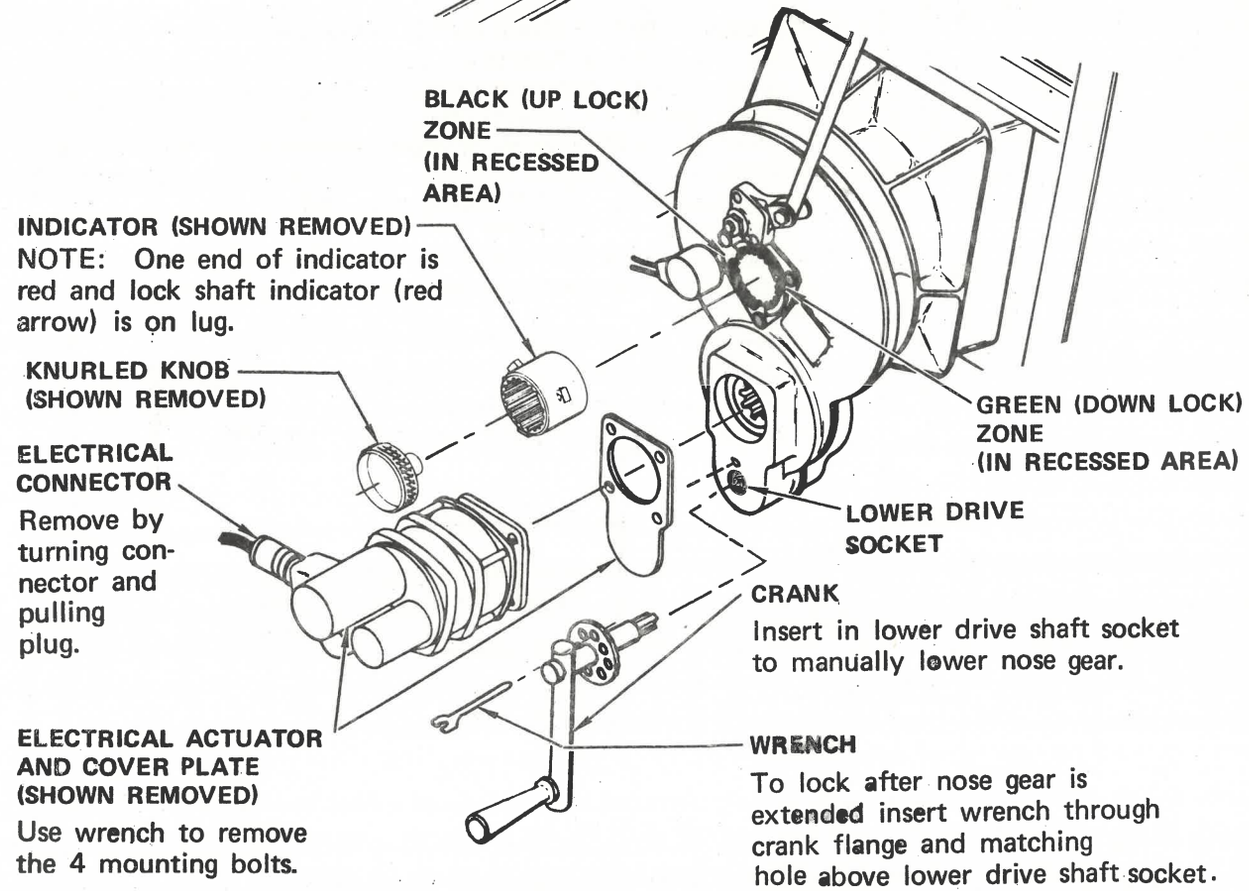
TO DOWN-LOCK GEAR:

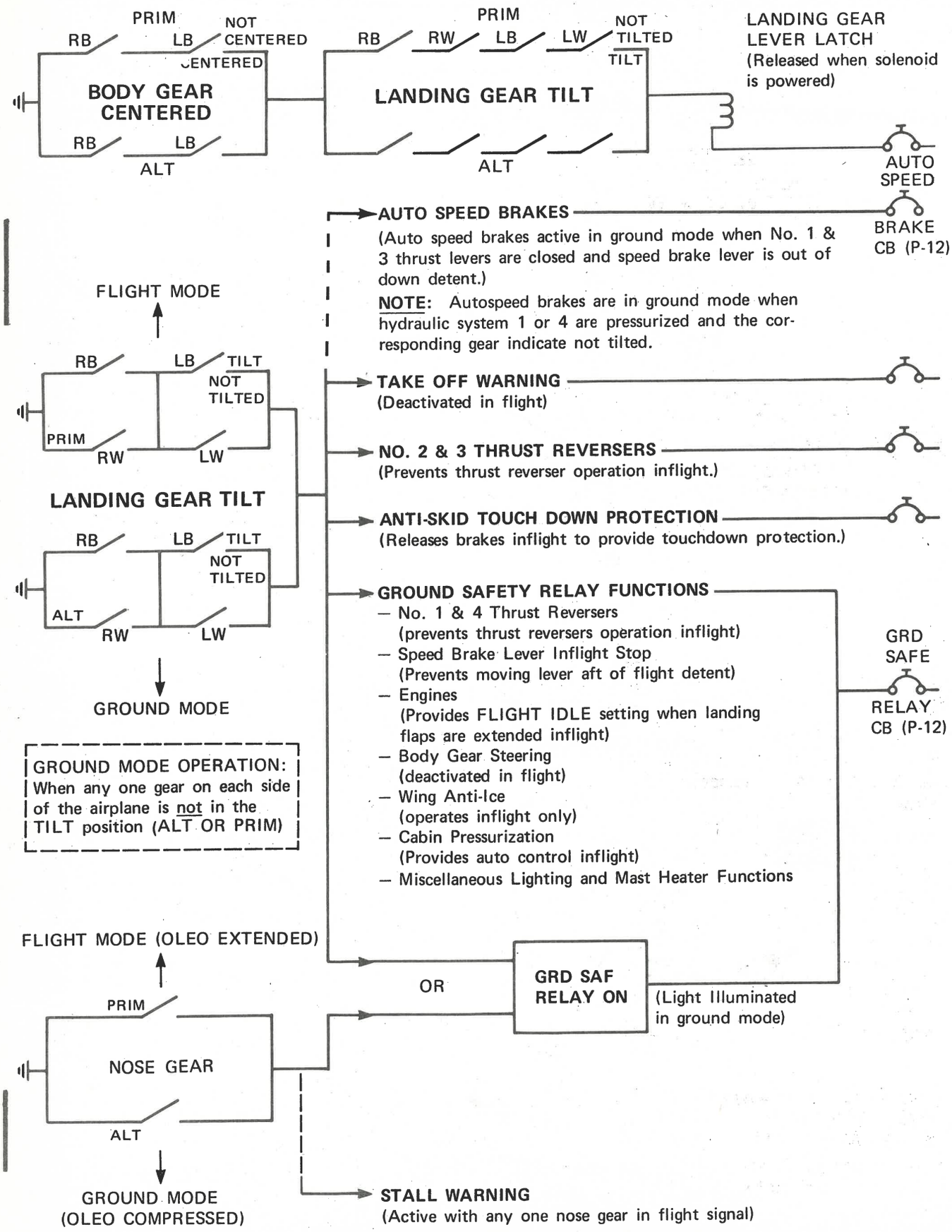
1. PERFORM OPERATIONS 1, 2 & 3 ABOVE.
2. BREAK LOCKWIRE & REMOVE KNURLED KNOB.
3. REVERSE INDICATOR (RED END OUTB'D) & ROTATE CRANK CCW UNTIL INDICATOR ENGAGES SLOTTED SHAFT.
4. REPLACE & TIGHTEN KNOB.
5. NOTE POSITION OF LOCK SHAFT INDICATOR ARROW (SEE N.G. ROTATION DIAGRAM ABOVE):
   A. ARROW TO THE RIGHT OF THE UP-LOCK POSITION – ROTATE CRANK CW TO THE DOWN AND LOCKED POSITION.
   B. ARROW TO THE LEFT OF THE UP-LOCK POSITION – ROTATE CRANK CCW TO THE TRAVEL LIMIT, THEN ROTATE CRANK CW TO THE DOWN AND LOCKED POSITION.
6. CHECK GEAR DOWN AND LOCKED – ARROW IN GREEN ZONE.
7. CONTINUE APPLYING LOAD CW AND SECURE CRANK BY INSERTING PIN (WRENCH HANDLE) THROUGH MATCHING HOLES IN CRANK FLANGE AND GEARBOX.

CAUTION: RESTORE DOWN LOCKING INDICATOR TO NORMAL POSITION (RED END INB'D) BEFORE RETRACTING NOSE GEAR.

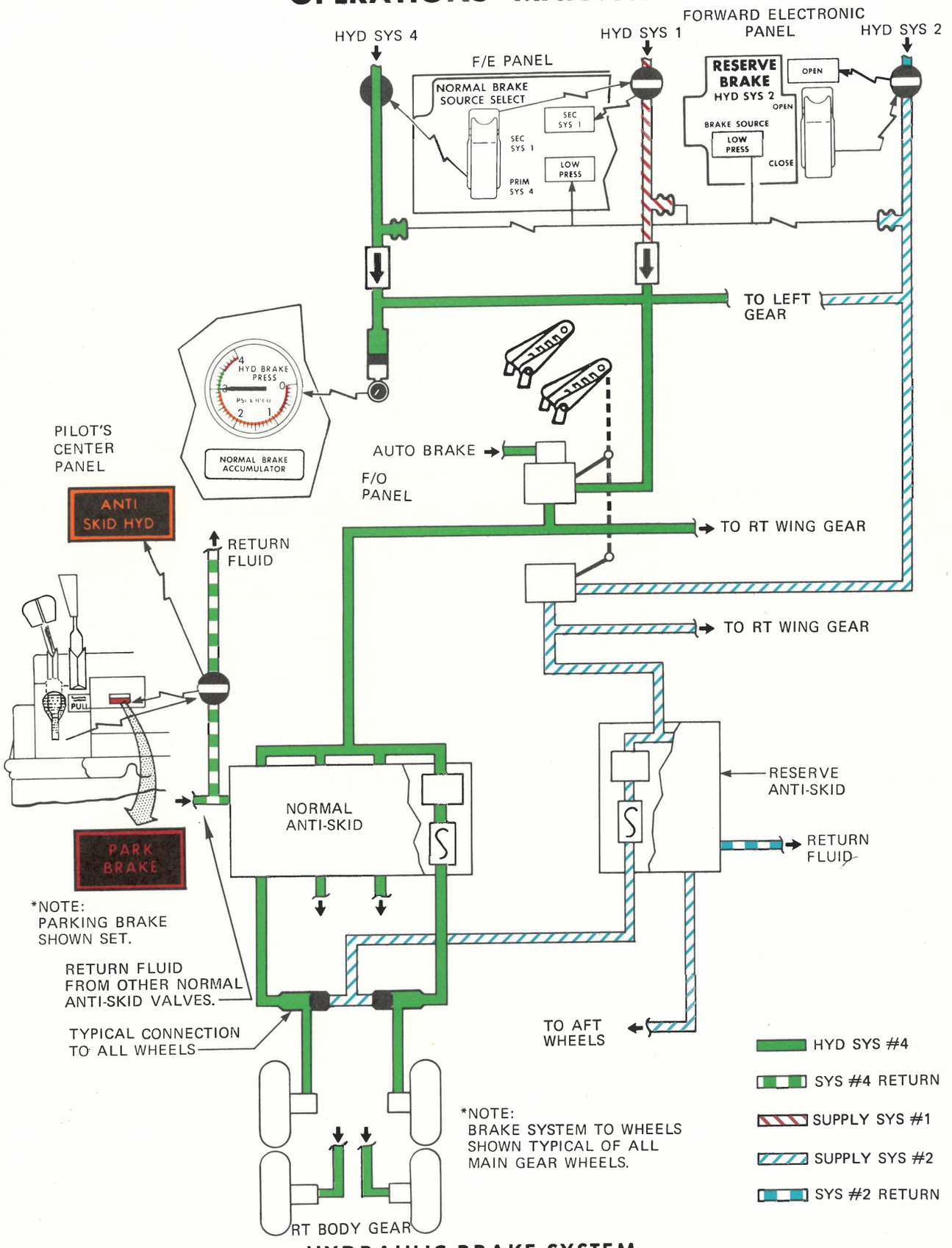
LOWER ELECTRONIC
COMPARTMENT
LEFT SIDE OF WHEEL
WELL







LANDING GEAR TILT FUNCTIONS



HYDRAULIC BRAKE SYSTEM

LANDING GEAR

Normal landing gear extension and retraction power is supplied by two independent hydraulic sources; the No. 1 hydraulic system for the nose and body gear and the No. 4 system for the wing gear. The alternate extension system utilizes electric motors to unlock the doors and the landing gear. Landing gear weight and air loading will extend gear to the locked position. Manual extension facilities are also provided for the nose gear. The landing gear doors require hydraulic power to close after once being opened. During initial retraction, automatic braking is applied to the main gear wheels.

The main landing gear trucks must be in a tilted position before retracting the gear. A lever latch prevents the landing gear lever from being moved to the UP position until all primary or all alternate TILT sensors indicate gear tilted. With one of the two TILT sensors on each main gear indicating gear tilted, the gear can be considered safe for retraction. The lever latch can be manually moved allowing the landing gear to be retracted.

The wing landing gear can be extended separately for use as air brakes. Resulting airflow and pressures for this configuration may result in the body gear DOOR OPEN lights illuminating.

Although the landing gear is designed to permit emergency landings to be accomplished with a combination of any one main gear on each side of the airplane and the nose gear down and locked, the one wing gear not extended configuration should be avoided. The airplane attitude with one wing gear not extended will be wing low on the side gear is not extended. For these configurations, with not all gear extended, the increased loads on the remaining gear will decrease strength margin.

LANDING GEAR POSITION SENSORS

A primary and an alternate system of sensors are utilized for landing gear position indications and warnings. The primary (PRIM) system has sensors to determine the following:

- gear down and locked.
- gear up and locked.
- gear tilted.
- gear doors closed.

The alternate (ALT) system has sensors to determine the following:

- gear down and locked.
- gear tilted.
- gear doors closed.
- nose gear up.

Annunciator lights are provided on the flight engineer's landing gear annunciator module to display the indications from either the primary or alternate system. Annunciator lights are not provided for the gear up and locked sensors.

The landing gear position indication and warnings with either the primary or alternate system inoperative will be normal except for the following:

- If the primary system is deactivated the red GEAR light will not illuminate with gear down and locked even though the lever is out of the DN detent.

GROUND SAFETY RELAY

Ground or inflight functions of various airplane equipment are controlled by the ground safety relay. Failure of the ground safety relay to operate in the inflight mode is indicated by the ground safety relay light remaining illuminated.

BRAKES

All the main landing gear wheels have hydraulic braking. The normal brake system is powered by the No. 4 hydraulic system, with system No. 1 as an alternate source. When utilizing system No. 1 as an alternate hydraulic source, common tubing is utilized downstream of the normal brake source select valve. The brake pressure indicator reflects the normal brake system pressure at the accumulator when using either system No. 4 or 1. With loss of system hydraulic pressure, the brake pressure should hold unless the brake pedals are depressed or a leak has occured in the normal brake system.

A reserve brake system, powered by the No. 2 hydraulic system, is also provided. Braking with either the normal or reserve brake system is modulated by the anti-skid system. On later airplanes that have the ANTI-SKID LDG GR TILT INPUTS panel, the reserve brake system does not have touchdown protection. Parking brakes will not hold when hydraulic system N. 2 is depressurized.

ANTI-SKID

The anti-skid system modulates the brake pressure to prevent tire damage and skidding of the wheels. With the anti-skid switch in the ON position, the system is operative when one main landing gear is down and locked. The system has annunciator lights to indicate system malfunctions. The anti-skid system is inoperative and anti-skid hydraulic light is illuminated when parking brakes are set.

Skid protection is provided for each wheel. Each wheel is compared with a wheel on the opposite side of the airplane for locked wheel protection. The wheel skid function prevents each wheel from skidding by reducing brake pressure to that wheel.

The system provides protection against inadvertent brake application at touchdown (touchdown protection). This function is controlled by an input from the landing gear tilt sensors which electrically prevents braking until one gear on each side of the airplane is on the ground.

STEERING

Nose and body gear steering is powered by the No. 1 hydraulic system. Both of the pilots' tillers will control nose wheel steering. The body gear steering is controlled by nose wheel position. The body gear steering will operate automatically during medium to sharp turns. All steering is deactivated in flight. A switch is provided to deactivate body gear steering for takeoff and landing.

With hydraulic system No. 1 depressurized the use of the tiller in direction of turn will improve turning capability. However, application of high forces on the nose wheel tiller may result in misalignment of the nose gear and tiller.

LANDING GEAR DOORS (RELEASE HANDLES)

The hydraulically actuated doors are powered by the hydraulic system used to operate the respective gear, hydraulic system 1 for the nose and body gear hydraulic system 4 for the wing gear. Two ground release handles, one in each body gear wheel well, will release both wing and body gear doors on the respective side of the airplane. One ground door release handle is in the nose wheel well. Operating instructions are located at each handle.

Landing gear door release handles must be in the "DOOR OPEN" position and locked while doors are open. Before pressurizing hydraulic systems 1 or 4 the position of the doors and release handles should be verified.

BRAKE COOLING

To prevent the possibility of brake overheat, precautions are necessary when braking is used during landings. The brake energy chart (reference page 18.50.05) provides a means to approximate the heat energy levels in the brakes. The rejected takeoff shown as dashed lines on the chart represent brake energy levels associated with a maximum braking effort. The normal landing stop lines represent brake energy levels associated with a moderate braking stop. The use of reverse thrust will substantially reduce the resultant brake energy levels.

Brake cooling time with the airplane parked or inflight with the gear retracted is relatively long. With the gear retracted and doors closed, air circulation for cooling is reduced to a minimum. Cooling time can be substantially reduced by leaving gear extended inflight.

If more than one stop is made without allowing time for brake cooling, the brake energy levels will be additive. The use of excessive braking during taxi operations will increase the brake energy level significantly.

The brake housing and wheel temperatures will continue to rise after a braking stop for as much as 30 minutes.

DANGER RANGE

- Clear runway immediately after stop (tires will deflate).
- Do not set parking brakes.
- Anticipate wheel fires (hydraulic fluid, grease or tires).
  - Dry chemical extinguishers preferred, fog or foam acceptable.

CAUTION: **APPROACH WHEELS ONLY IF FIRE OCCURS. IF ONE OR MORE TIRES REMAIN INFLATED APPROACH FROM THE FRONT OR REAR.**

  - Avoid spraying extinguisher or coolant directly on inflated tires or wheels.
  - After one hour fog or foam may be used to reduce cooling time. If tires are deflated water may be used.
- Mandatory tire, wheel and brake replacement.

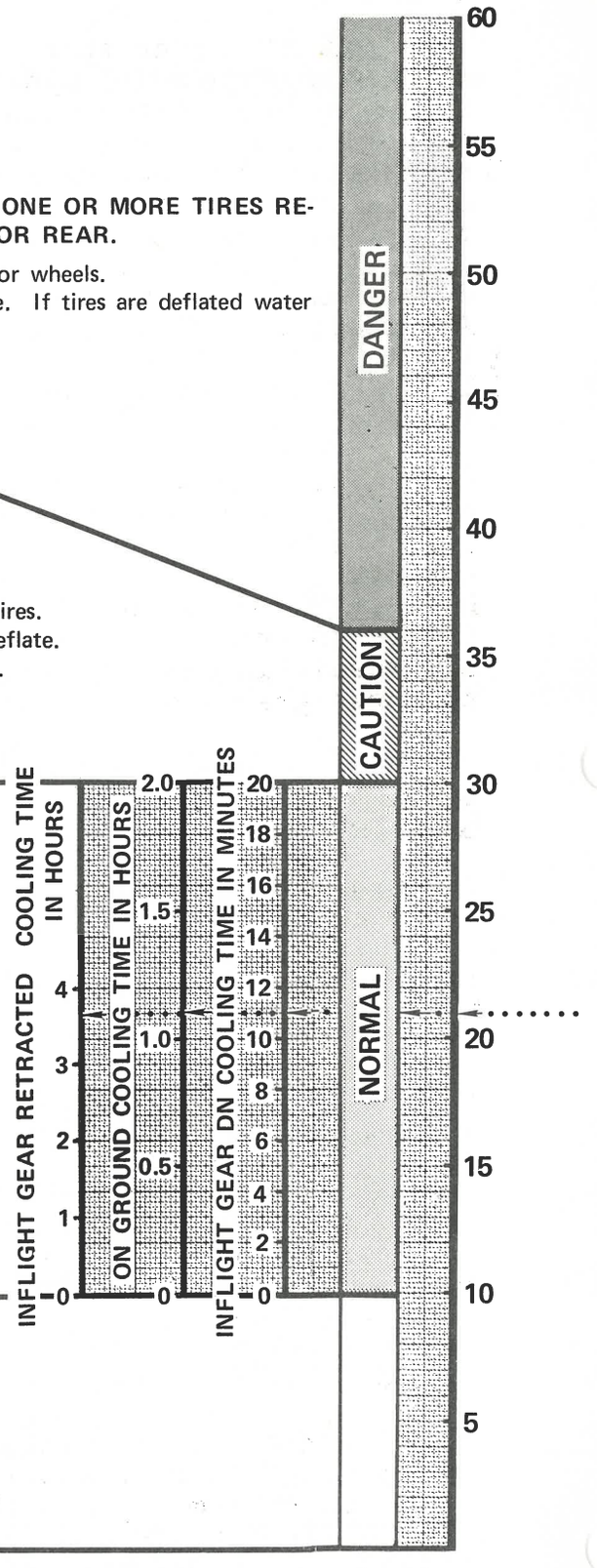
CAUTION RANGE

- If airplane is parked do not set parking brakes, (tires may deflate).
  - Do not approach wheels for one hour.
  - Maintenance inspection (visual) required for brakes, wheels and tires.
  - Delay takeoff for at least an hour to be assured tires will not deflate.
- If immediate takeoff is necessary use 25 minute gear down cooling.

NORMAL RANGE

- For normal braking operations use cooling times, ON GROUND, INFLIGHT GEAR DN or INFLIGHT GEAR RETRACTED, as necessary to remain within the NORMAL brake energy range.

No special procedure required.



BRAKE ENERGY
(Sheet 1 of 2)

NOTES:

To Determine Brake Energy Levels For:
- Rejected Takeoff use dashed Brake ON Speed lines.
- Normal Landing Stop use solid lines.

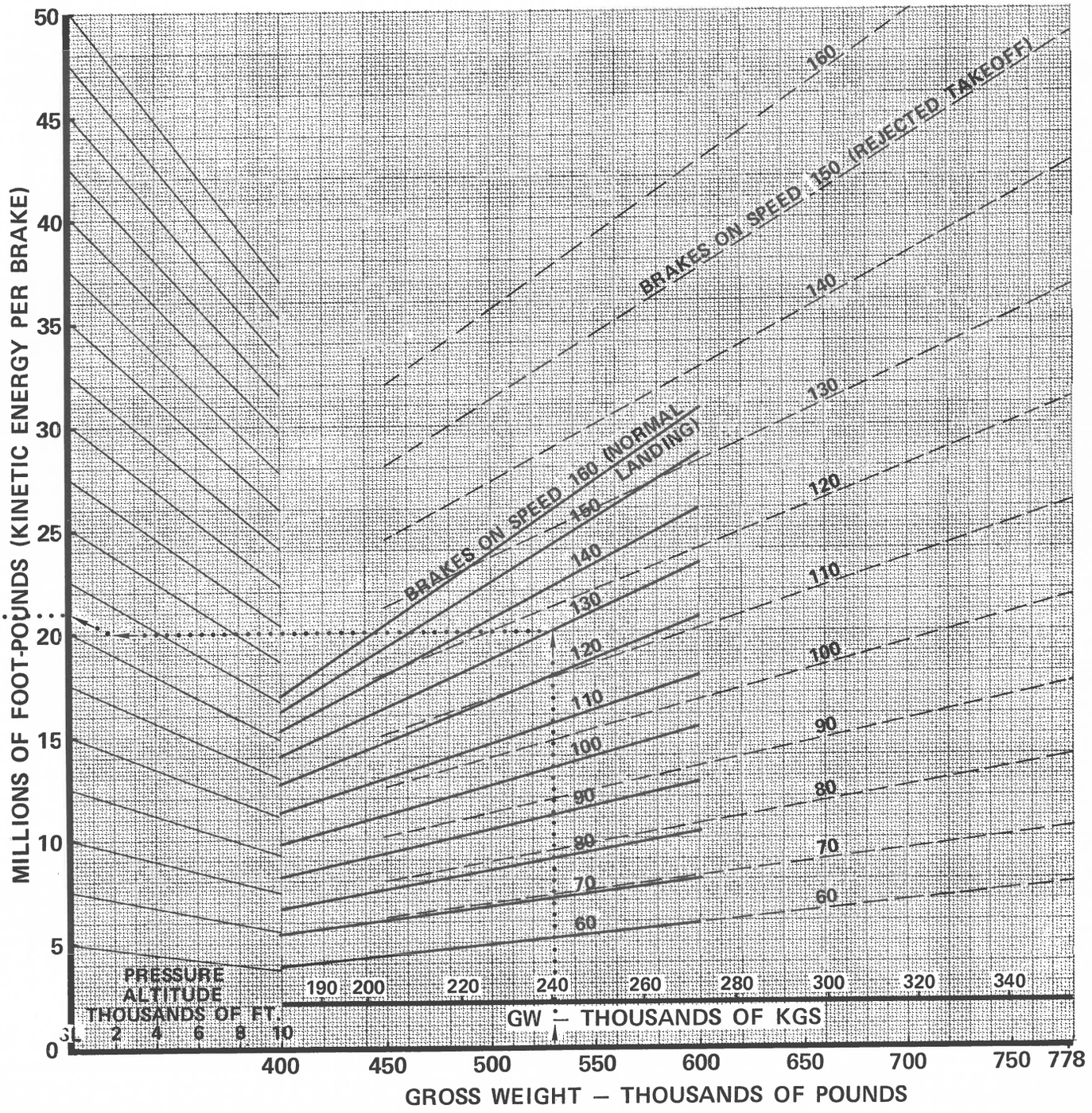
For brakes on speed:
- Use IAS subtracting 50% of headwind or adding tailwinds.
- or use INS ground speed.

CHART DOES NOT CONSIDER THE EFFECT OF REVERSE THRUST.

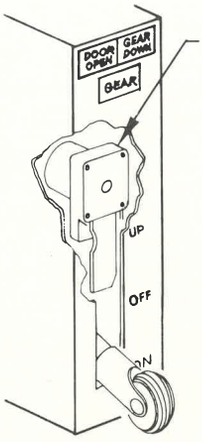
EXAMPLE (Normal Landing Stop)

Gross Weight – 530,000 pounds (240,000 kgs)
Pressure Altitude – 2,000 feet
Brakes on speed – 130 knots (no wind)
No reversers

Resultant Brake Energy – 21 million foot-pounds
Cooling time parked – 1 hour 6 minutes
Inflight gear DN – 11 minutes
Inflight gear UP – 3 hours 40 minutes

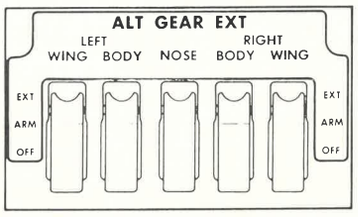


BRAKE ENERGY
(Sheet 2 of 2)



