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DELTA AIR LINES

L1011- PRM
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FILE IN FRONT OF INTRODUCTION PAGE, PRM

Future revisions of the L-1011 manuals will be accomplished through the use of new advanced typesetting equipment which facilitates preparation of the text into a standardized format.

The introduction page makes reference to the use of "reverse print" (white letters on a black background) for the presentation of all illuminated annunciator legends. However, this reverse print typesetting feature was not available at the time that revision number 5 was being prepared for print, as originally expected.

As a result, all illuminated annunciator legends are temporarily represented in bold capital letters (without reverse print or shading) whenever they appear in normal text. This corresponds visually to the current format for un-illuminated legends and all switch positions. Shading is used when annunciator legends are presented in an enlarged form, such as in graphics.

The use of reverse print is a visually distinctive feature and will be used in subsequent revisions after it is incorporated in our new publishing equipment.

USE OF THIS MANUAL

The Pilot's Reference Manual is designed as a training manual and an in-depth reference manual. the PRM is designed for pre-study and post-study and not classroom use.

Specific conventions are followed throughout the PRM. Each section is presented as a buildup of the system beginning with basic components. the section is outlined in a Table of Contents and may be followed by a foldout of the system schematic. This gives a complete description by showing the relationship between the controls and indicators and the system. In addition, Panel Drawings are included in a pocket in the back of the PRM.

The PRM is based on the L-1011-1 model. Other L-1011 model differences are discussed as they apply and are printed at the end of each section on blue paper.

The titles of controls and indicators are written in a complete and unabbreviated manner (unless abbreviated by the manufacturer) in capital letters. A switch position is always indicated in bold capital letters (e.g. BOOST PUMP - **ON**. Illuminated annunciators are described in reverse print (e.g. YAW/SAS FAIL).

Warnings describe operating procedures or techniques which, if not carefully followed, will result in personal injury or loss of life. Cautions describe operating procedures or techniques which, if not carefully followed, will result in damage to equipment. Notes are used to add emphasis, establish correlations or focus special attention.

Whenever the text describes a control or indicator, an amplifying graphic will be included on the same or opposite page. Graphics will be presented in the most normal configuration of the system as described by the text.

Normally, checklist items and specific limitations are presented only in the POM. If their inclusion is necessary to adequately describe the system, they will be presented in both the POM and PRM.

SCOPE

The Pilot's Reference Manual has been prepared in compliance with the FAA Approved Airplane Flight Manual (AFM). Procedures which differ from the FAA AFM have been designed to assure an equivalent level of safety.

Each pilot is issued the manual which remains the property of Delta Air Lines, Inc. Each pilot must keep the entire manual in a current status.

REVISIONS

Revisions are accompanied by a Transmittal Sheet covering the highlights of the revision and filing instructions. Each revision is entered on the Revision Log with its effective date. Deletions, additions or changes are denoted by the use of a solid vertical line to the left or right of the revised material.

MANUAL RIGHTS

The Pilot's Reference Manual has been prepared for the use of Flight Operations personnel under the auspices of Delta Air Lines, Inc.

In the event of sale or other use of this manual for purposes other than as outlined above, no warranty, expressed or implied, is made as to the accuracy, sufficiency, or suitability of material in this manual or of any revision. It is understood and agreed by users of this manual that such users will hold harmless and indemnify Delta Air Lines, Inc. against any claims or actions which may arise or claim to arise from the use of such material.

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L-1011 AIRCRAFT TYPES

Presented below is a brief summary of the model types of L-1011 aircraft operated by Delta Air Lines. The system information for the basic model of L-1011-1 aircraft are presented on the white pages. Other models are presented on blue "Aircraft Differences" pages at the end of each system chapter. Aircraft effectivity in the differences section will be delineated under the page number and date. For instance, if the differences outlined on that page apply to all L-1011-500 aircraft (751-756), but the differences outlined on that page also apply to ships 736 - 741, then there will be a box showing:

SHIPS 751 - 756
SHIPS 736 - 741

If the differences apply to L-1011-500 aircraft ships 751-753, then the effectivity box will so state, and so on. In the interest of clarity, there will be only one effectivity box per page. If two groups of aircraft are different from the basic L-1011-1 aircraft operated by Delta, each groups' differences will be shown on its own page.

L-1011-1
Ships 712, 723, 725 & 727-735)

This is the basic aircraft type operated by Delta and described on the White pages for each system.

L-1011-250
(Ships 736-741)

These aircraft were delivered to Delta as L-1011-1 aircraft. They have subsequently been modified or are to be modified by Delta for international operation with the following differences from L-1011- 1aircraft:

- Passenger seating configuration is 269 total; 12 First Class, 54 Business Class, and 203 Tourist.
- An INS/FMS long range navigation system is installed, functionally identical to that installed on the L-1011-500 aircraft.
- A center section fuel tank is installed.
- Total fuel system capacity (213,640 lbs.) and operation is the same as the L-1011-500 aircraft.
- Heavy duty landing gear, brakes and wheels are installed.
- Brake pedal pressure for max braking is reduced.
- RB 211-524B4; engines will be installed.
- Maximum Takeoff Gross Weight on the aircraft is 474,000 lbs.

After certification tests, maximum takeoff gross weight will be 510,000 lbs.

L-1011-500
(Ships 751-753)

These are the aircraft originally purchased by Delta as international aircraft with long range fuel and navigation capabilities. Very basically, they differ from the L-1011-1 described in the white pages as follows:

- The aircraft length is 13.5 feet shorter and the wingspan is 9 feet longer than the L-1011-1.
- An active controls system, "ACS", is installed.
- A long range navigation system consisting of 3 Inertial Navigation Systems coupled to a Flight Management System is installed.
- RB211-524B4 engines rated at 50,000 lbs. thrust are installed.
- Passenger seating is 241 total divided 12 First Class, 32 Business Class and 197 Tourist.
- Maximum Takeoff Gross Weight on the aircraft is 510,000 lbs.
- A center-section fuel tank is installed, increasing fuel capacity from 159,600 lbs. to 213,640 lbs.
- Heavy duty landing gear, brakes and wheels are installed.
- There is no lower galley installed.

L-1011-500
(Ships 754-756)

These are aircraft specified and formerly operated by Pan Am until purchased by Delta and modified to conform generally to the Delta L-1011-500 specification. The differences from the L-1011-500 aircraft purchased originally by Delta are:

- There are only 2 cargo doors (no bulk cargo door in the aft fuselage).
- The Standby Flight Instruments are somewhat smaller and are arranged slightly differently. The Standby Altimeter can only be set in millibars.
- Cabin Interphone CALL switches are arranged differently.
- Control wheel MIC switch is located on the forward side of the yoke under the index finger.
- The MAG/DG switches are guarded.
- An AFT CARGO COMPARTMENT SMOKE and FIRE EXTINGUISHER PANEL is installed.
- There is a Potable Water Quantity Indicator below the APU controls, on the S/O Panel.
- the Flight Recorder does not have Trip Date encoding.
- Maximum takeoff Gross Weight on the aircraft is 510,000 lbs.
- Passenger seating is 241 total divided 12 First Class, 32 Business Class and 197 Tourist.
- There is no lower galley installed.

L-1011 AIRCRAFT TYPES (CONT'D.)

L-1011-1/100/200

This aircraft was originally purchased by Delta as an L-1011-1 and subsequently modified by Delta to be an airplane that could serve either as a domestic aircraft or an international aircraft, depending on need. The differences from an L-1011-1 are as follows:

- A center section fuel tank is installed.
- Total fuel system capacity is 178,400 lbs.
- Heavy duty landing gear, brakes and wheels are installed.
- Passenger seating configuration is 255 total; 12 First Class, 48 Business Class and 195 Tourist.
- Neither a Flight Management System nor an Omega Navigation System is installed.
- Maximum Takeoff Gross Weight on the aircraft is 466,000 lbs. (430,000 lbs. - Domestic Operations).

When operated as an L-1011-100 aircraft internationally, the following change is also effected:

- All three VD/DG systems are removed and 3 Inertial Navigation Systems are installed.

When operated as an L-1011-200 aircraft internationally, the following change is also effected in addition to that above:

- Three RB211-524B4 engines of 50,000 lbs. thrust are installed.
- Maximum Takeoff Gross Weight on the aircraft is 474,000 lbs.

NOTE: For performance purposes, if any one of the three engines is replaced by an RB211-22B engine of 42,000 lbs. thrust, the aircraft will operate an an L-1011-100.

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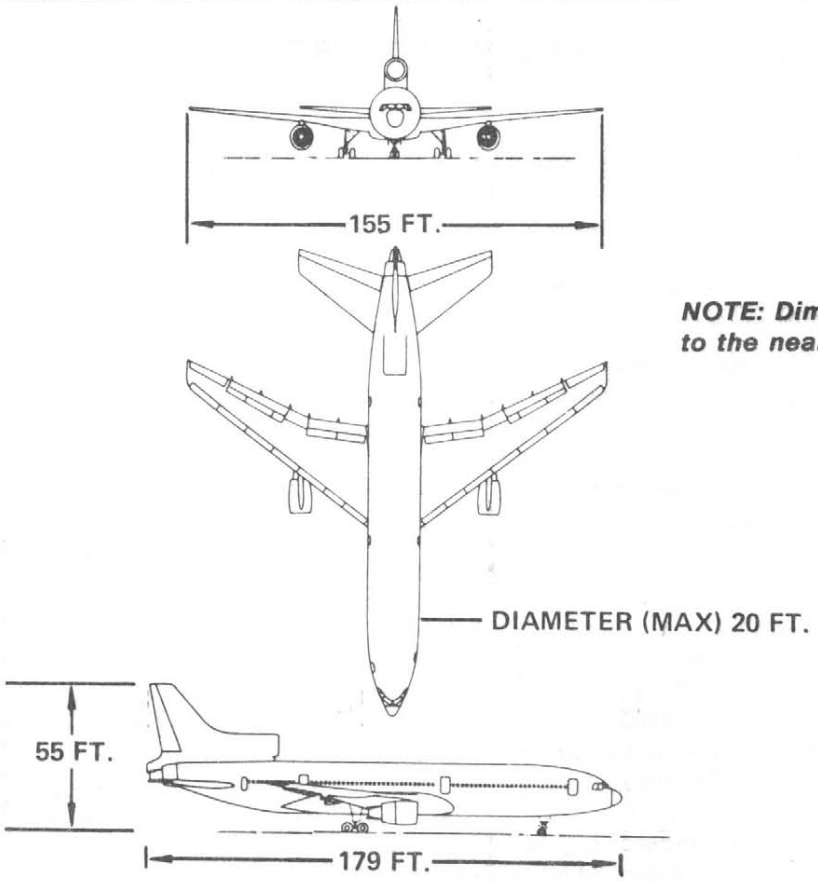
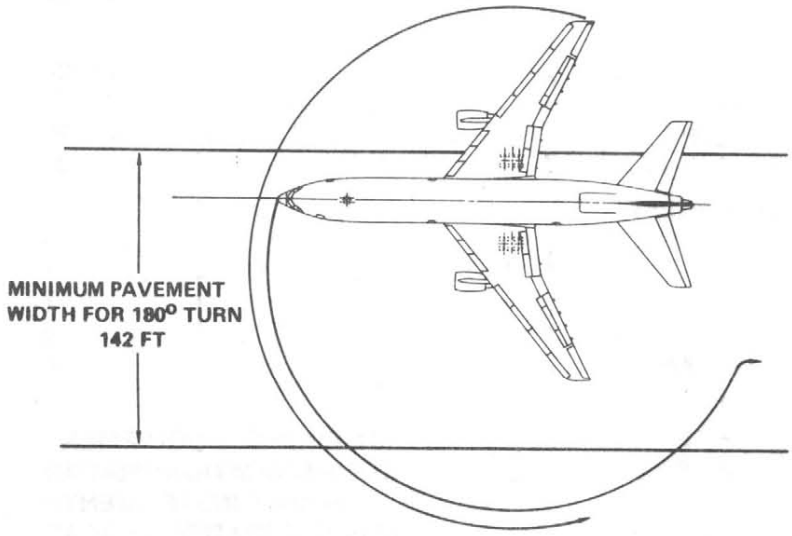
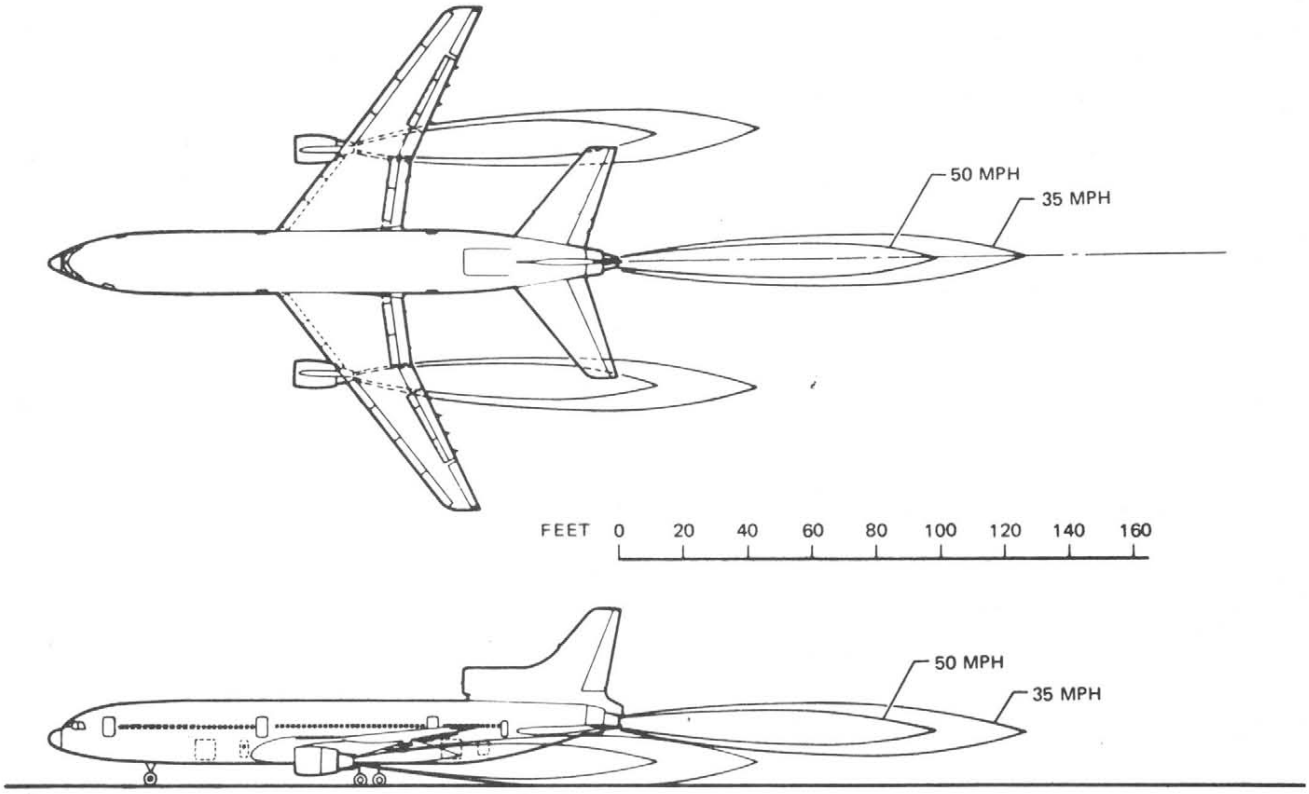


NOTE: Dimensions rounded off to the nearest foot.

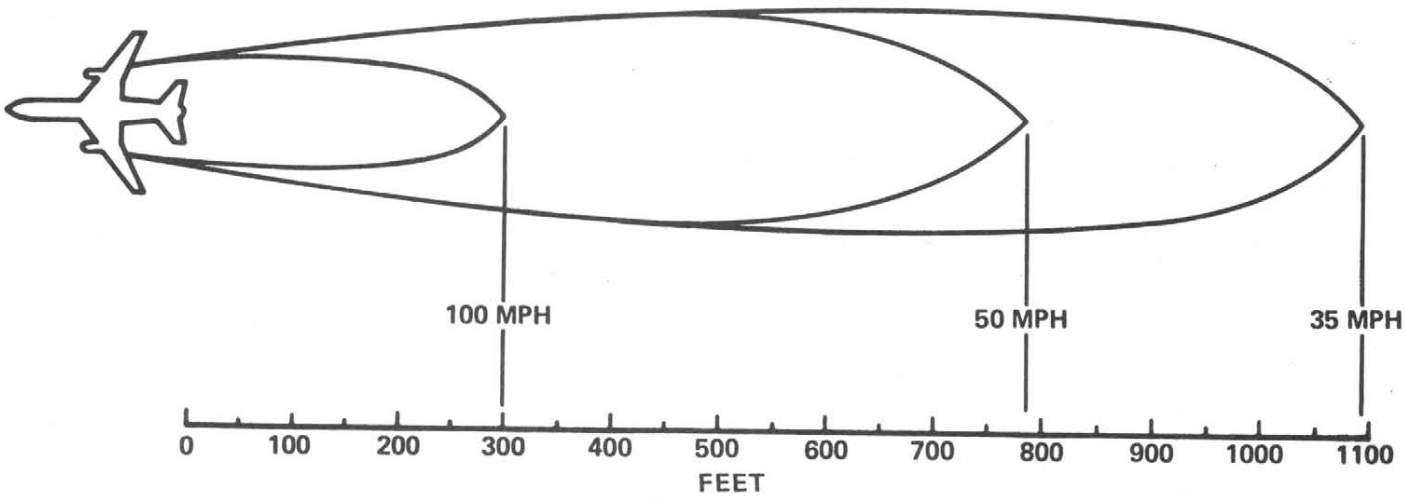
DIMENSIONS



TURNING RADIUS



GROUND IDLE



TAKEOFF THRUST

JET BLAST

PASSENGER DOORS

The eight passenger plug-type doors are identified as number one through four, left and right. For example, the forward left door is identified as the L1 door. The first three doors on each side are double width doors. The L4 and R4 doors are single width doors. Door operation is covered in the Emergency Equipment section.

CARGO COMPARTMENTS AND DOORS

There are three cargo compartments. Each compartment on the -1 aircraft is classified as a class D compartment, and requires no fire detection or protection.

The forward and mid cargo compartments are for containerized cargo. The aft cargo compartment is for bulk cargo and live animals.

All three cargo compartment access doors are on the right side of the aircraft. These outward opening doors are normally opened and closed electrically. The doors may be manually opened or closed by use of a hand crank stowed in the forward avionics compartment.

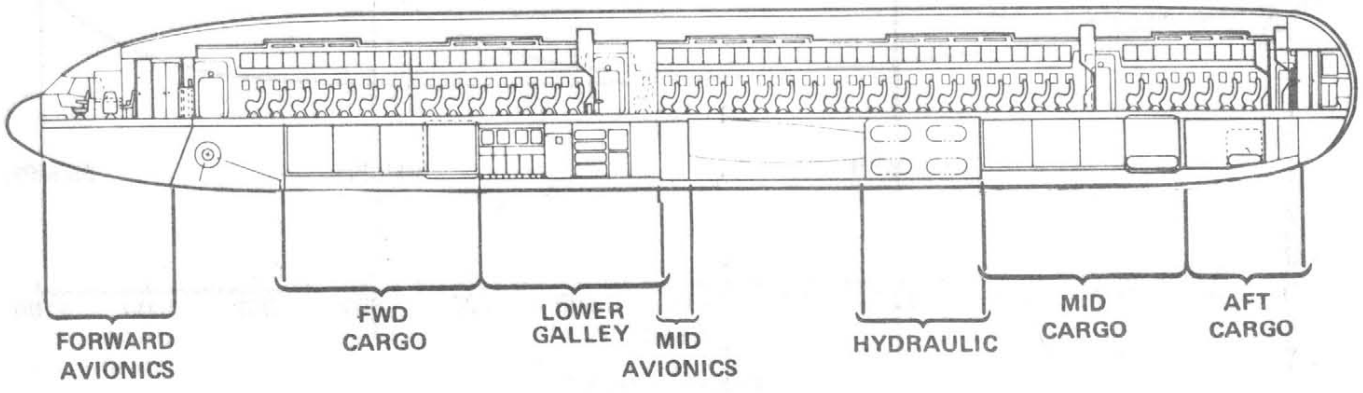
EQUIPMENT COMPARTMENTS

Located beneath the flight station is the Forward Avionics compartment. This compartment, which is also referred to as the Forward Electronics Service Center (FESC), is accessible in flight by a hatch in the flight station floor. The external access plugtype door is on the bottom of the fuselage, aft of the radome. This access door can only be opened from outside the aircraft.

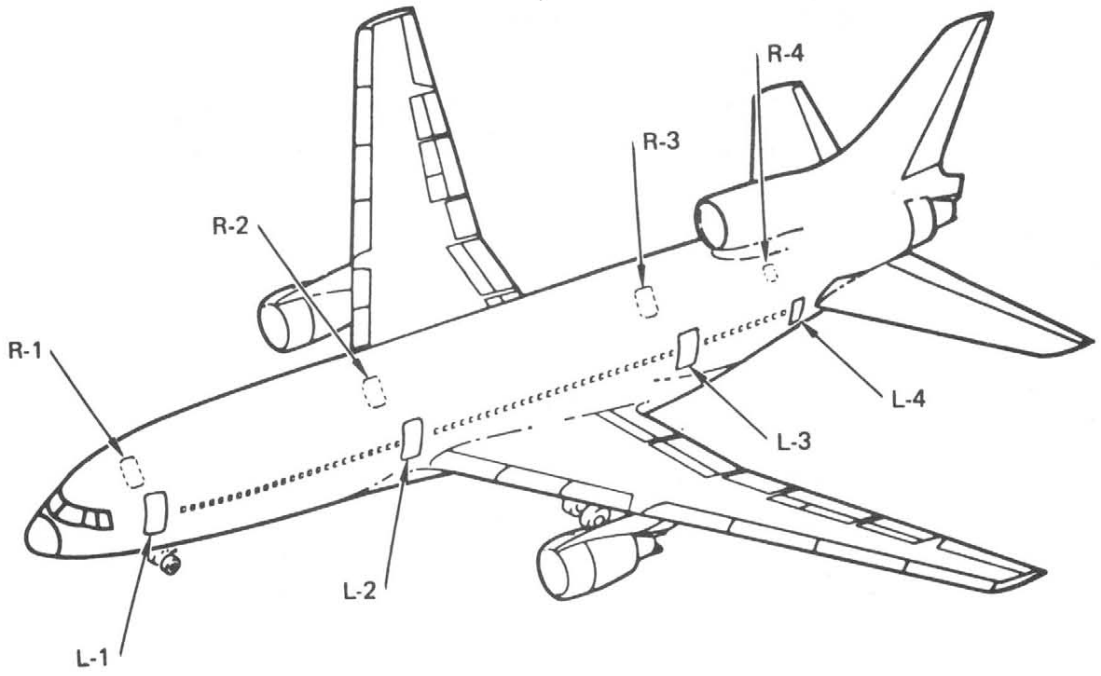
The Mid Avionics compartment (also referred to as the MESC) is located in the center of the fuselage. This compartment is accessible in flight through a door located in the lower galley. There are two doors which must be opened to gain access from the outside. These doors are located under the right wing leading edge. The outer door is an outward opening door in the wing fairing and is in a non-pressurized area. The inner plug-type door opens inward into the pressurized area of the midavionics compartment. Both these doors can be opened from inside or outside the aircraft.

An inward opening plug-type galley service door is located on the right side of the aircraft aft of the forward cargo door.

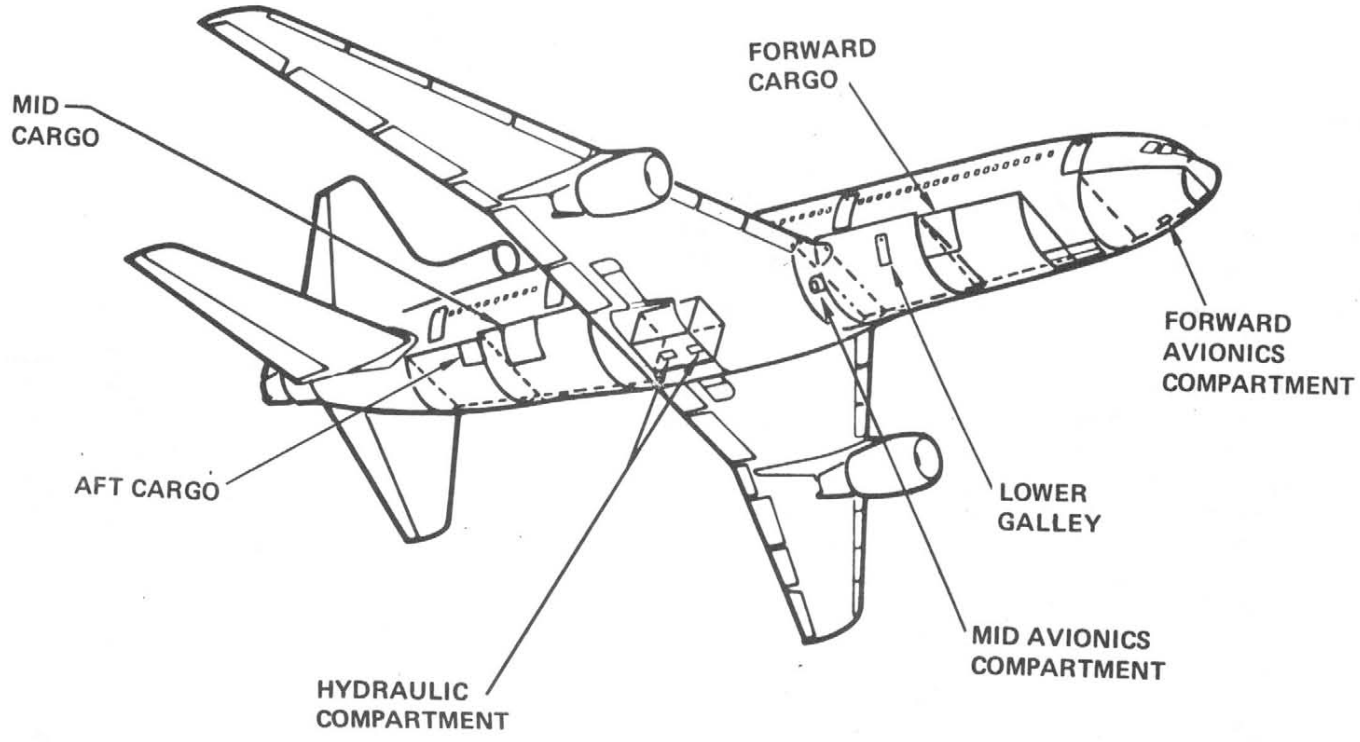
The hydraulic compartment is located between the main gear wheel wells in a non-pressurized area. The compartment is not accessible in flight. Access to the hydraulic compartment is through two outward opening doors on the underside of the fuselage.



COMPARTMENTS

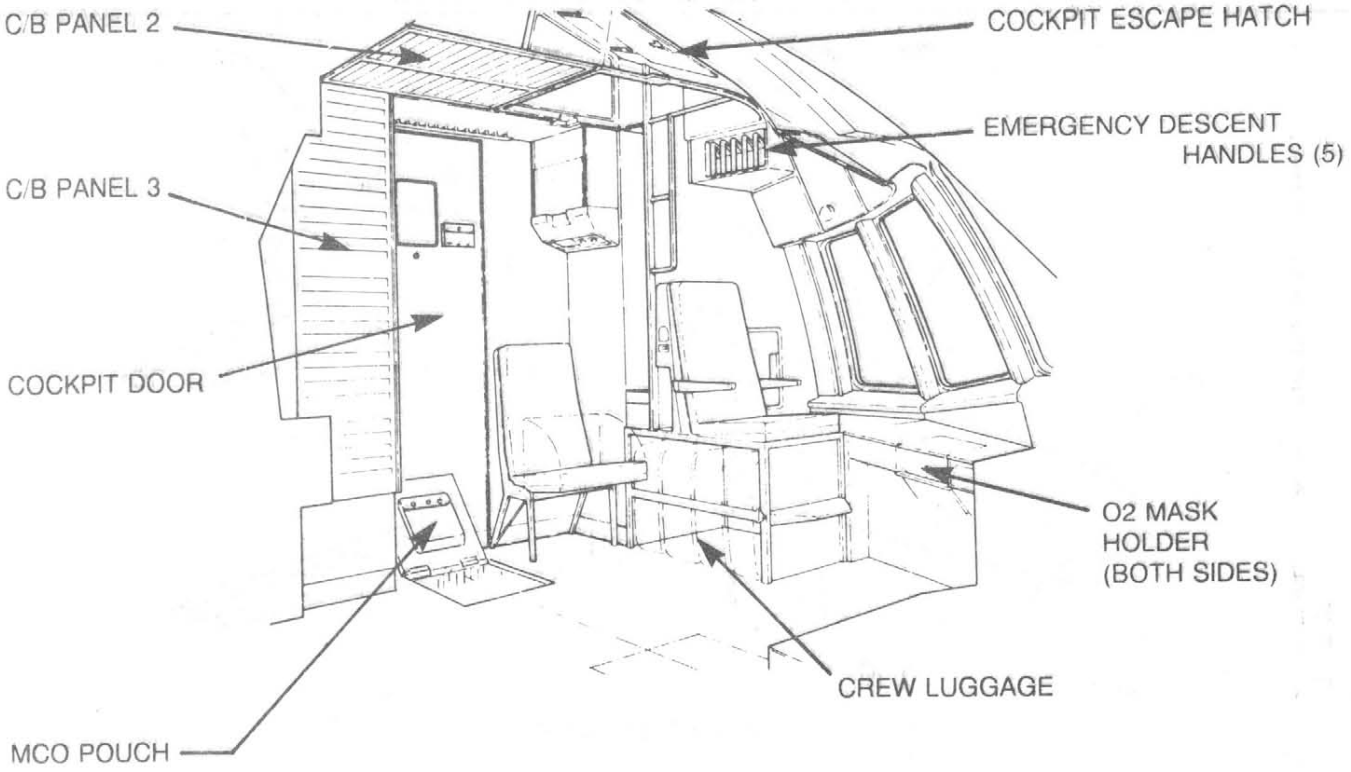


PASSENGER DOORS



COMPARTMENT DOORS

DOORS



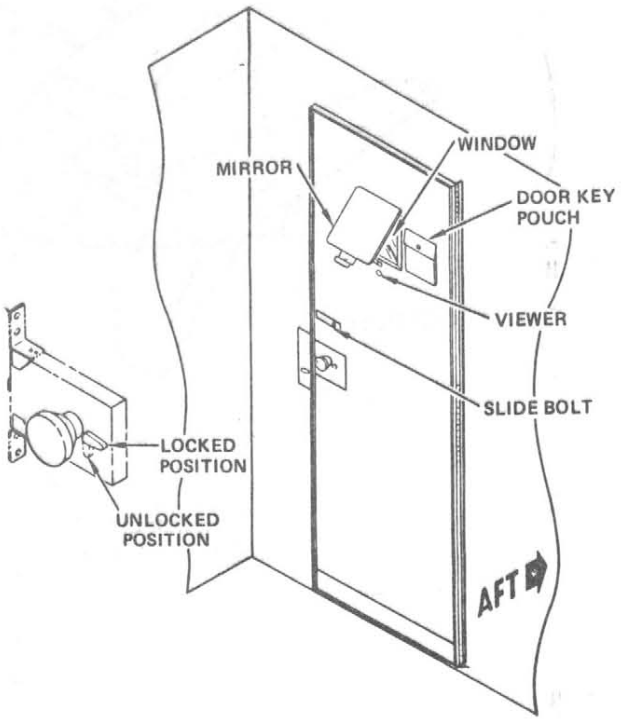
COCKPIT VIEW (LEFT SIDE)

COCKPIT DOOR

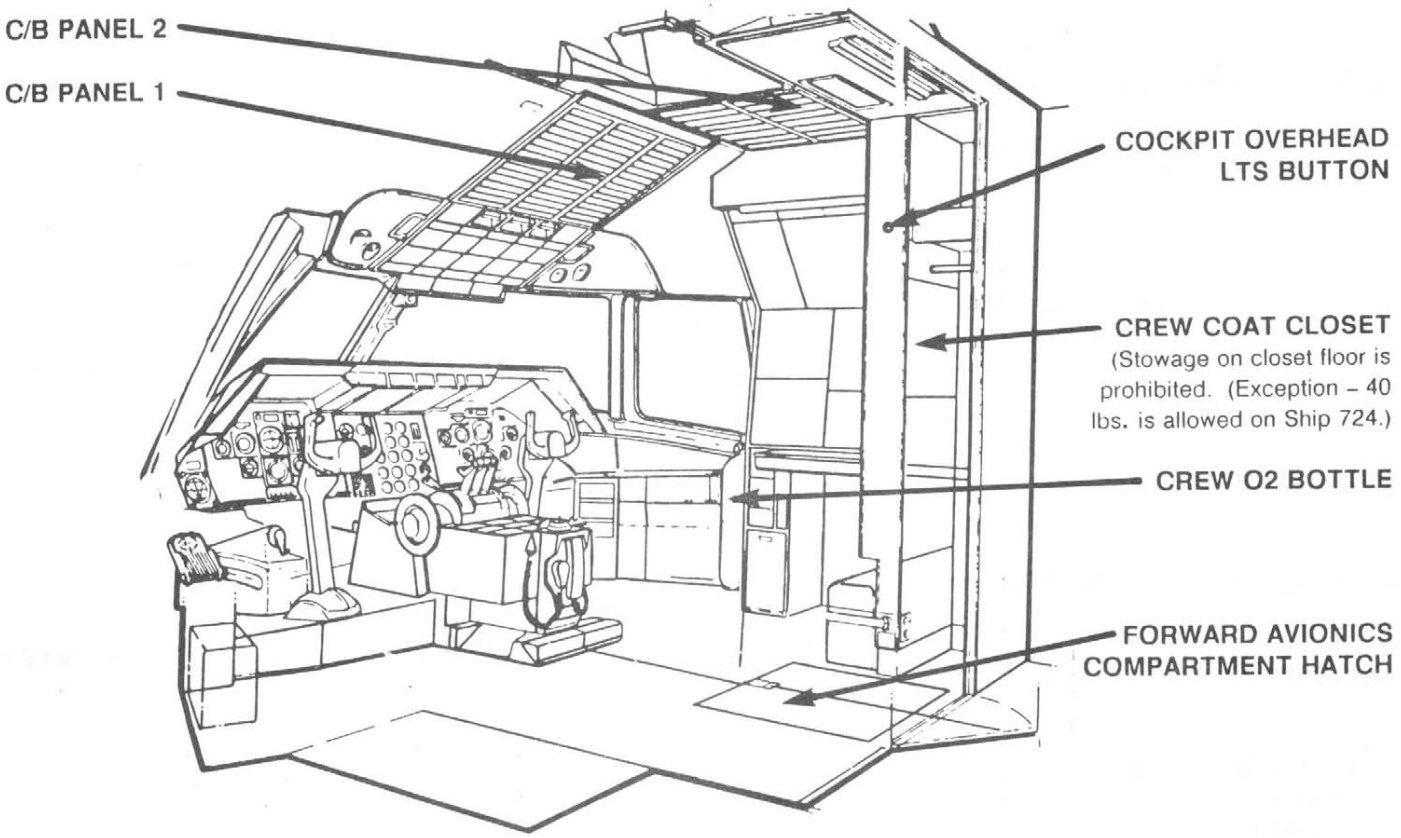
The cockpit door contains a window that is normally covered by a hinged mirror on the cockpit side. Next to the mirror is a key pouch for the cockpit door key.

Below the mirror is a wide angle viewer to scan the cabin area.

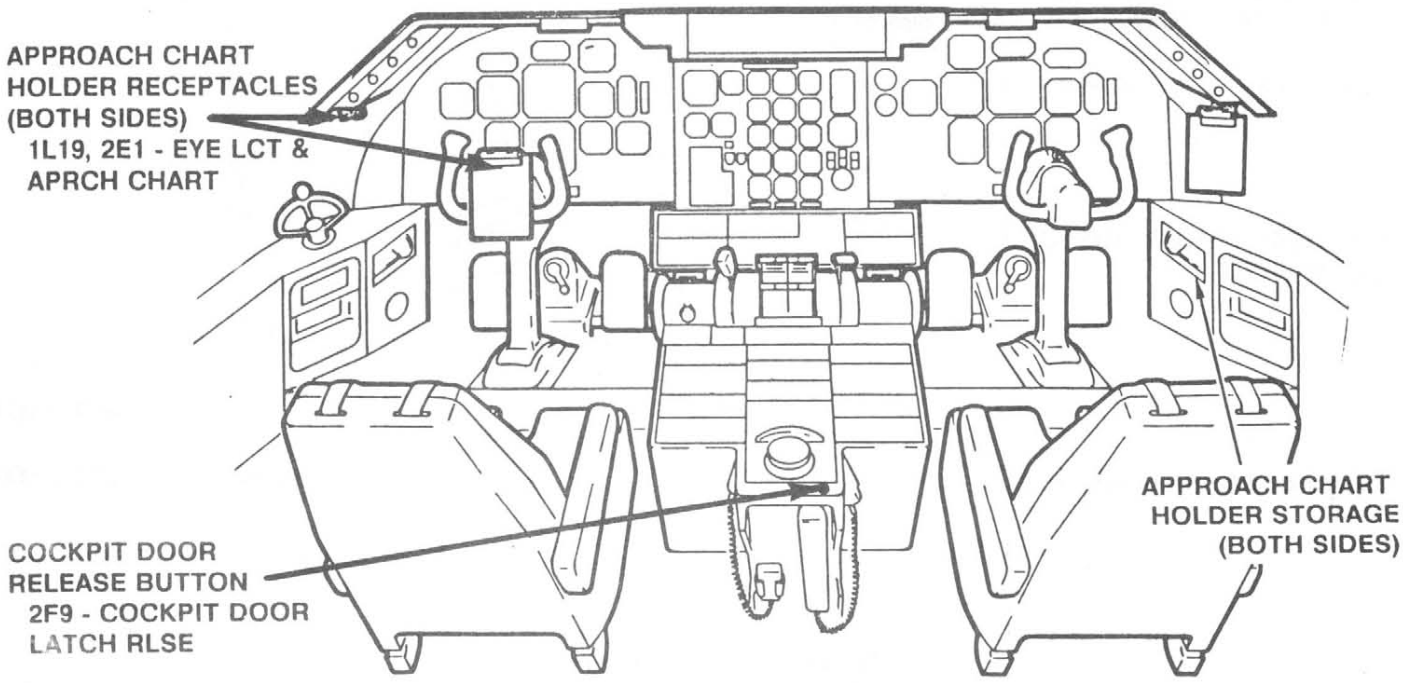
The door knob has a key lock on the cabin side and a manual knob-lock lever on the cockpit side. The manual knob-lock lever prevents the knob from turning. The door frame contains a lock plate that houses a solenoid operated door latch and manual latch-lock lever. As long as power is on the airplane, or the manual latch-lock lever is in the locked position, the door latch is engaged to allow the door to be locked by the manual knob-lock lever located on the door. When the solenoid is de-energized, and the manual latch-lock lever is in the unlocked position, the door latch is released allowing the door to be opened regardless of the position of the manual knob-lock lever on the door. A DOOR RELEASE button, located on the aft end of the pedestal, may be used to release the electric latch.



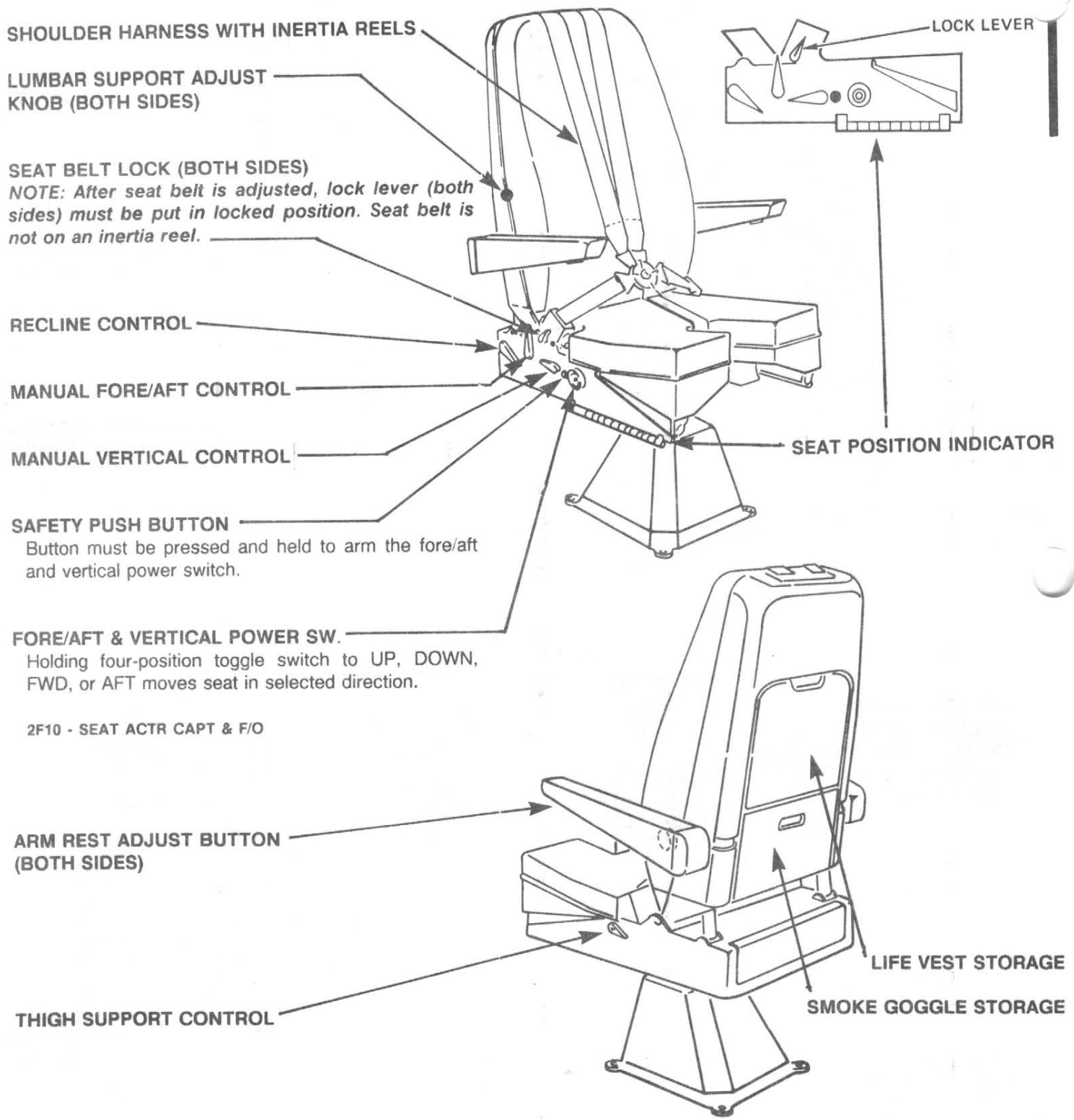
COCKPIT DOOR



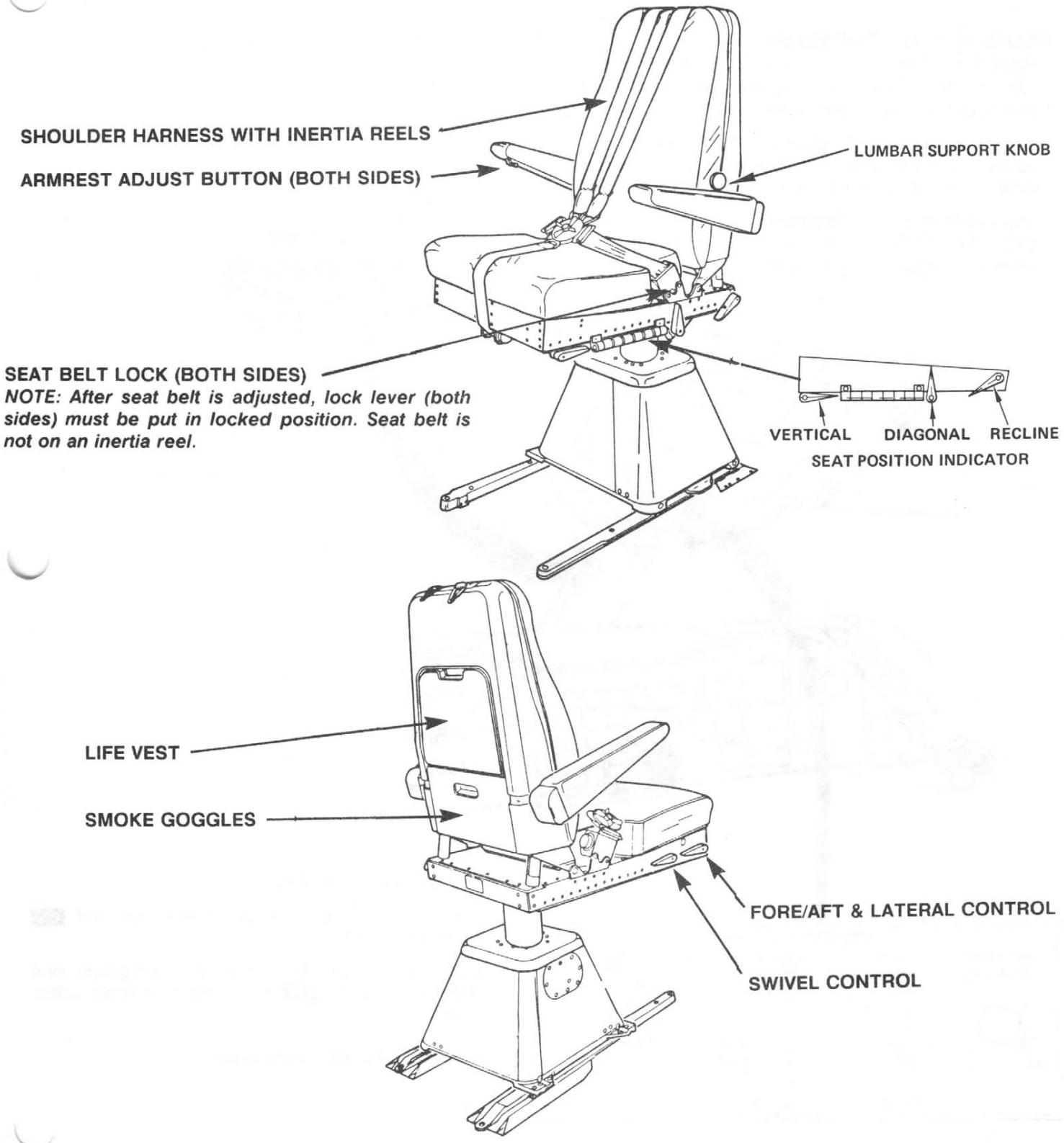
COCKPIT VIEW (RIGHT SIDE)



APPROACH CHART HOLDERS/RECEPTACLES



CAPTAIN'S SEAT CONTROLS
(F/O's Controls Are Opposite)



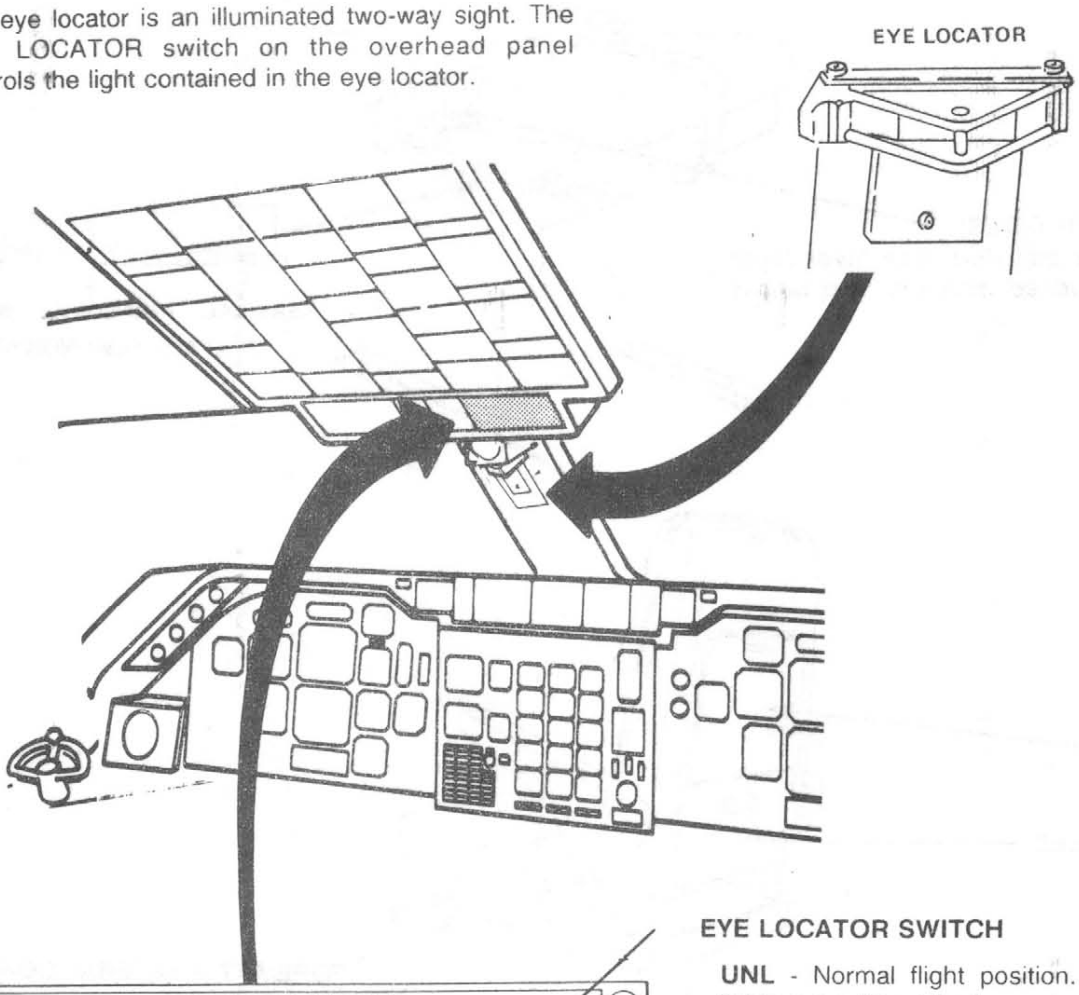
SECOND OFFICER'S SEAT CONTROLS

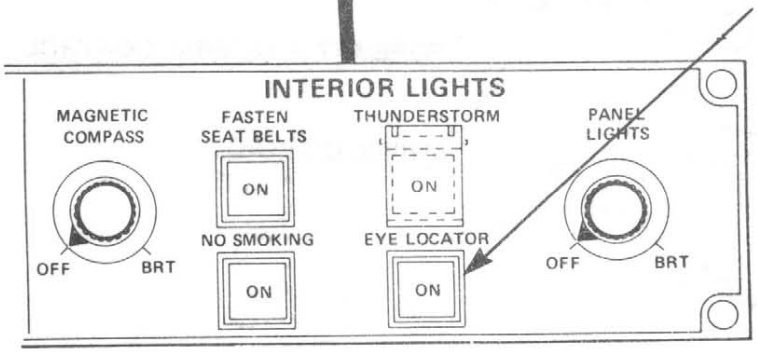
PILOTS' EYE LOCATOR/VISIBILITY

Visibility from the L-1011 cockpit is illustrated on the adjacent page. This visibility is predicated upon each pilot having the same relative eye position.

To assist the pilot in obtaining the optimum eye position for panel scan and runway visibility, an eye locator is installed on the center windshield post.

The eye locator is an illuminated two-way sight. The EYE LOCATOR switch on the overhead panel controls the light contained in the eye locator.



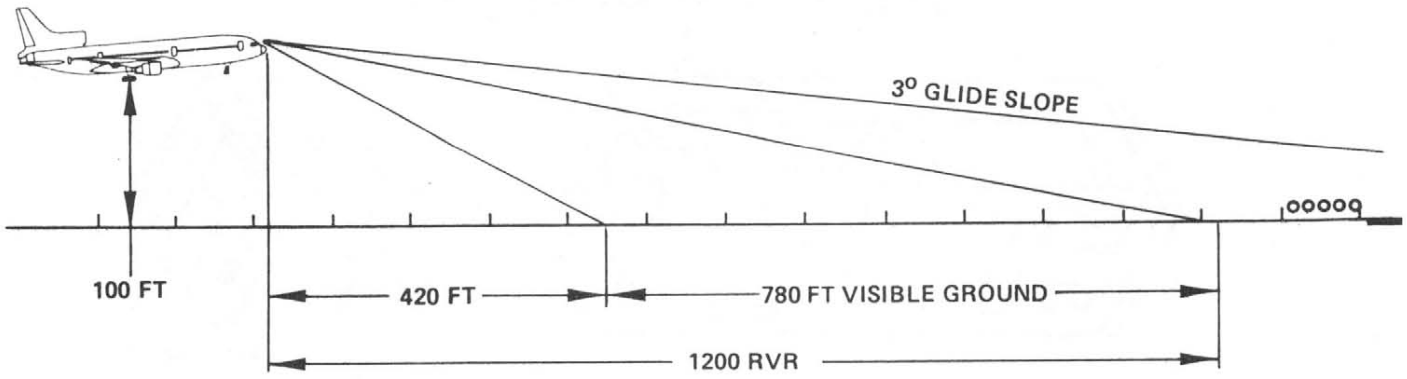


EYE LOCATOR SWITCH

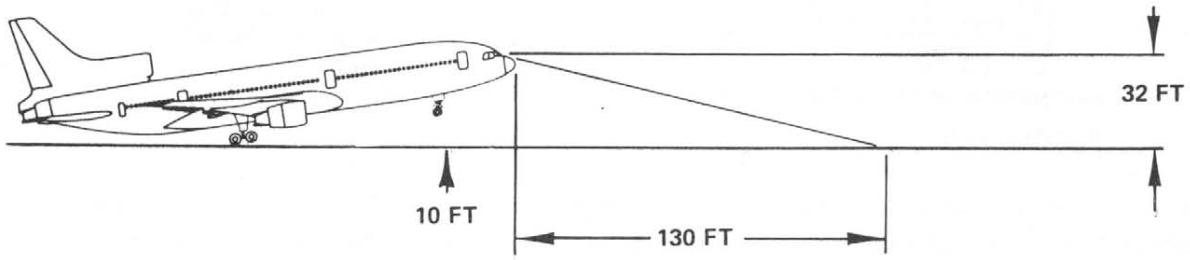
UNL - Normal flight position. Eye locator and **ON** lights are extinguished.

LCH - Eye locator light illuminates to highlight seat alignment targets. **ON** illuminates to indicate switch position.

1L19, 2E1 - EYE LCT & APRCH CHART

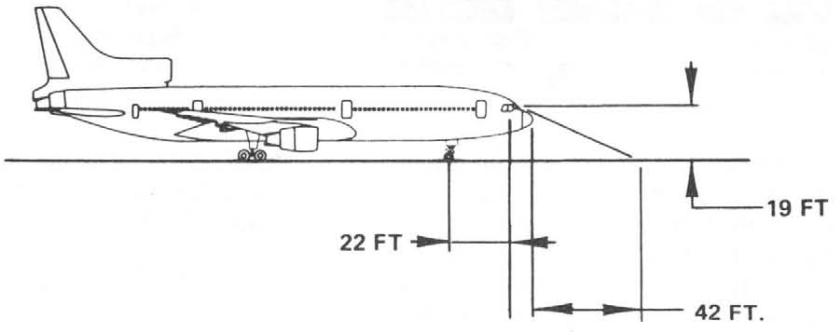


APPROACH



8° BODY ANGLE AT TOUCHDOWN

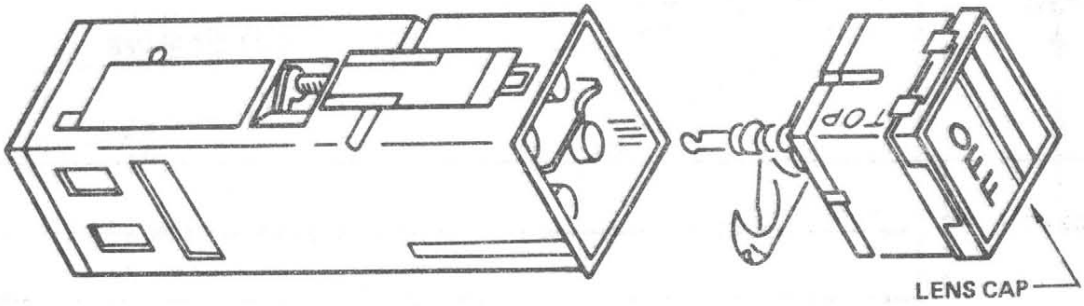
TOUCHDOWN

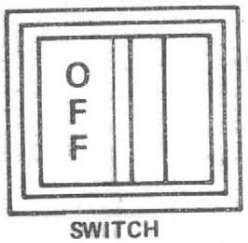


TAXI AND ROLLOUT

COCKPIT VISIBILITY

SWITCH ASSEMBLY

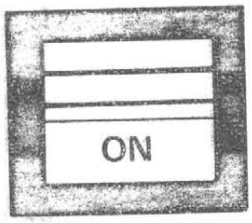




CHROME

SWITCH
- MOMENTARY OR LATCHING
- SWITCH LIGHT

BLACK



INDICATOR
- INDICATOR ONLY

The switchlights and most indicator lights are constructed as shown in the diagram. The lens cap may display a maximum of two legends. Each legend may be a word, flowbar, or a disagreement (intransit) indicator. Legends are color-coded to indicate the following:

- Red – Emergency Condition.
- Amber – Abnormal Condition.
- White or Green – Normal Condition.
- Blue – Disagreement.

Throughout the PRM/POM an illuminated light is shown in reverse print: OFF, ON, LO PRESS, FLOWBAR (indicates an illuminated flowbar), etc.. Extinguished lights are shown in bold print: **OFF, ON, LO PRESS, FLOWBAR.**

A chrome frame distinguishes a switch. The switch may be momentary or latching. When a switch is latched, the lens cap is flush with the panel. The abbreviation **LCH** in the PRM/POM indicates a latched switch. When a switch is unlatched, the lens cap protudes approximately 1/8 inch from the panel. **UNL** is the abbreviation for an unlatched switch.

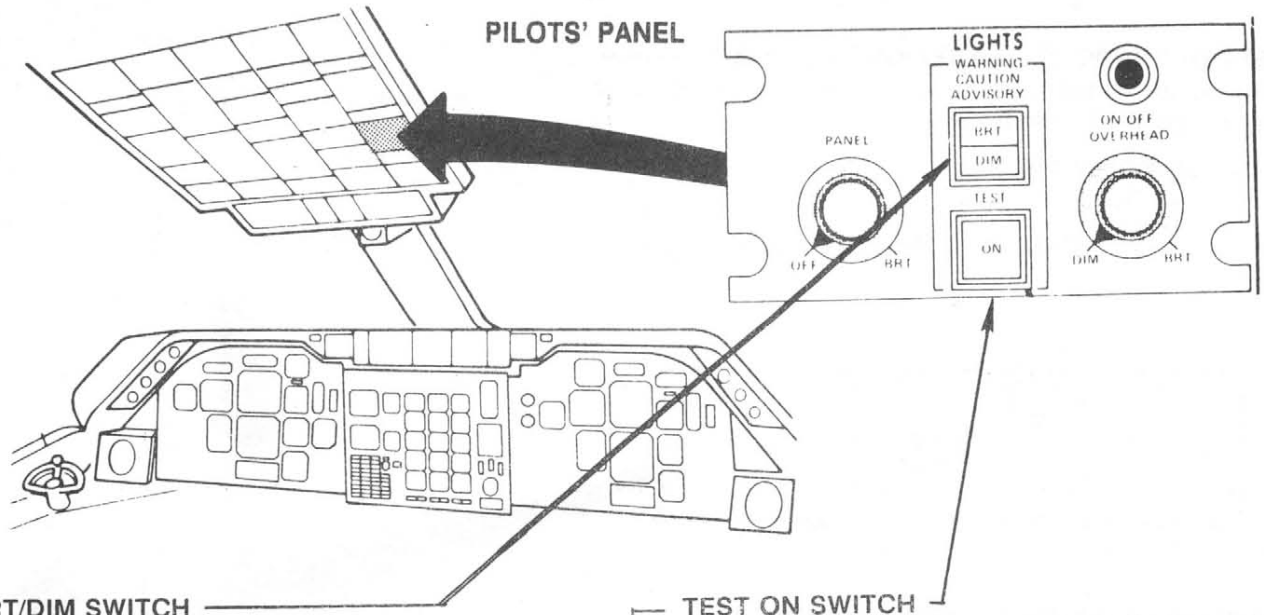
An indicator light having no switch function will have a black frame.

Each switchlight and indicator light contains either two or four bulbs, depending on the number of Legends involved. Spare bulbs are located in a drawer under the S/O's work table on the right hand side.

To replace bulbs (latching type switches must be unlatched), insert fingernails in the notches along the sides of the lens cap assembly (Note: Pilots' Annunciator Panel and S/O's Annunciator Panel lights are different, see Warning Section) and pull straight out. Remove burned out bulbs from the base end and replace. Check the groove in the lens cap assembly and word TOP is positioned on the top side before re-inserting the lens cap assembly.

NOTE: To prevent inadvertent actuation, pull the following circuit breakers before replacing respective bulbs:

- RAT C/B'S 3G10, 1L3, and 1B14.
- IDG DISCONNECT C/B 3G15.
- FUEL JETTISON C/B's 3U3, 3U11, 3U12, and 3U18.
- Passenger Oxygen manual control C/B's 1J15, 1J16, 1J17, and 1J18.



BRT/DIM SWITCH

Selects the intensity of illumination of switch, indicator, and annunciator lights on the respective (Pilot's or S/O's) panels.

UNL - Lights illuminate at full intensity. **BRT** illuminates to indicate switch position.

LCH - Lights illuminate at reduced intensity. **DIM** illuminates to indicate switch position.

- If THUNDERSTORM light switch is latched, lights will illuminate at full intensity regardless of position of BRT/DIM switch.

2H1, 2, 3, 4, 5 - F/E'S IND LT TEST
2H8, 9, 10 - PILOT'S IND LT TEST
2J3, 4 - IND LT FE PANEL UPPER & LOWER

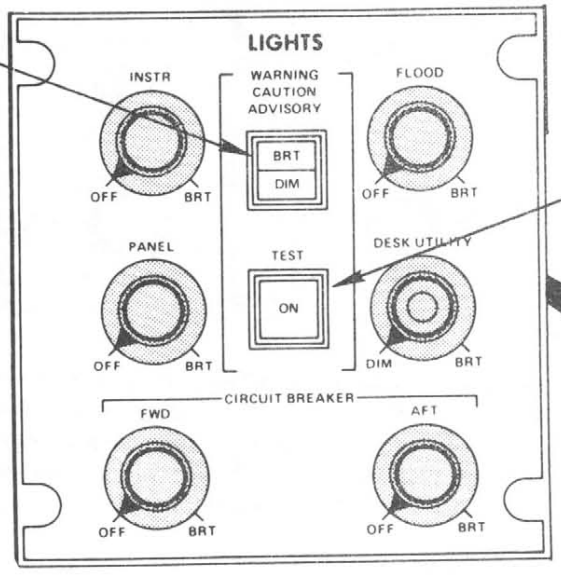
TEST ON SWITCH

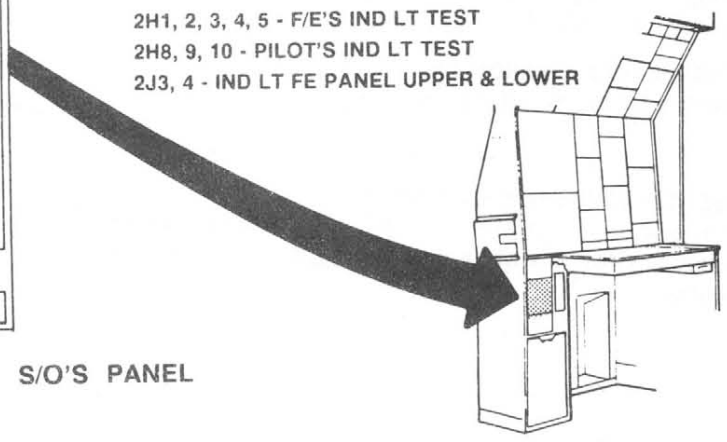
Provides means of testing switch, indicator, and annunciator lights on the respective (pilot's or S/O's) panels. LCH then UNL recalls any active warning lights.

UNL - Normal position. Lights are individually controlled. **ON** is extinguished.

LCH - **ON** indicates switch position. All switch, indicator, and annunciator lights illuminate except:

- Pilot's TEST does not illuminate:
  - Engine FIRE PULL handles.
  - MASTER FIRE lights.
  - AFCS WARNINGS panel ALERT lights.
  - MARKER BEACON lights.
- S/O's TEST does not illuminate:
  - APU **FIRE PULL** handle.
  - FIRE DETECTION LOOP TEST panel lights.
  - WHEEL WELL FIRE TEST panel lights.
  - APU GEN flowbar and **OPEN DIFF** indicators and red fault flags if APU Master Switch is **OFF**.
- Lights will automatically extinguish after five minutes unless the switch is unlatched sooner.





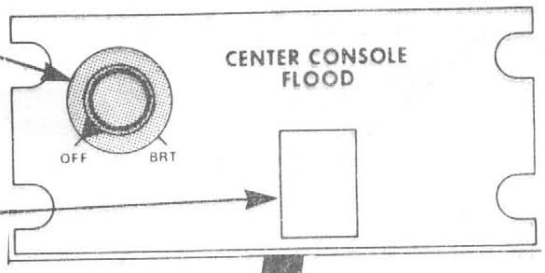
S/O'S PANEL

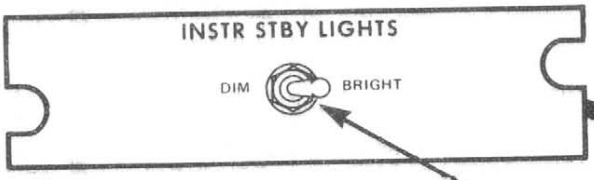
CENTER CONSOLE FLOOD LIGHT CONTROL

Rotate to control intensity of center console flood light. Light is recessed in panel.

3J4 - CTR CONSOLE FLOOD

CENTER CONSOLE FLOOD LIGHT





INSTR STBY LIGHTS DIM/BRIGHT SWITCH

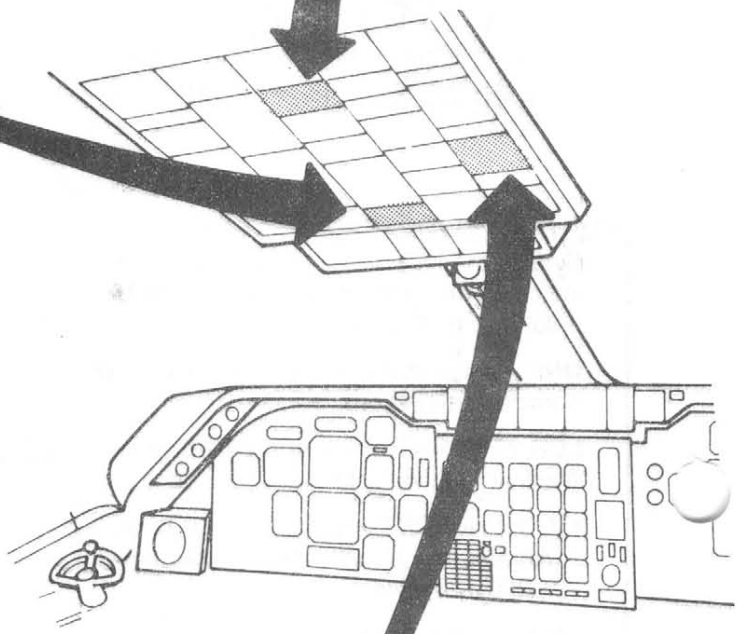
Controls intensity of standby lights on Pilot's and S/O's instrument panels. Lights are normally extinguished. DC standby bus power illuminates lights automatically if DC essential bus fails.

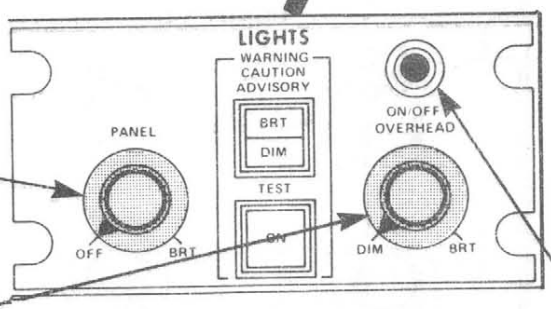
- Switch also controls intensity of emergency light in the cockpit ceiling which is powered by the emergency lighting system.

DIM - Lights are armed to illuminate at reduced intensity.

BRIGHT - Normal position. Lights are armed to illuminate at full intensity.

3J11 - STBY LT RELAY





PANEL LIGHTS CONTROL

Rotate to control intensity of pilot's overhead panel background lights.

2E3 - OVHD & EYEBROW PNL
2M7, 8, 9, 10 - OVERHEAD PANEL LIGHTING

OVERHEAD LIGHTS CONTROL

Rotate to control intensity of cockpit ceiling fluorescent lights when selected ON by either push-button.

COCKPIT OVERHEAD LIGHTS BUTTON

Alternate action pushbutton that controls illumination of the fluorescent lights in the cockpit ceiling. An identical pushbutton is located on the wall between C/B panel 3 and the crew coat closet.

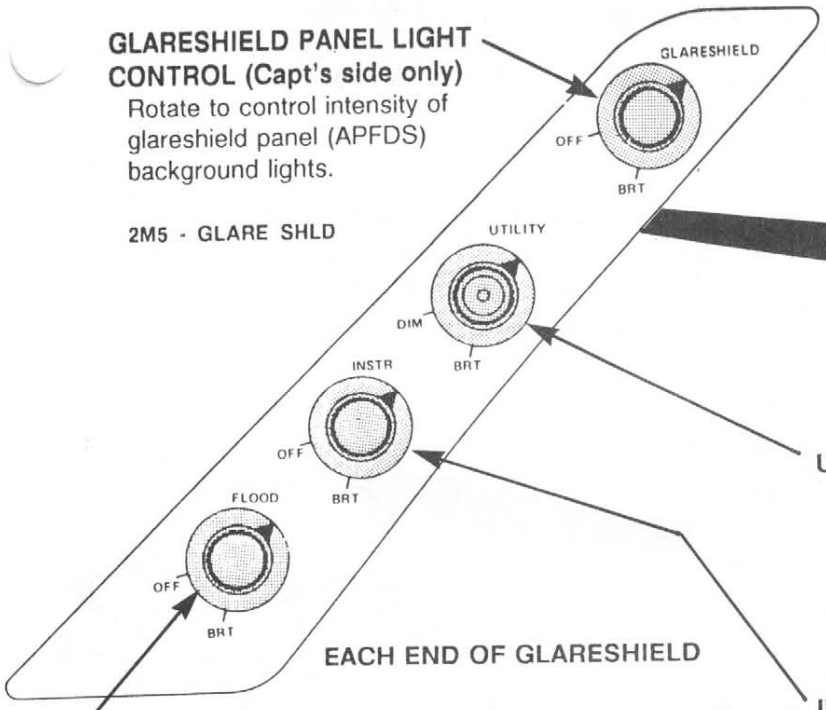
2K10 - OVHD FLOOD

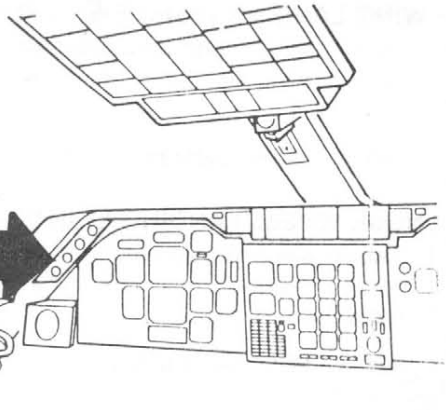
PILOT OVERHEAD PANEL LIGHT CONTROLS

GLARESHIELD PANEL LIGHT CONTROL (Capt's side only)

Rotate to control intensity of glareshield panel (APFDS) background lights.

2M5 - GLARE SHLD





UTILITY LIGHT CONTROL

Combination rotary control and alternate action pushbutton that controls illumination of respective pilot's lap area. Lights are located in the cockpit ceiling and mounted on a swivel. Pushbutton on/off switch is in center of intensity control.

INSTRUMENT PANEL LIGHTS CONTROL

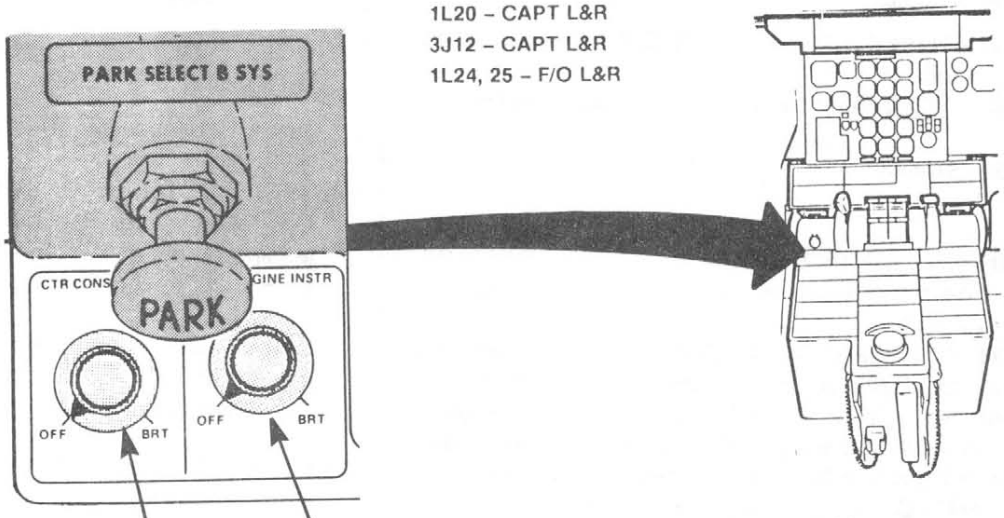
Rotate to control intensity of respective pilot's instrument panel background lights. Captain's control also controls Captain's interphone, oxygen regulator, first observer's audio selector panel and first and second observer's oxygen regulator panel lights.

1L20 – CAPT L&R
3J12 – CAPT L&R
1L24, 25 – F/O L&R

FLOOD LIGHT CONTROL

Rotate to control intensity of respective pilot's instrument panel floodlights. Captain's control also controls center instrument panel floodlights.

3J5 - CAPT & F/O FLOOD



CTR CONSOLE LIGHT CONTROL

Rotate to control intensity of center console background lights.

2E10 - CTR CONSOLE PNL
2M1, 2, 3, 4, 5, - FWD CONSOLE, AFT CONSOLE L & R THROT STAND

ENGINE INSTR LIGHTS CONTROL

Rotate to control intensity of center panel instruments and background lights.

3J13 - CTR INST & GLARE SHLD
1L22, 23 - CTR L & R

PILOT PANEL LIGHT CONTROLS

WING LANDING LIGHT SWITCHES

Two-position toggle switches that control the left and right landing lights mounted in wing fillet leading edges.

2G9, 10 - WING LANDING

NOSE WHEEL LANDING LIGHTSWITCH

Two-position toggle switch that controls landing/taxi lights mounted on nose wheel strut for landing brilliance.

2G6, 7 - NOSE GEAR LIGHTS

NOSE WHEEL TAXI LIGHT SWITCH

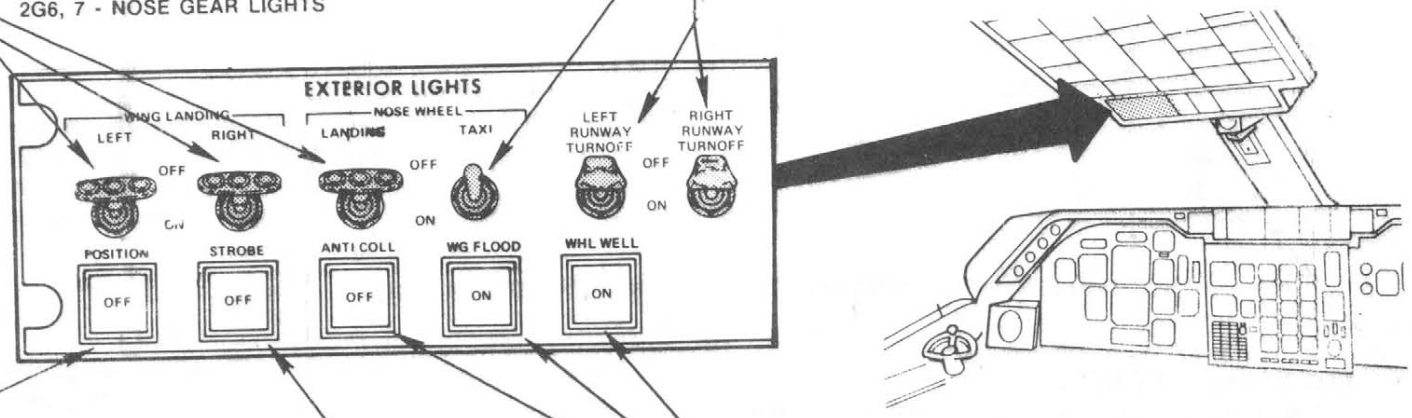
Two-position toggle switch that controls landing taxi lights mounted on nose wheel strut for taxi brilliance.

2G6, 8 - TAXI

RUNWAY TURNOFF LIGHT SWITCHES

Two-position toggle switches that control lights in the fuselage wing fillet leading edge.

2G4, 11-RUNWAY TURNOFF



STROBE LIGHTS SWITCH

Controls forward and aft strobe lights, mounted on each wing tip.

LCH - Normal flight position. **OFF** extinguishes and stobe lights illuminate.
UNL - **OFF** illuminates and strobe lights extinguish.

2G5 - STROBE

POSITION LIGHTS SWITCH

Controls/arms the four position lights mounted on each wing tip.
LCH - Normal position. **OFF** is extinguished. The two white lights on the aft end of each wing tip, the lower red light on the left wing tip and lower green light on the right wing tip illuminate. The upper green and red position lights are armed to illuminate when the **ANTI-COLL** light switch is latched.
UNL - **OFF** is illuminated and position lights extinguish.

2K3, 4, 5, 6 - WING POSITION

WHEEL WELL LIGHTS SWITCH

Controls wheel well lights.
LCH - **ON** is illuminated and wheel well lights illuminate.
UNL - **ON** is extinguished and wheel well lights extinguish.

2K1, 2 - WHEEL WELL CONT PWR

WING FLOOD LIGHTS SWITCH

Controls fuselage mounted lights to illuminate wing leading edges and engine inlets.
LCH - **ON** illuminates and wing flood lights illuminate.
UNL - **ON** extinguishes and wing flood lights extinguish.

2G3 - WING FLOOD

ANTI-COLLISION LIGHTS SWITCH

Controls rotating lights on top and bottom of fuselage.
LCH - Normal position when aircraft is in motion or any engine is operating. **OFF** is extinguished and anti-collision lights illuminate.
- Upper red and green position lights illuminate if POSITION lights switch is latched.

UNL - Normal position when aircraft is parked and engines shut down. **OFF** illuminates and anti-collision lights extinguish.

3J15, 16, 17, 18-ANTI-COLLISION LTS

EXTERIOR LIGHT CONTROLS
(EYEBROW PANEL)

MAGNETIC COMPASS LIGHT CONTROL

Rotate to control intensity of magnetic compass light.

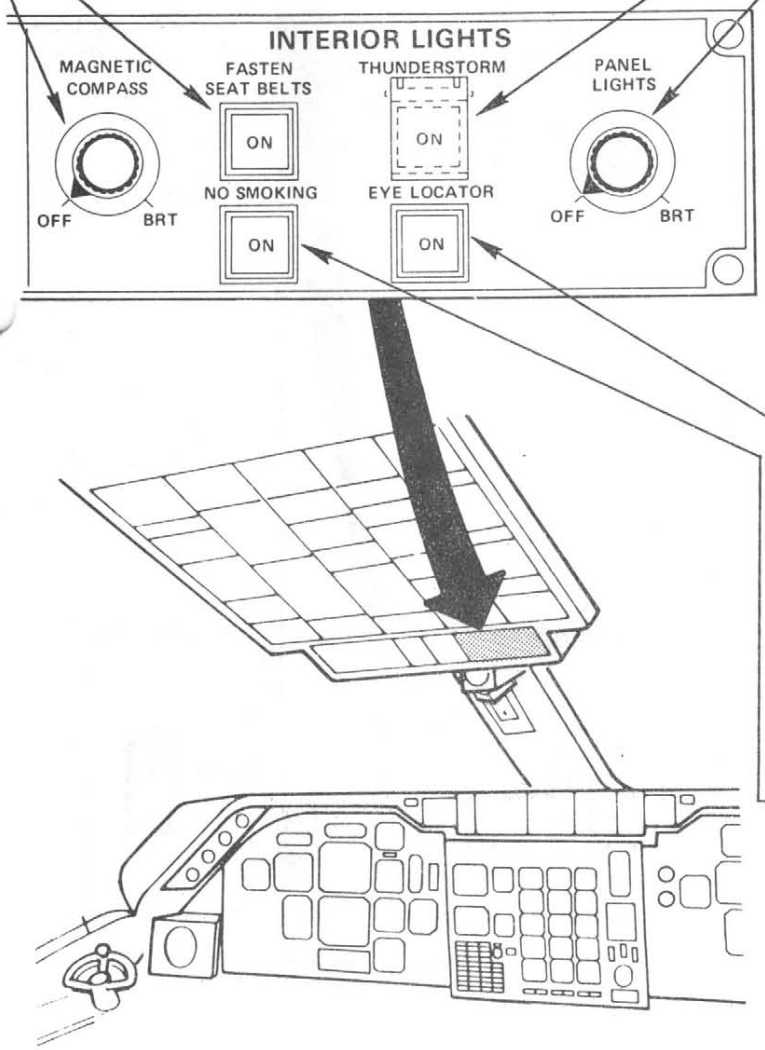
1F8 - LIGHTS, STBY COMPASS

FASTEN SEAT BELT SIGN SWITCH

LCH - **ON** illuminates, single chime sounds, and cabin **FASTEN SEAT BELT** and lavatory **RETURN TO SEAT** signs illuminate.

UNL - **ON** extinguishes, single chime sounds, and cabin and lavatory sign lights extinguish.

2C9 - SEAT SIGNS
2C11 - ORD LTS
5K18, 19 - FASTEN SEAT BELTS



THUNDERSTORM LIGHT SWITCH (GUARDED)

LCH - **ON** illuminates and all dimmable cockpit lights illuminate at full intensity regardless of dimming control position.

- To prevent excessive heat buildup do not leave this switch latched to provide general cockpit illumination.

UNL – **ON** extinguishes and intensity of cockpit lights determined by respective dimming control.

3J2 – THUNDERSTORM LT

EYEBROW PANEL LIGHT CONTROL

Rotate to control intensity of eyebrow panel background lights.

2E3 - OVHD AND EYEBROW PANEL

EYE LOCATOR LIGHT SWITCH

LCH - **ON** illuminates and pilots' eye position locator light illuminates.

UNL - **ON** extinguishes and pilots' eye position locator light extinguishes.

2E1 - EYE LCT AND APRCH CHART

NO SMOKING SIGN SWITCH

LCH - **ON** illuminates, single chime sounds, and cabin **NO SMOKING** signs illuminate.

UNL - **ON** extinguishes, single chime sounds, and cabin **NO SMOKING** signs extinguish.

2C10 - NO SMOKING SIGNS
2C11 - ORD LTS
5K16, 17 - NO SMOKING

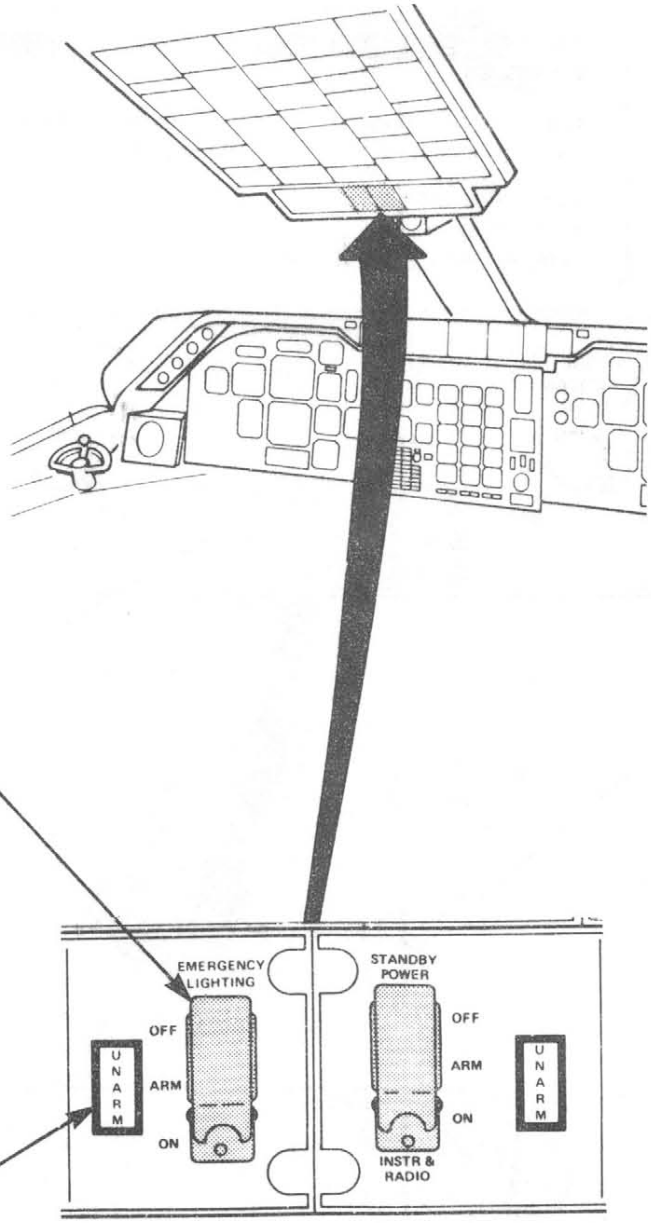
INTERIOR LIGHT CONTROLS
(EYEBROW PANEL)

EMERGENCY LIGHTS

The emergency lights system consists of aisle and entry way, lights located throughout the cabin, evacuation area lights on the outside fuselage adjacent to each cabin door, and a single light in the cockpit ceiling to illuminate the escape hatch area. Emergency light battery packs are located throughout the cabin to illuminate groups of emergency lights. Each battery pack will power its associated emergency lights for approximately 20 minutes.

The emergency lights are normally extinguished, and are controlled by an EMERGENCY LIGHTING switch on the pilots' eyebrow panel, and an EMER switch on the F/A panels at L1 and L4 doors and the lower galley.

With the EMERGENCY LIGHTING switch in ARM, the emergency lights illuminate automatically when power is lost on the DC essential bus. Positioning the EMERGENCY LIGHTING switch to ON or pressing any of the F/A EMER switches manually illuminates the emergency lights. If the emergency lights have been turned on from either flight attendant panel, they can only be turned off by the cockpit switch.



EYEBROW PANEL

EMERGENCY LIGHTING SWITCH

Guarded three position toggle switch.

OFF - Normal position for aircraft shutdown. Disarms the automatic function of all emergency lights.

- Emergency lights will still illuminate if any F/A panel EMER switch is actuated. EMERGENCY LIGHTING switch must be positioned to **ARM** and back to **OFF** to extinguish the lights.

ARM - Normal position from before start until shutdown. Emergency lights are armed to illuminate automatically if DC essential bus power is lost.

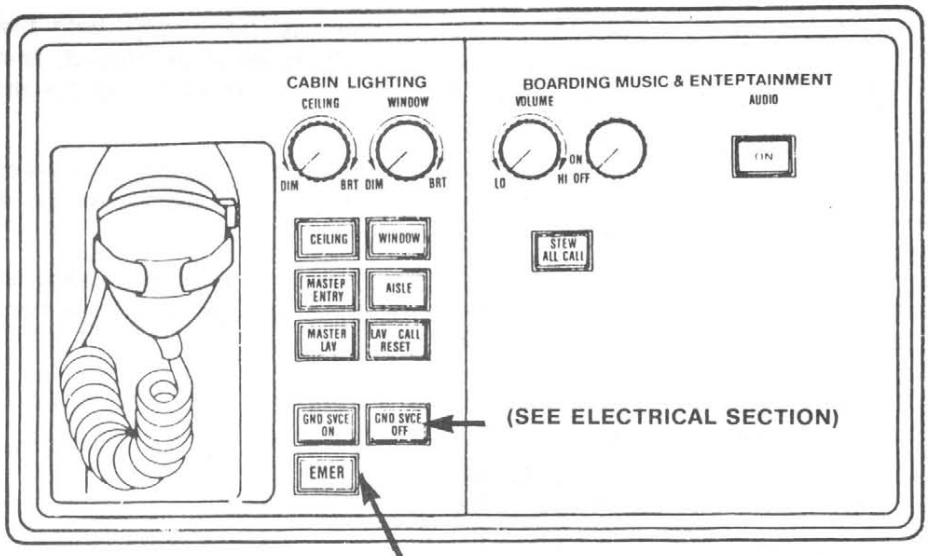
ON - Emergency lights illuminate.

3J6 - EMER LT CHARGE SENSE

UNARM LIGHT (AMBER)

Illuminates when the DC standby bus is powered and EMERGENCY LIGHTING switch is in **OFF** or **ON**, or when switch is in ARM and any emergency light illuminates.

1K14 - EMER UNARM IND



DOOR 1L F/A'S PANEL

LAVATORIES (2)

FLIGHT ATTENDANT SEATS
8 SINGLE
2 DOUBLE
2 SINGLE

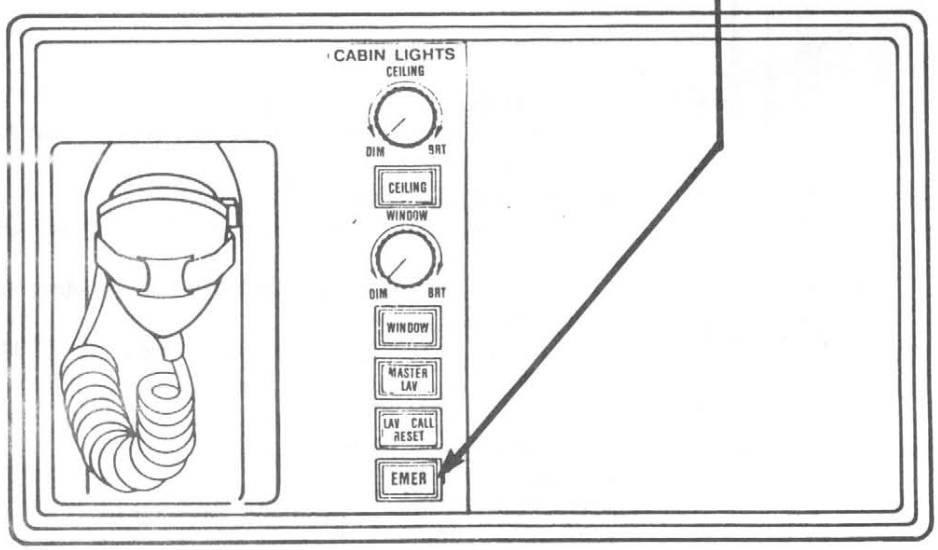
EMERGENCY LIGHT SWITCH (3)

Momentary switch. When pressed, all emergency lights illuminate regardless of position of cockpit EMERGENCY LIGHTING switch, and the **UNARM** light in the cockpit illuminates. Lights may be extinguished only by cycling the flight station switch from arm to OFF.

1K16 - EMER UNARM IND
3J6 - EMER LT CHG SENSE

EMER

LOWER GALLEY
BETWEEN THE LIFTS



DOOR 4L F/A'S PANEL

LAVATORIES (5)

GALLEY LIFTS

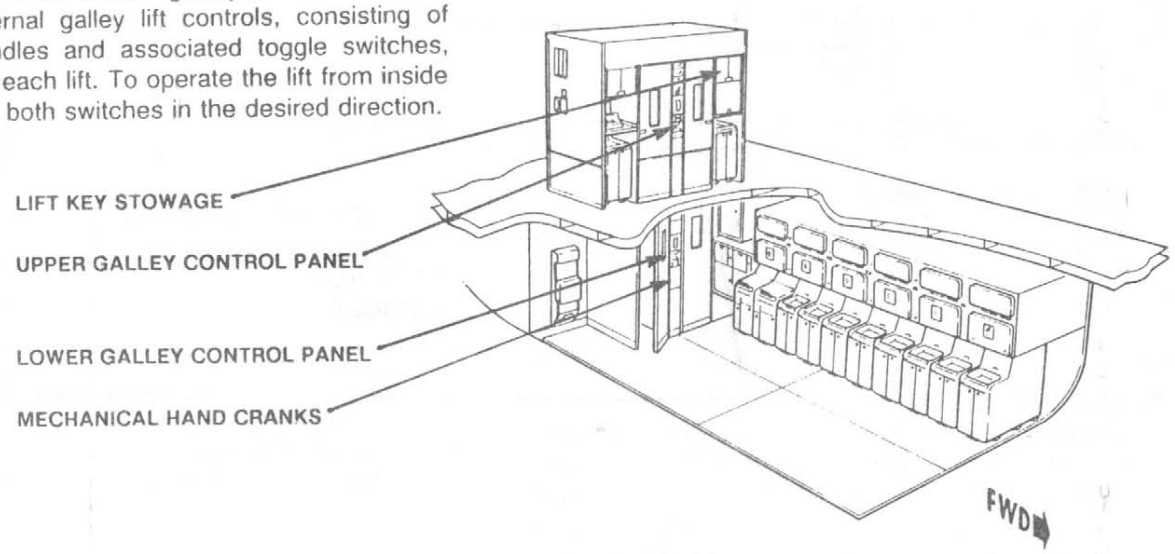
Two lifts provide access from the main cabin to the lower galley. Each lift may transport either one person or one service cart at a time. In addition, the top of each lift cage can be used to stow a serving cart while the lift is in the down position.

Each lift is operated by two electric motors designated as A and B. Should one motor fail, the remaining motor will operate the respective lift at half speed. To transport serving carts, external galley lift controls are located on panels between the lift doors at the upper and lower galleys. To transport personnel, internal galley lift controls, consisting of two assist handles and associated toggle switches, are installed in each lift. To operate the lift from inside press and hold both switches in the desired direction.

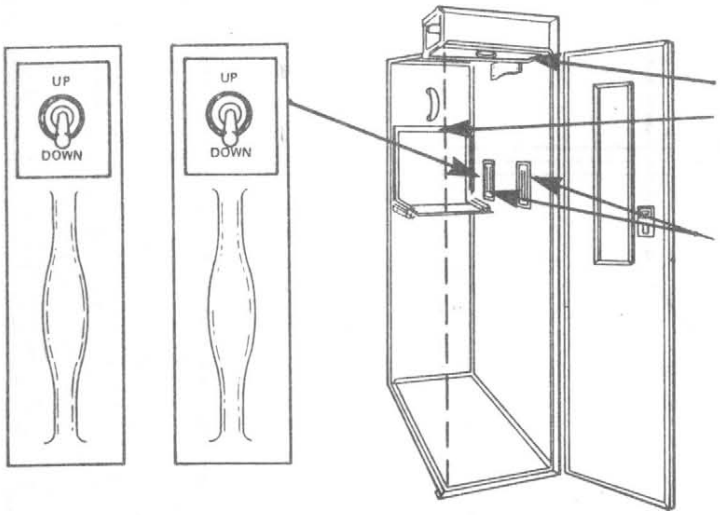
NOTE: To operate the lifts electrically, both the lower and upper lift doors must be closed, and any serving cart removed from the top of the lift cage.

Mechanical hand cranks are located below the lower galley lift control panel to provide a manual means of raising and lowering the lifts.

A fold-down step and hatch in the top of each lift cage provides a means of emergency escape from the lift or lower galley.



MID CABIN AREA



INTERNAL LIFT CONTROLS

GALLEY LIFT CAGE

LIFT CONTROL TOGGLE SWS

Press and hold both switches in desired direction to activate lift.

- To arm the toggle switches:
  - The upper and lower galley lift doors must be closed;
  - The Master Key switch must be in position to enable the respective lift;
  - Serving cart must be removed from top of lift cage.

4L21 - GALLEY LIFT ISLN
4C2 - LIFT LEFT
5G11 - LIFT RIGHT
3Z10 - PASS SVCE BUS 1R
3Z16 - PASS SVCE BUS 3L

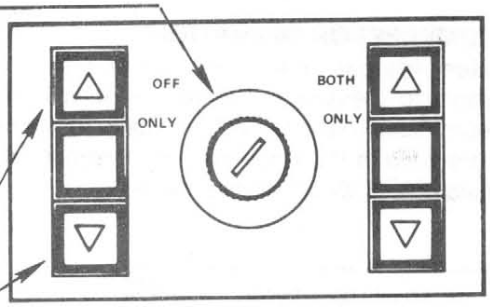
MASTER KEY SWITCH

Four position key operated switch that controls availability of electrical power to the lifts. Key is stowed in a compartment adjacent to the left (Captain's) lift.

OFF - Power is removed from both lifts.

BOTH - Power is available to both lifts.

ONLY - Power is available only to the selected lift.



UPPER GALLEY PANEL

LIFT CONTROL SWITCHES

Momentary switches which control electric operation of the respective lift cage from the outside.

- Respective arrowhead illuminates on the upper and lower galley control panels anytime a motor is powered.

△**(UP)** – Cage is energized to move up.
STOP Overrides any up or down signal to stop cage.
▽**(DOWN)** – Cage is energized to move down.

4L21 - GALLEY LIFT ISLN
4C2 - LIFT LEFT
5G11 - LIFT RIGHT
3Z10 - PASS SVCE BUS 1R
3Z16 - PASS SVCE BUS 3L

NOTE: External lift control switches are not to be used to transport personnel.

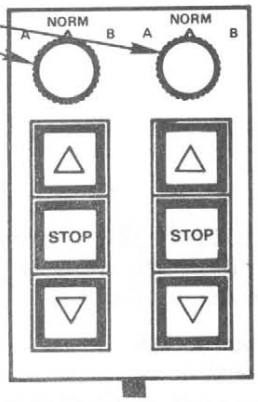
MOTOR SELECTOR SWITCHES (2)

Three position rotary switch.

NORM - Normal position with both motors operating.

A - B motor removed from system. Respective cage will move at half normal speed.

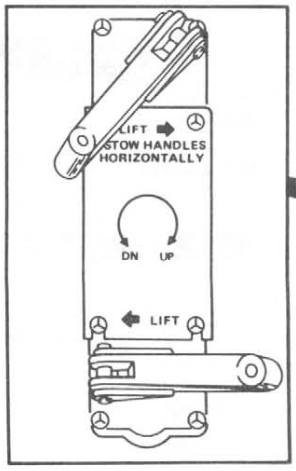
B - A motor removed from system. Respective cage will move at half normal speed.

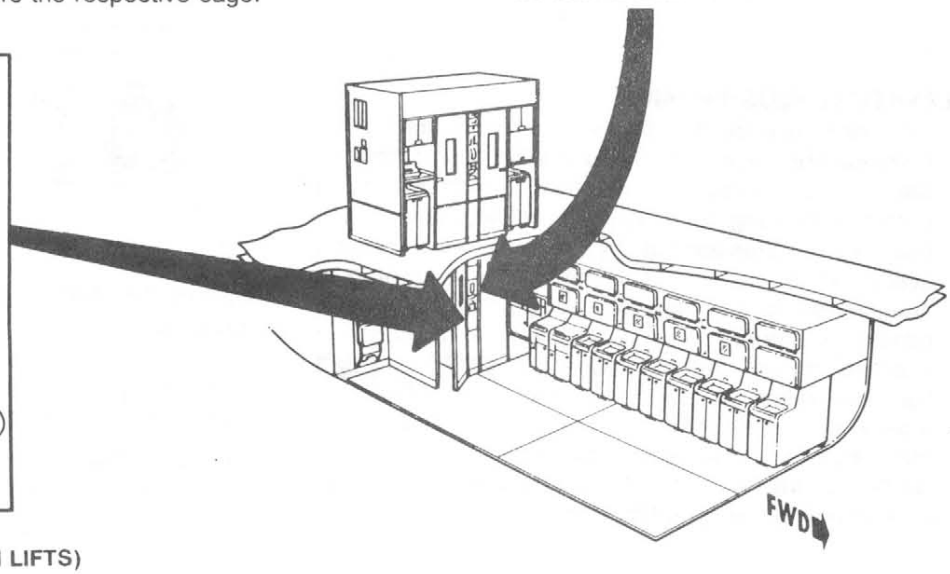


LOWER GALLEY PANEL

MECHANICAL HAND CRANKS (2)

Provides mechanical operation of the lift cages. Clockwise rotation raised the respective cage. Counterclockwise rotation lowers the respective cage.

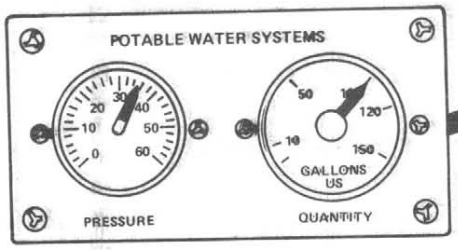




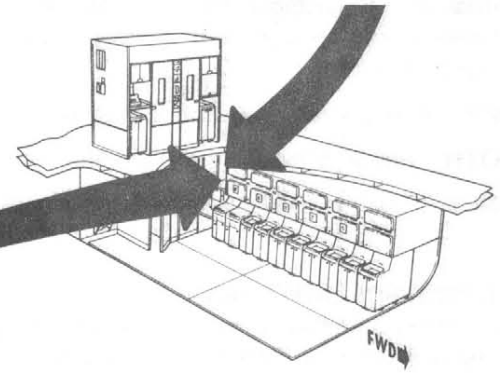
LOWER GALLEY (BETWEEN LIFTS)

WATER COMPRESSOR OPERATION

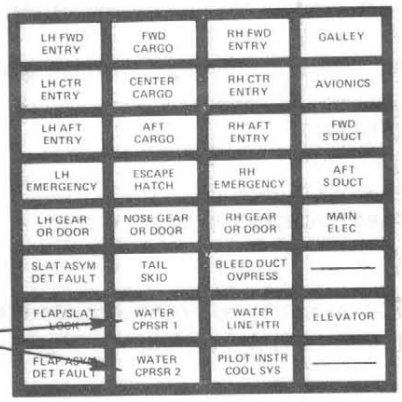
The water system uses two motor-driven air compressors to pressurize the water reservoir. Each compressor motor operates automatically to maintain desired pressure in the reservoir. System cannot be pressurized unless water valve is closed.



WATER FILL VALVE LEVER ACCESS
Behind kleenex box by sink



LOWER GALLEY



S/O ANNUNCIATOR PANEL

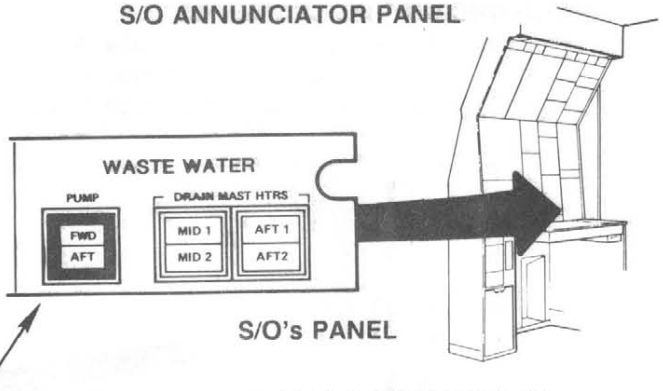
WATER CPRSR LIGHTS (2)

Respective light illuminates when a compressor fails to run after receiving a run signal.

4G20 - WATER SVCE PRESS
4H20 - WATER PRESS
5G2, 5 - WATER SYSTEM PRESSURIZATION

LAVATORY FLUSH PUMPS

The two forward lavatories are connected to a common flushing manifold and holding tank. Likewise. the five aft lavatories are also connected to a common flushing manifold and holding tank. Each manifold is pressurized by one of three pumps contained in each holding tank. The pumps run sequentially when signalled by the lavatory flush handles. If a pump fails the next pump in sequence is signaled to run, and the respective FWD or AFT light illuminates on the S/O's Annunciator Panel to indicate the system should be checked by Maintenance (also see Abnormal Procedures). Normal operation of the lavatories will continue as long as one pump is operable in each system.



S/O's PANEL

WASTE WATER PUMP FWD / AFT LIGHTS (AMBER)

Respective light illuminates when any of the three flush pumps in each holding tank fails to operate after receiving a run signal.

2B3, 6, 9 - FWD LAV FLUSH PUMPS
5B5, 8, 11 - FLUSH PUMP AFT LAV

MOVIE SYSTEM

A video-tape based movie projection system is installed. Operation of the projector equipment is controlled from panels in the cabin. When any projector is in operation the respective FWD or AFT light illuminates on the S/O's instrument panel. A guarded alternate-action switch is also installed on the S/O's instrument panel to permit shutdown of all projectors from the cockpit.

MOVIE INTERRUPT SWITCH

Guarded alternate-action switch which permits flight crew to shutoff all power to the movie projector system. When switch is actuated OFF illuminates (white) after power is removed from all projectors.

4D5-12 - MOVIES PROJECTOR 1, 2, & 3.

AURAL WARNING SYSTEM

The tables on the following two pages describe the types of aural warnings which are provided, and what conditions are required to actuate, silence and test each warning. Certain warnings can be tested using the AURAL WARN TEST panel on the S/O's instrument panel. This panel tests only the aural warning, and not the system or equipment. However, the unsafe takeoff position checks the circuitry to the three cargo doors and lights and the jammed elevator system and lights. The takeoff warning will not sound for an open cargo door during takeoff.

AURAL WARNING TEST SELECTOR

Five position selector that determines which warning is tested when the aural warning TEST button is pressed.

A/C OVSP - Sounds overspeed clacker.

CAB PRESS - Sounds cabin altitude intermittent horn (same sound as unsafe takeoff).

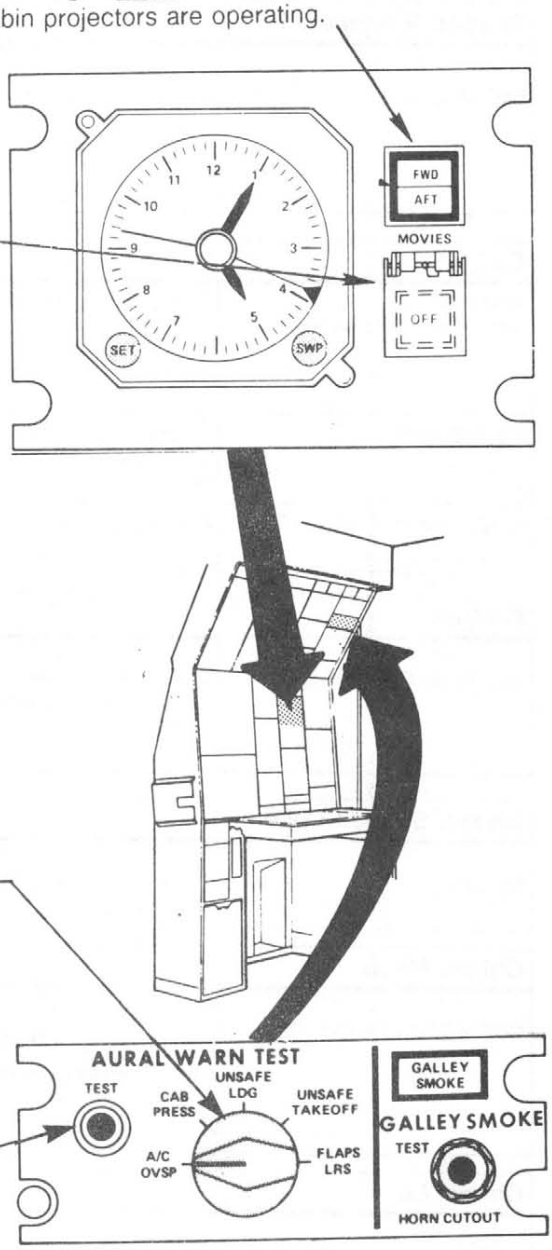
UNSAFE LDG - Sounds steady horn that indicates when landing gear is not down and locked for landing.

UNSAFE TAKEOFF - Sounds intermittent horn that indicates an unsafe takeoff condition. The FWD CARGO, MID CARGO, AFT CARGO and ELEVATOR lights on the S/O's Annun. Panel, and the DOOR and ELEVATOR lights on the Pilots' Annunciator Panel also illuminate. This test also checks the circuitry to the three cargo doors and lights and the elevators and lights.

FLAP LRS - Sounds buzzer. LRS system has been deactivated. LRS computer still installed and performs scheduling of Rudder Hydraulic Limiter. Buzzer sounds for 2 seconds if computer has failed.

MOVIE OPERATING LIGHT (WHITE)

FWD illuminates when forward cabin projector is operating. AFT illuminates when mid cabin or aft cabin projectors are operating.



S/O'S INSTRUMENT PANEL

AURAL WARNING TEST BUTTON

- Momentary pushbutton to test aural warnings.
- When pressed and held, activates aural warning for the system selected by the aural warning test selector.

1L6 - TEST & RESET
1L7 - OVSP
1L8 - MULT SND

AURAL WARNINGS

WARNING/CONDITION	ACTUATION	SILENCING	TESTING
Beeper, Intermittent			
EMERG EVAC	Sounds at all stations when command switch on cockpit panel is activated.	HORN CUTOUT button on each evacuation signalpanel will silence respective panel's beeper.	Same as actuation.
Bell			
APU FIRE (Also, horn in aft fuselage)	Overheat or fire in APU compartment.	• BELL CUTOUT button. • FIRE PULL Handle. • Master FIRE lights.	Fire Detection Loop Test panel. APU MASTER POWER switch must be ON for horn, which is located on the bottom left side of the aft fuselage, to sound.
ENGINE FIRE	Overheat or fire in engine accessory area or burner section.	• BELL CUTOUT button. • FIRE PULL Handle. • Master **FIRE** lights.	Fire Detection Loop Test panel.
WHEEL WELL FIRE	Overheat or fire in either main landing gear wheel well.	• BELL CUTOUT button. • Master FIRE lights.	Wheel Well Fire Test panel.
C-Chord			
ALTITUDE ALERT	At ± 250 ft. on approach to, or deviation from, the selected altitude.	½–second duration.	Test button on altitude select panel.
Chime, Single Stroke			
SELCAL	Call from selected station.	Press **SELCAL** light.	Radio check.
Chime, Hi-Lo			
CABIN-TO-FLT STA CALL	Call button on any handset with cabin interphone selected and dial set to FLT STA.	Single Hi-Lo chime per call.	Same as actuation.
Chime, Lo			
GROUND-TO-FLT STA CALL	Activation of GND-TO-CKPT call button in nose wheelwell.	Single Lo chime per call.	Same as actuation.
Clacker			
AIRCRAFT OVERSPEED	Indicated airspeed at or exceeding V_{MO}/M_{MO}.	Reduce airspeed to below V_{MO}/M_{MO}.	AURAL WARN TEST panel.
Glideslope			
GROUND PROXIMITY WARNING SYSTEM (GPWS)	Excessive deviation below the ILS glide slope.	Warning will sound until condition is corrected, or GS light is pressed.	Press PULL UP light on GPWS panel.

AURAL WARNINGS (CONT'D.)

WARNING/CONDITION	ACTUATION	SILENCING	TESTING
Horn, Intermittent			
CABIN ALTITUDE	Cabin altitude in excess of 10,000 ft.	HORN CUTOUT button above Cabin pressure Control panel.	AURAL WARN TEST panel.
ELEVATOR	Jammed elevator. All throttles must be below Max continuous thrust position and aircraft on the ground.	Warning sounds until condition is corrected.	AURAL WARN TEST panel.
UNSAFE TAKEOFF	Any two throttles advanced beyond 50% of takeoff position, and any of the following: • Flaps not within 4° to 22° takeoff range. • Pitch trim not within 2.5° to 8° band. • Speedbrake lever not full FWD. • One or more slat segment lights extinguished.	Warning sounds until condition is corrected.	AURAL WARN TEST panel.
Horn, Steady			
UNSAFE LANDING	Gear not down and locked and: • Airspeed less than 180 kts. with any throttle retarded to idle. • Flaps extended more than 30°.	HORN CUTOUT button on center console. Will not silence until gear is down and locked.	AURAL WARN TEST panel.
Tone, Intermittent			
GALLEY SMOKE (Flashing Galley SMOKE)	Excessive smoke in galley.	HORN CUTOUT switch on Galley Smoke panel.	GALLEY SMOKE panel TEST switch.
GALLEY DUCT FIRE (Steady Galley SMOKE)	Fire or overheat in galley duct.	HORN CUTOUT switch on Galley Smoke panel.	Guarded ALARM TEST switch in lower galley (ground only).
Tone, Intermittent Increasing Rate			
DECISION HEIGHT (DH)	At 50 ft. above selected DH on respective radio altimeter. Repetition rate increases as aircraft approaches DH.	Off automatically at DH.	Use DH Select Knob on radio altimeter.
Wailer			
AUTOPILOT DISCONNECT	Disconnect of either AP channel by any means (APFDS logic or pilot). Disconnect of both AP channels in dual A/L mode.	2-second duration. Horn may also be silenced prior to 2 seconds by depressing either Alert Light, either A/P Control Wheel Disconnect Button or by reengaging an A/P	Engage and disconnect each autopilot channel.
Whoop Whoop, Pull Up			
GROUND PROXIMITYWARNING SYSTEM (GPWS)	• Excessive sink rate below 2500 ft. AGL. • Excessive closure rate toward rising terrain. • Descent immediately after takeoff. • Not in landing configuration below 500' AGL.	Warning will sound until condition is corrected or INHIBIT switch is pressed.	Press PULL UP light on GPWS panel.

PILOTS' ANNUNCIATOR PANEL

The Pilots' Annunciator Panel provides a means of alerting the crew to a warning or malfunction in one of the aircraft systems. The specific malfunction can then be identified by examination of the affected system panel(s). All lights on this panel will illuminate when the Warning, Caution, and Advisory Lights TEST switch is latched on the Pilot's Overhead Panel. When Advisory Lights Test Sw is latched, the remaining lights blink for 10 seconds then stay on steady for up to 5 minutes or until Test Sw unlatched. the Engine 2 Fail Armed Light illuminates steady.

When a malfunction is first detected the annunciator lights flashes for 10 seconds then illuminates steady until the condition is corrected, or the RESET button is pressed.

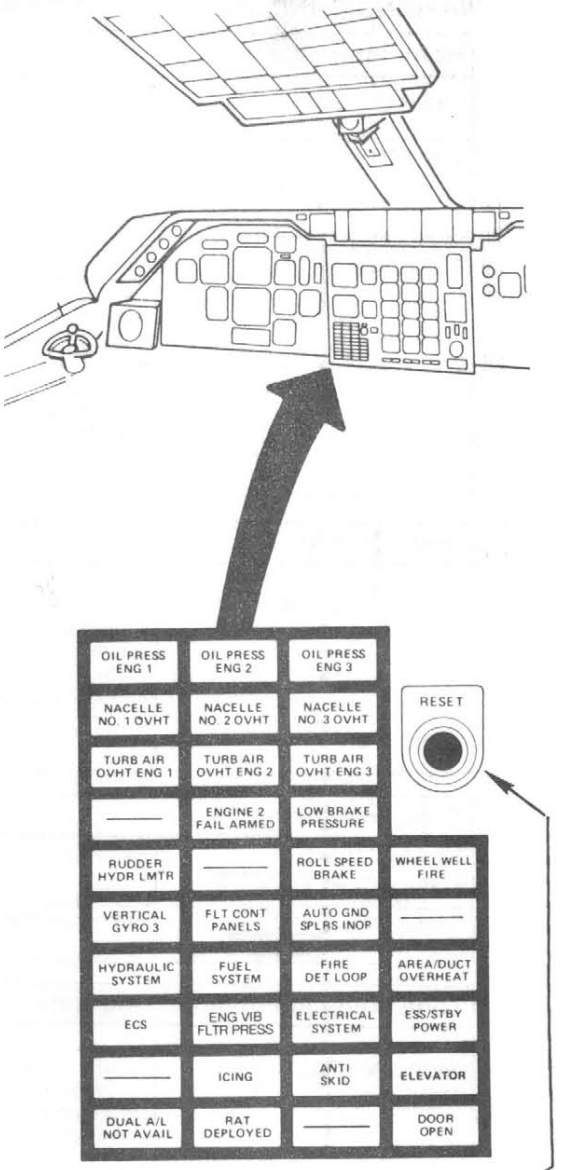
NOTE: The green ENG TWO FAIL-ARMED light is a normal indication and always illuminates steady.

Each annunciator light contains two bulbs.

To replace bulbs, press the lens cap and release. An internal latch will be released and the light assembly will be spring-loaded away from the panel approx. – inch. Pull the light straight out until the back of the light is clear of the panel. Release the light assembly, and allow it to pivot on the retainer clip to expose the bulbs. Remove burned out bulbs from the base end and replace.

To insert the light assembly, press in firmly against the panel and release. The light should latch and the lens cap be flush with the surrounding lights.

CAUTION:
LIGHTS WILL NOT ILLUMINATE IF UNLATCHED.



ANNUNCIATOR LIGHT RESET BUTTON

- Momentary pushbutton.
- Pressing button extinguishes all illuminated annunciator panel lights except the green ENG TWO FAIL-ARMED.
  - Any lights for systems which have malfunctioned, and have not been corrected can be recalled by latching and unlatching the Warning, Caution, and Advisory Lights TEST switch on the Pilot's Overhead Panel.

PILOTS' ANNUNCIATOR PANEL

PILOTS' ANNUNCIATOR LIGHTS

ANNUN LIGHT	CONDITION	ASSOCIATED INDICATORS
OIL PRESS ENG 1 OIL PRESS ENG 2 OIL PRESS ENG 3	Engine No. 1, 2 or 3 oil pressure is below 18 psi. Cross-check with associated indicators.	• Oil quantity indicator. • Oil temperature indicator. • Oil pressure indicator.
NACELLE NO. 1 OVHT NACELLE NO. 2 OVHT NACELLE NO. 3 OVHT	• Pneumatic leak (duct rupture). • Selected loop(s) detect an overheat.	• Respective engine loop lights on the NACELL PYLON OVERHEAT DET TEST panel. • Respective HI-PRESS valve closed on Pneumatic panel.
TURB AIR OVHT ENG 1 TURB AIR OVHT ENG 2 TURB AIR OVHT ENG 3	Both thermal switches detect excessive air temperature at N_2 turbine.	Respective **OVHT** light on ENG TURBINE COOLING AIR panel.
ENGINE 2 FAIL ARMED	Illuminates when flaps are in takeoff range and No. 2 engine N_2 RPM exceeds 83% to indicate the **ENG 2 FAIL** lights are armed to illuminate if loss of No. 2 engine thrust occurs during takeoff (N_2 RPM below 79%). Light extinguishes upon liftoff and **ENG 2 FAIL** lights are disarmed.	**ENG TWO FAIL** lights (Captain's & First Officer's).
LOW BRAKE PRESSURE	Brake accumulator pressure is low.	• Brake Press indicator. • S/O BRAKE ACCUM NORM/ALT **LOW PRESS** light.
RUDDER HYDR LMTR	Rudder hydraulic limiter scheduling is incorrect for existing airspeed.	• **FLT CONT PANELS** light. • **PUSH** light on RUDDER LIMITER HYDRAULIC's.
ROLL SPEED BRAKE	• Spoiler L & R1 fault. • Spoiler L & R1 control jam with flaps extended. • Mixer fault for spoilers L & R_2, 3 & 4. Monitor PFCS panel for specific fault.	Associated SPOILER **OFF PUSH** light.
WHEEL WELL FIRE	Wheel well fire detection system has sensed an excessive main gear wheel well temperature.	WHEEL WELL FIRE TEST panel loop lights.

PILOTS' ANNUNCIATOR LIGHTS

ANNUN LIGHT	CONDITION	ASSOCIATED INDICATORS
VERTICAL GYRO 3	Vertical gyro 3 has failed while not being used (on ship 724, monitors No. 3 INS gyro platform when installed) and is labeled "ATT 3".	• ATT MON on the instrument comparator panel.
FLT CONT PANELS	Flight control system has malfunctioned. Monitor overhead panels for specific fault.	• RUDDER HYDR LIMITER. • Any FCES FAIL except STALL WARN. • Any PITCH or ROLL MONITOR FAIL. • RUDDER OFF. • AILERON OFF. • SPOILER OFF. • SPOILER PUSH. • MACH FEEL FAIL. • RUDDER HYD PUSH.
AUTO GND SPLRS INOP	• Automatic ground spoilers are inoperative. • DLC may be operative if light caused by loss of C system hudraulic pressure.	• Illumination of any two FAIL and or OFF lights in the DLC AUTO SPOILER switches. • HYD SYS C LO PR light. • Speedbrake automatic disable lights with flaps extended beyond 30°.
HYDRAULIC SYSTEM	Hydraulic system has malfunctioned. Monitor hydraulic system panel.	• Reservoir quantity indicators (4). • Reservoir fluid monitor LO QTY/HI TEM lights (4) • ATM lube monitor HI TEM/LO PR lights (2). • Engine driven pump control switch OFF lights (4). • Engine driven pump HI TEM/LO PR lights (4). • Brake accumulator LOW PRESS lights.
FUEL SYSTEM	Fuel system has malfunctioned. Monitor fuel system panel.	• Tank 2L, 1, 3, 2R pump switch LOW lights (8). • 2L & 2R INBD tank LOW lights (2). • ENG 1, 2, & 3 FUEL PRESSURE lights (3).
FIRE DET LOOP	Selected loop(s) detect an overheat (fire) in the respective engine or APU.	• Master FIRE warning lights. • Respective FIRE PULL handle. • Respective loop lights on the FIRE DETECTION LOOP TEST panel.
AREA/DUCT OVERHEAT	Engine bleed air ducting is overheated or ruptured. Monitor pneumatic and wing anti-ice panels for specific fault.	• Wing anti-ice DUCT FAIL lights (2). • Engines 1, 2, & 3 DUCT OVHT lights (3). • A, B, C, D, E, J, & H AREA OVHT lights (7).
ECS	Environmental control system has malfunctioned. Monitor pneumatic panels.	• Pressure relief valve FWD & AFT OPEN lights (2). Cabin pressure FAULT light. • Manual selector switches MNL lights (2). • Cool air overboard CLOSE light. • Avionic air FWD & MID OVBD LO FLO lights (4). FWD, MID, & AFT cargo heat HOT lights (3). • Pack flow control valve OVHT lights (3). • Hot air isolation valve OVHT lights (2). • RAM AUTO light. • Floor Heat FAIL light (if installed).
ENG VIB FLTR PRESS	• Vibration exceeds 2.5 units, or • Excessive pressure differential across an engine oil filter.	• Engine VIB indicators. • Engine 1, 2, & 3 FILTER PRESSURE lights (3).

PILOTS' ANNUNCIATOR LIGHTS

ANNUN LIGHT	CONDITION	ASSOCIATED INDICATORS
ELECTRICAL SYSTEM	• Electrical system has an abnormal condition. Monitor electrical panel. • Light is illuminated as long as the APU MASTER POWER switch is ON and APU is not operating.	• IDG DISCONNECT LOW PRESS lights (3). • GENERATOR FIELD OPEN lights (4). • FLT STA BUS FAIL lights (3). • Bus TIE BREAKER OPEN lights (3). • APU GEN OIL low PRESS light.
ESS/STBY POWER	AC or DC essential standby power source has failed. Monitor electrical panel for specific fault.	• Standby power ON light. • DC essential and standby bus FAIL lights. • AC essential and standby bus FAIL lights.
ICING	Icing probe is detecting ice build-up.	If icing conditions exist, ice will begin to form on windshield posts.
ANTI SKID	Selected Anti-skid system is inoperative or parking brake is set.	Anti-skid switch OFF light.
ELEVATOR	An elevator jam has been detected. Aircraft must be on the ground, and throttles at less than max. continuous thrust for light to be armed to illuminate.	ELEVATOR light on S.O.'s Annunciator panel. Intermittent horn will sound.
DUAL A/L NOT AVAIL	Dual A/L operation (CAT III) not available unless fault can be cleared.	• Flashing ALERT and [NO DUAL] on AFCS warning panel. • Any system failure which would affect APFDS operation such as NAV, HDG, or ATT flags, nav radios, YAW SAS etc.
RAT DEPLOYED	RAT is deployed.	Ram air turbine switch UNLKD and PRESS lights.
DOOR OPEN	Any passenger or compartment door not securely closed. Monitor S.O's Annun. Panel.	The annunciator lights in the top five rows on the S.O's Annun. Panel (except for gear doors).

SECOND OFFICER'S ANNUNCIATOR PANEL

LH FWD ENTRY	FWD CARGO	RH FWD ENTRY	GALLEY
LH CTR ENTRY	CENTER CARGO	RH CTR ENTRY	AVIONICS
LH AFT ENTRY	AFT CARGO	RH AFT ENTRY	FWD S DUCT
LH EMERGENCY	ESCAPE HATCH	RH EMERGENCY	AFT S DUCT
LH GEAR OR DOOR	NOSE GEAR OR DOOR	RH GEAR OR DOOR	MAIN ELEC
SLAT ASYM DET FAULT	TAIL SKID	BLEED DUCT OVPRESS	———
FLAP/SLAT LOCK	WATER CPRSR 1	WATER LINE HTR	ELEVATOR
FLAP ASYM DET FAULT	WATER CPRSR 2	PILOT INSTR COOL SYS	———

S/O'S INSTRUMENT PANEL

The S O's Annunciator Panel provides a means of alerting the S O to a warning or malfunction in one of the aircraft doors or a system fault All lights on this panel will illuminate when the Warning, Caution, and Advisory Lights TEST switch is latched on the lower left side of the S O's Instrument Panel.

When a malfunction is detected the annunciator light illuminates until the condition is corrected.

Each annunciator light contains two bulbs.

To replace bulbs, press the lens cap and release. An internal latch will be released and the light assembly will be spring-loaded away from the panel approximately – $\frac{1}{4}$ inch. Pull the light straight out until the back of the light is clear of the panel. Release the light assembly, and allow it to pivot on the retainer clip to expose the bulbs. Remove burned out bulbs from the base end and replace.

To insert the light assembly, press in firmly against the panel and release. The light should latch and the lens cap be flush with the surrounding lights.

CAUTION:
LIGHT ASSEMBLIES WILL NOT ILLUMINATE IF UNLATCHED.

SECOND OFFICER'S ANNUNCIATOR PANEL LIGHTS

ANNUNCIATOR LIGHT	CONDITION	ASSOCIATED INDICATORS
	The following lights are self explanatory. They indicate that a specific door or hatch is not securely closed and latched.	**DOOR OPEN** illuminates on the Pilots' Annunciator Panel when any of these lights illuminate.

LH FWD ENTRY	FWD CARGO	RH FWD ENTRY	GALLEY
LH CTR ENTRY	CENTER CARGO	RH CTR ENTRY	AVIONICS
LH AFT ENTRY	AFT CARGO	RH AFT ENTRY	FWD S DUCT
LH EMERGENCY	ESCAPE HATCH	RH EMERGENCY	AFT S DUCT
			MAIN ELEC

SECOND OFFICER'S ANNUNCIATOR PANEL LIGHTS

ANNUN LIGHT	CONDITION	ASSOCIATED INDICATORS
LH GEAR OR DOOR NOSE GEAR OR DOOR RH GEAR OR DOOR	• If the pilots' **IN TRANS** , **DOOR** , and three green lights are all illuminated a door fault exists. The illuminated light on this panel identifies which door. • If the pilots' **IN TRANS** light is illuminated, but the **DOOR** and one or more green lights are extinguished a gear fault exists. The illuminated light on this panel identifies which gear.	• Pilots' red **IN TRANS** light. • Pilots' red **DOOR** light. • Pilots' 3 green (LEFT GEAR, NOSE GEAR and RIGHT GEAR) down-and-locked lights. • Visual landing gear position indicators.
SLAT ASYM DET FAULT	A fault is detected in the slat asymmetry detection system.	Slat segment lights and slat position indicator.
TAIL SKID	Tailskid is in transit (tailskid position does not agree with landing gear lever position), or tailskid is contacting the ground.	Landing gear lever position.
BLEED DUCT OVPRESS	Pressure downstream of engine isolation valve is excessive.	Engine isolation valve **-FB-** extinguished.
FLAP/SLAT LOCK	The leading edge slats or trailing edge flaps have locked due to asymmetry.	• Flap indicator. • Slat indicator and lights.
WATER CPRSR 1	Water compressor No. 1 has failed.	None.
WATER LINE HTR	Waterline heater has failed, or No. 2 heater is supplementing No. 1 heater.	None.
ELEVATOR	An elevator jam has been detected. Aircraft must be on the ground, and throttles at less than max. continuous thrust for light to be armed to illuminate.	**ELEVATOR** light on Pilots' Annunciator Panel. Intermittent horn will sound
FLAP ASYM DET FAULT	A fault is detected in the flap asymmetry detection system.	Flap position indicator.
WATER CPRSR 2	Water compressor No. 2 has failed.	None
PILOT INSTR COOL SYS	Instrument cooling fan has failed or is not producing sufficient airflow.On ships 723 and up light also indicates when diverter has actuated.	None
PILOT INSTR COOL FAN	Ships 712-722 The Pilot Instrument Cooling Fan may have failed	None

-END-

AIRCRAFT GENERAL

GENERAL DESCRIPTION

PASSENGER CABIN

Galley and Cabin Servide Centers
The food service system includes forward, mid, and aft cabin galley complexes. The forward complex includes GI, GIA, and GIB; the mid, G2 and G3; and the aft, G4 and G5. there is no underfloor galley.

Lifts
Not installed.

Water Supply System
Potable water is supplied to galley and lavatory facilities from a tank installed in the aft cargo compartment. A water shutoff valve is located at each of the galleys, accessible through a door below the countertop. The shutoff valve in the main supply line, located below the water tank, is not accessible in flight.

A water pressure and quantity gauge is provided at the water servicing panel located in the bottom of the fuselage beneath the R2 door. On Ships 754–756, an additional quantity gauge is located on the S/O panel. The second officer should check these gauges during his preflight walkaround inspection.

Lavatories
Ships 736–741 have a lavatory on the left side of the business class section and one aft of 2R door. Ships 751–753 have an additional lavatory behind door 2L. Ships 754–756 have an additional lavatory behind door 2R.

CARGO, BAGGAGE AND SERVICE COMPARTMENTS

Cargo and Baggage Compartments
The forward cargo compartment has a smoke detection system and a fire extinguishing system installed. the same is true of the aft cargo compartment on Ships 754–756. There is no C3 door on Ships 754–756.

Accessories Compartments
Access to the MESC is through the cabin floor on the right aisle just aft of galley No. 3. A ladder stowed in the overhead of the MESC compartment provides access. A handle to release the ladder is located on the inboard side.

Compartment and Service Doors
A wider cargo door, designated CIA, is installed to provide access to the forward cargo compartment.

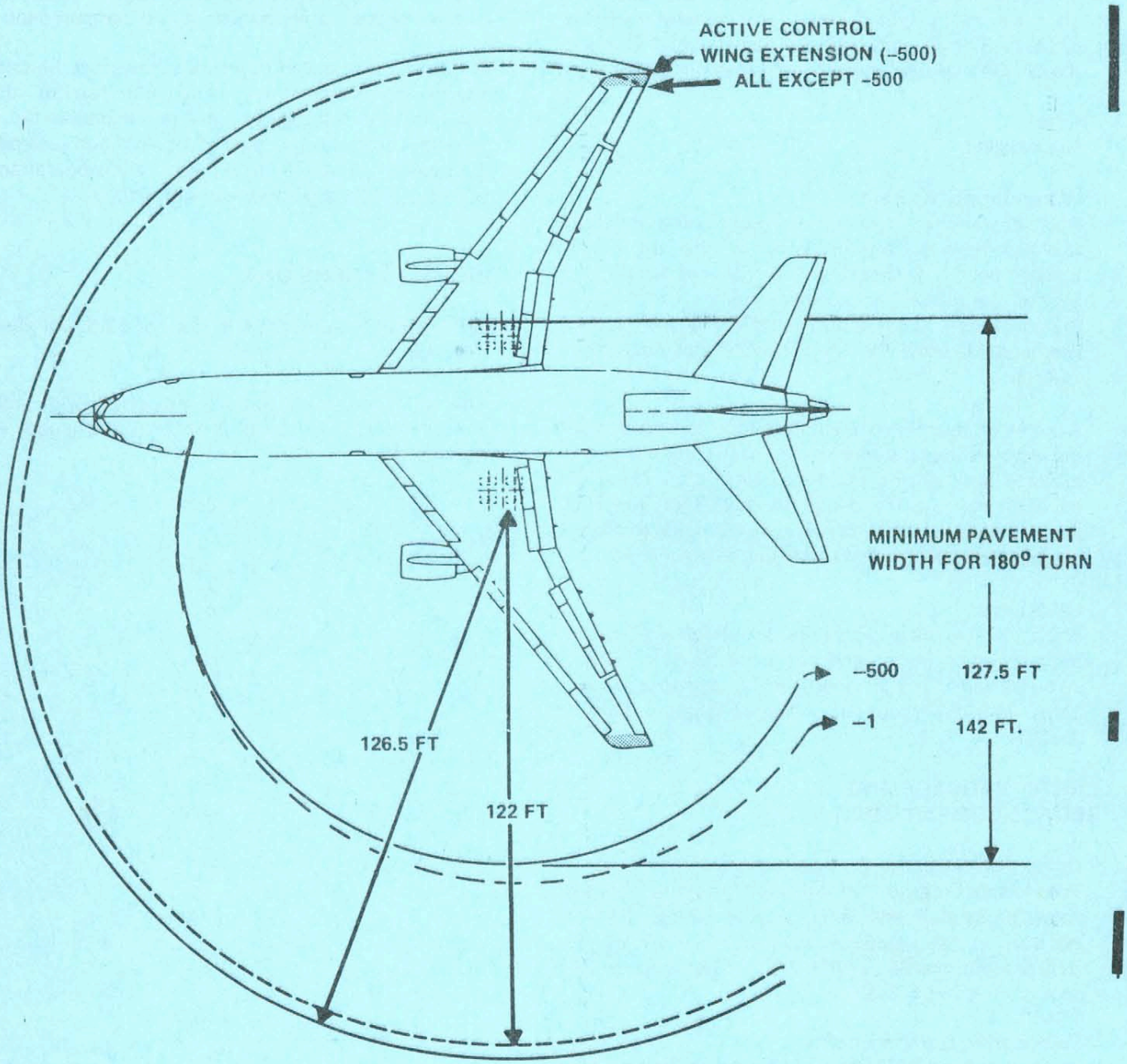
A C2 door is installed to provide access to the center cargo compartment. The C2 fairing door mechanically retracts to provide clearance for the ground cargo loader during loading and unloading operations. The C2 fairing door must be retracted before the C2 cargo door can be opened.

AIRCRAFT DIMENSIONS

The aircraft length is 164 ft. 2 in, or 13.5 feet shorter than the –1.

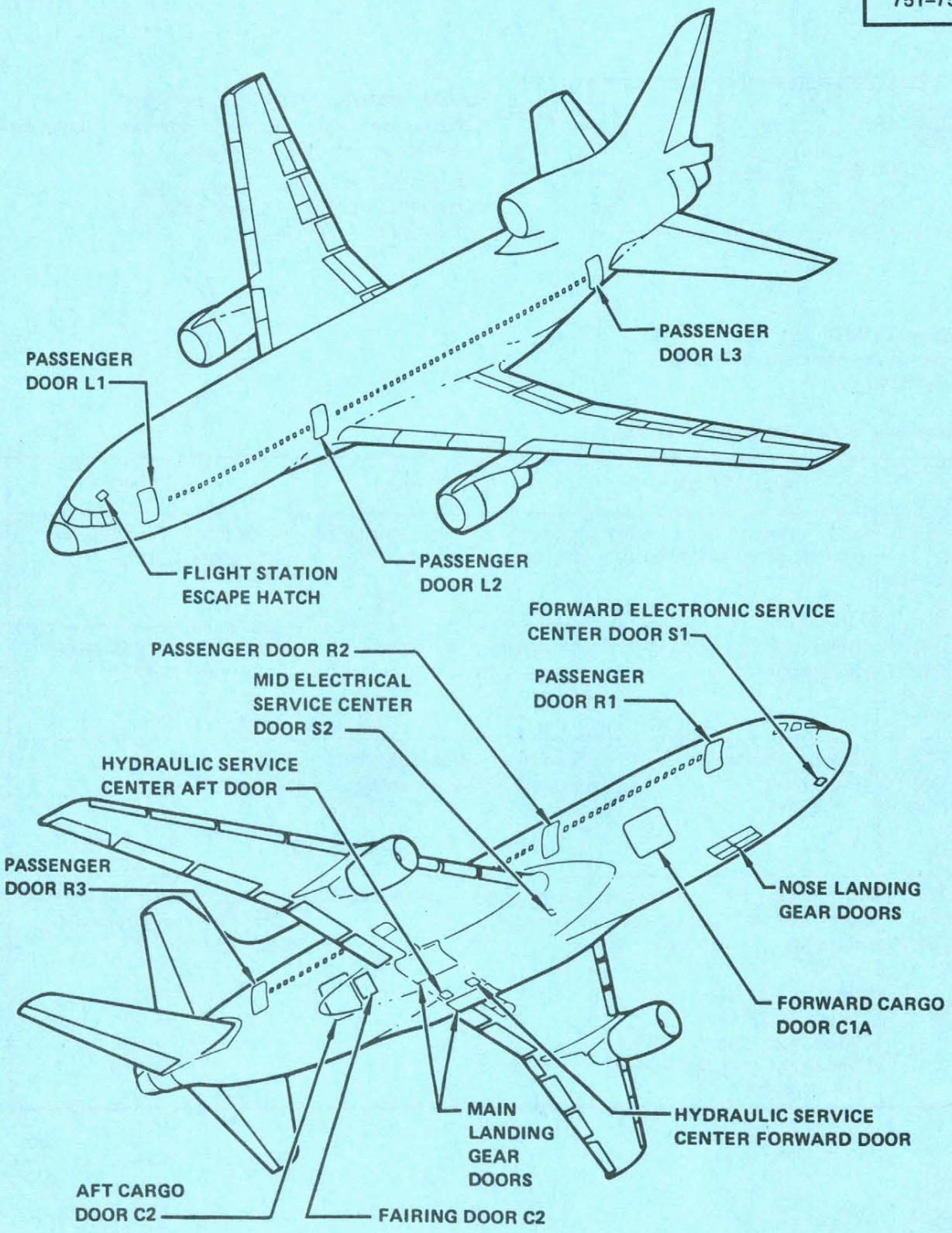
The wing span of aircraft equipped with active controls (ACS) is 164 ft. 4 in. or 9 feet longer than the –1.

TURNING RADII



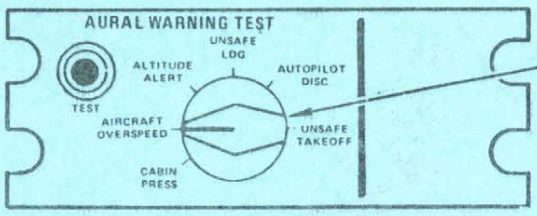
DOOR LOCATIONS

751–756



751–756

AURAL WARNING TEST PANEL



AURAL WARNING TEST SELECTOR

Rotary selector. Certain positions have been rearranged and others changed:

ALTITUDE ALERT – Sounds C chord.
AUTOPILOT DISC – Sounds wailer.
FLAPS LRS – Deleted.

AURAL SIGNAL CHART

The following aural signals are not installed:

- GALLEY SMOKE

The following aural signals are added or changed:

CONDITION, SIGNAL	ACTUATION	SILENCING	TESTING
GALLEY DUCT FIRE, ALTERNATING TONE	Fire or overheat in the forward, mid or aft galley exhaust ducts	Tone cutout button on the galley duct overheat panel.	Test button on the galley duct overheat panel.
FWD CARGO COMPARTMENT ALTERNATING TONE	Smoke in the forward cargo compartment.	Tone cutout switch on the forward cago compartment panel.	Test switch on forward cargo compartment panel.
AFT CARGO COMPARTMENT ALTERNATING TONE (754–756)	Smoke in the aft cargo compartment.	Tone cutout switch on the aft cargo compartment panel.	Test switch on aft cargo compartment panel.
UNSAFE TAKEOFF INTERMITTENT HORN	Any 2 throttles advanced beyond 50% takeoff thrust position and: • Flaps not in takeoff position (4° to 22°). • Pitch trim not within takeoff band (1.3 to 7.7). • Speedbrake lever not forward. • One or more slat segments not fully extended.	Warning will sound until condition is corrected.	Test button and selector on aural warning test panel at second officer's station.

PILOTS' ANNUNCIATOR PANEL (SHIPS 751-753)

OIL PRESS ENG 1	OIL PRESS ENG 2	OIL PRESS ENG 3	
NACELLE NO. 1 OVHT	NACELLE NO. 2 OVHT	NACELLE NO. 3 OVHT	
TURB AIR OVHT ENG 1	TURB AIR OVHT ENG 2	TURB AIR OVHT ENG 3	
SMOKE	ENG 2 FAIL ARMED	LOW BRAKE PRESSURE	
RUDDER HYDR LMTR	——	ROLL SPEED BRAKE	WHEEL WELL FIRE
ATT 3	FLT CONT PANELS	AUTO GND SPLRS INOP	——
HYDRAULIC SYSTEM	FUEL SYSTEM	FIRE DET LOOP	AREA/DUCT OVERHEAT
ECS	ENG VIB FLTR PRESS	ELECTRICAL SYSTEM	ESS/STBY POWER
——	ICING	ANTI SKID	ELEVATOR
DUAL A/L NOT AVAIL	RAT DEPLOYED	ALTN FUEL MONITOR	DOOR OPEN

PILOTS' ANNUNCIATOR PANEL LIGHTS

The following annunciator lights are not installed:

- VERTICAL GYRO 3

The following annunciator lights are added or changed:

ANNUNCIATOR LIGHT	ASSOCIATED INDICATORS	CONDITION
SMOKE (amber)	• Light illuminated on the galley duct overheat panel. Alternating tone in flight station. • Illumination of any of the four detector lights on the forward cargo compartment smoke detector panel. If SMOKE is also illuminated on the FWD cargo compartment panel, an alternating tone sounds.	The FWD, MID or AFT galley duct is overheated or smoke is detected in forward cargo compartment.
ATT (amber)	Fail flags on ADI, if in use.	INS 3 platform has failed.
ROLL SPEEDBRAKE (amber)	Same as -1 aircraft.	Spoilers L&R1 jammed with flaps either up or down. Failure of mechanical spoiler limiters to shift in agreement with flap position.

SECOND OFFICER'S ANNUNCIATOR PANEL (SHIPS 751-753)

ELEVATOR	FWD CARGO AFT LOCK	PILOT INSTR COOL SYS	AVIONICS
L1 ENTRY	FWD CARGO FWD LOCK	R1 ENTRY	CABIN OVHD EXHAUST FAN
L2 ENTRY	CENTER CARGO	R2 ENTRY	MAIN ELEC
L3 ENTRY	AFT CARGO	R3 ENTRY	FWD S DUCT
——	ESCAPE HATCH	——	AFT S DUCT
LH GEAR OR DOOR	NOSE GEAR OR DOOR	RH GEAR OR DOOR	——
SLAT ASYM DET FAULT	——	BLEED DUCT OVPRESS	WATER CPSR 1
FLAP/SLAT LOCK	FLAT ASYM DET FAULT	WATER LINE HTR	WATER CPSR 2

SECOND OFFICER'S ANNUNCIATOR PANEL LIGHTS

The following lights are not installed:

- LH EMER
- RH EMER
- GALLEY
- TAILSKID

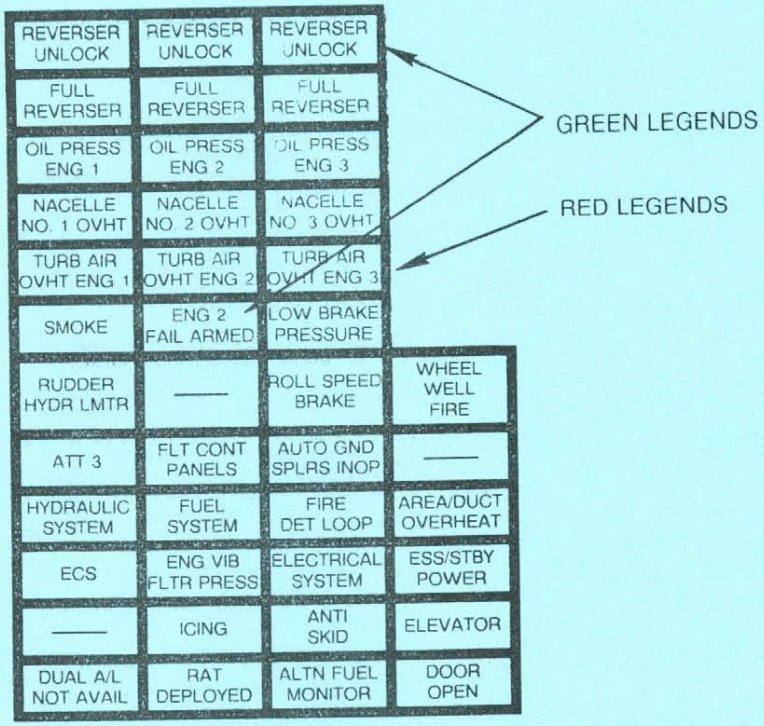
Some individual lights are labeled differently or are rearranged on the panel.

The following lights are changed:

- LH & RH, FWD, CTR & AFT ENTRY replaced by L&R 1, 2 & 3 ENTRY
- PILOT INSTR COOL FAN replaced by PILOT INSTR COOL SYSTEM.

ANNUNCIATOR LIGHT	ASSOCIATED INDICATORS	CONDITION
ELEVATOR (amber)	Intermittent horn in flight station.	Elevator jammed. All throttles must be below 50% T.O. thrust position and aircraft on the ground.
CAB OVHD EXHAUST FAN (amber)	None	Cabin overheat exhaust fan has failed or is not producing sufficient airflow.
FWD CARGO AFT LOCK	Pilot's amber DOOR position light.	FWD cargo aft latches not locked.
FWD CARGO FWD LOCK (amber)	Pilot's amber DOOR position light.	FWD cargo forward latches not locked.

PILOTS' ANNUNCIATOR PANEL (SHIPS 754–756)



PILOTS' ANNUNCIATOR PANEL LIGHTS

The following annunciator lights are not installed:

- VERTICAL GYRO 3

The following annunciator lights are added or changed:

ANNUNCIATOR LIGHT	ASSOCIATED INDICATORS	CONDITION
SMOKE (amber)	• Light illuminated on the galley duct overheat panel. Alternating tone in flight station. • Illumination of any of the four detector lights on the forward or aft cargo compartment smoke detector panel on Ships 754–756. If SMOKE is also illuminated on the FWD or AFT cargo compartment panel, an alternating tone sounds.	The FWD, MID or AFT galley duct is overheated or smoke is detected in forward cargo compartment.
ATT (amber)	Fail flags on ADI, if in use.	INS 3 platform has failed.
ROLL SPEEDBRAKE (amber)	Same as –1 aircraft.	Spoilers L&R1 jammed with flaps either up or down. Failure of mechanical spoiler limiters to shift in agreement with flap position. Mixer fault for spoilers L&R 2, 3, and 4.

SECOND OFFICER'S ANNUNCIATOR PANEL (SHIPS 754-756)

ELEVATOR	FWD CARGO FWD LOCK	PILOT INSTR COOL SYS	AVIONICS
L1 ENTRY	FWD CARGO AFT LOCK	R1 ENTRY	CABIN OVHD EXHAUST FAN
L2 ENTRY	AFT CARGO	R2 ENTRY	MAIN ELEC
L3 ENTRY	———	R3 ENTRY	FWD S DUCT
———	ESCAPE HATCH	———	AFT S DUCT
LH GEAR OR DOOR	NOSE GEAR OR DOOR	RH GEAR OR DOOR	———
SLAT ASYM DET FAULT	———	BLEED DUCT OVPRESS	WATER CPSR 1
FLAP/SLAT LOCK	FLAT ASYM DET FAULT	WATER LINE HTR	WATER CPSR 2

SECOND OFFICER'S ANNUNCIATOR PANEL LIGHTS

The following lights are not installed:

- LH EMER
- RH EMER
- GALLEY
- TAILSKID

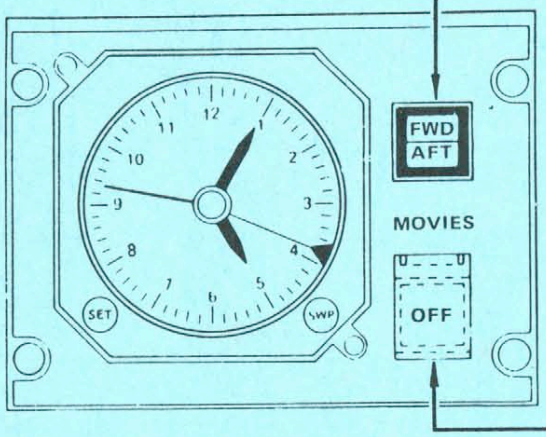
The following lights are changed:

- LH & RH, FWD, CTR & AFT ENTRY replaced by L&R 1, 2 & 3 ENTRY
- PILOT INSTR COOL FAN replaced by PILOT INSTR COOL SYS

Some individual lights are labeled differently or are rearranged on the panel.

ANNUNCIATOR LIGHT	ASSOCIATED INDICATORS	CONDITION
ELEVATOR (amber)	Intermittent horn in flight station.	Elevator jammed. All throttles must be below 50% T.O. thrust position and aircraft on the ground.
CAB OVHD EXHAUST FAN (amber)	None	Cabin overheat exhaust fan has failed or is not producing sufficient airflow.
FWD CARGO AFT LOCK	Pilot's amber DOOR position light.	FWD cargo aft latches not locked.
FWD CARGO FWD LOCK (amber)	Pilot's amber DOOR position light.	FWD cargo forward latches not locked.

MOVIE SWITCHES



PROJECTOR OPERATING LIGHTS

FWD is illuminated when either first class cabin projector is operating. AFT is illuminated when mid cabin or aft cabin projectors are operating.

MOVIE INTERRUPT SWITCH

Guarded alternate-action switch. Shuts off all power to the movie projectors. OFF indicates projectors are deenergized.

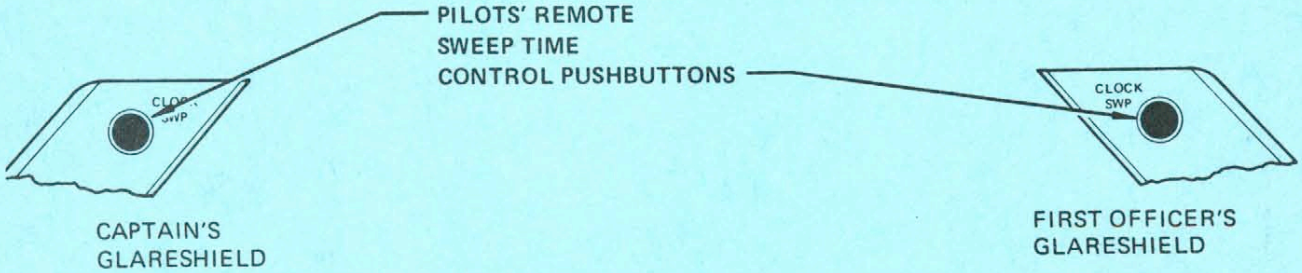
CLOCK SWEEP CONTROL

Controls minute and second hands of short term timer function. Performs same function as the Sweep Time Control Pushbutton on the clock face.

First push: Initiates minute and second hand movement to display up to 12 minutes elapsed time.

Second push: Stops the timer and holds the hands at the current display.

Third push: Resets hands to zero out timer.



GLARESHIELD SIDE PANELS

-END-

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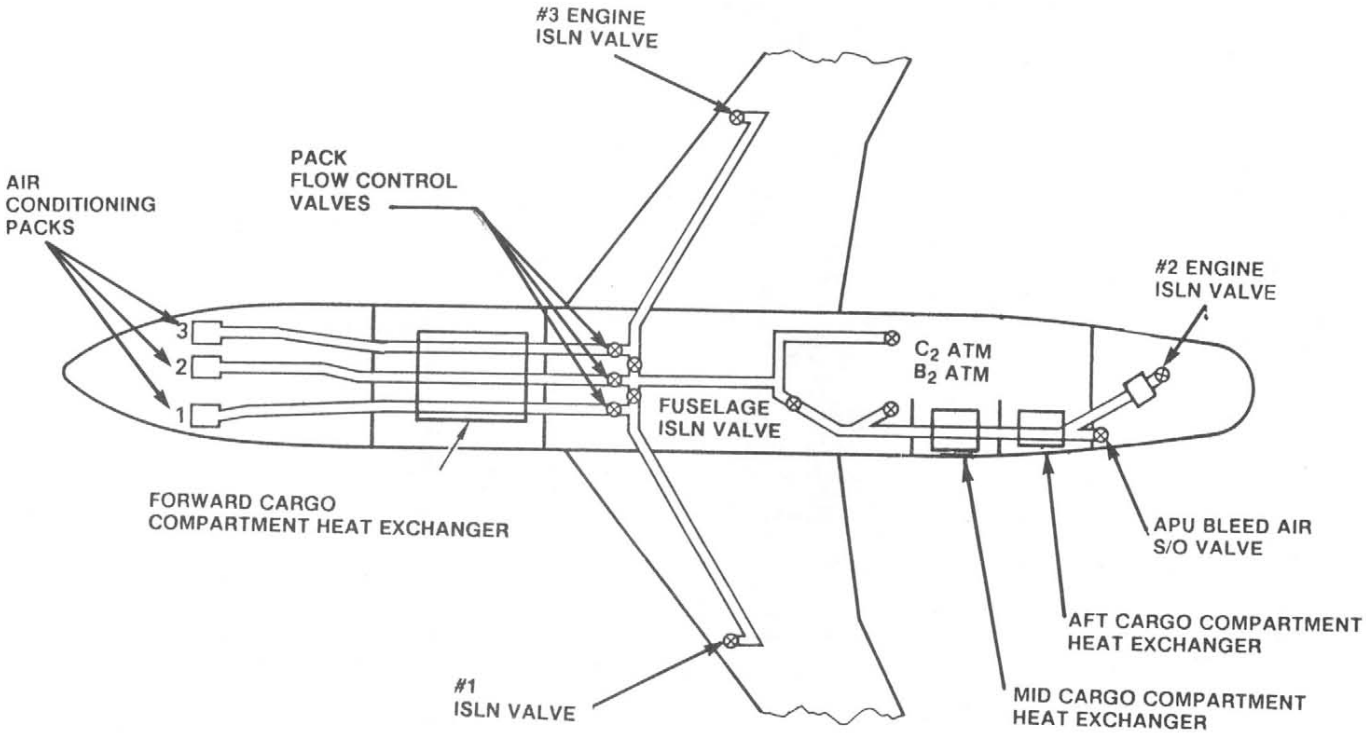
(OPPOSITE SIDE BLANK)

GENERAL

Bleed air from the pneumatic system is used for air conditioning, pressurization, equipment cooling and cargo compartment heating. Temperature control is provided by three air conditioning packs. Pressurization control is provided through two outflow valves.

Bleed air is supplied through the crossbleed manifold to a flow control valve for each pack. The packs are located in the unpressurized area on either side of the nose wheel well. Number one pack is on the left, and number two and three packs are located on the right.



PNEUMATIC SUPPLY TO AIR CONDITIONING SYSTEM

AIR CONDITIONINGCOMPONENTS (Overview)

Each pack contains two heat exchangers and an Air Cycle Machine (ACM). Bleed air from the pack flow control valve is cooled through a primary and a secondary heat exchanger. The cooling provided by the heat exchangers is controlled by the position of ram air exhaust doors (louvers) which determine the flow of ambient air across the heat exchangers.

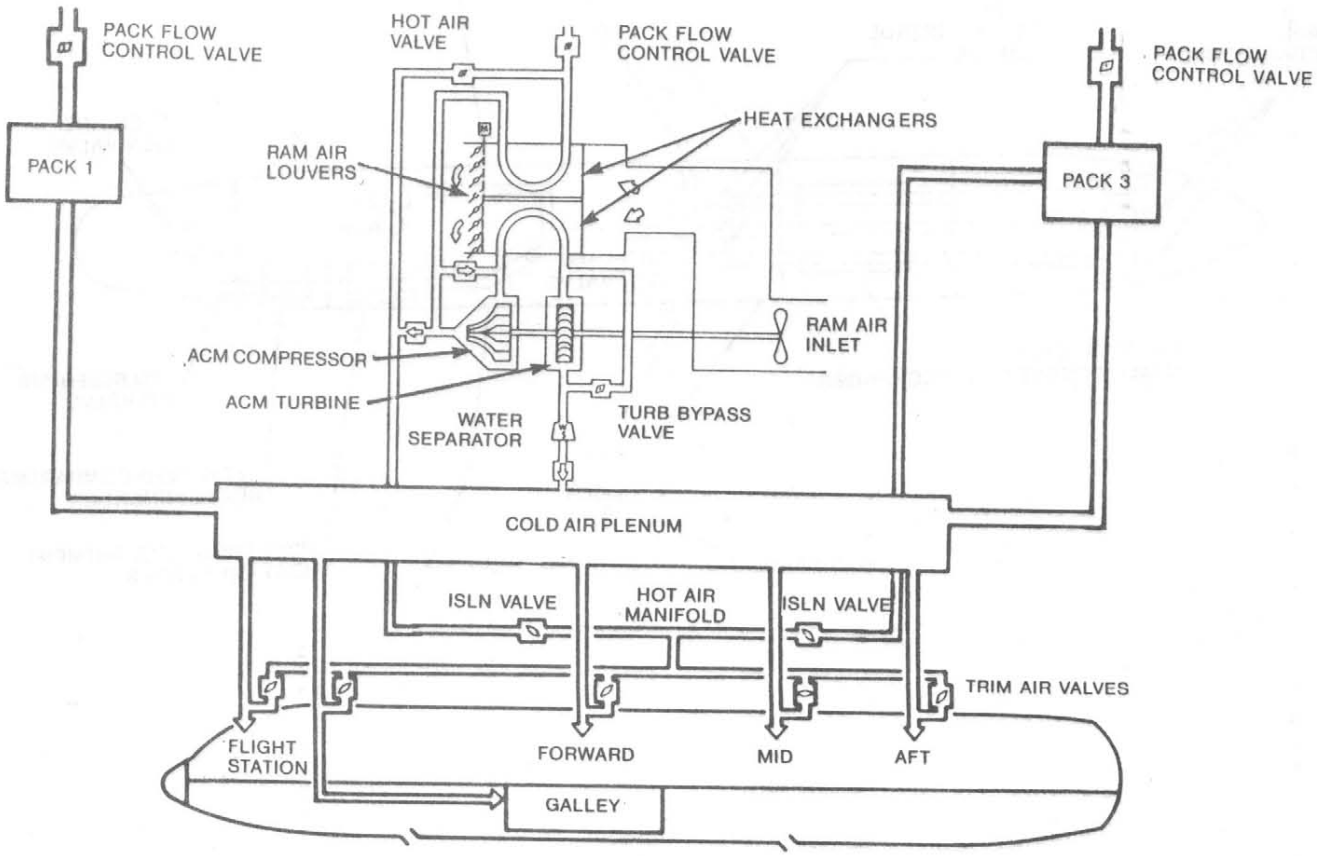
Additional cooling is provided as needed by the ACM. The ACM is a combination compressor and turbine powered by the bleed air flowing through the pack. When the ACM is operating, air from the primary heat exchanger passes through the ACM compressor and is heated through compression. The air then passes through the secondary heat exchanger and then through the ACM expansion turbine where it is cooled rapidly to below ambient air temperature.

The amount of cooling provided by the ACM is controlled by the turbine bypass valve. Maximum cooling occurs when the valve is fully closed which causes maximum air flow through the ACM turbine.

In addition to the above function, the ACM also drives a fan which forces ambient air across the heat exchangers.

Air from the ACM passes through a water separator to remove excessive moisture which is discharged overboard across the heat exchangers. The evaporative action enhances the efficiency of the heat exchangers.

Conditioned air from all three packs is ducted to a cold air plenum chamber for distribution to the cabin. The air from the cold air plenum chamber is mixed with trim air from a hot air manifold supplied by packs two and three. With the mixing of these sources, proper temperature air is provided to each of the five cabin zones.



AIR CONDITIONING PACK

PACK FLOW CONTROL SWITCH (3)

Controls flow of air into the pack.

- **-FB-** indicates valve is open regardless of switch position.
- Valve is spring-loaded closed when the pneumatic duct is unpressurized.

UNL - Electrical control power is applied to signal pneumatic pressure to close the valve.

LCH - Electrical control power is removed to signal pneumatic pressure to open the valve.

- Valve modulates to maintain a scheduled air flow depending on aircraft altitude.
- On all aircraft the No. 2 pack flow control valve will close (-FB- extinguish) if the C2 ATM is operating and duct pressure drops to 12 psi or less.
  - On -500 or -200 aircraft, the No. 2 pack flow control valve will close if either the B2 or C2 ATM is operating and duct pressure drops too low. (Approximately 15 PSI).

After the pressure has increased, or the ATM(s) no longer has a run signal, the pack flow control valve will reopen. It will be necessary, however, to manually cycle the hot air valve switch and the hot air isolation valve switch in order to restore their operation.

OVHT - The Air Cycle Machine (ACM) is protected from excessive internal temperatures. If the compressor discharge (CPRSR DISCH) or ACM discharge (ACM DISCH) temperature becomes excessive,(CPRSR DISCH above 220°, ACM DISCH above 96°) the pack flow control valve will lock closed and illuminate the (amber) **OVHT** light. The -FB- will extinguish when the valve closes. When the area cools, **OVHT** extinguishes and the lockout can be removed by cycling the pack flow control switch. Temperature can be monitored with ECS Temperature Selector.

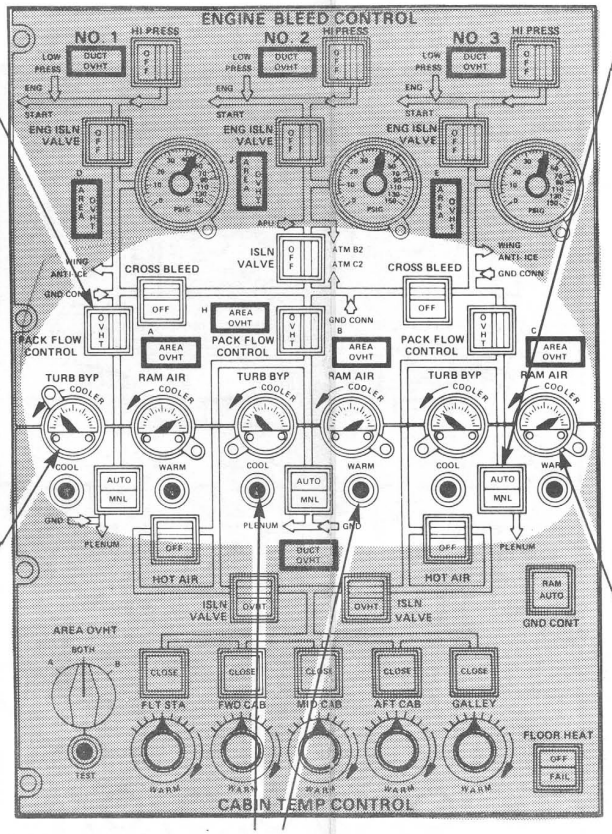
1H3, 4, 5 - PACK FLOW CONTROL
3G12 - ECS IND LT

TURB BYP INDICATOR (3)

Pointer indicates relative position of the respective ACM turbine bypass valve. Valve is full closed when the pointer is at the 9 o'clock (full cool) position.

- With **AUTO-MNL** switch in **AUTO**, the turbine bypass valve is controlled automatically (see Zone Temperature Selectors).
  - With the pack operating, the turbine bypass valve is positioned full warm until the ram air louvers have reached the full cool position as indicated on the RAM AIR indicator (9 o'clock position on the ground, 1 o'clock position in flight). The turbine bypass valve will then be positioned as needed to achieve the required ACM discharge temperature.
  - With the pack shut off, the turbine bypass valve will be pre-positioned to the 11 o'clock position to prevent overloading the pack during start up.

3V5, 6, 7, 8, 17, 18 - PACK AUTO/MAN



AIR CONDITIONING PANEL

COOL/WARM BUTTONS

Momentary pushbuttons used to position the RAM AIR louvers & TURB BYP valve when the respective **AUTO/MNL** switch is in **MNL**.

3V5, 6, 7, 8, 17, 18, - PACK AUTO/MAN

AUTO/MNL SWITCH (3)

Used to select means of positioning the pack RAM AIR louvers and TURB BYP valve. The position of the RAM AIR louvers and TURB BYP valve then determines pack output temperature.

AUTO - **AUTO** illuminates; RAM AIR louvers and TURB BYP valve position and pack output temperature are controlled automatically (see Zone Temperature Selectors).

- With the pack operating, the RAM AIR louvers are pre-positioned to the 9 o'clock (full open) position on the ground. In flight, the louvers are positioned as necessary between the 1 o'clock and 3 o'clock positions.
  - With the pack shut off, the RAM AIR louvers are prepositioned to 9 o'clock on the ground, 1 o'clock in flight.
  - The RAM AIR louvers must travel to their coldest position(9 o'clock on the ground, 1 o'clock in flight), before the TURB BYP valve will begin to move toward cooler.
- With the pack shut off, the TURB BYP is pre-positioned to the 11 o'clock position (in flight or on the ground) to prevent overloading the pack during start up.
- ACM discharge temperature is limited to 2°C (36°F) to prevent icing in the water separator.

MNL - **MNL** illuminates. COOL/WARM buttons are used to position RAM AIR louvers and TURB BYP valve to determine pack output temperature.

- The RAM AIR louvers can be positioned through the full travel range in flight or on the ground.
  - The RAM AIR louvers must travel to their coldest (9 o'clock) position before TURB BYP will begin to move towards COOLER.
  - The TURB BYP must travel to the full warm position before the RAM AIR will begin to move toward warmer.
  - ACM and compressor discharge temperatures must be monitored to prevent pack overheat and/or water separator icing.

3V5, 6, 7, 8, 17, 18 - PACK AUTO/MAN

RAM AIR INDICATOR (3)

Pointer indicates relative position of the respective pack ram air exit louvers. Louvers are full open when the pointer is at the 9 o'clock (full cool) position.

- With the **AUTO-MNL** switch in **AUTO** the louvers are pre-positioned and controlled automatically (see Zone Temperature Selectors).
  - With the pack shut off, the louvers are pre-positioned to the 9 o'clock position on the ground and 1 o'clock in flight.
  - On the ground, with the **GND CONT** switch unlatched, and **RAM AUTO** illuminated, the louvers may position to the in-flight range (1 o'clock to 3 o'clock position) to provide a rapid warm-up of the aircraft (less cool air passing through the heat exchangers).

3V5, 6, 7, 8, 17, 18 - PACK AUTO/MAN

HOT AIR SWITCH (2)

Respective switch controls air supply from just downstream of the pack flow control valves in packs #2 and 3 to the hot air manifold.

- **FB** illuminates when valve is open regardless of switch position.
- Valve is spring-loaded closed when the pneumatic duct is unpressurized.

UNL – Electrical control power is applied to signal pneumatic pressure to close the valve. **OFF** illuminates to indicate switch position.

LCH – Electrical control power is removed to signal pneumatic pressure to open the valve.

- Valve modulates as required to maintain a constant temperature in the hot air manifold.
- Respective valve is locked closed when the associated pack flow control valve is closed. Switch must be cycled after pack flow control valve opens to reopen the hot air valve.
- B oth Hot Air valves are locked closed when the **DUCT OVHT** light illuminates (Hot Air manifold above 145°). When **DUCT OVHT** extinguishes, the lockout can be removed by cycling the HOT AIR switches.

3W6 – TEMP CONT HOT AIR MANIF

HOT AIR ISLN VALVE SWITCH (2)

Respective switch controls air supply from the primary heat exchangers in packs #2 and 3 to the hot air manifold.

- **FB** illuminates when valve is open regardless of switch position.
- Valve is spring-loaded closed when the pneumatic duct is unpressurized.

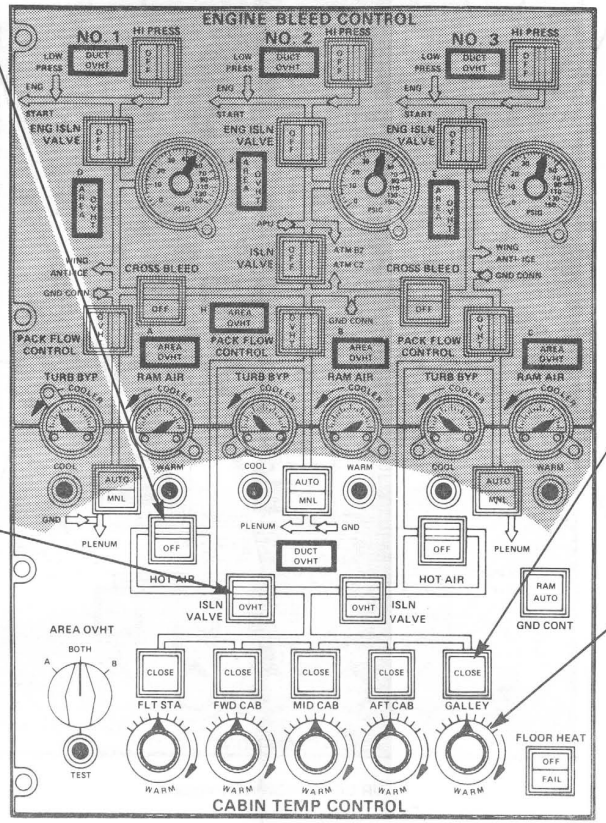
UNL – Electrical control power is removed to signal pneumatic pressure to close the valve.

LCH – Electrical control power is applied to signal pneumatic pressure to open the valve.

- Pneumatic pressure drives the valve to the full open position.
- Respective valve is locked closed when the associated pack flow control valve is closed. Switch must be cycled after pack flow control valve opens to reopen the isolation valve.
- Both Isolation valves are locked closed when **DUCT OVHT** light illuminates. (Hot Air Manifold above 145°) When **DUCT OVHT** extinguishes, the lock-out can be removed by cycling the ISLN VALVE switches.

OVHT – Illuminates in both switches when a leak is detected in the hot air manifold located in the aft end of the forward avionics compartment. Isolation valves are locked closed while **OVHT** lights are illuminated. When the area cools, **OVHT** extinguishes and the lockout can be removed by cycling the ISLN VALVE switches.

3W7, 8 – ISLN NO. 2, NO. 3



AIR CONDITIONING PANEL

ZONE TRIM SWITCH (5)

Controls arming of the zone temperature selector and motor-driven trim air valve from the hot air manifold to the respective zone.

UNL - Zone temperature selector for the zone is deactivated. Respective zone trim air valve is electrically closed. Only air from the cold air plenum is ducted to the affected zone. In addition, that zone temperature selector knob will have no influence on pack output temperature. The **CLOSE** light is armed and illuminates when the valve closes.

NOTE: If all Zone Trim switches are unlatched while the pack AUTO/MNL switches are in AUTO , THE TURB BYP and RAM AIR indicators will drive to the "shutdown" position (TURB BYP to 11 o'clock, RAM AIR to 9 o'clock on the ground, 1 o'clock in flight) resulting in very cold output temperatures.

LCH - Zone temperature selector is powered to control the respective zone trim air valve. Respective zone trim air valve modulates (electrically) to maintain zone temperature at the desired level. The CLOSE light is extinguished.

3V3, 4 - TEMP CONT FLT STA
3V9 THRU 16 - ZONE CENTER TEMPERATURE CONTROL

ZONE TEMPERATURE SELECTOR (5)

- With Air Conditioning Packs in **AUTO**

FWD, MID and AFT CABIN Selectors – The position of each selector provides a desired temperature input to the pack controller and to the respective trim air valve. The pack controller compares the selected temperature with the actual temperature in each zone and then regulates the output temperature of Pack 2 and Pack 3 to meet the demands of the cabin zone requiring the coldest air. The trim air valves for the remaining zones then modulate to admit more warm air to those zones in order to maintain the temperature selected by the respective Zone Temperature Selector.

FLT STA Selector - The position of this selector provides a desired temperature input to pack #1. The pack controller compares the selected temperature to actual cockpit temperature and then regulates Pack 1 output temperature as needed. However, if a Cabin Zone requires colder air than the cockpit, Pack 1 output temperature will decrease to meet that demand. The FLT STA trim air valve will then modulate to maintain the selected temperature in the cockpit.

GALLEY Selector - This selector controls only the position of the galley trim air valve.

- With Air Conditioning Packs in **MNL**, the associated Zone Temperature Selectors still select a desired temperature for that zone. However, only the trim air valve is modulated for temperature control. When trim air valve temperature control is unsatisfactory the respective Pack(s) output temperature must be adjusted manually.

3V3, 4 - TEMP CONT FLT STA
3V9 THRU 16 - ZONE CENTER TEMPERATURE CONTROL

PACK SELECT
Selects pack system to be monitored by the PACK FLOW and ECS Temperature Indicators.

3V1 – ECS AIR TEMP IND
3V2 – PACK FLOW IND

PACK FLOW INDICATOR
Displays output air flow of pack in hundreds of cubic feet per minute as determined by the PACK SELECT knob. Normal pack flow is between 2000 and 2500 CFM. Pack #1 flow will normally indicate 300–400 CFM more than pack 2 or 3.

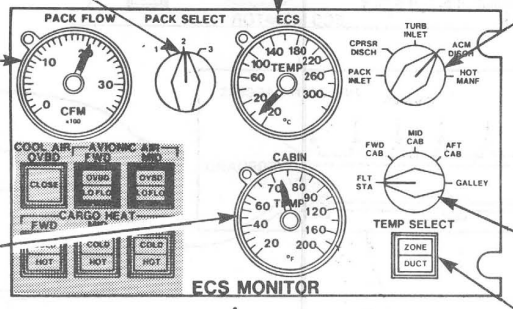
3V2 – PACK FLOW IND

CABIN TEMPERATURE INDICATOR
Displays temperature in degrees Fahrenheit at location determined by the position of the Cabin zone/duct temperature selector **and** ZONE/DUCT TEMP SELECT switch.

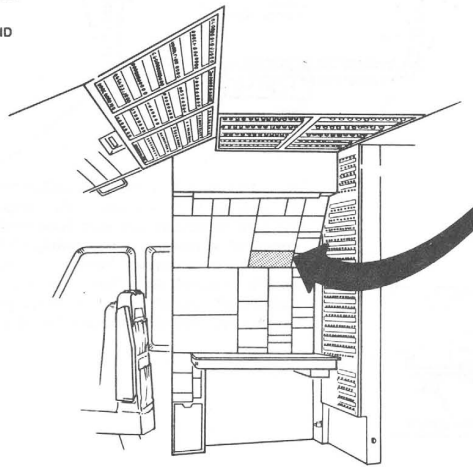
3V1 – ECS AIR TEMP IND

ECS TEMPERATURE INDICATOR
Displays temperature in degrees centigrade at location determined by the position of the ECS Temperature selector.

3V1 – ECS AIR TEMP IND



S/O's UPPER PANEL RIGHT SIDE



CABIN ZONE/DUCT TEMPERATURE SELECTOR
Selects which zone/supply duct temperature will be displayed on the CABIN Temperature indicator (degrees Fahrenheit).

3V1 – ECS AIR TEMP IND

ECS TEMPERATURE SELECTOR
Selects temperature to be displayed on the ECS Temperature indicator (degrees centigrade).

PACK INLET – Displays temperature at the inlet to the selected pack flow control valve (bleed air temperature). Temperature will vary with engine thrust setting and the opening and closing of the pneumatic HI PRESS valve (Approximately 160° – 200°C in cruise).

CPRSR DISCH – Displays temperature at the outlet of the selected pack Air Cycle Machine (ACM) compressor. Temperature will vary with the position of the associated turbine bypass valve (TURB BYP IND) (Approximately 60°–80°C in cruise).

TURB INLET – Displays temperature at the inlet of the selected pack ACM. Temperature will vary with ram air exit louver position. (RAM AIR IND) (Approximately 15°–25°C in cruise).

ACM DISCH – Displays temperature at the outlet of the selected pack ACM turbine. Temperature will vary with the position of the associated turbine bypass valve (TURB BYP IND) (Approximately 15°–25°C in cruise with TURB BYP IND full warm).

HOT MANF – Displays temperature of the air supplied to the hot air manifold from the selected pack HOT AIR valve (pack #2 or 3). The HOT AIR valve modulates to regulate this temperature to 110°C.

3V1 – ECS AIR TEMP IND

ZONE/DUCT TEMP SELECT SWITCH
Selects whether zone temperatures or zone supply duct temperatures will be displayed on the cabin temperature indicator.

LCH – DUCT illuminates. Supply duct temperature for the selected zone will be displayed on the cabin temperature indicator.

UNL – ZONE illuminates. Cabin temperature in the selected zone will be displayed on the cabin temperature indicator.

3V1 – ECS AIR TEMP IND

COOL AIR OVERBOARD SWITCH

LCH -- Galley vent valve is open. Avionic air overboard valves are open on the ground and closed in flight. (Open in flight if cooling fan fails)

UNL -- **CLOSE** illuminates to indicate switch position and galley vent and Avionic cooling valves are closed.

1J14 Air Overboard.

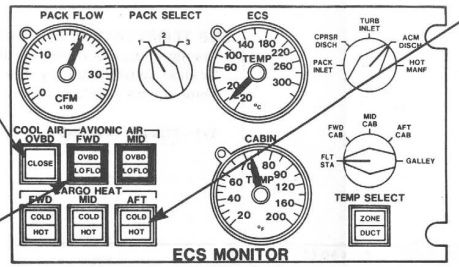
CARGO HEAT SWITCHES (3)

LCH -- Fan is armed to operate and maintain normal temperature. **HOT** will illuminate if compartment temperature reaches 95°F. (Fan will automatically shut off.)

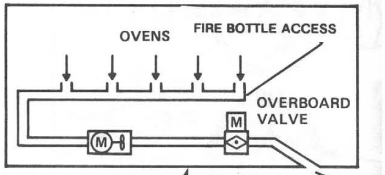
UNL -- Fan and Hot light are disarmed.

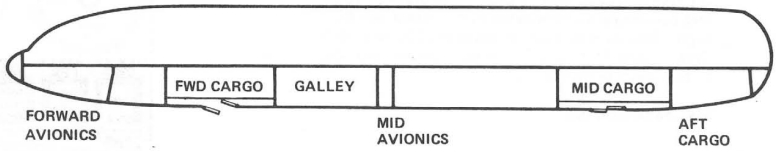
• **COLD** will illuminate at 45°F regardless of switch position.

