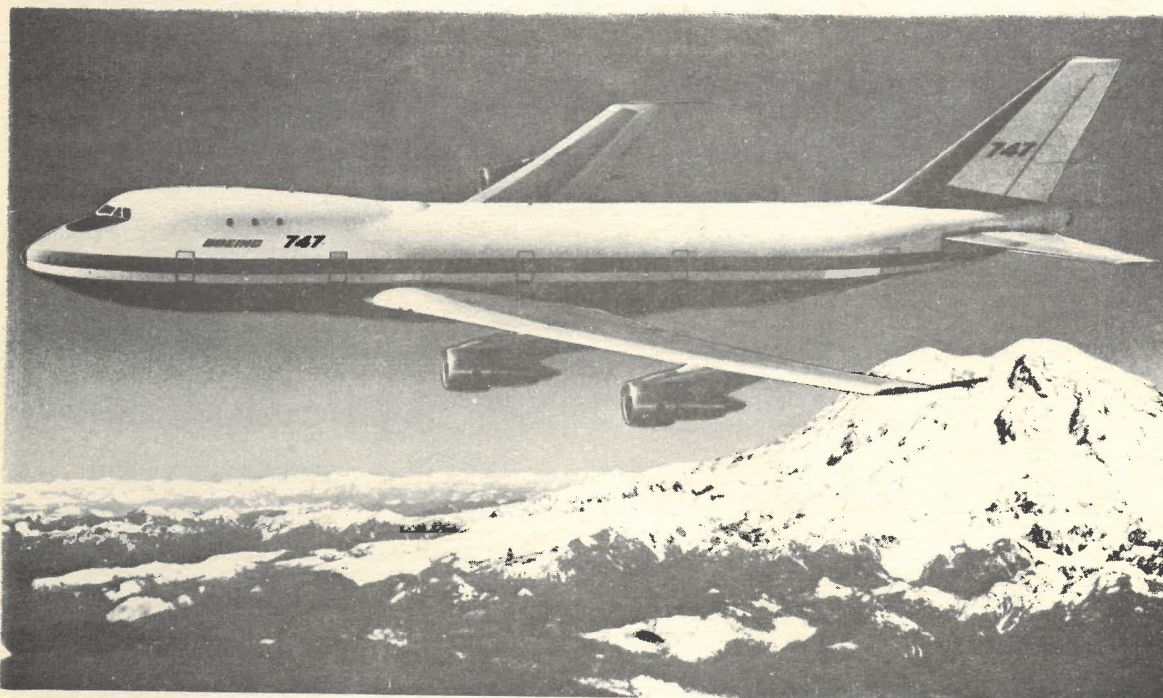


FLIGHT CREW Systems Description

BOEING 747



NORTHWEST AIR LINES



BOEING

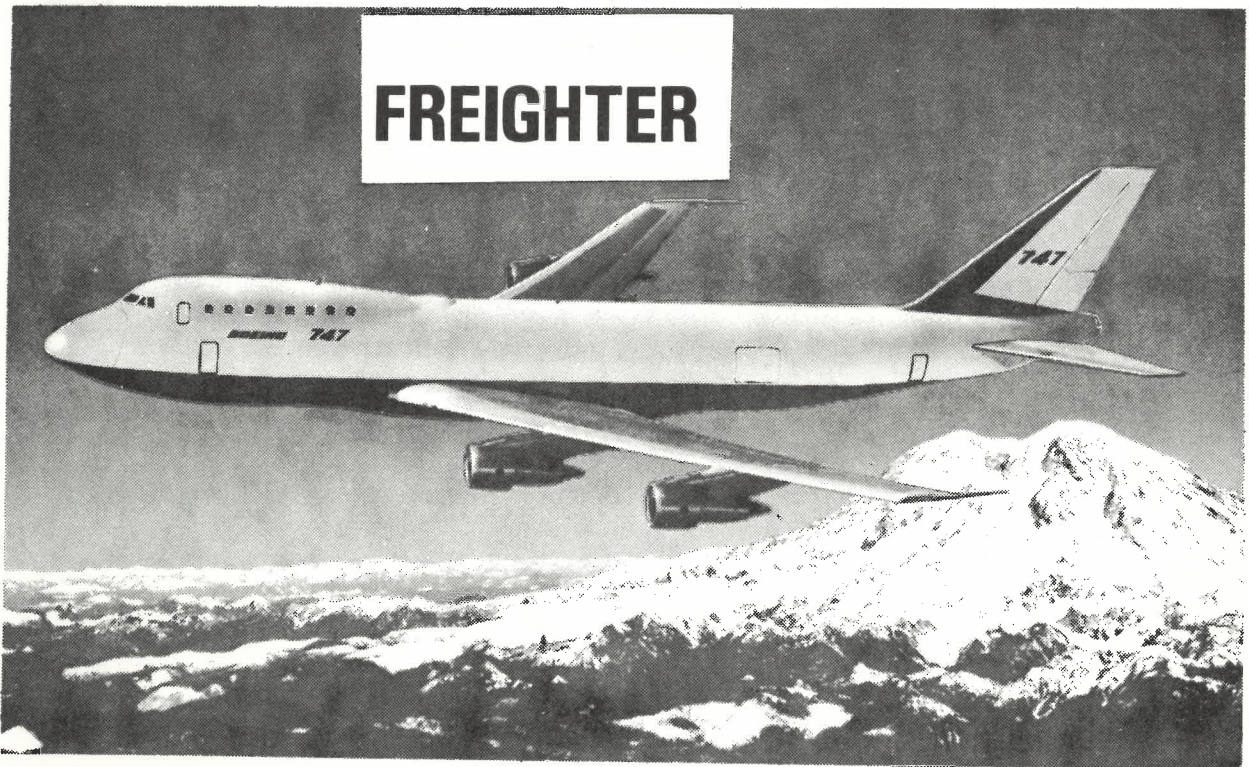
747



FLIGHT CREW

Systems Description

NORTHWEST AIR LINES



| | |
|---|----|
| COCKPIT REFERENCE, PERFORMANCE & FLIGHT PLANNING DATA | 01 |
| EMERGENCY OPERATING PROCEDURES | 02 |
| ALTERNATE OPERATING PROCEDURES | 03 |
| DIMENSIONS & GENERAL ARRANGEMENT | 06 |
| | 13 |
| AIR CONDITIONING & PRESSURIZATION | 21 |
| AUTOPILOT & FLIGHT DIRECTOR | 22 |
| COMMUNICATIONS | 23 |
| ELECTRICAL POWER | 24 |
| EQUIP/FURNISHINGS | 25 |
| FIRE PROTECTION | 26 |
| FLIGHT CONTROLS | 27 |
| FUEL | 28 |
| HYDRAULIC POWER | 29 |
| ICE & RAIN PROTECTION | 30 |
| INSTRUMENTS | 31 |
| LANDING GEAR | 32 |
| LIGHTING | 33 |
| NAVIGATION | 34 |
| OXYGEN | 35 |
| PNEUMATIC | 36 |
| APU | 49 |
| DOORS | 52 |
| WINDOWS | 56 |
| EMERGENCY EQUIPMENT | 58 |
| ENGINES | 72 |
| MISCELLANEOUS SYSTEMS & EQUIPMENT | 84 |
| | 85 |
| | 86 |
| OPERATING BULLETINS | 87 |

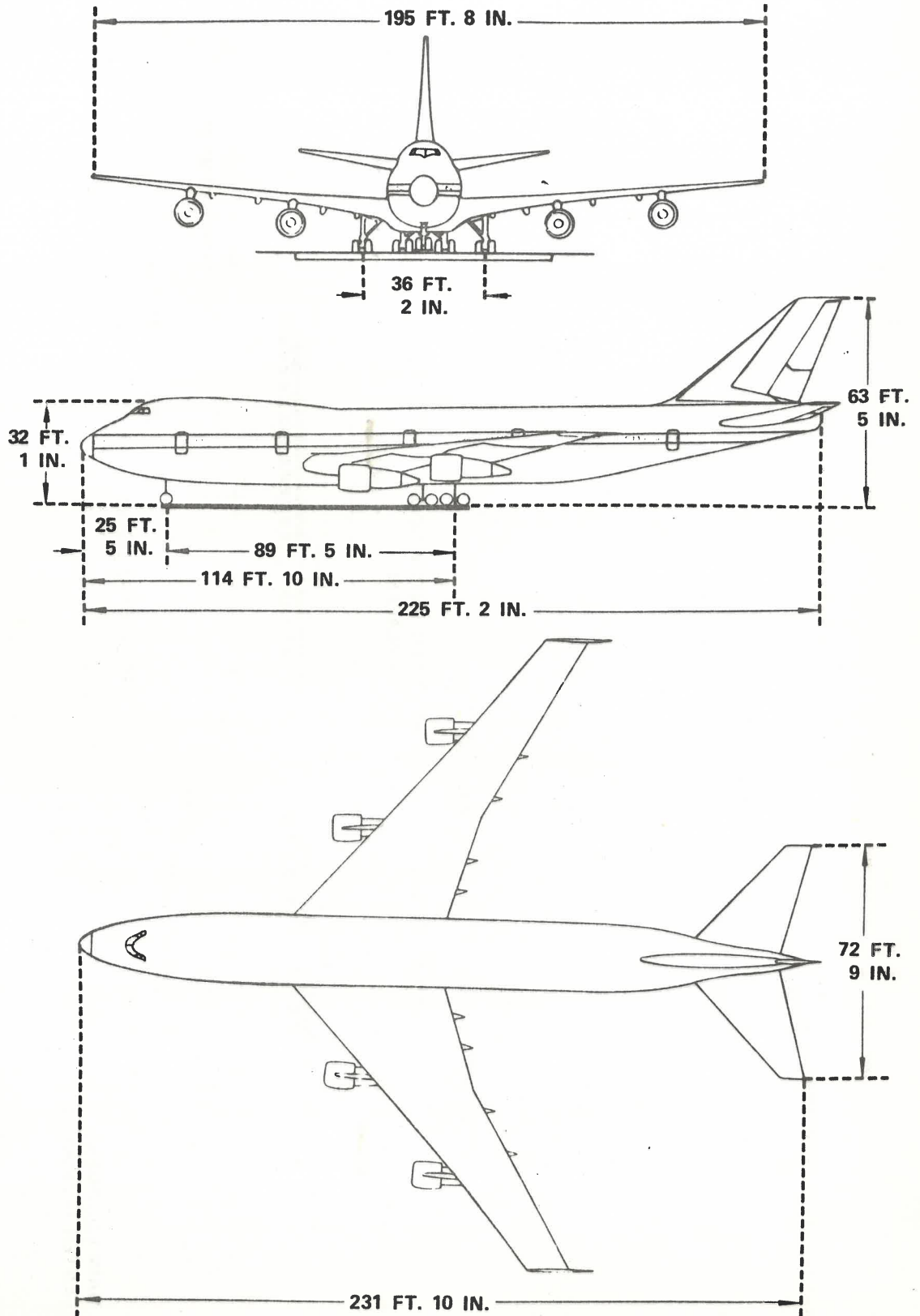
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|---|----|------|
| COCKPIT REFERENCE, PERFORMANCE & FLIGHT PLANNING DATA | 01 | ▶ |
| EMERGENCY OPERATING PROCEDURES | 02 | ▶ 02 |
| ALTERNATE OPERATING PROCEDURES | 03 | ▶ |
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| PNEUMATIC | 36 | ▶ |
| APU | 49 | ▶ |
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| | 86 | ▶ |
| OPERATING BULLETINS | 87 | ▶ |

| | |
|---|----|
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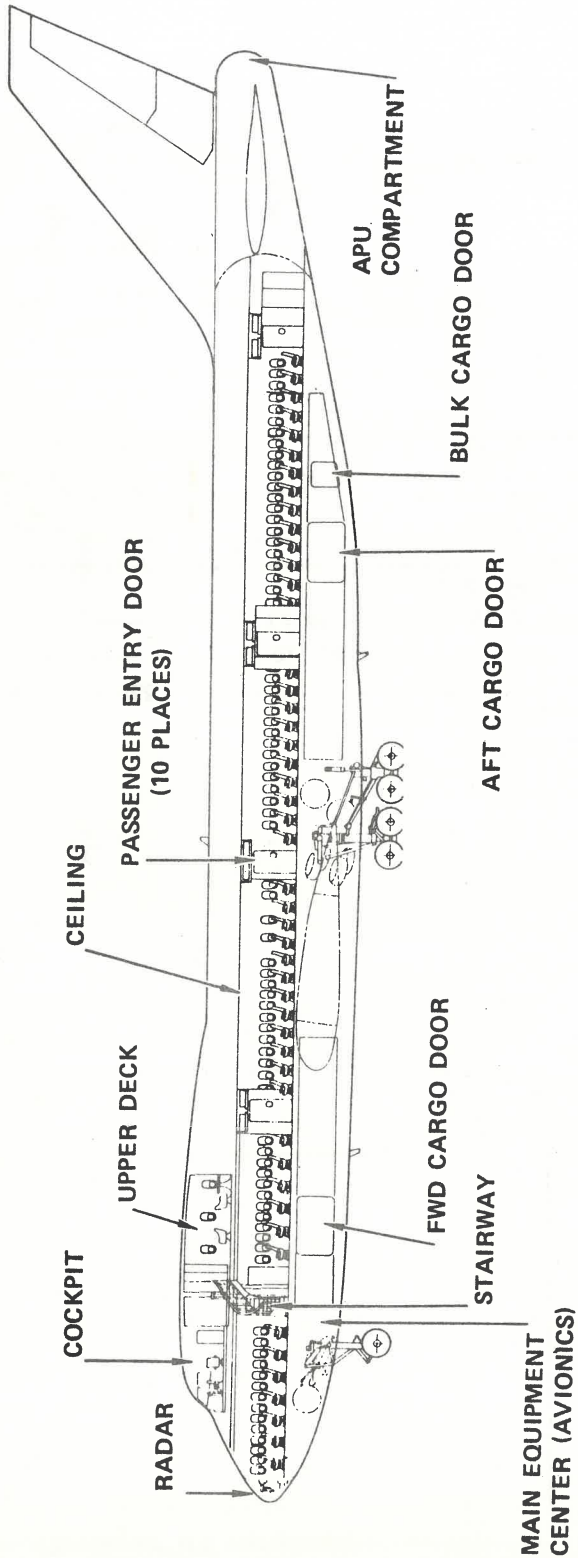
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|---|----|
| COCKPIT REFERENCE, PERFORMANCE & FLIGHT PLANNING DATA | 01 |
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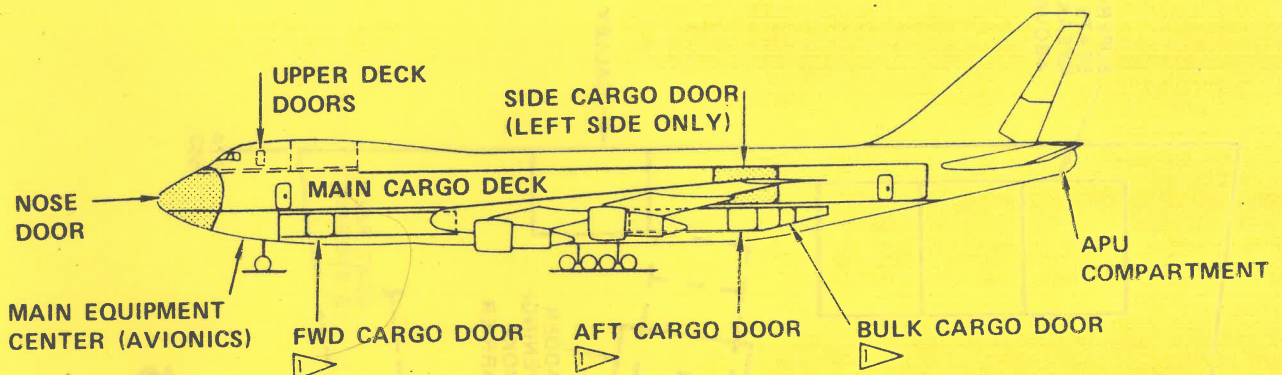


PRINCIPAL DIMENSIONS:



AIRCRAFT DECK STRUCTURE:





▷ Right side only

RIGHT SIDE ONLY

AIRPLANE DECK STRUCTURE

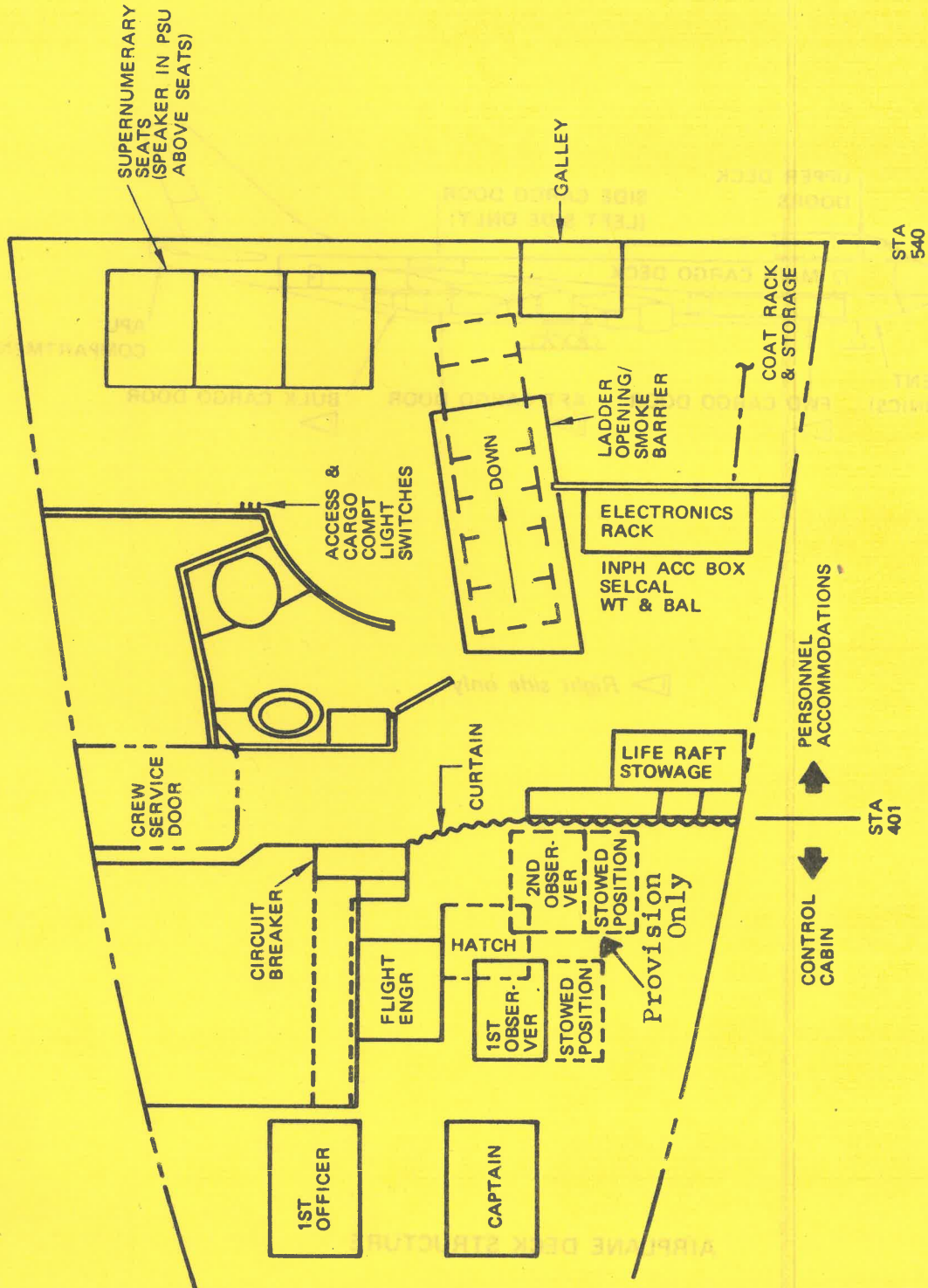
NORTHWEST ORIENT

BOEING 747



FREIGHTER

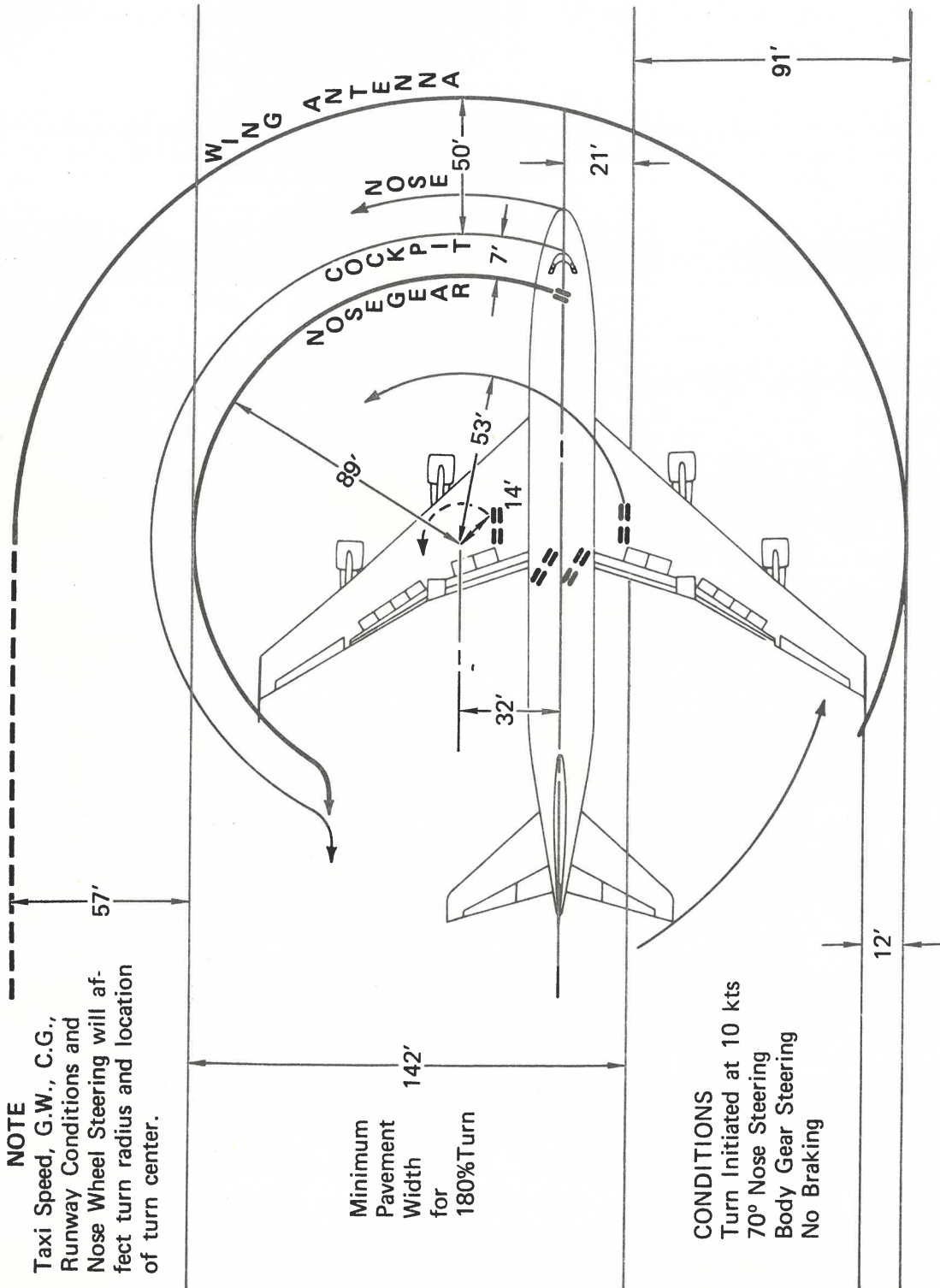
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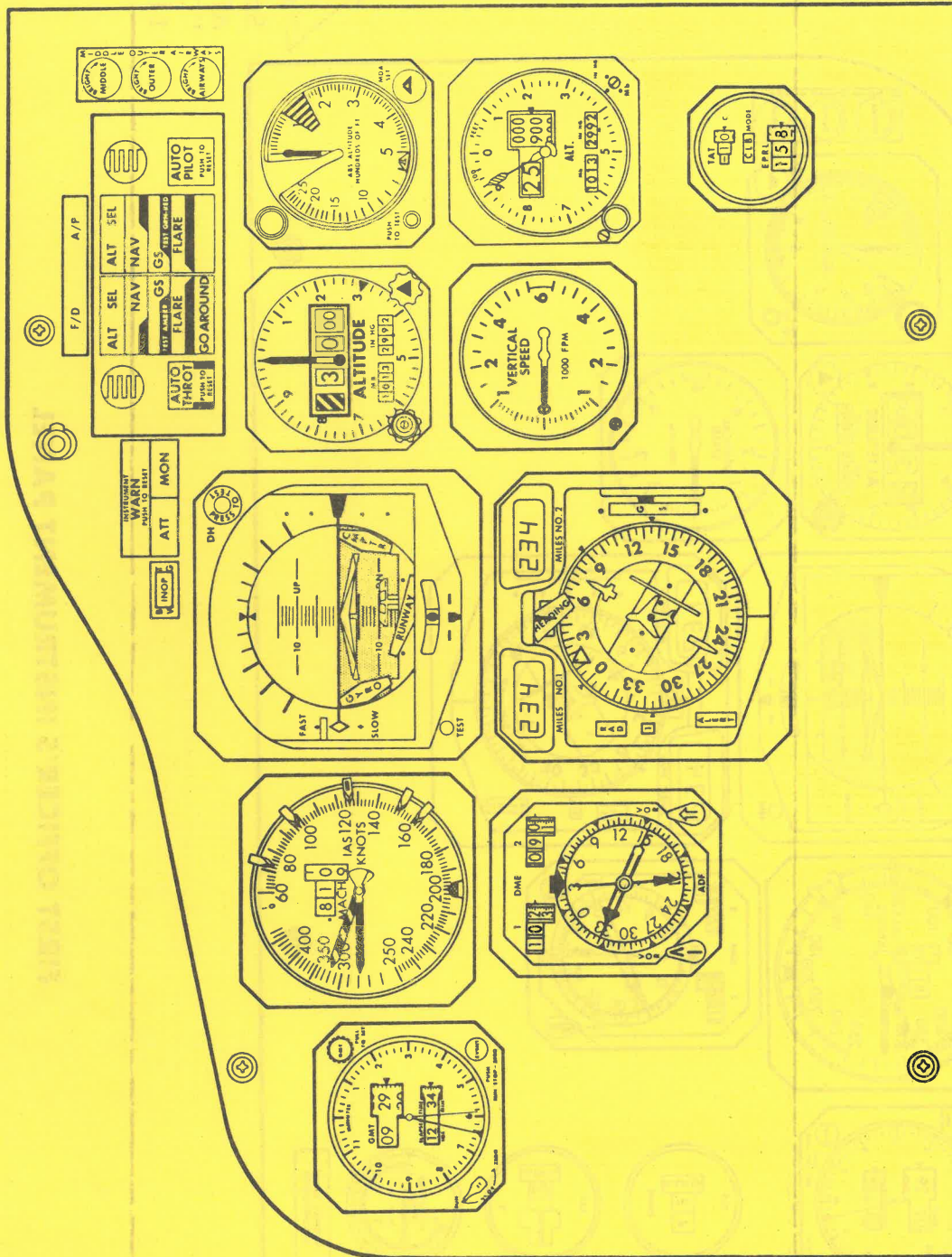


FLIGHT CREW ACCOMMODATIONS



AIRCRAFT TURNING RADIUS:



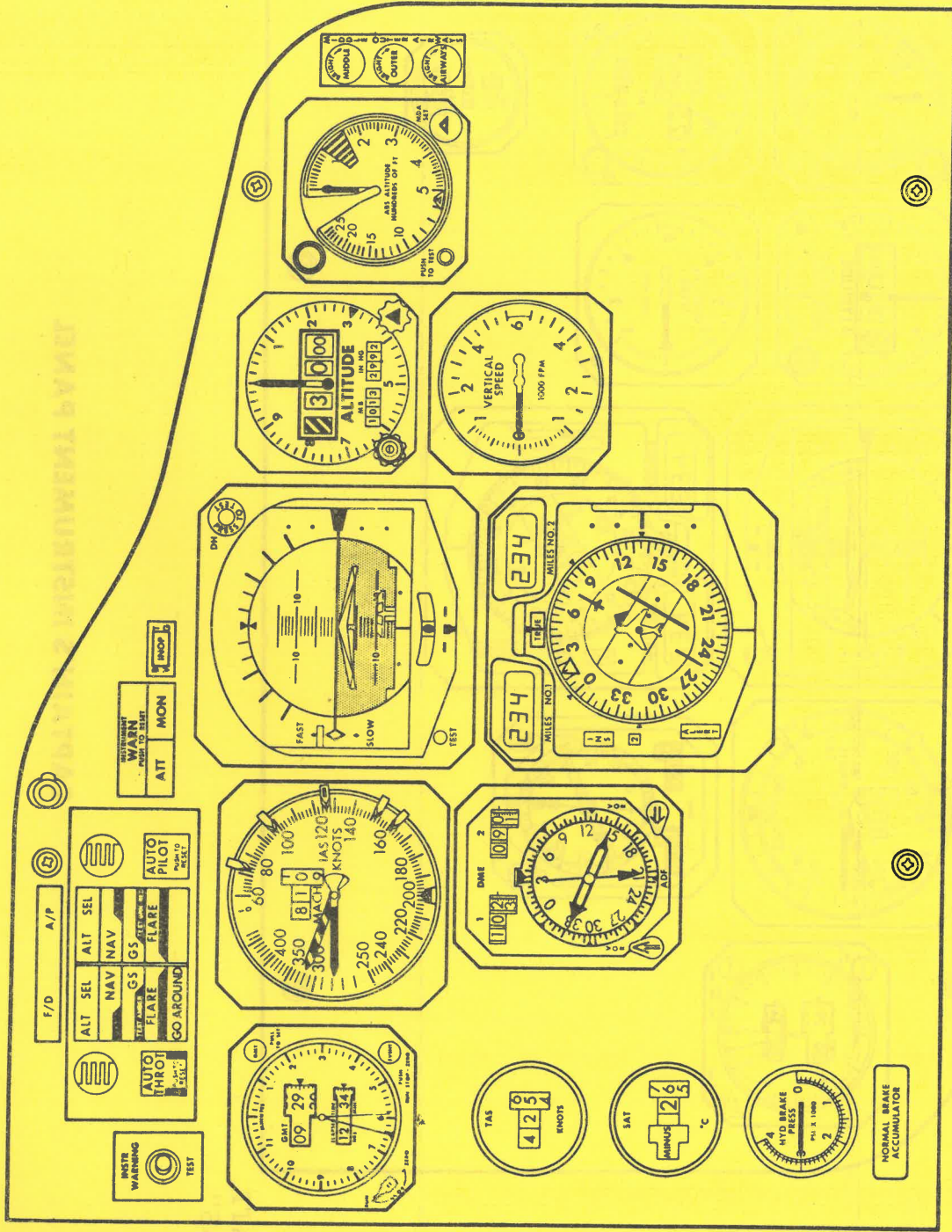


CAPTAIN'S INSTRUMENT PANEL



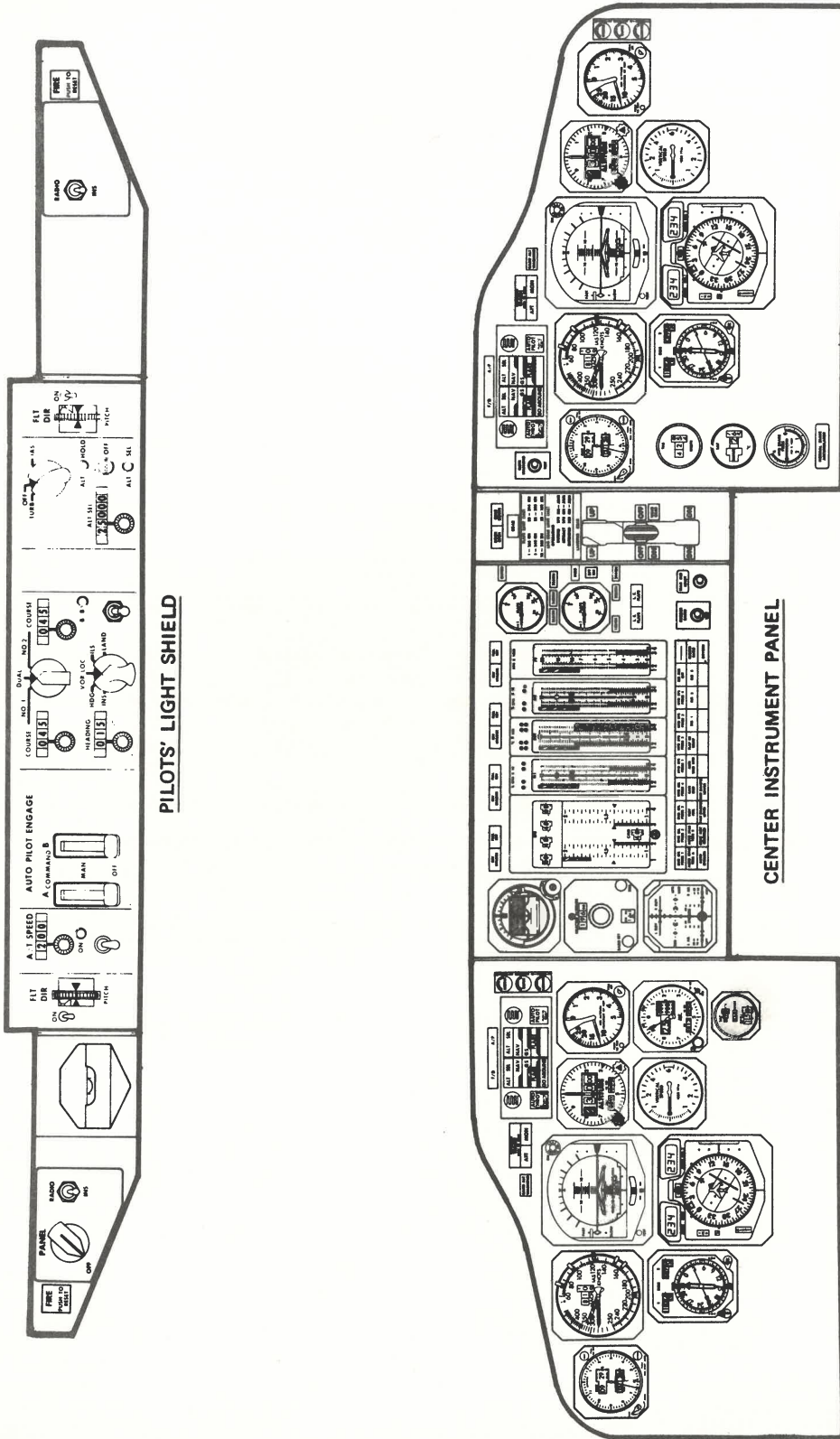
↳ "Buzzer"
 Sounds when ATT.
 light of "CIWS"
 illuminates

"Ruzzer"
Sounds when
ATT. Light of
"CIWS"
illuminates



FIRST OFFICER'S INSTRUMENT PANEL

PILOT'S INSTRUMENT PANEL:



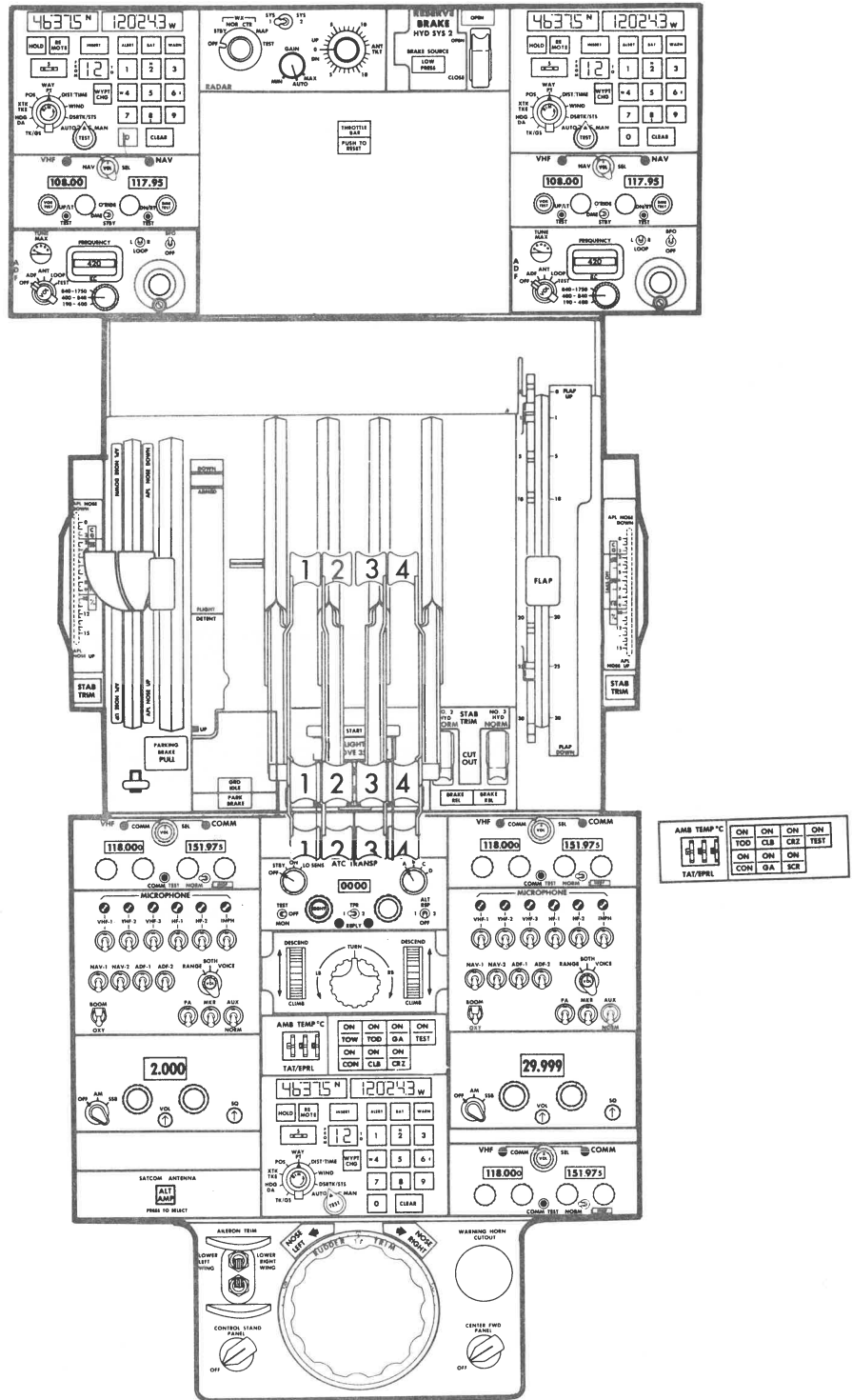
PILOTS' LIGHT SHIELD

CENTER INSTRUMENT PANEL

FIRST OFFICER'S INSTRUMENT PANEL

CAPTAIN'S INSTRUMENT PANEL

PILOT'S CONTROL STAND:



GEAR LIMIT (IAS)

| |
|-------------------|
| FLAPS LIMIT (IAS) |
| 1-245 KN 20-214KN |
| 5-240 KN 25-205KN |
| 10-235KN 30-190KN |

LDG GEAR LIMIT (IAS)

| |
|--------------------|
| OPERATING |
| EXTEND 270KN-82M |
| RETRACT 270KN-82M |
| EXTENDED 320KN-82M |

LANDING GEAR

UP OFF DN

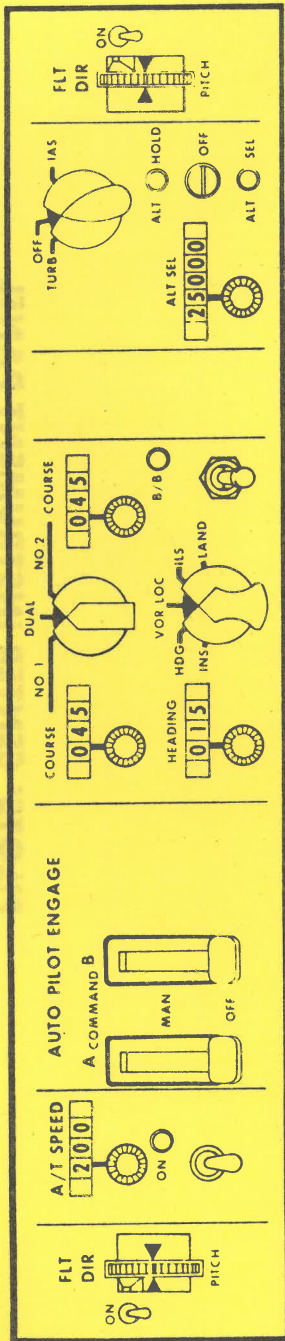
UP OFF DN

HING GEAR DN

MODE

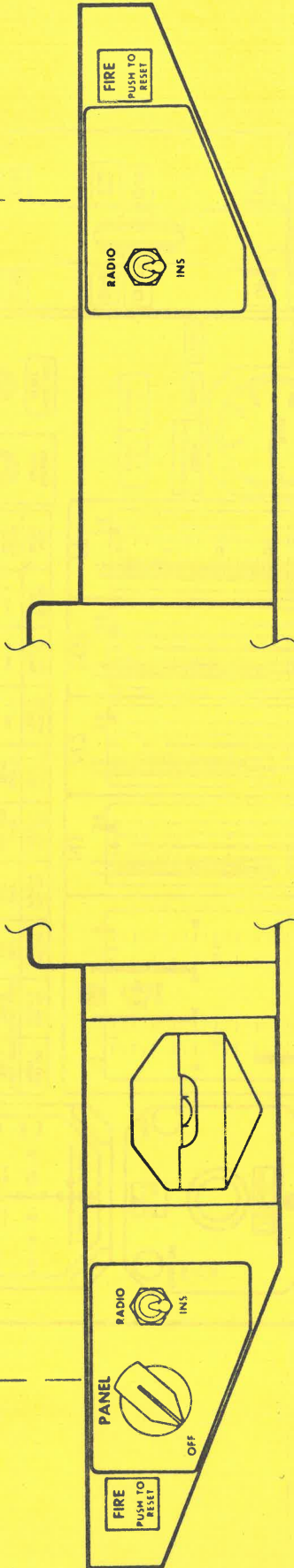
| | | |
|----------------|------------|------|
| FIRE DETECTION | AUTO BRAKE | TEST |
|----------------|------------|------|

PILOTS' CENTER INSTRUMENT PANEL



NOSE DR

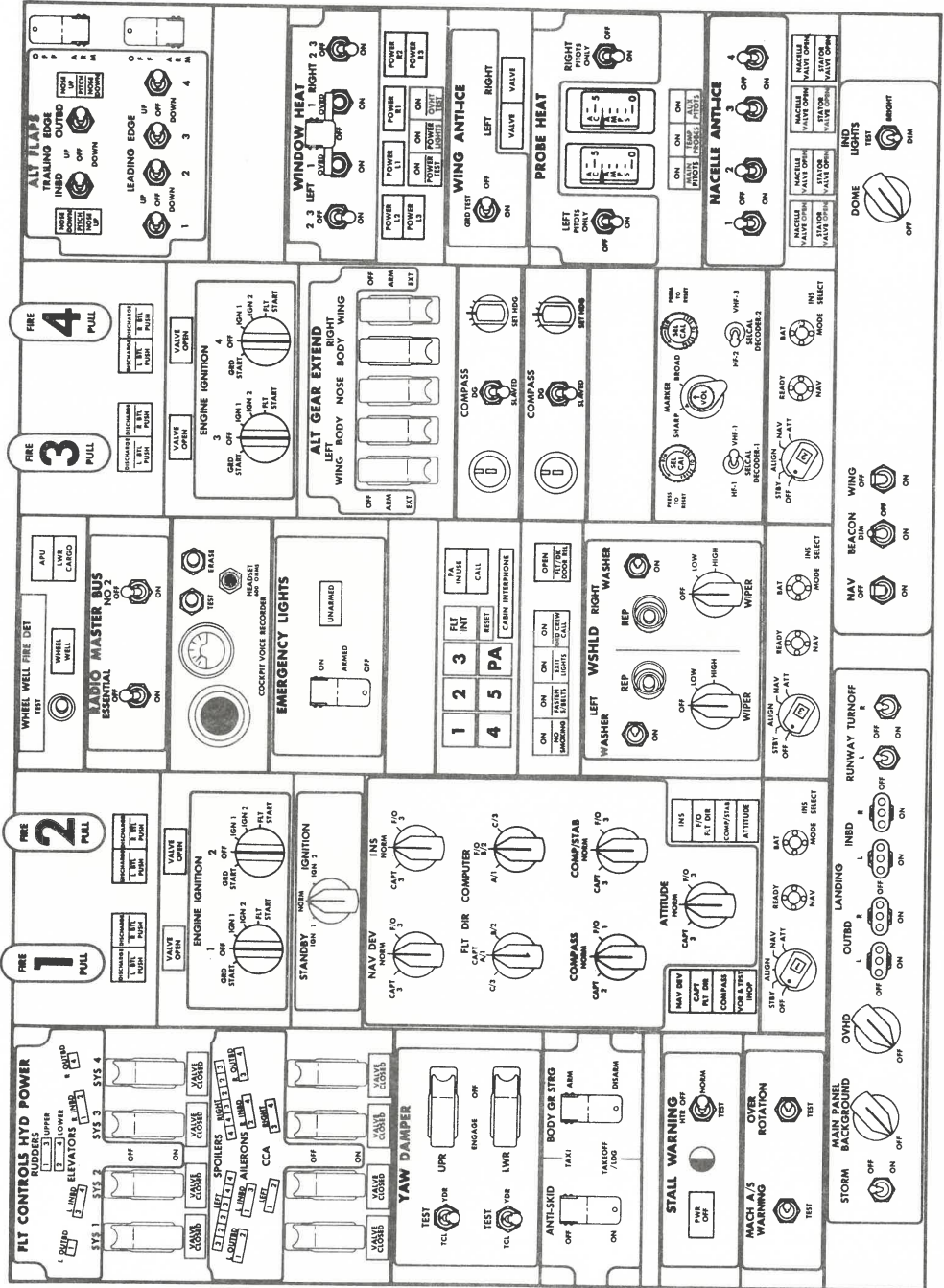
NOSE DR

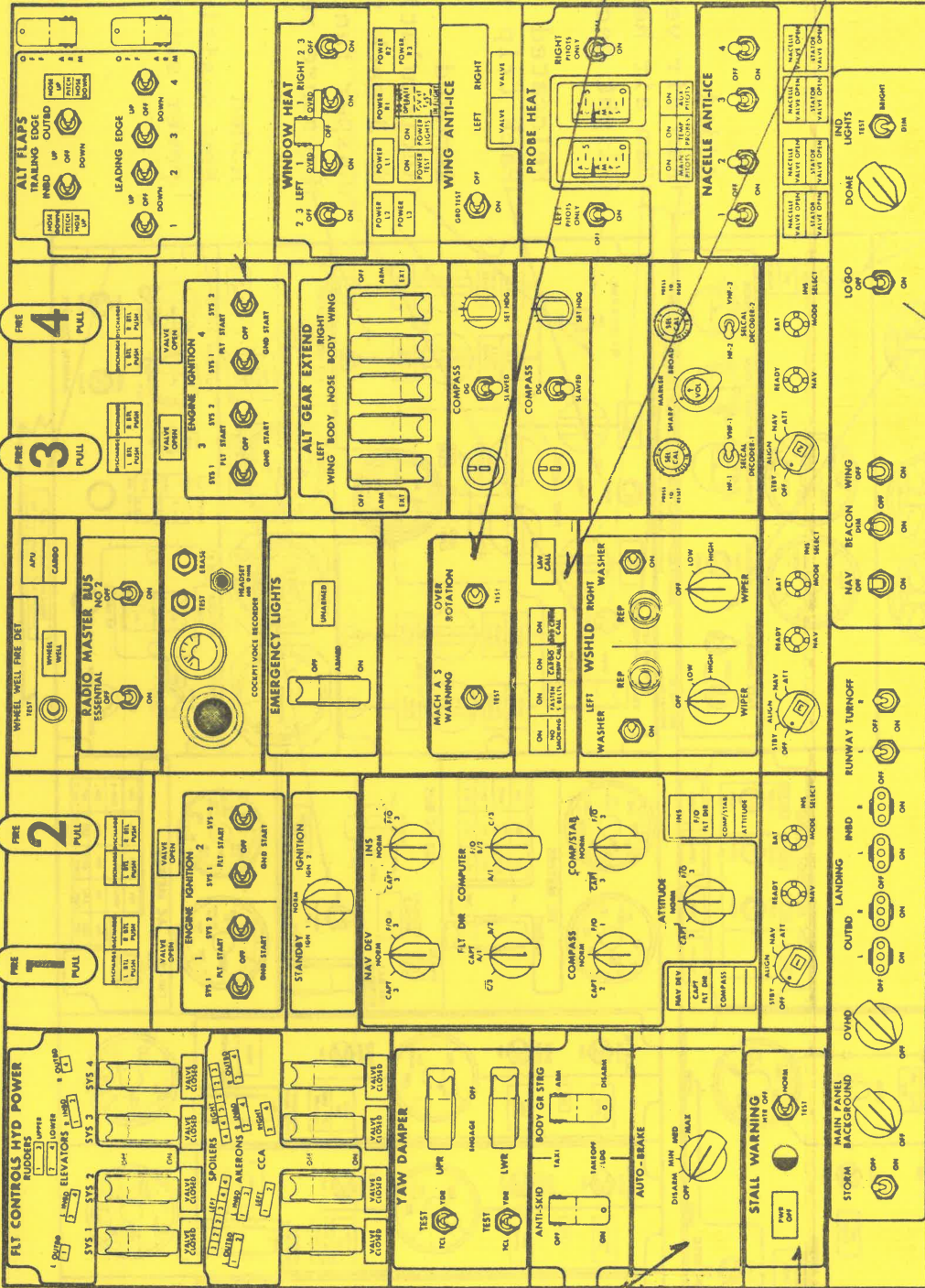


PILOTS' LIGHTSHIELD



PILOT'S OVERHEAD PANEL:





New type
IGNITION
switches

MACH A/S test
relocated and
interphone
call system
removed

CARCO CREW
call and LAV.
call added

LOGO light
switch added

AUTO BRAKE
control panel
added

STALL WARNING
control panel
relocated

PILOTS' OVERHEAD PANEL

Removed

All upper deck temp. controls and switches.

Zone 4 compartment / duct indicator.

Zone 4 overheat light.

Zone 4 temp. switch.

No. 3 pack selector switch.

No. 3 pack control switch.

Added

Ram air vent valve.

Ram air heater switch.

Flight deck fan switch.

Relocated

Pack trip reset switch.

Removed

Recirculating fan switches.

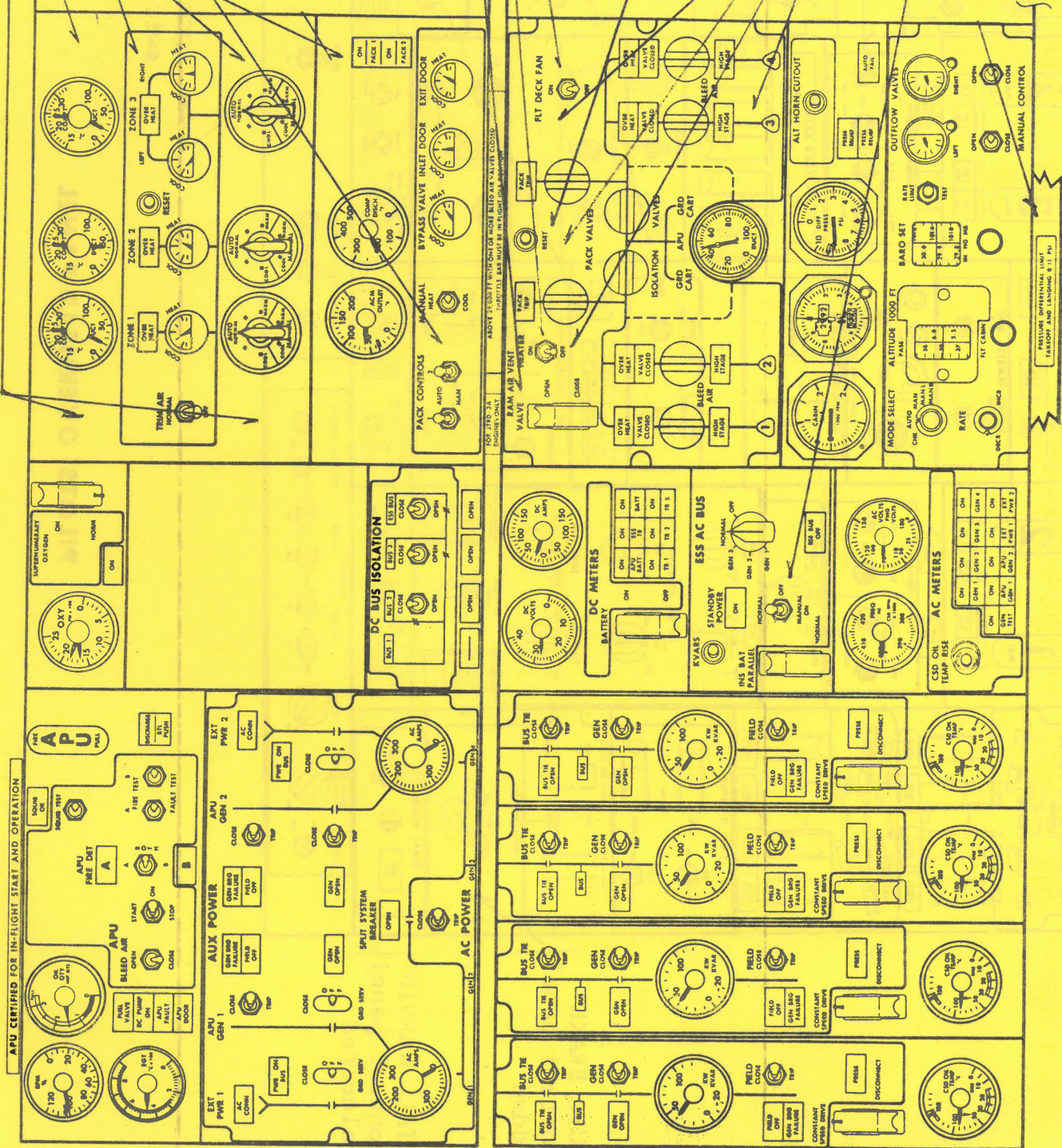
No.3 pack valve switch.

Gasper fan switch.

Pressure relief lights.

Added

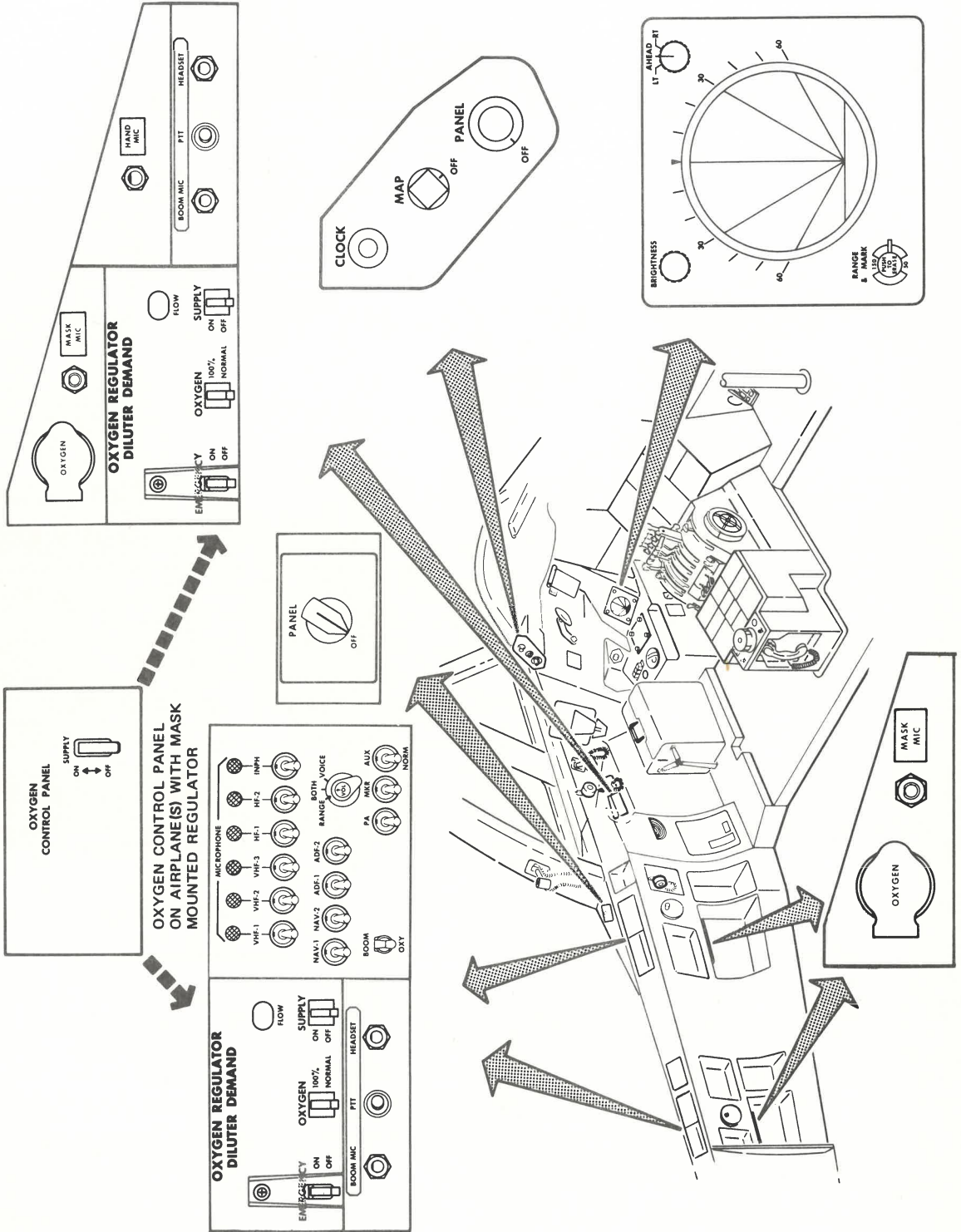
New position to standby power switch.



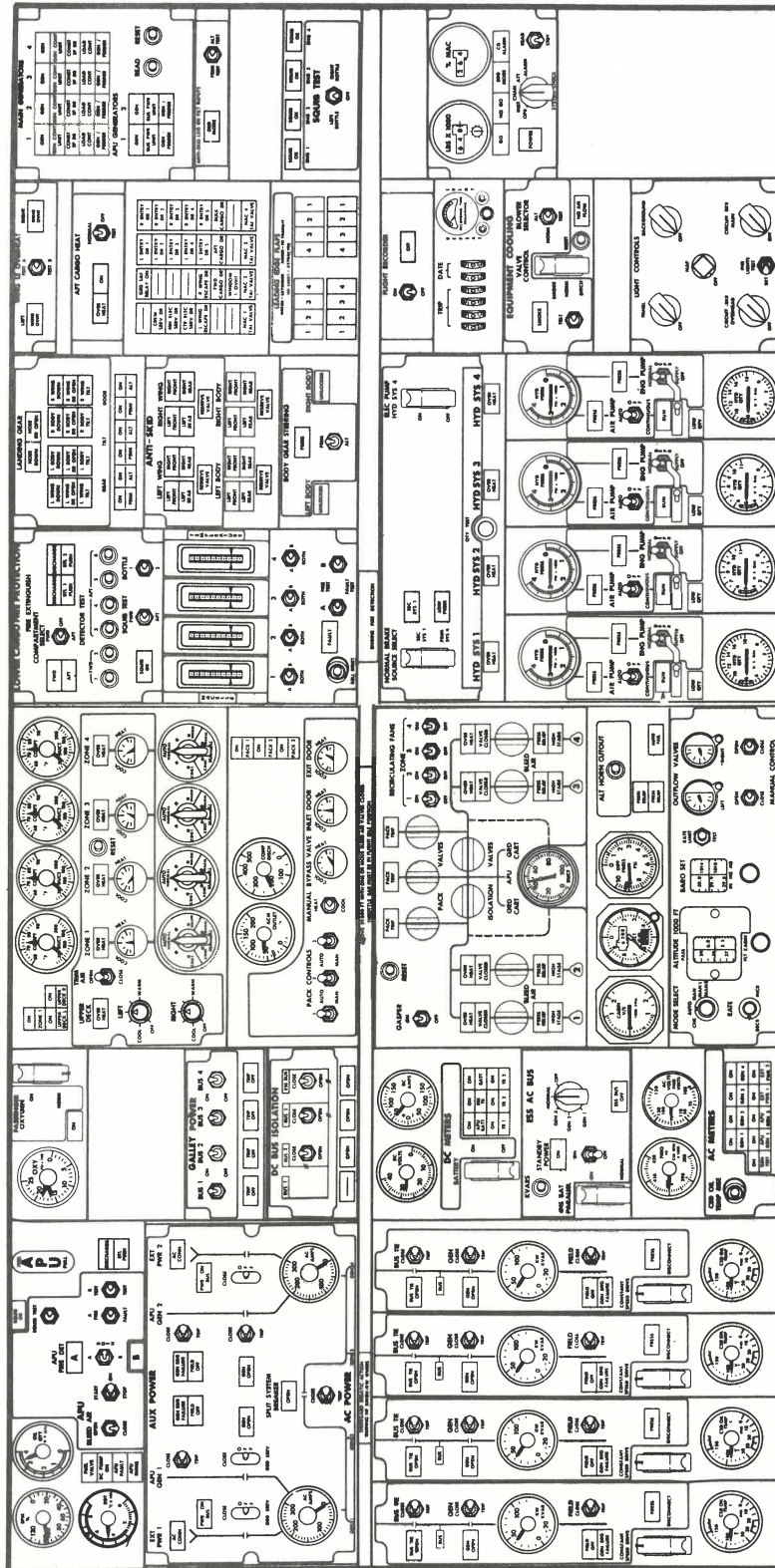
FLIGHT ENGINEER'S INSTRUMENT PANEL-UPPER PANELS -LEFT



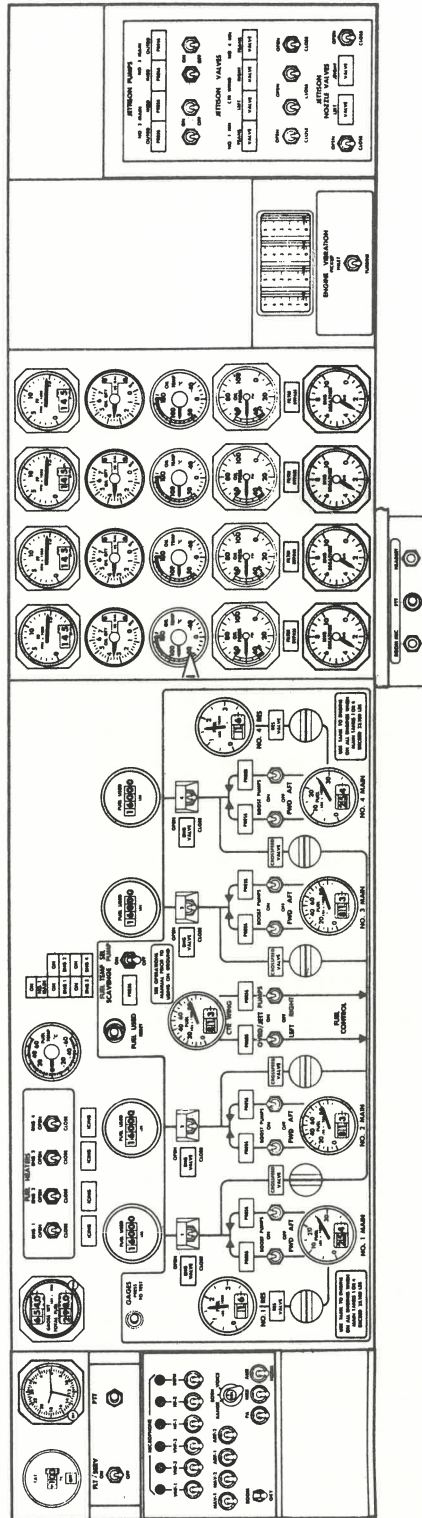
PILOT'S AUXILIARY AND OBSERVER'S PANELS:



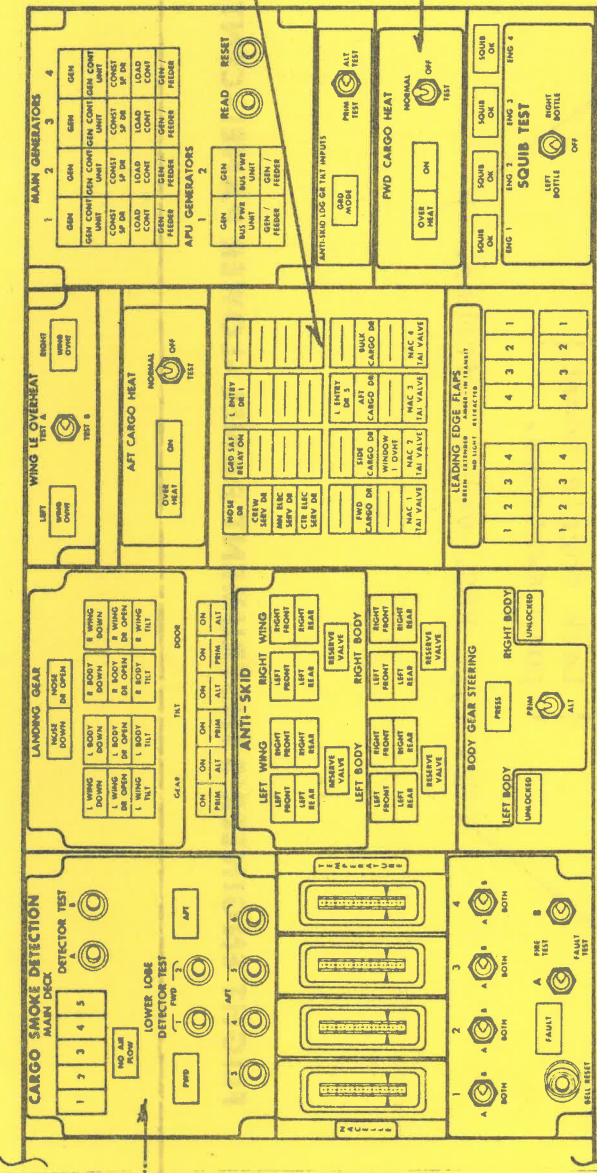
SECOND OFFICER UPPER INSTRUMENT PANEL:



SECOND OFFICER LOWER INSTRUMENT PANEL:



Added
Cargo smoke
detection
panel with
main deck
detectors.

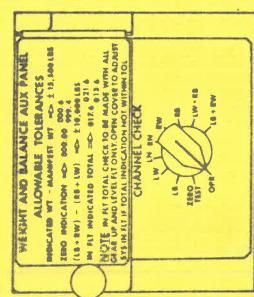
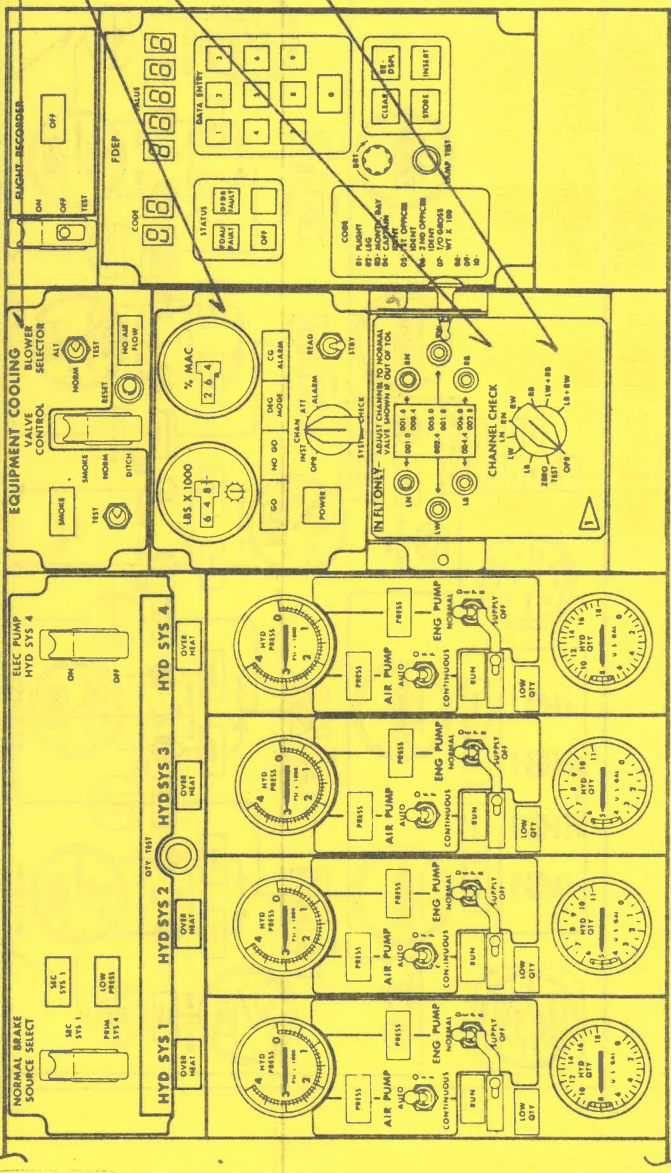


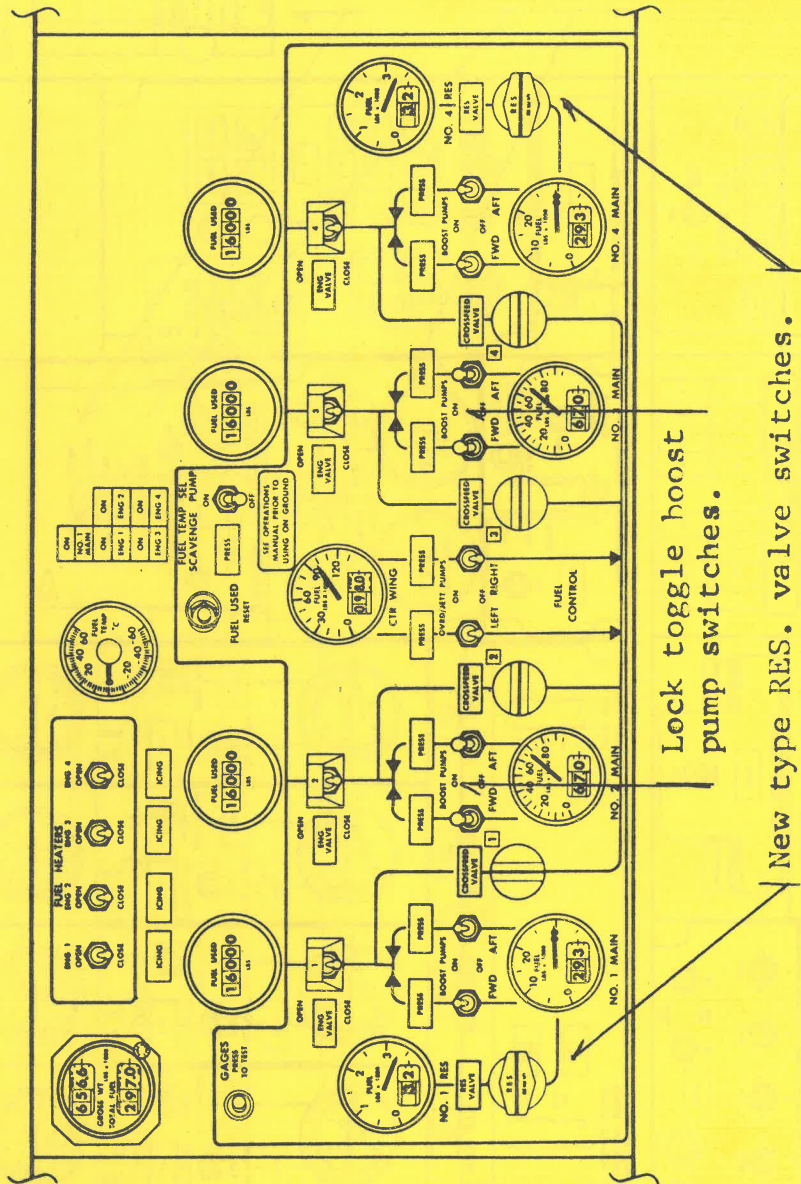
Changes in door
lights in annunciator
panel.

Added
Forward cargo heat panel.

Relocated
Equipment cooling panel.
Weight and balance
control panel.
Lighting control panel.

Added
Weight and balance
AUX. control panel.

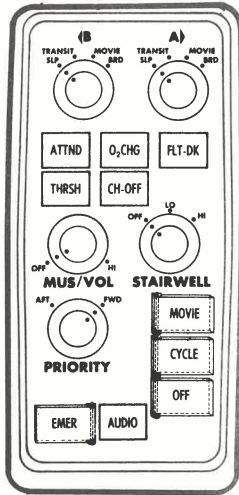




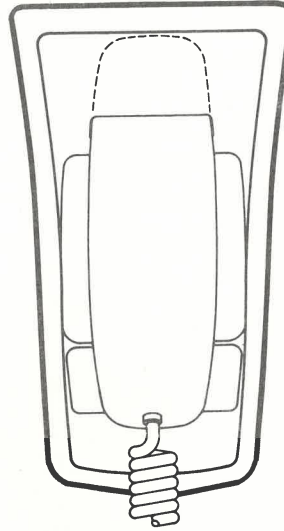
FLIGHT ENGINEER'S INSTRUMENT PANEL -LOWER PANEL-CENTER



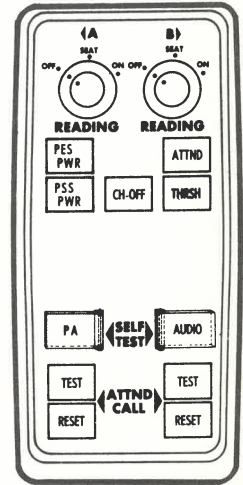
FLIGHT ATTENDANTS PANELS:



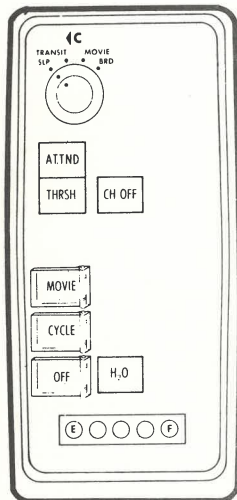
STATION 1L



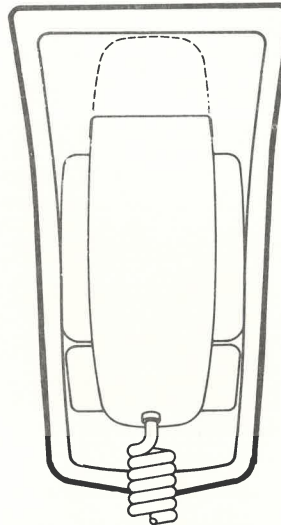
STATIONS 1L & 1R



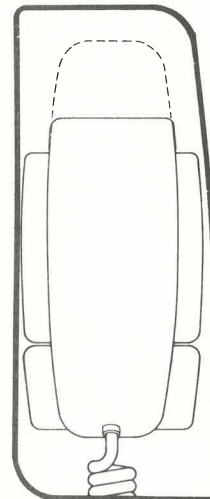
STATION 1R



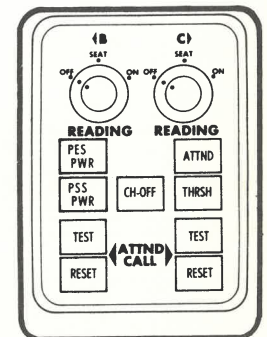
STATION 2L



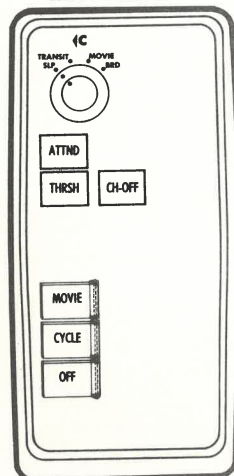
STATIONS 2L & 3L



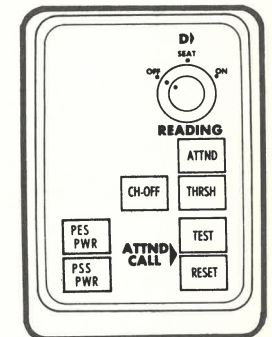
STATIONS 2R & 3R



STATION 2R

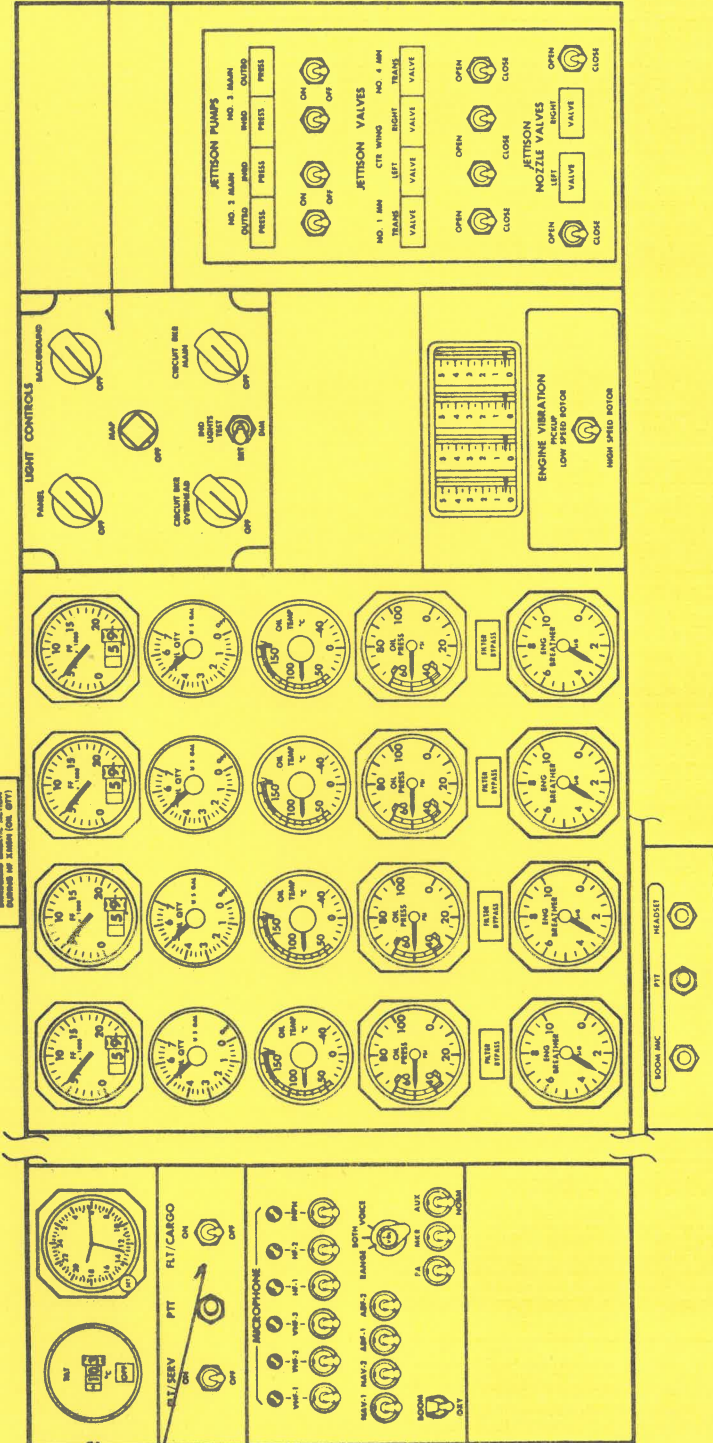


STATION 3L



STATION 3R

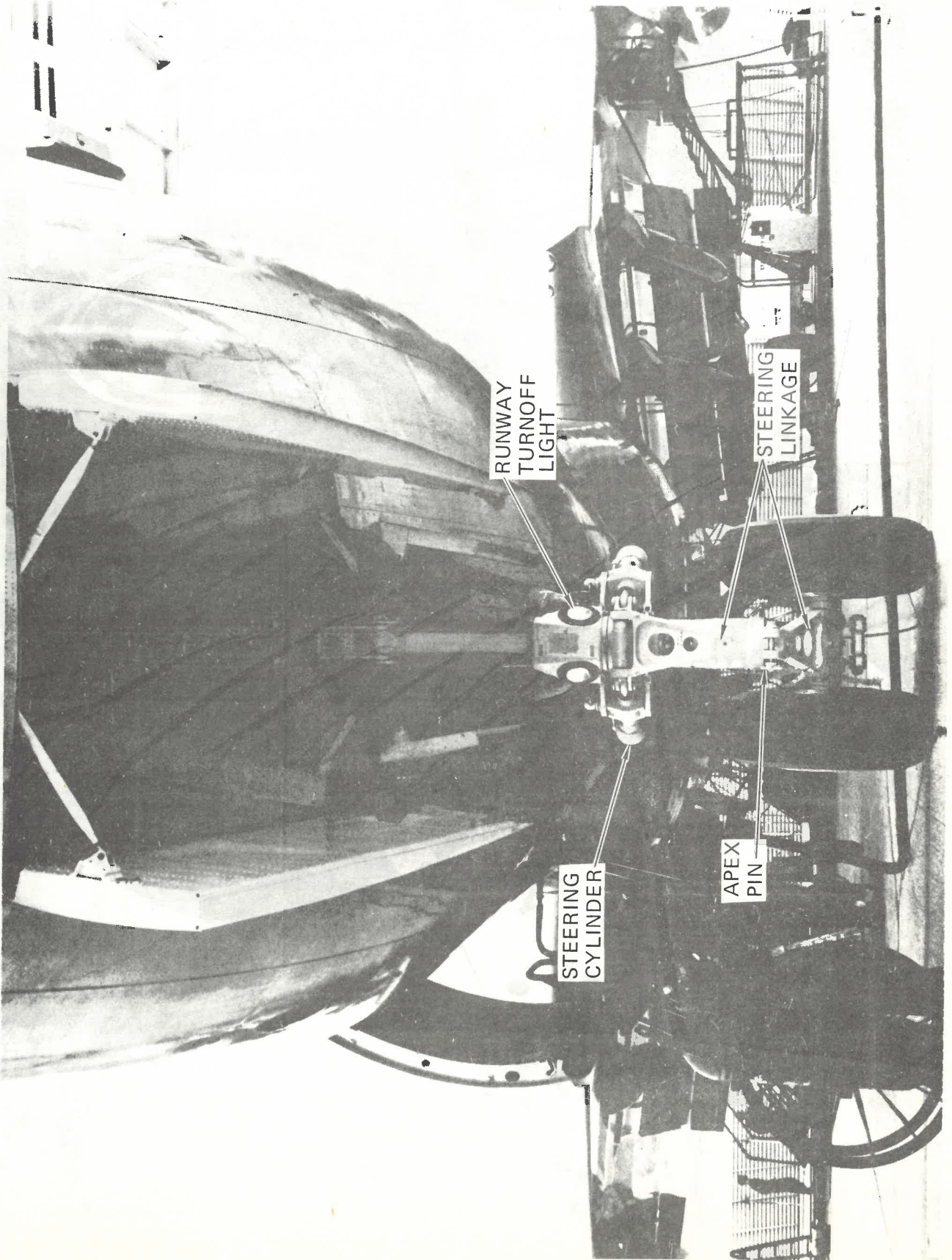
New location
of lighting
control panel.



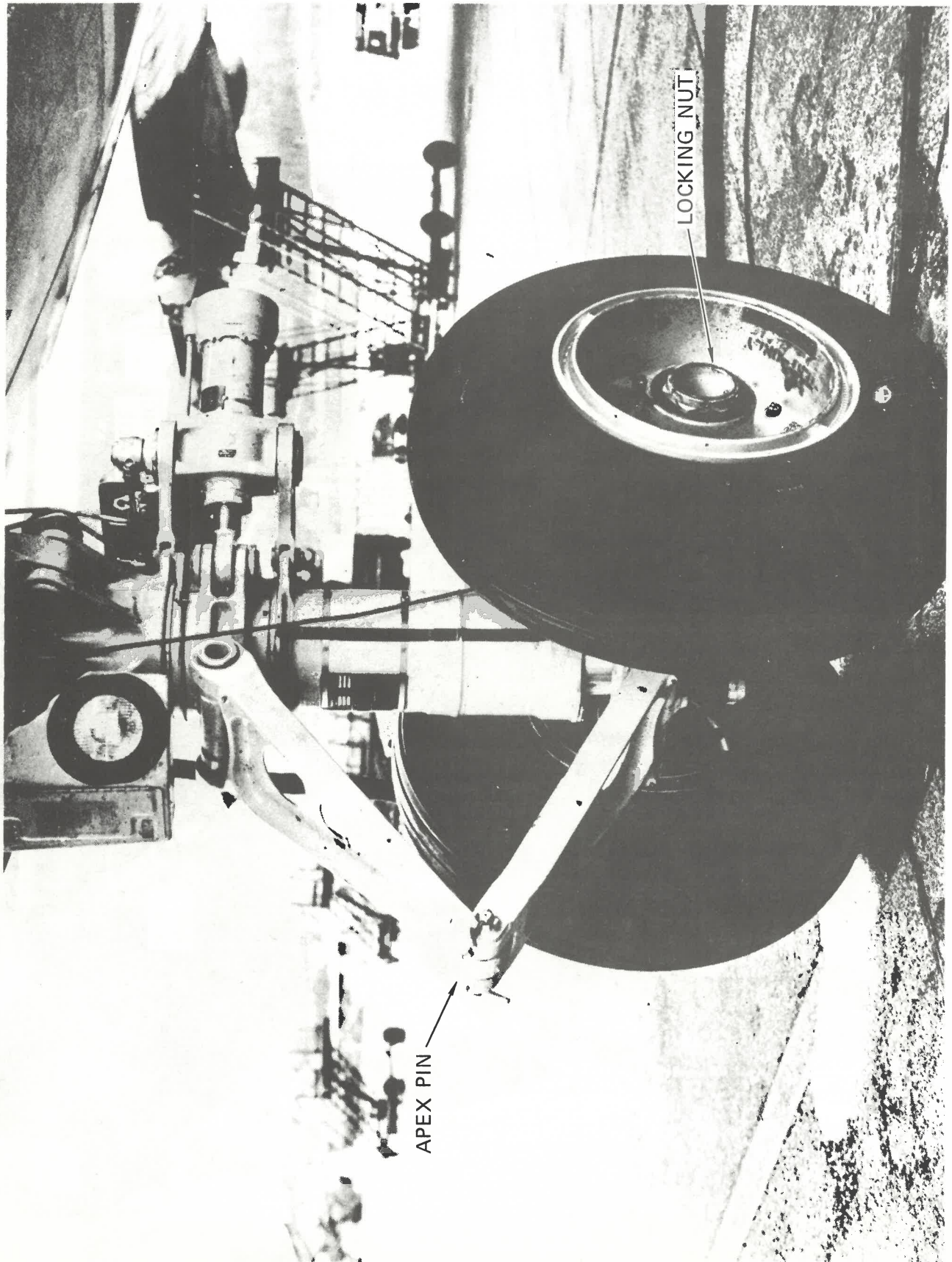
Added
Flt/Cargo
interphone
switch.

FLIGHT ENGINEER'S INSTRUMENT PANEL-LOWER PANEL-LEFT & RIGHT

| | |
|---|----|
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NOSE WHEEL AREA



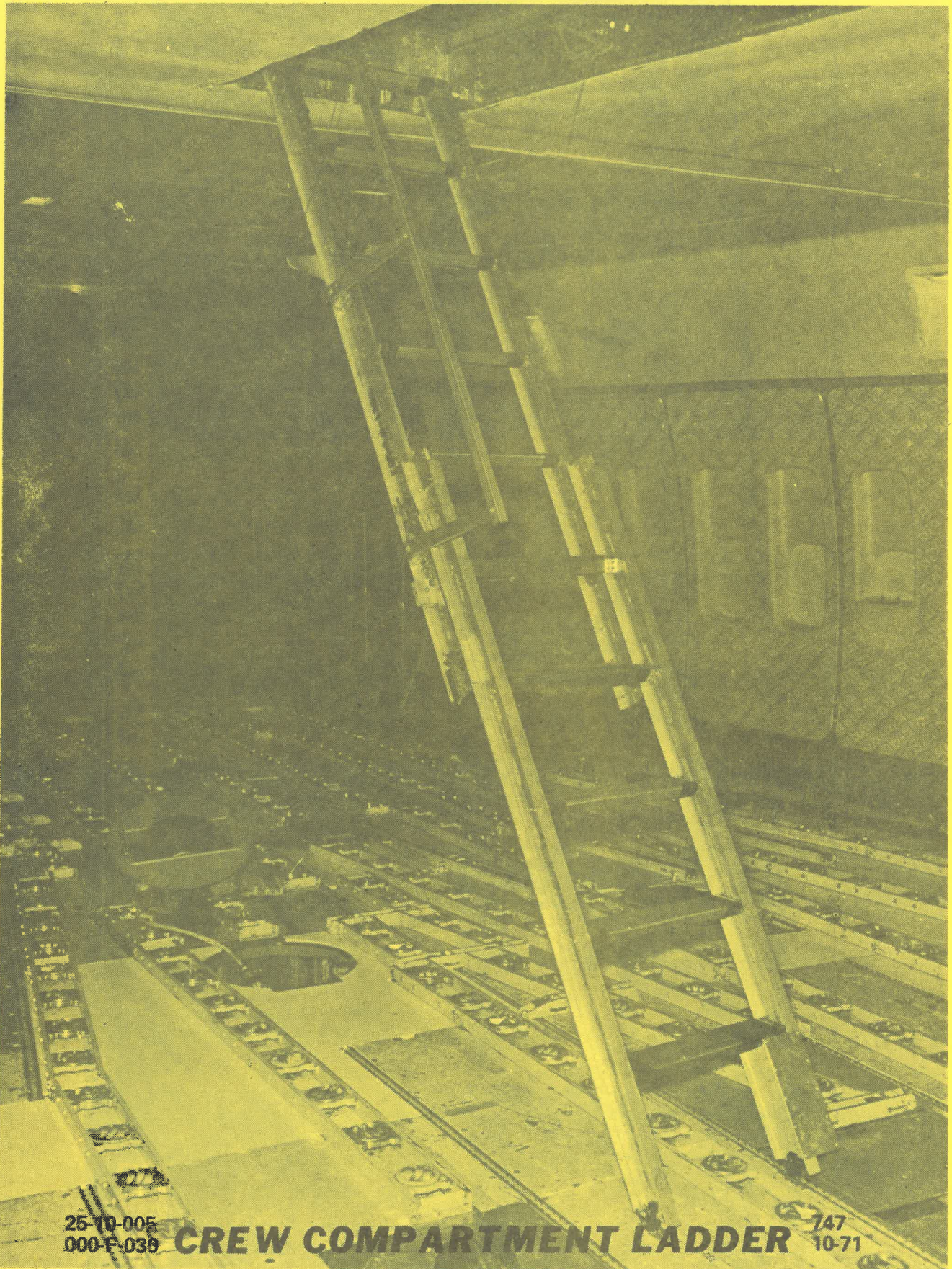
NOSE WHEEL

NORTHWEST ORIENT
BOEING 747



FREIGHTER

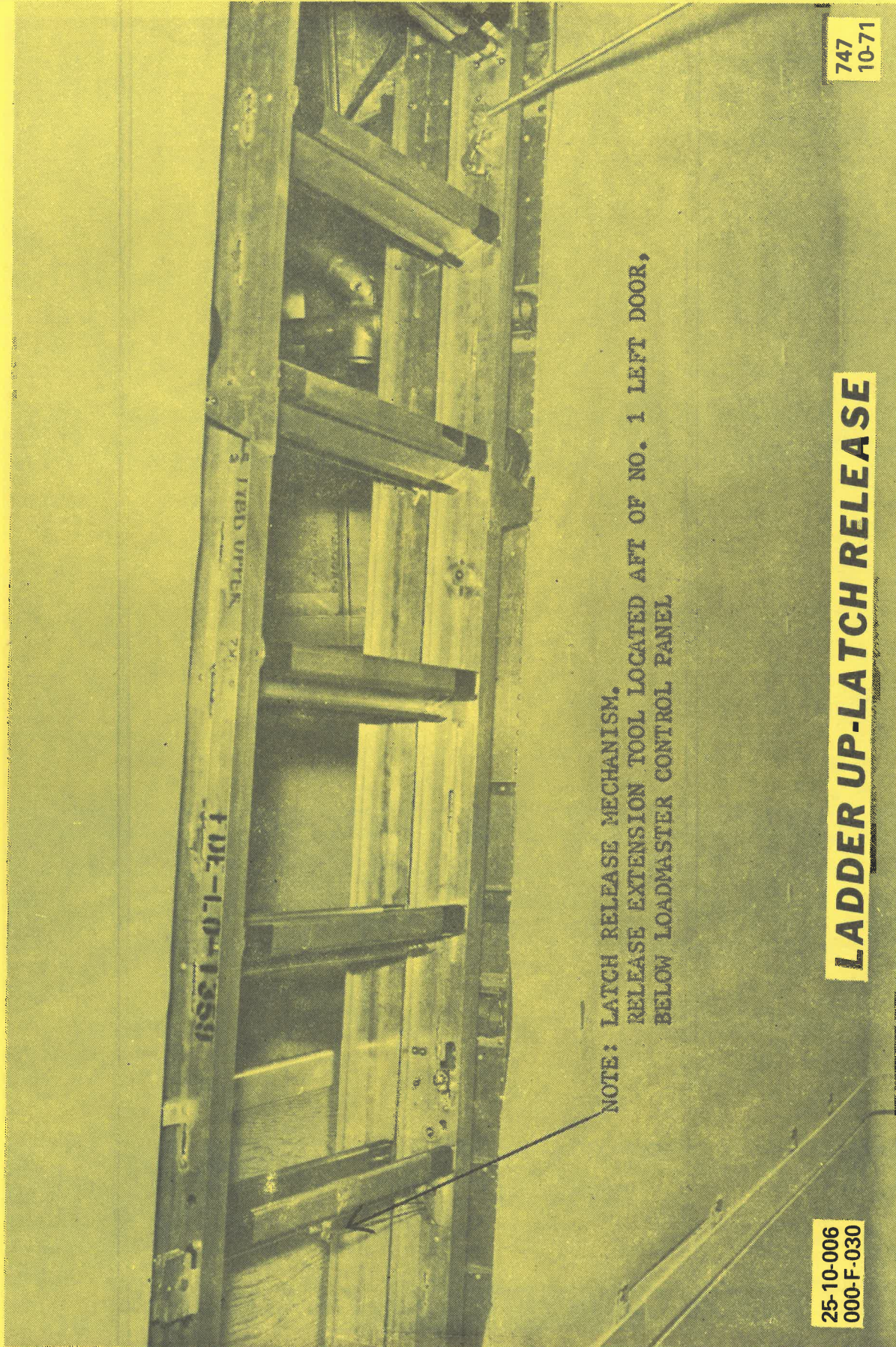
13:01F



25-10-005
000-F-036

CREW COMPARTMENT LADDER

747
10-71

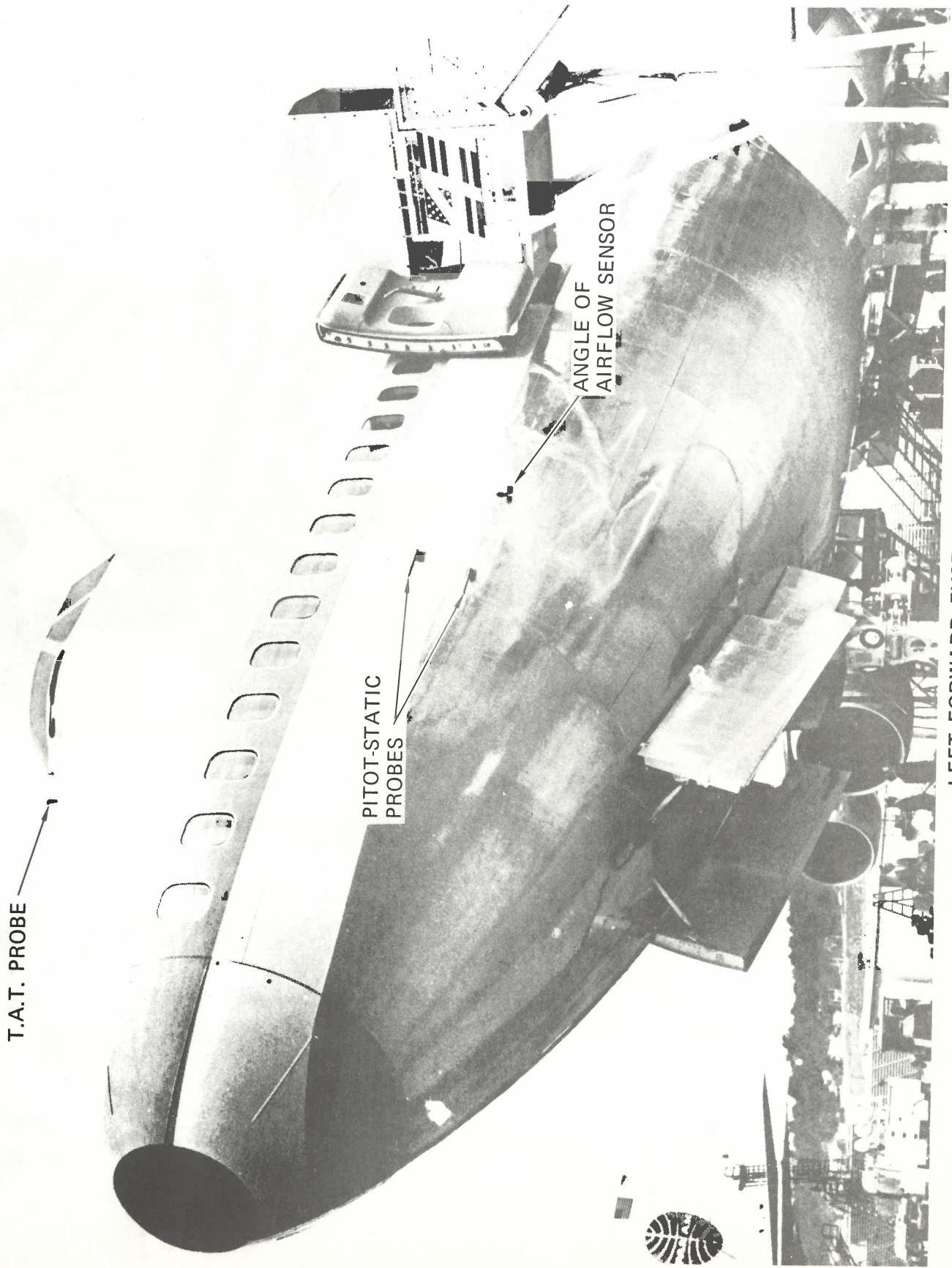


747
10-71

NOTE: LATCH RELEASE MECHANISM.
RELEASE EXTENSION TOOL LOCATED AFT OF NO. 1 LEFT DOOR,
BELOW LOADMASTER CONTROL PANEL

LADDER UP-LATCH RELEASE

25-10-006
000-F-030

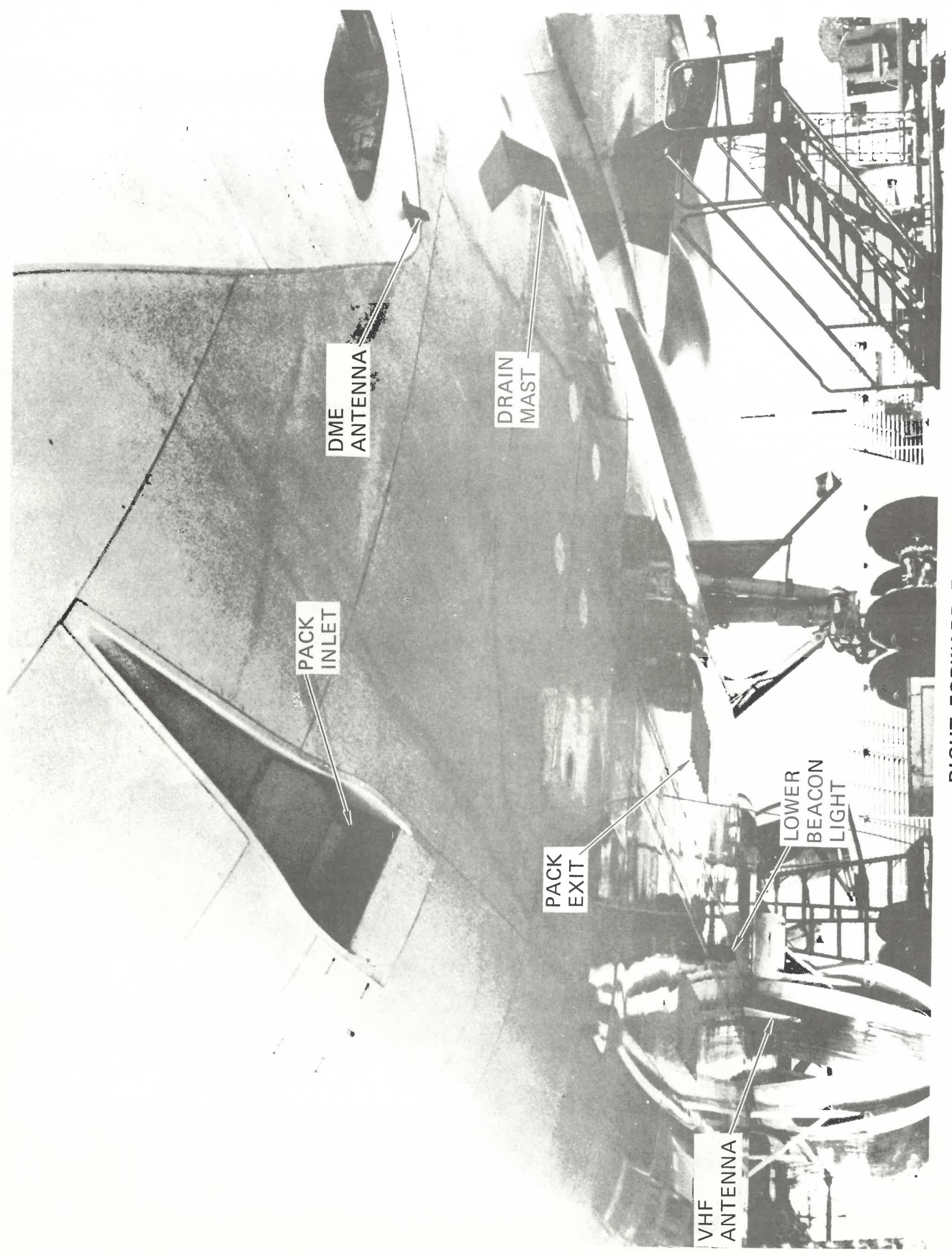


T.A.T. PROBE

PITOT-STATIC
PROBES

ANGLE OF
AIRFLOW SENSOR

LEFT FORWARD FUSELAGE

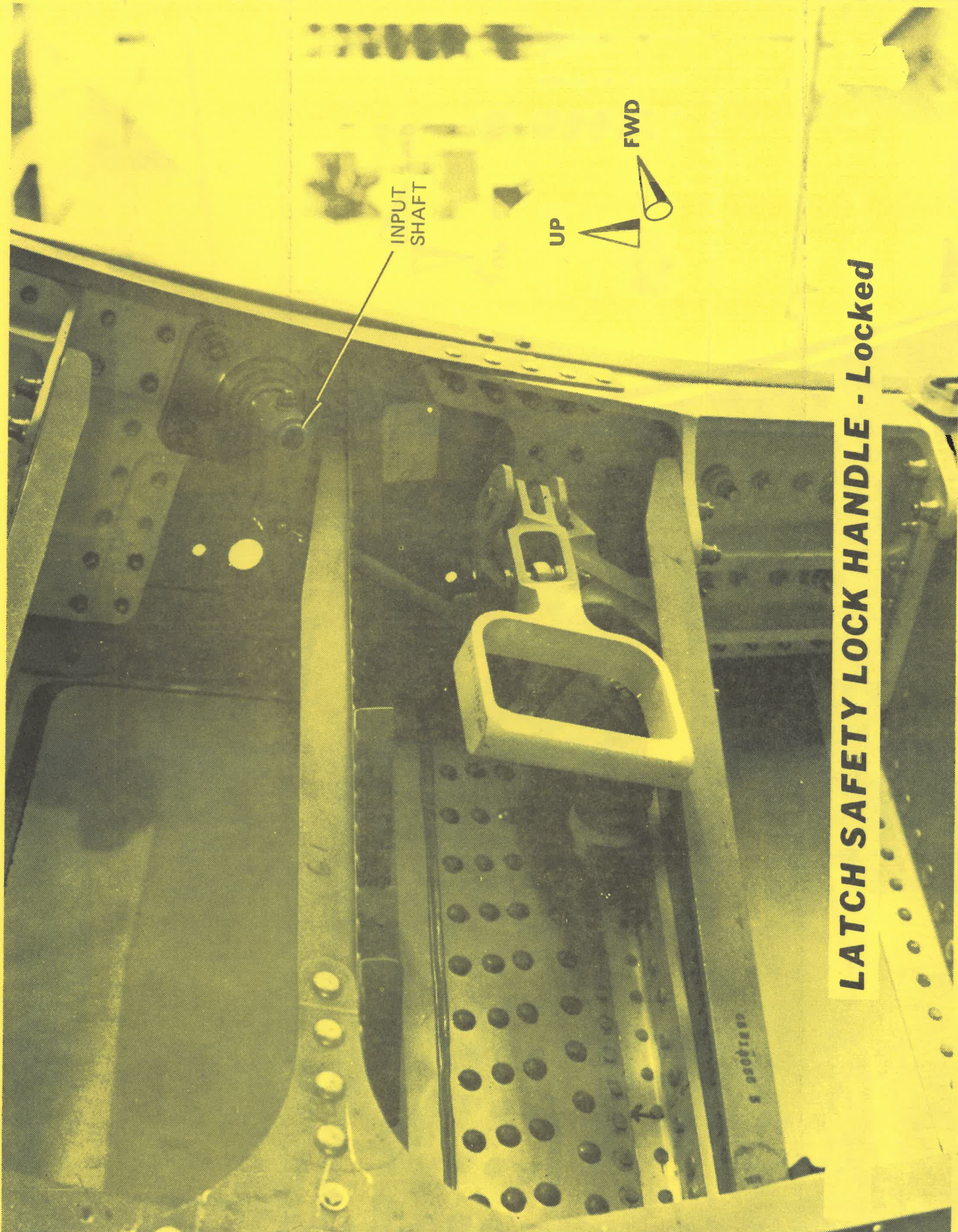


RIGHT FORWARD FUSELAGE

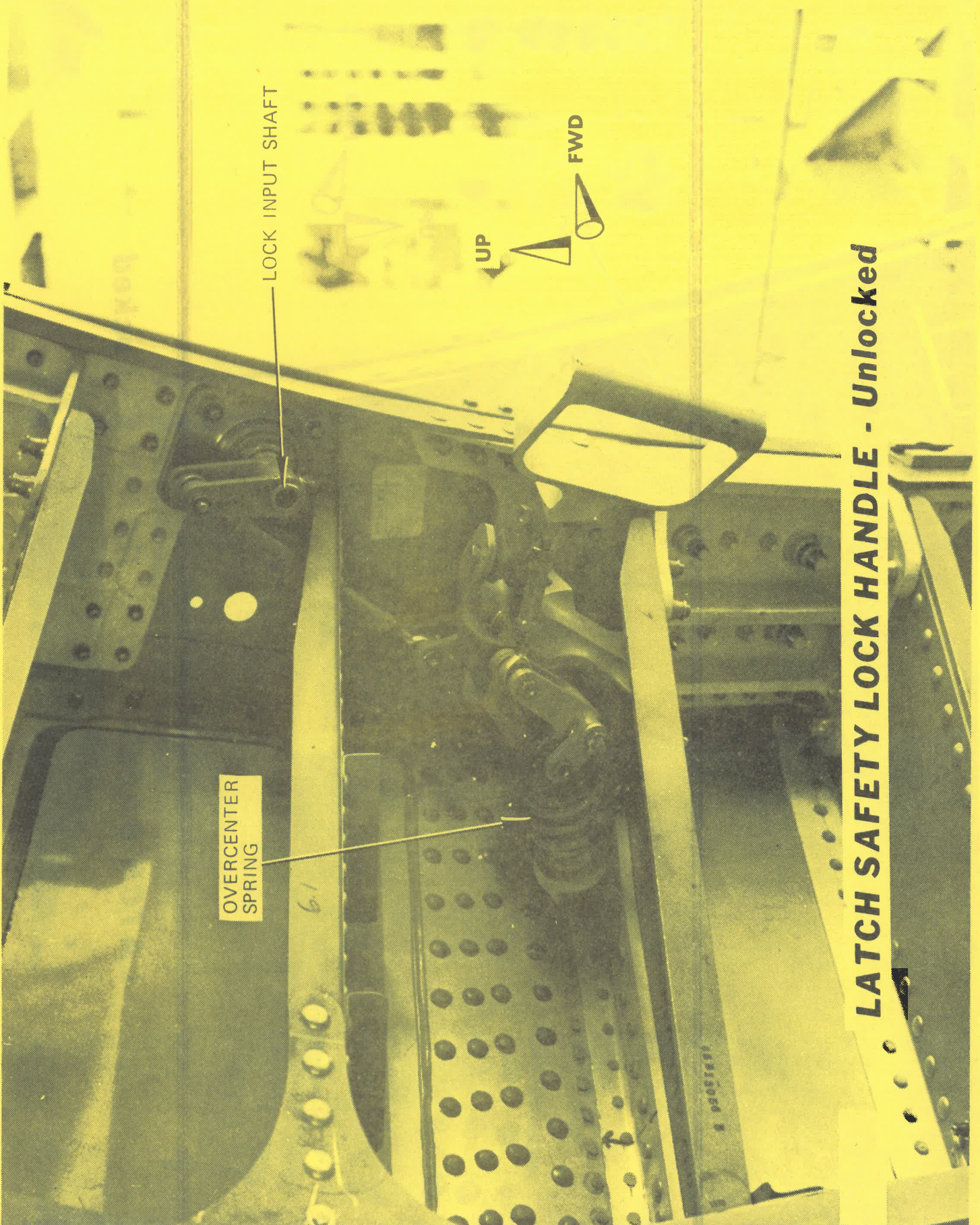
RETRORF



FREIGHTER
13:03F



LATCH SAFETY LOCK HANDLE - Locked



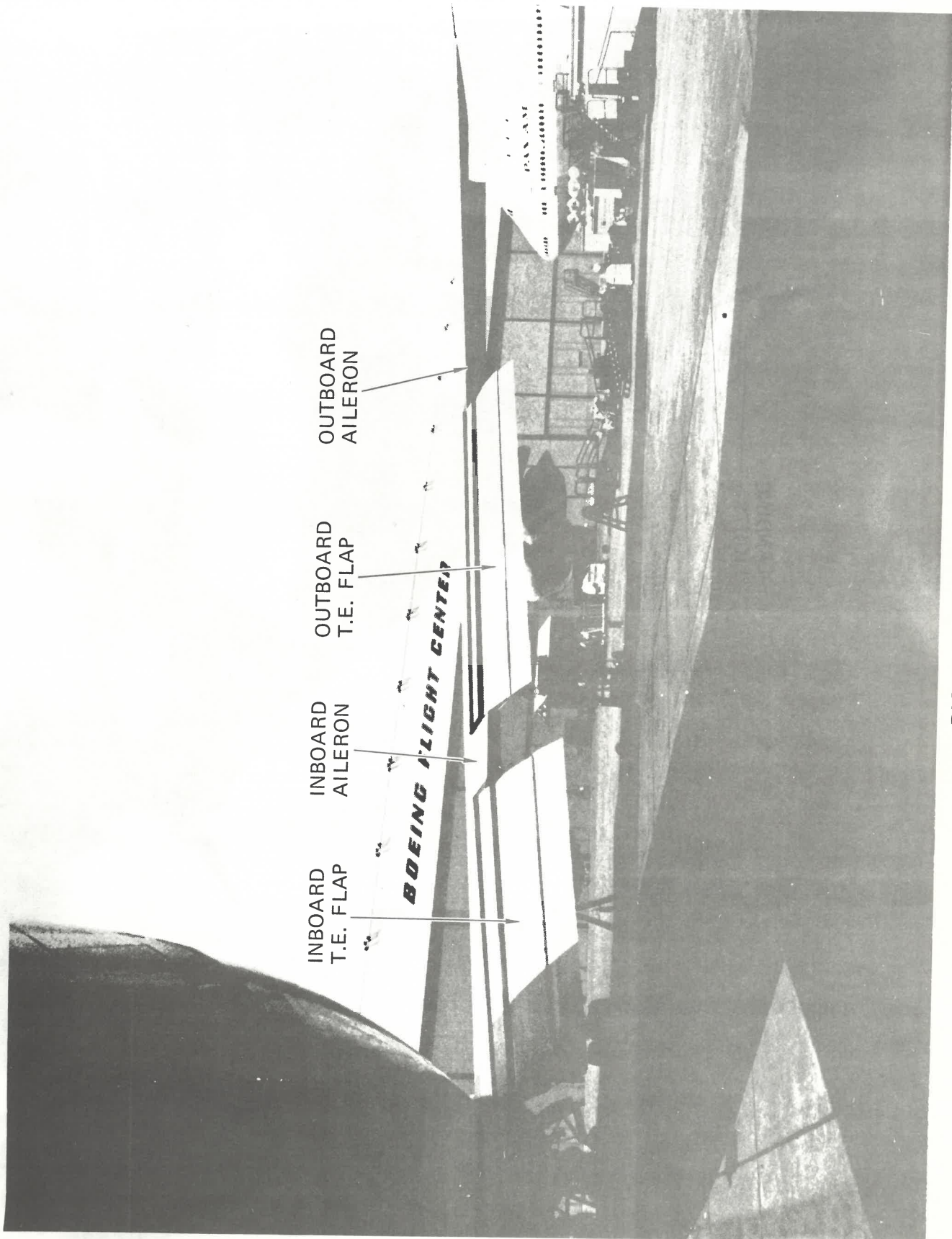
LOCK INPUT SHAFT

OVERCENTER SPRING

UP

FWD

LATCH SAFETY LOCK HANDLE - Unlocked



INBOARD
T.E. FLAP

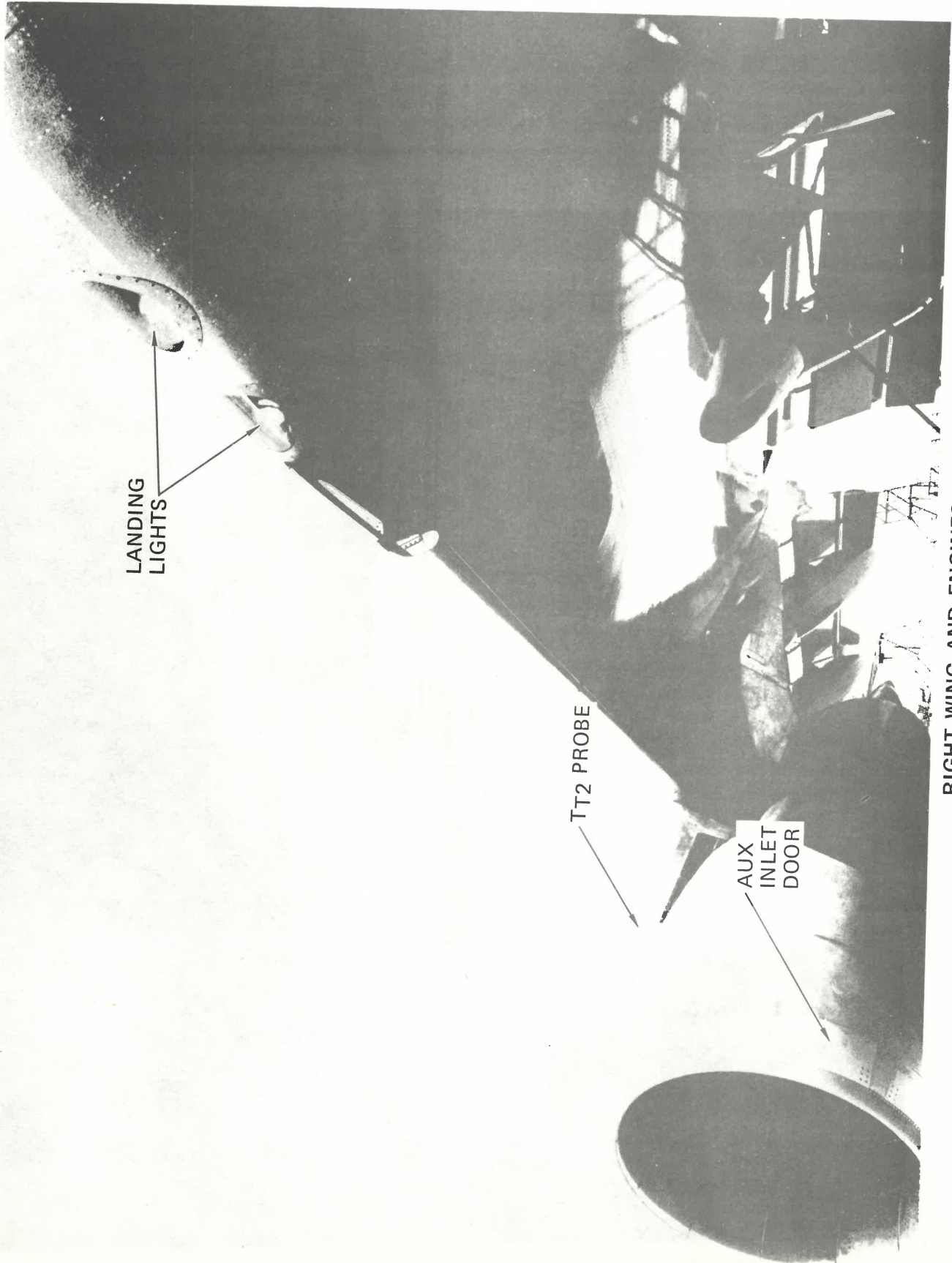
INBOARD
AILERON

OUTBOARD
T.E. FLAP

OUTBOARD
AILERON

BOEING FLIGHT CENTER

RIGHT WING AREA

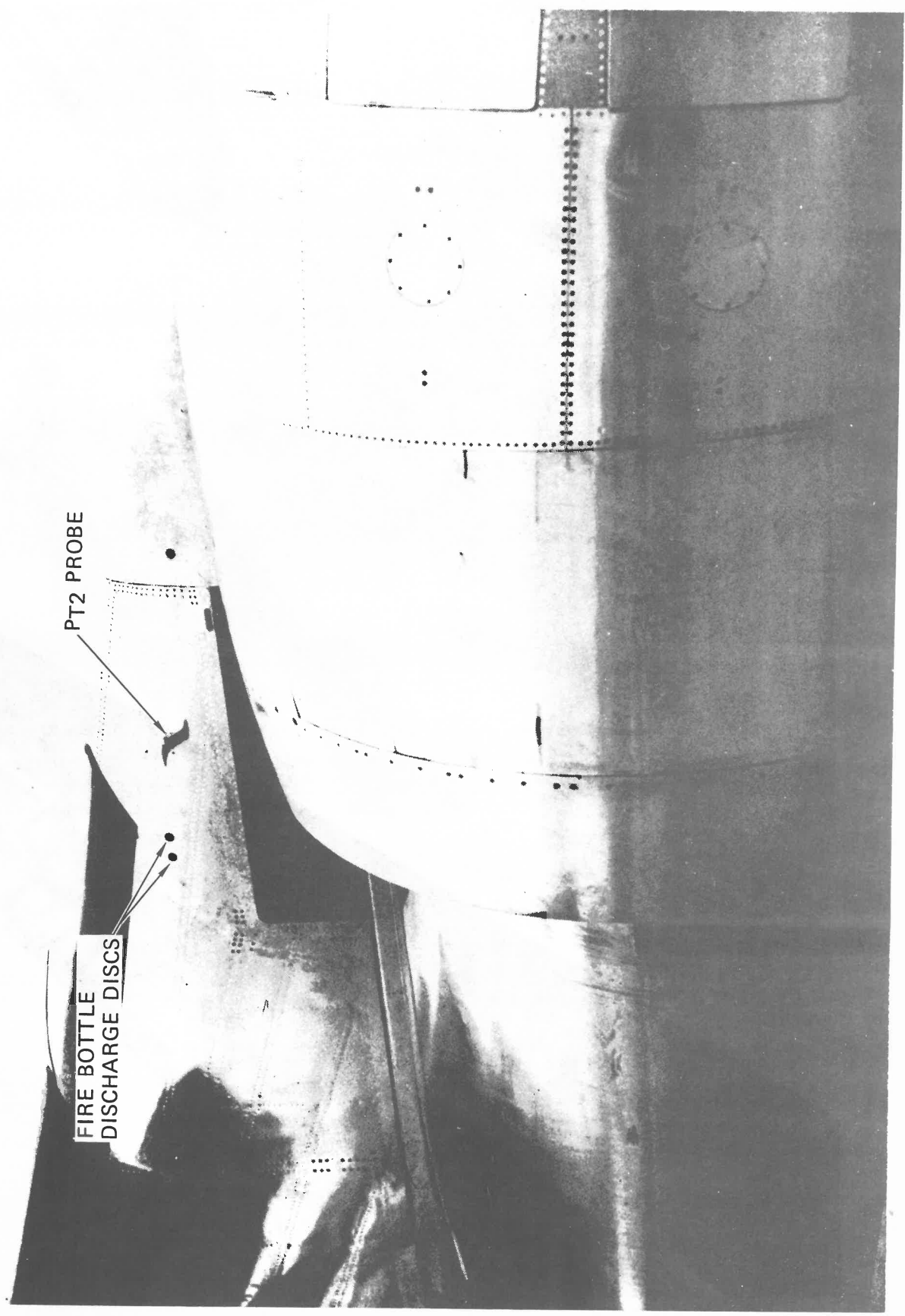


LANDING
LIGHTS

TT2 PROBE

AUX
INLET
DOOR

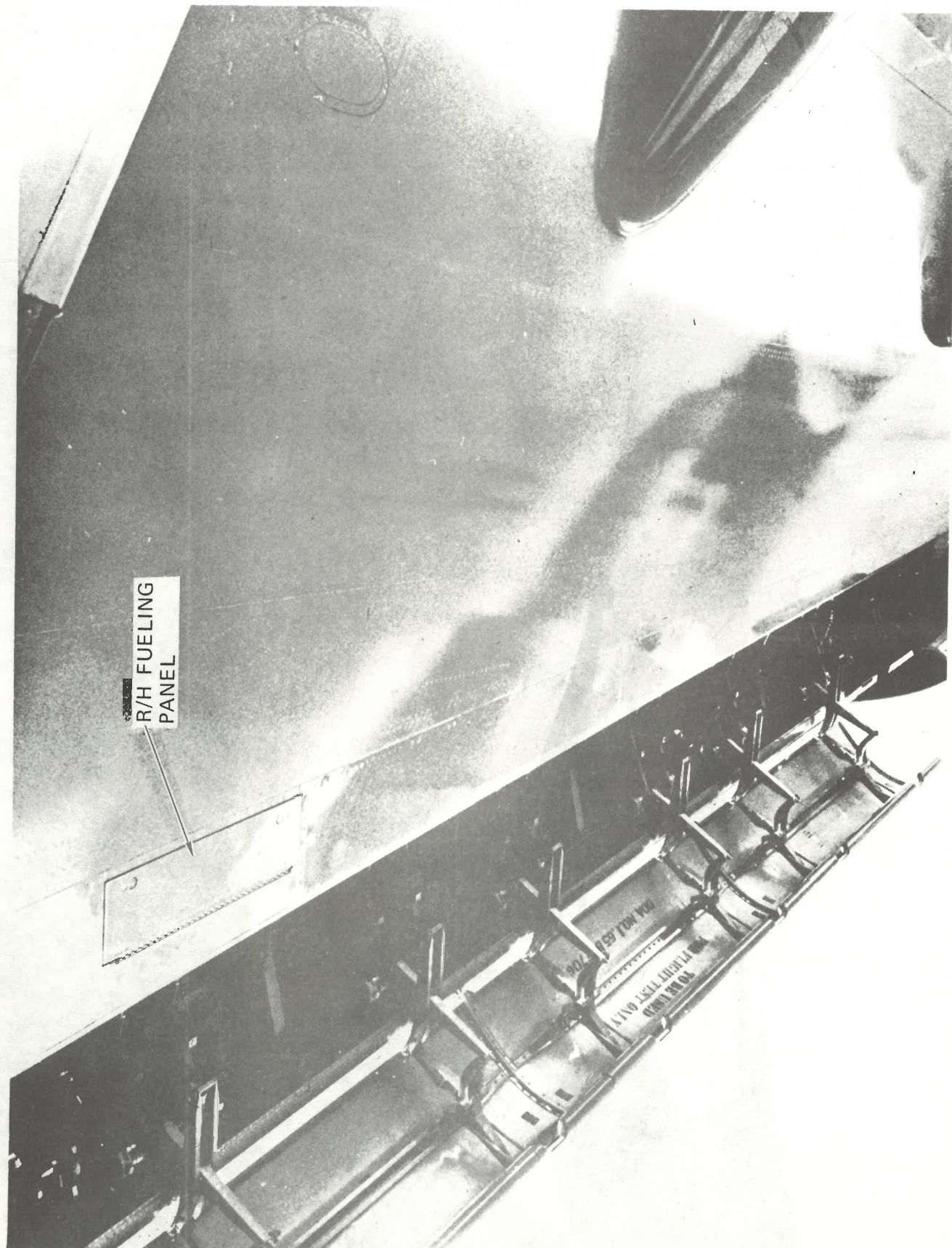
RIGHT WING AND ENGINES



PT2 PROBE

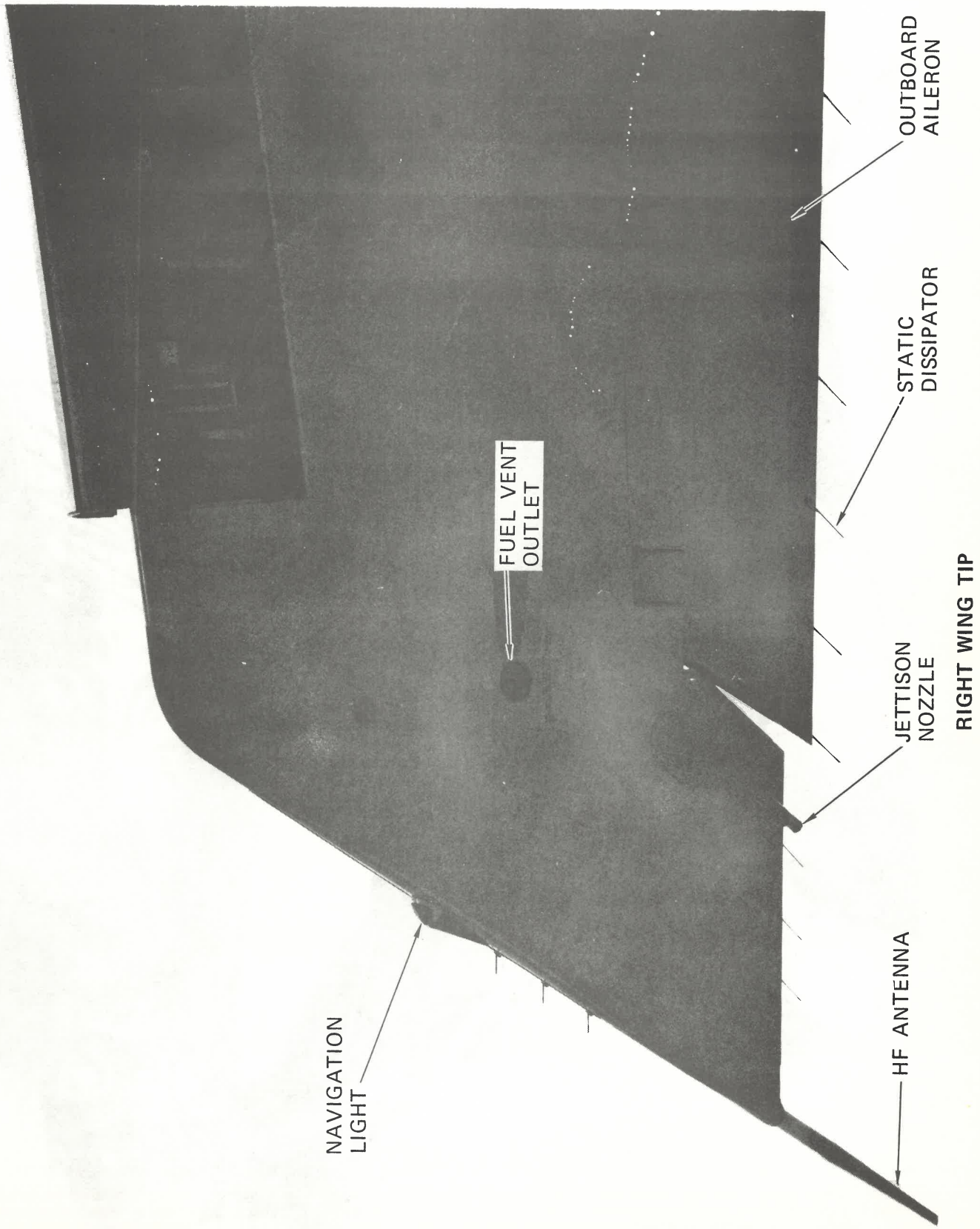
FIRE BOTTLE
DISCHARGE DISCS

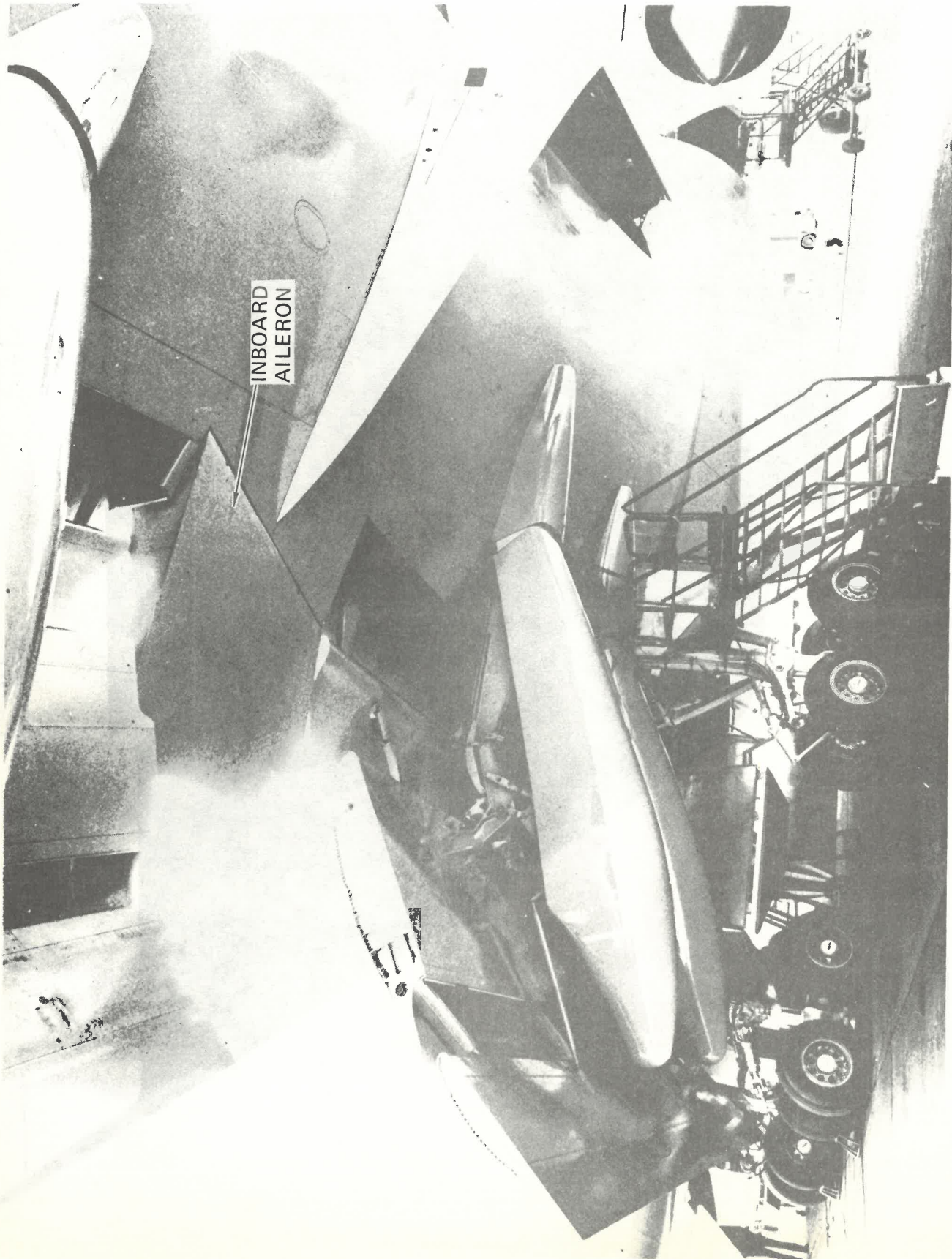
ENGINE - RIGHT SIDE



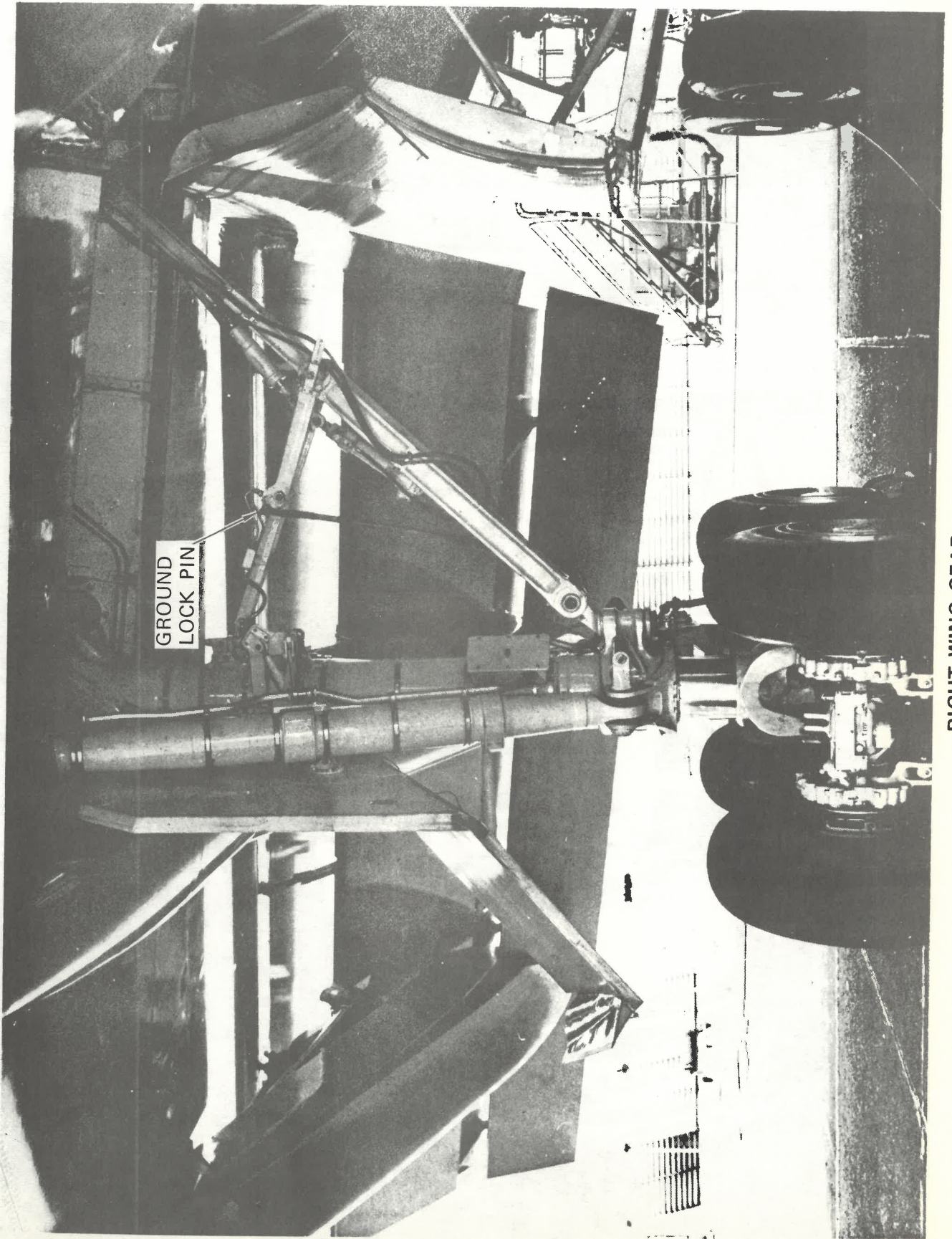
R/H FUELING
PANEL

UNDERSURFACE - RIGHT WING



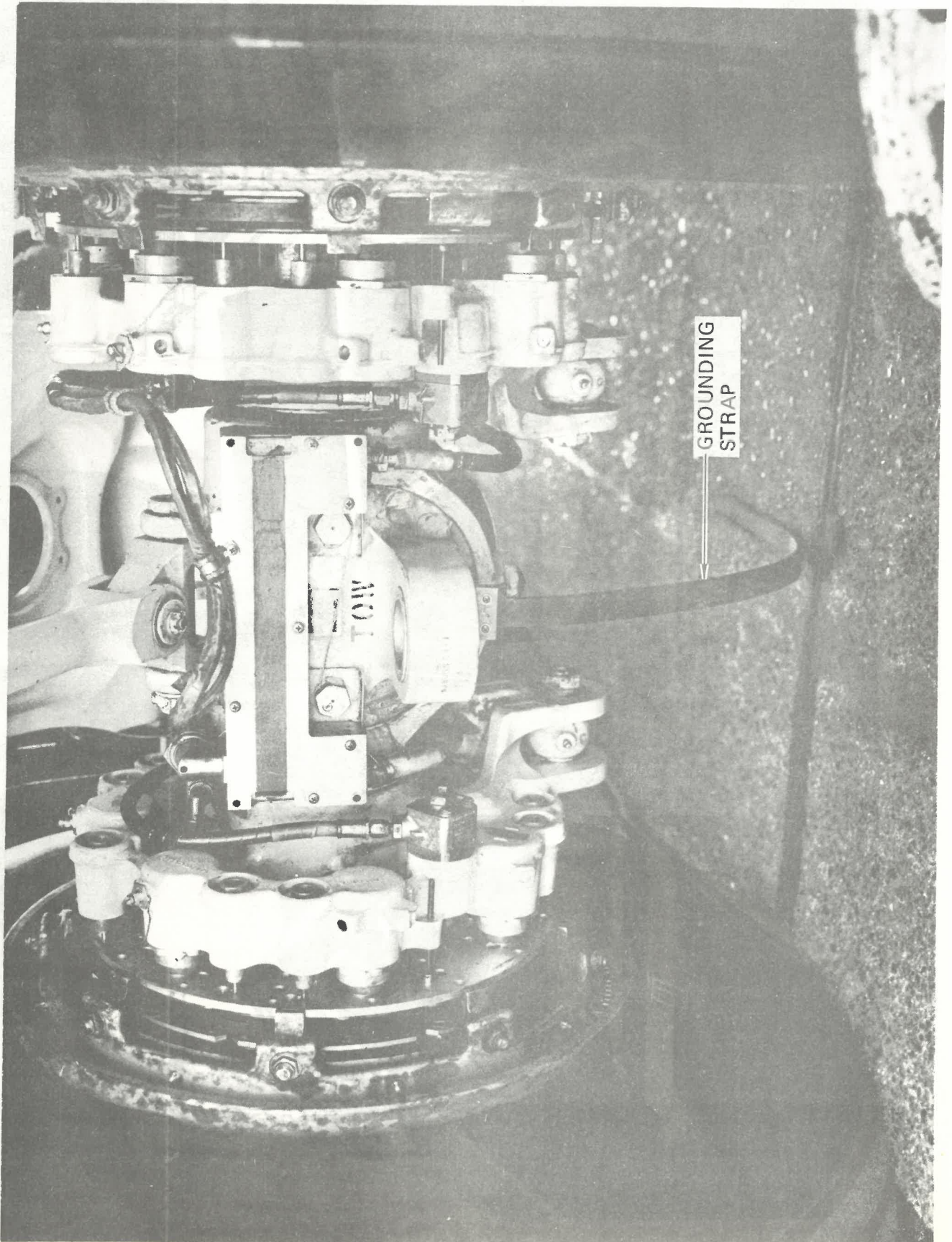


RIGHT WING TRAILING EDGE



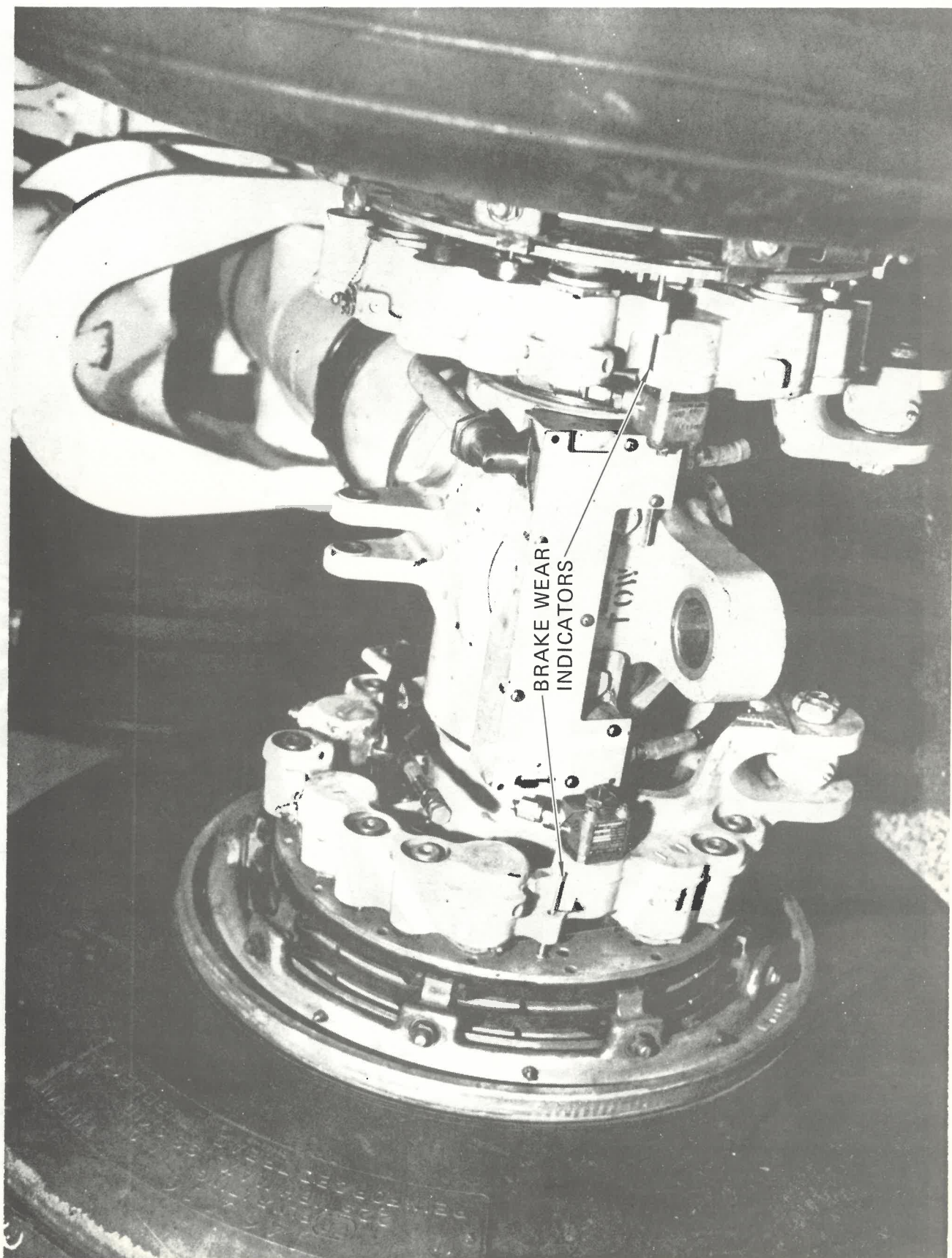
GROUND
LOCK PIN

RIGHT WING GEAR

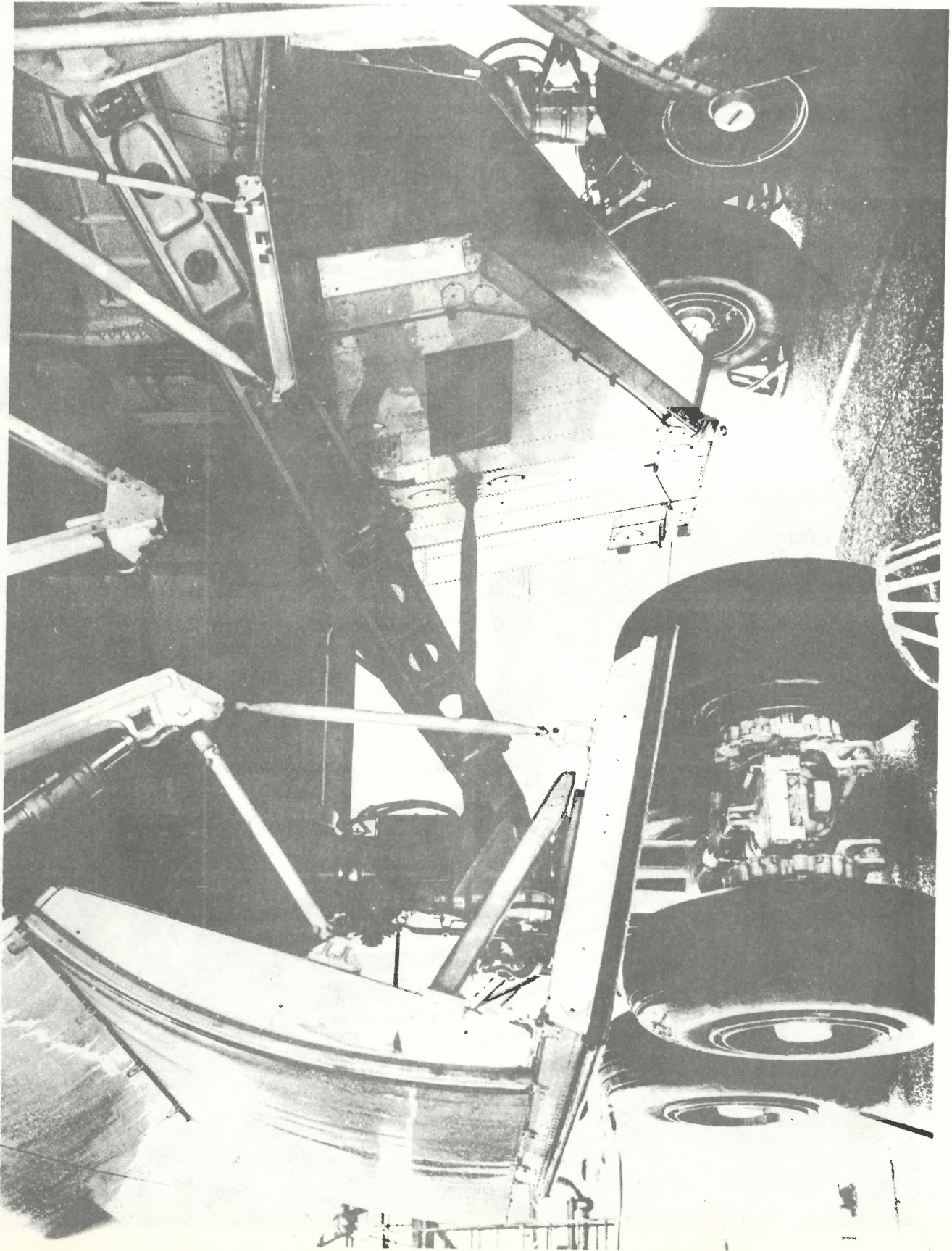


GROUNDING
STRAP

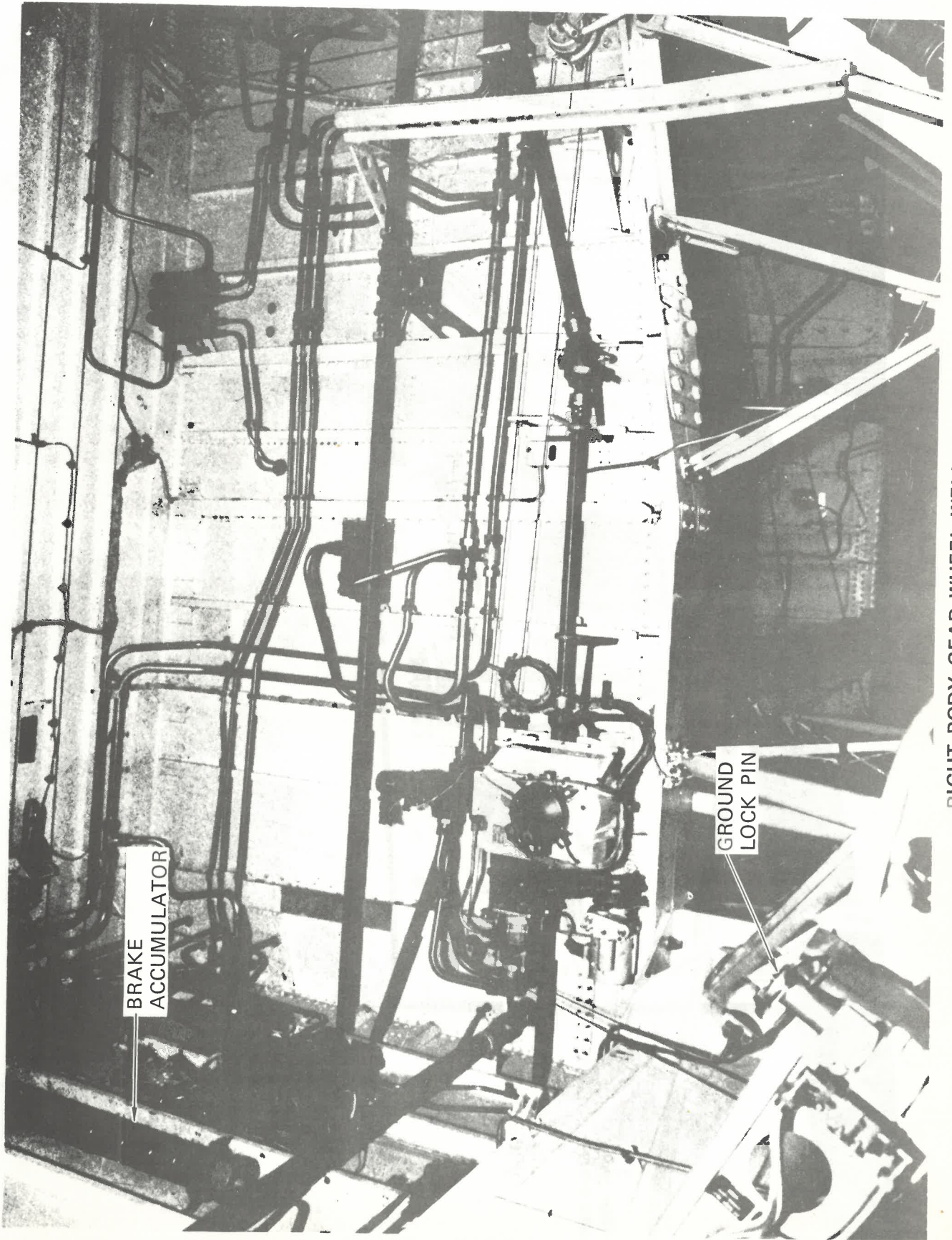
MAIN GEAR



MAIN GEAR BRAKES



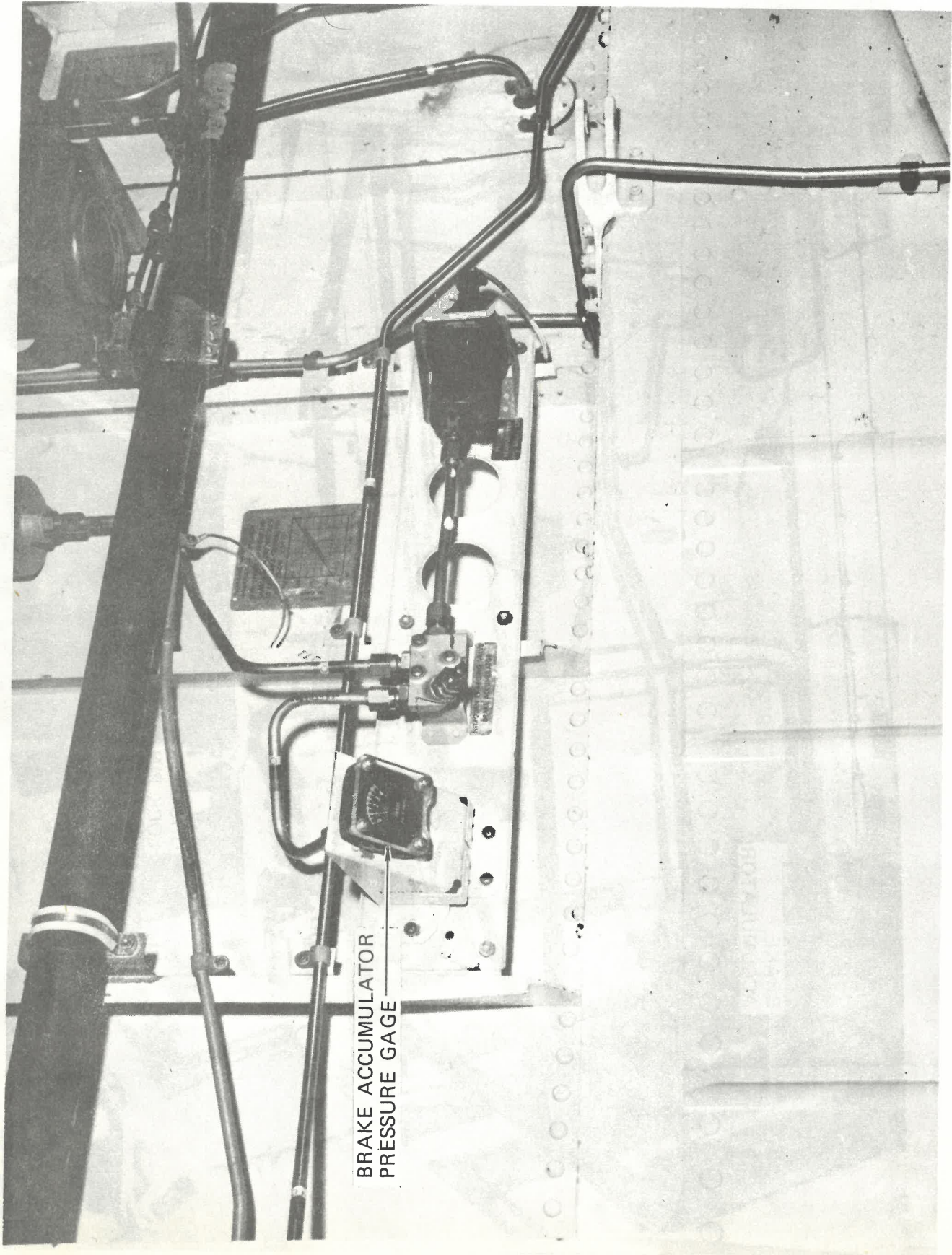
RIGHT BODY GEAR



BRAKE
ACCUMULATOR

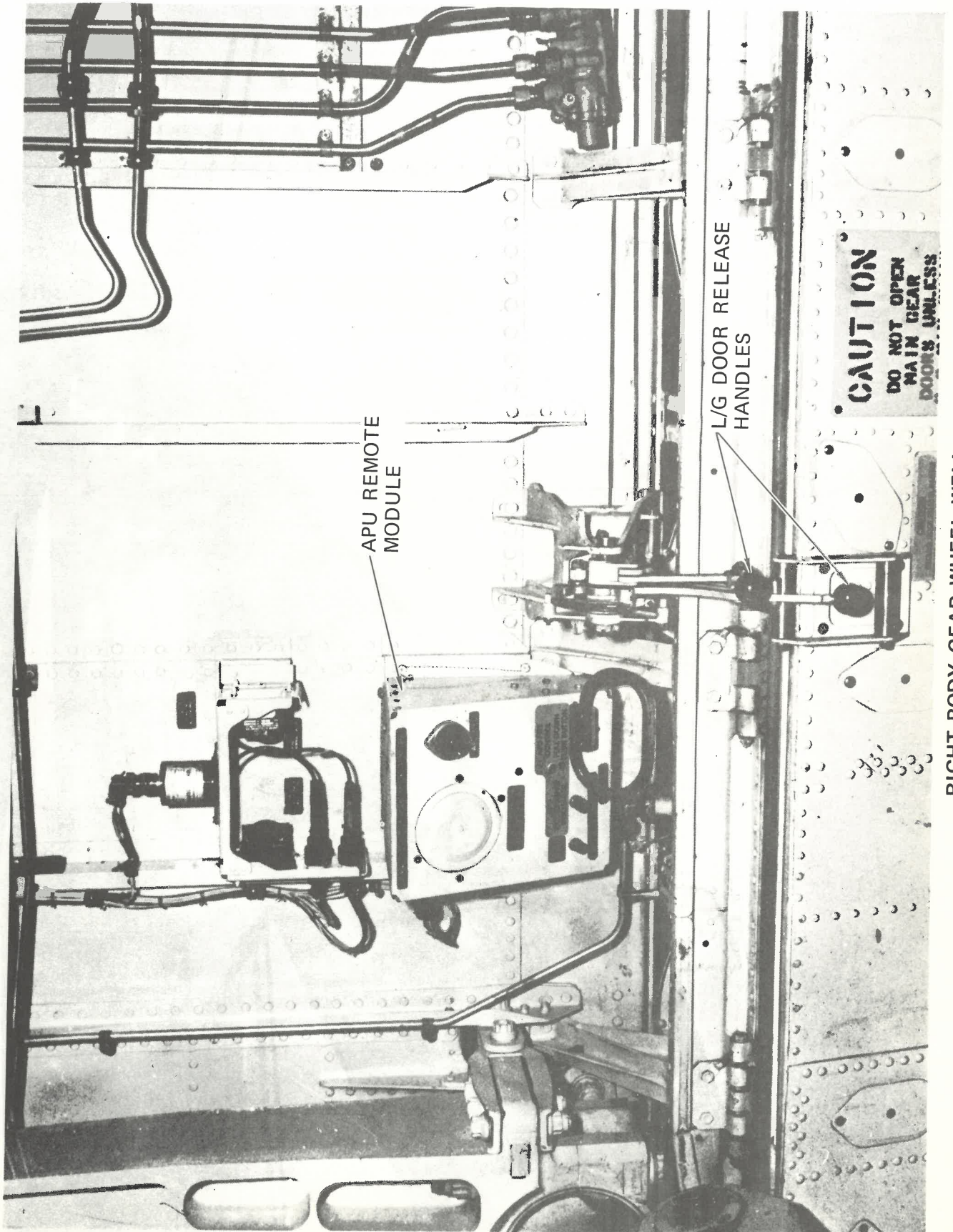
GROUND
LOCK PIN

RIGHT BODY GEAR WHEEL WELL



BRAKE ACCUMULATOR
PRESSURE GAGE

RIGHT BODY GEAR WHEEL WELL

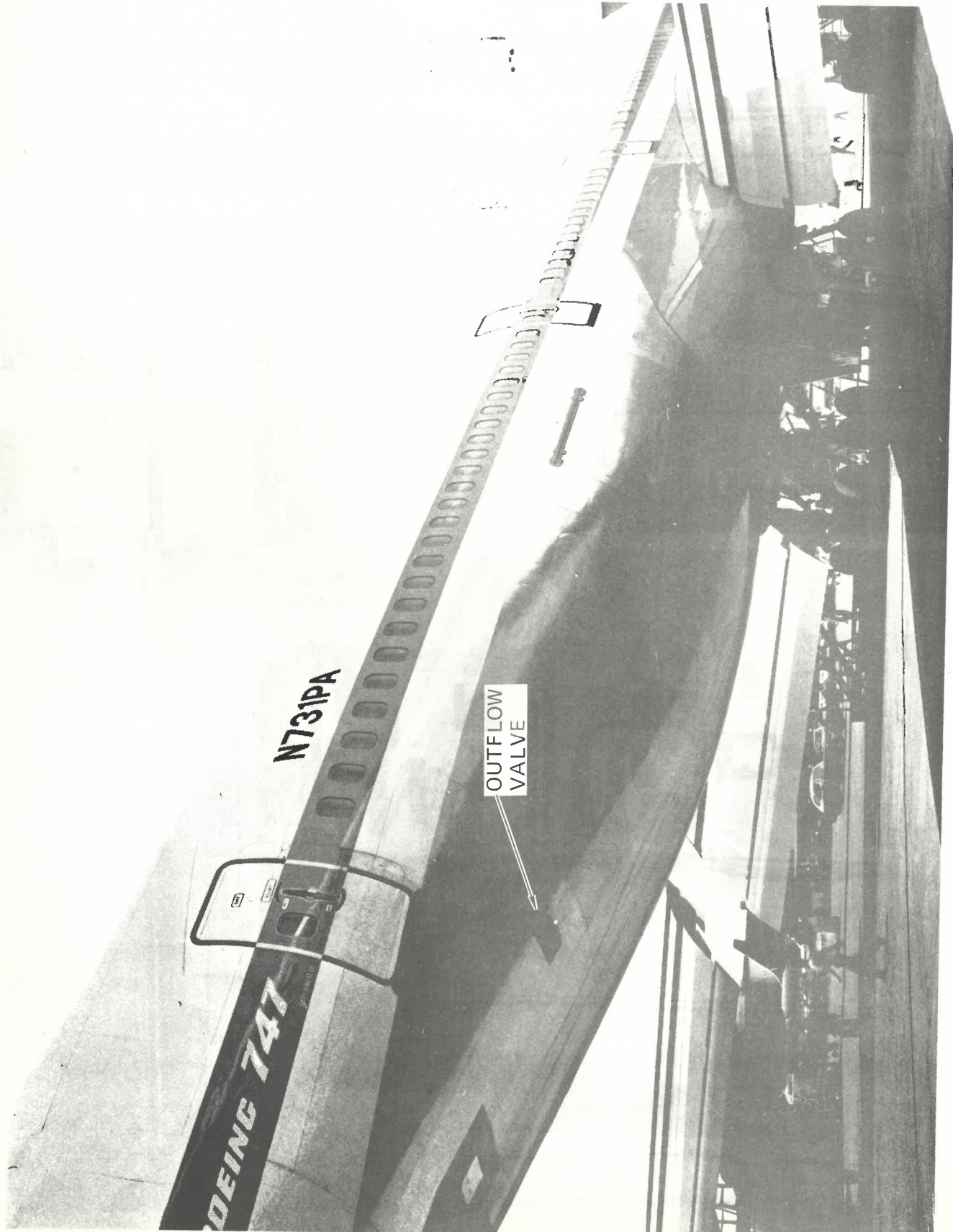


APU REMOTE
MODULE

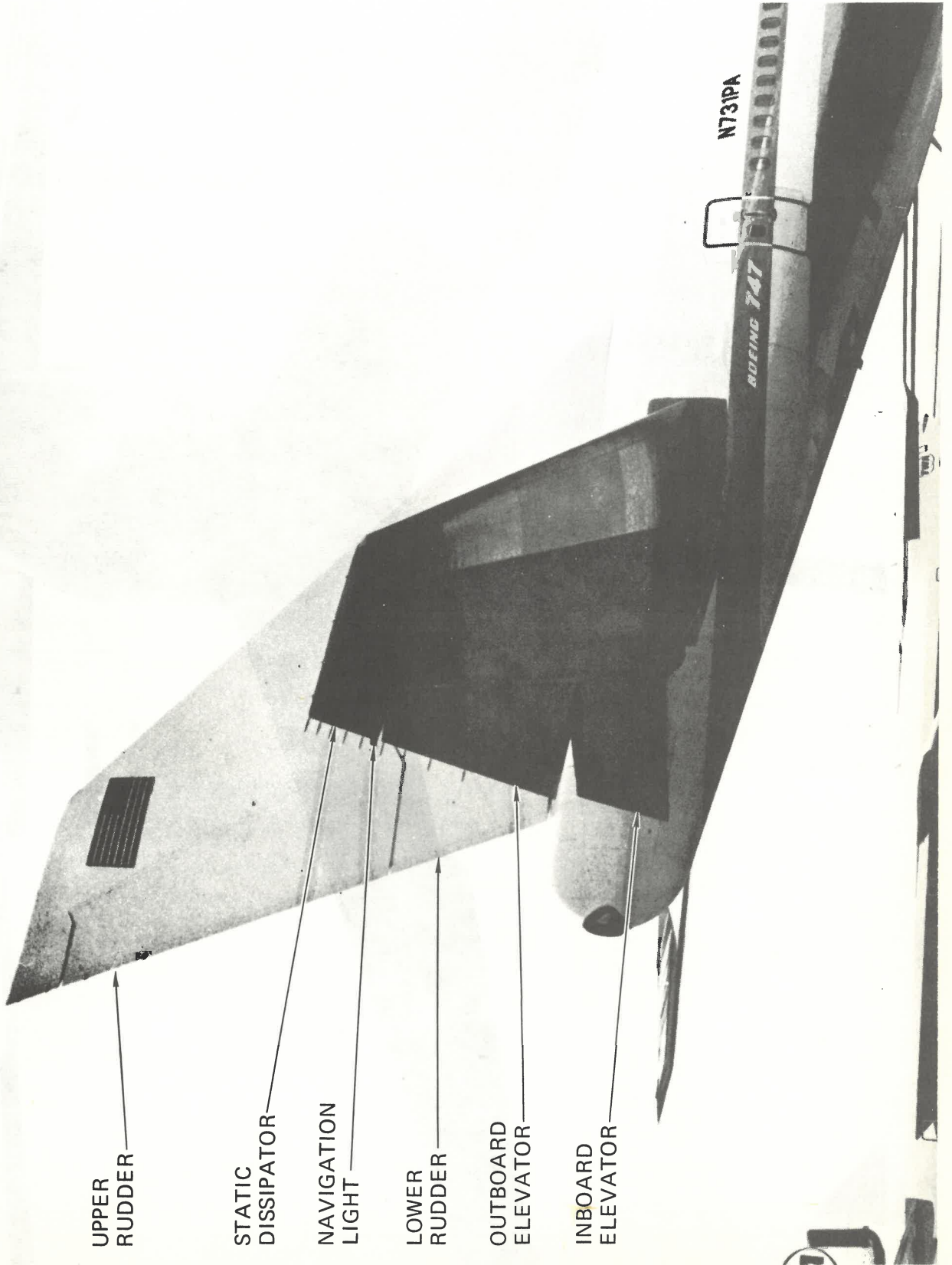
L/G DOOR RELEASE
HANDLES

CAUTION
DO NOT OPEN
MAIN GEAR
DOORS UNLESS

RIGHT BODY GEAR WHEEL WELL



RIGHT AFT FUSELAGE



UPPER
RUDDER

STATIC
DISSIPATOR

NAVIGATION
LIGHT

LOWER
RUDDER

OUTBOARD
ELEVATOR

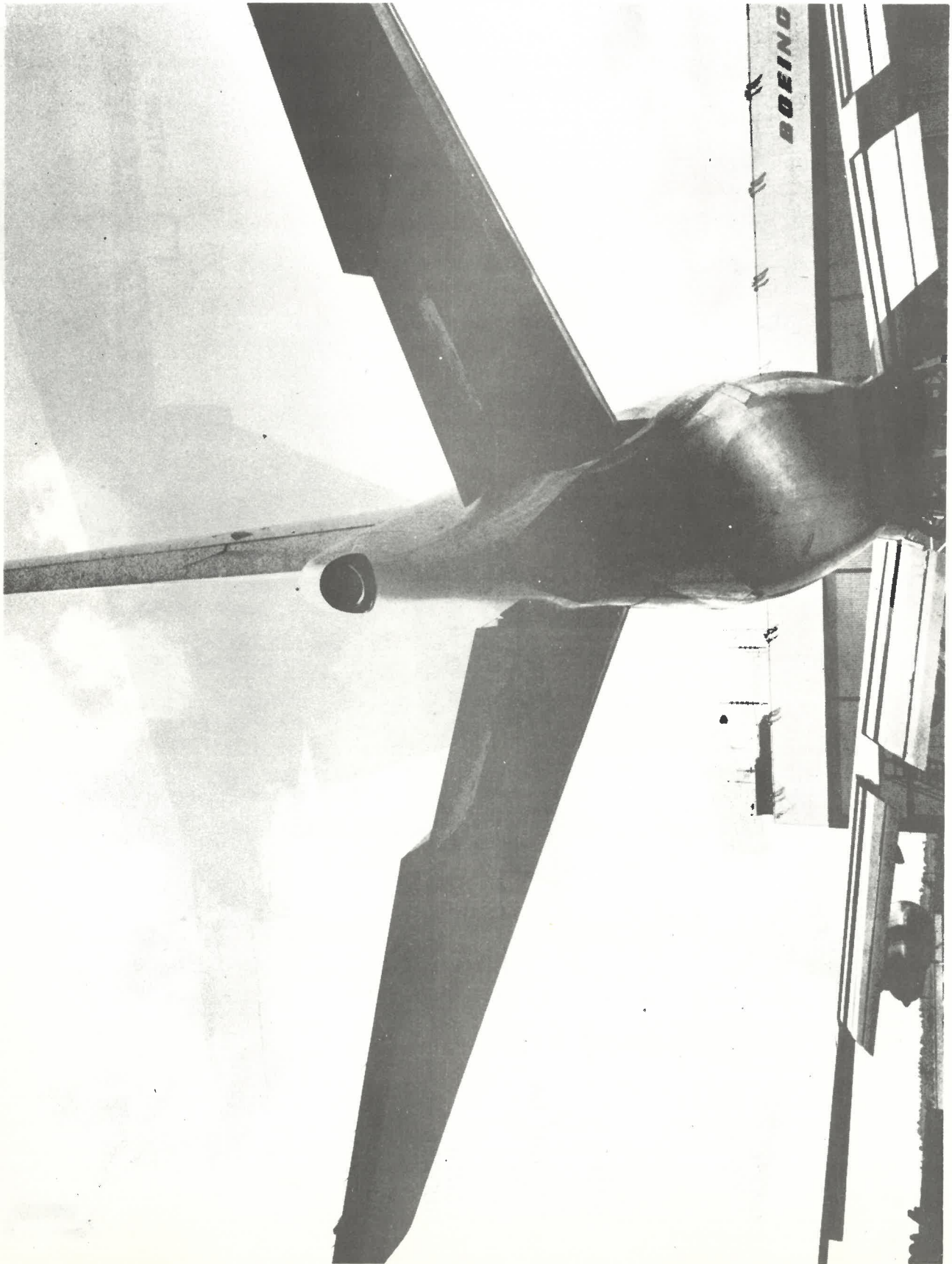
INBOARD
ELEVATOR

EMPENNAGE

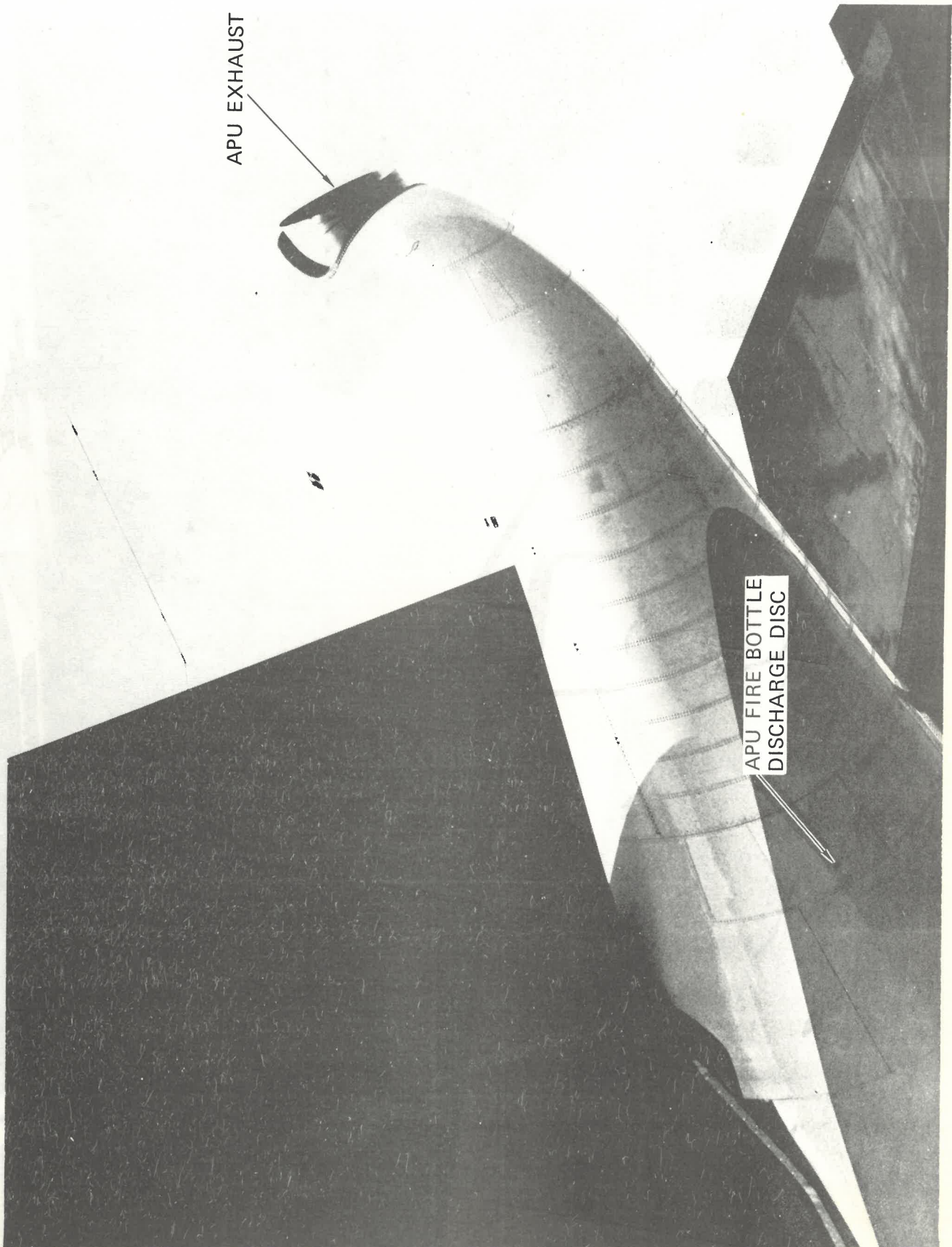
NORTHWEST ORIENT
BOEING 747



Pre-Flight
13:20



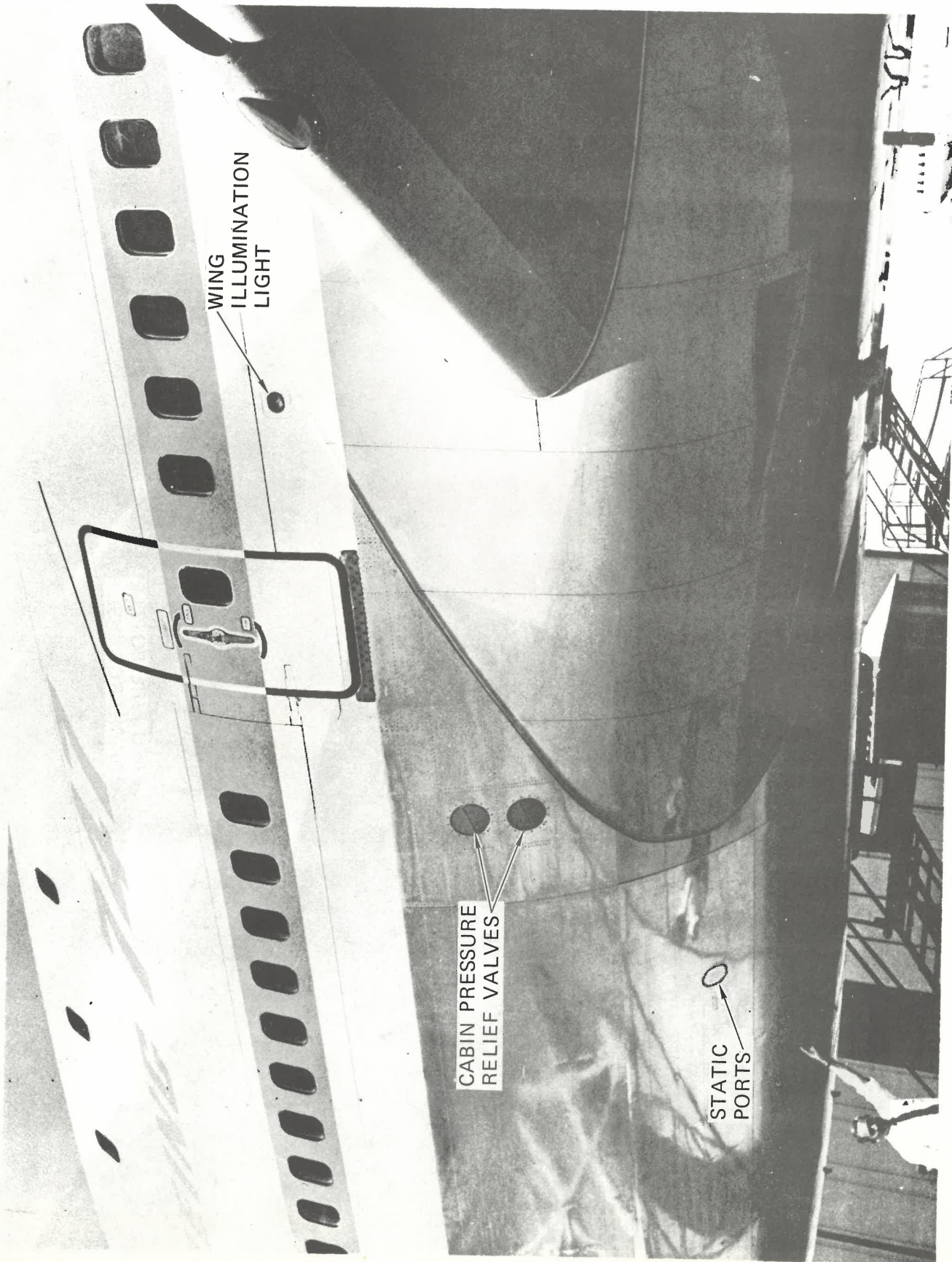
FLIGHT CONTROL SURFACES



APU EXHAUST

APU FIRE BOTTLE
DISCHARGE DISC

APU AREA

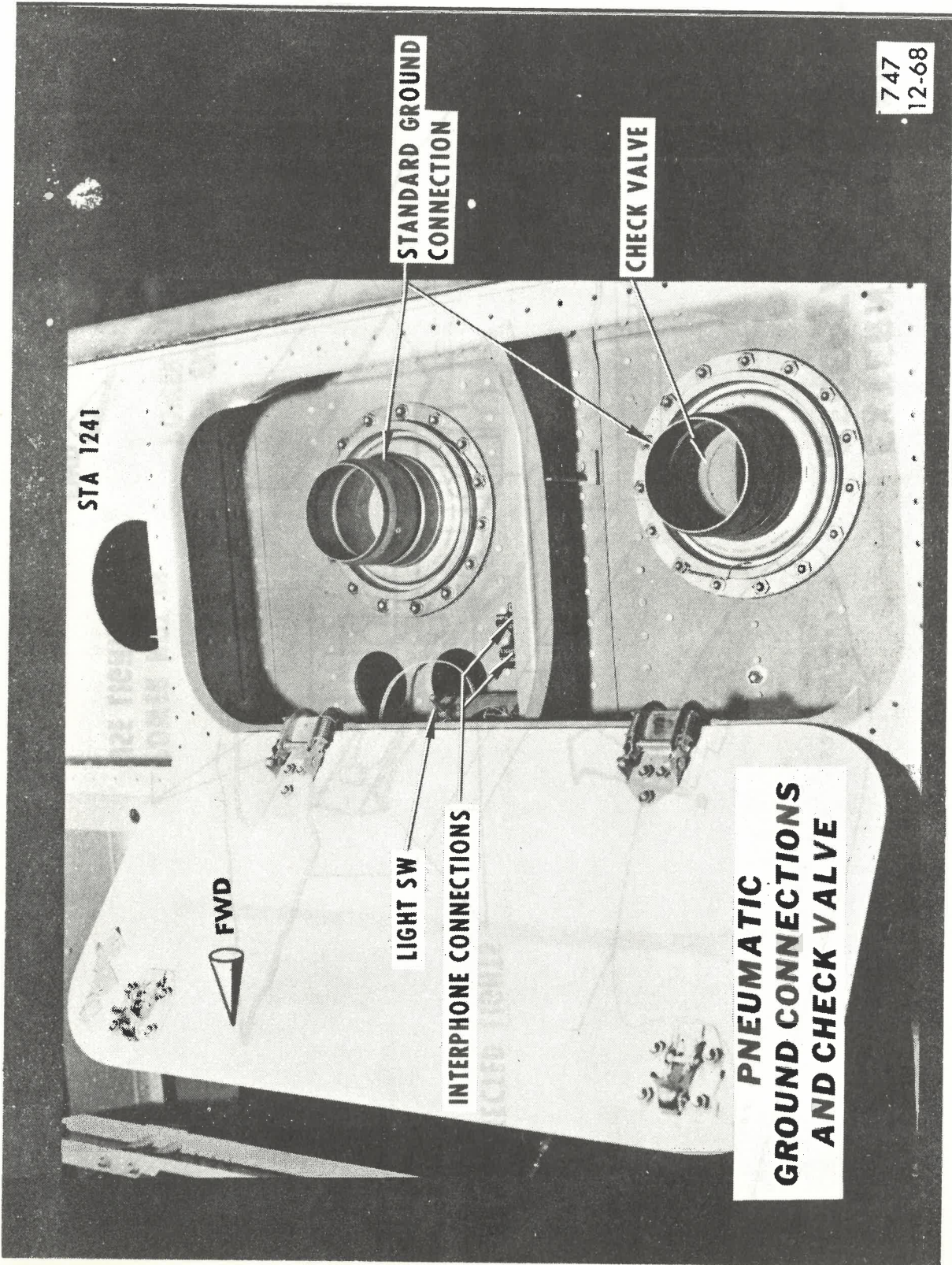


WING
ILLUMINATION
LIGHT

CABIN PRESSURE
RELIEF VALVES

STATIC
PORTS

LEFT FORWARD FUSELAGE



STANDARD GROUND CONNECTION

CHECK VALVE

LIGHT SW
INTERPHONE CONNECTIONS

PNEUMATIC GROUND CONNECTIONS AND CHECK VALVE

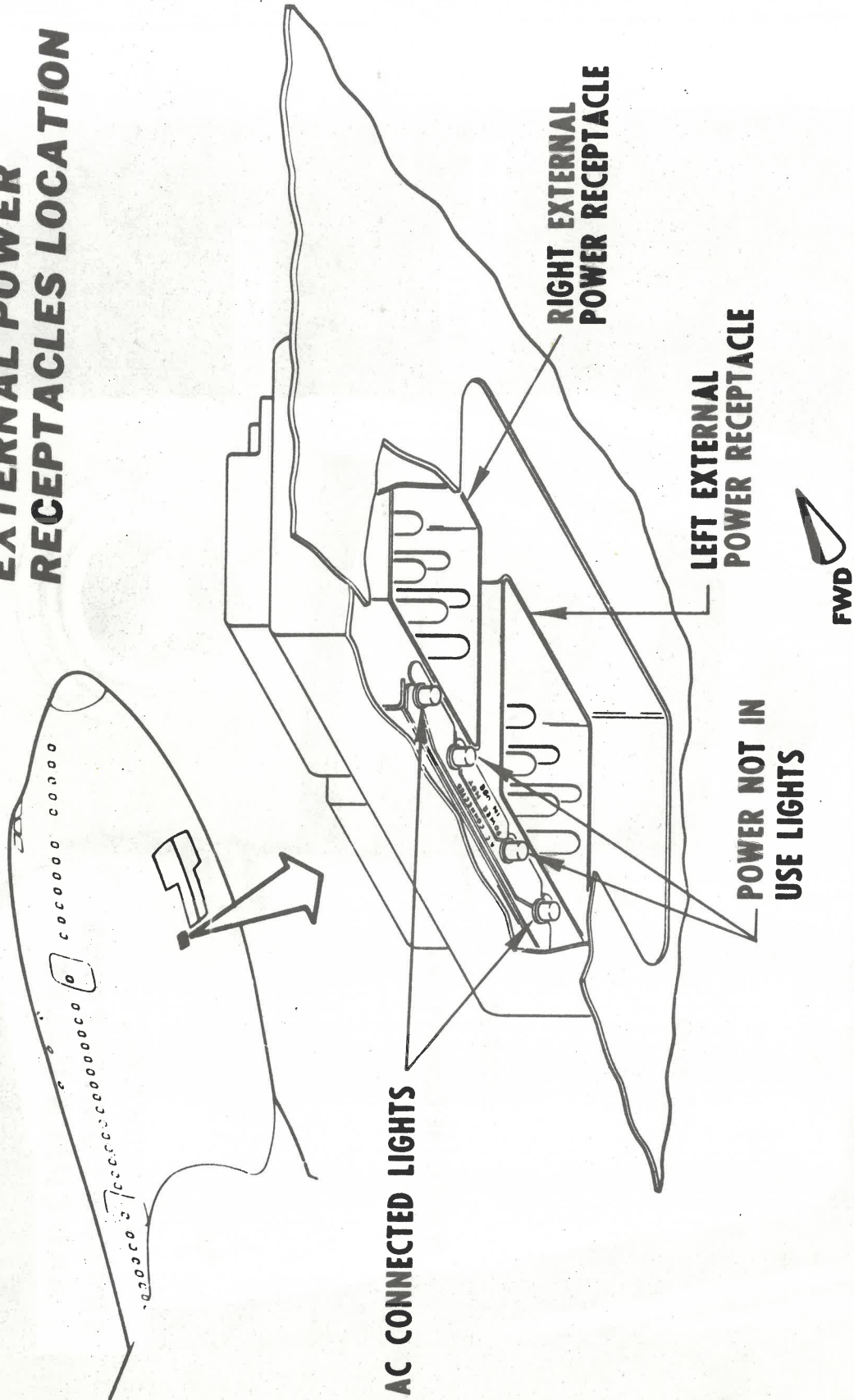
747
12-68

STA 1241

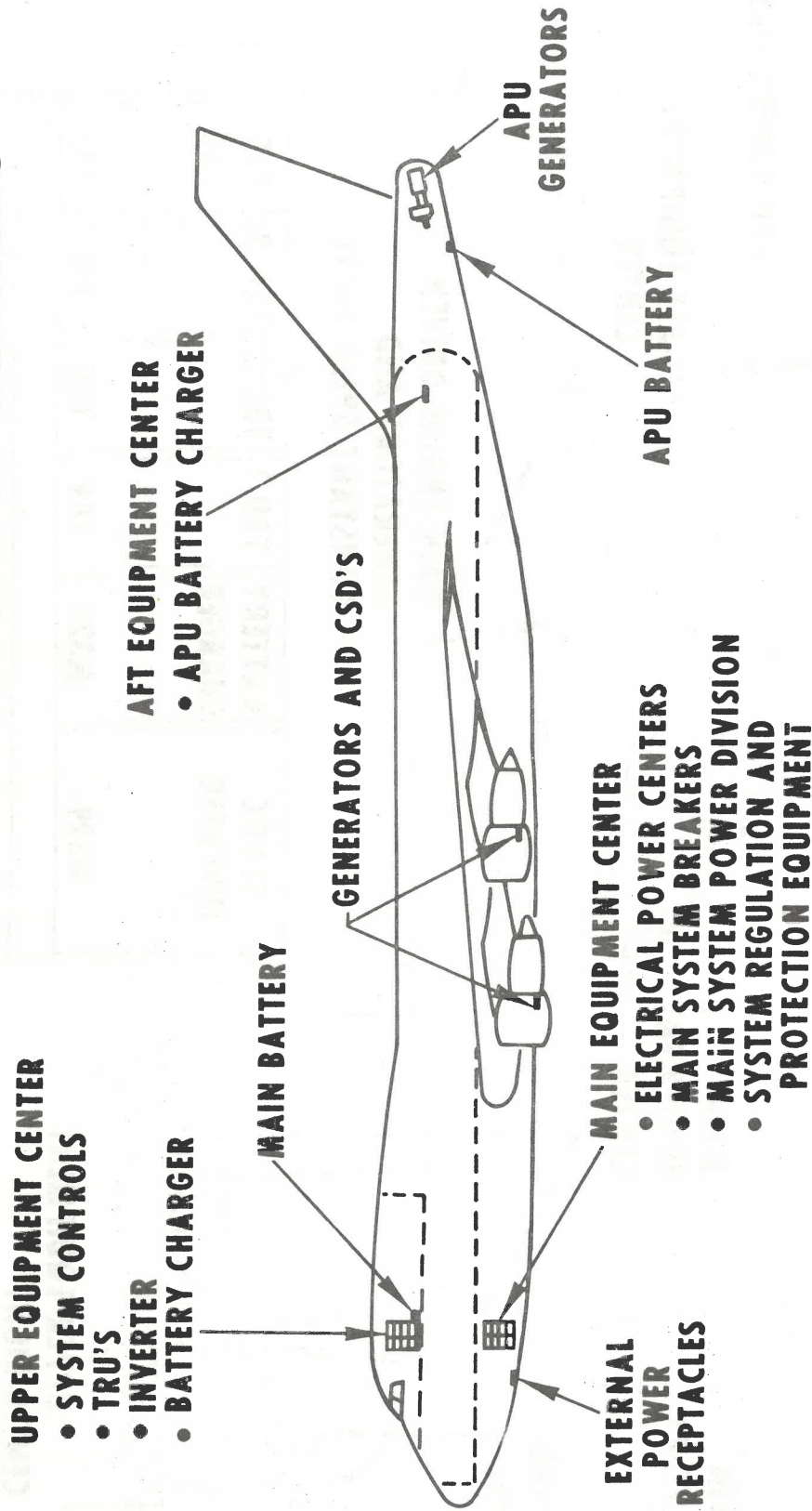
FWD



**EXTERNAL POWER
RECEPTACLES LOCATION**

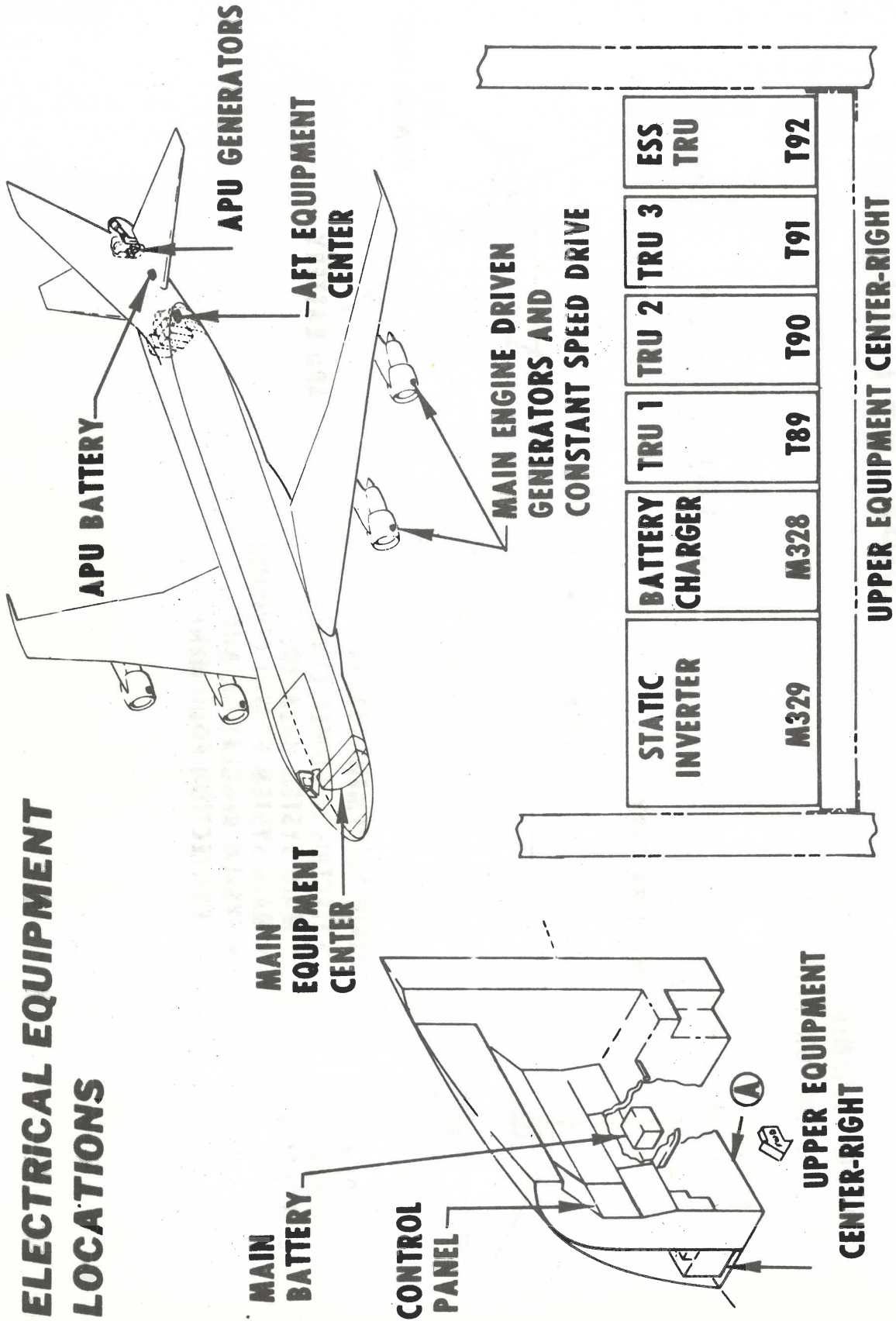


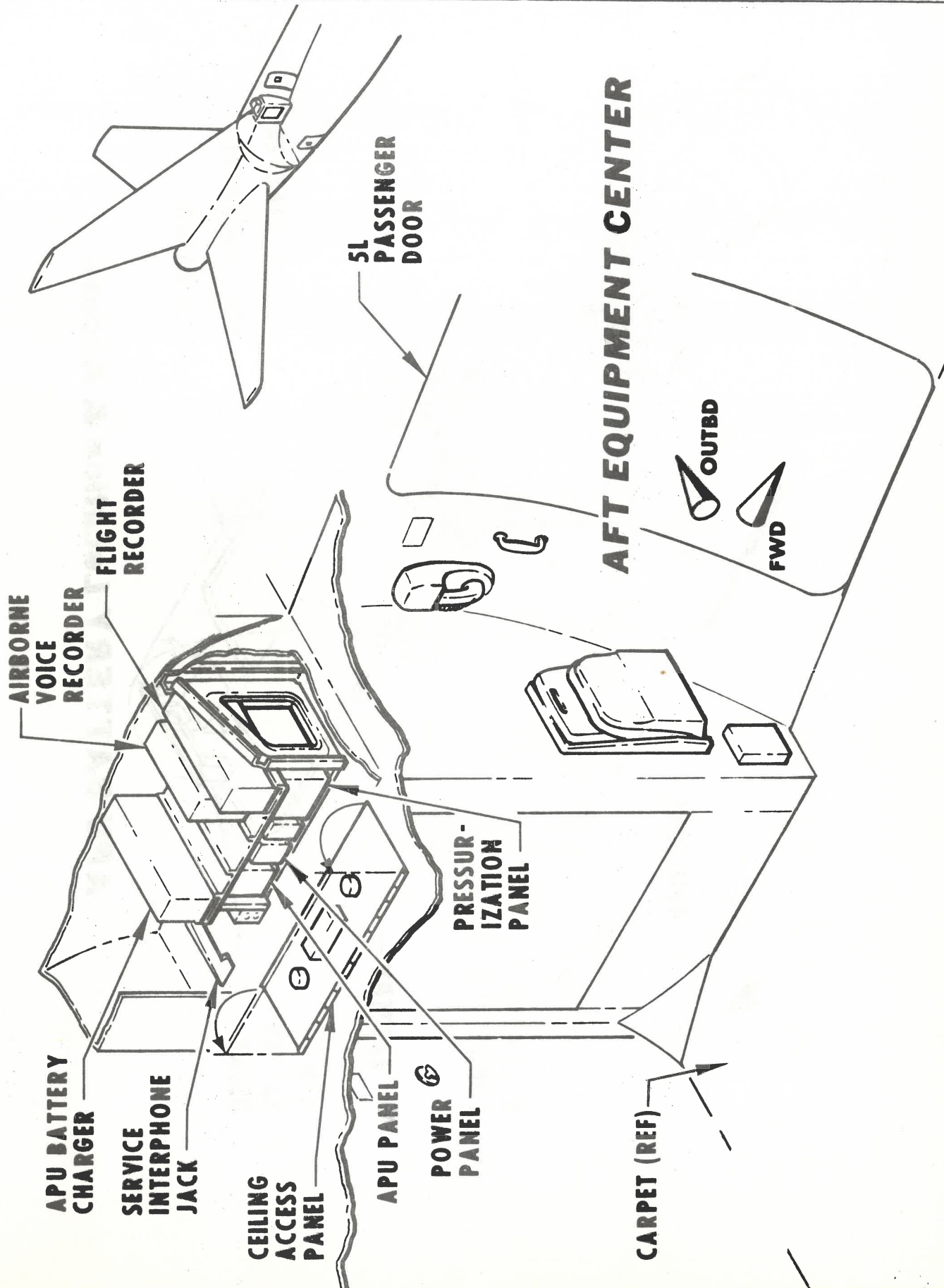
ELECTRICAL SYSTEM EQUIPMENT LOCATIONS





ELECTRICAL EQUIPMENT LOCATIONS





5L PASSENGER DOOR

AFT EQUIPMENT CENTER

OUTBD

FWD

AIRBORNE VOICE RECORDER

FLIGHT RECORDER

APU BATTERY CHARGER

SERVICE INTERPHONE JACK

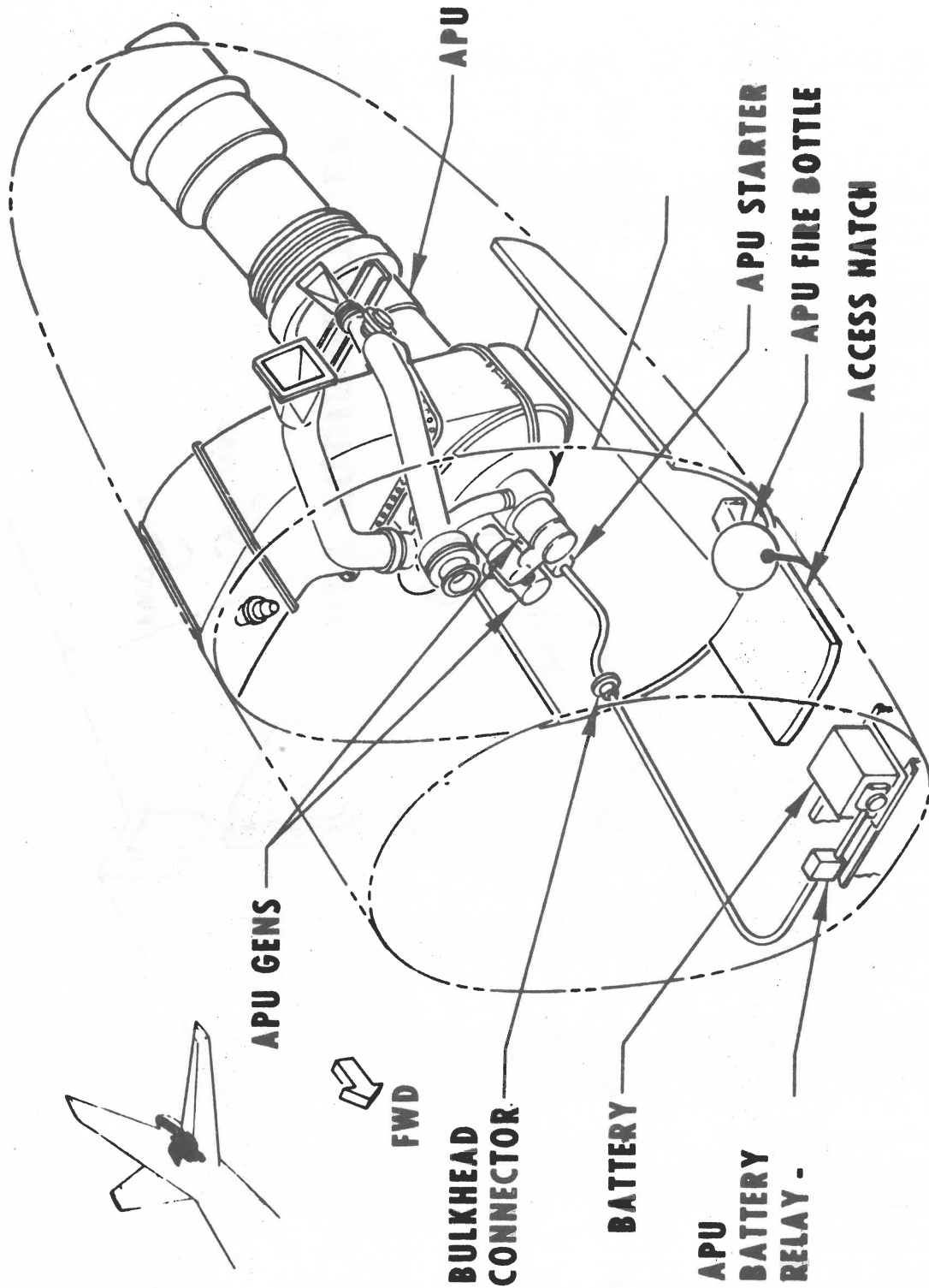
CEILING ACCESS PANEL

APU PANEL

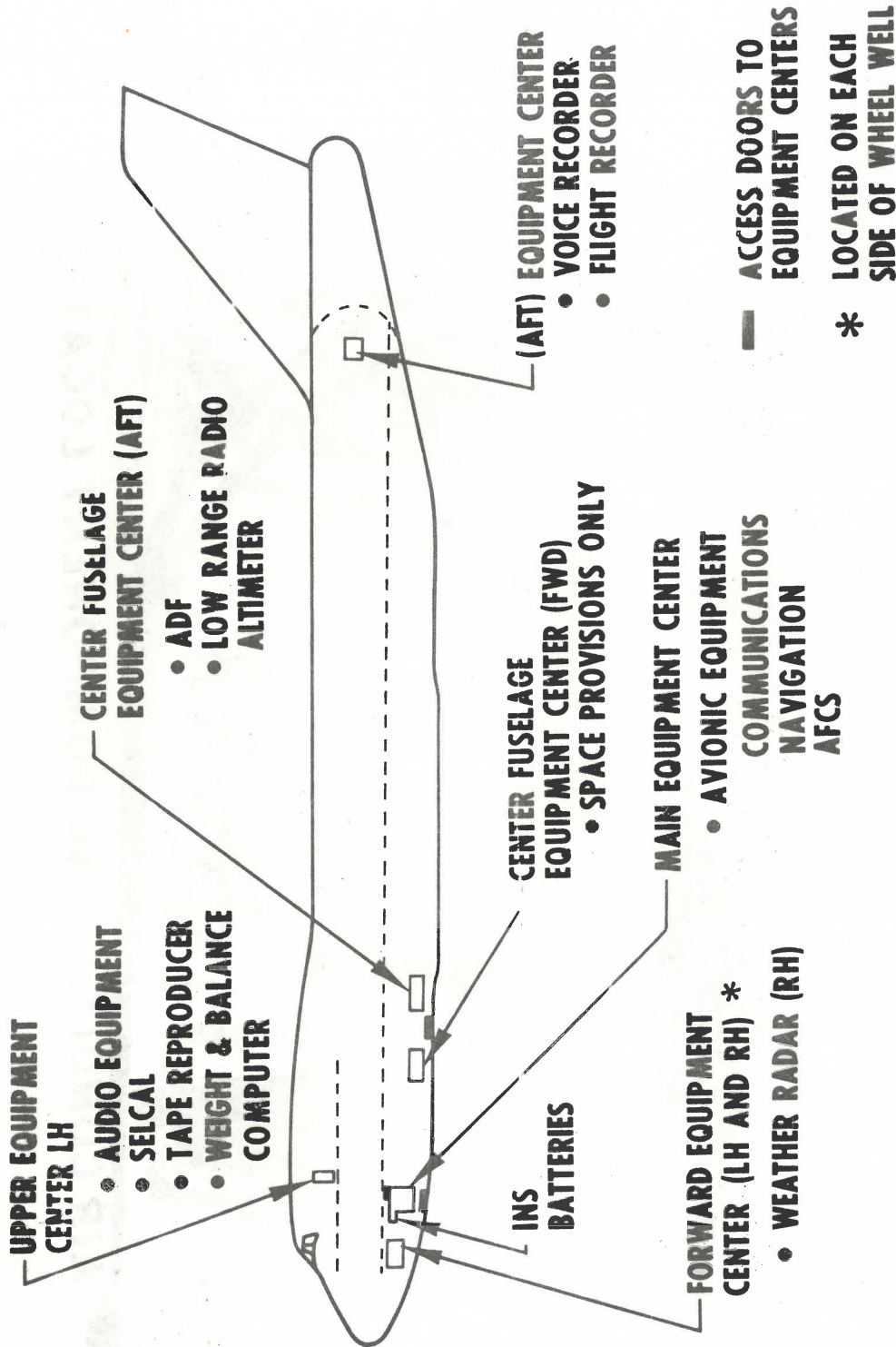
POWER PANEL

PRESSURIZATION PANEL

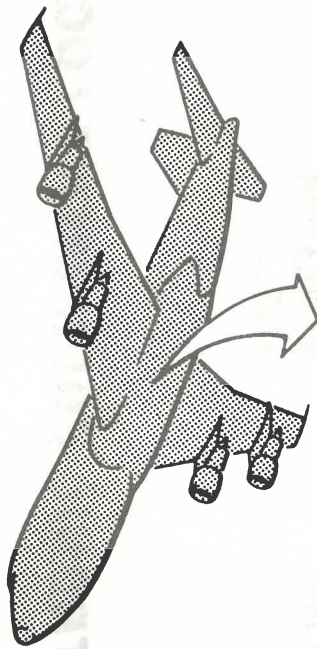
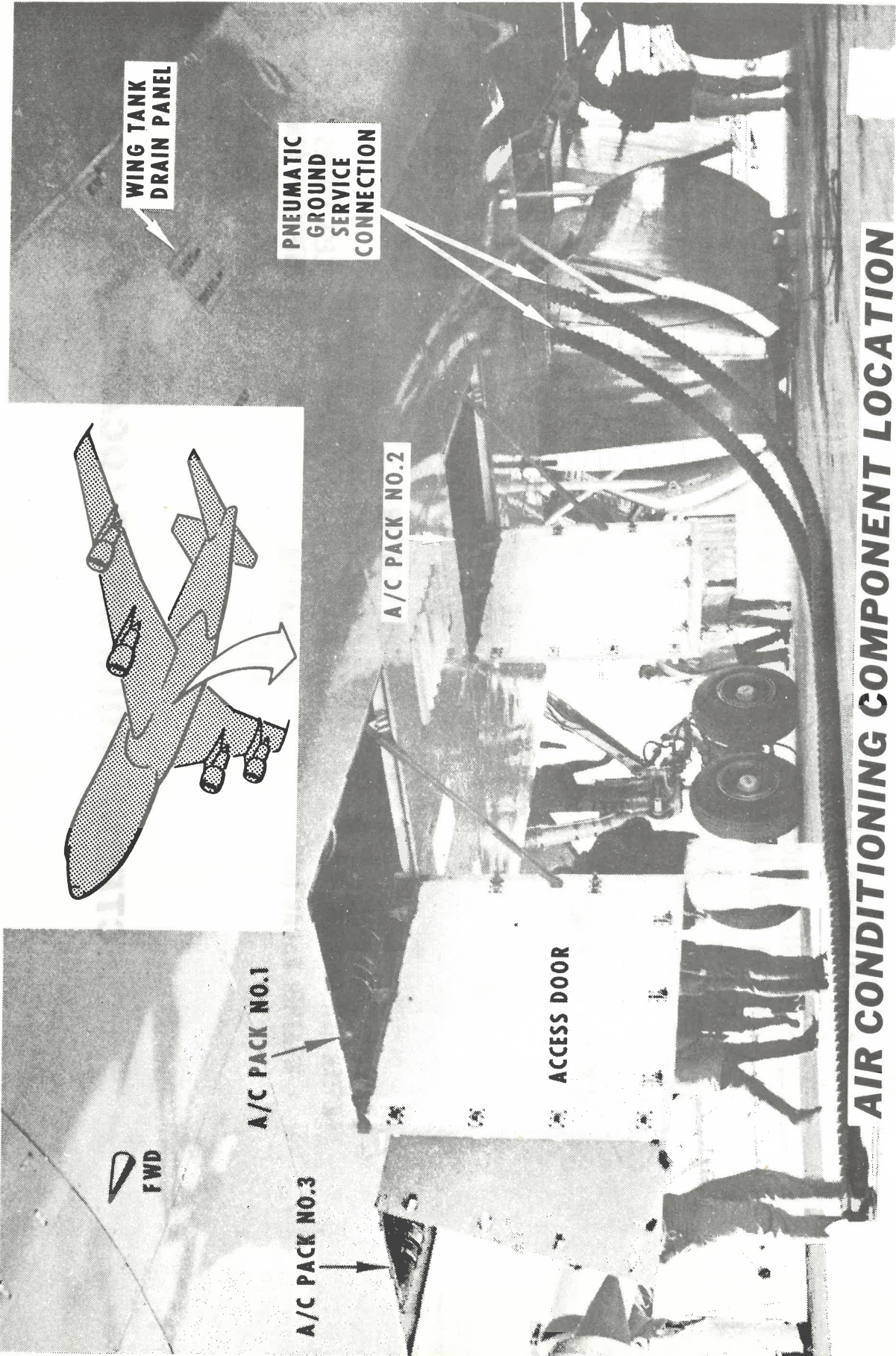
CARPET (REF)