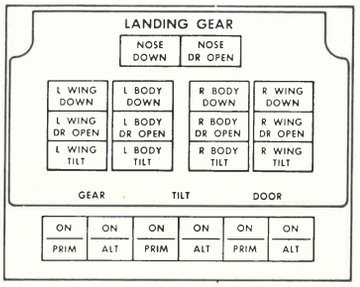
NORMAL EXTEND CYCLE INDICATIONS

- ALL LIGHTS OFF
- GEAR LIGHT ON
- DOOR OPEN LIGHT ON
- GEAR DOWN LIGHT ON
  GEAR LIGHT OFF
- DOOR OPEN LIGHT OFF



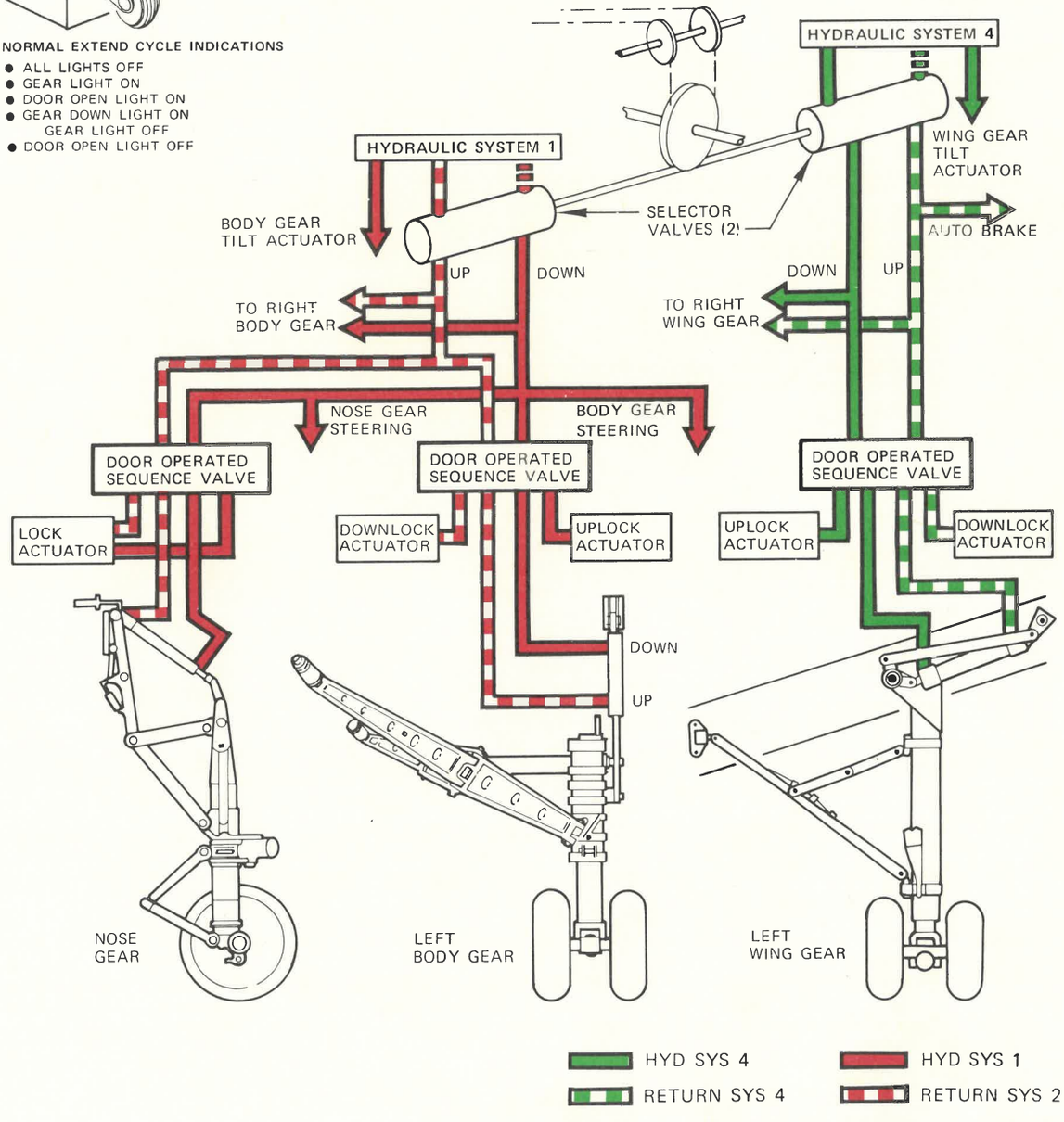
ALTERNATE GEAR EXTENSION

ELECTRICALLY UNLOCKS THE DOORS AND UNLOCKS THE GEAR UPLOCK ALLOWING THE DOORS AND GEAR TO FREEFALL

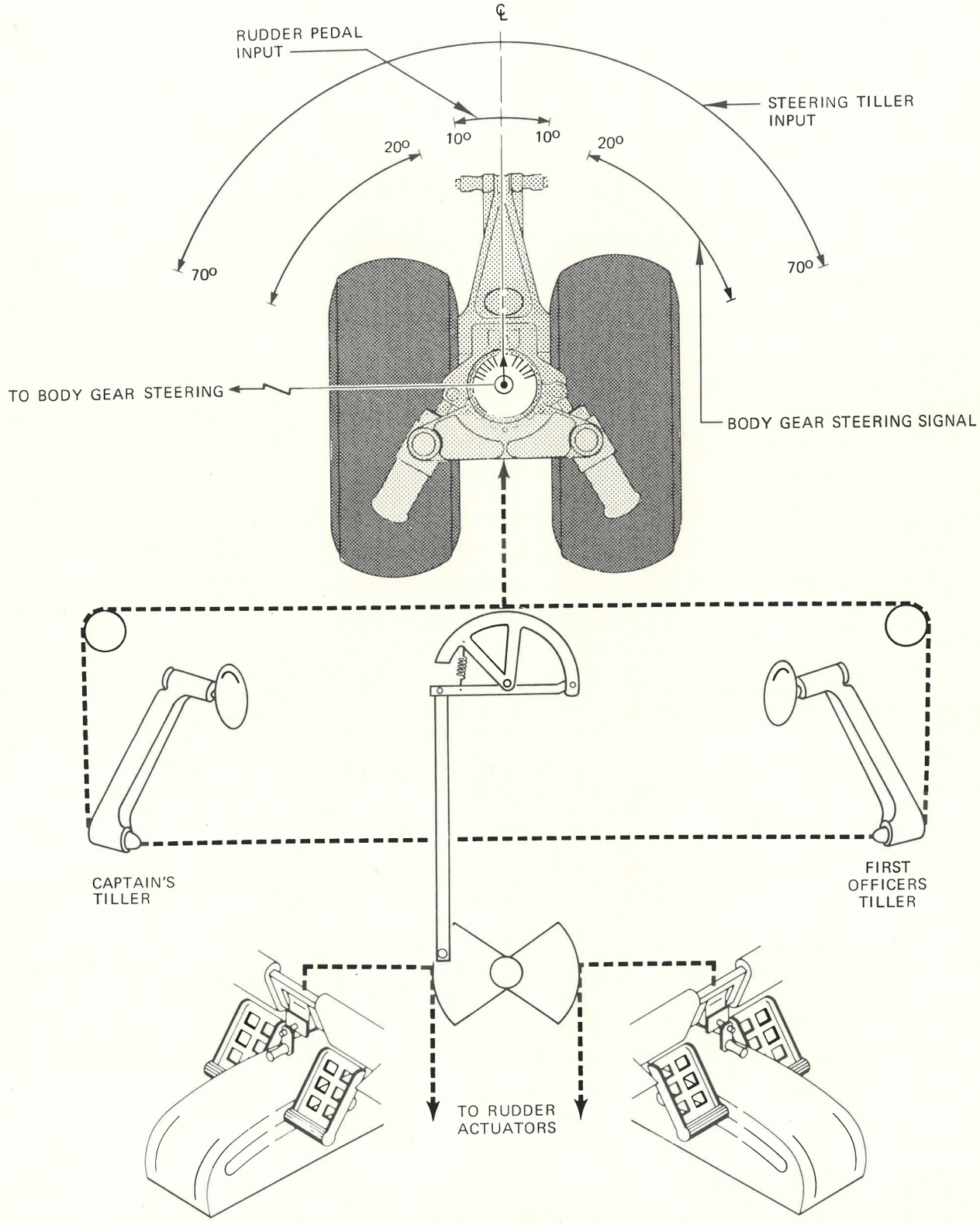


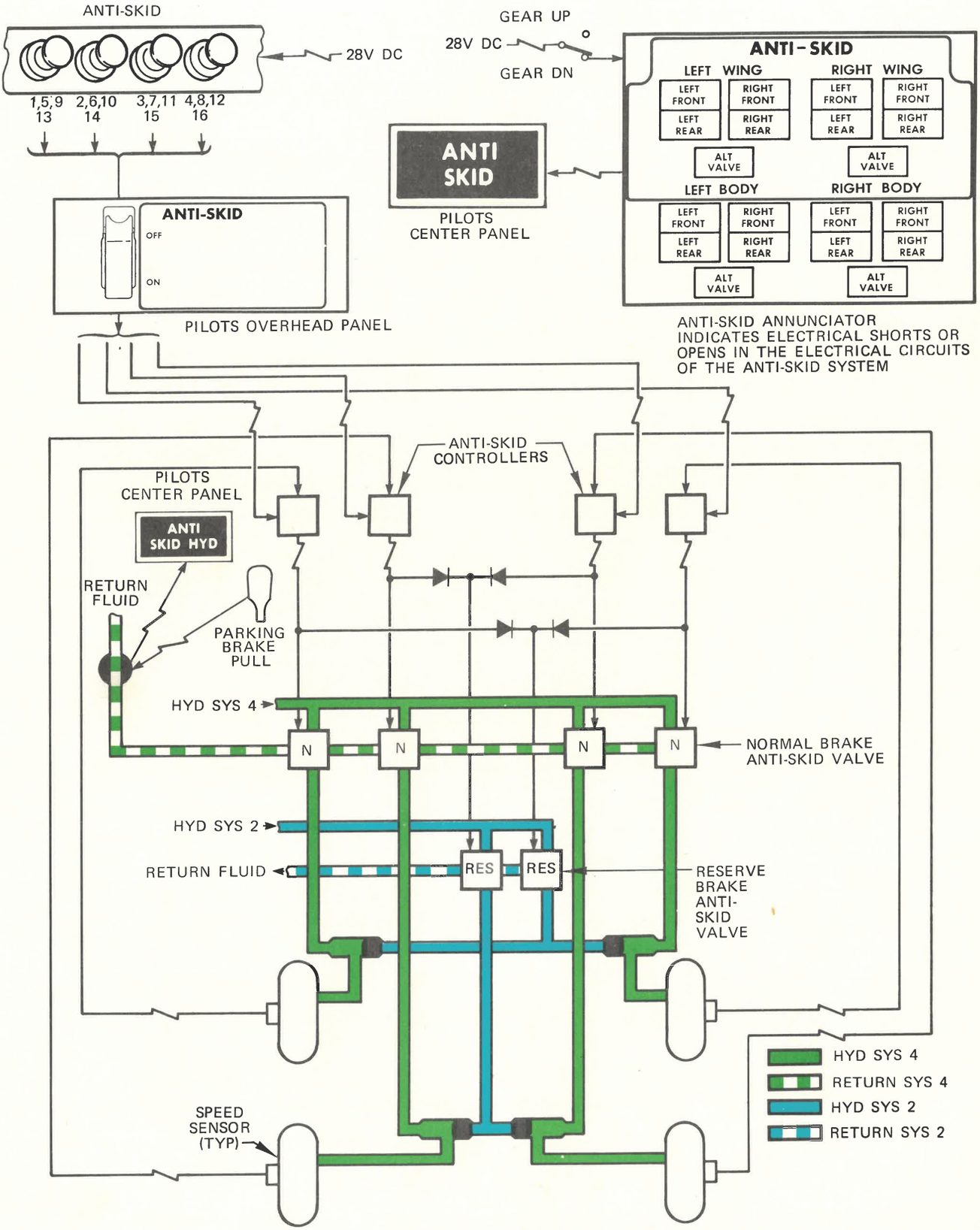
LANDING GEAR ANNUNCIATOR PANEL

WHEN "GEAR," "TILT" OR "DOOR" IS SELECTED, LIGHTS INDICATE THE CONDITION OF THE COMPONENTS USED



LANDING GEAR


℄
RUDDER PEDAL INPUT
STEERING TILLER INPUT
10°
10°
20°
20°
70°
70°
TO BODY GEAR STEERING
BODY GEAR STEERING SIGNAL
CAPTAIN'S TILLER
FIRST OFFICERS TILLER
TO RUDDER ACTUATORS



ANTI-SKID SYSTEM

CHAPTER 19

CROSS REFERENCE

FOR	REFER TO	CHAPTER
Autopilot	AUTOMATIC FLIGHT	7
Other Navigation Instruments	AUTOMATIC FLIGHT and FLIGHT INSTRUMENTS	7 14

INERTIAL NAVIGATION SYSTEM

TO CHECK PRESENT POSITION DATA

All INS sets may be checked simultaneously if each remote switch is pressed prior to pressing one hold switch.

Hold Switch.....PRESS
Press HOLD switch when over known checkpoint. HOLD switch will illuminate.

Data Selector.....POS
Check latitude and longitude are frozen in data indicators.

Position Coordinates.....CHECK
Compare displayed latitude and longitude with latitude and longitude of known checkpoint.

Hold Switch.....PRESS
The HOLD switches will extinguish and the latitude and longitude displays will revert to current present position.

TO INSERT ADDITIONAL WAYPOINTS

If not inserted during preflight or if the flight plan is changed, insert additional waypoint data, using same procedure as in preflight. Place waypoint selector to desired waypoint to receive coordinates.

NOTE: To avoid immediate automatic switching to new leg, do not insert new waypoint data into waypoints shown in the FROM-TO indicator.

TO CHANGE COURSE (THREE METHODS)

Method No. 1:

To change the latitude and longitude coordinates of the appropriate waypoint to insure normal cycling of the FROM-TO display which will maintain the desired flight path.

Remote Switch.....PRESS
Press REMOTE switch on each INS module and check that it illuminates.

Data Selector.....WAY PT

Waypoint Selector.....APPROPRIATE NUMBER
Place the waypoint selector on all three modules to the same number.

Numbered Switch (keyboard).....PRESS
The INSERT switch will illuminate. Load appropriate latitude.

Insert Switch.....PRESS
The INSERT switch will extinguish.

Numbered Switch (keyboard).....PRESS
The INSERT switch will illuminate. Load appropriate longitude.

Insert Switch.....PRESS
The INSERT switch will extinguish.

Method No. 2:

To change the order of waypoints in the FROM-TO display.

Waypoint Change Switch.....PRESS
The WYPT CHG and INSERT switches will illuminate.

Numbered Switch (keyboard).....PRESS
Press the desired waypoint number to be displayed in the FROM position. Press the desired waypoint number to be displayed in the TO position.

Insert Switch.....PRESS
The INSERT switch will extinguish.

NOTE: This must be accomplished individually on each INS module, as the REMOTE switch will be of no assistance.

Method No. 3:

To fly from present position to any waypoint.
Waypoint Change Switch.....PRESS
Check that WYPT CHG and INSERT switches illuminate.
"0" Switch (keyboard).....PRESS
Check that "0" appears in FROM side of FROM-TO indicator.
Numbered Switch (keyboard).....PRESS
Press numbered switch representing waypoint desired and check correct number appears in TO side of FROM-TO indicator.
Insert Switch.....PRESS
Check that WYPT CHG and INSERT switches extinguish.

NOTES: Position at change point may be obtained by positioning waypoint selector to "0" and data selector to WAY PT. Read position in data indicators.

If the MAN position is used, the INS will not switch to the next navigation leg, but will continue to furnish steering signals to maintain the desired track for the completed navigation leg. The ALERT light will flash until the waypoints are changed or AUTO is selected. Displayed navigation information also remains relative to the completed navigation leg. After passing a waypoint with the switch in MAN, automatic leg switching can be resumed by switching to AUTO.

TO DETERMINE DISTANCE AND TIME

Data Selector.....DIST/TIME
The distance displayed is the distance from the airplane to the waypoint number in the TO display. The time displayed is the time required to fly to the waypoint number in the TO display, based on current ground speed.
WYPT CHG Switch.....PRESS
The INSERT and WYPT CHG switches will illuminate. The distance displayed will change to indicate the distance between the two waypoints in the FROM-TO display. The time displayed will change to indicate the time required to fly between the two waypoints in the FROM-TO display, based on current ground speed.
Numbered Switch (keyboard).....PRESS
Load desired waypoint numbers into the FROM-TO display.

NOTE: This method may be used to display distance and time between any two waypoints which have been previously inserted into the INS (i.e., 1-2, 3-5, 6-1, etc.) Do not press INSERT switch unless course change is desired.

Clear Switch.....PRESS
The WYPT CHG and INSERT switches will extinguish. The DIST/TIME displays will revert to indicating the distance and time from the aircraft to the waypoint in the TO display.

TO UPDATE PRESENT POSITION

Present position may be updated on all INS sets simultaneously if each REMOTE switch is pressed prior to pressing one HOLD switch.

Hold Switch.....PRESS
Press HOLD switch when over known checkpoint. HOLD switch will illuminate.

Data Selector.....POS
Check latitude and longitude are frozen in data indicators.

Position.....UPDATE
Load and insert latitude and longitude of known checkpoint using the same procedure as when inserting present position during preflight. HOLD switch will extinguish. Data indicators will drive and display current updated position.

NOTE: If the position update appears unreasonable to the INS, the red WARN light will illuminate and the HOLD switch will remain illuminated when the INSERT switch is pressed. The inserted latitude and longitude will remain displayed. Recheck data. If incorrect, load and insert correct position. If correct, reset WARN light by:

Hold Switch.....PRESS
HOLD switch will extinguish.

Data Selector.....DSRTK/STS

Test Switch....PRESS AND RELEASE
Press and release repeatedly until WARN light extinguishes.

TO DISPLAY INERTIAL PRESENT POSITION AFTER UPDATING

Inertial present position is the position that would have been displayed if the INS had not been updated.

Inertial present position will be displayed on all sets if each REMOTE switch is pressed prior to pressing one HOLD switch.
Hold Switch.....PRESS
HOLD switch will illuminate.
Data Selector.....WAYPOINT
Inertial present position will be displayed in data indicators and will show the position at the time HOLD switch was depressed.

TO REMOVE UPDATED PRESENT POSITION

Cannot be removed from all INS sets simultaneously.
Data Selector.....DSRTK/STS
Hold Switch.....PRESS
HOLD switch will illuminate.
Numbered Switch (keyboard).....PRESS
INSERT switch will illuminate. Press any switch and check switch number appears in last digit of right-hand data indicator.
Insert Switch.....PRESS
HOLD switch and INSERT switch will extinguish. The last digit of right-hand data indicator will show the number of the switch pressed or the number 5, whichever is lower.

NOTE: Inertial present position may be displayed with the data selector in either POS or WYPT, with HOLD switch illuminated.

VHF NAVIGATION RADIO SYSTEM

TO SET VHF NAVIGATION RADIOS

(Captain's and First Officer's controls are identical.)
RADIO/INS Switch.....RADIO
VHF Navigation Frequency Selector.....SET TO DESIRED FREQUENCY
Frequency Indicator.....DISPLAYS DESIRED FREQUENCY
Audio Selector Panel.....ADJUST
Course Transfer Switch.....DUAL
In the DUAL position, the Captain's VHF navigation radio (No. 1) is the source of signals to channel A and C autopilot/flight director computers. The First Officer's VHF navigation radio (No. 2) is the source of signals to channel B autopilot/flight director computer.

In the No. 1 position channel A, C and B computers are referenced to the Captain's radio; the No. 2 position uses the First Officer's radio similarly.
Course Selector....ROTATE TO SET DESIRED COURSE
Course Indicator (on pilots' lightshield)...DISPLAYS DESIRED COURSE
Rotation of the No. 1 course selector moves the course pointer on the Captain's HSI; the No. 2 course selector has the same action on the First Officer's HSI.

NAVIGATION SYSTEM MALFUNCTION INDICATIONS

BOTH CENTRAL INSTRUMENT WARN LIGHTS FLASHING

Both ATT lights will be illuminated.
Both WARN Lights.....PRESS TO EXTINGUISH

Standby Attitude Indicator (And Other Instruments).....CROSSCHECK AGAINST ADI'S

The malfunctioning ADI may or may not have a GYRO flag in view.

Attitude Switch.....TRANSFER APPROPRIATE PILOT TO 3

Check that the ATTITUDE light (pilots' overhead panel) does not illuminate. Check that both ATT lights extinguish.

ONE CENTRAL INSTRUMENT WARN LIGHT FLASHING

Illuminated WARN Light.....PRESS TO EXTINGUISH

ADI and HSI on Side That Had Flashing Light...CHECK FOR FLAGS

IF GYRO FLAG IN VIEW:

Attitude Switch.....TRANSFER APPROPRIATE PILOT TO 3

Check that the ATTITUDE light (pilots' overhead panel) does not illuminate. Check that the GYRO flag disappears.

IF HEADING FLAG (HSI) IN VIEW:
(With RADIO/INS Switch in RADIO)
Compass Switch.....TRANSFER TO OTHER PILOT'S COMPASS

Check that the COMPASS light (pilots' overhead panel) does not illuminate. Check that the HEADING flag disappears.

(With RADIO/INS Switch in INS)
INS Switch.....TRANSFER APPROPRIATE PILOT TO 3

Check that the INS light (pilots' overhead panel) does not illuminate. Check that the HEADING flag disappears.

IF GS FLAGS (HSI AND ADI) IN VIEW:

NAV DEV Switch.....TRANSFER APPROPRIATE PILOT TO 3

Check that the NAV DEV light (pilots' overhead panel) does not illuminate. Check that the GS flags disappear.

IF NAV FLAG (HSI) IN VIEW:
(With RADIO/INS Switch In RADIO)
NAV DEV Switch.....TRANSFER APPROPRIATE PILOT TO 3

Check that the NAV DEV light (pilots' overhead panel) does not illuminate. Check that the NAV flag disappears.

IF NAV FLAG (ADI) IN VIEW:
(With RADIO/INS Switch In INS)
INS Switch.....TRANSFER APPROPRIATE PILOT TO 3

Check that INS light (pilots' overhead panel) does not illuminate. Check that the NAV flag disappears.

IF RADIO ALTIMETER FLAG IN VIEW:
No transfer capability. Runway rising function will be lost.

NO CENTRAL INSTRUMENT WARNING LIGHT FLASHING

IF CMPTR FLAG (ADI) IN VIEW:
Flight Director
Computer Switch.....TRANSFER
Check that a FLT DIR light (pilots' overhead panel) does not illuminate. Check that the CMPTR flag disappears.

IF WARNING FLAG (RMI) IN VIEW:
Compass Switch.....TRANSFER TO OTHER PILOT'S COMPASS
Check that the COMPASS light (pilots' overhead panel) does not illuminate. Check that the warning flag disappears.

IF RUNWAY FLAG (ADI) IN VIEW:
(With No Flags)
No transfer capability.
(With NAV Or Radio Altimeter Flag)
Refer to appropriate flag write up.

INS WARN LIGHT ILLUMINATED

If WARN light is accompanied by instrument warning flags or lights, switch associated instruments and autopilot to a valid INS.
INS Data Selector.....DSRTK/STS
Observe action code digits.
INS Test
Switch.....PRESS AND RELEASE
Action code digits will be replaced by malfunction code digits. Continue to press and release test switch until action code digits return or the WARN light extinguishes.

IF THE INS WARN LIGHT EXTINGUISHES:
Malfunction was transient; the INS can be used normally.

IF THE INS WARN LIGHT DOES NOT EXTINGUISH:
Comply with the action code displayed.
Action Code.....CHECK
The second and third digits of the right-hand indicator will show 01, 02, 04, or 05, indicating action to be taken, as follows:
01 - Shut down INS.
02 - Cross check with other INS units for degradation of navigation information. Select ATT if necessary.
04 - Down mode to STBY and restart alignment (ground operation only).
05 - Down mode to OFF and perform turn-on procedures again (ground operation only).

NOTE: The INS WARN light will not illuminate with an action code 03. This code indicates erratic signals from a normal INS to the instruments. It would be detected by instrument warning flags.

RESTARTING INS NO. 3 DURING FLIGHT AFTER SHUTDOWN

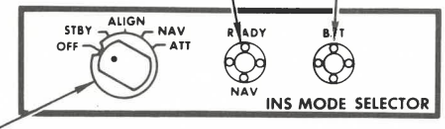
INS Mode Selector.....OFF
Airplane Power.....ON
INS Bat Transfer.....NORMAL
INS Mode Selector.....ATTITUDE
Attitude info only (No NAV) is subsequently available from INS 3.

READY/NAVIGATE LIGHT (Green)

With the mode switch in ALIGN, this light illuminates when the desired alignment status of the INS is attained. Will remain illuminated until NAV is selected. The READY/NAVIGATE light illuminates momentarily when alignment is accomplished with the mode selector in NAV.

BATTERY LIGHT (Red)

This light illuminates only if while operating on battery power the INS automatically shuts down due to low battery unit voltage. The INS operates on battery power for one 10-second period during coarse leveling. If the battery unit charge is below the required minimum level during this period, the INS will shut down and the red BAT and WARN lights will illuminate. On the ground, horn in wheel well sounds if condition exists for over 30 seconds.



PILOTS' OVERHEAD PANEL

MODE SWITCH

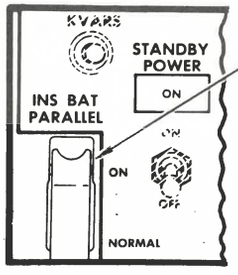
This switch selects the modes of the INS. The knob must be pulled for rotation across mechanical stops between STBY and ALIGN and between NAV and ATT.

STBY – Used only during ground operation; it starts fast warmup.

ALIGN – Used only during ground operation while the airplane is parked. Setting mode switch to ALIGN will start gyro operation and automatic INS alignment provided the unit is warmed up. Fine alignment will not start until present position is inserted at the control module.

NAV – Used for normal operation after automatic alignment is complete. This position must be selected before moving the airplane. The INS will automatically sequence through the standby and alignment modes of operation when the NAV position is selected from any other position, provided the airplane is parked and present position is inserted. Going directly from OFF to NAV will eliminate the automatic shutdown feature in the event of an overheat. The automatic battery check will also be eliminated.

ATT – Used to provide only INS attitude signals. This position shuts down the computer so that navigation and steering signals are not provided. The ATT position can be selected from any other position. Once the ATT position is selected, INS alignment is lost and it must be realigned on the ground before the navigation mode can again be used.



FLIGHT ENGINEER'S PANEL
UPPER LEFT

INS BATTERY PARALLEL SWITCH

Used to parallel INS No. 1 and INS No. 3 batteries in the event of complete loss of airplane AC power (amber BAT lights on all three INS control modules illuminated).

ON – Increases battery powered life of INS No. 1 by connecting INS No. 1 and 3 batteries to INS No. 1.
- Standby power ON light must be illuminated to arm ON position.
- INS No. 3 disconnected from INS No. 3 battery.

NORMAL – INS No. 1 connected to INS No. 1 battery.
- INS No. 3 connected to INS No. 3 battery.

INERTIAL NAVIGATION SYSTEM (MODE SELECTOR MODULE)

LEFT DATA INDICATOR

Displays latitude, track, heading, cross track distance, distance, wind direction, or desired track, as selected by the data selector.

REMOTE SWITCH (Amber)

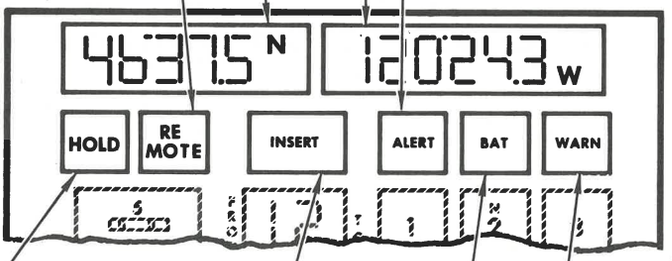
Permits simultaneous loading and inserting of waypoint data and updating present position in multiple system installations with a single control module.

RIGHT DATA INDICATOR

Displays longitude, ground speed, drift angle, track angle error, time, wind speed, or system status, as selected by the data selector.

ALERT LIGHT (Amber)

Illuminates when 2 minutes from waypoint; flashes when past waypoint in MAN mode when ground speed is in excess of 250 knots; extinguishes when INS automatically switches to next navigation leg in AUTO mode.



INSERT SWITCH

Controls entry of key board data into the computer.

WARN LIGHT (Red)

Illuminates when system self-check circuits detect an out-of-tolerance condition.

HOLD SWITCH

Used in conjunction with other controls to stop displayed present position from changing, to perform a position update, to display inertial present position, to eradicate a position update, and to display recorded malfunction codes.

BAT LIGHT (Amber)

Illuminates when system is operating on battery power.

INERTIAL NAVIGATION SYSTEM
(CONTROL MODULE)
(Sheet 1 of 2)

WAYPOINT SELECTOR

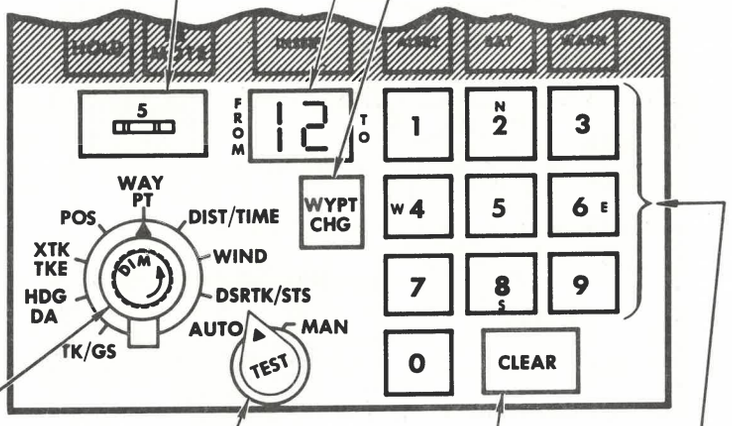
Used in conjunction with the WAYPT position on the data selector to insert waypoint and destination positions into the computer. "0" thru "9" waypoints. "0" is to display the coordinates of the latest present position update or course change from present position.

FROM-TO INDICATOR

Indicates the flight leg for which navigation data is being computed. Automatically goes to 12 when system is turned on and waypoint data has been inserted.

WY PT CHG SWITCH

Allows different waypoint numbers to be loaded into FROM-TO display through the keyboard.



DATA SELECTOR

Used to select data to be displayed in the data indicators.

TEST SWITCH/AUTO-MAN SWITCH

TEST — Push to test lamps (data indicators — all 8's); with WARN light illuminated and data selector in DSRTK/STS, the push-release sequence will replace an action code with malfunction codes.

AUTO-MAN — In AUTO, the waypoint numbers in the FROM-TO display will automatically sequence to the next flight leg when waypoint is reached. In MAN, the next flight leg number must be set manually through the keyboard.

KEYBOARD

Used to load present position and waypoint latitude and longitude into data indicators, to load desired performance index number, and to change waypoint from-to numbers.

CLEAR SWITCH

Used to clear data indicators when erroneous data has been loaded.

INERTIAL NAVIGATION SYSTEM
(CONTROL MODULE)
(Sheet 2 of 2)

WAY PT

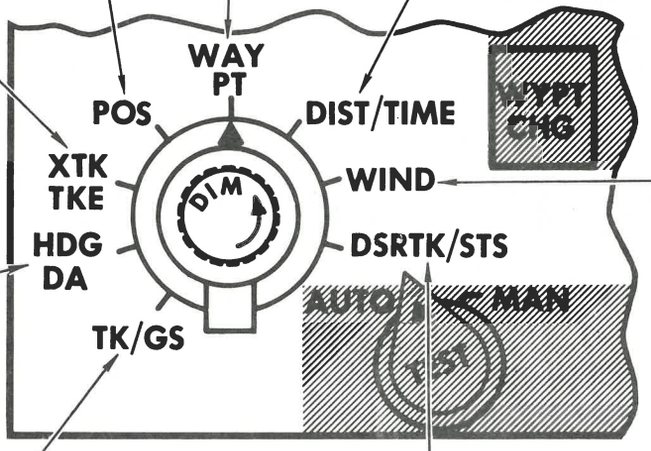
Used with waypoint selector and keyboard to insert waypoints; waypoint set with waypoint selector is displayed on data indicators (latitude in left data indicator, longitude in right). This position is also used to display inertial present position (see HOLD switch).

POS

Position latitude displayed in left data indicator; longitude in right data indicator.

DIS/TIME

Distance and time to next waypoint. Distance displayed in left data indicator; time in right data indicator.



XTK/TKE

Cross track distance (L or R) displayed in left data indicator; track error in right data indicator.

WIND

Wind direction displayed in left data indicator; wind velocity in right data indicator.

HDG/DA

Airplane true heading displayed in left data indicator; drift angle in right data indicator.

TK/GS

Present track displayed in left data indicator; ground speed in right data indicator.

DSRTK/STS

Desired track displayed in left data indicator; system status (alignment status, performance index, or malfunction codes) in right data indicator.

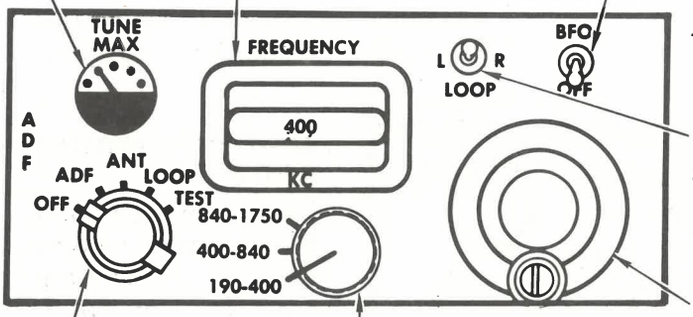
INERTIAL NAVIGATION SYSTEM
CONTROL MODULE
(DATA SELECTOR)

TUNING METER

Displays relative strength of signal being received. Most desirable reception is achieved by tuning for maximum needle deflection. Minimum needle deflection indicates most accurate aural null point when using loop rotation procedure.

FREQUENCY INDICATOR

190-1750 Kilohertz.



FREQUENCY BAND SELECTOR

Used to select one of three bands of frequencies from which an exact frequency may be selected by manual tuning.

BEAT FREQUENCY OSCILLATOR (BFO) SWITCH

- Allows precise tuning. With the switch in BFO a high pitched tone will be heard when the frequency indicator approaches a receivable signal. The tone will then decrease in pitch until it "zero beats" (no audio) when the receiver is precisely on the frequency of the receivable signal. If the frequency indicator is tuned past the exact frequency, the tone will again become audible rising in pitch.
- The BFO position also provides a tone allowing unmodulated CW keying to be heard.

LOOP POSITION CONTROL

Switch has L-R positions. Loop rotation is possible with the function selector in the LOOP position.

TUNING CONTROL

Used to tune desired frequency within a band. As tuning control is rotated, the frequency indicator will show frequency being received. Depressing the tune control gives a BFO tone for precise tuning.

MODE SWITCH

ADF – Both the sense and loop antennas operate and bearing information is displayed on the RMI's.

ANT – The non-directional antenna is utilized, and the receiver is used for reception of audio signals.

LOOP – Determination of bearing to station is made by selective rotation of loop antenna until an aural null, or loss of signal occurs. This can be determined by listening to the signal or by observing the tuning meter for minimum needle deflection.

TEST – ADF needle on the RMI will drive to the lubber line position, provided the corresponding ADF/VOR switch is in the ADF position.

AFT ELECTRONIC PANEL

FUNCTION SELECTOR

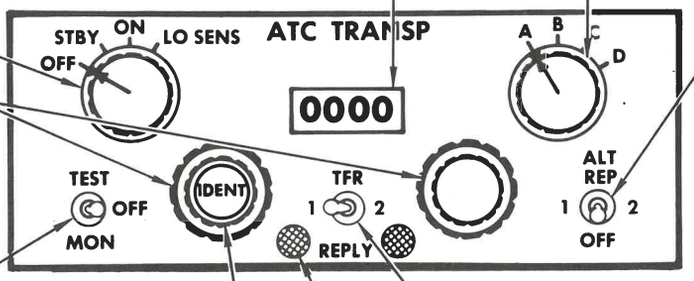
STBY – Warmup.
ON – Normal position for reception and transmission of signals.
LO SENS – Positioned at verbal request of ATC controller to prevent excessive brightening of radarscope when airplane close to ground station.

CODE INDICATOR

Displays code set by code selector.

MODE SELECTOR

Modes A and B for air traffic control use; mode C for altitude reporting; mode D not assigned.



CODE SELECTORS

Used to set transponder code.

ALTITUDE REPORTING SWITCH

Used to provide automatic altitude reporting signal to ground station from No. 1 or No. 2 central air data computer.

TEST SWITCH

TEST – Proper system functioning is indicated by illumination of REPLY light.
MON – REPLY light is illuminated when transponder responds to ground interrogation.

TRANSFER SWITCH

Selects No. 1 or No. 2 transponders.

IDENTIFICATION SWITCH

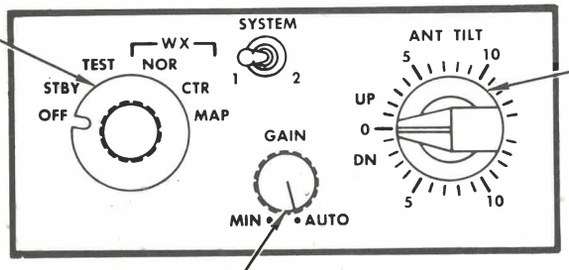
Used to give additional pulse reply for positive identification, upon request from ground station.

REPLY LIGHTS (Green)

Illuminate in response to test signal or when transponder is interrogated by ground signal. (See TEST SWITCH.)

FUNCTION SELECTOR

STBY – Standby for warmup; no transmission, no scan.
TEST – A distinctive test pattern is displayed on indicator.
NOR – Places system in normal operation mode.
CTR – Places system in contour mode, causing areas of intense returns to be highlighted.
MAP – Causes antenna beam to be reshaped, providing a pattern suitable for ground mapping.

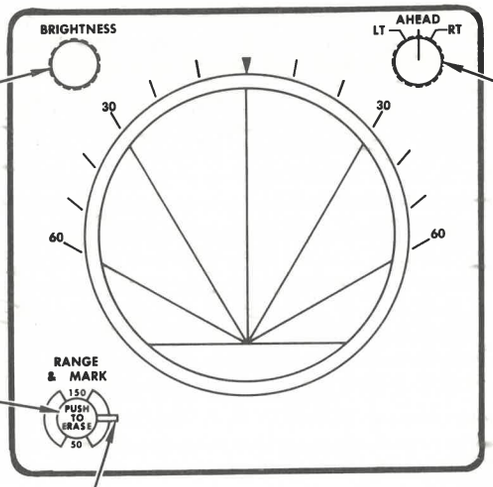


ANTENNA TILT CONTROL

FORWARD ELECTRONICS PANEL

GAIN CONTROL

MIN – Clockwise rotation causes increase in receiver sensitivity.
AUTO – Maintains receiver at optimum receiver sensitivity.



BRIGHTNESS CONTROL

Adjusts brightness of edge lights and control markings on the indicator.

OFFSET SWITCH

LT – Scope presentation moves right increasing area scanned to left.
AHEAD – Normal scan.
RT – Scope presentation moves left increasing area scanned to right.

ERASE SWITCH

Push and release. Display brightens and then all returns are erased.

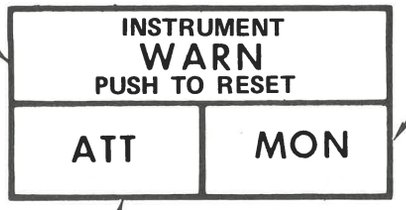
PILOTS' AUXILIARY PANELS

RANGE AND MARKS CONTROL

OFF – No range marks.
50 MILES – Two 25-mile range marks.
150 MILES – Three 50-mile range marks.
300 MILES – Six 50-mile range marks.

INSTRUMENT WARNING LIGHT (Red)

- Flashes on both pilot's panels when ATT lights are illuminated.
- Flashes on each pilot's panel when that pilot has the following flags come into view.
  GYRO
  GS (After glide slope capture)
  NAV (After localizer capture)
  Radio Altimeter (Below 1500 feet)
  HEADING
- Pressing each flashing WARN light will extinguish that light and reset the system.



COMPUTER MONITOR WARNING LIGHT (Amber)

Illuminates when power is lost to the central instrument warning system computer. WARN light does not illuminate. Pressing the MON light will cause it to dim.

ATTITUDE COMPARISON WARNING LIGHT (Amber)

- Both pilot's ATT lights will illuminate when a difference – 4 degrees on localizer or 6 degrees otherwise – exists in pitch or roll between the two ADI's.
- Causes both instrument WARN lights to flash.
- Pressing instrument WARN light dims associated ATT light.
- ADI differences must be corrected to extinguish ATT lights.

