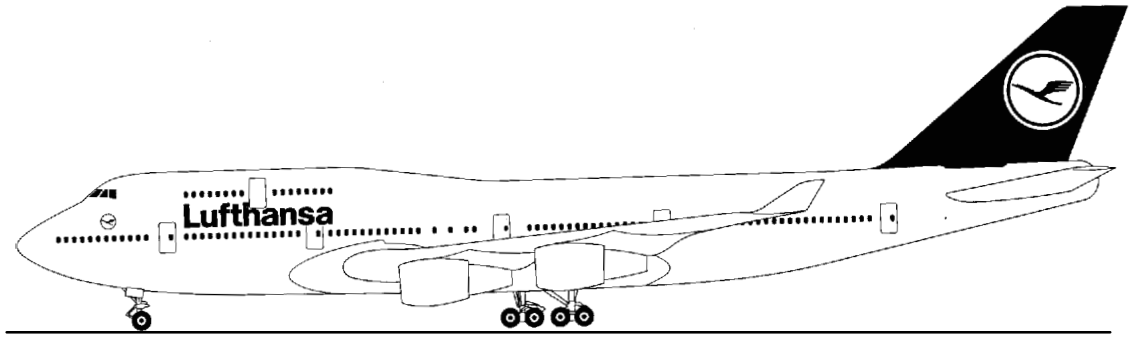
Lufthansa Technical Training

Training Manual B 747-400



ATA 34-1 1 PITOT-STATIC

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ATA 34-1 1 PITOT / STATIC SYSTEM

PITOT-ST ATIC SYSTEM - INTRODUCTION

The pitot-static system uses pitot-static probes and flush static ports to sense both pitot and ambient air pressures. These two pressures are used by the air data computers and other airplane systems to calculate flight parameters such as mach number, true airspeed, computed airspeed, and altitude.

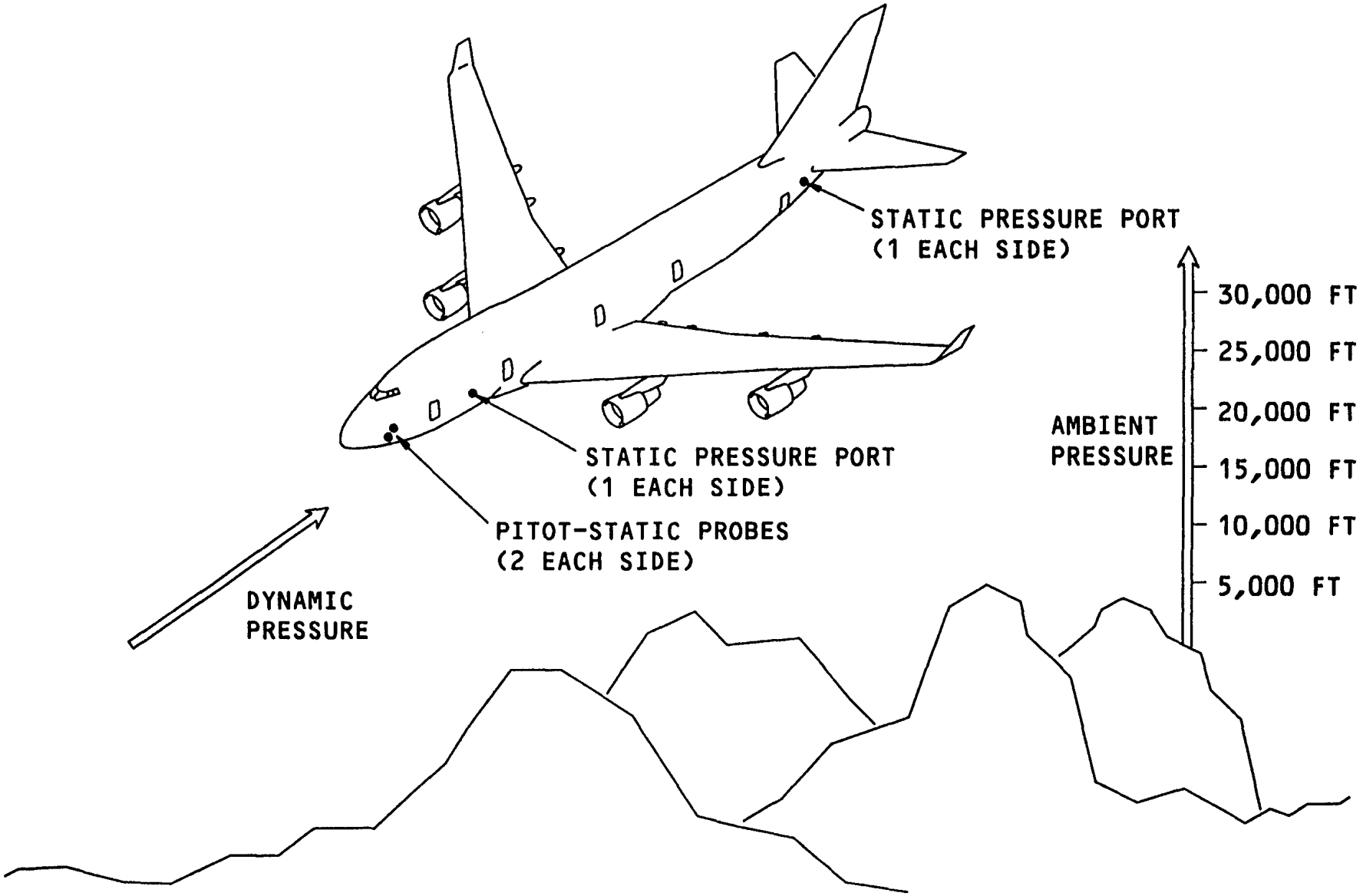


Figure 1 PITOT-STATIC SYSTEM - INTRODUCTION

PITOT-ST ATIC SYSTEM

The pitot-static system gets air pressure inputs from four pitot-static probes and four flush static ports on the airplane fuselage.

The airplane systems use two types of air pressure values:

- Static air pressure (Ps) is the ambient air pressure surrounding the airplane.
- Pitot air pressure (Pt) is total air pressure. It is composed of both static air pressure and dynamic air pressure. Dynamic air pressure is the pressure caused by the airplane moving through the air and is calculated by subtracting Ps from Pt.

The pitot-static system consists of:

- Pitot-static probes
- Flush static ports
- Source select valves
- Pneumatic lines and hoses
- Drain valves

Airplane systems that use both the pitot air pressure and static air pressure are:

- Air data computers (ADCs)
- Standby airspeed indicator
- Elevator feel computer (EFC)

The airplane systems use static air pressure and pitot air pressure to calculate airplane altitude and airspeed.

The standby altimeter uses static pressure (Ps) from the alternate static ports only.

Electrical heating circuits heat the pitot-static probes to prevent ice formation.

The pitot-static system has thirty-one drain valves that remove trapped moisture.