APU BATTERY Location & Access



ELECTRONIC EQUIPMENT LOCATIONS



AIR CONDITIONING COMPONENT LOCATION

| | |
|--|-----------|
| COCKPIT REFERENCE, PERFORMANCE & FLIGHT PLANNING DATA | 01 |
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| ALTERNATE OPERATING PROCEDURES | 03 |
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AIR CONDITIONING SYSTEM

Air is directed from the pneumatic manifold to the three air conditioning packs (air cycle machines) through a pack valve controlled from the S/O panel. The three packs process and supply conditioned air to a common manifold which supplies this air to Zones 1, 2, 3, 4, and the Upper Deck Stateroom. Zone temperature control is accomplished automatically after selecting the desired zone temperature with the zone temperature switches, on the S/O panel. Whatever zone requiring the coolest temperature becomes the controlling zone. The trim air valves of the other zones will modulate open to provide hot trim air to be mixed with the conditioned air from the packs to satisfy the temperature requirements of their respective zones.

Manual temperature control of each pack and manual control of each zone trim air valve is provided from the S/O panel.

Zone 1 is the Cockpit. Zone 2 is the First Class Cabin. Zone 3 is the Center Coach Cabin and is the largest area. Zone 4 extends from number 4 door to the rear bulkhead.

Conditioned air for the Upper Deck Stateroom is tapped off Zone 2 prior to addition of trim air and further heated by temperature controlled electric heaters in the ducting.

Gasper air is taken off Zone 4 prior to addition of trim air. A Gasper fan controlled from S/O panel provides a positive supply of cool air to all zones.

Recirculating fans, located in the pressurized area above the cabin ceiling, for Zones 1, 2, 3, and 4 augment the system during periods of decreased airflow and for ground operation.

Automatic overtemp protection for the packs is provided by tripping closed the pack valve, which shuts the pack down. Duct overheat protection for the trim air system causes the trim air valve to drive closed. Once fault has cleared, system must be reset by buttons on the S/O panel.



AIR CONDITIONING

GENERAL

- i. Air is directed from the pneumatic manifold to three air conditioning packs. The output of the packs supply a common conditioned air manifold which supplies the four zones of the aircraft.
 - a. Two connectors are provided for external conditioned air.
 - b. The aircraft is divided into four zones for temperature control.
 - (1) Zone No. 1 - Flight compartment
 - (2) Zone No. 2 - Forward Cabin and Upper Stateroom
 - (3) Zone No. 3 - Mid Cabin
 - (4) Zone No. 4 - Aft Cabin
 - c. Additional ventilation is provided for all zones by recirculation blowers.
 - (1) Controlled by toggle switches on S/O panel.
 - d. A gasper fan provides the coolest air to all the zones.
 - (1) Controlled by switch on S/O panel.
 - (2) Used on ground for cooling passenger entertainment multiplex system.

SYSTEM OPERATION

1. Airflow to the heat exchangers and air cycle machines is provided from the pneumatic manifold through the pack valves. This conditioned air is then discharged into a common manifold, which supplies the four zones of the aircraft. Individual zone temperature requirements are satisfied by the addition of hot air from the trim air valves.
 - a. Pack valves are controlled by three rotary selector switches located on S/O panel.
 - (1) Electrically controlled and pneumatically operated. (Requires sufficient air pressure to open pack valve.)
 - b. The packs may be controlled automatically or manually by three pack control switches located on the S/O panel.
 - (1) Automatic position - Controls temperature of air from packs, determined by zone requiring the coolest temperature.
 - (a) Systems calling for heat.
 - '1' Turbine bypass valves modulate towards the Heat position.
 - '2' Ram air exit and inlet doors modulate toward Heat position if further heating is desired.
 - (b) System calling for cooling.



FREIGHTER

21:01F

AIR CONDITIONING

The B-747F will have two packs only to provide ventilation, air temperature control, and cabin pressurization. The airplane is divided into three individually controlled temperature zones.

Zone #1 - Control cabin and supernumerary accommodation area

Zone #2 - Fwd end of main cargo deck

Zone #3 - Aft end of main cargo deck

The trim air is added to the conditioned air from the pneumatic manifold instead of downstream of the packs. The upper deck electric heaters and recirculation blowers have been removed. The gasper fan has been removed. A flight deck fan, controlled by switch on the S/O panel, provides ventilation on the ground or during a single pack operation.

A flight deck ram vent valve and electric heater are controlled by switches on the S/O panel for ventilation during unpressurized flight.

The supernumerary area has conditioned air from Zones #1 and #2. The quantity of air is controlled by a manually operated mix valve for temperature control.

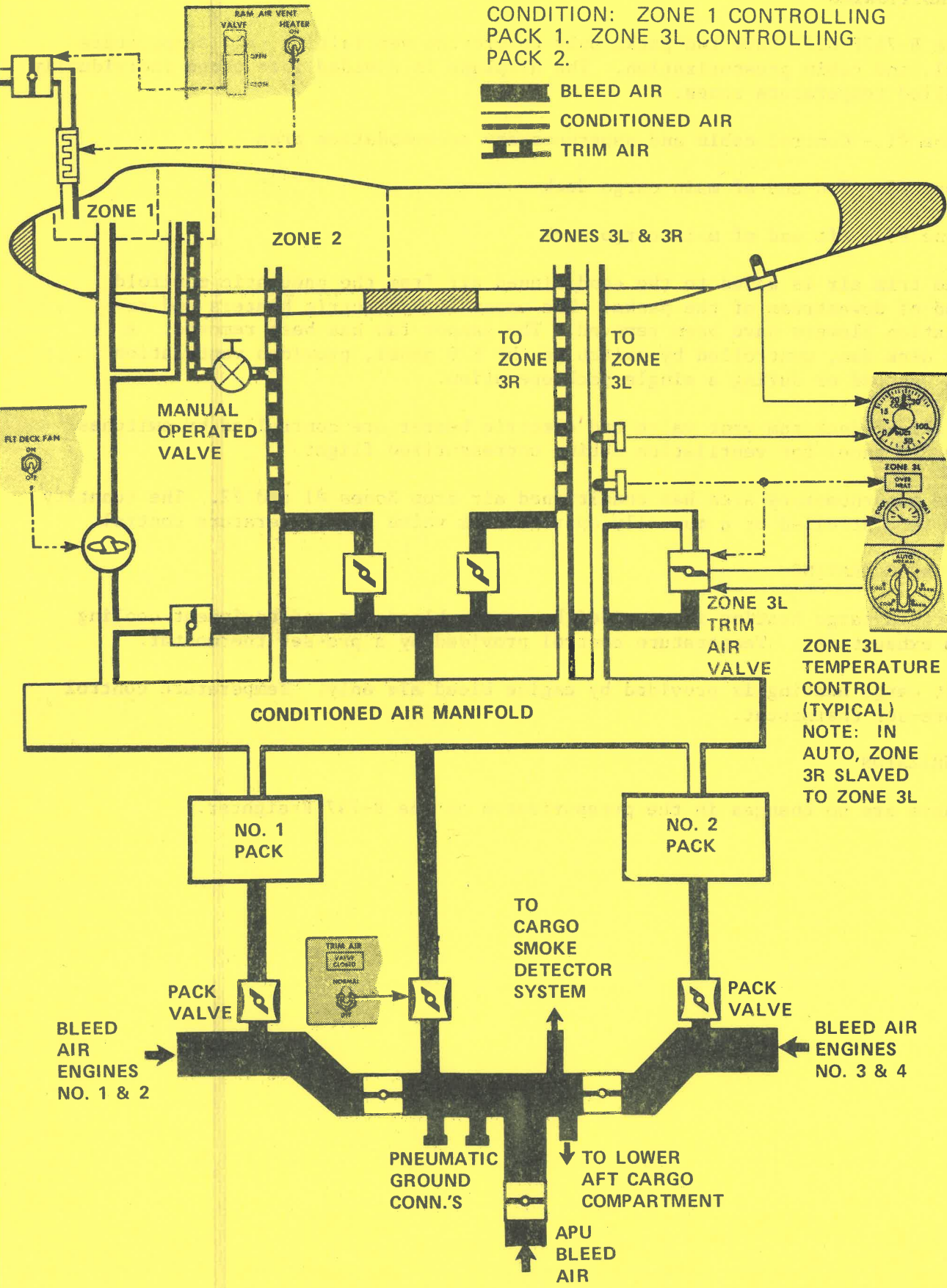
LOWER CARGO HEATING

Forward cargo heating is provided by engine bleed air and equipment cooling system exhaust air. Temperature control provided by a pre-set thermostat.

Aft cargo heating is provided by engine bleed air only. Temperature control by a pre-set thermostat.

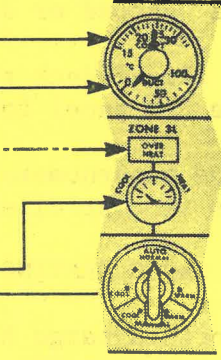
PRESSURIZATION

There are no changes in the pressurization on the B-747 Freighter.



CONDITION: ZONE 1 CONTROLLING
 PACK 1. ZONE 3L CONTROLLING
 PACK 2.

- BLEED AIR
- CONDITIONED AIR
- TRIM AIR



ZONE 3L
 TRIM
 AIR
 VALVE

ZONE 3L
 TEMPERATURE
 CONTROL
 (TYPICAL)
 NOTE: IN
 AUTO, ZONE
 3R SLAVED
 TO ZONE 3L



SYSTEM OPERATION (Cont.)

- '1' Turbine bypass valve is modulated toward the cool position only after the ram air inlet and exit doors have opened.
- '2' Coldest temperature available from the packs is 35°F.
- (2) Manual position - Freezes the position of turbine bypass valves and ram air inlet door. Ram air exit door is driven cool.
 - (a) Temperature control is provided by manual temperature switch through pack pushbutton selector switches on S/O panel.
 - '1' Only the turbine bypass valve and ram air inlet door may be controlled.
- c. The following indications may be monitored by their respective indicators through pushbutton selector switches, located on S/O panel.
 - (1) Turbine bypass valve position
 - (2) Ram air inlet and exit door position
 - (3) ACM (duct) outlet temperature
 - (4) Compressor discharge temperature
- d. Trim air switch (Open/Close) located on S/O panel controls master trim air valve.
 - (1) Open position - Supplies trim air to all trim air valves.
 - (2) Close position - Shuts off all trim air to all trim air valves.
- e. Zone temperature controls (Auto/Manual) located on S/O panel, regulates pack and zone temperature requirements.
 - (1) Auto - The zone that requires the coldest temperature controls the output of all packs. Hot trim air will be added to the conditioned air for the remaining zones.
 - (a) Trim air valve position is monitored on four individual indicators located on S/O panel.
 - (b) Four dual indicators monitor zone duct and compartment temperature.
 - '1' Zone No. 1 indicator is time shared with upper deck left and right through pushbutton selector switches.
 - 'a' Supplemental heating is provided the upper deck by electric heaters, controlled by two rotary switches on S/O panel.
 - (2) Manual - Allows manual positioning of trim air valve.
 - (a) If all zone temperature controls are selected to Manual, pack output temperature will be 35°F.



AIR CONDITIONING FAULTS

1. Excessive ACM outlet temperature (185°).
 - a. Illuminates Pack Trip light.
 - b. Closes pack valve.
 - c. Ram air exit door partially opens in flight only.
 - d. Turbine bypass valve opens.

NOTE: May be reset by switch on S/O panel.

2. Excessive compressor discharge temperature (425°).
 - a. Illuminates Pack Trip light.
 - b. Closes pack valve.
 - c. Ram air inlet and exit doors cool.
 - (1) Ram air exit door partially opens in flight only.
 - d. Turbine bypass valve opens.

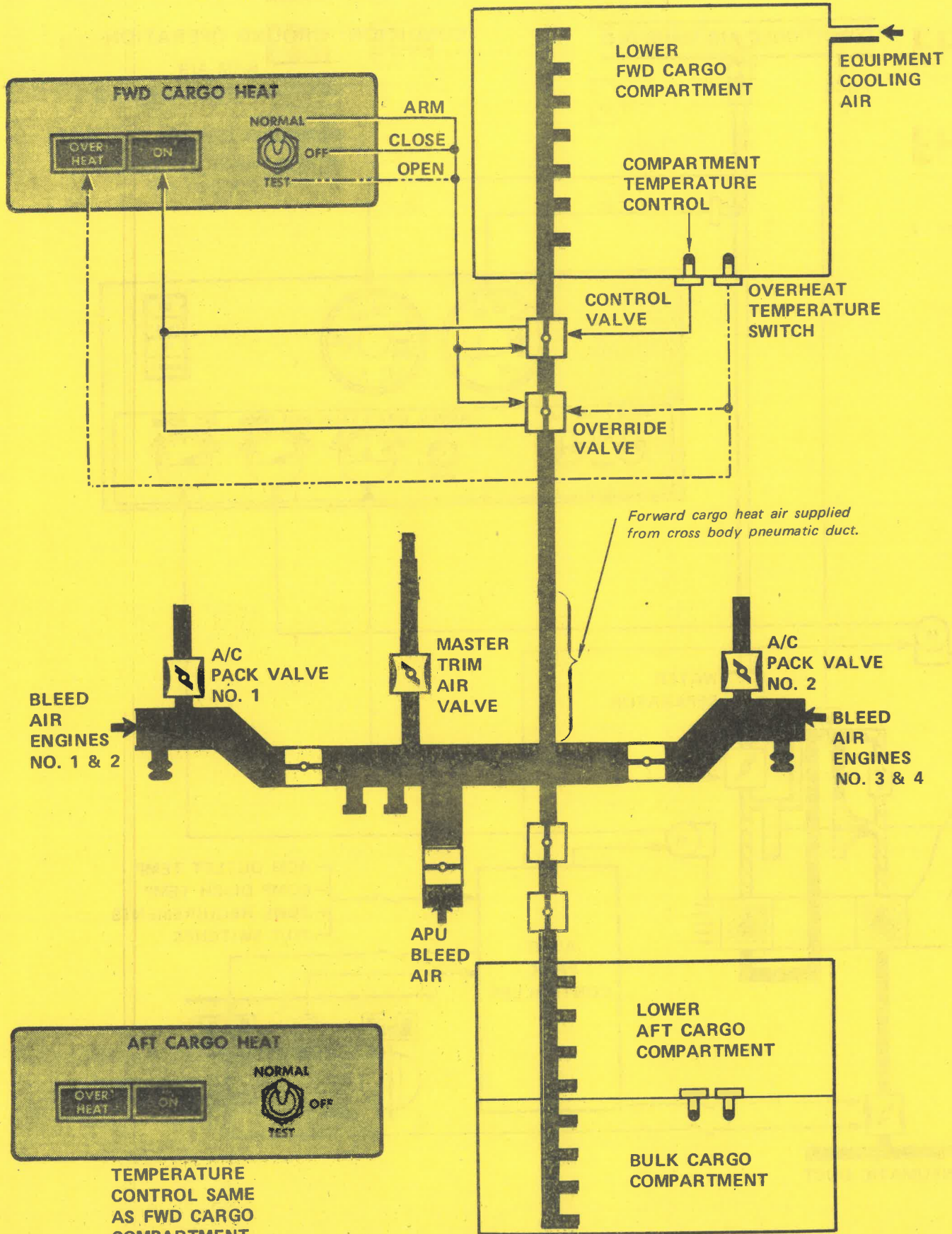
NOTE: May be reset by switch on S/O panel.

3. Turbine bypass valve out of sequence with ram air inlet or exit door by 50%.
 - a. Illuminates Pack Trip light.
 - b. Closes pack valve.
 - c. Ram air inlet and exit doors cool.
 - (1) Ram air exit door partially opens in flight only.
 - d. Turbine bypass valve opens.

NOTE: May be reset by switch on S/O panel.

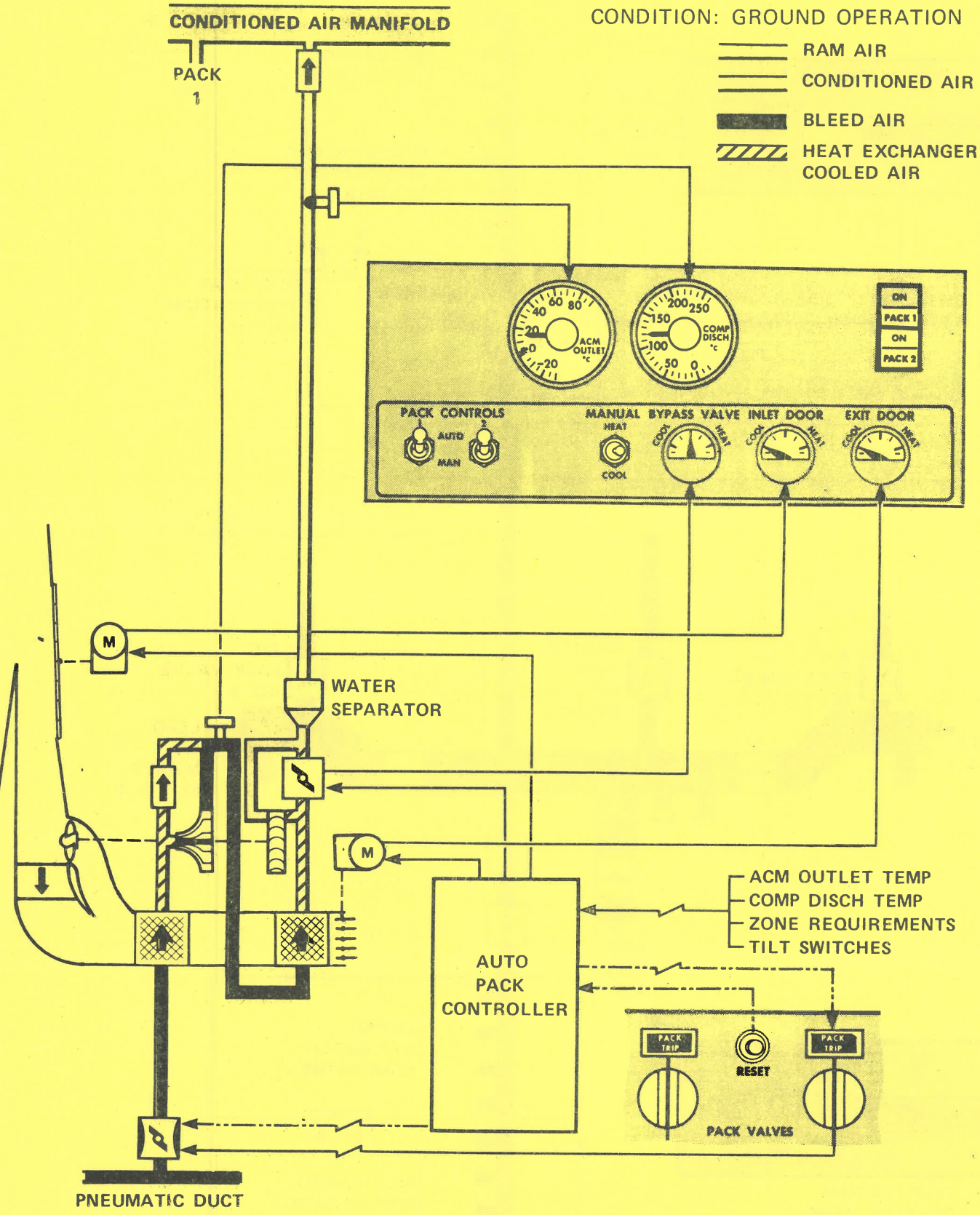
4. Zone trim overheat (185°).
 - a. Illuminates Zone Trim Overheat light.
 - b. Closes zone trim air valve.

NOTE: May be reset by switch on S/O panel when zone duct temperature is below 160°.



TEMPERATURE CONTROL SAME AS FWD CARGO COMPARTMENT

LOWER CARGO COMPARTMENT HEATING



PACK TEMPERATURE CONTROL

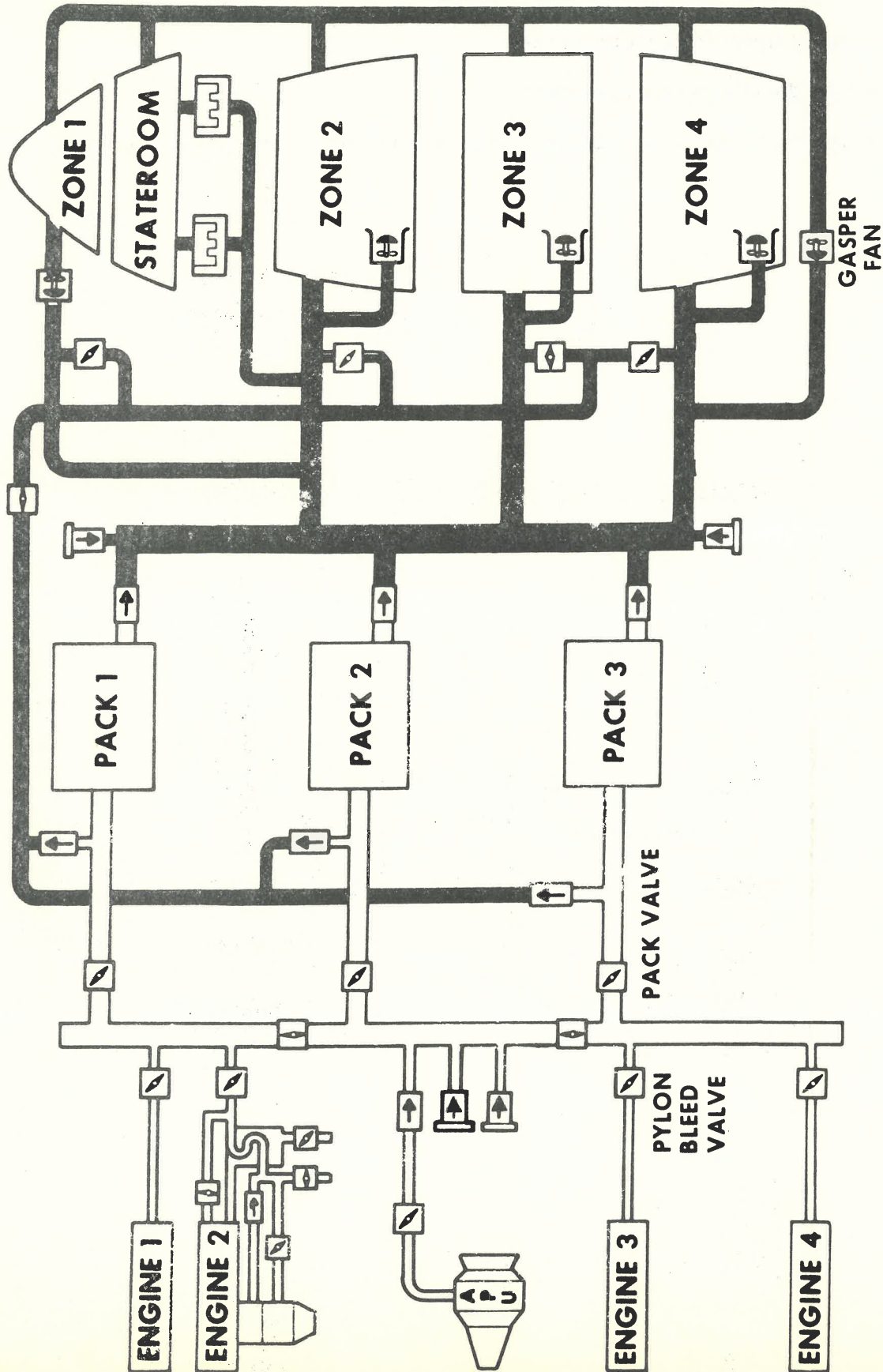


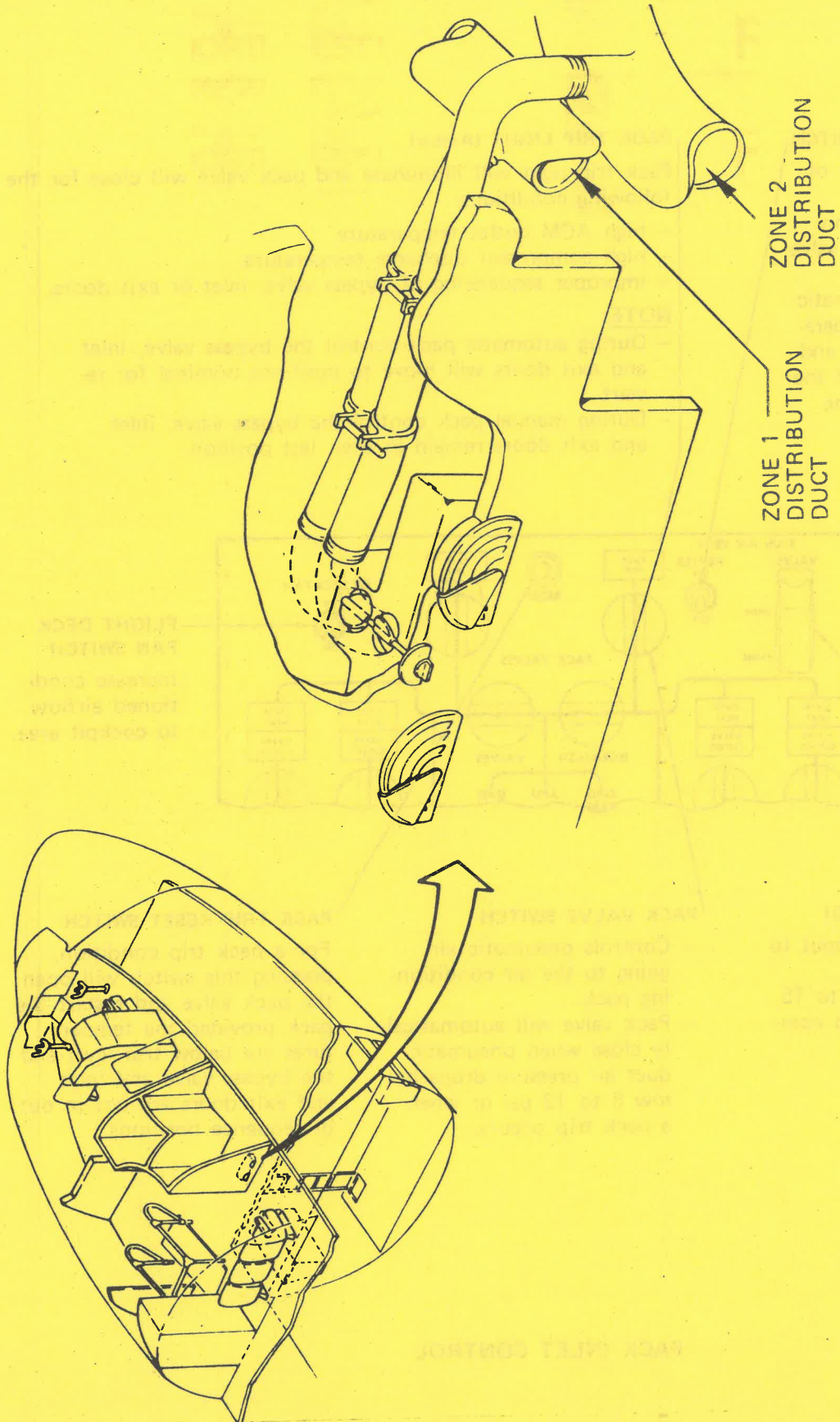
AIR CONDITIONING FAULTS (Cont.)

5. Upper deck overheat (duct 185° or 400° surface).
 - a. Illuminates Upper Deck Overheat light.
 - b. Shuts off the affected electric heater.

NOTE: May be reset by switch on S/O panel or by shutting off the affected electric heater.

AIR CONDITIONING SYSTEM





SUPERNUMERARY TEMPERATURE CONTROL



RAM AIR HEATER SWITCH

- Provides capability of heating ram air.
- Heater operates only when the ram air valve is opened.
- Thermostats automatically limit the temperature at the heater and the temperature of the ram air entering the cockpit area.

PACK TRIP LIGHT (Amber)

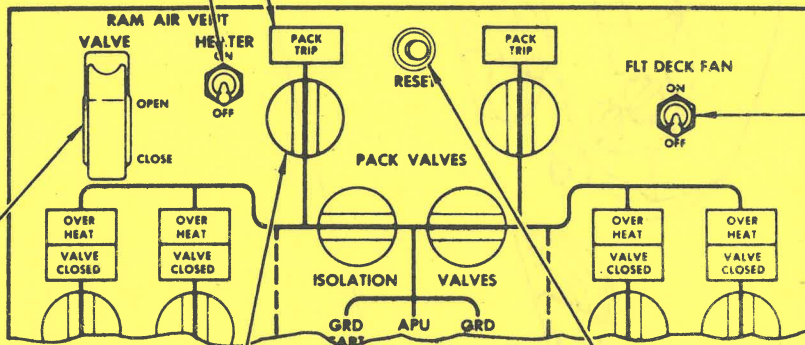
Pack trip light will illuminate and pack valve will close for the following conditions:

- high ACM outlet temperature
- high compressor discharge temperature.
- improper sequencing of bypass valve, inlet or exit doors.

NOTE:

- During automatic pack control the bypass valve, inlet and exit doors will move to positions nominal for re-start.
- During manual pack control the bypass valve, inlet and exit doors remain in their last position.

FLIGHT ENGINEER'S PANEL



FLIGHT DECK FAN SWITCH

Increase conditioned airflow to cockpit area.

RAM AIR VENT SWITCH

- Controls ram air input to cockpit area.
- Approximately 10 to 15 seconds required to completely open vent.

PACK VALVE SWITCH

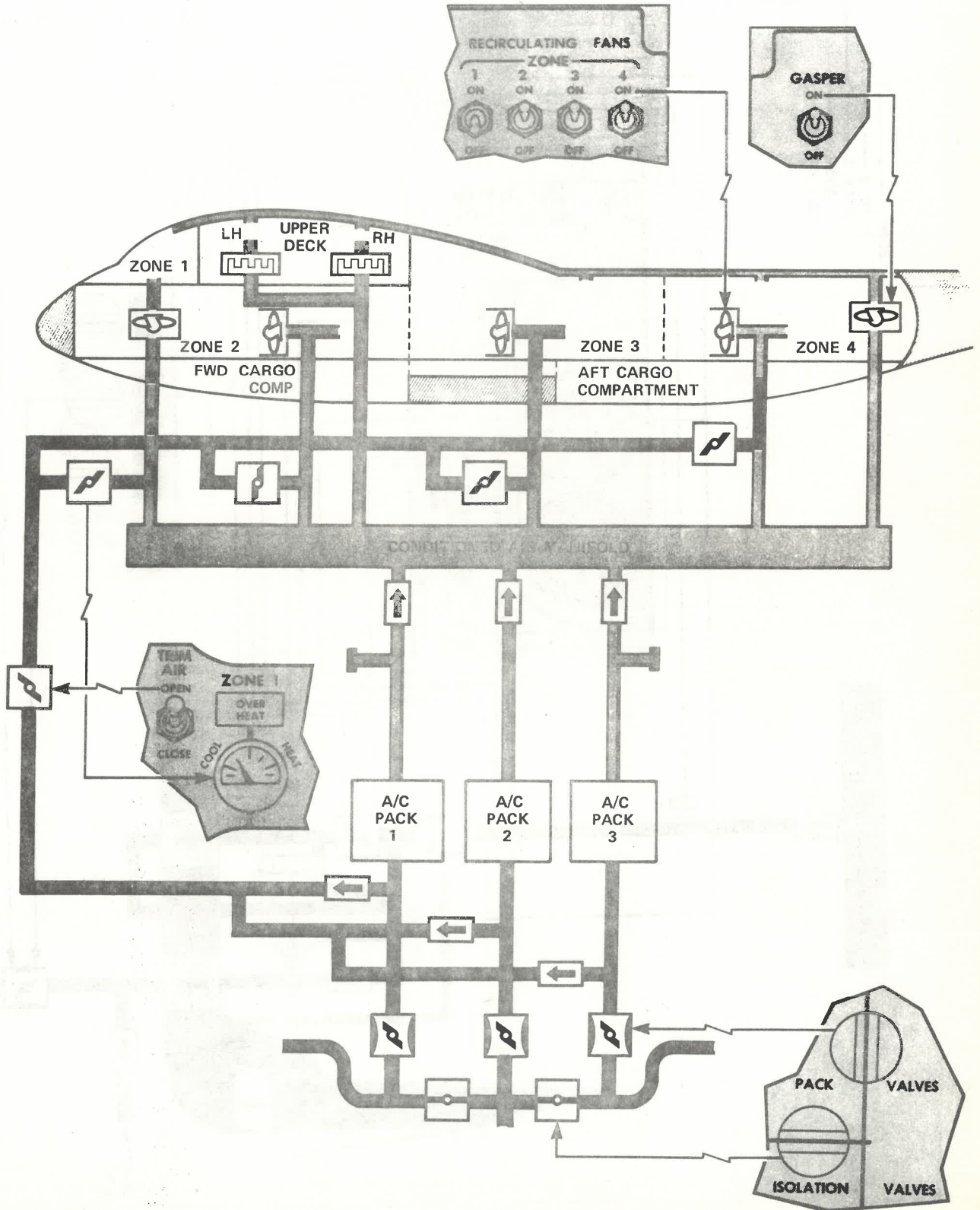
- Controls pneumatic air going to the air conditioning pack.
- Pack valve will automatically close when pneumatic duct air pressure drops below 8 to 12 psi or when a pack trip occurs.

PACK TRIP RESET SWITCH

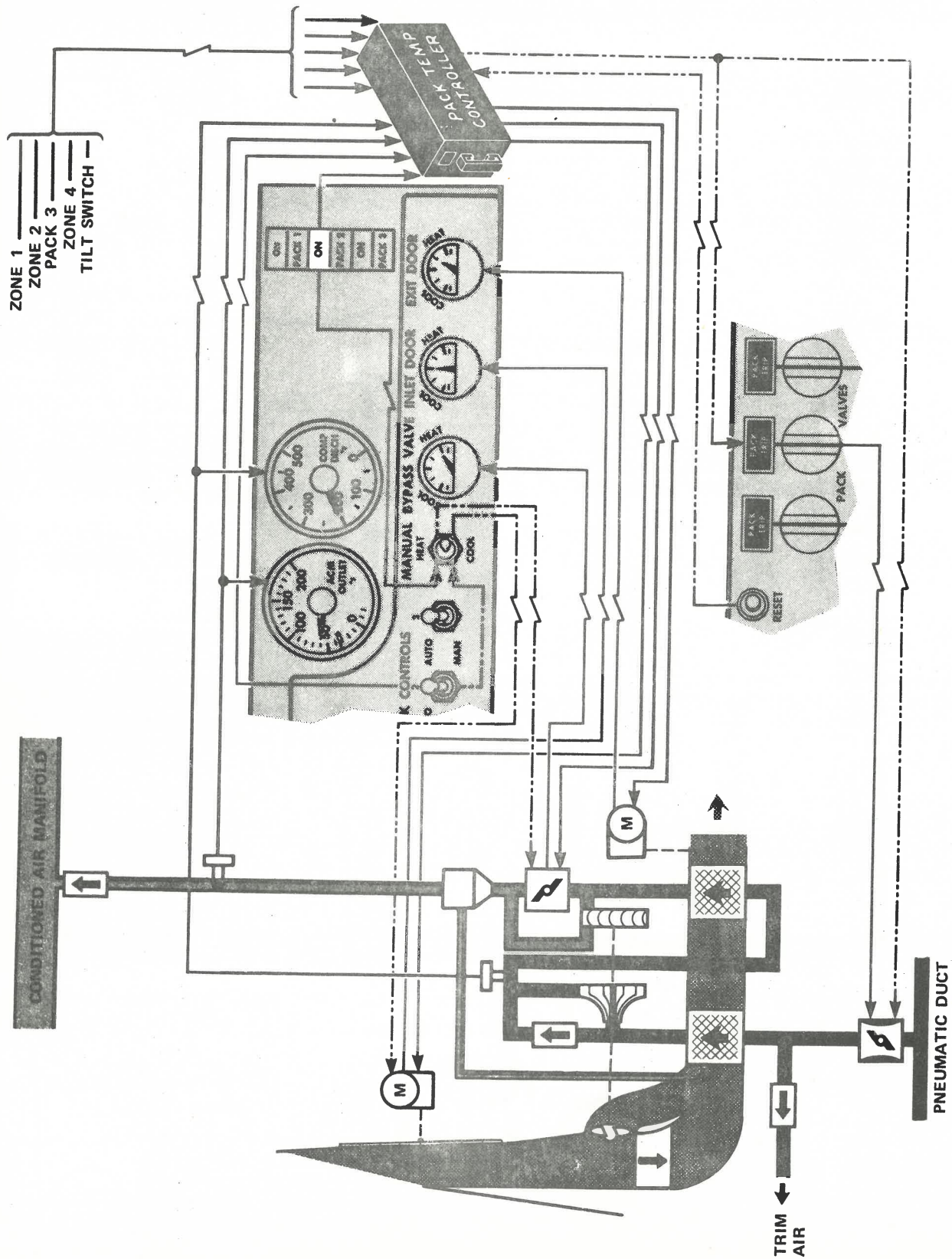
For a pack trip condition, pressing this switch will open the pack valve and restart the pack provided the temperatures are below trip level and the bypass valve and inlet and exit doors are not in out of sequence positions.



AIR CONDITIONING TRIM AIR SYSTEM



PACK TEMPERATURE CONTROL SYSTEM



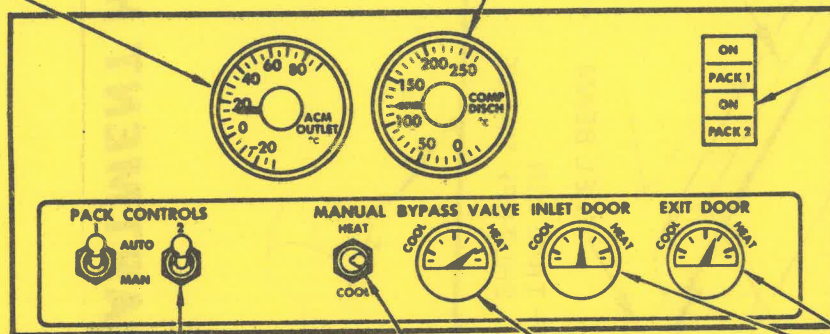


AIR CYCLE MACHINE OUTLET TEMPERATURE INDICATOR

Indicates pack outlet temperature. Normally ACM outlets should read similar. Normal range 35°-135°**F** (2° - 57°**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 MAN.

FLIGHT ENGINEER'S PANEL

PACK CONTROL SWITCH

AUTO – Normal operation.
MAN – Removes pack from automatic control; freezes position of bypass valve and inlet door (until manually toggled); and moves the exit door to 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

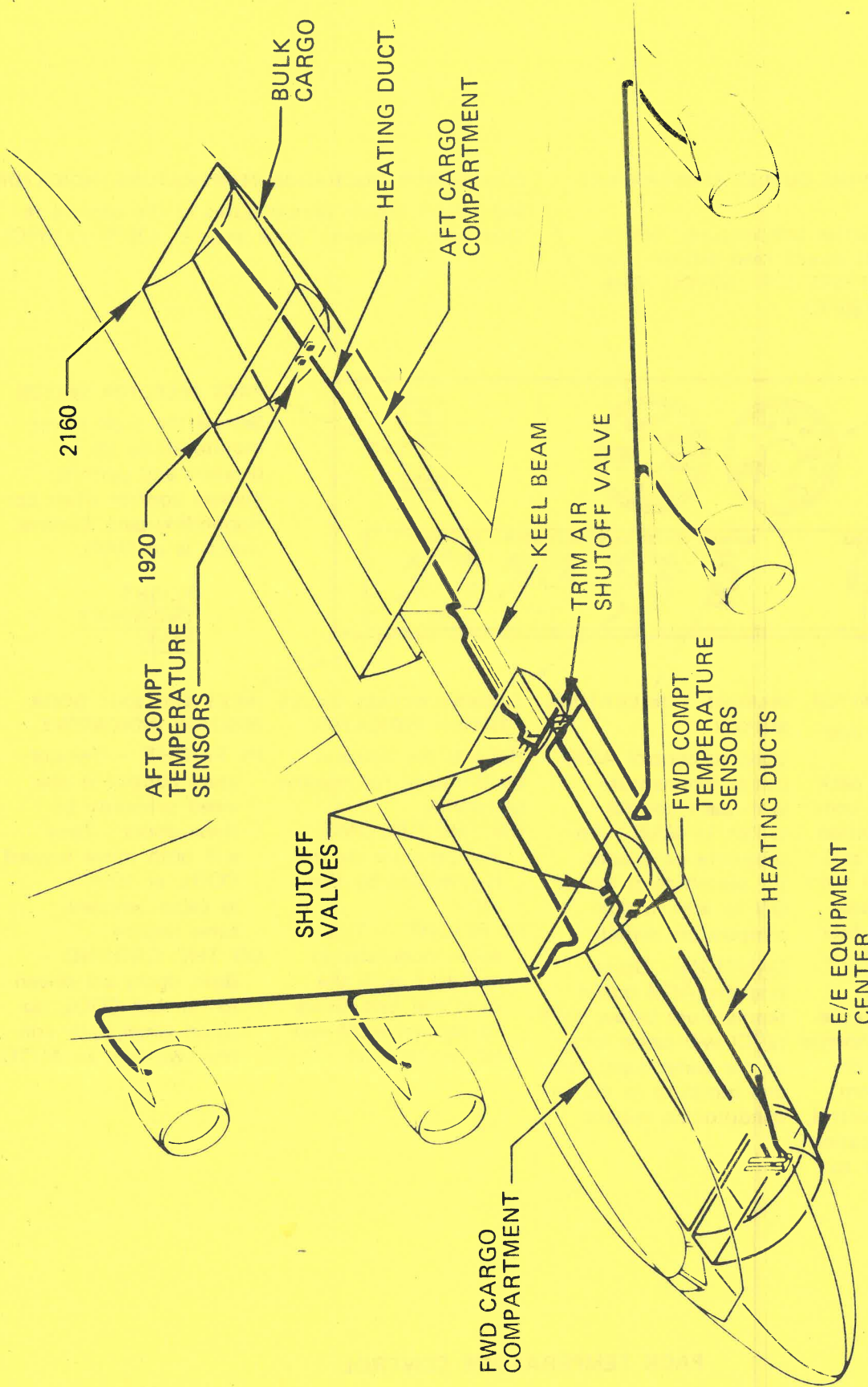
Used to control ACM outlet temperature with pack control switch in MAN. Appropriate pack selector switch must be ON to arm manual temperature switch.
CAUTION: Operating the ACM outlet temperature below 35°**F** (2°**C**) will cause icing of the water separator and moisture in the air conditioning system.

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.

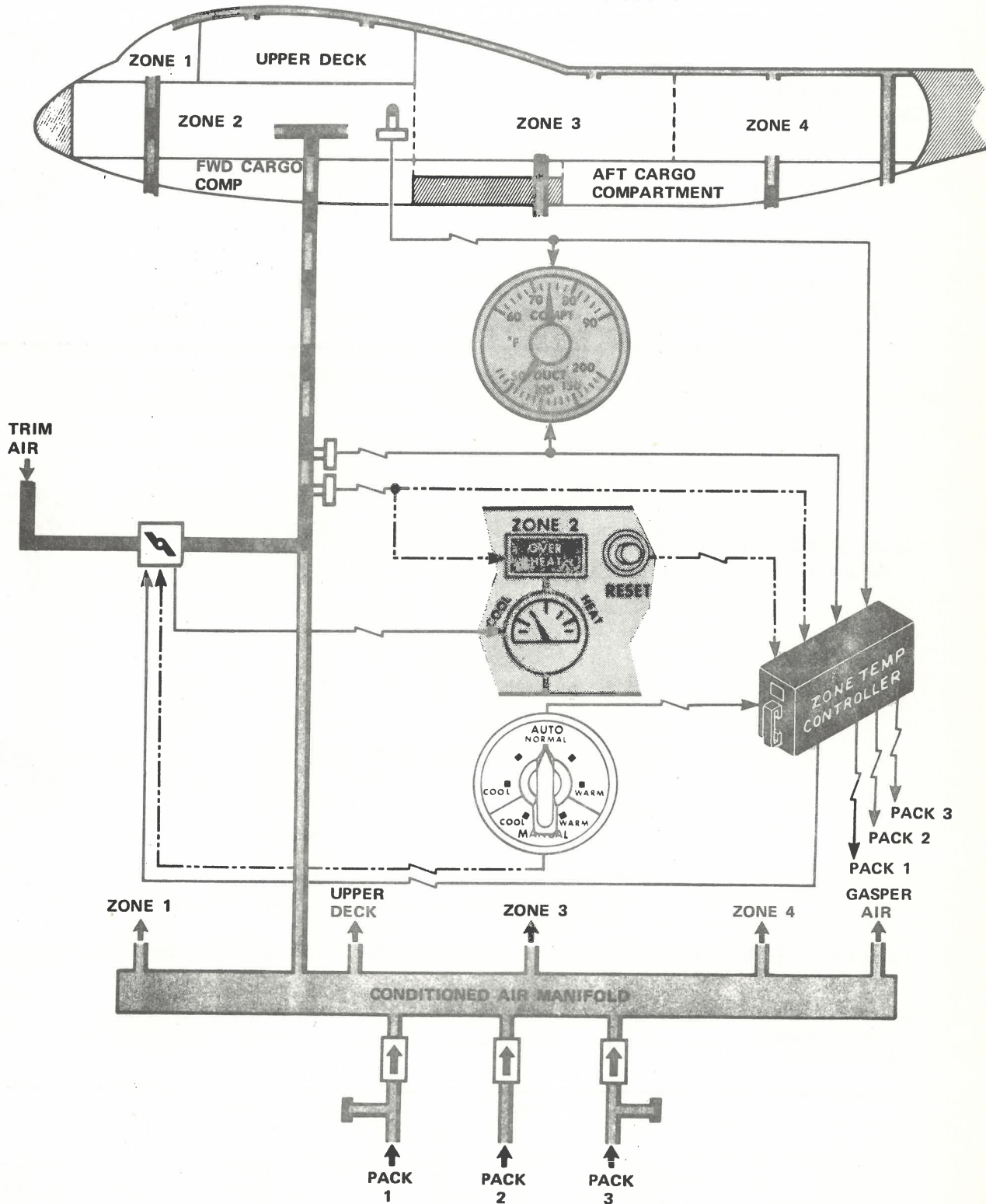
INLET AND EXIT DOOR POSITION INDICATORS

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.

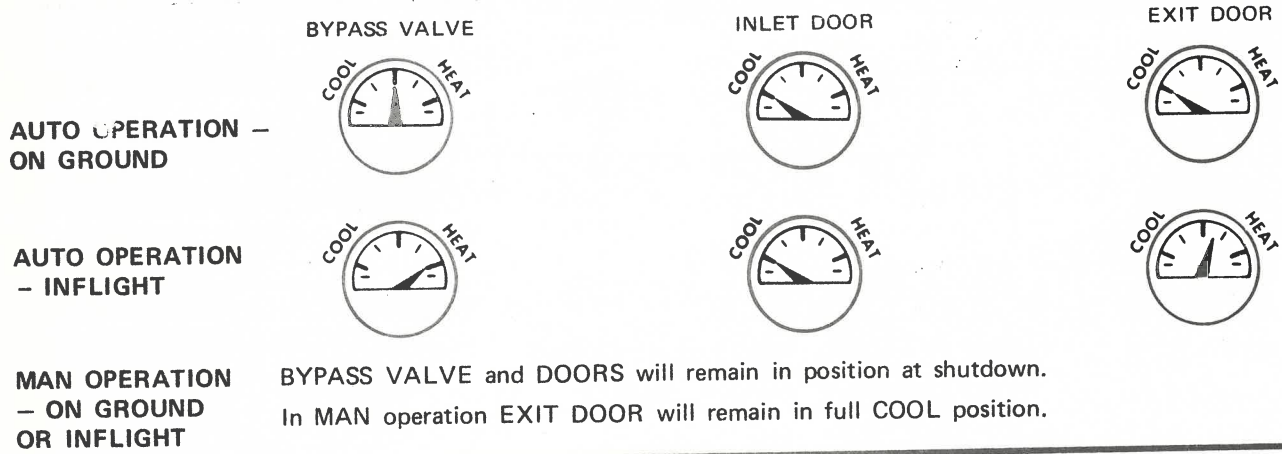


CARGO COMPARTMENT HEATING

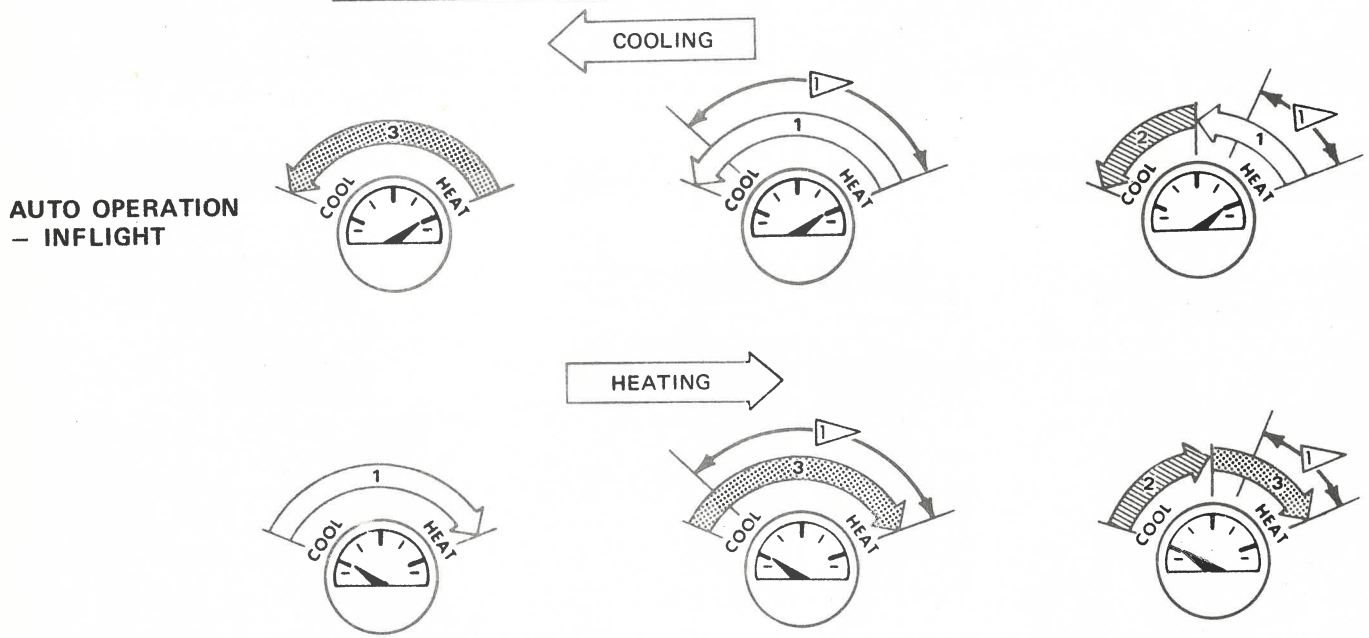
ZONE TEMPERATURE CONTROL SYSTEM



BYPASS VALVE, INLET AND EXIT DOOR INDICATORS



BYPASS VALVE, INLET and EXIT DOOR SEQUENCING



 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.

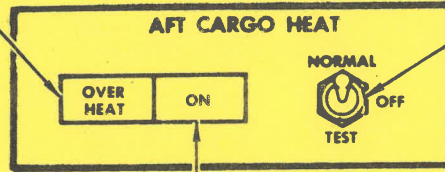
PACK TRIP - OUT OF SEQUENCE - RANGE



BYPASS VALVE position near full COOL with INLET DOOR and/or EXIT DOOR near full HEAT.

LOWER AFT CARGO OVERHEAT LIGHT (Amber)

Indicates compartment temperature is above normal.



LOWER AFT CARGO HEAT SWITCH

NORMAL – When heat is required valves open and bleed air heats compartment.

OFF – Closes override valve and control valves

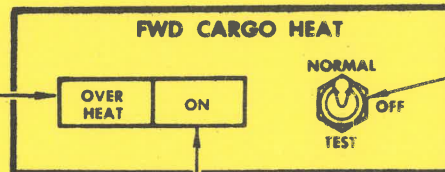
TEST – Valves open regardless of compartment temperature.

LOWER AFT CARGO HEAT ON LIGHT (Green)

Illuminates when heat is supplied to compartment. (Override and control valve open).

FLIGHT ENGINEER'S PANEL

LOWER FWD CARGO OVERHEAT LIGHT (Amber)



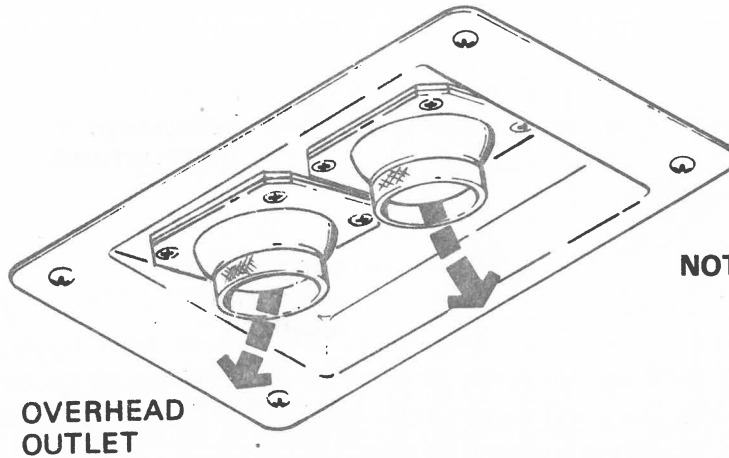
LOWER FWD CARGO HEAT SWITCH

LOWER FWD CARGO HEAT ON LIGHT (Green)

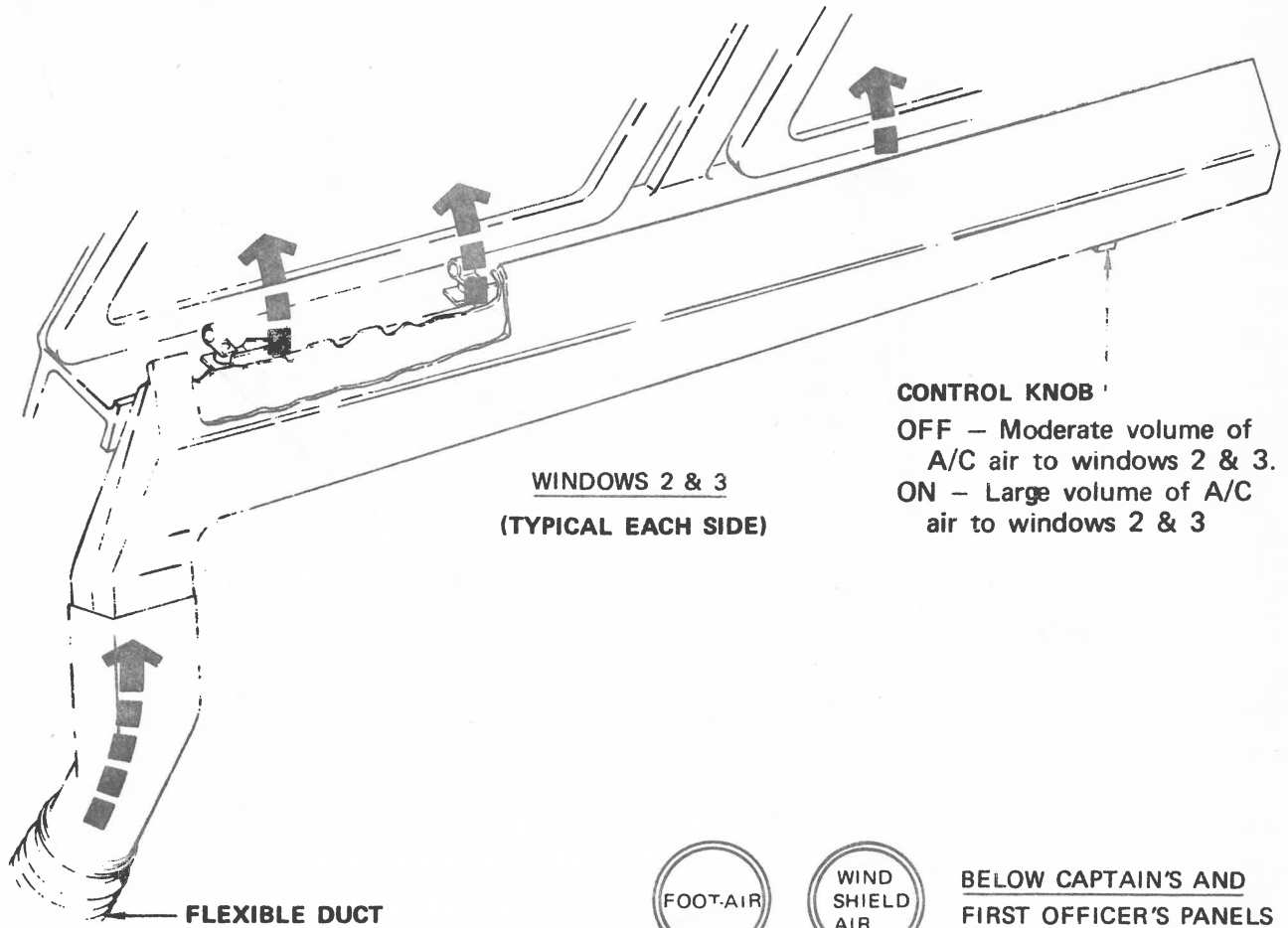
FLIGHT ENGINEER'S PANEL

NOTE: Operation of the fwd cargo heat system is similar to aft cargo heat system except equipment cooling air is also routed to the compartment.

PILOT'S A/C AIR DISTRIBUTION SYSTEM



NOTE: On some airplanes a fixed anemostat outlet is also used as an overhead outlet.

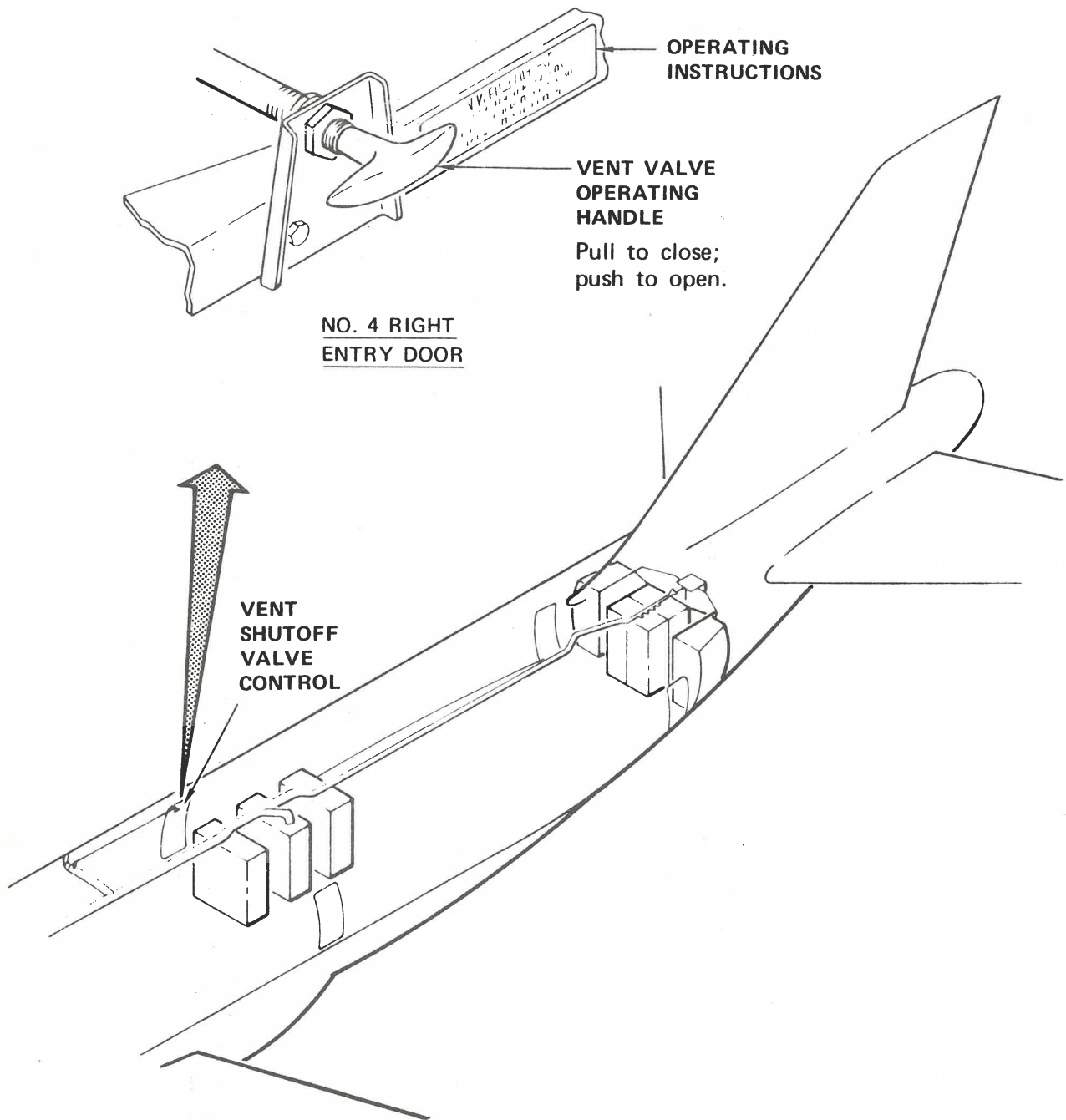


WINDSHIELD/FOOT AIR CONTROLS

WINDSHIELD – Distributes A/C air to No. 1 windows.

FOOT-AIR – Distributes A/C air around pilots' rudder pedals.

LAVATORY AND GALLEY VENT SYSTEM



ZONE AND UPPER DECK TEMPERATURE CONTROL PANEL

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 LIGHT (Amber)

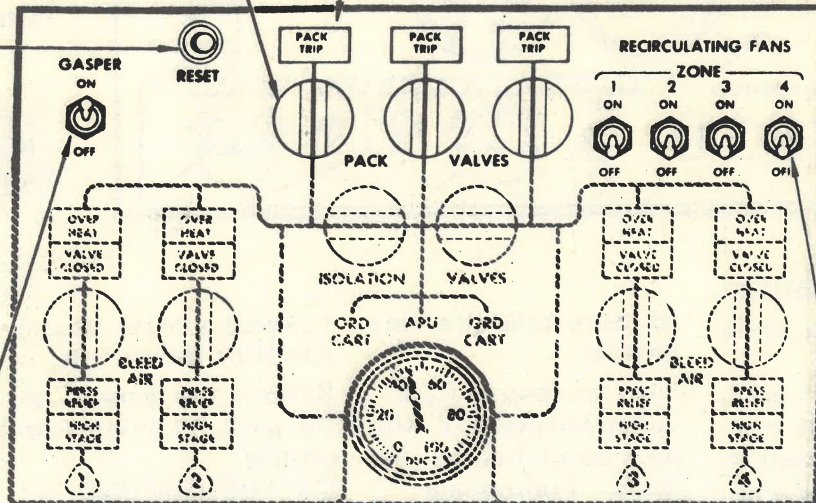
Flight/Ground:

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 TRIP RESET SWITCH

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.



FLIGHT ENGINEER PANEL

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

Recirculate conditioned air. No. 1 is for the cockpit; No. 2, 3 & 4 for the passenger cabin.

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 TEMPERATURE CONTROL PANEL

AIR CYCLE MACHINE OUTLET TEMPERATURE INDICATOR

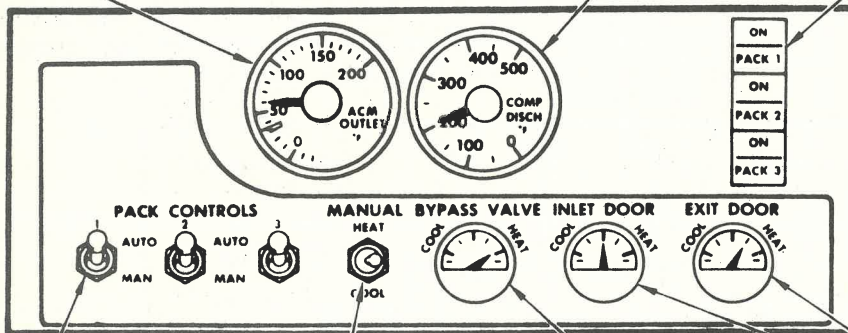
Indicates pack outlet temperature to the conditioned air manifold. Normally ACM outlets should read similar. Normal range 35-160° F (2° -71° C). Pack trips at 185° F (85° C).

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

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).

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.

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.

NOTE: There is a delay in indicator response of about 18 seconds when switching from MAN to AUTO, or when electrical power is placed on the system and the packs opened.

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.

PACK INLET CONTROL PANEL

UPPER DECK OVER-HEAT 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

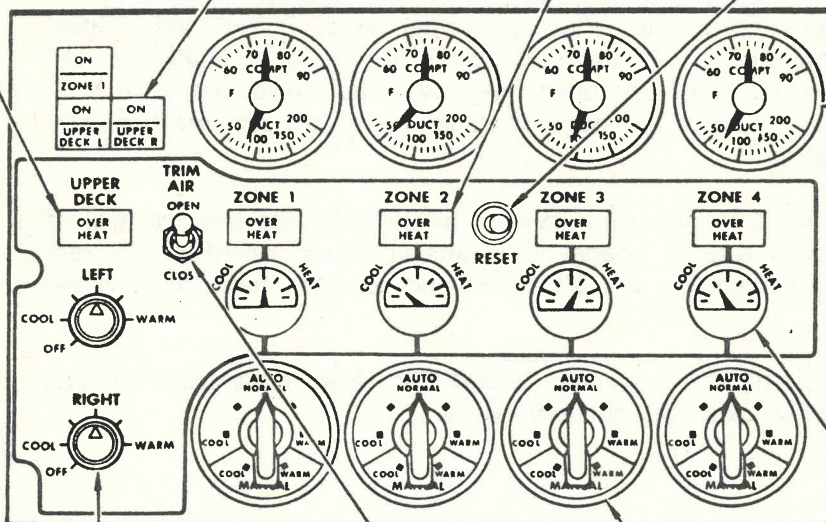
Provides selection for temperature readouts on zone 1 indicator.

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 but will not reposition automatically in MANUAL mode.

ZONE OVERHEAT RESET SWITCH

Extinguishes OVER-HEAT light and permits reset of auto control when temperature drops below 160°F (71°C). Also can be used to reset upper deck overheat.



ZONE COMPARTMENT/DUCT TEMPERATURE INDICATORS

Continuous temperature readouts for zones 2, 3 & 4.

FLIGHT ENGINEER'S PANEL

UPPER DECK TEMPERATURE SWITCHES

- OFF - Resets overheat.
- 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.

TRIM AIR SWITCH

- OPEN - Master trim air valve opens when any pack is operating.
- CLOSE - All trim air is shut off by master trim air valve.

ZONE TEMPERATURE SWITCHES

- AUTO - Selects desired compartment temperature. The zone that requires the coldest air will control the output of all packs that are in AUTO. Hot trim air will be added to the conditioned air to the remaining zones.
- MANUAL - Manually positions the trim air valve.

TRIM AIR INDICATORS

Display relative position of zone trim air valves. Maintain existing position when all pack valves are closed and associated zone temperature switch is in AUTO.



PRESSURIZATION SYSTEM

The B-747 Pressurization System is an electronic system designed to minimize the control and monitor functions of the flight crew. The system has built in reliability through the use of three modes:

1. Automatic (AC Operation)
2. Rate Monitor (DC Automatic Operation)
3. Manual (DC Operation)

Pressurization is controlled by regulating the outflow of air from the pressurized section of the airplane. This is accomplished by automatic or manual control of two electrically operated outflow valves. The automatic system limits the maximum differential to 8.9 PSI. The controller automatically programs the climb or descent schedule to provide the lowest rate of pressure change.

Positive pressure relief valves are located on the left hand side of the aircraft, forward of the wing. These valves are located behind hinged doors that open when valve unseats and relieves pressure. The valves will reseat automatically but the door must be closed manually on the ground. Press relief lights illuminate when valves are open. Negative relief valves are located in the forward and aft cargo compartment doors. The negative relief valves are also mechanically connected to the door opening mechanism.

Additional protection is provided by a rate monitor system which will take over control of both outflow valves whenever the cabin rate of change is excessive. After takeover, the rate monitor system illuminates an Auto Fail light on the S/O panel and controls the outflow valves to decrease cabin rate of change.

An altitude warning horn sounds if the cabin exceeds 10,000 feet. Also if the cabin altitude reaches 15,000 feet, a signal is provided to close the outflow valves.



GENERAL

1. The pressurization controller maintains the desired cabin pressure through control of the two outflow valves located in lower aft end of fuselage.
 - a. Pressurization controller located on S/O panel.
 - (1) A five-position mode selector switch.
 - (a) "CHK" position – allows closing of outflow valves on the ground by positioning flight cabin altitude selector.
 - (b) "Auto" position – prevents pressurization on the ground; in flight outflow valves will modulate to control cabin during climb or descent to desired altitude.
 - '1' Outflow valve motor is AC operated.
 - (c) "Manual" position – allows manual control of both outflow valves.
 - '1' Two outflow valve manual control toggle switches will operate outflow valves through a DC motor.
 - (d) "Man L" position – left outflow valve controlled manually and right outflow valve controlled automatically.
 - (e) "Man R" position – right outflow valve controlled manually and left outflow valve controlled automatically.
 - (2) Pressurization rate switch controls rate of cabin climb and descent.
 - (a) Range – 150 foot-2,500 foot climb
100 foot-1,500 foot descent
 - (b) Index Mark – 500 foot climb
300 foot descent
 - (3) Flight/cabin altitude selector – selects cabin altitude for flight level.
 - (4) Barometric setting selector – allows selection of barometric pressure for controller.
 - (5) Rate limit test switch – tests rate monitor function on preflight when aircraft is unpressurized.
 - (a) Rate monitor function actuated by 2,000 foot descent or 3,100 foot climb of cabin (emergency backup system for pressure controller).
 - (6) Auto Fail light located above pressurization control on S/O panel.
 - (a) Illuminates when rate monitor system in control.
 - (b) Illuminates when rate limit test switch is actuated.

NOTE: Auto Fail light remains illuminated until selector switch positioned to manual (de-activates rate monitor function).



GENERAL (Cont.)

- (7) Two left/right outflow valve position indicators – allows monitoring of outflow valve position.
- (8) Cabin pressure differential pressure indicator located on S/O panel.
 - (a) Displays differential pressure between cabin and ambient.
 '1' Normal maximum in Auto – 8.9 psi
- (9) Cabin altitude indicator located on S/O panel.
 - (a) Displays cabin altitude with pointer and digital readout.
- (10) Cabin vertical speed indicator located on S/O panel.
 - (a) Displays cabin rate of change in 1,000 foot increments.

PRESSURE RELIEF VALVES (2)

1. Pressure relief valves located in forward cargo compartment.
 - a. Opens when pressure differential reaches 9.25 psi from remote ambient sensor.
 - b. Opens when pressure differential reaches 9.70 psi from ambient sensing on relief valve.
 - c. Pressure Relief Valve lights illuminate when respective pressure relief valve opens.

VACUUM RELIEF VALVES (4)

1. Vacuum relief valves located on main forward and aft cargo doors.
 - a. Opens when ambient pressure exceeds compartment pressure.

CABIN ALTITUDE WARNING

1. At a cabin altitude of 10,000 feet or above an intermittent horn sounds.
 - a. May be cut-off by Alt. horn cutout switch on S/O panel.

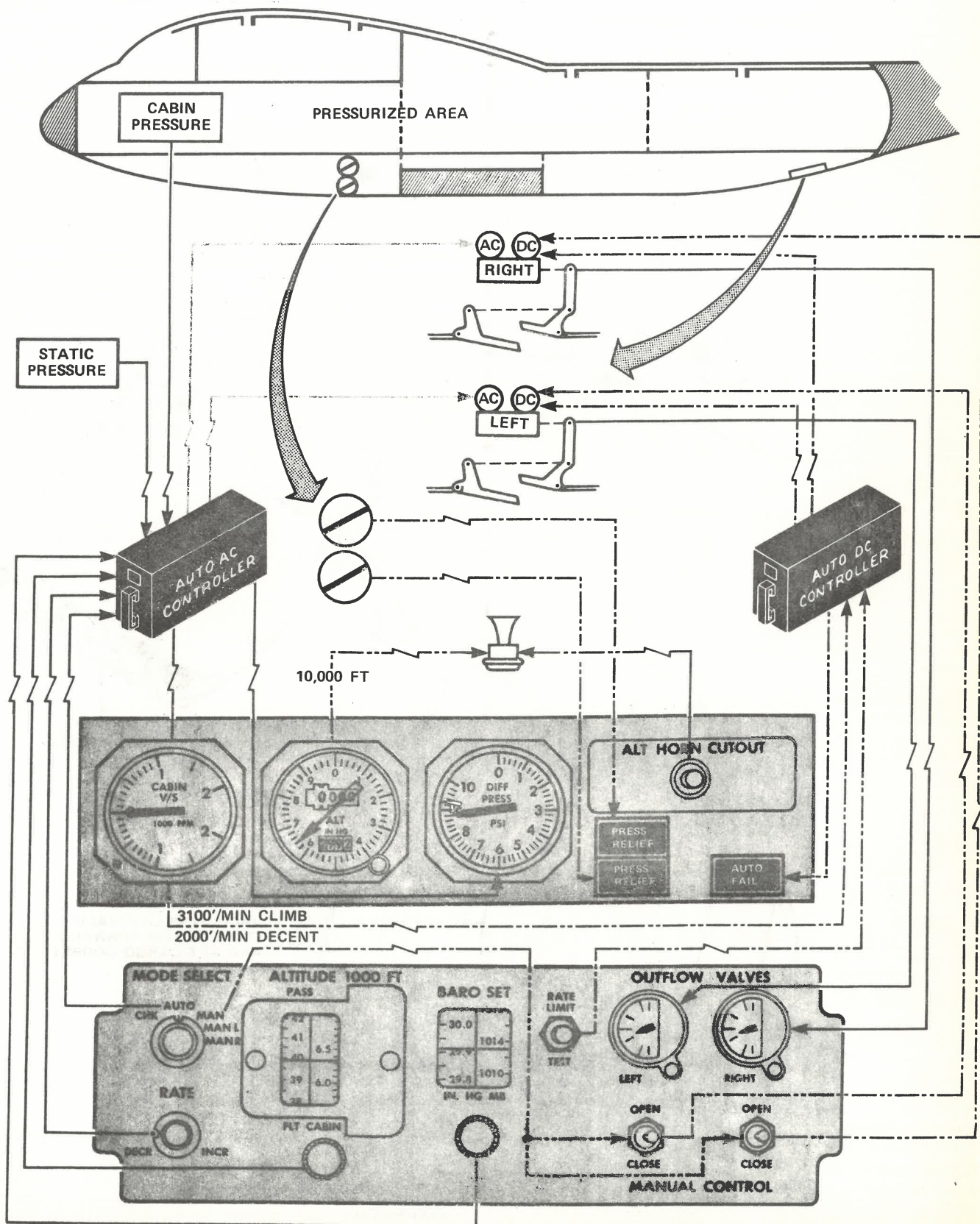
PRESSURIZATION LIMITS *

1. 8.9 psi maximum automatic.
2. 9.25 psi manual.
 - a. Backup relief at 9.70 psi.
3. .07 psi maximum on ground.

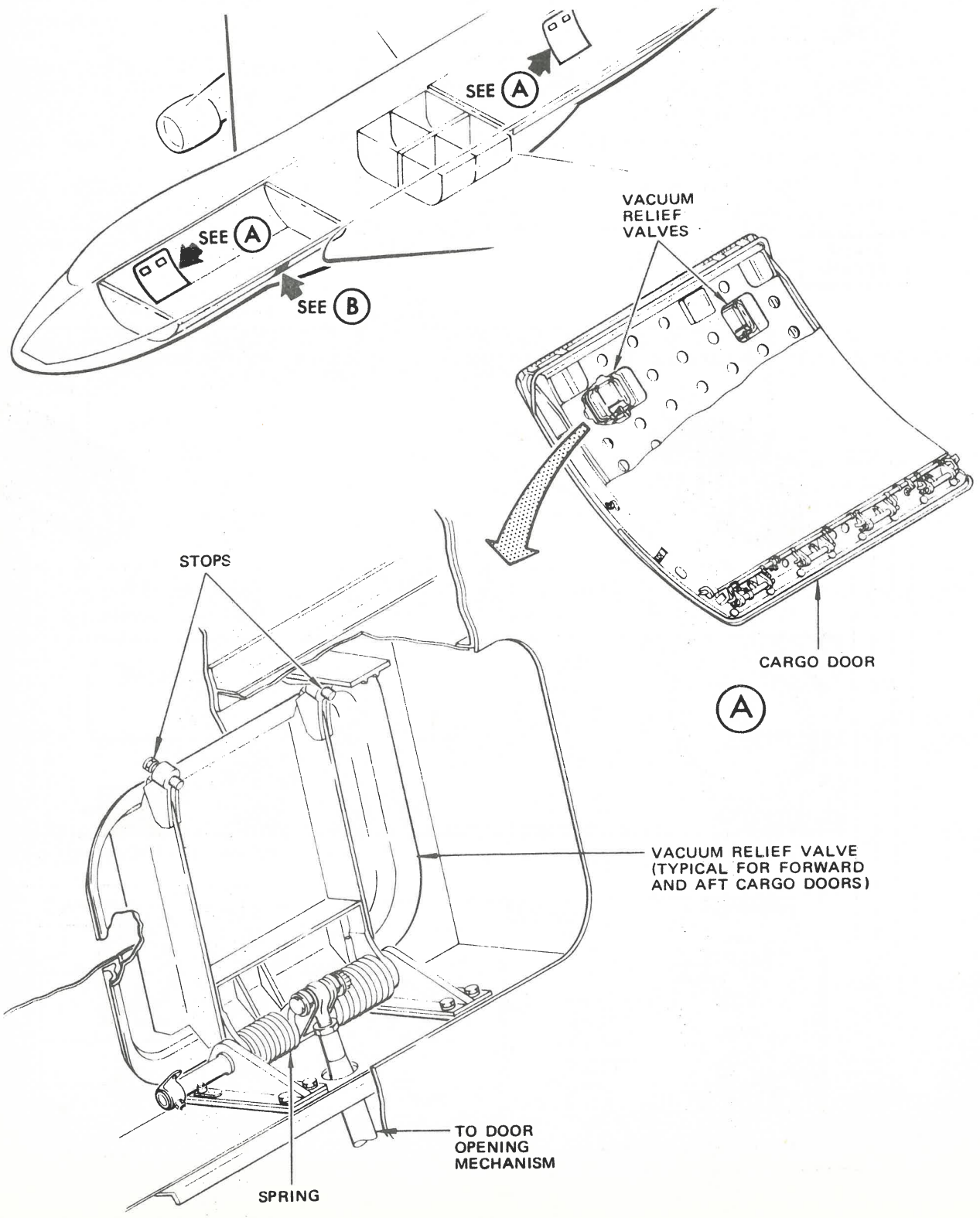
NOTE: Cabin upon reaching 15,000 feet will cause cabin altitude limiter on outflow valve to close valves.



PRESSURIZATION CONTROL SYSTEM



FWD & AFT CARGO DOOR RELIEF VALVES

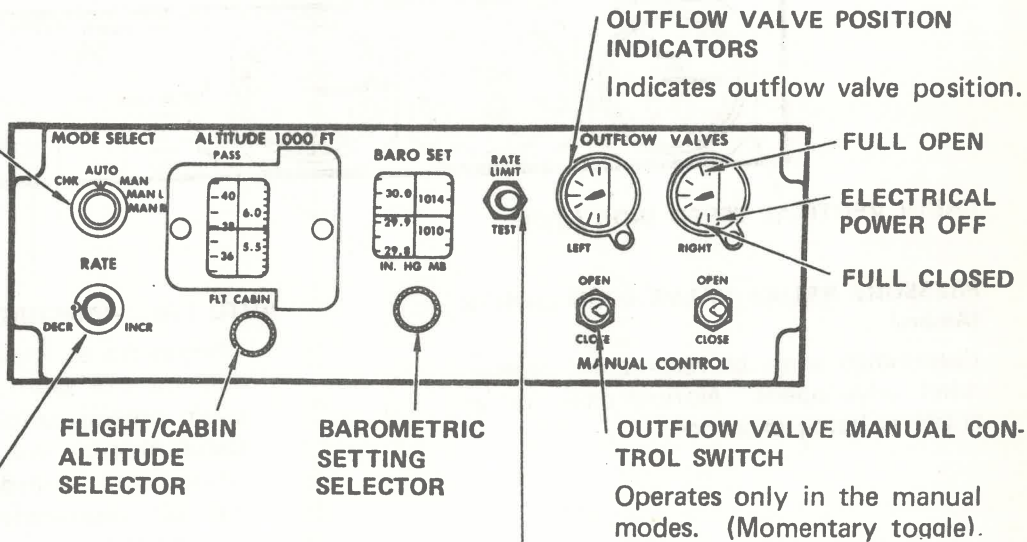


PRESSURIZATION CONTROL PANEL

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.

**FLIGHT
ENGINEER
PANEL**



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.

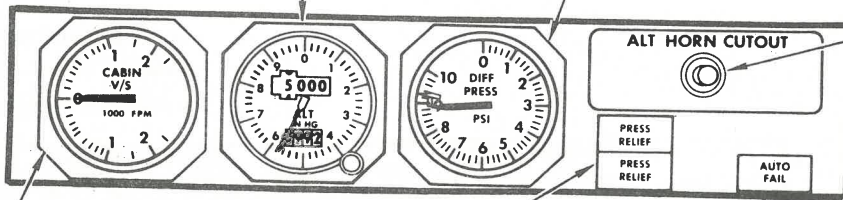
PRESSURIZATION MONITORING PANEL

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

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.

FLIGHT ENGINEER PANEL



EQUIPMENT COOLING AND CARGO HEAT SYSTEM:

Equipment cooling blowers pull conditioned air behind the cockpit electrical panels and through the main equipment racks. The warm exhaust air from the blowers is used in normal flight to heat the forward cargo compartment. The two main equipment cooling blowers are controlled by a three-position blower selector switch located on S/O panel. The flight deck blower operates any time AC power is available. Lack of air flow in the ducts illuminate a 'No Air Flow' light. If the 'No Air Flow' condition exists on the ground, a crew call horn will sound. The 'No Air Flow' light will not extinguish until reset button is pressed. A 'Smoke' light will illuminate when there is smoke in either equipment cooling duct. Illumination of the 'Smoke' light will open the flight deck dump valve, open the flow control valve, close the cargo shut-off valve and shut off the flight deck blower (in flight only).

A three-position valve control switch, located on S/O panel, provides control of the flow control valve and dump valve and is normally guarded in the normal position.

The aft cargo compartment is supplied heat from the pneumatic manifold through the control and over-ride valves, when compartment temperatures are below normal control range. With the aft cargo heat switch on S/O panel in normal, both the control valve and over-ride valve open and hot air flows directly into the compartment. Illumination of the heat 'On' light indicates both valves are open. Once temperature is satisfied, the thermostat control in the cargo compartment closes the control valve and extinguishes the heat 'On' light. Should an overheat condition exist in the aft cargo compartment, the overheat thermostat will close the over-ride valve, extinguish the heat 'On' light, and illuminate the 'Over-Heat Light.' The aft cargo heat system can be tested by placing the cargo heat switch to the Test position.



GENERAL

1. Forced airflow is provided through the equipment racks (main and flight deck) and is discharged into the forward cargo compartment for heating.
 - a. Equipment cooling control module on S/O panel provides control and warning for system.
 - (1) Guarded valve control switch provides control of valves for normal or emergency conditions.
 - (a) Normal position (ground only) – Provides control of blowers, closes cargo compartment valve and opens flow control valve by landing gear safety switch.

'1' In flight the forward cargo shutoff valve opens and the flow control valve will close when cabin differential pressure reaches a predetermined pressure.
 - (b) Smoke position – Provides control to open dump valve, opens flow control valve, closes forward cargo shutoff valve and turns off flight deck blower. (In Flight Only)
 - (c) Ditch position – Provides control to close dump and flow control valves. Forward cargo shutoff valve position will not change.

'1' The ditch position should not be selected on the ground as the cargo compartment valve will be closed preventing equipment cooling airflow.
 - (2) Smoke light will illuminate when equipment cooling smoke is detected.
 - (a) Illumination of this light will cause dump and flow control valves to open, close the forward cargo shutoff valve and stop flight deck blower.
 - (3) Smoke detector test switch provides a check of the smoke detector system.
 - (a) Smoke light illuminates.
 - (4) Blower selector switch provides control for main equipment rack blowers.
 - (a) Norm. position – Provides control for normal blower operation.
 - (b) ALT. position – Provides control for alternate blower operation.
 - (c) Test position – Turns off blowers, illuminates No Air Flow light and sounds ground crew call horn.

'1' After test system must be reset.
 - (5) No Air Flow light illuminates with insufficient airflow to equipment cooling system.
 - (a) Ground – Crew call horn sounds.
 - (b) Inflight – The system will automatically go to the smoke mode.
 - (6) No airflow reset switch provides a means of resetting the no airflow detection system.



AFT CARGO HEAT

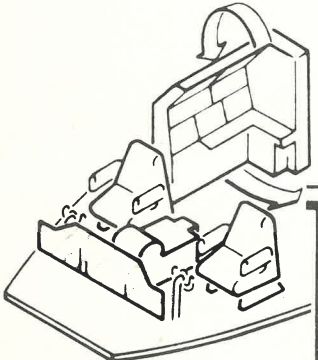
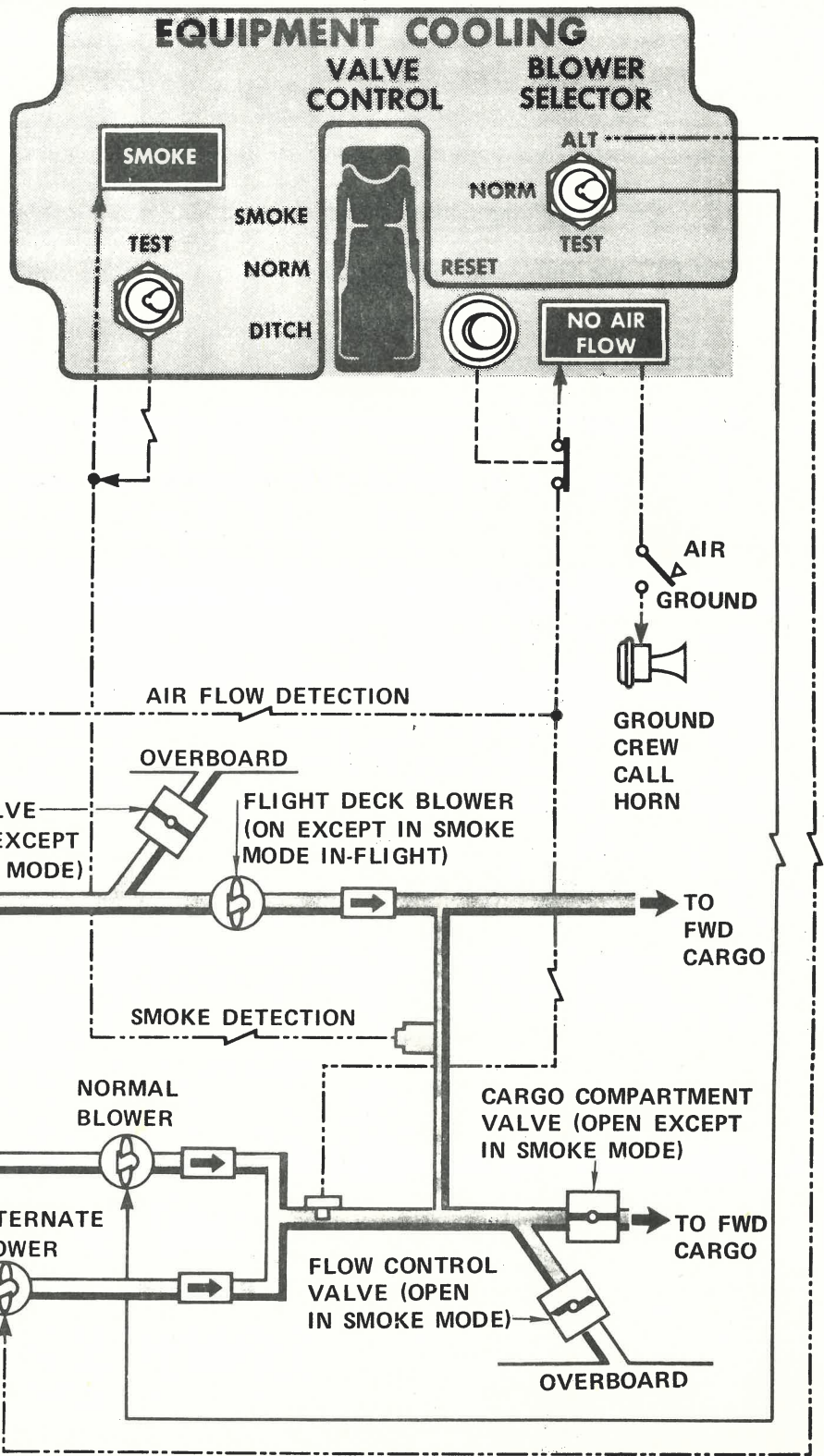
1. Aft cargo is heated from pneumatic air through two valves controlled by a three-position switch on S/O panel.
 - a. "Normal" position – Opens override valve.
 - (1) Override valve must be open to allow thermo- statically operated control valve to open.
 - (a) "ON" light illuminates when control valve is open.
 - b. "OFF" position – Closes override valve.
 - c. "Test" position – Opens both override valve and control valve to check system regardless of aft cargo temperature.
2. Overheat protection of aft cargo compartment causes override valve to close.
 - a. "Overheat" light will illuminate when override valve closes.

EQUIPMENT COOLING SYSTEM

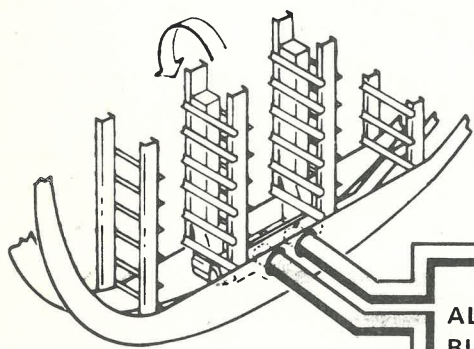
CONDITION: CRUISE

— EXHAUST AIR — CABIN AMBIENT

VALVE CONTROL SWITCH
 SMOKE — System in smoke mode.
 NORM — Flow control valve open on ground, closed in-flight.
NOTE: System will go to smoke mode if SMOKE or NO AIR FLOW light illuminates.
 DITCH — Flow control valve closed.

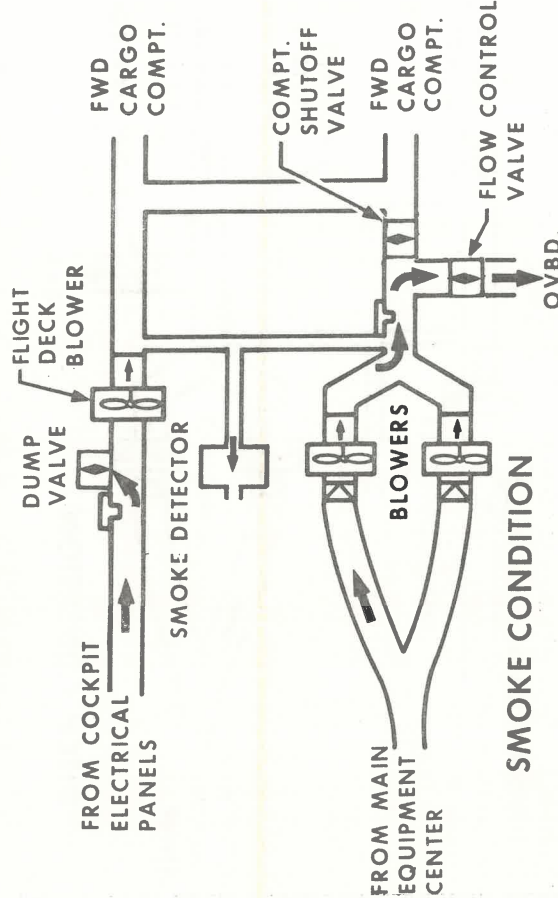
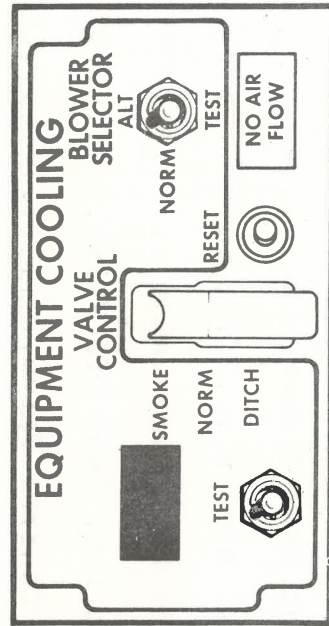


FLIGHT DECK COOLING

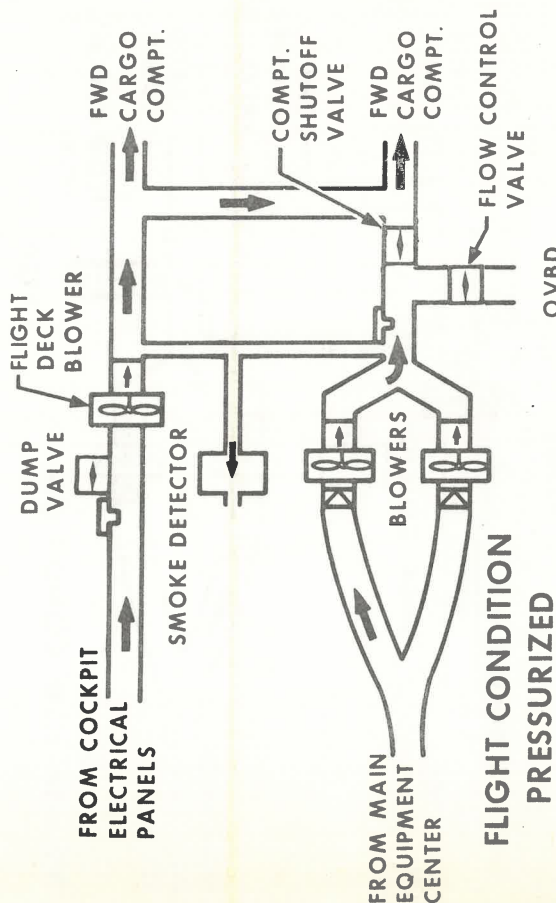
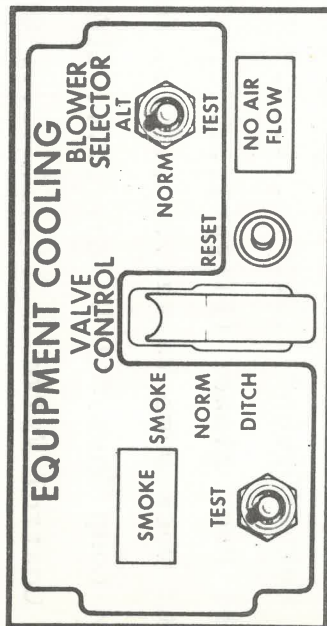


MAIN EQUIPMENT COOLING

EQUIPMENT COOLING CONDITIONS (NORMAL - SMOKE)



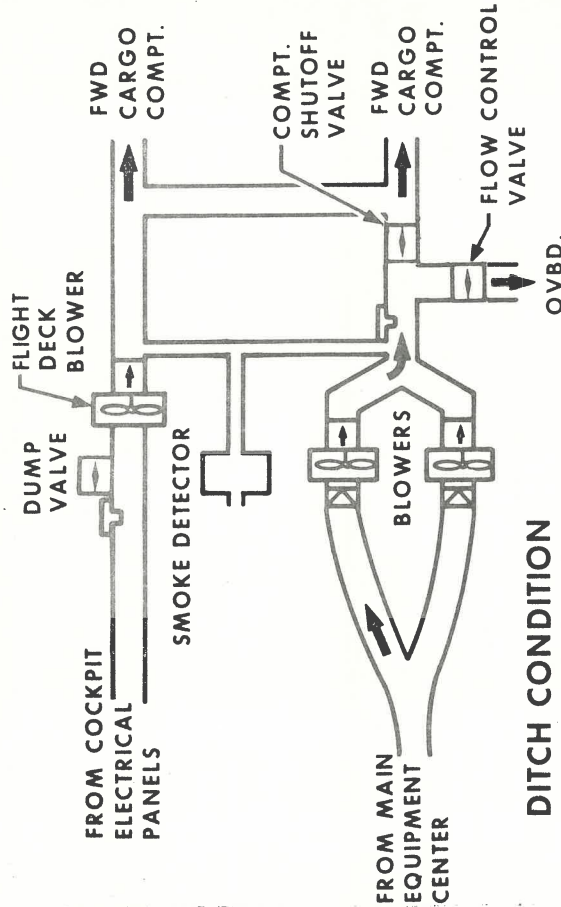
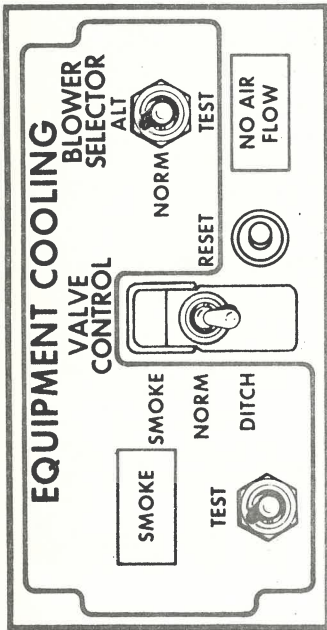
SMOKE CONDITION



**FLIGHT CONDITION
 PRESSURIZED**

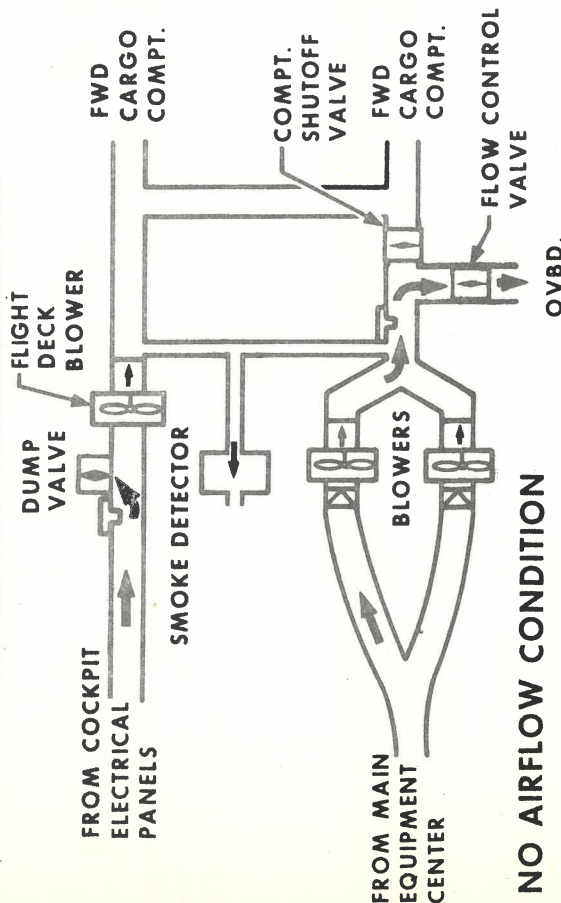
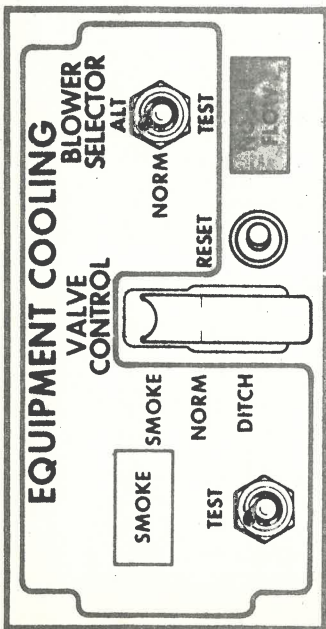
| | |
|----------------------------------|--------|
| Flight Deck Blower | OFF |
| Normal Blower | ON |
| Flight Deck Dump Valve | OPEN |
| Cargo Compt Shut Off Valve | CLOSED |
| Flow Control Valve | OPEN |

EQUIPMENT COOLING CONDITIONS (NO AIR FLOW - DITCH)



DITCH CONDITION

- Flight Deck Blower..... ON
- Normal Blower..... ON
- Flight Deck Dump Valve..... CLOSED
- Cargo Comp Shut Off Valve..... OPEN
- Flow Control Valve.....CLOSED

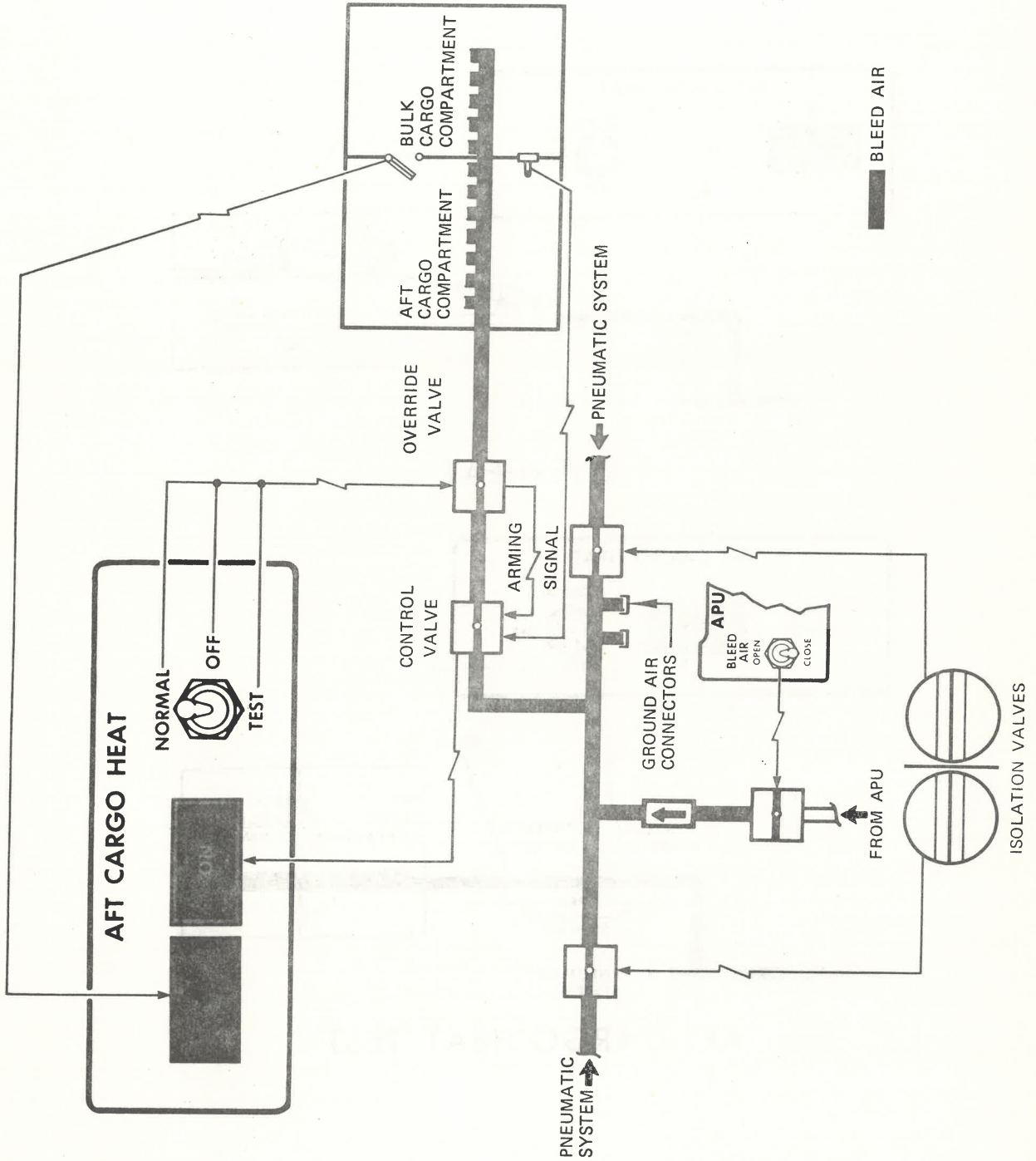


NO AIRFLOW CONDITION

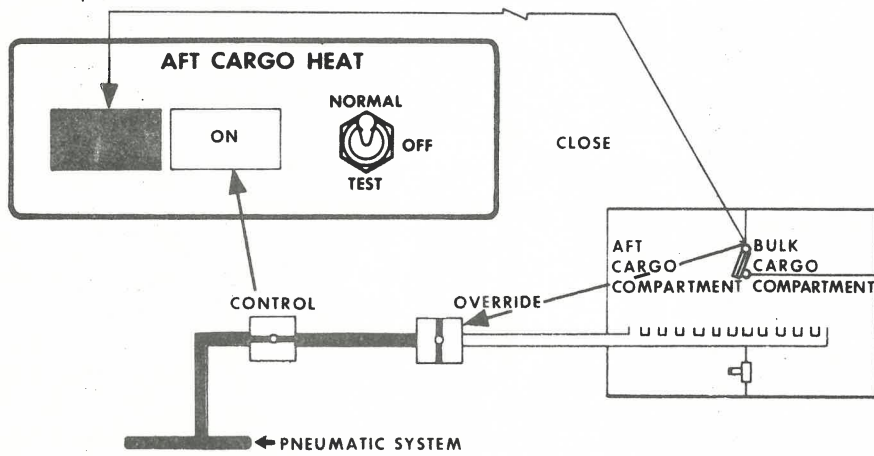
- Flight Deck Blower (Ground)..... ON
- Crew Horn (Ground).....SOUNDS
- Flight Deck Blower (Flight).....OFF
- Flight Deck Dump Valve..... OPEN
- Cargo Comp Shut Off Valve..... CLOSED
- Flow Control Valve OPEN



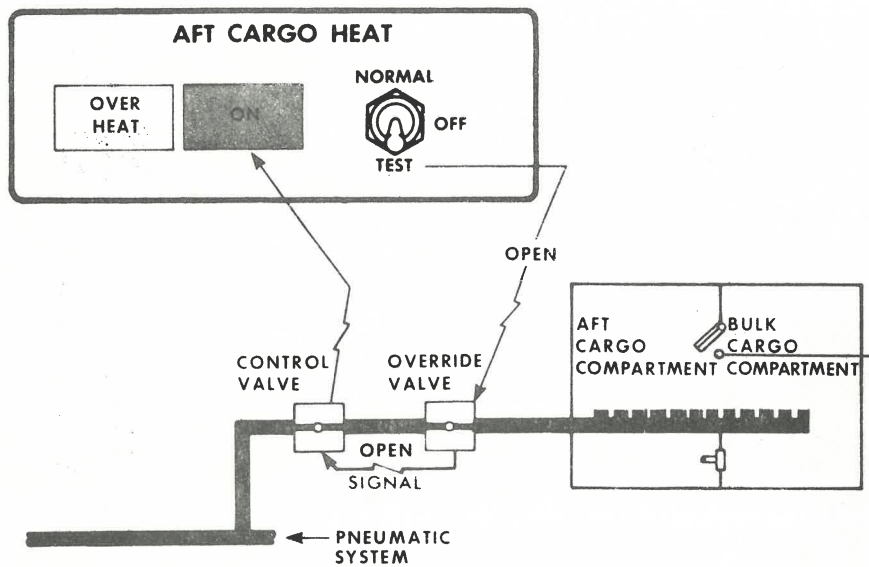
AFT CARGO HEAT SYSTEM



AFT CARGO HEAT (OVERHEAT AND TEST)



OVERHEAT



AFT CARGO HEAT TEST

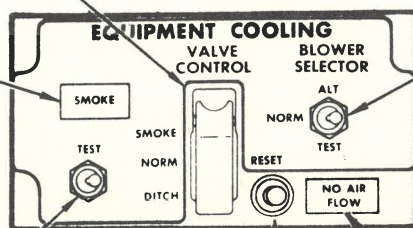
EQUIPMENT COOLING AND CARGO HEAT CONTROL PANEL

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 and all air will be routed into the forward cargo compartment.
SMOKE – System will go to smoke mode. Air dumped overboard.
DITCH – Closes lower overboard valve to prevent water entry upon ditching.

SMOKE DETECTOR LIGHT (Amber)

Illuminates during smoke test or when smoke is detected in the equipment cooling ducting. Cooling air is automatically discharged overboard. System will go to smoke mode.



BLOWER SELECTOR SWITCH

Selects either of two main blowers to provide cooling airflow in the lower electronics compartment. **TEST** position turns off main blowers. Flight deck blower continues to operate during **TEST**.

SMOKE DETECTOR TEST SWITCH

TEST – Checks the smoke detection system. **SMOKE** light illuminates.

NO AIR FLOW RESET SWITCH

Resets the equipment cooling system. **NO AIR FLOW** light will extinguish approx 30 seconds after air flow has been restored.

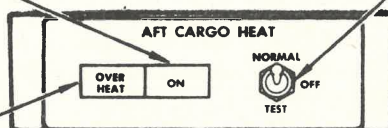
NO AIR FLOW LIGHT (Amber)

Illuminates to indicate less than normal cooling air flow. Ground crew call horn will sound continuously if light illuminates on ground. Until reset the system will go to smoke mode and cooling air flow maintained by cabin pressure differential.

FLIGHT ENGINEER'S PANEL

LOWER AFT CARGO HEAT ON LIGHT (Green)

Illuminates when heat is supplied to compartment. (Override and control valve open).



LOWER AFT CARGO HEAT SWITCH

NORMAL – When heat is required valves open and bleed air heats compartment.
OFF – Closes override and control valves.

LOWER AFT CARGO OVER-HEAT LIGHT (Amber)

Indicates compartment temperature is above normal.

TEST – Valves open regardless of compartment temperature.

FLIGHT ENGINEER'S PANEL

| | |
|---|----|
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| ALTERNATE OPERATING PROCEDURES | 03 |
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AUTO-FLIGHT SYSTEM:

The Automatic Flight Control System is an integrated system comprised of independent, yet related, systems: The Autopilot/Flight Director System, and the Auto-Throttle System. Primary controls for the Auto/Flight System are located on the Mode Select Panel mounted just under the glare shield. Here at your finger tips are the controls to set up the Flight Director for guidance or the Autopilot to fly you along any heading, airspeed, altitude, nav. radio course or INS course you desire.

FLIGHT DIRECTOR MODES:

Any time the 'Flt Dir' switch is on, the Flight Director command bar is in view for the respective ADI. The Flight Director pitch wheels moves the pitch bars up or down for pitch reference. The speed mode switch has two operating positions: The TURB position provides attitude control for optimum turbulence penetration with no heading reference and the IAS position provides for automatic pitch control reference to maintain the indicated airspeed existing at the time the IAS position is selected. The IAS or TURB position will trip off automatically when 'Alt Hold' is selected, a pre-selected altitude is captured, or when ILS glide slope is captured.

The Altitude Mode Select Switch has two operating positions: The 'Alt Hold' position will maintain altitude existing at time of engaging the switch. 'Alt Hold' switch automatically trips off when ILS glide slope is captured or when speed mode switch is moved to IAS or TURB position. The 'Alt Select' position may be used to capture and hold any altitude preset in the altitude selector window. Flight path must be set up prior to capture by using the pitch wheel control or by engaging the IAS position on the Speed Mode Selector, at the desired speed. When the altitude is captured, the Speed Mode Switch reverts to 'OFF' automatically.

The Course Transfer Switch has three operating positions: No. 1, Dual, and No. 2. The Dual position provides No. 1 VHF NAV and course information to 'A' Autopilot and the captain's Flight Director while No. 2 VHF NAV and course information to 'B' Autopilot and the first officer's Flight Director System. The No. 1 position provides No. 1 VHF NAV and course information for both Autopilots and Flight Director Systems. The No. 2 position provides No. 2 VHF NAV and course information for both systems. Selecting ILS or Land on the Navigation Mode Switch will revert the course transfer switch to 'Dual' automatically.

The Navigation Mode Switch selects the source of navigation information to be used by the Flight Directors or Autopilots. (A/P switch in command position). The Navigation Mode Switch has five positions:

1. INS - Arms the Flight Director/Autopilot to capture and track the INS course. Until the aircraft is within capture range of the INS course, the Flight Director/Autopilot will follow the selected heading on the Mode Select Panel.
2. HDG - The Flight Director/Autopilot will provide guidance or fly to the Magnetic Heading set in the selector window.
3. VOR/LOC - The Flight Director/Autopilot is armed to capture and track the selected VOR course or selected localizer. Prior to course capture, control is referenced to the heading in the selector window.
4. ILS - The Flight Director/Autopilot is armed to capture and track the localizer course and glide slope. Capture of the localizer is adjusted for angle of intercept and rate of closure. Prior to course capture, control is referenced to the heading selected in the Heading Selector.



AUTO-FLIGHT SYSTEM: (Continued)

Prior to Glide Slope capture, pitch control is referenced to whatever pitch control has been selected. (Pitch Wheel, Speed Mode Selector, or Altitude Mode Selector).

5. LAND - Arms the Flight Director/Autopilots (both channels) to provide normal ILS and Flare commands. Both autopilots may be engaged in Command position if both VHF NAV receivers are tuned to the same ILS frequency and the same course is selected on No. 1 and No. 2. The Flare Mode is armed in the Land position when the airplane is below 1500 feet of radio altitude and the autopilots begin dual channel operation. At 53 feet of radio altitude the Flare Command is captured.

The Back Beam Switch (B/B) provides non-ambiguous Flight Director roll commands on the back course of the localizer (VOR/LOC mode only). This is a Flight Director ONLY mode. Autopilot will drop to Manual if in command.

AUTOPILOT MODES:

MAN - When either autopilot engage switch 'A' or 'B' is in MAN position, conventional Autopilot operation is available by the Autopilot Flight Controller. In addition to being able to fly the Autopilot manually, Altitude Hold Mode and Turbulence Mode is also available.

COMMAND - When either Autopilot Engage Switch is in Command position, any pitch mode selected by Speed Mode Selector or Altitude Mode Selector and any Roll Mode selected by Navigation Mode Selector is available. Amber and red Autopilot lights illuminate to provide Autopilot faults or dis-engagement warning.

FLIGHT MODE ANNUNCIATORS:

Annunciators located on respective pilot instrument panels are divided to show Flight Director Modes armed and captured on the left while the right side provides information concerning Autopilot Modes armed or captured.

ALT SEL - Armed by selecting the Altitude Select Switch.

NAV - Armed by selecting INS, VOR/LOC, ILS or LAND positions on the Navigation Mode Switch.

GS - Armed by selecting ILS or LAND.

FLARE - Armed at 1500 feet of Radio Altitude when in LAND Mode with G/S and LOC captured.

GO-AROUND (Flight Director only) - Armed by Glide Slope Capture.



FREIGHTER

22:01F

AUTO-PILOT AND FLIGHT DIRECTOR

There are no significant changes in the flight guidance system on the B-747F.

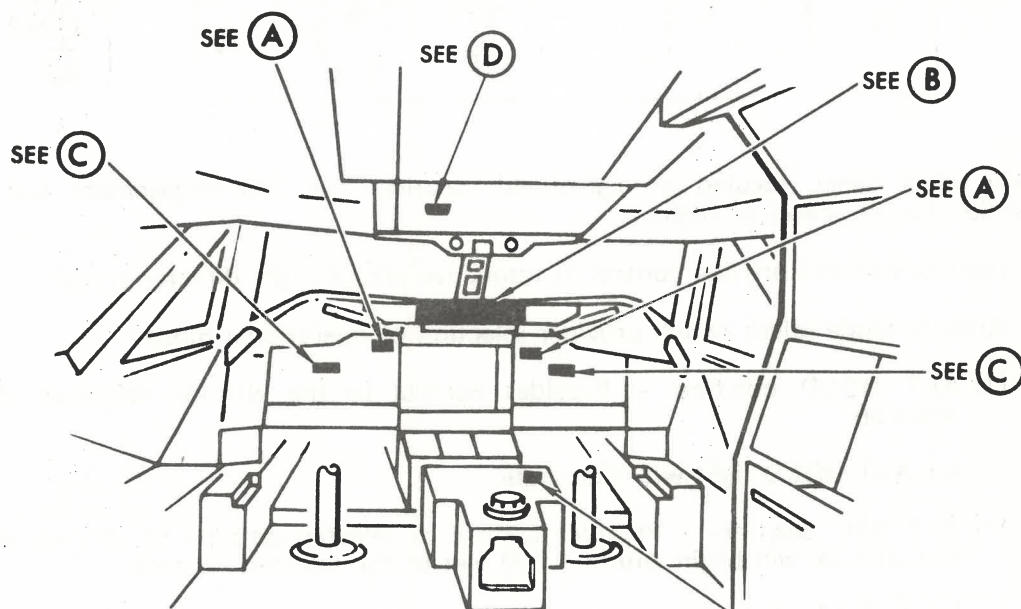
The "Altitude Pre-Select" mode tolerances have been tightened, to provide better altitude capture.

Automatic stabilizer trim during A/P operation will now pulse at 5 second intervals during the "Altitude Pre-Select" and "Altitude Hold" modes.

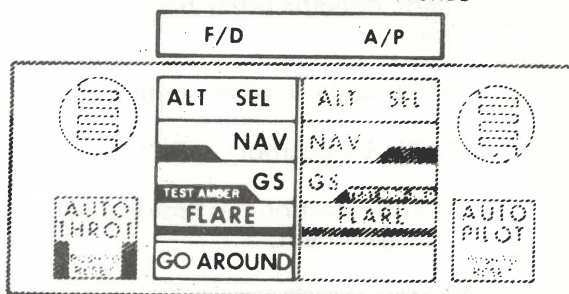
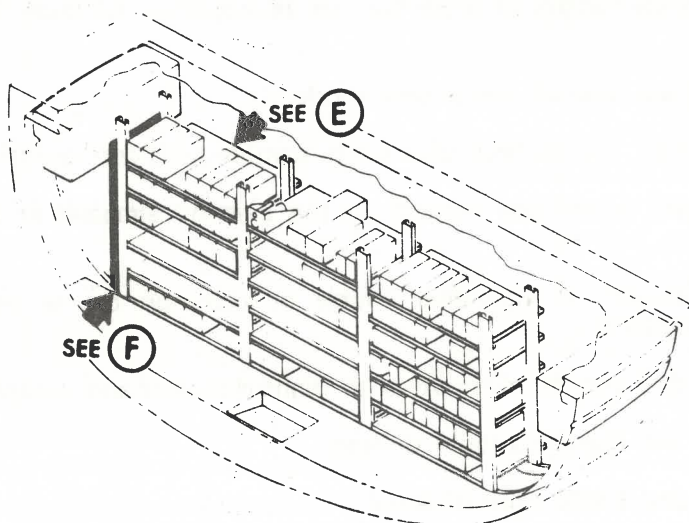
Selecting the "Turbulence Mode" will not disable the automatic stabilizer trimming as it now does on the present fleet.

FLIGHT DIRECTOR:

1. Flight Director System provides the pilots with attitude information from the INS system, heading information from the magnetic heading reference system, computed air data information from central air data system, altitude information from radio altimeter system, and radio information from VOR/ILS system.
 - a. Flight mode annunciation is provided the pilots, displaying the armed and capture modes.
 - b. Navigation/attitude transfer system allows the pilots to select an alternate signal source in the event of system failure.

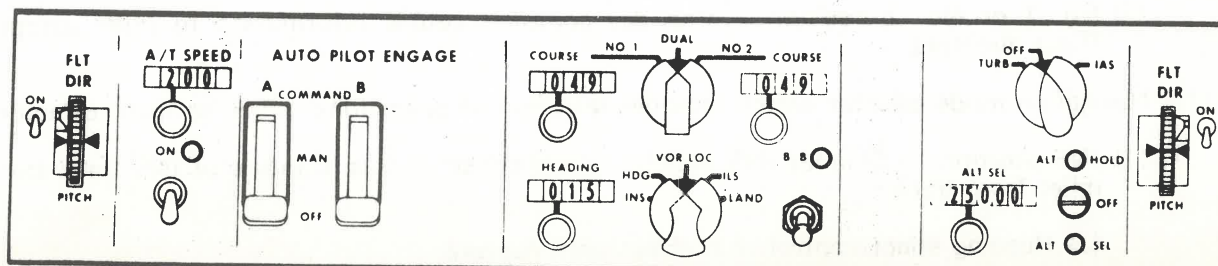


PALM OPERATED
 GO-AROUND SWITCHES



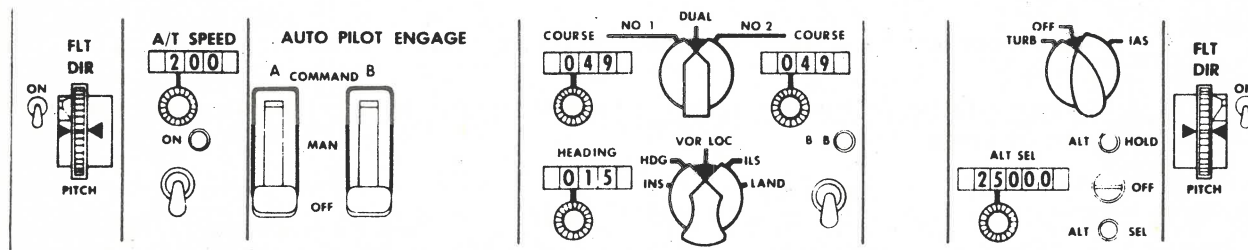
FLIGHT MODE
 ANNUNCIATOR

(A)



FLIGHT DIRECTOR:

AP—FD MODE SELECT PANEL



1. Mode select panel, located on lightshield, provides for F/D engagement and operational mode selection for all phases of flight.
 - a. Control switches provide control of respective pilot's flight director system.
 - b. Altitude mode select switch provides selection of operational mode.
 - (1) ALT HOLD position — Provides control to the altitude reference existing at time of selection.
 - (a) ALT HOLD light will illuminate.
 - (2) ALT SEL position — Provides control to selected altitude by altitude selector. Capture of this altitude will begin within 1,200 feet of the selected altitude.
 - (a) ALT SEL light will illuminate.
 - c. Flight director pitch trim wheels provide control of pitch bar, on its respective Attitude Director Indicator.
 - d. Speed mode selector switch provides selection of operational mode.
 - (1) TURB position — Provides wing level and lowered gain pitch attitude hold configuration.
 - (2) IAS position — Provides automatic pitch axis control to the existing airspeed at time of engagement.
 - e. Course transfer switch provides selection of individual course or common course reference information to flight directors and autopilots.
 - (1) DUAL position — Provides individual course information to flight directors and autopilots.
 - (a) Nav. No. 1 — Autopilot "A" and Captain's flight director.
 - (b) Nav. No. 2 — Autopilot "B" and F/O's flight director.
 - (2) No. 1 or No. 2 position — Provides common course information to both autopilots and flight directors.
 - f. Navigation mode selector switch provides selection of operational mode to flight director.
 - (1) INS position — Couples INS system to flight instruments. Capture of INS track starts at 7.5 miles from track.
 - (a) Heading select control is in effect until capture.



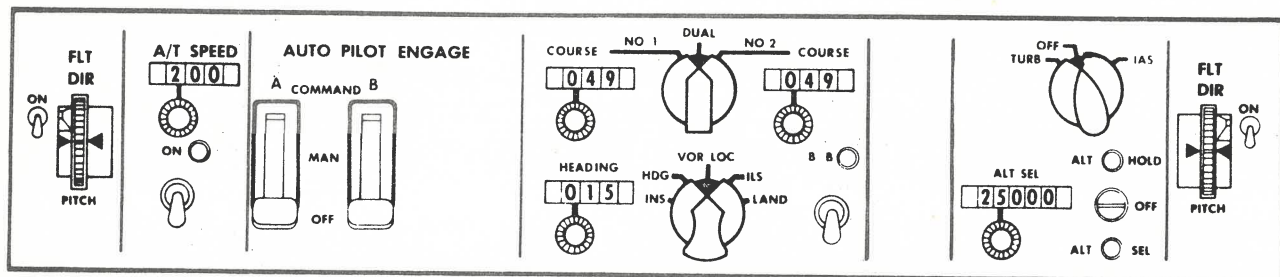
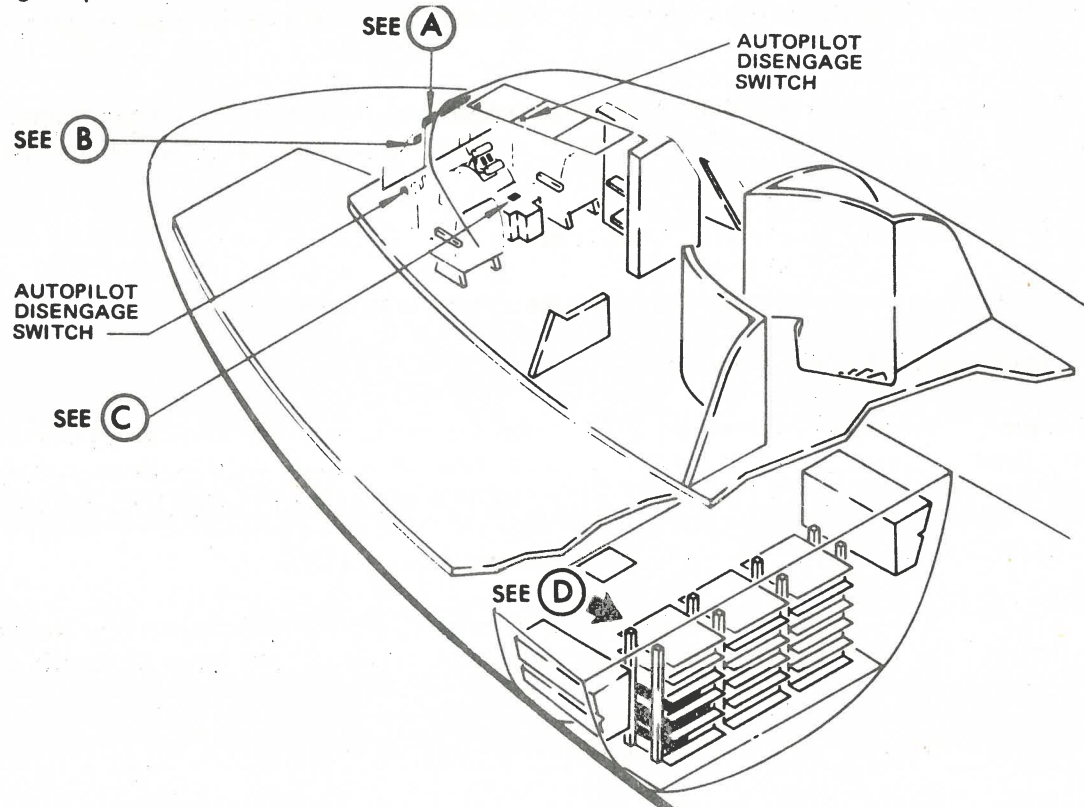
FLIGHT DIRECTOR:

AP-FD MODE SELECT PANEL (Cont.)

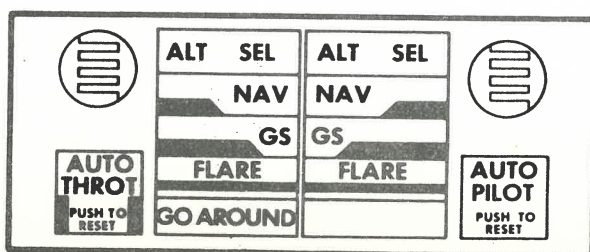
- (2) HDG position - Couples flight director system to a selected heading reference, as set by the heading selector knob.
 - (a) Heading is displayed in window, on mode select panel.
 - (b) Heading bug on both horizontal situation indicators are controlled by heading selector knob.
- (3) VOR/LOC position - Provides VOR or localizer control to flight director system. Capture depends upon angle of intercept and rate of closure for localizer or angle of intercept only for VOR.
 - (a) Heading select control is in effect until capture.
 - (b) Back beam switch provides selection of back course localizer control.
 - '1' Back Beam light will illuminate.
- (4) ILS position - Provides localizer and glide slope control to flight director. Localizer capture depends upon angle of intercept and rate of closure. Glide slope can be intercepted above or below slope and capture can be made only after capturing localizer.
 - (a) Heading select and pitch control are in effect until capture
 - (b) After glide slope capture, the go-around function is armed. Actuating go-around switches (on No. 2 and No. 3 thrust levers) will display wings level 12 pitch up attitude.
- (5) Land position - Used during autoflight operation with flare mode.

AUTOPILOT:

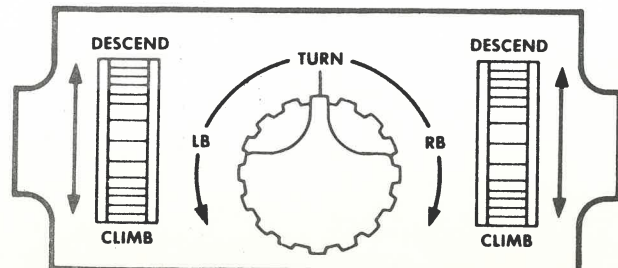
1. The automatic flight system provides computed commands to the airplane control surfaces, obtaining and maintaining the desired flight path or altitude. The auto flight system also provides fail safe, dual channel (A and B) auto land capability, through glide slope capture and flare control.
 - a. An auto throttle system assists in landing and in holding patterns.
 - b. Flight mode annunciation is provided to display the armed and capture modes, during auto flight operation.



MODE SELECT PANEL



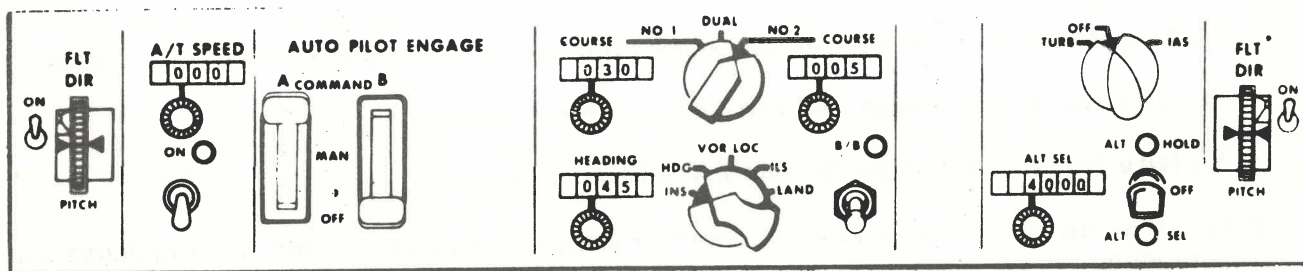
FLIGHT MODE ANNUNCIATOR



FLIGHT CONTROLLER

AUTOPILOT:

A/P – F/D MODE SELECT PANEL



1. Mode select panel located on lightshield provides for A/P engagement and operational mode selection in all flight regimes.
 - a. Engage switches (A or B Autopilot) provide selection of manual or command operating modes.
 - (1) Manual position – Provides automatic control to basic attitude and heading reference.
 - (a) Pitch and roll attitude are controlled by flight controller, located on aft electronic panel.
 - (2) Command position – Provides command operation to autopilot as determined by the mode select switches.
 - (a) Roll command is provided by NAV mode selector switch.
 - (b) Pitch command is provided by altitude or Turb/Speed mode selector switches.
 - b. Altitude mode select switch provides selection of operational mode.
 - (1) ALT Hold position – Provides control to the altitude reference existing at time of selection.
 - (a) ALT Hold light will illuminate.
 - (2) ALT Select position – Provides control to selected altitude by altitude selector. Capture of this altitude will begin within 1200 feet of the selected altitude.
 - (a) ALT SEL light will illuminate.
 - c. Speed mode selector switch provides selection of operational mode.
 - (1) Turb position – (Operative in manual mode only) provides wings level and lowered gain pitch attitude hold configuration.
 - (2) IAS position – Provides automatic pitch axis control to the existing airspeed at time of engagement.
 - d. Course transfer switch provides selection of individual course or common course reference information.



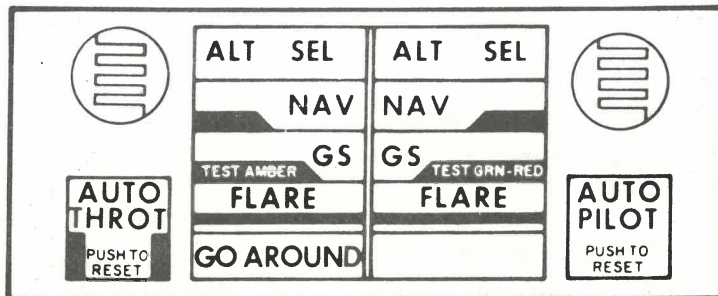
AUTOPILOT:

A/P – F/D MODE SELECT PANEL (Cont.)

- (1) DUAL position – Provides individual course information to flight directors and autopilots.
 - (a) NAV No. 1 – Autopilot "A" and Captain's Flight Director.
 - (b) NAV No. 2 – Autopilot "B" and F/O's Flight Director.
 - (2) No. 1 or No. 2 position – Provides common course information to both flight directors and autopilots.
- e. Navigation mode selector switch provides selection of operational mode to autopilot.
- (1) INS position – Couples INS system to autopilot. Capture of INS track starts at 7.5 nautical miles from track.
 - (a) Heading select control is in effect until capture.
 - (2) HDG position – Couples autopilot to a selected heading selector knob.
 - (a) Heading is displayed in window, on mode select panel.
 - (b) Heading bugs on both horizontal situation indicators are controlled by heading selector knob.
 - (3) VOR/LOC position – Provides VOR or localizer control to autopilot system. Capture depends upon angle of intercept and rate of closure for localizer or angle of intercept only for VOR.
 - (a) Heading select control is in effect until capture.
 - (4) ILS position – Provides localizer and glide slope control to autopilot. Localizer capture depends upon angle of intercept and rate of closure. Glide slope can be intercept from above or below slope and capture can be made only after capturing localizer.
 - (a) Heading select and pitch control are in effect until capture.
 - (5) LAND position (operative only in DUAL position of course transfer switch) – Provides dual channel auto land operation with flare mode. Dual channel operation will not begin until localizer/glide slope capture, radio altitude less than 1,500 feet, and both engage switches in COMMAND position.
 - (a) Unless both engage switches are in COMMAND position at 150 feet of radio altitude, autopilot will disengage.
 - '1' Autopilot Red Warning light on mode annunciator flashes and wailer sounds.



FLIGHT DIRECTOR/AUTO PILOT:

FLIGHT MODE ANNUNCIATOR

1. Flight mode annunciators, located on the respective pilot's instrument panel, display operating mode status and malfunction warnings to auto flight system.
 - a. ALT Select light – Illuminates amber when altitude mode select switch is placed to ALT Select position.
 - (1) Green when selected altitude is captured.
 - b. NAV light – Illuminates amber when navigation mode switch is positioned to INS – VOR/LOC – ILS or Land position.
 - (1) Green after capture.
 - c. GS light – Illuminates amber when navigation mode switch is in ILS or Land position.
 - (1) Green after capture.
 - d. Flare light – Illuminates amber at glide slope capture.
 - (1) Green at predetermined flare point.
 - e. Go-Around light – Used for flight director operation only.
 - f. Autopilot light
 - (1) Flashing amber – System in land mode, but second A/P engage switch not in command.
 - (2) Steady red – Indicates an invalid signal to A/P system.
 - (3) Flashing red – System disconnected.
 - g. Auto Throttle light
 - (1) Amber – Airspeed error in excess of ± 10 knots.
 - (2) Steady red – Self test switch on computer not in off position.
 - (3) Flashing red – System disconnected.

NOTE: Pushing F/D side of display illuminates all amber lights. Pushing A/P side of display illuminates all green lights.

FLIGHT DIRECTOR/AUTOPILOT MODE SELECTOR PANEL:

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

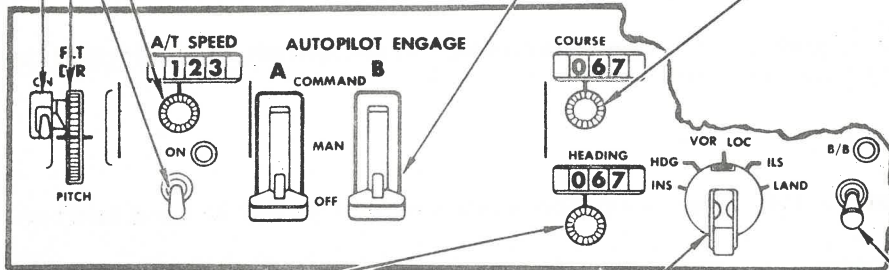
Rotation of the selector sets the desired autothrottle airspeed on the adjacent digital indicator.

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.

FLIGHT DIRECTOR/AUTOPILOT MODE SELECTOR PANEL:

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.

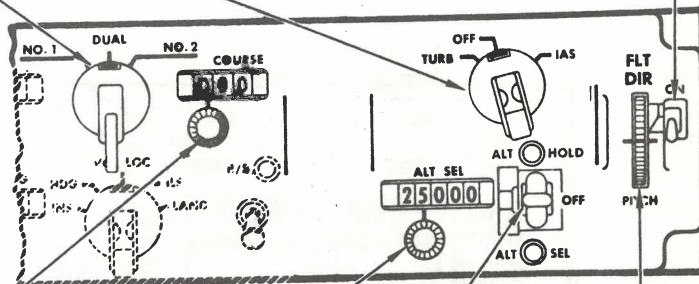
COURSE TRANSFER SWITCH

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.

FLIGHT DIRECTOR SWITCH (FIRST OFFICER)
(First Officer's ADI)



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.



FLIGHT MODE ANNUNCIATOR:

FLIGHT DIRECTOR APPROACH PROGRESS DISPLAY

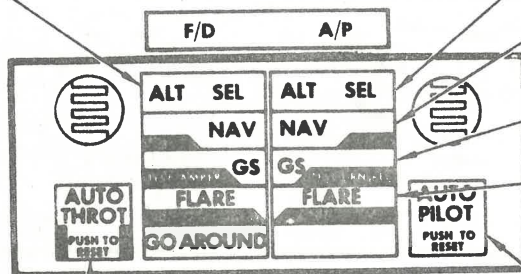
ALT SEL }
NAV } Same light functions as in autopilot
GS } operation.
FLARE }

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.

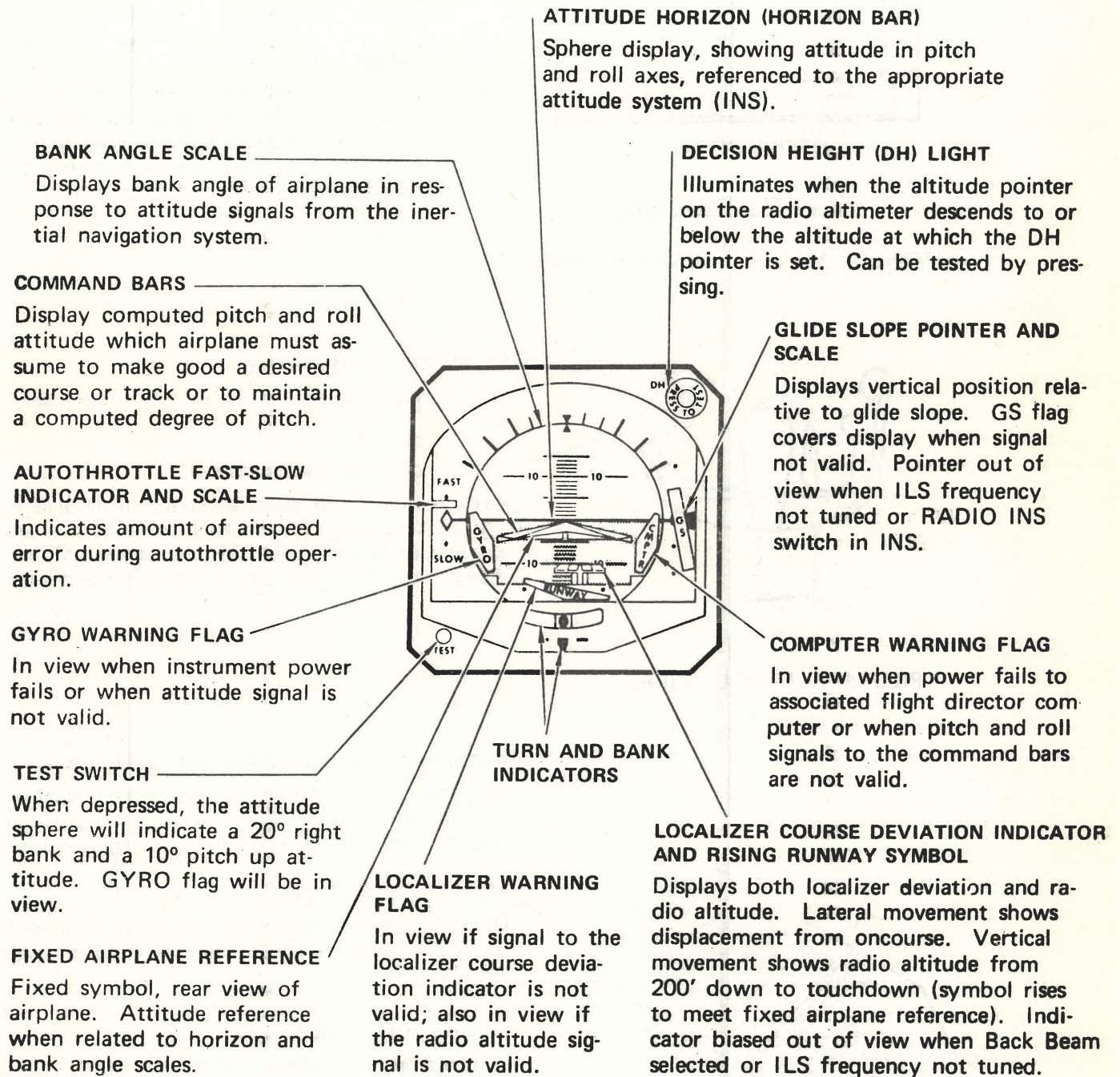
FLASHING RED (Momentary) – System disengaged. Flashes (and aural warning sounds) only as long as disengage switch on control wheel is held depressed.

Will flash continuously for fault disengagement. Reset by single push on control wheel switch or by pushing light cap.

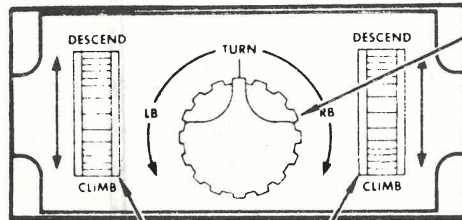
TESTS –

- Pushing F/D (TEST AMBER) side of display will illuminate all amber lights; pushing A/P (TEST GRN-RED) side will illuminate all red and green lights and will cause autothrottle warning light at other pilot's display to flash red.
- Pushing autopilot warning light will illuminate both autopilot warning lights flashing red and will cause aural warning to sound.
- Pushing autothrottle warning light will illuminate both autothrottle warning lights flashing red.

FLIGHT DIRECTOR (ATTITUDE DIRECTOR INDICATOR)



AUTOPILOT CONTROLS



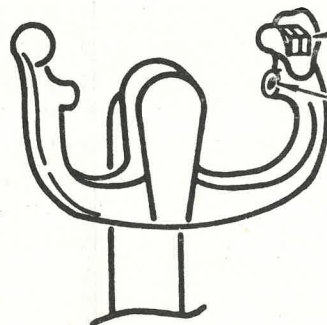
PITCH CONTROLS

AFT ELECTRONICS PANEL

TURN CONTROL

- For use with autopilot in MANUAL operation.
- In single channel operation (COMMAND), moving control out of detent will disengage autopilot from COMMAND to MAN.
- In dual channel operation (LAND), moving control out of detent will disengage one channel to OFF and one channel to MAN if flare is not armed. If flare is armed, the turn controller will cause both channels to disengage to OFF.

AUTOPILOT MANUAL CONTROL MODULE



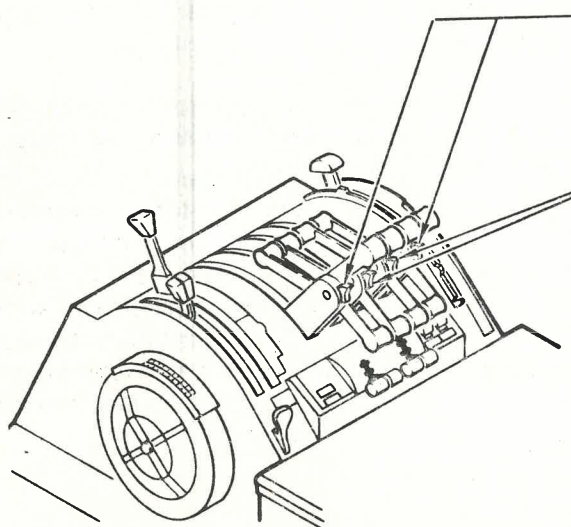
STABILIZER TRIM SWITCH

Switch activation will cause autopilot disengagement.

AUTOPILOT DISENGAGE SWITCH

Pushing switch will cause autopilot to disengage, autopilot warning light to flash red, and the aural warning to sound. Releasing the switch will extinguish the light and silence the aural warning.

PILOTS' CONTROL WHEEL



THRUST LEVERS

AUTOTHROTTLE DISENGAGE SWITCHES (1 & 4)

Depressing either switch will disengage the autothrottle only and cause the autothrottle warning light to flash red as long as the switch is depressed.

GO AROUND SWITCHES (2 & 3)

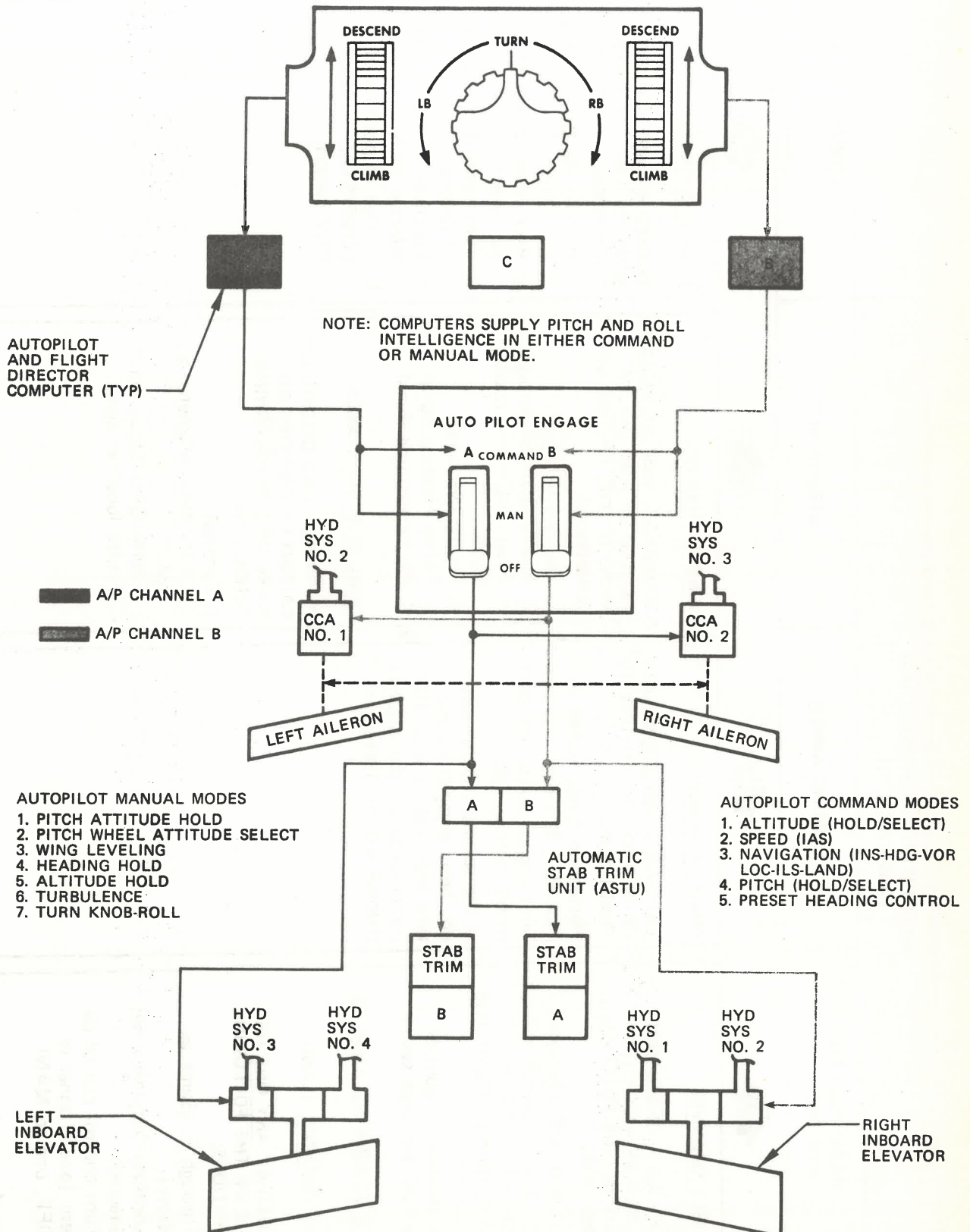
Depressing either switch will disengage the autothrottle in the same manner as the autothrottle disengage switches.

In ILS or LAND mode (after glide slope capture), depressing either switch will:

- Disengage the autopilot and autothrottle. (AUTOPILOT 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, pre-determined pitch up command.

MISCELLANEOUS AUTOPILOT CONTROLS

AUTOPILOT SIGNAL FLOW SCHEMATIC:



AUTOPILOT WARNING LIGHTS:

| AUTOPILOT WARNING LIGHTS (AND WAILER) | | | |
|--|---|--|---|
| FLASHING RED (AND WAILER) | FLASHING AMBER | STEADY RED | COMMAND TO MAN |
| <p>SINGLE CHANNEL</p> <p>WARNING - (DISENGAGE) CAUSED BY ANY ONE OR MORE OF THE FOLLOWING CONDITIONS:</p> <ol style="list-style-type: none"> 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. <p>(SEE FLASHING AMBER)</p> <p>DUAL CHANNEL (LAND)</p> <p>CAUSED BY ANY ONE OR MORE OF THE FOLLOWING CONDITIONS:</p> <ol style="list-style-type: none"> 1. Through 5. (Same as above). 6. Localizer frequency not selected. 7. Turn control out of detent (one channel to OFF, one to MAN). <p>*Use of manual trim levers will <u>not</u> cause disengage.</p> | <p>SINGLE CHANNEL</p> <p>CAUTION - (NO DISENGAGE) CAUSED BY THE FOLLOWING CONDITION:</p> <p>Navigation mode switch in "LAND", but only one autopilot engage switch in "command" (above 150').</p> <p>If the second channel has not been engaged by the time the airplane is at 150' (radio altitude), the engaged channel will be disengaged.</p> | <p>SINGLE CHANNEL</p> <p>WARNING - (NO DISENGAGE) CAUSED BY ANY ONE OR MORE OF THE FOLLOWING CONDITIONS:</p> <ol style="list-style-type: none"> 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. <p>DUAL CHANNEL (LAND)</p> <p>WARNING - (NO DISENGAGE) CAUSED BY ANY ONE OR MORE OF THE FOLLOWING CONDITIONS:</p> <ol style="list-style-type: none"> 1. Cam-out. 2. Faulty radio altimeter signal. 3. Faulty Glide Slope signal. 4. Faulty localizer signal. | <p>SINGLE CHANNEL</p> <p>CAUSED BY ANY ONE OR MORE OF THE FOLLOWING CONDITIONS:</p> <ol style="list-style-type: none"> 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. |



AUTOMATIC STABILIZER TRIM SYSTEM

Dual automatic stabilizer trim units are continuously functioning any time the autopilot is in Manual or Command operation. The system provides only an 'Amber' warning for that system with a computer or mechanical malfunction. The only action is to switch to the other autopilot system.

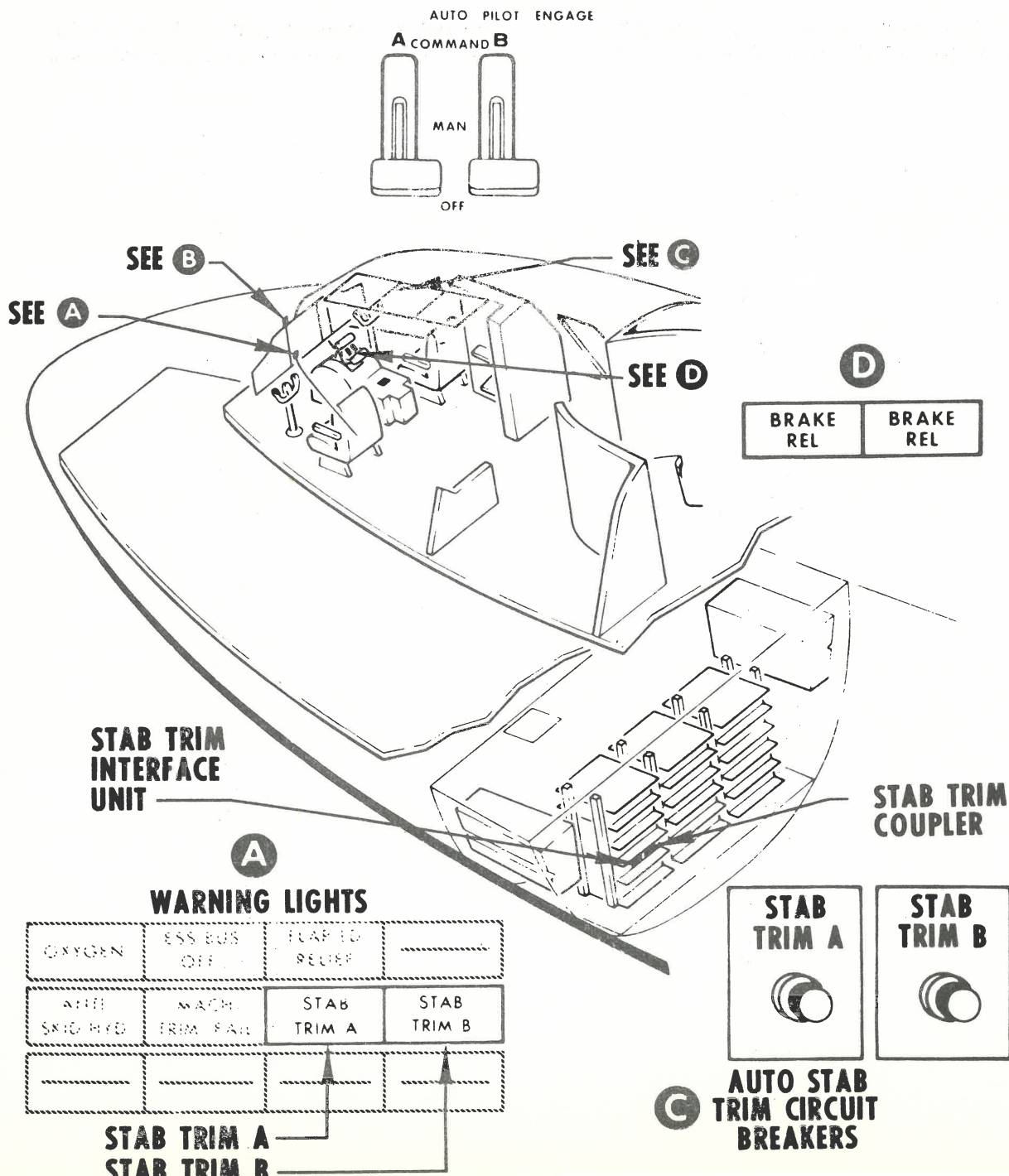
The purpose of the automatic stabilizer trim unit is to remove elevator loading during autopilot operation by trimming the stabilizer. The automatic stabilizer trim unit is operational for any mode of ENGAGED autopilot operation. During the 'Turbulence' mode, the automatic stabilizer trim unit remains engaged but DOES NOT TRIM the stabilizer. The warning lights remain operative.

In Dual autopilot operation (Land Mode), the first autopilot engaged will have its 'ASTU' active. The second 'ASTU' will remain in standby and will take over automatically in case of a failure.