INSTRUMENT WARNING TEST SWITCH

Push to test. Both pilot's ATT and MON lights illuminate steady. Both WARN lights flash. ATT and MON lights extinguish when test switch is released. Each WARN light will continue to flash until that light is pushed.

INS SYSTEM COMPARATOR LIGHTS (Amber)

Individual light will illuminate when corresponding INS system is out of tolerance with the other two systems.

INS 1	INS 2	INS 3

PILOTS' CENTER PANEL

NAVIGATION DEVIATION SWITCH

- Transfers VHF navigation radio inputs to pilots' instruments.
- NORM: CAPT on VHF NAV 1
  F/O on VHF NAV 2
- NAV DEV light illuminates if transfer does not actually occur.

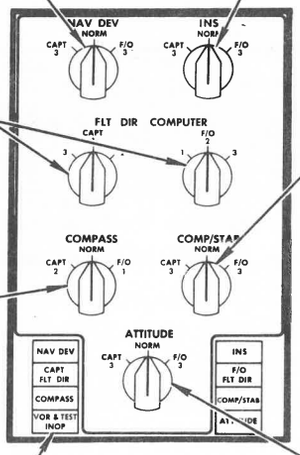
FLIGHT DIRECTOR COMPUTER SWITCH

- Transfers flight director computer inputs to pilots' ADI's.
- FLT DIR light illuminates if transfer does not actually occur.

COMPASS SWITCH

- Transfer magnetic compass inputs to pilots' instruments.
- NORM: CAPT on compass 1
  F/O on compass 2
- COMPASS light illuminates if transfer does not actually occur.

(DEACTIVATED)



PILOTS' OVERHEAD PANEL

INERTIAL NAVIGATION SYSTEM SWITCH

- Transfers INS inputs to pilots' instruments.
- NORM: CAPT on INS 1
  F/O on INS 2
- INS light illuminates if transfer does not actually occur.

COMPASS/STABILIZATION SWITCH

- Transfers directional gyro function of INS inputs to pilots' magnetic compass.
- NORM: CAPT on INS 1
  F/O on INS 2
- COMP/STAB light illuminates if transfer does not actually occur.

ATTITUDE SWITCH

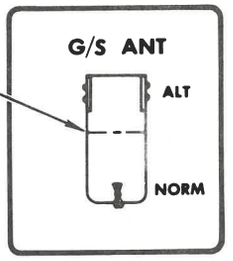
- Transfers vertical gyro function of INS inputs to pilots' ADI's.
- NORM: CAPT on INS 1
  F/O on INS 2
- ATTITUDE light illuminates if transfer does not actually occur.

INS SYSTEM COMPARATOR & INSTRUMENT SWITCHING

G/S ANTENNA SWITCH 1

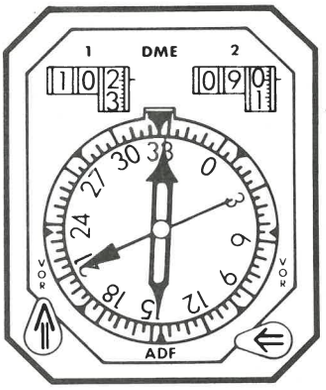
NORM – G/S antennas in nose gear doors are used. This position must be used for Cat II approaches.

ALT – G/S antennas in nose antenna are used. May be tried if normal antenna appears inoperative.



CAPTAIN'S PANEL

1 *EARLY AIRPLANES UNTIL RETROFITTED*



PILOTS' PANELS

DME SWITCH

O'RIDE – DME will search up to 200 miles on TVOR.

DME – DME will search up to 200 miles on VOR; 50 miles on TVOR.

STBY – System warmup; indicator masked.

FREQUENCY INDICATORS (2)

FREQUENCY SELECTORS

Rotation of selectors changes displayed frequency (left side).

VOR TEST SWITCH

Used to perform VOR test.

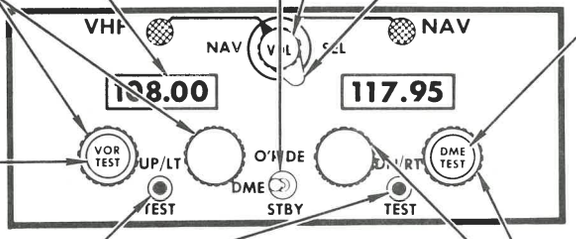
ILS TEST SWITCHES

Used to perform ILS test.

VOLUME SWITCH

FREQUENCY TRANSFER SWITCH

Used to select either of two preset frequencies. Adjoining light illuminated when corresponding frequency is selected.



FORWARD ELECTRONIC PANEL

DME TEST SWITCH

– Bar flag appears for one second simulating loss of power.

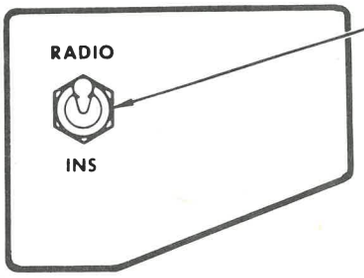
– Dashed lines appear for one second simulating loss of data.

– Indicator drives to 000.0 (-0, +.1 tolerance).

FREQUENCY SELECTORS

Rotation of selectors changes displayed frequency (right side).

PILOTS' LIGHTSHIELD

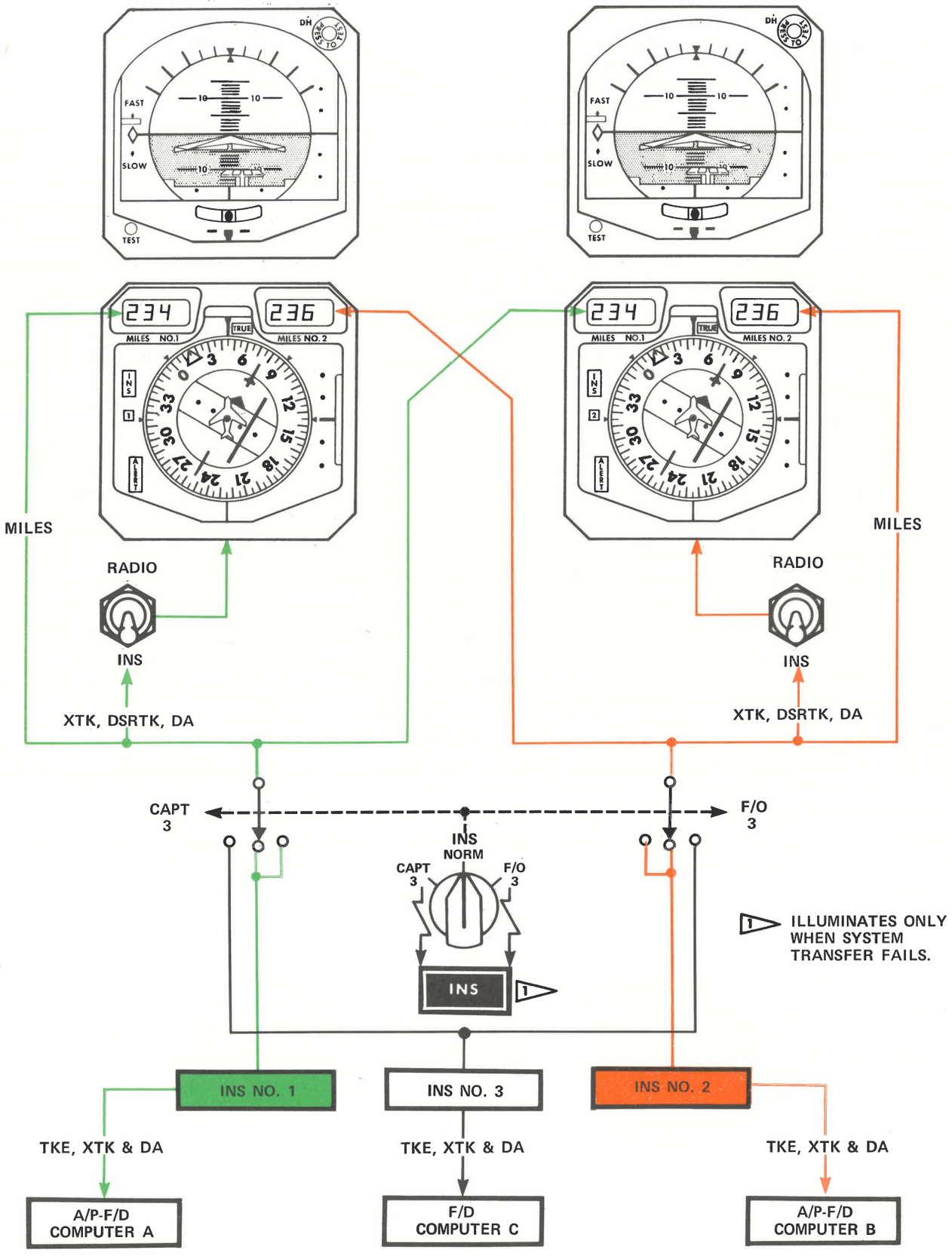


RADIO/INERTIAL NAVIGATION SYSTEM (INS) SWITCH

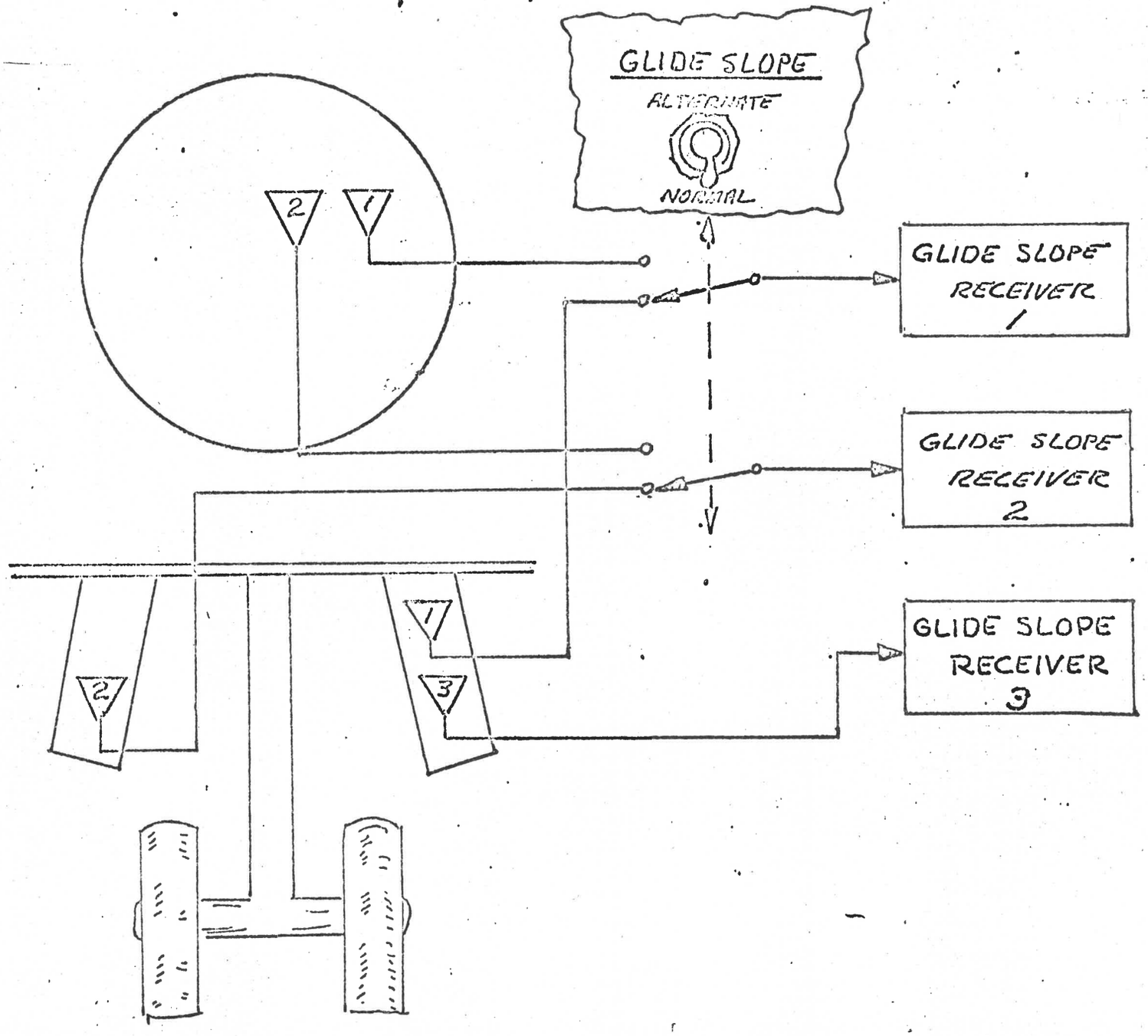
RADIO – Navigation instruments referenced to the VHF navigation radio system and magnetic compass.

INS – Navigation instruments referenced to the inertial navigation system (except RMI's).

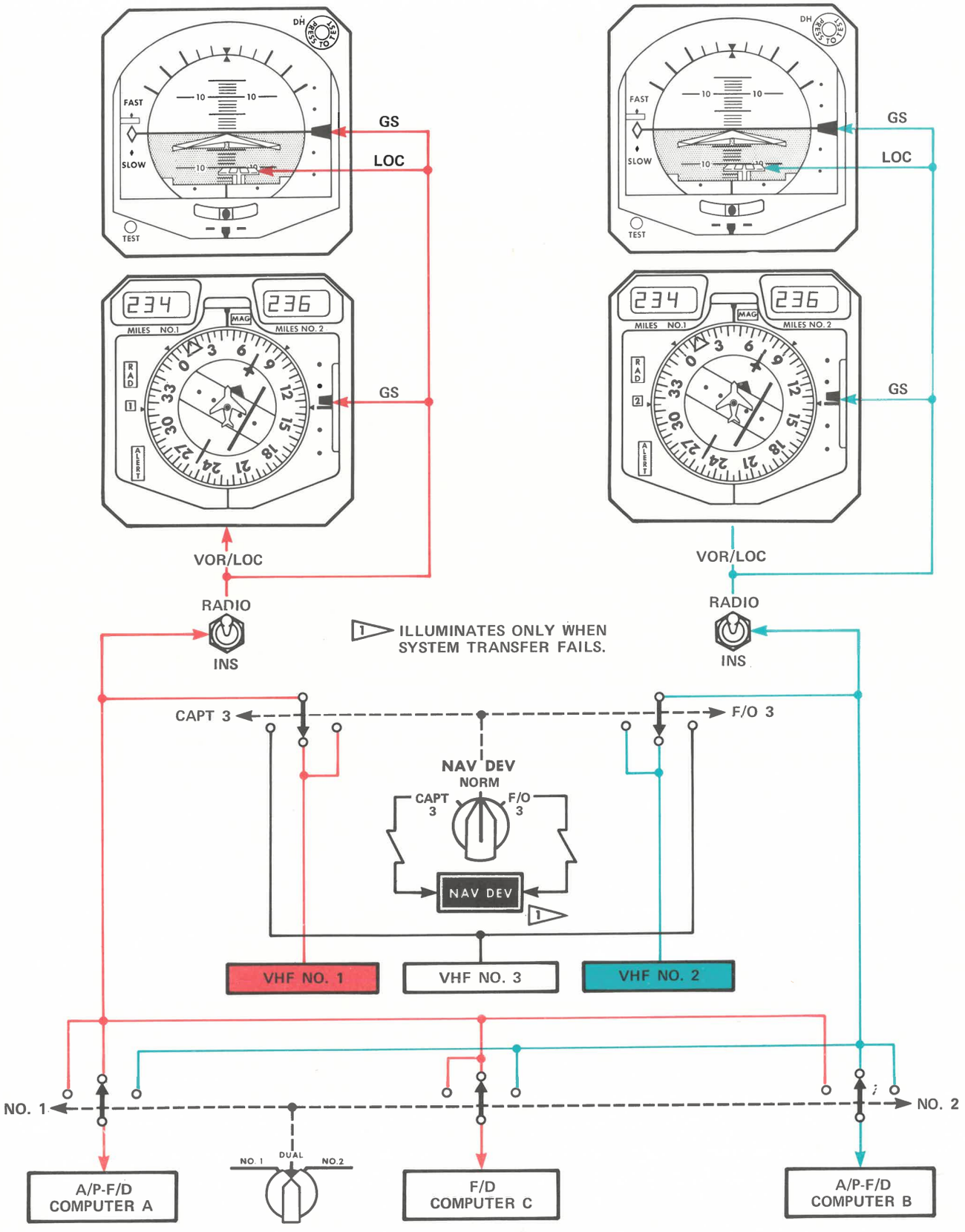
VHF NAVIGATION RADIO AND DISTANCE MEASURING EQUIPMENT



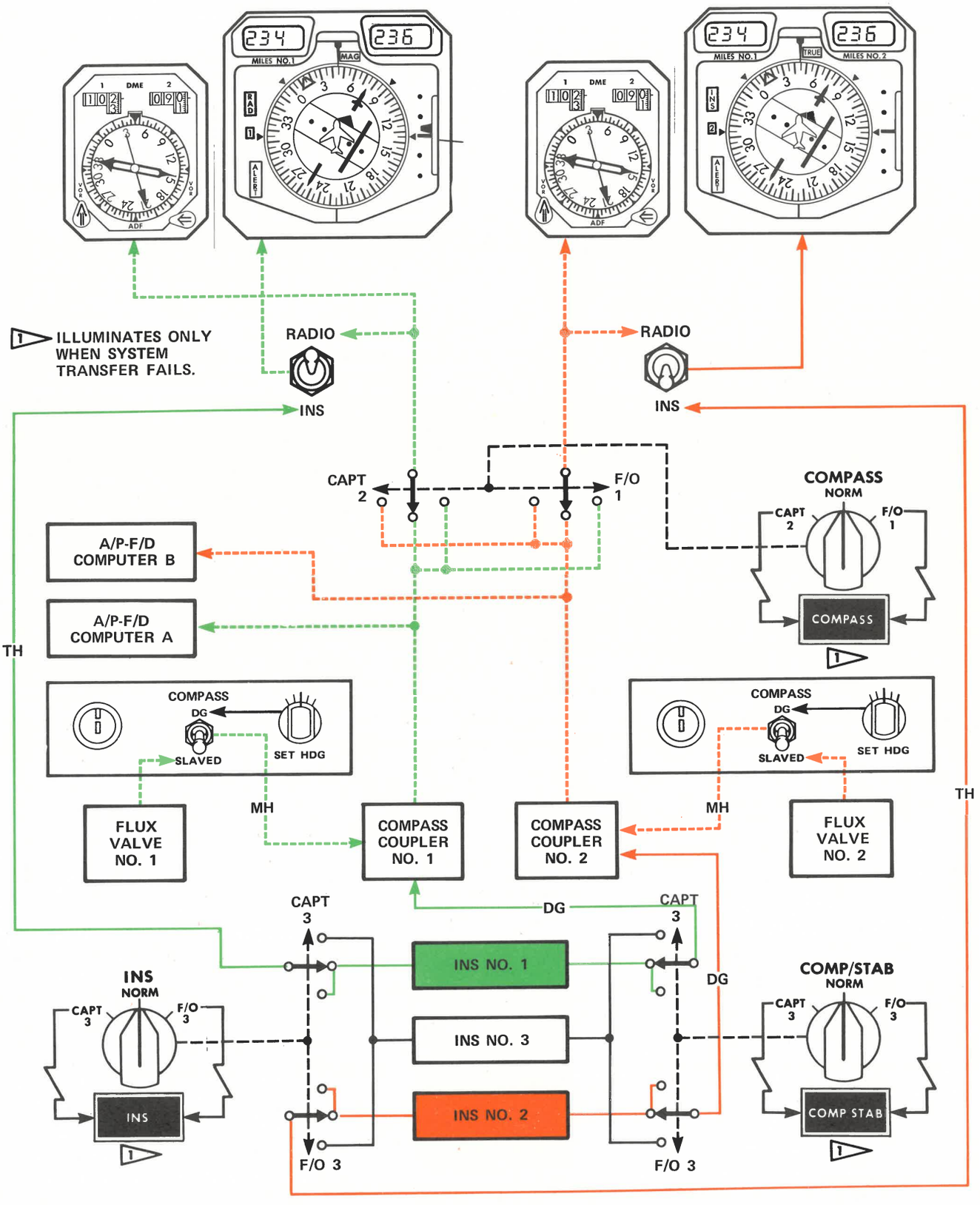
NAVIGATION SWITCHING (INS)



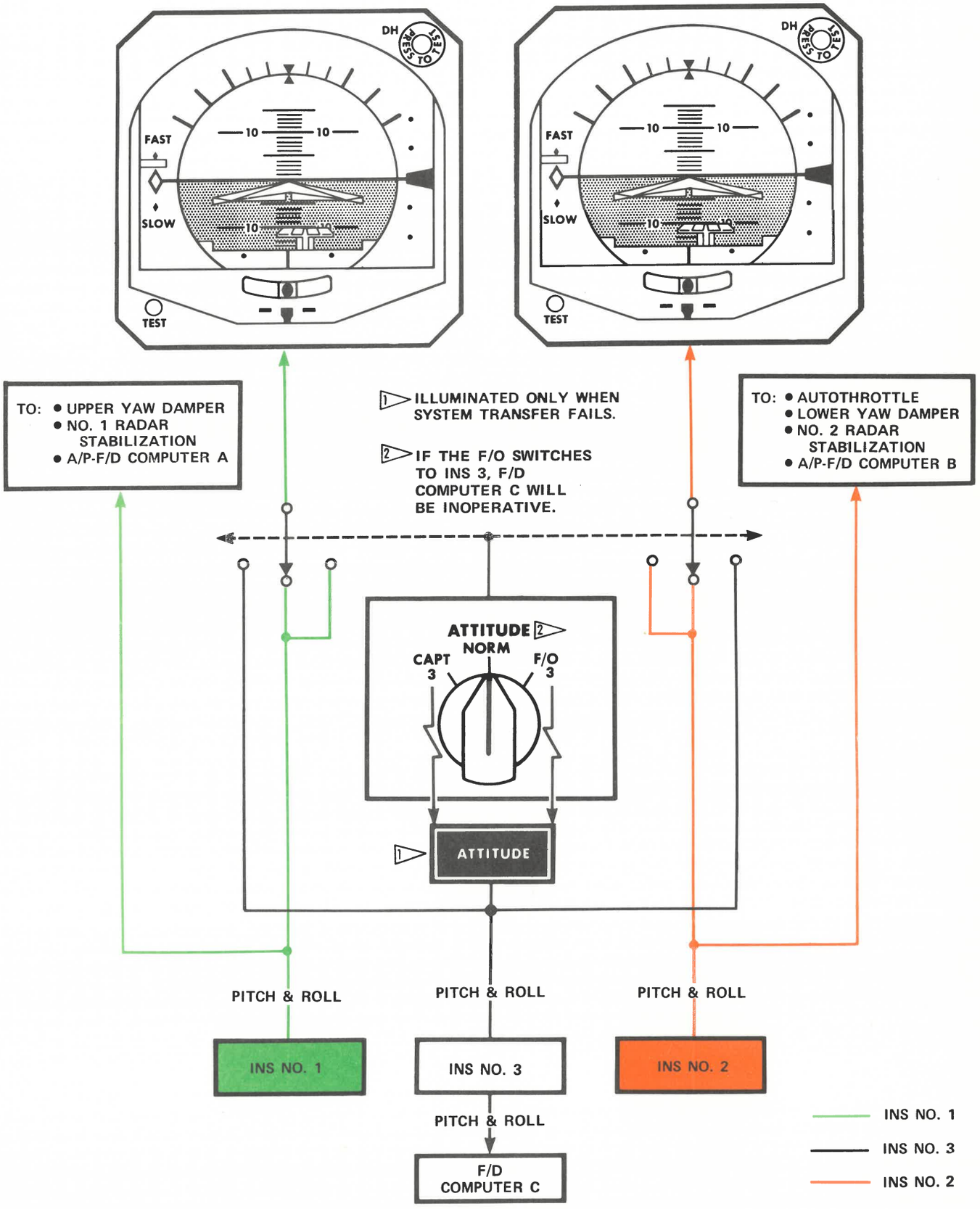
747-30 GLIDE SLOPE ANTENNAE SWITCHING 19-305.



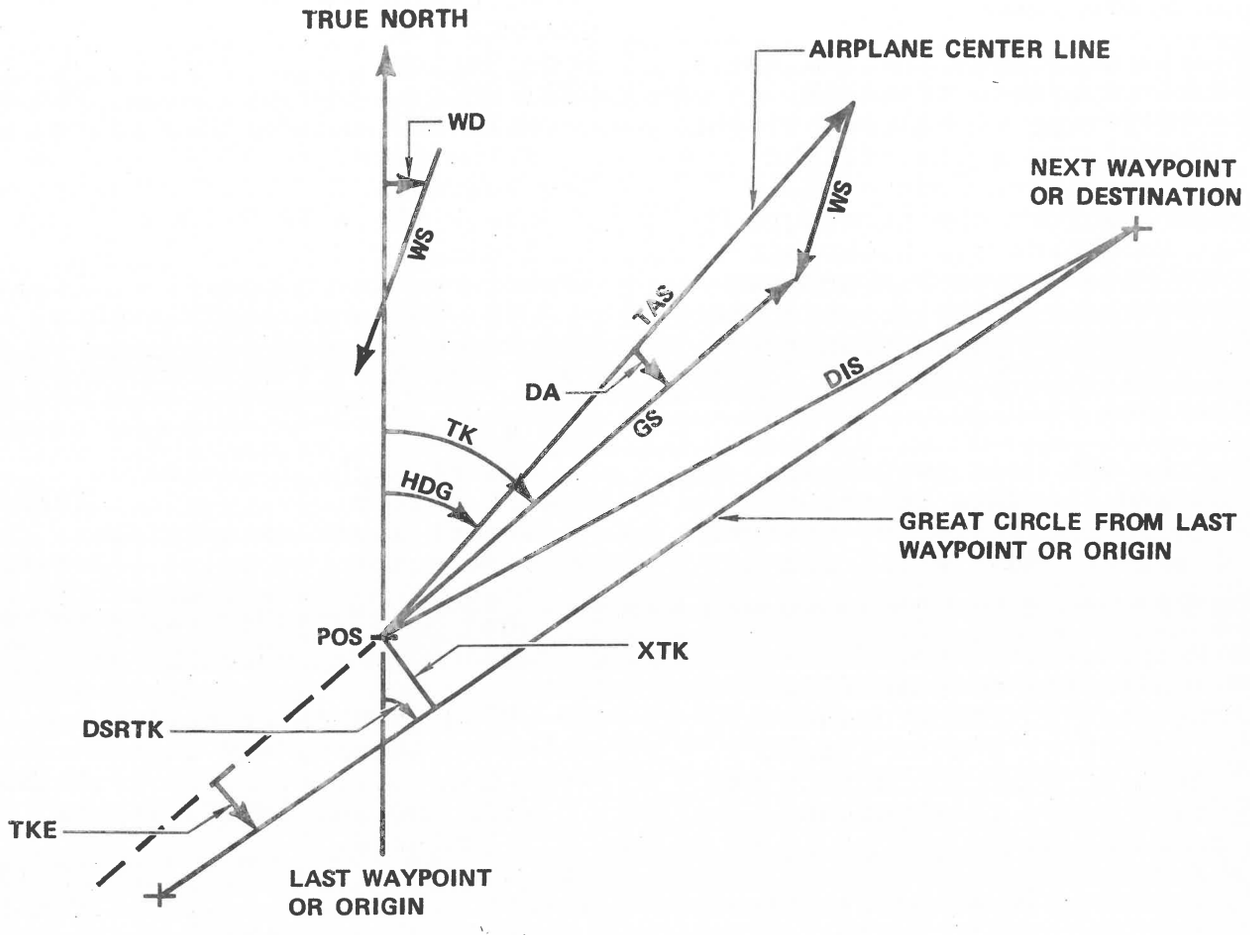
NAVIGATION SWITCHING (RADIO)



COMPASS SWITCHING (TRUE & MAGNETIC)



ATTITUDE SWITCHING



The following navigation measurement terms are used with the Inertial Navigation System and the computed values are displayed on the INS control module or on the pilots' flight instruments.

(HDG) True Heading is the angle between the airplane center line and True North.
(TAS) True Airspeed
(WS) Wind Speed in knots.
(WD) Wind Direction Angle is the angle between True North and the wind vector.
(TK) Ground Track Angle is the angle between True North and an imaginary line on the earth's surface connecting successive position points over which the airplane has flown (ground track).
(GS) Ground Speed
(DA) Drift Angle is the angle between the airplane's true heading and ground track.
(DSRTK) Desired Track Angle is the angle between True North and an imaginary line on the ground connecting successive position points desired to overfly; this line being the great circle segment that lies between two successive waypoints.
(XTK) Cross Track Distance is the shortest distance between the airplane's present position and the desired track.
(TKE) Track Angle Error is the angle between the airplane's actual ground track and desired ground track. It is equal to the desired track angle minus the ground track angle.
(POS) Present Position is the actual latitude and longitude position of the airplane.
(DIS) Distance is the great circle distance.

INS NAVIGATION DATA

INS PROGRAM TAPES

On early airplanes the INS operational tape is a type 31H. With this tape installed, flight crews desiring a post-flight present position update would have to perform the procedure prior to shutdown. Later airplanes have a type 31J program which automatically gives a present position update when present position is inserted following system turn on.

With the INS mode switch in ALIGN and the data selector switch in DSRTK/STS the desired performance index will read as follows:

31H Program
4 - indicating no post-flight present position update.
5 - indicating a post-flight present position update was made prior to shutdown.

31J Program
5 - should always appear after system turn on or following down moding to standby.

TO DETERMINE IF AN INS IS PROGRAMMED FOR 31H OR 31J:

Mode Switch.....ALIGN
WYPT CHG.....PRESS
WYPT CHG and INSERT lights illuminate.
Key Board.....PRESS 99
Check 99 in FROM-TO indicator.
Insert Switch.....PRESS
WYPT CHG and INSERT lights extinguish.
Data Selector.....WAY PT
Waypoint Selector.....0
Key Board.....PRESS N2376
Insert light illuminates.
Insert Switch.....PRESS
Insert light extinguishes.
Data Selector.....DIS/TIME
Readout on data indicators
4663 0007 - indicates 31H
4663 0010 - indicates 31J

TO RESUME NORMAL OPERATION

Prior to loading way points -
WYPT CHG.....PRESS
WYPT CHG and INSERT lights illuminate.
Key Board.....PRESS 12
Insert.....PRESS
WYPT CHG and INSERT lights extinguish.
FROM-TO Indicator.....CHECK
Check that 12 appears in the FROM-TO indicator.

ACTION CODES & MALFUNCTION CODES

- WITH NO WARN SIGNAL THE DISPLAY WILL BE BLANK.
- WITH A WARN SIGNAL PRESENT

ACTION CODES DISPLAYED

- Air or Ground operation
  - 01 – Turn system OFF
  - 02 – Check NAV Data – if degraded, switch to ATTITUDE.
  - 03 – Check Instruments ← No WARN LITE
- Ground operation only
  - 04 – Downmode to STBY and restart alignment.
  - 05 – Downmode to OFF and again perform turn on.