3W9,10 CARGO TEMP CONTROL FWD, MID, AFT
4B5,8,11 COMPT FANS CARGO



ECS MONITOR





AVIONIC AIR INDICATORS

Avionic Cooling

Cooling for the forward and mid avionics compartments is provided by air that is ducted around the equipment in each compartment and exhausted overboard by continuously running fans.

On the ground, the cooling air is exhausted overboard through the forward pressurization outflow valve located under the forward cargo compartment. An Overboard Valve in each avionic compartment is also open on the ground to provide additional airflow.

In flight, the Overboard Valve closes and cooling is provided by a combination of the fans and pressurization air exhausting through the forward outflow valve. In the event of a fan failure, a differential pressure switch across the fan will detect the failure and signal the appropriate Overboard Valve to open. Anytime an Overboard Valve is open the appropriate **OVBD** light will illuminate. If the amount of cooling air flow is too low, for any reason, an air flow sensor will illuminate the respective **LO FLO** light.

• In FLT, the battery charger is deactivated if MID OVBD illuminates.

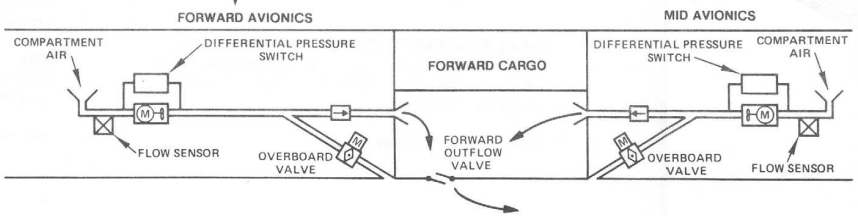
5E14 -- FWD AVIONICS FAN
5D14 -- FAN AVIONICS RACK MAIN
2L5 -- AVIONICS AIR MON

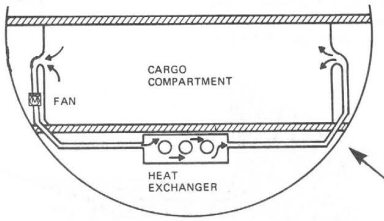
Galley Vent

The lower galley ovens are vented overboard by a continuously running fan and by differential pressure when the aircraft is pressurized. The air is exhausted through a normally open overboard valve.

A fire bottle access port is located behind the aft serving cart to provide a means of extinguishing a fire in the galley duct. Before discharging a fire bottle, the oven overboard valve should be closed by unlatching the cool air overboard switch.

4C11 COMPT FAN GALLEY





CARGO COMPARTMENT HEATING

Air is drawn from one side of the compartment by a fan, heated by the heat exchanger and sent back to the compartment. The fan is controlled to maintain approximately 65°F in the compartment. The forward compartment heat exchanger utilizes the three air conditioning pack ducts that run forward under the compartment. The mid and aft compartment heat exchanges utilize the single duct that runs forward from the number 2 engine and the APU.

CONDITIONED AIR DISTRIBUTION

The pressurized area of the aircraft is divided into 5 zones:

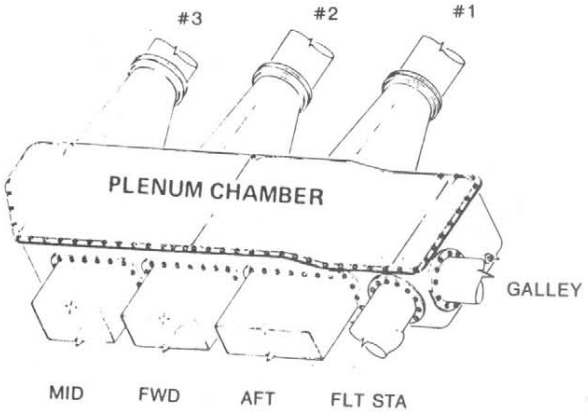
- FLT STA - cockpit area.
- FWD CAB - area between doors L1/R1 and L2/R2.
- MID CAB - area between doors L2/R2 and L3/R3.
- AFT CAB - area aft of doors L3/R3.
- GALLEY - lower galley area.

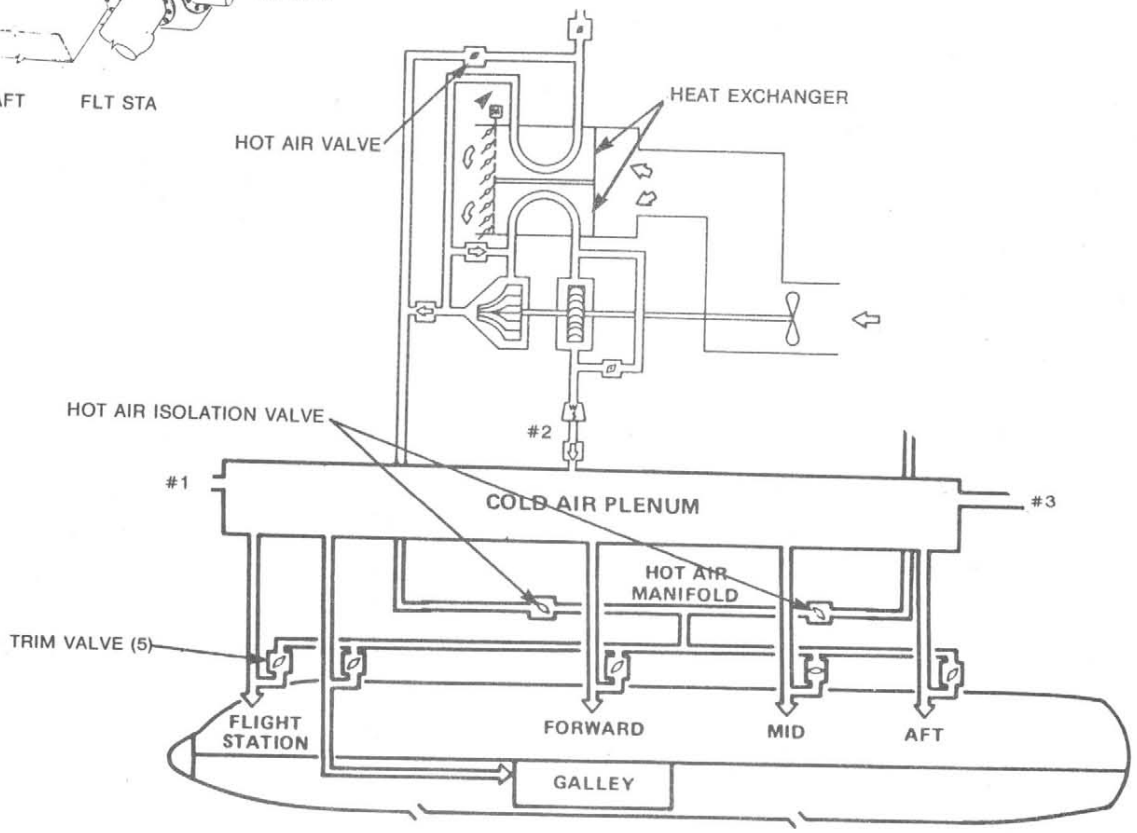
The output of all three air conditioning packs is ducted to a common cold air plenum chamber for distribution to the five cabin zones. While some mixing of air occurs in the plenum chamber, air from pack #1 tends to flow primarily to the aft cabin, the flight station and the lower galley. Air from pack #2 is directed to the forward cabin and pack #3 supplies the mid cabin.

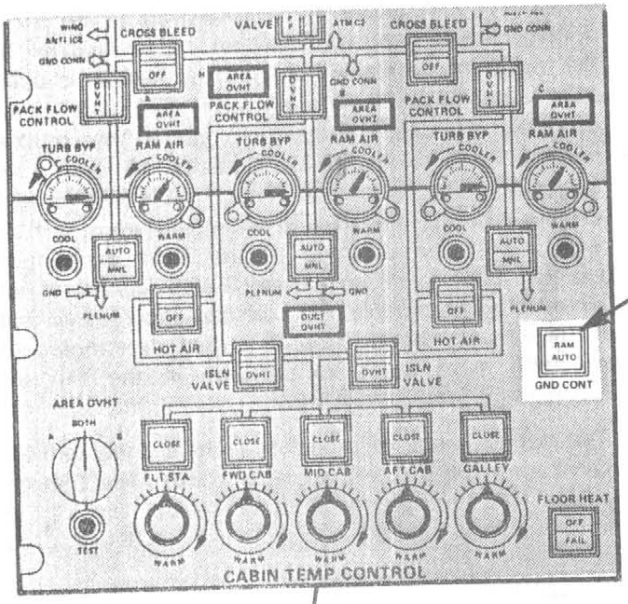
TEMPERATURE CONTROL SYSTEM

Plenum chamber air temperature is controlled to be cold enough to satisfy the requirements of the zone needing the coldest air. To warm the air supplied to the remaining zones, a hot (trim) air system is used from packs #2 and 3. The trim air system uses hot air from two sources. Air that has passed through the primary heat exchangers of packs #2 and 3 is supplied to the respective hot air ISLN VALVE and then to a hot air manifold. The temperature of this air varies with the opening of the heat exchanger exhaust louvers. Packs #2 and 3 each contain a hot air valve which modulates to provide uncooled air that is mixed with the air from the heat exchangers to maintain a constant temperature in the hot air manifold (approximately 110°C).

The hot air manifold provides air to a zone trim air valve for each of the five cabin zones. The trim air valves add the proper amount of hot air to the individual zone supply ducts to maintain the desired zone temperature.







S/O's UPPER PANEL -- RIGHT SIDE

GND CONT SWITCH

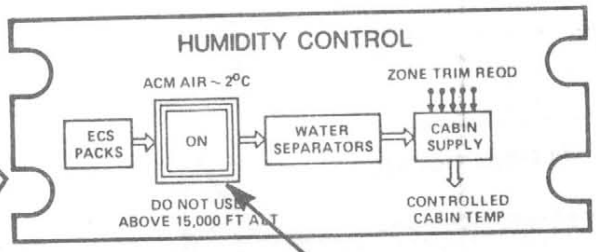
Used to provide for rapid warm-up of a coldsoaked aircraft on the ground. Switch has no effect in flight.

UNL - RAM AUTO illuminates to indicate switch position. Permits the automatic pack controller to close the ram air exit louvers to the 1 O'clock to 3 O'clock position on the ground (same as inflight pre-position). This provides faster warm-up.

- Individual pack **AUTO/MNL** switch must be in **AUTO** for **RAM AUTO** to affect respective pack.

LCH - Normal position. **RAM AUTO** is extinguished. Ram air exit louvers are positioned to the full cold (9 O'clock position) on the ground with the individual pack **AUTO/MNL** switches in **AUTO**.

3V5, 6, 7, 8, 17, 18 - PACK AUTO/MAN



HUMIDITY CONTROL SWITCH

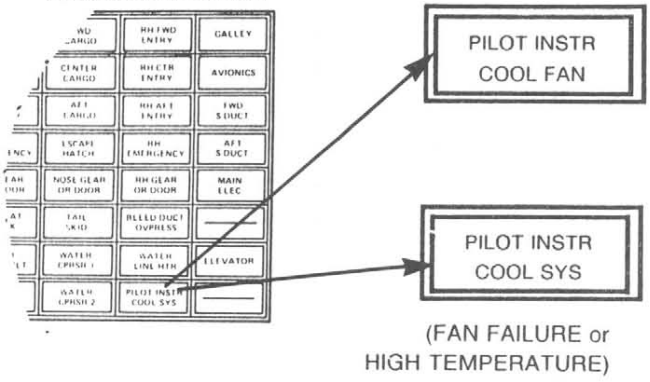
Aids in removing excess moisture from the air as it passes through the water separators.

LCH - ON illuminates to indicate switch position. Pack output temperature is reduced to +2°C to increase the efficiency of the water separator.

- Individual pack **AUTO/MNL** switch must be in **AUTO** for the Humidity Control switch to affect respective pack.
- Maintaining supply duct temperature at approximately 55°F will further assist in preventing excessive humidity and fog formation in the cabin.
- Delta's maximum altitude for use is 5000 ft.

UNL - ON extinguishes. Humidity control system is shut-off.

3V9 - ZONE TEMP CONT FWD CABIN



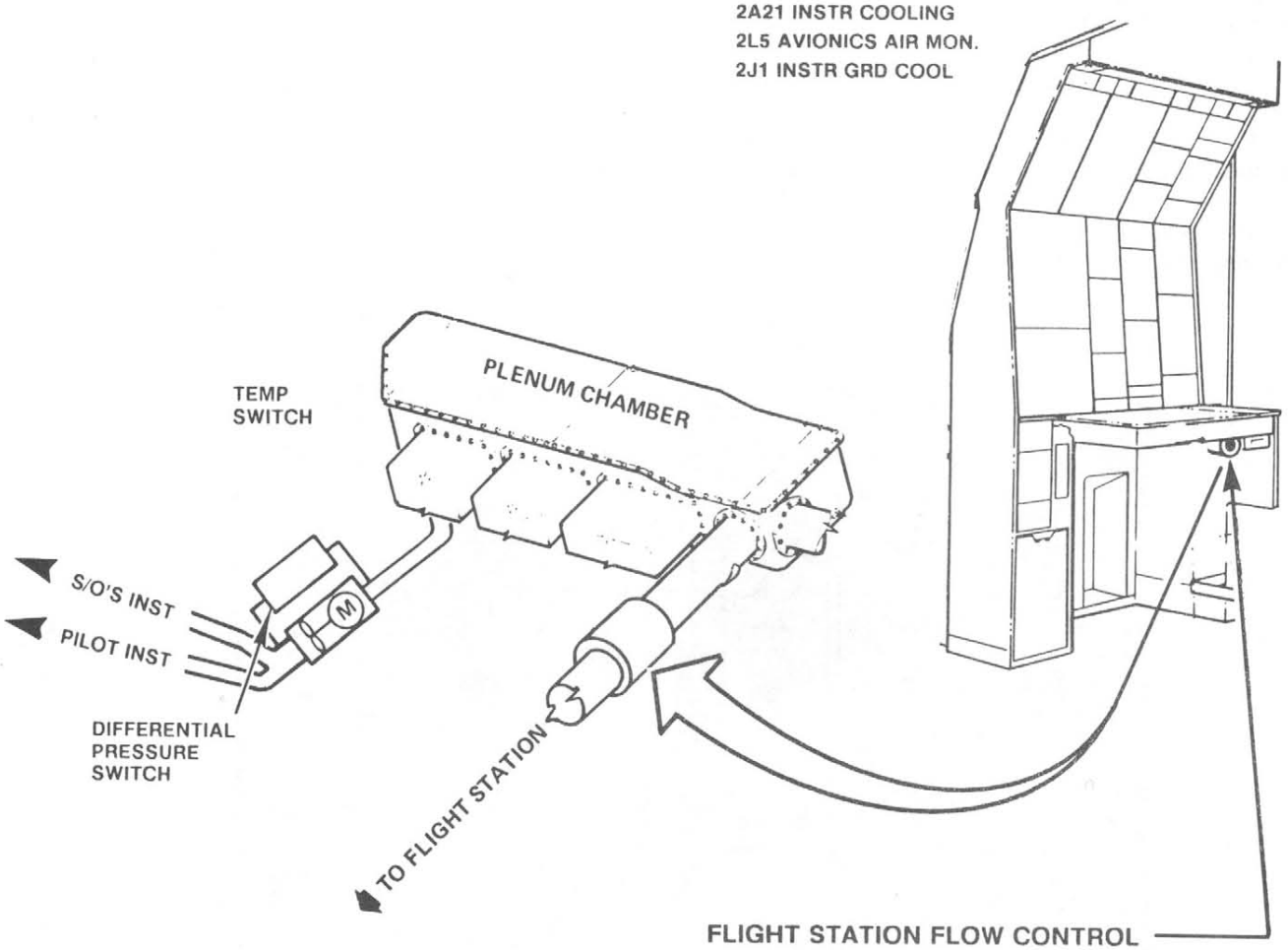
INSTRUMENT COOLING

The **Pilot Instr Cool Fan** light (Ships 712–722) will illuminate if instrument cooling air flow is too low. The instrument cooling fan draws air from the air conditioning ducting.

2A21 INSTR COOLING
265 AVIONICS AIR MON.

The **Pilot Instr Cool Sys** light (Ships 723 and subsequent) will illuminate if the fan has failed, or the diverter valve has opened to draw cooling air from the forward avionics compartment rather than from the aft cabin air supply duct because the aft cabin air is too hot.

2A21 INSTR COOLING
2L5 AVIONICS AIR MON.
2J1 INSTR GRD COOL



FLIGHT STATION FLOW CONTROL

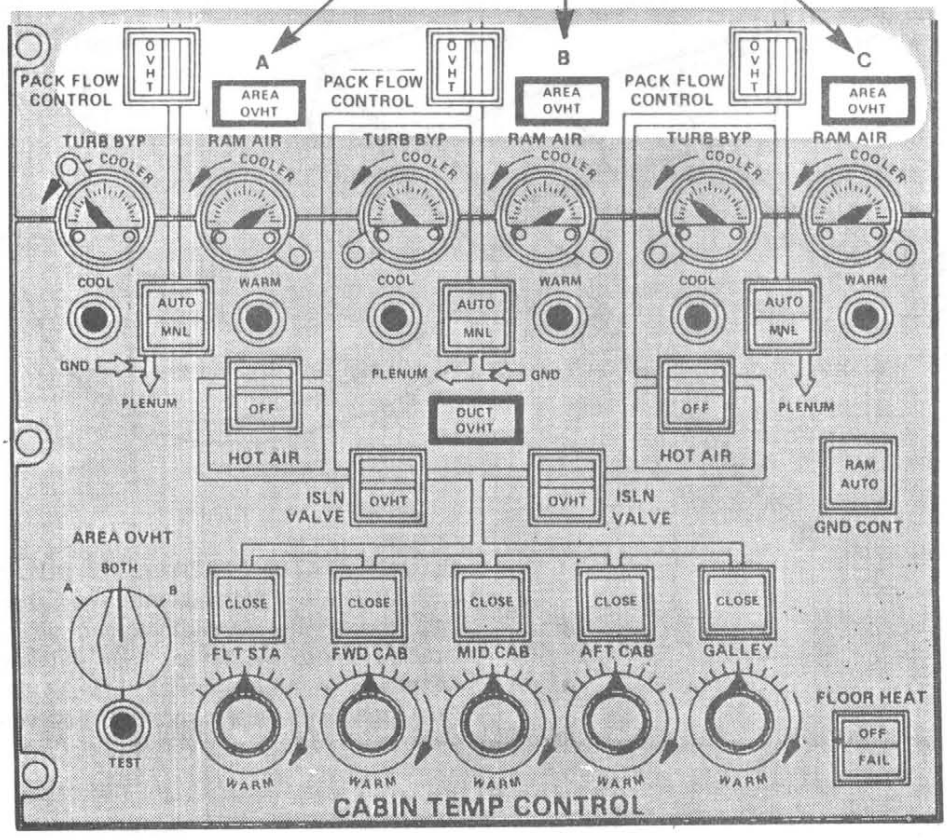
Ships 719 and subsequent have a manual adjustment for the control of flight station air supply. May be pulled out to restrict air flow and lower noise level. Pushing in increases air flow. Other aircraft are equipped with an automatic air flow valve.

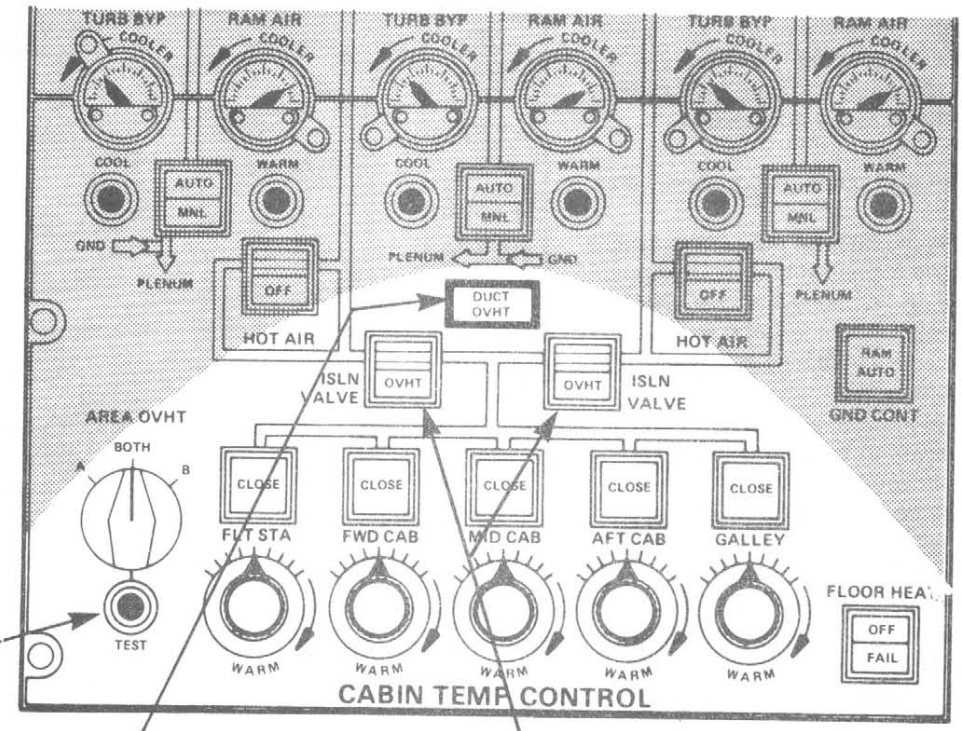
AREA OVERHEAT LIGHTS (3)

The A, B and C **AREA OVHT** lights will illuminate to indicate excessive temperature around the ducting from the pack flow control valves that are located beneath the floor of the mid avionic service center forward to the air conditioning packs on either side of the nose wheel well.

- If the high temperature occurs in the forward cargo heat exchanger, the A, B, and C **AREA OVHT** lights will illuminate simultaneously.
- If the high temperature occurs before or after the forward cargo heat exchanger and all three pack flow control switches are latched, only one **AREA OVHT** light will illuminate.
- If less than all three pack flow control switches are latched, more than one light may illuminate if the overheat occurs before or after the forward cargo heat exchanger.
- A leaking duct could cause an adjacent **AREA OVHT** light to illuminate.
- The A, B and C **AREA OVHT** circuits provide indication only, there is no automatic valve closure.

3W13 DUCT AREA OVHT DET DC
3W14 DUCT AREA OVHT DET AC





DUCT OVERHEAT

The **DUCT OVHT** light indicates that the Hot Air Manifold temperature has reached 145°C.

- Both HOT AIR valves and both HOT AIR Isolation valves will close. The valves will remain closed until the temperature decreases to 120°C and the valve switches are cycled.
- The temperature existing at the HOT AIR isolation valves may be observed by selecting HOT MANF and Pack 2 and 3 on the ECS monitor panel. Normal temperature is 110°C.

3W5 HOT AIR MANF IND

AREA OVHT TEST

The Area Overheat System utilizes two identical overheat detection loops designated as A and B loops.

- With the AREA OVHT selector in the BOTH position, which is the normal position, an **AREA OVHT** light may be illuminated by the signals from both A and B loops or from either A or B loop.
- With the AREA OVHT selector in the A or B position only that loop is operative for each **AREA OVHT light.**
- The AREA OVHT TEST button provides the capability of testing both A and B detection loops or either A or B depending upon the posiion of the AREA OVHT selector.

3W13 DUCT AREA OVHT DET DC

HOT AIR ISOLATION OVERHEAT LIGHTS

The illumination of the **OVHT** lights in both Hot Air Isolation Switches indicates that the area surrounding the Hot Air Manifold at the aft end of the Forward Avionic Service Center has reached approximately 130°F.

- The isolation valves will close and remain closed until the temperature decreases and the Isolation valve switches are cycled.

3W8 ISLN NO 3

FLOOR HEAT SWITCH Ship 724 Only

LCH – Electric heating elements under the cabin floor over the wing center section are turned on.

UNL – The heating elements are turned OFF.

- **FAIL** indicates system malfunction regardless of Switch position

3W11 FLOOR HEAT CONT

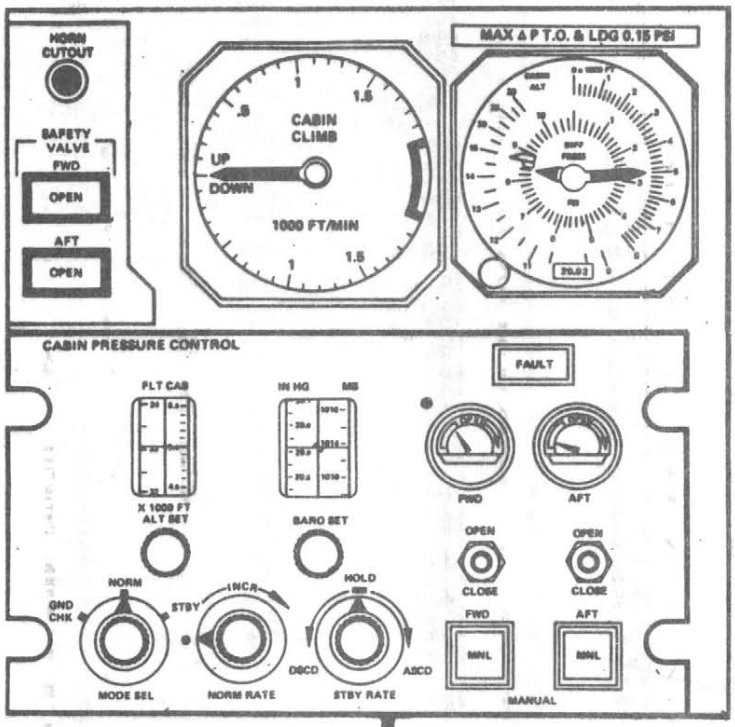
3W12 FLOOR HEAT PWR

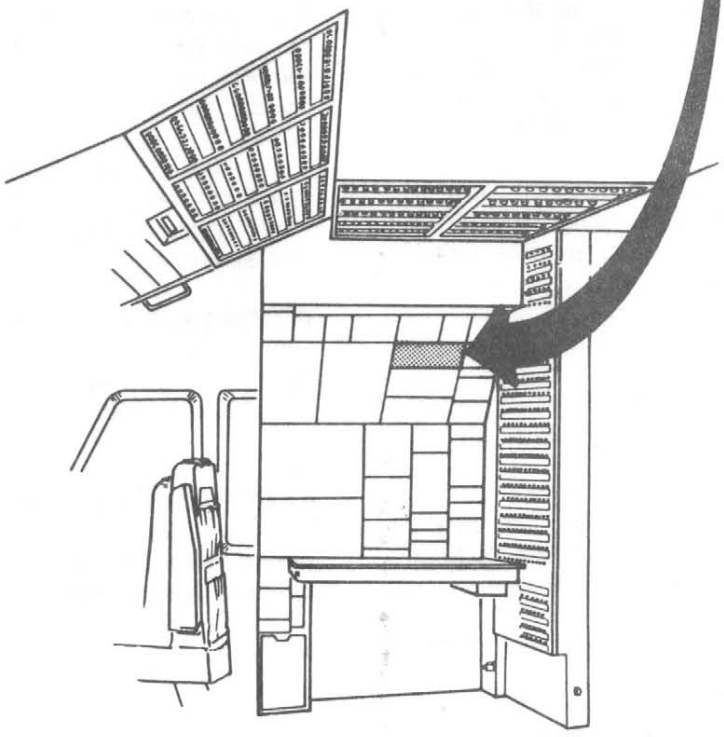
PRESSURIZATION

Cabin pressure control is maintained by varying the opening of two electrically operated outflow valves. The outflow valves. The outflow valves are located under the forward and mid cargo compartments.

There are three methods of controlling outflow valve opening.

- The Normal mode will maintain a preselected cabin altitude with provisions for barometric corrections. Selection of the landing field elevation will allow the Normal mode to depressurize the aircraft during descent. The outflow valves will be full open on the ground in the Normal mode.
- The Ground Check mode (for ground use only) allows the outflow valves to be controlled by the Normal mode controls while the aircraft is on the ground (for maintenance and preflight checks).
- The Standby mode allows direct control of cabin altitude by use of the STBY RATE knob.
- The Manual mode allows direct control of the individual outflow valves at a rate that is slower than that provided by the Normal and Standby modes by use of the MANUAL Selector switch and toggles.





FLT/CAB ALT SET KNOB AND SCALES

- Used to preset intended cruise altitude on the FLT scale when the Normal mode is in use.
  - At 8.4 psi differential pressure, the cabin altitude will be that which is displayed on the CAB scale.
  - The cabin altitude displayed on the CAB scale will be maintained at aircraft altitudes up to 1000' above what is displayed on the FLT scale. This would result in an 8.6 PSI differential pressure (maximum when the Normal mode is in use).
- Used to preset altitude of the intended landing airport on the CAB scale.
  - Aircraft will be depressurized when selected landing cabin altitude is reached.

3X10 CABIN PRESSURE CONT 3X10 AUTO PWR

MODE SEL KNOB

GND CHK

- Overrides air-ground sensing and allows Normal mode to pressurize the aircraft on the ground if a cabin altitude below field elevation is selected on the CAB side of the FLT/CAB scale. (Maintenance use only).

NORM

- Provides automatic pressurization control as determined by the selection made on the FLT/CAB scale and the position of the NORM RATE knob. Outflow valves are powered from No. 3 AC bus.

STBY

- Cabin pressure is controlled by the STBY RATE knob.

3X9 CABIN PRESSURE CONT AUTO PWR

NORM RATE KNOB

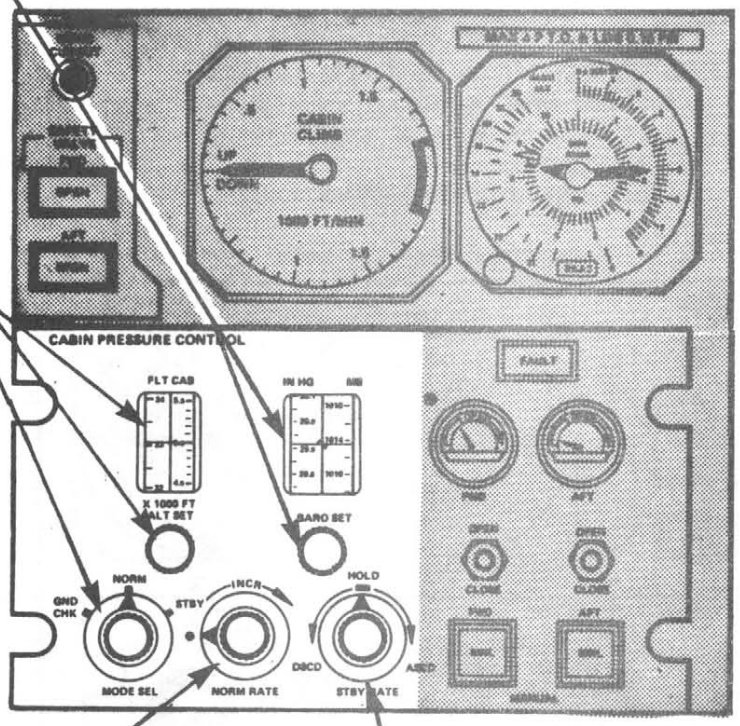
- Selects cabin altitude rate of change with the MODE SEL in NORM.
  - The Dot position provides a 500 feet per minute rate of climb and a 300 feet per minute rate of descent.
  - The rate of change may be varied from 200 to 1500 feet per minute rate of climb and 120 to 900 feet per minute rate of descent.

3X9, 10 CABIN PRESSURE CONT AUTO PWR

BARO SET KNOB AND SCALES

- Used to set barometric correction in inches of Mercury and Millibars when the Normal mode is in use.
  - Has no effect in the Standby or Manual modes.

3X10 CABIN PRESSURE CONT AUTO PWR



STBY RATE SELECTOR KNOB

- Controls cabin altitude when the MODE SEL knob is positioned to STBY. Outflow valves are powered from No. 3 AC bus.
  - Cabin altitude rate of change may be controlled from 0 to 1000 feet per minute rate of climb or descent.
  - The HOLD position will maintain the existing Cabin altitude.
  - Outflow valves will not open automatically when the aircraft is on the ground.
  - ALT SET and BARO SET controls have no effect when STBY is selected with the MODE SEL knob.

3X11, 12 CABIN PRESSURE CONT

HORN CUTOUT BUTTON

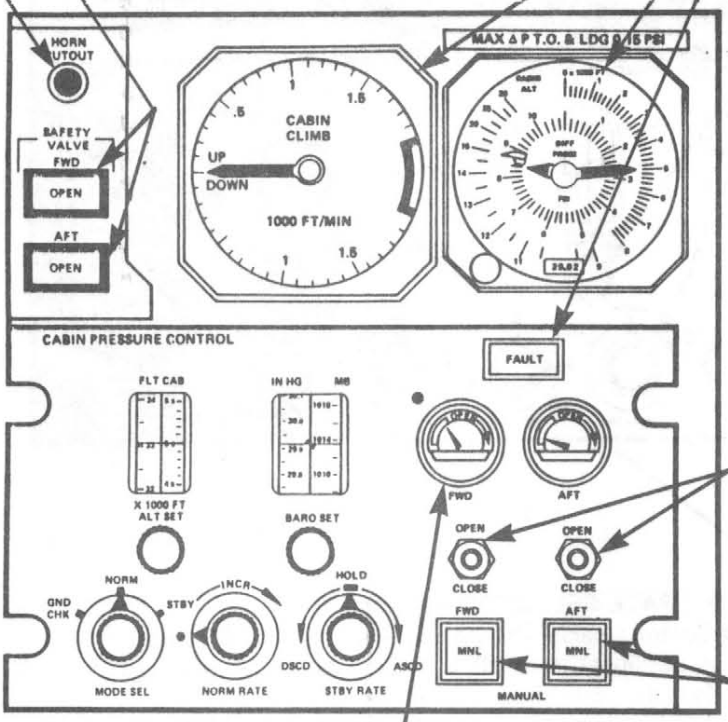
- Momentary push button switch that silences intermittent horn which sounds at 10,000 feet cabin altitude.

1L6 AURAL WARN TEST & RESET
1L8 AURAL WARN MULT SND.

FWD/AFT SAFETY VALVE OPEN LIGHTS

- Illuminate when respective cabin pressure safety relief valve is open at approximately 8.7 PSI differential pressure.
  - Will extinguish when safety valve closes.

3X9 CABIN PRESSURE CONTROL AUT



FWD/AFT OUTFLOW VALVE POSITION INDICATORS

- Indicate position of outflow valves in any mode of operation.
- "Green Band" between 9 and 11 o'clock indicates normal in flight range above 15000 feet aircraft altitude.
- "Dwell Dot" adjacent to the FWD indicator is the point at which the forward outflow valve will stop until the aft outflow valve is fully closed.
  - Ensures adequate cooling air flow from the forward and mid avionics compartments.
  - Only applies in the NORM or STBY modes.

1H 1, 2 MANUAL CABIN PRESS CONTROL

CABIN CLIMB INDICATOR

- Indicates rate of cabin altitude change.

CABIN ALT/DIFF PRESS INDICATOR

- Long pointer indicates cabin altitude on outer scale.
- Short pointer indicates cabin differential pressure on inner scale.
  - Yellow index between 8.4 and 8.6 psi differential pressure which is the maximum range of the Normal mode.
  - Red index is at the 8.7 mark. A cabin pressure safety relief valve should begin to open.

FAULT LIGHT

- Illuminates when either outflow valve is open beyond the end of the green band when **aircraft** is above 15,000 feet.
  - Both outflow valves will be locked in position.
  - **Manual** must be selected on both outflow valves to return the valve to within the green band.
  - The **FAULT** will extinguish when the valve(s) returns to the green band.
- Illuminates when the Cabin Altitude exceeds 11,500 feet.
  - Both valves will be driven towards close until the **Cabin Altitude** decreases to 11,000 feet.
  - The light will remain illuminated until control is regained and both **MNL** switches are latched at least momentarily.

1H 1, 2 MANUAL CABIN PRESS CONTROL

MANUAL OPEN/CLOSE SWITCHES

- Manually control individual outflow valves when appropriate **MNL** switch is latched.

1 H 1, 2 MANUAL CABIN PRESS CONTROL

MANUAL FWD/AFT SWITCHES

LCH – MNL illuminates, outflow valves are individually controlled with associated **OPEN – CLOSE** toggle switches utilizing standby DC power.

- Outflow valve movement will be considerably slower in **MNL** than in NORM or STBY.
- **ECS** light will illuminate on the Pilot's Annunciator Panel.
- The Manual Mode is unaffected by airground sensing.

UNL – MNL extinguishes. Outflow valve control is determined by the position of the MODE SEL Selector.

1H 1, 2 MANUAL CABIN PRESS CONTROL

AIR CONDITIONING AND PRESSURIZATION

GENERAL DESCRIPTION

AIR CONDITIONING

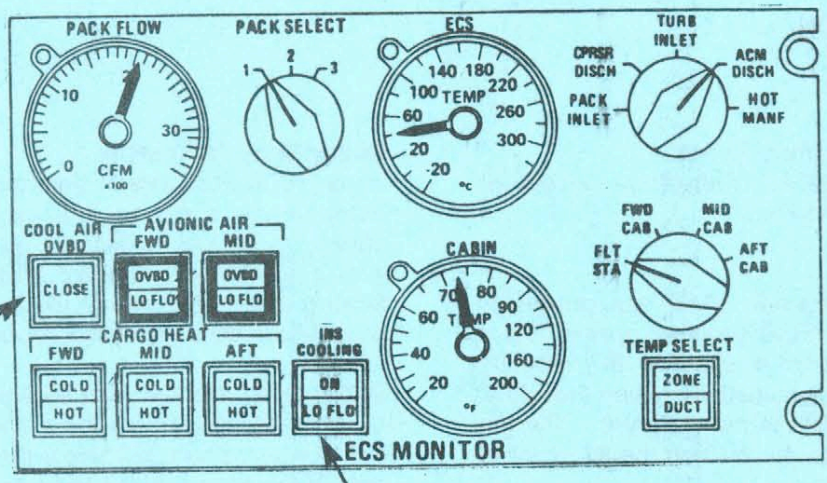
Cabin Temperature Control Panel
There are no associated underfloor galley air conditioning systems installed.

INS Cooling
Inertial Navigation System (INS) equipment is normally cooled by the FESC cooling system, but it can also be cooled by the standby INS cooling system, which turns on automatically when the FESC cooling fan fails or cooling is not sufficient. The fan can be actuated manually by latching the INS cooling switch.

Galley Exhaust System
Air is continuously drawn from the ceiling of all three galley areas, and from the cabin overhead circuit breaker panel and transformer panel by a cooling fan and is exhausted overboard through a valve in the forward upper right side of the fuselage. A series of temperature sensors monitor for exhaust duct fires.

Cabin Overhead Exhaust System
Air is exhausted from above the passenger cabin ceiling when a sensor detects the temperature in the area is too warm. A fan will turn on, and a valve in the aft upper right side of the fuselage will open automatically to exhaust the air overboard.

ECS MONITOR PANEL



COOL AIR OVERBOARD SWITCH

Unlatching the Cool Air OVBT switch will signal the FESC, MESC, galley exhaust flow control valves and overhead exhaust valve to close. If the cabin overhead exhaust system was operating, the fan relay will also be deenergized, stopping the fan.

1J14 – AIR OVBD

INS COOLING SWITCH

Provides control and indication of INS cooling fan in FESC.

INS – ON is illuminated and INS fan is turned on. This position is used to manually actuate the INS cooling fan.

OUT – Normal position. No legends are illuminated and INS fan is not operating. LO FLO indicates airflow in ventilation duct is too low. The fan should come on automatically, and the ON legend should be illuminated. LO FLO will go out when thermistor senses cooler air, but fan will keep operating. Switch must be cycled in and then out to turn fan off after being turned on automatically.

The INS cooling fan will automatically come on each time power is initially applied to the aircraft. The low–flow sensor momentarily senses the lack of cooling airflow. The INS cooling switchlight must be cycled to turn off and rearm the fan.

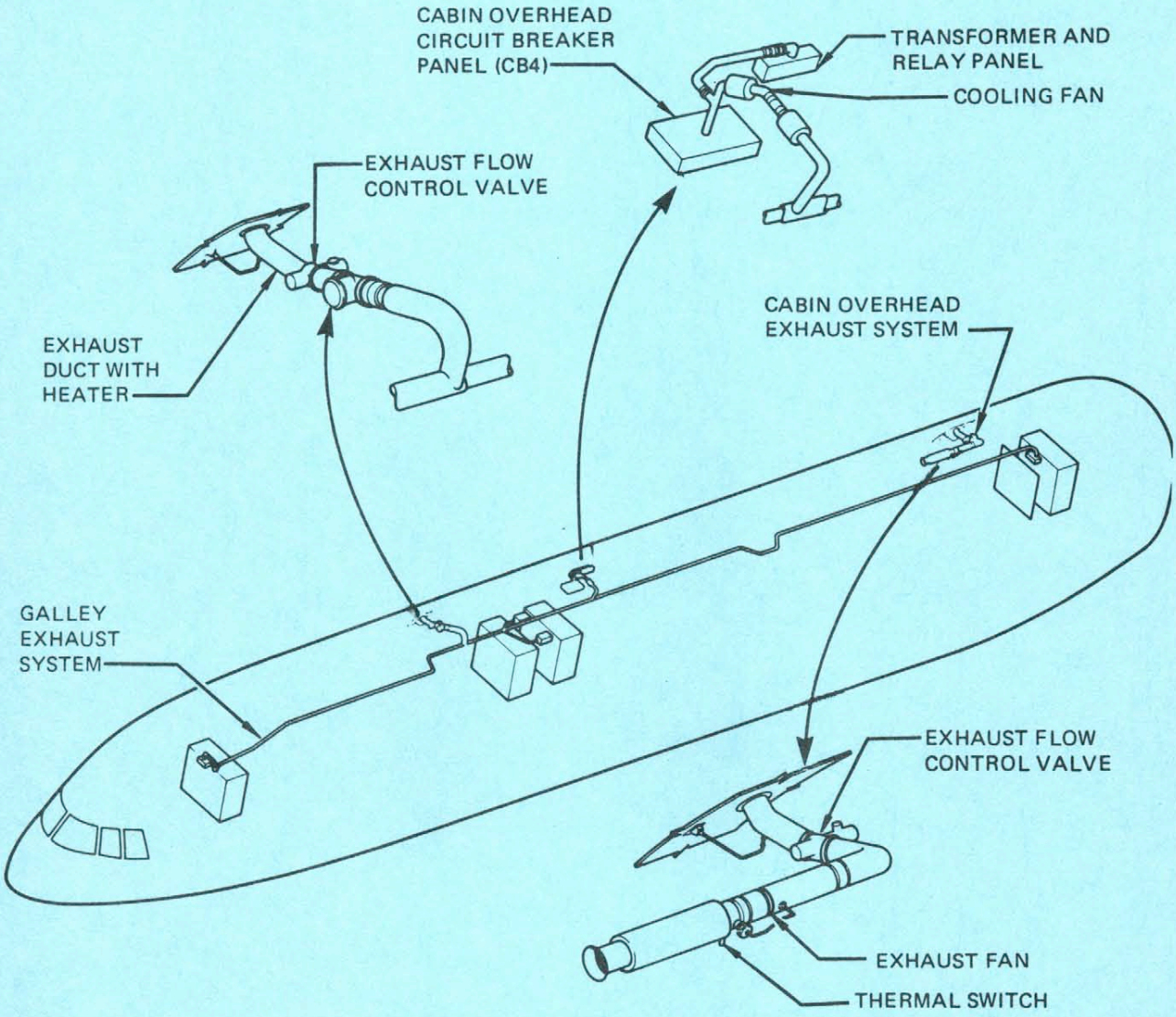
3H7, 9 – INS COOLING FAN

CABIN ZONE DUCT TEMPERATURE SELECTOR

Galley position removed.

3V1 – ECS AIR TEMP IND

GALLEY AND CABIN OVERHEAD EXHAUST SYSTEMS



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GENERAL

The Avionic Flight Control System (AFCS) provides automatic modes of control throughout the total flight profile from takeoff to landing. The AFCS consists of four major subsystems:

- Autopilot/Flight director System (APFDS)
- Speed Command/Auto Throttle System (SCS)
- Stability Augmentation System (YAW SAS)
- Flight Control Electronics System (FCES)

AUTOPILOT/FLIGHT DIRECTOR SYSTEM (APFDS)

The APFDS is designed for fully automatic approaches and landings. The APFDS in conjunction with the Speed Control System (SCS), Stability Augmentation System (YAW SAS), Flight Control Electronics System (FCES), and other equipment provides the following capabilities:

- Roll and pitch attitude hold/Control Wheel Steering (CWS)
- Heading (HDG) select and hold
- Altitude (ALT) select and hold
- Vertical speed (VS) select and hold
- Indicated airspeed (IAS) hold
- Vertical navigation (VNAV) guidance
- VOR navigation
- Lateral navigation (LNAV) guidance
- Localizer Guidance (LOC), Localizer and Glide Slope Guidance (APR, A/L)
- Turbulence (TURB) smoothing
- Category I ILS approach
- Category II & III approach/land
- Takeoff guidance
- Thrust management (TM) from FMS
- Automatic go–around
- Failure protection and warning
- Automatic fault isolation
- Lift compensation during turns

A Direct Lift Control (DLC) system enhances the performance of the APFDS during approach. The DLC provides accurate tracking of the glide slope with a minimum change in pitch (see Flight Control section).

General System Configuration

The APFDS consists of two identical control channels; each channel can be used independently to provide autopilot and flight director functions for control of the airplane about its pitch and roll axes. Channel A is associated with the left side (Capt's) of the APFDS, and Channel B with the right side (F/O's). Each channel provides independent output signals for control of associated pitch and roll autopilot servos and command signals to control the pitch and roll command bars of an associated attitude director indicator (ADI). Each channel also provides separate mode annunciation and failure warning indicators on the Captain's and First Officer's instrument panels.

Each APFDS channel can be engaged to provide either the flight director function, the autopilot function, or both. The engagement of either function results in command signal outputs for simultaneous control around both the pitch and roll axes. Both flight directors can be engaged at any time; both autopilots can be engaged at the same time only after the approach/land mode has been selected (A/L ARM).

The operation of each autopilot servo is monitored at all times the autopilot is engaged. When a failure is detected, both the pitch and roll servos of the affected APFDS channel are disconnected.

AUTOFLIGHT/FLIGHT DIRECTOR

Aircraft control functions of the APFDS are provided through the use of the autopilot and the flight director.

Control Wheel Steering

CWS – This function of each APFDS channel can be employed to provide a basic mode of autopilot operation using manual inputs for pitch and roll from either pilot's control wheel. In this mode, the airplane's pitch and roll attitudes are normally held constant, but can be changed by applying an appropriate force to either control wheel. Additionally, no heading mode or pitch mode (except for ALT HOLD) can be engaged. When CWS is engaged, the autopilot will maintain the existing heading if the bank angle does not exceed 3 degrees. If the bank angle is greater, the autopilot will maintain the existing roll attitude. If the bank angle is greater than 35 degrees, the autopilot will roll the aircraft back to and maintain a maximum bank angle of 35 degrees.

The turbulence feature (TURB) is also a function of CWS mode. Engagement of the TURB switch on the APFDS panel will cause the autopilot engage lever to drop from CMD to the CWS position. The flight director command bars on the ADI will bias from view and the autothrottles, if engaged, will disconnect. This will be accompanied by all pitch and roll modes disengaging and proper warnings annunciated on the AFCS warning panel. The AFCS panel shows "TURB" engaged, and all other modes disengaged. The autopilot will operate with reduced gains in order to provide a softer ride in turbulent conditions. The TURB feature can be terminated by depressing the TURB switch again, or by disconnecting the autopilot. If any other mode of autopilot operation is desired it must be re-engaged.

Command

CMD – In the Command Mode, the APFDS can be programmed to respond to selected inputs from numerous sources through computer interfacing. In normal operation, it is imperative that prior to selecting this mode, a roll mode (HEADING/NAV) and a pitch mode (ALT HOLD, IAS) are first engaged. Each will be appropriately annunciated on the AFCS Mode Panel. If a roll mode and a pitch mode are not first selected, the APFDS **remains in the CWS mode** and will hold the existing pitch and roll attitude. An absence of mode annunciation in the AFCS mode annunciation should provide a passive alert that an improper configuration exists.

Automatic pitch trim is provided during operation in all of the pitch axis modes when either autopilot channel is engaged in the **CWS** or **CMD** position. The automatic trim system acts to relieve any load on the autopilot servos. This also helps prevent sudden pitch changes when the autopilot is disengaged.

Stability Augmentation System (YAW SAS)

YAW SAS functions are controlled by switches on the Flight Control Electronic Systems Panel. YAW SAS provides full time yaw damping and turn coordination. Also provided is runway alignment and rollout guidance, in approach/land mode only, through parallel operation of the rudder. The rollout guidance will also give limited nosewheel steering. During all other phases of flight, the rudder operates in series.

AUTOTHROTTLE SYSTEM SPEED COMMAND (SCS)

The speed command system is independent of the APFDS operation but may be interfaced with it. The SCS provides two modes; the indicated airspeed mode (not to be confused with the IAS pitch mode of the APFDS) and the stall margin mode. The IAS mode provides (1) a selectable speed reference for the Autothrottle System and (2) an "on speed" visual display as selected on the IAS window. The stall margin or ALPHA mode is signified by a blue "ALPHA" flag covering the digital display of the IAS window and can provide three types of information. If the TO/GA switch on the control column is pressed with either an F/D or autopilot in command, the ALPHA flag automatically appears over the IAS window. If the speed command "donut" is centered, it will command a pitch attitude resulting in a minimum speed of 1.25Vs based on AOA computations up to a maximum of 18° pitch attitude. At that point, the aircraft will continue to climb at 18° pitch and could accelerate to a speed greater than 1.25 Vs. Keep in mind that in this mode the 1.25 Vs is maintained by pitch, regardless of power setting. Another facet of the stall margin or ALPHA mode is that regardless of aircraft configuration if the airspeed drops below 1.3 Vs based on AOA computations, when the SCS is not in TO/GA or approach, the ALPHA flag will drop into view. Inputs to ALPHA are also received pertaining to C.G. loading, wind gusts, and excessive sink (flight path angle > three degrees) to modify the 1.3 Vs. The ALPHA flag will drop into view regardless of flap configuration or autothrottles ON or OFF. The third and perhaps the most universally used feature is the approach feature. The ALPHA flag will drop into view any time the flaps are extended past 30°. Again, ALPHA will provide 1.3 Vs modified by C.G. loading, wind gusts and excessive sink (flight path angle > three degrees).

The scales of the speed indication change according to which mode the SCS is in.

IAS MODE = ±20 kts.
TO/GA = ±10° Pitch
APPROACH = ±5° Angle of Attack

The throttles are linked to the speed command system by engaging the ATS Switch on the Thrust Panel. This may be done at any time except when the TO/GA mode is engaged or the airplane is on the ground. The throttles are clutched to an electric motor and will be positioned to maintain the speed set in the IAS window or 1.3 Vs when the ALPHA flag covers the speed setting. If the ATS is engaged with the throttles staggered, the throttles will remain staggered.

THRUST MANAGEMENT MODE (TM)

The Thrust Management (TM) mode is a function of the Flight Management System (FMS). TM does not provide slow/fast indication on the ADI, but provides autothrottle operation for climb, cruise and descent. When TM is engaged the speed command donut is biased to the center indice. All computations are made in the Flight Management Computer (FMC).

TM may be engaged along with any pitch mode, but the Autothrottle System (ATS) must be **OFF before** TM is engaged. ATS may be selected **ON after** TM is engaged and then the autothrottles will follow FMS thrust management commands.

FLIGHT CONTROL ELECTRONIC SYSTEM (FCES)

The FCES consists of:

- A Trim Augmentation Computer for manual and automatic pitch trim, Mach trim and Mach feel compensation.
- An FCES Computer for Primary Flight Control System monitoring, stall warning, direct lift control, automatic ground spoiler control, altitude alert and fault isolation monitoring indication.

AUTOPILOT/FLIGHT DIRECTOR/COMMAND MODE ENGAGEMENT COMBINATIONS TABLE

AUTOPILOT ENGAGEMENT STATUS	FLIGHT DIRECTOR ENGAGEMENT STATUS	SELECTED COMMAND MODE	RESULT
OFF	OFF	Will Not Engage	F/D command bars out of view.
	ON	None	F/D command bars visual cues for manual control to a pitch attitude hold and a roll heading hold.
	ON	Takeoff or Go-Around	F/D command bars visual cues for manual control to a wings level roll attitude and an optimum rotation and climb out maneuver.
	ON	Any other (1)	F/D command bars visual cues for manual control to a computed guidance signal.
BASIC (CWS)	OFF	None	Automatic pitch attitude and roll attitude/heading hold with control wheel steering. F/D command bars out of view.
	ON	None	Automatic pitch attitude and roll attitude/heading hold with control wheel steering. Flight Director pitch and roll attitude hold.
	ON	Takeoff or Go-Around	Automatic pitch attitude and roll attitude/heading hold with control wheel steering. F/D command bars visual cues for manual control to a wings-level roll attitude, and an optimum rotation and climb-out maneuver.
	ON	Altitude Hold	Automatic altitude hold. Roll attitude/heading hold with control wheel steering. Flight Director altitude hold/roll attitude hold.
	ON	Turbulence	Automatic pitch and roll attitude hold with control wheel steering, both at reduced gain levels. F/D command bars out of view.
	ON	Any Other	Automatic pitch and roll attitude/heading held with control wheel steering. F/D command bars visual cues for manual control to a computed flight path.
COMMAND (CMD)	OFF	Any (2)	Automatic control to a computed guidance signal. F/D command bars out of view.
	ON	Any (2)	Automatic control to a computed guidance signal. F/D command bars follow autopilot command.

(1) The turbulence mode can be engaged only when the autopilot is engaged. When TURB is engaged, the F/D command bars are biased out of view.

(2) Engagement of the turbulence mode causes automatic reversion of the autopilot to its basic mode of operation.

THRUST ATS SWITCH

Two position toggle switch.

ATS – Engages autothrottle to hold selected speed, or if TM switch is engaged, performance management selected by FMS.

- Single or dual channel engagement is provided by ATS switches on FCES panel.
- When in TO/GA flaps extend through 30 degrees, or IAS drops below 1.3Vs, ALPHA (angle of attack) flag covers IAS readout and autothrottles are programmed to maintain ALPHA speed.

NOTE: When not in TO/GA and speed drops below 1.3Vs or the flaps are positioned beyond 30°, the ALPHA flag is referenced to 1.3Vs with automatic compensation for a forward acceleration (as would be caused by a tail gust), forward c.g. condition and excessive sink rate.

- ATS automatically disengages when TO/GA switch is pressed, TURB, or IAS is engaged, and upon landing.

NOTE: To prevent excessive throttle movement, do not engage ATS switch until IAS display and actual airspeed are approximately the same.

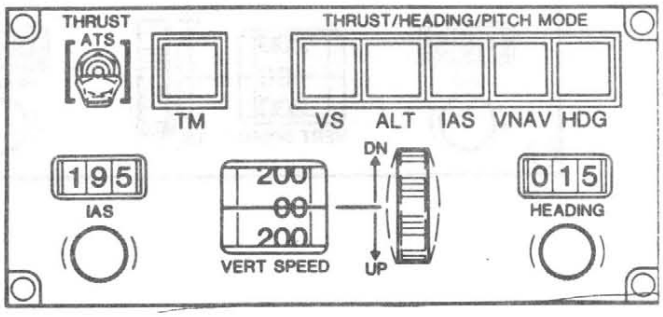
OFF – ATS is disengaged.

1A1 – AUTOTHROT SERVO
1A2, 20 – SPEED CONT
2K18, 19 – AFCS WARNING

THRUST MANAGEMENT SWITCH (TM)

Provides automatic control of the throttles through the FMS to maintain the selected performance management mode.

- THRUST ATS switch must be disengaged before TM switch is engaged. After TM is engaged ATS may be engaged to provide autothrottle control through FMS.
- Both TM and ATS will disengage when a failure in the FMS is detected.



HEADING/PITCH MODE SELECTION PANEL

IAS SELECTOR KNOB

Knob provides selection of the IAS reference for the speed command system. Depending on configuration, a minimum of 1.25 or 1.3Vs is automatically programmed by ALPHA mode regardless of speed selected.

IAS DISPLAY

Indicates selected airspeed. ALPHA flag (not shown) covers IAS numbers when system is operating in ALPHA mode.

VERTICAL SPEED DISPLAY
Provides readout for selected vertical speed in VS mode. Synchronized to aircraft vertical speed when VS mode is not engaged.

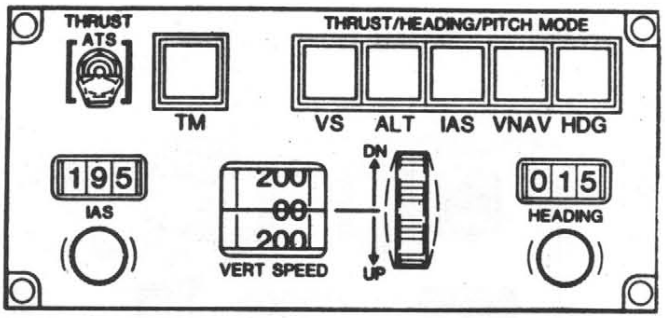
VERTICAL SPEED CONTROL WHEEL
Rotary thumbwheel that provides control of the vertical speed reference for the APFDS when VS mode is selected. Inoperative in all other modes.

HEADING MODE SWITCH
Alternate action switch.

Pressing switch holds heading selected and provides heading reference for F/D and/or autopilot in CMD. Mode is inhibited in A/L mode after localizer capture. Cannot be engaged in TURB mode. Disengages when pressed second time. Maximum bank angle is 28° at 200 knots, decreasing to 15° at 450 knots.

HEADING DISPLAY
Indicates selected heading.

HEADING SELECT KNOB
Knob that provides selection of APFDS heading reference. Positions heading bug on both HSI's.



HEADING/PITCH MODE SELECTION PANEL

PITCH MODE SWITCHES (4)

Alternate action switches. The switch illuminates to show selected mode. Engaged mode is annunciated on both AFCS MODES annunciator Panels. One pitch mode may be selected at a time.

A pitch mode may be selected if a F/D is ON or an Autopilot is positioned to CMD. The exception is ALT which is functional with CWS selected on the Autopilot. Any pitch mode may be used with the HDG or NAV mode. However no pitch mode can be used in the TURB mode. The selected mode may be disengaged by pressing the switch again or by disengaging the engaged Autopilot and F/D.

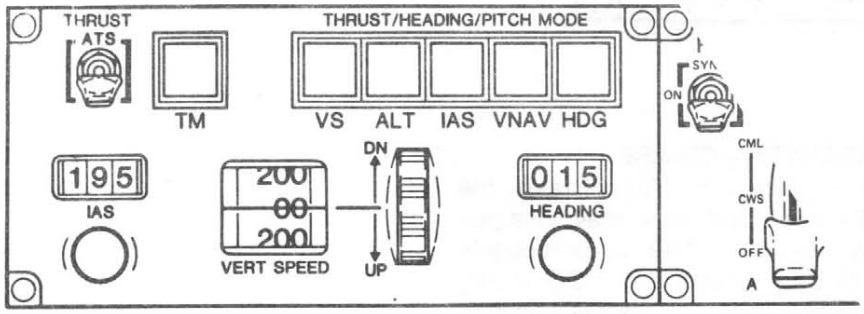
VS – Holds vertical speed existing at engagement. After engagement, VS may be varied by rotating thumbwheel and may be used for G/S capture. VS usage is inhibited in A/L mode **after** GS capture.

ALT – Holds altitude existing at engagement. May be engaged at any vertical speed with either autopilot in CWS or CMD or at least one F/D on. ALT may be used for G/S capture. ALT is inhibited in A/L mode **after** G/S capture. When ALT ARM is used on ALTITUDE SELECT panel, ALT engages automatically when aircraft reaches selected altitude. (F/D on or Autopilot in CMD mode.)

IAS – Holds indicated airspeed existing at engagement by varying the pitch of the aircraft and disengages autothrottles if in use. Inhibited in APR or A/L modes.

NOTE: IAS is selected as a pitch mode. It should not be confused with the airspeed selection function of the ATS panel discussed later in this chapter.

VNAV – Causes aircraft to follow commanded vertical profile from the FMS in climb and descent, but cannot be engaged while in ALT MODE unless FMS cruise altitude differs from actual cruise altitude by more than 750 ft. This small altitude difference is within the capture brackets for the FMS VNAV program.



HEADING/PITCH MODE SELECTION PANEL

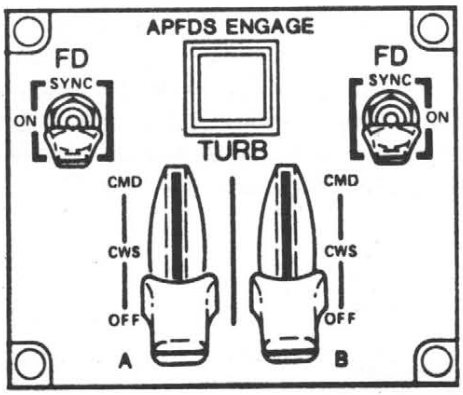
FLIGHT DIRECTOR SWITCH (2)

Three position toggle switch.

OFF – ADI command bars biased out of view.

ON – Engages F/D display on the selected side. A basic attitude hold mode for both pitch and roll is initially displayed until a NAV and/or pitch mode is selected.

SYNC – With no command modes engaged, this synchronizes the F/D to existing aircraft attitude. Presently, there are no Delta procedures to function.



F/D DISPLAY DIFFERENCES – CRUISE

Since individual gyros precess at different rates, the Captain's and F/O's command bars may disagree slightly in stabilized cruise. This is particularly noticeable in the roll bars when using HDG mode. The flight director on the same side as the engaged autopilot may be centered, while the other flight director may indicate a slight turn is required. This is a normal condition in cruise, but if desired, may be alleviated by slewing the compass and aligning the HSI heading bug precisely with the lubber line. The F/D roll bar should then center.

TURBULENCE SWITCH

Alternate action–pushbutton switch. Pressing the switch:

- Engages turbulence mode any time the autopilot is in the CMD or CWS mode unless the A/L or TO/GA modes are engaged.
- Switch illuminates and both pilots' AFCS TURB mode annunciators indicate turbulence mode is engaged.
- Trips autopilot switch (bat handle) to CWS if in CMD and disengage all other modes.
- Disengages autothrottles, and thrust management.
- Biases Flight Director bars out of view.
- Reduces pitch and roll gains by 50 per cent.
- Automatic pitch trim remains operative.

Once the turbulence mode is established, no other mode may be engaged until the turbulence mode is manually disengaged.

The turbulence mode is disengaged by pressing the switch a second time or by disengaging autopilot. The switch extinguishes and the TURB mode annunciators disappear.

APFDS ENGAGE PANEL
(GLARESHIELD)

AUTOPILOT SWITCH (2)

Three position lever type switch (bat handle) that is solenoid held out of the OFF position.

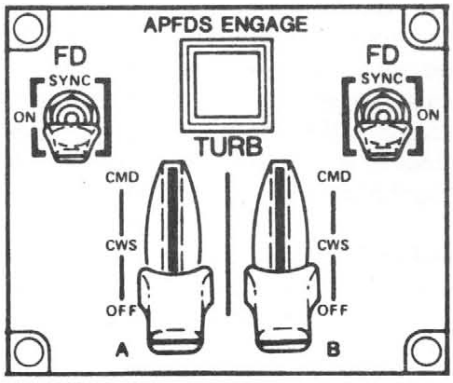
Each solenoid-held switch controls one autopilot and cannot be engaged unless all signals are valid. Only one switch may be engaged at a time unless when A/L mode is selected.

OFF – Disengages autopilot. However, the autopilot computers remain synchronized with the aircraft attitude.

CWS – Engages one autopilot at a time in the Control Wheel Steering mode to provide:

- Pitch hold up to 18°.
- Heading hold if bank is 3° or less.
- Bank hold between 3° and 35° max. Will return to 35° if engagement bank angle is greater than 35°. No navigation modes are available. Altitude hold may be engaged. Autopitch trim is operative except when force is applied to control wheel. Control wheel electric trim is operative with force applied to control wheel (four pounds or more).

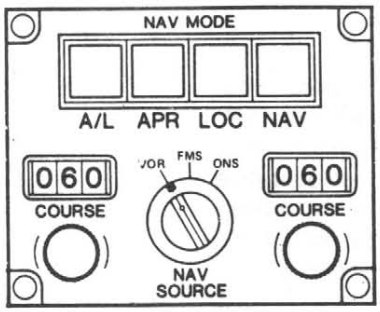
CMD – Same as CWS if no modes engaged. Any compatible NAV and Heading/Pitch modes may be engaged. Autopilot trim operative.



APFDS ENGAGE PANEL
(GLARESHIELD)

NAVIGATION SELECTION SYSTEM

Provides capability to couple the APFDS to selected radio navigation facilities for aircraft guidance, automatic approach, and landings. When pressed, the alternate action switches illuminate to identify selected mode and that mode is annunciated on both AFCS MODES annunciator panels. One autopilot must be engaged in CMD or at least one flight director must be on. Pressing the second time extinguishes the light and disengages the switch function (except A/L with autopilot in CMD).



NAVIGATION MODE SWITCHES (4)

A/L – (Approach/Land). The APFDS is armed for approach and autoland when either or both autopilots are engaged in CMD and and ILS frequency is selected. LOC ARM, G/S ARM, and A/L ARM appear in both AFCS mode annunciators. This provides CAT II or III autoland capability and hand flown F/D approach down to CAT I minimums.

APR – Arms APFDS for capture and tracking of localizer and glide slope of CAT I quality. LOC ARM and G/S ARM appear in both AFCS MODES annunciators. ILS frequency must be selected.

LOC – Arms APFDS for capture and tracking of localizer. Glide slope capture is not available. LOC ARM appears in both AFCS MODES annunciators. However, LOC is not usable for backcourse approaches.

NAV – Selects VOR/FMS/ONS lateral guidance to APFDS. To select VOR NAV mode, a VOR frequency must be tuned. VOR ARM appears in both AFCS MODES annunciators, followed by VOR after beam capture. If VOR station is not valid, VOR ARM will annunciate but F/D bars will bias out of view. Using FMS or ONS, LNAV appears in both AFCS MODES annunciators.

COURSE DISPLAY (2)

Indicates selected VOR course or ILS runway heading. Repeated on respective HSI course bar.

NAV SOURCE SELECT SWITCH

Controls the source of NAV information presented to the roll computer when NAV mode is selected, switch position must agree with HSI source switch position before autopilot NAV mode can be engaged. If switch is moved when autopilot is in CMD and NAV engaged, bat handle will drop to CWS.

COURSE SELECTOR KNOB

Left selector knob sets the No. 1 VOR receiver to desired course and positions course pointer on Captain's HSI. The course selector must be set to the proper course for an ILS approach to provide the APFDS computer "A" with the information necessary to determine drift angle and runway alignment.

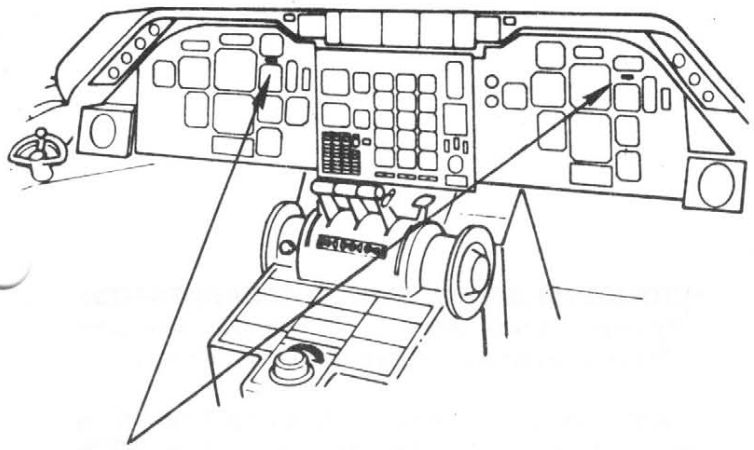
Right selector knob sets No. 2 VOR receiver to desired course and positions course pointer on First Office's HSI. The course selector must be set to the proper course for an ILS approach to provide the APFDS computer "B" with the information necessary to determine drift angle and runway alignment.

NOTE: With the NAV Source Select Switch in FMS or ONS, the Course Select Knob will have no effect on the course deviation bar.

NAVIGATION MODE SELECTION PANEL (GLARESHIELD)

ALTITUDE SELECTION SYSTEM

Provides continuous altitude alert capability at all altitudes. Provides additional capability for automatic capture of selected altitudes.



ALTITUDE

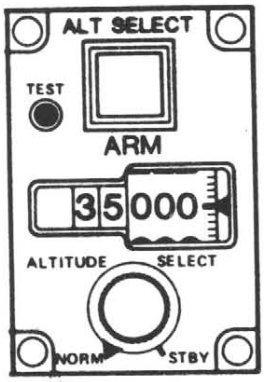
ALTITUDE ALERT LIGHT

ALTITUDE is illuminated 750 feet before reaching selected altitude. At 250 feet before reaching the selected altitude, the **ALTITUDE** lights extinguish and a C-chord sounds. If altitude deviates by 250 feet after reaching 250 feet of selected altitude, the tone sounds and the lights will flash continually until 250 feet is recaptured or a new altitude is selected.

The lights are inhibited below 2500 feet radio altitude, however, the C-chord is operative at all altitudes. Captain's ALTITUDE light is referenced to the Captain's altimeter; First Officer's ALTITUDE light is referenced to the First Officer's altimeter.

The aural warning altitude reference is switched by the NORM/STBY selector.

ALTITUDE ALERT SYSTEM TEST SWITCH
Permits check of the altitude alert system



AIR DATA SOURCE SELECTOR KNOB

NORM – The aural warning and APFDS Altitude Capture altitude reference is the No. 1 ADC and Captain's altimeter setting.

STBY – The aural warning and APFDS Altitude Capture altitude reference is the No. 2 ADC and First Officer's altimeter setting.

NOTE: The Altitude Lights are not switchable and receive data from their respective ADC's.

1B4 –FCES COMPUTER
1J21, 1K27 – ALTITUDE ALERT
3G9 – ALTITUDE ALERT INDICATOR LIGHT

ALTITUDE PRESELECT SYSTEM ARMING SWITCH
Pressing alternate action switch the first time arms APFDS for automatic capture of selected altitude.

Switch remains illuminated until selected altitude is reached and **ALT ARM** appears in both AFCS annunciators. Altitude hold is automatically engaged when selected altitude is captured. At capture **ALT SELECT** switch extinguishes, and ALT switch illuminates. **ALT** appears in both AFCS annunciators.

Pressing the switch a second time (before altitude capture) extinguishes switch and disengages altitude select.

SELECT ALTITUDE WINDOW
Displays altitude selected by control knob. Flag covers window if system fault occurs.

ALTITUDE SELECTOR CONTROL KNOB
Selects altitude for automatic capture by APFDS, and reference for altitude alert system. ALT SELECT ARM must be selected **after** altitude is selected.

ALTITUDE SELECTION PANEL
(GLARESHIELD)

ALTITUDE SELECT OPERATION

Set the desired altitude using the ALTITUDE SELECT knob. This arms the altitude alert function.

If automatic APFDS altitude capture is desired, press the ALT SELECT ARM switch. Switch should illuminate and ALT ARM should appear in both AFCS MODES ANNUNCIATOR panels.

At 750' before reaching altitude selected, the ALTITUDE lights illuminate. At 250' before reaching selected altitude, ALTITUDE lights extinguish and C chord sounds.

Just prior to reaching the selected altitude, the selected pitch mode will automatically disengage. This is known as the capture zone.

CAUTION:

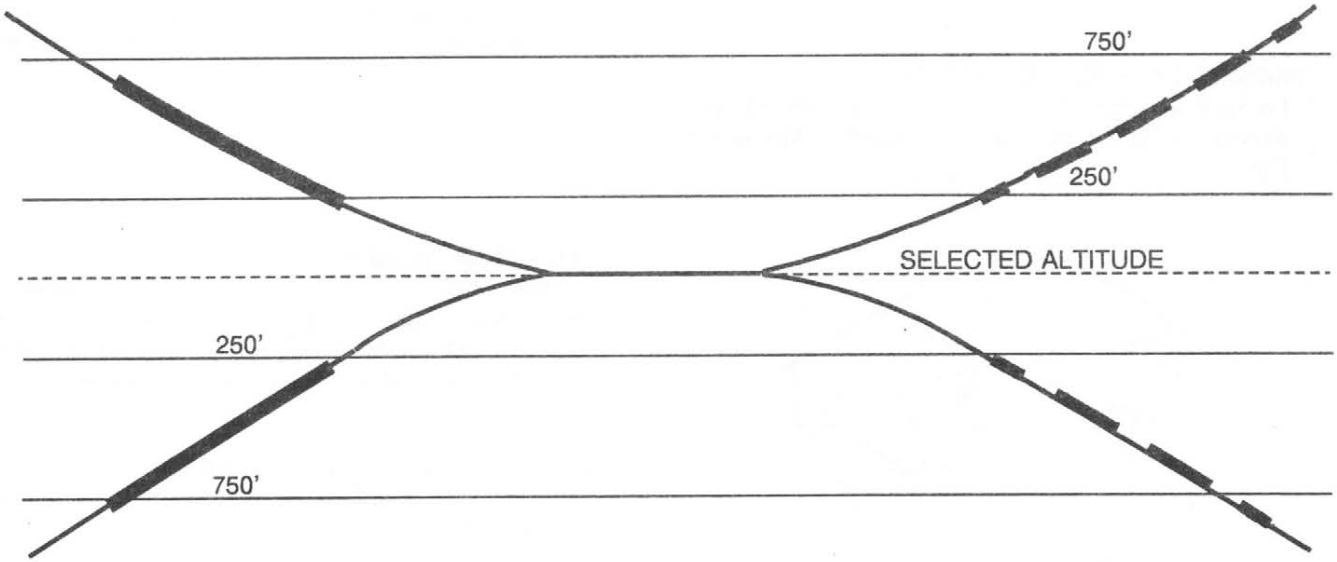
ENGAGING ANOTHER PITCH MODE PRIOR TO ALT CAPTURE WILL RESULT IN THE CANCELLING OF THE ALTITUDE CAPTURE MODE.

When desired altitude is captured, ALT SELECT ARM extinguishes, ALT appears in both AFCS MODES ANNUNCIATOR panels and APFDS ALT switch illuminates.

ALTITUDE SELECT ARM is automatically disarmed when:

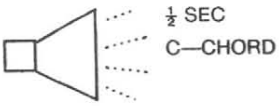
- Selected altitude is captured.
- Illuminated ARM switch is pressed.
- ALTITUDE SELECT knob is rotated.

NOTE: Exercise caution when changing F/O's course selector to avoid bumping altitude selector knob and disarming the altitude to be captured.

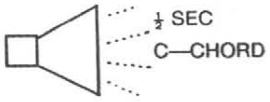


ALTITUDE
ON
STEADY

ALTITUDE
OUT



ALTITUDE
FLASHES



CONTROL WHEEL

Takeoff/Go-Around Switch (TO/GA)

The TAKEOFF and GO-AROUND modes are both selected by the TO/GA switch, however the squat (AOG) switch signal determines the active mode. The Airplane On Ground (AOG) signal has no further influence on the mode selection once it is established, i.e., TAKEOFF will not change to GO-AROUND when the airplane lifts OFF, nor will GO-AROUND change to TAKEOFF if the wheels happen to touch the ground during a go-around.

- A second actuation of the selection switch will not deactivate the mode.
- The mode can only be deactivated by selecting another pitch mode or by turning off the autopilot and both flight directors.
- For takeoff, command bars on the ADI provide command cues for a wings level attitude, and an optimum rotation and climb-out maneuver. The pitch command is limited to 18° or 1.25 Vs whichever occurs first.
- For go-around, commands are provided for flight director and/or autopilot control.

Pitch Trim Thumbwheel

The proportional pitch trim control wheel is normally used only in manual flight. However, it can also be used in conjunction with the autopilot, but only when in CWS mode. Even then, it will be inactive unless a pitch force greater than 4 pounds is being applied to the control wheel while a proportional trim wheel is being moved. This makes trimming while in CWS the same as in manual control, i.e., change the attitude by applying a control force, maintain the desired attitude by maintaining the force, then reduce the force to zero by means of the trim control. Whenever the applied pitch force is less than 4 pounds the proportional trim wheel is disabled and the automatic trim system is enabled. Manual application of trim is seldom required in CWS unless a substantial change in attitude is made.

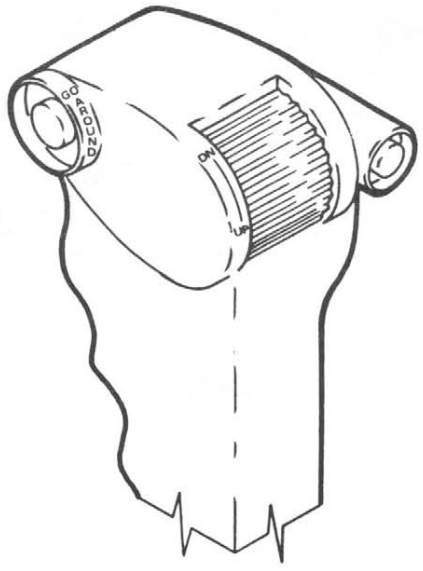
Autopilot Disconnect Switch

Either autopilot disconnect switch will, if activated, release any solenoid-held (A, B or A and B) autopilot switches to the OFF position. This produces a two-second aural warning (wailer), activates the flashing ALERT light and annunciates AP DISC.

- A second actuation of the switch immediately cancels all three warnings.
- If the flight directors are off, all active modes are also cancelled. However, if a flight director is on, there will be no effect on the active modes and they merely become flight director modes.

TAKEOFF/GO-AROUND SWITCH

Permits engagement of takeoff (TO) mode with aircraft on the ground, and Go-Around (GA) mode in flight.



CONTROL COLUMN AND WHEEL

PITCH TRIM THUMBWHEEL

Applies trim at rate proportional to speed of thumbwheel rotation It is inoperative with an autopilot in CMD, but will operate in CWS only while manual pitch input of greater than 4 pounds is applied.

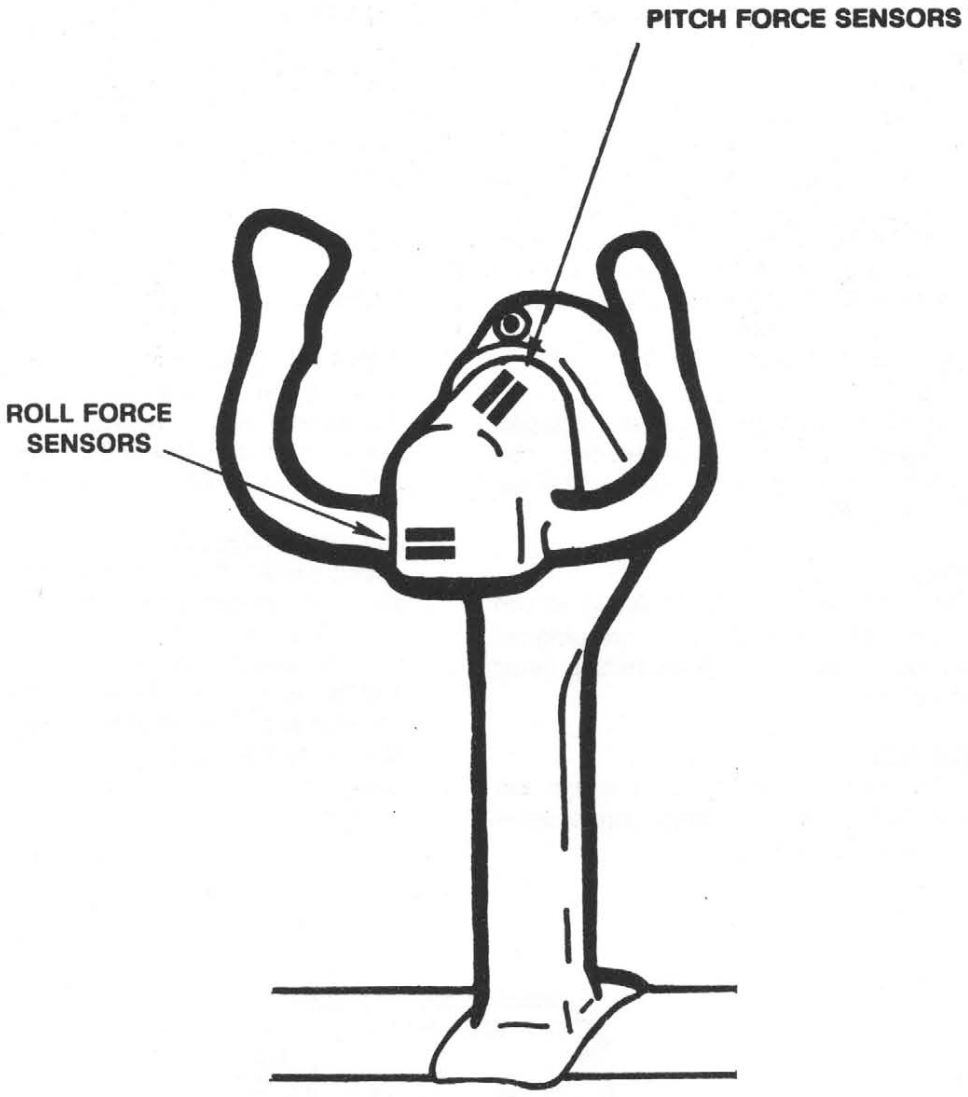
AUTOPILOT DISCONNECT SWITCH

Pressing momentary pushbutton switch disconnects autopilot(s).

WHEEL FORCE SENSORS

The CWS force sensors are located in pairs in the hub of each control wheel. Each control wheel has two (sets) pitch and two roll sensors. One "set" controls A autopilot and the other controls B autopilot.

Loss of one pitch or roll sensor results in pitch or roll loss in the affected autopilot only. Loss of a "set" of pitch or roll sensors results in loss of CWS for the affected autopilot only.



AFCS MODE ANNUNCIATOR

TEST 1 SWITCH

Momentary pushbutton switch when pressed causes illuminated display of modes as shown.

LEFT COLUMN

LOC (WHITE)
Localizer captured.

GA (WHITE)
Glide slope captured.

A/L (WHITE)
Autopilots have conducted self checks and dual computations are being used. Armed to appear at 1500 feet radio altitude and 25 seconds after glideslope capture, whichever occurs last, to indicate A/L track. Automatic landing capability has been established.

ALIGN (WHITE)
Appears at 150 feet RA if A/L is in use and autopilot is in CMD. Indicates that runway alignment has been initiated, and that localizer guidance will be available during the landing rollout.

FLARE (WHITE)
Appears at radio altitude of 50 feet if A/L is in use and autopilot is in CMD. Indicates the flare program has been initiated. If engaged, ATS will reduce thrust at a programmed rate.

ROLLOUT (WHITE)
Appears at 5 feet radio altitude if A/L is in use and autopilot is in CMD, and indicates wings level command has been initiated.

RIGHT COLUMN

HDG SEL (WHITE)
Heading select mode engaged.

VS (WHITE)
Vertical speed mode engaged.

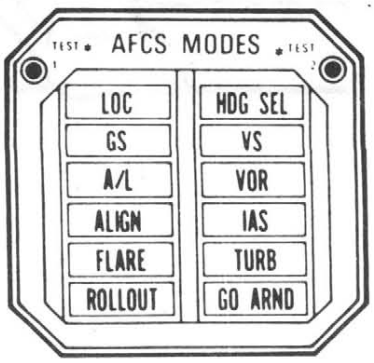
VOR (WHITE)
NAV mode selected and VOR captured.

IAS (WHITE)
Airspeed hold mode engaged. IAS held by pitch attitude.

TURB (WHITE)
Turbulence mode engaged. Automatically disconnects ATS. Autopilot trips to CWS (control gains reduced). No CMD modes are available for APFDS until TURB is disengaged.

GO ARND (WHITE)
Appears when the TO/GA switch is pressed in flight, after flaps extended to landing position if autopilot is in CMD, or flight director is on. ATS is disconnected. DLC is stowed. Wings level and minimum speed of 1.25Vs up to a maximum pitch attitude of 18° is commanded. HDG may be engaged.

1B1, 19, CAPT, F/O APCS
MODE IND



AFCS MODE ANNUNCIATORS (2) SHEET 1
PILOT'S INSTRUMENT PANEL

AFCS **MODE ANNUNCIATOR**
TEST 2 SWITCH
Pressing switch causes display of modes as shown.

LEFT COLUMN

LOC ARM **(BLACK)**
Armed for localizer capture.

GS ARM **(BLACK)**
Armed for glideslope capture.

A/L ARM **(BLACK)**
Armed for an automatic landing (CMD only).

ALN ARM **(BLACK)**
Appears when A/L is annunciated (A/L track). Indicates the align function is armed. YAW SAS goes to parallel operation.

FLR ARM **(BLACK)**
Appears when A/L is annunciated (A/L track). Indicates autopilot self checks have been conducted and computers are armed for flare function.

TAKEOFF (WHITE)
Appears when the takeoff/go around switch is pressed while on the ground with a flight director on. Flight director will display takeoff and climbout commands with wings-level in roll axis unless HDG is also engaged.

RIGHT COLUMN

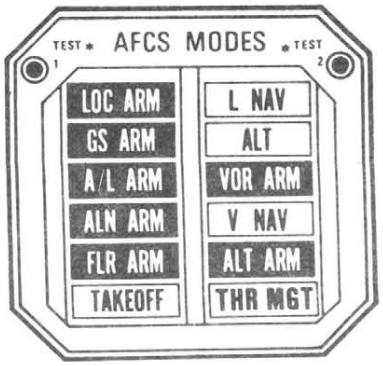
LNAV (WHITE)
FMS or ONS providing steering signals to the AFCS.

ALT (WHITE)
Altitude hold mode engaged. Automatically appears when altitude is captured by altitude select mode. Also appears if ALT mode is manually selected.

VOR ARM (WHITE)
NAV mode selected and armed for VOR capture. VOR frequency must be valid.

VNAV (WHITE)
FMS provides vertical steering information.

ALT ARM **(BLACK)**
The altitude select mode is armed to capture the selected altitude.



AFCS MODE ANNUNCIATORS (2) SHEET 2
(PILOT'S INSTRUMENT PANEL)

ALERT SWITCH
Flashes when annunciator appears. ALERT light reset by pressing once. Annunciator is reset by pressing ALERT light twice. If a second annunciator appears, switch may be reset without canceling first annunciator. ALERT light flashes when either test switch is pressed.

AP DISC (RED)
Indicates total autopilot disconnect.

AP LIMIT (RED)
Autopilot has reached limit of authority to position stabilizer.

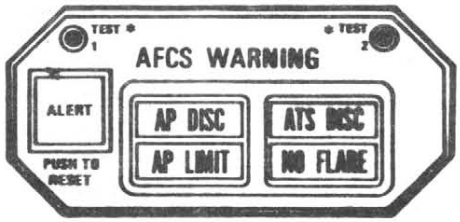
NO DUAL (ORANGE)
After A/L annunciated, this indicates that only one autopilot is engaged. Also indicates an autopilot failure after A/L annunciated and both autopilots are engaged. As a fail message NO DUAL indicates that any additional failures could result in total autopilot disconnect and loss of flight director guidance.

Annunciation cannot be reset by pressing ALERT. NO DUAL is inhibited below 150 feet until the landing roll.

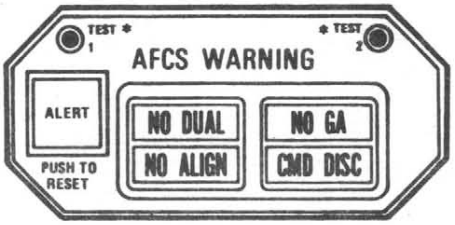
NO ALIGN (ORANGE)
Appears if A/L mode is selected and no autopilot is engaged.

Also appears at LOC capture with A/L mode selected and autopilot in CMD if there is a failure in the alignment/ rollout mode, or if inbound course settings differ by more than 6 degrees, compasses differ by more than 6 degrees or the combination of course setting and compass differences exceed 6 degrees. If problem is not cleared prior to A/L track (glideslope captured for 25 seconds and below 1500 feet radio altitude), annunciation will lock and can only be cleared by disconnecting autopilot and clearing A/L mode.

TEST 1 BUTTON PRESSED



TEST 2 BUTTON PRESSED



ATS DISC (RED)
Indicates autothrottle was disengaged manually by ATS disconnect switch on throttles, or automatically by engagement of Go–Around or TURB mode. Also appears if disconnect caused by ATS computer channel failure.

NO FLARE (ORANGE)
Appears at 150 feet radio altitude for autopilot approaches using the APR mode and for flight director only approaches using the A/L or APR modes. Also appears if flare computer or radio altimeter fails.

NO GA (ORANGE)
Appears after glide slope capture if a fault is detected in the go–around computations.

CMD DISC (ORANGE)
Indicates autopilot has tripped from CMD to CWS because an incompatible frequency was tuned or a sensor input to the autopilot is faulty.

AFCS WARNING INDICATOR (PILOT'S INSTRUMENT PANEL)

FAIL – OPERATIONAL

This status is defined as the ability of a system to revert to a fail–passive status in the event of a fault with appropriate warning and with no degradation in autopilot performance. No single failure will result in the loss of both autopilots.

FAIL – PASSIVE

This status is defined as the ability of the system to detect a fault, provide a warning and automatically disengage the autopilot in a manner to limit any accompanying acceleration forces or flight path deviations.

FAIL – SOFT

This status is defined as the ability of a system to withstand a failure without endangering passenger safety and without producing excessive deviations in the flight path.

NOTE: These three terms are used frequently in reference to the AFCS, and these levels should be familiar terminology for all flight crews.

AFCS REDUNDANCY LEVELS TABLE

	FAIL OPERATIVE	FAIL PASSIVE	FAIL SOFT
AUTOPILOT FLIGHT DIRECTOR (APFDS) **CRUISE**			Selectable Channel A or B
AUTOPILOT FLIGHT DIRECTOR (APFDS) **APROACH/LAND**	Normal (Channel A and B Engaged)	Automatically selected after 1st fail operative failure Channel A or B manually selectable	
SPEED CONTROL SYSTEM (SCS)		Normal (Channel 1 and 2 Engaged)	Channel 1 or 2 Manually Selectable
YAW DAMPER (SAS)	Normal (Channel 1 and 2 Engaged)	Automatically Selected after 1st Fail Operative Failure Channel A or B Manually Selectable	
FLIGHT CONTROL ELECTRONICS SYSTEM (FCES)		Normal (Channel 1 and 2 Engaged)	Channel 1 or 2 Manually Selectable

NOTE: Normally, a monitoring system provides a warning for each of the above conditions.

NAV MODE

The NAV mode works in conjunction with the NAV SOURCE SELECT switch and respective HSI data switches to provide command guidance to the APFDS. There are three sources of guidance in this mode:

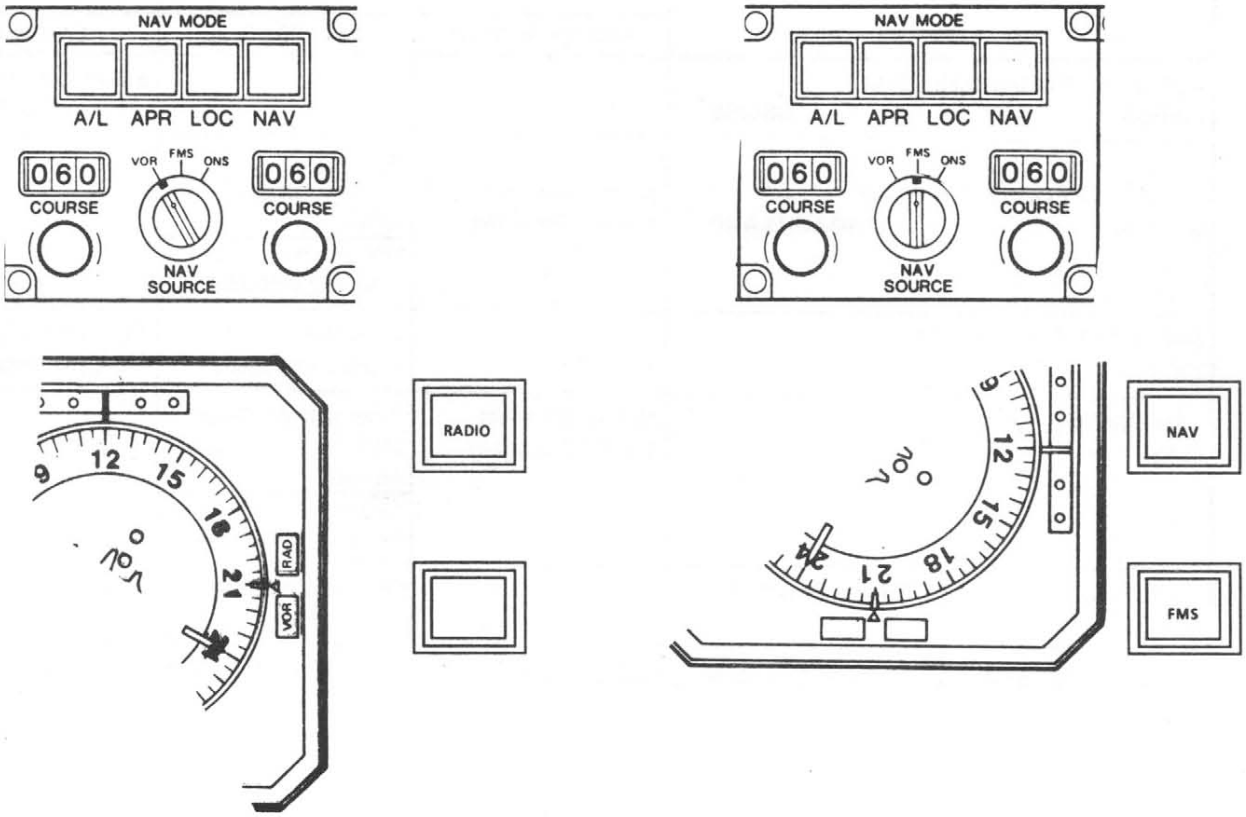
- VOR
- FMS
- ONS

The NAV mode works in the following ways.

VOR – The HSI **RADIO/NAV** Switch must be in the RADIO position and the NAV SOURCE Selector must be in VOR. When the **NAV** switch is pressed, NAV mode engages, and the NAV switch illuminates. VOR ARM will appear on the AFCS MODES annunciator panel followed by VOR when track capture occurs.

NOTE: If the VOR frequency is invalid when NAV mode is engaged, the flight director bars will bias from view. The flight director flag will appear, and the autopilot bat handle will drop from CMD to CWS. Any previously engaged mode compatible with VOR ARM will remain annunciated and the respective mode light will remain illuminated (e.g. HDG).

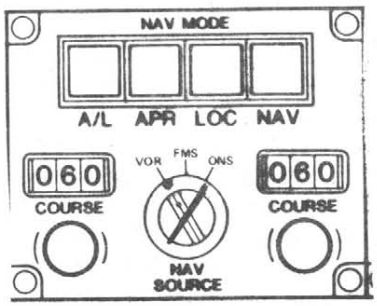
FMS – The HSI **RADIO/NAV** Switch must be in NAV position, the **FMS/ONS** Switch must be in **FMS**, and the NAV SOURCE Selector must be in the FMS position. When the **NAV** switch is pressed, NAV mode engages, and the NAV switch illuminates. LNAV will appear on the AFCS MODES annunciator panel. Steering commands from the Flight Management System will be provided to the NAV mode of the APFDS.

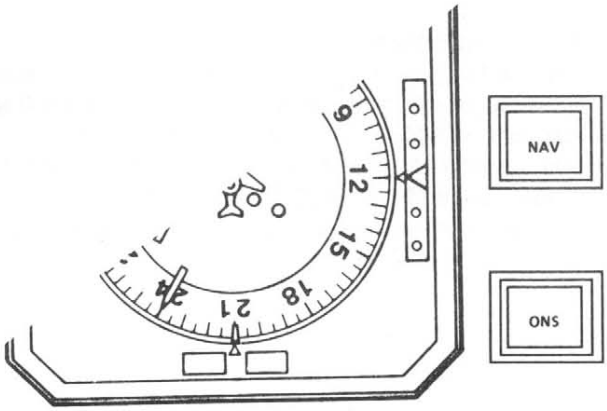


APFDS NAV MODE
SHEET 1 of 2

NAV MODE (CONT'D.)

ONS – The HSI **RADIO/NAV** Switch must be in the NAV position and the NAV SOURCE Selector must be in the ONS position. When the **NAV** Switch is pressed, NAV mode engages and the NAV switch illuminates LNAV will appear on the AFCS MODES annunciator panel. Steering commands from the Omega Navigation System will be provided to the NAV mode of the APFDS.





ENGAGE LOGIC

If the HSI Switches and NAV SOURCE Selector Switch always match **before** the APFDS NAV mode is selected, all engage logic is satisfied to provide the desired mode. However, if the switches do not match before APFDS NAV mode is selected flight director and autopilot will react as follows:

Flight Director Engage Logic

- The HSI switch positions and the position of the NAV SOURCE selector **must** agree for each panel side that the respective F/D switch is ON, or the ADI F/D flag will appear when the NAV mode is engaged. The flight director bars will bias out of view. NAV will remain engaged and the appropriate mode determined by the position of the NAV SOURCE selector will be displayed in the AFCS MODES annunciator panels.
- If F/D flag(s) appear in the ADI(s) when NAV mode is engaged, HSI switches can be switched into agreement with the NAV SOURCE selector and the F/D flag(s) will retract. If NAV SOURCE selector is repositioned in an effort to achieve a match with the HSI switches, the NAV mode will disengage and the flight directors will assume a basic pitch–roll hold mode..

Autopilot Engage Logic

- Autopilot can be engaged in CMD if flight director NAV mode is valid.
- If autopilot is in CWS or CMD and NAV mode is selected with no agreement between NAV SOURCE selector and either set of HSI switches, NAV mode will not engage.
- If autopilot is in CMD, NAV mode selected and the NAV SOURCE selector is moved, the NAV mode will disengage and the autopilot bat handle will drop to CWS.
- Once autopilot is engaged in CMD and valid NAV mode is engaged, either or both sets of HSI switches can be moved without affecting autopilot operation.

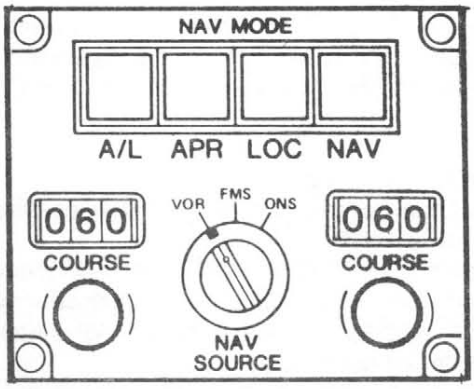
APFDS NAV MODE
SHEET 2 of 2

LOCALIZER MODE

The localizer (LOC) mode provides a guidance to capture and track an ILS localizer radio beam using either the autopilot or flight director. Normally, LOC mode is used when traffic control requires that an assigned altitude be maintained while tracking the localizer. The other approach modes (APR and A/L) will capture and track the glide slope and cannot be used when altitude must be maintained.

- LOC mode permits an early switch from VOR to ILS when an extended localizer beam is available.
- If altitude must be maintained well into the approach, it is probable that an above beam capture of the glide slope will be required.

LOC mode is selected by tuning at least one of the ILS receivers to the airport localizer frequency, setting in the localizer course with the COURSE knob and pressing the LOC switch.



NAV MODE PANEL
(GLARESHIELD)

Switching – LOC to APR or A/L

There are some factors that should be observed when switching from LOC to APR or A/L in order to obtain glide slope capture.

- The glide slope capture "window" is very narrow – $\frac{1}{3}$ dot above or below beam center on the glide slope display. Unless APR or A/L is selected prior to passing through this window, the glide slope will not be captured.
- Failure to capture will soon be obvious in a below beam capture attempt using the ALT mode. However, when VS is used for pre–capture pitch guidance, as would be normal in an above beam capture, it is possible that the rate of descent selected would not be sufficient to ensure glide slope capture, or the capture would be delayed excessively.
- Failure to capture will not be as obvious using the VS mode as when ALT is used. If the aircraft and glide slope descent rates are similar, paralleling of the glide slope could occur. An obvious deviation may not be indicated on the HSI or Flight Director depending on the selected and actual vertical speed and the amount of deviation.
- The only positive indication of failure to capture would be given by the AFCS MODES annunciators, which would continue to display G/S ARM.

The recommended procedure to avoid a failure to capture the glide slope is to select APR or A/L well in advance of the glide slope and, **in an above beam capture** establish a substantial rate of descent to assure glide slope intercept. At 160 KIAS a 3° glide slope descends at 848 feet per minute and the intercept vertical speed must be substantially greater than this for positive capture.

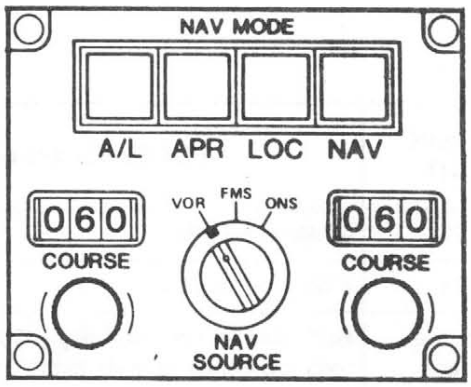
APPROACH MODE

The approach mode (APR) is certified for use in weather operations with CAT I or greater minima. A manual and visual takeover is required.

- APR mode provides less rigid control than the A/L mode and is more tolerant of ILS beam distortions, since it is not intended to provide either guidance or control of the actual landing maneuver. The flight director (F/D) display is not biased out of view, but its commands must be ignored **after** reaching CAT I minimums because the APR system was not designed or certified to provide guidance beyond this point.
- The APR mode is designed for use at runways with ILS facilities that are not approved for CAT II or III weather minimums.
- The APR mode does not require any radio altimeter inputs to be fully functioning. It is the only mode in which computed glide slope information is available to the APFDS if both radio altimeters are inoperative. Its gain programming and functional sequencing use other inputs.

The APR mode may be selected by tuning at least one ILS frequency, setting in the localizer course with the COURSE knob on the NAV Mode panel, and pressing the APR switch (light illuminates).

Note: In the APR mode, glide slope capture will not disengage ALT ARM. If ALT ARM is left engaged, and the selected altitude is reached AFTER glide slope capture, APR will disengage and ALT capture will occur.



NAV MODE PANEL
(GLARESHIELD)

APPROACH/LAND USAGE

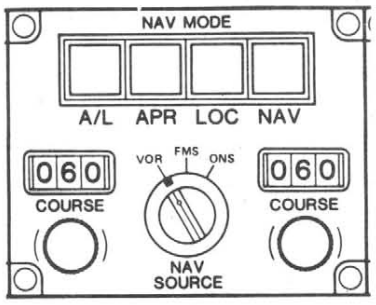
The initials of the mode name, A/L, may be misinterpreted to mean "Autoland", as applicable to the Flight Director and the autopilots. However, this is not the case. The mode has two separate and distinct usages each of which has its own termination point:

- The APPROACH usage (of A/L) is intended for Flight Director guidance only, in manual or CWS, and terminates its function at CAT II weather minimums.
  - Flight Director guidance was not certificated for use below 100 feet and a manual completion of the landing under visual guidance is required.
  - There is no Flight Director guidance for the runway alignment or flare maneuvers.
  - The Flight Director display gives only ILS tracking guidance and it is biased out of view at 50 feet above the ground.
- The LAND usage (of A/L) is for automatic control through Approach **and** Landing by one or two autopilots and does not terminate its function until completion of the landing roll. A fully automatic landing can be performed using only one autopilot if weather conditions are CAT II or better. CAT III weather requires the use of dual autopilots.
- When the L-1011 was certificated, the AFCS was certified for operation in Category III conditions. Fully automatic landings can be made at appropriate CAT II or CAT III facilities and routine use of the auotmatic landing feature is recommended.
- Pilots should operated the aircraft in accordance with procedures in Flight Training Section under "ILS Approaches."

CATEGORY	DECISION HEIGHT	FORWARD VISIBILITY (RVR)
1	200 Ft.	$\frac{1}{2}$ Mile (2600 Ft.)
2	100 Ft.	$\frac{1}{4}$ Mile (1200 Ft.)
3A	All-Weather Operation to Touchdown	Sufficient forward visibility (700 ft. RVR) to accomplish rollout by cues outside flight station.
3B	All-Weather Operation to Touchdown	Accomplish rollout with appropriate instruments and sufficient forward visibility (150 ft. RVR) for taxi guidance.
3C	All-Weather Operation to Touchdown	Accomplish rollout and delivery at gate position with no outside visual guidance.

APPROACH/LAND (A/L) MODE

The Approach/Land mode can be selected by tuning either or both ILS receivers to the desired localizer frequency, selecting the localizer course with the COURSE knobs on the NAV mode panel, and pressing the A/L switch (light illuminates).



The mode will be armed if the following conditions are met:

- All required interlocks are satisfied. Either or both flight directors are engaged and/or either autopilot is engaged in CMD
- TURB, NAV, GO ARND, TAKEOFF, APR or IAS hold mode is not engaged.

Upon arming, LOC ARM, G/S ARM, AND A/L ARM messages will be displayed in the AFCS annunciators and the A/L switch will be illuminated. If neither autopilot is in CMD but one or both F/D's are on, only LOC ARM and G/S ARM will be annunciated.

A/L ARMED

- After A/L mode is armed, the second autopilot may be engaged in CMD.
- Pre-capture guidance modes which may be used with A/L selected are pitch-hold/roll-hold, HDG, ALT hold, VS, and ALT select.

- When localizer capture occurs, the LOC ARM message is removed and a LOC message is displayed. At glide slope capture, the G/S ARM message is removed and a G/S message is displayed. Pitch and roll pre-capture guidance modes (HDG, ALT, VS, etc.) are automatically disengaged at the localizer and glide slope capture points, respectively.

AFTER LOC ENGAGE

AFTER GS ENGAGE

DUAL A/L ENGAGE

An A/L track computation is initiated when the localizer and glide slope deviation errors are less than a pre-determined level, the glide slope beam has been tracked for at least 25 seconds, and the radio altitude is less than 1500 feet. At this time, if one or both autopilots are engaged in CMD, an A/L message will replace the A/L ARM message to indicate that the autopilot function has achieved fail operational status. ALN ARM (Align arm) and FLR ARM (Flare arm) messages are displayed. The SAS is also reconfigured at this time to provide a $\pm 30^{\circ}$ (and parallel) rudder authority. Nose up trim bias is also added at this time.

APPROACH/LAND (A/L) MODE (CONT'D.)

A runway alignment computation is initiated with the system in the A/L track configuration and at a radio altitude of 150 feet. At this point, the ALN ARM message is replaced with an ALIGN message, and command signals are generated to align the aircraft with the runway heading. A combination roll and yaw side slip maneuver is used to remove any crab angle caused by crosswinds before touchdown. If the ALIGN message is annunciated at 150' RA, the pilot is assured of guidance during the landing roll.

At a radio altitude of 50 feet, a flare maneuver computation is initiated which provides appropriate flight path commands to achieve a smooth touchdown. The FLR ARM message is replaced by a FLARE message at this time. The autothrottle system is also triggered to begin a programmed deceleration at 50' RA.

AFTER FLARE ENGAGE

At 5 feet radio altitude, a rollout computation is initiated which provides a wings level command. The aircraft continues to track the localizer. A ROLLOUT message will be displayed at this time. At touchdown, a nose down bias is added to the flare computation to produce a controlled nose down rate. Rollout guidance is initially a combination of roll and yaw. After touchdown, when the ailerons become ineffective, only yaw guidance is available. When the rudder becomes ineffective, the aircraft is controlled by means of (limited) nose wheel steering.

Autopilot steering may be manually overridden with nose wheel steering during rollout using the Flight Director and expanded localizer display. An alternate method of manual control would be to disengage the autopilot, use rudder pedal steering, and the expanded localizer information for guidance (the flight director will bias out of view in conjunction with autopilot disengagement).

AFTER ROLLOUT ENGAGE

The A/L mode may be manually released by:
- Turning off both flight directors and disconnecting both autopilots from CMD.

The A/L mode will be released automatically:
- Upon loss of required interlocks
- If GO ARND is engaged.

NOTE: Fail-passive A/L mode may be used for CAT II operation including autoland. Either autopilot must be engaged in CMD before arming A/L.

In A/L mode using flight directors only (autopilots off), command bars are biased out of view at 50 feet radio altitude.

On the following pages, the flight director (A/L) and automatic approach are discussed. In the interest of simplicity, they will be discussed separately.

AUTOMATIC APPROACH/LANDING

Usage of the A/L mode optimizes the flight guidance and control system. Ssuch usage is considered normal operation, even when operating under visual flight rules or, weather permitting, when using less than CAT III ILS facilities. Fully automatic approach, landing, and rollout, can be made in the A/L mode with only one of the autopilots engaged, i.e., for CAT I and II landings. However, use of both autopilots is recommended. ILS equipment requirements are listed in the Normal Procedures section of the P.O.M.

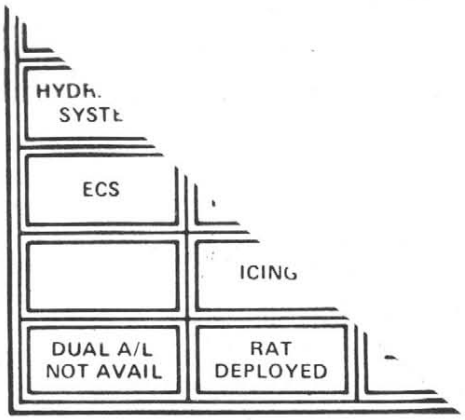
The system is operational when used in weather conditions that deny the opportunity of manual control in the event of a failure. This establishes the initial considerations that must be satisfied when a landing is intended in CAT III weather conditions.

- All automatic functions will continue unaffected (fail operational, by definition) and the automatic landing will be completed without aunnciation of the failure until speed falls below 90 knots during the landing rollout.

There are two monitoring systems that report on the "duality" status of the AFCS:

- The "DANA" light is a cruise monitor that forewarns of the unavailability of dual A/L whenever it detects a failure that may preclude achievement of dual A/L track status, i.e., its activation is not dependant upon prior selection of A/L. It can be reset in flight, and its purpose is to allow ample time to refile if the destination forecast would require dual A/L. The "DANA" light is inhibited after A/L track (1500 feet radio altitude AND 25 seconds after glideslope capture; the latter of the two), but will annunciate when the airspeed drops below 90 knots. This recall serves as a reminder for a postflight logbook entry and as an advisory message for maintenance and the next flight crew.

PILOT'S ANNUNCIATOR PANEL



"DANA" LIGHT

- The other "duality" status warning consists of a flashing ALERT light and a NO DUAL legend on the AFCS warning panel. This warning can occur only during the period between achievement of A/L track status and 150 feet radio altitude. It also serves as a reminder when a single autopilot is being used.

Due to the high reliability of the system, the NO DUAL legend is inhibited below 150 feet radio altitude to avoid annoyance at a critical time.

The probability of a dual failure from 150 feet to touchdown is extremely remote and illumination of a flashing light at a critical time is not desirable.

AUTOMATIC APPROACH/LANDING (CONT'D.)

Although the aircraft is capable of fully automatic flight from initial climb to the end of landing rollout, the accuracy of its performance will be improved by two short periods of manual flight, during which the lateral and directional trim are reset. The need for this is not obvious in an all-engines operating situation, and it is not required for satisfactory flight, but it will improve the accuracy of automatic flight. There are two basic reasons for this requirement:

- It is likely that the lateral distribution of fuel will change during the flight.
- The lateral and directional trim requirements at cruise altitudes and Mach numbers differ from those at approach altitudes and airspeeds.

The minimum trim resets are as follows:

- Prior to initial engagement of the Autopilot and at the beginning of cruise.
- Prior to initiation of localizer capture, when the aircraft is near approach airspeed and altitude.
- Trim reset is not a requirement; it should be observed to provide the APFDS with optimum initial conditions for a more accurate approach and landing.

Aircraft manuvering response is purposely restricted for passenger comfort reasons, so close-in capture is not likely to be successful. For optimum capture of the localizer:

- The airspeed should not exceed 170 KIAS and the intercept angle should not exceed 45°.
- The point of intercept should be at least 10 NM from the threshold for a 45° intercept and this distance should be increased to 15 miles for a 60° intercept.
- Intercepts made at higher than approach speeds or closer in, should be made at a lesser intercept angle to avoid excessive capture manuvering.
- Capture manuvering is automatically programmed as a function of speed and intercept angle, which are sensed as beam closure rate or angular velocity about the transmitter, with the goal of minimizing the number of overshoots required for capture.
- Unless the intercept angle is small or the distance from the threshold is great, capture manuvering may be initiated well in advance of any movement of the course deviation bar from the fully deflected position. In most cases ILS will be annunciated prior to movement of the deviation bar due to sensitivity differences within the system.

The initial approach configuration should be established before capture manuvering begins.

- Select approach flaps.
- Select approach manuvering airspeed in the IAS window of the THRUST panel.
- Autothrottles may be engaged or disengaged, as required. It is possible to make an automatic landing while controlling airspeed by manual manipulation of the throttles, but automatic throttle control is required under certain weather conditions.
- Establish automatic control by selecting CMD, the VS or ALT, and desired intercept heading in the HDG mode.
- Tune both VHF NAV receivers to the ILS frequency and set the inbound front course.
- Select A/L
- The AFCS Modes annunciators will display LOC ARM, G/S ARM, and A/L ARM together with the existing pitch and roll modes. The ARM annunciations will appear whether or not all the required interlocks and valid signals are present. If they are not present, there will be no capture of the ILS.
- The second autopilot can be engaged in CMD only after A/L ARM appears.

Engagement of both autopilot servos allows the "best" signals of the dual-dual roll, pitch and yaw channels to go to both servos in each axis. Both servos of each pair are connected to their respective flight controls and both are active in control of the aircraft. Failure of either servo will thus have no effect on the automatic control of the aircraft.

AUTOMATIC APPROACH/LANDING

Localizer Capture

The point at which localizer capture manuvering begins is determined by the angular velocity (beam closure rate) of the aircraft in relation to the localizer. This angular velocity is a function of ground speed, intercept angle, and distance from the localizer transmitter. When the angular velocity is high, i.e., high ground speed, high intercept angle, short distance out, or any combination thereof, capture manuvering will commence, and may even be completed, i.e., LOC ARM changes to LOC before the course deviation bar leaves its fully deflected position. However, if the angular velocity is low, capture manuvering may not start until the course deviation is less than one dot.

Roll manuvering limitations during localizer capture has limitations that are the same as those imposed in the HDG SELECT mode below 200 KIAS:

- 4°/second maximum roll rate
- 28° maximum bank angle

When the commanded bank angle becomes 5° or less, the deviation from beam center 3/4 dot or less, and at least 25 seconds have elapsed since localizer capture (when LOC ARM changes to LOC), localizer track status will have been achieved. **There will be no specific annunciation of this change.** Attaining localizer track status futher restricts the maximum bank angle to 10°, another reason for the 10 mile minimum intercept distance.

If the radio altitude is greater than 1500 feet when localizer track status is achieved, a single step gain programming will occur. At 1500 feet radio altitude, the single step reduction is replaced by continuous gain programming that accounts for beam convergence throughout the remainder of the approach. Instantaneous radio altitude is the parameter that controls this program.

The localizer can be captured using only one NAV receiver but both receivers should be tuned to the ILS frequency and the localizer front course as soon as practicable. The reasons for this are that the "ILS frequency tuned" logic will be missing for one of the autopilots and the YAW SAS computers begin to monitor both course reference signals when localizer capture occurs. If more than 6° difference between the course signals is detected, flashing ALERT lights and the NO ALIGN message appear on the AFCS Warning panels. This causes no immediate problem because it can be corrected anytime prior to A/L track by setting the proper course and frequency.

- If the correct frequency is not tuned prior to A/L track, the flight director on that side will be biased out of view and a flight director failure flag will appear on that ADI.
- If NO ALIGN remains after A/L track, then the only corrective action is recycling both autopilots and both flight directors through the OFF positions. This restarts the entire automatic validity check cycle, which takes about two minutes for completion and stabilization of the computed data.
- Abandonment of the approach is recommended if this situation develops.
- If the aircraft is maintained on the localizer and glideslope, the recycle time is reduced to about 30 seconds.

It is very important that the slip indicator ball be kept centered while tracking the localizer prior to achieving A/L track status. With all engines operating, assure first that the thrust is symmetrical (individual throttles can be adjusted without disconnecting the ATS), then apply the required lateral directional trim. The rudder (YAW SAS) is in series at this time and the response to trim inputs will be the same as manual control.

The rudder trim input should be set to zero when A/L track status is achieved to avoid a possible yaw transient that would occur upon autopilot disconnect (either an automatic disconnect because of failure or an intentional disconnect during the landing roll).

- No yaw transient would occur upon selection of G/A because the rudder will remain in parallel control, but it would occur later by the selection of another mode unless the trim were reset to zero.
- Resetting the rudder trim to zero results in lateral direction mistrim again, but no beam offset is required because an integrator becomes active in A/L track and provides compensation for steady state out-of-trim conditions.

Both NAV receivers should be tuned to the ILS frequency and the inbound course set in both course windows before achieving A/L track status. If this is not done, a NO DUAL message will be displayed in the AFCS Warning panels.

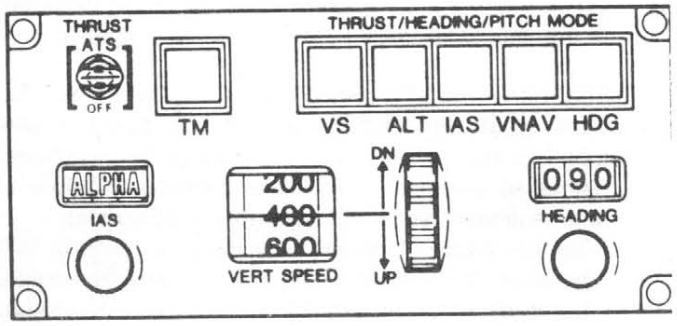
AUTOMATIC APPROACH/LANDING (CONT'D.)

Glide Slope Capture

Glide slope capture cannot be initiated until after localizer capture. Localizer TRACK capture is not a G/S pre-capture requirement, so nearly simultaneous capture of the localizer and glideslope is possible. At this point, if not already accomplished, continue landing preparations:

Desired configuration – Flaps 22 (V_{REF} + 20)

- The landing gear should be lowered when the glideslope deviation reaches $1\frac{1}{2}$ – 1 dot.
- Landing flaps should be selected at glideslope intercept.
- When the flap **lever** is placed beyond 30°, the DLC system becomes active. The Speed Command System **(SCS)** shifts to the stall margin mode (ALPHA) after the **flaps** have extended beyond 30°.
- DLC function is indicated by automatic modulation of the speed brake lever and spoiler position modulation as shown on the surface position indicator (SPI), both within the DLC range.



To minimize bracketing of the glideslope during capture, an immediate nosedown bias of about 680 FPM is applied to the pitch axis when glideslope capture is initiated (1/3 dot from beam center). This bias replaces the pre-capture pitch command and it approximates the glideslope at approach speed. Radio guidance signals then provide guidance for G/S capture. At initiation of capture, the G/S ARM annunciation changes to G/S and the pre-capture pitch mode annunciation disappears and its switchlight is extinguished.

- When 25 seconds have elapsed since initiation of G/S capture and the deviation from beam center is 1/6 dot or less, the status changes to G/S track. **There is no annuciation of this change.**
- Starting at 500 feet radio altitude, the G/S gain is programmed linearly to zero at a 50 foot height to compensate for beam convergence.

A localizer capture at the prescribed distance from the transmitter usually results in a G/S capture from below the beam while in the ALT mode.

- An above-beam glideslope capture may be made using the VS mode. At 160 knots ground speed, a 3° glideslope descends at 848 FPM and the intercept vertical speed must be substantially greater than this for a positive G/S intercept.
- Glideslope capture occurs within 1/3 dot above/below beam center. An apparent glideslope capture can occur without actually capturing the glideslope, or capture is delayed by nearly paralleling the glideslope. If the rate of descent approximates that of the glideslope, and descent is initiated in close proximity to the G/S beam, a failure to capture will be indicated by G/S ARM and A/L arm legends continuing to be displayed on the mode annunciator.

AUTOMATIC APPROACH/LANDING (CONT'D.)

The F/D pitch command bar will be centered because of the VS command, the flight instruments will indicate a descent, and the raw radio data display on the HSI will not indicate an obvious deviation from G/S. The only obvious indication of failure to capture will be given by the AFCS Modes annunciators, which will continue to display G/S ARM and A/L messages.

G/S capture cannot be initiated until LOC capture has been initiated.

A/L Capture

When the aircraft reaches 1500 feet radio altitude and 25 seconds have elapsed since GS capture, the A/L ARM will change to A/L. The autopilot becomes fail operational and the "voting system" commences a continous evaluation of the inputs from the four channels in each aircraft axis in order to determine the most acceptable signals to be used during the remainder of the approach. ALN ARM and FLR ARM messages will appear with the annunciation A/L, indicating that the required interlocks are valid for the runway alignment and flare maneuvers. If the runway alignment computations are not found to be in a fail operational status:

- ALERT lights flash.
- NO DUAL and NO ALIGN messages appear on the AFCS Warning panels.

If the computations are valid, but only one autopilot is in CMD, a reminder will be given:

- ALERT lights flash
- NO DUAL message appears
- The ALERT lights can be reset, but the NO DUAL message will remain unless the other autopilot is engaged in CMD.

After A/L track status is achieved, the autopilot can still be overpowered by manual application of pitch or roll inputs which will not disconnect the autopilot(s). They can only be disconnected by one of the disconnect switches.

- When A/L appears, the rudder control shifts from series to parallel resulting in rudder pedal movement when YAW SAS inputs are made. The shift can be verified by noting that the rudder pedals can no longer be moved freely.
- The maximum rudder deflection available to the autopilot increases from ±8° to ±30°.
- A nose-up pitch bias is applied to the automatic pitch trim system so that if only one autopilot is in CMD and it disconnects, nose down transient input from the flight controls cannot occur. This bias has no effect as long as the aircraft remains under autopilot control and is not indicated on the SPI.
- Indication that the bias is being applied is apparent by a half-turn movement of the manual trim wheel in the nose-up direction.

AUTOMATIC APPROACH/LANDING (CONT'D.)

After A/L track status is achieved, both lateral and directional trim should be set to zero. This is to eliminate any transient yaw. Rudder trim is not effective when the Yaw SAS system is in parallel operation.

Pitch trim should be included as a specific item of the instrument scan during the entire period from initiation of A/L track until landing flare.

Autopilot disconnect during this period would be the result of a second or third failure. Assure proper trim is applied throughout the A/L track as an increased landing sink rate could result from a mis-trim condition.

- The trim function can be monitored by resting one's hand or leg lightly on the manual trim wheel.
- A mis-trim condition of a large magnitude will be indicated on the stabilizer out of trim indicators (Cats eyes) of the Surface Position Indicator (SPI). This condition would result if both systems have failed to maintain proper trim.
- Consider abandoning the approach if a trim problem exists and its source is not readily apparent. The purpose of the mistrim indication is to warn of a possible pitch transient when and if the autopilot is disengaged.

Align Capture

In crosswind conditions, the localizer is tracked in a wings-level crab. A smooth landing cannot be made unless the crab angle is quite small. A runway alignment maneuver is performed to avoid landing gear side-loads at touchdown. This maneuver changes the method of tracking the localizer from a wings-level crab to a wing-down sideslip, which will align the fuselage with the runway and continue to track the localizer beam center.

Note: The maximum bank angle of the alignment function is $3\frac{1}{4}°$. This limits the maximum crosswing component, underwhich alignment can be maintained, to 18 knots. Crosswind components of a greater magnitude will require some crab in addition to slideslip. A bank of less than 5° is sufficient for alignment at landing speed with a crosswind component of 30 knots. However, some crab angle will remain at touchdown.

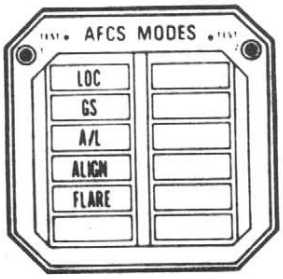
- A steady-state sideslip is not conducive to passenger comfort, so the maneuver is performed as near touchdown as possible.
- At 150 feet radio altitude the alignment maneuver is automatically initiated.
- Initiation of the align maneuver is indicated by the ALN ARM annunciation changing to ALIGN.

- The flight director is not programmed to command this sideslip maneuver, so it will be useful only as a monitor of the tracking of the ILS.
- The radio altimeter aural alert signal will commence at 50 feet above the selected altitude.

AUTOMATIC APPROACH/LANDING (CONT'D.)

Flare Capture

At 50 feet radio altitude, the flare maneuver is initiated and the annunciation changes from FLR ARM to FLARE. The maneuver consists of several simultaneous actions:



- An increase in lift due to an increase in pitch attitude.
- An increase in lift due to modulated closing of the DLC spoilers.
- SCS is programmed to reduce airspeed at a rate of 0.9 knots per second and a programmed thrust reduction.
- ATS can modulate thrust in flight to a minimum of flight idle.
- Glideslope gain programming is reduced to zero at 50 feet radio altitude.

The flare maneuver is a mathematical computation based solely on the rate of change in the radio altitude. Spoiler modulation provides accurate tracking of the computed flare path in gusty conditions as it did glideslope tracking. Modulated reductions in thrust combined with pitch and DLC modulations produce a smooth reduction in airspeed during the flare.

The sideslip attitude is retained, as necessary, during the flare and touchdown and during the early portion of the rollout until the auto ground spoilers actuate at truck tilt.

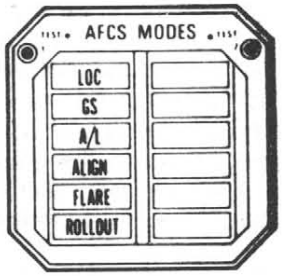
- There is no danger of wing tip or engine pod contactwith the ground because a bank angle in excess of 15^{o} would be required.

The rate of sink at touchdown is programmed to be 1.9 feet per second. The computer program is based on pitch trim being within limits at the initiation of flare, therefore, a harder landing will result if the trim is out of tolerance in the nose–down direction. At forward CG it is possible that the automatic pitch trim will reach the nose–up limit during the flare; in this case, a mistrim indication will appear on the SPI, and the touchdown rate of sink may be greater than 1.9 feet per second. The automatic pitch trim system operates throughout the flare maneuver until touchdown.

AUTOMATIC APPROACH/LANDING (CONT'D.)

Rollout

When the radio altimenter senses a height where the main gear is five feet above the runway, the rollout computation is initiated and is annunciated by ROLLOUT legends in the AFCS Mode panel. At this point the wings are leveled from any slide slip angle that was input during the ALIGN maneuver. This final annunciation completes the sequence of automatic landing annunciations.



The touchdown and landing events include:

- At touchdown, the automatic ground spoilers deploy.
- The ATS drives the throttles to ground idle, arranging the throttle linkage so reverse thrust can be applied manually.
- Aileron and rudder control inputs continue, with control emphasis shifting to the rudder. This control transfer is quite rapid when the automatic ground spoilers deploy.
- The nose gear is allowed to descend to the runway at a controlled rate (2° pitch per second) to avoid hard contact.
- The nose wheels will be aligned with the runway at initial contact (because of the nose wheel centering cam) even though the rudder pedals may be displaced from center by the parallel rudder control inputs.
- Weight on the nose gear places the nose wheels under control of rudder pedal steering. Heading control is maintained through the parallel rudder control inputs as the rudder loses its aerodynamic effectiveness.
- At approximately 60 knots, manual control of the nose wheel steering should be assumed.
- Guidance for directional control is provided by the HSI localizer and expanded localizer in the ADI's when supplemental hand steering control, asymmetric braking or reverse thrust application is required.

FLIGHT DIRECTOR APPROACH-A/L MODE

The HSI RADIO/NAV switches should be in RADIO. Any pitch mode, except IAS, is compatible and the initial approach to the ILS facility can be made under heading (HDG) guidance, or in the NAV mode with the NAV source selector in VOR. In this latter case, both flight directors should be ON and one NAV receiver tuned to the VOR frequency. While still tracking the VOR radial, tune the other NAV receiver to the ILS frequency and set the inbound front course in the COURSE window.

The NAV switch will be illuminated and VOR will be indicated on the AFCS MODES annunciators. Both F/D and the HSI associated with the radio tuned to the VOR will give indications relative to the VOR station, but the other HSI will indicate the situation relative to the ILS station.

When ready to intercept the localizer, press the A/L switch. This illuminates the A/L switch and extinguishes the NAV switch, removes the VOR annunciation, and substitutes LOC ARM and G/S ARM. The flight director associated with the receiver tuned to the VOR will be biased out of view, but the associated HSI will continue displaying VOR guidance.

Tune the other receivers to the ILS frequency and set the inbound front course on its COURSE selector. Both HSI and F/D will now display the situation relative to the localizer.

- The F/D will continue with the existing pitch command, but will enter a heading hold mode until capture of the localizer is initiated.
- If the HDG mode is used for pre-capture guidance, both F/D's will display HDG guidance until localizer capture is initiated.

FLIGHT DIRECTOR APPROACH-A/L MODE (CONT'D.)

The maximum pitch and roll commands of the F/D are restricted. Close-in capture with F/D commands is not feasible unless the intercept angle is reasonable small. The aircraft can be banked to angles greater than the F/D maximum, but when this is done, the F/D will command an opposite bank, directing a return to the maximum command angle, which could be confusing.

- For optimum capture of the localizer, the airspeed should not exceed 120 KIAS, and the intercept angle should not exceed 45°.
- The point of intercept should be at least 10 NM from the threshold for a 45° intercept and this distance should be increased to at least 15 NM for a 60° intercept.
- Intercepts made at higher speeds or closer in should be made at lesser intercept angles to avoid excessive capture maneuvering.
  - Capture maneuvering is automatically programmed as a function of speed and intercept angle with the goal of minimizing the number of overshoots required for capture.
  - Unless the intercept angle is very small, capture maneuvering will be initiated well in advance of any movement of the course deviation bar from the fully deflected position on the HSI.

The initial approach configuration should be established before capture maneuvering commences. This involves selection of approach flaps and approach maneuvering airspeed in the IAS window on the THRUST panel. Autothrottles may be engaged or disengaged, as desired.

When the localizer capture maneuvering starts, the LOC ARM annunciation changes to LOC and the pre-capture guidance is released, removing its annunciation.

The annunciation change indicates that localizer capture has begun even though there may be no movement of the course deviation bar.

Capture is completed when:

- Deviation becomes less than 3/4 dot.
- The command bank angle is less than 5°.
- At least 25 seconds have elapsed since initiation of capture.

Localizer gain programming, which is a single-step reduction in heading sensitivity, takes place and the status changes from capture to track, although the change is not annunciated.

The initiation of localizer capture releases the roll axis mode, but the pitch axis mode is retained until glideslope capture. Localizer capture and track in the A/L mode are the same as they are in APR and LOC modes until 1500 feet radio altitude is reached. Below this height, A/L localizer track differs from APR and LOC in that a second programming of localizer gain is begun, this programming being based on radio altitude. Glideslope capture cannot be initiated until after localizer **capture** is initiated, but localizer **track** status is not a precapture requirement, so nearly simultaneous capture of localizer and glideslope is possible.

To allow ample time for trimming before glideslope capture maneuvering, which commences at 1/3 dot deviation:

- The landing gear should be lowered and the airspeed reduced to Vref + 20 when the glideslope deviation decreases to 1 dot.
- Landing flaps should be selected at glideslope intercept.

DLC will become active when the flap handle is moved through the 30° position.

- DLC activation depends on flap **handle** position while SCS speed reference change depends on **flap** position.
- The flaps will respond by also moving through the 30° position and, in so doing, will cause the SCS reference to change from indicated airspeed to angle of attack, placing the SCS in stall margin mode (ALPHA).

FLIGHT DIRECTOR APPROACH-A/L MODE (CONT'D.)

The SCS reference change will be indicated by the appearance of a blue ALPHA flag that obscures the digital airspeed selection in the IAS window of the THRUST panel.

The speed error display (SLOW/FAST needle) on each ADI will continue to indicate speed error based on angle of attack. There is no change in the corrective action to the indicated error if the ATS is not engaged. For example, a SLOW indication results from an angle of attack that is too large and the corrective action is to increase speed by increasing thrust. (Pitch changes cannot be used for speed control because they are already being used for altitude control and will be used later for glideslope capture and track.) All responses to speed commands must be made through throttle manipulation only.

- The speed error display is usable until initiation of the landing flare.
- Flight director guidance should not be used below 100 feet (even though the display remains in view until a 50 foot height is reached) because flight director guidance was not certificated for use below 100 feet.
- Autothrottles should not be used below 100 feet because there will be no throttle-retarding flare computations.

The glideslope is normally captured from below the beam, but can also be captured from above. When a glideslope capture starts, the G/S ARM annunciation changes to G/S and the pre-capture pitch mode is released, removing its annunciation.

A glideslope capture timer starts with initiation of capture. When 25 seconds have elapsed and glideslope deviation is 1/6 dot or less, the status changes from glideslope capture to glideslope track. This change in status is not annunciated. When these conditions have been satisfied, the first stage of glideslope gain programming occurs, reducing the pitch sensitivity of the flight director.

In a flight director approach, care must be exercised to assure that the deviation is indeed reduced to less than 1/6 dot displacement some time after the 25 second delay period. If this accuracy is not achieved, the F/D will so indicate by means of a prominent "fly up" or "fly down" command even though the HSI glideslope deviation indicator may appear to be indicating "on glideslope". Compliance with the F/D command is required to achieve a glideslope track status, without which no further gain programming can occur.

Achievement of A/L track status requires that a GS track status exist for at least 25 seconds and that the radio altitude be less than 1500 feet. When both of these requirements have been satisfied, A/L track status will have been achieved, but there will be **no** announcement of it on the AFCS Modes annunciator.

- There will be flashing ALERT lights and NO ALIGN annunciation on the AFCS Warning panels.

- At 150 feet radio altitude, flashing ALERT lights with NO FLARE will be annunciated.

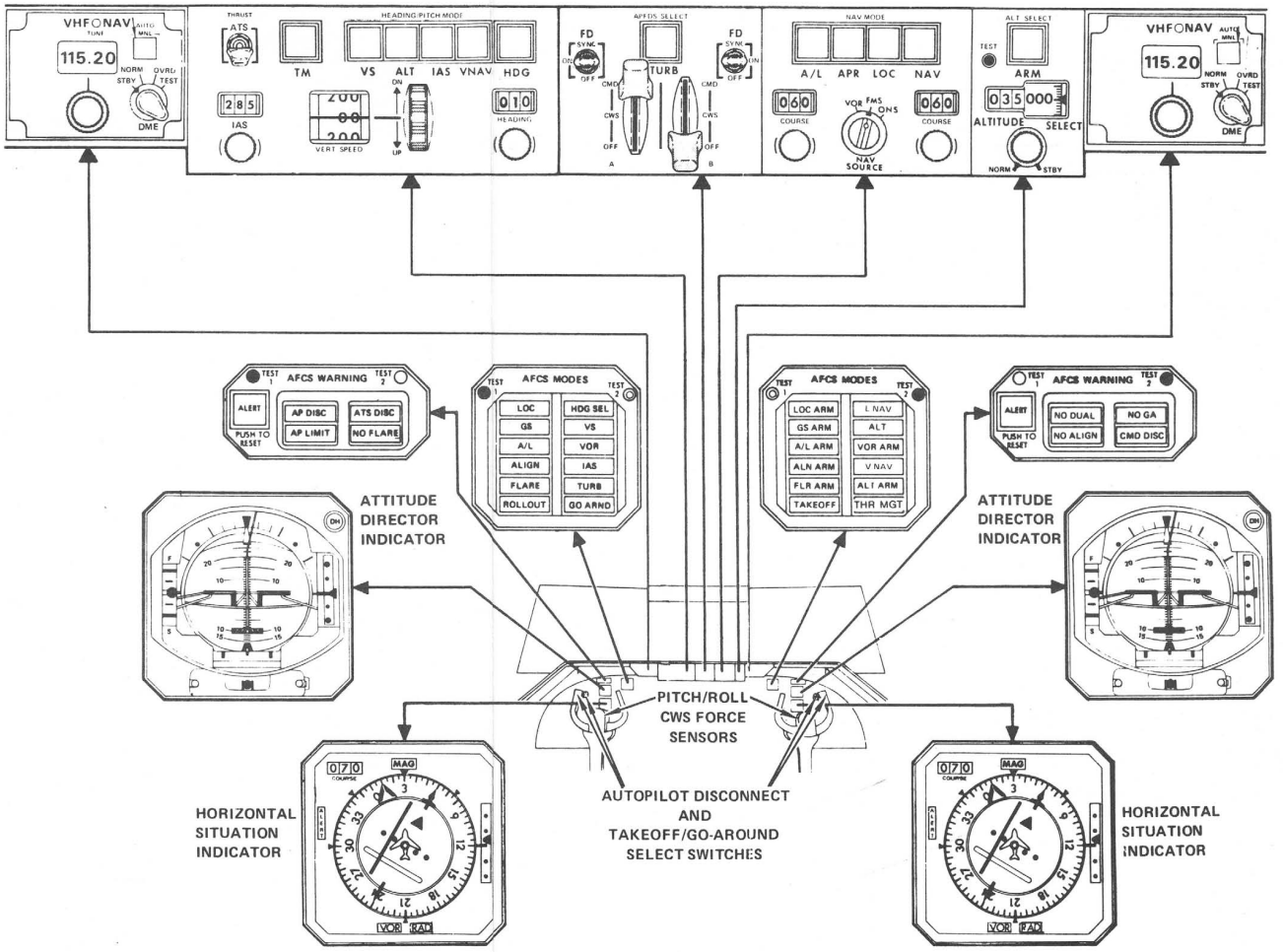
NOTE: These are reminders that there is no F/D guidance for runway alignment or flare. The warnings may be reset, if desired.

- At 50 feet radio altitude, the F/D display will be biased out of view.

FLIGHT DIRECTOR APPROACH-A/L MODE (CONT'D.)

An unsatisfactory F/D approach can be discontinued at any time, regardless of flap setting by pressing the TO/GA switch on the control wheel. This action will provide F/D guidance for the go-around.

- If F/D guidance is not desired for the go around, the A/L guidance mode can be released, even in A/L track status, by a second actuation of the A/L switchlight.
- It should be noted that if autopilot is in CMD, the mode can be released in this manner only before A/L track status is achieved.
- Selection of TO/GA will disconnect the autothrottle servo, but will not affect the remainder of the speed control system.
- The ATS switch will drop to the OFF position, but there will be no ATS DISC warning.
- If it is not already in the stall margin mode (ALPHA), i.e., if the flap deflection is less than 30°, the SCS will switch to TO/GA mode.
- The stall margin command angle of attack will be changed from that angle associated with 1.3Vs which had been used during the approach, to that angle associated with 1.25Vs for the go-around.
- Light weight and low ambient temperatures both tend to increase the resulting pitch attitude. This attitude is limited to a maximum of 15° and any excess thrust will be converted to increased airspeed.
- If TO/GA is not selected when discontinuing the approach, the autothrottle servo must be manually disengaged. The speed command will be IAS if the flap extension is less than 30°, or it will be referenced to the angle of attack for 1.3Vs if the flap extension is greater than 30°.



AFCS FLIGHT STATION COMPONENTS

Ships 751-756

Ships 738-741

AUTOFLIGHT

GENERAL DESCRIPTION

THRUST MANAGEMENT MODE

The Thrust Management (TM) mode is a function of the Flight Management System (FMS). TM provides autothrottle operation for the climb, cruise, and descent. All computations are made in the Navigation Computer Unit (NCU).

TM may be engaged simultaneously with any pitch mode but the Auto Throttle System (ATS) must be off at the time of engagement. ATS may be selected On after engaging TM and then the autothrottles will follow FMS thrust management commands.

APFDS/FMS INTERFACE

Flight Management commands may be coupled to either APFDS. Vertical steering commands are supplied to both pitch computers for use in the V-NAV mode. If Thrust Management is engaged, valid pitch commands are produced during climb (climb armed and V-NAV engaged) and cruise (altitude hold). Coupled descent mode requires that thrust management mode, V-NAV mode, and L-NAV mode be engaged. Should altitude capture occur when V-NAV is engaged, the V-NAV mode will be disengaged and superseded by the altitude hold mode.

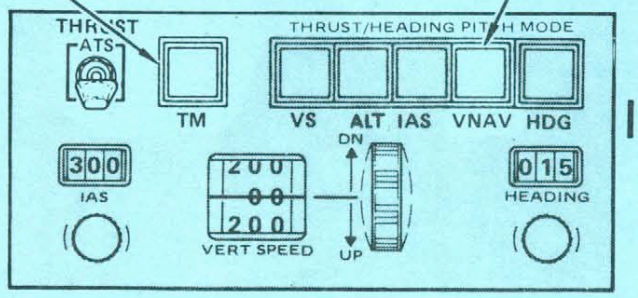
THRUST MANAGEMENT CONTROLS AND INDICATORS

THRUST MANAGEMENT (TM) SWITCH

When selected on, the switch is illuminated and arms the ATS switch for FMS inputs.

V-NAV SWITCH

When selected on, the switch is illuminated and couples the APFDS to pitch commands from the FMS for programmed climbs and descents.

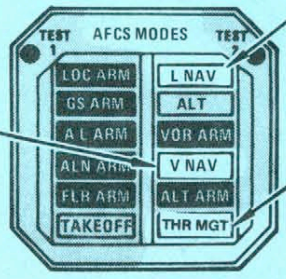


L-NAV

The INS is providing steering commands to the APFDS NAV mode.

V-NAV

The APFDS V-NAV mode is engaged and the FMS is providing vertical steering commands.



THR MGT

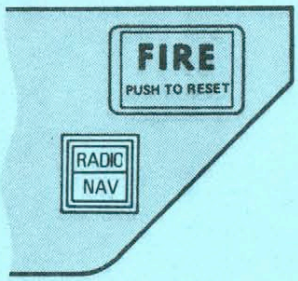
The autothrottle system is receiving inputs from the FMS computer, ***provided*** TM has been selected prior to placing ATS "ON".

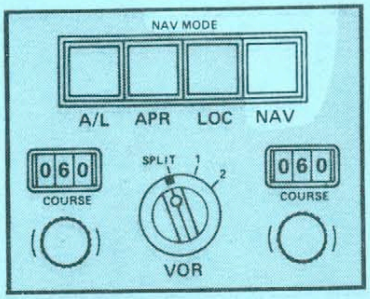
Ships 751-756

Ships 738-741

APFDS/INS INTERFACE

When either or both Radio/NAV switches are in NAV and then the APFDS NAV mode is selected, L NAV appears in the APFDS mode annunciatiors. The No. 1 INS supplies computer A, and the No. 2 INS supplies computer B. If NAV is already engaged and operating in the radio mode (VOR annunciated) at the time the Radio/NAV switches are placed in NAV, VOR remains annunciated; and the APFDS continues to use radio information until NAV is disengaged and then reengaged. If a localizer frequency is selected on the VHF NAV panel, the autopilots will not engage while the Radio/NAV switches are in NAV. When both Radio/NAV switches are in RADIO, the APFDS NAV mode uses VOR data. However, if NAV is already engaged and operating in the INS mode L-NAV remains annunciated. NAV will continue to use INS information until NAV is disengaged and then reengaged and VOR appears in the APFDS mode annunciators.





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GENERAL

The Auxiliary Power Unit (APU) provides electrical and pneumatic power for ground operations and backup electrical and pneumatic power in flight. The APU is a gas turbine engine which drives a free turbine. The free turbine drives a pneumatic load compressor and an AC generator.

Fuel for the APU is supplied from the No. 2 engine fuel line. Aircraft battery power is used to provide power for APU starting.

The APU control panel is located on the lower right hand side of the S/O's instrument panel. An exterior APU control panel is located on the lower fuselage between the wing roots.

APU Load Compressor

Air flow and pressure are controlled by variable inlet guide vanes (IGV's) on the load compressor.The air enters the pneumatic manifold between the No. 2 ENG ISLN VALVE and the Aft Fuselage ISLN VALVE. Do not mix APU air with any other source.

APU Generator

The APU generator is identical to the engine driven generators, and is rated at 81KW up to 14,000 feet. Due to limited cooling, the generator is limited to 54KW above 14,000 feet.

The APU generator is capable of powering the entire aircraft at normal loads. It is connected to the aircraft electrical system through the AC TIE BUS by the APU GENERATOR BREAKER. The APU generator can be paralleled with the engine driven generators, but cannot be paralleled with external power.

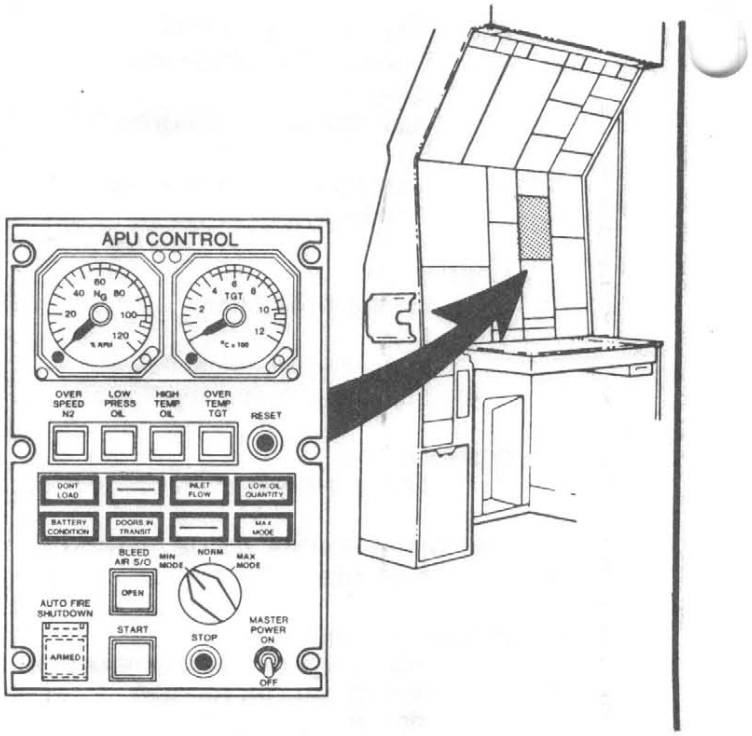
APU electrical power has priority over pneumatic power. The APU generator is driven by the free turbine through a gearbox, and generator output is dependent upon maintaining a constant RPM on the free-turbine. With heavy electrical loads the inlet guide vanes on the pneumatic load compressor will modulate toward the minimum airflow position to maintain free turbine RPM and assure proper generator output.

APU Fire Protection (See Fire Protection)

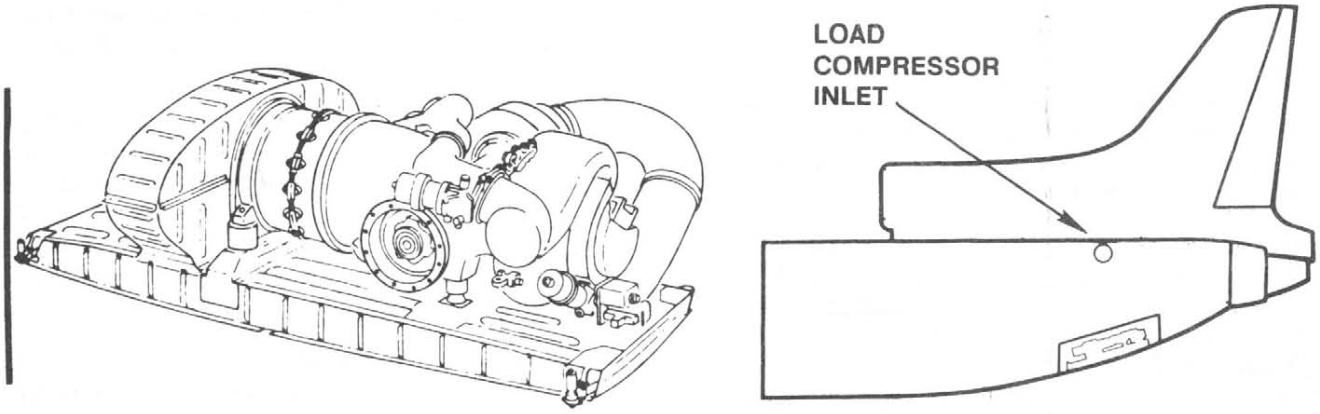
Two fire extinguisher bottles provide fire extinguishing for the APU and the No. 2 engine. An Auto-Fire Shutdown system is armed on the ground at all times, and in-flight provided the AUTO FIRE SHUTDOWN switch is latched. If an APU fire occurs, the APU will immediately shut down, the inlet door will close, and the MAIN fire bottle will automatically discharge into the APU compartment. Pulling the APU FIRE PULL handle will also shutdown the APU and expose the Fire Discharge switch to permit manual fire extinguishing.

Automatic Fault Shutdown

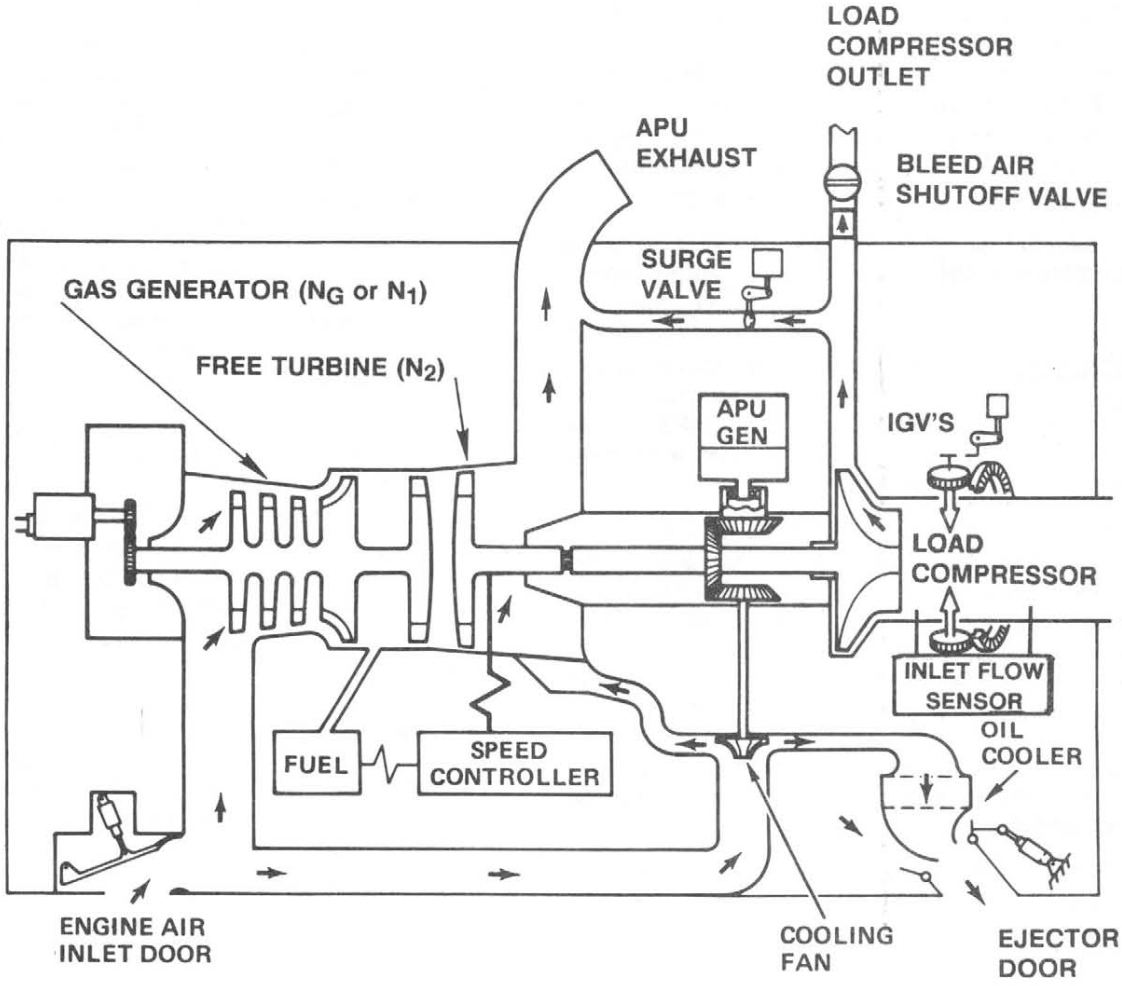
An automatic fault shutdown feature provides immediate APU shutdown if certain abnormal conditions exist. In some instances, an automatic shutdown is indicated by the appearance of a red FAULT flag on the APU control panel. The APU will shut down for N2 overspeed, low oil pressure, high oil temperature or a TGT overtemp. If an auto shutdown occurs for a hung start or a load compressor inlet flow problem, no red flag will appear.



S/O'S INSTRUMENT PANEL



APU COMPARTMENT



APU SCHEMATIC

APU OPERATION

The APU is totally self-contained and independent of other aircraft systems. However, for safety and operational considerations, the APU should be operated in accordance with the Normal Procedures section of the POM.

APU Start

The Cockpit Safety Inspection must be completed before starting the APU during pre-flight. This assures that all aircraft systems are properly configured for APU operation.

Positioning the APU MASTER POWER switch to ON supplies aircraft battery power to operate the APU. The AUTO FIRE SHUTDOWN ARMED light illuminates, and the switch should be latched. The PRI light will illuminate on the fuel panel and then extinguish to indicate the primary emergency shutoff valve has opened. The secondary emergency shutoff valve is normally open, and the SEC light remains extinguished. If the secondary valve has been closed by a manual or automatic fire shutdown, the SEC light will illuminate when the start button is pressed and extinguish when the valve is open.

The BLEED AIR S/O switch should be unlatched and MIN selected on the Compressor Mode Selector. All APU indicator lights should be extinguished and no [FAULT] flags should be in view. Select BAT on the DC Meters Selector to monitor APU starter engagement. APU is selected on the AC Meters Selector to monitor APU generator operation.

When the START switch is pressed and released DOORS IN TRANSIT will illuminate for approximately 10 seconds and then extinguish when the inlet (ejector door deactivated) door is fully opened. DON'T LOAD will now illuminate to indicate starter engagement. Starter engagement is also indicated by approx. a +50 indication on the DC AMPS gauge, and NG will begin to rise. For actual amperage, multiply the indication by 5.

Light-off should occur at about 15% NG. Automatic start termination will occur unless NG reaches the green band (55%) within 40 seconds after the starter engages. Automatic termination will also occur if TGT exceeds 760°C before NG reaches the green band. At 55% NG the starter will disengage, and the TGT auto shutdown limit will shift to 1066°C. Above 55% NG, the start can be abandoned manually by pressing the STOP button. Press the STOP button if NG hangs in the green band for more than 5 seconds with DON'T LOAD illuminated.

DON'T LOAD extinguishes when the free turbine (N2) is on-speed (above 95%). This completes the start cycle.

Supplying Electrical Power

The APU FIELD BREAKER and GENERATOR BREAKER are normally armed to close when the DON'T LOAD light extinguishes. However, if EXT POWER is ON it must be removed to permit the APU GENERATOR BREAKER to close and power the AC TIE BUS.

The APU generator is capable of supplying the normal aircraft electrical loads. However, total continuous loads must be limited to 81KW (54 above 14,000'). Monitor APU electrical load carefully if GALLEY POWER switches are latched, or other high load items are operated (i.e. hydraulic AC PUMPS, fuel TANK PUMPS, etc.).

Supplying Pneumatic Power

A surge valve is installed between the load compressor outlet duct and gas generator exhaust duct. The surge valve modulates as needed to prevent excessive pressure build-up in the outlet duct.With the BLEED AIR S/O switch unlatched, the load compressor is signaled to the MIN flow position, and it is normal for the surge valve to open to relieve load compressor pressure.

With the BLEED AIR S/O switch latched, load compressor output is determined by the position of the Compressor Mode Selector. If the Compressor Mode Selector is in NORM, an increase in mass air flow is scheduled. If APU air supply exceeds pneumatic system demands, surging can occur when too much air is dumped into the exhaust duct. This can result in high TGT and unstable APU operation. To help prevent surging, position the Compressor Mode Selector to MIN and latch at least one PACK FLOW CONTROL switch before latching the BLEED AIR S/O switch.

The APU can normally supply the air conditioning packs with the Compressor Mode Selector in MIN. If an ATM is operated, or duct pressure drops too low, position the Mode Selector to NORM. With NORM selected, if duct pressure is too low or MAX MODE illuminates, reduce bleed air demands or electrical loads. If duct pressure exceeds 30 psi, increase bleed air demands or re-select MIN mode to prevent surging.

In-Flight Operation

The APU may be operated in-flight up to 31,000', and may be started in-flight up to 25,000'. However, due to cold-soak, start reliability is increased at altitudes below 10,000'.

NG TACHOMETER
Indicates gas turbine speed (N1).
3S12 - CONT PWR

TEST BUTTON
When pressed and held, tachometer pointer drives to 3 o'clock position.

TGT INDICATOR
Indicates Turbine Gas Temperature (NG). APU will shut down if TGT exceeds:
- 760°C while NG is below the green band (during start).
- 1066°C (red radial) while NG is in the green band.

3S12 - CONT PWR

TEST BUTTON
When pressed and held, TGT pointer drives to 3 o'clock position.

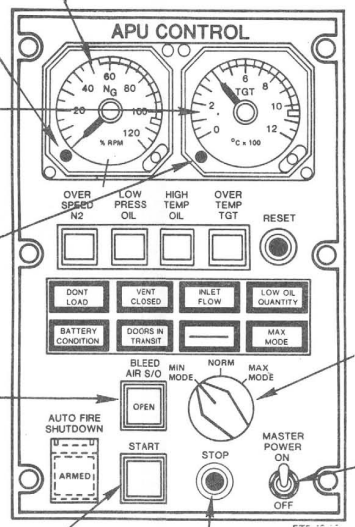
BLEED AIR S/O SWITCH
Controls bleed air supply from APU to the pneumatic system.

LCH - Normal position when using APU bleed air. Valve is electrically armed to open; valve is opened by APU bleed air pressure.
- At least one PACK FLOW CONTROL switch should be latched before BLEED AIR S/O is latched.
- BLEED AIR S/O closes automatically when:
  - APU FIRE PULL handle (interior or exterior panel) is pulled.
  - APU auto-shutdown occurs.
  - Duct pressure drops too low (about 6 psi).

OPEN - Illuminates when valve is opened.

UNL - Normal position for APU shutdown, and when any other pneumatic source is supplying bleed air. Electrical power is removed to close the shutoff (S/O) valve, and the IGV's are commanded to the MIN position. OPEN extinguishes when the valve is closed.
- Except in an emergency, switch must be unlatched when the pneumatic system is pressurized by any other source.

3S18 - APU BLEED AIR VALVE



START SWITCH
- Momentary switch that initiates APU start cycle.
- To start the APU, switch must be pressed until DOORS IN TRANSIT illuminates. The switch may then be released, and the APU start cycle will continue automatically.
- Pressing the switch opens the SEC EMERGENCY SHUTOFF, if closed.

3S13 - POWER CONTROL

STOP BUTTON
Initiates normal APU shutdown. When pressed and released:
- APU GENERATOR FIELD trips OPEN
- APU shifts to MIN mode.
- NG RPM is programmed to drop to approx. 60% for 80-90 seconds for cool-down.
  - Fuel valve is then closed.
  - 40 seconds later DOORS IN TRANSIT illuminates until inlet door closes.
- If button is pressed during start, shutdown will not actually occur until NG exceeds 55% (starter cutout).

3S13 - POWER CONTROL

COCKPIT CONTROL PANEL

COMPRESSOR MODE SELECTOR
Selects operating mode of the load compressor IGV's.

MIN - Normal position of the selector for APU start, shutdown, and when bleed air demands are small (i.e. only operating air conditioning packs). IGV's are positioned to the minimum flow stop.

NORM - Normal position when bleed air demands are high (i.e. operating either ATM). IGV's are scheduled to modulate to maintain constant mass flow within operating limits of the APU.

MAX MODE - Not used in normal operation. Selector is springloaded out of this position. IGV's are commanded to the full open (max. flow) position.
- APU automatically shifts to MIN mode, regardless of selector position, during APU start, shutdown, or when BLEED AIR S/O is unlatched.
- With APU BLEED AIR SHUTOFF latched OPEN and GND START switch pressed, APU automatically shifts to MAX MODE.
- With Mode Selector in NORM or MAX MODE, IGV's will position to reduce bleed air output as needed to maintain constant load compressor RPM to assure stable generator output.

3S13 - POWER CONTROL

MASTER POWER SWITCH
Controls electrical power to the APU.

OFF - Normal position after APU shutdown. Removes all electrical power from the APU.
- Closes PRI EMERGENCY SHUTOFF valve.
- Resets APU circuits following any APU fire or auto shutdown.
- Removes all power from APU panel controls and indicators **except** the BATTERY CONDITION light.

ON - Electrically held position. Must be in this position to operate the APU.
- Opens PRI EMERGENCY SHUTOFF valve provided the APU FIRE PULL handle on both the interior and exterior APU panels are IN, and no AUTO FIRE SHUTDOWN signal is present.
- Powers the APU GENERATOR FIELD and APU GENERATOR BREAKER OPEN lights.
- Powers all APU panel controls and indicators.
- Pressing the POWER ON switch on the APU External Control Panel will release the MASTER POWER switch from ON to OFF after the APU is shut down, and the inlet and ejector doors have closed.
- Position of BATTERY switch does not affect APU operation.
- Do not use MASTER POWER switch to shut down the APU.

3B10 - BATT PWR
3B13, 14 - POWER CONTROLLER BUS 2

FAULT FLAGS (RED) (4)

Appearance of a [FAULT] flag indicates APU has automatically shut down.

- An automatic shutdown occurs if:
  - N2 (free-turbine) limit speed is exceeded.
  - Oil pressure is too low (NG above 55% and loss of pressure occurs for 10 secs.)
  - Oil temperature is too high.
  - NG (gas turbine) TGT is too high.
- Appropriate [FAULT] flag identifies cause of shutdown.
- After shutdown cycle is complete, MASTER POWER switch must be cycled to permit [FAULT] flag reset.
- All [FAULT] flags appear during a S/O's Panel LIGHTS TEST provided the APU MASTER POWER switch is ON. APU will not shutdown during LIGHTS TEST, and APU MASTER POWER switch does not have to be cycled to reset the flags.

3S12 - CONT PWR
3S13 - POWER CONTROL

AUTO FIRE SHUTDOWN SWITCH & ARMED LIGHT

Guarded two-position switch that controls arming of the APU AutoFire Shutdown system in-flight.

IN FLIGHT:

LCH - Normal switch position. System is armed, and ARMED illuminates as long the APU MASTER POWER switch is ON.
UNL - System is disarmed and ARMED is extinguished.

ON GROUND:

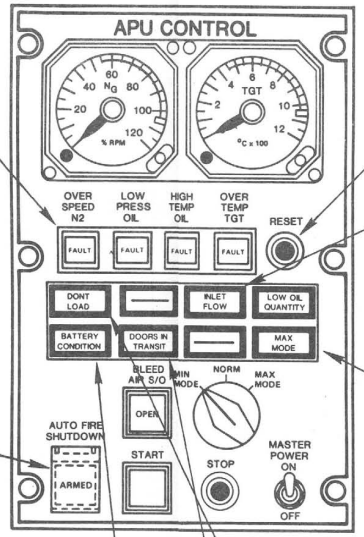
System is armed and, ARMED is illuminated regardless of switch position. The system is disarmed when the APU MASTER POWER switch is OFF.

ARMED - When illuminated, an APU fire will cause an auto-fire shutdown, and the following will occur:

- APU GENERATOR FIELD opens.
- BLEED AIR S/O valve closes.
- APU immediately shuts down.
- PRI and SEC EMERGENCY SHUTOFF (fuel) valves close.
- Inlet and ejector doors close.
- When doors close, MAIN APU/No. 2 Engine fire bottle is discharged.

AUTO FIRE SHUTDOWN does not affect visual or aural fire warnings. Performing a FIRE DETECTION LOOP TEST will not cause an auto fire shutdown.

2L8 - MLG GND SENSE
3S13 - POWER CONTROL
1C18 - APU FIRE SHUTDOWN
1J7 - APU FIRE SHUTDOWN
3B15, 16 - APU PRI FW SOV



BATTERY CONDITION LIGHT (AMBER)

- Illuminates when battery charger is deactivated. May be caused by:
  - Overheated battery.
  - Battery powering either the DC or AC (inverter) standby buses.
  - MASTER RADIO ESSENTIAL switch is latched, and no DC ESS BUS power.
  - Failure of mid avionics compartment fan (MID OVBD).
- Illuminates regardless of position of APU MASTER POWER switch.
- Do not attempt APU start with light illuminated.

3A15 - BAT CHG

DON'T LOAD LIGHT (AMBER)

Illuminates when the free-turbine (N2) is off speed.

- APU GENERATOR FIELD is tripped OPEN .
- BLEED AIR S/O should be unlatched.

3S12 - CONT PWR

DOORS IN TRANSIT LIGHT (AMBER)

Illuminates unless inlet and ejector doors are in the required position.

- Illuminates when START switch is pressed until doors are open.
- Illuminates after APU is shutdown (approx. 120 seconds after pressing STOP button) until doors are closed.

3S13 - POWER CONTROL

RESET BUTTON

- Press to reset [FAULT] flag(s).
- APU MASTER POWER switch must be ON.
- [FAULT] flag(s) remain in view if condition still exists.

3S13 - POWER CONTROL

INLET FLOW LIGHT (AMBER)

- Illuminates when the inlet to the load compressor is obstructed (ice build-up or foreign object ingestion).
  - APU will shutdown unless MAX MODE is illuminated.
  - After shutdown is complete, the MASTER POWER switch must be cycled to extinguish the light and permit a re-start.
- Inlet flow auto-shutdown is inhibited in flight.

3B10 - APU BAT PWR
3B13, 14 - APU CONTROLLER BUS 2, GND BUS
3S12 - CONT PWR

LOW OIL QUANTITY LIGHT (AMBER)

- Illuminates to indicate oil tank needs servicing.
- Light is inhibited in flight.

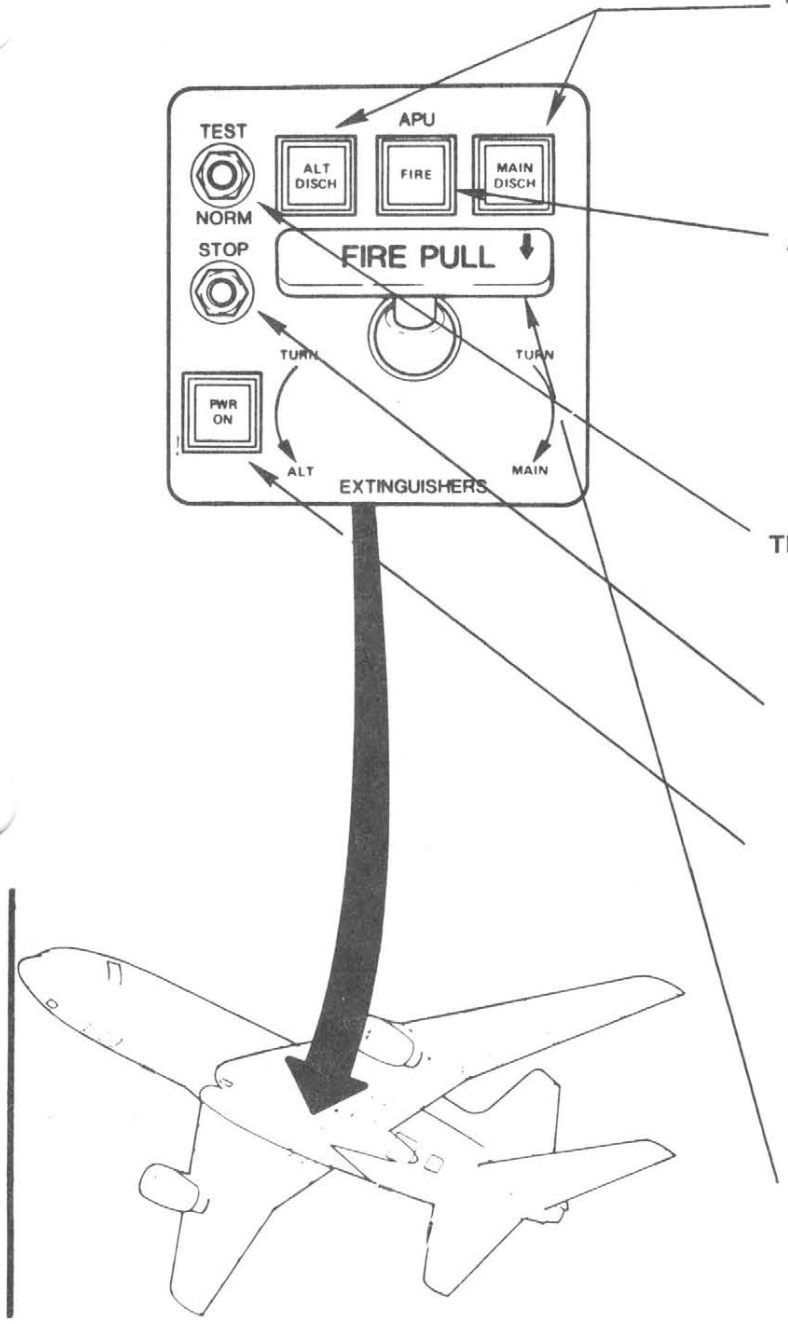
3S11 - IGNITION

MAX MODE LIGHT (AMBER)

Illuminates to indicate load compressor IGV's are in the full-open position for maximum bleed air output.

- The IGV's should go to the full-open position when:
  - Compressor Mode Selector is held in the MAX MODE position.
  - Engine GRND START switch is pressed while the APU BLEED AIR S/O switch is latched.
  - Compressor Mode Selector is in NORM and maximum air output is required.
- In-flight, the light may also illuminate with the Compressor Mode Selector in MIN at altitudes above 19,000'.
- Illumination of MAX MODE with the Compressor Mode Selector in NORM indicates that the APU has reached maximum bleed air supply capability.
- **MAX MODE** extinguishing with the engine GRND START switch latched, or with the Compressor Mode Selector held in MAX MODE indicates that APU bleed air supply is being limited by APU generator load.

3S13 - POWER CONTROL



LOWER FUSELAGE FORWARD OF MAIN GEAR WHEEL WELLS

MAIN DISCH & ALT DISCH LIGHTS (AMBER)

- Respective light illuminates to indicate extinguisher bottle has discharged.
- Corresponding APU/Engine No. 2 lights illuminate in the cockpit (See Fire Protection).

1C16, 17 - APU MAIN, ALTN

APU FIRE LIGHT (RED)

- Illuminates when APU fire is detected.
- External warning horn sounds.
- Cockpit fire warning bell and associated APU fire warning lights are activated (See Fire Protection).

1D16, 17 - ALARM LOOP A & B

1D18 - MASTER ALARM POWER

1K4, 8 - FIRE DETECTION APU

TEST BUTTON

When pressed, ALTN DISCH and MAIN DISCH lights illuminate. FIRE also illuminates if APU MASTER POWER switch is ON.

NORM STOP BUTTON

Press, pause and release to initiate normal APU shutdown.

POWER ON SWITCH & LIGHT (WHITE)

- POWER ON illuminates when APU MASTER POWER switch is ON.
- Pressing momentary switch for approx. 10 seconds, after APU has shutdown will release MASTER POWER switch to OFF, and POWER ON extinguishes.

3B10 - BAT PWR

3B13 - POWER CONTROL

APU EXTERNAL FIRE PULL HANDLE

- Pulling handle down accomplishes the following: Warning horn and bell are silenced.
  - APU GENERATOR FIELD opens.
  - BLEED AIR S/O valve closes.
  - APU is immediately shutdown.
  - PRI and SEC EMERGENCY SHUTOFF (fuel) valves close.
  - Inlet closes.
- With handle pulled:
  - Rotate handle clockwise to discharge main fire bottle.
  - Rotate handles counterclockwise to discharge alternate fire bottle.

1C16, 17 - APU MAIN, ALTN

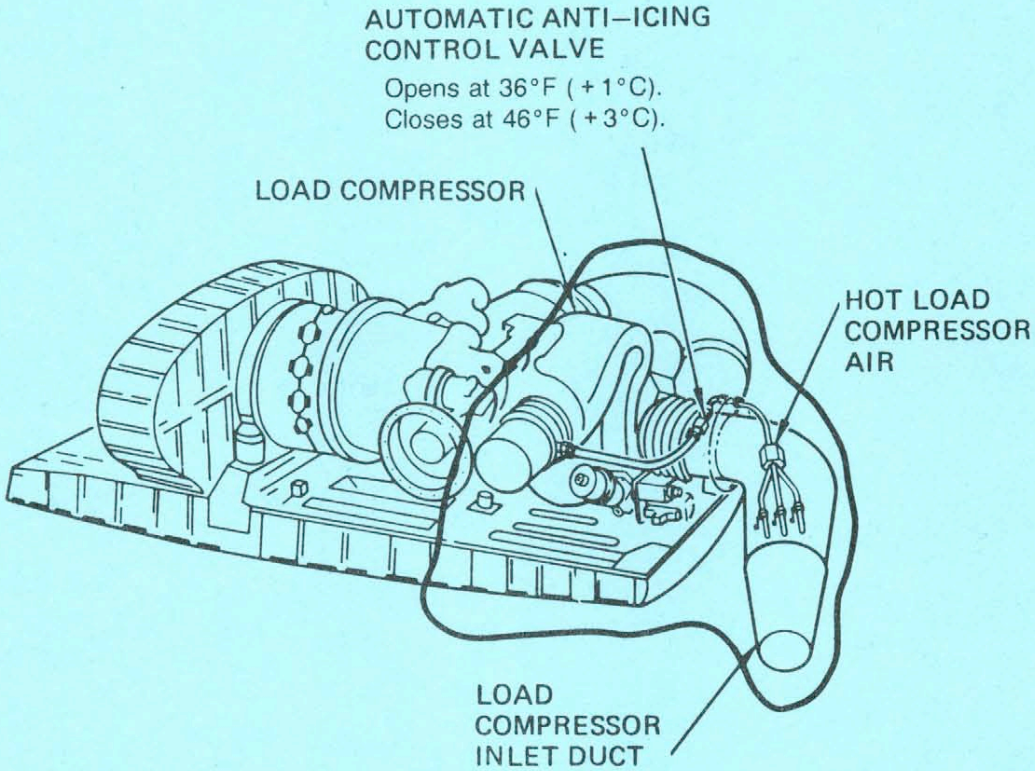
EXTERNAL CONTROL PANEL
-END-

AUXILIARY POWER UNIT (APU)

APU INLET DUCT

To reduce the possibility of an inlet flow shutdown, a warm – air heater system is installed in the inlet duct to the load compressor.

At low ambient temperature the automatic anti–icing control valve will open to supply hot load compressor air into the inlet of the compressor to prevent the formation of ice.



On Ship 753, when the APU Master power Switch is placed on, Engine No. 2 Bleed Air is used to heat the APU compartment to help ensure APU starts up to 25,000 ft.

(OPPOSITE SIDE BLANK)

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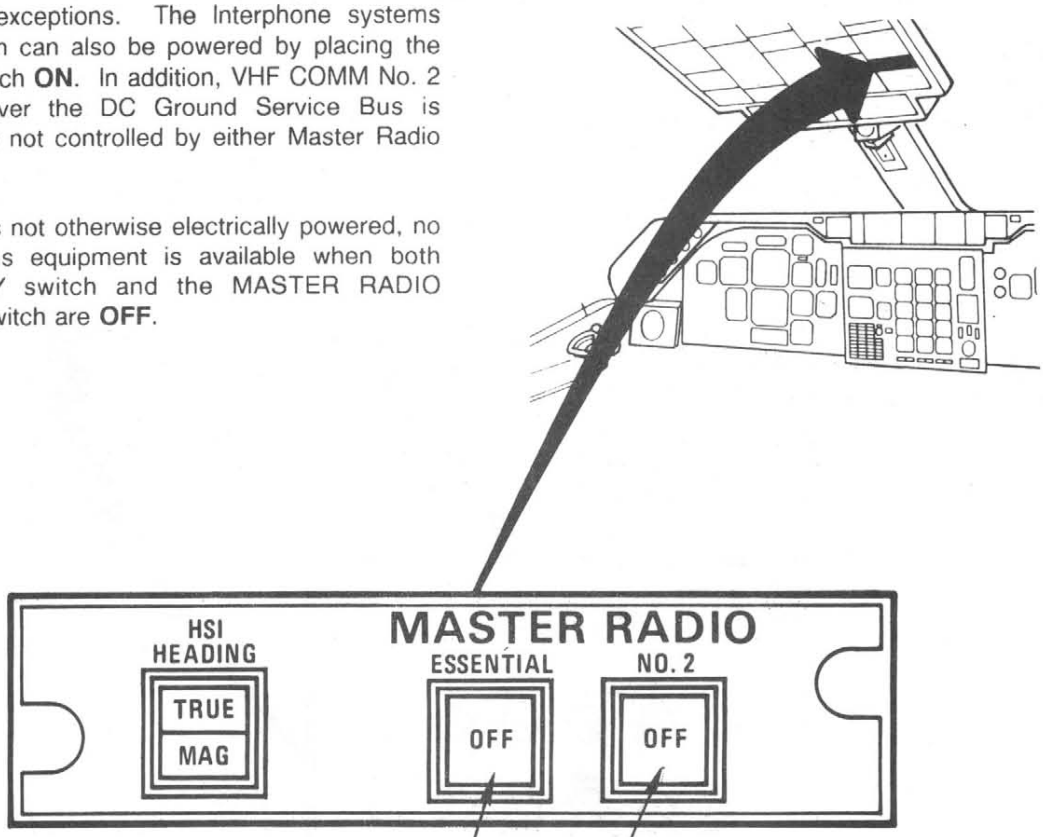
(OPPOSITE SIDE BLANK)

MASTER RADIO PANEL

The two Master Radio Switches provide normal control power for all communications systems, with the following exceptions. The Interphone systems and PA system can also be powered by placing the BATTERY switch **ON**. In addition, VHF COMM No. 2 is **ON** whenever the DC Ground Service Bus is powered. It is not controlled by either Master Radio Switch.

If the aircraft is not otherwise electrically powered, no communications equipment is available when both the BATTERY switch and the MASTER RADIO ESSENTIAL switch are **OFF**.



ESSENTIAL MASTER RADIO SWITCH

LCH – Powers FLIGHT INTERPHONE, PA, VHF COMM No 1, HF No. 1, VOICE RECORDER, WEATHER RADAR No.1, RADIO ALTIMETER No. 1. With loss of power to the DC ESS bus, VHF COMM No. 1, PA and FLT INTERPHONE are powered directly from the Battery, regardless of BATTERY switch position.

UNL – Removes power from the above equipment. Exception: If the BATTERY switch is **ON**, the Interphone and PA systems will remain powered.

1B10, 11 – ESS MASTER RADIO CONT, PWR

NO. 2 MASTER RADIO SWITCH

LCH – Powers VHF COMM No. 3, HF No. 2, ADF No. 2 (provided No. 2 AC and DC buses are powered).

UNL – Power is removed from the above equipment.