AUTOMATIC STABILIZER TRIM SYSTEM (ASTU)

1. The automatic stabilizer trim system provides stabilizer trim whenever the autopilot is engaged.
 - a. Channel A or B automatic stabilizer trim system is engaged through respective A/P engage switches.
 - b. Stab Trim A and Stab Trim B lights are located on center instrument panel and illuminate if failure of automatic stabilizer trim system or if stabilizer and elevator are out of trim by 2 1/2°.

NOTE: During dual-channel operation of the autopilot, a malfunction occurring in the ASTU system, that system will automatically disengage and the alternate system will switch in.



**AUTOMATIC STABILIZER TRIM WARNING LIGHTS:**PILOTS' CENTER PANEL**AUTO STAB
TRIM A****AUTO STAB
TRIM B****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).



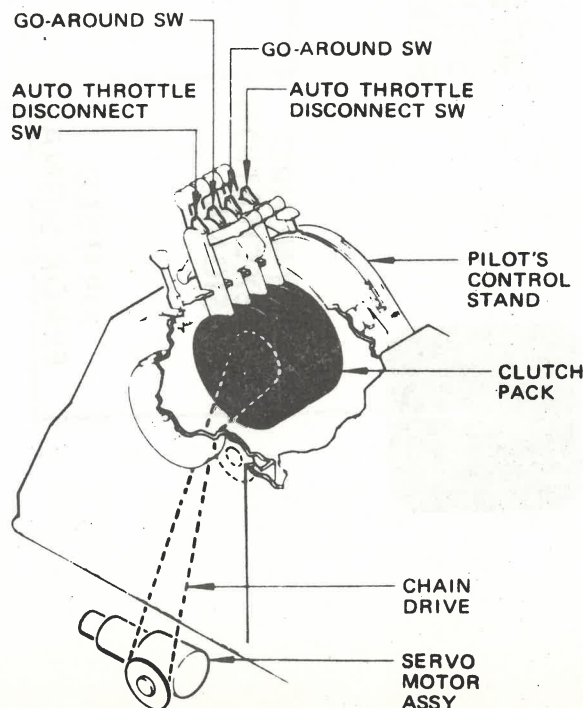
AUTO THROTTLE SYSTEM:

The auto-throttle speed selector permits a speed of 99 - 259 knots to be set in the display. This speed in the selector window references the fast/slow speed indicators on the left side of both ADI's, regardless of the position of the auto-throttle engage switch. The speed selector also positions the internal speed command bug on the Mach/Airspeed indicators.

When the auto-throttle engage switch is positioned to ON, the indicator light illuminates and the auto-throttle speed system takes control of the throttles to maintain selected speed. The throttles can be over-ridden at all times by the pilot. Auto-throttle disconnect switches are located on each of the four throttle levers to be actuated by the palm or heel of the hand. The actuation of any one switch disengages the auto-throttle system. The switches on No. 2 and No. 3 throttles also actuate the 'Go-Around' command on the flight director system, when armed. The auto-throttle warning lights will show 'Amber' whenever the speed is above or below 10 knots in reference to the selected speed. The auto-throttle warning lights will flash red, whenever the auto-throttles are disconnected.

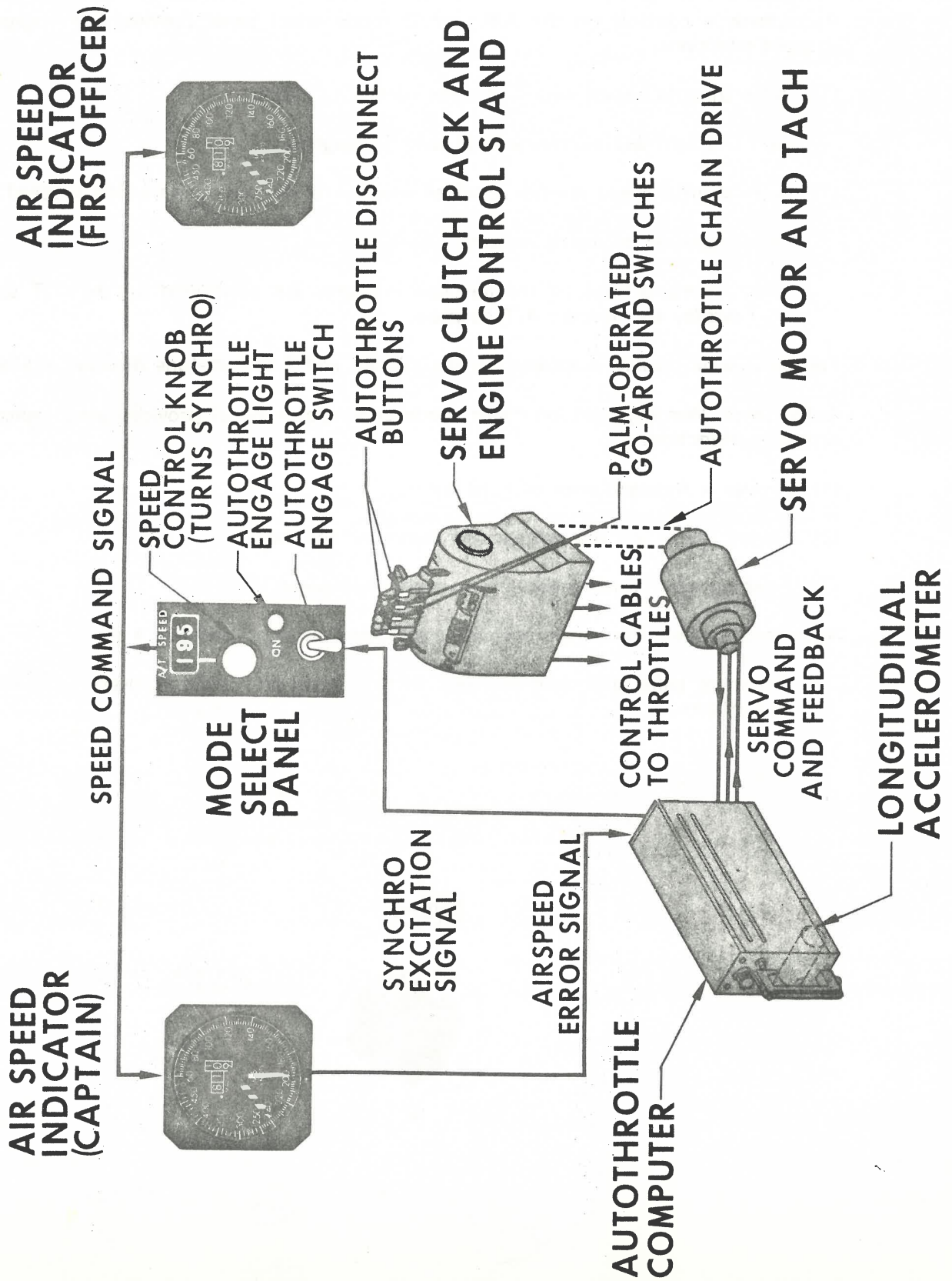
AUTO-THROTTLE SYSTEM:

1. Auto throttle system provides control of aircraft thrust levers to maintain a preselected airspeed during maneuvering, approach and landing phases of flight.
 - a. Auto throttle controls on the A/P – F/D mode select panel provide A/T engagement and airspeed selections.
 - (1) Auto throttle engage switch provides control of system.
 - (a) ON light will illuminate with switch engagement.
 - (2) Auto throttle speed selector provides selection of desired auto throttle airspeed.
 - (a) Displayed on digital indicator.
 - (b) Command bugs on the airspeed indicator are positioned by the A/T selector and display the selected A/T airspeed.
 - b. Fast/slow scale display is located on the captain and F/O's attitude director indicator (ADI).
 - c. Auto Throt Warning light on flight mode annunciator panel provides alert indications and system malfunction.
 - (1) Amber – Airspeed error of ± 10 knots.
 - (2) Steady red – Self test switches on computer not "off".
 - (3) Flashing red – System has automatically disengaged.
 - d. Auto throttle palm disconnect switches are located on No. 1 and No. 4 thrust levers.
 - (1) Actuating palm go-around switches on No. 2 and No. 3 thrust levers will also disengage A/T system.



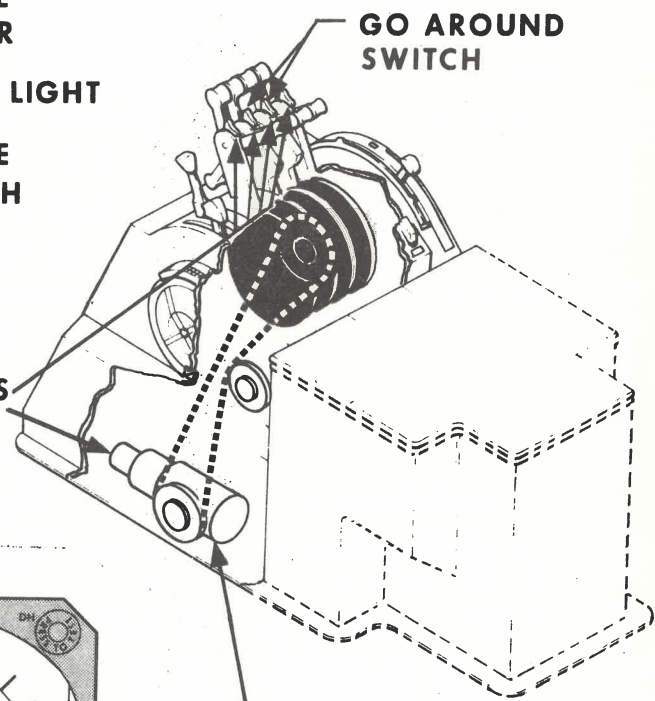
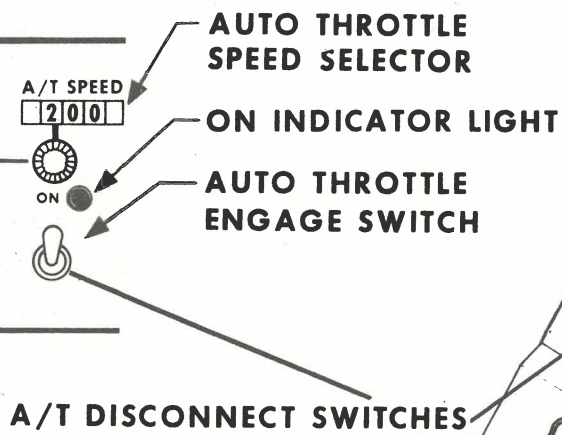
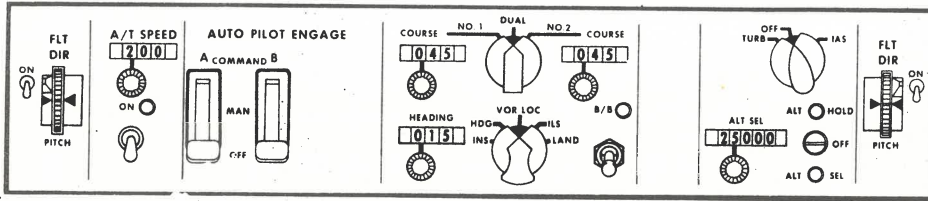
AUTO-THROTTLE SCHEMATIC:

AUTO-THROTTLE SPEED CONTROL SEQUENCE

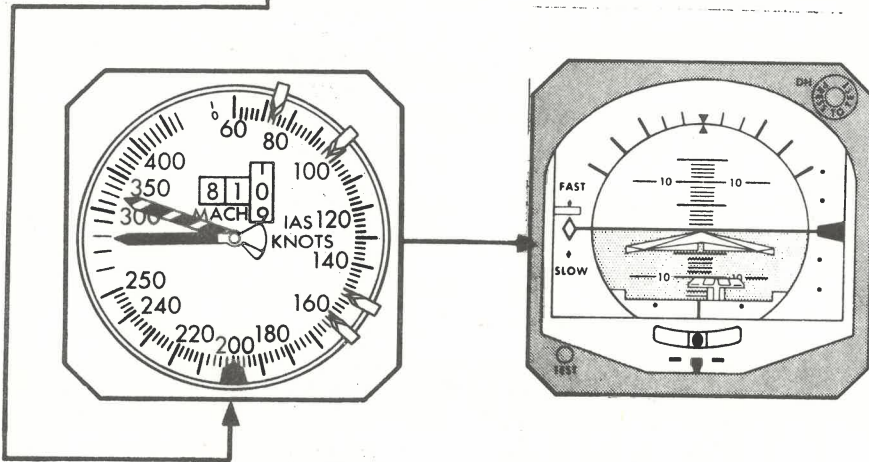




AUTO THROTTLE CONTROL SYSTEM:



AUTO THROTTLE SERVO MOTOR



| | |
|---|----|
| COCKPIT REFERENCE, PERFORMANCE & FLIGHT PLANNING DATA | 01 |
| EMERGENCY OPERATING PROCEDURES | 02 |
| ALTERNATE OPERATING PROCEDURES | 03 |
| DIMENSIONS & GENERAL ARRANGEMENT | 06 |
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COMMUNICATIONS

Three separate VHF communication systems are provided, each with a separate antenna. Each control panel on the aft pedestal has dual tuning selection. There are two complete HF communication systems, each with a separate antenna. Each is capable of single side band and amplitude modulation operation.

The control panels are located on the pedestal. Selcal control panel is located on pilot's overhead panel and provides crew alerting that ground stations desire to communicate. Each crew station has an audio selector panel which is used to select the communication or navigation system as desired. Transmitter selection is provided through push button switches while receiver selection is provided through receiver toggle switches. A voice recorder records all conversations in the cockpit as well as all inputs to the audio selector panels. The latest 30 minutes of recording is preserved. The voice recorder tape may be erased with aircraft on the ground, parking brake set and erase button actuated.

Cockpit personnel can communicate via the flight interphone system and with ground personnel at nose wheel well. A service interphone system comprised of 22 station jacks is provided for ground personnel communication. A FLT/SVC interphone switch on S/O panel allows paralleling the service and flight interphone systems. A cabin interphone system allows telephone-type communication between the cockpit and passenger cabin attendant stations and between separate attendant stations. In addition, the cabin interphone system may be paralleled with the flight interphone system through a FLT INT switch on cabin interphone module, located on pilot's overhead panel. Station selection is provided through a two-tone telephone dialing system. If station called is busy, no dialing tone is available to complete the call. The passenger address system enables crew members to make announcements to the passengers. It also supplies boarding music and selectable pre-recorded announcements. In the event of cabin decompression a pre-recorded emergency message automatically sounds over the system.

PA announcements uses the cabin interphone system through the two tone dialing and has priority over the entertainment and interphone system. The passenger entertainment system (PES) provides music and movie audio to each passenger seat via headset. Each seat has a channel selection/volume control panel. Controls for the passenger entertainment system is on cabin attendant panels 1L through 4L. Passenger entertainment system may be turned off through a 'PES OFF' button on cabin attendant panels 1R through 4R. PA and audio test buttons on cabin attendant panel 1R must be off at all times or cabin reading lights will flash throughout the cabin. These test buttons are for use by maintenance personnel only to test the 'PES'. The passenger call system and flight crew/ground call system is provided for alerting personnel.

VHF COMMUNICATION SYSTEM

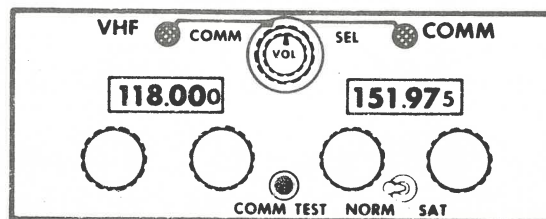
GENERAL

1. The 747 aircraft provides facilities for transmitting/receiving voice communications to ground stations or other aircraft and provides navigation/distance information to the flight instruments, weather conditions by radar, announcements to the passengers and communication between crew members or ground personnel.
 - a. Passenger entertainment is also provided to entertain the passenger in flight by stereo or monaural music and motion picture audio.

VHF COMMUNICATION SYSTEM

1. Three separate VHF communication systems are provided for the pilots.
 - a. Three dual head VHF control panels are located on aft electronic panel.
 - (1) Two pre-set frequencies available by selector switch.
 - (a) Green light illuminates indicating which head is selected.
 - (2) Antenna selector switch provides selection of normal VHF antenna or SAT COM antenna.
 - (3) Communication test button, on panel, provides operational check of receiver operation.

NOTE: No provisions for squelch level adjustment (level pre-set).





FREIGHTER
23:01F

COMMUNICATIONS

The B-747F aircraft has the same VHF and HF communication as the present B-747 fleet.

The cabin interphone system has been replaced with a cargo interphone/intercom system with integral cargo call system. The ground service interphone system has two additional jacks installed at the aft cargo door. The handset has been removed from the cockpit. A handset in the fwd and aft cargo deck is provided for cargo communication. The flight interphone system can be connected to either the service or cargo interphone systems thru two switches located on the S/O panel.

No PA system is installed. The flight deck may contact supernumerary personnel via a monitor speaker thru the cargo interphone system.

An aft CG intermittent alarm signal from the weight & balance system will provide visual and audible warning to the main deck and lower cargo areas.

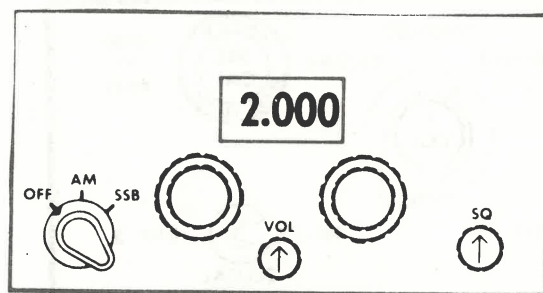
The passenger entertainment and passenger service system has been removed.

HF COMMUNICATION SYSTEM

HF COMMUNICATION SYSTEM

1. Two separate HF communication systems provide amplitude or single side band long range communication.
 - a. Two HF control panels located on aft electronic panel.
 - (1) Four frequency selector knobs provide frequency range in 1 kcs steps.
 - (2) Mode selector switch provides either amplitude or single side band mode of operation.
 - (3) Squelch control provides selection of squelch level.

NOTE: HF transmitter must be keyed, after frequency selected, to start system automatic tuning.

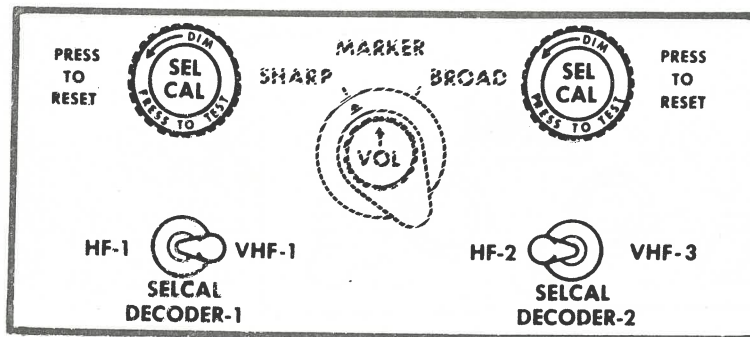


HF CONTROL PANEL

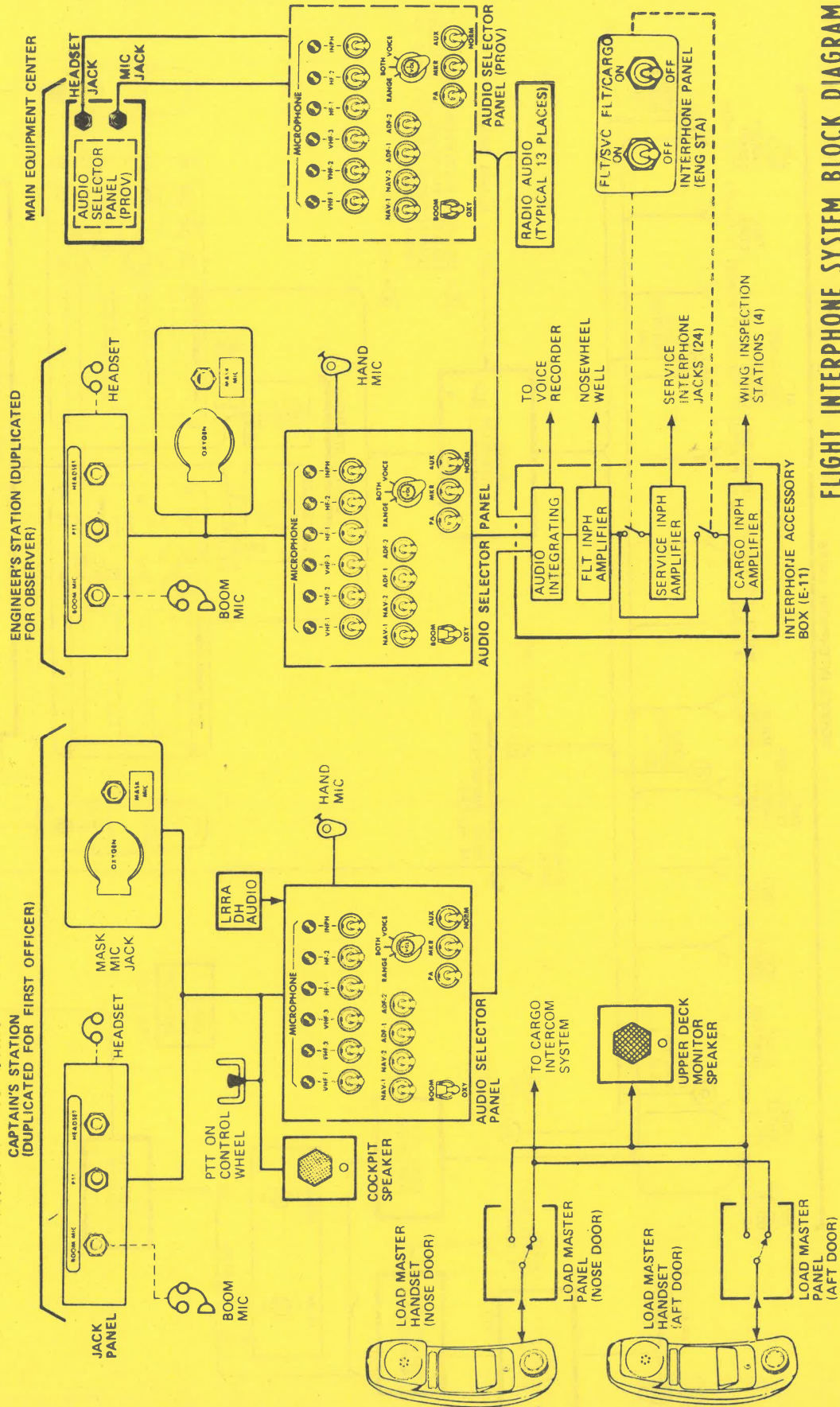
SELCAL SYSTEM

SELCAL SYSTEM

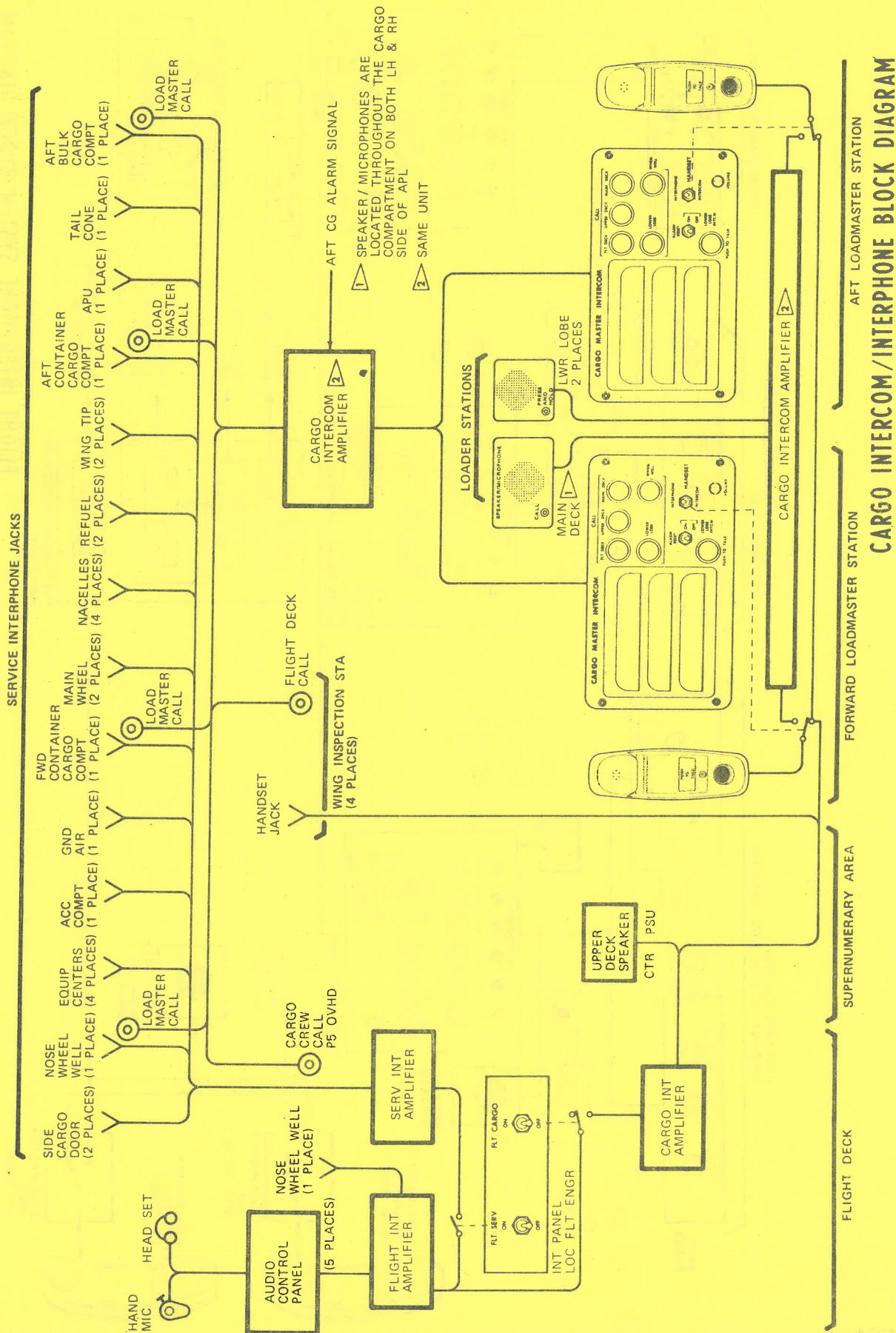
1. Two SELCAL/Auralert systems are installed on aircraft to provide a means by which the ground operator may alert the aircraft for further communication.
 - a. Dual Selcal control panel is located on pilot's overhead panel.
 - (1) Selcal selector switches provide selection of desired communication system.
 - (2) Selcal lights illuminate and flash when aircraft is called.
 - (a) Pressing On lights extinguish lights and resets system.
 - b. Dual selcal decoder is located at upper equipment center.
 - (1) Selector switches provide selection of proper selcal code.
 - c. Chime located underneath S/O panel emits two tones when aircraft is called.



SELCAL CONTROL PANEL



FLIGHT INTERPHONE SYSTEM BLOCK DIAGRAM

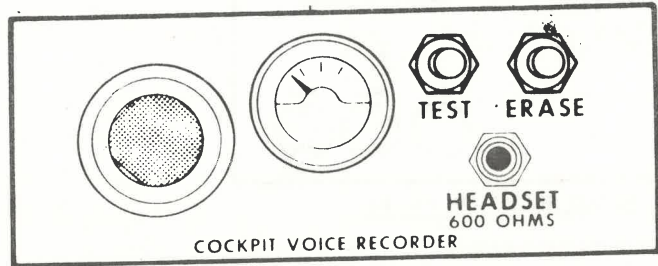


VOICE RECORDER SYSTEM

VOICE RECORDER SYSTEM

1. Voice recorder system records and preserves the latest 30 minutes of flight crew communication and conversation.
 - a. Control panel is located on pilot's overhead panel.
 - (1) Test button provides operational check of system.
 - (a) Meter displays pointer in green range.
 - (2) Erase button provides erasure of previously recorded information.
 - (a) Parking brake on control stand must be set before erasing.

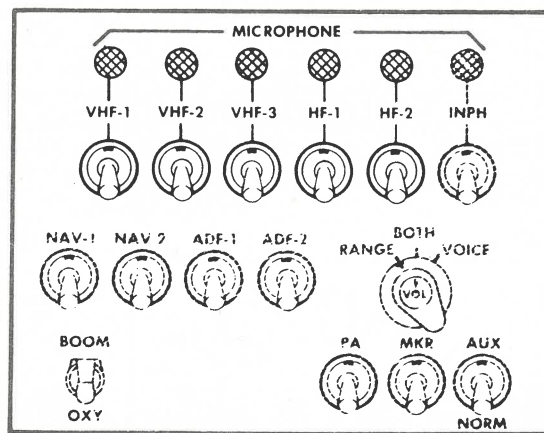
NOTE: Voice recorder system operates automatically when the essential AC bus is powered.



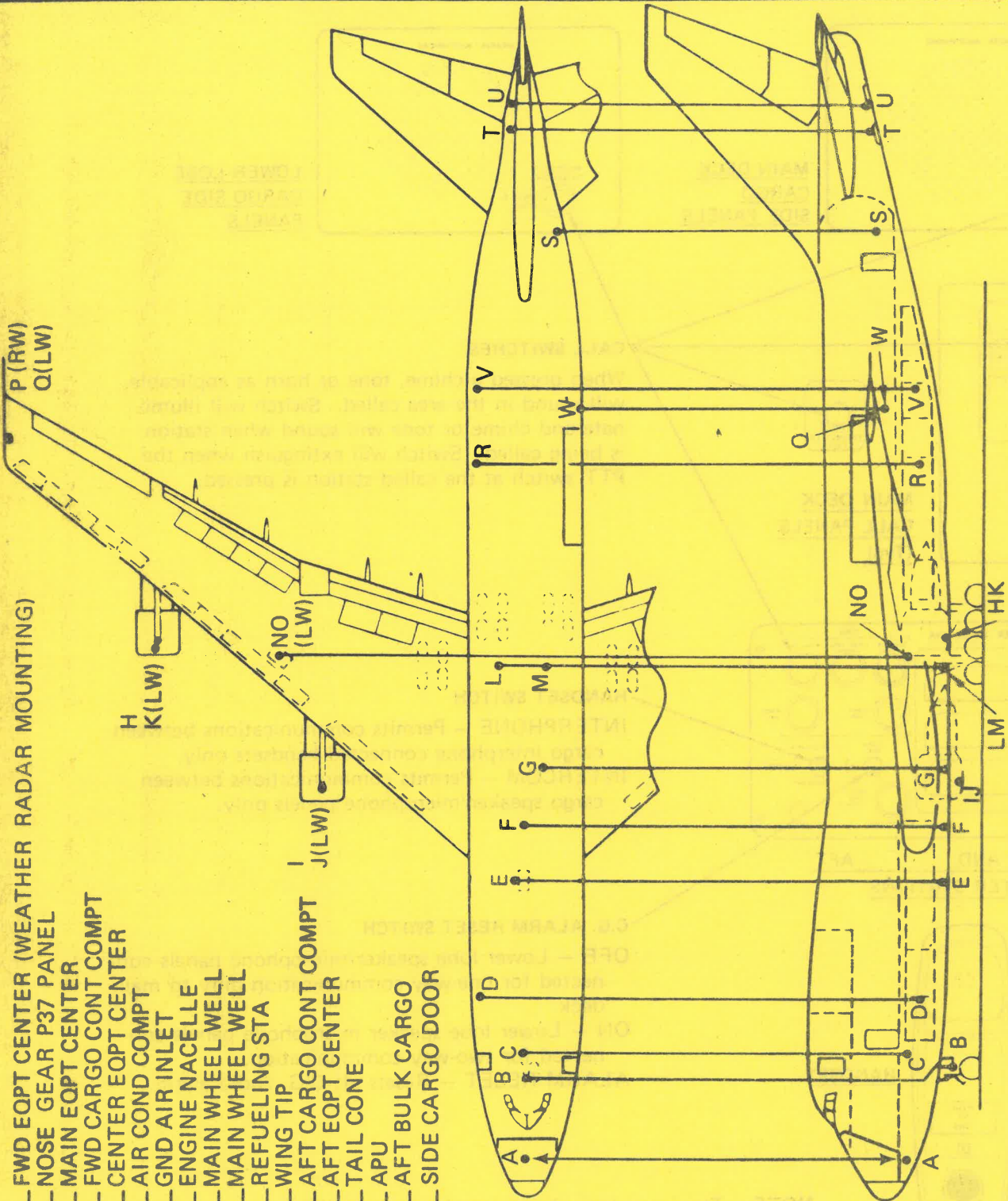
AVOID SELECTOR PANELS

AUDIO SELECTOR PANELS

1. Audio selector panels provide a means of selection of receiver inputs and transmitter microphone inputs.
 - a. Jackboxes are located at the respective pilot and observer stations.
 - (1) Mike selector pushbutton switches illuminate when depressed.
 - (2) A filter switch provides filtering of navigation and ADF receiver inputs.
 - (3) Normal/Aux switch provides selection of normal or auxiliary amplifier.



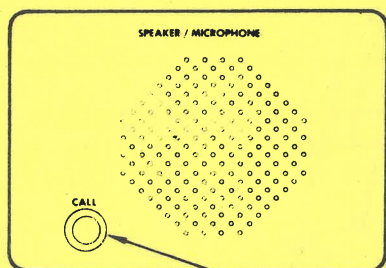
AUDIO SELECTOR PANEL



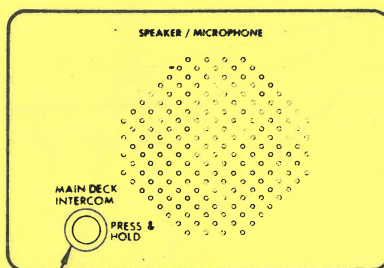
SERVICE INTERPHONE JACK LOCATIONS

- A FWD EQPT CENTER (WEATHER RADAR MOUNTING)
- B NOSE GEAR P37 PANEL
- C MAIN EQPT CENTER
- D FWD CARGO CONT COMPT
- E CENTER EQPT CENTER
- F AIR COND COMPT
- G GND AIR INLET
- H, I, J, K, ENGINE NACELLE
- L MAIN WHEEL WELL
- M MAIN WHEEL WELL
- N, O, REFUELING STA
- P, Q, WING TIP
- R AFT CARGO CONT COMPT
- S AFT EQPT CENTER
- T TAIL CONE
- U APU
- V AFT BULK CARGO
- W SIDE CARGO DOOR

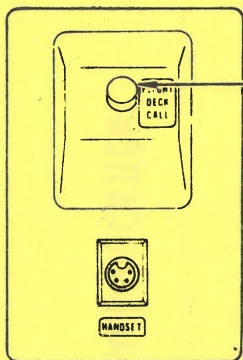
NOTE: The main cabin door and the main cabin door are located on the left side of the aircraft. The main cabin door is located on the right side of the aircraft. The main cabin door is located on the left side of the aircraft. The main cabin door is located on the right side of the aircraft.



**MAIN DECK
 CARGO
 SIDE PANELS**



**LOWER LOBE
 CARGO SIDE
 PANELS**

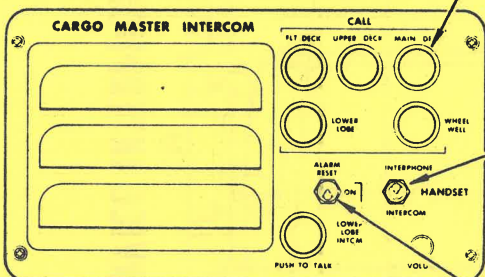


**MAIN DECK
 CALL PANELS
 (Typ)**



CALL SWITCHES

When pressed a chime, tone or horn as applicable will sound in the area called. Switch will illuminate and chime or tone will sound when station is being called. Switch will extinguish when the PTT switch at the called station is pressed.



**FORWARD AND AFT
 LOADMASTER STATIONS**

HANDSET SWITCH

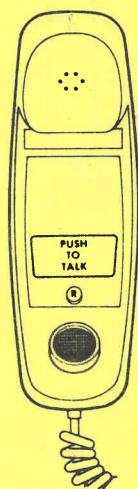
INTERPHONE — Permits communications between cargo interphone connected handsets only.
INTERCOM — Permits communications between cargo speaker/microphone panels only.

C.G. ALARM RESET SWITCH

OFF — Lower lobe speaker/microphone panels connected for one-way communication only to main deck.

ON — Lower lobe speaker microphone panels connected for two-way communication.

ALARM RESET — Resets aft C.G. audio alarm.

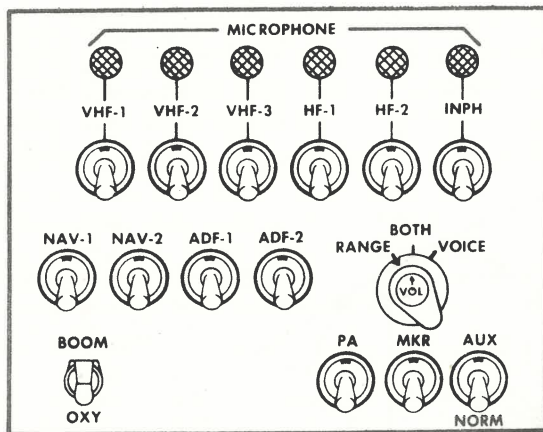


HANDSET

NOTE: The cargo interphone may be connected to the flight interphone and the service interphone from the flight engineers panel.

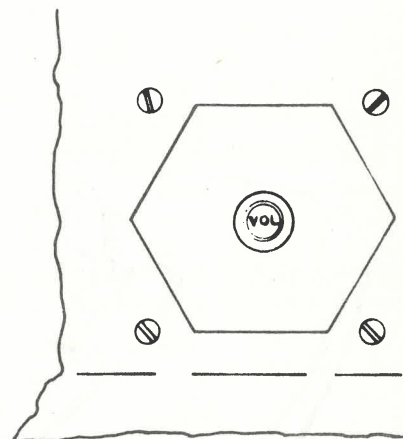
FLIGHT INTERPHONE SYSTEM

1. Flight interphone system allows flight crew members to communicate with each other.
 - a. One flight interphone jack in nose wheel well.
 - (1) Allows ground personnel to communicate with cockpit, regardless of position of service interphone switch.
 - b. R/T-INT switch (rocker type) on pilot's control wheel.
 - (1) R/T position (Top rocker switch) – When actuated will key whatever is selected on audio selector panel.
 - (2) INT position (Bottom rocker switch) – When actuated, will key flight interphone system only.



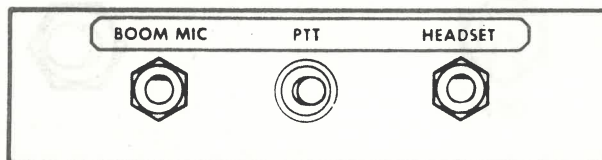
AUDIO SELECTOR PANEL

(A)



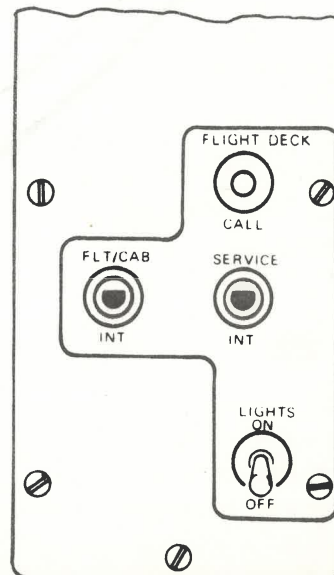
INTERPHONE SPEAKER

(B)



JACK PANEL

(C)

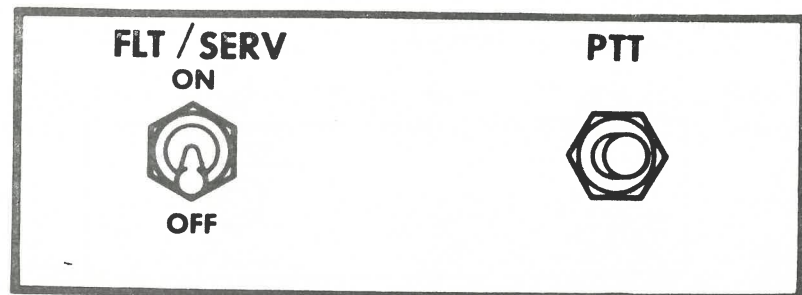
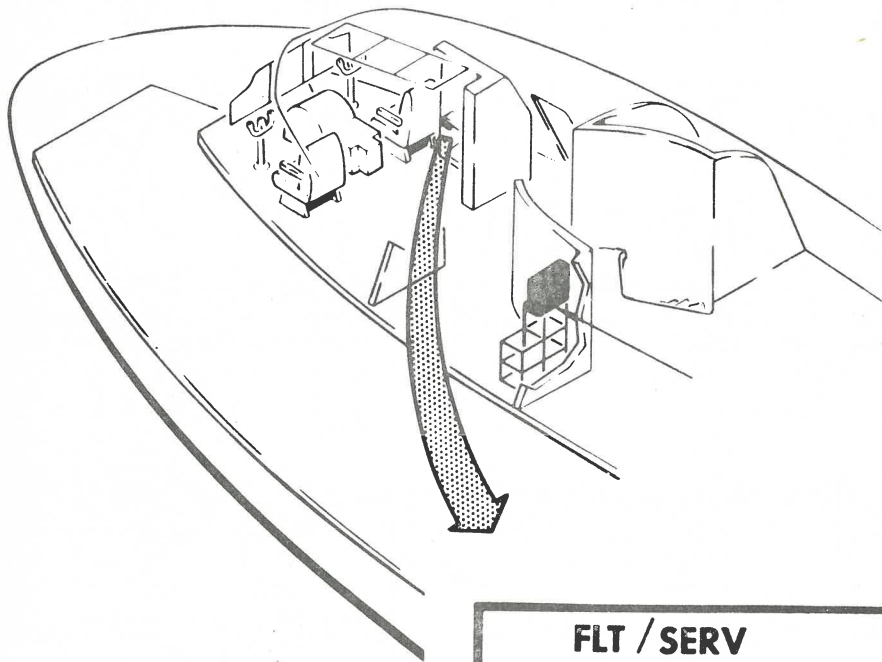


NOSE WHEEL WELL CONTROL PANEL

SERVICE INTERPHONE SYSTEM

SERVICE INTERPHONE SYSTEM

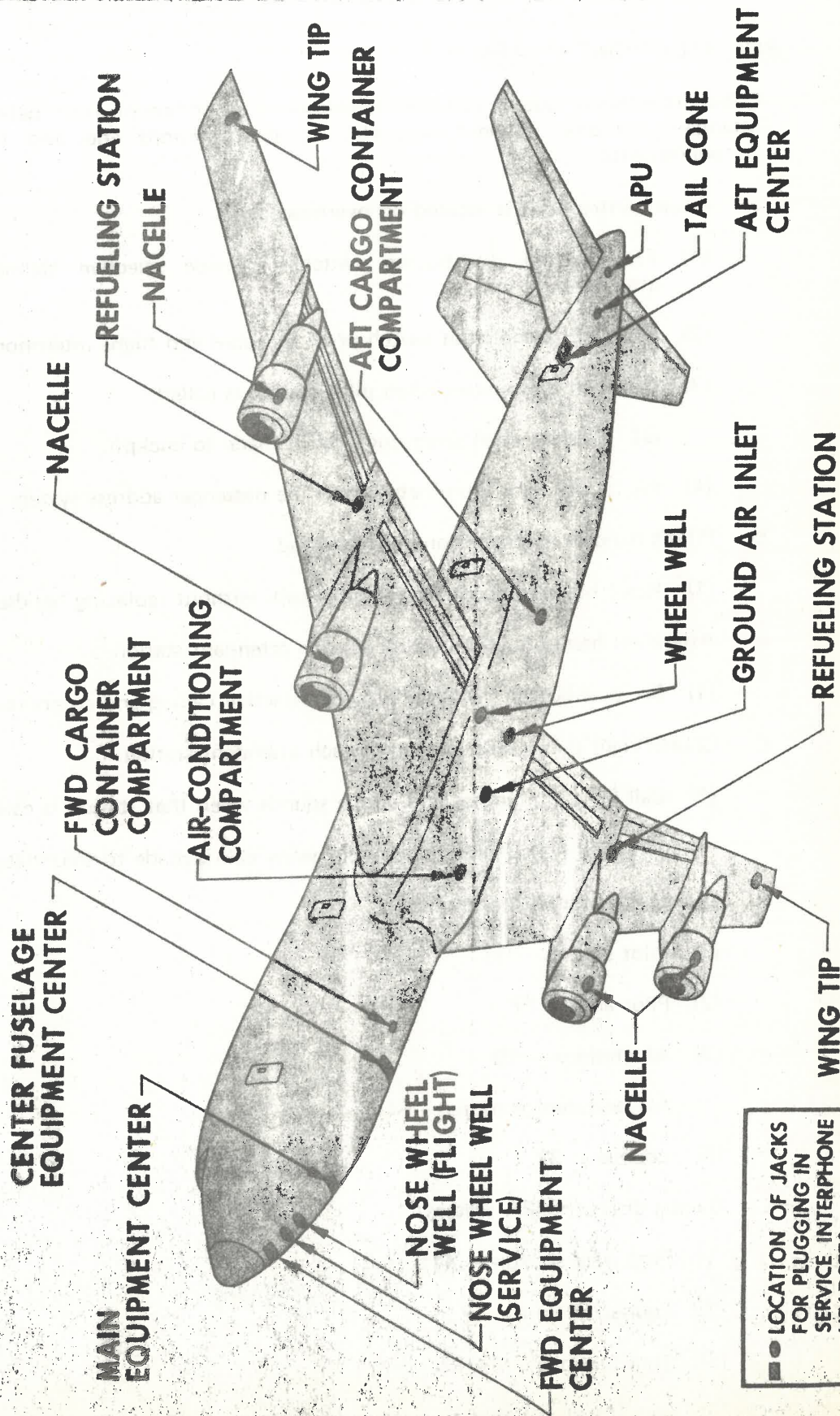
1. Service interphone system enables ground personnel to communicate with one another from various servicing stations.
 - a. 22 handset jacks comprise the service interphone system.
 - b. Service interphone switch (FLT/SERV) located on S/O panel.
 - (1) "ON" position – Connects service and flight interphone systems together.
 - (a) Enables flight crew to communicate with ground personnel.
 - (2) "OFF" position – Isolates service and flight interphone systems.





SERVICE INTERPHONE FACILITIES

SERVICE INTERPHONE FACILITIES



● LOCATION OF JACKS FOR PLUGGING IN SERVICE INTERPHONE HEADSETS



CABIN INTERPHONE SYSTEM

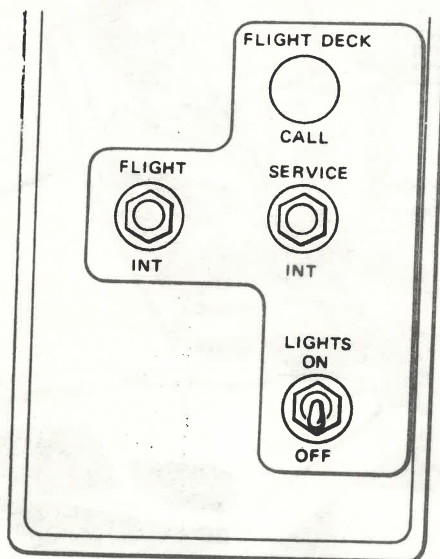
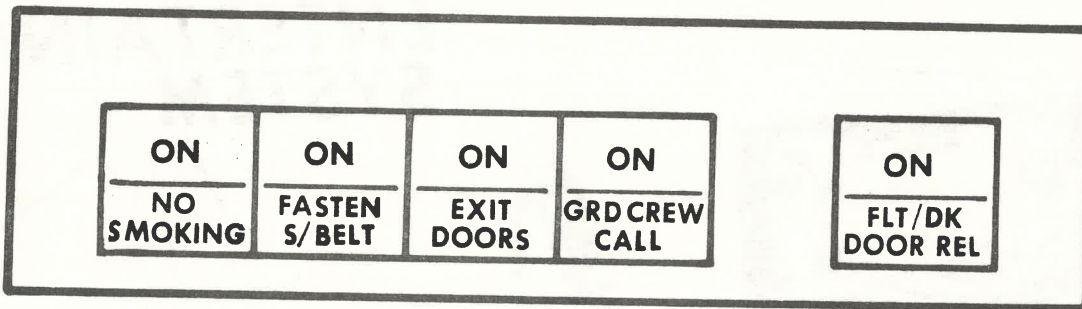
CABIN INTERPHONE SYSTEM

1. Cabin interphone system provides telephone type communication between cockpit and passenger attendant stations, between separate attendant stations and also for making public address announcements.
 - a. Pilots control unit is located on overhead panel.
 - (1) Five lighted pushbutton switches provide selective calling and communication of attendant stations.
 - (2) ON/OFF pushbutton switch provides cabin and flight interphone systems to be paralleled.
 - (3) Call light illuminates when pilot station is called.
 - (a) Flashes when emergency call is made to cockpit.
 - (4) PA In Use light illuminates when the passenger address system is used in cabin.
 - b. Pilot's handset is located on control stand.
 - (1) Reset button permits consecutive calls without replacing handset in cradle.
 - c. Attendant handsets (10) located at each attendant station.
 - (1) Six pushbutton switches provide selective calling and communication with other stations.
 - d. Chime/Light panel (10) located at each attendant station.
 - (1) Call light illuminates and chime sounds when that station is called.
 - (a) Call light flashes when emergency call is made to that station.
 - e. Dialing directory (interphone)
 - (1) Pilot station – 31
 - (2) Pilot alert – PP
 - (3) All stations – 55
 - (4) All attendant stations – 54
 - (5) Lounge – 32
 - f. Dialing directory (PA system)
 - (1) First class section – 41
 - (2) Tourist section – 42
 - (3) Both sections – PA/PA
 - (a) If call initiated from attendant station – 43

GROUND CREW CALL SYSTEM

GROUND CREW CALL SYSTEM

1. Ground crew call system enables flight crew or ground personnel to alert one another.
 - a. Grd Crew Call light, located on overhead panel, illuminates and chime sounds when ground personnel are calling.
 - b. Flight Deck Call light on nose wheel control panel illuminates and horn sounds when flight crew is calling.



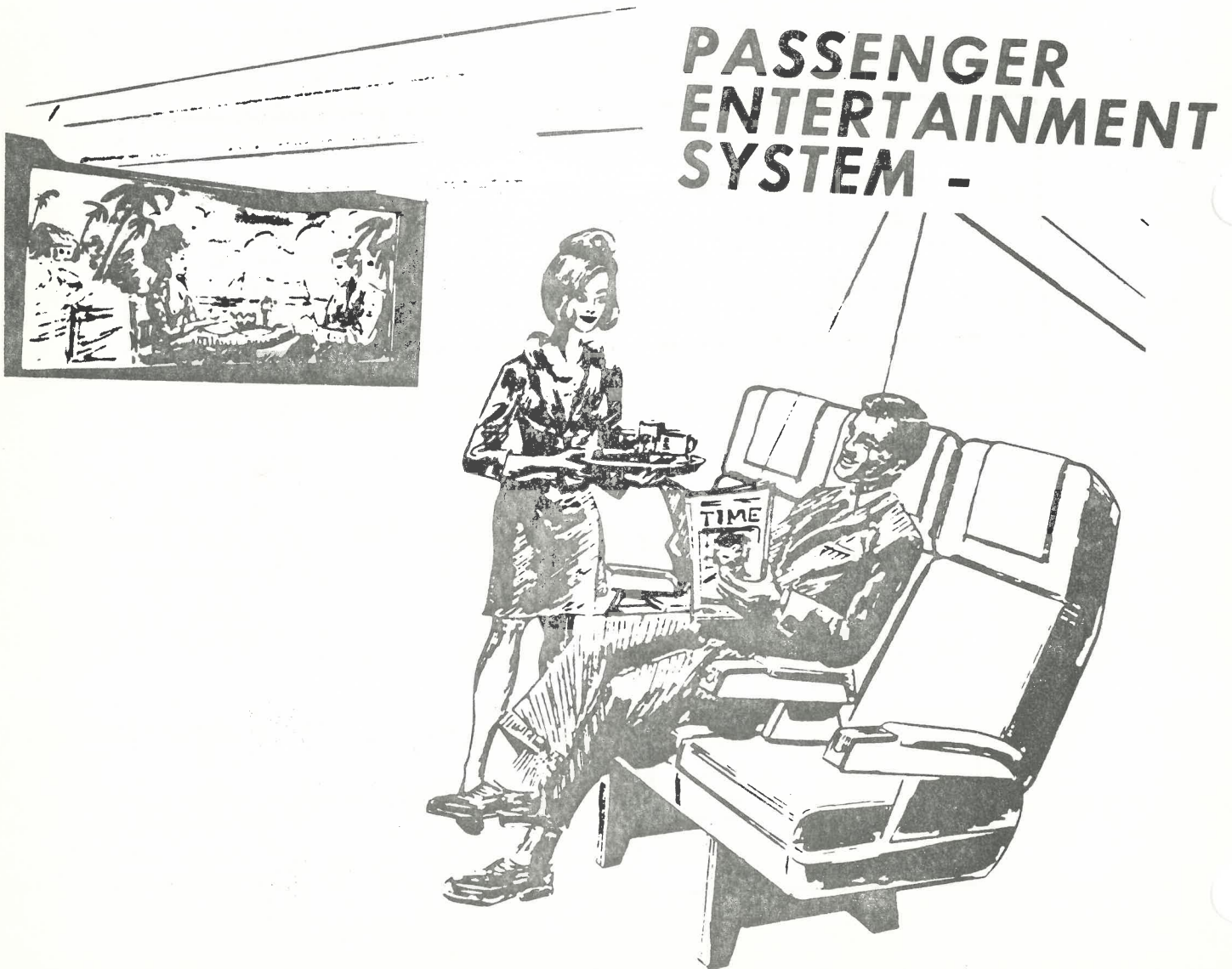
NOSE WHEEL WELL CONTROL PANEL

PASSENGER ENTERTAINMENT SYSTEM

PASSENGER ENTERTAINMENT SYSTEM

1. Passenger entertainment is provided in the 747 aircraft, by movies or by stereo/monaural music.
 - a. Movie control is provided at two flight attendant stations on the left side of the aircraft. (1L and 4L station).
 - b. Music is controlled by each passenger at his seat control panel.
 - (1) Individual headsets are provided.

NOTE: Announcements from the pilot or zone attendant automatically interrupt the program selected.



VHF/HF/SELCAL COMMUNICATION CONTROL PANELS

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 SELECTOR (2 Each)
 Rotation of selectors changes displayed frequency.

FREQUENCY TRANSFER LIGHT (2-Green)
 Illuminates to show which frequency has been selected by transfer switch.

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)

SATCOM ANTENNA

 PRESS TO SELECT
 Provisions only

OVERHEAD PANEL

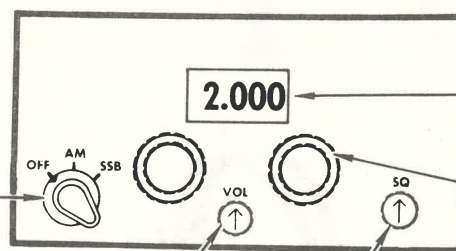
MARKER BEACON CONTROL
 Sensitivity adjustment for beacon identification.
 SHARP – Decreased sensitivity to more sharply define marker beacon fix.
 BROAD – Increased sensitivity to ensure reception.

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

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 INDICATOR
 Range from 2 to 30 MHz.

FREQUENCY SELECTOR (4)
 Rotation of each of the 4 selectors changes the corresponding number.

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.

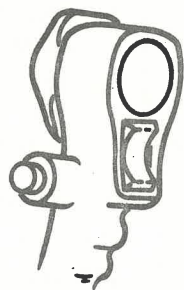
AUDIO SELECTOR PANEL

CONTROL WHEEL PTT SWITCH
 MIC — Keys lighted mic selector.
 INT — Allows pilot to talk over interphone without pressing INPH transmit switch.

OXYGEN MASK MICROPHONE

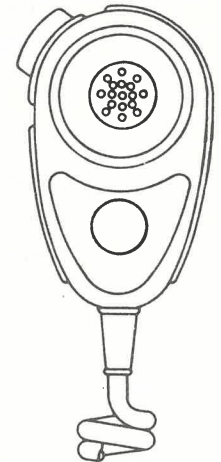
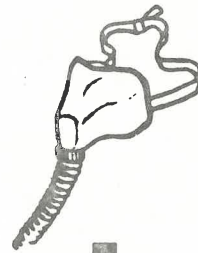
BOOM MICROPHONE (PROVISIONS ONLY)

HAND MICROPHONE



MIC

INT

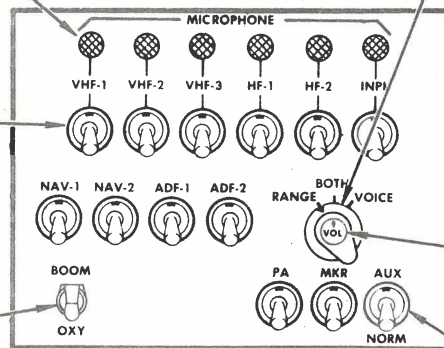


TRANSMIT SWITCH (6)
 Press in to select transmitter; depressed switch will illuminate. Only one switch may be depressed at any time.

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.

INPUTS

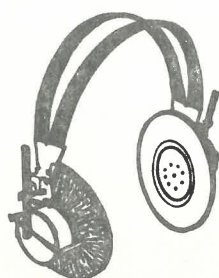


ADF FILTER SWITCH
 VOICE — Range signals are filtered out when selected. Allows only voice to be heard.
 BOTH — Both range signals and voice can be heard.
 RANGE — Voice is filtered out when selected. Allows only range signals to be heard.

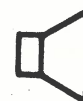
INTERPHONE VOLUME CONTROL

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

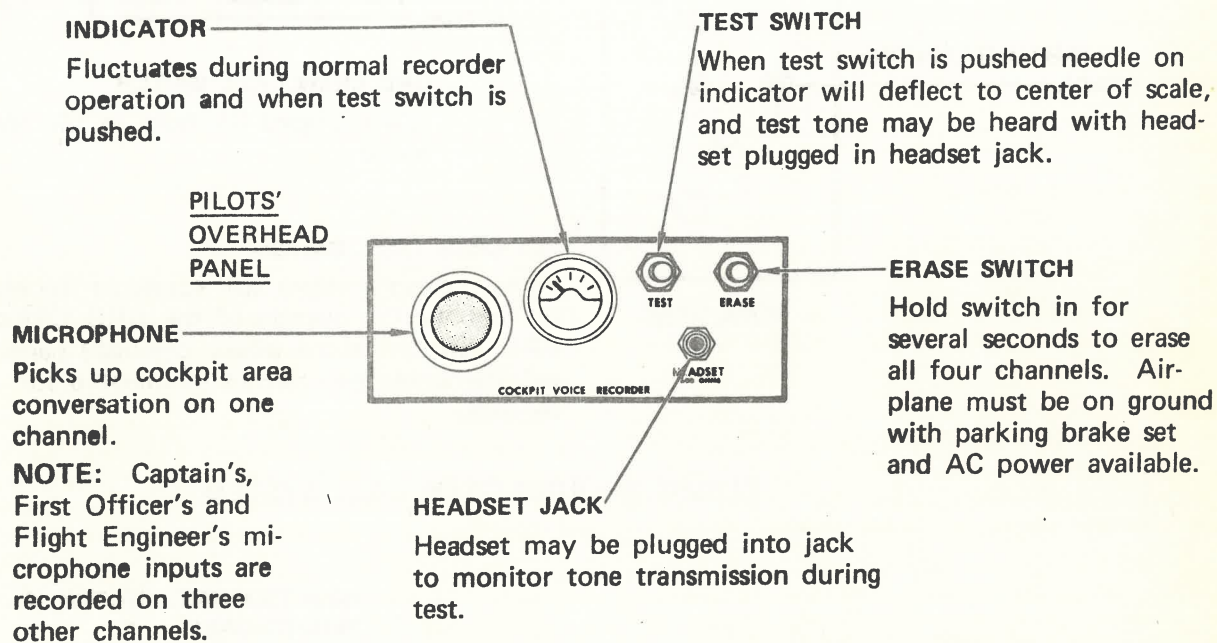


HEADSET



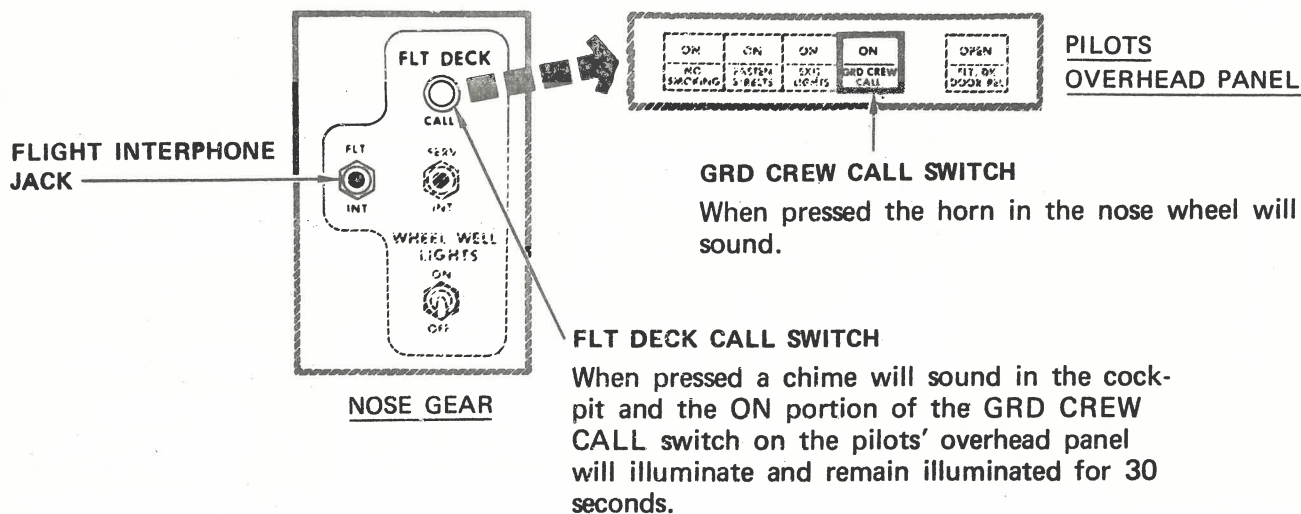
COCKPIT LOUDSPEAKER

VOICE RECORDER CONTROL PANEL

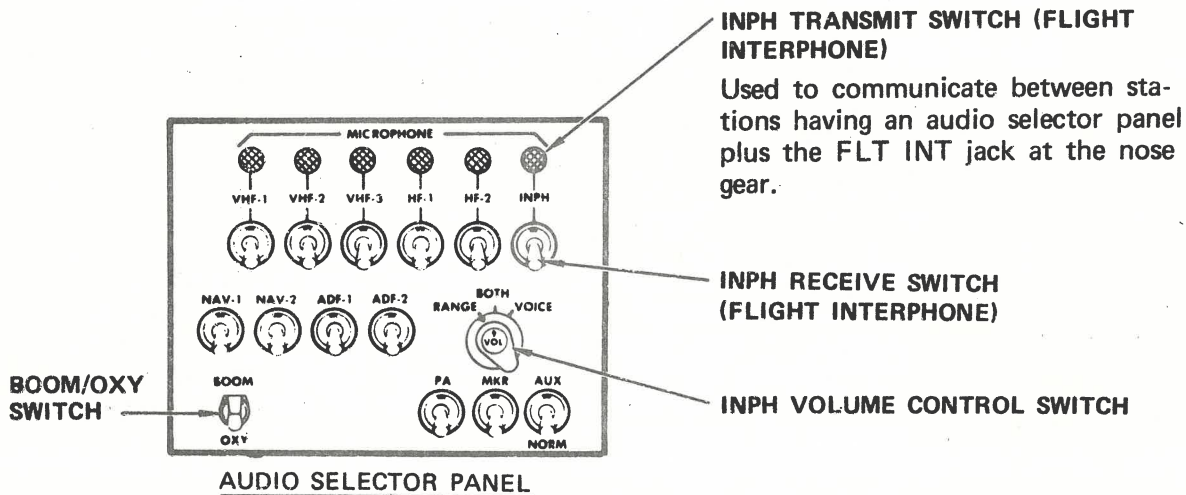


NOTE: With the essential radio master switch ON, the voice recorder runs through a complete cycle approximately every 30 minutes. It then begins a new cycle — erasing the old recording and recording the new. If an "incident" occurs, consideration should be given to deactivating the voice recorder, if desired, to preserve the recording.

FLIGHT INTERPHONE PANEL



FLIGHT/GROUND CREW CALL SYSTEM



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.

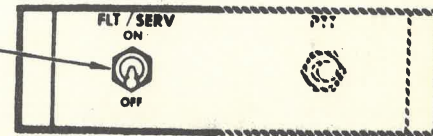
To Listen To Flight Interphone:

Press the INPH receive switch up.

SERVICE INTERPHONE PANELS

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.



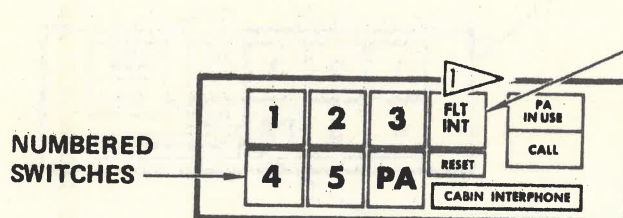
FLIGHT ENGINEER'S
PANEL

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.

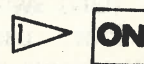
To Connect Flight and Cabin Interphones:

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.

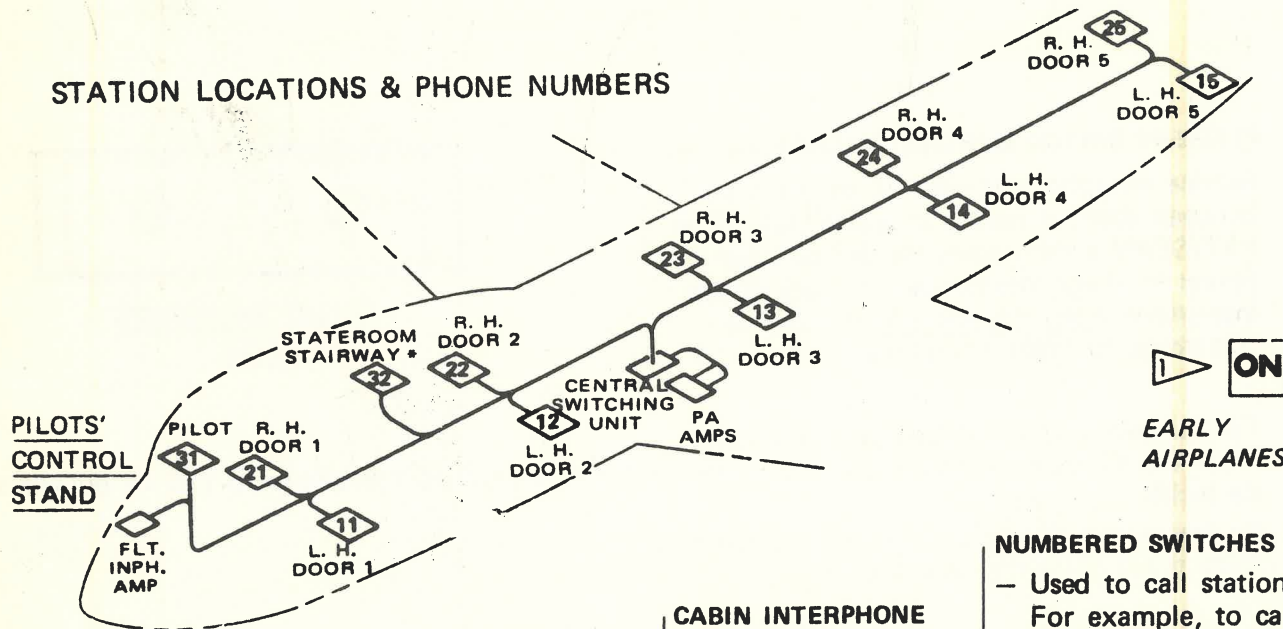
NOTE: Always press the FLT/INT switch again to extinguish the FLT/INT light when the conversation is ended. Leaving the light illuminated is the same as leaving the handset off the hook and will cause the cabin attendant to receive a busy signal.



EARLY AIRPLANES

CABIN INTERPHONE CONTROL PANELS

STATION LOCATIONS & PHONE NUMBERS



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

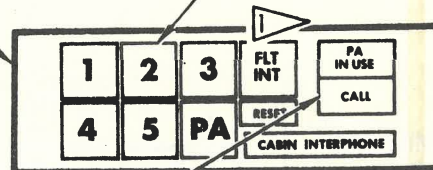
PILOTS' HANDSET

CABIN INTERPHONE MODULE

Used to communicate between stations having a handset.

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

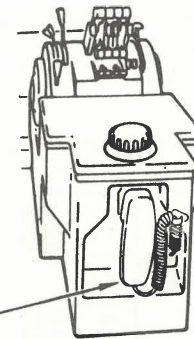
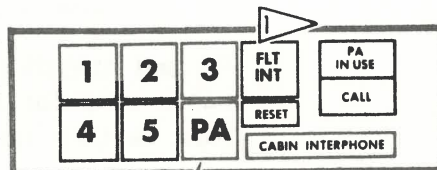
- Illuminates steady for normal call (31) from cabin attendant.
- Illuminates flashing for priority call (PP or 55) from cabin attendant.
- Single chime sounds for both types of calls.
- Light extinguishes when pilots' handset is lifted off hook.

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.

PASSENGER ADDRESS CONTROL PANELS

PILOTS' OVERHEAD PANEL



CONTROL STAND

PASSENGER ADDRESS

With Handset:

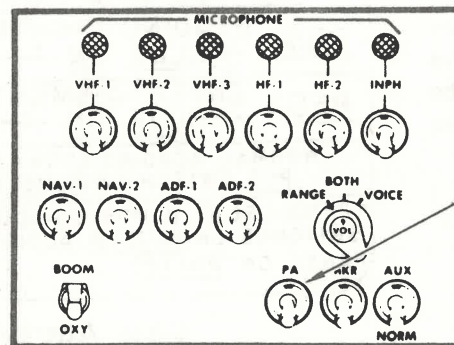
- Lift handset off of hook. Listen for dial tone.
The dial tone must be present before the PA switch can be used.
If the PA is being used by another station, the PA IN USE light will illuminate.
- Push PA switch twice.
The PA light will illuminate indicating the pilots are connected to the priority side 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.

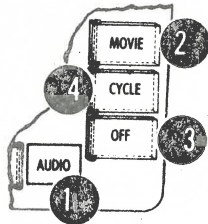
AUDIO SELECTOR PANEL

NOTE: Only the control stand handset can be used to make PA announcements from the cockpit.

PASSENGER ENTERTAINMENT CONTROLS

The passenger entertainment system (PES) provides music and movie audio to each passenger seat via headset. Each seat has a channel selection/volume control panel and a headset jack. Entertainment system audio is automatically overridden by Passenger Address System.

CONTROLS AND INDICATORS



Cabin Attendant Panels 1L thru 4L

1. AUDIO button (panel 1L only) – Turns on PES to individual passenger seats. Blue–OFF, white–ON.
2. MOVIE button – Starts movie projector.
 - Normally two movies provided.
 - Projector shows first movie, then stops.
 - Blue–OFF, white–ON.
3. OFF button – Stops movie projector.
4. CYCLE button – Pressing cycle button with projector stopped (OFF) turns on cycle indicator and cycles projector forward (without showing movie) to end of movie. Projector then stops and movie off indicator turns on. At end of second movie projector stops and must be serviced. Projector must be stopped before cycling.



Cabin Attendant Panels 1R thru 4R

5. PES OFF button – Turns passenger entertainment system power off or on to respective zones. Blue–ON, white–OFF.

NOTE: Both the PES button and the PSS button must be ON (blue) for passenger entertainment system operation.



Cabin Attendant Panel 1R

6. PA and AUDIO buttons – For use by Maintenance only for functionally testing the PES. Must be OFF (blue) at all times.

PSS AND PES OPERATION

| | |
|---|---|
| PSS | READING LIGHTS AND CALL SYSTEM — BLUE ON — WHITE OFF — |
| PES | ENTERTAINMENT & MOVIE SYSTEM — BLUE ON — WHITE OFF — |
| NORMAL READING LIGHT & CALL OPERATION PSS SWITCH ON (BLUE) CHIME ON (BLUE) | |
| NORMAL SEAT & MOVIE AUDIO OPERATION PSS & PES SWITCHES ON (BLUE) & AUDIO SWITCH ON NO. 1 L H PANEL ON (WHITE) | |
| PA AND AUDIO SELF-TEST SWITCHES BELOW MUST BE BLUE (OFF) AT ALL TIMES | |

Cabin Attendant Panel 1R

7. Placard

PSS AND PES OPERATION

| | |
|---|---|
| PSS | READING LIGHTS AND CALL SYSTEM — BLUE ON — WHITE OFF — |
| PES | ENTERTAINMENT & MOVIE SYSTEM — BLUE ON — WHITE OFF — |
| NORMAL READING LIGHT & CALL OPERATION PSS SWITCH ON (BLUE) CHIME ON (BLUE) | |
| NORMAL SEAT & MOVIE AUDIO OPERATION PSS & PES SWITCHES ON (BLUE) & AUDIO SWITCH ON NO. 1 L H PANEL ON (WHITE) | |

Cabin Attendant Panel 4R
(also Nos. 2R & 3R C/A seats)

8. Placard

PASSENGER SERVICE CONTROLS

The passenger service system includes the passenger reading lights and the passenger call system (lights and chime).

5. **ATTND CALL RESET** button — Resets call light system.

CONTROLS AND INDICATORS



Cabin Attendant Panels 1R thru 4R

1. **READING** Lights Control Knob —

SEAT — reading lights are controlled by each passenger seat switch in respective zone.

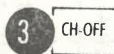
ON — all reading lights are on in the respective zone.



Cabin Attendant Panels 1R thru 4R

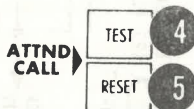
2. **PSS OFF** button — Turns passenger service system power off or on to respective zones. Blue—ON, white—OFF.

NOTE: Button must be ON (blue) for passenger entertainment system operation.



Cabin Attendant Panels 1 thru 4, L & R

3. **CH—OFF** button — Turns off passenger chime audio. Blue—ON, white—OFF.



Cabin Attendant Panels 1R thru 4R

4. **ATTND CALL TEST** button — Tests passenger row call lights. During test all call lights will be on when reading lights are in the ON or SEAT position in respective zone.

| | |
|---|----|
| COCKPIT REFERENCE, PERFORMANCE & FLIGHT PLANNING DATA | 01 |
| EMERGENCY OPERATING PROCEDURES | 02 |
| ALTERNATE OPERATING PROCEDURES | 03 |
| DIMENSIONS & GENERAL ARRANGEMENT | 06 |
| | 13 |
| AIR CONDITIONING & PRESSURIZATION | 21 |
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ELECTRICAL SYSTEMS:

Primary AC electrical power is supplied by four 60 KVA engine driven generators. Each generator isolated has a continuous load capability of 54 KW and a 5 minute load limit of 81 KW. Generator frequency is maintained at 400 cycles by four engine driven constant speed drives. Generator voltage is maintained at 115 volts by voltage regulators within each generator control unit. Each generator is controlled through a field relay and its output connected to its respective AC load bus through a generator breaker. Each AC load bus can be connected to the sync tie bus through a bus tie breaker and split system breaker. The field relay, GB, BTB, and SSB are controlled by switches on S/O panel. Protective circuits in the generator control unit will isolate the fault and trip the appropriate breakers. Under certain faults, the bus tie breaker will automatically reclose to minimize power losses to any of the load busses. Should a fault occur, the system will not only isolate the fault but will also identify the failed component and provide a readout on the Main/APU generator fault annunciator, when the 'read' button is pressed.

The essential AC bus is normally powered by AC load bus No. 4, but can be powered by generators No. 1, 2, and 3 or turned off. When the essential power selector switch is positioned to Gen 1, 2, or 3, AC power is supplied directly from the respective generator and not the associated load bus.

28 volt DC power is supplied to the DC busses by transformer-rectifier units, powered by the 115 volt AC busses. The DC busses can be isolated by DC bus isolation switches on S/O panel, but are normally connected in parallel. The maximum continuous DC load for each T/R is 75 amps.

Battery power is provided by a main aircraft and an APU battery, controlled by a single guarded battery switch. The APU battery is used for APU starting. The main and APU batteries are maintained in a fully charged state by individual battery chargers. The battery chargers are powered by the ground service bus.

The ground service bus may be powered by any one of three ways by selecting the appropriate switch:

1. Normally powered from No. 1 AC load bus (main generators, external power or APU)
2. Powered by No. 1 external power source by selecting Grd. Serv.
3. Powered by No. 1 APU generator by selecting Grd. Serv.

The ground handling bus is automatically connected to or APU-GEN 1. This bus is powered on the ground and only by these two sources. External Pwr No. 1 has priority in supplying this bus.

The standby AC and DC busses are normally powered by the essential AC & DC busses. With essential power failure, the AC standby bus may be powered from a static inverter and the DC standby bus directly by the main aircraft battery, through a standby power switch on S/O panel.

An auxiliary power unit (APU) installed in the tail of the airplane drives two generators that can power the main AC load busses. APU generators are identical to the main engine driven generators but can be operated at higher output because of forced air cooling. APU generator power cannot be paralleled with each other or to any other AC power sources on the tie bus.



ELECTRICAL SYSTEMS: (Continued)

External power sources can supply the main AC load busses through two external power receptacles. These are located aft of the nose wheel well on the lower right side of the aircraft. External power sources cannot be paralleled with each other or to any other AC power source on the tie bus.

AC and DC meters through switches, provide a readout of the selected source. A generator test switch on the AC meter control panel, provides permanent magnet generator voltage and CSD RPM readout.

Galley power is provided by switches on the S/O panel. Bus No. 1 switch powers the forward galley. Bus No. 3 switch powers the mid galley while bus No. 2 and 4 provide power to the aft galley. Galley 'Trip Off' lights illuminate if a faulty galley circuit occurs or from galley overloading the APU or external power source.



FREIGHTER

24:01F

ELECTRICAL

The B-747F electrical system is the same as our present fleet with a few exceptions.

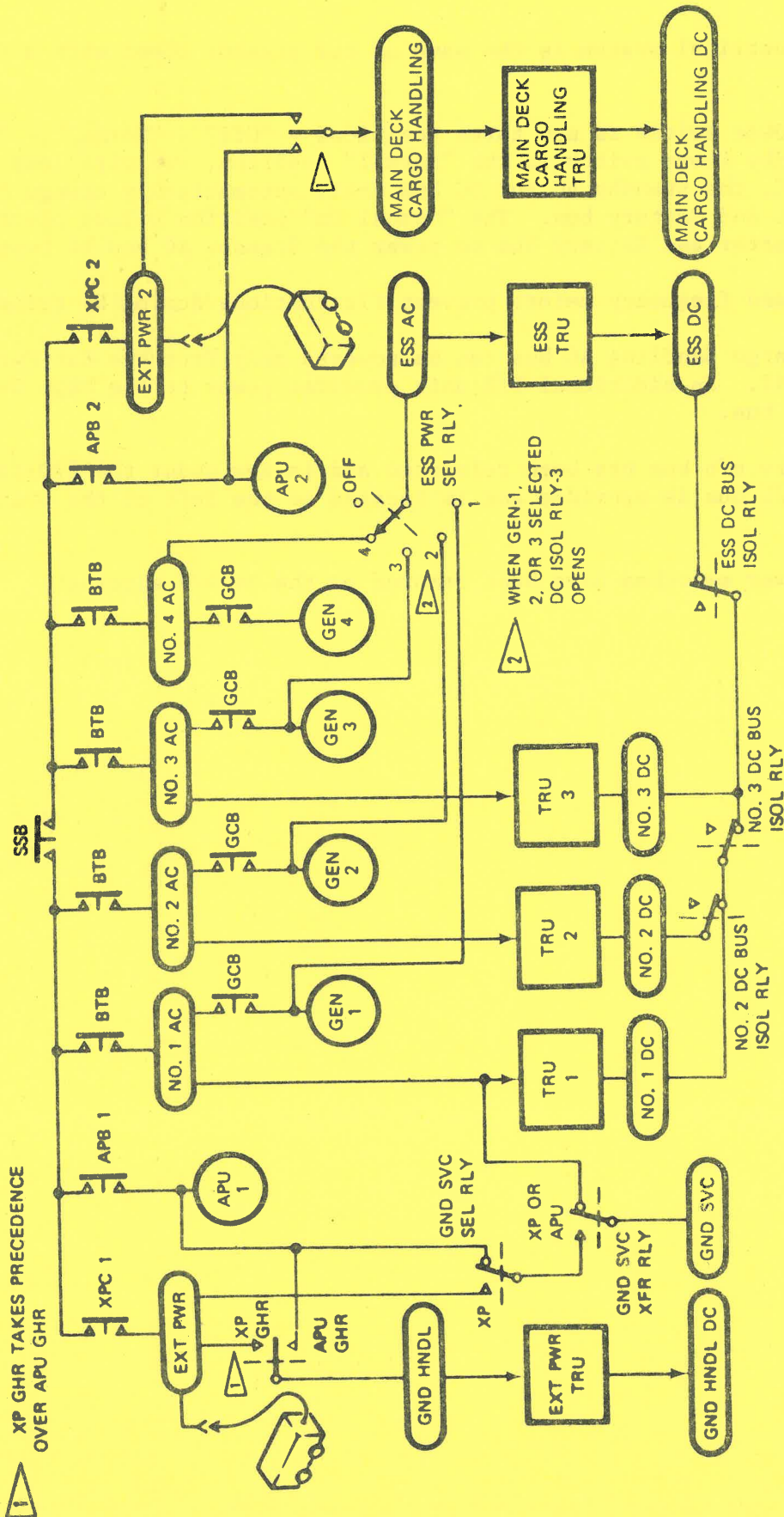
The Standby Power switch is now three positions - "Off" - "Normal" - "Manual On" with the Standby Power switch in the "Normal" position, and with loss of essential AC or DC, the Standby AC and DC bus shall automatically change over to static inverter and Battery bus. The "Manual On" position allows pilot to select static inverter and Battery bus to power the Standby AC and DC busses.

New Watt/Var and frequency meters prevent fluctuations during HF transmissions.

A Main Deck Cargo Handling AC bus can be powered only from the Ext Pwr #2 or APU generator #2. An additional T/R unit provides power to the Main Deck Cargo Handling DC bus.

The Hot Battery c/b bus has been relocated and is now under the S/O table. An Essential AC c/b bus is provided and is located to the left of the overhead c/b panel.

The galley power switches have been removed on the B-747F aircraft.



ELECTRICAL POWER SYSTEM - AVIONICS GENERAL



ELECTRICAL SYSTEMS:

GENERAL

1. Electrical power is furnished by four engine driven generators. Two APU driven generators or two ground power units.
 - a. Engine driven generators may be operated isolated or parallel.
 - (1) Isolated – Each generator supplies its respective bus.
 - (2) Parallel – All generators supply a common sync tie bus which supply all main busses.
 - b. A split system breaker (SSB) divides the sync tie bus in half.
 - (1) Split system breaker is controlled manually by switch on S/O panel.
 - (a) SSB Open light on S/O panel illuminates when breaker is tripped.

AC POWER SYSTEM

1. Six 115V AC main load busses and two 115V AC ground busses.
 - a. Busses No. 1 – No. 2 – No. 3 – No. 4 are powered by their respective generators or tie bus.
 - b. Essential bus is powered through a rotary essential power selector switch on S/O panel.
 - (1) Normal position – Powered from No. 4 AC load bus.
 - (2) No. 1, No. 2 No. 3 position – Powered from respective generator.
 - (3) Essential Bus Off light located on S/O panel.
 - (a) Illuminates with essential bus failure.
 - (4) Master Essential Bus light located on center instrument panel.
 - (a) Illuminates (does not flash) with essential bus failure.
 - c. Standby bus is powered normally by the essential AC bus.
 - (1) May be powered from static inverter controlled by switch on S/O panel.
 - (a) Standby Power On light illuminates when switch turned on.
 - d. Ground service bus is normally powered by AC bus No. 1.
 - (1) May be powered from APU generator No. 1 or external power No. 1 when their respective control switch, located on S/O panel, is placed in the GRD SERV position.
 - e. Ground handling bus is powered on the ground only by APU generator No. 1 or external power No. 1.
 - (1) External power No. 1 has priority – must be plugged into aircraft only.
 - (2) Loads supplied are the No. 4 electric hydraulic pump, fueling valves, service interphone and cargo handling.

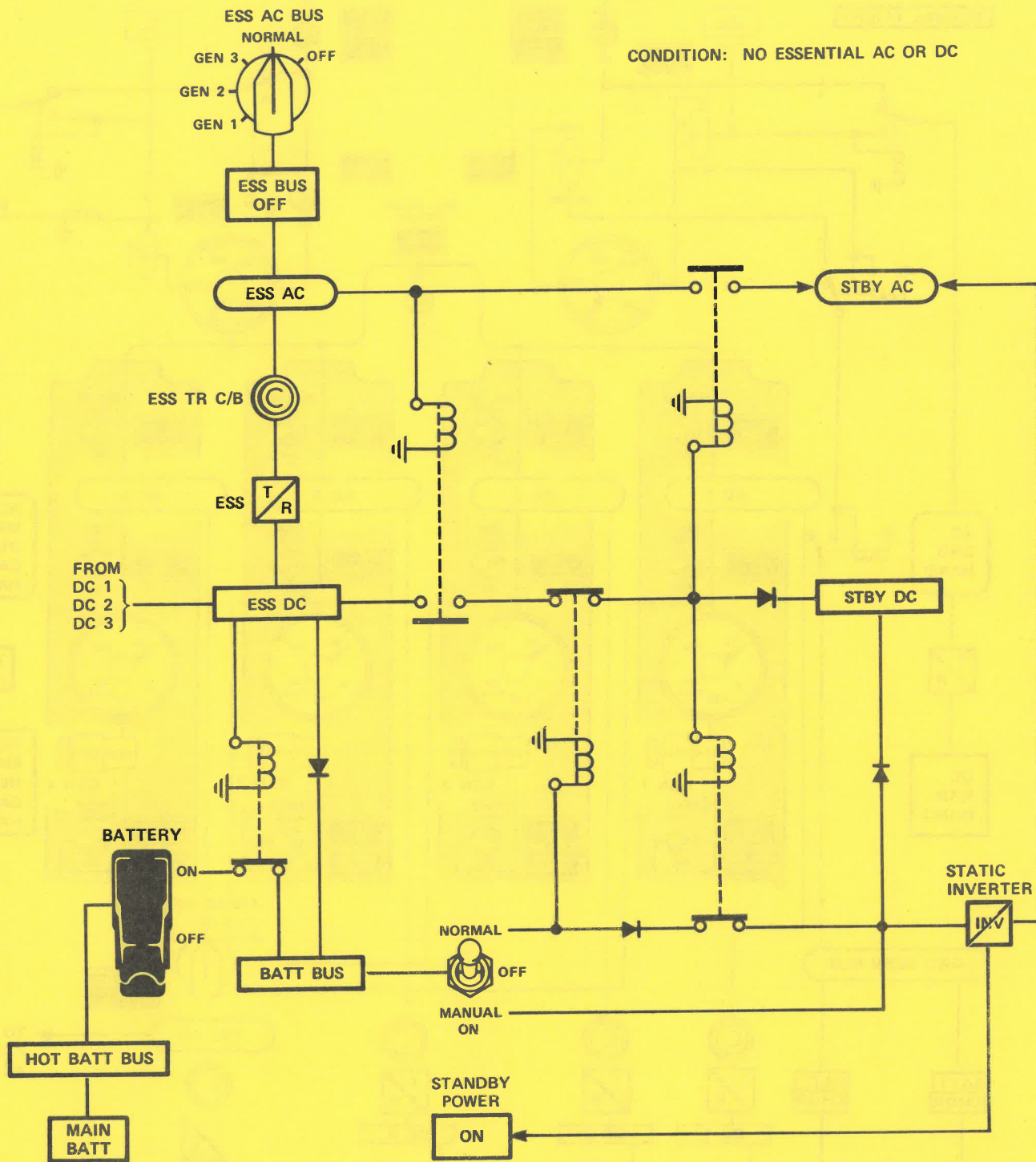
DC POWER SYSTEM:

DC POWER SYSTEM

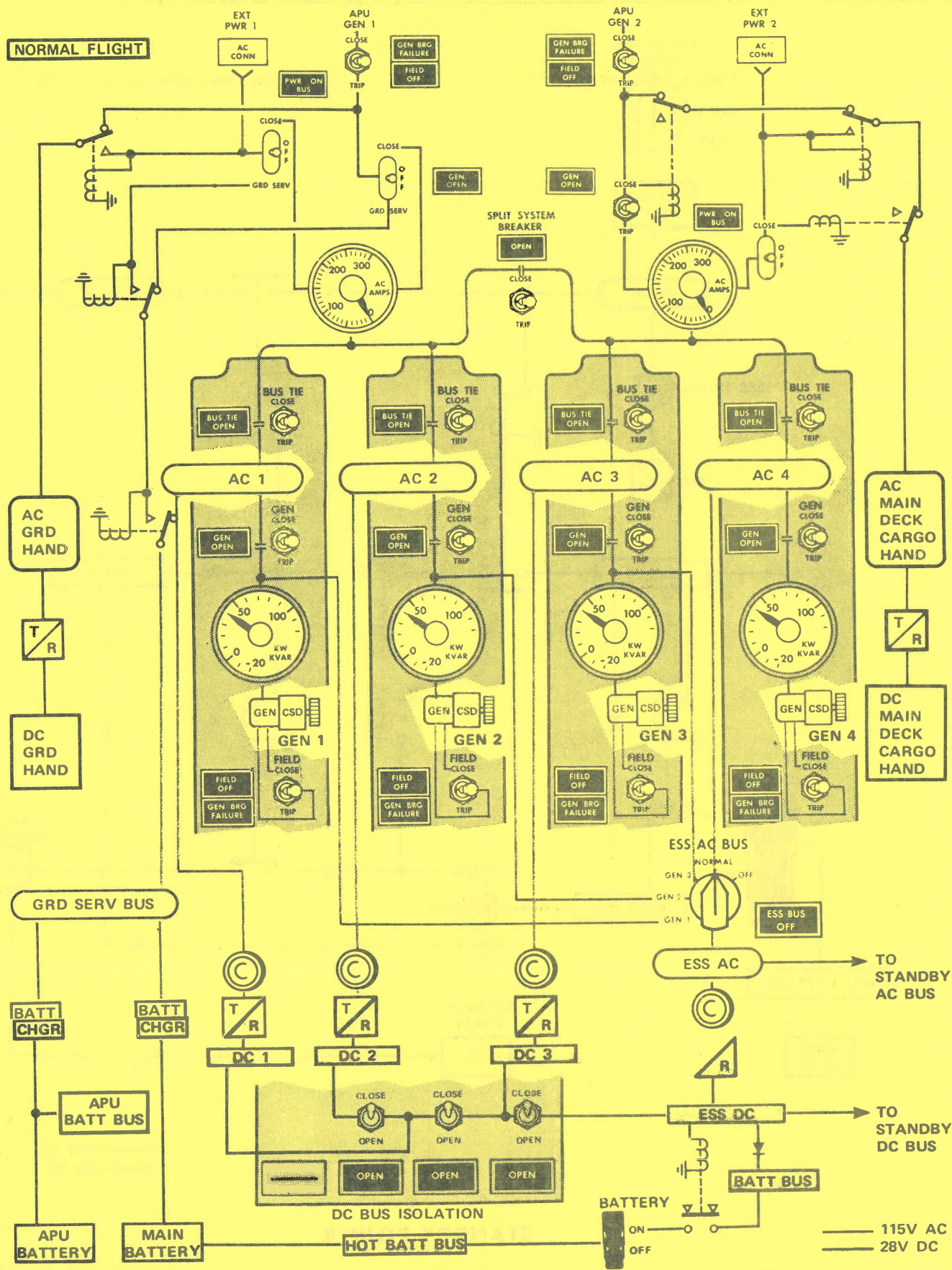
1. Five 28 volt DC busses.
 - a. Bus No. 1 – No. 2 – No. 3 are operated in parallel by their respective T/R's.
 - (1) T/R output displayed on DC ammeter through pushbutton selector switches located on S/O panel.
 - (2) Bus voltage displayed on DC voltmeter through pushbutton selector switches located on S/O panel.
 - b. Essential bus is normally powered by the essential T/R.
 - (1) Can be powered by bus No. 1 – No. 2 – No. 3 if essential T/R fails.
 - (2) Essential T/R output and essential DC bus voltage displayed on ammeter and voltmeter through pushbutton selector switches located on S/O panel.
 - c. Standby bus normally powered from essential DC bus.
 - (1) May be powered from battery bus controlled by standby power switch located on S/O panel.
 - d. DC bus isolation switches located on S/O panel control relays to isolate the busses.
 - (1) Open lights on S/O panel illuminate when respective switch is positioned to open.

BATTERY POWER SYSTEM

1. Two battery busses.
 - a. Hot battery bus powered directly from battery.
 - b. Battery bus normally powered from essential DC bus.
 - (1) With loss of the essential DC bus, it is powered from battery through guarded battery switch on S/O panel.
 - c. Battery is located on floor behind S/O panel.
 - (1) Maintained by battery charger on rack next to battery.
 - (2) Battery voltage and amperage displayed on indicators through pushbutton selector switches on S/O panel.



STANDBY POWER



ELECTRICAL POWER SYSTEM



GROUND POWER SYSTEM:

GROUND POWER

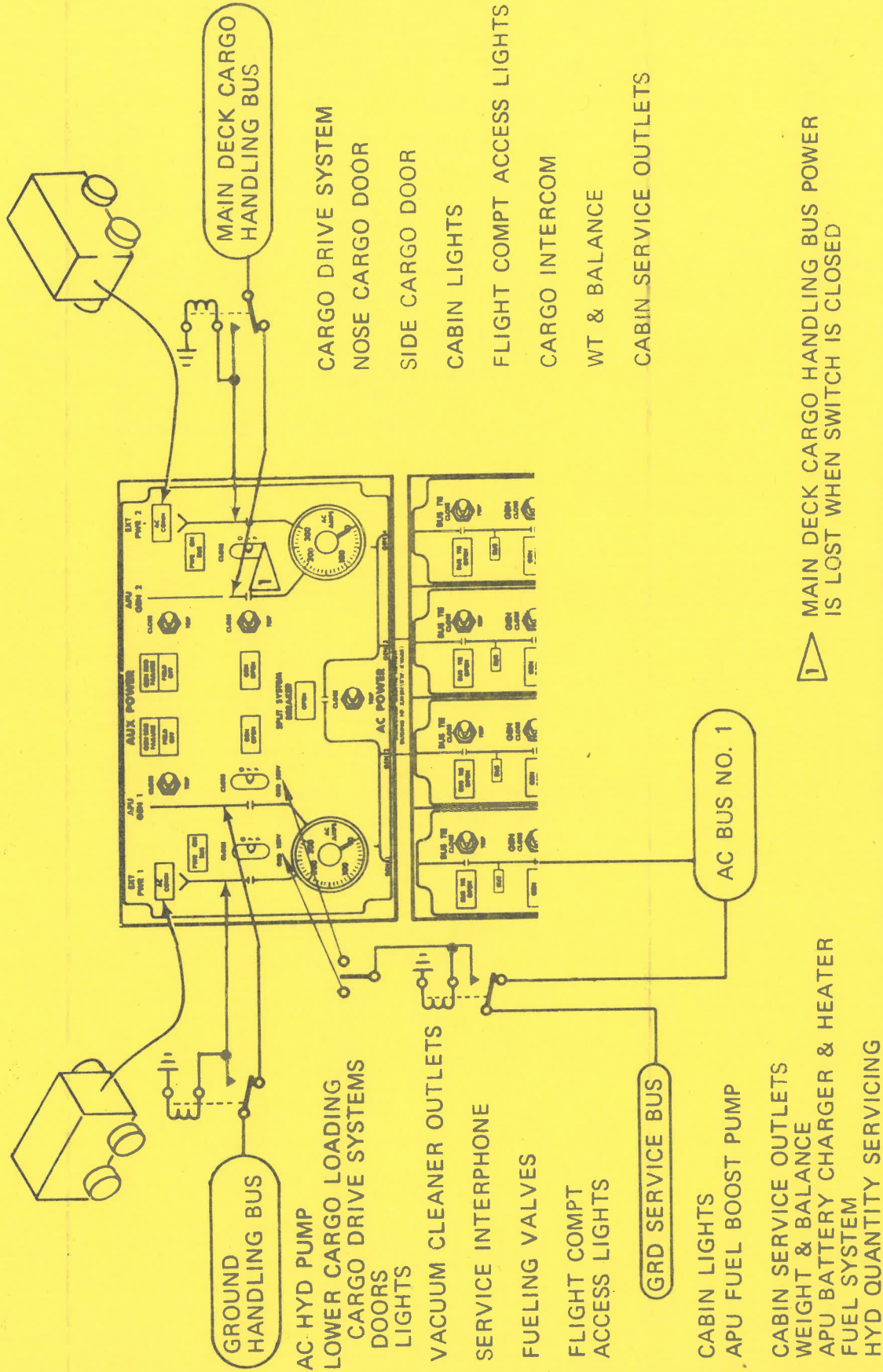
1. Two external power receptacles on forward right side of fuselage are provided.
 - a. With both external power units supplying power – the split system breaker automatically trips, preventing paralleling.
 - b. AC Connected lights, located near receptacles illuminate when external power is plugged into aircraft.
 - c. Power Not In Use lights, at receptacles, illuminate until external power is being used.
2. External power units are controlled by their respective switch on the S/O panel.
 - a. AC CONN lights on S/O panel illuminate when external power plugged into aircraft.
 - b. No. 1 external power switch controls No. 1 external power system.
 - (1) GRD SERV position allows No. 1 external power to supply the ground service bus.
 - c. No. 2 external power switch controls No. 2 external power system.
 - d. PWR On Bus lights, on S/O panel, illuminate when external power supplies the aircraft.
 - e. Bus power control units provide control and protection for external power.
 - f. Ammeters on S/O panel display loads from individual power units. (APU or external power).



MAIN AIRCRAFT GENERATOR SYSTEM:

MAIN GENERATOR SYSTEM

1. Constant speed drive (CSD) converts the varying speed of the engine to a constant RPM, so that its generator will provide a constant 400 cycle output.
 - a. Completely self-contained oil system.
 - (1) Oil is cooled by fan air.
 - (2) Oil temperature is displayed on indicators located on S/O panel.
 - (a) Outlet temperature is a measurement of CSD oil cooling.
 - (b) RISE temperature is a measurement of CSD workload.
 - '1' To read rise temperature, CSD oil temp rise button, on S/O panel, must be pressed.
 - (3) Low Oil Pressure lights on S/O panel illuminate with low oil pressure.
 - b. Guarded CSD disconnect switches on S/O panel provide a means of disconnecting CSD from engine.
 - (1) Actuating disconnect switch will electrically trip its respective generator breaker.
 - (2) A positive CSD disconnect can be verified by PMG voltage indicating zero and CSD RPM reading zero.
2. Generators rated at 60 KVA consist of a permanent magnet generator and a three-phase generator on a common shaft.
 - a. PMG output used for control power and generator excitation (field current).
 - (1) PMG voltage may be read on AC voltmeter through pushbutton selector switches, on S/O panel (Gen test pushbutton switch must be pressed).
 - b. Main generator output voltage and frequency are displayed on meters through pushbutton selector switches located on S/O panel.
 - c. Main generator real and reactive loads displayed on individual KW/KVAR meter.
 - (1) KVAR button must be pressed to read reactive load of generator.
 - d. Generators are cooled by fan air.
 - e. GEN BRG Failure lights on S/O panel illuminate with impending failure.
3. Generator control units (GCU) provide voltage regulation, control power and fault protection for its respective generator.
4. Load controller units provide KW balance of generators, when operating in parallel and perform frequency control (JOG), before generators are paralleled.



GROUND HANDLING AND SERVICE POWER



MAIN AIRCRAFT GENERATOR SYSTEM:

5. Generator field relay completes the generator field circuit and is controlled by field switches on S/O panel.
 - a. Field Off lights on S/O panel illuminate when field relay has tripped for its respective generator.
6. Generator breakers connect output of generator to load bus and are controlled by gen switches on S/O panel.
 - a. GEN Open lights on S/O panel illuminate when generator breaker trips for its respective generator.
7. Bus tie breakers connect load bus to sync tie bus and are controlled by bus tie switch on S/O panel.
 - a. Bus Tie Open lights on S/O panel illuminate when breaker has tripped for its respective generator.
8. Automatic paralleling will allow generator breaker to close when load controllers JOG generator frequency, within limits.
 - a. On 747 aircraft, there is no manual frequency control.
9. Manual paralleling (Random) is accomplished by closing appropriate bus tie breaker for its respective generator.
 - a. No precaution necessary.
10. Fault annunciator module located at S/O panel displays generator unit failures (for maintenance) and generator or bus faults (for flight crew).
 - a. Panel may be read by actuating read switch located below panel.
 - b. Panel may be reset by actuating read and reset switch at same time.
11. Faults effecting the generator output will cause a trip of its respective bus tie breaker, followed by a trip of the field relay and generator breaker.
 - a. BTB will automatically reclose, restoring power to bus.
 - b. Displayed on annunciator module as Gen Cont Unit.
12. Generator feeder faults are divided into differential fault zones, depending upon where the short occurs.
 - a. Zone No. 1 differential fault will trip field relay and generator breaker if short occurs between generator and generator breaker.
 - b. Zone No. 2 differential fault will trip all breakers (vertical trip) if short occurs between GB and BTB.
 - (1) No automatic reclosure of BTB.



MAIN AIRCRAFT GENERATOR SYSTEM:

- c. Displayed on annunciator panel as Gen/Feeder.

NOTE: If Gen/Feeder displayed on annunciator, consider all conditions before resetting breakers, as electrical fire could result.

- 13. Bus faults caused by a short on sync tie bus will cause the split system breaker to trip and the two associated BTB's to trip.

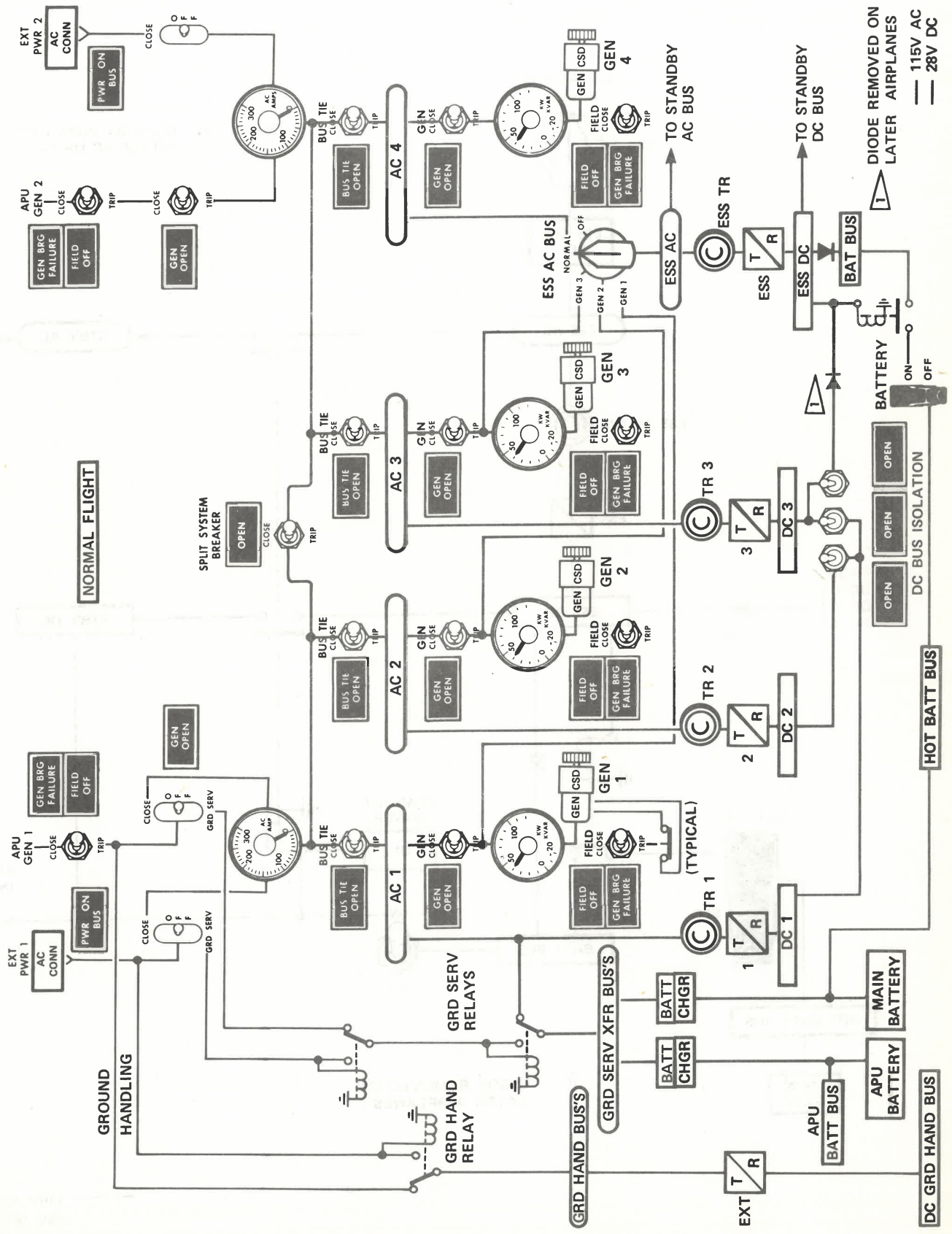
- a. If APU or external power is furnishing power to aircraft, their breakers will trip also.
- b. Displayed on annunciator panel as Gen/Feeder.

NOTE: If Gen/Feeder displayed on annunciator, consider all conditions before resetting breakers, as electrical fire could result.

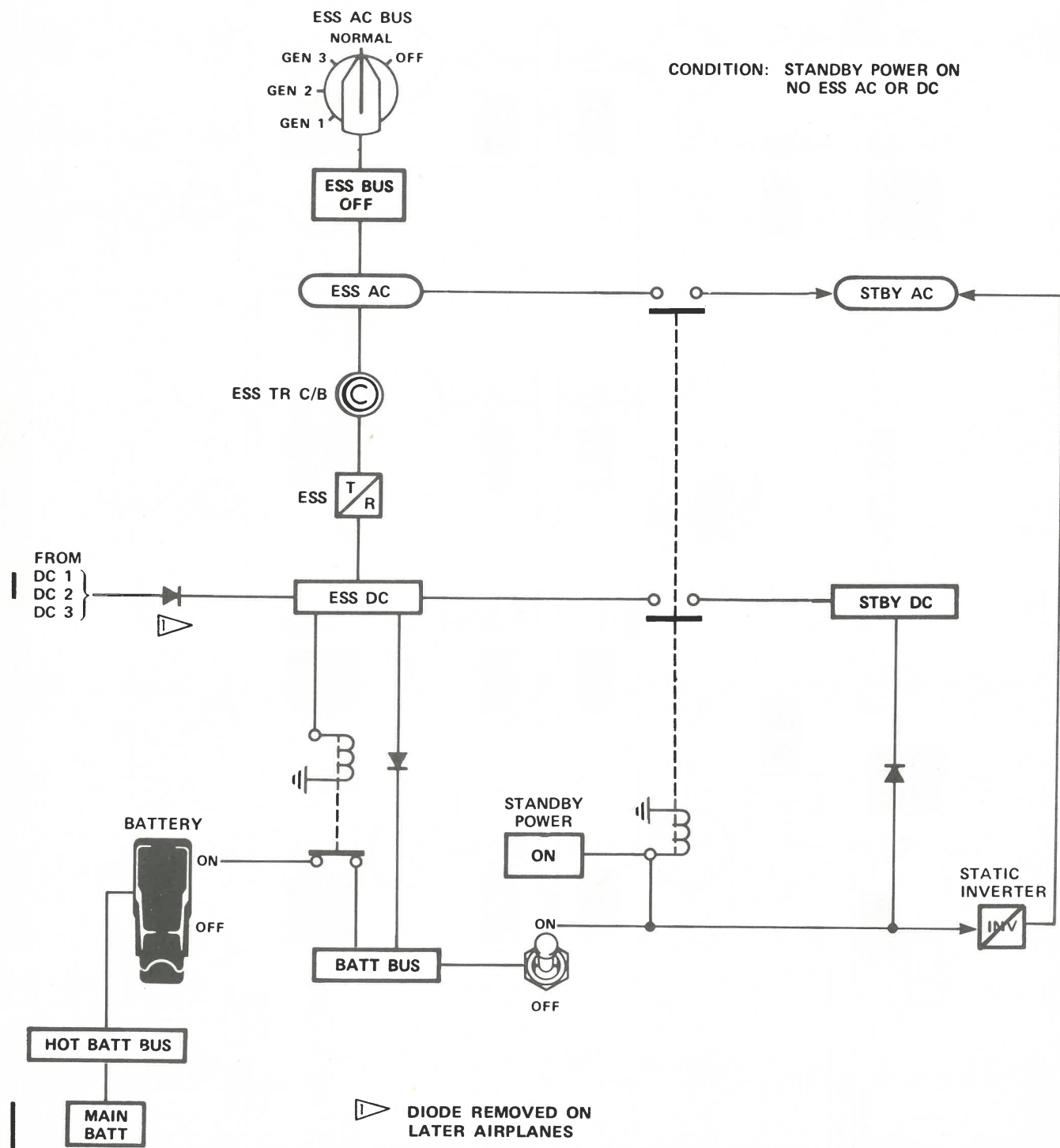
GALLEY POWER SYSTEM

- 1. Power is controlled to the galleys by four switches located on S/O panel.
 - a. Galley Trip Off lights on S/O panel illuminate if galley power is automatically disconnected.
 - (1) All galleys will trip off if 250 Amps is exceeded when using APU or external power.

ELECTRICAL SCHEMATIC:



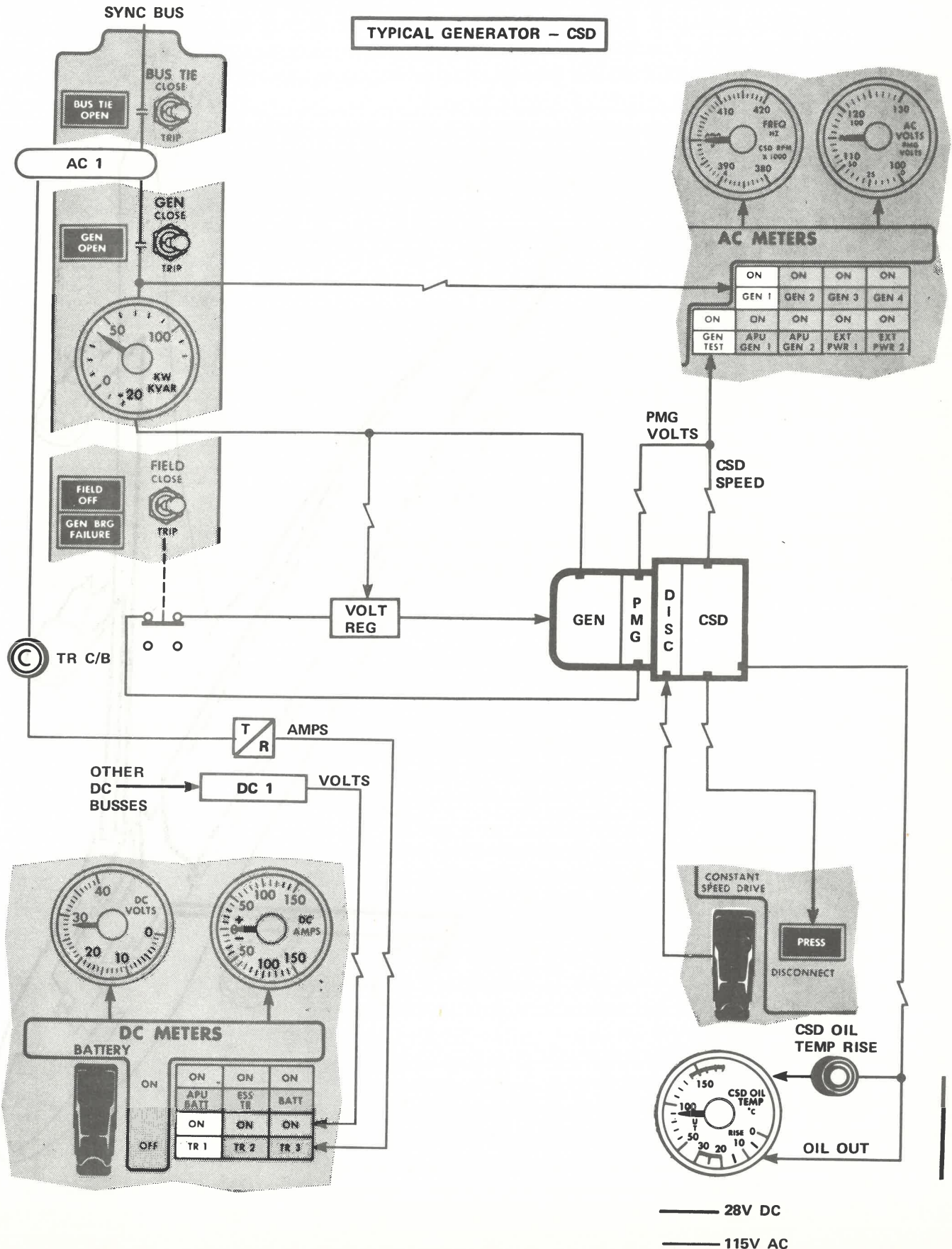
STANDBY POWER:



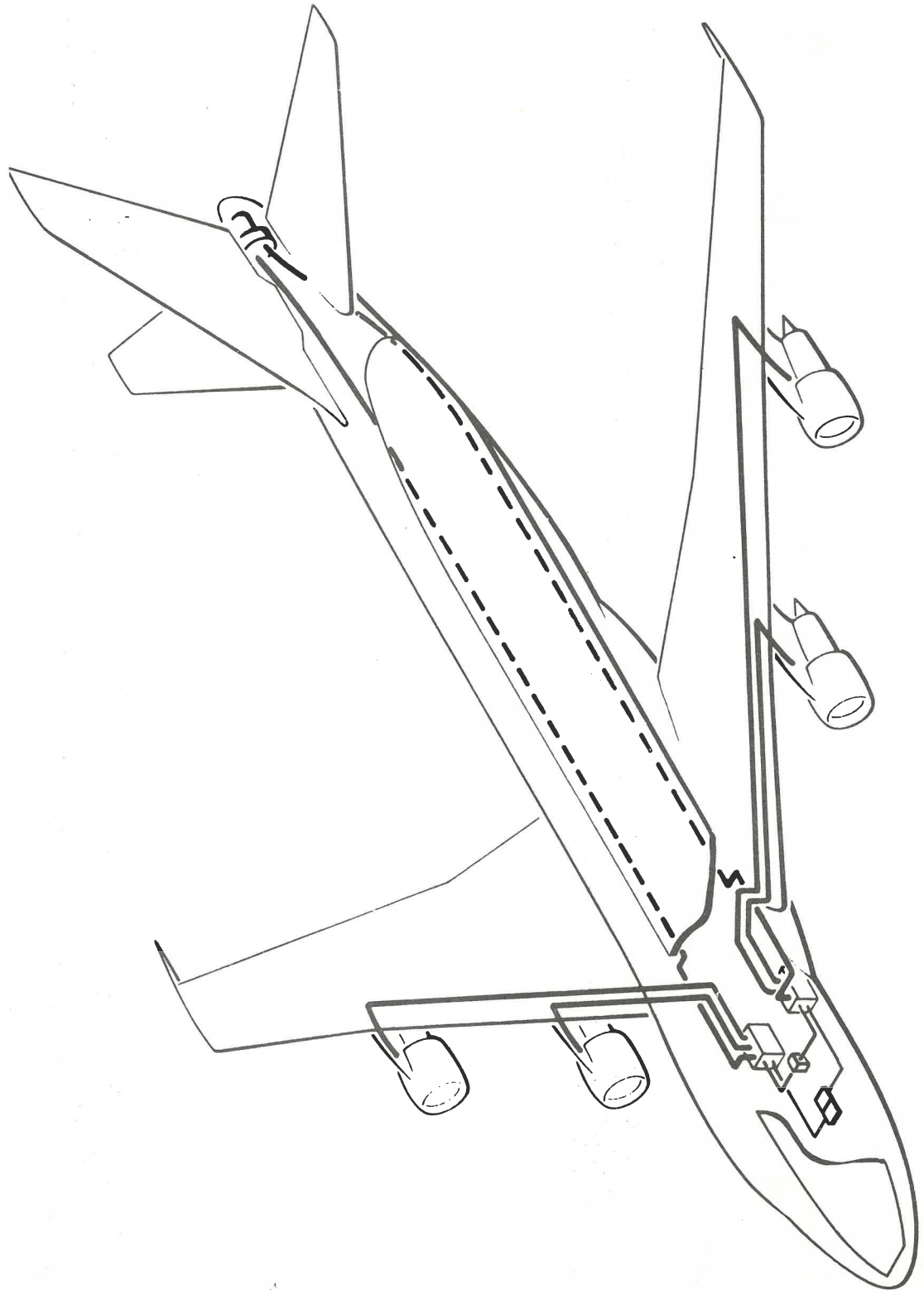
CONDITION: STANDBY POWER ON
 NO ESS AC OR DC

— 115V AC
 28V DC

CSD AND GENERATOR SCHEMATIC:



PRIMARY POWER DISTRIBUTION:



GROUND HANDLING AND SERVICE BUS LOADS:

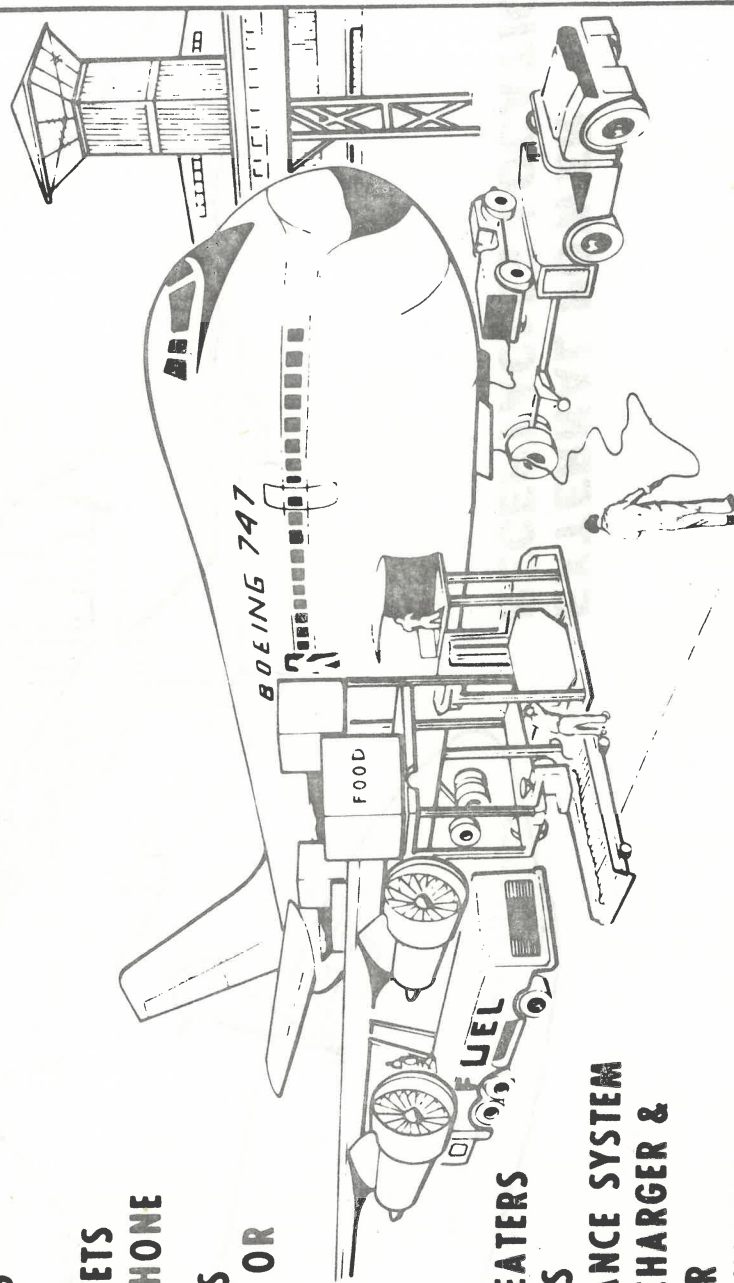
**GROUND HANDLING &
 GROUND SERVICE BUSES**

**GROUND HANDLING BUS
 (POWERED ONLY ON THE GROUND)**

1. CARGO LOADING
2. TOWING
3. CLEANING OUTLETS
4. SERVICE INTERPHONE

**GROUND SERVICE BUS
 (POWERED IN FLIGHT OR
 ON THE GROUND)**

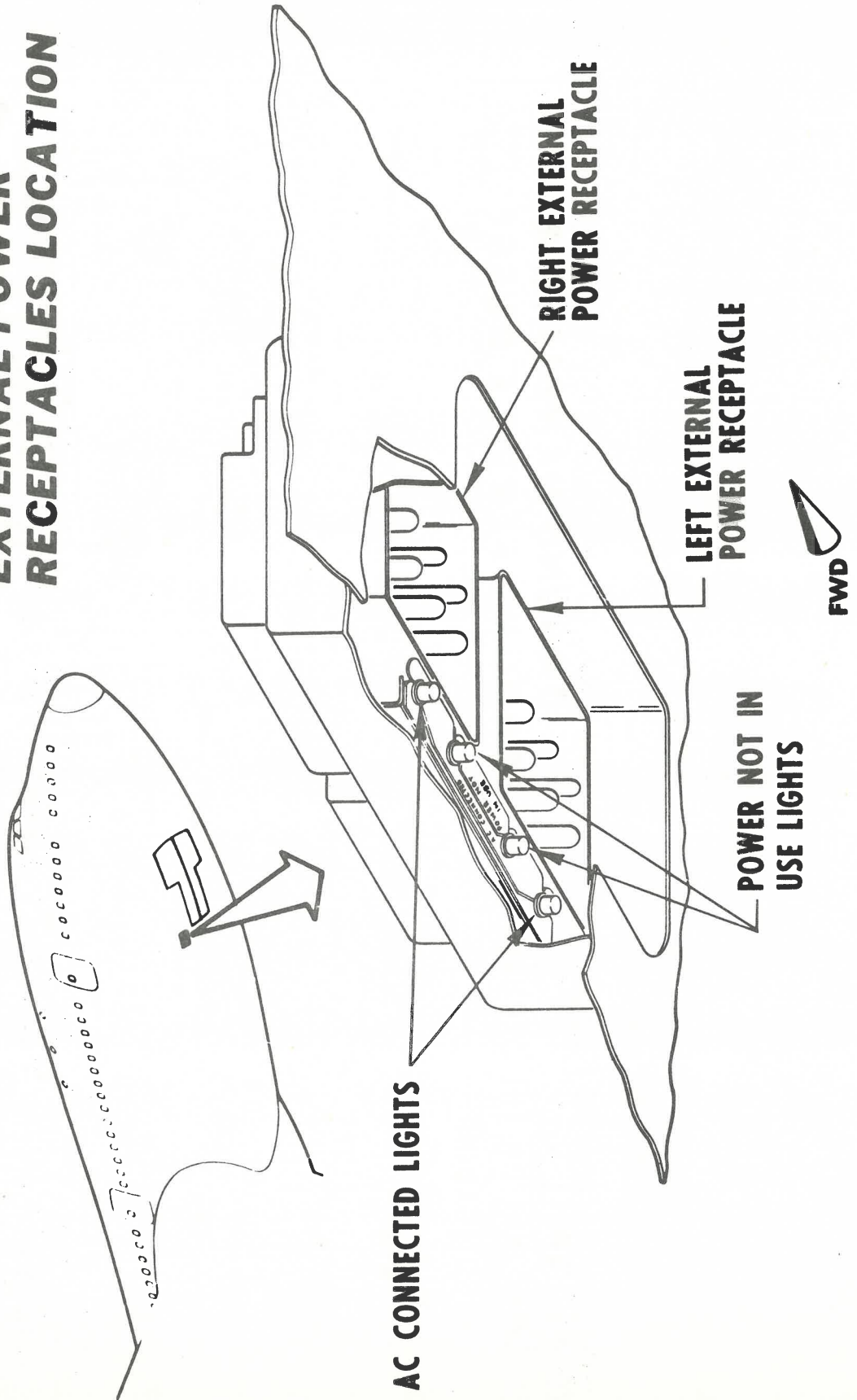
1. LIGHTS
2. APU FUEL BOOST PUMP
3. DRAIN MAST HEATERS
4. SERVICE OUTLETS
5. WEIGHT & BALANCE SYSTEM
6. APU BATTERY CHARGER & BATTERY HEATER
7. MAIN BATTERY HEATER
8. FUEL SYSTEM





EXTERNAL POWER RECEPTACLES:

**EXTERNAL POWER
RECEPTACLES LOCATION**



GENERATOR CONTROL UNIT:

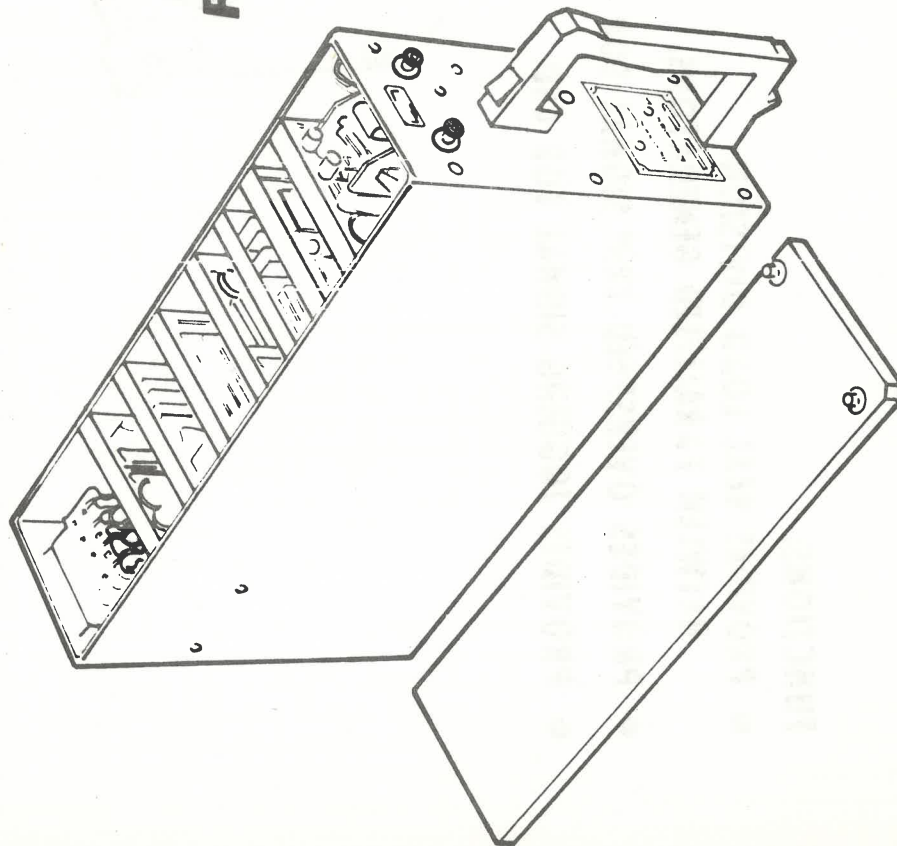
**GENERATOR CONTROL
UNIT FUNCTIONS**

GENERATOR CONTROL UNIT

Purpose:

PROVIDES CONTROL AND PROTECTION FOR:

- GENERATOR EXCITATION
- GENERATOR CONTROL RELAY (FIELD RELAY)
- GENERATOR CIRCUIT BREAKER
- BUS TIE BREAKER

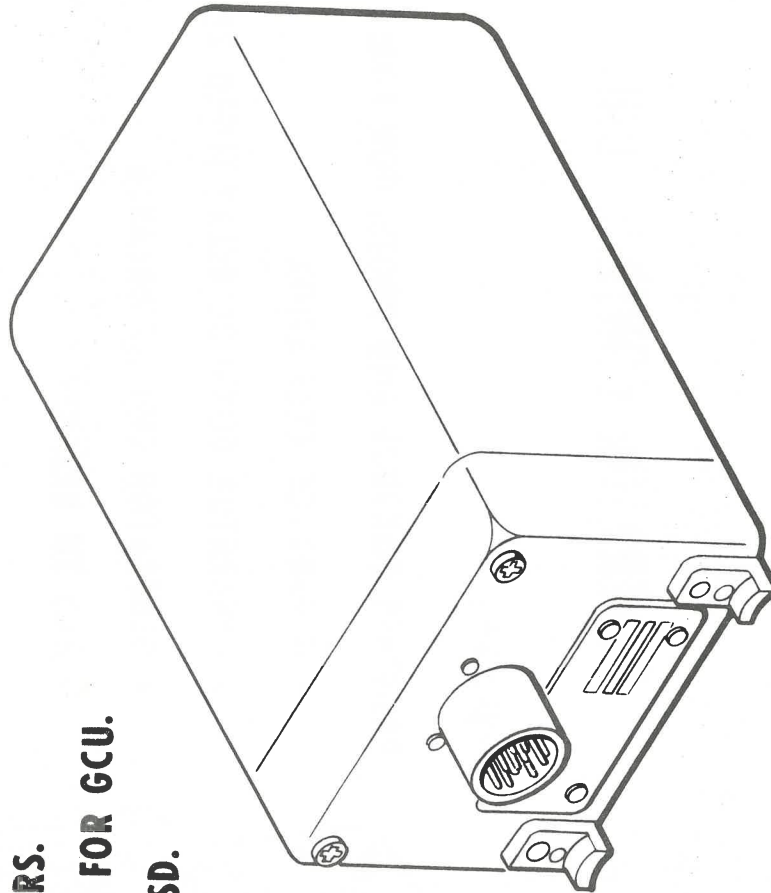


NOTE: VOLTAGE REG. AND FIELD RELAY LOCATED IN GCU.

LOAD CONTROLLER:

FUNCTIONS:

- PROVIDES REAL LOAD DIVISION BETWEEN PARALLELED GENERATORS.
- PROVIDES OVERSPEED TRIP SIGNAL FOR GCU.
- PROVIDES JOGGING SIGNAL FOR CSD.



LOAD CONTROLLER

BUS POWER CONTROL UNIT:

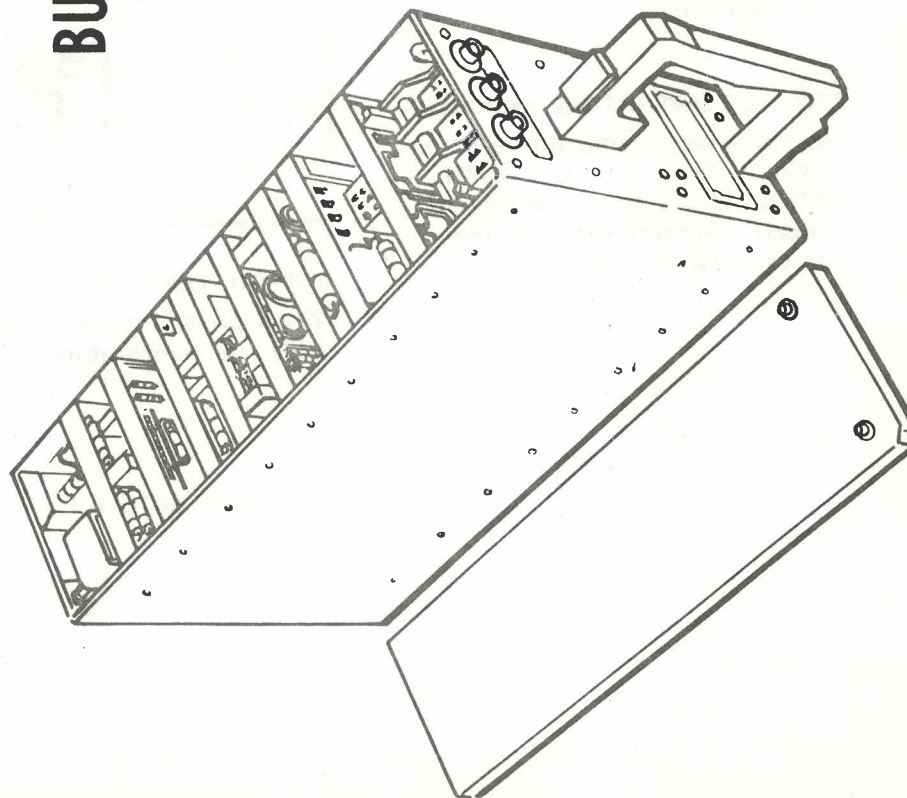
BUS POWER CONTROL UNIT FUNCTIONS

BUS POWER CONTROL UNIT

Purpose

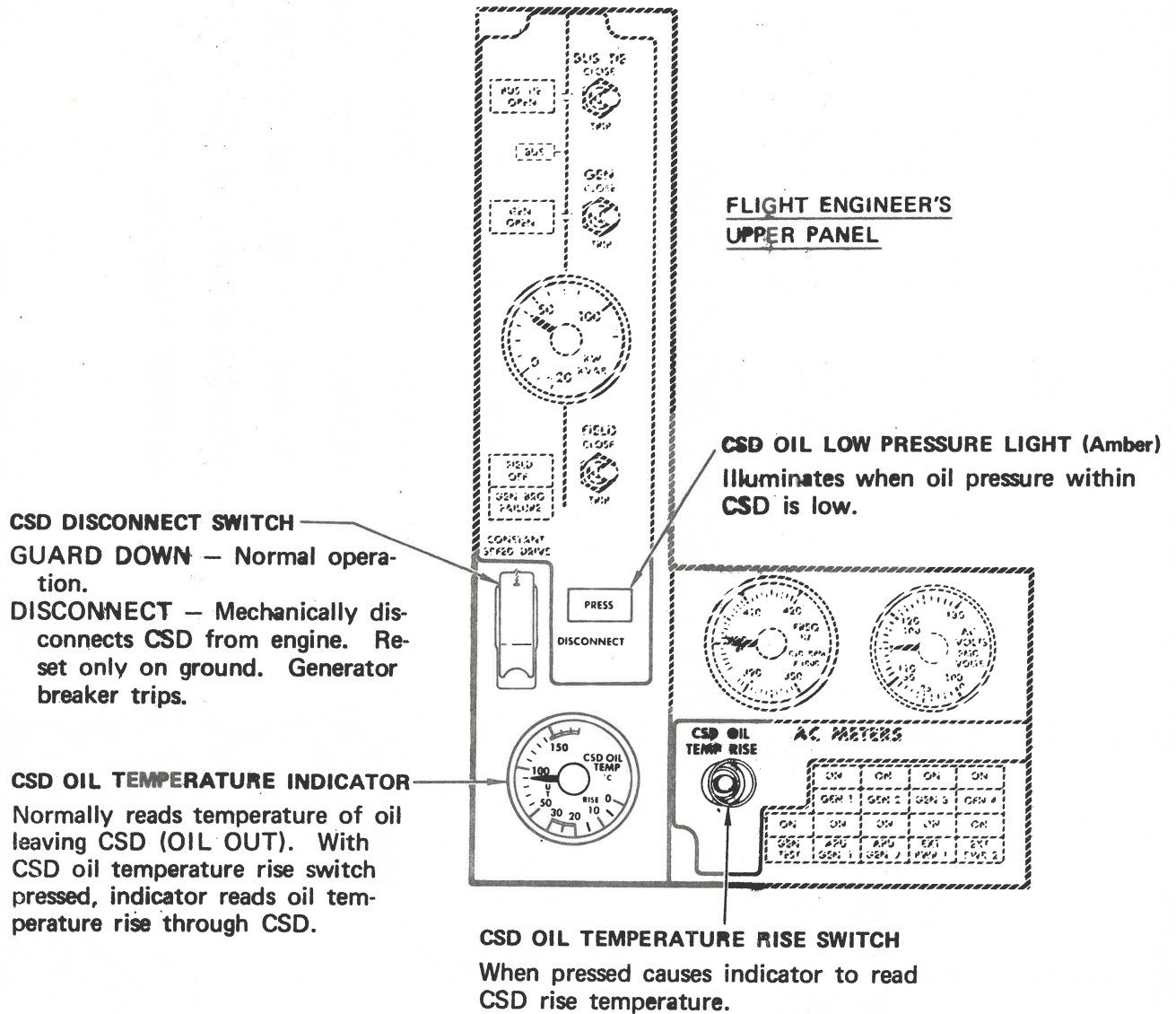
PROVIDES CONTROL AND PROTECTION FOR:

- AUX POWER UNIT GENERATOR SYSTEM
- EXTERNAL POWER DISTRIBUTION
- TIE BUS CONTROL AND PROTECTION
- GROUND SERVICE POWER
- GROUND HANDLING POWER



PROVIDES ANNUNCIATOR SIGNAL TO MAINTENANCE ANNUNCIATOR PANEL

CONSTANT SPEED DRIVE CONTROL PANEL:



AC POWER MODULE

GENERATOR CONTROL PANEL:

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.

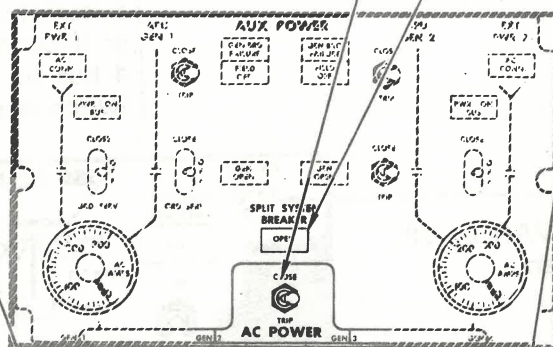
F/E UPPER PANEL

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.

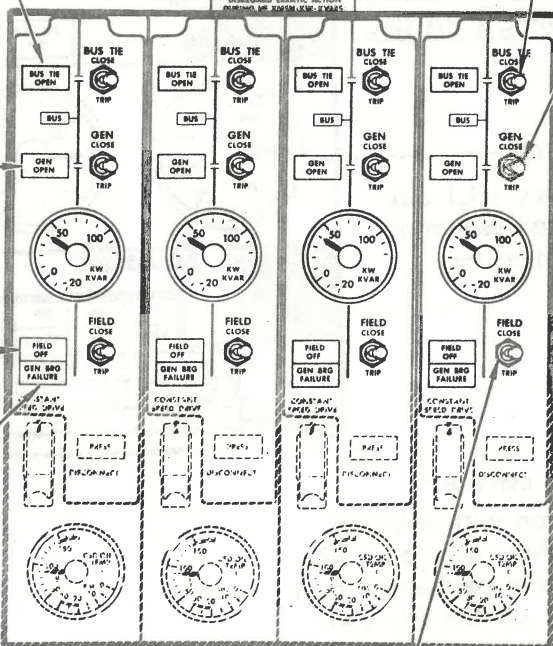
GENERATOR BREAKER SWITCH

TRIP — Generator disconnected from its AC bus. Trips due to CSD disconnect, engine shutdown, CSD or electrical faults, APU or external power breaker closed.

GENERATOR FIELD OFF LIGHT (Amber)

ILLUMINATED — Indicates generator field deactivated.

CLOSE — Connects generator to its respective bus. Trips external or APU power if connected to sync bus.



GENERATOR BEARING FAILURE LIGHT (Amber)

ILLUMINATED — Indicates impending generator bearing failure.

GENERATOR FIELD SWITCH

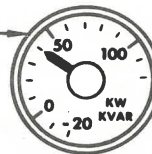
TRIP — Deactivates generator field and trips generator breaker. Trips automatically due to electrical faults and when fire switch is pulled.

AC POWER MODULE

A/C POWER INDICATORS:

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.

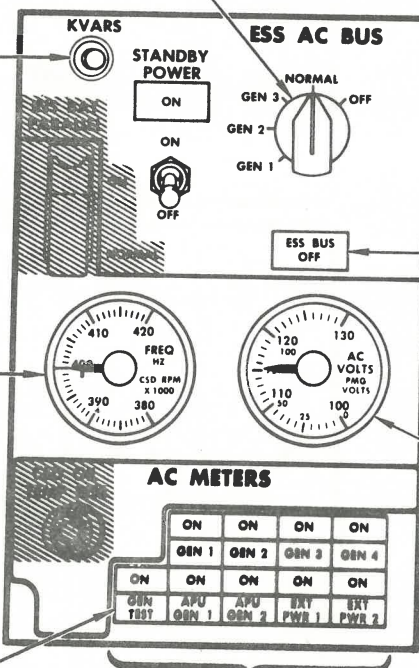
KVAR SWITCH

Press to read KVAR on all KW/KVAR meters.

F/E UPPER PANEL

FREQUENCY METER

Indicates frequency (Hz) output of the selected generator and CSD RPM when test switch pressed.



ESS BUSS OFF

PILOTS' CENTER PANEL

ESSENTIAL BUS OFF LIGHT (Red)

ILLUMINATED – Indicates that the essential AC bus is not powered.

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

DC POWER CONTROLS AND 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

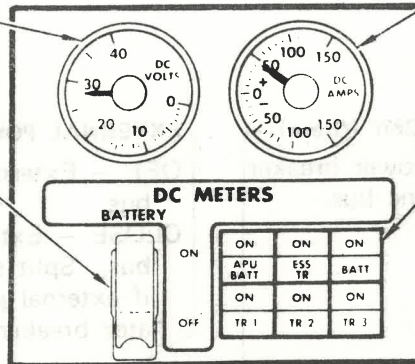
- Battery isolated from all loads except hot battery bus.
- Battery will continue to receive charge.
- APU will automatically shut down.

DC AMMETER

Indicates DC current output of selected source.

DC METERS SWITCHES (Blue)

Press to read voltage and amperage on DC meters. White ON light will illuminate in depressed switch.



FLIGHT ENGINEER'S PANEL
DC METERS MODULE

DC BUS 3 ISOLATION SWITCH

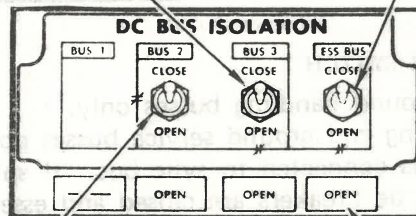
OPEN – DC bus 3 and essential DC bus isolated from busses 1 and 2.

CLOSE – Bus 3 paralleled with DC bus 1. Also paralleled with DC bus 2 and essential bus if other isolation switches are closed. Isolation relay 3 opens automatically (switch does not move) when essential power switch is moved to the 3, 2 or 1 position.

DC ESSENTIAL BUS ISOLATION SWITCH

OPEN – Essential DC bus isolated.

CLOSE – Essential DC bus paralleled with DC bus 3 and busses 2 and 1 if other isolation switches are closed.



DC BUS 2 ISOLATION SWITCH

OPEN – Bus isolated.

CLOSE – Bus 2 paralleled with DC bus 1. Also paralleled with DC bus 3 and essential bus if other isolation switches are closed.

DC BUS ISOLATION RELAY OPEN LIGHTS (Green)

Illuminates when corresponding isolation relay is open.

FLIGHT ENGINEER'S PANEL

DC BUS ISOLATION MODULE

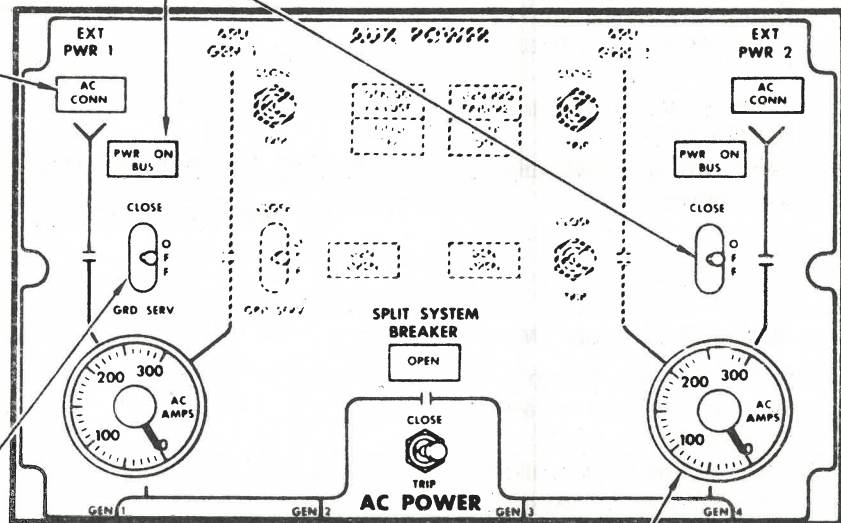
EXTERNAL POWER CONTROL PANEL:

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.

F/E UPPER PANEL

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.

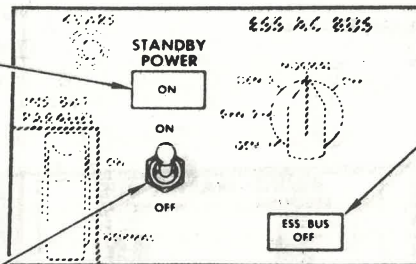


EXTERNAL POWER 1 BREAKER SWITCH
OFF – External power on ground handling busses only.
GRD SERV – Ground handling and ground service busses powered.
CLOSE – External power 1 is connected to sync bus. If split system breaker and all bus tie breakers are closed and essential power switch is in NORMAL, the entire electrical system will be powered.

AUXILIARY POWER AMMETER
 Indicates current output of the auxiliary generator powering the sync bus.

STANDBY POWER CONTROL PANEL

STANDBY POWER ON LIGHT (Green)
ILLUMINATED – Indicates that standby power switch is ON.



ESSENTIAL BUS OFF LIGHT (Red)
 Illuminated when essential AC power is lost.

FLIGHT ENGINEER'S
PANEL

STANDBY POWER SWITCH

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 – Standby power system is powered from essential busses.

RADIO MASTER AND GALLEY POWER CONTROL PANEL:

ESSENTIAL RADIO BUS SWITCH

ON – Connects essential radio buses 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

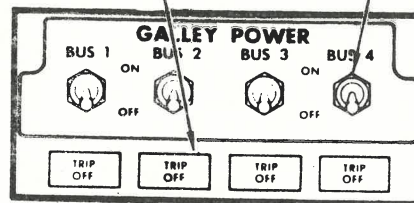


RADIO MASTER BUS MODULE

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

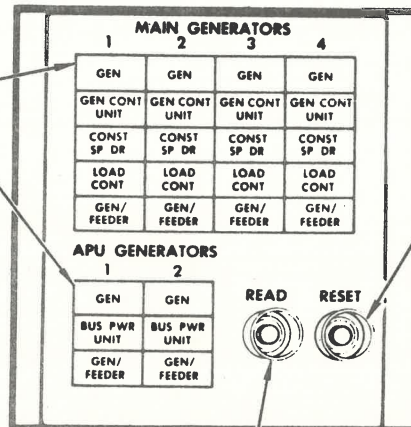


GALLEY POWER MODULE

MAIN/APU GENERATOR FAULT ANNUNCIATOR:

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

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FIRE PROTECTION SYSTEM

ENGINES:

Two separate engine fire detector loops are installed for each engine, designated 'A' and 'B' loops. Each loop provides both relative temperature indications and fire warning. One Nacelle temperature indicator for each engine will reflect the temperature sensed by each loop. Loop 'A' temperatures are indicated by the left needle and loop 'B' by the right needle. The Loop Selector Switch is used to select the loop or loops which will be used to sense a fire condition. If an open circuit in the loop sensing occurs, it will not show on the Nacelle Temperature Indicator except during test and the respective loop needle will indicate at the bottom of scale. If a short circuit in the loop sensing occurs, it will move the respective loop needle to the top of the scale, causing fire warning to occur.

The Fire Detector System will respond to a fire condition with the following indications:

1. Master fire warning lights will illuminate
2. Fire warning bell will sound.
3. Engine fire switch will illuminate and remain illuminated as long as fire condition exists.
4. Nacelle Temperature Indicator will be in the upper fire range and remain as long as fire condition exists.

Each engine has two fire bottles which may be discharged separately into the Nacelle area. Two red thermal discharge indicators are located on right hand side of the strut. Selection of a bottle is provided by an individual discharge switch which detonates an explosive charge (Squib) to fire the bottle. Discharge of the respective bottle will be indicated by illumination of the associated amber Discharge Light.

A continuity check of each Squib circuit is provided by a single 'Squib Test' switch and lights if circuit is OK.

The engine fire switch when pulled will lock and a yellow flag extends; in addition:

1. Engine Fuel Shutoff Valve closes.
2. Depressurizes Hydraulic Pump
3. Shuts off fluid to the Engine Hydraulic Pump
4. Closes engine Bleed Valve
5. Trips Field Relay
6. Arms both Bottle Discharge Switches

AUXILIARY POWER UNIT:

Dual fire detection loops are provided for the APU. Both Loops 'A' and 'B' are located around the APU itself, and either can provide fire warning. A Loop Selector Switch allows selection of either or both loops. When a fire condition exists, the Fire Detector System will:

AUXILIARY POWER UNIT: (continued)

1. Illuminate Master Fire Warning Lights.
2. Illuminate APU Fire Light on overhead panel.
3. Illuminate APU Fire Switch on S/O panel.
4. Sound fire bell.
5. (On the Ground) will illuminate red APU fire light and sound steady horn in right hand body wheel well.

One fire bottle is provided and may be discharged into the APU area by pressing Bottle Discharge Switch. The amber Discharge Light will illuminate when bottle has discharged. A check of the Squib circuit is provided by Squib Test Switch and illumination of light, if circuit is OK. A Thermal Discharge Indicator for APU fire bottle is located on left side of fuselage, just forward of the APU. When the APU Fire Switch is pulled, a yellow flag extends and locks; in addition:

1. Arms the fire bottle
2. Closes fuel valve
3. Closes APU door when RPM decreases to 50%.
4. Shuts down DC fuel pump, if running.

WHEEL WELLS:

There is one detector loop in each of the four main wheel wells. A fire or overheat condition in any one of the main wheel wells will initiate a fire warning. The fire detectors will illuminate the Master Fire Warning Lights, Wheel Well Fire Light, and sound the fire bell.

LOWER CARGO COMPARTMENTS:

Fire detection is provided by smoke detectors in each compartment: Two smoke detectors in forward cargo compartment and four in the aft cargo compartment. The fire detectors will illuminate Master Fire Warning Lights, the fwd or aft lower cargo fire warning light on S/O panel, lower cargo fire light on pilot's overhead panel, and sounds fire bell.

Two fire bottles are provided and may be discharged separately into either the forward or aft lower cargo compartment through a Compartment Select Switch and Bottle Discharge Switches. When its respective bottle has discharged, an amber discharge light illuminates. The No. 1 bottle has the larger capacity and is used for the initial discharge. The two Squib circuits on each bottle may be tested by Squib Test Switch and illuminates light if circuit is operational. A thermal discharge of either or both fire bottles will illuminate the No. 1 Discharge Light. The Compartment Select Switch also closes off the airflow to the selected compartment.

WING LEADING EDGE:

A dual loop provides overheat warning for the pneumatic cross-ship manifold and engine strut area. Either loop is capable of providing the warning by illuminating 'Wing Ovht' light on S/O panel. The system is strictly a warning with no resulting valve action.



FREIGHTER

26:01F

FIRE PROTECTION

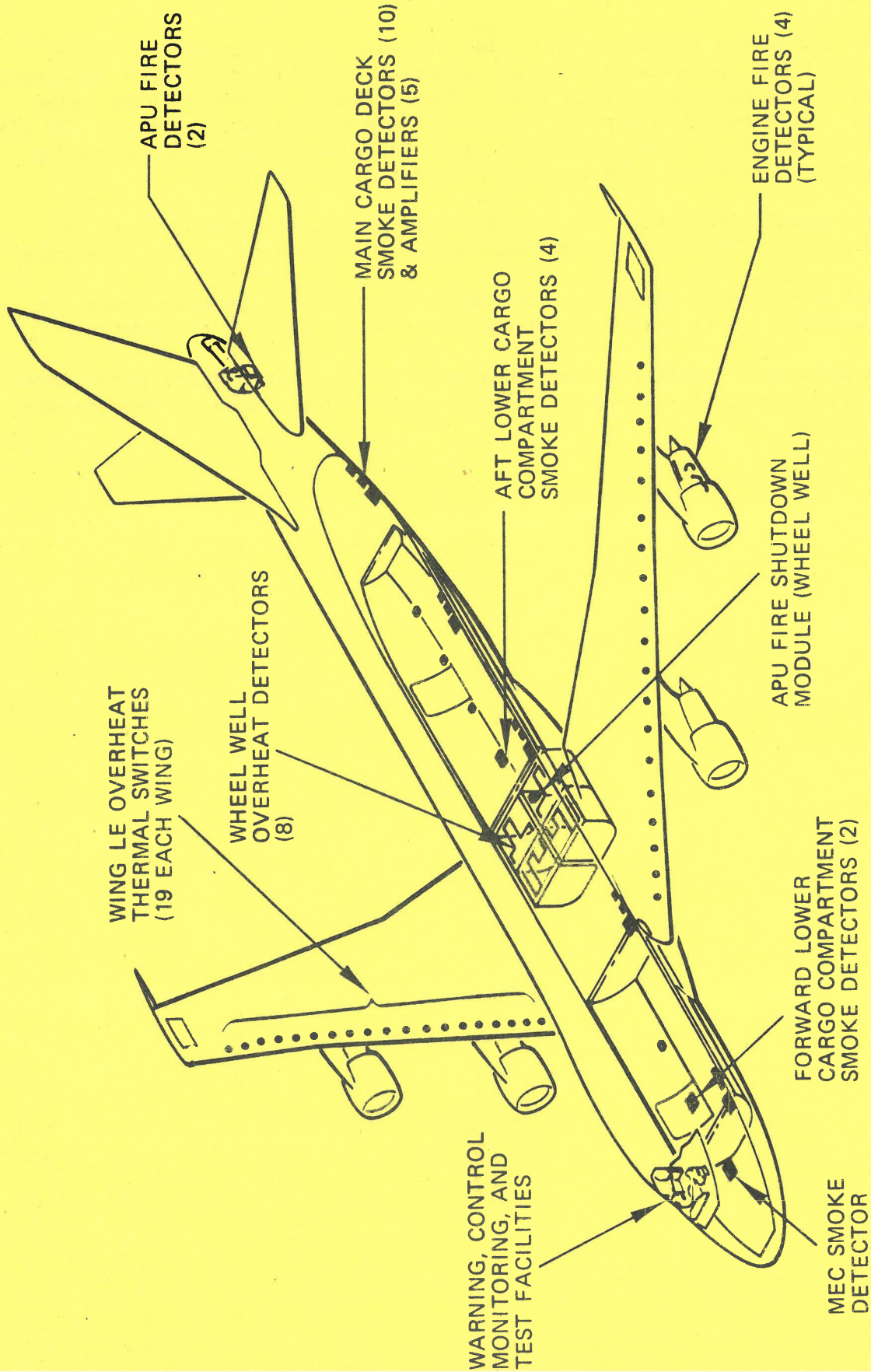
The fire protection system on the B-747F is similar to the present fleet except for the lower and main deck cargo detection system. Five smoke detectors are provided in the main cargo deck area. Five detector lights provide cargo fire warning. Test switches provide a check of the system integrity. A "NO AIR FLOW" light on the cargo smoke detection panel illuminates when vacuum source is insufficient to maintain adequate airflow thru the detectors.

Lower fwd cargo compartment has two smoke detectors to provide lower fwd cargo fire warning. Two detector switches provide a check of system integrity.

Lower aft cargo compartment has four smoke detectors to provide lower aft cargo fire warning. Four detector switches provide a check of the system.

A "Fire Detection" light has been installed on the center pilot annunicator panel. It will illuminate with a loop fault of the engine nacelle temperature indicating system.





FIRE PROTECTION AREAS

ENGINE FIRE PROTECTION SYSTEM:

GENERAL

1. Fire detection and protection is provided for the engines, the A.P.U. and the lower forward and aft cargo compartments. The wheel well area is provided with fire detection only.
 - a. Two separate engine fire detection systems are installed for each engine.
 - (1) Each system provides both relative temperature level indications and fire detection capability.
 - (2) Each engine has two fire extinguishing bottles which may be discharged separately into the nacelle area.
 - b. Two separate APU fire detector systems are installed and either system will provide fire protection and warnings.
 - (1) One fire extinguisher bottle is provided and may be discharged into the APU area.
 - c. The forward and aft cargo compartments have smoke detectors which are each capable of providing fire detection and fire warning.
 - (1) Two fire extinguishing bottles may be used for discharge into either cargo compartment.
 - d. One continuous fire detection loop is installed with detector elements in each of the main landing gear wheel wells.
 - (1) A fire or overheat condition in one of the main wheel wells will initiate a firewarning.

ENGINE FIRE DETECTION

1. The engine fire detection system provides detection in each of four engines through continuous dual-element sensors.
 - a. Engine nacelle temperature indicators are located on the S/O panel.
 - (1) Indicate relative temperature levels in the engine nacelle area through dual pointers on a vertical scale (one for each loop A & B):
 - (a) Relative temperature displayed by green, amber and red bands on vertical scale indicator.
 - '1' If nacelle temperature reaches red band, a firewarning will be initiated.
 - '2' If short exists in the detector system, pointer will indicate in "S" band.
 - '3' If an open exists in the detector system, pointer will indicate in "O" band.
 - b. Four nacelle fire detector switches are located on S/O panel.
 - (1) Both position — Either A or B detectors will initiate a firewarning.
 - (2) A or B position — Only the selected detector will initiate a firewarning.

ENGINE FIRE PROTECTION SYSTEM:

- c. Two nacelle fire/fault test switches (A & B) are located on S/O panel.
 - (1) Fire test position – Introduces a simulated fire signal that causes nacelle temperature indicators to indicate in red band and initiate a firewarning.
 - (a) Illuminates Master Firewarning lights (two) on the glareshield.
 - '1' Push to reset firewarning system.
 - (b) Illuminates all engine fire switches on pilots' overhead panel.
 - (c) Firewarning bell sounds.
 - (2) Fault Test position – Simulates short in detector system causing nacelle temperature indicators to indicate in the "S" band.
 - (a) Illuminates Fault light on S/O panel.

NOTE: With an open detector system there will be no response to the fire/fault test.

- d. Fire bell reset switch
 - (1) Press to extinguish Master Firewarning lights, silence firewarning bell and reset firewarning circuits.

ENGINE FIRE PROTECTION AND EXTINGUISHING

- 1. Two fire extinguishing bottles located in the strut provide fire fighting capability for an engine fire.
 - a. Two red thermal discharge disks on right side of engine strut.
 - b. Squib circuit continuity may be checked by a squib test switch on the S/O panel.
 - (1) Left Bottle position – Checks continuity of left bottle squibs.
 - (a) Illuminates all Squib OK lights on S/O panel.
 - (2) Right Bottle position – Checks continuity of right bottle squibs.
 - (a) Illuminates all Squib OK lights.
 - (3) OFF position – Squib test system is deactivated.
- 2. Four engine fire switches are located on pilots' overhead panel.
 - a. Pulling engine fire switch – rotates a yellow flag into view locking the switch in the pulled position.
 - (1) Arms fire extinguisher system.
 - (a) Pressing either of two fire extinguisher discharge switches discharges bottle.
 - '1' Discharge light illuminates and remains illuminated to indicate bottle has discharged.

MAIN DECK CARGO FIRE WARNING LIGHTS (Red)

Illuminates for a smoke condition in the indicated main deck cargo area. Pilots' CARGO fire warning and master FIRE warning lights will illuminate and fire warning bell will sound.

Remains illuminated as long as smoke condition exists.

NO AIRFLOW LIGHT (Amber)

Illuminates when vacuum source is insufficient to maintain an adequate airflow through the detectors.

LOWER CARGO FIRE WARNING LIGHTS (Red)

Illuminates for a fire condition in the indicated lower cargo compartment or during test. Pilots' CARGO fire warning and master FIRE warning lights will illuminate and fire warning bell will sound.

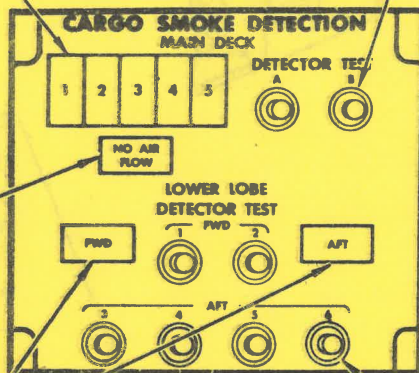
Remains illuminated as long as fire condition exists.

MAIN DECK CARGO DETECTOR TEST SWITCHES

Simulates a smoke condition at the individual detectors. Main deck cargo fire warning lights, pilots' CARGO fire warning light and master FIRE warning light will illuminate and fire warning bell will sound while switch is pressed.

LOWER CARGO DETECTOR TEST SWITCHES

Simulates a fire condition at the individual detectors. Respective lower cargo fire warning light, pilots' CARGO fire warning light and master FIRE warning lights will illuminate and fire warning bell will sound while switch is pressed.



FLIGHT ENGINEER'S PANEL

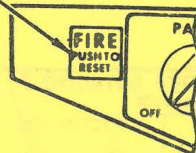
CARGO FIRE DETECTION

MASTER FIRE WARNING LIGHTS (Red) (CAPTAIN'S AND FIRST OFFICER'S)

Illuminates for a fire condition, or during test, for the following areas:

- Engine nacelles (also fire warning bell)
- APU (also fire warning bell)
- Main landing gear wheel wells (also fire warning bell)
- Main deck cargo area (also fire warning bell)
- Lower forward or aft cargo compartments (also fire warning bell)

Push to extinguish master FIRE warning lights, silence fire warning bell and reset warning circuits.



PILOTS' LIGHTSHIELD

ENGINE FIRE SWITCHES (Red)

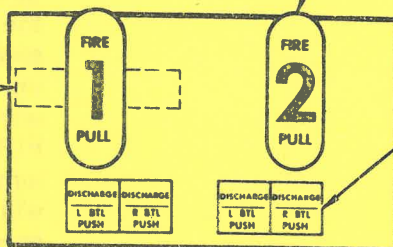
Illuminates for a nacelle fire condition or during test. Remains illuminated as long as fire condition exists.

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.
- Closes bleed air valve.

FIRE SWITCH FLAG

When FIRE switch is pulled yellow flag rotates into view and locks switch in pulled position.



PILOTS' OVERHEAD PANEL

ENGINE FIRE EXTINGUISHER DISCHARGE SWITCHES (Blue)

With engine FIRE switch pulled, press to discharge indicated fire extinguisher bottle. Amber DISCHARGE light illuminates and remains illuminated to indicate extinguisher bottle discharged.

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 the fire warning bell will sound while switch is pressed.



PILOTS' OVERHEAD PANEL

WHEEL WELL FIRE WARNING LIGHT (Red)

Illuminates for a wheel well fire condition or during test. Remains illuminated as long as fire condition exists.

APU FIRE WARNING LIGHT (Red)

Illuminates for an APU fire condition or during test. Remains illuminated as long as fire condition exists.

CARGO FIRE WARNING LIGHT (Red)

Illuminates for either a main deck or lower cargo fire condition or during test. Remains illuminated as long as fire condition exists.



ENGINE FIRE PROTECTION SYSTEM:

ENGINE FIRE PROTECTION AND EXTINGUISHING (Cont.)

- (2) Closes fuel shutoff valve.
- (3) Depressurizes engine driven hydraulic pump and shuts off hydraulic fluid supply.
- (4) Trips generator field after a time delay.
- (5) Closes bleed air valve.

APU FIRE PROTECTION SYSTEM:

A.P.U. FIRE DETECTION

1. The APU fire detection system provides detection in the APU compartment through continuous dual-element sensors. Either system will provide fire protection and warning.
 - a. Two APU fire/fault test switches (A & B) are located on the S/O panel.
 - (1) Fire Test position – Introduces a simulated fire signal that initiates a firewarning.
 - (a) Illuminates Master Firewarning lights (two) on the glareshield.
 - (b) Illuminates the APU fire switch.
 - (c) Illuminates APU Warning light on pilots' overhead panel.
 - (d) Firewarning bell sounds.
 - (e) APU firewarning horn sounds at remote APU panel.
 - (f) Illuminates APU Fire light at remote APU panel.
 - (2) Fault Test position – Simulates a short in the detector system and the (A & B) Fault lights illuminate on the S/O panel.

NOTE: With an open detector system there will be no response to fire/fault test.

A.P.U. FIRE PROTECTION AND EXTINGUISHING

1. One fire extinguishing bottle located on the forward side of the APU firewall provides fire fighting capability for an APU fire.
 - a. One red thermal discharge disk on left side of fuselage below APU.
 - b. Squib circuit continuity may be checked by a squib test switch on S/O panel.
 - (1) Squib Test position – Checks continuity of bottle squib.
 - (a) Illuminates the Squib OK light on S/O panel.
 - (2) OFF position – Squib test system is deactivated.
2. There are two APU fire switches, one at S/O panel and another at the remote APU panel located in the right body gear wheel well.
 - a. Pulling either APU fire switch.
 - (1) Shuts down the APU.
 - (2) Arms the APU fire extinguisher.
 - (a) Pressing fire extinguisher discharge switch on S/O panel or the remote APU control panel discharges the bottle.
 - '1' A Discharge light on S/O panel illuminates.

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 and fault in the F band.
- A single detector electrical open will not affect fire warnings or temperature indications.
- With a detector short the associated indicator will be locked in the F band.

PILOTS' CENTER PANEL

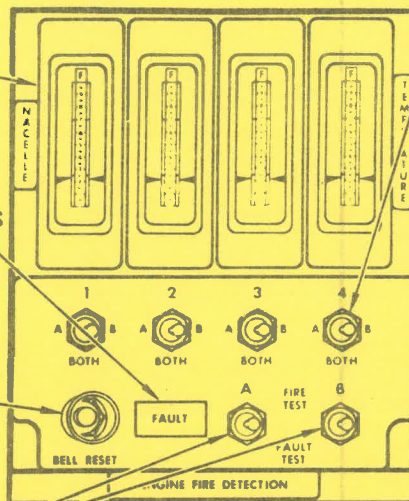
FIRE DETECTION

NACELLE FIRE DETECTOR FAULT LIGHTS (Amber)

Illuminates to indicate a detector fault or during test.

FIRE BELL RESET SWITCH

Press to extinguish master FIRE warning lights, silence fire warning bell and reset warning circuits.



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.

FLIGHT ENGINEER'S PANEL

NACELLE FIRE/FAULT TEST SWITCHES

Introduces a simulated fire or fault signal in selected detector with system indication as follows:

| One Test Switch Position | Other Test Switch Position | INDICATION |
|--------------------------|----------------------------|----------------|
| FIRE | FIRE | FIRE |
| FIRE | FAULT | FIRE and FAULT |
| FIRE | NORMAL | FIRE |
| FAULT | FAULT | FAULT |
| FAULT | NORMAL | FAULT |

(Nacelle Fire Detector Switch in BOTH)

FIRE

- Engine FIRE switches illuminates
- Master FIRE warning lights illuminate and fire warning bell sounds.
- Nacelle temperature indicators for selected detector move to red band.

NOTE: With a detector open there will be no response to FIRE TEST.

FAULT

- Nacelle FIRE DETECTION and FAULT lights will illuminate.
- Nacelle temperature indicator moves to F band.



LOWER CARGO FIRE PROTECTION:

LOWER CARGO SMOKE AND FIRE DETECTION

1. The lower cargo smoke and fire detection system provides detection in the forward and aft cargo compartments through six smoke detectors. Two for the forward cargo and four for the aft cargo compartment.
 - a. Six lower cargo detector (pushbutton) test switches are located on the S/O panel.
 - (1) Pushing each of the detector switches simulates a fire signal at that detector and initiates a firewarning.
 - (a) Respective Lower Cargo Firewarning light (forward or aft) will illuminate on S/O panel.
 - (b) Pilots' Lower Cargo Firewarning light will illuminate on pilots' overhead panel.
 - (c) Master Firewarning lights (two) will illuminate on glareshield.
 - (d) Firewarning bell sounds.

LOWER CARGO FIRE PROTECTION AND EXTINGUISHING

1. Two fire extinguisher bottles located in the aft end of the forward cargo compartment provides fire fighting capability for both cargo compartments.
 - a. The No. 1 fire extinguishing bottle (larger capacity) is provided for the initial discharge.
 - b. Thermal relief for either bottle will dump into the forward cargo compartment and turn on the bottle No. 1 Discharge light on the S/O panel.
 - c. A three-position compartment select switch is located on S/O panel.
 - (1) OFF position – Disarms bottle discharge switches.
 - (2) FWD position – Selects forward compartment for bottle discharge and closes equipment cooling airflow to forward compartment.
 - (3) AFT position – Selects the aft compartment for bottle discharge and closes the aft cargo heat valve.
 - d. Pressing either of two lower cargo extinguisher discharge switches (BTL No. 1 and BTL No. 2) on S/O panel will discharge the bottles.
 - (1) No. 2 bottle discharge switch is guarded.
 - (2) Respective Discharge lights will illuminate.
 - e. The No. 1 and No. 2 bottle forward and aft squibs may be checked by two test switches on S/O panel.
 - (1) The Squib OK light will illuminate if each squib is operational.



WHEEL WELL FIRE PROTECTION:

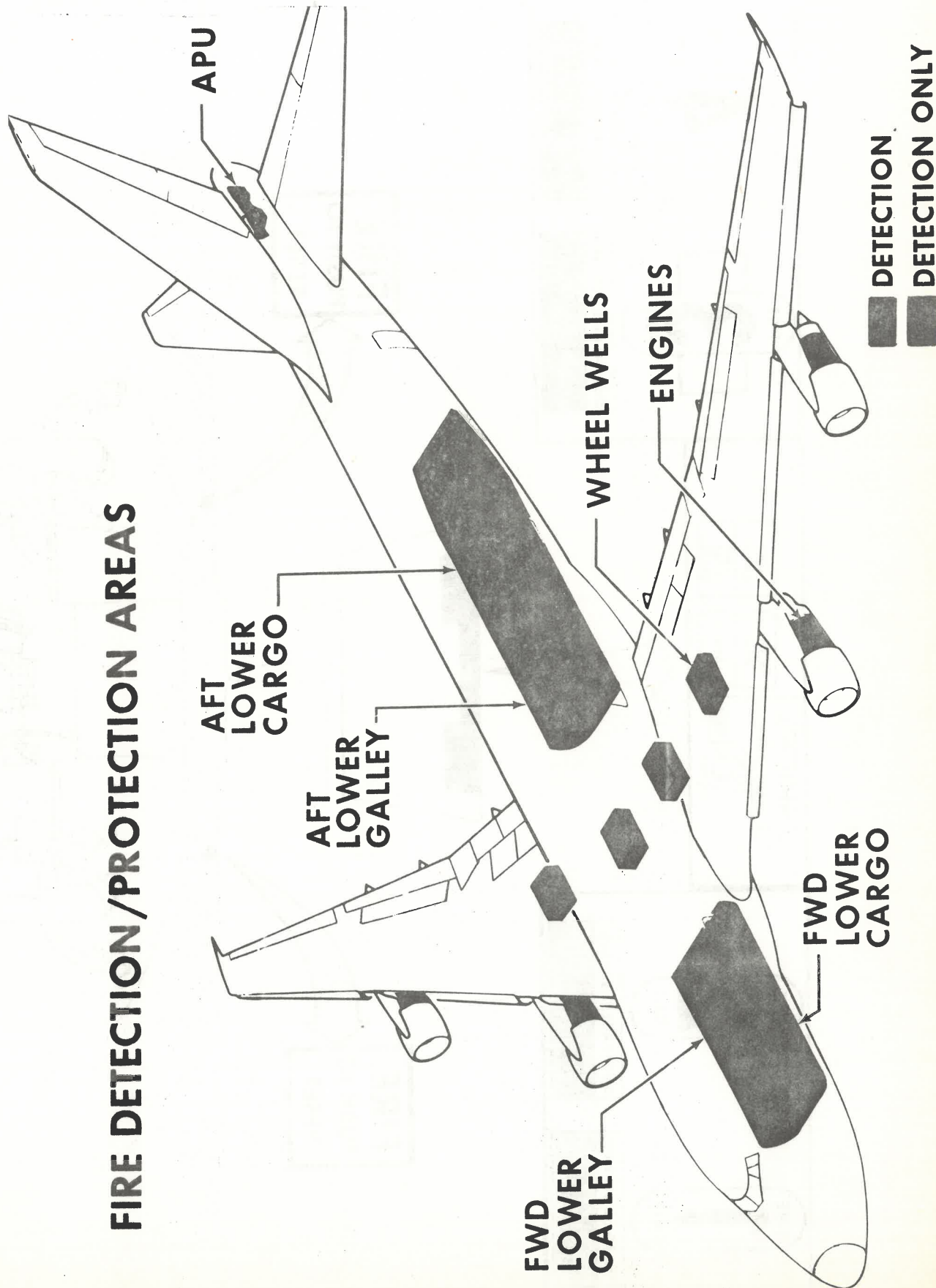
WHEEL WELL FIRE DETECTION

1. The wheel well fire detection system provides detection only, for each of the main gear wheel wells through a continuous single element detector.
 - a. Wheel well fire detection test switch located on pilots' overhead panel. Depressing test switch simulates a fire or overheat condition.
 - (1) Illuminates Master Firewarning lights on glareshield.
 - (2) Illuminates the Wheel Well Warning light on the pilots' overhead panel.
 - (3) Sounds the fire bell.
 - b. The Warning lights and bell may be reset by pressing either Master Firewarning light or by reset button on S/O panel.