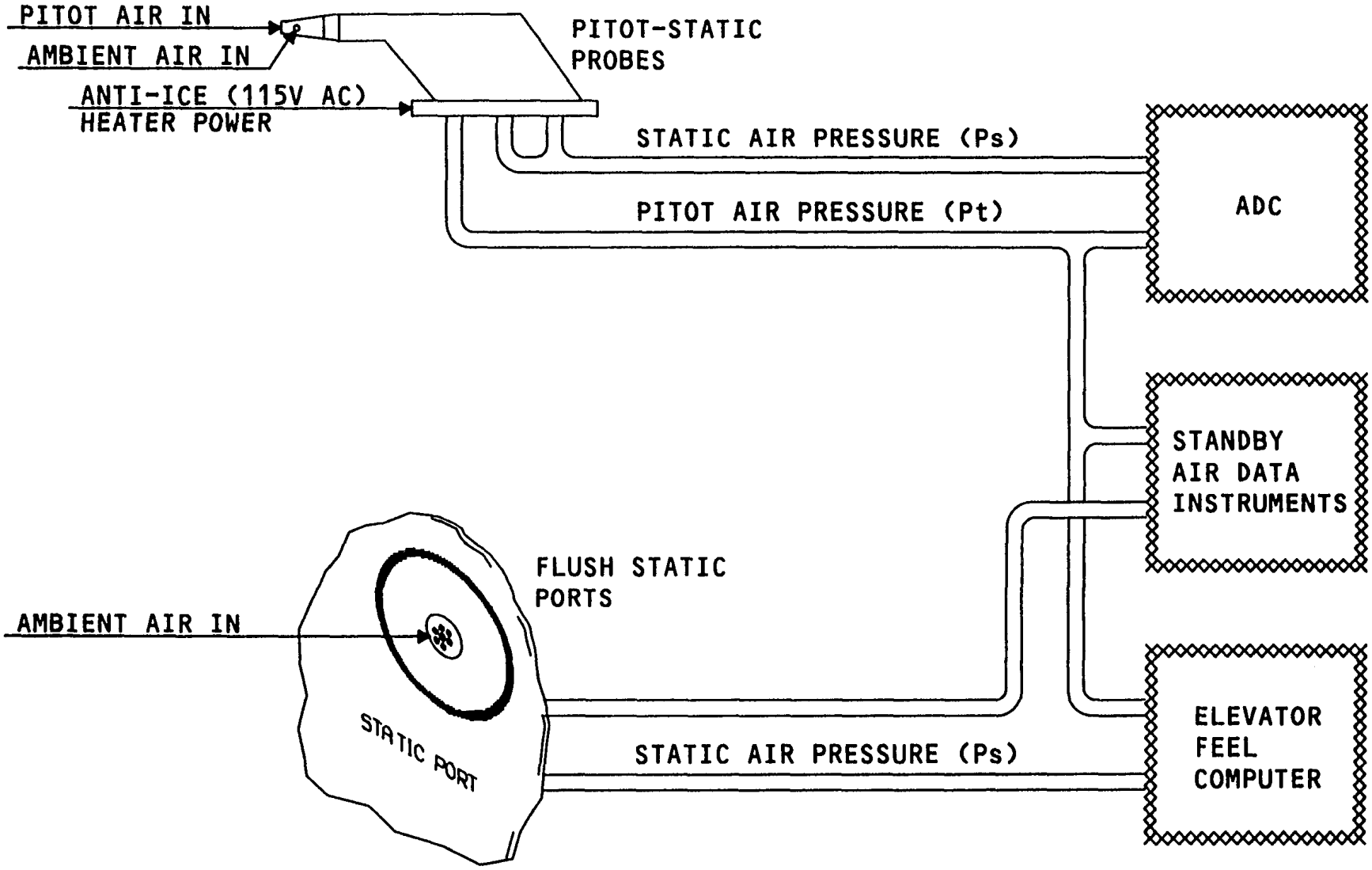
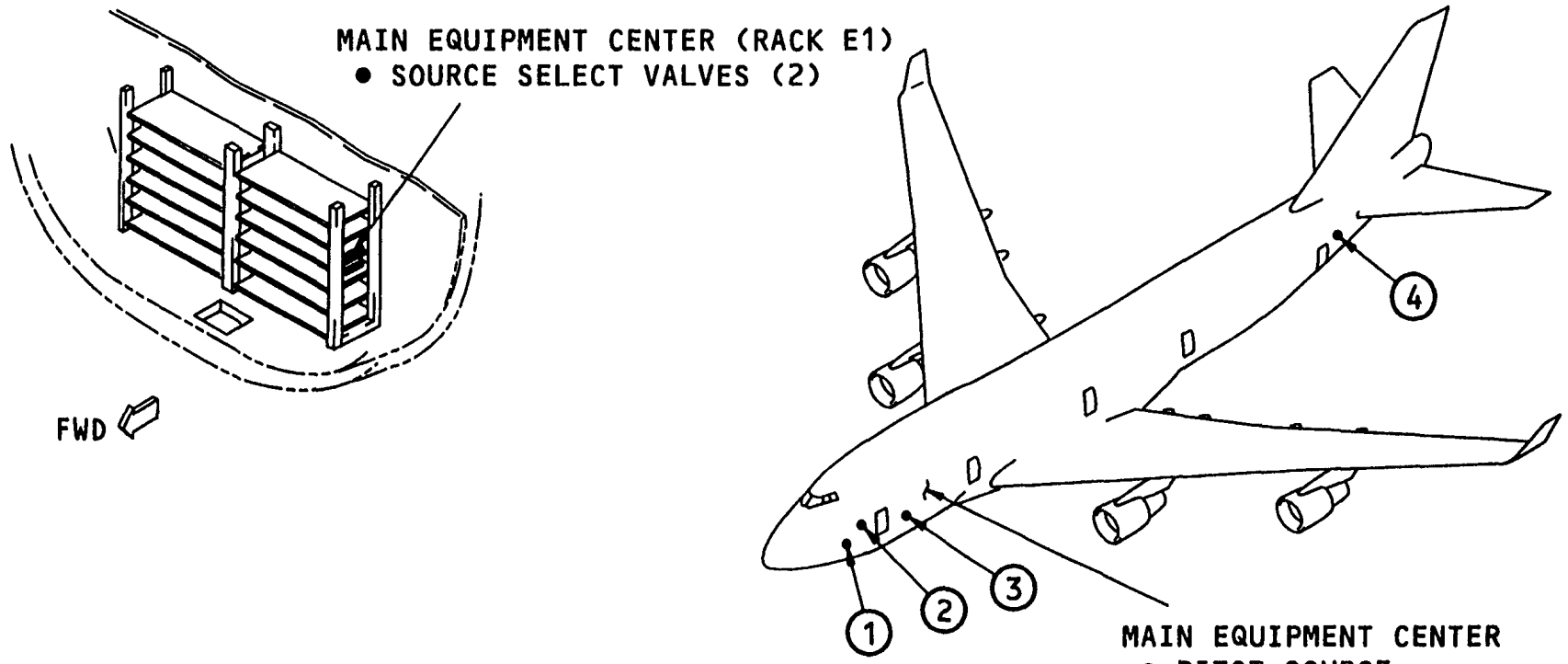


Figure 2 PITOT-STATIC SYSTEM

COMPONENT LOCATIONS

The pitot-static system components are:

- Left and right auxiliary (AUX) pitot-static probes
- Left and right main pitot-static probes
- Left and right alternate flush static ports
- Left and right dedicated flush static ports
- Pitot source select valve
- Static source select valve



NO.	SENSOR	STATION	WATERLINE
①	AUX PITOT-STATIC PROBES (L & R SIDES)	270	190
②	MAIN PITOT-STATIC PROBES (L & R SIDES)	275	207
③	ALTERNATE FLUSH STATIC PORTS (L & R SIDES)	680	167.48
④	DEDICATED FLUSH STATIC PORTS (L & R SIDES)	2367	243

Figure 3 COMPONENT LOCATIONS

DRAIN LOCATIONS

General

The pitot-static system drains are at 31 low points in the pitot-static lines. The drains are in areas that are easily accessed by maintenance personnel.

Forward Equipment Center

There are fourteen drains for the lines mounted on the fuselage walls and bulkheads in the forward equipment center crawlways:

- Drains numbered 1 through 4 are at STA 260.
- Drains numbered 5 through 14 are at STA 400.

Main Equipment Center

There are eight drains for the lines mounted on the stanchions of the EI and E2 electronics racks:

- Drains numbered 15 through 22 are at STA 434.