3F4, 5 – MASTER RADIO PWR. CONT. ESS
MASTER CONT. NO.2
3AA12,13 – No. 2 RADIO BUS

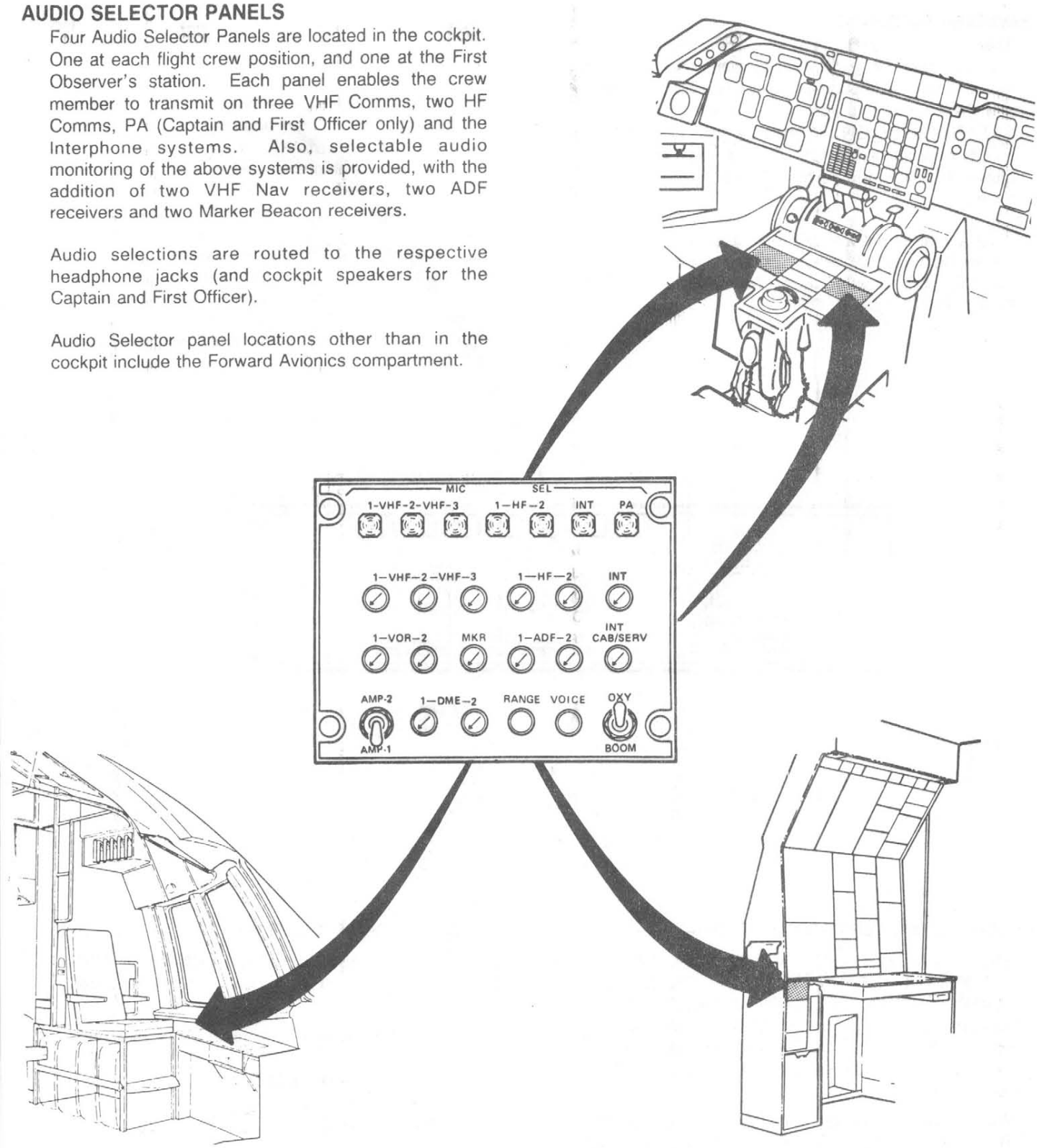
MASTER RADIO SWITCHES
(PILOT'S OVERHEAD PANEL)

AUDIO SELECTOR PANELS

Four Audio Selector Panels are located in the cockpit. One at each flight crew position, and one at the First Observer's station. Each panel enables the crew member to transmit on three VHF Comms, two HF Comms, PA (Captain and First Officer only) and the Interphone systems. Also, selectable audio monitoring of the above systems is provided, with the addition of two VHF Nav receivers, two ADF receivers and two Marker Beacon receivers.

Audio selections are routed to the respective headphone jacks (and cockpit speakers for the Captain and First Officer).

Audio Selector panel locations other than in the cockpit include the Forward Avionics compartment.



AUDIO SELECTOR PANELS

PILOT'S CENTER CONSOLE - 2
SECOND OFFICER'S LOWER INSTRUMENT PANEL
FIRST OBSERVER'S CONSOLE -1
FORWARD AVIONICS COMPARTMENT -1

MIC SELECTOR SWITCHES (7)

Two-position interlock pushbutton switches connect microphone inputs to radio transmitters, Interphone, or PA System illuminated when selected.

Note: The PA selector is deactivated on all Audio Panels except the Captain's and First Officer's.

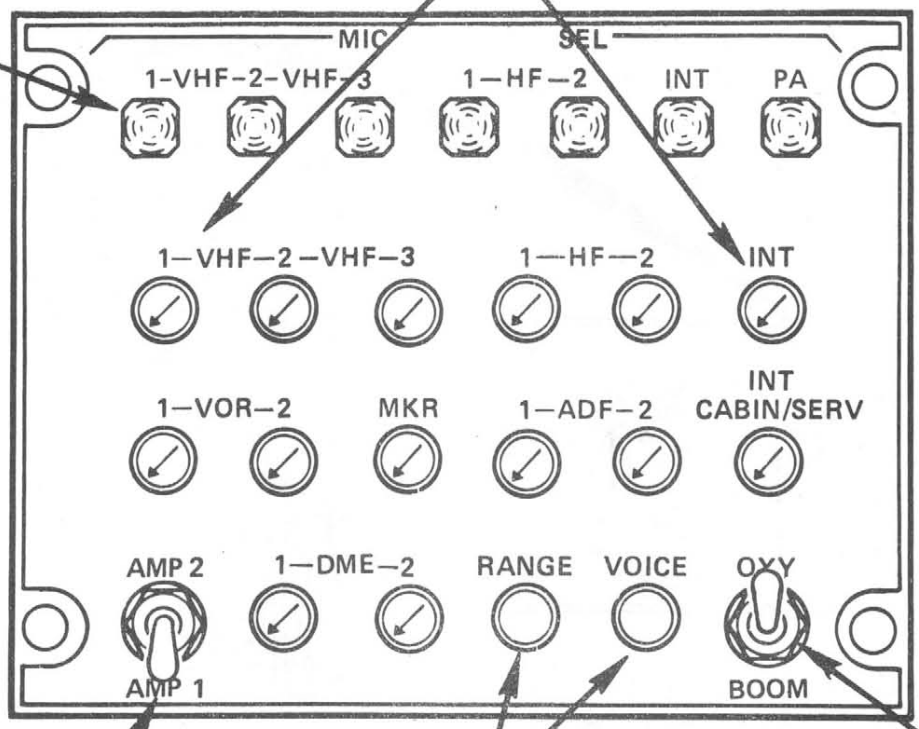
Pressing a switch to the **IN** position selects its transmitter, illuminates its light and deselects (raises) any other switch previously selected. It is possible for only one switch to be depressed at any given time.

RECEIVE SWITCHES (14)

Connects the radio receivers, marker beacon or Interphone System to the respective headset/cockpit speaker. Any number of sources may be selected at a given time.

IN – Monitors respective receiver and illuminates light in switchpost. Rotating switchpost clockwise increases volume.

OUT – Deselects monitoring of respective receiver.



AMPLIFIER SWITCH

Two-position toggle switch provided for amplifier selection.
AMP 1
AMP 2

FILTER SWITCHES (2)

RANGE IN – Only range signals are heard. Voice is filtered out.

VOICE IN – Only voice signals are heard. Range is filtered out.

BOTH IN – Both range and voice signals are monitored, with range signal predominant

MICROPHONE SELECTOR SWITCH

Two-position toggle switch which allows the control column microphone switch to be used in conjunction with either an oxygen mask microphone or a boom microphone.

OXY – Selects oxygen mask microphone (normal Delta position).

BOOM – Selects boom microphone.

AUDIO SELECTOR PANEL
(TYPICAL)

INTERPHONE SYSTEMS

Four separate interphone systems and a mechanic-pilot calling system are employed on the L-1011. All are powered by the MASTER RADIO ESSENTIAL SWITCH, or by placing the BATTERY switch to **ON**.

FLIGHT INTERPHONE

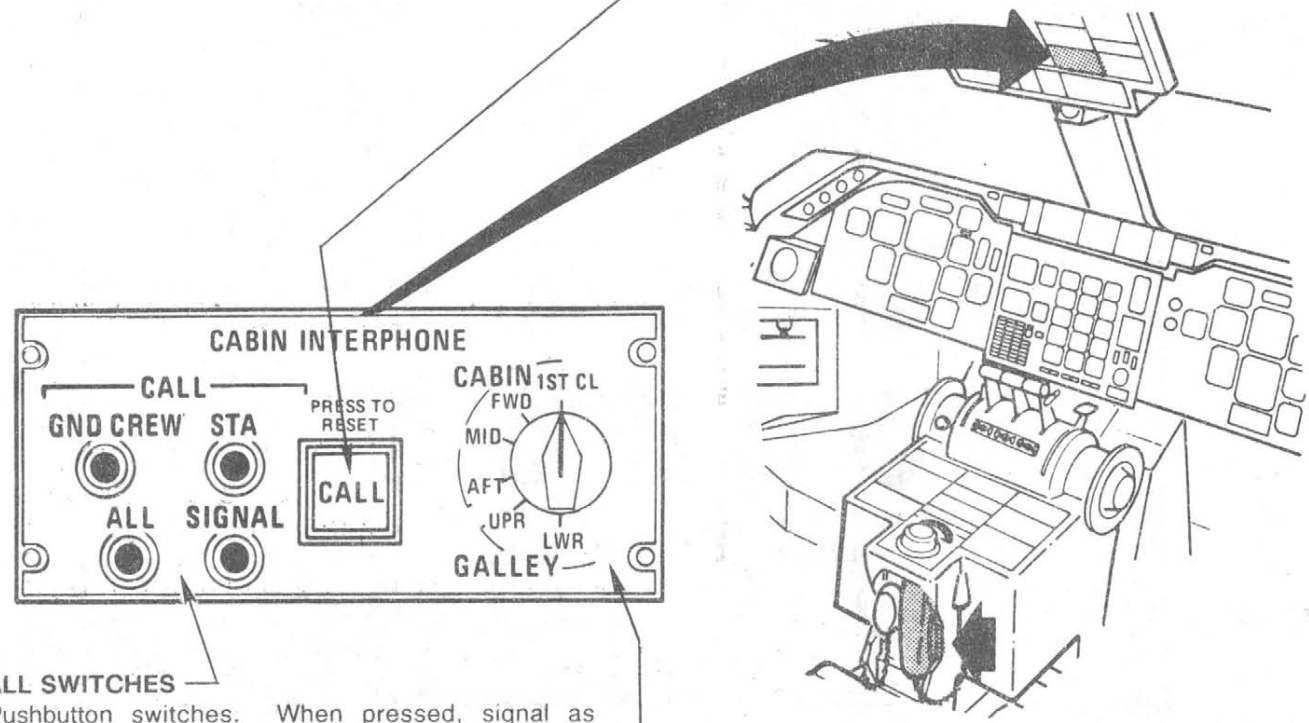
The Flight Interphone system connects the four flight station audio selector panels and one located in the FESC. The Flight Interphone can also be used to communicate with ground crew at the nose wheel well station. A ground crewman can signal the cockpit by use of a switch at the nose wheel well station which sounds a chime in the cockpit.

CABIN INTERPHONE PANEL (COCKPIT)

After a Cabin Interphone station has been called using the Cabin Interphone Panel, the Flight Crewmember can then communicate on the Cabin Interphone system, using his hand microphone, by selecting the INT Transmit switch on his Audio Panel. Pressing the CABIN/SERV INT receive switchpost will allow interphone audio over his headset jack and the cockpit speaker (Captain and First Officer only). There is also an Interphone handset located at the rear of the Center Console.

CALL RESET SWITCHLIGHT

When flight station is called, a hi-low chime sounds and CALL is illuminated. Pressing the switchlight resets light and chime for next call to be received.



CALL SWITCHES

Pushbutton switches. When pressed, signal as follows:

GND CREW – Sounds horn in nose wheel well

STA – Sounds hi-low chimes and illuminates Flight Attendant call light at station selected with Station Selector Switch.

SIGNAL – Sounds cabin chimes.

ALL – Sounds hi-low chimes at all stations and illuminates all Flight Attendant call lights, regardless of Station Selector Switch position.

2L1 – GND SVC INTPH
1A14, 3C18 – FLT INTPH AMPL

STATION SELECTOR SWITCH

Six-position rotary switch for selecting the cabin or galley station to be called. The placarded positions represent stations.

2L7 – CABIN AND GALLEY INTPH
2C8 – HIST ADVSY IND

CABIN INTERPHONE PANEL

CABIN INTERPHONE SYSTEM

The Cabin Interphone System connects 11 locations throughout the aircraft:

- Flight Station (1)
- Cabin (9): Left/Right Door Stations, Upper Galley.
- Lower Galley (1)

Calling (dialing) is a separate function from speaking on the system. Once a call is in progress, simply picking up a cabin/cockpit interphone handset will enable that station to be on line. In this manner, interphone communications can be monitored from any cabin station. However, when the calling feature is employed, the call is announced by a hi-low chime at the location called.

SERVICE INTERPHONE SYSTEM

The Service Interphone system contains 18 interphone jacks placed at external service locations on the aircraft. The system is activated by a switch located on a panel beneath the Second Officer's desk, which normally remains unlatched. When that switch is latched, the Service Interphone system is interconnected with the 11 cabin interphone positions, allowing communications throughout the interior and exterior of the aircraft. The Flight Crewmember may communicate on Service Interphone by pressing the INT microphone selector and depressing the INT CABIN/SERV audio selector on his Audio Panel.

GALLEY INTERPHONE SYSTEM

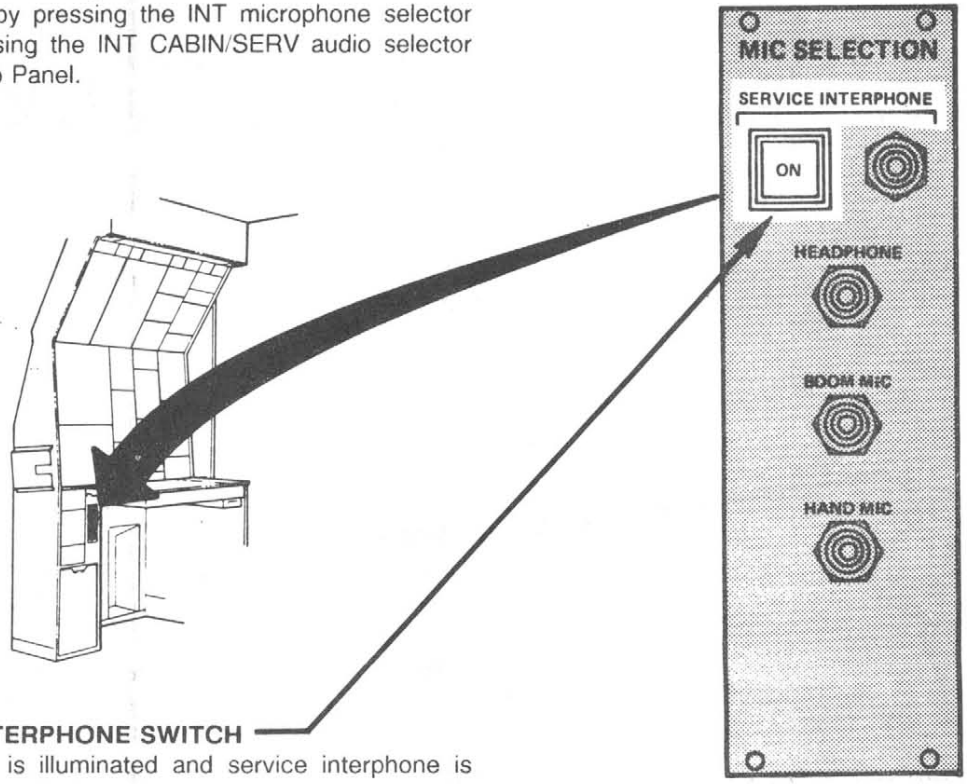
Three of the cabin interphone locations are equipped with dual-type handsets that can communicate on either the cabin or the galley interphone system:

- 1L door
- Upper Galley
- 4R door

A selector switch on the above three cabin handsets permits the selection of galley or cabin interphone.

A speaker panel is located in the Lower Galley between the lift doors. When a call is made to the lower galley using the Galley Interphone System, it is not necessary for the Lower Galley attendant to use the interphone handset to answer. The Galley Attendant may initiate a call through the Galley Interphone by using the Galley Interphone controls.

The lower galley also has controls that turn on a separate open microphone located in the upper galley. With this one-way feature, the lower galley attendant can monitor activities in the mid cabin Service Center. There are no indications at the upper galley when the open microphone is on. This feature is not part of the cabin or galley interphone systems.

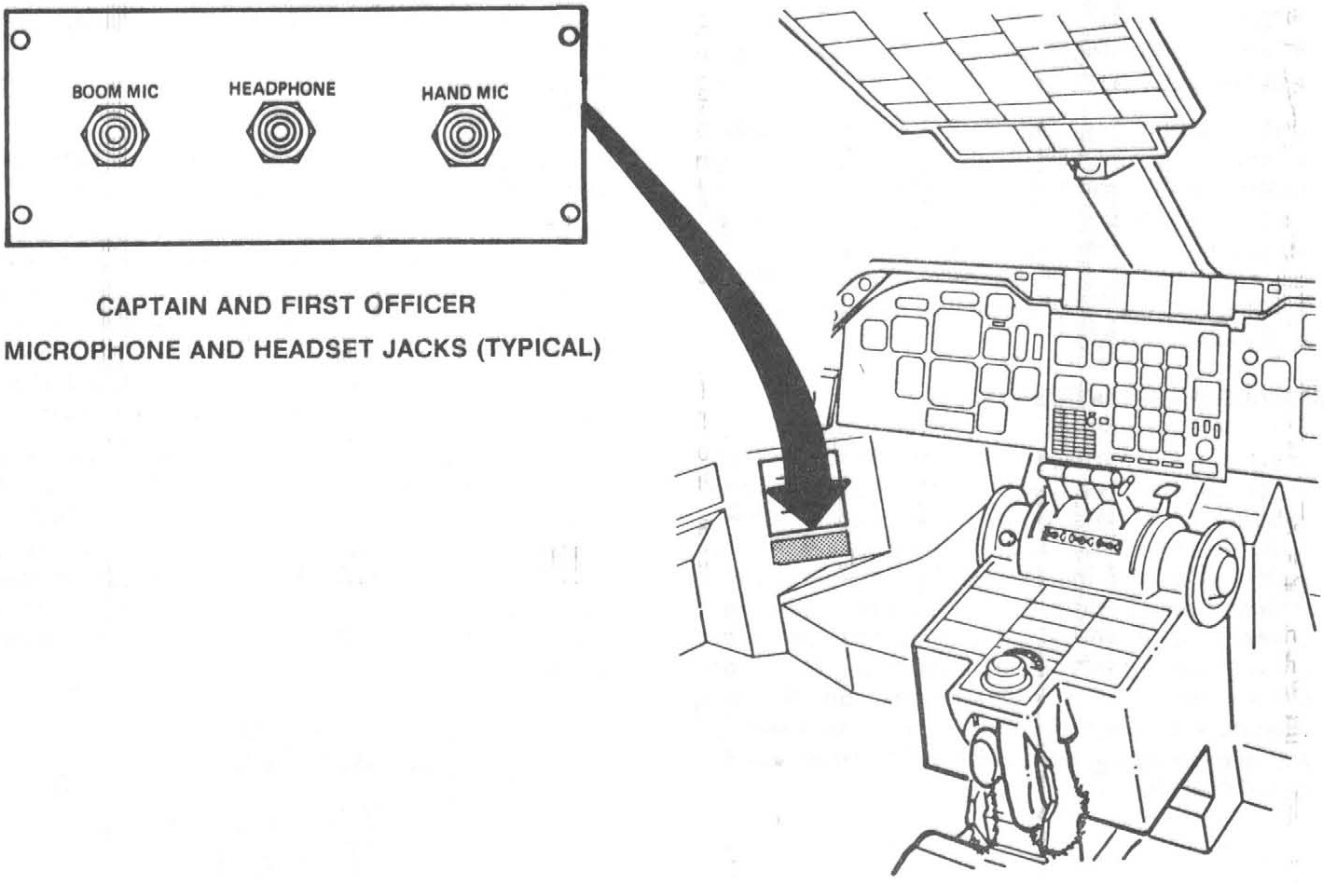


SECOND OFFICER'S MICROPHONE AND HEADSET JACK PANEL

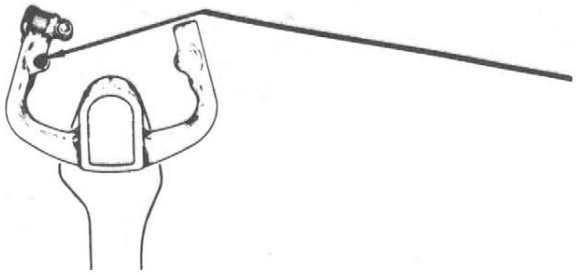
SERVICE INTERPHONE SWITCH

LCH – ON is illuminated and service interphone is active.

UNL – ON is extinguished and service interphone is deactivated.



CAPTAIN AND FIRST OFFICER
MICROPHONE AND HEADSET JACKS (TYPICAL)



CAPTAIN'S CONTROL WHEEL
(FIRST OFFICER'S OPPOSITE)

MICROPHONE SWITCH

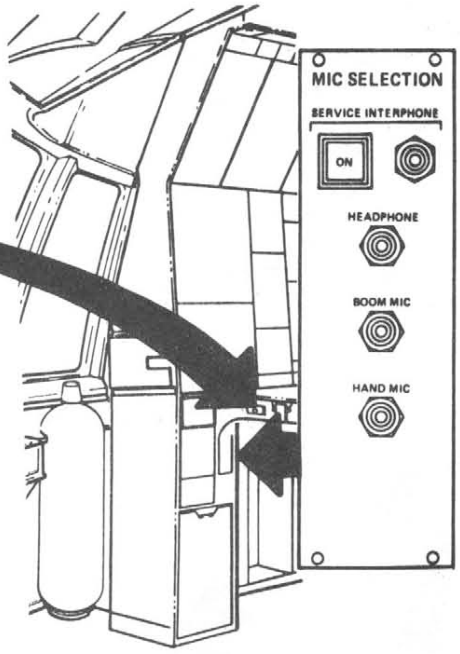
Three–position sliding switch, spring–loaded to the center (neutral) position. Used in conjunction with the oxygen mask microphone.

RADIO – (Forward). Permits transmission outside the flight station via Transmit selection made on respective Audio Panel.

ICS – (Aft). Permits transmission on Flight Interphone inside the Flight Station to Flight Crewmembers and to the nose wheelwell station.

MICROPHONE AND HEADSET JACKS

SECOND OFFICER



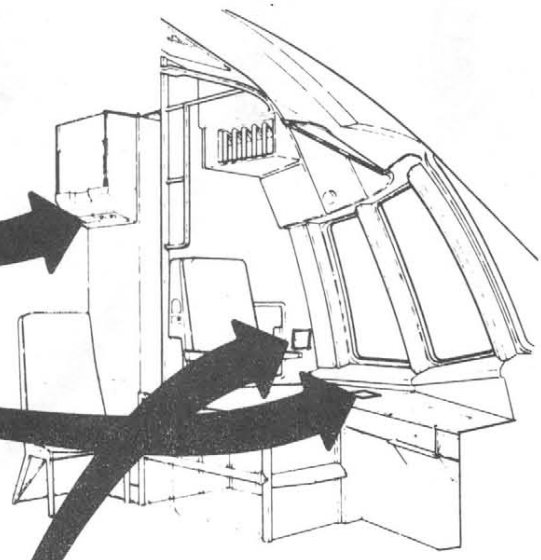
SECOND OFFICER

MICROPHONE SWITCH

Three-position toggle switch, spring-loaded to the center (neutral) position. Used in conjunction with the oxygen mask microphone.

RADIO – Permits transmission outside the Flight Station via the Transmit selection made on respective Audio Panel (except PA).

ICS – Permits transmission on Flight Interphone inside the Flight Station to Flight Crewmembers and to the nose wheelwell station.



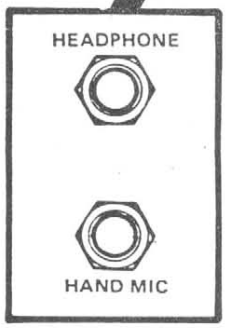
SECOND OBSERVER FIRST OBSERVER

MICROPHONE SWITCH

Three-position toggle switch, spring-loaded to the center (neutral) position. Used in conjunction with the oxygen mask microphone.

RADIO – Permits transmission outside the Flight Station via the Transmit selection made on respective Audio Panel (except PA).

ICS – Permits transmission on Flight Interphone inside the Flight Station to Flight Crewmembers and to the nose wheelwell station.



FIRST OBSERVER

MICROPHONE AND HEADSET JACKS

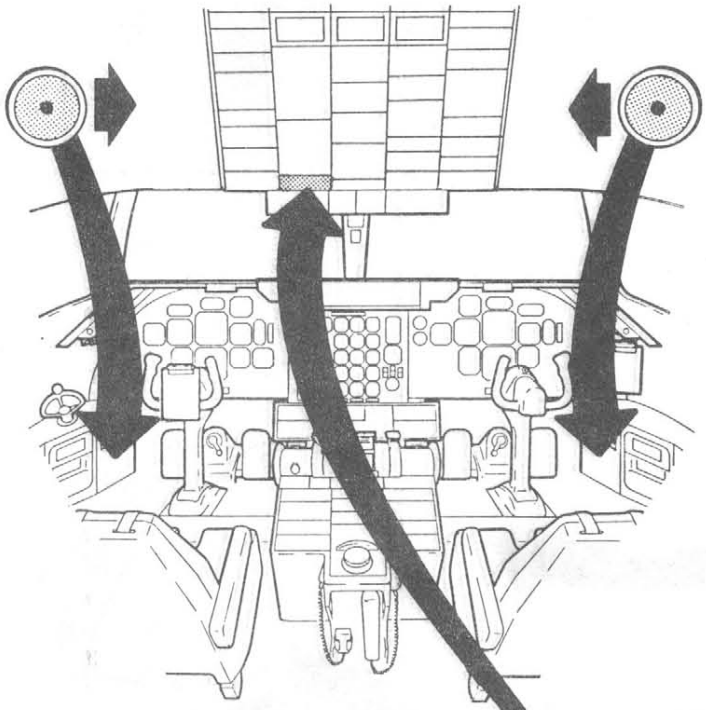
COCKPIT SPEAKERS

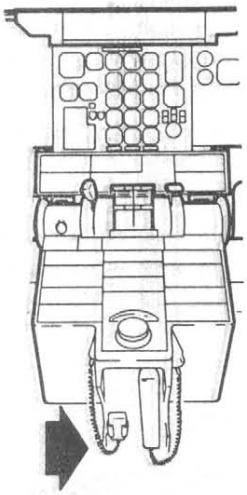
On aircraft 713–721, the Captain's and First Officer's cockpit speaker panels are located on the respective left and right lower consoles. On Ship 722 and subsequent, the speaker panels are located on the left and right overhead side trim panels. All are equipped with a volume control knob.

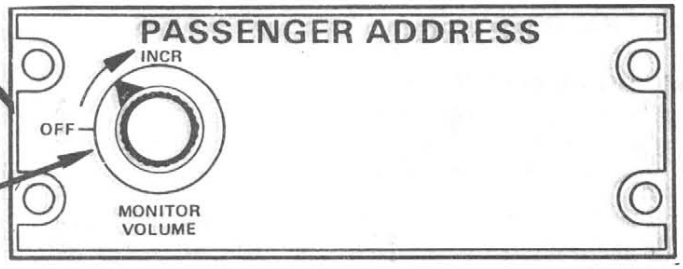
A long term modification program is in effect to modify 713–721 to add an overhead speaker. Its volume will be controlled via the volume control knob on the lower console speaker.

PASSENGER ADDRESS SYSTEM

A Passenger Address system is provided as a means of one–way communications from the crew to the passengers. The system is powered by the MASTER RADIO ESSENTIAL switch, or by placing the BATTERY switch to **ON**. To communicate on PA, a Flight Crewmember may select the PA microphone switch on his Audio Panel (Captain and First Officer only), or use the PA microphone located at the rear of the center console. A PA selection is also available on all interphone handsets in the cabin. PA announcements made from the cockpit will override those in progress being made from a cabin station.







MONITOR VOLUME CONTROL

Rheostat volume control switch permits PA announcements to be monitored over the cockpit speakers.

1A15, 16 – PA NO.1, NO.2

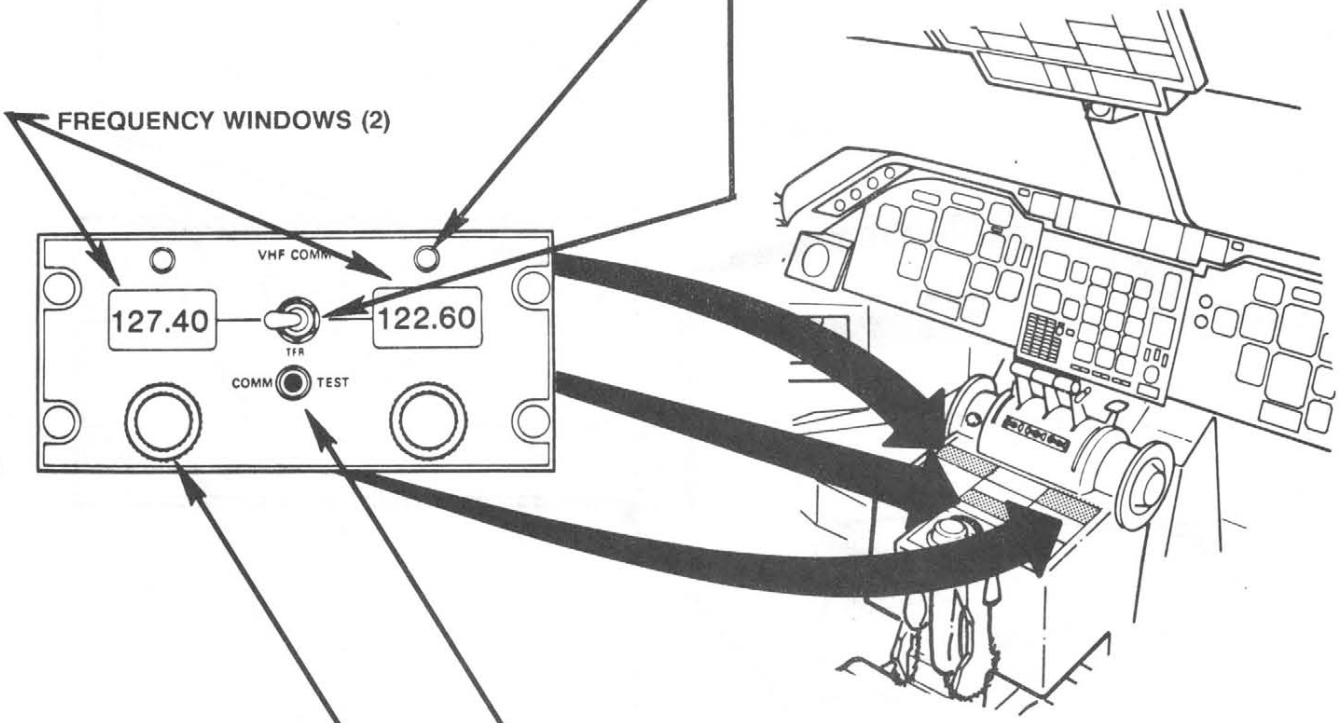
PASSENGER ADDRESS MONITOR PANEL
(PILOT'S OVERHEAD PANEL)

VHF COMMUNICATION

Three VHF COMM Control panels are located on the center console may vary in general appearance but all functions are identical. A typical Control panel has two display windows with frequency selector knobs directly below them. A green indicator light above each window indicates the frequency selected in the window. Displayed frequency selection is made with a toggle switch located between the frequency windows.

FREQUENCY LIGHT (2)
Illuminates to indicate which frequency display has been selected by transfer switch.

TRANSFER SWITCH
Selects operating frequency. Other window is provided for pre-selection of another frequency.



COMM TEST SWITCH
Pushbutton switch that disables the squelch circuit. With squelch feature disabled, background noise or static will accompany audio signal. Releasing the button switch removes the noise, indicating a functioning squelch circuit.

FREQUENCY SELECTOR (2)
1A11 – VHF No. 1
2L4 – VHF No. 2
1C23 – VHF No. 3

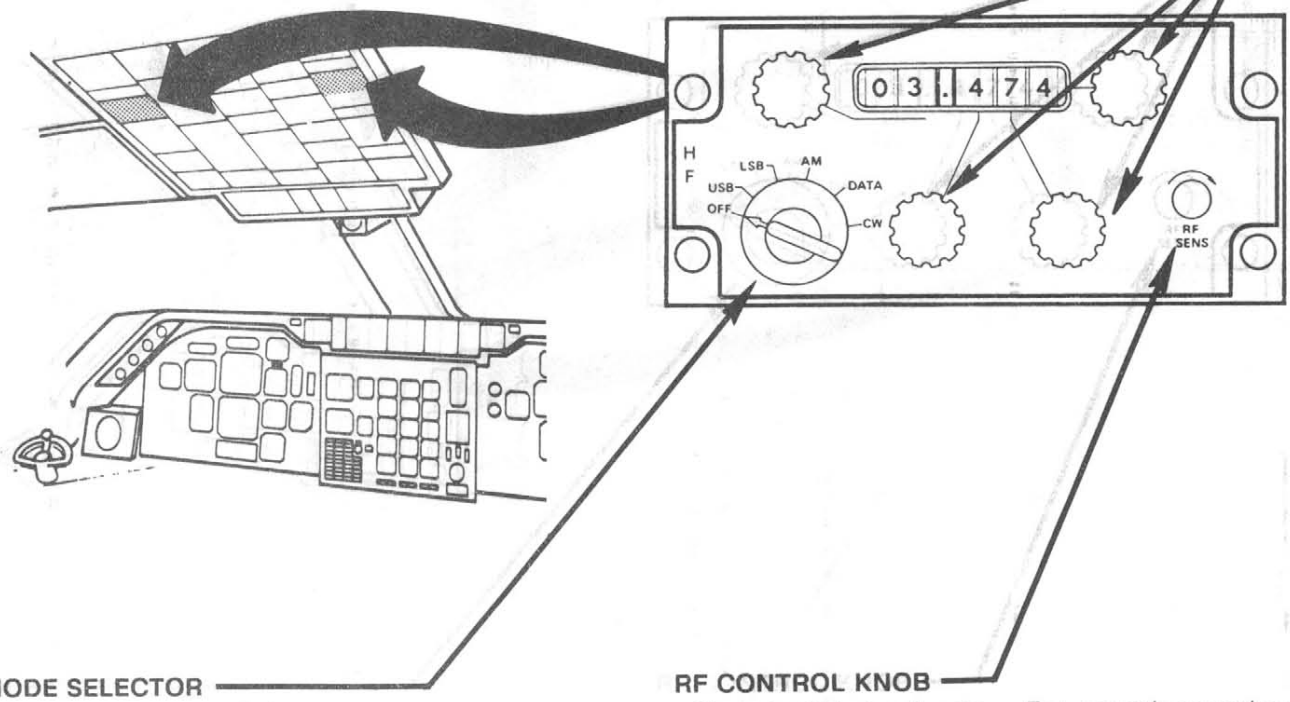
VHF COMMUNICATION PANEL

HF COMMUNICATION RADIO

The HF communications system consists of two separate radio transceivers, providing long-range communications within a frequency range of 2.0 to 29.9 MHz. These solid-state units are ready for transmission almost immediately after switch-on. Simultaneous transmission on both radios is not possible. Also, system logic prevents HF receiver operation whenever either radio is transmitting. Automatic tuning to the selected frequency (for transmission) is provided by selecting the appropriate HF radio on the Interphone panel and momentarily keying the mike switch. Refer to the Delta Flight Operations Procedures Manual (International) for information concerning long-range communications.

CAUTION:
DO NOT OPERATE THE HF TRANSMITTER WHILE FUELING OPERATIONS ARE IN PROGRESS.

FREQUENCY SELECTOR KNOBS (4)
Left upper knob selects megahertz.
Left lower knob selects kilohertz in hundreds.
Right lower knob selects kilohertz in tens.
Right upper knob selects kilohertz.



MODE SELECTOR
Six-position rotary switch.

OFF – Power is removed from the HF unit.

USB – (Upper side band). Normal mode used for all HF communications on this unit.

LSB – (Lower side band). Deactivated. If selected, transmissions will utilize USB.

AM – (Amplitude modulation). Limits effective range of transmissions.

DATA/CW – Deactivated

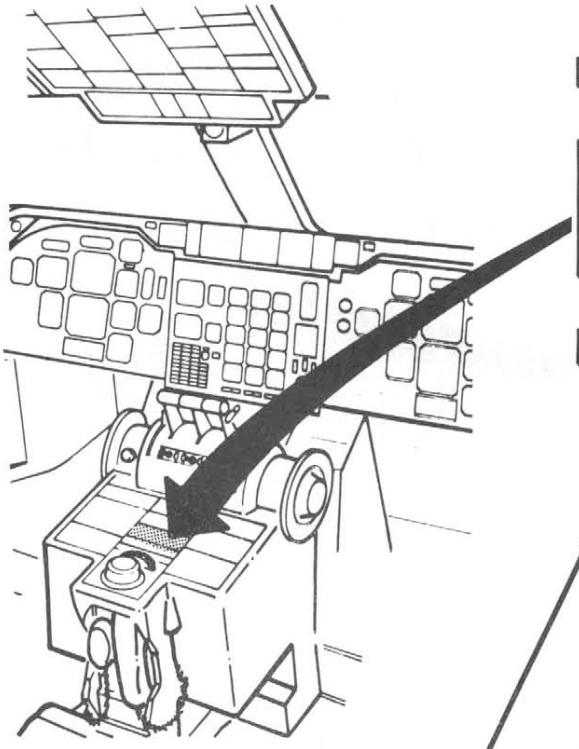
RF CONTROL KNOB
Controls RF signal gain. For normal operations, should not be in the full counter-clockwise position (zero RF gain).

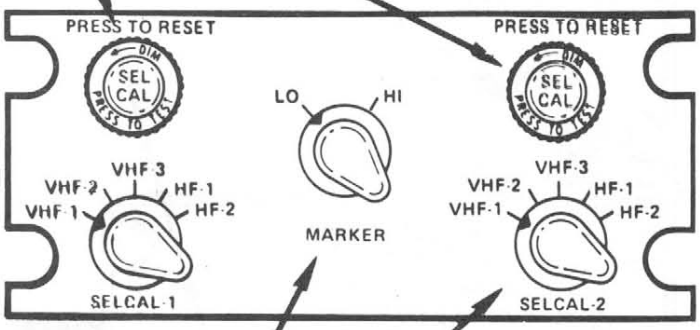
HF COMMUNICATION PANEL

SELCAL SYSTEM

The SELCAL decoder consists of two decoder units in a single box. The aircraft's unique SELCAL code is pre-set by maintenance and placarded at the upper left corner of the First Officer's main instrument panel and on the bulkhead adjacent to CB panel NO. 3. Both decoders are set to the same code. The operator selects the communications system to be monitored with the SELCAL-1 and/or SELCAL-2 selector switches. When a radio signal containing the proper code is detected by a SELCAL decoder, the flight station chime will sound and the respective light switch on the SELCAL control panel will illuminate.

SELCAL SWITCHLIGHT (2)
Indicates decoder is activated by selected communications system. Pressing the switchlight will reset the light and chime.





SELECTOR SWITCHES (2)
Five-position rotary switch. The communications system selected is monitored for coded tone signal on its respective SELCAL unit.

1C5 - SELCAL

MARKER BEACON SENSITIVITY SWITCH
Two-position rotary switch that selects magnitude of marker beacon signal reception sensitivity.

LO - (Normal position). Low sensitivity to more sharply define the marker beacon fix.

HI - High sensitivity to marker beacon signal. Normally not used for aircraft position fixing.

SELCAL PANEL

EXPANDABLE FLIGHT DATA ACQUISITION AND RECORDING SYSTEM (EFDARS)

The EFDARS is an airborne system designed to continuously sample and record aircraft information in a crash-protected recorder. System components include a Flight Data Acquisition Unit (FDAU), Digital Flight Data Recorder (DFDR), a Flight Data Entry Panel for control purposes and an aircraft Locator Beacon. The FDAU receives and transmits all data for the DFDR which continuously records all monitored aircraft data during the most recent 25-hour period of operation.

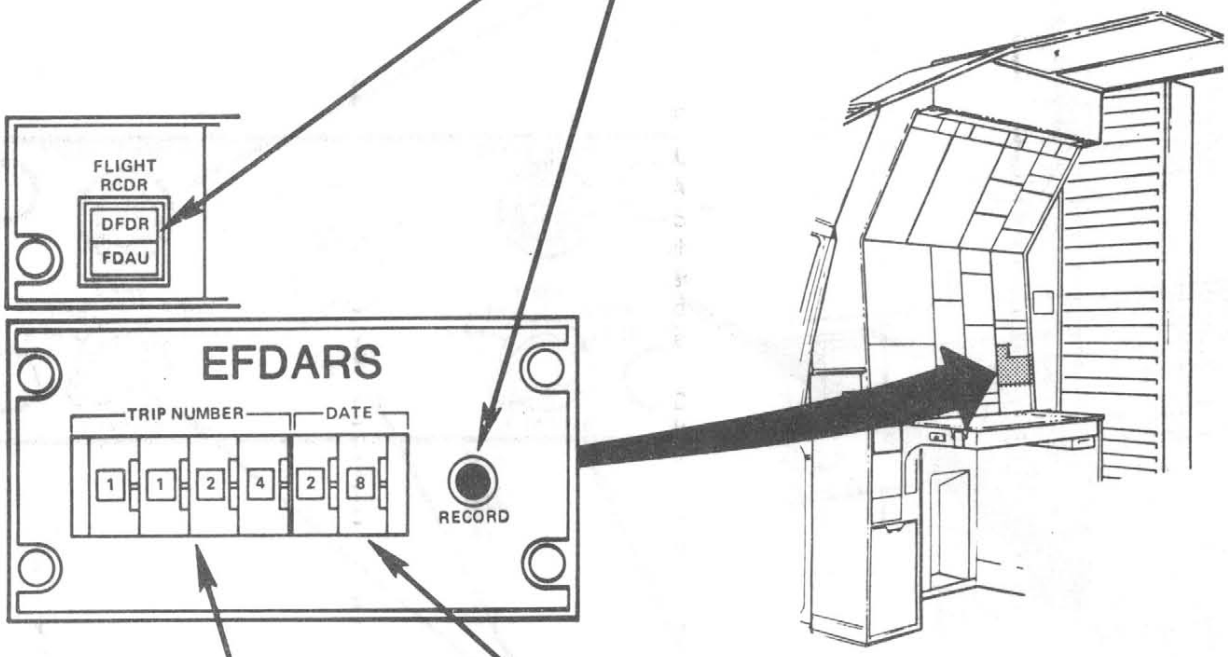
FLIGHT RECORDER SWITCH LIGHT

LCH – Power is applied to the Recorder. The DFDR legend extinguishes immediately. The FDAU legend extinguishes 30 seconds after switch is latched. This verifies that both units are operating. Illumination of either legend indicates failure of that unit.

UNL – Power is removed from the unit. Both DFDR and FDAU legends are illuminated.

RECORD SWITCH

Pushbutton switch used to "index" trip number and date into the Flight Recorder. Can be used as an event marker.



TRIP NUMBER SELECTOR

Set trip number in display windows by rotating adjacent thumbwheels. Use the published flight number preceded by zeros, as necessary.

DATE SELECTOR

Set current day of month by rotating adjacent thumbwheels.

3G4,5 – Flt Recorder

FLIGHT RECORDER
(SECOND OFFICER'S LOWER INSTRUMENT PANEL)

COCKPIT VOICE RECORDER

This system records all selected audio from the Captain's, First Officer's and Second Officer's Audio Selector Panels. In addition, it records all audio monitored by the Flight Station area microphone.

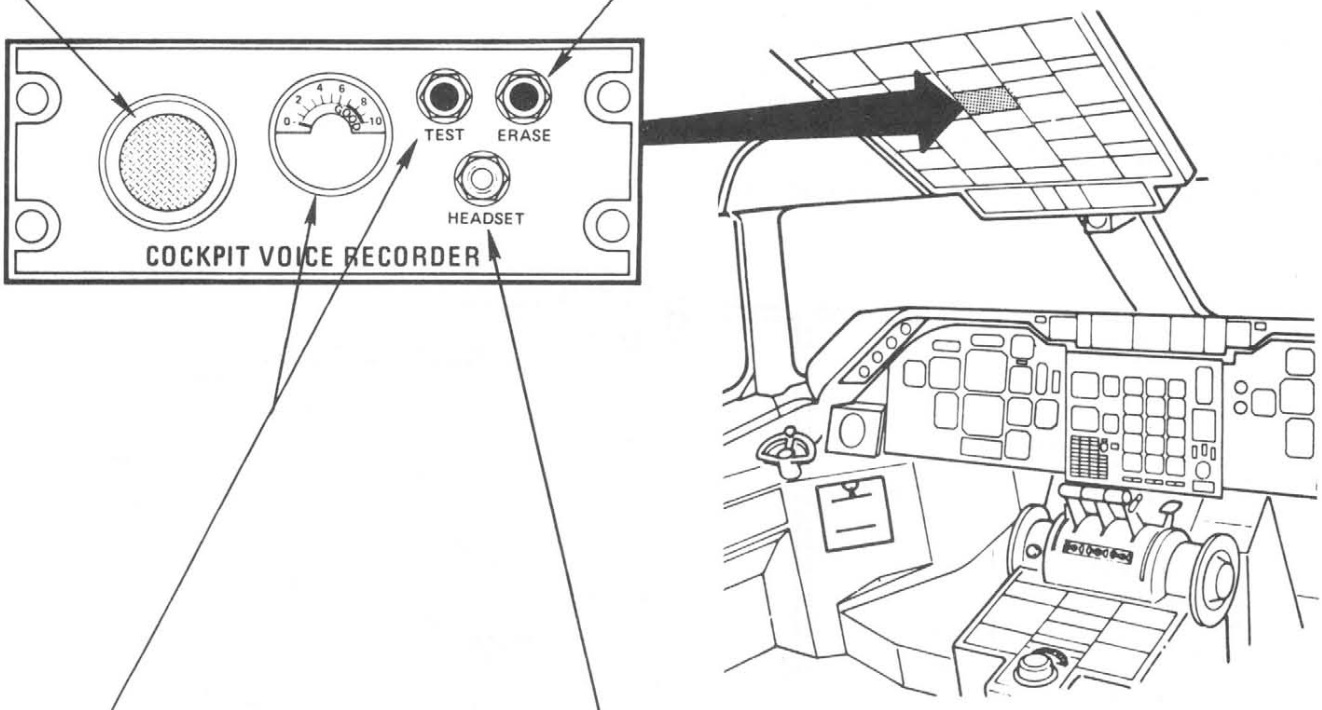
The recorder feature records the most recent thirty minutes of data, provided that the Essential AC Radio Bus is powered.

COCKPIT MICROPHONE

Open microphone when Essential AC Radio Bus is powered.

ERASE SWITCH

Press pushbutton switch for two seconds to erase entire 30 minutes of recorded data, provided that the aircraft is on the ground with parking brakes set, and the Essential AC Radio Bus is powered.



TEST SWITCH AND INDICATOR

Press pushbutton switch to check the recorder unit function. While switch is pressed, the needle in the indicator should move to the GOOD range.

HEADSET JACK

Permits system performance check by crewmember through monitoring audio being recorded.

VOICE RECORDER PANEL
(PILOT'S OVERHEAD PANEL)

WEATHER RADAR (Ships 712-733)

The dual weather radar system consists of two pilot-selectable receiver/transmitter units with a common antenna and control panel. The system provides inflight weather information and storm detection up to 180 nautical miles and includes facilities for the presentation of storm cells within clouds, ground mapping and terrain avoidance. The system contains test circuits for system operational testing.

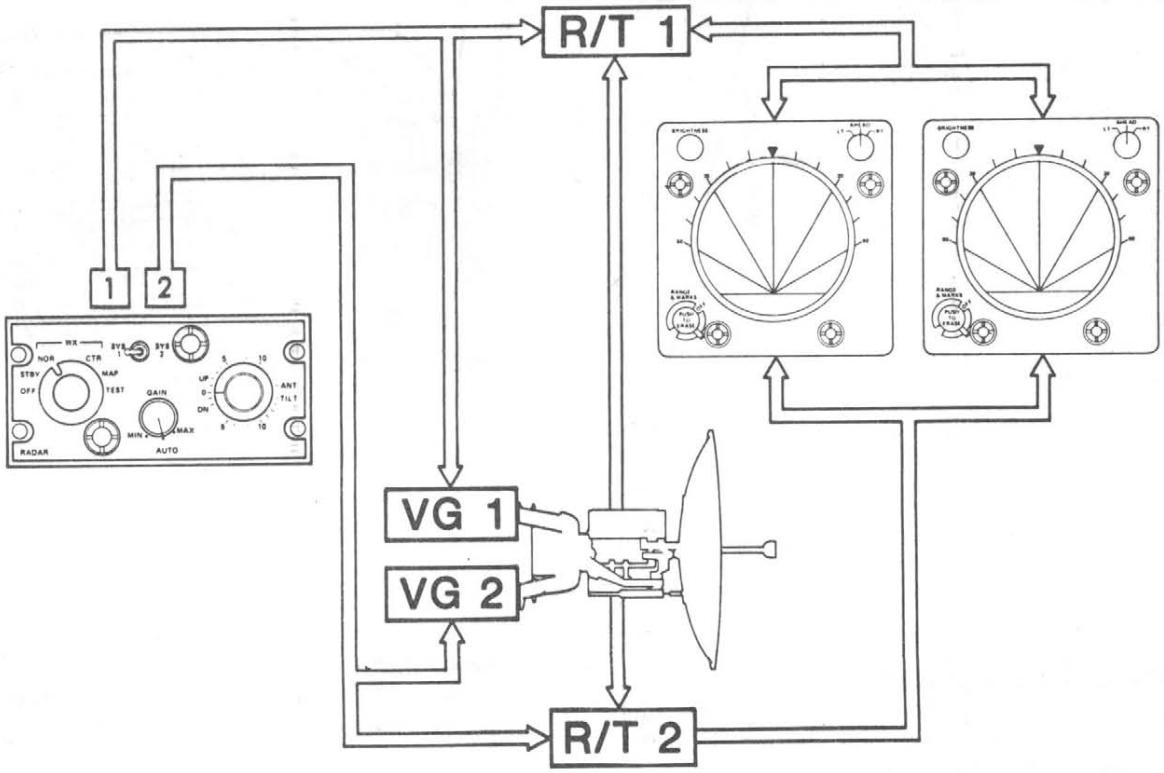
The radar CRT indicators, located in the left/right forward pedestal, are equipped with bright display storage tubes that permit direct viewing under all cockpit lighting conditions.

Test circuits provide a means of checking total system performance, both inflight and on the ramp. While in "test" mode, there is no hazard to ground personnel or interference with other receivers. A sector scan antenna provides for a surveillance area in azimuth of 90° each side of the aircraft centerline (180° total sweep angle) and ±14° in tilt from the aircraft's longitudinal axis (pitch reference). The antenna is stabilized in both pitch (±25°) and roll (±43°).

The antenna, located under the radome, forms the transmitter energy into a beam sweeping 90° left and right of the aircraft centerline. It serves both as the transmitting and receiving antenna.

CAUTION:

DO NOT TURN ON RADAR WHEN ON THE GROUND AND LOCATED WITHIN 100 FEET OF A REFLECTING OBJECT SUCH AS A HANGAR OR ANOTHER AIRCRAFT. THE RADAR RECEIVER WILL BE DAMAGED BY THE INTENSITY OF THE REFLECTED SIGNAL.



SYSTEM TRANSFER SWITCH

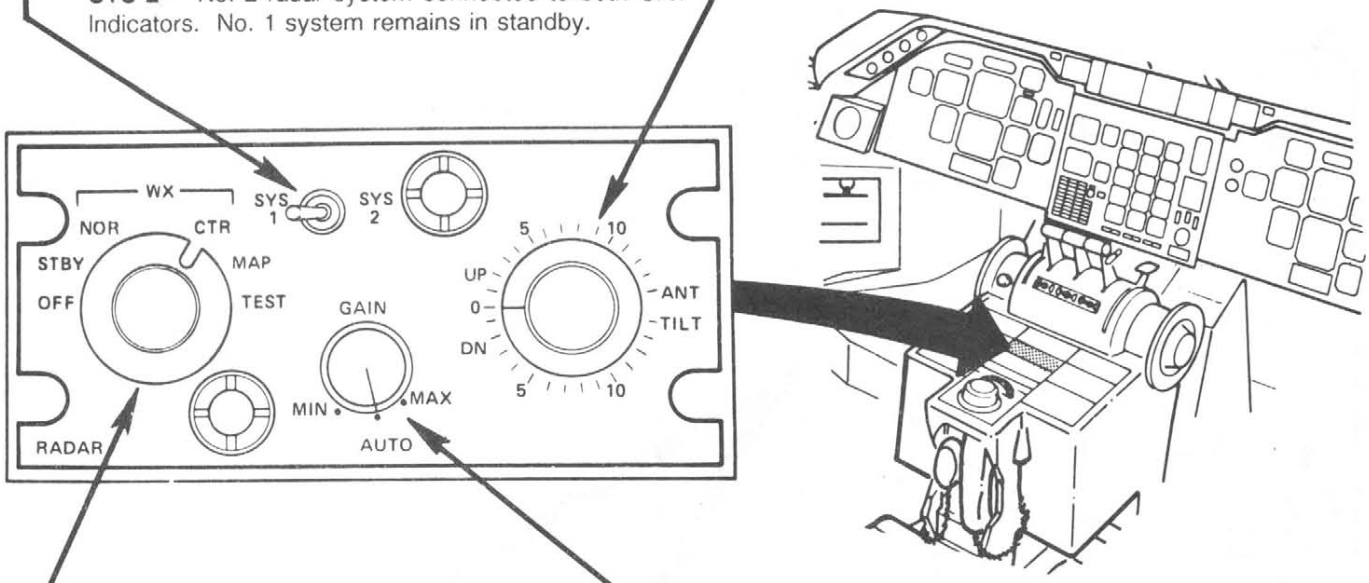
Two-position toggle switch.

SYS 1 - No. 1 radar system connected to both CRT Indicators. No. 2 system remains in standby.

SYS 2 - No. 2 radar system connected to both CRT Indicators. No. 1 system remains in standby.

ANTENNA TILT CONTROL KNOB

Rotary knob permits manual control of antenna tilt ±14° from horizontal. Markings are in one degree increments.



FUNCTION SELECTOR SWITCH

Six-position rotary switch that provides selection of the system operating modes or functions.

OFF - Power is removed.

STBY - Initiates a 3-4 minute warm-up period. Selection of an operational mode in lieu of STBY will also activate the warm-up period.

NOR - Provides a display of all objects within the radar beam scan that have sufficient density to reflect the beam.

CTR - The Contour circuit alters the normal radar presentation to display areas of high rainfall rate gradients as black holes in the return. These "holes" also represent areas of greatest turbulence.

MAP - Changes polarization of the radiated beam to provide a plan picture of prominent landmarks and terrain features in slant range. Azimuth bearing of the return is relative to the aircraft heading.

TEST - Displays a self-test pattern on the CRT indicators which permits evaluation of the radar receiver and indicator. The transmitter and its associated circuits are inoperative while the test pattern is displayed. The TEST position may also be used in lieu of the STBY position for initial 3 minute warmup (both systems are warmed up simultaneously.

GAIN CONTROL KNOB

Rotary knob permits manual adjustment of receiver sensitivity from MIN to MAX. An AUTO position implements the automatic gain control function.

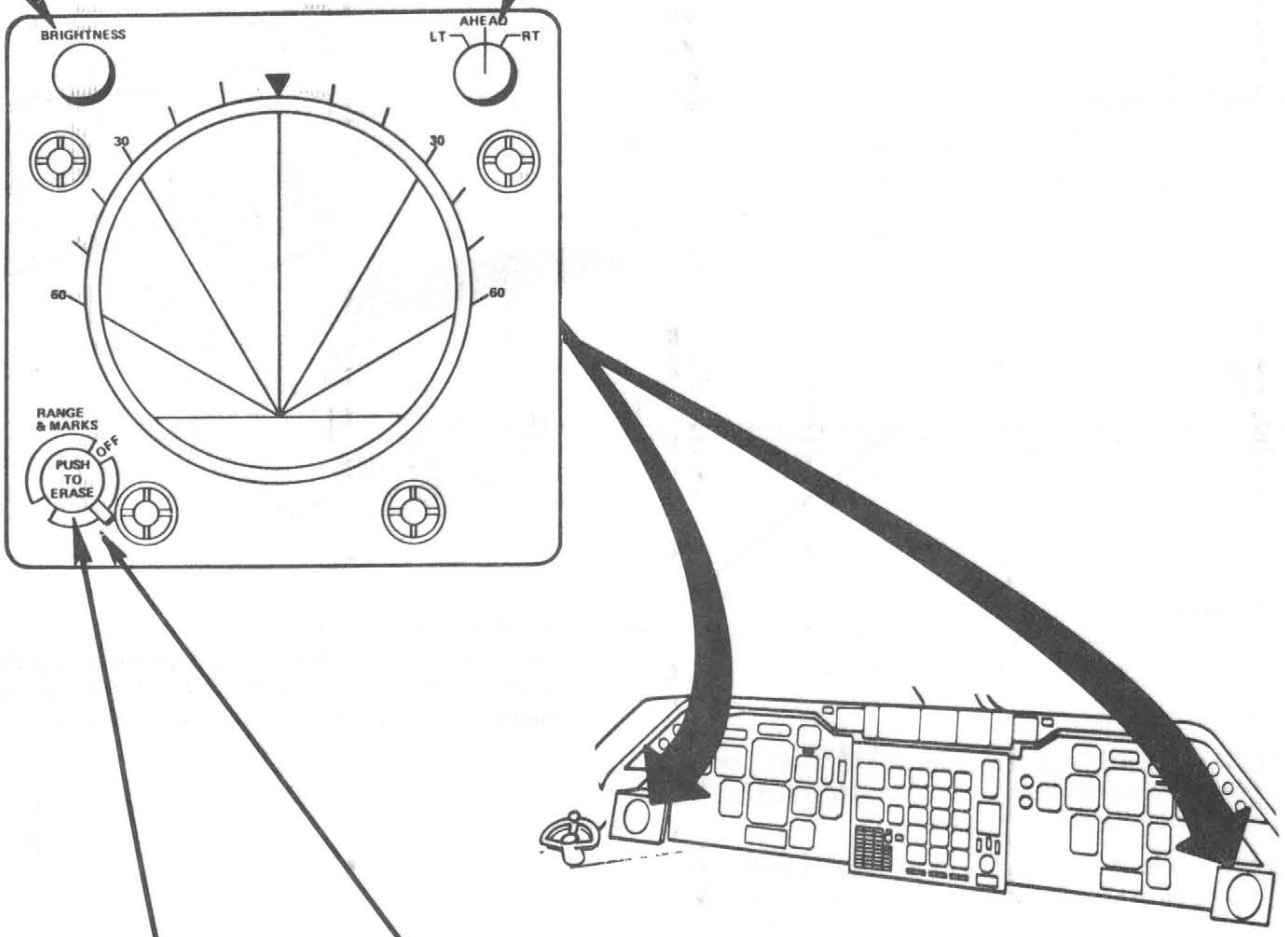
WEATHER RADAR CONTROL PANEL
(CENTER CONSOLE)

BRIGHTNESS CONTROL
Rotary knob controls brightness of target returns.

INDICATOR SWEEP CONTROL
Three-position rotary switch controls radar sweep.

AHEAD – Sweep is centered on nose of aircraft.

LT /RT – Sweep is offset to left or right of aircraft nose to increase side coverage.



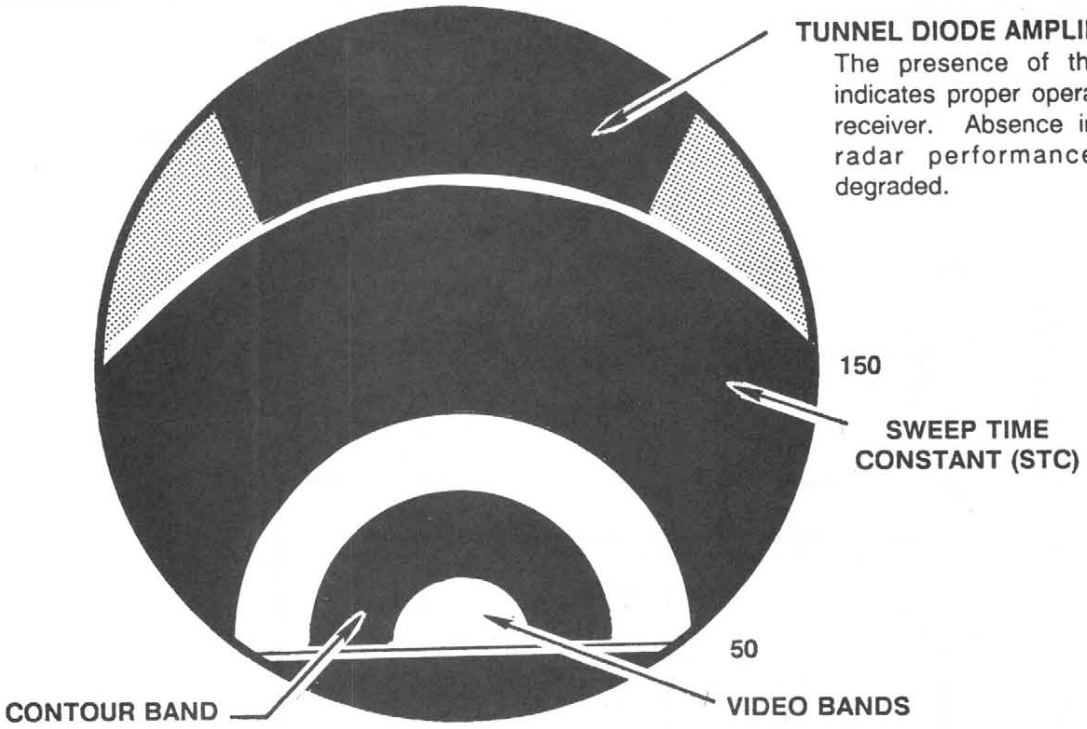
ERASE SWITCH
Momentary pushbutton switch provides for quick removal of the existing display.

RANGE SELECTOR SWITCH
Four-position rotary switch selects ranges and displayed range marks.

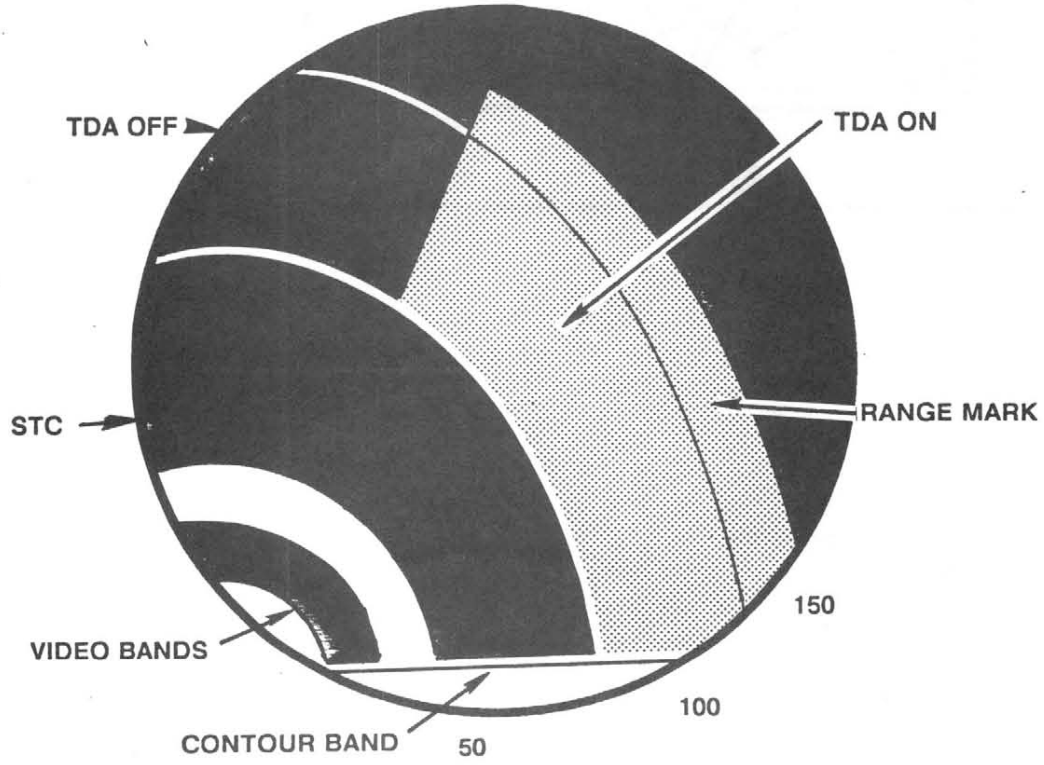
50 NM Range – 25 NM Marks
150 NM Range – 50 NM Marks
300 NM Range – 50 NM Marks

OFF – Power is removed from CRT indicator.

WEATHER RADAR INDICATOR
(SHIPS 712-733)



NORMAL DISPLAY



OFFSET DISPLAY

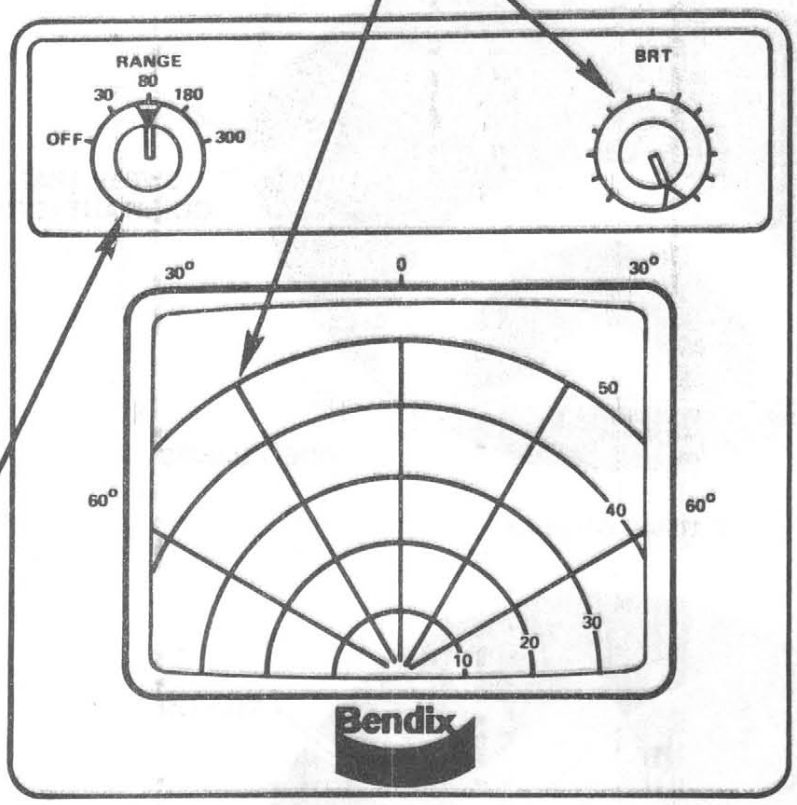
RADAR TEST PATTERN DISPLAY

WEATHER RADAR/COLOR INDICATOR
(Ships 734 and subsequent)

Ships 734 and subsequent are equipped with color radar, same as found on the -500 aircraft.

CURSOR MARKS (5)
Marks are in increments of 30°.

BRIGHTNESS CONTROL
Controls brightness of entire CRT Indicator.



RANGE SELECTOR SWITCH

Selects range to be displayed on CRT indicator. The number that appears outside the switch shows the selected maximum range in nautical miles.

WEATHER RADAR/COLOR INDICATOR
(SHIPS 734 - SUBSEQUENT)

INDICATOR TEST

The presence of the tunnel diode amplifier (TDA) window indicates proper operation of the radar receiver. Absence indicates that the radar performance is seriously degraded. The TDA window may shift slightly in azimuth from scan to scan, and width may vary. This is normal.

RANGE MARKS

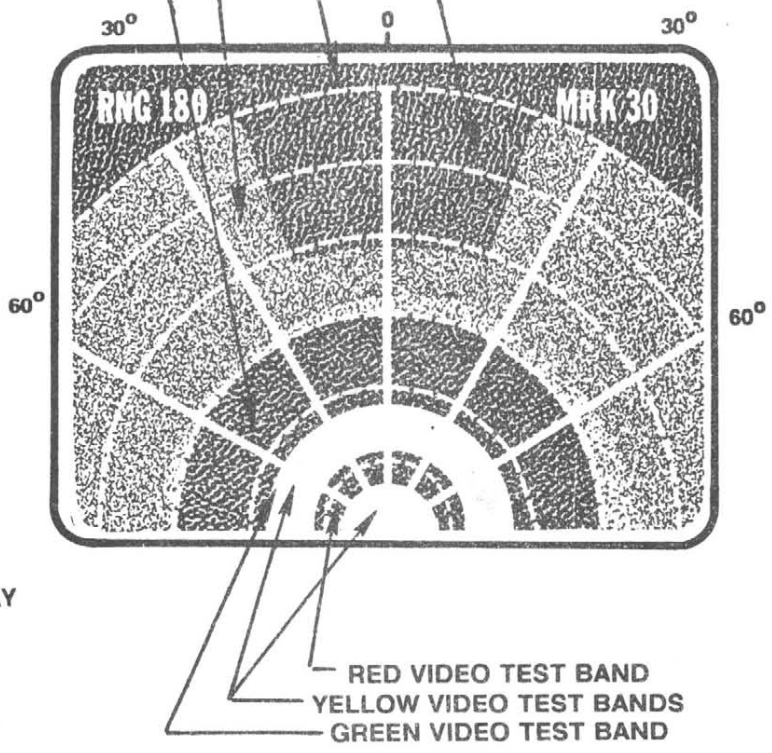
Six range marks should be visible.

BACKGROUND NOISE

Background noise (snow) intensity will vary from system to system. As long as the STC effect and TDA window are visible, the background noise intensity is not critical.

SENSITIVITY TIME CONTROL (STC)

Normal STC effect will show reduced background noise (snow) or no noise, extending from the outer video band to approximately 100 NM. The STC is a time varying gain control for decreasing the sensitivity of nearby targets. This maintains the same display intensity for near targets as for similar long-range targets.



RADAR TEST PATTERN DISPLAY

Video bands (red and yellow) are not necessarily of the same width. Tolerance for one band is up to twice the width of the other. The width of the narrow green bands, adjacent to the yellow bands, is not critical.

-END-
(OPPOSITE SIDE BLANK)

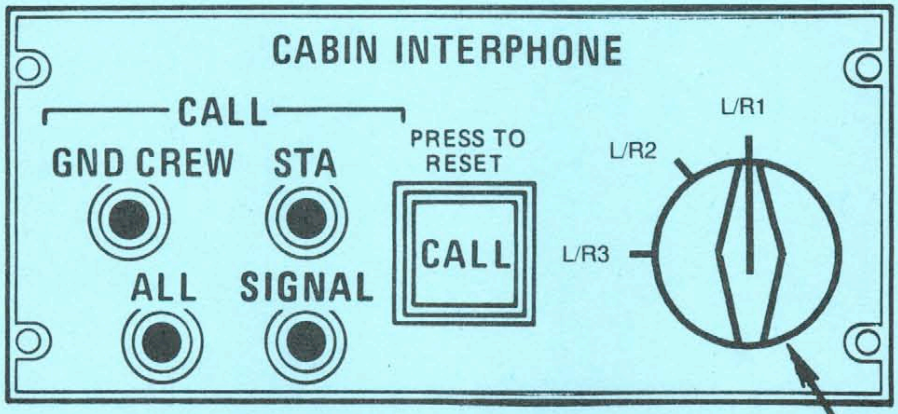
CABIN INTERPHONE

Six interphone units are installed in the cabin permitting communication between all six door locations and the flight station.

GALLEY INTERPHONE

Not installed.

CABIN INTERPHONE PANEL



STATION SELECT SWITCH

Rotary selector for cabin station to be called.

L/R 1
L/R 2
L/R 3

CONTROLS AND INDICATORS

-END-
(OPPOSITE SIDE BLANK)

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APU OPERATION ..... APU SECTION
LIGHTING ..... AIRCRAFT GENERAL SECTION
RADIO POWER ..... COMMUNICATION/RADAR SECTION

GENERAL

Main AC power is provided by three engine-driven generators. An APU-driven generator which can be paralleled to the engine-driven generators is also installed to provide AC power on the ground and, if needed, in flight. An external AC power receptacle is also provided for ground power.

A standby inverter, powered by the battery, is provided to supply backup AC power to equipment critical to continued flight.

Main DC power is provided by three main T R units powered from the A C Load Buses. A fourth T R, powered by the AC ESSENTIAL BUS provides DC power for essential loads. The aircraft battery also provides a backup source of DC power.

BUS DISTRIBUTION

The three engine-driven generators power respective AC Load Buses. The AC Load Buses normally operate in parallel through the AC TIE BUS to permit the generators to equally share AC loads. An AC ESSENTIAL BUS can be powered by AC Load Bus No. 3 (normal), or directly from generator 1 or generator 2. The AC STBY BUS is normally powered by the AC ESSENTIAL BUS. The standby inverter, powered by the battery, provides a backup source of power to the AC STBY BUS.

The three AC Load Buses power three Main T R units which supply the respective DC Load Buses. The DC Load Buses normally operate in parallel through the DC TIE BUS to permit the T R's to equally share DC loads. The AC ESSENTIAL BUS powers an essential T R to supply power for the DC ESSENTIAL BUS. If the Essential T R fails, the DC ESSENTIAL BUS will continue to be powered by the remaining T R's as long as the T R's are paralleled (DC BUS ISOLATION switch unlatched). The DC STBY BUS is normally powered by the DC ESSENTIAL BUS. The battery provides a limited backup source of power to the DC STBY BUS.

In addition to its backup functions, the battery provides power for APU starting and control. The APU is connected to the BAT BUS through its MASTER PWR switch.

CIRCUIT BREAKER PANEL DESCRIPTION

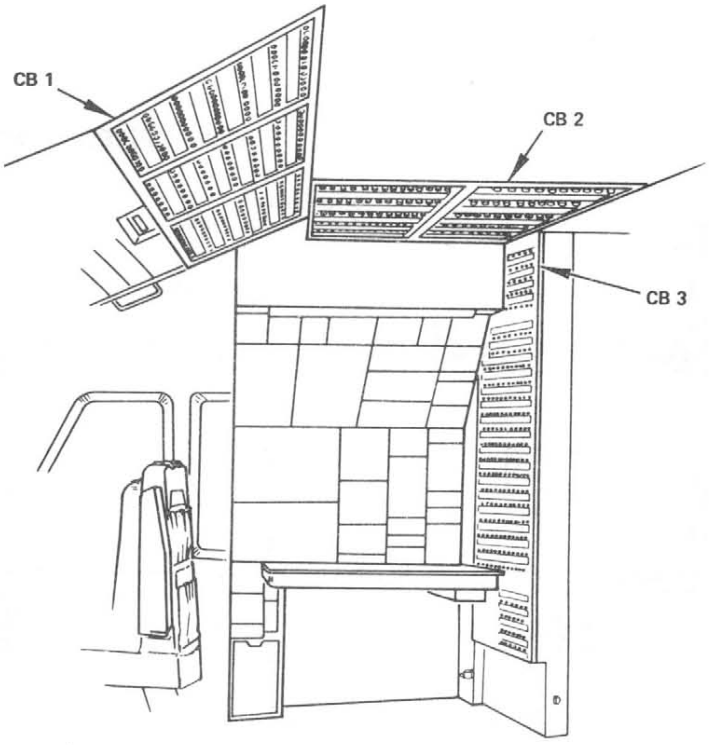
There are five primary circuit breaker (C B) panels. C B panels are located as follows:

- Panel 1 – Aft of pilot's overhead panel.
- Panel 2 – Above the S O's panel.
- Panel 3 – Right side of S O's position.
- Galley Panel 4 – Aft left (Capt's) side of galley.
- Galley Panel 5 – Aft right (F O's) side of galley.

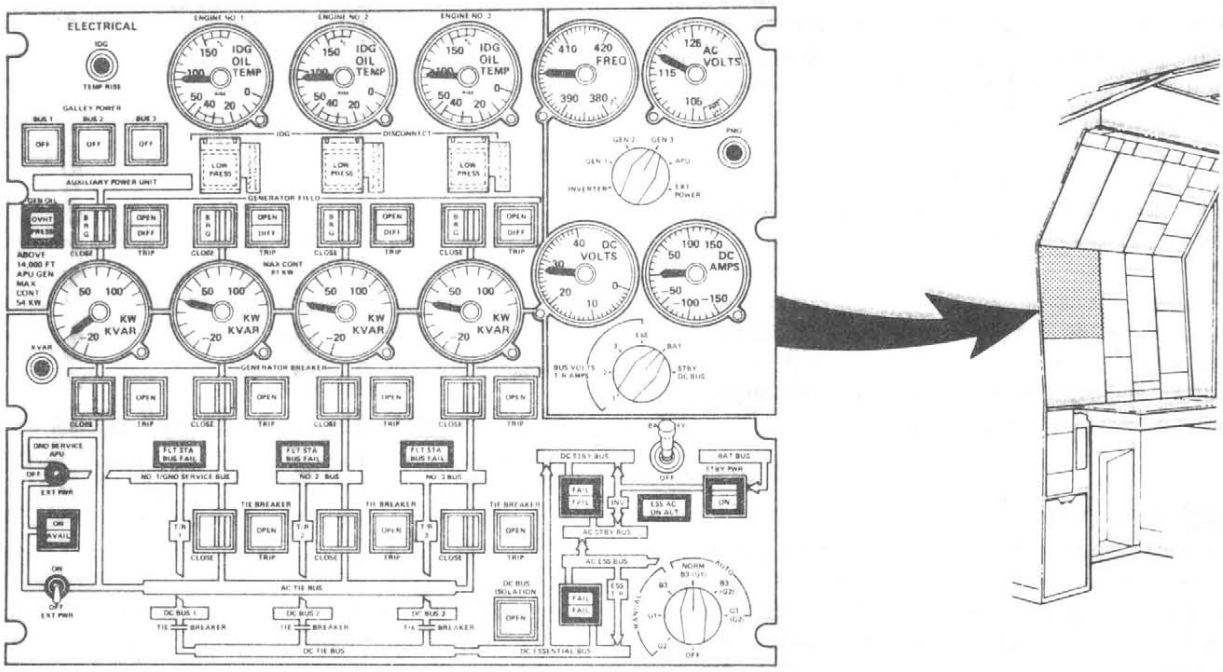
Circuit breakers are identified by panel position as well as by name. For example, circuit breaker 3F3 is located on panel 3 (S O's right side) on row F (placarded) and the third circuit breaker from the left (also placarded). All circuit breakers are identified in this manner.

REMOTE CONTROL CIRCUIT BREAKERS

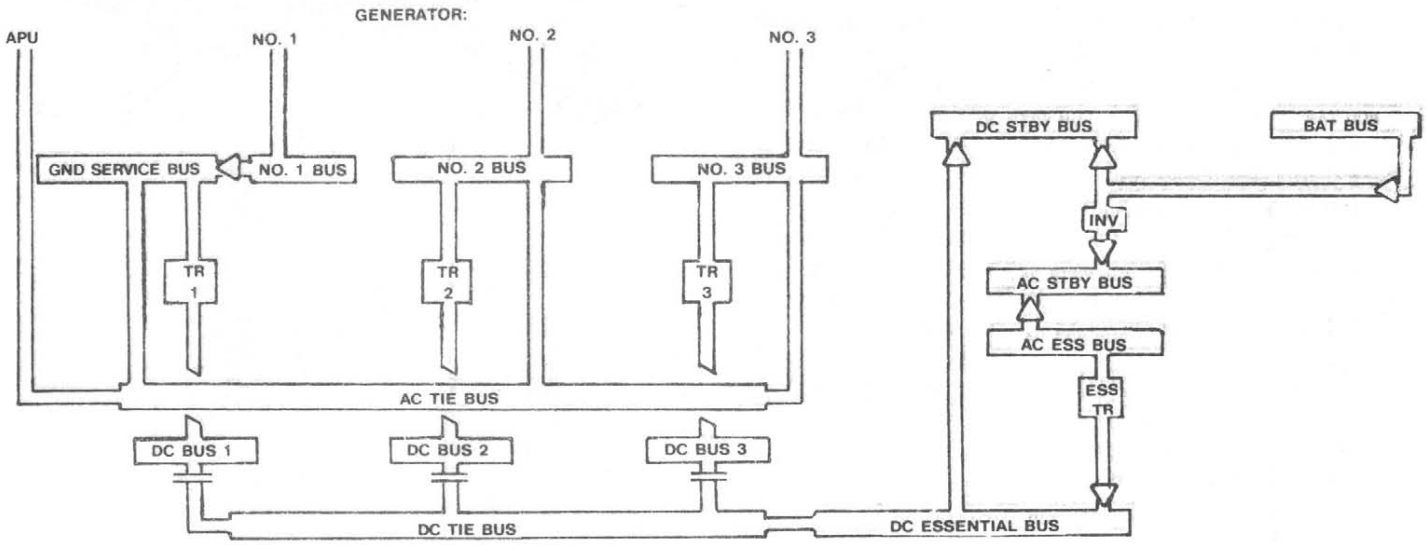
Remote Control Circuit Breakers (RCCB's) are used on high load items to reduce the length of high current wiring. Each item of equipment which is protected by an RCCB has a circuit breaker installed on the circuit breaker panel. This circuit breaker electrically signals the RCCB unit located in the MID Avionics compartment to open or close. If the RCCB senses an overload, it will automatically trip and signal the circuit breaker in the cockpit to also trip.



CIRCUIT BREAKER PANEL LOCATION



SECOND OFFICER'S ELECTRICAL PANEL



BUS DISTRIBUTION

INTEGRATED DRIVE GENERATOR (IDG)

Each engine has a constant speed drive and generator that are mounted together in an assembly which forms the Integrated Drive Generator (IDG).

Oil contained in the IDG governs the drive speed and is used for lubrication and cooling of both the drive and generator. The IDG OIL TEMP gauges normally monitor oil outlet temperature. The normal IDG outlet temperature is approximately 90°C. A caution band is marked beginning at 145°C. The IDG OIL TEMP gauges will display the temperature difference between the oil inlet and outlet (TEMP RISE), when the IDG TEMP RISE button is pressed. The normal RISE will be approximately 10°C. A caution band is marked beginning at 25°C.

A combination **LOW PRESS** light and guarded IDG DISCONNECT switch is located below each IDG OIL TEMP indicator. **LOW PRESS** illuminates when oil pressure in the IDG is too low, or IDG oil temperature is too high. Pressing the momentary IDG DISCONNECT switch with electrical power available engages a spring-loaded disconnect that can only be reset by maintenance. Subsequent engine rotation will then cause a disconnect to occur, and will damage the disconnect mechanism. For this reason, circuit breaker 3G15 must be pulled to prevent an inadvertent IDG disconnect anytime bulbs are replaced for the **LOW PRESS** light.

AIRCRAFT GENERATORS

An identically rated generator is installed on each engine and the APU. Each generator is rated at 81 kilowatts (KW). However, due to limited cooling, the APU GENERATOR is restricted to 54 KW above 14,000'. Each generator contains a separate permanent magnet generator (PMG) to provide generator control power.

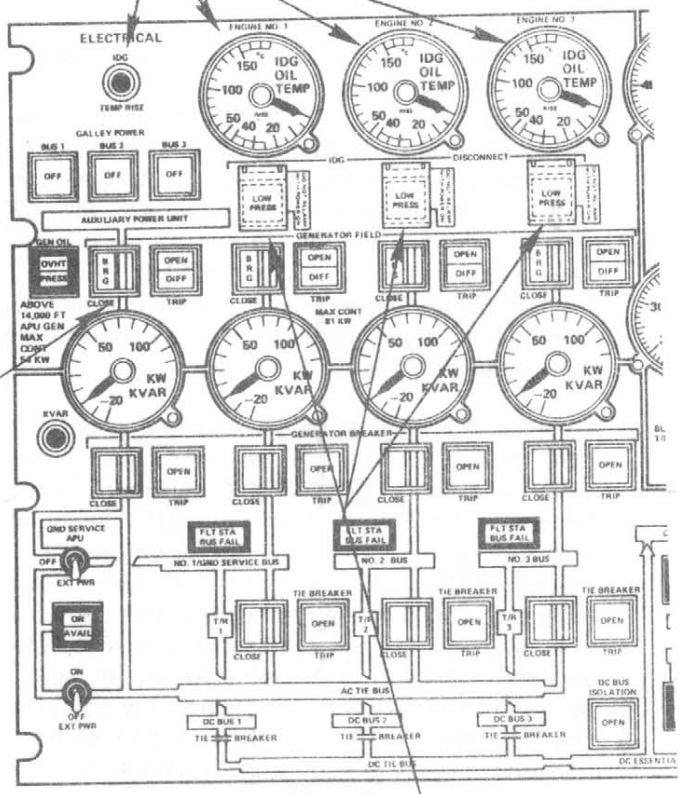
GENERATOR CONTROL UNIT (GCU)

Each generator is provided with a GCU which provides all automatic and manual control of the generator. The GCU's work both independently and together to control GENERATOR FIELD, GENERATOR BREAKER and TIE BREAKER operation, as well as paralleling and fault isolation functions. Power for the GCU's is supplied by either the DC STBY BUS or PMG power.

GENERATOR FIELD

No power can be produced by a generator (except by the PMG) until the generator field is closed. Opening and closing of each generator field is controlled by the respective GCU. Before a generator field can close, the generator must be on speed and all trip-open signals removed. In addition, for the engine driven generators, the respective FUEL AND IGNITION switch must be **ON**, and the FIRE PULL HANDLES **IN**. Once the generator field is closed, the field is energized to produce 117 volts.

GENERATOR FIELD CLOSE and TRIP switches are provided on the panel for each generator. These switches provide manual inputs through the GCU's to control each generator field as well as indicate the status of each generator field.



IDG OIL TEMP/RISE INDICATOR (3)

Displays either IDG oil outlet temperature, or IDG oil temperature rise between the IDG oil inlet and outlet. Temperature indication is determined by the position of the IDG TEMP RISE button.

RELEASED – Normal position. Indicators display IDG oil outlet temperature. Should remain below upper yellow band (145°C).

PRESSED – Indicators display the temperature difference (RISE) between the IDG oil inlet and outlet. RISE indicates how hard the IDG is working and should remain below the lower yellow band (25°C).

3G16 – ELECTRIC METER SWITCH

3AA18 – IDG OIL TEMP

GENERATOR FIELD SWITCH (8)

Momentary switches which manually control generator field operation.

CLOSE – Pressing the CLOSE switch removes any TRIP open lock-out and arms the generator field to CLOSE automatically as commanded by the GCU. **FLOWBAR** illuminates when generator field is closed. Generator field must be closed for generator to produce power.

BRG – (Amber) De-activated. However, lights illuminate during a S/O light test.

TRIP – Pressing the TRIP switch locks the generator field open until the CLOSE switch is pressed.

OPEN – (Amber) Illuminates when generator field is open.

- Generator field opens automatically when:
  - FUEL AND IGNITION switch is **OFF**
  - Generator is underspeed.
  - Generator voltage is out of limits (locks open).
  - FIRE PULL HANDLE is pulled (locks open).
  - DIFFERENTIAL (DIFF) fault is detected (locks open).
- **ELECTRICAL SYSTEM** illuminates on the Pilot's Annunciator Panel when any **OPEN** illuminates.

DIFF – (Amber) Illuminates when a differential fault (open or shorted feeder) is detected. **OPEN** also illuminates. Pressing the CLOSE switch will extinguish **DIFF** light, but **OPEN** remains if fault still exists.

1K15, 16, 17 – GEN CONT UNIT

3B17 – APU GEN CONT UNIT

IDG DISCONNECT SWITCH (3)

- Guarded momentary switch.
- When pressed, IDG drive is disconnected from the engine. Except in an emergency, switch should not be pressed unless N3 is above 20%.

LOW PRESS – (Amber) Illuminates when IDG oil pressure is too low or oil temperature is too high. Normally illuminates when engine is shutdown or IDG is disconnected. **PULL C/B 3G15 BEFORE REPLACING LIGHT BULBS.**

- Once disconnected, IDG must be reset by Maintenance.
- **ELECTRICAL SYSTEM** illuminates on the Pilot's Annunciator Panel when any **LOW PRESS** illuminates.

3D10, 13, 16 – LOAD CONTROL AND FAIL IND

3G15 – IDG DISC

3AA17 – IDG OIL LOW PRESS

KW/KVAR METERS

Each generator is provided with a combination KW/KVAR meter to indicate real (KW) and reactive (KVAR) loads. Normally, these meters indicate the kilowatt (KW) load on each generator. The total electrical load on the aircraft can be determined by adding each meter reading together. During parallel operation a load controller divides generator loads so that KW indications should agree within approximately 5 KW.

The total AC bus loads that can be reasonably expected on most flights are as follows:

- Ground operation: 40 KW average; 95 KW max.
- In-flight: 75 KW average; 130 KW max.

Individual generator loads are limited to :

- Max continuous: 81 KW.
  (54 KW for APU above 14,000').
- Max 5 minutes: 90 KW.
- Max 15 seconds: 105 KW.

A KVAR button, when pressed, selects the KVAR indication on all four meters. KVAR (kilovolt amps reactive) is an indication of how efficiently the generator control circuits are functioning. KVAR indications should be approximately equal when generators are operating in parallel.

GENERATOR BREAKER

After the GENERATOR FIELD is closed, the generator is energized, but no power is supplied to any bus until the respective generator breaker is closed (except GEN 1 or GEN 2 can be selected to supply the AC ESSENTIAL BUS). Opening and closing of each generator breaker is controlled by the respective GCU. Before a generator breaker can close, the respective GENERATOR FIELD must be closed, and all trip-open signals removed. The generator breaker will now close if the respective load bus is unpowered, or when proper phase, voltage and frequency is achieved to permit auto parallel to occur.

GENERATOR BREAKER CLOSE and TRIP switches are provided on the panel for each generator. These switches provide manual inputs through the GCU's to control each generator breaker as well as indicate the status of each generator breaker.

AC TIE BREAKER

The load buses can be connected to the AC TIE BUS by the AC tie breakers. Opening and closing of each AC tie breaker is controlled by the respective GCU. Before an AC tie breaker can close, all trip-open signals must be removed. The GCU will close the AC tie breaker automatically when its respective load bus is unpowered, or to parallel the generators when external power is removed while the engine driven generators are powering the load buses.

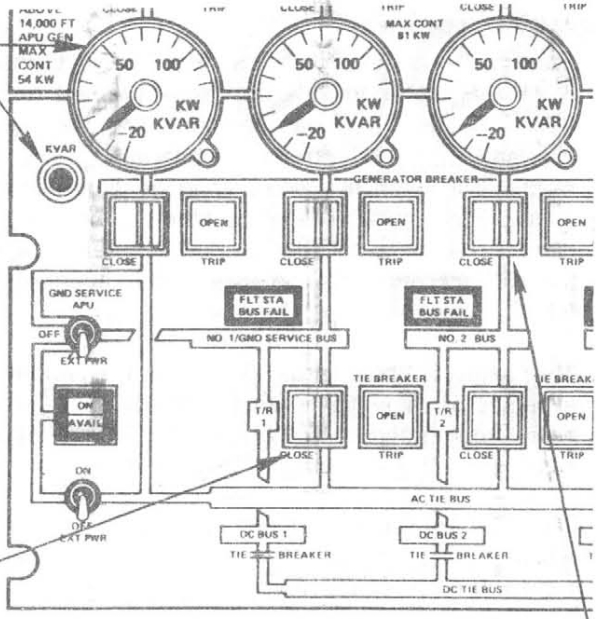
TIE BREAKER TRIP and CLOSE switches are provided on the panel for each engine driven generator. These switches provide manual inputs through the GCU's to control the respective AC tie breaker as well as indicate the status of each AC tie breaker.

GENERATORS IN PARALLEL

With all AC TIE BREAKERS and GENERATOR BREAKERS closed, the generators are operating in parallel and sharing loads equally. As long as the AC TIE BREAKERS are closed, any generator can power any load bus. This is the normal configuration of the electrical system. When allowed to operate automatically, each GCU will bring its generator on the line and parallel it with any other AC source except external power. This function is called auto-parallel.

To initiate auto-parallel, the GENERATOR FIELD is first tripped **OPEN**. When the BUS TIE BREAKER, GENERATOR BREAKER and GENERATOR FIELD CLOSE switches are subsequently pressed, the GCU automatically controls the paralleling process, assuring proper phasing of the generator.

NOTE: Manually closing the GENERATOR BREAKER while the GENERATOR FIELD is closed and the associated load bus is powered, or manually closing the AC TIE BREAKER while the associated GENERATOR BREAKER is closed and the AC TIE BUS is powered may cause damage to the generators (random parallel).



KW/KVAR METER (4)

Displays either generator total load (KW) or reactive load (KVAR). Indication is determined by the position of KVAR button.

RELEASED – Normal position. Indicators display each generator's KW load.

- Should be kept below 81 KW.
- Above 14,000', APU load should be kept below 54 KW.

PRESSED – Indicators display each generator's KVAR load. In parallel operation, KVAR indications should be approximately equal between generators.

3G16 – ELECTRIC METER SWITCH

AC TIE BREAKER SWITCH (6)

Momentary switch which manually controls bus tie breaker operation.

CLOSE – Pressing the CLOSE switch removes any TRIP open lock-out (except differential fault) and arms the tie breaker to close automatically as commanded by the GCU. **FLOWBAR** illuminates when tie breaker is closed.

- The tie breakers must be closed for the engine driven generator(s) to power the AC TIE BUS or operate in parallel. The tie breaker must also be closed for the APU generator or EXT POWER to power the respective AC Load Bus.
- The respective tie breaker closes automatically if a 'dead' (unpowered) AC Load Bus is sensed.

TRIP – Pressing the TRIP switch locks the tie breaker open until the CLOSE switch is pressed. **OPEN** (amber) illuminates when tie breaker is open.

Tie breaker opens automatically when:

- EXT POWER is powering the AC TIE BUS while the respective AC generator is powering the AC Load Bus.
- An AC generator output voltage frequency exceeds limits while the generators are operating in parallel.
- A fault is sensed on the AC TIE BUS.
- Differential fault is sensed between the GENERATOR BREAKER and the tie breaker.

CAUTION:

MANUALLY CLOSING THE AC TIE BREAKER WHILE THE GENERATOR BREAKER IS CLOSED AND THE AC TIE BUS IS POWERED MAY CAUSE DAMAGE TO THE GENERATORS. (RANDOM PARALLEL).

GENERATOR BREAKER SWITCH (8)

Momentary switch which manually controls generator breaker operation.

CLOSE – Pressing the CLOSE switch removes any TRIP open lock-out (except differential fault) and arms the generator breaker to close automatically as commanded by the GCU. **FLOWBAR** illuminates when generator breaker is closed.

- GENERATOR FIELD must be closed (**FLOWBAR**) before generator breaker can close.
- Generator breaker must be closed for generator to power the respective AC Load Bus.
- Closing the APU generator breaker connects the APU generator to the AC TIE BUS.

TRIP – Pressing the TRIP switch locks the generator breaker open until the CLOSE switch is pressed. **OPEN** (amber) illuminates when generator breaker is open.

- Generator breaker opens automatically when the respective GENERATOR FIELD is open.
- The APU generator breaker also opens when a fault is detected on the AC TIE BUS.
- GEN 1 or GEN 2 can be selected to power the AC ESS BUS when the respective generator breaker is open provided the GENERATOR FIELD is closed (**FLOWBAR**).

CAUTION:

MANUALLY CLOSING THE GENERATOR BREAKER WHILE THE GENERATOR FIELD IS CLOSED AND THE ASSOCIATED LOAD BUS IS POWERED MAY CAUSE DAMAGE TO THE GENERATORS. (RANDOM PARALLEL).

APU GENERATOR

The APU generator provides an additional source of electrical power. The APU is the normal source of AC power during ground operation.

The APU generator is identical to the engine driven generators. The APU N_2, unlike the engines, operates at a constant RPM so a constant speed drive is not required. Instead, an adapter gearbox is installed between the generator and the APU free turbine (N_2) to provide oil cooling and lubrication for the generator. An **OVHT** and **PRESS** light is located adjacent to the APU GENERATOR FIELD switches. OVHT illuminates when oil temperature in the adapter is too high. PRESS illuminates when oil pressure in the adapter is too low.

The APU generator is controlled by a GCU, and the APU GENERATOR FIELD, GENERATOR BREAKER, and KW/KVAR meter are the same as the engine driven generators. However, the GENERATOR BREAKER connects the APU directly to the AC TIE BUS. This permits the APU generator to power the load buses through the AC TIE BREAKERS.

The APU generator can be paralleled with the engine driven generators. Paralleling the APU generator with the engine driven generators during engine start eliminates power interruptions.

EXTERNAL POWER

The AC TIE BUS and load buses may also be powered by external power. The external power receptacle is located aft of the nose wheelwell. An **AVAIL/ON** light and EXT POWER switch are installed on the S/O's panel. When external power is plugged in, and is usable, the green AVAIL light will illuminate. Positioning the EXT POWER switch to ON selects external power. When external power is on the AC TIE BUS, the white ON light illuminates.

Because external power is not controlled as closely as the aircraft generators, it cannot be paralleled with them. A bus priority circuit provides that external power has priority on the AC TIE BUS and each aircraft generator has priority on its load bus. To prevent parallel operation with external power, the priority circuit will open the respective AC TIE BREAKER when the aircraft generator is powering its load bus and external power is applied to the AC TIE BUS. The APU GENERATOR BREAKER will open whenever external power is applied to the AC TIE bus. The AC TIE BREAKERS and APU GENERATOR BREAKER will close automatically when external power is removed from the AC TIE BUS.

APU GEN OIL OVHT / PRESS LIGHTS (amber)

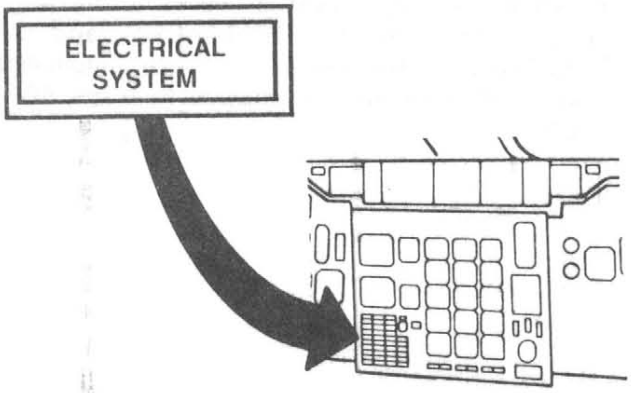
- Monitors condition of the oil in the APU Generator adapter unit.
- Lights are armed to illuminate only when APU MASTER POWER switch is **ON**.

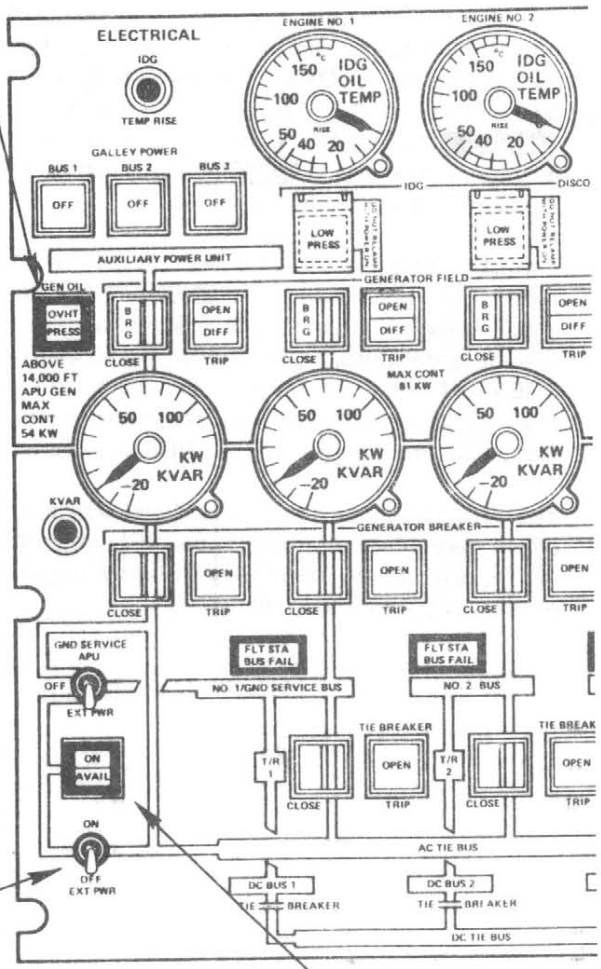
OVHT – Illuminates if adapter oil is too hot.

PRESS – Illuminates if adapter oil pressure is too low.

- **ELECTRICAL SYSTEM** light illuminates on the Pilot's Annunciator Panel when **PRESS** or **OVHT** illuminates.

3S15 – EJECTOR & VENT VALVE





EXT POWER SWITCH

Two-position toggle switch which controls the selection of AC external power.

ON – Electrically held position which connects external power to the AC TIE BUS.

- Green **AVAIL** light must be illuminated for switch to remain in the on position.
- Trips GND SERVICE switch to off position.
- Opens APU GENERATOR BREAKER.
- Opens Bus TIE BREAKER(S) if engine generator(s) are powering the Load Buses.

OFF – Disconnects external power from the AC TIE BUS.

- Switch trips off if voltage, frequency or phase is out of limits.

EXTERNAL POWER ON / AVAIL LIGHTS

ON – (White) Illuminates when external power is powering the AC TIE BUS.

AVAIL – (Green) Illuminates when external power is connected and is of proper voltage, frequency and phase rotation.

GALLEY POWER

Power to the ovens, coffee makers, refrigeration units, etc. is provided by three galley buses. Each galley bus is an extension of the respective AC Load Bus. Manual control of power to the galley buses is provided by three GALLEY POWER switches on the S/O's panel, and a GALLEY POWER EMER OFF switch in the lower galley. The GALLEY POWER switch must be latched on the S/O's panel and the OFF light extinguished before power is supplied to the respective galley bus. The normal position of the lower galley EMER OFF switch is unlatched. Latching the switch shuts off all power to the three galley buses and **EMER OFF** illuminates; the three **OFF** lights on the S/O' panel will also illuminate.

AUTO-LOAD MONITOR (LOAD SHEDDING)

The auto-load monitor system is provided to prevent over-loading the generators. Each generator is capable of supplying the total aircraft electrical load unless galley power and/or hydraulic AC PUMPS are in use. If the load on any generator exceeds 95 KW, the auto-load monitor will shutoff (load shed) power to the galleys and AC PUMPS if the respective switches are latched. The three GALLEY POWER **OFF** lights will illuminate, and the AC PUMPS **ON** lights will extinguish. Once load shedding has occurred, all three GALLEY POWER switches must be unlatched before power can be restored to any galley bus. Likewise, both AC PUMPS switches must be unlatched before power can be restored to either pump.

GALLEY POWER EMER OFF SWITCH

Guarded switch which provides emergency means to shutoff power to Galley Bus 1, 2, and 3.

UNL – Normal position. Power to galley Bus 1, 2, and 3 is controlled from S/O's panel.

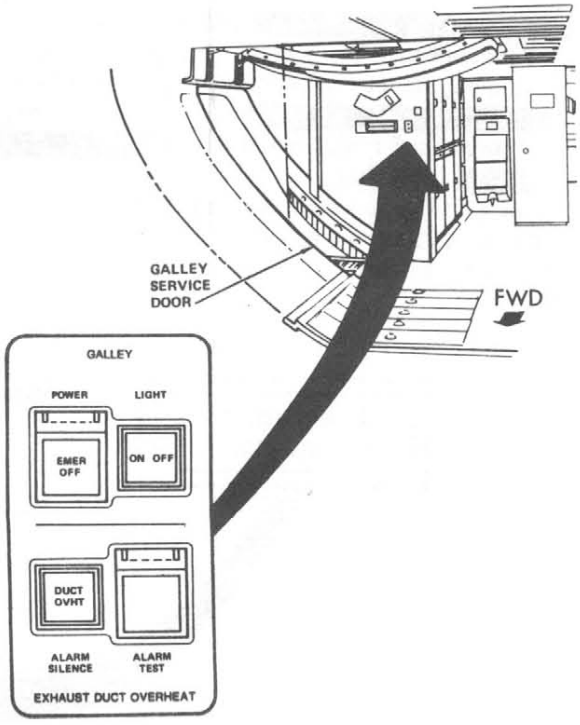
LCH – Power is removed from galley Bus 1, 2, and 3. **EMER OFF** illuminates. All three GALLEY POWER **OFF** lights illuminate on S/O's panel.

FLIGHT STATION BUS

Each AC Load Bus is made up of more than one bus segment (see power distribution diagrams at the end of this section). Power to the galley, AC hydraulic pumps, T/R's, fuel boost pumps, passenger service buses, and flight station buses is supplied through separate segments of each load bus. A **FLT STA BUS FAIL** light is provided for each AC Load Bus and illuminates anytime power is lost to the flight station bus segment of the respective load bus or the load bus itself.

DIFFERENTIAL FAULT PROTECTION (FEEDER FAULT)

A differential protection circuit monitors for short or open leads between the GENERATOR FIELD, GENERATOR BREAKER and AC TIE BREAKER for each generator. Each GENERATOR FIELD TRIP switch contains a **DIFF** light. When **DIFF** illuminates the differential protection circuit has sensed a fault. The GENERATOR FIELD and GENERATOR BREAKER will also TRIP **OPEN**. Additionally, if the fault is between the GENERATOR BREAKER and AC TIE BREAKER, the TIE BREAKER will also TRIP **OPEN**.



GALLEY POWER SWITCH (3)

- Provides cockpit control of power to the galley buses.
- BUS 2 switch also controls power to the forward and aft coffee bars.

LCH – Normal flight position. Respective galley bus is powered.

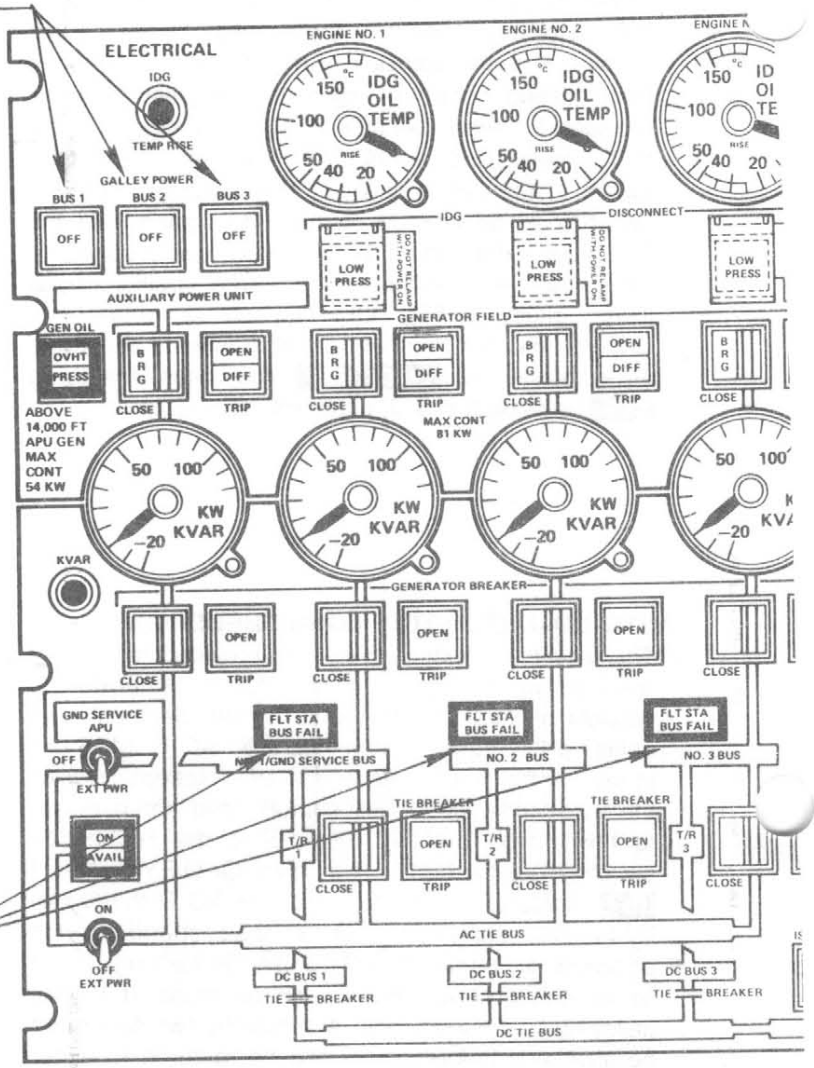
UNL – Power is removed from respective galley bus.

OFF – Illuminates to indicate when galley bus is unpowered for any reason.

Galley power is removed and all three **OFF** lights illuminate when:

- GALLEY POWER EMER OFF switch in the lower galley is latched.
- The Auto-Load Monitor system senses an excessive generator load (load shedding). All three GALLEY POWER switches must be unlatched to reset the system.

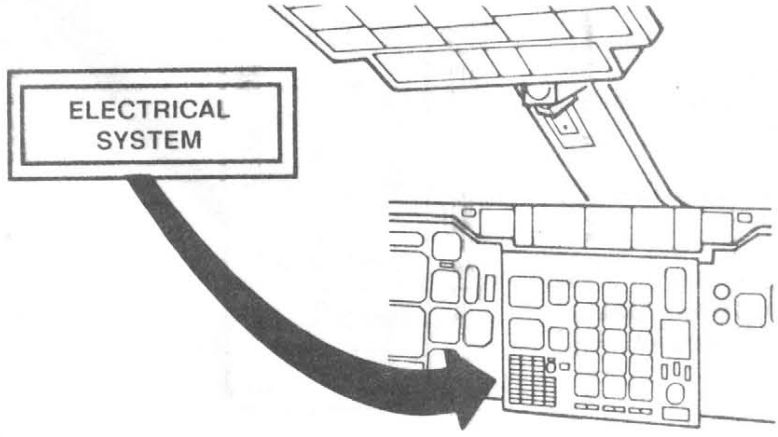
3G11 – IND LT AC BUS
3G14 – GEN OVERLOAD PROTECT
4B17 – GALLEY CONT BUS 1 (Do Not Pull)
4C6,7 – GALLEY CONT BUS 2 & 3 (Do Not Pull)
5F18, 19, 20 – GALLEY POWER BUS 1, 2, 3



FLIGHT STA BUS FAIL LIGHT (Amber) (3)

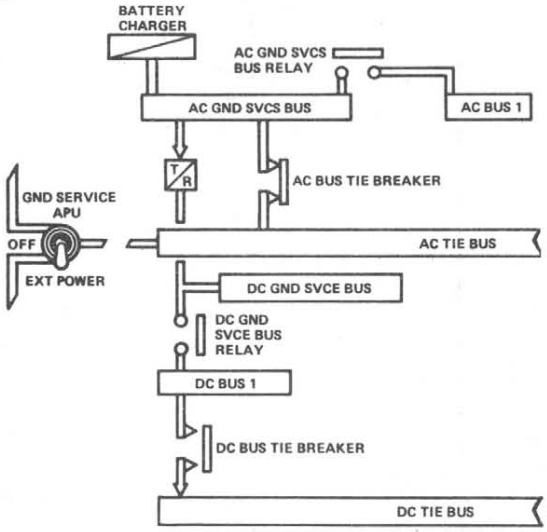
- Illuminates when power is lost to the Flight Station Bus segment of the respective AC Load Bus.
- **ELECTRICAL SYSTEM** illuminates on the Pilot's Annunciator Panel when any **FLIGHT STA BUS FAIL** illuminates.

3D10, 13, 16 – LOAD CONT AND BUS FAIL IND
3E9, 10, 11 – FLIGHT STA PWR
3G11 – AC BUS IND



GROUND SERVICE POWER

The GND SERVICE BUS is an extension of the No. 1 AC Load Bus and No. 1 DC Load Bus. The ground service bus may be separated from the No. 1 load buses to permit servicing and clean-up work to be performed without having to power instruments, gyros, radios, etc. The ground service buses may be separated from the No. 1 load buses and powered from external power or APU GENERATOR **only** while the aircraft is on the ground and the No. 1 AC Load Bus is unpowered. The **FLT STA BUS FAIL** lights are extinguished on all buses due to no power for the lights.



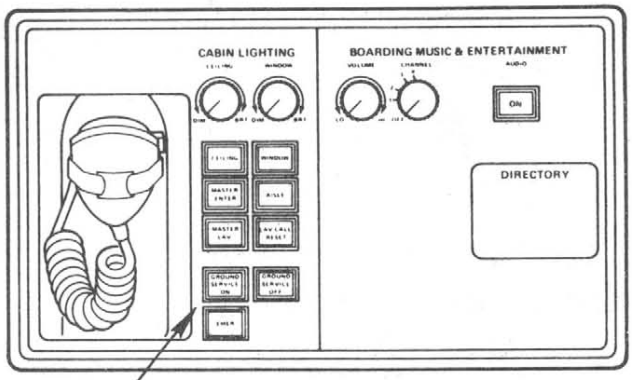
GROUND SERVICE BUS ARRANGEMENT

DC POWER

28V DC power is provided by transformer-rectifiers and the aircraft battery. Each AC Load Bus powers a T/R rated at 75 amps. The output of each T/R is supplied to its respective DC BUS.

DC TIE BREAKERS

The three main DC Load buses can be connected to the DC TIE BUS by closing the DC tie breakers. Opening and closing of the three DC tie breakers is controlled by the DC BUS ISOLATION switch. Normally, the switch is unlatched and the DC tie breakers are closed. Latching the switch opens the DC tie breakers: **OPEN** illuminates when all three DC tie breakers have opened. The DC ESSENTIAL BUS remains connected to the DC TIE BUS when the switch is latched. The DC tie breakers will open anytime the switch is latched. However, once opened, the DC tie breakers will not close when the switch is unlatched unless the essential T R is powered, or any two of the three main T R's are powered.



FWD FLT ATT'S STATION - DOOR 1R

FORWARD F/A'S GND SVCE SWITCHES (DOOR 1L)

- Momentary switches.
- Provides means of controlling external power to the GND SERVICE BUS from the F A's panel at door 1L.

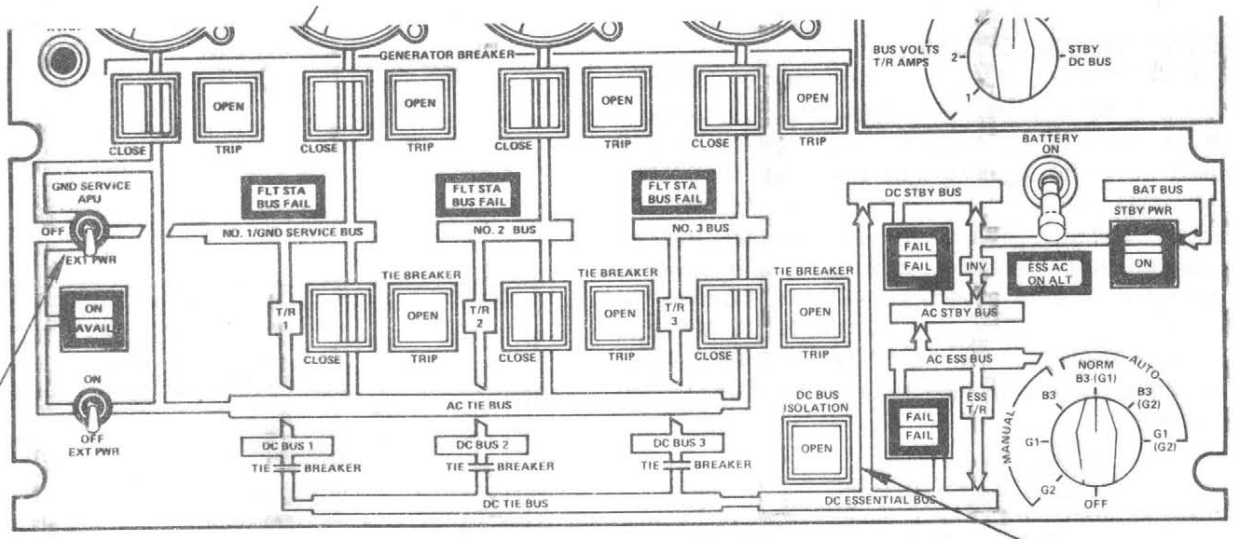
GND SVCE ON - Pressing switch applies external power to the GND SERVICE BUS.

- **GND SVCE ON** illuminates to indicate that GND SERVICE BUS is powered and controlled from F A's panel.
- S O's GND SERVICE switch is released from EXT POWER to **OFF**.
- Switch is inhibited if:
  - External power volts, frequency or phase is out of limits.
  - S O's GND SERVICE switch is in the APU position.
  - Aircraft generators are powering the Load Buses.

GND SVCE OFF - Switch is inhibited unless **GND SVCE ON** is illuminated.

- Pressing switch extinguishes the GND SVCE ON light and shuts off external power to the GND SERVICE BUS.

3A17 - GND SVCE GALLEY EXT



GND SERVICE SWITCH

Three position toggle switch.

- Permits APU or EXT POWER to power only the GND SERVICE BUS to permit servicing operations without having to power all aircraft buses.

APU – Electrically held position. APU GENERATOR power is supplied only to the ground service bus.

- APU power must be available.
- Inhibits F A's GND SVCE switches at 1L door.
- Cannot be selected in flight.

OFF – Normal position. Ground service bus is connected to the No. 1 Load Bus.

EXT POWER – Electrically held position. External power is supplied only to the ground service bus.

- EXT POWER must be available.
- The switch will release to **OFF** if the EXT POWER switch is positioned to **ON** to supply external power to all Load Buses. The switch will also release to **OFF** if the F A's GND SVCE switch is pressed **ON**, and ground service power control will be transferred to the F A's panel.

When either APU or EXT POWER position of the GND SERVICE switch is selected:

- BATTERY switch must be **OFF** to prevent discharging the battery.
- Battery charger will operate while the ground service bus is powered provided:
  - BATTERY switch is **OFF**.
  - STANDBY POWER switch is not **ON**.
  - MASTER RADIO ESSENTIAL switch is unlatched.

3B14 – GND BUS CONTROLLER

DC BUS ISOLATION SWITCH

Controls the 3 DC TIE BREAKERS.

UNL – Normal position. DC Bus 1, 2 and 3 are connected to the DC TIE BUS.

LCH – Isolates DC Bus 1, 2 and 3 from the DC TIE BUS. DC ESSENTIAL BUS remains connected to the DC TIE BUS.

OPEN (Amber) illuminates when all three DC TIE BREAKERS have opened.

- DC Essential power is required to illuminate the **OPEN** light.

3A9, 10, 11 – TIE BUS CONT

3A12, 13, 14 – TIE BUS PWR BUS

3F2, 3 – DC TIE BUS CONT PWR

ESSENTIAL POWER

Equipment required to assure safe operation of the aircraft for an indefinite period is powered by the AC and DC essential buses.

AC ESSENTIAL BUS

The AC ESS BUS is normally powered by the No. 3 BUS. The AC ESS BUS may also be powered directly from the No. 1 or No. 2 generator. The AC Essential Bus Power Selector controls which source(s) of power will be used for the essential bus. The Essential Bus Power Selector is normally in one of the AUTO positions which provides an automatic backup power source for the essential bus. In these positions, the AC ESS BUS will automatically switch to the backup power source if the primary source is lost, and **ESS AC ON ALT** will illuminate. A red **FAIL** light illuminates if power is lost to the AC ESS BUS. In the MANUAL positions, no automatic backup power source is provided.

DC ESSENTIAL BUS

The DC ESS BUS is powered by the AC ESS BUS through the essential T R. When the DC TIE BREAKERS are closed, any T R will also power the DC ESS BUS through the DC TIE BUS. A red **FAIL** light illuminates if power is lost to the DC ESS BUS.

STANDBY POWER

The AC and DC STBY BUSES are normally powered by the AC and DC ESS BUSES. If loss of power occurs on the AC and/or DC essential bus, either or both of the standby buses can be powered by the battery. With only battery power available to power the standby buses, the Captain's flight instruments and the necessary equipment to assure a normal descent and raw data approach will remain operative. Communications from VHF No. 1 is available directly from the battery provided the ESSENTIAL RADIO switch is latched. A red **FAIL** light illuminates if power is lost to the AC OR DC STBY BUS.

DC STBY BUS FAIL LIGHT (RED)

- Illuminates when power is lost to the DC STBY BUS.
- DC ESSENTIAL BUS must be powered to illuminate the light.
- ESS/STBY PWR illuminates on the Pilot's Annunciator Panel if FAIL illuminates.

3F1 – DC STBY PWR

AC STBY BUS FAIL LIGHT (RED)

- Illuminates when power is lost to the AC STBY BUS.
- ESS/STBY PWR illuminates on the Pilot's Annunciator Panel if FAIL illuminates.

1K10 – AC STBY BUS SENSE
1K13 – DC STBY IND
3F12 – AC STBY BUS PWR

AC ESS BUS FAIL LIGHT (RED)

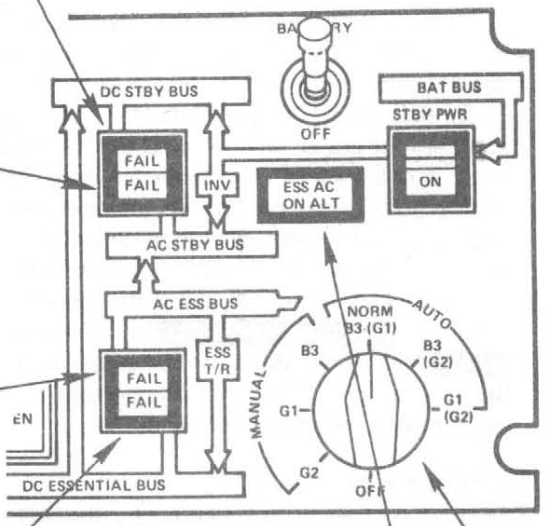
- Illuminates when power is lost to the AC ESSENTIAL BUS.
- ESS/STBY PWR illuminates on the Pilot's Annunciator Panel when FAIL illuminates.

1K13 – DC STBY IND
3F14 – BUS SENSING AC ESS

DC ESS BUS FAIL LIGHT (RED)

- Illuminates when power is lost to the DC ESSENTIAL BUS.
- ESS/STBY PWR illuminates on the Pilot's Annunciator Panel when FAIL illuminates.

3G13 – DC AUTO XFR
1K13 – DC STBY IND



ESS AC ON ALT LIGHT (Amber)

Illuminates if the AC ESS BUS Power Selector is in one of the AUTO positions and AC ESSENTIAL BUS power automatically switches to the alternate power source. Indicates primary power source has failed.

1K11 – AC ESS BUS CONT.

AC ESS BUS POWER SELECTOR

Seven position selector which provides means to select power source for the AC ESSENTIAL BUS.

AUTO – Selecting any of the three AUTO positions provides automatic switching to alternate power source if primary power to the AC ESSENTIAL BUS fails.

NORM B3(G1) – Normal position. No. 3 AC Load Bus provides primary power to the AC ESSENTIAL BUS. No. 1 generator provides automatic alternate.

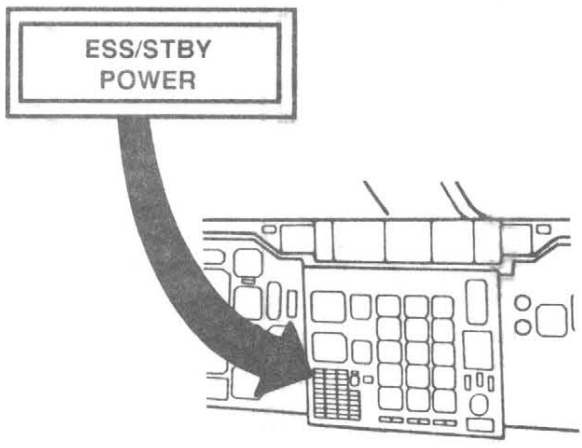
B3(G2) – No. 3 AC Load Bus is primary. No. 2 generator provides automatic alternate.

G1(G2) – No. 1 generator is primary. No. 2 generator provides automatic alternate.

MANUAL – Selecting any of the three MANUAL positions selects single power source for the AC ESSENTIAL BUS.

OFF – Power to the AC ESSENTIAL BUS is shutoff.

3E12, 13, 14 – ESS POWER GEN 1, 2 and Bus 3.



MASTER RADIO ESSENTIAL SWITCH

With the ESSENTIAL switch latched, power for the essential radio bus is supplied by the ESSENTIAL AC and DC BUS. However, if power is lost to the DC ESSENTIAL BUS, power for VHF COMM 1, the PA and FLT INT will automatically transfer to the battery.

With the ESSENTIAL switch unlatched. power to the essential radio bus is removed; **except**, if the BATTERY switch is **ON**. battery power will be supplied to the PA and FLT INT. Refer to the Communications/Radar section for power requirements of other radio equipment.

STANDBY POWER SWITCH

Manual control of AC and DC STBY BUS power is provided by a STANDBY POWER Switch mounted on the pilot's eyebrow panel. The normal position of this switch for flight is ARM. In ARM, with the BATTERY switch **ON**, power for the AC and/or DC STBY BUSES will automatically transfer to the battery if power is lost on the respective ESSENTIAL bus.

The **OFF** position of the switch prevents the AC STBY BUS from transferring to the battery. However, if DC ESSENTIAL BUS power is lost while the BATTERY switch is **ON**. the DC STBY BUS will still transfer to the battery.

The **ON** position of the switch manually transfers both the AC STBY BUS and DC STBY BUS to battery power regardless of the position of the BATTERY switch or status of AC or DC ESSENTIAL BUS power.

An UNARM light adjacent to the switch illuminates if the AC STBY BUS and/or the DC STBY BUS are not armed to transfer automatically (BATTERY switch **OFF** or Standby Power switch **OFF**).

MASTER RADIO ESSENTIAL SWITCH

Controls power to the essential communications busses.

LCH – Normal position for all flight operations.

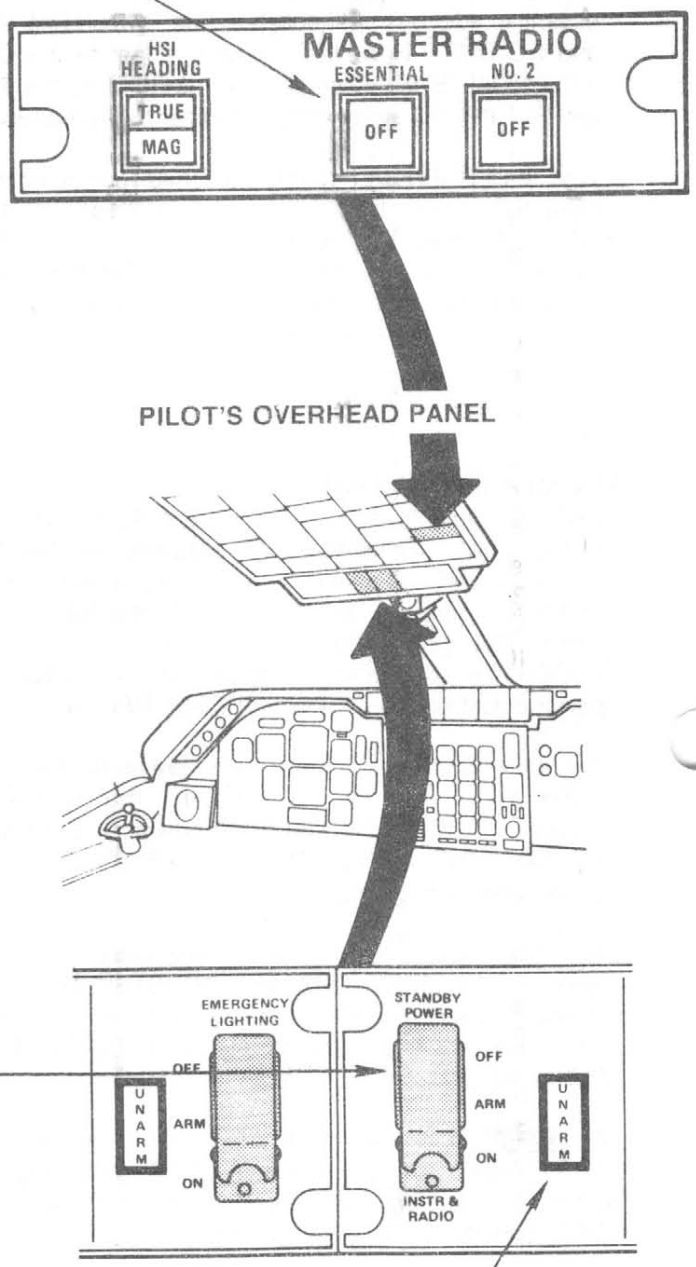
- Provides battery power to:
  - VHF COMM 1
  - P. A.
  - FLT INT
- Power source transfers to the essential buses, when powered, and also supplies:
  - HF COMM 1
  - ADF 1
  - MKR BCN
  - INSTR COMPARATOR
  - SELCAL
  - VOICE RCDR
  - DME 1
  - WX RADAR 1

UNL – Normal position when removing power from the aircraft.

- Removes essential communications power.
- OFF illuminates to indicate switch position.
- Positioning the BATTERY switch to **ON** overrides this position and supplies power to the P. A. and FLT INT.

1B10 – ESS MSTR RADIO CONT

1B11 – ESS MSTR RADIO PWR



STANDBY POWER SWITCH

Three position toggle switch.

OFF – Normal position when removing power from the aircraft.

- Isolates AC STBY BUS from battery power.

ARM – Normal flight position.

- Provides for automatic transfer of the AC STBY BUS to the battery powered inverter if AC ESS BUS fails.
- BATTERY switch must be **ON** for AC STBY BUS automatic transfer to occur.

ON – Manually transfers AC STBY BUS and DC STBY BUS to battery power regardless of BATTERY switch position.

1B12 – STANDBY DC CONT

UNARM LIGHT (Amber)

Illuminates if the DC STBY BUS is powered and:

- STANDBY POWER switch is **OFF** and the BATTERY switch is **ON**. or
- STANDBY POWER switch is not **ON** and the BATTERY switch is **OFF**.

1K13 – DC STBY IND

BATTERY POWER

The aircraft battery is a 28 volt nickel cadmium battery located on the floor of the mid avionics compartment. The battery powers the battery bus, APU control and starting, and can be used to power the DC STBY BUS and AC STBY BUS (through an inverter).

The battery is charged by a 38 volt 40 amp pulse charger, powered from the AC GND SERVICE BUS. To protect avionics equipment from high voltage surges, the battery charger is shutoff when the battery is powering the AC and or DC STBY BUSES.

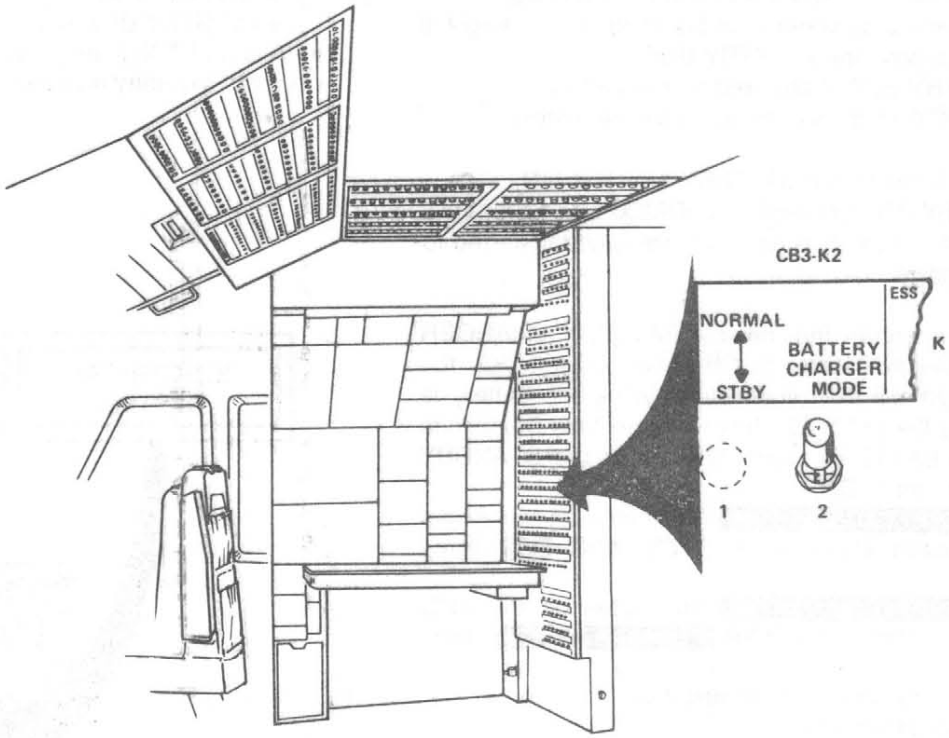
The -500 aircraft, ship 724, and ship 730 and subsequent, have a BATTERY CHARGER MODE switch installed in circuit breaker panel position 3K2. The lever-lock toggle switch is normally left in the NORMAL position. Selecting STBY reduces battery charger voltage to approximately 30 volts. This causes the battery charger to function as a T R so that it may continue to operate while the battery is powering the AC and or DC STBY BUSES.

The BATTERY switch is normally **ON** for all flight operations, and provides for automatic transfer of the DC STBY BUS to the battery if DC ESSENTIAL BUS fails.

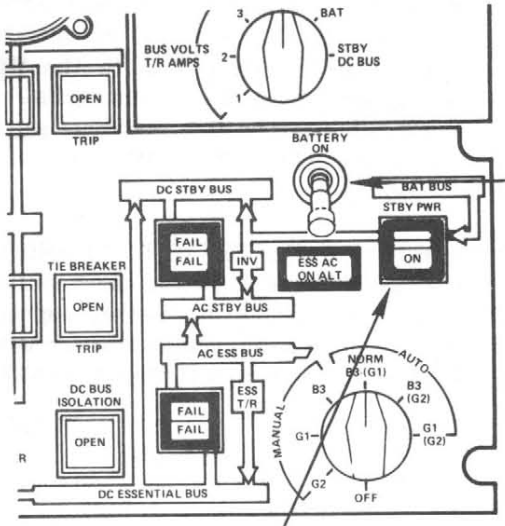
STANDBY POWER INDICATIONS

A combination FLOWBAR and ON light is installed to indicate standby bus power status. The **FLOWBAR** illuminates to indicate that the STANDBY POWER switch has been positioned to **ON** and the standby buses have transferred to battery power. The **ON** light illuminates to indicate that an auto-transfer of the AC STBY and or DC STBY BUS to battery power has occurred while the STANDBY POWER switch is in the ARMED position.

On aircraft which have the BATTERY CHARGER MODE switch installed in circuit breaker position 3K2. **ON** will also illuminate anytime the battery supplies power to the STBY bus for more than five seconds, regardless of the position of the STANDBY POWER switch.



BATTERY CHARGER MODE SWITCH



STBY PWR LIGHT

Indicates when AC or DC STBY BUS transfers to battery power.

FLOWBAR – Illuminates when the STANDBY POWER switch is **ON** to confirm the following:

- The battery-powered standby inverter is energized and powering the AC STBY BUS.
- DC STBY BUS is powered by the battery.
- ENG START BUS is powered by the battery.

ON – Illuminates if BATTERY switch is **ON**, STANDBY POWER switch is ARMED and either the AC or DC STBY BUS has automatically transferred to battery power.

On those aircraft that have a BATTERY CHARGER MODE switch installed in CB panel position 3K2, the **ON** light will also illuminate anytime the battery is powering the DC STBY bus for more than 5 seconds with the BATTERY switch **ON** and or the STANDBY POWER switch **ON**.

- **ELECTRICAL SYSTEM** illuminates on the Pilot's Annunciator Panel when STBY PWR **ON** illuminates.
- **BATTERY CONDITION** illuminates on the APU Panel if either STBY PWR **FLOWBAR** or **ON** illuminates.

1B12, 13 - STANDBY DC CONT AND PWR
1B15 - ENG START PWR
1K10 - AC STBY BUS SENSE
1K12 - ENG START BUS IND
1K13 - DC STBY IND

BATTERY SWITCH

Two position switch.

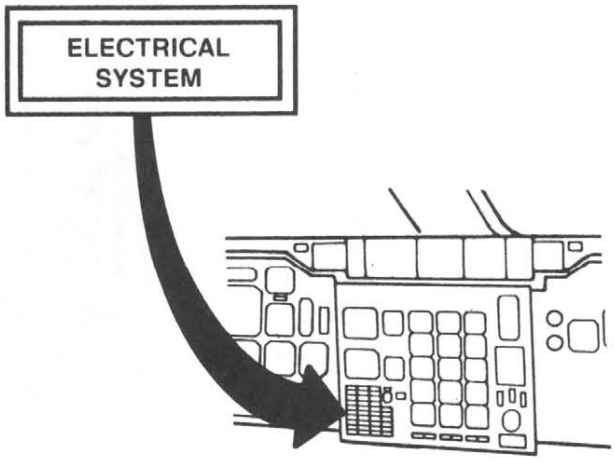
OFF – Normal position when removing all power from the aircraft, or when only the GND SERVICE BUS is powered.

- Battery is isolated from the AC and DC STBY buses.
- Power remains available to the BATT BUS.
- **OFF** position is overridden by:
  - Positioning the STANDBY POWER switch to **ON** (powers AC and DC STBY buses).
  - Latching the MASTER RADIO ESSENTIAL switch (powers ESSENTIAL COMM BUS).
  - Positioning the APU MASTER POWER switch to **ON** (power provided for APU control and start).

ON – Position for all normal flight operations.

- DC STBY BUS is normally powered by the DC ESSENTIAL BUS. If essential bus power is lost, the DC STBY BUS will transfer to the battery.
- PA and FLT INT are powered.

1B12, 13 - STANDBY DC CONT AND PWR



AC & DC CONTROLS AND INDICATORS

Indication of frequency and voltage of the AC power sources is provided by the FREQ and AC VOLT meters. While the generators are in parallel, these meters will indicate the resultant average frequency and volts. In order to read individual generator frequency and volts, the generator must be isolated.

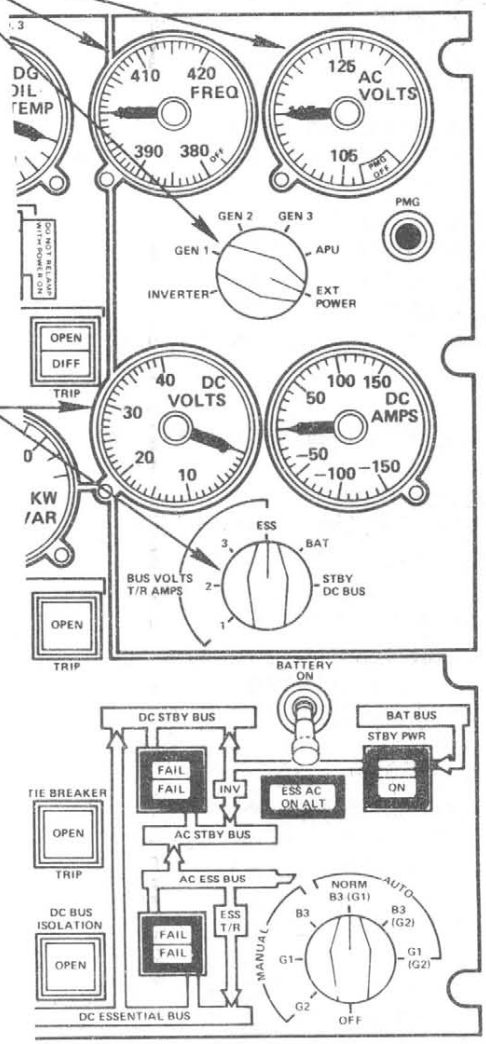
The Permanent Magnet Generator portion of the main generator will produce voltage anytime the generator is rotating.

Voltage and amperage of the DC buses and the battery are indicated on the DC VOLTS and DC AMPS meters. While the T/R's are in parallel, the DC VOLTS meter will indicate the resultant average voltage, but the DC AMPS meter will indicate actual T/R or BAT current flow. To read individual DC bus volts, the DC BUS ISOLATION Switch must be latched **OPEN**.

AC METERS AND SELECTOR

Displays the selected frequency and volts. Normal frequency is 400 + /–4 Hz. Normal volts 117 + /– 3.

- The INVERTER position will only indicate frequency and volts when the battery is powering the AC STBY BUS. Normal volts 115 + –3.
- The PMG TEST button will cause the AC VOLTS meter to indicate Permanent Magnet Generator volts as an indication of generator rotation. PMG volts may be read with the GENERATOR FIELD opened or closed. Normal PMG indication is 125V. Press PMG TEST while and IDG is being disconnected: an indication dropping to the PMG OFF range confirms IDG disconnect.



DC METERS & SELECTOR

Displays the selected DC volts and amps.

- Normal position of the selector is BAT. Normal battery voltage indication should be between 28–34. Minimum voltage is 22.
- Battery DC AMPS indications are to the positive (+) side for a battery discharge, and to the negative (–) side for a battery charge. When the battery charge is low, the battery charger will supply a steady charge to the battery of –40 amps. When the battery is fully charged, the AMPS indication will cycle between 0 and –40 amps.
- In the STBY DC BUS position, DC VOLTS will indicate DC STBY BUS voltage, but the DC AMPS will indicate '0' since there is no ammeter connection in this position.

BUS VOLTS – Should be equal as long as the DC tie breakers are closed. To read individual DC bus volts, the DC BUS ISOLATION switch must be latched **OPEN**.

T/R AMPS – Will indicate properly with the DC tie breakers open or closed. A '0' amp indication identifies an inoperative T R.

TABLE OF CIRCUIT BREAKERS

The following circuit breaker listing is arranged by associated system. Circuit breakers are listed in alphabetical order within each system. The alpha-numeric panel locator is listed following the circuit breaker name. For the -500 aircraft and -1 aircraft having certain panel differences the panel locator designator is given for all configurations by using **or** to indicate that more than one circuit breaker location exists.

AIRCRAFT GENERAL

ANN RESET 1L9
AURAL WARN 1L6, 7, 8
COCKPIT DOOR LATCH RLSE 2F9
EVAC SIGNAL 1B17
GND SVCE OUTLET DC 2J7
JET PUMP 2A4
LAV FLUSH PUMPS 2B3, 6, 9
LAV RAZOR OUTLET FWD 2A3 OR 2A1

REFR CONT 2C5
SEAT ACTR CAPT, F/O 2F10
SERVICE OUTLET DC 2K11
T/O AURAL WARNG 2H7
WATER HEATER FWD 2A7 OR 2A5, 6

AIR COND/PRESSURIZATION

AVIONICS AIR MON 2L5
CABIN PRESSURE CONT 3X9-12
CARGO TEMP 3W9, 10
COOL AIR OVBD 1J14
ECS AIR TEMP IND 3V1
FLOOR HEAT 3W11,12
HOT AIR MANF IND 3W5
HOT AIR MANF ISLN 3W7, 8
HOT AIR MANF TEMP CONT 3W6
INSTR COOLING 2A21, 2J1
MAN CABIN PRESS CONT 1H1, 2
OUTFLOW VALVES 3X14, 17
PACK AUTO/MAN 3V5-8,17,18
PACK FLOW CONT 1H3-5
PACK FLOW IND 3V2
TEMP CONT FLT STA 3V3, 4 OR 3V11, 12
TEMP CONT FWD CAB 3V9, 10 OR 3V3, 4
TEMP CONT MID CAB 3V11, 12 OR 3V9, 10
TEMP CONT AFT CAB 3V13, 14
TEMP CONT GALLEY 3V15, 16

APU

APU BAT PWR 3B10
APU BLEED AIR VALVE 3S18 OR 1H13
APU GEN CONT UNIT 3B17
APU T.R PWR 3B11
CONT & PRI FW SOV 3B15, 16
CONTROLLER BUS 2 2B13
CONTROLLER GND BUS 3B14
EJECTOR AND VENT VALVE 3S15
EMERG SHUTOFF 1D15
FIREWALL SHUTOFF 1D15
FIREWALL SHUTOFF PRI & SEC 3S7,8
FUEL SHUTOFF 1D13
IGNITION 3S11
INLET DOOR 3S9
POWER CONTROL 3S13
PRI SHUTOFF 1D14

AUTOFLIGHT

ALT ALERT NO. 1 1K27
ALT ALERT NO. 2 1J21
AFCS MODES IND 1B1, 19 OR 1B3, 19
AFCS WARNING 2K18, 19
AUTO THROT SERVO 1A1
PITCH & ROLL NO 1, 2 SYS 1A6, 24
SPEED CONT NO 1, 2 SYS 1A2, 20
TRIM AGMT 1A7, 8,25,26
YAW SAS NO 1,2 SYS 1A5, 23

COMMUNICATIONS/RADAR

AUDIO CONT 1A12, 13
AUDIO CONT CAPT & F/E 3C16
AUDIO CONT FLT INPH AMPL 3C16
AUDIO CONT F/O AND OBS 3C17
CABIN & GALLEY INTPH 2L7
ESS MASTER RADIO 1B10, 11
ESS RADIO BUS 3F6-9
FLT DATA RECDR 1J24, 1K26, 3G4, 5
FLY INTPH AMPL 1A14
GND SVCE INTPH 2L1
HF NO 1 & 2 1C1, 3, 19, 21
MASTER RADIO CONT 3F5
MASTER RADIO PWR 3F4
MECH CALL 2L2
MULTIPLEX SYSTEM 2D10, 11
NO. 2 RADIO BUS 3AA12-6
PA NO 1 & 2 1A15, 16
SELCAL 1C5, 24
VHF NO 1 1A11
VHF NO 2 2L4
VHF NO 3 1C23
VOICE RCDR 1D1
WEATHER RADAR 1D2, 3, 20, 21

TABLE OF CIRCUIT BREAKERS (CONT'D.)

ELECTRICAL

AC BUS IND 3G11
AUTO XFR DC 3G13
BAT CHG INTLK 2L6
BUS SENSING AC ESS 3F14
BUS 3 GALLEY PWR 3A16
ELECTRIC METER SWITCH 3G16
EMERG UNARM IND 1K14
ENG START BUS IND 1K12
ENG START PWR 1B15, 3F10
ESS BUS CONT AC 1K11
ESS BUS DC STBY PWR 3F1
ESS BUS DC TIE BUS CONT & PWR 3F2, 3
ESS POWER 3E12–14
FLT STA PWR BUS 1, 2, 3 3E9–11
FWD AC GND SERV 3Z11
GALLEY FEEDER 3Y5, 6, 11, 12, 17, 18
GEN CONTROL UNITS 1K15–17
GEN OVERLOAD PROJECT 3G14
GND SVCE GALLEY EXT 3A17
GND SVCE BUS FWD AC 3Z11
IDG DISC 3G15
IDG OIL LOW PRESS 3AA17
IDG OIL TEMP 3AA 18
LOAD CONT & FAIL IND BUS 1, 2, & 3 3D10, 13, 16
STBY BUS PWR AC 3F12
STBY BUS SENSE AC 1K10
STBY DC CONT PWR 1B12, 13
STBY IND DC 1K13
STBY INV VOLTAGE 1K18
TIE BUS CONT PWR 3A9–14
TR POWER 1, 2, 3, 3E16–18
TR POWER ESS 3F17

FIRE PROTECTION

APU ALARM LOOP A, B 1D16, 17
APU FIRE SHUTDOWN 1C18, 1J7 OR 1J6
APU SEC EMER SHUTOFF 1J7 OR 1J8
ENG OVHT LOOP ALARM 3L1–4, 7–10, 13–16
ENG TURB OVHT DET 3M1–3, 7–9, 13–15
FIRE DET TEST 1J5
FIRE EXTINGUISHERS 1C10–17
FIRE EXT LT 2F7
FIRE HORN 3S6
FIRE BELL POWER 1J6 OR 1K9
FWD CARGO FIRE EXT 1A17, 18
FWD CARGO SMOKE DET 1J8, 9
LOOP A & B ALARM ENG & APU 1K1–8

FIRE PROTECTION (CONT'D.)

MASTER ALARM PWR APU 1D18
MASTER ALARM PWR ENG 1, 2, 3 1J1–3
MASTER ALARM PWR WHL WELL APU 1J4
SMOKE DET 2J5, 6
WHEEL WELL FIRE LOOP A & B 3S1, 2

FLIGHT CONTROLS

ACS CHANNEL 1 3Y9, 10
ACS CHANNEL 2 3Y15, 16
ACS MEMORY 1B16
ACS RSU AC 3Y4
AFT COUPLES 1B9, 27
AILERON SERVOS 2J19–22
ASYM BRAKE LE SLAT NO 1 2H22
ASYM BRAKE SLAT FLAP NO 2 1J10, 11
ASYM BRAKE TE FLAP NO 1 2H21
DLC SERVOS 2H14, 15
FCES COMPUTERS & AOA 1B4, 5
FLAP LOAD RELIEF 2H12, 13, 20
LE SLAT EXTEND LIGHT 3K18
LE SLAT POSITION IND 3K17
LOCK LIGHT SLAT FLAP 1J12, 13
RT AOA 2F1
RUDDER FUSING 2L16
RUDDER HYDR LMTR 2H12,20
RUDDER MECH LMTR 2K15, 16
RUDDER SERVOS 2K12–14
SPOILER 1, 2, 3, LIMITER 2J14
SPOILER DWELL DC & AC 1B7, 8
SPOILER SERVOS 2J15–18
STABILIZER SERVOS 2H16–19
STICK SHAKER 1B6, 2F2
TE FLAP POSN IND 3K16
TRIM AGMT 1A7, 8, 25, 26

FLIGHT INSTRUMENTS

ADI CAPT 1F2
ADI F/O 1F23
ADICAPT ALT 1F23
ADI F O ALT 1F23
ADI F O ALT 1E5
ALT SOURCE SEL CAPT INSTR 1E1
ALT SOURCE SEL F O INSTR 1E2
ALTM CAPT 1F4
ALTM F O 1F22
ALTN ADI 1E19

(CONT'D.)

TABLE OF CIRCUIT BREAKERS (CONT'D.)

FLIGHT INSTRUMENTS (CONT'D.)

ELECT CLOCK SYS 1B18
GPWS 1B1, 2 OR 1C8, 9
HSI CAPT 1F3
HSI F/O 1F21
IAS/MACH CAPT 1F1
IAS/MACH F/O 1F19
INS VERT GYRO 1G24
INS 3/GYRO 3 1E24
INSTR CMPRN MON PWR 1D8, 26
INSTR XFMR NO 1 1F5
INSTR XFMR NO 2 & 3 1D9, 27
SAT/TAS 1F27
STBY ALTM 1E9
STBY HRZN IND 1F6
STBY HRZN IND LT 1F7, 1J27
TOTAL TEMP 3R12
VERT SP IND 1E4, 21

FUEL

BOOST PUMPS 3U5-10, 13-15 OR 3U 3, 4, 7-10, 13-15
EMER & L X FEED ENG 1 3T7
EMER & R X FEED ENG 3 3T13
ENG 2 PRI EMER 3R18
ENG 2 SEC EMER C X FEED 3T10
FUEL SHUTOFF VALVES 1D10-15
FUEL TEMP 3R13
FUEL QTY IND 3T2-5
FUEL QTY IND TEST 3T1
GRAVITY FEED VALVE 1H14, 15
JTSN ARM 3U18
JTSN & DEFUEL 3U2 OR 3, 3U11, 12
PUMP IND INBD 3U1 OR 3U2
SCAVENGE VALVE 1-1A & 3-3A 3U5, 6
SCAVENGE VALVE 1A & 3A 3U16
TANK VALVES 3T6, 9 12
TRANSFER VALVE 1A & 3A 3U5, 6

HYDRAULICS

AC HYD MOTOR IND 2L10
AC PUMPS 2L12, 22
ATM PUMP CONT IND 2L13, 19
DELTA P & RSVR TEMP IND 2L9
PRESS IND 2M13
PTU CONT & IND 2L14, 15
PUMP & FIREWALL SHUTOFF VALVE CONT 1L15-18
QTY INDICATORS 2M12
QTY TEMP PRESS IND LT 2M14-21
RAT AUTO DEPLOY 1L3
RAT IND LT 3G10
RAT MAN DEPLOY 1B14
RUDDER FUSING 2L16

ICE AND RAIN

AIR DATA HEAT SENSE 3H5
ALPHA HEAT 2E12, 22
ENG ANTI-ICE 2D15, 19, 20
DRAIN MAST HEATER 2E13-15
ICE SENSOR 2D12, 13
PITOT HEAT CAPT PRIMARY 3H14
PITOT HEAT 2E16-18
RAIN REPELLENT 1L1, 2
TOTAL TEMP 2E19, 20
WINDOW HEAT LT SIDE 2B12, 20
WINDOW HEAT RT SIDE 2B20, 21
WINDSHIELD DEFOG & F O WIPER PWR 2C12-14
WINDSHIELD HEAT LEFT 2B15, 16
WINDSHIELD HEAT RIGHT 2B18, 19
WINDSHIELD WASHER 2C19, 21
WINDSHIELD WIPER CAPT 3H15, 17
WING ANTI-ICE CONT 2D22
WIPER CONT F O 2C15

LANDING GEAR

ALT GEAR CONT 1L14
BRAKE ANTI SKID 2F22, 2G 17
BRAKE PRESS IND 2G21
DOOR POS IND 1L13
GEAR CONT 2F17, 18
MLG GND SENSE 2L8
NOSE STEERING 2F19
PARKING BRAKE 2G18, 22
PROX SW PWR 1L10, 11, 3H2, 3, 4
TAILSKID 2F12, 13
TRUCK LEVEL 2F16
WARN HORN 1L12

TABLE OF CIRCUIT BREAKERS (CONT'D.)

LIGHTS

5VAC INSTR LIGHTS 1L20-26
ANTI COLLISION 3J15-18
AISLE LIGHTS 1L5, 2A10, 11
CAPT & F/O FLOOD 3J5
CAPT INSTR 3J12
CIRCUIT PANEL 2E11, 3BB9, 10
CLOSET & LAV LT FWD 2K7
CONSOLE 2M1-4
CTR CONSOLE FLOOD 3J4
CTR CONSOLE PANEL 2E10
CTR & GLARESHIELD 3J313
DOOR WARN LT 3H2
ECS IND LT 3G12
EMER LT CHARGE 3J6-10
EYE LCT & APRCH 1L19, 2E1
EYEBROW 2M11
FLOODLIGHT 3J1
FLT CONT ALT ALERT IND LT 3G9
FLT KIT FLOOD LTS 2E7
FWD SERVICE CTR 2K9
FE INSTR 2E9
FE PANEL IND LT 2J3, 4
FE PANEL 2E2
F/O INSTR 2E5
FWD LAV LT 2K11
GALLEY & LAV 1L4
GLARESHIELD 2M6
EPR IND 2H6
HOST ADVSY IND 2C8
IND LT TEST FE 2H1-5
IND LT TEST PILOTS 2H8-10
INSTR PNL FLOOD 1F9
INSTR PNL FE 3BB11-14, 3CC9-18
INSTR LIGHTING 1L20-26
LANDING WING 2G9, 10
NO SMOKING SIGNS 2C10
NOSE GEAR LIGHT 2G6-8
ORD LT 2C11
OVERHEAD 2M7-10
OVHD & EYEBROW PNL 2E3
OVVHD FLOOD FLT STA 2K10
PFCS ADS DH IND LT 3G8
PILOTS IND LT 2J2
REFUEL FLOOD 2L11
RUNWAY TURNOFF 2G4, 11 OR 2J8-11
SEAT SIGNS 2C9
SIDE CONSOLE FLOOD 2E8

LIGHTS (CONT'D.)

STANDBY COMPASS 1F8
STANDBY HORIZON 1J27
STANDBY LIGHT RELAY 3J11
STROBE LT CONT 2F4
THROT STAND 2M5
THUNDERSTROM LT 3J2
UTILITY LT CREW 3J3
WHEEL WELL LT 2K1,2
WING FLOOD 2G3
WING FLOOD CONT 2F3
WING POSITION 2K3-6

NAVIGATION

ADF 1D6, 24
AIR DATA COMPUTER 1G8, 27
ATC 1G3, 21
ELECTRIC CLOCK SYS 1B18
COMPASS COUPLER 1G7, 26
COMPASS COUPLER NO 1 1K19, 24
COMPASS COUPLER NO 2 1J19
DME 1D5, 23
DR GYRO 1G5, 23
FLT MGT 1E8, 26
ILS 1G4, 22
INS ALTN 2 1J26, 27
INS CONT & FAN 2C19, 21
INS COOLING FAN 3H6, 8
INS DC 1E5, 22
INS HEATER 1G25, 1E6, 25, OR 1H22, 25
INS POWER 1E7
INS 1 1K20
INS 2 1K22, 1G25
INS VERT GYRO 1G24
INS VERT GYRO 31E24
INS 3 PRI 1H21
INS ALT PRI 1H24
INS DC 1E5, 22
OMEGA NAV 1G9, 1E8
MARKER BEACON 1D7
RADIO ALTM 1D4, 22
RDDMI CAPT 1E20
RDDMI F O 1E3
RDDMI 1 1K25
RDDMI 2 1J2O
VHF DC PREAMP 1G2, 20
VHF DC VOR RCVR 1G1, 19
VG INS 1 1G6
VG INS 2 1G24
VOR 1 1K21
VOR 2 1J22

TABLE OF CIRCUIT BREAKERS (CONT'D.)