MALFUNCTION CODES DISPLAYED -- When:

Test switch pushed and released
10–63 malfunction codes

MODE STATUS AND ACTUAL PERFORMANCE INDEX

9	Standby mode
8	Coarse level
7	Coarse azimuth
6	Fine align
5	Actual Performance Index
4	
3	
2	
1	
0	

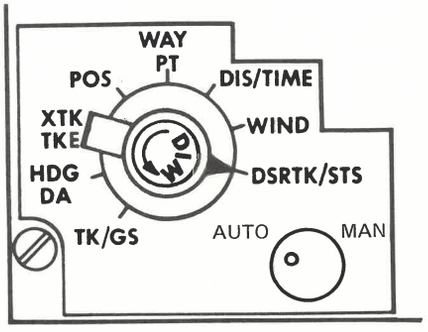
BLANK

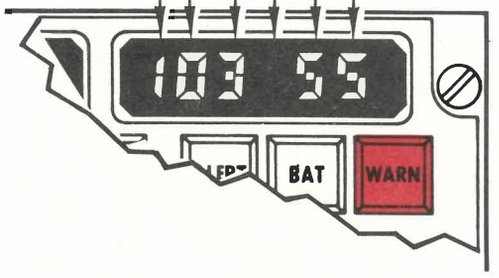
NAV MODE INDICATOR

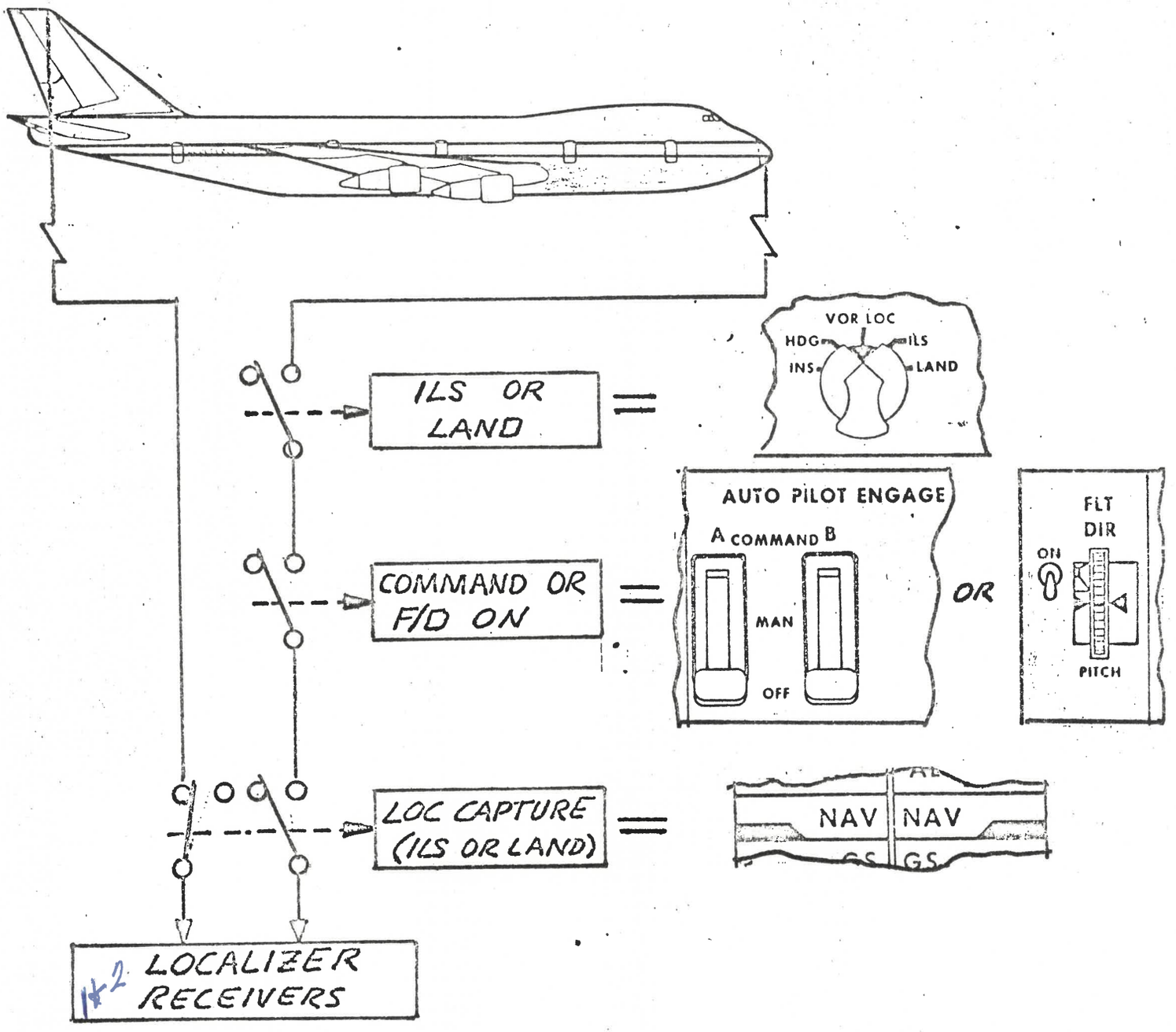
0 = Not in NAV mode
1 = In NAV mode

DESIRED PERFORMANCE INDEX

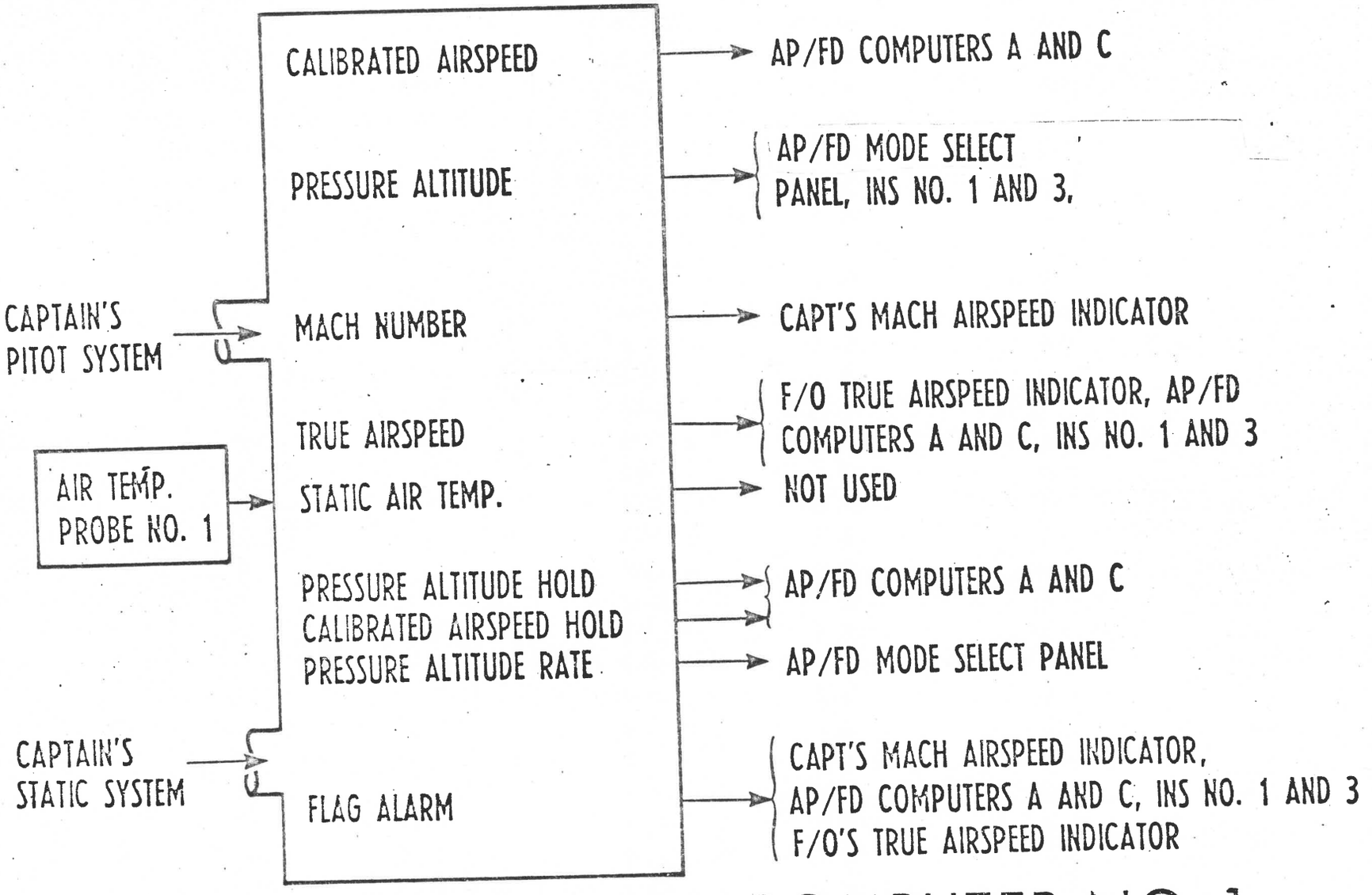
5,4,3,2,1,0



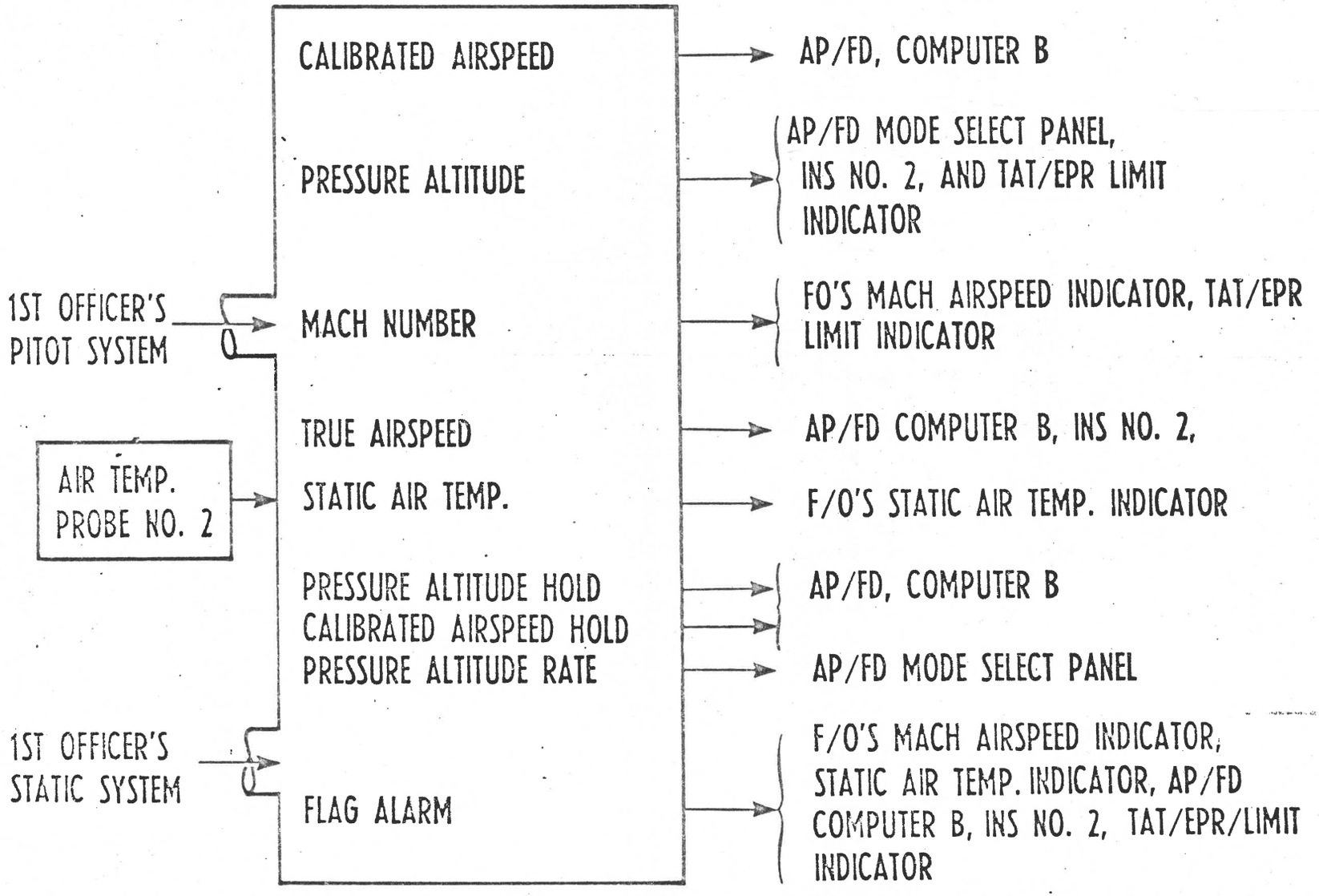




747 LOCALIZER ANTENNAE SWITCHING 19-290

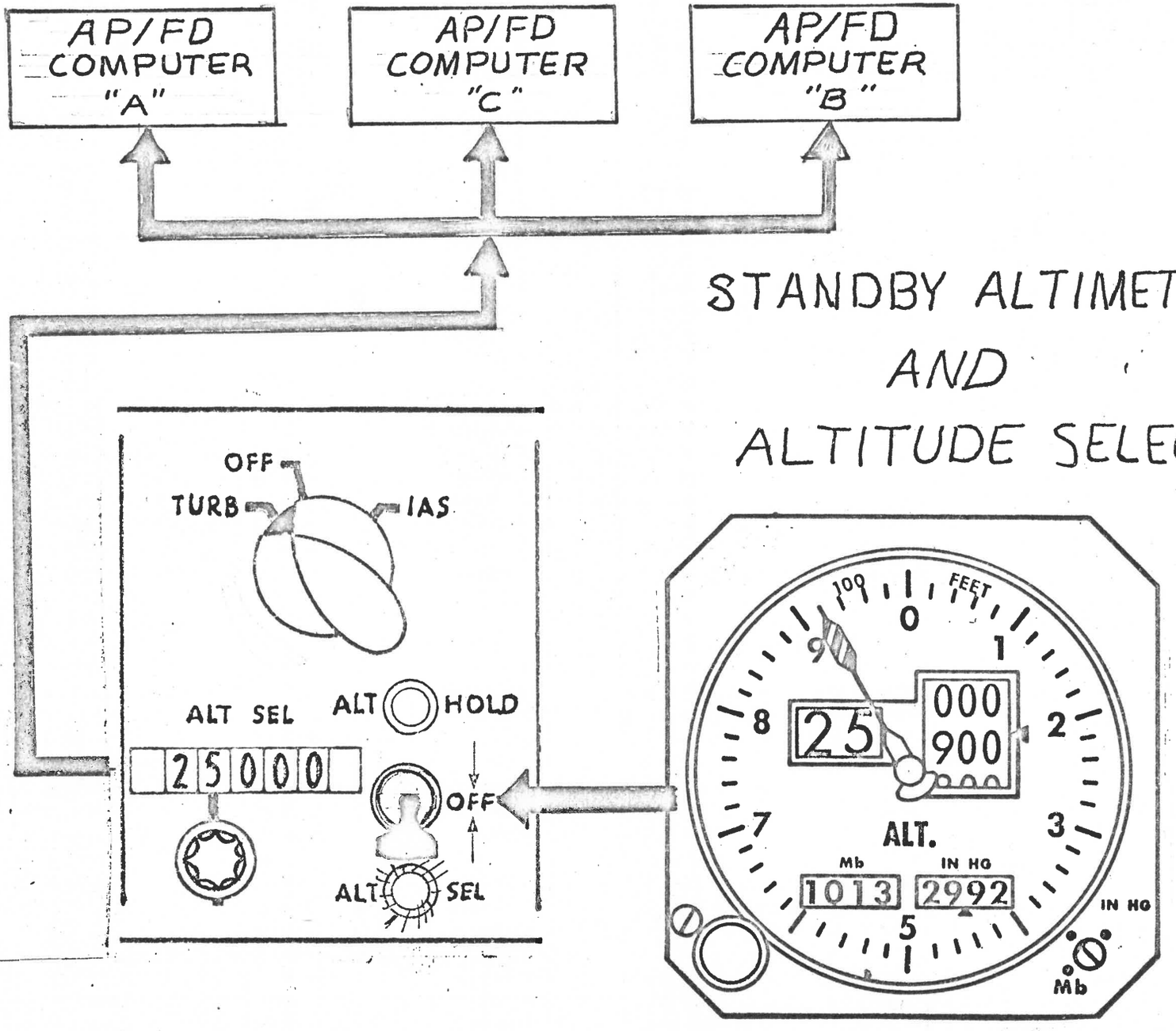


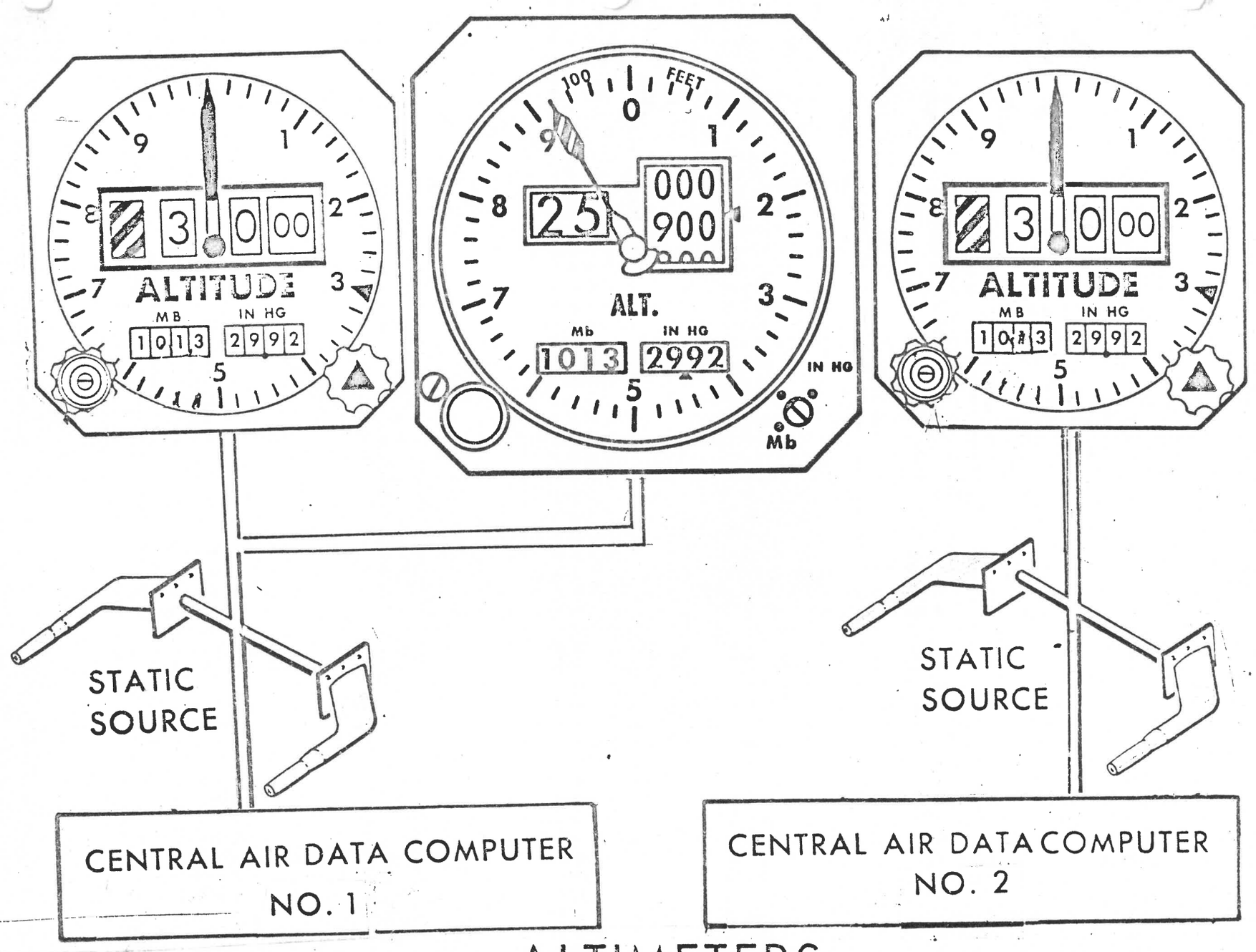
747-51 CENTRAL AIR DATA COMPUTER NO. 1 19-387



747-51 CENTRAL AIR DATA COMPUTER NO. 2 19-388

STANDBY ALTIMETER AND ALTITUDE SELECT

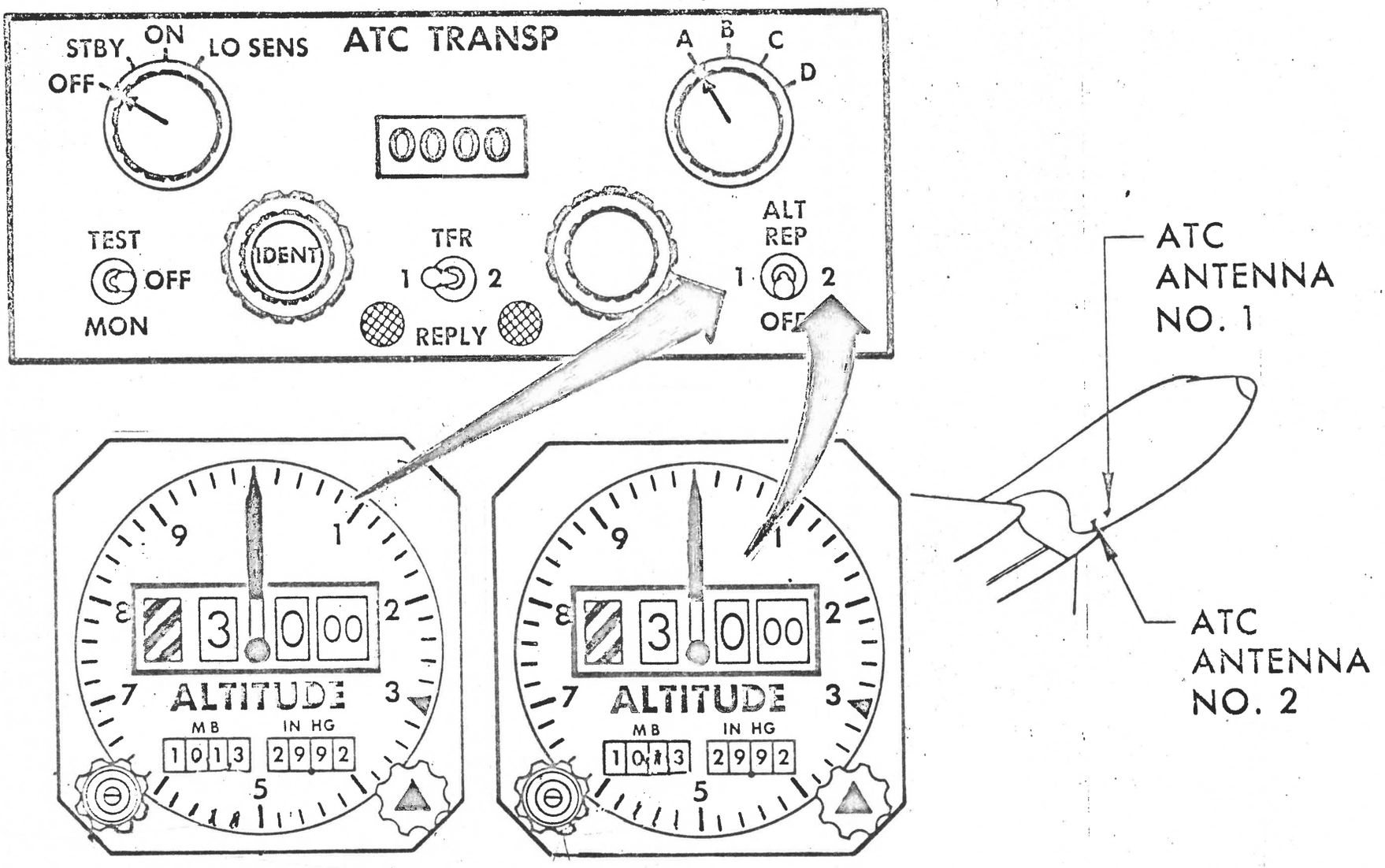




747-51

ALTIMETERS

19-398



ATC TRANSPONDER

747-51

19-341

CHAPTER 20

CROSS REFERENCE

FOR	REFER TO	CHAPTER
Air Driven Hydraulic Pump	HYDRAULIC POWER	16
Wing and Engine Anti-Ice	ICE AND RAIN PROTECTION	17
Leading Edge Flaps	FLIGHT CONTROLS	13
Pneumatic Air Distribution	AIR CONDITIONING AND PRESSURIZATION	6

BLEED AIR OVERHEAT LIGHT ILLUMINATED

Bleed Air Valve Switch.....CLOSE
Check that VALVE CLOSED light illuminates and the OVERHEAT light extinguishes.

IF VALVE CLOSED LIGHT DOES NOT ILLUMINATE AND OVERHEAT LIGHT DOES NOT EXTINGUISH:
Thrust Lever.....RETARD
Flight conditions permitting retard thrust lever until OVERHEAT light extinguishes.

HIGH STAGE BLEED AIR VALVE FAILURE

- High Stage Valve Failed Closed
This condition is indicated by one HIGH STAGE light being extinguished while other three lights are illuminated. In icing conditions, if possible, maintain at least 70% N1 RPM in level flight. In descent, during prolonged icing, accelerate affected engine to 70% periodically.

- High Stage Valve Failed Open
This condition is indicated by one HIGH STAGE light being illuminated while other three lights are extinguished. No action is necessary unless PRESS RELIEF light also illuminates, in which case:
Bleed Air Valve Switch.....CLOSE

IF PRESS RELIEF LIGHT DOES NOT EXTINGUISH:
Thrust Lever.....RETARD

NOTE: With pressure relief light illuminated nacelle temperature indications should be above normal.

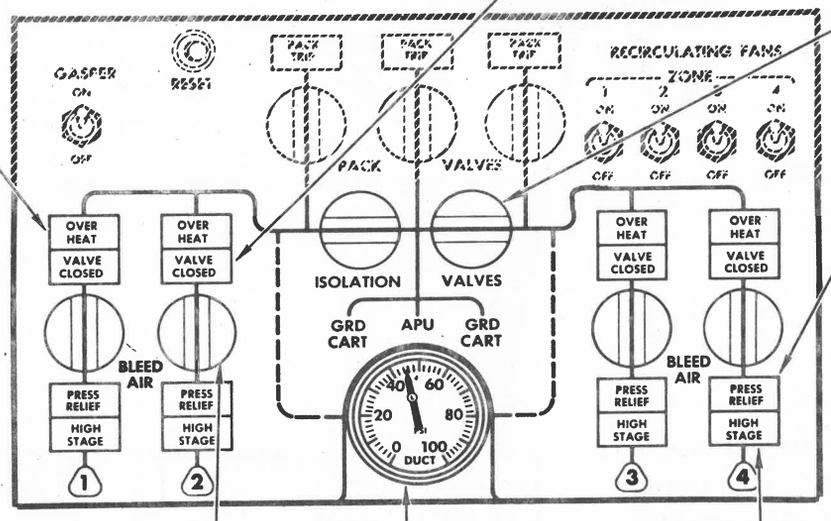
BLEED AIR OVERHEAT LIGHT (Amber)

Illuminates if bleed air temperature is excessive.

NOTE: Bleed air valve has a temperature control function which should close the bleed air valve automatically for this condition.

BLEED AIR VALVE CLOSED LIGHT (Amber)

Illuminated whenever engine bleed air valve is fully closed.



FLIGHT ENGINEER PANEL

DUCT ISOLATION VALVE SWITCH

Isolates wing ducts from rest of pneu matic system.

PRESSURE RELIEF LIGHT (Amber)

Indicates bleed pressure upstream of bleed valve is excessive and relief valve has opened.

BLEED AIR VALVE SWITCH

Initiates engine bleed air valve operation. In open position the valve

- regulates engine bleed air pressure to 45 psi maximum.
- modulates and if necessary closes for excessive bleed air temperatures.
- prevents reverse flow except when ignition switch is in the start positions.

In close position

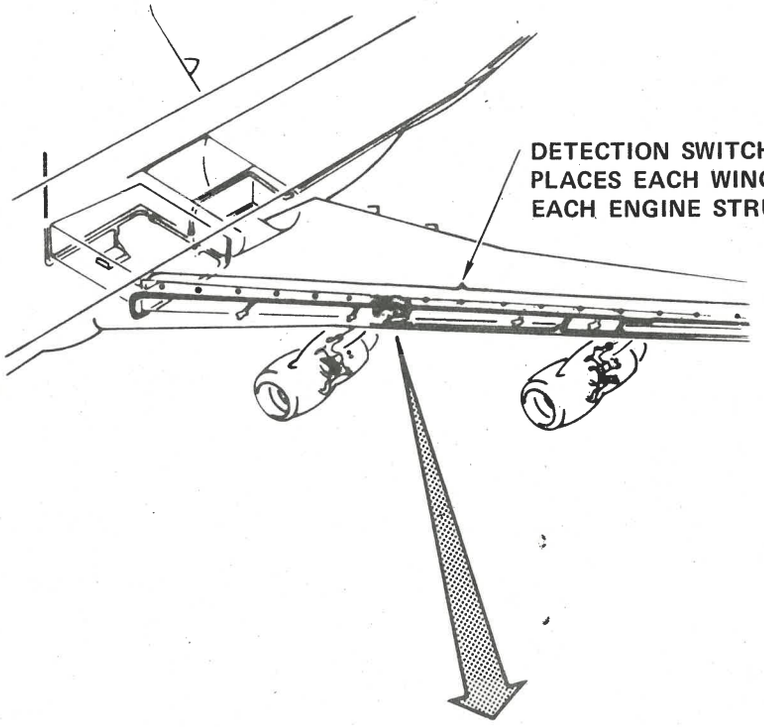
- shuts off engine bleed air supply.
- closes high stage bleed air valve.

DUCT PRESSURE INDICATOR

Displays left and right pneumatic duct pressure. Sensors are located out board of isolation valves.

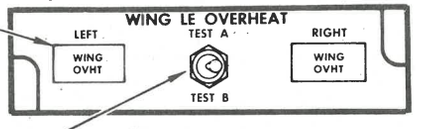
HIGH STAGE LIGHT (Green)

Indicates high stage bleed valve has automatically opened to replace low stage bleed. High stage bleed is used for pneumatic air supply during low thrust operation.



WING OVERHEAT LIGHTS (Amber)

Indicates pneumatic duct leakage/ rupture or engine strut overheat in respective wing.

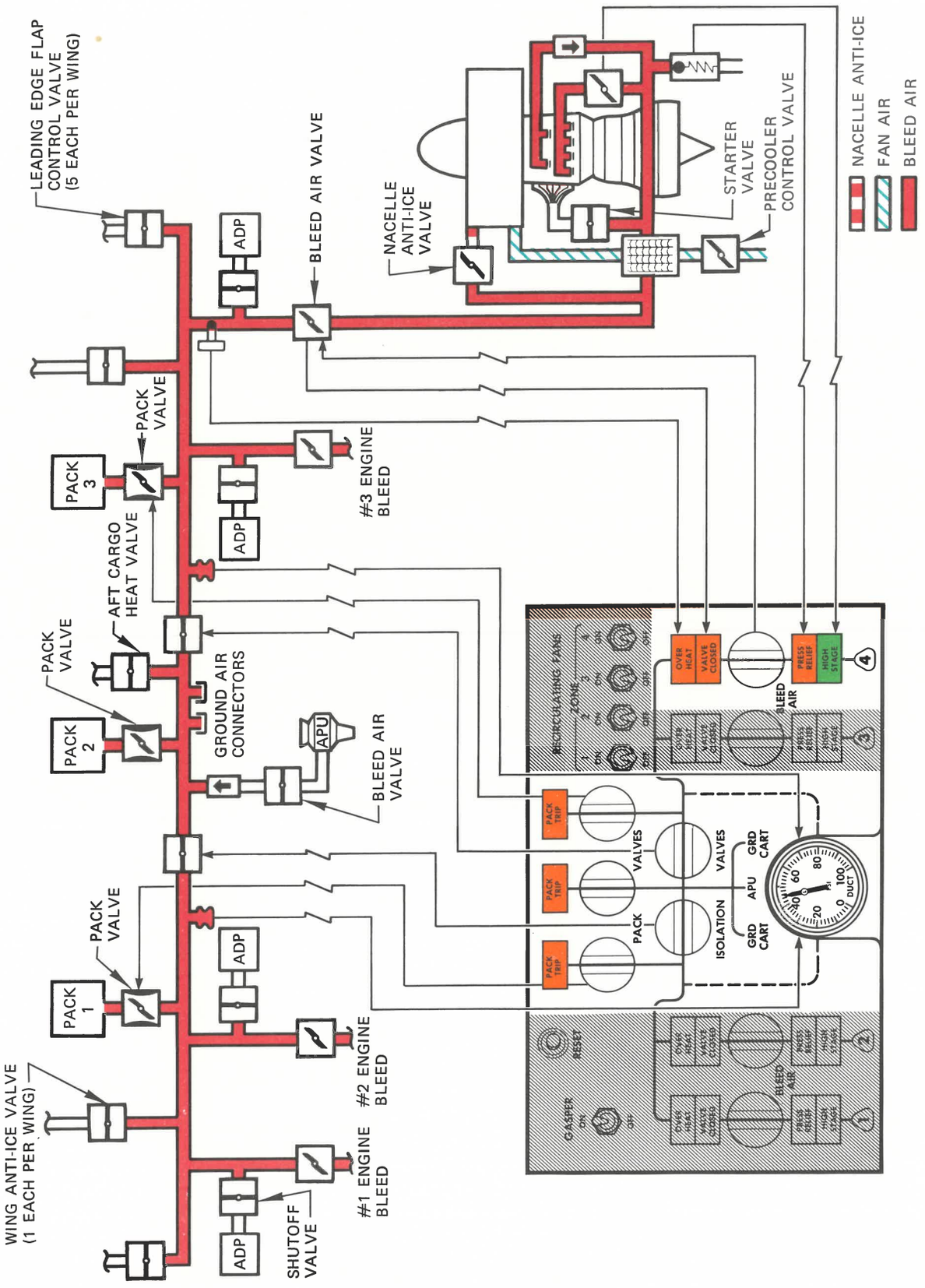


FLIGHT ENGINEER PANEL

WING OVERHEAT TEST SWITCH

TEST A – Momentary position. Checks electrical continuity to the detectors. Both LEFT and RIGHT WING OVHT lights will illuminate if circuit is satisfactory.

TEST B – Checks continuity from the detectors. On later airplanes the circuit is completed (grounded) at each detector. The overheat lights will illuminate for both configurations.

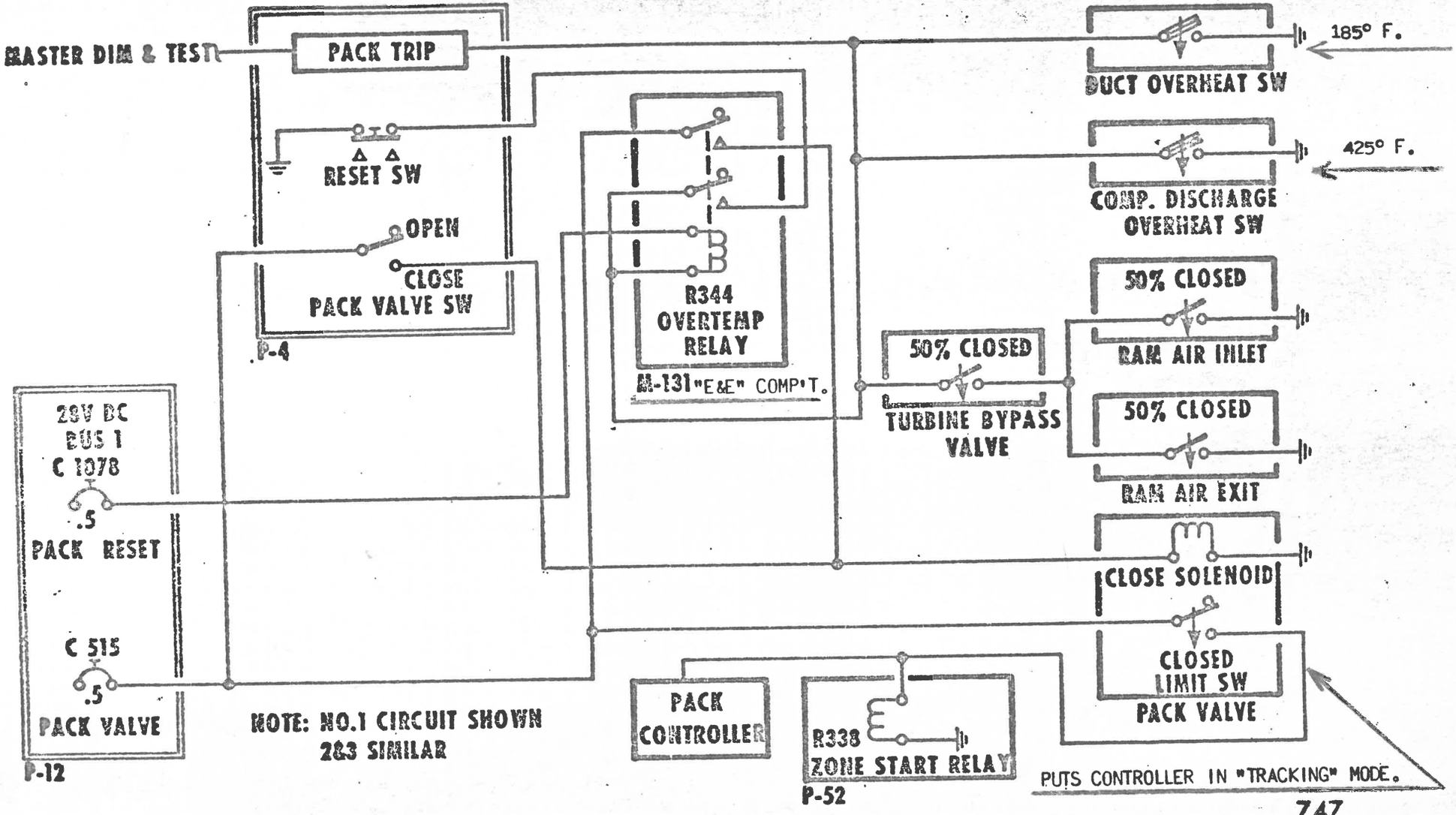

LEADING EDGE FLAP CONTROL VALVE (5 EACH PER WING)
BLEED AIR VALVE
NACELLE ANTI-ICE VALVE
STARTER VALVE
PRECOOLER CONTROL VALVE
NACELLE ANTI-ICE
FAN AIR
BLEED AIR
ADP
PACK VALVE
PACK 3
#3 ENGINE BLEED
AFT CARGO HEAT VALVE
PACK VALVE
PACK 2
GROUND AIR CONNECTORS
APU
BLEED AIR VALVE
PACK VALVE
PACK 1
#2 ENGINE BLEED
#1 ENGINE BLEED
WING ANTI-ICE VALVE (1 EACH PER WING)
SHUTOFF VALVE
RECIRCULATING FANS
ZONE
OVHT HEAT
VALVE CLOSED
PRESS RELIEF
HIGH STAGE
BLEED AIR
PACK TRIP
VALVES
ISOLATION
PACK
APU
GRD CART
DUCT
PSI
CASPER RESET

GENERAL DESCRIPTION

Engine compressor bleed air is utilized for cabin pressurization, air conditioning, thermal anti-icing of the wing leading edges and the engine inlets, pneumatic drives for leading edge flaps, aft cargo compartment heat, and air driven hydraulic pumps. Separate engine bleed air sources are used for engine stator anti-icing and for engine fan thrust reverser operation.