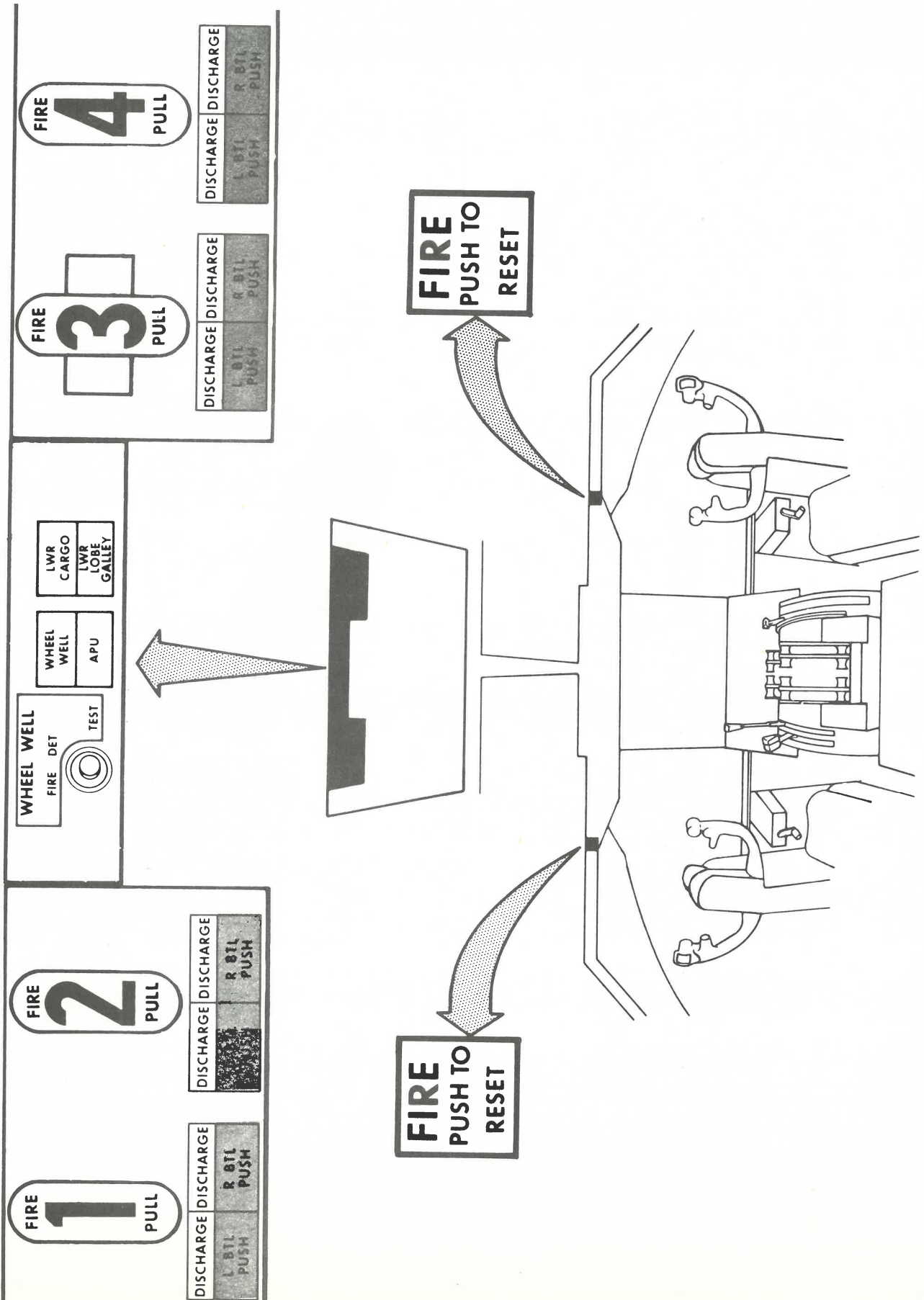


FIRE DETECTION/PROTECTION AREAS:

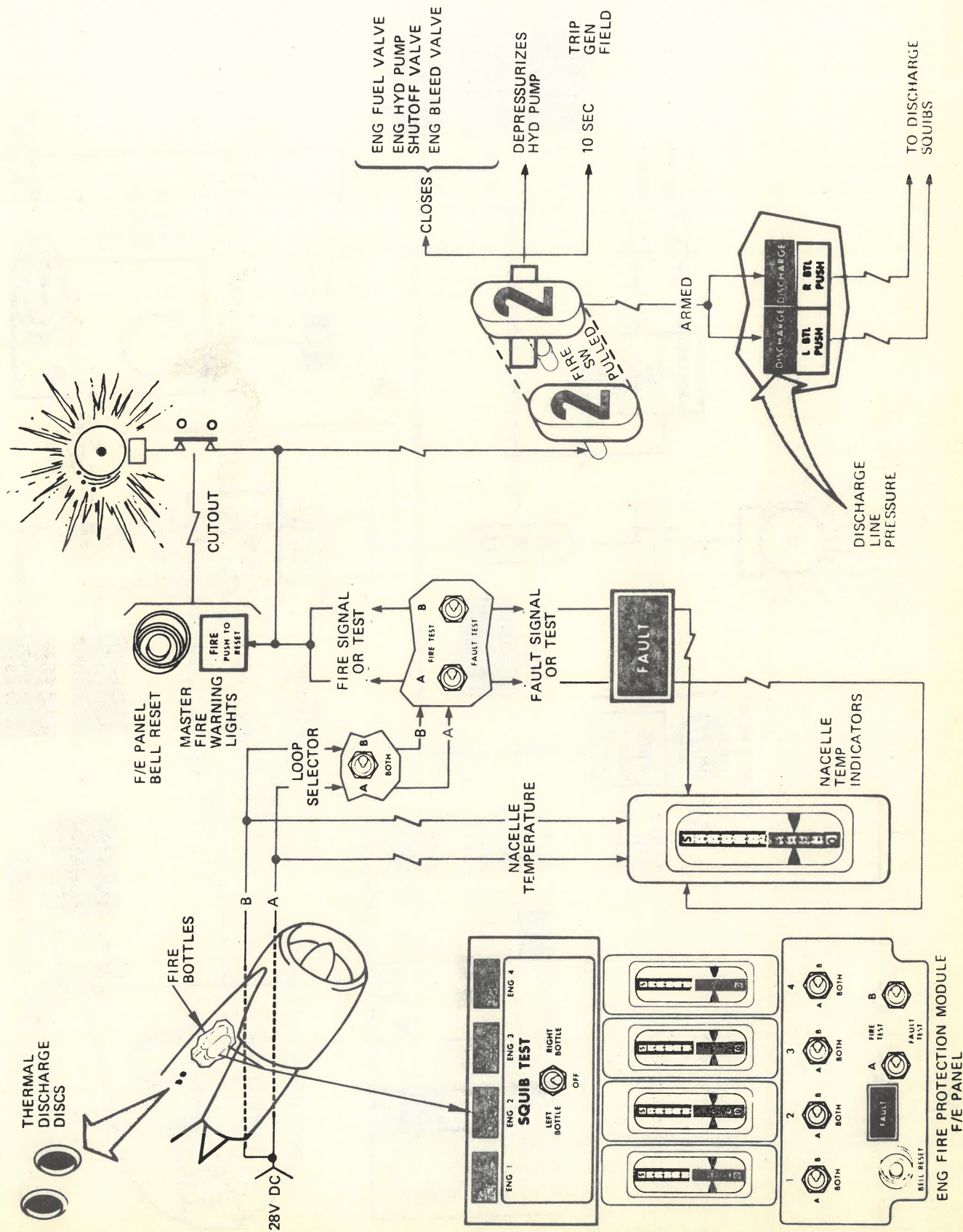
FIRE DETECTION/PROTECTION AREAS



FIRE WARNING LIGHTS:

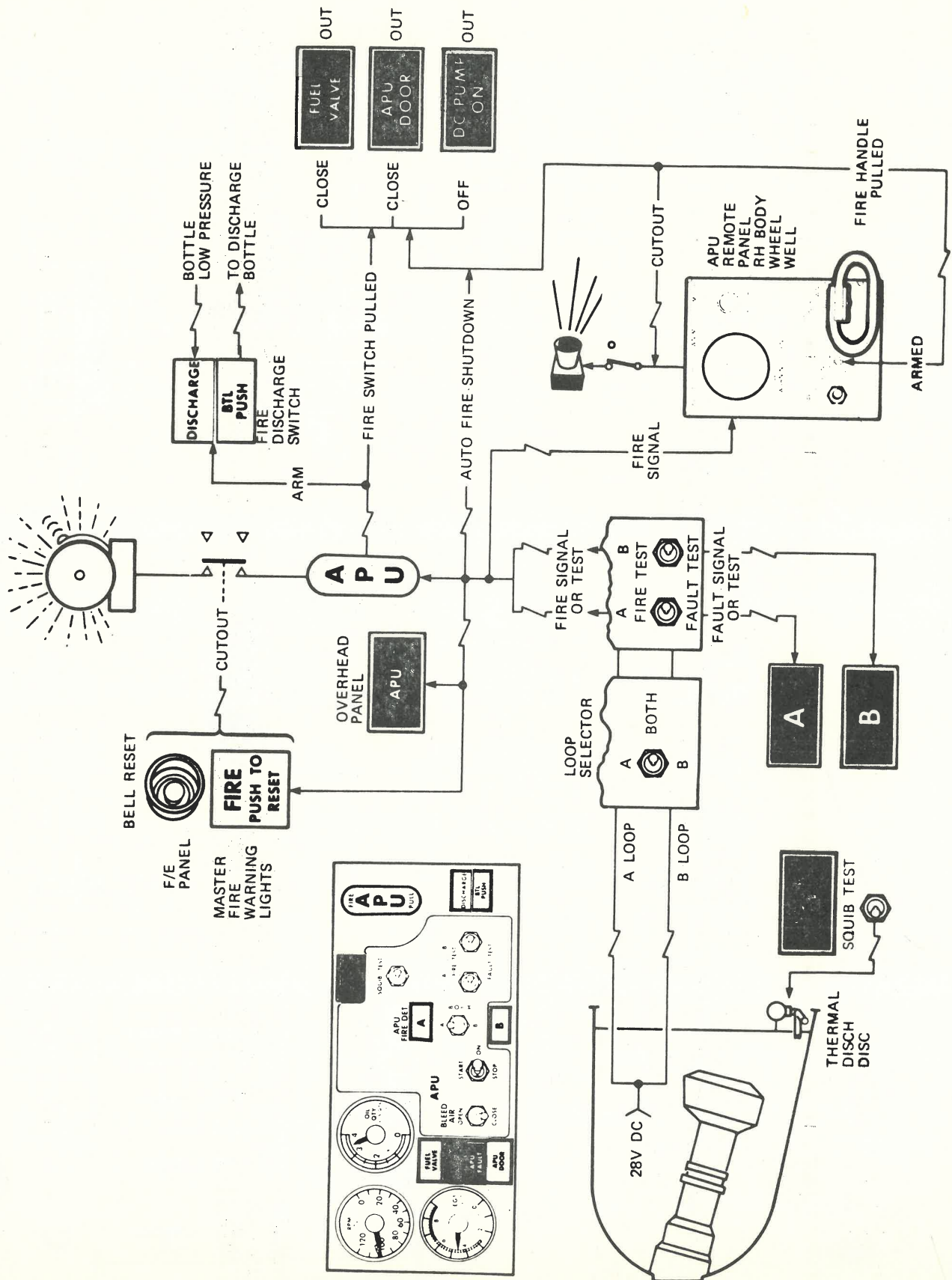


ENGINE FIRE PROTECTION SYSTEM:



ENGINE FIRE PROTECTION

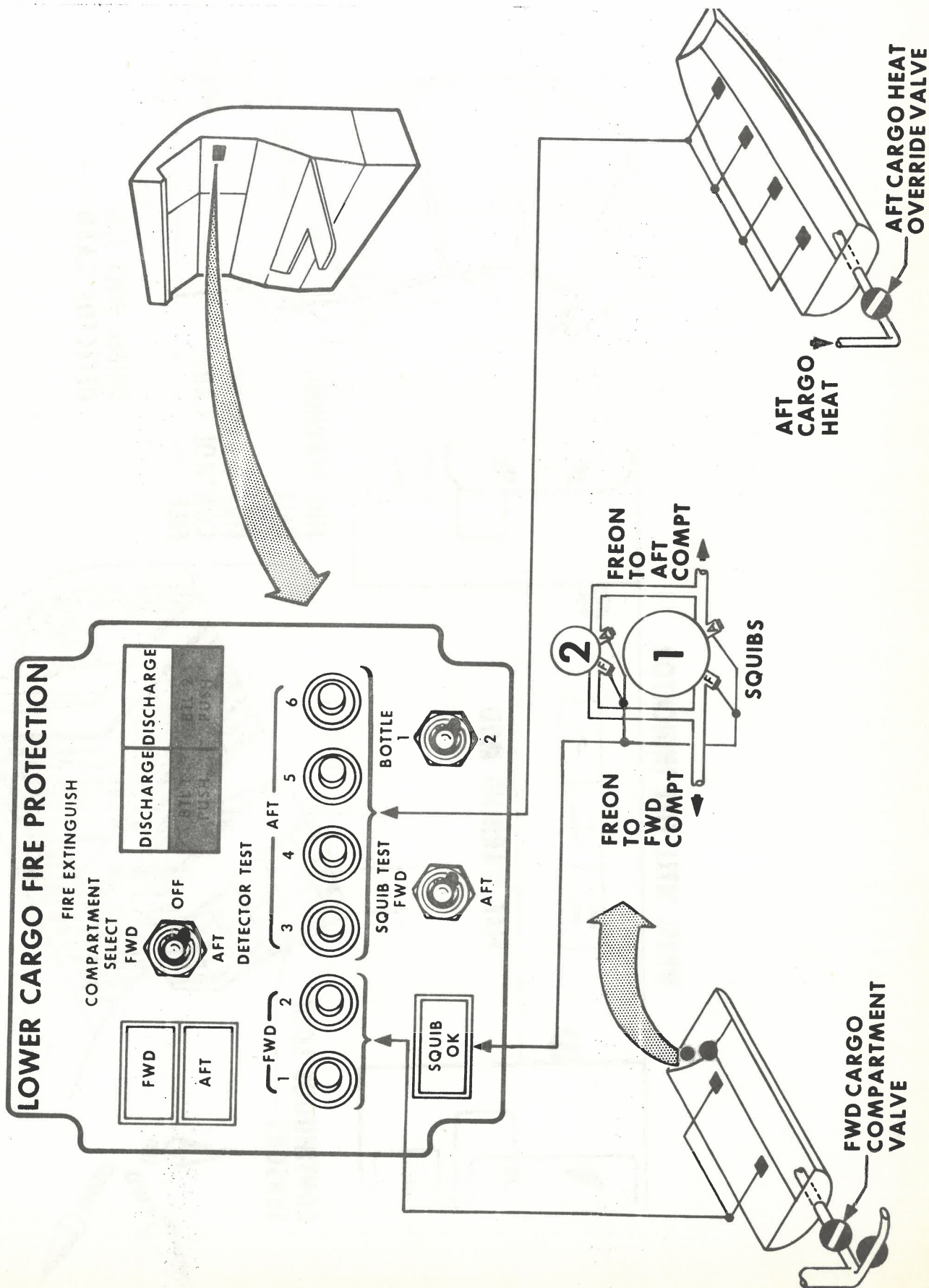
APU FIRE PROTECTION SYSTEM:



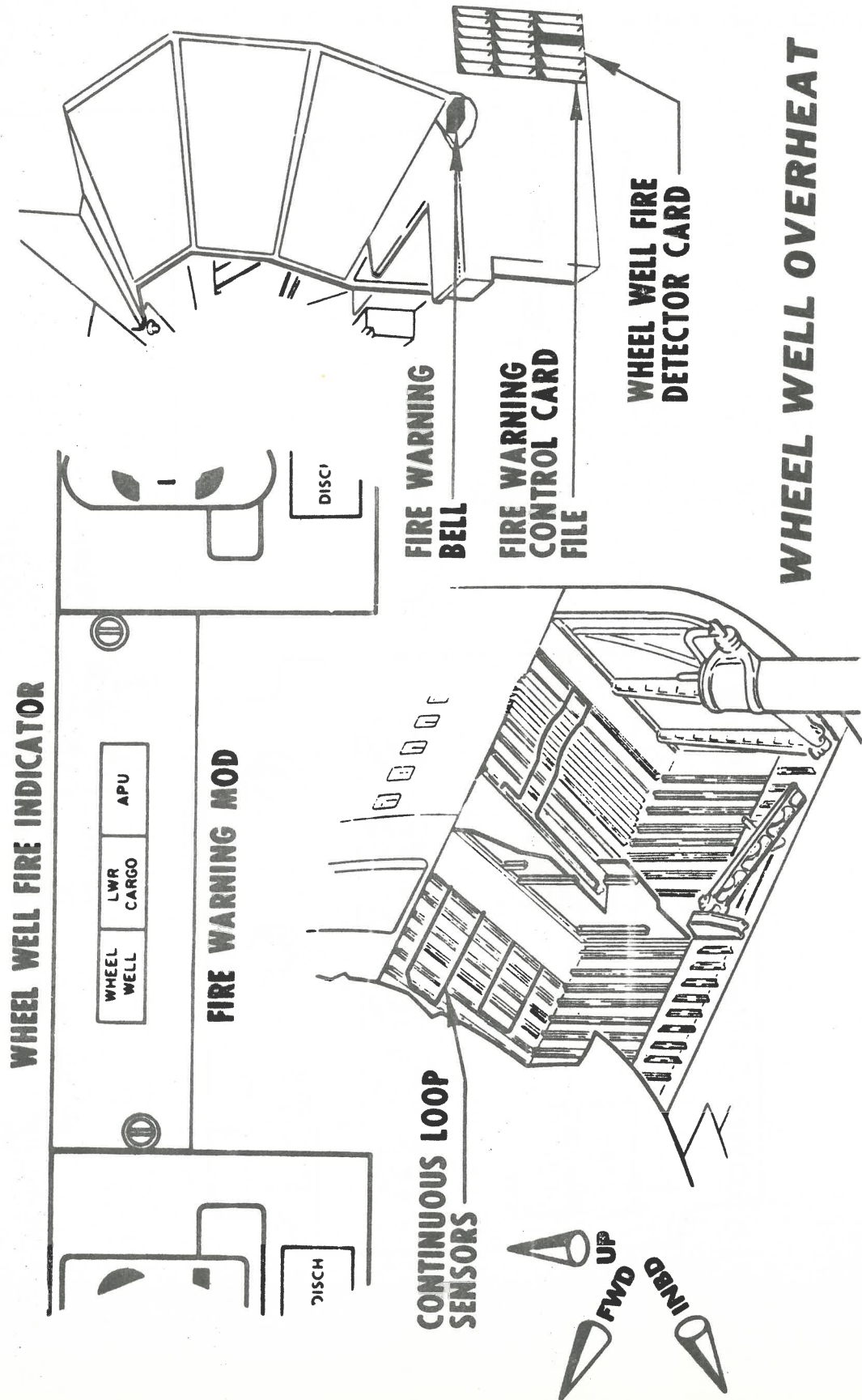
APU FIRE PROTECTION



LOWER CARGO FIRE PROTECTION SYSTEM:



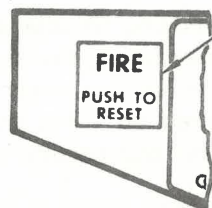
WHEEL WELL OVERHEAT SYSTEM:



WHEEL WELL OVERHEAT

MASTER FIRE WARNINGS & WHEEL WELL FIRE PROTECTION PANELS:

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.

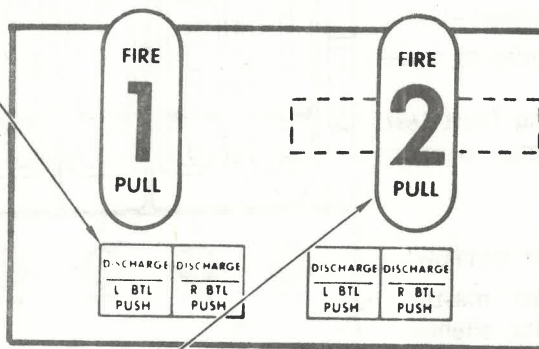
Push to extinguish master fire warning lights, silence fire warning bell and reset warning circuits.

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.

ENGINE NACELLE FIRE PROTECTION PANELS:

NACELLE TEMPERATURE INDICATORS

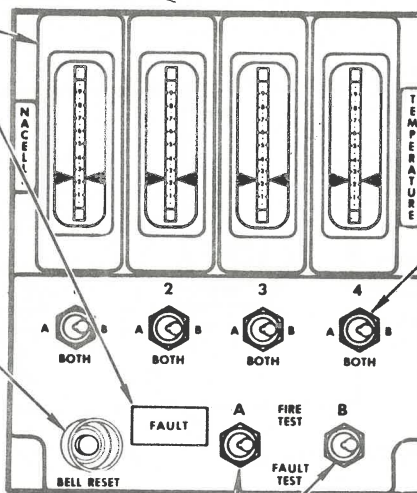
- Indicate relative temperature levels in the engine nacelle area. Normal indication will be in the green band; overheat in the amber band; fire in the red band.
- With a fire condition existing and fire warnings initiated, a detector short will cause the warnings from that detector to be locked on. 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

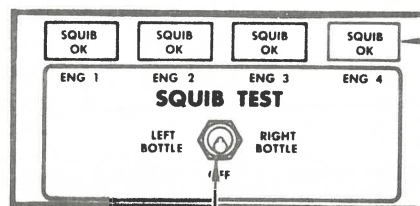
FIRE TEST - Introduces a simulated fire signal.

- 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



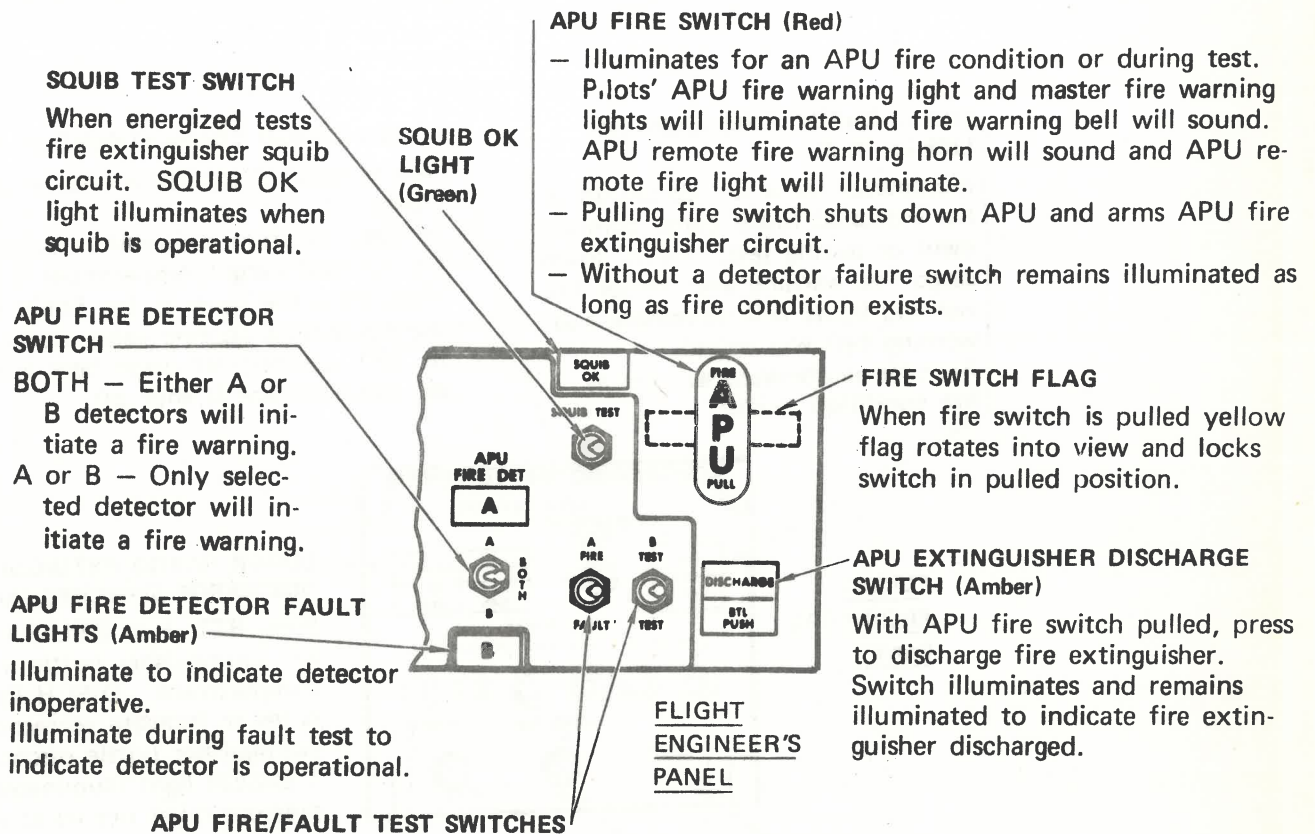
SQUIB OK LIGHTS (Green)

Illuminate to indicate operative extinguisher circuit.

SQUIB TEST SWITCH

Selects bottle for squib test.

APU FIRE PROTECTION PANELS:

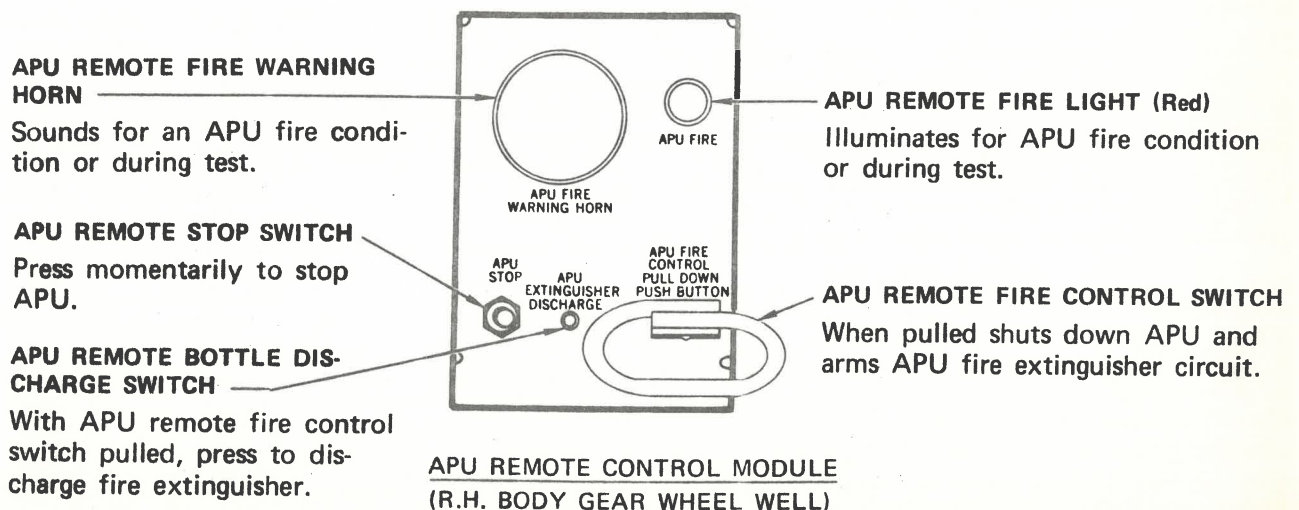


APU FIRE/FAULT TEST SWITCHES

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.



LOWER CARGO FIRE PROTECTION PANEL:

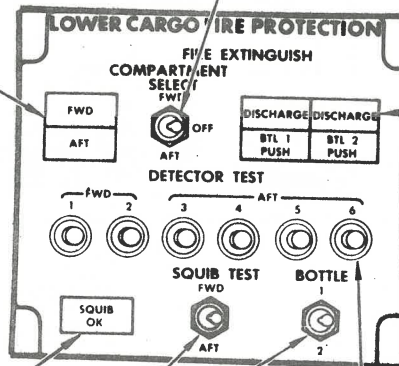
LOWER CARGO FIRE WARNING LIGHTS (Red)

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 over-pressure 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.

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FLIGHT CONTROL SYSTEMS

The B-747 Flight Control System is powered by four independent hydraulic systems. Pitch control is provided by inboard and outboard elevators and an adjustable stabilizer. Yaw control is provided by a split rudder, and lateral control by inboard and outboard ailerons coupled with spoilers. Hydraulic power is designed so each primary flight control axis receives power from all four hydraulic systems. Each primary control surface is powered by a dual hydraulic actuator supplied by two hydraulic systems except for the outboard elevators which are powered by a single source system. Twelve spoilers are powered by single hydraulic actuators with three hydraulic systems supplying the various groups. The horizontal stabilizer is powered hydraulically and controlled electrically under normal operations. Leading edge devices are pneumatically powered with an electrical backup. The outboard and inboard trailing edge flaps are powered by separate hydraulic systems with an electrical backup.

LATERAL CONTROL SYSTEM

Lateral control is accomplished using inboard/outboard ailerons and flight spoilers. Outboard ailerons may be used when the trailing edge flaps are other than full up and hydraulic power is available. Artificial feel is provided mechanically. Left and right central control actuators (CCA) receive lateral control inputs from the control wheels and transfer this control to aileron and spoiler hydraulic power packages. Autopilot lateral input is also provided to the CCA's. Control wheel rotation of 10 degrees from either side of neutral will initiate the flight spoilers. The F/O's wheel is bussed to the Captain's wheel through a load limiter which provides independent wheel movement, if one side jams. Aileron trim is electrical and both switches must be activated to initiate trim.

PITCH CONTROL SYSTEM

Pitch control is accomplished using inboard and outboard elevators and/or the adjustable stabilizer. The inboard elevators receive inputs from the control yoke through the elevator feel system. The outboard elevators are dependent on the opposite inboard elevators for their boost package input. The stabilizer can be adjusted by using the electric trim switches, the autopilots, or the manual trim levers. The manual trim levers will over-ride any other inputs. Stabilizer trim rates vary as a function of airspeed. Stabilizer trim indicators move with stabilizer movement displaying position and actuate an artificial sound emitting device. Stab trim cut out switches provide hydraulic pressure shut off capability. Stabilizer 'Brake Rel' lights illuminate during trimming operation when hydraulic pressure is available to release the brakes. The auto pilot trims the stabilizer at one-half the main electric rates. The horizontal stabilizer is normally powered by hydraulic systems No. 2 and No. 3. With a loss of No. 3 system the stabilizer can be powered by system No. 1 automatically through a hydraulic motor/pump using a portion of trapped return fluid from the No. 3 system.

YAW CONTROL SYSTEM

Yaw control is accomplished with a split (upper and lower) rudder. At high airspeeds, rudder movement is programmed by rudder ratio changers. The rudder ratio changers are adjusted by using 'Q' sensing inputs. There is a yaw damper input to each rudder power package. Rudder feel is mechanically produced. Rudder trim is mechanical and will move the rudder pedals when actuated. A 'Rudder Ratio' light on the Pilot's Center Annunciator Panel will illuminate when test switch is pressed, power to comparator fails, or rudder ratio actuators travel differ. Yaw Dampers are controlled by normally guarded switches to the 'Engage' position. The Yaw Damper and Turn Coordinator test switches provide a test of these systems.



FLIGHT CONTROL SYSTEMS (continued)

SPEED BRAKE/SPOILER SYSTEM

Spoilers 1 through 5 and 8 through 12 are controlled by the ailerons and act as Flight Lateral Spoilers. Spoilers 3 through 10 are controlled by the Speed Brake handle, while 1, 2, 11 and 12 are restricted to ground use only because of pitch effect on the aircraft. The Speed Brake handle cannot be moved past the Flight Detent unless at least two main landing gear, one on each side, are on the ground. The automatic Speed Brake system provides automatic extension at touch down, if armed. The system also provides automatic retraction of all Flight/Ground Spoilers when a go-around is initiated. An intermittent horn will sound if No. 3 throttle is advanced and Speed Brake is not in Down Detent. An 'Auto Spoilers' light on Pilot Center Annunciator Panel will illuminate if a failure occurs to the automatic Speed Brake system.

FLT. CONTROLS HYD POWER SWITCHES

This module located on Pilot's Overhead Panel provides through switches the ability to shut off hydraulic power to selected flight controls. Placard on panel indicates the hydraulic supply to the various Flight Control power packages. 'Valve Closed' lights on this panel illuminate when respective shut-off valve is positioned closed.

FLIGHT CONTROL POSITION INDICATOR

This indicator located on the Instrument Panel, displays the Control Surface Position in degrees. Aileron display is for outboard aileron only. Elevator display is for outboard elevator only. Rudder display is for both upper and lower rudders. Spoiler display is for spoilers No. 4 and No. 12 only.

TRAILING EDGE FLAP SYSTEM

The two inboard flaps are actuated by one hydraulic power drive through hydraulic system No. 1 while the outboard flaps are powered by hydraulic system No. 4. With hydraulic failure of a system, electrical back-up is provided. Flap position indicators (outbd and inbd) located on Pilot's Instrument Panel display flap position and provide flap asymmetry protection by a needle spread within each indicator. Normal flap extension time is about 45 seconds. Alternate flap extension is provided by switches on Pilot's Overhead Panel. This is accomplished electrically. Alternate electrical extension/retraction time is approximately six minutes.

LEADING EDGE FLAPS

The 26 leading edge flaps are grouped into sets and sequenced by flap handle position, and outboard/inboard trailing edge flap position. At T/E flap position 1, L/E flap sets 2 and 4 extend and at position 5 of T/E flaps, sets 1 and 3 extend. The leading edge flaps are normally powered pneumatically. An alternate means of operation is provided by switches on Pilot's Overhead Panel for electrical extension/retraction of each L/E set (time about 90 seconds). Leading edge flap lights on Pilot's Instrument Panel and S/O Panel provide status position of L/E flaps. During reverse operation, automatic retraction prevents exhaust gas damage to the L/E flaps.

NORTHWEST ORIENT

FREIGHTER



27:01F

FLIGHT CONTROLS

The basic flight controls on the B-747F are the same as the present fleet; however, some minor changes have been made.

The maximum extension of spoilers 5, 6, 7 & 8, when on the ground, has been increased to 45°. This was necessary because of no turbine reversing.

The leading edge flap alternate operation has been improved by the addition of four relays that isolate the power units from each other. This provides L/E flap extension and retraction synchronization. The L/E flaps will not retract when reversing the engines.

An improved asymmetry detector for the inboard T/E flaps will provide greater sensitive asymmetry protection.

A two stage flap load relief system is provided on the B-747F. With flaps at 25° and flap speed exceeded, a flap load limit light illuminates along with retraction of flaps in two stages --- 25° and then further retraction to 20°.



BOEING

"IN FLIGHT" SPEED BRAKES EXTENDED

SPOILERS 3,4,9,10 UP 45 DEG MAX

SPOILERS 5-8 UP 20 DEG MAX

LATERAL CONTROL ROLL RATES INCREASE WITH S.B. UP

LATERAL CONTROL FLIGHT SPOILERS EXTENDED

SPOILERS 1-4 & 9-12: PROPORTIONAL TO CONT WHEEL WITH 45 DEG MAX

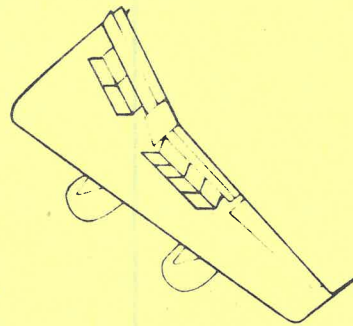
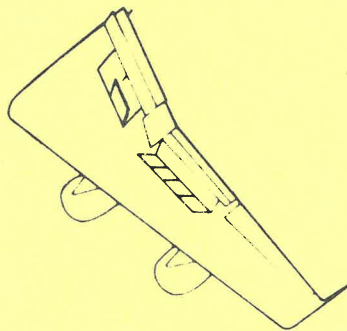
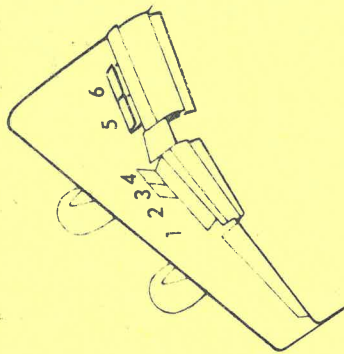
SPOILERS 5 & 8: PROPORTIONAL TO CONT WHEEL WITH 20 DEG MAX

SPOILERS 6 & 7: NOT ACTUATED BY LATERAL CONTROL

GROUND SPEED BRAKES

SPOILERS: ALL UP 45 DEG. (REVISED S.B.)

SPEED BRAKE PROGRAM



AILERON CONTROL SYSTEM:

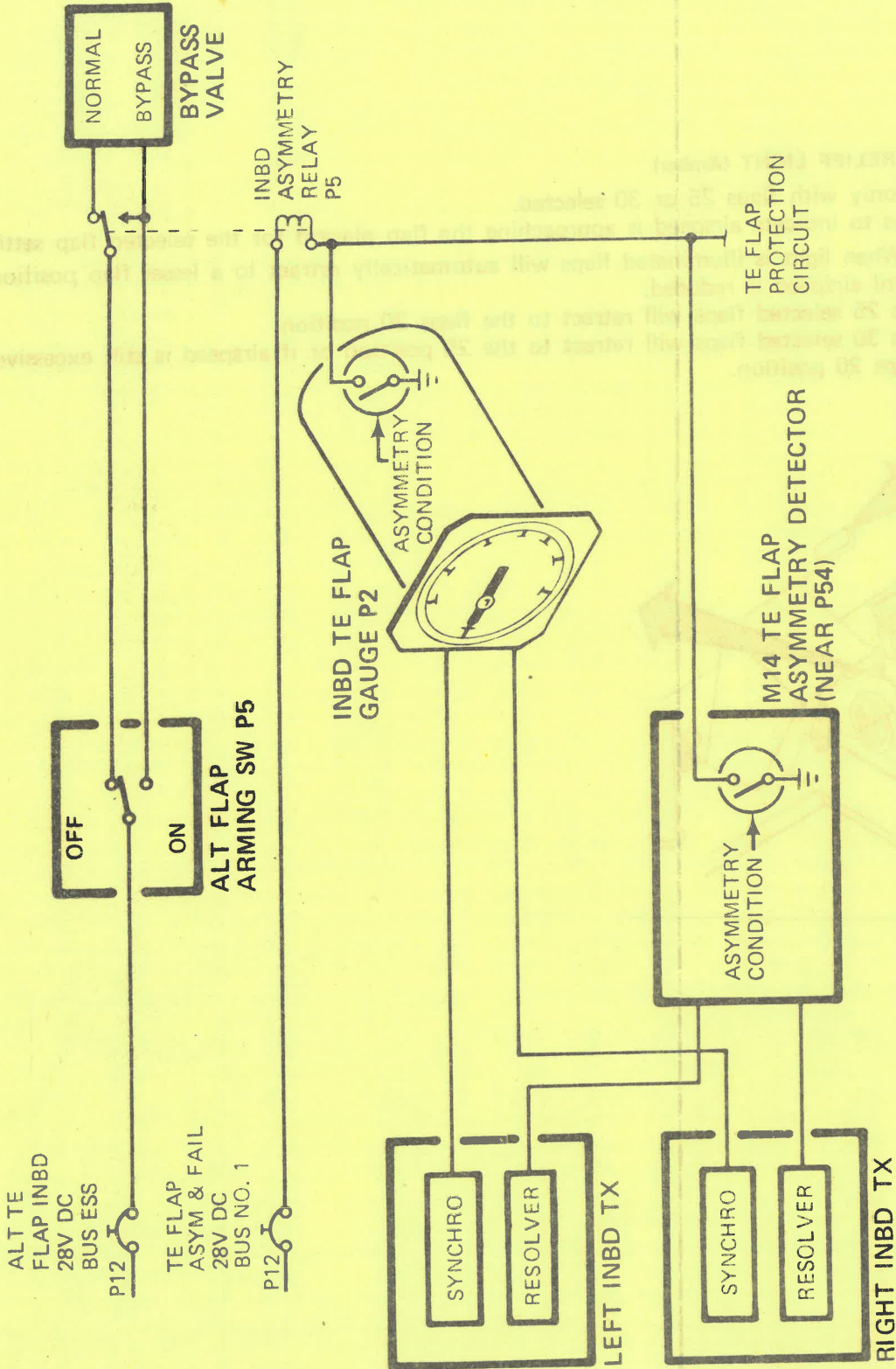
AILERONS

1. Aileron control wheel movement mechanically positions two hydraulic powered central control actuators. Output from each CCA control their respective aileron programmer and spoiler mixer, which control hydraulic power packages.
 - a. Hydraulic power for aileron and spoiler systems are controlled by "FLT CONTROLS HYD POWER" switches on pilots' overhead panel.
 - (1) "VALVE CLOSED" lights, located below switches, illuminate when respective flight control hydraulic power switches are placed to off.
 - b. Aileron trim is provided by two switches (must be operated together) on pilots' control stand.
 - (1) Electrically repositions control system neutral position.
 - (a) Control wheel will be displaced from neutral.
 - c. Aileron feel and control wheel centering is provided artificially by a spring loaded cam and roller assembly.
 - d. Aileron position for left and right outboard ailerons are displayed on a flight control position indicator, located on center instrument panel.
 - e. A load limiter and lost motion device, located at the base of the F/O's control column, are provided to permit system operation in the event of a component failure.
 - f. Two mechanically connected central control actuators located in their respective body wheel well, provide hydraulic control of the aileron programmers and spoiler mixers.
 - (1) Left CCA is powered from hydraulic systems No. 1 and No. 2.
 - (2) Right CCA is powered from hydraulic systems No. 3 and No. 4.
 - g. A hydraulic powered package, located forward of each aileron, powers their respective aileron.
 - (1) Left outboard aileron is powered by hydraulic systems No. 1 and No. 2.
 - (2) Right outboard aileron is powered by hydraulic systems No. 3 and No. 4.
- NOTE:** Outboard ailerons are electrically locked out with flaps above position 1.
- (3) Left inboard aileron is powered by hydraulic systems No. 1 and No. 3.
 - (4) Right inboard aileron is powered from hydraulic systems No. 2 and No. 4.

ELEVATOR CONTROL SYSTEM:

ELEVATORS

1. Control column movement mechanically positions control valves in the inboard elevator hydraulic powered packages. Each inboard elevator mechanically controls the opposite outboard elevator hydraulic power package.
 - a. Hydraulic power for elevator systems is controlled by "FLT CONTROLS HYD POWER" switches on pilots' overhead panel.
 - (1) "VALVE CLOSED" lights, located below switches, illuminate when respective flight control hydraulic power switches are placed off.
 - b. Elevator feel is provided artificially by an elevator feel computer and an elevator feel unit.
 - (1) Elevator feel computer receives pitot/static pressure and stabilizer position input signals and directs modulated hydraulic pressure to elevator feel unit.
 - (a) An "ELEV FEEL" light located on center instrument panel illuminates with a 25% difference between the hydraulic pressure outputs from the computer.
 - (2) Elevator feel unit provides artificial feel to the elevators by a hydraulically controlled spring loaded cam/roller assembly.
 - c. Elevator position, for left and right outboard elevators, is displayed on a flight control position indicator, located on the center instrument panel.
 - d. A hydraulic powered package, located forward of each elevator, powers their respective elevator.
 - (1) Left outboard elevator is powered by hydraulic system No. 1 only.
 - (2) Right outboard elevator is powered by hydraulic system No. 4 only.
 - (3) Left inboard elevator is powered by hydraulic systems No. 3 and No. 4.
 - (4) Right inboard elevator is powered by hydraulic systems No. 1 and No. 2.



INBOARD TRAILING EDGE FLAP ASYMMETRY DETECTION

NORTHWEST ORIENT

BOEING 747



FREIGHTER

27:04F

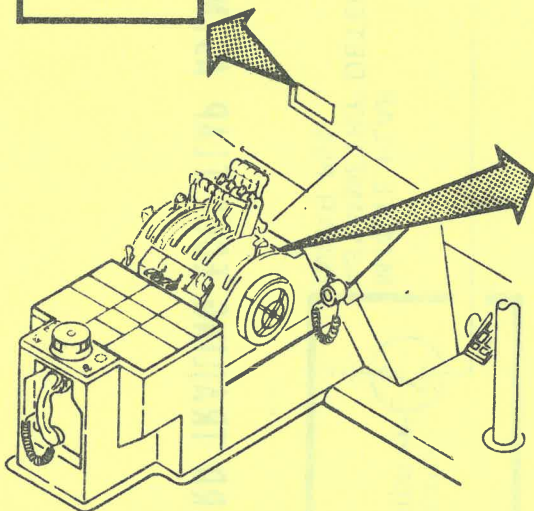
FLAP LOAD RELIEF LIGHT (Amber)

- Operates only with flaps 25 or 30 selected.
- Illuminates to indicate airspeed is approaching the flap placard for the selected flap setting.

NOTE: - When light is illuminated flaps will automatically retract to a lesser flap position and hold until airspeed is reduced.

- With flaps 25 selected flaps will retract to the flaps 20 position.
- With flaps 30 selected flaps will retract to the 25 position or if airspeed is still excessive to the flaps 20 position.

FLAP LD
RELIEF





RUDDER CONTROL SYSTEM:

RUDDERS

1. Rudder pedal movement mechanically positions control valves in the rudder hydraulic powered packages.
 - a. Hydraulic power for rudder systems is controlled by flight control hydraulic power switches on pilots' overhead panel.
 - (1) "VALVE CLOSED" lights, located below switches, illuminate when respective "FLT CONTROLS HYD POWER" switches are placed off.
 - b. Rudder ratio changers limit rudder travel for a given airspeed and altitude.

NOTE: Maximum rudder travel is reduced from 25° at low airspeeds to approximately 3° as airspeed increases.

- (1) A rudder ratio comparator unit monitors the position of the two rudder ratio changers.
 - (a) A "RUDDER RATIO" light, located on center instrument panel, illuminates with significant difference between ratio changers or during system test.
 - (b) A "RUDDER RATIO TEST" switch, located on center instrument panel, tests rudder ratio comparator system.
- c. Rudder feel is provided artificially by a spring loaded cam/roller assembly.
- d. Rudder trim and centering is provided from trim knob on pilots' control stand.
 - (1) Mechanically repositions control system neutral position.
 - (a) Rudder pedals will be displaced from neutral.
- e. Rudder position for upper and lower rudders are displayed on a flight control position indicator, located on center instrument panel.
- f. A hydraulic powered package, located forward of each rudder, powers their respective rudders.
 - (1) Upper rudder is powered by hydraulic system No. 1 and No. 3.
 - (2) Lower rudder is powered by hydraulic system No. 2 and No. 4.



YAW DAMPER CONTROL SYSTEM:

YAW DAMPERS

1. A series yaw damper system is installed on the aircraft to provide automatic control of natural yaw oscillations (dutch roll). The yaw damper system has approximately 4° of authority to each rudder power control unit and is not felt at the rudder pedals.
 - a. Upper and lower yaw dampers are controlled by "YAW DAMPER ENGAGE" switches located on pilots' overhead panel.
 - (1) Upper yaw damper powered by hydraulic system No. 3.
 - (2) Lower yaw damper powered by hydraulic system No. 2.
 - b. Upper and lower yaw dampers may be checked by "TEST" switches on pilots' overhead panel.
 - (1) YDR position — Rudder indices on flight control position indicator, moves right and slowly returns to neutral. Rate of turn indicators move left.
 - (2) OFF position — Rudder indices move left and slowly return to neutral. Rate of turn indicators return to neutral.
 - (3) TCL position (flaps down) — Rudder indices will move left and return to neutral. When switch is released, rudder indices move right and return to neutral.
 - (a) Rudder indices and rate of turn indicators do not move, when flaps are up.



HORIZONTAL STABILIZER CONTROL SYSTEM:

HORIZONTAL STABILIZER

1. Horizontal stabilizer is positioned by hydraulic motors that are controlled electrically by stabilizer trim switches on control wheels or manually by stabilizer trim levers on left side of control stand.
 - a. Hydraulic power to stabilizer trim motors are controlled by two guarded "STAB TRIM CUTOUT" switches on pilots' control stand.
 - b. Stabilizer "BRAKE REL" lights, located on pilots' control stand, illuminate while trimming and brakes are released.
 - c. Two stabilizer trim motors, located at the base of the jack screw in the tail section of the aircraft.
 - (1) Left hydraulic motor is powered by hydraulic system No. 2.
 - (2) Right hydraulic motor is powered by hydraulic system No. 3.
 - (a) With loss of No. 3 hydraulic system pressure, a standby hydraulic motor/pump assembly is operated by hydraulic system No. 1 and uses No. 3 hydraulic system return fluid to operate right stabilizer motor.
 - d. A trim rate controller reduces stabilizer trim rates as airspeed increases.
 - e. "STAB TRIM" indicators on both sides of control stand provide visual indication of stabilizer position.
 - (1) If stabilizer position is not within takeoff range (green band), a warning horn will sound when No. 3 thrust lever is advanced.

NOTE: Stabilizer trim is electrically cutout when elevator control column is displaced excessively from neutral in a direction opposed to the trim.

TRAILING EDGE FLAP CONTROL SYSTEM:

GENERAL

1. Trailing edge flap system provides additional lift during take off and landing by increasing the camber of the wing.
 - a. Normal operation of trailing edge flaps is accomplished hydraulically from flap control lever, located on pilots' control stand.
 - (1) Outboard flaps are operated by hydraulic system No. 4.
 - (2) Inboard flaps are operated by hydraulic system No. 1.
 - (3) The flap load relief system will retract flaps to 25° position if airspeed exceeds 169 knots and flaps at 30°.
 - (a) A "FLAP LD RELIEF" light located on center instrument panel will illuminate when airspeed exceeds 169 knots and flap lever selected to 30° position.
 - b. Alternate operation of trailing edge flaps is accomplished electrically by switches on pilots' overhead panel.
 - (1) Trailing edge "ALT FLAPS" master switch.
 - (a) "ARM" position — Bypasses hydraulic motors and arms trailing edge directional switches.
 - (2) "TRAILING EDGE" directional switches.
 - (a) Controls inboard and outboard electric flap motors.
- NOTE: Flap load relief system and asymmetry protection will be inoperative when using alternate flap system.
- c. Outboard and inboard flap position indicators are located on center instrument panel.
 - (1) Range of indication is 0° to 30°.
 - (2) Asymmetry protection will shut off hydraulic pressure to motor when more than 12% difference exists between inboard or outboard flap needles.



LEADING EDGE FLAP CONTROL SYSTEM:

1. Leading edge flap system, which consists of variable camber and Krueger flaps, provides additional lift during takeoff/landing and operates in conjunction with the trailing edge flaps.
 - a. Leading edge flaps are numbered 1 through 26 from left to right and are grouped in four sets.
 - (1) Set No. 1 — Consists of variable camber flaps 1 through 5 and 22 through 26.
 - (2) Set No. 2 — Consists of variable camber flaps 6 through 8 and 19 through 21.
 - (3) Set No. 3 — Consists of variable camber flaps 9 through 10 and 17 through 18.
 - (4) Set No. 4 — Consists of Krueger flaps, 11 through 13 and 14 through 16.
 - b. Normal operation of leading edge flaps is controlled automatically by position of the trailing edge flaps. Power to position all leading edge flaps is provided by air motors supplied by pneumatic system.
 - (1) Flaps 0 — All leading edge flaps retracted.
 - (2) Flaps 1 — Leading edge flaps sets No. 2 and No. 4 are extended when outboard trailing edge flaps reach 1.
 - (3) Flaps 5 — Leading edge flap sets No. 1 and No. 3 are extended when inboard trailing edge flaps reach 5.

NOTE: All leading edge flaps will retract when all four reverse thrust levers are moved to reverse thrust position.

- c. Alternate operation of leading edge flaps is accomplished electrically by switches on pilots' overhead panel.
 - (1) Leading edge "ALT FLAPS" master switch.
 - (a) "ARM" position — Arms leading edge directional switches.
 - (2) Leading edge directional switches.
 - (a) Controls leading edge flap motors and shuts off air to leading edge air motors.
- d. Amber and blue "L.E. FLAPS" position lights located on center instrument panel.
 - (1) Amber position light illuminates while leading edge flap sets are intransit.
 - (2) Blue position light illuminates when leading edge flap sets are extended in agreement with flap lever position.

NOTE: With all leading edge flap sets retracted at trailing edge flap position 0 both position lights are extinguished.

- e. "LEADING EDGE FLAPS" Annunciator lights located on S/O panel.
 - (1) Amber lights illuminate for leading edge flap sets intransit.
 - (2) Green lights illuminate for leading edge flap sets extended.

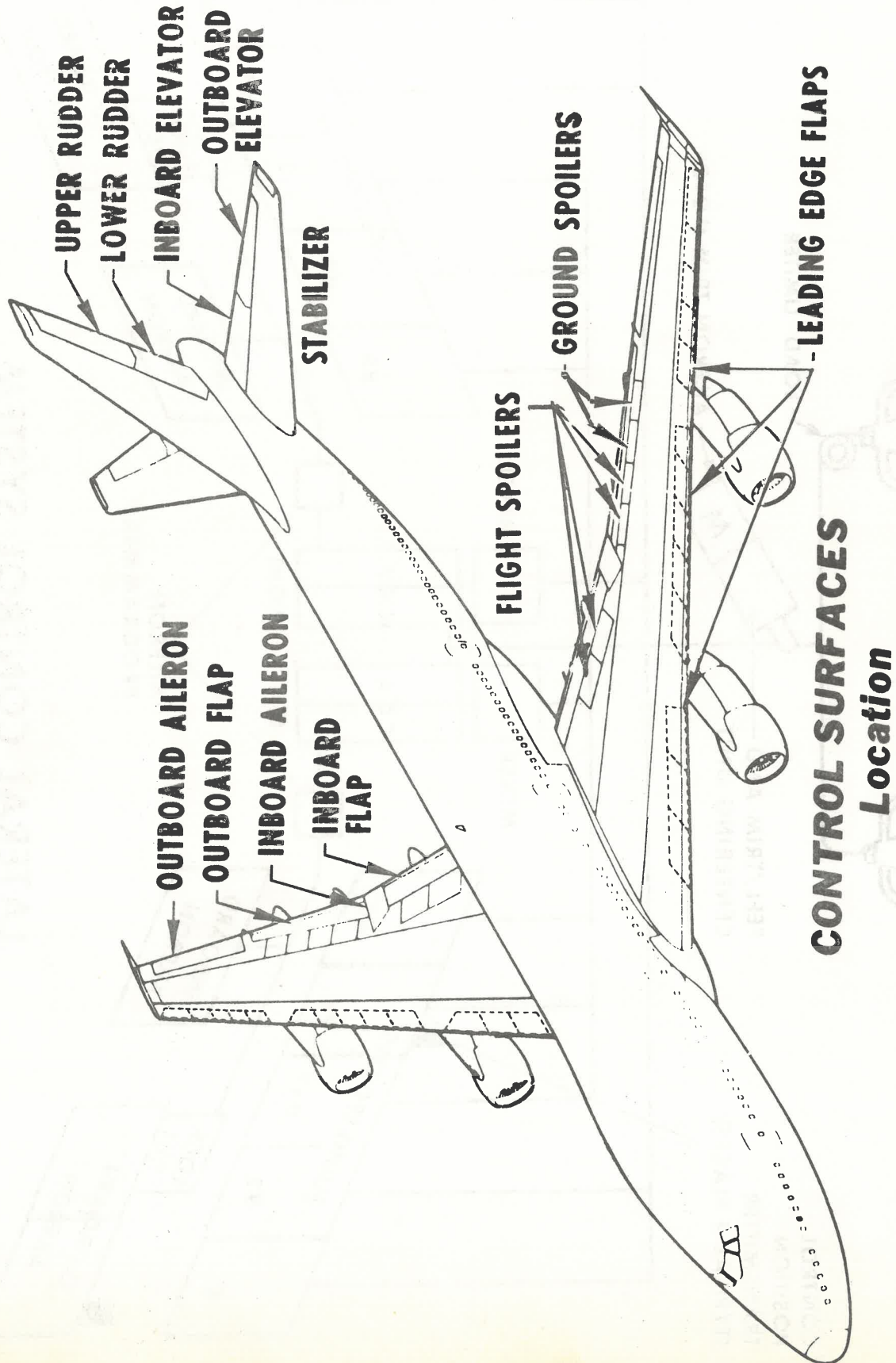


SPOILER CONTROL SYSTEM:

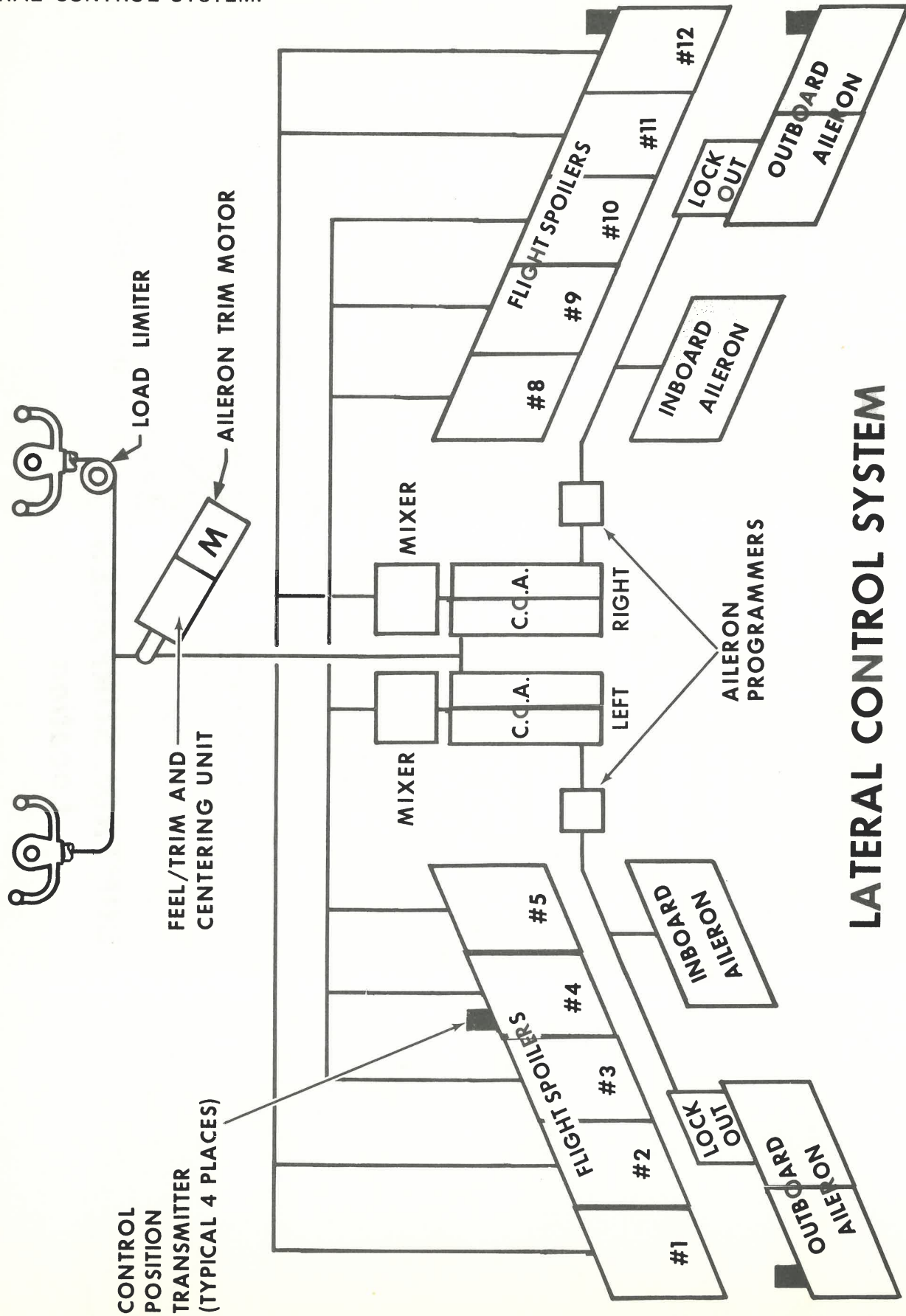
GENERAL

1. The hydraulically operated spoiler system supplements the aileron in providing lateral control of the aircraft and acts as speed brakes both in flight and on the ground.
 - a. Spoilers are numbered 1 through 12 from left to right and are grouped as to lateral control, flight and ground modes of speed brake operation.
 - (1) Lateral control is augmented by all spoilers except numbers 6 and 7 through movement of aileron control wheel.
2. Speed brake function is controlled by a four-position speed brake lever located on pilots' control stand.
 - a. "DOWN" position – Spoilers retracted, will move to the "UP" position on the ground when:
 - (1) One left and one right main gear is not tilted and
 - (2) No. 1 and No. 3 thrust levers retarded to less than 50% thrust and
 - (3) No. 2 or No. 4 thrust lever actuated in the reverse range.
 - b. "ARMED" position – Speed brake lever moves to the "UP" position when:
 - (1) One left and one right main gear is not tilted and
 - (2) No. 1 and No. 3 thrust levers retarded to less than 50% thrust.
 - (a) "AUTO SPOILERS" light, located on center instrument panel, illuminates when auto ground spoiler system inoperative.
 - c. "FLIGHT DETENT" position – Permits manual extension of spoilers No. 3 through No. 10 only in flight.
 - (1) Spoilers 5–6, 7–8 have limited travel (20°) to prevent tail buffet.
 - (2) Locking solenoid prevents speed brake lever movement past flight detent when airborne.
 - d. "UP" position – Ground function only, all spoilers extended.
 - (1) Advancing No. 1 or No. 3 thrust lever above 50% forward thrust automatically moves lever to "DOWN" detent.
3. Spoiler position displayed on flight control position indicator located on center instrument panel.
 - a. Displays No. 4 and No. 12 spoiler positions.
4. Hydraulic power for spoiler system controlled by flight controls hydraulic power switches on pilots' overhead panel.
 - a. Valve Closed lights, below the switches, illuminate when respective flight control hydraulic power switches are placed off.

CONTROL SURFACES:



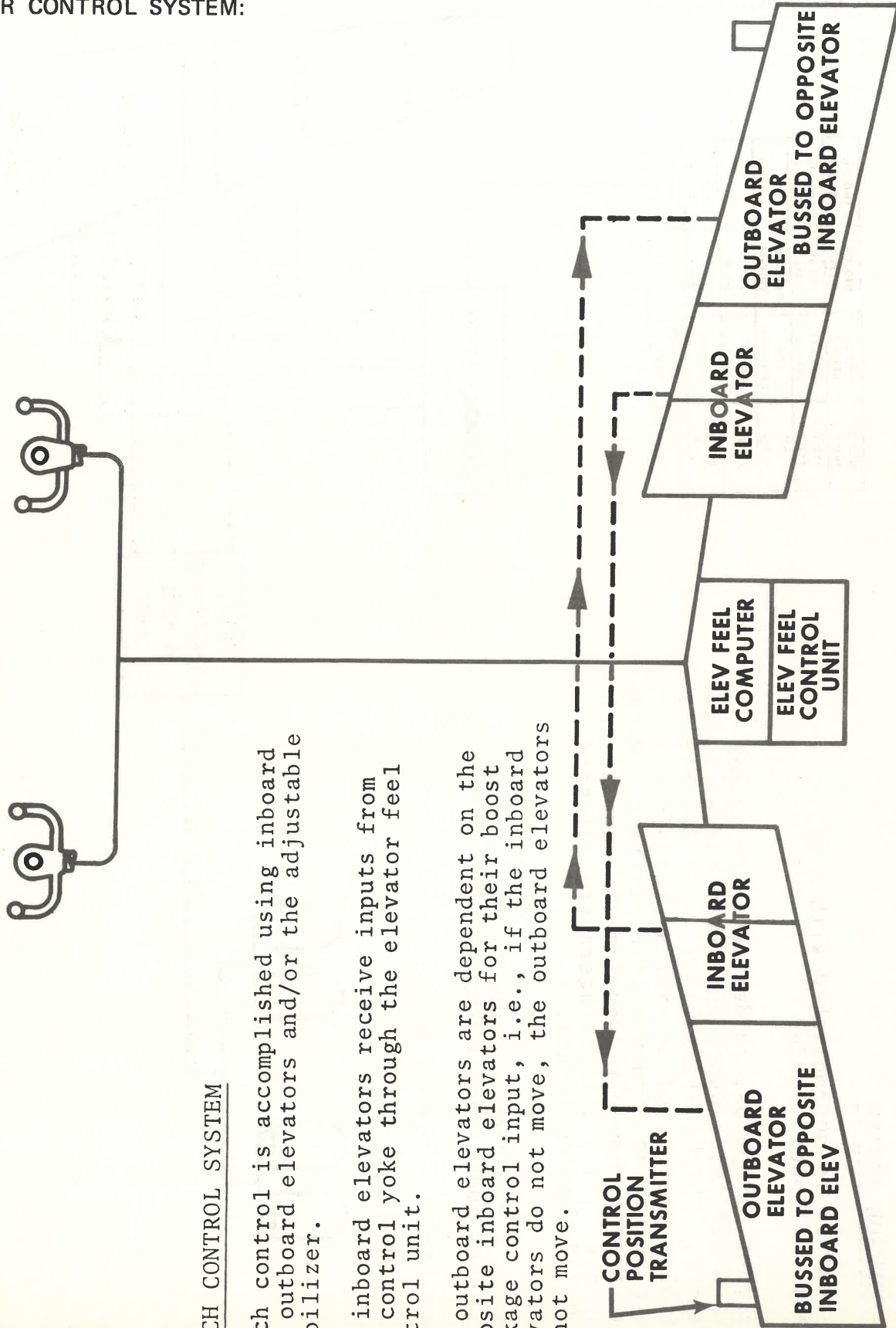
LATERAL CONTROL SYSTEM:



LATERAL CONTROL SYSTEM



ELEVATOR CONTROL SYSTEM:



PITCH CONTROL SYSTEM

Pitch control is accomplished using inboard and outboard elevators and/or the adjustable stabilizer.

The inboard elevators receive inputs from the control yoke through the elevator feel control unit.

The outboard elevators are dependent on the opposite inboard elevators for their boost package control input, i.e., if the inboard elevators do not move, the outboard elevators do not move.

RUDDER CONTROL SYSTEM:

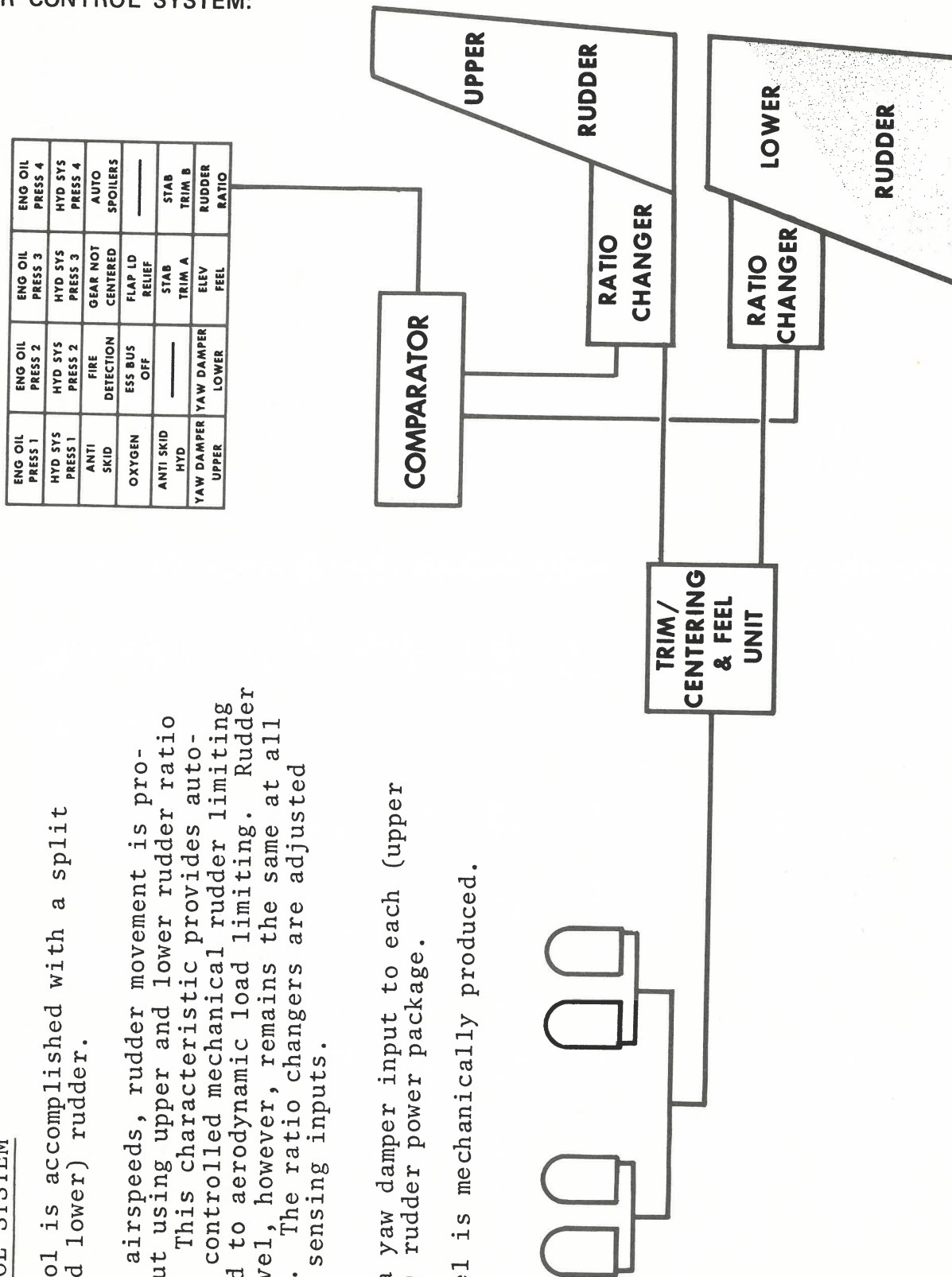
YAW CONTROL SYSTEM

Yaw control is accomplished with a split (upper and lower) rudder.

At higher airspeeds, rudder movement is programmed out using upper and lower rudder ratio changers. This characteristic provides automatically controlled mechanical rudder limiting as opposed to aerodynamic load limiting. Rudder pedal travel, however, remains the same at all airspeeds. The ratio changers are adjusted using "Q" sensing inputs.

There is a yaw damper input to each (upper and lower) rudder power package.

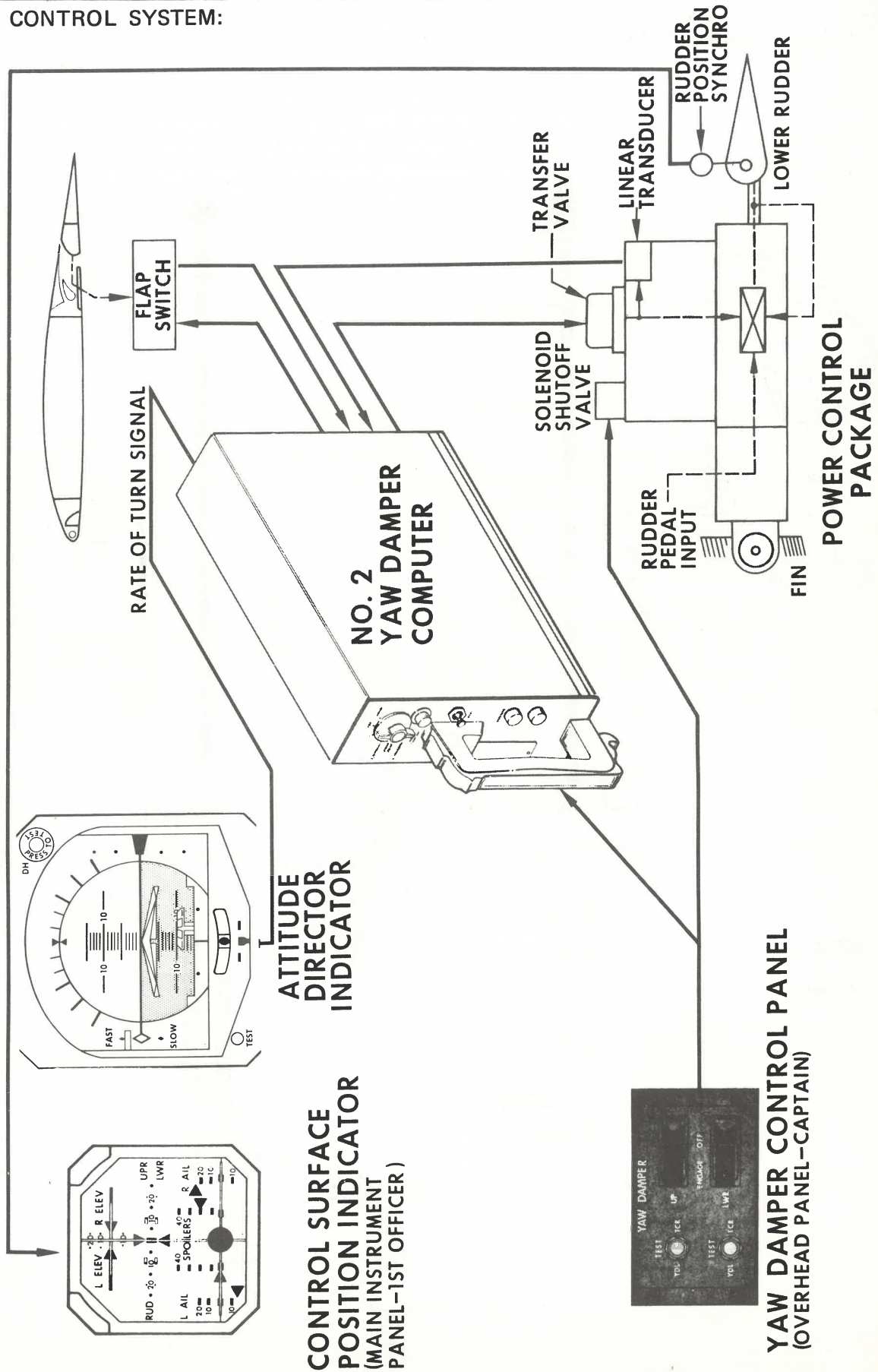
Rudder feel is mechanically produced.



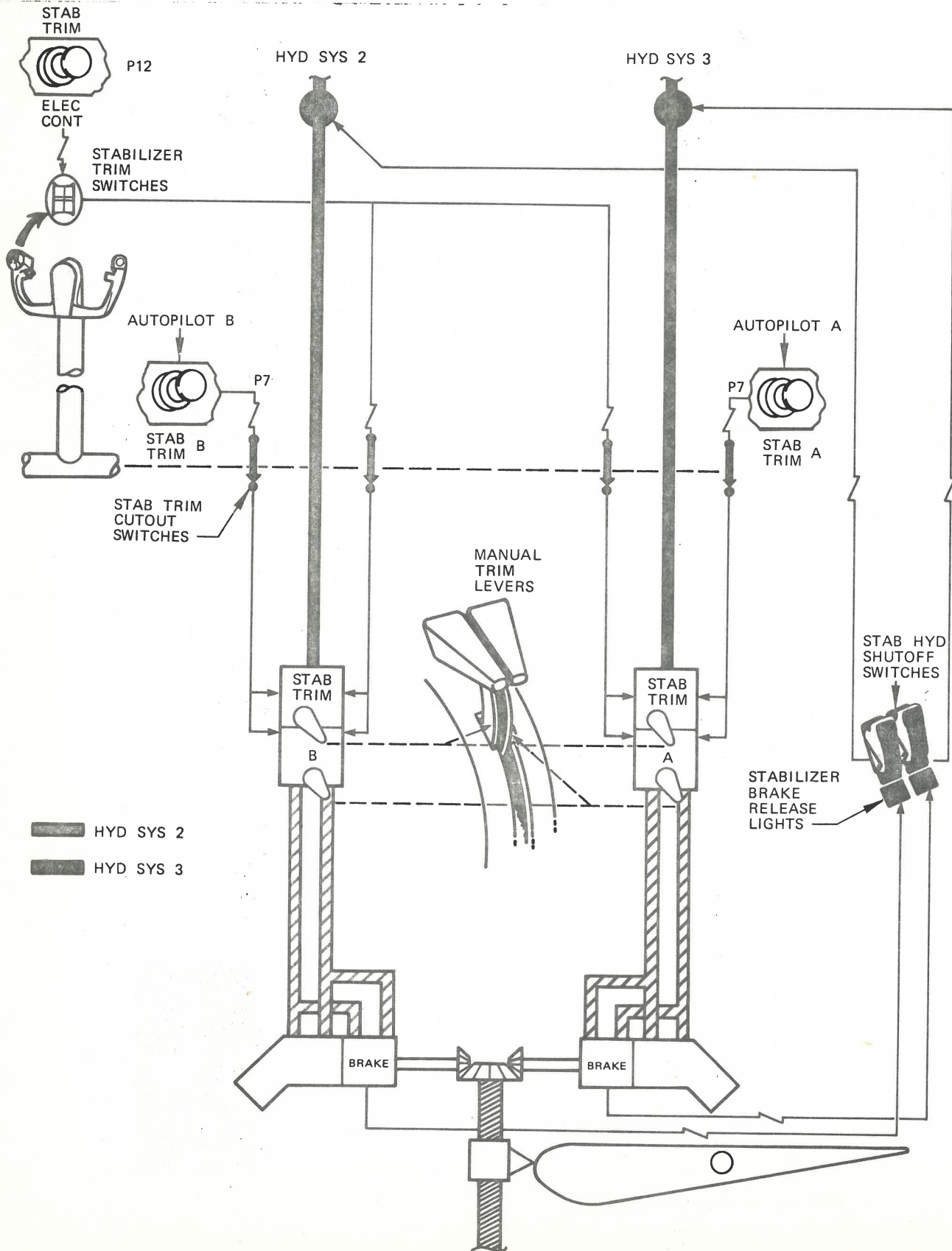


YAW DAMPER CONTROL SYSTEM:

**YAW DAMPER DIAGRAM
 SHOWN FOR LOWER RUDDER (CHANNEL NO. 2)**



STABILIZER TRIM SYSTEM:



STABILIZER CONTROLS:

**STABILIZER TRIM INDICATOR
 TRIM LIMITS (UNITS)
 MANUAL CONTROL**

1/4 to 14-3/4 units

**ELECTRIC & AUTOPILOT TRIM
 LIMITS**

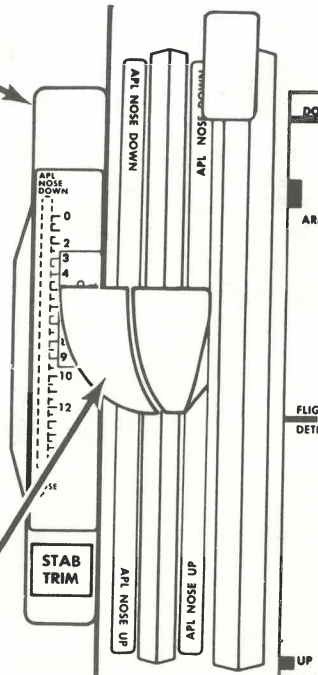
1.8 to 12 units

GREEN BAND

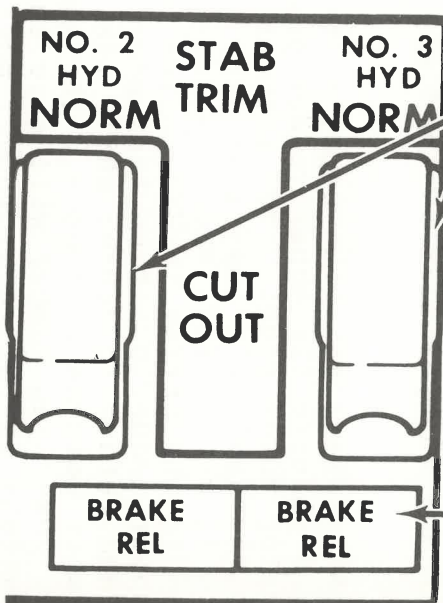
2-1/2 to 9-1/2 units
 nose up

An intermittent horn will sound if No. 3 thrust lever is advanced for take-off with trim not in green band.

**STABILIZER MANUAL
 TRIM LEVERS**

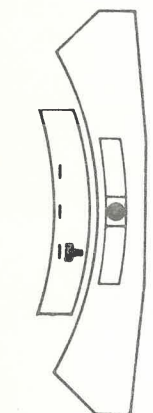
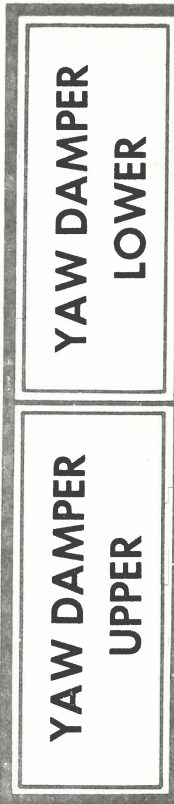
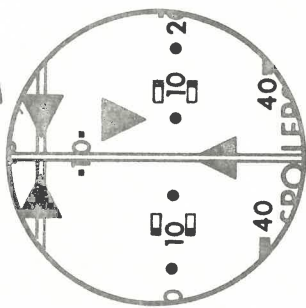
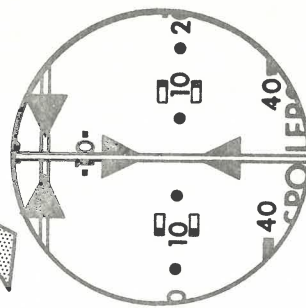
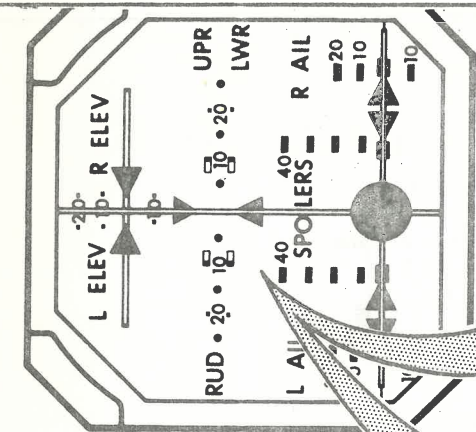


**STABILIZER TRIM
 SWITCHES**



**STABILIZER
 HYDRAULIC
 SHUTOFF SWITCHES**

**STABILIZER
 BRAKE LIGHTS**



ADI

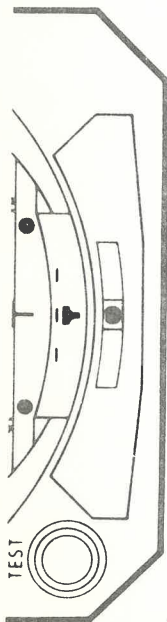
TEST



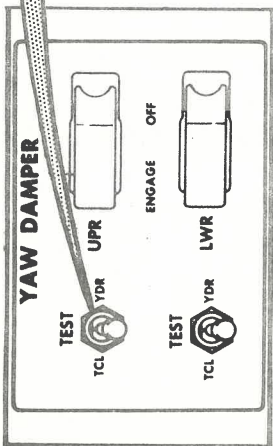
TCL

YDR

(PUSH AND HOLD)



ADI

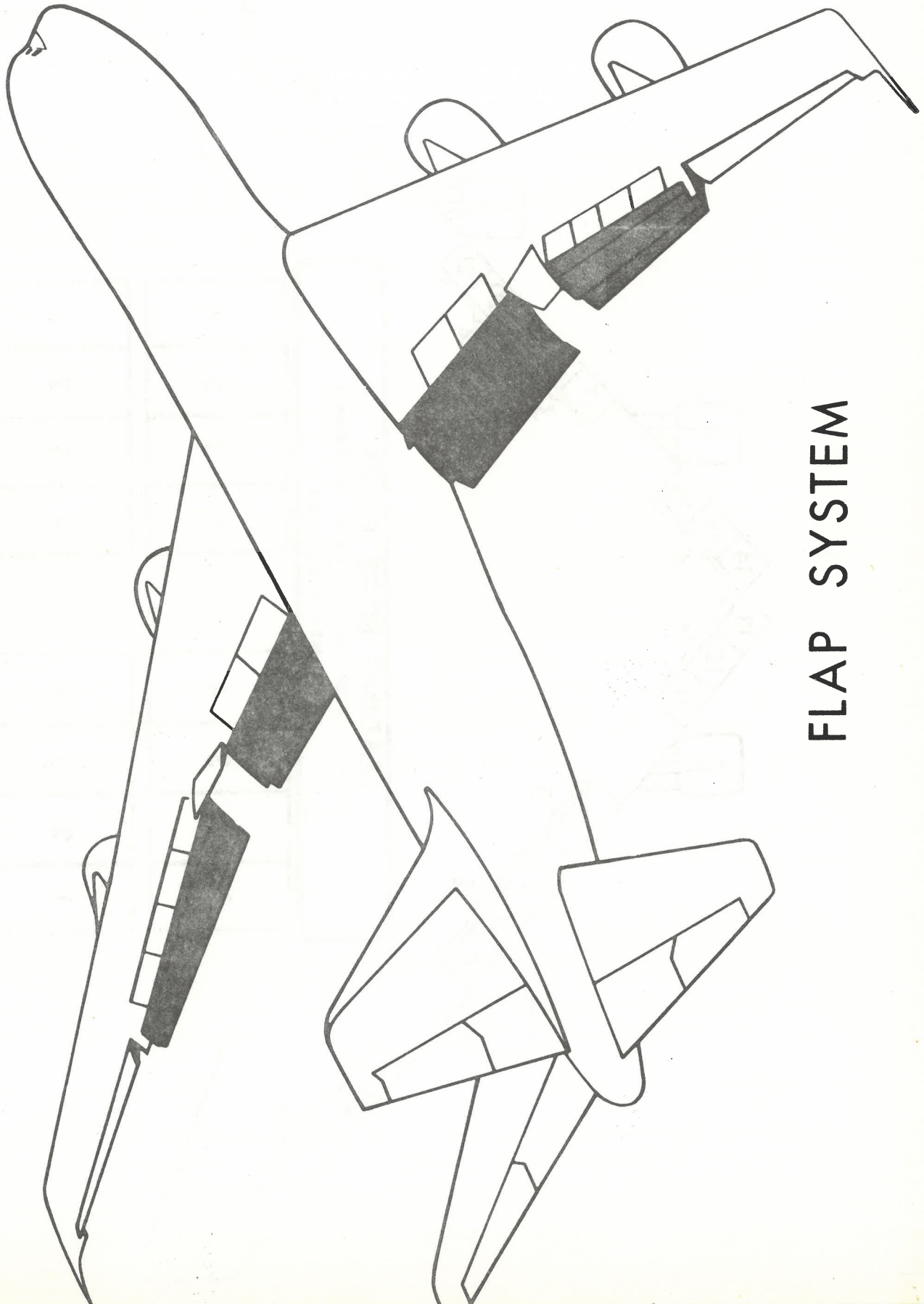


YAW DAMPER TEST

While on the overhead panel, the yaw damper test can be made. From this point on, this system will be in continuous automatic operation without further action being required provided Electrical Power is on the busses and #2 and #3 Hydraulic systems are pressurized.

TO TEST: First move the upper test switch to YDR and observe the upper rudder position indicator moves right, then returns to center while the Captain's turn indicator (bottom of ADI) will move left. When the switch is released to its spring loaded center position the upper rudder position indicator will swing left and return to center while the turn indicator returns to center. The same test on the lower yaw damper will give the same indications on the lower rudder position indicator while the First Officer's turn indicator moves left then centers.

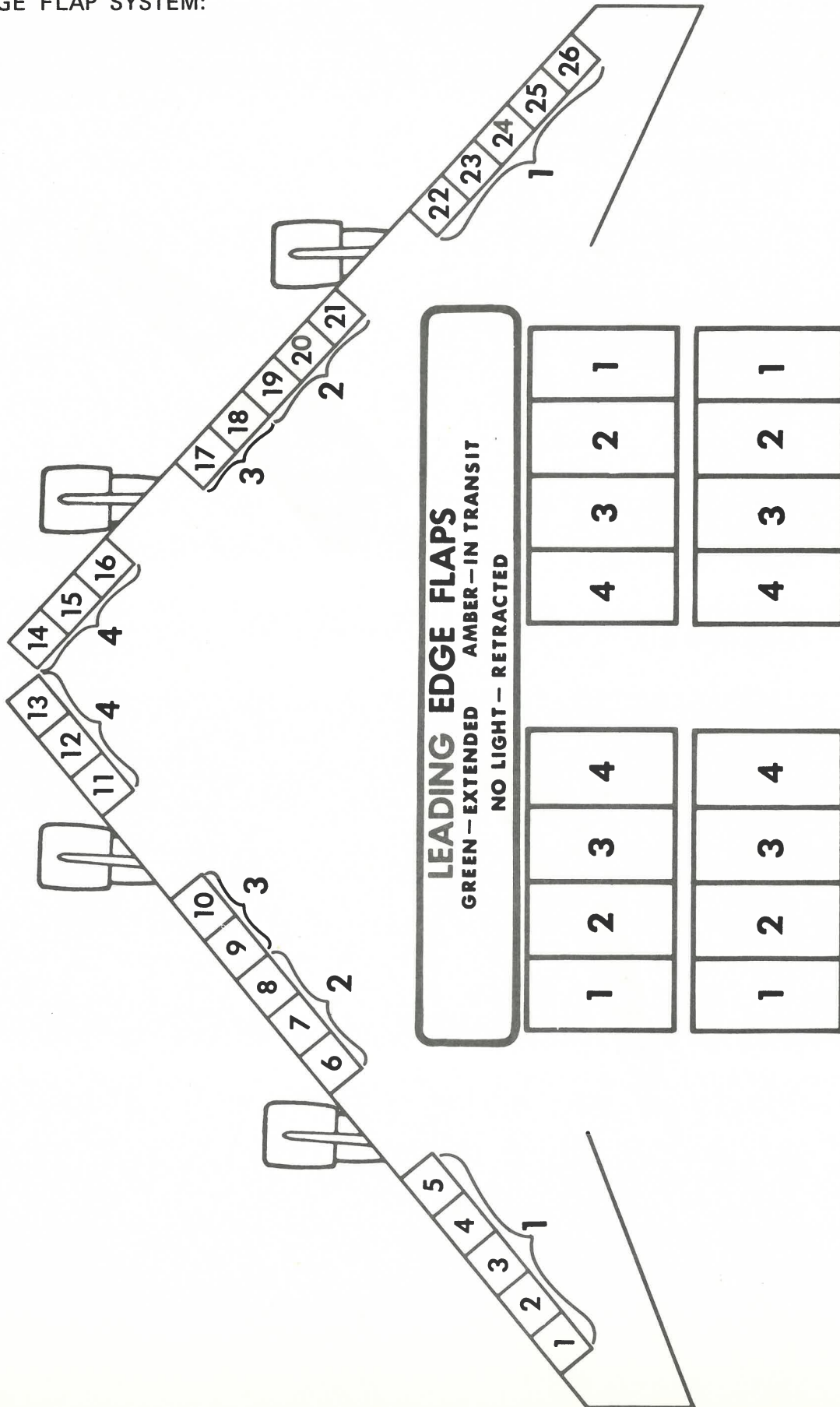
TRAILING EDGE FLAPS SYSTEM:



FLAP SYSTEM

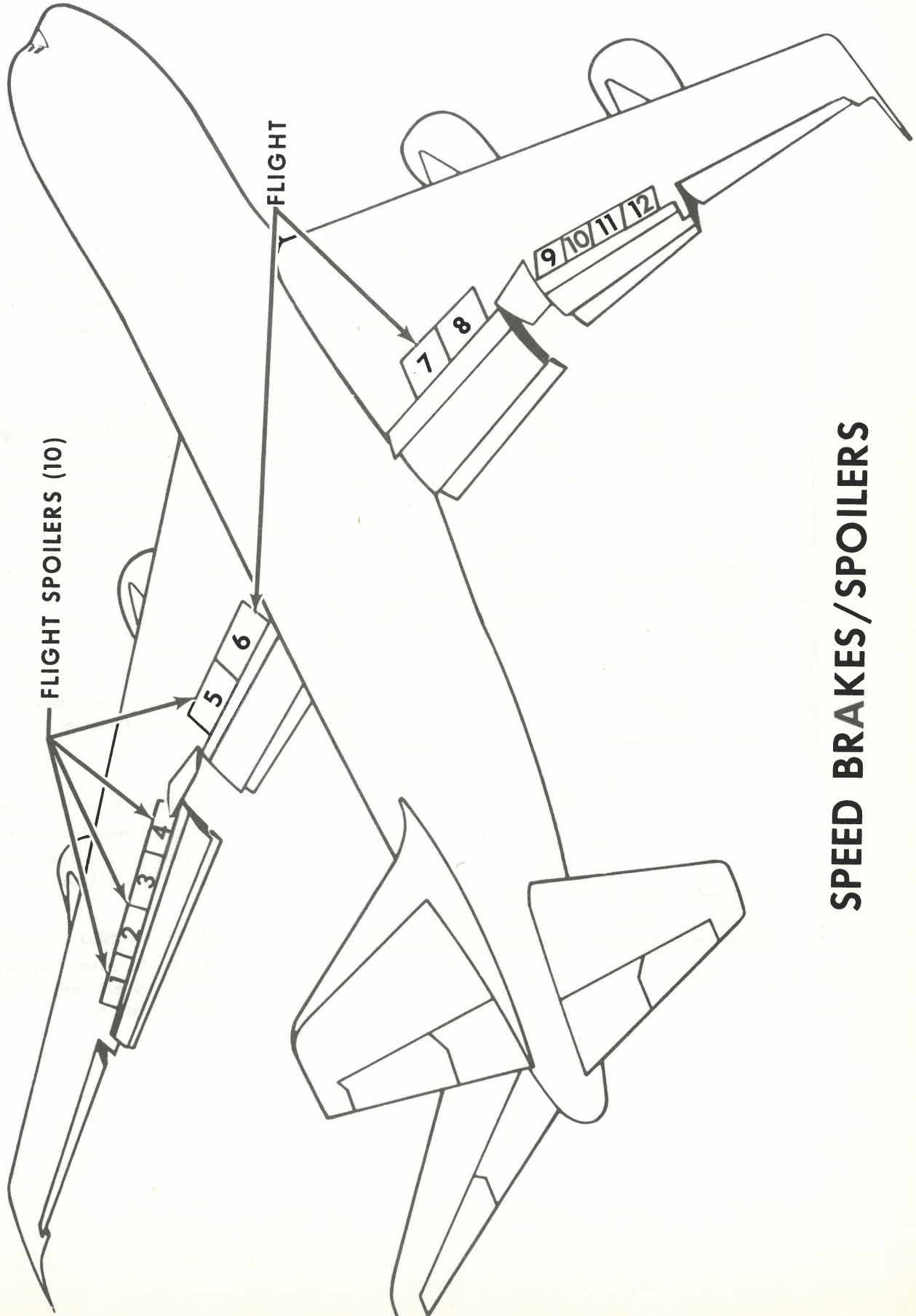


LEADING EDGE FLAP SYSTEM:



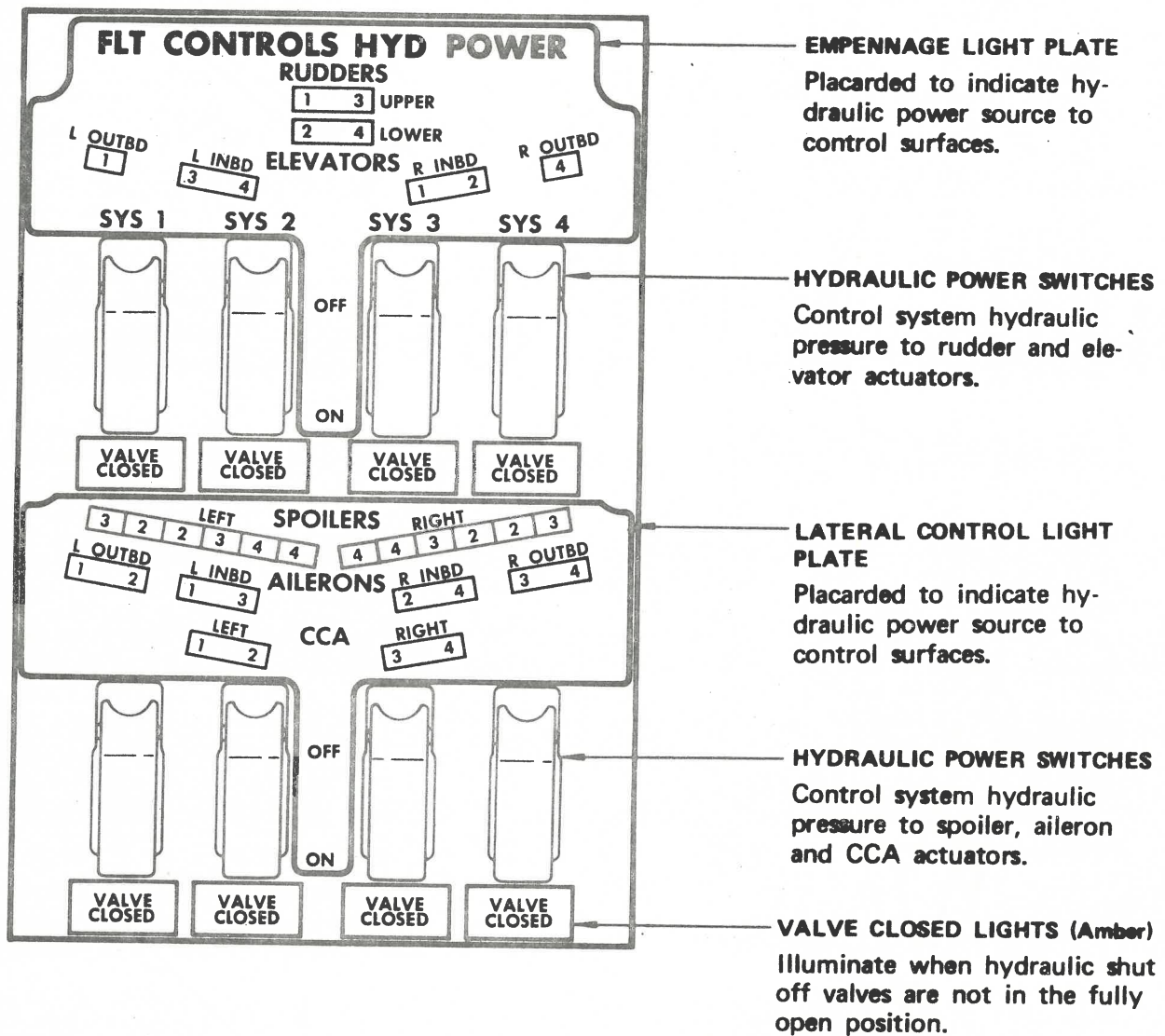


SPEED BRAKE/SPOILER SYSTEM:



SPEED BRAKES/SPOILERS

FLIGHT CONTROLS HYDRAULIC SHUT-OFF CONTROL PANEL:



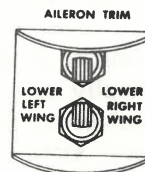


AILERON AND FLIGHT SPOILER CONTROL PANELS:



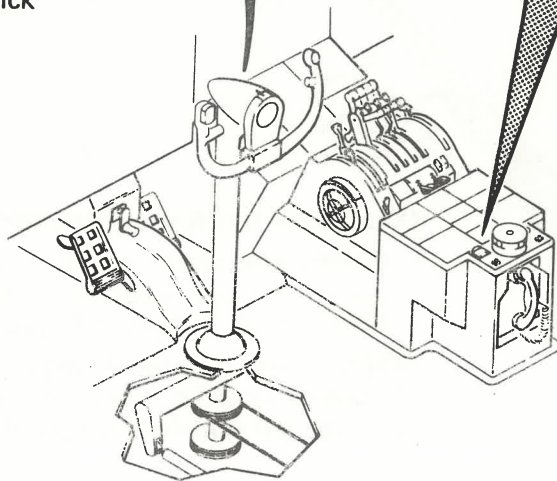
AILERON TRIM INDICATOR

- 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.



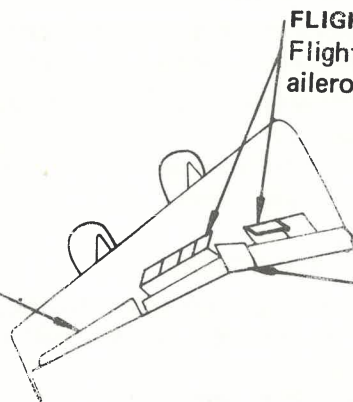
CONTROL WHEELS

- 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.

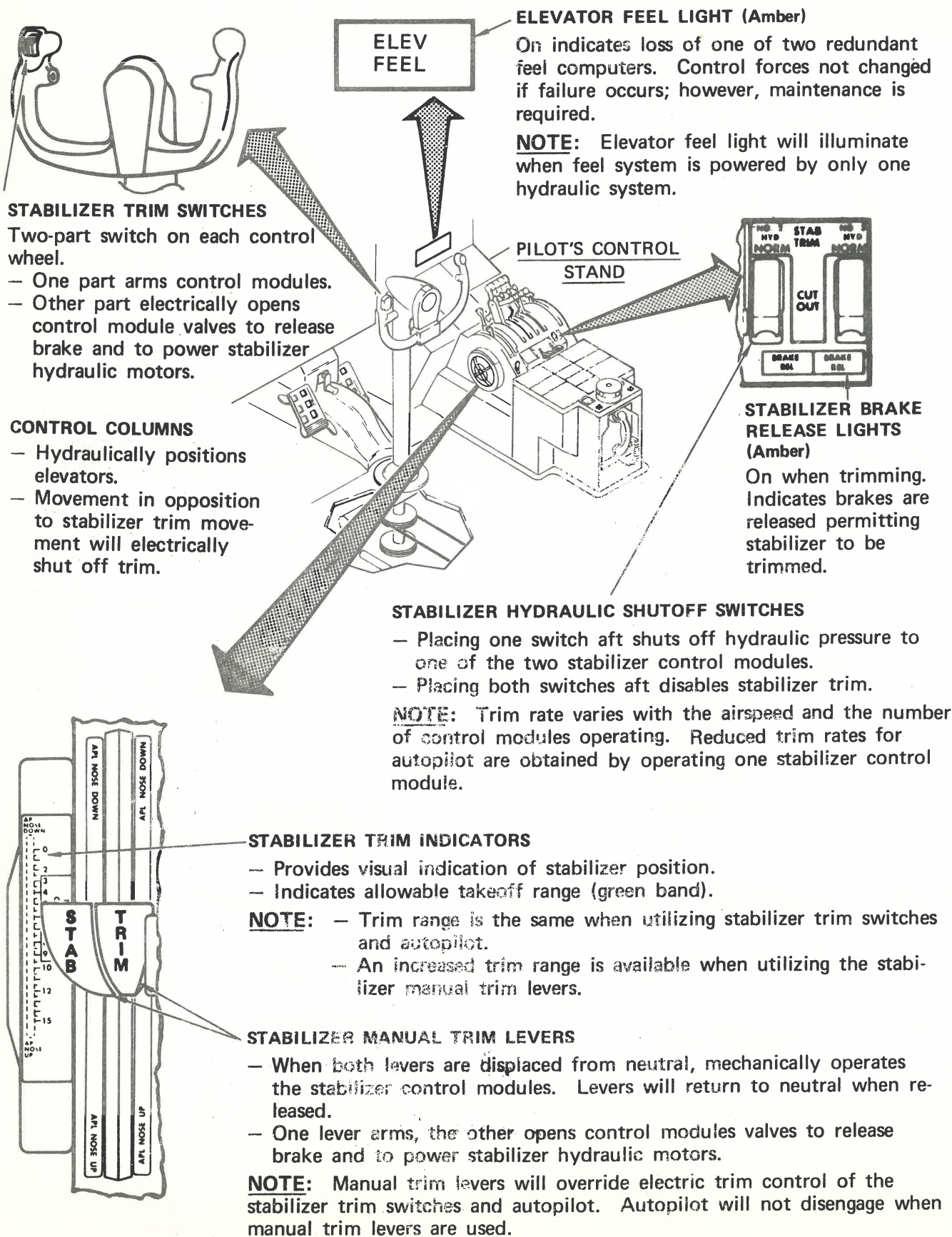
FLIGHT SPOILERS (SHOWN EXTENDED)
 Flight spoilers extend to supplement ailerons for roll control.

OUTBOARD AILERON
 Locked out when flaps are retracted above position 1.

INBOARD AILERON



ELEVATOR AND STABILIZER CONTROL PANELS:

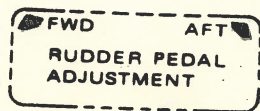
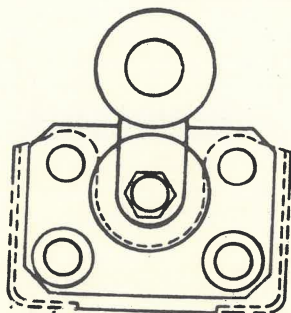




RUDDER CONTROL PANELS:

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.

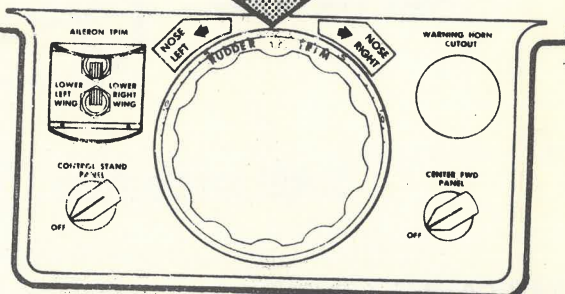
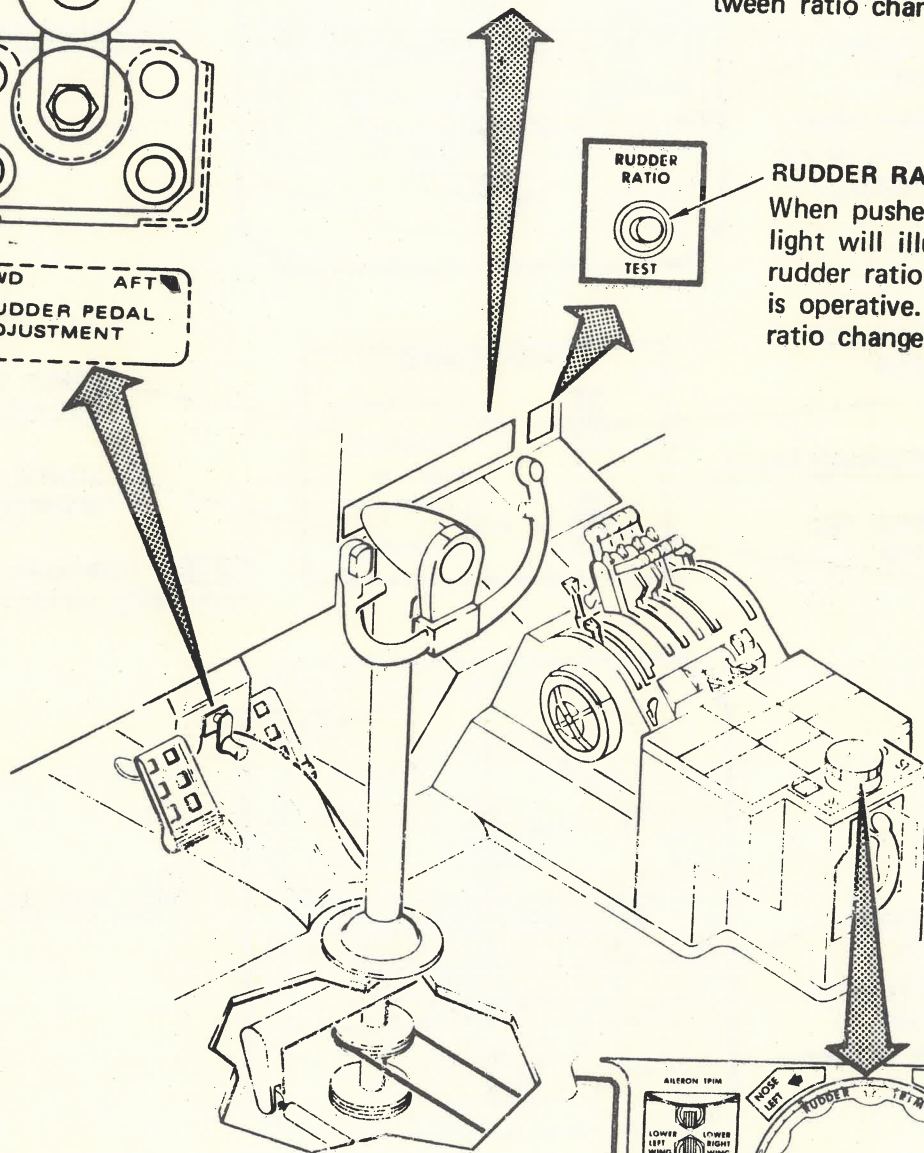


RUDDER RATIO TEST SWITCH

When pushed, RUDDER RATIO light will illuminate. Tests that rudder ratio changer comparator is operative. Rudder pedals and ratio changers are unaffected.

RUDDER PEDALS

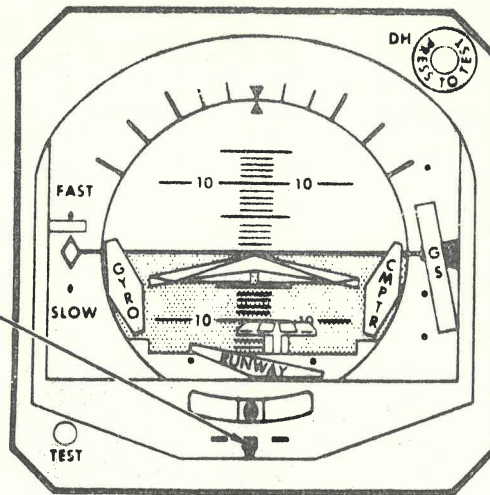
Hydraulically position rudder,



RUDDER TRIM WHEEL

- Mechanically repositions control system neutral position.
- Rudder pedals will be displaced from neutral.

YAW DAMPER CONTROL PANEL:



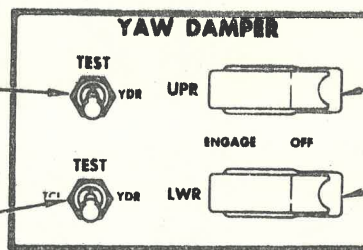
RATE-OF-TURN INDICATOR
 Out of view when power is lost to upper yaw damper.

CAPTAIN'S PANEL

UPPER YAW DAMPER AND TURN COORDINATOR TEST SWITCH

OVERHEAD PANEL

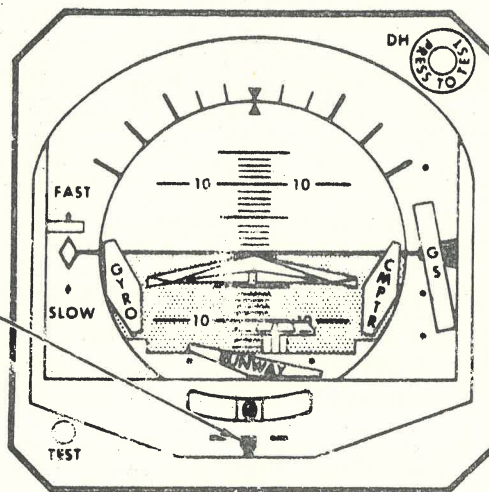
LOWER YAW DAMPER AND TURN COORDINATOR TEST SWITCH



UPPER YAW DAMPER ENGAGE SWITCH

LOWER YAW DAMPER ENGAGE SWITCH

NOTE: Interlocks prevent tests from being performed in flight.



RATE-OF-TURN INDICATOR
 Out of view when power is lost to lower yaw damper.

FIRST OFFICER'S PANEL

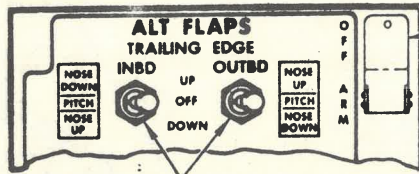
PILOTS' CENTER PANEL



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).

TRAILING EDGE FLAP CONTROL PANELS:



TRAILING EDGE ALTERNATE FLAP ARM SWITCH
 ARM – Bypasses hydraulic flap motors during alternate extension and arms trailing edge directional switches.

TRAILING EDGE DIRECTIONAL SWITCHES

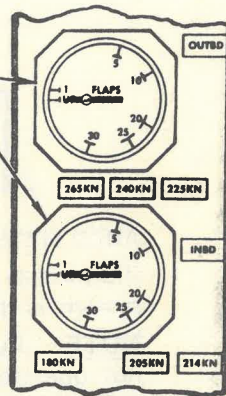
- Control inboard and outboard electric flap motors. Switches will hold in any position.
- No asymmetry protection is provided for during electrical extension.
- Placards indicate direction of airplane pitch if only one switch is used.

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) | |

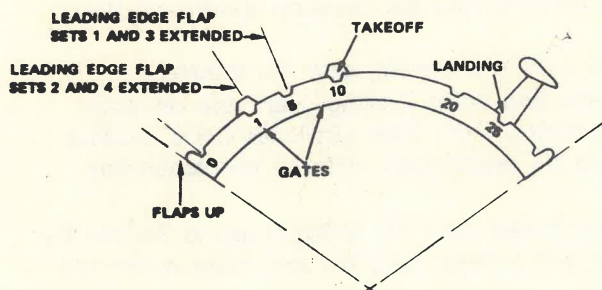
FLAP LIMIT SPEED PLACARDS

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.

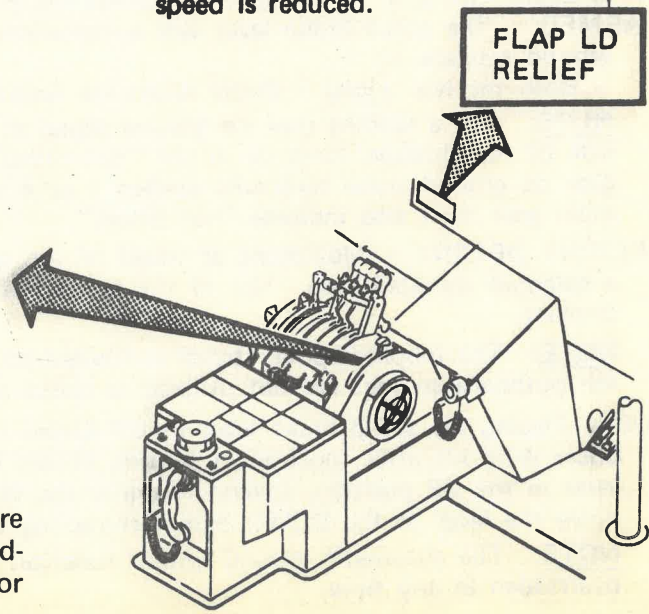
Trailing Edge Flaps



Flap Handle Positions Control Stand

Flap handle. Gates at positions 1 and 10 are provided as reminders that airspeed and leading edge flap conditions shall be satisfied prior to proceeding to next flap position.

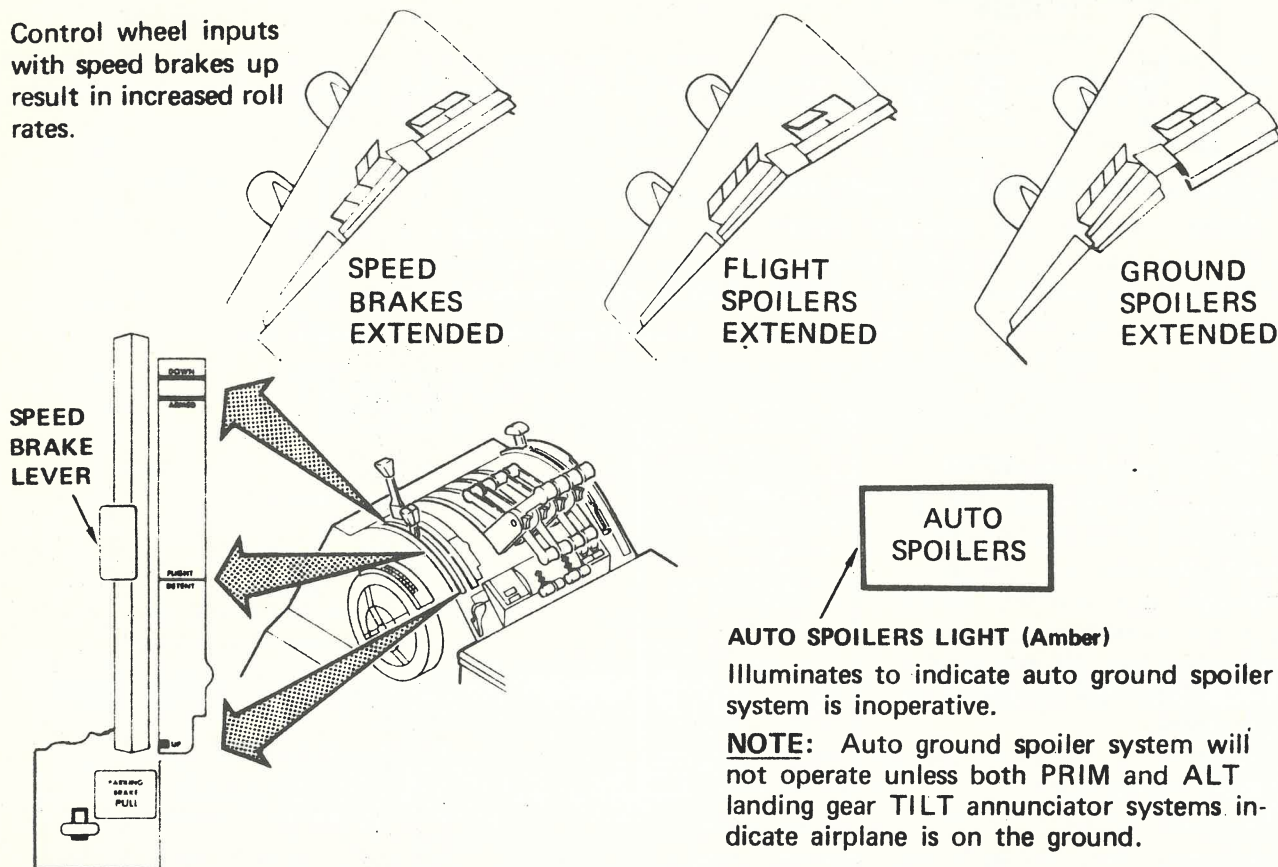
FLAP LD RELIEF



TRAILING EDGE FLAPS

SPEED BRAKE AND GROUND SPOILER CONTROL PANELS:

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."

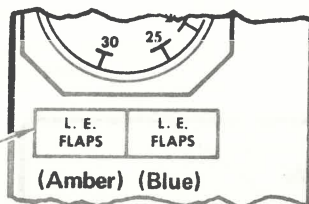
FLIGHT DETENT – Movement or travel of the speed brake lever for inflight use is limited by a solenoid actuated stop. Use of the speed brakes will reduce wing lift and slow down the airplane.

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.

LEADING EDGE FLAP CONTROL PANELS:



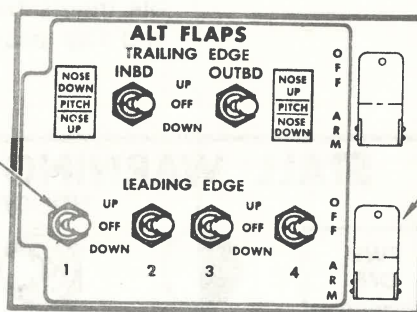
POSITION LIGHTS

- 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

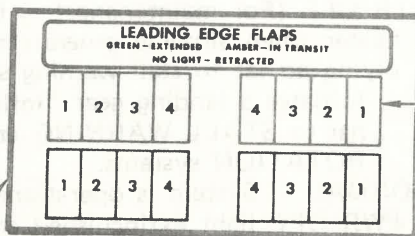
WHEN ARMED:

- 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

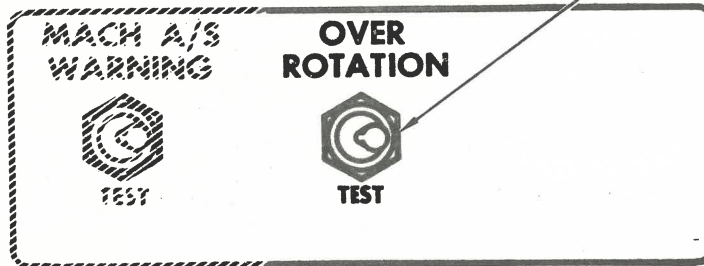
- Lights extinguished for LE flaps retracted.
- Amber lights illuminate for LE flaps in transit.
- Green lights illuminate for LE flaps extended.

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.

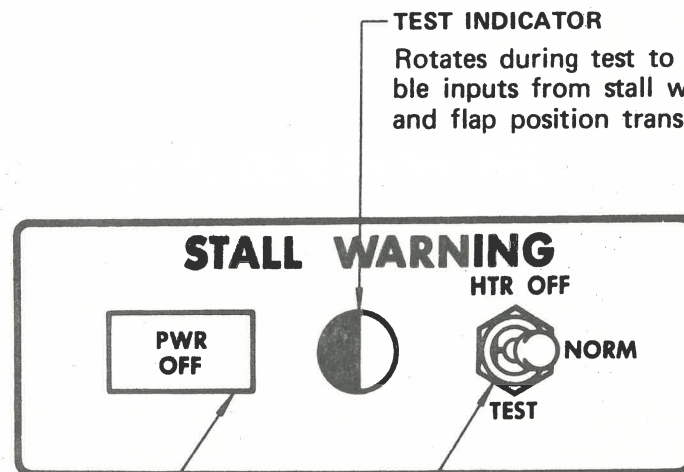
STALL WARNING AND OVER-ROTATION CONTROL PANELS:



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.

FLIGHT CONTROL POSITION INDICATOR:

LEFT ELEVATOR

Monitors position of left outboard elevator.

UPPER RUDDER

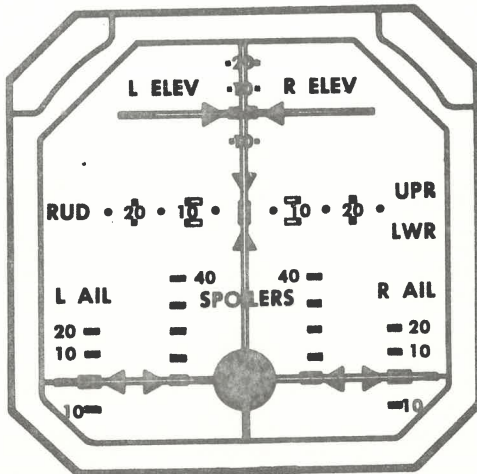
Monitors position of upper rudder.

LEFTAILERON

Monitors position of left outboard aileron.

LEFT SPOILERS

Monitors position of No. 4 spoiler



RIGHT ELEVATOR

Monitors position of right outboard elevator.

LOWER RUDDER

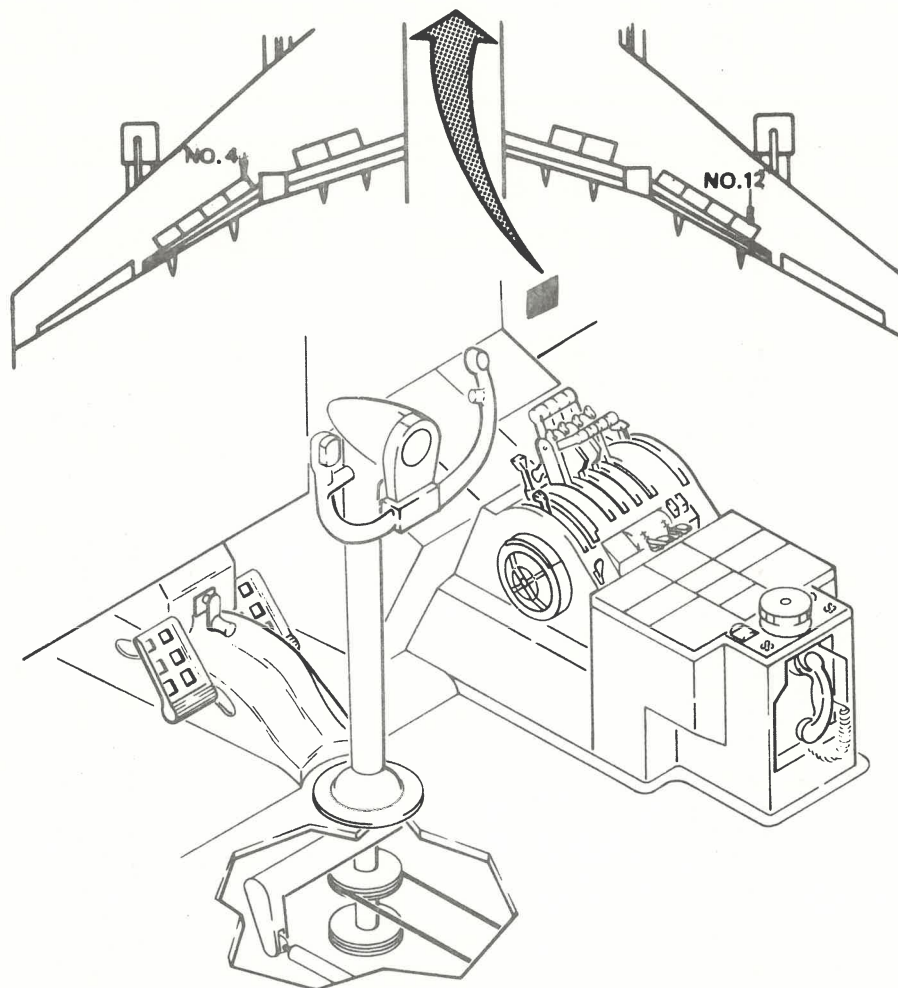
Monitors position of lower rudder.

RIGHTAILERON

Monitors position of right outboard aileron.

RIGHT SPOILERS

Monitors position of No. 12 spoiler



POSITION INDICATOR

| | |
|---|----|
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| EMERGENCY OPERATING PROCEDURES | 02 |
| ALTERNATE OPERATING PROCEDURES | 03 |
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FUEL:

The B-747/1 series aircraft has a total fuel load capability of about 316,000 pounds while the B-747/2 carries about 341,000 pounds.

Fuel is carried in seven tanks that are interconnected by valves and a crossfeed manifold. Fuel can be fed from any main or center wing tank to any engine. The fuel tanks are vented to surge tanks located in each wing tip, which provide for thermal expansion or overfilling. A single outlet located at each wing tip lower surface provides near atmospheric pressure in the tanks during all flight attitudes. Each main tank and the center wing tank has two AC Boost Pumps, each pump being powered from separate electrical busses. A Bypass valve permits suction feed in the event of Boost Pump failure.

All fuel controls and indicators necessary for flight crew operation of the system are located on the S/O panel.

Rapid fueling and defueling is provided by an external fueling station in each wing. An automatic shutoff system will close the fueling valves when the tanks are full. The electrical power for fueling is provided by external power, APU, or battery power. Overwing fill ports are provided for the four main fuel tanks only. Fuel Quantity Indicators on S/O panel provide an indication of fuel in each tank plus the gross weight/total fuel indicator, which displays the total of each individual tank. Fuel measuring sticks, mounted in the bottom of each tank, provide a mechanical means of determining fuel in each tank. A fuel temp indicator is provided to monitor fuel temperature for icing or overheat conditions. Fuel heat is provided from 15th stage engine bleed air to raise the fuel temperature when icing conditions exist. The No. 2 main tank normally supplies fuel for APU operation. Fuel pressure is provided by a DC operated pump when AC power is not available.

With AC power available, the No. 2 aft boost pump furnishes APU fuel pressure. The fuel jettison system provides a means of dumping fuel overboard inflight to reduce the aircraft weight.

Fuel may be jettisoned directly from the inboard tanks and the center wing tank and through transfer valves from No. 1 and No. 4 main tanks. The center wing boost pumps and the four jettison boost pumps in tanks No. 2 and No. 3 transfer fuel to the wing dump nozzle valves. The fuel dumping rate is about 4800 pounds/minute or dumping from tanks 2 and 3 only about 4100 pounds/minute. The fuel dump standpipe level is about 26,000 pounds.

FUEL SYSTEM:

GENERAL

1. The fuel tanks provide fuel for the engines and are located in the interspar area of each wing and in the wing center section in the fuselage. The vent surge tank is located near the tip of each wing and has a capacity of 125 gallons.

| | | | |
|--|---------|-------------|--------------|
| a. Total fuel capacity is 316,250 lbs. | (747-1) | 341,700 | (747-2) |
| (1) Outboard Reserve tank | — | 3,350 lbs. | 3,350 lbs. |
| (2) Main tanks No. 1 and No. 4 | — | 29,600 lbs. | 29,600 lbs. |
| (3) Main tanks No. 2 and No. 3 | — | 82,000 lbs. | 82,000 lbs. |
| (4) Center wing | — | 86,350 lbs. | 111,800 lbs. |

PRESSURE FUELING SYSTEM

1. Pressure fueling system provides a rapid means of filling the fuel tank in the aircraft from an external fueling station in each wing.

- a. This system provides electronic control to close the refuel valves when the tanks are full.
- b. Refuel valves may be manually controlled with no electrical power on the aircraft.

NOTE: Overwing fueling is provided for main tanks only.

FUEL QUANTITY INDICATORS ON S/O PANEL PROVIDE AN INDICATION OF FUEL IN EACH OF THE SEVEN TANKS.

1. Fuel quantity totalizer indicator on S/O panel converts the signals from the seven primary indicators into total fuel quantity.
 - a. This indicator provides a counter indication of aircraft gross weight.
2. Fuel used indicators located on S/O panel display total fuel used per engine.
 - a. A fuel used reset switch located on S/O panel provides a means of resetting the indicators to zero.
3. External fuel quantity indicators located at left wing control panel provide the fuelers an indication of fuel in the tank.
 - a. Refuel power is controlled by switch on left wing control panel.
 - (1) Normal position — Normal AC power.
 - (2) Battery position — Will start static inverter and power is provided from standby system to indicators.
4. Fuel level measuring sticks provide a means of checking the accuracy of the indicators.



FREIGHTER

28:01F

FUEL SYSTEM

There are some changes to the fuel system on the B-747F aircraft. Additional fuel capacity will be about 2880 lbs — (2075 lbs in center tank, 403 lbs in each inboard main tank).

Check valves are provided to prevent cross ship fuel transfer.

Boost pump switches for # 2 and # 3 tanks are a lever lock type. Each main tank is equipped with ejector pumps to remove water from tank sumps. Each ejector pump will operate automatically by a boost pump, whenever that pump is operating.

A newly designed vent scoop provides a positive pressure on the tanks during flight. Over-pressure protection for the vent system will cause a disk to blow out, leaving an approximate 3" hole on the underside of the wing.

Flashing main tank boost pump low pressure lights will flash inflight only for the following conditions.

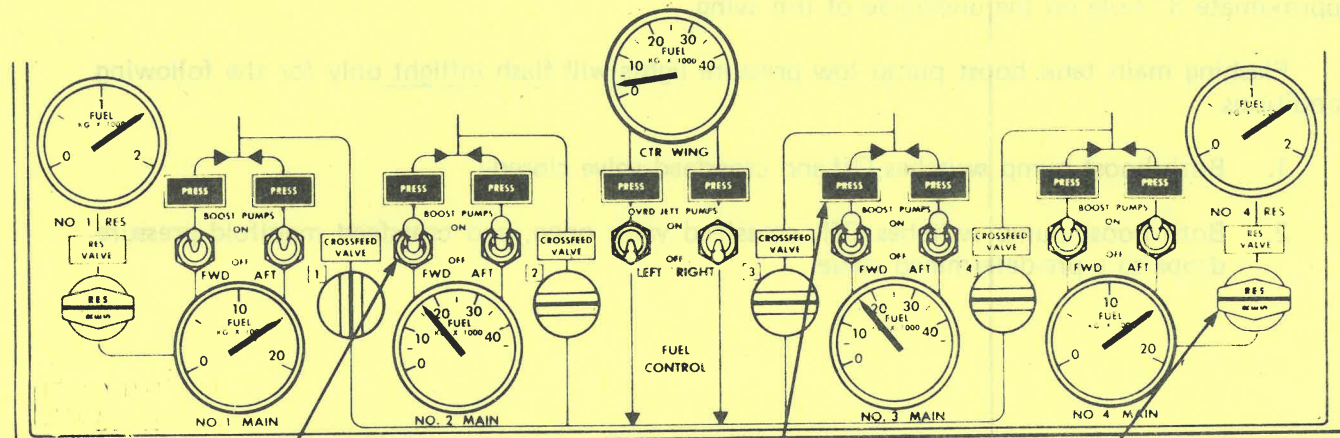
1. Both boost pump switches Off and crossfeed valve closed.
2. Both boost pump switches Off, crossfeed valve open, and crossfeed manifold pressure drops to a pre-determined value.

FREIGHTER



FREIGHTER

28:02F



LARGER LOCK TOGGLE SWITCHES

FUEL LOW PRESSURE LIGHTS FLASH WHEN CROSSFEED VALVE IS CLOSED AND THE BOOST PUMPS OFF

DIFFERENT RESERVE VALUE SWITCHES

ENGINE FUEL FEED SYSTEM

1. The engine fuel feed system delivers fuel from the tanks to the engines at all aircraft altitudes. The system consists of fuel manifolds, boost pumps and valves controlled from S/O panel.
 - a. The engine fuel feed manifold is used to distribute fuel from the boost pumps to the engines.
 - b. Engine fuel shutoff valves provide a means for shutting off fuel to the engine and are controlled by switches on S/O panel or by engine fire switches.
 - (1) ENG Valve light on S/O panel illuminates bright in transit and goes dim when fuel shutoff valve closes.
 - c. Two fuel boost pumps in each main tank deliver fuel under pressure to the engines, and are controlled by switches on S/O panel.
 - (1) PRESS. lights on S/O panel illuminate when boost pump pressure falls below a predetermined pressure.
 - d. Two OVRD/JETT. Pumps in center wing tank provide fuel to the manifold or fuel jettison system. Pumps are controlled by switches on S/O panel.
 - (1) PRESS. lights on S/O panel illuminate when boost pump pressure falls below a predetermined pressure.
 - e. The center tank scavenge pump removes residual fuel remaining in the tank and transfers it into the No. 2 main tank. Pump is controlled by a switch on S/O panel.
 - (1) PRESS. light on S/O panel illuminates when pressure falls below predetermined pressure.
 - (2) Pump output volume is low and requires considerable time to transfer fuel. (Approximately 1800 lbs/hour.)
 - f. Engine fuel crossfeed valves provide a means of directing fuel to the manifold and are controlled by rotary switches on S/O panel.
 - (1) Crossfeed Valve lights on S/O panel illuminate while valve is intransit.
 - g. Reserve tank valve provides a means of directing fuel to No. 1 or No. 4 tank, and are controlled by rotary switches on S/O panel.
 - (1) RES. VALVE lights on S/O panel illuminate while valve is intransit.
 - h. Fuel heat valves direct 15th stage air to the fuel heater and are controlled by switches on S/O panel.
 - (1) Icing lights located on S/O panel illuminate when fuel filter is approaching a bypassed condition.
 - (2) A fuel temperature indicator displays fuel temperature in No. 1 tank or temperature down stream of engine fuel heater, through pushbutton selector switches on S/O panel.



Fuel
28:04

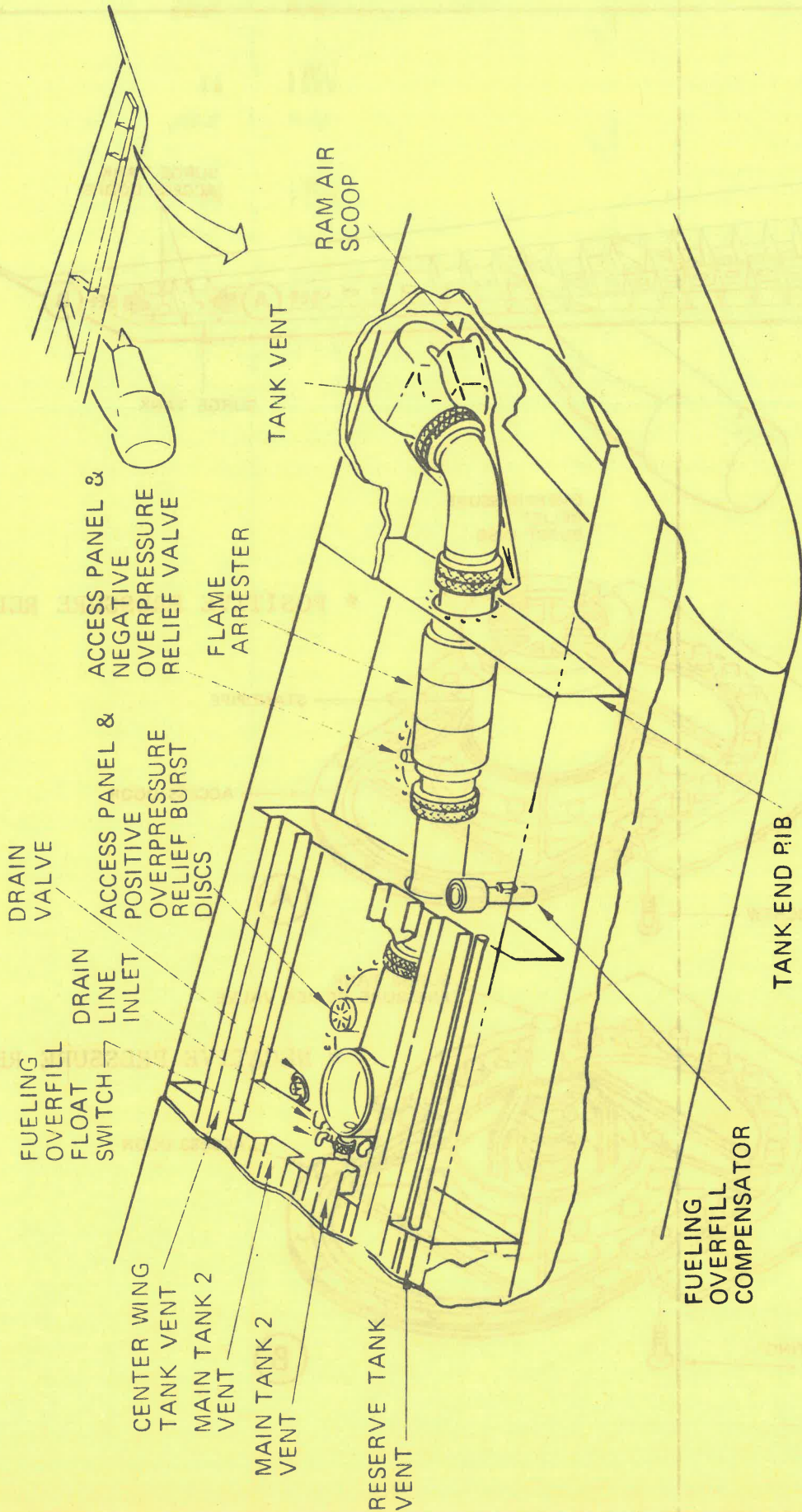
A.P.U. FUEL FEED SYSTEM

1. The APU fuel feed system supplies fuel from No. 2 main tank to the APU in the aft end of the fuselage.
 - a. With AC power on the aircraft the fuel is supplied from the No. 2 aft boost pump and is controlled by the APU master switch.
 - b. With DC power only, fuel is supplied from a DC pump controlled by APU master switch.
 - (1) DC Pump ON light located on S/O panel illuminates when DC pump is operating.
 - (2) DC pump is automatically turned off when fuel is being supplied from No. 2 aft boost pump.

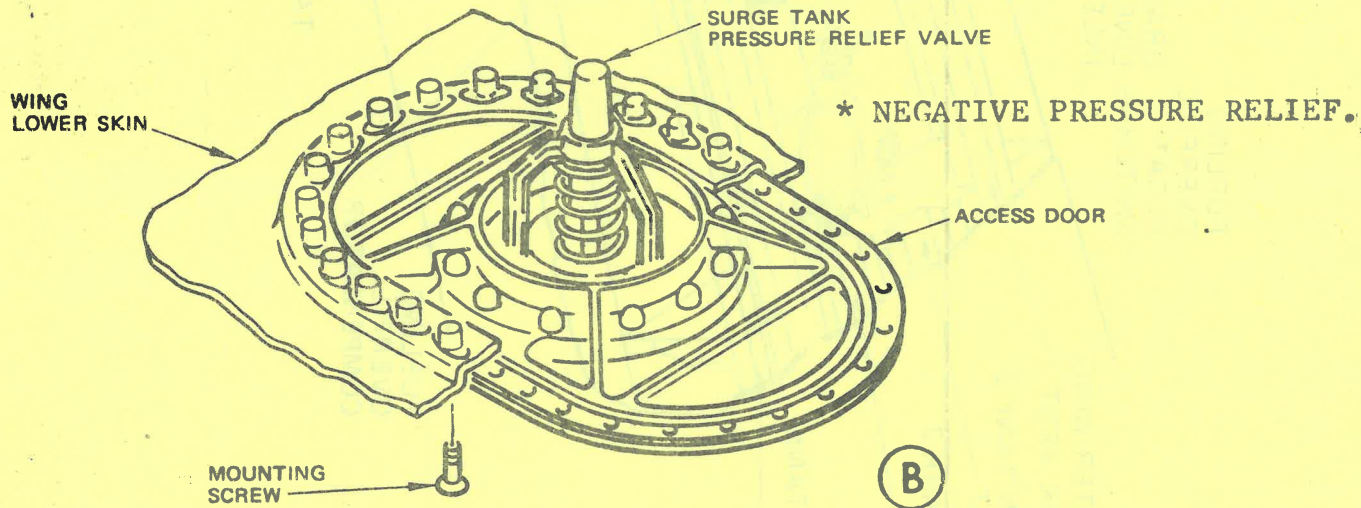
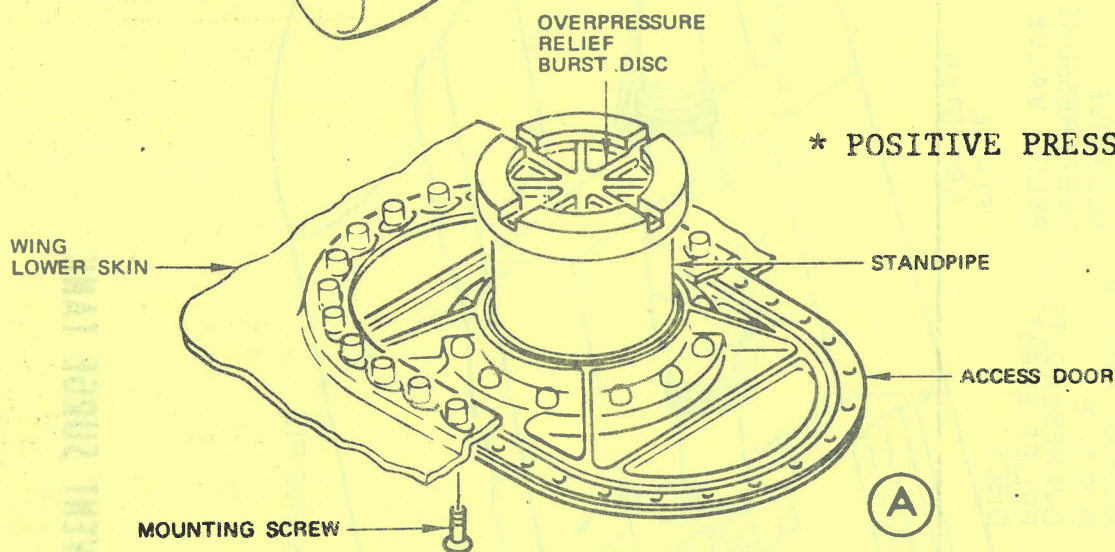
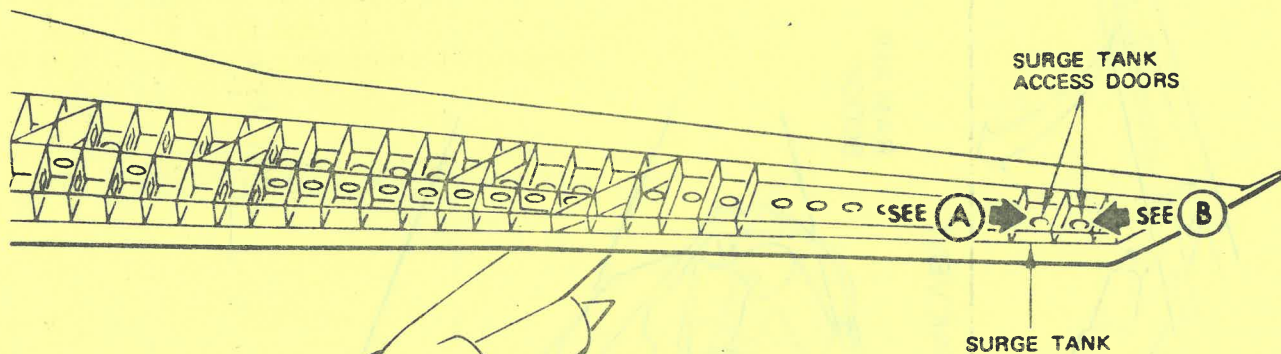
FUEL JETTISON SYSTEM

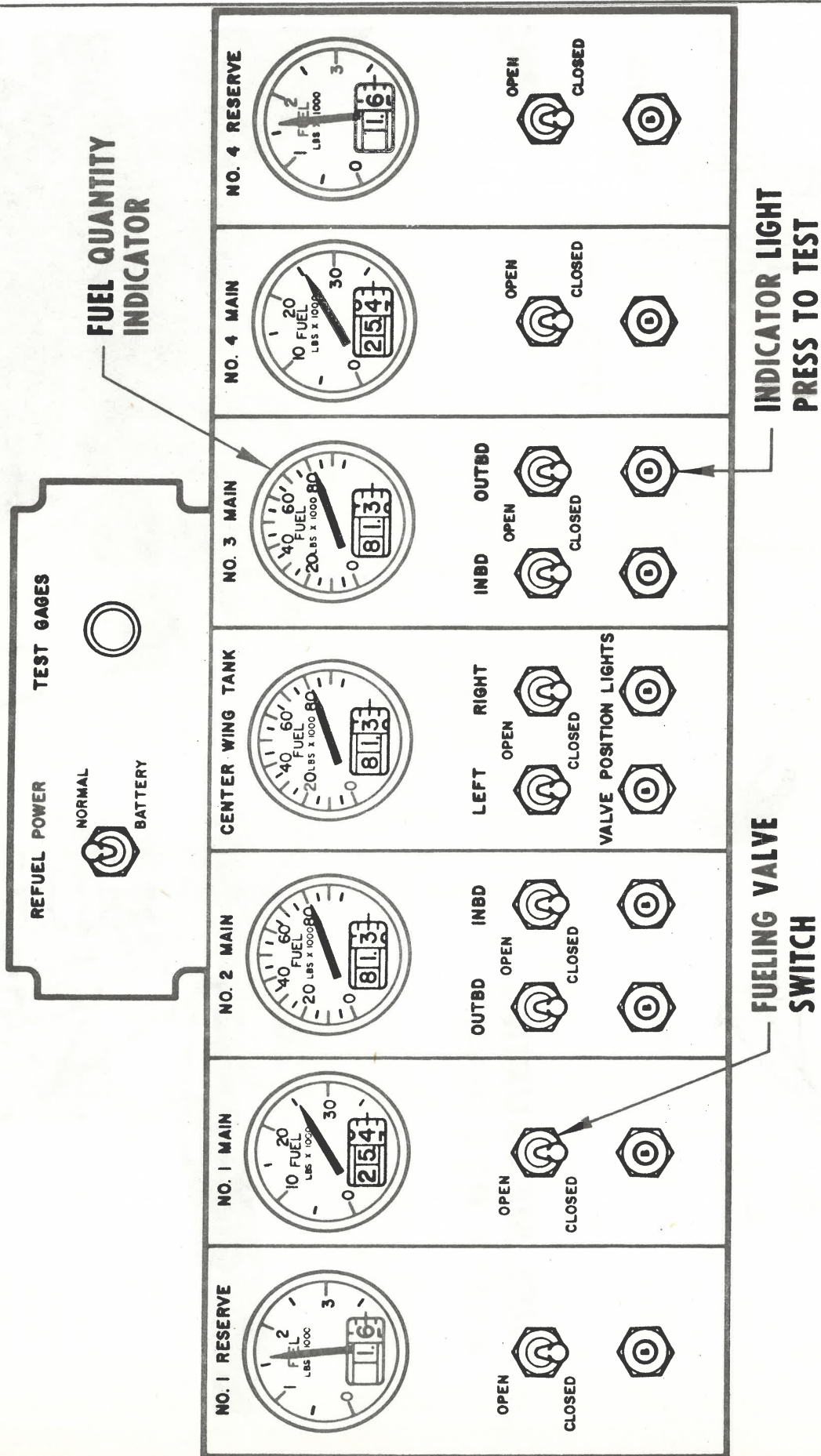
1. The fuel jettison system provides a means of dumping fuel overboard in flight to reduce the weight of the aircraft.
 - a. Main tank fuel jettison pumps deliver fuel from No. 2 and No. 3 tanks to the jettison manifold and are controlled by switches on S/O panel.
 - (1) PRESS. light on S/O panel illuminates when pressure falls below a predetermined pressure.
 - b. Jettison transfer valves in No. 1 and No. 4 tanks direct the flow of fuel into tanks No. 2 and No. 3, and are controlled by switches on S/O panel.
 - (1) VALVE lights on S/O panel illuminate while valve is intransit.
 - c. Two center wing jettison valves direct flow of fuel from the OVRD/JETT. pumps to the fuel jettison manifold and are controlled by switches on S/O panel.
 - (1) VALVE lights on S/O panel illuminate while valve is intransit.
 - d. Two fuel jettison nozzle valves provide a means of controlling the fuel to the nozzles and are controlled by switches on S/O panel.
 - (1) VALVE light on S/O panel illuminates while valve is intransit.
 - e. Fuel jettison nozzles located at each wing tip trailing edge, discharge fuel overboard during jettison operation.

NOTE: During fuel jettison operations, to get fuel from reserve tanks, reserve valves must be opened.

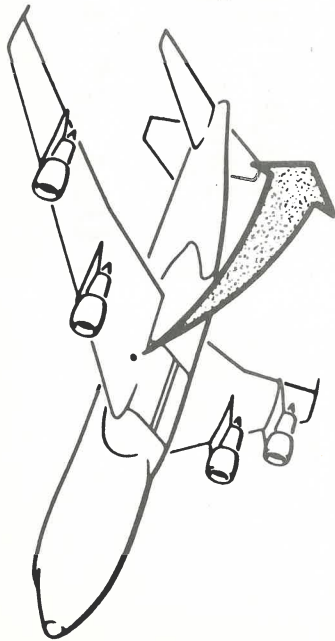
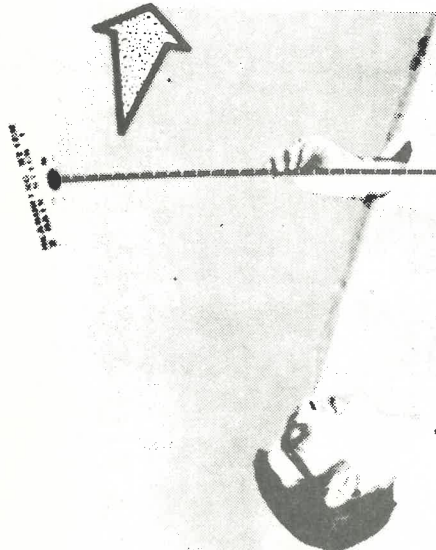
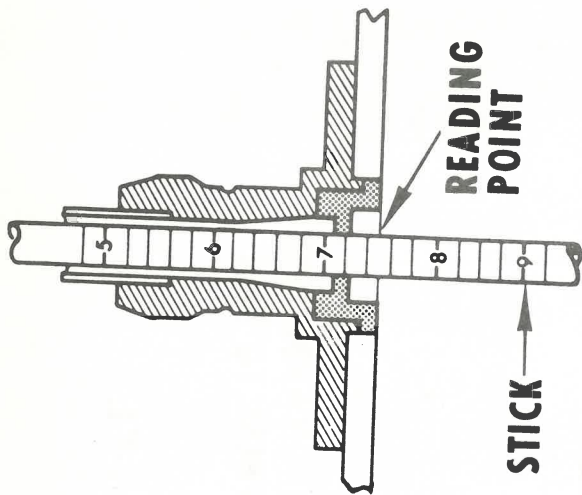


VENT SURGE TANK

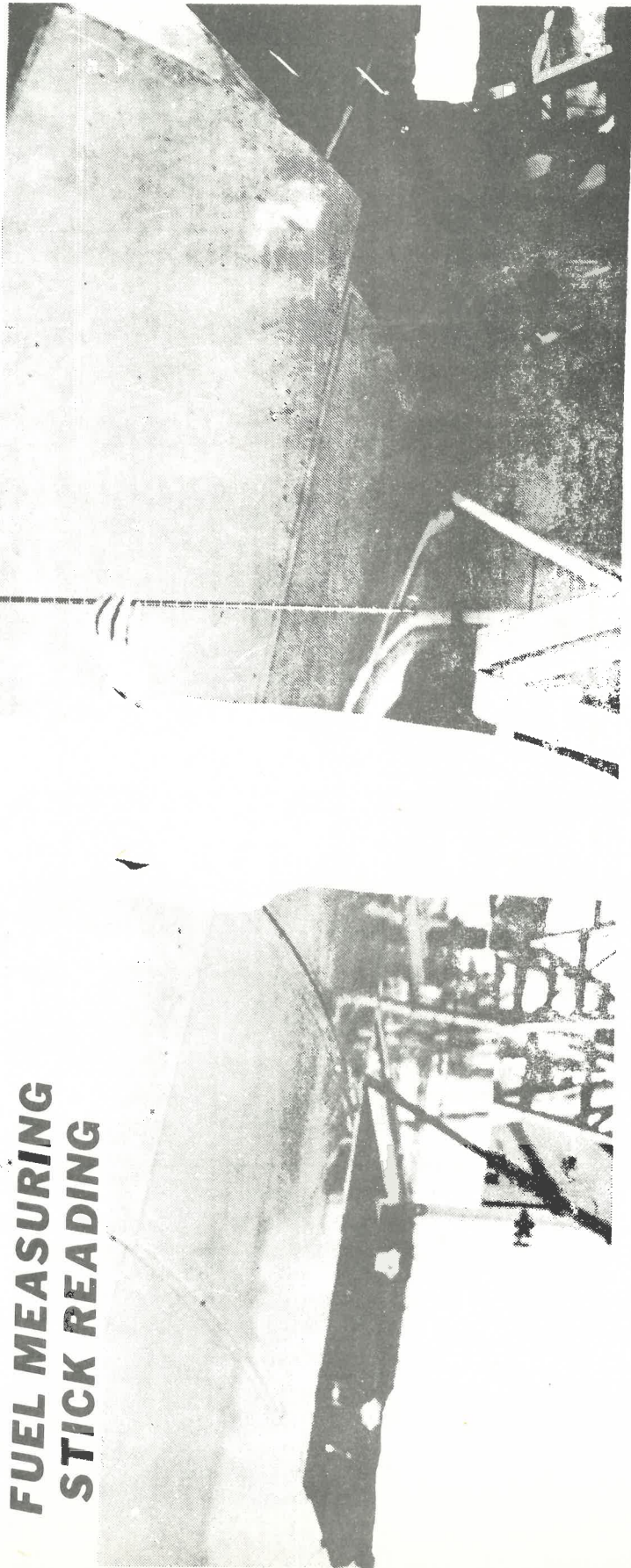




FUELING STATION CONTROL PANEL

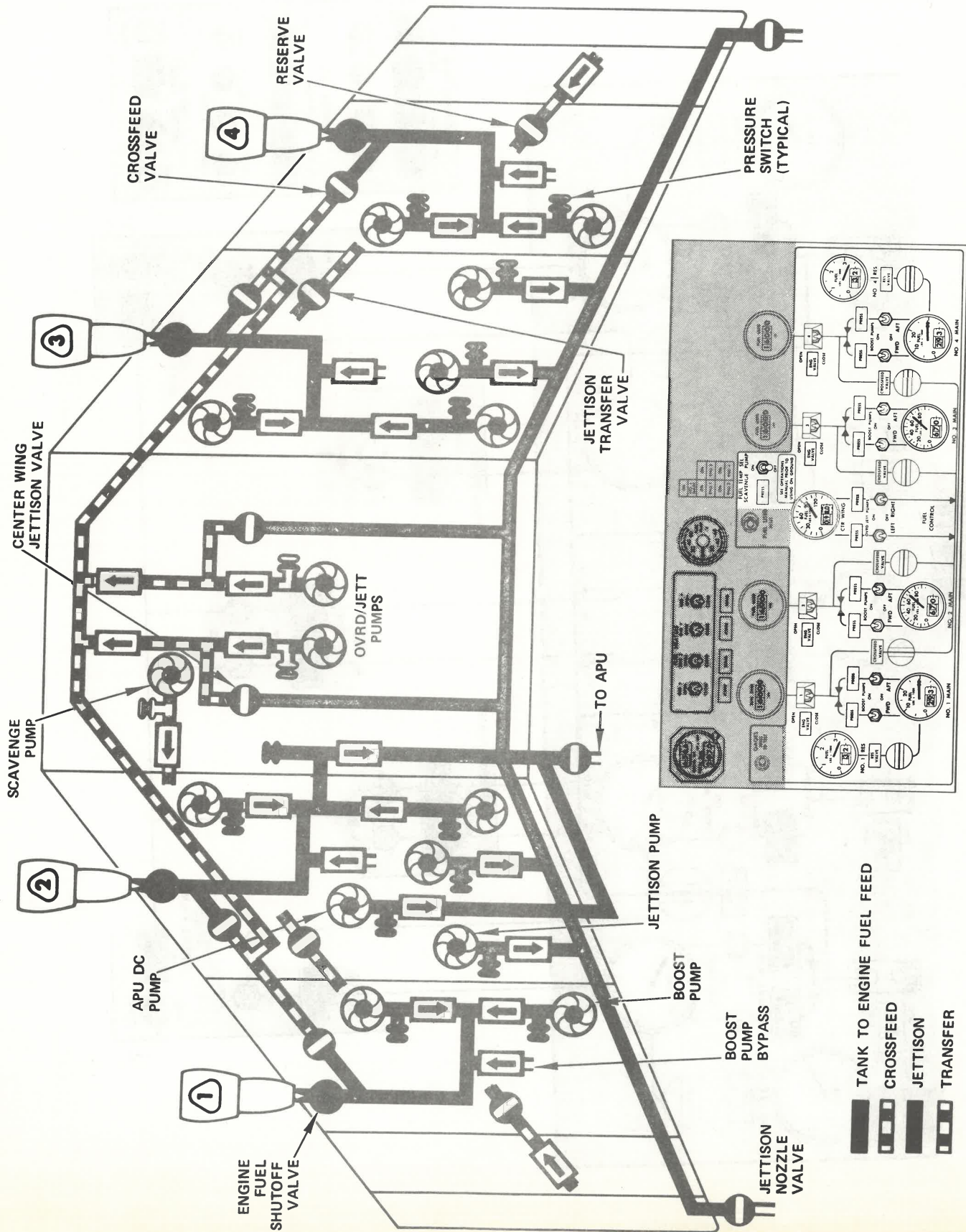


**FUEL MEASURING
STICK READING**



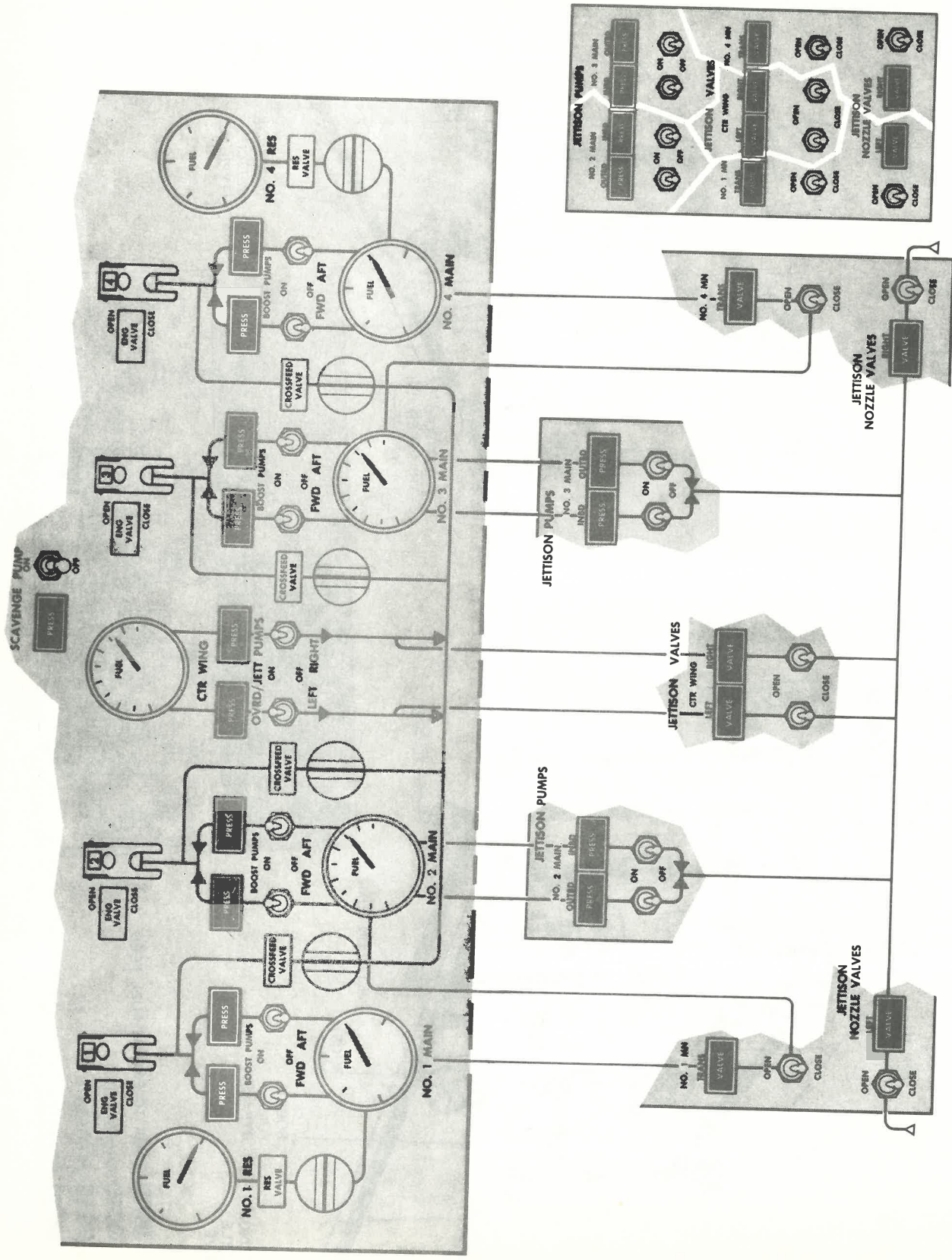


FUEL SYSTEM SCHEMATIC:



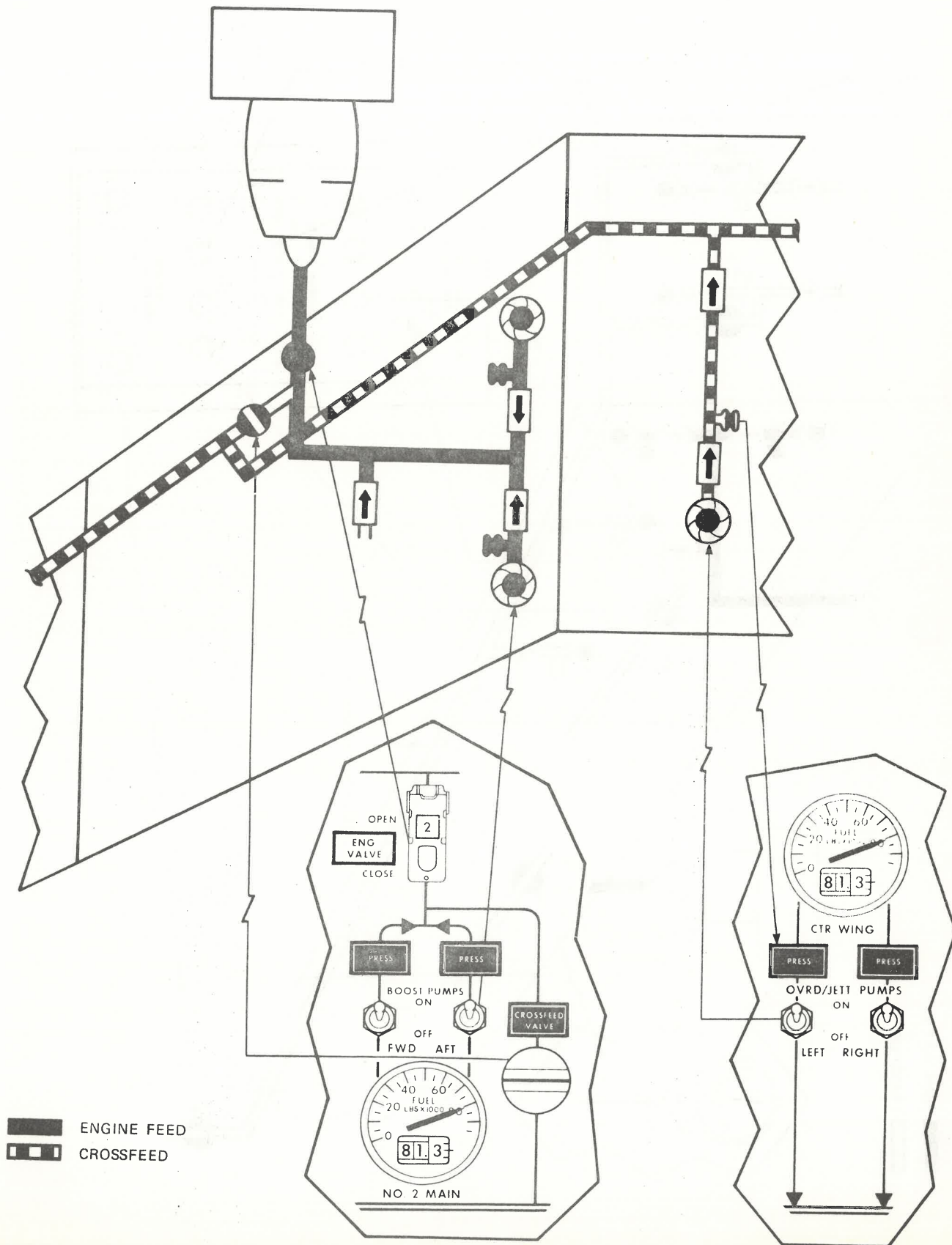
- TANK TO ENGINE FUEL FEED
- CROSSFEED
- JETTISON
- TRANSFER

FUEL SYSTEM CONTROLS:



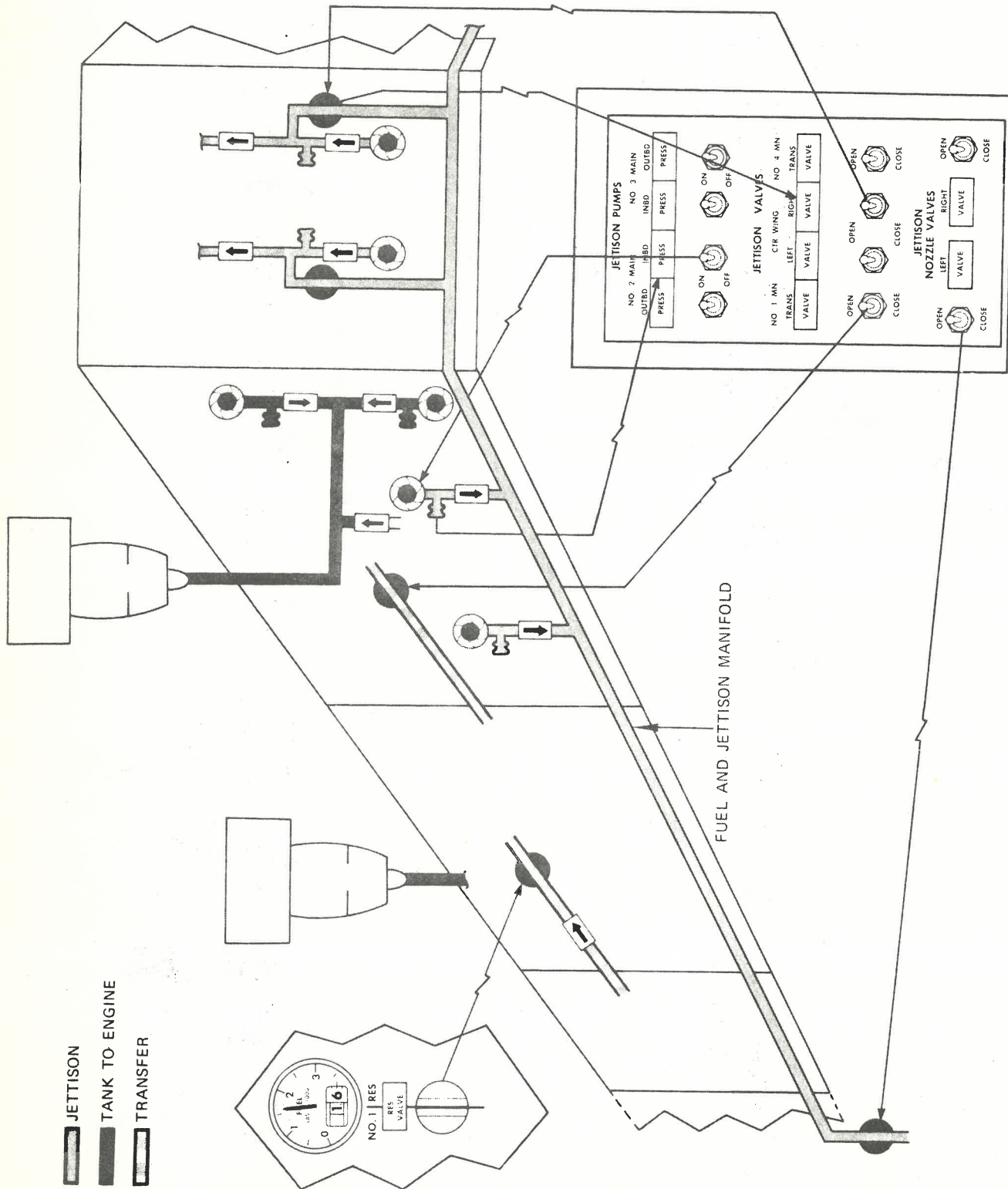


ENGINE FEED AND CROSSFEED SYSTEM:





FUEL JETTISON (ACTIVATED)



FUEL MEASURING CONTROLS/INDICATOR PANEL:

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 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 RESET SWITCH

Press to reset fuel used indicators.

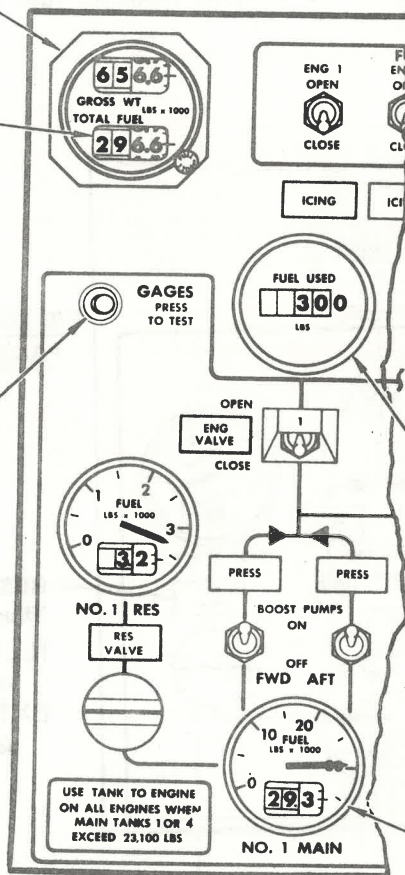
FUEL USED INDICATOR

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

TANK TO ENGINE FUEL FEED CONTROL PANELS:

ENGINE FUEL SHUTOFF SWITCH

OPEN – Engine fuel valve will open when the start lever is positioned to RICH or IDLE. Valve will close when the start lever is positioned to CUTOFF or when the engine fire switch is pulled even though the fuel shutoff switch is in the OPEN position.

CLOSE – Engine fuel valve will close and engine will be isolated from all fuel supply.

FUEL SHUTOFF VALVE LIGHT (White)

BRIGHT – Valve in transit.
DIM – Valve closed.
EXTINGUISHED – Valve open.

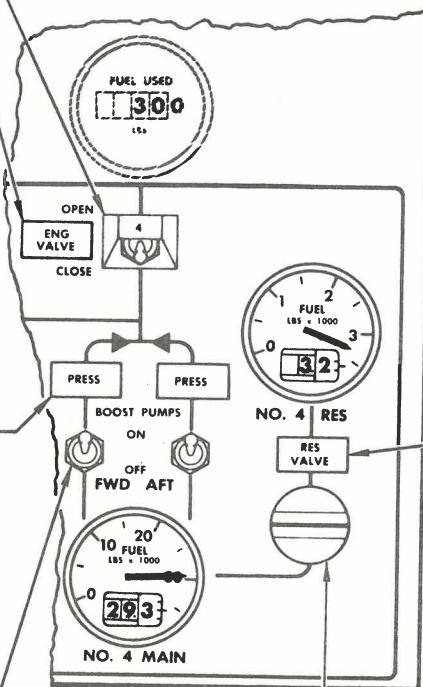
FUEL BOOST PUMP LOW PRESSURE LIGHT (Amber)

ILLUMINATED – When fuel pressure low or associated pump switch is in the OFF position.

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.

F/E LOWER PANEL



RESERVE FUEL VALVE LIGHT (Blue)

ILLUMINATED – Transfer valve in transit.
EXTINGUISHED – Transfer valve fully open or closed.

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 CROSSFEED CONTROL PANEL:

SCAVENGE PUMP LOW PRESSURE LIGHT (Amber)

Light may illuminate momentarily when pump is switched "ON".
Illuminates steady when scavenging is complete.

SCAVENGE PUMP SWITCH

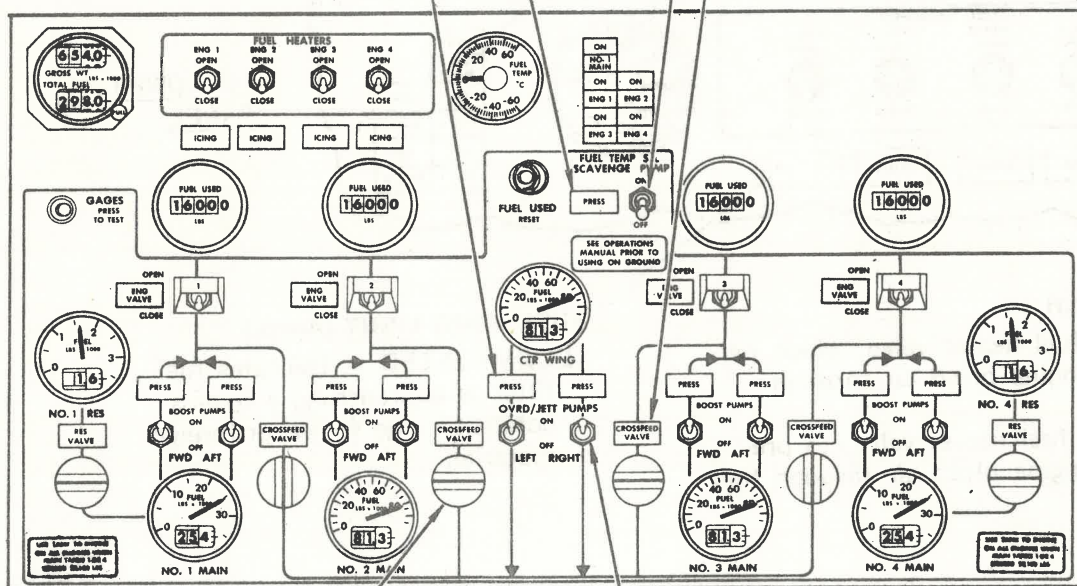
ON – Transfers residual center wing tank fuel from a position below the override/jettison pump intakes to the No. 2 main tank.

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.

FUEL SYSTEM MODULE

NOTE: Do not use center wing tank **SCAVENGE PUMP** on the ground when No. 2 MAIN tank is full.

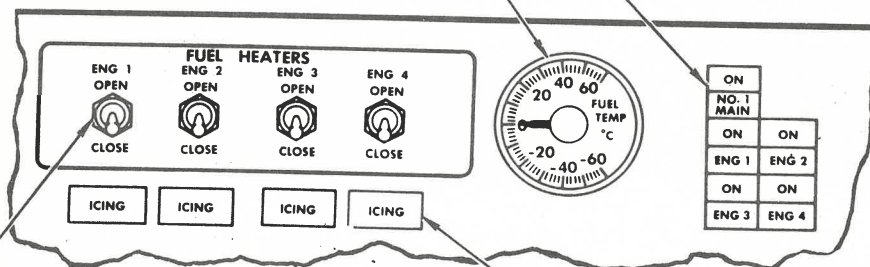
FUEL HEAT CONTROL PANEL:

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

FUEL JETTISON CONTROL PANEL:

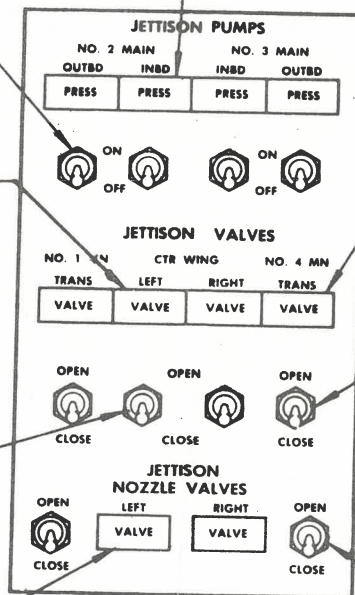
JETTISON PUMP LOW PRESSURE LIGHTS (Amber)
 Light may illuminate momentarily when pump switch placed to "ON". Illuminates steady when fuel is below standpipe level.

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.



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.

| | |
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HYDRAULIC POWER SYSTEM

Four separate and independent main hydraulic systems are provided to power the flight controls and landing gear system. Each system is color coded and identified by the engine that supplies it. Color identification is red for No. 1, blue for No. 2, orange for No. 3, and green for the No. 4 hydraulic system.

Flight control hydraulic power assignment is placarded on the 'Flight Controls Hydraulic Power' module, located on overhead panel and on the 'Stab Trim Cut Out' module on the pedestal. Brake system hydraulic assignment is also placarded on the 'Normal Brake Source Select' and 'Reserve Brake' system modules. Inboard landing gear and flap systems such as nose and body gear extension and retraction, nose gear steering, and inboard flaps are powered by hydraulic system No. 1. Hydraulic system No. 4 powers the wing gear and outboard flaps. Autopilot 'A' uses hydraulic system No. 3, while autopilot 'B' uses hydraulic system No. 2.

The components of all four main hydraulic systems are basically the same: however, hydraulic system No. 4 has an AC electric pump while the others do not. System No. 1 and 4 reservoirs are larger than No. 2 and 3 system reservoirs.

Each system incorporates a reservoir, an air driven pump located in their respective engine pylon strut and an engine driven pump located on the engine accessory section. The controls and indicators for the hydraulic systems are located on the S/O panel, while summary lights are displayed on the pilot's annunciator panel.

Hydraulic Reservoirs store fluid for the system pumps and its quantity is displayed on hydraulic gauges, located on S/O panel. In addition amber 'Low Qty' lights are provided as a flight crew warning.

Engine driven pumps (EDP) are controlled by toggle switches on S/O panel and fluid supply from the reservoir may be shut off by the fire switch or 'Supply Off' guarded position of the engine pump control switch. The EDP pressure output is approximately 3000 PSI and if its pump output falls to a pre-determined value, an amber low pressure light illuminates on S/O panel.

Air Driven Pumps (ADP) are provided to supplement the engine driven pumps during periods of high demand. The air driven pumps are controlled by toggle switches on the S/O panel. The 'auto' mode of this switch, when selected, allows the ADP to run if the hydraulic system pressure drops. A blue 'Run' light on S/O panel confirms ADP operation while ADP low pressure lights illuminate on S/O panel, if its pump pressure is too low. The ADP is protected by an over speed trip circuit.

AC Electric Driven Pump (ACP) is powered by ground handling bus and is controlled by guarded, solenoid held toggle switch on S/O panel. This pump provides a brake pressure source and will power any actuator powered by hydraulic system No. 4. The AC electric driven pump affects none of the hydraulic pump low pressure lights; however, its pump output is displayed on the system No. 4 pressure gauge.

The pilot's Hyd Sys Low Press Lights on Annunciator Panel are summary lights and will only illuminate when both the 'EDP' and 'ADP' low pressure lights illuminate.

Each hydraulic system has an amber 'overheat' light that illuminate when case drain temperature limits are reached. A standby hydraulic system is provided to supply the stabilizer trim and elevator feel systems if its primary hydraulic source fails.



HYDRAULIC POWER SYSTEM:

GENERAL

1. Four identical but independent hydraulic systems. (Color coded: No. 1—Red, No. 2—Blue, No. 3—Yellow, No. 4—Green).
 - a. Hydraulic reservoir located in respective engine nacelle strut.
 - (1) Pressurized from pneumatic manifold or engine bleed air systems.
 - (2) Four hydraulic quantity indicators, located on S/O panel display proper fluid level when indication is in green band.
 - (a) Four Low Quantity lights on S/O panel illuminate when quantity drops below a predetermined level.
 - (b) Hydraulic "QTY TEST" switch on S/O panel checks integrity of indicating system.
 - b. Each system has two hydraulic pumps in parallel. (No. 4 hydraulic system incorporates an additional AC operated hydraulic pump.)
 - (1) A "HYD PRESS" indicator for each system is located on S/O panel.
 - (2) Low "PRESS" lights, two for each system, located on S/O panel.
 - (3) A hydraulic "OVERHEAT" light for each system, located on S/O panel, illuminate when fluid temperature is excessive.
 - (a) Pump case drain fluid cooled by heat exchangers located in respective main fuel tanks.
 - (4) Engine driven pump controlled by three-position switch located on S/O panel.
 - (a) "NORMAL" position — Pump operative with engine running.
 - (b) "DEPR" position — Pump output closed and pump goes to feather position.
 - (c) "SUPPLY OFF" position — Pump feathers and fluid supply valve closes.
 - (5) Air driven pump controlled by three-position switch on S/O panel.
 - (a) "AUTO" position — Pump runs automatically with pneumatic air available and system hydraulic pressure below 2600 psi.
 - '1' A "RUN" light for each air driven pump, on S/O panel, illuminate whenever pump is operating.
 - '2' Four air driven pump Low Pressure lights, on S/O panel, illuminate when engine driven Low Pressure lights illuminate and ADP output pressure falls below predetermined level.
 - (b) "OFF" position — Shuts off pneumatic air to pump.
 - (c) "CONTINUOUS" position — Pump operates continuously, if pneumatic air available.



FREIGHTER

29:01F

HYDRAULICS

There are no changes in the hydraulic system on the B-747F.



HYDRAULIC POWER SYSTEM:

'1' ADP Low Pressure light will illuminate anytime its pressure is low.

(5) An AC electrically operated hydraulic pump supplies pressure to No. 4 hydraulic system only. Controlled by "ELEC PUMP HYD SYS 4" guarded switch located on S/O panel.

(a) Operates on ground only with External No. 1 or APU No. 1 power.

(b) Provides hydraulic pressure for brakes with engines shut down.

(6) Four "HYD SYS PRESS" lights, on pilots' center instrument panel illuminate with system low pressure. (Both ADP and EDP Low Pressure lights must be illuminated.)

(7) Normal hydraulic system pressure 3,000 psi.

(a) Pressure relieved at 3,500 psi.

c. Hydraulic power distribution.

(1) Hydraulic system No. 1 powers the following units.

(a) Rudder — ½ upper

(b) Elevators — Left outboard and ½ left inboard.

(c) Ailerons — ½ left outboard, ½ left inboard.

(d) Central control actuator — ½ No. 1 (left).

(e) Brakes — Secondary source.

(f) Trailing edge flaps — Inboard

(g) Landing gear — Left and right body gear and nose gear.

(h) Stabilizer trim — Uses a separate hydraulic motor/pump to drive right stabilizer, if No. 3 hydraulic system fails.

(i) Nose and body gear steering.

(2) Hydraulic system No. 2 powers the following units:

(a) Rudder — ½ lower

(b) Elevator — ½ right inboard

(c) Spoilers — No. 2, 3, 10, 11

(d) Ailerons — ½ left outboard and ½ right inboard.

(e) Central control actuator — ½ No. 1 (left)

(f) Stabilizer trim — left motor

(g) Brakes — reserve source

(h) Autopilot "B"

(i) Stabilizer trim "B"



HYDRAULIC POWER SYSTEM:

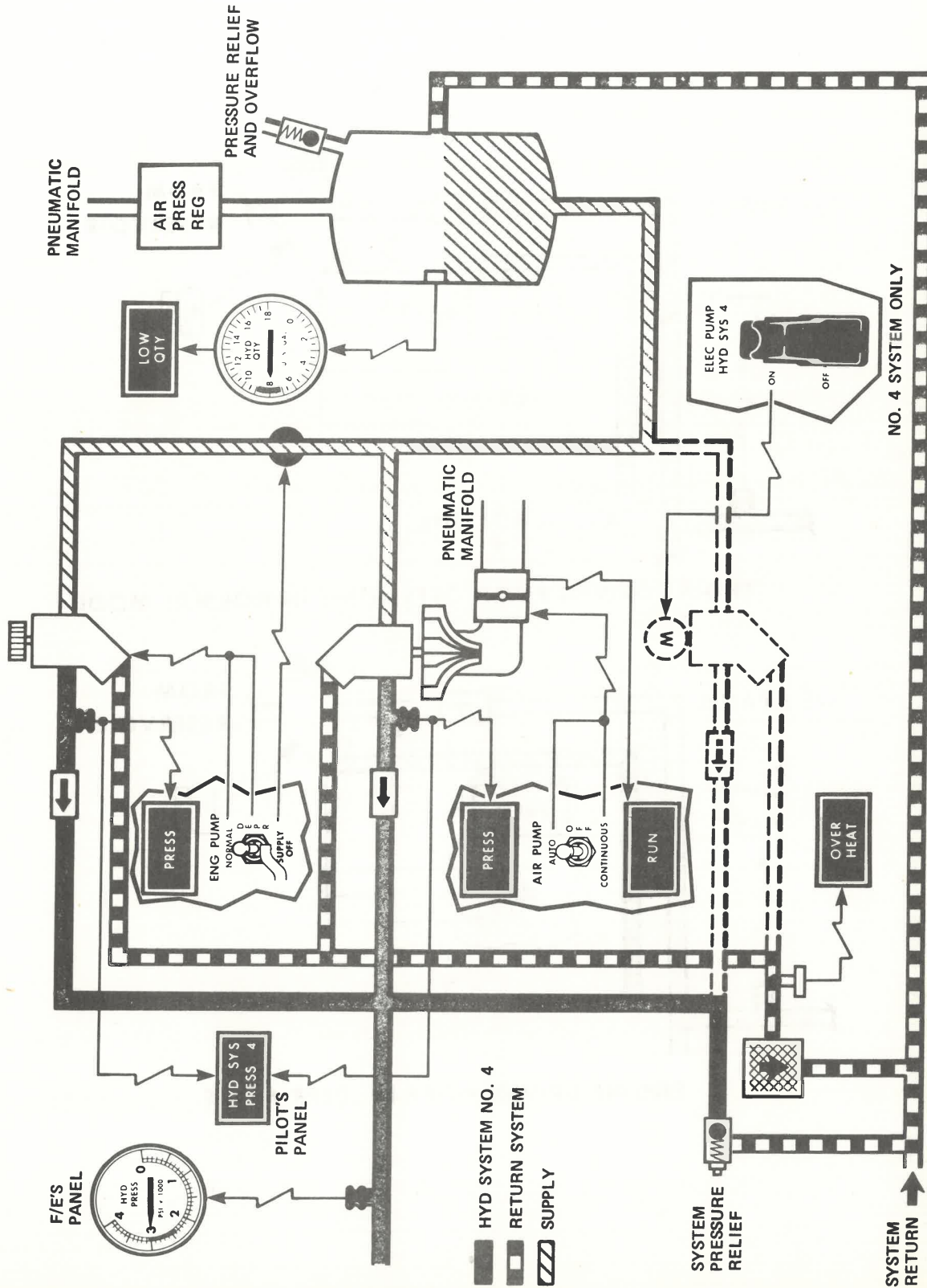
(3) Hydraulic system No. 3 powers the following units:

- (a) Rudder — ½ upper
- (b) Elevator — ½ left inboard
- (c) Spoilers — No. 1, 4, 9, 12
- (d) Ailerons — ½ left inboard and ½ right outboard
- (e) Central control actuator — ½ No. 2 (right)
- (f) Stabilizer trim — right

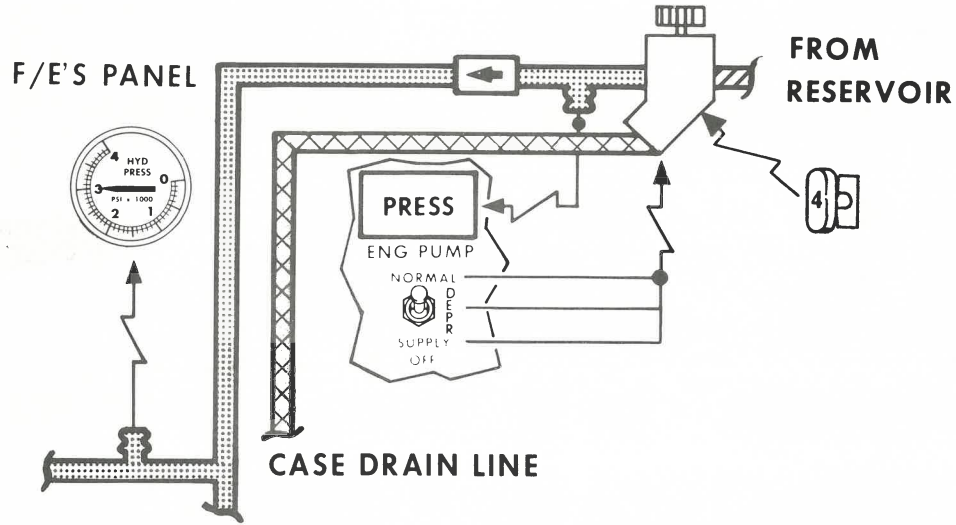
(4) Hydraulic system No. 4 powers the following units:

- (a) Rudder — ½ lower
- (b) Elevators — ½ left inboard and right outboard
- (c) Spoilers — No. 5, 6, 7, 8
- (d) Ailerons — ½ right inboard and ½ right outboard
- (e) Central Control Actuator — ½ No. 2 (right)
- (f) Trailing edge flaps — outboard
- (g) Landing gear — wing gears
- (h) Brakes — primary source

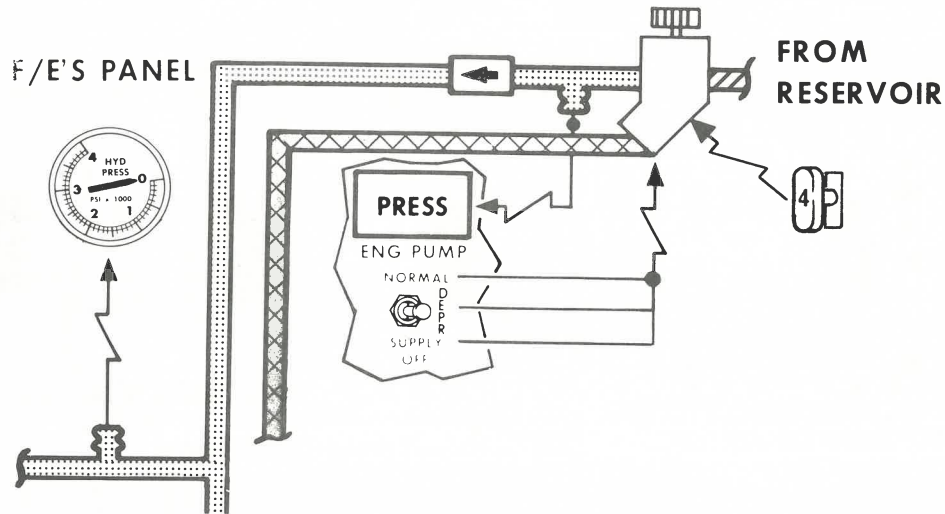
NO. 4 HYDRAULIC SYSTEM SCHEMATIC:



ENGINE DRIVEN PUMP OPERATING MODES:

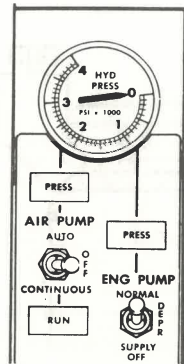


ENGINE DRIVEN PUMP OPERATING IN NORMAL MODE

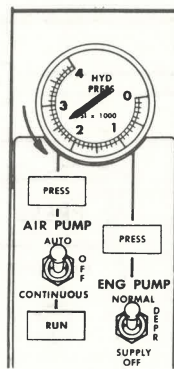
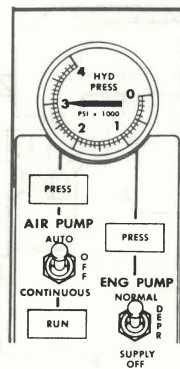
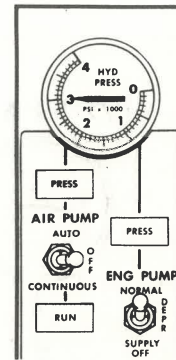


ENGINE DRIVEN PUMP IN DEPR MODE

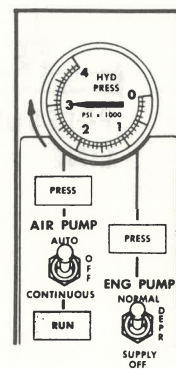
AIR DRIVEN PUMP OPERATING MODES:



ADP OFF SELECTION

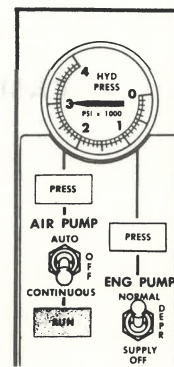


**2800 PSI
+ 10 SEC**

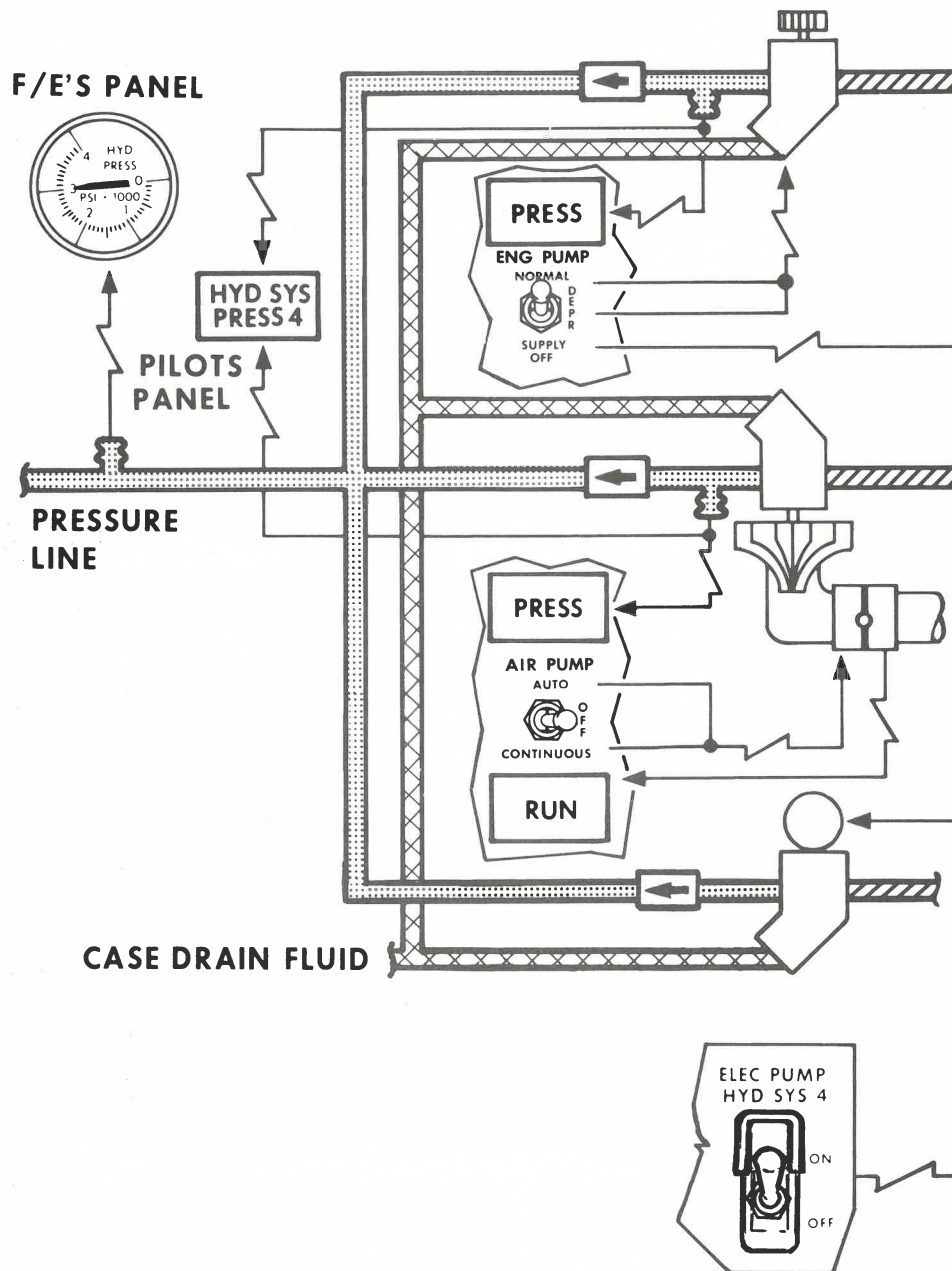


ADP AUTO OPERATION

**CONTINUOUS
MODE OPERATION**



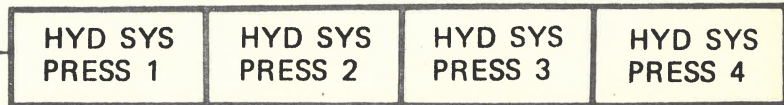
NO. 4 A/C PUMP OPERATION:



HYDRAULIC CONTROLS AND INDICATORS:

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.