OXYGEN

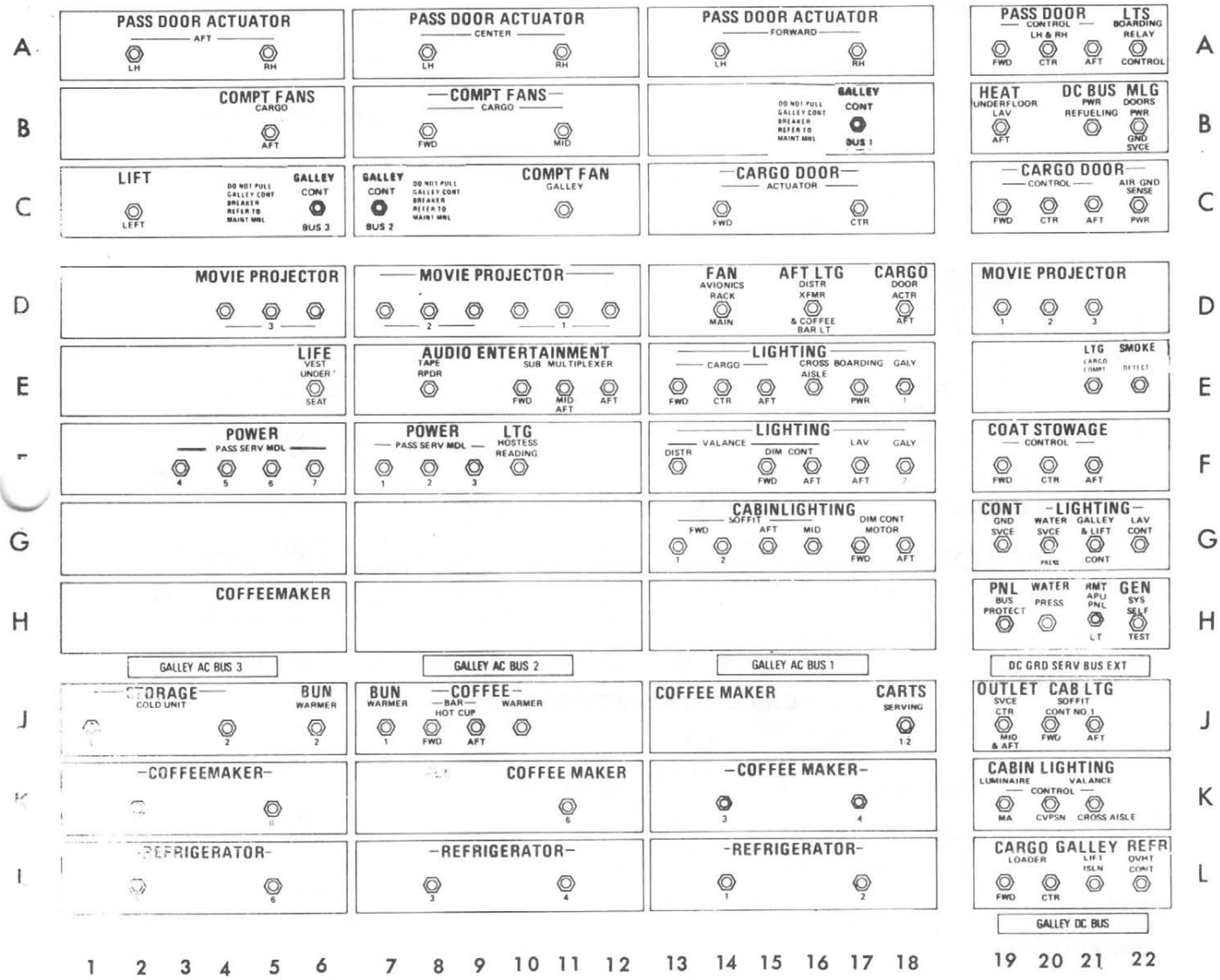
OXYGEN PASSENGER 1J15–18

PNEUMATICS

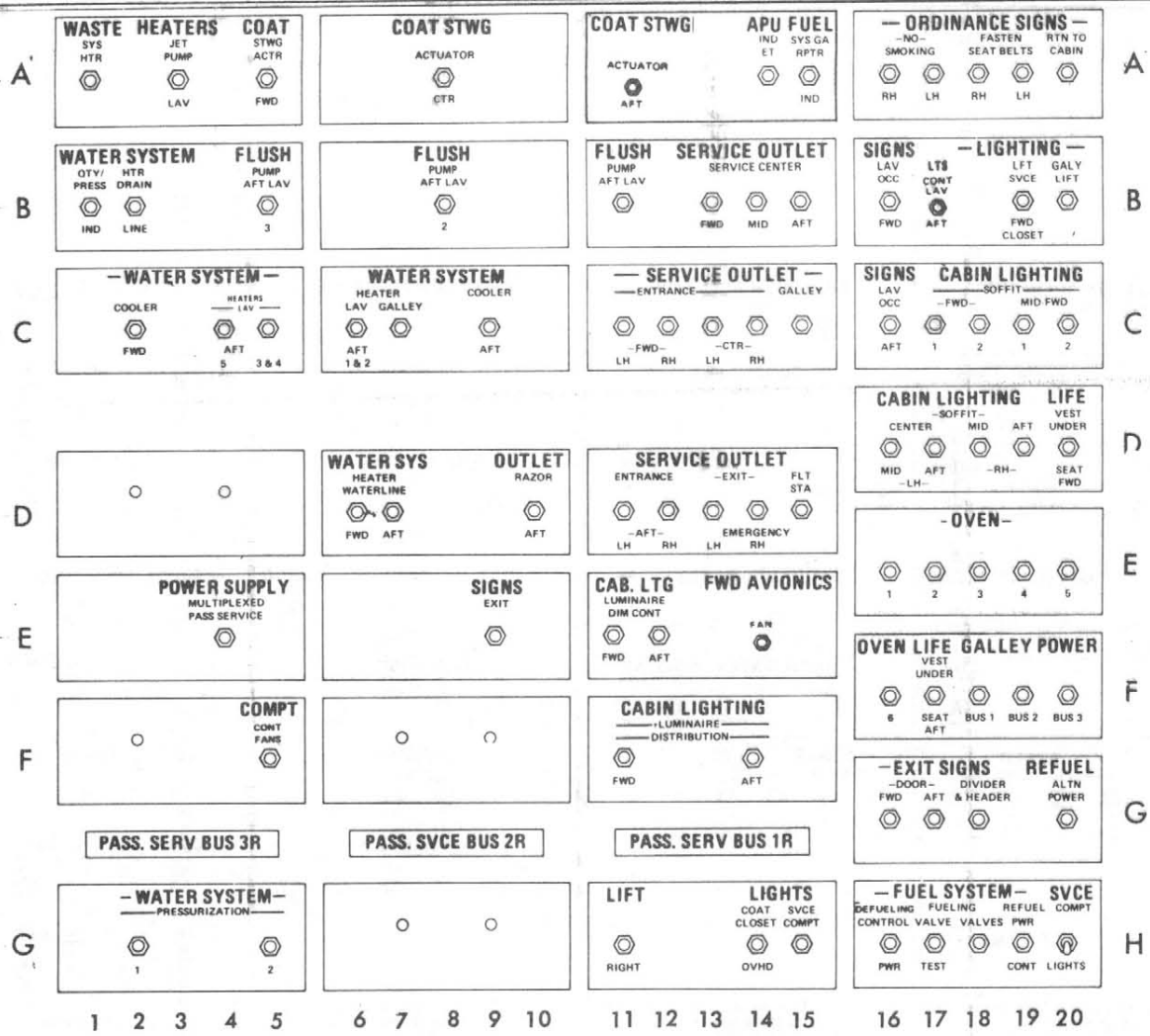
BLEED AIR IND 3R17
CROSS BLEED VALVES 1G17, 18
DUCT AREA OVHT DET 3W13, 14
ENG ISLN VALVES 1G10–12
FUS ISLN VALVE 1G16
HI FLOW CONT 1H6
HI PRESS VALVES 1G13–15
ECS SCHED ENG 1,3 1C8, 9 or 1H8, 9

POWERPLANT

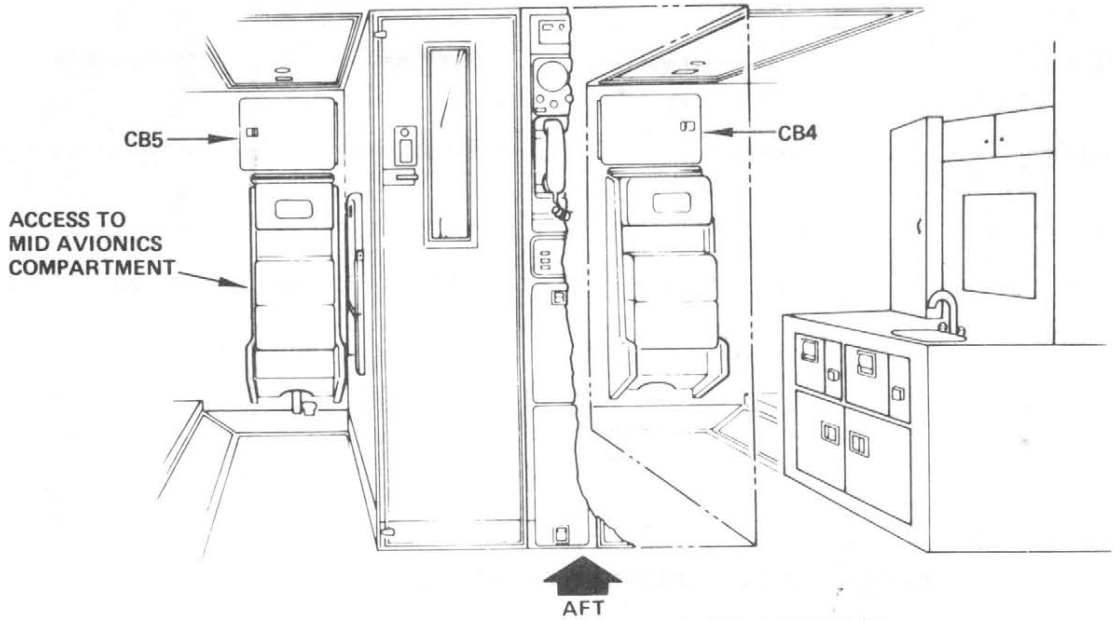
ALL ENG CONT IGN SEL 3L18
B START IGN 1F13–15
CONT IGN 3R8, 9
ENG INSTR RESET 3R15
ENG START PWR 1B15, 3F10
ENG OUT IND 3R7
ENG VIB 3R2, 3
EPR IND 2H6, 3L5, 11, 17
FUEL CONT AMP 3P6, 12, 18
FUEL FLOW 3P5, 11, 17
FUEL LOW PRESS 3P4, 10, 16
FUEL SHUTOFF 1F16–18
FUEL FLOW RGLTR 1E16–18
GND IDLE 3N2, 8, 14
HP 3 BLEED AIR 1E16–18
OIL LO PRESS LT 3N5, 11, 17
OIL PRESS 3R10
OIL QTY 3R14
OIL TEMP 3P1, 7, 13
REV IND 3N4, 10, 16
START AIR VALVE 3N3, 9, 15
START CONT 1E13–15
START IGN SYS A 3N6, 12, 18
TACH N1 3P2, 8, 14
TACH N2 3P3, 9, 15
TACH N3 1E10–12
TAT EPR 3R12
TGT 1F10–12
TGT WARN 3R11
THRUST REVERSE 1H16–18



GALLEY CIRCUIT BREAKER PANEL - NO. 4

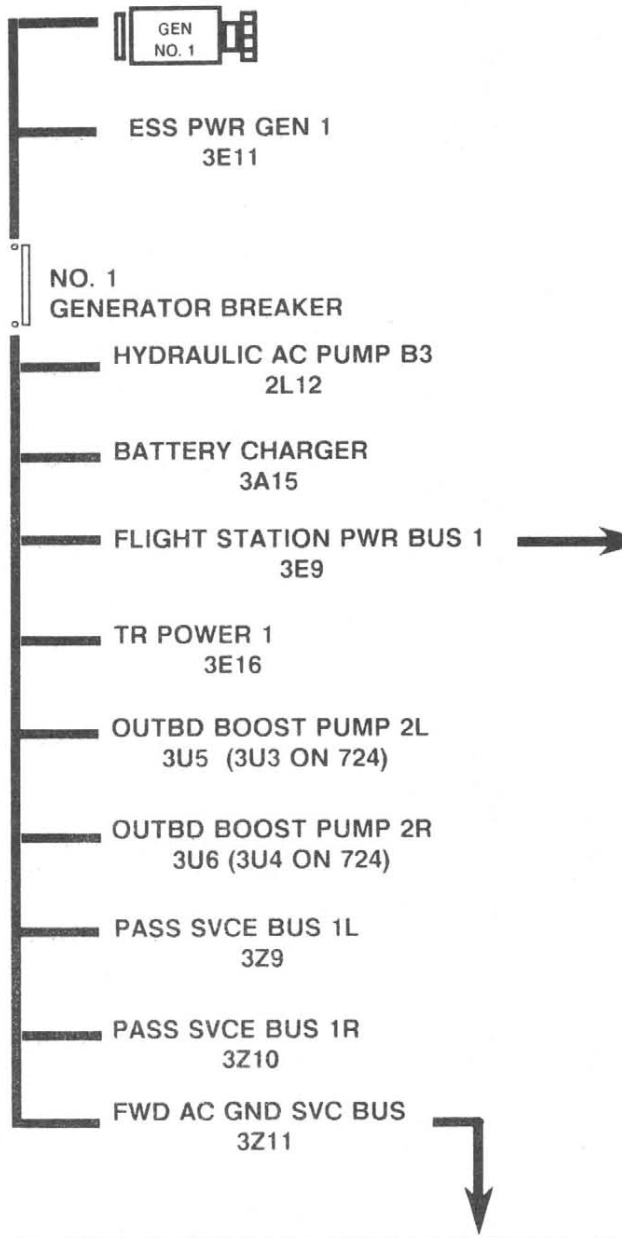


GALLEY CIRCUIT BREAKER PANEL - NO. 5



GALLEY CIRCUIT BREAKER PANEL LOCATION
(OPPOSITE SIDE BLANK)

AC BUS NO. 1 AND GROUND SERVICE BUS



2K2	WHEELWELL LT PWR
2K3	WING POSITION LIGHTS FWD NO. 1
2K4	WING POSITION LIGHTS FWD NO. 2
2K5	WING POSITION LIGHTS AFT L
2K6	WING POSITION LIGHTS AFT R
2K7	FWD CLOSET AND LAV LT
2K9	FWD SERVICE CTR LT
2K10	OVHD FLOOD FLT STA LT
3T2	FUEL QTY IND 1
3T3	FUEL QTY IND 2L
3T4	FUEL QTY IND 2R
3T5	FUEL QTY IND 3

FLIGHT STA. BUS. NO.1

1E24	INS-3/GYRO 3
1E25	INS- 3 HTR
1L19	EYE LCT AND APPROACH CHART LIGHTING
1L20	CAPT L INSTRUMENT LIGHTING
1L21	CAPT R INSTRUMENT LIGHTING
1L22	CTR L INSTRUMENT LIGHTING
1L23	CTR R INSTRUMENT LIGHTING
2A3	FWD LAV RAZOR OUTLET
2B.3	FWD LAV FLUSH PUMP NO. 1
2B12	LEFT WINDOW HEAT SIDE WINDOWS FWD PWR
2B13	LEFT WINDOW HEAT SIDE WINDOWS AFT PWR
2C13,14, 15	WINDSHIELD DEFOG AND F/O WIPER PWR
2D12	ICE SENSOR AC
2E1	EYE LCT AND APPROACH CHART LIGHTS
2E2	FE PANEL LIGHTS
2E3	OVHD AND EYEBROW PNL LIGHTS
2E12	LEFT ALPHA HEAT
2E14,15	DRAINMAST HEATER AFT, MID
2E16	PITOT HEAT F/O SEC
2F1	R AQA
2H12	FLAP LOAR RELIEF CHAN-1
2M6	GLARESHIELD PANEL LIGHTING
2M7	OVERHEAD L PANEL LIGHTING
2M8	OVERHEAD L CTR PANEL LIGHTING
2M9	OVERHEAD R CTR PANEL LIGHTING
2M10	EYEBROW PANEL LIGHTING
2M12	HYDRAULIC QTY INDICATORS
2M13	HYDRAULIC PRESS INDICATORS
3D10	LOAD CONT AND FAIL IND BUS 1
3N6	START IGN SYS A, ENG NO. 1
3P1	OIL TEMP, ENG. NO. 1
3P2	TACH N1 ENG NO. 1
3P3	TACH N2 ENG NO. 1
3P5	FUEL FLOW, ENG. NO. 1
3P6	FUEL CONT AMPL, ENG NO. 1
3R2	ENG VIB ALL ENGINES
3V1	ECS- AIR TEMP IND
3V4	TEMP CONT FLT STA AC
3V6	PACK 1 AUTO MAN AC
3CC-9	FE PANEL LIGHTS, UPPER NO. 1
3CC-10	FE PANEL LIGHTS, UPPER NO. 2A
3CC-11	FE PANEL LIGHTS, UPPER NO. 2B
3CC-12	FE PANEL LIGHTS, UPPER NO. 3
3CC-13	FE PANEL LIGHTS, LOWER NO. 1A
3CC-14	FE PANEL LIGHTS, LOWER NO. 1B
3CC-15	FE PANEL LIGHTS, LOWER NO. 1C
3CC-16	FE PANEL LIGHTS, LOWER NO. 1D
3CC-17	FE PANEL LIGHTS, LOWER NO. 2
3CC-18	FE PANEL LIGHTS, LOWER NO. 3

AC BUS NO. 2 AND RADIO BUS NO. 2

GEN NO. 2

ESS PWR GEN 2
3E13

NO. 2
GENERATOR BREAKER

WINDSHIELD LEFT HEAT PWR
2B16

FLIGHT STATION PWR BUS 2
3E10

TR POWER 2
3E17

INBD BOOST PUMP TANK 1
3U7

INBD BOOST PUMP TANK 2L
3U8

INBD BOOST PUMP TANK 2R
3U9

INBD BOOST PUMP TANK 3
3U10

PASS SVCE BUS 2
3Z15

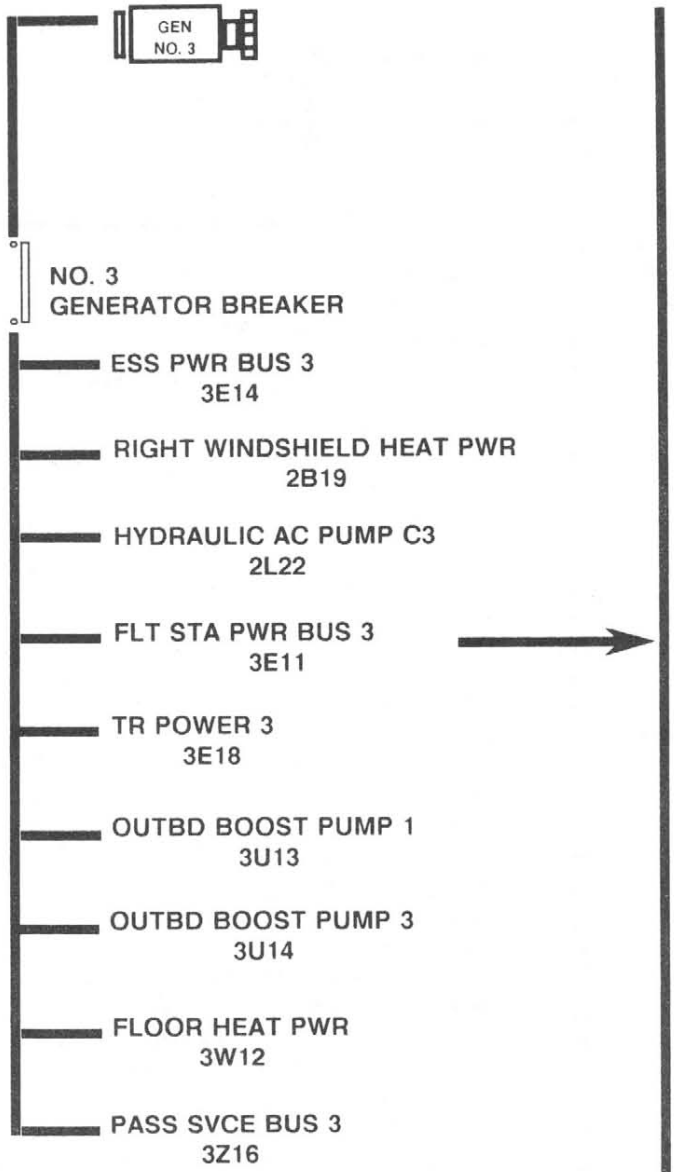
3AA14,15,16 – NO. 2 RADIO BUS

1C21	HF AC NO.2
1D20	WEATHER RADAR IND NO.2
1D21	WEATHER RADAR RT NO.2
1D22	RADIO ALTM NO.2
1D23	DME NO.2
1D26	INSTR CMPRN MONITOR
1G21	ATC NO.2

FLIGHT STA. BUS. NO.2

1D27	INSTR XFMR NO.3 NO.2 NAVIGATION
1A20	SPEED CONTROL NO.2
1A23	YAW SAS NO.2
1A24	PITCH AND ROLL NO.2
1A25	TRIM AGMT AC NO.2
1E19	ALTN ADI NO.2
1E20	CAPT RDDMI–2
1E21	VERT SP IND NO.2
1E26	AREA NAV NO.2
1F19	IAS MACH F O NO.2
1F20	IDA NO. 2F O
1F21	HSI NO. 2F O
1F22	ALTM NO. 2F O
1F26	MAP DISPLAY NO.2
1F27	SAT TAS NO.2
1G22	ILS NO.2
1G23	DIR GYRO NO.2
1G24	INS/VERT GYRO NO.2
1G25	INS HEATER NO.2
1G26	CMPS CPLR NO.2
1G27	AIR DATA CMPTR NO.2
1J19	CMPS CPLR–2
1J20	RDDMI–2
1J21	ALT ALERT–2
1J22	VOR–2
1J23	SURF POSN IND
1J24	FLT DATA CRDR
1J27	VAC STBY HORIZ LT
1L24	F O L INSTRUMENT LIGHTING
1L25	F O R INSTRUMENT LIGHTING
2A7	WATER HEATER FWD
2B6	FWD LAV FLUSH PUMP NO.2
2E5	INSTR LIGHTS F O
2E17	PITOT HEAT F O PRIM
2E18	PITOT HEAT CAPT SEC
2E19	TOTAL TEMP L
2G3	WING FLOOD LIGHTS
2G4	RUNWAY TURNOFF LH LIGHTS
2G5	STROBE LIGHTS
2G7	NOSE GEAR LT LAND
2G8	NOSE GEAR LT TAXI
2G9	WING LANDING LIGHT LH
3D13	LOAD CONT AND FAIL IND BUS 2
3N12	START IGN SYS A, ENG NO.2
3P7	OIL TEMP ENG NO.2
3P8	TACH N1 ENG 2
3P9	TACH N2 ENG 2
3P11	FUEL FLOW, ENG NO.2
3P12	FUEL CONT AMPL, ENG NO.2
3R7	ENG OUT IND ALL ENGINES
3R8	CONT ING SYS A, ALL ENGINES
3R9	CONT ING SYS B, ALL ENGINES
3R10	OIL PRESS, ALL ENGINES
3R12	TAT ALL ENGINES
3V8	PACK 2 AUTO MAN AC
3V10	FWD CABIN AC TEMP CONT

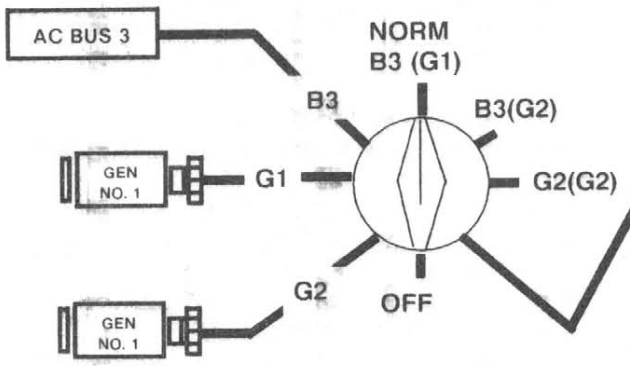
AC BUS NO. 3



FLIGHT STA. BUS. NO.3

2A21	INSTR COOLING
2B9	FWD LAV SLUCH PUMP NO.3
2B21	RT SIDE WINDOW HEAT FWD PWR
2B22	RT SIDE WINDOW HEAT AFT PWR
2C9	SEAT SIGNS
2C10	NO SMOKING SIGNS
2C21	INS FAN WINDSHIELD WASHER PUMP
2E9	FE INSTR LTS
2E10	CTR CONSOLE PNL LTS
2E11	CKT BRKR PNL LTS
2E20	TOTAL TEMP R ANTI-ICE
2E22	RIGHT ALPHA HEAT ANTI-ICE
2F10	SEAT ACTR CAPT AND F/O
2F19	NOSE STEERING
2F22	BRAKE ANTI-SKID
2G10	WING LANDING RH LTS
2G11	RUNWAY TURNOFF RH LTS
2G21	BRAKE PRESS IND
2H20	FLAP LOAD RELIEF CHAN 2
2M1	FWD CONSOLE PANEL LIGHTING
2M2	FWD CONSOLE R PANEL LIGHTING
2M3	AFT CONSOLE L PANEL LIGHTING
2M4	AFT CONSOLE R PANEL LIGHTING
2M5	THROT STAND PANEL LIGHTING
1L26	CB1 PANEL LIGHTING
3D16	LOAD CONT AND FAIL IND BUS 3
3N18	START ING SYS A, ENG NO. 3
3P13	OIL TEMP ENG 3
3P14	N1 TACH ENG NO. 3
3P15	N2 TACH ENG NO. 3
3P17	FUEL FLOW, ENG. NO. 3
3P18	FUEL CONT AMPL, ENG NO. 3
3R13	FUEL TEMP, ALL ENGINES
3R14	OIL QTY, ALL ENGINES
3V12	MID CABIN AC TEMP CONT
3V14	AFT CABIN TEMP CONT AC
3V16	GALLY TEMP CONT AC
3V18	PACK 3 AUTO/MAN AC
3W14	DUCT AREA OVHT DET AC
3X10	CABIN PRESSURE CONT PWR AUTO
3X12	CABIN PRESSURE CONT STBY PWR
3X14	OUTFLOW VALVE FWD
3X17	OUTFLOW VALVE AFT
3BB9	FE CB PANEL LTS CB2
3BB10	FE CB PANEL LTS CB3
3BB11	FE INSTRUMENT PANEL UPPER LEFT
3BB12	FE INSTRUMENT PANEL UPPER RIGHT
3BB13	FE INSTRUMENT PANEL LOWER LEFT

ESSENTIAL AC BUS AND ESSENTIAL AC RADIO BUS



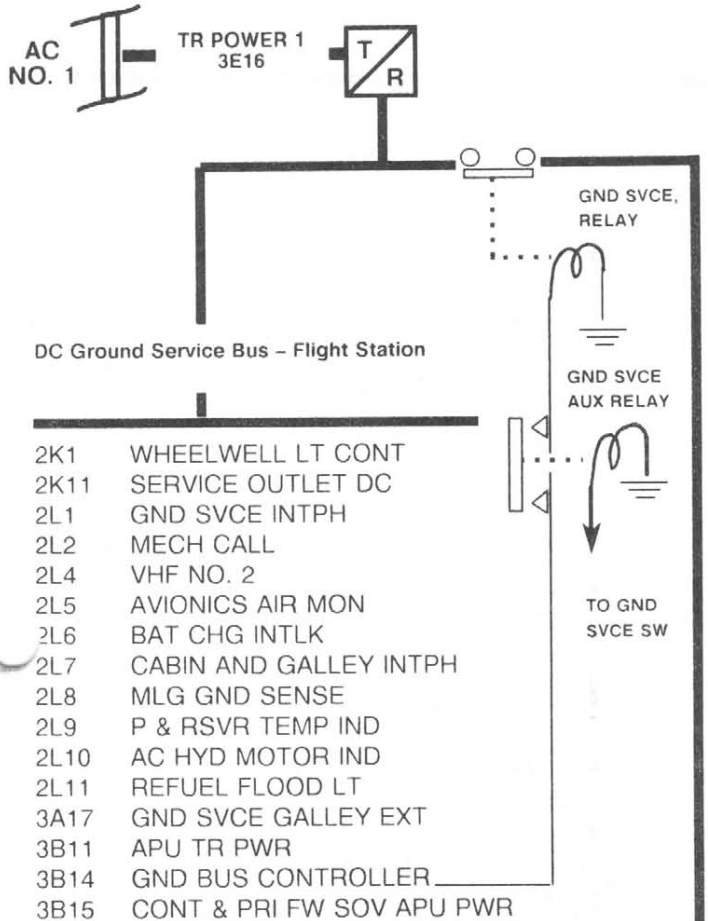
1A1 AUTO THROT SERVO
1A5 YAW SAS NO. 1
1A6 PITCH AND ROLL NO. 1
1A7 TRIM AGMT AC NO. 1
1B5 FCES COMPUTER AC AND L AOA
1B8 SPOILER DWELL AC
1E3 F O RDDMI NO. 1
1E4 VERT SP IND NO. 1
1E6 INS PWR NO. 1
1E7 INS HTR NO. 1
1E8 AREA NAV NO. 1
1D9 INSTR XFMR NO. 2
1K24 CMPS CPLR-1
1K24 RDDM-1
1K26 FLT DATA RCDR
1K27 ALT ALERT-1

3F7,8,9 – ESS RADIO BUS

1C3 HF NO. 1 AC
1D1 VOICE RCDR
1D2 WEATHER RADAR IND NO. 1
1D3 WEATHER RADAR RT NO. 1
1D4 RADIO ALTM NO. 1
1D5 DME NO. 1

3F12 AC STBY BUS PWR
3F14 BUS SENSING AC ESS
3F17 ESS POWER
3G5 FLIGHT RECORDER AC
3H14 CAPT PRI PITOT HEAR
3H17 CAPT WSHLD WIPER POWER
3J1 F E FLOOD LT
3J5 CAPT AND F O FLOOD LT
3J7 EMER LTS CHARGE, LEFT FWD
3J8 EMER LTS CHARGE, LEFT AFT
3J9 EMER LTS CHARGE, RIGHT FWD
3J10 EMER LTS CHARGE, RIGHT AFT
3J12 CAPT INSTR LIGHTS
3J13 CTR INSTR & GLARESHIELD LIGHTS
3J15 ANTI-COLL EXT LT, LOWER LH
3J16 ANTI-COLL EXT LT, LOWER RH
3J17 ANTI-COLL EXT LT, UPPER FWD
3J18 ANTI-COLL EXT LT, UPPER AFT
3K16 TE FLAP POS IND
3K17 LE SLAT POS IND
3L2 OVHT LOOP A PWR ENG NO. 1
3L4 OVHT LOOP B PWR ENG NO. 1
3L5 EPR IND ENG NO. 1
3L8 OVHT LOOP A PWR ENG NO. 2
3L10 OVHT LOOP B PWR ENG NO. 2
3L11 EPR IND ENG NO. 2
3L14 OVHT LOOP A PWR ENG NO. 3
3L16 OVHT LOOP B PWR ENG 3
3L17 EPR IND ENG NO. 3

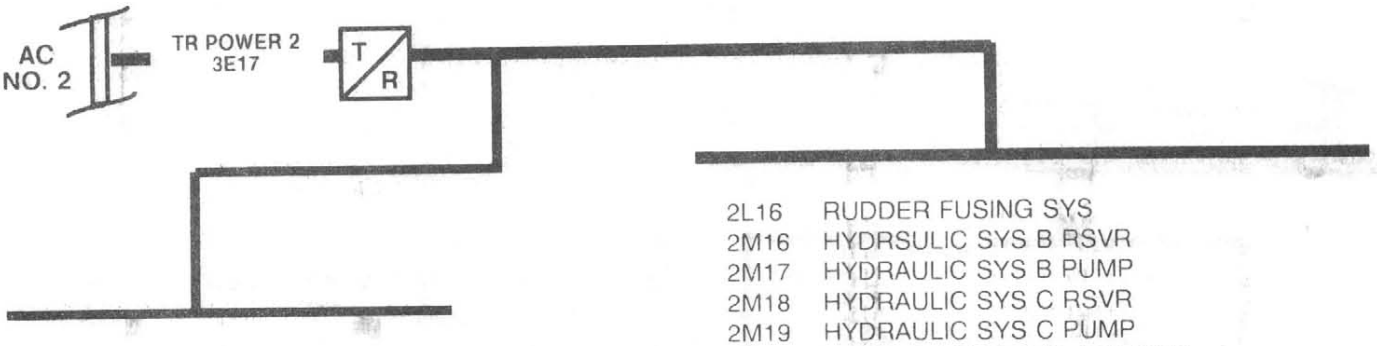
DC BUS NO. 1 AND GROUND SERVICE BUS



2K1 WHEELWELL LT CONT
2K11 SERVICE OUTLET DC
2L1 GND SVCE INTPH
2L2 MECH CALL
2L4 VHF NO. 2
2L5 AVIONICS AIR MON
2L6 BAT CHG INTLK
2L7 CABIN AND GALLEY INTPH
2L8 MLG GND SENSE
2L9 P & RSVR TEMP IND
2L10 AC HYD MOTOR IND
2L11 REFUEL FLOOD LT
3A17 GND SVCE GALLEY EXT
3B11 APU TR PWR
3B14 GND BUS CONTROLLER
3B15 CONT & PRI FW SOV APU PWR
3B17 APU GEN CONT UNIT
3C16 AUDIO CONT CAPT & F/E
3C17 AUDIO CONT F/O & OBS
3C18 FLT INTPH AMPL
3T1 FUEL QTY IND TEST

2B14 SIDE WINDOW L AFT HEAT CONT
2C15 F/O WIPER CONT
2D13 ICE SENSOR DC
2D15 ENG 1 ANTI-ICE
2E13 DRAINMAST HEATER CONT
2F2 STICK SHAKER
2F12 TAIL SKIN CONT
2F13 TAIL SKID IND
2H1 FE IND LIGHT TEST 1
2H2 FE IND LIGHT TEST 2
2H3 FE IND LIGHT TEST 3
2H3 FE IND LIGHT TEST 4
2H5 FE IND LIGHT TEST 5
2H13 FLAP LOAD RELIEF IND
2H14 DLC SERVO A
2H15 DLC SERVO B
2J2 PILOTS' IND LT
2J3 IND LT FE PANEL UPPER
2K12 RUDDER SERVO A
2K13 RUDDER SERVO B 2K13
2K14 RUDDER SERVO C
2L13 HYDRAULIC ATM PUMP CONT & IND SYS B
2L14 HYDRAULIC PTU CONT & IND SYS B-A
2M14 HYDRAULIC SYS A RSVR
2M15 HYDRAULIC SYS A PUMP
3A11 TIE BUS CONT BUS
3A12 TIE BUS PWR BUS 1
3N1 ACCESS VENT VALVE ENG 2
3N2 GND IDLE ENG NO. 1
3N3 START AIR VALVE ENG NO. 1
3N4 REV IND, ENG NO. 1
3N5 OIL LOW PRESS LIGHT , ENG NO. 1
3P4 FUEL LOW PRESS, ENG NO. 1
3R3 ENG VIB ALL ENGINES LT
3S1 WHEELWELL FIRE DETECTOR LOOP A
3S2 WHEELWELL FIRE DETECTOR LOOP B
3T1 FUEL QTY IND TEST
3T6 TANK VALVE, ENG 1
3T7 EMER AND L X-FEED ENG 1
3U2 INBD PUMP IND
3U3 JTSN & DEFUEL 2L AND 2R
3V2 PACK FLOW IND
3V3 TEMP CONT FLT STA DC
3V5 PACK 1 AUTO MAN DC
3W5 HOT AIR MANIF TEMP IND
3W6 HOT AIR MANIF TEMP CONT
3W7 HOT AIR MNAIF ISLN NO. 2

DC BUS NO. 2 AND RADIO BUS NO. 2



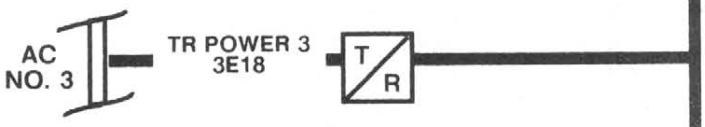
1A26 AFCS TRIM AGMT DC NO. 2
1B19 AFCS MODE IND
1B27 AFCS NO. 2 AFT COUPLER
1G19 VHF-DC VOR RCVR NO. 2
1G20 VHG-DC PREAMP NO. 2
2A4 LAV JET PUMP
2B15 WINDSHIELD LEFT HEAT CONT
2D18 ANTI-ICE VHF ANT
2D19 ANTI-ICE ENG 2
2F3 WING FLOOD LT CONT
2F4 STROBE LT CONT
2F6 WEIGHT & BAL DC
2F7 FIRE EXT LT
2F16 GEAR TRUCK LEVEL
2F16 GEAR CONT NO. 1
2G6 NOSE GEAR LT CONT
2G18 PARKING BRAKE NO. 1
2H6 EPR IND
2H7 T O AURAL WRNG
2H8 PILOTS IND LT TEST 1
2H9 PILOTS IND LT TEST
2H16 STABILIZER SERVO LB
2H17 STABILIZER SERVO RC
2J4 IND LT F E PANEL LOWER
2J15 SPOLIER SERVO A2L
2J16 SPOLIER SERVO B1, 4. 6, L & R
2J17 SPOLIER SERVO C3, 5, L & R
2J18 SPOLIER SERVO D2R
2K15 RUDDER MECH LMTR A
2K16 RUDDER MECH LMTR B
2K18 AFCS WARNING CAPT
2L15 PTU CONT & IND SYS C-D
2L16 RUDDER FUSING SYS
2M16 HYDRSULIC SYS B RSVR
2M17 HYDRAULIC SYS B PUMP
2M18 HYDRAULIC SYS C RSVR
2M19 HYDRAULIC SYS C PUMP
3A9 TIE BUS CONT BUS 1DC PWR
3A13 TIE BUS PWR BUS 2 DC PWR
3B13 CONTROLLER BUS 2 APU PWR
3B16 CONTROL AND PRI F W SOV BUS 2 APU PWR
3N7 ACCESS VENT VALVE ENG
3N8 GND IDLE ENG NO. 2
3N9 START AIR VALVE, ENG NO. 2
3N10 REV IND, ENG NO. 2
3N11 OIL LOW PRESS LIGHT, ENG NO. 2
3P10 FURL LOW PRESS, ENG NO. 2
3R11 TGT WARN ALL ENGINES
3T9 TANK VALVE, ENG NO. 2
3T10 SEC EMERG C X-FEED ENG NO. 2
3U11 JTSN AND DEFUEL 1
3V7 PACK 2 AUTO MAN DC
3V9 FWD CABIN TEMP CONTROL DC
3V11 MID CABIN TEMP CONTROL DC
3W8 HOT AIR MANIF ISLN NO. 3
3W9 CARGO TEMP FWD, MID
3W10 CARGO TEMP, AFT
3W11 FLOOR HEAT CONT
3X9 CABIN PRESSURE AUTO CONT
3AA12 NO. 2 RADIO BUS MASTER CONT
3AA17 IDG OIL LOW PRESS

3AA13-NO. 2 RADIO BUS DC

TO NO. 2 MASTER RADIO SWITCH

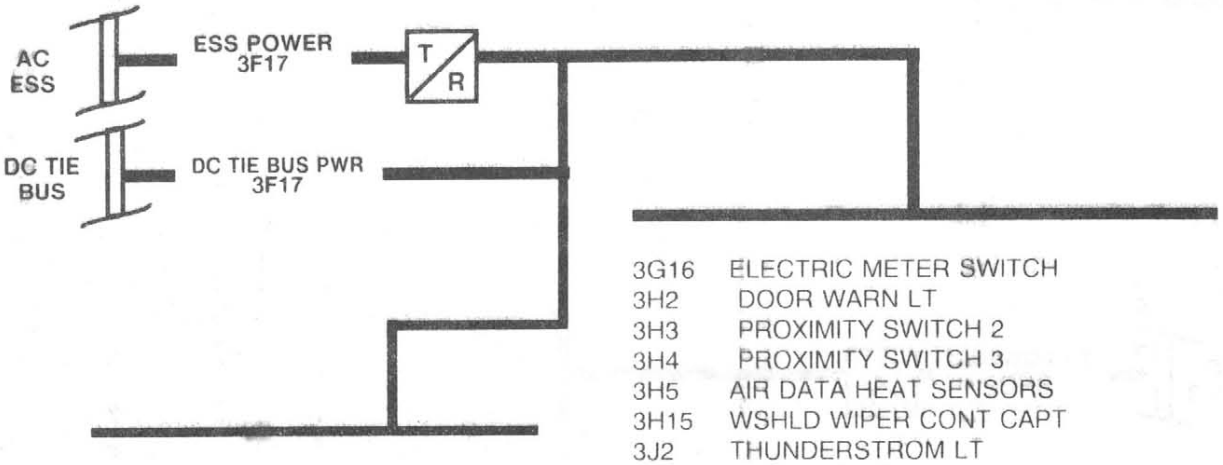
1C19 HF COMM NO. 2 DC
1C23 VHF COMM NO. 3
1D24 ADF NO. 2

DC BUS NO. 3



2A10	AISLE LT L LAV
2A11	AISLE LT R LAV
2B18	WINDSHIELD RIGHT HEAT CONT
2B20	RIGHT SIDE WINDOW HEAT CONT
2C8	HOST ADVSY IND
2C11	ORD LIGHT
2C19	INS CONT WINDSHIELD WASHER CONT
2D10	MULTIPLEX SYSTEM CC 23
2D11	MULTIPLES SYSTEM CC 1, 4
2D20	ANTI-ICE ENG 3
2D22	WING ANTI-ICE CONT
2E8	SIDE CONSOLE FLOOD LIGHTS
2F9	DOOR LATCH RLSE
2F18	GEAR CONT NO. 2
2G22	PARKING BRAKE NO. 2
2H10	PILOTS IND LT TEST 3
2H18	STABILIZER SERVO LA
2H19	STABILIZER SERVO RD
2H21	ASYM BRAKE NO. 1 TE FLAP
2H22	ASYM BRAKEKNO. 1 LE SLAT
2J19	AILERON SERVO C INBD. L AND R
2J20	AILERON SERVO A INBD & OUTBD. L
2J21	AILERON SERVO B INB & OUTBD L AND R
2J22	AILERON SERVO D INB & OUTBD. R
2K19	AFCS WARNING F O
2L19	HYDRAULIC ATM PUMP CONT & IND SYS C
2M20	HYDRAULIC SYS D RSVR
2M21	HYDRAULIC SYS D PUMP
3A10	TIE BUS CONT BUS 2
3A14	TIE BUS PWR BUS 3
3A16	BUS 3 GALLEY POWER
3N13	ACCESS VENT VALVE ENG 3
3N14	GND IDLE ENG NO. 3
3N15	START AIR VALVE, ENG NO. 3
3N16	REV IND. ENG NO. 3
3N17	OIL LOW PRESS LIGHT, ENG NO. 3
3P16	FUEL LOW PRESS. ENG NO. 3
3R15	ENG INSTR RESET ALL ENGINES
3R17	BLEED AIR IND ALL ENGINES
3R18	ENGINE 2 PRI EMER ALL ENGINES
3T12	TANK VALVE ENG 3
3T13	EMER AND R X-FEED ENG 3
3U12	JTSN AND DEFUEL 3
3U15	OUTB BOOST PUMP IND
3V13	AFT CAB TEMP CONTROL DC
3V15	GALLEY TEMP CONTROL DC
3V17	PACK 3 AUTO MAN DC
3W13	DUCT AREA OVHT DET DC
3X11	CABIN PRESSURE CONT STBY
3AA18	IDG OIL TEMP

ESSENTIAL DC BUS AND ESSENTIAL DC RADIO BUS



1A2 SPEED CONT NO. 1 SYS AFCS
1A8 TRIM AGMT DC NO. 1 SYS AFCS
1B1 AFCS MODE IND
1B4 FCES COMPUTERS DC
1B6 FCES STICK SHAKE
1B7 SPOILER DWELL DC AFCS
1B9 AFT COUPLER NO. 1 AFCS
1E1 ALT SOURCE SEL CAPTS INSTR
1E2 ALT SOURCE SEL F O INSTR
3F1 DC STBY PWR
3F2 DC TIE BUS CONT
3F3 DC TIE BUS PWR
3F4 ESS MASTER RADIO PWR
3F5 MASTER RADIO CONT
3F6 ESS RADIO BUS DC

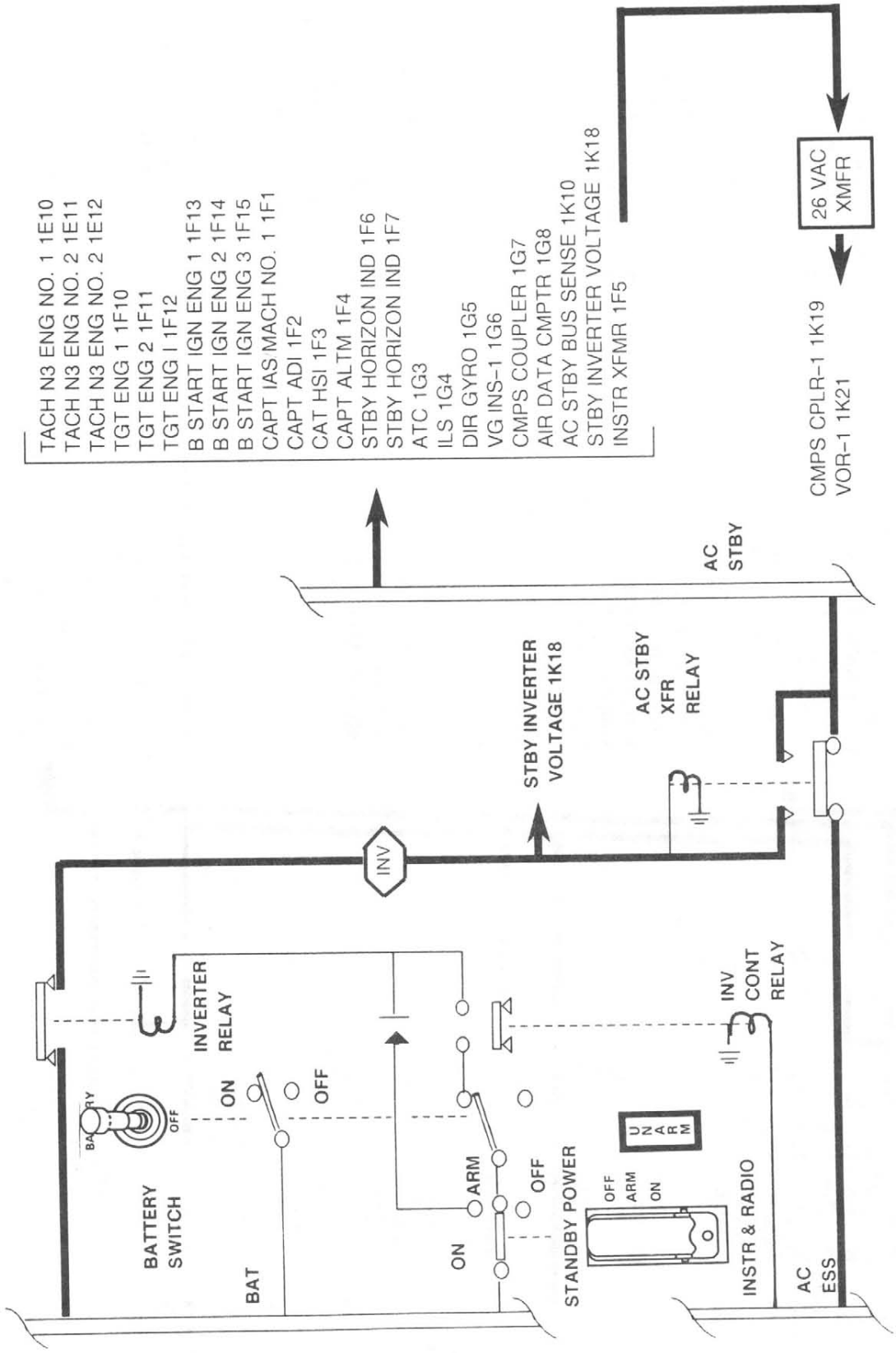
3G16 ELECTRIC METER SWITCH
3H2 DOOR WARN LT
3H3 PROXIMITY SWITCH 2
3H4 PROXIMITY SWITCH 3
3H5 AIR DATA HEAT SENSORS
3H15 WSHLD WIPER CONT CAPT
3J2 THUNDERSTROM LT
3J3 CREW UTILITY LT
3J4 CTR CONSOLE FLOOD LIGHTS
3J6 EMER LTS CHARGE SENSE
3J11 STBY LT RELAY
3K18 LE SLAT EXTEND LT
3L1 OVHT LOOP A ALARM ENG NO. 1
3L3 OVHT LOOP B ALARM ENG NO. 1
3L7 OVHT LOOP A ALARM ENG NO. 2
3L9 OVHT LOOP B ALARM ENG NO. 2
3L13 OVHT LOOP A ALARM ENG NO. 3
3L15 OVHT LOOP B ALARM ENG NO. 3
3L18 ALL ENG CONT IGN SEL
3M1 ENG NO. 1 TURB OVHT DET A
3M2 ENG NO. 1 TURB OVHT DET B
3M3 ENG NO. 1 TURB OVHT DET IND
3M7 ENG NO. 2 TURB OVHT DET A
3M8 ENG NO. 2 TURB OVHT DET B
3M9 ENG NO. 2 TURB OVHT DET IND

3F10 ENG START PWR
3G4 FLT RECORDER DC
3G8 PFCS ADS/DH IND LT
3G9 FLT CONT ALT ALERT IND LT
3G10 RAT IND LT
3G11 AC BUS IND
3G12 ECS IND LT
3G13 DC AUTO XFR
3G14 GEN OVERLOAD PROJECT
3G15 IDG DISC

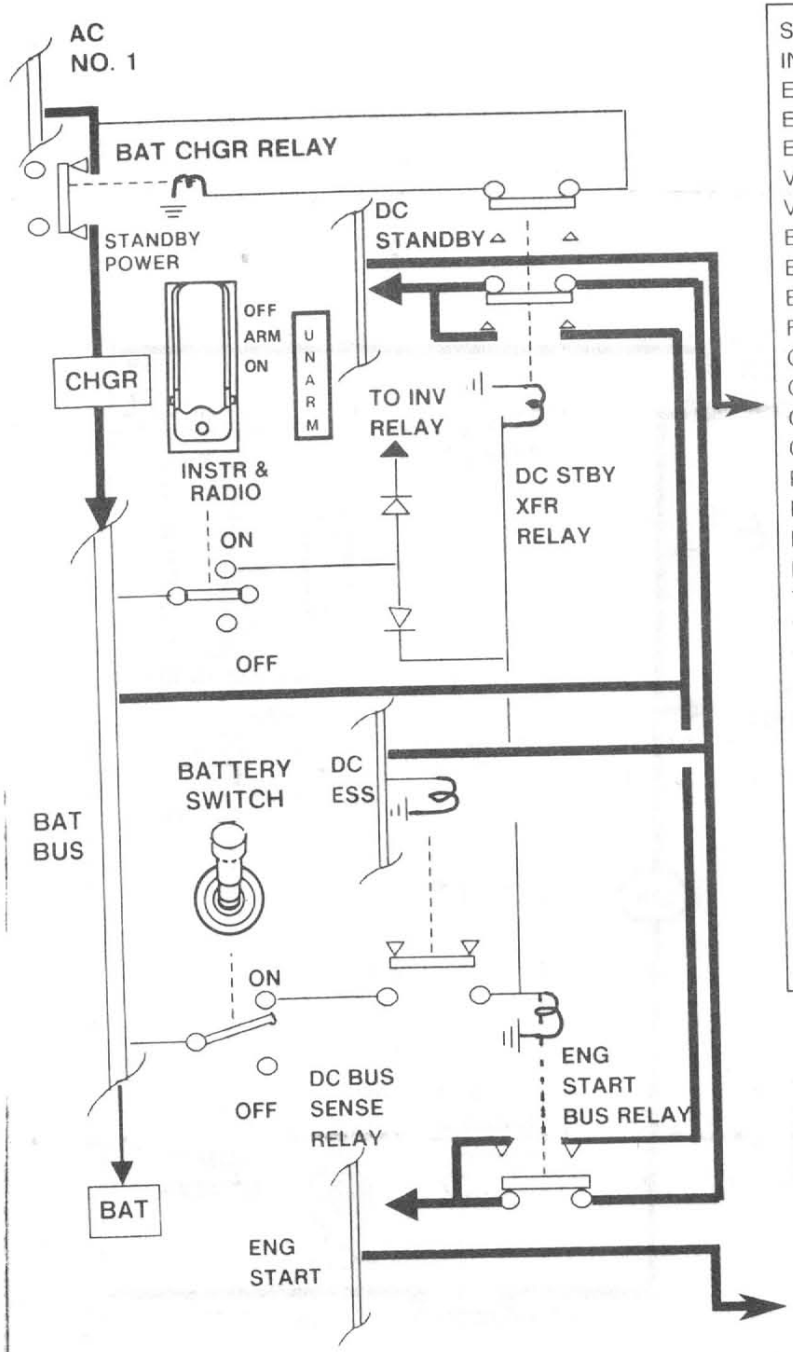
3F6 – ESS RADIO BUS DC

HF COMM NO. 1 DC 1C1
SELCAL COMM 1C5
ADF NO. 1 1D6
MARKER BEACON NO. 1 1D7
INST CMPRN MON PWR NO. 1 1D8

AC STANDBY BUS



DC STANDBY BUS



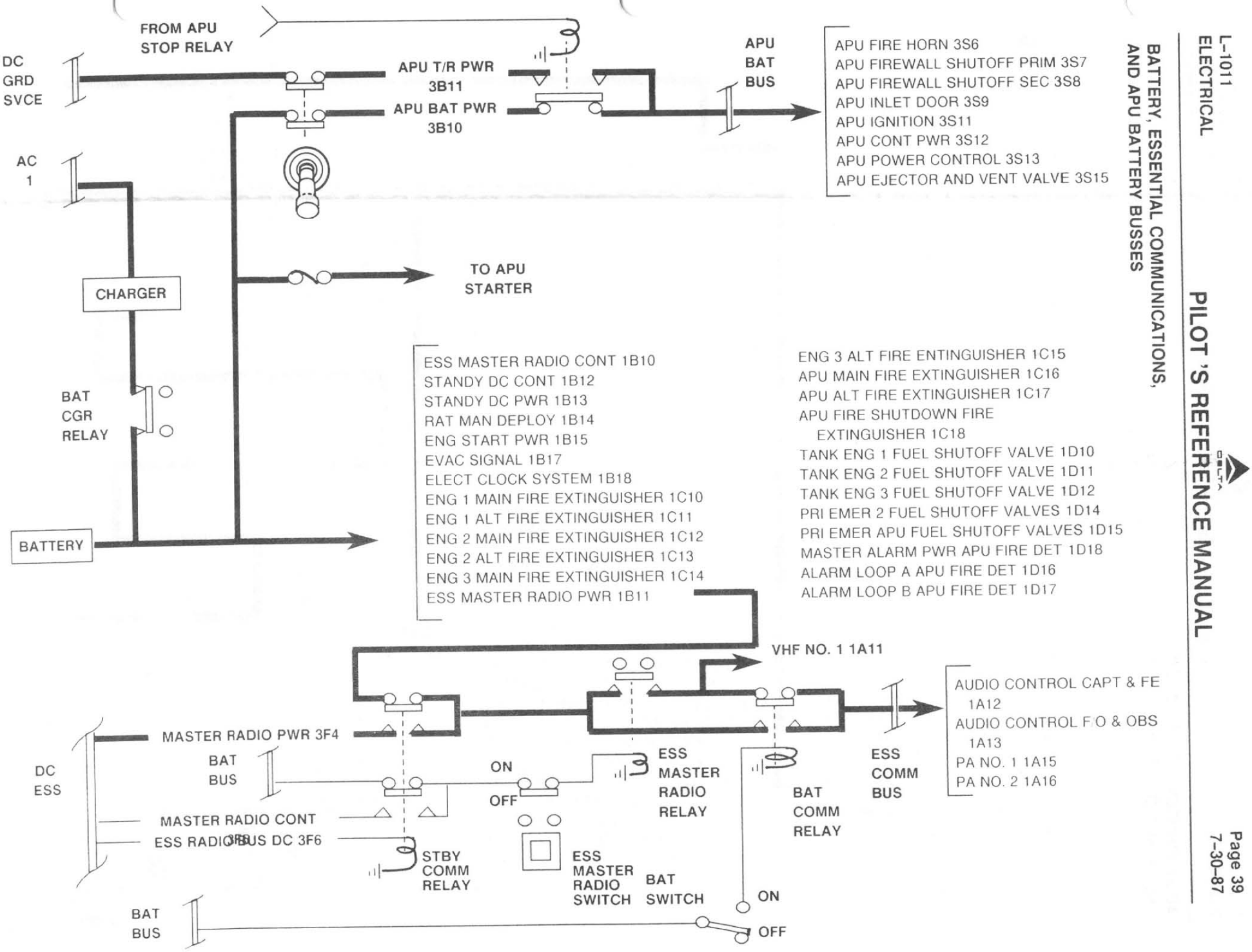
STBY COMPASS LIGHT 1F8
INSTR PNL FLOOD LIGHT 1F9
EMER FUEL SHUTOFF ENG 1 1F16
EMER FUEL SHUTOFF ENG 2 1F17
EMER FUEL SHUTOFF ENG 3 1F18
VHF DC VOR RCVR NO. 1 NAVIGATION 1G1
VHF DC PREAMP NO. 1 NAVIGATION 1G2
ENG 1 ISLN VALVE 1G10
ENG 2 ISLN VALVE 1G11
ENG 3 ISLN VALVE 1G12
FUS ISLN VALVE 1G16
CROSSBLEED VALVE L 1G17
CROSSBLEED VALVE R 1G18
CABIN PRESS MANUAL CONTROL FWD 1H1
CABIN PRESS MANUAL CONTROL AFT 1H2
PACK FLOW CONTROL 1 1H3
PACK FLOW CONTROL 2 1H4
PACK FLOW CONTROL 3 1H5
PACK HIGH FLOW CONT 1H6
THRUST REVERSE ENG 1 1H16
THRUST REVERSE ENG 2 1H17
THRUST REVERSE ENG 3 1H18
MASTER ALARM PWR ENG 1 1J1
MASTER ALARM PWR ENG 2 1J2
MASTER ALARM PWR ENG 3 1J3
WHL WELL AND APU
MASTER ALARM PWR 1J4
FIRE DETECTION TEST 1J5
FIREBELL PWR FIRE DETECTION 1J6
APU FIRE SHUTDOWN 1J7
NO. 2 ASYM BK LE SLAT 1J10
NO. 2 ASYM BK TE FLAP1J11

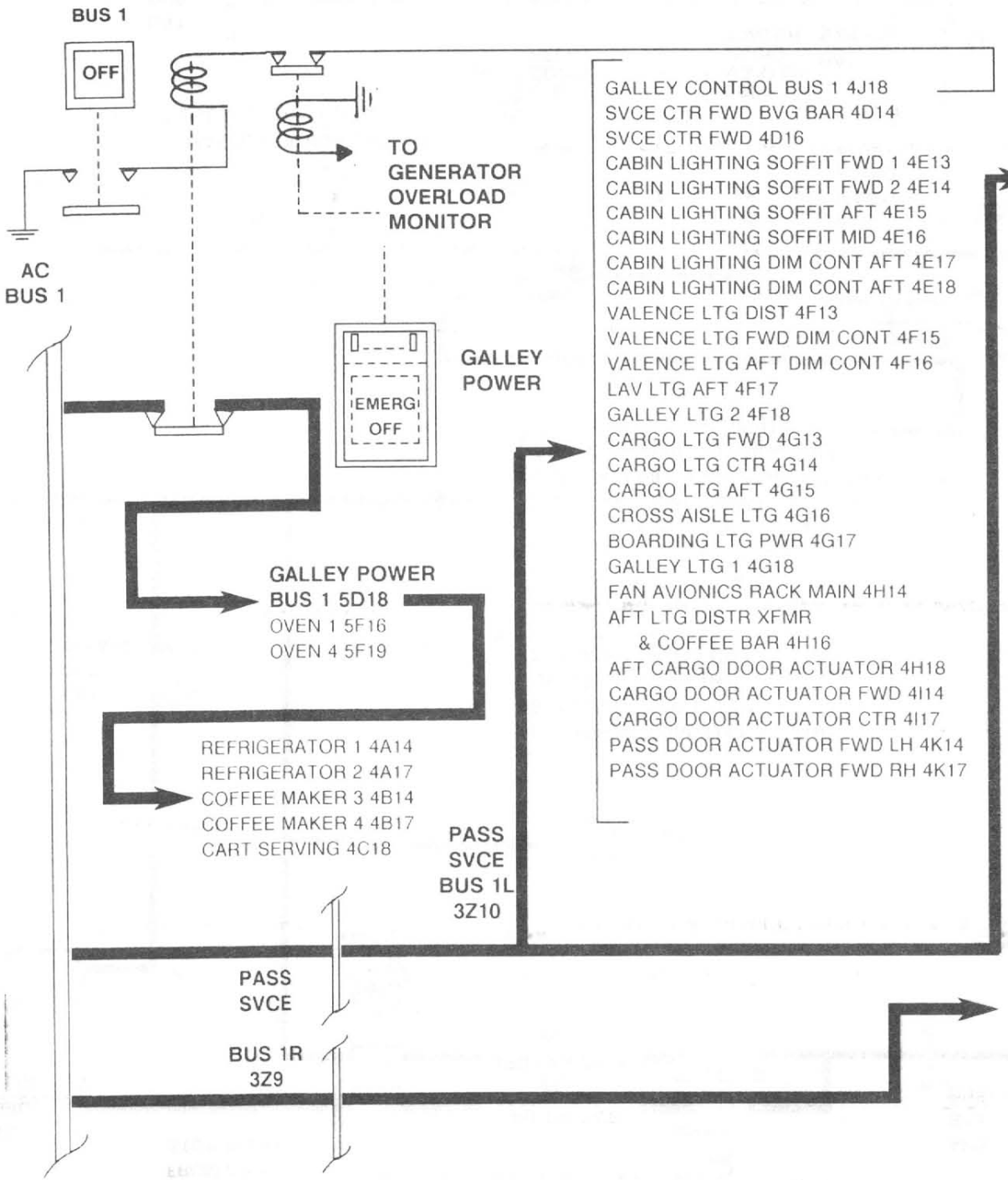
START JET VALVE ENG 2 1E14
START JET VALVE ENG 3 1E15
HP3 BLEED AIR ENG 1 1E16
HP3 BLEED AIR ENG 2 1E17
HP3 BLEED AIR ENG 3 1E18
HI PRESS VALVES ENG 1 1G13
HI PRESS VALVES ENG 2 1G14

LOCK LIGHT LE SLAT 1J12
LOCK LIGHT TE FLAP 1J13
AIR OVBD 1J14
PASS OXYGEN NORMAL MASK 1J15
PASS OXYGEN NORMAL GEN 1J16
PASS OXYGEN OVERRIDE MASK 1J17
PASS OXYGEN OVERRIDE GEN 1J18
LOOP A ALARM ENG 1 1K1
LOOP A ALARM ENG 2 1K2
LOOP A ALARM ENG 3 1K3
LOOP A ALARM APU 1K4
LOOP B ALARM ENG 1 1K5
LOOP B ALARM ENG 2 1K6
LOOP B ALARM ENG 3 1K7
LOOP B ALARM APU 1K8
AC ESS BUS CONT 1K11
DC STBY IND 1K13
EMER UNARM IND 1K14
GEN 1 CONTROL UNITS 1K15
GEN 2 CONTROL UNITS 1K16
GEN 3 CONTROL UNITS 1K17
RAIN REPELLANT INBD 1L1
RAIN REPELLANT OUTB 1L2
RAT AUTO DEPLOY 1L3
GALLEY AND LAV LIGHTS 1L4
AISLE LIGHTS 1L5
AURAL WARN TEST & RESET 1L6
AURAL WARN OVSP 1L7
AURAL WARN MULT SND 1L8
ANN RESET 1L9
PROX SW PWR NO. 1 1L10
PROX SW PWR NO. 4 1L11
WARN HORN LANDING GEAR 1L12
DOOR POSN IND LANDING GEAR 1L13
ALTN GEAR CONT 1L14

HI PRESS VALVES ENG 3 1G15
ENG START BUS SENSE 1K12
HYD PUMP AND FIREWALL SHUTOFF
VALVE CONT
SYS A 1L15
SYS B 1L16
SYS C 1L17
SYS D1L18

BATTERY, ESSENTIAL COMMUNICATIONS, AND APU BATTERY BUSSES





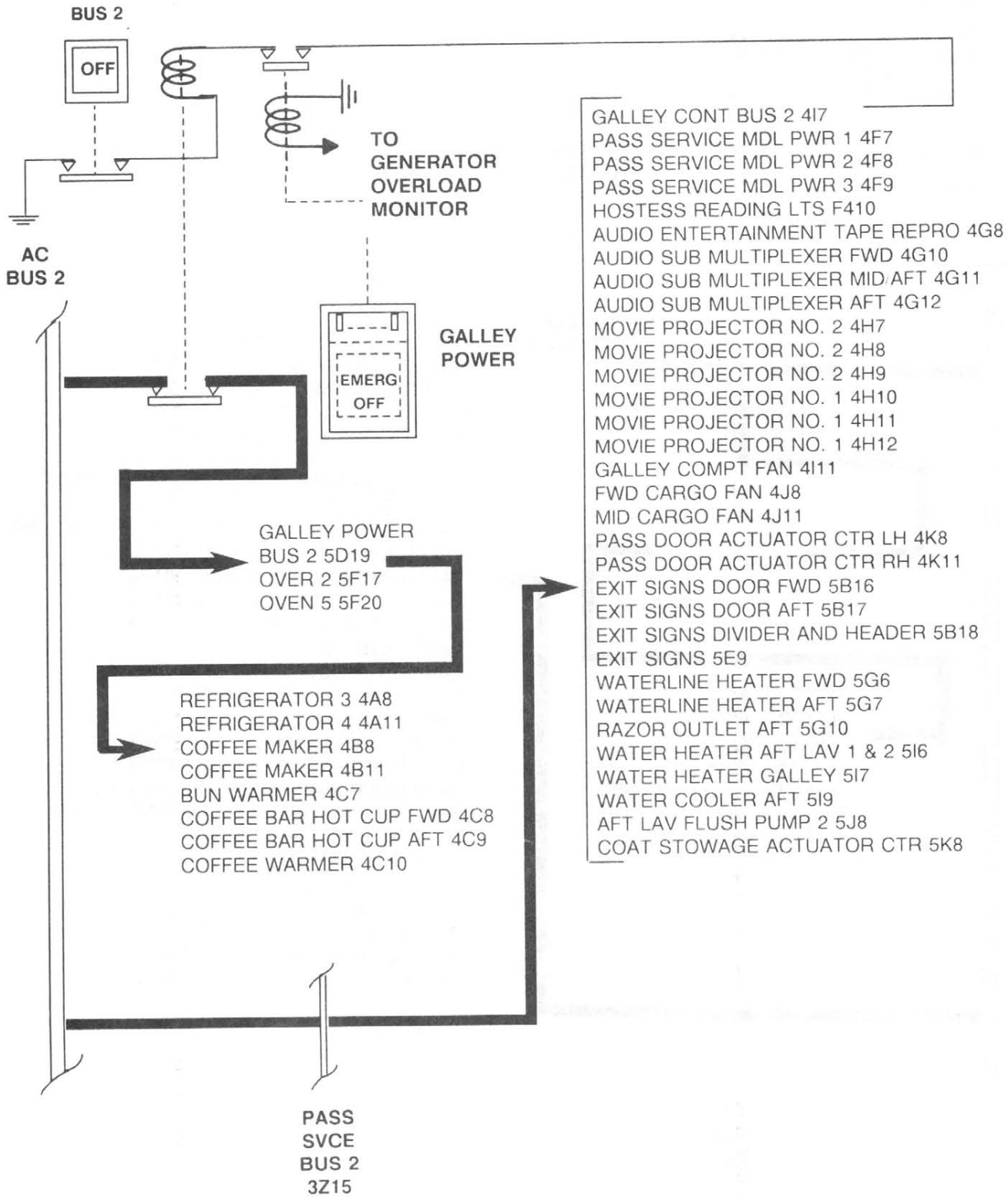
GALLEY CONTROL BUS 1 4J18
SVCE CTR FWD BVG BAR 4D14
SVCE CTR FWD 4D16
CABIN LIGHTING SOFFIT FWD 1 4E13
CABIN LIGHTING SOFFIT FWD 2 4E14
CABIN LIGHTING SOFFIT AFT 4E15
CABIN LIGHTING SOFFIT MID 4E16
CABIN LIGHTING DIM CONT AFT 4E17
CABIN LIGHTING DIM CONT AFT 4E18
VALENCE LTG DIST 4F13
VALENCE LTG FWD DIM CONT 4F15
VALENCE LTG AFT DIM CONT 4F16
LAV LTG AFT 4F17
GALLEY LTG 2 4F18
CARGO LTG FWD 4G13
CARGO LTG CTR 4G14
CARGO LTG AFT 4G15
CROSS AISLE LTG 4G16
BOARDING LTG PWR 4G17
GALLEY LTG 1 4G18
FAN AVIONICS RACK MAIN 4H14
AFT LTG DISTR XFMR
& COFFEE BAR 4H16
AFT CARGO DOOR ACTUATOR 4H18
CARGO DOOR ACTUATOR FWD 4I14
CARGO DOOR ACTUATOR CTR 4I17
PASS DOOR ACTUATOR FWD LH 4K14
PASS DOOR ACTUATOR FWD RH 4K17

AC PASSENGER SERVICE BUSSES 1L AND 1R AND GALLEY AC BUS 1

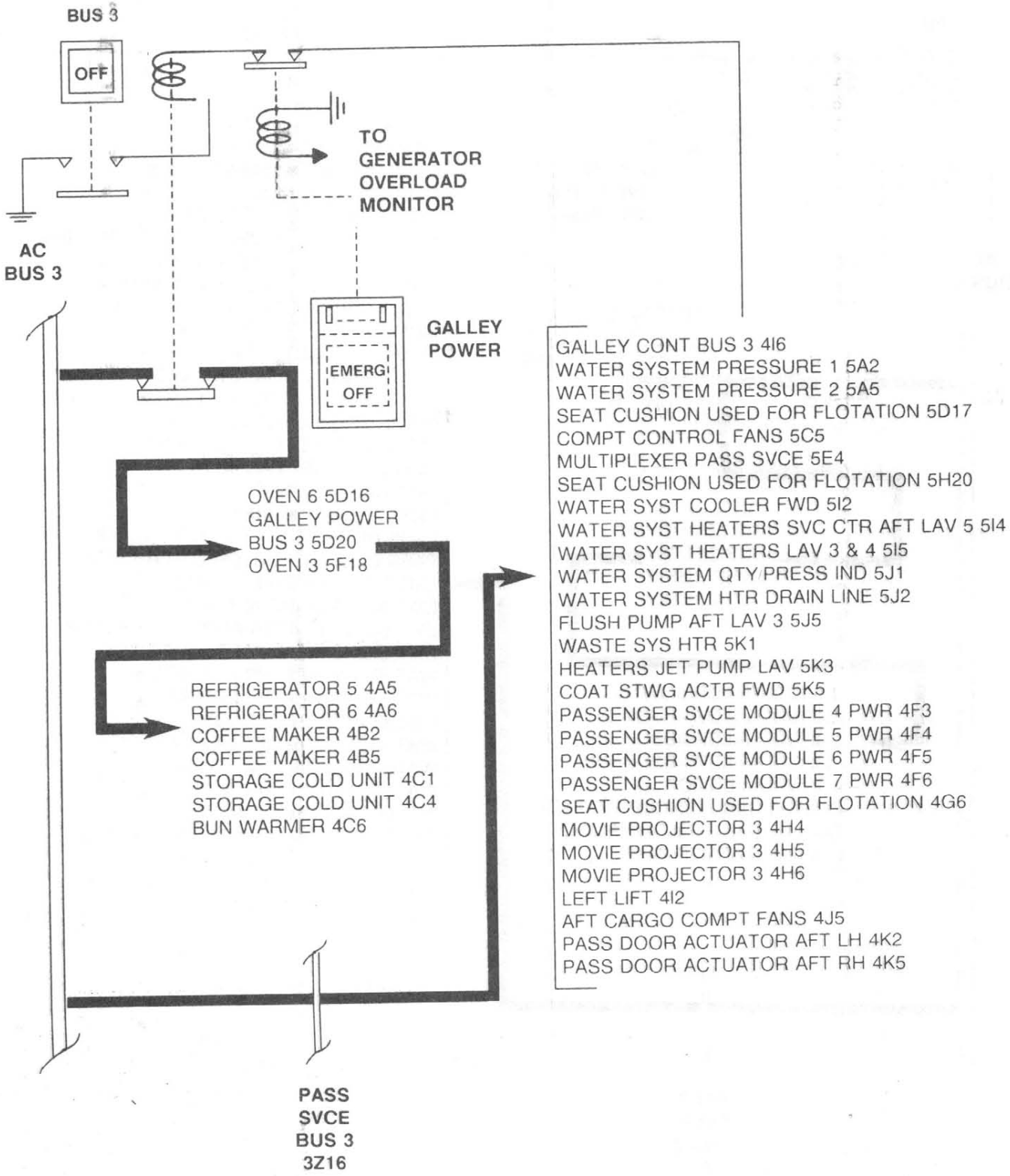
SOFFIT LIGHTING CENTER MID LH 5H16
SOFFIT LIGHTING CENTER AFT LH 5H17
SOFFIT LIGHTING MID RH 5H18
SOFFIT LIGHTING AFT RH 5H19
SIGNS LAV OCC AFT 5I16
SOFFIT LIGHTING FWD 1 5I17
SOFFIT LIGHTING FWD 2 5I18
SOFFIT LIGHTING MID FWD 1 5I19
SOFFIT LIGHTING MID FWD 2 5I20
SIGNS LAV OCC FWD 5J16
LTS CONT LAVE AFT RB17
AFT LOUNGE TABLE LAMPS 5K18
LIFT SVCE LTG FWD CLOSE 5K19
GALLEY LIFT LTG 5K20

LIFT RIGHT 5A11
OVERHEAD COAT CLOSET LIGHTS 5A14
SVCE COMPT LIGHTS 5A15
SVCE COMPT LIGHTS SWITCH (MESC) 5A20
CABIN LTG LUMN FWD DIM CONT 5E11
CABIN LTG LUMN AFT DIM CONT 5E12
AVIONICS FAN FWD 5E14
SERVICE OUTLET AFT LH ENTRANCE 5G11
SERVICE OUTLET AFT RH ENTRANCE 5G12
SERVICE OUTLET EMERG LH 5G13
SERVICE OUTLET EXIT EMERG RH 5G14
SERVICE OUTLET FLT STA 5G15
SERVICE OUTLET FWD LH ENTRANCE 5I11
SERVICE OUTLET FWD RH ENTRANCE 5I12
SERVICE OUTLET CTR LH ENTRANCE 5I13
SERVICE OUTLET CTR RH ENTRANCE 5I14
SERVICE OUTLET GALLEY ENTRANCE 5I15
FLUSH PUMP AFT LAV 1 5J11
SERVICE OUTLET FWD SERV CTR 5J13
SERVICE OUTLET MID SERV CTR 5J14
SERVICE OUTLET AFT SERV CTR 5J15
COAT STWG ACTUATOR AFT 5K11
LTG AFT LOUNGE TABLE LAMPS 5K13
APU IND ET 5K14
FUEL SYS GA RPTR IND 5K15

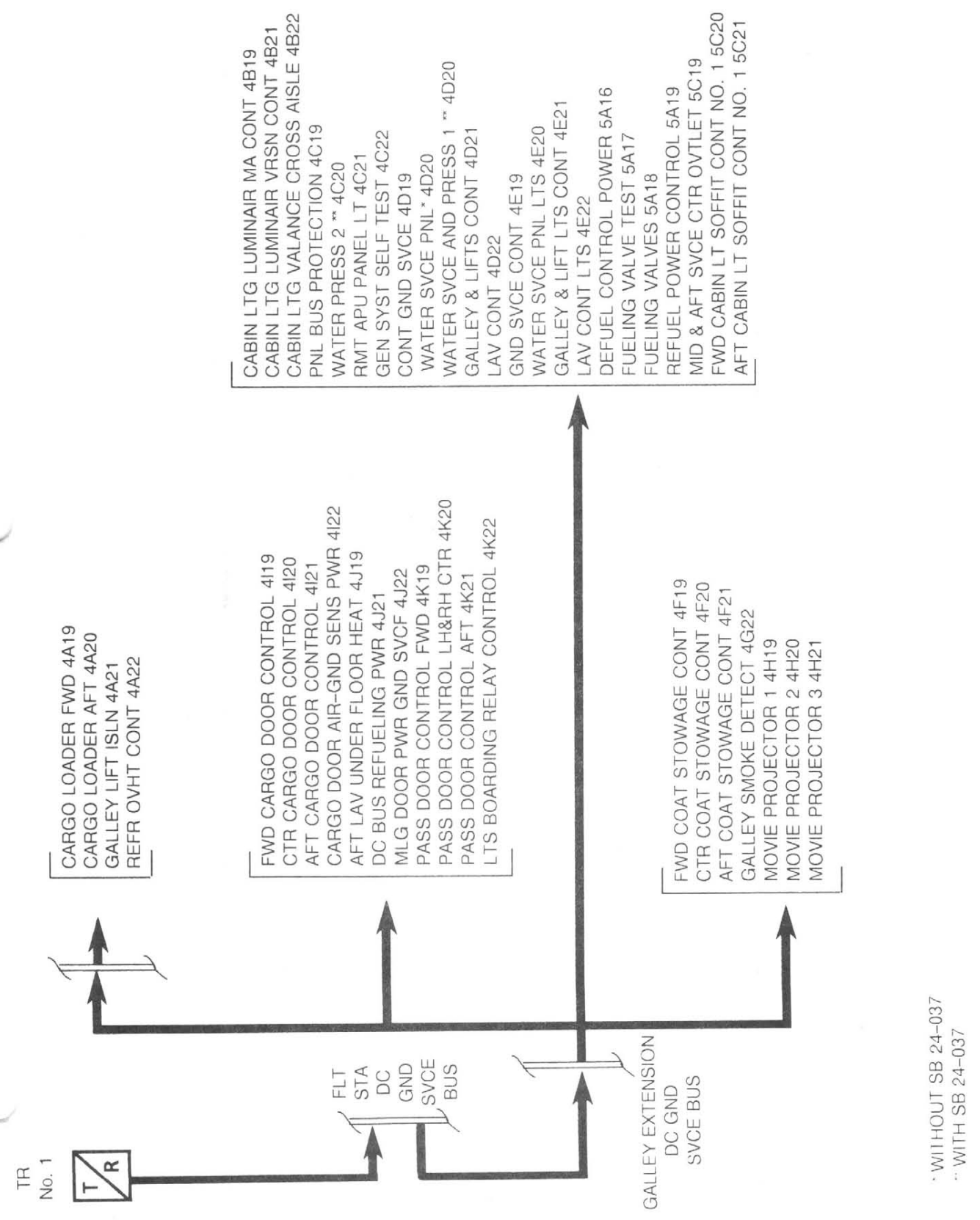
AC PASSENGER SERVICE BUS 2 AND GALLEY AC BUS 2



AC PASSENGER SERVICE BUS 3 AND GALLEY AC BUS 3



GALLEY DC BUS AND GALLEY DC GROUND SERVICE BUS EXTENSION



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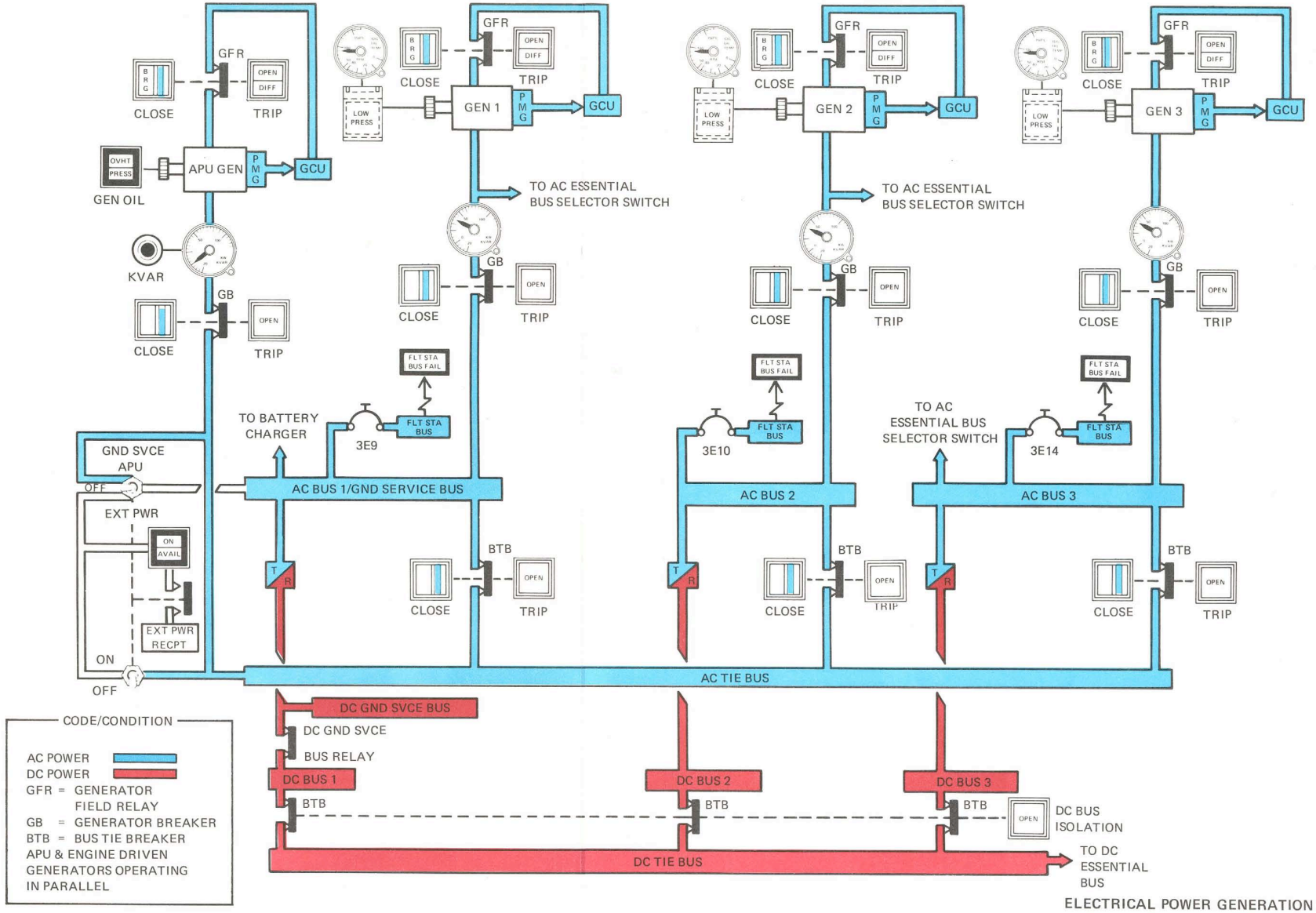
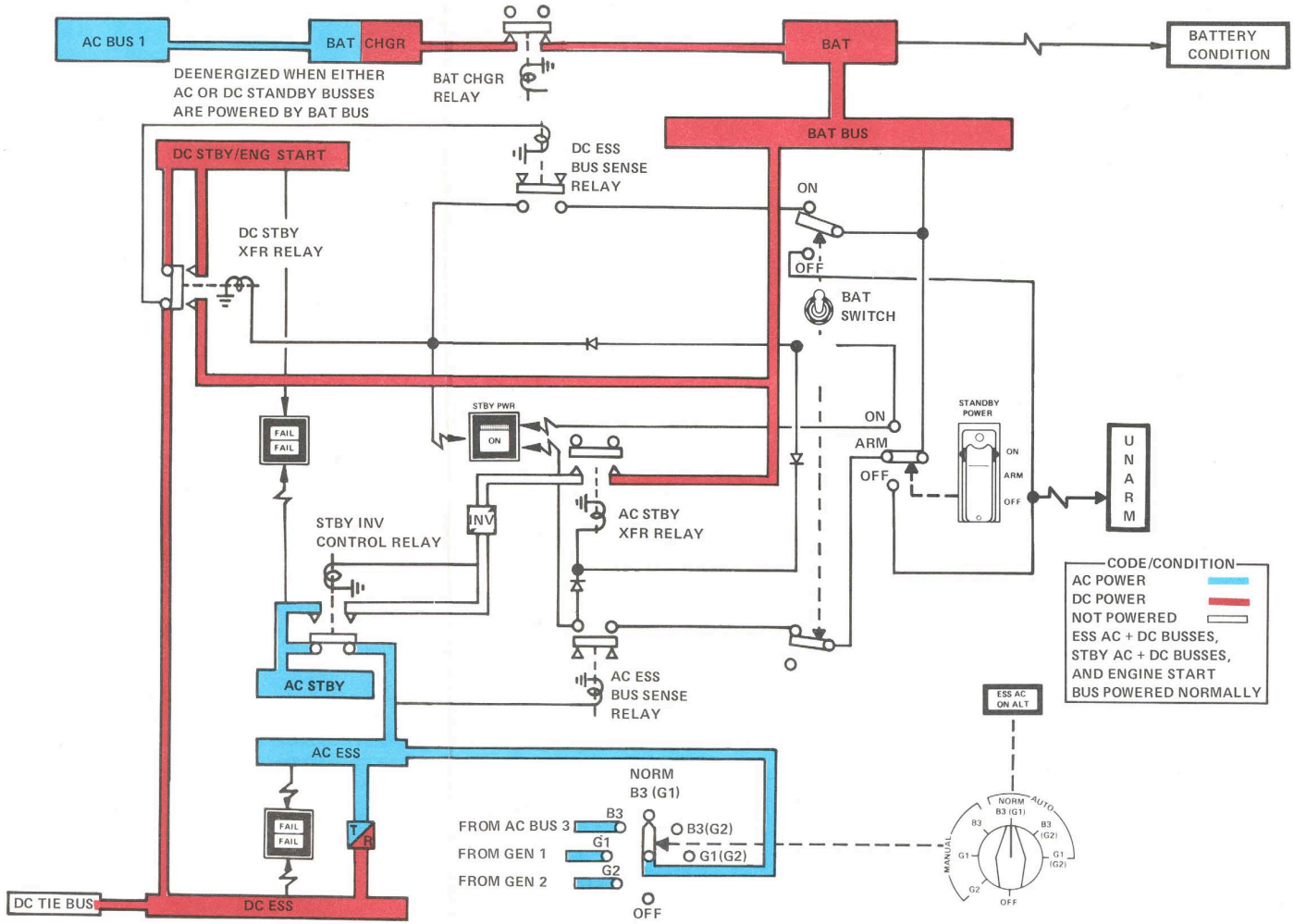
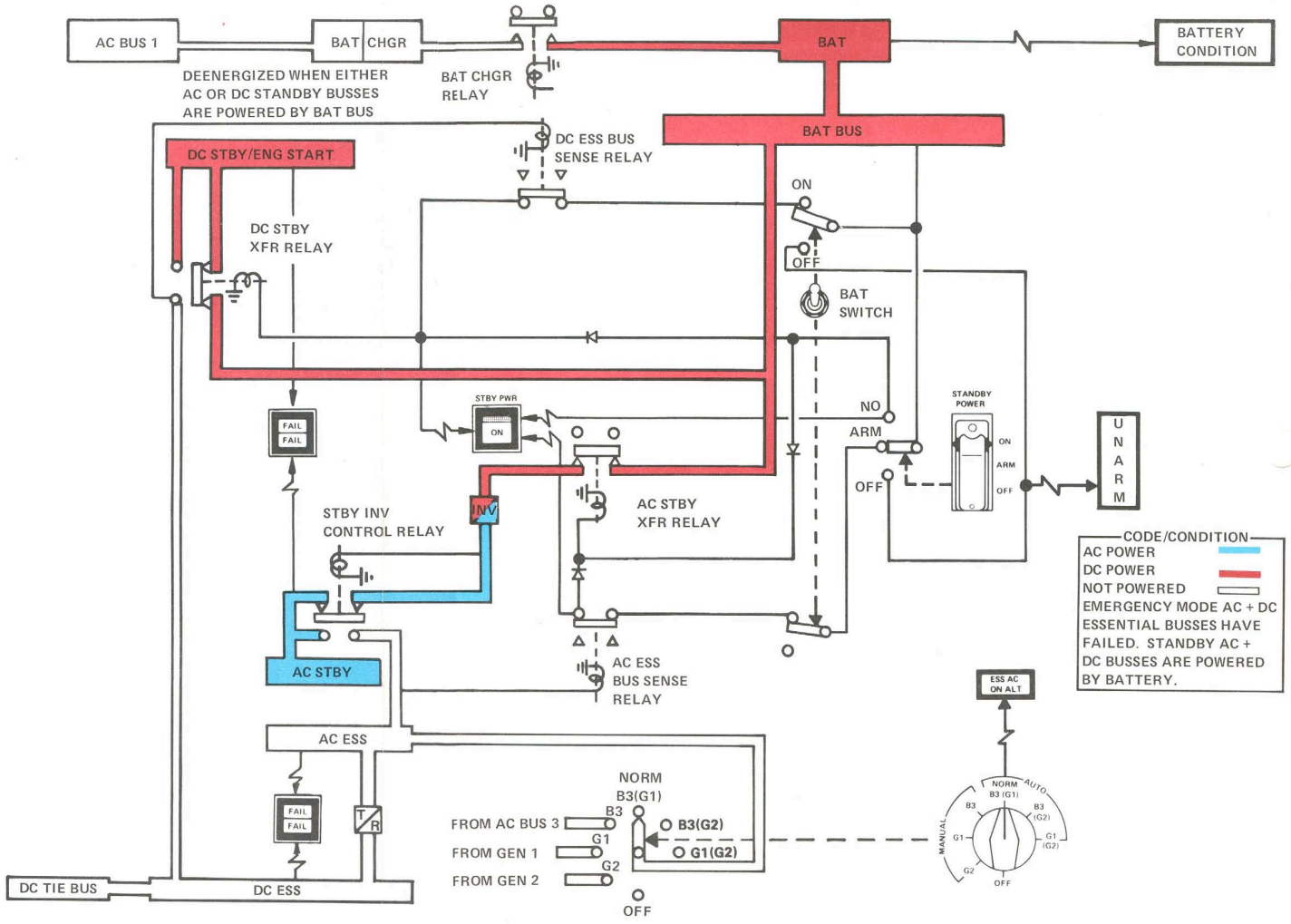


ELECTRICAL POWER GENERATION



NORMAL, ESSENTIAL, AND STANDBY POWER OPERATION



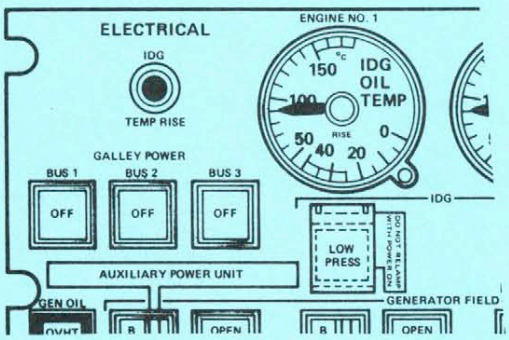
EMERGENCY STANDBY POWER OPERATION

ELECTRICAL

GALLEY POWER

The forward, mid, and aft galley complexes are powered from ac buses 2, 1, and 3, respectively, through Remote Control Circuit Breakers (RCCBs). The DC ESSEN BUS supplies power for the control and indication circuits.

The control circuit for each galley complex incorporates two RCCBs, an EMERGENCY POWER SHUTOFF switch at each of the three galleys, a trip reset circuit breaker for each RCCB in the Flight Station on circuit breaker panel 3, and a GALLEY BUS POWER switch for each galley on the Second Officer's electrical panel. Power to the galley complexes is normally controlled by the associated galley power switch.



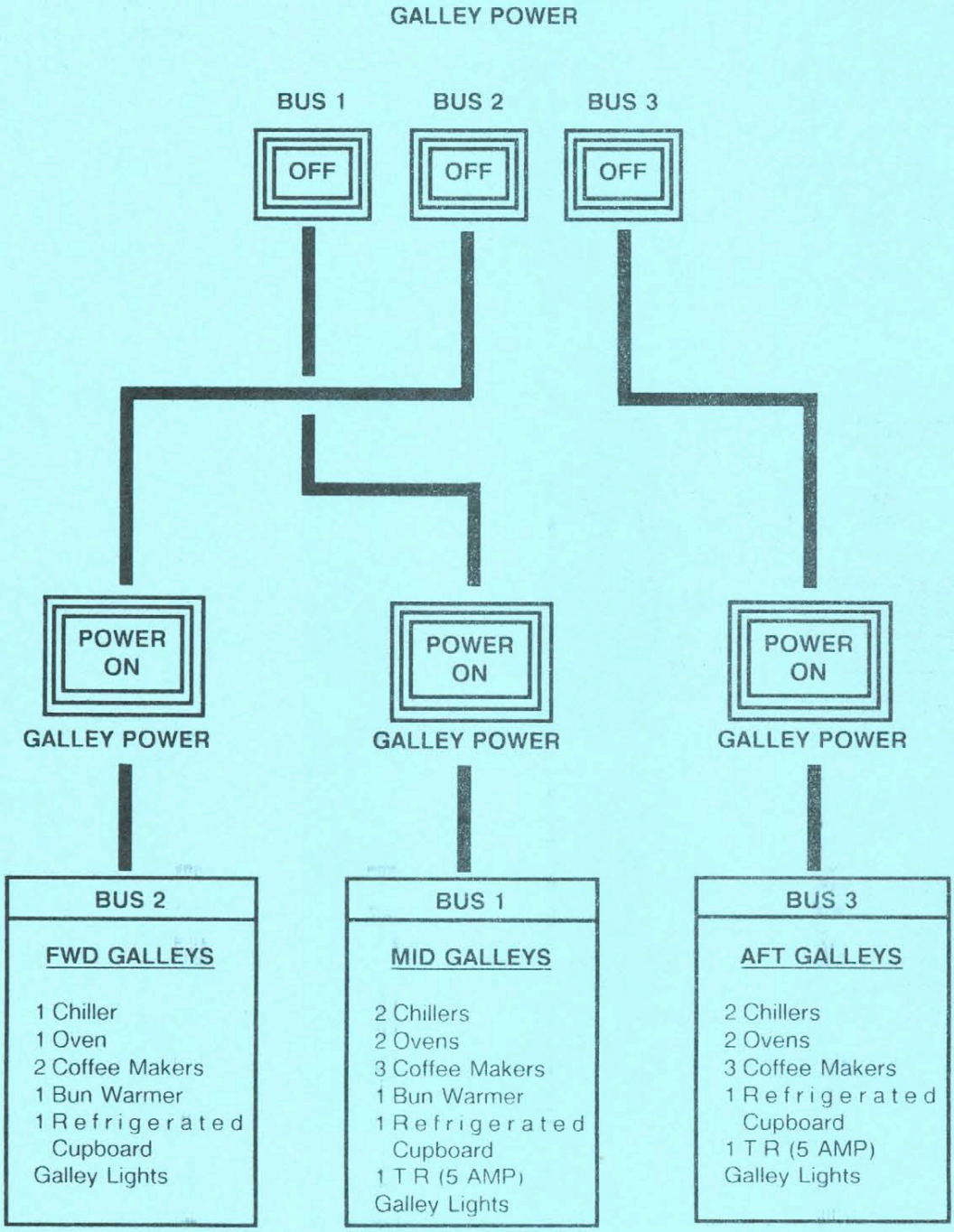
GALLEY POWER SWITCHES

IN – Connects ac power to respective cabin galleys. The Bus 1 switch powers the mid cabin galleys. The Bus 2 switch powers the forward cabin galleys. The Bus 3 switch powers the aft cabin galleys.

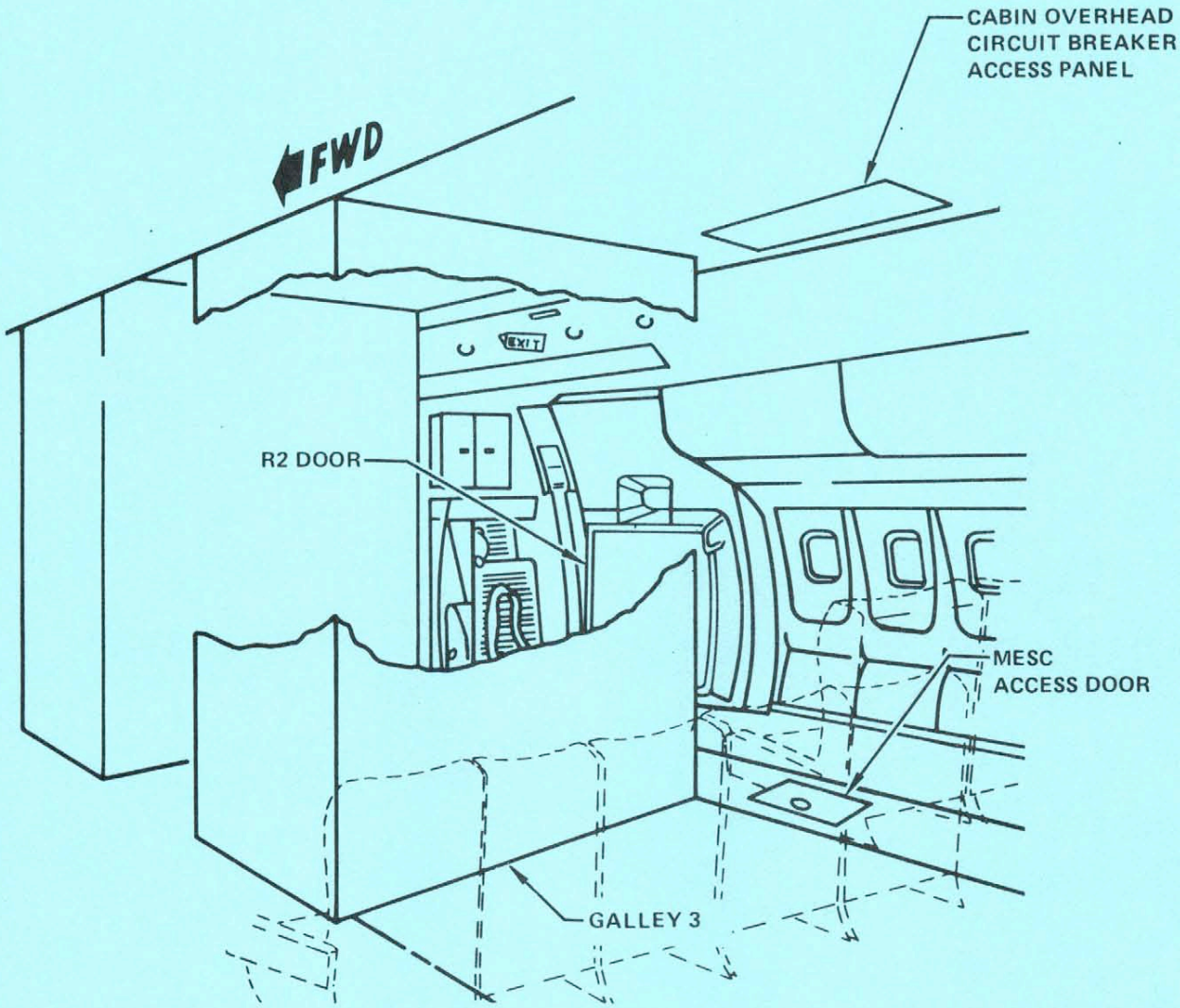
CIRCUIT BREAKERS

The circuit breaker panel for passenger service buses Nos. 1A, 1B, 2, and 3 and the DC GROUND SERVICE BUS is located in the ceiling in the mid cabin area, and is identified as CB panel 4. This panel replaces CB panels 4 and 5 installed on the dash one aircraft. An access door in the overhead trim swings down to reveal the circuit breakers.

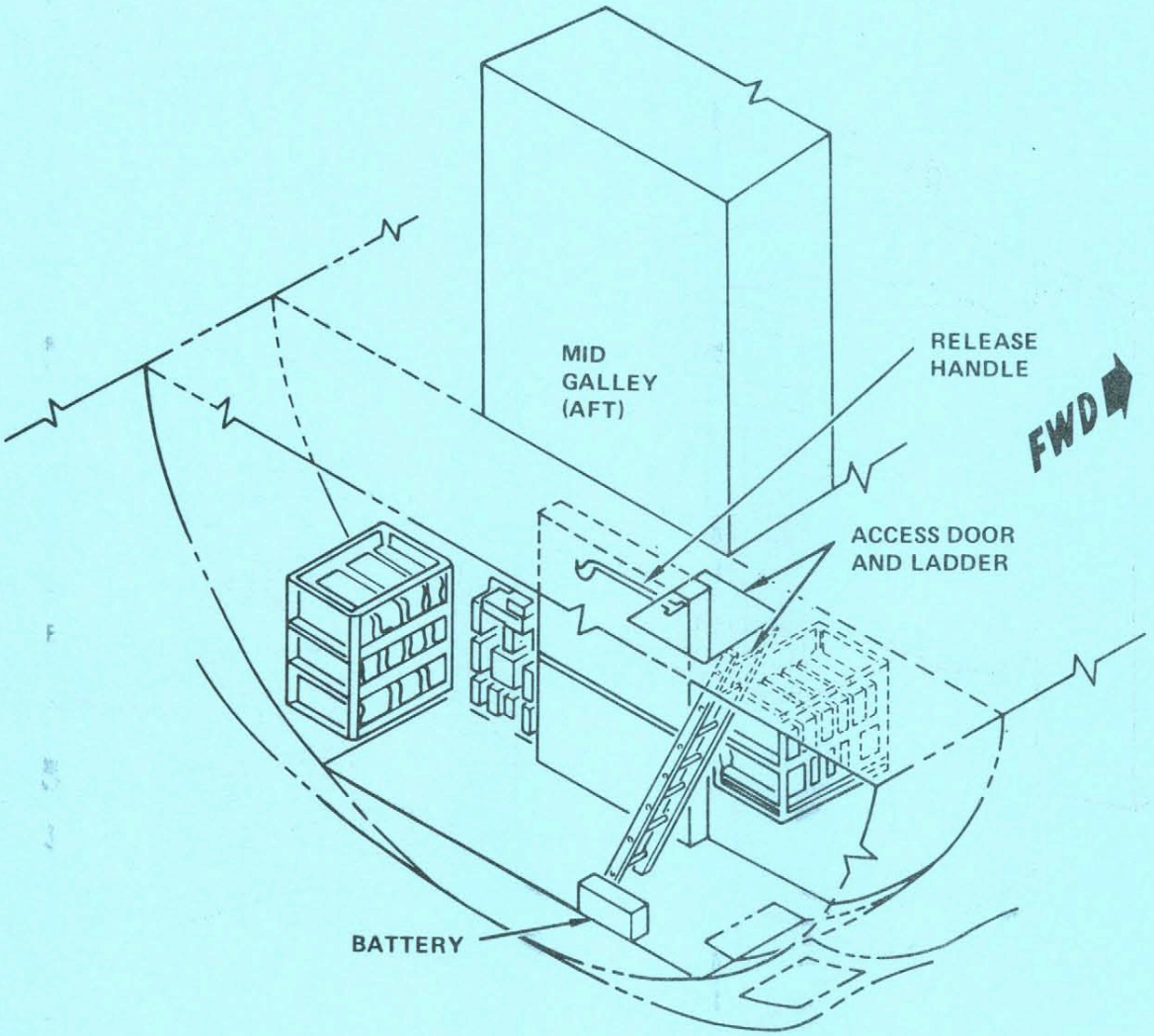
FLIGHT STATION AND GALLEY POWER SWITCHES



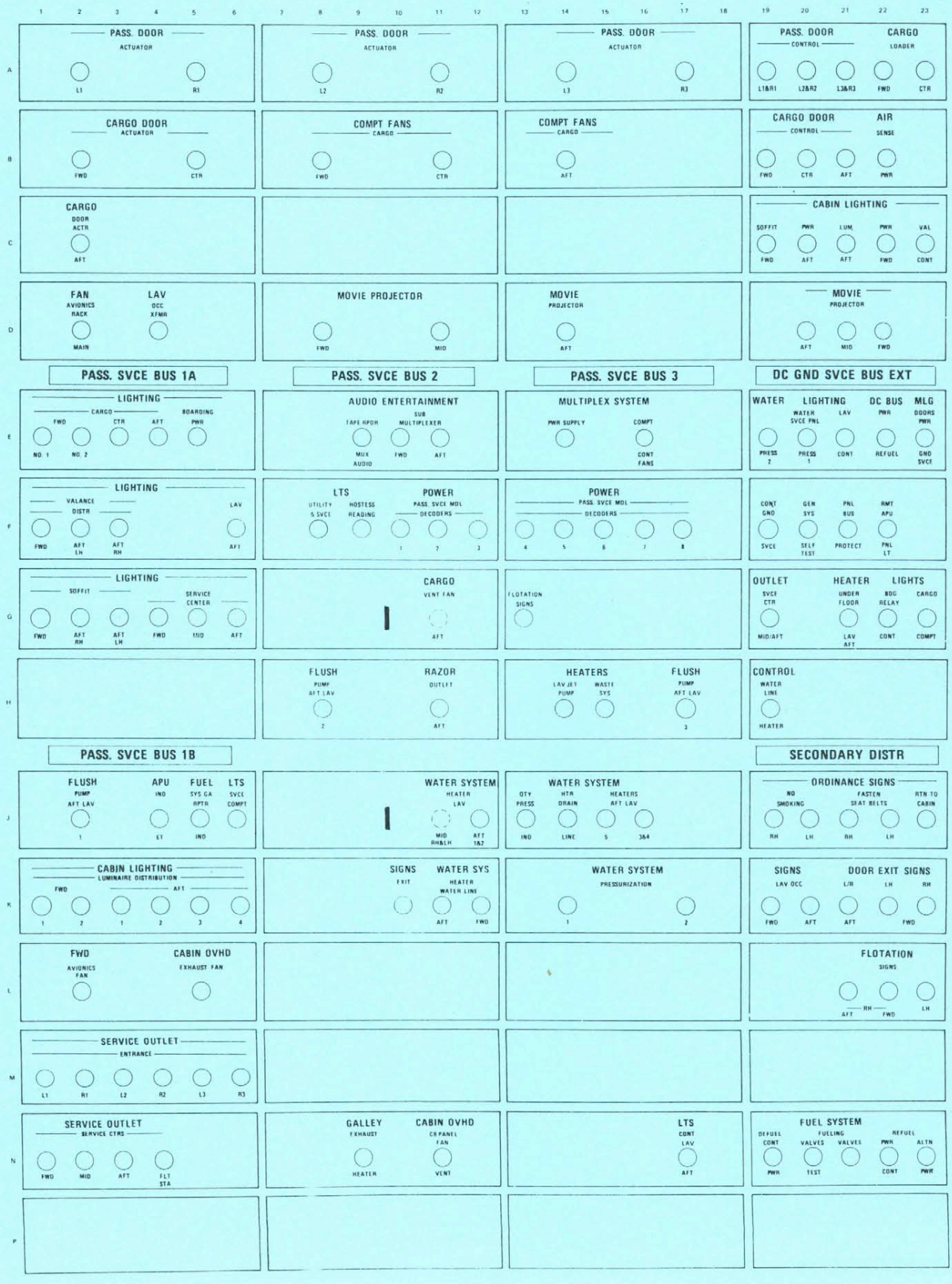
CABIN CIRCUIT BREAKER PANEL LOCATION



MID ELECTRICAL SERVICE CENTER ACCESS



MID CABIN OVERHEAD CIRCUIT BREAKER PANEL (CB PANEL 4)



CIRCUIT BREAKER BUS LOCATIONS (SHEET 1)

This list shows the additions, deletions, and changes to the flight station circuit breakers.

AC BUS 1

- 1E24 VG INS 3 – was INS VERT GYRO
- 1E25 INS 3 – was INS HTR
- 26B STROBE – deleted
- 3U3 OUTBD BOOST PUMP 2L – was at 3U5
- 3U4 OUTBD BOOST PUMP 2 – was at 3U6
- 3D10 FLT STA BUS 1 FAIL IND – was LOAD CONT BUS 1 FAIL IND 3D10
- 3U5 & 6 TRANSFER VALVE 1 & 1A, 3 & 3A – added
- 3Y4 ACS PSU AC – added
- 3Y5 MID GALY FEEDER 1 – added
- 3Y6 MID GALY FEEDER 2 – added
- 2H12 FLAP LOAD RELIEF CHAN 1 – deleted
- 2A1 FWD LAV RAZOR OUTLET – was at 2A3
- 2HR RUDDER HYD LMTR CHAN 1 – added

FORWARD AC GROUND SERVICE BUS

- 3T12 FUEL QTY IND 1 & 1A – Tank 1A indicator added
- 3T5 FUEL QTY IND 3 & 3A – Tank 3A indicator added
- 2K7 FWD CLOSET AND LAV LT – deleted
- 2K11 FWD LAV LT – added

AC BUS 2

- 1G24 VG INS 2 – was INS VERT GYRO
- 1G25 INS 2 – was INS HTR
- 2F4 STROBE LT CONT – changed – was at 265
- 2A5 WATER HEATER FWD L – added
- 2A6 WATER HEATER FWD R – was at 2A7
- 3D13 FLT STA BUS 2 FAIL IND – was LOAD CONT BUS 2 FAIL IND 3D13
- 3V10 MID CABIN AC TEMP CONT – MID replaces FWD
- 3Y9 ACS CHAN 1 – added
- 3Y9 FWD GALLEY FEEDER 1 – added
- 3Y10 FWD GALLEY FEEDER 2 – added

NO. 2 RADIO BUS

No changes.

AC BUS NO. 3

- 3D16 FLT STA BUS 3 FAIL IMD – was LOAD CONT BUS 3 FAIL IND 3D16
- 3V12 FLT STA AC TEMP CONT – was MID CABIN FLT STA TEMP CONT 3VR
- 3V16 GALLEY TEMP CONT AC – deleted
- 3Y15 ACS CHAN 2 AC – added
- 3Y17 AFT GALY FEEDER 1 – added
- 3Y18 AFT GALY FEEDER 2 – added
- 2C21 WINDSHIELD WASHER PUMP – was INS FAN WINDSHIELD WASHER PUMP 2C21
- 2H20 FLAP LOAD RELIEF CHAN 2 – deleted

ESSENTIAL AC BUS

- 1B1 GPWS AC – added
- 1E8 FLT MGT NO. 1 – added
- 1E8 AREA NAV NO. 1 – deleted
- 1E6 No. 1 INS HTR – was PWR
- 1E7 No. 1 INS PWR – was HTR
- 3H8 INS COOLING FAN PWR – added

ESSENTIAL AC RADIO BUS

No Changes

DC BUS 1

- 3N1 ACCESS VENT AIR – deleted
- 3U1 INBD PUMP IND – was at 3U2
- 3U2 JTSN & DEFUEL 2L AND 2R – was at 3U3
- 3V5 TEMP CONT FWD CAB DC – FWD CAB replaces FLT STA
- 2F12 TAIL SKID CONT – deleted
- 2F13 TAIL SKID IND – deleted
- 2H13 FLAP LOAD RELIEF IND – deleted
- 2J1 INSTR GND COOL – added
- 2J2 CAPT IND LT – was PILOTS' IND LT 2J2

CIRCUIT BREAKER BUS LOCATIONS (SHEET 2)

DC GROUND SERVICE BUS

- 2J5 SMOKE DETECTOR A – added
- 2J6 SMOKE DETECTOR B – added
- 2J7 GND SVCE OUTLET DC – added
- 2K11 SERVICE OUTLET DC – added
- 2L7 CABIN INTPH – was CABIN AND GALLEY INTPH 2L7
- 3A17 GND SVCE CABIN EXT – was GND SVCE GALLEY EXT 3A17
- 3C17 AUDIO CONT F O & OBS FECS – FECS added

DC BUS NO. 2

- 2A4 LAV JET PUMP – deleted
- 2C5 REFER CONT – added
- 2D18 ANTI-ICE VHF ANT – deleted
- 2H8 CAPT IND LT TEST 1 2H8 – CAPT replaces PILOTS
- 2H9 CAPT IND LT TEST 2 – CAPT replaces PILOTS
- 2J14 SPOILER SERVO LMTR 1, 2, 3 – added
- 2K15 RUDDER MECH LMTR A – deleted
- 2K16 RUDDER MECH LMTR B – deleted
- 3N7 ACCESS VENT AIR – deleted
- 3V9 MID CABIN TEMP CONTROL DC – MID replaces FWD
- 3V11 FLT STA TEMP CONTROL DC – FLT STA replaces MID CABIN
- 3Y10 ACS CHAN 1 DC – added

NO. 2 RADIO BUS

- 1C19 HF NO. 2 DC – was HF COMM NO. 2 DC 1C19
- 1C23 VHF NO. 3 – was VHF COMM NO. 3 1C23
- 1C24 SELCAL NO. 2 – added

DC BUS NO. 3

- 2C8 HOST ADVSY IND – deleted
- 2C19 WINDSHIELD WASHER CONT – was INS CONT WINDSHIELD CONT 2C19
- 2E7 FLT KIT FLOOD LTS – added
- 2H20 RUDDER HYD LMTR CHAN 2 – added
- 3A16 BUS 3 GALLEY POWER – deleted
- 3M13 ACCESS VEMT AIR – deleted
- 3V15 GALLEY TEMP CONTROL DC – deleted
- 3Y16 ACS CHAN 2 DC – added

ESSENTIAL DC BUS

- 1B2 GPWS DC – added
- 1B3 AFCS MODE IND – was at 1B1
- 1B9 AFT COUPLER NO. 1 – was at 1B7
- 1E5 NO. 1 NAV & INS DC – added
- 1E22 NO. 2 NAV & INS DC – added
- 3H6 INS COOLING FAN CONT – added

ESSENTIAL DC RADIO BUS

No Changes

AC STANDBY BUS

No Changes

DC STANDBY BUS

- 1C8 ECS SCHED ENG NO. 1 – added
- 1C9 ECS SCHED ENG NO. 2 – added
- 1H14 GRAVITY FEED VALVES TANK 1A – added
- 1H15 GRAVITY FEED VALVES TANK 3A – added
- 1J8 FWD CARGO SMOKE DET A – added
- 1J9 FWD CARGO SMOKE DET B – added
- 1K9 FIREBELL PWR FIRE DETECTION – was at 1J6

ENGINE START BUS

- 1E13 START CONT ENG 1 – was START JET VALE ENG 1 1E13
- 1E14 START CONT ENG 2 – was START JET VALE ENG 2 1E14
- 1E15 START CONT ENG 3 – was START JET VALE ENG 3 1E15
- 1E16 FUEL FL RGLTR ENG 1 – was HP3 BLEED AIR ENG 2 1E16
- 1E17 FUEL FL RFLTR ENG 2 – was HP3 BLEED AIR ENG 2 1E17
- 1E18 FUEL FL RGLTR ENG 3 – was HP3 BLEED AIR ENG 3 1E18
- 1H14 GRAVITY FEED TANK 1A – added
- 1H15 GRAVITY FEED TANK 3A – added

BATTERY BUS

- 1A17 FWD CARGO FIRE EXT ALTN – added
- 1A18 FWD CARGO FIRE EXT MAIN – added

ESSENTIAL COMMUNICATIONS BUS

No Changes

APU BATTERY BUS

No Changes

(OPPOSITE SIDE BLANK)

GENERAL DESCRIPTION

EMERGENCY EXITS

The eight cabin doors and the flight station overhead escape hatch comprise the nine emergency exits.

FLIGHT STATION ESCAPE HATCH

The crew emergency exit is located in the top of the flight station aft of the pilots' seats. The hatch opens in and aft. Five emergency descent handles are provided, each connected to an inertia reel.

Before climbing out through the hatch, the crew member grasps a handle and exits over the side of the aircraft, facing inward. The inertia reel slows the descent.

Evacuation Signal Panel

Ten evacuation signal panels are provided: one in the flight station, eight in the cabin area (one at each flight attendant's station), and one in the galley.

DOORS

Flight Station Door

This door is manually operated by a standard doorknob. A key is required to open the door from the cabin side; however, if electrical power is available and the cockpit is occupied, the door lock may be released electromagnetically by a pushbutton switch on the center console. The door can be opened from inside the cockpit at any time by rotating the doorknob.

Passenger Cabin Doors

Six double width entry doors, L & R 1, 2 and 3, are provided for normal entry and exit. In addition, the single width rear doors, L & R 4, are provided for emergency exit.

A flight attendant's station is located at each of the eight cabin doors.

The six forward entry doors can be opened electrically or mechanically (spring-loaded units). The two aft doors can only be opened mechanically. Controls for opening the doors from inside the aircraft are located on a panel just forward of each door. Each of the eight doors has manual controls for external operation located forward of and adjacent to the door on the outside skin.

Whenever any of the eight doors is not closed and locked, the respective light on the Second Officer's annunicator panel is illuminated. The six forward doors are equipped with an inflatable slide/raft. The two aft doors are equipped with an inflatable slide. Operation of the door emergency release, with the girt bar engaged, will open the door mechanically and deploy the slides automatically. The six forward doors cannot be opened electrically if the girt bar is engaged.

A manual inflation handle is installed at the top of the slide assembly and becomes visible when the slide is deployed. If the automatic inflation mechanism malfunctions, the manual handle must be pulled to inflate the slide.

The emergency lighting system provides illumination inside the cabin at all eight passenger doors and their evacuation slide area.

Slide/Raft Equipment

1. Survival Kit

   Canopy with Mast and Rods
   Dye Marker
   Hand Pump
   Bailing Bucket
   Water Canteen
   Sponge
   Whistle
   Flashlight
   Repair Kit
   Scout Knife
   Mirror
   Day-Night Flares (2)
   First Aid Kit
   Survival Book

2. Sea Anchor

3. Heaving Line

4. Boarding Stations

5. Locator Light

6. Upper and Lower Tube Inflation Valves.

SEAT CUSHIONS

The bottom cushion of each passenger seat may be used as a flotation device. Straps are provided on the underside of each cushion as hand-holds.

LIFE VESTS

Crew vests are located at each crew member's seat. A special compartment is provided in the back of the Captain's, First Officer's, and Second Officer's seat.

Passenger vests are located in pouches under each seat. Spare vests are located as follows:

7 - Forward stowage compartment

12 - Adjacent to doors 2L/R and 3L/R, three on each side

6 - Three in each doghouse across the aisle from 4L/4R.

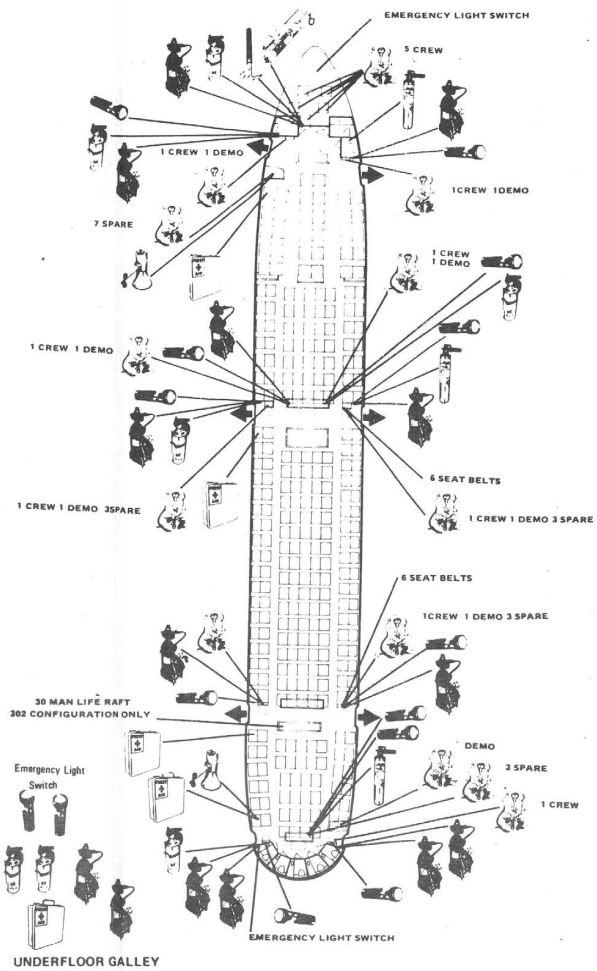
EMERGENCY RADIOS

The Rescue 99 emergency radio is installed as part of the overwater equipment and is located in the cockpit adjacent to the First Observer's seat. Operating instructions are placarded on the unit.

GENERAL DESCRIPTION

L-1011-1 EMERGENCY EQUIPMENT LOCATION

H_2O EXTINGUISHERS	1 – In coat closet # 1 (FWD right coat closet). 1 – At 2R jumpseat. 1 – In doghouse AFT center seat R.H. side
HALON EXTINGUISHERS Halon extinguishers will replace CO_2 extinguishers. Either the Halon extinguishers or the CO_2 will be on the aircraft, not both.	1–In cockpit left side of A/C 1–Adjacent to 1L jumpseat 1–Forward of 2L jumpseat 1–Adjacent to 4L jumpseat 2–In lower galley
CO_2 EXTINGUISHERS	1 – In cockpit left side A/C. 1 – In compartment adjacent to 1L jumpseat 1 – Forward of 2L jumpseat 1 – In doghouse AFT center seat L.H. side 2 – In lower galley on either side, adjacent to each jumpseat
EMERGENCY OXYGEN	Mask location in Passenger Service Units above each set of seats. 1 – Mask overhead at each F/A seat except MSC which is equipped with two. 2 – Masks in each lavatory unit. 2 – Masks overhead in lower galley, 1 over each jumpseat. 2 – Masks overhead at aft F/A double jumpseat.
SUPPLEMENTAL OXYGEN	(See locations below).
FIRST AID OXYGEN CHEMICAL OXYGEN BOTTLES (AVIOX) Single Pak Units	(See locations below). 1 – Adjacent to 1R, 2R, 3R, 4L, 4R jumpseat. 2 – At MSC (behind last row B zone center seats). 2 – At Aft F/A double seat. NOTE: Gaseous O_2 bottles at these locations on Ship #728 and subsequent ships.
O_2 (GASEOUS)	1 – Behind 1L jumpseat 1 – Behind 2L jumpseat 1 – Behind 3L jumpseat 2 – In lower galley on either side adjacent to jumpseat
FIRST AID KIT	1 – In overhead stowage bin AFT of 1L door. 1 – In overhead stowage bin AFT of 2L door. 1 – In overhead stowage bin AFT of 3L door. 1 – In overhead stowage bin FWD of 4L door. 1 – Lower galley attached to wall over sink
MEGAPHONE	1 – In FWD stowage compartment adjacent to 1L door. 1 – In overhead stowage bin FWD of 4L door.
FIRE AXE	1 – In cockpit on left bulkhead.
SEAT BELT EXTENSIONS	6 – In jumpseat storage compartment at 2R door. 6 – In jumpseat storage compartment at 3R door.
EMERGENCY LIGHT SWITCH	1 – In cockpit. 1 – On FWD F/A panel at 1L. 1 – On AFT F/A panel at 4L. 1 – Lower galley above interphone system.
DOOR EXITS	3 – Doors on left side of A/C – automatic slide/raft at doors 1 – 3L. 1 – Door on left side of A/C – automatic slide at 4L door. 3 – Doors on right side of A/C – automatic slide/raft at doors 1 – 3R. 1 – Door on right side of A/C – automatic slide at 4R door.
FLOTATION EQUIPMENT	Single lane slides at 4L and 4R. Each passenger seat cushion.
SLIDE/RAFTS	1 – 51 man double lane slide/raft at 1L and 1R door. 1 – 51 man double lane slide/raft at 2L and 2R door. 1 – 51 man double lane slide/raft at 3L and 3R door. Radio beacon located in cockpit. 1–30 man life raft in 3 crossaisle coat room (302 configuration only)
LIFE VESTS	Passenger life vests under each seat. 5 – Crew vests in cockpit. 1 – Crew vests at each crew position. 25 spare lifevests located: 7 – In FWD stowage compartment adjacent to 1L door 3 – In stowage compartment of 2L and 2R jumpseats. 3 – In stowage compartment of 3L and 3R jumpseats. 3 – In doghouse across the aisle from 4L jumpseat. 3 – In doghouse across the aisle from 4R jumpseat. 1 – Demo vest at each single jumpseat.
FLASHLIGHT LOCATIONS	1 – Above 1L jumpseat. 1 – Adjacent to 1R jumpseat. 4 – Behind and attached to 2R, 3R, 2L, and 3L jumpseats – 1 at each station. 1 – Behind last row B zone center seats – right. 1 – Behind last row B zone center seats – left. 1 – Above 4L jumpseat. 1 – Above 4R jumpseat. 2 – Adjacent to aft double jumpseat. 1 – Lower galley attached to wall over sink. 1 – Lower galley adjacent to jumpseat – right side.



L-1011-1 EMERGENCY EQUIPMENT LOCATION

(OPPOSITE SIDE BLANK)

EVACUATION COMMAND SWITCH

A guarded switchlight provided to activate the evacuation signal system.

IN - Energizes the evacuation signal intermittent horn and flashing EVAC light in flight station, galley, and each passenger door. EVAC is illuminated.

OUT - Disables horn and flashing lights. EVAC is extinguished.

HORN CUTOUT SWITCH

A momentary pushbutton switch provided to silence the evacuation signal at the panel.

1B17 - EVAC SIGNAL

PILOTS' OVERHEAD PANEL

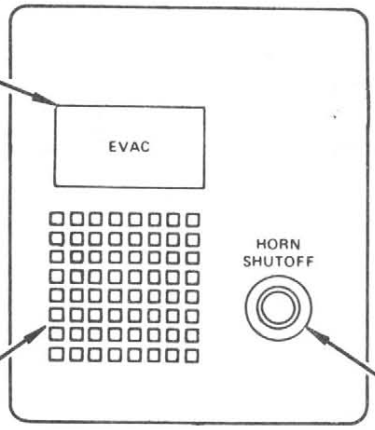
1B17 - EVAC SIGNAL

EVACUATION LIGHT

Flashes when evacuation command switch is pushed to IN position.

HORN

sounds intermittently when the command switch is IN. Horn is silenced with horn cutout switch.



EVACUATION LIGHT

(Same as pilots')

HORN

(Same as pilots')

HORN CUTOUT SWITCH

(Same as pilots')

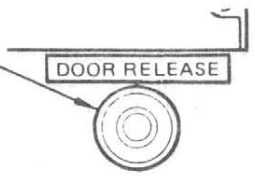
An Evacuation Signal Panel is located on the aft side of all Passenger Entry and Emergency Exit Doors. The Galley Evacuation Signal Panel is located between the Galley Lifts near Galley Ceiling.

EMERGENCY EVACUATION SIGNAL PANELS (10)

FLIGHT STATION DOOR RELEASE SWITCH

Momentary pushbutton switch. When held in, switch energizes a solenoid that releases the cockpit door lock.

2F9 – DOOR LATCH RLSE



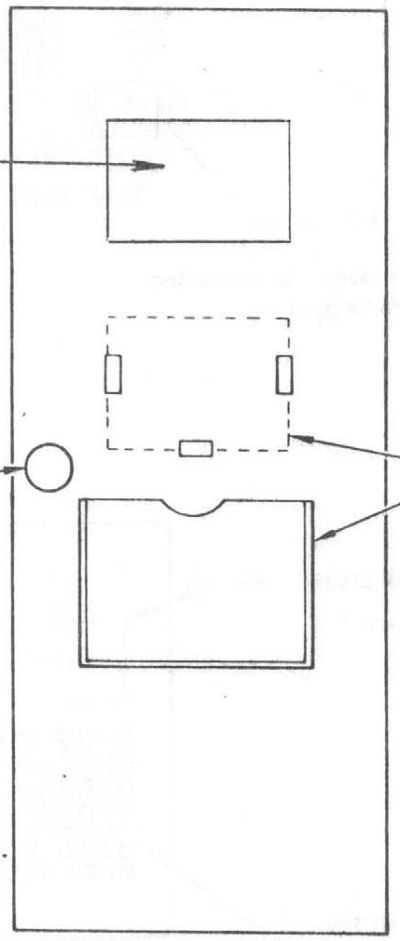
CENTER CONSOLE

MIRROR/WINDOW

Hinged cover which can be opened from the cockpit side to view passenger compartment.

DOOR KNOB

The aft knob of the door requires a key to open the door from the cabin side. The door can be opened at any time from the cockpit by rotating the forward knob.



FLIGHT STATION SIDE
LOOKING AFT

FLIGHT STATION DOOR
(FLIGHT STATION SIDE)

CONTROLS & INDICATORS

EXIT SIGN

1, 2, 3 and 4; L & R.
Battery operated incandescent lighted sign controlled by the emergency lighting system.

EVACUATION SLIDE LEVER

1, 2, 3 and 4; L & R.
Engages or detaches the evacuation slide girt bar latching mechanism on all cabin doors, and controls the open and close circuits on doors 1, 2, and 3; L & R.

DOOR EMERGENCY T-HANDLE

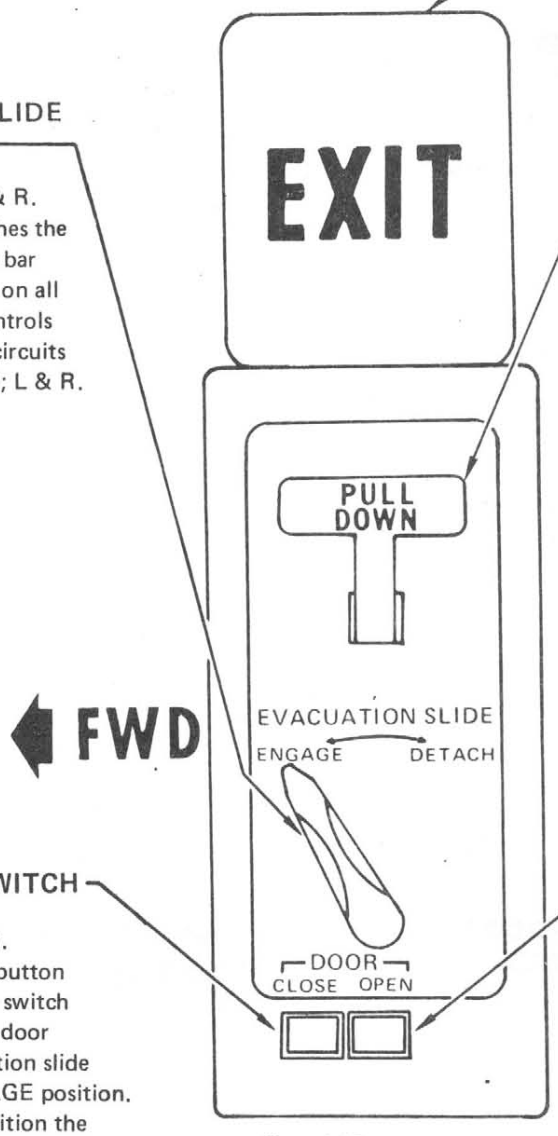
1, 2, 3 and 4; L & R.
Manually opens the door and deploys the evacuation slide.

The handle has two detents. The first detent withdraws the locking pin so that door can be opened with speed wrench. Pulling the actuator all the way down to the second detent mechanically opens the door.

Pulling the T-Handle to second detent, with the evacuation slide lever in the ENGAGE position, opens the door and deploys the slide.

Pulling the T-Handle to second detent, with the evacuation slide lever in the DETACH position, opens the door without deploying the slide.

The handle must be in the stowed position to have electrical power to the door.



DOOR CLOSE SWITCH

1,2, and 3; L & R.
Momentary pushbutton switch. Holding the switch in electrically closes door provided the evacuation slide lever is in the ENGAGE position. In the DETACH position the door cannot be closed electrically.

DOOR OPEN SWITCH

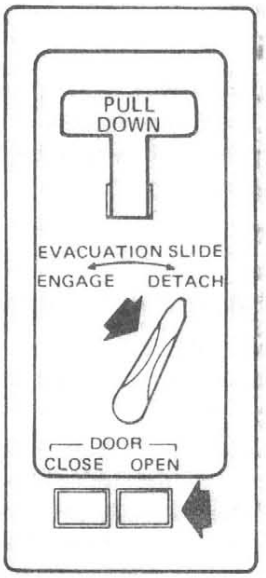
1, 2, and 3; L & R.
Momentary pushbutton switch. Holding the switch in electrically opens door provided the evacuation slide lever is in the DETACH position. In the ENGAGE position, the door cannot be opened electrically.

4L and 4R
The doors open only with the emergency PULL handle. They must be closed manually.

DOORS CANNOT BE OPERATED ELECTRICALLY IN FLIGHT

GALLEY LEFT CB PANEL

DOOR OPERATING CONTROLS
(FORWARD OF EACH DOOR INSIDE THE CABIN)

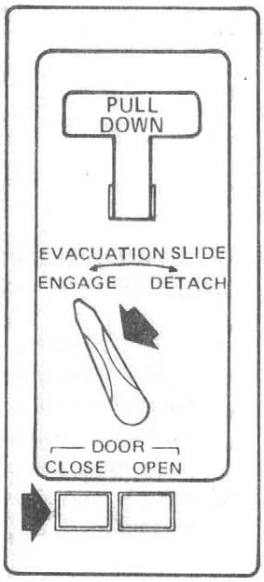


OPENING DOOR NORMAL MODE

GIRT BAR DETACHED

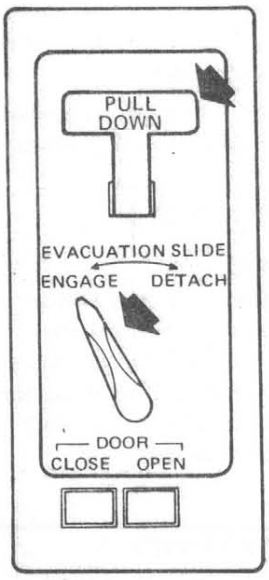
Push OPEN switch to unlock and open door electrically.

CLOSING DOOR – NORMAL MODE



GIRT BAR ENGAGED

Push CLOSE switch to close and lock door electrically.

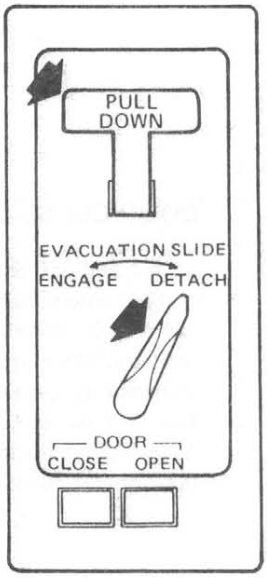


OPENING DOOR – EMERGENCY MODE

GIRT BAR ENGAGED

Emergency handle unlocks and opens door mechanically and deploys escape slide automatically.

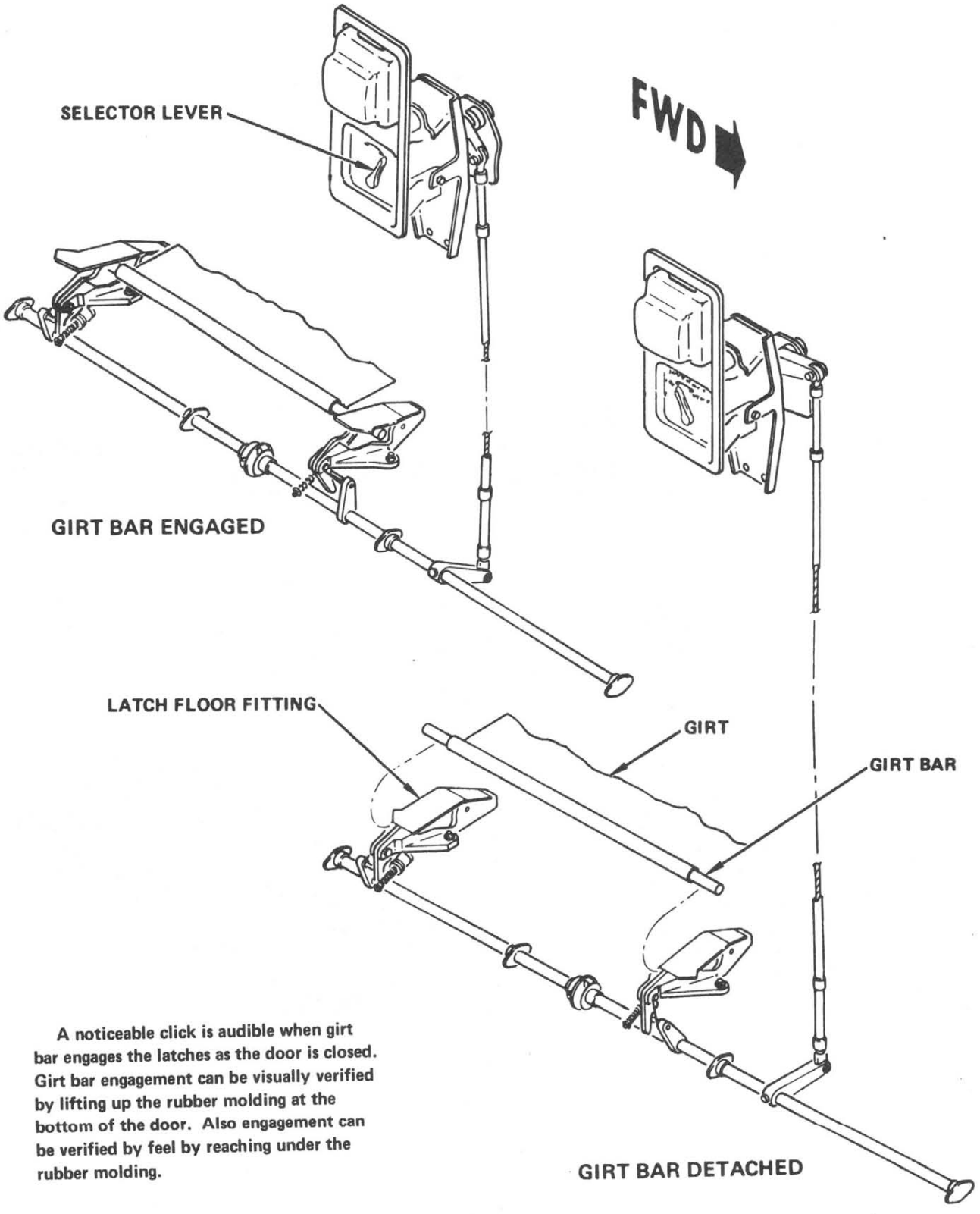
OPENING DOOR – MANUAL MODE



GIRT BAR DETACHED

Pull handle
1st detent unlocks door
2nd detent opens door mechanically.

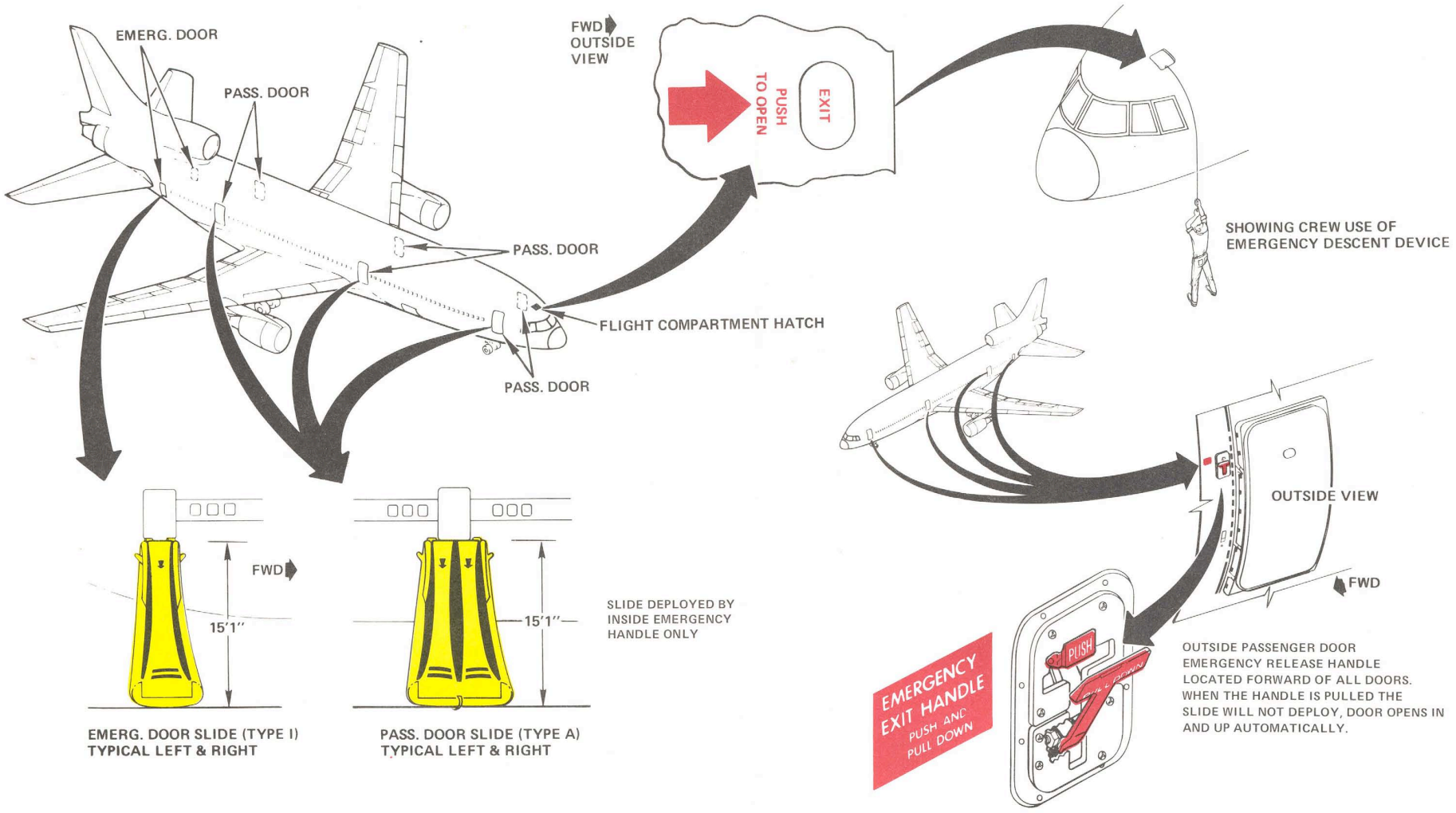
PASSENGER DOOR CONTROL
L & R 1, 2 and 3



A noticeable click is audible when girt bar engages the latches as the door is closed. Girt bar engagement can be visually verified by lifting up the rubber molding at the bottom of the door. Also engagement can be verified by feel by reaching under the rubber molding.

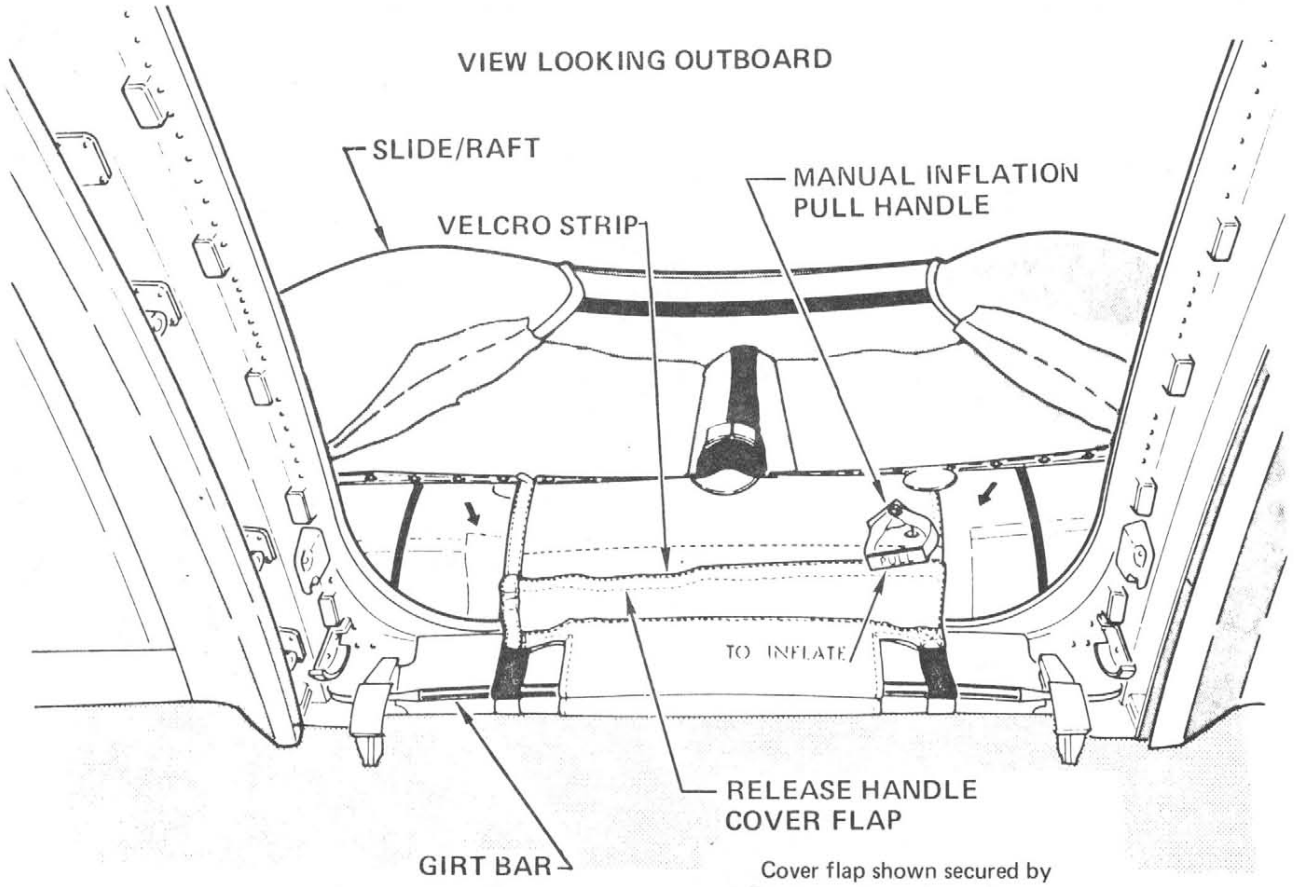
GIRT BAR POSITIONS
(ONE AT EACH PASSENGER DOOR -8)

(OPPOSITE SIDE BLANK)

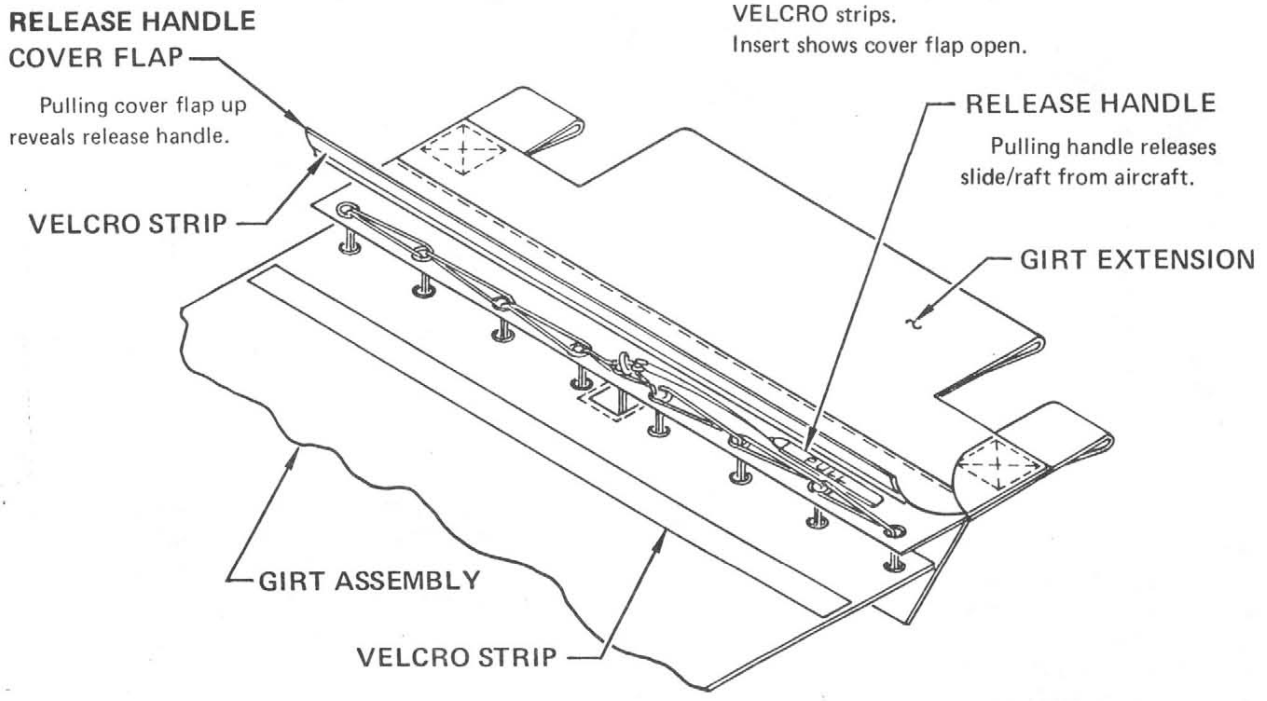


EMERG. DOOR SLIDE (TYPE I)
TYPICAL LEFT & RIGHT

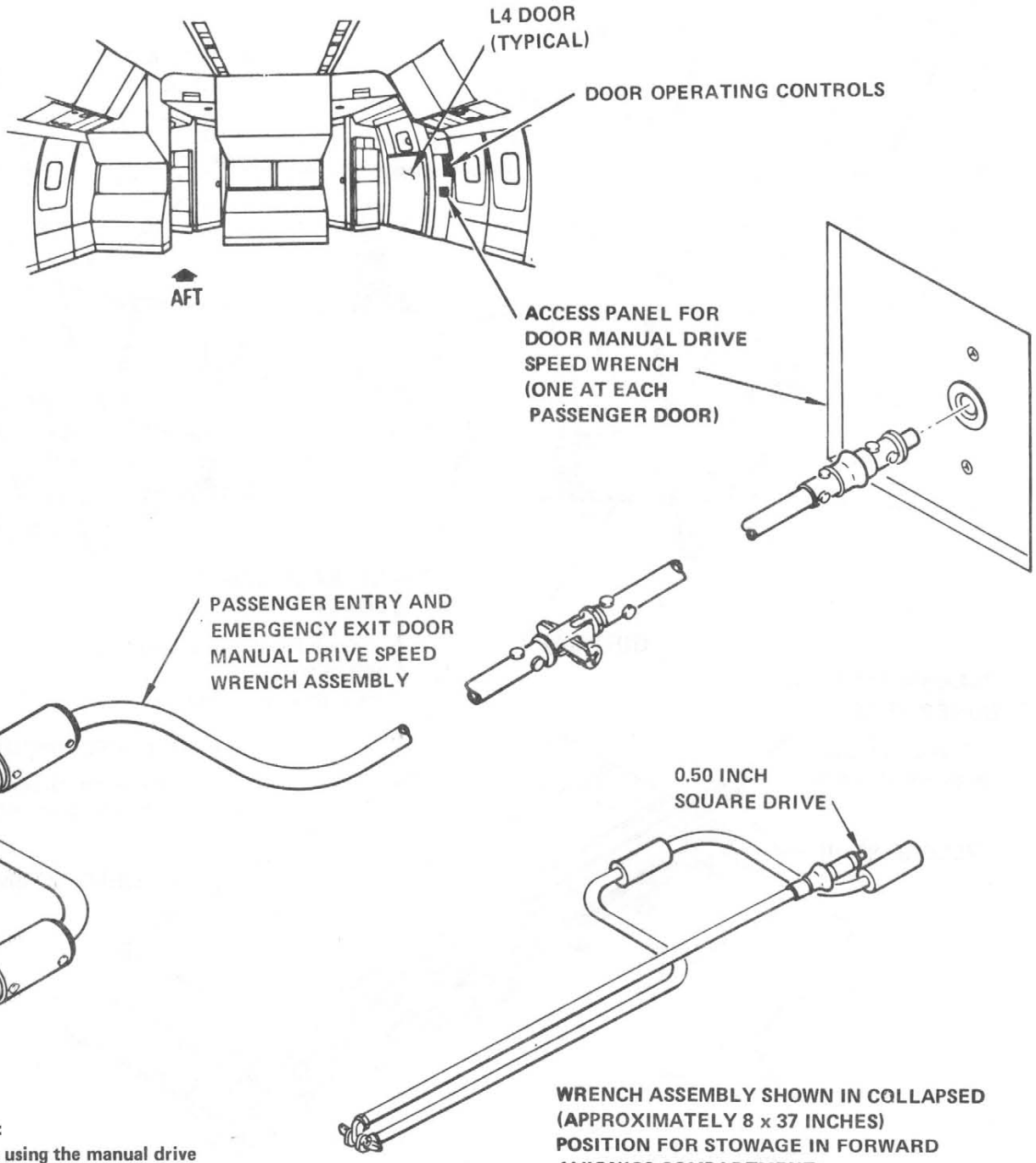
PASS. DOOR SLIDE (TYPE A)
TYPICAL LEFT & RIGHT



Cover flap shown secured by VELCRO strips.
Insert shows cover flap open.

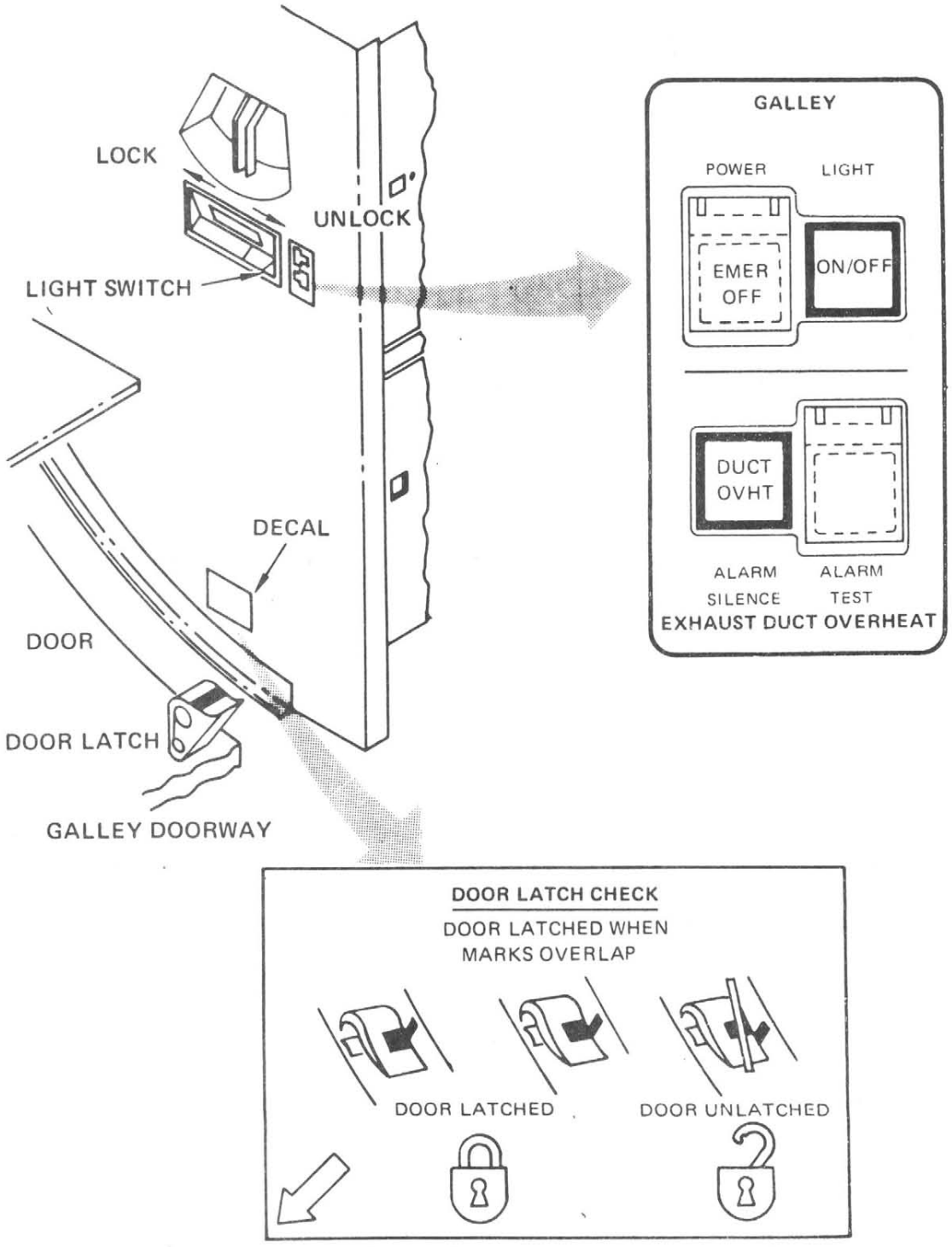


ESCAPE SLIDE MANUAL INFLATION HANDLE
(SLIDE SHOWN DEPLOYED AND INFLATED)



NOTE:
Before using the manual drive wrench, pull the inside T-Handle to the first detent to release door locks. When door is closed, push the T-Handle CLOSED to lock the door.

PASSENGER DOOR MANUAL DRIVE
SPEED WRENCH ASSEMBLY



GALLEY SERVICE DOOR, GALLEY EMERGENCY POWER SHUTOFF SWITCHLIGHT AND GALLEY EXHAUST DUCT OVERHEAT PANEL CONTROLS

(OPPOSITE SIDE BLANK)

EMERGENCY EQUIPMENT

GENERAL DESCRIPTION

EMERGENCY EQUIPMENT

Passenger Cabin Doors

There are six passenger cabin doors. The L/R3 doors are double entry Type-A doors, but they are four inches shorter in height than the L/R1 and 2 doors. All six doors can be opened either electrically or manually and can be used for normal entry and exit or for emergency exit.

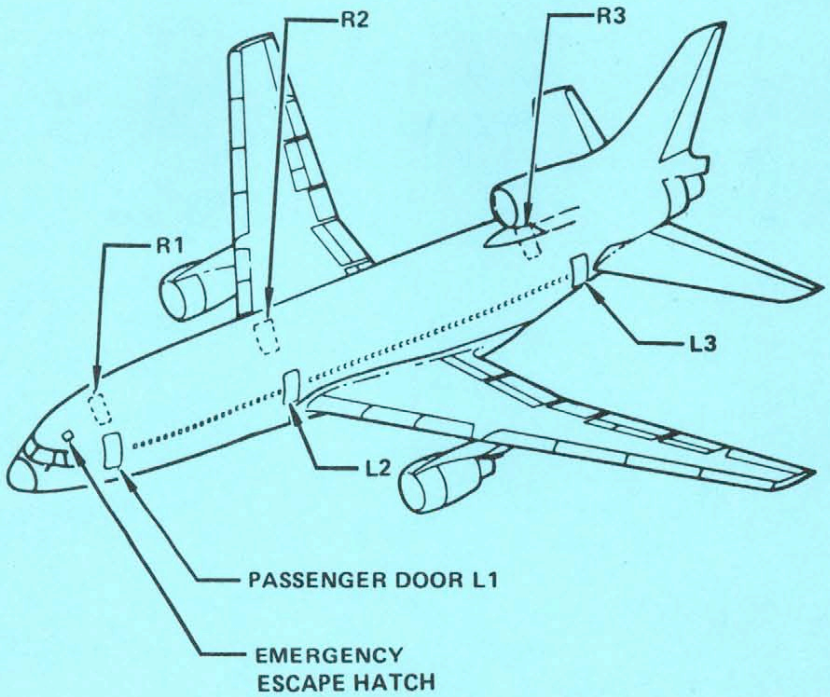
All six doors are equipped with slide/rafts. The slide/rafts located at the L/R3 doors are larger 56-man capacity compared to the 51-man capacity slide/rafts located at L/R 1 and 2.

A flight attendant's station is located at each of the six doors.

Evacuation Signal Panel

Seven evacuation signal panels are provided – one in the flight station and six in the cabin area (one at each flight attendant's station). The evacuation signal can only be initiated from the panel in the flight station.

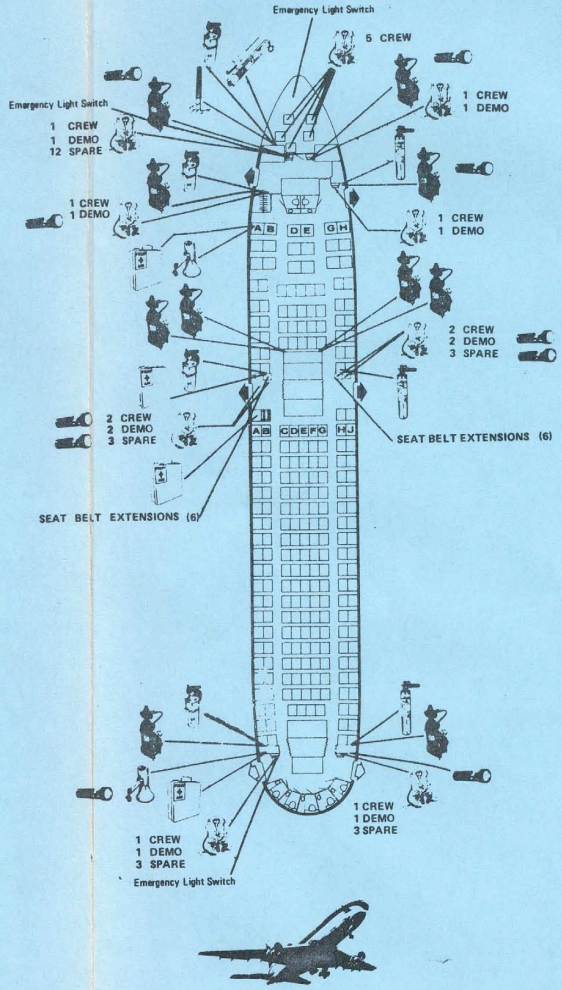
EMERGENCY EXIT LOCATIONS



(OPPOSITE SIDE BLANK)

L-1011-500 EMERGENCY EQUIPMENT LOCATION

H_2O EXTINGUISHERS	1 – Adjacent to 1R jumpseat 1 – Forward of 2R jumpseat 1 – Behind last row of seats of C zone - right side
HALON EXTINGUISHERS	1 – Cockpit Aft Second Observers Seat 1 – Adjacent to 1L jumpseat 1 – Forward of 2L jumpseat 1 – Behind last row of seats of C zone - left side
EMERGENCY OXYGEN	Masks located in Passenger Service Units above each set of seats. Each set of seats has one extra mask. 1 – Mask overhead at each Flight Attendant seat 2 – Masks in lavatory unit
SUPPLEMENTAL OXYGEN	Gaseous bottles (see locations below)
FIRST AID OXYGEN	Gaseous bottles (see locations below)
GASEOUS OXYGEN BOTTLES	4 – Adjacent to 1L and 1R jumpseats, in compartment above 1LA and 1RA jumpseats 4 – Forward of coat closet (two on each side) 2 – Behind last row of seats of C zone (one on each side)
FIRST AID KIT	1 – Overhead bin aft of 1L 1 – Overhead bin aft of 2L 1 – Overhead bin forward of 3L 1 – Overhead Bin Forward Of 2L
MEGAPHONE	1 – Overhead bin aft of 1L 1 – Overhead bin forward of 3L
FIRE AXE	1 – In cockpit on left side
SEAT BELT EXTENSIONS	6 – Storage compartment 2L jumpseat 6 – Storage compartment 2R jumpseat
EMERGENCY LIGHT SWITCH	1 – In cockpit 1 – On forward Flight Attendant panel at 1L 1 – On aft Flight Attendant panel at 3L
DOOR EXITS	3 – Doors on left side of aircraft - automatic slide/rafts at doors 1 - 3R 3 – Doors on right side of aircraft - automatic slide/rafts at doors 1 - 3R
FLOTATION EQUIPMENT	Each passenger seat cushion
SLIDE/RAFTS	51 – Passenger capacity slide/rafts at 1L and 1R doors 51 – Passenger capacity slide/rafts at 2L and 2R doors 56 – Passenger capacity slide/rafts (two feet longer) at 3L and 3R doors
LIFE VESTS	Passenger life vests under each seat 1 – Red crew vest at each crew position 24 – Spare vests located: 12 – In compartment above 1LA jumpseat 3 – Adjacent to Flight Attendant jumpseat at 2L and 3L 3 – Adjacent to Flight Attendant jumpseat at 2R and 3R
FLASHLIGHT LOCATIONS	1 – Adjacent to 1L jumpseat. 1 – Adjacent to 1LA jumpseat. 1 – Adjacent to 1RA jumpseat. 1 – In forward right stowage area – adjacent to 1R jumpseat. 2 – Adjacent to 2L jumpseat. 2 – Adjacent to 2RA jumpseat. 1 – Above 3L handset. 1 – Above 3R handset.



L-1011-500 EMERGENCY EQUIPMENT LOCATION

END

(OPPOSITE SIDE BLANK)

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FIRE DET LOOP light....2
Fire detection loop test panel....3

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GALLEY SMOKE light and panel....9
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-500 DIFFERENCES

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FORWARD CARGO SMOKE DETECTION....1/3-4
FORWARD CARGO FIRE EXTINGUISHER....1/3-4

CROSS REFERENCES

APU AUTO FIRE SHUTDOWN....APU
PORTABLE FIRE EXTINGUISHERS....EMERGENCY EQUIPMENT
EMERGENCY SHUTOFF VALVES AND TANK VALVES....FUEL
GENERATOR FIELD BREAKER....ELECTRICAL
HYDRAULIC PUMP SHUTOFF VALVES....HYDRAULICS
PNEUMATIC HI-PRESS AND ENGINE ISLN VALVES....PNEUMATICS

GENERAL

Fire or overheat detection is provided for the engines, APU, nacelles, pylons, main wheel wells and galley exhaust duct. Smoke detection is also provided for the galley. All fire and overheat detection circuits use dual-loops or sensors except for the galley system.

Fire protection if provided by two freon type fire extinguisher bottles installed for each engine. The fire bottles for engine No. 2 are also used for the APU.

ENGINE/APU FIRE DETECTION

Dual-loops are used to monitor the temperature around the accessory and burner sections of each engine.

The FIRE DETECTION LOOP TEST panel on the upper portion of the S/O's panel is used to monitor and control the fire detection loops.

When a fire (loop overheat) is detected, the following indications occur:

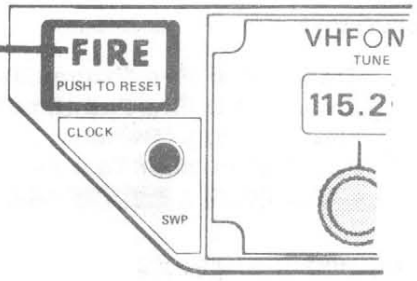
- Fire warning bell sounds.
- Respective FIRE PULL handle light illuminates.
- Both master FIRE lights illuminate.
- Respective fire detection loop lights illuminate.
- FIRE DET LOOP light illuminates on the Pilot's Annun. Panel.
- An APU fire warning sounds the external APU fire warning horn if the APU MASTER POWER switch is ON. The horn is inhibited in flight.

MASTER FIRE WARNING LIGHT (2)

- Illuminates when:
  - Any engine, APU, or wheel well loop selector is selected to BOTH and **both** the A and B fire loops detect an overheat.
  - Any engine, APU, or wheel well loop selector is selected to A or B and the **selected** loop detects an overheat.
- Pressing either FIRE light extinguishes both lights and silences the fire warning bell.

1J14 - MASTER ALARM PWR ENG 1, 2, 3, WHEEL WELL & APU

1J6 - FIREBELL PWR

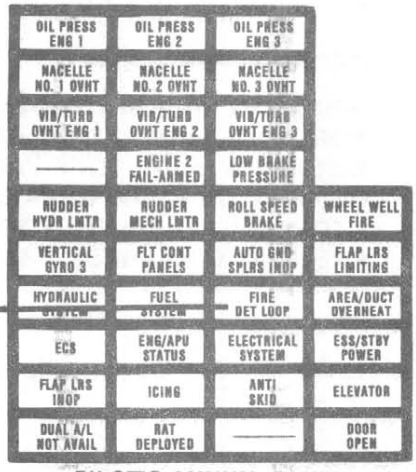


GLARESHIELD

FIRE DET LOOP LIGHT

Illuminates when any A or B light illuminates on the FIRE DETECTION LOOP TEST panel.

1K1, 2, 3 - LOOP A ALARM; ENG 1, 2, 3
1K4 - LOOP A ALARM; APU
1K5, 6, 7 - LOOP B ALARM; ENG 1, 2, 3
1K8 - LOOP B ALARM; APU



PILOT'S ANNUN. PANEL

A AND B LOOP LIGHTS (AMBER) (8)

- Illuminates when:
  - Respective TEST button is pressed.
  - Overheat is detected by respective fire detection loop.
- FIRE DET LOOP illuminates on Pilot's Annun. Panel when any A or B light illuminates.

1D16-18 - APU FIRE DETECT
1K1-8 - FIRE DETECTION LOOP A & B ALARM

LOOP SELECTOR (4)

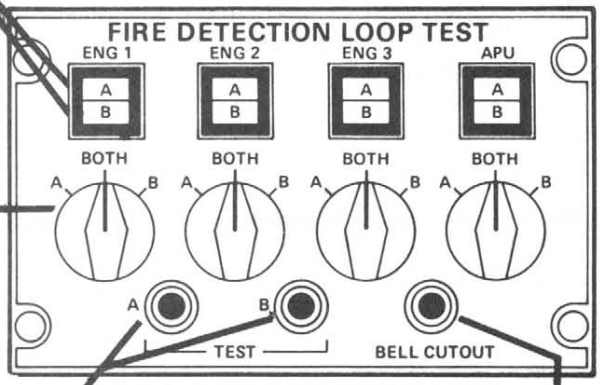
Determines which fire detection loop(s) will activate the engine/APU fire warnings.

BOTH - Both A & B fire detection loop lights must illuminate on the respective engine to activate fire warnings.

A - Deactivates the B loop. Illumination of the A light activates fire warnings.

B - Deactivates the A loop. Illumination of the B light activates fire warnings.

1D16-18 - APU FIRE DETECT
1K1-8 - FIRE DET LOOP A & B ALARM, ENG 1-3/APU



S/O'S UPPER INSTRUMENT PANEL

FIRE DETECTION LOOP TEST BUTTONS

Tests fire warning circuits by introducing a false fire signal into the detector loop circuits.

- With loop selectors in A or B, pressing respective TEST button activates fire warnings.
- With loop selectors in BOTH, both TEST buttons must be pressed to activate fire warnings.

1D16-18 - APU FIRE DETECT
1K1-8 - FIRE DET LOOP A & B ALARM, 1-3/APU

FIRE WARNING BELL CUTOUT BUTTON

Pressing button silences fire warning bell.

1J5 - FIRE DETECTION TEST
1J6 - FIREBELL POWER

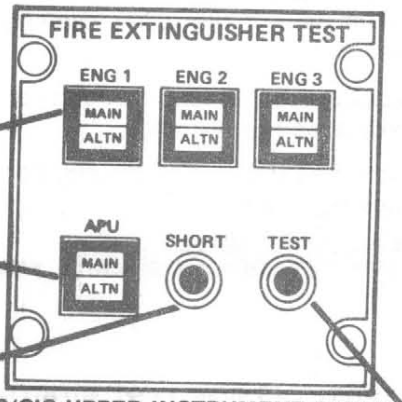
ENGINE/APU FIRE EXTINGUISHING

The three engine FIRE PULL handles located on the upper portion of the pilot's overhead panel. An APU FIRE PULL handle is installed on the upper left corner of the S/O's instrument panel for the APU.

Each engine contains two freon fire extinguisher bottles. The MAIN and ALTN bottles are identical and are identified as ALTN and MAIN on each engine. The No. 2 engine and APU share the same set of bottles.

Fire extinguisher discharge is controlled by a toggle switch behind each FIRE PULL handle. Pulling the handle exposes the switch to permit actuation. Pressing the switch to the left discharges the respective ALTN bottle, and ALTN illuminates to indicate bottle discharge. Pressing the switch to the right discharges the respective MAIN bottle, and MAIN illuminates to indicate bottle discharge. Power to discharge the bottles is supplied by the battery bus.

The FIRE EXTINGUISHER TEST panel on the upper portion of the S/O's panel is used to test the fire extinguisher circuits.



S/O'S UPPER INSTRUMENT PANEL

MAIN AND ALTN LIGHTS (AMBER) (8)

- When TEST is pressed, lights illuminate to indicate continuity in the respective circuits.
- When TEST and SHORT is pressed, an illuminated light indicates a short in the respective circuit.

2F7 - FIRE EXT LT

SHORT BUTTON

TEST button must be pressed and held to arm the SHORT button.

- With the TEST and SHORT buttons pressed all **MAIN** and **ALTN** lights should extinguish.
  - Any light which illuminates indicates the respective circuit is shorted.

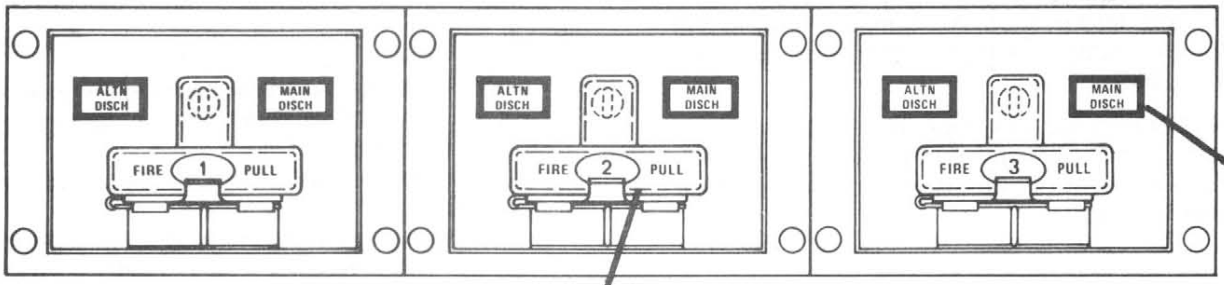
2F7 - FIRE EXT LT

TEST BUTTON

With the button pressed, all MAIN and ALTN lights should illuminate to indicate continuity in the respective circuits.

- Any light which remains extinguished with the TEST button pressed indicates a failure of the circuitry, or a discharged bottle.
- Pressing the SHORT button while TEST is pressed extinguishes all lights to indicate no circuits are shorted.

2F7 - FIRE EXT LT



PILOT'S OVERHEAD PANEL

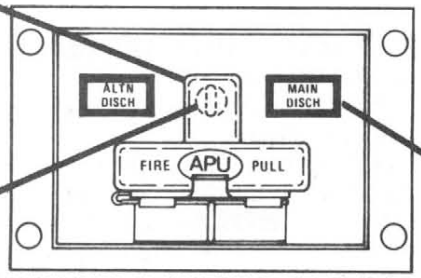
ENGINE/APU FIRE PULL HANDLE (4)

IN - Normal position to permit engine/APU operation.

FIRE PULL - Illuminates (red) when:
- System is tested.
- Respective engine loop(s) detect an overheat. Remains illuminated until fire is extinguished [loop(s) return to normal temperature range].
- Associated loop light(s) will also be illuminated on the FIRE DETECTION LOOP TEST panel.

PULLED - Provides emergency engine shutdown by causing the following to occur.
- Silences the fire warning bell. The APU handle also silences the external warning horn. (Bell will sound with subsequent fire warning.)
- Extinguishes master **FIRE** lights. (Lights will illuminate with subsequent fire warning.)
- Exposes fire extinguisher discharge switch.
- Closes the ENG ISLN VALVE (BLEED AIR S/O on APU).
- Opens the GENERATOR FIELD.
- Closes the fuel EMERGENCY SHUTOFF valve(s), and on engines 1 and 3 closes the ENG TANK valve.
- Closes the engine hydraulic pump FIREWALL S/O valve(s).
- APU handle signals inlet & ejector doors to close.

1K1 thru 8 - FIRE DETECTION LOOP A OR B ALARM ENG. 1, 2, 3, APU
1C16, 17 - FIRE EXTINGUISHER APU MAIN & ALT



S/O'S UPPER INSTRUMENT PANEL

FIRE DISCHARGE SWITCH (4)

Spring-loaded toggle switch controls discharge of the two fire bottles for each engine and APU. No. 2 engine and APU share the same fire bottles.

CENTER - Normal spring-loaded position. Switch is guarded in this position as long as the respective FIRE PULL handle is in.

LEFT - ALTN fire bottle is discharged.

RIGHT - MAIN fire bottle is discharged. The No. 2 engine/APU MAIN bottle can also be discharged automatically by the APU AUTO FIRE SHUTDOWN system.

1C10 thru 15 - ENG 1, 2, 3 MAIN, ALTN

MAIN DISCH & ALTN DISCH LTS (AMBER) (8)

- Respective light illuminates when fire bottle has discharged.
- When a bottle is discharged for No. 2 engine or APU the corresponding light also illuminates on the other panel, and on the APU External Control Panel.

1C10 thru 17 - ENG 1, 2, 3, APU MAIN, ALTN

NACELLE/PYLON OVERHEAT DETECTION

A dual-loop system monitors temperatures in the nacelle and pylon areas to detect high pressure bleed air leaks.

The NACELLE/PYLON OVHT DET TEST panel on the upper portion of the S/O's panel is used to monitor and control the nacelle/pylon overheat detection loops.

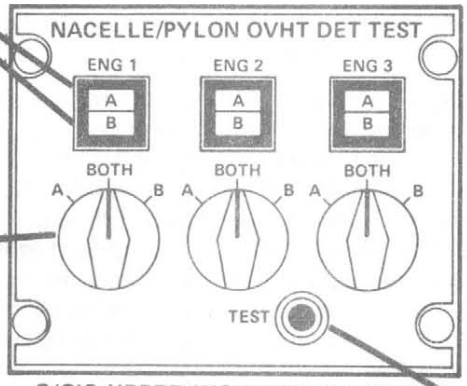
When an overheat is detected, the respective loop light(s) illuminate and:

- The HI PRESS VALVE closes if:
  - BOTH selected and **either** loop light illuminates.
  - A or B is selected and the selected loop light illuminates.
- The corresponding NACELLE OVHT light illuminates on the Pilot's Annun. Panel when:
  - BOTH selected and **both** loop lights illuminate.
  - A or B is selected and the selected loop light illuminates.

A AND B LOOP LIGHTS (AMBER) (6)

- Illuminates when:
  - TEST button is pressed and BOTH or respective loop is selected.
  - Overheat is detected by respective nacelle/pylon overheat detection loop.
- Respective NACELLE OVHT illuminates on Pilot's Annun. Panel when both loop lights illuminate or if selected loop light illuminates.

3L1, 3, 7, 9, 13, 15 - ENG OVHT LOOP A & B ALARM



S/O'S UPPER INSTRUMENT PANEL

LOOP SELECTOR (3)

Determines which nacelle/pylon overheat detection loop(s) will illuminate the respective NACELLE OVHT light and close the engine HI-PRESS valve.

BOTH - Both A an B lights must illuminate on the respective engine to illuminate the associated NACELLE OVHT light. The engine HI-PRESS valve will close when **either** loop light illuminates.

A - Deactivates B loop. Illumination of A light illuminates NACELLE OVHT & closes HI-PRESS valve.

B - Deactivates A loop. Illumination of B light illuminates NACELLE OVHT & closes HI-PRESS valve.

3L2, 4, 8, 10, 14, 16 - ENG OVHT LOOP A & B PWR

NACELLE/PYLON OVHT DET TEST BUTTON

Tests overheat detection circuits by introducing a false overheat signal into the detector loop circuits.

- Pressing TEST illuminates the 3 NACELLE OVHT lights on the Pilot's Annun. Panel, and illuminates the selected loop lights.
  - With loop selector switches in BOTH all (6) loop lights illuminate.

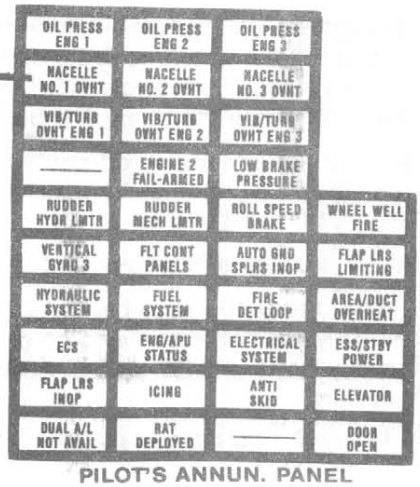
3L2, 4, 8, 10, 14, 16 - ENG OVHT LOOP A & B PWR

NACELLE OVHT LIGHT (AMBER) (3)

Illuminates when:

- Respective nacelle/pylon overheat detector selector is in BOTH and both loops detect an overheat on the respective engine.
- Respective nacelle/pylon overheat detector selector is in A or B and selected loop detects an overheat.
- Nacelle/pylon TEST button is pressed.

3L1-4 - NO. 1 ENGINE OVHT LOOP A & B ALARM & PWR
3L7-10 - NO. 2 ENGINE OVHT LOOP A & B ALARM & PWR
3L13-16 - NO. 3 ENGINE OVHT LOOP A & B ALARM & PWR



PILOT'S ANNUN. PANEL

TURBINE OVERHEAT DETECTION

Two thermal switches are installed in each engine to monitor the temperature of the bleed air that is being used to cool the internal parts of the engine. An excessive temperature may be an indication of impending engine failure.

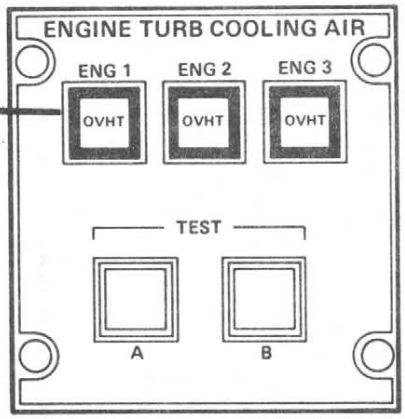
The ENG TURB COOLING AIR panel on the upper portion of the S/O's panel is used to test the turbine overheat detection switches.

When **both** thermal switches in an engine detect an excessive cooling air temperature the respective VIB/TURB OVHT will illuminate on the Pilot's Annun. Panel.

OVHT LIGHTS (RED) (3)

- Illuminates when:
  - Both TEST switches are pressed at the same time.
  - Both A & B thermal switches detect an overheat.
- Respective VIB/TURB OVHT illuminates on Pilot's Annun. Panel when OVHT illuminates.

3M1, 2, 3, 7, 8, 9, 13, 14, 15 - ENG TURB OVHT DETECTION



S/O'S UPPER INSTRUMENT PANEL

ENG TURB COOLING AIR TEST SWITCHES

Tests thermal switch status in each engine.

- Switch illuminates while switch is pressed.
- Pressing both switches at the same time illuminates the three OVHT lights, and the three VIB/TURB OVHT lights on the Pilot's Annun. Panel.
  - Illumination of an OVHT & VIB/TURB OVHT light when only one TEST switch is pressed indicates the remaining thermal switch has sensed an overheat or a system failure.

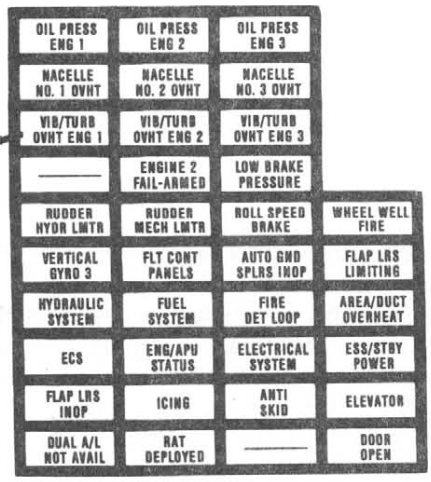
3M1, 2, 3, 7, 8, 9, 13, 14, 15 - ENG TURB OVHT DETECTION

VIB/TURB OVHT LIGHT (RED) (3)

Illuminates when:

- Turbine overheat is sensed.
- Excessive engine vibration is sensed (see Power Plant section).
- During engine turbine overheat or vibration system tests.

3M1, 2, 3, 7, 8, 9, 13, 14, 15 - ENG TURB OVHT DETECTION



PILOT'S ANNUN. PANEL

WHEEL WELL FIRE DETECTION

Continuous dual-loops are used to monitor the temperature in the main wheel wells to detect a fire or overheated brakes.

The WHEEL WELL FIRE TEST panel on the upper right portion of the S/O's panel is used to control and monitor the wheel well fire detection loops.

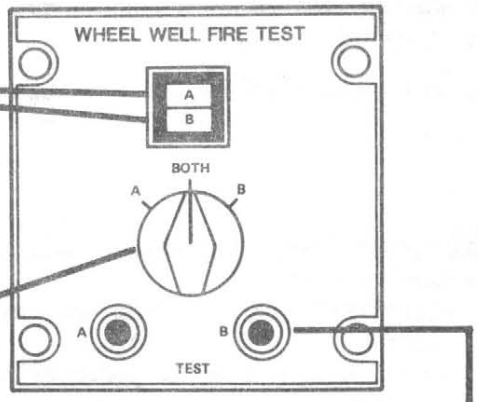
When a wheel well fire (loop overheat) is detected, the following indications occur:

- Fire warning bell sounds.
- Both master FIRE lights illuminate.
- Wheel well fire detection loop light(s) illuminate.
- WHEELWELL FIRE light illuminates on the Pilot's Annun. Panel.

A AND B LOOP LIGHTS (AMBER) (2)

- Illuminates when:
  - TEST button(s) pressed and BOTH or respective loop is selected.
  - Overheat is detected by the respective wheel well fire detection loop.
- WHEELWELL FIRE illuminates on Pilot's Annun. Panel when either loop light illuminates with BOTH selected, or if selected loop light illuminates.

3S1, 2 - FIRE DETECTOR; LOOP A, B



S/O'S UPPER INSTRUMENT PANEL

LOOP SELECTOR

Determines which fire detection loop(s) will activate the wheel well fire warnings.

BOTH - Both A & B fire detection loop lights must illuminate to activate fire warning.

A - Deactivates the B loop. illumination of the A light activates fire warnings.

B - Deactivates the A loop. illumination of the B light activates fire warnings.

3S1, 2 - FIRE DETECTOR; LOOP A, B

LOOP TEST BUTTONS

Tests fire warning circuits by introducing a false fire signal into the detector loop circuits.

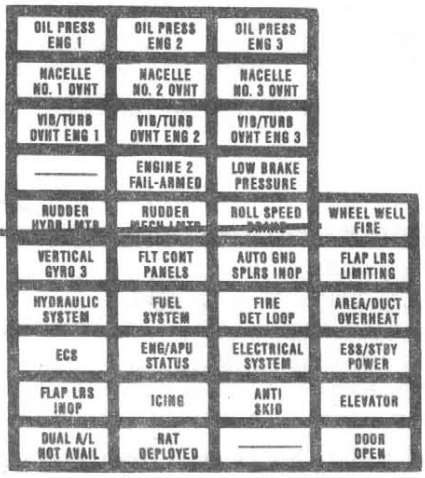
- With loop selector in A or B, pressing respective TEST button activates fire warnings.
- With loop selector in BOTH, both TEST buttons must be pressed to activate fire warnings.

3S1, 2 - FIRE DETECTOR; LOOP A, B
1J5 - FIRE DETECTION TEST
1J4 - FIRE DETECTION MASTER ALARM PWR; WHEEL WELL APU

WHEEL WELL FIRE LIGHT (RED)

Illuminates when:

- Wheel well fire loop selector is in BOTH and either loop detects an overheat.
- Wheel well fire loop selector is in A or B and respective loop detects an overheat.
- Wheel well fire system is tested.



PILOT'S ANNUN. PANEL

GALLEY SMOKE/EXHAUST DUCT OVERHEAT DETECTION

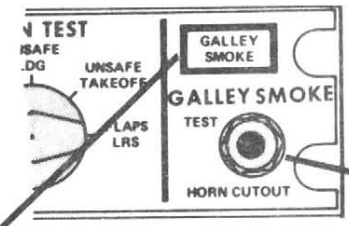
A single circuit is provided to detect galley smoke or an overheat (fire) in the galley oven exhaust duct.

An optical detector is provided to detect smoke in the galley. If galley smoke is detected, the GALLEY SMOKE light on the S/O's panel flashes and the cockpit alternating tone sounds.

A thermal switch is installed in the galley exhaust duct to detect a fire. If an exhaust duct overheat (fire) is detected, the GALLEY SMOKE light illuminates steady and the cockpit alternating tone sounds. The DUCT OVHT light illuminates in the galley and a a warning bell sounds.

The cockpit alternating tone can be silenced by positioning the GALLEY SMOKE TEST switch to HORN CUTOUT. The galley bell can be silenced by pressing the ALARM SILENCE switch in the galley.

Access to the galley oven duct is provided through a door located below the aft oven. This door can be opened to permit the use of a portable HALON fire extinguisher bottle.



S/O'S INSTRUMENT PANEL

GALLEY SMOKE LIGHT (AMBER)

Illuminates:

- FLASHING when;
  - –Smoke is detected in the galley.
  - –GALLEY SMOKE TEST is selected on the cockpit switch.
- STEADY when;
  - –A duct overheat (fire) is detected in the galley oven exhaust duct.
  - –ALARM TEST switch is pressed in the galley (aircraft must be on the ground).

4E22 GALLEY SMOKE DETECT

GALLEY SMOKE TEST/HORN CUTOUT SWITCH

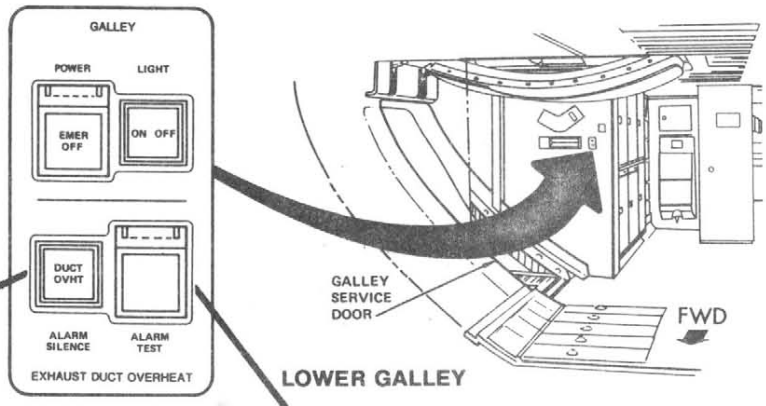
3-position toggle switch.

TEST - Activates alternating tone warning horn and flashes the GALLEY SMOKE light. Upon releasing the selector, the horn will sound for 10 seconds or until HORN CUTOUT is selected.

OFF - Normal spring-loaded center position.

HORN CUTOUT - Silences alternating tone warning horn.

4E22 - GALLEY SMOKE DETECT



LOWER GALLEY

DUCT OVHT ALARM SILENCE SWITCH

Pressing DUCT OVHT switch silences warning bell in galley. Light remains illuminated until duct temperature returns to normal range.

4E22 - GALLEY SMOKE DETECT
1L8 - MISC AURAL WARN MULT SND

ALARM TEST SWITCH

Guarded momentary-action switch. Provides means of testing galley duct overheat system. When pressed:

- DUCT OVHT illuminates.
- Galley warning bell sounds.
- GALLEY SMOKE illuminates steady on S/O's panel.
- Alternating tone in cockpit sounds.
- Cannot be tested in flight.

4E22 - GALLEY SMOKE DETECT

END

FIRE PROTECTION

GENERAL DESCRIPTION

GALLEY DUCT OVERHEAT DETECTION

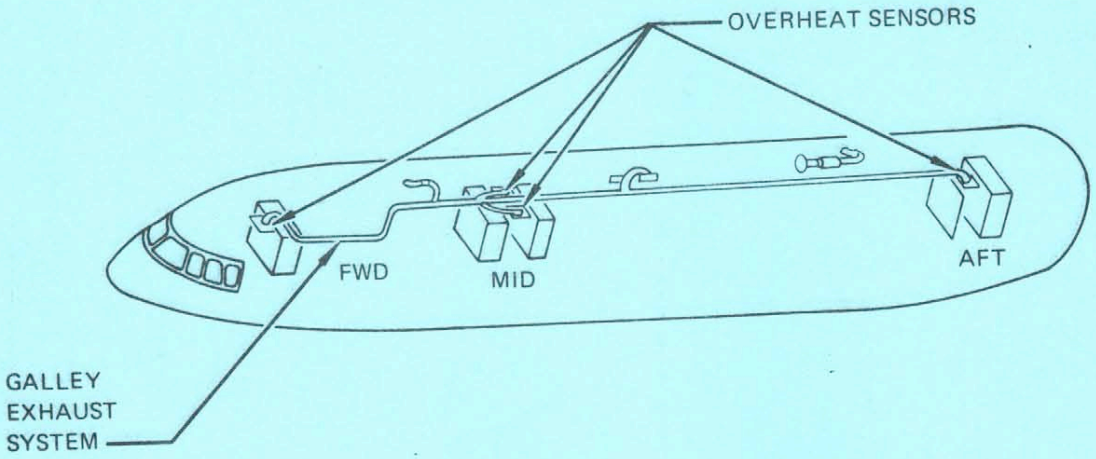
Visual warning is provided on the pilots' annuciator panel and second officer's galley duct overheat panel for an overheat condition in the forward, mid, and aft galley exhaust ducts. An aural warning is also provided.

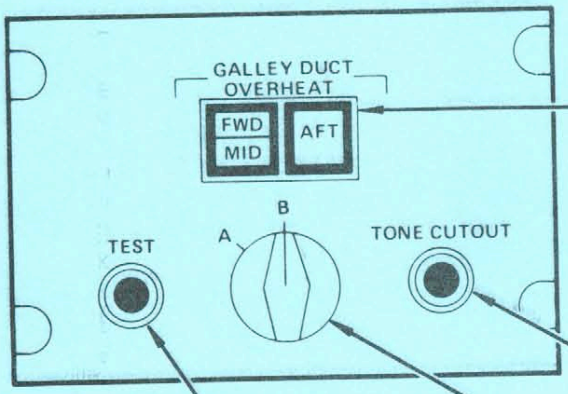
FORWARD CARGO SMOKE DETECTION AND FIRE EXTINGUISHING

Visual warning is provided on the pilots' annunciator panel and second officer's forward cargo compartment panel for smoke detection in the forward cargo compartment. An aural warning is also provided in the flight station. Two fire extinguisher bottles are located below the center wingbox. This provides two discharges (main and alternate) for the compartment.

CONTROLS AND INDICATORS

GALLEY EXHAUST DUCT OVERHEAT DETECTION SYSTEM





OVERHEAT LIGHTS

Galley FWD, MID, and AFT duct overheat lights come on to indicate an overheat condition in respective galley. Illumination of any overheat light will illuminate the SMOKE legend on the pilots' annunciator panel.

TONE CUTOUT BUTTON

Pressing momentary pushbutton silences intermittent tone.

OVERHEAT CIRCUIT SELECTOR

Two-position rotary switch.

A- Power to the overheat circuit is being supplied through CBs 2 & 5.

B- Power to the overheat circuit is being supplied through CBs 2 & 6.

OVERHEAT TEST BUTTON

Press and hold Test button.

Illuminates FWD, MID, and AFT overheat lights.

SMOKE is illuminated on pilots' annunciator panel, and an alternating tone should sound.

Functions the same with the overheat circuit selector in either A or B.

FORWARD CARGO SMOKE AND FIRE EXTINGUISHER PANEL

MAIN AND ALTERNATE DISCHARGE SWITCHES

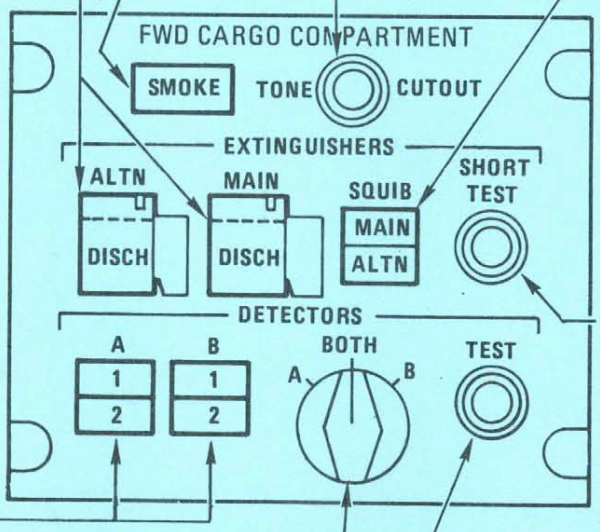
Lifting the guard and depressing the momentary switch completes the firing circuit to the selected squib, which releases the contents of the appropriate fire extinguisher bottle.

After bottle discharge, the appropriate DISCH light will be illuminated. DISCH will be illuminated any time bottle pressure drops below a preset valve. The DISCH lights are also illuminated during the second officer's panel light test.

SMOKE DETECTION LIGHT

Is illuminated to indicate smoke in forward cargo compartment. It is also accompanied by an alternating tone.

SMOKE WARNING TONE CUTOUT BUTTON



MAIN AND ALTERNATE SQUIB ANNUNCIATOR LIGHTS

When Test button is pressed, MAIN and ALTN squib lights are illuminated to indicate extinguisher firing squib circuit integrity.

SHORT TEST BUTTON

With the Test button pressed to illuminate the MAIN and ALTN squib lights, pressing the Short Test button extinguishes the lights, which indicates all circuits are good. If either of the MAIN or ALTN lights remains illuminated, its circuit is shorted.

SMOKE DETECTOR CIRCUIT LIGHTS

Detector lights are illuminated to indicate smoke in the forward cargo compartment. Illumination of any circuit light will illuminate the SMOKE legend on the pilots' annunciator panel.

SMOKE DETECTOR CIRCUIT SELECTOR

BOTH - Normal position. Activation of either detector 1 or 2 in both A and B circuits illuminates the SMOKE legend and sounds the aural warning.

A - Disables B circuit. Activation of either detector in A circuit gives smoke warning.