Forward Cargo Compartment

There are three drains for the lines mounted on the side of a stanchion in the left forward area of the cargo compartment:

- Drains numbered 23 through 25 are at STA 740.

AFT Cargo Compartment

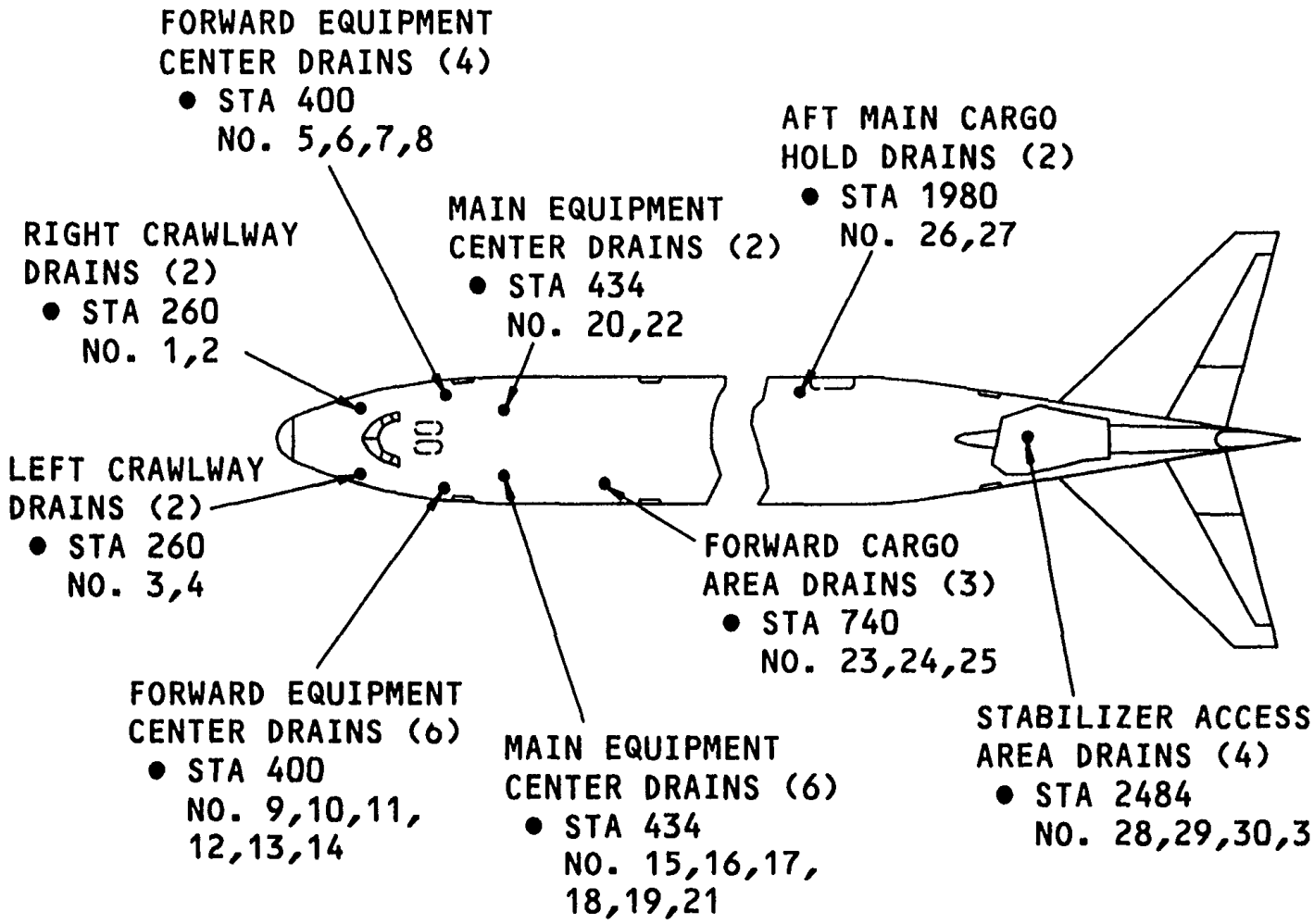
There are two drains for the lines mounted on a stanchion behind an access panel next to the cargo bay light switch:

- Drains 26 and 27 are at STA 1980.

Stabilizer Access Area

There are four drain plugs behind the rear pressure bulkhead and below the elevator feel computer:

- Drains 28 through 31 are at STA 2484.



DRAIN NO.	TYPE
1 & 2	STATIC
3 & 4	STATIC
5 & 8	PITOT
6 & 7	STATIC
9,11 & 13	STATIC
10,12 & 14	PITOT
20	STATIC
22	PITOT
15,17 & 19	STATIC
16,18 & 21	PITOT
23	STATIC
24 & 25	PITOT
26 & 27	PITOT
28 & 30	PITOT
29 & 31	STATIC

Figure 4 DRAIN LOCATIONS

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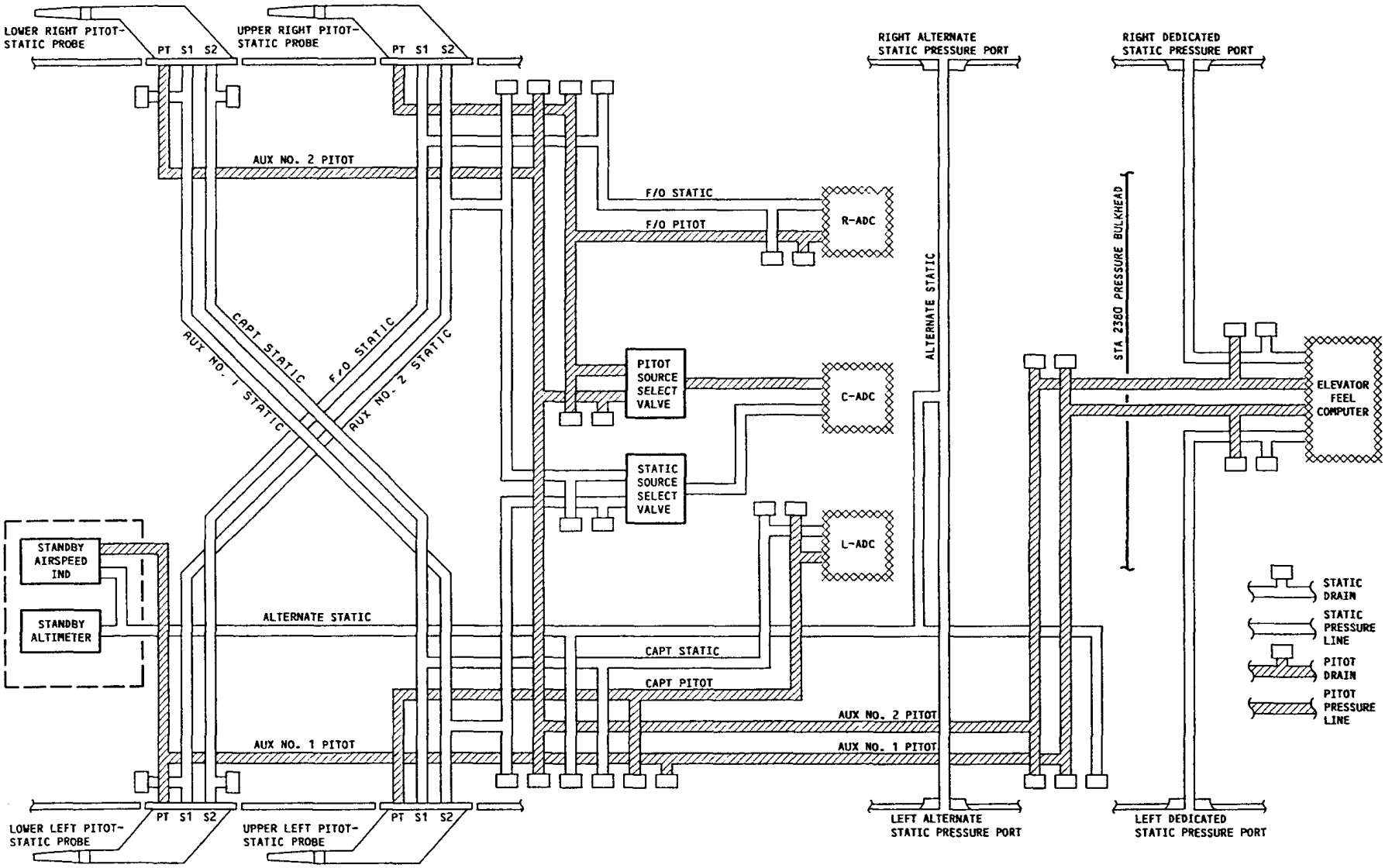