The pneumatic system automatically selects either high or low stage bleed air from the engine compressor and delivers pressure regulated and temperature limited air to the pneumatic duct. Normally during takeoff, climb, cruise and most holding conditions the system draws low stage air. For descent and other low engine thrust conditions the high stage is required to provide for system demand.

Bleed air temperature is normally controlled by a "precooler" which utilizes engine fan air to cool the bleed air.



21-51-005
000-L-000A

PACK TRIP COOLING PACK CIRCUIT

747
8-69

CHAPTER 21

CROSS REFERENCE		
FOR	REFER TO	CHAPTER
Fire Protection	FIRE PROTECTION	12
Fuel	FUEL	15
Icing and Anti-Icing	ICE AND RAIN PROTECTION	17
Pneumatics	PNEUMATICS	20
Inflight Starting Envelope	PERFORMANCE INFLIGHT	23

CROSSBLEED START

If a crossbleed start is desired or required utilizing an operating engine:

- Insure that area to rear of the operating engine is clear.
- Turn all pneumatic bleeds not required, including air conditioning packs, OFF.
- Advance thrust lever of operating engine slowly until pneumatic pressure is approximately 40 PSI (less 1 PSI per 1000 ft. of pressure altitude) and HIGH STAGE valve light remains illuminated. 70% N2 is the nominal power setting required to attain 40 PSI duct pressure.

NOTE: Power settings above 70% N2 may cut out high stage bleed (HIGH STAGE valve light will extinguish) and reduce duct pressure below required minimum.

STARTING IN HIGH TAILWINDS

Move the start lever to RICH (cold engine) or IDLE (warm engine) at maximum motoring speed. A slightly higher EGT should be anticipated.

USE OF FUEL HEAT

Prior to Takeoff or Approach

If No. 1 fuel tank temperature is 0°C or below:
Fuel Heat Switches.....OPEN
Check that engine fuel temperatures rise.

After one minute (two minutes if No. 1 tank temperature is below -40°C):
Fuel Heat Switches.....CLOSE
Check that engine fuel temperatures return to approximately the previous reading.

NOTE: When the fuel heat switch is placed to OPEN the fuel temperature downstream of the fuel heater may exceed 60°C. Such a reading on the fuel temperature indicator should not be regarded as abnormal.

In Flight

If a fuel icing light illuminates or at thirty-minute intervals when No. 1 fuel tank temperature is 0°C or below:
Fuel Heat Switches.....OPEN
Check for fuel temperature rise.

During operation at maximum climb or maximum cruise thrust:
Thrust Levers.....ADJUST
Maintain EPR within maximum limit.

After one minute (two minutes if No. 1 tank temperature is -40°C or below):
Fuel Heat Switches.....CLOSE
Check for fuel temperature decrease.
Thrust Levers.....AS REQUIRED

NOTE: If ICING light does not extinguish when fuel heat is applied and the temperature is above freezing, suspect fuel contamination.

STARTING, ENGINE IN REVERSE

Starting with engine thrust reverser(s) in reverse position is permissible:
Reverse Thrust
Levers.....DOWN (FORWARD) POSITION
Forward Thrust
Levers.....IDLE POSITION

Observe normal start procedures. When bleed pneumatic pressure builds up thrust reverser(s) should return to forward (stowed) position.

ENGINE(S) STUCK IN REVERSE DURING GROUND OPERATION

If, after a reversing cycle or after a start in reverse, the engine fails to return to forward thrust, monitor EGT closely and (in a clear area) recycle the affected engine reverse thrust lever to the reverse thrust position. Accelerate to 30% N1 RPM and rapidly return the reverse thrust lever to the forward idle thrust position. If the engine fails to return to the forward thrust position, shut down the affected engine. Do not give directional command changes until the reverser has had time to complete its travel. Avoid rapid cycling of the reverser system. Approximate times for reverser travel are:
extend - 2 seconds
retract - 5 seconds

MANUAL OVERRIDE START

A manual override start will be required if:
- BLEED AIR VALVE FAILS TO OPEN
  This failure is indicated when the bleed air VALVE CLOSED light does not extinguish when the engine ignition switch is positioned to GRD START.
- STARTER VALVE FAILS TO OPEN
  This failure is indicated when the starter VALVE OPEN light does not illuminate when the engine ignition switch is positioned to GRD START.

If one of the above failures occur the start procedure must be coordinated between the flight and ground crew. The ground crewman will, on the Captain's command:
- "Open Bleed Air Valve" (VALVE CLOSED light should extinguish)
  OR
- "Open Starter Valve" (VALVE OPEN light should illuminate)

Engine Ignition
Switch.....GRD START
Observe normal starting indications and procedures.

Engine Ignition Switch.....OFF
F/E calls "46% N2" and places ignition switch to OFF.

The ground crewman will, on the Captain's command:
- "Release Bleed Air Valve" (If bleed air valve does not close pneumatically the ground crewman will have to close manually)
  OR
- "Release Starter Valve" (Check that VALVE OPEN light extinguishes.)

ABORTED START

Abnormal starting fuel flows (normal FF IDLE: 850-1050 lbs/hr; 385-475 kg/hr; RICH: 950-1150 lbs/hr; 430-520 kg/hr), an illuminated high stage light, high tailwinds, or a low pneumatic duct pressure may result in an unsatisfactory start attempt.

Abort the start if any of the following conditions occur:
- No EGT rise within 20 seconds after start lever movement.
- If N2 acceleration is sluggish and/or EGT is climbing rapidly through 500°C.
- Engine fails to accelerate to IDLE RPM within 90 seconds after start lever movement.

Engine Start Lever.....CUTOFF
Check fuel flow decreases; motor the engine for 30 seconds or until EGT is less than 100°C, whichever is longer. If ignition switch has been released, do not re-engage until N2 is less than 20%.

If EGT did not exceed 593°C and a re-start is desired:
Engine Start Lever.....RICH/IDLE
Use normal start procedures.

NOTE: After an initial engine cooling period, two consecutive start attempts and engine cooling periods may be performed without disengaging the starter. If a satisfactory start is not obtained on the second attempt, place the ignition switch to OFF after cooling the engine. Allow N2 to decrease to zero to provide starter cooling before attempting another start.

LOW DUCT PRESSURE START

If the recommended minimum starting duct pressure (30 psi) cannot be maintained, starts may be attempted if the duct pressure - after start valve is open - versus ambient temperatures are within the following values:

OAT°C	SL to 5000'	Above 5000'
+10 & above	21 psi	21 psi
+10 to -10	22 psi	21 psi
-10 to -20	23 psi	21 psi
-20 to -30	25 psi	23 psi

Air Conditioning
Packs.....ALL CLOSED
Ignition Switch.....GRD START
Start Lever.....RICH/IDLE
Position start lever to RICH/IDLE when at least 16% N2 RPM is attained. A slower N2 acceleration and a more rapid EGT rise should be anticipated.

NOTE: Due to the variation in engine start characteristics the inability to obtain a satisfactory start on one engine does not preclude a satisfactory start on another. Cross-bleed start may be used on remaining engines after one engine has been started.

NO N1 ROTATION

If EGT begins to rise and N1 rotation has not been observed on the RPM indicator:

Engine Start Lever.....CUTOFF
Check fuel flow decreases and continue to hold the engine ignition switch in GRD START for thirty seconds to clear engine.
Engine Ignition Switch.....OFF
When N2 has decreased to 20% or less and a re-start is desired, start engine using normal start procedure but request ground crew to observe N1 for rotation.

START VALVE FAILS TO CLOSE

VALVE OPEN light remains illuminated after engine ignition switch is returned to OFF.

Engine Start Lever (respective engine).....CUTOFF
Check fuel flow decreases.

BLEED AIR VALVE CLOSED LIGHT DOES NOT ILLUMINATE AT STARTER CUTOUT

Bleed Air Valve (respective engine).....CLOSE
Check VALVE CLOSED light illuminates.

If engine motoring is required due to an aborted start:
Bleed Air Valve.....OPEN
Follow aborted start motoring procedure.

NOTE: Malfunction (failure to close or sluggish operation) of the bleed air valve check feature will increase possibility of surge/stall during any phase of engine operation.

ENGINE OVERTEMPERATURE ON THE GROUND OTHER THAN START:

Engine Start Lever.....CUTOFF
Check fuel flow decreases. If fuel flow does not decrease, place engine fuel shutoff switch to CLOSE.
Pack Valves.....CLOSED
Place pack valve switches to the close position.
Engine Ignition Switch.....GRD START
When N2 of the affected engine has decreased to below 20%, place the engine ignition switch to GRD START and motor the engine until EGT is below 100°C. A restart may be made if desired and engine limitations have not been exceeded.

ENGINE OVERTEMPERATURE DURING TAKEOFF AND IN THE AIR

Overtemperatures of, or exceeding, 870°C for the JT9D-3A engine and of, or exceeding, 925°C for the JT9D-7 engine require immediate flight crew action. Flight at reduced thrust to maintain EGT within limits is allowed at the Captain's discretion, but the engine should, flight conditions permitting, be shut down.

Momentary overtemperatures to 870°C for the JT9D-3A engine and to 925°C for the JT9D-7 engine should be noted in the airplane log giving the maximum temperature reached and the duration of the overtemperature.

HIGH OIL CONSUMPTION

Oil consumption in excess of one U.S. quart (average) per hour on a flight should be noted in the airplane log for maintenance review.

NOTE: It is usually impossible for the flight crew to determine if the excessive consumption is external or internal to the engine. Abnormally high breather pressure associated with high oil consumption may be evidence that an internal problem exists. In either case thrust reduction on the affected engine, if feasible, may decrease the consumption rate.

LOW OIL QUANTITY INDICATION

Oil Pressure.....MONITOR
If the oil quantity indication decreases to one U.S. gallon the oil pressure must be monitored closely. If the oil pressure drops below the green band or begins to fluctuate the Low Engine Oil Pressure procedure should be followed.

HIGH ENGINE OIL TEMPERATURE

Thrust Lever.....RETARD
Oil temperature should rise momentarily after thrust reduction and then begin to return to green band.
- If temperature returns to green band, higher thrust settings may be used as long as the temperature remains in green band.
- If temperature does not return to green band within twenty minutes, or if the red radial indication is exceeded, shut down engine.

LOW ENGINE OIL PRESSURE

(Engine oil pressure indication below green band.)

If oil pressure is in the yellow band, monitor other engine instruments and continue operation to the next landing. The ENG OIL PRESS light on the pilots' center panel should illuminate when the oil pressure is in the yellow band or below.

If the oil pressure drops below the yellow band, shut down the engine, or operate at the minimum thrust required to maintain flight.

Illumination of the ENG OIL PRESS light, with no other abnormal indication, does not require thrust reduction or shutdown. However other engine instruments should be observed frequently for any indication which would require such action.

OIL FILTER BYPASS LIGHT ILLUMINATED

(At 50 PSI differential pressure the FILTER BYPASS light will illuminate for the affected engine, indicating an impending oil filter bypass.)

Thrust Lever.....RETARD
Retard the thrust lever to reduce filter differential pressure, flight conditions permitting.
- If FILTER BYPASS light extinguishes, operate at the reduced power setting.
- If FILTER BYPASS light does not extinguish, shut down the engine or operate at the minimum thrust required to sustain flight.

HIGH ENGINE BREATHER PRESSURE

(Maximum breather pressure is 7.5 PSI for continuous operations and 9.0 PSI for transient operations. During transient operations, breather pressure should not exceed 7.5 PSI for a period of more than 30 seconds.)

Thrust Lever.....RETARD
If thrust reduction results in acceptable breather pressure and other engine instruments do not indicate a significant engine problem flight at reduced thrust is allowed, at the captain's discretion, but all engine parameters should be monitored.

If thrust reduction does not result in acceptable breather pressure and/or if other engine instruments substantiate an engine problem the engine should, flight conditions permitting, be shut down.

HIGH ENGINE VIBRATION

Actual or impending engine difficulties may be detected by the Airborne Vibration Monitor (AVM). However, AVM values may vary between engines. Therefore AVM values should be observed and recorded (with stabilized thrust settings) periodically during flight to detect significant vibration changes.

Any distinct trend of increasing or decreasing AVM values during an extended period of time over one or more flights should be entered in the flight log.

The following values are representative of the range of the normal values:

Turbine:	0.2 to 0.7 IPS
Inlet:	0.2 to 1.2 IPS

If, at any time with stabilized thrust setting, a rapid increase in excess of 0.5 IPS is observed:
Thrust Lever.....RETARD
Retard the thrust lever of the affected engine to return the AVM value to within 0.5 IPS of its previous value.
- If the thrust reduction returns the AVM value to within 0.5 IPS of its previous value and all other engine parameters are normal continue to operate at that thrust setting.
- If thrust reduction does not return the AVM value to within 0.5 IPS of its previous value or if other engine abnormalities exist the engine should be shut down, flight conditions permitting.

FUEL HEATER VALVE FAILED CLOSED

(Fuel temperature does not rise when fuel heat switch is in OPEN position.)

Fuel Temperature and Engine Operation....MONITOR
A possibility of engine flameout exists if ICING light illuminates and fuel heat cannot be applied.

FUEL HEATER VALVE FAILED OPEN

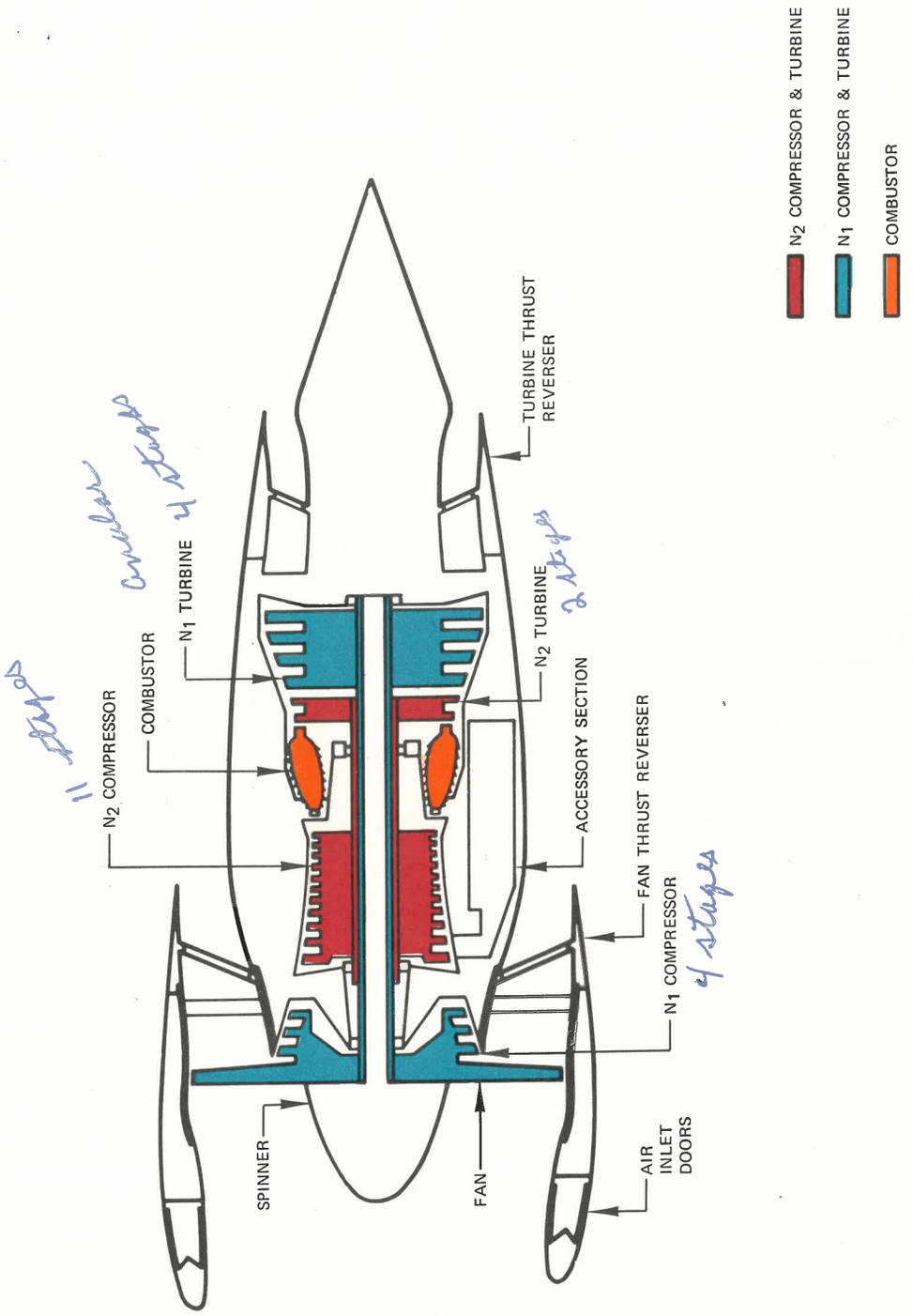
(Fuel temperature does not decrease when fuel heat switch is in CLOSE position.)

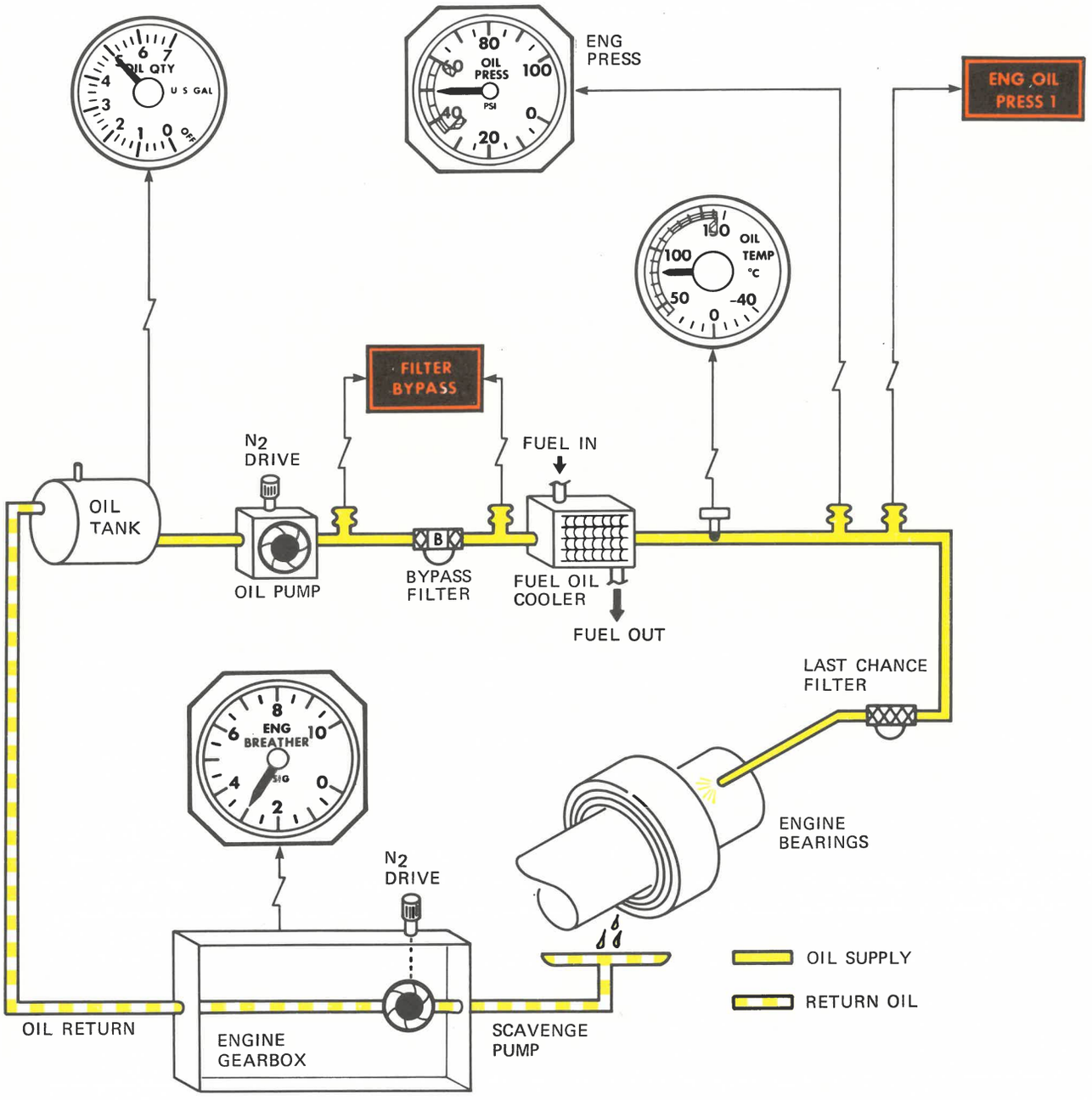
Engine Indicators.....MONITOR
Monitor engine indicators, particularly oil temperature, closely. If allowable oil temperature cannot be maintained, shut down engine.

GROUND IDLE LIGHT ILLUMINATED IN FLIGHT

The GRD IDLE light illuminated in the air, with trailing edge flaps at 25 or 30, indicates that one or more of the engines has remained at ground idle. Maintain a minimum of 55% N1 RPM on all engines to assure proper engine acceleration capability.

POWER PLANT SCHEMATIC




OIL QTY
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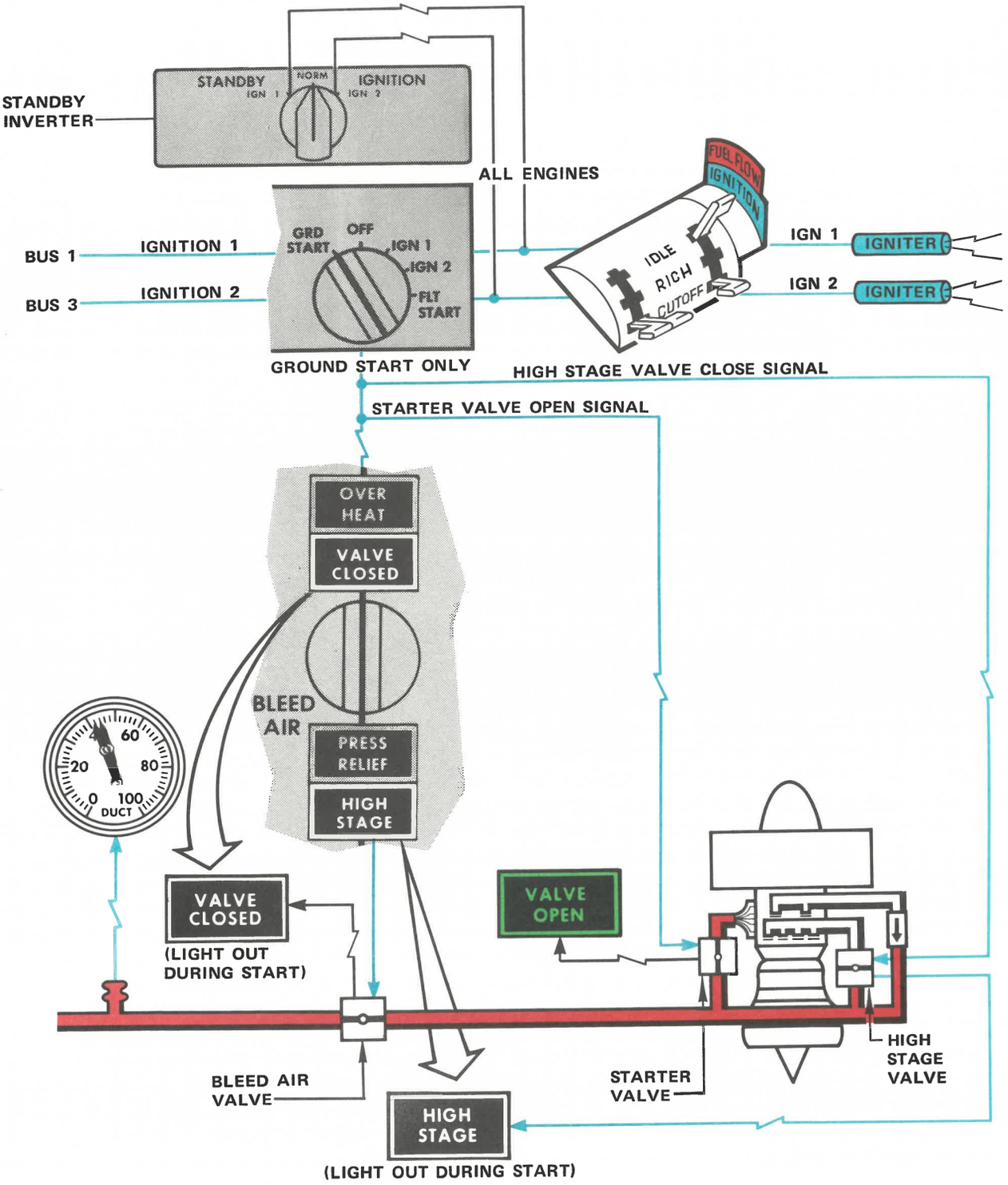
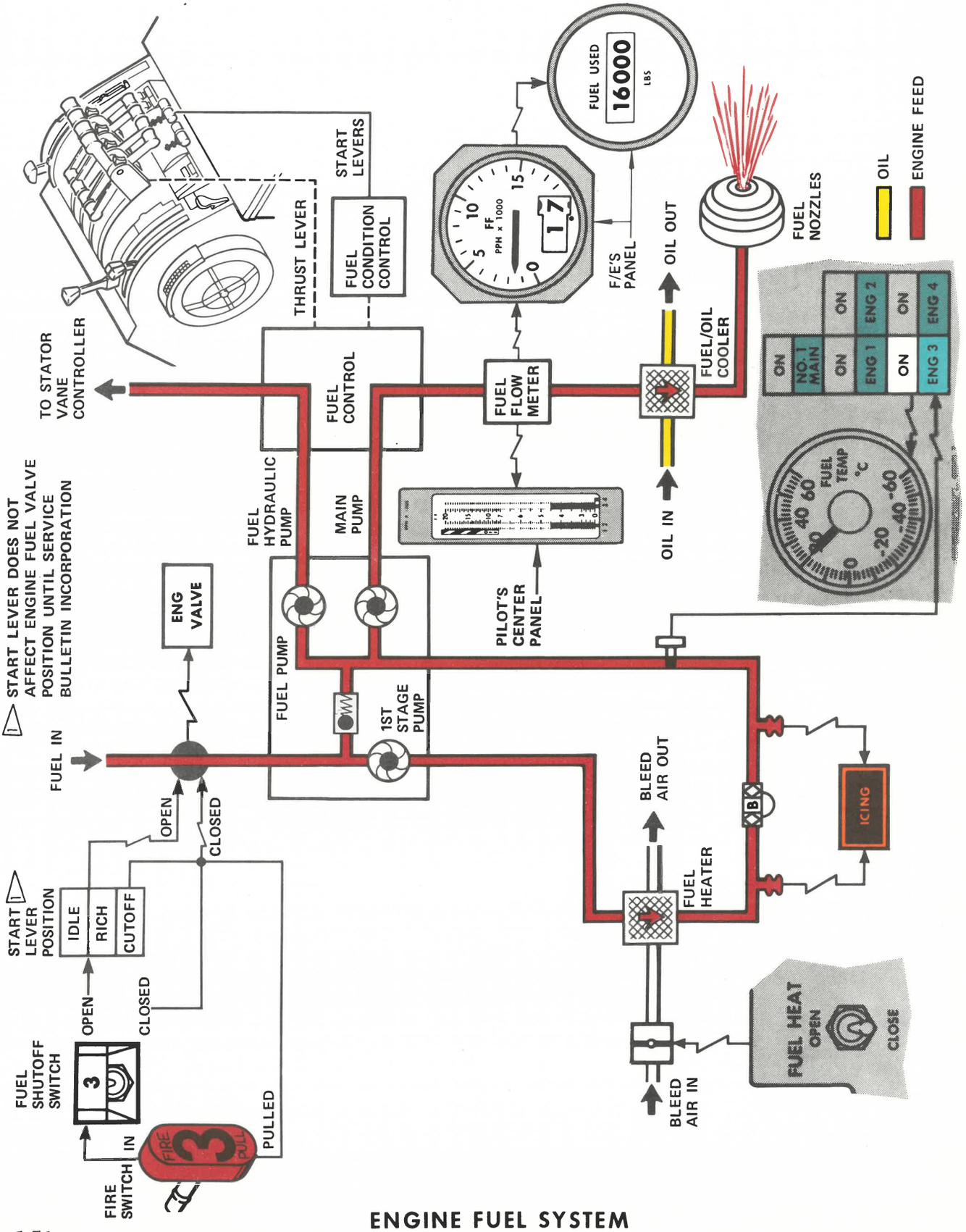
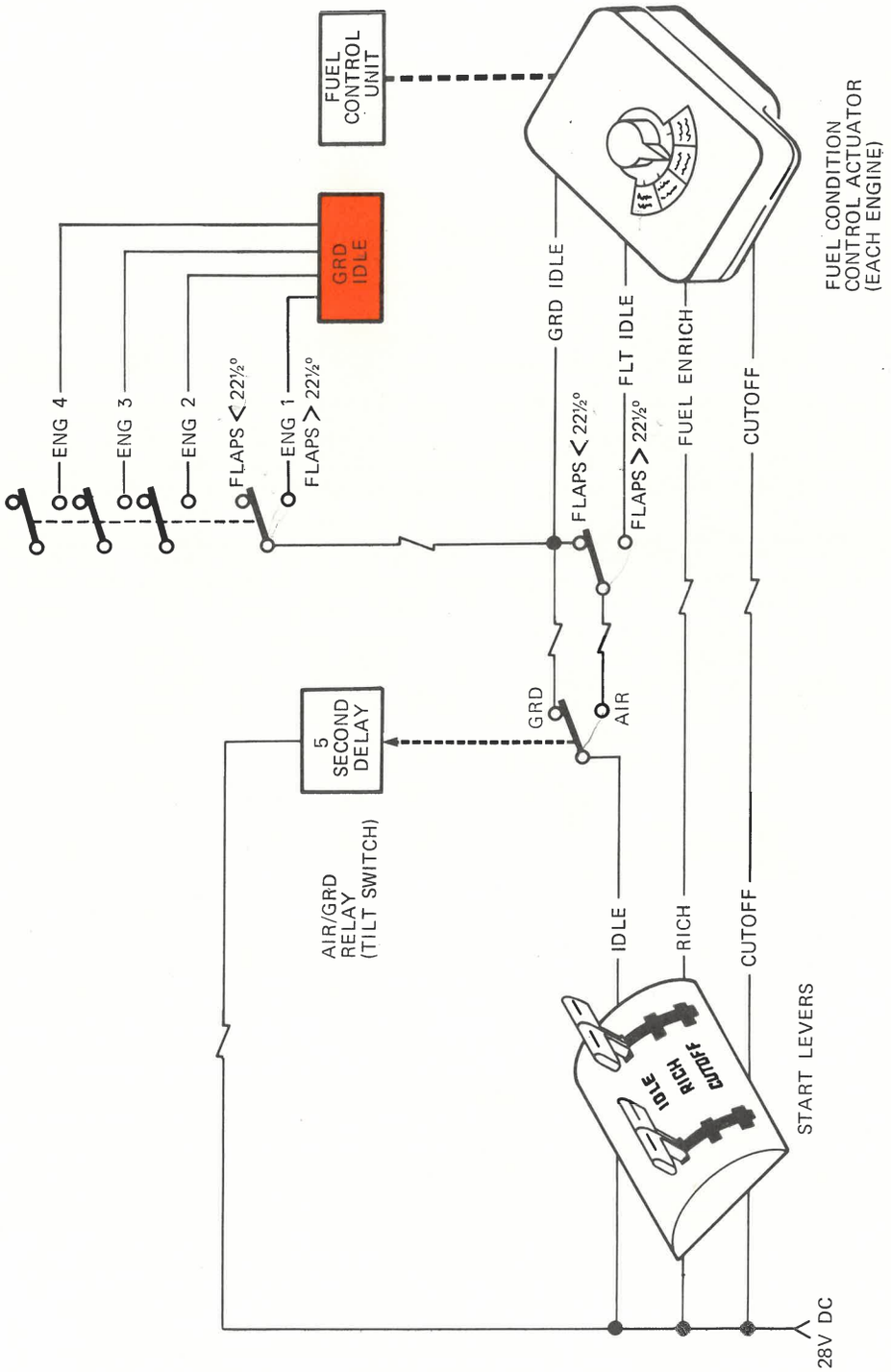
ENG OIL PRESS 1
OIL TEMP
°C
FILTER BYPASS
N2 DRIVE
FUEL IN
OIL TANK
OIL PUMP
BYPASS FILTER
FUEL OIL COOLER
FUEL OUT
LAST CHANCE FILTER
ENG BREATHER
SIG
ENGINE BEARINGS
N2 DRIVE
OIL SUPPLY
RETURN OIL
OIL RETURN
ENGINE GEARBOX
SCAVENGE PUMP