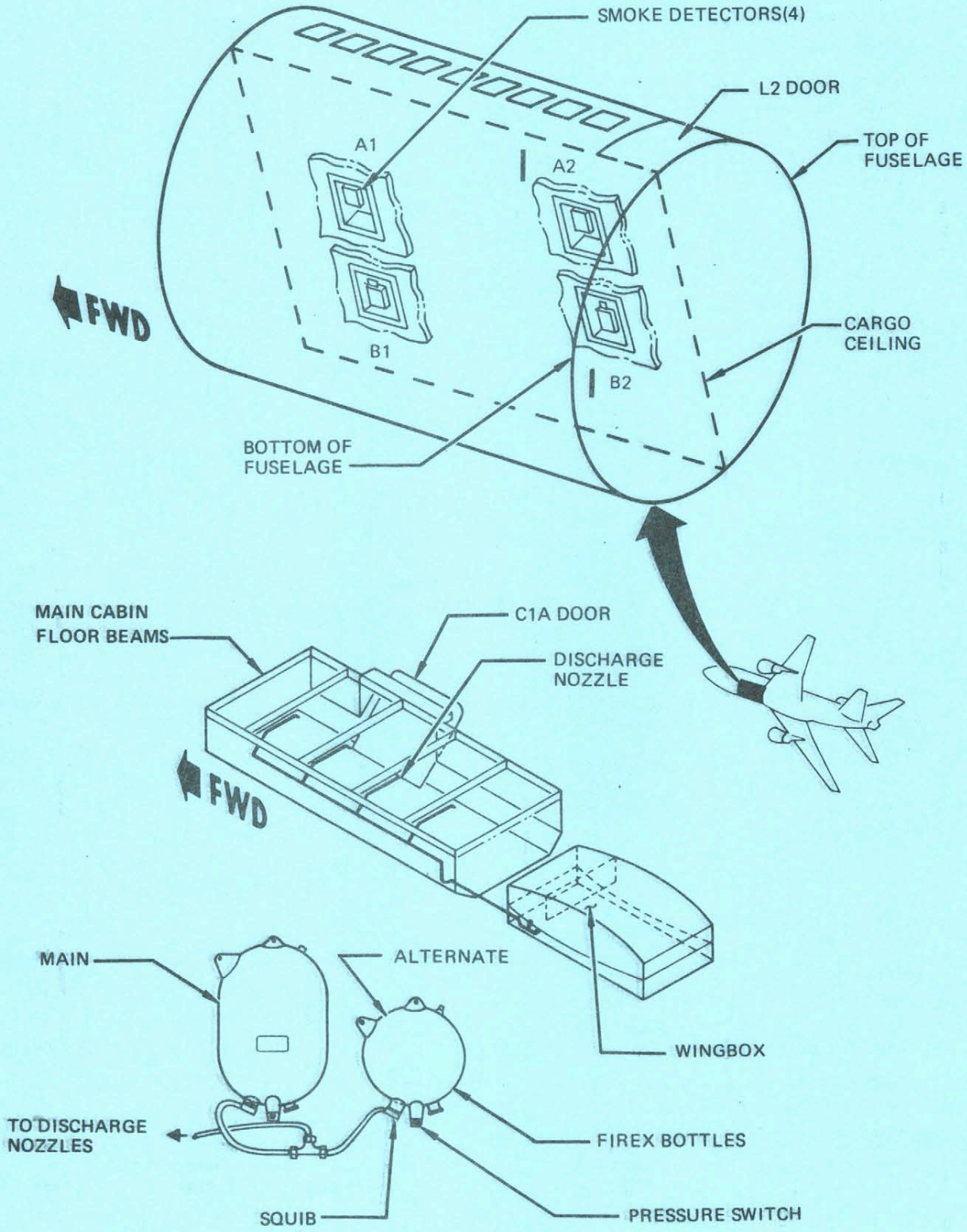
B - Disables A circuit. Activation of either detector in B circuit gives smoke warning.

SMOKE DETECTOR TEST BUTTON

With selector in BOTH, pressing Test button:

- Illuminates the 4 detector lights.
- Illuminates MAIN and ALTN squib lights.
- Illuminates SMOKE light.
- Illuminates the SMOKE light on the pilots' annunciator panel.
- Causes an alternating tone to sound.

FORWARD CARGO FIRE EXTINGUISHER AND SMOKE DETECTION SYSTEM



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CROSS REFERENCES

Auto THROTTLES SYSTEM (ATS) ..... AUTOFLIGHT
YAW SAS ..... AUTOFLIGHT

GENERAL

The primary flight controls are ailerons, spoilers, stabilizer, and rudder. The elevators are not directly positioned by pilot inputs, but are linked by cable to the stabilizer and move in response to stabilizer position.

The secondary flight controls consist of flaps and slats. Many flight control functions are affected by flap position. In this section, the term 'flaps up' refers to flaps retracted (0°); 'flaps not up' refers to flaps being in **any** position **except** retracted.

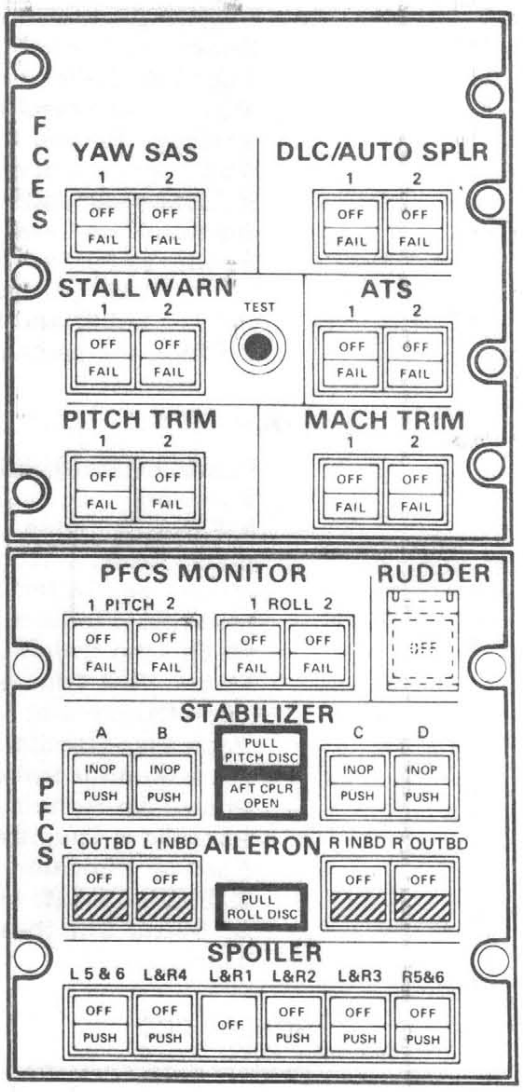
All flight controls are hydraulically powered by one or more of the hydraulic systems. Any control only needs one of its systems to operate. Flight crew control inputs to the hydraulic servo units, located at each flight control surface, are provided mechanically and/or electrically. Since all controls are hydraulically powered, artificial feel and control centering units are provided. Trim tabs are not used on any flight control surface. Trim is accomplished by changing the neutral reference point on the hydraulic servo units which repositions the flight control surface.

PFCS AND FCES PANELS

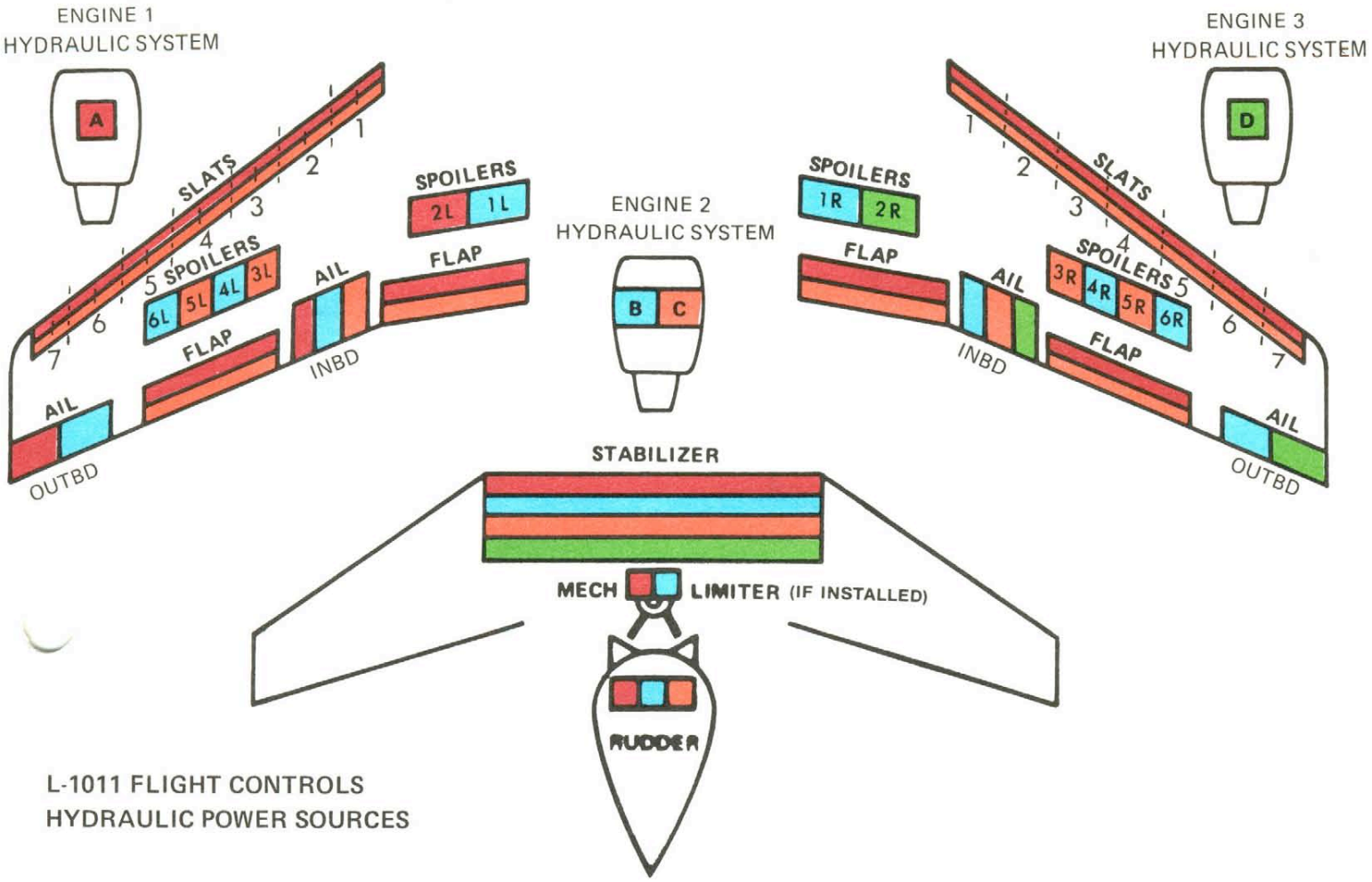
Two panels are installed on the overhead panel to provide control and monitoring of the hydraulic and electronic inputs to the flight controls.

The FCES(Flight Control Electronics System) panel provides fail indications and ON-OFF control of the electronically operated flight control, stall warning and auto-throttle systems. The control switches on this panel are normally latched, with all lights extinguished.

The PFCS (Primary Flight Control System) panel, located directly below the FCES panel, contains switches which provide the capability to shutoff the hydraulics servo units for the primary flight controls, and also indicate system malfunctions. The control switches on this panel are normally latched, with all lights extinguished.



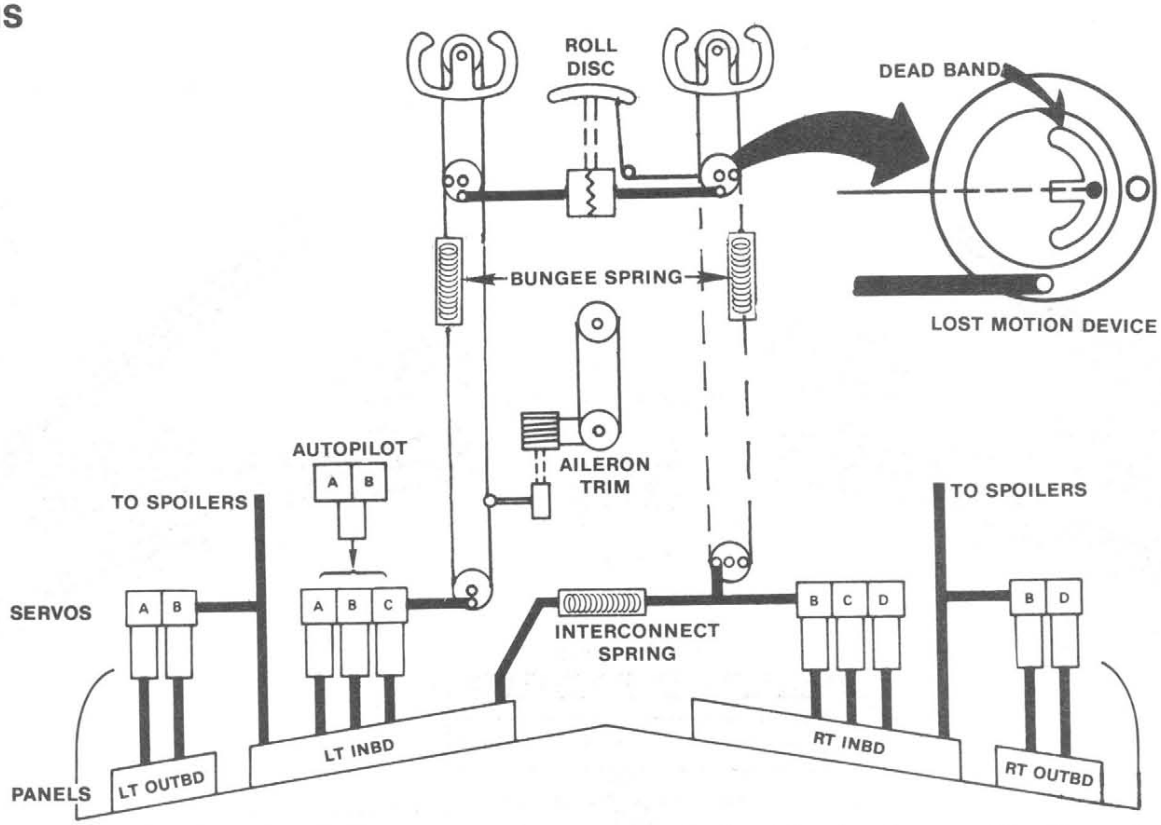
PILOT'S OVERHEAD PANEL



L-1011 FLIGHT CONTROLS
HYDRAULIC POWER SOURCES

FLIGHT CONTROL PANELS AND HYDRAULIC POWER SOURCES

AILERONS



There is an inboard and outboard aileron on each wing. The four ailerons operate full time and each is powered independently by either 2 or 3 of the hydraulic systems.

Normal roll control is provided by rotating either control wheel which move cables from the Capt's control wheel (left cable path) to the left inboard (master) aileron servo. Trim is provided by effectively shifting the neutral position of the cable input to the left inboard servo. Autopilot inputs are made independently to the left inboard aileron servo.

The left inboard servo uses hydraulic pressure from hydraulic systems A, B and C to position the left inboard aileron panel. Aileron panel position is fed back to the servo. Movement is stopped when the aileron position corresponds to the control wheel/trim input. Position of the left inboard aileron panel is transmitted mechanically to provide the control input to the left outboard aileron servo and right inboard aileron servo. Position of the right inboard aileron panel is transmitted mechanically to provide the control input to the right outboard servo.

With the flaps not up, the position of the left and right inboard aileron panels also provide the control inputs to the spoiler system for roll augmentation (see Spoilers/Speed Brakes section).

A set of cables is also provided from the F/O's control wheel (right cable path) to the right inboard aileron servo. A lost motion device, located at the base of the F/O's control column, provides a dead band between the right cable path and the right inboard aileron servo. The dead band prevents any interference in control inputs should a difference exist in cable tension between the left and right cable paths. A roll disconnect mechanism is provided to separate the Capt's and F/O's cable control paths should a malfunction occur in either side. Pulling the ROLL DISC handle separates the Capt's and the F/O's cable paths, and the dead band is removed from the lost motion device to provide the F/O with direct control of the right aileron system. An interconnect spring between the left aileron and right aileron servo permits the F/O to control the right ailerons without interference from the left inboard aileron.

A PFCS MONITOR ROLL system is provided for the roll cables. A cable jam in either aileron cable path will be sensed by monitor bungee springs. The bungee springs signal the ROLL monitor which will illuminate the respective AILERON ////// **(crosshatch) and** PULL ROLL DISC lights on the PFCS panel (SPOILER PUSH lights will also illuminate; see Spoiler Speed Brake section). These lights will remain illuminated until both ROLL monitor switches are unlatched to reset the system.

ROLL MONITOR SWITCH (2)

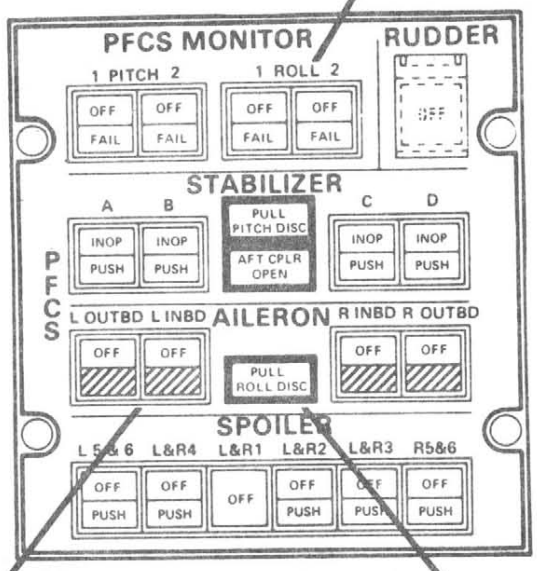
Monitors for jams in Capt's or F/O's aileron cable control paths.

LCH - Normal position. **OFF** is extinguished and **FAIL** light is armed. With either switch latched and operative, an aileron cable jam is indicated by illumination of the respective AILERON ////, PULL ROLL DISC, and respective SPOILER PUSH.

FAIL - Illuminates to indicate respective ROLL monitor channel has failed.

UNL - Channel is unpowered and **OFF** illuminates to indicate switch position. **FAIL** light is disarmed.
- With one channel inoperative, remaining channel provides normal roll monitor operation.
- If both channels inoperative, no roll monitoring is available.
  - AILERON [////], **PULL ROLL DISC** and associated SPOILER **PUSH** lights are disarmed with both switches unlatched.

1A6, 24 - PITCH AND ROLL



PILOTS OVERHEAD PANEL

AILERON SWITCH (4)

Electrically controls aileron servo shutoff valves.

LCH - Normal position. **OFF** is extinguished and [////] (crosshatch) light is armed. Respective aileron servo is powered.

//// - Crosshatch illuminates if either ROLL monitor detects a jam in the respective aileron cable path.

UNL - Respective aileron servo is electrically energized to shut off. **OFF** illuminates to indicate switch position. [////] light is disarmed.
- With servos shutoff, an aileron will tend to float up. Unlatching an inboard aileron switch will affect other ailerons and spoilers.

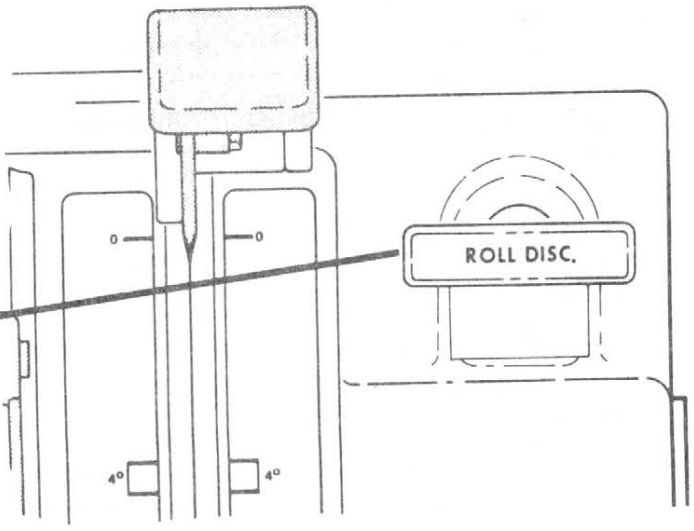
CAUTION:
DO NOT UNLATCH IN FLIGHT UNLESS SPECIFICALLY REQUIRED BY EMERGENCY PROCEDURES.

2J19, 20, 21, 22 - AILERON SERVO C, A, B, & D
3G8 - IND LT PFCS/ADS/DH

PULL ROLL DISC LIGHT (AMBER)

Illuminates when ROLL monitor detects a cable jam in either cable control path.

3G8 - IND LT PFCS/ADS/DH



CENTER CONSOLE

ROLL DISC HANDLE

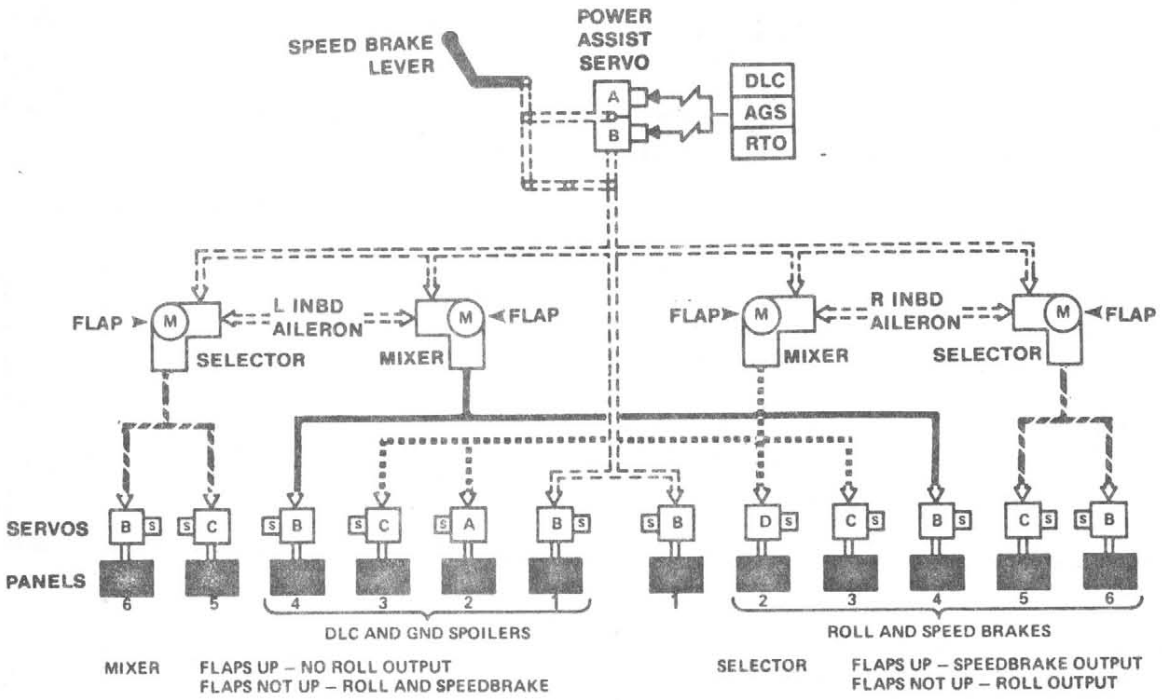
Controls roll disconnect and lost motion device.

DOWN - Normal position. Roll disconnect is coupled and handle lights extinguished.

PULLED - Roll disconnect is opened, and dead band is removed from lost motion device.
- Handle will illuminate when disconnect is open.
- Rotate handle 90° counterclockwise to lock handle in pulled position.
  - Do not allow handle to snap back into the down position.

2J2 - PILOTS IND LT

SPOILERS/SPEED BRAKES



There are six spoiler panels on each wing. Each spoiler panel is powered by one of the four hydraulic systems. Mechanical control inputs are provided to a hydraulic servo for each panel. Spoiler inputs are controlled by the SPEED BRAKE lever, the DLC/AGS (Direct Lift Control/Auto Ground Spoiler) system, and the RTO (Rejected Takeoff) system. The spoilers also receive inputs from the aileron system to provide roll augmentation during flaps extended operations.

SPOILER switches on the Primary Flight Control System (PFCS) panel may be used to unpower the servos in pairs, if necessary.

Spoiler Functions:

- Flaps up - Spoilers 2-6 provide speed brakes.
- Flaps not up (4° or more) - Spoilers 2-6 provide roll augmentation.
- Flap lever more than 30° - Spoilers 1-4 provide DLC in-flight and AGS upon touchdown.
- Flaps in any extended position - spoilers 1-4 deploy for rejected takeoff (RTO system), or upon landing, when any two throttles are positioned to reverse thrust. The RTO system will also deploy spoilers 2-6 with flaps up.

MIXERS AND SELECTORS

Spoiler panel #1 on each wing is controlled directly by cable inputs from the SPEED BRAKE lever when the flaps are not up. With flaps up, the servos for the #1 panels are electrically shutoff.

Spoiler panels 5 & 6 are controlled through a spoiler selector in each wing. The selectors schedule panels 5 & 6 to function as speed brakes with flaps up, and for roll augmentation with flaps not up.

Spoiler panels 2, 3, & 4 are controlled through a spoiler mixer in each wing. The mixers schedule panels 2-4 to function only as speed brakes with flaps up, and mix speed brake/roll augmentation inputs with flaps not up. The left mixer actually controls the #4 panels on both wings while the right mixer controls panels 2 & 3 on both wings.

SPOILER L&R1 SWITCH

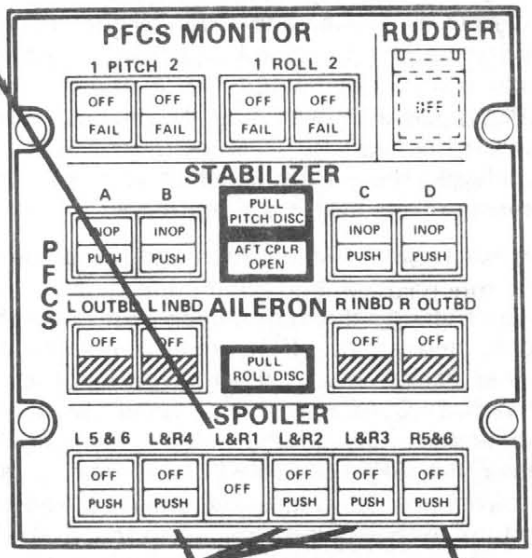
LCH - Normal position. Servos operate L & R spoiler panels #1 as scheduled by SPEED BRAKE lever and flap position.

- With flaps not up panels respond to SPEED BRAKE lever movement.
- With flaps retracted servos are deactivated and panels stow.

UNL - L & R #1 spoiler servos are electrically energized to shut off and panels are stowed. OFF illuminates to indicate switch position.

ROLL SPEED BRAKE illuminates on the Pilot's Annun. Panel when OFF illuminated with flaps not up.

2J16 - SPOILER SERVO B
3G6 - IND LT PFCS/ADS/DH



PILOT'S OVERHEAD PANEL

SPOILER L&R2, L&R3, AND L&R4 SWITCHES

LCH - Normal position. L & R spoiler panels #2, 3, and 4 operate in response to SPEED BRAKE lever and/or roll inputs as programmed by flap position through the left and right mixer assemblies.

- With flaps not up panels provide roll augmentation in response to aileron position and speed brakes in response to SPEED BRAKE lever movement.
- With flaps up panels respond only to SPEED BRAKE lever movement.

PUSH - illuminates if either ROLL monitor channel detects a jam in the respective roll control cable path.

ROLL SPEED BRAKE illuminates on the Pilot's Annun. Panel to indicate mixer programming is incorrect for flap position.

UNL - Respective L & R spoiler servos are electrically energized to shut off and panels stow. OFF illuminates to indicate switch position. **PUSH** light is disarmed.

2J15, 16, 17, 18 - SPOILER SERVO A, B, C, & D
3G8 IND - LT PFCS/ADS/DH

SPOILER L5&6 AND R5&6 SWITCHES

LCH - Normal position. Spoiler panels L 5 & 6, and R 5 & 6 operate in response to SPEED BRAKE lever or roll inputs as programmed by flap position through the left and right selector assemblies.

PUSH - illuminates if either ROLL monitor channel detects a jam in the respective roll control cable path. Illumination of **both** L5&6 PUSH and R5&6 PUSH indicates that selector programming is incorrect for flap position.

- With flaps not up panels only provide roll augmentation in response to aileron position.
- With flaps up panels respond only to SPEED BRAKE lever movement.

UNL - Respective 5 & 6 spoiler servos are electrically energized to shut off and panels stow. OFF illuminates to indicate switch position. **PUSH** light is disarmed.

- With flaps up, pulling the SPEED BRAKE lever will cause asymmetric spoiler panel extension unless both switch positions agree.

2J15, 17, 18 - SPOILER SERVO A, B, & D
3G8 - IND LT PFCS/ADS/DH

SPOILERS/SPEED BRAKES (CONT'D)

SPEED BRAKE LEVER

The position of the SPEED BRAKE lever, located to the left of the throttles on the center console, controls all spoiler panel deployment except roll augmentation. A power assist servo is provided to reduce the force required to manually move the SPEED BRAKE lever and to provide automatic lever movement for DLC, AGS, and RTO spoiler functions. The power assist servo uses hydraulic pressure from systems A and/or B.

An Automatic Disable button and two amber lights are installed on the top of the SPEED BRAKE lever. Pressing the button once illuminates the two lights and shuts off hydraulic pressure to the power assist servo. With the power assist servo shutoff, DLC, AGS, and RTO spoiler functions are inoperative. Considerable force is required to move the SPEED BRAKE lever out of the O° (stowed) position to provide manual speed brakes, and the lever is spring-loaded to the stowed position. Pressing the Automatic Disable button again extinguishes the lights and restores hydraulic pressure to the power assist servo.

Speed Brake Functions

With flaps up, pulling the SPEED BRAKE lever extends spoiler panels 2 through 6 on each wing. With, flaps not up movement of the the SPEED BRAKE lever extends spoiler panels 1 through 4 on each wing for DLC, AGS and RTO functions. **Manual speed brake extension is prohibited in flight unless flaps are up.**

ROLL AUGMENTATION

With flaps up all roll control is provided by the ailerons. With the flaps not up, the spoiler mixers and selectors for panels 2 through 6 are programmed to provide roll augmentation in response to aileron position. When roll augmentation is active, movement of the inboard ailerons will command the mixers and selectors to extend panels 2 through 6 a proportional amount on the wing with the up aileron. If spoiler panels 1 through 4 are extended on both wings by the DLC system, a roll input will deploy panels 5 & 6 and will cause panels 2 through 4 to extend further on the wing with the up aileron.

SPEED BRAKE LEVER

- Provides manual positioning of spoilers for speed brakes.
  - With lever in forward (0°) position spoilers are stowed.
  - With lever in the aft (MAX) position all panels available for speed brakes (depending on flap position) deploy to max extension.
- Indicates operation of spoilers by DLC, AGS or RTO systems.
  - Range of DLC spoiler operation is marked on pedestal.
- Lever is normally power assisted and will remain in any selected position.
  - The DLC, AGS and RTO systems also operate through the power assist servo.
  - The power assist servo is powered by hydraulic systems A and/or B.

AUTOMATIC DISABLE BUTTON AND LIGHTS

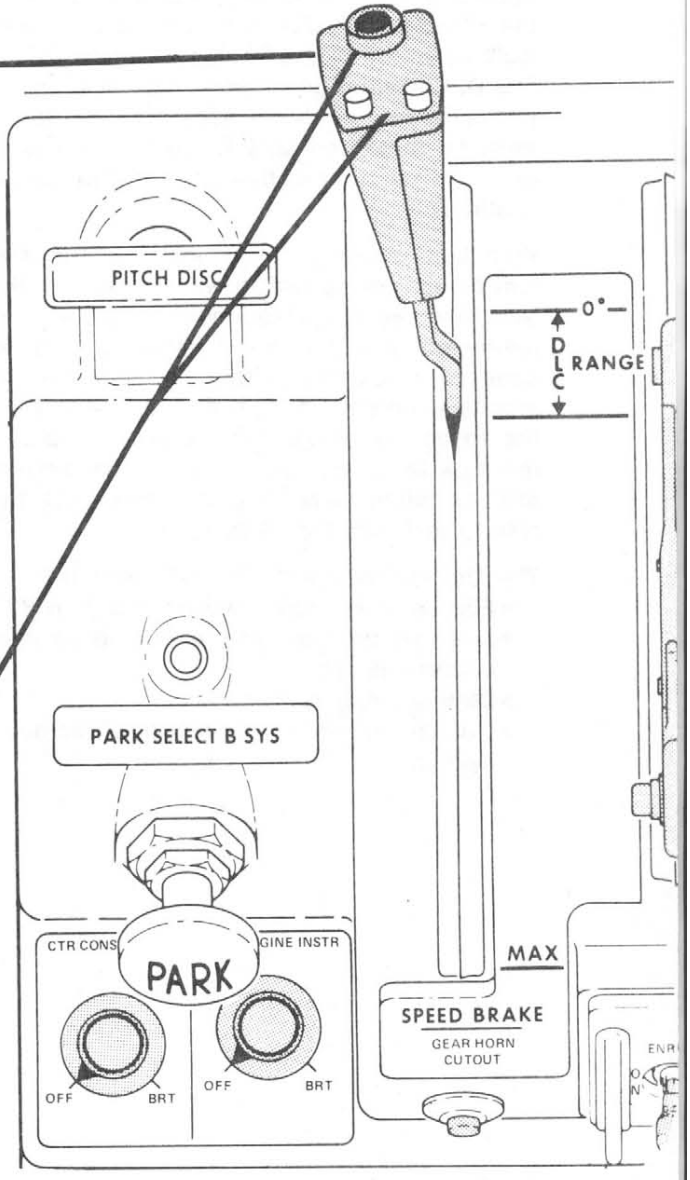
Pressing the Automatic Disable button electrically shuts off hydraulic pressure to the power assist servo and causes the two amber lights on the lever to illuminate.

- Considerable force will be required to move the SPEED BRAKE lever out of the stowed position, and the handle must be held in the desired position.
- DLC, AGS and RTO spoilers are inoperative.
  - If the aircraft is in a configuration that calls for automatic spoilers, **both** DLC/AGS FAIL lights illuminate.

Pressing the Automatic Disable button a second time restores hydraulic pressure to the power assist servo and extinguishes the two amber lights on the lever.

- If both DLC/AGS FAIL lights are illuminated, **both** switches must be cycled to restore the DLC, AGS and RTO systems.

2H14, 15 - DLC SERVO A, B



CENTER CONSOLE

SPOILERS/SPEED BRAKES (CONT'D)

DIRECT LIFT CONTROL (DLC)

The DLC system provides a means of controlling sink rate with a minimum of pitch change during approach. With either DLC/AGS switch latched on the FCES panel, DLC operation begins automatically when the flap lever is positioned beyond 30°. The DLC system provides an electrical input to the power assist servo to drive the SPEED BRAKE lever aft to extend spoiler panels 1 through 4 on each wing to the middle of the DLC range (approximatley 7°).

With DLC active, a pitch input to the stabilizer (either pilot or autopilot) will cause the DLC system to make a corresponding change in spoiler extension. A pitch down input will cause the spoilers to extend further to decrease lift and increase the sink rate. A pitch up input will cause the spoilers to retract to increase lift and decrease the sink rate. This results in a more stable pitch attitude while increasing or decreasing the sink rate to maintain the glide path.

The DLC spoilers automatically retract if:

- Flap lever is positioned to less than 30°.
- Any two throttles are advanced to max continuous thrust.
- Stall warning occurs.
- Go-Around mode is selected for the auto-flight system.

AUTO GROUND SPOILERS (AGS)

With either DLC/AGS switch latched on the FCES panel, and the flap lever positioned beyond 30°, AGS system is armed to deploy spoilers automatically when truck tilt **or** strut compression is sensed. The AGS system provides an electrical input to the power assist servo to drive the SPEED BRAKE lever aft to fully extend spoiler panels 1 through 4 on each wing.

The AGS sytem is inhibited or AGS spoilers retract automatically if:

- Flap lever is positioned to less than 30°.
- Any two throttles are advanced to Max continuous thrust.
- Go-Around mode is selected for the auto-flight system.
- On ground signal is lost.
- C system hydraulic pressure is lost with the landing gear lever DOWN. AUTO GND SPLRS INOP light will illuminate on the Pilot's Annun. Panel.
  - If the landing gear is extended while the landing gear lever is not DOWN (jammed lever or wheel well fire procedure), truck tilt could occur in flight. This could cause an inadvertent spoiler deployment. To prevent this, Abnormal Procedures require that both DLC/AGS switches must be unlatched.

REJECTED TAKEOFF SPOILERS (RTO)

With either DLC/AGS switch latched on the FCES panel, RTO spoilers are provided automatically when any two throttles are positioned to reverse thrust. The RTO system provides an electrical input to the power assist servo to drive the SPEED BRAKE lever aft to fully extend spoiler panels 1 through 4 on each wing (if flaps are up panels 2 through 6 extend).

RTO spoilers retract automatically when throttles are positioned out of reverse.

DLC/AGS SWITCH (2)

Provides control of Direct Lift Control, Auto Ground Spoilers, and Rejected Takeoff spoilers.

LCH - Normal position. DLC/AGS systems are armed. **OFF** light is extinguished and **FAIL** light is armed.

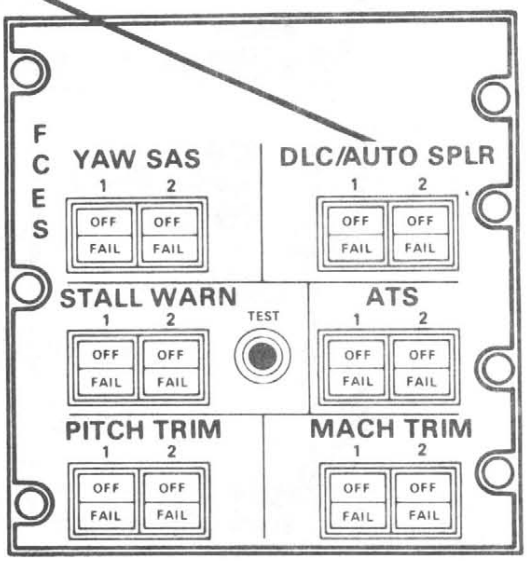
- Power assist servo must be operative (lever lights extinguished).
  - If speed brake lever lights are illuminated both DLC/AGS FAIL lights will illuminate when DLC/AGS operation required. Speed brake lever lights must be extinguished and both DLC/AGS switch must be cycled to reset the system.
- DLC system will control spoiler panels 1 - 4 on each wing within the DLC range when the flap lever is positioned beyond 30°. Panels retract if:
  - Flap lever positioned to less than 30°.
  - Two throttles advanced to max continuous.
  - Stall warning.
  - Go-Around mode selected.
- AGS system will fully deploy spoiler panels 1 - 4 on each wing upon landing if the flap lever is positioned beyond 30°. Panels retract if:
  - Flap lever positioned to less than 30°.
  - Two throttles advanced to max continuous.
  - On Ground signal is lost.
  - C hydraulic pressure lost & gear lever DOWN.
- RTO system will fully deploy spoiler panels 1 - 4 on each wing when any two throttles are positioned to reverse (Panels 2 - 6 if flaps up). Panels retract when throttles are out of reverse.

UNL - Channel is unpowered and OFF illuminates to indicate switch position. **FAIL** light is disarmed.

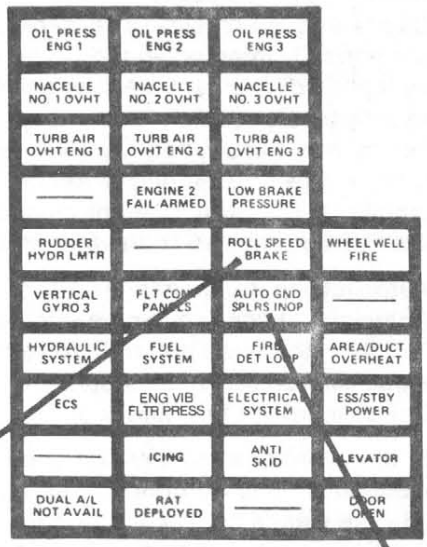
- With one channel inoperative, remaining channel provides normal DLC/AGS and RTO operation. At least one channel must be operative for CAT III approach.
- With both channels inoperative, no DLC/AGS or RTO operation is available.

AUTO GND SPLRS INOP illuminates on the Pilot's Annun. Panel if both DLC/AGS switches unlatched or both FAIL lights illuminate.

2H14, 15 - DLC SERVO A, B



PILOT'S OVERHEAD PANEL



PILOT'S ANNUN. PANEL

ROLL SPEED BRAKE LIGHT (AMBER)

Illuminates to indicate spoiler panels L&R 1 through 4 are not all in the correct mode for the flap position.

3G9 - FLT CONT ALT ALERT

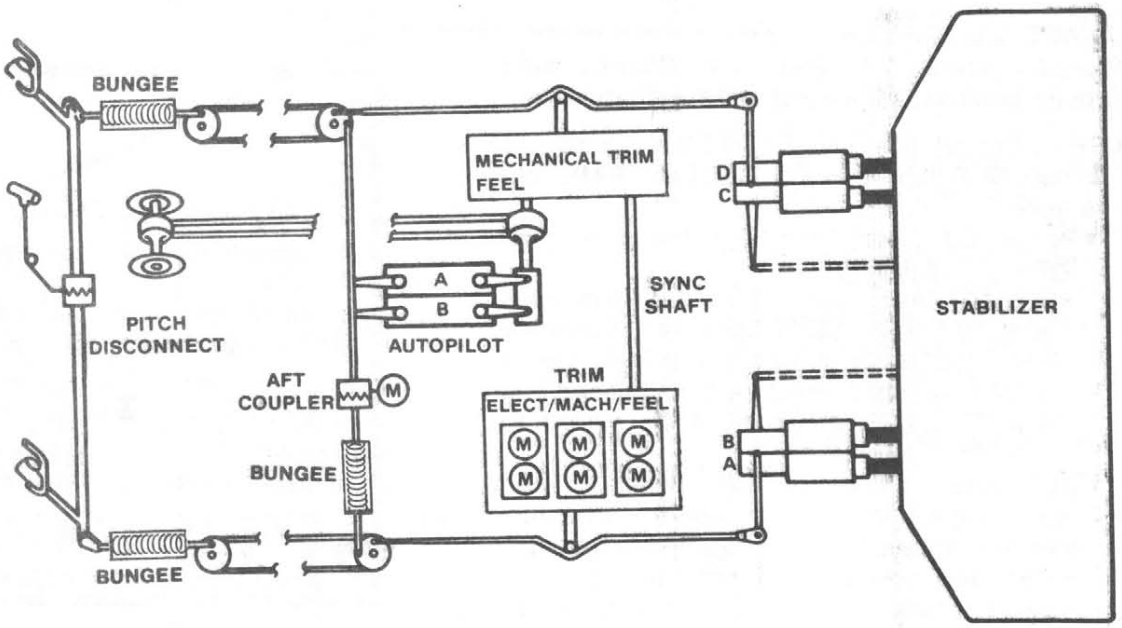
AUTO GND SPLRS INOP LIGHT (AMBER)

Indicates that automatic extension of spoilers will not occur at touchdown.

- Both DLC/AGS switches unlatched, or
- Both DLC/AGS FAIL illuminated, or
- Gear handle down & no C sys. hyd. pressure.

2K18 - AFCS WARNING, CAPT

STABILIZER



The entire stabilizer is a moveable surface and provides the primary means of pitch control. The stabilizer servos are powered independently by the four hydraulic systems.

Pitch control is provided by the control columns which move separate control cables from the Capt's and F/O's side. The separate cable paths are normally interconnected at the control columns by a pitch disconnect mechanism, and at the stabilizer by an aft coupler. From the aft coupler, control inputs are transmitted by two sets of push-pull rods to the four stabilizer servos to position the stabilizer. This arrangement assures that all stabilizer servos receive the same signal.

Autopilot inputs are made at the aft coupler unit. Artificial feel and trim inputs effectively change the length of the push-pull rods to re-position the four stabilizer servos. These inputs are reflected in control column position and feel.

In the event of a malfunction, the pitch disconnect mechanism and aft coupler can be opened to isolate the Capt's control inputs to servos A & B, and the F/0's control inputs to servos C & D.

The left and right elevators are not directly controllable, but move strictly in relation to stabilizer position.

A PFCS MONITOR PITCH system is provided for the pitch cables. A cable break or jam in either cable path will be sensed by monitor bungee springs. The bungee springs signal the PITCH monitor which will illuminate the respective STABILIZER PUSH lights on the PFCS panel (A & B or C & D). **PUSH** lights extinguish when the two respective switches are unlatched. Unlatching the affected switches illuminates the PULL PITCH DISC light, and commands the aft coupler to open. AFT COUPLER OPEN illuminates when the coupler has opened. Regardless of how many STABILIZER switches are unlatched no more than two stabilizer servos can be shut off at one time.

PITCH MONITOR SWITCH (2)
Monitors for jams or breaks in the Capt's or F/O's cable control paths.

LCH - Normal position. **OFF** is extinguished and **FAIL** light is armed. With either switch latched and operative, a stabilizer cable jam or break is indicated by illumination of the respective STABILIZER A & B or C & D PUSH lights.

FAIL - Illuminates to indicate respective PITCH monitor channel has failed.

UNL - Channel is unpowered and OFF illuminates to indicate switch position. **FAIL** light is disarmed.
- With one channel inoperative, remaining channel provides normal pitch monitor operation.
- With both channels inoperative, no pitch monitoring is available.
  - **PUSH** and **PULL PITCH DISC** lights are disarmed with both switches unlatched.

1A6, 24 - PITCH AND ROLL

STABILIZER SWITCHES
Electrically controls stabilizer servo shutoff valves and aft coupler.

LCH - Normal position. Respective stabilizer servo is powered.

INOP - Illuminates if hydraulic pressure is lost to the respective servo.

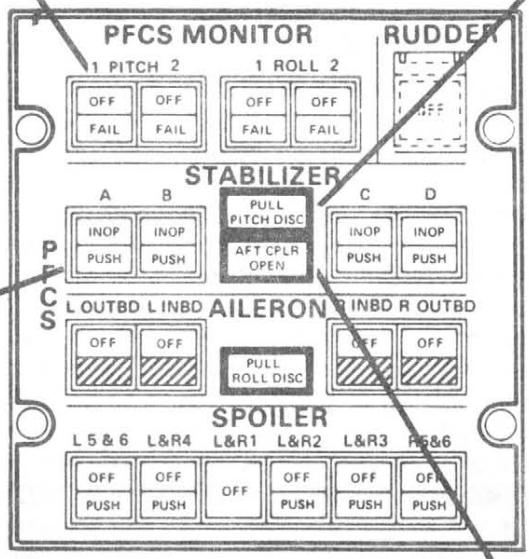
PUSH - Illuminates to indicate a cable jam or break has been detected in the respective cable control path by either PITCH monitor channel.

UNL - Respective stabilizer servo is electrically energized to shut off. **PUSH** light is disarmed. INOP illuminates when pressure is shut off to the respective servo.
- An elevator warning will occur if A or C is unlatched on the ground with the throttles retarded.
- The aft coupler will open, and AFT COUPLER OPEN illuminates, if A & B or C & D switches are unlatched.
  - PULL PITCH DISC will illuminate when the AFT COUPLER OPEN illuminates **provided** PUSH lights had been illuminated.
- Maximum airspeed is 250K with A & B or C & D unlatched, or loss of any two hydraulic systems.

2H16, 17, 18, 19 - STABILIZER B, C, A, D

PULL PITCH DISC LIGHT (AMBER)
- Advisory light to pull the PITCH DISC handle.
- Illuminated by the PITCH monitor system after the STABILIZER A & B or C & D switches have been unlatched following a jammed or broken cable indication (PUSH lights).

3G8 - IND LT PFCS/ADS/DH



PILOT'S OVERHEAD PANEL

AFT COUPLER OPEN (AMBER)
- Indicates that pitch system aft coupler has opened.
- Illuminates any time STABILIZER switches A & B or C & D are unlatched at the same time.

1B9 - NO.1 AFT COUPLER
1B27 - NO. 2 AFT COUPLER

STABILIZER (CONT'D)

PITCH DISCONNECT

The pitch disconnect mechanism is provided to separate the Capt's and F/O's cable control paths at the control column. The pitch disconnect is used in conjunction with the aft coupler, located at the stabilizer, although their operation is independent. Pulling the pitch disconnect separates only the control inputs at the control column. If the aft coupler is closed, control inputs from one column (cable path) will be transmitted through the aft coupler to the opposite cable path.

Control of the aft coupler is tied to the position of the four STABILIZER switches. These switches are normally latched, and the aft coupler is closed. If a cable break or jam is detected between the Capt's control column and the aft coupler (left path) or F/O's control column and the aft coupler (right path), the PUSH lights illuminate in the respective pair of STABILIZER switches. Switches A and B illuminate if the malfunction is in the left cable path, and switches C and D illuminate if the malfunction is in the right cable path. Unlatching the illuminated switches shuts off the respective stabilizer servos and opens the aft coupler (AFT COUPLER OPEN and PULL PITCH DISC illuminates). Pulling the PITCH DISC handle separates inputs at the control column to permit the pilot with the operative servos to fly the aircraft.

ELEVATORS

The elevators are mechanically positioned by cables as a function of stabilizer position. The elevators are designed to provide additional pitch-up capability at low speed, and are streamlined with the stabilizer throughout most flight regimes.

Frangible links are installed in the elevator cables which are designed to break if excessive force is required to position the elevators. If a link breaks an ELEVATOR light on the S/O's and Pilot's Annun. Panel illuminates and the takeoff warning horn sounds. This warning is inhibited unless the aircraft is on the ground with the throttles retarded.

PITCH DISC HANDLE

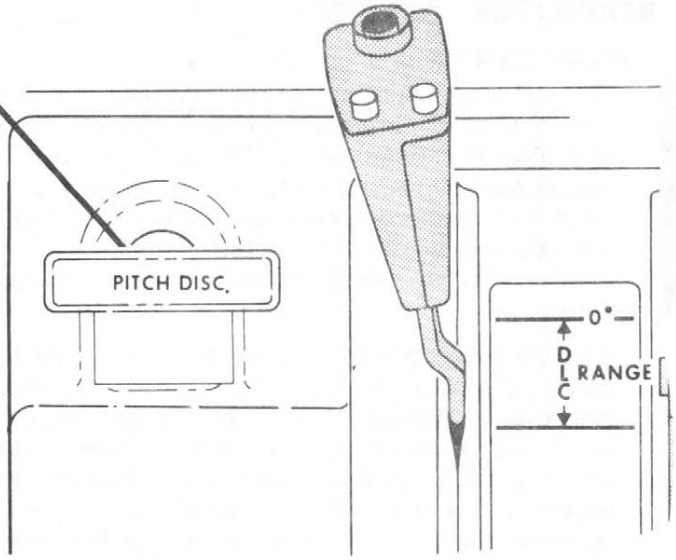
Provides control of pitch disconnect mechanism.

DOWN - Normal position. Pitch disconnect is coupled and handles lights extinguished.

PULLED - Pitch disconnect is opened.

- Handle will illuminate when disconnect is open.
- Rotate handle 90° clockwise to lock handle in pulled position.
  - Do not allow handle to snap back into the down position.
- With handle pulled and STABILIZER switches C & D unlatched both autopilots are inoperative.

2J2 - PILOT'S IND LT



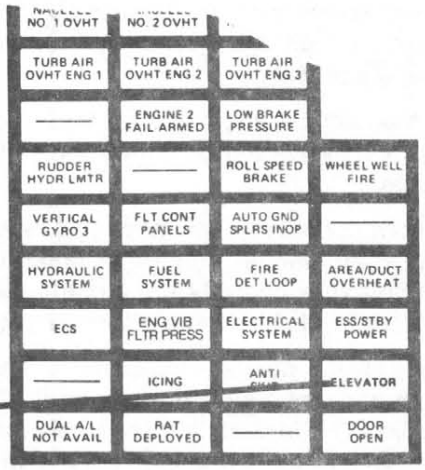
CENTER CONSOLE

ELEVATOR LIGHTS (AMBER)

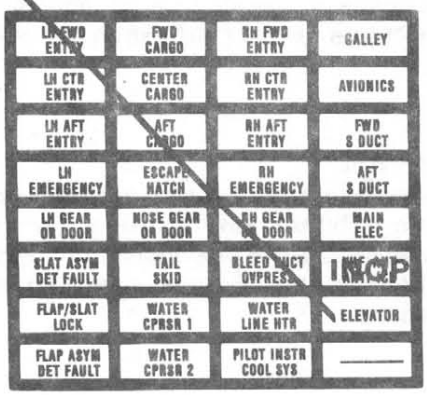
Illuminate and takeoff warning sounds if an elevator cable has been overstressed.

- Warning is inhibited unless the aircraft is on the ground and the throttles are retarded.
- Lights illuminate and warning sounds on the ground if **either** STABILIZER switch A **or** C is unlatched.

C/B1B9 - NO 1. AFT COUPLER
2H7 - T/OAURAL WRNG



CENTER INSTRUMENT PANEL



S/O'S PANEL

STABILIZER (CONT'D)

STABILIZER TRIM

The stabilizer pitch trim system consists of a trim unit in each control path. The left trim unit uses two electric motors; while the right trim unit is mechanical. These trim units are coupled with a pitch trim synchronizing shaft so that any input into one side will be transmitted to the other. Trim inputs shift the neutral position of the stabilizer servos.

The electrical pitch trim system is operated by using a thumbwheel on the Capt's and F/O's control wheels. The pitch trim rate is proportional to the speed of thumbwheel rotation. Autopilot trim inputs are also made through the electrical trim system. If one pitch trim channel fails, the trim rate is reduced to 50% of the normal rate. Another electric trim method is Mach trim. Mach trim uses two additional electric motors in the Capt's trim unit that are independent of the pitch trim electric motors. Mach trim compensation is provided to protect against Mach tuck in the speed range above Mach .55.

The mechanical pitch trim system is operated by using a hand wheel on either side of the center console.

The control columns will move to a new neutral position when manual, electric or Mach trim is used. The pilots may override the electric pitch trim and Mach trim with the manual trim wheels.

A neutral trim position indicator is located on the side of each mechanical trim wheel. These indicators display the stabilizer position that will exist when zero force is applied to the control column. The total trim range is 0° to 10°. The takeoff trim range is from 2½° to 8° and is marked on the indicators by a green band. Regardless of the trim setting, applying a maximum force of approximately 65 pounds to the control column is sufficient to compensate for the most extreme mistrim condition.

MACH FEEL

The Mach feel system provides artificial feel forces for the stabilizer control system. Two independent electric motors are installed in the electric trim unit to increase the column feel forces as speed increases.

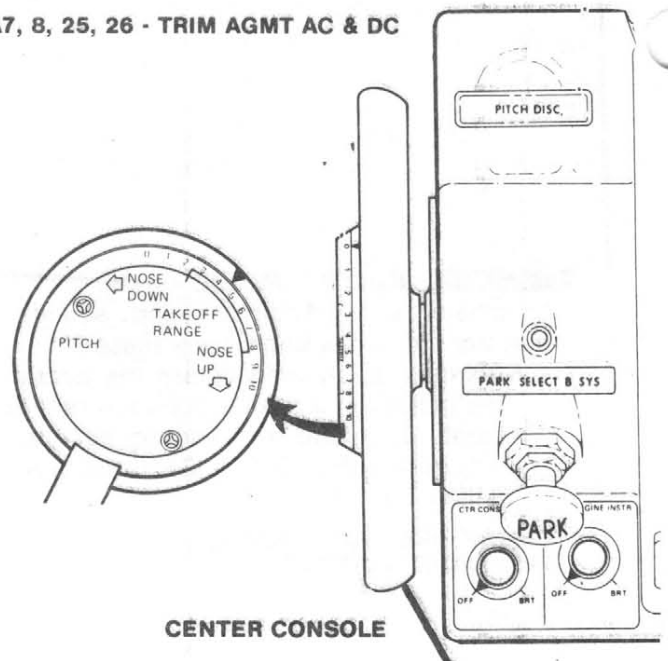
PILOT'S CONTROL WHEELS

PITCH TRIM THUMBWHEEL (2)

Provides control of PITCH TRIM system.

- Rotating thumbwheel provides stabilizer trim at a rate directly proportional to the rate at which the thumbwheel is moved.
- Thumbwheel is inhibited when either autopilot is operating with a pitch mode engaged.
- With autopilot in CWS thumbwheel will provide trim only while a force is being applied to the control column.

1A7, 8, 25, 26 - TRIM AGMT AC & DC



CENTER CONSOLE

MECHANICAL TRIM WHEEL (2)

Provides manual control of stabilizer trim system and overrides electrical trim inputs.

- Wheels rotate any time electric trim occurs (Pitch trim, autopilot trim, Mach trim).
- Indicator show the trim position in degrees of stabilizer angle.
- Takeoff warning will sound on the ground when throttles are advanced unless stabilizer trim is in the green band (2½° to 8°).

PITCH TRIM SWITCH (2)

Controls power and provides monitoring of the electric pitch trim system.

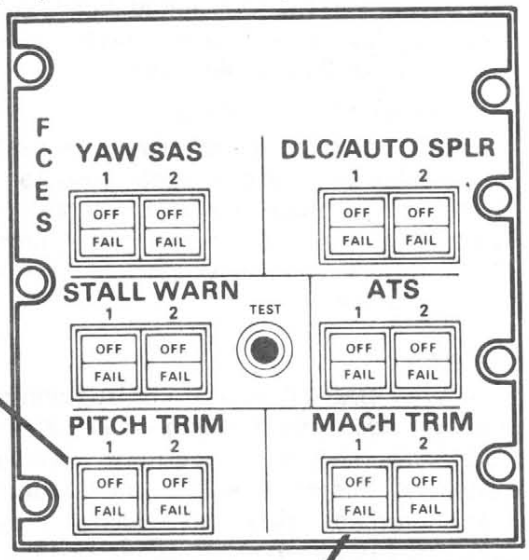
LCH - Normal position. Pitch trim system is operative for autopilot or thumbwheel use. **FAIL** light is armed.

FAIL - (Amber) Illuminates to indicate respective pitch trim channel has failed.

UNL - Respective pitch trim channel is inoperative. **OFF** (white) illuminates to indicate switch position. **FAIL** light is disarmed.

- With one channel inoperative, remaining channel provides trim at one half the normal rate.
- With both channels inoperative autopilots are inoperative. Mechanical trim remains available.

1A7, 8, 25, 26 - TRIM AGMT AC, DC



PILOT'S OVERHEAD PANEL

MACH TRIM SWITCH (2)

Provides control and monitoring of Mach trim system.

LCH - Normal position. Mach trim provides an automatic pitch up trim input to the stabilizer to counteract the pitch down tendency that occurs with an increase in Mach (tuck). **FAIL** light is armed.

FAIL - (Amber) Illuminates to indicate respective Mach trim channel has failed.

UNL - Respective Mach trim channel is inoperative. **OFF** (white) illuminates to indicate switch position. **FAIL** light is disarmed.

- With one channel inoperative, remaining channel provides normal mach trim operation.
- With both channels inoperative, engage an autopilot above .55M (.75M on -500).

1A7, 8, 25, 26 - TRIM AGMT AC, DC

MACH FEEL SWITCH (2)

Provides control and monitoring of Mach feel system.

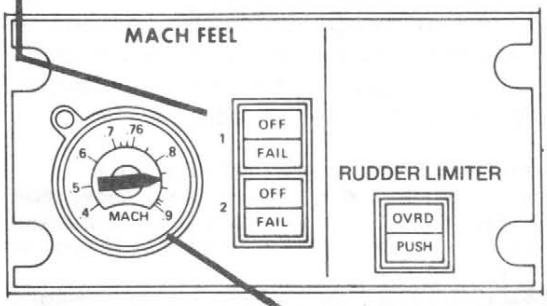
LCH - Normal position. Mach feel provides an increase in force required to move the control column in pitch as speed increases. **FAIL** light is armed.

FAIL - (Amber) Illuminates to indicate respective Mach feel channel has failed.

UNL - Respective Mach feel channel is inoperative. **OFF** (white) illuminates to indicate switch position. **FAIL** light is disarmed.

- With one channel inoperative, remaining channel provides normal Mach feel operation.
  - If channel 2 fails Mach feel indicator may also be inoperative although normal Mach feel scheduling will still be provided by channel 1.
- If both channels are inoperative altitude and/or airspeed are limited (see Flight Controls Abnormal Procedures).

1A7, 25 - TRIM AGMT



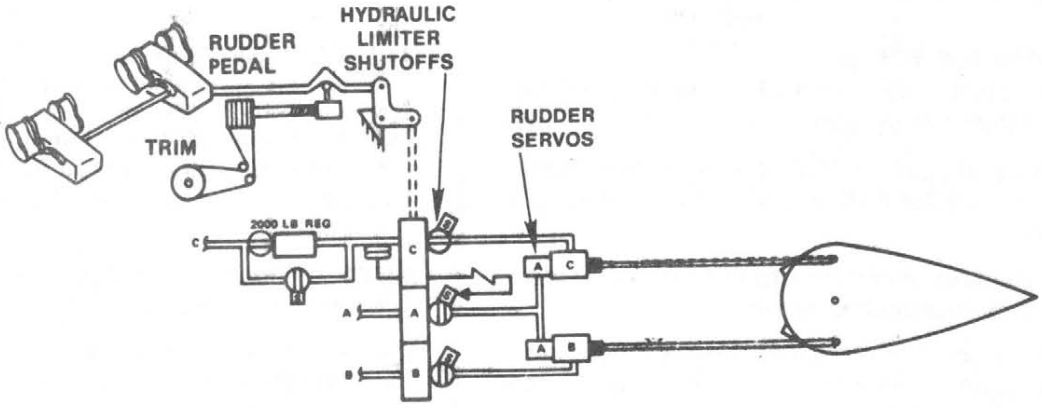
MACH FEEL INDICATOR

Indicates feel force scheduled by the Mach feel system in terms of Mach number. Indicator should correspond to reading on Airspeed/Mach indicator.

- If MACH FEEL channel 2 fails, the indicator will remain in the position that existed at the time of the failure. Normal Mach feel can still be provided through channel one.
- With loss of electrical power, the indicator will point to the 12 O'clock position.

1A7, 25 TRIM AGMT

RUDDER



The rudder is a single surface powered by hydraulic systems A, B, and C.

Rudder inputs are provided by the Capt's and F/O's rudder pedals which control a single set of cables to the rudder servos. Trim is provided by effectively shifting the neutral position of the cable inputs to the rudder servos.

Rudder Hydraulic Limiting

The rate of rudder travel is scheduled by a hydraulic limiter. At low speeds the rudder is powered by hydraulic systems A, B, and C each supplying 3,000 pounds of pressure. At medium speeds the available pressure and/or sources are reduced. At high speeds the rudder is powered by system C regulated to 2,000 psi. The following chart shows the actual hydraulic limiter schedule:

RUDDER HYDRAULIC LIMITING SCHEDULE

Aircraft No.	Less than 164K	Above 164K	Above 260K
712-723, 725-729	ABC	C	C @ 2,000 psi
724, 730-741	ABC	B, C @ 2,000	C @ 2,000 psi

RUDDER HYDR LMTR illuminates on the Pilot's Annun. Panel if hydraulic limiter scheduling is incorrect for existing airspeed. The RUDDER LIMITER HYDRAULIC switch PUSH light will illuminate with insufficient pressure and/or loss of hydraulic system sources to the rudder. Unlatching the switch illuminates OVRD and restores all available hydraulic systems to power the rudder at 3,000 psi. Hydraulic pressure to the rudder servos is also controlled by the RUDDER switch on the PFCS panel. The normal position of this switch is latched and guarded. Unlatching this switch will shut-off all pressure to the rudder and OFF illuminates. With this switch unlatched the rudder streamlines with the vertical stabilizer.

Hydraulic System A Rudder Fuse

The line from hydraulic system A to the rudder is protected with a hydraulic system fuse. The hydraulic fuse is designed to prevent loss of hydraulic system A in the event severe damage occurs to the #2 engine. The fuse automatically shuts off the system A fluid supply to the rudder upon sensing an excessive flow (broken line).

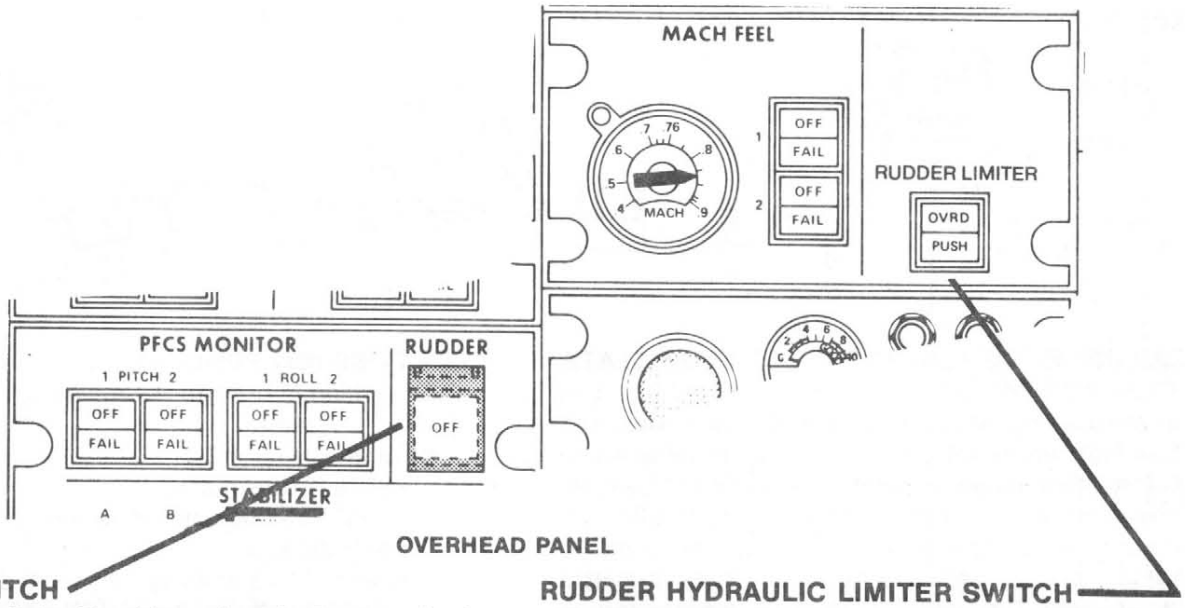
Hydraulic System C Loss

Loss of hydraulic system C pressure automatically signals the hydraulic shut-off valve for hydraulic system A to open and supply 3,000 pounds of pressure to the rudder regardless of airspeed. This is to assure a powered rudder throughout all flight regimes.

YAW SAS

The YAW SAS (Yaw Stability Augmentation System) provides yaw damping, as signaled by a yaw rate gyro, and automatic turn coordination by detecting aileron position. These functions are considered as **series** inputs. That is, the inputs do not affect rudder pedal position or feel. No autopilot inputs are used by the rudder while it is in the series mode (2-axis autopilot).

The YAW SAS supplies **parallel** inputs (affects rudder pedal position and feel) when the autoflight system is engaged in the A/L mode and A/L track status is achieved. When the YAW SAS engages in the parallel mode the autoflight system becomes a 3-axis autopilot. This refines tracking of the localizer and provides runway alignment and rollout guidance capability for automatic landing. Control and monitoring of YAW SAS is provided by two YAW SAS switches on the FCES panel (refer to Autoflight section).



OVERHEAD PANEL

RUDDER SWITCH

Guarded switch. Provides electrical control of rudder servo shutoff valves.

LCH - Normal position. Rudder servos are powered.

UNL - All three rudder servos hydraulic limiter shutoff valves are electrically energized to shut off. Red OFF light illuminates to indicate switch position.

- Rudder is unpowered and will streamline with the vertical stabilizer.
- YAW SAS is inoperative.

2K12, 13, 14 - RUDDER SERVO A,B, C

RUDDER HYDRAULIC LIMITER SWITCH

Provides control and monitoring of rudder hydraulic limiter operation.

LCH - Normal position. **PUSH** light is armed, and **OVRD** light is extinguished.

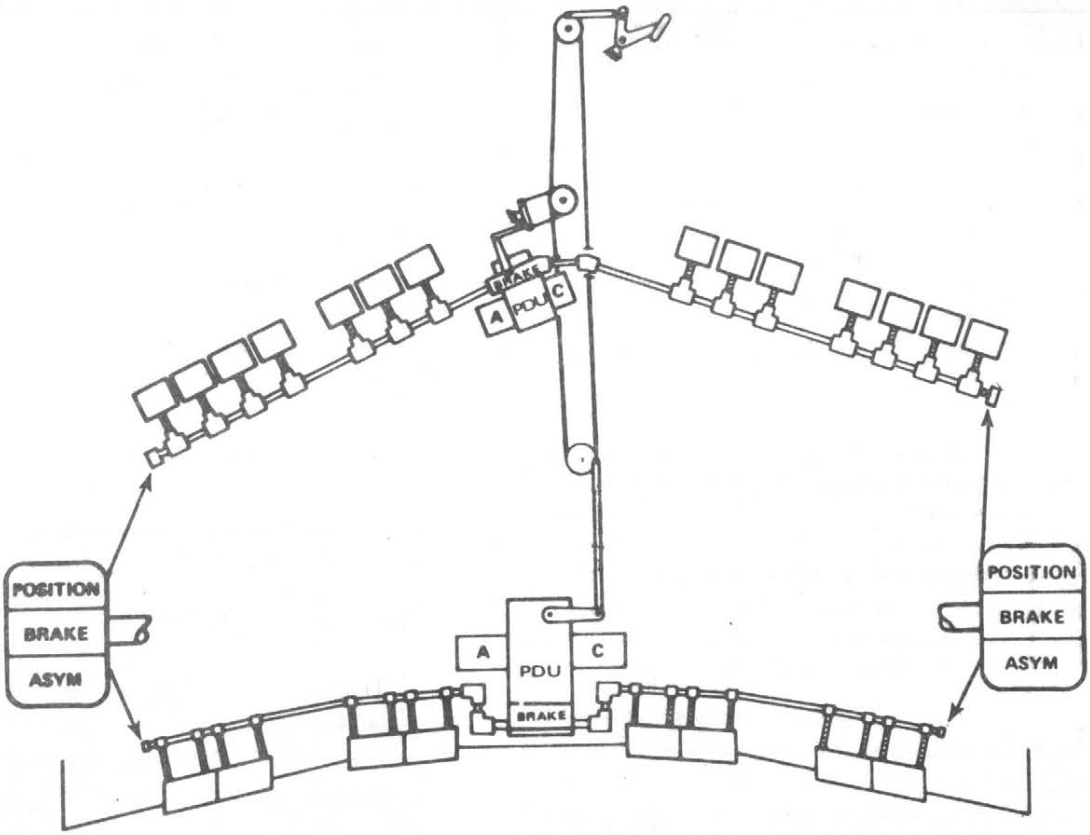
- Rate of rudder travel is decreased as speed is increased.
  - Refer to table on facing page for actual hydraulic limiter schedule.

PUSH - (Amber) illuminates when the number of systems and/or pressure is insufficient for flight regime. RUDDER HYDR LMTR also illuminates on the Pilot's Annun. Panel. RUDDER HYDR LMTR will also illuminate if rudder is being operated by too many systems or too much pressure.

UNL - Rudder is powered by systems A, B, and C at 3,000 psi regardless of airspeed. OVRD illuminates to indicate switch position and **PUSH** is disarmed.

2K12, 13, 14 - RUDDER SERVO A, B, C
2H12,20 - RUDDER HYDR LMTR

FLAPS/SLATS



TRAILING EDGE FLAPS/LEADING EDGE SLATS

There is an inboard and outboard set of flaps, and seven leading edge slat panels, on each wing. The four flaps are powered by hydraulic systems A and C through a single power drive unit (PDU). A similar power drive unit, also powered by hydraulic systems A and C, operates the slats. Either hydraulic system can operate the flaps and slats, but at a slower rate. The power drive units operate torque shafts and screwjacks which position the flaps and slats mechanically.

At the outboard end of each torque shaft is a position transmitter which drives the respective cockpit flap/slat position indicator. Also located in each transmitter unit is a flap asymmetry detector and brake. The detectors continuously compare torque shaft position and apply the brakes to the affected torque shafts if an asymmetry occurs. When either a flap or slat asymmetry is detected, the FLAP/SLAT LOCK light illuminates on the S/O's Annun. Panel. The asymmetry brakes can only be reset on the ground.

FLAP POSITION FUNCTIONS:

Flap position is used to determine several functions in other systems:

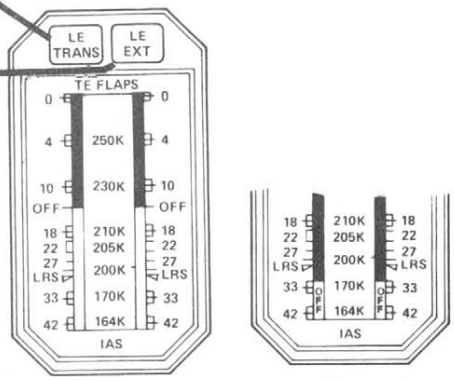
- **Flaps up;**
  - Slats are retracted.
  - Spoilers programmed to operate as manual speedbrakes.
  - Loss of hydraulic systems A & C to rudder illuminates RUDDER HYDRAULIC LMTR
- **Flaps extended to any position;**
  - Slats are fully extended.
  - Spoilers programmed for roll augmentation.
  - Loss of hydraulic systems A, B, or C illuminates RUDDER HYDRAULIC LMTR
- **Flaps between 3° and 27°;**
  - Flap takeoff warning inhibited.
- **Flaps more than 30°;**
  - Unsilenceable warning horn sounds unless all landing gear are down and locked.
  - Disarms GPWS landing configuration warning.
  - Activates auto-throttle/speed command system ALPHA mode.
- **Flap lever more than 30°;**
  - Enables DLC operation, and arms AGS for landing.

LE TRANS LIGHT (AMBER)

Not all leading edge slats are in the required position.

LE EXT LIGHT (GREEN)

All (14) leading edge slats are fully extended.



CENTER INSTRUMENT PANEL

FLAP INDICATOR

A moving tape that indicates the position of the left and right wing trailing edge flaps.

- Airspeed limit is placarded for each flap position.
- Two types of power loss indicators are used. On some indicators the tapes will position to an OFF mark between 10° and 18°. On the remaining indicators, power loss is indicated by OFF appearing at the bottom of both tapes.

3K16 - POS TE FLAP

FLAP LEVER

Controls flap and slat extension or retraction. Lever is spring-loaded in detents at:

0° - UP.

4° - Slat positioning gate -takeoff/approach.

10° - Takeoff/approach.

14° - Takeoff (Ships 738-741 and 724 only)

18° - Takeoff.

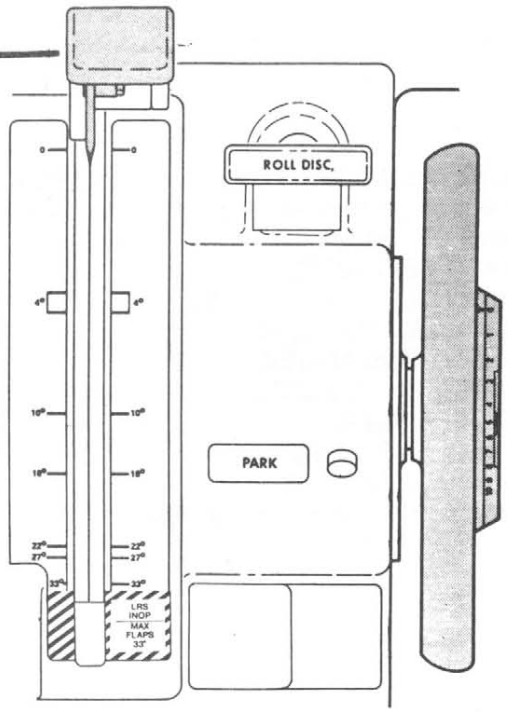
22° - Approach/go-around gate.

27° - Not used.

33° - Landing.

42° - Alternate (short field) landing.

The gate at 4° will stop lever movement as a reminder to pause to permit slat re-positioning. A similar gate at 22° identifies the go-around position during retraction only.



CENTER CONSOLE

SLAT MONITOR PANEL

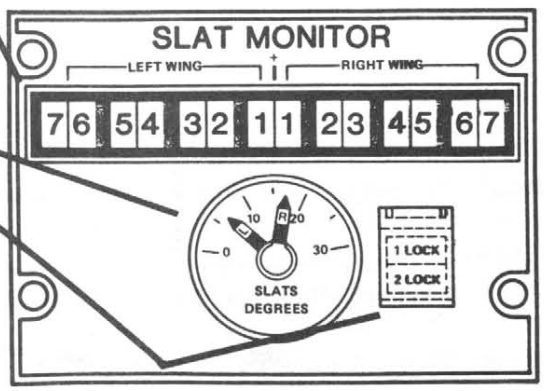
Respective green lights illuminate when the associated slat panel is extended. The green **LE EXT** light illuminates on the flap indicator when all slats are extended.

SLAT DEGREES INDICATOR - Indicates the position of the slat torque shafts.

SLAT LOCK SWITCH - Normal position is unlatched and guarded to permit slat power drive unit to operate.

- Latching the switch shuts off hydraulic pressure to the slat power drive unit. Slats are locked in existing position. **1 LOCK** **2 LOCK** illuminates to indicate switch position.

1J10 - NO. 2 ASYM BRAKE LE SLAT
2H22 - NO. 1 ASYM BRAKE LE SLAT
3K17 - POSN IND LE SLAT



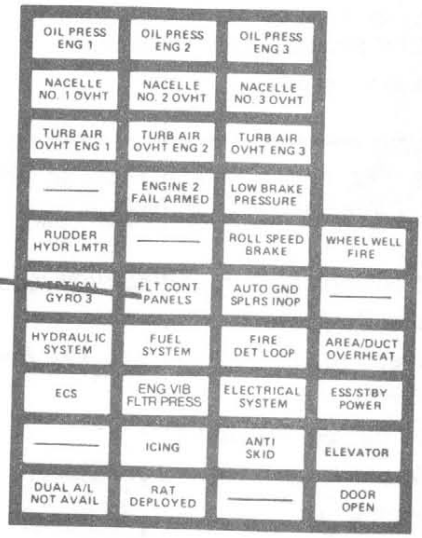
S/O's INSTRUMENT PANEL

FLAPS/SLATS (CONT'D)

FLT CONT PANELS PANELS LIGHT (AMBER)

Illuminates if any of the following lights illuminate:

- Any FCES **FAIL** except STALL WARN.
- MACH FEEL **FAIL**.
- Any PFCS MONITOR **FAIL**.
- **RUDDER MECH LIMITER**.
- **RUDDER HYDR LIMITER**.
- RUDDER HYD **PUSH**.
- RUDDER **OFF**.
- Any AILERON **OFF**.
- Any SPOILER **OFF**.
- L5&6 or R5&6 SPOILER **PUSH**.



CENTER INSTRUMENT PANEL

SLAT ASYM DET FAULT LIGHT (AMBER)

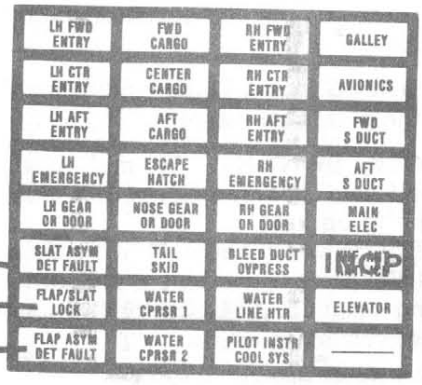
Indicates a slat asymmetry detection system fault.

FLAP/SLAT LOCK LIGHT (AMBER)

Indicates that an asymmetry has been detected in either the flaps or slats.

FLAP ASYM DET FAULT LIGHT (AMBER)

Indicates a flap asymmetry detection system fault.



S/O'S INSTRUMENT PANEL

STALL WARN SWITCH (2)

Controls power and provides monitoring of the stall warning system.

LCH - Normal position. Stall warning system is operative. **FAIL** light is armed.

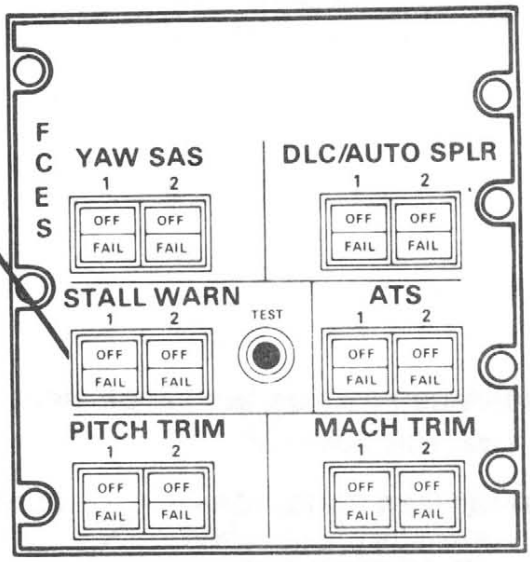
- With both switches latched, a stall warning provided by either channel will operate the F/O's stick shaker.

FAIL - (Amber) illuminates to indicate respective stall warning channel has failed.

UNL - Associated stall warning channel and stick shaker are shut off. **OFF** illuminates to indicate switch position. **FAIL** light is disarmed.

- Channel No. 2 must be unlatched to enable channel No. 1 to operate the Capt's stick shaker.

1B6, 2F2, - STICK SHAKER
1B4 - L AOA
2F1 - R AOA

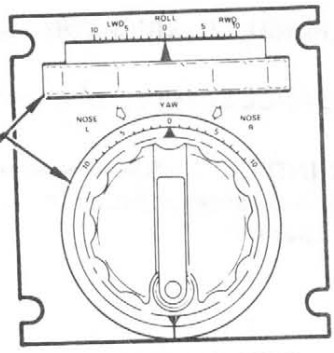


PILOT'S OVERHEAD PANEL

STALL WARN TEST BUTTON

Pressing switch provides stall angle of attack input to the stall warning system.

- With both STALL WARN switches latched, TEST operates only the F/O's stick shaker.
- TEST button inhibited in flight.



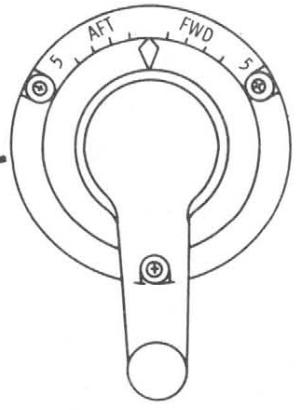
CENTER CONSOLE

AILERON AND RUDDER TRIM CONTROLS

- Provides control of aileron and rudder trim settings.
- Pointers indicate units of aileron trim and degrees of rudder trim.

RUDDER PEDAL ADJUSTMENT (2)

- Rotate to adjust position of rudder pedals.
- Total adjustment range is 9 inches. Indicator shows adjustment in inches from center of range.



BETWEEN RUDDER PEDALS

SURFACE POSITION INDICATOR (SPI)

1J23 - SURF POSN IND

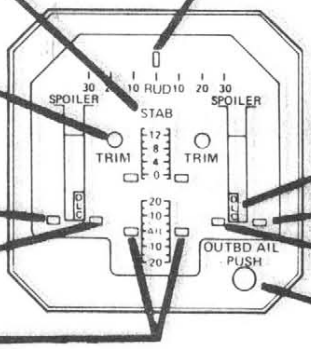
STABILIZER INDICATOR
- Total range 1° nose down to 14° nose up.
- Trim range 0 to 10° nose up.

STABILIZER AUTO-TRIM WARNING FLAG
Appears if aircraft is not in trim while an autopilot is engaged.

SPOILER PANEL L5 INDICATOR

SPOILER PANEL L4 INDICATOR

AILERON INDICATORS
Normally indicates position of inboard ailerons.



CAPT'S INSTRUMENT PANEL

RUDDER INDICATOR

DLC RANGE INDICATOR

SPOILER PANEL R6 INDICATOR

SPOILER PANEL R2 INDICATOR

OUTBD AILERON BUTTON
When pressed, aileron indicators display outboard aileron position.

END

FLIGHT CONTROLS

GENERAL DESCRIPTION

SPOILERS, SPEEDBRAKES, AND DLC

No. 1 spoiler panels are operative as speedbrakes with flaps retracted or extended. However, use of speedbrakes with flaps extended is prohibited in flight. Hydraulically powered mechanical limiters are activated with flaps retracted (less than 4^{o}) to limit the extension of No. 1 spoiler panels to 20^{o} maximum, and to limit extension of the Nos. 2 and 3 spoiler panels to 30^{o} maximum. Jam protection is provided for the No. 1 spoiler panels. If a jam is sensed, the No. 1 spoiler actuators are depowered to retract. If a No. 1 spoiler jam occurs or if the mechanical limiters fail to shift to agree with the flap position, the ROLL SPEED BRAKE legend is annunciated on the pilots' annunciator panel.

SPOILER FUNCTIONS TABLE

	PANEL NO. 1	PANELS 2 THROUGH 6
FLAPS UP	Speedbrakes, limited to 20°	Speedbrakes, panels 2 & 3 limited to 30°. Panels 4, 5, and 6 not limited

HORIZONTAL STABILIZER

If a jammed elevator is detected on the ground with all throttles between idle and 50% takeoff thrust, an ELEVATOR legend is illuminated on the second officer's annunciator panel, and the unsafe takeoff aural warning is sounded.

RUDDER LIMITER PRESSURE SCHEDULE

HYD SYS	AIRSPEED, KN		
	BELOW 186	186 TO 260	ABOVE 260
A	3000 psi		
B	3000 psi	3000 psi	
C	3000 psi	2000 psi	2000 psi

LIFT AUGMENTATION SYSTEM

Trailing Edge Flaps

Full flap extension is 33^{o}. The flap load relief system is not installed.

Active Control Equipped Aircraft

ACTIVE CONTROL SYSTEM (ACS)

The Active Control System (ACS) redistributes wing loading through symmetrical deflection of the outboard ailerons.

Two identical ACS channels, each capable of full system operation, are controlled by switchlights located on the FCES panel. The system is fail-operational, and a number of faults can be tolerated without system disengagement. Any system fault will cause the ACS FIRST FAIL light on the FCES panel and the FLIGHT CONT PANELS light on the pilots' annunciator panel to come on. Additionally, should the fault be essential to channel engagement, that channel will automatically disengage, and the associated ACS FAIL light will be illuminated.

Both ACS switches are normally left latched in after landing and are automatically reengaged when electrical and hydraulic power becomes available.

On the ground, with ACS engaged, the outboard ailerons will be up 8° more than the inboard ailerons (flaps extended or retracted). Below 90 knots the ACS is inhibited to prevent continuous aileron action.

In flight, with flaps extended, the outboard ailerons will be up 8° more than the inboard ailerons. In flight, with flaps retracted, the outboard ailerons will be down 2° less than the inboard ailerons.

MANEUVERING DIRECT LIFT CONTROL (MDLC)

MDLC enhances pitch control at higher gross weights and airspeeds. The MDLC system is an extension of the DLC/AUTO SPLR system and is controlled by the same switches on the FCES panel. MDLC is inhibited with the flaps extended and below 0.65 Mach.

The system is designed to deploy spoilers No. 1 through 6 as a function of positive acceleration. The spoilers will extend 5.4 degrees when a load factor of 1.2 g is encountered. As the load factor increases, the spoilers extend further until reaching the DLC servo limit of 20 degrees, and the stick shaker will activate at 1.75 g.

MDLC is a dual channel, fail-soft system, and either channel is capable of providing full system operation.

CONTROLS AND INDICATORS

FLAP CONTROL LEVER

A 14^{O} detent position is added to the flap control lever. It is used for a takeoff flap setting. The 27^{O} and 42^{O} detent position placards have been deleted.

FLAP LRS OVERRIDE SWITCH

The switch that was loacted on the center console has been deleted.

SURFACE POSITION INDICATOR AND STABILIZER TRIM WHEEL

The stabilizer trim range is $+0.5^{O}$ (nosedown) to -12^{O} (noseup). The takeoff trim range is 1.3^{O} to 7.7^{O}.

FLAP POSITION INDICATOR

TRAILING EDGE FLAP POSITION INDICATOR

A moving tape indicates position of the left and right trailing edge flaps.

OFF INDICATOR

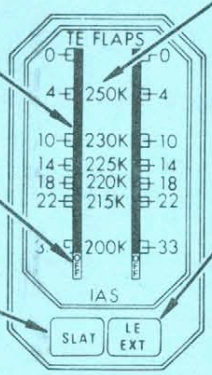
Red OFF appears when power is removed from instrument.

3K16 - POS IND TE FLAP

LEADING EDGE SLAT INTRANSIT LIGHT (RED)

SLAT is illuminated to indicate leading edge slats are not in selected position within 20 seconds after flaps are selected. The annunciation remains if any slat panel is not extended. The light cannot be tested with the slats retracted.

3K18 - LE SLAT EXTEND LT



PILOTS' CENTER INSTRUMENT PANEL

FLAP-LIMITING SPEED PLACARD

Limiting IAS for that degree of flap extension.

LEADING EDGE SLAT EXTENDED LIGHT (GREEN)

LE EXT is illuminated to indicate all leading edge slat segments are fully extended. Light flashes while slats are in transit.

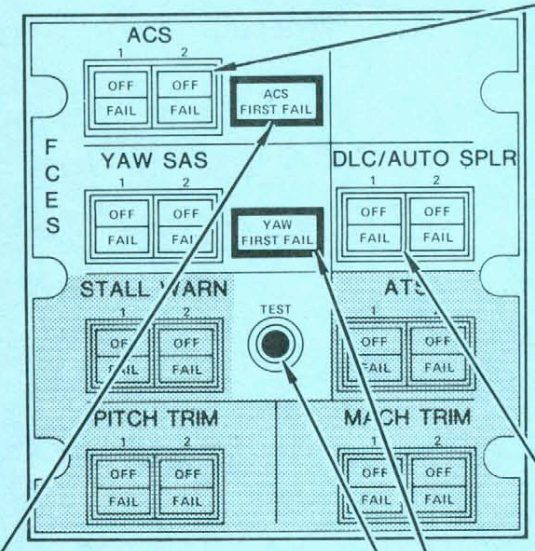
3K18 - LE SLAT EXTEND LT

Also Effective On
Ships 738-741
Ship 724

AIRCRAFT DIFFERENCES

FLIGHT CONTROL ELECTRONICS SYSTEM PANEL (WITH ACTIVE CONTROLS)

- Normally all switches are latched (in) and no switchlights are illuminated.
- Both channels of each system are normally used. Systems are operative on either channel alone.
- FAIL is illuminated in one or both channel switches with detection of fault.
- FLT CONT PANELS is annunciated with fail indication and is extinguished when respective switch is unlatched (OFF).
- OFF is illuminated with switch unlatched. FAIL is extinguished.



ACS SWITCHES

With both switches latched in, indicate ACS system status. Without hydraulic pressure, both FAIL lights will be illuminated. When FAIL is illuminated, the system monitor has detected a fault essential to channel engagement and has automatically deactivated the affected channel. Unlatching the switch(es) deactivates affected channel(s), disarms fault monitoring, and illuminates the OFF legend.

1B16 – ACS MEMORY
3Y4 – ACS PSU AC
3Y9, 10 – ACS CHAN 1 AC, DC
3Y15, 16 – ACS CHAN 2 AC, DC

DLC/AUTO SPLR SWITCHES

Control automatic spoiler deployment when commanded by:

- Direct Lift Control or Autoground Spoilers (Flaps 30^{o} or more, airspeed 0.65 Mach and below).
- Maneuvering Direct Lift Control (Flaps retracted, airspeed 0.65 Mach and above).

With both switches latched in, the DLC/AUTO SPLR and MDLC systems are powered. Switchlights indicate the MDLC status during ground confidence test and DLC/AUTO SPLR status at all other times. A circuit fault causing automatic deactivation of a DLC/AUTO SPLR channel will also inhibit MDLC spoiler activity in that channel.

Unlatching either switch will deactivate MDLC and DLC/AUTO SPLR in that channel. With both channels off or failed, speedbrakes must be manually extended, and DLC is inoperative.

2F1, 2 – AOA STICK SHAKE
2H14, 15 – DLC SERVO A, B
1B5, 6 – AC AOA, STICK SHAKE

ACS FIRST FAIL LIGHT

Light will come on upon detection of any fault within ACS system and remain on until fault is corrected. FLIGHT CONT PANELS will also be annunciated when the ACS FIRST FAIL LIGHT is on.

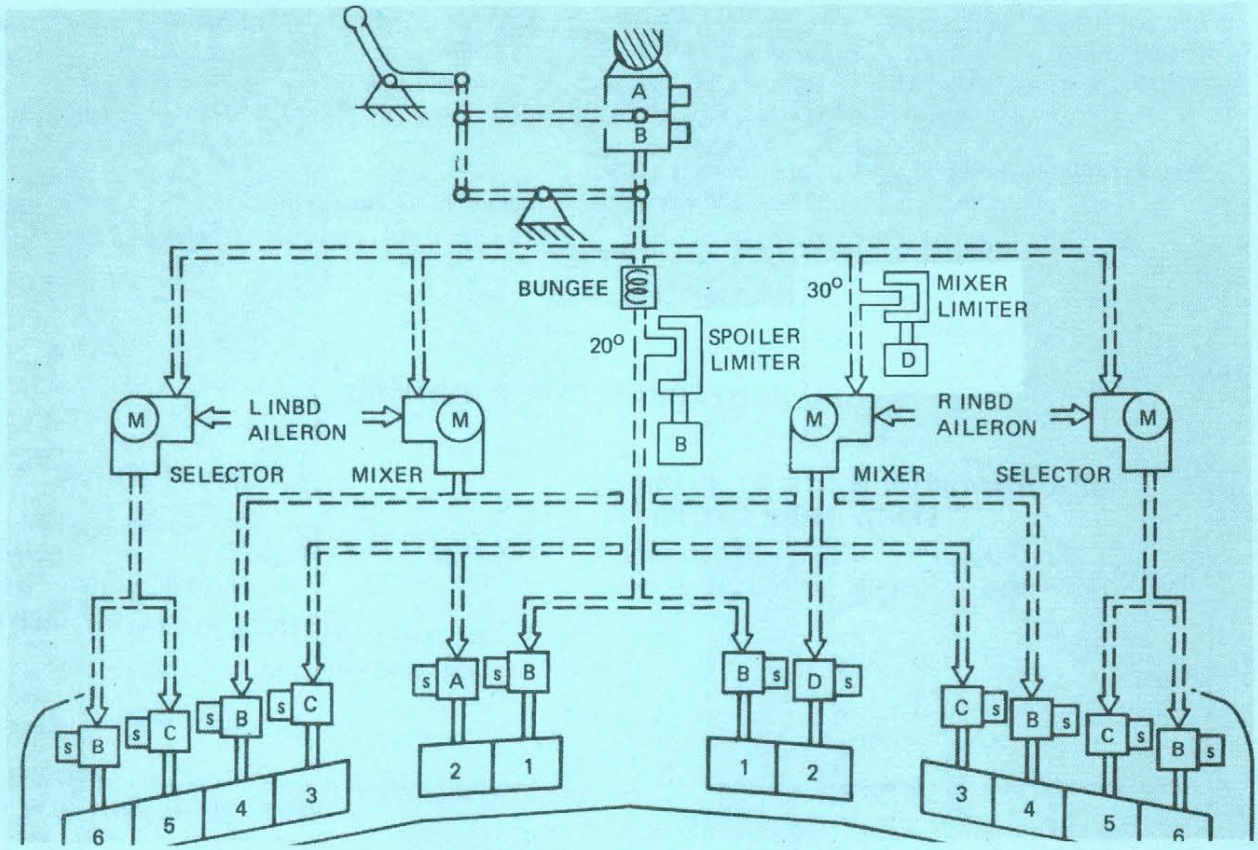
STALL WARNING TEST SWITCH

Momentary pushbutton switch permits checking MDLC or stall warning systems on the ground. With DLC/AUTO SPLR switches latched in, pressing switch will check MDLC system. Unlatching DLC/AUTO SPLR switches will permit checking stall warning system.

YAW FIRST FAIL LIGHT

Light will come upon detection of any fault within yaw SAS system and remain on until fault is corrected.

SPOILER SERVO LIMITERS



GENERAL

Two pitot-static tubes are located on each side of the aircraft. Each tube contains a pitot intake and two isolated static intakes. The static systems are cross-coupled "diagonally" across the airplane to average any effects of side-slip, roll rate, etc., on the system.

CENTRAL AIR DATA COMPUTERS (CADC)

The CADC system receives ram and static pressure inputs from the pitot-static system and electrical temperature signals from the total temperature probes; the inputs and signals are used to generate altitude, airspeed, and temperature information. This information is displayed on the pilots' instruments and is also used to calculate Mach number, true airspeed, and static temperature. These computed outputs are displayed on the pilots' instruments. Also, several CADC outputs are provided to external systems.

No. 1 CADC
- TAS - to the Omega nav system
- Captain's VSI
- Captain's Airspeed/Mach
- Captain's Altimeter
- AFCS
- Flap and Rudder Load Relief
- Transponder
- Flight Recorder
- Flight Management System

No. 2 CADC
- TAS
- SAT
- First Officer's VSI
- First Officer's Airspeed/Mach
- First Officer's Altimeter
- AFCS
- Flap and Rudder Load Relief
- Transponder
- Instrument Comparison Monitor
- TAT/EPR Indicator
- Flight Management System

Loss of a valid signal or an internal failure in an instrument causes a warning flag to appear in the appropriate instrument(s).

PITOT/STATIC INSTRUMENTS

The standby airspeed indicator, standby altimeter, and cabin differential pressure indicator are the only pure pitot static instruments.

ATTITUDE REFERENCE SYSTEM

The attitude reference system provides a stable horizontal reference plane from which aircraft pitch and roll attitudes can be determined. Two identical attitude reference systems are provided. Each system consists of a vertical gyro and an Attitude Director Indicator (ADI).

Vertical gyro (VG) No. 1 provides attitude information to the Captain's attitude direction indicator (ADI). VG No. 2 provides attitude information to the First Officer's ADI. VG No. 3 is an alternate source of attitude information for either pilot's ADI. In addition to the ADI's, attitude information is provided to the weather radar, compass system, autopilot/flight director, instrument comparator, and the flight recorder.

As a backup for the two systems, a standby attitude indicator is provided with an independent pitch and roll reference.

INSTRUMENT COMPARATOR

An instrument comparison system compares the Captain's and First Officer's flight instruments indications. If there is a discrepancy between two like instrument indications, a flag is displayed on the INSTR COMPARATOR panel. When a failure occurs, the pilots decide which instrument has failed and select the appropriate alternate instrument source. The INSTR COMPARATOR and INSTRUMENT SOURCE SELECT panels are on each pilot's instrument panel.

GROUND PROXIMITY WARNING SYSTEM

Description

The ground proximity warning system (GPWS) warns the flight crew of a potentially dangerous flight path relative to the ground. The system monitors five abnormal flight conditions:

Pull Up Warning

- Excessive sink rate below 2500 ft.AGL
- Excessive closure rate toward rising terrain.
- Descent immediately after takeoff
- Not in landing configuration below 500 ft. AGL

Glide Slope Alert

- Excessive deviation below the glide slope.

The system will not warn against:
- Landing short of the runway or where no runway exists if the airplane is in landing configuration with a normal rate of descent and no glide slope
- Approaching extremely steep terrain such as a sheer cliff.

The system automatically shuts down if the radio altimeter is inoperative.

Warning Indications

PULL UP & GS lights are located on each pilot's panel just below the vertical speed indicator.

The voice warning is through the GPWS speaker. Volume is preset and is not adjustable.

When the potentially dangerous condition is corrected, the warning stops and the system automatically resets. The voice warning and lights are deactivated below 50 ft. AGL and above 2500 ft. AGL.

System Controls

The GPWS/INHIBIT Switch is used to deactivate the GPWS. The switch is normally guarded and safetied in the OFF position.

The GLIDE SLOPE alert can be deactivated by pressing either GS light before or after receiving the warning provided NAV 1 is tuned to an ILS frequency. The Glide Slope alert system is automatically rearmed by momentarily channeling ILS frequency selector off channel.

Fault Monitor Warning

The GPWS FAIL light illuminates when GPWS is not functioning. The light also illuminates when PULL-UP light is pressed for system test or by pressing the lens cap on the GPWS FAIL light.

ATTITUDE FLAG (ORANGE)

Attitude input signals are not valid or power sources have failed. All attitude displays should be disregarded.

1F2 - CAPT ADI
1F20 - F/O ADI
1G6 - VG/INS–1
1G24 - NO. 2 - INS/VERT GYRO
1E24 - INS–3/GYRO

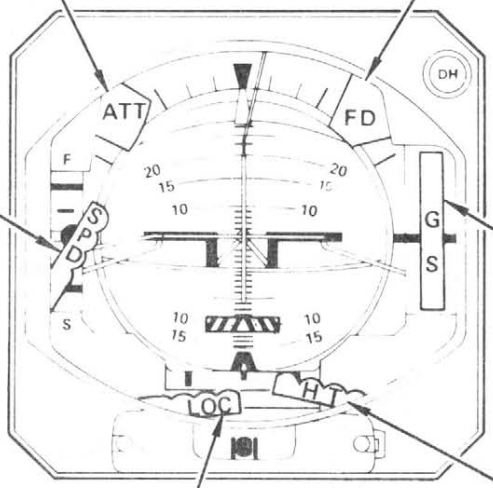
SPEED COMMAND FLAG (ORANGE)

Speed command information is not valid

1A2, 20 - SYSTEM SPEED CONT

FLIGHT DIRECTOR FLAG (ORANGE)

Pitch and roll commands from the flight director system are not valid or power sources have failed. Command bars bias out of view.



GLIDE SLOPE FLAG (ORANGE)

Loss of valid glide slope frequency input or power sources have failed.

1G4, 22 - ILS

HT FLAG (ORANGE)

Radio altimeter information not valid.

1D4, 22 - RADIO ALTM

LOCALIZER FLAG (ORANGE)

Loss of valid localizer frequency input or power source have failed.

1G4,22 - ILS

ATTITUDE DIRECTOR INDICATOR FAIL FLAGS
(PILOT'S INSTRUMENT PANEL)

CONTROLS & INDICATORS

FIXED ROLL ANGLE SCALE

Roll angle is displayed by the roll angle pointer against the roll angle scale. Scale is marked from zero at 10, 20, 30, 45 and 60 degrees left and right.

SPEED DEVIATION POINTER

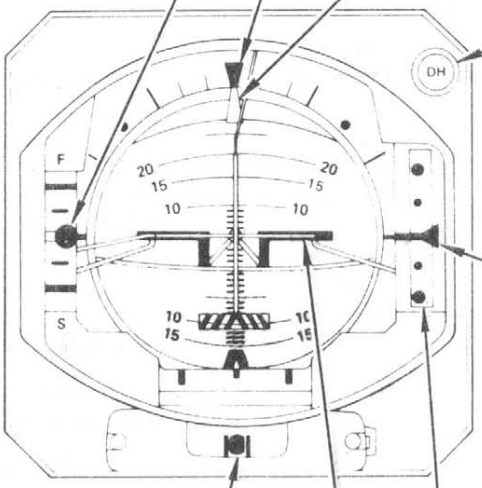
Indicates actual speed is faster, equal to, or slower than desired speed command alpha mode or auto throttle selection. It will bias out of view if signals are invalid.

ROLL ANGLE POINTER

Displays roll angle against fixed roll angle scale.

DECISION HEIGHT (DH) INDICATOR LIGHT

Illuminates when aircraft is at or below DH selected on radio altimeter. The lights are a repeater of DH light on radio altimeter. Pressing DH light on radio altimeter extinguishes this light.



GLIDE SLOPE DEVIATION POINTER

Indicates aircraft position (fixed-center index) in relation to glide slope beam (movable pointer). When pointer is below, the aircraft is above glide slope. When pointer is above the center, aircraft is below glide slope.

GLIDE SLOPE DEVIATION SCALE

Indicates glide slope deviation against glide slope deviation pointer. When aircraft is on glide slope, pointer is opposite center index.

INCLINOMETER

Displays slip and skid information for aid in coordinating turns.

FIXED AIRCRAFT REFERENCE SYMBOL (YELLOW)

Attitude sphere moves in pitch and roll to indicate aircraft attitude against fixed aircraft reference symbol.

ATTITUDE DIRECTOR INDICATOR (2) – SHEET 1

(PILOT'S INSTRUMENT PANEL)

CONTROLS & INDICATORS

ATTITUDE SPHERE

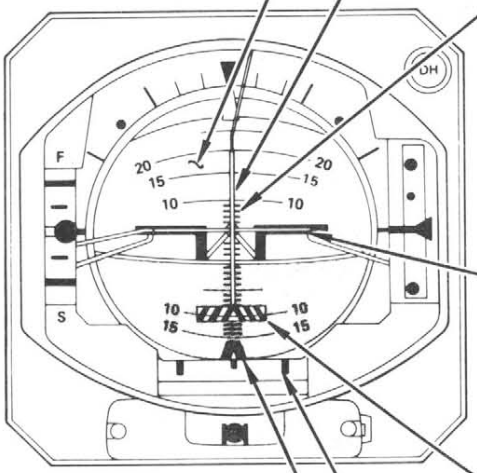
Displays both pitch and roll attitude by its physical relationship against fixed aircraft reference symbol. The horizon is represented by a white line separating the blue (sky) from the black (earth) portions.

ROLL COMMAND BAR

Bar position in relation to center of fixed aircraft reference symbol indicates roll commands. Bar to the right of center commands right roll. Bar to left of center commands left roll.

ATTITUDE SPHERE PITCH SCALE

Pitch angle is displayed by the fixed aircraft reference symbol against the attitude sphere pitch scale. Scale is marked in one degree increments from 0 to 20 degrees and at 10, 15, 20, 30, 40, 60, 80, and 90 degrees up and down. The scale is marked with the small word PUSH between 60 and 80 degrees and the large word PUSH between 80 and 90 degrees pitch up. The small word PULL is between 40 and 60 degrees and the large word PULL between 80 and 90 degrees pitch down.



PITCH COMMAND BAR

Bar position in relation to fixed aircraft reference symbol indicates pitch commands. Bar below aircraft symbol commands nose down pitch. Bar above aircraft symbol commands nose up pitch.

RISING RUNWAY

Display radio altimeter information. The symbol moves vertically with radio altimeter inputs. The symbol indicates radio altitude from 200 feet to 0.

LOCALIZER DEVIATION POINTER

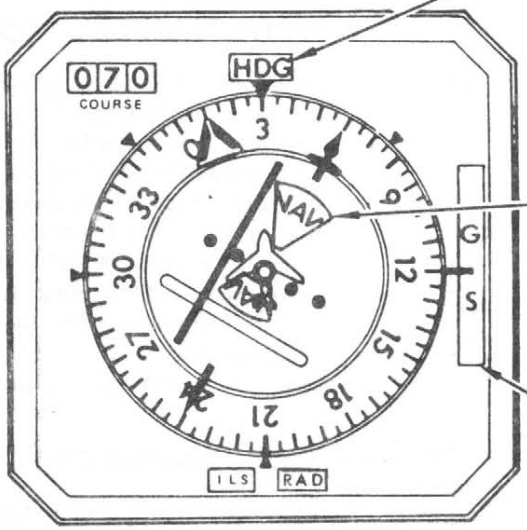
Indicates aircraft position (fixed center index) in relation to localizer beam (movable pointer). Scale is expanded and pointer will displace approximately three times as far for the same deviation as the HSI pointer.

LOCALIZER DEVIATION SCALE

Indicates localizer deviation against localizer deviation pointer. When pointer is opposite center index, aircraft is on localizer.

ATTITUDE DIRECTOR INDICATOR (2) – SHEET 2

(PILOT'S INSTRUMENT PANEL)



1F3 - CAPT HSI
1F21 - F/O HSI

HEADING FAIL FLAG (ORANGE)

Heading annunciator flag HDG covers window when selected source is unreliable.

1D27 - INSTR
1F3, 21 - CAPT/F/O HSI
1F5 - INSTR XFMR NO. 1
1G5, 23 - DIR GYRO
1G26, 1K19 - CMPS CPLR

NAV LEGEND FAIL FLAG (ORANGE)

Indicates failure of course signal as selected.

1G1, 19 - VOR RCVR
1G2, 20 - PREAMP
1G4, 22 - ILS
1K21, 1J22 - VOR 1/2

GLIDE SLOPE FAIL FLAG (ORANGE)

GS fail flag covers GS scale if signal is weak or the receiver fails.

1G4, 22 - ILS

HORIZONTAL SITUATION INDICATOR FAIL FLAGS

(PILOT'S INSTRUMENT PANEL)

HEADING INDEX
Indicates magnetic heading on compass card.

HEADING POINTER
Indicates APFDS heading selected.

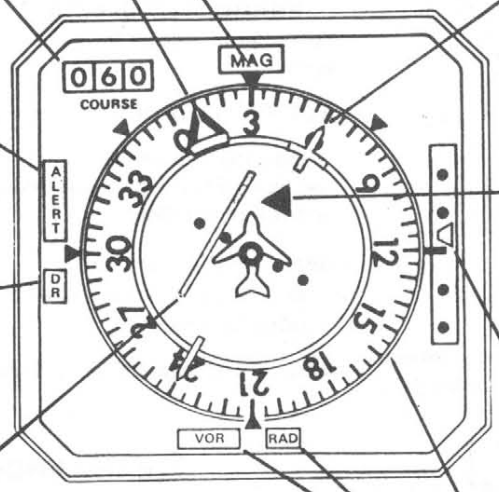
COURSE DISPLAY
Indicates VOR course selected, or FMS/ONS desired track.

ALERT LIGHT
Illuminates whenever the FMS or ONS is approaching a waypoint change.

DEAD RECKONING DR
Illuminates whenever the FMS or ONS is computing a course between a from and to waypoint and not receiving valid NAVAID signals.

DEVIATION BAR
Displays VOR, LOC, or NAV course deviation. One dot deviation indicates:

VOR - 5°
LOC - 1¾°
NAV - 3.5 miles



NAV SYSTEM SOURCE DATA INDICATORS
Indicates which navigation system is providing the display. The sources of navigation data are:

LEFT
ILS - Instrument Landing System
VOR - VHF omni range
NAV - Navigation mode

RIGHT
RAD - Radio
FMS - Flight Management System
ONS - Omega Navigation System

COURSE POINTER
Indicates VOR course as selected by the navigation mode selector panel, or FMS/ONS desired track.

TO-FROM POINTER
Appears at nose or tail of course pointer to indicate selected course is TO or FROM the station or waypoint.

GLIDE SLOPE DISPLAY
Glide slope scale and bar appear when LOC frequency is selected. One dot = ¼° scale appears when FMS is selected but bar is biased from view.

HSI COMPASS CARD
Captain's card receives information from mag. heading system No. 1 F/O's card receives information from mag. heading system No. 2.

HORIZONTAL SITUATION INDICATOR(2)
(PILOT'S INSTRUMENT PANEL)

CORRECTED ALTIMETER (2)

Displays corrected altitude from air data computers. Captain's altimeter from ADC1, first officer's from ADC2. Alternate selector switches permit captain's or first officer's altimeter to be operated by either ADC.

INSTRUMENT VIBRATOR FLAG

With no power to the vibrator circuit, a red flag is visible. With power the area is black.

1E9 - STBY ALTM

STATIC SYSTEM CORRECTION FLAG (YELLOW)

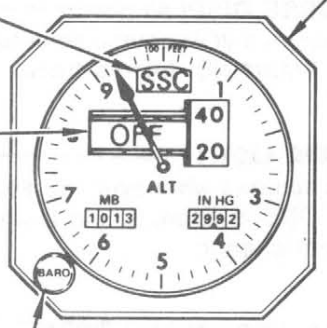
Indicates failure of air data computer to correct for static error.

ALTITUDE WINDOW

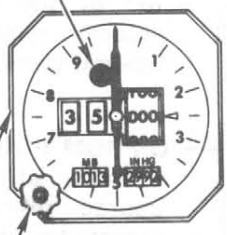
Indicates altitude above sea level. Flags replaces altitude indication as follows:

OFF - Indicates failure of the instrument or total failure of air data inputs.

NEG - Indicates below sea level.



1F4 - CAPT ALTM
1F22 - F/O ALTM
1G8, 27 - AIR DATA COMPTR



BARO KNOB

Sets barometric pressure in millibars and inches of mercury.

BARO KNOB

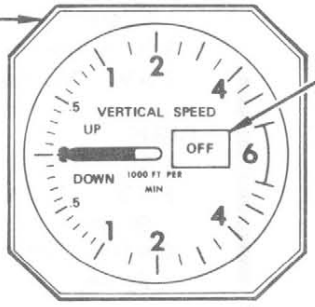
Knob sets barometric pressure in millibars and inches of mercury.

STANDBY ALTIMETER

Pressure instrument. Direct reading from first officer's static system and is not corrected for static system errors. Does not have a fail flag.

VERTICAL SPEED INDICATOR (2)

Operates by inputs from the air data computer, captain's by ADC 1, first officer's by ADC 2. The alternate selector switch may be used to switch vertical speed inputs to the opposite ADC.



OFF FLAG (ORANGE)

Indicates loss of power or unreliable indication.

1E4, 21 - VERT SP IND
1G8, 27 - AIR DATA COMPTR

ALTIMETERS AND VERTICAL SPEED INDICATOR

(PILOT'S INSTRUMENT PANEL)

MACH INDICATOR

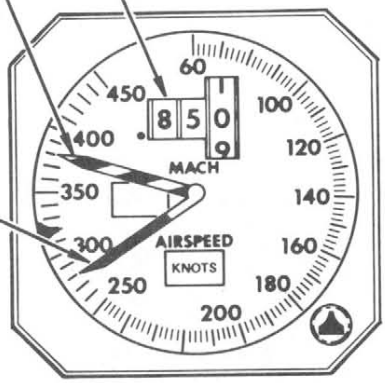
Corrected mach from air data computer. Captain's by ADC 1, first officer's by ADC 2.

MAXIMUM SPEED POINTER

Maximum speed pointer receives signal from the air data computer and indicates the maximum operating speed. Overspeed clacker sounds if speed is exceeded.

IAS POINTER

IAS pointer receives signal from air data computer.

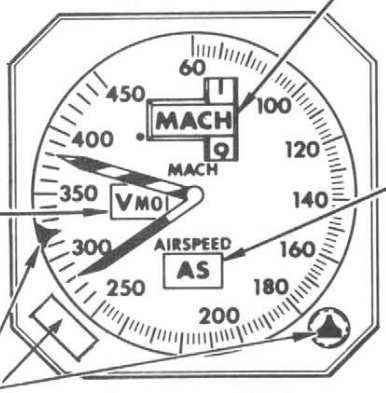


NORMAL INDICATION - NO FAILURE

1F1 - IAS/MACH IND-1
1F19 - IAS/MACH IND-2

MACH FLAG (ORANGE)

Mach reading unreliable.



AS FLAG (ORANGE)

Airspeed indication unreliable or loss of power.

VMO FLAG (ORANGE)

The maximum speed pointer indication unreliable or loss of power.

REFERENCE SPEED BUG AND SETTING KNOB

ALL FAILURE WARNING FLAGS SHOWING

If all flags appear simultaneously, the instrument has lost electrical power.

1F1 - IAS/MACH IND-1
1F19 - IAS/MACH IND-2
1G8, 27 - AIR DATA COMPTR

SELECTABLE V_{MO} SWITCH (COVERED)

Permits disconnecting the maximum speed pointer from the air data computer and manually setting it to 270K for gear down flight.

AIRSPEED/MACH INDICATOR
PILOT'S INSTRUMENT PANEL (2)

AC STANDBY BUS
MUST BE ENERGIZED

BANK ANGLE INDICATOR

STANDBY HORIZON INDICATOR

BANK ANGLE SCALE

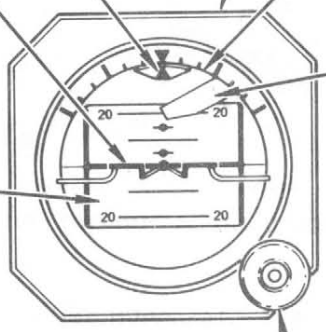
FIXED AIRPLANE
REFERENCE

FAIL FLAG

Attitude indications are not valid or power source has failed.

PITCH SCALE

Also visible when caged.



1F6, 7 - STBY HRZN
INSTR LT

CAGING/PITCH TRIM CONTROL

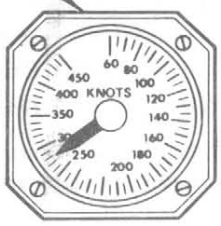
Pull out for caging.

LOCK – Pull out (cage) and turn appx. ¼" clockwise.

UNLOCK – Turn appx. ¼" counter-clockwise and release (spring loaded) to uncaged position.

STANDBY AIRSPEED
INDICATOR

Operates direct from F/O pitot/static system inputs and is uncorrected.



STANDBY HORIZON AND AIRSPEED INDICATORS
PILOT'S INSTRUMENT PANEL

CONTROLS & INDICATORS

DECISION HEIGHT (DH) WARNING SWITCHLIGHT

Illuminates when reaching decision height altitude. Also illuminates DH light on ADI. Press light extinguish DH light on ADI will also extinguish. Rotating set knob so that counter reads below decision height will also extinguish light. Also illuminates at 2500 and 1000 feet as proximity warning. Press DH light to reset.

DECISION HEIGHT (DH) BUG

The DH bug moves up or down as tape moves up or down to remain opposite selected decision height. Intermittent tone starts when 50 feet from bug. Tone stops at the bug. DH light on as altitude is passed.

AIRCRAFT POINTER

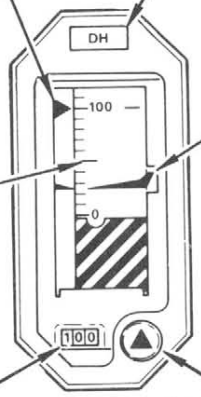
Stationary pointer indicates height above terrain.

ALTITUDE TAPE (GREEN 0-500 FT BLUE 500-2500 FT)

Tape movement displays altitude from zero to 2500 feet.

GROUND SYMBOL (BLACK AND YELLOW STRIPES)

Appears below zero on tape.



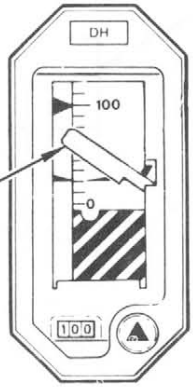
1D4, 22
RADIO ALTM

DECISION HEIGHT COUNTER

Indicates decision height setting. Displays altitude from zero to 499 feet. Covered by black mask above 500 feet and white mask below zero.

DECISIONS HEIGHT SET KNOB (YELLOW TRIANGLE)

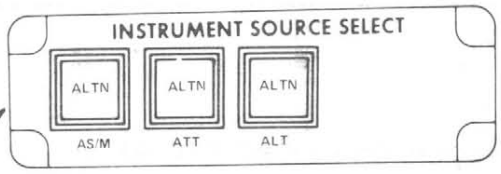
Sets DH in wondow and places bug on tape at selected decision height.



FAIL FLAG (FIRE ORANGE)

Indicates loss of reliable radio altitude indication. The ADI rising runway vertical motion indications will be unreliable.

RADIO ALTIMETER (2)
PILOT'S INSTRUMENT PANEL



ALTERNATE SOURCE SELECT PANEL (2)

OUT - Normal position. No lights on.

AS/M, ATT and ALT signals are from normal source.

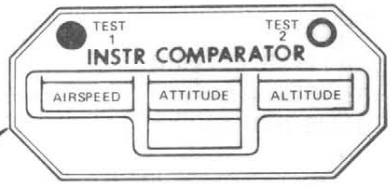
IN – ALTN indicates that alternate source data is selected. Except for ATT, the selector pressed first takes priority and it is not possible for the Captain and First Officer to simultameously use AS/M or ALT.

AS/M - Selects other ADC to airspeed/mach indicator.

ATT - Selects No. 3 gyro to ADI. Both ATT switches may be in ALTN at the same time.

ALT - Selects other ADC to altimeter and vertical speed indicator.

1E1,2 - ALT SOURCE SEL CAPT INSTR - F/O INSTR



INSTRUMENT COMPARATOR PANEL (2)

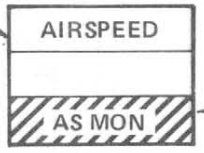
TEST 1 - Displays all comparison flags on both pilots' indicators. The ATT flag in the ADI appears on the side that is activated. If both pilots' tests 1 are pressed at the same time, all comparison flags except ATTITUDE will appear and the VERT GYRO 3 light on pilots' annunciator panel will illuminate.

TEST 2 - Displays all monitor flags.

1D8, 26 - INSTR COMPRN MON

COMPARISON FLAGS (3)

Indicates captain's and first officer's instruments are displaying a significant difference.

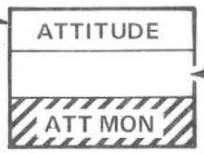


MONITOR FLAGS (3)

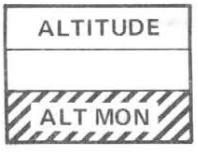
Indicates comparison monitor failure.

ATTITUDE comparator normally monitors VG 1, 2, and 3. If a significant difference occurs in VG 1 or 2, ATT flag appears in the respective ADI. If VG 3 is at fault the VERTICAL GYRO 3 light on the Pilot's annunciator panel illuminates.

If ALTN ATT selected, or VG 3 has failed, a difference between the two remaining gyros will cause both ATTITUDE legends to appear.



Normal condition is blank. Instruments are operating properly.



LEGEND (ALL YELLOW)

INSTRUMENT COMPARISON MONITOR AND SOURCE SELECT PANELS
PILOT'S INSTRUMENT PANEL

GPWS OPERATION

System Test

Each PULL UP light also serves as a test switch. Depress either PULL UP light. Note the voice warning of "Whoop whoop, pull up; whoop whoop, glideslope." Both PULL UP lights should flash, and the GS lights and GPWS FAIL light should come on.

NOTE: If glideslope warning has been deactivated (by pressing the GS light) and not rearmed, the GS light will remain out during the test.

The glideslope alert mode can be disarmed by depressing the GS light to prevent a nuisance warning when a valid glideslope signal is being received and the pilot flying specifically intends not to follow it. Deactivating the glideslope mode is permissible when:

- An ILS approach is made to one runway and the landing is made on a parallel runway.
- An ILS approach is made to circling minimums followed by a circling approach to another runway.
- The glideslope touchdown point is substantially displaced from the runway threshold and the captain elects to use this additional runway for landing and
- Making a backcourse approach.

Alternate Operation

Inhibit GPWS for emergency or abnormal conditions that would produce a "not" in landing configuration" warning. (Refer to appropriate Emergency/ Abnormal Procedures.)

The GPWS fault monitor warning circuits continuously self-test the system on the ground. This self-test feature is identical to the pilot-initiated test, except the GS and PULL UP lights do not illuminate, and the aural warning is not heard. The GPWS FAIL light illuminates automatically if the system fails the self-test.

Inflight Operation

PULL UP WARNING: If a PULL UP warning occurs the crew will take immediate corrective action by increasing the attitude and thrust for maximum climb rate as the aircraft configuration and profile permit. Since the warning time provided by the system is only a few seconds, time is not available for the normal "smooth" maneuver. The warning will stop when the airplane has been flown out of the danger area.

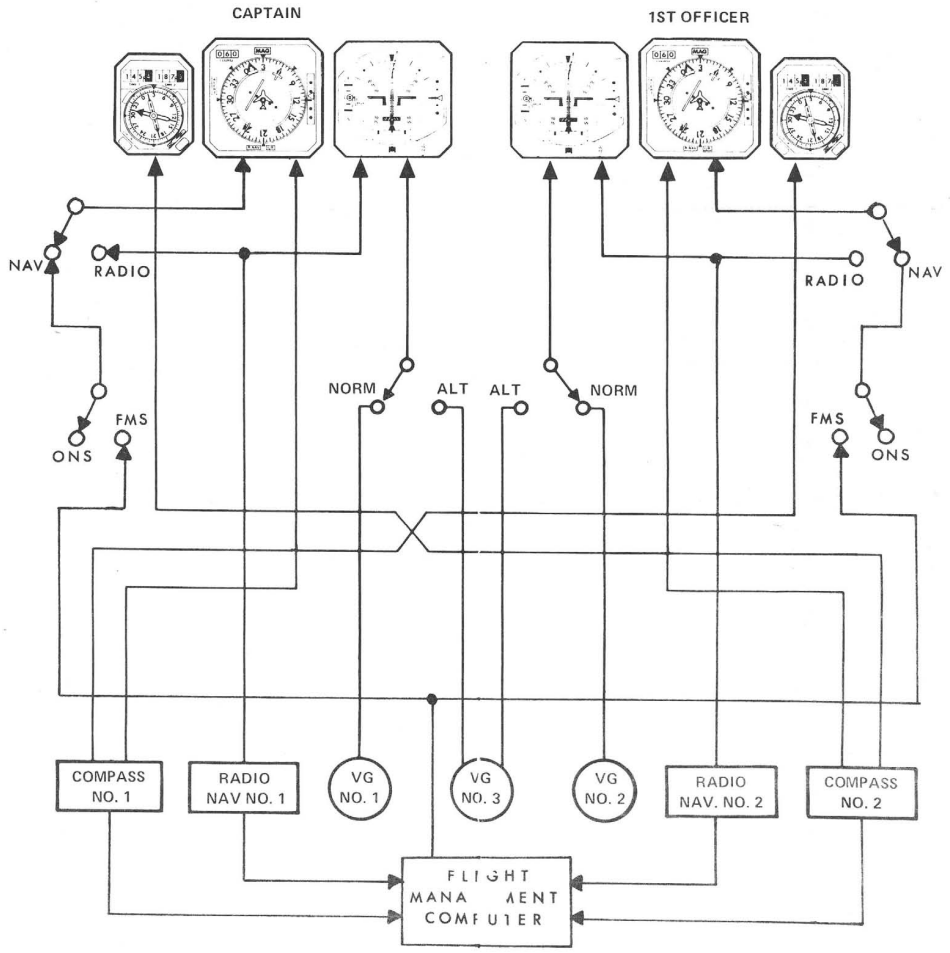
GLIDE SLOPE ALERT: If the GLIDE SLOPE alert occurs while receiving a valid glideslope signal, return the airplane to the glideslope or execute a missed approach.

NOTE: Do not deactivate GPWS except for planned abnormal or emergency operation.

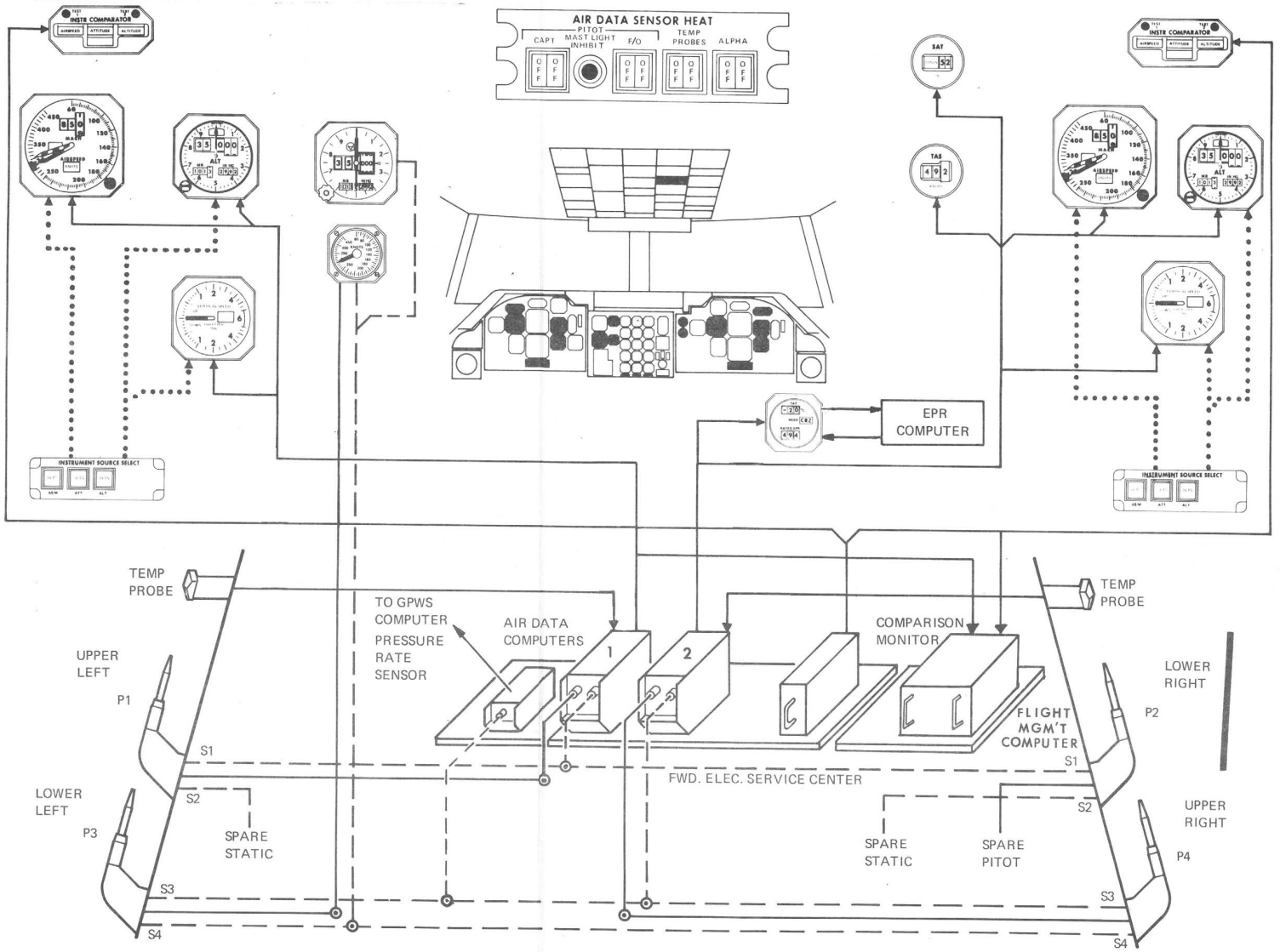
Whenever the GPWS is deactivated (Inhibit switch used), the date and time of deactivation must be entered in the Aircraft Logbook.

(OPPOSITE SIDE BLANK)

SCHEMATIC



ATTITUDE, HEADING & RADIO INSTRUMENT SYSTEM



PITOT–STATIC AND AIR DATA SYSTEMS

Ships 751-756

Ships 738-741

FLIGHT INSTRUMENTS

GENERAL DESCRIPTION

ATTITUDE REFERENCE SYSTEM

The attitude reference is provided by three inertial navigation systems (INS). Normally, INS No. 1 supplies information to the captain's Attitude Director Indicator (ADI), and INS No. 2 supplies information to the first officer's ADI. INS No. 3 is a backup source of attitude information for either the captian's or first officer's ADI and may be selected by pressing the attitude (ATT) switch on the instrument source select panel.

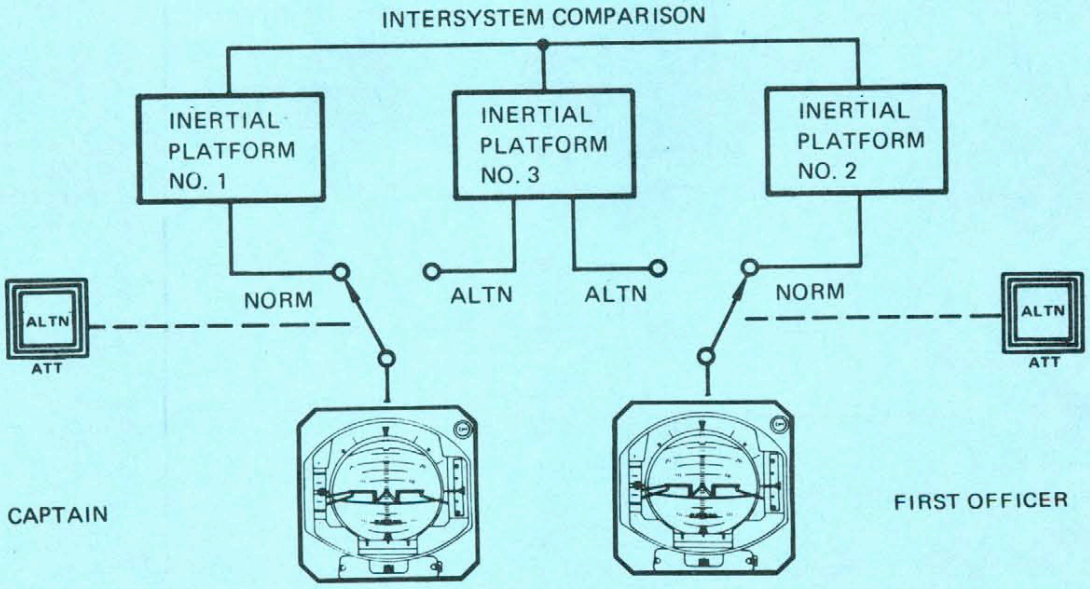
All three attitude systems feed information to the instrument comparison monitor for use by the instrument failure warning system. This controls the ATTITUDE annunciator in the instrument comparator and a separate ATT 3 legend on the pilots' annunciator panel.

AIR DATA COMPUTER

In addition to normal instrument outputs digital output signals of altitude, calibrated airspeed, true airspeed, Mach, and total air temperature are supplied from both air data computers to the flight management system. Output altitude and true airspeed signals are supplied by ADC No. 1 to the No. 1 inertial navigation system, and by ADC No. 2 to INS 2 and INS 3.

SCHEMATIC

ATTITUDE INSTRUMENT SIGNAL DIAGRAM

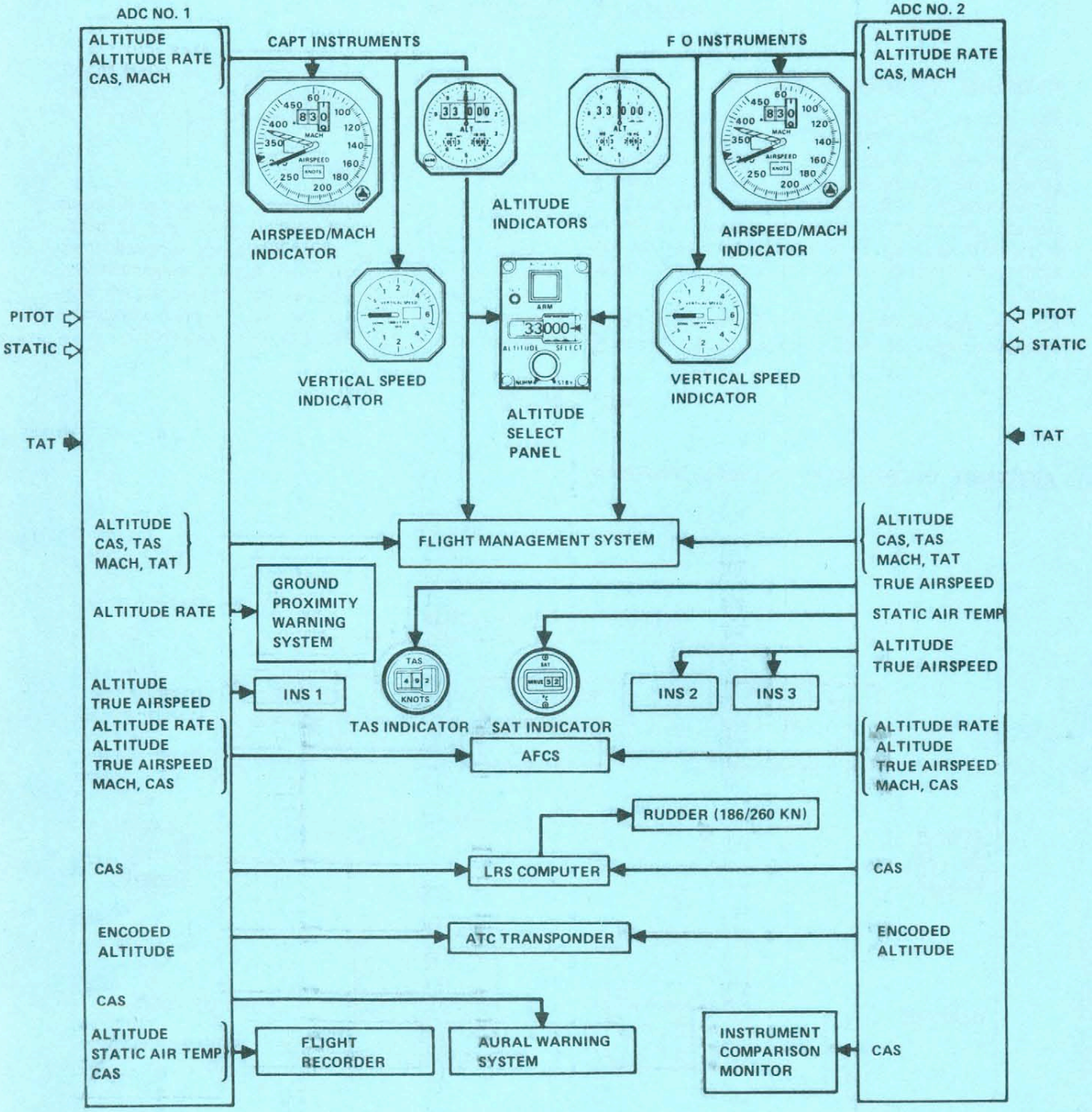


AIRCRAFT DIFFERENCES

AIR DATA COMPUTER (ADC) OUTPUTS

Ships 751-756

Ships 738-741



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SYSTEM OPERATION

SCHEMATICS

L-1011-1 FUEL SYSTEM ..... SCHEMATIC 1
SHIP 724 FUEL SYSTEM ..... SCHEMATIC 2

CROSS REFERENCE

APU FUEL SUPPLY ..... APU
ENGINE FUEL SYSTEM ..... POWERPLANT
FUEL USED RESET ..... POWERPLANT

OPPOSITE SIDE BLANK

GENERAL

Four separate fuel tanks are located in the wings, two in each wing. The tanks are integral parts of the wing structure and function as a three tank system.

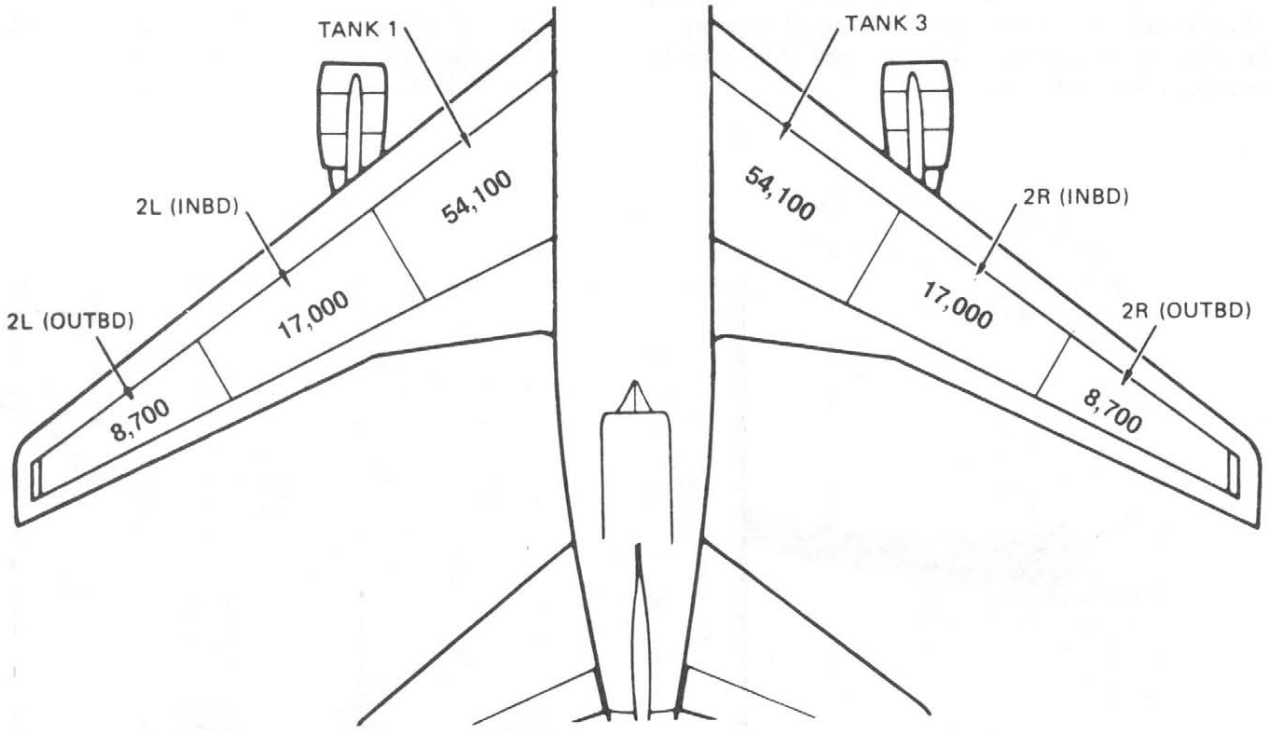
Tanks 1 and 3 normally supply fuel directly to their respective wing engines. Tanks 1 and 3 each consist of a single compartment with an individual capacity of approximately 54,100 pounds.

Tanks 2L and 2R, located in the outboard section of each wing, comprise a system supplying engine number two and the APU. Each tank segment consists of an inboard compartment (17,000 lbs.) and an outboard compartment (8,700 lbs.). Total fuel capacity for each tank segment is 25,700 lbs.

Total aircraft fuel capacity is approximately 159,600 lbs.

Fuel from any tank can be selected and routed to supply any engine and/or APU through a crossfeed manifold.

FUEL TANK ARRANGEMENT



FUEL QUANTITY INDICATION SYSTEM

The fuel system control panel is located on the lower left hand section of the Second Officer's Panel. The panel is schematically arranged to show the functional position of system components and general system flow.

Tanks 2L, 1, 3 and 2R each have a FUEL Quantity Indicator. In addition, a GROSS WT TOTAL FUEL Indicator is provided to display total fuel on board and aircraft gross weight. A SET knob on the totalizer permits the Second Officer to enter the initial ramp weight for each flight. As fuel is burned, gross weight total fuel decrease accordingly.

Fuel quantity is measured by probes contained in each tank. A signal conditioner combines the signals from the tank probes and provides a separate output to the tank indicator and TOTAL FUEL Indicator. Failure of a quantity indicator will not affect the TOTAL FUEL reading.

The quantity indicators for tanks 2L and 2R normally display combined fuel contained in the inboard and outboard compartments. By latching the 2L or 2R INBD QTY switch, only the fuel quantity contained in the inboard compartment will be displayed on the respective indicator. The GROSS WT/TOTAL FUEL reading will reflect the quantity reduction. The **LOW** light on each switch illuminates when fuel quantity in the inboard compartment is less than 700 pounds regardless of switch position.

TANK PUMPS

Two TANK (boost) PUMPS are installed in each tank to provide fuel under pressure, through the fuel manifold, to each engine. The TANK PUMPS are housed in a surge box at the inboard section of each tank.

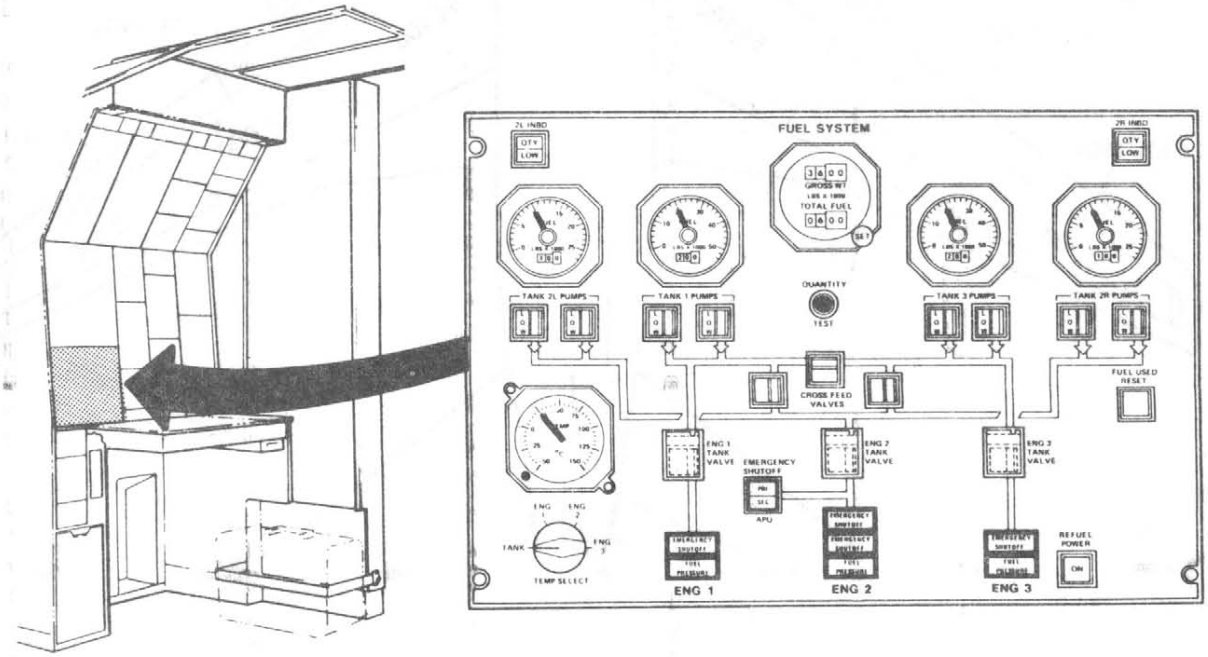
The TANK PUMPS are controlled by individual switches. A **LOW** pressure light in each switch monitors pump output when the respective switch is latched.

A check valve is installed in the outlet of each pump. These valves prevent fuel from flowing back into a tank from the crossfeed system. An engine will suction feed if the TANK PUMP fails.

TANK SCAVENGE SYSTEM

Each tank contains a scavenge system which prevents accumulation of water in the tank and assures adequate fuel to the TANK PUMPS at low fuel levels.

Operation of the scavenge system is automatic and continuous as long as at least one TANK PUMP is operating in the respective tank. The scavenge system uses fuel flow from the TANK PUMPS, acting through jet pump ejectors to pick up fuel and any accumulated water from low points in the tank. Scavenged fuel, as well as any water, is returned to the surge box where it is delivered by the TANK PUMPS to the engines.



TANKS 2L AND 2R FUEL LEVEL MAINTENANCE

Fuel is provided to engine number two directly from the inboard compartments of tanks 2L and 2R. For simplification, only one segment of the tank 2 system (ie, 2L) will be described here. However, both left and right segments are identical.

A float operated check valve provides for the transfer of fuel from the outboard compartment to the inboard compartment. Depending on the total fuel load, the outboard compartment is allowed to remain full (or unchanged) as fuel is provided to engine 2 from the inboard compartment.

When the inboard compartment is depleted to approximately 1,000 lbs., fuel is gravity-transferred from the outboard compartment for continued operation. In this manner, compartment fuel levels are maintained that provide proper wing loading throughout the flight regime.

FUEL MIGRATION, TANKS 2L OR 2R AND WING LOADING

Fuel load distribution in tanks 2L and 2R is subject to wing loading restrictions which are addressed in SP3921, ARM. The crewmember is assured of meeting those restrictions if the fuel is distributed according to DELTA approved fuel loading schedule and DELTA approved fuel management procedures are subsequently followed.

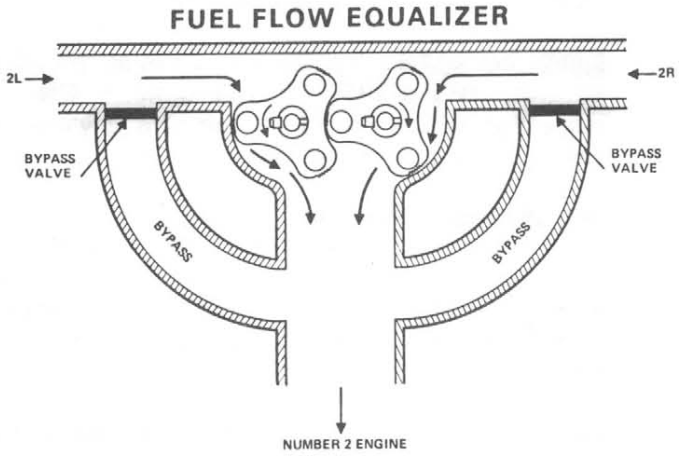
Since the migration of fuel from one tank compartment to another (i.e., inappropriate transfer of fuel) can significantly alter the desired load schedule, its recognition is important.

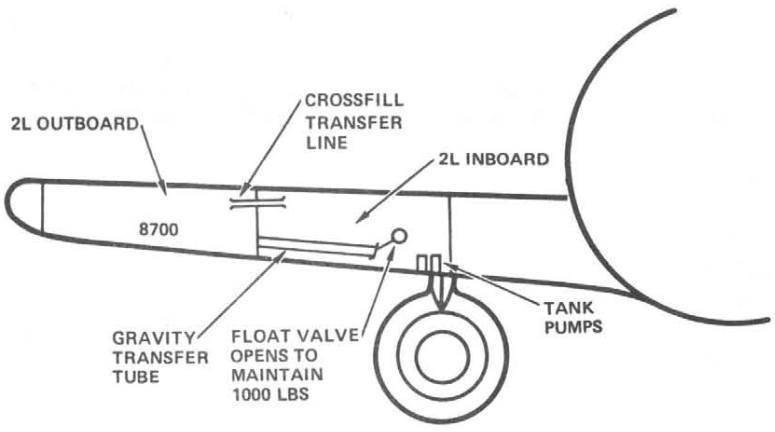
During normal aircraft operations, migration would be suspected if the outboard compartment indicated less than full (8,700 lbs.) when tank segment fuel was greater than 10,000 lbs. (but not full). Migration would also be apparent if the inboard compartment fuel quantity was greater than approximately 1,300 lbs. whenever total fuel in the tank segment was less than 10,000 lbs. This commonly occurs to a limited degree during a prolonged static condition with boost pumps off.

Normally, operating the boost pump(s) in that tank segment will allow the scavenge feature to redistribute small amounts of migrated fuel to its proper compartment. However, large quantities of migrated fuel cannot be accommodated in this manner and should be regarded as abnormal (suspected failure of the float operated check valve). Refer to Fuel Abnormal Procedures; Minimum Fuel, Limitation Section, POM, and Weight and Balance, SP 3921, ARM.

FLOW EQUALIZER

A Flow Equalizer is installed at the manifold junction between tanks 2L and 2R to assure equal fuel flow from each tank. This minimizes any imbalance between 2L and 2R. A bypass is provided to supply fuel if the equalizer fails.

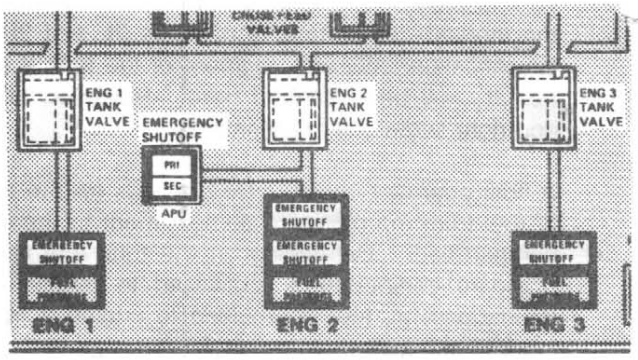




TANK VALVES

A TANK VALVE is installed in the fuel line leading to each engine. Unlatching a guarded TANK VALVE switch closes the valve and shuts off fuel to the respective engine. The ENG 2 TANK VALVE also controls fuel to the APU. The ENG 1 and ENG 3 TANK VALVES are also closed when the respective FIRE PULL Handle is pulled.

A disagreement light is provided in each switch, and illuminates anytime the valve is not in the required position.



EMERGENCY SHUTOFF VALVES

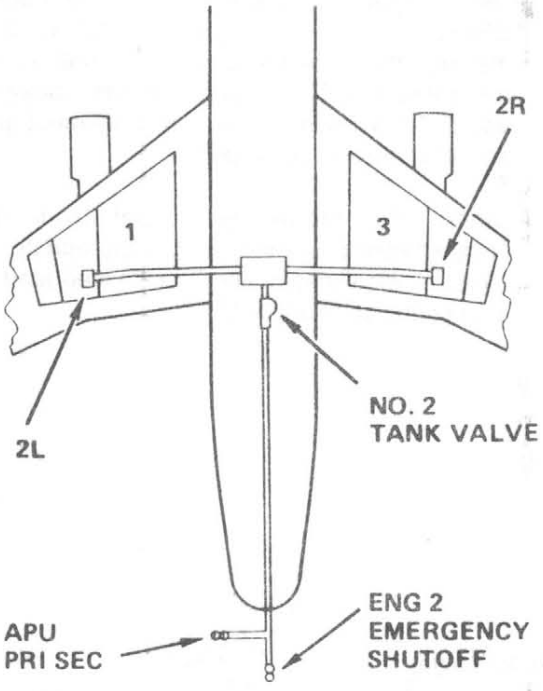
Engines 1 and 3 each have one EMERGENCY (firewall) SHUTOFF valve which is controlled by the position of the respective FIRE PULL Handle. Engine 2 has two EMERGENCY SHUTOFF valves controlled by the No. 2 FIRE PULL Handle.

APU FUEL SUPPLY

Fuel is routed to the APU from the line leading to the No. 2 engine downstream of the ENG. 2 TANK VALVE. Primary and Secondary EMERGENCY SHUTOFF valves are provided to control fuel to the APU.

Both valves are closed when an APU Fire Pull Handle (interior or exterior panel) is pulled, or an APU AUTO FIRE SHUTDOWN occurs. In addition, the PRI valve closes anytime the **APU MASTER POWER** Switch is **OFF**. The SEC valve is normally open.

PRI and SEC disagreement lights are provided. With the **APU MASTER POWER** switch **ON**, the respective light is armed to illuminate anytime the valve is not in the required position.



FUEL JETTISON SYSTEM

TANK PUMP pressure is used to jettison fuel through the refuel defuel manifold. Fuel may be jettisoned from any or all tanks. A jettison nozzle is located at each wing trailing edge just outboard of the outboard flaps.

Electrical shutoffs individually terminate fuel jettison from the affected tank when fuel in tanks 1 and 3 reach 8,000 pounds each or fuel in tanks 2L and 2R reach 4,000 pounds each. This assures a minimum of 24,000 pounds of fuel remaining when all possible fuel has been jettisoned. In addition, fuel jettison is automatically terminated in 2L or 2R when inboard compartment level drops below 900 pounds. When inboard compartment level increases, fuel jettison resumes automatically.

FUEL QUANTITY INDICATOR (4)

- Indicates fuel quantity, in thousands of pounds, in respective tank.
- Max capacity is 54,100 pounds each for tanks 1 and 3, and 25,700 pounds each for tanks 2L and 2R.
- The position of the 2L and 2R INBD quantity switches determine whether the respective indicators display the total fuel in the tanks, or only the fuel contained in the inboard compartment.
- With loss of power, pointer and digital indicator remain in last indicated position.

3T2 thru 5 - FUEL QTY IND

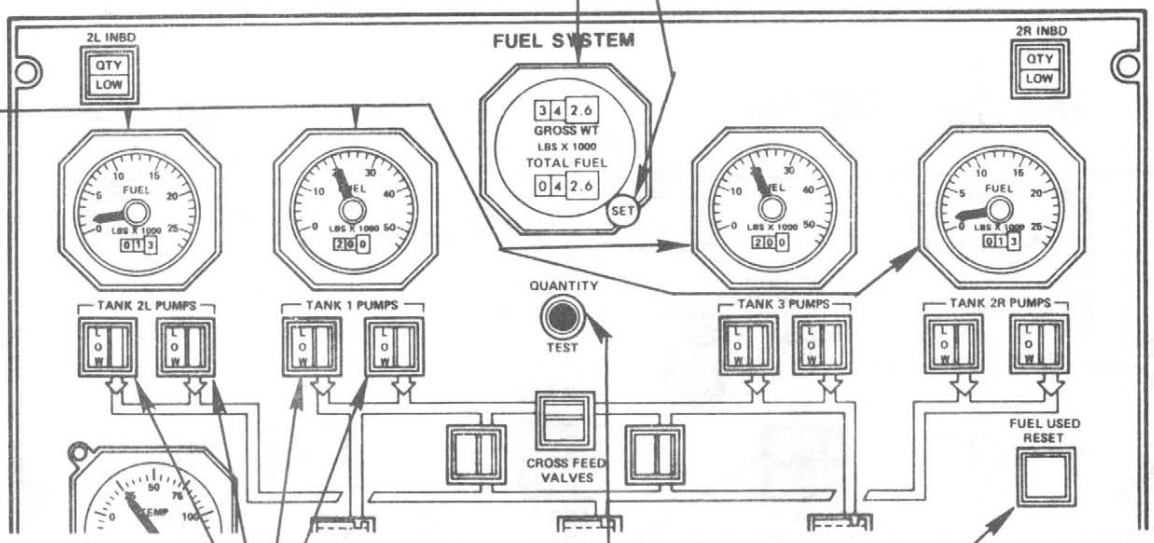
GROSS WT/TOTAL FUEL INDICATOR

- Provides indication of present gross weight and total fuel quantity.
- TOTAL FUEL display is independent of individual tank Fuel Quantity indicators.
- Indicates quantity is reduced when 2L or 2R QTY LOW switch is latched.

3T1 thru 5 - FUEL QTY IND

SET KNOB

- Push and turn SET Knob to select aircraft gross weight displayed in GROSS WT window.
- As total fuel decreases, GROSS WT indicator decreases automatically.



TANK PUMPS SWITCH (8)

Controls operation of fuel tank boost pump.

UNL - Pump is de-energized; **FLOWBAR** is extinguished and **LOW** light is disarmed.

LCH - Normal flight position. Pump is energized and provides pressure. **FLOWBAR** illuminates to indicate switch position and **LOW** light is armed.

LOW (Amber) - Illuminates when pump output pressure is too low.

The **FUEL SYSTEM** light on the Pilots' Annunciator Panel illuminates when **LOW** illuminates.

3U2 - INB PUMP IND (3U1 - SHIP 724)
3U15 - OUTBD PUMP IND
3U5 - 10, 13 & 14 - BOOST PUMP (3U3 - SHIP 724)

FUEL USED RESET

Press and hold to reset all fuel counters to zero.

QUANTITY TEST BUTTON

rovides means of testing quantity indication system.

- When button is pressed and held, a full tank input is sent to the signal conditioners.
- Fuel Quantity indicators and TOTAL FUEL indicator drive to full indications.
- GROSS WT indication increases.
- **LOW** illuminates in both INBD QTY switches.
- Refueling will be interrupted while button is pressed.

3T1 - FUEL QTY IND TEST

CROSSFEED VALVES SWITCH (3)

Controls operation of the crossfeed valves to provide the means of feeding any engine from any tank.

LCH – Crossfeed valve opens. **FLOWBAR** illuminates to indicate switch position.

UNL – Crossfeed valve closes. Flowbar is extinguished.

DISAGREEMENT LIGHT (BLUE) – Illuminates when valve position and switch position disagree.

3T7, 10, 13 – EMER & X-FEED

ENG TANK VALVE SWITCH (3)

Controls position of Engine Tank Valve.

UNL - Valve is closed. **FLOWBAR** is extinguished.

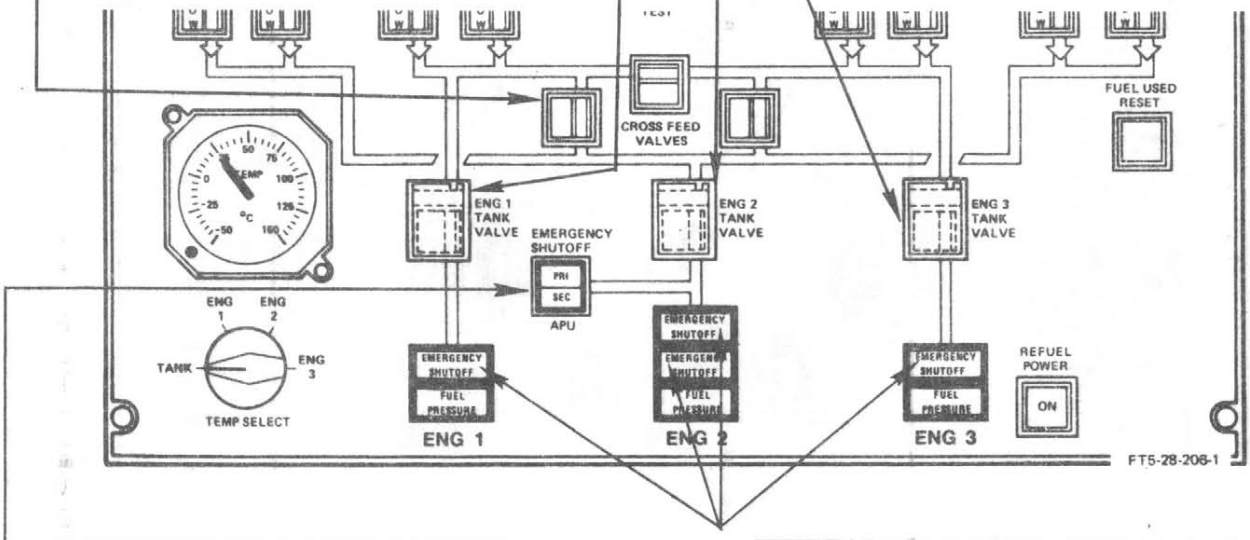
LCH - Normal switch position. Valve is open. **FLOWBAR** illuminates to indicate switch position.

NOTE: Pulling FIRE PULL Handle 1 or 3 closes the respective Tank Valve and extinguishes the flowbar regardless of switch position. No. 2 Tank Valve is independent of the No. 2 FIRE PULL Handle.

DISAGREEMENT LIGHT (BLUE) – Illuminates when valve is not in the required position.

3T6, 9, 12 – ENG TANK VALVE

1D10, 11, 12 – FUEL SHUTOFF VALVE



APU EMERGENCY SHUTOFF LIGHTS

- Monitors position of APU Primary (**PRI**) and Secondary (**SEC**) EMERGENCY (firewall) SHUTOFF valves.
- Lights are armed to illuminate only when the APU MASTER POWER switch is **ON**.
- **PRI** or **SEC** illuminates when respective valve position disagrees with required position.

With FIRE PULL Handle in:
- Lights extinguish when valves are open.
- Lights illuminate when valves are closed.

With FIRE PULL Handle pulled or AUTO FIRE SHUTDOWN:
- Lights extinguish when valves are closed.
- Lights illuminate when valves are open.

1D15 – FUEL SHUTOFF VALVE APU

3S7, 8 – FIREWALL SHUTOFF

1J7, 8 – APU FIRE SHUTDOWN & APU SEC EMER SHUTOFF

3B15, 16 – CONTROL & PRI FW SOV

EMERGENCY SHUTOFF LIGHT (Amber) (4)

- Monitors position of Emergency (firewall) Shutoff Valve.
- Engine No. 1 and 3 are each provided with one valve.
- Engine No. 2 is provided with two valves.
- Illuminates when valve position disagrees with position selected by FIRE PULL Handle.

With FIRE PULL Handle **IN**:
- Light extinguishes when valve is open.
- Light illuminates when valve is closed.

With FIRE PULL Handle **PULLED**:
- Light extinguishes when valve is closed.
- Light illuminates when valve is open.

1D14 – FUEL SHUTOFF VALVE PRI EMER 2 (Close)

3T7, 10, 13 – EMER & X-FEED

3R18 – ENG 2 PRI EMER (Open)

TANKS 2L AND 2R INBD QTY SWITCH/ LOW LIGHT (2)

Provides capability to monitor fuel quantity contained in the inboard compartment of tank 2L and 2R, and provides warning of low inboard compartment quantity.

UNL – Normal position. **QTY** is extinguished. Fuel quantity indicators display total fuel (inboard and outboard compartment) contained in the respective tank (2L or 2R).

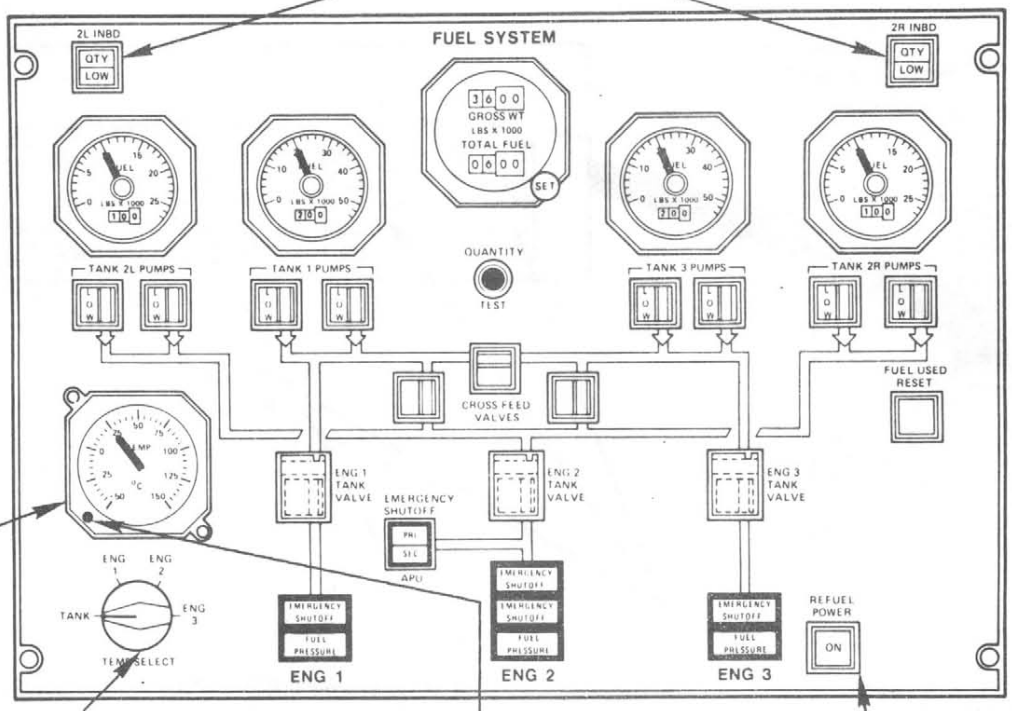
LCH – **QTY** illuminates to indicate switch position. Fuel quantity indicator displays fuel contained in the inboard compartment for the respective tank (2L or 2R).

LOW (Amber) – Illuminates when fuel contained in the inboard compartment is less than 700 pounds regardless of QTY switch position.

The FUEL SYSTEM light on the Pilots' Annunciator Panel illuminates when **LOW** illuminates.

- Inboard quantity should not exceed 1,000 pounds unless the outboard compartment is full.
- QTY switch is inhibited when REFUEL POWER **ON** switch is illuminated.
- TOTAL FUEL Indicator quantity is reduced when 2L or 2R INBD switches are latched.

3T1, 3, 4 – FUEL QTY IND TEST, 2L & 2R



TEMP SELECTOR

Four position selector which determines temperature probe monitored by the TEMP Indicator.

3R13 – FUEL TEMP

TEMP INDICATOR

Monitors fuel temperature in tank 2L, or downstream of the fuel/oil heat exchanger at the inlet to each engine fuel control as selected by the TEMP SELECTOR.

3R13 – FUEL TEMP

TEST BUTTON

Pointer drives to the 12 o'clock position when button is pressed.

REFUEL POWER SWITCH

- Momentary switch that provides means of shutting down all refueling defueling operations from the cockpit.
- When switch is pressed, the SYSTEM POWER switch on the Wing refueling defueling panel is released to **OFF**, and the **ON** light extinguishes.

ON – Illuminates to indicate SYSTEM POWER Switch on the refueling defueling panel is **ON**.

5H19 – REFUEL POWER CONTROL

TANK DUMP SWITCHES (4)

- Controls operation of tank dump valves.
- Switches are armed to operate only when FUEL JETTISON MASTER Switch is latched.

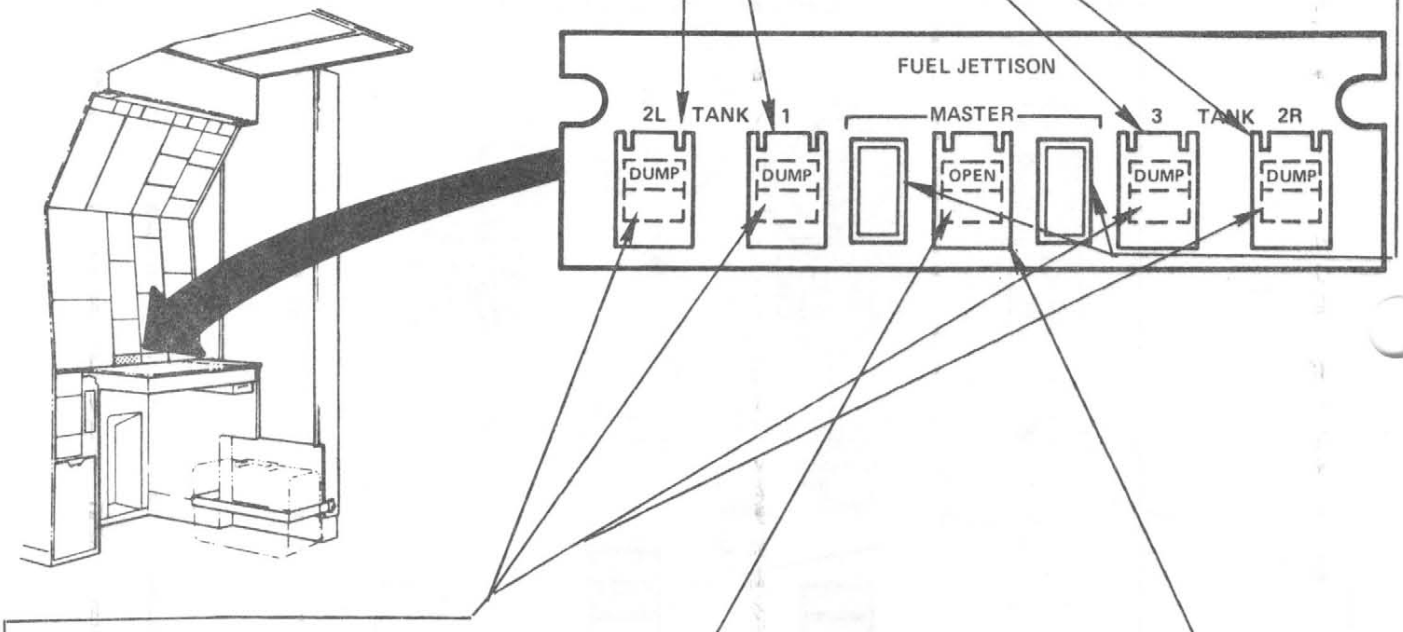
UNL - Normally guarded in this position. Dump valves close and **DUMP** is extinguished.

LCH - Dump valves open provided FUEL JETTISON MASTER Switch is latched. **DUMP** illuminates to indicate switch position. Fuel jettisoning is automatically terminated when fuel level in the tanks is reduced to:

- 8,000 pounds each in tanks 1 and 3.
- 4,000 pounds (or less than 900 pounds inboard) each in tanks 2L & 2R.

JETTISON VALVE DISAGREEMENT LIGHTS (BLUE) (2)

Illuminates when Jettison Valve position disagrees with position selected by FUEL JETTISON MASTER Switch.



DISAGREEMENT LIGHTS (BLUE) - Illuminates when valve is not in the required position.

LCH -

- **Above** shut-off level, light illuminates until valve is open.
- **Below** shut-off level, light illuminates until valve is closed.
- The 2L and 2R lights may cycle as inboard tank quantity fluctuates around the 900 pound level.

UNL - Light illuminates until valve is closed.

3U3 - JTSN & DEFUEL 2L & 2R
3U11, 12 - JTSN & DEFUEL 1 & 3

FUEL JETTISON MASTER SWITCH

Controls position of the two wing jettison valves and cross-ship isolation valve, and controls arming of the four TANK DUMP switches.

UNL - Normally guarded and safetied in this position. The two wing jettison valves and cross-ship isolation valve close, and the four TANK DUMP switches are disarmed. **OPEN** is extinguished.

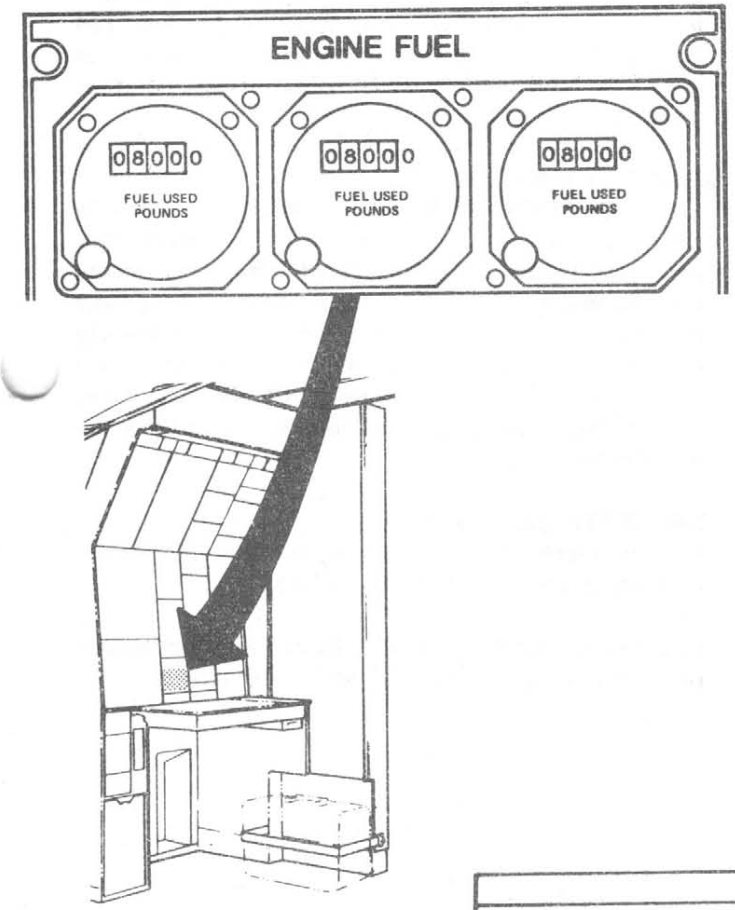
LCH - The two wing jettison valves and cross-ship isolation valve are opened, and the four TANK DUMP switches are armed **OPEN** illuminates to indicate switch position.

DISAGREEMENT LIGHT (BLUE) - Illuminates when position of the cross-ship isolation valve disagrees with selected position.

3U18 - JETTISON ARM

FUEL USED COUNTERS

Three fuel used counters, located on the Second Officer's lower panel, display the fuel used by each engine since the last resetting of the indicator. The counter reset switch is located adjacent to the counters on the fuel panel. If the reset switch is pressed and held, all indicator counter drums are driven to zero. A test knob is provided on each indicator. When turned clockwise, its respective Fuel Used Indicator functions at a rate of 10,000 pph. In addition, the associated FUEL FLOW Indicator on the Pilot's Instrument panel will indicate 10,000 pph. Refer to Powerplant Section, PRM.



REFUELING/DEFUELING

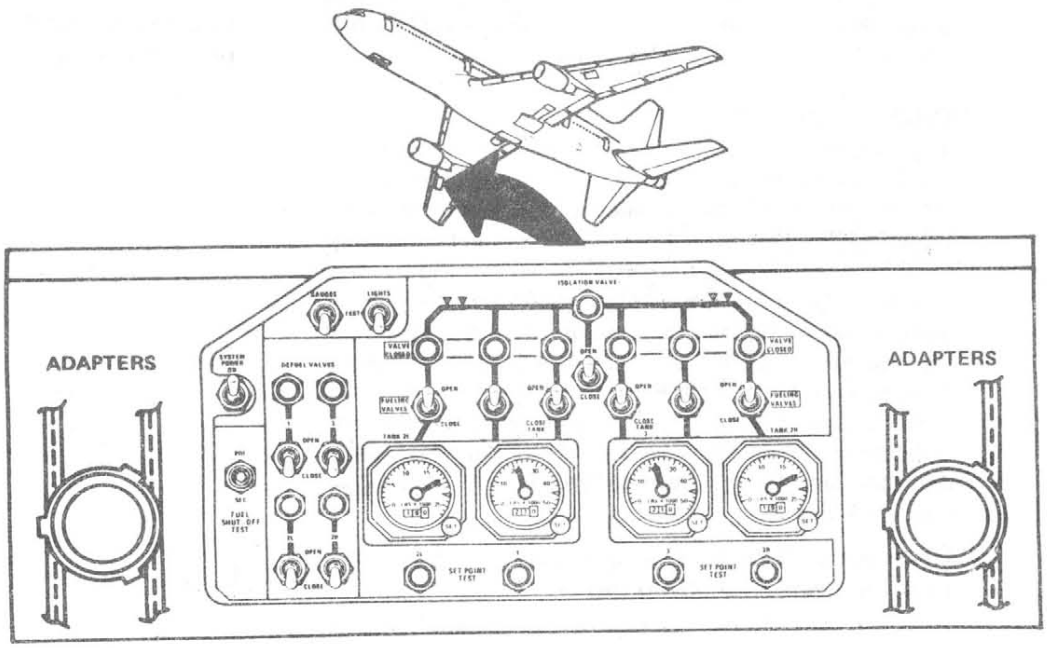
Pressure refueling as well as defueling is accomplished through two adapters located in the leading edge of each wing just outboard of the engines. Gravity refueling receptacles are also provided on the top of each wing.

A refueling defueling control panel is located between the two adapters on the right wing. With battery power available, pressure refueling and defueling are accomplished using this panel. Fuel transfer between tanks can also be accomplished using this panel provided AC power is available. The TANK PUMPS must be used to provide the pressure to transfer fuel.

When refueling tanks 2L and 2R, fuel enters the outboard compartment and gravity feeds into the inboard compartment through a float-operated check valve. When inboard compartment quantity reaches 1,000 pounds, the valve closes and any additional fuel is stored in the outboard compartment until it is filled to capacity. Once the outboard compartment is full, any additional fuel then spills through an overflow pipe into the inboard compartment.

The fuel Quantity Indicators on the Refueling Defueling panel are normally used to determine desired quantity and are independent of the cockpit indicators. Dripless sticks are also provided in each tank.

Procedures for refueling, defueling, and tank to tank transfer are contained in the ARM in SP 3583.



REFUEL PANEL

SHIP 724

GENERAL

Two additional fuel tanks are installed in the wing center section forward of the main wheel wells. The tanks are identified as 1A and 3A (alternate), and function as an extension of their respective main tanks. Fuel must be transferred from the alternates into the mains in order to be used.

The 1A and 3A tanks may only be used when Ship 724 is operating in the -200 configuration.

REFUELING/DEFUELING

Operation is identical to remaining -1 fleet except for additional controls required to refuel tanks 1A and 3A.

No fuel is loaded into tanks 1A or 3A unless all main tanks are full.

TANKS 1A/3A

Tanks 1A and 3A each consist of a single compartment with a capacity of approximately 9,560 pounds. This additional fuel gives Ship 724 a total capacity of approximately 178,360 pounds.

TANK 1A/3A FUEL QUANTITY INDICATION SYSTEM

The quantity indicators for tanks 1 and 3 normally display the combined fuel contained in the respective main and alternate. By latching the TANK 1A or TANK 3A QTY Switch, only the fuel quantity in the alternate tank will be displayed on the respective indicator. The GROSS WT TOTAL FUEL reading will reflect the quantity reduction. The LOW light on each switch illuminates when fuel quantity in the alternate is less than 150 pounds if XFR switches are latched.

NORMAL 1A/3A XFR

Transfer of fuel from the alternates to the mains is accomplished by the normal 1A 3A XFR Switches. When these switches are latched, the main tank fuel Scavenge Valves are closed and the alternate tank Normal Transfer Valves are opened. Main tank scavenge fuel from the TANK PUMPS is now routed through jet pump ejectors in the alternate tanks to transfer fuel from the alternate tanks into the mains. At least one TANK PUMP must be operating in main tanks 1 and 3 to use the normal transfer system. Unlatching the Normal 1A/3A XFR Switches closes the alternate Normal Transfer Valves and opens the main tank Scavenge Valves.

The Normal 1A 3A XFR valve is automatically closed when the respective main is full.

TANK 1A/3A SCAVENGING

A scavenging system is also provided for Tanks 1A and 3A. This system uses TANK PUMP pressure through separate jet pump ejectors to scavenge fuel and accumulated water from the alternate tanks and return it to its respective main. The Alternate Tank Scavenge Valves are opened when the aircraft is in flight, and alternate tank scavenging continues regardless of the position of the Normal 1A 3A XFR Switches. The Alternate Tank Scavenge Valves are closed on the ground.

This separate scavenge system is the reason why the XFR switches may be unlatched on Ship 724 after transfer from 1A 3A is complete. However, at least one Tank Pump Switch must remain latched for the respective tank.