Figure 5 PITOT–STATIC SYSTEM – INTERFACE DIAGRAM

PITOT INTERFACE

Input Pressures

Each pitot-static probe supplies a single source of pitot pressure to the pitot system. The four sources are:

- CAPT PITOT (upper left main probe)
- F/O PITOT (upper right main probe)
- AUX PITOT No. 1 (lower left auxiliary probe)
- AUX PITOT No. 2 (lower right auxiliary probe)

Distribution Interface

Pneumatic lines and hoses connect the pitot pressures from the pitot-static probes to the following pressure sensitive devices:

- Right air data computer (F/O PITOT)
- Left air data computer (CAPT PITOT)
- Elevator Feel Computer (AUX PITOT No. 1 & 2)
- Standby Airspeed Indicator (AUX PITOT No. 1)

The pitot source select valve directs either AUX PITOT No. 2 or F/O PITOT to the center ADC. The pitot source select valve is controlled by the air data source select switch on the F/O P3 panel. The pitot source select valve is normally selected to AUX PITOT No. 2, and switches to F/O PITOT when the F/O selects the center ADC.

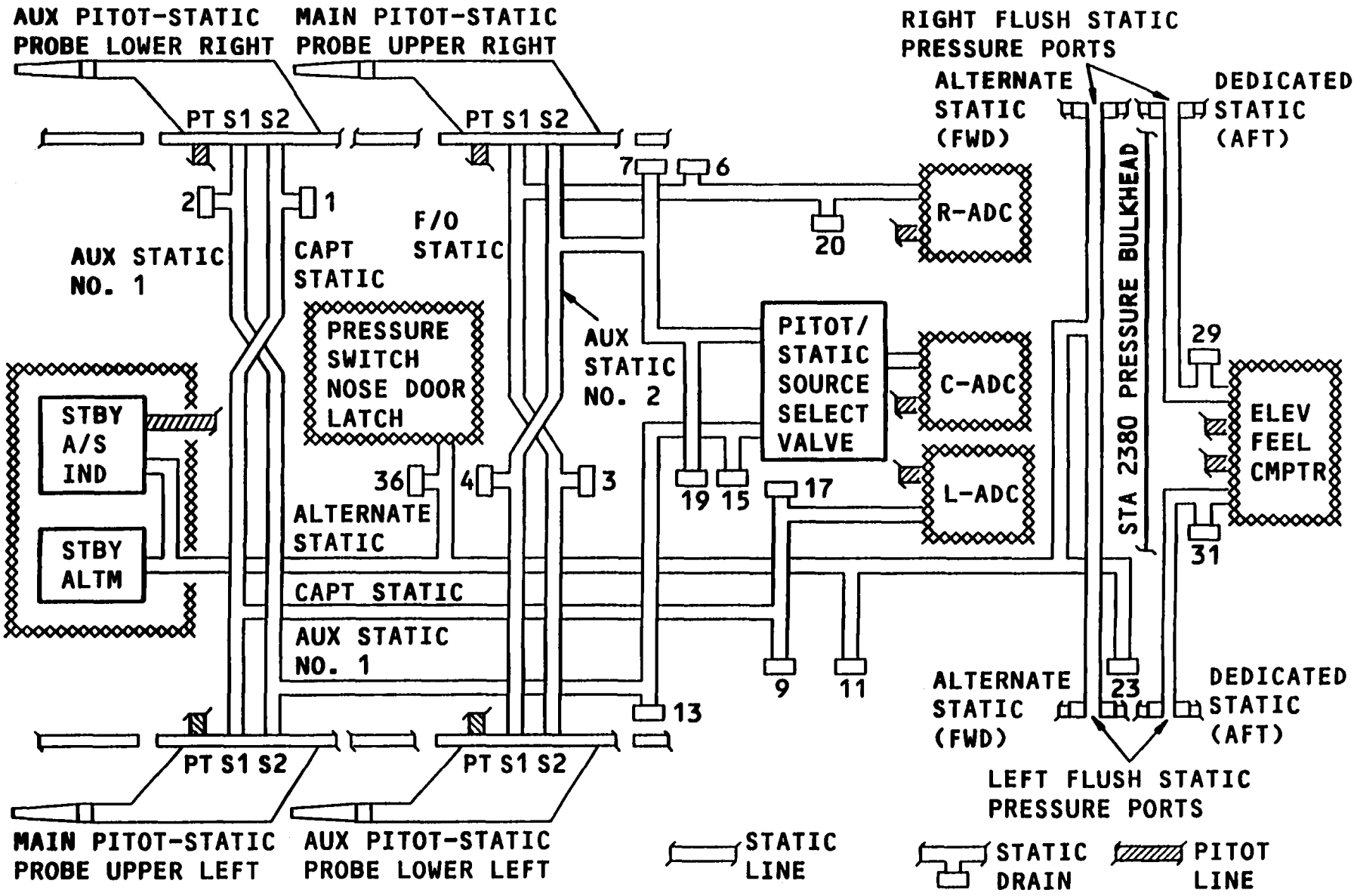

Figure 6 PITOT INTERFACE

STATIC INTERFACE

Input Pressures

Each of the four pitot-static probes supplies two sources of ambient air pressure. Each one is cross-connected to a source on the opposite side of the airplane. The upper left pitot probe connects to the lower right probe. The lower left pitot probe connects to the upper right. This configuration provides these four isolated static sources:

- CAPT STATIC (upper left S1 and lower right S2)
- F/O STATIC (upper right S1 and lower left S2)
- AUX STATIC No. 1 (upper left S2 and lower right S1)
- AUX STATIC No. 2 (upper right S2 and lower left S1)

Two more static subsystems are available from four flush static pressure ports:

- Alternate STATIC (forward left and right flush static ports)
- Dedicated STATIC (aft left and right flush static ports)

Distribution Interface

Pneumatic lines and hoses connect the static (ambient) pressure from the different static inputs to these pressure sensitive systems/devices:

- Right air data computer (F/O STATIC)
- Left air data computer (CAPT STATIC)
- Center air data computer (AUX STATIC No. 2 or AUX STATIC No. 1)
- Standby airspeed indicator and standby altimeter: (ALTERNATE STATIC)
- Elevator feel computer: (DEDICATED STATIC)

Distribution Interface

The static source selector valve directs either AUX STATIC No. 1 or AUX STATIC No. 2 to the center ADC. The air data source select switch on the F/O's P-3 panel controls the source select valve. The static source selector valve is normally selected to AUX STATIC No. 1, and switches to AUX STATIC No. 2 when the FIO selects the center ADC.