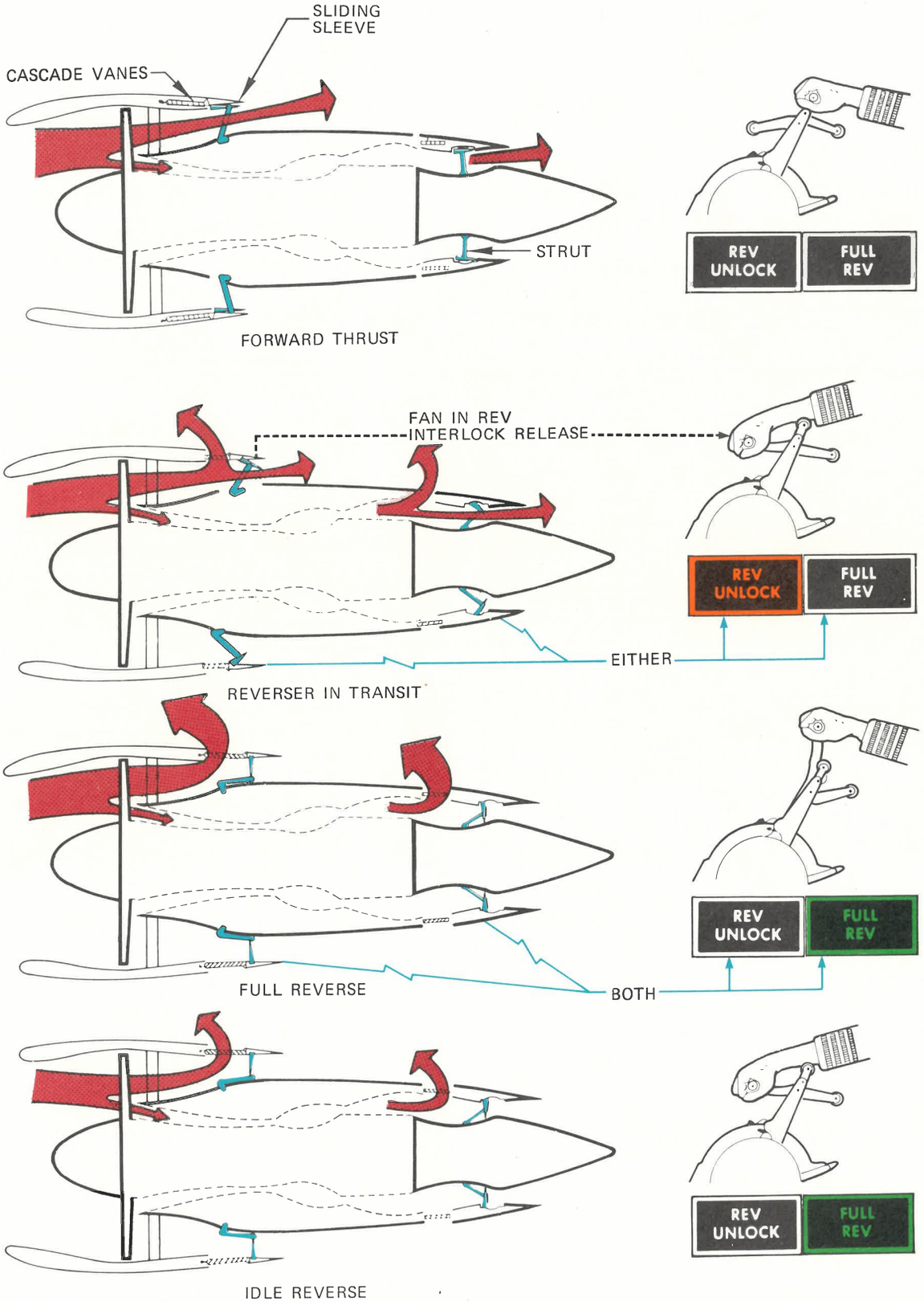
START & IGNITION SYSTEM



ENGINE FUEL SYSTEM



FUEL CONDITION ACTUATOR



THRUST REVERSER SYSTEM

The airplane is equipped with four Pratt and Whitney JT9D engines mounted below the wings. The engines are rated at 43,500 pounds of thrust (45,000 with water injection) at sea level in temperatures up to +80°F. The engine is a forward fan, twin spool axial compressor type with a high bypass ratio (5 to 1) which results in the fan delivering approximately 75% of the thrust. The low pressure compressor unit (N1) consists of a single-stage fan and a three-stage compressor connected by a through shaft to a four-stage turbine. The high pressure compressor unit (N2) consists of an eleven-stage compressor unit connected to a two-stage turbine through concentric shafting. Variable stators, automatically positioned by fuel pressure, provide an adequate stall margin for engine starting, acceleration and low power operation. The fuel control unit schedules fuel to provide the thrust called for by the thrust lever setting.

There are two engine idle speeds; low (ground) idle is used during ground operation and during all flight operations except the approach and landing when the engines shift to high (flight) idle to facilitate engine acceleration for a go-around. In the air the idle speed is determined by the position of the trailing edge flaps. Until the flaps are positioned to 25 or 30 the engines remain in low idle. High idle is then programmed and maintained until 5 seconds after touchdown. Landing gear tilt sensors then dictate a shift to low idle. The engine inlet is designed to provide optimum cruise performance. Auxiliary air inlet doors open to supplement the air supply on takeoff or at high power/low airspeed flight conditions.

Accessories are driven by the N2 compressor through an angled gearbox. A complete self-contained oil system provides for lubrication and cooling of internal parts. The thrust reverser system provides means of reversing both fan and turbine exhaust air. Both reversers work in an identical manner and are controlled by a single reverse thrust lever.

The engine starting system provides means of rotating the N2 compressor to establish airflow through the engine. Air pressure to start the engines is normally obtained from the APU but can be supplied by ground equipment or an operating engine. Dual, physically and electrically independent 4-joule ignition systems are 115V AC powered. A standby ignition system utilizes standby inverter AC power to provide ignition from the battery. The nacelle inlets and first-stage stators have thermal anti-icing.

Engine bleed is utilized to provide fuel heat when fuel icing is encountered or is anticipated. Immediately after fuel heat is applied, EPR will decrease approximately .01 due to increased engine bleed air usage. The increase in temperature of the fuel entering the fuel control unit will cause the metered fuel flow to rise. After about fifteen seconds the EPR will have increased approximately .03 with a corresponding rise in N1, N2 and EGT.

When the use of fuel heat is terminated, EPR will rise approximately .01 due to the decreased use of bleed air. In approximately two minutes, as fuel temperature decreases, EPR, fuel flow, N1, N2 and EGT will return to the original pre-fuel heat usage setting.

Changes in engine parameters with the use of fuel heat are normal. Thrust lever position should be adjusted only when maximum EPR limits would be exceeded.

CHAPTER 22

WARNING SYSTEMS

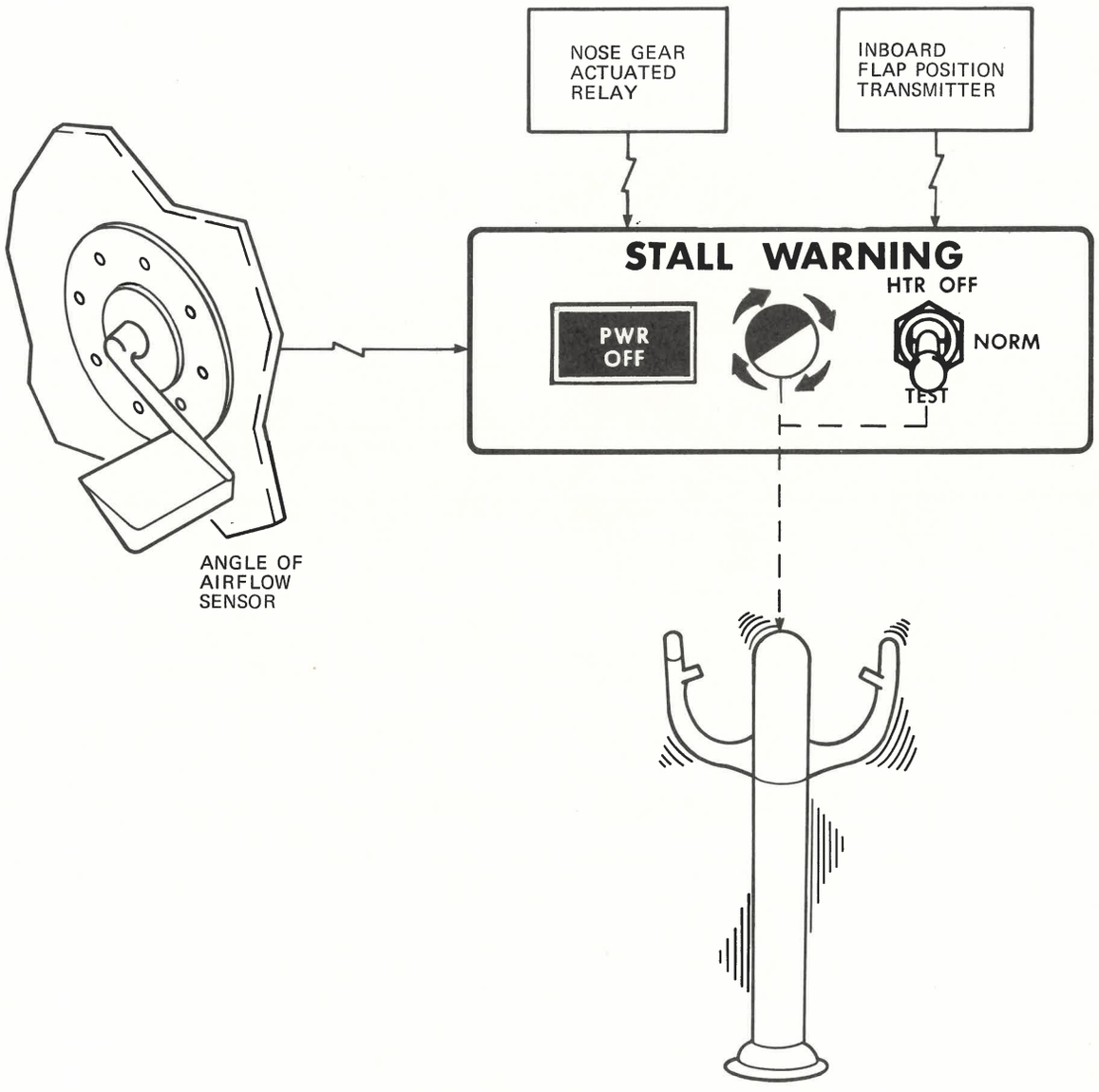
This chapter contains a listing of the warning lights, annunciators, aural and tactile warning devices that advise of a hazardous or potentially hazardous situation.

The recommended procedures for dealing with warning lights or devices are contained in the appropriate procedural or system chapters of this manual.

CONDITION	AURAL WARNING	VISUAL WARNING	REMARKS
Engine Fire	Bell in cockpit.	Both red master fire warning lights on pilots' lightshield illuminate. Respective engine fire switch on pilots' overhead panel illuminate.	Push either of the master fire warning lights or the fire bell reset switch to silence the fire warning bell, extinguish the master fire warning lights and reset the warning circuits.
APU Fire	Bell in cockpit. Horn in wheel well.	Both red master fire warning lights on pilots' lightshield illuminate. Red APU light on pilots' overhead panel illuminate APU fire switch on F/E's panel illuminates. APU remote fire light in wheel well illuminates.	
Wheel Well Fire	Bell in cockpit.	Both red master fire warning lights on pilots' lightshield illuminate. Red WHEEL WELL light on pilots' overhead panel illuminates.	
Lower Cargo Compartment Fire	Bell in cockpit.	Both red master fire warning lights on pilots' lightshield illuminate. Red LWR CARGO light on pilots' overhead panel illuminates. Red FWD or AFT light on F/E's panel illuminates.	
Impending Stall			Control column shakes.
Overrotation on Takeoff			Control column shakes.
Unsafe Takeoff Configuration	Intermittent horn in cockpit.		Horn sounds if #3 thrust lever is advanced over 50% of travel and: (1) stabilizer not in green band, or (2) flaps not at 10 or 20, or (3) speed brake lever not in DOWN detent, or (4) body gear not centered. The warning horn will not sound at low ambient temperatures (-45° F, -43° C and below) due to the #3 thrust lever position not actuating the thrust lever switch.

CONDITION	AURAL WARNING	VISUAL WARNING	REMARKS
Excessive Operating Speed	Clacker sounds in cockpit.		
Autopilot Disengagement	Wailer sounds in cockpit.	Autopilot warning lights (Captain and F/O panels) flash red.	
Autothrottle Disengagement		Autothrottle warning lights (Captain and F/O panels) flash red.	
Excessive Attitude Differences		When an excessive attitude difference exists between Captain and F/O ADI's, ATT lights illuminate steady amber and instrument WARN lights on Captain and F/O panels flash red.	WARN light on affected side will flash if a GYRO or GS flag appears on an ADI regardless of attitude difference.
HSI Failure		Instrument WARN light on Captain or F/O panels flash red.	WARN light on affected side will flash if a HEADING, NAV or GS flag appears on an HSI.
Radio Altimeter Failure		Instrument WARN light on affected side will flash red below 1500 feet.	Warning flag in view on failed radio altimeter.
Excessive INS Position Difference		Respective amber INS comparator light on pilots' center panel illuminates.	Respective INS WARN light and other failure warning flags and annunciators may also indicate specific malfunction.
Reaching Decision Height		DH light (amber) on ADI illuminates when decision height is reached.	
Landing Gear Door Open		Landing gear DOOR OPEN light (red) on pilots' center panel illuminates.	DR OPEN light (amber) on F/E panel will illuminate for affected door when DOOR PRIM and DOOR ALT switches depressed.

CONDITION	AURAL WARNING	VISUAL WARNING	REMARKS
Landing Gear Not Down and Locked		Red GEAR light on pilots' center panel illuminates.	Light on when: (1) landing gear is not in agreement with landing gear lever, or (2) landing gear lever is not in DN detent with gear down and locked, or (3) any thrust lever is retarded to idle and landing gear is not down and locked.
Landing Gear Not Down and Locked	Steady horn in cockpit.		Horn sounds when: (1) landing gear is not down and locked and any thrust lever is retarded to idle with flaps at 1, 5, 10, or 20. Horn can be silenced utilizing the warning horn cutout switch on pilots' control stand. (2) landing gear is not down and locked with flaps at 25 or 30 and thrust levers in any position. Horn can be silenced by pulling aural warning power circuit breaker on P-6 panel.
Excessive Cabin Altitude	Intermittent horn in cockpit when cabin altitude exceeds 10,000 feet.	Amber AUTO FAIL light on F/E panel illuminates.	AUTO FAIL light will illuminate only on excessive rate of cabin pressure change.
INS on Battery Power with Airplane on Ground	Horn in nose wheel well sounds if condition exists for 30 seconds.	INS amber BAT MODE light illuminates.	
Loss of Equipment Cooling with Airplane on Ground.	Horn in nose wheel well sounds.	NO AIR FLOW light on F/E panel illuminates.	



STALL WARNING SYSTEM

24.60

Dispatch Deviations

SECTION 24.70

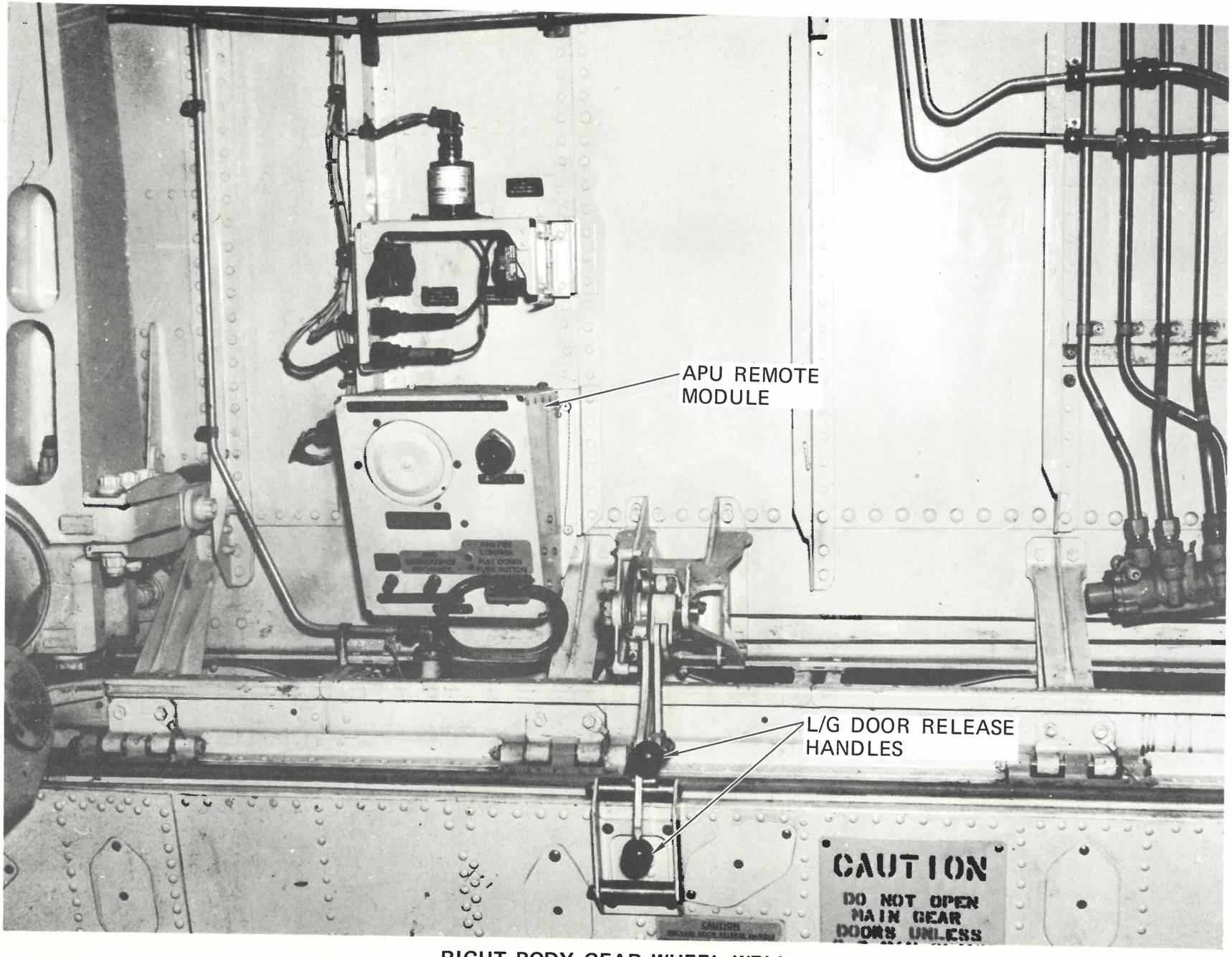
This section is provided for insertion, by the airline, of guidance information regarding company policy appropriate to aircraft dispatch.

BOEING 747

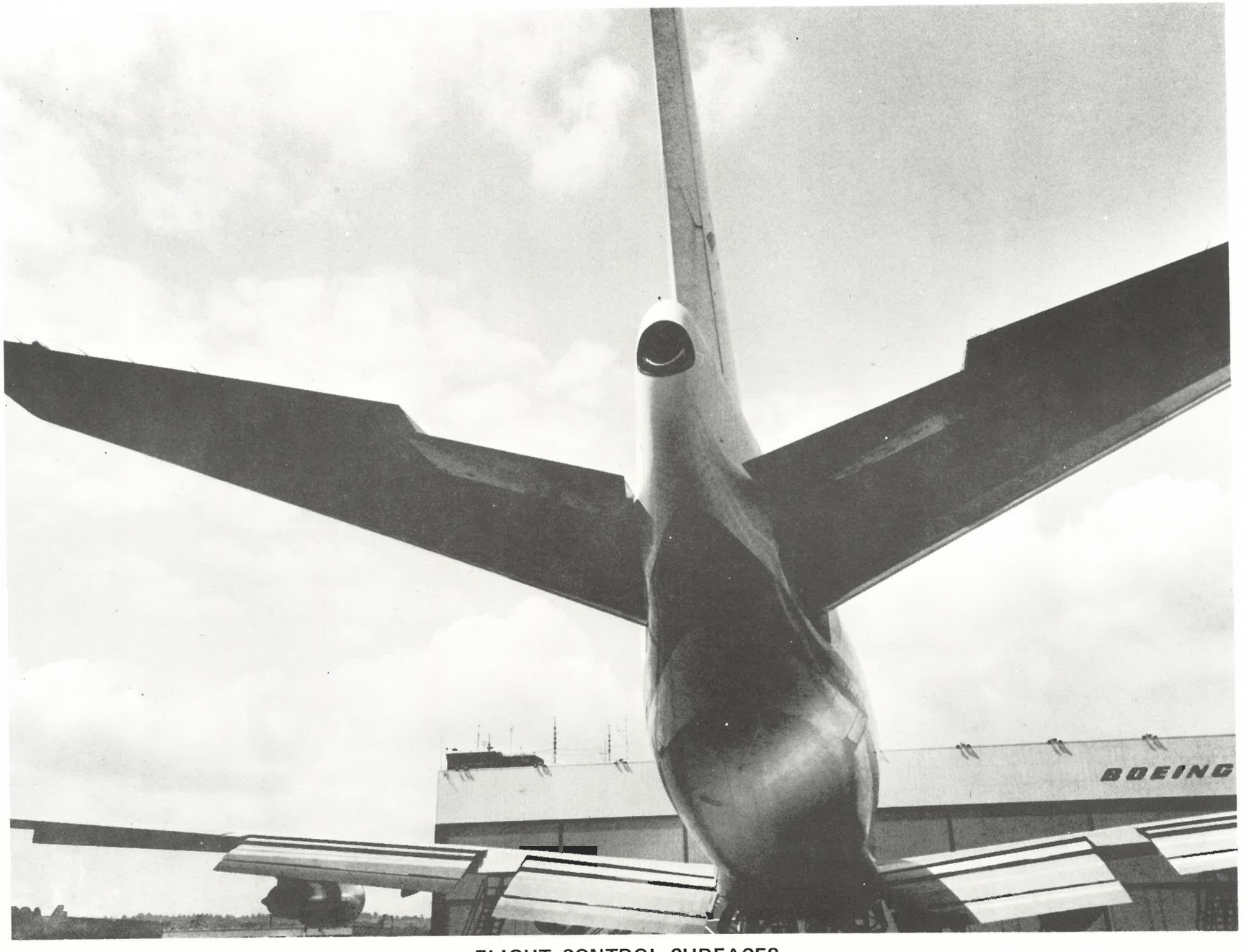
OPERATIONS MANUAL

SECTION 24.70

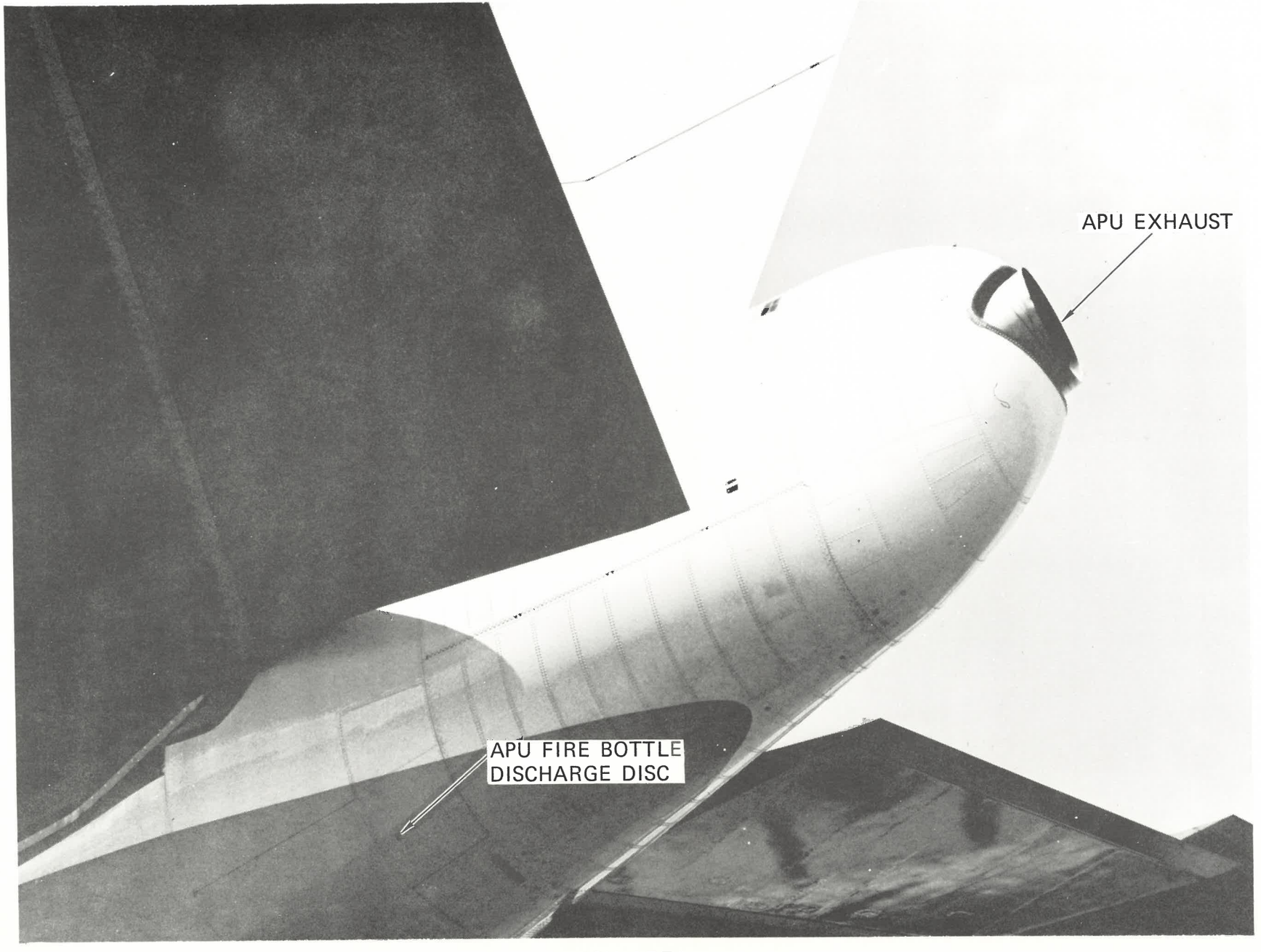
This section is provided for insertion, by the airline, of guidance information regarding company policy appropriate to aircraft dispatch.