GRAVITY TRANSFER

1A 3A GRAVITY TRANSFER switches provide a back-up means of transferring fuel from the alternates to the mains. When latched, the gravity transfer valves are opened to permit fuel to transfer from the alternate into the main as main tank quantity is reduced. Main tank fuel quantity must be considerably reduced for gravity transfer to occur. Flapper check valves prevent fuel flow from the main into the alternate.

FUEL JETTISON SYSTEM

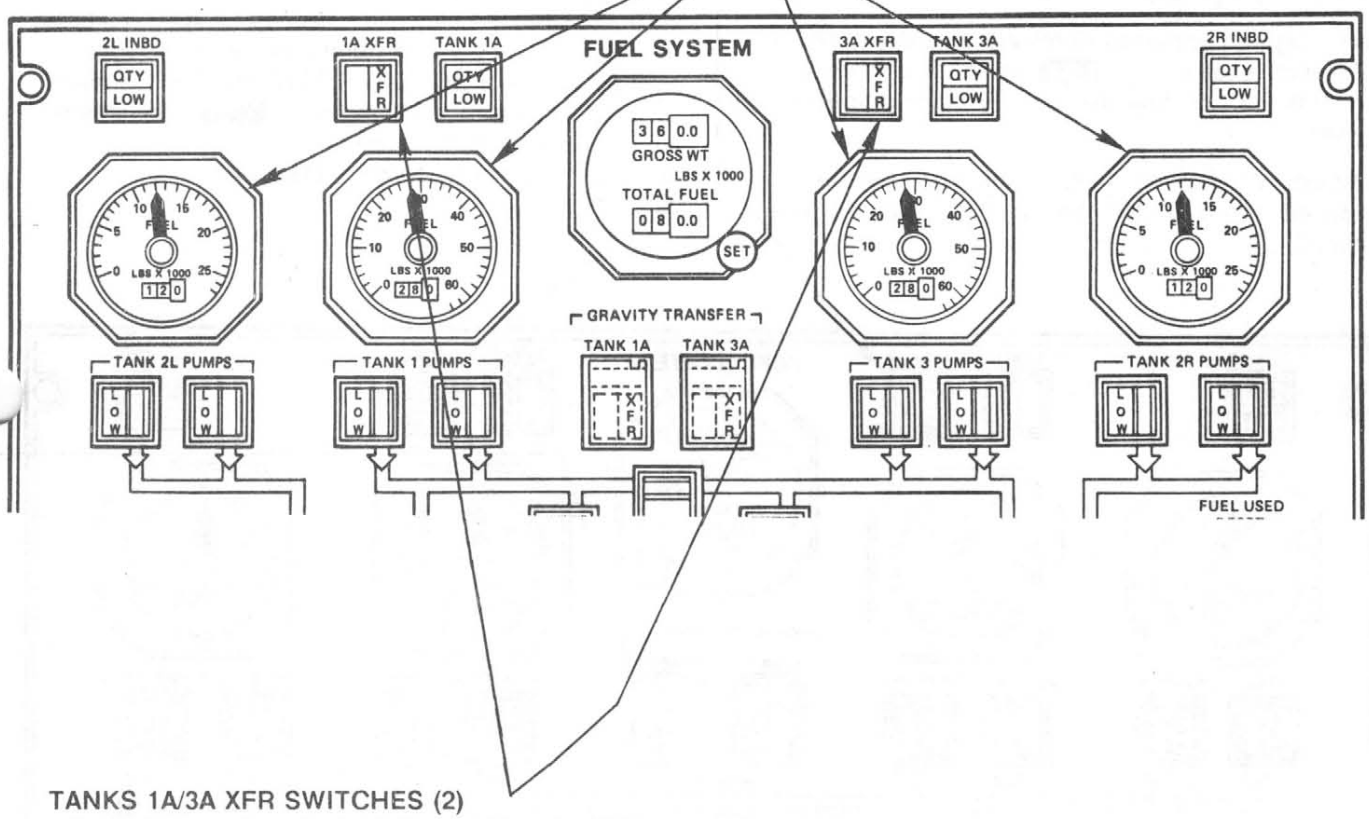
Fuel from tanks 1A and 3A must be transferred to the respective main tank to be jettisoned.

Latching the FUEL JETTISON MASTER automatically opens the 1A 3A GRAVITY TRANSFER valves.

SHIP 724

FUEL QUANTITY INDICATOR (4)

- 2L and 2R indicators function the same as -1 aircraft.
- 1 and 3 indicators display either total fuel in tanks 1 plus 1A or 3 plus 3A, or fuel in 1A or 3A only. Quantity displayed is determined by the position of the TANK 1A or 3A QTY switches.
- Capacity is approximately 63.560 pounds each for tanks 1 plus 1A and 3 plus 3A.



TANKS 1A/3A XFR SWITCHES (2)

Controls operation of 1A/3A Normal Transfer Valves.

LCH - Normal position for flight when tanks 1A/3A contain fuel.

- Main tank scavenge valve is closed.
- Normal Transfer Valve opens, provided main tanks are less than full, to permit transfer of fuel from the alternate to the respective main.
- **XFR** illuminates when Normal Transfer Valve is open.
- **LOW** lights in TANK 1A/3A QTY switches are armed.
- At least one TANK PUMP must be operating in each main tank to provide the fuel flow necessary to transfer fuel from the respective alternate.

UNL - Normal position when tanks 1A/3A are empty.

- Main tanks scavenge valve is opened.
- Normal Transfer Valve is closed.
- **XFR** is extinguished when valve is closed.
- **LOW** lights in TANK 1A/3A QTY switches are disarmed.

DISAGREEMENT LIGHT (BLUE) - Illuminates when Normal Transfer Valve position disagrees with required position.

3U5, 6 - TRANSFER VALVE TANK 1 and 1A, 3 and 3A

3U16 - SCAVENGE TANK 1A and 3A

SHIP 724

TANK 1A/3A QTY SWITCH/ LOW LIGHT

Provides means of monitoring fuel quantity in tanks 1A and 3A.

UNL - Normal Position Fuel Quantity Indicators dispaly total fuel in tanks 1 + 1A and 3 + 3A. **QTY** is extinguished.

LCH - Fuel Quantity Indicators display only the fuel contained in tanks 1A or 3A. **QTY** illuminates to indicate switch position.

LOW - Light is armed to illuminate only when 1A 3A XFR switch is latched. **LOW** illuminates when less than 150 lbs. of fuel remains in the respective alternate.

- GROSS WT TOTAL FUEL Indicator quantity is reduced when TANK 1A or 3A switches are latched.

GRAVITY TRANSFER TANK 1A/3A SWITCH (2)

Controls operation of 1A 3A gravity transfer valves.

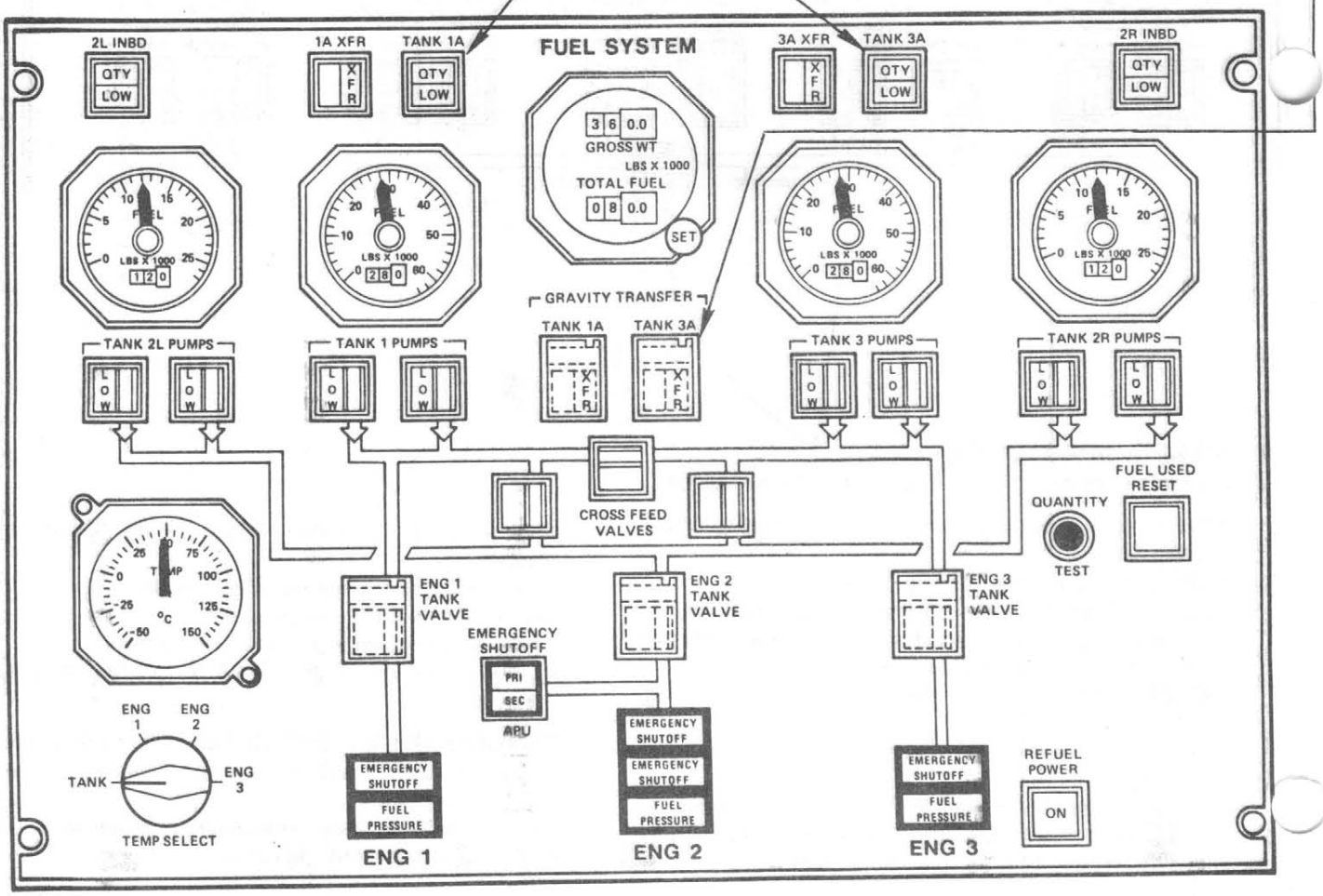
UNL - Normal position. Gravity transfer valve is closed. **XFR** is extinguished.

LCH - Gravity transfer valve is opened. **XFR** illuminates to indicate switch position.

DISAGREEMENT LIGHT (BLUE) – Illuminates when valve position disagrees with required position.

- All but approximately 800 pounds of fuel in each alternate can be transferred by the gravity system.
- Latching the FUEL JETTISON MASTER switch opens the transfer valves and **XFR** illuminates regardless of switch position.

1H14, 15 - GRAVITY FEED VALVE TANK 1A, 3A



SHIP 724

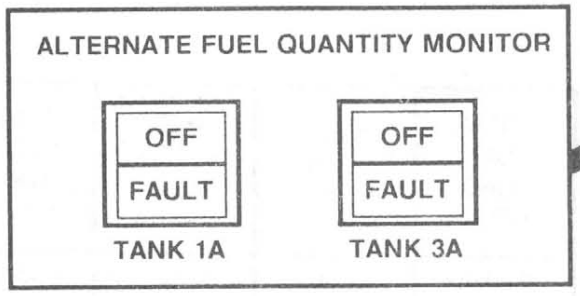
ALTERNATE FUEL QUANTITY MONITOR PANEL

An Alternate Fuel Quantity Monitor system is installed on Ship 724. Its function is to alert the crew whenever there is an inappropriate distribution of fuel with regard to tanks 1 or 3 and their alternates.

The **ALT FUEL MONITOR** light illuminates any time the main plus alternate tank quantity is less than 32,000 pounds and more than 1,000 pounds is contained in the respective alternate tank. Also, the respective **FAULT** light on the Alternate Fuel Quantity Monitor panel will illuminate. These lights will also illuminate if a failure in the system is detected.

Normal position of the 1A 3A OFF FAULT switches is latched and lights extinguished. Unlatching a switch illuminates **OFF** light, and the respective monitor is deactivated. Latching an ALT QTY switch also deactivates the associated monitor, but **OFF** remains extinguished.

If **ALT FUEL MONITOR** illuminates, check for corresponding **FAULT** light, and latch respective **ALT QTY** switch to check alternate tank quantity. If unwanted fuel is contained in 1A/3A refer to Fuel Abnormal procedures (blue pages). If fuel quantity in 1A/3A is correct, unlatch respective **OFF/FAULT** switch to extinguish warning indications.

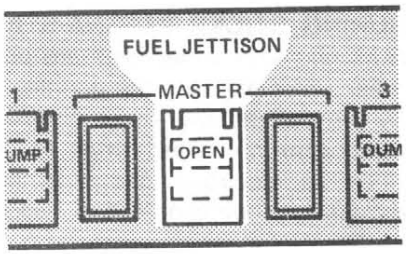


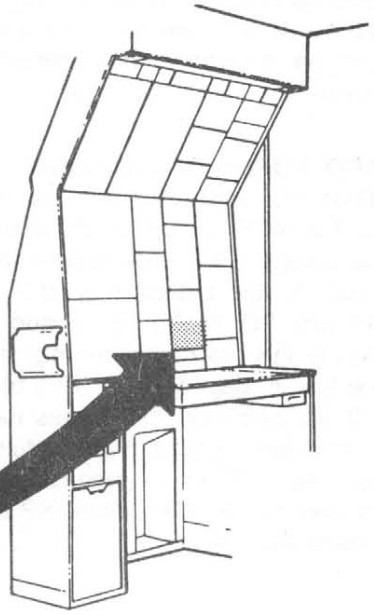
SECOND OFFICER'S PANEL

PILOTS' ANNUNCIATOR PANEL

FUEL JETTISON MASTER SWITCH

In addition to –1 functions, latching switch opens the GRAVITY TRANSFER Valves.





FUELING

LATERAL IMBALANCE OF FUEL LOAD

The maximum allowable fuel imbalance between wings is 1,500 lbs. This figures is to include the sum of any migrated fuel in both 2L and 2R Tanks.

FUEL MEASURING STICKS (MAGNA-STICKS)

The fuel measuring stick assemblies are provided as a manual means of measuring the quantity of fuel in tanks. They can be employed as an alternate means of determining fuel on board prior to and after refueling when an electronic gauge is inoperative. For normal refueling operations, the sticks are not used.

FUEL DISTRIBUTION CHARTS

The following fuel service distribution charts are found in SP 3583, Fuel and Oil Service, ARM. Locate the required fuel load in the left hand column. Adjacent columns provide individual tank quantities in pounds, based on a nominal fuel density of 6.7 pounds per gallon.

NON-STANDARD FUEL DISTRIBUTION

When operations are conducted with an inoperative fuel guage in Tanks 2L or 2R (both at the fueling panel and the cockpit), it is permissible to load 2L and 2R Tanks to the extent that the outboard compartments are full (8,700 lbs.) and there is enough fuel in the inboard compartments to obtain a reading on the No. 4 Magna-stick. This means that Tanks 1 and 3 will be serviced with less fuel than is shown in the standard distribution schedule for that particular fuel load. Refer to Non-Standard Fuel Loading For Inoperative 2L 2R Guage, SP 3583; and Abnormal Procedures, Fuel.

TOTAL FUEL LOAD 63,000 POUNDS OR LESS

- Feed from tank to respective engine for entire flight.

TOTAL FUEL LOAD (LBS)	TANK 1 & 3 EACH	TANK 2L & 2R EACH	TANKS 1A & 3A (SHIP 724 ONLY)
24,000	8,000	4,000	EMPTY
30,000	10,000	5,000	↓
36,000	12,000	6,000	
42,000	14,000	7,000	
48,000	16,000	8,000	
54,000	18,000	9,000	
60,000	20,000	10,000	
63,000	21,000	10,500	

TOTAL FUEL LOAD FROM 63,000 TO 84,000 POUNDS

- Feed from tank to respective engine for takeoff.
- When practical, start crossfeeding all engines from Tank 2.
- When quantities are equal, use tank to engine for remainder of flight (quantities must be equal by the time total fuel is reduced to 58,000 pounds).

TOTAL FUEL LOAD (LBS)	TANK 1 & 3 EACH	TANK 2L & 2R EACH	TANKS 1A & 3A (SHIP 724 ONLY)
64,000	21,000	11,000	EMPTY
66,000	↓	12,000	↓
68,000		13,000	
70,000		14,000	
72,000		15,000	
74,000		16,000	
76,000		17,000	
78,000		18,000	
80,000		19,000	
82,000		20,000	
84,000	21,000	21,000	

TOTAL FUEL LOAD FROM 84,000 TO 154,000 POUNDS

- Feed from tank to respective engine until total fuel quantity is 84,000 pounds.
- Crossfeed all engines from tank 2 until quantities are equal.
- When quantities are equal, use tank to engine for remainder of flight.

NOTE: Delaying crossfeed operation until total fuel load is reduced to 84,000 pounds assures that minimum tank 2 fuel requirements are met regardless of aircraft zero fuel weight.

SHIP 724: TOTAL FUEL LOAD FROM 154,000 TO 178,360 POUNDS

With fuel in Tanks 1A and 3A:

- Latch XFR switches after engine start.
- Feed from tank to respective engine for takeoff.
- Before 14,000 lbs. has been used, begin crossfeeding from tanks 1 1A and 3/3A to all engines.
- Unlatch XFR switches after tanks 1A and 3A are empty and the LOW lights are illuminated.
- Continue crossfeeding until quantities in tanks 1,2 and 3 are equal.
- Feed tank to respective engine for remainder of flight.

When no fuel is contained in tanks 1A and 3A, follow the above procedure, except that the XFR switches remain unlatched at all times. This will ensure that the main tanks (1 and 3) are continuously scavenged in flight, provided at least one TANK PUMP switch remains latched for the respective tank.

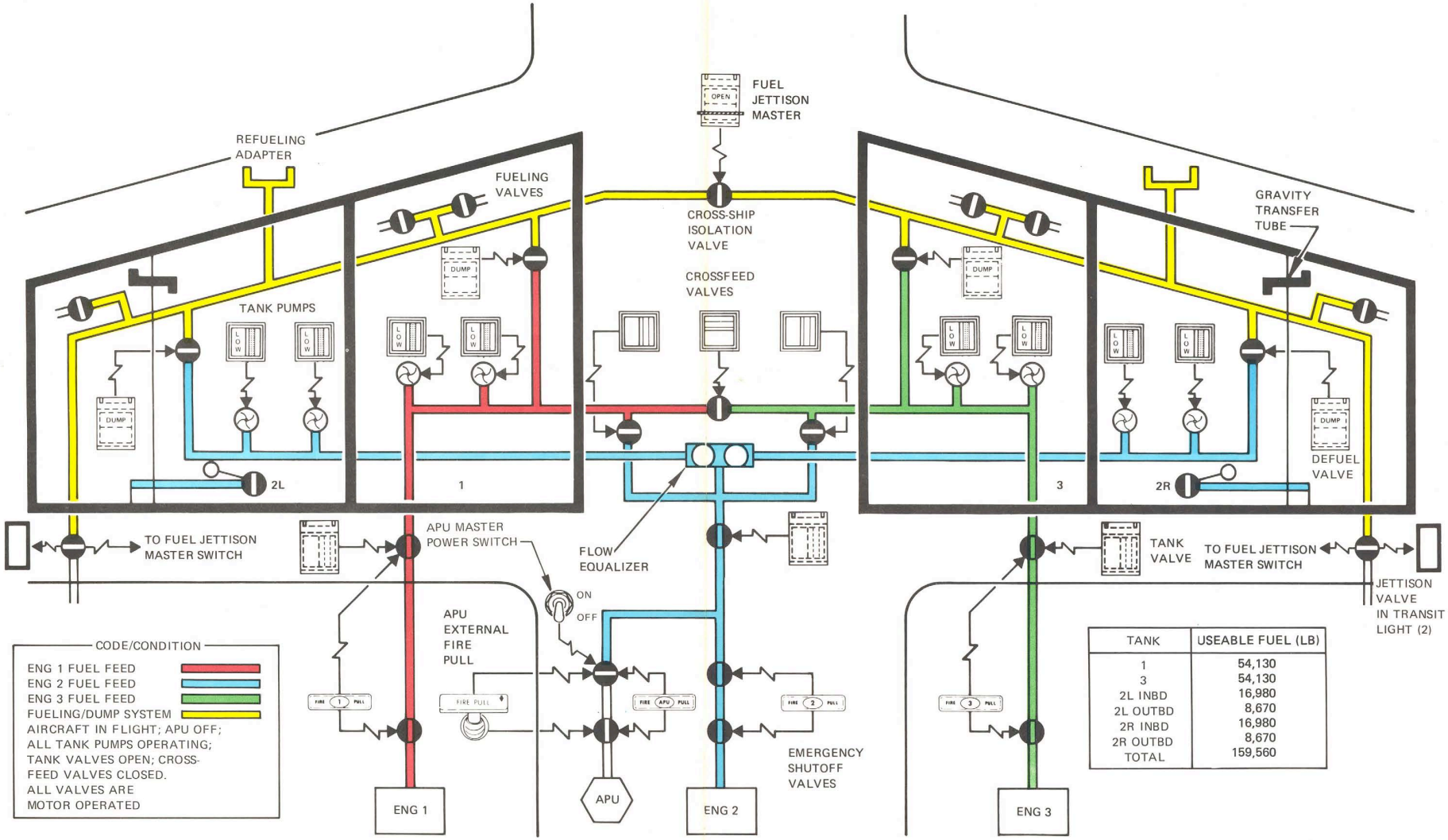
TOTAL FUEL LOAD (LBS)	TANK 1 & 3 EACH	TANK 2L & 2R EACH	TANKS 1A & 3A (SHIP 724 ONLY)
86,000	21,700	21,300	EMPTY
88,000	22,300	21,700	
90,000	23,000	22,000	
92,000	23,700	22,300	
94,000	24,300	22,700	
96,000	25,000	23,000	
98,000	25,700	23,300	
100,000	26,300	23,700	
102,000	27,000	24,000	
104,000	27,700	24,300	
106,000	28,300	24,700	
108,000	29,000	25,000	
110,000	29,700	25,300	
112,000	30,300	25,650	
120,000	34,300		
124,000	36,300		
128,000	38,300		
132,000	40,300		
136,000	42,300		
140,000	44,300		
144,000	46,300		
148,000	48,300		
152,000	50,300		
154,000*	51,300		
156,000	52,300		
158,000	53,300		
159,000	53,800		
159,240**	53,970		0
160,000			400
162,000			1400
164,000			2400
166,000			3400
168,000			4400
170,000			5400
172,000			6400
174,000			7400
176,000			8400
178,000			9400
178,360			9560

* MAXIMUM PRACTICAL FUEL LOAD FOR -1 AIRCRAFT OR FOR SHIP 724 WHEN OPERATED AS -1 AIRCRAFT.

** FULL MAIN TANKS

OPPOSITE SIDE BLANK

SCHEMATIC



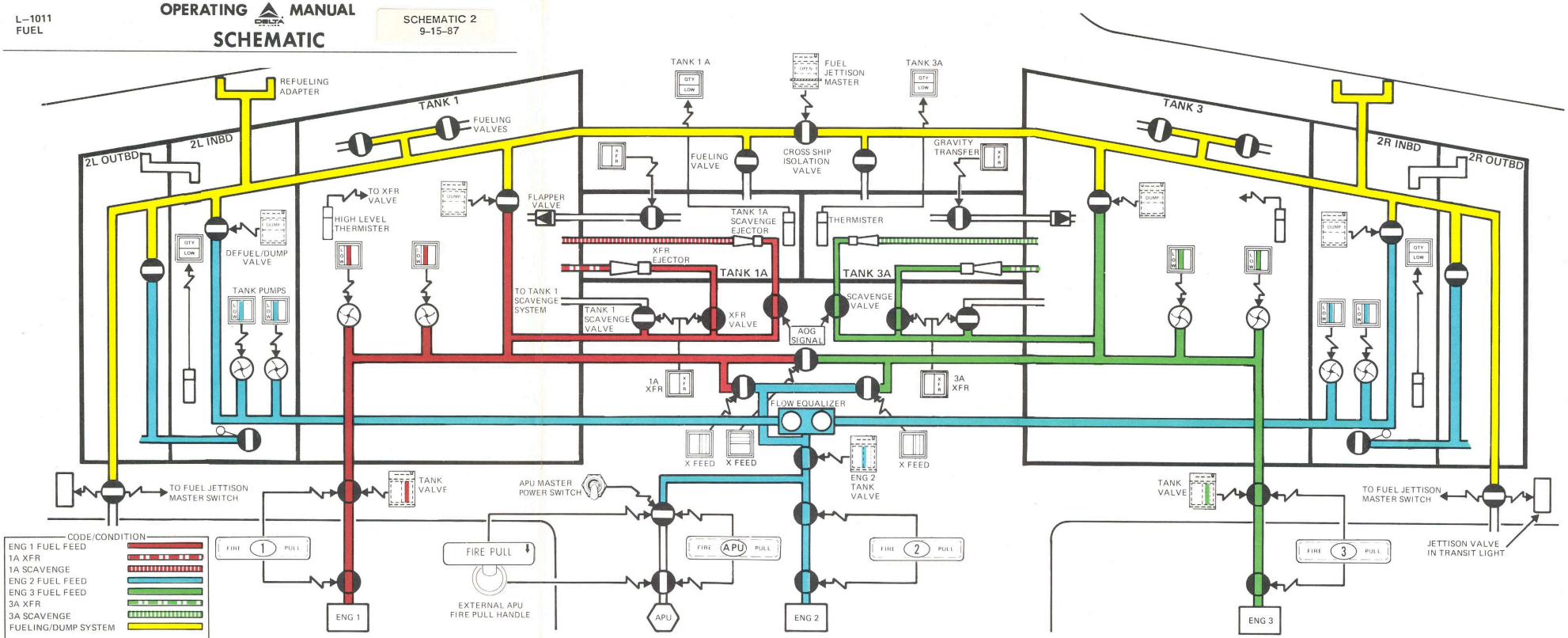
TANK	USEABLE FUEL (LB)
1	54,130
3	54,130
2L INBD	16,980
2L OUTBD	8,670
2R INBD	16,980
2R OUTBD	8,670
TOTAL	159,560

FUEL SYSTEM

OPERATING MANUAL

SCHEMATIC

SCHEMATIC 2
9-15-87



FUEL SYSTEM (AIRCRAFT WITH CENTER WING AUX, TANKS)

ALL LONG-RANGE AIRCRAFT

EXCEPT SHIP 724

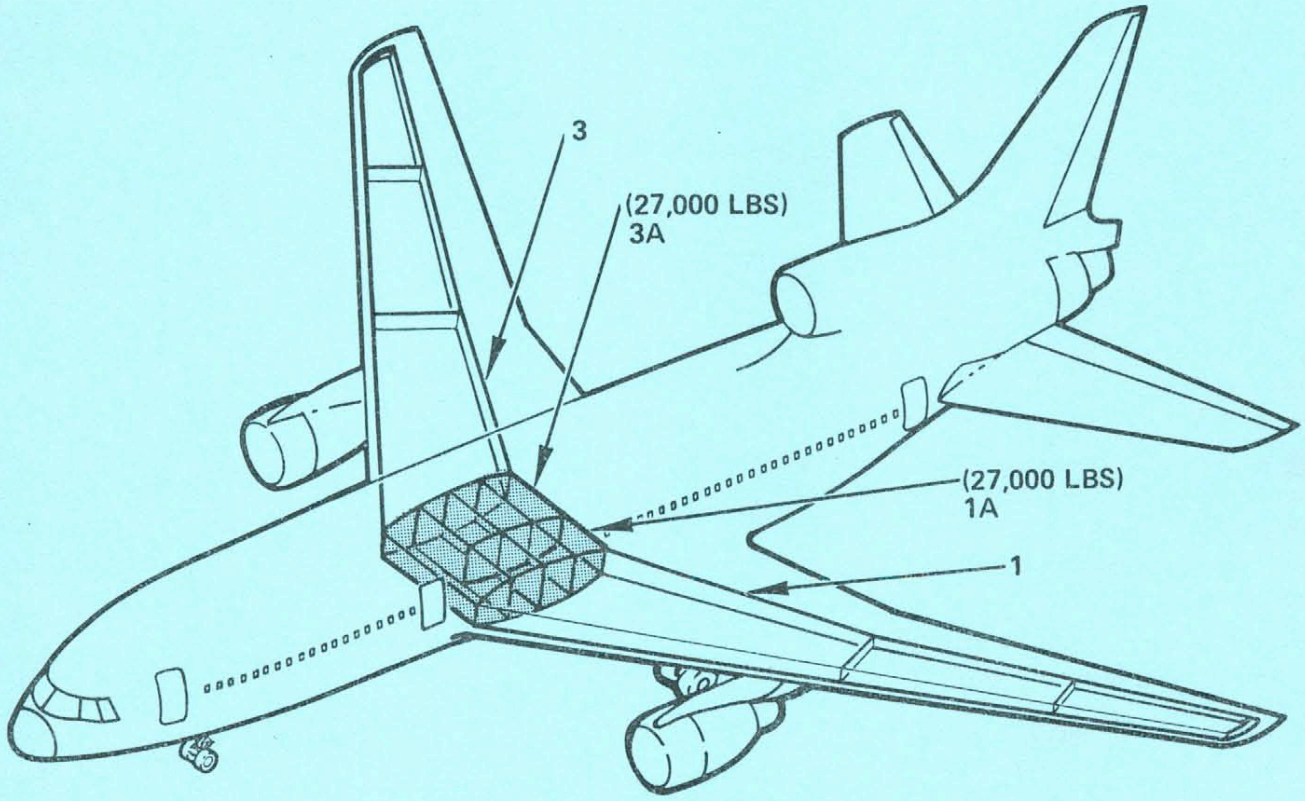
INBOARD (1 AND 3) AND CENTER SECTION (1A AND 3A) TANKS

Tanks 1 and 1A operate as one tank, as do tanks 3 and 3A. Fuel in each center section tank is normally transferred into its adjacent inboard wing tank by means of a scavenge/transfer system. The scavenge transfer systems consist of four jetpump compound ejector assemblies in each center section tank, powered by flow from the tank pumps in tanks 1 and 3.

Designed for continuous operation, the scavenge/transfer systems are controlled by switches on the fuel system panel that open transfer valves. Overfilling of the mains is prevented by an override signal from high-level thermistors in tanks 1 and 3 that closes or prevents the opening of the transfer valves until approximately two minutes after the thermistors have been uncovered by fuel usage. When the thermistors are covered by fuel, the transfer valves close immediately. Vents located near the top of the tanks will permit fuel to flow back into tanks 1A and 3A from tanks 1 and 3 in the event of failure of the thermistor or transfer valve.

GRAVITY TRANSFER SYSTEM

A gravity transfer system is provided in case of failure of the scavenge transfer system. When the gravity transfer valves are opened, all but approximately 1400 pounds in each tank will drain from tanks 1A and 3A into tanks 1 and 3. Check valves prevent reverse flow if the gravity transfer valves are open.



ALL LONG-RANGE AIRCRAFT

EXCEPT SHIP 724

FUEL CONTROL PANEL (SHEET 1)

TANKS 1A AND 3A TRANSFER SWITCHES

Used to transfer tank 1A fuel into tank 1 or tank 3A fuel into tank 3. At least one tank pump must be operating in the respective tank.

IN - Opens tank scavenge transfer valve. Blue in-transit light is illuminated until valve position agrees with switch position.
OPEN is illuminated whenever the transfer valve is open.
If fuel transfer is interrupted by the high-level thermistor, the transfer valve closes and **OPEN** is extinguished.
The 1A/3A transfer valves close if Master Jettison switch is latched in.

OUT - Closes the tank 1A or 3A transfer valve. Blue in-transit light is illuminated until valve closes. **OPEN** also goes out when valve is closed.

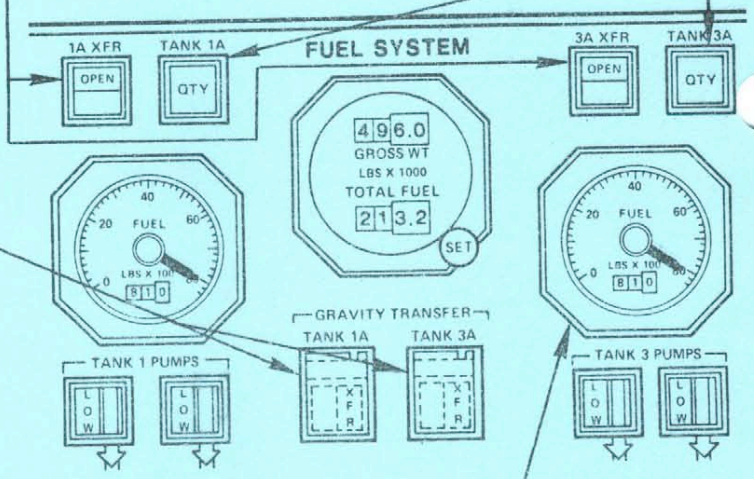
3U5,6 - TRANSFER VALVE TANK 1&1A, 3&3A

TANKS 1/1A AND 3/3A FUEL LOW/QUANTITY INDICATOR SWITCHES

Permit selective indication of fuel quantity and provide low-level warning.

IN - **QTY** is illuminated and the tank 1 or 3 fuel quantity indicator shows tank 1A or 3A fuel quantity only.

OUT - **QTY** is extinguished and fuel quantity indicator shows thtal tank 1 and 1A or 3 and 3A fuel quantity.



TANKS 1A AND 3A GRAVITY TRANSFER SWITCHES

Two position, guarded pushbutton switches. Permit gravity flow of fuel from tanks 1A and 3A into tanks 1 and 3 respectively.

IN - Opens gravity transfer valve. Gravity flow fuel transfer occurs if the fuel level in the receiving tank is below that of the transferring tank. A check valve prevents backflow of fuel from receiving tank to transferring tank. All but 1400 lbs of fuel can be transferred through the gravity transfer valve.

XFR is illuminated whenever switch is in. Blue in-transit light is illuminated whenever transfer valve is not in position commanded by gravity transfer switch.

OUT - Closes gravity transfer valve. **XFR** is extinguished.

The gravity transfer valve opens automatically when the fuel Master Jettison switch is latched in. When this occurs, the blue in-transit light is illuminated until valve opens and **XFR** is illuminated. The valve closes when the Master Jettison switch is unlatched.

1H14,15 - GRAVITY FEED VALVE TANK 1A, 3A

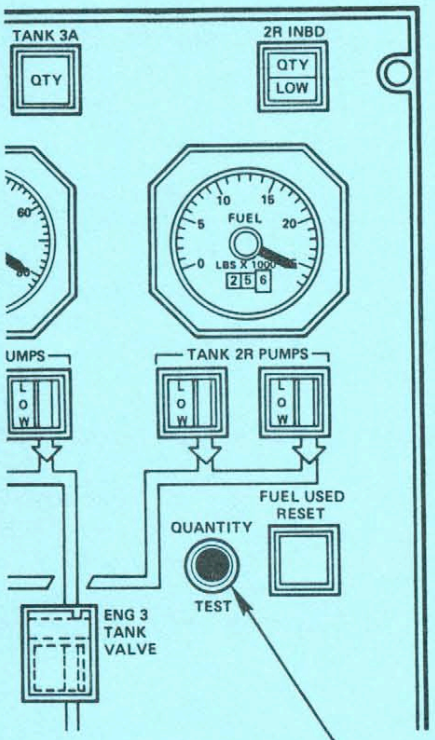
FUEL QUANTITY INDICATOR (4)

Indicates individual tank fuel quantity by weight.

ALL LONG-RANGE AIRCRAFT

EXCEPT SHIP 724

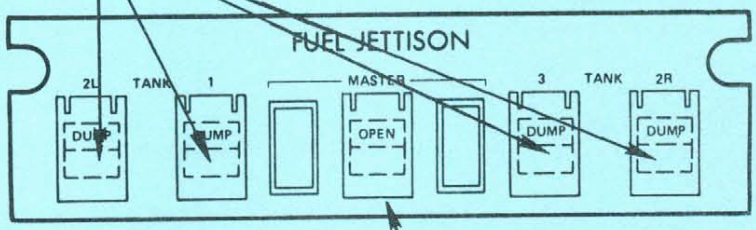
FUEL CONTROL PANEL



FUEL QUANTITY TEST BUTTON
Position changed.

FUEL JETTISON PANEL

TANK DUMP SWITCH DISAGREEMENT LIGHTS (BLUE)
Number 1 and 3 disagreement lights will cycle when fuel level in tanks 1 and 3 reaches shutoff level. They will cycle again as dumping continues when remaining fuel in the center section tanks gravity transfers into wing tanks.
3U3 - JTSN & DEFUEL 2L & 2R
3U11, 12 - JTSN & DEFUEL 1 & 3



MASTER JETTISON SWITCH
Functions same as on –1 aircraft except:

IN - Opens the tank 1A and 3A gravity transfer valves and closes the normal 1A 3A transfer valves (if open).

OUT - The gravity transfer valves and normal transfer valves return to the positions selected by their respective switches.
3U18 - JTSN ARM

ALL LONG-RANGE AIRCRAFT

EXCEPT SHIP 724

SYSTEM OPERATION

FUEL MANAGEMENT

Fuel Loading Procedure

The fuel loading procedures are guidelines for use in determining the required fuel distribution for any desired fuel quantity. The tanks may be fueled in any convenient sequence to achieve this distribution.

When fueling tanks 2L or 2R, the first 1,000 pounds of fuel is stored in the inboard compartment. Continued fueling will then fill the outboard compartment before additional fuel is added to the inboard compartment.

- Load fuel equally in tanks 1, 2 and 3 until total fuel load reaches 63,000 pounds.
- Load fuel in tank 2 until total fuel load reaches 84,000 pounds.
- Load fuel equally in tanks 1, 2 and 3 until tank 2 is filled.
- Load fuel equally in tanks 1 and 3 until they are filled.
- Load fuel equally in tanks 1A and 3A until they are filled.

Fuel Distribution/Usage

XFR switches should be latched after engine start. 1A 3A **XFR** switches should remain latched throughout flight with at least one TANK PUMP switch latched for the respective tank.

For total fuel loads up to 154,000 pounds, refer to the L-1011-1 fuel distribution usage in the FUEL section PRM.

Total Fuel Loads Above 154,000 pounds (Fuel in 1A and 3A)

- Feed tank to engine for taxi, takeoff and initial climb.
- Before 14,000 pounds of fuel has been used, crossfeed all engines from tanks 1 and 3 until tanks 1A and 3A are empty and quantities in tanks 1, 2 and 3 are equal.
- When quantities are equal, feed tank to engine for remainder of flight.

ALL LONG-RANGE AIRCRAFT

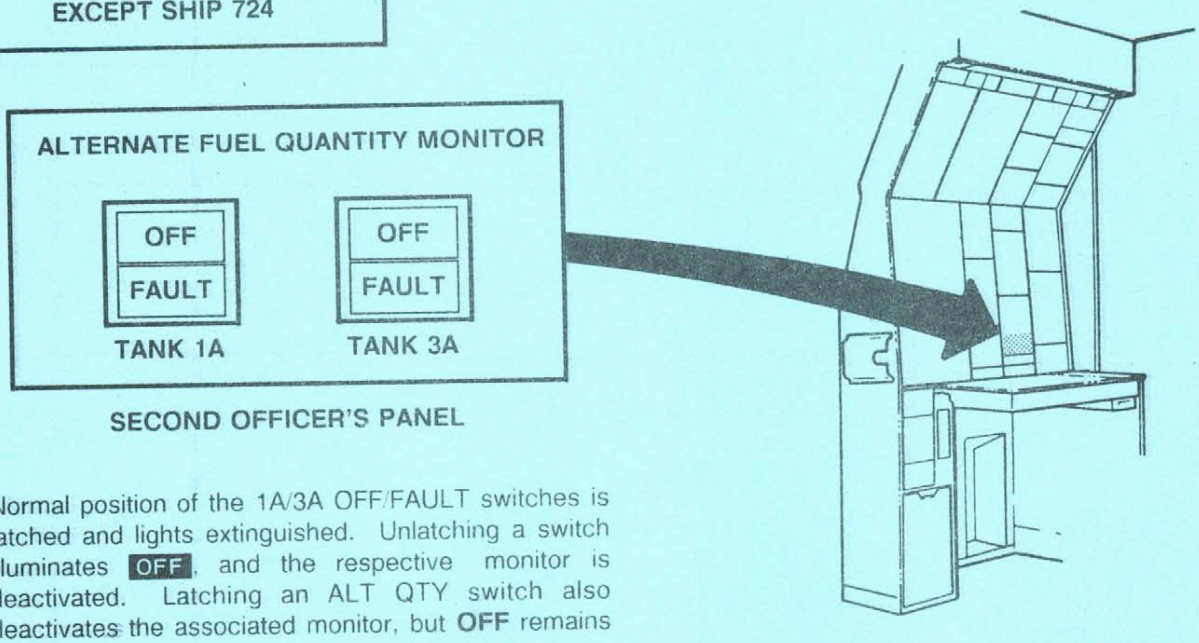
EXCEPT SHIP 724

FUEL LOAD LOCATIONS

TOTAL FUEL LOAD (LBS)	TANK SYSTEM 1 & 3 EACH	TANK 1A & 3A EACH	TANKS 2L & 2R EACH
154,000	51,400	EMPTY	25,650
156,000	52,300		
158,000	53,300		
At 159,200 lbs 1 & 3 mains are full			
160,000	54,300	400	
162,000	55,300	1,400	
164,000	56,300	2,400	
166,000	57,300	3,400	
168,000	58,300	4,400	
170,000	59,300	5,400	
172,000	60,300	6,400	
174,000	61,300	7,400	
176,000	62,300	8,400	
178,000	63,300	9,400	
180,000	64,300	10,400	
182,000	65,300	11,400	
184,000	66,300	12,400	
186,000	67,300	13,400	
188,000	68,300	14,400	
190,000	69,300	15,400	
192,000	70,300	16,400	
194,000	71,300	17,400	
196,000	72,300	18,400	
198,000	73,300	19,400	
200,000	74,300	20,400	
202,000	75,300	21,400	
204,000	76,300	22,400	
206,000	77,300	23,400	
208,000	78,300	24,400	
210,000	79,300	25,400	
212,000	80,300	26,400	
213,640	81,170	27,200	25,650

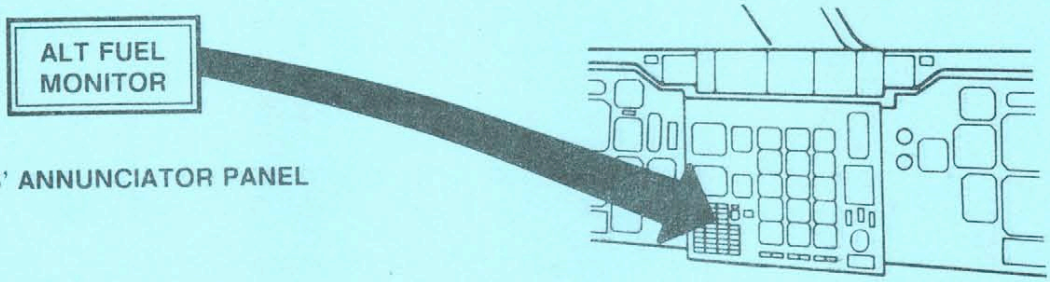
ALL LONG-RANGE AIRCRAFT

EXCEPT SHIP 724



SECOND OFFICER'S PANEL

Normal position of the 1A/3A OFF/FAULT switches is latched and lights extinguished. Unlatching a switch illuminates **OFF**, and the respective monitor is deactivated. Latching an ALT QTY switch also deactivates the associated monitor, but **OFF** remains extinguished.



PILOTS' ANNUNCIATOR PANEL

The **ALT FUEL MONITOR** light illuminates any time the main plus alternate tank quantity is less than 40,000 pounds and more than 1,000 pounds is contained in the respective alternate tank. Also, the respective **FAULT** light on the Alternate Fuel Quantity Monitor panel will illuminate. These lights will also illuminate if a failure in the system is detected.

If **ALT FUEL MONITOR** illuminates, check for corresponding **FAULT** light, and latch respective ALT QTY switch to check alternate tank quantity. If unwanted fuel is contained in 1A/3A refer to Fuel Abnormal procedures (blue pages). If fuel quantity in 1A/3A is correct, unlatch respective OFF/FAULT switches to extinguish warning indications.

-END-

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RSVR (LO QTY) Lights 2/3
(HI TEM)

SCHEMATICS

Hydraulic Power System 11

CROSS REFERENCE

AC PUMPS Load Monitoring . . . . . ELECTRICAL
ATM Pneumatic Supply . . . . . PNEUMATICS
Priority System . . . . . AIR CONDITIONING
Brake System . . . . . LANDING GEAR
Firewall Shutoff Valves . . . . . FIRE PROTECTION

GENERAL

There are four independent hydraulic systems designated systems A, B, C, and D. The hydraulic systems provide the power to operate the flight controls, flaps, slats, landing gear, brakes, tailskid and nosewheel steering. Any single system is capable of providing sufficient power to maintain control of the aircraft.

The hydraulic system control panel is located on the upper left section of the Second Officer's panel. The panel is schematically arranged to show the functional position of components and general system flow as is shown in the Schematic on page 11.

BASIC COMPONENTS

Each system contains certain basic components.

RESERVOIRS

The four system reservoirs are installed in the Hydraulic Service Center located in an unpressurized compartment between the two main landing gear wheel wells. To accommodate landing gear demands, the C system reservoir is approximately twice as large as the other system reservoirs.

A HYDRAULIC SYSTEM TEMP gauge and selector is installed above the HYDRAULIC SYSTEM panel to monitor the temperature of the fluid in the selected reservoir.

At the top of the HYDRAULIC SYSTEM panel are four FLUID LEVEL indicators which display the quantity of fluid in each system reservoir. A temperature compensator in each system provides a stabilized quantity indication regardless of changes in fluid temperature.

RSVR LO QTY and HI TEM lights are installed below each FLUID LEVEL indicator. The respective LO QTY light illuminates when fluid quantity in the reservoir is below approximately 1/4. The respective HI TEM light illuminates when temperature of the fluid returning to the reservoir is too high.

FIREWALL SHUTOFF VALVES

A firewall shutoff valve is provided in the line leading to the inlet of each engine driven pump. These motor-driven valves are only closed when the respective FIRE PULL Handle is pulled. When closed, the valve shuts off all fluid (including lubrication and cooling) to the engine driven pump.

ENGINE DRIVEN PUMPS

The engine driven pumps provide the primary source of hydraulic pressure for each system. Engine 1 drives the A1 pump to pressurize system A. Engine 2 drives both the B1 and C1 pumps to pressurize systems B & C. Engine 3 drives the D1 pump to pressurize system D.

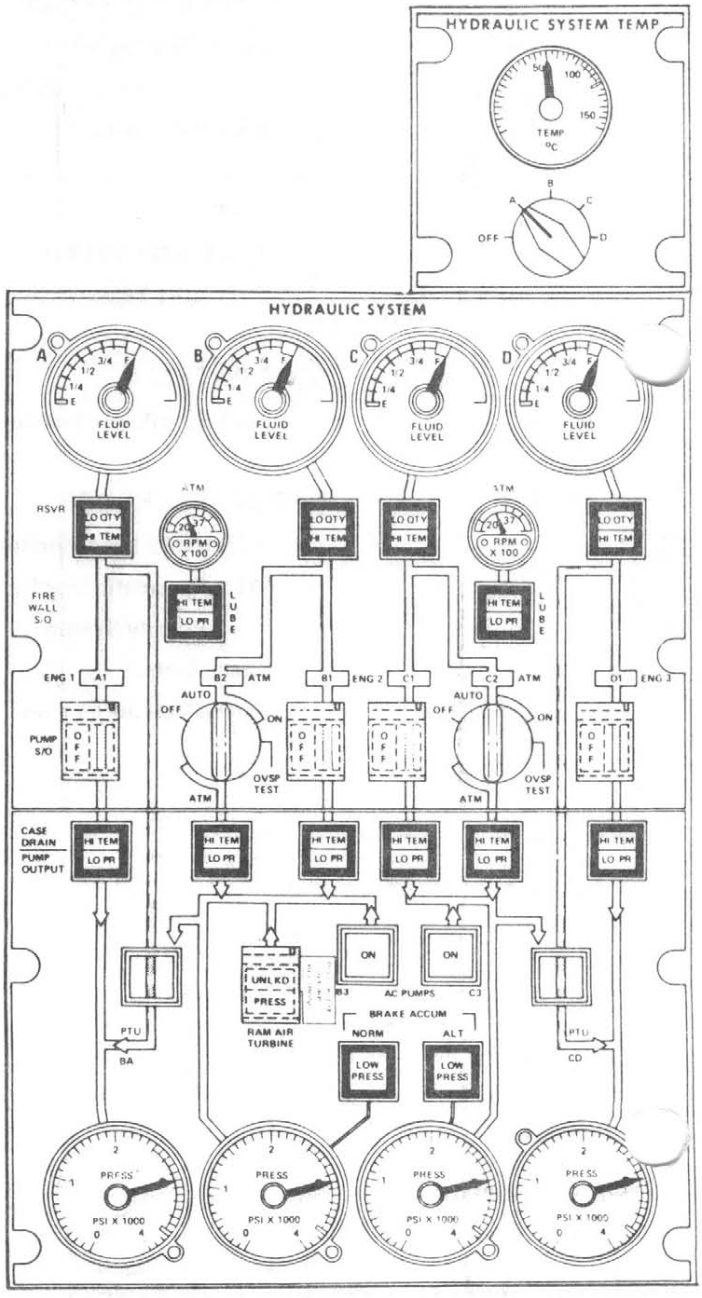
The engine driven pumps are self-regulating and are rated at 3,000 PSI. Output of the pumps is controlled by PUMP S/ switches. Unlatching a switch energizes an electrical solenoi that causes the pump to depressurize to stop pump output. Pump lubrication and cooling is still provided through the pump case drain. The pump shutoff design is fail-safe in that a loss of electrical power automatically restores the output of the pump.

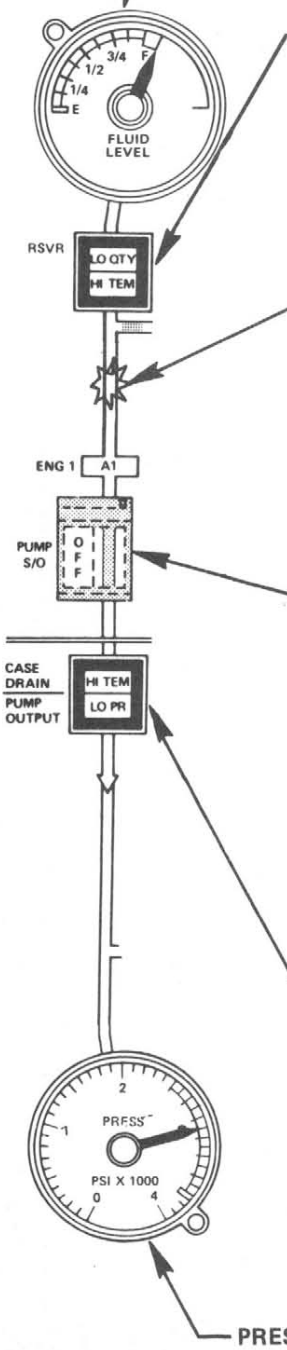
Pulling the FIRE PULL Handle also activates the respective Pump Shutoff solenoid(s).

CASE DRAIN HI TEM and PUMP OUTPUT LO PR lights are provided to monitor the operation of each engine driven pump.

SYSTEM PRESSURE INDICATORS

Four pressure indicators are provided to display the respective system hydraulic pressure.





FLUID LEVEL INDICATOR (4)

- Indicates quantity in respective system reservoir.
- Quantity should normally remain within the green band.
- Hydraulic system must be pressurized for an accurate indication.
- C system indicator will show a slight quantity increase when landing gear is extended.
- With loss of power, pointer indicates E.

2M12 – QTY

RSVR LO QTY/HI TEM LIGHTS (AMBER) (4)

LO QTY – Illuminates when fluid quantity is below approximately 1/4. Light is independent of reservoir quantity indicator.

HI TEM – Illuminates when temperature of fluid returning to the reservoir is too high for normal operation.

The HYDRAULIC SYSTEM light on the Pilots' Annunciator Panel will illuminate if either the LO QTY or HI TEM lights illuminate.

2M14, 16, 18, 20 – RSVR

FIREWALL SHUTOFF VALVES (4)
(Not shown on Panel)

- Electrically operated valves that control hydraulic fluid supply to the engine driven pumps.
- Normal valve position is open.
- Valves are closed only when the respective Fire Pull Handle is pulled.
  Fire Pull Handle No. 1 controls system A.
  Fire Pull Handle No. 2 controls system B and C.
  Fire Pull Handle No. 3 controls system D.

1L15, 16, 17, 18 – PUMPS FIREWALL SHUTOFF VALVE CONT.

PUMP S/O SWITCH (4)
A1, B1, C1 and D1

Guarded switch which controls output of the engine driven hydraulic pump.

LATCHED – Normal position. Pump is pressurized, and output is automatically regulated to maintain normal system pressure. Flowbar illuminates to indicate switch position.

UNLATCHED – Pump is electrically energized to stop pump output (depressurize). A system check valve isolates the pump from the rest of the hydraulic system. OFF illuminates to indicate switch position.

The pump S/O is also activated when the respective FIRE PULL Handle is pulled. However, flowbar remains illuminated and OFF extinguished as long as PUMP S/O switch remains latched.

1L15, 16, 17, 18 – PUMP & FIREWALL SHUTOFF VALVE CONT.
2M15, 17, 19, 21 – IND LT PUMP

CASE DRAIN HI TEM/PUMP OUTPUT LO PR LIGHTS (AMBER) (4)

Lights are armed to illuminate only if respective PUMP S/O is latched.

HI TEM – Illuminates when fluid temperature from the pump case drain is too high for normal operation.

LO PR – Illuminates when pump output pressure is too low for normal operation.

The HYDRAULIC SYSTEM light on the Pilots' Annunciator Panel will illuminate if either the HI TEM or LO PR lights illuminate.

2M15, 17, 19, 21 – IND LT PUMP

PRESS INDICATOR (4)

- Indicates hydraulic system pressure.
- Pressure should normally remain within the green band.
- With loss of power, pointer remains in last indicated position.

2M13 – PRESS

HYDRAULIC SYSTEMS B & C

In addition to the basic components, systems B & C also contains the following:

AIR TURBINE MOTOR (ATM)

Systems B & C each have an ATM which serves as a back-up source of hydraulic pressure. The ATM hydraulic pumps are identical to the engine driven pumps, but are driven through gear boxes by air turbines. Air from the pneumatic manifold drives the air turbines. The B2 ATM air duct is upstream of the Fuselage ISLN VALVE in the pneumatic system. The C2 ATM air duct is downstream of the Fuselage ISLN VALVE (see Pneumatic Section).

An ATM RPM indicator is provided for each ATM. With normal pneumatic supply available ATM RPM will be maintained in the green band while the ATM is operating.

LUBE HI TEM and LO PR lights are provided to monitor the condition of the lubricating oil in each ATM gearbox.

A rotary selector is provided to select operation of each ATM, and electrical power is required to control ATM operation. Normally, the ATM's are operated in Auto, and the engine driven pumps provide all necessary hydraulic power. If system B or C pressure drops below 2600 PSI, the respective ATM will run for about 17 seconds then shutoff. If pressure drops again, the ATM cycle will be repeated. When the selector is positioned to ON, the ATM will start and run continuously.

The C2 ATM has a priority on the pneumatic supply over the number 2 air conditioning pack. If pneumatic pressure drops below 12 PSI, while the C2 ATM is operating, the No. 2 Pack Flow Control valve will close to increase the air available to the C2 ATM (see Air Conditioning Section).

CASE DRAIN HI TEM and PUMP OUTPUT LO PR lights are provided to monitor the operation of each ATM.

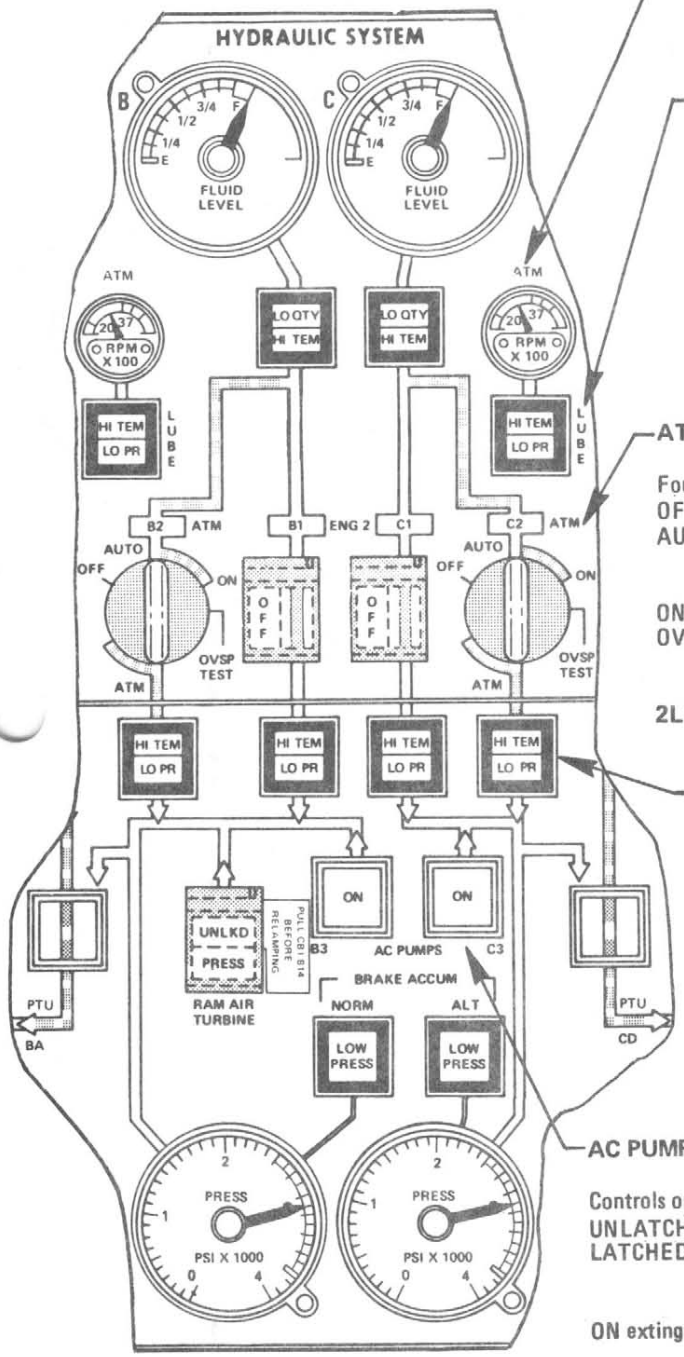
AC PUMPS

Systems B & C each have an electrically-driven AC PUMP which serves primarily to provide hydraulic pressure for ground handling purposes, but can be used in-flight in an emergency.

Latching an AC PUMP switch selects the pump to operate. ON illuminates when power is supplied to the motor. A pump will shutdown if the motor becomes overheated. The AC pumps are also part of the Auto-Load Monitoring system (see Electrical Section), and power will be turned off to both pumps if any generator load becomes excessive.

The AC pumps have less than one-third the flow capability of an engine driven pump or ATM, and under normal conditions should not be used to operate any flight control.

(CONTINUED)



ATM (AIR TURBINE MOTOR) TACHOMETER (2)

Indicates operating speed of the air turbine.
While the ATM is operating, RPM should normally remain in the green band.

ATM LUBE HI TEM/LO PR LIGHTS (Amber) (2)

Monitors condition of the ATM gearbox lubricating oil.
Lights are armed to illuminate only if respective ATM has a run signal.

HI TEM – Illuminates when gearbox oil temperature is too high for normal operation.
LO PR – Illuminates when gearbox oil pressure is too low for normal operation. May illuminate momentarily for "C" system during gear actuation.

The HYDRAULIC SYSTEM light on the Pilots' Annunciator Panel will illuminate if either the HI TEM or LO PR lights illuminate.

2L13, 19 ATM CONT & IND

ATM SELECTOR (2) B_2 and C_2

Four position selector that controls ATM operation.

OFF – Deactivates ATM. Also resets any overspeed trip signal.
AUTO – Normal flight position. Arms ATM to operate automatically when system pressure drops toward lower end of green band. ATM automatically shuts down after preset time. C_2 ATM normally cycles when landing gear is operated.
ON – ATM operates continuously.
OVSP TEST – Checks overspeed shutdown circuit and locks out ATM until ATM Selector is cycled to OFF. Intended for maintenance use only.

2L13, 19 ATM CONT & IND

ATM CASE DRAIN HI TEM/PUMP OUTPUT LO PR LIGHTS (Amber) (2)

Lights are armed to illuminate only if respective ATM selector is in the ON or OVSPD TEST position.

HI TEM – Illuminates when fluid temperature from the pump case drain is too high for normal operation.
LO PR – Illuminates when pump output pressure is too low for normal operation.

The HYDRAULIC SYSTEM light on the Pilots' Annunciator Panel will illuminate if either the HI TEM or LO PR lights illuminate.

AC PUMPS SWITCHES (2) B3 AND C3

Controls operation of AC pumps.

UNLATCHED – Normal flight position. Pump is de-energized.
LATCHED – Pump is selected to operate. ON illuminates to indicate power is available to the pump. System pressure indication verifies pump operation provided no other pumps are operating in that system.

ON extinguishes if the pump shuts down for any reason, including overheat or load shedding.

- Wait 90 seconds before re-start after shutting pump off.
- Limit continuous ground operation of an AC pump to 15 minutes.
- Do not operate any flight control using only the AC pumps.

2L10 – AC HYD MOTOR IND
2L12, 22 – AC PUMP

SYSTEMS B & C (SHEET 1)

HYDRAULIC SYSTEMS B & C (CONTINUED)

RAM AIR TURBINE (RAT)

System B has a RAT (propeller-driven hydraulic pump) which serves as an emergency source of hydraulic pressure. The RAT is stowed in a compartment just forward of the Hydraulic Service Center.

MIN 160 Kts FOR PROPER PRESSURE FROM RAT

The RAT will extend and operate automatically in-flight if:

- All three engine N_3 tachometers drop below flight idle.
- All four engine driven pumps and both ATM's are shut off.

The RAT may be extended manually by pressing the RAM AIR TURBINE switch. This switch is normally guarded and safetied. The UNLKD light on the switch illuminates whenever the RAT extends, and PRESS illuminates when the RAT is producing usable pressure.

The RAT must be re-stowed by Maintenance. On the ground remain clear of the RAT compartment unless the RAT Safety Bar is installed.

BRAKE ACCUMULATOR LIGHTS

A brake accumulator is provided for both Normal (System B) and Alternate (System C) brakes. The respective LOW PRESS light illuminates when the accumulator pressure drops too low to assure adequate brakes.

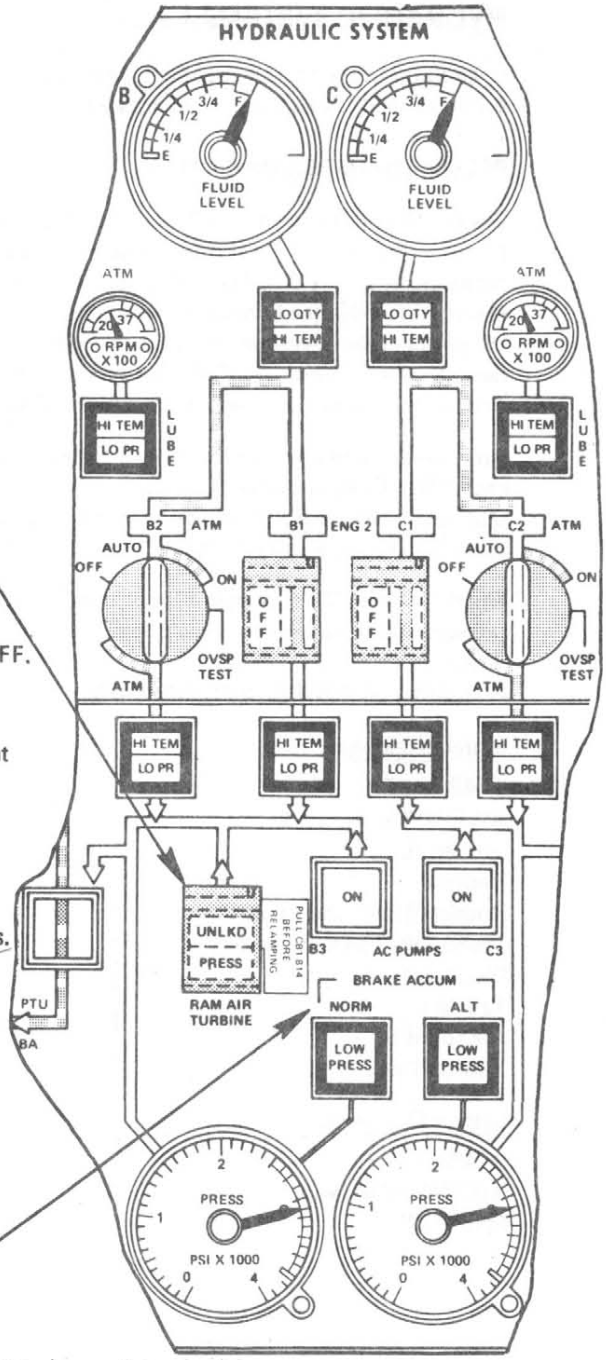
HYDRAULIC POWER DISTRIBUTION

System B powers:

Stabilizer
Ailerons
Spoilers L & R 1, 4 & 6
Rudder
Rudder Mechanical Limiter
Speedbrake handle assist servo
Brakes (Norm Sys B)
B-A PTU
Autopilot A
Yaw SAS #1

System C powers:

Stabilizer
Ailerons
Spoilers L & R 3 & 5
Rudder
Flaps/Slats
Landing Gear
Nosewheel Steering
Brakes (ALT Sys C)
C-D PTU



RAM AIR TURBINE (RAT) SWITCH/INDICATOR

Guarded and safetied momentary switch which provides manual RAT deployment. Annunciator lights verify RAT deployment and operation.

In flight the RAT will deploy automatically if:
- The RPM on all 3 engines falls below flight idle, or
- All four engine driven hydraulic pumps are shutdown and both ATM switches are OFF.

Pressing the RAT switch in-flight manually deploys the RAT.

UNLKD (amber) – Illuminates when RAT is deployed. The RAT DEPLOYED light illuminates on the Pilots' Annunciator Panel when UNLKD illuminates.

PRESS (green) – Illuminates when the RAT is providing useable pressure.

- Airspeed should be maintained above 160K to assure adequate pump output.
- RAT deployment (both manual and automatic) is inhibited on the ground.
- To prevent inadvertent RAT deployment, pull C/B 1B14 before changing light bulbs.
- Once deployed, the RAT must be re-stowed by Maintenance.

1L3 – RAT AUTO DEPLOY
1B14 – RAT MANUAL DEPLOY
3G10 – IND LT RAT

BRAKE ACCUM LIGHTS (Amber) (2)

LOW PRESS illuminates to indicate that respective accumulator pressure is too low for adequate braking.

The LOW BRAKE PRESS light illuminates on the Pilots' Annunciator Panel when either LOW PRESS lights illuminate.

2G22 – PARKING BRAKE NO. 2

HYDRAULIC SYSTEMS A & D

In addition to the basic components previously discussed, systems A and D also contain the following.

POWER TRANSFER UNIT (PTU)

Systems A and D each have a PTU which serves as the back-up pressure source for these systems. The PTU's are hydraulic motor-pumps. The B-A PTU uses hydraulic pressure in the B system to drive the hydraulic motor; which in turn drives the pump in the A system. There is no exchange of fluid between the systems. The C-D PTU uses C System pressure to drive the motor-pump and pressurize the D system.

An alternate action switch is provided to select operation of each PTU. Electrical power is required to initiate PTU operation. Once the PTU is operating, electrical power is again required to shutdown the PTU.

When only the PTU is pressurizing system A or D, normal pressure will be approximately 2600 PSI.

HYDRAULIC POWER DISTRIBUTION

System A powers:

STABILIZER
AILERONS (lt. wing)
Spoiler 2L
Rudder
Rudder Mechanical Limiter
Speedbrake handle assist servo
Flaps/Slats
Tail Skid
Autopilot B
Yaw SAS #2

System D powers:

STABILIZER
AILERONS (rt. wing)
Spoiler 2R

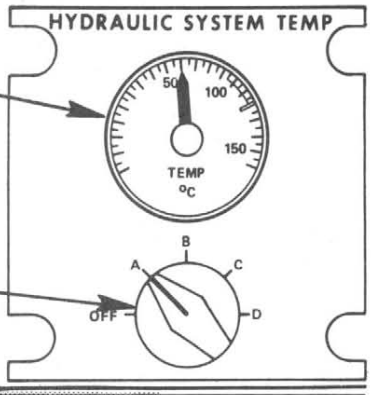
HYDRAULIC SYSTEM TEMP INDICATOR

Indicates temperature of hydraulic fluid in the reservoir for the system selected by the hydraulic Temperature Selector.

2L9△P + RSVR TEMP IND

TEMP SELECTOR

Five position selector that determines which system is monitored by the temperature indicator.



PTU (POWER TRANSFER UNIT) CONTROL SWITCHES (2) BA AND CD

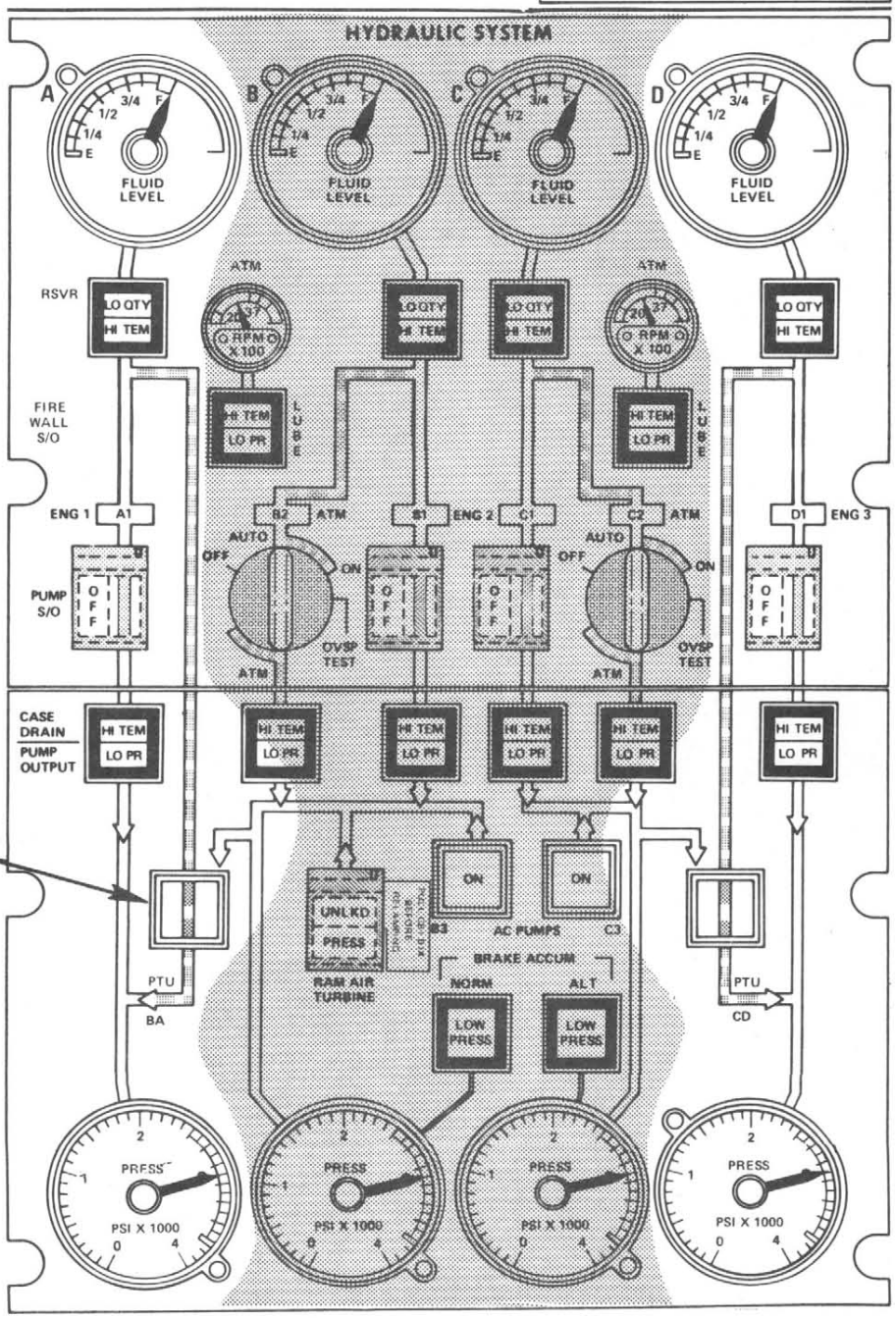
Alternate action switch selects operation of respective PTU.

When switch is pressed, PTU shutoff valve is electrically energized to open, and flowbar illuminates to indicate PTU has been selected to operate. System pressure indication verifies PTU operation, provided the engine driven pump is shutdown.

When switch is pressed again, PTU is electrically energized to shutdown, and flowbar extinguishes.

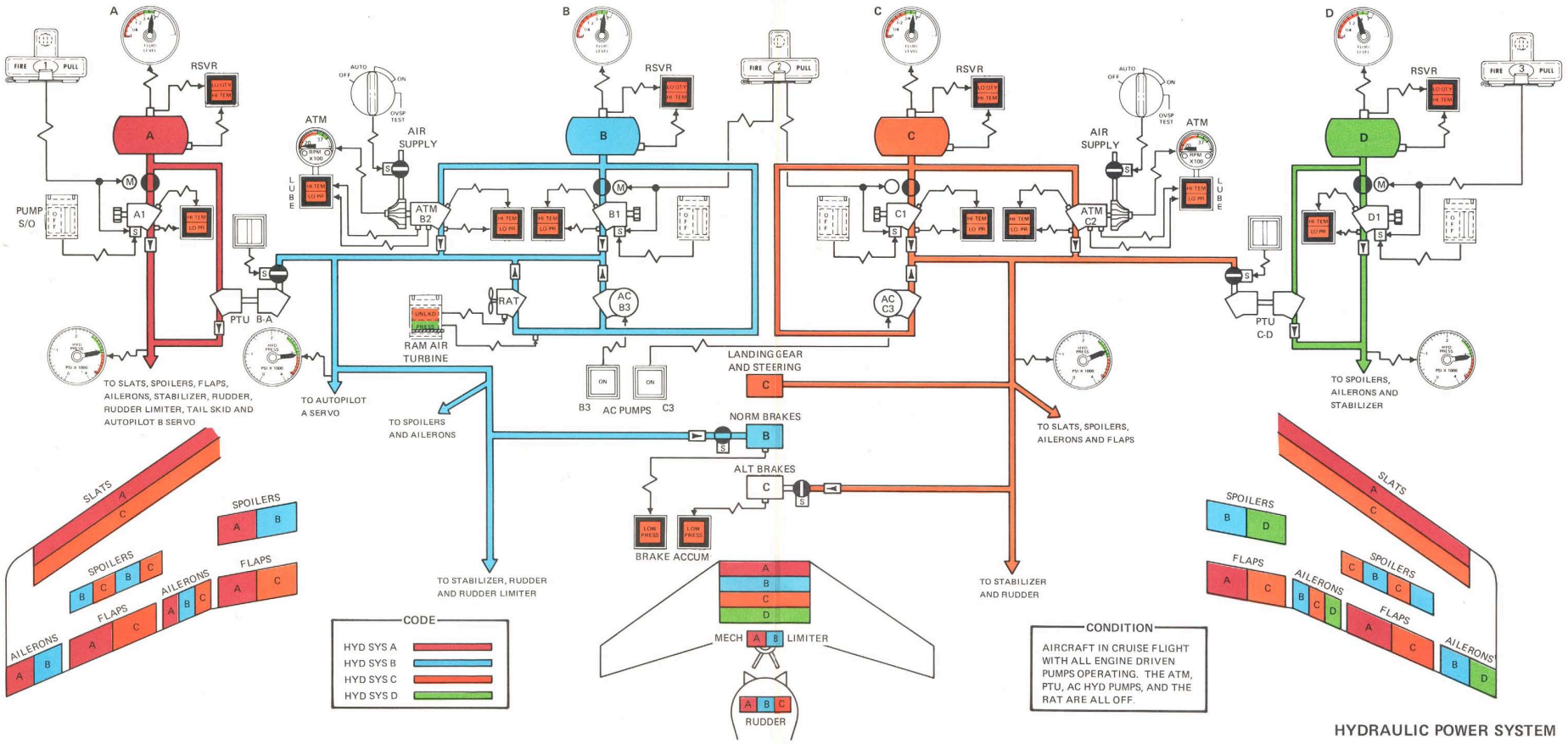
Normal selection is flowbar extinguished and PTU shutdown.

2L14, 15 – PTU CONT & IND



SYSTEMS A & D

(OPPOSITE SIDE BLANK)



HYDRAULIC POWER SYSTEM

HYDRAULICS

GENERAL DESCRIPTION

RUDDER MECHANICAL LIMITER

Not installed.

SCHEMATIC

SPOILER LIMITERS

The B system powers L and R No. 1 spoiler limiter. The D system powers L and R No. 2 and 3 spoiler limiters. With loss of hydraulic power, limiters are spring-loaded out of position.

GENERAL DESCRIPTION

ICE PROTECTION

Ice Detector

The ice detector includes a probe, mounted on the left fuselage side just aft of the radome, control box, and an ICING light on the Pilot's Annunciator Panel. Ice accumulation on the probe illuminates the ICING annunciator light. A time delay will keep the ICING annunciator light illuminated as long as icing conditions persist and for 60 seconds after the icing conditions cease.

GENERAL

Pneumatic anti-icing is provided for:

Wing leading edge slats

Engine cowls

Electric heaters provide anti-icing for:

Air data probes

Windshield and side windows

Water system drain masts

A defogging system blows hot air onto the inside of the windshields to augment the windshield electrical heating system.

Wing Anti–Icing

The wing anti-icing system prevents ice accumulation on the four outboard wing slats. Regulated bleed air is provided for wing anti-icing. Air flow is controlled by electrically signaled and pneumatically actuated shutoff valves. Sensors signal the shutoff valves to open and close to maintain the desired slat skin temperature. When the aircraft is on the ground, air-ground sensing locks out the wing anti-icing system. A test switch on the wing anti-ice panel permits checking the system when the aircraft is on the ground.

Engine Anti–Icing

The engine cowl and P1 probe on each engine use low pressure bleed air, which is ducted directly from the engine LOW PRESS duct, to prevent icing. An engine anti-icing shutoff valve controls flow.

Air Data Sensor Heat

Electrical heating is provided for the air data sensors to prevent sensor malfunction caused by icing.

Each of the four pitot-static probes contains two heating elements one in the mast and one in the head.

Each of the two total air temperature (TAT) probes contains a single heating element.

Each of the two angle-of-attack (alpha) sensors contains two heating elements.

Latching the four switchlights applies power to all the air data sensor heaters except the alpha low level heaters. As each switchlight is latched IN, its OFF legend is extinguished to indicate its heater is operating. However, the alpha OFF legends remain illuminated until the sensors reach normal operating temperature.

Windshield And Side Window Heat

The two windshields and two most forward side windows are electrically heated. Separate switches located on the pilots' overheat panel are provided for each of these heated windows. The two windshields are heated to a low temperature level (IDLE) when the switches are

unlatched and to a higher temperature level when the switches are latched. Fault lights illuminate whenever an overtemperature is sensed or when the temperature is low. An overheat condition does not lock out the system. Heat will be interrupted at a preset overheat temperature and restored when windshield temperature drops to the normal value.

Defog Fan

The defog fan blows flight station air on the two windshields and a portion of the left and right side windows to augment the windshield heat system. The fan should be operated when the airplane has been cold soaked or if the inside of the windshield is covered with condensation.

Water Drain Heaters

Electric heaters are provided for the water drain lines, water lines, and masts in the unheated areas of the aircraft.

RAIN PROTECTION

Windshield Rain Repellent System

The rain repellent system consists of four valve/timer nozzles (two for the Captain's windshield and two for the First Officer's windshield). The system is charged with repellent fluid from an aerosol type container which screws into the system. A window-type indicator displays a refill float when the fluid is low and a pressure gage, with green and red areas, indicates a go-no-go condition. If the refill float is visible or the pressure gage indication is in the red area, the container needs to be replaced.

The rain repellent system is used with the windshield wipers to improve visibility during heavy rain. Rain repellent fluid is sprayed onto the respective windshield by momentarily actuating the rain repellent switch on the Captain's or First Officer's wiper control panel. Repellent should never be sprayed on a dry windshield.

Windshield Washer System

The windshield washer system sprays washer fluid on the windshield panels. The system is used with the windshield wipers to clean the windshield.

A combination reservoir/pump is located in the forward electronic service center. A sight gage on the side of the reservoir/pump shows fluid level. The reservoir holds approximately one gallon of fluid. Fluid is routed from the reservoir pump, controlled by a single switch on the Captain's windshield wiper panel, two nozzles for the left windshield and two nozzles for the right windshield. Two control valves, one located in the left side console and one located in the right side console, provide variable fluid flow to the windshields.

Windshield Wipers

Independent, two speed windshield wiper controls are provided for the Captain and First Officer. Operation of windshield wipers on a dry window is not recommended.

CONTROLS & INDICATORS

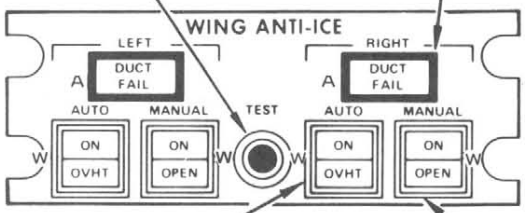
TEST SWITCH

Momentary pushbutton switch bypasses air/ground sensing switch to check system when airplane is on the ground. Pneumatic power must be available for test. Test is made with either auto or manual switches in. Pressing test switch causes OPEN legends to illuminate indicating anti-ice valve operation is normal.

2D22 - WING-ICE CONT

DUCT FAIL LIGHT

DUCT FAIL is illuminated to indicate air temperature around duct is excessive. Tested with ECS area overheat test switch.



2D22 – WING ANTI-ICE CONT

MANUAL SWITCH

IN - Bypasses automatic control unit and opens anti-ice valve. ON indicates switch position. OPEN indicates anti-ice valve has been opened either automatically or manually.

OUT . Deactivates manual mode. Anti-ice valve closes if auto mode is not on

AUTOMATIC SWITCH

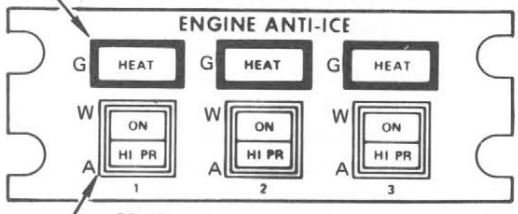
IN – Energizes wing anti-ice valve to operate automatically to maintain correct anti-icing temperature. ON is illuminated to show switch position position. OVHT is illuminated to indicate excessive slat temperature.

OUT – Deactivates automatic mode.

HEAT INDICATOR (3)

Illuminates when pressure in cowl leading edge is normal.

2D15, 19, 20 – ENG ANTI-ICE



2D15, 19, 20 – ENG ANTI-ICE

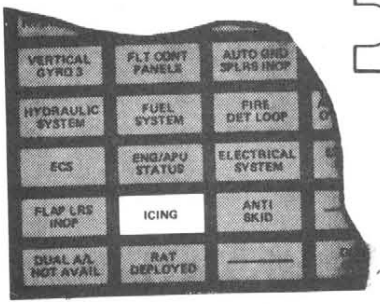
CONTROL SWITCH (3)

IN – System energized to operate with pressure.

ON – Indicates switch position.

HI PR – Overpressure in duct, system will continue to function using overpressure relief valve.

OUT – System deenergized and regulator/shutoff valve is closed.



ICE DETECTOR

Icing probe is accumulating ice. Light is on as long as icing conditions exits and for 60 seconds after icing ceases.

WING AND ENGINE ANTI-ICE CONTROLS
(OVERHEAD PANEL)

ALPHA (ANGLE OF ATTACK) SENSOR POWER SWITCH

Supplies power to left and right angle-of-attack sensor probes.

IN - Energizes sensor heaters. OFF is illuminated if temperature is too low.

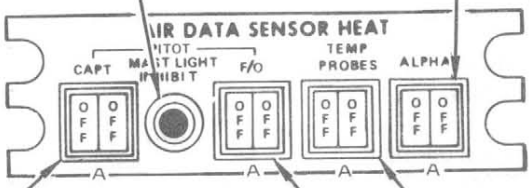
OUT - OFF illuminated, and probes are unheated.

NOTE: Use only bulb number 6839 when replacing ALPHA HEAT lamps.

2E12, 22 - LEFT AND RIGHT ALPHA HEAT

MAST LIGHT INHIBIT SWITCH

OFF legend illumination indicates pitot heaters have failed. Momentarily pressing switch extinguishes the OFF legend only if the mast heater has failed. OFF remains illuminated after pressing switch if the pitot head heater has failed.



CAPTAIN'S PITOT HEAT SWITCH

Supplies power to captain's left and right pitot mast/probes.

IN - OFF is extinguished and electrical power is supplied to respective mast/probe. OFF is illuminated with mast or probe heater failure.

OUT - OFF is illuminated, and probes are unheated.

2E18 - CAPT SEC PITOT HEAT
3H14 - CAPT PRI PITOT HEAT

FIRST OFFICER'S PITOT HEAT SWITCH

Supplies power to first officer's left and right pitot mast/probes.

IN - OFF is extinguished and electrical power is supplied to respective mast/probe. OFF is illuminated with mast or probe heater failure.

OUT - OFF is illuminated and probes are unheated.

2E16, 17 - F/O SEC and F/O PRIM

TEMPERATURE PROBE POWER SWITCH

Supplies power to left and right temperature probes.

IN - OFF is extinguished and electrical power is supplied to respective mast/probe. OFF is illuminated with heater failure.

OUT - OFF is illuminated and probes are unheated.

2E19, 20 - TOTAL TEMP, L, R

AIR DATA SENSOR HEAT PANEL
(OVER HEAD PANEL)

WINDSHIELD HEAT TEST SWITCH

With windshield heat switches IN or OUT and side window heat switches IN, pressing momentary pushbutton test switch tests windshield and side windows.

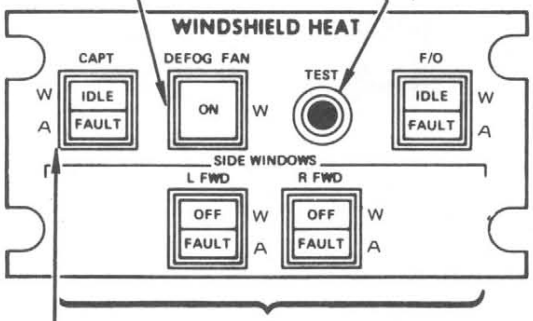
Normal test results in all four FAULT lights cycling on and off RAPIDLY.

DEFOG FAN CONTROL SWITCH

IN – Energizes defog fan. ON is illuminated to show switch position only.

OUT – Deenergizes defog fan and ON is extinguished.

2C13, – WINDSHIELD DEFOG AND F/O WIPER PWR



WINDSHIELD HEAT CONTROL SWITCH (2)

OUT - IDLE is illuminated whenever power is applied to the airplane and shows switch position. Low temperature warmup cycle is operating.

IN - Normal temperature control system is operating. IDLE is extinguished. FAULT is illuminated when there is a fault in the control unit or if the windshield heater element is burned out. Operation of first officer's windshield heat control is the same as the captain's.

2B15,16,18,19 - WINDSHIELD CONT, PWR

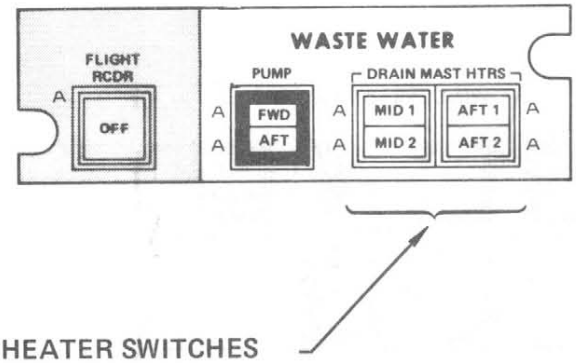
WINDOW HEAT CONTROL SWITCHES

OUT – Window heat system deenergized. OFF is illuminated to show switch position only.

IN – System operating on normal cycle. OFF is extinguished. FAULT is illuminated under same conditions as windshield fault indicator.

2B12, 20, 21 – SIDE WINDOWS

WINDSHIELD HEAT PANEL
(OVERHEAD PANEL)



DRAIN MAST HEATER SWITCHES

Permits selecting either the No. 1 or No. 2 heater element to prevent the mid, and aft water drain masts from icing.

IN - Selects the No. 1 mast heater element

OUT - Selects the No. 2 mast heater element

The drain mast heater indicator lights will illuminate if the internal temperature in the masts goes below a set temperature. If light remains illuminated longer than a few seconds, select the other heater element.

2E13, 14, 15 - DRAINMAST HEATER CONT AFT MID

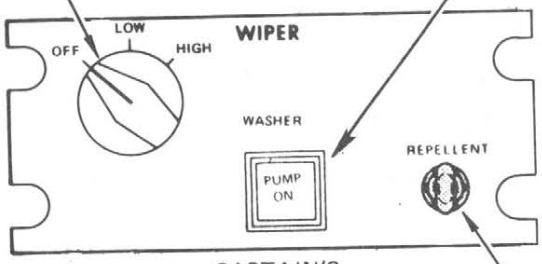
WASTE WATER DRAIN MAST HEATER SWITCHES
(SECOND OFFICER'S LOWER INSTRUMENT PANEL)

CONTROLS & INDICATORS

WINDSHIELD WIPER CONTROL SWITCH

Three position rotary switch that turn on and controls speed of captain's windshield wiper.

3H15, 17 - WINDSHIELD WIPER CONT, PWR



CAPTAIN'S
(OVERHEAD PANEL)

WINDSHIELD WASHER PUMP SWITCH

Alternate action switch. When pressed, PUMP ON illuminates and washer pump applies fluid to both windshields until pressed again.

Fluid flow is controlled by knobs located outboard of each weather radar indicator.

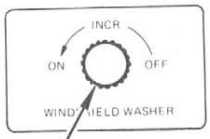
2C21 - WINDSHIELD WASHER PUMP

RAIN REPELLENT SWITCH

Holding the lever - locked toggle switch either right or left releases a measured amount of fluid to the Captain's windshield. Release switch to return to center OFF position.

1L1 - RAIN REPELLENT

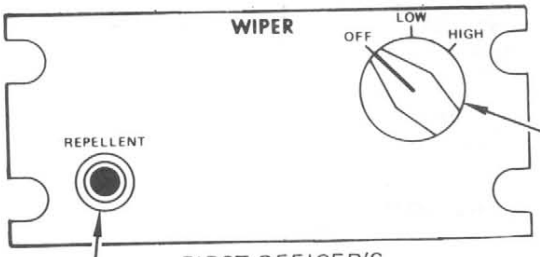
OUTBOARD OF EACH PILOTS' WEATHER RADAR INDICATOR



CAPT'S & F/O'S SIDE CONSOLE

FLUID FLOW CONTROL KNOB (2)

Either knob controls the rate of windshield washer fluid flow. After the pump is engegized, rotating the knob counterclockwise from OFF initiates fluid flow. Further rotation increases flow.



FIRST OFFICER'S
(OVERHEAD PANEL)

WINDSHIELD WIPER CONTROL SWITCH

Operates same as the captain's.

2C13, 15 - F/O WIPER PWR & CONT

RAIN REPELLENT SWITCH

WINDSHIELD WIPER, WASHER, AND RAIN REPELLENT CONTROL PANELS
(OVERHEAD PANEL)

ENGINE ANTI-ICE

Refer to BOOK I, NORMAL PROCEDURES: COLD WEATHER OPERATIONS Section.

The engine anti-ice valve is a pressure regulating and shutoff valve. When open, the green HEAT lights illuminate to indicate adequate bleed pressure in the cowling for anti-icing and verifies the engine anti-ice valve is open.

- If the valve opens, but fails to regulate pressure, the HI PRESS light will illuminate.

- With the HI PRESS light illuminated, delivery air pressure is too high. A pressure relief valve should open to relieve cowl lip pressure and avoid damaging the cowling.

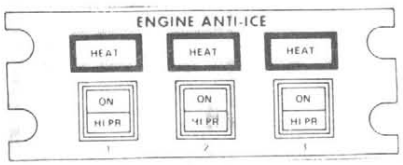
Ground Operation

In conditions when ice is expected:

Engine Anti-Ice----------ON

Check: ON Illuminates
HEAT Illuminates
HI PRESS Light OFF

When engine anti-icing is selected at ground idle, the valve will open, but the HEAT light may not illuminate. To check that the anti-icing system is operating, accelerate the engine until the HEAT light illuminates. This should normally occur by 75% N_3. Although the HEAT light may go out when the engine is decelerated to ground idle, the valve remains open to anti-ice the nose cowl.



Normal engine speeds may be used during climb, cruise, and holding.

Prolonged operation at idling speeds in icing conditions should be avoided, if possible.

After icing has ceased and ICING annunciator has been off for approximately one minute, turn engine anti-ice system(s) off.

WING ANTI-ICE

The wing anti-ice valve is a pneumatically operated valve. It is electrically energized to the open position.

Wing anti-ice is normally operated in the Auto Mode which uses a temperature sensor in the leading edge of each wing to control opening and closing of the wing anti-ice valve. Each sensor incorporates two thermal switches that react to skin temperature. One sensor operates the valve while the other operates the OVHT light for its respective wing.

- Each wing system is independent of the other.

- If a valve fails to close, the OVHT light illuminates.

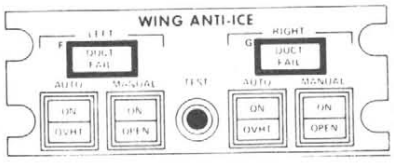
Ground Operation

On the ground, the wing anti-ice system is locked out to prevent overtemperature of the skin because of insufficient airflow over the wing. When the aircraft is on the ground, pressing the TEST switch bypasses the air/ground sensing and the system then operates as it would in flight (if electrical power and pneumatic pressure are available).

In-Flight Operation

Normally, the system is operated in the AUTO mode and the ON light illuminates to indicate switch position. In this mode, the system operates continuously as long as skin temperature is in the normal range.

- The OPEN light illuminates to indicate air pressure downstream of the regulator and shutoff valve.
- If the skin temperature starts to exceed the normal operating temperature, the anti-ice pressure regulator and shutoff valve will close and remain closed until the temperature decreases to a predetermined temperature value.



- If the AUTO system becomes inoperative, it may be operated in the MANUAL mode.

The DUCT FAIL light(s) indicate excessive temperature surrounding the wing anti-ice ducts in the same way as the seven AREA OVHT lights on the ECS panel.

The wing anti-ice ducting and dual loop sensors start downstream of the engine isolation valve. They are then routed to the outboard slats.

Refer to Abnormal Procedures if DUCT FAIL light illuminates.

WING ANTI-ICE ABOVE FL 200

Sudden changes in bleed air demands at high altitude may cause HI-PRESS bleeds to open too rapidly and cause overpressure or high flow trips of the pneumatic system with resultant loss of cabin pressure. The following procedure will avoid this condition.

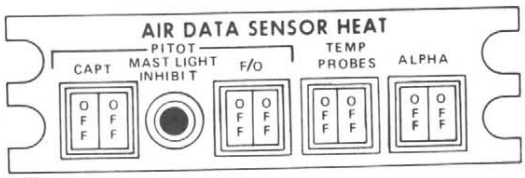
PRIOR TO USING WING ANTI-ICE ABOVE FL200:

1. LATCH PNEUMATIC CROSSBLEEDS
2. UNLATCH ANY TWO HI PRESS SWITCHES
3. LATCH WING ANTI-ICE
4. *WHILE OBSERVING DUCT PRESSURE:* LATCH HI PRESS SWITCHES (ONE-AT-A-TIME). Allow duct pressure to stabilize prior to latching each HI PRESS switch.

Should an overpressure occur (BLEED DUCT OV PRESS or High Flow Trip) refer to Pneumatic Abnormal Procedures.

AIR DATA SENSOR HEAT

Each of the four switches on the Air Data Sensor Heat Panel controls heat to two probes. For this reason, each switch incorporates a split OFF legend. Each of the OFF legends on a switch refers to its respective probe.



Temperature Probes

These two OFF lights illuminate if there is no current flow to the heater element in their respective probe. The light does not reflect switch position.

Pitot Heat

Each Pitot Heat Switch powers four heaters in two probes.

- One heater is in each probe while the second is in the mast supporting the probe. Loss of current to either heater causes the OFF lights to illuminate for the Pitot system.
- It is possible to determine which of two heaters has lost power by pressing the Mast Inhibit Button. This causes OFF to extinguish if it was caused by the Mast Heater.
- If OFF illumination was caused by the probe heater, the light stays illuminated after the Mast Inhibit Button is pressed.

Alpha Heat

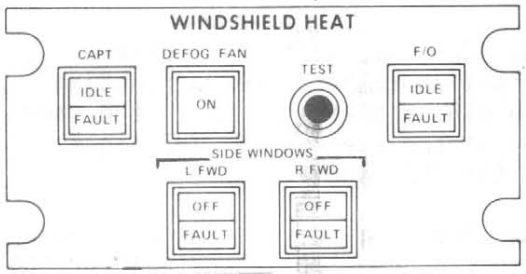
The Alpha Probe Heat is maintained by a cycling thermal switch within the probe. Since the current to the heater is cycling on and off, a system such as described for the Pitot system would result in the OFF lights cycling on and off as the heater cycled.

- To preclude this, a second thermal switch is installed.
- As long as the probe is heated, the temperature is maintained at and the secondary thermal switch is closed to keep the OFF light(s) from illuminating.
- If the probe is too cool, the secondary switch opens and OFF illuminates.
- OFF will generally remain illuminated for a short time after the ALPHA Probe Heat Switch is initially latched.

WINDSHIELD HEAT

The windshield heat system operates in two basic modes - Idle and Normal.

- In the Idle Mode (switch unlatched), the IDLE light is illuminated and low temperature preheating of the panes is provided.
- In the Normal Mode (switch latched), pane temperature is automatically controlled to normal operating temperature. During normal system operation, no lights will be illuminated. The FAULT light will illuminate if the system malfunctions.
- Overheat protection is provided to automatically limit maximum pane temperature if the normal system fails. Intermittent illumination of a FAULT light indicates the system is operating in the Overheat Mode. (Steady illumination of the FAULT light indicates that insufficient heat is being applied. (See Abnormal Procedures.)



Windshield Heat Test

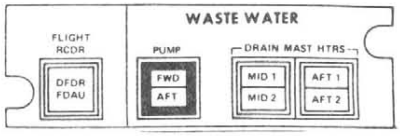
To test windshield heat system:

- Latch all windshield heat switches.
- Press and hold TEST. All four FAULT lights should flash continuously. If any FAULT light fails to illuminate, or illuminates steady, a system failure is indicated.

DRAIN MAST HEATERS

Each drain mast, MID and AFT, is provided with two heaters. Heater No. 1 is selected by latching its respective Drain Mast Heater switch. Heater No. 2 is selected by unlatching the respective switch.

If MID or AFT DRAIN MAST HTRS light illuminates, see Abnormal Procedures.



WINDSHIELD RAIN REPELLENT

The pressure gauge indicates the pressure remaining in the removable container. If gauge is in the green band, pressure should be adequate for normal system operation.

Anytime the REFILL float indicator is fully visible in the window, the fluid container must be replaced.

Rain repellent fluid must not be sprayed on dry windshield panels since undiluted fluid reduces visibility and may cause staining or minor corrosion of aircraft skin. (Operation of the windshield wipers under this condition will further reduce visibility by smearing the fluid).

The length of time the fluid remains effective depends upon rain intensity, airspeed, etc. Fluid applications may be necessary approximately every 2 to 5 minutes under conditions requiring use of the rain repellent fluid.

NOTE: Rain repellent fluid should not be applied to both windshields simultaneously.

WINDSHIELD WASHER

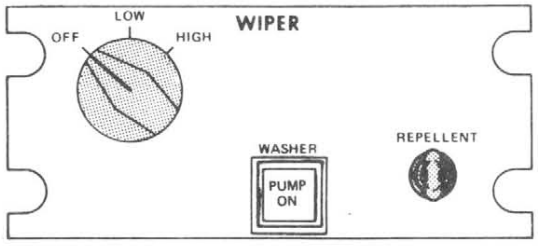
The windshield washer system is used to spray washer fluid on the left and right windshield panels and the windshield wipers are then operated to clean the outer glass, when required. As the windshield washer pump is a No-Go item, under certain conditions, its operation must be carefully observed to avoid continuous running of motor.

Two manually operated flow control knobs, one on the Captain's side console and one on the First Officer's side console, allow each pilot to control the volume of washer fluid sprayed on his windshield panel. Normally, this knob should be set approximately at mid-position.

NOTE: This knob must not be used as an ON/OFF control for windshield washer fluid. Turning the knob to full off position stops the fluid flow but leaves the pump motor running.

When the WASHER PUMP ON switch is pressed and ON illuminates:

- The pump operates and continues to operate until switch is again pressed and ON extinguishes.



END

(OPPOSITE SIDE BLANK)

ICE/RAIN PROTECTION

GENERAL DESCRIPTION

WATER/WASTE DRAIN HEATERS

The electrical circuit for the waterline heater under the center wingbox is disabled in flight. The circuit is disabled to reduce the fire hazard should center section fuel leak into the area. In flight, air from the MESC is passed through a steel shroud that surrounds the waterline. This prevents waterline freezing in flight.

VHF ANTENNA MAST ANTI-ICING

Not installed.

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TAILSKID 2

- **TAILSKID Light** 4

TRUCK POSITIONER 10

- **TRUCK Light** 4/10

-500 DIFFERENCES (BLUE PAGES)

Tailskid (not installed) 1

CROSS REFERENCES

Hydraulic Power Sources ..... **HYDRAULIC SECTION**

GENERAL

Normal extension/retraction of the landing gear is electrically controlled and hydraulically powered by hydraulic system C. Nosewheel steering is also provided by hydraulic system C.

Main gear brakes with full anti-skid protection are normally powered by hydraulic system B. An alternate brake pressure source, complete with independent anti-skid protection, is provided by hydraulic system C.

LANDING GEAR EXTENSION/RETRACTION

The landing gear lever, located on the center instrument panel provides electrical control for the normal hydraulic operation of the gear by hydraulic system C. In addition to the UP and DOWN positions of the lever, a NEUTRAL position is provided which isolates the landing gear from hydraulic system C.

A back-up means of extending the landing gear is provided by three mechanical release handles. All three handles mechanically release the respective uplock to allow the gear to free-fall. The NOSE & BYPASS mechanical release handle also positions a bypass valve which removes C system pressure from all gear retraction and extension lines, and ports fluid in the lines to return.

An additional gear extension method is provided by the ALTERNATE HYDRAULIC EXTENSION switch. This switch is only used if the gear will not extend and lock after pulling the mechanical release handles. Actuating this switch ports ALT SYS C brake accumulator pressure, through independent lines, to release all the gear uplocks to permit the gear to free fall and then pressurizes the down lock actuators.

TAILSKID

A retractable tailskid and shock strut is mounted on the bottom of the aft fuselage. The landing gear lever provides electrical control for the extension and retraction of the tailskid. With the landing gear lever UP, hydraulic system A retracts the tailskid into the up and locked position. With the landing gear lever DOWN hydraulic pressure unlocks the tailskid and air pressure in the strut extends it. With the gear lever in NEUTRAL the tailskid is isolated from the hydraulic system.

On takeoff or landing, tailskid contact will occur when pitch attitude exceeds approximately 12.5°.

LANDING GEAR LEVER

Three position lever that electrically controls the hydraulic extension and retraction of the landing gear and tailskid.

UP - Landing gear and tailskid are retracted.

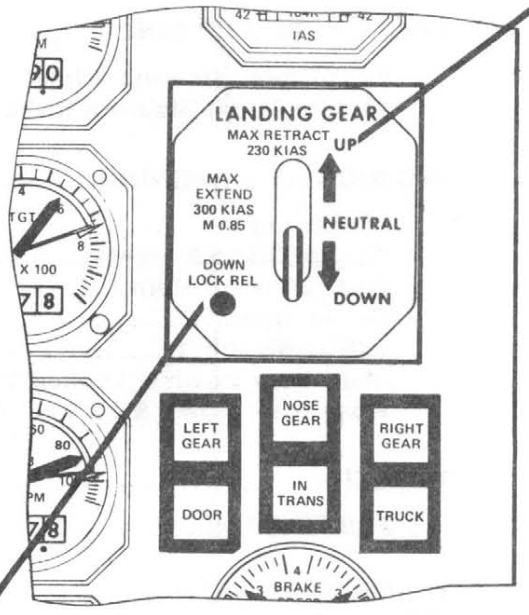
NEUTRAL - Normal flight position after landing gear is fully retracted.

- Landing gear and tailskid are isolated from their respective hydraulic systems.

DOWN - Landing gear and tailskid are extended.

- Anti-skid system is armed and can be tested.
- Lever must be pulled out before it can be placed to UP or NEUTRAL.
- Lever is locked in DOWN position when air/ground sensing signals an on ground condition, or if a main gear truck is not level.

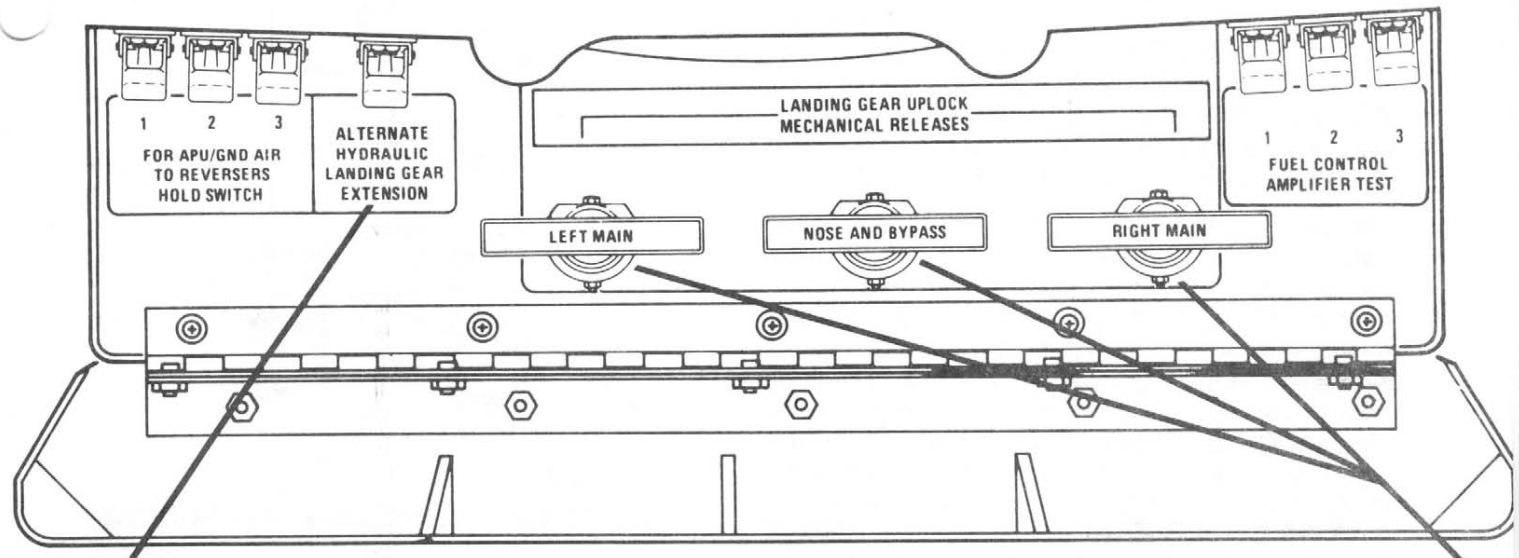
2F17, 18 - GEAR CONT
2F12 - TAIL SKID CONT



CENTER INSTRUMENT PANEL

DOWN LOCK REL BUTTON

Pushbutton which manually releases gear lever down lock to permit gear retraction if normal release fails after liftoff. Unless a greater emergency exists, refer to the Abnormal Procedures before pressing the button to override the down lock release.



ALTERNATE HYDRAULIC EXTENSION SWITCH

Guarded two-position switch that provides alternate means to hydraulically release the uplocks to permit the gear to free-fall, and to power the downlock actuators over-center.

- Used only when any gear fails to extend or lock down after pulling the mechanical release handles.

When actuated:

- The alternate extension valve is electrically opened to port fluid from the ALT SYS C brake accumulator through independent lines leading to the uplock releases and downlock actuators.
- Main gear doors remain open; nose gear doors close by the action of the gear going into the down and locked position. The three green down and locked lights, DOOR and IN TRANS lights on the center instrument panel, and LH GEAR OR DOOR and RH GEAR OR DOOR lights on the S/O's Annun. Panel will be illuminated.

1L14 - ALTN GEAR CONT

LANDING GEAR UPLOCK MECHANICAL RELEASES

Mechanically releases the uplocks to permit gear to free-fall to the down and locked position.

- The NOSE AND BYPASS handle must be pulled approx. seven inches. Each MAIN handles must be pulled approx. nine inches.
- With a MAIN handle pulled the respective main gear doors will remain open after the gear is down.
- The nose gear doors are mechanically closed by the action of the gear going into the down and locked position. Air loads on the doors may prevent the nose gear from locking into the down position until airspeed is reduced to as low as 190 KIAS.
- When all three handles are pulled the three green down and locked lights, DOOR and IN TRANS lights on the center instrument panel, and LH GEAR OR DOOR and RH GEAR OR DOOR lights on the S/O's Annun. Panel will be illuminated.
- If the normal landing gear lever is locked in the UP position the NOSE & BYPASS handle must be pulled first to port all hydraulic fluid to return to prevent fluid from being trapped in any cylinder.

When the NOSE AND BYPASS handle is pulled:

- MAIN handles will now operate regardless of the position of the normal landing gear lever.
- Nosewheel steering is inoperative.
- Do not re-stow NOSE AND BYPASS handles or gear may retract upon landing.

LANDING GEAR MECHANICAL RELEASE AND ALTERNATE EXTENSION CONTROLS
BASE OF CENTER CONSOLE

LANDING GEAR POSITION AND WARNING

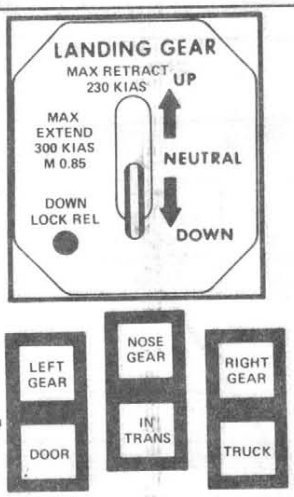
Proximity sensors are used to monitor the position of the landing gear, gear doors, main gear trucks and tailskid, and provide air/ground sensing on each gear. Proximity sensors operate by generating a magnetic field which is disrupted by a 'target' when the device is in the correct position.

The gear position and warning lights are located below the landing gear lever. Each of the three green lights illuminate only when the respective gear is down and locked. The red DOOR light illuminates when any door is open, and the red IN TRANS light illuminates when any gear **or** door position disagrees with the position selected by the landing gear lever. Three **GEAR OR DOOR** lights on the S/O's Annunciator Panel are provided to determine which gear or door is the cause of the DOOR or IN TRANS light. The amber TRUCK light illuminates when either main gear truck is not level.

A TAILSKID light on the S/O's Annunciator Panel illuminates anytime the tailskid makes ground contact, or its position disagrees with the position of the Landing Gear Lever.

A mechanical indicator is also provided on each gear to verify when the gear is down and locked. The nose gear visual indicator consist of two rods which align when the gear is down and locked. These rods can be seen through a view lens located on the aft bulkhead of the Forward Avionics Compartment. The main gear visual indicators are cylinders which protrude above their respective wings near the fuselage when the gear is down and locked. These cylinders can be seen through the mid-passenger compartment windows.

Unless all landing gear are down and locked, a warning horn will sound when any throttle is retarded at airspeeds below 180 KIAS (silenceable), or if flaps are positioned to 33° (unsilenceable).



CENTER INSTRUMENT PANEL

GEAR LIGHTS

LEFT GEAR, NOSE GEAR, RIGHT GEAR **LIGHTS (GREEN)** - Illuminates when respective gear is down and locked regardless of lever position.

DOOR **LIGHT (RED)** - Illuminates when any gear door is open. Respective GEAR OR DOOR light illuminated on S/O's Annun. Panel identifies which gear is affected.

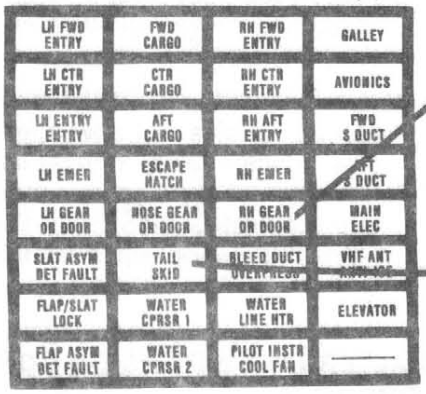
IN TRANS **LIGHT (RED)** - Illuminates when any door is open or any gear position disagrees with position selected by landing gear lever.

- Remains extinguished with landing gear lever in NEUTRAL provided all landing gear are up and all doors are closed.

TRUCK **LIGHT (AMBER)** - Illuminates when either main gear truck is not level.

- Landing gear lever is locked in DOWN position while light is illuminated.
- Normally illuminates momentarily at touchdown and liftoff.
- May illuminate during taxi if a tire is low.

1L10, 11 - PROX SW PWR
1L13 - DOOR POS IND
2F16.- TRUCK LEVEL
3H3, 4 - PROXIMITY SWITCH



S/O'S INSTRUMENT PANEL

GEAR OR DOOR LIGHTS (AMBER)

Respective light illuminates when doors or gear are not in the position selected by the gear lever.

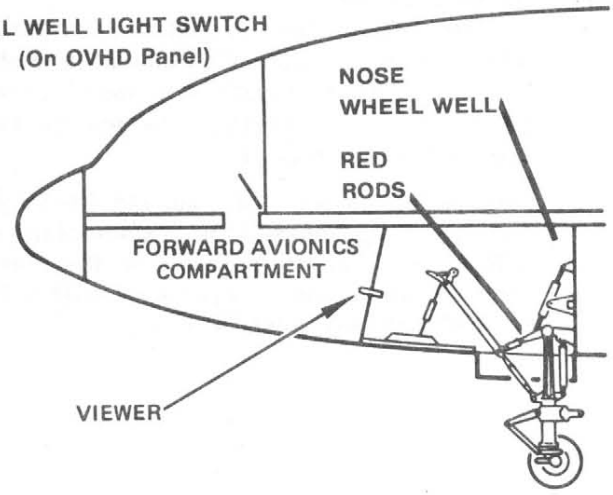
- IN TRANS will be illuminated on the center instrument panel and DOORS will be illuminated and/or one or more green down and locked lights extinguished.

1L10, 11 - PROX SW PWR NO. 1
1L13 - LANDING GEAR DOOR POS IND

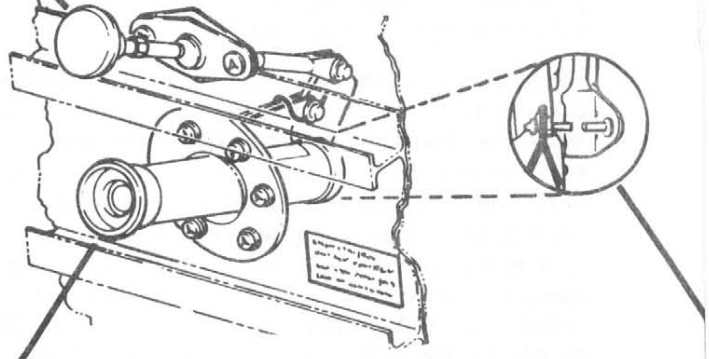
TAILSKID LIGHT

Illuminates when tailskid is not in the position selected by the landing gear lever, or following any ground contact of the tailskid.

1L13 - LANDING GEAR POS IND
2F13 - TAIL SKID IND
3H4 - PROXIMITY SWITCH 3



VIEW LENS COVER RELEASE KNOB
Pull to remove dust cover from view lens.

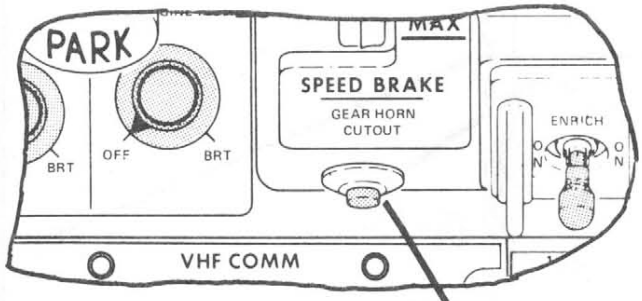


NOSE GEAR VIEW LENS

- Used to check nose gear down and locked visual indicator.
- Mounted on aft bulkhead of Forward Avionics Compartment.
- Access to compartment is through hatch in the cockpit floor.

NOSE GEAR DOWN & LOCKED VISUAL INDICATOR

- Two red rods align within one rod diameter when nose gear is down and locked.
  WHL WELL switch on EXTERIOR LIGHTS panel must be **ON** to view indicator, and view lens cover release knob pulled to view indicator.

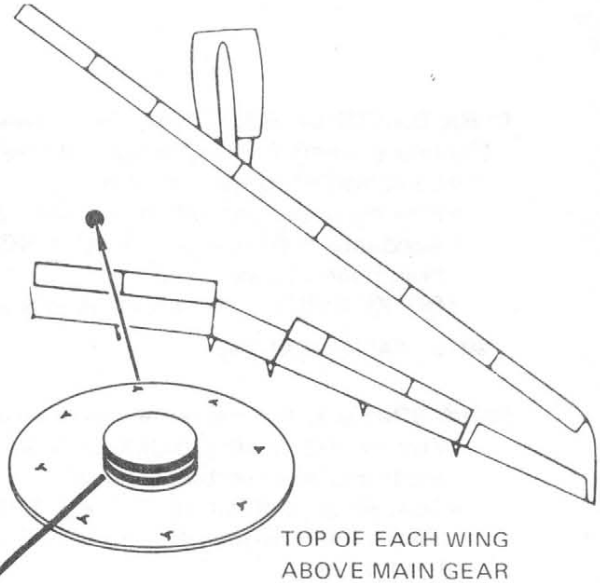


GEAR HORN CUTOUT BUTTON
Press to cancel silenceable gear warning horn.

GEAR WARNING HORN
Sounds to indicate gear is not down and locked when:

- Any throttle is retarded at airspeeds below 180 KIAS. This warning can be silenced.
- Flaps are positioned to 33° or more. This warning cannot be silenced.

1L12 - WARN HORN



TOP OF EACH WING
ABOVE MAIN GEAR

MAIN GEAR DOWN & LOCKED VISUAL INDICATOR
Protrudes above wing when respective main gear is down and locked. At night the WG FLOOD lights can be used to view indicator.

LANDING GEAR POSITION VISUAL AND AURAL INDICATORS

BRAKES

There are two separate and independent main gear braking systems. The normal brake system is powered by hydraulic system B and alternate brakes by hydraulic system C.

Each brake system has an accumulator to provide braking in the event of hydraulic system failure. With the anti-skid system OFF, 'B' system accumulator provides approximately 4 brake applications and 'C' system accumulator approximately 10 applications. The C system accumulator is considerably larger since it also provides the power to hydraulically extend and lock the landing gear when the ALTERNATE HYDRAULIC LANDING GEAR EXTENSION switch is actuated. A BRAKE SYS SELECT switch is located on the bottom right section of the center instrument panel to permit the crew to select NORM SYS B or ALT SYS C brakes.

During gear retraction, pressure is applied through hydraulic system C to stop wheel rotation. Air/ground sensing prevents normal brake application while airborne.

Hydraulic fuses are installed to prevent total system fluid loss in the event of a fluid leak in the lines leading to the brakes.

PARKING BRAKE

A PARK BRAKE knob is installed on the Capt.'s side of the center console. Pulling the knob, while holding the brake pedals depressed, closes the brake return line and traps the applied pressure from hydraulic system B.

Parking brakes are not available from hydraulic system C. Regardless of the position of the BRAKE SYS SELECT switch, pressure to the brakes will automatically revert to hydraulic system B when the PARK BRAKE knob is pulled.

PARK BRAKE LIGHTS (RED) (2)

Illuminate when parking brakes are set provided:

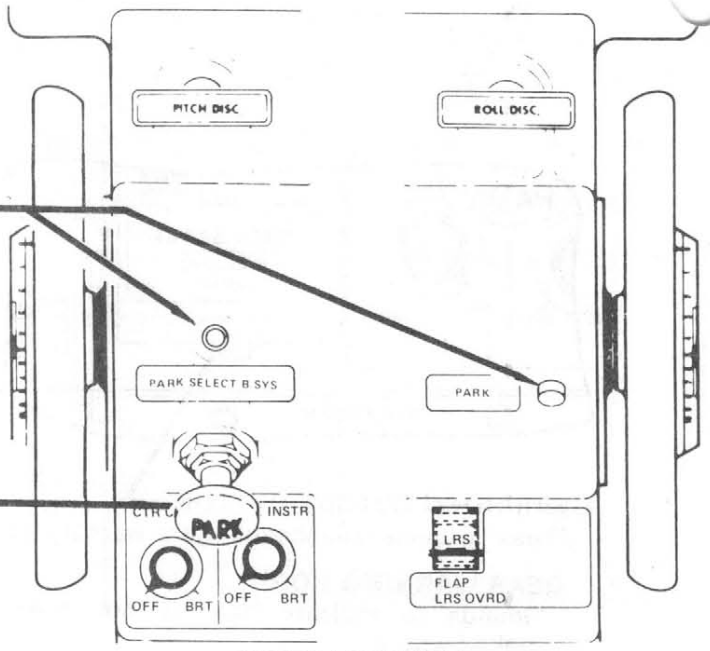
- Landing Gear Lever is DOWN.
- Parking brake shutoff valves have closed.
- Adequate pressure is trapped in NORM SYS B brake lines to assure brakes.
- BRAKE SYS SELECT switch is in NORM SYS B.

2G18 - PARKING BRAKE

PARK BRAKE KNOB

- Set by depressing brake pedals; pull PARK knob and release brake pedals.
- Overrides position of BRAKE SYS SELECT switch and provides NORM SYS B pressure to the brakes.
- Anti-skid is disarmed and OFF illuminates on the ANTI-SKID panel. ANTI-SKID also illuminates on the Pilot's Annun. Panel.
- Release by pressing both pedals and knob will return to stowed position.

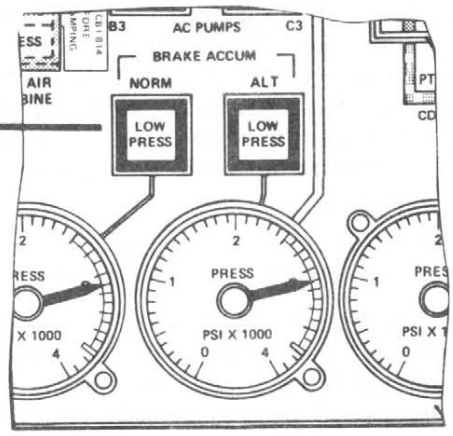
2G18,22 - PARKING BRAKE



CENTER CONSOLE

BRAKE ACCUM LIGHTS (AMBER) (2)

- LOW PRESS illuminates to indicate that respective accumulator pressure is too low to assure adequate braking.
- LOW BRAKE PRESS illuminates on the Pilot's Annun. Panel when either LOW PRESS light illuminates.



S/O'S HYDRAULIC PANEL

BRAKE PRESS INDICATOR

- Displays hydraulic pressure in the brake accumulators.
- Left needle (B) indicates pressure in the NORM SYS B accumulator. Right needle (C) indicates pressure in the ALT SYS C accumulator.
- Normal pressure is 3,000 PSI. When pressure is too low to assure adequate brakes the respective BRAKE ACCUM LOW PRESS light on the S/O's panel and the LOW BRAKE PRESS light on the Pilot's Annun. Panel illuminate.

2G21 - PRESS IND

BRAKE SYS SELECT SWITCH

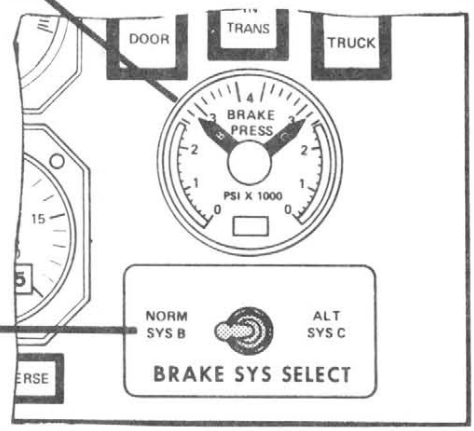
Provides means of selecting hydraulic supply and anti-skid system to be used.

NORM SYS B - Selects B hydraulic system to brakes.
- —Selects NORM anti-skid system.
- —With only B accumulator available approx. four brake applications may be made.

ALT SYS C - Selects C hydraulic system to brakes.
- —Selects ALT anti-skid system.
- —With only the C accumulator available approx. ten brake applications may be made.

- Switch must be in NORM SYS B to test either NORM or ALT anti-skid system.
- When PARK BRAKE knob is pulled, or if electrical power is lost, brakes will automatically switch to system B regardless of switch position.

2G18,22 - PARKING BRAKE



CENTER INSTRUMENT PANEL

ANTI-SKID

The NORM SYS B and ALT SYS C brake systems have separate anti-skid systems. Each system provides independent locked-wheel protection on every main gear wheel while optimizing the braking action on each wheel. The anti-skid system is capable of modulating pressure as required between full pressure and zero pressure to maintain optimum braking.

The ANTI-SKID control panel is located on the lower left side of the Pilot's overhead panel.

In order for the anti-skid system to operate:

- ANTI-SKID switch must be latched ON.
- Landing gear lever must be down.
- PARK BRAKE knob must be released.
- Main gear wheels must be in a spin-up condition.

To test the anti-skid system:

- ANTI-SKID switch must be latched ON.
- Landing gear lever must be down.
- PARK BRAKE knob must be released.
- NORM SYS B must be selected.
- DO NOT test the system while taxiing.

ANTI-SKID SWITCH

Provides control of anti-skid system.

LCH - Normal position from before takeoff until after landing. System is armed.

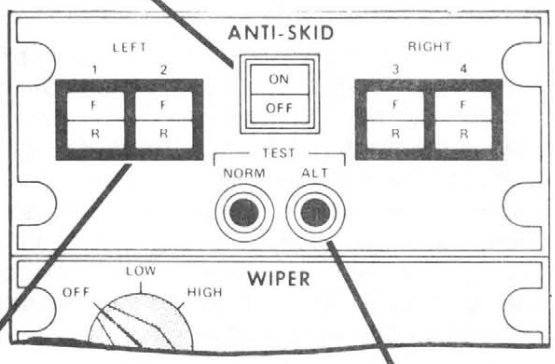
UNL - Normal position for ground operations. System is off.

ON (GREEN) - Illuminates when system is active.

OFF (AMBER) - Illuminates when system is disarmed or shutoff by:
- —Unlatching ANTI-SKID switch.
- —Setting PARK BRAKE.
- —System failure.

- Both lights extinguish when gear lever is in UP or NEUTRAL.
- **ANTI-SKID** illuminates on the Pilot's Annun. Panel when **OFF** illuminates.

2F22 - ANTI-SKID
2G17 - ANTI- SKID IND



OVERHEAD PANEL

ANTI-SKID LIGHTS (AMBER) (8)

- Individual lights illuminate to indicate the anti-skid sytem has released brakes on the affected wheel to prevent a skid. May also illuminate to indicate system failure.
- All lights should illuminate during NORM or ALT TEST to verify anti-skid protection is available to each wheel.

2F22 - ANTI-SKID

TEST NORM & ALT BUTTONS

- Provides means of testing the anti-skid system for both normal and alternate brakes.
- All (8) amber anti-skid lights and the green **ON** light should illuminate when either NORM or ALT button is pressed, provided:
  - —Landing Gear Lever is DOWN.
  - —BRAKE SYS SELECT is in NORM SYS B.
  - —ANTI-SKID switch is latched.
  - —PARK BRAKE is released.

2G17 - ANTI-SKID IND
2G18,22 - PARKING BRAKE

TRUCK POSITIONER

Maintains truck perpendicular with strut while the aircraft is in flight. This position is required for proper gear retraction.

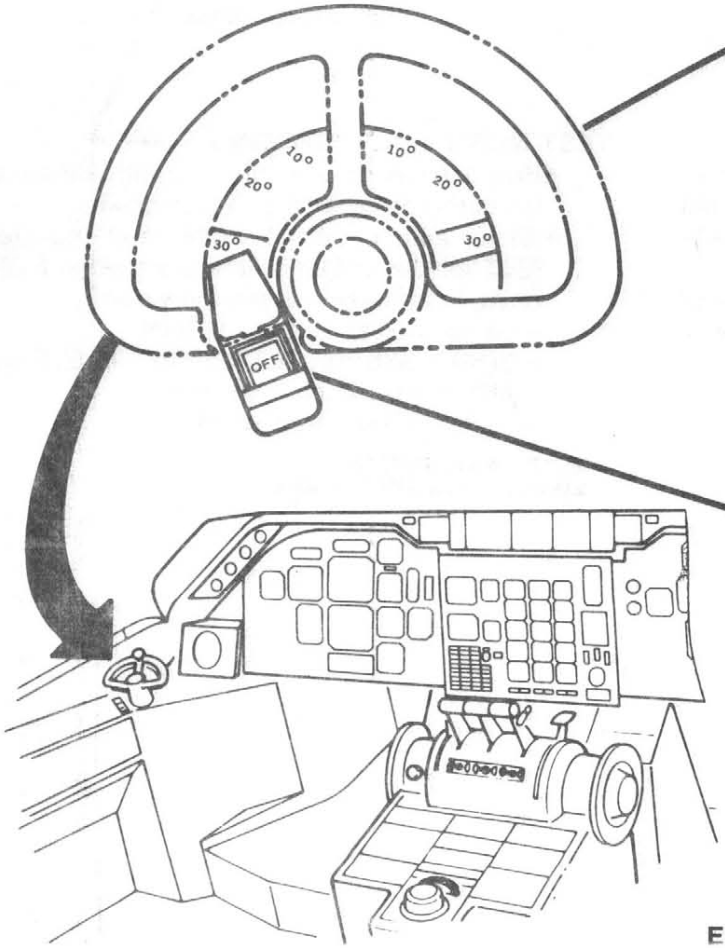
When either truck is not level the TRUCK light, below the landing gear control, illuminates. It is normal for TRUCK to illuminate at rotation and at touchdown. Illumination during taxi may indicate a deflated tire. The landing gear lever is locked in the DOWN position while TRUCK is illuminated. To prevent damage to the wheel wells, the abnormal procedures prohibit overriding the DOWN LOCK REL, if TRUCK is illuminated, unless a greater emergency exists.

The truck positioner uses hydraulic system C pressure. Anytime the landing gear is down and hydraulic system C pressure is lost, airloads may cause the truck to tilt and the TRUCK light to illuminate. The auto ground spoiler system uses the tilted position of the truck as part of the air/ground sensing for auto-spoiler deployment on landing. For this reason procedures require that DLC/ AUTO SPLR switches be unlatched when hydraulic system C pressure is lost.

NOSEWHEEL STEERING

Nosewheel steering is powered by hydraulic system C through the nose gear down line. Nosewheel steering is normally controlled through the wheel located on the Capt.'s side console. Nosewheel steering can also be controlled through the rudder pedals. A RUDDER PEDAL STEERING disconnect switch is located beneath the steering wheel to arm and disarm the rudder pedal steering system.

The airplane must be on the ground with the nose gear strut compressed for nosewheel steering to operate.



NOSEWHEEL STEERING WHEEL

- Provides steering control of nosewheel while on the ground.
- Overrides rudder pedal steering.
- System is deactivated when:
  - Nose gear is centered by a centering cam at liftoff.
  - NOSE AND BYPASS mechanical release handle is pulled.
  - Landing gear lever is in UP or NEUTRAL.
  - 'C' system hydraulic pressure is lost.

2F19 - NOSE STEERING

RUDDER PEDAL STEERING SWITCH

Provides control of rudder pedal steering system.

UNL - Normal position from before takeoff until after landing. System is operative and nosewheel will steer in response to rudder inputs (only on the ground).

LCH - Normal position for ground taxi operations System is off and OFF illuminates.

2F19 - NOSE STEERING

END

LANDING GEAR

GENERAL DESCRIPTION

TAILSKID

Not installed.

Subject: OMEGA NAVIGATION SYSTEM INSTALLATION

File in L-1011 Pilot's Operating Manual
Book II, NAVIGATION in front of Page 1.

OMEGA/VLF NAVIGATION SYSTEM (ONS)

The ONS is a worldwide, all-weather radio navigation aid which provides accurate aircraft position, navigation and guidance necessary for long range navigation.

Each ONS System consists of the following:

Receiver Processor Unit (RPU)
Control Display Unit (CDU)
Antenna Coupler Unit (ACU)

A single ONS system will be installed on six L-1011-1 aircraft. This is a temporary installation until the fall of this year when additional units become available for dual OMEGA systems. The system is not capable of auto pilot coupling and flight director commands should be considered invalid for navigation with OMEGA selected.

Position determination and navigation are available once the system has been activated and present position, time, and date (GMT) have been entered. Flight Plan waypoints may be entered on the ground or in flight.

Navigation is accomplished by selecting the RADIO/OMEGA toggle switch to OMEGA and tuning a VOR frequency. Desired course, cross track deviation, R-NAV annunciation, and OMEGA NAV flag will be displayed on the Captain's HSI only.

A blue light located above the RADIO/OMEGA switch will illuminate any time the switch is in the OMEGA position. Selecting an ILS frequency will drop OMEGA displays from the Captain's HSI, but will not change the RADIO/OMEGA switch to the RADIO position.

OPERATIONAL CAPABILITY SUMMARY:

In controlling and operating the system, the pilot is able to:

Store a great circle navigation flight plan.

Update the flight plan prior to or during flight by:

1. Waypoint Bypassing
2. Waypoint Change (Addition, Deletion)
3. Flight Path Track Change (Course Deviation)

Display navigation and guidance data on the CDU relative to the stored flight plan such as:

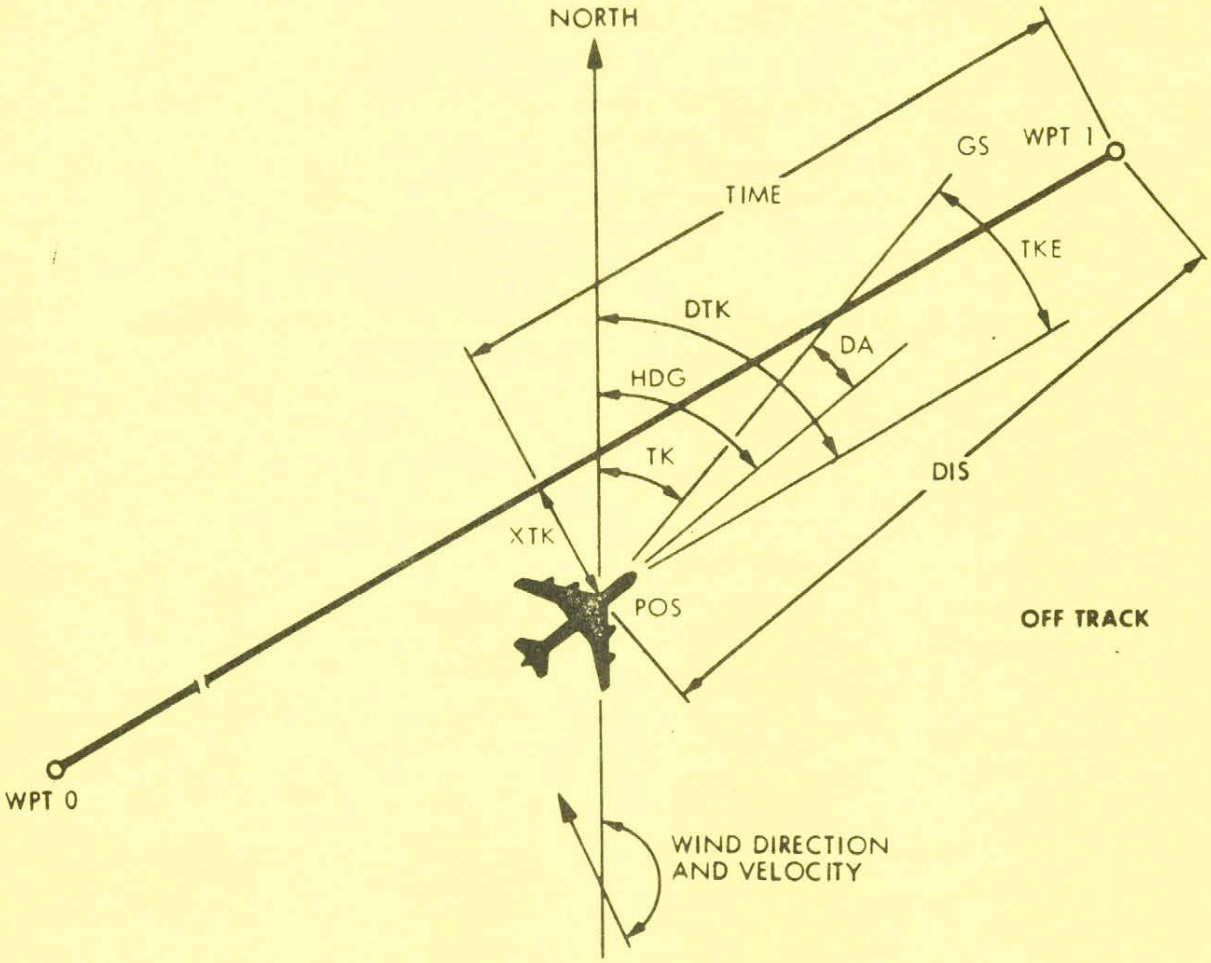
1. Track angle and ground speed.
2. Heading and drift angle.
3. Cross-track distance and track angle error relative to the desired track.
4. Present position coordinates.
5. Waypoint positions coordinates.
6. Distance and time to any waypoint.
7. Distance and time between any two waypoints.
8. Total distance and flying time remaining in flight plan.
9. Desired track.

Display navigation heading information on Captain's HSI.

Fly parallel offsets from the flight plan.

Fly the aircraft on a specified ground track.

GENERAL DESCRIPTION



The following navigation measurement terms are used with the OMEGA NAVIGATION SYSTEM (ONS). The computed values are displayed on the ONS CDU or on the Captain's HSI.

TK – Actual ground track as measured clockwise from magnetic north.

GS – Ground Speed.

HDG – Heading is the angle between magnetic north and the aircraft center line.

DA – Drift angle is the angle between aircraft heading and ground track.

XTK – Crosstrack distance is the shortest distance between the aircraft's actual ground track and desired ground track.

TKE – Track angle error is the angle between the airplane's actual ground-track and desired ground track. It is equal to the desired track angle minus the ground-track angle.

POS – Present position is computed position of the aircraft expressed in latitude and longitude.

DIS – Is the great circle distance with respect to aircraft position and the next selected waypoint.

WIND– Direction of wind with respect to true north.

DTK – Desired track angle is the great circle flight path on the earths surface connecting two successive waypoints; it is measured with respect to magnetic north.

TAS – True airspeed.

ONS NAVIGATION DATA

CONTROLS & INDICATORS

HEADING CURSOR

In MAG, indicates heading selected by APFDS Heading Selector.

COURSE CURSOR

In RAD indicates VOR or LOC course selected.

In ONS indicates desired track.

COURSE DISPLAY

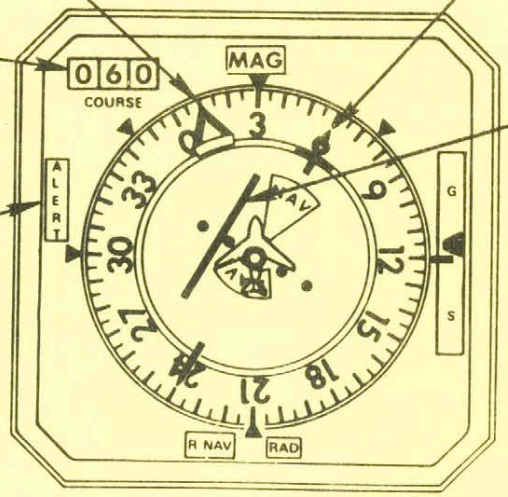
Indicates course selected by APFDS course selector.

DEVIATION BAR

In ONS indicates cross-track error. One dot = 3.75 NM.

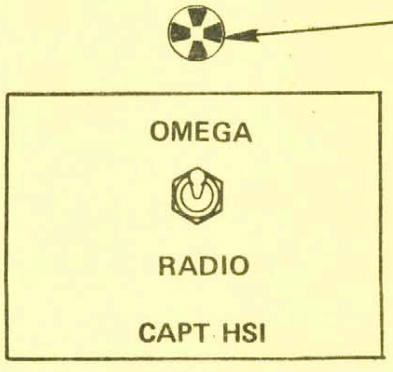
ALERT LIGHT

Illuminates 2 minutes prior to next ONS waypoint.



RNAV (ONS navigation displayed)

HORIZONTAL SITUATION INDICATOR WITH OMEGA SELECTED



LAMP (Blue)

Illuminates whenever switch is in the OMEGA Position.

OMEGA NAV MODE SWITCHING
PILOT'S CENTER CONSOLE

OPERATING MANUAL

CONTROLS & INDICATORS

LEFT NUMERICAL DISPLAY

Displays GMT, latitude, track, heading, cross track distance, distance, wind direction, desired track, magnetic heading as selected by the DISPLAY SELECTOR.

RIGHT NUMERICAL DISPLA

Display date, longitude, ground speed, drift angle, track angle error, time and speed, system status, true airspeed as selected by the DISPLAY SELECTOR.

FROM/TO AND WAYPOINT DISPLAY

Displays the flight leg for which data is being computed. With DISPLAY SELECTOR IN WPT, the number set in the thumbwheel appears in the TO display.

WAYPOINT SELECTOR SWITCH

A thumbwheel switch used to select the waypoints for which data is to be inserted or displayed when DISPLAY SELECTOR is in WPT.

MODE SWITCH

OFF – Removes electrical power.

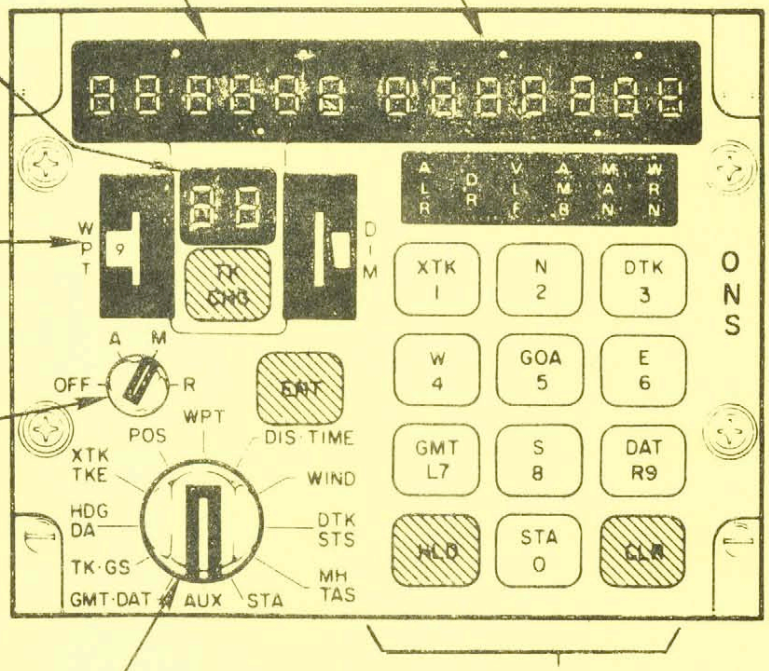
A (auto) – Provides sequential track leg changes automatically and permits manual override.

M (manual) – Permits manually initiated track leg changes.

R (remote) – Enables remote ranging features.

DISPLAY SELECTOR SWITCH

Selects data for presentation on LH and RH numerical displays.



DATA KEYBOARD PUSHBUTTONS

Used for manual entry of:
- Present Position.
- Waypoint Coordinates.
- FROM–TO Waypoints.
- Time, Date, Track Hold and Auxiliary Functions.

HLD (Hold) Pushbutton – Permits position check and position update.

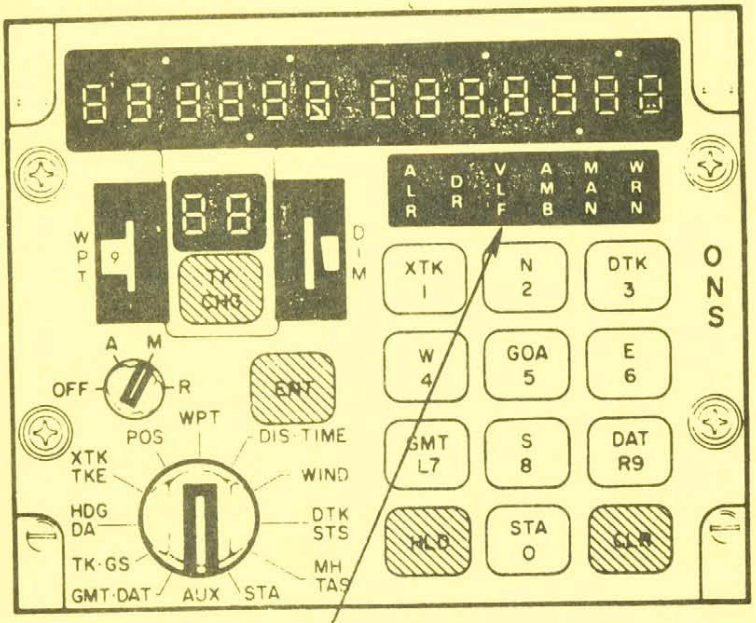
CLR (Clear) Pushbutton – Clears displayed date if not yet entered, or clears system of entered data if error was made in data entry routine.

ENT (Enter) Pushbutton – Transfers data entered via the keyboard into the system computer.

TK CHG (Track Change) – When pressed allows initiation of manual track leg change.

ONS CONTROL DISPLAY UNIT
PILOT'S CENTER CONSOLE (SHEET 1)

CONTROLS & INDICATORS



ANNUNCIATORS

ALR (alert amber)
Illuminates when 2 minutes from waypoint; flashes .5 minutes from waypoint when in Manual (M) Mode.

DR (Dead Reckoning – amber)
After system turn on following present position entry – goes out when system reaches NAV status (01 displayed on two least significant digits of RH numerical display with Display Selector set to DTKSTS).

Illuminate whenever OMEGA navigation capability is lost – remains on until NAV status (01) is regained.

Illuminates In-flight – When power is interrupted for more than 7 seconds but less than 7 minutes. Also, if power is interrupted for less than 7 seconds and NAV status is not regained within 2 minutes.

VLF Annunciator (amber) –
Comes on whenever the system is operating with signals from VLF stations as the primary navigation source.

AMB (Ambiguity – amber) –
Illuminates when OMEGA position ambiguity is detected and goes out when ambiguity disappears. If ambiguity does not disappear, pilot can initiate relaning (DR illuminates). The AMB and DR go out when relaning is completed.

MAN (Manual - amber) - Illuminates when manual entries are made in TAS, mag heading (if on, WRN goes out) or crosstrack offset to indicate these values have been manually entered. MAN remains illuminated until the manual entries are set to zero.

WRN (Warning - red)

Steady illumination indicates system failure.

A flashing WRN may indicate the following:

Insufficient data entry.
Loss of TAS, mag hdg or both.
Power interrupt of 7 secs but less than 7 minutes.
No sync within 3 minutes.
Failure of subassembly self-test.

ONS CONTROL DISPLAY UNIT
PILOT'S CENTER CONSOLE (SHEET 2)

OMEGA GROUND SETUP

LIGHT TEST:

1. MODE SW----------To A	Observe a 5 second test display which may be retained by setting DISPLAY SELECTOR to AUX and WPT thumbwheel to 9. Verify the following: - All 8s in LH, RH, and FROM-TO displays, except the most significant digit of RH display which is R. - Degree, decimal points and minute, NS, EW illuminate. - TK CHG, ENT, HLD and CLR buttons and ALR, DR, VLF, AMB, MAN and WRN annunciators illuminate.

PRESENT POSITION ENTRY:

1. DISPLAY SELECTOR----------POS	Verify model 211 appears in LH display
2. PRESENT POSITION----------ENT	a. PRESS N or S button. ENT illuminates. b. Load present position latitude. - Check correctness of entry. - Press ENT. c. Press W or E button. d. Load present position longitude. - Check correctness of entry. - Press ENT. - DR annunciator illuminates. NOTE: ENT remains illuminated until GMT and DATE are entered.

TIME AND DATE ENTRY:

3. DISPLAY SELECTOR----------GMT-DAT	
4. GMT (L7) BUTTON----------PRESS	LH display all blanks.
5. TIME (GMT)----------ENTER	Verify entry is correct. - Press ENT.
6. DAT (R9) BUTTON----------PRESS	RH display all blanks.
7. MONTH/DAY/YR (GMT)----------ENTER	Verify entry is correct. - Press ENT. - Check ENT extinguished, DR remains illuminated. NOTE: Time and date entry must be GMT and DAY must have 2 digits (i.e. 5-01-80) to allow ONS to automatically select radio stations for navigation.

8. ONS WAYPOINTS----------LOAD	a. DISPLAY SELECTOR----------WPT b. WPT SELECTOR----------1 Verify FROM is blank and a 1 is displayed in TO. NOTE: WPT 0 is reserved for establishing a track from aircraft present position and cannot be used for WPT entry. c. Repeat waypoint loading procedure for remaining waypoints (2, 3, 4 etc.). If more than 9 waypoints are required, load remaining waypoints enroute.
9. DISPLAY SELECTOR----------DTK/STS	Check status code numbers on RH display. Code 01 should appear within 5 to 8 minutes from system turn on indicating OMEGA NAV mode. DR will extinguish when code 01 is achieved.

INFLIGHT PROCEDURES

INITIAL TRACK SELECTION:

1. MODE SW----------A	
2. TK CHG BUTTON----------PRESS	Verify [TK CHG] and [ENT]. - Press 0 and number of initial enroute waypoint. - Check selected waypoint appears in FROM-TO display.
3. [ENT] BUTTON----------PRESS	Initiates ONS track, ENT and TK CHG extinguish.
4. ANY VOR FREQUENCY----------SELECT	No. 1 VHF NAV must have a VOR frequency selected before ONS data can be displayed on the Captain's HSI.
5. RADIO/OMEGA----------OMEGA	Blue light above switch illuminates. - HSI course pointer will now display ONS desired track and deviation bar cross track deviation. - R NAV is displayed on the HSI.
6. APFDS----------HDG	Using information off the HSI or ONS CDU, fly desired track using heading selector.

Additional procedures, Enroute Track Change, Track Hold, Offset, Position Check, etc., see Pilot Operating Manual supplied by the manufacturer (LITTON, IND.).

HEADING REFERENCE SYSTEM

The two compass systems consist of the following:

- Flux valve
- Directional gyro (DG)
- Compass coupler
- Compass controller
- Horizontal situation indicators (HSI)

The No. 1 system provides heading information for the captain's HSI and the first officer's radio digital distance magnetic indicator (RDDMI). The No. 2 system provides inputs to the first officer's HSI and the captain's RDDMI. Either system can be operated in the MAG or free DG mode.

Compass Coupler

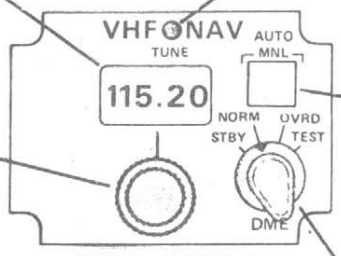
The compass coupler selects either the magnetic heading information from the flux valve or the compass information from the DG and produces usable signals for the flight instruments and AFCS.

Compass Controller

The compass controller consists of a mode selector switch, heading control, and sync indicator. The selector switch allows operation in either the MAG or DG mode. The set heading control is a five position, slow/fast rotary switch and can be operated in both MAG and DG modes. The indicator provides visual indication of synchronization in MAG mode.

FREQUENCY DISPLAY WINDOW

TUNE LIGHT
Illuminates when panel is in autotune mode and FMS computer is tuning or attempting to tune VHF NAV radios.



1K21 - VOR 1
1J22 - VOR 2

VHF NAV RADIO PANEL (2)
(GLARESHIELD)

FREQ. SELECTOR KNOBS
Concentric knobs. The outer knob selects digits to the left of the decimal point. The inner knob selects digits to the right of the decimal point.

When an ILS frequency is selected the corresponding GS frequency is also selected.

1H1 - VHF DC VOR RCVR, PREAMP
1H19 - VHF DC VOR RCVR, PREAMP

AUTO-MANUAL SWITCH
Alternate action switch

ENGAGED - drops "AUTO" flag over the frequency window and places frequency control of VOR and DME to the FMS computer.

DME SELECTOR SWITCH

STBY - Receiver operating but not transmitting. Four dashes in RDDMI window indicates no computed data.

NORM - Usable to 200 nm

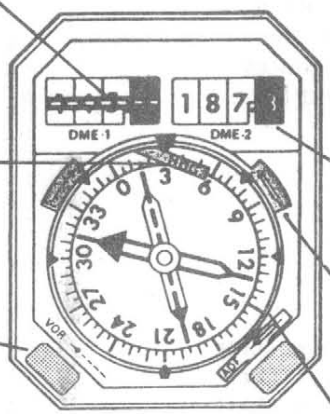
OVRD - Usable to 400 nm

TEST - DME fail flag, followed by four dashes, followed by four zeros in RDDMI window indicates satisfactory test.

DME FAIL FLAG
Four white dashes over distance display indicates no computed data. Orange and white barber pole indicates DME receiver failure.

HEADING FAIL FLAG (ORANGE)
Indicates compass card or complete signal failure.

RDDMI SELECTOR SWS (2)
Alternate action pushbutton switches. Push to select either ADF or VOR. The selection is shown above the switch in the shape of the respective VOR or ADF pointer.



RDDMI (2)
PILOTS' INSTRUMENT PANEL

1E20 - CAPT'S RDDMI
1E3 - F/O'S RDDMI
1K25 - RDDMI 1
1J20 - RDDMI 2

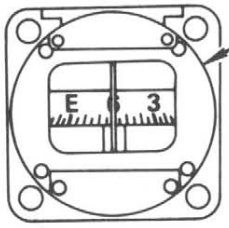
DISTANCE INDICATOR WINDOWS
Indicates slant range distance to selected VORTAC stations.

VOR/ADF FAIL FLAGS
Respective VOR or ADF signal input has failed.

COMPASS CARD
Rotates to indicate aircraft heading against heading index and relative bearing to selected VOR or ADF stations against VOR and ADF pointers. Capt's compass card is operated by compass No. 2. F/O's compass card is operated by compass No. 1.

VHF NAVIGATION RADIO AND RDDMI CONTROLS

CONTROLS & INDICATORS



MAGNETIC STANDBY COMPASS

WINDSHIELD CENTER POST

MAG/DG SWITCH

IN - MAG is illuminated to indicate that all heading system information is magnetic heading data.

OUT - DG is illuminated to indicated that all heading system information is true heading data and is operating as a gyro compass with no magnetic corrections.

PILOT'S OVERHEAD PANEL

1G5, 23 - DIR GYRO

HEADING SET CONTROL

Five position rotary switch used to slew the compass cards.

First index left or right is for slow alignment. Full over left or right is for faster alignment of sync indicator.

ALIGNMENT SYNC INDICATOR

Indicates sync condition of gyro and flux valve when operating in the MAG mode.

COMPASS CONTROL PANEL (2) AND MAGNETIC STANDBY COMPASS

HEADING INDEX
Indicates magnetic heading on compass card.

HEADING POINTER
Indicates APFDS heading selected.

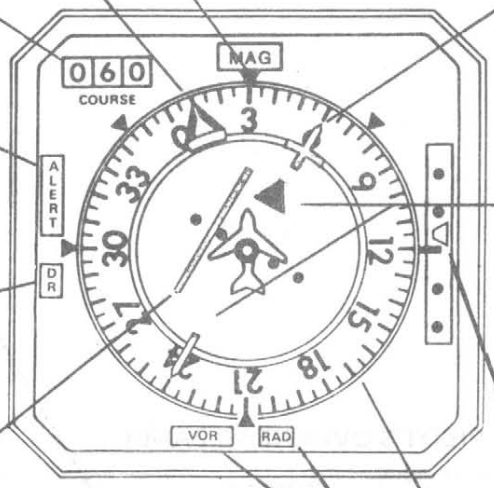
COURSE DISPLAY
Indicates VOR course selected, or FMS/ONS desired track.

ALERT LIGHT
Illuminates whenever the FMS or ONS is approaching a waypoint change.

DEAD RECKONING DR
Illuminates whenever the FMS or ONS is computing a course between a from and to waypoint and not receiving valid NAVAID signals.

DEVIATION BAR
Displays VOR, LOC, or NAV course deviation. One dot deviation indicates:

VOR - 5°
LOC - 1¾°
NAV - 3.5 miles



NAV SYSTEM SOURCE DATA INDICATORS
Indicates which navigation system is providing the display. The sources of navigation data are:

LEFT
ILS - Instrument Landing System
VOR - VHF omni range
NAV - Navigation mode

RIGHT
RAD - Radio
FMS - Flight Management System
ONS - Omega Navigation System

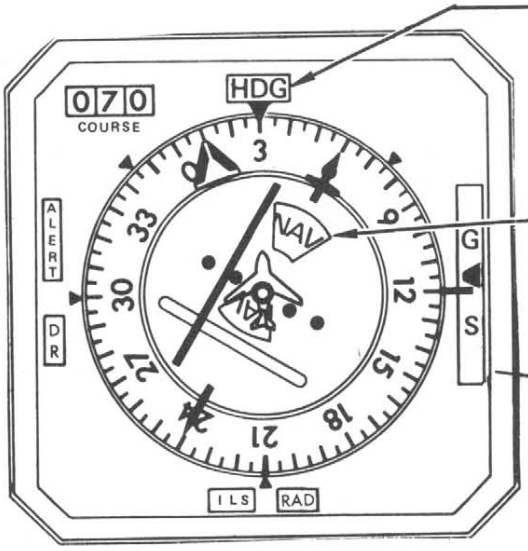
COURSE POINTER
Indicates VOR course as selected by the navigation mode selector panel, or FMS/ONS desired track.

TO-FROM POINTER
Appears at nose or tail of course pointer to indicate selected course is TO or FROM the station or waypoint.

GLIDE SLOPE DISPLAY
Glide slope scale and bar appear when LOC frequency is selected. One dot = ¼° scale appears when FMS is selected but bar is biased from view.

HSI COMPASS CARD
Captain's card receives information from mag. heading system No. 1 F/O's card receives information from mag. heading system No. 2.

HORIZONTAL SITUATION INDICATOR (2)
(PILOT'S INSTRUMENT PANEL)

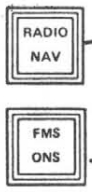


HEADING FAIL FLAG (ORANGE)
Heading annunciator flag HDG covers window when selected source is unreliable.

NAV LEGEND FAIL FLAG (ORANGE)
Indicates failure of HSI power or invalid navigation input.

GLIDE SLOPE FAIL FLAG (ORANGE)
GS fail flag covers GS scale if signal is weak or the receiver fails. Also covers scale if FMS vertical deviation portion fails.

HSI INFORMATION SWITCHES



Alternate Action - In RADIO, VOR/ILS information is displayed. In NAV, FMS or ONS information is displayed.

Momentary Action - Extinguished when RADIO/NAV switch is in RADIO. When RADIO/NAV switch is in NAV, FMS or ONS illuminates to indicate which NAV source will be displayed on HSI.

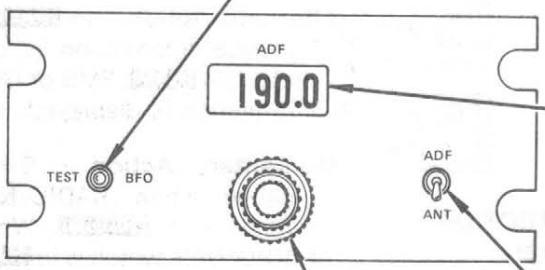
HSI - CIRCUIT PROTECTION
1F3 - CAPT HSI
1F21 - F/O HSI

HORIZONTAL SITUATION INDICATOR FAIL FLAGS
(PILOT'S INSTRUMENT PANEL)

BEAT FREQUENCY OSCILLATOR (BFO) AND TEST SWITCH

BFO – When BFO is selected a tone is heard while signal is being received. Tone changes in volume in proportion to signal strength. The tone allows unmodulated CW keying to be heard.

TEST – Drives selected ADF pointer to 9 o'clock position to indicate a successful self-test.



FREQUENCY WINDOW

Displays the selected frequency.

FREQUENCY SELECTOR

Three concentric knobs. Large knob controls 100's, middle knob controls 10's and small knob controls units and 1/10 ths.

ANTENNA SELECTOR SWITCH

Two position toggle switch

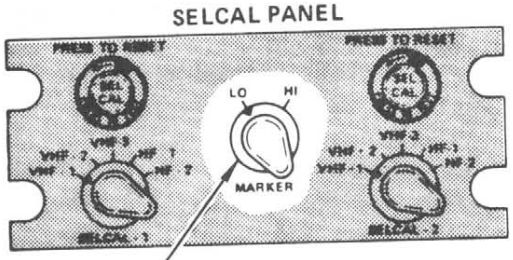
ADF – Selects both loop and sense antennas. RDDMI pointers will indicate the bearing to a selected station.

ANT – Selects only the sense antenna for range reception. RDDMI pointer will rest in the 3 o'clock position while ANT is selected.

ADF PANELS

CONTROLS & INDICATORS

SELCAL PANEL



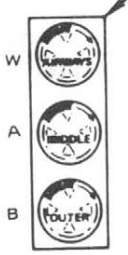
MARKER BEACON SENSITIVITY SWITCH

Two position rotary switch that selects degree of marker beacon sensitivity.

LO – Low sensitivity to more sharply define marker beacon fix.

HI – High sensitivity to ensure reception.

MARKER BEACON LIGHTS

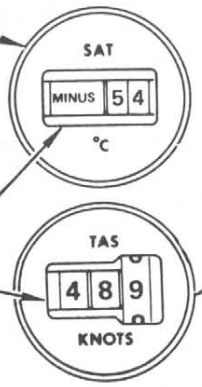


AIRWAYS, MIDDLE, OR OUTER lights flash when aircraft is over respective marker beacon transmitter and essential master radio switch is on. Flashing light is accompanied by an identification tone. Lights are pushed to self-test the bulbs. Marker beacon HI or LO sensitivity switch is located on the SELCAL panel. A marker beacon switch is located on each audio select panel.

1D7 - MARKER BEACON

STATIC AIR TEMP

Computed by ADC No. 2. Range –99° C to 50° C.



FAIL INDICATION

Orange warning off flag covers indicator with power or signal loss.

TRUE AIRSPEED

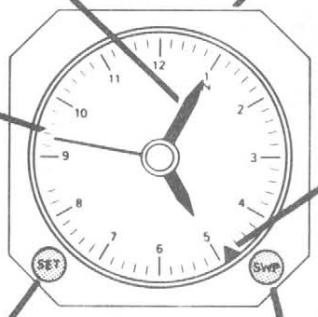
Computed by ADC No. 2. Range 150 to 650 knots.

1G27 - SAT/TAS

MARKER BEACON LIGHTS
AND FLIGHT DATA
PILOT'S INSTRUMENT PANEL

CLOCK (2)
The Captain's, First Officer's, and Second Officer's stations are equipped with sweep second, 12-hour clocks.

MINUTE HAND
One revolution equals one hour.



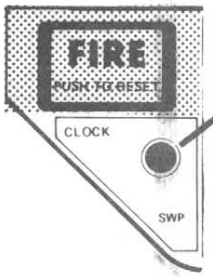
SWEEP SECOND HAND
One revolution equals one minute

12 MINUTE SWEEP BUG
Functions the same as the sweep second hand except that readout is in minutes. One revolution equals 12 minutes.

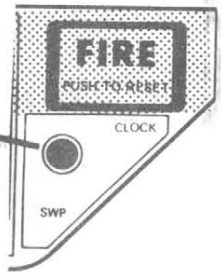
SET KNOB
To set hour and minute hands, pull then rotate.

SWEEP TIME CONTROL PUSHBUTTON
Pressing the momentary alternate action pushbutton starts the sweep second hand and 12 minute sweep bug. Pressing the button a second time resets the hand and but to zero (12 o'clock) position.

CAPTAIN'S



FIRST OFFICER'S



PILOTS' REMOTE SWEEP TIME CONTROL PUSHBUTTONS

Operates the same as the sweep time pushbutton control on the pilots' clocks. Captain's pushbutton will not operate First Officer's clock and vice versa.

NOT INSTALLED SHIPS 738-741

GLARESHIELDS

CONTROLS & INDICATORS

The No. 1 Transponder is energized whenever the AC standby bus is powered. The No. 2 Transponder is energized by the No. 2 master radio switch.

MODE SELECTOR SWITCH

Two position rotary switch used for type of air traffic control use.

A – Domestic identification position

B – International identification position

TRANSPONDER SELECTOR SWITCH

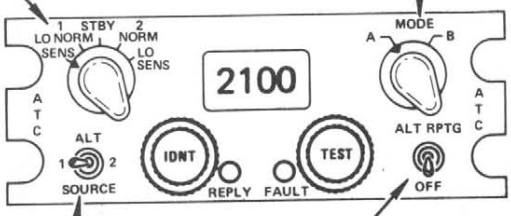
Five position rotary switch that selects the No. 1 or No. 2 transponders and their functions.

NO. 1
LO SENSE – Selects No. 1 transponder with LO SENSE function. This position is used at request of ATC controller to prevent excessive brightness on radar scope when aircraft is close to ground station.

NO. 1
NORM – Selects No. 1 transponder with NORM function for reception of interrogation and transmission of reply.

STBY – Both transponders are turned on in the warmup mode, but are not operating.

The NO. 2 LO SENSE and NORM positions operate the same as for the NO. 1 system except that the NO. 2 transponder is selected and operating.



ALTITUDE SOURCE SWITCH

Two position toggle switch that selects altitude source.

1 – NO. 1 ADC supplies data for altitude reporting.

2 – NO. 2 ADC supplies data for altitude reporting.

ALTITUDE REPORTING SWITCH

Two position toggle switch that selects altitude reporting.

ALT RPTG - Energizes altitude reporting system

OFF – Turns altitude reporting system off.

1G3 - ATC No. 1
1G21 - ATC NO. 2

ATC TRANSPONDER PANEL - SHEET 1
(CENTER CONSOLE)

CODE INDICATOR WINDOW

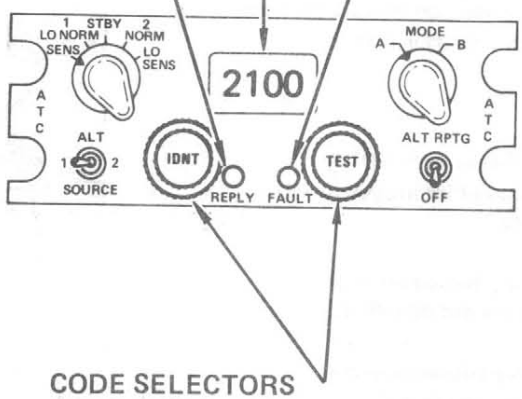
Displays code set by code selector

REPLY LIGHT (BLUE)

Reply light flashes when either transponder is transmitting a reply after interrogation, or when TEST button is pressed.

FAULT LIGHT (AMBER)

Fault light illumination indicates an internal failure of transponder selected.



CODE SELECTORS

Rotary knobs used to set transponder codes which appear in code indicator window.

IDENT – Momentary pushbutton switch concentric within left code selector. Pressing switch provides an additional pulse reply for positive identification upon request from ATC controller.

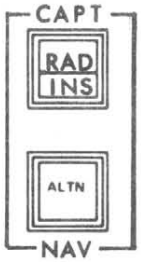
TEST – Momentary pushbutton switch concentric within right code selector. Pressing switch causes REPLY light to illuminate.

ATC TRANSPONDER PANEL – SHEET 2
(CENTER CONSOLE)

CONTROLS & INDICATORS

RADIO/INS SWITCHING (SHIP 724)

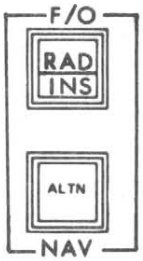
Provide means of selecting either VOR or INS navigation information to the HSI's and NAV mode of APFDS.



HSI OPERATION

RADIO - provides magnetic heading information to Captain's HSI, F/O's RDDMI. Course bar presents VOR data.

INS - provides true heading to Captain's HSI. Course bar presents INS 1 data. F/O's RDDMI still receives magnetic heading and VOR/ADF information.



HSI OPERATION

RADIO - provides magnetic heading information to F/O's HSI, Captain's RDDMI. Course bar presents VOR data.

INS - provides true heading to F/O's HSI. Course bar presents INS 2 data. Captain's RDDMI still receives magnetic heading and VOR/ADF information.

NOTE:
HSI remains in MAG HEADING if localizer frequency selected on VHF NAV panel.

NAV ALTN SWITCHES

Normal position unlatched, lights out. When switch is latched ALTN , INS 3 data is supplied to the HSI only, provided the respective RADIO/INS switch is in INS . Only one pilot may select ALTN at a time.

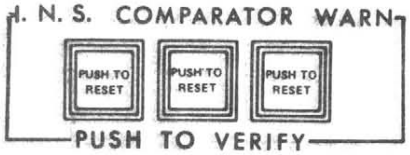
APFDS NAV MODE SWITCHING (SHIP 724)

Either or both RADIO/INS switches in INS - When APFDS NAV mode is selected, L-NAV appears in APFDS Modes Annunciators. No. 1 INS supplies computer "A", and No. 2 INS supplies Computer "B". However, if NAV is already engaged and operating in RADIO Mode (VOR annunciated) at the time the RADIO/INS switches are placed in INS , VOR remains annunciated and the APFDS continues to use radio information until NAV is disengaged then re-engaged. Also, if localizer frequency is selected on VHF NAV panel, autopilots will not engage while RADIO/INS switches are in INS .

- Both RADIO/INS SWITCHES IN RADIO - APFDS NAV mode uses VOR data. However, if NAV is already engaged and operating in INS mode (L-NAV annunciated) at the time RADIO/INS switches are placed in RADIO , L-NAV remains annunciated. NAV continues to use INS information until NAV is disengaged then re-engaged, and VOR appears in APFDS Modes Annunciators.

INS COMPARATIVE WARNING SYSTEM (SHIP 724)

System alerts the crew to check INS navigation if the three INS computers disagree in present position by more than a preset value. Illumination of a light does not necessarily indicate a computer failure. Unit is active while the three computers are in ALIGN and NAV modes.



PUSH TO RESET LIGHTS -
Illuminates when affected INS computer present position output disagrees with two other INS present position outputs by more than 3 miles plus 3 miles for every hour of computer operation.

Push-to reset to extinguish the light. Light will illuminate again whenever it is pressed as long as the present position of the INS disagrees with the other two beyond the preset values.

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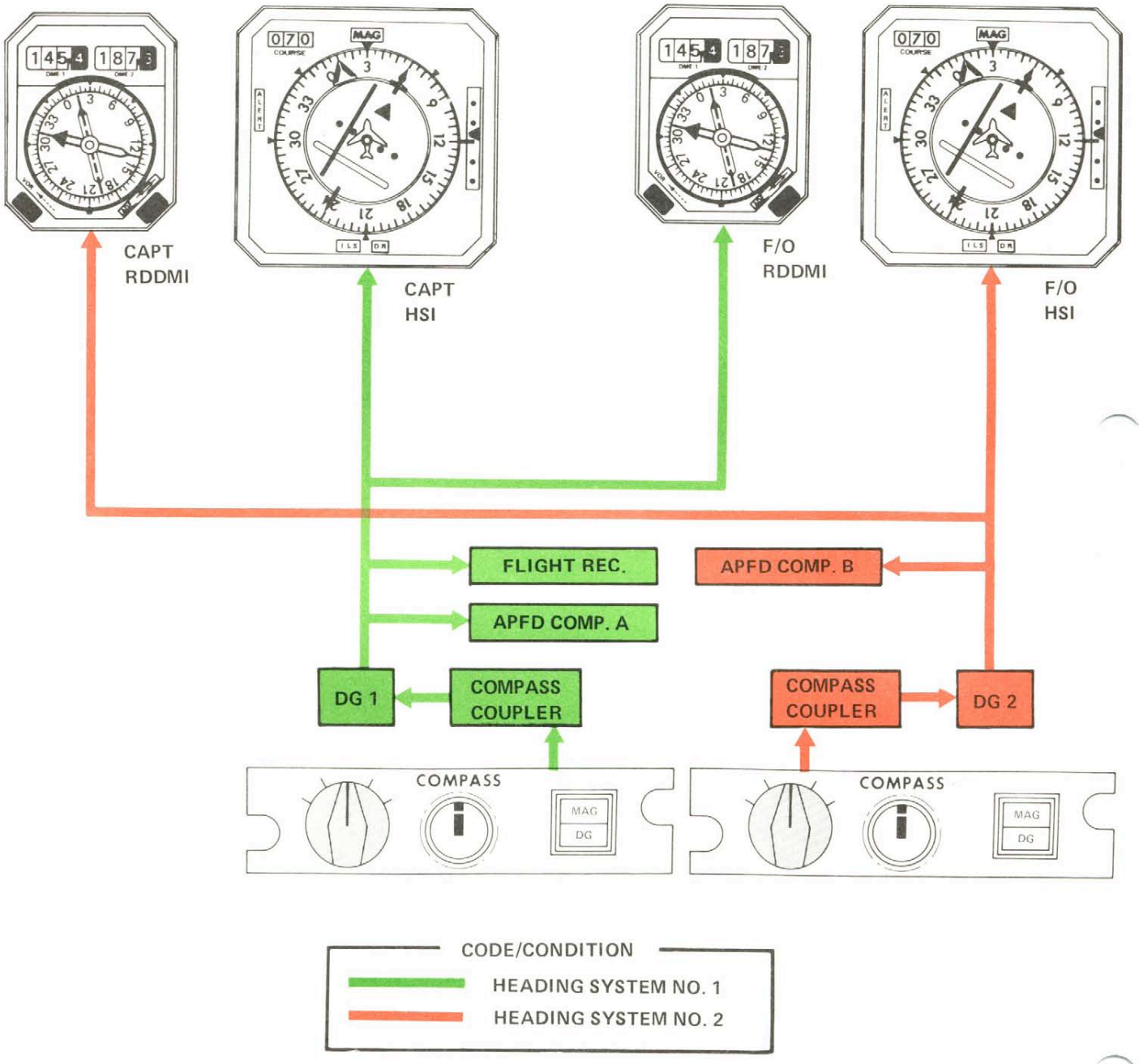


COMPASS HEADING SYSTEM

Ships 751-756

Ships 738-741

NAVIGATION

GENERAL DESCRIPTION

HEADING REFERENCE SYSTEM

Two heading reference systems are installed. Each system provides selection of a magnetic heading, sensed by a compass system, or an optional true heading, which is furnished by the Inertial Navigation Systems (INS). The No. 1 system provides heading information for the captain's Horizontal Situation Indicator (HSI) and the first officer's Radio Digital Distance Magnetic Indicator (RDDMI). The No. 2 system provides inputs to the first officer's HSI and the captain's RDDMI.

Either magnetic or true heading is selectable by using the HSI Heading switch on the master radio panel. To display reference on the HSI, the HSI HEADING switch must be in TRUE and the RADIO NAV switch must be in NAV. Any other combination of these switches results in the HSI compass card being referenced to magnetic. The RDDMI compass cards are referenced to magnetic in all cases.

NOTE: With FMS operational, waypoints are not loaded in the INS. See FMS procedures.

Magnetic heading stabilization is accomplished by use of platform heading input from the INS. This input also serves to provide a directional gyro reference when the system is operated in the DG mode.

INERTIAL NAVIGATION SYSTEM (INS)

Three INSs are installed. Each INS system consists of the following:

- Inertial Navigation Unit (INU)
- Control and Display Unit (CDU)
- Mode Select Unit (MSU)
- Battery unit
- Radio/NAV switching

Each system is configured to operate independently when the Flight Management System (FMS) is not operational. When the FMS is available and in use, however, the INS is integrated with the automated navigation function of the FMS.

Certain functions of the INS are always independent, such as pitch and roll attitudes, which are provided to the APFDS, weather radar, flight recorder, speed control system, and Attitude Direction Indicator (ADI).

Each INS CDU will display information inserted by the crew, and it will compute and display all the various parameters associated with INS navigation. The No. 1 and No. 2 INS will provide, on the respective HSI, a visual display of the horizontal situation relative to the intended flightpath; each will also supply APFDS steering information for automatic guidance along the intended flightpath. The No. 3 INS can be selected to provide navigational data to either HSI by latching the ALTN NAV switch on either Instrument Source Select panel.

The overall system is designed for the INS to supply position, heading, and velocity to the FMS for its use in refining position and flight data (waypoint paris). This refined data is then supplied to update the INS.

Ground Setup

Before flight, initial position and waypoints are inserted. Alignment starts when the Mode Select switch of the MSU is positioned to ALIGN. Alignment cannot be completed until present position is inserted separately into each INS. Alignment requires a nominal 15 minutes, during which time the aircraft must not be moved. Waypoints for INS 3 must be loaded by using the NO. 3 CDU. Waypoints for INS 1 and 2 may be loaded by using either INS CDU or the FMS.

NOTE: With the FMS operating, and the AUTO-MAN switch on INS 3 in MAN, the FMS will supply waypoint pairs to INS 3 as long as FROM-TO indicator displays 1-2.

Flight

Each INS has two general modes of operation. The NAV mode is preferred when the INS is functioning properly. When INS fails, navigation information becomes unusable, and the ATT mode can then be selected on the respective MSU. In this mode the INS continues to furnish pitch and roll attitude and platform heading to the using equipment.

FLIGHT MANAGEMENT SYSTEM (FMS)

The FMS comprises two major operational functions, which are as follows:

- Automated navigation
- Performance management

The two simultaneous functions are conceptually separate, except that performance management depends on stored and computed navigation data for certain performance management features, such as descent. The FMS computes lateral navigation, using available combinations of VOR, DME, INS, and air data. Performance management optimizes aircraft performance by

precisely controlling speeds, altitudes, and thrust settings to minimize aircraft costs, while assuring fuel conservation.