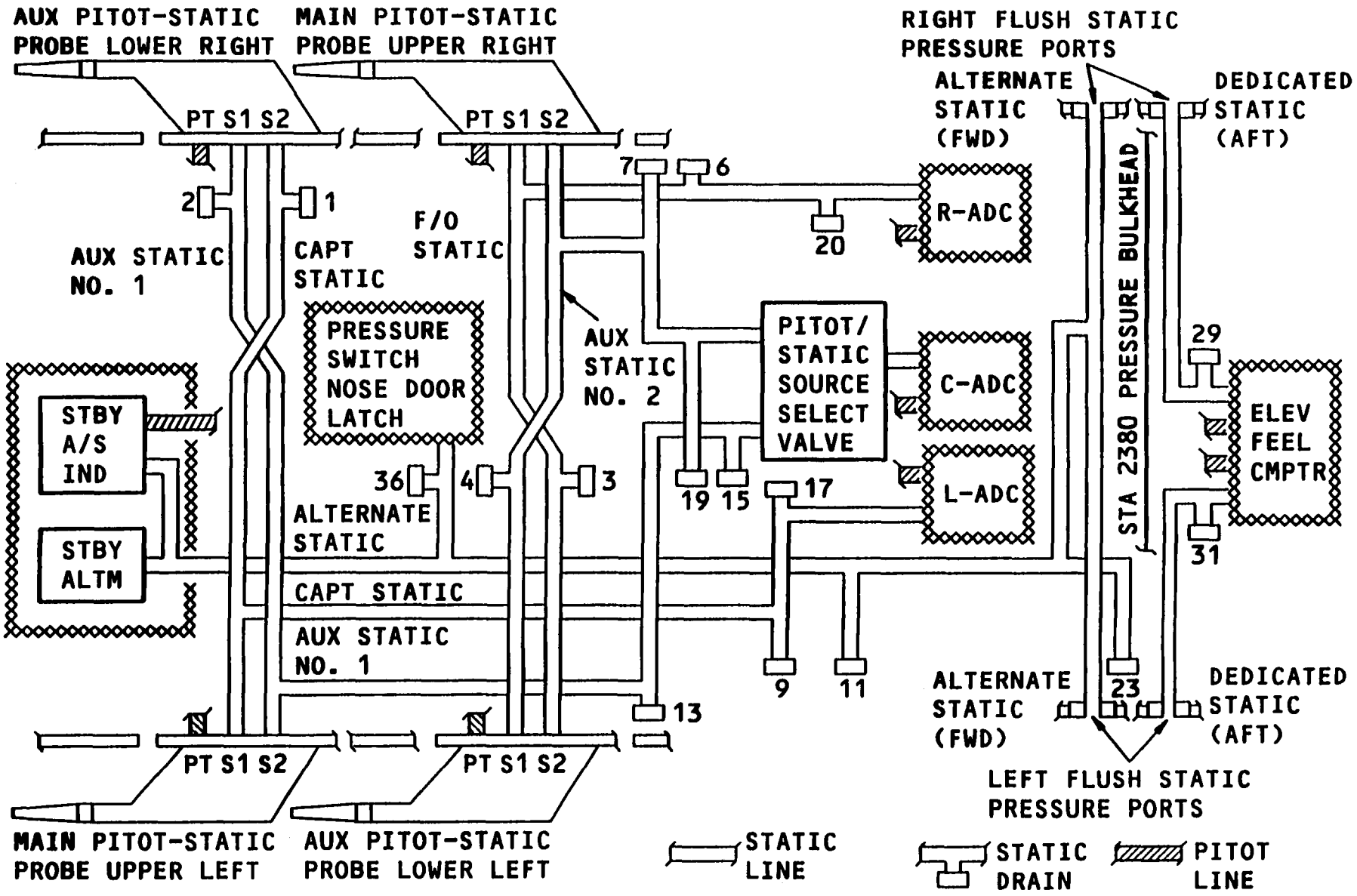

Figure 7 STATIC INTERFACE

PITOT PROBE

Purpose

The pitot-static probes get two types of air pressures:

- Pitot air pressure
- Static air pressure

Physical Description

The pitot-static probe is a hollow metal tube that is held several inches away from the airplane skin by a strut. The pitot-static probe is held away from the skin to keep airflow turbulence to a minimum.

The probe has three small ports that open into the hollow probe. Connected to these ports are three pneumatic lines that go to the base-plate of the probe:

- One port is open directly forward to take in pitot air pressure.
- Two ports, each with three holes, open onto the side of the probe to take in static air pressure.

The base-plate of the pitot-static probe contains electrical and pressure fittings.

- The pressure fittings allow the input air pressures to flow from the pitot-static probe into the pitot-static system.
- The electrical fittings connect to the anti-icing heater inside the pitot-static probe. The heater prevents ice from accumulating in the probe.

Installation and Removal

The pitot-static probe is attached with six mounting screws. The probe has two aligning pins which match holes in the airplane structure. To give a cabin pressure seal, a gasket is installed between the probe and airplane structure. S1 and S2 pressure lines are of different sizes to prevent improper connection (reversed) of the static pressure lines at the pitot-static probe.

The left and right pitot-static probes on the fuselage cannot be changed with each other.

The upper and lower pitot-static probes can be changed with each other.

CAUTION: PITOT-ST ATIC PROBES ARE DELICATE INSTRUMENTS AND ARE CRITICALLY ALIGNED ON THE AIRPLANE. EXTREME CARE MUST BE EXERCISED WHEN INSTALLING, REMOVING, OR HANDLING. DO NOTHING THAT PLACES ADDED WEIGHT OR STRAIN ON PROBE.

WARNING: DO NOT TOUCH PROBES WHILE HEATERS ARE ON. TEST HEATERS FOR OPERATION BY FEELING FOR HEAT RADIATION IN THE NEAR VICINITY OF HEATER BEING SUBJECTED TO TEST TO AVOID POSSIBILITY OF PERSONNEL BEING BURNED.