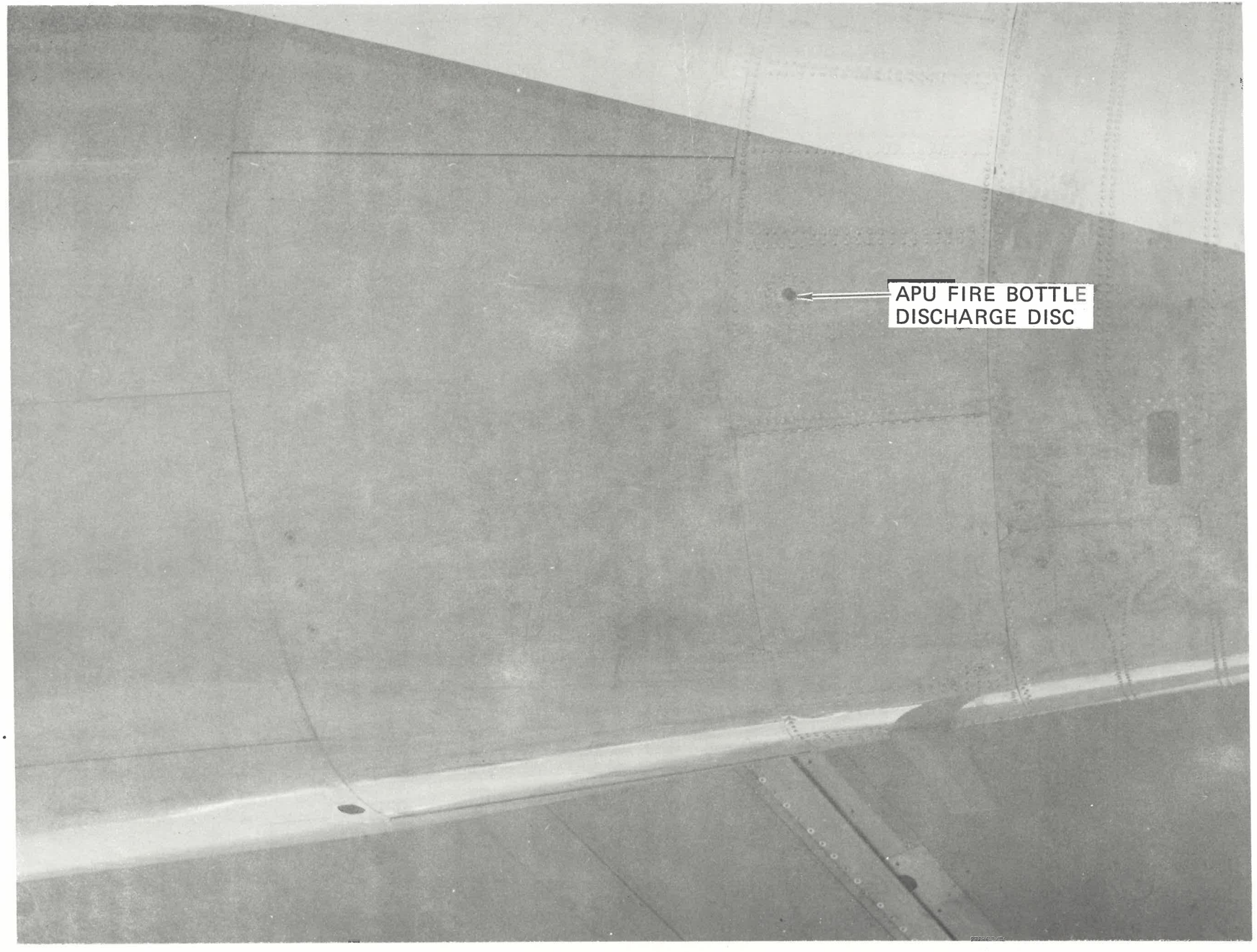
RIGHT BODY GEAR WHEEL WELL



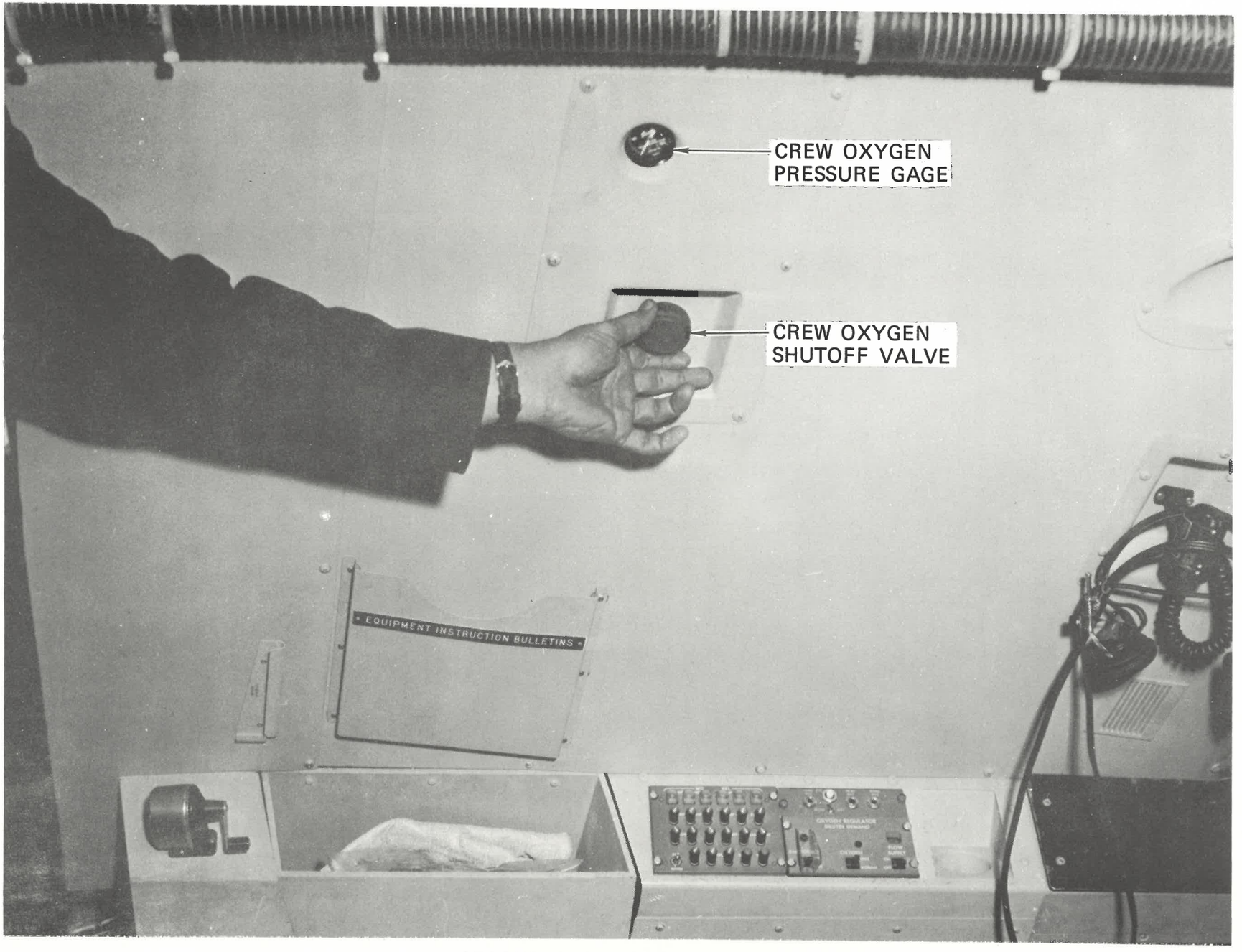
FLIGHT CONTROL SURFACES



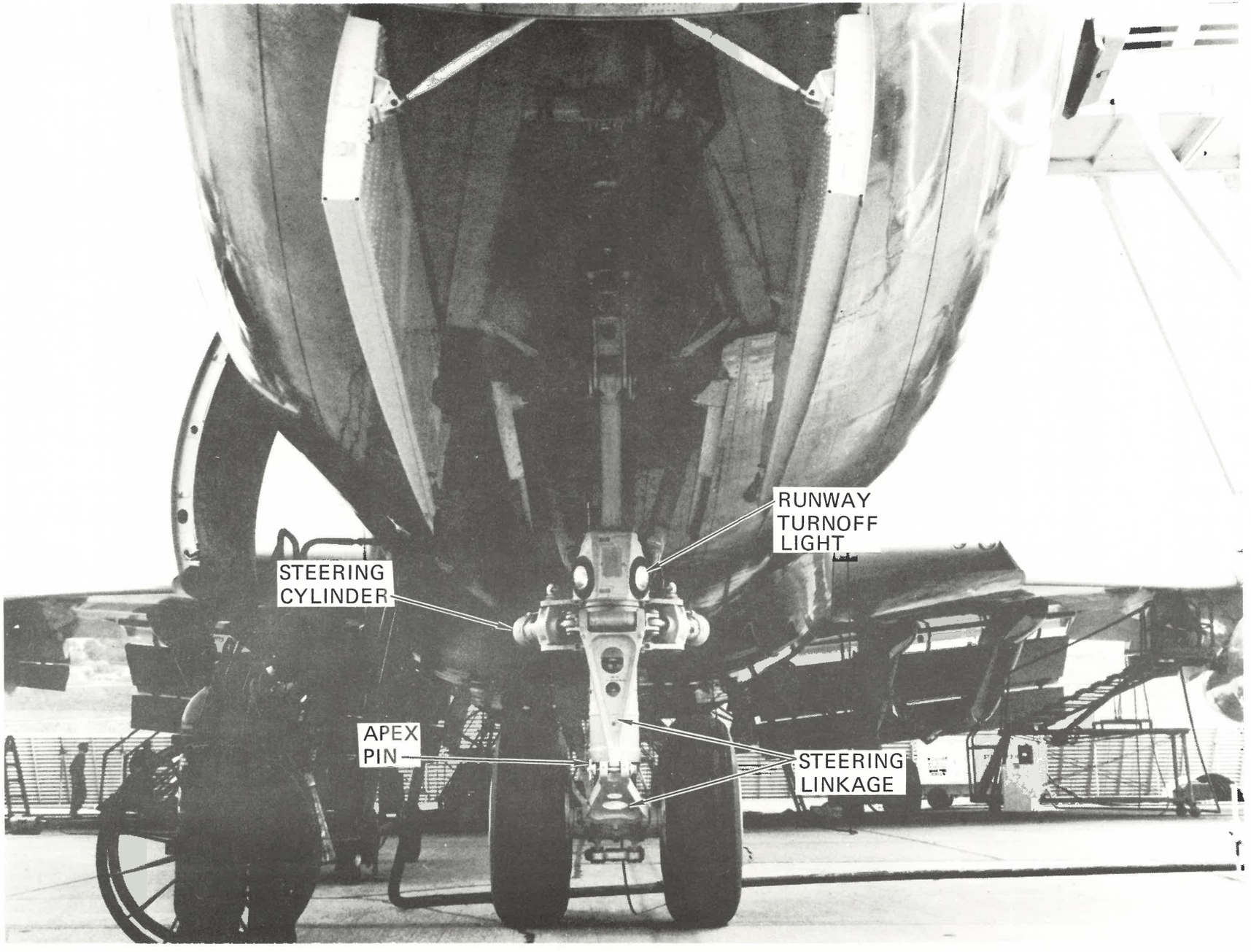
APU AREA



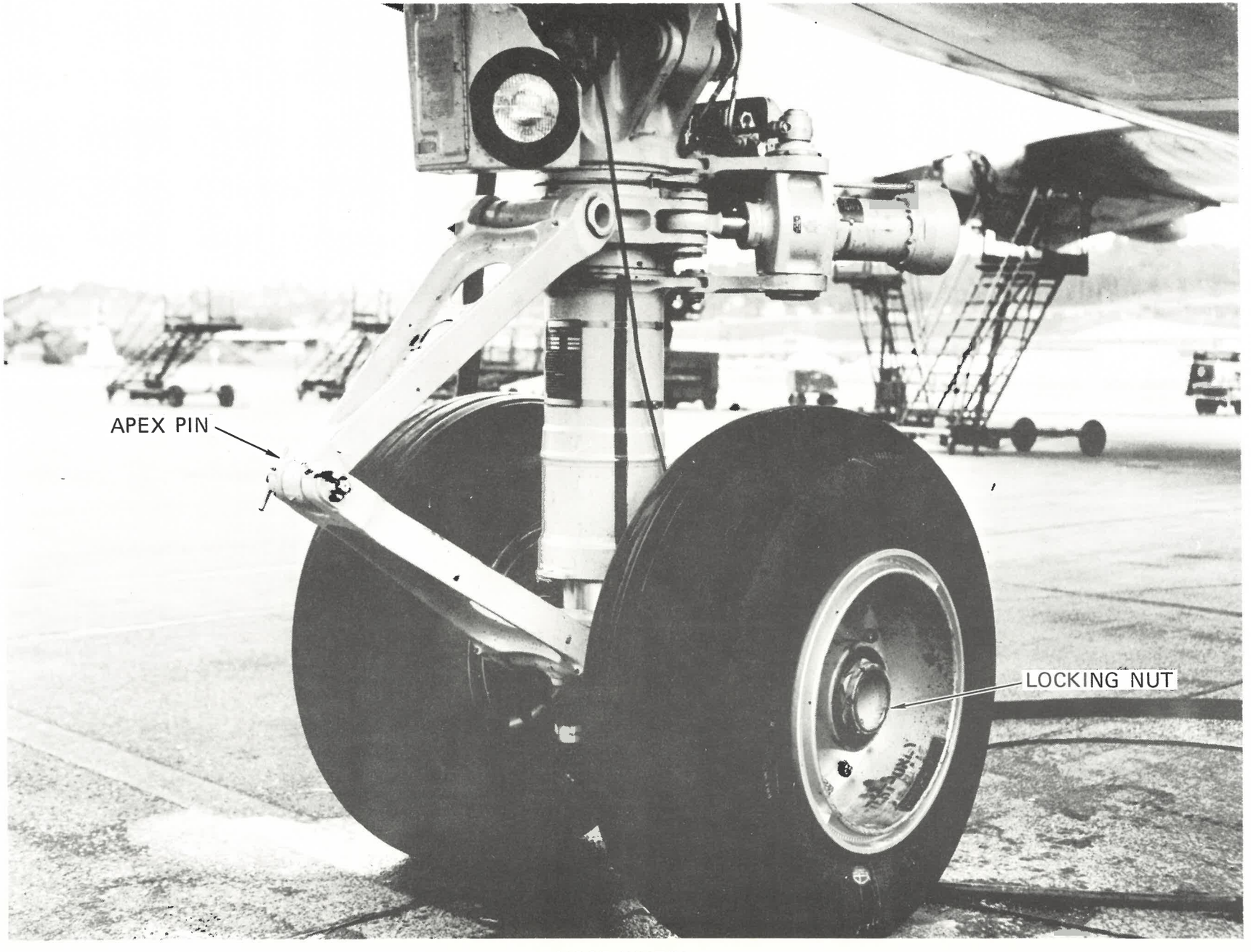
LEFT AFT FUSELAGE



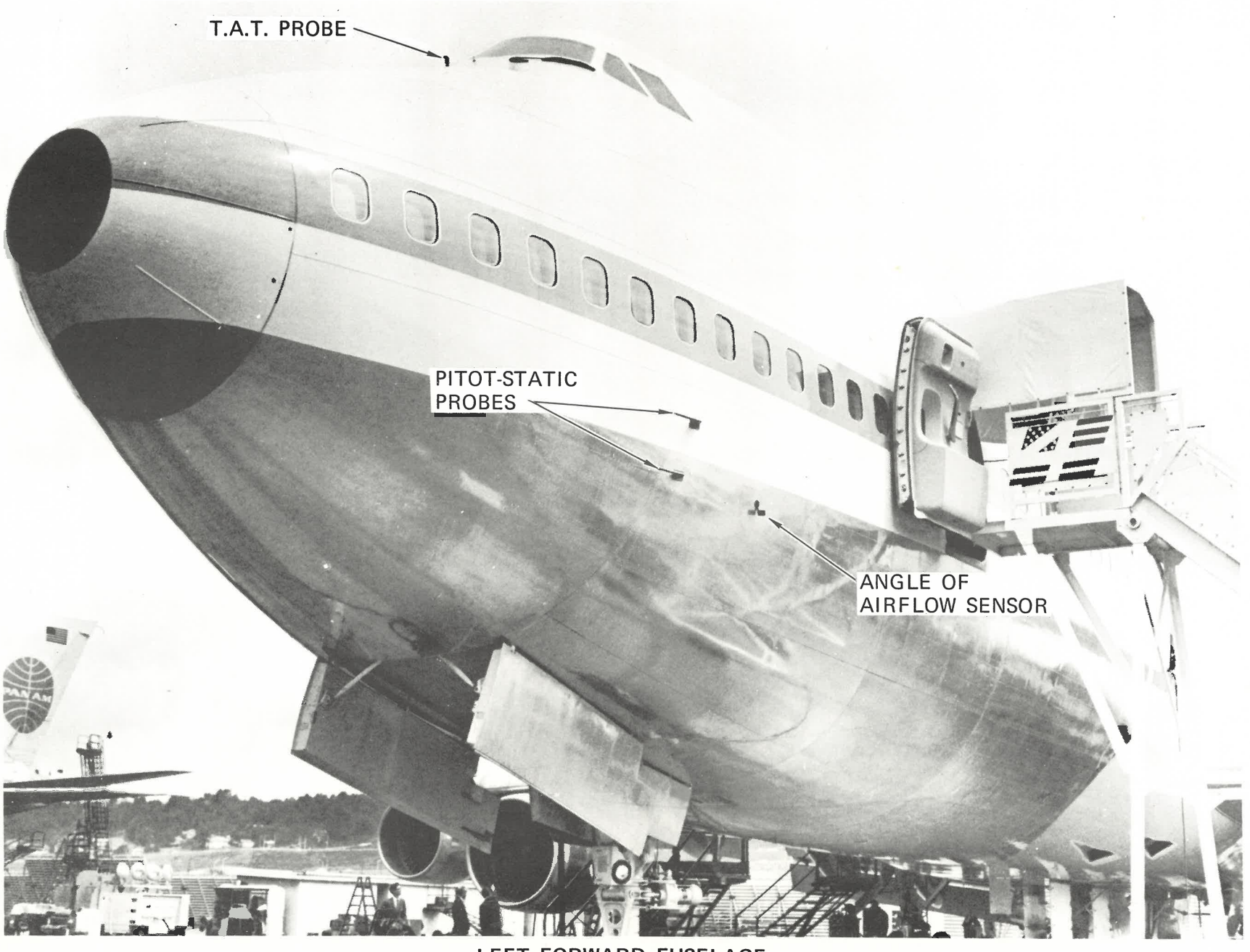
SECOND OBSERVERS STATION



NOSE WHEEL AREA

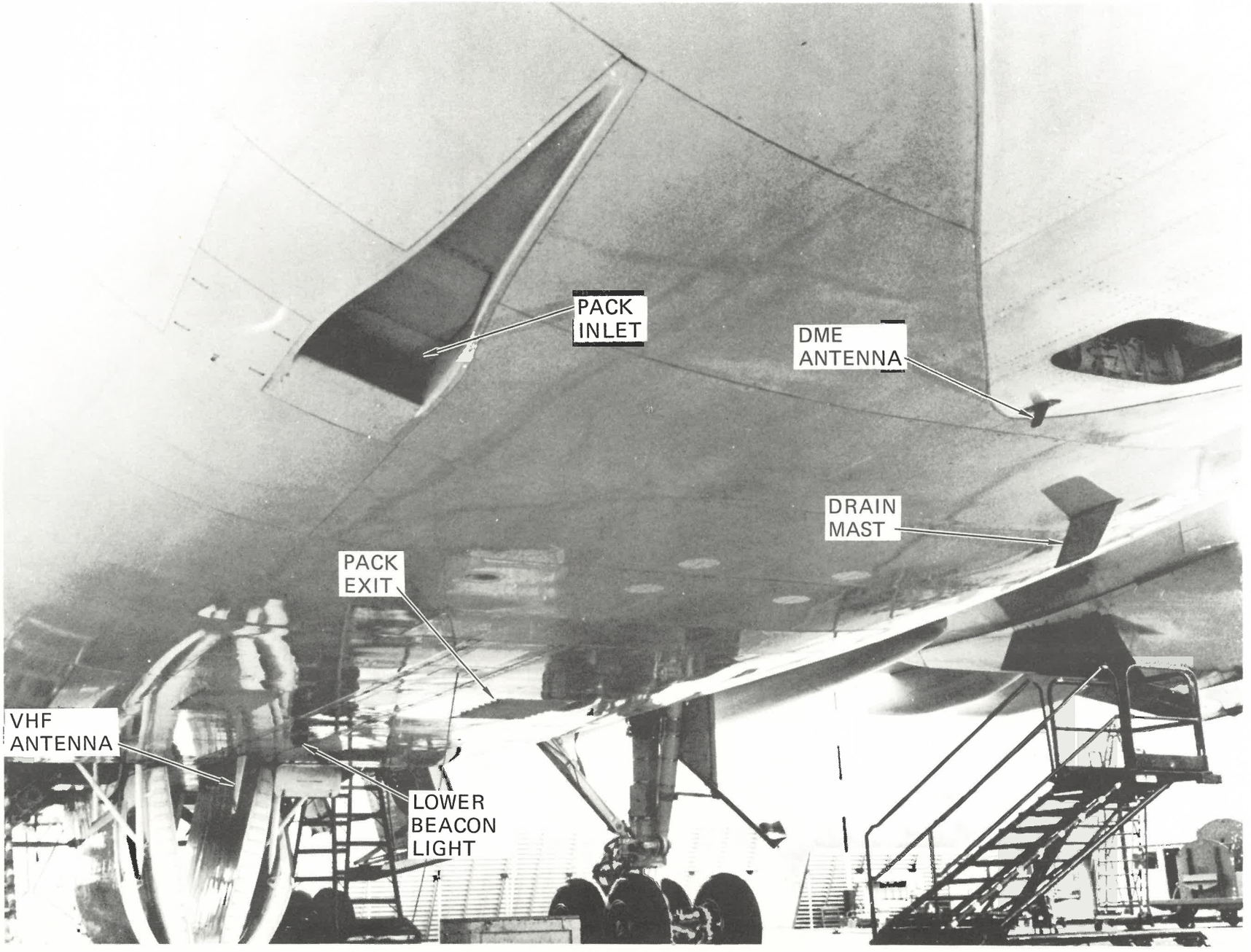


NOSE WHEEL

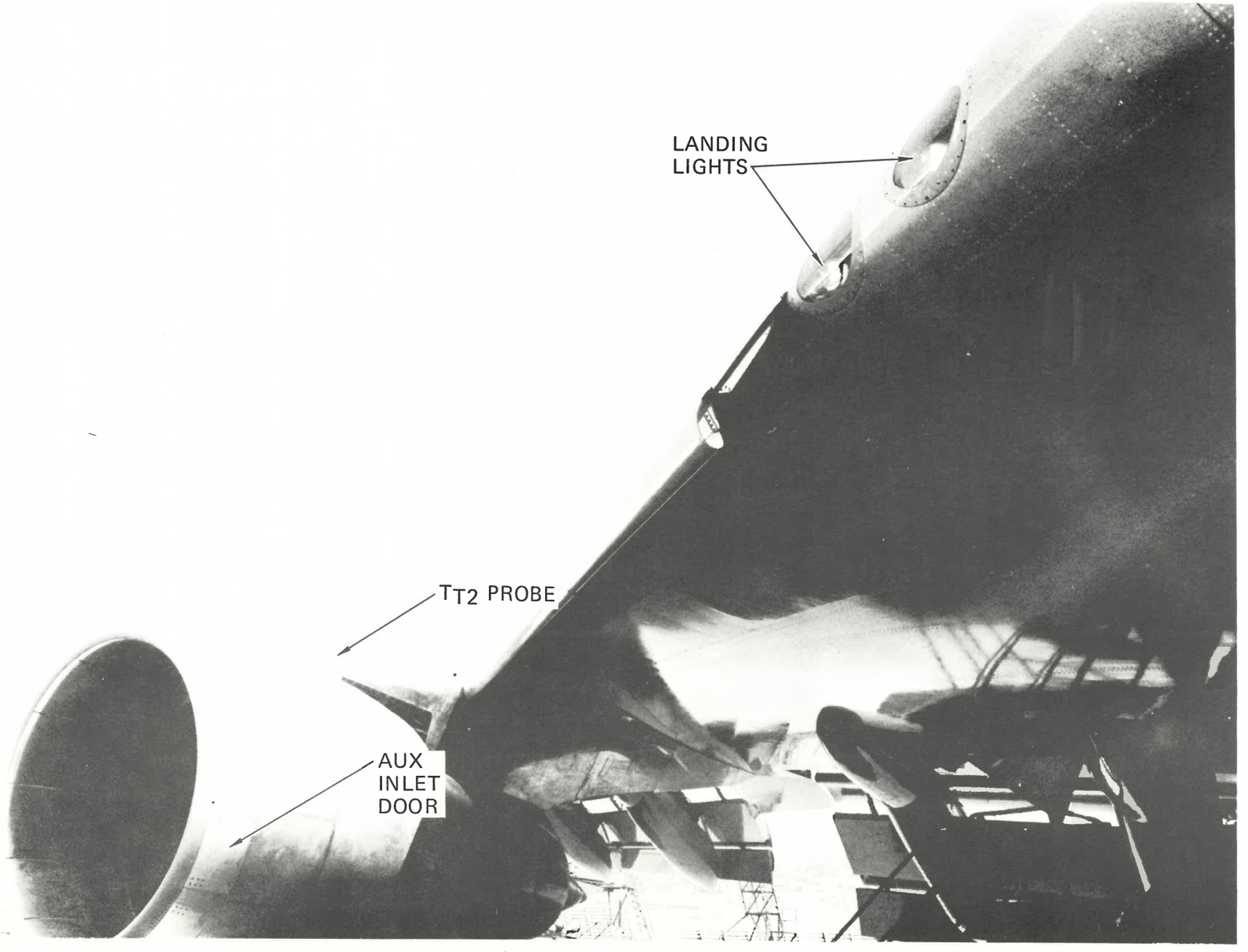


LEFT FORWARD FUSELAGE

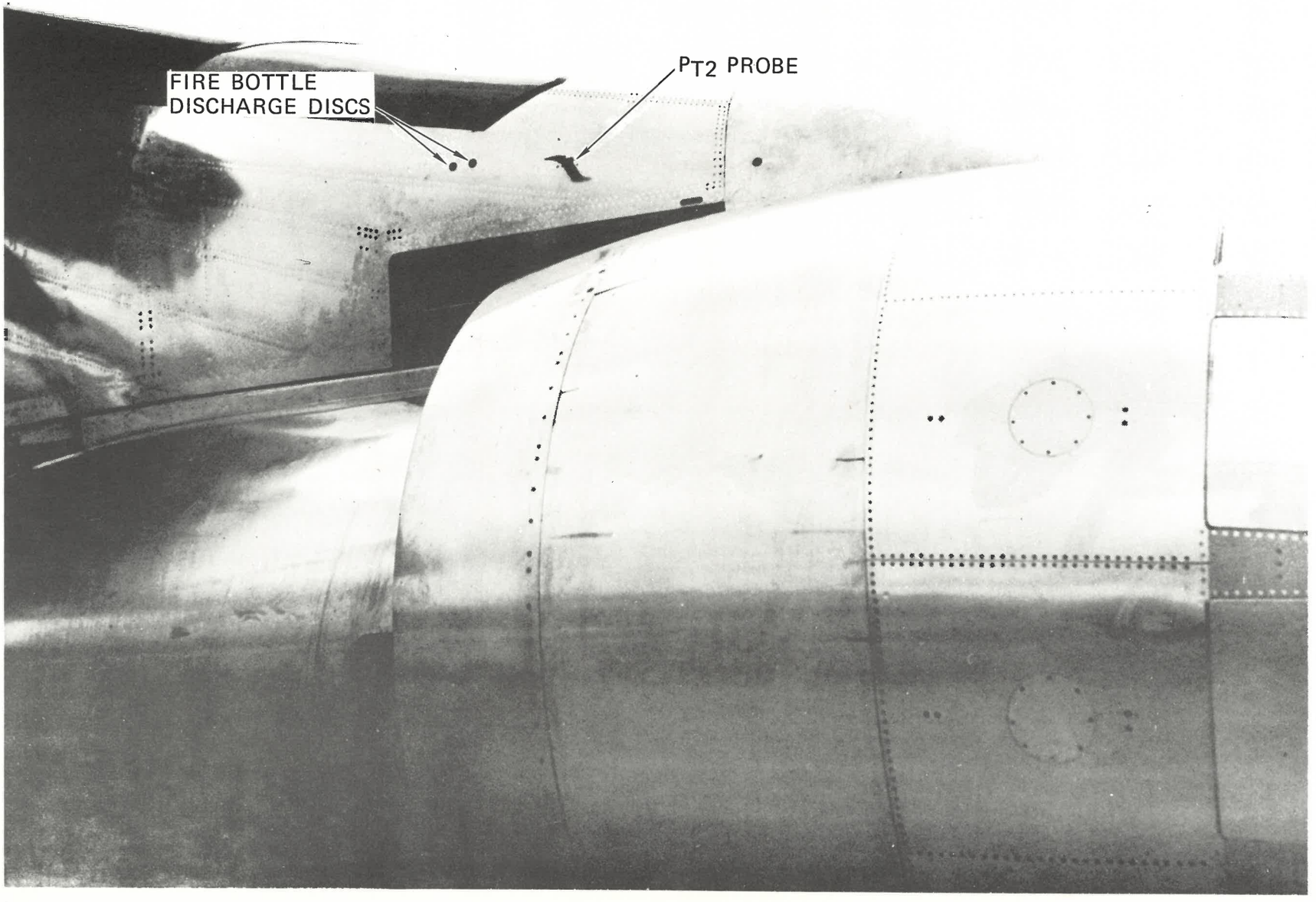
RIGHT FORWARD FUSELAGE



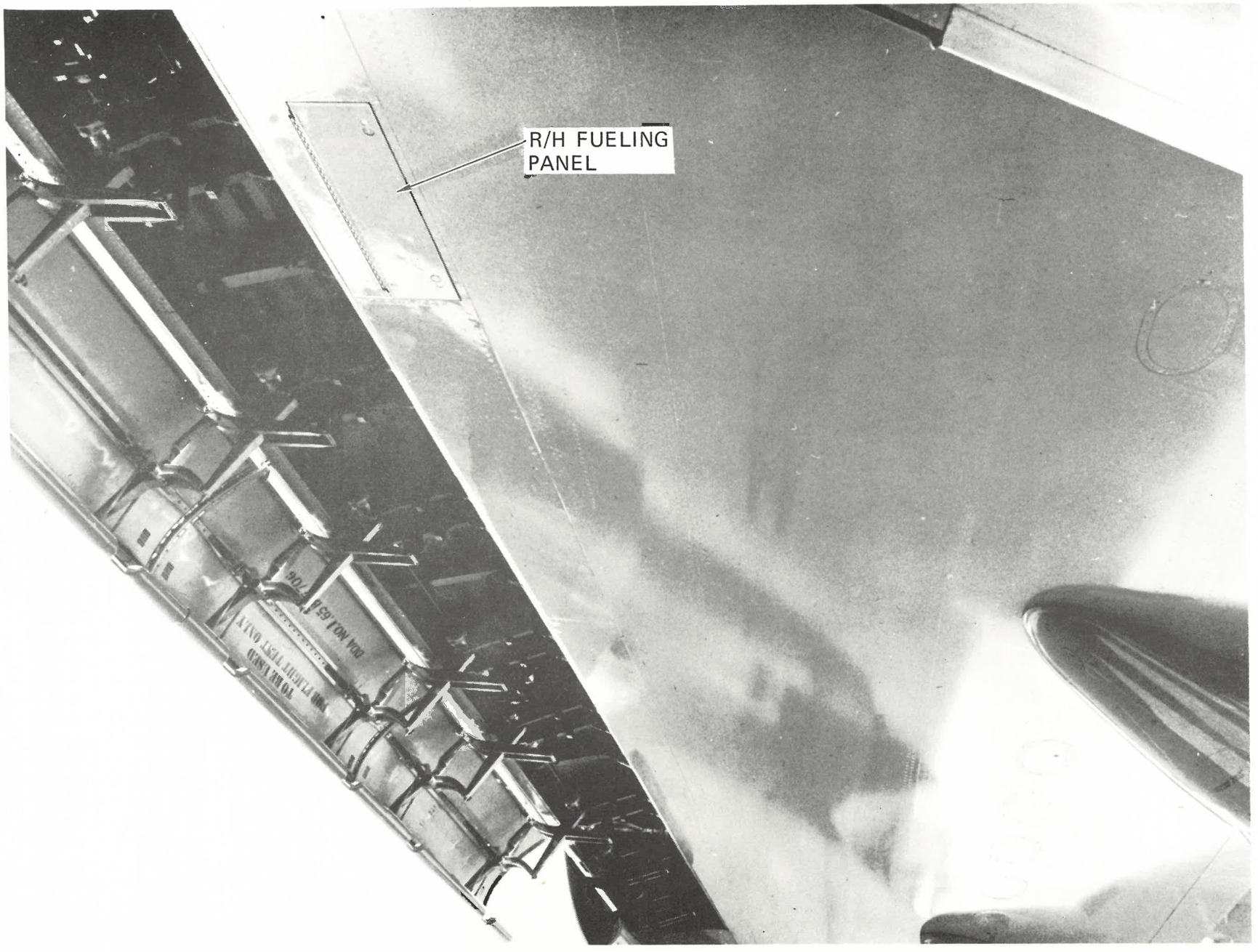
RIGHT FORWARD FUSELAGE



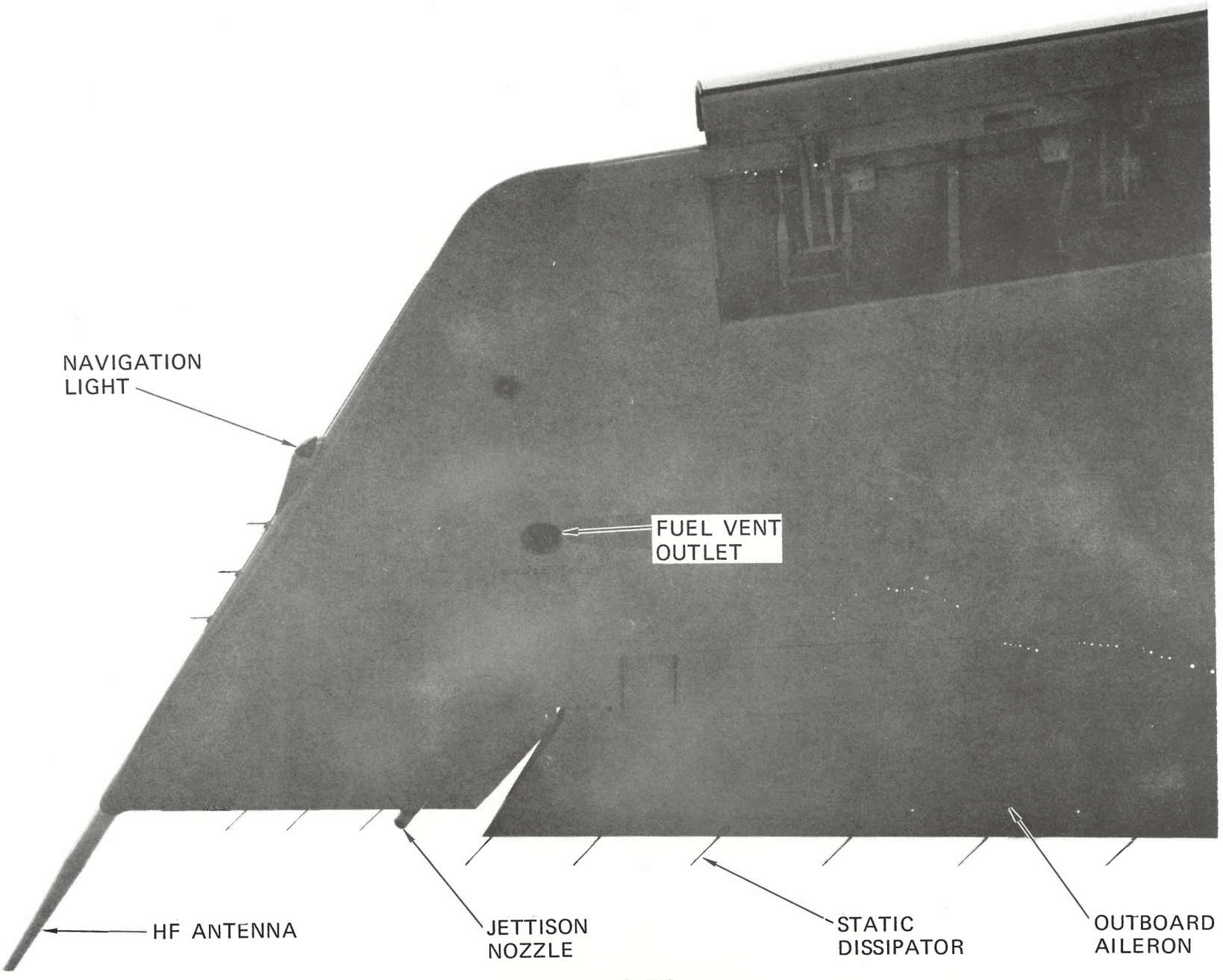
RIGHT WING AND ENGINES



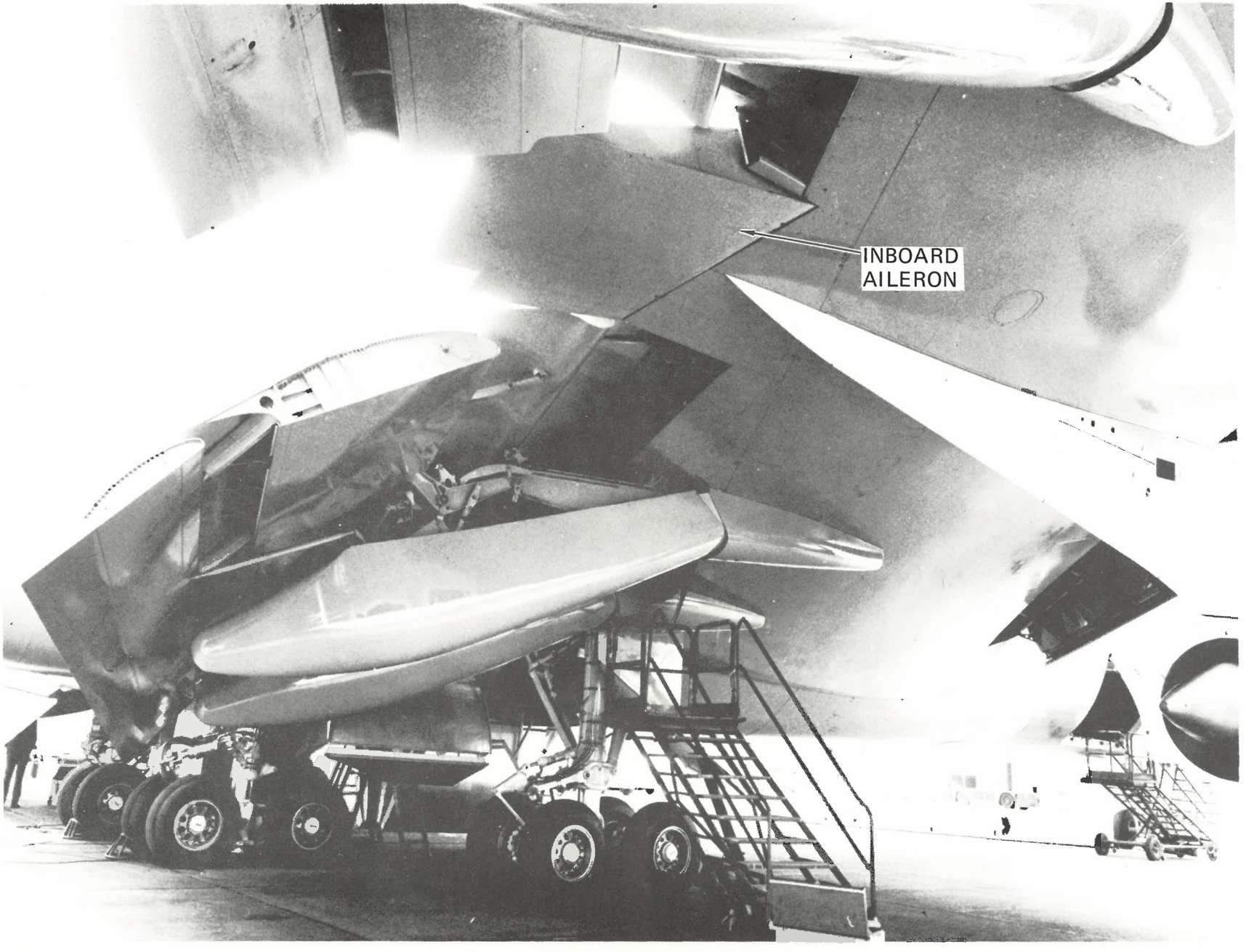
ENGINE – RIGHT SIDE