The FMS consists of a single flight management computer and two Control and Display Units (CDUs). The CDUs give the crew access to the computer for data insertion and for readout of stored and computed information. The FMS CDUs are different from those units associated with the INSs.

Inertial Navigation System (INS)

Although the INSs may operate independently of the FMS, the FMS may be utilized to increase accuracy of the INSs. For this to occur, position, heading, and velocity outputs of the three INSs are furnished to the FMS. Slight disagreements between the INSs are reconciled in the FMS and combined with available VOR/DME information to provide a refined computation of position. Updated information is then returned to the No. 1 and No. 2 INSs for display on the HSIs, and for steering commands to the APFDS.

Waypoint-pair information is also furnished to the INS by the FMS. When the INS is in operation with the FMS, flight plan waypoint information is set up by the crew in the FMS only. Initial position inputs for the INSs must be individually hand-loaded by the crew to prevent a possible incorrect initialization. The FMS must then continuously inform INS 1 and 2 of current From and To waypoints, which change with each waypoint switchover as the To waypoint is reached. Waypoints must be manually loaded into INS 3.

Using the refined information suplied by the FMS, the INSs provide steering and guidance to the APFDS, exactly as they do when operating independently.

VHF NAV

VOR and DMF equipment is also used by the FMS to refine the aircraft position. Both VOR bearings and DME distances are supplied to the FMS. With the flight plan and the geographical location of ground stations along the flight plan set up in the FMS, the computer determines feasible stations at any given time, automatically tunes the VHF NAV receiver to select stations, tests the signal, and utilizes the valid signals. On the basis of relative ground station positions, the computer then uses the best combination (i.e., VOR/DME or DME/DME) to determine a position based on radio inputs. The combination of radio and INS position data provides a highly accurate navigation system.

System Use

The flight plan is set up in the FMS through either CDU. Present position, destination, and intermediate waypoints are inserted, and the INSs are aligned. During flight, VOR/DME stations within reception range along the route are selected from the FMS memory or are inserted via the CDU. The FMS continuously computes the most probable present position by weighing all valid information from the three INSs and the VOR/DMEs. This information, along with the From/To waypoint pairs, is returned to the No. 1 and No. 2 INSs, which in turn provide steering and guidance to the APFDS.

Performance Management

The basic objective of performance management is operating economy. Based on manual and automatic inputs for gross weight, fuel weight, altitude, speed, etc., the FMS computes optimum parameters for controlling flight in a manner related to fuel conservation or cost and provides inputs to the AFCS for maintaining speed to achieve this objective.

Initial setup is made by the crew through either FMS CDU. Thereafter, the computer accepts information from engines, CADCs, etc. In flight, speed is maintained through appropriate application of autothrottles and pitch changes commanded through the APFDS for an optimum tradeoff of altitude control and throttle activity. The performance management operating modes are climb, cruise, step-climb, and descent.

CLIMB

During climb the FMS uses pitch to control airspeed according to any IAS/Mach climb schedule commanded. In addition, it controls the engines, through the Thrust Management (TM) mode of the autothrottle system, to any selected climb thrust schedule. Altitude holds are captured by using normal APFDS altitude select procedures. The system switches to cruise control upon interim altitude hold engagement and holds the selected climb IAS or Mach number in level flight. upon subsequent climb mode selection, the selected climb speed and EPR schedule are resumed.

The preset cruise altitude is captured by using the normal APFDS procedure for selecting ALT ARM. At cruise altitude capture, the FMS automatically switches to the cruise mode.

Ships 751-756

Ships 738-741

CRUISE

In the cruise mode, normal APFDS altitude hold is used for pitch, while throttles control speed according either to a selected Mach or IAS or to a computed optimum Mach, depending on the cruise option utilized. To minimize short-term throttle activity, small pitch bias commands are superimposed upon the APFDS altitude hold commands. The pitch bias commands are a function of Mach rate and are used to damp out short-term Mach excursions without affecting the throttle setting.

A turbulent-air feature is also provided in the cruise mode. The FMS senses rates of Mach-change, and when an index level is exceeded for a given time period, it activates the turbulent-air mode. The system then positions the throttles to the required EPR for the command flight condition and maintains this throttle setting until the turbulence decreases below the threshold level.

STEP-CLIMB

The FMS displays advisory information to assist the flight crew in the choice of a cruise altitude. The advisories consist of the optimum altitude advisory and the step-climb advisory. Optimum altitude is the altitude for optimum specific range, based on temperature, wind, and a projected weight/altitude profile. The step-climb advisory consists of an estimated time to begin the step-climb and wind-trade information, and it is based on an assumed step-climb of 4000 feet, unless a different altitude increment is manually entered. The wind-trade advisory provides a means of deciding if a step-climb is worthwhile on the basis of expected winds at the new altitude. Upon reaching the new altitude new step-climb advisories are initiated for a new step-climb based on a future optimum altitude.

DESCENT

The descent mode is programmed for a flight-idle descent, with the aircraft arriving at any predetermined geographical destination (latitude-longitude, waypoint, etc.) on altitude and on speed. This is accomplished by back-computing from the end-of-descent point (E*D) to determine the optimum top-of-descent point (T*D) based upon computer-stored aircraft performance parameters and the altitude and existing winds at cruise. To begin descent, APFDS altitude select procedure must be used to depart cruise altitude at the T*D point. Select APFDS V-NAV mode to control the decent.

The descent maneuvers consist of a gradual pushover to capture the Mach/IAS-hold schedule (using pitch commands, since all engines are at idle), and an altitude-capture/deceleration phase at the selected E*D altitude. The selected descent altitude is captured by using pitch axis commands. Normal APFDS altitude select and capture procedures are used to capture the final descent altitude.

V-NAV OPERATION

The FMS will not command the APFDS to depart any altitude. The APFDS altitude select procedure must be used to depart any captured altitude. Once the climb or descent is initiated the FMS will provide pitch commands (vertical guidance) through the APFDS V-NAV mode to provide selected aircraft performance.

Other Functions

Another feature of the FMS provides for the insertion of predicted windspeeds and direction at each waypoint in prestored or manually entered flight routes prior to takeoff. These, together with an average TAS, that can be keyed in, are used to calculate the estimated time en route (ETE) for each waypoint in the selected flight plan. After takeoff, the ETEs are switched to ETAs and continually updated, using actual winds encountered in flight.

CONTROLS AND INDICATORS

Ships 751-756

Ships 738-741

COMPASS CONTROL PANEL

MAG/DG Switch

In the DG position, indicated headings will be gyro headings, stabilized by the INS platform heading outputs.

CLOCK SWEEP AND CONTROLS

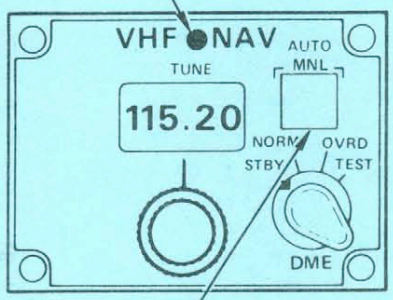
The remote clock sweep control switches for the Captain's and First Officer's clocks have been relocated to their respective miscellaneous lights control panel, except for Ships 738-741 which have no remote sweep controls.

VHF NAV RADIO PANEL

VHF NAV TUNE INDICATOR LIGHT

When AUTO has been selected with the AUTO/MNL switch, the FMS illuminates the VHF NAV tune indicator light to indicate that the VHF NAV radio is tuning automatically to an FMS-programmed frequency. The light goes out if the FMS accepts the radio information. If the radio information is rejected as invalid or of poor quality, another station frequency is selected, if available. After the last available station has been tuned, the light goes out if a satisfactory signal is not received within 45 seconds and is replaced with a CDU status warning.

When MNL has been selected with the AUTO/MNL switch, the FMS will not accept radio information, and the light should be extinguished.

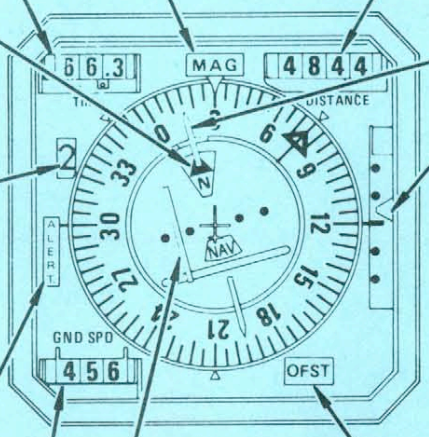


AUTO/MNL TUNING SELECTOR

IN (AUTO) - The VHF NAV radio will automatically tune frequencies sequenced by the FMS as needed en route.

OUT (MNL) - The radio must be manually tuned. The FMS will not accept inputs tuned manually.

HSI | Ships 751-756 | Ships 738-741



HEADING SOURCE ANNUNCIATOR

Indicates heading source.

MAG - Source is from compass system.

TRU - Source is from the INS.

HDG - Appears when selected heading source is unreliable.

TIME INDICATOR

Indicates time in minutes to next waypoint.

TO - FROM POINTER

Appears at nose or tail of course pointer to indicate selected course is to or from waypoint or station.

HSI NAV SYSTEM SOURCE INDICATOR

Normally, captain's HSI source data is from the No. 1 system, and the first officer's is from the No. 2 system.

If INS 3 is supplying either the captain's or first officer's HSI, 3 is annunciated.

ALERT INDICATOR

Appears when aircraft is about two minutes from waypoint.

GROUNDSPEED INDICATOR

Indicates groundspeed as computed by the INS.

DISTANCE INDICATOR

Indicates distance in nautical miles to next waypoint.

COURSE POINTER

Indicates APFDS selected course.

VERTICAL DEVIATION POINTER

Glideslope scale and bar appear when LOC frequency is selected. One dot equals 1/4°.

Vertical deviation is also indicated by the pointer when APFDS V-NAV is selected. Deviation is 300 ft per dot while en route and 150 ft per dot with approach flaps.

Scale and bar are blank when VOR is selected.

VERT flag covers scale when signal is weak or receiver fails.

COURSE DEVIATION BAR

Displays VOR, LOC, or NAV course deviation.
One dot indicates:

VOR - 5°

LOC - 1.25°

NAV - 3.75 nmi en route.
0.25 nmi on approach.

OFFSET INDICATOR

Appears when flying an offset parallel course. Offset courses are flown to avoid air traffic, weather, terrain, etc.

Offset is only available through the FMS CDU, although steering commands are provided by the INS.

HSI FAIL INDICATIONS

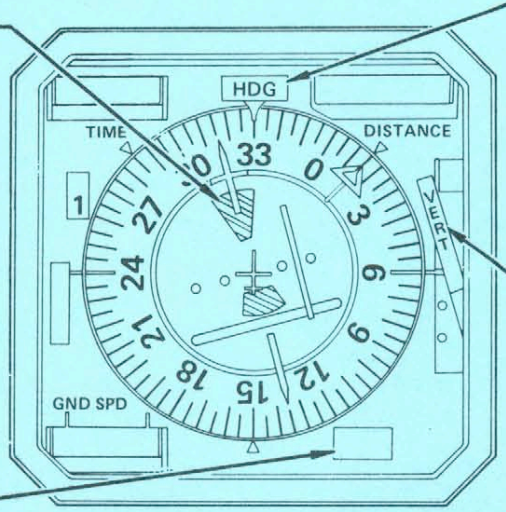
Ships 751-756

Ships 738-741

INVALID DEVIATION INDICATOR

Red and yellow stripes. This flag appears in both apertures with any of the following:

- Power failure
- Instrument failure
- Lack of valid signal



HDG INVALID FLAG

Red and black flag appears when the heading indication should be disregarded.

VERT FLAG

Red and black flag appears on the deviation scale with any of the following:

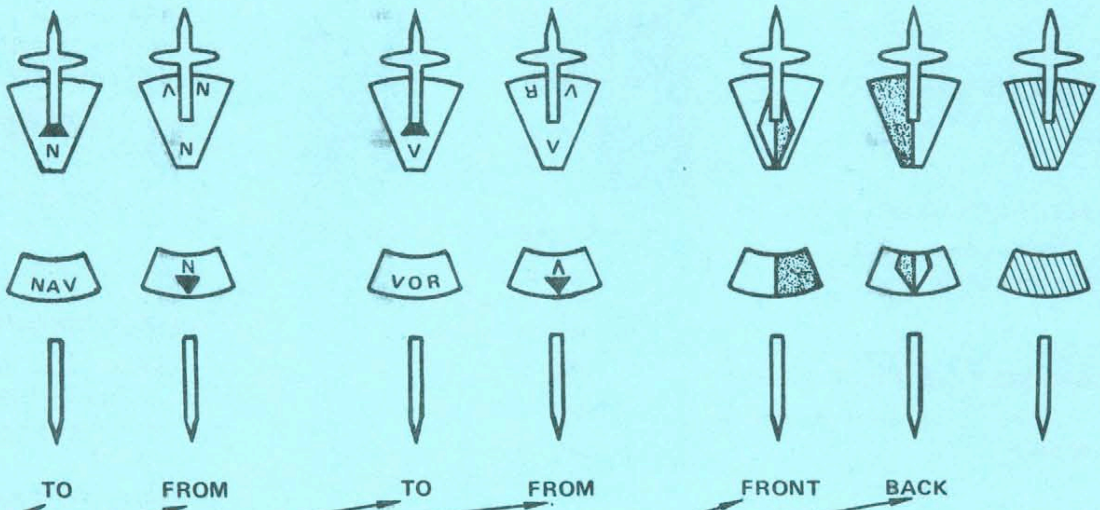
- Power failure
- Instrument failure
- Lack of external data valid signal

OFFSET INDICATOR

A black shutter covers the display with any of the following:

- Power failure
- Lack of input data
- Lack of valid signal

COURSE POINTER FLAGS



VOR - TO shows when the selected course is within ± 90° of the VOR. FROM shows otherwise.

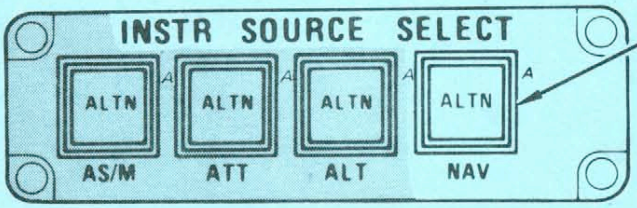
NAV - TO shows whenever another waypoint is available. FROM shows when the last stored waypoint has been passed.

ILS LOCALIZER - FRONT course indication is blue right and yellow left. BACK course indication is the opposite.

Ships 751-756

Ships 738-741

ALTERNATE NAVIGATION INSTRUMENT SOURCE SELECT SWITCH



CAPTAIN'S AND FIRST OFFICER'S
MAIN INSTRUMENT PANELS

ALTERNATE NAVIGATION INSTRUMENT SOURCE SELECT SWITCH

IN - Selects No. 3 INS navigation data to the HSI.

NOTE: THIS DOES* NOT *INCLUDE HEADING DATA

HSI HEADING TRUE/MAG SWITCH

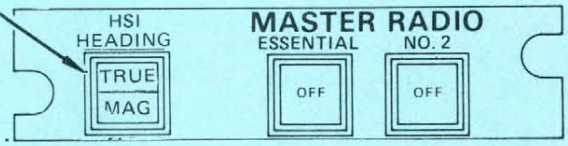
HSI HEADING TRUE/MAG SWITCH

Alternate-action pushbutton switch.

TRUE - HSI compass card receives true heading from the inertial navigation platform, provided NAV is selected on the RADIO/NAV switch.

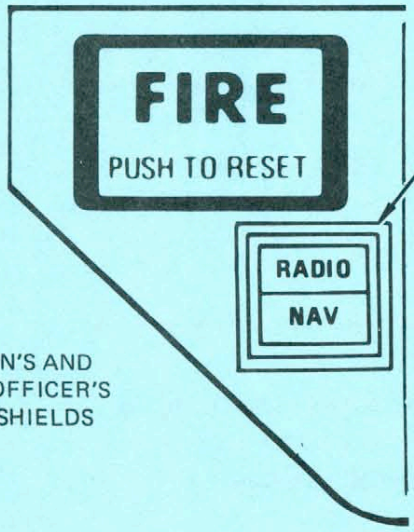
MAG - HSI compass card receives magnetic heading from the compass coupler. MAG is *always* displayed on the HSI if the RADIO/NAV switch is in RADIO, or whenever an ILS frequency is tuned.

Headings displayed on the FMS CDU for winds and track data will *always* be TRUE if the HSI heading switch is in TRUE or MAG if the switch is in MAG. This is independent of the position of the RADIO/NAV switches.



PILOTS' OVERHEAD PANEL

RADIO/NAV SWITCH



CAPTAIN'S AND
FIRST OFFICER'S
GLARESHIELDS

RADIO/NAV SWITCH

Alternate-action pushbutton switch.

RADIO - HSI receives navigation data from VHF NAV radio (VOR or ILS). APFDS NAV mode is armed to use VOR signals.

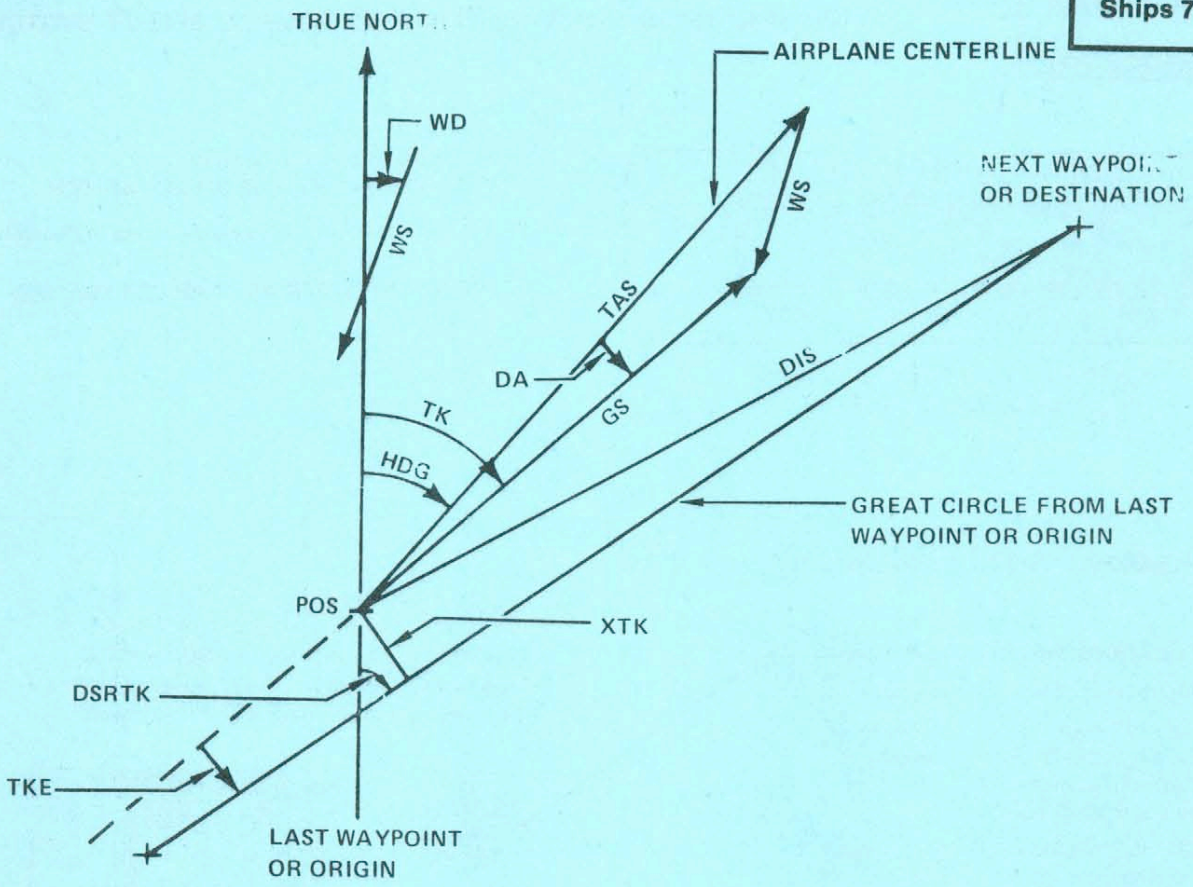
NAV - HSI receives navigation data from inertial navigation computer.

APFDS NAV mode is armed to use INS signals.

HSI reverts to radio display if ILS frequency is tuned on VHF NAV panel.

INS NAVIGATION DATA

Ships 751-756
Ships 738-741



The following navigation measurement terms are used with the Inertial Navigation System (INS), and the computed values are displayed on the INS CDU or on the pilots' flight instruments.

HDG – True heading is the angle between the airplane centerline and true north.

TAS – True airspeed

WS – Windspeed in knots

WD – Wind direction angle is the angle between true north and the wind vector.

TK – Ground-track angle is the angle between true north and an imaginary line on the earth's surface connecting successive position points over which the airplane has flown (ground-track).

GS – Groundspeed

DA – Drift angle is the angle between the airplane's true heading and ground-track.

DSRTK – Desired track angle is the angle between true north and an imaginary line on the ground connecting successive position points desired to overfly; this line is the great circle segment that lies between two successive waypoints.

XTK – Crosstrack distance is the shortest distance between the airplane's present position and the desired track.

TKE – Track angle error is the angle between the airplane's actual ground-track and desired ground-track. It is equal to the desired track angle minus the ground-track angle.

POS – Present position is the actual latitude and longitude position of the airplane.

DIS – Distance is the great circle distance.

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Ships 738-741

INS MODE SELECTOR UNIT (MSU)

MODE SELECTOR SWITCH

The knob must be pulled out before it can be rotated from ALIGN or NAV to STBY or ATT.

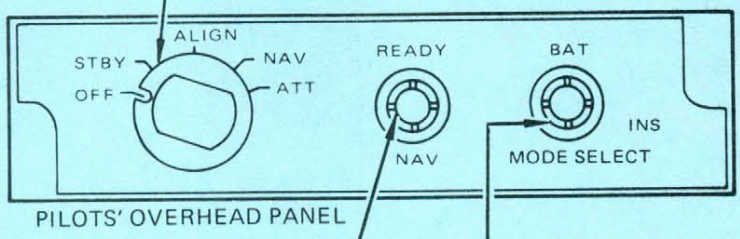
OFF - Inertial Navigation System (INS) power is off.

STBY - INS power is on. A display test may be performed, and present position and waypoints may be loaded. An automatic alignment sequence begins. The system is not affected by aircraft movement.

ALIGN - System aligns automatically. Present position latitude and longitude must be inserted before alignment can be completed. The aircraft must remain stationary while the INS is in the align mode.

NAV - Navigate mode. Normal flight operating mode. Must be selected prior to moving the aircraft.

ATT - INS provides pitch, roll, and platform heading outputs only. The CDU is blank, and navigational capability of the INS is disabled for remainder of flight.



PILOTS' OVERHEAD PANEL

READY NAV ANNUNCIATOR (GREEN)

Is illuminated in align mode to indicate that the alignment sequence is completed and the NAV mode may be selected. Is extinguished when Mode Selector is placed in NAV.

BATTERY ANNUNCIATOR (RED)

Is illuminated when the INS battery is being used and voltage is less than the minimum required to operate the INS. When this condition exists, the INS will shut down.

INS CONTROL AND DISPLAY UNIT (CDU) (SHEET 1)

Ships 751-756
Ships 738-741

HOLD KEY

When pressed, the key is illuminated and the present position is held in the computer's memory. When HOLD is illuminated, the meaning of selected data displayed is changed as follows:

POS - The updated present position will be frozen on the data display.

WAY PT - With the waypoint selector wheel at 0, the coordinates at which the platform was aligned are displayed. With the wheel at other than 0, the raw present position (without update) is shown.

WIND - The wind component on the nose (N) or on the tail (S for stern) is displayed. Useful for windshear evaluation on approach.

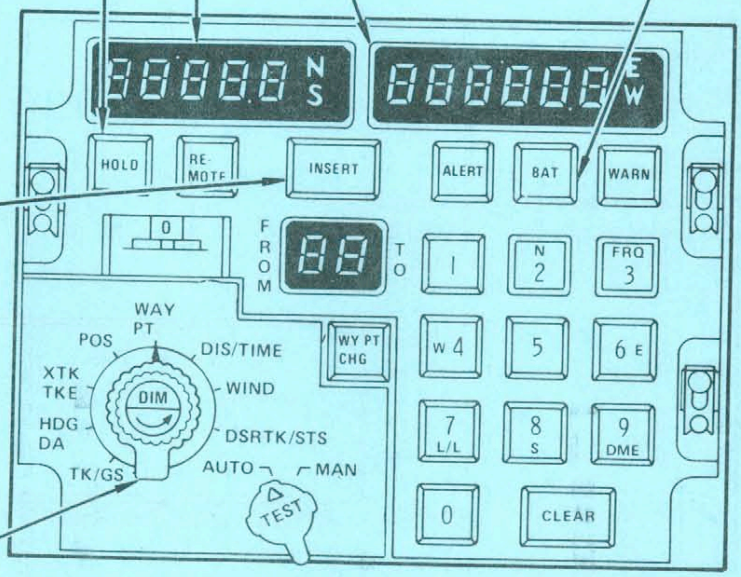
DSRTK - The left display shows 63-14 for the 31N program or 25-04 for the 31N FMS program.

LEFT AND RIGHT DISPLAYS

Data is displayed as selected by the Data Selector switch.

BATTERY ANNUNCIATOR (AMBER)

Illuminated when INS is operating on battery power.



INSERT KEY

Inserts loaded data into the computer. Key is normally illuminated while data is being loaded into the CDU, and it is extinguished when pressed to insert data into the INS computer.

Key is disabled while FMS is controlling the INS.

DATA SELECTOR

Selects navigational data for presentation on left and right displays.

TK/GS - Ground-track angle in degrees true appears in left data display. Groundspeed appears in right data display.

HDG/DA - True heading appears in left data display. Drift angle appears in right data display.

XTK/TKE - Crosstrack distance appears in the left data display. Track angle error appears in the right data display.

POS - Present position latitude and longitude appear in the data displays.

WAY PT - Coordinates of waypoint selected on the waypoint selector may be displayed.

DIS/TIME - Distance and time (at present groundspeed) to next waypoint appear in the data displays. Distance and time between any two waypoints or between present position (waypoint 0) and any waypoint appear in the data displays.

WIND - Wind direction (in degrees true) and speed in the data displays.

DSRTK/STS - True desired track angle and system status appear in the data displays.

Ships 751-756
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INS CONTROL AND DISPLAY UNIT (CDU) (SHEET 2)

REMOTE KEY

Provides for simultaneous loading and inserting of waypoints and for manual updates into three computers from one CDU.

Key is disabled while FMS is controlling INS.

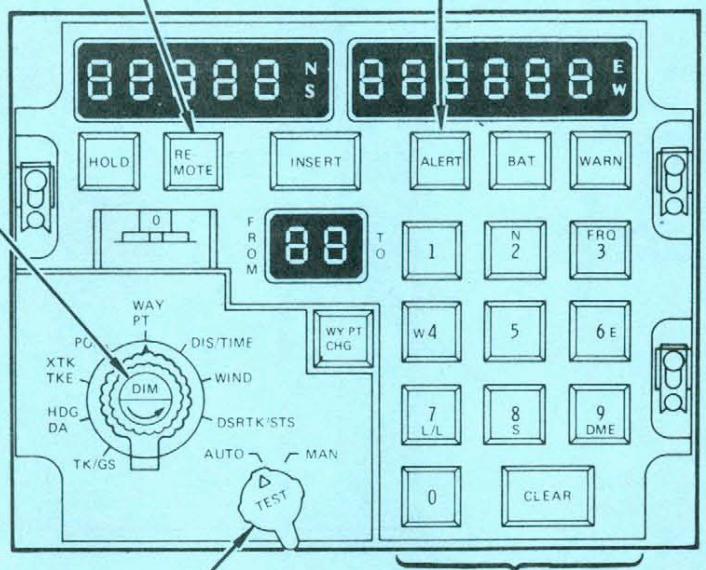
ALERT ANNUNCIATOR (AMBER)

Is illuminated about two minutes before reaching a waypoint, and is extinguished when the track change is made (AUTO/MAN switch in AUTO).

The light flashes if the AUTO/MAN selector is in MAN and waypoint is overflown.

DIM CONTROL KNOB

Concentric knob controls intensity of left, right, and From/To displays.



AUTO/MANUAL SELECTOR

In AUTO, the waypoint numbers in the From/To display will automatically sequence to the next flight leg when waypoint is reached. In MAN, the next flight leg number must be set manually through the keyboard.

TEST - Test of displays and indicators. Also used when data selector is in DSRTK/STS to display numerical codes that indicate specific malfunctions and to reset the malfunction warning circuits.

DATA KEYBOARD (10)

Pushbutton keys (0 through 9) for entering present position and waypoint coordinates, From/To waypoints, making and erasing updates, and triple mix operations.

Where the nature of the entry is such that the letter legends are expected, the pertinent key will furnish that input. These letters are:

- N or S for latitude
- E or W for longitude

Keyboard is disabled while FMS is controlling the INS.

INS CONTROL AND DISPLAY UNIT (CDU) (SHEET 3)

Ships 751-756
Ships 738-741

WARN ANNUNCIATOR (RED)

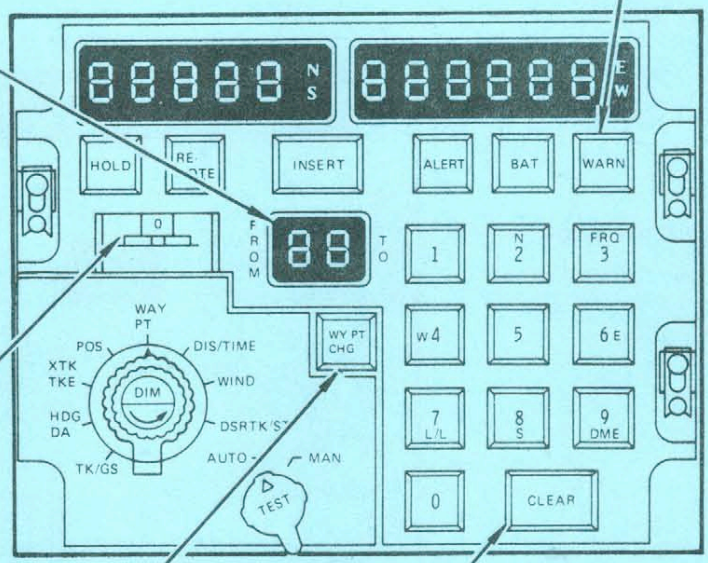
Illuminated when INS detects an abnormal condition.

FROM/TO DISPLAY

Numbers display the From/To waypoints defining the current navigation leg.

A single number in the From side of the display shows the computer interpretation of the waypoint selector setting when the data selector is positioned to WAY PT.

1-2 will always be displayed while FMS is controlling the INS.



WAYPOINT SELECTOR

Used to select the waypoints for which data is to be inserted or displayed when the data selector is in WAY PT.

Disabled while FMS is controlling the INS.

WAYPOINT CHANGE PUSHBUTTON

Used to make course changes and can also be used to display distance and time between two points.

Disabled while FMS is controlling the INS.

CLEAR PUSHBUTTON

Removes entered data from display if pressed before Insert key is pressed.

1E6 - NO. 1 INS HTR
1E7 - NO. 1 INS PWR
1G24 - VG/INS 2
1G25 - INS 2
1E24 - VG/INS 3
1E25 - INS 3

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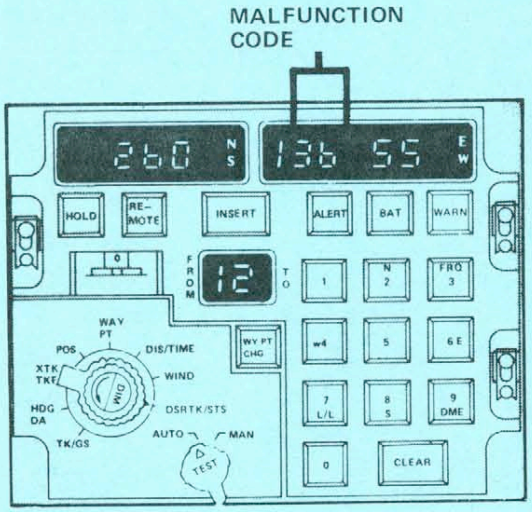
Ships 738-741

INS ACTION/MALFUNCTION CODES



Ensure that data selector is set to DSRTK/STS. (Action code is present in second and third digits of right data display.)

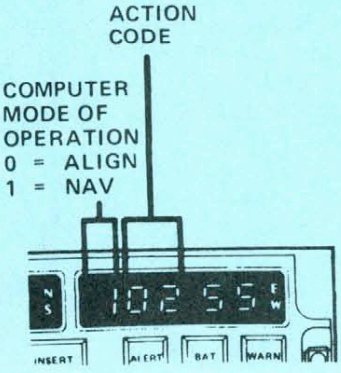
Press and release Test switch. (Malfunction code replaces action code in data display.)

Record malfunction code.

Repeat the second and third steps until either the second or third digit in right data display goes blank and WARN is extinguished, or action code reappears.

If WARN is extinguished and second and third digits go blank, failure was intermittent and has been cleared. INS can resume normal operation.

If WARN remains illuminated and action code reappears following last action code, comply with action code as follows:



Code	Action
01	Position mode selector to OFF to prevent damage to INS.
02	Watch data displays for degradation. Select ATT mode if accuracy degrades.
03	Check instruments and 26-volt circuit breakers. Outputs to APFDS, HSI, or ADI are unreliable.
04	Downmode to STBY and restart alignment (ground operation only).
05	Only active when the FMS is operating and requires that the FMS system inputs be checked.
06	Check present loaded position and reload.

INS MALFUNCTION CODES

The following *partial* list of INS malfunction codes is provided for information only.

Malf Code	Failed Test	Modes of Operation	Recommended Action Code
18	Excessive time in PI of 8	ALIGN	04
22*	TK or TKE + DA converter	ALIGN, NAV	03
23*	DA converter	ALIGN, NAV	03
24*	TKE or steering converter	ALIGN, NAV	03
25*	HDG or steering converter	ALIGN, NAV	03
26*	XTK converter	ALIGN, NAV	03
31	Groundspeed	NAV	02
32	Memory	STBY, ALIGN, NAV	02
33	Azimuth stabilization	STBY, ALIGN, NAV	01
34	Roll stabilization	STBY, ALIGN, NAV	01
35	Pitch stabilization	STBY, ALIGN, NAV	01
36	Accelerometer	STBY, ALIGN, NAV	01
37	Z-platform overtemperature	NAV	01
38	XY-platform overtemperature	NAV	01
39	Oven overtemperature	NAV	01
41**	Inserted/computed latitude comparison	ALIGN	06
42	Drift angle 45° or greater	NAV	02
43	Intersystem comparison	ALIGN	04
45	Loaded latitude or gyro scale factor	ALIGN	04
49	Position update	NAV	06
54	FMS inputs	NAV	05
56	Displayed present position differs from inertial position by more than 3 + 3T (T is NAV time in hours).	ALIGN, NAV	02
60	X or Y sample and hold change	ALIGN	04
61	X or Y sample and hold	ALIGN	04

* Failed test does not light WARN lamp on CDU. If groundspeed is less than 75 knots, failure must continue for a minimum of 6 seconds before this code is set. During flight, momentary power loss due to switchover can set this code.

** This malfunction is set if the loaded present position is more than 76 nmi from the calculated inertial position stored in the computer when the INS was last shut down. Check that correct present position was loaded. Reload if required. Rotate data selector to DSTRK/STS and clear malfunctions.

Ships 751-756

Ships 738-741

FMS CONTROL AND DISPLAY UNIT (CDU) (SHEET 1)

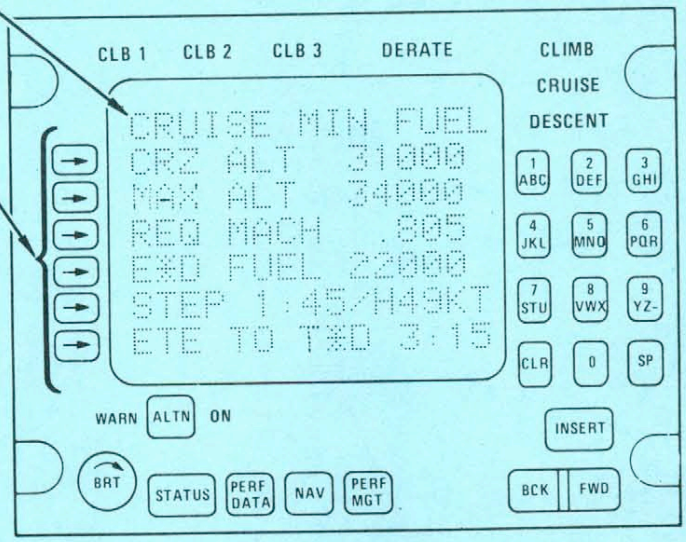
GAS PLASMA DISPLAY

Displays alphanumeric characters on 7 possible horizontal lines, each consisting of a possible 15 characters. A complete display of information is referred to as a "page." Line 1 (top) normally contains the page title or introduction. The bottom line, or scratchpad, is normally used for data entry information being loaded via the keyboard. The other lines display navigational or performance information. Some functions require more than one page of display, in which case other pages may be selected by the BCK/FWD key.

INDEX PUSHBUTTON SWITCHES (6)

Momentary switches are aligned with the lower 6 lines normally used to display information. They are used to select from a number of choices displayed or to call down an item to the scratchpad for insertion or change.

1E8, 26 - FLT MGT



CENTER CONSOLE

ALPHANUMERIC KEYS (10)

Pushbutton keys are used to insert data into the display and then to the flight management computer.

Numerals are selected by pressing the relevant key.

Letters are selected by repeatedly pressing the relevant key until the required letter appears on the display. Example: To select the letter K, press the number 4 key three times (display reads 4, then J, then K).

Repeated pressing is not required under the following conditions where the nature of the entry is such that the display is expecting a letter:

- N or S when associated with latitude
- E or W when associated with longitude,
- L or R when associated with track offset,
- M or P when associated with minus or plus; e.g., temperature.

FMS CONTROL AND DISPLAY UNIT (CDU) (SHEET 2)

Ships 751-756

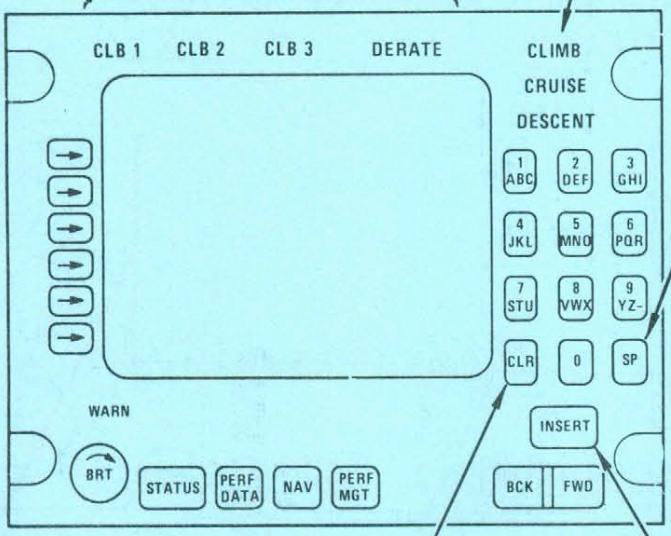
Ships 738-741

CLIMB RATING ANNUNCIATORS (4)

Indicates the climb rating selected.

MODE ANNUNCIATORS (3)

Indicates the performance management mode that is currently engaged.



SPACE KEY

Used only when 2 successive letters (or numerals) demand the use of the same key.

Example: ABC requires 1-1, space, 1-1-1, space, 1-1-1-1, space.

INSERT KEY

Causes the data keyed in to be inserted into the FMS computer.

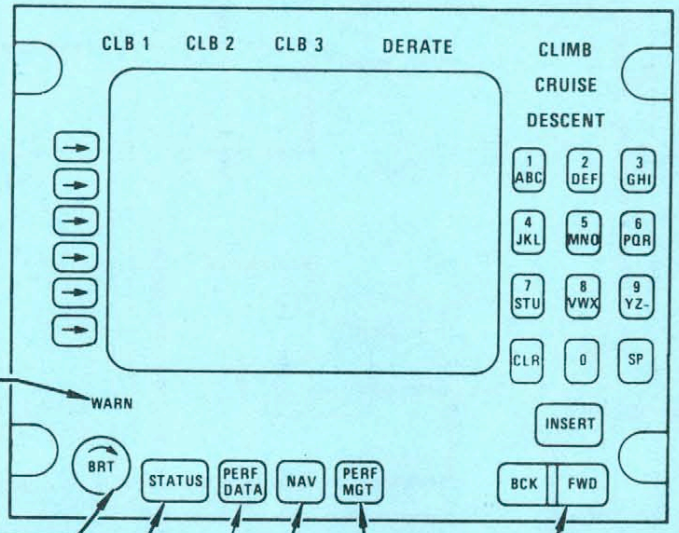
CLEAR KEY

Erases the last number selected with an alpha-numeric key (provided insertion or execution has not taken place). Displayed information will shift right one space. Repeated operation will erase complete selection, one character at a time.

Ships 751-756

Ships 738-741

FMS CONTROL AND DISPLAY UNIT (CDU) (SHEET 3)



WARN ANNUNCIATOR

Illumination indicates failure of the FMS.

BRIGHTNESS CONTROL

Controls brightness of display.

STATUS FUNCTION BUTTON

Function button and amber warning light. Warning is indicated by flashing or steady illumination of STATUS legend, depending on the degree of urgency. Pressing the key produces a diagnostic display.

PERF DATA FUNCTION BUTTON

Used to select engine thrust for takeoff and climb, as well as entering temperatures and reviewing engine-out performance.

NAV KEY

Used to select display for automated navigation setup, control, and status.

BACK OR FORWARD KEY

Permits paging backward (BCK) or forward (FWD) to reach the desired page when more than one page of information is available for the function selected.

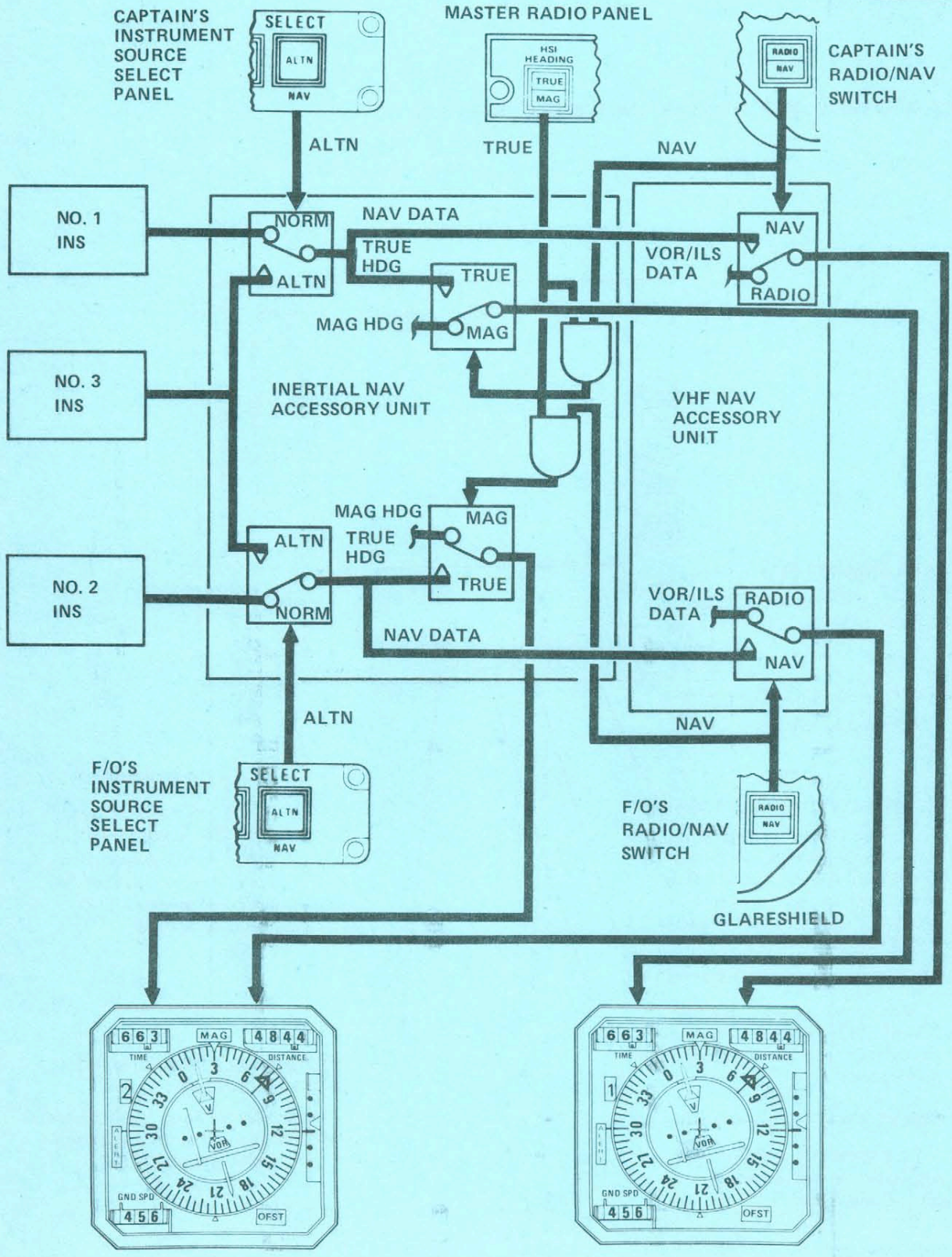
PERFORMANCE MANAGEMENT FUNCTION BUTTON

Used to select display for performance management setup, control, and status of climb, cruise, and descent.

SCHEMATIC

Ships 751-756
Ships 738-741

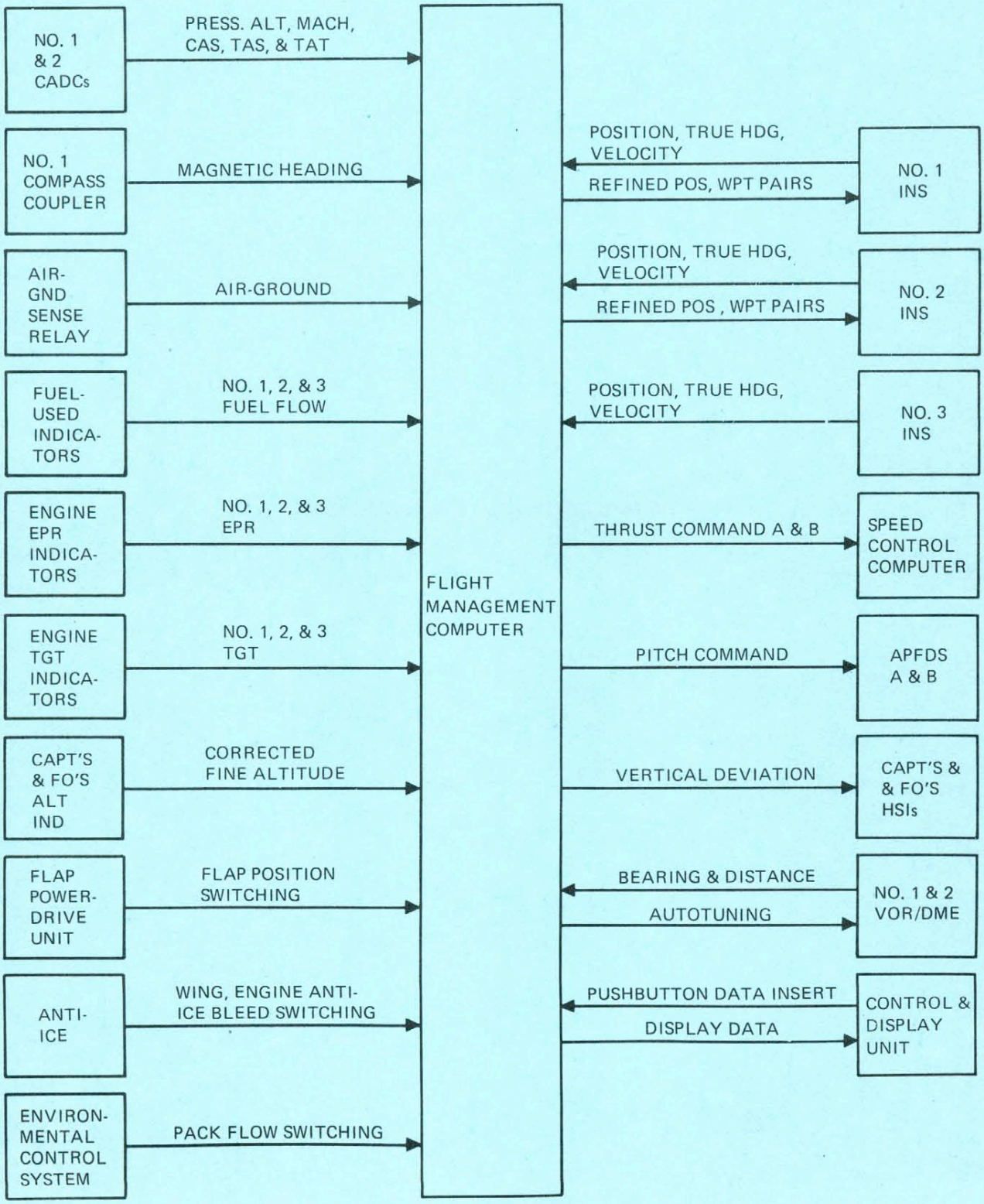
INS SWITCHING



Ships 751-756

Ships 738-741

FMS INPUTS AND OUTPUTS



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Ships 751-756

Ships 738-741

INS SYSTEM OPERATION

Present Position To Any Waypoint (FMS Inoperative/Not Installed)

1. WAYPT CHG SWITCH ----------PRESS	Check **WAYPT CHG** and **INSERT** switches illuminate.
2. "0" KEYBOARD SWITCH----------PRESS	Check "0" appears in FROM side of FROM-TO indicator.
3. WAYPOINT KEYBOARD NO.---------PRESS	- Press keyboard switch which represents desired waypoint and check correct number appears in TO side of FROM-TO indicator. - **INSERT**
4. INSERT SWITCH ----------PRESS	Check WAYPT CHG and INSERT extinguish.

Checking Initial Ramp Position/Course Change Point In Flight

1. WAYPOINT----------"0"	
2. DATA SELECTOR----------WAYPT	
3. HOLD SWITCH----------AS REQUIRED	- **HOLD** displays initial ramp position. - **HOLD** extinguished displays initial ramp position, or if in-flight course change had been accomplished coordinates which existed at point of course change.

Checking Raw Inertial Position

Inertial position is the present position that would have been displayed if the INS had not been updated.

1. HOLD SWITCH----------PRESS	- Check **HOLD** illuminates - If a check of all INS units' inertial position is desired, press **REMOTE** on each unit before accomplishing this step.
2. WAYPOINT SELECTOR----------1 THRU 9	
3. DATA SELECTOR----------WAYPT	Raw inertial position will be displayed.

Ships 751-756

Ships 738-741

INS Triple-Mix Update Operation (FMS Inoperative/Not Installed)

- INS Triple-Mix is a means of continually updating the position of 1, 2, or 3 INS units by using a position mathematically weighted and averaged from three operating INS units.
- All three INS units must be operating in NAV, and all WARN lights extinguished on CDU's.

TO SELECT TRIPLE-MIX:

1. DATA SELECTOR ----------DSTRK/STS

It is recommended that only INS No. 1 and 2 be selected for triple-mix update operation. Leave INS 3 displaying inertial position.

2. KEYBOARD SWITCH #4----------PRESS

- Press key No. 4 on INS units selected for Triple-mix update operation.
- 4 appears in last digit of right display.
- INSERT

NOTE: Positions that read the same on two CDU's is confirmation that triple-mix is functioning.

3. INSERT SWITCH ----------PRESS

- INSERT extinguishes.
- 4 remains in last digit of right display.
- Triple-mix update will be "eased on" over approximately a five minute period to prevent any sudden change in heading.
- At the end of the ease-on operation the position displays of selected INS units will be the same.
- If any INS inertial position differs from the "mixed" position by more than 3 miles + 3 miles for each hour in NAV (maximum of 18 miles) WARN 02-56 occurs. WARN can be extinguished by pressing TEST, but the 02-56 code remains until the faulty INS returns to a position within the 3 + 3T or 18 mile limit.

TO EXIT TRIPLE-MIX:

4. DATA SELECTOR----------DSTRK/STS

5. KEYBOARD SWITCH #5----------PRESS

- Press key No. 5 on INS units selected to exit triple-mix operation.
- 5 appears in last digit of right display.
- INSERT

6. INSERT SWITCH ----------PRESS

- INSERT extinguishes.
- 5 remains in last digit of right display indicating triple-mix eliminated.
- Displayed positions will gradually diverge depending on error rate.

TO ERASE/FLUSH TRIPLE-MIX UPDATE:

7. ERASING/FLUSHING UPDATES PROCEDURE----------ACCOMPLISH

Ships 751-756

Ships 738-741

Erasing/Flushing Updates (FMS Inoperative/Not Installed)

Updates must be erased from each INS separately.

1. **DATA SELECTOR----------DSRTK/STS**
2. **KEYBOARD SWITCH #1 ----------PRESS**
   - Press key #1; number will appear in last digit of right-hand display.
   - INSERT
3. **INSERT SWITCH ----------PRESS**
   - HOLD and INSERT extinguishes and 5 appears in last digit of right display indicating previous update(s) have been erased, and INS has returned to original program.

NOTE:
If update is removed from INS supplying an autopilot in the NAV mode, a sudden heading change may occur, as INS commands a return to raw inertial track.

END

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PORTABLE OXYGEN

- **Crew Walk-Around Bottles** 2
- **Passenger First Aid Bottles/Generators** 2

SYSTEM OPERATION

GENERAL 5

OPERATION - PORTABLE OXYGEN GENERATOR 5

CROSS REFERENCE

Portable Oxygen Bottle/Generator Locations....EMERGENCY EQUIPMENT

GENERAL

Two independent oxygen systems are installed; one for crew use and one for passenger emergency use. In addition, portable oxygen units are provided.

CREW OXYGEN SYSTEM (1000 psi min)

A single oxygen bottle, located to the left of the S/O's panel, supplies oxygen to regulators installed at the five crewmember stations. A gauge mounted on top of the cylinder displays bottle pressure. A pressure reducer provides oxygen to each regulator at 50-100 psi. Quick-donning masks are located in storage compartments near the Capt.'s, F/O's, and two observer's stations, and on a hanger bracket on the left side of the S/O's panel.

PASSENGER OXYGEN SYSTEM

The passenger emergency oxygen system, when activated, chemically generates oxygen to provide continuous oxygen flow for all passengers and flight attendants for approximately 15 minutes.

The system is activated and oxygen masks are deployed automatically when cabin altitude exceeds 13,000 feet. The system may be manually activated, and masks deployed, by latching the Passenger Oxygen MANUAL switch on the S/O's panel. MASKS DPLYD illuminates when the MANUAL switch is latched. An OXYGEN FLOW light illuminates on the same panel to indicate that the oxygen sequence timer has been activated either automatically or manually to deploy the masks and activate the oxygen generators.

Oxygen flow from the chemical generators cannot be stopped. Once activated, the oxygen generators produce oxygen until the chemical reaction is completed.

Masks are located:

- At each passenger seat (one extra mask is provided at each seat group).
- At each flight attendant's station.
- Two in each lavatory.
- Two in the lower galley (jump seat stations).

PORTABLE OXYGEN

Three types of portable oxygen bottles are available, crew walk-around bottles, passenger first aid bottles, and portable oxygen generators.

Crew Walk-Around Bottles (1650 psi min)

Portable gaseous oxygen bottles with smoke masks are installed as follows:

- One in the cockpit behind the First Observer's position.
- Two in the lower galley.

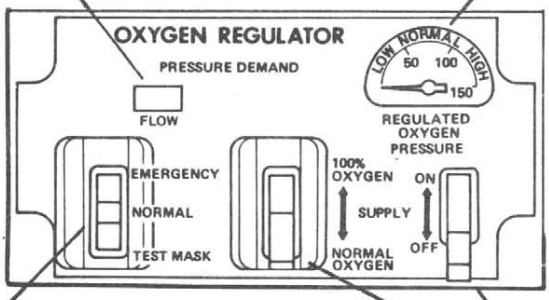
Passenger First Aid Bottles (1600 psi min)/ Portable Generators

On all L-1011 aircraft first aid bottles/portable generators are located at all doors, and at the upper galley and aft flight attendant jumpseat.

- On ships 701 through 727 gaseous first aid bottles are located at doors 1L, 2L and 3L; portable chemical oxygen generators are installed at all other locations.
- On ships 728 and up all first aid bottles are gaseous.

FLOW INDICATOR
White flag in view indicates oxygen flow.

REGULATED OXYGEN PRESSURE GAUGE
- Indicates oxygen pressure supplied to the regulator.
- Normal range is 50 - 100 psi.



EMERGENCY/NORMAL/ TEST MASK LEVER
Three position lever.

EMERGENCY - 100% oxygen flow is continuously supplied to the mask.
- If lever is left in EMERGENCY position, the Flight Crew Oxygen Bottle will be depleted.

NORMAL - Normal position. Oxygen is available to the mask as selected by the Oxygen Selector Lever.

TEST MASK - Provides 100% oxygen flow continuously to test mask. Lever is spring-loaded back to NORMAL from this position.

OXYGEN SELECTOR LEVER
Two position lever.

100% OXYGEN - Normal position. Below 28,000 feet cabin altitude, 100% oxygen is available to mask on demand. Above 28,000 feet cabin altitude, 100% oxygen flow is continuously supplied to the mask.

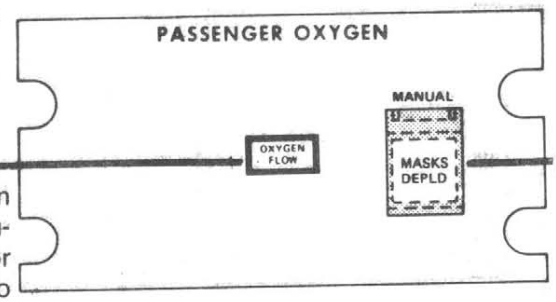
NORMAL OXYGEN - Below 28,000 feet cabin altitude, oxygen diluted with ambient air is available to mask on demand. Above 28,000 feet cabin altitude, 100% oxygen is available to mask on demand.

SUPPLY LEVER
Two position lever that controls flow from the regulator.

ON - Normally safetied in this position. Permits oxygen to flow from regulator to mask.

OFF - Regulator output is shutoff at the regulator.

CREW OXYGEN REGULATOR (5)



OXYGEN FLOW LIGHT

Illuminates when the oxygen sequence timer has been actuated either automatically or manually to signal the masks to deploy and activate the oxygen generators.

MANUAL SWITCH

Provides manual control to deploy passenger oxygen masks.

UNL - Normal position. **MASKS DPLYD** is extinguished.

- Masks and oxygen generators are armed to operate automatically if cabin altitude exceeds 13,000 feet.

LCH - Sequence timer is actuated to deploy masks and activate oxygen generators. MASKS DPLYD illuminates to indicate switch position.

1J15, 16, 17, 18 - PASS OXYGEN

NOTE: The FASTEN SEAT BELT and NO SMOKING signs in the cabin illuminate when oxygen masks are signaled to deploy manually or automatically.

PASSENGER OXYGEN PANEL
(SECOND OFFICER'S PANEL)

SYSTEM OPERATION

GENERAL

No smoking is permitted in the vicinity of any oxygen unit that is in use.

Whenever possible, use the portable gaseous bottles for first aid purposes.

OPERATION - PORTABLE OXYGEN GENERATOR

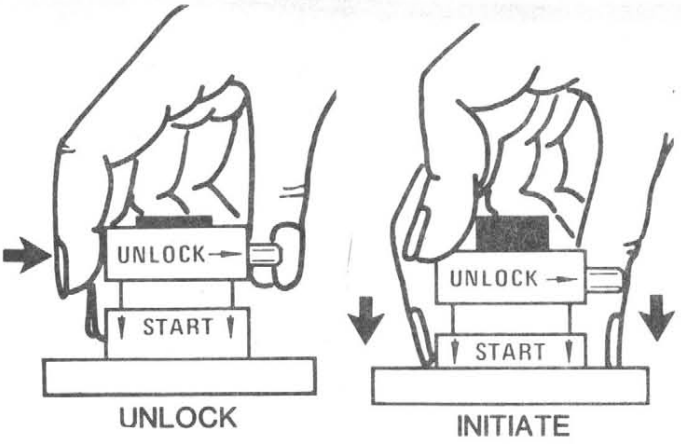
1. Unlatch cap and remove. A single mask and tubing is stored inside the cap and attached to the generator.

2. Unlock the actuating collar by pressing the green button all the way IN.

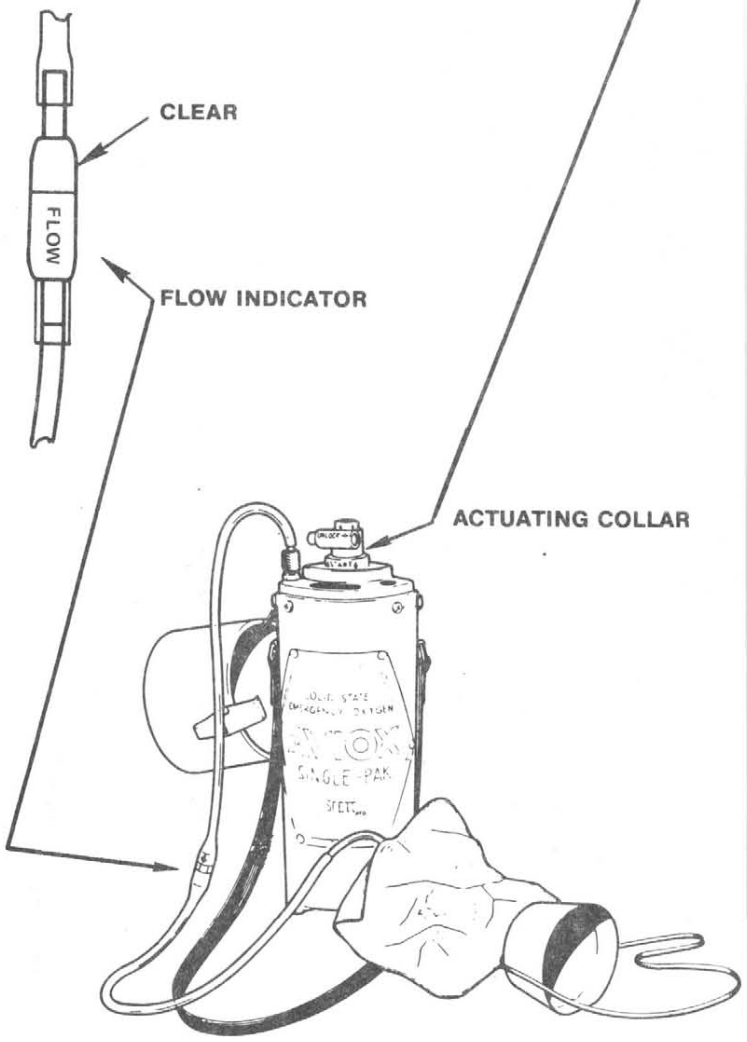
3. To start oxygen flow, push the green actuating collar DOWN. The black portion in the center is a rigid shaft and does not move.

4. Oxygen flow begins in approximately six seconds and the red pin will disappear from the clear portion of the flow indicator. Each generator provides a 4 liter per minute flow of oxygen for 20-25 minutes. The red pin reappears when oxygen flow ceases.

5. Heat is created during operation of the chemical units. Avoid contact with skin or flammable materials. Store used oxygen generators away from flammable material in the forward lavatory.



PORTABLE GENERATOR ACTUATION



PORTABLE OXYGEN GENERATOR

OXYGEN

No System Changes

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Air Conditioning . . . . . AIR CONDITIONING/PRESSURIZATION
APU to Ground Reverser Switches . . . . . POWERPLANT
APU Bleed Air . . . . . APU
ATM Pneumatic Supply . . . . . PNEUMATICS
Priority . . . . . AIR CONDITIONING/PRESSURIZATION
Cargo Compartment Heat . . . . . AIR CONDITIONING/PRESSURIZATION
Engine Anti-Ice . . . . . ICE/RAIN PROTECTION
Engine Start . . . . . POWERPLANT
Wing Anti-Ice . . . . . ICE/RAIN PROTECTION

(OPPOSITE SIDE BLANK)

GENERAL

Air for the pneumatic system is supplied by each aircraft engine, the APU, and ground air carts. These pneumatic sources provide air for:

- each engine starter
- three air conditioning packs
- two ATM hydraulic pumps
- wing anti-ice
- lavatory ventilation on the ground
- cargo heat

Engine Bleed Air

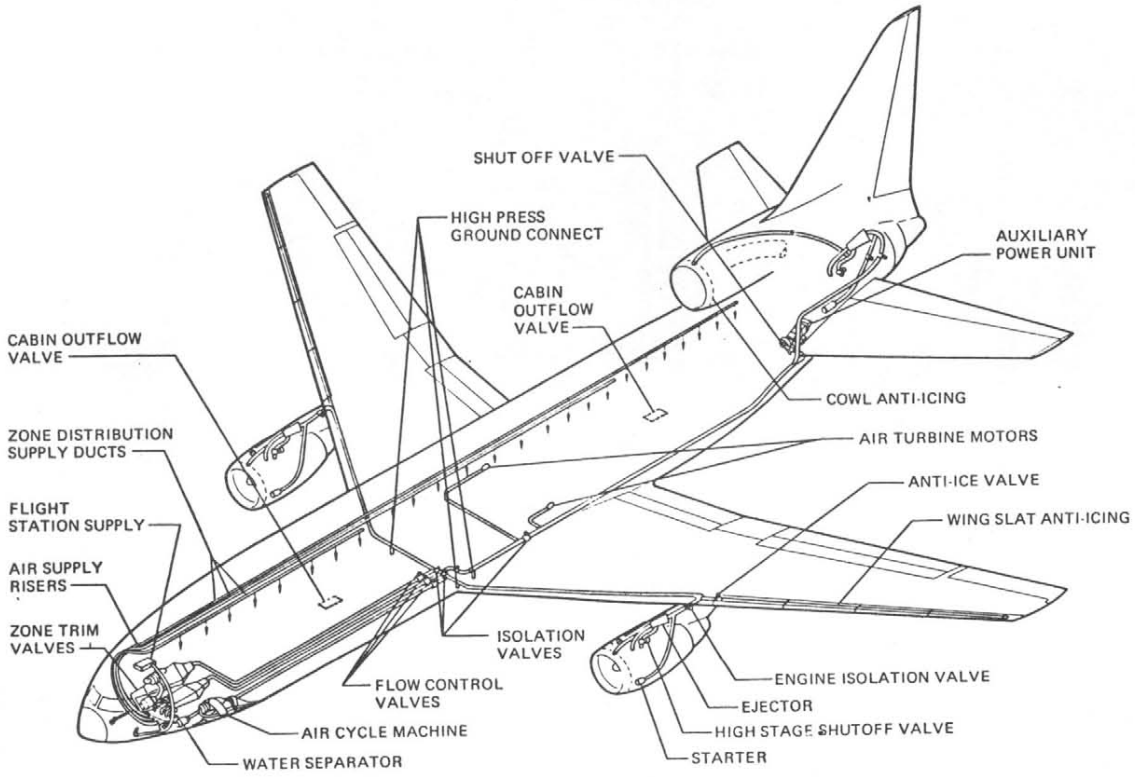
Each engine supplies low pressure bleed air from the N_2 compressor as the primary pneumatic supply. High pressure bleed air from the N_3 compressor supplements this low pressure air whenever system demands require higher pressure or temperature.

Low pressure air from the N_2 compressor is available anytime the engine is operating. Check valves are installed to prevent reverse flow. Low pressure air also provides engine anti-ice protection independent of the pneumatic system.

High pressure air from the N_3 compressor is ducted through a check valve and a high pressure shutoff valve. This valve is armed to open by the high pressure valve switch on the pneumatic panel. The high pressure valves do not modulate. High pressure air is also used for engine reverser operation independent of the pneumatic system.

An ejector is used to mix low and high pressure air before it enters the pneumatic distribution system. Under normal pneumatic loads, the ejector modulates to maintain desired duct flow without exceeding temperature limits. Anytime the C2 ATM has a "run" signal or wing anti-ice is in use, however, the ejector modulates to maintain the highest allowable duct temperature.

The pneumatic system has numerous protection systems to preclude overtemperature and/or overpressure. These systems as well as the normal controls and indicators will be discussed on subsequent pages in this section.



HIGH PRESSURE VALVE SWITCH

UNLATCHED - Valve is electrically energized to close and OFF illuminates.

LATCHED - Normal position except for engine start. The high pressure valve is armed to open when low pressure air is inadequate. The valve is signaled either full open or full closed and will remain closed whenever the engine isolation valve is closed.

FLOWBAR - Indicates that the valve is open. The high pressure valve closes automatically when:

- The engine isolation valve is closed
- Low pressure air is adequate
- NACELLE OVHT occurs
- DUCT OVHT occurs

1G13, 14, 15 - HI PRESS VALVES

ENGINE ISOLATION VALVE SWITCH

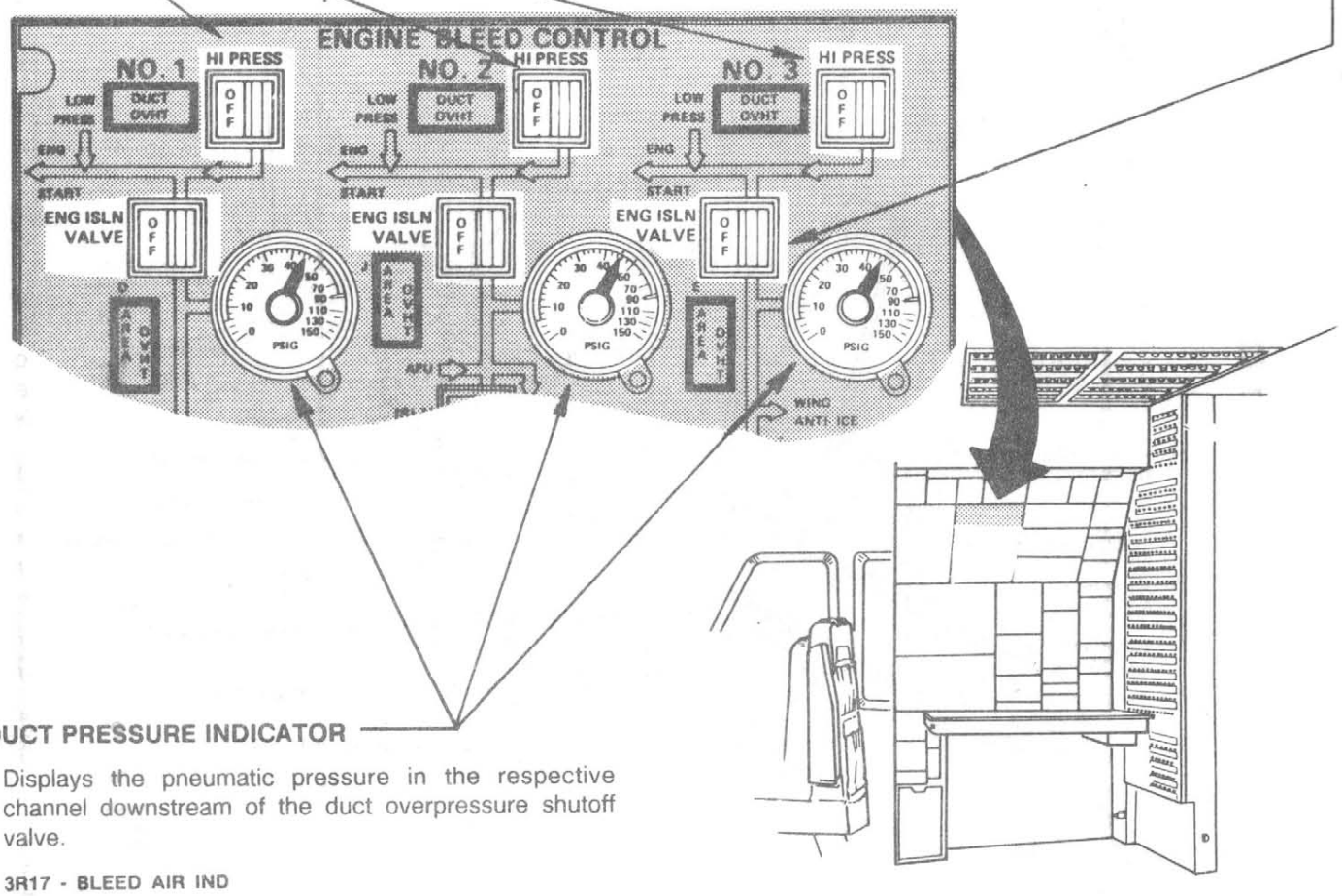
UNLATCHED - Valve is electrically energized to close and OFF illuminates.

LATCHED - Normal position. Each valve serves as a shutoff to prevent reverse flow of air to the engine and modulates to maintain desired duct pressure in its respective channel of the pneumatic system. During engine start or with the Air/Ground Reverser Switch activated, the valve is energized to allow reverse flow of air from the pneumatic system to the engine.

FLOWBAR - Indicates valve is open. The engine isolation valve closes automatically to prevent reverse flow of air (except as indicated above) under the following conditions:

- DUCT OVHT
- BLEED DUCT OVPRESS
- Area D or E AREA OVHT (engine 1 or 3)
- If the fire handle is pulled for the respective engine.

1G10, 11,12 - ENG ISLN VALVES



DUCT PRESSURE INDICATOR

Displays the pneumatic pressure in the respective channel downstream of the duct overpressure shutoff valve.

3R17 - BLEED AIR IND

FUSELAGE ISOLATION VALVE and CROSSBLEED VALVE SWITCHES

UNLATCHED - Electrical power is removed to close the respective valve and OFF Illuminates.

- With the fuselage isolation valve closed, the number two engine, APU, and B2 ATM are isolated from the crossbleed manifold.
- With a crossbleed valve closed, the associated wing engine, wing anti-ice system, and pack are isolated from the crossbleed manifold.
- These valves are not normally closed except to isolate portions of the pneumatic system for abnormal conditions or for troubleshooting.

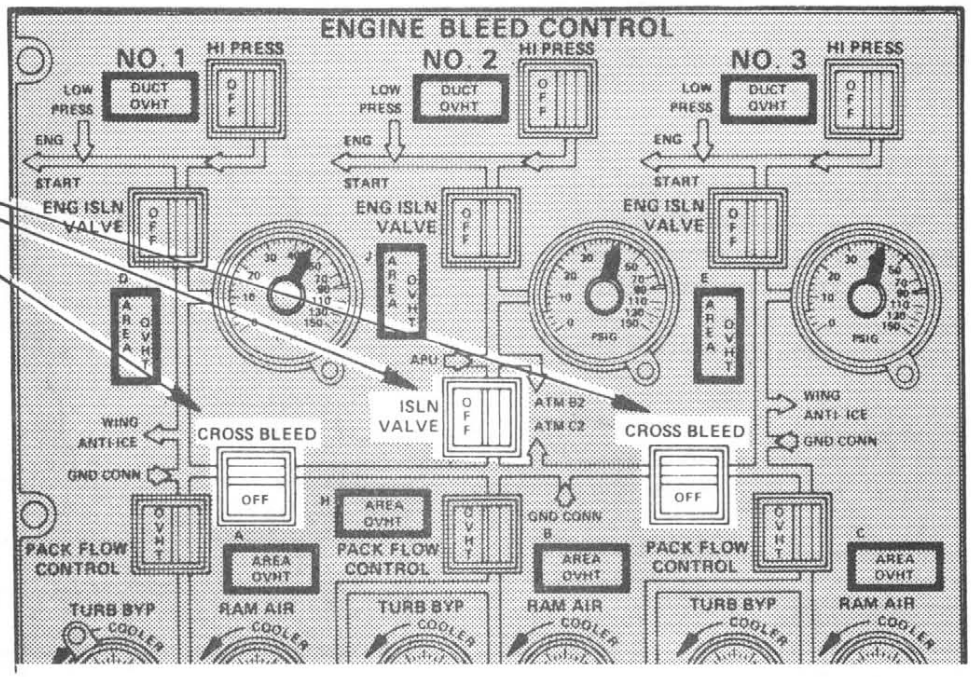
LATCHED - Normal position. Valves are electrically energized to open if pneumatic pressure is available.

FLOWBAR - Indicates valve is open. The fuselage isolation and crossbleed valves close automatically when an area H overheat is sensed. In addition, the respective crossbleed valve closes when an area D or E overheat is sensed.

NOTE: In the event of a loss of all generators, both crossbleed valves will remain operable.

1G16 - FUS ISLN VALVE

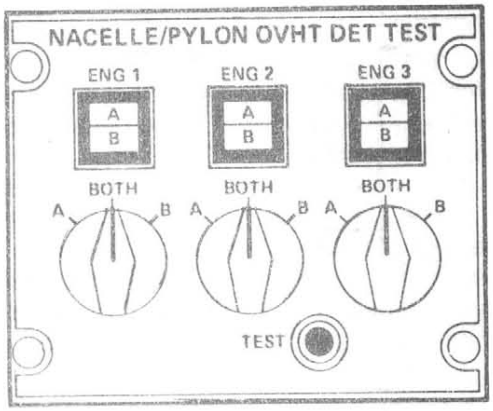
1G17, 18 - CROSSBLEED VALVES

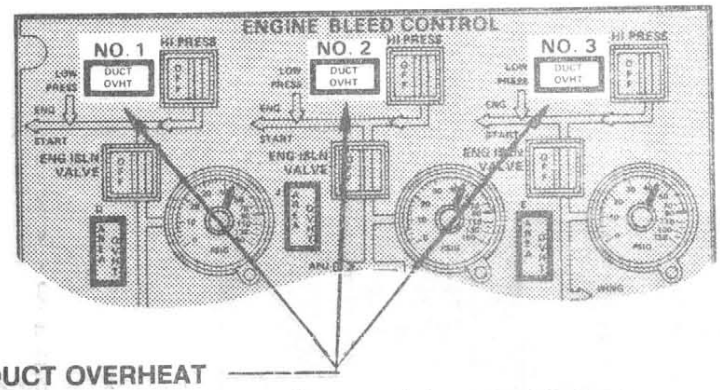


PROTECTIVE SYSTEMS

NACELLE/PYLON OVERHEAT

The Nacelle/Pylon overheat detection system monitors temperatures in the engine nacelle and pylon areas. Two loops monitor each engine and will detect a pneumatic duct leak. Unless deselected by a rotary control switch on the Second Officer's panel, detection of an overheat by either loop will illuminate the respective loop light and signal the high pressure valve to lock closed. After the temperature is reduced, the light(s) extinguish and normal control of the high pressure valve is restored.





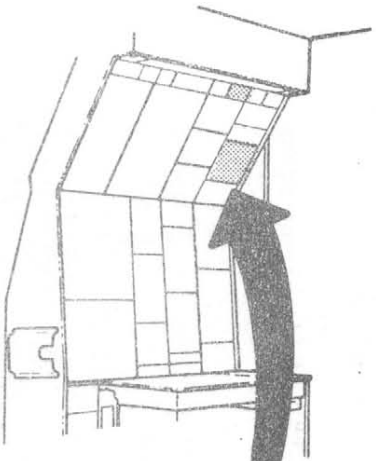
DUCT OVERHEAT

If excessive temperature is sensed downstream of an ejector, the **DUCT OVHT** light illuminates and the respective high pressure and engine isolation valves are signaled to lock closed. When the temperature is reduced, **DUCT OVHT** extinguishes and the system may be reset by cycling the associated valve switches.

BLEED DUCT OVERPRESSURE

Downstream of each engine isolation valve is an overpressure shutoff valve. This valve closes when an overpressure condition exists. Closure of any overpressure valve signals the respective engine isolation valve to lock closed, and illuminates the BLEED DUCT OVERPRESSURE light on the Second Officers annunciator panel. The overpressure valve re-opens when duct pressure is reduced. To reset the system and the **BLEED DUCT OVERPRESSURE** light, the engine ISOLATION VALVE switch must be unlatched.

Downstream of each overpressure valve is an overboard pressure relief valve. Should both the engine isolation valve and overpressure valve fail to limit duct pressure, the overboard pressure relief valve will dump the excessive pressure overboard to protect the system. White blowout discs are installed on the overboard line to indicate that an overboard pressure relief valve has actuated.



LH FWD ENTRY	FWD CARGO	RH FWD ENTRY	GALLEY
LH CTR ENTRY	CENTER CARGO	RH CTR ENTRY	AVIONICS
LH AFT ENTRY	AFT CARGO	RH AFT ENTRY	FWD S DUCT
LH EMERGENCY	ESCAPE HATCH	RH EMERGENCY	AFT S DUCT
LH GEAR DR DOOR	NOSE GEAR DR DOOR	RH GEAR DR DOOR	MAIN ELEC
SLAT ASYM DET FAULT	TAIL SKID	BLEED DUCT OVPRESS	——
FLAP/SLAT LOCK	WATER CPRSR 1	WATER LINE HTR	ELEVATOR
FLAP ASYM DET FAULT	WATER CPRSR 2	PILOT INSTR COOL SYS	——

S/O'S INSTRUMENT PANEL

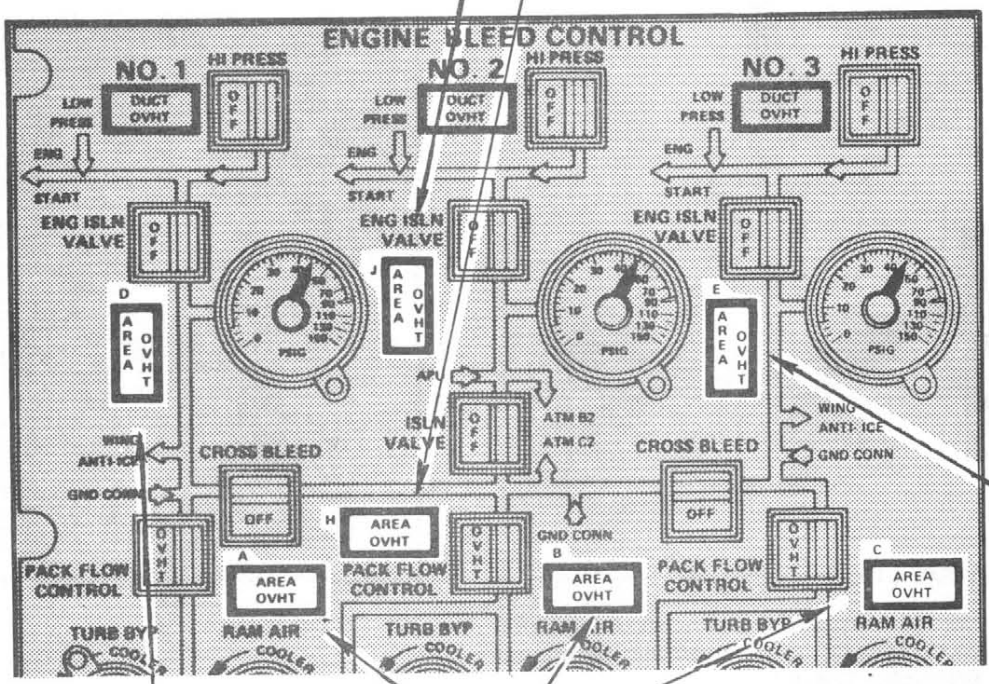
AREA OVERHEAT SYSTEM

Temperature in the areas surrounding the pneumatic ducts is monitored by the Area Overheat System. The system uses dual continuous loop heat sensors running along all ducts and is divided into nine areas which illuminate individual warning lights when excessive temperature is sensed in the respective area. Unless otherwise noted, the respective lights are only an indication of an overheat condition and provide no automatic protection. The following describes the areas being monitored and their letter designations:

Area J AREA OVHT
This loop monitors the temperature surrounding the duct leading from the number two engine isolation valve to the fuselage isolation valve.

Area H AREA OVHT
This loop monitors the temperature surrounding the crossbleed duct between the crossbleed valves and from the fuselage isolation valve to the number two pack flow control valve.

NOTE: If an overheat condition is sensed in area H, the area is isolated automatically by circuitry that sends a signal to the four related valves to close and lock. To reset the system, all four valves must be unlatched before any one is relatched.

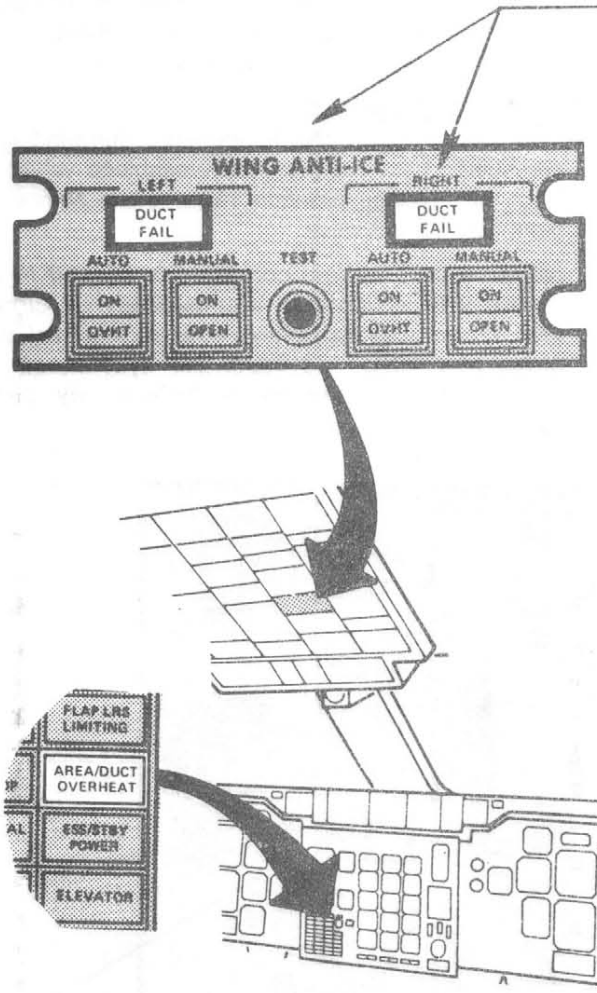


Area D AREA OVHT
This loop monitors the temperature surrounding the duct leading from the number one engine isolation valve to the left crossbleed valve and the number one pack flow control valve.

Areas A,B and C AREA OVHT
These loops monitor temperature surrounding the ducts downstream of the pack flow control valves (see Air Conditioning/Pressurization).

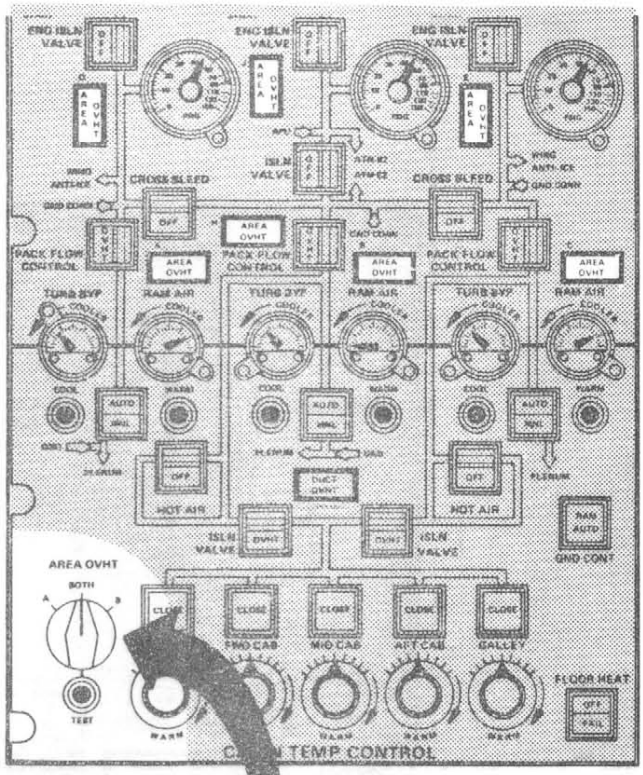
Area E AREA OVHT
This loop monitors the temperature surrounding the duct leading from the number three engine isolation valve to the right crossbleed valve and the number three pack flow control valve.

NOTE: If an overheat condition is sensed in either area D or E the respective area is isolated automatically by circuitry that sends a signal to the three respective valves to close and lock. To reset the system, all three valves must be unlatched before any one is relatched.



Areas F and G DUCT FAIL

These loops monitor temperature surrounding the ducts leading from the respective wing anti-ice valve to the anti-ice distribution duct in the leading edge of the wing (see Ice/Rain Protection). Although the light indication on the pilot's overhead panel reads DUCT FAIL, the condition that is sensed is one of overtemperature.



AREA OVERHEAT LOOP SELECTOR

BOTH - Normal position. Either A or B loop detecting an overheat condition will illuminate respective AREA OVHT light.

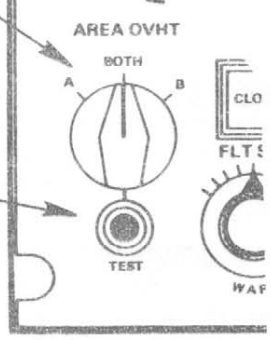
A - Only loop A provides overheat detection and indication.

B - Only loop B provides overheat detection and indication.

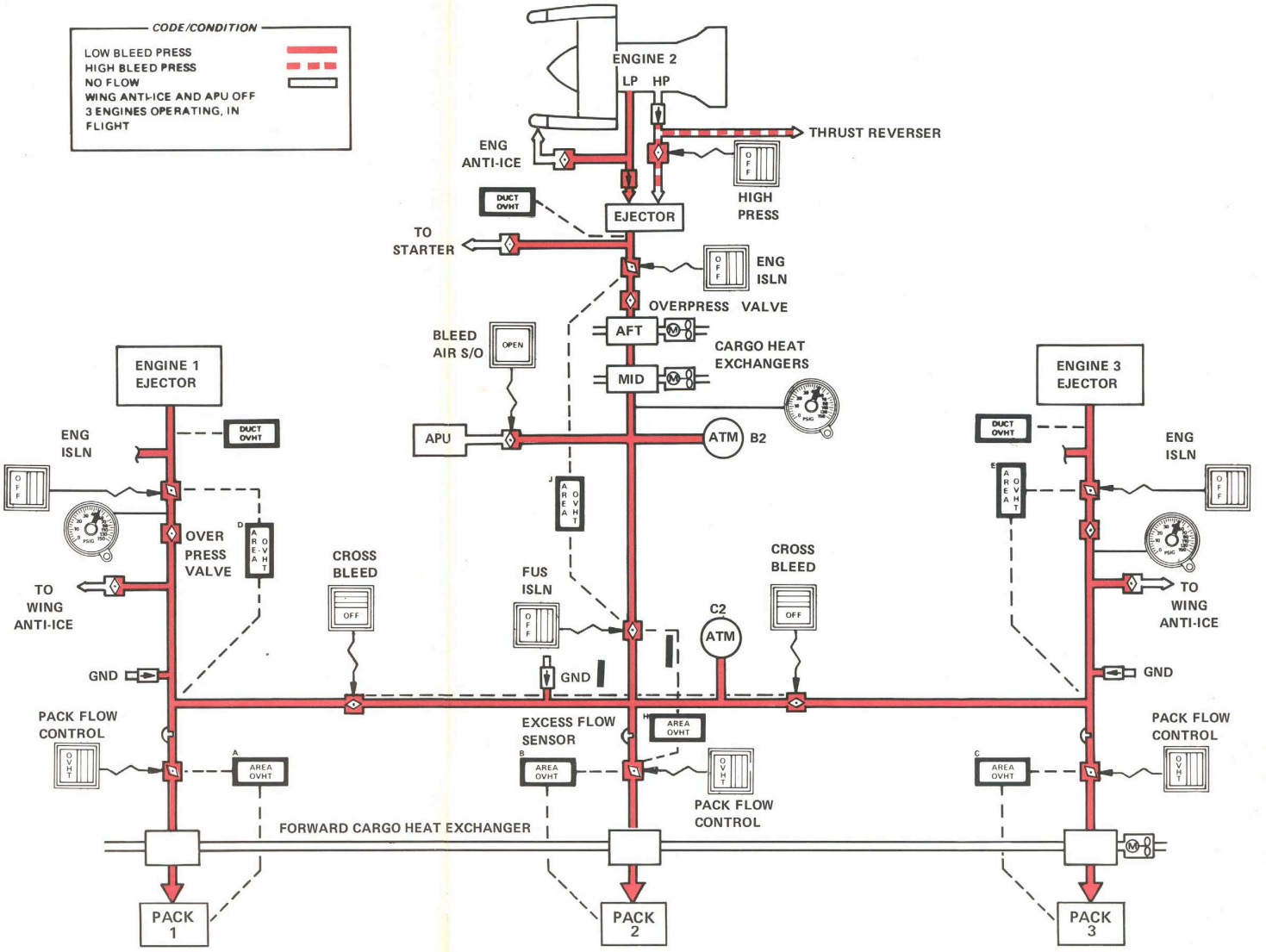
TEST BUTTON

TEST - Tests the circuitry of the selected loop. When pressed, the following lights illuminate:

- Seven AREA OVHT lights
- Two DUCT FAIL lights
- AREA/DUCT OVERHEAT light



NOTE: If pressed while selector is in BOTH, both loops are tested, and either loop is capable of giving an indication of a good test. Therefore the test is invalid if performed with the selector in the BOTH position.



BLEED AIR SUMMARY

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-250/-500 DIFFERENCES (Blue Pages)

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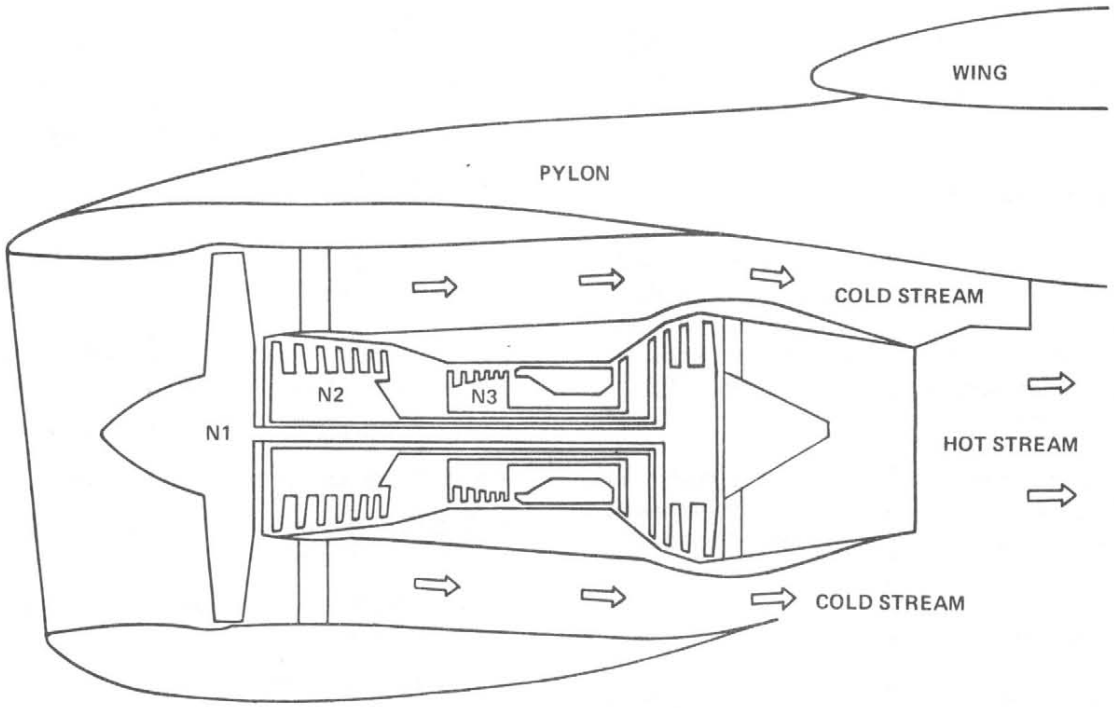
Engine Description 1
Engine Fire System 1

CONTROLS AND INDICATORS (-500) 2

(OPPOSITE SIDE BLANK)



ENGINE DESCRIPTION

Power for the L-1011 is furnished by three Rolls Royce RB-211-22B triple spool turbo fan engines, flat rated at 42,000 pounds thrust. The engine is approximately eight feet in diameter to accommodate the large fan and cold air bypass duct that surrounds the core engine.

The low pressure (N_1), intermediate pressure (N_2), and high pressure (N_3) compressors are each installed on a shaft with its respective driving turbine to form a spool. The three spools are installed on a common rotating axis such that rotation of any spool is mechanically independent of the other two.

The single stage N_1 compressor (fan) is driven by a three-stage turbine. The seven-stage N_2 and six-stage N_3 compressors are each driven by a single-stage turbine.

Fan discharge airflow is divided at approximately 5 to 1 ratio between two separate streams. The large flow from the outer fan zone is discharged through the cold stream bypass duct to produce about 75% of the total thrust. The second flow from the central fan zone is discharged to the core engine for hot stream generation.

N_2 and N_3 compressor bleeds provide airflow for the engine and aircraft pneumatic systems. Airflow for engine internal cooling is bled from all compressors.

To ensure an adequate surge margin through the whole RPM range of the intermediate compressor, an automatic airflow control system employing variable inlet guide vanes (VIGV's) is installed. The VIGV's are located just to the rear of the fixed inlet guide vanes at the air inlet to the intermediate pressure compressor. At low pressure ratios they are fully closed and progressively open with increasing values, being fully open at cruise conditions and above.

ENGINE FUEL SYSTEM

ENGINE FUEL PUMPS

The engine fuel pumping system consists of a low pressure centrifugal pump and a high pressure gear pump, both driven by a common shaft. The low pressure pump prevents cavitation of the high pressure pump. A spill and relief valve system returns excess fuel to the inlet of the high pressure pump.

FUEL CONTROL AMPLIFIER

An overtemp/overspeed control system on each engine provides for automatic limiting of TGT/RPM during high-thrust conditions. The Fuel Control Amplifier reacts to overspeeds and/or overtemps by reducing fuel to the engine sufficiently to hold TGT or N_2 RPM within limits.

Placing the FUEL CONTROL AMPLIFIER switch in OVRD (override) turns off the system. Overspeeds and overtemps must be controlled manually with the throttles.

FUEL FLOW REGULATOR

The fuel flow regulator and fuel pressure ratio control unit function to provide the required engine fuel.

Basically, the fuel flow regulator meters fuel to the spray nozzles to establish and maintain engine conditions as selected by the throttle levers. Ground idle RPM is approximately 60% N_3, or 10% less than flight idle. Minimum N_3 RPM is set at the flight idle limit automatically when airborne, when throttles are advanced to takeoff range, or when reverse thrust is selected.

ENGINE OIL SYSTEM

The engine oil system supply is contained in a tank on the external gear box. A pressure pump supplies oil through a filter to lubricate gears and bearings, then scavenge pumps return it to the tank through oil coolers and a scavenge filter. Air from the compressors is used to pressurize oil seals to prevent leakage.

The oil temperature gauge indicates oil temperature after passing through the filter, prior to going to the bearings. Oil is cooled by a fuel/oil cooler.

ENGINE STARTING AND IGNITION SYSTEMS

The engine starting and ignition systems consist of a pneumatic starter which rotates the N_3 rotor assembly through the accessory gear box drive, two dual output (high and low energy) igniter units, and two igniter plugs. The starter is driven by an external air supply, or by bleed air from any operating engine or the APU. Controls for selection of ignition and initiation of the start cycle are located on the pilots' overhead panel. Fuel and ignition switches are located just aft of the throttles.

When the GROUND START/ASSIST AIR START switch is pressed:

- GRD START/ASSIST AIR START is automatically held in until starting sequence is complete.
- Engine isolation and start valves are armed to open.
- APU is signaled to go to MAX MODE.
- PUSH legend in GROUND START RELEASE switch is illuminated.
- FUEL AND IGNITION switch is armed for high energy ignition.
- Starter valve is armed to open.

When the FUEL AND IGNITION switch is placed to **ON**:

- Engine high pressure fuel valve opens.
- Circuit is complete to selected ignition system.
- Starting fuel flow regulator is energized.

At approximately 46% RPM N_3:

- Start valve closes and engine isolation valve goes to pressure regulating mode.

At approximately 55% RPM N_3:

- Ground start switch is released.
- PUSH legend in ground start release switch is extinguished.
- Start ignition is terminated.
- Generator field breaker closes.

GROUND START RELEASE

The GND START RELEASE switch, if pressed while PUSH is illuminated, will:

- Release the GND START/ASSIST AIR START switch.
- Close start valve and engine isolation valve.
- Terminate ignition.

FLIGHT START

When latched, the WINDMILL AIR START switch provides high energy ignition to both ignitors if the fuel and ignition switch is on. The WINDMILL AIR START switch will remain latched until manually unlatched. There is no automatic release function.

CONTINUOUS IGNITION

Latching the CONTINUOUS IGNITION switch ON provides low energy ignition to both ignitor plugs. If an engine is shut down, continuous ignition on that engine is deactivated when the FUEL AND IGNITION switch is moved to **OFF**.

ENGINE THRUST MANAGEMENT

The method used to measure thrust on the RB-211 engine is EPR. EPR is based upon the fan and gas generator exhaust.

The rated EPR limit for the flight mode and the engine bleed air condition can be obtained from the ODM power charts, the rated EPR computer or the FLIGHT MANAGEMENT SYSTEM (FMS).

RATED EPR COMPUTER

The rated EPR computer determines the rated EPR limit for any of the six flight modes and four engine bleed air conditions which is displayed on the TAT/EPR gauge. The computer receives temperature inputs on the ground from the runway temperature selector on the rated EPR mode panel, located on the Second Officer's panel. Inflight, temperature inputs are received from the right temperature probe, pressure altitude inputs from ADC No. 2, and four engine bleed air conditions which are:

- No bleed.
- Any ECS packs using engine bleed air.
- Wing anti-ice.
- Engine anti-ice.

THRUST REVERSERS

A pneumatically actuated reverser system is used to reverse the fan stream air.

Movement of the throttle-mounted reverser levers electrically energizes valves which allow high pressure bleed air to be directed to the actuating system. The high pressure air unlocks the reverser and operates the air-driven reverser motor to drive the translating cowl to the reverse position in approximately two seconds. Fan air is then redirected for reverse thrust. A mechanical stop on each reverser lever prevents movement of the reverser lever beyond the reverse idle position until the doors are past the mid-travel position. This assures reverser doors operation and prevents inadvertent application of forward thrust.

Similarly, when the reverser levers are returned to the forward thrust position, a mechanical stop prevents movement of the throttle levers beyond idle position until reverser is past the mid-travel position.

Reverser operation in the air is prevented by air/ground sensing.

Annunciator lights on the pilots' instrument panel and on the second officer's panel indicate the status of the system.

THROTTLE ACTUATED WARNING DEVICES

If flaps, slats, speed brake or stabilizer trim settings are incorrect for takeoff, a takeoff warning horn sounds when throttles are advanced. The same horn sounds on the ground if an elevator jam is detected and the throttles are retarded.

When airborne, gear and flaps up, an aural warning is given below 180 knots when throttles are retarded.

AIRBORNE VIBRATION MONITOR

The airborne vibration monitor (AVM) system continuously indicates the engine vibration level, thereby monitoring the state of balance of the engine main rotating assemblies. The engine vibration indicator displays vibration level units on the second officer's panel.

Selector switches are provided to select and read fan vibrations from two separate pick-up points, (A or B). The A switch is normally latched.

A frequency selector switch allows the examination of a vibration reading to determine what portion of it is attributed to high, low and mid frequencies. For operational purposes, the selector switch is kept in the NORMAL position.

Either the A or B fan pickup vibration can be read by latching the respective switch. With both switches latched, the reading is unreliable.

NO. 2 ENGINE FAIL INDICATIONS

To reduce recognition time of failure of the center (No. 2) engine, a monitoring system is used to alert the pilot. The system consists of an **ENGINE 2 FAIL ARMED** light (Green) on the Pilot's Annunciator Panel, and two ENG 2 FAIL lights (Amber) on the glareshields. To operate, the flaps must be within the takeoff range and the aircraft on the ground.

When takeoff power is applied, the monitoring system is armed as the No. 2 engine N_2 accelerates through approximately 83%. This is annunciated by the illumination of the green ENGINE 2 FAIL ARMED light on the Pilot's Annunciator Panel. If N_2 subsequently decreases through approximately 79%, a steady amber ENG 2 FAIL warning is illuminated on each pilot's glareshield. (A false warning prior to advancing throttles, may be reset by pressing either ENG 2 FAIL warning light).

N_3 OVERRIDE SWITCH

The N_3 indicator is most important during engine start. Not only does it provide a display of N_3 speed, but also, it contains switching circuits which provide specific automatic control functions to the engine starting cycle.

N_3 indicator fluctuations during the engine start phase can generate erroneous signals which could prevent a successful start. In this case, the N_3 override switch can be used to inhibit the control features mentioned above.

THRUST REVERSER LEVERS

Selects and regulates reverse thrust. Interlock prevents engine acceleration until reversers are extended.

1H16, 17, 18 - THRUST REVERSERS

THROTTLE LEVERS

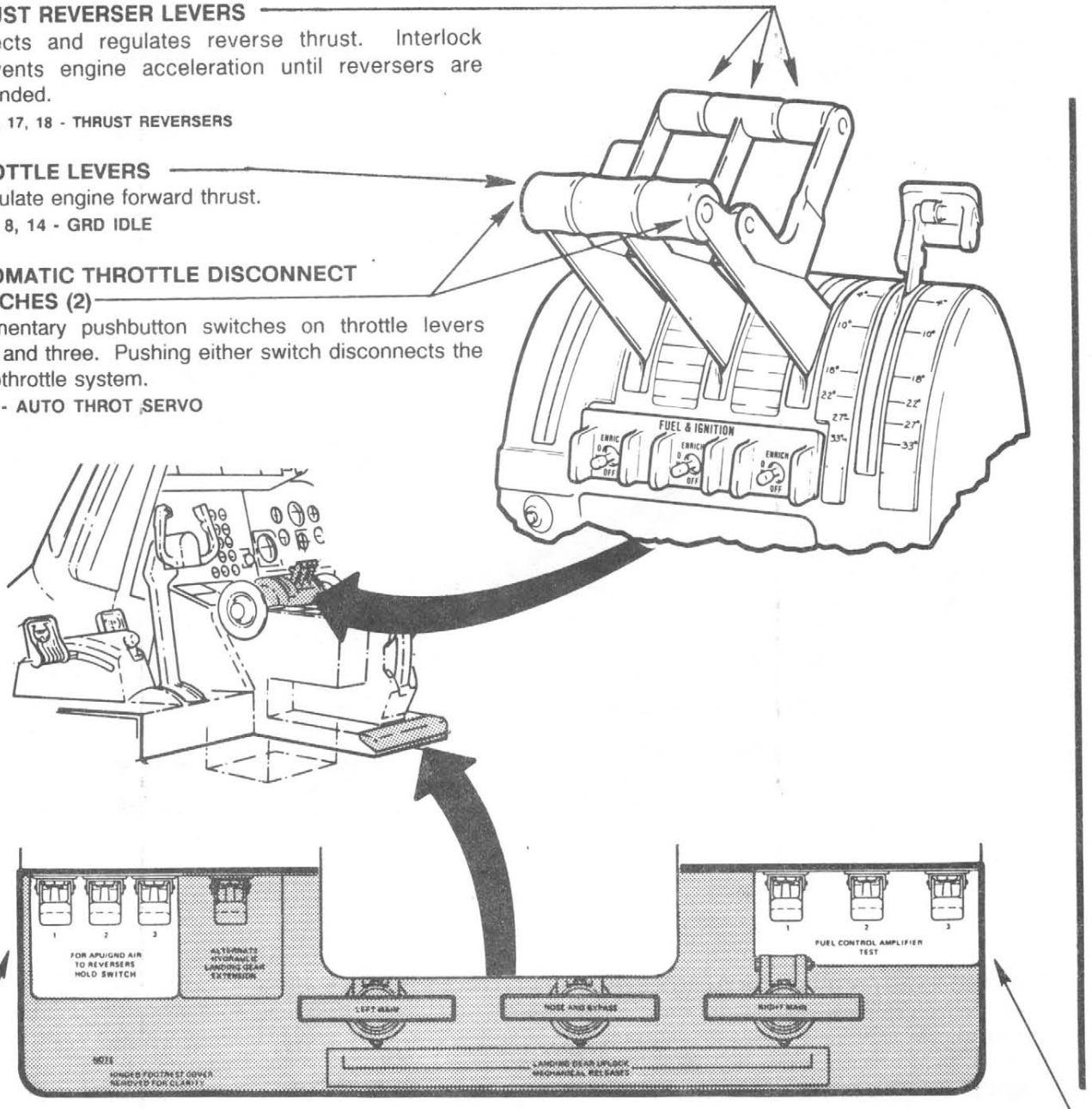
Regulate engine forward thrust.

3N2, 8, 14 - GRD IDLE

AUTOMATIC THROTTLE DISCONNECT SWITCHES (2)

Momentary pushbutton switches on throttle levers one and three. Pushing either switch disconnects the autothrottle system.

1A1 - AUTO THROT SERVO



(CENTER CONSOLE)

REVERSER TEST SWITCHES (3)

Momentary toggle switches which when held in the down position, test reverser operation. The high pressure and engine isolation valve switches must be latched in; reversers can then be operated with normal indications.

1H16, 17, 18 - THRUST REVERSE

FUEL CONTROL AMPLIFIER TEST SWITCHES (3)

(Fuel Control amp. SW for MTC only.)

Momentary toggle switches which when held in the down position, send a false signal to the amplifier.

N_2 RPM will decrease; TGT and fuel flow also decrease proportionately.

3P6, 12, 18 - CONT AMP

CONTINUOUS IGNITION SWITCH

IN - **ON** is illuminated and both low energy ignition systems are energized when the Fuel and Ignition switches are turned **ON**.

OUT - Deenergizes both low energy ignition systems. ON is extinguished.

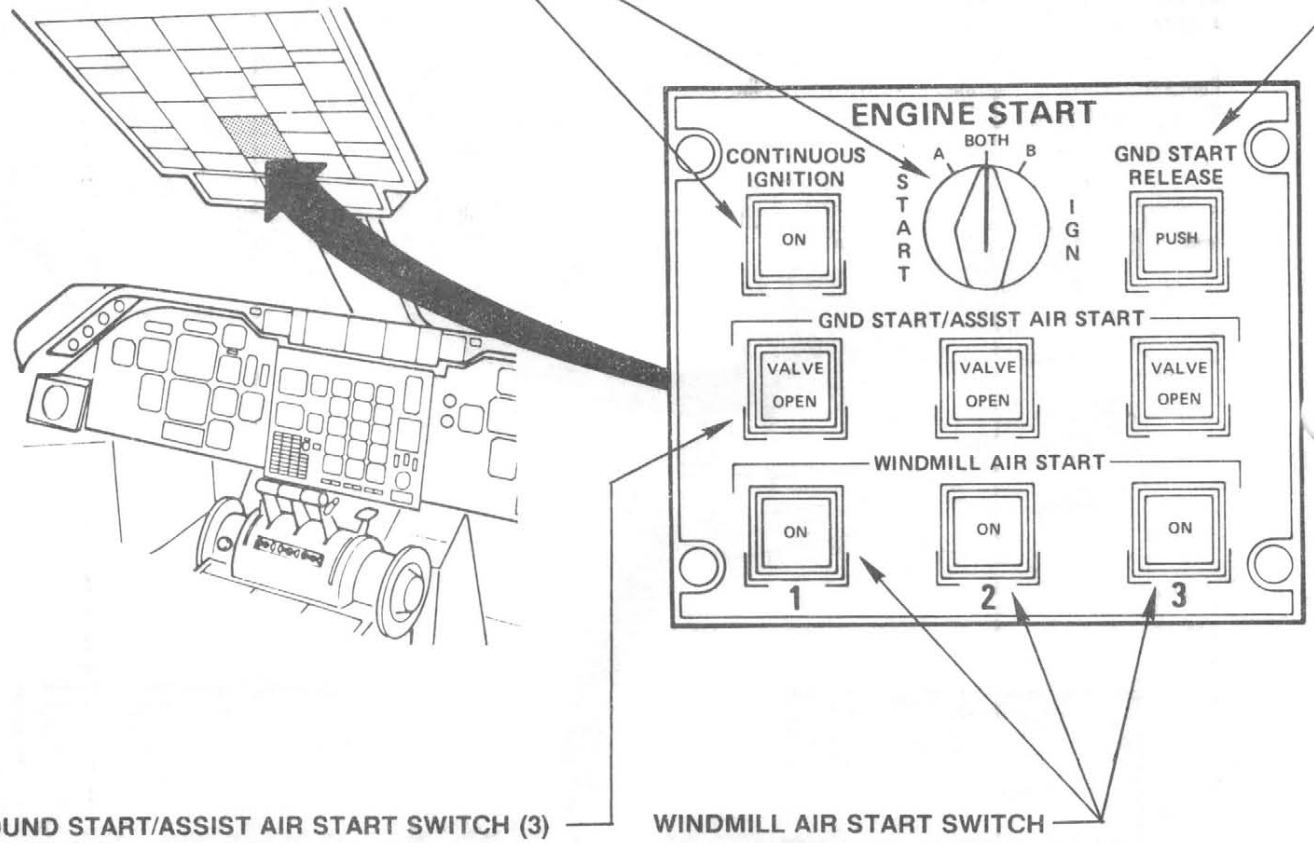
3R8, 9 - CONT IGN, SYS A, SYS B

IGNITION SYSTEM SELECTION SWITCH

Three-position rotary switch that selects ignition system A, B, or BOTH systems for GND START/ASSIST AIR START SWS.

GROUND START RELEASE SWITCH

Pressing momentary pushbutton switch deenergizes the start system. **PUSH** is illuminated while the GND START/ASSIST AIR START switch is in. PUSH is extinguished and the GND START/ASSIST AIR START switch is released when switch is pushed and held in for approximately two seconds, or when N_3 compressor reaches approximately 55% RPM.



GROUND START/ASSIST AIR START SWITCH (3)

Pressing switch arms high energy ignition system and arms engine start valve to open with pressure, and switch is electrically held in. **VALVE OPEN** and **PUSH** (on GRD START RELEASE switch) are illuminated. At approximately 46% N_3, the VALVE OPEN light is extinguished. At approximately 55% N_3, the GND START/ASSIST AIR START switch is automatically released, with an audible click, and the GRD START RELEASE PUSH light is extinguished.

3N6, 12, 18 - START IGN SYS A

1F13, 14, 15 - B START IGN

3F10 - ENG START PWR

3N3, 9, 15 - START AIR VALVE

WINDMILL AIR START SWITCH

IN - **ON** is illuminated and both high energy ignition systems are energized when the Fuel and Ignition switches are turned on.

OUT - Deenergizes both high energy ignition systems and ON is extinguished.

3N6, 12, 18 - START IGN SYS A

1F13, 14, 15 - B START IGN

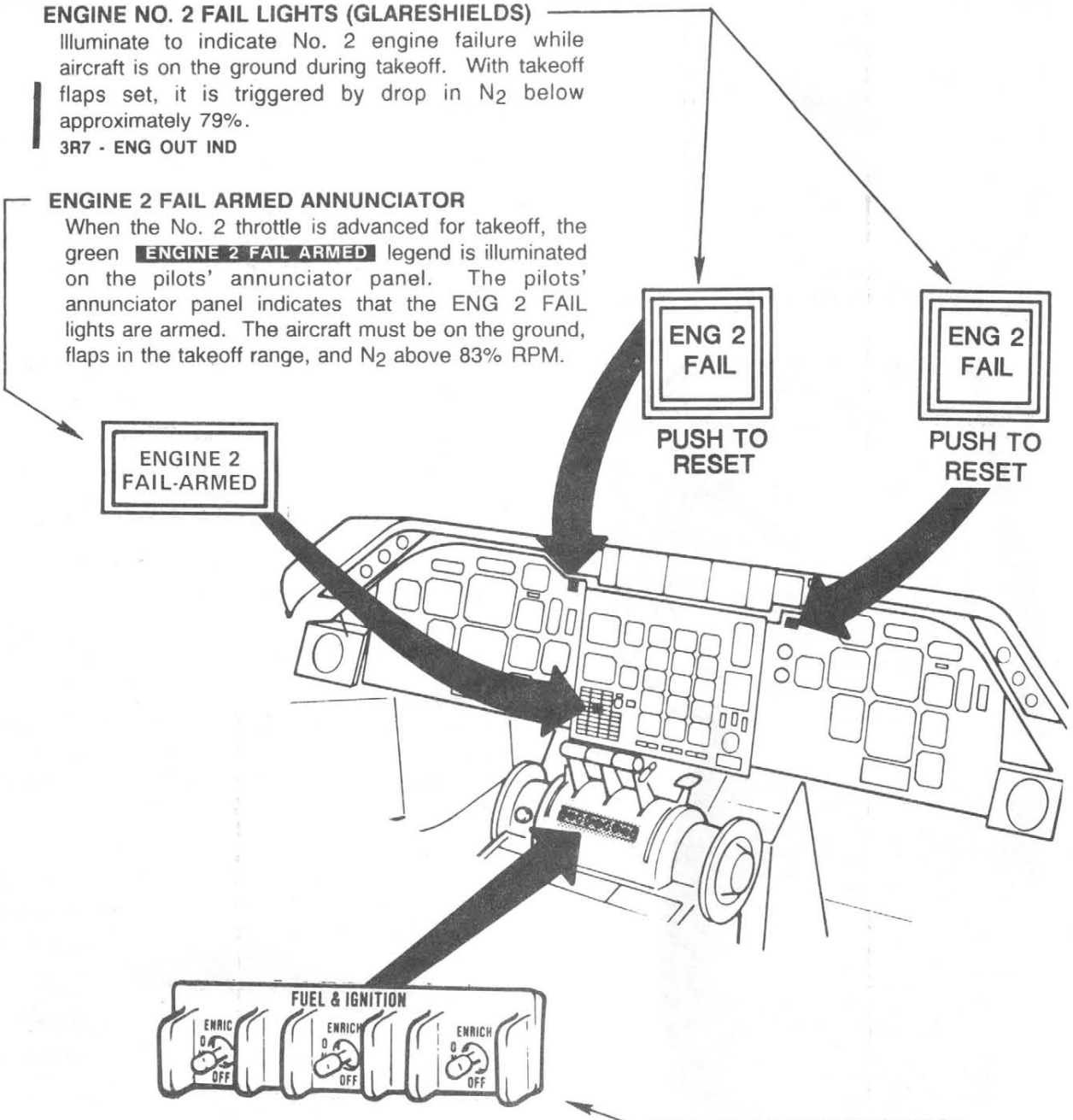
ENGINE NO. 2 FAIL LIGHTS (GLARESHIELDS)

Illuminate to indicate No. 2 engine failure while aircraft is on the ground during takeoff. With takeoff flaps set, it is triggered by drop in N_2 below approximately 79%.

3R7 - ENG OUT IND

ENGINE 2 FAIL ARMED ANNUNCIATOR

When the No. 2 throttle is advanced for takeoff, the green **ENGINE 2 FAIL ARMED** legend is illuminated on the pilots' annunciator panel. The pilots' annunciator panel indicates that the ENG 2 FAIL lights are armed. The aircraft must be on the ground, flaps in the takeoff range, and N_2 above 83% RPM.



FUEL AND IGNITION SWITCH

Three-position toggle switch.

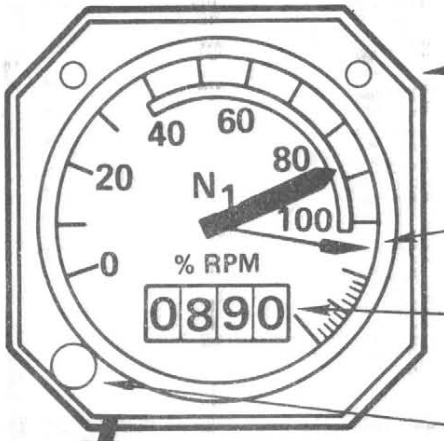
ON - Completes all ignition circuits to engine and opens high pressure fuel shutoff valves on fuel control.

OFF - Deactivates all ignition circuits to engine, closes high pressure fuel shutoff valves, and opens the respective generator field.

ENRICH - Spring-loaded position that adds fuel for starting.

1E13, 14, 15 - ENGINE START CONT

1F13. 14. 15 - B START IGNITION



N_1 TACHOMETER (3)
Indicates % of RPM of the fan (LP) compressor. Secondary thrust setting instrument.
3P2, 8, 14 - TACH N1

N_1 OVERSPEED POINTER (3)
Indicates and remains at overspeed RPM reached. Reset using the max indicator reset switch.

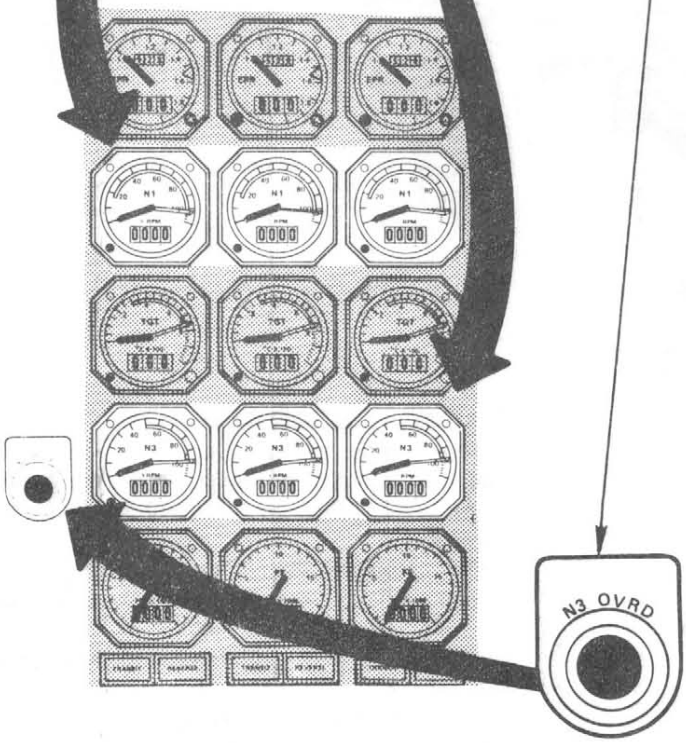
N_1 POINTER/COUNTER
Pointer indicates gross N_1 RPM. Counter indicates fine N_1 RPM. Counter flag drops when indicator fails.

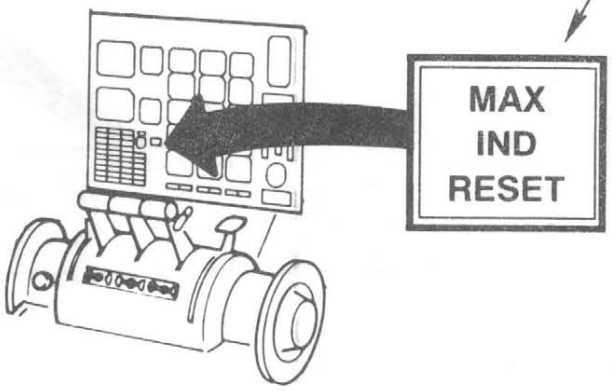
TEST BUTTONS
Pressing momentary pushbutton tests indicator. Pointer drives to 12 o'clock position to indicate normal operation.

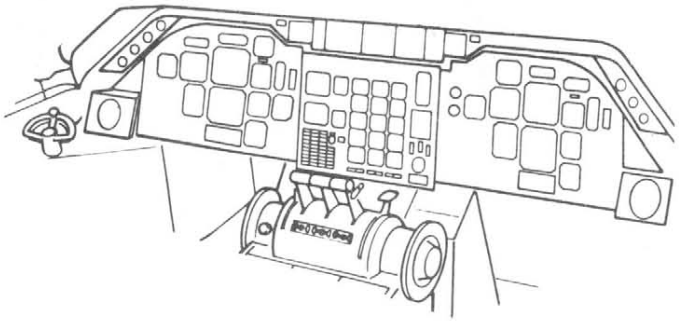
N_3 TACHOMETER (3)
Indicates % RPM of HP compressor. The N_3 pointer/counter and overspeed pointer operates the same as for N_1 tachometer.
1E10, 11, 12 - TACH N3

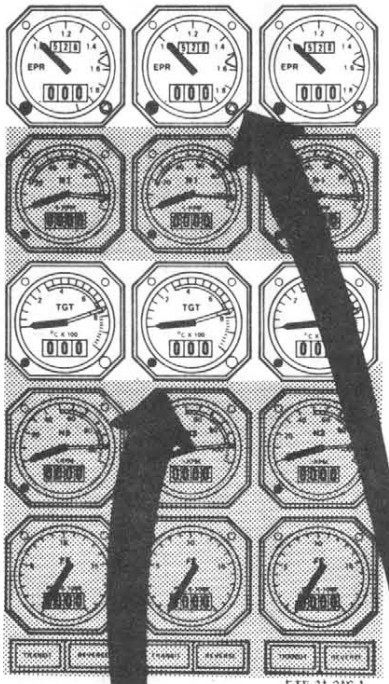
MAX INDICATOR RESET SWITCH
Momentary action switch that resets max. pointers.
3R15 - ENG INSTR RESET

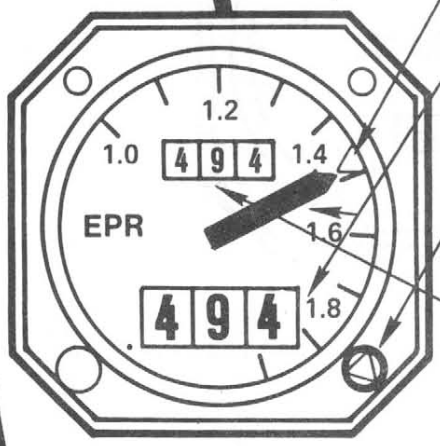
N3 OVERRIDE SWITCH
Overrides N_3 automatic switching functions when indicator fluctuates, so start may continue. Press and HOLD switch while override is desired. (Inoperative in flight).

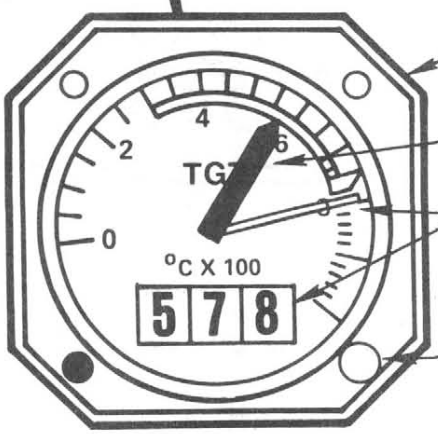












ENGINE PRESSURE RATIO INDICATOR - EPR (3)
Indicates ratio of integrated exhaust pressure to engine inlet pressure. Indicated value is proportional to thrust output. Primary thrust setting instrument.
3L5, 11, 17 - EPR IND

EPR BUG
Positioned by EPR set knob.

EPR POINTER/COUNTER
Pointer indicates gross engine EPR. Counter indicates fine engine EPR. Counter flag drops when indicator fails.

EPR SET KNOB
Positions EPR bug and numerical value in set counter.

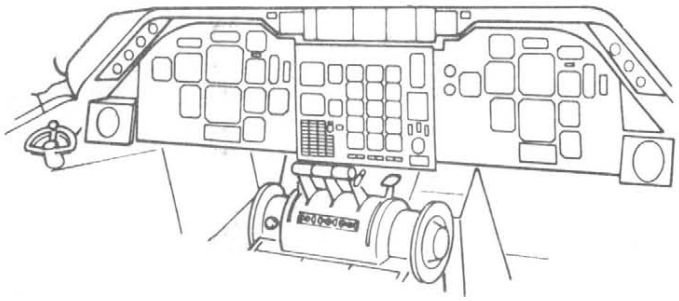
SET COUNTER
Indicates EPR bug position set with knob.

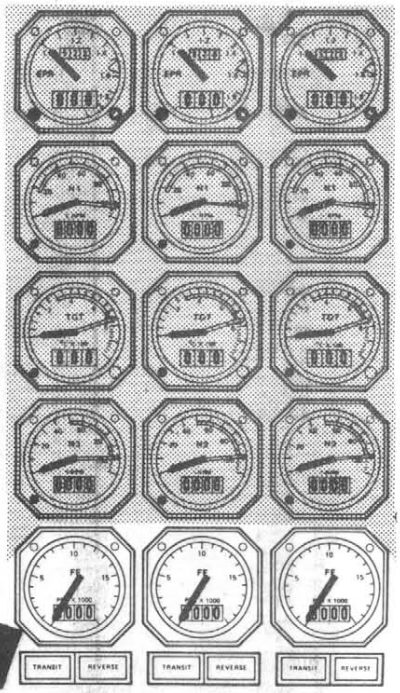
TURBINE GAS TEMPERATURE INDICATOR (TGT)
Indicates temperature of exhaust gas entering turbine inlet.
1F10, 11, 12 - TGT

TGT POINTER/COUNTER
Pointer indicates gross TGT. Counter indicates fine TGT. Counter flag drops when indicator fails.

OVER TEMPERATURE POINTER
Indicates and remains at overtemp reached. Reset using max indicator reset switch.

TGT CAUTION LIGHT (RED)
Indicates TGT is above 750°C.
3R11 - TGT WARN

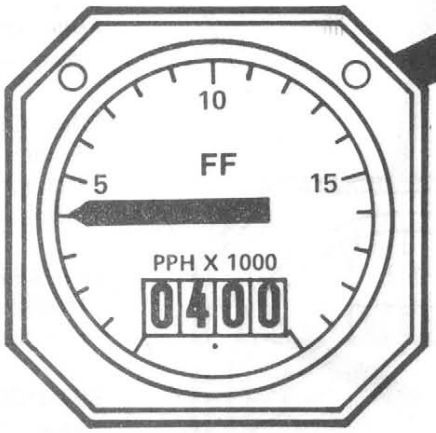


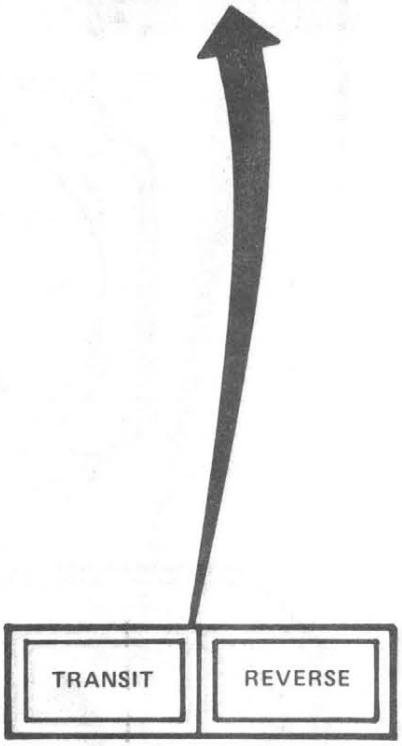


FUEL FLOW INDICATOR (3)

Indicates pounds per hour rate of metered fuel delivered to the engine.

3P5, 11, 17 - FUEL FLOW





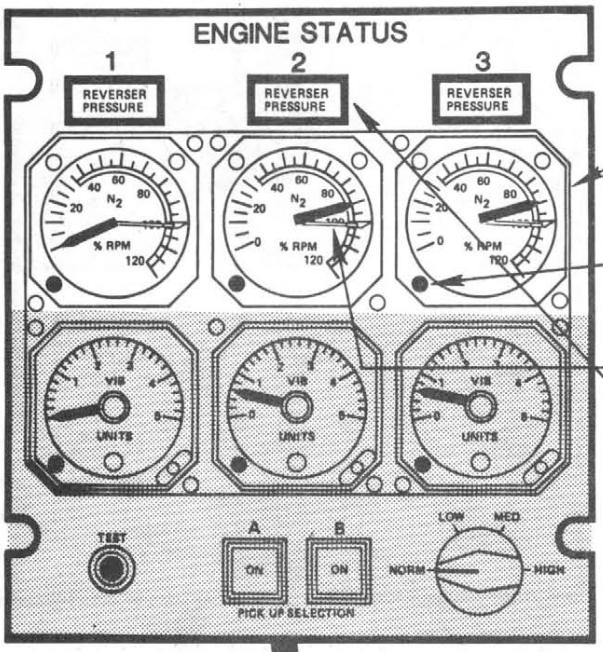
REVERSER INDICATOR LIGHTS (3 Sets)

TRANSIT and REVERSE are extinguished in forward thrust.

TRANSIT is illuminated any time reversers are not stowed and locked.

REVERSE is illuminated any time reversers are fully deployed.

3N4, 10, 16 - REV IND



N2 TACHOMETER (3)

Indicates % RPM of intermediate pressure compressor.

3P3, 9, 15 - TACH N_2

N2 TACHOMETER TEST BUTTON

Holding pushbutton switch in tests indicator by driving wide pointer to the 91% position.

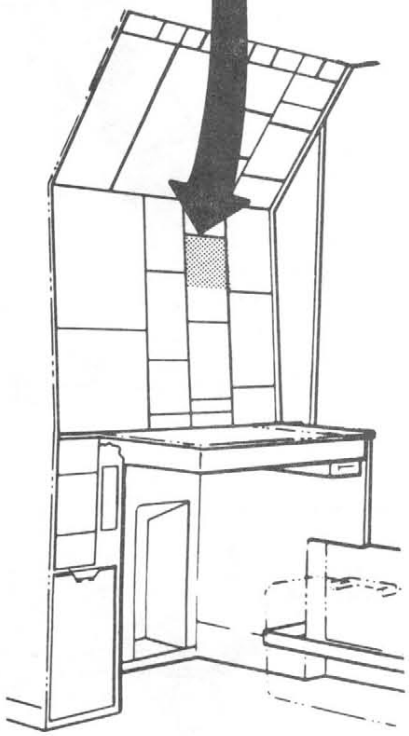
OVERSPEED POINTER

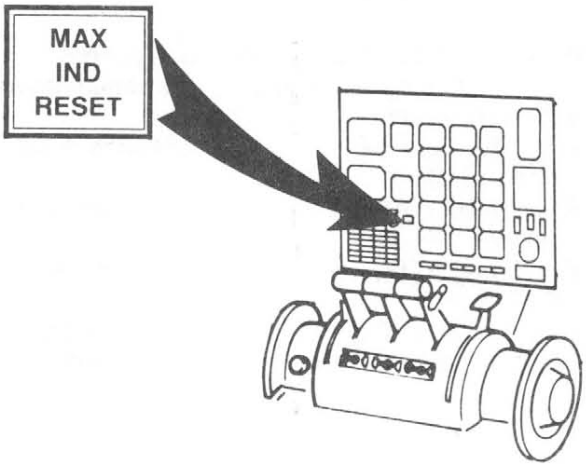
Indicates maximum attained RPM above 106% and remains at this point until reset with MAX IND RESET switch.

REVERSER PRESSURE INDICATOR LIGHT (3)

Indicate HP bleed supply air is available to operate reversers.

3N4, 10, 16 - REV IND





ENGINE VIBRATION INDICATOR (3)
Indicates a continuous reading of the vibration level as selected by pickup selector and filter selector.
3R2 - ENG VIB

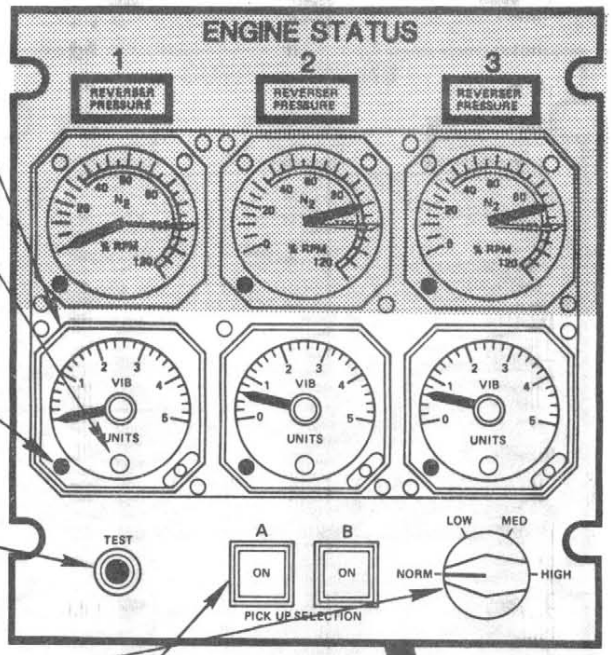
ENGINE VIBRATION CAUTION LIGHT (AMBER)
Light indicates abnormal vibration level. Also the ENG VIB FLTR PRESS light illuminates on the Pilot's Annunciator Panel after a two second delay.
3R3 - ENG VIB LT

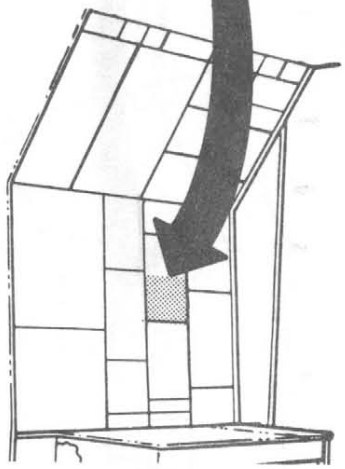
VIBRATION MONITOR TEST BUTTON
When pressed, tests indicator by driving pointer to approximately 4 units and illuminating engine vibration caution light.

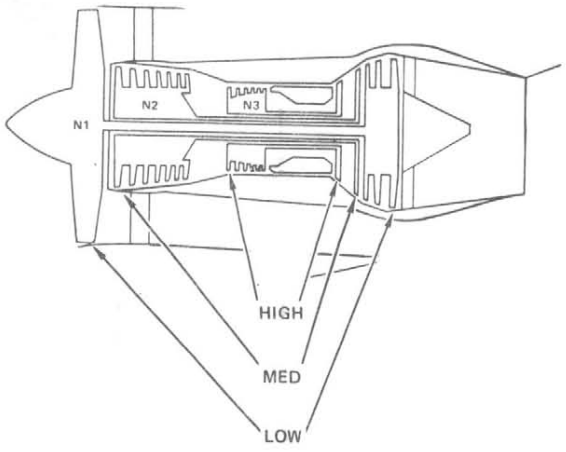
TEST BUTTON
Momentary pushbutton. When pressed, tests vibration system and indicators. Pointers move to approximately 4 units and the engine vibration caution light is illuminated.

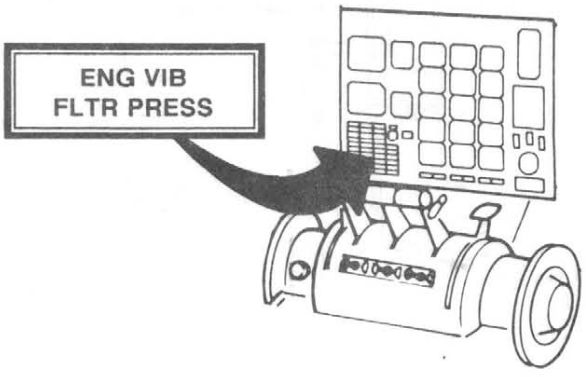
BROAD BAND VIBRATION FILTER SELECTOR
Four position rotary switch that selects frequency to be read on all engines simultaneously.

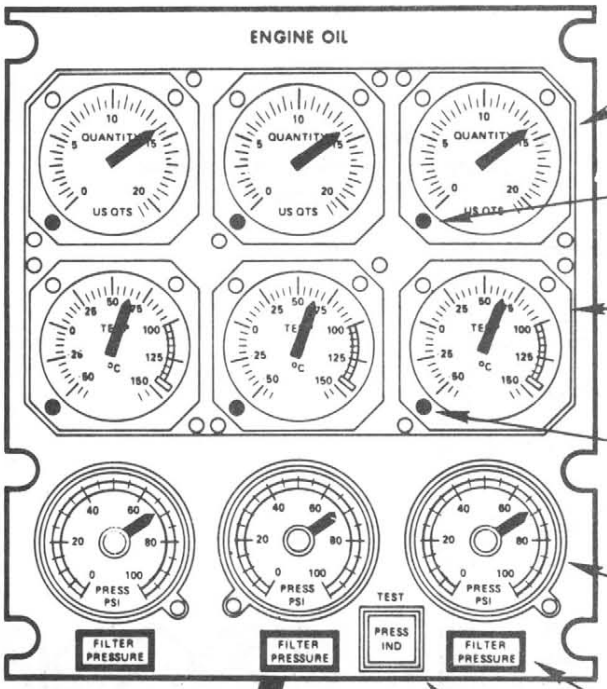
VIBRATION PICKUP SELECTOR SWITCHES
NOTE: Latching A and B switches simultaneously will cause invalid indications.
LCH - ON illuminates. Normal position is A latched ON, B unlatched.
A - Selects A pickup signal from all engines simultaneously.
B - Selects B pickup signal from all engines simultaneously.
UNL - ON extinguishes. With both ON lights extinguished, both A and B pickups are operating.











ENGINE OIL INDICATORS

OIL QUANTITY INDICATOR (3)
Indicates usable oil remaining in engine oil tank.
3R14 - OIL QTY

OIL QUANTITY TEST SWITCH
Momentary pushbutton switch that tests oil quantity indicator by driving pointer to 12 o'clock position.

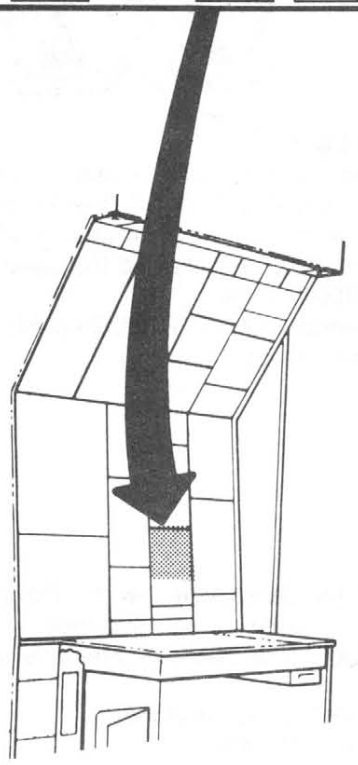
OIL TEMPERATURE INDICATOR (3)
Measures oil temperature after it passes through the pressure pump.
3P1, 7, 13 - OIL TEMP

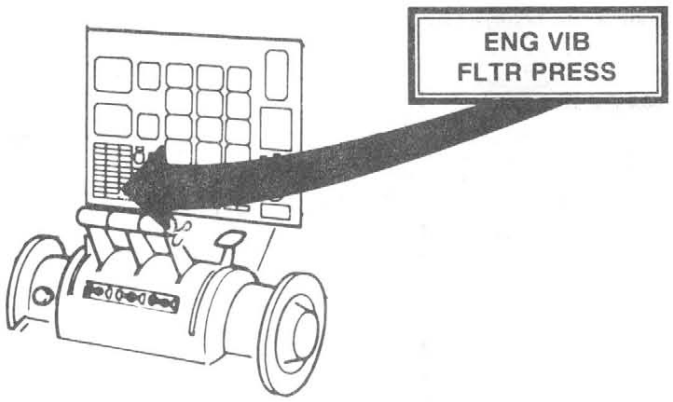
OIL TEMPERATURE TEST SWITCH
Momentary pushbutton switch that tests (oil temperature) indicator by driving pointer to 12 o'clock position.

OIL PRESSURE INDICATOR (3)
Indicates differential oil pressure between lubricating pump output and scavenge pump input.
3410 - OIL PRESS

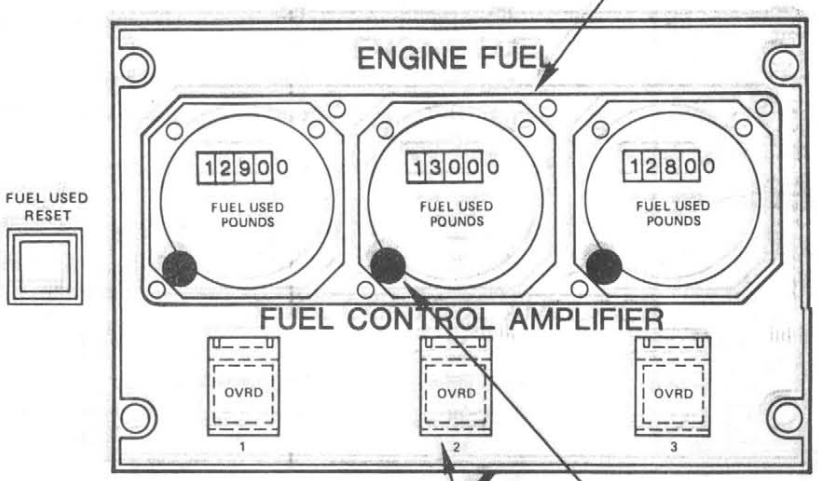
FILTER PRESSURE LIGHT (3)
FILTER PRESSURE is illuminated when pressure differential exists across oil filter because filter is becoming clogged. Also illuminates **ENG VIB FLTR PRESS** light on Pilot's Annunciator Panel.
3N5, 11, 17 - OIL LOW PRESS LIGHT

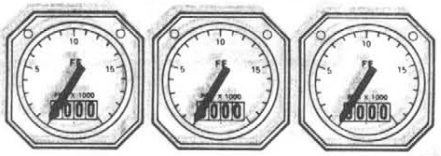
INDICATOR TEST
Pressing momentary pushbutton switch drives oil pressure indicator pointers to 9 o'clock position.

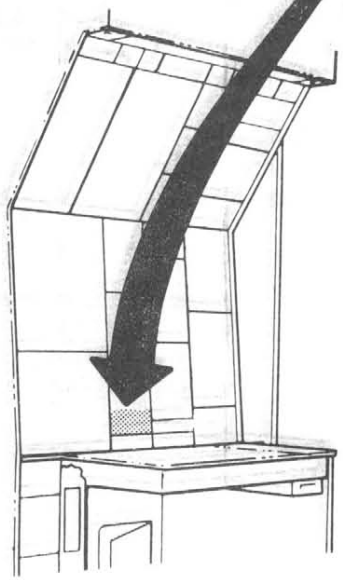




FUEL USED PANEL AND FUEL CONTROL AMPLIFIER PANEL







FUEL USED INDICATOR (3)
Indicates fuel used since last reset.
3P5, 11, 17 - FUEL FLOW

TEST KNOB (3)
Spring-loaded rotary knob for use on ground only.
- Turning knob CLOCKWISE checks fuel flow rate and fuel used system circuits, and drives FF indicators to 10,000 lbs/hr and fuel used indicators at a rate of 10,000 lbs/hr.
- Turning knob COUNTERCLOCKWISE checks only indicator's operation.

FUEL CONTROL OVERRIDE SWITCHES (3)
Guarded two position toggle switches.
IN - OVRD is illuminated. Overrides TGT and N_2 fuel limiting system.
OUT - **OVRD** is extinguished.
3P6, 12, 18 - CONT AMP

EPR FLIGHT MODE SELECTOR SWITCHES

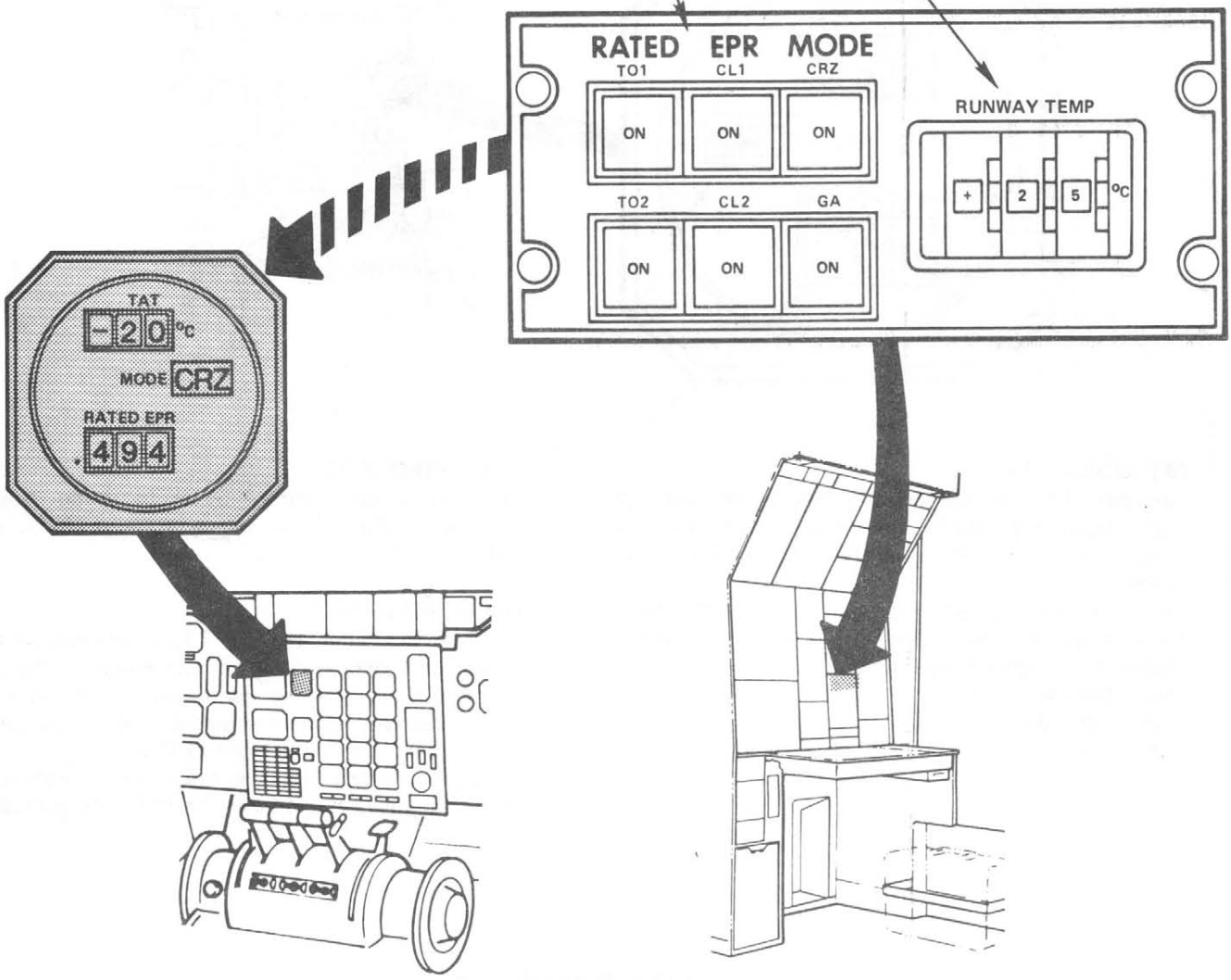
Momentary pushbutton switches used to select the computer rated EPR limit for the selected flight mode. EPR limit is indicated by the RATED EPR indicator of the TAT/EPR gauge. The flight modes are: TO1, CL1, CRZ, TO2, CL2 and GA.

ON is illuminated when its respective switch is momentarily pressed. Only one flight mode may be selected at a time. When power is initially applied to the aircraft, or after a power interruption of more than 20 seconds, the TO1 ON legend is illuminated.

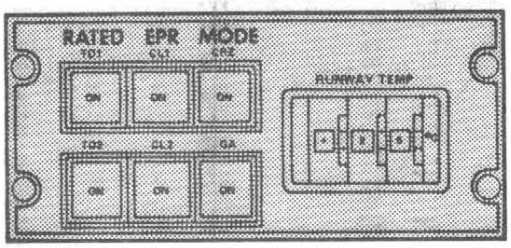
3R12 - TAT/EPR

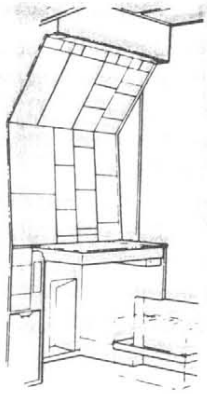
RUNWAY TEMPERATURE SELECTOR

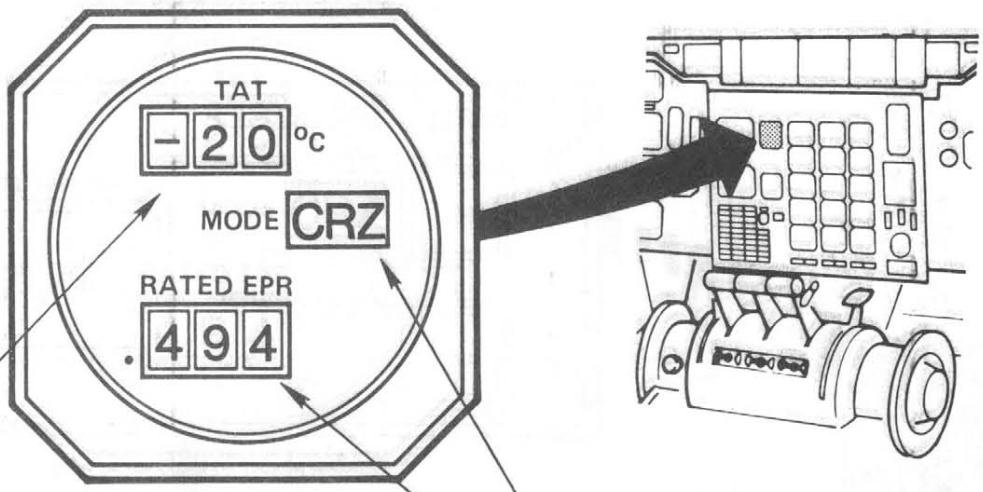
Thumbwheels provided to set runway temperature into the EPR computer. Used only for TAKEOFF modes TO1 and TO2.



RATED EPR MODE PANEL
SECOND OFFICER'S LOWER INSTRUMENT PANEL







TAT INDICATOR

Indicates total air temperature directly from the right temperature probe. TAT indications may be inaccurate on the ground if the temp. probe is heat soaked.

A failure flag appears over the indicator with power loss or system failure. Any TAT failure also causes a failure flag to appear over the RATED EPR indicator.

1H6 - EPR INDICATOR

3R12 - TAT/EPR

2H6 - EPR

MODE INDICATOR

Indicates mode selected by flight mode selector switches. The modes indicated are: TO1, CL1, CRZ, TO2, CL2 and GA.

RATED EPR INDICATOR

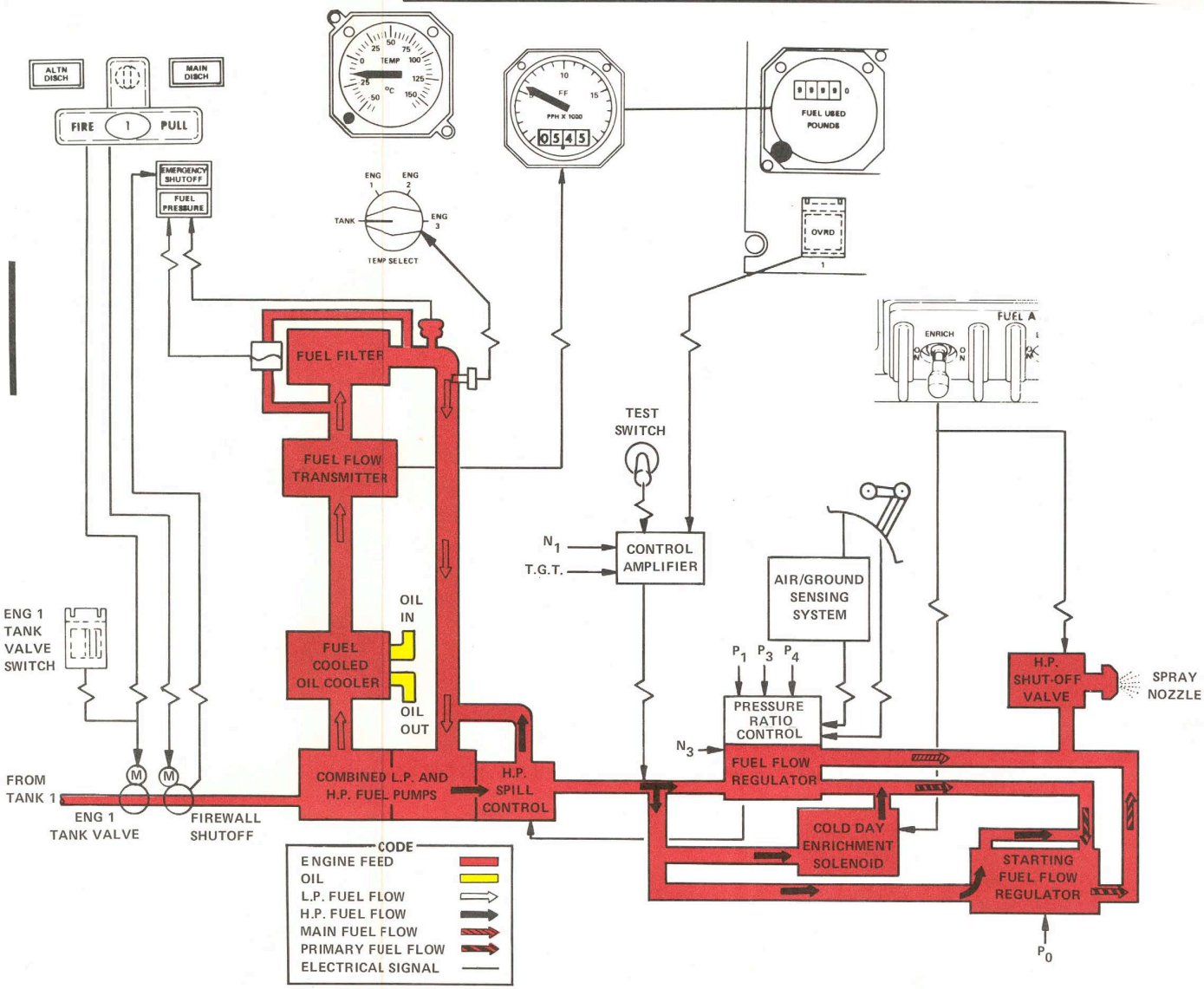
Indicates computer rated EPR limit for selected flight mode, and engine bleed air condition. The EPR indicator bugs (one for each engine) on the pilots' center instrument panel should be set to the desired EPR, not to exceed the rated EPR limit.

A failure flag appears over the indicator with power loss, computer system failure or TAT indicator failure.

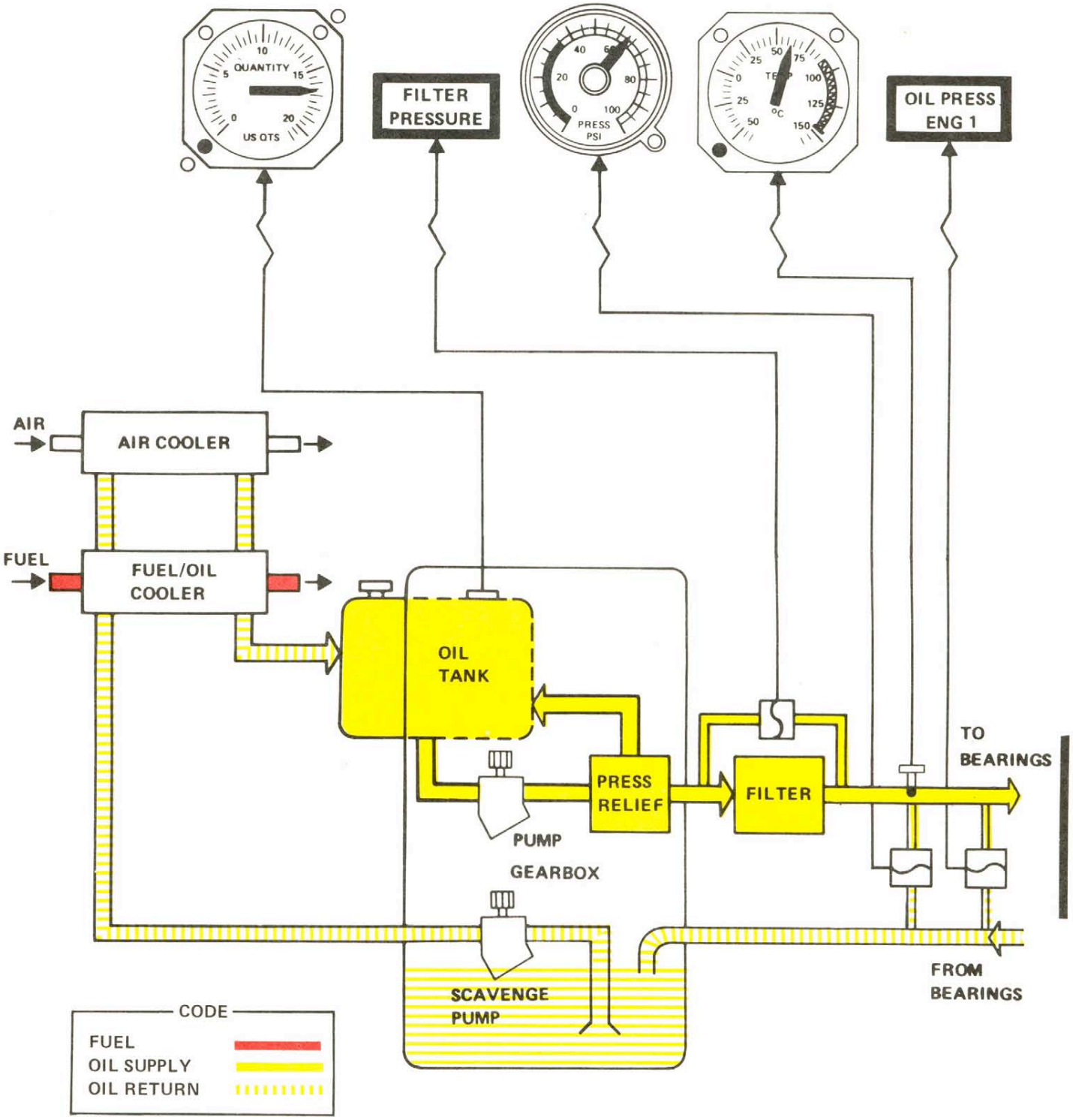
TAT/EPR INDICATOR

PILOTS' CENTER INSTRUMENT PANEL

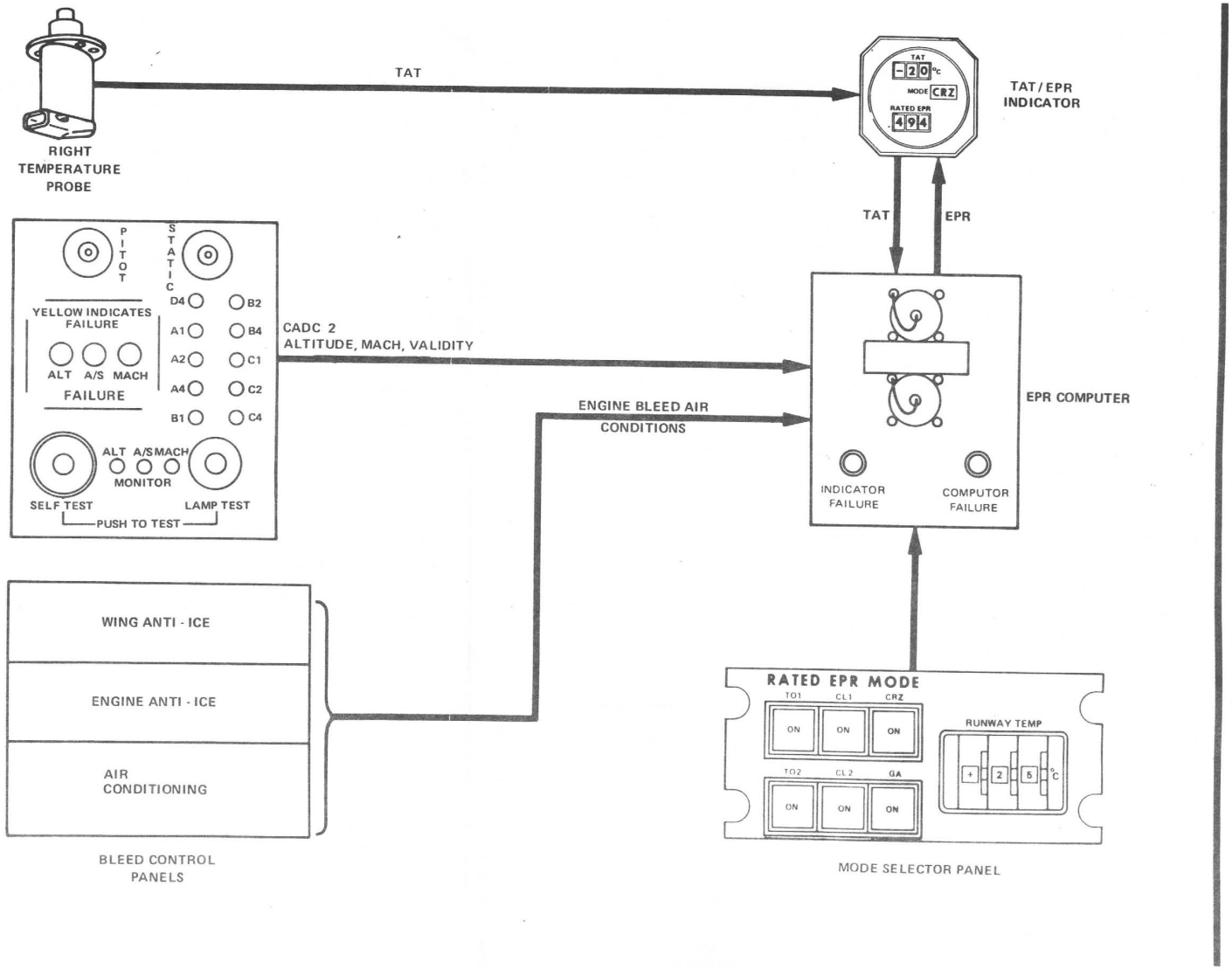
CONTROLS AND INDICATORS



ENGINE FUEL SYSTEM



ENGINE OIL SYSTEM



RATED EPR BASIC SYSTEM

POWERPLANT

GENERAL DESCRIPTION

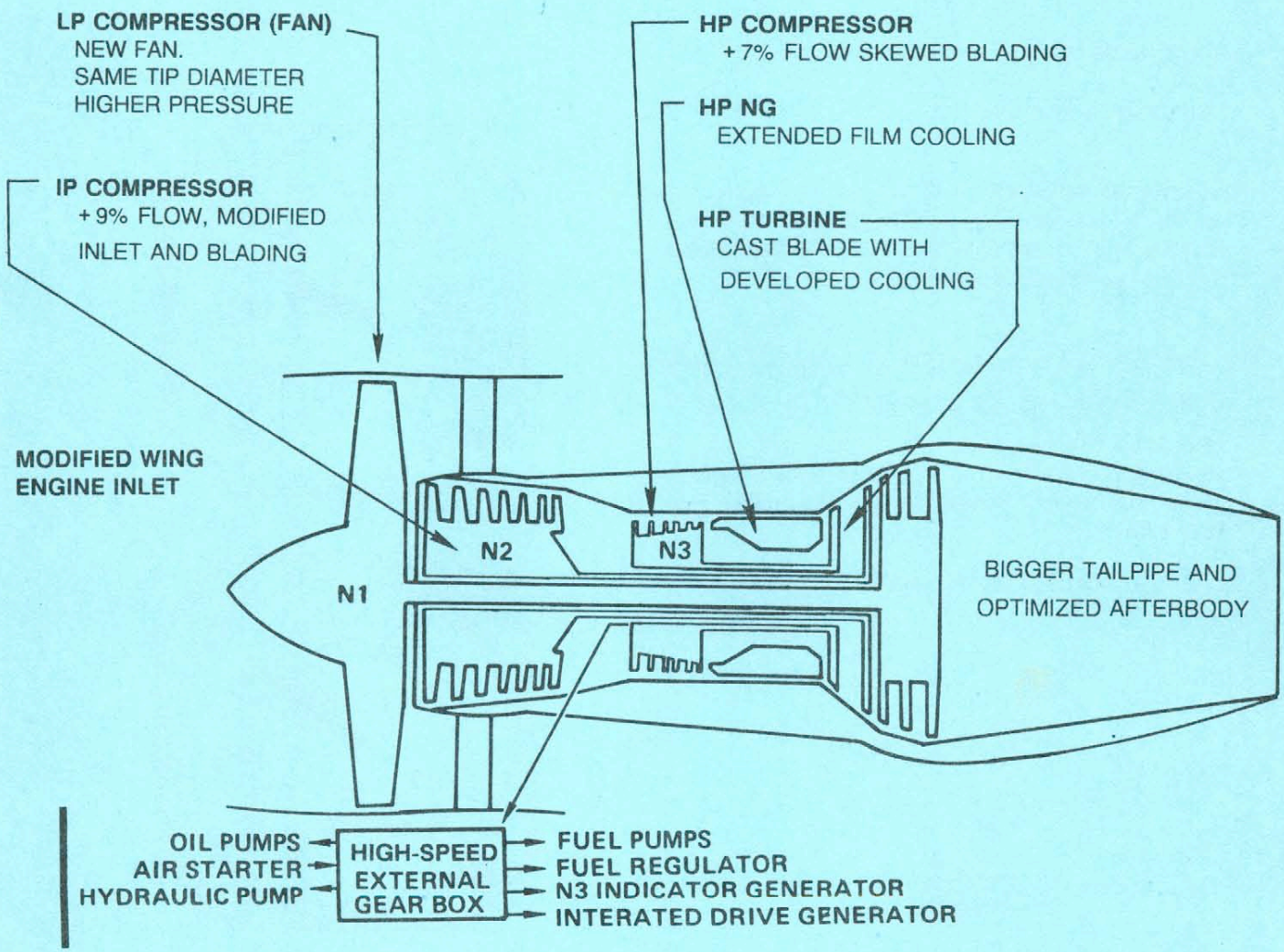
ENGINE DESCRIPTION

Power is furnished by three Rolls-Royce RB.211-524B engines. Engine maximum thrust is 50,000 pounds at standard day sea level conditions.

ENGINE FIRE SYSTEM

The engine fire extinguisher bottle pressure gauges, viewing ports and thermal discharge indicators have been deleted from nacelles on the wing engines and underneath the fuselage for APU and engine No. 2.

RB.211-524B CHANGES FROM -22B



PILOTS' ENGINE INDICATORS

The instrument faces and warning lights on the RB211-524B engine indications are the same as the RB211-22B engine indicators except that the operating range arcs, limit radials and overtemperature warning lights are changed to reflect the RB211-524B engine parameters.

SECOND OFFICER'S ENGINE INDICATORS

N_2 TACHOMETER (3)

scale range is from 0 to 120.

OVERSPEED POINTER

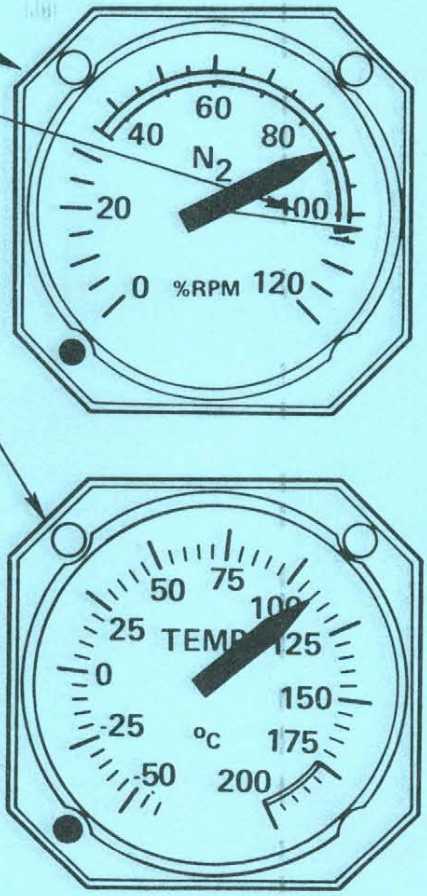
Indicates maximum attained RPM above 103% and remains at this point until reset with MAX IND Reset switch by maintenance crew.

OIL TEMPERATURE INDICATOR (3)

Scale range is from -50 to +200°C.

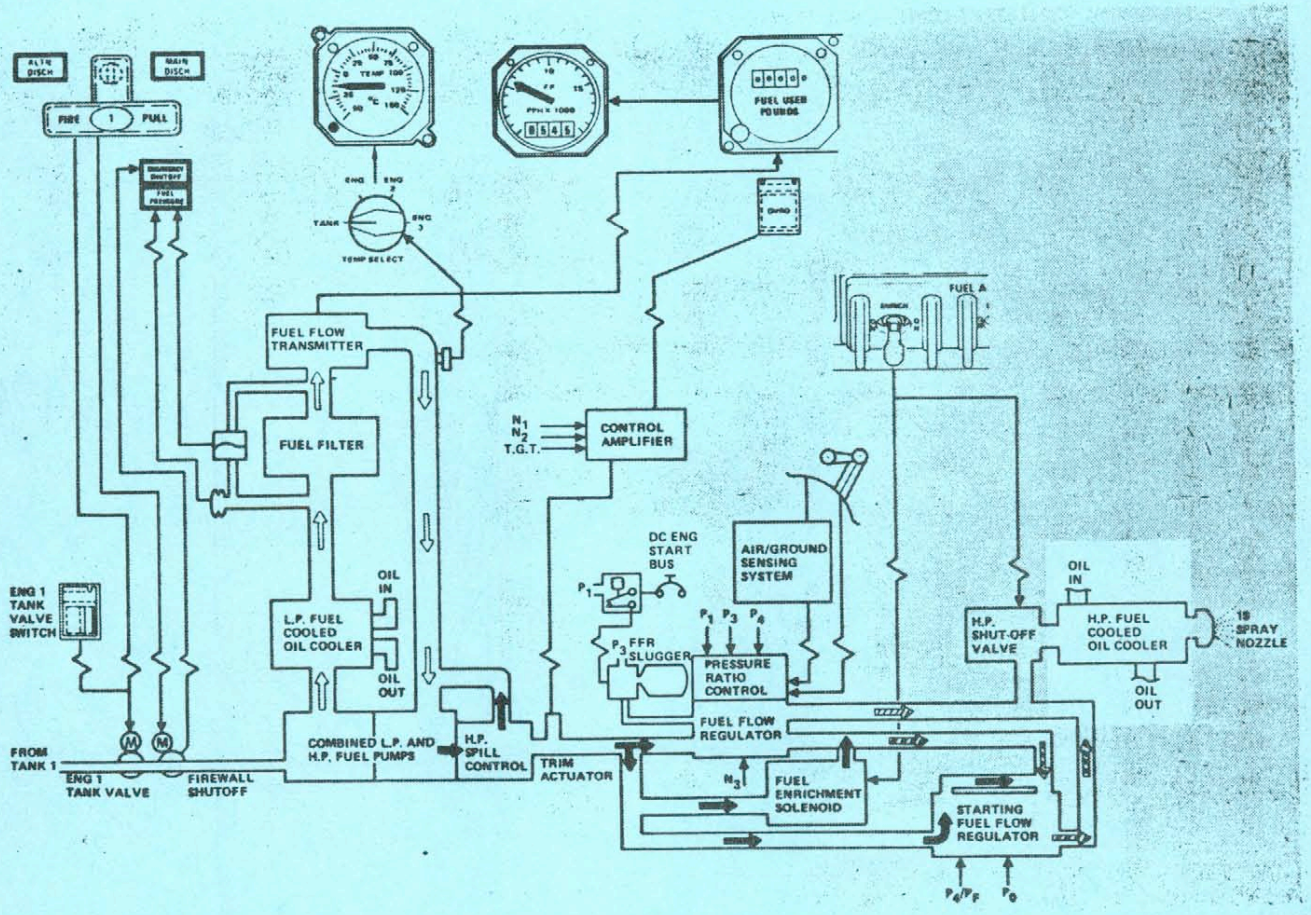
Normal oil temperatures are higher than on -1 aircraft due to the location of oil temperature sensor. Oil temperature no longer relates to engine fuel temperature.

3N5, 11, 17 - OIL LOW PRESS LIGHT

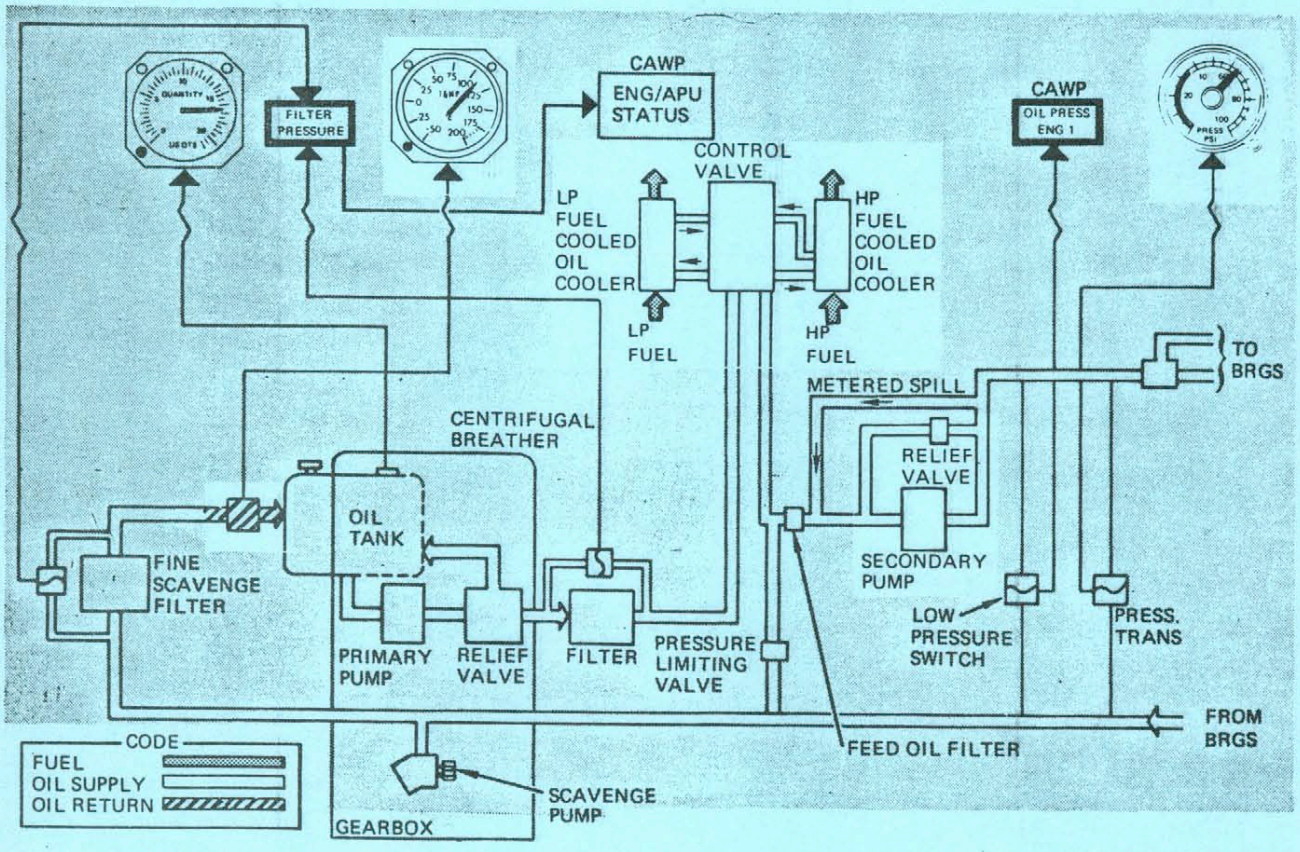


SCHEMATIC

ENGINE FUEL SYSTEM



ENGINE OIL SYSTEM



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PREFACE

This section is designed to provide L-1011 Flight Crews with reference material to assist in training and maintaining proficiency.