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.

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)

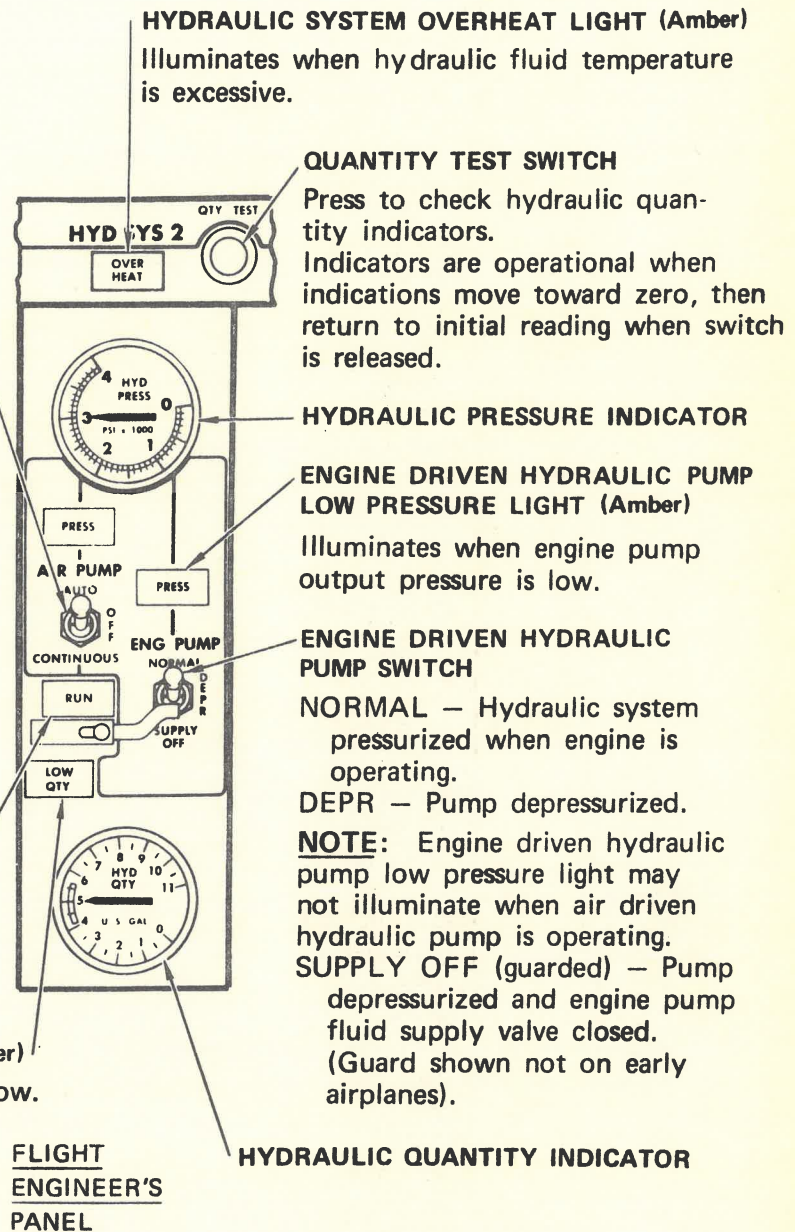
Illuminates when hydraulic quantity is low.

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.



FLIGHT ENGINEER'S PANEL

HYDRAULIC PRESSURE INDICATOR

ENGINE DRIVEN HYDRAULIC PUMP LOW PRESSURE LIGHT (Amber)

Illuminates when engine pump output pressure is low.

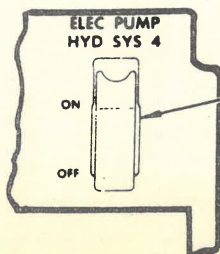
ENGINE DRIVEN HYDRAULIC PUMP SWITCH

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.

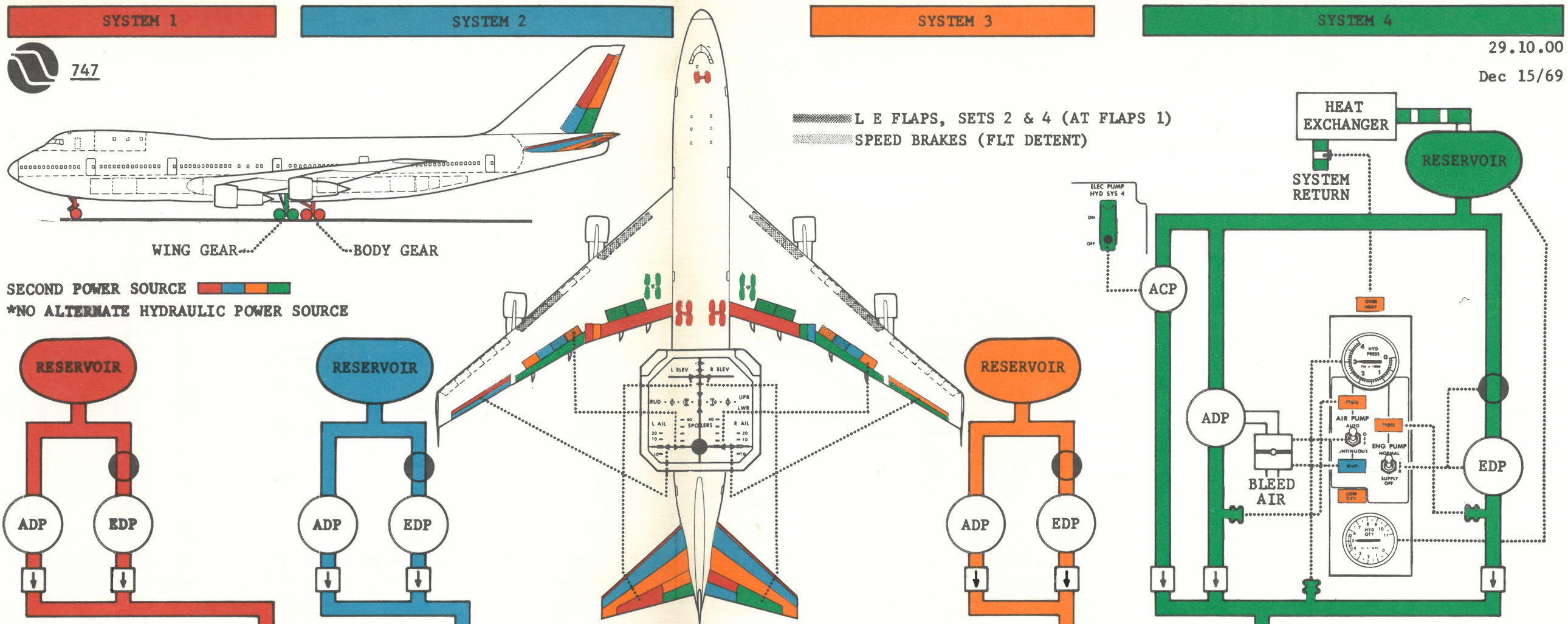
SUPPLY OFF (guarded) - Pump depressurized and engine pump fluid supply valve closed. (Guard shown not on early airplanes).



HYDRAULIC SYSTEM 4 ELECTRIC PUMP SWITCH

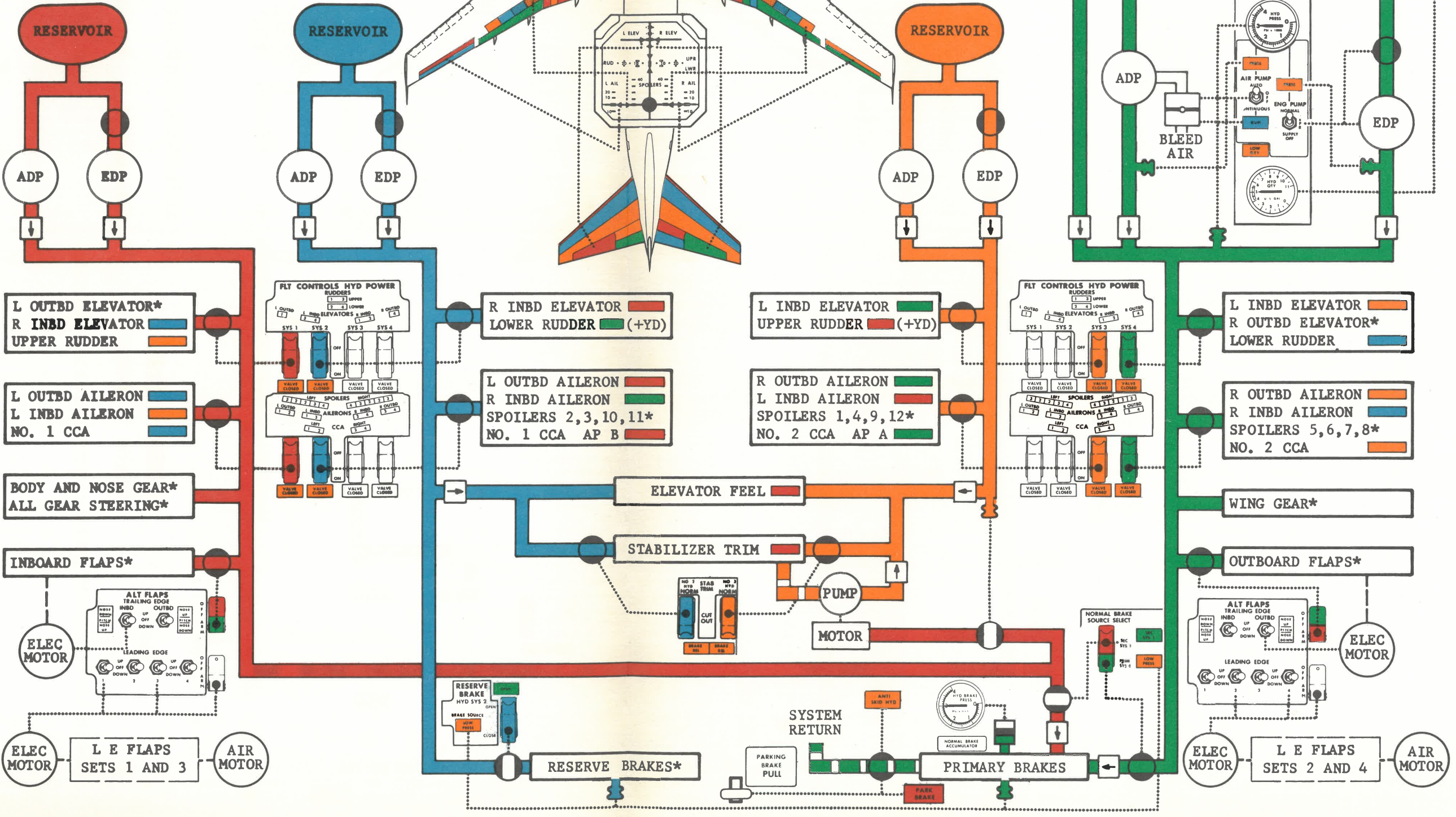
- Pressurizes hydraulic system 4.
- Pump can be operated only with APU or ground AC power.

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.



SECOND POWER SOURCE ■ ■ ■ ■

*NO ALTERNATE HYDRAULIC POWER SOURCE



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ICE AND RAIN PROTECTION SYSTEM:

The Anti-ice and Rain Protection Systems are designed to protect the aircraft and aid the pilots when operating under ice and rain conditions.

ENGINE ANTI-ICE:

Engine Nacelle anti-icing is provided to each nose cowl, EPR probe, and first stage stators through four Nacelle anti-ice switches, located on the cockpit overhead panel. These four switches provide control for the Nacelle and stator anti-ice valves, which are electrically controlled and pneumatically operated. These valves when open, act as pressure regulators and will automatically close if unable to maintain minimum operating pressure. Eight lights on the Nacelle anti-ice control panel provide indication that the Nacelle and stator anti-ice valves have opened. Should the Nacelle anti-ice valves fail to regulate the pressure allowing it to become excessive, the NAC-TAI VALVE WARNING LIGHT, on the S/O panel annunciator, would illuminate.

WING ANTI-ICE:

The leading edge of the wings from the wing tip to the inboard engines are protected from ice accumulation by hot air from the pneumatic manifold. There is no anti-ice protection provided for the wing root or empennage. The flow into the wing anti-icing system is controlled by two shutoff valves, one for each wing. Both valves are actuated by a single three position switch, ON, OFF, GRD TEST, located on the cockpit overhead panel.

Adjacent to the wing anti-ice switch control panel are two disagreement valve lights that illuminate any time the valve position and switch position do not agree. Wing anti-ice is rendered inoperative on the ground through the landing gear tilt switches. The 'GRD TEST' position of the wing anti-ice control switch allows the wing anti-ice valves to open on the ground and ground overheat protection is provided to automatically close both valves, if temperature limits are exceeded.

WINDOW HEAT ANTI-ICING:

The cockpit windows are electrically heated to provide anti-icing for the No. 1 left and No. 1 right windows and to provide defogging for the No. 2 and No. 3 left and right windows. Power to each window will automatically cycle to maintain correct operating temperature. The controls and indicator lights for normal system operation are located on the cockpit overhead panel. Overheat warning light is located on S/O annunciator panel. In addition to window heat, conditioned air may be used to defog the interior surface of the No. 1 windows. A knob at the base of the instrument panel controls the operation of this system.

PITOT/STATIC AND TEMPERATURE PROBE ANTI-ICING:

The left and right main pitot/Static probes, the left and right auxiliary pitot/static probes, and the No. 1 and No. 2 total air temperature probes are heated. The controls and ammeters for normal system operation are located on the probe heat panel on cockpit overhead. The main and auxiliary probes are dual electric element probes, while the total air temperature is a single element probe.

WINDSHIELD WIPERS:

Two windshield wipers are provided to maintain a clear area on the Captain's and First Officer's No. 1 windows. Each wiper is operated by a completely separate system to preclude a



ICE AND RAIN PROTECTION SYSTEM:

WINDSHIELD WIPERS: (Continued)

dual wiper failure. Two wiper speeds may be selected by the control switch at the panel, 'High' or 'Low'. The 'OFF' position is the Park position. In case the wiper motor overheats thermal overload protection will cut power to the motor. Wipers are used with rain repellent and windshield washer system.

RAIN REPELLENT SYSTEM:

A rain repellent system is provided to work in conjunction with the windshield wipers to improve visibility during heavy rain. The system provides independent control for each windshield by separate control switches. The maximum quantity of fluid sprayed per system activation is predetermined by setting of timer. The rain repellent system consists of a pressurized visual reservoir, located at stub wall aft of observer's station, and two nozzles which are shared with the windshield washer system.

WINDSHIELD WASHERS:

The No. 1 windshields may be washed through separate controls provided for left and right side. The washer fluid container is located behind captain's side panel with a view port and fluid level mark. The system is controlled from the windshield wiper control panel by two 'ON - OFF' toggle switches.



FREIGHTER

30:01F

ICE & RAIN PROTECTION

There are no changes on the ice and rain protection system for the B-747F.



ICE AND RAIN PROTECTION SYSTEM:

GENERAL

1. The engine cowls, EPR probes, and wing leading edges are thermal anti-iced from the aircraft's main pneumatic manifold.
2. Pneumatic air can also be used to de-fog the windshields.
3. The cockpit windows are electrically heated for anti-icing and defogging.
 - a. The windshields also have a wiper, washer, and a repellent system.
4. The pitot/static and temp probes and drain mast heaters are electrically heated for anti-icing.

ENGINE THERMAL ANTI-ICE

1. The engine nacelle thermal anti-icing system and the stator anti-icing system are controlled by nacelle anti-icing switches on the pilots' overhead panel.
 - a. The nacelle anti-icing control valves direct air for anti-icing of nose cowling and PT-2 probes.
 - (1) The Nacelle Valve Open light on the pilots' overhead panel will illuminate with switch "on" and sufficient air pressure to open the valve.
 - (2) The NAC TAI Valve light on the S/O panel will illuminate with an over pressure in the nacelle anti-icing system.
 - b. The stator anti-icing control valve directs 9th stage air for anti-icing of 1st stage stators.
 - (1) The Stator Valve Open light will illuminate when the valve is full open.

WING THERMAL ANTI-ICE

1. The wing thermal anti-ice system is controlled by switches on the pilots' overhead panel.
 - a. The wing anti-ice control valves direct air to the wing leading edge areas.
 - (1) A 3-position wing anti-ice switch controls the wing anti-icing system.
 - (a) GRD Test position - bypasses ground safety switch and allows **both valves to open**.
 - '1' Wing Anti-Icing Valve Open lights illuminate in transit.
 - '2' Overheat protection on the ground only will close both valves and illuminate Wing Anti-Ice Valve Open lights.
 - (b) Off position - closes wing anti-ice valves.
 - (c) On position - opens wing anti-ice valves in flight only.

COCKPIT WINDOW ANTI-ICING SYSTEM

1. The flight compartment windows are electrically heated to provide anti-icing for the No. 1 left and right windows and to provide defogging for the No. 2 and No. 3 left and right windows.

ICE AND RAIN PROTECTION SYSTEM:
COCKPIT WINDOW ANTI-ICING SYSTEM (Cont.)

- a. A window heat module on pilots' overhead panel provides control and operational status indication of the system.

- (1) Four window heat control switches (toggle type) control power to all windows.
- (a) On position - operating power is supplied to all windows.
 - (b) Off position - power is removed from all windows.
 - (c) Override position (No. 1 window power switches only) - bypasses heat controller and provides reduced heating for defogging only.

- (2) Three pushbutton selector switches used to monitor and check the window heat system.
- (a) Power lights switch - illuminates the six power on lights when power is being applied to windows.
 - (b) Power test switch - will bypass temperature controllers and apply continuous heat to the No. 1 windows only.

NOTE: Continued use of the PWR test switch may result in an overheated window.

- (c) Overheat test switch - simulates an overheat condition to the No. 1 (L and R) windows only.
 - '1' No. 1 (L and R) power lights will extinguish.
 - '2' No. 1 window overheat light on Second Officer's panel will illuminate.
 - '3' To reset system, turn both No. 1 window heat switches off and then back to on position.

- b. A windshield air knob (push-pull type) located below Captain and F/O panels.

- (1) Supplies conditioned air to No. 1 windows for defogging.

PITOT/STATIC AND TEMP PROBE ANTI-ICING

1. The four pitot/static probes (two on each side) and the two total air temperature probes are electrically heated for anti-icing.

- a. Power is controlled by two switches on pilots' overhead panel.

- (1) Operation of heaters may be monitored on ammeters through three pushbutton selector switches.
- (a) Main pitots
 - (b) Temp probes
 - (c) Aux pitots



ICE AND RAIN PROTECTION SYSTEM:

WINDSHIELD WIPER SYSTEM

1. Windshield wiper system is used as required during rain and with washer fluid applied.
 - a. The wipers are controlled by two 3-position windshield wiper switches.
 - (1) OFF
 - (2) LOW
 - (3) HIGH

NOTE: Do not operate wipers on a dry windshield.

WINDSHIELD WASHER SYSTEM

1. A windshield washer system is provided for pilots' No. 1 windows because of the extreme height above the ground.
 - a. The washers are controlled by a toggle type switch on the pilots' overhead panel.
 - b. A one-quart container is located behind the captain's side panel.
 - (1) A fluid level mark on the side panel indicates the refill level.

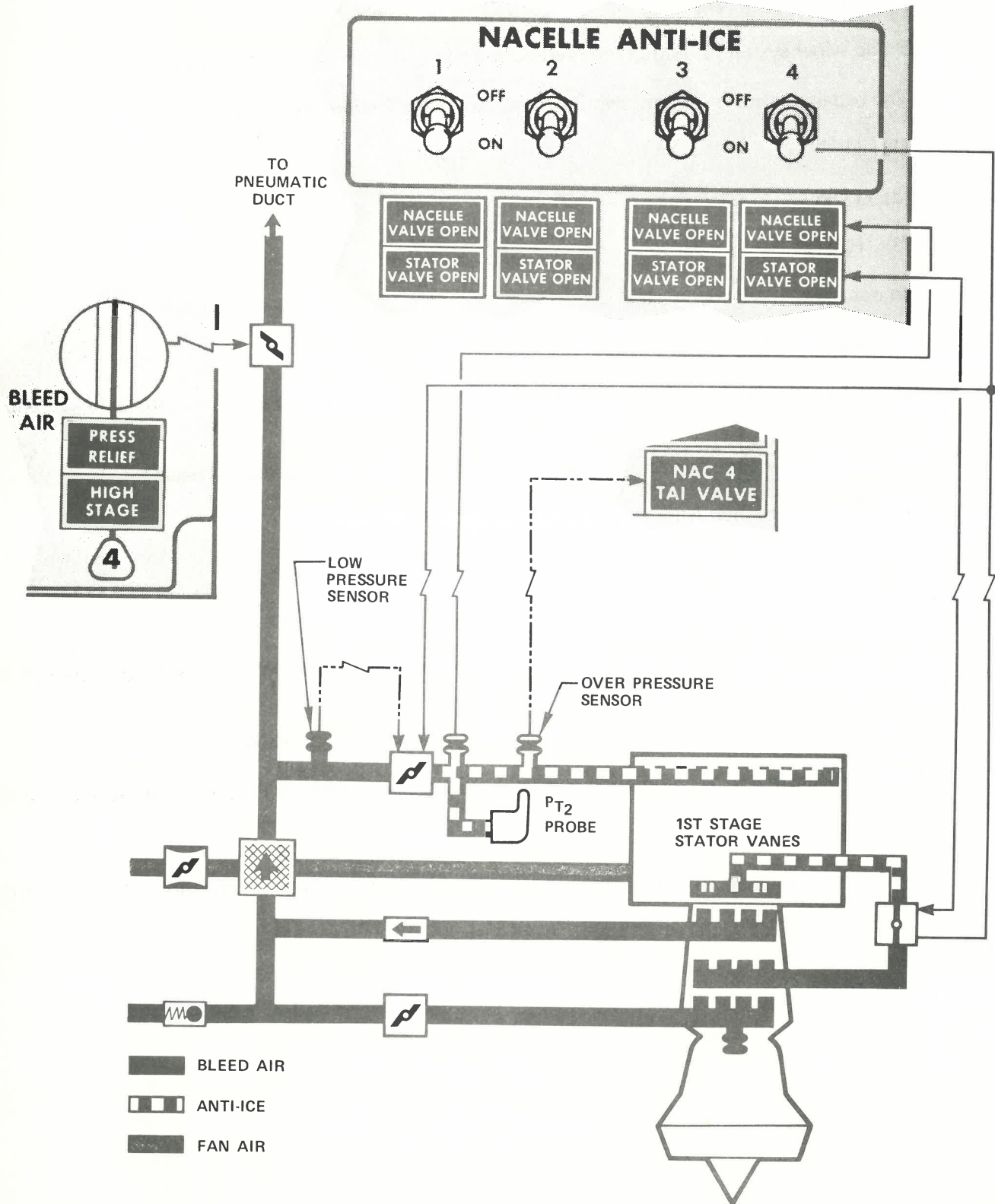
RAIN REPELLANT SYSTEM

1. A rain repellant system is provided to be used in conjunction with the windshield wiper system to improve windshield visibility during heavy rain.
 - a. Rain repellant system is controlled by pushbutton switches on pilots' overhead panel.
 - b. A pressurized repellant container is located on the stub wall behind the second observer's station.
 - c. A fluid level indicator located directly below the container.
 - d. A pressure indicator located directly below the fluid level indicator measures repellant bottle pressure.

DRAIN MAST HEATERS

1. Heaters are provided for the drain masts utilizing 115V AC in flight and 28V AC on the ground.

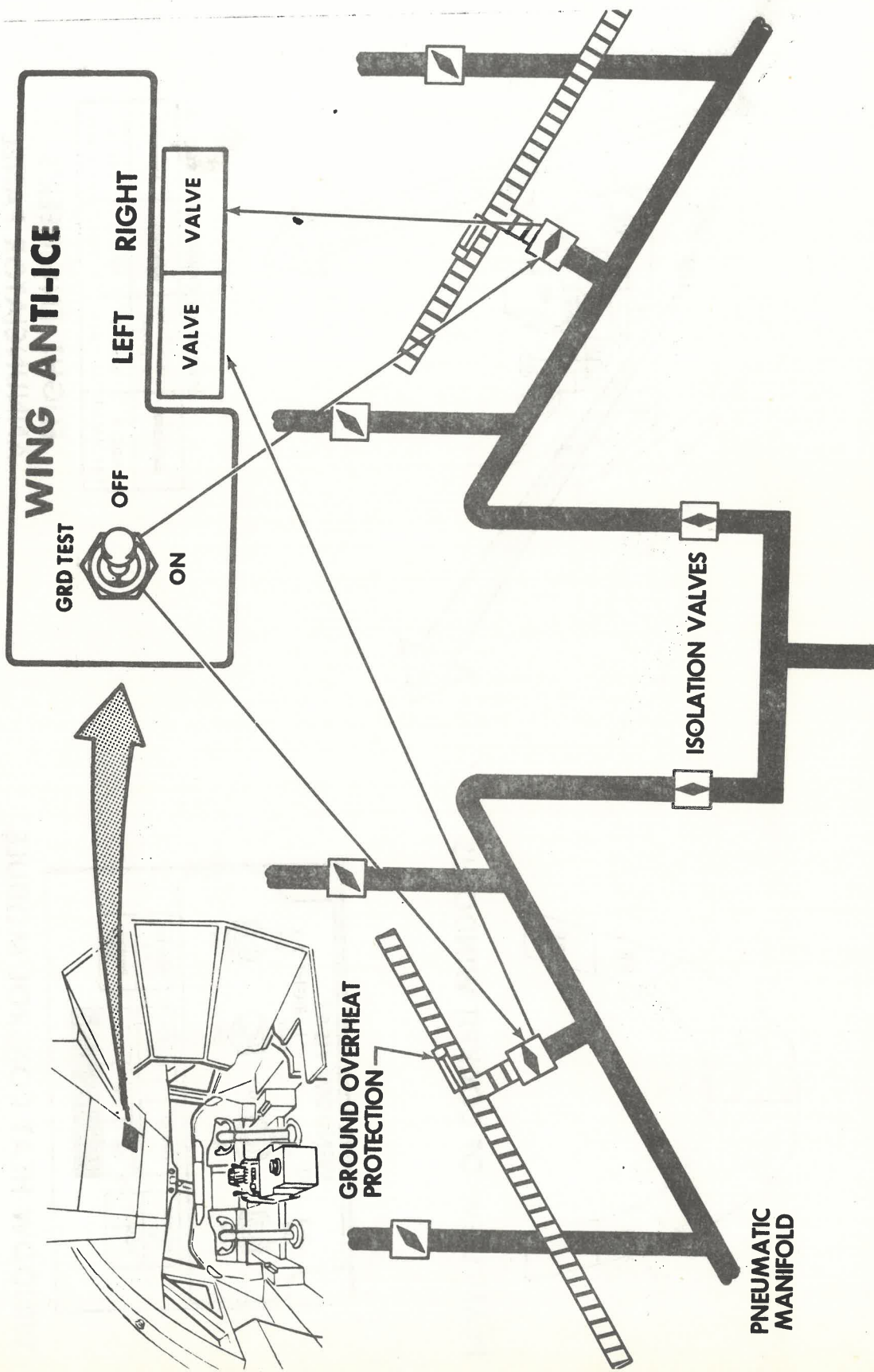
NACELLE ANTI-ICE SYSTEM:



NACELLE ANTI-ICE

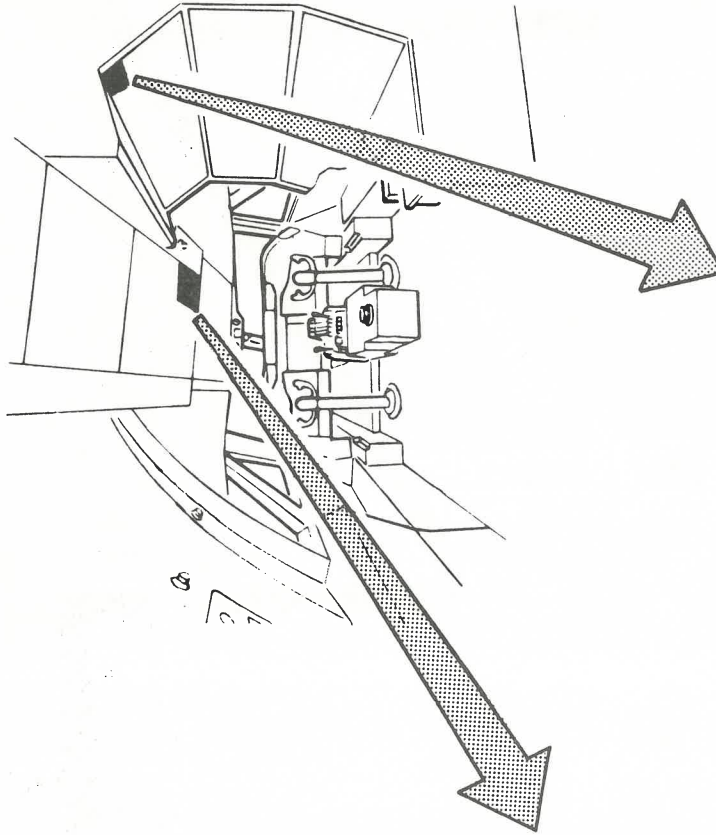


WING ANTI-ICE SYSTEM:



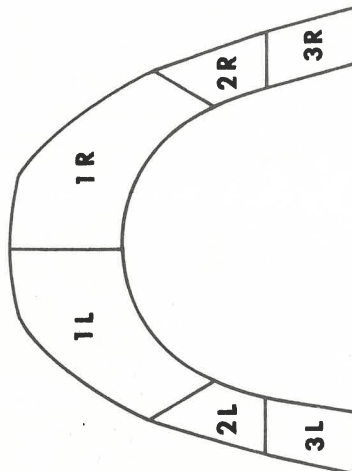


WINDOW HEAT SYSTEM:

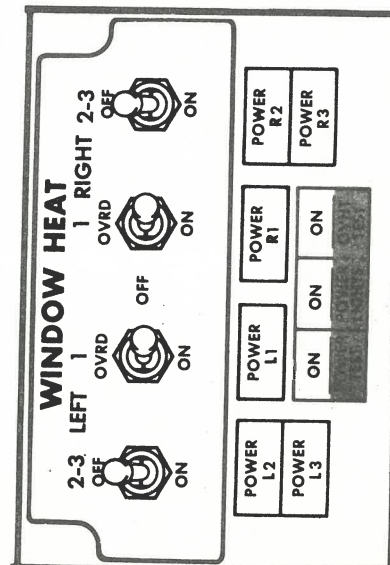


| | | | | | | |
|---|-----------|-----------|-----------|-----------|-----------|-----------|
| — | CARGO | DR | CARGO | DR | CARGO | DR |
| — | WINDOW | 1 | OVHT | — | — | — |
| — | NAC 1 | TAI VALVE | NAC 2 | TAI VALVE | NAC 3 | NAC 4 |
| — | TAI VALVE | TAI VALVE | TAI VALVE | TAI VALVE | TAI VALVE | TAI VALVE |

**FLIGHT ENGINEER'S
 ANNUNCIATOR PANEL**



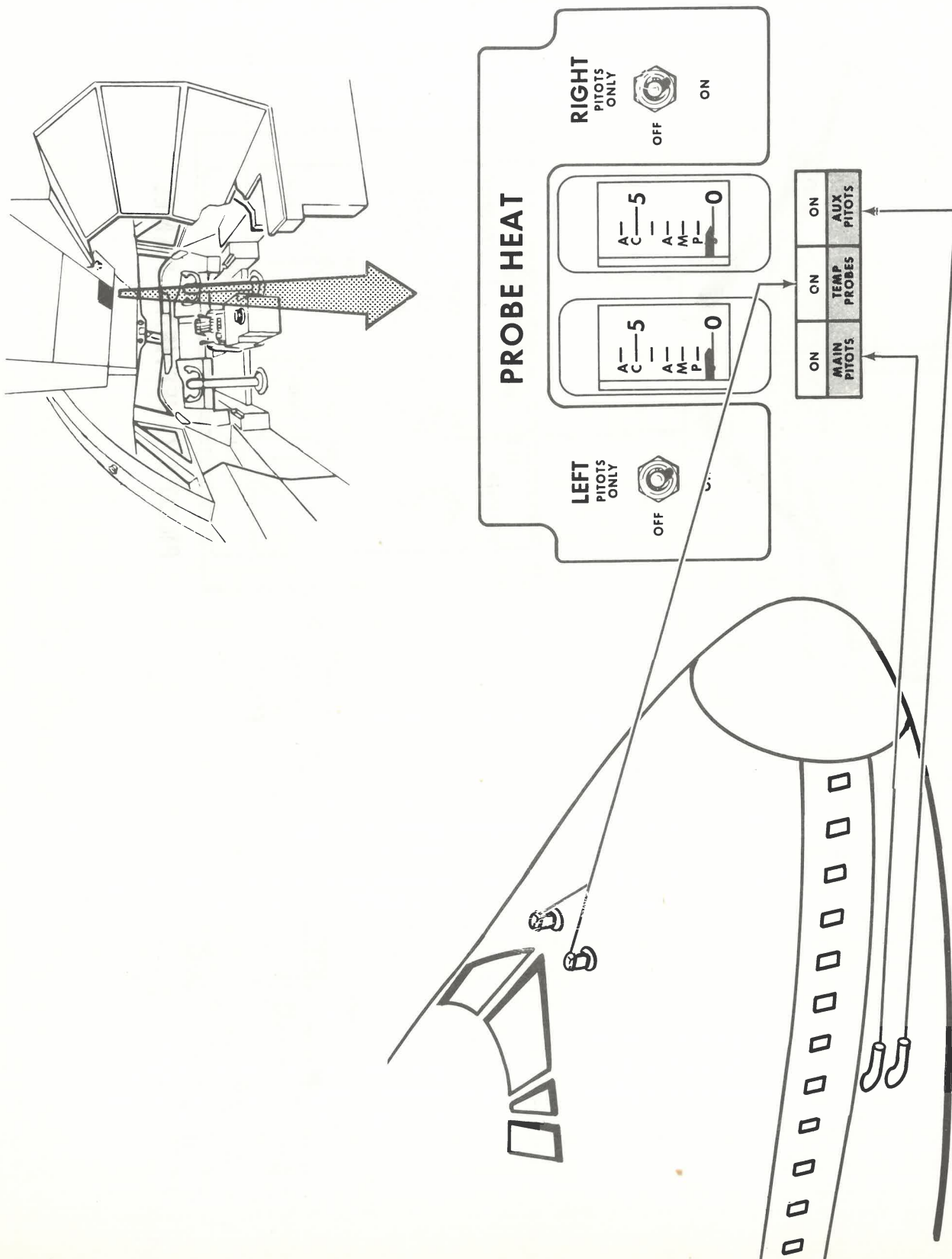
PLAN VIEW OF COCKPIT WINDOWS



WINDOW HEAT CONTROL MODULE

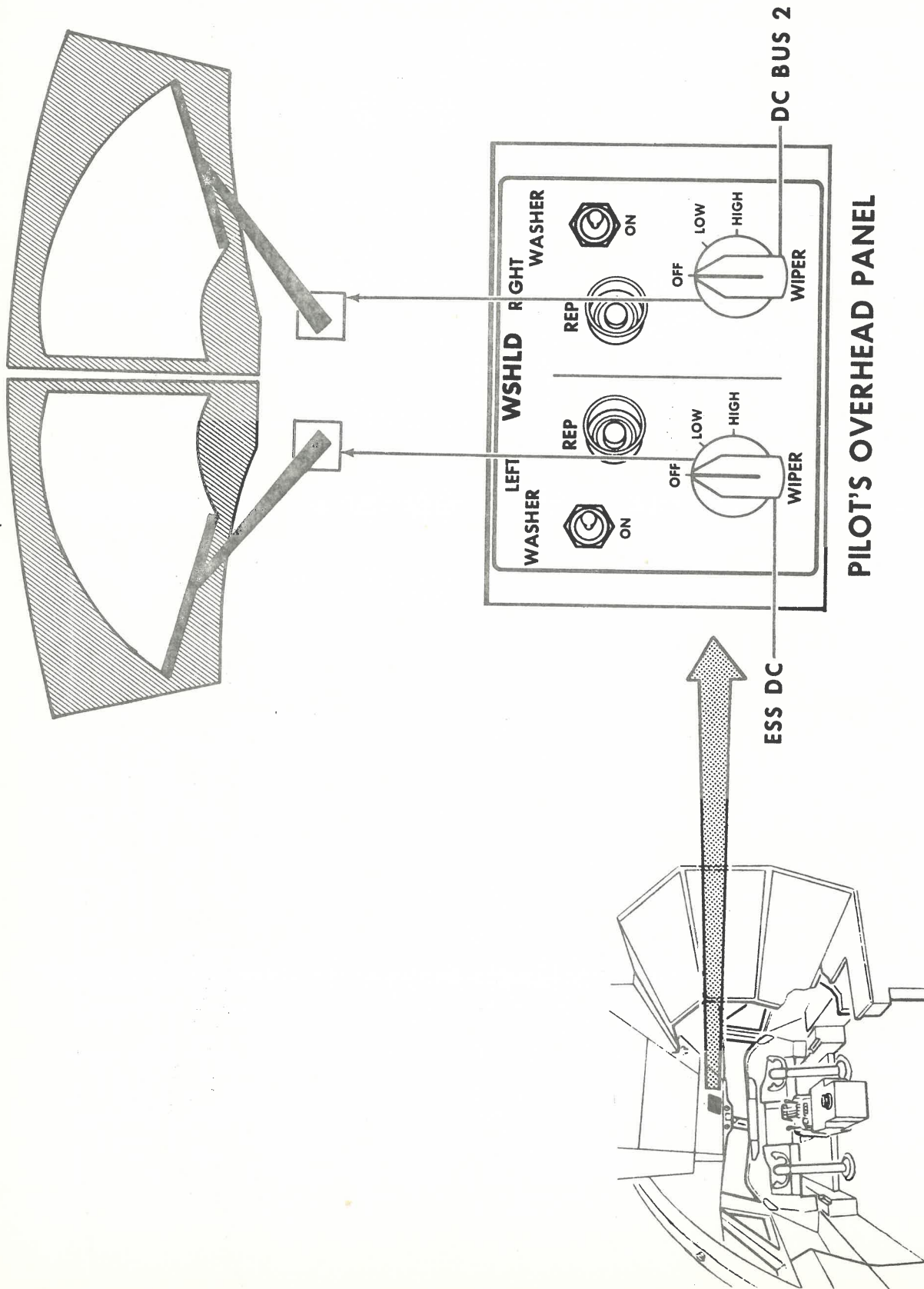


PROBE HEAT SYSTEM:



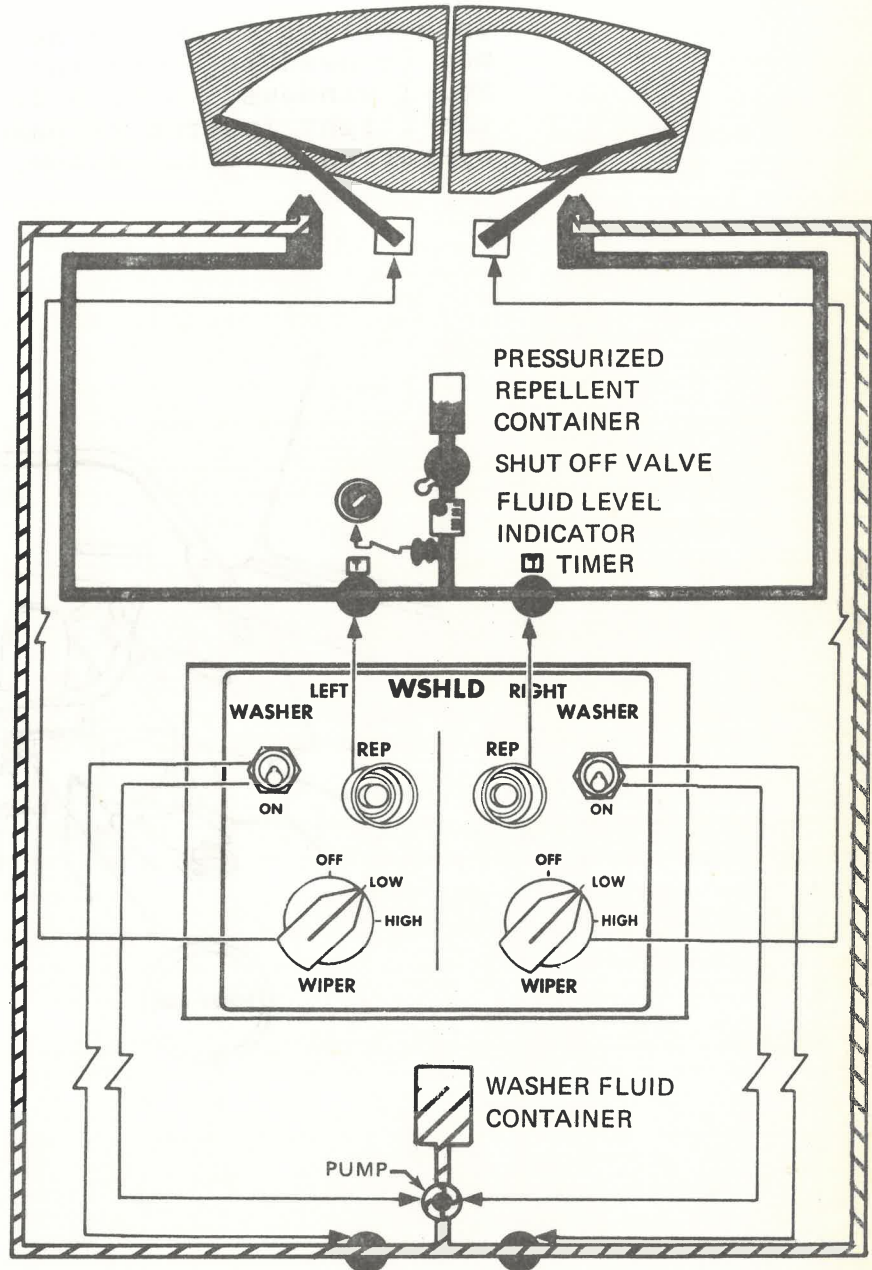


WINDSHIELD WIPER SYSTEM:





WINDSHIELD WASHER AND RAIN REPELLENT SYSTEM:

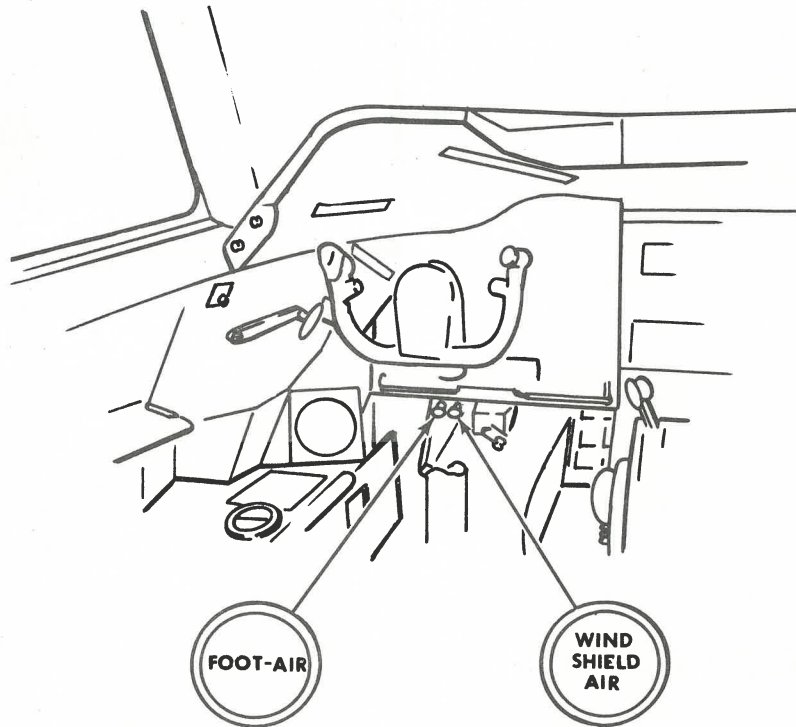


PILOT'S OVERHEAD PANEL

■ RAIN REPELLANT
▨ WASHER FLUID

WINDSHIELD DEFOGGING AND FOOT WARMER SYSTEM:

In addition to window heat, conditioned air may be used to defog internal surfaces of the No. 1 windows. A knob located at the base of the flight instrument panel controls the operation of this system.



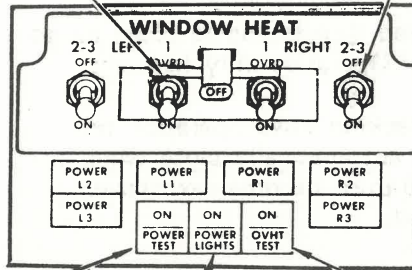
WINDOW HEAT CONTROL PANEL

CAPTAIN'S NO. 1 WINDOW HEAT SWITCH

ON – Window heat controller applies heat to window as required for anti-icing and defogging.
 OFF – Window heat not in use or to reset after an overheat trip.
 OVRD (Guarded position when installed) – A reduced constant heat applied to window for anti-fogging only.

FIRST OFFICER'S NOS. 2 AND 3 WINDOW HEAT SWITCH

ON – Applies heat to windows for defogging.



WINDOW HEAT POWER ON LIGHTS (Green)

Illuminated when window is being heated. Lights can be deactivated by power lights switch.

NOTE: Under conditions of high ambient temperature, the lights may not illuminate when system is turned on.

WINDOW HEAT POWER TEST SWITCH

Used to test No. 1 window heat systems if power on lights do not illuminate when system is turned on. Systems are operating normally when window heat power on lights (L1 and R1) illuminate.

NOTE: Continued use of the POWER TEST switch may result in an overheated window.

POWER LIGHTS SWITCH

Press to activate or deactivate the six window heat power on lights when desired.

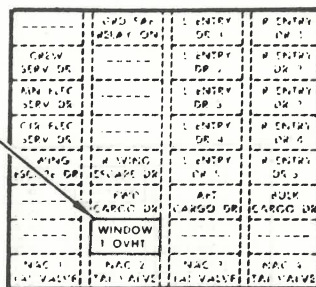
WINDOW OVERHEAT TEST SWITCH

Simulates an overheat condition for both No. 1 windows.

- L1, R1 POWER on lights will extinguish.
- WINDOW 1 OVHT light will illuminate.

NOTE: Do not operate in flight. In-flight operation may result in window damage. After test, switch the No. 1 window heat switches to OFF position momentarily to reset overheat trip circuits.

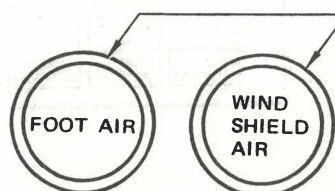
PILOTS' OVERHEAD PANEL



WINDOW NO. 1 OVERHEAT LIGHT (Amber)

- Illuminates when either the Captain's or First Officer's No. 1 window has an overheat condition. POWER on light for the overheated window will be extinguished. (Window heat power test switch now will not illuminate the POWER on light of the overheated window).
- Switching the affected window heat off will extinguish the WINDOW 1 OVHT light.
- The light may illuminate when switching from airplane power to APU or external power.

FLIGHT ENGINEER'S PANEL



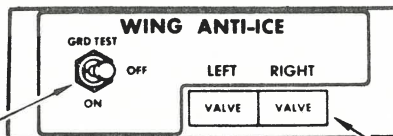
WINDSHIELD/FOOT AIR CONTROLS

Applies conditioned air to the No. 1 windows for defogging. Applies conditioned air at pilots leg positions.

BELOW CAPTAIN'S AND FIRST OFFICER'S PANELS

WING AND ENGINE ANTI-ICE CONTROL PANEL

PILOTS' OVERHEAD PANEL



WING ANTI-ICE SWITCH

ON – Opens both valves and directs engine bleed air to wing leading edge areas. Operative only in flight.

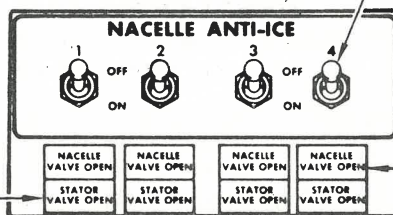
OFF – Closes both valves.

GRD TEST – Used for checking valve operation on ground. The valves will automatically close when the wing leading edge temperature becomes excessive. Operative only on ground.

WING ANTI-ICE VALVE LIGHTS (Blue)

Illuminates when associated valve is in transit.

PILOTS' OVERHEAD PANEL



STATOR ANTI-ICE VALVE OPEN LIGHTS (Green)

Illuminates when engine bleed air is being directed to engine 1st stage stators.

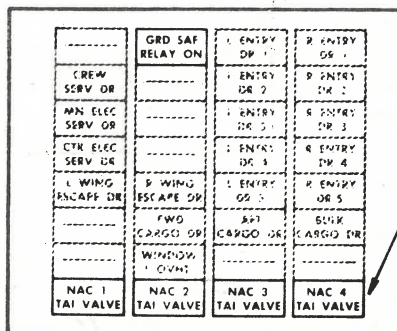
NACELLE ANTI-ICE SWITCHES

ON – Directs engine bleed air, when available, to nacelle cowl, engine 1st stage stators and engine PT₂ EPR probe. Valves will automatically close at low engine bleed pressure.

NACELLE ANTI-ICE VALVE OPEN LIGHTS (Green)

Illuminates when engine bleed air is being directed to the nacelle cowl and PT₂ EPR probe.

FLIGHT ENGINEER'S PANEL



NACELLE ANTI-ICE TAI VALVE LIGHTS (Amber)

Illuminate when nacelle anti-ice duct pressure is excessive.



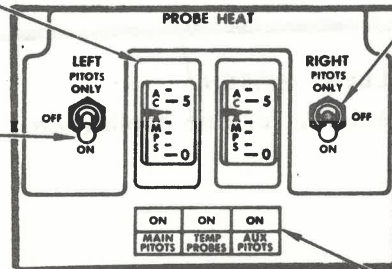
PROBE HEAT CONTROL PANEL:

LEFT PROBE HEAT METER

Indicates current used to heat probes selected by the probe heat meter switch.

LEFT PROBE HEAT SWITCH

- ON — Applies heat to:
- Captain's pitot-static probe.
 - No. 1 auxiliary pitot-static probe.
 - No. 1 temperature probe.
- PITOT ONLY — Same as above except no heat to temperature probe.



PILOT'S OVERHEAD PANEL

RIGHT PROBE HEAT SWITCH

- ON — Applies heat to:
- First officer's pitot-static probe.
 - No. 2 auxiliary pitot-static probe.
 - No. 2 temperature probe.
- PITOT ONLY — Same as above except no heat to temperature probe.

PROBE HEAT METER SWITCHES

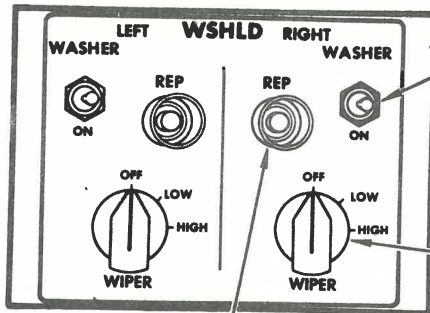
Press switch to monitor current used to heat probes.

NOTE: With the probe heat ON, the total air and static air temperature indicators will not give accurate indications on the ground.

PROBE HEAT

WINDSHIELD WIPER/WASHER AND REPELLENT PANELS:

PILOTS'
OVERHEAD
PANEL



WINDSHIELD WASHER SWITCH

ON — Applies washer fluid. Use windshield wipers after initial application.

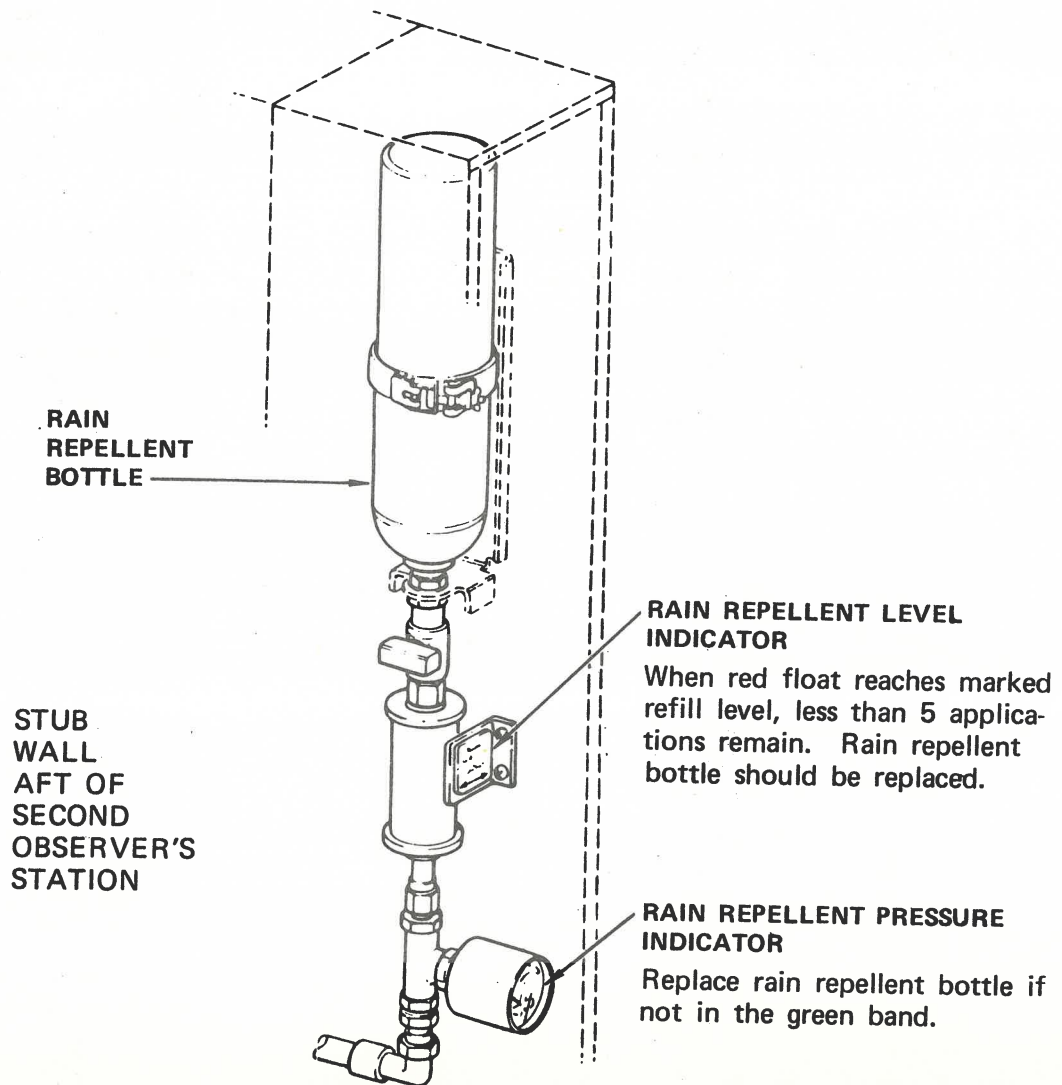
WINDSHIELD WIPER SWITCH

Use as required during rain or with washer fluid applied.

RAIN REPELLENT SWITCH

Press momentarily for one application.

NOTE: Do not use on dry windshield.



RAIN REPELLENT BOTTLE

STUB WALL
 AFT OF
 SECOND
 OBSERVER'S
 STATION

RAIN REPELLENT LEVEL INDICATOR

When red float reaches marked refill level, less than 5 applications remain. Rain repellent bottle should be replaced.

RAIN REPELLENT PRESSURE INDICATOR

Replace rain repellent bottle if not in the green band.

| | |
|---|----|
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| ALTERNATE OPERATING PROCEDURES | 03 |
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FLIGHT INSTRUMENTS:

The Pitot/Static pressure is sensed through four Pitot/Static probes: Captain's Main and Auxiliary, and First Officer's Main and Auxiliary. It supplies these two pressures to the air data flight instruments, and two central air data computers. Two alternate static sources are available through flush ports on each side of aircraft near forward cargo area. Normal Pitot/Static and temperature probes are heated electrically through the Probe Heat System, controlled and monitored from module on Pilot's overhead panel. The alternate static ports are not heated. Each pilot has a static source selector (Normal/Alternate) on his auxiliary panel.

Two central air data computers process data from their respective Pitot/Static system, temperature probes and compute corrections to altitude, airspeed, mach and air temperatures. Computed information is supplied to the Auto-Flight System, INS System, Mach Indicators, True Airspeed Indicator, Total and Static Air Temperature Indicators, Transponder (Altitude Reporting) and Yaw Dampers. Each central air data computer is connected to a total air temperature probe, located just forward of the windshield.

Two magnetic heading reference systems (MHRS) provide INS gyro stabilized magnetic heading information to the radio magnetic indicators (RMI), horizontal situation indicators (HSI), when in radio navigation mode, and auto-flight system. The system provides rapid synchronization of compass cards, about 700 degrees/minute. The MHRS has two modes of operation (Slaved and DG) selected on compass controllers, located on pilot's overhead panel. The Slaved mode is used at latitudes up to approximately 65 degrees, where compass data is generally reliable, while the DG mode is used at latitudes higher than 65 degrees to avoid large erratic magnetic errors or when Slaved mode is malfunctioning. A Set HDG Knob on compass controllers provides manual control of compass cards. The two radio magnetic indicators always display magnetic compass headings, VOR or ADF bearings, and DME No. 1 and No. 2 distances. Two horizontal situation indicators display VOR/ILS or INS navigation information, magnetic or true heading, and distance to next INS waypoint. Radio/Ins switches located on pilot's glareshield, select navigation inputs as well as heading information displayed on HSI. The Attitude Director indicators display aircraft roll and pitch, speed commands, decision height, navigation information through flight director commands, radio altitude below 200 feet through rising runway, and turn/slip indication. Gyro information is supplied by the INS systems. A standby Attitude Indicator is provided as a backup. The indicator is powered by the battery bus. With NO power it will operate for approximately 20 minutes. Two separate low range altimeters display radio altitude from 0 to 2500 feet. Flare tones are also provided at 100 feet, 35 feet, and 20 feet, to help the pilots during landing. Three electronic clocks are provided and are powered by the aircraft battery. The captain and first officer's clocks provide digital readouts and may be controlled remotely from buttons on their respective lightshield side panels. The Flight Recorder System provides a permanent record of airspeed, altitude, magnetic heading, and vertical acceleration as a function of time during flight. This system is controlled from module on S/O panel.

A Central Instrument Warning System (CIWS) monitors various flight instruments. System provides a warning when data to the ADI, HSI, and RMI flight instruments is invalid. This is accomplished by flashing a red instrument WARN light. The system also compares pitch and roll information between the two ADI's, by illuminating the amber ATT light and flashing the red instrument WARN lights. The system also monitors its own operation for failure and illuminates an amber NON light, if power is lost to CIWS computer. The system may be tested by a button, located on F/O's instrument panel.

Navigation/Attitude Instrument Transfer System provides alternate selection sources and warning indication if transfer not successful.



FLIGHT INSTRUMENTS (cont'd)

1. **NAV DEV SWITCH:** Provides VHF navigation receiver No. 3 to be transferred to either pilot's instruments.
2. **INS SWITCH:** Provides INS No. 3 navigation information and true heading information to be transferred.
3. **FLT DIR COMPUTER SWITCH:** Provides transfer of No. 3 computer to either pilot's flight director system or the ability to transfer both flight directors to a single computer.
4. **COMPASS SWITCH:** Provides transfer of both MAGNETIC compasses to a single magnetic heading reference system.
5. **COMP/STAB SWITCH:** Provides transfer of the compass stabilization signal from No. 3 INS to either pilot's magnetic heading reference system.
6. **ATTITUDE SWITCH:** Provides transfer of pitch and roll signals from No. 3 INS to either pilot's ADI.

The Navigation/Attitude Transfer System is located on pilot's overhead panel and Annunciator Lights on this module illuminate if transfer does not actually occur.



FREIGHTER

31:01F

FLIGHT INSTRUMENTS

No significant changes of Flight Instruments on the B-747F aircraft.

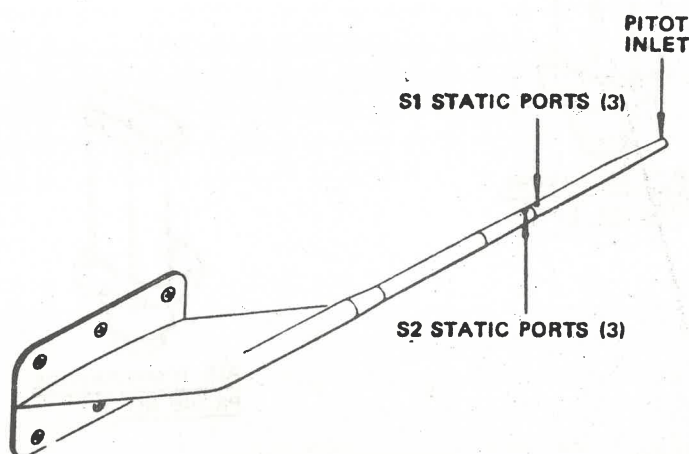
The Central Instrument Warning System (CIWS) will provide both visual and aural warnings. The aural warning is provided thru two small speakers, installed on each side of the pilot's instrument panel. The roll or pitch attitude comparison of the pilot Attitude Director Indicators is now 4 degrees at all times.

GENERAL

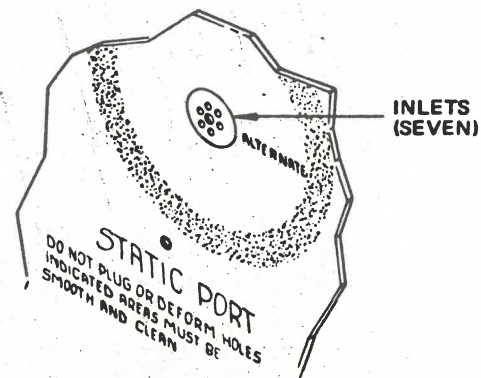
1. Flight instruments are grouped into two classes: air data and navigation instruments.
 - a. Air data instruments provide the pilots with altitude, airspeed, mach, air temperature and vertical velocity information.
 - (1) Central air data system provides computed air data to the aircraft flight control, inertial navigation system, air traffic control, and air data instrumentation system.

PITOT/STATIC SYSTEM

1. Pitot/static pressures are supplied to the air data instruments and central air data computers (CADS).
 - a. Pitot pressure is sensed from four separate pitot/static probes (two on each side of aircraft fuselage).
 - (1) Probes are heated electrically and controlled by probe heat switches on pilot's overhead panel.
 - (a) Amperage is displayed on vertical scale indicators through pushbutton selector switches, located on overhead panel.
 - b. Static pressure is sensed from either of two systems (normal or alternate) as selected by static source selectors, located on sidewalls.
 - (1) Normal static system is sensed from two sets of static ports on each pitot/static probe head.
 - (2) Alternate static system is sensed from two sets of flush ports located on each side of aircraft near forward cargo area.
 - (a) Ports are not heated.



PITOT STATIC PROBE
TYPICAL (2 RIGHT AND
2 LEFT)

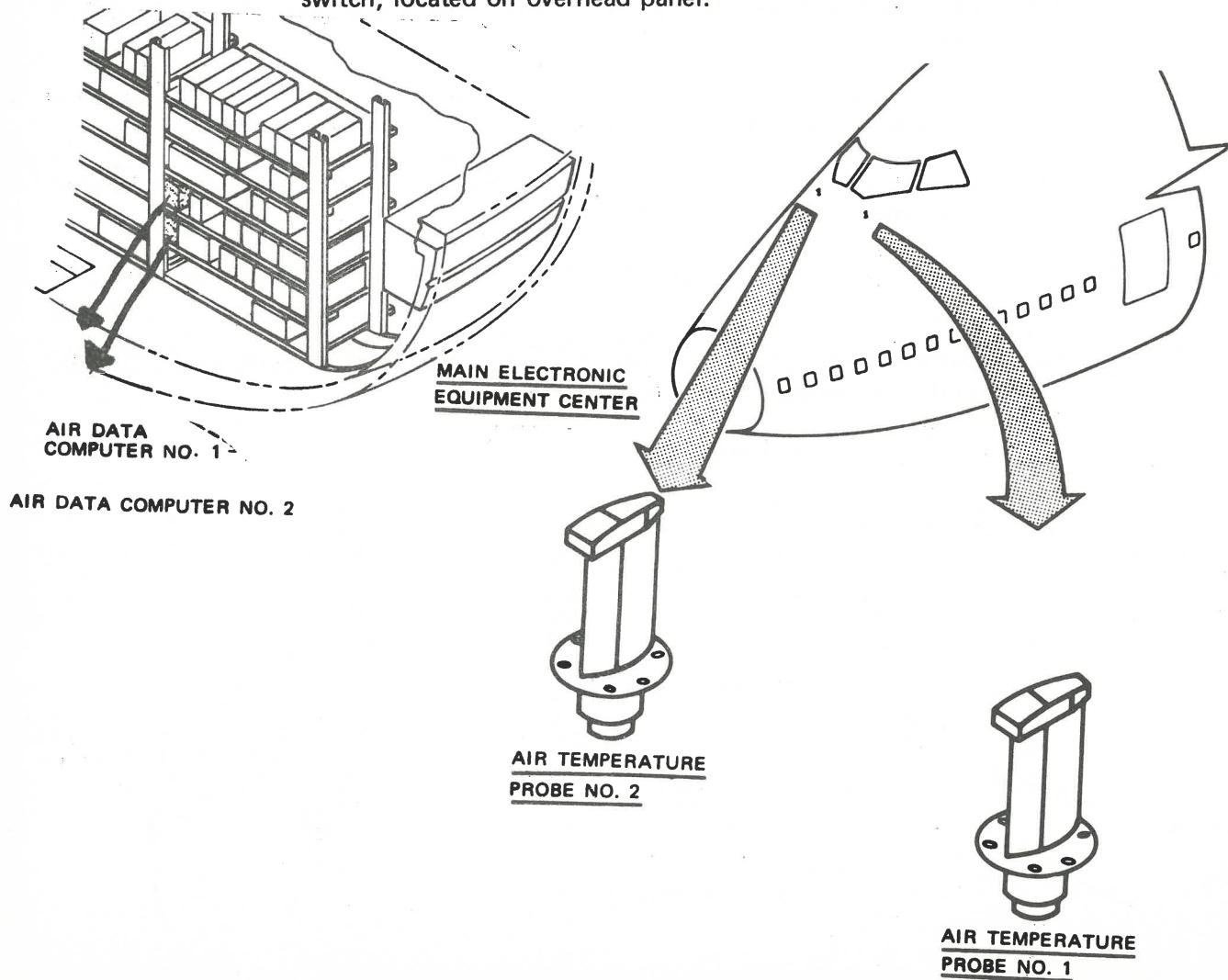


ALTERNATE STATIC PORT
RIGHT SIDE (LEFT SIDE SIMILAR)

CENTRAL AIR DATA SYSTEM (CADS)

1. Central air data system uses a pitot/static source and total air temperature to provide computed corrections to altitude, airspeed, mach and temperature.
 - a. Central air data system consists of two central air data computers and two total air temperature probes.
 - (1) Two total air temperature probes are located forward of the captain's and F/O's No. 1 windows.
 - (a) Probes are electrically heated for de-icing and controlled by switches on pilots' overhead panel.

'1' Amperage is displayed on vertical scale indicators through a pushbutton selector switch, located on overhead panel.

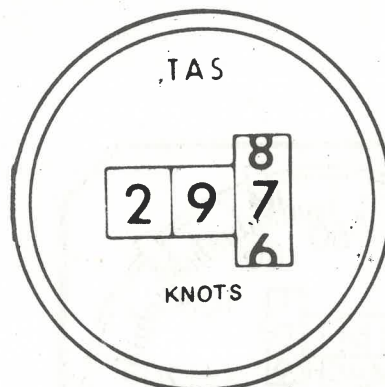




TRUE AIRSPEED INDICATOR

1. Located on F/O panel and provides visual indication of true airspeed as computed by the central air data computer system.
 - a. Digital readout displayed from 150–650 knots.
 - b. With system failure, a yellow off flag covers the readout counter.

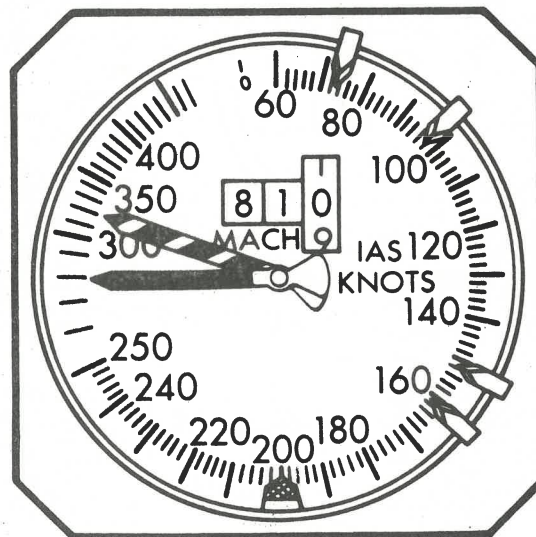
NOTE: When probe heat is ON for any significant interval on the ground, the temperature indications will be inaccurate and the warning flag may appear.



TRUE AIRSPEED INDICATOR

MACH/AIRSPEED INDICATORS

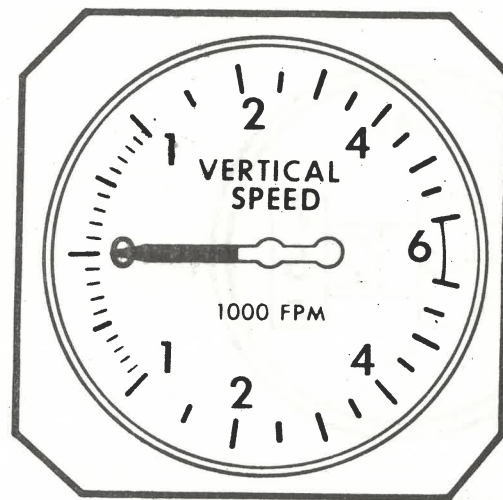
1. Located on captain and F/O's instrument panel; displays indicated airspeed by pointer readout and mach number by digital readout.
 - a. Indicated airspeed is derived from pitot/static pressures without corrections from central air data computer system.
 - (1) Linear scale from 60 to 250 knots only (non linear from 250 to 470 knots).
 - (2) Command A/S bug is set by the auto-throttle (A/T) speed selector.
 - b. Mach number is derived from pitot/static pressure corrected by central air data computer system on a digital readout.
 - (1) With system failure, a yellow off flag covers the readout counter.



AIRSPEED INDICATOR

INSTANTANEOUS VERTICAL VELOCITY INDICATOR

1. Located on captain and F/O's instrument panel and provides an indication of vertical speed during climb/descent.
 - a. Vertical speed is derived from static pressure without correction from central air data computer system.

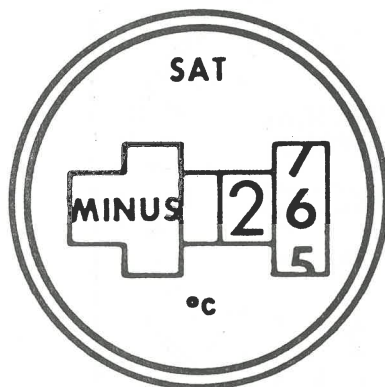


INSTANTANEOUS VERTICAL VELOCITY INDICATOR

STATIC AIR TEMPERATURE INDICATOR

1. Located on F/O instrument panel and provides visual indication of static air temperature as computed by central air data computer system.
 - a. Digital readout displayed from -99° to $+50^{\circ}$ C.
 - b. With system failure, a yellow off flag covers the readout counter.

NOTE: When probe heat is ON for any significant interval on the ground, the temperature indications will be inaccurate and the warning flag may appear.

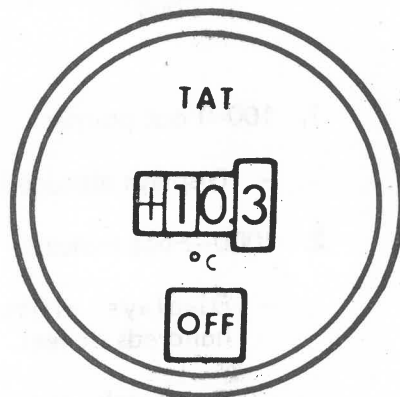


STATIC AIR TEMPERATURE INDICATOR

TOTAL AIR TEMPERATURE

1. Located on S/O panel and provides visual indication of total air temperature as computed by central air data computer system.
 - a. Digital readout displayed from -60° to $+60^{\circ}$ C.
 - b. With system failure, a yellow off flag appears in a window.

NOTE: When probe heat is ON for any significant interval on the ground, the temperature indications will be inaccurate and the warning flag may appear.



TOTAL AIR TEMPERATURE INDICATOR

ALTIMETERS

1. Located on captain and F/O's instrument panel and displays pressure altitude as sensed from raw static source.

Two independent Smith Electric Altimeters receive their static source from two independent static systems. These altimeters are dependent on electrical power for operation. Warning flag appears on face of instrument when electrical power off.

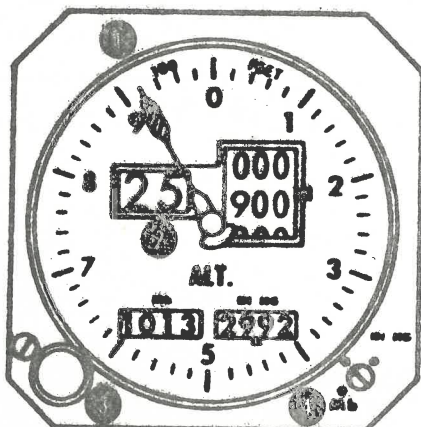
CONTROLS AND INDICATORS



Pilots' Instrument Panel

The standby altimeter displays altitude as sensed from the Captain's static source. Altimeter vibrator is provided.

CONTROLS AND INDICATORS



Captain's Instrument Panel

1. 100-Foot pointer
 - Displays altitude in 100-foot increments.
2. 1000-Foot indicator
 - Displays altitude in thousands of feet.
 - Includes digital readout within 50 feet.
 - Striped flag appears in first digit below 10000 feet.
3. Barometric Setting knob
 - Sets millibars (MB) and inches of mercury (IN HG) simultaneously.
4. Altitude Reference selector and "Bug"
 - Turn selector to set movable altitude "bug".

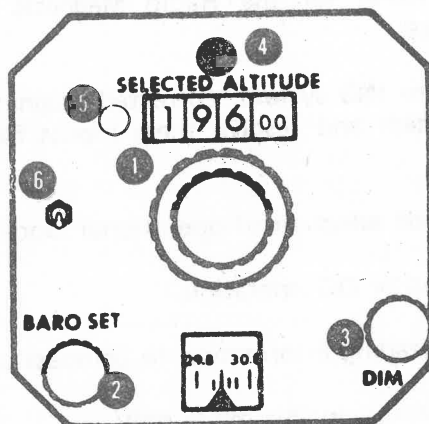
1. 100-Foot pointer
 - Displays altitude in 100-foot increments.
2. 1000-Foot indicator
 - Displays altitude in thousands and hundreds of feet.
 - Crosshatch appears in first digit below 10,000 feet.
 - Minus sign on red background appears in first digit below sea level.
3. Barometric Setting knob
 - Sets millibars (MB) and inches of mercury (IN HG) simultaneously.
4. Barometric mask
 - Blocks out MB or IN HG window if desired.

ALTITUDE ALERT UNIT

1. Located on pilot's center instrument panel.

An altitude warning indicator (AWI) alerts the pilots as they approach the selected altitude.

CONTROLS AND INDICATORS



Center Instrument Panel

1. Altitude selector and indicator
 - Selects altitude up to 42,000 feet in 100-foot increments.
2. Baro Set knob
 - Sets barometric pressure in inches of mercury.
3. DIM Altitude Warning lights

4. Baro Alt Warning light (blue)
 - ON when climbing or descending within approximately 1000 feet of selected altitude. Remains ON until within about 500 feet at which time a single aural tone sounds and light goes out.
5. Annunciator light (red) – ON if power to AWI off or interrupted.
6. Hi/Low switch – Varies tone sound level.

GENERAL

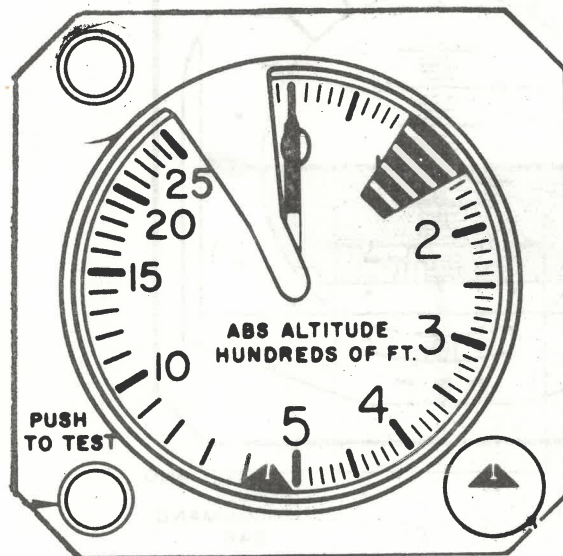
1. Navigation instruments provide the pilots with attitude, direction, course or track, distance and approach/landing information.

MAGNETIC HEADING REFERENCE SYSTEM (MHRS)

1. The MHRS provides precise magnetic heading information for the Radio Magnetic Indicators, Horizontal Situation Indicators, and other related systems.
2. Compass couplers receive true heading information from INS system, corrected magnetic heading information from magnetic compensator/flux valve system and resolve these inputs for a precise heading.
3. Compass controllers are located on overhead panel, provide selection of operational mode.
 - a. Mode select toggle switch provides selection of slaved or DG operation.
 - (1) Slaved mode – Provides gyro-slaved magnetic heading information to compass system.
 - (a) An annunciator displays synchronization status, in this mode only.
 - (2) DG mode – Provides only true heading information to compass system.
 - (a) Compass cards must be manually slaved for correct magnetic heading.
 - b. Set Heading Knob provides control to manually slave compass cards.
4. Radio/INS switches located on lightshield for each respective pilot provide selection of heading information to Horizontal Situation Indicator.
 - a. Radio position – Provides magnetic heading information to HSI.
 - b. INS position – Provides true heading information to HSI.

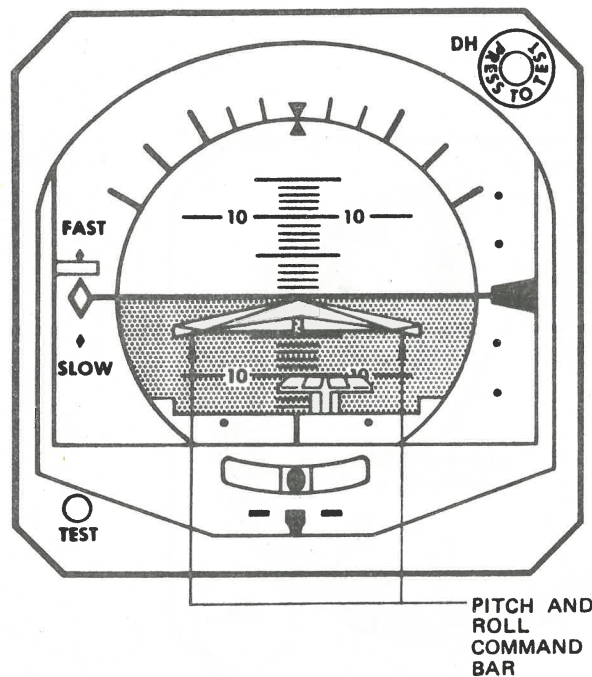
LOW RANGE RADIO ALTIMETER SYSTEM

1. The low range altimeters display height information during approach and landing phases of flight operation.
 - a. Radio altimeter indicators are located on pilot's respective instrument panels.
 - b. Altimeters read absolute altitude from 0 to 2500 feet.
 - c. Decision Height (DH) light on attitude director indicator illuminates when airplane is below the DH bug.
 - d. DH set knob, on altimeter, provides selection of decision height bug to whatever altitude pilot desires.
 - e. Test button, on altimeter, checks radio altimeter operation.
 - (1) Pushing to test — Radio altimeter pointer displays 250 feet and power flag appears.



ATTITUDE DIRECTOR INDICATORS (ADI)

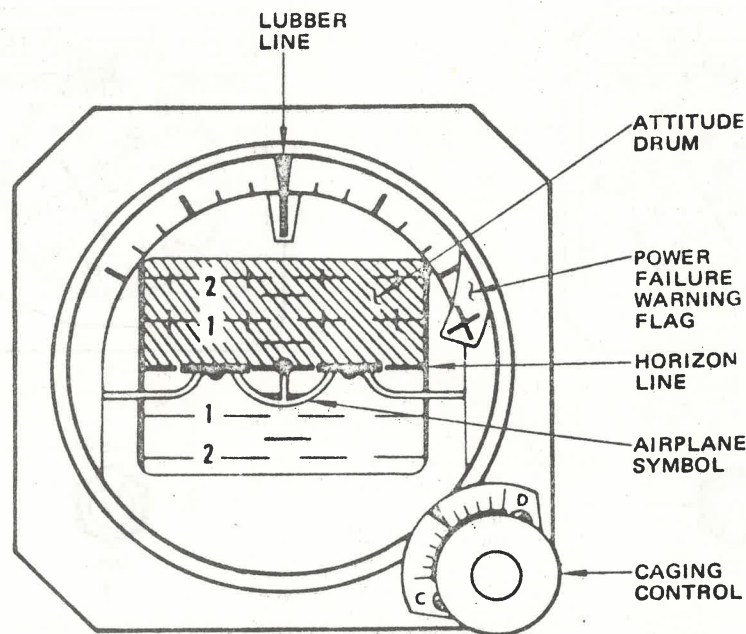
1. An Attitude Director Indicator is installed on each pilots' instrument panel. The indicators display pitch and roll attitude, localizer and glide slope deviation, radio altitude, speed commands, minimum decision altitude, flight director command bars, rate of turn signals and level of the aircraft.
 - a. Test switch on indicator will position sphere to 20° right bank and 10° pitch up attitude.
 - b. Warning flags for gyro, localizer, glide slope and flight director computer appear if signals are not valid.



ATTITUDE DIRECTOR INDICATOR

STANDBY HORIZON (SFENA)

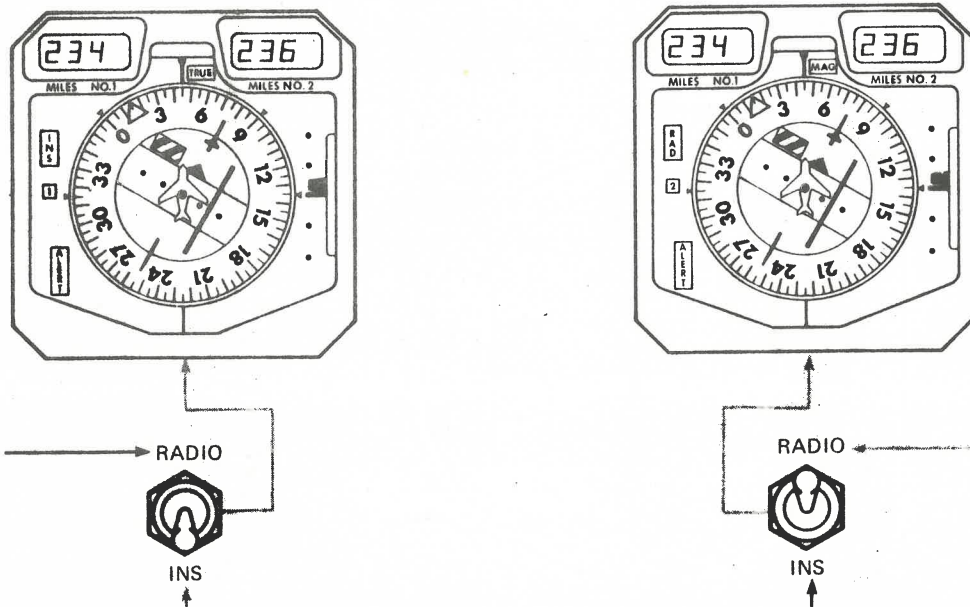
1. Standby attitude indicator is located on center instrument panel and provides a visual display of aircraft pitch and roll attitude.
 - a. Power is supplied from static inverter, which is powered from the battery.
 - (1) With a complete electrical failure, this horizon will provide attitude information for about 20 minutes.
 - b. Caging control/pitch trim control located on standby horizon.
 - (1) Pull out to fast cage.
 - (2) With knob in, rotation of knob controls airplane fixed reference.



STANDBY ATTITUDE INDICATOR

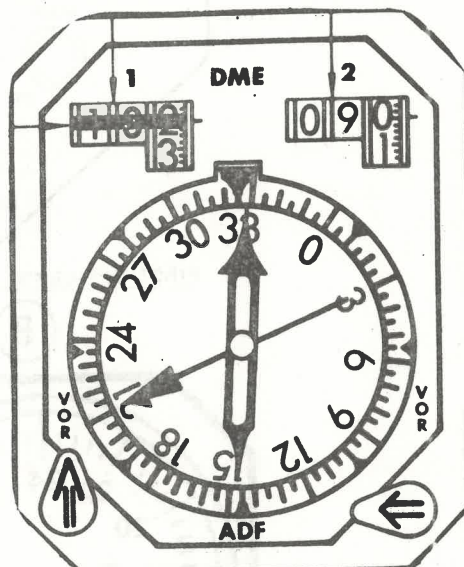
HORIZONTAL SITUATION INDICATORS (HSI)

1. A Horizontal Situation Indicator is installed on each pilots' instrument panel. The indicators display true heading or magnetic heading, VOR/ILS or INS information as determined by Radio/INS switches on lightshield.
 - a. INS mileage indicators show mileage to go to next INS waypoint.
 - b. INS Alert light illuminates within two minutes of a waypoint.
 - c. RAD/INS indicator shows the source (System No. 1 – No. 2 – No. 3) of data from either INS or Radio Navigation systems.
 - d. Heading reference displays true for INS operation or magnetic for radio operation.
 - (1) Warning flag appears in window if heading reference is not valid.
 - e. Navigation warning flag appears when Radio or INS input is lost.



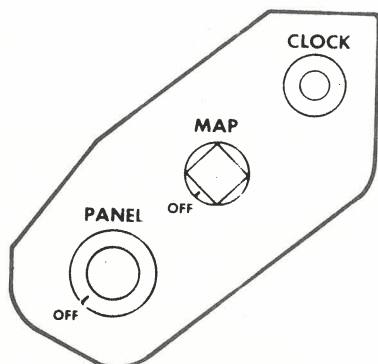
RADIO MAGNETIC INDICATORS (RMI)

1. Radio Magnetic Indicators, located on each pilots' instrument panel, display aircraft magnetic compass heading and VOR or ADF bearings.
 - a. VOR or ADF bearing display is provided by selector switches on indicator.
 - b. DME mileage windows display mileage from DME System No. 1 and No. 2.
 - c. Warning flag appears if heading information is not valid.



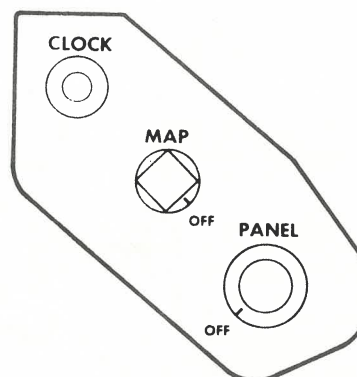
ELECTRONIC CLOCKS

1. Electronic clocks are installed on the captain, F/O and S/O's instrument panel.
 - a. The captain and F/O's clocks are identical and provide digital readout of Greenwich Mean Time (GMT), hours and minutes.
 - b. The S/O's clock has a 24-hour display with hour, minutes and sweep second hands.
 - c. Power for the clocks is from the hot battery bus.



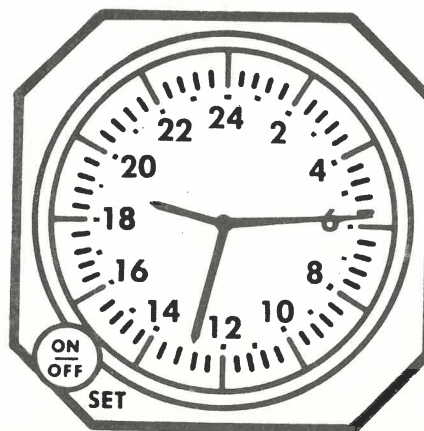
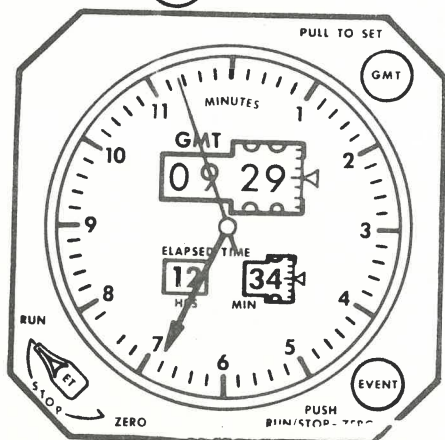
CAPTAIN'S CLOCK SWITCH

(A)



FIRST OFFICER'S CLOCK SWITCH

(B)

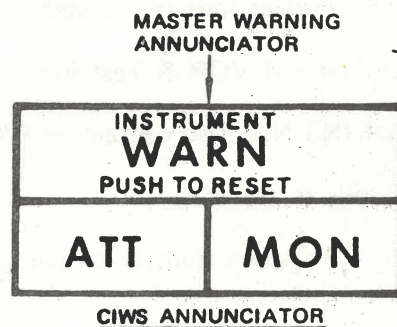


GENERAL

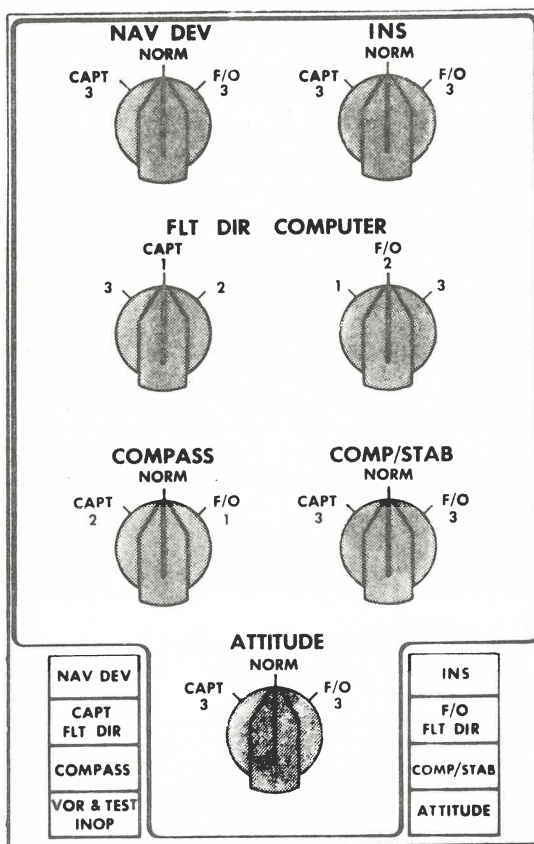
1. Flight instrument warning system is provided the pilots to alert them of invalid information.
 - a. Stall and over-rotation warnings are also provided to alert the pilots.

CENTRAL INSTRUMENT WARNING SYSTEM (CIWS)

1. Central instrument warning system, located on pilots' respective panel, provides a warning when data to flight instruments is invalid.
 - a. ATT light illuminates amber when a predetermined difference exists between captain and F/O's attitude director indicators.
 - b. MON light illuminates amber when power is lost to CIWS computer.
 - c. Instrument Warn light illuminates flashing red when flags appear in ADI – HSI – RMI – Radio Altimeters.
 - (1) Push to extinguish light and reset system.
 - d. Instrument warning test switch, located on F/O's instrument panel, provides test of ATT–MON and Instrument Warn lights on CIWS annunciator panel.
 - (1) ATT and MON lights extinguish when test switch is released. Warn light will continue to flash until light is pushed.



NAVIGATION/ATTITUDE TRANSFER SYSTEM



1. Navigation/Attitude transfer module, located on the overhead panel, provides selection of navigation/attitude sources and warning indication if transfer was not successful.
 - a. NAV DEV switch — Provides transfer of navigation receiver No. 3 to captain or F/O flight instruments.
 - (1) NAV DEV light illuminates if receiver fails to transfer.
 - (2) VOR & Test Inop light illuminates if VOR & Test function fails to transfer.
 - b. INS switch — Provides transfer of INS No. 3 to captain or F/O horizontal situation indicators.
 - (1) INS light illuminates if INS fails to transfer.
 - c. Capt. Flt. Dir. Computer switch — Provides transfer of computer No. 2 or No. 3 to captain's flight instruments.
 - (1) Capt. Flt. Dir. light illuminates if computer fails to transfer.
 - d. F/O Flt. Dir. Computer switch — Provides transfer of computer No. 1 or No. 3 to F/O's flight instruments.
 - (1) F/O Flt. Dir. light illuminates if computer fails to transfer.



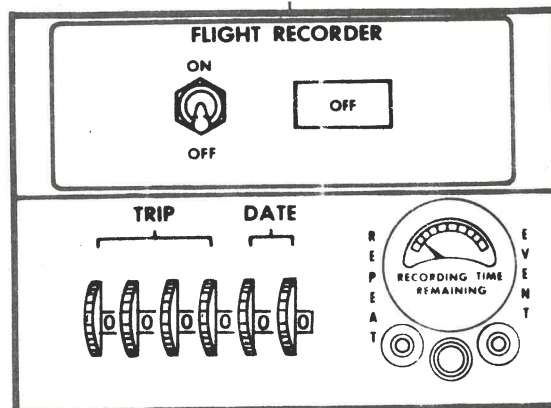
NAVIGATION/ATTITUDE TRANSFER SYSTEM (Cont.)

- e. Compass switch — Provides transfer of compass couplers to either captain or F/O's radio magnetic indicator.
 - (1) Compass light illuminates if compass coupler unit fails to transfer.
- f. Comp/Stab switch — Provides transfer of INS No. 3 compass stabilization platform to either captain or F/O's compass coupler unit.
 - (1) Comp/Stab light illuminates if INS No. 3 platform fails to transfer.
- g. Attitude switch — Provides transfer of INS No. 3 attitude platform to captain or F/O's attitude director indicators.
 - (1) Attitude light illuminates if INS No. 3 platform fails to transfer.

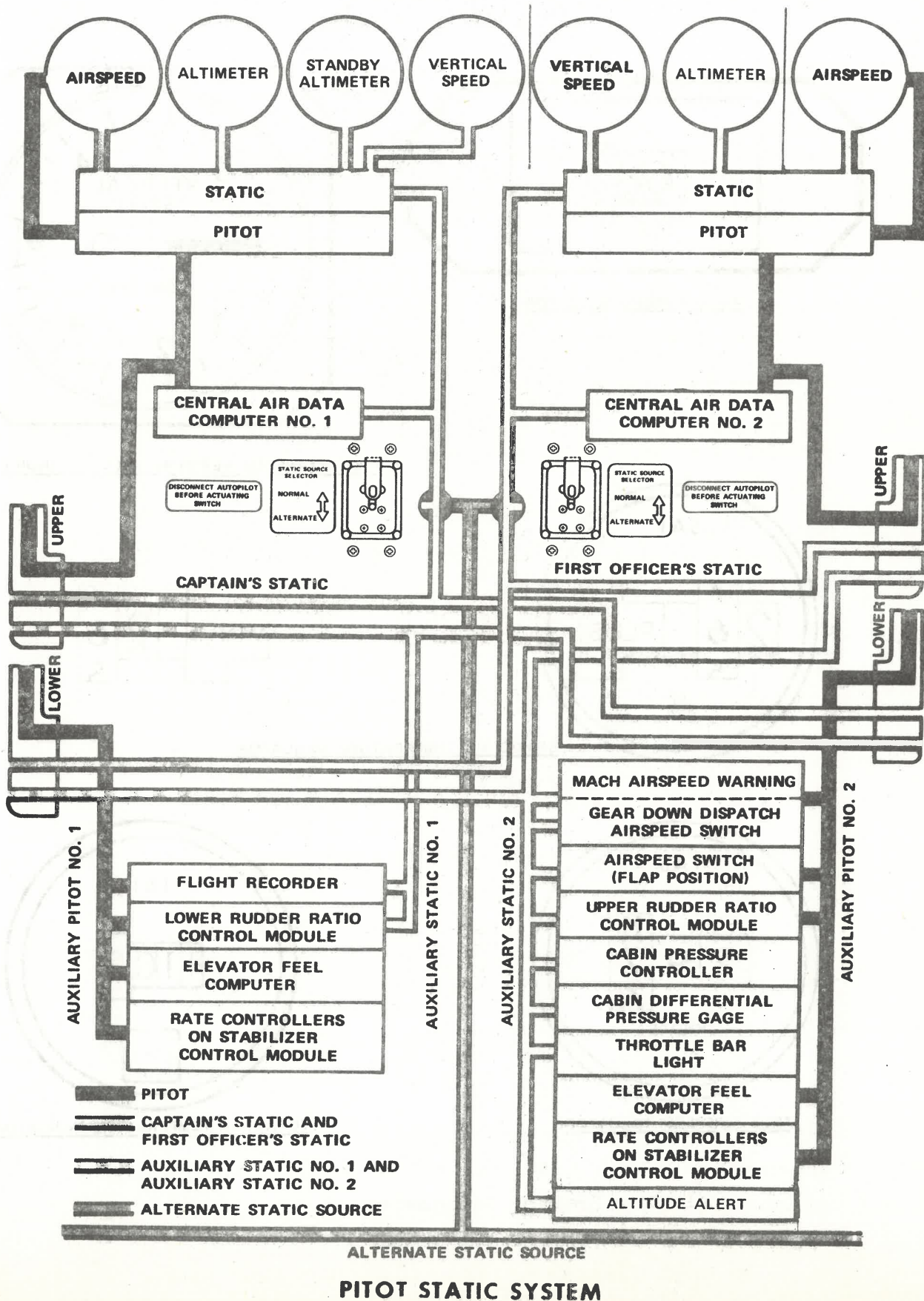
FLIGHT RECORDER SYSTEM

1. Flight recorder system provides a permanent record of the flight/date and records altitude, airspeed, magnetic heading and vertical acceleration.
 - a. Control panel located on S/O panel provides means of controlling system.
 - (1) OFF light on panel illuminates with power failure or tape breakage.
 - b. Trip and date encoder is located on S/O panel and provides selection of trip and date.
 - (1) Indicator displays remaining recording time of tape.
 - (2) Event button provides reference mark on tape to record special event.

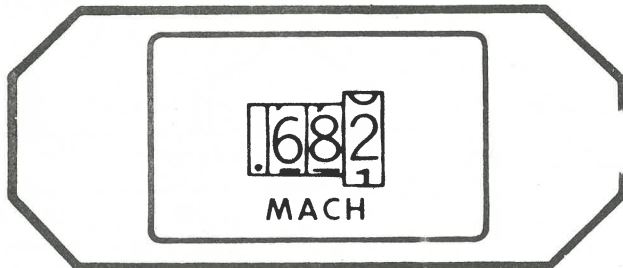
NOTE: If control switch, on control panel, is left off, recorder will turn on automatically as aircraft leaves ground.



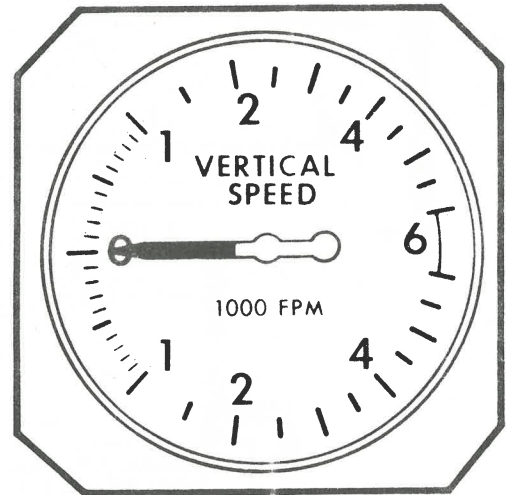
PITOT/STATIC SYSTEM:



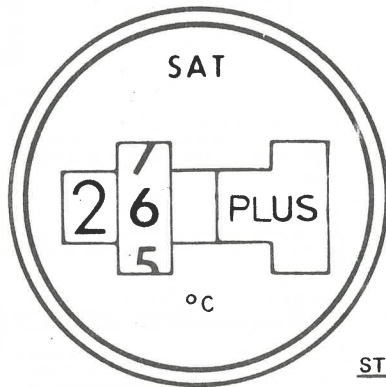
AIR DATA FLIGHT INSTRUMENTS:



MACH NUMBER INDICATOR



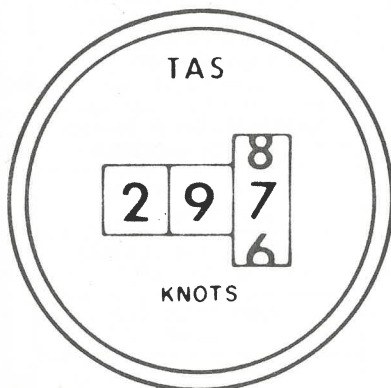
INSTANTANEOUS VERTICAL VELOCITY INDICATOR



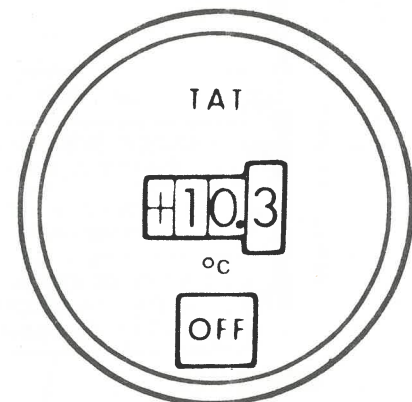
OR



STATIC AIR TEMPERATURE INDICATOR

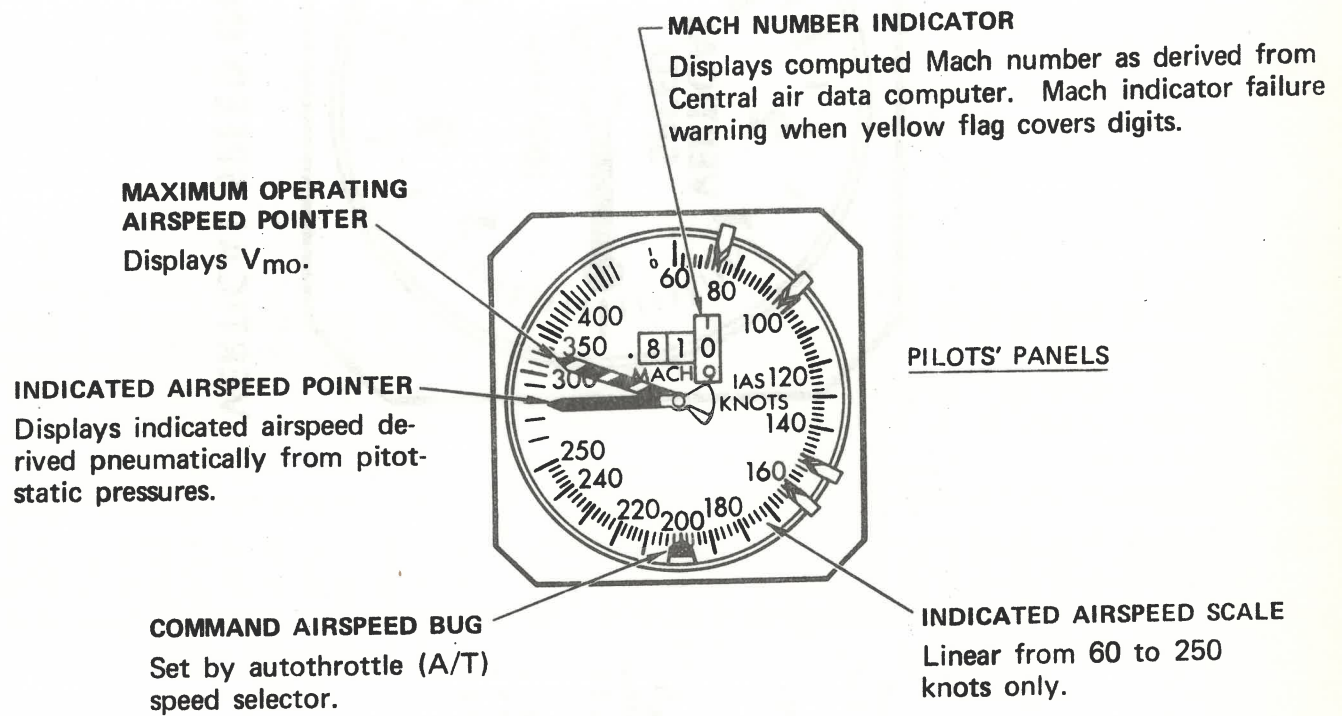


TRUE AIRSPEED INDICATOR

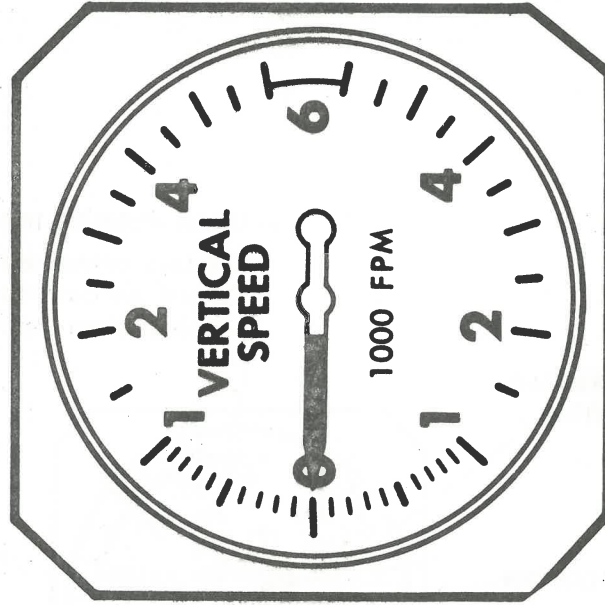


TOTAL AIR TEMPERATURE INDICATOR

MACH AIRSPEED INDICATOR PANEL:



MACH/AIRSPEED INDICATOR



VERTICAL SPEED INDICATOR

VERTICAL SPEED INDICATORS

The Captain's and First Officer's instrument panel each contain a Vertical Speed Indicator. These instruments indicate your aircraft's rate of climb or descent in feet per minute. It will read up to 6,000 feet climb or descent.

Instantaneous indication is provided through a pneumatically controlled mechanical system. With a constant altitude, this indicator will show a climb when entering a turn and a descent when rolling out of a turn. Therefore, if the needle is kept centered during a turn, the altitude will vary upon entry and rollout.

STATIC AIR TEMPERATURE INDICATOR

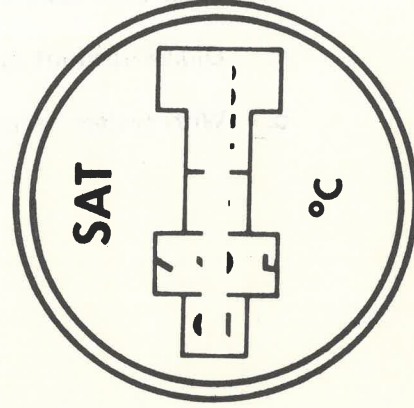
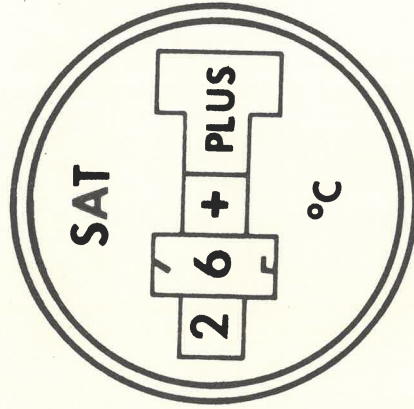
A Static Air Temperature Indicator (SAT) is located on the First Officer's instrument panel (to the left of the Airspeed Indicator).

This indicator presents static air temperature on a five drum numerical counter, (+50°C to -99°C). When the temperature is above zero, it is displayed on the left two drums and the right two drums will read PLUS. When the temperature is below zero, it is indicated on the right two drums and the left two will read MINUS.

Failure Indication

A yellow flag will cover the readout if a failure occurs.

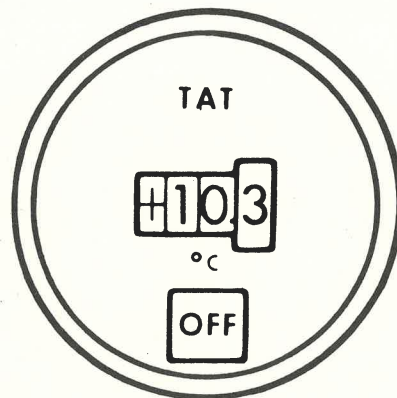
STATIC AIR TEMPERATURE INDICATOR



FAILURE INDICATION

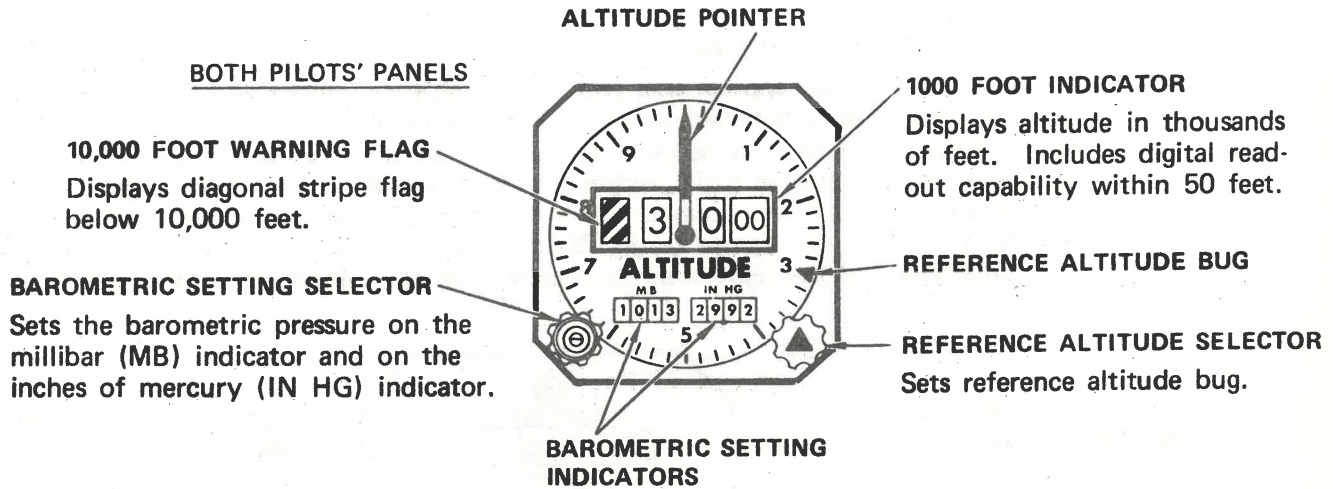
H. TOTAL AIR TEMPERATURE

1. Located on S/O panel and provides visual indication of total air temperature as computed by central air data computer system.
 - a. Digital readout displayed from -60° to $+60^{\circ}$ C.
 - b. With system failure, a yellow off flag appears in a window.

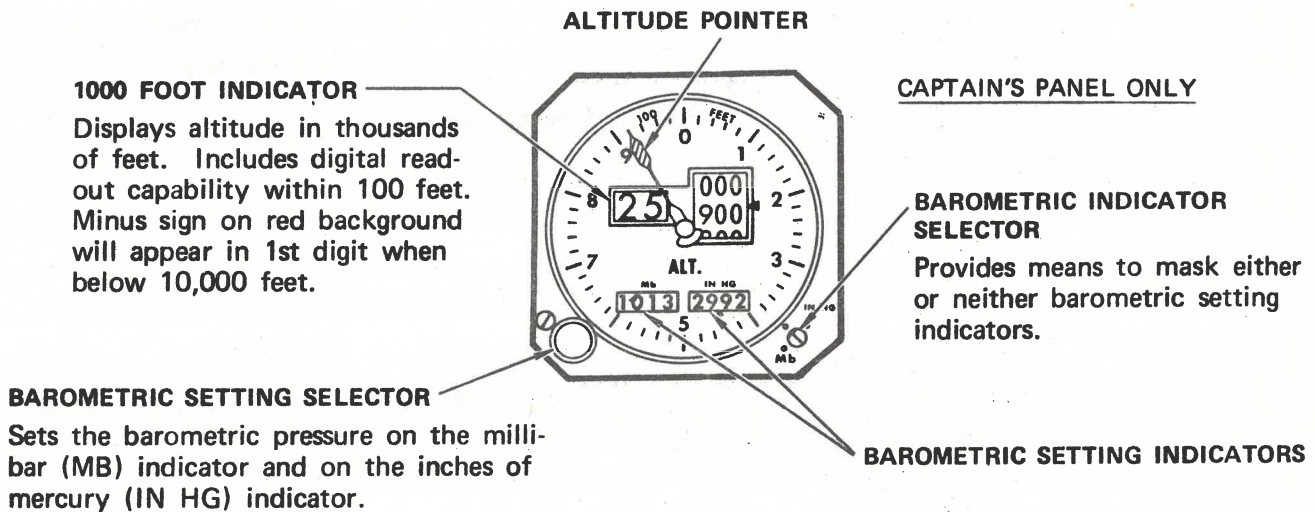


TOTAL AIR TEMPERATURE INDICATOR

ALTIMETER PANEL:



SERVO ALTIMETER



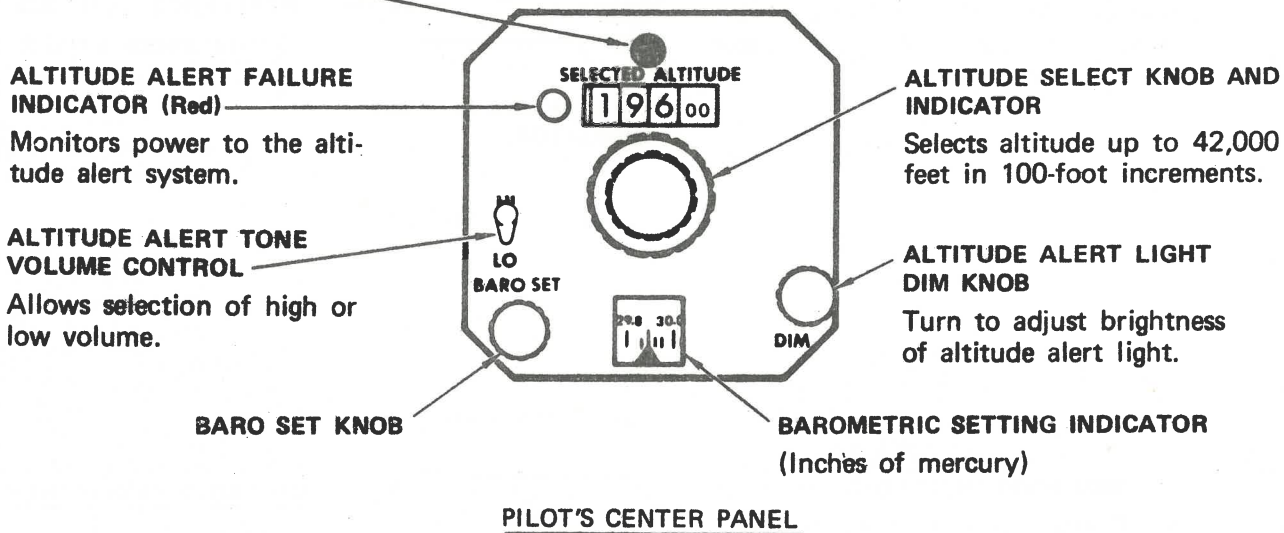
STANDBY ALTIMETER (PNEUMATIC)

ALTIMETERS

ALTITUDE ALERT UNIT PANEL:

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.



PILOT'S
 PANELS

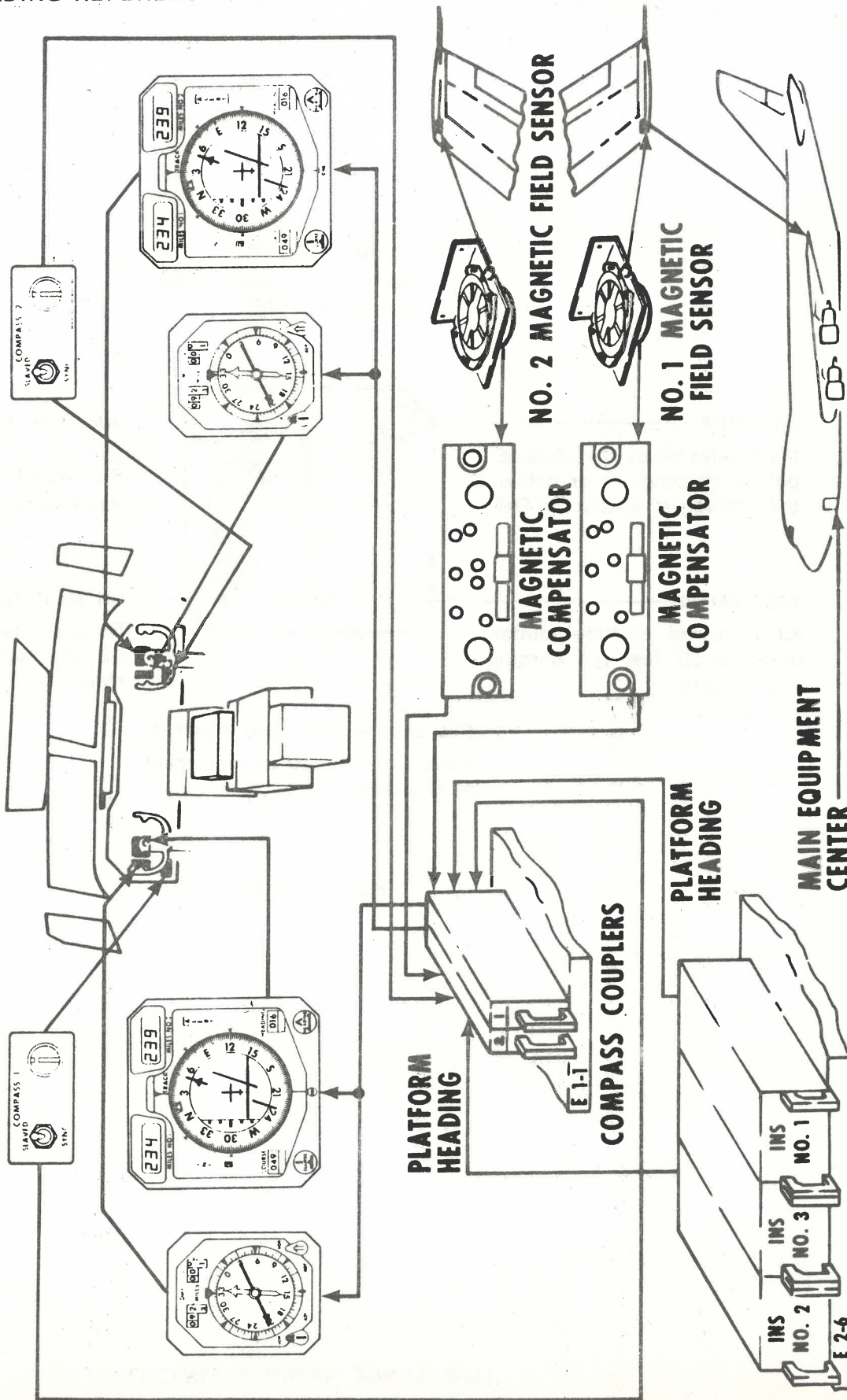


REMOTE ALTITUDE ALERT LIGHTS (BARO ALT WARNING)
 Decoded INOP

ALTITUDE ALERT

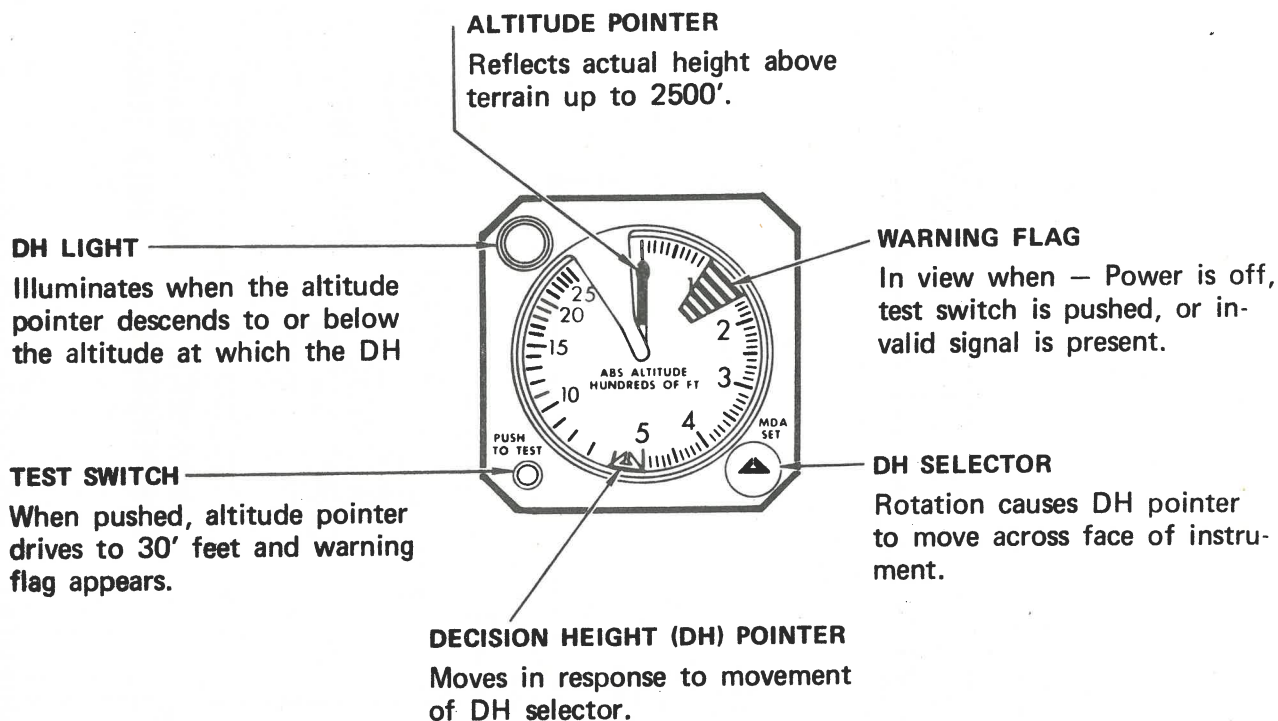


MAGNETIC HEADING REFERENCE SYSTEM:



MAGNETIC HEADING REFERENCE SYSTEM

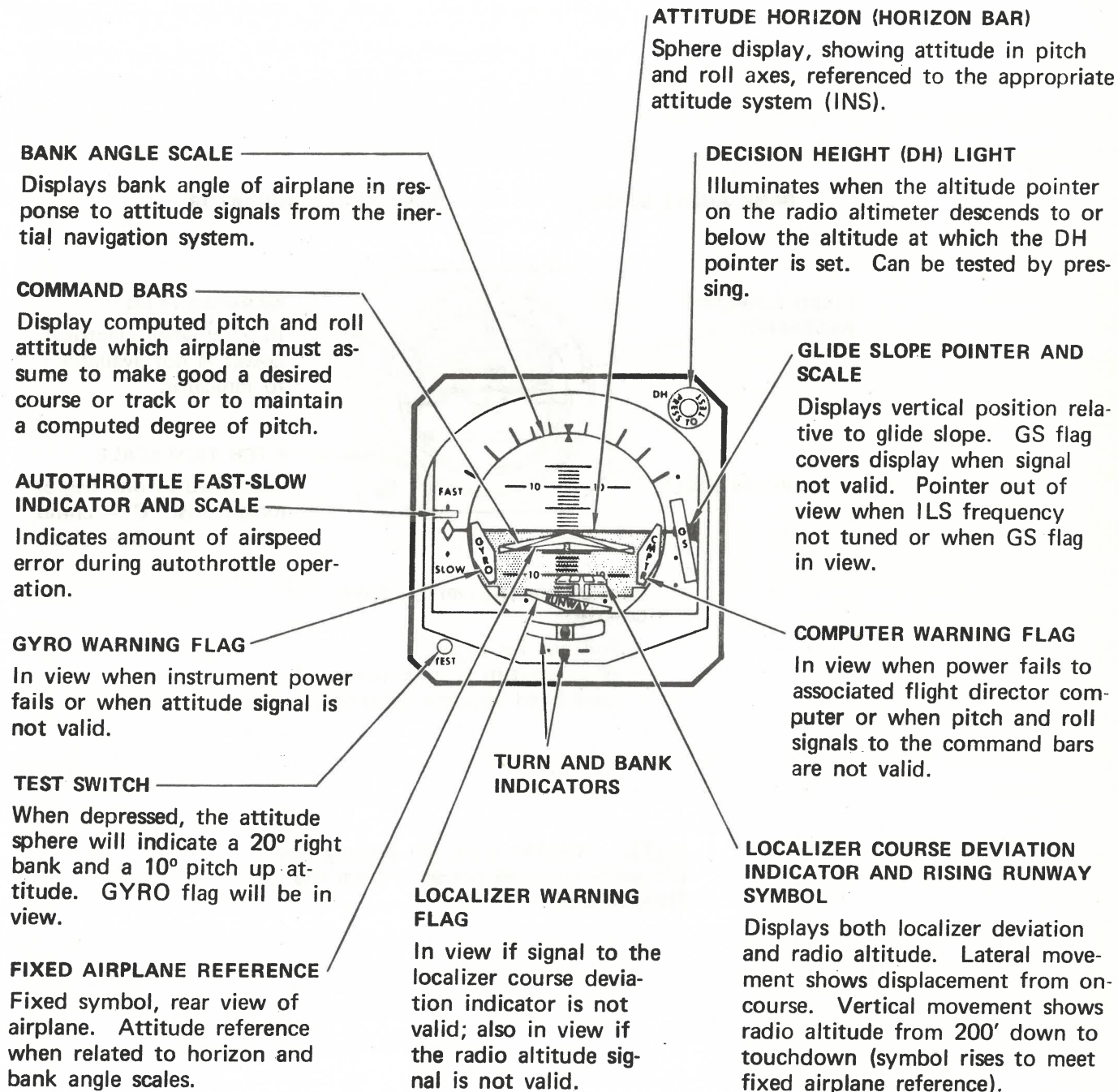
LOW RANGE ALTIMETER PANEL:



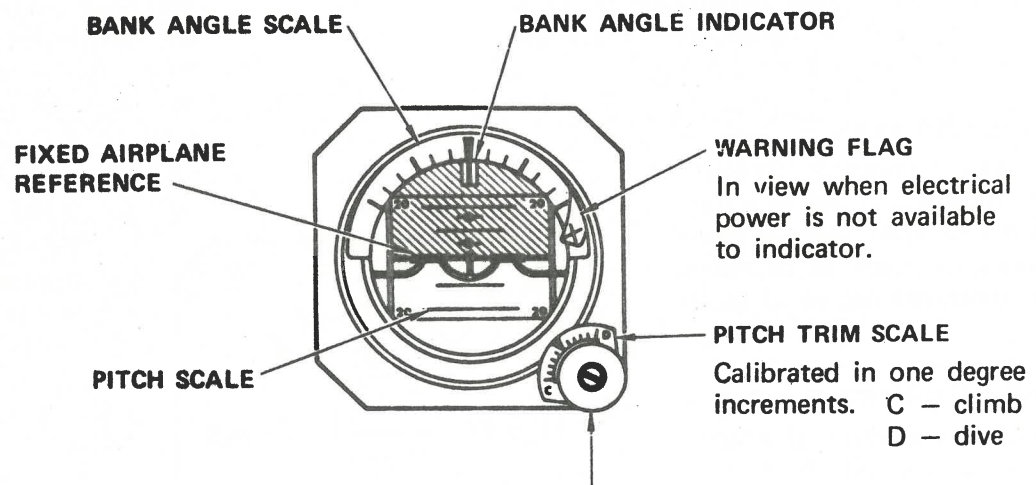
PILOTS' PANELS



ATTITUDE DIRECTOR INDICATOR (ADI)



STANDBY HORIZON INDICATOR:

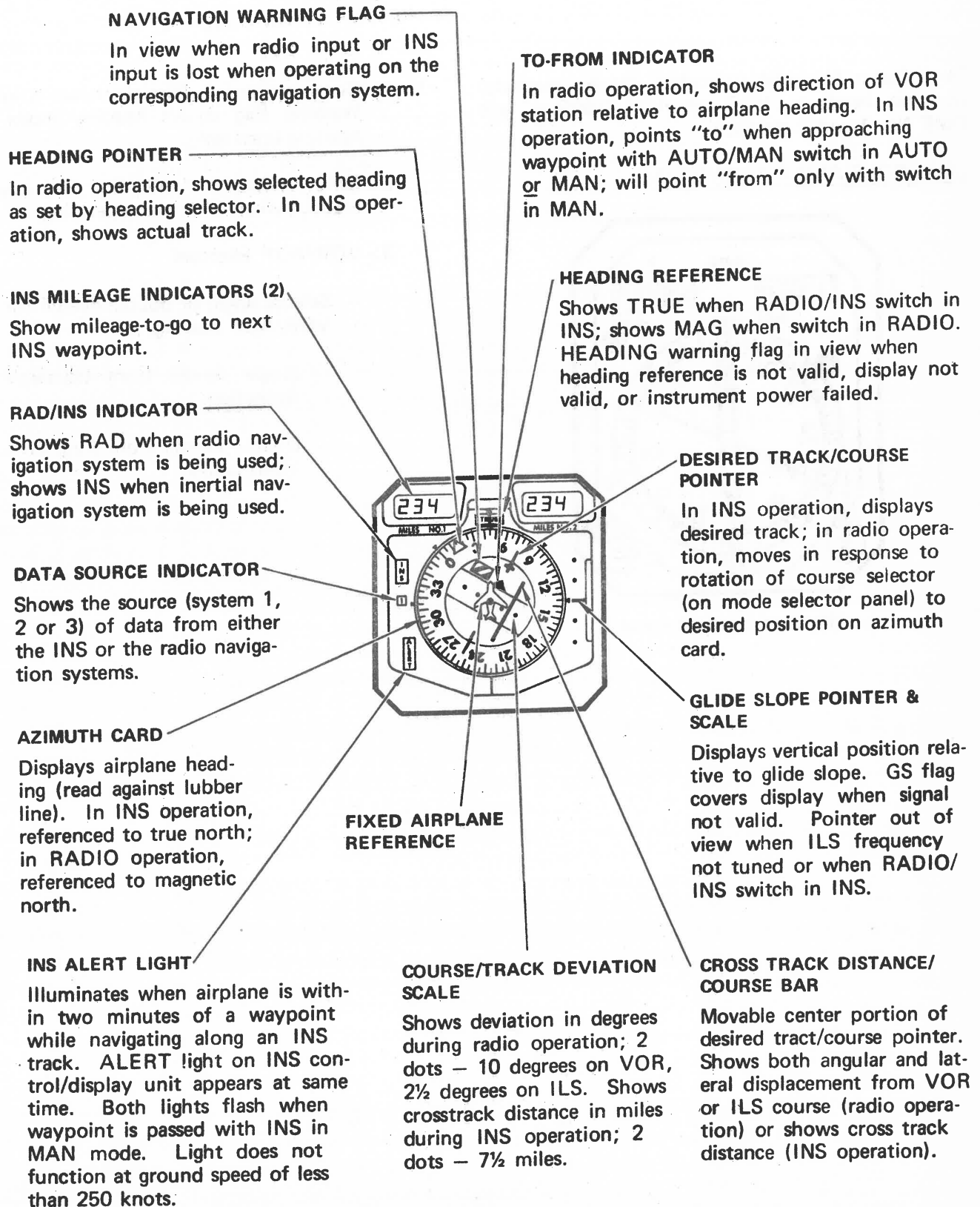


CAGING CONTROL/PITCH TRIM CONTROL

- Pull out for caging.
- When control is in, rotation adjusts fixed airplane reference.

NOTE: Powered from the Battery Bus.
(On early airplanes power is from the Standby Bus).

HORIZONTAL SITUATION INDICATOR (HSI)

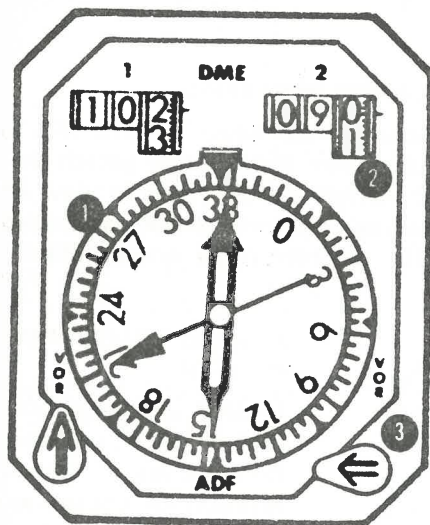


HORIZONTAL SITUATION INDICATOR

RADIO MAGNETIC INDICATOR (RMI)

Two Radio Magnetic indicators display magnetic compass headings, VOR or ADF bearings, and DME No. 1 and 2 distance.

CONTROLS AND INDICATORS



Pilots' Instrument Panel

1. Compass card – Displays heading information. Warning flag covers heading index if off or heading unreliable.
2. DME indicators – Warning flag covers digital readout when DME not operating.
3. VOR/ADF selectors
 - Selects single or double needle for respective VOR/ADF bearing.
 - Single needle from Captain's radio information.
 - Double needle from First Officer's radio information.

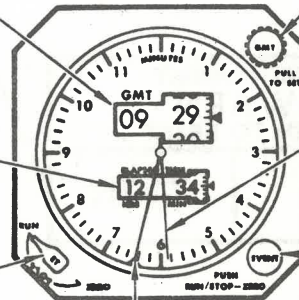
ELECTRIC CLOCK:

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.

PILOTS' PANELS



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.)

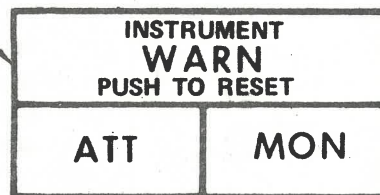
MINUTE HAND
 Moves in response to event switch actuation. Hand moves around full scale in 12 minutes.

ELECTRONIC CLOCK

CENTRAL INSTRUMENT WARNING PANEL (CIWS)

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 (On HSI)
- 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 AND INSTRUMENT SWITCHING:

INS SYSTEM COMPARATOR LIGHTS (Amber)
 Individual light will illuminate when corresponding INS system is out of tolerance with the other two systems.



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.

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.

FLIGHT DIRECTOR COMPUTER SWITCH

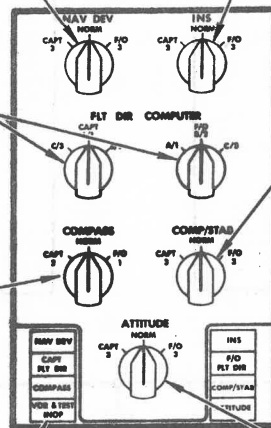
- Transfers flight director computer inputs to pilots' ADI's.
- FLT DIR light illuminates if transfer does not actually occur.

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.

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.



PILOTS' OVERHEAD PANEL

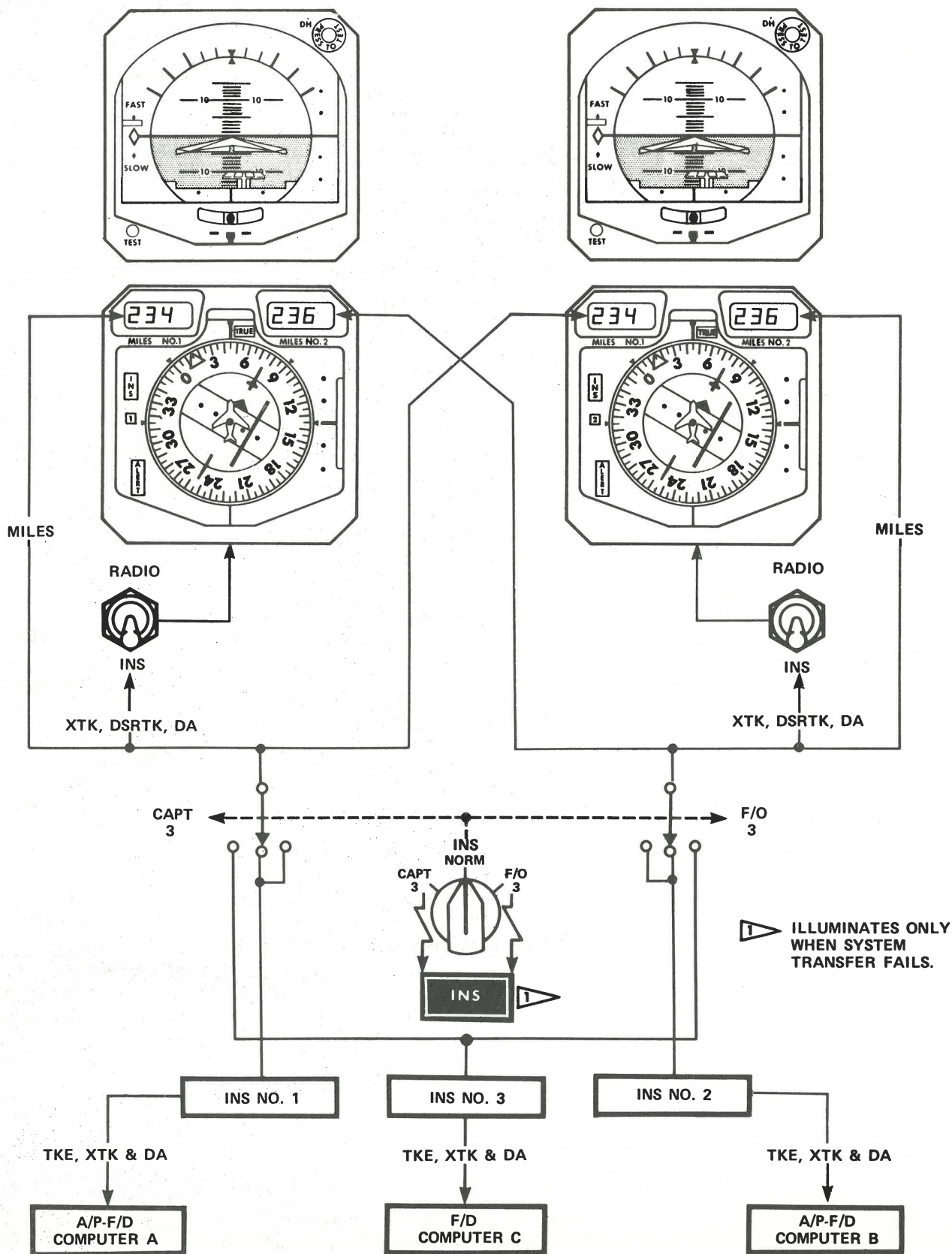
ATTITUDE SWITCH

- 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.

(DEACTIVATED)

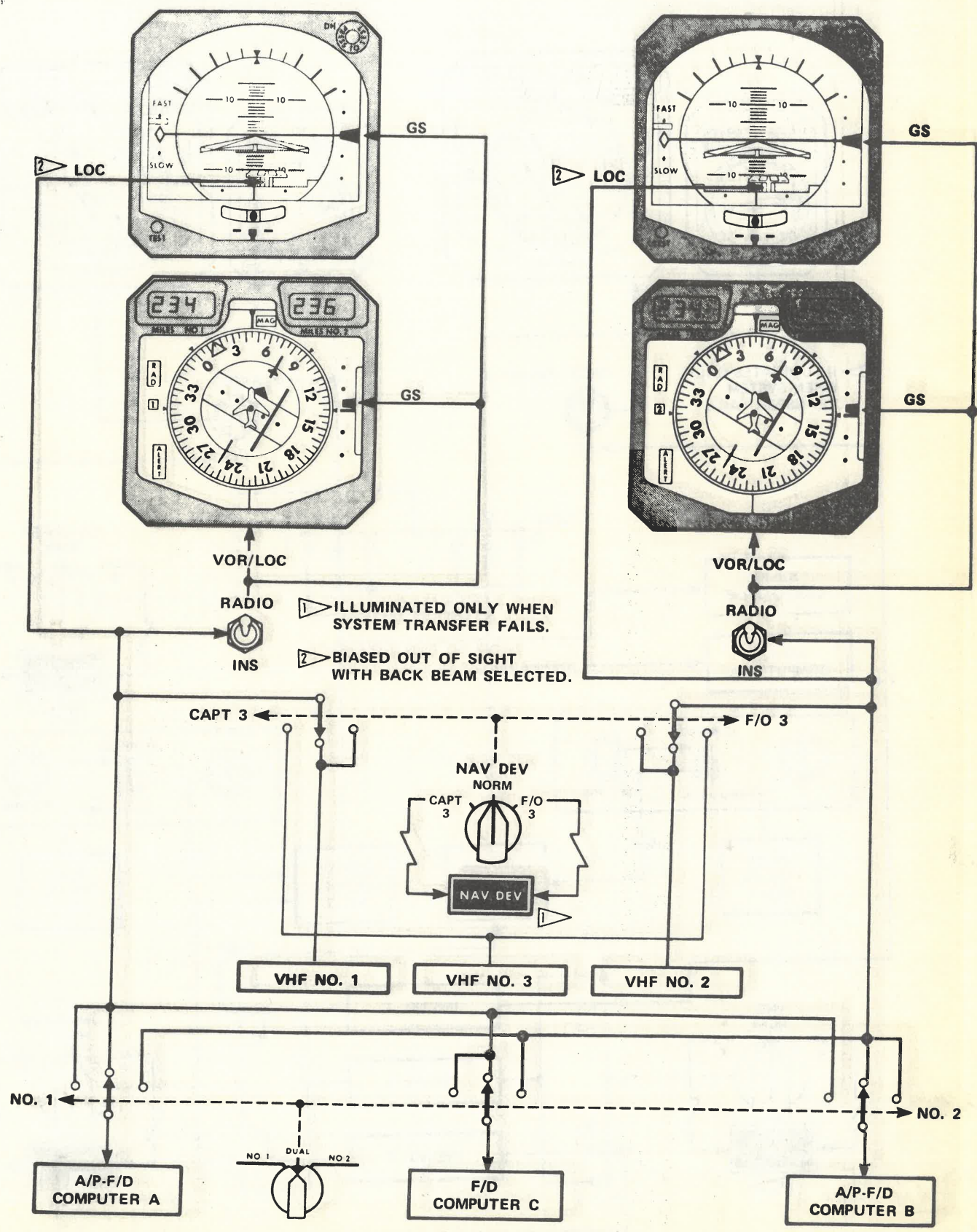


INS NAVIGATION SWITCHING:



NAVIGATION SWITCHING (INS)

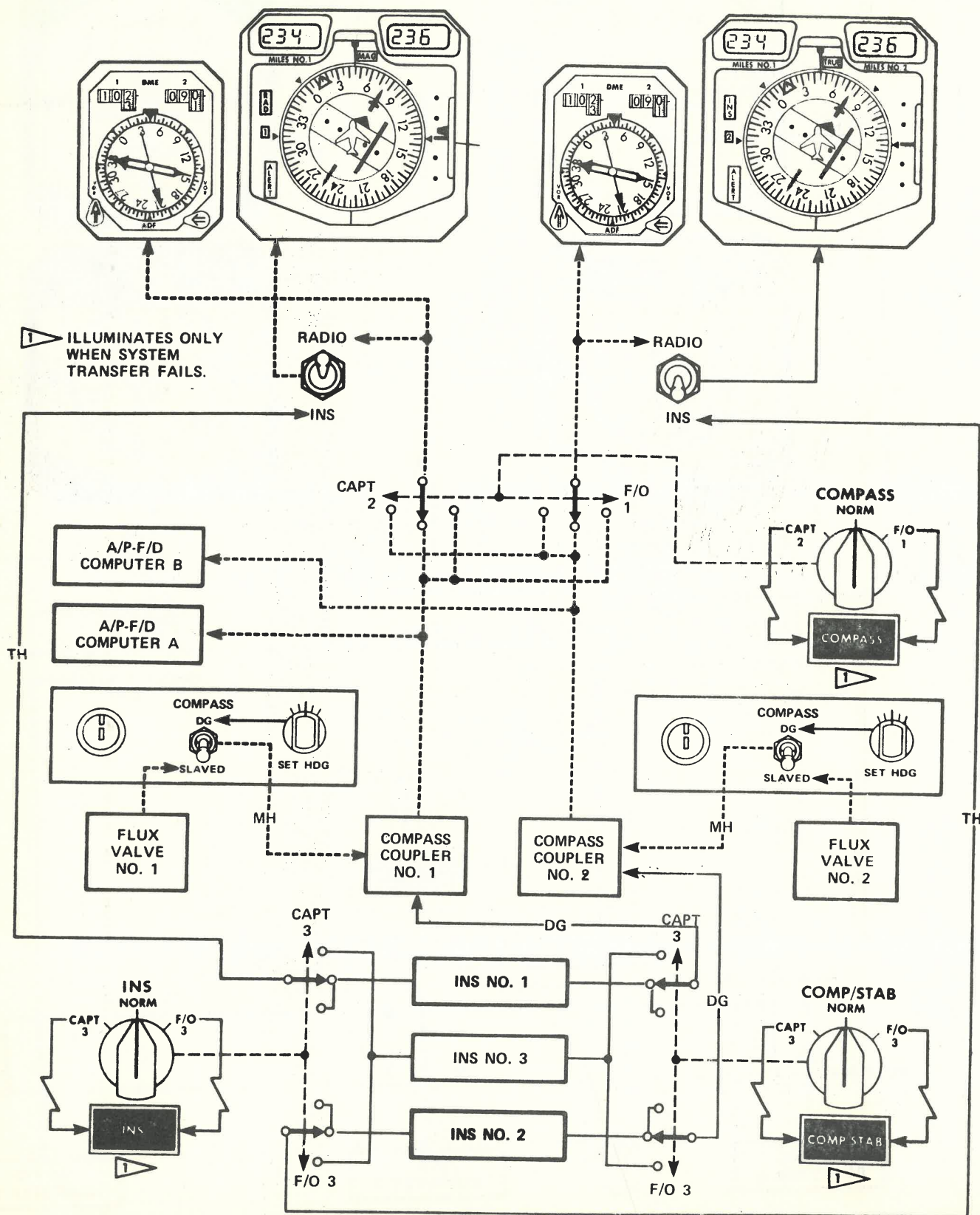
RADIO NAVIGATION SWITCHING:



NAVIGATION SWITCHING (RADIO)



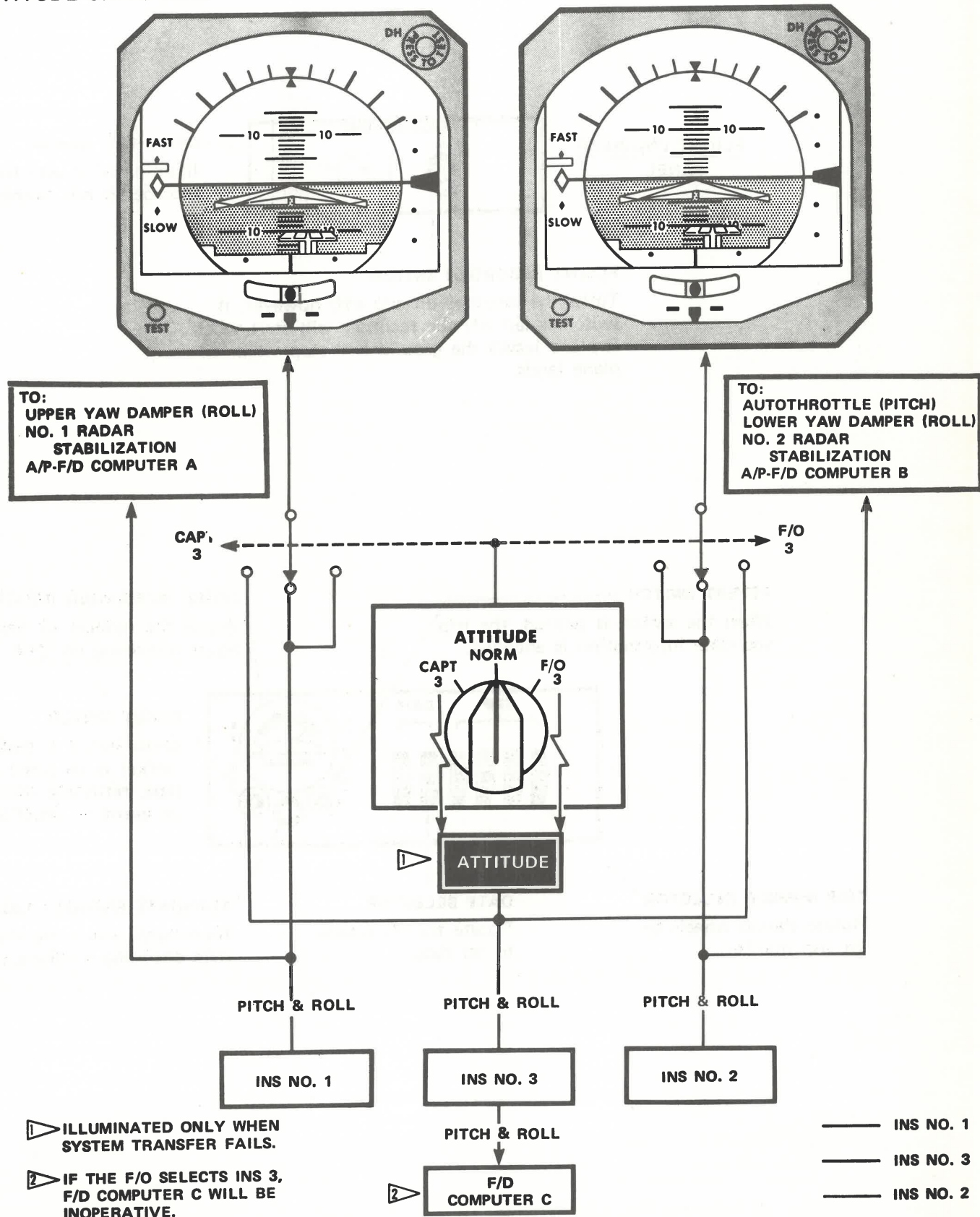
COMPASS SWITCHING:



COMPASS SWITCHING (TRUE & MAGNETIC)

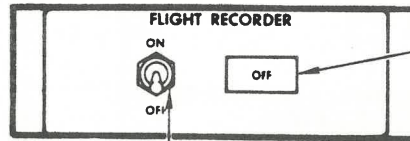


ATTITUDE SWITCHING:



FLIGHT RECORDER PANEL:

FLIGHT ENGINEER
 PANEL



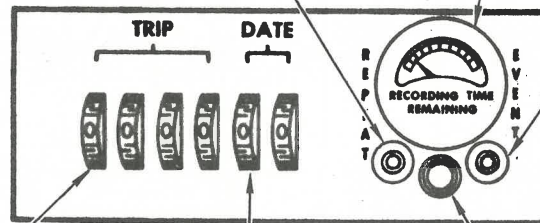
OFF LIGHT (Amber)
 Illuminated at any time the recorder is not running.

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.

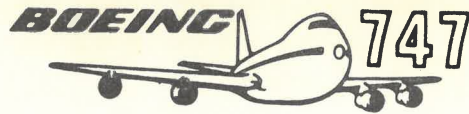


TRIP NUMBER SELECTOR
 Rotate thumb wheels to set trip number.

DATE SELECTOR
 Rotate thumb wheels to set date.

EVENT SWITCH
 When switch is pushed, a marker is recorded on the tape, reflecting the time of an event or situation.

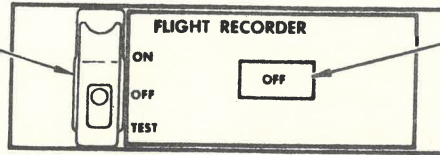
TRIP/DATE ENCODER LIGHT
 Illuminated while the trip and date encoding is taking place.



FLIGHT DATA RECORDER

FLIGHT RECORDER SWITCH (Guarded Switch)

The flight recorder will run with switch in OFF position when engine generators (not external power or APU) are powering the airplane. Recorder may be turned on manually with switch. TEST position (spring loaded) is same as ON position.



OFF LIGHT (Amber)
Illuminates when the recorder is not running or a fault exists.

CODE and VALUE Annunciator

The CODE annunciator on the left displays the identification code number of the parameter being entered in the flight recorder. The first two numbers pushed will appear in this CODE annunciator.

The right group of five VALUE annunciators display the value of the parameter being entered in the flight recorder. As the numerical value are being inserted, the numbers will transfer from right to left in the VALUE annunciator.

Pushbutton Keyboard.

The pushbutton keyboard consists of ten illuminated pushbuttons which are used to insert the CODE number of the parameter (flight, leg, date, captain's ident, first officer's ident, 2nd officer's ident, T/O gross wt + 100) and the numerical VALUE of the parameter.

FDAU FAULT and DFDR FAULT lights are not used.

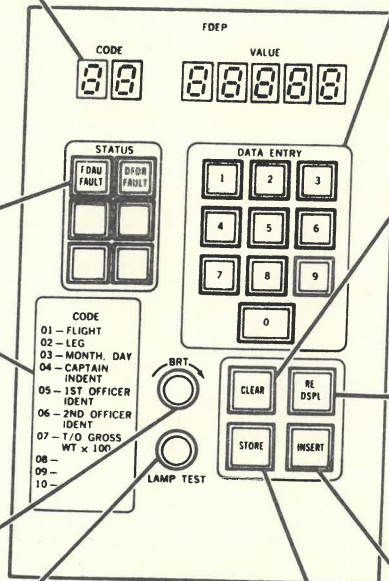
Parameter code numbers

BRT Knob

Rotating the BRT knob clockwise, increases the brightness of the IDENT and VALUE annunciators, push button, and panel lights.

LAMP TEST Button

Pushing the LAMP TEST button causes all lights to appear in the CODE and VALUE annunciators and causes all panel and pushbutton lights to come on.



CLEAR Button

Pushing the CLEAR button will erase the CODE and VALUE annunciators. This results in no data transmission to the flight recorder and allows new data to be selected and displayed.

REDSPL Button

Pushing the REDSPL button causes stored parameter to be redisplayed. When more than one parameter is stored, the REDSPL button must be pushed once for each stored parameter until desired parameter is redisplayed.

INSERT Button

Pushing the INSERT button causes the displayed parameter to be transmitted to the digital flight data recorder via the flight data acquisition unit. When both the CODE and VALUE annunciators go off, the recorder is ready to receive the next parameter. Up to four seconds may be required for the CODE and VALUE annunciators to clear.

STORE Button

Pushing the STORE button causes parameter inserted in the CODE and VALUE annunciators to be stored. Nine parameters may be stored.

FLIGHT DATA ENTRY PANEL (FDEP)

| | |
|---|----|
| COCKPIT REFERENCE, PERFORMANCE & FLIGHT PLANNING DATA | 01 |
| EMERGENCY OPERATING PROCEDURES | 02 |
| ALTERNATE OPERATING PROCEDURES | 03 |
| DIMENSIONS & GENERAL ARRANGEMENT | 06 |
| | 13 |
| AIR CONDITIONING & PRESSURIZATION | 21 |
| AUTOPILOT & FLIGHT DIRECTOR | 22 |
| COMMUNICATIONS | 23 |
| ELECTRICAL POWER | 24 |
| EQUIP/FURNISHINGS | 25 |
| FIRE PROTECTION | 26 |
| FLIGHT CONTROLS | 27 |
| FUEL | 28 |
| HYDRAULIC POWER | 29 |
| ICE & RAIN PROTECTION | 30 |
| INSTRUMENTS | 31 |
| LANDING GEAR | 32 |
| LIGHTING | 33 |
| NAVIGATION | 34 |
| OXYGEN | 35 |
| PNEUMATIC | 36 |
| APU | 49 |
| DOORS | 52 |
| WINDOWS | 56 |
| EMERGENCY EQUIPMENT | 58 |
| ENGINES | 72 |
| MISCELLANEOUS SYSTEMS & EQUIPMENT | 84 |
| | 85 |
| | 86 |
| OPERATING BULLETINS | 87 |



LANDING GEAR SYSTEM:

The landing gear on the B-747 consists of four struts each carrying a 4-wheel truck and a nose gear consisting of a strut with two wheels. Two of the main gear are wing mounted and two are body mounted. Each wing strut is hydraulically connected to the adjacent body strut in order to equalize uneven loads. NWA is presently deactivating this load leveling system. The size of the main gear necessitates that they be stowed in a tilted position. To accomplish this, hydraulic actuators tilt the trucks as soon as the aircraft is airborne.

Normal landing gear extension and retraction is supplied by two independent hydraulic sources: No. 1 hydraulic system for the nose and body gear, the No. 4 system for the wing gear. Normal extension/retraction of gear is controlled by the landing gear lever, located on the right side of pilot's center instrument panel. The lever has UP - OFF - DN WING GEAR - DN detent positions. The gear lever cannot be raised by a solenoid operated lever latch unless primary and alternate logic systems confirm gears are properly tilted and centered. The landing gear doors are hydraulic powered and may be opened on ground for inspection by door release handles. The alternate extension system utilizes electric motors controlled by switches on pilot's overhead panel, to unlock the doors and uplocks. Landing gear weight and air loading will extend the gear to the locked position. The alternate extension cycle requires about two minutes. Manual extension and down lock facilities are provided only for the nose gear. This manual nose gear extension system is stowed on the forward bulkhead, left side of main equipment center (Lower 4l).

Landing Gear and Door Lights located above gear handle display the status. The red 'Door Open' light illuminates if any door fails to indicate closed and is extinguished when all doors are closed.

The green 'Gear Down' light illuminates when all gears are down and locked.

The red 'Gear' light illuminates if all uplock and/or downlock indications DO NOT agree with landing gear handle position and extinguishes if there is agreement. It will also illuminate if any throttle is retarded to Idle and all gears are not down and locked.

Landing Gear Annunciator on S/O panel display gear and door status:

The amber 'Door' lights illuminate if door fails to indicate closed and is extinguished when doors are closed.

The green 'Gear Down' lights illuminate when gear is down and locked.

The amber 'Tilt' lights illuminate if gear fails to indicate a tilted condition and is extinguished when gear is fully tilted for safe retraction.

Pushbutton switches below annunciator allow selection of primary or alternate status.

NOSE GEAR STEERING SYSTEM:

A hydraulically powered nose wheel steering system is provided. Hydraulic system No. 1 powers this system through captain and first officer tiller controls. The tillers will move the nose wheel approximately 70 degrees either side of center. Both tillers have placards which indicate the center position of the nose wheels.



NOSE GEAR STEERING SYSTEM: (Contd.)

When taxiing, the cockpit height creates an illusion that the aircraft is moving slower than it actually is. This tendency exists particularly during runway turnoff after landing. As an aid in determining taxi speed, the INS data selector switch on the control display unit should be placed to the TK/GS position.

BODY GEAR STEERING SYSTEM:

To reduce excessive engine power needed for turns at low speeds and to prevent tire scuffing wear, normal nose wheel steering is supplemented by body gear steering. Nose and body gear steering is available when landing gear handle is in Down position and hydraulic system No. 1 is pressurized.

At about 17 degrees of nose wheel position hydraulic pressure is available and a 'Pressure' light on S/O panel illuminates. At about 20 degrees of nose wheel position the body gear steering is started and 'Unlock' lights illuminate on S/O panel, reflecting the status of left or right body gears. A PRIM/ALT switch on S/O panel allows selection of primary or alternate indication status.

The 'Gear Not Centered' light on pilot's annunciator center panel illuminates if either primary or alternate sensing indicates a body gear not centered. If any body gear is not centered for take-off an intermittent warning horn will sound when No. 3 throttle is advanced. Both body gears have to be centered in order to raise the gear handle past the Off' position after take-off. A switch on overhead panel allows the body gear steering to be inoperative for take-off.



LANDING GEAR AND AUTOBRAKE SYSTEM

The autobrake system is designed to relieve the pilot workload during busy periods. Also, it provides prompt, safe braking when needed and optimizes anti-skid operation. The autobrake system can be overridden and deactivated at any time by normal brake pedal operation.

Cockpit controls for the autobrake system consist of a rotary selector switch on the overhead panel and an amber "Autobrake" light on the pilot's annunciator panel. The pilot arms the system before each landing by selecting the Min, Med, or Max deceleration level. As the switch is rotated through the disarm position, the autobrake light momentarily illuminates, then extinguishes when the system arms.

At main gear touchdown, after wheel "spinup," the autobrake system smoothly begins to apply symmetrical braking and to control airplane deceleration to the selected level. This early brake application helps stabilize the airplane at touchdown. Either pilot can disarm the system and take over manual braking any time by applying normal pedal braking. When the system disarms, (1) autobrake pressure smoothly releases, (2) the selector switch automatically trips to the disarm position, and (3) the "Autobrake" light illuminates to indicate that autobrakes have disarmed.

The system will disarm whenever:

- A. Any brake pedal is applied,
- B. Takeoff thrust is applied while the airplane is on the ground (applying takeoff thrust in flight has no effect);
- C. Anti-skid is OFF or a fault is detected,
- D. An autobrake fault is detected.

The pilot can extinguish the "Autobrake" light by selecting OFF.

A single autobrake pressure control valve is installed in the normal braking system only (no autobraking using reserve braking system). This provision ensures that autobraking is symmetrical and anti-skid protection is maintained.

To control airplane deceleration, the autobrake control circuit first measures airplane deceleration from the anti-skid system wheel speed signals. Then it adjusts autobrake pressure (up or down) to maintain airplane deceleration at the selected rate. If application of reverse thrust starts to decelerate the airplane faster than the selected rate, the control circuit reduces autobrake pressure until the selected deceleration is regained. Similarly, removal of reverse thrust causes autobrake pressure to increase to maintain the selected deceleration rate.

When operating on slippery runways where the selected rate cannot be maintained, the control circuit continues to increase autobrake pressure trying to attain the selected deceleration. When this happens:

- A. The anti-skid system takes over braking control and maximizes braking effectiveness.
- B. Deceleration from reverse thrust adds to autobraking (i.e. does not cause autobrake pressure to reduce) until the selected deceleration rate is regained.



LANDING GEAR AND AUTOBRAKE SYSTEM (Cont.)

Under such conditions, manual braking could not improve airplane deceleration. On the Min or Med settings, autobrakes will consistently stop the airplane near the predicted field length as possible regardless of runway condition or amount of reverse thrust applied. On the Max setting, full brake pressure is applied at wheel spinup and held until system is disarmed. Therefore, when Max is selected, the airplane is always stopped in the shortest possible distance. The average deceleration rate for the three settings are:

| | | | | | |
|-----|---|----------------|---|-------|-----------|
| Min | - | 4 feet/sec | - | 6700' | of runway |
| Med | - | 6 feet/sec | - | 4600' | of runway |
| Max | - | 10-12 feet/sec | - | 3000' | of runway |

The autobrake system incorporates redundant arming and spinup circuits as well as complete failure monitoring system. These features ensure that no single malfunction can:

- A. Cause autobrakes to apply inadvertently.
- B. Require any action other than normal brake pedal application to take over manual braking control.
- C. Allow autobraking to interfere with anti-skid control.
- D. Cause blown tires.
- E. Allow autobraking when thrust levers are advanced to takeoff range.
- F. Cause autobrakes to apply insufficient braking without illuminating the "Autobrake" light.

If autobrake failure is detected, the following actions occur.

- A. Autobrake pressure is released.
- B. The selector switch automatically trips to the disarm position.
- C. The "Autobrake" light illuminates to indicate autobrakes have disarmed.

LANDING GEAR SYSTEM:

GENERAL

1. Landing gear system consists of two body gears, two wing gears and a nose gear operated from two independent hydraulic systems.
 - a. The aircraft weight is distributed between the respective body gear and wing gear, by a load equalizing system.
 - b. The main wing gear and doors are operated by hydraulic system No. 4.
 - (1) Wing gear trucks tilt 53° for stowage in the wheel well on retraction.
 - (a) Proper tilt sensed from primary and alternate proximity sensors.
 - '1' Gear "WING TILT" Annunciator lights on S/O panel illuminate through actuation of tilt pushbutton switches, if gear trucks not properly tilted.
 - c. The main body gear and doors are operated by hydraulic system No. 1.
 - (1) Body gear trucks tilt 8° for stowage in the wheel well on retraction.
 - (a) Proper tilt sensed from primary and alternate proximity sensors.
 - '1' Gear "BODY TILT" Annunciator lights on S/O panel illuminate through actuation of tilt pushbutton switches, if gear trucks not properly tilted.
 - (2) Body gear steering operates automatically through nose gear steering from hydraulic system No. 1 (gear downline).
 - (a) Operative at 20° of nose gear steering.
 - (b) A Body Gear Steering Pressure light located on S/O panel, illuminates when body gear steering operates.
 - (c) Body Gear Steering Unlocked lights located on S/O panel, illuminate for an unlocked indication, for the selected primary or alternate system.
 - '1' Primary or alternate systems selected for steering locked indication by switch on S/O panel.
 - (d) A "GEAR NOT CENTERED" light located on pilots' center instrument panel illuminates for either primary or alternate body gear unlocked indication.
- d. Nose gear and doors are operated by hydraulic system No. 1.
 - (1) Nose gear steering powered from hydraulic system gear down line through pilots' tillers.

NOTE: Landing gear lever latch will not release and a takeoff warning horn will sound when No. 3 thrust lever advanced and both primary and alternate systems indicate that a body gear is not centered.



LANDING GEAR EXTENSION AND RETRACTION

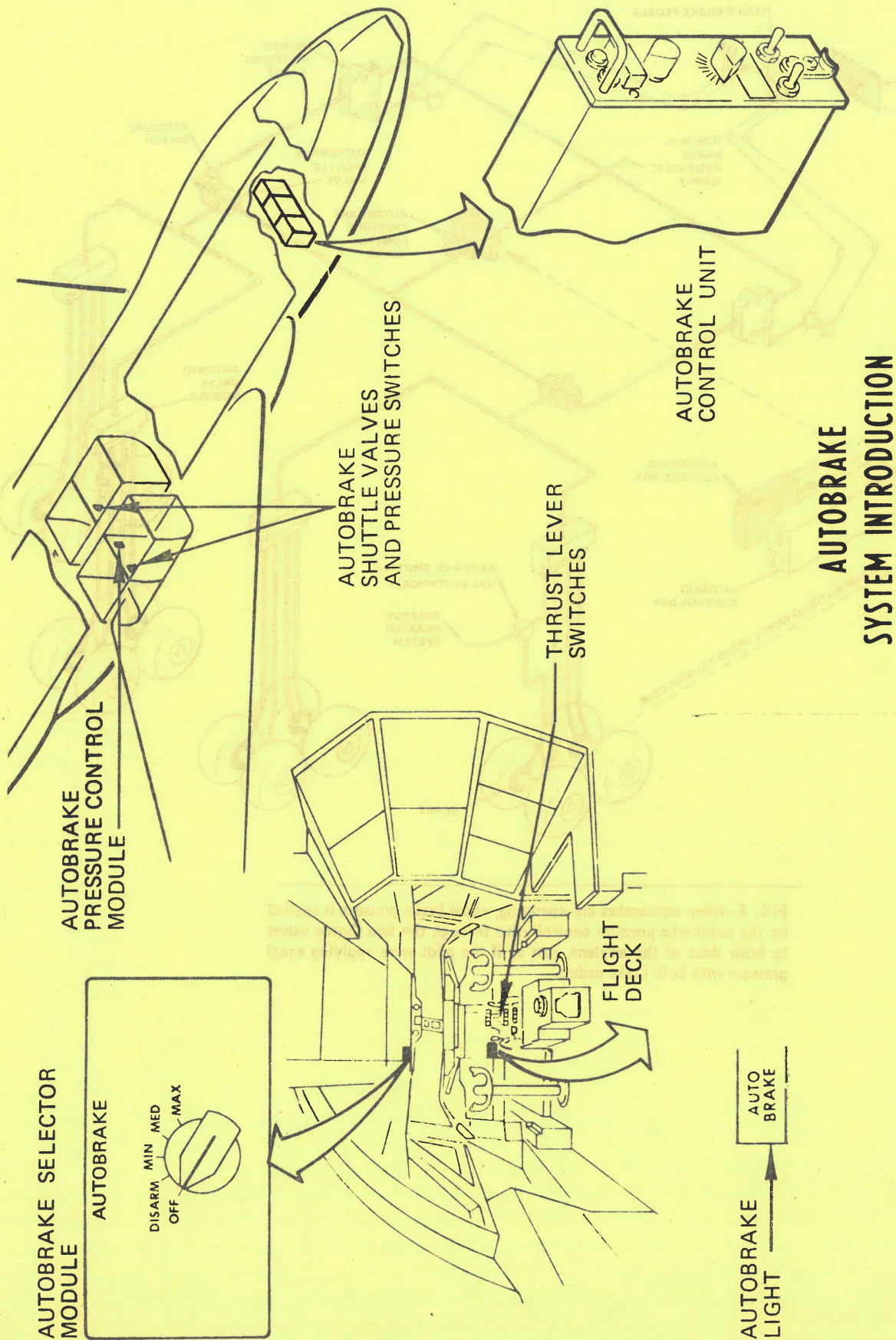
1. Normal gear and door extension-retraction by two independent hydraulic systems through a four-position landing gear selector valve.
 - a. "DN" position – Hydraulic pressure supplied to sequence doors and extend gears to down and locked position.
 - (1) Nose gear steering, body gear steering and brakes are all supplied through gear down lines
 - b. "UP" position – Hydraulic pressure supplied to sequence doors and gears to up and locked position.
 - (1) Automatic braking is supplied to stop main wheels.
 - (2) A lever latch prevents raising landing gear handle until all trucks are in the tilted position and body gear is centered.
 - (a) Lever latch should not be overridden manually when both primary and alternate sensors indicate a gear is not tilted.
 - c. "OFF" position – Depressurizes landing gear hydraulic system.
 - d. "WING GEAR DN" position – Extends wing gear only for additional drag.
2. Alternate gear and door extension utilizes electric motors to actuate uplocks, controlled by five switches located on pilots' overhead panel.
 - a. "EXT" position – Hold momentarily to initiate landing gear extension cycle.
 - b. "ARM" position – Leave in this position to continue alternate extension cycle.

NOTE: Nose gear can also be extended manually from Lower 41.

3. The status of each gear or door is displayed individually on S/O "LANDING GEAR" Annunciator light module through primary or alternate gear, tilt, and door pushbutton selector switches.
4. Gear and Door Annunciator lights located on center instrument panel provide visual indication to the pilots.
 - a. Green "GEAR DOWN" light – Illuminates when all gears are down and locked.
 - b. Red "GEAR" light – Illuminates for the following conditions:
 - (1) Landing gear intransit or not in agreement with landing gear lever.
 - (2) Landing gear up and trailing edge flaps 25⁰ to 30⁰ position.
 - (a) Warning horn sounds and cannot be silenced.
 - (3) With gear handle down, any thrust lever at idle and any one primary or alternate Gear Down Annunciator light indicates gear not down and locked.

NOTE: Red light is extinguished with gear handle in off position.

- c. Red "DOOR OPEN" light illuminates with any primary or alternate indication of a door open.