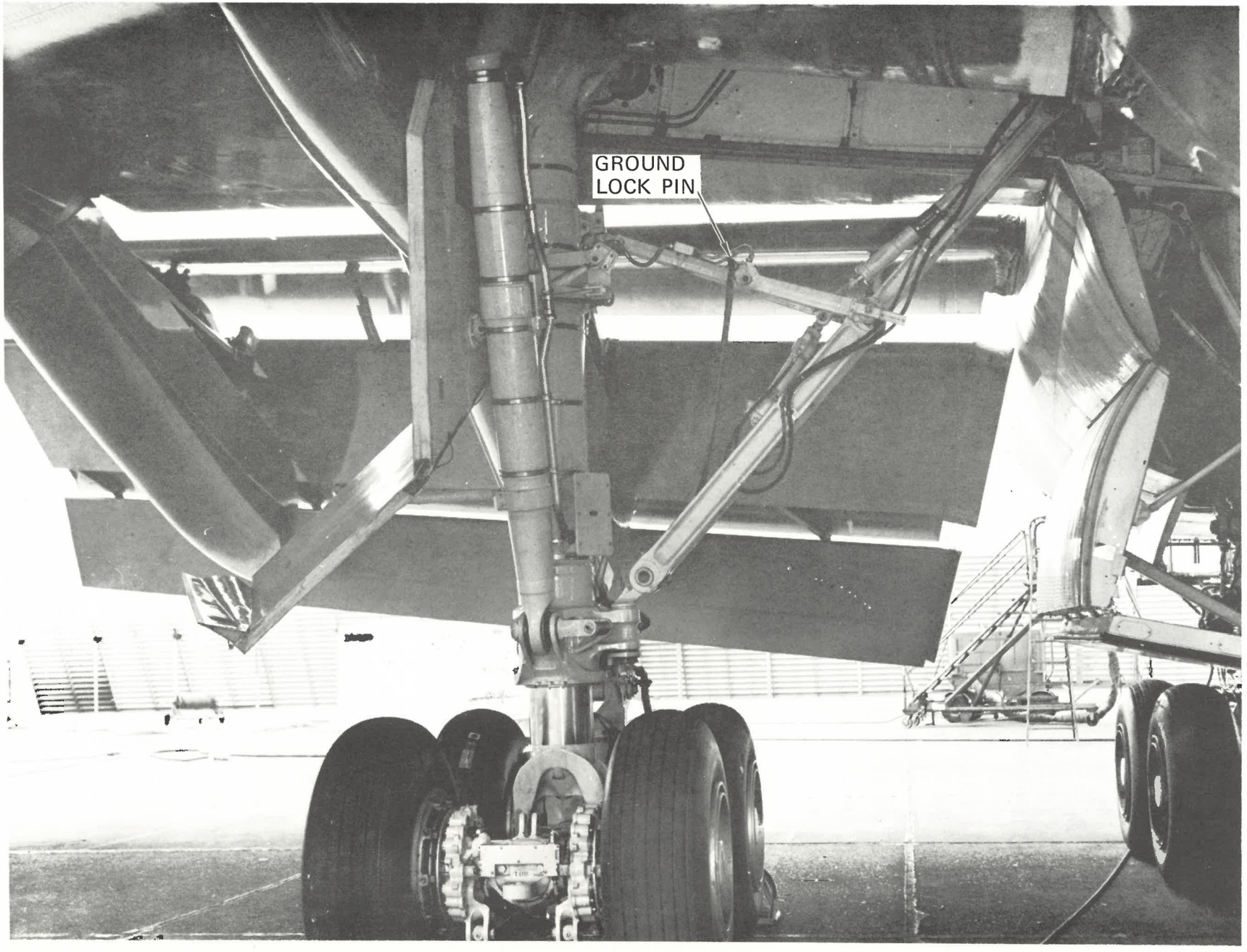
UNDERSURFACE – RIGHT WING



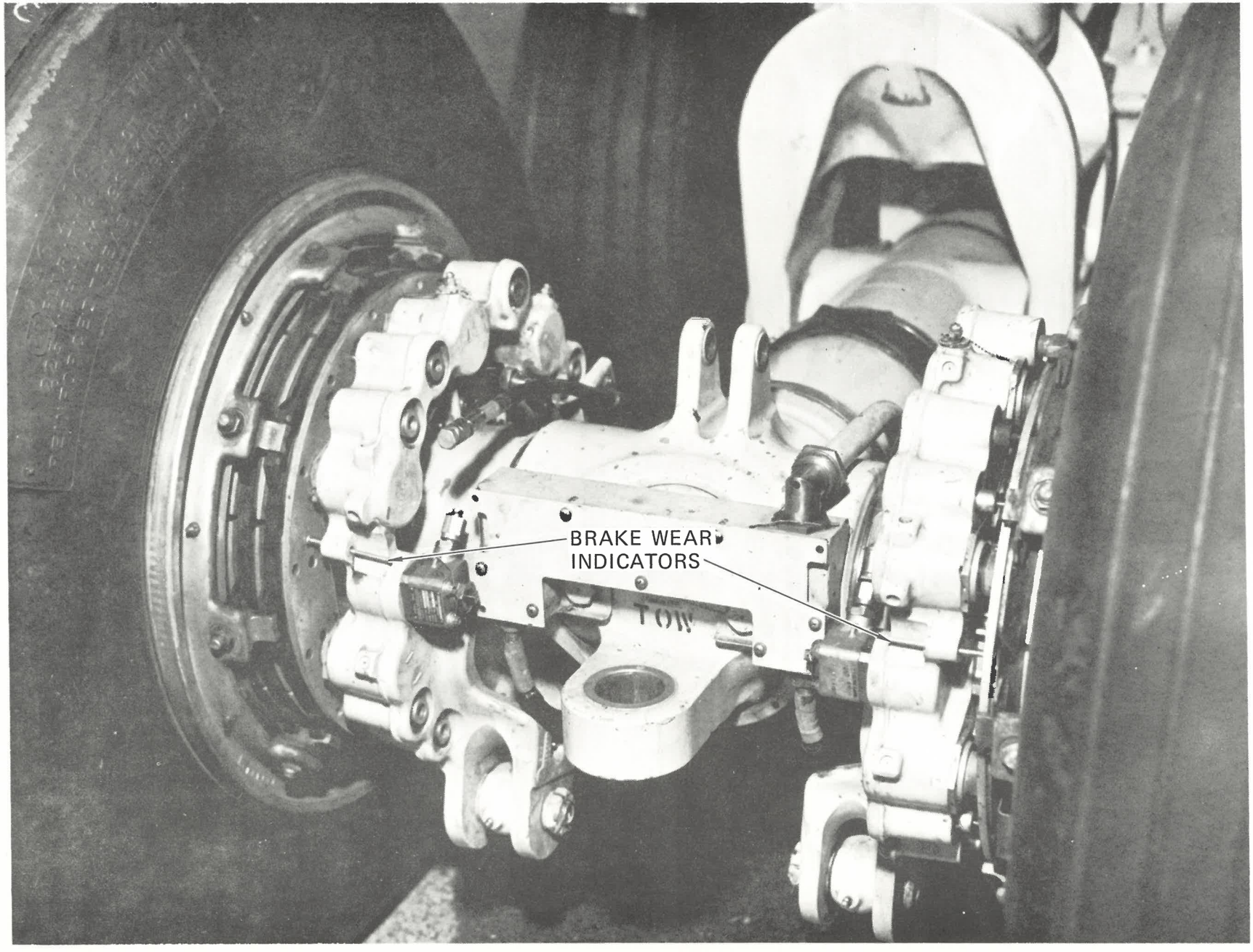
RIGHT WING TIP



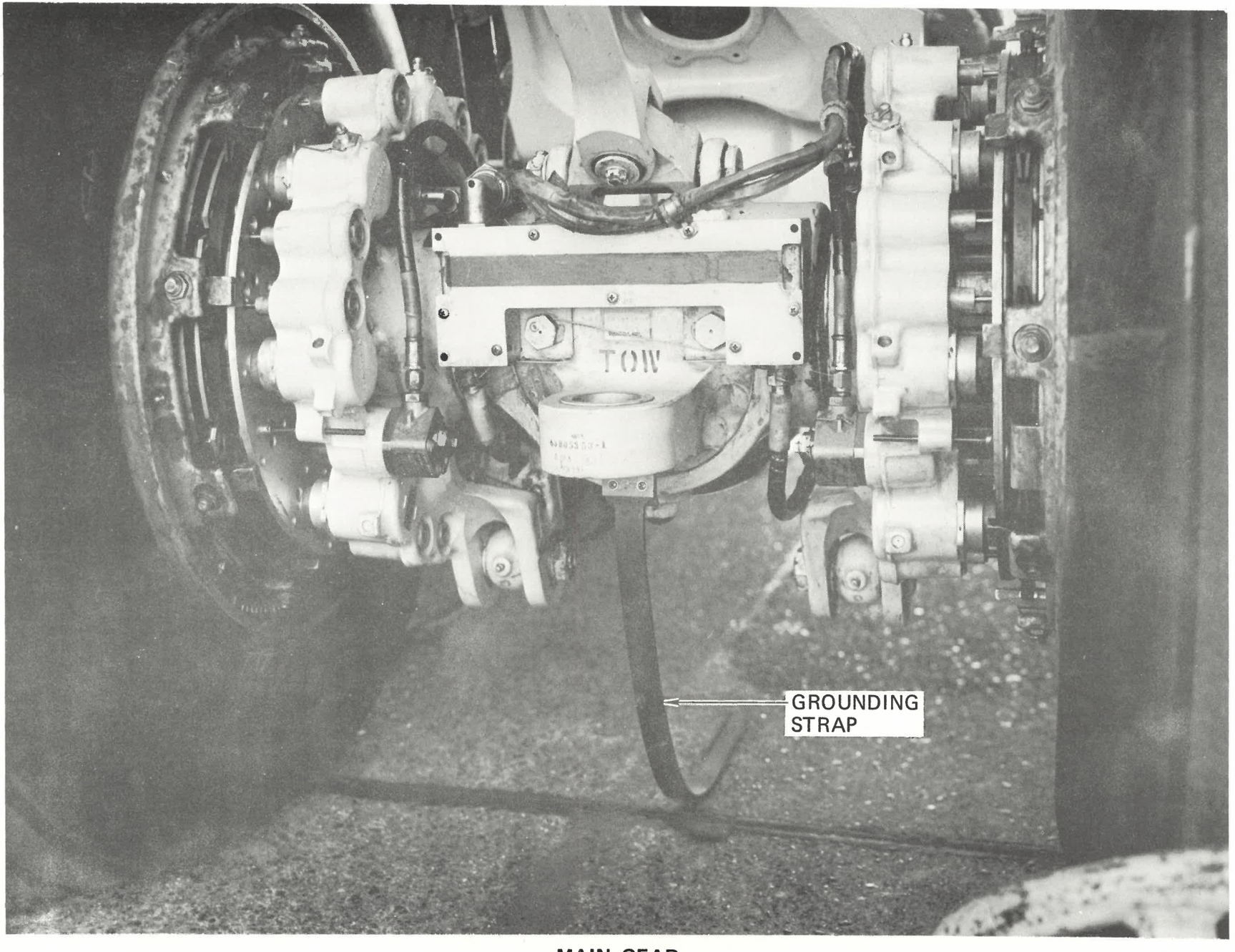
RIGHT WING TRAILING EDGE



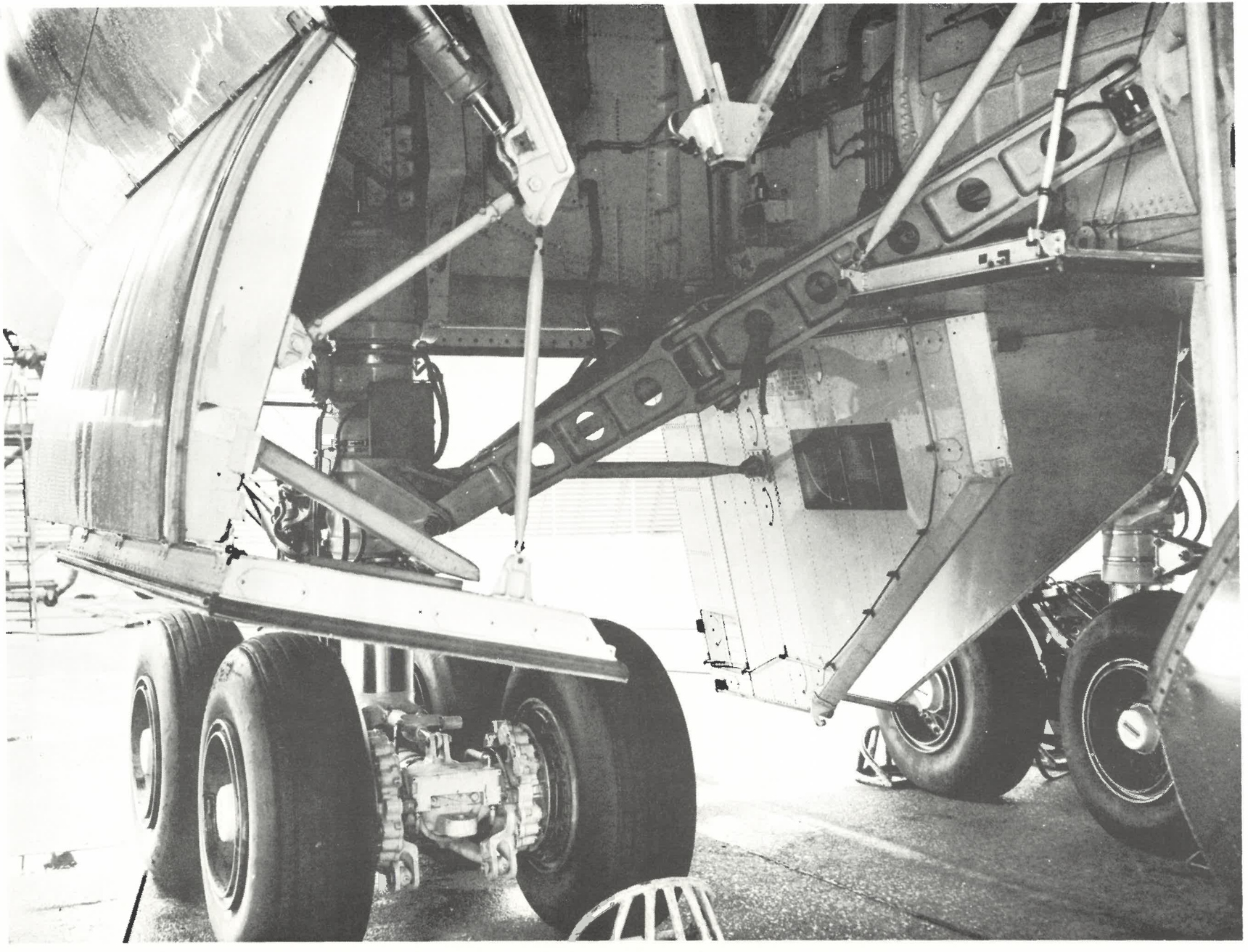
RIGHT WING GEAR



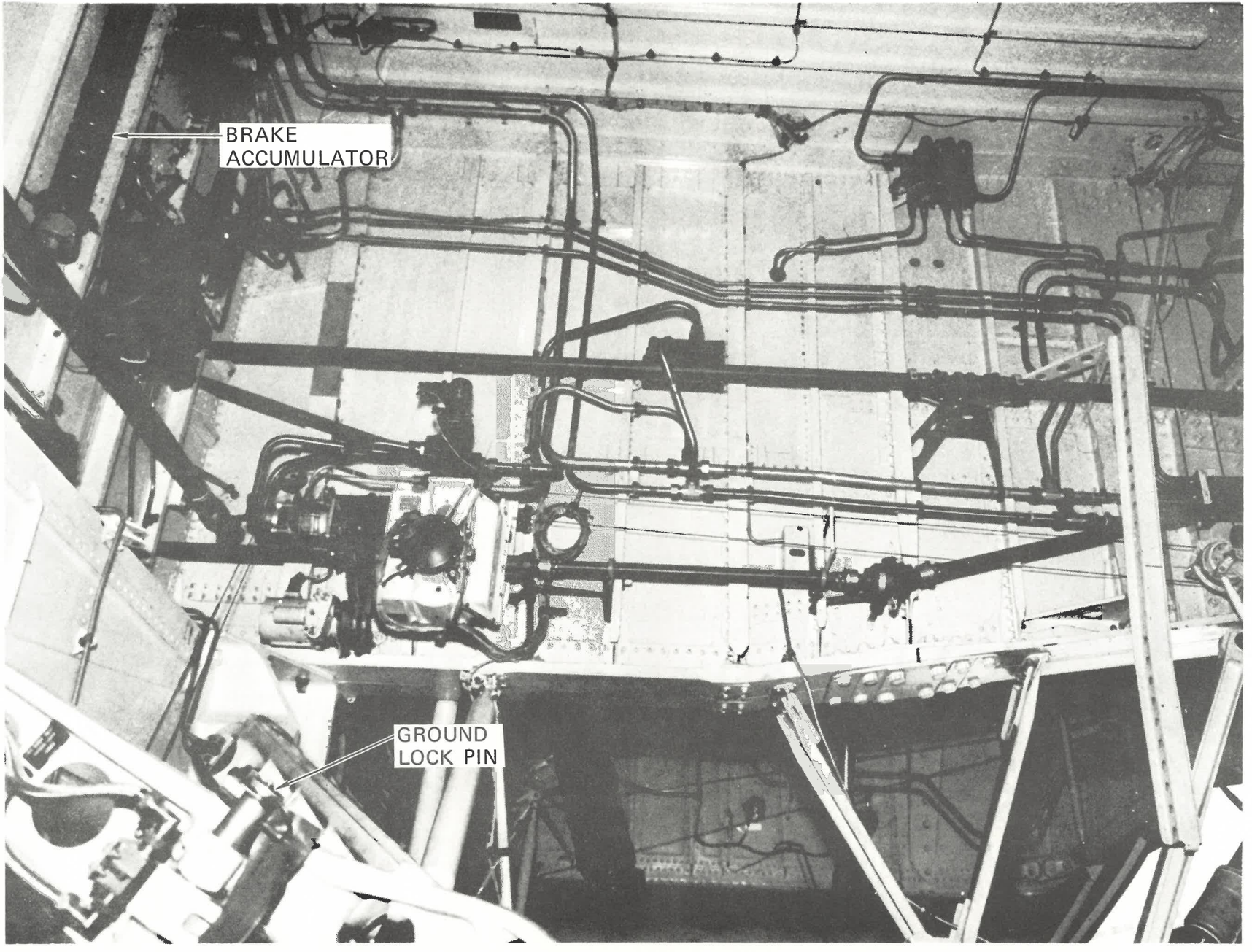
MAIN GEAR BRAKES



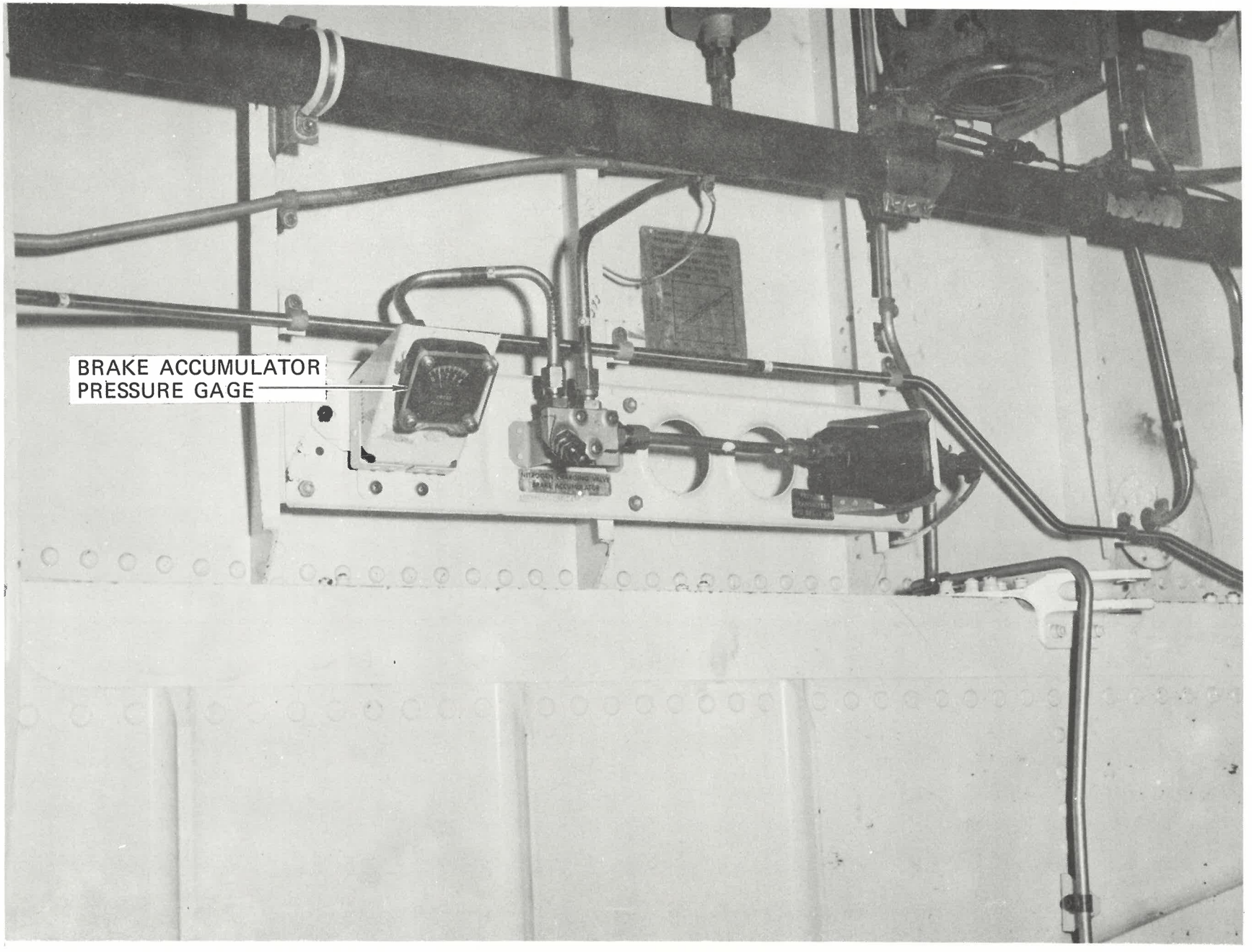
MAIN GEAR



RIGHT BODY GEAR

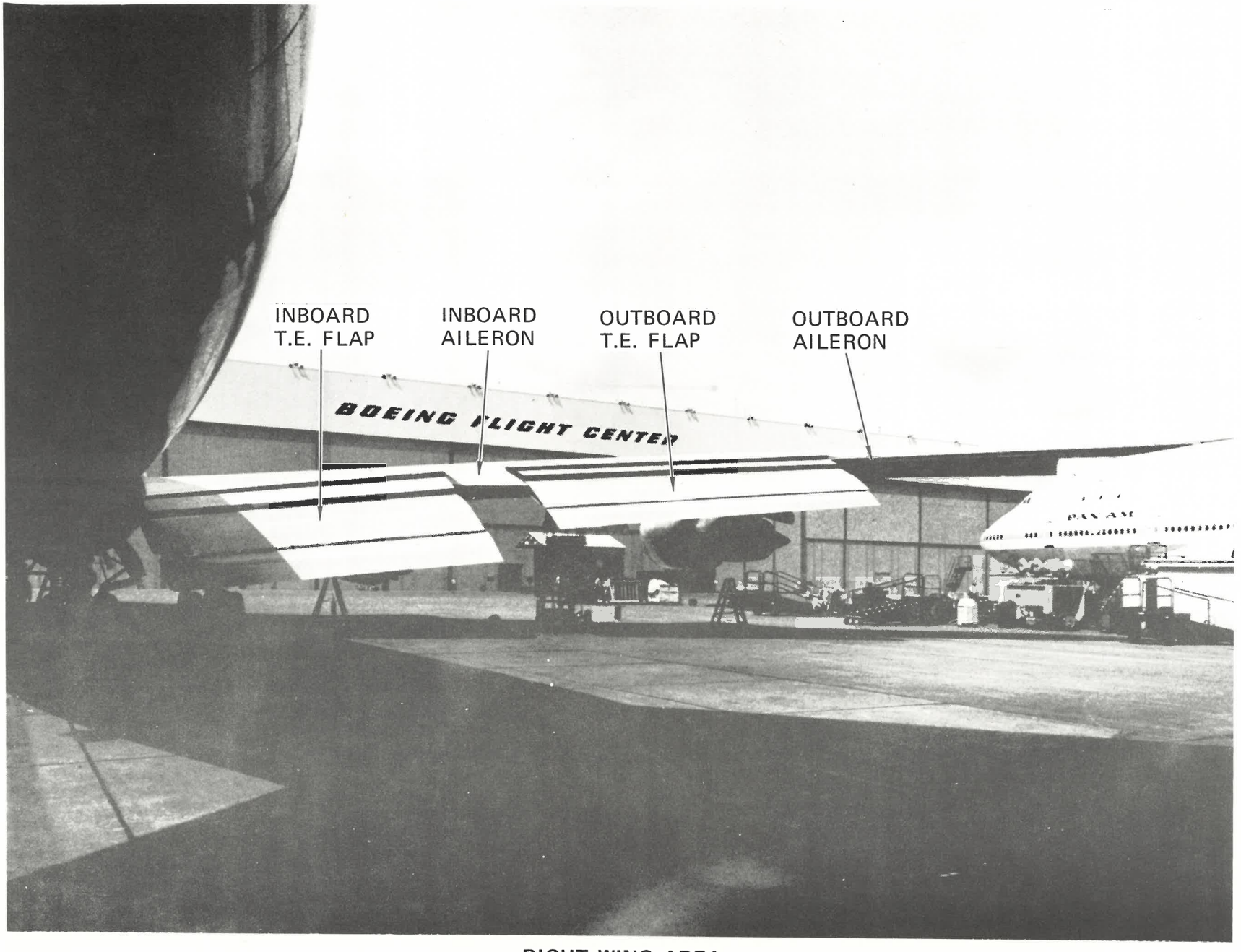


RIGHT BODY GEAR WHEEL WELL

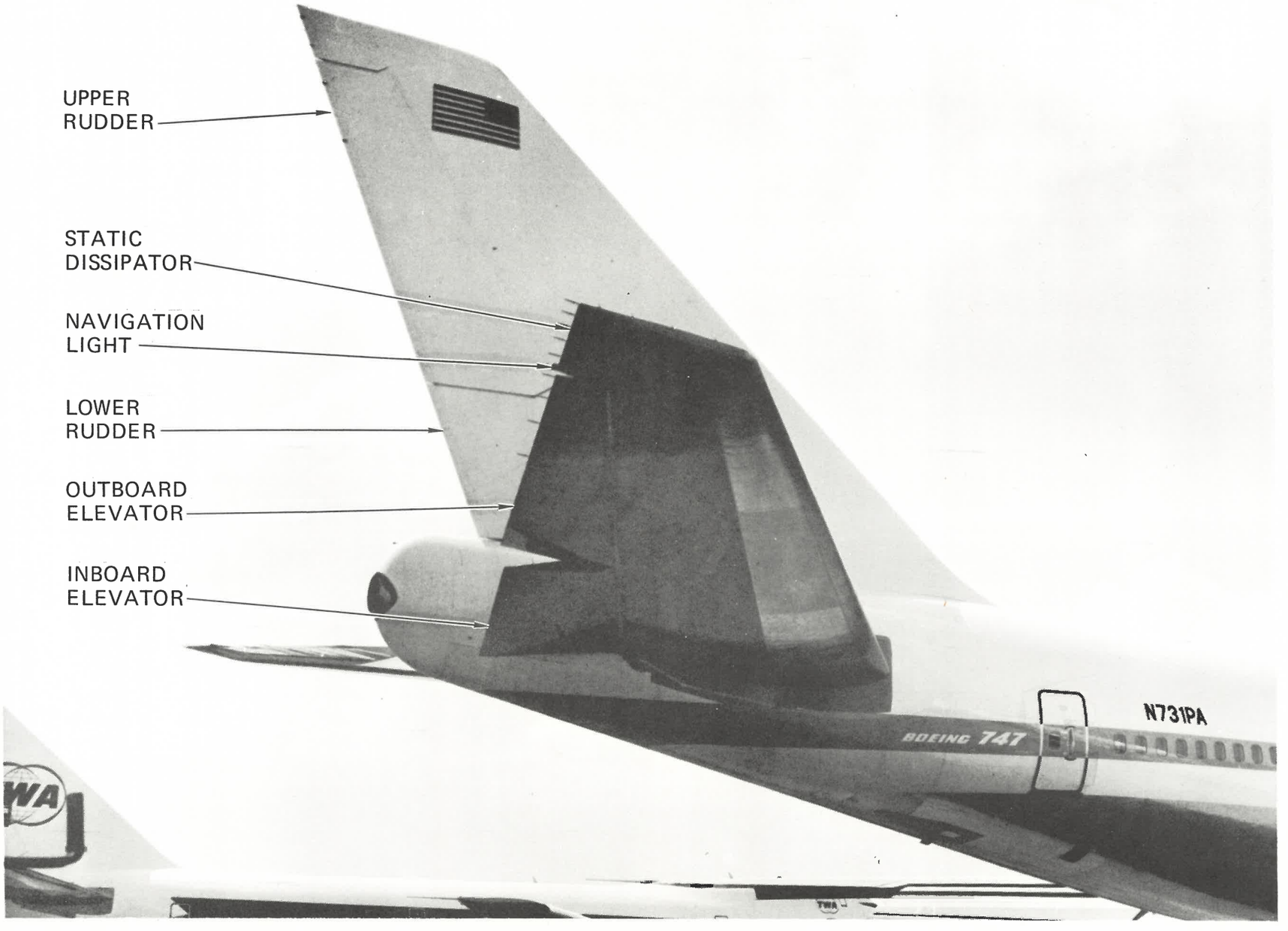


RIGHT BODY GEAR WHEEL WELL

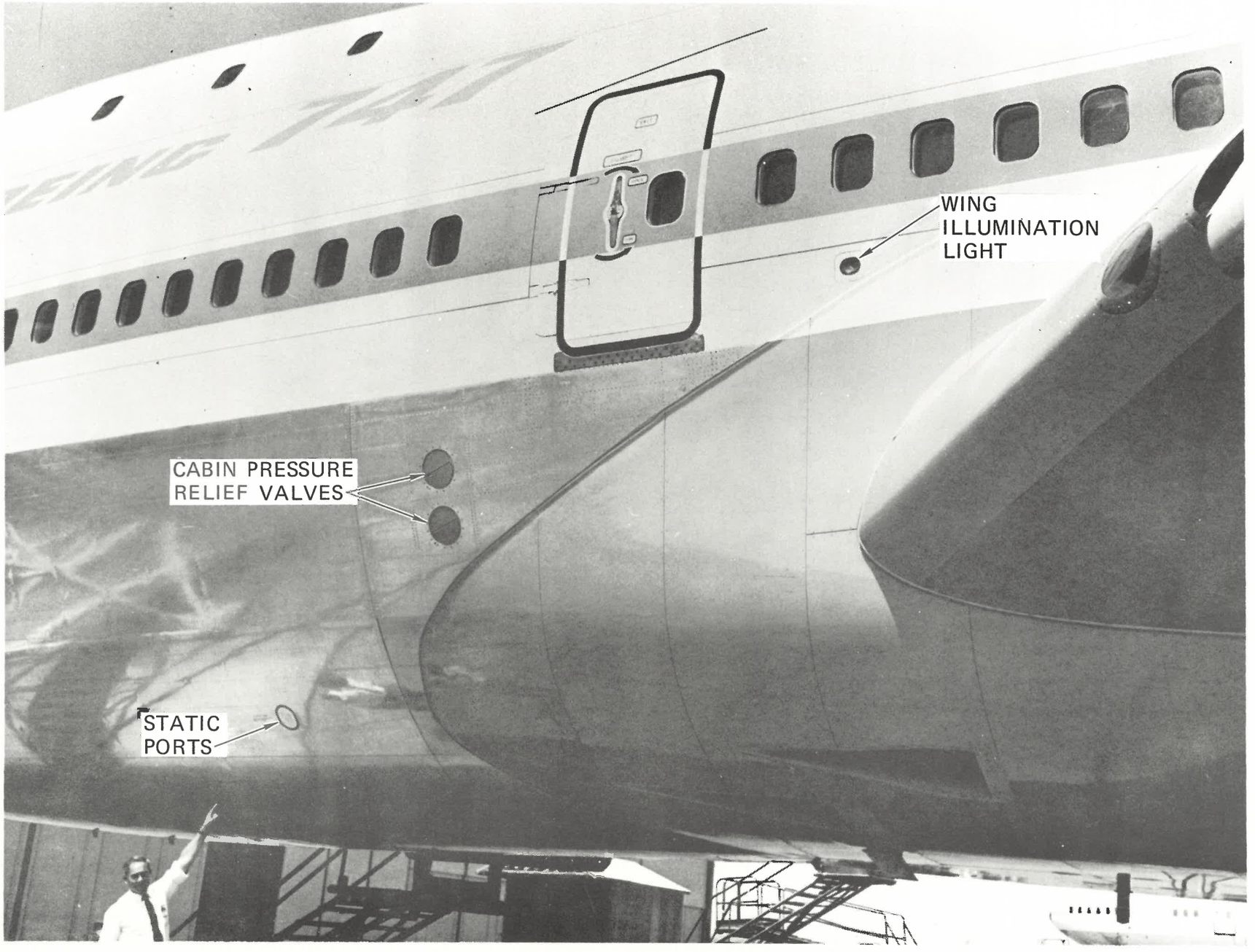
RIGHT AFT FUSELAGE



RIGHT WING AREA


UPPER
RUDDER
STATIC
DISSIPATOR
NAVIGATION
LIGHT
LOWER
RUDDER
OUTBOARD
ELEVATOR
INBOARD
ELEVATOR
N731PA
BOEING 747

EMPENNAGE



LEFT FORWARD FUSELAGE