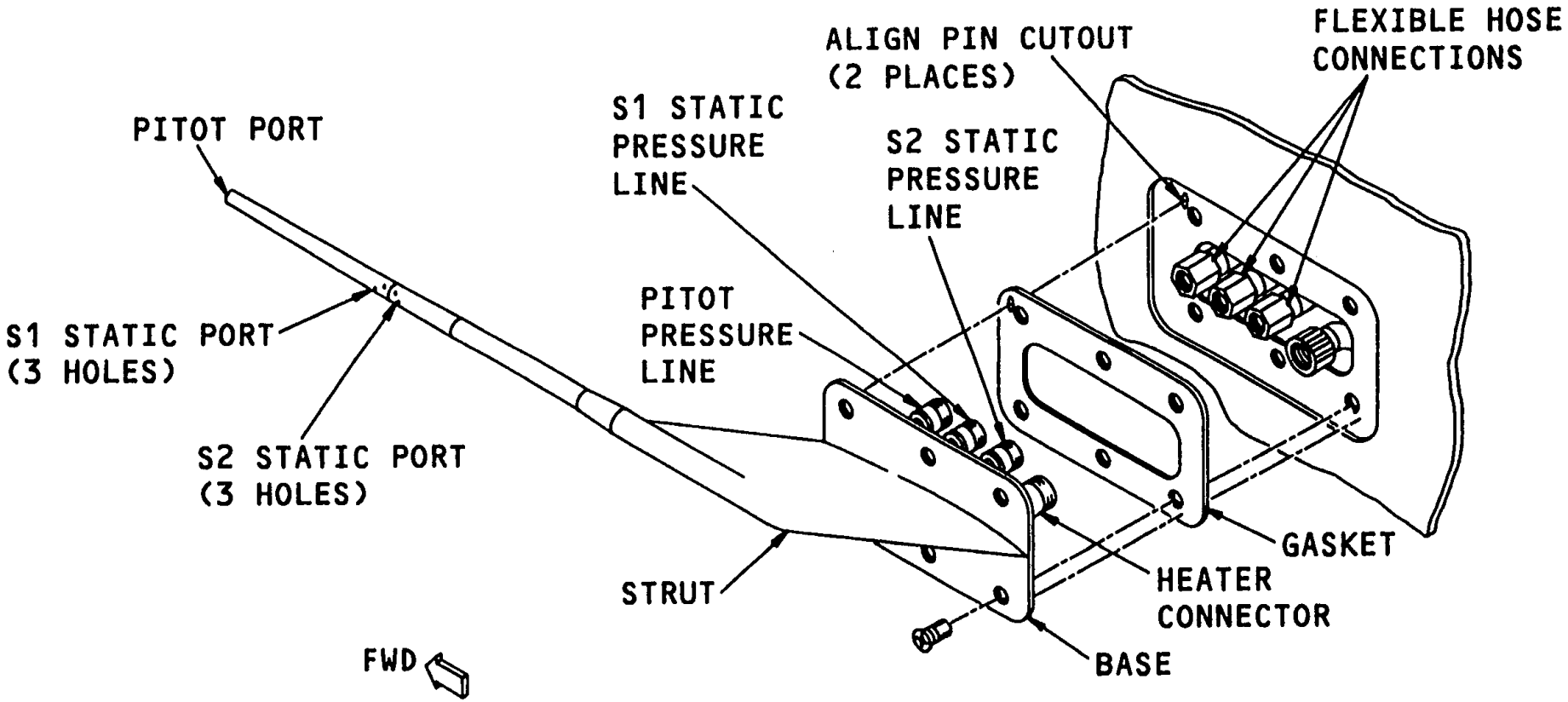

Figure 8 PITOT PROBE

STATIC PRESSURE PORTS

General

The two forward flush static pressure ports supply static pressure to the alternate static supply line that services the standby airspeed and standby altimeter flight instruments.

The two aft flush static pressure ports supply static pressure and are dedicated to only the elevator feel computer (EFC).

Access to the forward ALTERNATE STATIC ports is from inside the cargo compartment.

Access to the DEDICATED STATIC ports is from inside the elevator stabilizer compartment. This compartment is aft of the rear pressure bulkhead.

The retaining nut is torqued to a specific value and lock wired in place.

Physical Description

Each flush static port is installed flush with the skin of the airplane fuselage. A red circle is painted around the flush static port and a caution note is printed below it.

NOTE: DO NOT PLUG OR CAUSE DAMAGE TO ANY OF THE HOLES IN THE FLUSH STATIC PORTS.

Keep the airplane fuselage skin within the red circle around the flush static ports smooth and clean.

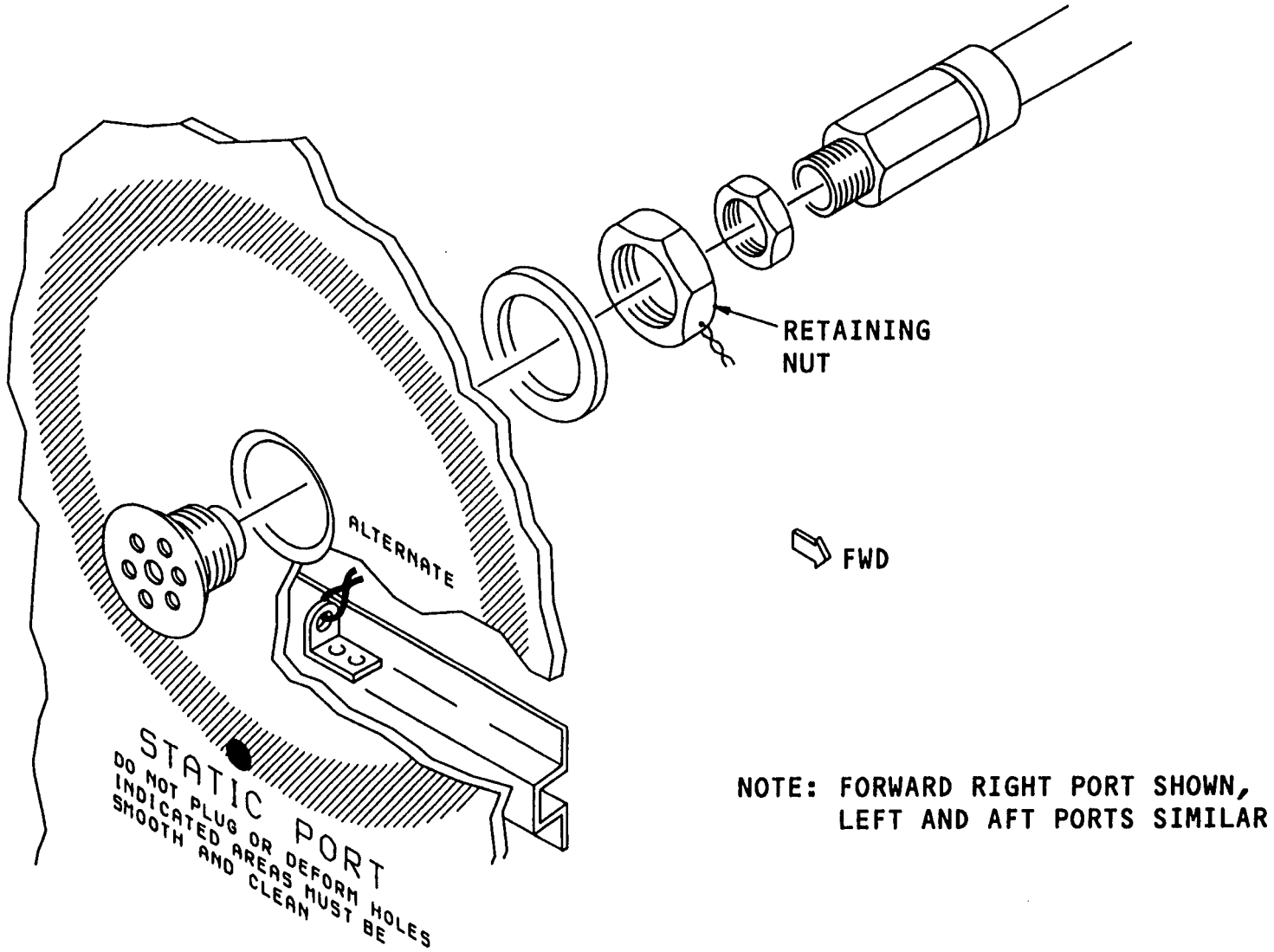

Figure 9 STATIC PRESSURE PORTS

DRAINS

General

The three types of drains are:

- Drain assembly
- Drain-plug
- Visco jet

The quick-release drain assembly is used on all drain lines except those in section 48, the stabilizer access area. Two drain-plugs are used on the pitot pressure lines in this area. Two axial Visco Jet type drains are used on the static pressure lines in this section due to the possibility of hydraulic fluid in these lines.

The quick-release and drain-plug types are designed to trap any moisture in the pitot or static pressure lines. The axial Visco Jet type drain is designed to allow any accumulated fluid to drain out of the lines.

Physical Description

The drain assembly type contains:

- Sight gauge with orange float ball
- Drain fitting with a spring-loaded seal and poppet valve
- Bayonet fitting cap

The drain-plug type is a cap that seals the end of the drain line.

The axial Visco Jet type contains a series of discs that rotate to allow fluid to drain out.

Operation

The bayonet fitting cap has a drain pin attached to the outside of the cap. To release any trapped water in the system:

- Remove the cap from the drain assembly and turn it upside down
- Insert the drain pin (on the cap) into the drain fitting to open the poppet valve and seat.