AUTOBRAKE SYSTEM INTRODUCTION

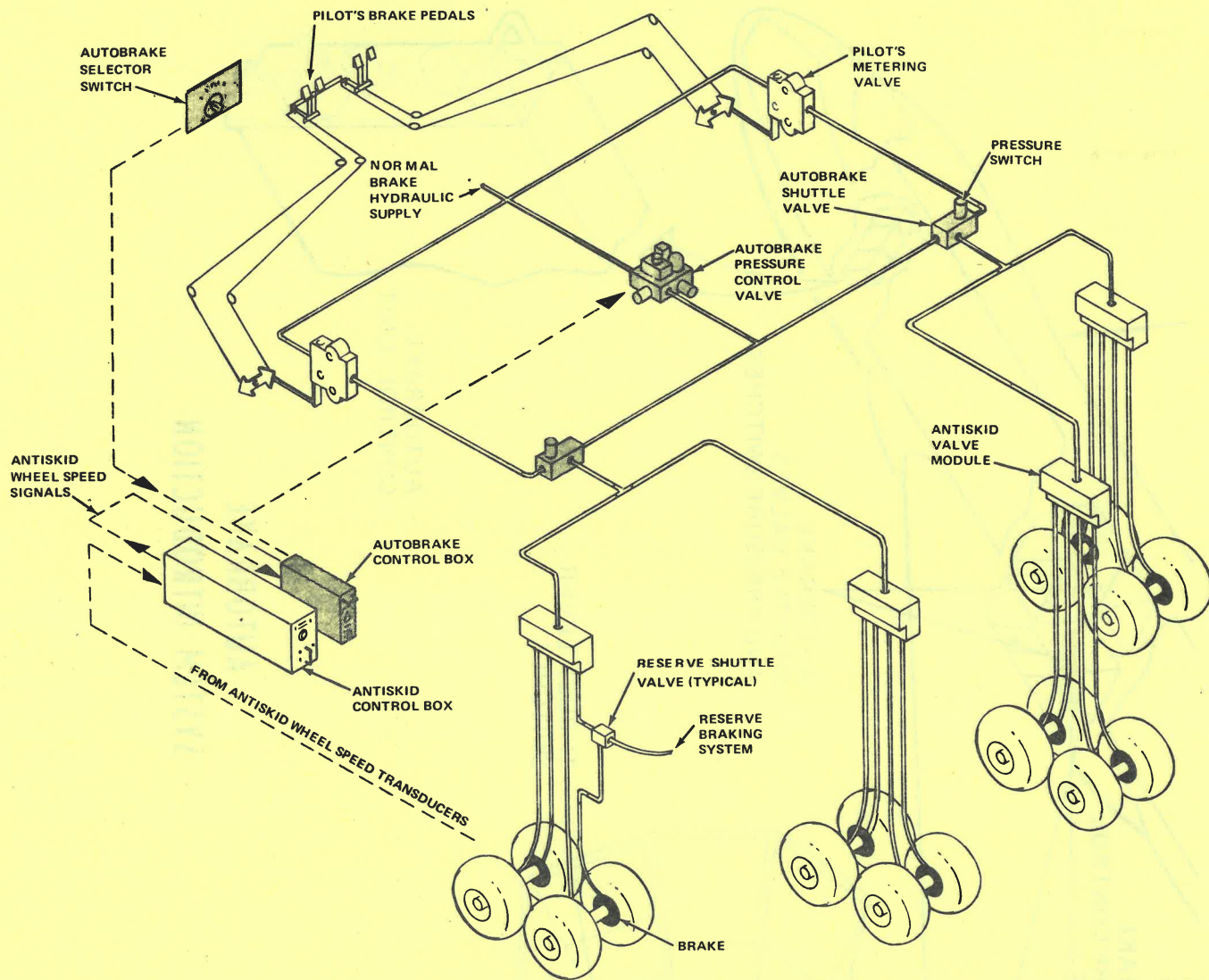
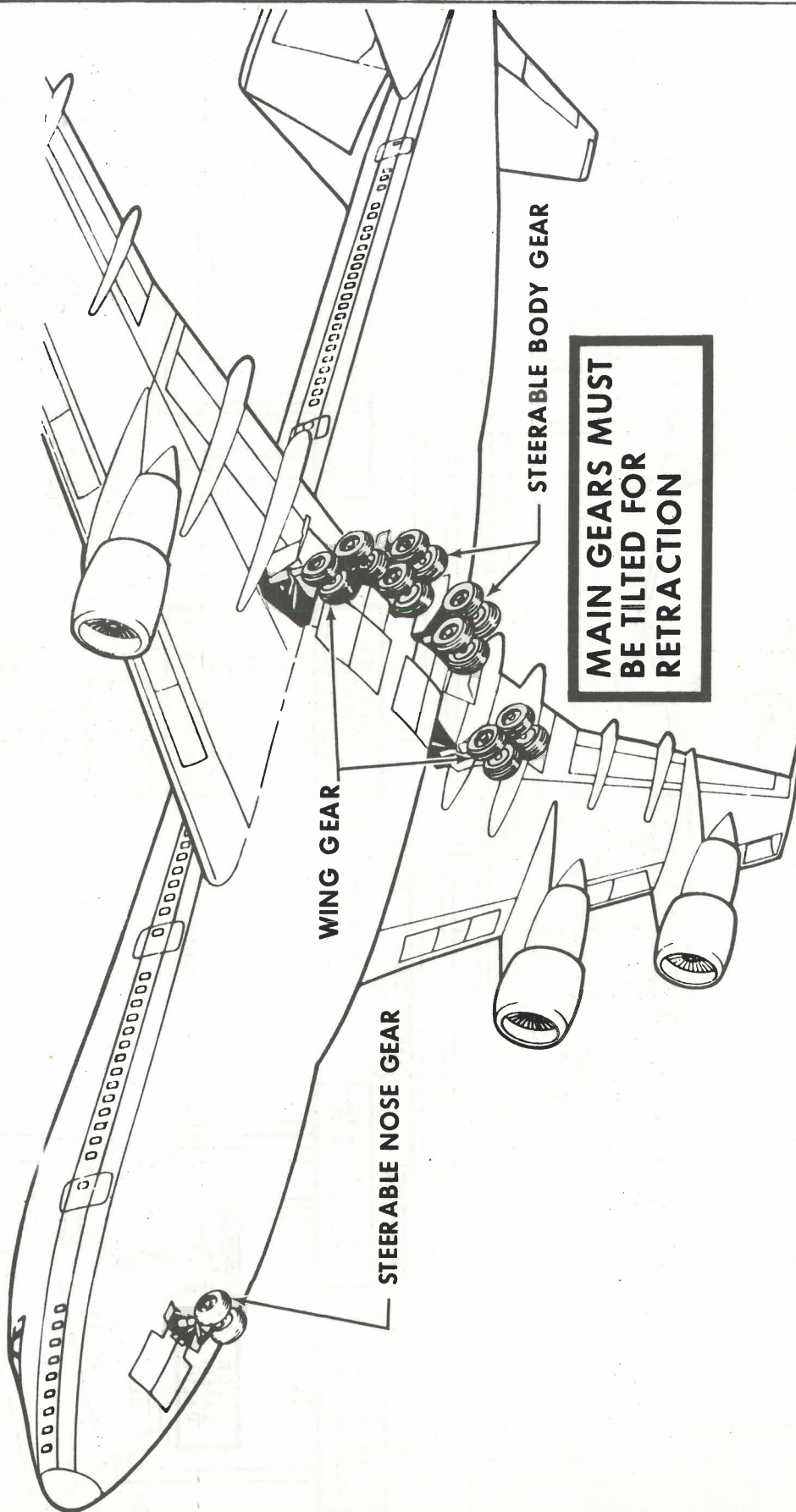
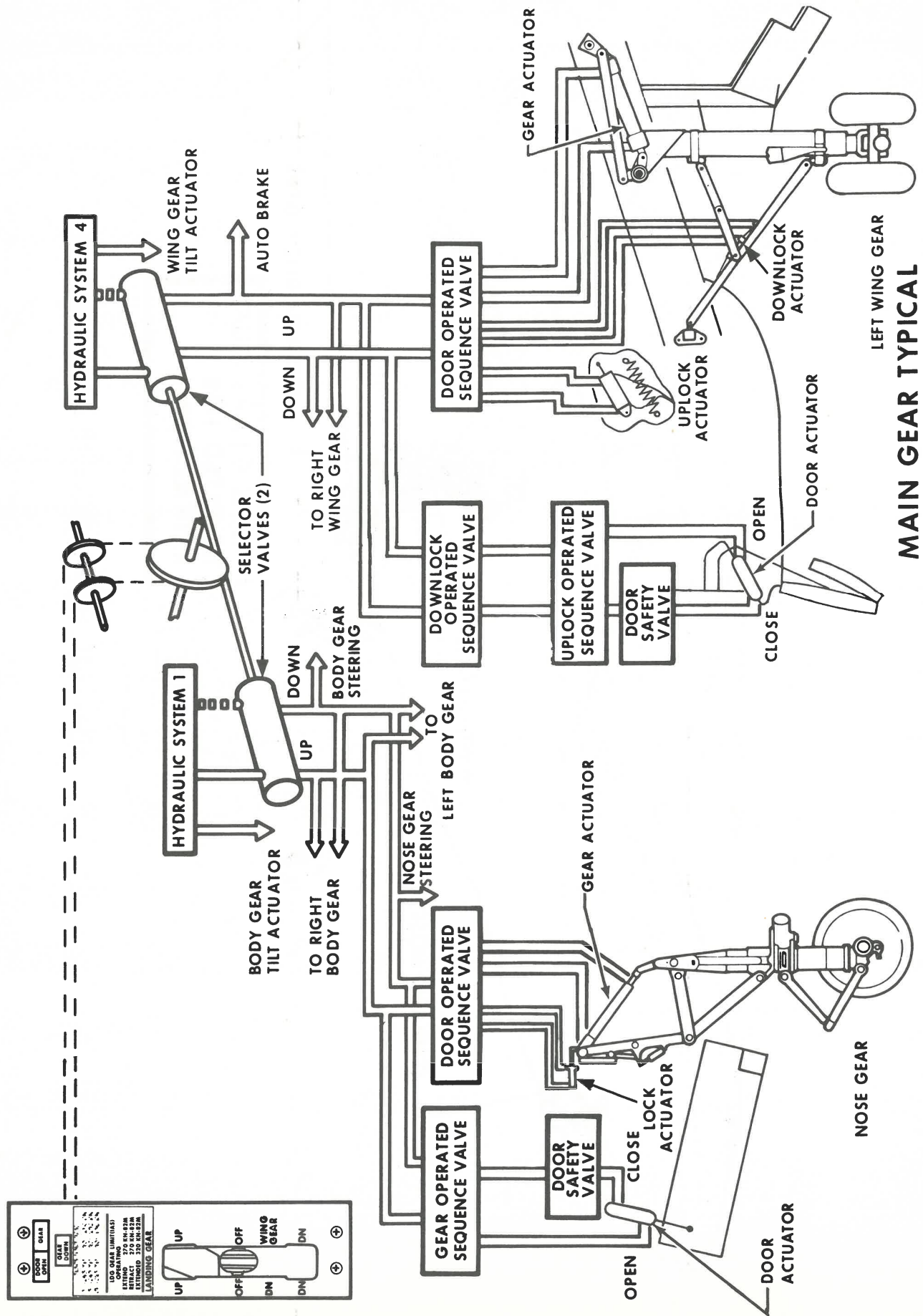
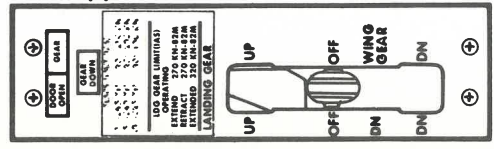


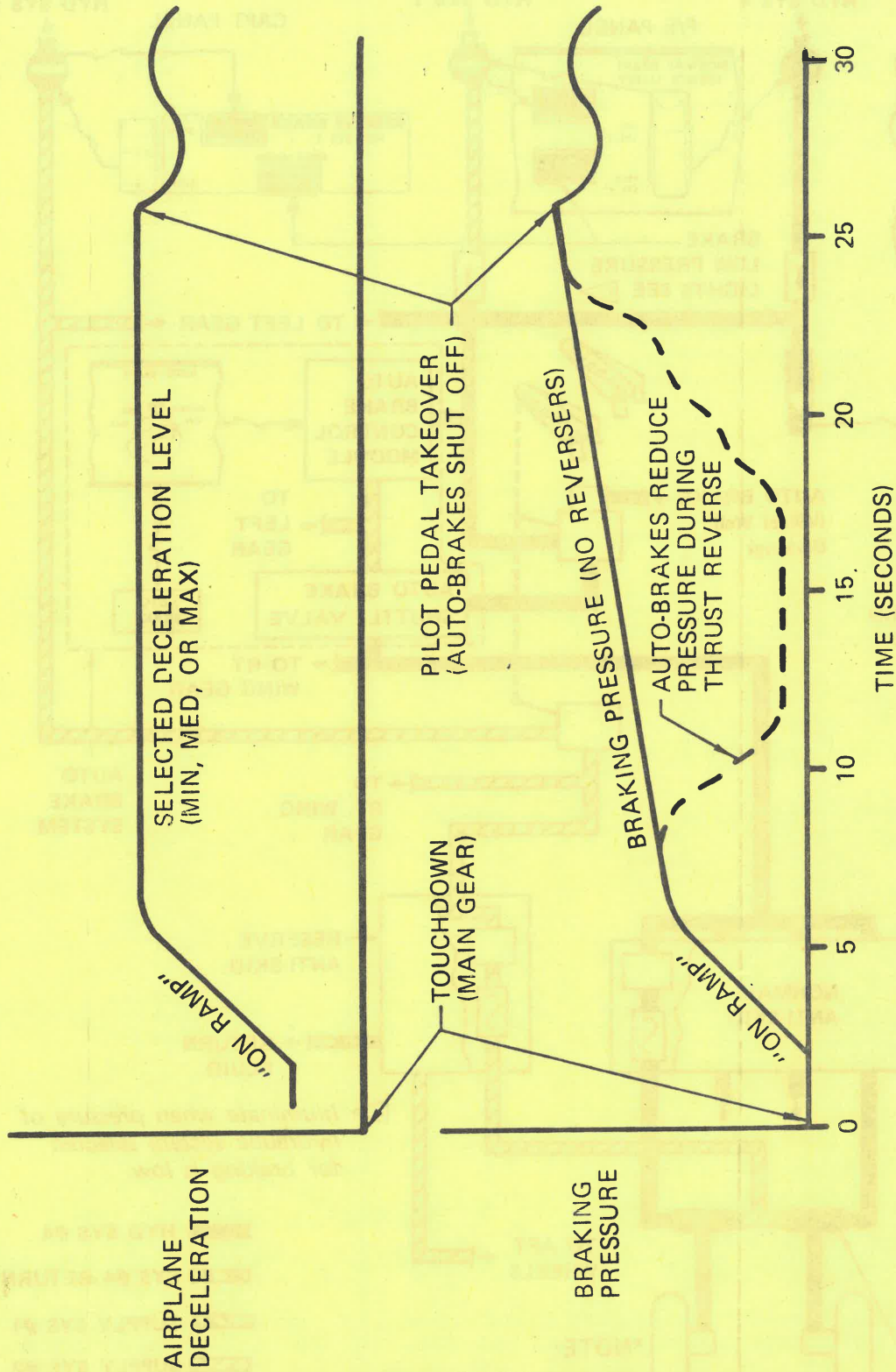
FIG. 2—When autobrakes are operating, equal brake pressure is applied by the autobrake pressure control valve through the two shuttle valves to both sides of the airplane, just as if the pilot were applying equal pressure with both brake pedals.



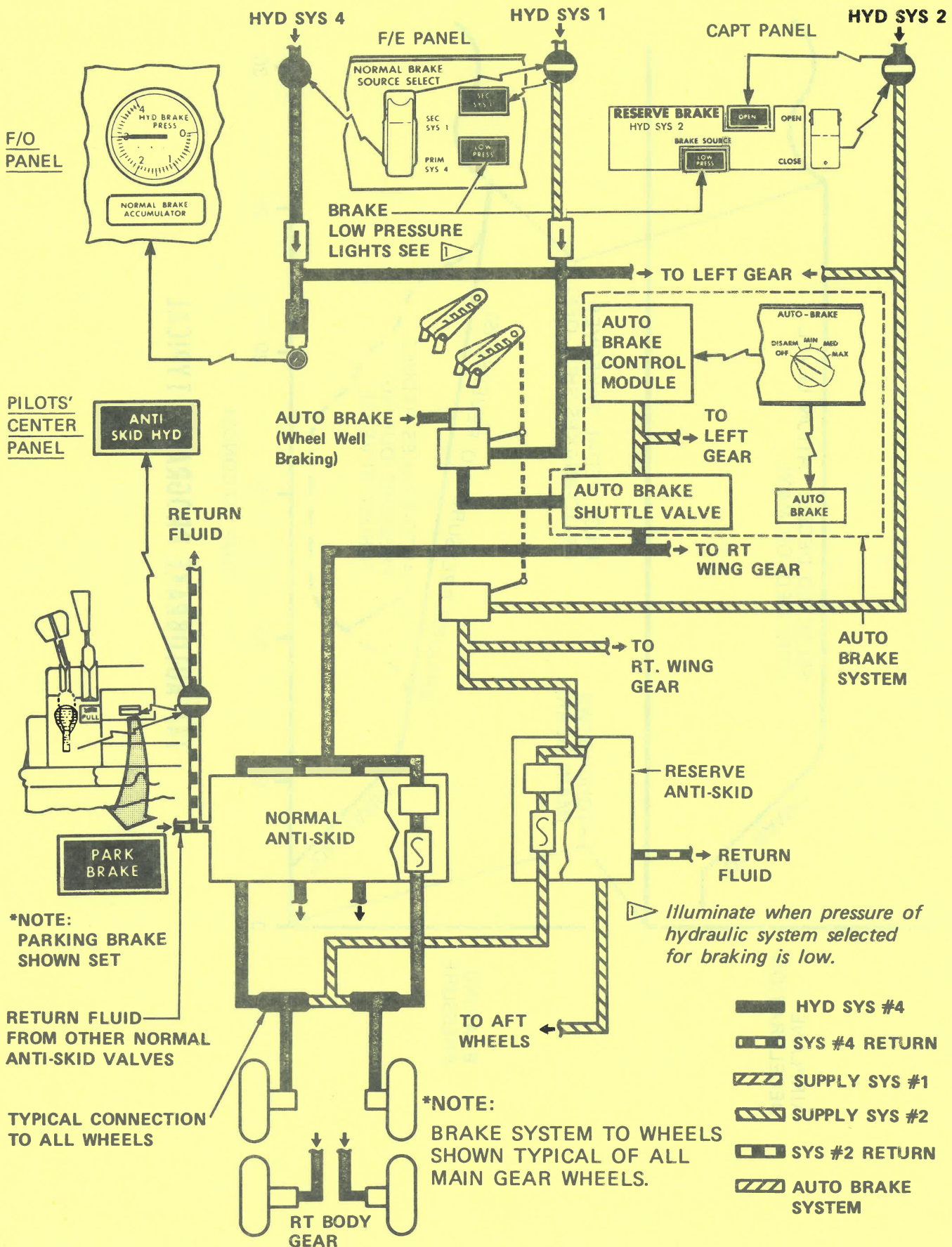


MAIN GEAR TYPICAL



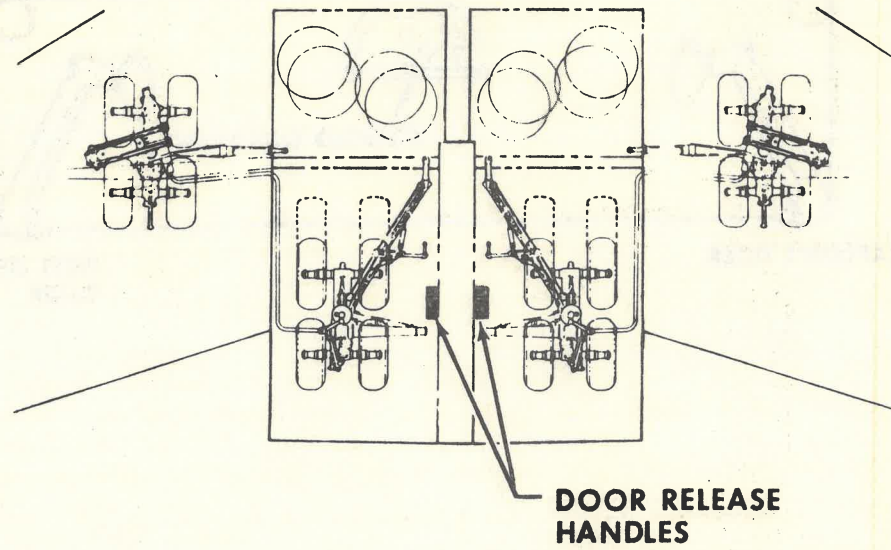
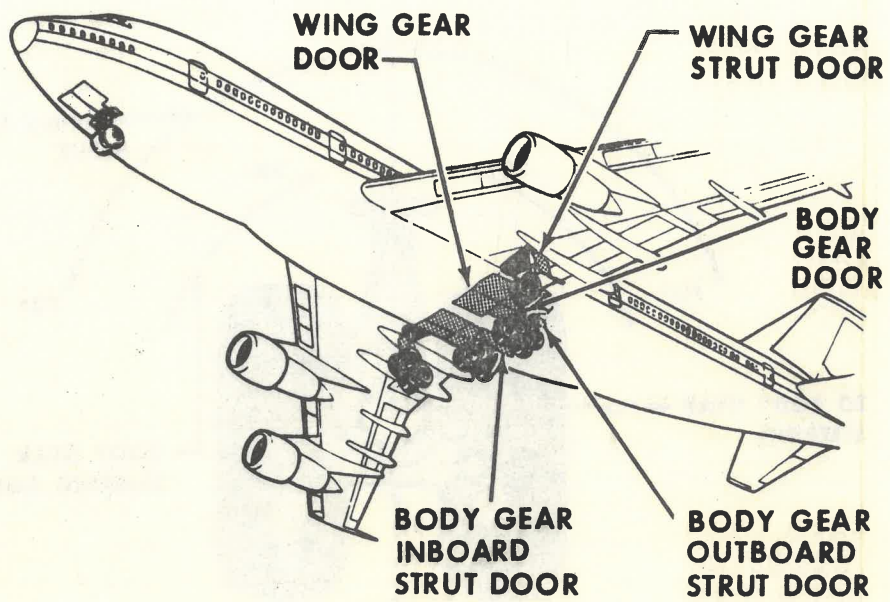


747 AUTOBRAKE PROGRAM - TYPICAL

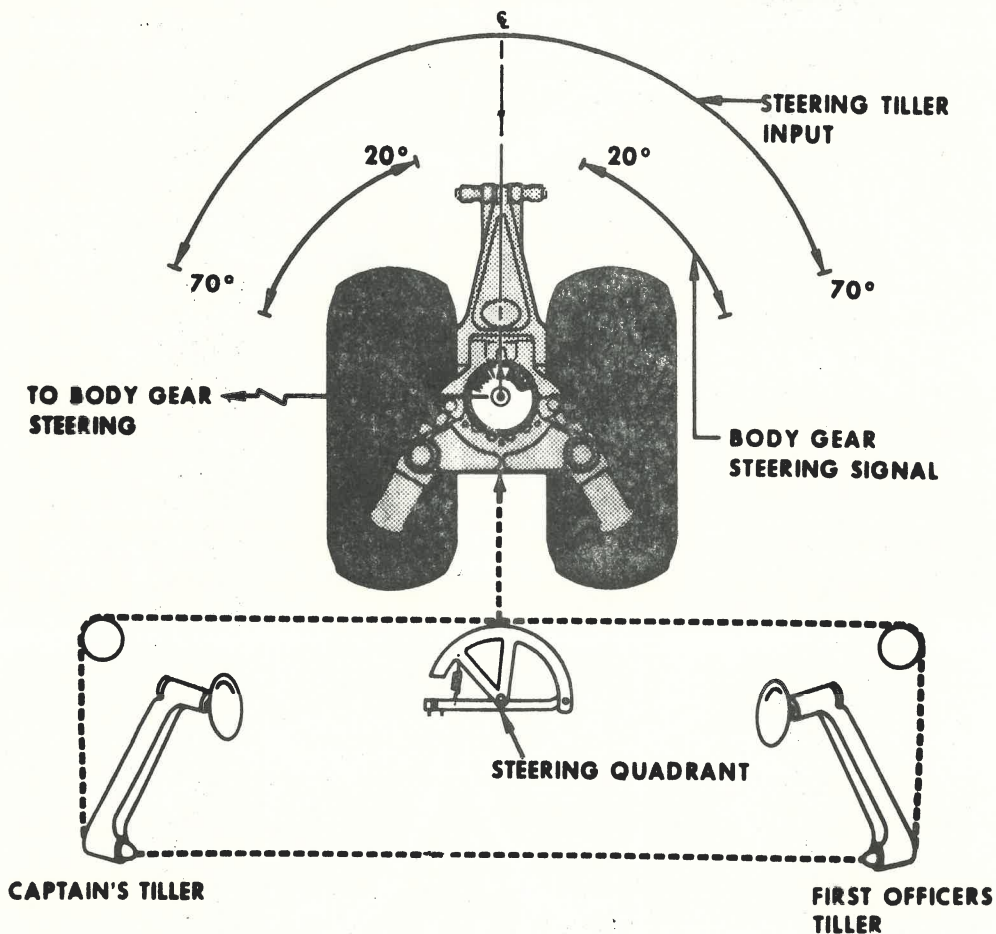




LANDING GEAR DOORS:



NOSE GEAR STEERING SYSTEM:



NOSE GEAR STEERING



AUTO BRAKE

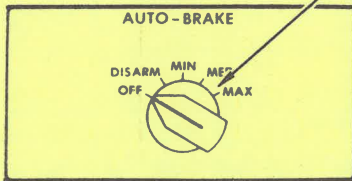
AUTO BRAKE LIGHT (Amber)
 Illuminates to indicate system is not armed or auto brake system is inoperative.

PILOTS' CENTER PANEL

NOTE: NWA airplanes this is a flashing light.

**AUTO BRAKE ARM SWITCH
 MIN-MED-MAX**

- Auto brake system is armed and deceleration level selected when switch is electrically held in MIN, MED or MAX position.
- With auto brake system armed brakes will be applied when airplane is on the ground and wheel spin-up has occurred.
- Switch will automatically move to DISARM position and AUTO BRAKE light will illuminate if:
 - Brake pedal/pedals are depressed.
 - Airplane on ground and No. 1 or 3 thrust levers in takeoff range.
 - Anti-skid system is not ON or fault exists.
 - Auto-Brake system fault or loss of electrical power.
 - Landing gear tilt functions not in agreement.



PILOTS' OVERHEAD PANEL

- DISARM - Brake pressure will release (if applied) and AUTO BRAKE light will illuminate when switch is in DISARM position.
- OFF - Positioning switch to OFF will extinguish AUTO BRAKE light.

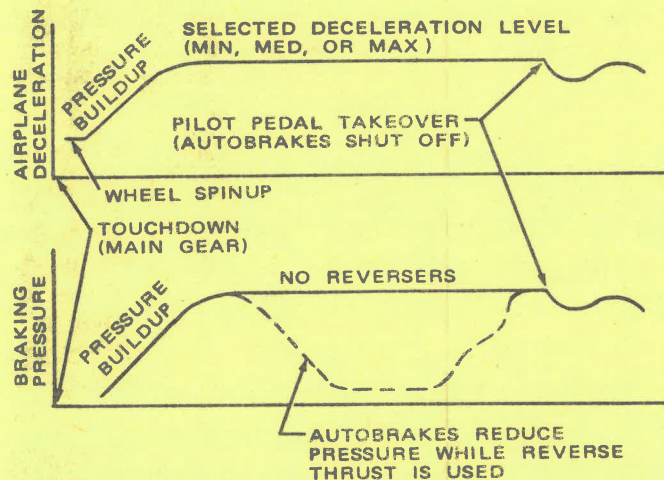
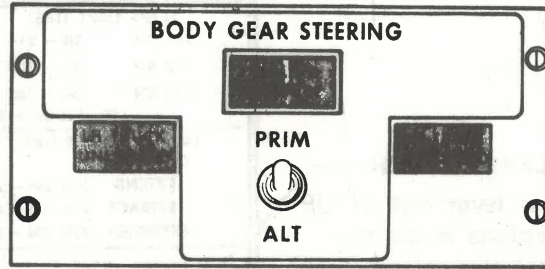
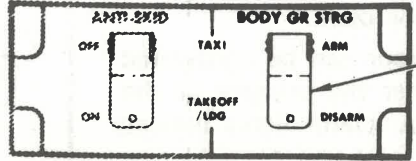


FIG. 3—The Autobrake system applies brake pressure smoothly and adjusts pressure to maintain airplane deceleration at the selected rate. If use of reverse thrust decelerates the airplane faster than the selected rate, the control circuit smoothly reduces brake pressure until the selected rate is regained.

BODY GEAR STEERING CONTROL:

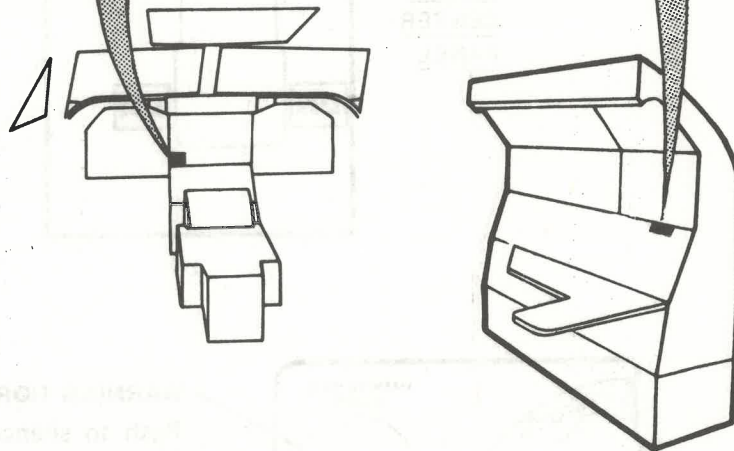
PILOTS' OVERHEAD PANEL



F/E PANEL



CENTER INSTRUMENT PANEL



LANDING GEAR CONTROL PANEL:

GEAR DOOR OPEN LIGHT (Red)

Illuminates with any one indication of a door open.

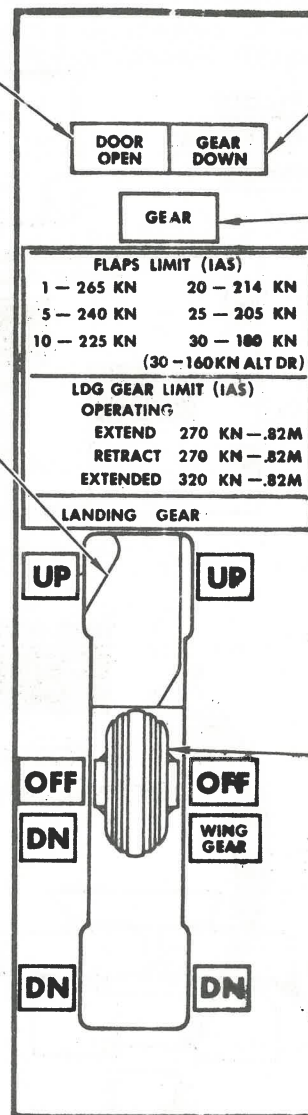
NOTE: A door can be considered closed if either the primary or the alternate annunciator lights indicate door closed.

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

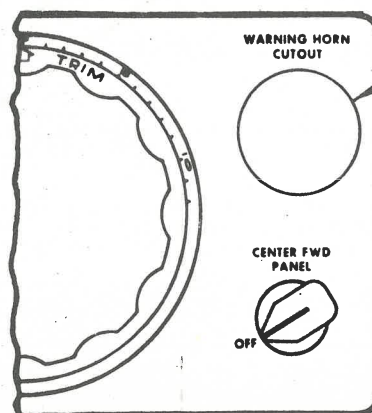
Illuminates for the following conditions:

- 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.

LANDING GEAR ANNUNCIATOR MODULE:

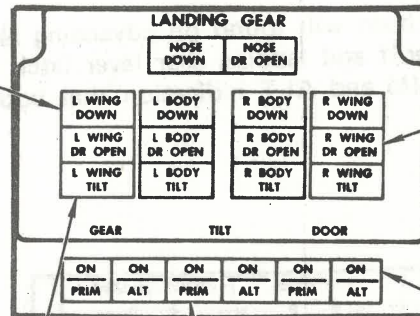
GEAR DOWN ANNUNCIATOR LIGHTS (Green)

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):

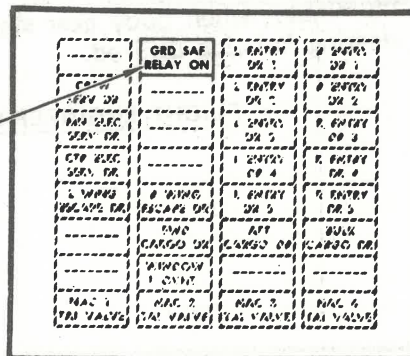
- Releases landing gear lever latch.
- Deactivates takeoff warning.
- De-energizes the ground safety relay.
- Activates anti-skid touchdown protection.
- Activates auto ground spoilers on landing.

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

BODY GEAR CONTROL PANELS:

GEAR NOT CENTERED LIGHT (Amber)

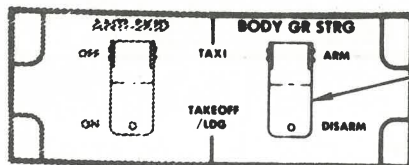
Illuminates for either a PRIM or ALT body gear unlocked indication.

NOTE: A warning horn will sound on advancing No. 3 thrust lever for takeoff and landing gear lever latch will not release with PRIM and ALT indication that body gear is not centered.

GEAR NOT CENTERED

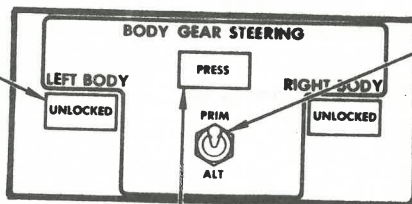
PILOTS'
CENTER
PANEL

PILOTS'
OVERHEAD
PANEL



BODY GEAR STEERING SWITCH
 DISARM position deactivates body gear steering for takeoff and landing.

BODY GEAR STEERING UNLOCKED LIGHTS (Amber)
 Illuminates for an unlocked indication for the selected PRIM or ALT systems.



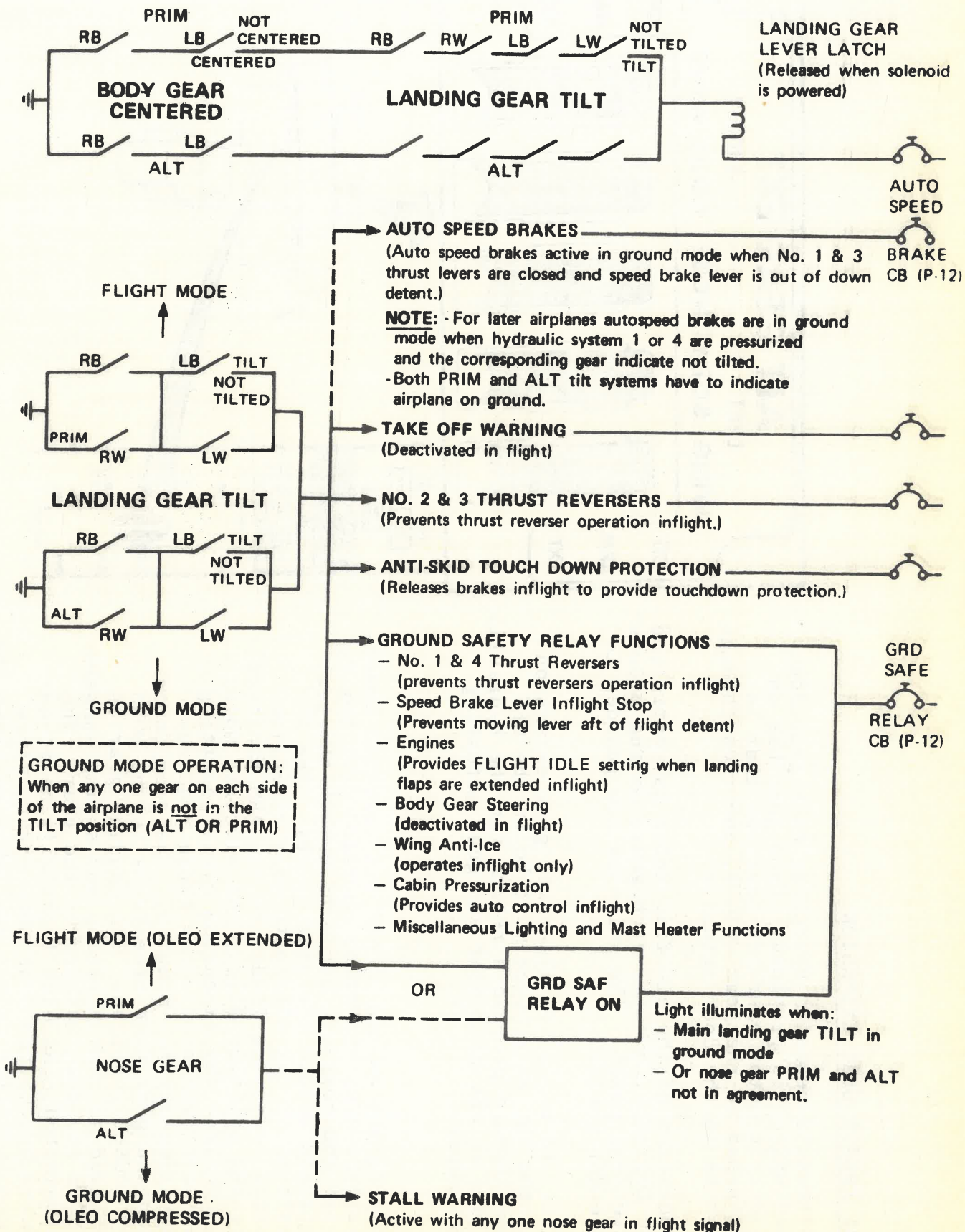
BODY GEAR STEERING ANNUNCIATOR SWITCH
 Monitors steering locked indications for selected PRIM or ALT systems.

BODY GEAR STEERING PRESSURE LIGHT (Amber)

Illuminates when body gear steering is powered and nose gear steering is being utilized.

FLIGHT ENGINEER'S PANEL

LANDING GEAR TILT SWITCH FUNCTIONS:



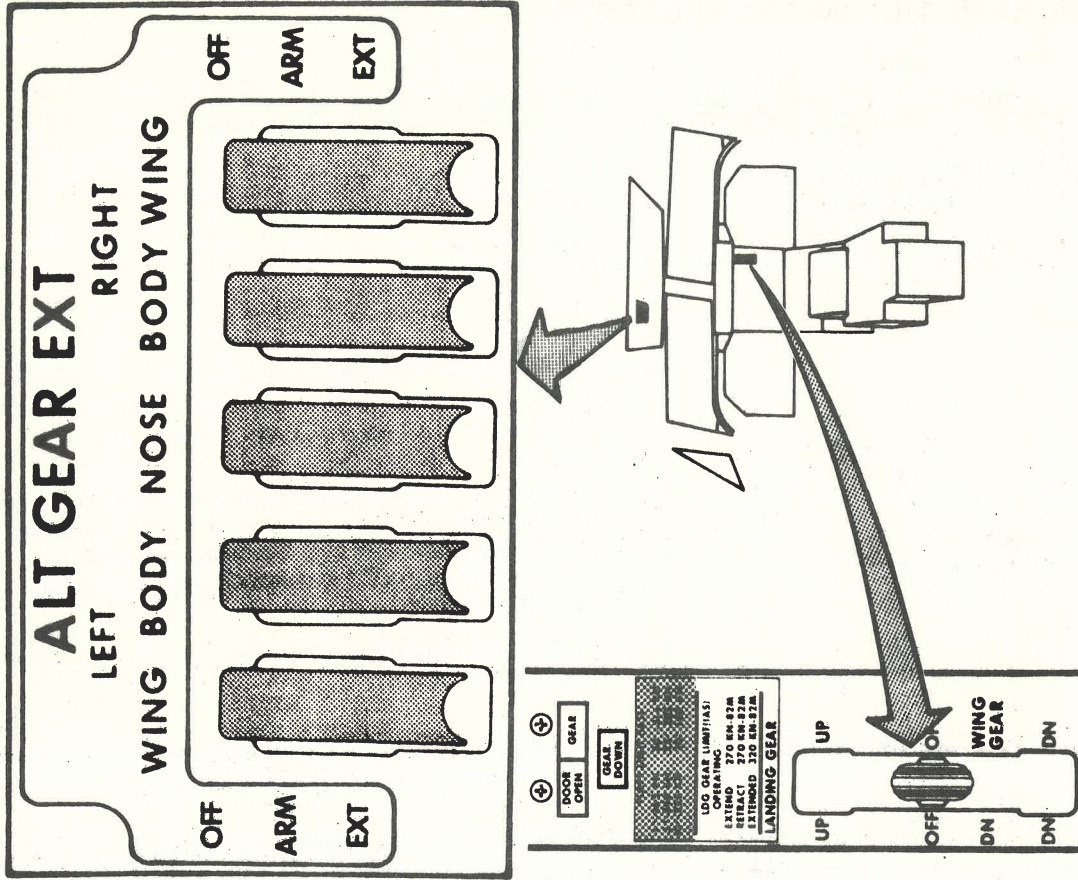
ALTERNATE GEAR EXTENSION

Alternate means of unlocking each gear door and uplock is provided. Each gear has an electric motor operated gear box that is attached to the gear uplock, and then through cables to the door actuator.

Operation of the electric motor is controlled by switches, one for each gear, on the pilots' overhead panel. The switches are guarded to the OFF position.

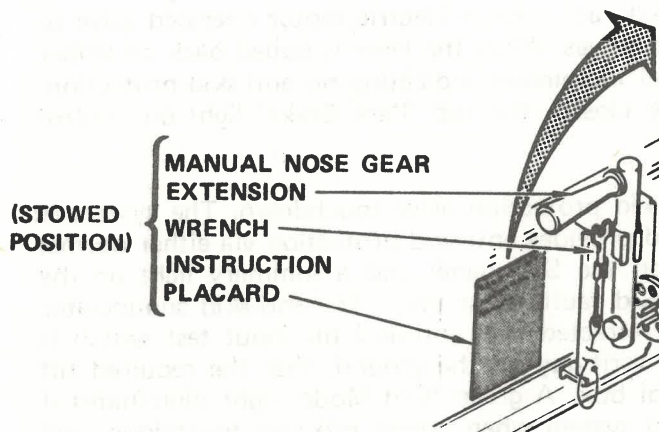
Prior to using the alternate gear extension system the gear lever must be in the OFF position to provide a return for the hydraulic fluid in the gear door and gear actuating cylinders.

Holding the switch in the EXT position momentarily, allows the motor operated gear box to start one complete cycle to unlock the gear door and unlock the gear uplock. The EXT position of the alternate gear extension switch is spring-loaded to the ARM position. The ARM position allows the electric motor to complete the extension cycle resetting the door mechanism. The cycle requires approximately two minutes. The gear doors open and gear then free falls to the DOWN and LOCKED position. The landing gear is designed so that airloads and spring bungees aid in the down locking of the gear. The illuminated GEAR DOWN light will be accompanied by the red DOOR OPEN light, since hydraulic power is not available to close the gear doors.



NOSE GEAR MANUAL EXTENSION CONTROL:

LOWER ELECTRONIC
 COMPARTMENT
 LEFT SIDE OF WHEEL
 WELL



N.L.G. MANUAL EXTENSION



ARROW IN GREEN ZONE INDICATES GEAR DOWN & LOCKED.

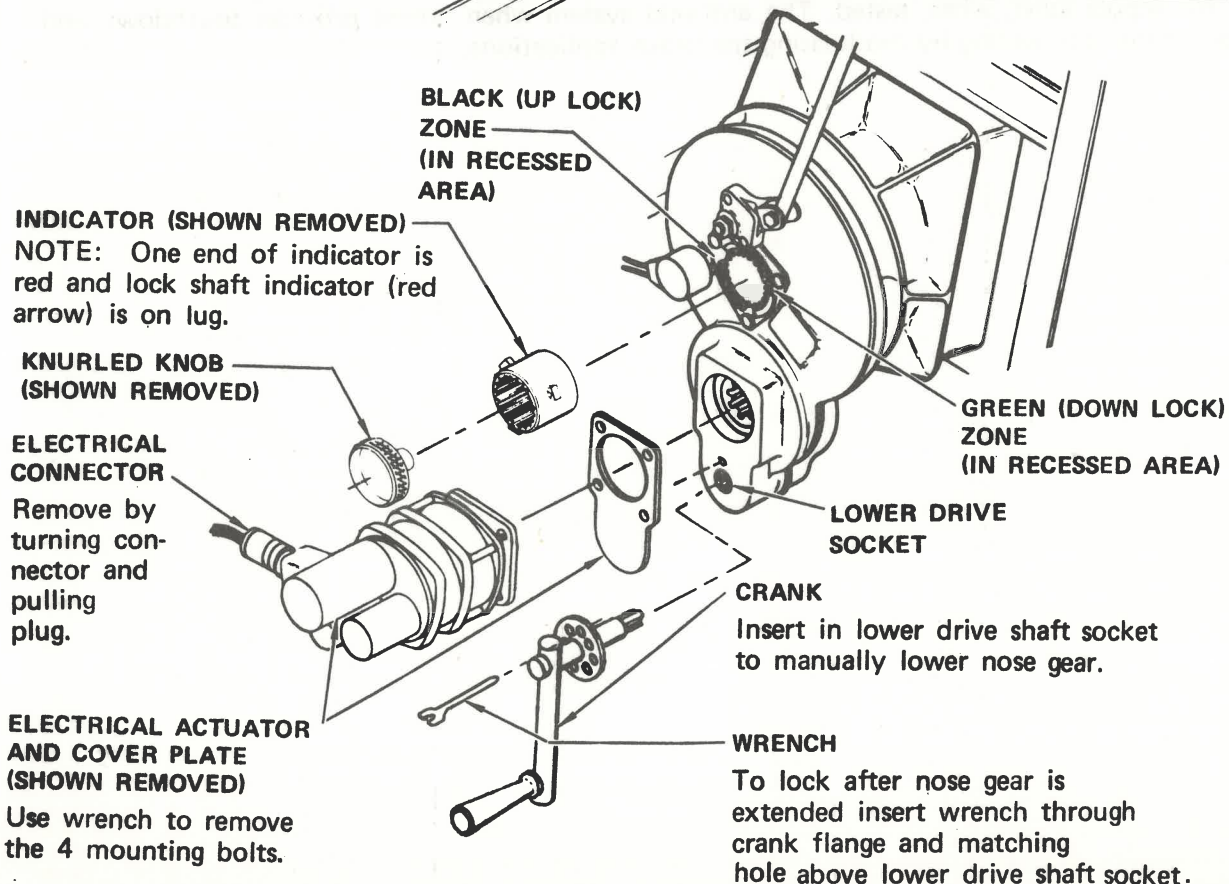
TO RELEASE GEAR - ARROW IN BLACK ZONE:

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 OUT'B'D) & ROTATE CRANK CCW UNTIL INDICATOR ENGAGES SLOTTED SHAFT.
4. REPLACE & TIGHTEN KNOB.
5. NOTE POSITION OF LOCK SHAFT INDICATOR (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 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.





BRAKE SYSTEM:

All sixteen main gear wheels have hydraulic braking capability provided by either the normal or reserve brake system. The normal brake system is pressurized by its primary source, hydraulic system No. 4 and if this system fails the No. 1 system is the secondary choice. This brake source selection is controlled by a switch on S/O panel. A green 'Sec Sys 1' light illuminates when this secondary source is selected. An amber 'Low Press' light illuminates on S/O panel to reflect status of brake source selected. An amber 'Low Press' light on reserve brake module on pilot's pedestal illuminates to reflect normal brake selected source status. The reserve brake system is controlled by switch on pilot's pedestal as well as an 'Open' light that illuminates when reserve brake valve is open. Hydraulic system No. 2 powers the reserve brake system.

A normal brake system pressure gauge is located on the F/O panel. The Accumulator pre-charge is 750 PSI. The reserve brake system has no accumulator or pressure gauge. Parking Brake Handle located on pedestal, when pulled back, actuates an electric motor operated valve to close and block return fluid from normal anti-skid valves. When the lever is pulled back an amber 'Anti-Skid Hyd' light on pilot's annunciator panel illuminates indicating no anti-skid protection. When this electric motor operated valve is fully closed, the red 'Park Brake' light on control stand illuminates.

Anti-Skid System provides touchdown and skid protection after touchdown. The system is controlled by a switch on the overhead panel and provides anti-skid protection via either normal or reserve brake systems. A fault annunciator on the S/O panel and a summary light on the pilot's annunciator indicate when electrical anti-skid faults exist only. The anti-skid annunciator lights are deactivated when the landing gear is retracted. An anti-skid tilt input test switch is located on S/O panel and provides a means of verifying on the ground, that the required tilt input signals are available to the anti-skid control box. A green 'Grd Mode' light illuminates if these tilt inputs exist, when tested. The anti-skid system when armed provides touchdown and skid protection on landing by modulating the brake applications.

BRAKE SYSTEM:

GENERAL

1. Brakes provided on all sixteen main gear wheels through normal and alternate brake control valves.
 - a. Normal hydraulic brake pressure is provided through a guarded "NORMAL BRAKE SOURCE SELECT" switch on S/O panel.
 - (1) "PRIM SYS 4" position — Hydraulic pressure from No. 4 system.
 - (2) "SEC SYS 1" position — Hydraulic pressure from No. 1 system.
 - (a) "SEC SYS 1" light illuminates when system No. 1 is selected.
 - (3) Two Brake Low Pressure lights illuminate when selected brake pressure is low.
 - (a) One light located on S/O panel
 - '1' For No. 4, No. 1 system and No. 2 system.
 - (b) One light located on forward electronic panel
 - '1' For No. 4, No. 1 or No. 2 systems.
 - NOTE: Both lights remain illuminated when No. 4 AC operated hydraulic pump is supplying brake pressure.
 - (4) A "HYD BRAKE PRESS" Indicator located on F/O's panel indicates normal brake system pressure.
 - b. Reserve hydraulic brake pressure is provided from hydraulic system No. 2 through a guarded "RESERVE BRAKE" selector switch on forward electronic panel.
 - (1) A valve "OPEN" light above switch illuminates when reserve brake valve is open.
 - c. Parking brakes are applied through parking brake lever located on pilots' control stand.
 - (1) A red "PARK BRAKE" light on pilots' control stand illuminates when anti-skid control valve is fully closed and parking brake lever is set.
 - (2) An "ANTI SKID HYD" light on pilots' center instrument panel illuminates when anti-skid control valve is not fully open.
 - d. A brake accumulator is located in the right body wheel well.
 - (1) Brake accumulator air precharge 750 psi.

ANTI-SKID SYSTEM

1. Anti-skid system modulates the brake pressure through a normal and reserve brake valve system to prevent tire damage and skidding of the wheels.

a. Normal anti-skid system controls wheels individually while reserve system controls wheels in pairs.

(1) System controlled by guarded "ANTI-SKID" switch on pilots' overhead panel.

(a) ON position — Anti-skid system operative.

'1' Above 10 knots

'2' Main gear down and locked

'3' Gear trucks are not tilted .

'4' Anti-skid control valve must be fully open

'b' "ANTI-SKID HYD" light — Located on center instrument panel and illuminates if valve not fully open.

b. Anti-skid annunciator located on S/O panel.

(1) Anti-skid Annunciator lights illuminate to indicate an anti-skid electrical failure for the indicated wheel.

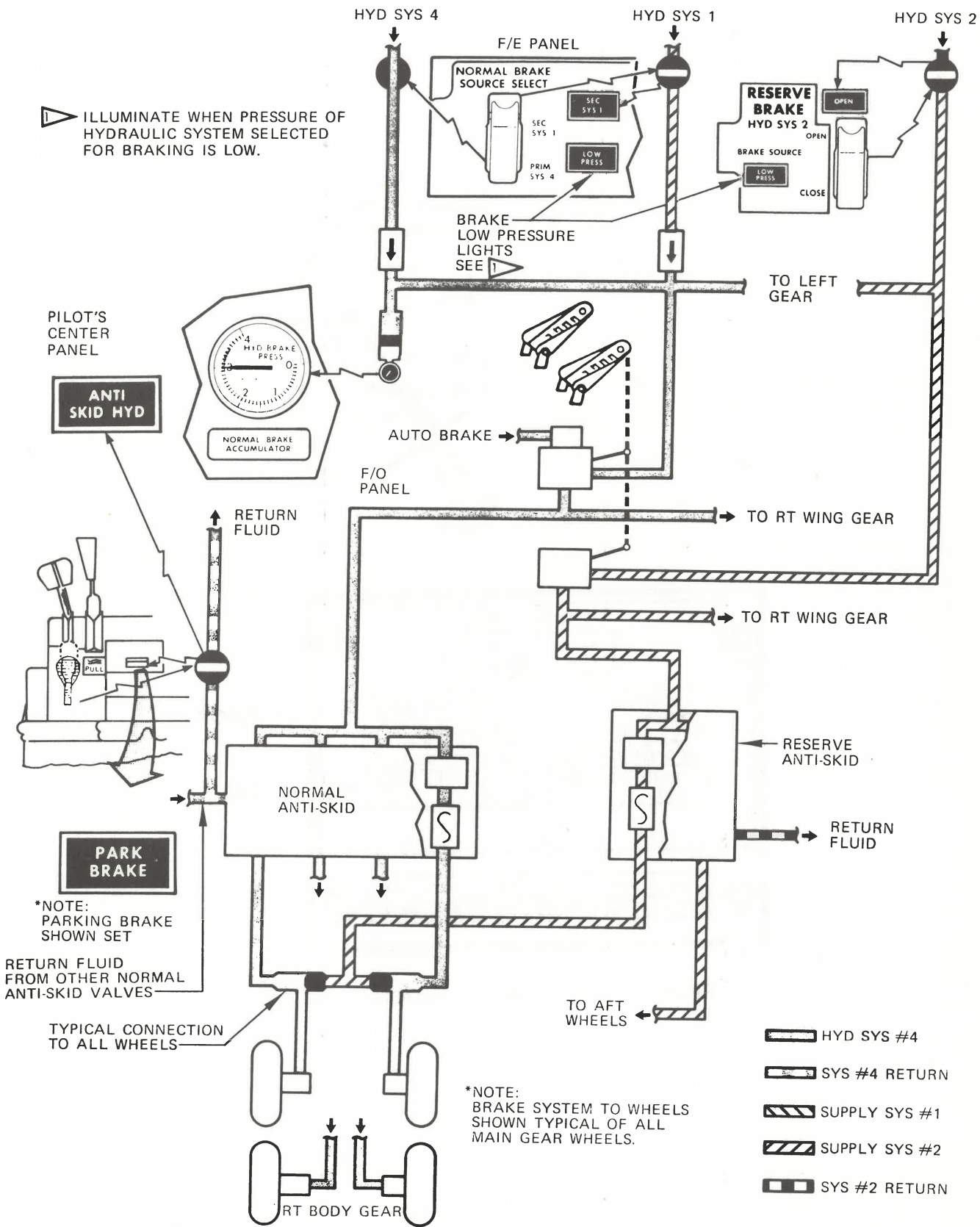
(2) "RESERVE VALVE" Annunciator lights illuminate to indicate an electrical failure in reserve anti-skid valve.

c. A Master "ANTI-SKID" light — Located on pilots' center instrument panel.

(1) Illuminates with an electrical failure in the anti-skid system, as indicated on the anti-skid annunciator located on S/O panel.

NOTE: Master light and Annunciator lights deactivated when landing gear is retracted.

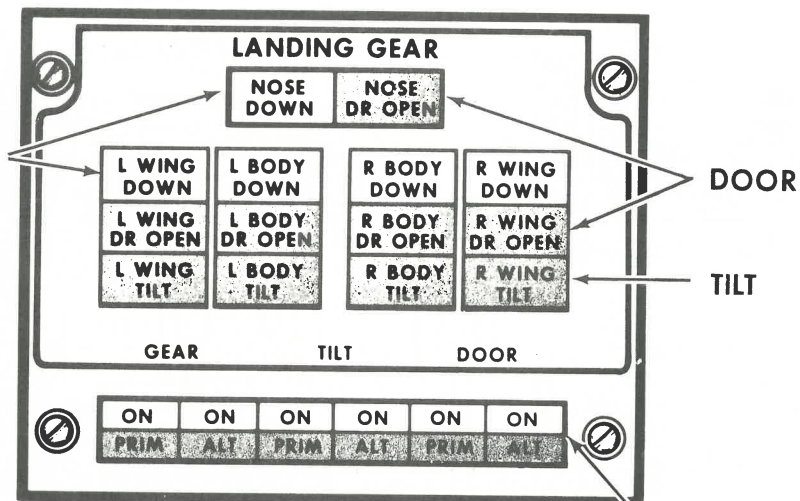
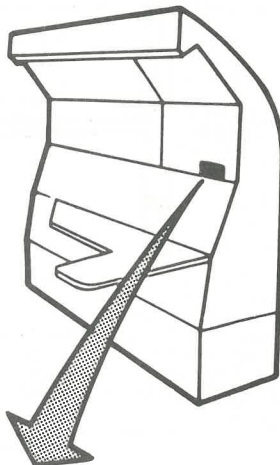
HYDRAULIC BRAKE SYSTEM:



HYDRAULIC BRAKE SYSTEM



LANDING GEAR ANNUNCIATOR:

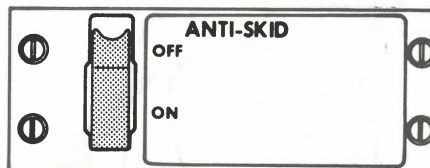


PRIMARY & ALTERNATE SWITCHES

ANTI-SKID CONTROL:

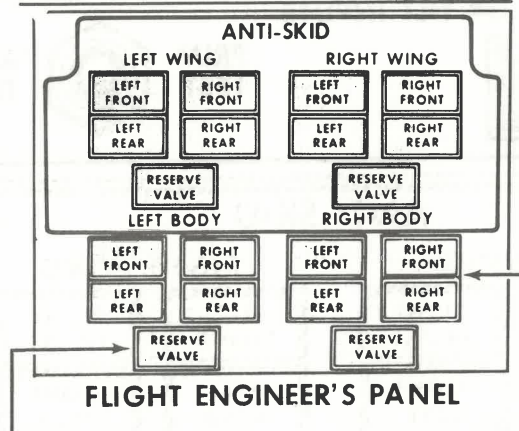
ANTI-SKID SWITCH

- 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

ANTI-SKID ANNUNCIATOR PANEL



RESERVE VALVE ANNUNCIATOR LIGHTS

ILLUMINATE TO INDICATE AN ELECTRICAL FAILURE IN RESERVE ANTI-SKID VALVE.

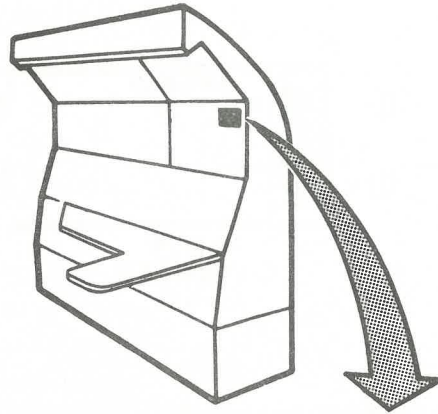
ANTI-SKID ANNUNCIATOR LIGHTS

ILLUMINATE TO INDICATE AN ANTI-SKID ELECTRICAL FAILURE FOR THE INDICATED WHEEL.

NOTE : ANTI-SKID LIGHT AND ANNUNCIATORS ARE DEACTIVATED WHEN THE LANDING GEAR IS RETRACTED.




ANTI-SKID LANDING GEAR TILT INPUTS TEST:



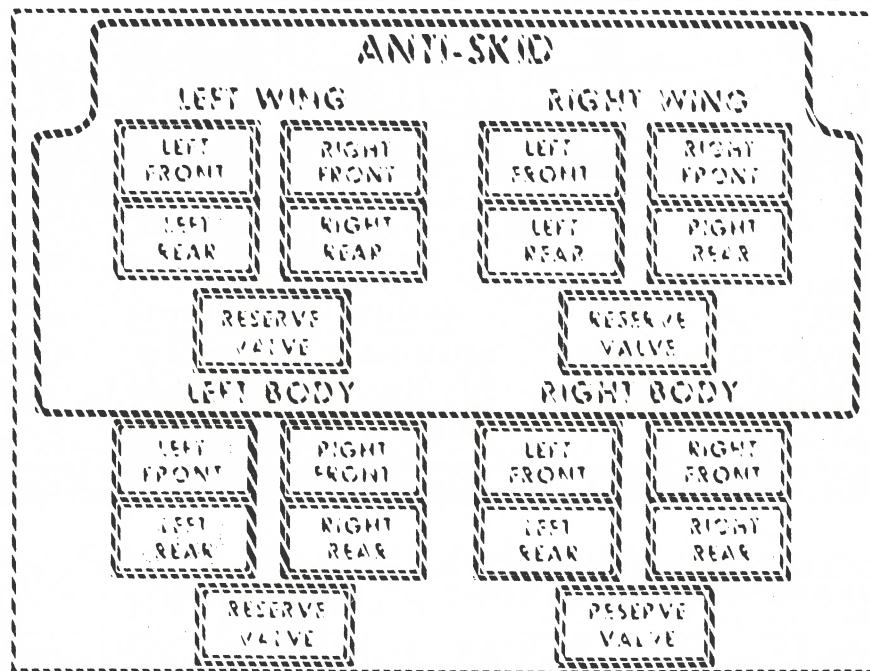
ANTI-SKID LDG GR TILT INPUTS

GRD
MODE

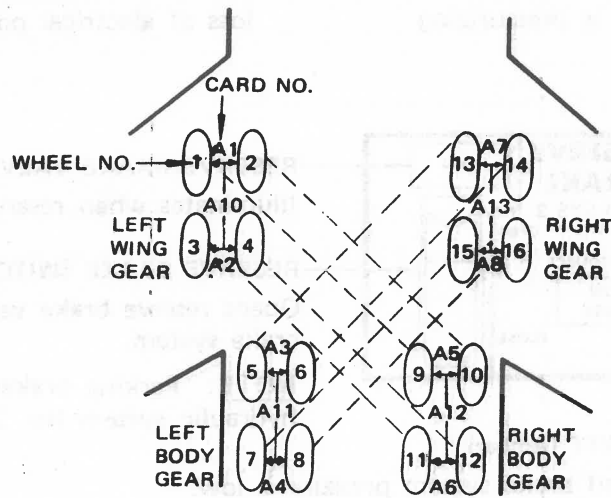
**PRIM
TEST**



**ALT
TEST**



WHEEL AND BRAKE NUMBERING:

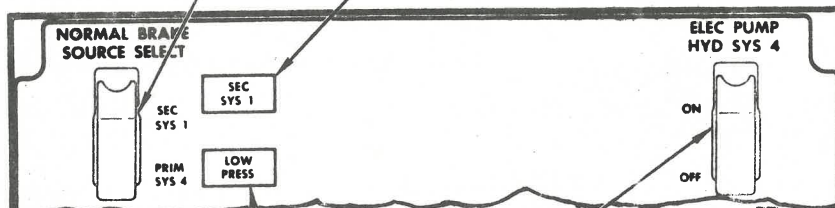


BRAKE SYSTEM CONTROL PANELS:

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.

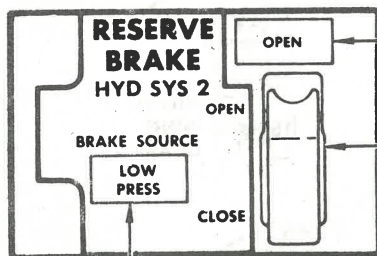
ENGINEER'S PANEL



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



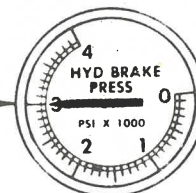
RESERVE BRAKE VALVE OPEN LIGHT (Green)
 Illuminates when reserve brake valve is open.

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.

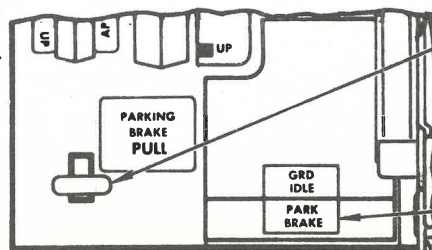
HYDRAULIC BRAKE PRESSURE INDICATOR
 Indicates normal brake system pressure. With no system pressure and parking brakes not set, indicates accumulator precharge pressure.



FIRST OFFICER'S PANEL

NORMAL BRAKE ACCUMULATOR

PILOTS' CONTROL STAND



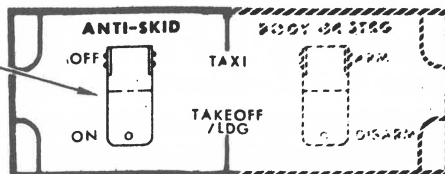
PARKING BRAKE LEVER
 To set brakes, move lever aft with brakes applied. Apply brakes to release parking brakes.

PARKING BRAKE LIGHT (Red)
 Illuminates when parking brakes are set.

ANTI-SKID CONTROL PANELS:

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

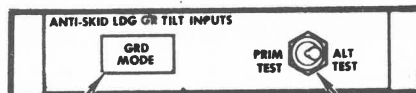
ANTI-SKID LIGHT (Amber)
 Illuminates to indicate electrical failure in the antiskid system.

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)*

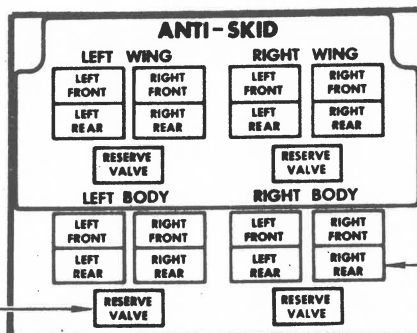
ANTI-SKID GRD MODE LIGHT (Green)

- 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.

MEMORANDUM

TO : Mr. Tolson

FROM : Mr. [Name]

SUBJECT: [Subject]

Reference is made to the report of [Name] dated [Date].

The information contained in the report is being reviewed.

It is noted that the report contains information regarding [Subject].

The information is being reviewed in light of the current situation.

It is recommended that the information be disseminated to [Name].

This recommendation is based on the information contained in the report.

The information is being reviewed in light of the current situation.

It is recommended that the information be disseminated to [Name].

This recommendation is based on the information contained in the report.

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It is recommended that the information be disseminated to [Name].

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It is recommended that the information be disseminated to [Name].

This recommendation is based on the information contained in the report.

| | |
|---|----|
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LIGHTING:

The cockpit is illuminated by flood lights and the instrument panels have integral lighting. Lighting is controlled at respective crew member's station. Warning and annunciator lights at S/O panel and pilot's instrument panels are checked by a test switch at their respective station. Blue legend lights on panels are provided to identify the selector switches. Storm lights are provided for illumination during thunderstorm activity and are controlled by a switch on pilot's lower overhead panel. Standby lighting illuminates automatically whenever the ground service bus is lost to provide instrument panel illumination.

The passenger compartment lighting and the master control for the reading lights are controlled at flight attendant stations. Individual control for passenger reading lights are controlled at seat panel. Passenger boarding lights at each door are controlled at respective cabin attendant station while the stairwell lighting is controlled at IL attendant station. Passenger advisory lights (Fasten Seat Belt and No Smoking) are controlled from pilot's overhead panel.

Emergency lights illuminate doorways, aisles, and escape slides as well as red exit signs over the doors. The emergency lighting system when armed, illuminate with loss of the essential DC bus from self contained batteries. Control of the emergency lighting system is from either the pilot's overhead panel or from IL cabin attendant station.

Aircraft exterior lights are controlled from pilot's overhead panel. The four navigation lights are controlled by the NAV switch and voltage to the lights on the ground is reduced to about one-half. The runway turnoff lights are automatically prevented from being on inflight. Both rotating beacons are dimmed automatically when the airplane is on the ground and can be dimmed inflight by going to the 'DIM' position of the beacon switch. Landing and runway turnoff lights are limited to five minutes when the aircraft is not moving.



LIGHTING SYSTEM:

GENERAL

1. Cockpit is illuminated externally by Flood lights and instrument panels for each crew member has integral lighting.
 - a. External and internal integral lighting of instrument panels are controlled at respective crew member's station.
 - b. Warning lights on S/O panel and pilot instrument panels may be checked by a master dim and test switch at their respective station.
 - c. Blue Legend lights on panels illuminate to identify the pushbutton selector switches.
 - d. Storm lights provide cockpit illumination and are controlled by switch on pilots' overhead panel.
 - e. Standby lighting to the instrument panels is provided automatically whenever power to the ground service bus is lost.

2. Passenger Compartment lighting is controlled by switches at various flight attendant stations.
 - a. Reading lights for each passenger are controlled by switches at individual seat.
 - b. Passenger Boarding lights at each door are controlled by switches at cabin attendants' station.
 - c. Stairwell lights are controlled by a rotary switch at 1L attendant station.
 - d. Passenger No Smoking and Fasten Seat Belt lights are controlled by switches on pilots' overhead panel.
 - e. Emergency Exit lights in each door or exit are controlled by switches on pilots' overhead panel.
 - (1) Emergency light switch on pilots' overhead panel provides for automatic or manual illumination of lights.
 - (a) OFF position — Removes power from Emergency Exit lights.
 '1' UNARMED light on overhead panel will illuminate.
 - (b) ARMED position — Lights will illuminate automatically with the loss of essential DC bus. Emergency light batteries are charged in this position.
 - (c) ON position — Will illuminate Emergency lights.
 '1' UNARMED light will also illuminate.

3. Aircraft exterior lighting is controlled by switches on pilots' overhead panel.
 - a. Wing lights
 - b. Runway Turnoff lights
 - c. Navigation lights
 - d. Anti-collision lights
 - e. Landing lights

NORTHWEST ORIENT



FREIGHTER

33:01F

LIGHTING

There are no lighting changes in the cockpit from our present B-747.

Main cargo deck lighting is provided by incandescent lights. Threshold and ceiling lights illuminate the cargo deck and the area immediately outside the airplane. Controls are located at the load master station and supernumerary area. Lights are powered from the Cargo Handling busses.

An emergency lighting system is provided to illuminate the cockpit, crew service door, and cargo deck area adjacent to the exits.

Logo lighting is provided to illuminate the NWA Logo on each side of the vertical stabilizer. A control switch for these lights are located on the pilot's overhead panel.

Flight deck access lights provide illumination to and from the cockpit. Control for these lights are located in the cockpit, load master panel, and main E/E compartment.

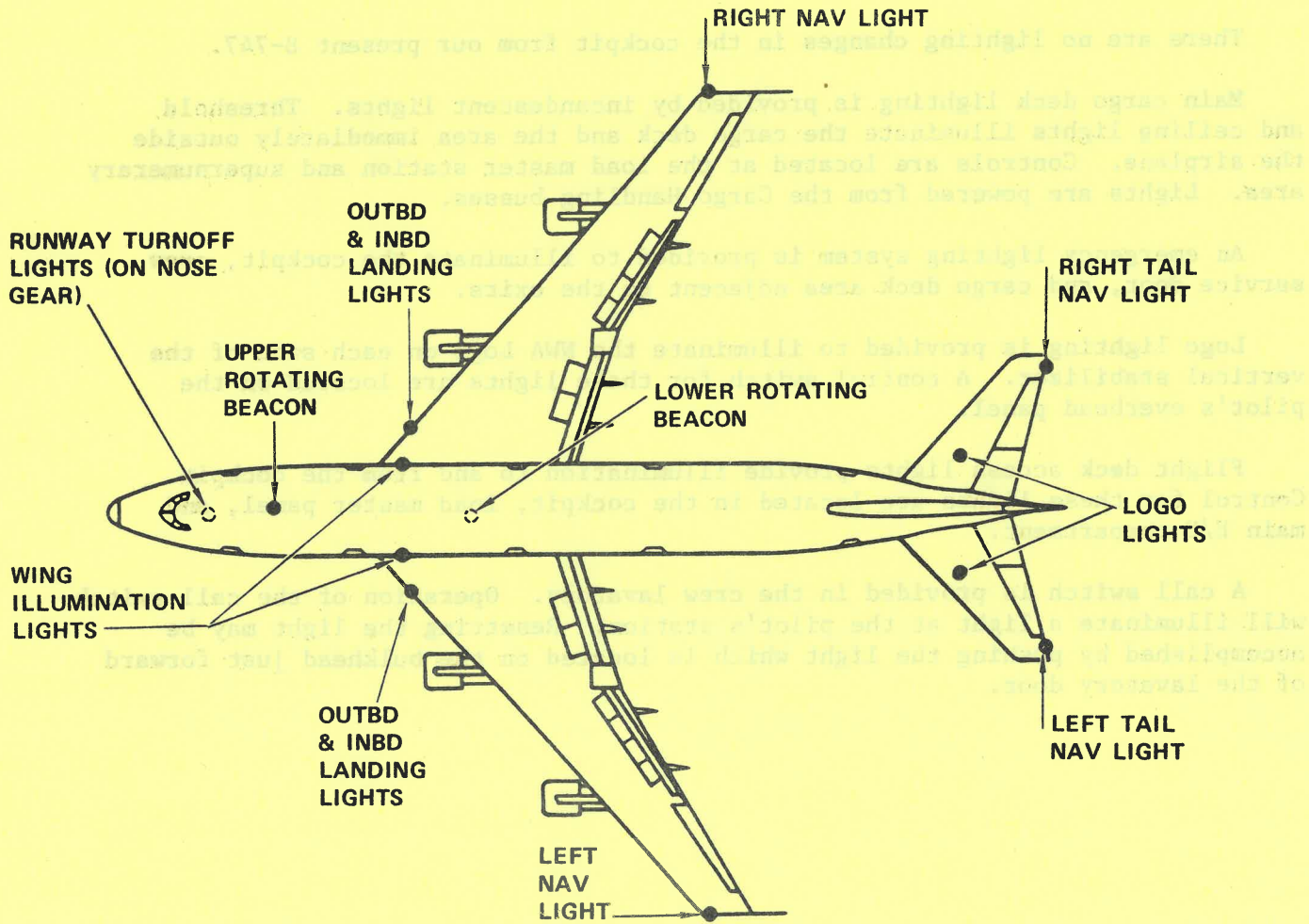
A call switch is provided in the crew lavatory. Operation of the call switch will illuminate a light at the pilot's station. Resetting the light may be accomplished by pushing the light which is located on the bulkhead just forward of the lavatory door.



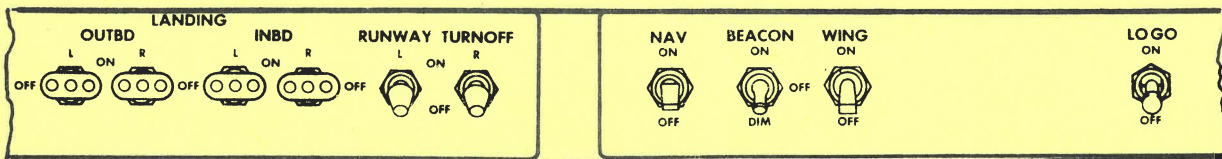
EXTERIOR LIGHTS LOCATION

EXTERIOR LIGHTS CONTROLS

EXTERIOR LIGHTING



EXTERIOR LIGHTS LOCATION



PILOTS' OVERHEAD PANEL

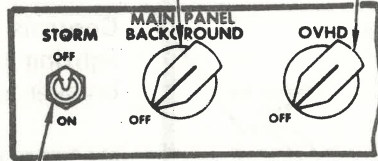
EXTERIOR LIGHTS CONTROLS

EXTERIOR LIGHTING

COCKPIT LIGHTING CONTROL PANEL:

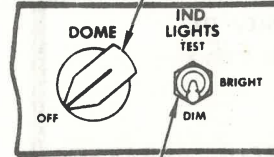
MAIN PANEL BACKGROUND LIGHT SWITCH

Controls intensity of Captain, F/O and center panel background lights.



OVERHEAD LIGHT SWITCH

Controls intensity of Pilots' overhead panel edge lighting.



DOVE LIGHT SWITCH

Controls intensity of Captain and F/O dome lights.

PILOTS' OVERHEAD PANEL

STORM LIGHT SWITCH

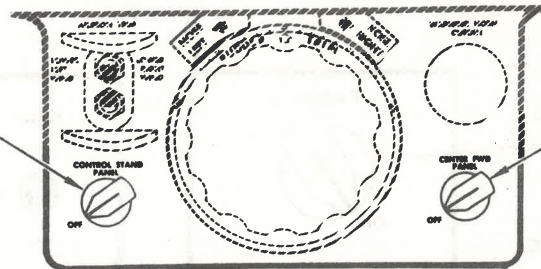
ON – Overrides background lighting switches to provide full intensity and turns on the dome lights.

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.



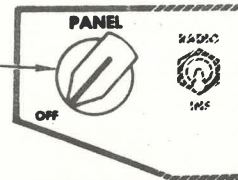
PILOTS' CONTROL STAND

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.



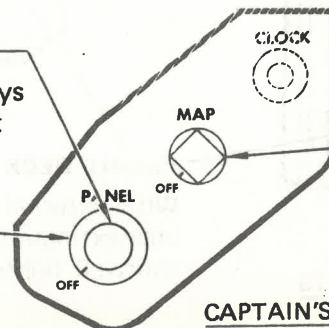
PILOTS' LIGHTSHIELD

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.



CAPTAIN'S AND F/O'S AUXILIARY PANELS

MAP LIGHT SWITCH

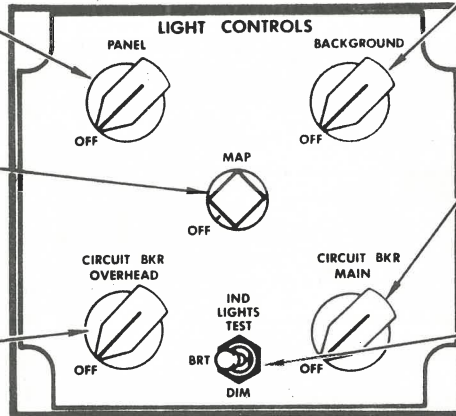
Pull out and rotate for variable intensity. Light located in ceiling.

COCKPIT LIGHTING CONTROL PANEL:

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.

OVERHEAD CIRCUIT BREAKER PANEL LIGHT SWITCH
 Controls intensity of edge lighting for P7 and P12 circuit breaker panels.



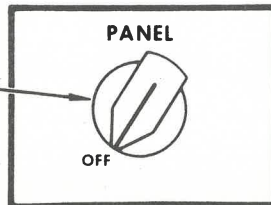
F/E'S AUXILIARY PANEL

BACKGROUND LIGHTS SWITCH
 Controls intensity of F/E panel background lights.

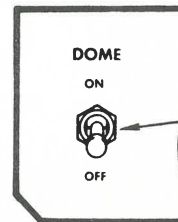
MAIN CIRCUIT BREAKER PANEL LIGHT SWITCH
 Controls intensity of edge lighting for P6 circuit breaker panel.

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.

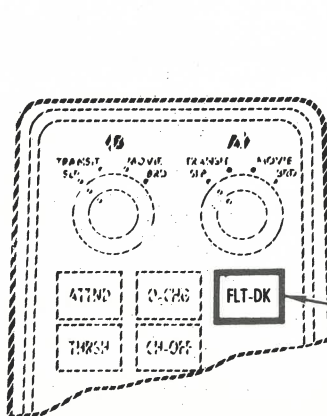


FIRST OBSERVER'S PANEL



FLIGHT ENGINEER'S DOME LIGHT SWITCH

P6 PANEL – LOWER RIGHT



CABIN ATTENDANTS PANEL – STA. 1L



EXTERIOR MAIN EQUIPMENT CENTER HATCH & CREW SERVICE DOOR

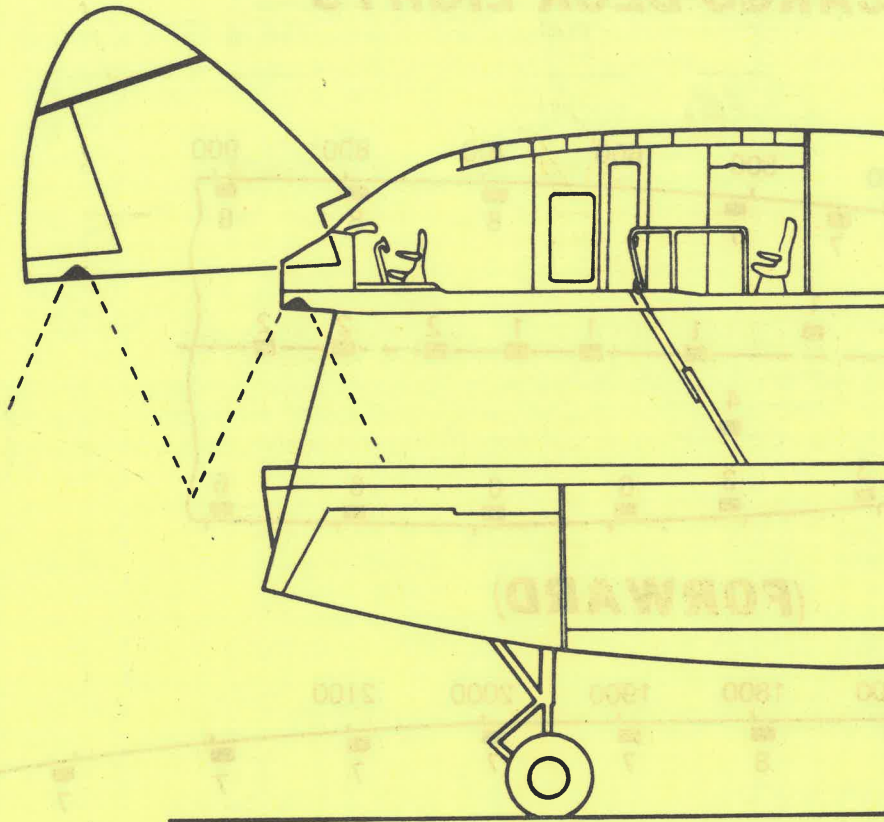
FLIGHT DECK ENTRY LIGHTS SWITCHES
 With external power established any switch illuminates/extinguishes entry lights consisting of spiral stairwell lights and E/E compartment light.

NORTHWEST ORIENT
BOEING 747



FREIGHTER

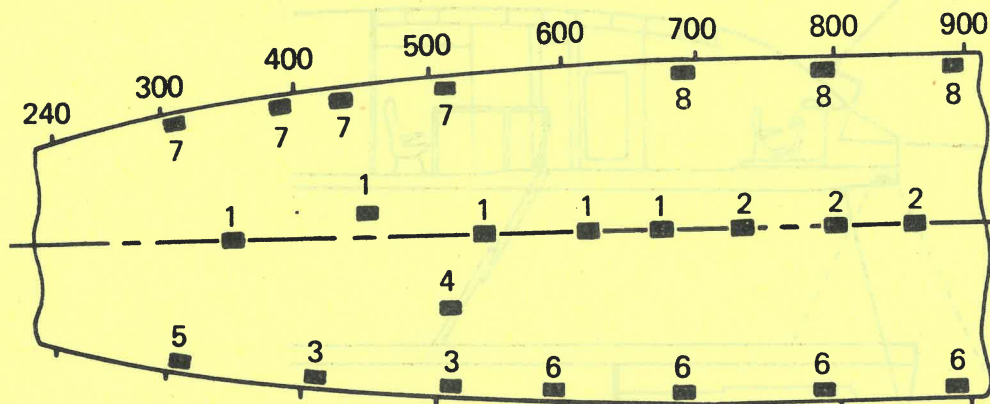
33:03F



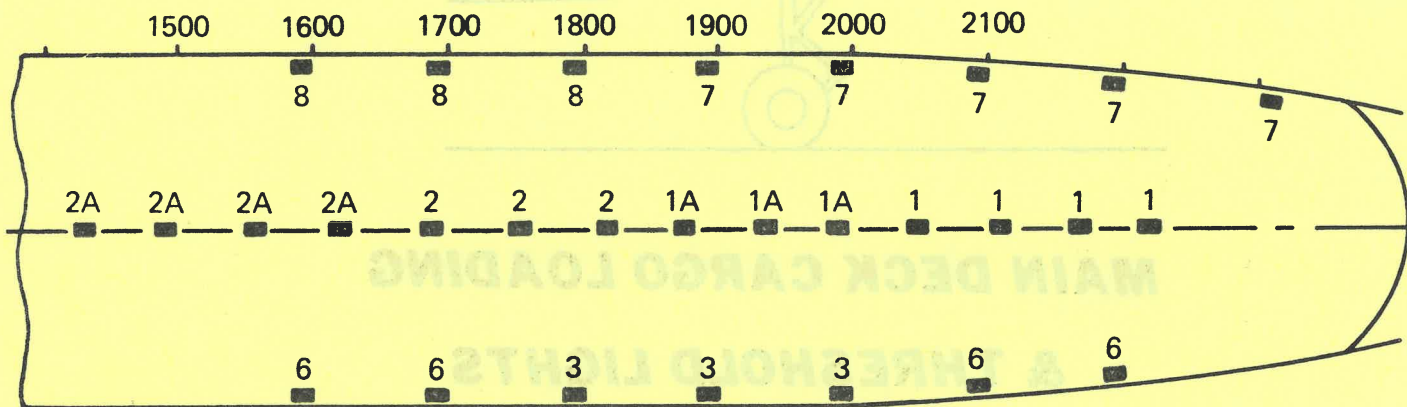
**MAIN DECK CARGO LOADING
& THRESHOLD LIGHTS**



MAIN CARGO DECK LIGHTS

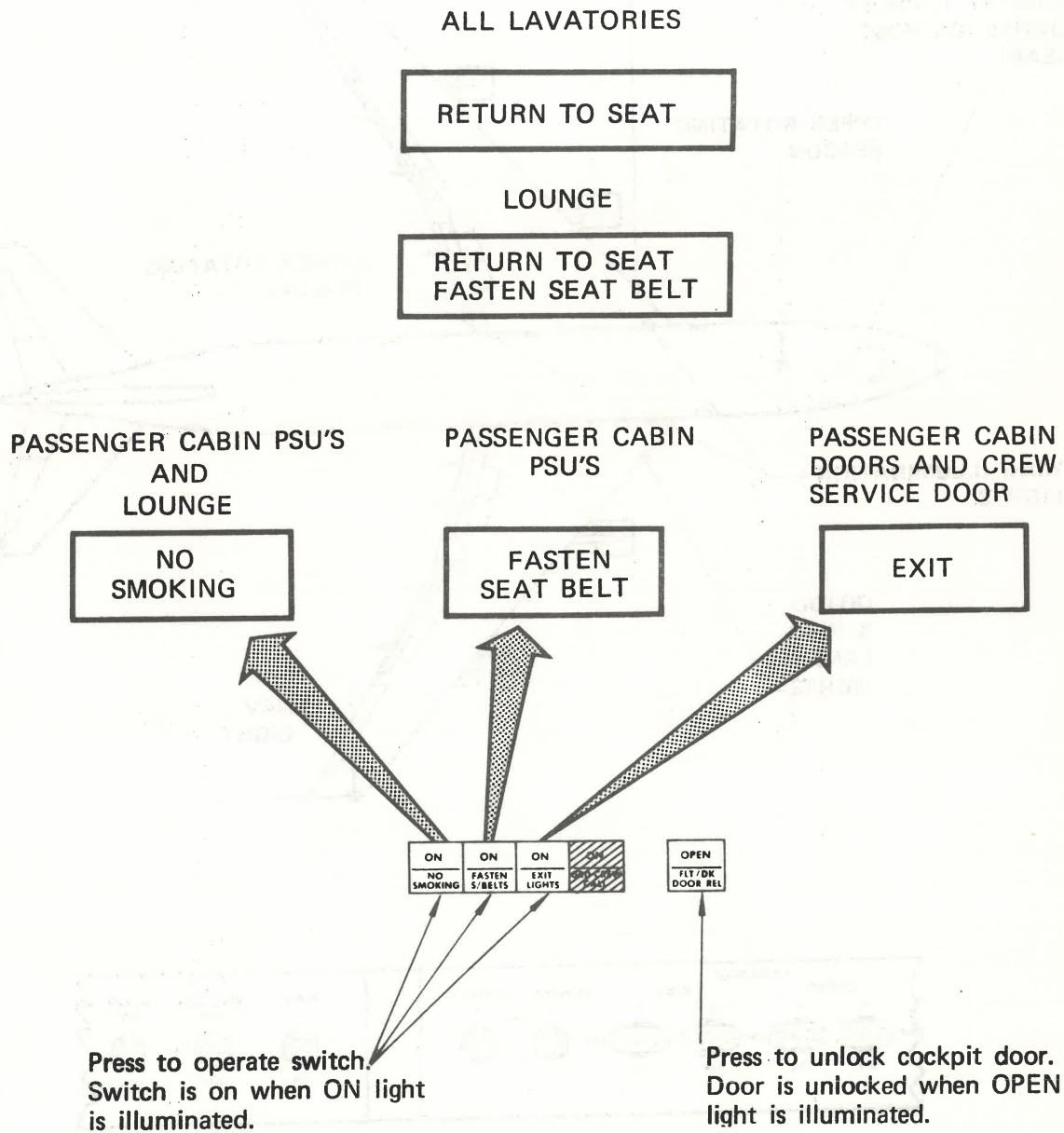


(FORWARD)



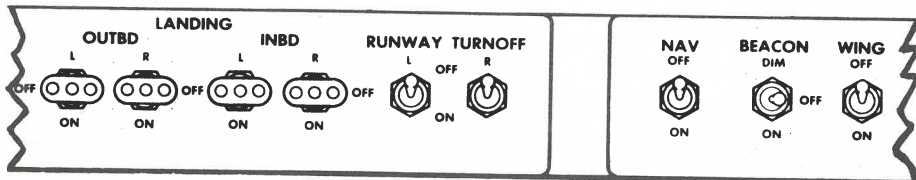
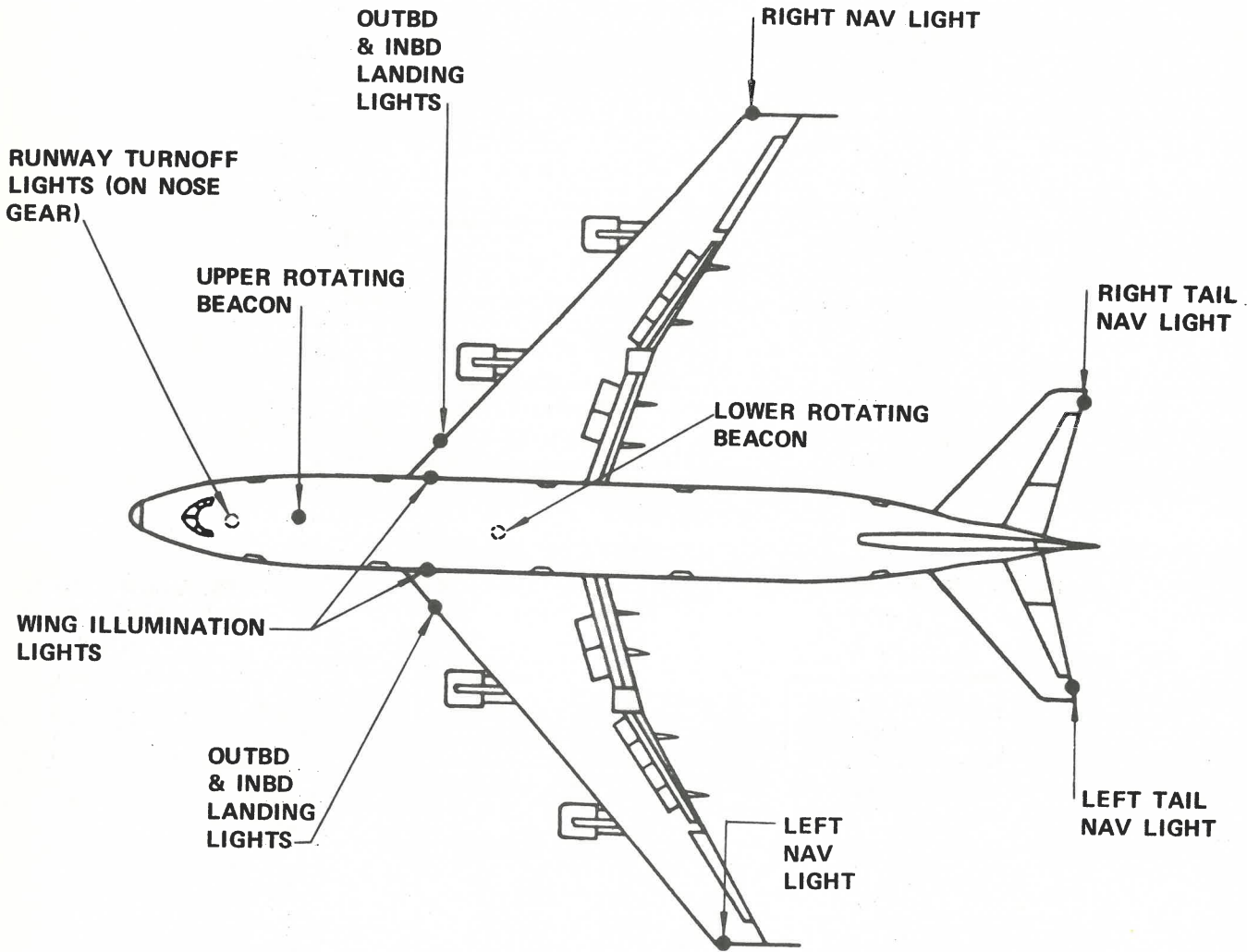
(AFT SECTION)

PASSENGER SIGN CONTROL PANEL:

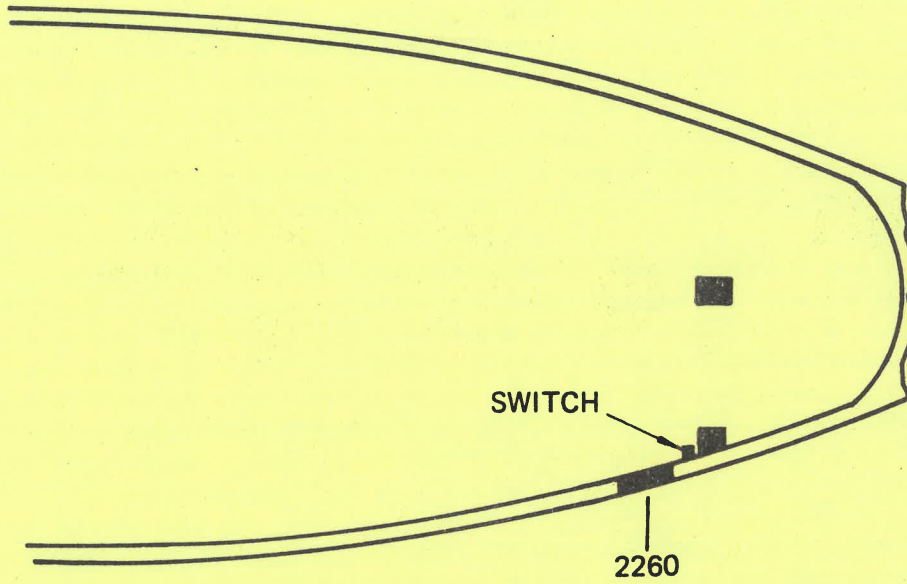


PILOTS' OVERHEAD PANEL

EXTERIOR LIGHTS LOCATION AND CONTROL PANELS:



PILOTS' OVERHEAD PANEL

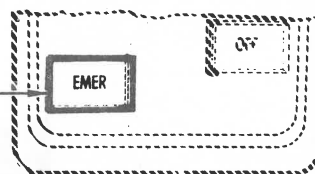


DOOR NO. 5 CARGO LIGHTS

EMERGENCY LIGHTS CONTROL PANELS:

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

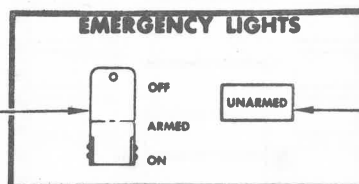
EMERGENCY LIGHTS SWITCH

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.

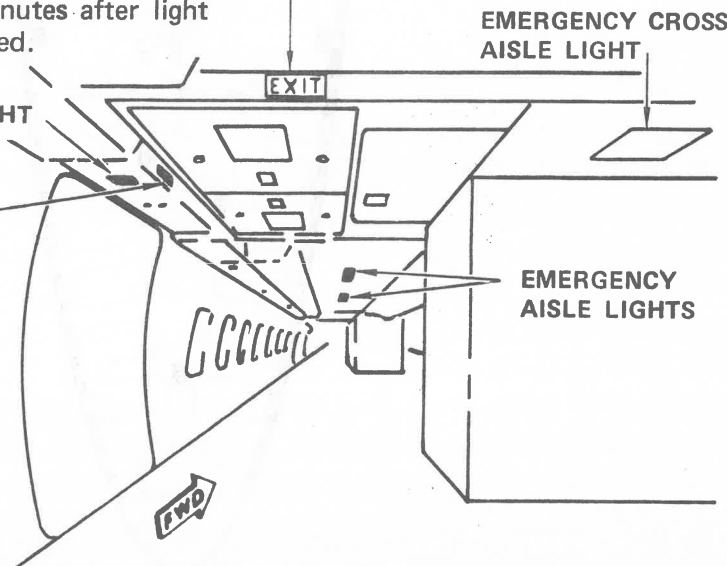
LUMINESCENT EXIT SIGN

Activated by light. Sign will glow for approximately twenty minutes after light source has been removed.

EMERGENCY DOOR LIGHT

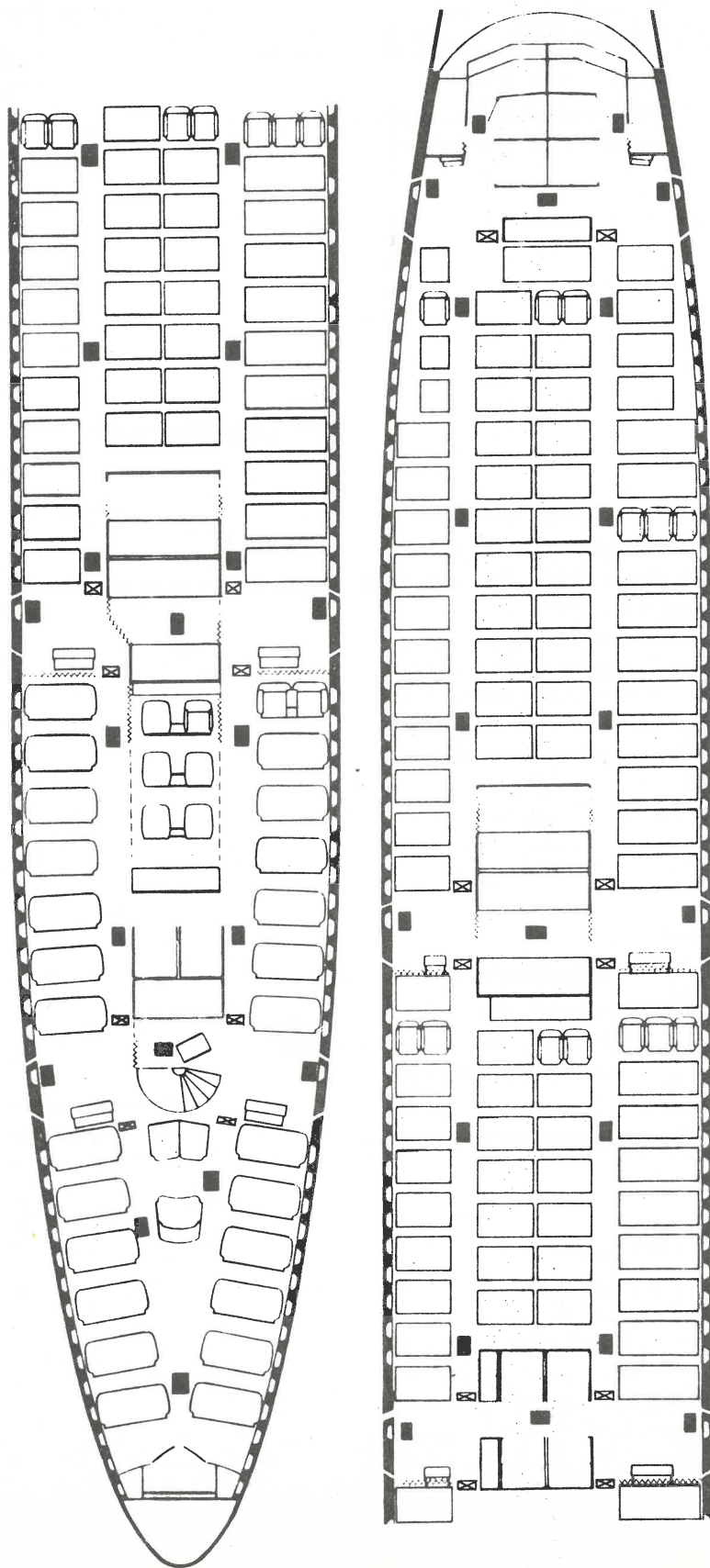
EXIT LIGHT

Equipped with four lamps. Two lamps controlled by EXIT LIGHTS switch for normal passenger deplaning operations. The other two lamps are powered by self contained nicad batteries and are controlled by EMERGENCY LIGHTS switches.





EMERGENCY LIGHTS LOCATION:



■ LIGHT
☒ LUMINESCENT SIGN

| | |
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| OPERATING BULLETINS | 87 |



NAVIGATION

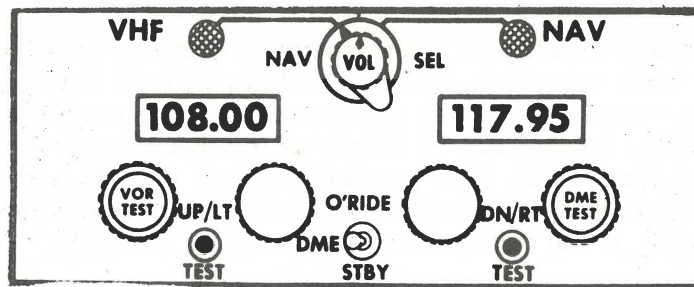
The inertial navigation system consists of three complete systems, each consisting of a navigation unit, battery unit, mode select unit, and a control display unit. Each system's battery provides approximately fifteen minutes continued operation, if aircraft electrical power is lost. The No. 3 INS battery and No. 1 battery can be paralleled through a switch on S/O panel to increase the operating time of No. 1 INS. This paralleling switch on S/O panel is dead until standby power switch is activated. Navigation parameter information is read directly on control display unit and displayed on HSI, if HSI switch is in Radio position.

Three navigation receivers provide VOR, ILS, Glide Slope and DME information to the pilots through the RMI's, HSI's, and ADI's. Each receiver has dual frequency selectors with DME channels that are automatically matched to VOR/ILS frequencies. Two navigation control panels located on forward pedestal are provided. The third navigation receiver may be transferred to either pilot through the instrument transfer switching system. An interfacing VOR, ILS, and DME system check is provided from the control panels. The air traffic control transponder provides a coded reply signal to identify aircraft on ground radar. Each aircraft is equipped with one control panel, located on aft pedestal, two transponders, and two antennas. A test/monitor switch on control panel provides a check and monitor of the system.

Two automatic direction finding systems (ADF) are provided in the frequency range of 190 to 1750 KHZ. The ADF control panels are located on the forward pedestal and provides an interface check of the ADF system. Marker beacon system provides visual and aural indications when flying over ground based markers. The marker beacon control panel is located on the pilot's overhead panel and the indicator lights on the respective pilot's instrument panels.

The Bendix RDR-1F X-Band weather radar system is comprised of two transmitter/receiver units, two PPI indicator scopes, a radar control panel located on forward pedestal, and one antenna. The antenna is stabilized by either the No. 1 or No. 2 INS systems. It provides a range up to 300 nautical miles and through an offset switch allows the pilots to view more of an area to the left or right of airplane centerline. This radar system also provides for automatic gain control. Tunnel diode amplification is provided to ensure maximum accurate contouring of significant storm systems. The radar is capable of being tested on the ground through a normal test pattern display.

VHF NAVIGATION SYSTEM



1. Three VOR/ILS navigation receivers are provided on the aircraft.
 - a. Two dual head VHF navigation control panels are located on forward electronic panel.
 - (1) Two pre-set frequencies available by selector switch.
 - (a) Green light illuminates indicating which head is selected.
 - (2) Test switches provided to check operation of VOR – ILS and DME systems.
 - (a) VOR test
 - '1' Select unuseable VOR frequency.
 - '2' Check that NAV flag appears on HSI.
 - '3' ADF/VOR switch on RMI to VOR position.
 - '4' Set course selector to 180°.
 - '5' VOR test button – Push and hold.
 - 'a' Course bar centers.
 - 'b' NAV flag on HSI disappears.
 - 'c' To/From pointer – 180°.
 - 'd' VOR pointer on RMI – 180°.
 - (b) ILS test
 - '1' Select unuseable ILS frequency.
 - '2' Check that NAV flag and GS flag appear on HSI.
 - '3' Set course selector to aircraft heading.
 - '4' ILS test switch (UP/LH or DN/RH) – Push and hold.



FREIGHTER

34:01F

NAVIGATION

No significant changes in the Navigation System on the B-747F.

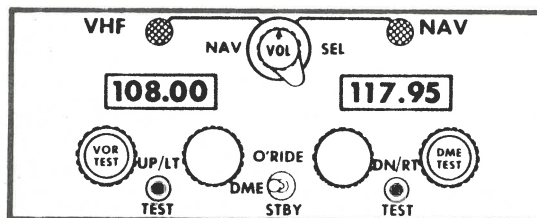


VHF NAVIGATION SYSTEM (Cont.)

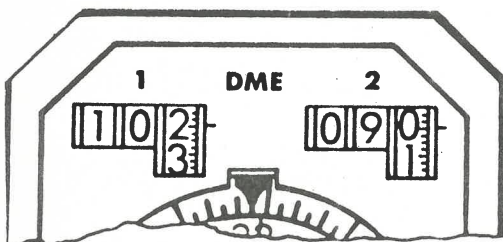
- 'a' UP/LH test – GS moves up one dot and course bar left one dot.
 - 'b' DN/RH test – GS moves down one dot and course bar right one dot.
 - 'c' NAV and GS flag disappear on HSI.
- (c) DME test
- '1' DME switch, on NAV control panel, to DME position.
 - '2' DME test button – Push and hold.
 - 'a' DME mileage indicators on RMI reads 000.

DME SYSTEM

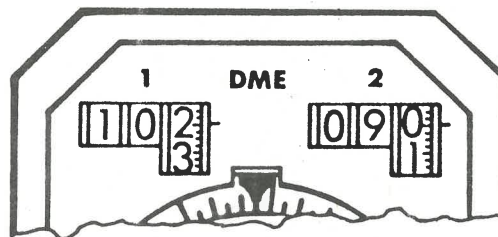
1. Two complete distance measuring equipment systems automatically measure distance between aircraft and selected ground station, displaying mileage on radio magnetic indicators.
 - a. DME control switch on respective pilot's navigation control panel provides selection of operation mode.
 - (1) DME position – System will search out to normal 197 NM range.
 - (2) O'Ride position. – Short range limit (50 miles) restored to normal range.
 - (a) Short range DME stations in frequency range of 108.0 to 111.9 mcs.
 - b. Mileage indicators located on radio magnetic indicators.
 - (1) Warning flag covers mileage indicator, when system fails.



VHF NAV CONTROL PANEL



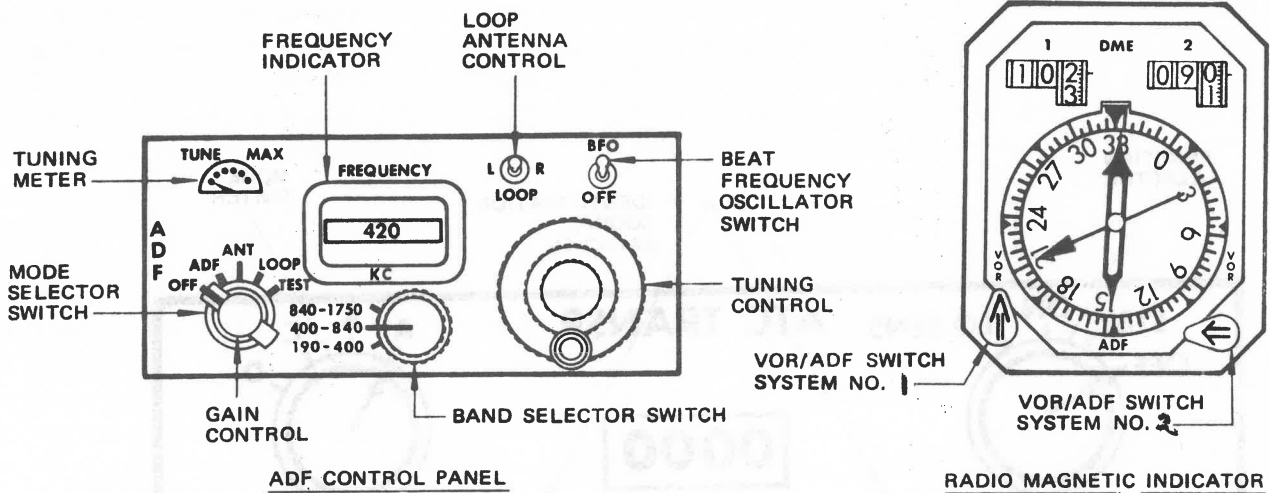
CAPTAIN'S DME DISPLAY



FIRST OFFICER'S DME DISPLAY

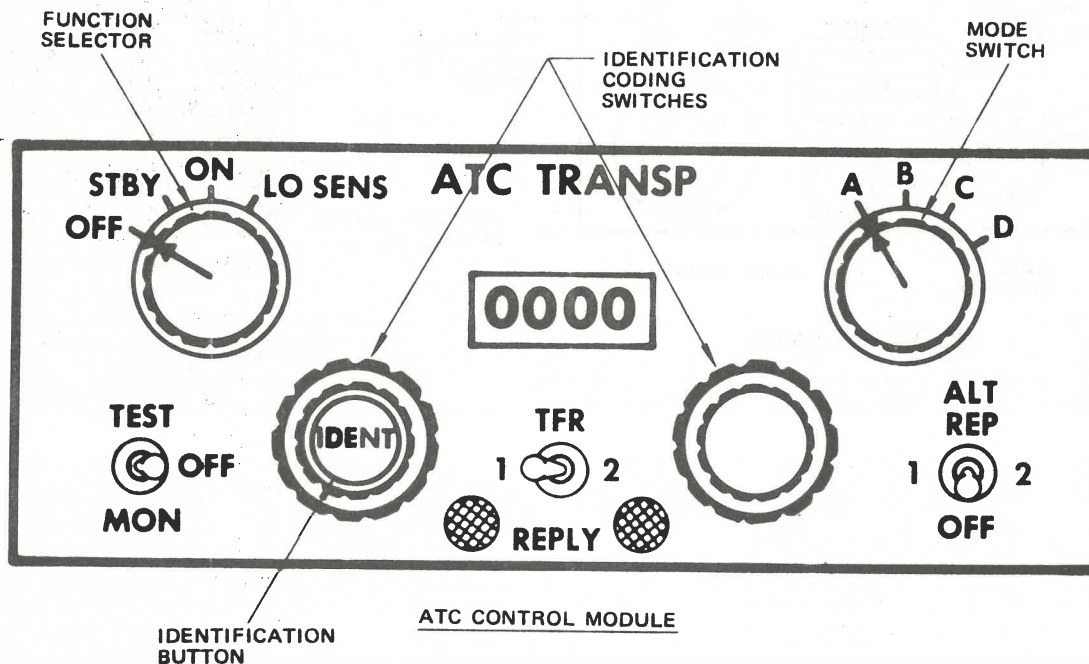
AUTOMATIC DIRECTION FINDER SYSTEM (ADF)

1. Two separate automatic direction finder systems are installed on the aircraft.
 - a. Two control panels are located on forward electronic panel.
 - (1) Mode selector switch, on panel, provides selection of operational mode.
 - (a) Test position of switch will drive RMI pointer to heading of aircraft (ADF/VOR switch on RMI to ADF position).



AIR TRAFFIC CONTROL SYSTEM (ATC)

1. An air traffic control system provides a coded pulse reply signal for air traffic control, when interrogated, to identify aircraft on radar scope.
 - a. Control panel located on aft electronic panel.
 - (1) Mode control switch provides selection of mode (A-B-C-D).
 - (2) Identification code switches provide for selection of proper code.
 - (a) Ident button on left switch provides an additional identification pulse to be transmitted.
 - (3) ALT Rptg switch provides selection of central air data computer No. 1 or No. 2.
 - (4) Test/Monitor switch provides a means of checking system.
 - (a) Test position – Produces simulated interrogation signal and illuminates Reply light.
 - (b) Monitor position – Normally kept in this position so that Reply light will illuminate indicating transponder operation enroute.



MARKER BEACON SYSTEM:

GENERAL

Marker beacon system provides visual and aural indications when flying over ground based transmitters. These installations include airway fan marker, station locator Z markers, and ILS outer, middle, and inner markers.

CONTROLS AND INDICATORS



Pilot's Overhead Panel

1. Marker Sensitivity switch

SHARP — Decreased sensitivity to more sharply define marker beacon or fix.

BROAD — Increased sensitivity to ensure reception.

VOLUME — Controls aural volume.



Pilots' Panel

2. Marker lights

AIRWAYS (white) — Flashes when passing over the station airways or ILS inner marker.

OUTER (blue) and MIDDLE (amber) — Flashes when passing a fan marker or ILS markers.



Audio Selector Panel

3. Marker Audio switch — Allows pilot to listen to marker aurally.

Outer — 400 cycle intermittent tone

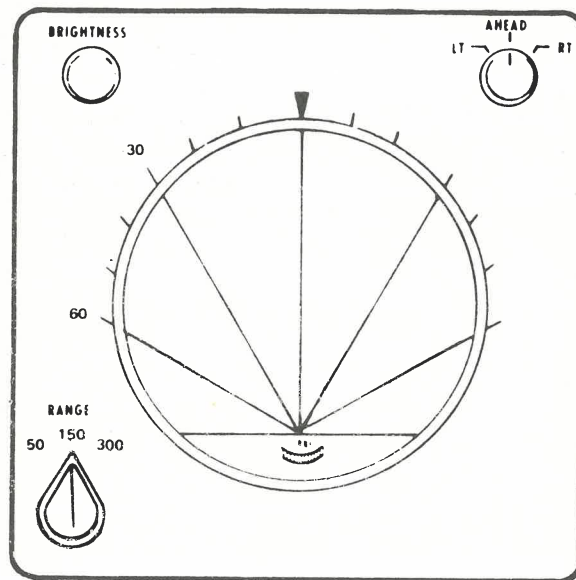
Middle — 1300 cycle intermittent tone

Inner — 3000 cycle intermittent tone

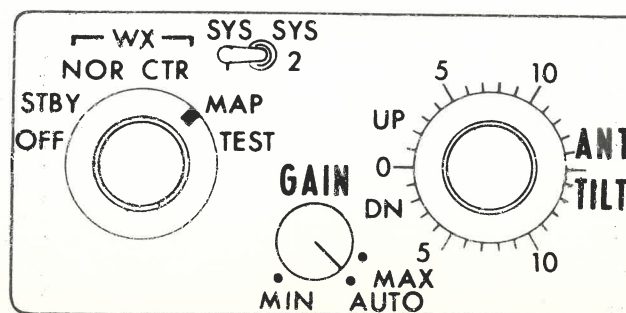
Airways — 3000 cycle intermittent tone

WEATHER RADAR SYSTEM

1. Radar system consists of two identical systems to provide navigation information and weather pictorial information up to 300 nautical miles.
 - a. Control panel is located on forward electronic panel.
 - (1) Mode selection switch provides a selection of modes of operation.
 - (2) A system transfer switch provides selection of system No. 1 or No. 2.
 - (3) Tilt switch provides selection of antenna position, $\pm 15^\circ$ up or down.
 - (4) Receiver gain control provides adjustment of receiver sensitivity.
 - (a) Auto position of control adjusts and maintains gain automatically.
 - b. Two radar scopes located on respective pilot's side panel display a visual picture, from 90° each side of center.
 - (1) Position control, on indicator, provides a means of shifting pictorial display left or right.
 - (2) Range selection switch provides selection of 50–150 and 300 nautical mile range.



INDICATOR

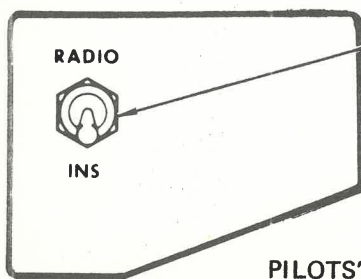
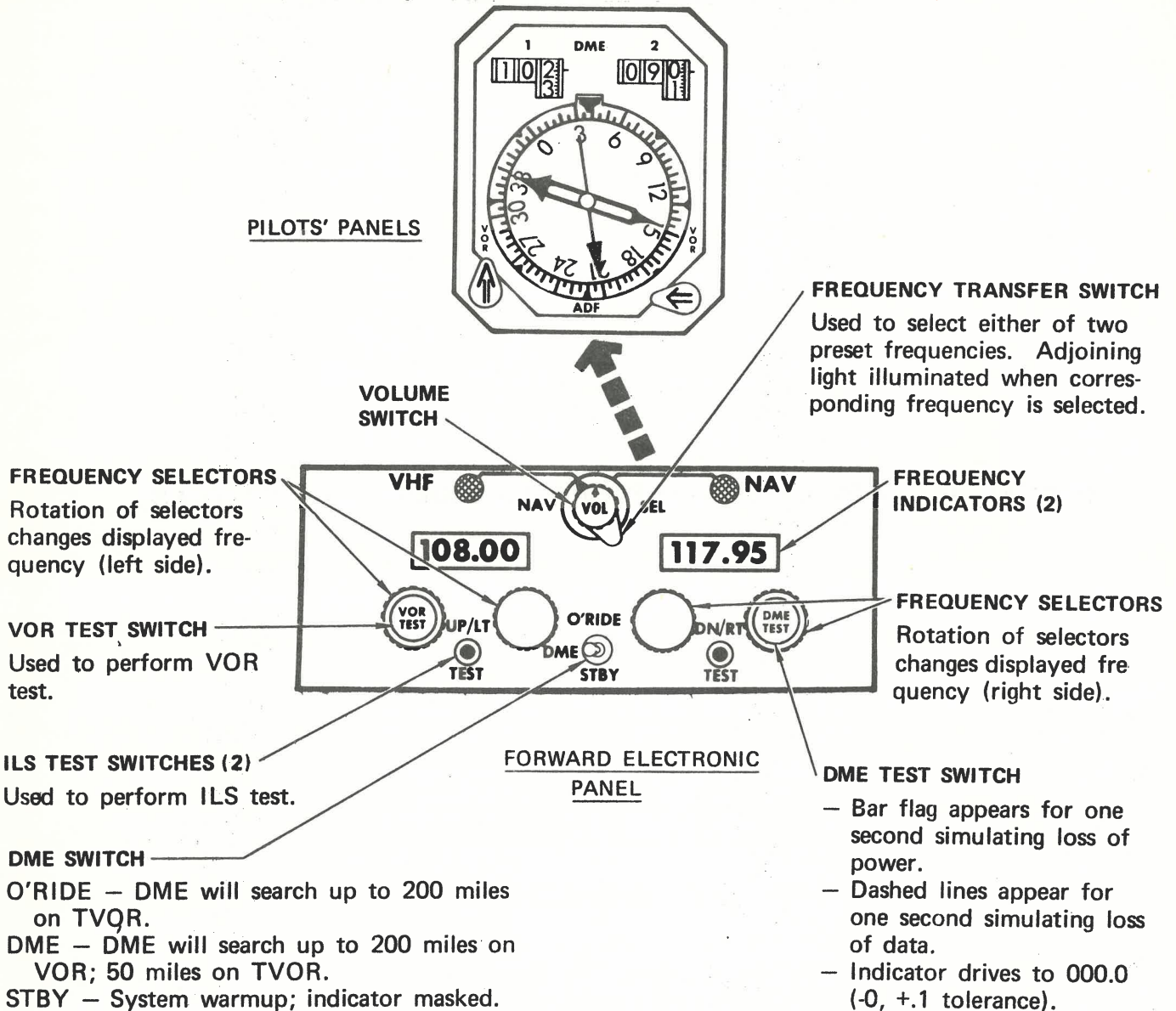


CONTROL PANEL



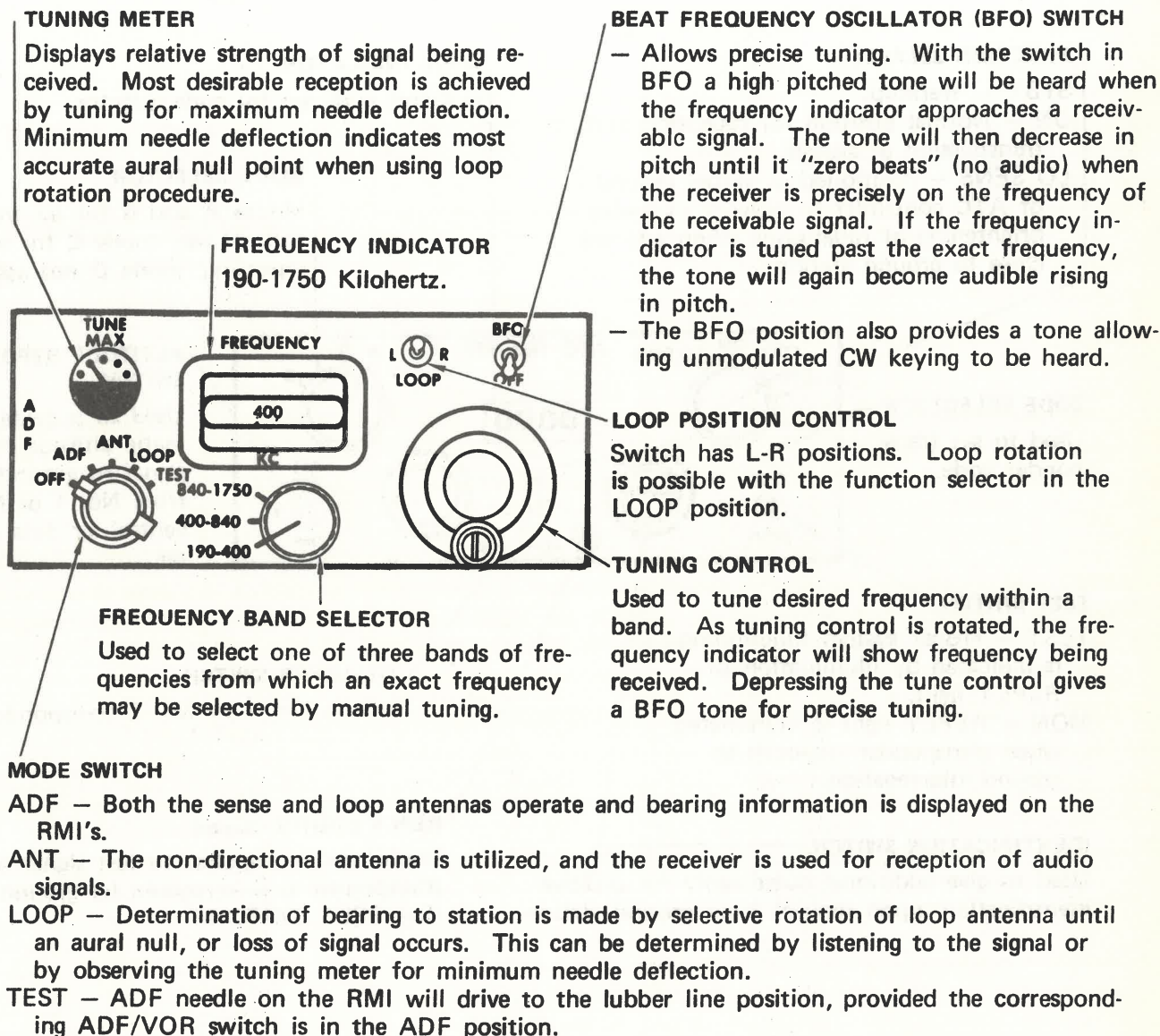
INERTIAL NAVIGATION SYSTEM IS PRESENTED UNDER SEPARATE COVER.

VHF NAVIGATION RADIO/DME CONTROL PANELS:



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).

AUTOMATIC DIRECTION FINDING CONTROL PANEL:



AFT ELECTRONIC PANEL

ATC TRANSPONDER CONTROL 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

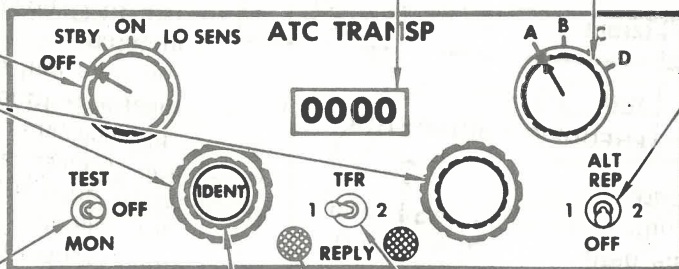
Modes A and B for air traffic control use; mode C for altitude reporting; mode D not assigned.

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)

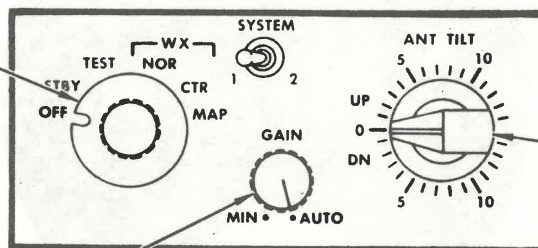
Illuminate in response to test signal or when transponder is interrogated by ground signal. (See TEST SWITCH.)

WEATHER RADAR CONTROL PANELS:

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.

FORWARD ELECTRONICS
 PANEL



ANTENNA TILT CONTROL

GAIN CONTROL

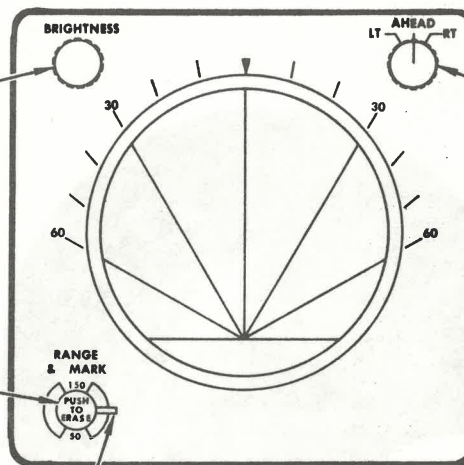
- MIN – Clockwise rotation causes increase in receiver sensitivity.
- AUTO – Maintains receiver at optimum receiver sensitivity.

BRIGHTNESS CONTROL

Adjusts brightness of edge lights and control markings on the indicator.

ERASE SWITCH

Push and release. Display brightens and then all returns are erased.



OFFSET SWITCH

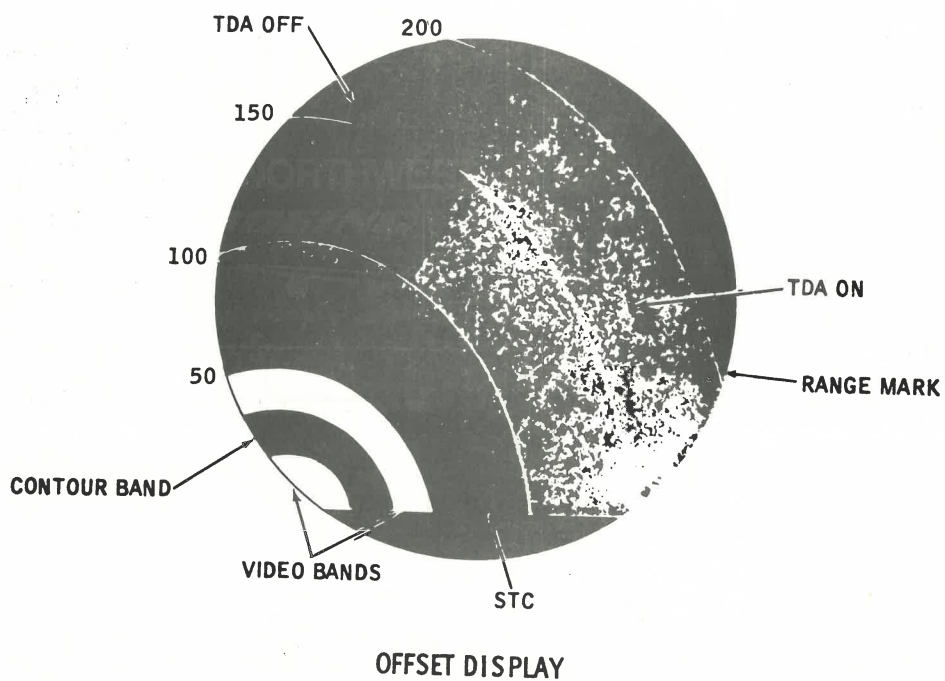
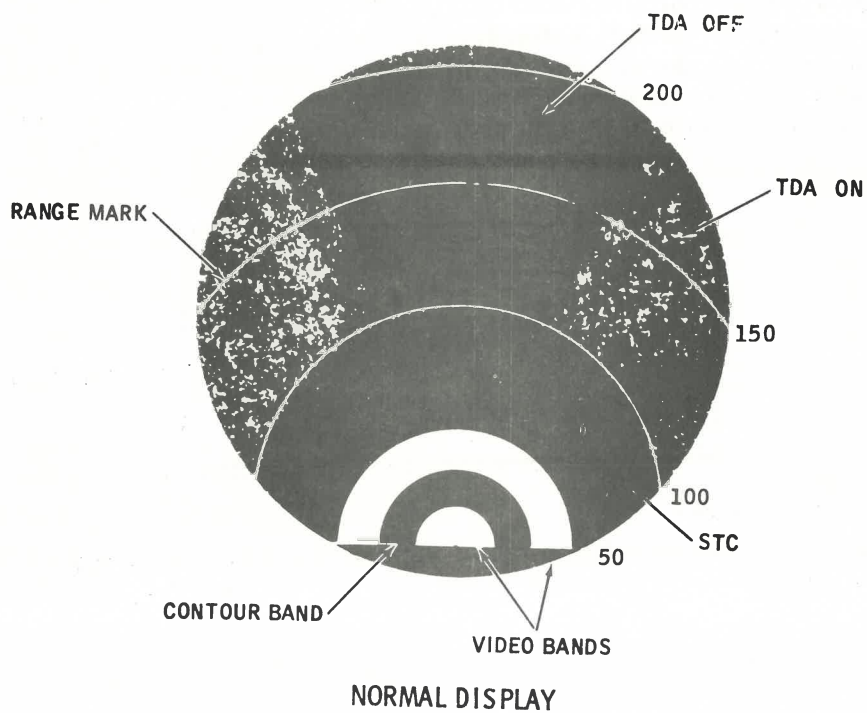
- LT – Scope presentation moves right increasing area scanned to left.
- AHEAD – Normal scan.
- RT – Scope presentation moves left increasing area scanned to right.

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.

WEATHER RADAR:



| | |
|---|----|
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OXYGEN:

The crew oxygen system delivers oxygen to five stations in the cockpit. Oxygen is supplied at each station through individual diluter demand regulators mounted on the oxygen mask. Oxygen pressure is reduced from high to low pressure prior to entering the mask regulators.

The crew oxygen bottle is located on ceiling of forward cargo compartment. An oxygen shutoff valve in cockpit is provided to turn off oxygen supply. A thermal discharge indicator (Green) is located on right side of forward fuselage, aft of forward cargo door.

Passenger oxygen system delivers oxygen to each passenger and attendant in the cabin, stateroom, and lavatories. Five passenger bottles are located in ceiling of forward cargo compartment. A thermal discharge line connects to the same discharge indicator as the crew. Oxygen masks are provided in service units above all passenger seats, in each lavatory, and at each attendant's station. A red indicator on service unit door, indicates door is not properly stowed. The passenger oxygen system is activated automatically by an aneroid device when cabin reaches 14,000 feet. It can also be activated electrically by a switch on the S/O panel.

After passenger oxygen system is activated, oxygen pressure will automatically release masks, cabin lights and cabin signs illuminate, and a pre-recorded oxygen message is presented over the PA system. System must be reset by manual reset handle located at the main equipment center hatch (Lower 4).

Portable oxygen system is provided for therapeutic use.

Bottles are located in main cabin along with an oxygen mask with each bottle. One bottle with a full-face mask is located in the cockpit. Minimum flight crew and passenger oxygen bottle pressure is 1400 PSI. Portable oxygen bottle pressure is 1200 PSI.



OXYGEN SYSTEM:

GENERAL

1. The oxygen system provides low pressure oxygen to the crew and passengers.
 - a. Crew oxygen system provides breathing oxygen to five crew stations in the cockpit.
 - (1) Crew bottle is located on ceiling of forward cargo compartment.
 - (a) Thermal discharge indicator located right side of forward fuselage.
 - (2) Oxygen shutoff valve is provided to turn off crew oxygen supply.
 - (3) Crew oxygen masks and diluter demand regulators are provided at each station.
 - (4) Oxygen pressure indicator on S/O panel displays crew oxygen bottle pressure.
 - b. Passenger oxygen system provides protective breathing oxygen to each passenger and attendant.
 - (1) Five passenger bottles are located in ceiling of forward cargo compartment.
 - (a) Thermal discharge line connected to same discharge indicator as crew.
 - (2) Three flow control units provide oxygen to passengers and attendants when cabin reaches 14,000 feet.
 - (a) Two units are controlled electrically by passenger oxygen switch on S/O panel.
 - (b) Flow control valves must be reset after actuation by manual reset handle, located at entrance to Lower 41.
 - '1' Cannot be reset above 12,000 feet cabin.
 - (3) Oxygen pressure indicator on S/O panel displays passenger system pressure.
 - (4) Passenger Oxygen Indicator lights illuminate when passenger system is activated.
 - (a) Lights are located on S/O panel, pilot center instrument panel and cabin attendant stations 1L and 4L.
 - (5) Oxygen masks are provided in service units above all passenger seats, in each lavatory, and at each attendant's station.
 - (a) A red indicator on service unit door, indicates door is not properly stowed.
 - c. Portable oxygen system provides a portable supply of oxygen for therapeutic use.
 - (1) 22 bottles located in main cabin under outboard passenger seats.
 - (a) An oxygen mask is provided with each bottle.
 - (2) One bottle with a full face mask is located in the cockpit.



OXYGEN

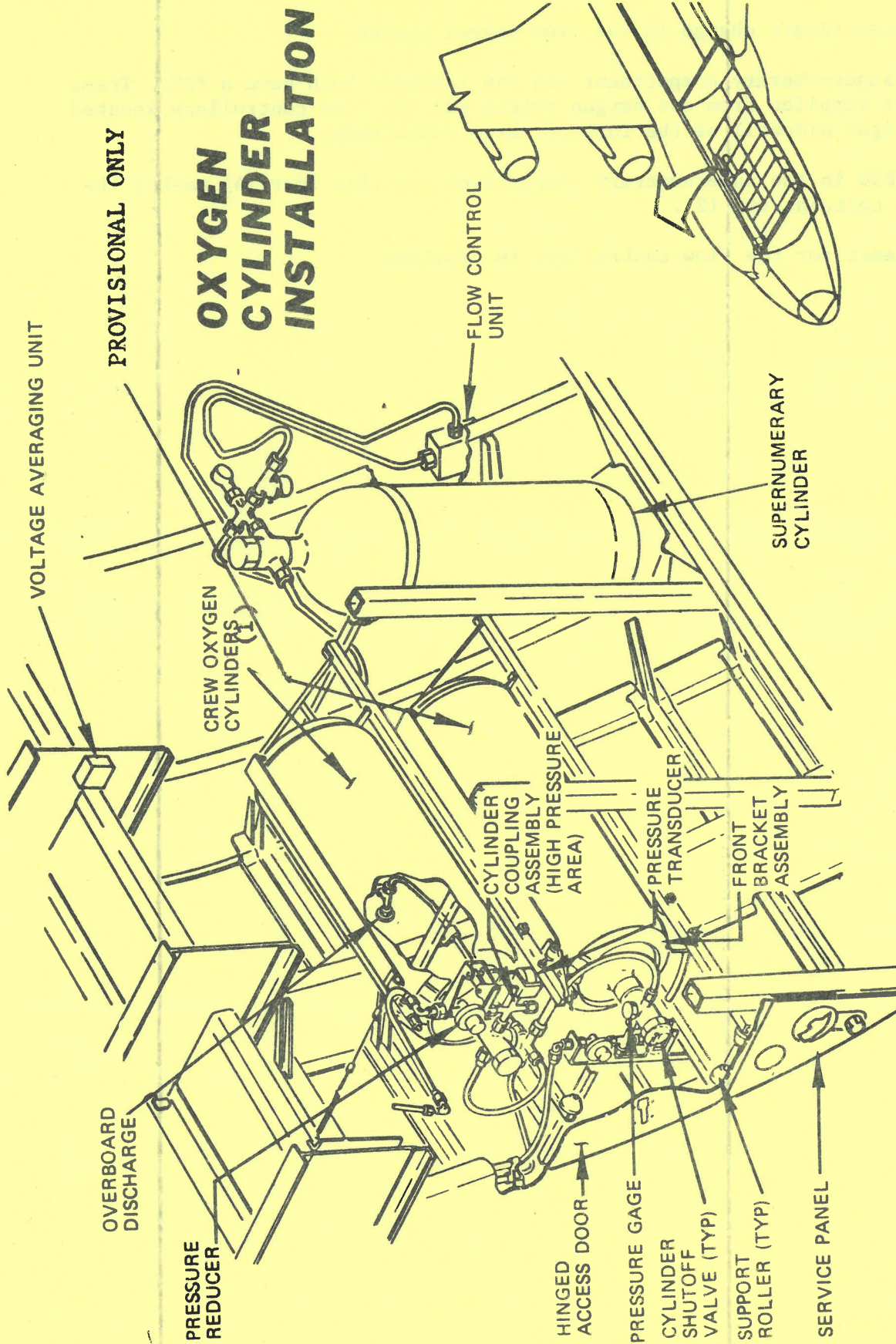
No significant change in the crew oxygen system.

The supernumerary compartment and the lavatory both have a PSU. These units are supplied from one oxygen bottle and two flow controllers located on the right sidewall of the forward cargo compartment.

The PSU in the supernumerary compartment contains four (4) masks; the lavatory contains two (2).

No reset for the flow controllers is provided.





PROVISIONAL ONLY

OXYGEN CYLINDER INSTALLATION

VOLTAGE AVERAGING UNIT

CREW OXYGEN CYLINDERS (1)

FLOW CONTROL UNIT

SUPERNUMERARY CYLINDER

OVERBOARD DISCHARGE

PRESSURE REDUCER

CYLINDER COUPLING ASSEMBLY (HIGH PRESSURE AREA)

PRESSURE TRANSDUCER

FRONT BRACKET ASSEMBLY

HINGED ACCESS DOOR

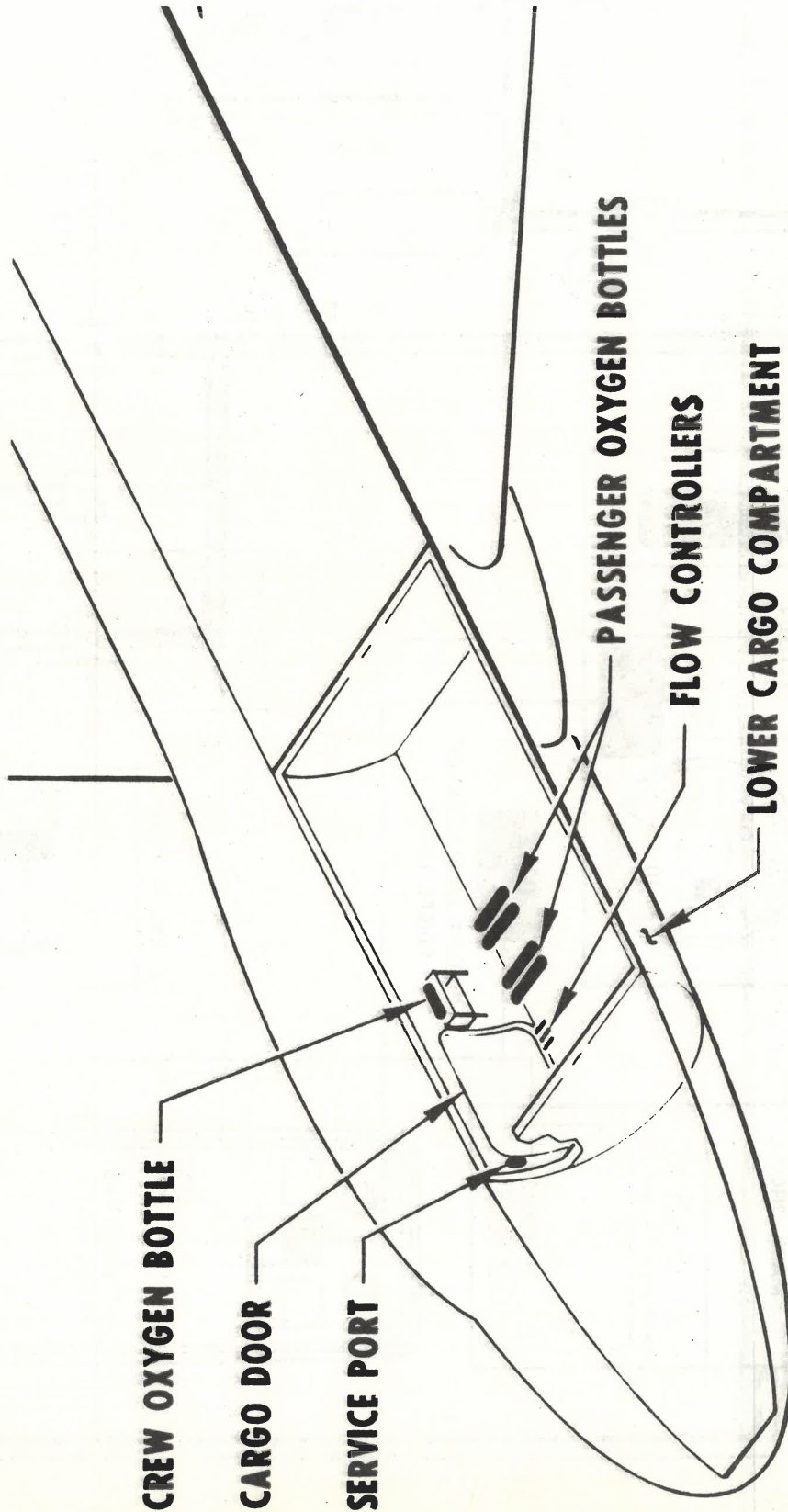
PRESSURE GAGE

CYLINDER SHUTOFF VALVE (TYP)

SUPPORT ROLLER (TYP)

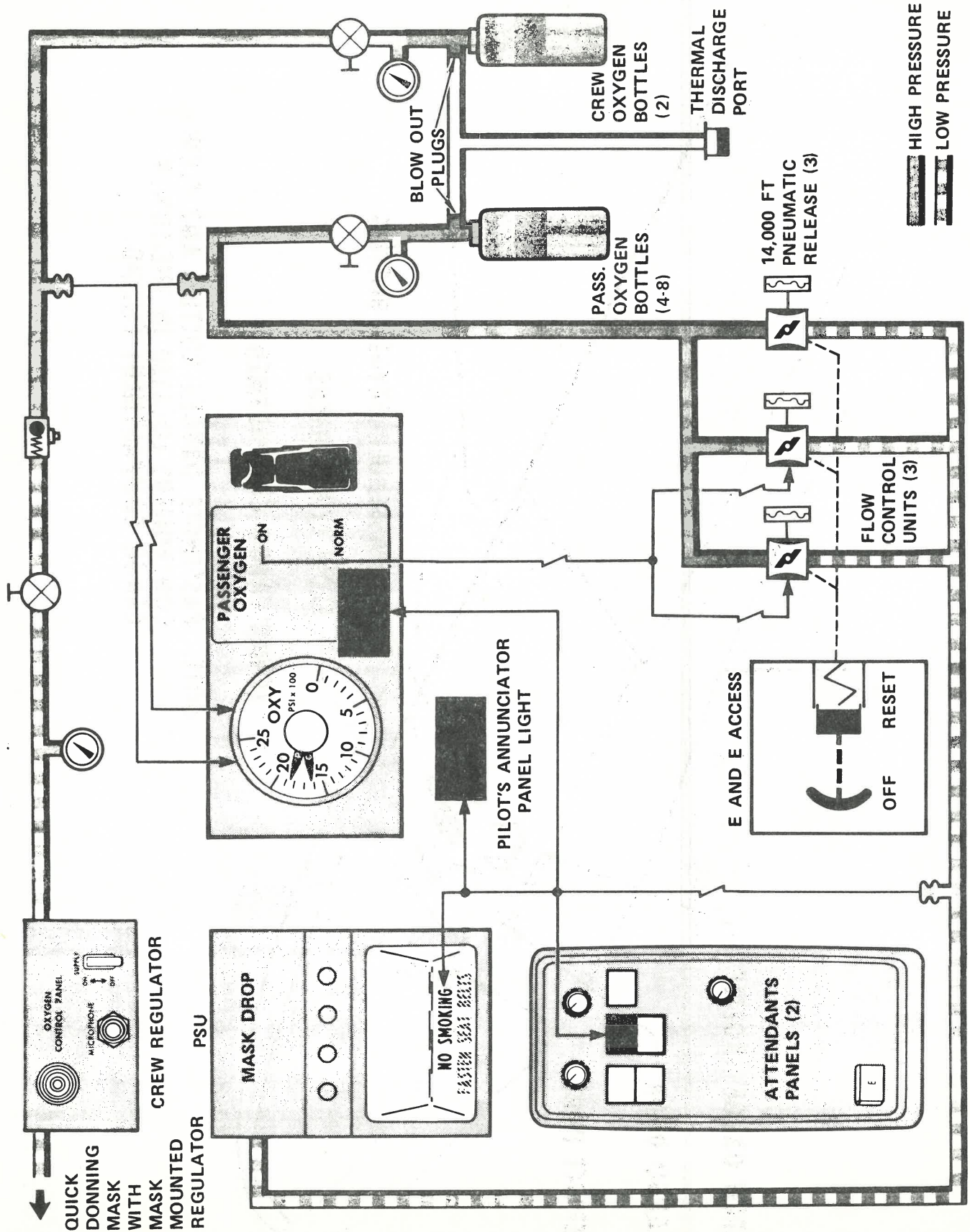
SERVICE PANEL

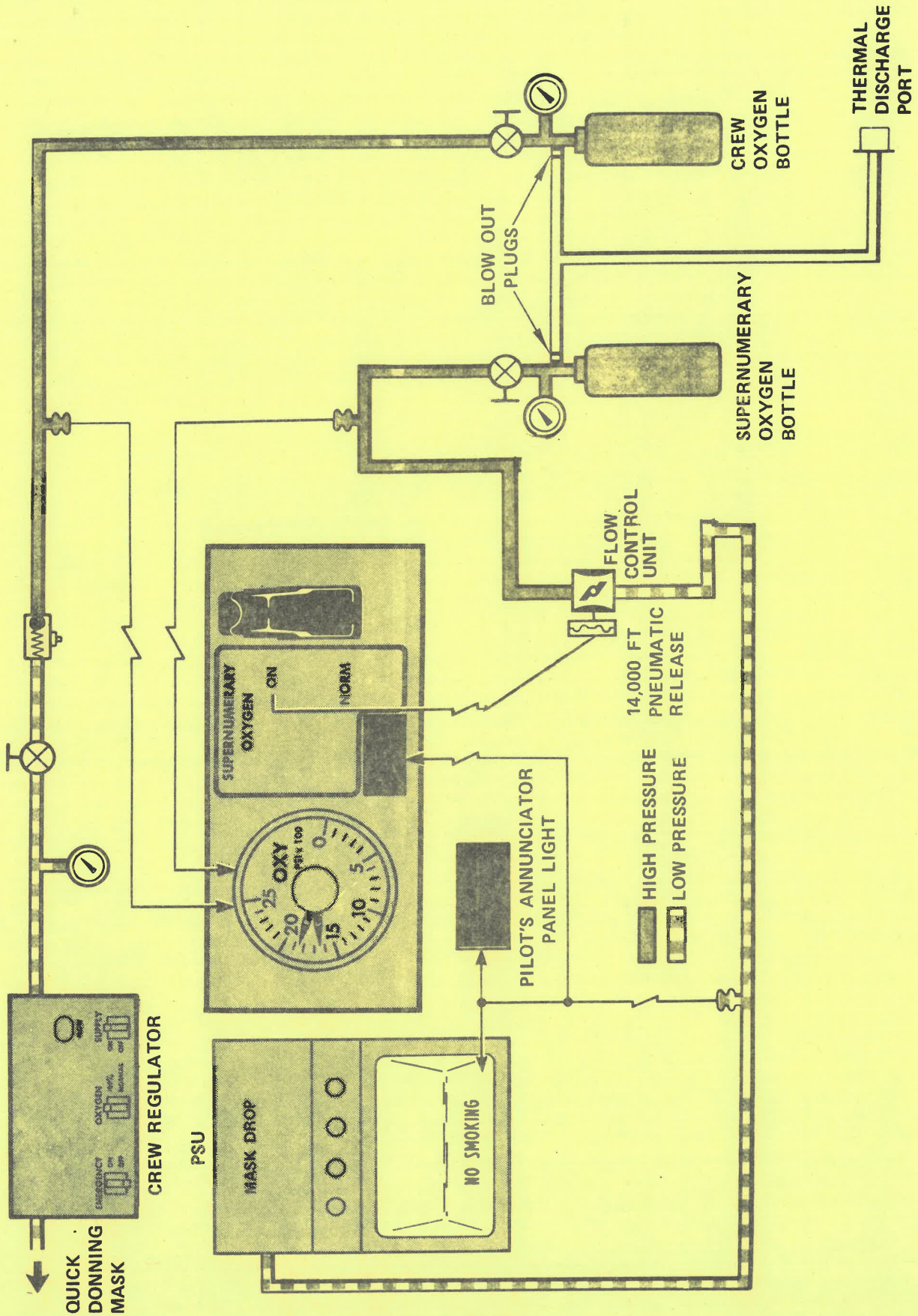
OXYGEN SYSTEM LOCATION:



NOTE: PASSENGER OXYGEN BOTTLES AND FLOW CONTROLLERS LOCATED IN THE LOWER CARGO COMPARTMENT CEILING.

OXYGEN SYSTEM SCHEMATIC



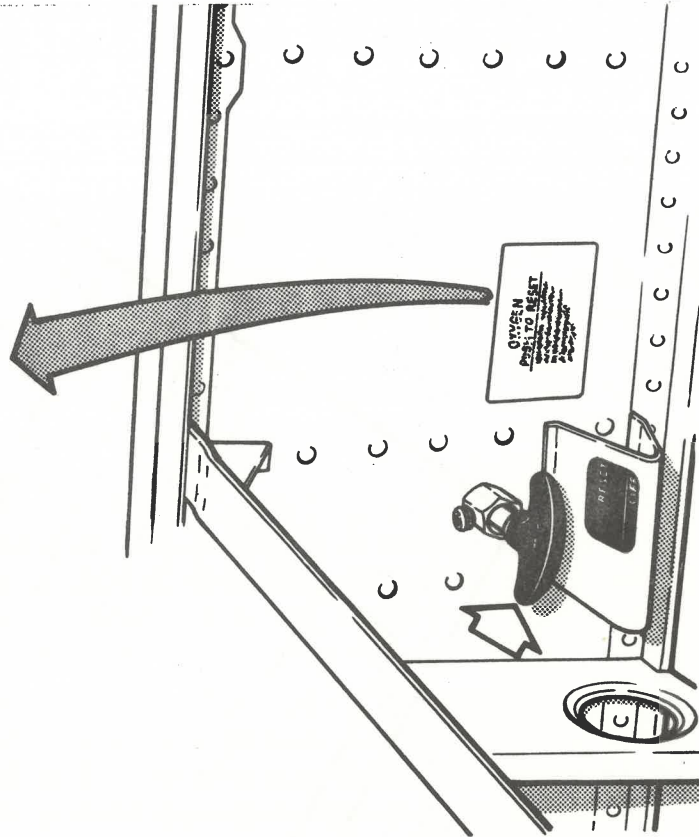


OXYGEN SYSTEM

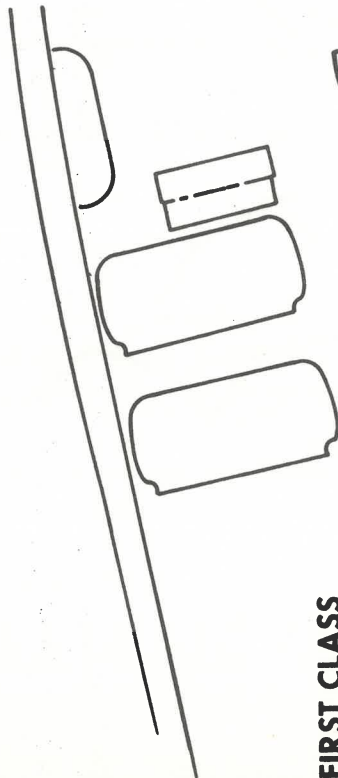
OXYGEN MANUAL RESET:

**OXYGEN
 PUSH TO RESET**

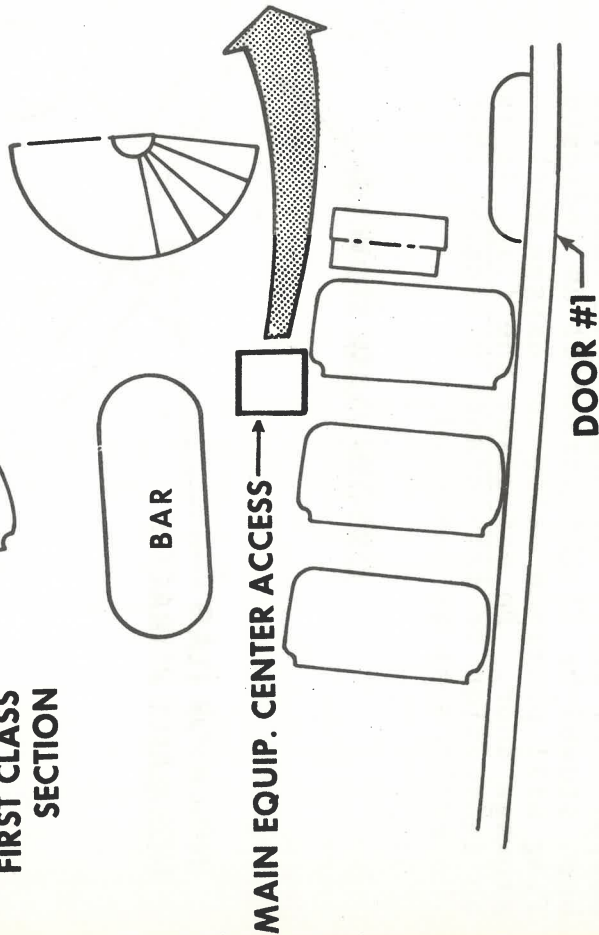
PUSH HANDLE TO RESET
 POSITION, HOLD FOR
 5 SEC., AND THEN
 RETURN TO OFF
 POSITION.



**MANUAL RESET HANDLE IN
 MAIN EQUIPMENT CENTER**

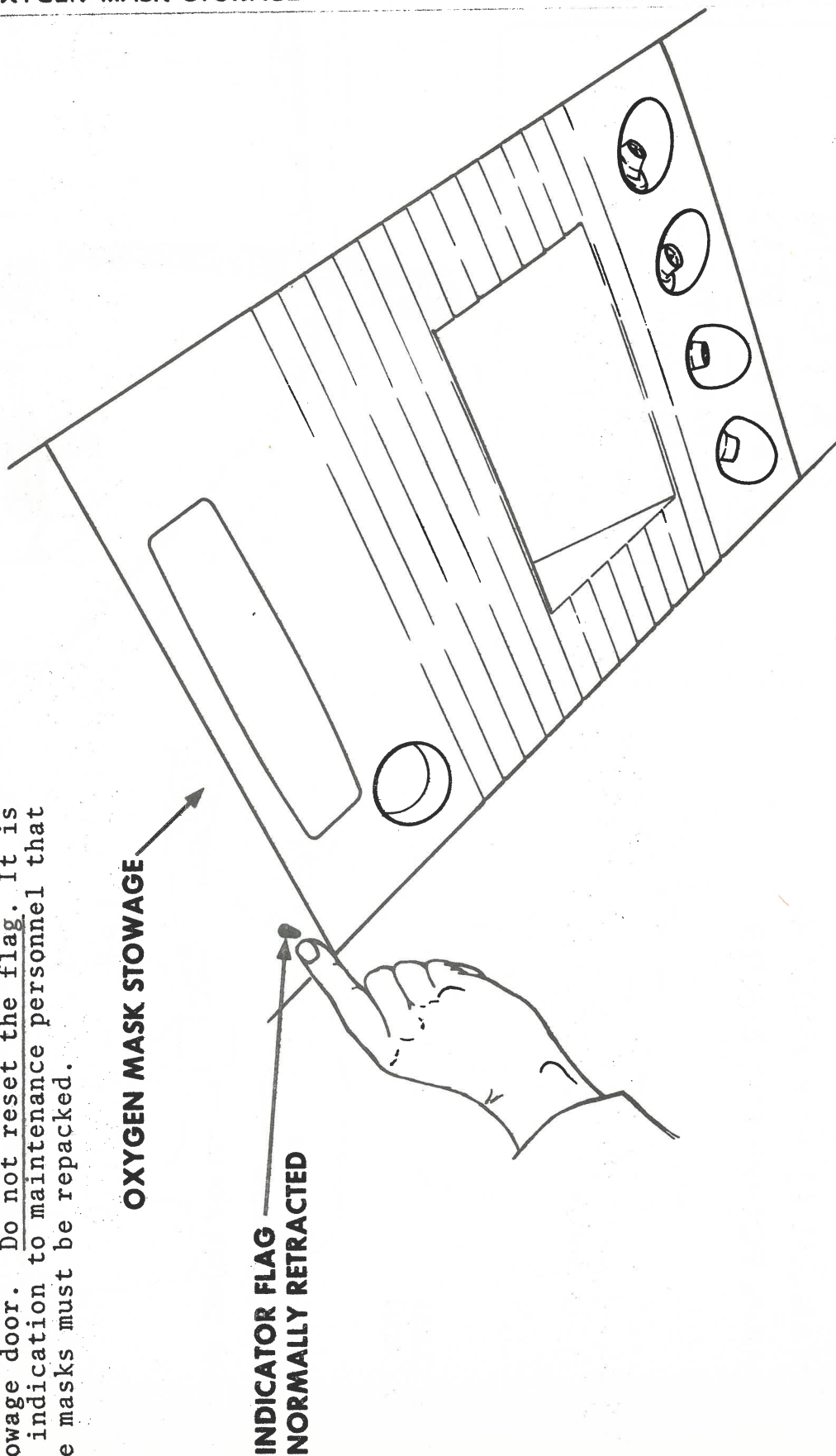


**FIRST CLASS
 SECTION**



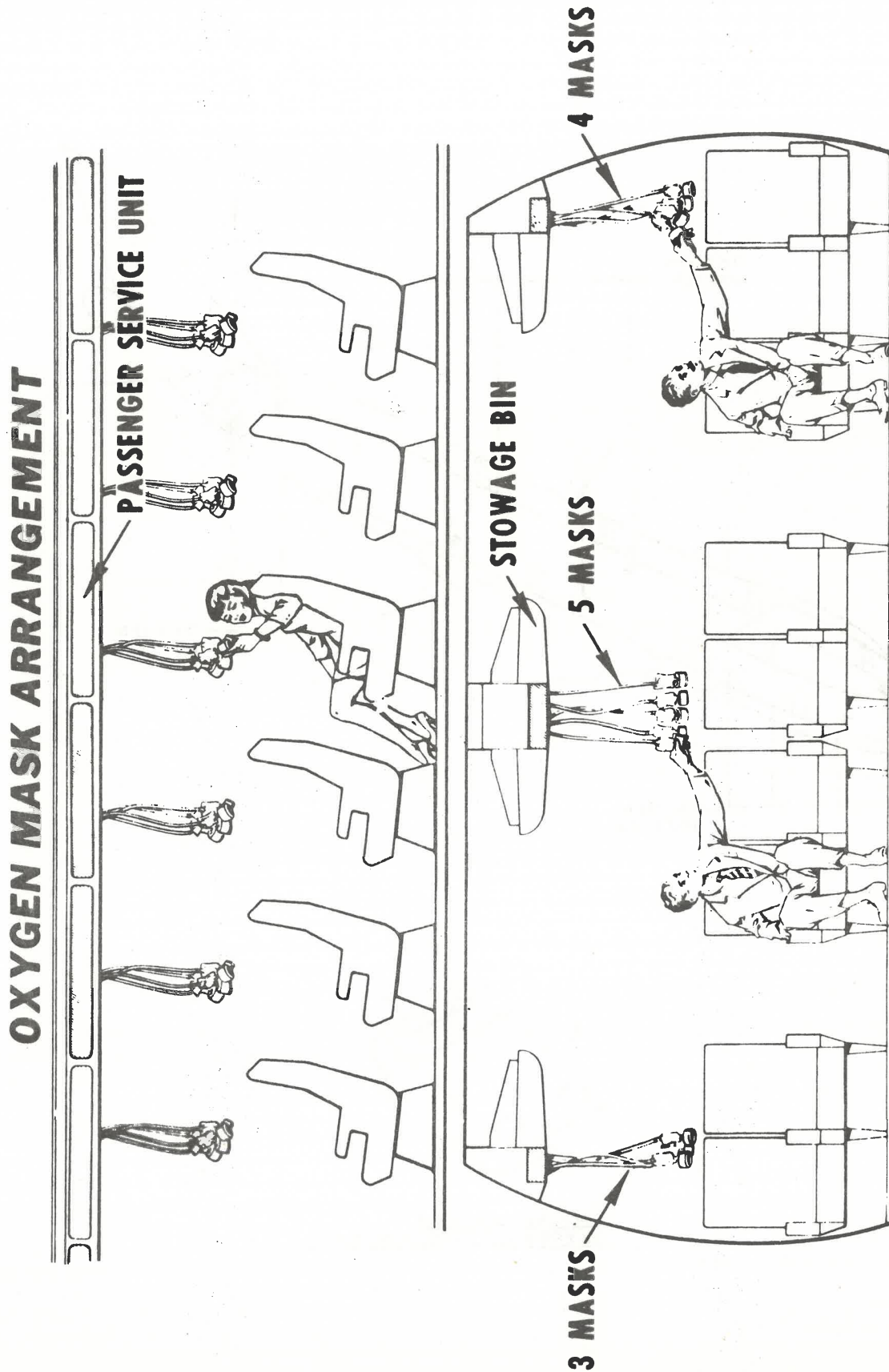
PASSENGER OXYGEN MASK STOWAGE:

When the masks are no longer needed they may be stowed in the oxygen mask stowage compartment until landing. When masks have been stowed by flight personnel an indicator flag will protrude below the oxygen mask stowage door. Do not reset the flag. It is an indication to maintenance personnel that the masks must be repacked.

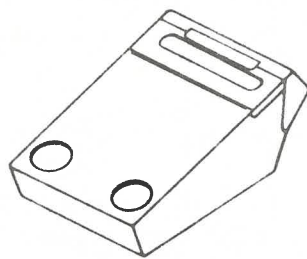
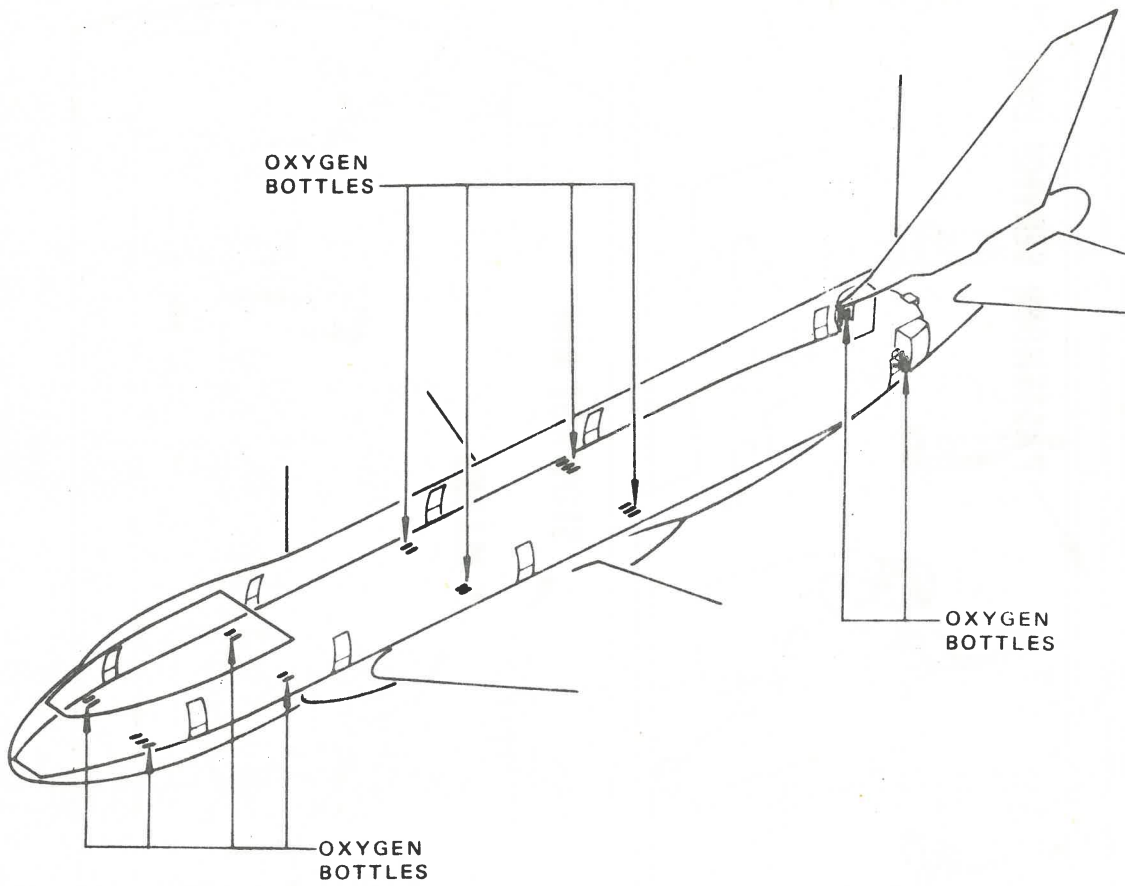




OXYGEN MASK ARRANGEMENT:

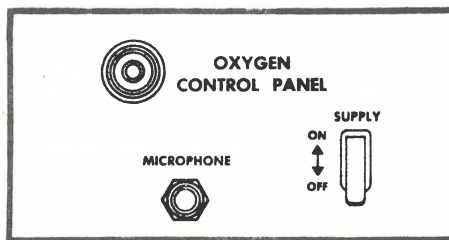


PORTABLE OXYGEN BOTTLES LOCATION:

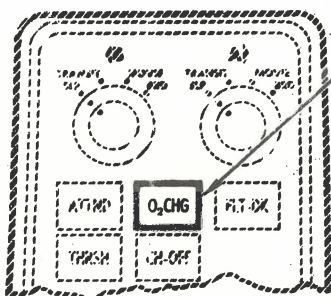


TYPICAL PORTABLE
OXYGEN BOTTLES CONTAINER

OXYGEN SYSTEM CONTROL PANELS:



OXYGEN CONTROL PANEL



CABIN ATTENDANTS' PANELS - STATIONS 1L AND 4L

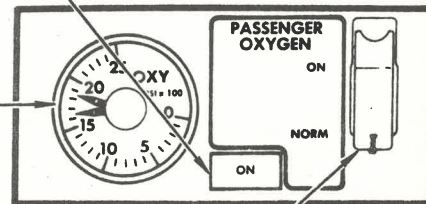
PASSENGER OXYGEN INDICATOR LIGHT (Amber)
 (Red) - Cabin Attendants'
 ILLUMINATED - System activated.



PILOTS' CENTER PANEL

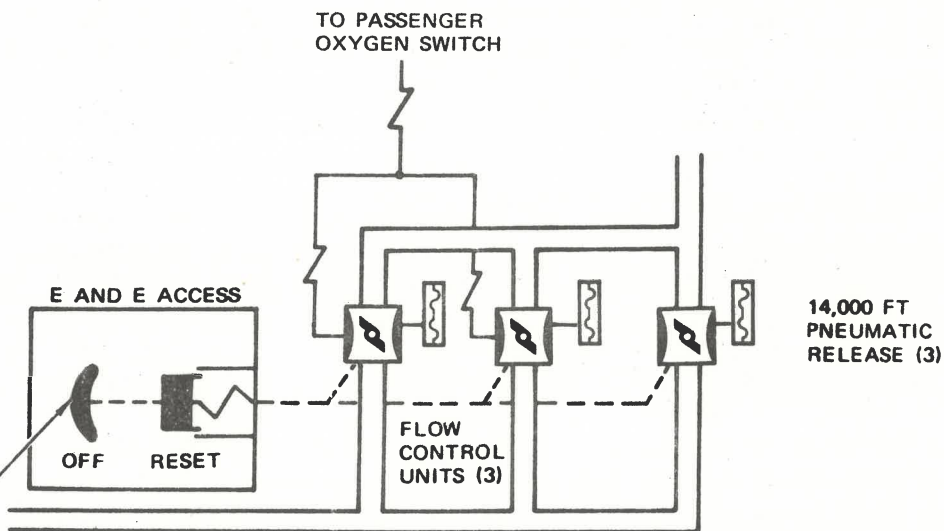
F/E PANEL

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.

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PNEUMATICS:

The primary sources of air for the system is taken from engine bleeds. For ground operation air may be supplied by the APU or external air carts. Bleed air is extracted from either the engine low or high stage compressor, depending on engine thrust and pneumatic requirements. For takeoff, climb, and cruise conditions, the system provides low stage air. For descent and other low engine thrust conditions, the high stage is required to provide for system demands. Pressure and temperature regulated bleed air from the engines is delivered to the pneumatic manifold. The left and right wind pneumatic manifolds may be isolated through isolation valves, controlled by switches on the S/O panel. The pneumatic manifold provides air for:

1. Engine Starting
2. Air Conditioning/Pressurization
3. Wing Anti-icing
4. L/E Flaps Actuation
5. Air Driven Hydraulic Pumps
6. Aft Cargo Heat
7. Pressurizing Water Tanks
8. Pressurizing Hydraulic Reservoirs

Pneumatic control switches and lights are located on the S/O panel.

A Duct Pressure Indicator upstream of each isolation valve displays engine bleed air performance.

Bleed Air Valve Switches control the engine bleed air valves which perform four functions:

1. Serve as a shutoff valve for engine bleed air
2. Regulate pressure to 45 PSI
3. Act as a reverse flow check valve
4. Automatically close engine bleed air valves if temperature limits are exceeded.

Bleed Air Overheat Light illuminates if bleed air temperature is excessive. This indicates a malfunction of the pre-cooler system. Illumination of this light means the bleed valve has not been closed.

Bleed Air Valve Closed Light illuminates anytime the engine bleed air valve is closed.

High Stage Light illuminates anytime the high stage bleed valve has automatically opened to replace low stage bleed.

Pressure Relief Light illuminates indicating bleed air pressure upstream of the engine bleed air valve is excessive and the relief has opened to vent the air overboard. This light indicates a malfunction of the pressure regulating device for the high stage bleed and the valve has failed to close.

Wing Leading Edge Overheat contains a dual loop to provide overheat warning. The warning is provided by an amber light on the S/O panel. A test switch allows a check of each loop. The system is strictly a warning system with NO resulting valve action.



GENERAL

1. Environmental control in the aircraft and air-driven units in several systems require a supply of compressed air which is provided by the pneumatic system.
 - a. Pneumatic system may be isolated between each wing.
 - b. Warning is provided to detect duct rupture or leakage in the engine struts or along the pneumatic manifold.

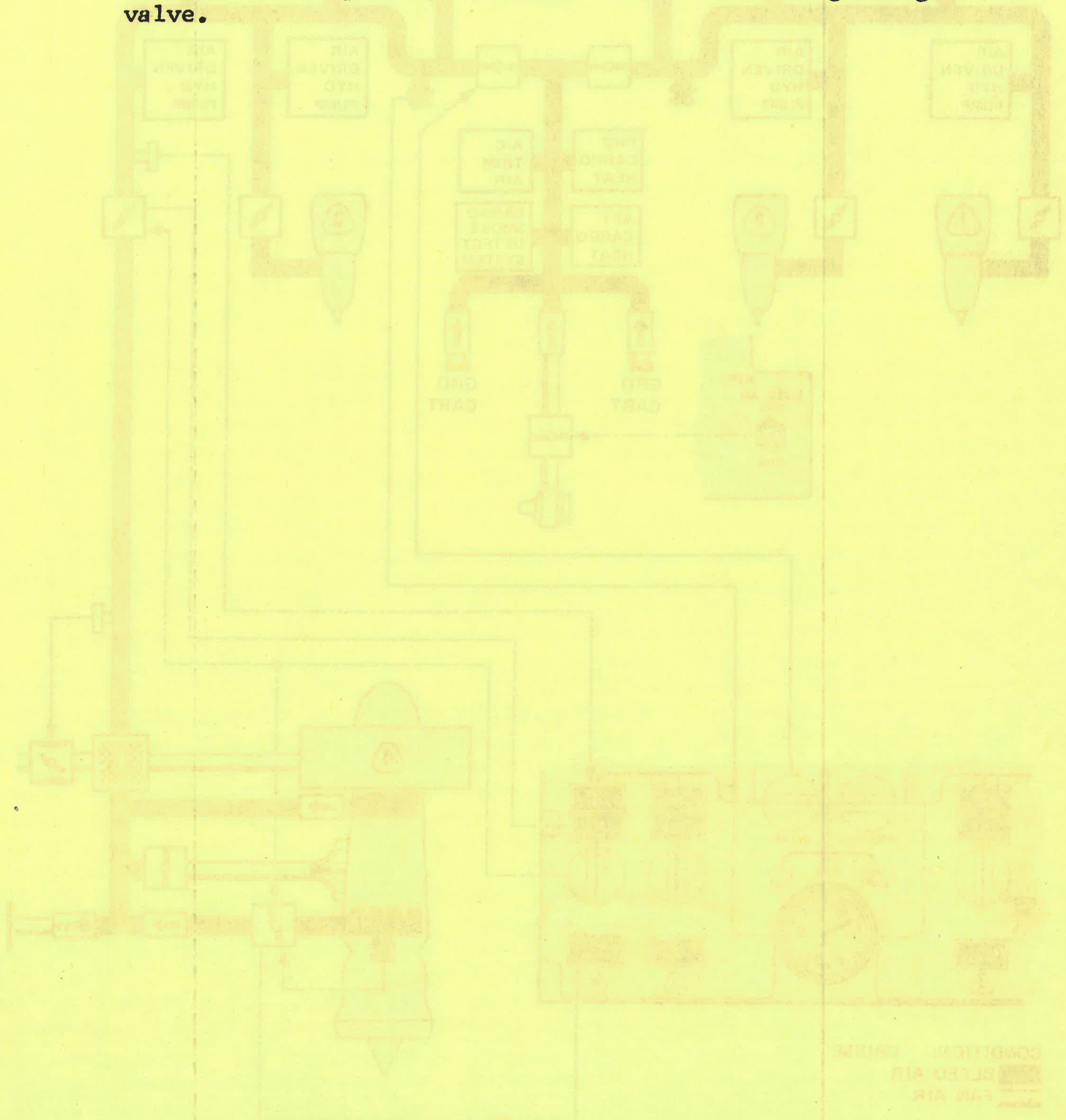
PNEUMATIC MANIFOLD AIR SOURCES

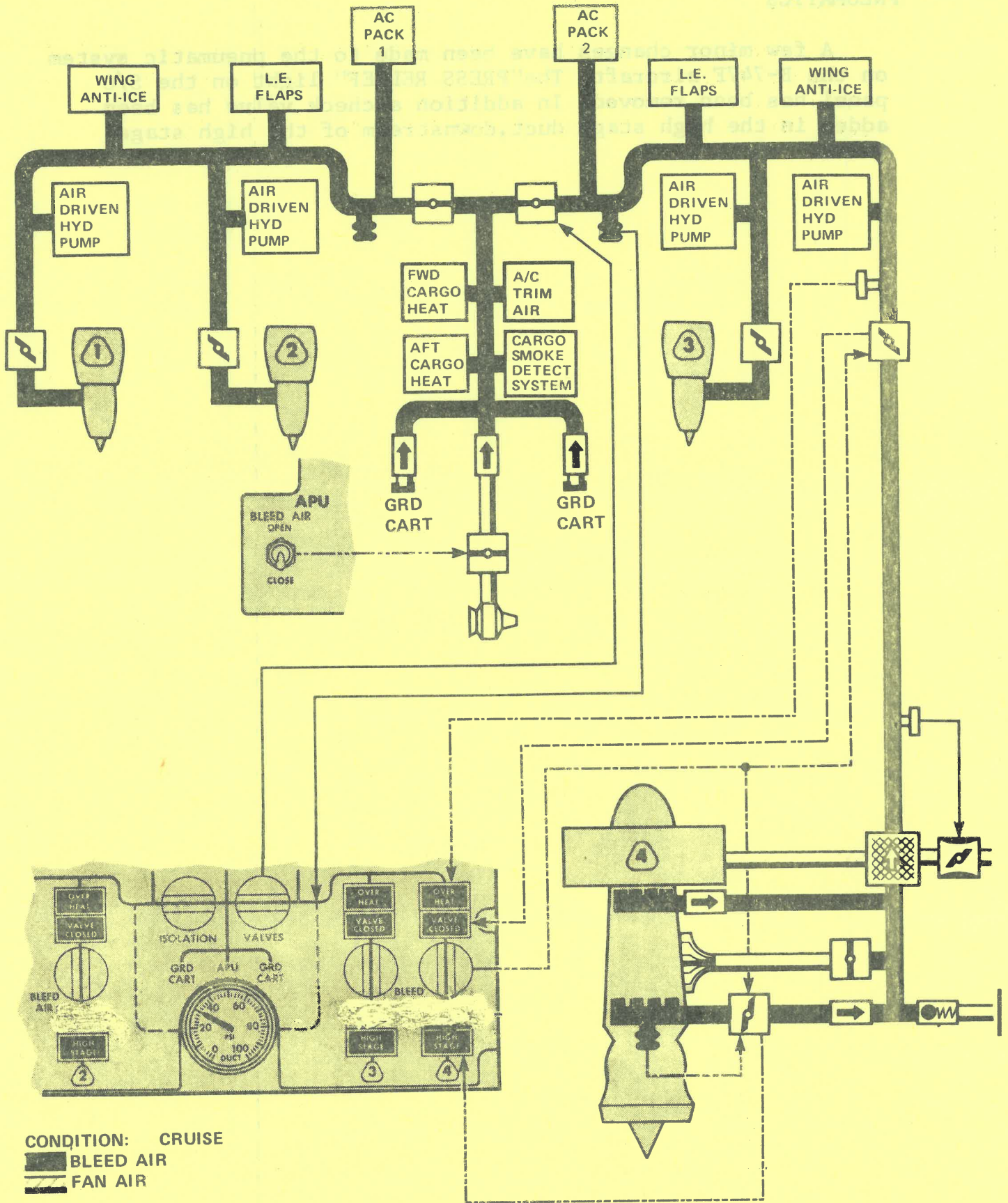
1. External Air Cart
 - a. Two connectors in cross body duct between isolation valves.
2. A.P.U. Air
 - a. Bleed valve controlled by switch on S/O panel.
 - (1) Air supplied from APU between isolation valves
3. Engine bleed air
 - a. Supplied through engine bleed (pylon) valve.
 - (1) Air to bleed valve either 8th or 15th stage.
 - (a) 15th stage bleed valve opens when 8th stage output is insufficient to supply pneumatic requirements.
 - '1' High stage light illuminates when 15th stage valve opens.
 - '2' 15th stage valve is electrically driven closed when engine ignition switch is in "GRD START" position.
 - (2) Engine bleed valve is electrically controlled -- pneumatically operated.
 - (a) Spring loaded closed.
 - (b) Controlled by engine bleed switch on S/O panel.
 - (c) A "Valve Closed" light illuminates when engine bleed valve is fully closed.
 - (3) Functions of engine bleed valve.
 - (a) Regulates at 45 psi.
 - (b) Closes at 47 psi.
 - (c) Regulates air temperature.
 - (d) Closes at excessive high air temperature.
 - (e) Prevents reverse airflow.



PNEUMATICS

A few minor changes have been made to the pneumatic system on the B-747F aircraft. The "PRESS RELIEF" light on the S/O panel has been removed. In addition a check valve has been added in the high stage duct, downstream of the high stage valve.







PNEUMATIC MANIFOLD AIR SOURCES (Cont.)

- (f) Opens on engine starting with engine ignition switch in "GRD START" position.
 - '1' "Valve Closed" light extinguishes.
- (g) Fire switch will close valve.
- b. Pressure Relief light illuminates when pressure relief valve opens.
 - (1) Caused from a failure of the pressure regulator of engine bleed valve.
 - (2) Air dumps into engine cowl through pressure relief valve.
- c. Overheat light illuminates when temperature of air from engine bleed valve is excessive.
 - (1) Caused from a failure of the temperature regulator of engine bleed valve.
 - (2) Illumination of this light does not close engine bleed valve.

PNEUMATIC MANIFOLD

1. Duct extends along the wing front spar to air conditioning bay. Supplies air for following:
 - a. Leading edge flaps.
 - b. Wing thermal anti-ice (TAI).
 - c. Aft cargo heat.
 - d. Air driven hydraulic pumps (ADP).
 - e. Pressurize water tanks.
 - f. Pressurize hydraulic reservoir.
 - g. Air conditioning packs.
2. Pneumatic manifold air pressure is measured on duct pressure indicator.
 - a. Dual indicator located on S/O panel.
 - b. Pressure sensed outboard of isolation valves.

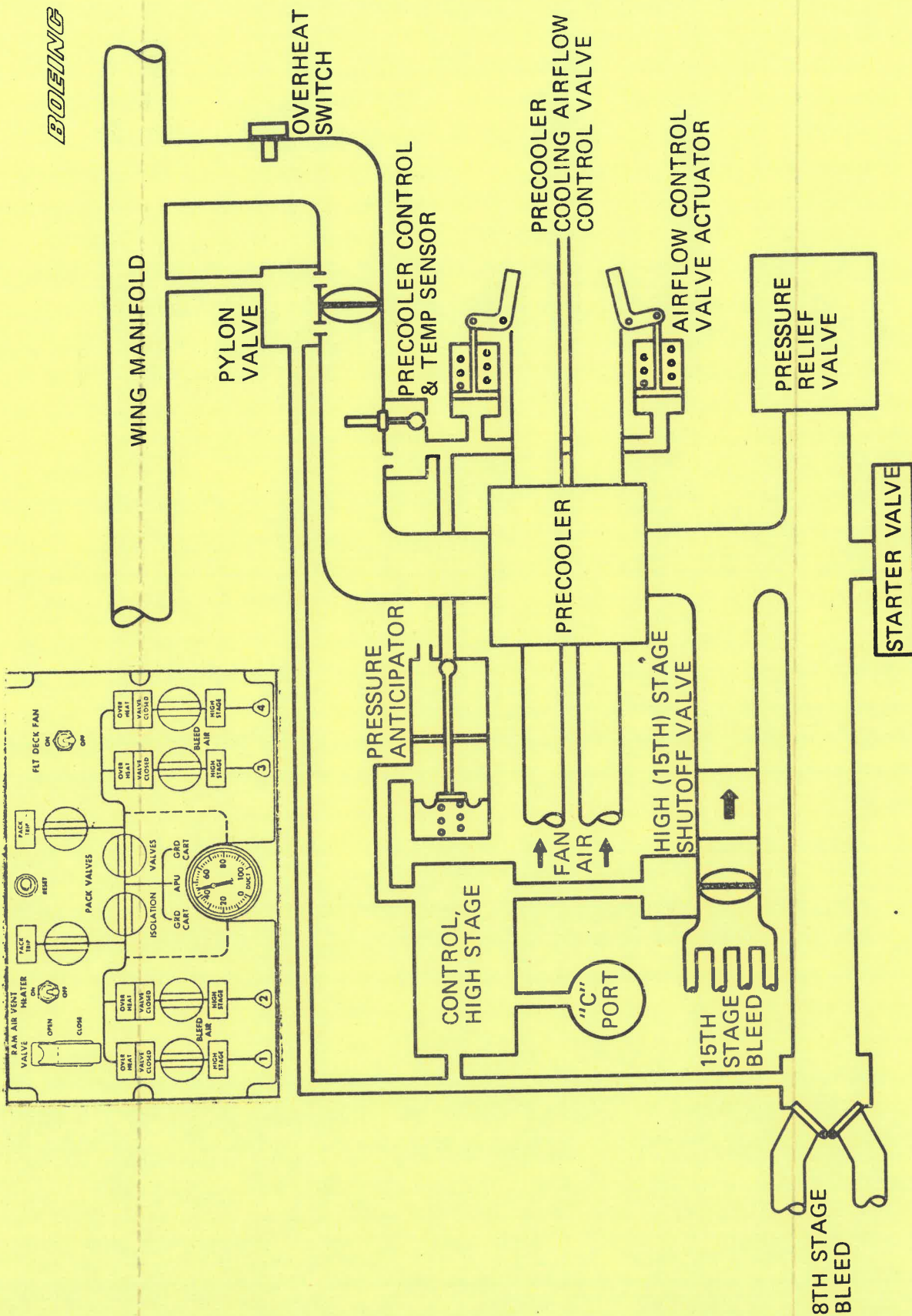
ISOLATION VALVES

1. Isolates left or right wing pneumatic manifold.
2. Controlled by isolation valve switches on S/O panel.
3. Pneumatic manifold may be isolated to eliminate the following conditions:
 - a. Air conditioning smoke.
 - b. Low duct pressure.
 - c. Wing leading edge overheat.



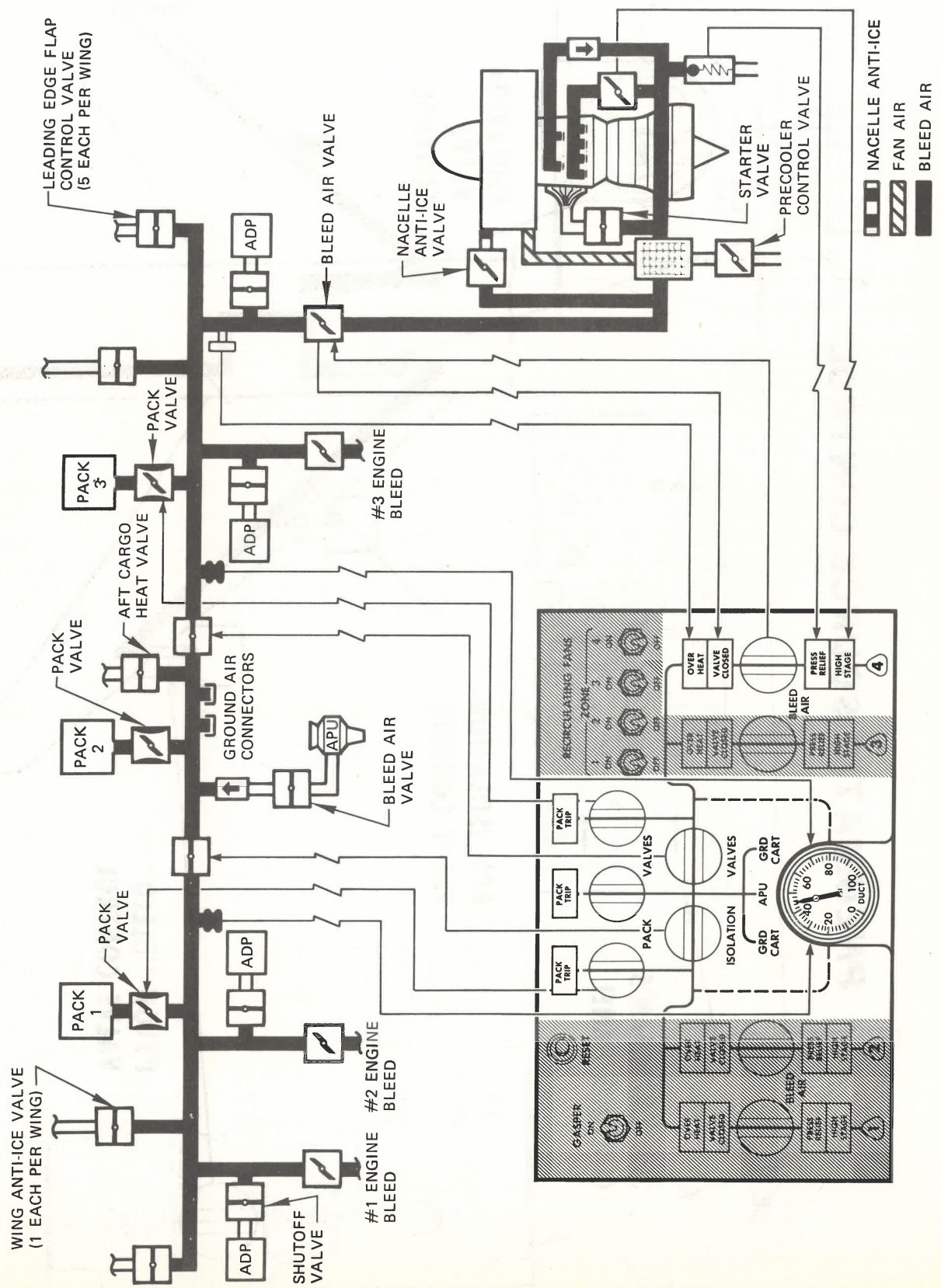
WING LEADING EDGE OVERHEAT SYSTEM

1. Wing leading edge overheat indication is provided to detect a overheat condition in engine strut or leakage/rupture in the pneumatic manifold.
 - a. Wing Leading Edge Overheat lights for respective wing located on S/O panel will illuminate with an overheat condition.
 - (1) A three-position wing overheat test switch located on S/O panel provides check of overheat detection switches.
 - (a) Test A position — checks continuity of "A" overheat detector switches and illuminates both Left and Right Wing Overheat lights.
 - (b) Test B position — Checks continuity of "B" overheat detector switches and illuminates both Left and Right Wing Overheat lights.