In the interest of creating one document that pilots can refer to for a general review of many situations that are likely to be encountered during training and line operations, some in-depth discussion pertaining to Normal, Abnormal and Emergency procedures is included in this section.

Where there is a conflict with other sections of the POM or the PRM, FOPM, FCB's or directives issued by Flight Operations Management, those publications will prevail and should be considered the "last word".

Consider this section as an expansion and discussion of Normal, Abnormal and Emergency procedures and how they might be **applied.**

It will be presented in three general categories..

- Those maneuvers and procedures associated with Normal flight operations which are accomplished during simulator and/or aircraft training.
- A discussion of flight maneuvers associated with Emergency or Abnormal situations.
- A discussion of flight maneuvers and performance characteristics unique to large swept wing aircraft in general and the L-1011 in particular.

The flight profile illustrations and associated reference material represent one method of accomplishing flight maneuvers. They are typical and conditions of flight may preclude following the illustrated maneuver exactly. Good judgment and common sense should prevail.

OPERATIONAL PHILOSOPHY

Since the procedures for the L-1011 are designed for use by experienced flight crewmembers, procedural sequences follow a logical panel flow pattern, insofar as practical. The pilot flying, PF, should call for the appropriate checklist and the pilot not flying, PNF, should respond.

At times, training may seem to be conducted in a somewhat mechanical fashon. This is due to the instructor's efforts to prioritize the vast amount of information that confronts the transitioning pilot. With this approach, emphasis can be given to material most relevant and effective in accomplishing the task at hand.

During flight training, crews will experience a generic line operation environment. This environment is designed to afford pilots an opportunity to hone old skills and apply newly acquired knowledge to normal and abnormal situations peculiar to the L-1011 operation.

This experience will provide a **basis** upon which crews can exercise sound and reasonable judgements when confronted with similar or unique problems during line operations.

Evidence shows that the uncommunicative/ unresponsive pilot often fails to contribute to sound cockpit resource management. It is recommended, therefore, that pilots **communicate** intentions and **announce** configuration changes, thus avoiding surprises for other crewmembers, e.g; forewaring others that the autopilot will be disengaged on short final for a manual landing; delaying gear extension; etc..

Emergency Procedures are designed so that initial action items are accomplished, without delay, in a deliberate, systematic manner, then verified by reading(item and response), and responding to the appropriate checklist. Abnormal Procedures are accomplished by referring to the appropriate section in the POM.

Critical operations, such as closing a throttle or shutting off a fuel-ignition switch, should be verified by another crewmember.

Crews are encouraged to use **all** available resources, information, equipment and people, regardless of weather conditions. When the training environment requires exceptions to this rule, the instructor should make absolutely clear the conditions that prevail, e.g.; a hand flown Flight Director approach; entries into approach to stall maneuvers; etc..

During line operations, only the Captain will conduct: low visibility takeoffs (less than 1600 RVR,1/4 mile); CAT II/III ILS approaches, approaches and landings with engine(s) inoperative; and landings on ice covered runways.

The following performance guidelines, for check and training purposes, are taken from FAA Advisory Circular 61-77:

"The airspeed, altitude and heading tolerances given represent the minimum performance expected in good flying conditions. Consistantly exceeding those tolerances before corrective action is initiated is indicative of unsatisfactory performance".

Altitude	±100 ft.
Airspeed	±10 knots
Heading	±10°
Bank angle,(Steep Turns)	±5°
Engine failure after V_1, Heading	±20°

AUTOFLIGHT PROCEDURES

When manually flying to Flight Director commands, the "Pilot Not Flying" should normally make all selections of modes, headings, courses, speeds and frequencies at the request of the "Pilot Flying". This enhances the overall safety of operation by requiring both pilots to check and agree on all settings while one pilot concentrates on flying the airplane.

With the autopilot in command (CMD), those controls that affect flight path tracking may be manipulated by the pilot flying. This method of autoflight control will result in maximum safety of flight, crew coordination and efficiency, and minimize crew work load.

For training purposes, the procedures outlined are based on conventional autopilot/flight director operation used in conjunction with VOR/ILS, etc., navigational facilities. Occasionally, reference will be made to the Flight Management System (FMS) for clarification and orientation.

For operation of the FMS and its interface with the APFDS, refer to the L-1011 Long Range Navigation handbook.

STANDARD CALLOUTS

One of the fundamentals of Crew Resource Management is the standardization of procedural language. The vast majority of ASRS reports filed with NASA-FAA contain "information transfer problems."

Proper adherence to Standard Callouts will stimulate more meaningful communications and will refine the crew concept, particularly in the area of early detection of crew member error. It will also heighten awareness of aircraft altitude, position and instrument indications.

GLOSSARY OF TERMS

The aeronautical terms defined in this glossary have been gathered from a number of sources. In the interest of brevity, use of these terms in the accompanying text will normally be by abbreviation or symbol only.

This glossary is also meant to provide for the crew member a reference source of terms used in analysis of aircraft performance.

SPEEDS

IAS – Indicated Airspeed. Airspeed indicator reading as installed in the airplane, uncorrected for static source position error.

CAS – Calibrated Airspeed. Airspeed indicator reading as installed in the airplane, corrected for static source position error.

EAS – Equivalent Airspeed. Airspeed indicator reading as installed in the airplane, corrected for static source position error and compressibility.

TAS – True Airspeed. Airspeed indicator reading as installed in the airplane, corrected for static source position error, compressibility, and density altitude.

a – Speed of Sound. A function of temperature only.

M – Mach Number. The ratio of TAS to the speed of sound under given condition.

V_A – Design Maneuvering Speed. The maximum speed for which the aircraft is designed for full abrupt control deflection without incurring structural damage.

V_B – Design speed for maximum gust intensity penetration (Rough Air Speed).

V_D/M_D – Design Dive Speed. The highest speed demonstrated during FAA certification.

$V_{L/D\ (MAX)}$ – Airspeed for maximum ratio of lift to drag.

V_{LE}/M_{LE} – Maximum landing gear extended speed. the maximum safe flight speed with the landing gear in the extended position. On the L-1011, this is also the maximum speed for extending the landing gear. (300 KIAS)

V_{LO}/M_{LO} – Maximum Landing Gear Operating Speed. the maximum airspeed at which the landing gear may be retracted on the L-1011. (230 KIAS)

V_{LOF} – Liftoff Speed. The speed at which the airplane becomes airborne. The minimum climb gradient capability at this speed shall be 0.3%.

V_{MCA} – Air Minimum Control Speed. The speed at which, upon sudden failure of the critical engine, it is possible to control the airplane and maintain straight flight with a zero yaw or bank angle of not greater than 5°, without exceeding a 20° heading change. Rudder and aileron may be applied, as necessary, as long as rudder pedal force does not exceed 180 pounds.

V_{MCG} – Ground Minimum Control Airspeed. The minimum speed at which directional control of the aircraft can be maintained with the critical engine failed and the remaining engines at takeoff thrust. Only aerodynamic controls may be used. Nosewheel steering is currently not allowed in determination of this speed.

V_{MO}/M_{MO} – Maximum Operating Speed. The maximum speed permitted for any operation in the clean configuration.

V_{MU3} – Minimum Unstick Speed, all engines (3) operating. The minimum speed at which it is possible to lift off the ground, without undue hazard, and continue a takeoff.

SPEEDS (CONT'D.)

V_{MBE} – Maximum Brake Energy Speed. The maximum speed on the ground from which a stop can be accomplished within the energy capabilities of the brakes.

V_R – Rotation Speed. The speed at which rotation to the liftoff attitude is commenced. VR must be sufficiently high that rotating 5 knots early, one engine out, or 10 knots early all engines operating, will not result in a marked increase in the scheduled takeoff distance.

V_{REF} – 1.3Vs, gear down, flaps 33° for existing gross weight. Basis for most landing speed calculations.

V_S – FAA Stalling Speed. The minimum speed measured in the stall. This can be considered a baseline characteristic of the airplane.

V_{STO} – Stall Speed In The Takeoff Configuration. This speed varies with aircraft gross weight and is established in flight at idle power, takeoff flaps and gear down. This is also considered a baseline characteristic of the airplane.

V_1 – Takeoff Decision Speed. The speed at which recognition of an engine failure requires a decision on whether to stop or go. This speed is such that a full stop can be made on the runway without exceeding the maximum brake energy available. If the decision is to continue the takeoff, the speed must be sufficient to continue the acceleration on the remaining engines to V_2 at a height of 35 feet above the takeoff surface within the confines of the usable takeoff distance.

V_2 – Takeoff Safety Speed. The target speed to be reached at, or before, reaching the end of the takeoff distance available and a height of 35 feet above the takeoff surface with one engine inoperative. It is a speed arbitrarily selected to optimize performance within confines of the following constraints:

- Must provide a safe margin, 20% above the stall speed.
- Must be sufficient to maintain a minimum climb gradient of 0.30%.
- Must be achieved at, or before, reaching the end of the runway.
- Must be at least 10% above Vmca.

This is also the target speed for second segment climb.

AERODYNAMICS AND PERFORMANCE

C.G. – Center of gravity.

C.P. – Center of pressure (center of lift).

g – Acceleration due to gravity.

k – Temperature recovery factor.

L/D – Ratio of lift to drag.

NAM/LB – Nautical Air Miles per pound of fuel.

ISA – International Standard Atmosphere, as accepted by the International Civil Aviation Organization.

OAT – Outside Air Temperature. The free air static (ambient) temperature.

SAT – Static Air Temperature. The outside, ambient, air temperature as computed by the Central Air Data Computer and presented on the Static Air Temperature Indicator or derived from the Temperature Conversion (TAT to SAT) Chart.

TAT – Total Air Temperature. Static air temperature plus adiabatic compression (RAM) rise as indicated on the Total Air Temperature indicator.

W – Airplane gross weight.

a (alpha) – Angle of Attack (AOA). This is the angle between a reference line in a body and the line of the relative airflow.

y (gamma) – Flight Path Angle, (angle between flight path and the horizontal).

Compressibility – Variation in the density of the air due to local pressure variations as the air passes over the aircraft.

Critical Mach Number – The aircraft flight Mach number at which the local airflow velocity equals the speed of sound at a specified point on the aircraft.

Boundary Layer – The layer of air immediately adjacent to the aircraft skin which is moving slower than the free airstream.

Flow Separation – The point at which the boundary layer flow no longer adheres to the airflow surface.

Shock Waves – A surface in the airflow about the airplane across which an abrupt reduction of velocity occurs, together with associated changes in density, pressure and temperature.

ENGINE

EPR – Engine pressure ratio is the ratio between the engine air inlet pressure and the exhaust gas pressure measured downstream of the turbine.

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ENGINE (CONT'D.)

IEPR – Integrated Engine Pressure Ratio. The EPR is based on a modified total exhaust pressure. On the RB.211, this modified exhaust pressure is the integrated average of the fan and core engine exhaust pressures (weighted by their respective nozzle areas).

TGT – Turbine Gas Temperature. The engine hot stream temperature measured, in the RB .211, in the low pressure turbine section.

F/F – Fuel Flow.

N_1 – Fan and low pressure compressor speed (normally expressed in a percent of the maximum rpm).

N_2 – Intermediate pressure compressor speed (normally expressed in a percent of the maximum rpm).

N_3 – High pressure compressor speed (normally expressed in a percent of the maximum rpm).

SFC – Specific Fuel Consumption. The amount of fuel consumed in pounds per hour divided by the thrust of the engine in pounds at a particular EPR setting.

WEIGHTS

MEW – Manufacturer's Empty Weight – Weight of the airplane, including the structure, power plants, furnishing, systems and other items that are considered an integral part of a particular configuration. Essentially, this is a dry weight, containing only those fluids which are contained in a closed system, such as the hydraulic system fluids.

OEW – Operating Empty Weight – The manufacturer's empty weight plus the weight of the oil, water, unusable fuel, crew, crew baggage, passenger equipment, and emergency equipment.

MZFW – Maximum Zero Fuel Weight – The maximum weight authorized for an airplane with payload with no usable fuel.

MGW – Maximum Gross Weight – The maximum weight authorized by the Airplane Flight Manual for an airplane and its contents.

MTOW – Maximum Takeoff Weight – the maximum airplane gross weight permitted for takeoff under any condition, but which may be further restricted by fuel loading, C.G. position, and performance requirements.

MTW – Maximum Taxi Weight – The maximum airplane gross weight permitted for taxi but which may be further restricted by fuel management requirements.

MLW – Maximum Landing Weight – The maximum airplane weight permitted for a touchdown with a rate of descent of 10 feet per second. This weight may be further restricted by performance requirements.

CLIMB SEGMENT DEFINITIONS

First Segment Climb – This segment extends from the 35 foot height to the point where the landing gear is fully retracted. It assumes a constant V_2 speed.

Second Segment Climb – This segment extends from the end of the First Segment to a gross height of at **least** 400 feet, at a constant V_2 speed.

Third Segment Climb – This segment assumes a level flight acceleration during which the flaps are retracted in accordance with the recommended speed schedule at takeoff thrust.

NOTE: ALL references, unless otherwise stated, are made to the -1 aircraft.

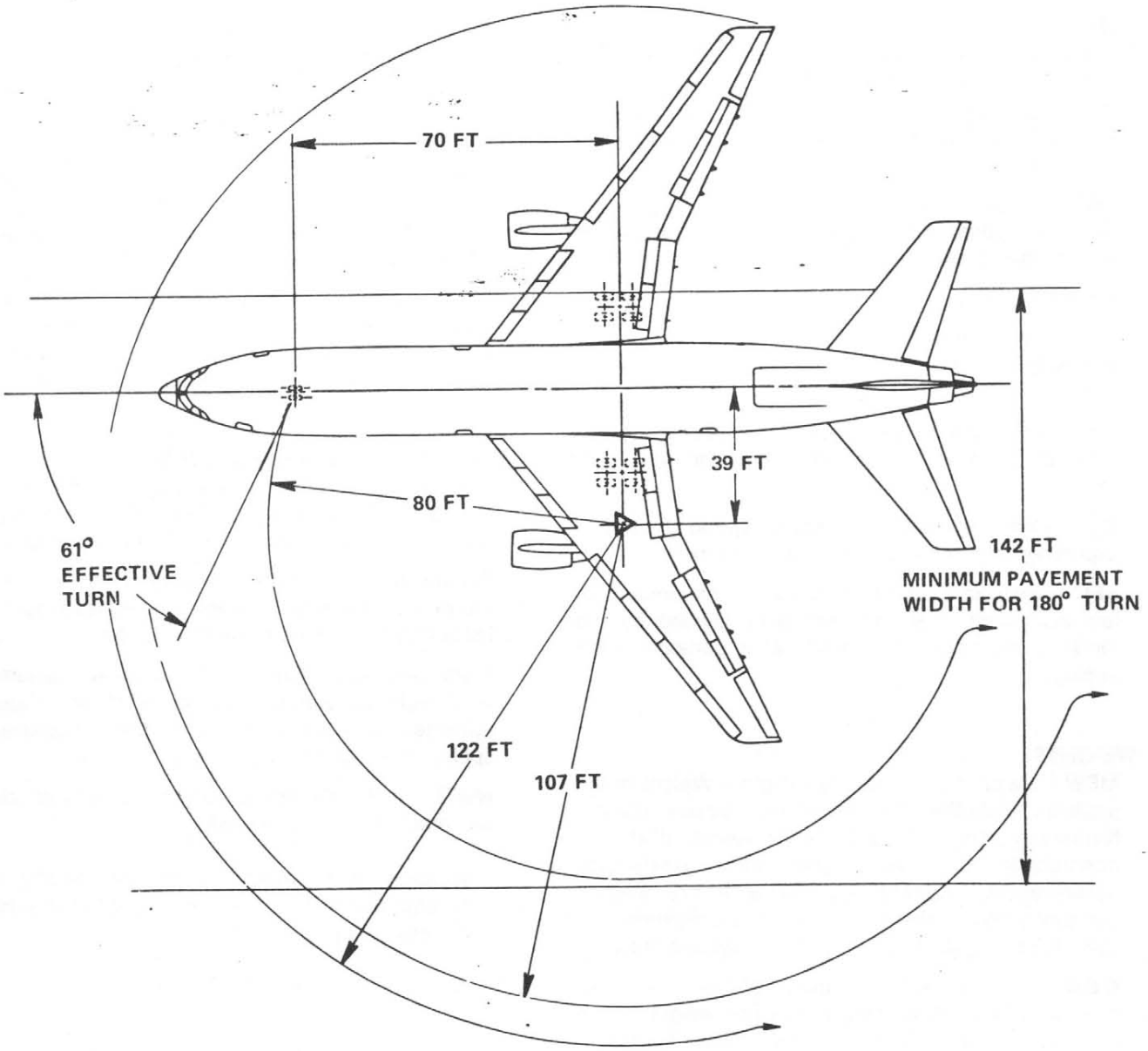
Discussions concerning speeds are usually made with reference to V_2 or V_{ref} for the sake of simplicity and consistency.

NORMAL OPERATIONS/ PROCEDURES TRAINING

PREFLIGHT

Seat Adjustment

By referencing the eye locator and the fore/aft seat index indicators, adjust the seat so as to attain an optimum position for control column manipulation, instrument viewing, and outside visual cues. Sight, just down the top of the glareshield, is recommended for good visual landing perspective. Adjust the rudder pedals to assure full throw and proper brake application.



▷ THEORETICAL CENTER OF TURN FOR MINIMUM TURNING RADIUS. TURN INITIATED WITH AIRPLANE IN MOTION. APPROXIMATELY IDLE THRUST ON ALL ENGINES. NO DIFFERENTIAL BRAKING.

TURN RADII

PREFLIGHT (CONT'D.)

Oxygen Masks and Interphone

Assure proper adjustment of radio/interphone communication and desired audio level of cockpit speakers and headsets. After checking the oxygen mask, regulator and interphone, place the mask in its storage compartment in such manner that it will be quick-donning and require the use of just one hand.

(Refer to FOPM, Section 5 for standard crew bell/verbal signals.)

Lighting

Adjust cockpit and instrument lighting as necessary and according to individual requirements. Do not use thunderstorm lighting for general cockpit illumination due to excessive heat generation. Exterior position lights normally remain on at all times. Latch anti-collision lights on just prior to engine start or pushback, as appropriate.

Parking Brake

Do not push down or rotate the parking brake handle as this may eventually result in a fouled cable.

Departure Briefing

Appropriate items should be discussed in sufficient detail to ensure preparedness and understanding by all crew members. These items may include:

- Weather and Ops Specs Requirements.
- Abnormals; Crew Duties
- Runway Condition
- Terrain Considerations
- SID/Special Pages

PUSHBACK

"The Captain will conduct all interphone communication with the CSA/tug operator", (FOPM, Section 5), during pushback. This insures direct communication between the two parties most directly involved with movement of the aircraft. The terms "Brakes Released" and "Brakes Set" should be used to eliminate any confusion.

ENGINE START

The Captain may, at his discretion, delegate engine starting to the F/O and S/O so he can devote his attention to the pushback and any last minute "problems."

Starter time restrictions (5 minutes) and light-off limitations (within 30 seconds) should be monitored using the stop-clock feature. Before the Fuel/Ignition switch is moved to ON, both OIL PRESSURE and N_2 PRM must be indicated and announced by the S/O.

When the Fuel/Ignition switch is placed to the ON position, announcing it will heighten crew awareness of its position and prompt a glance at the clock sweep second hand for light-off limitations. If the engine fails to light-off within 15 seconds of "FUEL ON" (using either A or B ignition), select BOTH and refer to the MEL for appropriate action. Remember, the only clue you may receive regarding a tailpipe fire may be from outside the cockpit, i.e., tower personnel, other aircraft or your own passengers. Numerous malfunctions are possible during engine starts. A review of Normal Procedures, Power Plant Abnormals and Emergency Procedures (Tailpipe Fire) is appropriate. Complete the After Start checklist before starting the Taxi.

The preferred starting sequence is 2-1-3, with delayed start on engine(s) 1 and/or 3. This sequence may be varied depending upon prevailing conditions. Plan crossbleed delayed starts so that no power changes are required on the running engine(s). This is to preclude a crash re-engagement of the starter due to pneumatic pressure changes.

(See Normal Procedures, Taxi Considerations.)

TAXI

It is recommended that two engines be operating for all taxiing. Single engine taxiing produces extremely high exhaust wake velocities not appropriate on congested ramps/taxiways.

When commencing the taxi, apply only enough thrust to start the aircraft moving, approximately 35-40% N1. If an unusually large amount of power is required to begin movement, consider starting additional engines. The following are tips to consider while taxiing the L-1011:

- Use equal thrust to start the aircraft rolling.
- Aircraft response to throttle movement is slow, particularly at high gross weights. Allow time for aircraft response before increasing thrust beyond nominal amounts.
- Keep thrust as low as possible while maneuvering in ramp areas. Engine noise level in the cockpit is low and not indicative of thrust output.
- Taxi at a speed that is safe for existing conditions. The height of the cockpit, 19 ft. above the ground, gives the illusion of moving slower than is actually the case.
- Idle thrust will usually maintain taxi speed.
- Exercise care to keep the nose wheels on the taxiway centerline.
- Both Captain and F/O should direct their attention outside the cockpit until clear of ramp congestion before carrying on with Taxi checklist items.

TAXI (CONT'D.)

Extreme care should be exercised when taxiing at "close quarter" airports such as La Guardia. The centerline is no guarantee that wingtips will clear, as indicated, for example, by the caution remark on the Los Angeles (10-9) Jeppesen Airport plate. Centerline to centerline spacing in this case is less than a foot wider than the wingspan of the -500!

STEERING

The steering wheel provides approximately 60° of nose wheel steering. The rudder pedals provide 10° of nose wheel steering when the Rudder Pedal Steering switch is UNLATCHED "ON". Rudder pedal steering is de-activated when:

- The Rudder Pedal Steering switch is LATCHED "OFF".
- The steering wheel exceeds 10° of travel. (This technique places a strain on the steering clutches).
- The steering wheel is held during rudder pedal inputs.
- Inflight.

BRAKING

Apply brakes slowly and smoothly. When taxiing in congested areas, monitor pressures and quantities.

- Avoid riding the brakes. To enhance brake cooling, allow the aircraft to accelerate, then brake to a slower taxi speed. Repeat as necessary.
- Avoid differential braking. This practice may subject the nose gear to excessive side loads.
- Avoid braking in turns. Anticipate turns and slow the aircraft prior to initiating.
- The anti-skid system should be unlatched OFF for all taxi operations.
- It requires about 15 to 20 minutes for brake temperatures to peak. If hot brakes are suspected after a long taxi at high gross weights during hot days, alternating brake pedal application for a few minutes at a time, while holding position, or delaying gear retraction for a few minutes after takeoff may help to dissipate some of the heat.

TURN RADIUS

The "Turn Radii" illustration depicts the minimum turn capability of the L-1011.

The wingtip on the outside of the turn is aft of the center of turn, and moves outward during a minimum radius turn. The wingtips extend 78 feet from the taxiway centerline and cannot be seen from the cockpit.

When a short radius turn is required, use the outboard engine thrust in conjunction with nose wheel steering to maintain taxi speed.

Use as wide a turn radius as possible to avoid scrubbing tires.

The long wheel base of the L-1011, along with the location of the nose gear, (20 feet aft of the pilot's position), requires particular consideration during ground operation. The center of turn is near the main gear, (90 feet aft of the pilot), so the pilot must overshoot the intended line of travel before commencing the turn.

FLIGHT CONTROL CHECK

The Flight Control Check is also described in the Normal Procedures, Taxi section of the POM.

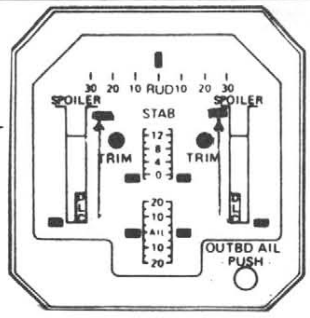
The check will be performed by the F/O during taxi when he can devote his full attention to the SPI. It should not be performed during engine start or when there are other heavy demands on the hydraulic system, e.g., flaps in motion, Captain checking rudders, etc.

All four hydraulic systems must be pressurized by any combination of engine pumps, ATMs and/or PTUs. All engines do not have to be running. Electric hydraulic pumps should not be used to activate any flight controls, including the flaps.

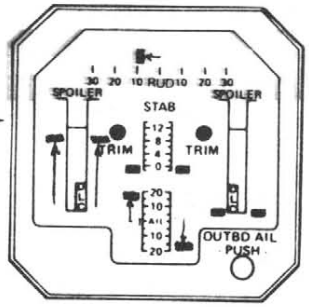
The following example pertains to the -1 aircraft. A slightly different indication will be seen on the -500 models due to the Active Control System and (spoiler) Mixer Limiter.

FLIGHT CONTROL CHECK (CONT'D.)

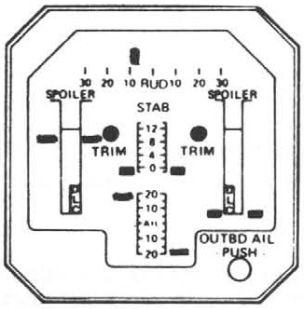
- Spoiler handle moved FULL AFT; Inboard Spoiler indices move FULL UP. Spoiler handle moved FULL FORWARD. Inboard indices return to bottom of scale.



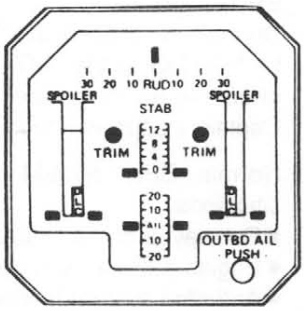
- The SPI diagram at right shows correct indications when the control wheel is deflected full left. Note spoiler, aileron and rudder indices.



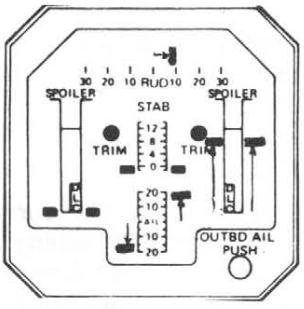
- Push "Outboard Aileron" button to confirm the outboard ailerons position coincides with inboard ailerons.



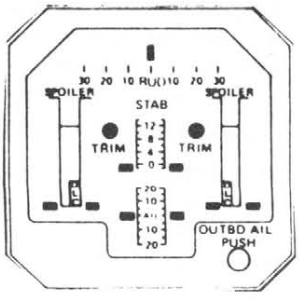
- The control wheel is returned to neutral.



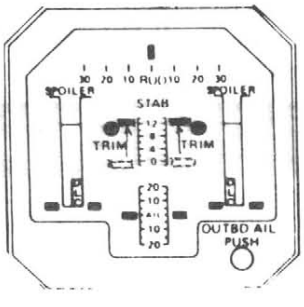
- The control wheel is deflected full right and the SPI is checked for the indications shown. Outboard ailerons are checked again using the "Outboard Aileron" button.



- The control wheel is returned to neutral and outboard ailerons checked a third and last time.



- The horizontal stabilizer is checked by slowly pulling the control column full aft then pushing full forward and checking for full deflection on the stabilizer indices. (Proper elevator response is indirectly checked as a result of the stabilizer check.)



AUTOFLIGHT PANEL - TAKEOFF SETTINGS

During taxi and before taking the runway, the following items should be accomplished:

- Nav Radios - Set (As desired)
- Autopilots - OFF
- Flight Directors - ON
- APFDS Heading Select - Runway Heading Set/Engaged/Annunciated
- Initial Altitude - Selected/Armed/Annunciated
- APFDS Takeoff Mode, Takeoff - Selected/Annunciated
- IAS Window - V_2 + 70

Airspeed Bugs

Set the primary bug on the airspeed indicator, controlled by the adjacent set knob, at V_2 IAS. Insofar as the number of bugs permit, additional bugs are set at V_1, V_R, V_2 + 20 and V_2 + 60.

Set the IAS window to V_2 + 70.

NOTE: Rotating the bugs through the 11 o'clock position may cause them to fall out of the track.

EPR Bugs

During taxi, set the EPR bugs at the value computed by the FMS or the S/O. The use of Alternate EPR is encouraged whenever possible, subject to the Captain's approval, to increase engine life.

Normal EPR should be used in the following situations:

- Runway is contaminated.
- Engine anti-ice is in use.
- Anti-skid system is inop.
- Airport restrictions, Jeppesen yellow pages.
- Runways less than 7000 ft.
- Other than Flaps 10° takeoff.
- Any EPR guage inoperative.
- Unstable weather conditions.

Prior to takeoff, the S/O determines the current temperature and updates the takeoff EPR setting. If a significant temperature difference exists from that used in the AWABS computations, consult the ARM or the lower section of the AWABS for maximum allowable takeoff weights.

The S/O should set the runway surface temperature, reported or indicated SAT, into the EPR computer and select the appropriate power setting to be displayed, Normal or Alternate, on the TAT/EPR gauge. If a significant discrepancy exists between displayed EPR settings and the chart value, the latter will take precedence.

The S/O can test the ENGINE 2 FAIL lights when throttles are at idle and flaps are in the takeoff range. He should alert the Captain and F/O before testing, then:

- Press the ENG 2 N_2 indicator test button.
- Indicator drives to 91%. Passing through 83%, the warning system is Armed.
- Test button is released. When the indicator drops through 79%, the ENG 2 FAIL lights illuminate.
- The system is reset by pressing either of the two ENG 2 FAIL lights.

Flap Settings

Unless otherwise required by airport or performance restrictions, a Flaps 10° configuration will be used for takeoff. The crew will determine the appropriate flap configuration to be used by checking the AWABS document or the ARM. The S/O will annotate the TO/L card with the appropriate flap setting, EPR values and V speeds.

NOTE: Flap configurations and operations for the long range L-1011 aircraft differ from the dash-one aircraft. That information is presented in other sections.

TAKEOFF

General

Prior to takeoff, a briefing should be made in minimum but adequate detail outlining the plan of action for the takeoff and departure. It should include a review of the SID, ATC clearance and navigation radio management. It presumes the use of standard L-1011 policies and procedures but should include additional items necessary for that particular takeoff, e. g., air conditioning packs, anti-ice systems, other out of the ordinary items. It is also recommended that the PNF be briefed to update headings, altitudes and airspeeds on the Autoflight panel.

Regardless of which pilot is making the takeoff, only the Captain will make the abort decision. To assure this, the Captain's hand will remain on the top portion of the throttles after the power is set and until V_1 speed. When the F/O "backs up" the throttles, he should remove his hand after power is set to avoid injury in the event of an abort.

TAKEOFF (CONT'D.)

The PNF and the S/O will monitor engine performance for any significant malfunction during the takeoff. Initially the S/O should give particular attention to the N_2 gauges as they are important indicators of transitional engine performance.

NOTE: If N_2 red-lines before other engine parameters are met, Variable Inlet Guide Vanes (VIGV's) are suspect.

Be prepared for sudden thrust changes if VIGVs shift back into the correct schedule.

Fuel Control Amplifiers have been known to malfunction during takeoff, giving an indication of a loss of power on one or more engines. Generally, if ALL engine indications are LOW, including N_2, it may well be a fuel control amplifier problem (icing conditions not considered). N_1 and N_3 should also be scanned during the takeoff roll to determine the true status of engine performance.

Before latching the amplifier(s) to OVERRIDE, conditions permitting, retard the throttle(s) significantly towards idle, (idle being preferred). Overtemp and/or Overspeed protection is removed with the amplifiers in OVRD.

Setting Takeoff EPR

The pointer bug on each EPR indicator is the primary means of setting takeoff EPR. The digital counters should be used only as alert indicators for possible EPR over-boost. Do not set takeoff EPR by reference solely to the digital counters.

Set takeoff EPR by advancing throttles, in equal measure and with deliberate but gentle pace, to the target EPR. While doing so, monitor engine instruments to ensure equal engine response. After attaining the target EPR, prior to 80 knots, maintain the throttle position throughout the takeoff roll. As aircraft speed increases, the indicated EPR will decrease slightly as much as .01 - .02. It is very important to set the desired EPR early and not "chase" it. It is not necessary to reset it after accelerating beyond 80 knots.

NOTE: If a takeoff warning horn sounds after commencing the takeoff, discontinue the takeoff, (see Abort Procedures, this section). Determine the cause and take appropriate action before attempting another takeoff. Check Brake Energy Limits chart, ODM, if appropriate.

Engine 2 Fail Armed Light

The crew must verify that the green ENG 2 FAIL ARMED light on the Pilot's Annunciator Panel is illuminated during application of takeoff thrust. If the light does not illuminate:

- Continue the takeoff, using ALTERNATE power, if the actual weight is NOT within 10,000 lbs. of ALTERNATE runway allowable weight.
- Continue the takeoff, while advancing the throttles to NORMAL power, if the actual weight IS within 10,000 lbs. of ALTERNATE runway allowable weight.
- REJECT the takeoff if the actual weight is within 10,000 lbs. of NORMAL runway allowable weight.

The crew, therefore, should note the actual gross weight as compared to the alternate maximum and normal maximum allowable weights, as indicated on the TO/L data card.

NOTE: The Flight Director Takeoff Mode should not be used for takeoff when using Improved Performance Procedures. The same holds for -500 aircraft when takeoff weight is less than 400,000 lbs. Standard Policies recommend using Heading Select and Vertical Speed (Full Up) until the acceleration and clean-up portion of the climbout is commenced.

When low visibility conditions prevail during the above cases, i.e., less than 1600 RVR, the policy that requires the Flight Director T/O mode does not apply. Heading Select and Vertical Speed (Full UP) should be used.

Takeoff Procedures - Flaps 10

Normally, a rolling takeoff is preferred at all weights and should be made at gross weights less than 293,000 lbs.

After starting the takeoff roll, maintain directional control with rudder pedals. Keep the nose wheel firmly on the runway by holding light forward pressure on the control wheel.

After V_1 the pilot flying should have both hands on the control wheel. The PNF should call out V_1, V_R and V_2 as each speed is attained.

As the airspeed approaches V_R, relax forward pressure on the control column so as to arrive at V_R prepared to rotate. The PF verifies rotation speed on his airspeed indicator and applies back pressures to affect a smooth, positive rotation.

TAKEOFF (CONT'D.)

Takeoff and initial climb performance depends upon rotating at the correct speed and rate to the initial climb attitude. Late or slow rotation increases the takeoff distance significantly. Early, rapid or over-rotation may cause tailskid contact with the runway. Tailskid contact will occur at pitch attitudes in excess of 12.5°. Fuselage contact will occur at approximately 14°. An improperly executed rotation will decrease initial climb performance.

Momentary illumination of the TRUCK light, Landing Gear Panel, is the initial positive instrument indication of liftoff.

NOTE: To preclude a possible tail strike, do not rotate beyond 11° pitch until the aircraft has become airborne.

After liftoff, readjust the pitch attitude as necessary for proper performance. Do not exceed 18°. When a positive rate of climb is confirmed, call for gear retraction. The PNF should verify and call out "Positive Rate", before retracting the landing gear.

SPECIAL TAKEOFF PROCEDURES

La Guardia

Normal L-1011 takeoff operations at La Guardia airport are conducted with 10° flaps. However, in addition to the usual performance data limits, all taxi and takeoff operations must comply with PAVEMENT LOADING LIMITATIONS published in the applicable Weight and Balance Standard Practice. This chart, based on New York Port Authority criteria, gives the maximum weight and C.G. combinations allowed on runway and taxiway areas extending on piers over the water. The normal weight versus C.G. limitations depicted in the Weight and Balance Standard Practice must still be observed since some portions of the pier loading chart lie outside the NORMAL weight/C.G. envelope.

An 18° flap takeoff on runways 4 or 31 provides the performance necessary to take off or abort PRIOR TO REACHING THE PIER AREA. Hence, increased payloads can be accommodated since pavement loading restrictions do not apply. The 18° flap performance figures incorporate an unbalanced field length analysis using the pier portion of the runway, in effect, as STOPWAY.

AWABS II Weight Data Record will be provided for Flaps 10° or 18° takeoffs. The presence of Flaps 18° performance figures does not necessarily mean that a Flaps 18° takeoff is required. If, however, the aircraft weight/C.G. falls outside the pier loading restrictions for Flaps 10°, the AWABS II WDR will be transmitted without data under the Performance Data Section, Flaps 10° columns. Instead, the term "OVERWEIGHT" will be displayed and the phrase "C.G. OUT OF RANGE" will appear just to the right of the THRUST/FLAP designator.

If runway 4 or 31 is not available or desired when an 18° flap takeoff is anticipated, plan ahead and consult with the load planner and/or flight control.

Only Normal power will be used for all Flaps 18° takeoffs. After takeoff:

- Above 400 ft. AGL, or clear of obstacles, and at V_2 + 10 minimum,. retract the flaps from 18° to 10°.
- At 1,000 ft. AGL, latch VS 1000 and continue with normal flap retraction schedule.

Denver

At high altitude/ambient temperatures it will, at times, be necessary to use a 4° takeoff flap setting. The crew determines from AWABS II whether takeoff is based on 10° or 4°.

Only NORMAL power will be used for all Flaps 4° takeoffs. Tailwind takeoffs are not permitted. After takeoff:

- At 1000 ft. AGL latch VS 1000, set CLIMB THRUST and resume normal noise abatement procedures.

Improved Performance - Clearway (And/Or Stopway)

The maximum allowable takeoff weight is the smallest of:

- Performance Weight Limit (smaller of)
  - Runway Allowable Takeoff Weight (RATOW)
  - Climb Limit Weight (CLW)
- Structural Limit Weight
- Takeoff Weight based on Landing (Landing Weight plus fuel burn = Takeoff Weight)

The procedure to compute these weights is outlined in the ARM (L-1011 Airport Restrictions - On Line Cities).

REVISION NOTIFICATION

FLIGHT OPERATIONS DEPT.

DELTA

PUBLICATION: L-1011 PILOT'S REFERENCE MANUAL **DATE:** 9-20-88

REVISION NUMBER: 17 **PAGE:** 1 of 1

ENTER THE ABOVE REVISION NUMBER AND DATE ON MANUAL REVISION LOG SHEET

REMOVE	INSERT	REMARKS
Flight Training Section **Part I** Pgs. 1–47 **Part II** Pgs. 1–3	**Flight Training Section** Pgs. 1–58	Revised Flight Training text.

SPECIAL TAKEOFF PROCEDURES (CONT'D.)

If the actual takeoff weight exceeds the maximum allowable for each of the thrust/flap combinations indicated in the ARM/AWABS, payload must be reduced. For certain airports/runways, however, SPECIAL PERFORMANCE has been developed.

Prior to removing payload, ACTUAL takeoff weight is compared with SPECIAL PERFORMANCE maximum allowable weights (SPMAW). If ACTUAL takeoff weight exceeds SPMAW, payload must be reduced. Otherwise, the flight may be dispatched using SPECIAL computations.

These SPECIAL computations are known as "FLAPS_____, IMPROVED PERFORMANCE - CLEARWAY" and are spelled out in the ARM.

As previously mentioned, V_1, the TAKEOFF DECISION SPEED, is defined as that speed at which, if engine failure occurs, a full stop can be made on the runway without exceeding the maximum brake energy available or the takeoff may be continued, with the remaining engine(s), to V_2 at a height of 35 ft. above the takeoff surface within the confines of the usable takeoff distance (i. e., the end of the runway).

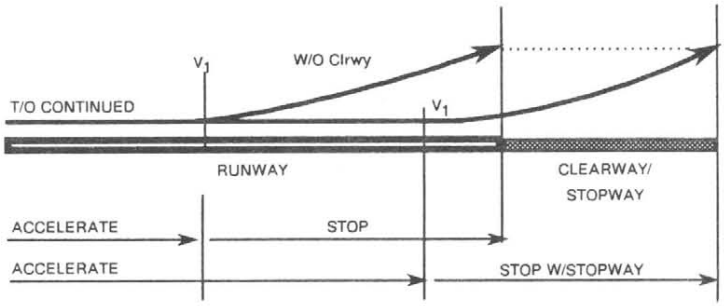
A CLEARWAY is defined as an area beyond the [end of] runway, not less than 500 feet wide, centrally located about the extended centerline above which no object nor any portion of terrain protrudes .

A STOPWAY is an area beyond the runway, not less than the width of the runway, centrally located about the extended centerline for use in decelerating the aircraft during a refused takeoff and capable of supporting the airplane without inducing structural damage. A STOPWAY may be a CLEARWAY, but the reverse is not true. CLEARWAYS/STOPWAYS, in effect, increase the usable takeoff distance as it pertains to allowable weight and V speed calculations. The CLEARWAY now becomes part of the "usable takeoff distance" within which the aircraft can be brought to a stop or attain V_2 and a 35 ft. altitude upon reaching the end. It permits the load planner to use various flap settings in order to improve takeoff performance. The tradeoff is an increase in V speeds. However, the addition of a clearway accommodates the speed increase by allowing the pilot to rotate further down the original runway and still meet the requirement to either stop on the remaining surface or continue and attain the 35 ft. parameter.

During some Improved Performance Clearway takeoffs when the clearway is not also a Stopway, V_1 Improved Performance may be less than V_1 Normal Takeoff performance since only the original runway surface remains available for the refusal at a higher gross weight.

For all improved performance clearway takeoffs, the following restrictions apply:

- Alternate power not authorized.
- Tailwind components not authorized.
- All thrust reversing systems must be operative.
- All anti-skid systems must be operative.



Crosswind Takeoff

If a crosswind condition exists, maintain directional control with the rudder.

The upwind wing tends to rise during acceleration and lateral control requirements will decrease but may not return to neutral during the ground roll. Maintain runway centerline with wings level. There is no difference in rotation technique from that of a standard takeoff.

During strong crosswind conditions, a rolling takeoff combined with slower throttle movement during engine spool-up is recommended to prevent engine surge.

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CLIMB

For normal operation, the APFDS Takeoff mode (TOGA) is employed. The pitch bars and SCS "donut" will command a pitch attitude that will yield an angle of attack (AOA) equal to 1.25 Vs or a pitch attitude of 18° maximum, whichever provides the greater airspeed.

When the T/O mode of the APFDS is inoperative or not used, maintain V_2 +10 and Flaps 10 until reaching the flap retraction altitude. V_2 +10 approximates best angle of climb speed with takeoff flaps. If V_2 +10 is exceeded during the initial climb, adjust the pitch to arrest the acceleration but do not attempt to reduce the climb speed back to V_2 +10. Continue the climb at the higher speed. Limit the pitch attitude to 18°. Prior to reaching 1000 ft. AGL, the S/O selects the proper climb mode on the EPR panel which in turn will display the proper climb EPR on the TAT/EPR gauge. (The FMS Control Display Unit [CDU] will also annunciate the required climb EPR as well as the required climb IAS for existing conditions.)

Flap Retraction

The following is a description of the Delta Standard Noise Abatement Takeoff/Departure Procedure:

- At 1000 ft. AGL or obstacle clearance altitude, whichever is higher, latch VS 1000 fpm. The pitch bar will command a slight nose down to facilitate acceleration to the flap retraction speed schedule.
- At V_2 +20, select Flaps 4° and set Climb Thrust.
- At V_2 +60, select Flaps 0°.
- At V_2 +70, latch IAS and maintain V_2 +70 until 3000 ft. AGL.
- At 3000 ft. AGL, latch VS 1000 fpm and accelerate to 250 KIAS, continuing the climb. Update the SCS airspeed to 250. (This keeps the "donut" updated).
- At 250 K, latch IAS and climb to 10,000 ft.
- At 10,000 ft. MSL, latch VS 1000 fpm, accelerate to enroute climb speed, e. g. 300K/Cruise Mach, Update the SCS to 300.
- At 300 K, latch IAS and continue climb until Cruise Mach is achieved. Cruise Mach may then be maintained using the VS mode.

FMS Discussion

When the FMS is used, the noise abatement procedure is modified as follows:

- When climb power is called for, the pilot, after confirming that CLIMB ARMED is annunciated on the FMS CDU may latch THRUST MANAGEMENT, confirm annunciation in the AFCS MODE ANNUNCIATOR, then select AUTOTHROTTLES. The thrust management computer will slowly set climb power as shown on the FMS CDU. Guard the throttles until the power has stabilized.
- Upon reaching 3000 feet AGL, instead of selecting VS 1000 fpm to accelerate to 250 K, the pilot may select VNAV which will automatically program the proper climb speed below 10,000 ft. MSL then enroute climb speed, as displayed on the FMS CDU, above 10,000 ft. MSL.
- The SCS "donut" will center (on the F-S scale) and remain there whenever Thrust Management is in use.

NOTE: Refer to the POM/PRM operational differences involving the autothrottle system on Ships 759 - 762.

Departure Turn

Obstruction clearance, noise abatement or departure procedures may necessitate an immediate turn after takeoff. Initiate the turn at the appropriate altitude and maintain V_2 +10 (18° pitch, maximum) with takeoff flaps (10°). Following the pitch commands of the Flight Director, while in the T/O or G/A mode, will keep the aircraft at no less than 1.25 Vs during turning maneuvers.

CAUTION

WHEN THE T/O OR G/A MODE OF THE FLIGHT DIRECTOR IS NOT USED, THE BANK ANGLE SHOULD BE LIMITED TO 15° UNTIL MANEUVERING SPEED IS ATTAINED; i.e., V_2 +10 OR GREATER.

At or above flap retraction altitude, reduce pitch and retract flaps according to the normal speed schedule.

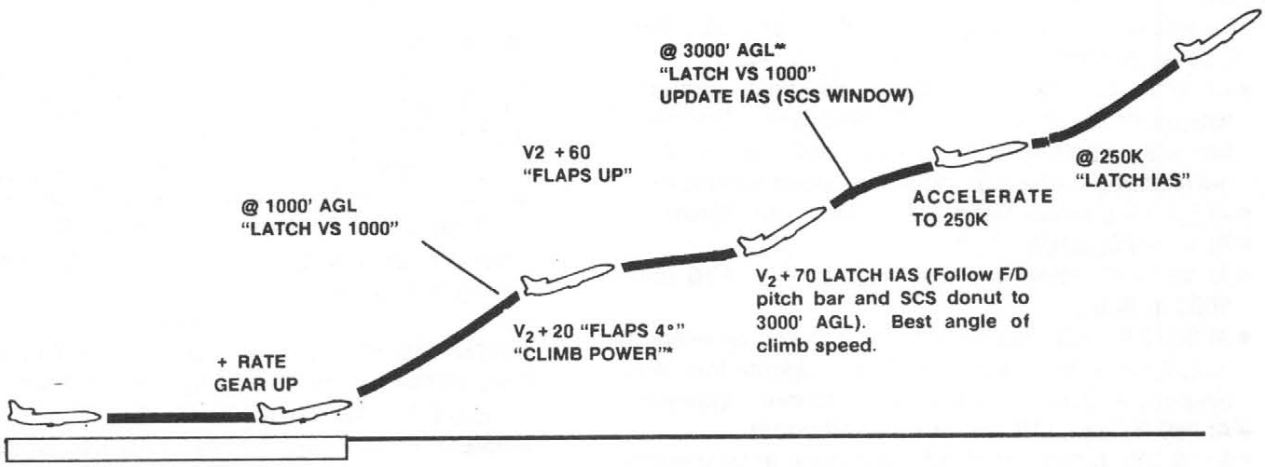
Monitor flap retraction. When flap lever is in the UP position, confirm that both flap position indicators show that flaps have retracted and that the leading edge lights are extinguished.

After Takeoff and Climb Checklist

This check contains a variety of actions that depend upon many factors and is accomplished as the situation dictates. The PF is not required to call for it. The S/O has the duty to monitor these items, bring any that are overlooked to the attention of the pilots flying and announce when the check is completed.

Use of Landing Lights

Weather permitting, use of landing lights up to FL 180 is encouraged to make the aircraft more visible.



* **If FMS is operating, pilot may:**
- Verify "Climb Armed" in FMS CDU.
- Latch Thrust Management.
- Verify Thrust Management in AFCS Mode Annunciator.
- Autothrottles – ON.
- Guard throttles as power is set by Thrust Management computer.

** **If FMS is operating, pilot may:**
- Latch V–NAV (FMS programs APFDS to 250K below 10,000 ft. and min cost climb airspeed above 10,000 ft.)

NORMAL TAKEOFF AND NOISE ABATEMENT CLIMBOUT

CLIMB (CONT'D.)

Climb Power/Performance

- For takeoff gross weights less than 360,000 lbs., employ a 300 knot/cruise mach speed schedule with CL2 power. If the rate of climb falls below 500 ft./min., use CRZ power.
- For takeoff weights of 360,000 lbs. and above, use 300K/cruise mach speed schedule with the CRZ power setting.

Comply with applicable airspeed/altitude restrictions during climb. If FMS performance data is not available and where conditions permit, the following speed management procedure is recommended:

After accelerating to 300 knots, select 300 in the SCS IAS window and engage the IAS pitch mode.

Upon reaching initial cruise mach (approximately 24,000 ft.), latch the VS pitch mode. Thereafter, adjust vertical speed as necessary to maintain cruise mach.

Use of autothrottles (ATS) during climb is prohibited unless used in conjunction with FMS Thrust Management.

CRUISE

Initial Cruise

The following discussion applies to operation without an FMS computer. For information concerning operation with FMS data available, refer to the FMS Manual.

Upon reaching the assigned altitude, select the target cruise airspeed in the SCS IAS window. Using the FAST/SLOW donut as reference, maintain climb thrust and allow the aircraft to accelerate to a speed 2 or 3 knots above the desired target cruise IAS. Set target cruise EPR.

Allow aircraft to stabilize on the target airspeed, then disconnect the autopilot and correct trim, if necessary. Good trim is essential in order to achieve best fuel economy.

Make subsequent minor thrust adjustments using only the center engine, being careful not to exceed the maximum cruise EPR. Maintain proper speed as weight decreases. Maintaining a balanced thrust between Engines 1 & 3 cannot be overemphasized.

Continue to re-adjust the cruise EPR's in 10,000 lb. fuel burn-off weight increments. Re-check aircraft trim and use center engine for thrust trimming as necessary.

At certain weight/altitude combinations, the L-1011 exhibits a relatively flat thrust required curve in the Mach .80-.84 region. The apparent speed stability is reduced in this region and more attention is required to maintain a precise cruise Mach number. Refer to the Operational Data Manual).

Autothrottles should not be used in cruise configuration without FMS Thrust Management due to the possibility of occasional fluctuations in TGT which adversely affect engine life.

NOTE: If the Captain or F/O leaves his station ABOVE FL 250 the remaining pilot must don and utilize his oxygen mask. ABOVE FL 410 the Captain or F/O must be on oxygen at all times (FOPM, Section 5).

Enroute Fuel Planning

The Second Officer monitors cruise fuel consumption and assures proper fuel distribution. He will periodically advise the Captain of the fuel status during cruise. The computerized flight plan will provide the crew with a basis of comparison. Any significant deviation from planned fuel burn, for reasons other than system malfunction, should be addressed for planning purposes.

DESCENT

In the absence of ATC traffic / arrival requirements, plan the descent so as to arrive at a point approximately 30 miles from the airport of intended landing at 10,000 feet and 250 KIAS. The combination of aerodynamic cleanliness and slightly higher flight idle thrust make the L-1011 difficult to "go down and slow down".

A good rule of thumb is to begin the descent at a point where the distance in miles to the airport is equal to 3 times cruise altitude (in thousands of feet) + 15.

This ratio (altitude vs. distance) should remain fairly constant if a 2000 fpm descent rate is maintained (no wind). This approximate 3:1 ratio can also be used to monitor progress throughout the descent and as a planning guide where crossing altitude restrictions must be met.

DESCENT (CONT'D.)

Use Cruise Mach/300 KIAS during descent.

All crew members should maintain an active awareness of altitude at all times and the Altitude Select feature should be set and armed for all intermeidiate altitudes. Use standard callout procedures for altitude assignments.

The S/O monitors ATIS and copies weather, field conditions, and NOTAMS as applicable.

Speed Brakes

Speed brakes may be used to increase descent rate at any speed, and there should be no reluctance on the part of the pilot to use them. They should, however, be used judiciously for passenger comfort. At high speeds, full speed brakes can produce undesirable airframe buffeting that approaches light turbulence in severity. Any time that the speed brakes are used, they should be slowly extended or retracted. Use of speed brakes with flaps extended is not permitted.

Anti-Icing Systems

If a descent is made through icing conditions, comply with the procedures and restrictions to the use of A/I at altitude as stated in the cold weather procedures section of Supplemental Information. Use wing A/I prior to entering icing conditions and to remove any accumulated ice prior to extending flaps/slats. Refer to the Prolonged Holding discussion on this page.

HOLDING

For fuel conservation, hold using clean configuration with the speeds shown on the Landing Data Chart (or ODM). Use clean configuration in icing conditions. Accomplish holding at the highest practical altitude, and request ATC to approve an increase in holding speed if the chart speed is higher than FAA hold speed.

Above 14,000 feet MSL maintain V_{ref} + 90 minimum clean. If flaps 4 must be used below 14,000 feet MSL, maintain V_{ref} + 40 minimum.
Maximum FAA holding speeds are:

- Through 6000 feet MSL – 200 KIAS.
- Above 6000 feet through 14,000 feet MSL – 210 KIAS.
- Above 14,000 feet MSL – 230 KIAS.
  Advise ATC if it is not practical to hold within FAA hold speed requirements and advise ATC of desired hold speed.

Holding in Turbulence

Avoid holding in turbulence, if possible. If it is necessary, reduce bank angles to minimize G-loads, and consider complying with turbulent airspeed restrictions. If turbulence becomes moderate to severe, request a holding pattern away from the area of turbulence.

Prolonged Holding

When holding for an extended period at air temperatures below 10°C TAT, engine icing may occur regardless of visible moisture. This phenomenon is due to super cooling of intake air caused by venturi effect on the air stream as it enters the engine intake. Select Continuous Ignition and Engine Anti-ice – **ON.**

Maintain highest practical thrust when flying with anti-ice ON in icing conditions. Any engine(s) which have been operating at or near idle thrust should be accelerated to 90% N_1 for approximately 5 seconds at 10 minute intervals.

Holding Procedures

- See ODM for speed and flap setting (not above FAA max. without ATC approval).
- Begin speed adjustment within 3 minutes of arrival at the holding fix.
- Headings after entry and while holding should compensate for known wind effects. Advise ATC if an increase in airspeed is necessary, or if unable to accomplish part of holding procedure. Turns during entry and while holding should be made at:
  - 3° per second or
  - 30° bank angle or
  - 25° bank angle using the flight director, whichever requires the least bank angle. Holding, at altitude, using the autopilot in command may produce such a shallow bank angle that the aircraft may exceed the boundary of the holding pattern. It may be necessary to use the CWS mode during turns.
- Time holding legs as follows:
  - Inbound Leg:
    14,000 feet (MSL) or below – 1 minute.
    Above 14,000 feet (MSL) – 1 1/2 minutes.
  - Outbound Leg:
    The initial outbound leg should be flown for 1 or 1½ minutes (as required by altitude). Timing for subsequent outbound legs should be adjusted to achieve proper **INBOUND** leg time.

    Outbound timing begins over or abeam the fix, which ever is later. If the abeam position cannot be determined, start timing when the turn to the outbound heading is completed.

APPROACH/LANDING

All approaches and landings will be conducted in accordance with the Standard Callouts and Policies portion of the Normal Procedures section, L-1011 Pilot's Operating Manual.

Unless otherwise required, it is recommended that all approaches incorporate the use of the A/L APFDS mode. (ILS mode on Ships 759 – 762).

Below 10,000 ft. MSL, maintain 250 KIAS as long as practical, consistent with judicious approach planning and ATC imposed restrictions. The Approach Checklist should be completed as early as practical but in no case later than five minutes before landing. Keep in mind that the Lower Galley must be clear and the cabin must be secure before landing (300 + passengers, in some cases). The checklist, however, is designed to be read after the aircraft is prepared for the approach.

Approach Preparation

Thorough planning is the key to a safe, unhurried, professional approach. Review and brief the approach chart data according to current Delta Operations Specifications procedures and consider an alternate course of action prior to beginning the approach.

Make sure someone has assumed the responsibility for "minding the store" while the others go about preparing for the approach. The PF should also assign specific tasks, e. g., windshield wipers, rain repellant, etc., to specific individuals.

Approach Briefing

The PF should include in his briefing the following items as applicable:

- ATIS Advisories
- Flight Plan Message Notams
- Approach Plate
  - Designated Approach
  - Chart Number and Date
  - Required Minimums
  - NAVAID/Frequency/ID
  - FAP/FAF Altitude
  - MDA, DH or AH
  - MA Point and Procedure

Aircraft Lights

The use of landing and/or turnoff lights beginning at 18,000 ft. is recommended for safety. In the presence, however, of fog or undercast, turning on lights too early may contribute to visibility problems. If landing lights are postponed until approaching the runway threshold, the pilot flying may delegate that task to another crew member. Strobe lights should be turned off in flight when there is adverse reflection from clouds as, for example, during CAT III approaches.

Airspeed Bugs

Set the primary bug on the airspeed indicator (controlled by the adjacent set knob) at threshold speed (V_{ref}). Additional bugs should be set for the approach. All selectors should be identical on both A/S indicators insofar as the number of bugs permit.

Speed Brake – Flap/Slat Management

When slowing the aircraft in the speed range from 250 knots to the flaps 0° speed on the landing data card, spoilers are more effective for deceleration than flaps. Extending flaps/slats at the maximum placarded speeds causes unnecessary stress on the aircraft and should be avoided. Flaps should be extended on schedule commensurate with required/desired airspeeds. The chart speeds provide a good margin above minimum maneuvering speeds at all aircraft weights.

NOTE: Do not use speedbrakes with flaps extended.

Approach Flaps

The pilot flying calls each flap setting even if moving the flap selector himself. Flaps are extended one position at a time, the flap indicators checked for correct movement, and the airspeed, including the IAS window, is adjusted to the required speed.

When flaps are extended to the 4° position, check the slat LE EXT light. Check slat monitor lights illuminated, slat lock lights extinguished, and slat position indicator.

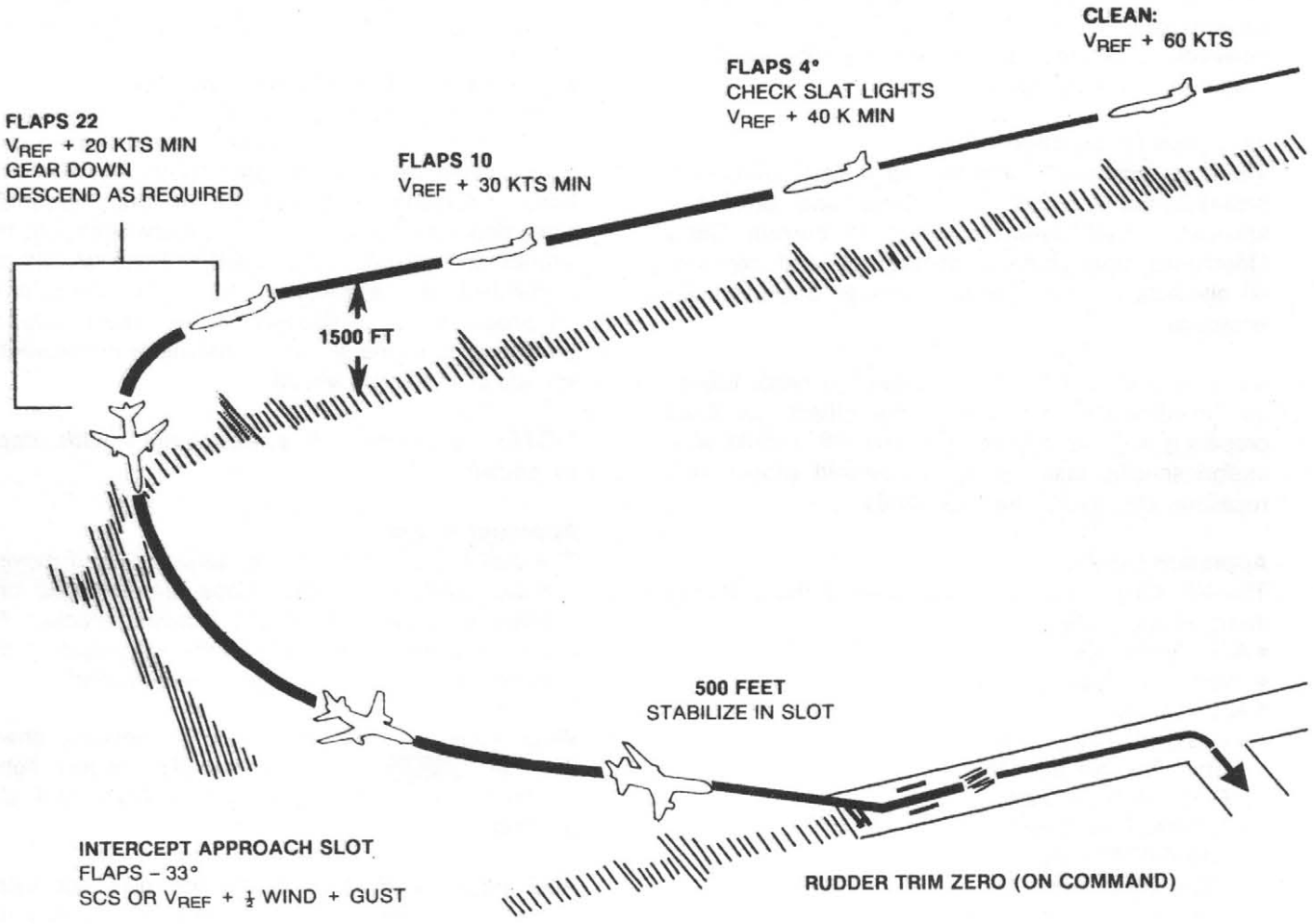
After each selection is made, the pilot not flying checks for correct flap movement, announces the assigned or minimum airspeed as indicated on the landing data card, and updates the IAS window.

The initial approach is normally flown with 10° flaps at V_{ref} + 30 minimum.

APPROACH/LANDING (CONT'D)

IF ONE ENGINE INOPERATIVE APPROACH/LANDING:

- Use normal Descent, Approach and Before Landing checklists.
- Consider fuel jettison.
- APU – ON.
- If landing at other than destination, check:
  - Runway Allowable Landing Weight. (Structural overweight landings are authorized, see FOPM.)
  - Climb Limit Weight.
- Brief handling of rudder trim, if necessary.



2 OR 3 ENGINE APPROACH AND LANDING

APPROACHES/LANDING (CONT'D.)

Airspeed Additives

All approaches should be flown using the Speed Command System (SCS). Since SCS computes additives for gust factor, sink rates, and C.G., there is no requirement for additional speed additives when SCS is operational and used.

If the SCS is inoperative or, in the judgement of the Captain, erroneous, V_{ref} (BUG) plus additives must be used.

Add $\frac{1}{2}$ the steady headwind component and all of the gust factor (not to exceed 20 knots) to the bug setting. Reduce to V_{ref} plus gust factor over the threshold.

Procedure for Normal Visual Approach to Landing

The key to a successful VFR approach is proper planning and execution with the aircraft on speed and altitude, positioned to make a touchdown in the touchdown zone. If any of the parameters cannot be met or if there is doubt that touchdown will occur in the touchdown zone, a go-around is the proper course of action.

During a VFR approach and in keeping with good resource management practices, all suitable navigation and approach aids shall be utilized for assistance. If an ILS glideslope or VASI is available, do not descend below the ILS glideslope prior to the middle marker or, in the case of VASI, until a lower altitude is necessary for a safe landing.

When executing a straight in or other VFR approach, plan the approach so as to arrive at a point 3 miles from the end of the runway at approximately 1000 feet AGL. This will coincide with a 3° glideslope. Stability at this point provides a reference for all VFR approaches from which an approach may be successfully completed in the normal touchdown zone with a touchdown aiming point 1000 feet beyond the end of the runway.

When on a downwind, an abeam position of approximately $1\frac{1}{2}$ miles at 1500 to 1700 feet AGL with the aircraft configured to Flaps 10° and a speed of V_{ref} +30 minimum is ideal. Extend flaps to 22° as the turn to final is commenced and establish a descent rate of 700-800 fpm. Gear and landing flaps are extended as conditions dictate, however, aircraft sink rate should be stabilized and the landing configuration established by 1000 feet AGL.

At 500 feet AGL, airspeed, descent rate and runway line-up should be established. If they are not, initiate a go-around.

A normal runway descent profile coincides with a 3° glide path. Aircraft position in relation to this glide path can be checked by using the 300 ft./mile formula as a guide, i.e., for every mile from the runway threshold, the aircraft altitude above TDZ elevation should increase by 300 ft. AGL. (At 2 miles, aircraft altitude should be 600 ft. AGL; at 3 miles, 900 ft. AGL, etc.) If available, DME may be checked against altitude. A final altitude check may be made as the approach lights (standard configuration) begin to disappear under the glareshield. At this point, 250-300 feet AGL coincides with a normal glide path. Speed and sink must be firmly established.

The flare normally consists of a pitch change of approximately 2 degrees. Begin initiating the flare at approximately 30 ft..

Radio altimeter call-outs by the Second Officer will aid the pilot during the flare and landing. These call-outs, subject to the Captain's discretion, should begin at 70 ft. and continue to zero in 10 ft. increments. Flare pitch attitude must not exceed 12.5° which could result in a tail strike.

Generally, smoother landings can be achieved by completing the flare while closing the throttles. The ground spoilers will deploy automatically but this should be **confirmed** by noting the spoiler handle in the full aft position.

CAUTION

DO NOT REVERSE THE DIRECTION OF THE REVERSER DOORS OPERATION WHILE STILL "IN TRANSIT". WAIT UNTIL THE SYSTEM IS IN EITHER FULL REVERSE OR FORWARD IDLE.

After the main gear touchdown and during the landing roll, the nose wheel will normally tend to contact the runway rather firmly unless prevented to do so by easing the nose down using gentle control column back pressure. Immediate hard braking on a dry surface will result in a pronounced nose-over tendency. Continue to fly the aircraft until the nose wheel is in contact with the ground.

APPROACHES/LANDING (CONT'D.)

There is a pronounced nose-up tendency when number two engine is operated at or near maximum reverse thrust. This should be anticipated and appropriate forward pressure applied to the control column. This phenomena becomes more pronounced at lower landing gross weight.

For primary directional control, the rudder will be more effective than nose wheel steering down to 80 knots.

CAUTION

DO NOT APPLY REVERSE THRUST ABOVE IDLE POWER WHEN BELOW 60 KNOTS. POSSIBLE ENGINE DAMAGE COULD RESULT DUE TO HOT GAS INGESTION.

Reduce reverse thrust so as to arrive at reverse idle at 70 knots, then forward idle at a normal taxi speed. After deselecting reverse thrust, ensure that the REVERSER PRESSURE lights (S/O Panel) are extinguished.

Brakes/Anti-Skid

Brakes should normally be used only during the latter part of the ground roll to prevent overheating and excessive brake wear.

Apply pressure to the brake pedals firmly but smoothly and attempt to maintain consistent pedal force down to minimum speed.

Do not modulate the brake pedals during brake application but keep a steadily increasing pressure applied to allow the anti-skid system to function at its optimum.

Do not use nosewheel steering to increase steering angles. This could result in nosewheel side-slip and loss of steering effectiveness. Refer to Cold Weather Section in the POM for information concerning braking techniques on wet runways.

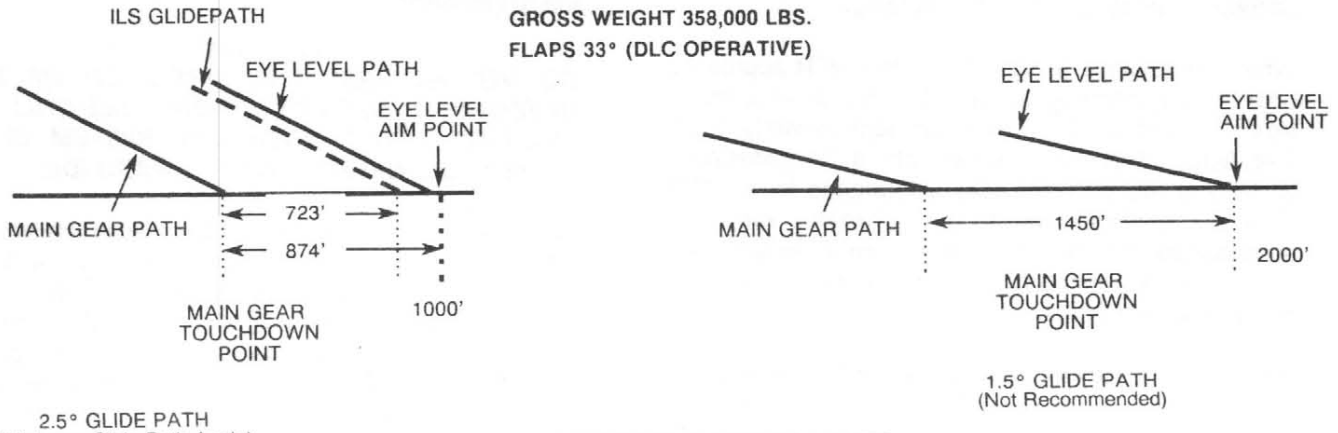
Threshold Crossing Height (TCH)

Category II criteria for the glideslope height above the threshold is 50 ft.(+10, -3) in order to provide a nominal wheels-over-threshold height on the approach. Because of this requirement, a Flight Director, Coupled or Autoland ILS approach will not be continued beyond 200 ft. AGL on a glide slope which yields less than a 47 ft. threshold crossing height (TCH) unless the flight path is **manually** adjusted to allow a threshold crossing height of 50 ft. or greater.

NOTE: In the final approach attitude, the L-1011 glide slope antenna, located in the nose, is approximately 33 ft. above and 100 ft. ahead of the main landing gear. "On glide slope", a TCH of 50 ft. can yield a MLG to runway lip clearance of only 5 or 6 feet.

APPROACH AND LANDING GEOMETRY

GROSS WEIGHT 358,000 LBS.
FLAPS 33° (DLC OPERATIVE)



RUNWAY THRESHOLD HEIGHT DATA

GLIDE PATH DEGREES	BODY ATTITUDE DEGREES	THRESHOLD CLEARANCE-FEET - EYE LEVEL AIM POINT					
		1000 FT.		1500 FT.		2000 FT.	
		EYE LEVEL	GEAR	EYE LEVEL	GEAR	EYE LEVEL	GEAR
1.5	8.8	26.4	-11.8	39.5	1.3	52.6	14.4
2.5	7.8	43.5	5.4	65.3	27.2	87.1	48.9
3.5	6.8	61.2	23.1	91.7	53.7	122.2	84.2

APPROACH/LANDING (CONT'D.)

Autoland approaches and landings are approved on all CAT II ILS systems and those CAT I ILS systems that yield glideslope threshold heights (TCH) of at least 47 ft.

Short Touchdowns

Documentation of CAT III approaches, however, requires use of a CAT II or CAT III facility.

During the approach, there often is a tendency to drop below the glide path in the final stages and to touchdown short of the desired reference point. This tendency to "duck-under" is particularly marked in instrument conditions, commencing at breakout to visual reference. It is also noticeable under VFR conditions and must be recognized and avoided as it could result in a touchdown far short of the intended point.

NOTE: Touchdown zone safety margin and threshold height are substantially reduced if the ILS glide path is less than 2 1/2 degrees and/or glide slope ground intercept point is less than 1,000 ft. from the runway threshold.

The characteristics of swept wing aircraft are such that it is virtually impossible to arrest a high rate of descent and flare at a speed close to Vref. Moreover, it is also virtually impossible to obtain a reprieve by a last-moment application of thrust. The aircraft must be maintained on the glide slope with a constant rate of descent that will permit the flare a few feet above the ground. Therefore, major adjustments to sink rate and thrust, e. g., the "Slam/Dunk" approach, should be accomplished well out from the threshold in order to be stabilized by 1000 ft. AGL. The aircraft should be aimed so as to touch down approximately 1,000 ft. beyond the threshold.

Crosswind Landing

When landing in a crosswind, limit the maximum bank angle to 5° upon touchdown.

Rudder and aileron applications just before touchdown must be sustained and the aircraft must be flown through-out the landing roll. Lateral control is effective down to 60-40 knots.

Do not plan an extended hold-off. Land slightly on one main gear, if required. As the aircraft settles onto all wheels and aileron effectiveness decreases, increase the amount of aileron deflection and hold the aircraft firmly on the runway with forward pressure on the control column.

In crosswind/tailwind conditions, plan to reduce reverse thrust (progressively) at a higher speed than normal to avoid engine surge due to hot gas ingestion.

VASI (Visual Approach Slope Indicator)
The VASI system uses red and white indicator lights, positioned adjacent to the runway touchdown point. These indicator lights project a visual glide path from the approach end of the runway. Each light unit projects a beam composed of a white (upper) segment and a red (lower) segment.

The VASI is normally aligned to intersect the runway at approximately 1,000–1,500 ft. beyond the threshold.

- If the proper glide path is maintained, the visual indication will be that the aircraft will overshoot the downwind bars (white light indication) and undershoot the upwind bars (red light indication).
- If below the proper glide path, the pilot will see the color of both bars as red.
- Adjusting to the proper glide path, the pilot will see the color of the downwind bar progressively change from red, to pink, to white.
- If above the glide path, both bars will be seen as white. Adjusting down to the proper glide path, the upwind bar will progressively change from white, to pink, to red.

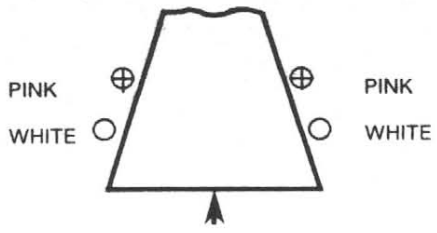
NOTE: To insure reception of the proper VASI visual ques, descent should not be initiated until the aircraft is aligned with the runway.

Three–Bar VASI
Some airports served by widebody aircraft have a 3–bar VASI system which provides two visual glidepaths to the same runway. The downwind glide path is the same as that provided by the standard 2–bar VASI. The upwind glide path is higher than the other and is designed for the use of pilots flying wide-body aircraft. When flying the 3–bar VASI, use the upwind glide path.

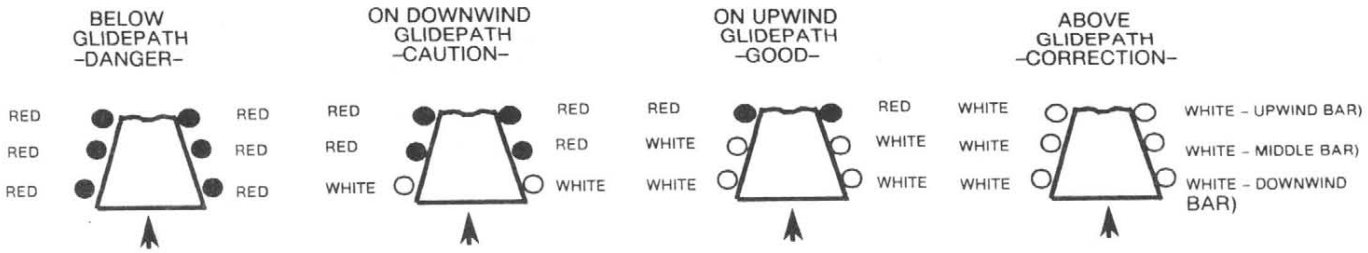
Two–Bar VASI
The 2–bar VASI can be used for glide path reference on the L–1011, but it is important not to use the normal display intended for aircraft of a smaller category. Plan to approach to stay high on the "normal" glide path. Establish a descent path to maintain a light pink color on the upwind bar and full white on the downwind bar.

In hazy visual conditions or when the approach is into the sun, the VASI white lights may have a yellow, brown or orange tint. This phenomenon may also occur at night. The red lights, however, will not be affected and the color differentiation will remain evident.

TWO BAR VASI
L–1011 ON GLIDEPATH



THREE BAR VASI
L–1011 ON GLIDEPATH



ILS APPROACH – GENERAL

Application of ILS procedures is determined by visibility and availability of avionics equipment. Delta policy prescribes that when the visibility is less than 4000 ft. RVR (3/4 mile) both the flight director and the autopilot, if operative, will be used.

Although the L–1011 is a Category IIIb aircraft, there will be many times when its full capability will not be used. The procedures for conducting an ILS approach are essentially the same for all ILS approaches as far as establishing configuration, speeds and intercept angles are concerned.

There are only three types of ILS approaches possible:

- Raw Data (No Flight Director or Autopilot)
- Flight Director only
- Fully Coupled (Autopilot and Flight Director) Approach

The following matrix shows the equipment configuration associated with various weather minima and who is permitted to conduct the approach.

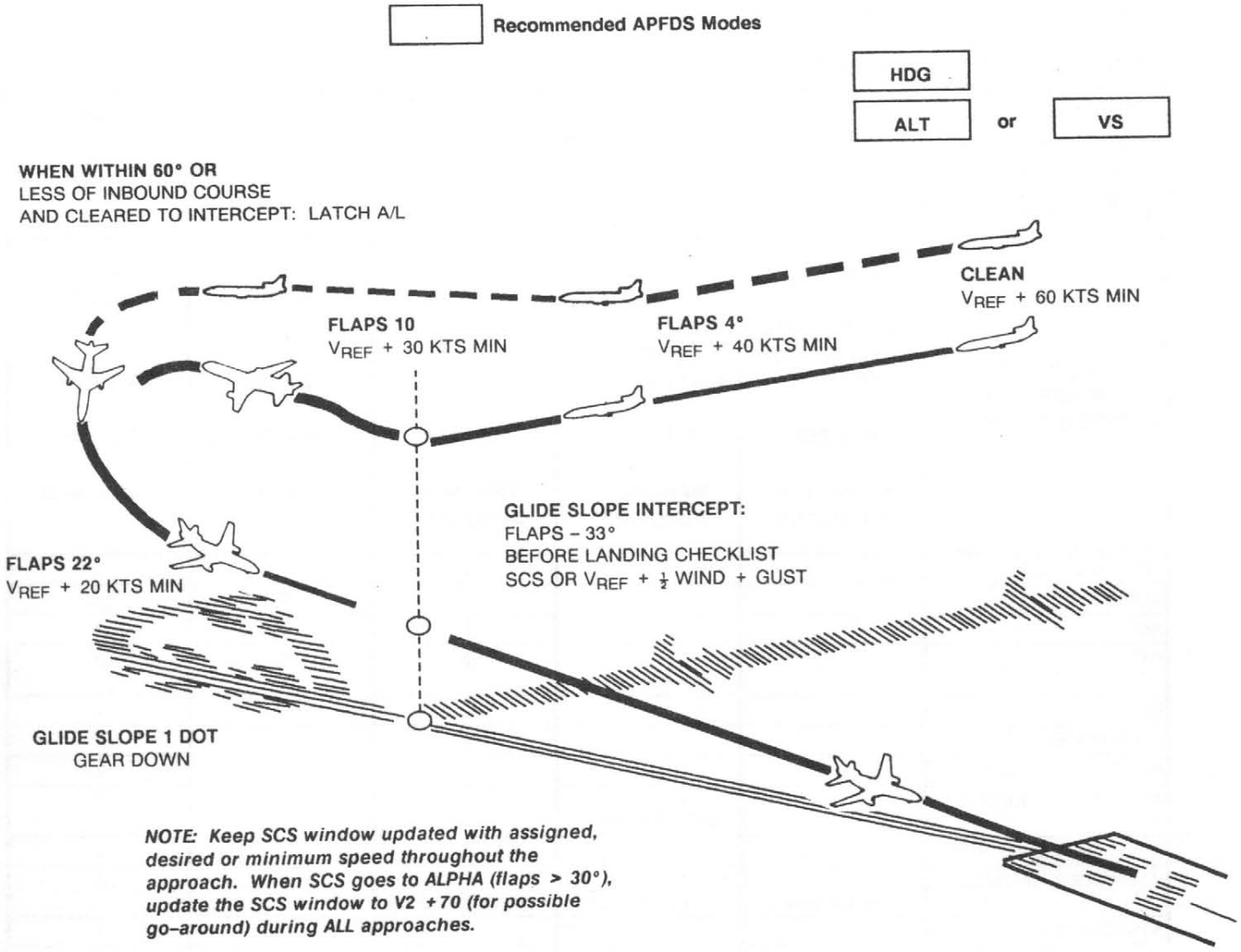
EQUIPMENT REQUIRED IN ADDITION TO FAR 121	BASIC ILS DOWN TO AND INCLUDING 4000 RVR, ¾ MI D.H. 250' MANUAL or AUTOLAND	CAT I W/TDZ & CL DOWN TO 2000 RVR, ½ MI. D.H. 200' MANUAL or AUTOLAND	CAT II CAPT ONLY 1200 RVR D.H. 100' MANUAL or AUTOLAND	CAT IIIa CAPT ONLY 700 RVR A.H. 50' AUTOLAND	CAT IIIb CAPT ONLY 300 RVR A.H. 50' AUTOLAND
LOC – G/S RECVRS	1	2	2	2	2
ADC		2	2	2	2
ADI			2	2	2
F/D		2 (1 if A/P Used)	2	2	2
R/A			2	2	2
AFCS MODE ANNUN		1*	2	2	2
AFCS WARN ANNUN		1*	2	2	2
AUTO APPR COUPLER		1 (If F/D Not Used)	1	2	2
PITCH TRIM (CHANNELS)			1	2	2
YAW–SAS (CHANNELS)	1 (If A/L Is Used)	1 (If A/L Is Used)	1 (If A/L Is Used)	2	2
ATS (CHANNELS)				1	1
DLC/AGS (CHANNELS)				1	1
RAIN REMOVAL (Incl both W/S Wipers)			1	1	1
INSTR COMPAR (Both Sides)			1	1	1
A/L MODE			1	1	1
RUDDER PEDAL STEER					1

Dispatch requirements may differ from those of enroute.

- If both channels of the Mach Feel Fail, use of the autopilot is prohibited.
- If both channels of the Pitch Trim Fail, the Autopilot is inoperative.
- CAT IIIa is automatic to touchdown.
- CAT IIIb is automatic through rollout (90 knots).

* Individual AFCS warning and mode annunciations may be inoperative provided landing minimums do not depend upon their use (see MEL).

INSTRUMENT APPROACHES (CONT'D)



NOTE: Keep SCS window updated with assigned, desired or minimum speed throughout the approach. When SCS goes to ALPHA (flaps > 30°), update the SCS window to V2 +70 (for possible go-around) during ALL approaches.

ILS – 2 OR 3 ENGINES

ILS APPROACH - GENERAL (CONT'D.)

Due to high reliability of the L-1011 APFDS, the aircraft is seldom dispatched without CAT IIIb capability.

The Approach (APR) mode is less sensitive than the Approach/Land mode and will tend to "dampen" the effect of noisy ILS signals. This will allow for more stable tracking during the approach, especially while tracking the localizer prior to the outer marker. Keep in mind that the Approach mode will not make an autoland and may be used if the lowest minimums published for a given ILS are CAT I or higher.

For CAT II or lower approaches, use the Approach/Land (A/L) mode.

NOTE: There is nothing to preclude the pilot from using Dual Autopilots and completing an autoland (TCH permitting) on any approach.

Since the Approach/Land mode provides full autoland capability, it is recommended that this feature be used fully when flying an ILS approach in low visibility conditions. This is preferable to disconnecting the autopilot at a low altitude (below 100 ft. AGL), and hand flying to touchdown. Nose up trim bias, programmed to occur at A/L track during the coupled approach, causes an out of trim condition which the pilot must be prepared to counteract. This technique may also cause a ballooning effect on short final, an undesirable reaction when ceilings are marginal.

For A/L approaches it is imperative that the airplane be in trim so autopilot authority is not degraded. Normally, it is desirable to commence an ILS approach with an intercept angle to the Localizer at approximately 45°, with the intercept occurring from below the glide path, at any reasonable distance outside the marker. This allows adequate time for appropriate configuration changes without rushing the approach.

Configuration and airspeed for the localizer intercept are optimally flaps 22°, gear up and V_{ref} + 20 kts minimum. There is nothing to preclude the pilot from postponing selection of flaps to 22° until the glideslope is alive and is probably the preferred course of action with an engine inoperative. Bear in mind that optimum Localizer capture occurs in the 160 – 150 knot range.

CAUTION

A/L OR APR CANNOT BE ARMED IF USING THE IAS PITCH MODE TO COMPLY WITH ALTITUDE ASSIGNMENTS. APFDS MUST BE IN VS OR ALT HOLD.

The HSI course deviation indicator (CDI) bar remains at full scale deflection until the aircraft is approximately 2 1/2 degrees from the selected course. The RDDMI is helpful in providing supplemental course information during initial intercept, if a compass locator is employed with the outer marker.

If "cleared for the approach", commence the intercept turn at the first movement of the flight director roll command bar. Of course, raw data should always be included in the scan on any approach. The expanded scale localizer on the ADI provides a more sensitive indication of course tracking when approaching the threshold. Update the heading bug to final approach course heading on all approaches and have it standing by for a possible go-around.

Establish final approach configuration and airspeed as the glide path is intercepted. The gear is lowered at approximately 1 dot deviation and the landing flaps (33°) after the gear indicates down and locked. The Before Landing Checklist is accomplished. (Be aware of the flaps 33° limit speed of 170 knots.) Check the glide path altitude when crossing the Outer Marker.

If the ATC vector to final is high and at some distance from the marker, gear and landing flap extension may be delayed until the aircraft is within a reasonable distance from the marker allowing, however, adequate time to be in the landing configuration and on speed (SCS donut or V_{ref} plus additives) when crossing the outer marker to insure a stabilized approach. Cross check altitude at the outer marker with the approach plate. When stabilized on the glide path, note the rate of descent, pitch attitude, and thrust required.

Avoid the tendency to concentrate only on the flight director pitch and roll command bars. Continually validate displayed information by comparing all sources. Use the SCS "donut" or Bug plus additives for proper airspeed control. When stabilized on the glide path the rate of descent will normally be 700 – 800 feet per minute.

The Altitude Select may be set (but not armed) to MA altitude after initial approach altitude is captured.

Decision Height

Barometric altimeters are equipped with a moveable bezel having three fixed indicator bugs. Set the orange bug to the DH or MDA as applicable. The additional bugs will then indicate DH (MDA) + 100 ft. and 200 ft. respectively.

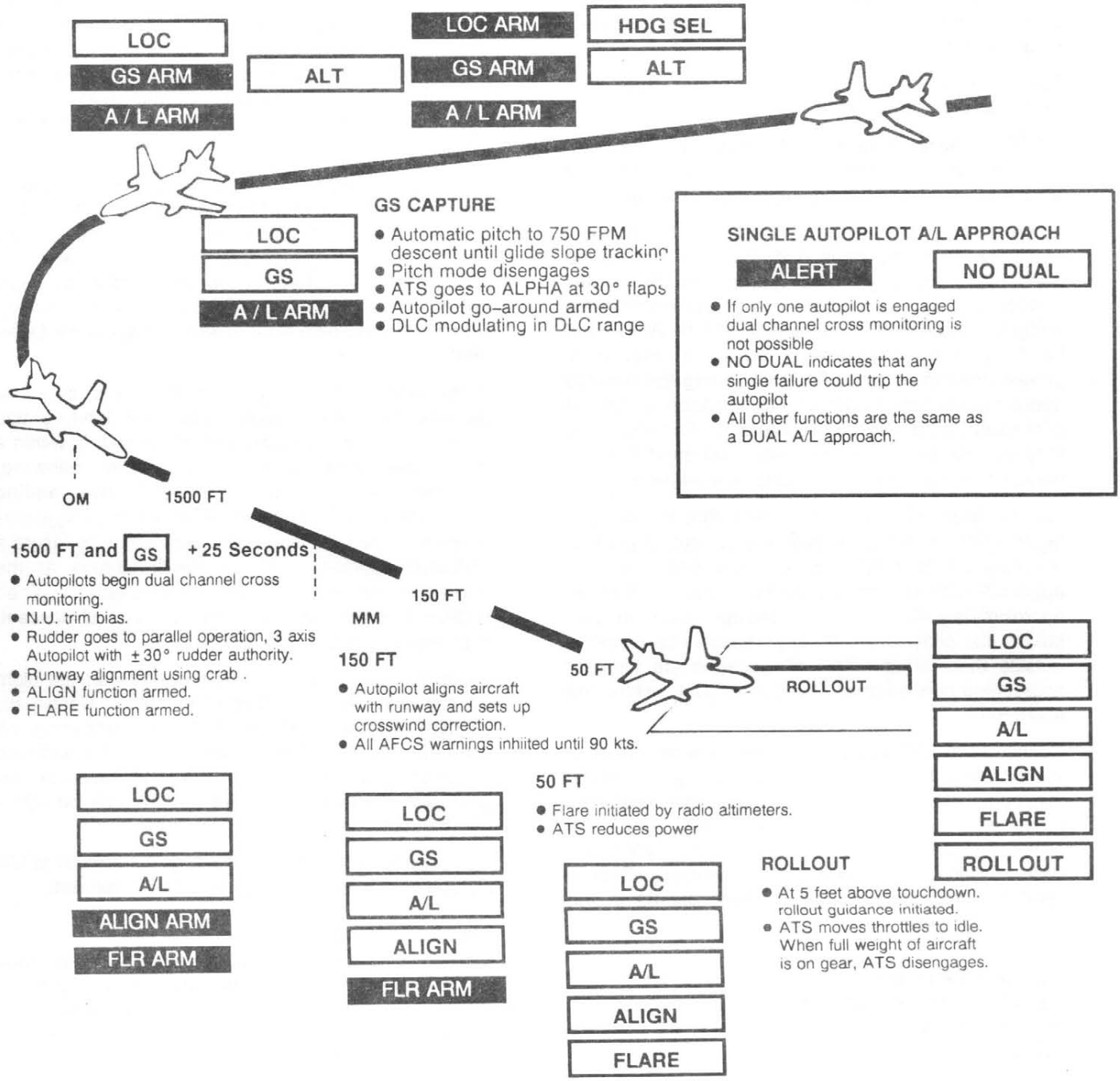
Recommended APFDS Modes

APPROACH

- Tune both ILS's and set up inbound course with course knobs
- Set DH/Alert Height on altimeters.
- Set Flight Directors ON (should already be on). Set Autopilot to CMD.
- Use HDG select to maneuver.
- Use VS or ALT for pitch guidance.
- Update approach speeds in IAS window as flap configurations are changed.
- Engage Autothrottles (may already be on).
- Set intercept heading with heading knob.
- Latch A/L mode selector after cleared to intercept and within 60° of inbound course.
- Second Autopilot to CMD (check 5 "bat-handles," i.e., 2 Autopilots, 2 F/D's, 1 Autothrottle).

LOC CAPTURE

- Capture point varies with beam rate change and angle of intercept
- HDG SEL disengages – Update HDG



DUAL A/L APPROACH

ILS APPROACH - GENERAL (CONT'D.)

As the approach progresses, the DH light will illuminate at 2,500 ft. and again at 1000 ft. AGL which simply serves as a proximity warning (in addition to its normal DH function). Both pilots should reset their respective light. (See Normal Procedures, Standard Policies and Callouts.)

Do not continue the approach below DH unless the aircraft is in a position from which a normal approach to the runway can be made and adequate visual reference maintained. If, upon arrival at DH or any time thereafter, any of the above requirements cannot be met, immediately commence the missed approach procedure.

NOTE: For training purposes, the published DH will apply unless the instructor specifies otherwise.

WHEN VISUAL CONTACT WITH THE RUNWAY IS ESTABLISHED, MAINTAIN THE GLIDE PATH UNTIL REACHING FLARE HEIGHT. DO NOT "DUCK UNDER" THE GLIDE PATH FOR THE PURPOSE OF ACHIEVING GEAR TOUCHDOWN AT A POINT SHORT OF THE GLIDE PATH/GROUND INTERCEPT POINT.

Definitions

- *Category IIIa (CAT IIIa)* – A precision automatic instrument approach and landing (using the A/L mode of the APFDS), to touchdown only, with visual reference available for manual rollout of the aircraft. Controlling RVR is less than 1200, but not less than 700 feet (200 meters). No decision height is required. Alert height is 50 feet.
- *Category IIIb (CAT IIIb)* – A precision automatic instrument approach and landing (using the A/L mode of the APFDS) including automatic rollout, with visual reference available for taxi. Controlling RVR is less than 700, but not less than 150 feet (50 meters). Delta's minimum is not less than 300 feet (100 meters). No decision height is required. Alert height is 50 feet.
- *Alert Height (AH)* – A height defined for operational use by pilots (100 feet or less above the highest elevation in the touchdown zone) above which a CAT III approach would be discontinued and a missed approach initiated if a failure occurred in one of the redundant operational systems of the aircraft or relevant ground equipment. This height is based on characteristics of an aircraft and its particular fail-operational airborne CAT III system.

Operational Concepts

- The aircraft system is designed to provide sufficient information to the pilot so that the landing may be safely continued and completed, or a go-around safely executed, from any altitude following any single failure or reasonable combination of failures.
- The primary mode of CAT IIIa operations is automatic to touchdown. The primary mode of CAT IIIb is automatic through touchdown and rollout.

Acceptable CAT IIIa/IIIb Approaches

- An acceptable CAT IIIa/IIIb approach and landing is described below, with no APFDS equipment failures.
  - Autoland (A/L) track mode achieved prior to 1000 feet AGL.
  - Touchdown bank angle does not exceed 3 degrees.
  - Autopilot commands wings level at touchdown.
  - Touchdown occurs at a point at least 200 feet beyond the threshold and prior to the start of the second single runway weather marking.
  - The fuselage centerline is no more than 27 feet from the runway centerline at touchdown.
- The CAT IIIa approach/landing is considered completed after all three landing gear are on the ground. The CAT IIIb approach/landing/rollout is considered completed at 90 knots or less during the automatic rollout, at which time any muted malfunction would be indicated by a "DANA" light annunciation on the pilot's annunciator panel.

Crew Qualifications and Procedures

- Operations to CAT IIIb minima (less than 700 RVR) require special crew qualifications. The required training is an integral part of our initial/transition/upgrade syllabus.
- The Captain should brief the F/O to:
  - Remain inside, on instruments, throughout the approach and rollout.
  - Callout all annunciations on the AFCS mode panel.
  - Callout any "flags" prior to A.H.
  - After touchdown, give steering commands, e.g., "steer left," "steer right," or "on centerline."
- Delta's CAT IIIb operation involves an approach that is automatic through landing and rollout, but is dependent upon expeditious reverse and manual braking to effect a safe, smooth deceleration to taxi speed.

  During actual CAT III operating conditions, RVR's as low as 300 feet will be encountered. It is anticipated that the psychological effect of limited forward visibility will encourage early and firm application of the brakes. Captains should be encouraged to follow these instincts, but not to disregard passenger comfort and safety in the process.

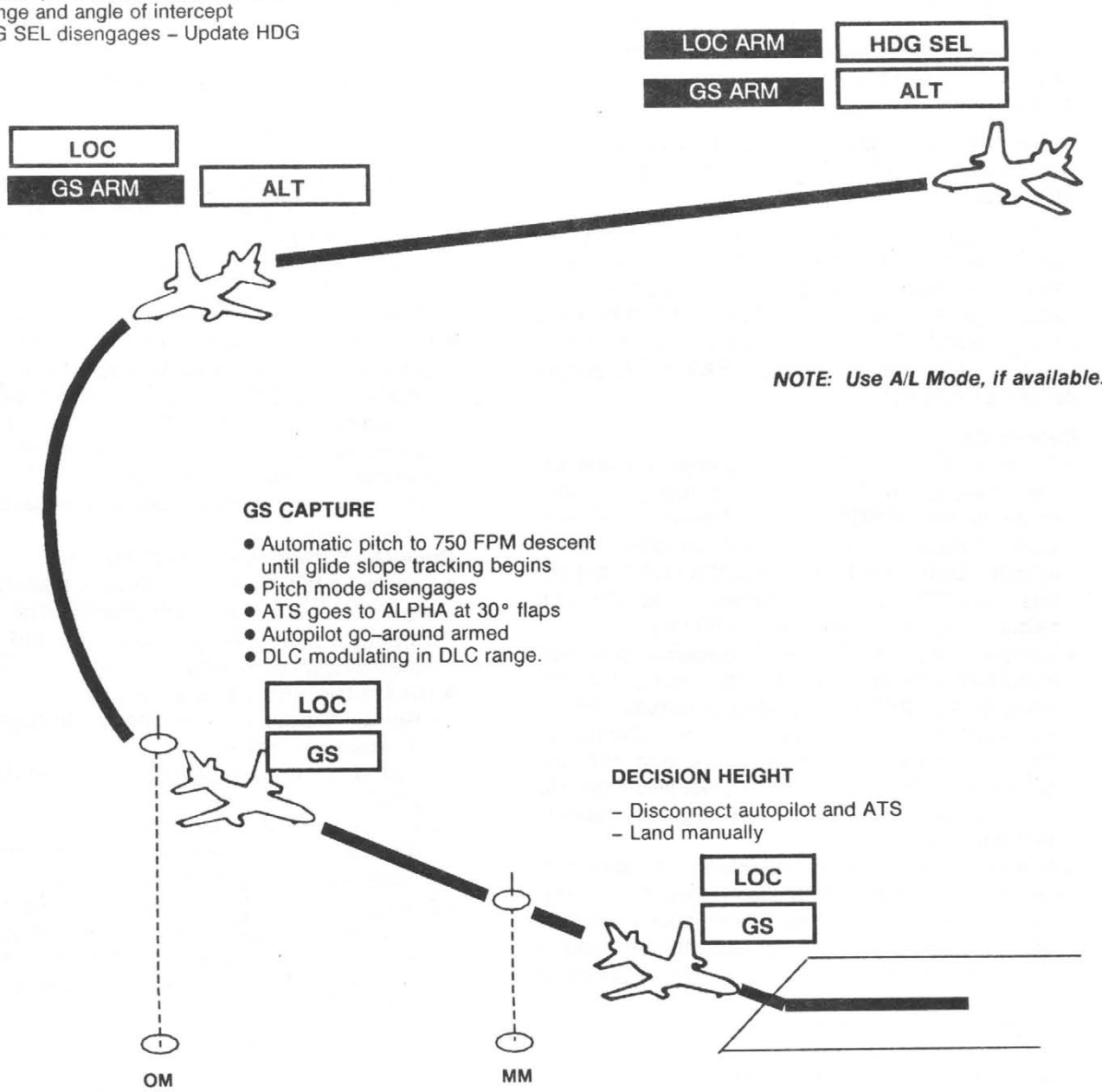
Recommended APFDS Modes

APPROACH

- Tune both ILS's and set up inbound course with course knobs.
- Set DH on altimeters.
- Set Flight Directors ON (should already be on). Set Autopilot to CMD.
- Use HDG select to maneuer.
- Use VS or ALT for pitch guidance.
- Update approach speeds in SCS window as flap configurations are changed.
- Engage Autothrottles (may already be on).
- Set intercept heading with heading knob.
- Latch APR mode selector when cleared to intercept and heading within 60° of inbound course.

LOC CAPTURE

- Capture point varies with beam rate change and angle of intercept
- HDG SEL disengages – Update HDG



APPROACH MODE (ILS)

ILS APPROACH - GENERAL (CONT'D.)

Firm, but less than maximum brake effort should be applied as soon as nose wheel contact is achieved. In the event that the centerline runway lights begin to show an alternating red and white pattern indicating that 3000 feet of runway remain, and the aircraft is not already at a safe taxi speed, this braking effort will be increased to a maximum effort.

- Normal reverse thrust techniques should be used. If the runway braking action is reported to be less than good, or the centerline lighting is reported to be obscured, a CAT IIIb approach will not be initiated.
- The F/O has a special responsibility during the rollout phase of a CAT III landing. He must maintain instrument scan and alert the Captain to any excursion in heading, or to any deviation from the expanded localizer display. The language used (i.e. "steer left, steer right" or "drifting left, drifting right", etc.) must be clearly briefed by the Captain prior to initiating the approach to avoid confusion or misinterpretation.

The F/O should assist the Captain with taxiing until proper outside orientation is assured before getting involved with After Landing checklist items.

INSTRUMENT APPROACH

All CAT II and CAT III Approaches/Landings will be conducted by the Pilot-in-Command. The F/O accomplishes the duties/functions shown below and assists the Captain as directed.

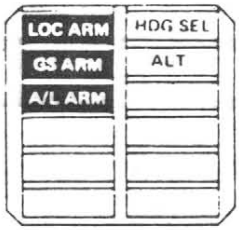
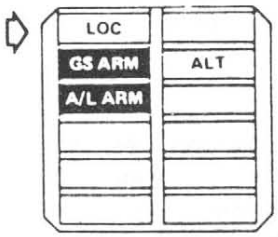
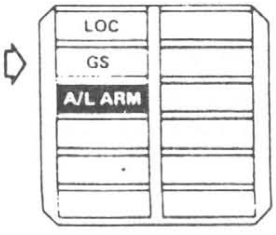
NOTE: The following procedures are to be used in conjunction with Standard Callouts and Policies, Normal Procedures.

A First Officer may make CAT I approaches/landings at the discretion of the Captain. Under such circumstances, the duties and functions in the following procedures assigned to the Captain will be performed by the pilot flying, and the pilot not flying will perform the procedures assigned to the F/O.

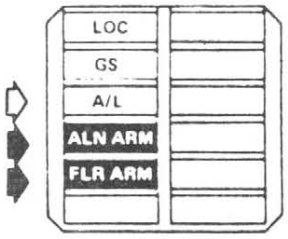
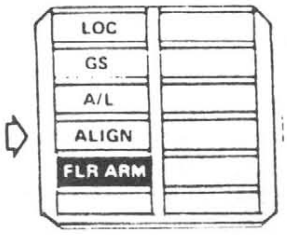
CAT I, II, III APPROACHES
Single or Dual Autopilot – As required

Captain	First Officer
• Check Pilot Annunciator Panel for any faults that prevent the approach (recall/check).	• As directed.
• VHF NAV Radios – Tune and identify ILS frequency.	• Tune VHF NAV radio as required – identify ILS frequency.
• Course Selectors – Set to inbound ILS course.	• As directed.
• ADF – Tune/Identify/Select(VOR/ADF switches as required))	• As directed.
• Altimeters – Set to DH/Alert Height(as appropriate). Barometric altimeters are set to TDZ +50 ft on CAT III. However all functions and callouts on a CAT III approach are based on the Radio Altimeter only.	• As directed.
• Marker Beacon – Button in, volume up.	• As directed.
• Check aircraft in trim – pitch, roll, yaw, and thrust.	• As directed.
• Both Flight Directors – On.	• As directed.
• One Autopilot to CMD.	• As directed.
• Autothrottles – As required (ON for CAT IIIa/IIIb)	• As directed.
• Heading Select – On and set to desired heading.	• As directed.
• Pitch Mode – As required	• As directed.
• Turn on localizer (appx): – 10 miles from runway – 45° localizer intercept angle (max.). – 12 miles from runway – 60° localizer intercept angle (max.).	• As directed.

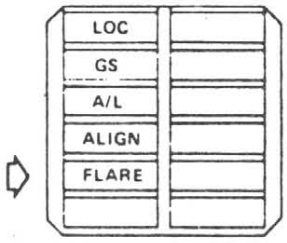
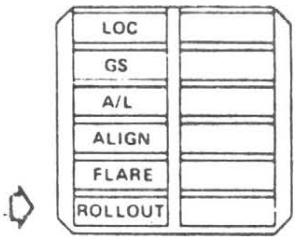
INSTRUMENT APPROACHES (CONT'D)

Captain	First Officer
• Prior to LOC capture: – Flaps – 22° (for optimum capture). Flaps 10° will result in slightly higher than optimum airspeeds for LOC capture. – IAS Selector – V_{ref} +20 (optimum speed for LOC capture – 160 – 150 KIAS). – A/L Mode Switch – Latch. Verify that mode annunciators are the same as F/Os. – CAT I may be conducted in APR mode if A/L mode is not available. Autopilot must be disengaged at 200 feet. (No autoland in APR mode.) – Second autopilot to CMD. – Check 5 bat handles (2 F/D, 2 A/P, 1 ATS). – Check Slow/Fast Indicator for proper indication.	• As directed. After A/L mode is selected, F/O calls out all AFCS mode annunciations. **AFCS MODES**  ***NOTE: If using APR mode or flight director only in A/L to CAT I, LOC and GS will be the only annunciations.***
• Monitor localizer capture. After LOC capture, update heading to approach heading. Check compass No. 1 and No. 2 difference should not exceed 3°.	• Call "LOC capture." **AFCS MODES** 
• Glideslope one dot – "Gear Down".	• Call "glideslope alive." At Captain's command, extend gear.
• Glideslope capture (1/3 dot deviation), "Flaps 33, Before Landing Checklist".	• Call "glideslope capture." Select landing flaps upon command. Call modes progression. • Set Altitude Select to missed approach altitude. **AFCS MODES** 
• As flaps are extended beyond 30° verify DLC operation and Alpha mode of the SCS. Update speed window to V_2 +70. (Adding 15 knots to clean speed will approximate V_2 +70.) • Confirm F/O callout.	• Verify and callout DLC operation and ALPHA mode. • "Over (fix) at _____ feet. Altimeters crosscheck, No flags."

INSTRUMENT APPROACHES (CONT'D.)

Captain	First Officer
• Monitor A/L ARM changes to A/L capture at 1500 feet radio altitude and 25 seconds after glideslope capture, whichever occurs **last**. – Note pitch trim bias – 1.5° trim nose up – approximately ½ turn of mechanical trim wheel. Verify: – Rudder to parallel. – Pitch attitude approximately 7.5° to 8° nose up. NO DUAL will appear if conditions are not right for a dual autopilot approach. Single autopilot use is acceptable for CAT I or II.	• Call modes progression. "A/L CAPTURE", "ALIGN ARM", "FLARE ARM." **AFCS MODES**  ***NOTE: If autopilots are disconnected after approach land track, the aircraft will have a significant nose-up tendency. This is due to the trim bias used by the APFDS, and considerable push force may be required until the stabilizer is re-trimmed.***
• Reset DH pushlight and verify APFDS performance versus HSI raw data LOC and GS tracking.	• Call "1000 feet and reset." Reset DH pushlight and verify APFDS performance versus raw data display.
• Check: – Flight Instruments – No flags – Instrument Comparator – AFCS Warning Panel – Pilot Annun. Panel	• Be alert for, and callout, any indications of equipment failure.
• Check and verify Surface Position Indicator Auto Trim Flags (cat-eyes) do not indicate out of trim condition. ***NOTE: Pitch trim bias is not shown on the SPI.***	• Call "200 above" (Use Radio Altimeter only on CAT III approaches).
• CAT I – At DH, Continue Approach/Go-Around based on visibility stating: "Approach Lights or Runway in Sight" or "TOGA".	• As directed.
• At 150 feet radio altitude, ALIGN is annunciated. ***NOTE: ALIGN annunciation confirms that you will have guidance for automatic rollout.***	• Call "100 above" and "ALIGN" **AFCS MODES** 

INSTRUMENT APPROACHES (CONT'D)

Captain	First Officer
• CAT II – At DH, Land/Go-Around based on visibility, stating "Runway in sight" or "TOGA."	• As directed. ***NOTE: Second Officer, at Captain's discretion, calls out radio altimeter altitudes in 10 foot increments, beginning at 70 feet.***
• CAT III	• During CAT III approaches, these altitude callouts will be **omitted** to prevent distraction from more essential callouts.
– At Alert Height (50 feet RA), continue approach/land if no failures or flags have occurred.	– Callout "Alert Height", confirm that landing is assured by reference to expanded localizer and LOC/GS tracking of the APFDS.
– At 50 feet RA, FLARE is annunciated.	– Callout "FLARE". **AFCS MODES**  **At 50 feet RA**
• Continue to monitor landing maneuver and visual references, i.e., Touchdown Zone, Lights, Runway Centerline, etc.	• Continue to monitor instruments and auto trim operation during flare, by noting movement of trim wheel.
• At 5 feet RA, ROLLOUT is annunciated. ***NOTE: A CAT IIIb landing and automatic rollout should NOT be abandoned if ROLLOUT annunciation does not occur.***	• Callout "ROLLOUT." **AFCS MODES**  **At 5 feet RA**
• Touchdown: – Pitch attitude – 9° to 10°. – Autothrottles – Retard and Disconnect. – Thrust levers to idle reverse.	• S/O confirms AGS extended and calls out "Spoilers extended." • S/O advise engines in reverse.

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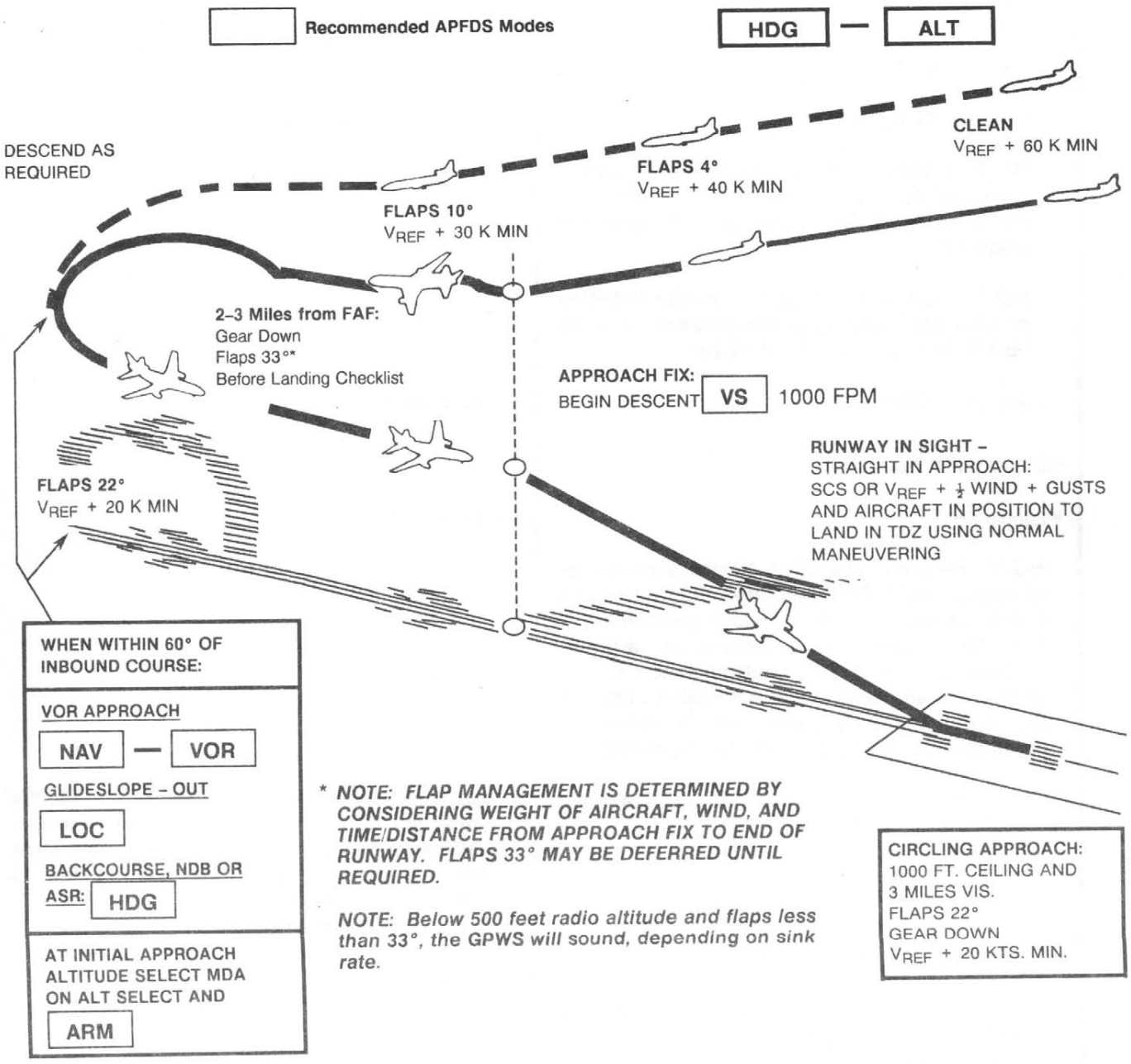
INSTRUMENT APPROACHES (CONT'D)

Captain	First Officer
Category IIIa Approach	
• Landing Roll:	• Landing Roll:
– Nose down at programmed rate for nosewheel touchdown.	– Continue to monitor rollout alignment versus expanded localizer and HSI deviation. Give steering commands as briefed. Hold slight forward pressure on the control column to prevent nose from rising.
– Apply reverse thrust, as required.	– S/O advise engines in reverse.
– Reverse idle by 70 knots.	– S/O calls out airspeed during deceleration.
NOTE: If rudder pedal nosewheel steering is inoperative, use of Nosewheel Steering Wheel during the landing roll may be required.	– As directed.
NOTE: Autotrim operates from the initiation of flare until main gear touchdown. A nose up trim in excess of 8° will occur.	
– Autopilots **OFF**.	– As directed.
Category IIIb Approach	
• Landing Roll:	• Landing Roll:
NOTE: Failure of the AFCS Modes annunciator to display ROLLOUT will have no noticeable effect on the automatic rollout performance. The Pilot may notice excessive aileron movement if there is any disturbance to the localizer beam, and may at his option continue the rollout manually using runway centerline lights and his heading cursor for guidance.	
– Nose down at programmed rate for nosewheel touchdown (automatic).	– Continue to moniter rollout alignment versus expanded localizer and HSI localizer deviation. Give steering commands as briefed. Hold slight forward pressure on the control column to prevent nose from rising.
– Apply reverse thrust, as required.	– S/O advise engines in reverse.
– Reverse idle by 70 knots.	– S/O callsout airspeed during deceleration.
NOTE: Autotrim operates from the initiation of flare until main gear touchdown. A nose up trim in excess of 8° will occur.	– As directed.
– Autopilots **OFF** at completion of landing roll.	– As directed.

INSTRUMENT APPROACHES (CONT'D)



NON-PRECISION APPROACH PROCEDURE

NON-PRECISION APPROACHES

Operations Specifications authorize the use of non-precision approaches including VOR/DME, LOC, BACK COURSE, NDB and Surveillance Radar (ASR). PRECISION RADAR APPROACHES (PAR) ARE NOT AUTHORIZED.

Using the autopilot and autothrottles during a non-precision approach reduces crew workload and allows more time for management and monitoring the approach. Also, correct use of the Altitude Select/ARM feature can help prevent descents below authorized altitudes. Be aware, however, that ultimate responsibility for excursions below MDA, prior to seeing the runway, lies with the crew, not the autopilot.

The minimum altitude for disengaging the autopilot on a Non-Precision approach is when leaving MDA.

Vectoring to the non precision final approach is normally accomplished using the HDG and pitch modes, VS or ALT. Flaps are extended and the aircraft slowed as required/assigned. Stabilized flaps 22° (V_{ref} +20 minimum) configuration should be achieved by at least 2 - 3 miles prior to the final approach fix.

When established on an intercept heading and "cleared for the approach", the pilot may latch NAV (if a VOR approach) or LOC (if a localizer approach) to assist in final approach course capture. The L-1011 does not have automatic back course tracking capability; therefore, final approach course tracking during a back course (as well as an NDB or ASR) approach must be accomplished, when using autoflight, in the HDG mode. When hand flying, the HDG should be kept updated.

BACK COURSE APPROACHES

To maintain proper aircraft/localizer signal sensing, set the HSI course selectors to the inbound localizer front course setting. During a back course approach, spurious glide path signals may be presented without warning flags. These indications must be ignored. The G/S ALERT mode of the GPWS should be de-activated whenever valid glide path information is not available.

ASR APPROACH

During an ASR approach, the controller provides guidance in azimuth and distance only. Elevation guidance is not normally given unless requested by the pilot. The controller may advise the pilot when to commence the descent to MDA.

An ASR approach should be conducted only after reference to the appropriate Jeppesen approach plate. Fly the approach using standard non-precision approach procedures. At the missed approach point, the controller will terminate guidance and advise the pilot to execute the published missed approach unless the pilot reports the runway in sight.

VERTICAL GUIDANCE

On all non-precision approaches, the MDA is set on the barometric altimeter and 250 ft. is set in the radio altimeter. Once stabilized at the initial approach altitude, the MDA may be set and armed on the Altitude Select. Two to three miles from the final approach fix/point, extend the landing gear. After the gear indicates down and locked, extend flaps to 33° (assuming a straight forward approach, all engines operating. Complete the Before Landing Checklist. Upon reaching the final approach fix/point, use VS 1000 to descend to MDA. When MDA is captured and ALT ARM changes to ALT HOLD, the missed approach altitude may be placed in the Altitude Select window.

FLAP MANAGEMENT

Flap management is determined by considering aircraft gross weight, wind, time/distance from the approach fix to the runway, circling approach, engine configuration, etc. Landing flaps (33°) may be delayed if the situation warrants.

NOTE: Below 500 ft. radio altitude and flaps less than 33°, the GPWS will sound, depending upon sink rate.

Refer to Non-Precision Approach Profile, in this section, for Back Course, VOR, NDB, LOC and ASR approaches.

A back course approach may be accomplished using raw data information displayed on the HSI in conjunction with the HDG, VS and ALT SELECT or ALT modes.

APPROACH/LANDING (CONT'D)

GEAR DOWN
FLAPS 33°
SCS OR V_{REF} + ½ WIND + GUST

NORMAL SLOT

1. PRESS TOGA **GO-AROUND**
2. APPLY GO-AROUND THRUST WHILE ROTATING TO CLIMB ATTITUDE.
3. RETRACT FLAPS TO 22°.
4. POSITIVE RATE OF CLIMB – GEAR UP.
5. LATCH **HDG** AND **ALT ARM**

FLAP RETRACTION SCHEDULE

22° TO	10°	V_{REF} + 10 KTS
10° TO	4°	V_{REF} + 20 KTS
4° TO	0°	V_{REF} + 60 KTS

2 ENGINE MISSED APPROACH

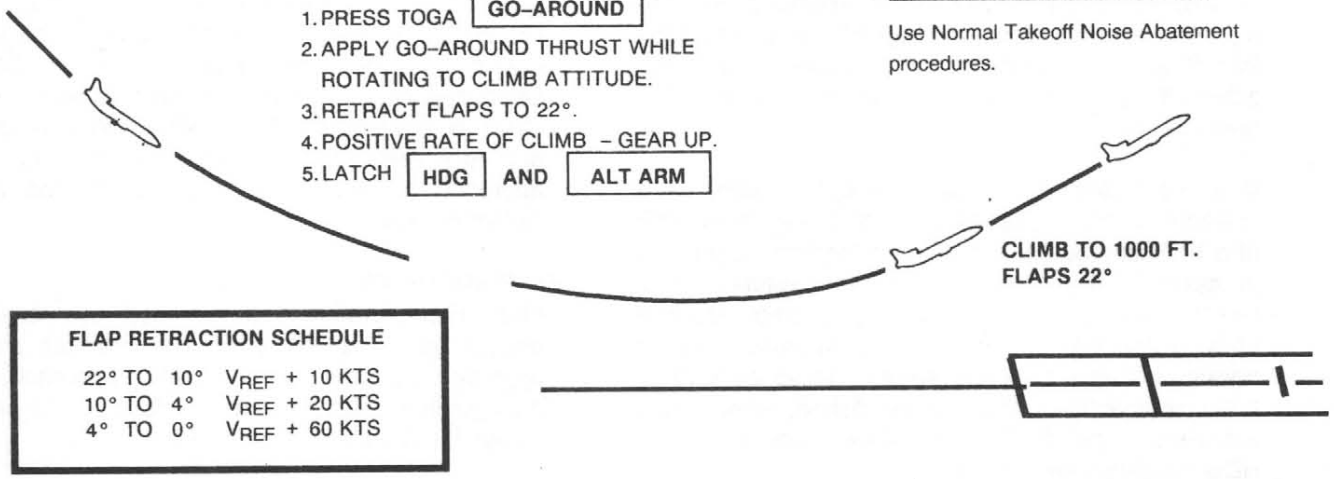
When Clear of Obstacles and at Not Less Than 1,000 ft. AGL:

- LATCH **ALT** and accelerate.
- At V_{REF} + 10 – Flaps 10°
- At V_{REF} + 20 – Flaps 4°
- At V_{REF} + 60 – Flaps Up
- At V_2 + 70 – Latch **IAS** and set climb thrust.

3 ENGINE MISSED APPROACH

Use Normal Takeoff Noise Abatement procedures.

CLIMB TO 1000 FT.
FLAPS 22°



MISSED APPROACH PROCEDURE
2 OR 3 ENGINES

CIRCLING APPROACH

Delta aircrews are restricted to circling approach landing minima of 1,000 ft. ceiling/three miles visibility, which may be higher than those depicted on the Jeppesen Approach plates. Extra caution should be observed with regard to obstructions outside the normal circling area (two miles).

The configuration should be Landing Gear down, Flaps 22°, with sufficient thrust to maintain V_{ref} + 20 knots in level flight. However, this configuration may be altered as commensurate with the type of approach being flown.

The maximum bank angle throughout the circling maneuver should not exceed 30°, particularly when aligning with the runway on final approach. Excessive nose-down attitudes associated with high bank angles can be dangerous at low altitudes. Select flaps 33° when intercepting the normal approach glide slope.

Plan to use a normal approach glide slope and runway aiming point which may necessitate a considerable reduction in thrust after turning onto final.

Wind drift allowance planning will be necessary in order to properly accomplish final alignment.

It is imperative that the runway be kept in sight at all times during the circle to land maneuver. Do not concentrate solely on monitoring cockpit instruments. Maintain visual references and be alert for other airport traffic.

If a missed approach is required while circling, turn towards the runway area to reach the missed approach heading even if the turn is more than 180°. This will ensure clearance of obstructions in the airport vicinity.

NOTE: A circling approach is the only instrument procedure that requires a minimum reported ceiling height (e.g., LGA ILS 4 circle to land 31).

The Barometric Altimeter is primary for altitude information during a circling approach.

NORMAL MISSED APPROACH (M/A) PROCEDURE

Discussion

If it becomes necessary to execute a M/A or reject a landing, arrest the descent while simultaneously advancing the throttles to G/A power. Since it is very likely that M/A's will be accomplished on the A/P and since the G/A mode (while using autoflight) is armed ONLY when in the ALPHA mode, i. e., flap position greater than 30°, it behooves the pilot to press the TOGA button before the flaps have a chance to retract through 30° on their way to 22°. This is not as critical when hand flying, as on a Flight Director approach, but it's a good habit to establish. When not using the autopilot, i.e., Flight Director only approach, the TOGA button can be pressed and go-around mode established at any time regardless of aircraft configuration. Also, since V_{ref} (1.3 VS) is greater than V_2 (flaps 22°), there is no requirement to accelerate prior to initial flap retraction. Remember, the G/A mode commands a pitch attitude and programs the SCS donut to 1.25 VS (18° max), and this may result in an airspeed indication that is actually less than the Bug (V_{ref}, 1.3 VS). Also, until HDG select is engaged, the APFDS will command wings level only. Adverse yaw at this time will not be reflected on the Roll Command Bar as long as the wings are level.

NOTE: If a missed approach is required at any time while executing an instrument approach, continue inbound on the final approach course until reaching the missed approach point (MAP) BEFORE INITIATING ANY TURNS, to ensure adequate obstacle clearance. Climb to MA altitude may be commenced immediately.

In the following procedure, it is assumed that at DH the aircraft is in the landing configuration and the APFDS status is:

- Either or both autopilot switches engaged in CMD.
- Both flight directors ON.
- ATS engaged; speed is approximately V_{ref}.

TAKEOFF/GO-AROUND BUTTON (TOGA) . . . . . PRESS

- All heading, pitch and nav modes disengage.
- GO ARND is annunciated on both AFCS Mode Annunciator panels. All other annunciations are removed.
- Autothrottles disengage
- DLC Spoilers automatically stow.
- If both autopilots were engaged, the last one engaged for the approach will disengage.

NORMAL MISSED APPROACH PROCEDURE (CONT'D.)

GO-AROUND THRUST ..... SET

FLAPS ..... 22°

After A Positive Rate Of Climb Has Been Established:

LANDING GEAR ..... UP

APFDS HDG SELECT ..... LATCH

ALTITUDE SELECT ..... SET/ARMED

Follow the published or assigned missed approach procedure using Heading Select and NAV if subsequently intercepting a radial. Upon reaching 1000 ft. AGL, initiate the flap retraction schedule using the noise abatement profile (see pages 18 and 42).

The go-around mode will remain engaged until any pitch mode is engaged (IAS, VS, etc., normally VS at 1000 ft. AGL). Heading Select can be used without releasing the go-around mode.

The go-around mode can also be manually released by turning off both flight directors and disengaging the autopilot from CMD, i. e., "clearing" the autoflight panel.

Refer to missed approach profile page 40.

ABNORMAL/EMERGENCY MANEUVERS

Abort/Rejected Takeoff

Rejected takeoff accidents have some common ingredients which include:

- Lack of prior planning as to the possibility of an abort.
- Slow reaction in applying maximum stopping techniques.
- Failure to maintain maximum braking and reverse thrust until a safe stop is assured.

The abort decision must be made and appropriate procedures initiated before reaching V_1 so that deceleration can begin at or below V_1.

Rejecting a takeoff solely for a caution/warning light is not recommended AT or NEAR V_1. Every possible scenario can't be covered in this discussion but the mechanical conditions warranting an abort near V1 would, in and of themselves, have to be of such a serious nature (engine failure, doubt as to whether the airplane will fly, etc.) as to outweigh the risk to airplane and occupants that a high speed rejected takeoff would impose.

When the decision is made to abort the takeoff the Captain should announce his intentions and:

- Close the throttles.
- Apply the wheel brakes (as required).
- Select reverse thrust.
- Confirm ground spoilers deployed. (Should deploy automatically with application of reverse thrust.)

If the rejection is made close to V_1 speeds, the above actions must be done rapidly and simultaneously, using maximum braking effort.

The F/O can assist by holding slight forward pressure on the control column while advising the tower of the abort and whether or not assistance is desired.

While the aircraft is decelerating, the S/O, if the immediate situation requires it and conditions permit, may contact the IFSC with some brief pertinent instructions and have the Emergency Evacuation Checklist at the ready.

If the situation is critical, bring the aircraft to a stop and set the parking brake. Now full attention can be devoted to the problem. If a fire, accomplish the appropriate pre-emptive steps. If the decision is made to evacuate the aircraft, call for and complete the Evacuation Checklist in its proper sequence. (See DITCHING/EVACUATION, POM)

If the Captain elects to issue amplified evacuation instructions he may do so over the PA system while the F/O and S/O complete the evacuation checklist. If the S/O is designated to issue the instructions then the Captain and F/O should complete the evacuation checklist.

ABNORMAL/EMERGENCY MANEUVERS

If the abort does not terminate in an evacuation, consult and comply with the Brake Energy Limitations Chart, ODM, Abnormals Section.

- Make note of the speed when brakes are applied.
- If temperatures are indicated as safe, a subsequent T/O may be commenced. However, serious consideration should be given to cooling the gear after takeoff by leaving them extended for several minutes. Excessive temperatures can be generated simply by friction on the axles and tire flexing.
- If brake temperatures are in doubt, have Maintenance inspect the brakes prior to the next takeoff.
- Brakes should be released during the cooling period.
- Since wheel fuse plug melting may be imminent, consideration should be given to taxiing clear of the active runway.

TAKEOFF - ENGINE FIRE/FAILURE AFTER V_1

If an engine fire/failure occurs after V1, the primary concerns are:

- Control of the aircraft and
- Obtaining proper performance

These essentials must be met before the malfunction can be handled.

If the malfunction results in an immediate yaw (engine failure), maintain directional control by smoothly applying rudder proportionate with thrust decay.

Rotate smoothly at V_R at a normal or slightly slower rate to target pitch attitude. F/D pitch bar is programmed to 1.25 V_S or 18° maximum. Cross check airspeed indicator for V_2 to V_2 +10. Use the Flight Director pitch bar and SCS "donut" to acquire proper pitch attitude.

Apply rudder and aileron to control heading and keep the wings level. Correct rudder input will approximately center the control wheel. This will result in a minimum drag configuration.

- Retract the landing gear after positive rate of climb is verified.
- The L-1011 is certified to meet climb performance requirements with an engine out using alternate takeoff power; however, thrust should be increased to normal takeoff power for additional performance margin.
- Maintain V_2 to V_2 + 10 to 1000 ft. AGL.
- When clear of obstacles but not less than 1000 ft. AGL, accelerate, using ALT hold, and retract flaps on schedule.
- At V_2 +70 (best 2 engine climb speed), latch IAS, set climb power and climb to desired/assigned altitude.
- Complete the Engine Fire/Failure follow up checklists and the After Takeoff Checklist.
- Advise ATC of intentions.

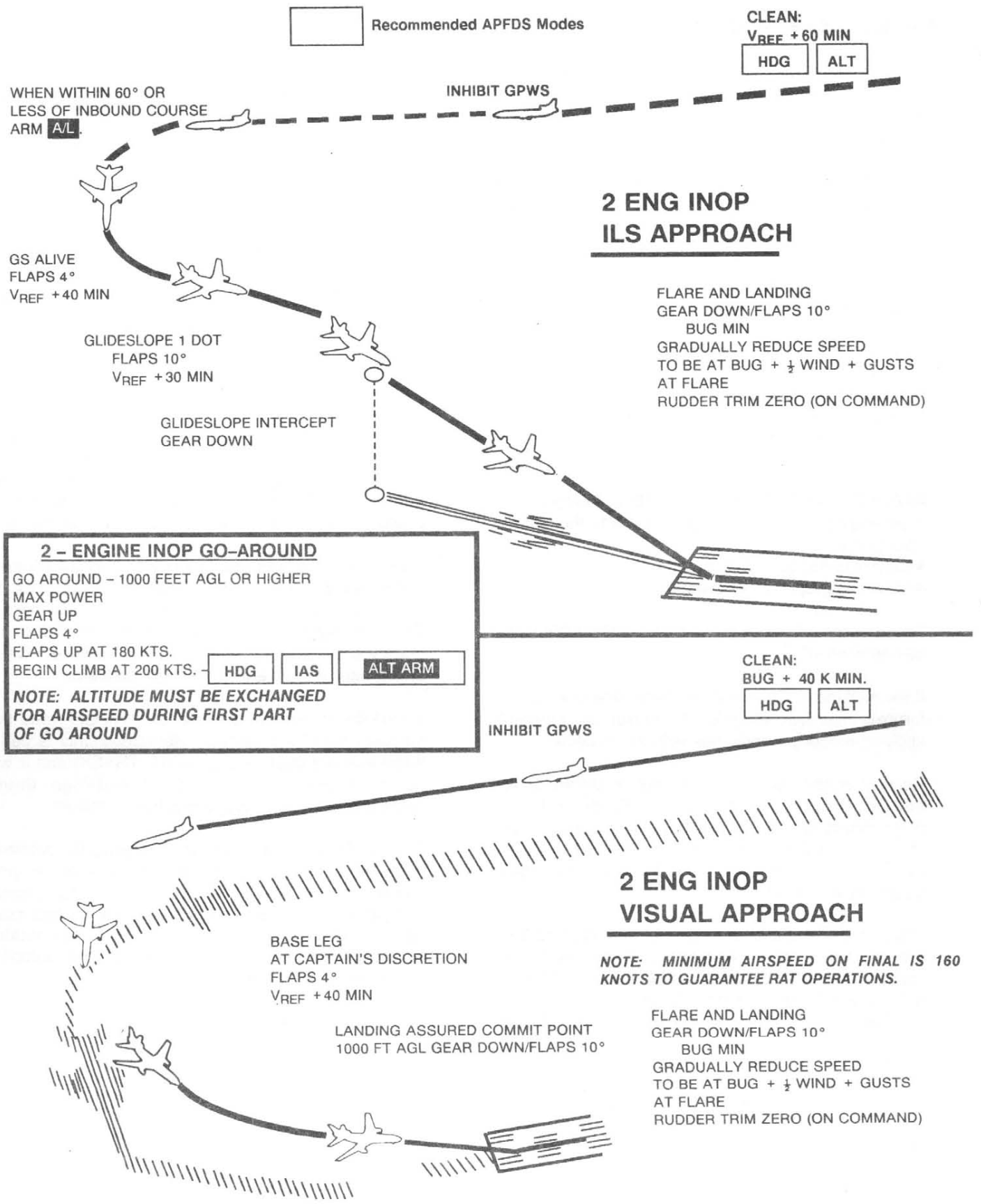
Engine Fire Discussion

If the flight crew is faced with an engine fire or severe damage during a critical phase of the flight, such as at rotation, it is essential that the pilot flying get the aircraft in the proper configuration (gear up), established in the climb with the aircraft performing properly and stabilized before taking appropriate action. Serious engine problems should be dealt with as soon as possible but not at the expense of aircraft control. Once stabilized, the memory items of the appropriate checklist should be methodically pronounced by the PF and completed by the PNF's.

If turns are required, be aware that a Flight Director commanded turn will produce bank angles close to 30°, thus substantially degrading climb performance. The pilot will have to "look through" the F/D to fly shallower bank angles during such conditions. Once clean, bank angles are of no major concern.

When the rudder is trimmed to eliminate yaw, the autopilot may be engaged. Remember this is not a three axis autopilot (except in A/L TRACK) and it will not hold wings level at low speed-high thrust combinations unless the rudder trim is correct.

All models of the airplane are approved for autoland operations to CAT III minimums with an engine inoperative except for Ships 759 - 762 (digital autopilots). For these four airplanes, all engines must be operating down to alert height. Full rudder authority, ±30°, is available through the autopilot only when in A/L TRACK.



TWO ENGINES INOPERATIVE APPROACH/GO-AROUND

ONE ENGINE INOPERATIVE APPROACH/LANDING (Refer to Emergency Procedures Section for Appropriate Checklists.)

During all inflight operation with an inoperative engine, use rudder control as necessary to counteract asymmetric thrust, maintain directional control and wings level. The control wheel will be centered with proper rudder input. If the control wheel remains displaced, spoilers may be raised introducing unnecessary drag. The aircraft will also be in a yaw condition.

With the exception of trim considerations and S/O systems responsibilities, an approach with an engine out is essentially the same as one with all engines operating. It is recommended that the aircraft be kept as clean as possible as late into the approach as conditions permit. Flight Director turns at 28° bank angles with flaps at 22° will result in significant degradation in aircraft performance. It would be prudent, therefore, to delay flaps 22° until the glide slope is "alive". Likewise, during a go-around, when the flight director roll bar is followed, i.e., 28° bank angles, while still in the go-around (alpha) mode, the pitch bar will display a significantly lower than normal attitude in order to maintain 1.25 VS, resulting in a very shallow climb or, at moderate landing weights, even a shallow descent. A straight out climb offers no problems and once ALT is selected at 1000 ft. AGL and ALPHA is removed, these considerations disappear.

If rudder trim is used while maneuvering for landing, assure that it is returned to zero prior to landing.

CAUTION SHOULD BE EXERCISED WHEN USING ASYMMETRICAL REVERSE THRUST WHICH COULD ADVERSELY AFFECT DIRECTIONAL CONTROL DURING LANDING ROLLOUT.

ONE ENGINE INOPERATIVE GO-AROUND

The missed approach procedure with an engine out is the same as the normal go-around except at 1000 ft. AGL latch ALT (hold), accelerate in level flight, retracting flaps on schedule. Delay calling for CLIMB POWER until after V_2 +70 is attained and IAS is latched.

Full rudder authority, ±30°, is available to the Autopilot when in A/L TRACK and throughout auto go-around. Yaw, during this time, will be controlled by the autopilot. But be prepared to immediately apply rudder input when a pitch mode is selected or altitude capture occurs as the system will revert to dual axis autopilot with turn coordination capability only.

TWO ENGINES INOPERATIVE APPROACH/ LANDING (Refer to the Emergency Procedures Section for Appropriate Checklists.)

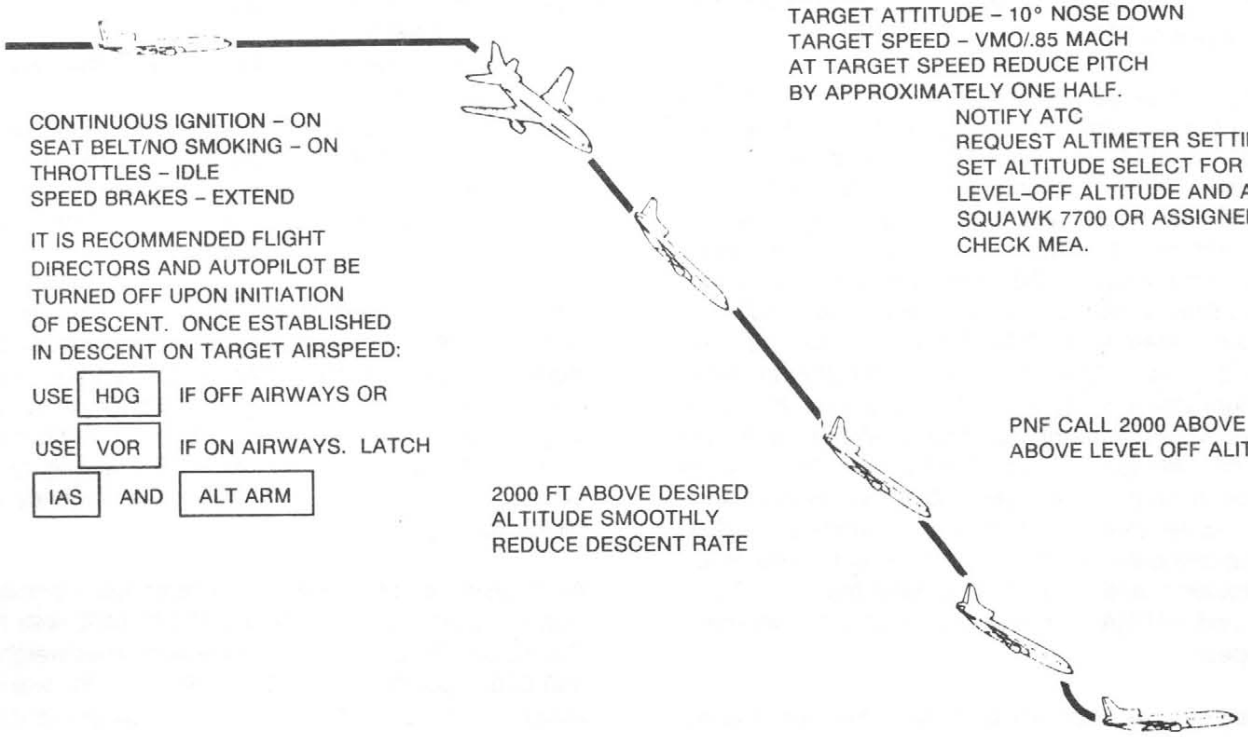
While the loss of one engine requires no changes to the normal procedures (except for the missed approach), loss of the second engine requires a substantial change of procedures to effect a safe approach and landing.

The aircraft must be flown precisely. Maintain the control wheel centered as in the one engine inoperative procedure. Thrust for single engine maneuvering is not excessive at lighter gross weights (e.g., normal landing weights). The only viable option open to the Captain is an immediate landing at the nearest suitable airport. Declare an emergency and check your options.

As a point of reference, the aircraft will maintain a stabilizing pressure altitude of 3800 ft. MSL with Max Continuous Thrust on one engine at a gross weight of 340,000 pounds at STD + 9°C. At warmer temperatures, e.g., STD +20°C, the weight must be reduced to approximately 320,000 pounds to maintain a stabilizing pressure altitude of 2400 ft. MSL. It is, therefore, recommended that the gross weight be reduced to minimum for existing conditions prior to commencing the approach. An ILS should be used to aid in the approach due to the unusual configuration, airspeed and sink rates involved in a TWO ENG OUT approach. Accurate speed control is necessary if threshold speed, thrust setting and altitude are to be correct. On the downwind leg, complete the appropriate checklists and slow to V_{REF} + 60, minimum. BUG = V_{ref} +20 (160 knots minimum for RAT effectiveness).

AIRWORK

[ ] Recommended APFDS Modes



CONTINUOUS IGNITION – ON
SEAT BELT/NO SMOKING – ON
THROTTLES – IDLE
SPEED BRAKES – EXTEND

IT IS RECOMMENDED FLIGHT DIRECTORS AND AUTOPILOT BE TURNED OFF UPON INITIATION OF DESCENT. ONCE ESTABLISHED IN DESCENT ON TARGET AIRSPEED:

USE [HDG] IF OFF AIRWAYS OR

USE [VOR] IF ON AIRWAYS. LATCH

[IAS] AND [ALT ARM]

INITIATE TURN, IF DESIRED
30° NORMAL – 45° MAX. BANK
LOWER NOSE
TARGET ATTITUDE – 10° NOSE DOWN
TARGET SPEED – VMO/.85 MACH
AT TARGET SPEED REDUCE PITCH
BY APPROXIMATELY ONE HALF.

NOTIFY ATC
REQUEST ALTIMETER SETTING
SET ALTITUDE SELECT FOR
LEVEL–OFF ALTITUDE AND ARM
SQUAWK 7700 OR ASSIGNED CODE.
CHECK MEA.

2000 FT ABOVE DESIRED
ALTITUDE SMOOTHLY
REDUCE DESCENT RATE

PNF CALL 2000 ABOVE AND 1000
ABOVE LEVEL OFF ALITUDE.

LEVEL OFF AT OR ABOVE MEA
CONFIRM SPEEDBRAKES RETRACTED.
PASSENGER OXYGEN REQUIRED
ABOVE 14,000'.
CREW OXYGEN REQUIRED
ABOVE 10,000'.

If structural damage is suspected, limit airspeed as much as possible and avoid high maneuvering loads.

NOTE: WHEN PASSENGER OXYGEN SUPPLY IS DEPLETED, MAX OPERATING ALTITUDE IS 10,000'.

EMERGENCY DESCENT

TWO ENGINES INOPERATIVE APPROACH/ LANDING (CONT'D.)

Maintain a clean configuration. Plan a slightly wide, easy pattern, to allow for increased airspeed and slightly shallower turns. When the glideslope is alive, select flaps 4° and fly V_{ref} +40 minimum. Just prior to descent (e.g., one dot glide path deviation), select flaps 10° and fly V_{ref} +30 or 160 KIAS minimum. When ready to begin descent (e.g., glide path intercept), extend the landing gear and complete the Before Landing Checklist. A normal glide path should result in a sink rate of approximately 800 – 900 feet per minute due to the increased airspeed. Once beyond the commit point (minimum of 1000 ft. AGL), plan the approach so as to cross the threshold at BUG plus additives, not to exceed V_{ref} +40.

TWO ENGINE INOPERATIVE GO-AROUND

Prior to the approach, consult the appropriate charts to determine if a go-around is possible, based on aircraft gross weight, temperature and field elevation. If a go-around is possible, plan to initiate the maneuver at or above 1000 ft. AGL. Below that altitude, it is doubtful if the descent can be arrested. Adequate acceleration in the initial stage of go-around is essential. To obtain the desired increase in airspeed, it may be necessary to slightly increase the rate of descent.

When the decision to go-around is made, the pilot must immediately apply maximum thrust, maintain, or decrease slightly, the pitch attitude to increase airspeed while simultaneously raising the landing gear. If the glidepath has been maintained, it should not be necessary to lower the nose. The established descent rate should be sufficient for acceleration. Retract the flaps to 4° as soon as possible.

As the airspeed increases through 180 knots, retract the flaps and slats. Continue to descend until the airspeed reaches 200 knots. At this point, a gentle rotation should be made and the climbout continued, at approximately 200 knots minimum. The attitude change should be a matter of only a few degrees. With the flight director in use, IAS may be latched upon reaching 200 knots to assist in pitch control during the rotation and climbout.

EMERGENCY DESCENT

Refer to the Emergency Descent procedures in the Emergency Procedures section, POM.

Loss of cabin pressure may be caused by the pressurization system or structural damage. Attempt to determine that cabin pressure is uncontrollable before initiating a rapid descent. If structural integrity is in doubt, limit changes to configuration and airspeed as much as possible. If conditions permit, determine the extent of the damage from the cabin crew.

Don oxygen masks and establish crew communications. The crew must select OXY on the BOOM/OXY switch. The success of this maneuver depends upon the crew's ability to communicate and coordinate.

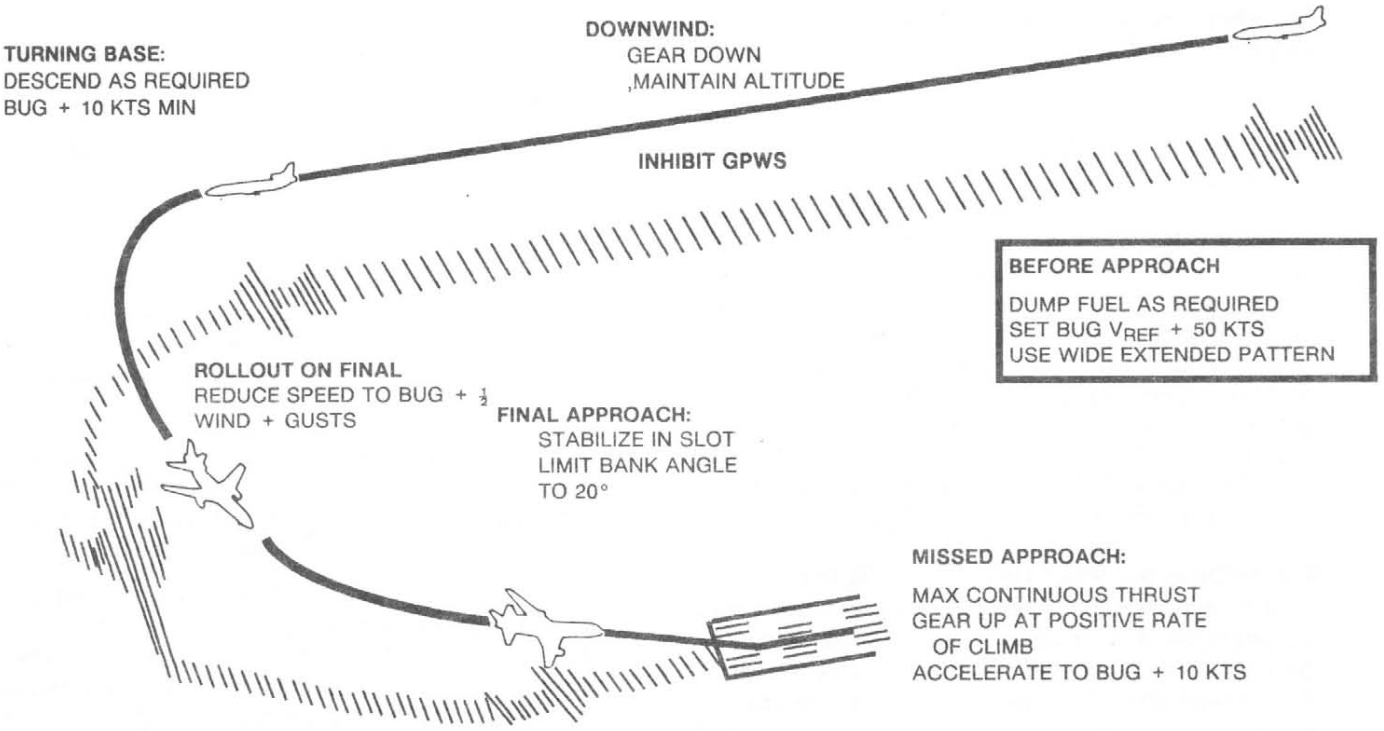
It is essential that the S/O swiftly evaluate the situation and determine the status of cabin pressurization. Inform the Captain immediately if cabin pressurization cannot be maintained.

A rapid descent may be initiated on heading or the aircraft may be banked to establish a proper nose down attitude. This should be an unhurried, smooth maneuver. Avoid abrupt control inputs and negative G forces. There may be several food service carts loose in the cabin, not to mention standing passengers and crew members.

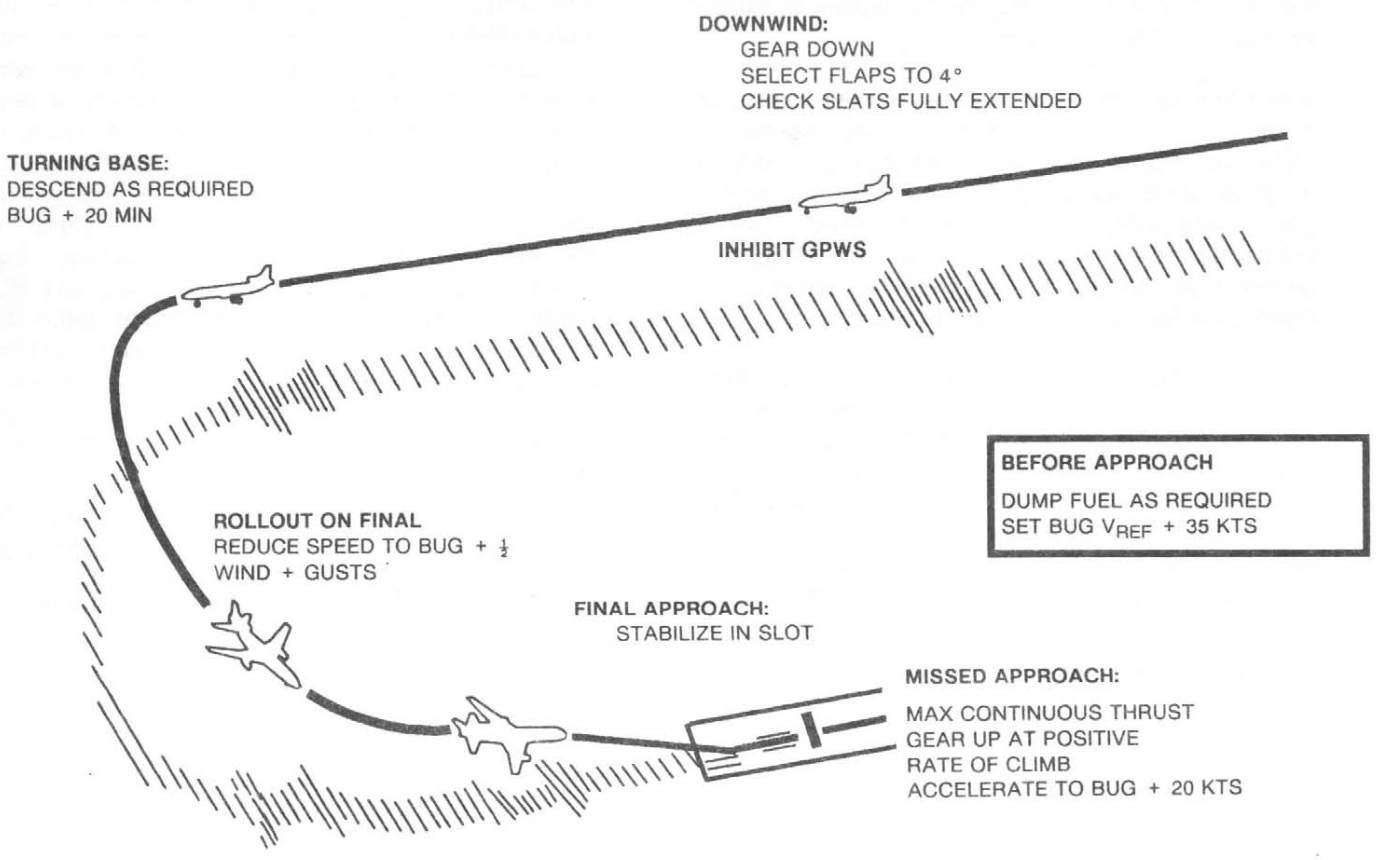
Turn on the CONT IGN; SEAT BELT and NO SMOKING signs; disconnect the ATS and **SMOOTHLY** close the throttles and lower the nose to approximately 10° below the horizon while extending the speedbrakes. Accelerate to a target speed of Vmo/M.85. If a turn entry was used, roll wings level as the pitch attitude is established. It is recommended that the Autopilot be disengaged and the Flight Directors turned off to eliminate "clutter" on the ADI. As the target speed is reached, flight directors may be turned on. IAS (hold) and HDG modes will be helpful in maintaining pitch and directional control throughout the remaining descent. Pitch attitude will gradually shallow out as altitude is lost. The flight director pitch bar will aid in this direction as well as in providing smooth altitude capture from a high rate of descent.

The F/O notifies ATC and obtains the appropriate clearance along with the current altimeter setting and information concerning MEA/terrain clearance. If communications with ATC are firmly established, remain on the present squawk. If unable to communicate with ATC, squawk 7700. He also calls out 2000 ft. and 1000 ft. above level off altitude.

The S/O verifies that all checklist items have been completed, and that the cabin oxygen system has deployed if the cabin has exceeded 14,000 ft.



NO FLAP LANDING



NO FLAP – FULL SLAT LANDING

EMERGENCY DESCENT (CONT'D.)

Use the Altitude Select/ARM feature to alert the crew when level off altitude is approaching. If the altitude select is "ARMED", the flight director will command a smooth capture in spite of the extreme descent rate.

If turbulence is encountered during the descent, reduce to turbulence penetration speed.

Determine a new course of action based on weather, oxygen, fuel remaining and available airports.

NOTE: When PAX oxygen supply is depleted, the maximum operating altitude is 10,000 ft. PAX O_2 is required above 14,000 ft. cabin altitude. Crew O_2 is required above 10,000 ft. cabin altitude.

PARTIAL FLAP LANDING

The aircraft angle-of-attack on landing with partial flaps will be higher than that for the normal landing configuration. It is, therefore, important that the speed not be allowed to bleed off below that recommended due to the possibility of striking the tail skid on the runway.

A normal approach should be made holding threshold speed or slightly higher through the flare. Do not attempt to prolong the flare.

Manually extend the spoilers or make suitable allowances for their absence in planning the stop.

If it becomes necessary to go around, **do not retract the flaps.**

NO FLAP LANDING

If it becomes necessary to execute a no-flap landing, consider the following:

- Reduce gross weight as much as possible if conditions permit.
- Tire damage may occur if landing speed exceeds 195 knots. This equates to gross weights in excess of 360,000 lbs. V_{ref} at 360,000 equals 144 knots. No flap/no slat bug setting is V_{ref} +50 = 194 knots. (-500 V_{ref} @ 360,000 lbs. = 147 knots.
  - Tire limiting speeds are the same for all L-1011 aircraft models.
- Automatic spoilers will not be armed to actuate on touchdown. Plan to manually deploy ground spoilers.

Refer to Abnormal Procedures/Flight Controls and assure that all applicable checklists are completed early in the approach phase in order to allow ample time for planning.

Due to the high airspeeds, the downwind leg should be extended to give more time to accomplish the turn onto final approach and achieve runway alignment.

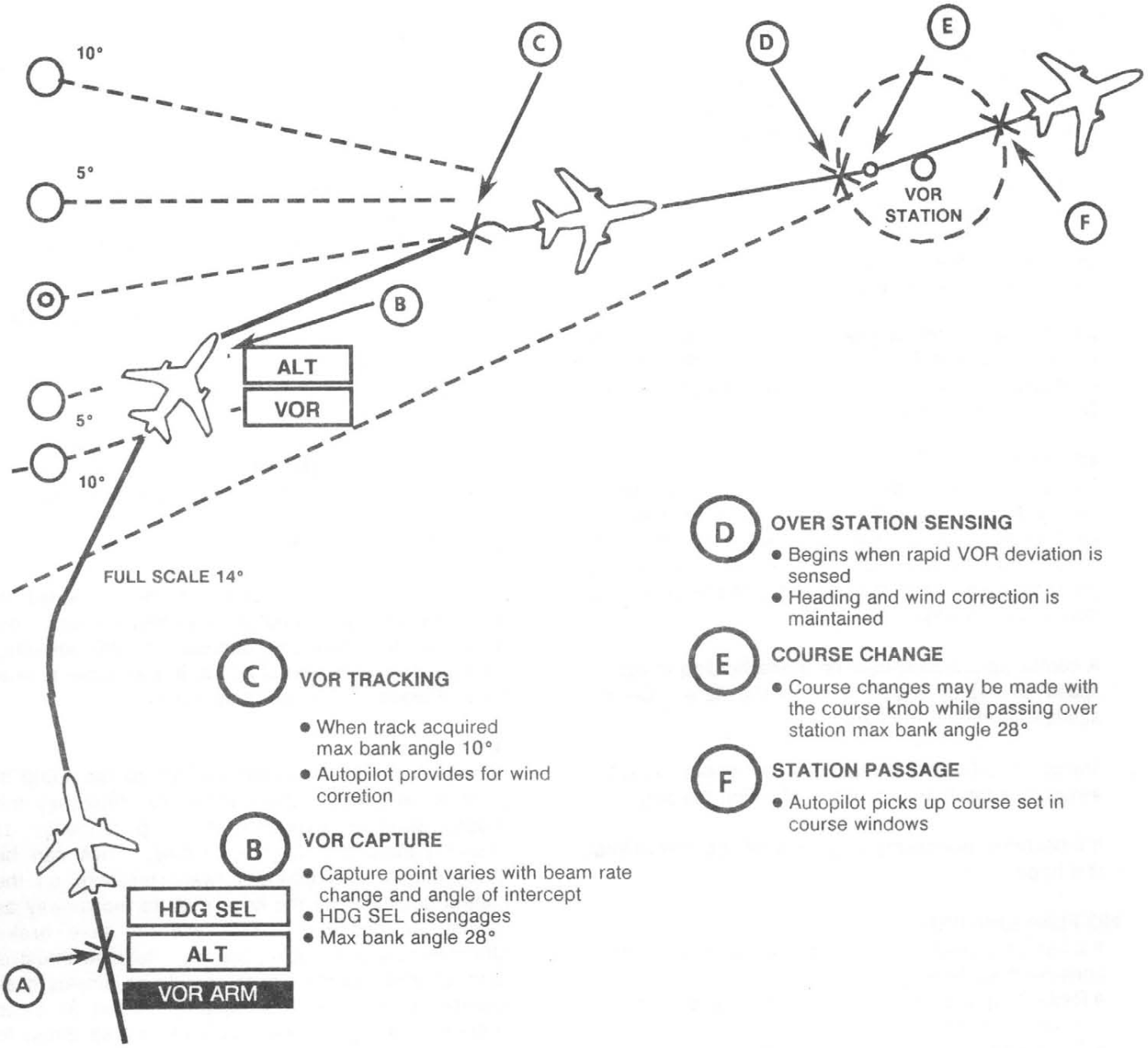
After turning onto final, reduce speed to the Bug setting (plus the appropriate wind additives) after a normal approach is established. Plan to turn onto final far enough out to allow the airplane to fly into the glidepath from a level flight attitude.

After intercepting the proper glidepath, expect a sink rate of approximately 900-1,000 fpm. Concentrate on precise control of airspeed and glidepath. Keep in mind that reductions in airspeed may not be immediate due to a low drag configuration.

Only a small change in pitch attitude is needed for flare and landing. Do not prolong the flare and avoid an excessive nose-high attitude. In this low-drag configuration with ground effect, it is possible to float several thousand feet down the runway.

After Landing

Attempt to land the aircraft as near to the 1,000 ft. point as possible. After manually deploying the ground spoilers, expect a pitch-up tendency as spoiler panels 2 through 6 deploy. This can be counteracted by applying forward pressure on the control column. Fly the nose gear to the runway as quickly as possible. This will increase brake effectiveness by reducing the lift. Reverse thrust is most effective at the higher speeds so employ it as quickly as possible after landing. Bring all three engines into idle reverse applying reverse thrust to engines 1 & 3 and feeding in engine 2. This will aid in keeping the nose wheel firmly on the runway. Spoiler panels 2 through 6 will automatically deploy (if not previously manually deployed) when reverse thrust is selected. After all wheels are on the runway and the spoilers are deployed, continue braking with one steady application. Confirm proper anti-skid operation.



C **VOR TRACKING**

- When track acquired max bank angle 10°
- Autopilot provides for wind corretion

B **VOR CAPTURE**

- Capture point varies with beam rate change and angle of intercept
- HDG SEL disengages
- Max bank angle 28°

D **OVER STATION SENSING**

- Begins when rapid VOR deviation is sensed
- Heading and wind correction is maintained

E **COURSE CHANGE**

- Course changes may be made with the course knob while passing over station max bank angle 28°

F **STATION PASSAGE**

- Autopilot picks up course set in course windows

A **VOR ARMED FOR CAPTURE**

- Tune VOR and set desired course with course knobs
- Set intercept heading with heading knob
- Set autopilot to CMD, set flight director ON (may already be on)
- Press NAV mode selector when within 60° heading of inbound radial.
- Use HDG select knob to maneuver
- Use VS or ALT for pitch guidance.

Recommended APFDS Modes

VOR INTERCEPTS

STEEP TURNS

The objective of the steep turn maneuver is to familiarize the pilot with airplane handling characteristics and stimulate instrument crosscheck development. It is not intended that the pilot should bank greater than 25° – 30° for normal or abnormal procedures.

ENTRY

The steep turn will be accomplished using "raw data". Stabilize in trim at 250 knots on heading and altitude. Avoid abrupt aileron inputs. Smoothly increase the bank angle to 45°. On entering the turn, the aircraft will tend to nose down. An increase in lift is required as the bank angle is increased at a constant airspeed and altitude to balance the increase in load factor ("g"). This is accomplished by a slight increase in angle of attack (pitch attitude), all of which causes an increase in drag which must be compensated for by a slight increase in thrust.

Pitch attitude varies from approximately 5° in level flight to 6 – 7° in a stabilized 45° bank.

Start the rollout when within 15° of desired heading. Upon request, the pilot not flying may set the HSI heading bug and announce when within 15° of rollout heading. There will be a noticeable nose up tendency upon rollout. Adjust thrust and stabilizer as necessary.

Steep turn target parameters are: Airspeed ±10 knots; Altitude ±100 ft.; Bank Angle ±5°; Rollout +10° of selected heading.

APPROACHES TO STALL AND RECOVERY

Over recent years, several situations have occurred involving ground contact after takeoff or during approach. While other distractions were usually a factor, the probability of a successful recovery would have been increased if near maximum aircraft performance had been achieved immediately upon recognition of the flight path problem.

The traditional stall recovery techniques that lower the nose to trade altitude for airspeed may be acceptable at high altitudes, but at low altitude these methods do not approach the maximum aircraft performance that may be required to avoid ground contact.

Normal Stall Indications

The FAA requires a warning for the pilot of an impending stall. Natural stall buffet does not provide adequate warning in all configurations for the L-1011. Therefore, an artificial stick shaker system has been installed. This is designed to activate at 1.07 V_S (i.e. 7% above stall).

The stick shaker, the buffet and the actual stall are all tied directly to specific angles of attack. Because there is a fixed angle of attack relationship between stall and stick shaker, the stick shaker can provide the pilot with a stall margin reference. This may be necessary in some critical situations.

It is important to understand the difference between a stall warning and an actual stall on this aircraft. The pilot may be familiar with several different aircraft types and in some of those aircraft the stall warning and the actual stall occur at about the same time. With a relatively low thrust to weight ratio on those aircraft, the only acceptable recovery may have been to lower the nose to achieve acceleration and to accept the resulting loss of altitude.

This is significantly different on the L-1011 and most modern jet transport aircraft because the stall warning occurs at a reasonable margin prior to the actual stall. The L-1011 also has a relatively high thrust to weight ratio.

This combination enables the pilot to safely recover from most critical low altitude situations without significant altitude loss.

Natural buffet may occur prior to the stick shaker in some situations. Although this stall buffet may be hard to detect in turbulent conditions, be alert for this warning.

Simulator – Entry

Approaches to stall will be performed in the Flaps 0°, Flaps 10° and Flaps 33°/gear down configurations. The maneuvers are designed to be performed in the simulator to provide experience in the normal low speed capabilities of the aircraft and in the recommended recovery if a stall warning is encountered. The Flight Instructor will direct all preparation and entry procedures. The pilot will be expected to initiate the recovery when the initial stall indication is observed.

These entry procedures are designed to provide realistic training and can be **utilized only in the flight simulator.** These entry procedures are **not to be used or demonstrated in the aircraft due to safety considerations.**

APPROACHES TO STALL AND RECOVERY (CONT'D.)

Aircraft - Entry

Procedures for performing approaches to stall in the airplane are in the POM, Supplemental Procedures. These procedures must be reviewed and used when performing approaches to stall in the airplane during test flights and training.

Standard Recovery Technique

The Standard Recovery Technique is to be used to recover from approaches to stall which are unexpectedly encountered during line operations. The technique is also used during simulator training.

Because time and altitude may not allow for indecision, the intent of the Standard Recovery Technique is to outline a simple, difinitive technique that will quickly change the flight path and provide the best opportunity to avoid ground contact in critical low altitude situations.

The L-1011 is unique in that Lockheed has indicated that a 18° pitch attitude target is applicable in any configuration other than gear down/33 flaps. For this configuration the target is reduced to 15°.

The objective is to control the vertical flight path of the aircraft. This can be best achieved by aggressive thrust application and proper pitch control to CHANGE THE FLIGHT PATH DIRECTION WITHOUT DELAY and maintain positive control of the aircraft. Management of all available energy is important.

In addition to being used for stall recovery, the Standard Recovery Technique also applies to:

- Ground Proximity "Pull-Up" Warning
- Significant windshear, severe turbulence or excessive sink rates below 1000' AGL.
- Combinations of the above.

When Ground Contact Is A Factor:

- APPLY MAXIMUM AVAILABLE THRUST
  - Aggressively push throttles full forward - "Firewall".
  - Disconnect Autothrottles, if engaged.
  - Simultaneously roll wings level.
- PITCH - ROTATE TOWARD 15°/18°
  The target pitch attitude on the L-1011 is dependent upon configuration. Use 15° with Flaps 33, gear down. Use 18° for all other configurations.
  - Simultaneously with thrust application, rotate at a smooth gradual rate toward a target pitch attitude of 15°/18°.
  - Disengage Autopilot.
  - Read through Flight Director pitch commands.
- RESPECT ANY STALL WARNINGS
  - Stop rotation if stick shaker or buffet is encountered.
  - Use INTERMITTENT stick shaker as the upper control pressure limit and continue to try to move toward the target pitch.
- CONTROL FLIGHT PATH WITH PITCH
  - Use 18°/15° nose up as the target pitch attitude throughout the recovery unless ground contact becomes imminent.
  - If ground contact becomes imminent, increase pitch attitude gradually to stop the descent.
  - Continue to respect any stall warnings and retain positive control of the aircraft.
  - The pilot not flying should call out vertical speed, altitude and/or radio altitude, as appropriate.
- MAINTAIN CONFIGURATION
  - Minimize gear and flap changes until ground contact is no longer a factor.

When Ground Contact Is Not A Factor Or Is No Longer A Factor:

- Aggressive thrust application is still appropriate but;
  - Try to avoid exceeding engine limitations, if possible.
  - Simultaneously roll wings level.
- Adjust target pitch attitude as appropriate for the conditions.
  - 5° to 10° degrees nose up is suitable at most altitudes.
- Appropriate configuration changes may be made as desired.
- Accelerate back to normal speed.
  - Minimize altitude loss during acceleration.

To ensure a full understanding of the Standard Recovery Techniue a further discussion of each element follows.

APPROACHES TO STALL AND RECOVERY (CONT'D)

Apply Maximum Available Thrust

Anytime that ground contact is a factor, the pilot should not be concerned with normal engine limitations. Throttles should be pushed aggressively full forward to the "Firewall" to achieve maximum available thrust. The pilot can be confident that the engines will operate satisfactorily at full throttle for as long as necessary to complete the recovery.

The primary benefit will be to provide a straightforward action that will result in maximum thrust, without referring to the engine instruments.

When ground contact is not a factor try to avoid exceeding engine limitations.

Pitch – Rotate Toward 18°/15°, Wings Level

The 18/15° degree nose–up target pitch attitude was chosen for the following reasons:

- A simple, definitive action which the pilot can perform in a high stress situation.
- It points the aircraft away from the terrain and provides time to assess the problem.
- It is clearly marked on the attitude indicator and is similar to normal takeoff and go–around pitch attitudes.
- At full thrust, 18° pitch will normally provide a climb and avoid a stall indication.
- With Landing Gear extended and 33° flaps, 15° pitch is the best target attitude.
- Wings level provides maximum lift.

For best energy management, the desired rotation should be somewhat slower than the normal rotation rate used for takeoff.

In most stall conditions, the key is proper management of all available energy. This target pitch provides a reasonable balance between climb and acceleration and should not be exceeded unless ground contact becomes imminent.

Control pressures higher than normal may be required for proper pitch control since the airplane may be out of trim. These control pressures may be aircraft nose up or aircraft nose down, dependent upon whether the airplane was trimmed into the stall situation.

When ground contact is not a factor the target pitch attitude may be decreased to 10° or even 5° at high altitudes to aid in accelerating back to desired speed.

Respect All Stall Warnings

At any time, if stick shaker or buffet is encountered, respond with a slight change of **control pressure** to stop the stall warning, and then continue smoothly working the nose toward the desired target attitude. If back pressure on the control column is being used, any conscious effort to actually lower the **pitch attitude** will result in greater altitude loss.

If ground contact is imminent, **intermittent** stall warning may provide the only available reference to fly the aircraft near the maximum acceptable angle of attack. The higher pitch attitude and the lower airspeed must be accepted until ground contact is avoided.

Control Flight Path with Pitch

Immediately after establishing maximum thrust and target pitch attitude, check the vertical speed and the altitude above the ground. The VSI and the Radio Altimeter normally are the best instruments for evaluating flight path direction. Unless ground contact is imminent, continue to use the target pitch of 18°/15°.

If ground contact should become imminent, increase pitch attitude gradually, in small increments, to stop the descent. Continue to respect any stall warnings and maintain positive control of the aircraft.

CAUTION

FLIGHT DIRECTOR PITCH COMMANDS ARE NOT PROGRAMMED TO PROVIDE RECOVERY GUIDANCE. IT IS ADVISABLE TO "LOOK THROUGH" FLIGHT DIRECTOR COMMANDS DURING THE RECOVERY.

Maintain Configuration

If ground contact is a factor, minimize changes to gear or flap positions during the recovery. All attention should be focused toward flying the aircraft and avoiding ground contact. If the recovery is to be simple and effective, configuration changes must be held to a minimum.

If the aircraft is in a landing configuration, selecting go–around flaps may be beneficial to reduce drag but pitch and thrust control are far more important. Raising the gear will briefly increase the drag.

When ground contact is not a factor appropriate configuration changes may be made.

WINDSHEAR SIMULATOR TRAINING

The following windshear maneuvers have been designed to give the pilot experience in dealing with representative windshear encounters in the simulator.

- An encounter on the runway after V1 and prior to rotation.
- An encounter shortly after takeoff.
- An encounter on approach.

Windshear During Takeoff Roll

In this exercise a windshear will be encountered during the ground roll prior to liftoff. While an increasing performance shear will normally be easy to detect, a decreasing performance shear may appear to the pilot only as a brief lack of normal acceleration because the windshear is balanced by normal acceleration of about 2 to 3 knots per second. It would require a significant windshear to produce a rapid loss of airspeed on takeoff roll.

If the shear occurs after V_1, key efforts must be made to maximize aircraft performance for liftoff and climbout.

These key efforts are "firewall" thrust and initiate rotation at the 2000 feet remaining point even if airspeed is low. It may require higher than normal pitch attitude to achieve liftoff if the airspeed is below normal rotation speed.

Once the aircraft is airborne continue with the Standard Recovery Technique. The primary objective is to manage available energy so as to avoid ground contact. 18 degrees pitch attitude will normally produce a climb. If ground contact is still imminent, make gradual pitch increases to achieve a climb while avoiding stall warnings.

Windshear After Liftoff

In this exercise, the windshear will be encountered after liftoff. In a decreasing performance shear the first problem is the normal tendency of the pilot to lower the nose in response to the decreasing airspeed. This is compounded by the natural characteristic of the aircraft nose to lower to return to an "in-trim" condition.

Because there is no departure flight path reference, like a glideslope, **maintaining a near normal pitch attitude after takeoff is the most important single pilot action to maintain a climb and to avoid ground contact in this type of windshear.** If the pitch attitude is allowed to decrease, only momentarily, it may result in a descent that may be impossible to stop prior to ground contact.

Windshear During Approach

An ILS glideslope or a VASI provides a flight path reference that makes it easier to recognize a windshear on approach. An unusual throttle position can also provide a good clue to a windshear encounter.

Because the aircraft is already in a descent prior to a windshear encounter, **a positive application of thrust and pitch is required to change flight path direction.** A slow gradual rotation rate provides better energy management than a rapid rotation.

A normal go-around configuration change to flaps 22° should not be discouraged as long as pitch and thrust application are promptly accomplished and ground contact is not imminent. Flaps 22° reduces drag but increases stall speed slightly. Raising the gear is not recommended if ground contact is a factor because it increases drag momentarily and gear down is desirable if ground contact does occur.

Energy Management for Windshear

While the Standard Recovery Technique has been simplified to enable easy application, each pilot should understand that the objective is to manage all of the available energy to avoid ground contact and maintain positive aircraft control.

While 18° pitch will normally provide a climb, in a strong downdraft the aircraft may continue to descend. If ground contact is imminent, there is no choice but to increase pitch.

If reasonable altitude exists and the descent rate is not excessive, i.e. ground contact is not imminent, it may be better to continue a controlled descent rather than going to maximum pitch too early and have no reserve energy left if ground contact then becomes imminent. Because most windshears are caused by relatively small weather patterns, the chances are good that if the aircraft can be kept airborne for approximately 30 seconds it can successfully fly out of the windshear.

If 18° pitch results in a rapid climb during the recovery, it may be prudent to reduce the target pitch attitude slightly to establish some acceleration. Once again the key is proper management of energy throughout the recovery.

AIRCRAFT MANEUVERS AND DISCUSSION

DUTCH ROLL

This maneuver is performed to familiarize the pilot with DUTCH ROLL characteristics and YAW DAMP operation.

Dutch Roll can be induced, with no YAW SAS, by rough air or lateral/directional over-control. Dutch Roll is dampened by inherent aircraft stability. The higher the angle of attack, however, the less the damping.

Unlatch both YAW – SAS switches and induce a Dutch Roll by rudder walking up to a bank angle of 10°. (Do not allow bank to exceed 15°.) When the wing has reached its lowest deflection, apply lateral control to stop it from rising. Hold for an instant, then center the wheel. Repeat as necessary, noting that the oscillations and amount of wheel displacement are decreasing. Continue until the Dutch Roll has ceased.

MACH TRIM/MACH TUCK

The Mach Trim feature corrects for the mach tuck, providing longitudinal stability at the higher speeds. Demonstration of the Mach Trim feature will include the effect of an inoperative mach trim. The training will include a discussion of limitations applicable to operations with an inoperative mach trim.

Training for the following maneuvers is begun at approximately 35,000 ft.

Unlatch the MACH TRIM switches. Beginning with a stabilized flight condition at approximately Mach .78, increase thrust to maximum cruise thrust and lower the nose to establish a 1,500 fpm rate of descent. Use the stabilizer trim to maintain zero trim loads. Initially, as speed increases, it will be necessary to use nose-down trim to compensate for a pitch-up tendency. Discontinue trimming at Mach .82.

As the speed increases, observe that a tuck-under becomes evident at approximately Mach .86, which will require a pull force in increasing amounts as airspeed increases to M_{mo}.

When the overspeed warning sounds, recover by first raising the nose then retrimming before closing the throttles. Do not allow the airspeed to exceed M_{mo}.

Initiate a descent at approximately 1,500 fpm with the MACH TRIM switches unlatched and the aircraft trimmed for Mach .82. Latch the MACH TRIM switches and observe that in order to maintain the same rate of descent (with increasing speed), a push force is required. In addition, observe that the stabilizer automatically trims nose-up to correct for Mach tuck.

Recover as before. The stabilizer will continue to correct automatically until the airspeed is reduced to approximately Mach .80.

MACH TRIM INOPERATIVE

The MACH TRIM system corrects for the MACH TUCK to provide longitudinal stability at high speeds.

Stabilize at 1500 ft./min descent with MACH TRIM switches unlatched and aircraft trimmed for M.82. Latch MACH TRIM switches and observe that to maintain rate of descent with increasing speed, a push force is required. Notice also that the stabilizer is automatically trimmed nose up to correct for MACH TUCK.

Recover as before. Stabilizer will continue to correct automatically until speed is reduced to about M.80.

ENGINE FAILURE TRAINING

One engine inoperative simulation is accomplished with takeoff flaps and gear down at a speed of V_2 +10 knots. Maintain directional control with the rudder. Do not use Autothrottles (ATS).

Apply sufficient rudder in engine out conditions to avoid excessive yaw angles. From any yaw, a strong rolling tendency develops which must be compensated for by opposite aileron. When sufficient rudder is applied, there is practically no requirement for aileron control except at airspeeds near minimum control speeds. This fact can be used to judge whether sufficient rudder has been applied during engine out operations. The amount of rudder required varies only with airspeed and thrust. There is no need to vary the rudder angle when rolling into or maintaining a turn. The rudder should be kept in one position unless thrust or airspeed changes. The slip indicator is also an indication of yaw and can be cross-checked against the aileron.

While operating on two engines, level turns will be accomplished maintaining airspeed as directed by the instructor.

MACH TRIM OPERATIVE (CONT'D.)

SIMULATED TWO ENGINE INOPERATIVE APPROACH/GO AROUND

Two engine inoperative approaches and go-arounds will be simulated during the Emergency Maneuvers phase of training. These maneuvers will be set up as outlined in this section. The instructor will give the pilot a simulated field elevation and advise him when to start the go-around.

DRIFTDOWN

Under some conditions (heavy gross weight and high altitude), the aircraft will not maintain altitude with Maximum Continuous thrust on the remaining engine(s). If this should occur, consult the DRIFTDOWN procedures in the ODM. This procedure is used only when an engine or engines are inoperative. It enables the pilot to trade altitude for time and distance until leveling off at a "Stabilizing Altitude" that will enable the aircraft to maintain Long Range Cruise or meet Minimum Climb Gradients, if necessary, using Maximum Continuous Thrust (MCT).

Example:
@400,000 lbs. G.W., standard day - the L-1011 can maintain FL 180 cruise altitude at 313 KIAS (413 TAS). At this high gross weight, the thrust level would be substantially higher than usual, resulting in a fuel consumption rate of approximately 19,000 lbs./hr (APU operating).

With two engines inoperative, at a gross weight of 340,000 lbs., the aircraft can maintain 3,800 ft. at approximately 260 KIAS with a consumption rate of about 14,300 lbs./hr (APU operating), using a thrust setting LESS than MCT.

FLIGHT TRAINER

Since the advent of "Advanced Simulator Training", it has been Delta's policy to incorporate one day of training in the aircraft.

It affords the pilot an opportunity to apply newly acquired skills and to experience subtle differences between the simulator and the airplane.

The primary objective, particularly on the L-1011, is to offer the transition/upgrade pilot a chance to acquire his/her "perspective" with respect to approaches and landings. It also affords Captains an opportunity to practice taxi techniques. The perspective on the L-1011 during the flare maneuver is significantly different than most other aircraft in the fleet.

If Captains have not been trained under a Phase II training program (i.e., advanced simulator plus initial LOFT), they will be required to complete certain maneuvers on the aircraft, e. g., an ILS, missed approach, simulated engine out approach, etc.

All F/Os will receive a check ride on the aircraft including a normal takeoff, engine out ILS, engine out visual approach, and a missed approach.

Some FMS demonstration may be given depending upon time available and numbers of students on board, etc.