The orange float ball inside the transparent sight gauge shows the water level.

The drain-plug type installed in section 48 is opened by simply unscrewing the plug. This will allow the accumulated fluid to drain out.

The Visco Jet type drains are automatic.

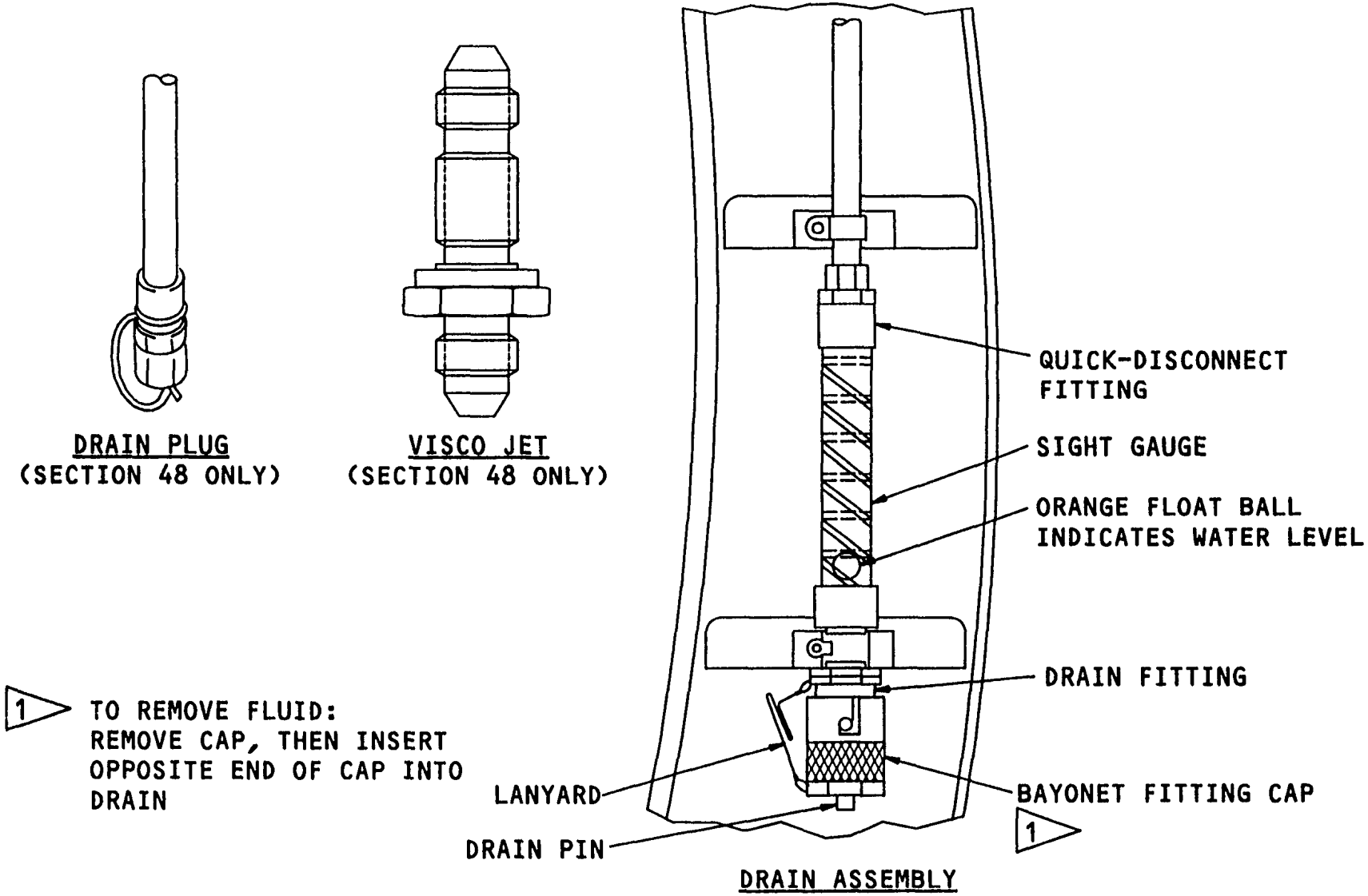

Figure 10 DRAINS

SOURCE SELECT VALVES

General

The pitot source select valve and the static source select valve provide pneumatic pressures from one of two pitot and static sources to the center air data computer (ADC-C).

Physical Description

The source select valve is an electrically-operated pneumatic-control valve that weighs 1.7 pounds. The valve has three quick-disconnect pneumatic fittings.

Operation

The source select valve has two input ports (A and B) and one output port (C). Port selection is controlled by two electrical coils inside the valve. An input to either coil will cause the valve to switch. The valve remains latched in the last position when the signal is removed. Each coil has a micro-switch that disconnects the drive signal after the valve switches to the desired position. An output ground is sent to the EIUs to show the position of the valve.

When the F/O has left or right ADC selected on his ADC source select switch, the valve is in position 1 (Port A to Port C). If the FIO selects the center ADC, the valve switches to position 2 (Port B to Port C). There are no visual position indications on the valves.

If a pitot or static source select valve fails to switch when commanded by the F/O air data source select switch, an EICAS status message (P/S XFR VLV) comes on. This indicates the EIU detects a disagreement between the ADC source select switch and the source select valve position.

Normal maintenance procedures should be used to troubleshoot a failed switch. A pitot-static test set should be used at the valve to determine if the valve port selection is correct as commanded from the flight deck.