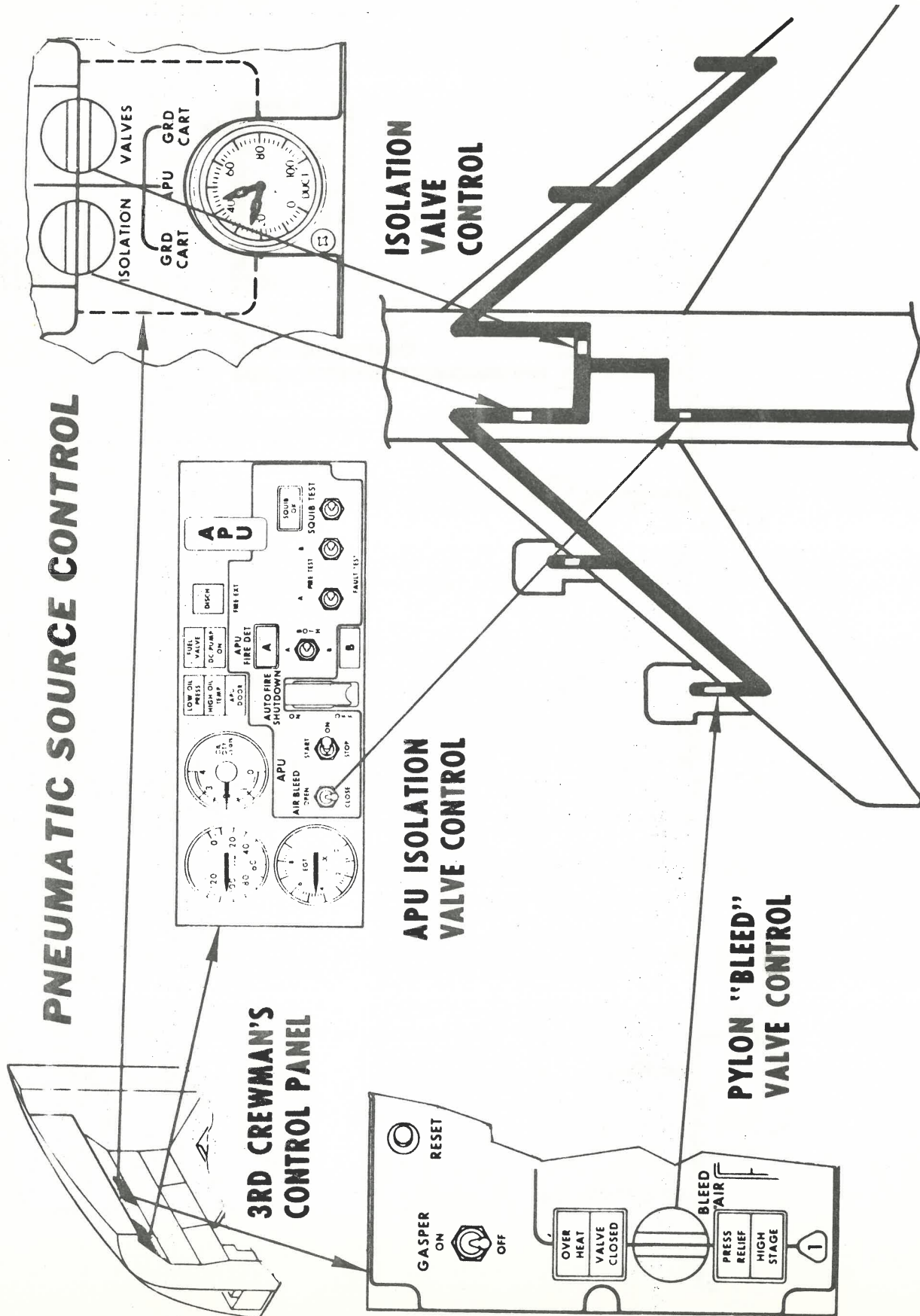
ENGINE PNEUMATIC SYSTEM OPERATION

PNEUMATIC SYSTEM SCHEMATIC:



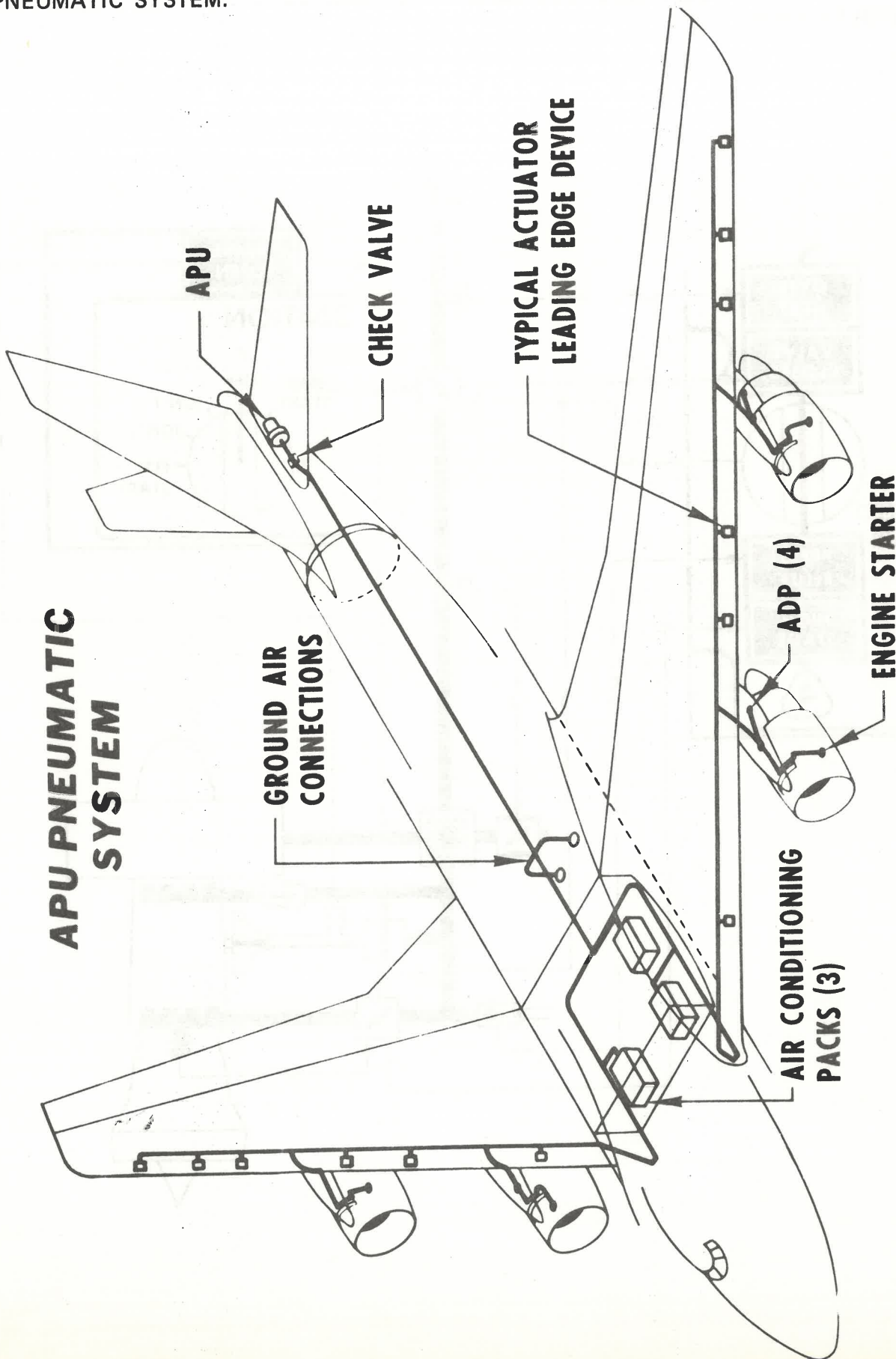


PNEUMATIC SOURCE CONTROLS:

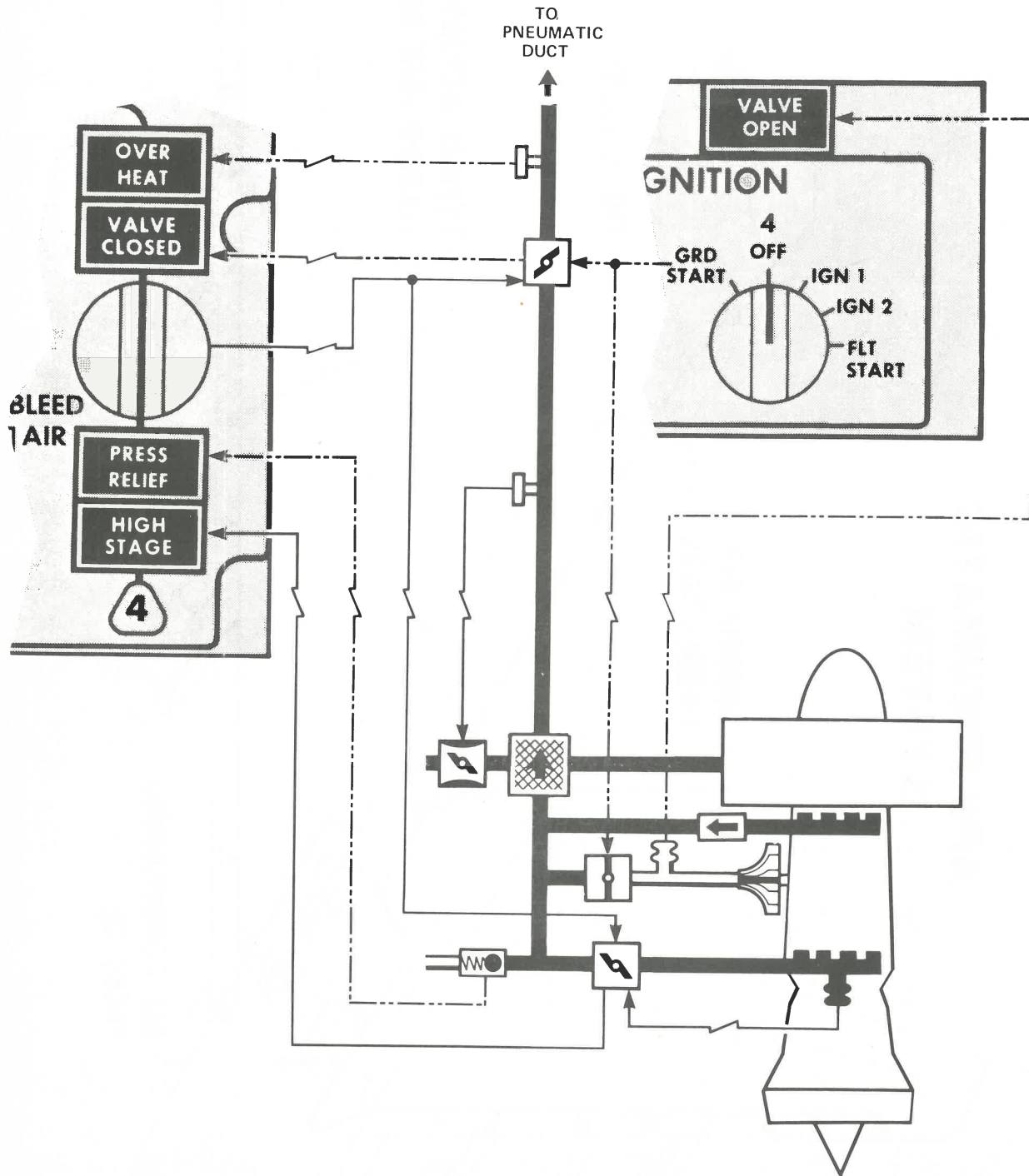




APU PNEUMATIC SYSTEM:

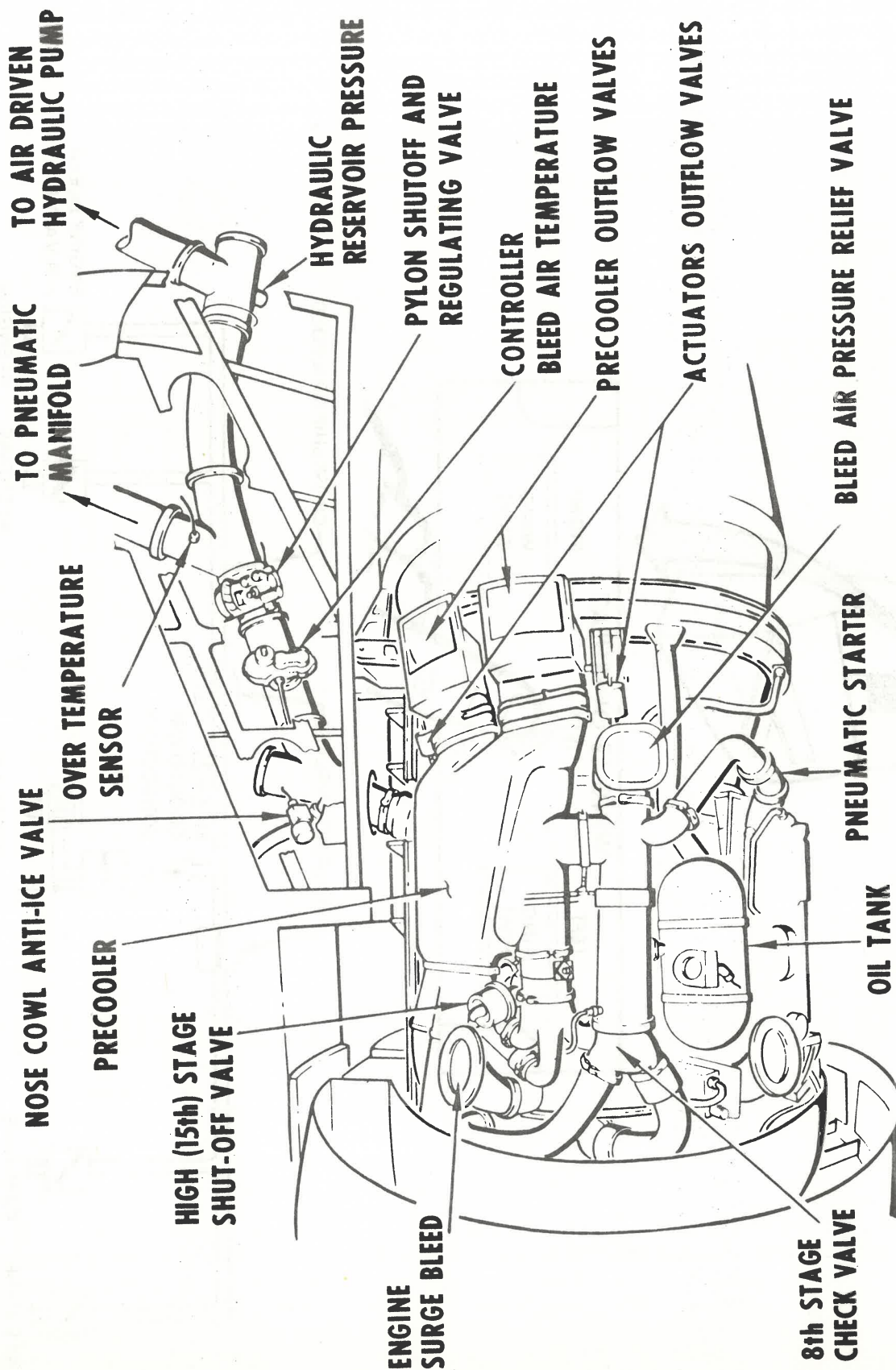


ENGINE BLEED AIR:

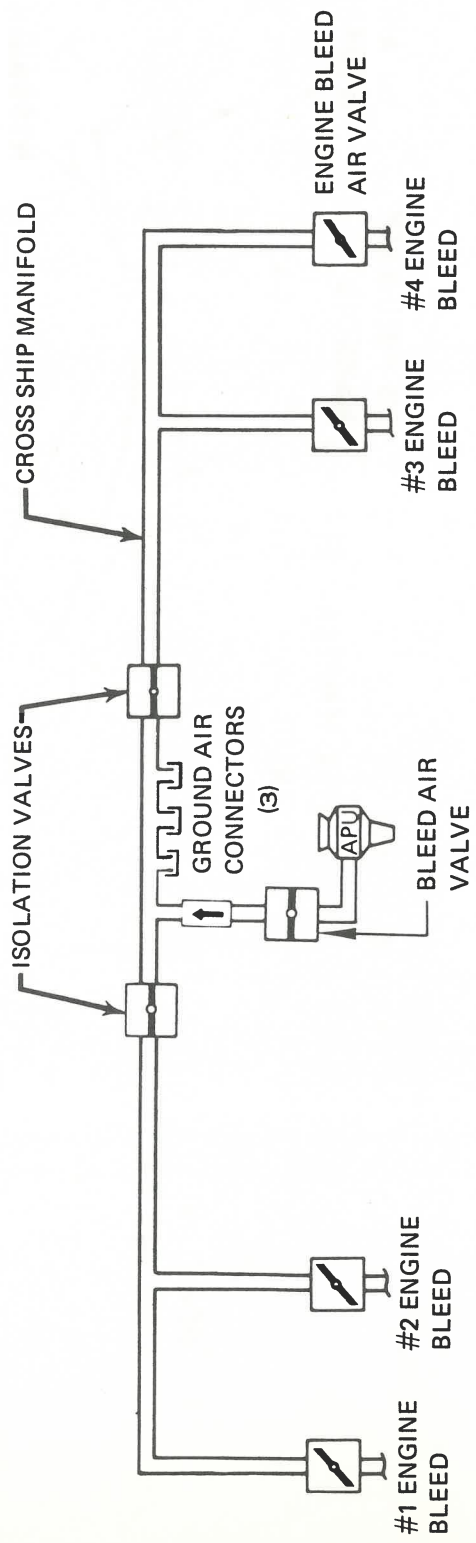
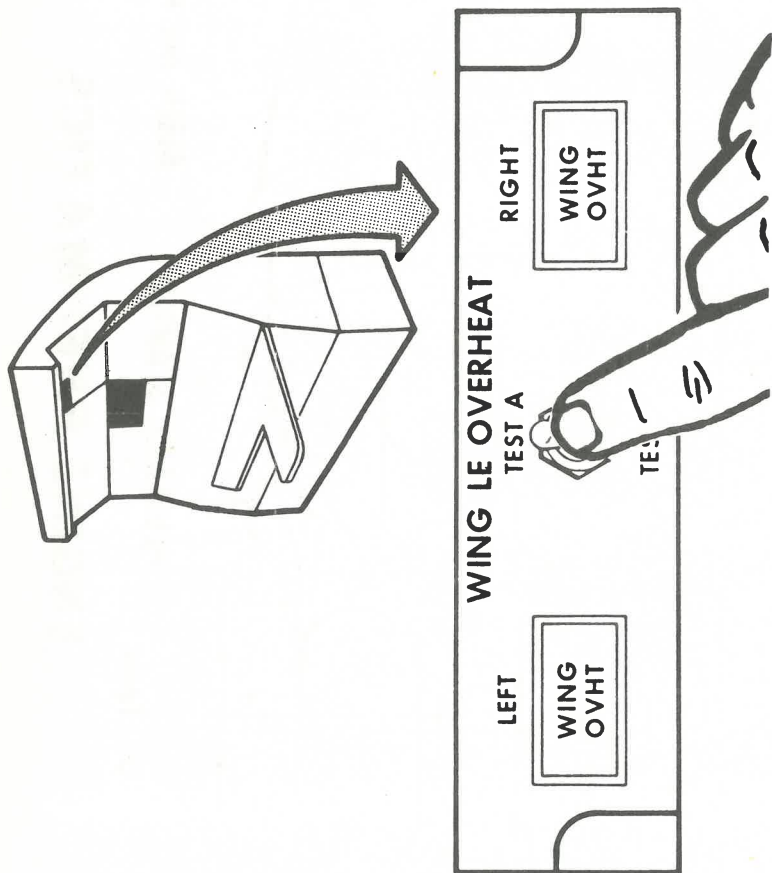




ENGINE PNEUMATICS LOCATION:



ENGINE PNEUMATICS



PNEUMATIC SYSTEM:

BLEED AIR OVERHEAT LIGHT (Amber)

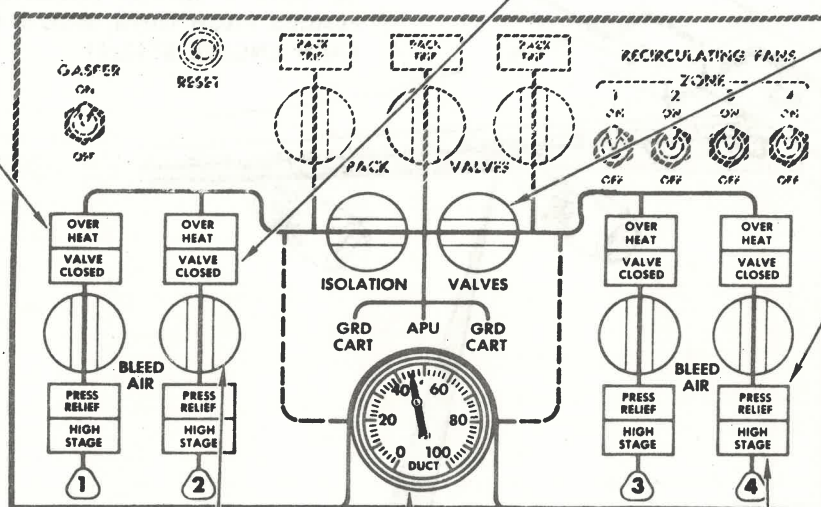
Illuminates if bleed air temperature is excessive.

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 pneumatic 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

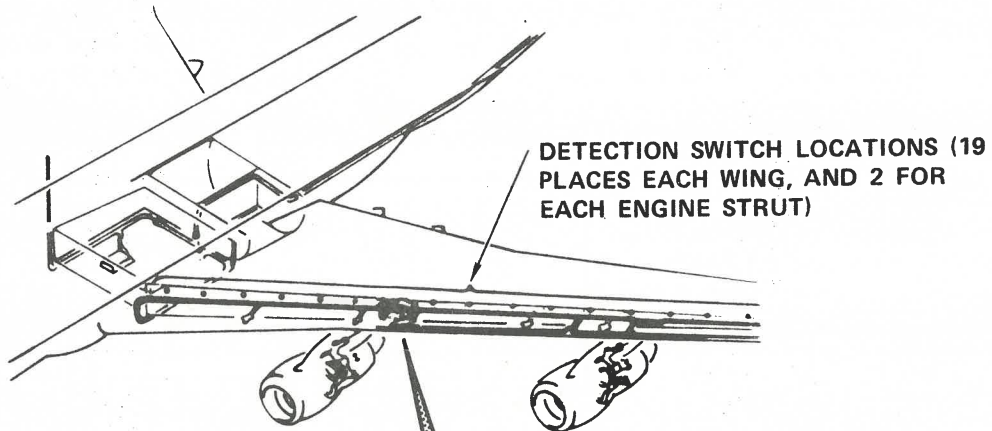
- shuts off engine bleed air supply.
- closes high stage bleed air valve.

DUCT PRESSURE INDICATOR

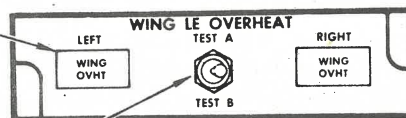
Displays left and right pneumatic duct pressure. Sensors are located out board of isolation valves.

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 overheating
 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.

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AUXILIARY POWER SYSTEM

The APU is a gas turbine engine located in the tail cone of the aircraft, and is isolated from structure and control surfaces by a firewall. It provides electrical and pneumatic power on the ground and because of system redundancy makes operating the APU inflight unnecessary. The two APU driven generators will normally supply the entire electrical loads. APU generators are rated at 90 KVA because of forced cooling. The APU provides bleed air for:

1. Air Conditioning
2. Engine Starting
3. L/E Flaps
4. Air Driven Hydraulic Pumps
5. Water Tank Pressure
6. Aft Cargo Compartment Heat

When electrical and pneumatic loads are powered simultaneously, automatic controls reduce pneumatic power to favor electrical requirements. A battery, identical to the main airplane battery, is provided for APU starting. The main aircraft battery switch must be on in order to start the APU.

Fuel is normally supplied to the APU by the No. 2 aft boost pump from tank No. 2, but could be supplied from any other tank through the crossfeed system. When the AC ground service bus is not powered, a DC fuel pump powered by the battery bus and controlled by the APU switch, will supply fuel. With power on the AC ground service bus, No. 2 aft main boost pump operates automatically and the DC fuel pump is shut down by a pressure switch.

The APU oil system is a self-contained system. A quantity indicator is provided on the S/O panel.

A remote control panel located in the right body wheel well provides the ground crew with a means for:

1. Stopping APU
2. Fire Warning
3. Fire bottle discharge.

Normal control of the APU is provided from the S/O panel.

Auto shut circuits will cause APU shutdown by closing the APU fuel valve and illuminates the APU fault light, alerting the crew.



AUXILIARY POWER UNIT (APU)

1. The APU is located in tail section of aircraft and supplies electrical/pneumatic power.
 - a. APU is normally controlled at S/O panel or can be shut down at remote APU panel in right body wheel well.
 - (1) If APU shut down at remote panel, DC fuel pump continues to run.
 - b. APU inlet door on right side of tail cone provides air for cooling accessories and air to APU compressor.
 - c. APU generators are rated at 90 KVA because of forced cooling.
 - (1) With both APU generators supplying power — the split system breaker automatically trips, preventing paralleling.
 - (2) Bus power control units provide voltage regulation, control, and protection for each APU generator.
2. APU normal starting sequence is initiated at S/O panel.
 - a. Master battery switch on.
 - (1) Controls APU battery located in tail cone.
 - (a) APU battery is electrically heated by a blanket.
 - (2) Select APU battery position by pushbutton selector on S/O panel and check voltage.
 - (3) Check that oil quantity indicator on S/O panel is above 1 quart.
 - b. APU master switch on.
 - (1) Fuel shut off valve opens.
 - (a) Fuel Valve In-transit light on S/O panel illuminates, then goes out.
 - (2) DC fuel pump will operate with no AC power on aircraft.
 - (a) DC Pump On light at S/O panel illuminates.

NOTE: With AC power on aircraft, fuel to APU is supplied by No. 2 aft main boost pump, which will shut off DC pump.

 - (3) APU air inlet door opens fully on ground or partially in flight.
 - (a) APU Door light on S/O panel illuminates then goes out.
 - c. APU master switch to start.
 - (1) APU battery voltage on indicator drops, indicating power to starter.



FREIGHTER

49:01F

A.P.U.

No significant changes in APU design or operation.

Range markings have been removed from oil quantity gauge.



AUXILIARY POWER SYSTEM

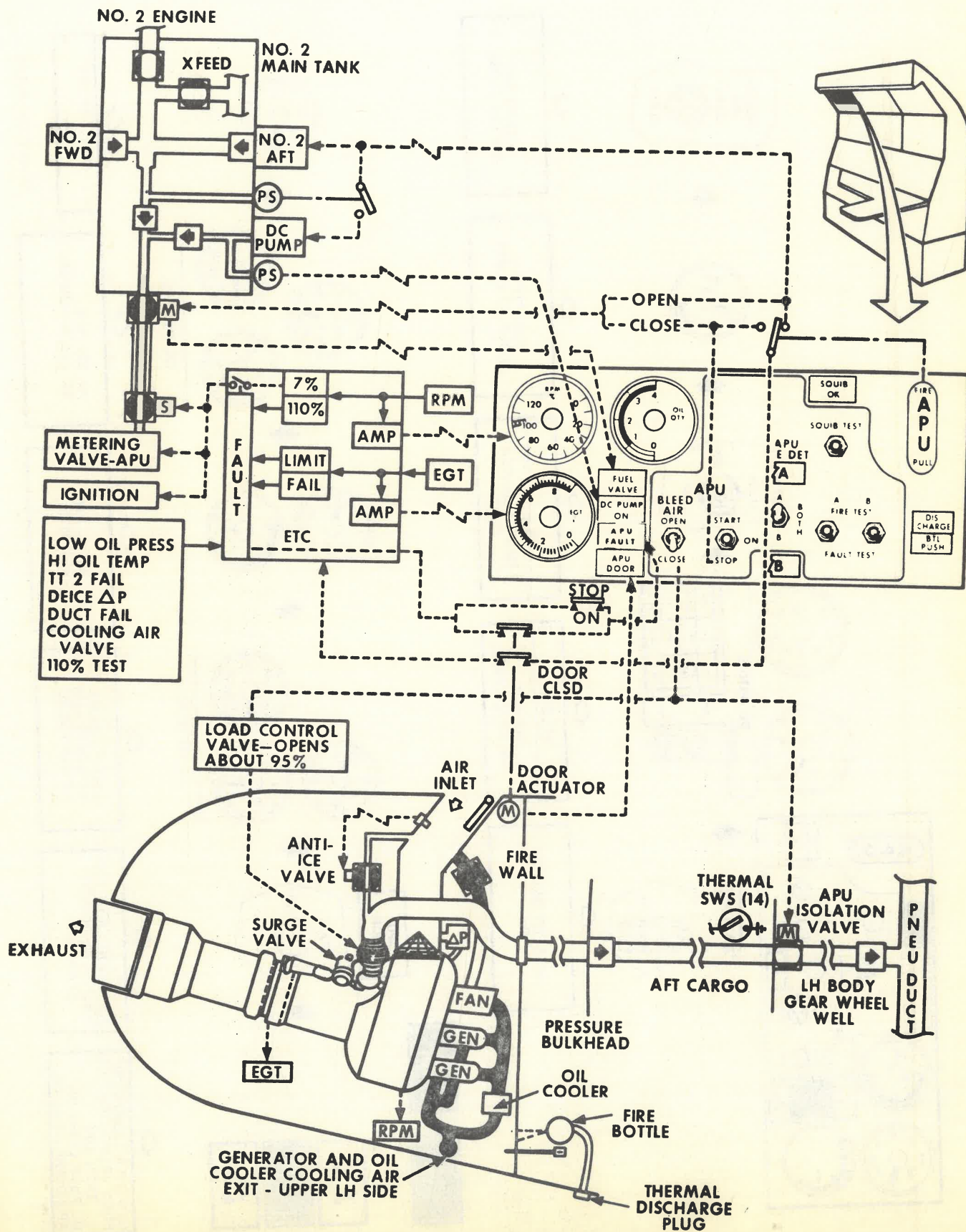
- (2) APU battery ammeter reads zero (rendered inoperative until APU RPM reaches 50%).
 - (3) APU RPM indicator on S/O panel starts to rise.
 - d. APU RPM 7%
 - (1) Fuel solenoid opens.
 - (2) Ignition starts.
 - (3) APU EGT indicator on S/O panel displays rise (light off).
 - e. APU RPM 50%.
 - (1) Starter power cut off.
 - (a) Voltmeter reading APU battery, returns to normal.
 - (b) Ammeter is now operative.
 - f. APU RPM 95%.
 - (1) Ignition is cut off.
 - (2) APU air and electrical power available.
 - (a) APU air supplied to pneumatic manifold through APU bleed valve controlled by APU bleed air switch on S/O panel.
3. APU shut down is accomplished from S/O panel or remote panel.
- a. Bleed air switch off.
 - (1) EGT on indicator decreases.
 - b. APU master switch stop.
 - (1) Fuel Valve In-transit light on S/O panel illuminates and goes out.
 - (2) DC Pump On light located at S/O panel goes out.
 - (a) If APU shut down from remote panel — DC fuel pump continues to run and light remains illuminated.
 - (3) APU Fault light illuminates until APU door is closed.
 - (a) If APU shut down from remote panel — APU Fault light will not illuminate.
 - (4) APU Door light illuminates until door is fully closed.
4. Automatic shut down of APU will occur with a malfunction or fire being sensed.



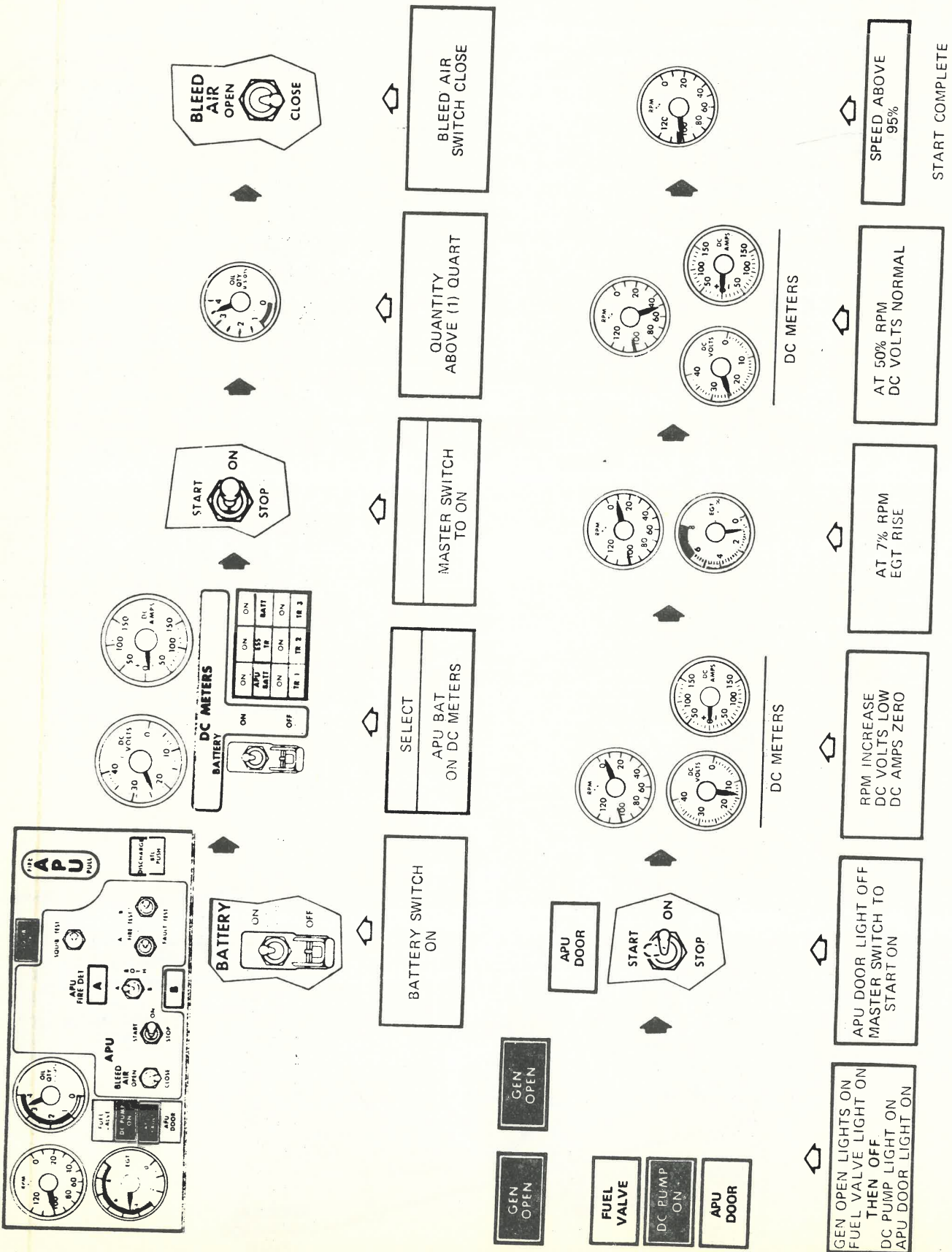
AUXILIARY POWER SYSTEM

- a. APU Fault light on S/O panel will illuminate, if shut down caused by malfunction only.
 - (1) If shut down by fire – Fault light will not illuminate.
5. APU electrical faults will cause the appropriate Generator Breaker or Field light on S/O panel to illuminate, indicating breaker has tripped.
 - a. APU electrical faults are displayed on fault annunciator module located on S/O panel.
6. APU GEN BRG Failure lights on S/O panel illuminate with an impending failure.

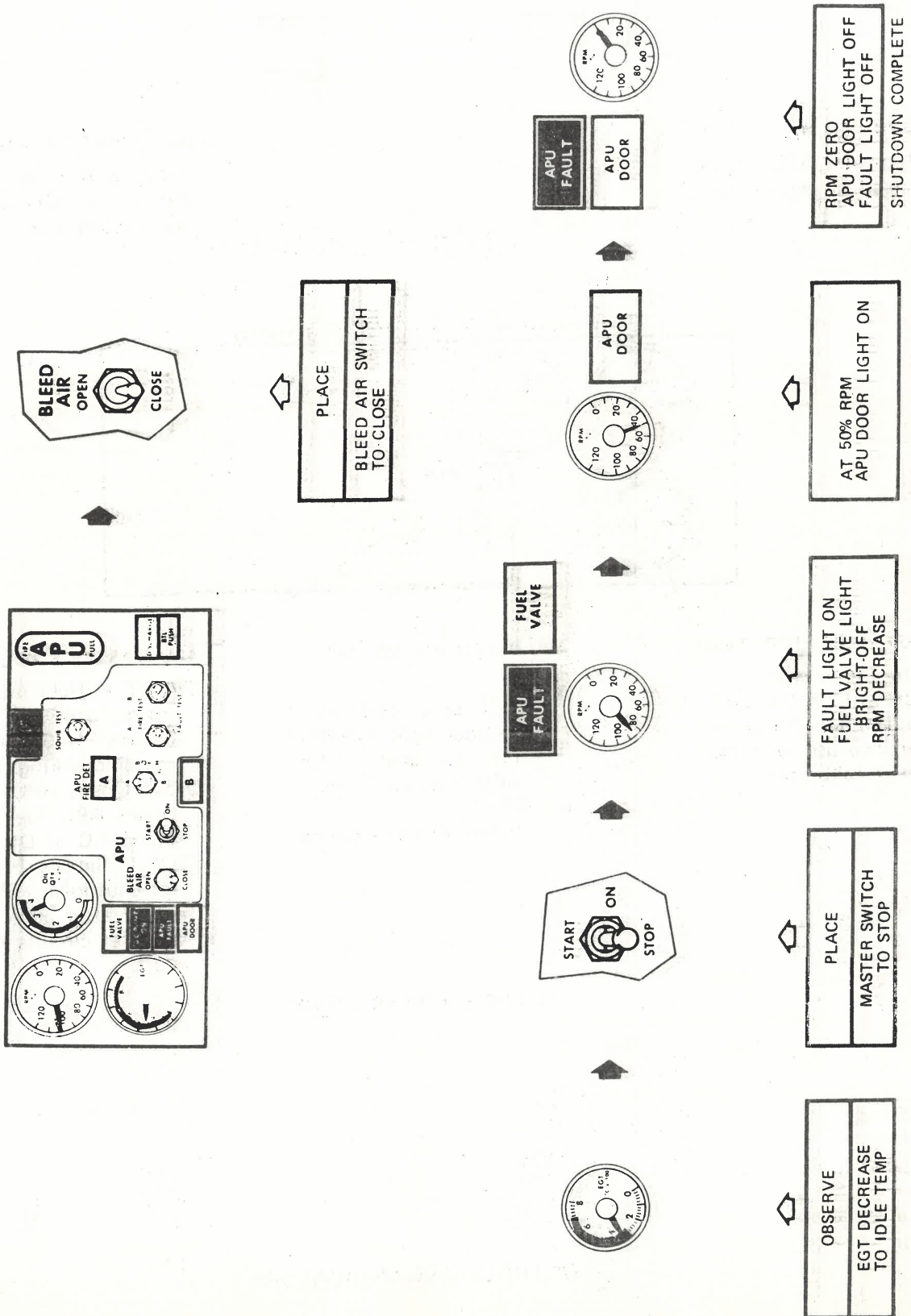
AUXILIARY POWER UNIT SCHEMATIC



APU START PROCEDURE



APU STOP PROCEDURE

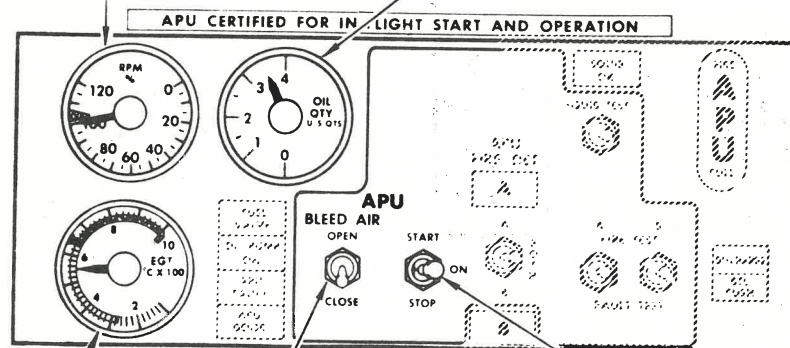




APU CONTROLS AND INDICATORS

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.



EGT INDICATOR (Typ)
 The index mark (brown) on the EGT indicator is for maintenance use in instrument calibration.

APU BLEED AIR SWITCH
OPEN
 - APU provides bleed air to pneumatic manifold.
 - Provides bleed air for APU inlet anti-icing.
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 shutdown to reset circuits for another start.

FLIGHT ENGINEER'S PANEL

APU ANNUNCIATOR

APU FUEL SHUTOFF VALVE LIGHT (Blue)

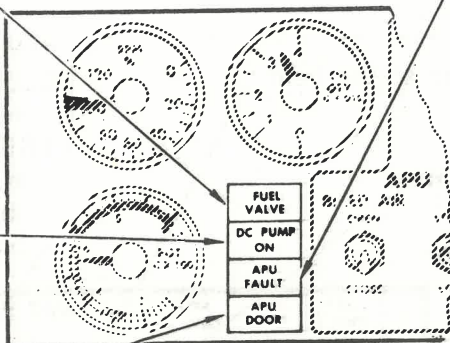
EXTINGUISHED – APU fuel shutoff valve open or closed.
 ILLUMINATED -- Valve in transit.

DC PUMP ON LIGHT (Green)

ILLUMINATED – APU DC fuel pump operating.

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%.



FLIGHT ENGINEER'S PANEL

APU FAULT LIGHT (Amber)

ILLUMINATED – APU has shut down due to:

- Low oil pressure
 Low oil pressure shut-down 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
- Excessive pressure drop across APU inlet screen
- Duct failure overheat
- Loss of control power
 Air inlet temperature
 Compressor discharge pressure
 EGT information
 Speed input signal
- Normal shutdown – Light will extinguish when APU door has closed.

ANNUNCIATOR LIGHTS

APU ELECTRICAL CONTROL PANEL

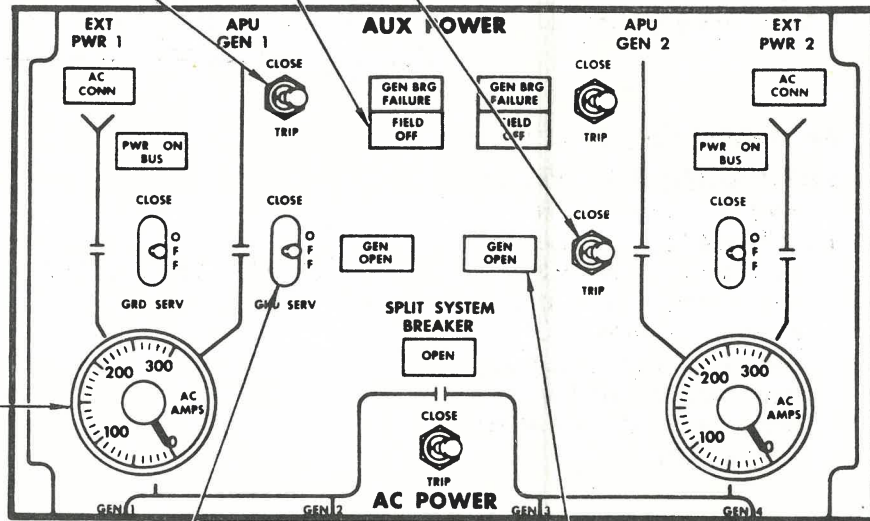
APU FIELD OFF LIGHT (Amber)
 ILLUMINATED – Indicates generator field is deactivated.

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

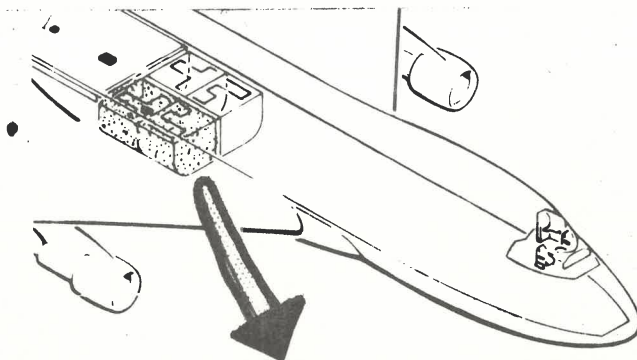
AUXILIARY POWER AMMETER
 Indicates current output of the auxiliary generator powering the sync bus.



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.

APU REMOTE CONTROL PANEL



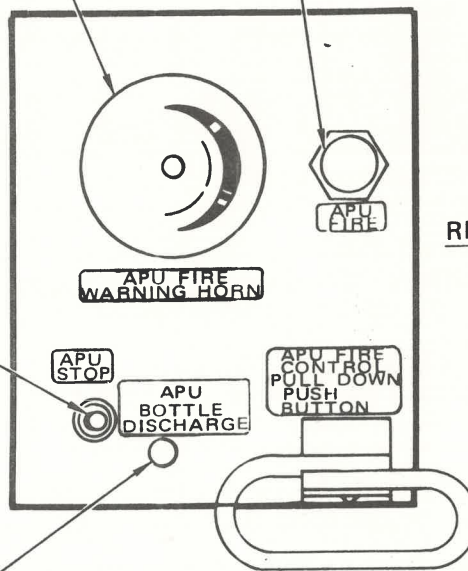
APU REMOTE FIRE WARNING HORN
 Sounds upon receiving fire signal. Silenced when fire switch in wheel well or on flight engineer's panel is pulled or fire is extinguished. Also sounds during fire test. Deactivated when gear is retracted.

APU REMOTE FIRE LIGHT (Red)
 Illuminates upon receiving fire signal. Goes out when fire is extinguished. Also illuminates during fire test.

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.



RIGHT BODY WHEEL WELL

APU REMOTE CONTROL MODULE

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DOORS:

The ten main cabin doors have two operating modes: Manual (no power opening or slide deployment) and Automatic (power opening and slide deployment). Each door has an inflatable escape slide stowed on its inboard lower portion except No. 3 doors which have a door/wing ramp plus an off-wing slide. A rope to guide passengers on to the wing in event of a ditching is stowed overhead at each No. 3 door. Opening any of the doors from the outside automatically positions the mode selector to Manual. A slide inflation bottle is located in top portion of door except doors 3L and 3R, which are located in the left side or right of the escape slide cover. A door power assist bottle gauge is located near floor level, to the left of each door. Slide Manual inflation handles are provided on the side edge of the doors. When door girt bars are engaged (Ships 601 through 612 only) Girt Bar Indicator Lights show red.

A crew service door is on the upper deck in the forward right side of the fuselage along with a track-mounted escape slide, on the floor adjacent to the door.

An escape hatch and five escape reels are located in the ceiling of the cockpit. A braking mechanism within the reel slows the 'Fall' rate to the equivalent of a two foot drop.

Door annunciator lights on S/O panel reflect status of the doors.

The cockpit door is an electrically/manually operated door. The door has a solenoid operated latch which can be released from the pilot's overhead panel. The loss of essential power will automatically release the latch. If the door is opened from the cabin, a key must be used.

GENERAL:

1. The cockpit and cabin are provided with emergency evacuation systems. The cockpit has a crew service door floor mounted escape slide and in addition, escape reels which may be used for exit through the overhead escape hatch. The ten main cabin doors have built in emergency evacuation systems. Overwing main cabin doors provide another feature consisting of a fairing mounted slide which may be operated in conjunction with its respective main cabin door.

FIVE ESCAPE REELS:

1. These reels are located near the overhead escape hatch and are attached to structure.
 - a. Each reel has approximately 40 feet of stainless steel tape.
 - b. Each has a built in brake mechanism built into the hand grip.

NOTE: Cockpit escape route in order of preference:

- (1) Circular stairwell
- (2) Crew service door
- (3) Overhead hatch via escape reels

CREW SERVICE DOOR FLOOR MOUNTED ESCAPE SLIDE:

1. A floor mounted escape slide is located on floor tracks inboard of the crew service door.
 - a. The slide pack may be positioned in two positions.
 - (1) Aft for ground operations
 - (2) Forward for inflight (directly in front of crew service door).
 - (a) Floor track stops insure proper positioning.

2. Manual operation:

- a. Lift handle on left side and push it out manually. The slide should inflate.
- b. If the slide fails to inflate, the freon bottle trigger may be tripped manually.

DOOR MOUNTED ESCAPE SLIDES:

1. Escape slides are located in all cabin doors except No. 3 overwing doors which incorporate a ramp type slide.
2. Arming of the escape system.
 - a. Closing the cabin doors from the outside will automatically engage the girt bar and arm the system on ships 601 through 612. On ships 613 through 615 closing the cabin doors from the outside will not engage the girt bar and arm the system.



FREIGHTER

52:01F

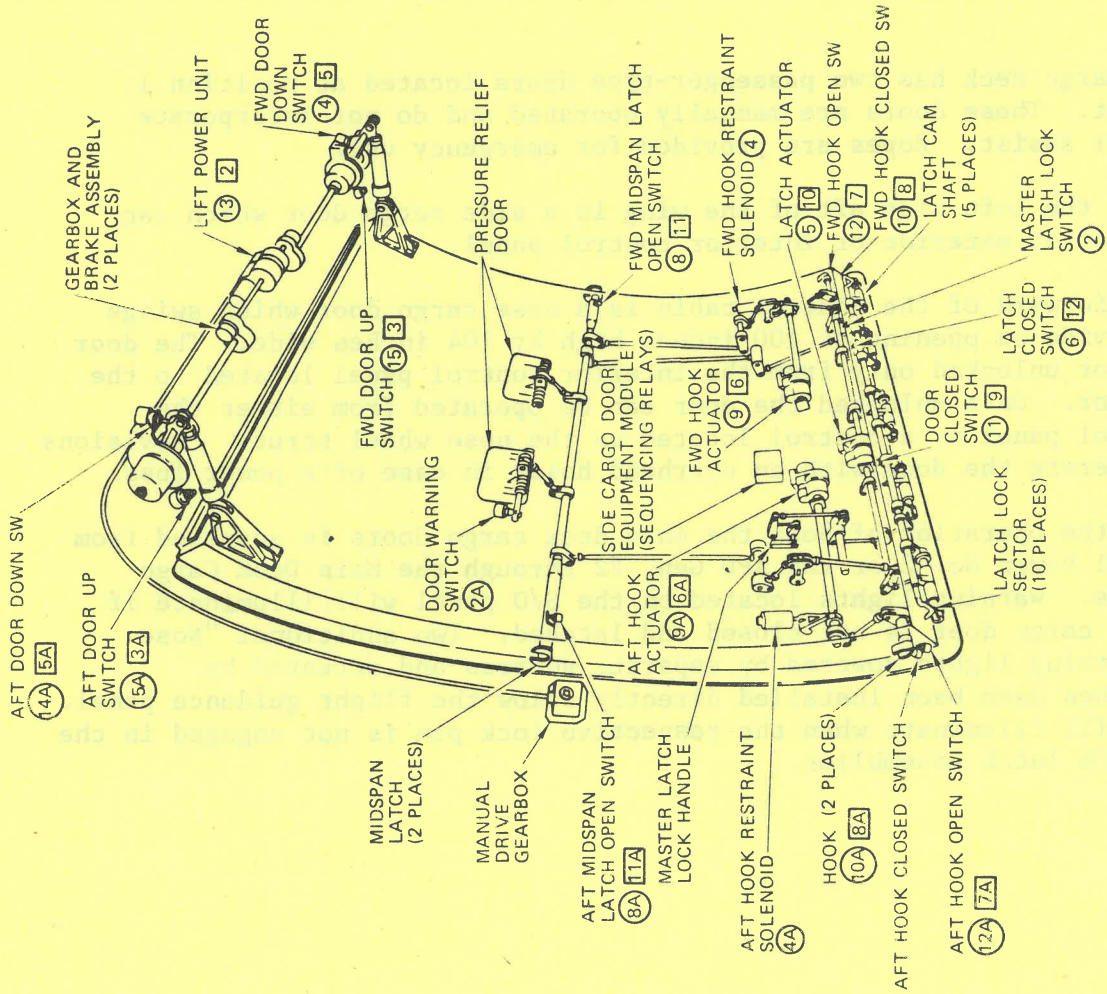
DOORS

The main cargo deck has two passenger-type doors located at position 1 left and 5 left. These doors are manually operated and do not incorporate chutes or power assist. Ropes are provided for emergency use.

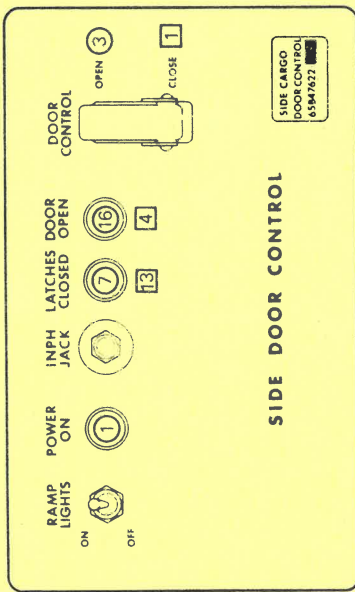
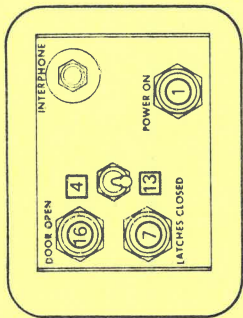
Located on the left side aft of the wing is a side cargo door which can be operated from an exterior or interior control panel.

Below and forward of the control cabin is a nose cargo door which swings upwards to provide an opening of 100 inches high by 104 inches wide. The door can be locked or unlocked only from the interior control panel located to the left of the door. Once unlocked the door can be operated from either the interior control panel or a control located on the nose wheel strut. Provisions are made to operate the door with an overhead hoist in case of a power loss.

Power for the operation of both the main deck cargo doors is supplied from either External Power No. 2 or the APU Gen. #2 through the Main Deck Cargo Handling busses. Warning lights located on the S/O panel will illuminate if any main cabin cargo door is not closed and latched. Two additional "Nose Door" amber warning lights powered by separate sources and actuated by separate switches have been installed directly below the flight guidance panel. These lights will illuminate when the respective lock pin is not engaged in the No. 1R or No. 8R latch assemblies.



SIDE CARGO DOOR SCHEMATIC





DOOR MOUNTED ESCAPE SLIDES: (continued)

- (1) With system armed the word 'automatic' appears in the viewing window.
 - (2) Opening the door from the outside disarms the escape system.
 - b. Closing the cabin door from the inside requires the attendant to manually arm the system by positioning the emergency system handle to 'automatic.'
3. Automatic deployment and inflation of escape system.
- a. Opening cabin door from the inside will deploy the slide and automatically inflate same.
 - (1) Door opening is power assisted from an air bottle.
 - (2) Slide is inflated by freon bottle and injector pumps.
4. Manual deployment and inflation of escape system.
- a. Pulling manual inflation handle on aft side of door will trigger freon bottle and inflate slide.

NO. 3 OVERWING DOOR ESCAPE SYSTEM:

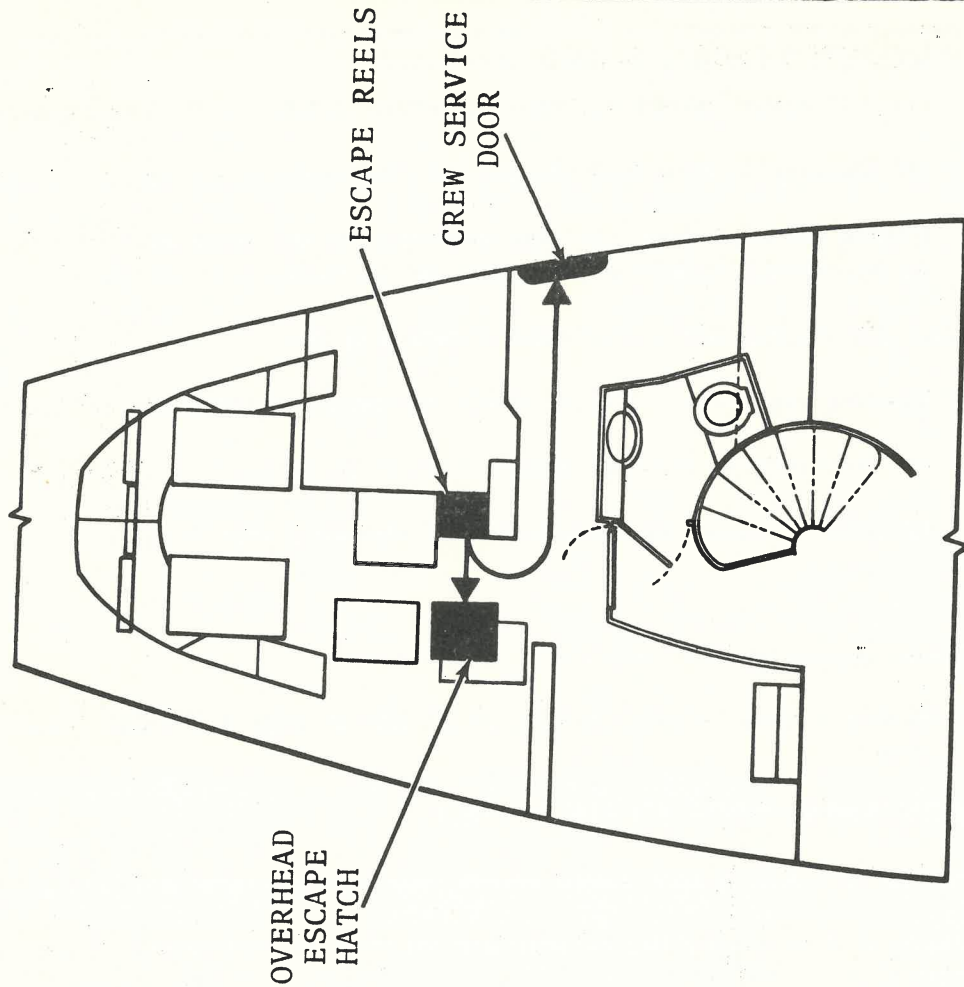
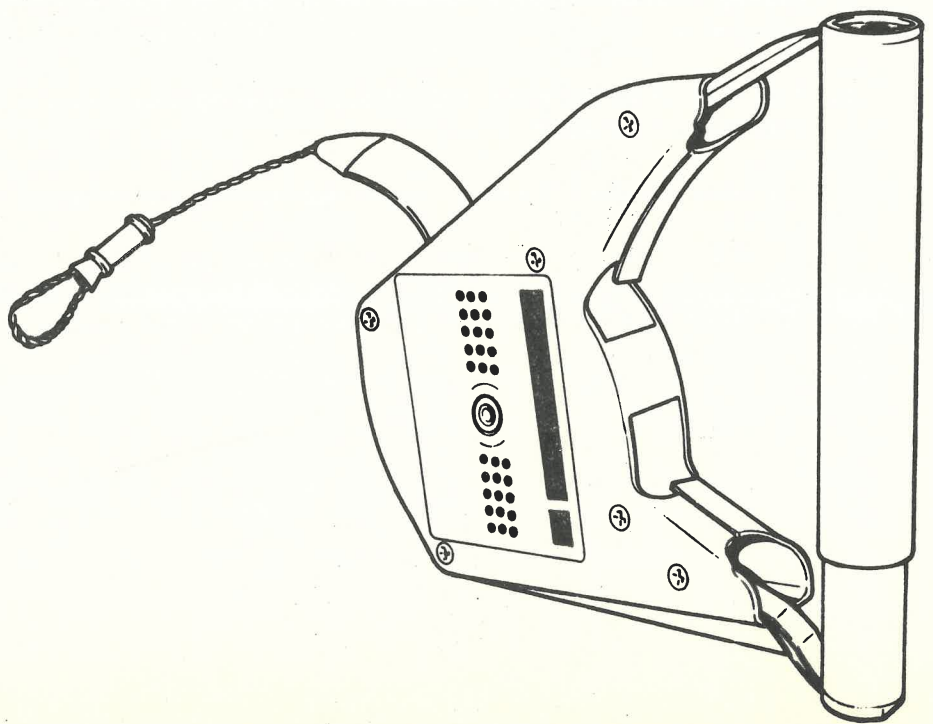
1. The No. 3 overwing door escape system incorporates a ramp and fairing mounted wing slide.
2. Arming and automatic deployment and inflation of this system is identical with all cabin doors.
3. Manual deployment and inflation of escape system.
 - a. Pulling manual inflation handle on aft side of door will trigger freon bottle and inflate ramp slide.
 - b. For manual deployment and inflation of wing slide, two manual control handles in cabin sidewall are provided.
 - (1) Long Handle - Provides manual deployment and inflation of wing slide.

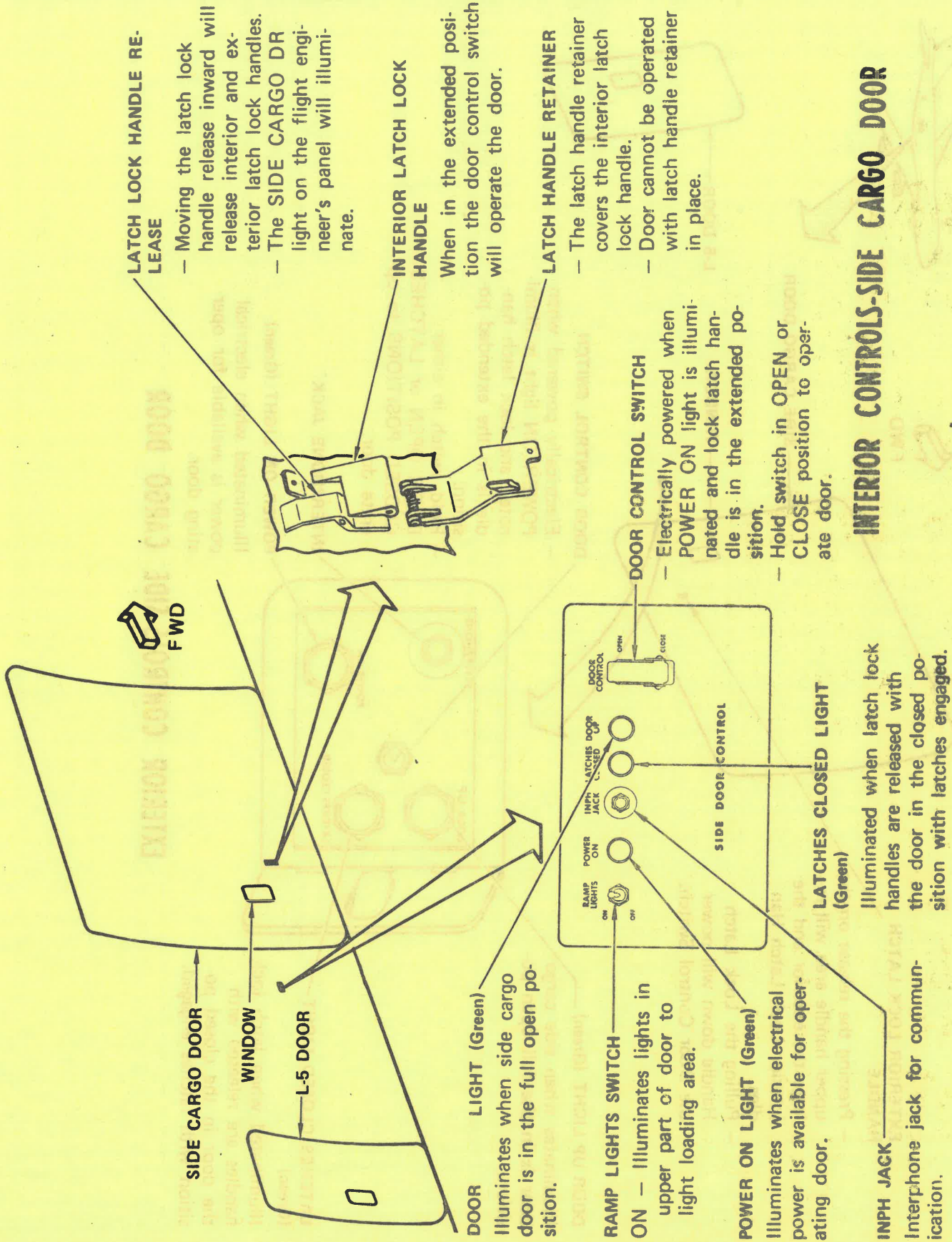
NOTE: No. 3 main cabin door must be opened prior to pulling long handle.

- (2) Short Handle - Deactivates the wing slide in the event of a ditching.

COCKPIT ESCAPE REELS

Five escape reels, for flight crew use in a ground emergency, are stowed in the ceiling above the Flight Engineer's station. They may be used for descent to the ground using the overhead escape hatch or crew service door. These devices are inertia reels which slow the "fall" rate to the equivalent of a 2 foot drop.





LATCH LOCK HANDLE RELEASE

- Moving the latch lock handle release inward will release interior and exterior latch lock handles.
- The **SIDE CARGO DR** light on the flight engineer's panel will illuminate.

INTERIOR LATCH LOCK HANDLE

When in the extended position the door control switch will operate the door.

LATCH HANDLE RETAINER

- The latch handle retainer covers the interior latch lock handle.
- Door cannot be operated with latch handle retainer in place.

DOOR CONTROL SWITCH

- Electrically powered when **POWER ON** light is illuminated and lock latch handle is in the extended position.
- Hold switch in **OPEN** or **CLOSE** position to operate door.

INTERIOR CONTROLS-SIDE CARGO DOOR

DOOR LIGHT (Green)
Illuminates when side cargo door is in the full open position.

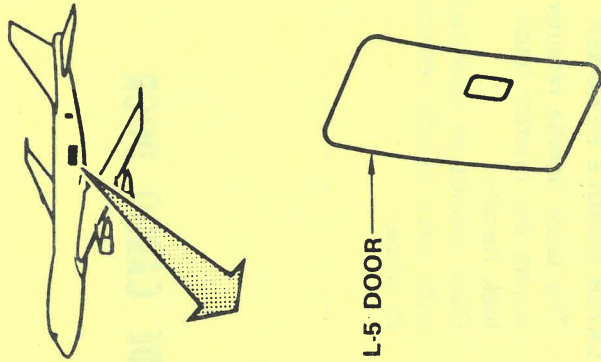
RAMP LIGHTS SWITCH
ON - Illuminates lights in upper part of door to light loading area.

POWER ON LIGHT (Green)
Illuminates when electrical power is available for operating door.

INPH JACK
Interphone jack for communication.

LATCHES CLOSED LIGHT (Green)

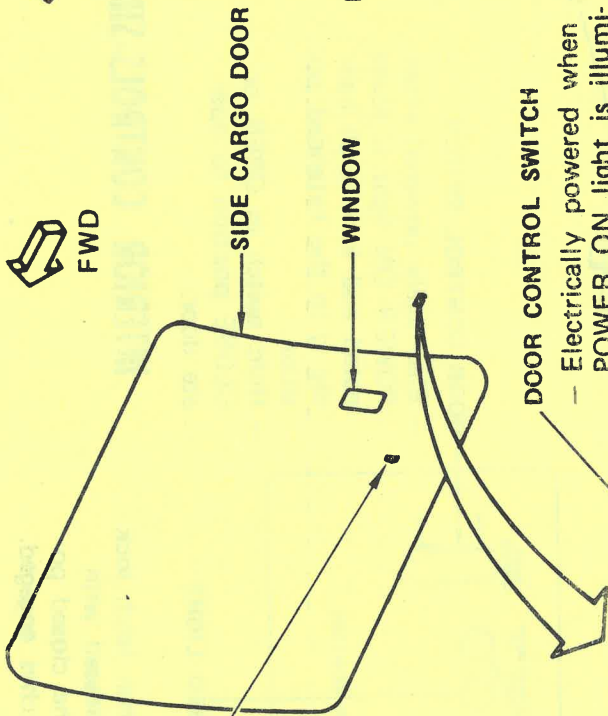
Illuminated when latch lock handles are released with the door in the closed position with latches engaged.



L-5 DOOR



FWD



SIDE CARGO DOOR

WINDOW

DOOR CONTROL SWITCH

Electrically powered when POWER ON light is illuminated and lock latch handle is in the extended position.

Hold switch in either DOOR OPEN or LATCHES CLOSED POSITIONS to operate door.

INTERPHONE JACK

POWER ON LIGHT (Green)

Illuminated when electrical power is available for operating door.

EXTERIOR LOCK LATCH HANDLE

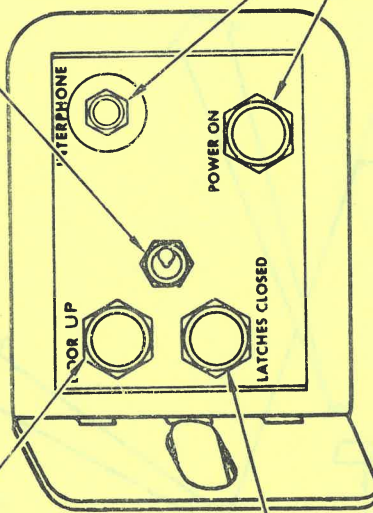
- Pressing the release on the upper handle area will release the exterior and the interior Lock Latch Handles.
- Pulling the Lock Latch Handle down will power the Door Control Switch.

DOOR UP LIGHT (Green)

Illuminates when side cargo door is in the full open position.

LATCHES CLOSED LIGHT (Green)

Illuminated when latch lock handles are released with the door in the closed position with latches engaged.

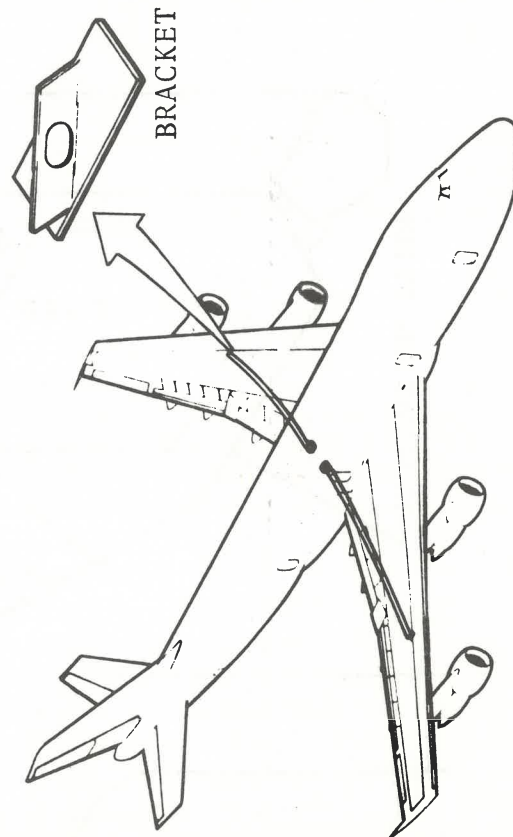
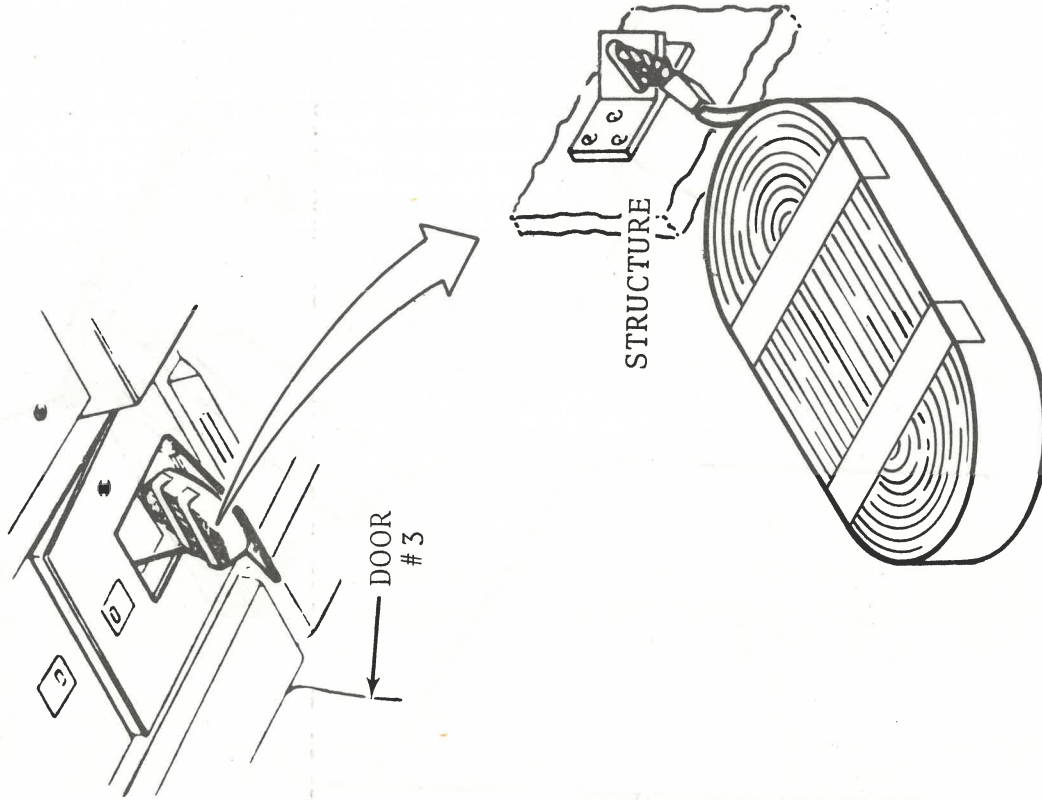


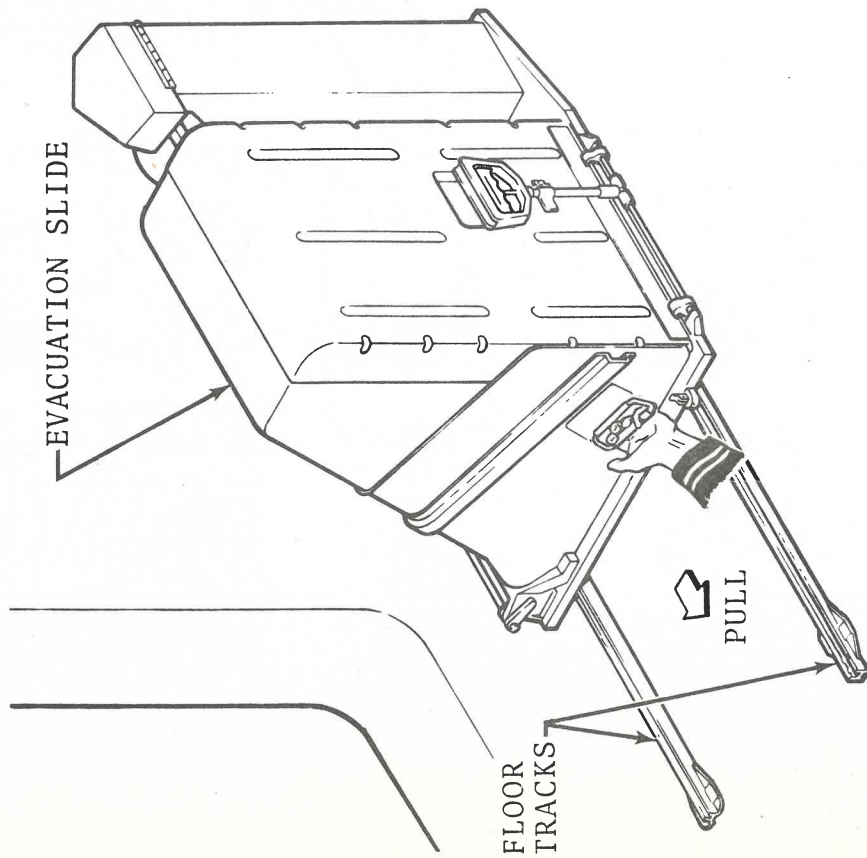
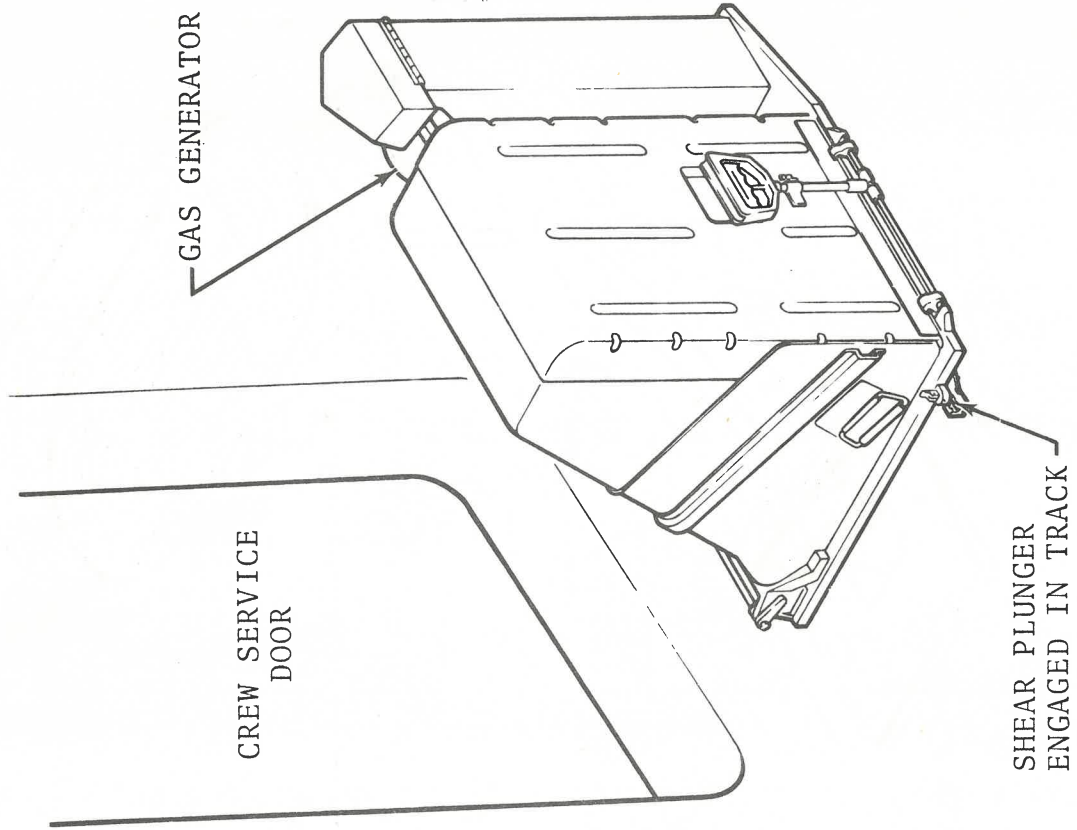
EXTERIOR CONTROLS-SIDE CARGO DOOR

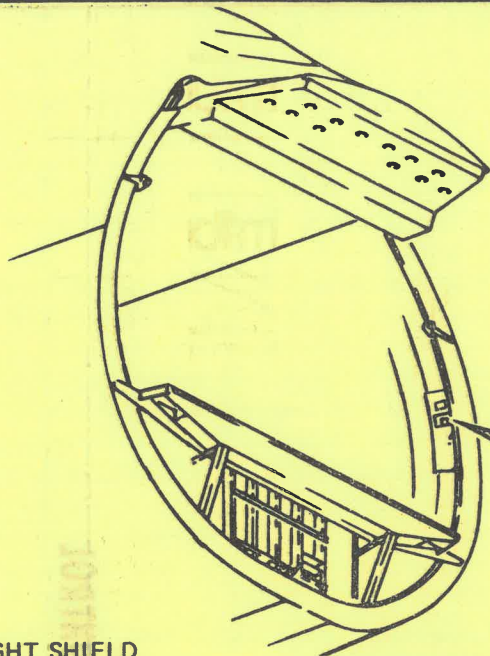
ESCAPE ROPES:

Overwing escape ropes are contained in the overhead life raft adjacent to doors 3L and 3R. Compartments are labeled to identify rope locations.

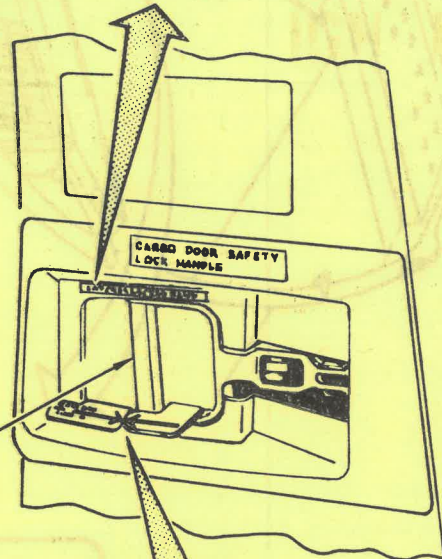
One end of each rope is permanently secured to the airplane structure. The opposite end is equipped with a snap fastener. This fastener is pulled out onto the wing and is attached to a bracket located between the inboard and outboard engines. The rope level is such that children may grasp it without difficulty, while traversing the wing, during ditching. These ropes could also be used for emergency land evacuation.







LATCHES LOCKED-HANDLE FLUSH



PILOTS' LIGHT SHIELD

(2) **NOSE DR**

NOSE DR LIGHTS (Amber) ILLUMINATED – Indicates nose cargo door may not be locked closed.

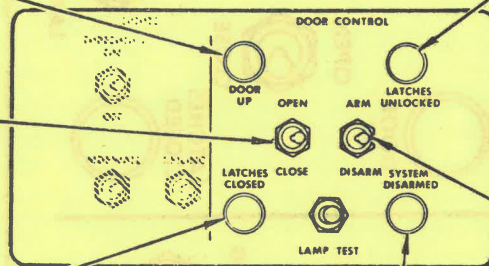
NOSE DOOR SAFETY LOCK HANDLE

NOSE DR light on Flight Engineer's panel will illuminate when handle is not in the locked position.

DOOR UP LIGHT (Green) ILLUMINATED – Door is open fully.

OPEN/CLOSE SWITCH
 Opens or closes the nose door when the ARM/DISARM switches are in the ARM position.

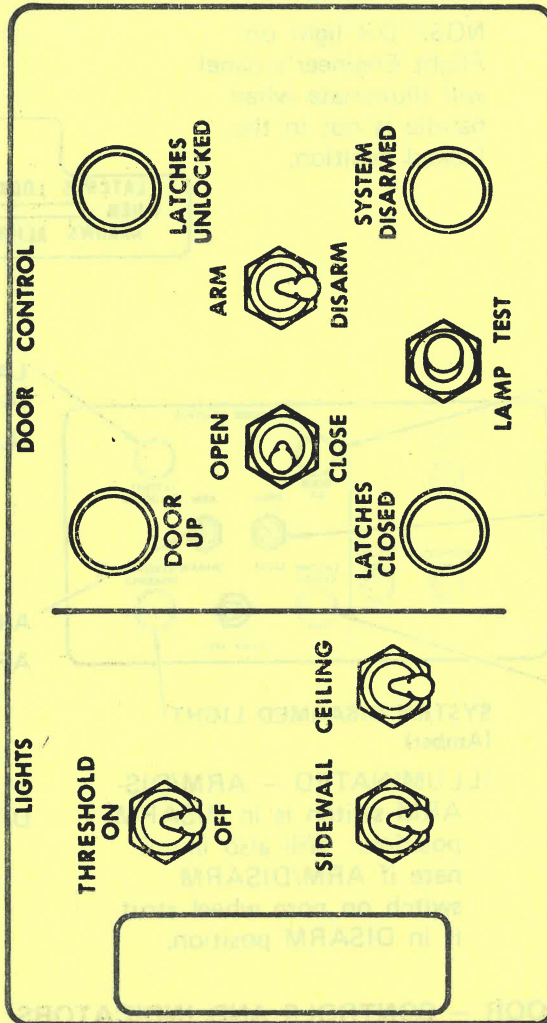
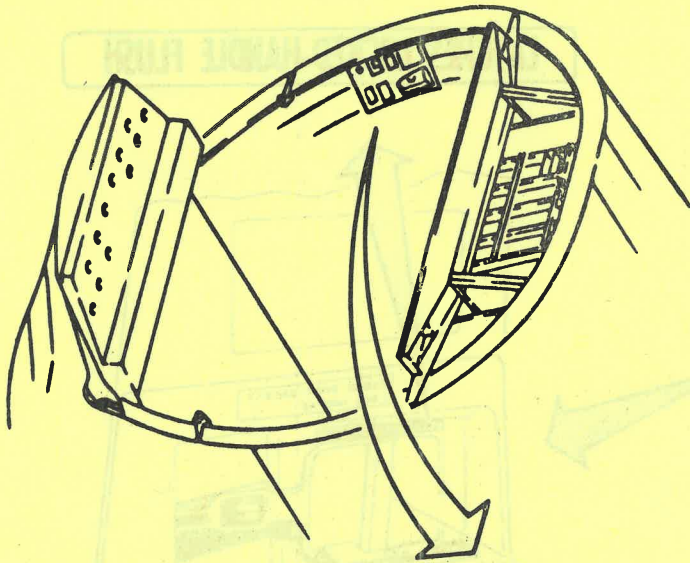
LATCHES CLOSED LIGHT (Green) ILLUMINATED – Latches are closed.



SYSTEM DISARMED LIGHT (Amber) ILLUMINATED – ARM/DISARM switch is in DISARM position. Will also illuminate if ARM/DISARM switch on nose wheel strut is in DISARM position.

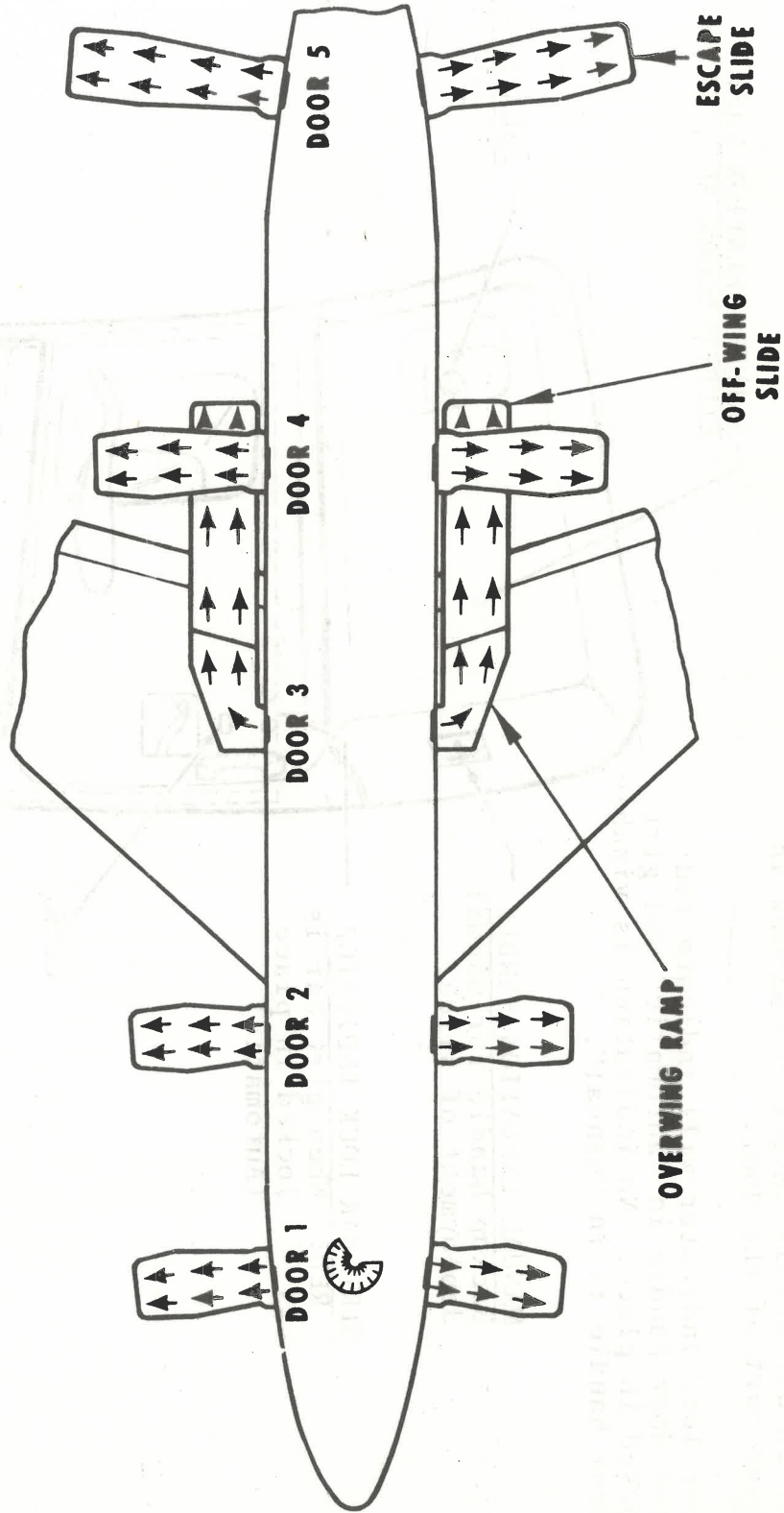
LATCHES UNLOCKED LIGHT (Amber) ILLUMINATED – Latches are unlocked – function of Nose Door Safety Lock Handle.

ARM/DISARM SWITCH
 ARM – Will arm the OPEN/CLOSE switch if ARM/DISARM switch on nose wheel strut is also in the ARM position.
 DISARM – Removes power to the OPEN/CLOSE switch.



NOSE CARGO DOOR CONTROL

ESCAPE SLIDES AND RAMPS CONFIGURATION (MAIN DECK)



DOORS AND ESCAPE DEVICES:

All doors are similar except doors 3L and 3R have an air bottle inspection window in the lower part of the door.

Girt bar lock indicator will indicate red with the door handle in "automatic" and girt bar locked in place. No indication is visible when door handle is in "manual".

MANUAL INFLATION HANDLE
 Backup handle for manual deployment of slide.

GIRT BAR LOCK INDICATOR
 RED: When girt bar is locked in place (Automatic)

RAMP INFLATION GAGE
 DOORS 3L & 3R ONLY

SLIDE INFLATION GAGE
 EXCEPT DOORS 3L & 3R

ESCAPE SLIDE LAMP

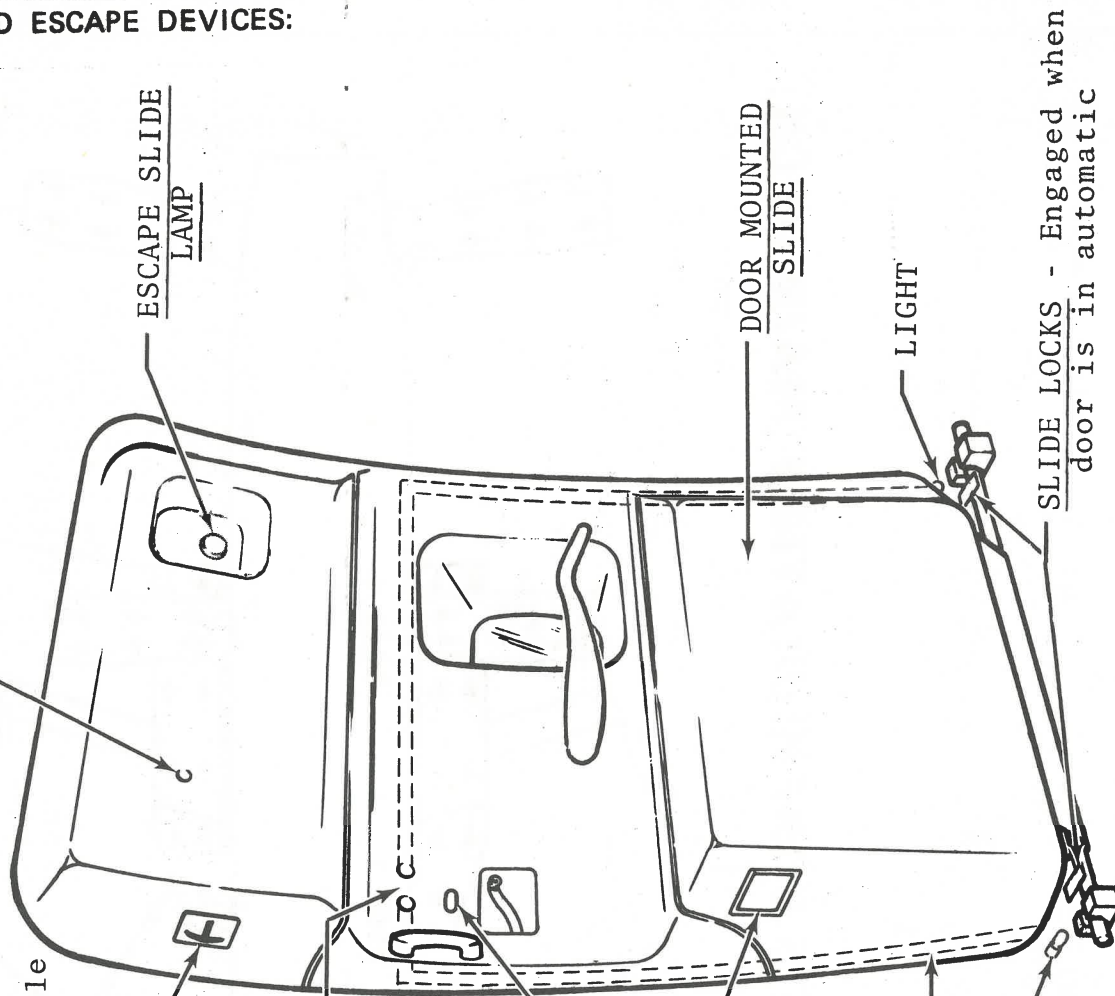
DOOR MOUNTED SLIDE

LIGHT

SLIDE LOCKS - Engaged when door is in automatic

OPTIC TUBE

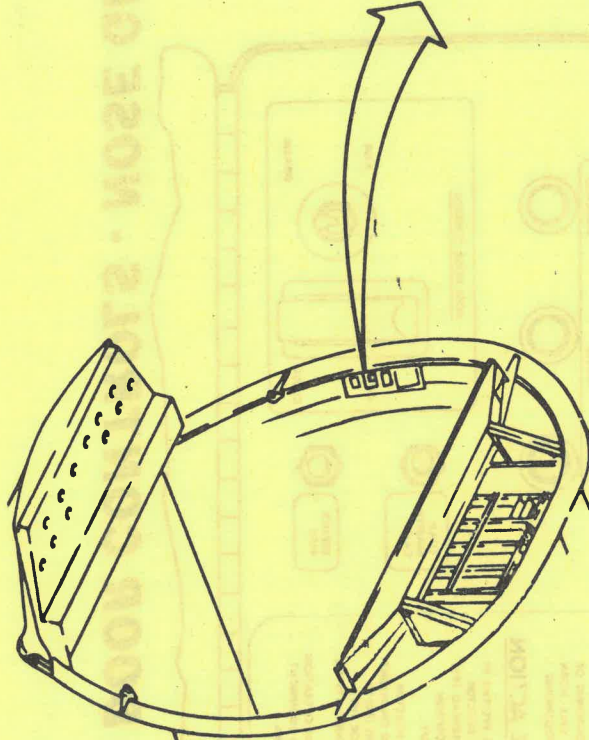
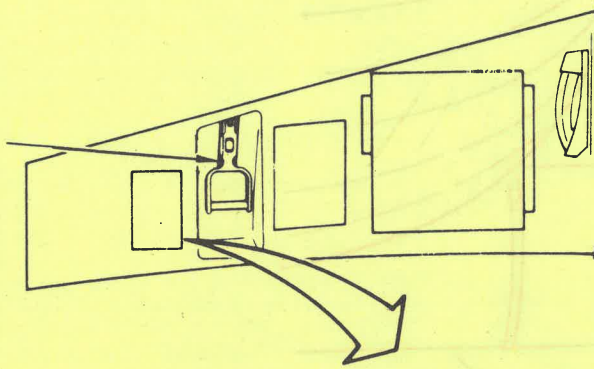
LIGHT



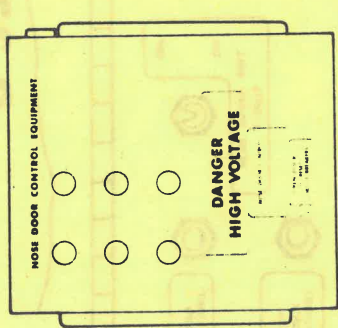


NOSE DOOR SAFETY LOCK HANDLE

NOSE DR light on Flight Engineer's panel will illuminate when handle is not in the locked position.



LATCHES UNLOCKED LIGHT (Amber)
 ILLUMINATED — Latches are unlocked — function of Nose Door Safety Lock Handle.



CIRCUIT BREAKER PANEL

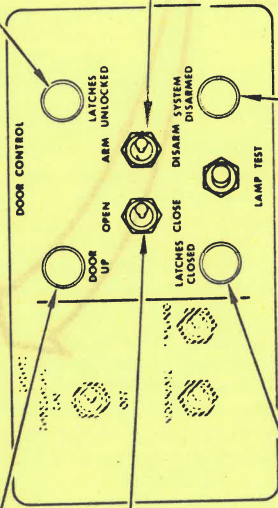
DOOR UP LIGHT (Green)
 ILLUMINATED — Door is open fully.

OPEN/CLOSE SWITCH
 Opens or closes the nose door when the ARM/DISARM switch is in the ARM position.

LATCHES CLOSED LIGHT (Green)
 ILLUMINATED — Latches are closed.

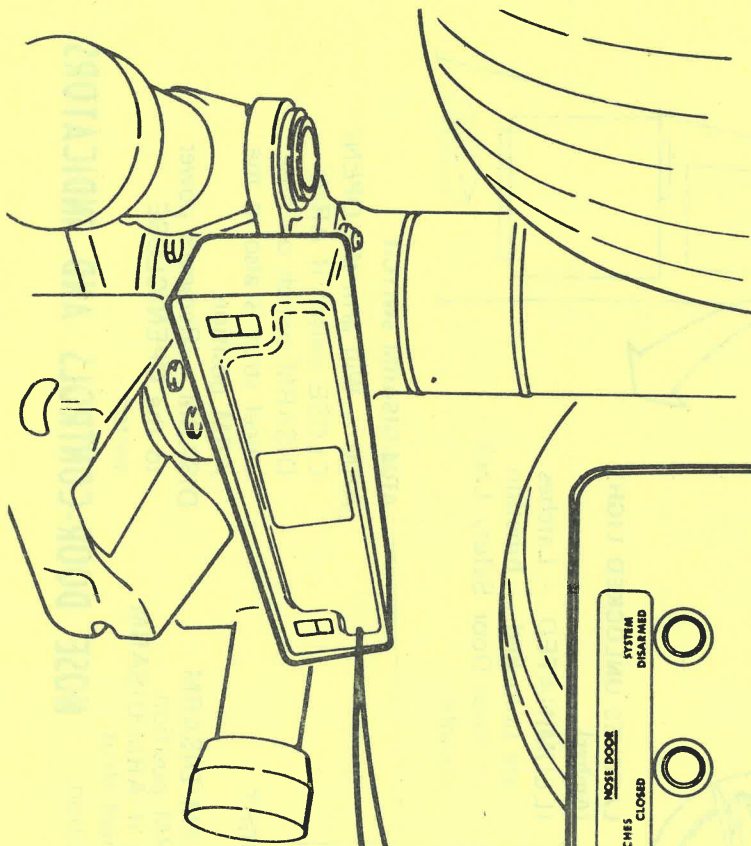
ARM/DISARM SWITCH

ARM — Will arm the OPEN/CLOSE switch if ARM/DISARM switch on nose wheel strut is also in the ARM position.
 DISARM — Removes power to the OPEN/CLOSE switch.



SYSTEM DISARMED LIGHT (Amber)
 ILLUMINATED — ARM/DISARM switch is in DISARM position. Will also illuminate if ARM/DISARM switch on nose wheel strut is in DISARM position.

NOSE DOOR-CONTROLS AND INDICATORS



ATTENTION
 CONTINUOUS SOUNDING OF GROUND CREW CALL HORN REQUIRES THE FOLLOWING IMMEDIATE ACTION

IMMEDIATE ACTION

1. SHUT DOWN INS SYSTEMS BY PLACING MODE SELECTOR SWITCH ON OVERHEAD (PS) PANEL IN OFF POSITION FOR EACH SYSTEM.
2. PLACE BLOWER SELECTOR SWITCH LOCATED ON FLIGHT ENGINEER'S PANEL (IN) TO ALT POSITION FOR THE EQUIPMENT COOLING SYSTEM.
3. RESTORE NORMAL OPERATION OF THE INS AND EQUIPMENT COOLING SYSTEMS.

UNLOCKED

LATCHES CLOSED

NOSE DOOR SYSTEM DISARMED

LOAD MASTER CALL

SERVICE BUMP

NOSE DOOR CONTROL

OPEN

CLOSE

FLIGHT BRCK CALL

FLIGHT BUMP

NOSE WHEEL WELL

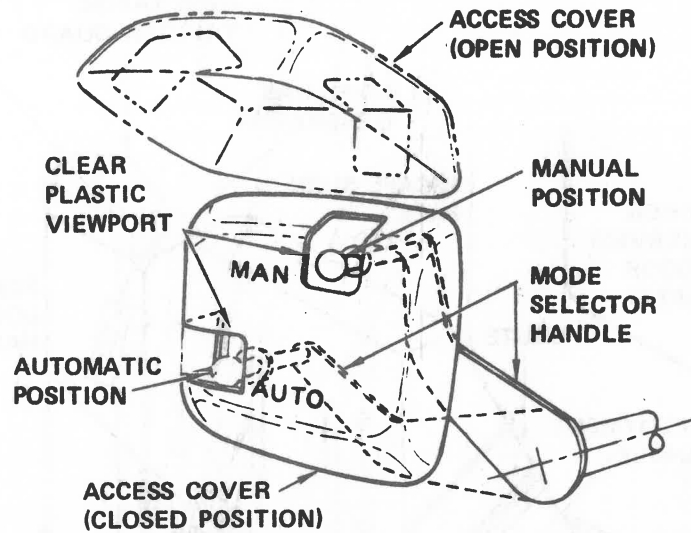
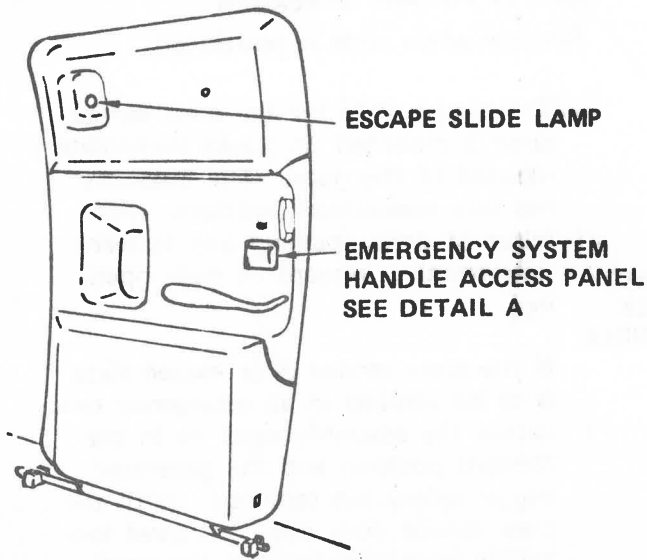
ON

OFF

P-37 BOX, DOOR CONTROLS - NOSE GEAR

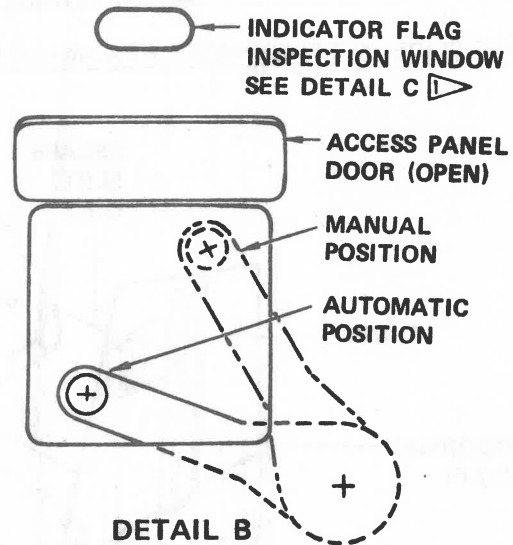
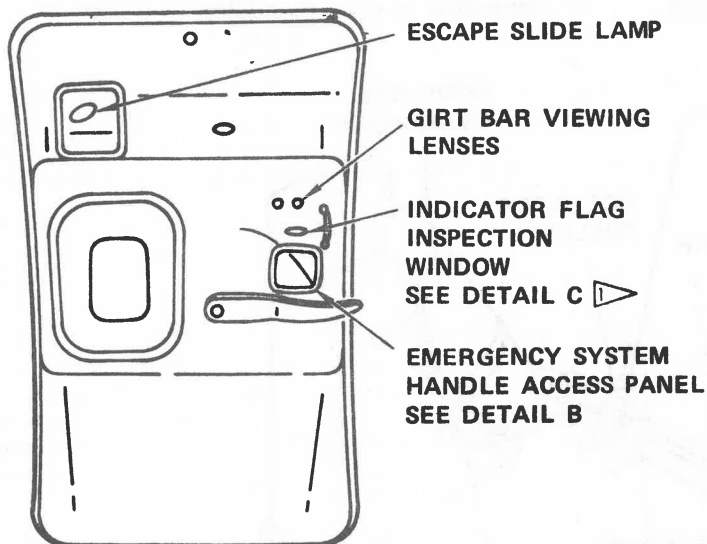


PASSENGER DOORS INTERIOR VIEW:

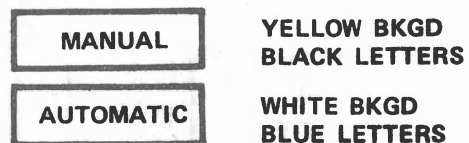


DETAIL A

MODIFIED PASSENGER DOOR – INTERIOR VIEW



DETAIL B

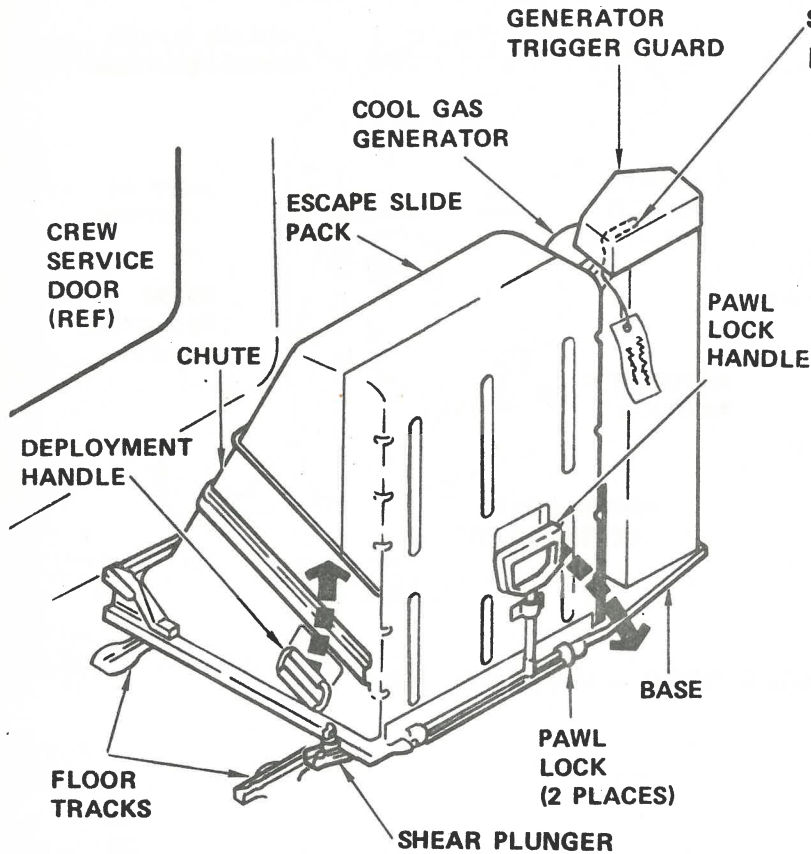


DETAIL C

▷ NO. 5 ENTRY DOOR INDICATOR FLAG INSPECTION WINDOW IS BELOW EMERGENCY SYSTEM HANDLE ACCESS PANEL

UNMODIFIED PASSENGER DOOR – INTERIOR VIEW

ESCAPE SLIDE - CREW SERVICE DOOR:

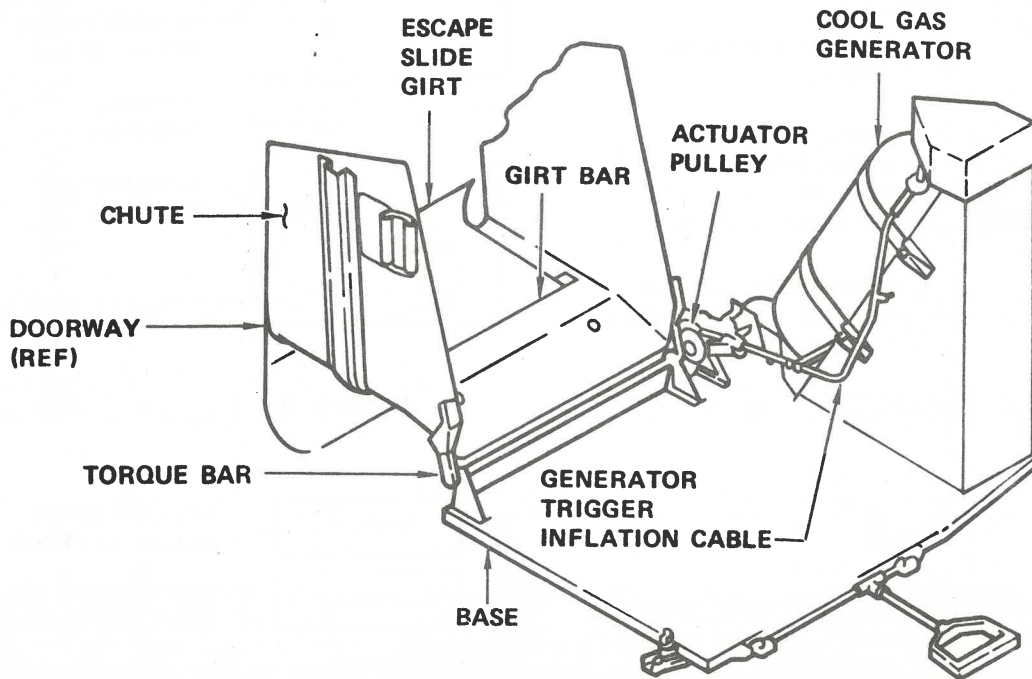


SAFETY PIN AND STREAMER
 Remove when slide is positioned.

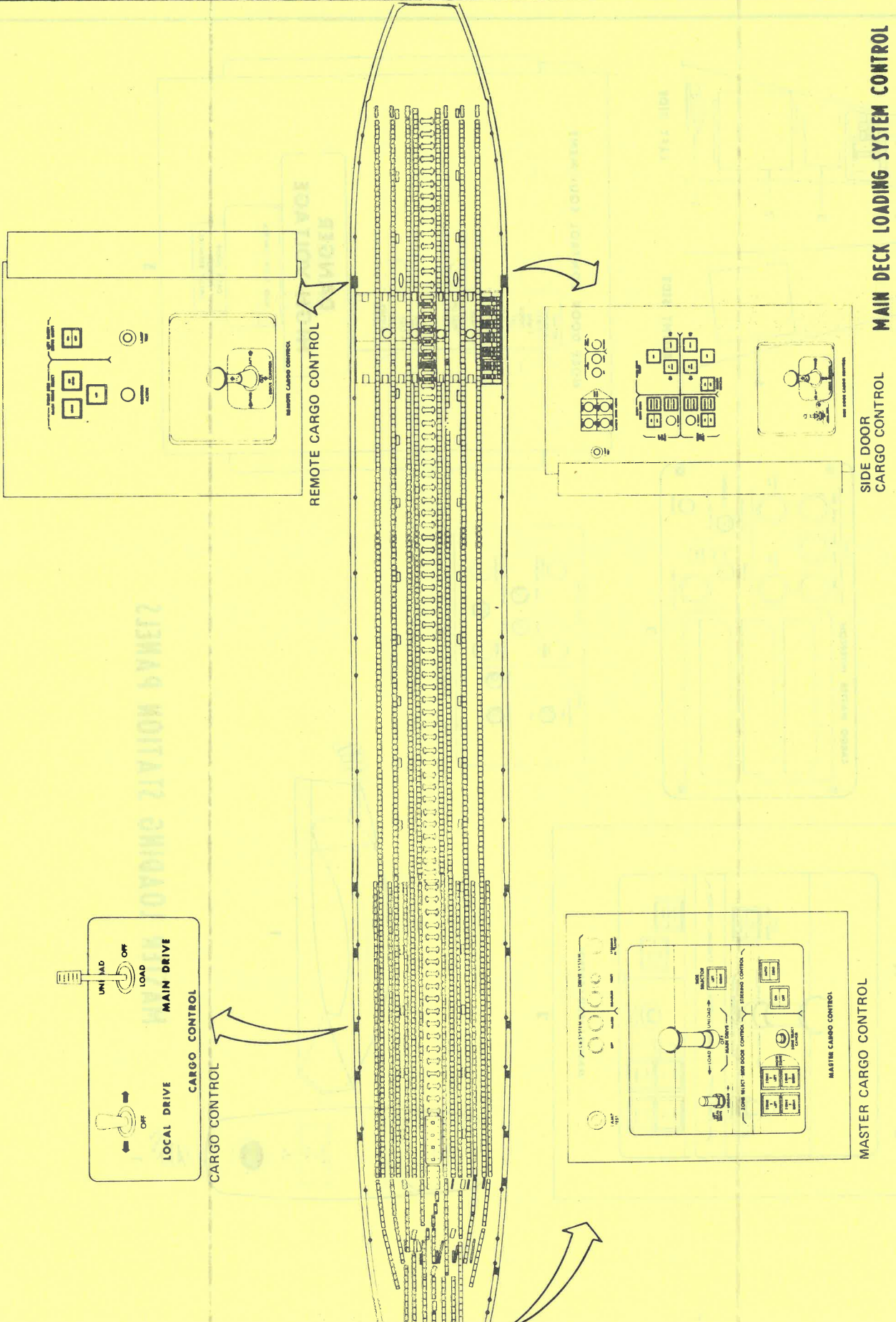
The escape slide for the crew service door is mounted on tracks immediately inboard of the door. The assembly has two maintained positions. Aft (clear of door opening) and forward (immediately inboard of door opening).

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.

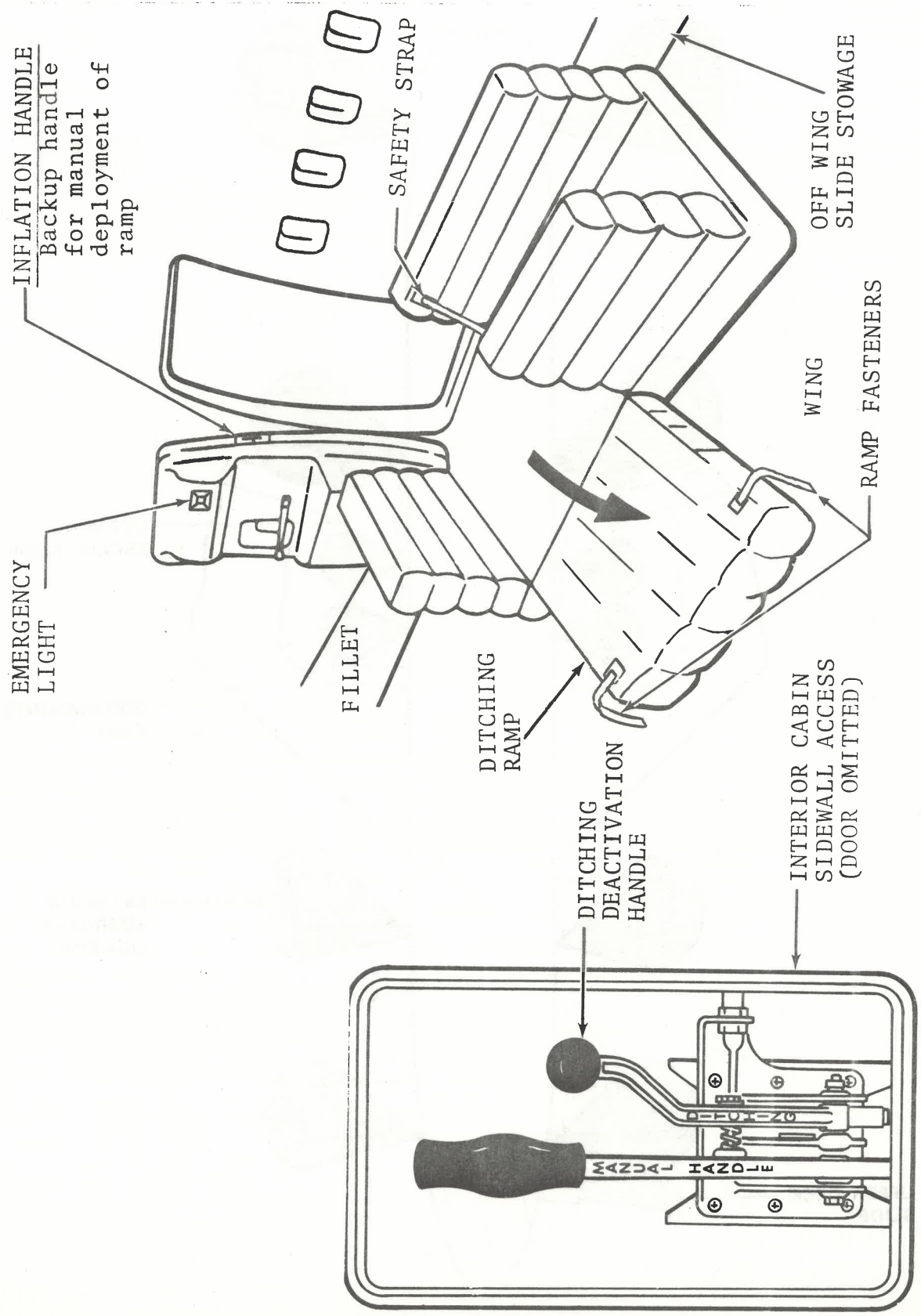
ESCAPE SLIDE IN DEPLOYMENT READINESS POSITION



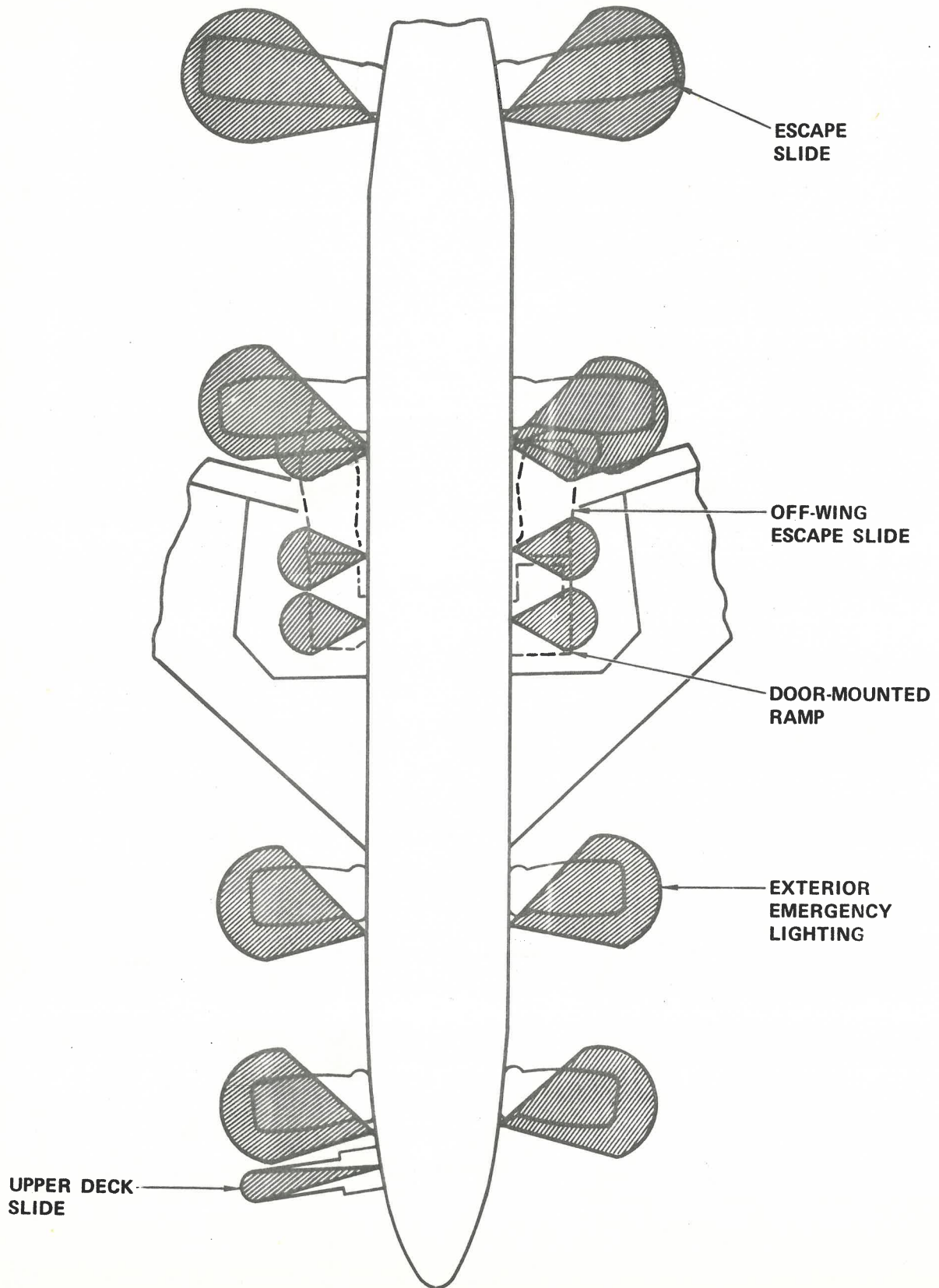
ESCAPE SLIDE DEPLOYED



OFF-WING ESCAPE SLIDE MANUAL CONTROLS:



EXTERIOR EMERGENCY LIGHTS AND ESCAPE SLIDES:



| | |
|---|----|
| COCKPIT REFERENCE, PERFORMANCE & FLIGHT PLANNING DATA | 01 |
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| ALTERNATE OPERATING PROCEDURES | 03 |
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| OPERATING BULLETINS | 87 |

EMERGENCY EQUIPMENT DESCRIPTION AND LOCATION:

1. Escape ropes, chemical and water fire extinguishers, 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.

COCKPIT

1. Five life vests
 - a. Located behind each seat.
2. Five smoke goggles
 - a. Located at each crew member position.
3. Five escape reels
 - a. Located near overhead escape hatch.
4. One CO₂ bottle
 - a. Located on Lower P-6 circuit breaker panel.

COCKPIT STUB PARTITION

1. Portable O₂ bottle and mask -- 1
2. First aid kit -- 1
3. Crash axe -- 1

LOUNGE AND STAIRWELL AREA

1. Eight life vests
 - a. Under passenger seats
2. One portable O₂ bottle and mask
 - a. In closet compartment below attendant's phone panel.
3. One water bottle
 - a. In closet compartment below attendant's phone panel.

CABIN

1. Twenty-three portable O₂ bottles with mask.
 - a. Under outboard passenger seats by main cabin doors.
2. Three dry chemical extinguishers.
 - a. Left side under attendant seat bustle.



EMERGENCY EQUIPMENT:

CABIN (Cont.)

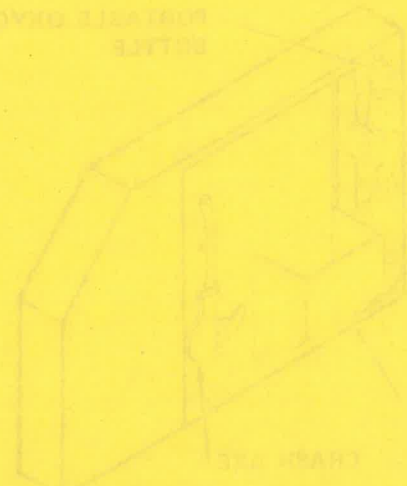
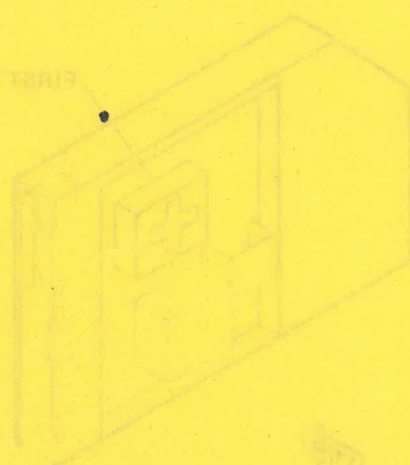
3. Three H₂O extinguishers.
 - a. Right side near attendant's seat bustle.
4. Two megaphones.
 - a. In overhead stowage bins.
5. Two first aid kits.
 - a. In forward and aft closets.
6. One crash axe.
 - a. In aft closet
7. Provisions for twenty-one life rafts (NWA - 16).
 - a. Located in center overhead compartments.
8. Four automatic radio beacons.
 - a. Two located in life raft (left side by doors No. 1 and No. 4).
 - b. Two located in life raft (right side by doors No. 3 and No. 5).
9. Passenger life vests.
 - a. Stowed under each seat.
10. Attendant life vests and spares.
 - a. Under attendant's seats.
11. Two escape ropes.
 - a. Located by No. 3 overwing doors.
12. Cabin Emergency lights (approximately 60).
 - a. Not detachable.

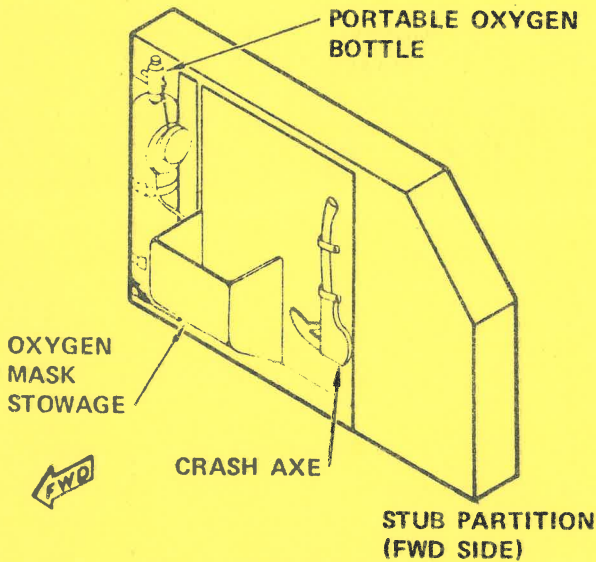
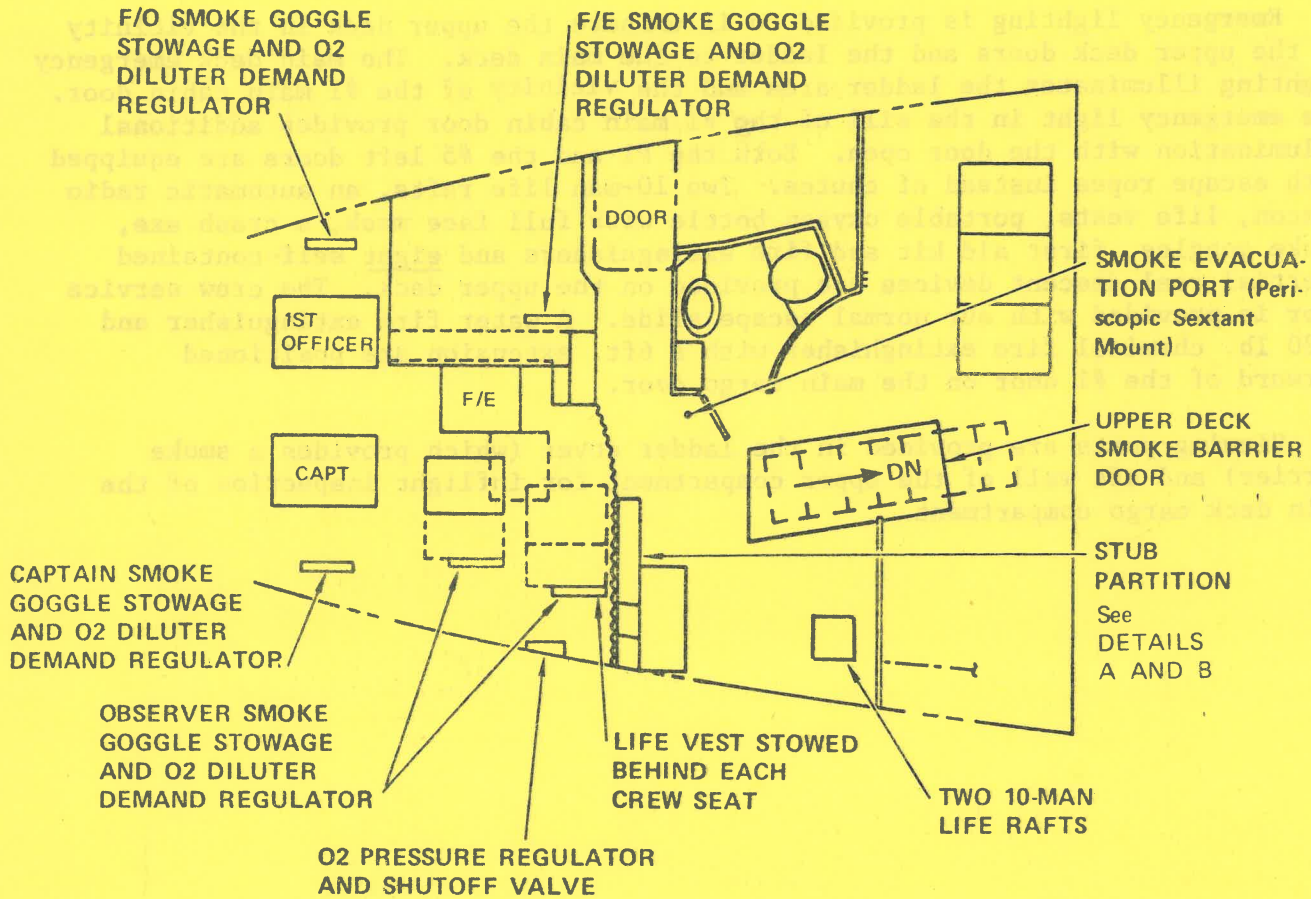


EMERGENCY EQUIPMENT

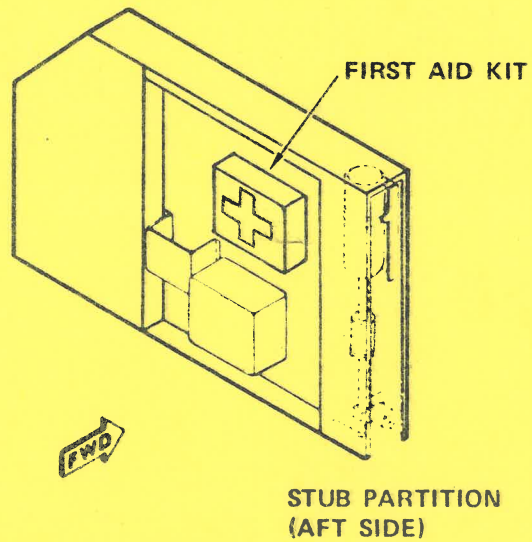
Emergency lighting is provided to illuminate the upper deck in the vicinity of the upper deck doors and the ladder to the main deck. The main deck emergency lighting illuminates the ladder area and the vicinity of the #1 main cabin door. One emergency light in the sill of the #1 main cabin door provides additional illumination with the door open. Both the #1 and the #5 left doors are equipped with escape ropes instead of chutes. Two 10-man life rafts, an automatic radio beacon, life vests, portable oxygen bottle with full face mask, a crash axe, smoke goggles, first aid kit and fire extinguishers and eight self-contained inertial reel descent devices are provided on the upper deck. The crew service door is provided with our normal escape slide. A water fire extinguisher and a 20 lb. chemical fire extinguisher with a 6ft. extension are positioned forward of the #1 door on the main cargo door.

Viewing ports are provided in the ladder cover (which provides a smoke barrier) and aft wall of the upper compartment for inflight inspection of the main deck cargo compartment.





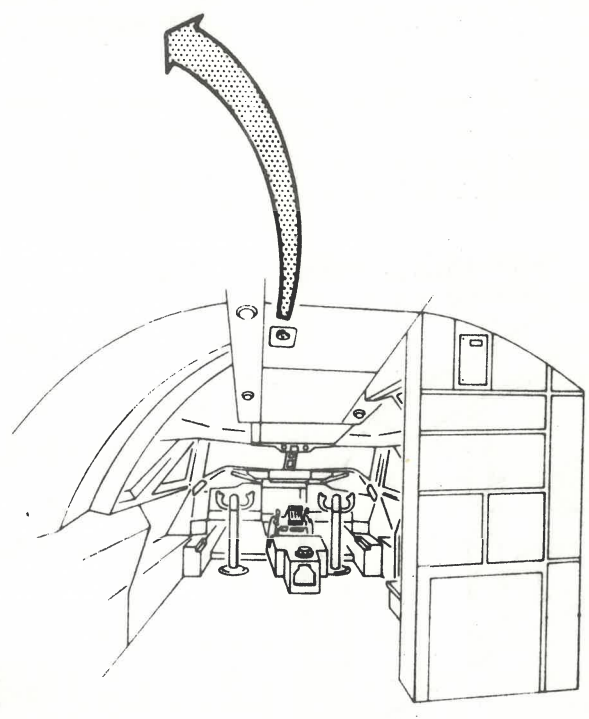
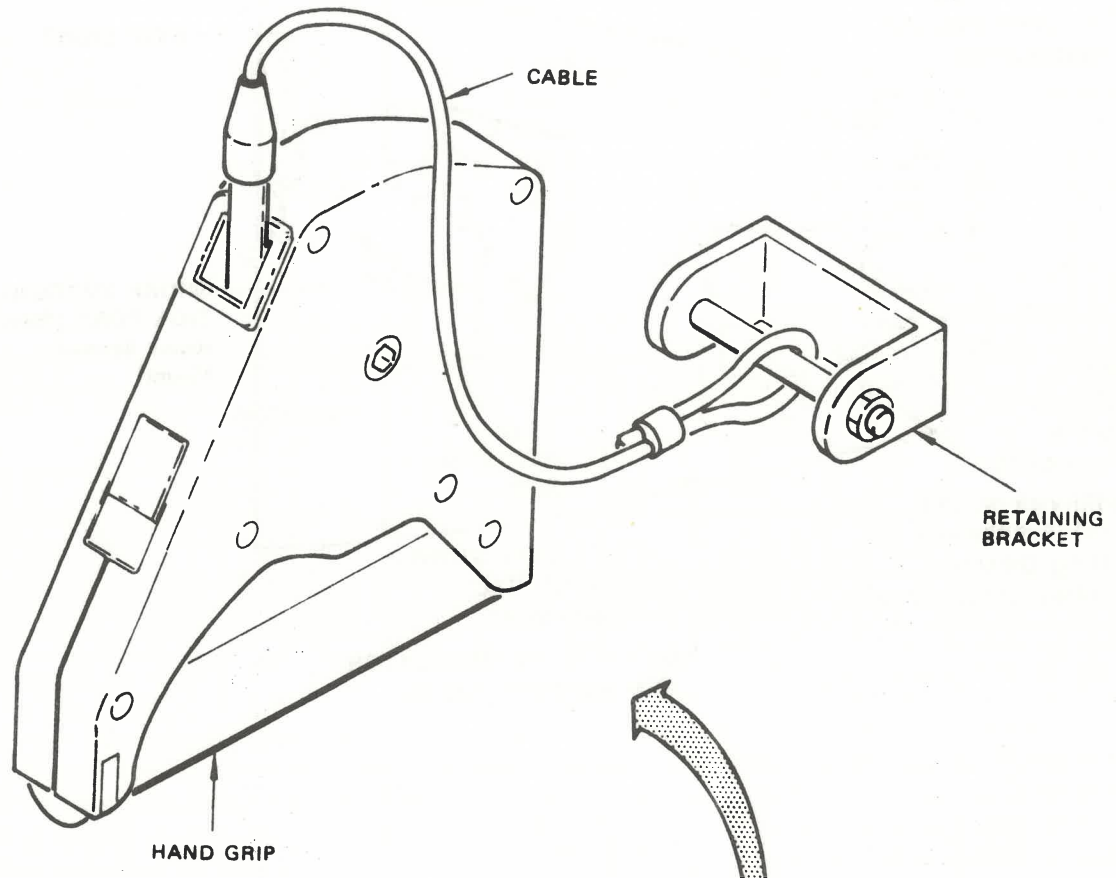
DETAIL A



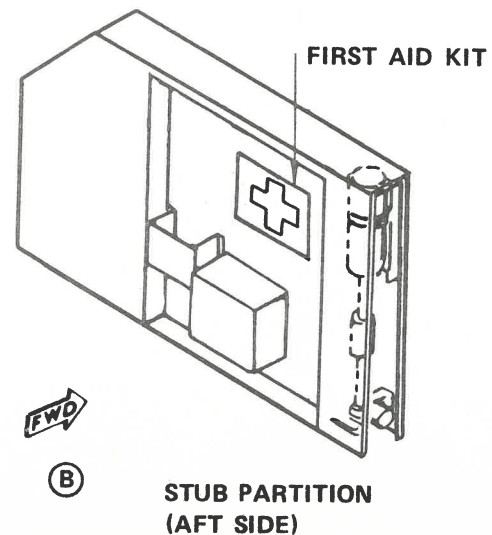
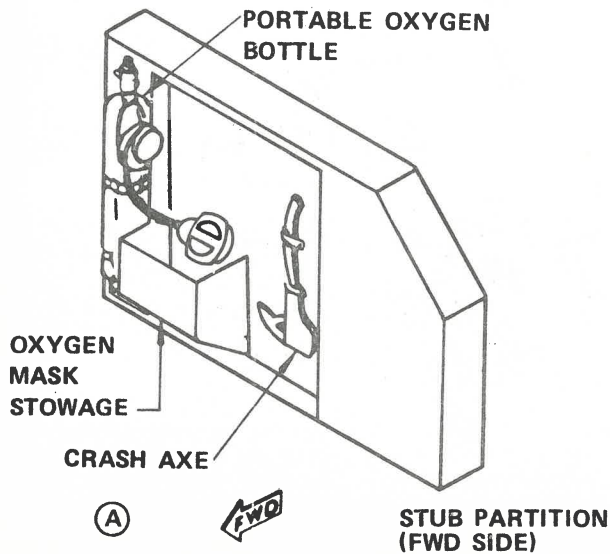
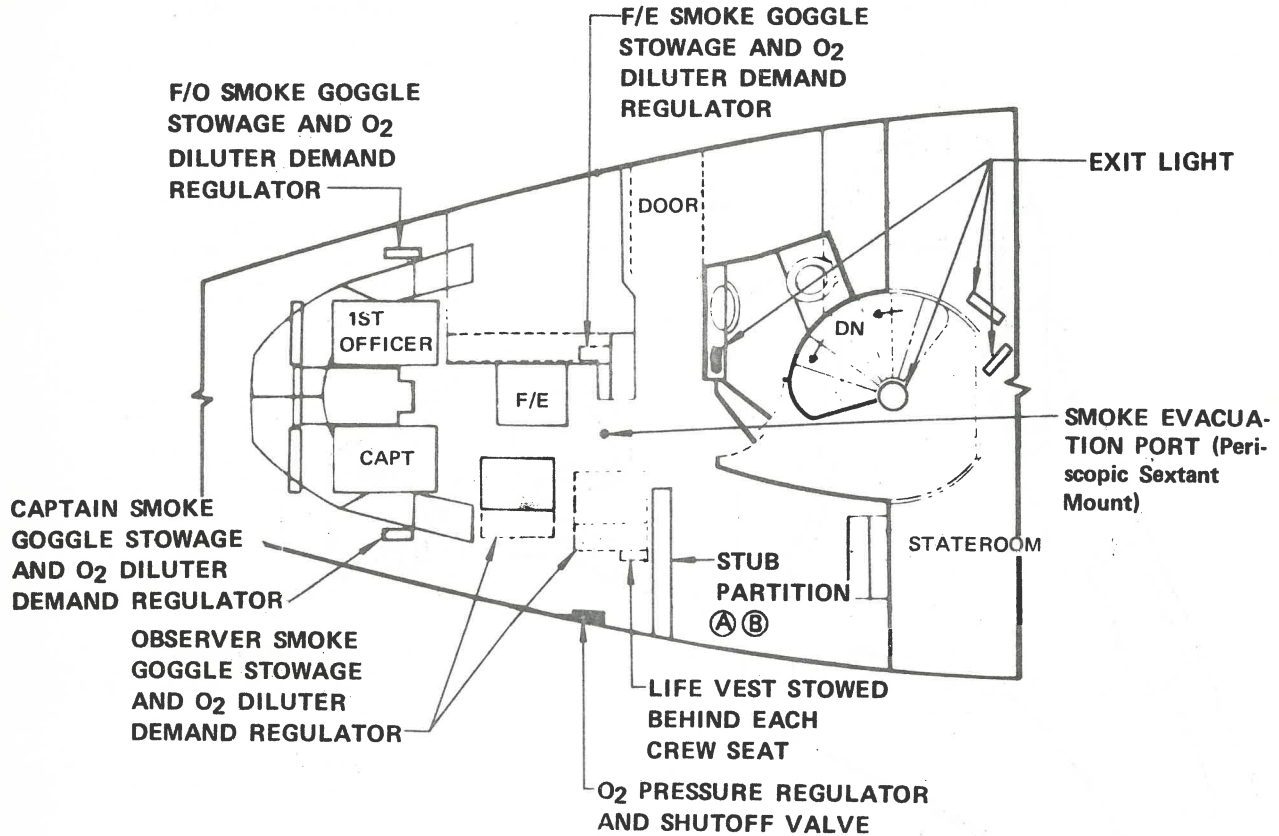
DETAIL B

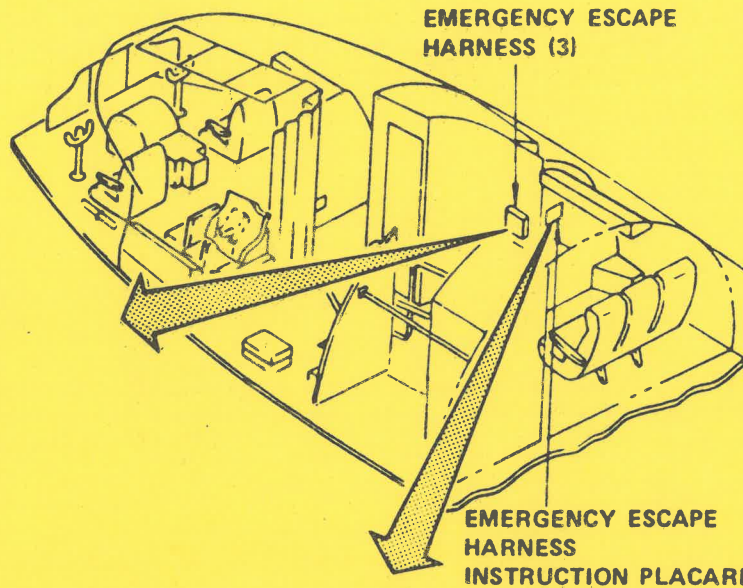
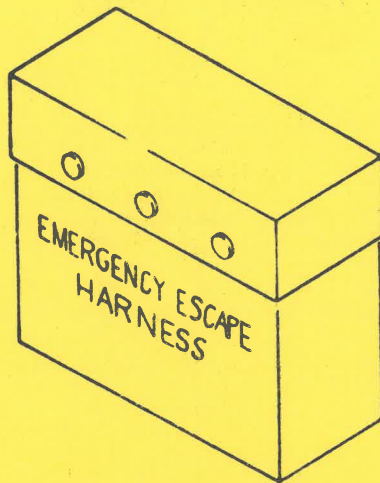


DESCENT REELS



COCKPIT LOCATION:





EMERGENCY ESCAPE INSTRUCTIONS

DON GARMENT



DON GARMENT WITH BUCKLES FORWARD.



PUT BLACK STRAP OVER SHOULDER AND TIGHTEN.



TIGHTEN STRAP.

EVACUATE AIRPLANE



HOLD ONTO ESCAPE REEL. EVACUATE AIRPLANE THROUGH EXIT DESIGNATED BY CREW MEMBER. AVOID STRADDLING OTHER LINES.

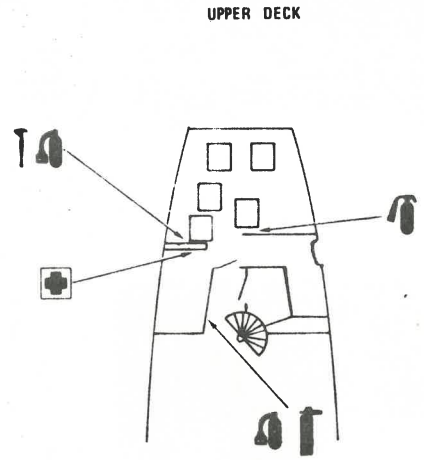
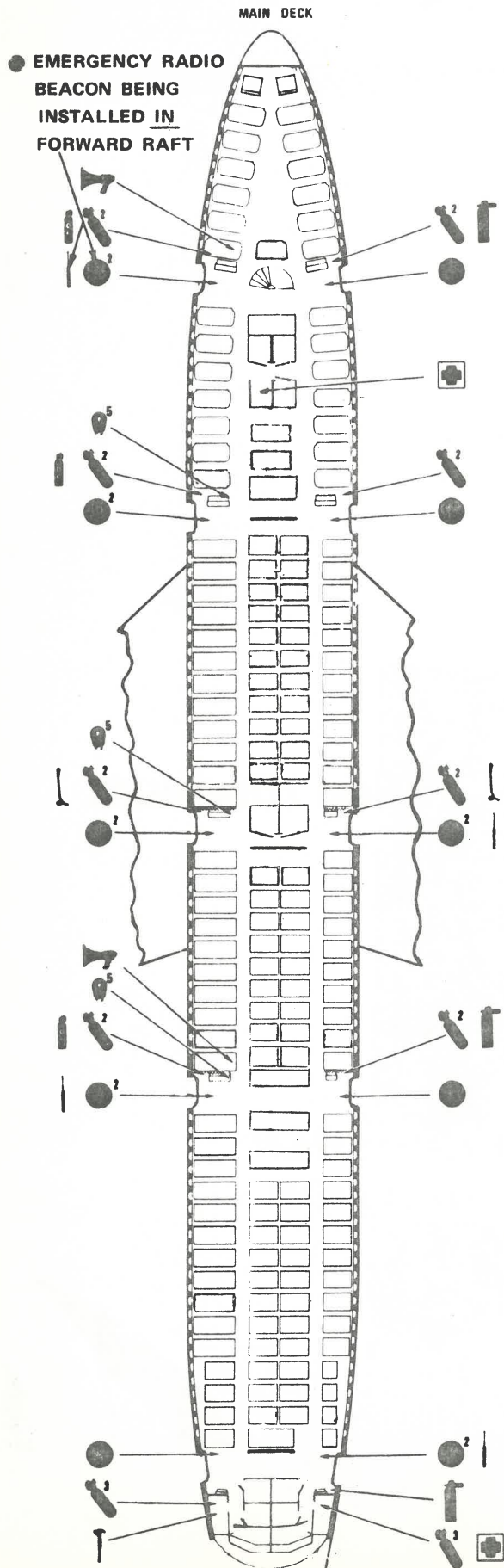


UPON REACHING SURFACE, UNHOOK RED STRAP AND MOVE TO SAFE AREA BEFORE REMOVING GARMENT.












IF EVACUATING INTO WATER DON GARMENT PRIOR TO DONNING LIFE VEST. DO NOT INFLATE VEST INSIDE AIRPLANE.



**STATEROOM FIRE EXTINGUISHER
AND OXYGEN BOTTLE LOCATION**



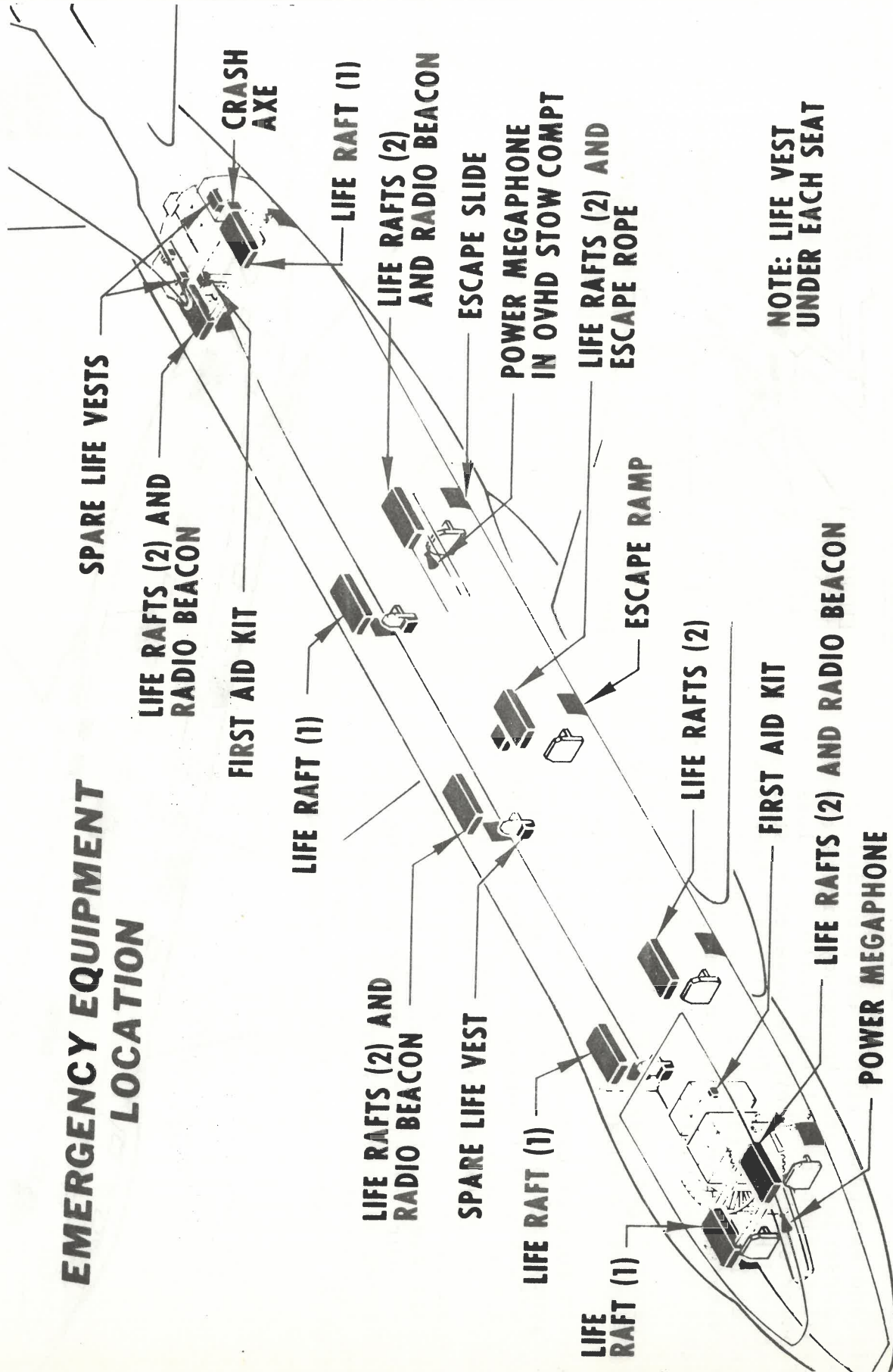
LEGEND:

-  PORTABLE OXYGEN (CREW)
-  PORTABLE OXYGEN
-  OVERWING DITCHING ROPE
-  CRASH AXE
-  LIFE RAFT, 25-MAN
-  MEGAPHONE
-  EMERGENCY RADIO BEACON
-  CHILD LIFE VESTS
-  FIRE EXTINGUISHER, DRY CHEMICAL
-  FIRE EXTINGUISHER, WATER
-  FIRE EXTINGUISHER, CARBON DIOXIDE

NOTE: LIFE VESTS WITH ALL PASSENGER AND CREW SEATS



**EMERGENCY EQUIPMENT
 LOCATION**



**NOTE: LIFE VEST
 UNDER EACH SEAT**



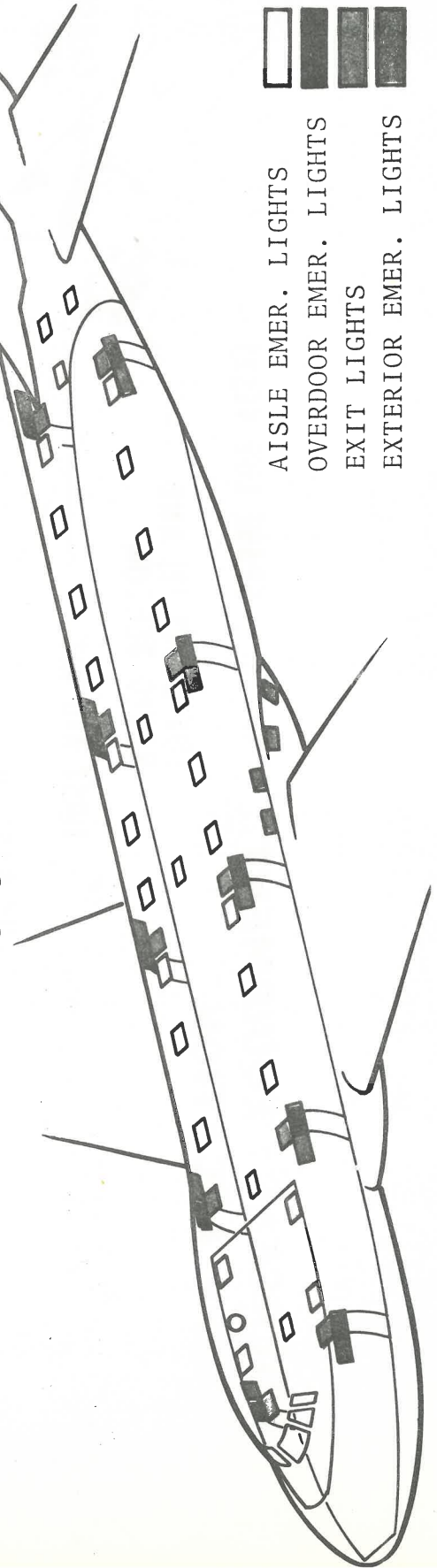
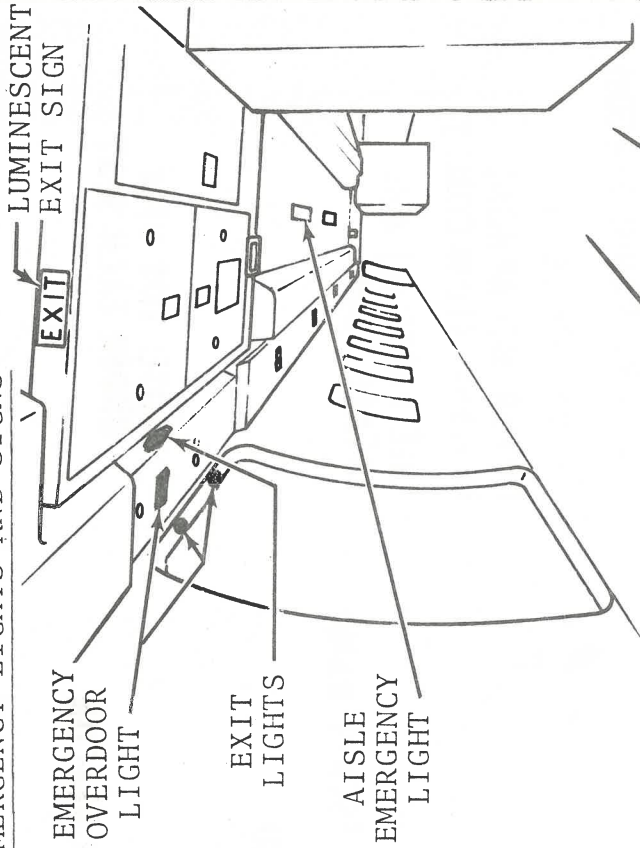
PASSENGER CABIN EMERGENCY AND EXIT LIGHTS

Exit and emergency lights are provided at each passenger door. Emergency lights are normally off but will illuminate if a loss of power occurs. They are powered by self-contained batteries. In addition, there are many ceiling emergency lights which will illuminate. None of the emergency and exit lights are removable.

Emergency lights may be easily recognized by the flat rectangular shape.

Caution must be exercised in checking emergency lights. If power is not on the aircraft, the self-contained batteries will be exhausted after approximately fifteen minutes of light operation. A trickle charger built into each light will recharge the batteries, but it takes approximately sixteen hours of aircraft power to bring a discharged battery back to full charge. A good rule of thumb would be one minute of operation requires one hour of recharging.

EMERGENCY LIGHTS AND SIGNS



AISLE EMER. LIGHTS
 OVERDOOR EMER. LIGHTS
 EXIT LIGHTS
 EXTERIOR EMER. LIGHTS

| | |
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POWER PLANT

The Pratt and Whitney JT9D-3 or JT9D-7 engine is a two-spool, axial flow turbo fan engine of high compression and high bypass ratio. At present time the fleet has both the JT9D-3 and -7 engines and they can be intermixed with proper placarding, located on bottom of center pilot's instrument panel. The JT9D-3 engine delivers 43,500 pounds of thrust (dry), while the -7 engine is rated at 45,500 pounds (dry). The N_1 low stage compressor consists of one fan stage plus three additional compression stages and is driven by the last four stages of the turbine. The N_2 high stage compressor consists of eleven stages and is driven by the first two stages of the turbine. The first four stator stages of the N_2 compressor are variable and are driven by a single actuator powered by the engine driven fuel pump. These variable stator vanes prevent compressor stalls during starting, acceleration, and deceleration. The engine accessories are driven by the N compressor.

Air is bled from the engine for various functions. Engine fan air is used for the pre-cooler, igniter blast, and generator cooling. Fourth stage air is dumped overboard during starting and low power operation through a single ring bleed, which encircles this stage. This single ring bleed is called a surge bleed valve or 3.0 bleed and is actuated by engine pump fuel pressure. Ninth stage air is dumped overboard during starting, through four bleed valves. These bleeds called starting bleeds or 3.5 bleeds are actuated by 15th stage air. Two additional bleeds called 4.0 bleeds, dump fifteenth stage air overboard during reversing and impending compressor stall conditions. Eighth or fifteenth stage air is used to supply all the pneumatic requirements.

Engine starting is accomplished by four rotary selector switches on pilot's overhead panel. A Valve Open light, above each rotary selector switch, illuminates when start valve is open.

The ignition system is a dual AC powered system and is designed for continuous operation. Either single or dual ignition is controlled by the four rotary selector switches on the overhead panel. A standby Single ignition system is controlled by a rotary selector switch on the overhead panel and is powered by the standby inverter. When using the standby ignition system, the captain's magnetic heading reference system is rendered inoperative.

The engine oil system provides lubrication and cooling and its operation is monitored through gauges and warning lights. A six gallon oil tank is located on each engine. The oil is cooled through an oil cooler by fuel.

The engine fuel system provides the correct amount of fuel requirements as determined by the fuel control unit. Fuel from the tank enters a two stage engine driven pump, fuel heater, fuel filter, fuel control unit, fuel flow transmitter, fuel cooled oil cooler, and fuel manifold. This dual purpose two stage engine driven fuel pump supplies hydraulic power to the variable stator vanes and the 3.0 ring bleed valve.

The water injection system (B-747-200 series) provides controlled water to the engine during take-off allowing maximum thrust power to be developed. Control of this water injection system is from the S/O panel. However, NWA policy has been to render the system inoperative.



POWER PLANT (Cont.)

The forward thrust reversers are pneumatically operated by a 15th stage air driven motor. 75% of the reverse thrust is developed by the forward reversers that reverse fan exhaust air by 22 blocker doors through cascade vanes. The aft thrust reversers are pneumatically controlled and mechanically operated by the accessory drive pad. The aft reversers reverse exhaust air by 12 blocker doors through cascade vanes. Reverse indicator lights on the center instrument panel display reverse system status. An amber Rev Unlock light illuminates when either reverse sleeve unlocks, while the green Full Rev light illuminates when both sleeves are in full reverse.

A throttle bar light on forward pedestal, illuminates above 35,000 feet, to alert flight crew to install throttle bar and prevents retarding throttles at altitude, which may result in compressor stall. A total air temperature/engine pressure ratio limit system provides limit engine EPR power settings for various modes of operation as a function of altitude, temperature and Mach number. The TAT/EPR module is located on the aft pedestal. A test button is provided to check the calibration of each operating mode. An Amb. Temp Selector is used for takeoff modes ONLY; you must set ambient temperature in Centigrade prior to takeoff. An EPRL indicator on the Captain's instrument panel displays the maximum safe EPR limit for the particular flight mode selected. In addition, the computed total air temperature is displayed on this instrument. Warning flags will appear in this instrument with a computer failure or computer error.

NORTHWEST ORIENT

FREIGHTER

BOEING 747



72:01F

ENGINES

The B-747F aircraft is provided with JT9D-7F engines, rated dry at 46,740 pounds of thrust. The engines will be operated at the -7A thrust level of 46,150 pounds of thrust.

A larger oil tank with an increased quantity of 10 gallons has been provided.

The lower left 3.5 (start) bleed has been removed. The 3.0 (surge) bleed and lower right 3.5 (start) bleed will operate together as the tandem bleed system. The 4.0 bleeds will be deactivated.

The dual ignition system will be 4 Joule, 115 Volt AC powered, and controlled by two toggle-type switches on the overhead panel.

The secondary inlet doors on the nose cowl have been removed.

The JT9D-7F engine will have no turbine reversing. The thrust reversing sequence valve has been replaced with a positive supply shutoff valve, controlled by throttle actuated reverse switches.

NORTHWEST ORIENT

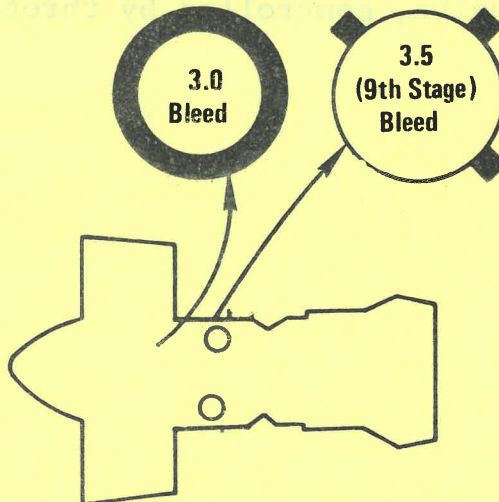


FREIGHTER

72:02F

Bleed Control System

- ONE 3.0 SURGE BLEED
- THREE 3.5 STARTING BLEEDS
- NO 4.0 REVERSE AIR BLEEDS





GENERAL

1. Pratt & Whitney Engine (JT9D-3) (JT9D-7)
 - a. 43,500 lbs. (dry) 45,500 (dry)
 - b. 45,500 lbs. (wet) 47,000 (wet)
2. JT9D engine consists of two axial flow compressors in series (one low pressure compressor N_1 and one high pressure compressor N_2), an annular combustion chamber and a six stage turbine.
3. N_1 compressor consists of one fan stage plus three additional compression stages.
 - a. N_1 compressor is driven by the last four stages of the turbine.
4. N_2 compressor consists of eleven stages.
 - a. N_2 compressor is driven by the 1st two stages of the turbine.
 - b. Engine accessories are drive by the N_2 compressor.
 - c. N_2 compressor RPM is speed-governed by the fuel control.
 - d. The first four stages have variable stators.
 - (1) Positioned by fuel control.
 - (2) Prevents stalling of engine compressor during starting, acceleration and deceleration.

ENGINE AIR BLEED SYSTEM

1. Air is bled for various functions from the engine.
 - a. Fan air
 - (1) Pre-cooler and igniter blast.
 - (2) Generator cooling
 - b. Fourth stage air
 - (1) Dumped overboard during starting and lower power operation.
 - (2) Dumped through two fourth stage bleed valves.
 - (a) Called surge bleed valves.
 - c. Ninth stage air
 - (1) Dumped overboard during engine start, through four bleed valves (two on each side of engine).
 - d. Eighth or Fifteenth stage air
 - (1) Supply air to pneumatic manifold



THRUST REVERSING SYSTEM

1. Forward thrust reversing system reverses fan exhaust air by 22 blocker doors through cascade vanes.
 - a. Forward reversers are pneumatically controlled and mechanically driven from a 15th stage air driven motor.
 - b. When forward reverser is in full reverse, the thrust reverse levers are unlocked.
 - c. 75% of reverse thrust is developed by forward reversers.
2. Aft thrust reverse system reverses the exhaust air by 12 blocker doors through cascade vanes.
 - a. Aft reversers are pneumatically controlled and mechanically operated by accessory drive pad.
3. Reverse indicator lights on center instrument panel.
 - a. Amber (reverse unlock) light illuminates when either reverse sleeve unlocks.
 - b. Green (full reverse) lights illuminate when both sleeves are in full reverse.

NOTE: Thrust reversing is blocked out in flight.

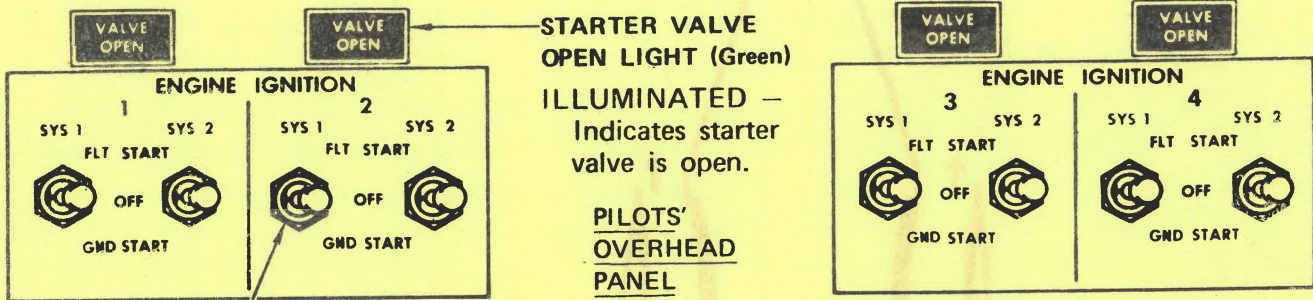
IGNITION SYSTEM

1. Normal ignition system
 - a. Dual (four-joule) AC powered system per engine.
 - (1) System designed for continuous operation
 - (2) System is controlled by rotary selector switch on pilot's overhead panel.
 - (a) All positions of ignition selector switch - ignition is through start lever position switch.
2. Standby ignition
 - a. AC power supplied by standby inverter.
 - (1) Back up ignition system for an all-engine flameout in flight.

NOTE: No ignition available when start lever is in cutoff position.

ENGINE OIL SYSTEM

1. Six gallon oil tank is located on each engine.
 - a. Minimum oil for departure

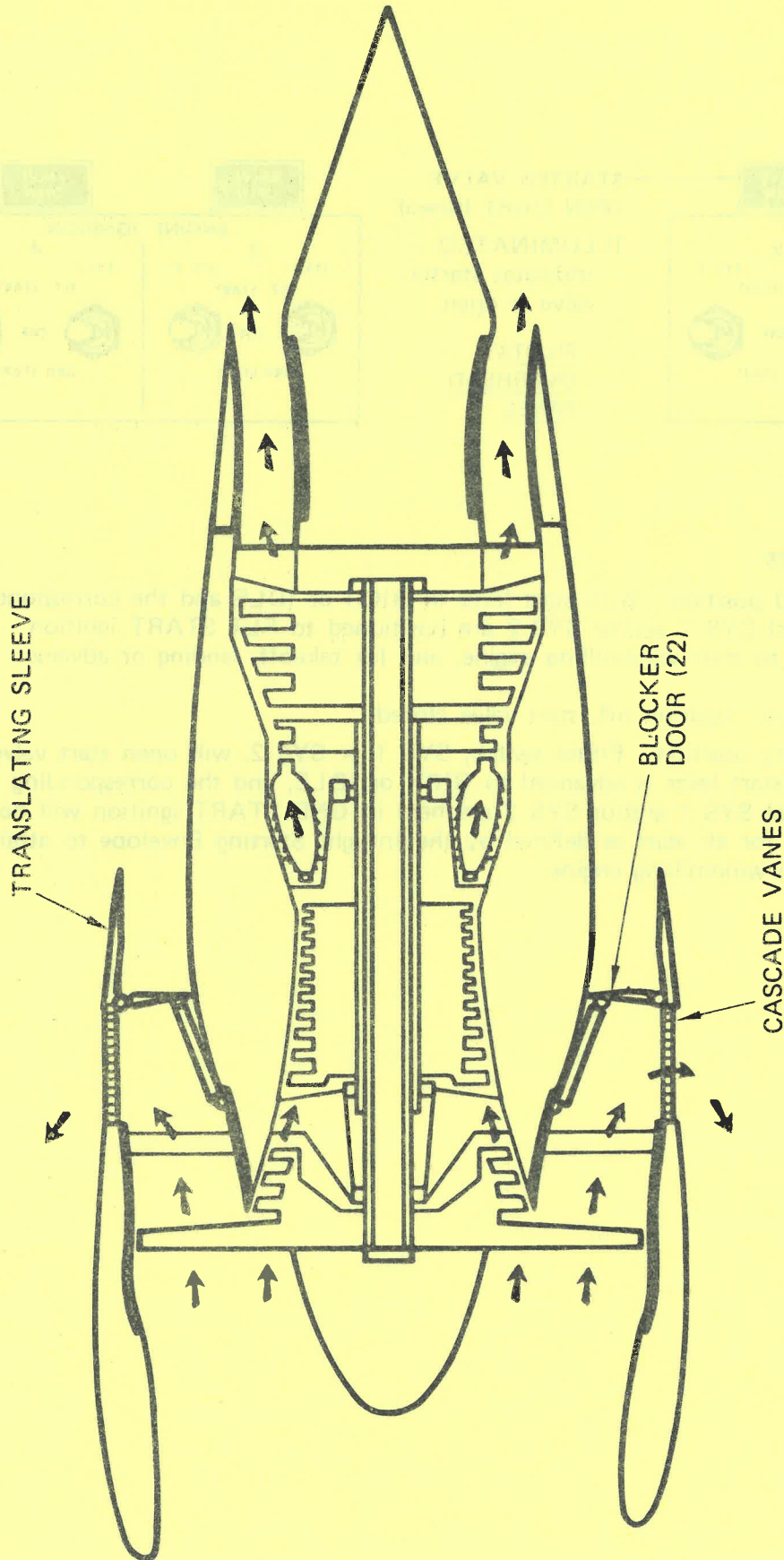


ENGINE IGNITION SWITCHES

FLT START — Maintained position. With start lever in RICH or IDLE and the corresponding engine ignition switch(es) SYS 1 and/or SYS 2 are positioned to FLT START ignition will be supplied. Used to start windmilling engine, and for takeoff, landing or adverse weather conditions.

OFF — Maintained position. Ignition off, start valve closed.

GND START — Momentary position. Either switch, SYS 1 or SYS 2, will open start valve of selected engine. When start lever is advanced to RICH or IDLE, and the corresponding engine ignition switch(es) SYS 1 and/or SYS 2 are held in GND START ignition will be supplied. May be used for air start as defined by the Inflight Starting Envelope to attain required N2 for starting windmilling engine.



ENGINE THRUST REVERSER - FULL REVERSE



ENGINE OIL SYSTEM (Cont.)

2. Self contained oil system for lubrication and cooling of engine.
3. Oil is cooled by fuel cooled oil cooler.
4. Low Oil Pressure lights located on the center instrument panel.
 - a. Illuminates when oil pressure drops below lower red line on gauge.
5. Filter Bypass lights are located on S/O panel.
 - a. Illuminates when oil is bypassing main oil filter.
 - b. Reduce thrust until light extinguishes and continue engine operation at reduced thrust. If light fails to extinguish, shut engine down.
6. Oil temperature and pressure indicators are on S/O panel.

ENGINE FUEL SYSTEM

1. Engine fuel requirements are determined by the fuel control unit.
 - a. Fuel condition control motor located on each fuel control.
 - (1) Controlled electrically by three-position start lever.
 - (a) Cutoff position — drives fuel control condition motor to cutoff position.
 - (b) Rich position — drives the fuel control condition motor to rich position.
 - (c) Idle position — drives the fuel control condition motor to the ground idle position.

'1' Fuel control condition motor driven to the flight idle position when flaps are extended beyond 22 1/2°.
 - b. Ground Idle light is located on pilot's control stand.
 - (1) Normally off in the air.
 - (a) If light illuminates in flight when flaps are in landing position, one or more engines are in ground idle.
 - (b) Light should illuminate 5 seconds after touchdown with landing flaps selected.
 - c. Dual purpose, dual stage engine driven fuel pump supplies fuel pressure to fuel control unit and hydraulic power to variable stator vanes and bleed valves.

ENGINE STARTER

1. Normal start pressure is 40—45 psi.
2. Minimum pressure is 30 psi.



ENGINE INSTRUMENTS

1. EPR indicator. (Vertical tape readout.)
 - a. Located on center instrument panel.
 - b. EPR has digital readout also.
 - c. Set Reference Knob on indicator has two modes of operation.
 - (1) Mode No. 1 (knob in) – Sets desired EPR in lower window and all four bugs to a set position on scale.
 - (2) Mode No. 2 (knob out) – Locks inboard bugs at set position and a new EPR may be set on outboard bugs.

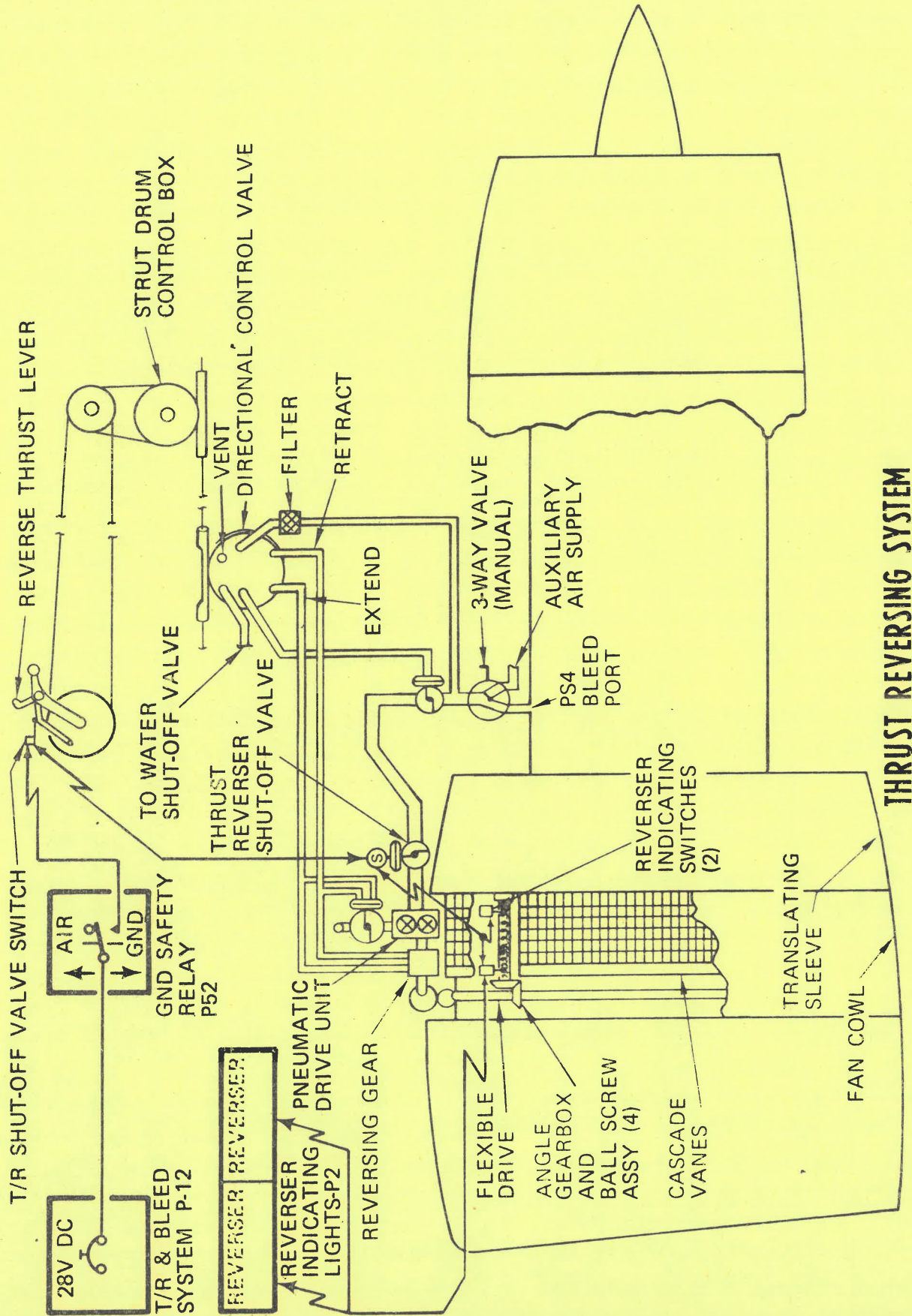
NOTE: Pushing knob back in will align inboard bugs with outboard bugs.

- d. Loss of power or instrument failure causes tape to drive off scale and off flag appears.
2. N₁ RPM indicator. (Vertical tape readout.)
 - a. Located on center instrument panel.
 - b. N₁ range of indication

| | |
|----------------------------|-----------|
| (JT9-3-A) | (JT9D-7) |
| (1) Green range 15-96% | 15-96% |
| (2) Yellow range 96-101.4% | 96-104.2% |
| (3) Red line 101.4% | 104.2% |
 - c. An Overspeed Amber Warning light for each tape is located on indicator.
 - (1) Illuminates when red line on indicator is exceeded.
 - (2) Reset by 'Maximum Indication Reset' switch. Located on center instrument panel.
 - d. Loss of power or instrument failure causes tape to drive off scale and off flag appears.

3. N₂ RPM indicator. (Vertical tape readout.)
 - a. Located on center instrument panel.
 - b. N₂ range of indication.

| | |
|----------------------------|-----------|
| (JT9D-3-A) | (JT9D-7) |
| (1) Green range 45-96% | 45-96% |
| (2) Yellow range 96-100.6% | 96-102.5% |
| (3) Red line 100.6% | 102.5% |



ENGINE INSTRUMENTS (Cont.)

- c. An Overspeed Amber Warning light for each tape is located on indicator.
 - (1) Illuminates when red line on indicator is exceeded.
 - (2) Reset by 'Maximum Indication Reset' switch located on center instrument panel.
 - d. Loss of power or instrument failure causes tape to drive off scale and off flag appears.
4. EGT indicators. (Vertical tape readout.)
- a. Located on center instrument panel.
 - b. EGT range of indication

| | |
|----------------------------|-----------|
| (JT9D-3-A) | (JT9D-7) |
| (1) Green range 400-816°C | 400-875°C |
| (2) Yellow range 816-846°C | 875-915°C |
| (3) Red line 846°C | 915°C |
 - c. Overtemperature Amber Warning light for each tape. Located on the indicator.
 - (1) Steady when EGT temperature enters red range.
 - (2) Steady Amber light must be reset by 'Maximum Indication Reset' switch.
 - d. A Red Overtemperature Warning light for each tape located on indicator.
 - (1) Flashes when EGT temperature enters red range by 5° and will go to steady red after fifteen seconds.
 - (2) Steady when EGT temperature enters red range by 15°
 - e. Loss of power or instrument failure causes tape to drive off scale and off flag appears.
5. Fuel flow indicators. (Vertical tape readout.)
- a. Located on center instrument panel.
 - b. Measures fuel flow to engine in pounds per hour.
 - c. Loss of power or instrument failure causes tape to drive off scale and off flag appears.
6. Fuel flow indicator. (Pointer and digital readout.)
- a. Located on S/O panel.
 - b. Power loss or instrument failure causes a flag to cover digital readout window.

ENGINE INSTRUMENTS (Cont.)

7. Oil quantity indicator. (Pointer type.)
 - a. Located on S/O panel.
 - b. Indicates quantity of useable oil in tank.
 - c. Power loss or instrument failure causes pointer to go to OFF position.
8. Oil temperature indicator. (Pointer type.)
 - a. Located on S/O panel.
 - b. Indicates oil in temperature.
 - c. Oil temperature ranges.
 - (1) Green range 40-120°C
 - (2) Yellow range 120-162°C
 - (3) Top Red line 162° C

NOTE: Can be in yellow range for 20minutes.

- d. Power loss or instrument failure causes pointer to go below scale.
9. Oil pressure indicator. (Pointer type.)
 - a. Located on S/O panel.
 - b. Indicates oil pressure leaving the main oil filter.
 - c. Oil pressure indication ranges.
 - (1) Green range 40-60 psi
 - (2) Yellow range 34-40 psi
 - (3) Lower Red line 35 psi
 - (4) Upper Red line 60 psi
 - d. Power loss or instrument failure indicator pointer remains in last position.
10. Engine breater pressure indicator. (Pointer type.)
 - a. Located on S/O panel.
 - b. Indicates condition of internal engine oil seals.



ENGINE INSTRUMENTS (Cont.)

- c. Indicator reads from 0 – 10 psi
 - (1) Normal cruise range 2 – 3 psi
 - (2) Recommended engine shutdown at 7.5 psi

Note: May go to 9.0 PSI for 30 sec. for transient operation.
- d. Power loss or instrument failure indicator pointer remains in last position.

11. AVM (Vertical scale pointer type.)

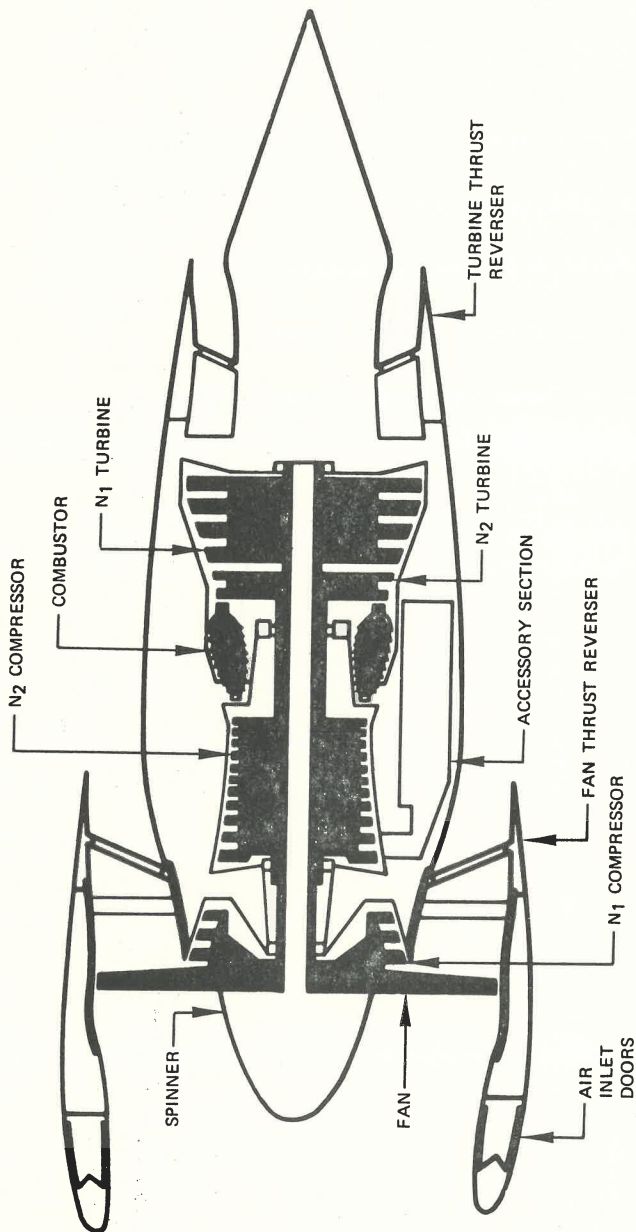
- a. Located on S/O panel.
- b. Indicates engine vibration (front or rear).
- c. Two position engine vibration pick up switch.
 - (1) Inlet position – senses vibration at front of engine.
 - (2) Turbine position – senses vibration at rear of engine.
- d. Power loss or instrument failure causes indicator pointer to go to 0.

WATER INJECTION SYSTEM

- 1. Provisions provided for water injection on all 747 aircraft.



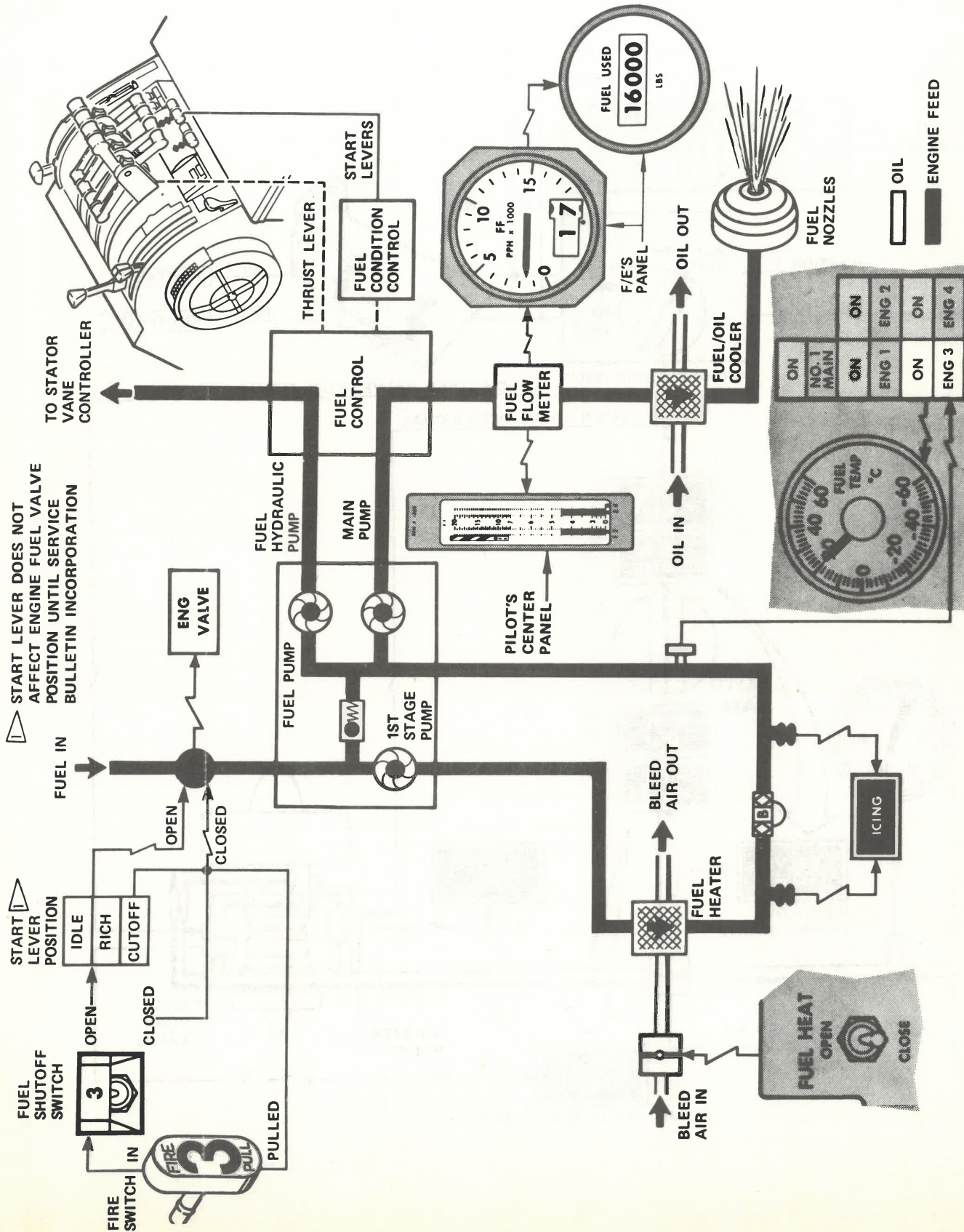
JT9D ENGINE:



- N2 COMPRESSOR & TURBINE
- N1 COMPRESSOR & TURBINE
- COMBUSTOR

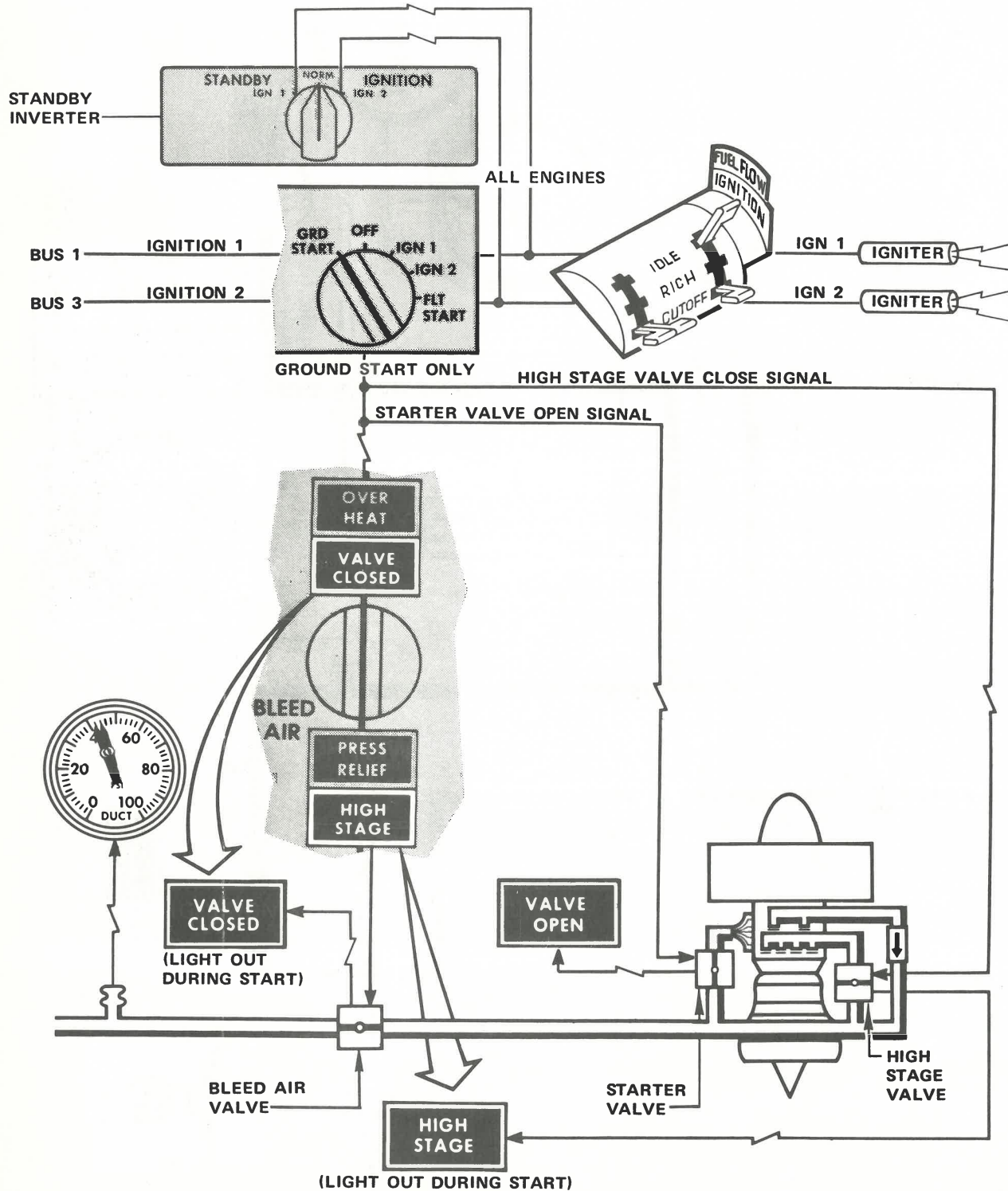


ENGINE FUEL SYSTEM

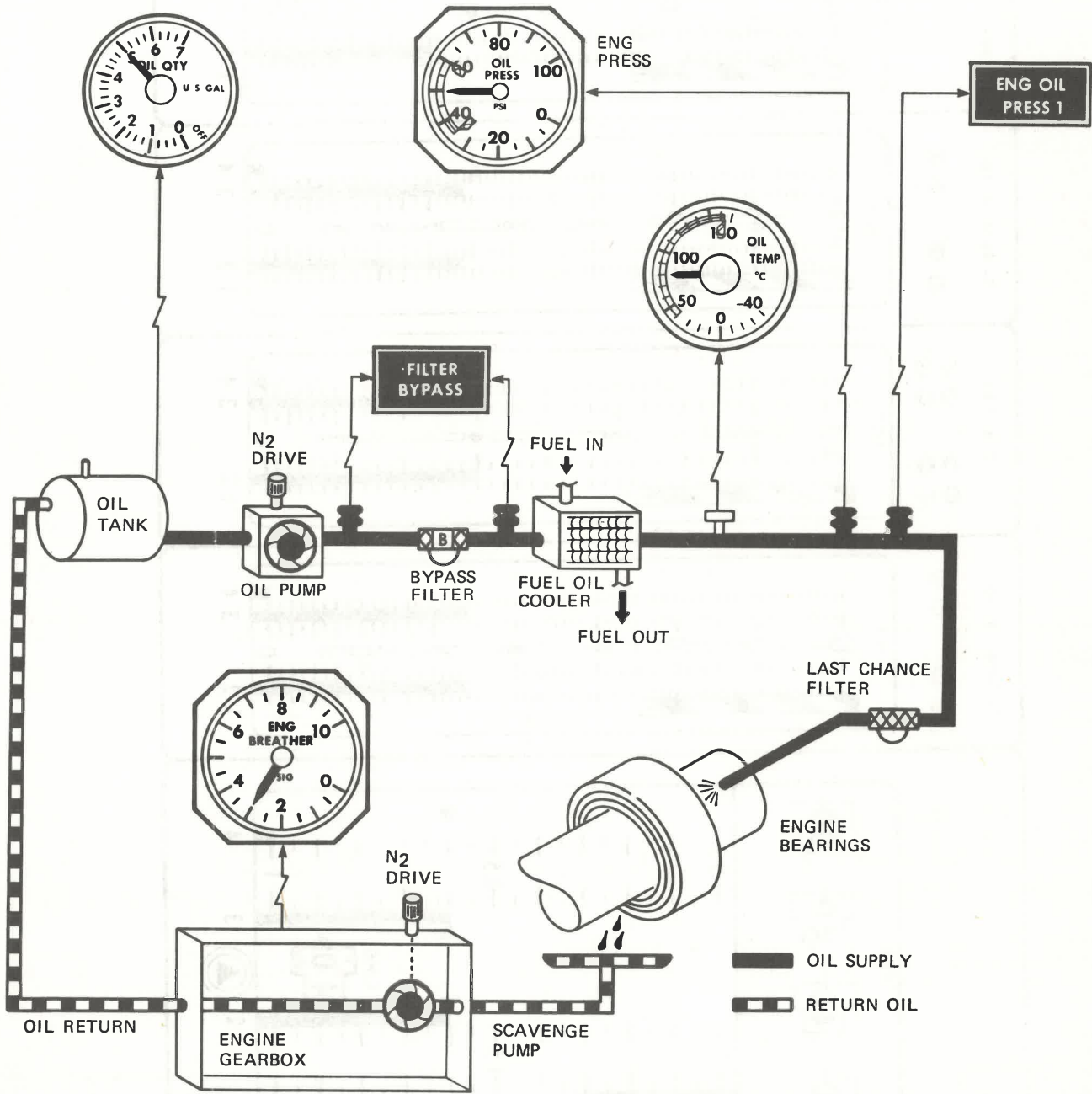


| | | | |
|------------|-------|-------|-------|
| ON | ON | ON | ON |
| NO. 1 MAIN | ENG 1 | ENG 2 | ENG 4 |
| ON | ON | ON | ON |
| ENG 3 | | | |

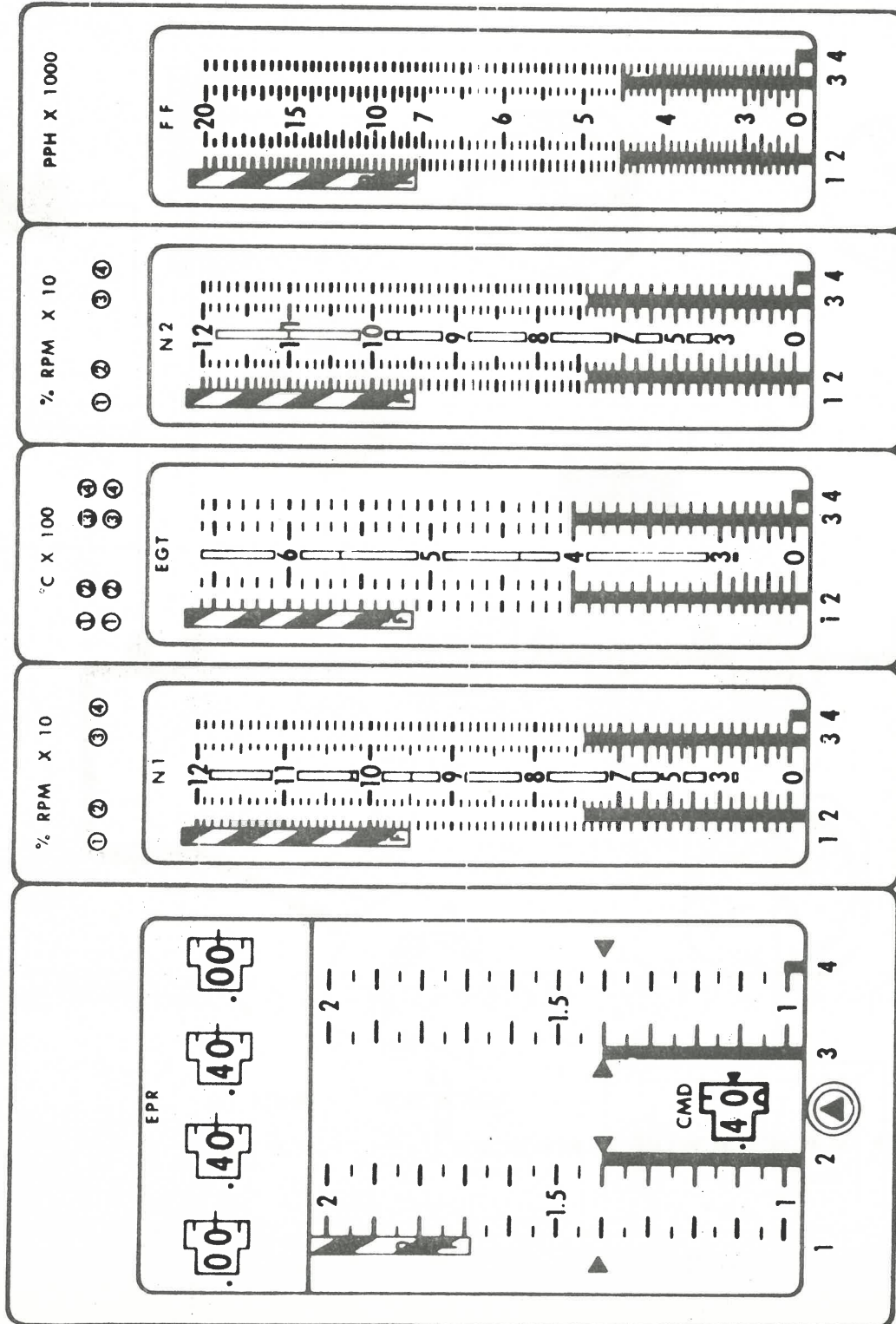
ENGINE START & IGNITION SYSTEM



ENGINE OIL SYSTEM

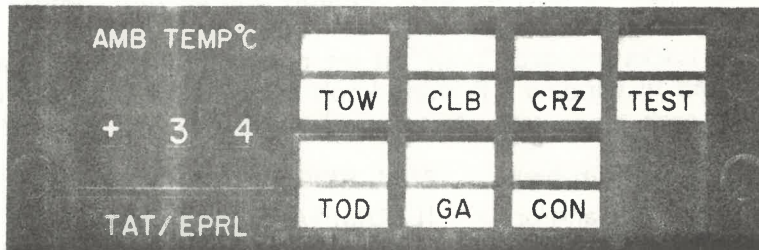


PILOT'S VERTICAL TAPE INDICATORS

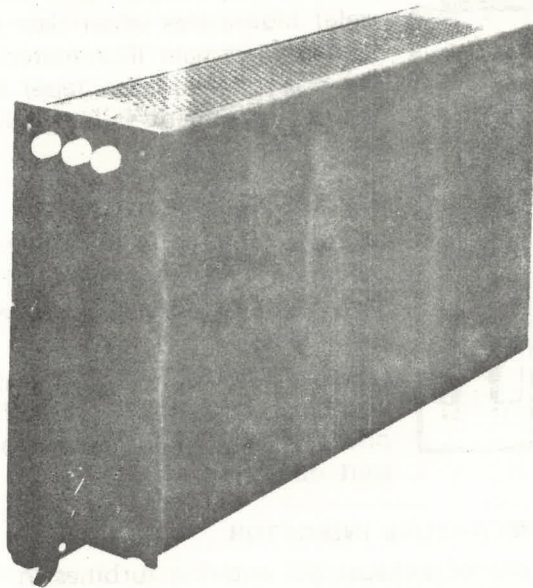




TAT/EPR SYSTEM



FLIGHT MODE SELECTOR



COMPUTER

INDICATOR



PILOT'S ENGINE INDICATING INSTRUMENT PANELS

ENGINE PRESSURE RATIO INDICATOR

Indicates ratio of turbine discharge pressure to compressor inlet pressure. Primary thrust setting instrument. Tape and digital readout. Desired EPR set by reference knob which has two modes of operation:

MODE I (Knob in) – Sets desired EPR in lower window and all four “bugs” at set position on scale.

MODE II (Knob out) – Locks inboard “bugs” at set position. New EPR may then be set on outboard “bugs” and in window. Pushing knob in will align inboard “bugs” to outboards. OFF flag appears (for each tape) with electrical power loss or instrument failure.

REVERSER UNLOCKED LIGHT (Amber)
ILLUMINATED – Either fan and/or turbine reversers are not in full forward thrust position.

FULL REVERSE LIGHT (Green)
ILLUMINATED – Both fan and turbine reversers are in the full reverse position.

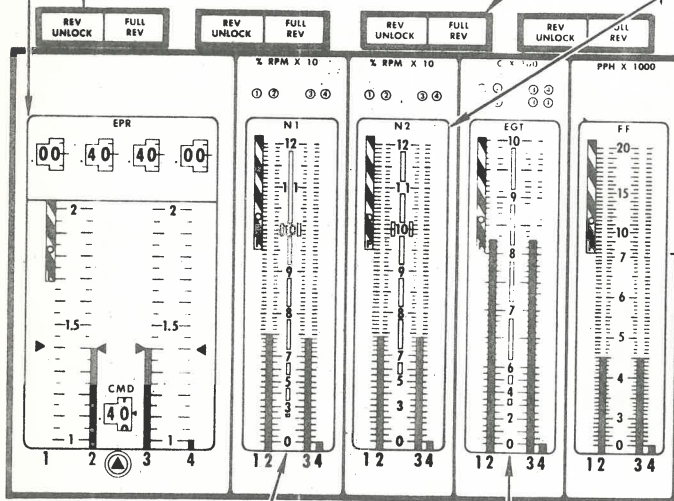
N2 RPM INDICATOR

Indicates percent of RPM of high pressure compressor. Tape readout. Amber light (at top of scale) illuminates when tape goes into red range. Light will remain illuminated until reset. OFF flag appears (for each tape) with electrical power loss or instrument failure. Tape goes to “0” with signal loss.

FUEL FLOW INDICATOR

Indicates metered fuel flow to engine in pounds per hour. Tape readout. OFF flag appears (for each tape) with electrical power loss or instrument failure.

NOTE: The fuel flow indicator(s) may give an erroneous indication of fuel flow when electrical power is applied to the airplane with the engines shut down.

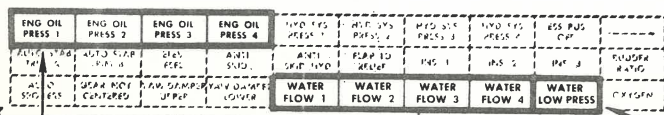


N1 RPM INDICATOR

Indicates percent of RPM of low pressure compressor. Secondary thrust setting instrument. Function same as N2 indicator.

EXHAUST GAS TEMPERATURE INDICATOR

Indicates temperature of exhaust gas entering turbines in ° C. Tape readout. Amber and red overtemperature lights at top of scale. Amber light illuminates when the maximum EGT is exceeded (temperature enters red range). If EGT continues to increase the red light will flash then illuminate steady after 15 seconds of flashing. The red light will also illuminate steady if the maximum limit of the red “flashing” range of EGT is exceeded. When either light illuminates steady, it will remain illuminated until reset. OFF flag appears with electrical power loss or instrument failure.



ENGINE LOW OIL PRESSURE LIGHT (Amber)

ILLUMINATED – Indicates engine oil pressure is below 25 PSI

WATER FLOW LIGHT (Green)

ILLUMINATED – Indicates water flow to engine.

WATER LOW PRESSURE LIGHT (Amber)

ILLUMINATED – Indicates low water pressure to any engine.

MAXIMUM INDICATION RE-SET SWITCH

Use to extinguish lights on N1, N2, and EGT indicators.

ENGINE CONTROL PANELS

REVERSE THRUST LEVER

Selects power for reverse thrust. Cannot be actuated unless forward thrust levers are in idle position. Interlock prevents application of reverse thrust until fan reverser reaches full reverse position.

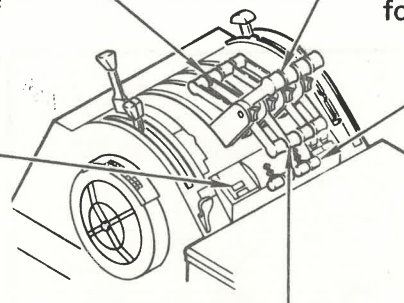
FORWARD THRUST LEVER

Selects power. Movement unrestricted except when reverse thrust levers are being used or fan reverser is not in forward position.

GROUND IDLE LIGHT (Amber)

Illuminates on the ground if trailing edge flaps are at 25 or 30.

NOTE: If illuminated in the air when trailing edge flaps are positioned to 25 or 30, one or more of the engines has remained in ground idle.



FLIGHT ENGINEER'S THRUST LEVERS

ENGINE START LEVER

CUTOFF – Fuel and ignition off.
RICH – An enriched quantity of fuel available to engine and ignition available as selected.

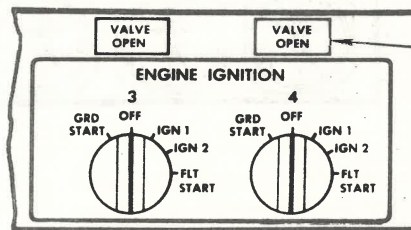
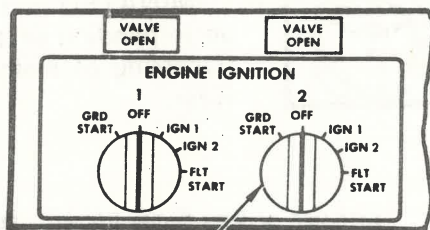
Use to start a cold engine.

Move start lever to IDLE after EGT stabilizes.

IDLE – Fuel available to engine and ignition available as selected. Use to start a warm engine.

PILOTS' CONTROL STAND

PILOTS' OVERHEAD PANEL



STARTER VALVE OPEN LIGHT (Green) ILLUMINATED – Indicates starter valve is open.

ENGINE IGNITION SWITCH

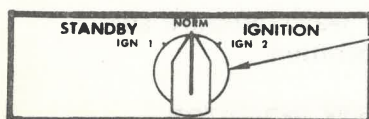
GRD START – Momentary position. Opens start valve. Dual ignition supplied when start lever is advanced to the RICH or IDLE position. May be used in the air within the parameters of the Inflight Starting Envelope to attain required N2 for starting windmilling engine.

OFF – Held position. Ignition off and start valve closed. Push to rotate out of this position.

IGN 1 – Held position. Provides continuous ignition through ignitor No. 1 only. For use in adverse weather conditions.

IGN 2 – Held position. Provides continuous ignition through ignitor No. 2 only. Use same as for IGN 1.

FLT START – Held position. Dual ignition supplied with start lever in the RICH or IDLE position. Use to start windmilling engine, and for takeoff, landing or adverse weather conditions.



PILOTS' OVERHEAD PANEL

STANDBY IGNITION SWITCH

Utilizes standby bus AC power to provide ignition from battery.

IGN 1 – Provides continuous ignition to all engines through ignitor No. 1 when start levers are in the RICH or IDLE position.

NORM – Off.

IGN 2 – Provides continuous ignition to all engines through ignitor No. 2 when start levers are in the RICH or IDLE position.

NOTE: Captain's heading information will be lost if the Standby Ignition Switch is positioned to IGN 1 or IGN 2.

S/O ENGINE INDICATING INSTRUMENT PANELS

FUEL FLOW INDICATOR

Indicates metered fuel flow to engine in pounds per hour. Pointer and digital readout. Warning flag appears in front of counter with electrical power loss or instrument failure.

OIL QUANTITY INDICATOR

Indicates quantity of usable oil in tank. Pointer goes to OFF with electrical power loss.

BREATHER PRESSURE INDICATOR

Monitors breather pressure inside engine. Provides indication of condition of internal engine oil seals and mechanical integrity of oil compartments.

OIL TEMPERATURE INDICATOR

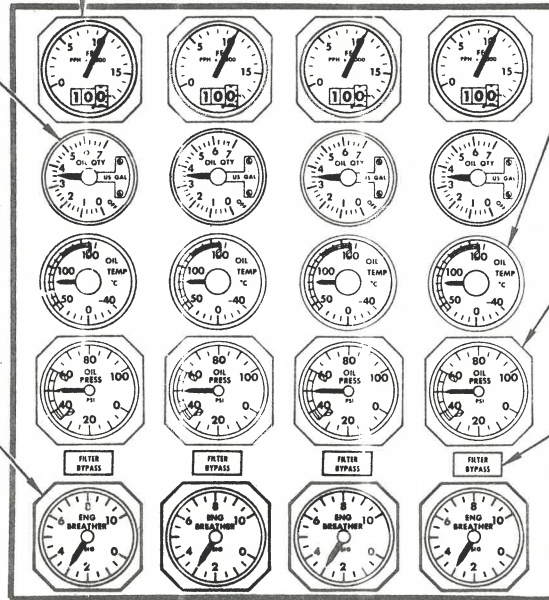
Indicates temperature of oil entering engine bearings.

OIL PRESSURE INDICATOR

Indicates pressure of oil leaving the filter.

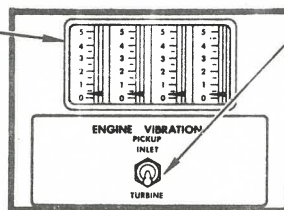
FILTER BYPASS LIGHT (Amber)

ILLUMINATED — Indicates an impending or actual bypassing of main oil filter.



ENGINE VIBRATION INDICATORS

Indicate continuous engine vibration level. Zero reading with engine operating indicates system is not functioning.



ENGINE VIBRATION PICKUP SWITCH

INLET — Senses vibration at inlet section of all engines simultaneously.

TURBINE — Senses vibration at turbine section of all engines simultaneously.

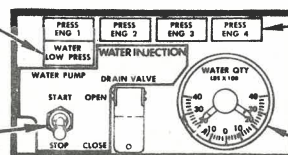
NOTE: On later airplanes the Engine Vibration Switch positions are **LOW SPEED ROTOR & HIGH SPEED ROTOR** and sense N1 and N2 vibration respectively.

WATER LOW PRESSURE LIGHT (Amber)

ILLUMINATED — Indicates low water pressure to any engine.

WATER PUMP SWITCH

START — Turns on all water pumps.



WATER PRESSURE LIGHTS (Green)

ON — Indicate water pressure adequate for operation.

WATER QUANTITY INDICATOR

WATER DRAIN VALVE SWITCH

OPEN — Drains water from tank and lines.
CLOSE — Closes water drain valve.

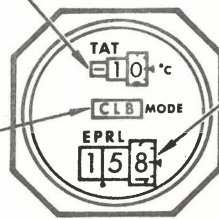
TAT/EPR CONTROLS AND INDICATOR PANELS

TOTAL AIR TEMPERATURE INDICATOR

Failure warning flag appears over indicator with electrical power loss or system failure. Any TAT failure will also cause failure warning flag to appear over EPRL indicator.

CAPTAIN'S INSTRUMENT PANEL

SELECTED FLIGHT MODE
 Displays mode selected on EPRL mode selector panel.

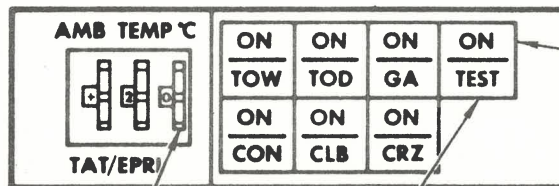


EPR LIMIT FOR SELECTED MODE

Failure warning flag appears over indicator with electrical power loss, system failure or concurrently with failure warning flag on TAT indicator.

TAT/EPRL DIGITAL INDICATOR

PILOTS' CONTROL STAND



MODE SELECTORS
 ON light illuminates when mode is selected.

MANUAL TEMPERATURE SELECTOR
 Used in determining takeoff EPR limits. Pre-empted computed TAT information when takeoff mode is selected.

TEST SWITCH
 When the TEST switch and a mode select switch are depressed the following values will appear in the TAT and EPRL windows of the digital indicator:
 TAT - 10° (± .5)
 EPRL - (all values ± .005)

| | | |
|-----------|-----------|-----------|
| TOW 1.499 | TOD 1.474 | GA 1.463 |
| CON 1.356 | CLB 1.356 | CRZ 1.313 |

TAT/EPRL MODE SELECTOR

| | |
|---|----|
| COCKPIT REFERENCE, PERFORMANCE & FLIGHT PLANNING DATA | 01 |
| EMERGENCY OPERATING PROCEDURES | 02 |
| ALTERNATE OPERATING PROCEDURES | 03 |
| DIMENSIONS & GENERAL ARRANGEMENT | 06 |
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WATER AND WASTE SYSTEMS:

Potable water tanks are located in the forward cargo compartment on the aft bulkhead. These tanks are pressurized by bleed air from the pneumatic system or when bleed air is not sufficient a small electric compressor provides the necessary air pressure. The water system is serviced from a panel located in the center of the fuselage at the leading edge of the wing. Water is plumbed to the galleys, lavatories, wash basins, and drinking fountains. It is cooled by small electric refrigeration units at each fountain and heated by an electric heater at each wash basin. Five water quantity lights at No. 2L attendant panel indicate the water quantity in the tanks. Eleven lavatories are provided in the cabin for passenger comfort and one lavatory for crew is located on upper deck. Waste water from the galleys, wash basins, and drinking fountains is carried overboard through three heated drain masts.

WEIGHT AND BALANCE SYSTEM:

This system indicates total aircraft weight and C.G. position when the airplane is on the ground. A computer combines signals from strain gauge transducers in each landing gear axle with information from a pitch attitude sensor, and provides a readout on indicators located on S/O panel. The computer also performs system check functions, Go/No-Go signals, and provides a warning if C.G. limits are exceeded. The system is normally left 'ON' while on the ground as a five minute warm up period is required before the system will indicate properly.



WATER AND WASTE SYSTEM:

GENERAL

1. The water and waste systems provide water for and disposes waste water from drinking fountain, galleys, and lavatory wash basins. The self contained toilet system collects waste which is drained by ground service.
 - a. Potable water tank is located in aft section forward cargo compartment.
 - (1) Water system is serviced from panel located on underside, forward fuselage.
 - (2) Water Quantity Indicator lights at service panel illuminate to display quantity.
 - (3) Water Quantity Indicator lights at attendant station 2L illuminate to display water tank quantity. (Empty - 1/4 - 1/2 - 3/4 and Full.)
 - (4) Water coolers are provided on sidewall of each lavatory.
 - (5) Water heaters are provided in each lavatory.
 - (a) Heaters have overheat protection and must be reset.
 - b. Waste water is gathered and directed overboard through heated drain mast.
 - c. Eleven lavatories are provided in the cabin for passenger comfort.
 - d. One lavatory for crew is located on upper deck.



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MISCELLANEOUS SYSTEM & EQUIPMENT

WATER/WASTE SYSTEM

A pressurized water system is provided by a single 100-gallon tank. Provisions for filling the tank to full, 1/2 full, or 1/4 full by means of a manual filling selector valve are provided. Pressurization for the system is provided by bleed air augmented by an AC operated air compressor.

WEIGHT AND BALANCE SYSTEM

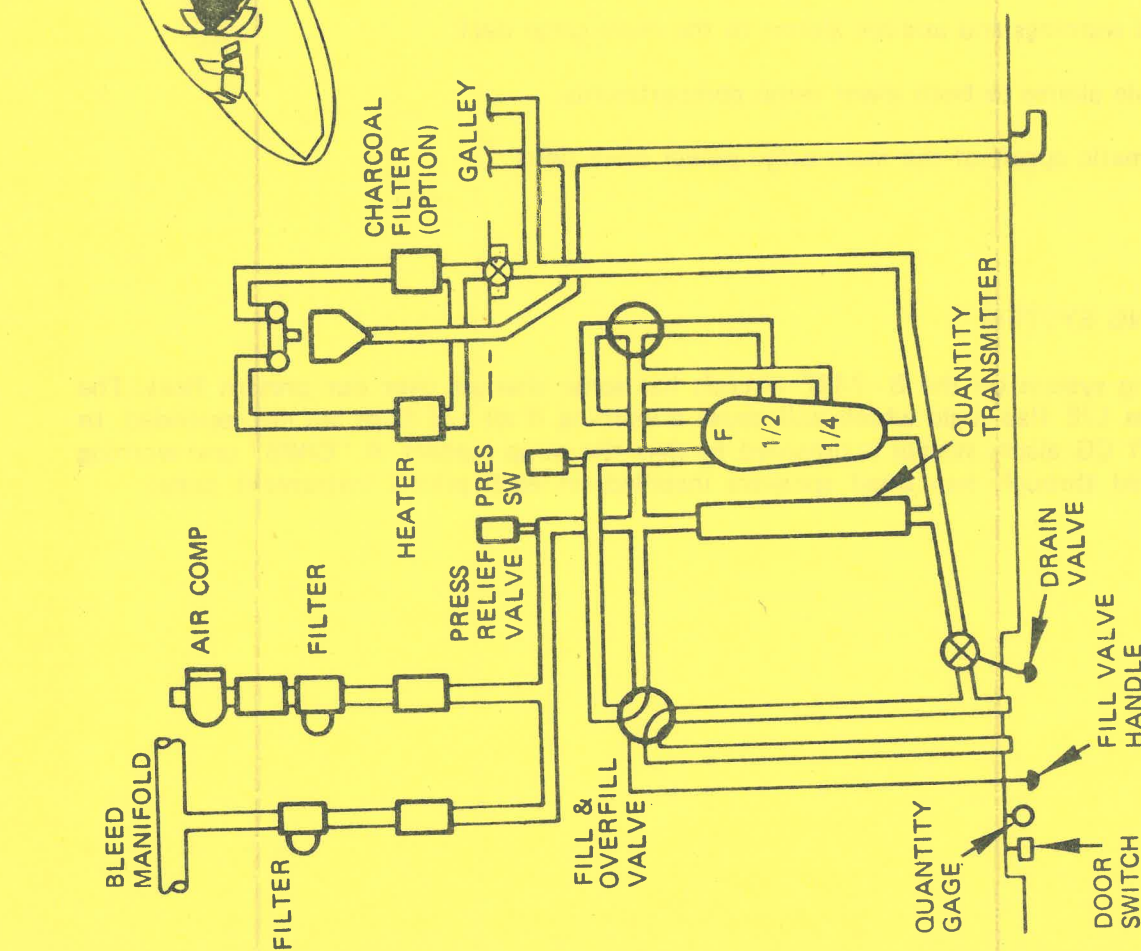
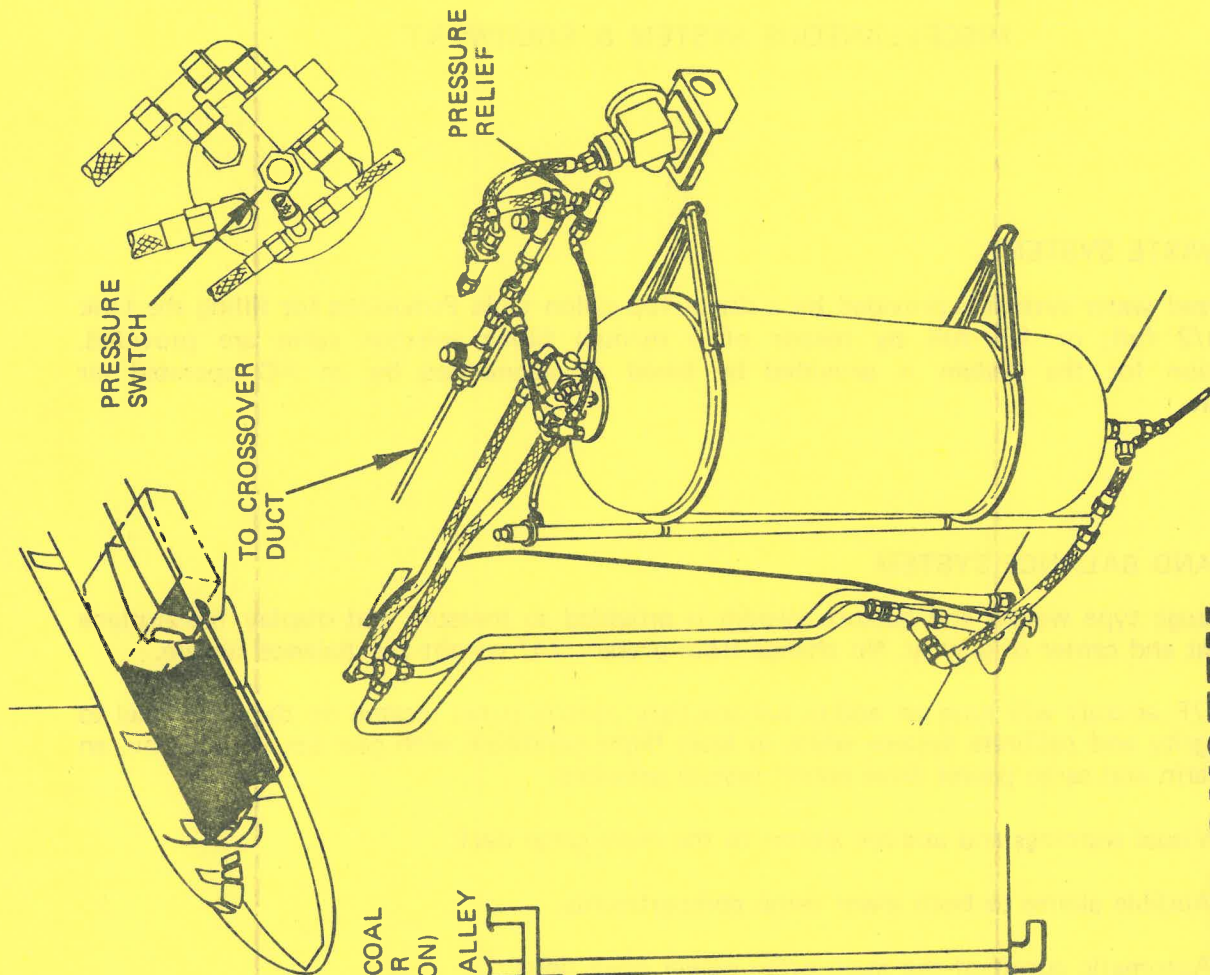
A strain gauge type weight and balance system is provided to measure and display the airplane gross weight and center of gravity. No change from present 747 weight and balance system.

The B-747F aircraft will have an additional auxiliary control panel located on the S/O panel to check integrity and calibrate system while in level flight condition with gear up. In addition, an aft C.G. alarm and cargo power drive cutoff system provides:

1. Visual warnings and audible alarms to the main cargo deck.
2. Audible alarms to both lower cargo compartments.
3. Automatic cutoff of the main cargo power drive units.

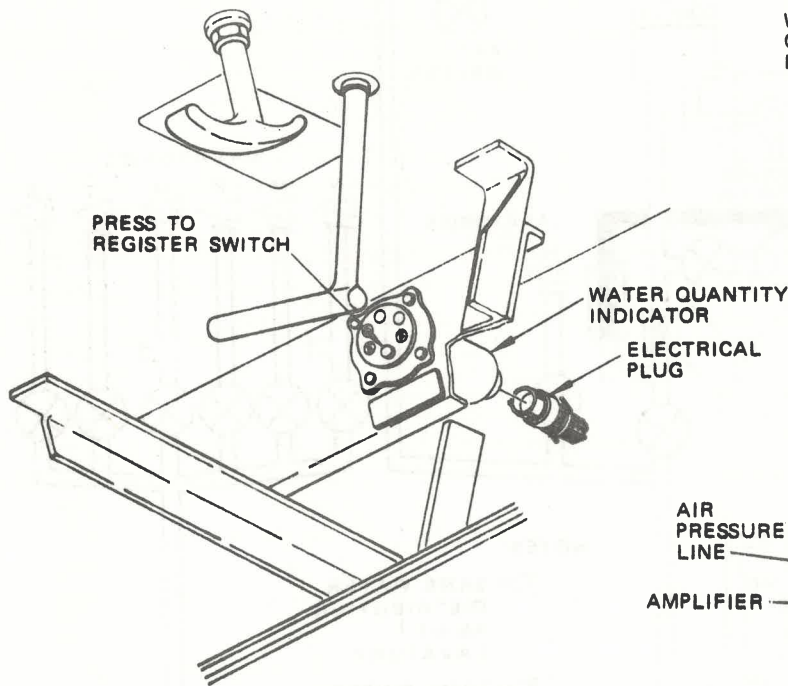
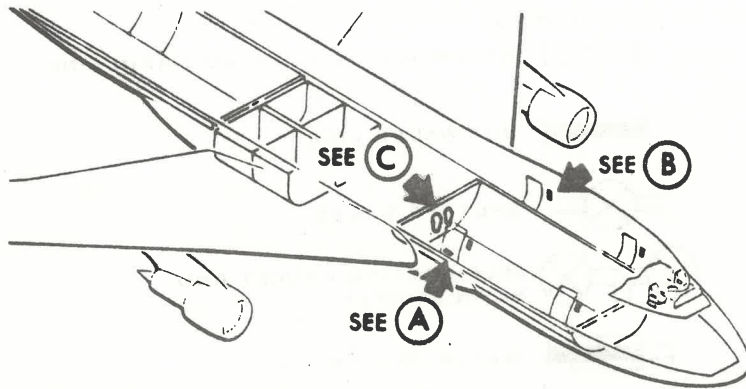
ORAL WARNING SYSTEM

The oral warning system on the B-747F aircraft has some changes over our present fleet. The T/O warning has L/E flap logic which will cause a warning if all L/E flaps are not extended. In addition, the aft CG alarm system is provided to alert the cargo loaders. A "CIWS" oral warning has been provided through two small speakers installed on each pilot's instrument panel.



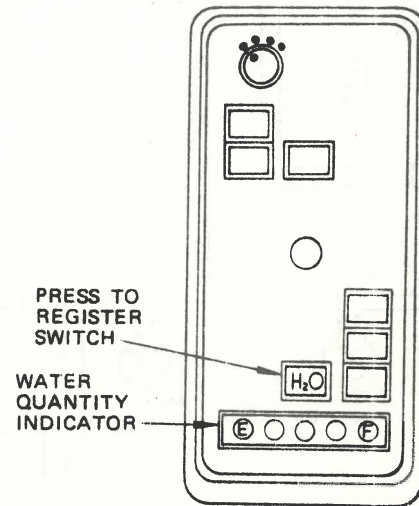
747 WATER SYSTEM

WATER SYSTEM COMPONENT LOCATION:



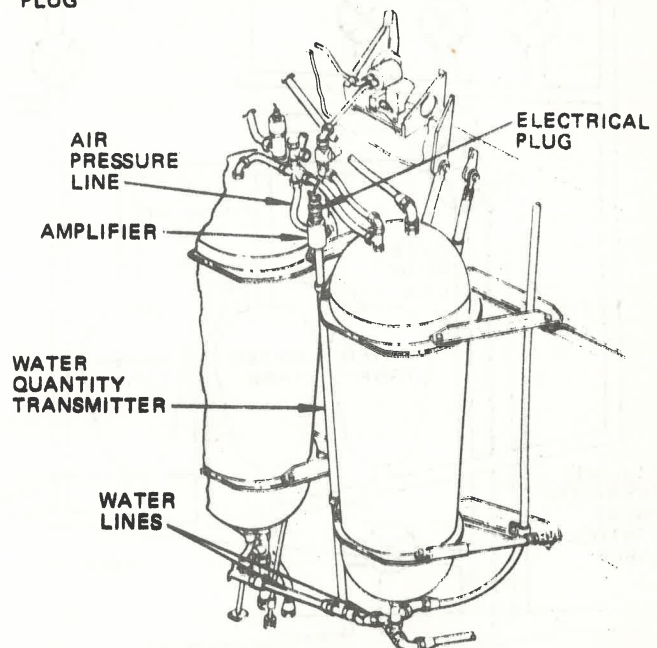
WATER SERVICE PANEL

(A)



ATTENDANT'S LEFT NO. 2 PANEL

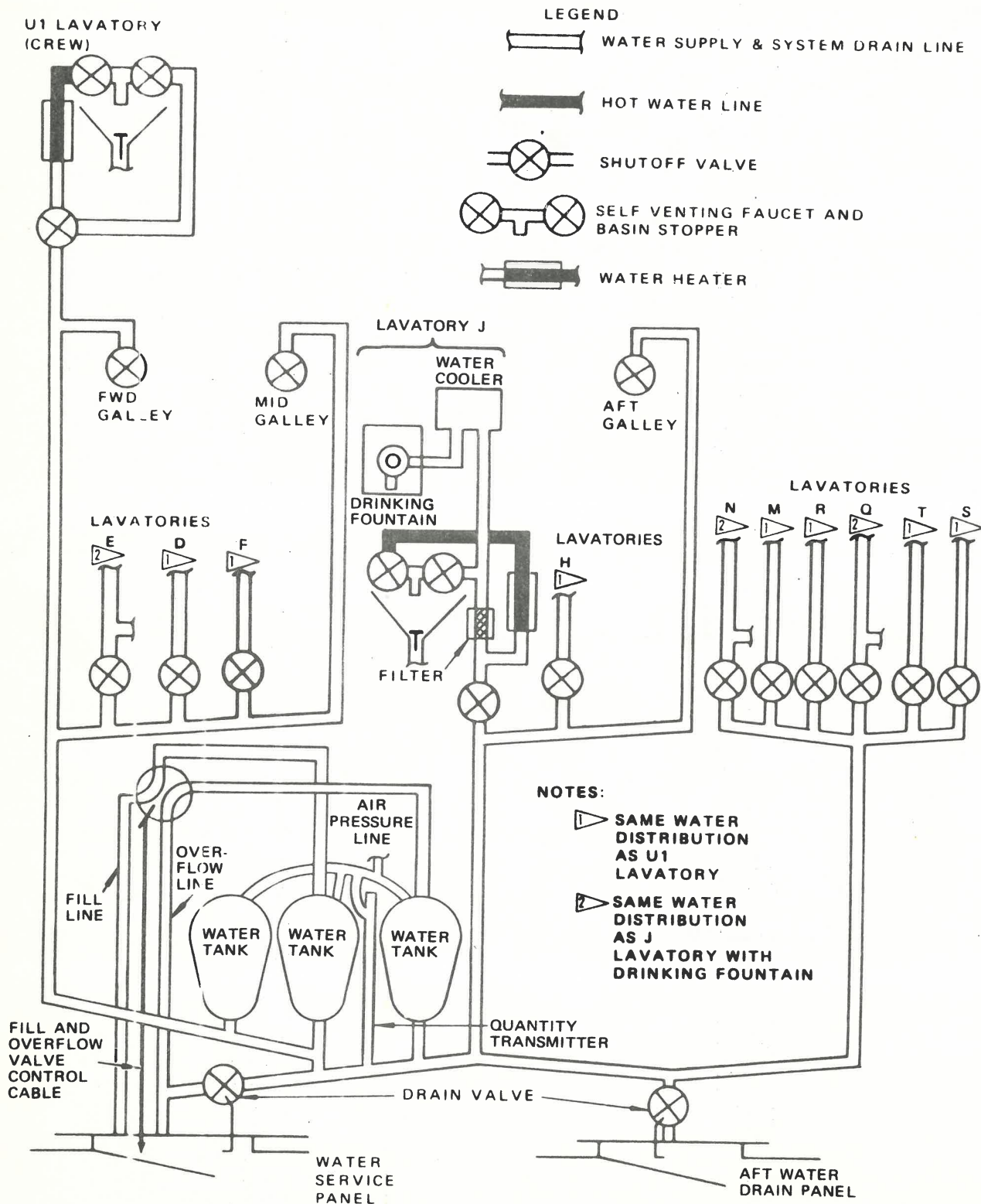
(B)

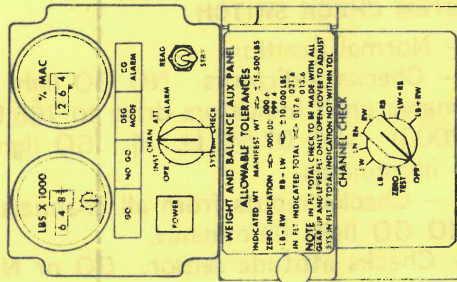
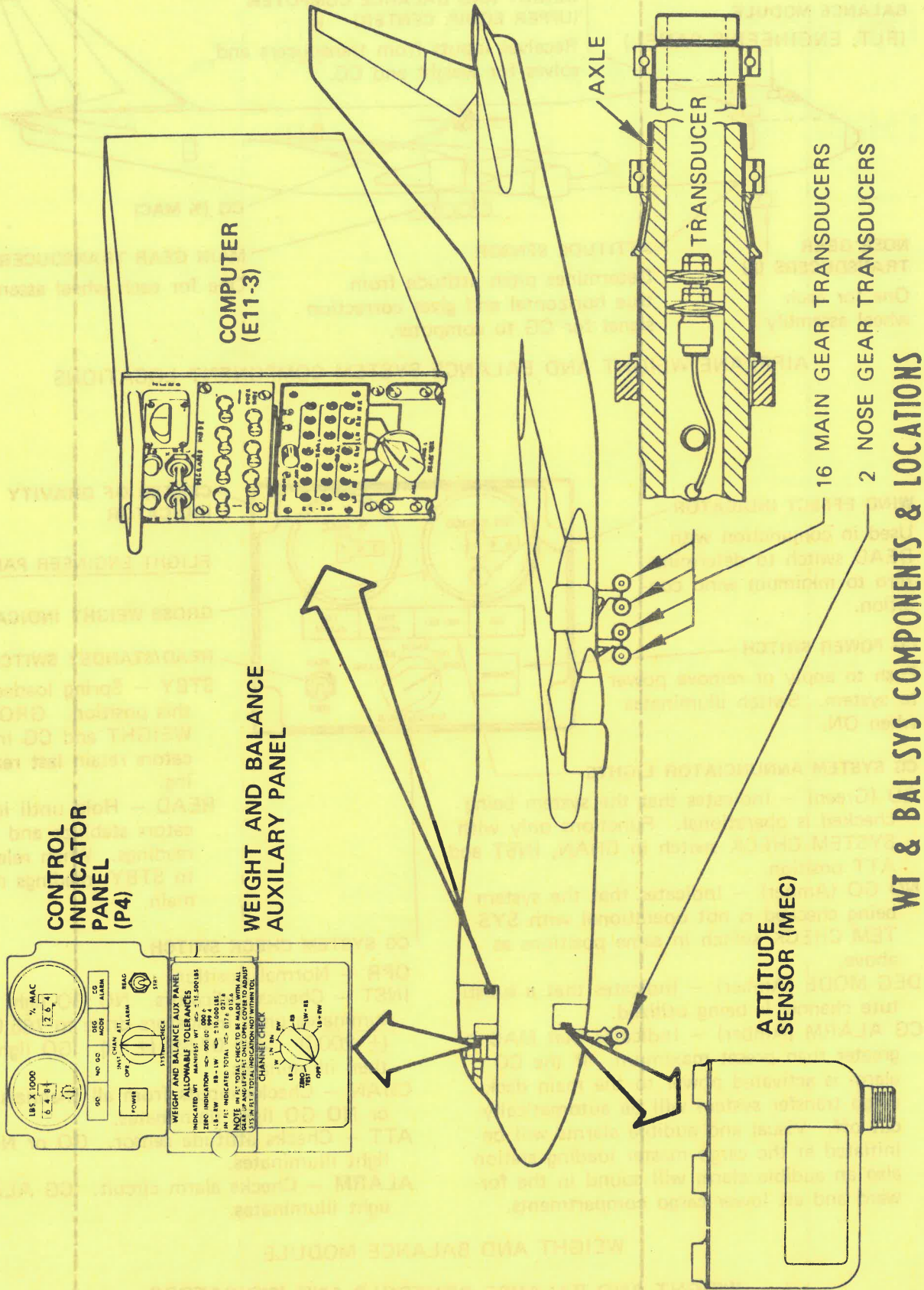


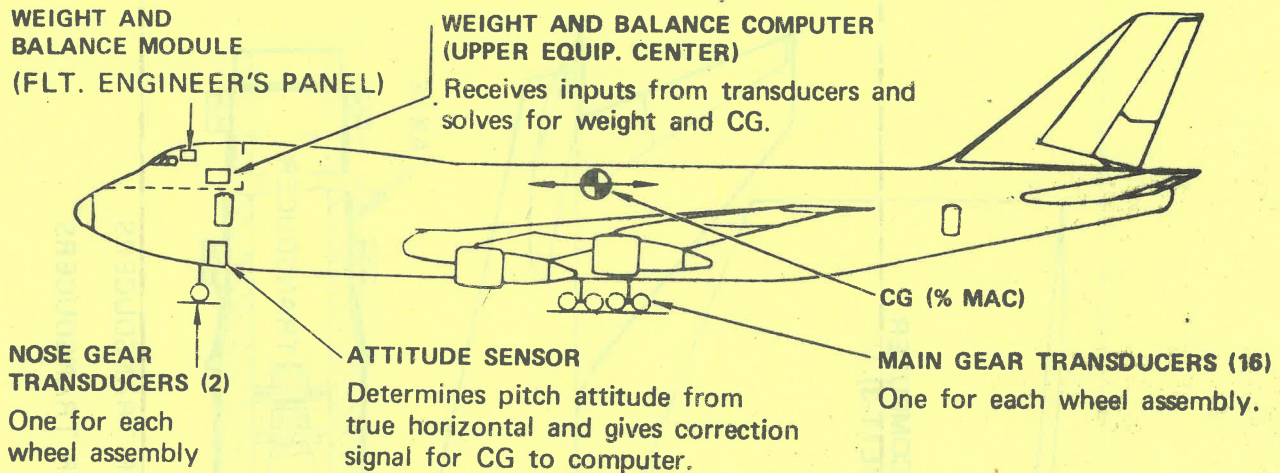
WATER QUANTITY TRANSMITTER

(C)

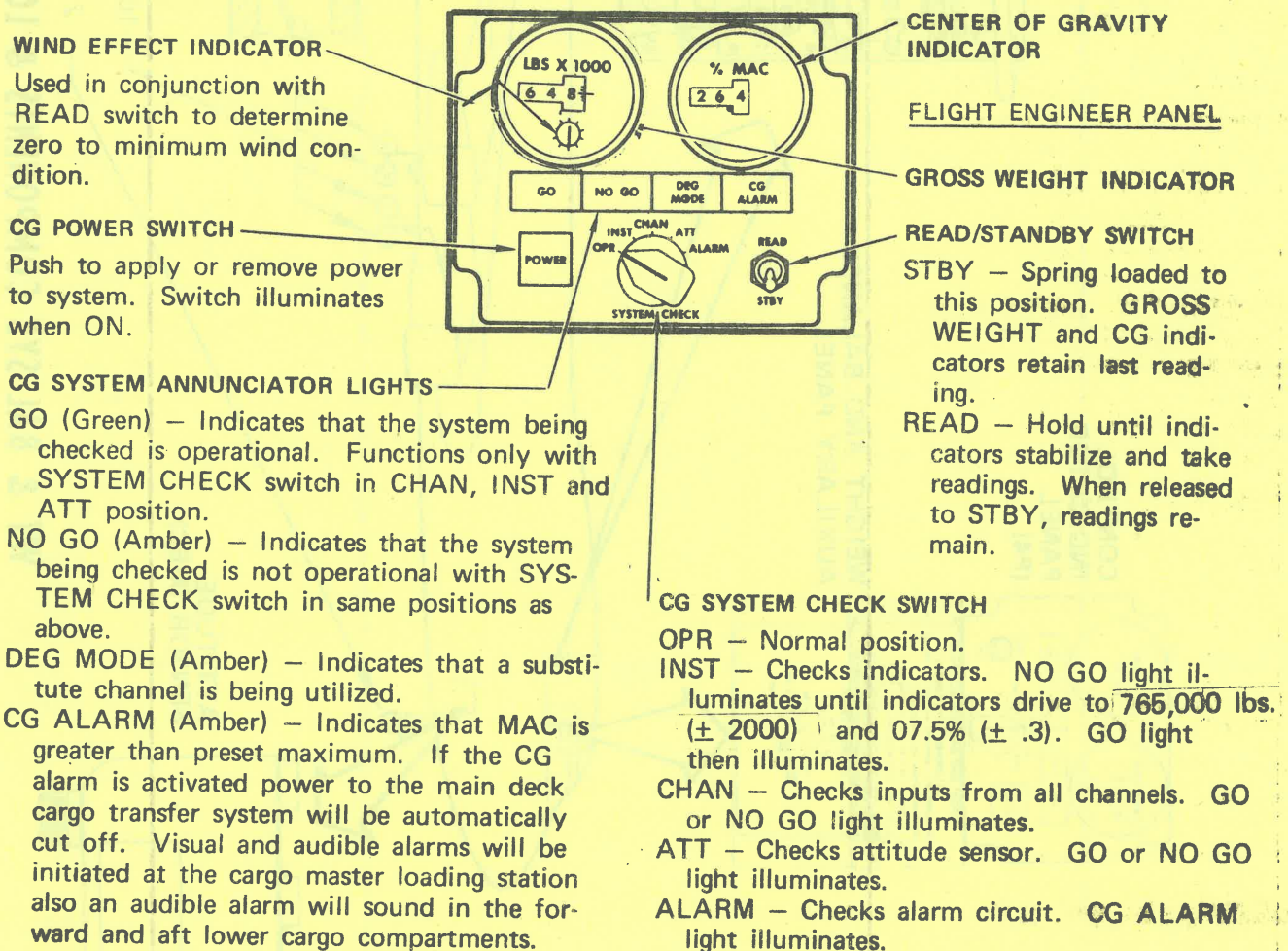
WATER SYSTEM FLOW DIAGRAM:







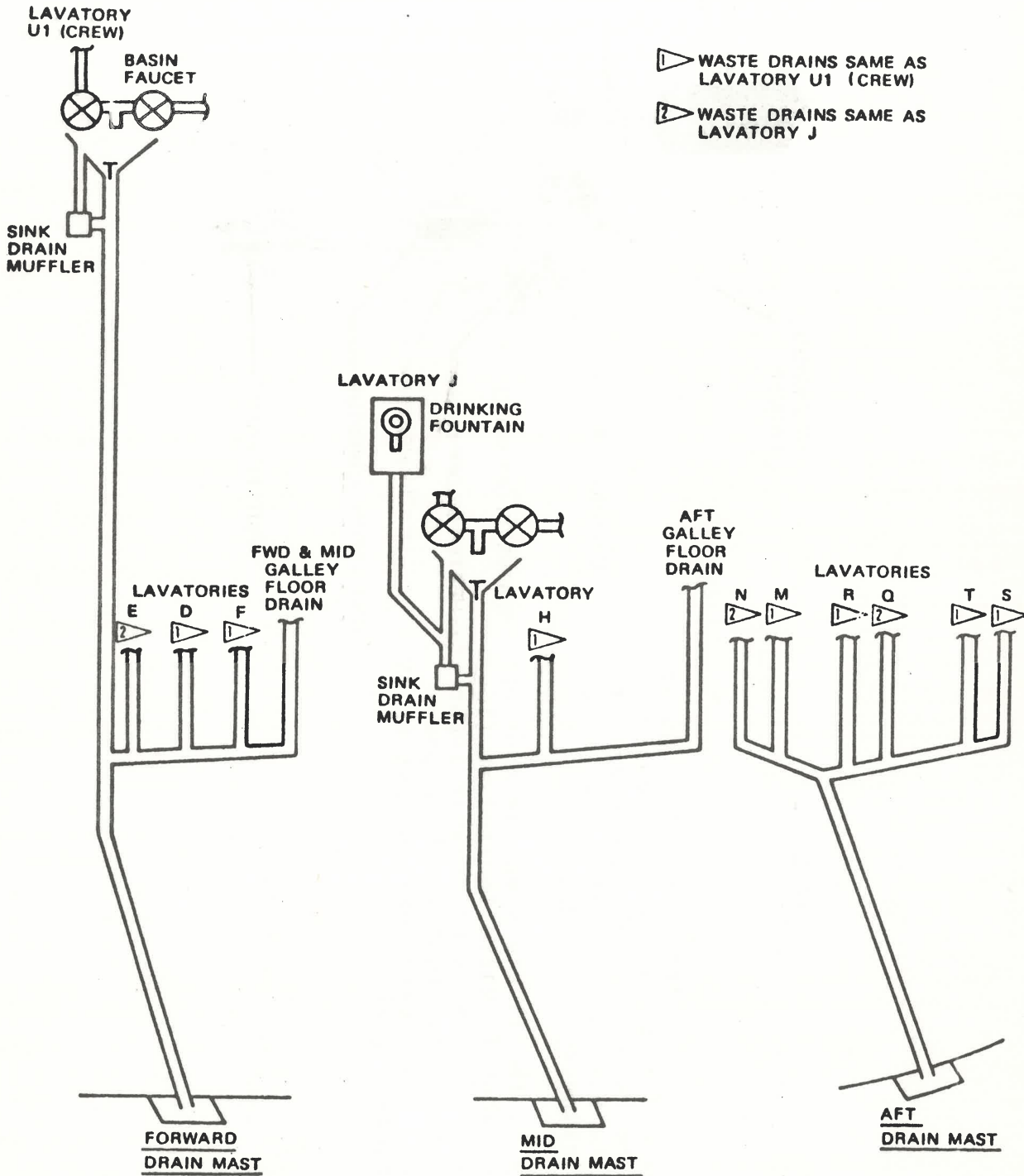
AIRPLANE WEIGHT AND BALANCE SYSTEM COMPONENT LOCATIONS

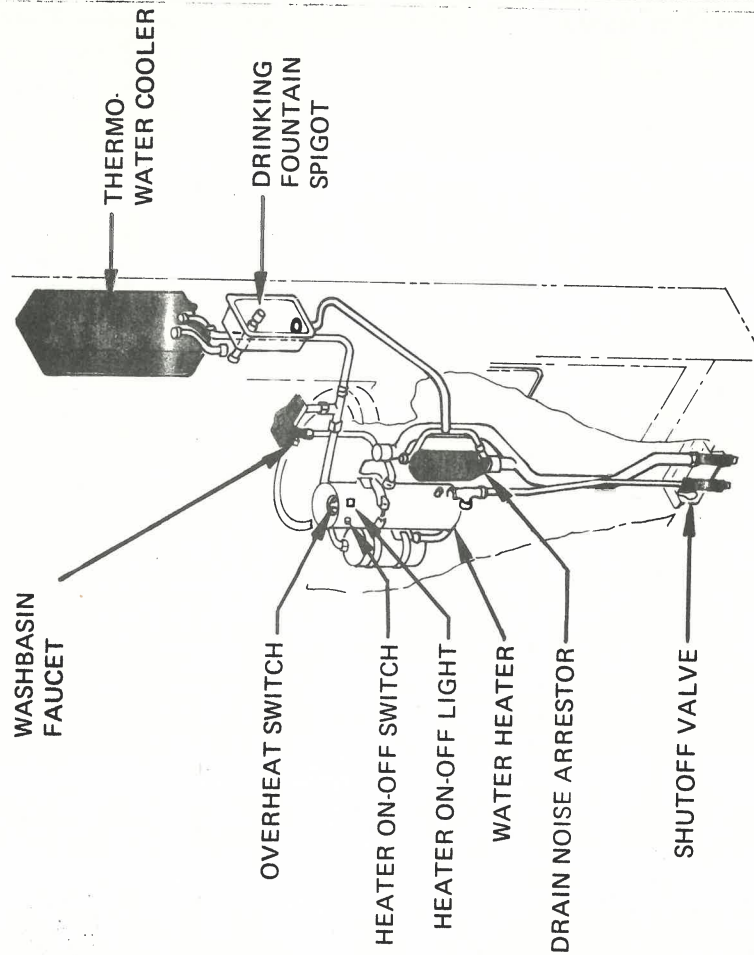


WEIGHT AND BALANCE MODULE

WEIGHT AND BALANCE CONTROLS AND INDICATORS

WASTE WATER DRAIN SCHEMATIC:





The water cooler is a thermo electric water cooler powered through a circuit breaker located on the P4 panel. The noise arrester eliminates the hissing from the sink's overflow and drinking fountain drains.

Water supply to the lavatory may be shut off using a water shutoff valve located at floor level in a recess. The water heater light when illuminated means that you have power to the heater. The heater switch must be ON and the overheat switch set before the tank will heat.

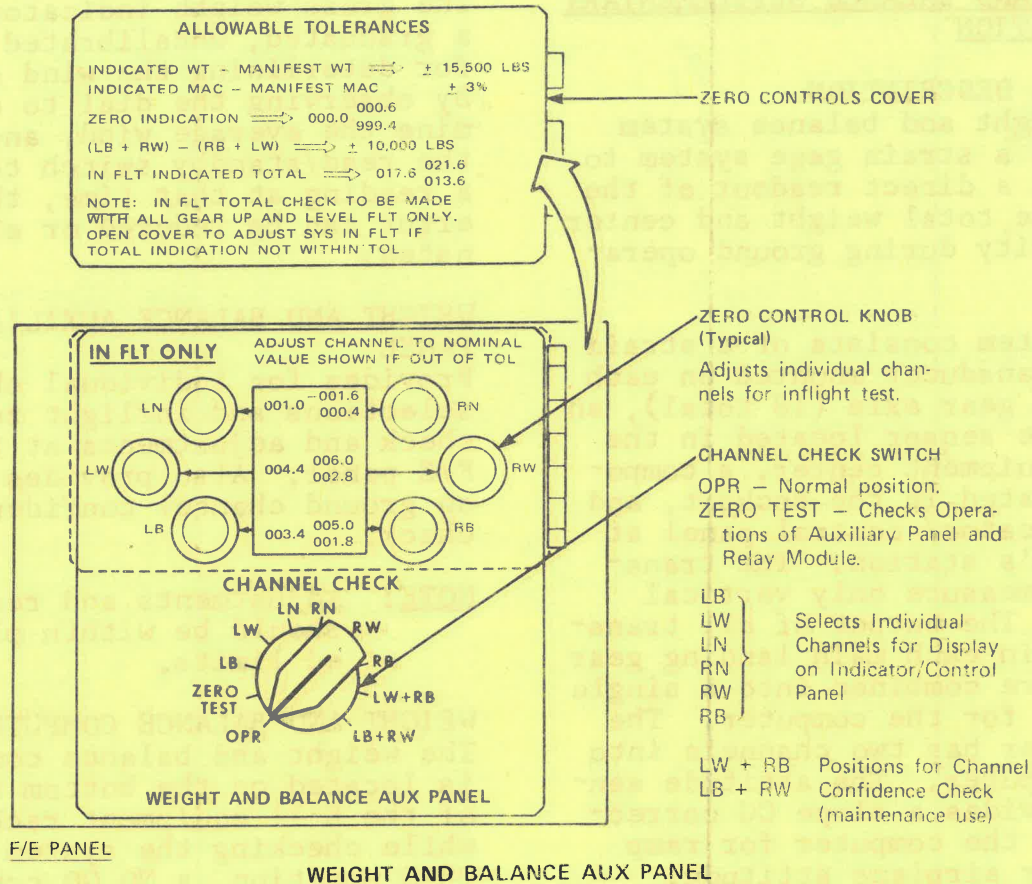


Figure 2-10

In the event the OPR test exceeds the tolerance values (IN FLT indicated total), a zero test is made. The zero test assures proper operation of all functions required to isolate separate system channels. A satisfactory zero test is followed by a check of each of the six individual channels. Any channel out of placarded tolerance can then be adjusted to the placarded value. The OPR position is then rechecked to confirm that the system has been re-established within tolerance.

An additional check, referred to as a confidence check, is also provided. This check, which is primarily intended for ground use, totals the weight on the left wing gear and right body gear so it can be compared with the weight on the left body gear and right wing gear. A reliable system will indicate equal distribution of weight. Unequal weight distribution between these two positions identifies a malfunctioning channel, which in turn can be located by further checks of each individual channel.

NORTHWEST ORIENT



FREIGHTER

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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 AUXILIARY PANEL

Provides for individual channel selections and inflight zero check and adjustments at the F/E panel. Also provides for on ground channel confidence check.

NOTE: Adjustments and readings should be within placarded limits.

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.



WEIGHT AND BALANCE SYSTEM:

GENERAL

1. The weight and balance system computes the weight and center of gravity for the aircraft, and provides a warning if C.G. limits are exceeded.
 - a. Weight inputs from transducers in each wheel axel, and C.G. inputs from attitude sensor unit are provided to the computer.
 - b. Weight and balance control module located on S/O panel, provides control, warning, and weight/C.G. indication.
 - (1) Pushbutton power switch provides control of system.
 - (a) Switch illuminates when pushed On.
 - (2) System selector switch provides selection of system operation to be checked.
 - (a) OPR. position — This position is provided for taking gross weight and C.G. readings.
 - '1' No Status lights should illuminate.
 - (b) INST. position — Provides a check of indicators by driving weight to 765,000 lbs. and C.G. to 07.5%.
 - '1' No Go light illuminates until indicators reach predetermined values.
 - 'a' No Go light extinguishes and Go light illuminates.
 - (c) CHAN. position checks channel inputs
 - '1' Go or No Go light illuminates depending upon condition of gear channel.
 - '2' Deg. Mode light will illuminate with channel in degraded mode.
 - (d) ATT. position — Checks condition of attitude sensor.
 - '1' Go or No Go light illuminates depending upon condition of sensor.
 - (e) ALARM position — Checks alarm circuit.
 - '1' C.G. Alarm light illuminates indicating C.G. is greater than 38%.
- (3) READ/STBY switch provides weight and C.G. information to the indicators.
 - (a) STBY position — Spring loaded to this position. Retains last reading of weight and C.G. information to indicators.
 - (b) READ position — Provides weight and C.G. information to indicators.
 - '1' Release READ switch when wind indicator on gross weight indicator shows zero or minimum wind condition.



GENERAL (Cont.)

- (4) Gross weight indicator displays gross weight in digital readout window.
 - (a) Digital readout from zero to 800,000 lbs.
 - (b) Increment lines are 200 lbs. each.
- (5) Center of gravity indicator displays center of gravity in % of MAC.
 - (a) Digital readout from 5% to 45% of MAC.

NORTHWEST ORIENT



FREIGHTER

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| CONDITION | AURAL WARNING | VISUAL WARNING | REMARKS |
|--|-----------------------------|---|--|
| Excessive Operating Airspeed | Clacker sounds in cockpit. | | |
| Autopilot Disengagement | Wailer sounds in cockpit. | Both autopilot Warning lights (Captain's and F/O's panels) flash red. | |
| Autothrottle Disengagement | | Both autothrottle warning lights (Captain's and F/O's panels) flash red. | |
| Excessive Attitude Differences. *** | "Buzzer" sounds in cockpit. | Instrument WARN lights on Captain and F/O panels flash red for 4° difference in attitude. ATT lights illuminate steady amber. | Push WARN lights to extinguish WARN lights and silence buzzer. ATT lights will remain illuminated as long as attitude difference remains. WARN light on affected side will flash if a G flag appears on an ADI regardless of attitude differences. |
| Excessive Heading Differences | | Instrument WARN lights on Captain & F/O panels flash red for 6° difference in heading. HDG lights illuminate steady amber. | WARN light on affected side will flash if a HEADING, NAV, or GS flag appears on an HSI regardless of heading difference. |
| HSI Failure | | Instrument WARN light on Captain's or F/O's panels flash red. | WARN light on affected side will flash if a HEADING, NAV, or GS flag appears on an HSI. |
| Radio Altimeter Failure | | WARN light on affected side will flash red below 1500 feet. | Warning flag in view on failed radio altimeter. |
| Reaching Decision Height | Tone sounds. | 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's panel will illuminate for affected door when DOOR PRIM and DOOR ALT switches depressed. |

NORTHWEST ORIENT

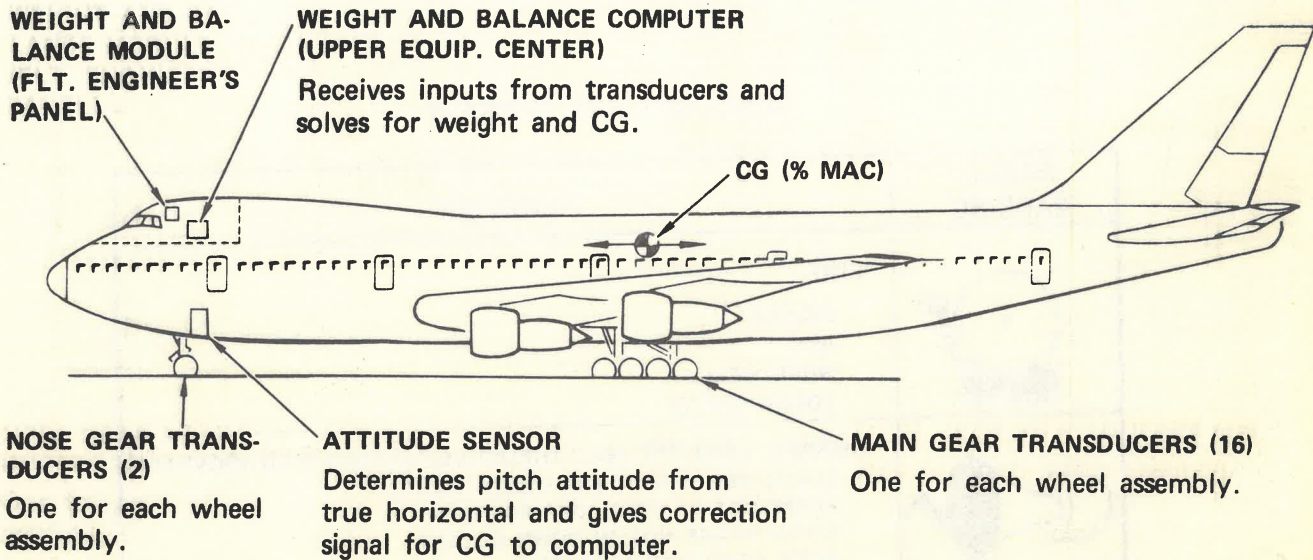
FREIGHTER



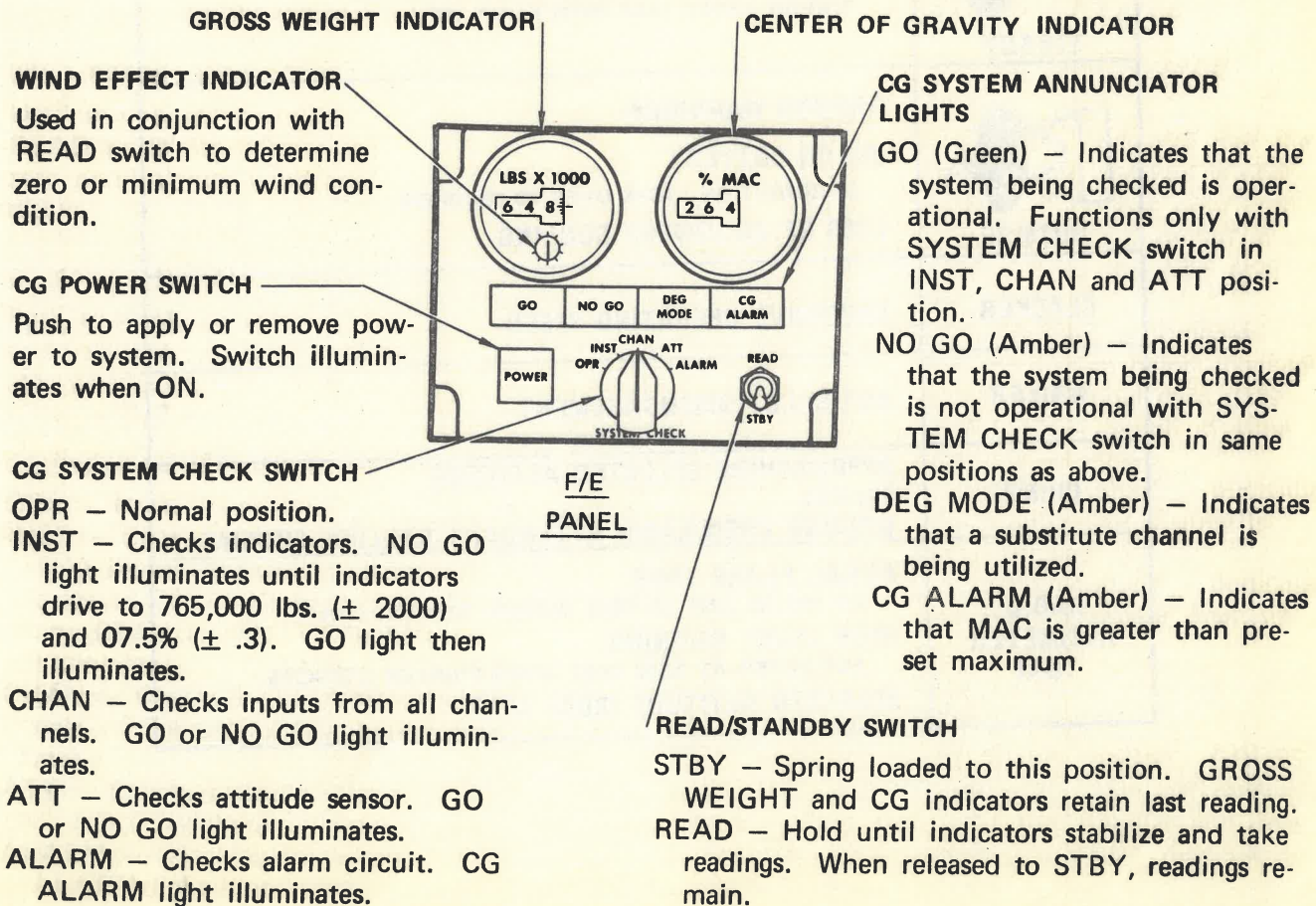
84:08F

| 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. | |
| Main Deck Cargo Compartment Fire **** | Bell in cockpit. | Both red master fire warning lights on pilots' lightshield illuminate. Red CARGO light on pilots' overhead panel illuminates. Appropriate red numerical smoke detector light on F/E's panel illuminates. | |
| Lower Cargo Compartment Fire | Bell in cockpit. | Both red master fire warning lights on pilots' lightshield illuminate. Red CARGO light on pilots' overhead panel illuminates. Red FWD or AFT smoke detector light on F/E's panel illuminates. | |
| Impending Stall | | | Control column shakes. |
| Overrotation on Takeoff | | | Control column shakes. |

WEIGHT AND BALANCE CONTROL PANEL:

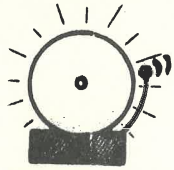
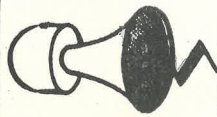

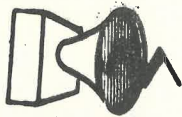


AIRPLANE WEIGHT AND BALANCE SYSTEM COMPONENT LOCATIONS



AURAL WARNING:

AURAL WARNING SUMMARY

| AURAL WARNING | CONDITION |
|--|---|
|  | FIRE ENGINE APU WHEELWELL LOWER CARGO |
|  INTERMITTENT | UNSAFE TAKEOFF (No. 3 THRUST LEVER ADVANCED ABOVE 50%) STABILIZER NOT IN THE GREEN RANGE FLAPS NOT AT TAKE-OFF POSITION SPEED BRAKE NOT IN DOWN DETENT BODY GEAR NOT CENTERED EXCESSIVE CABIN ALTITUDE |
|  STEADY | LANDING GEAR NOT DOWN AND LOCKED THRUST LEVER IDLE WITH FLAPS 25° |
|  OUTSIDE | GROUND WARNINGS: INS ON BATTERY IF CONDITION LASTS OVER 30 SECONDS LOSS OF EQUIPMENT COOLING |
| CLACKER | EXCESSIVE OPERATING SPEED |
| WAILER | AUTOPILOT DISENGAGEMENT |
| CHIME | APPROACHING SELECTED ALTITUDE SELCAL GROUND CREW/CABIN ATTENDANT CALLING COCKPIT |
| RADIO ALTIMETER TONE | AURAL FLARE TONE AT 100, 35, AND 20 FEET DURING DESCENT ONLY HIGH LEVEL WARNING ACTIVATED AT 2,500 FEET WHEN POINTER UNMASKS SELECTED ALTITUDE (BUG) TONE |



AURAL WARNING DESCRIPTION

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. |



AURAL WARNING DESCRIPTION:

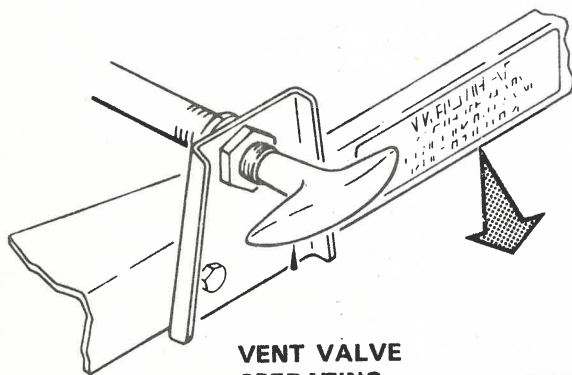
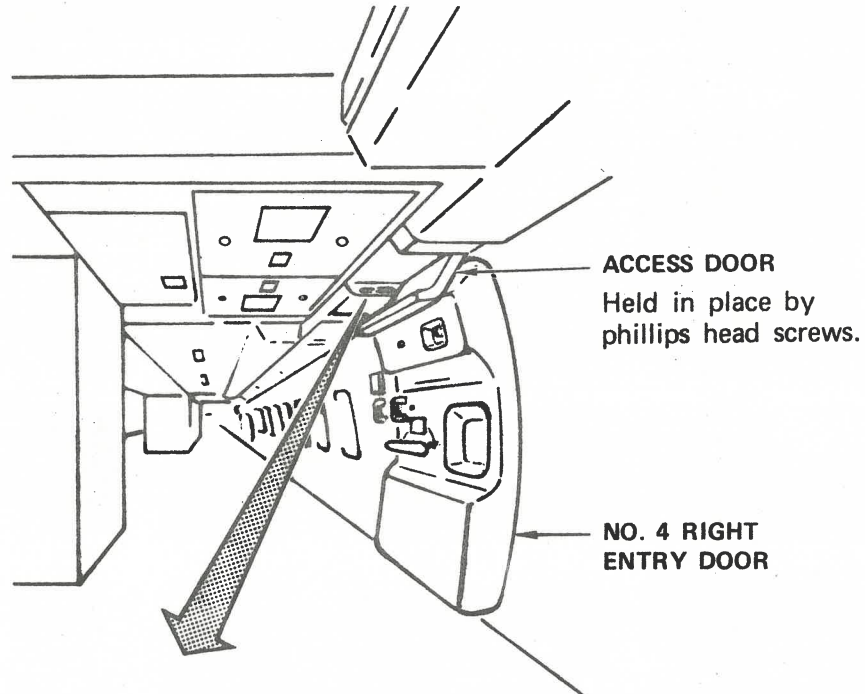
| CONDITION | AURAL WARNING | VISUAL WARNING | REMARKS |
|-----------------------------------|----------------------------|--|--|
| Excessive Operating Speed | Clacker sounds in cockpit. | | |
| Autopilot Disengagement | Wailer sounds in cockpit. | Autopilot warning lights (Captain and F/O panels) flash 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. |

AURAL WARNING DESCRIPTION:

| 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. | | Horn will silence and circuit will reset automatically when the cabin altitude returns to less than 10,000 feet. Horn can also be silenced by the altitude horn cut-out switch on F/E's panel. |
| 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. | |



LAVATORY/AND GALLEY VENT COMPONENTS LOCATION:



**OPERATING
INSTRUCTIONS**

**VENT VALVE
OPERATING
HANDLE**

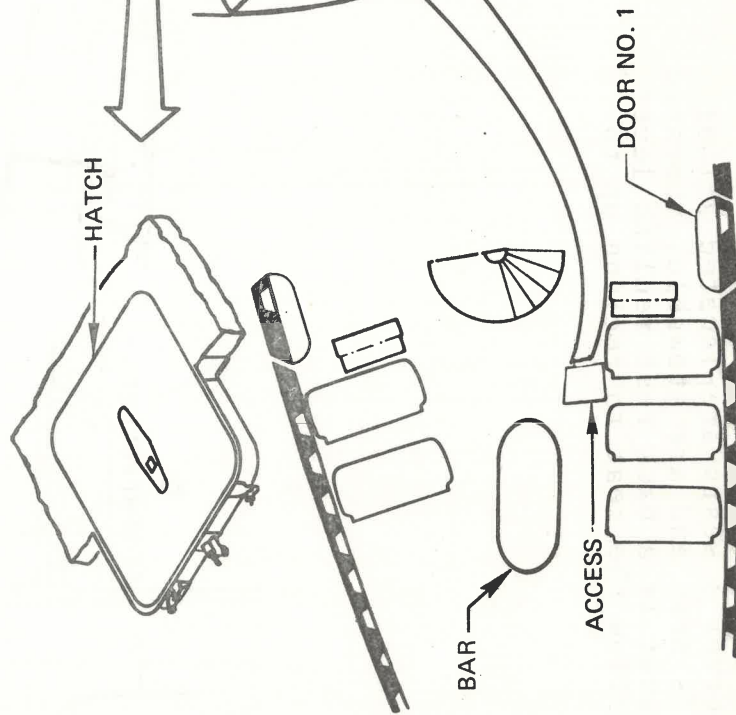
VENT CONTROL

LOW : UNLOCK, PULL AND LOCK.
NORMAL: UNLOCK, PUSH AND LOCK.
TO LOCK: ¼ TURN CLOCKWISE—OPPOSITE TO UNLOCK

Main Equipment Center Access Hatch

This hatch must be opened to reset the oxygen system flow regulators, to gain access to the manual extension system for the nose gear, and for access to the electrical or electronic equipment located in the main equipment center.

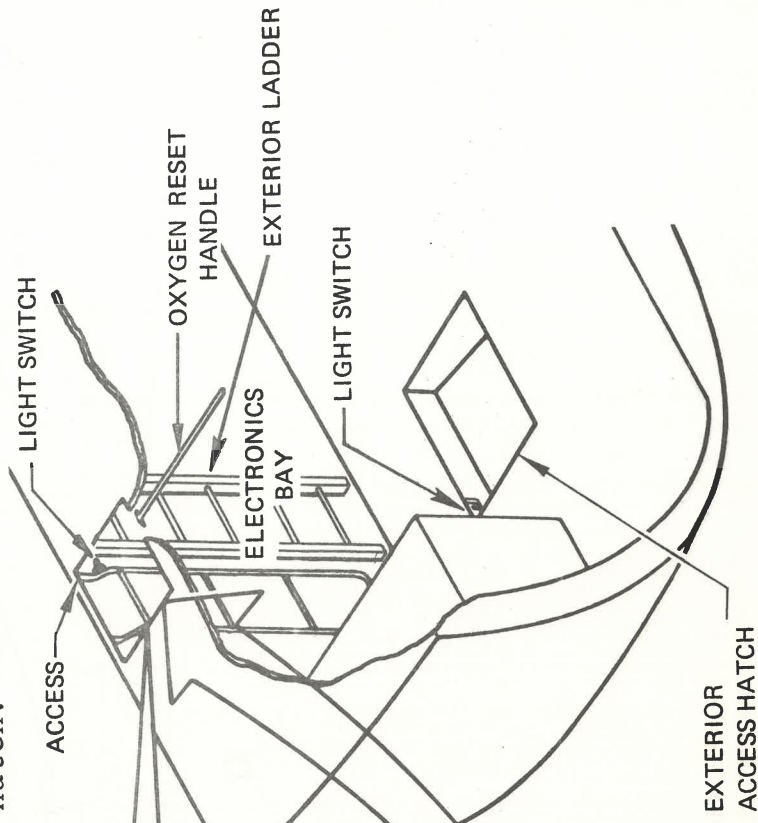
The hatch is located forward and to the left of the spiral staircase. This is a standard removable type hatch with four latching pins.



To gain entry, lift the carpet, rotate the handle, and lift the hatch.

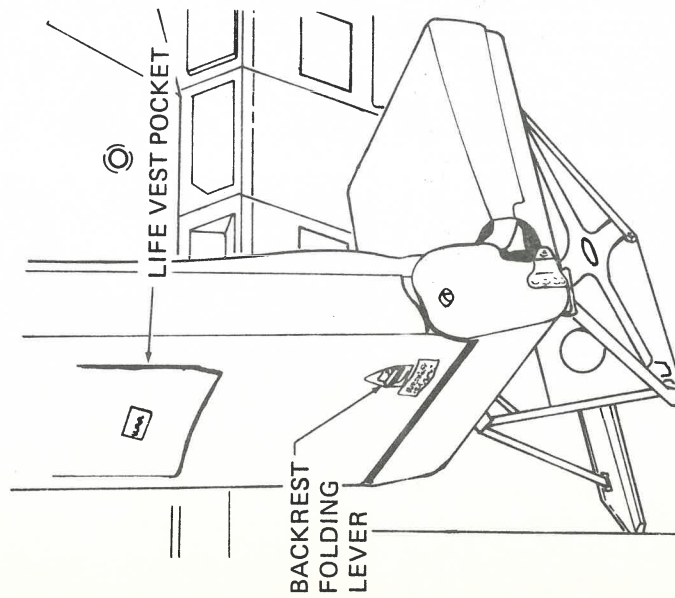
The oxygen reset handle, with placarded instructions is located on the aft floor-beam of the hatchway.

A ladder leading down to the main equipment center is attached to the forward bulkhead. Light switches, controlling the lights in the electronic bay area, are located in the upper right hand corner as you face the ladder and to the left of exterior access hatch.

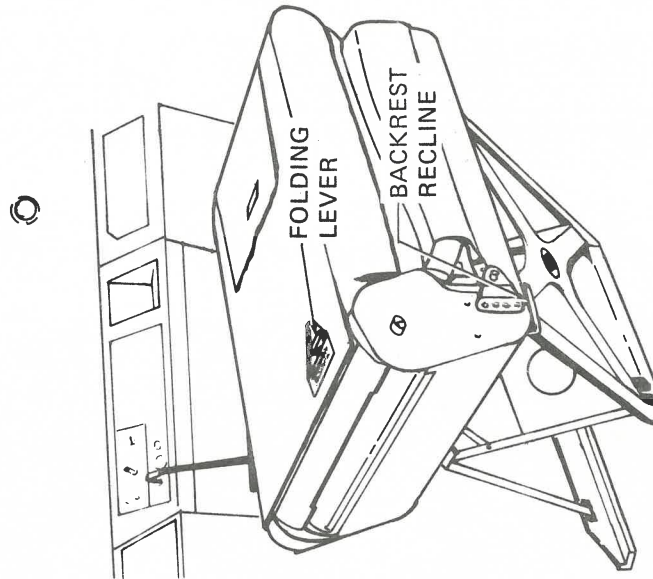


Observers' Seats

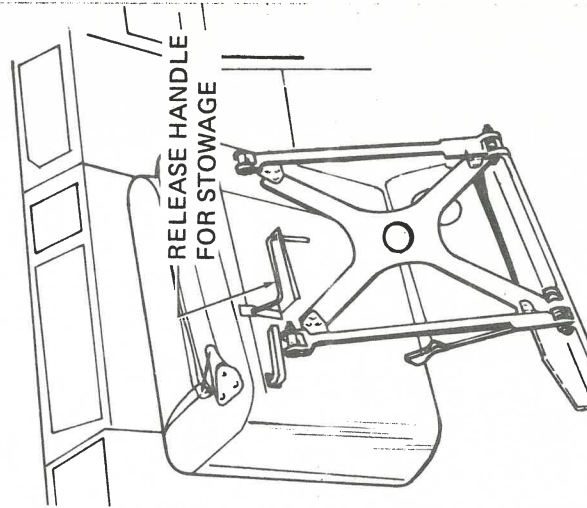
The two observer's seats are located aft of the Captain's seat and are stowable. Located under each seat is a back rest recline lever which will allow the seat to recline up to 25°.



OBSERVER'S SEAT (IN USE)



OBSERVER'S SEAT (MID POSITION)



OBSERVER'S SEAT (STOWED)

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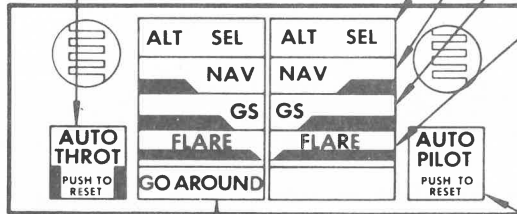
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AUTOTHROTTLE WARNING LIGHT
AMBER — Airspeed error greater than 10 knots.
STEADY RED — Self-test switch not in OFF position.
FLASHING RED — System disconnect.

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.



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.

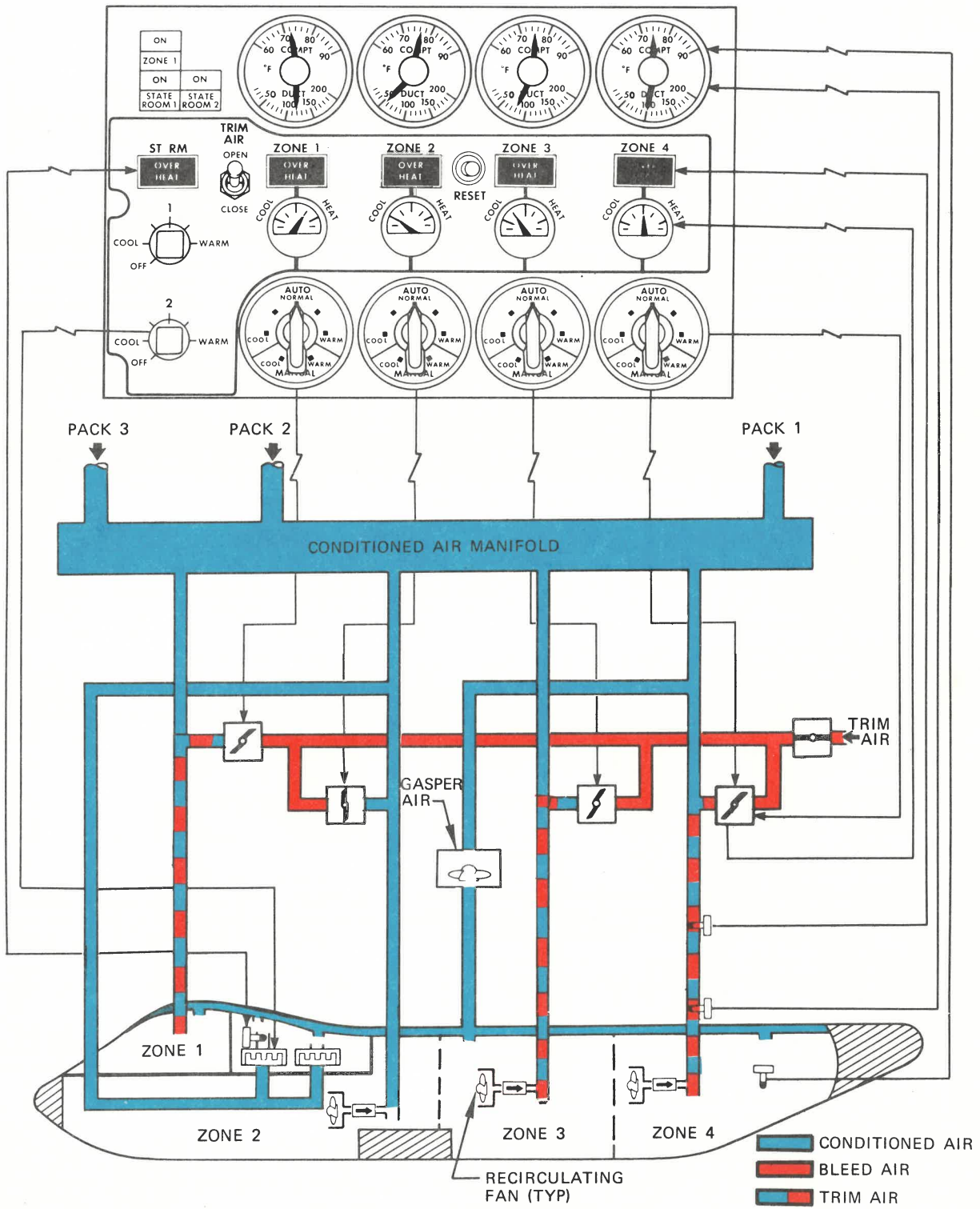
GO-AROUND — Flight director operation only. Illuminates when palm-operated go-around switches on thrust levers are activated.

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.
FLASHING RED — System disconnect.

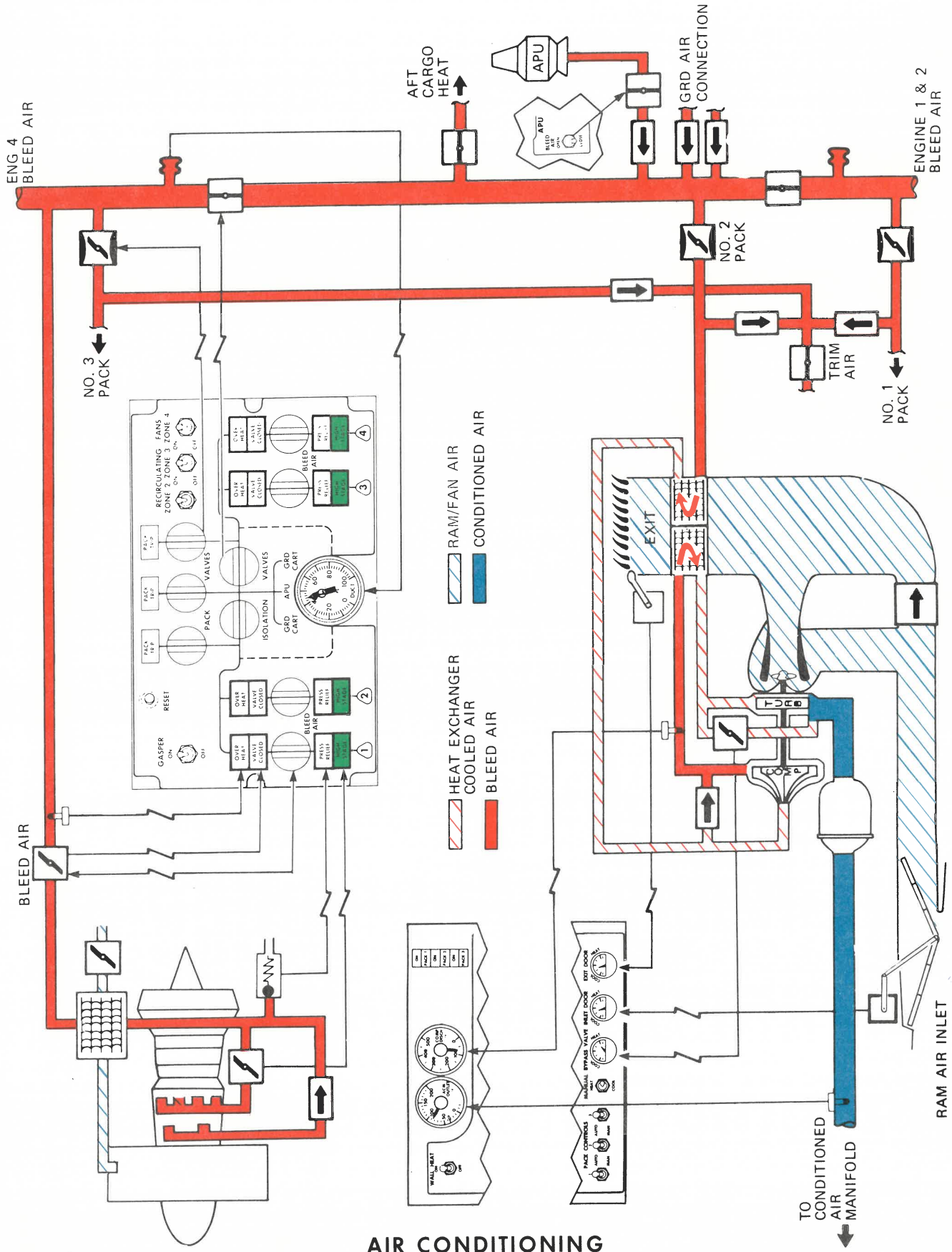
TEST:
 Pushing F/D side of display will illuminate all amber lights; pushing A/P side will illuminate all red and green lights.



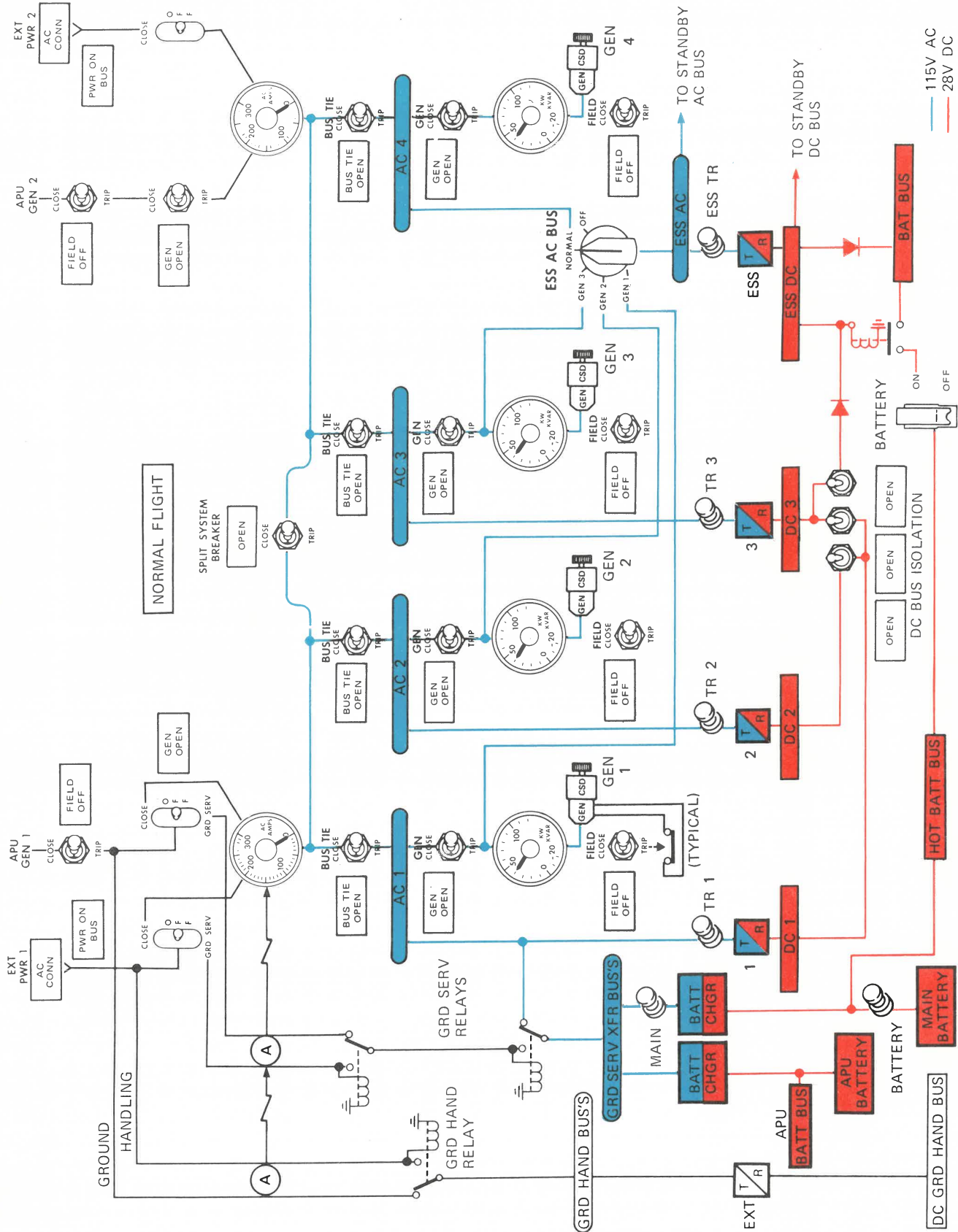
CONDITION: ZONE 2 IN CONTROL OF PACKS



AIR CONDITIONING

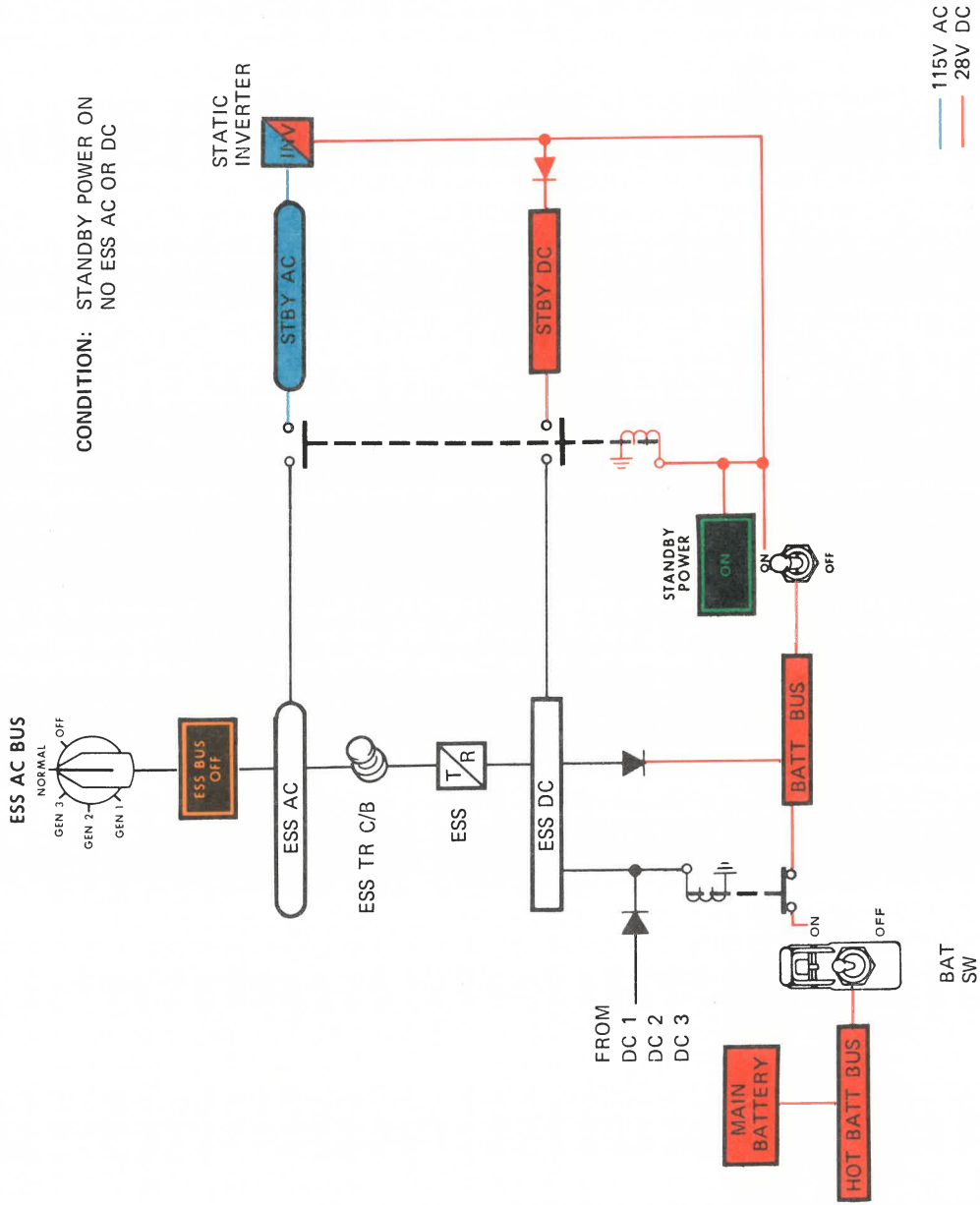


AIR CONDITIONING

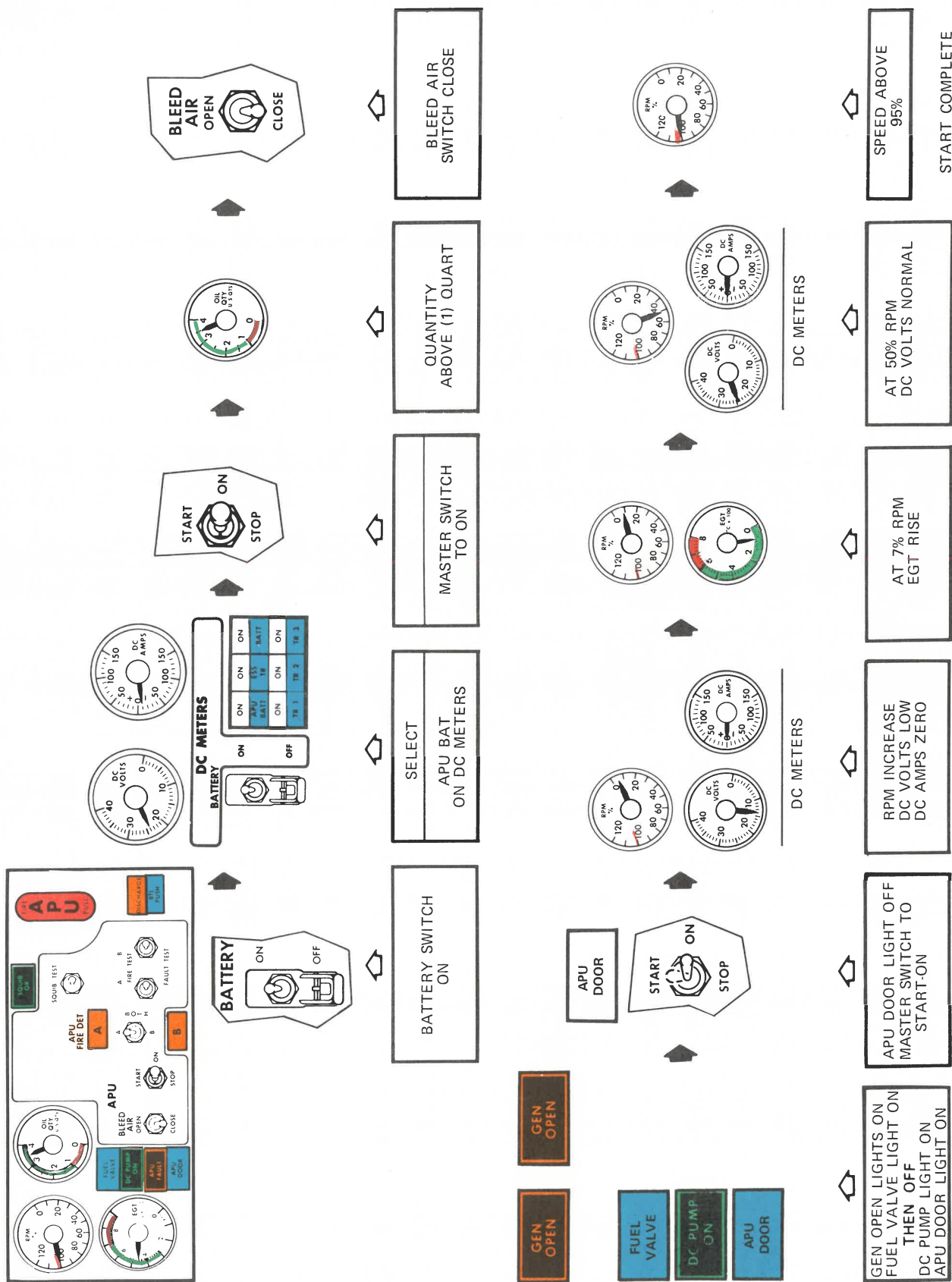


ELECTRICAL POWER SYSTEM

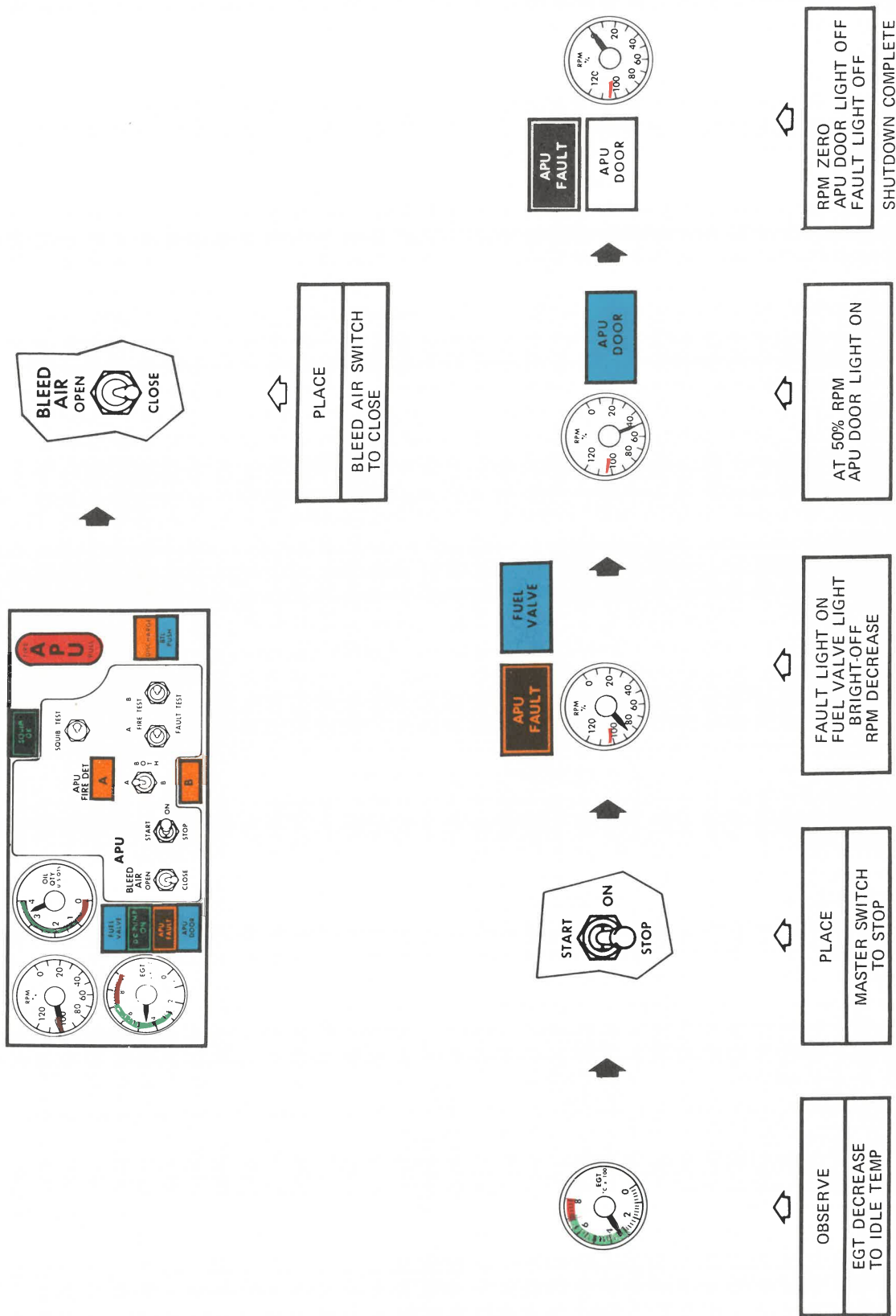
— 115V AC
— 28V DC



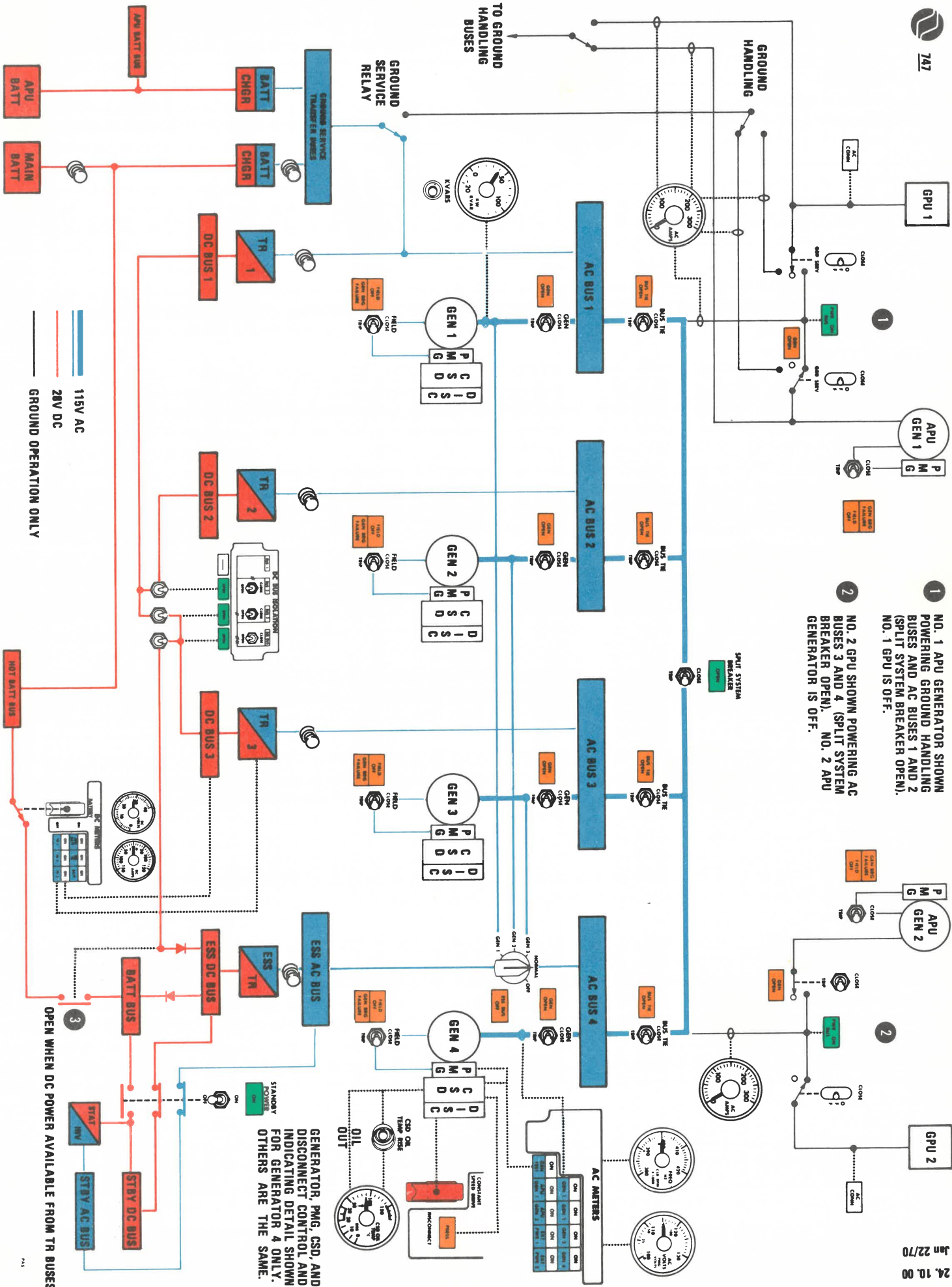
STANDBY POWER



APU START PROCEDURE



APU STOP PROCEDURE



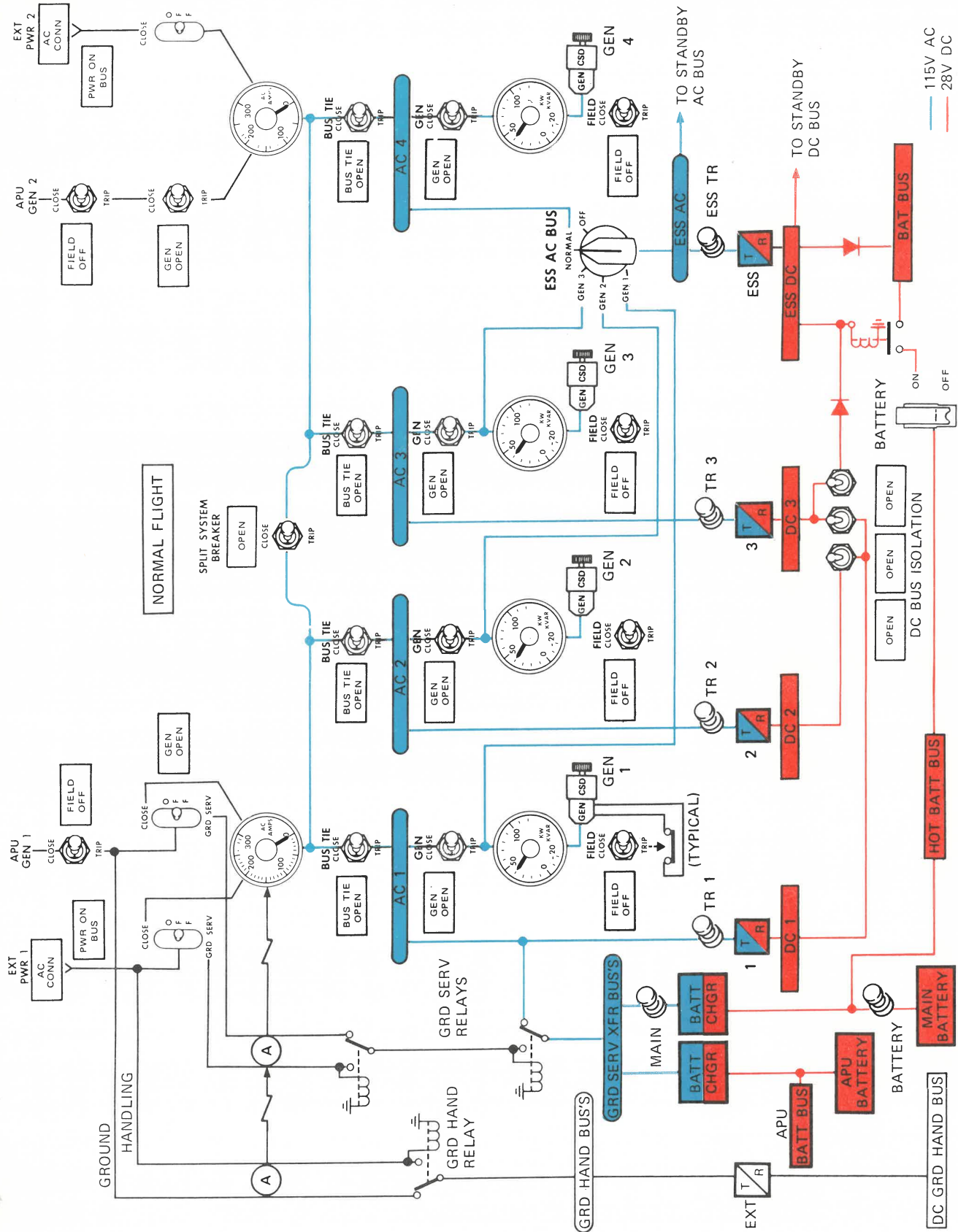
1 NO. 1 APU GENERATOR SHOWN POWERING GROUND HANDLING BUSES AND AC BUSES 1 AND 2 (SPLIT SYSTEM BREAKER OPEN). NO. 1 GPU IS OFF.

2 NO. 2 GPU SHOWN POWERING AC BUSES 3 AND 4 (SPLIT SYSTEM BREAKER OPEN). NO. 2 APU GENERATOR IS OFF.

GENERATOR, PMG, CSD AND DISCONNECT CONTROL AND INDICATING DETAIL SHOWN FOR GENERATOR 4 ONLY. OTHERS ARE THE SAME.

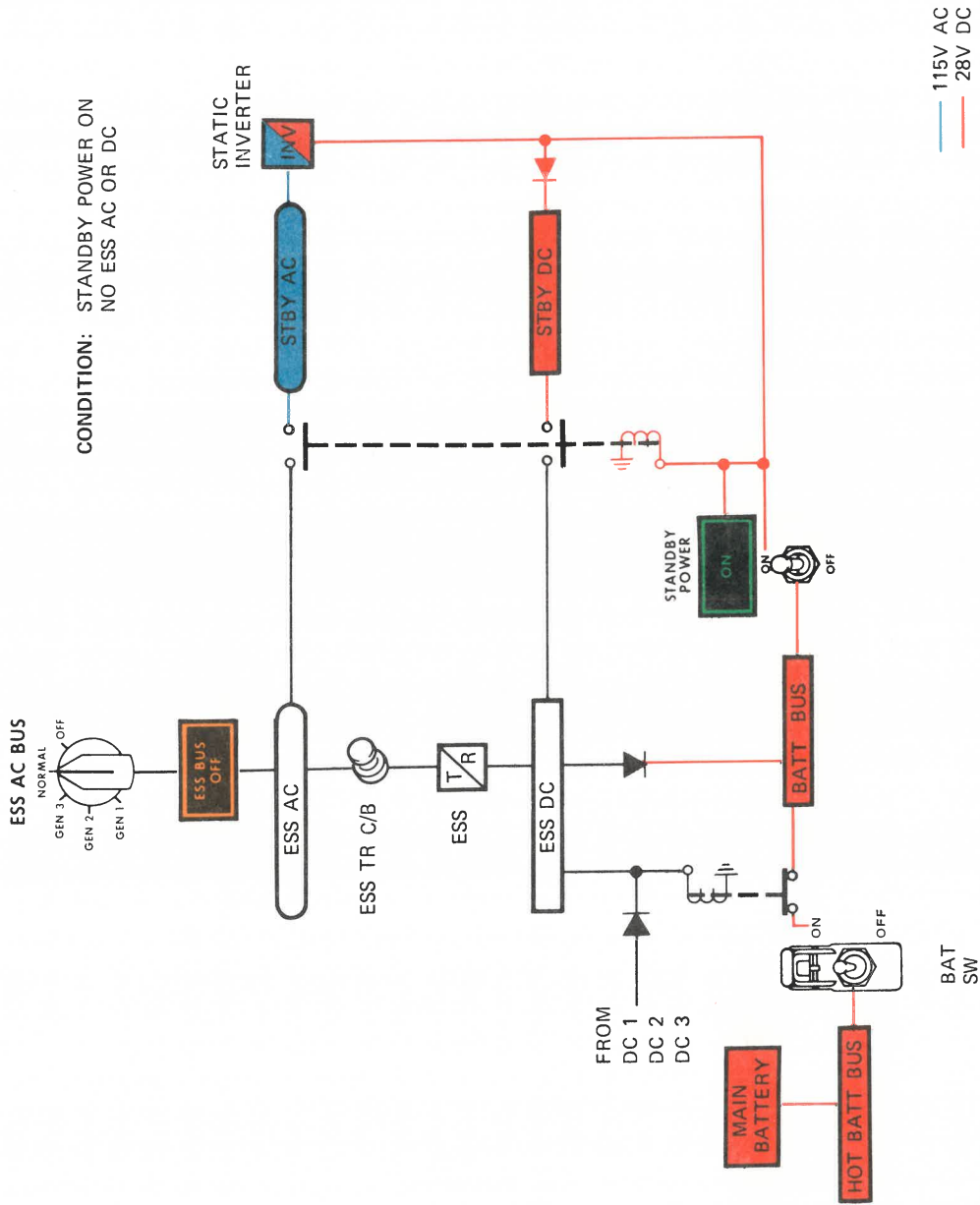
115V AC
28V DC
GROUND OPERATION ONLY

OPEN WHEN DC POWER AVAILABLE FROM TR BUSES

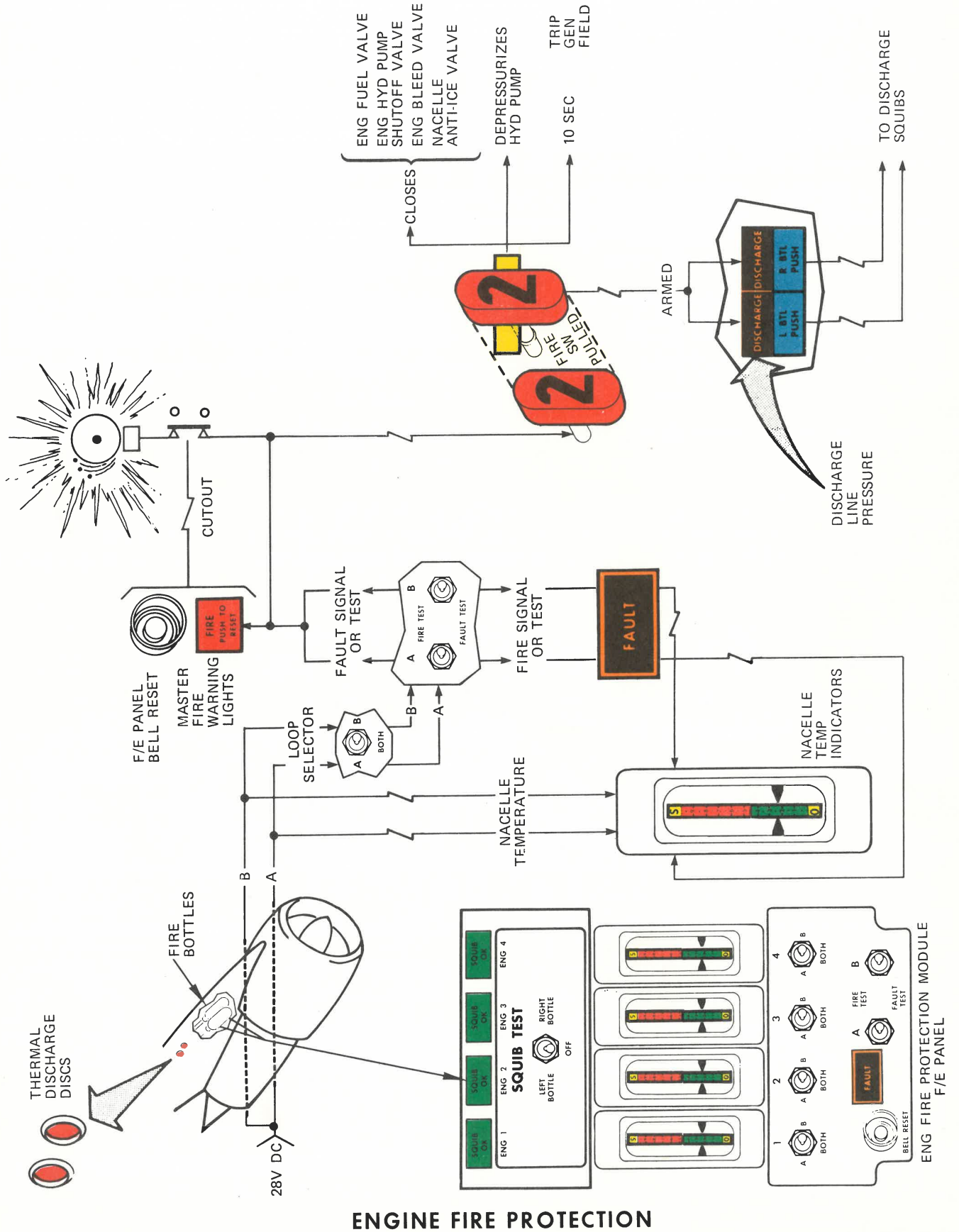


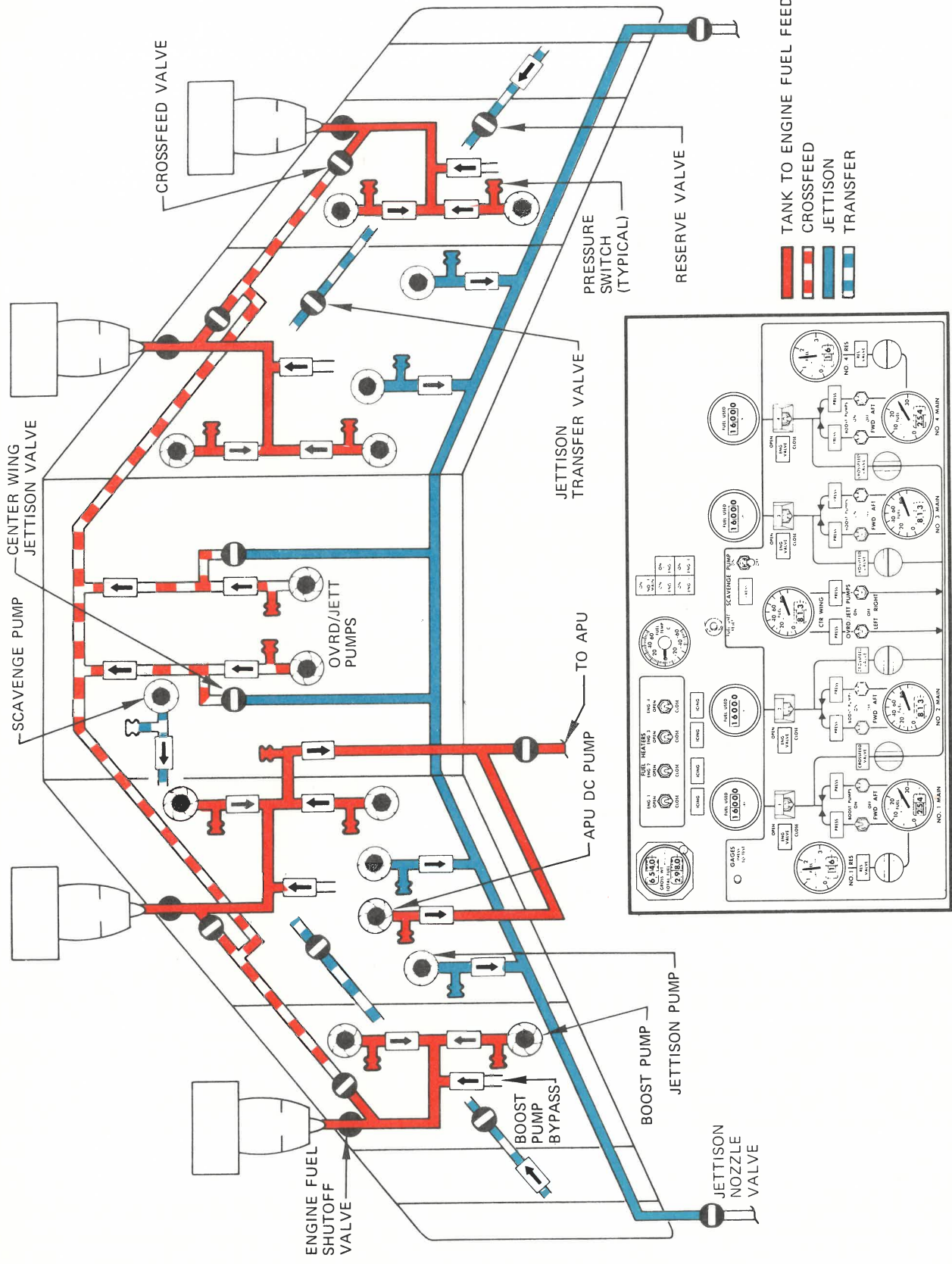
ELECTRICAL POWER SYSTEM

— 115V AC
— 28V DC



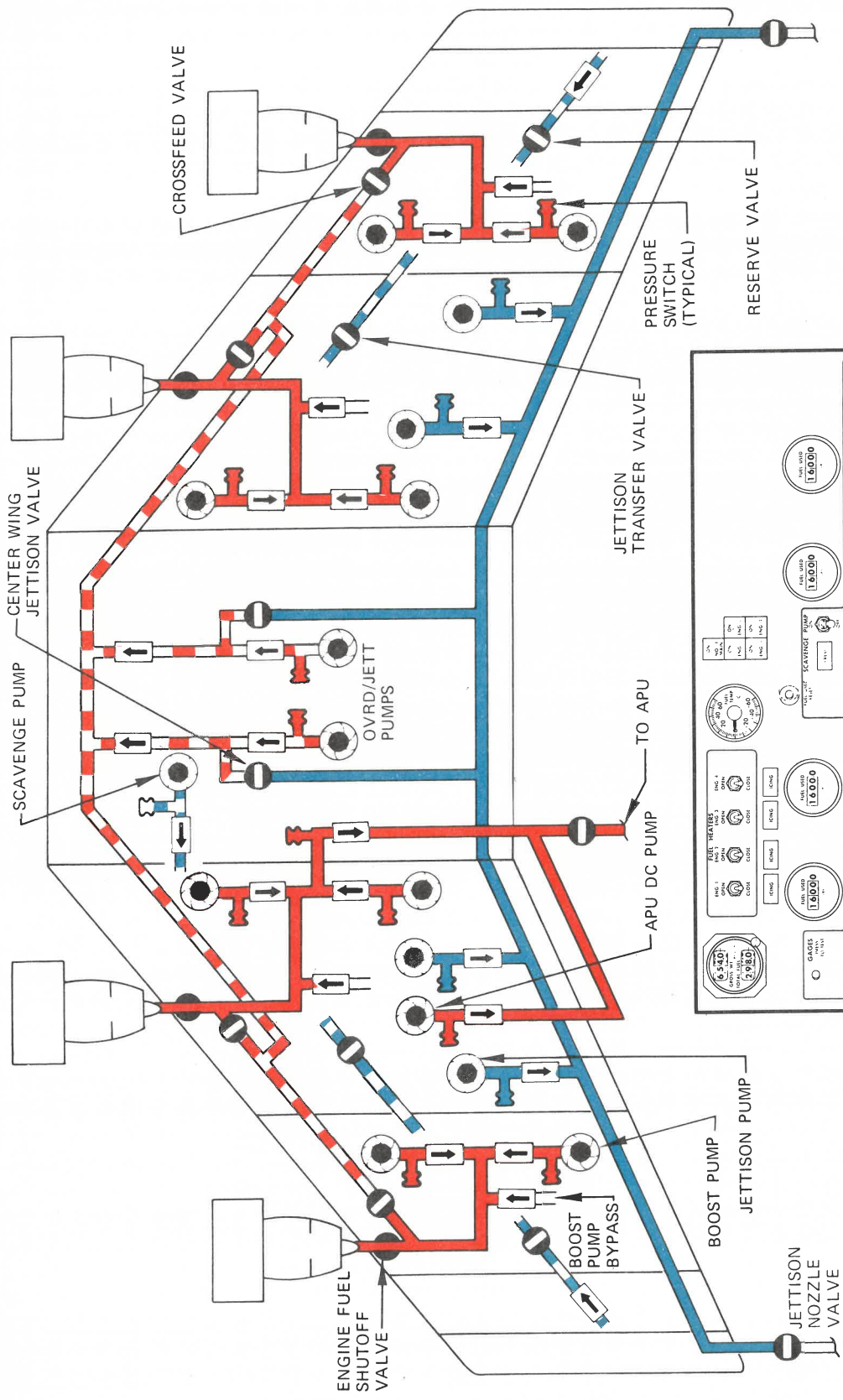
STANDBY POWER



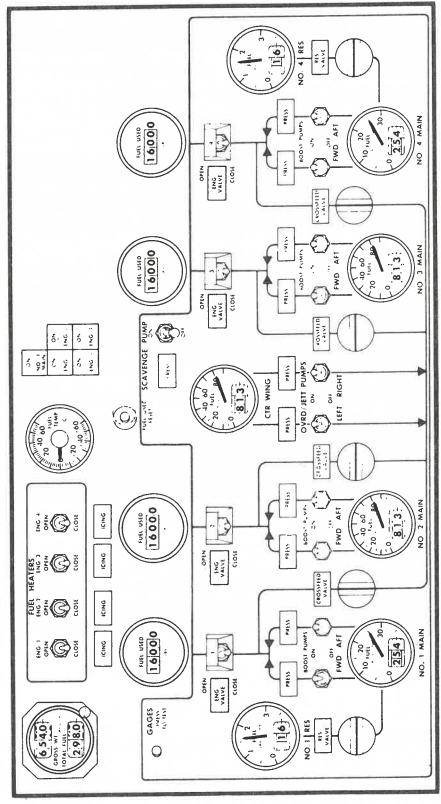


- █ TANK TO ENGINE FUEL FEED
- █ CROSSFEED
- █ JETTISON
- █ TRANSFER

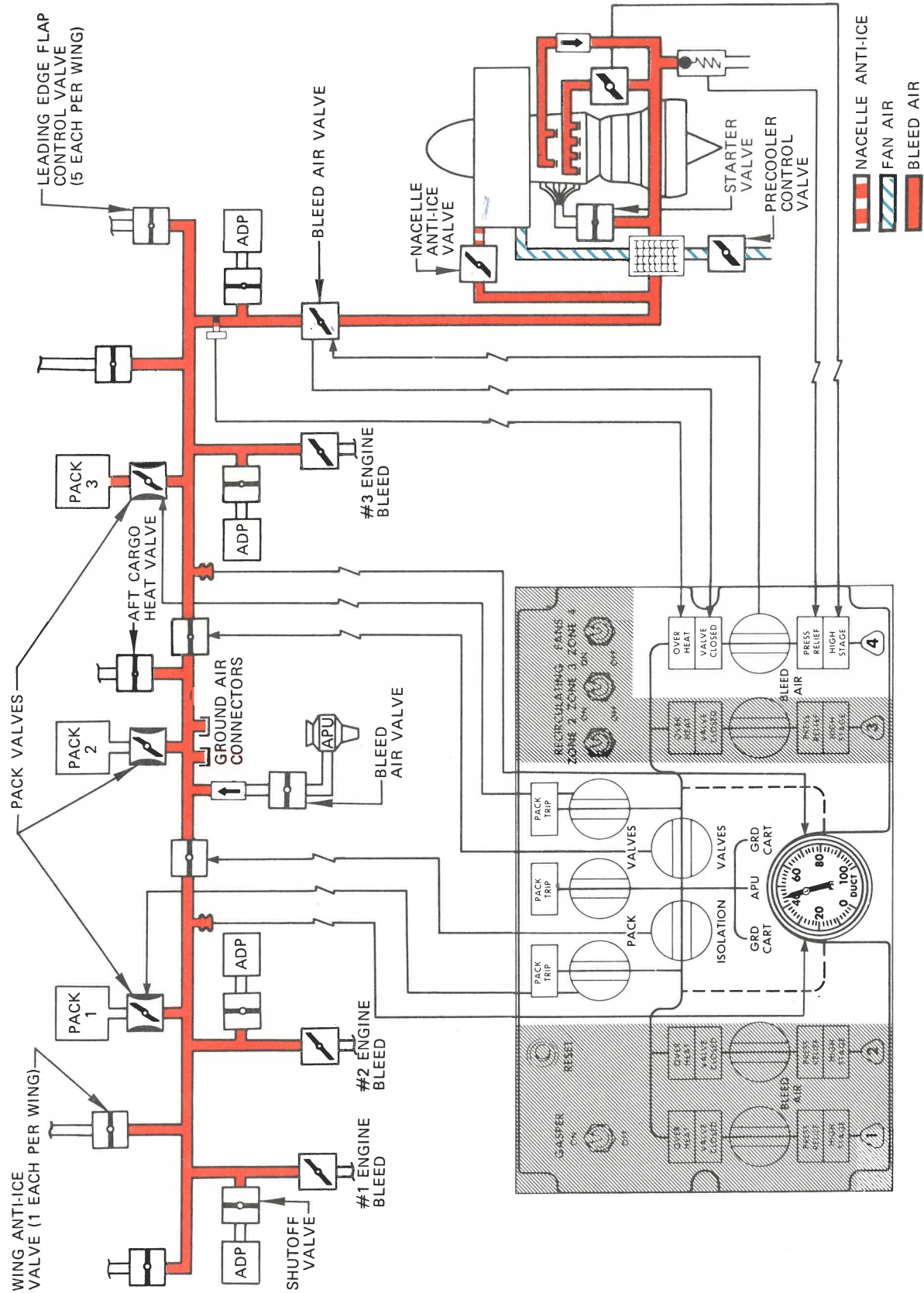
FUEL SYSTEM



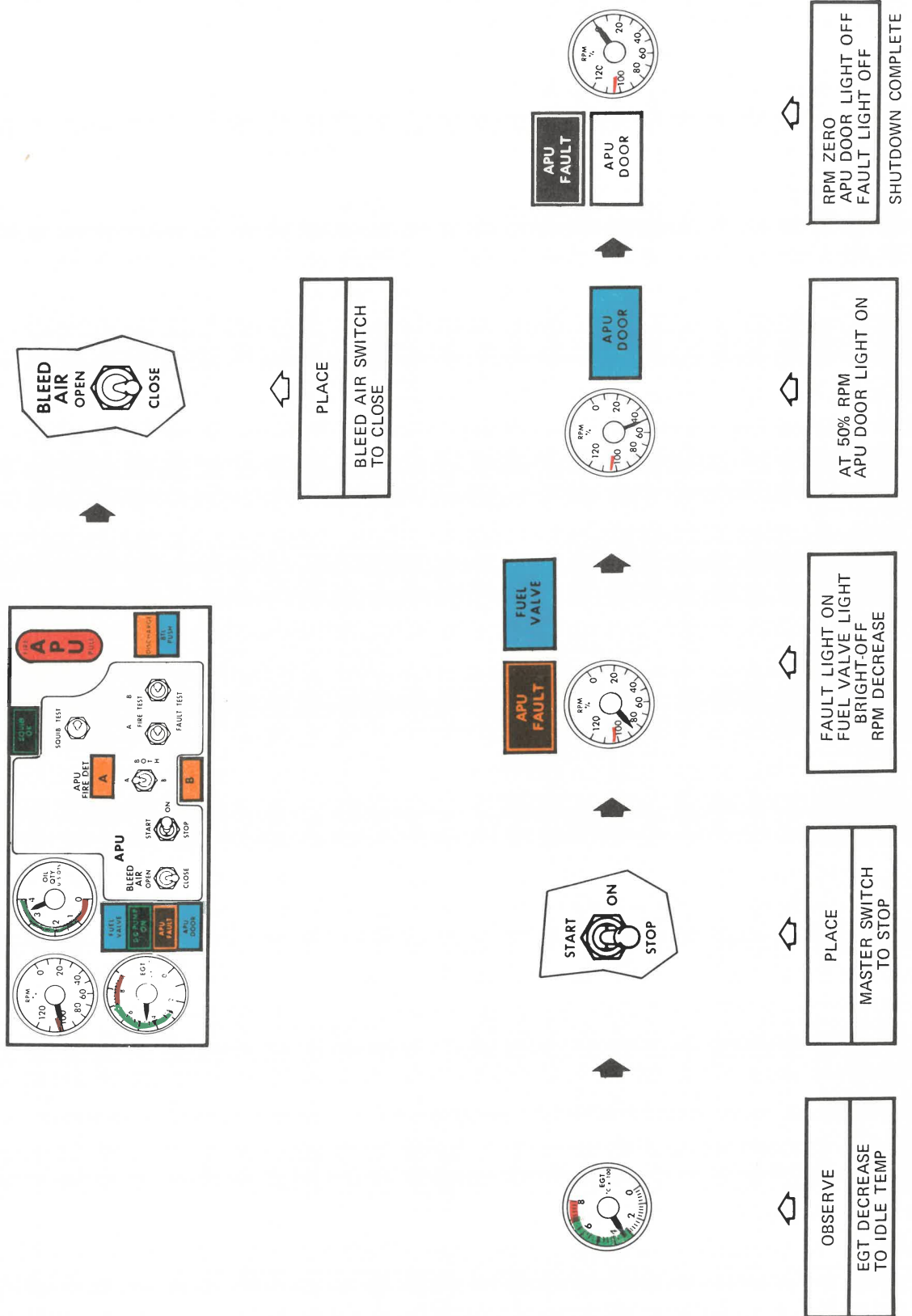
- █ TANK TO ENGINE FUEL FEED
- █ CROSSFEED
- █ █ JETTISON
- █ TRANSFER



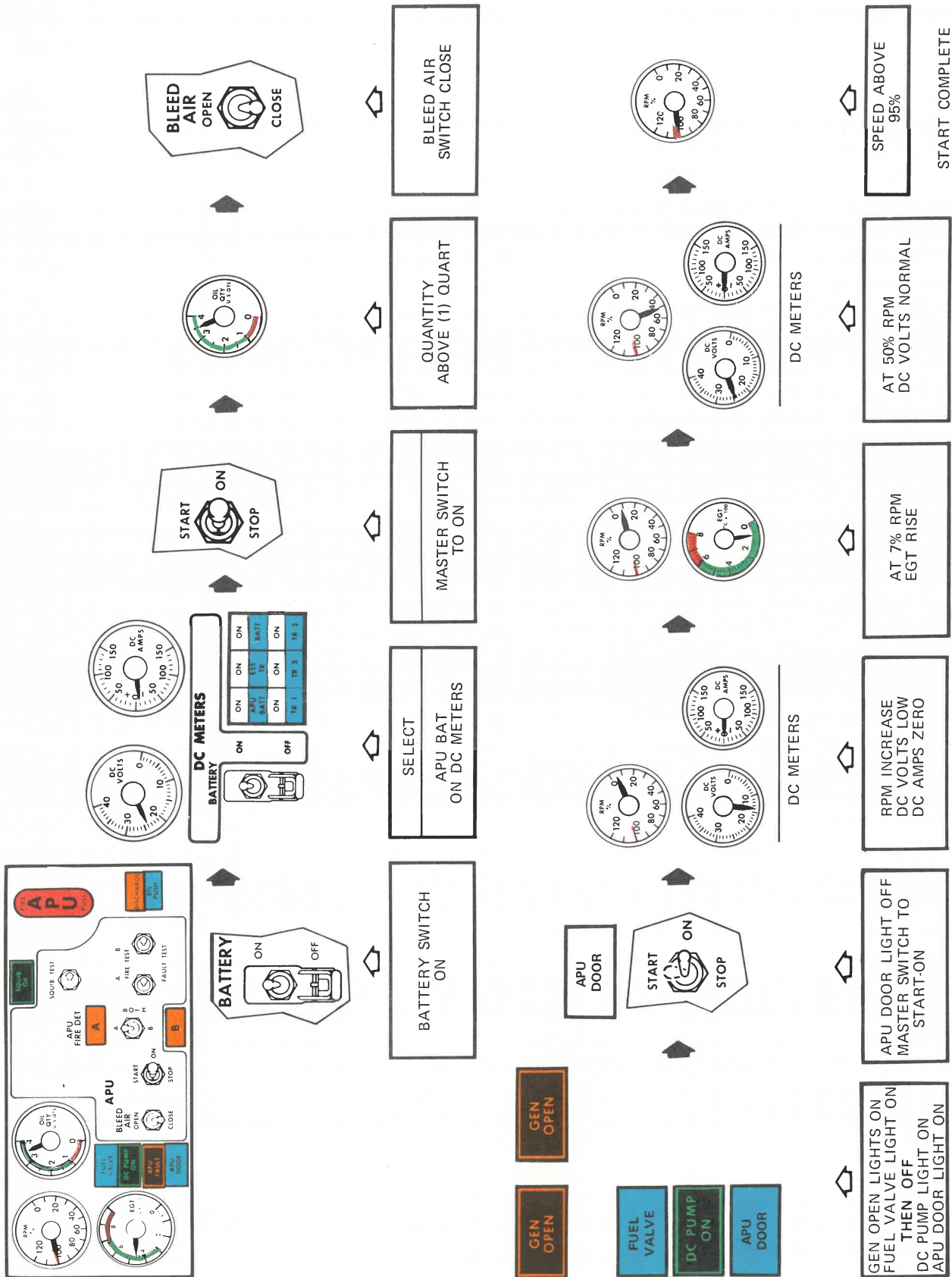
FUEL SYSTEM



PNEUMATIC SYSTEM



APU STOP PROCEDURE



APU START PROCEDURE



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.

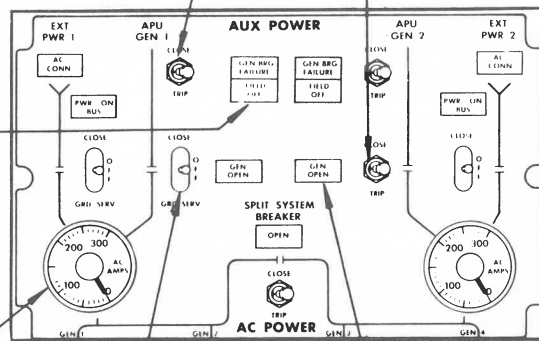
APU GENERATOR 2 BREAKER SWITCH
CLOSE – Generator connected to sync bus.
TRIP – Generator disconnected from sync bus. Automatically trips on APU shutdown or when external or airplane power is connected to the bus.

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.

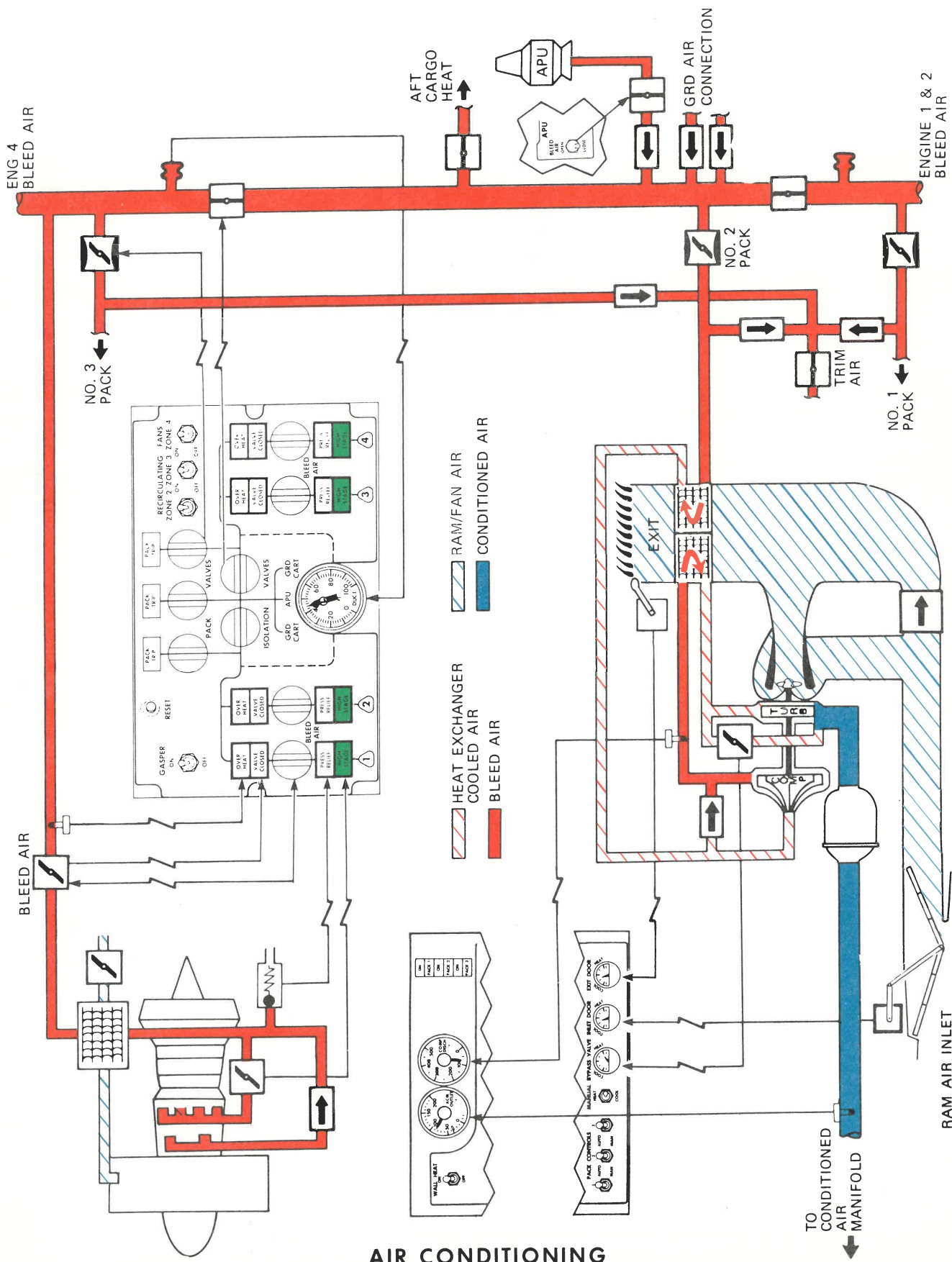
APU GENERATOR 1 BREAKER SWITCH
OFF – External power on ground handling busses only.
GRD SERV – Ground handling and ground service busses powered.
CLOSE – Ground handling, ground service and sync busses powered. If split system breaker and all bus tie breakers are closed and essential power switch is 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

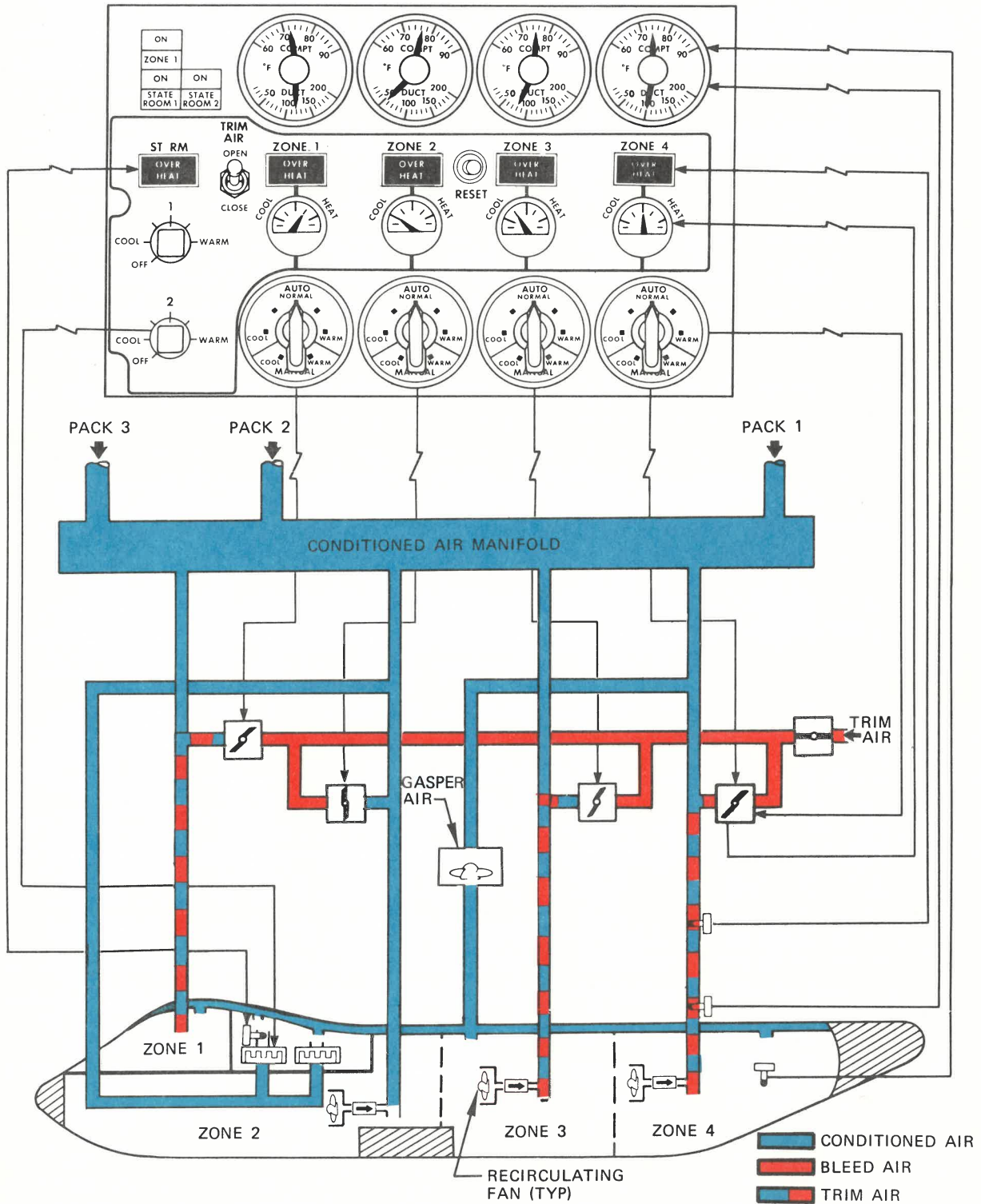
APU ELECTRICAL CONTROLS



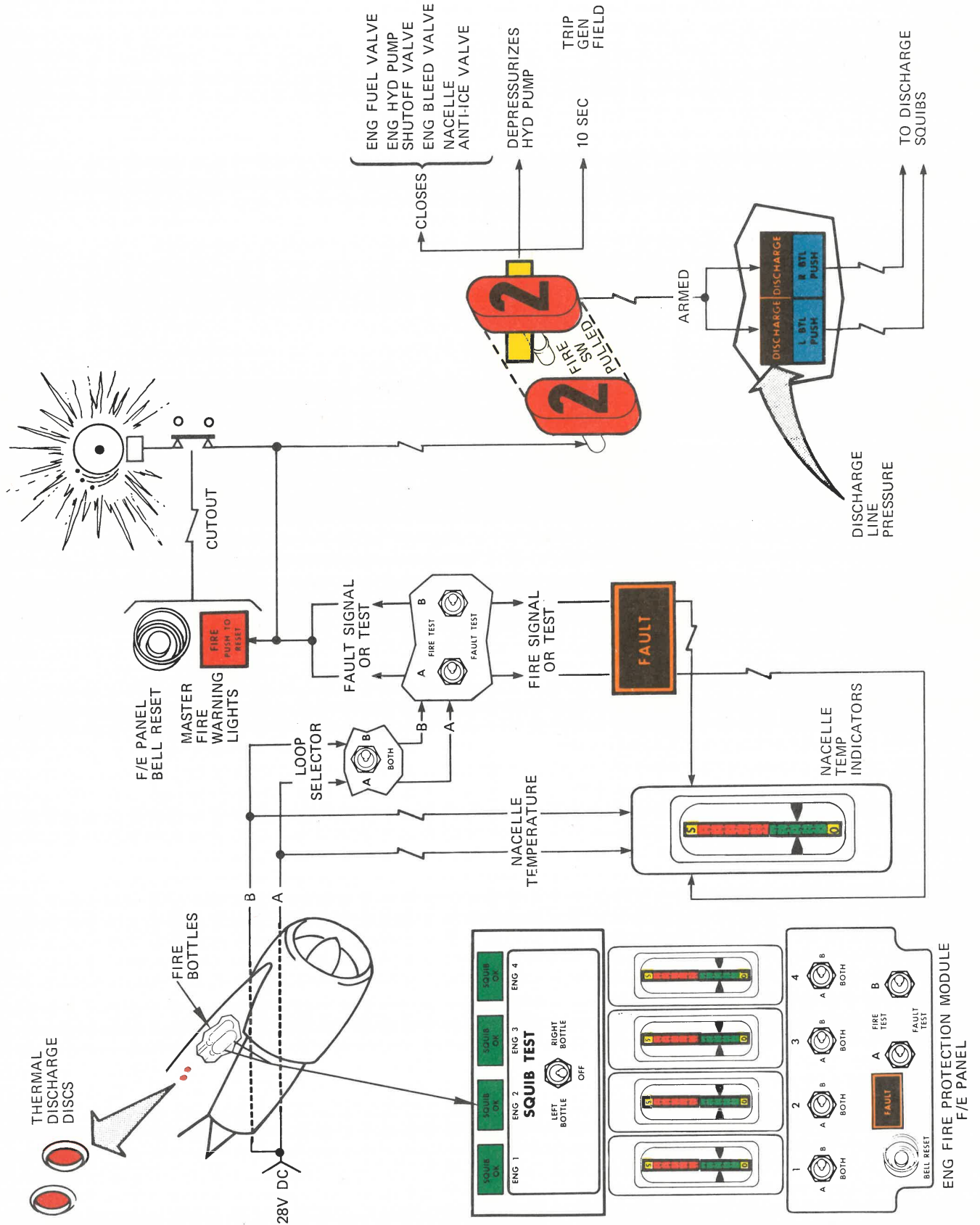
AIR CONDITIONING



CONDITION: ZONE 2 IN CONTROL OF PACKS



AIR CONDITIONING



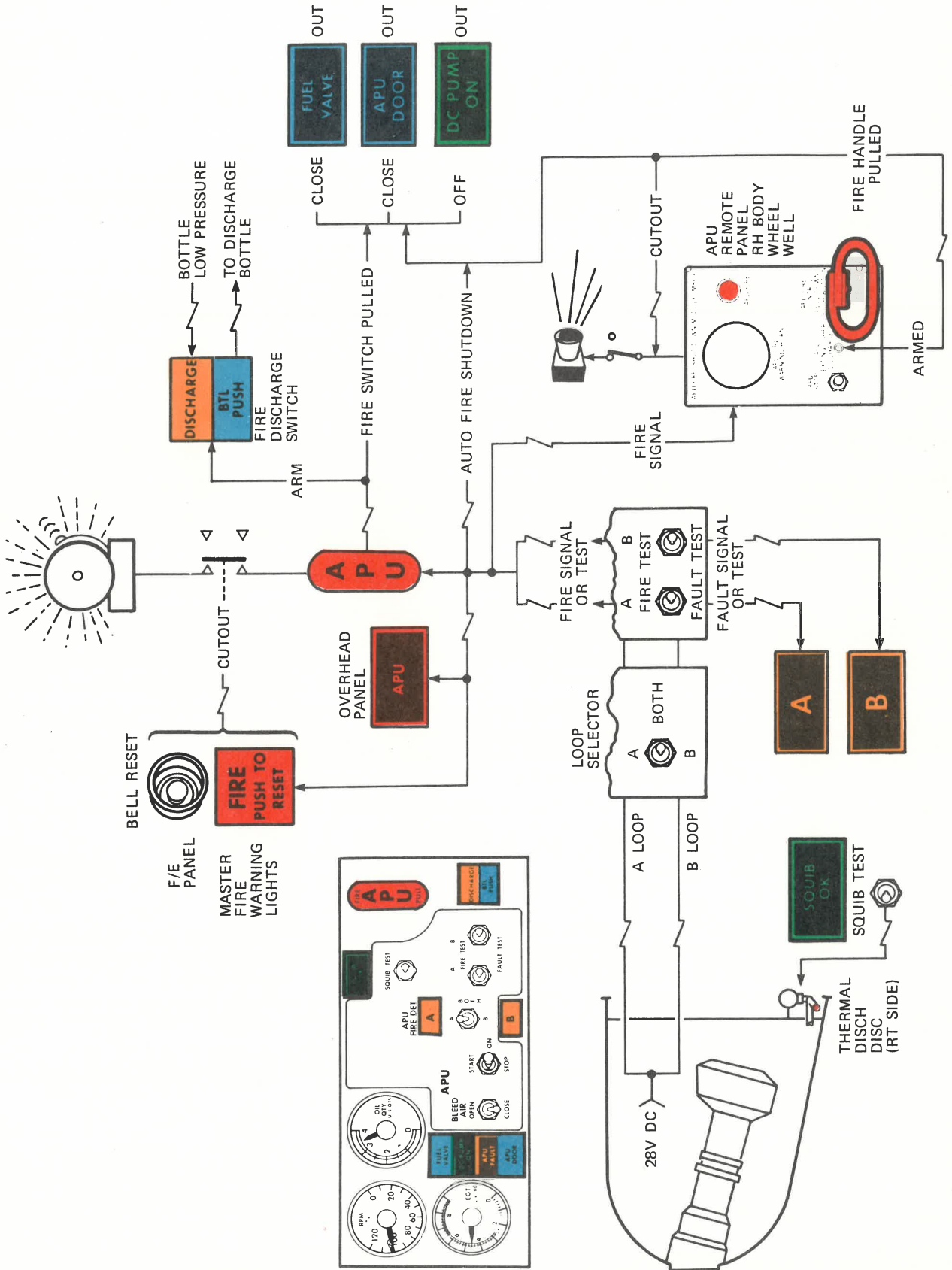
- ENG FUEL VALVE
- ENG HYD PUMP SHUTOFF VALVE
- ENG BLEED VALVE
- NACELLE ANTI-ICE VALVE
- DEPRESSURIZES HYD PUMP
- TRIP GEN FIELD
- 10 SEC

TO DISCHARGE SQUIBS

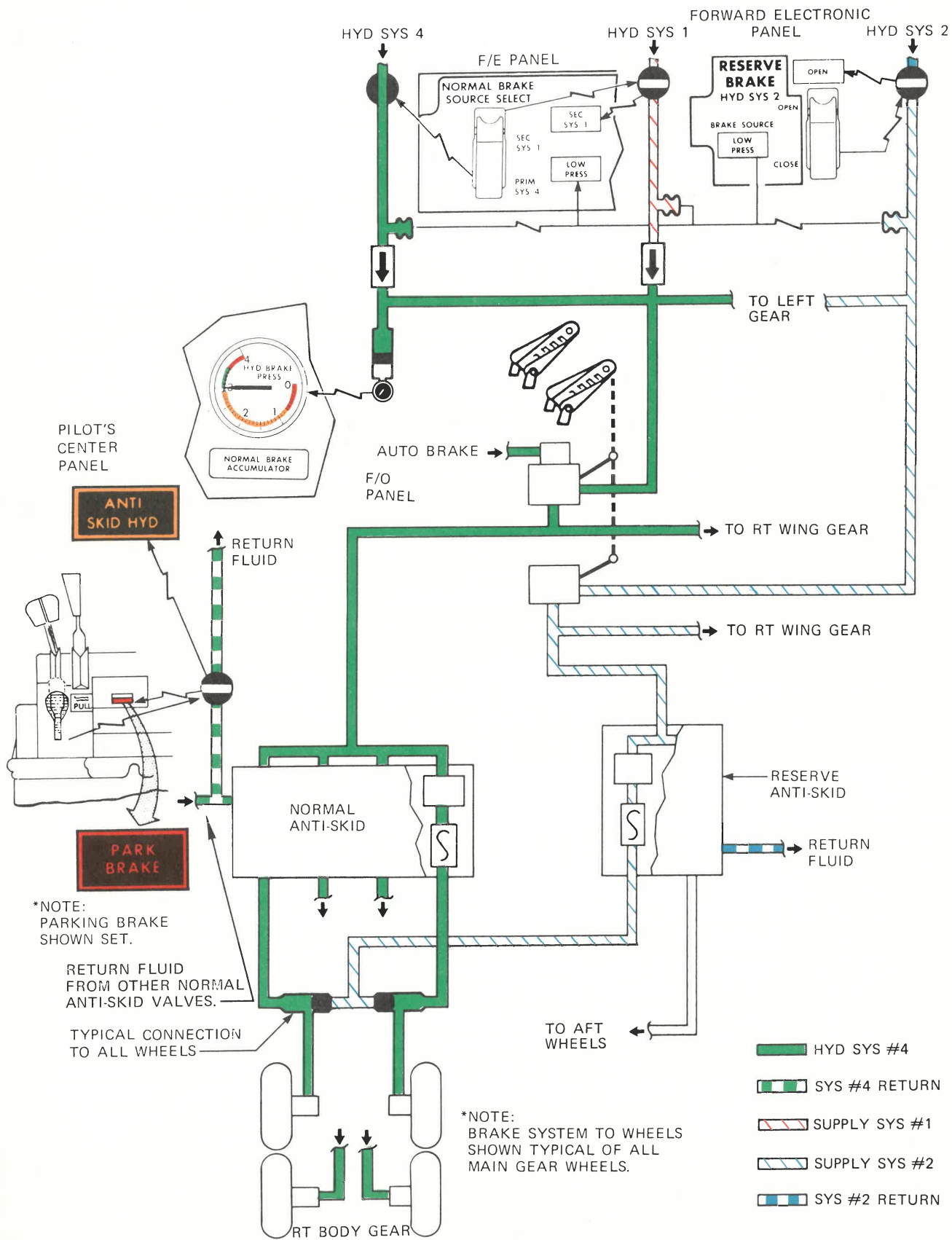
DISCHARGE LINE PRESSURE

ENGINE FIRE PROTECTION

ENG FIRE PROTECTION MODULE F/E PANEL



APU FIRE PROTECTION



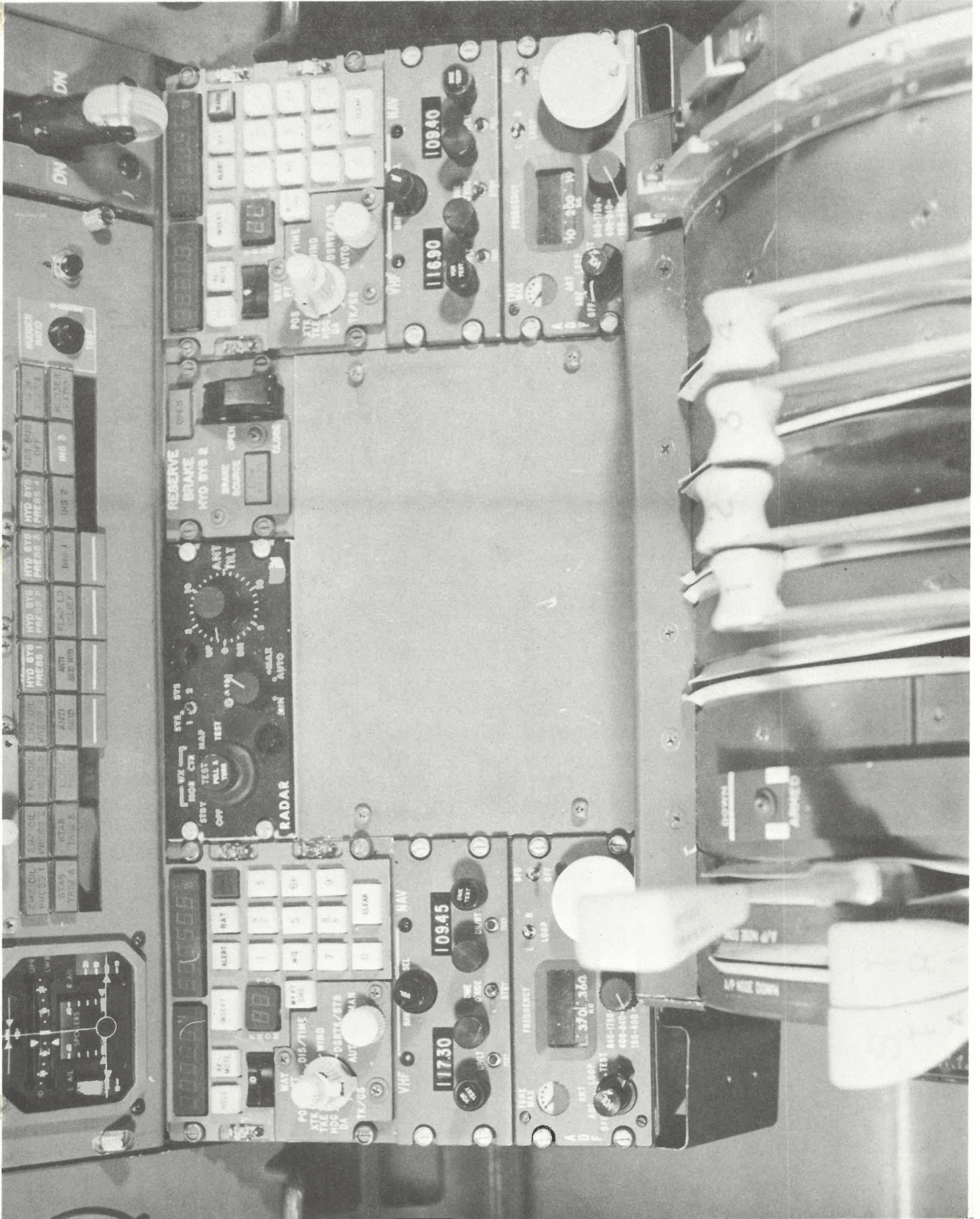
*NOTE: PARKING BRAKE SHOWN SET.

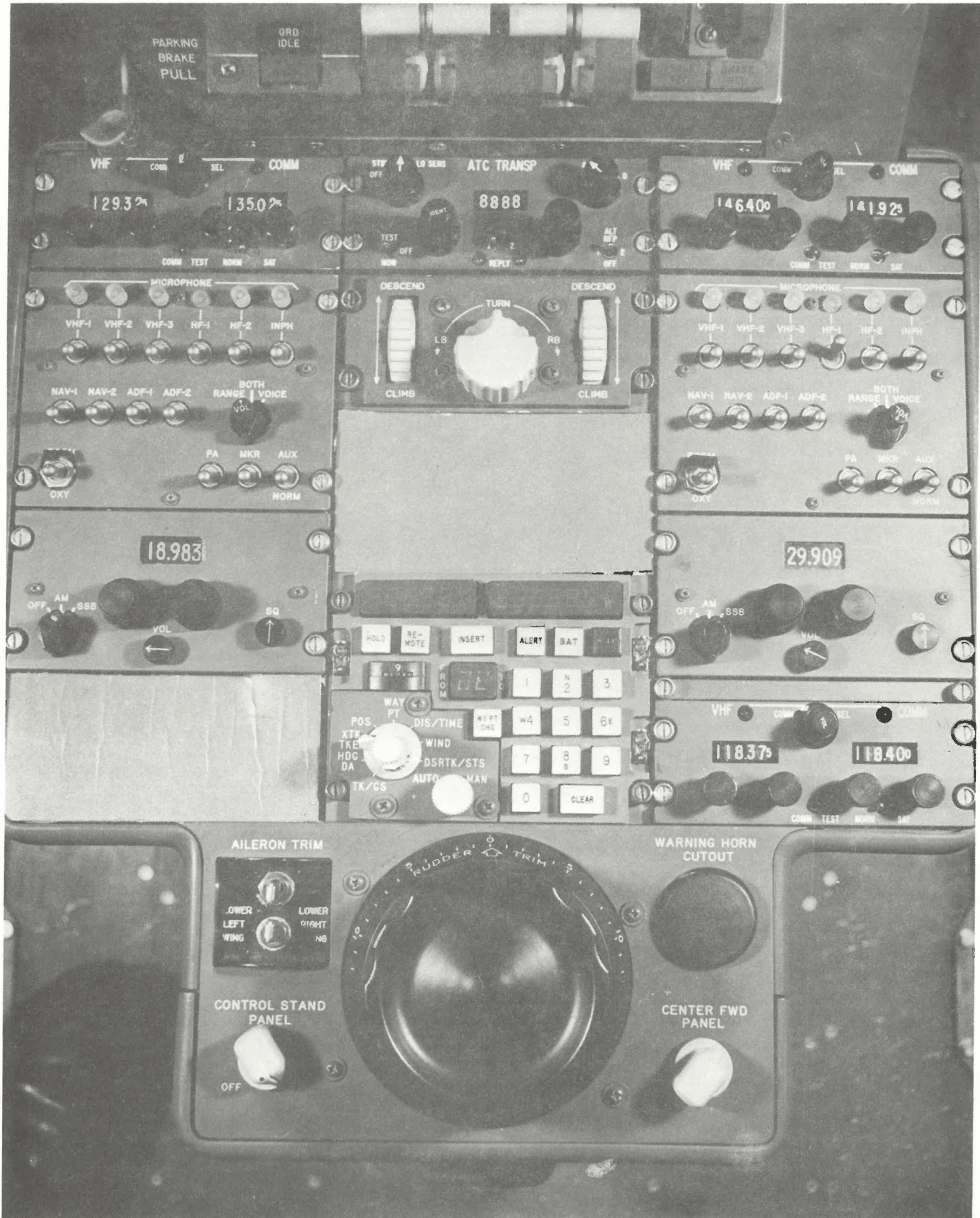
RETURN FLUID FROM OTHER NORMAL ANTI-SKID VALVES.

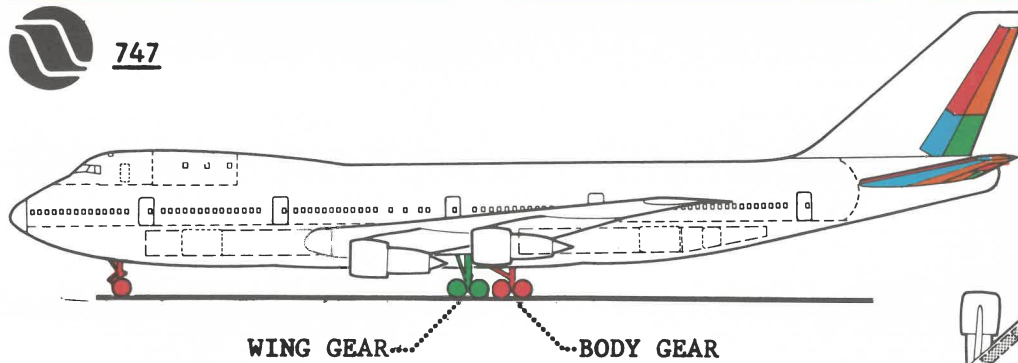
TYPICAL CONNECTION TO ALL WHEELS

*NOTE: BRAKE SYSTEM TO WHEELS SHOWN TYPICAL OF ALL MAIN GEAR WHEELS.

HYDRAULIC BRAKE SYSTEM







▨ L E FLAPS, SETS 2 & 4 (AT FLAPS 1)
 ▨ SPEED BRAKES (FLT DETENT)

SECOND POWER SOURCE ■ ■ ■
 *NO ALTERNATE HYDRAULIC POWER SOURCE