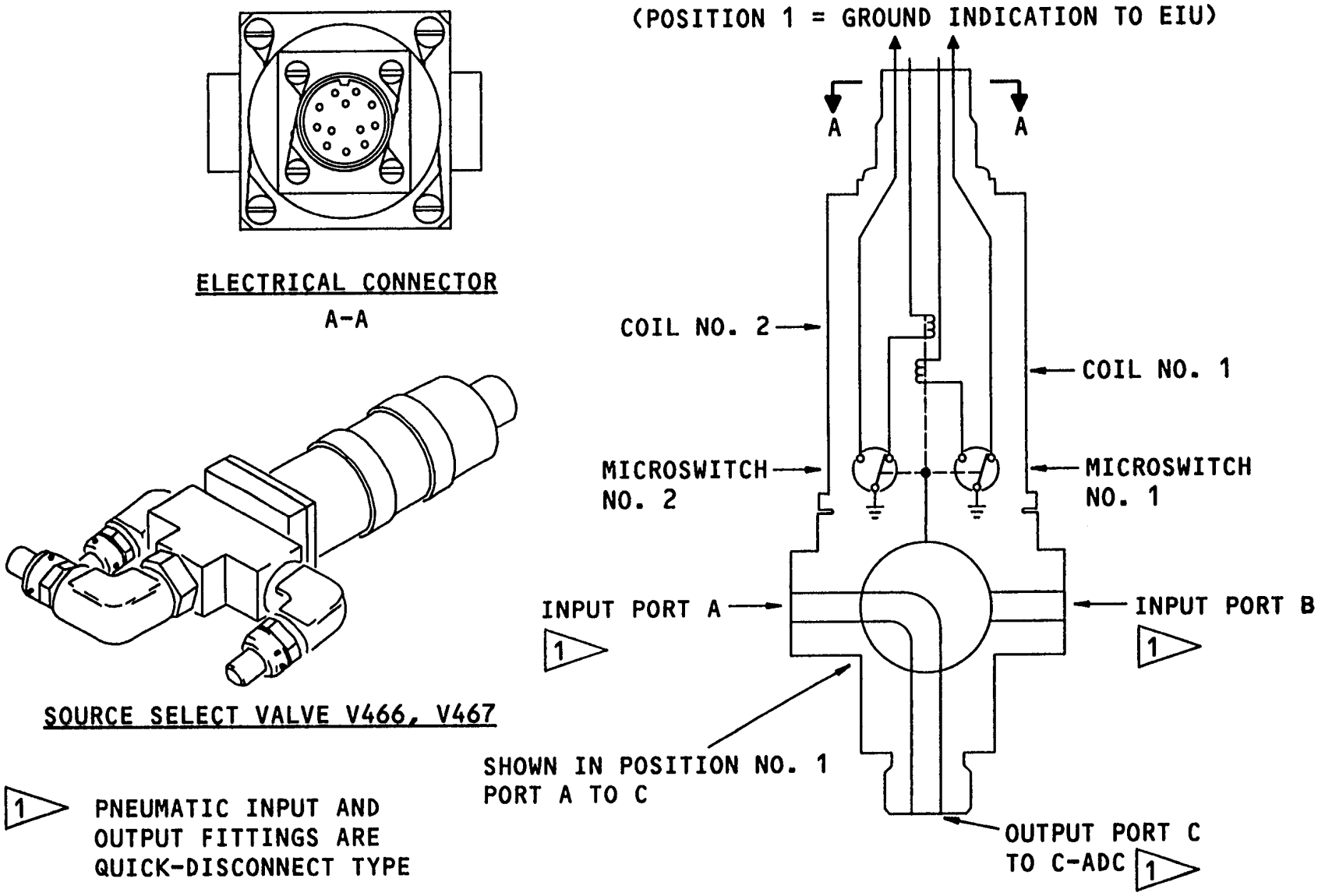

Figure 11 SOURCE SELECT VALVES

MAIN PROBE HEATER CIRCUIT

Operation

Each main pitot-static probe receives anti-icing current to a strut and probe head heater. On the ground, with the engines not running, the probe heaters are not on.

During start, at 50 percent N2 engine RPM on any engine, relays R7423 and R7425 are energized. The strut of the probe is supplied with 115v ac. Reduced power is supplied to the head heater through a current-limiting diode in the circuit.

In flight, relay R7425 is de-energized and relay R7423 remains energized through the engine speed sense card or relay R7334. The head and strut heaters receive 115v ac.

The current to the heaters is sensed by two sensors. If power is not supplied through either heater, the current sensor supplies an analog discrete to the left, center and right EIUs. When either the strut or the head heater has no current, a level C EICAS message HEAT P/S CAPT or HEAT P/S F/O shows.

The current sensors send an analog discrete to the ADC system to indicate proper operation in the anti-icing circuits. The ADC sets a discrete, I for heat-on, 0 for heat-off and sends this to all airplane user systems. Some user systems use this bit to select which ADC to use. The ADC's will not alter any output data if the heater circuits fail.

Test

Probe heater operation is checked on the ground by the central maintenance computers. During a ground test, relays R7421 and R7423 are energized and provide the head and strut heaters with 115v ac. Test results show on the CDU and EICAS displays.

NOTE: OPERATION AND TEST OF THE AUXILIARY PITOT-ST ATIC PROBE HEATER CIRCUIT IS THE SAME AS FOR THE MAIN CIRCUIT EXCEPT THE EICAS MESSAGES ARE HEAT P/S L AUX AND HEAT P/S R AUX.

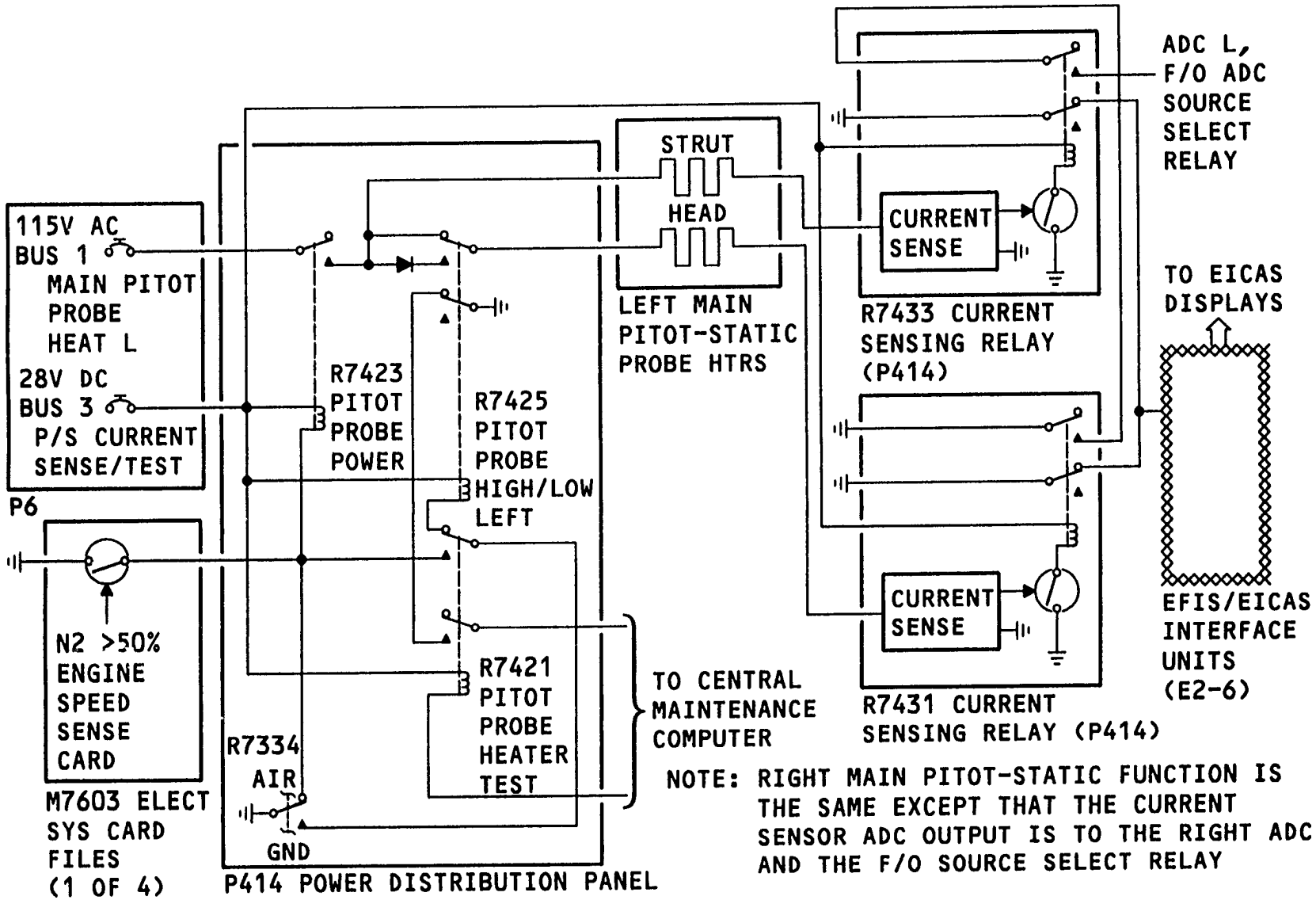

Figure 12 MAIN PROBE HEATER CIRCUIT

P/S PROBE HEAT - GROUND TEST-1

General

To start a P/S probe heat test:

- Select the CMC GROUND TEST menu. (chapter 30 Ice & Rain)
- Push the PROBE HEAT L LSK (Note that INHIBITED shows above PROBE HEAT L and PROBE HEAT R).
- The ENABLE TEST screen shows on the CDU.

The ENABLE TEST screen lists all conditions that must be satisfied to complete the PROBE HEAT L test. These conditions are:

- AIRPLANE ON GROUND
- SET GND TEST SWITCH ON P461 (OR IN MAIN EQUIP CTR) TO ENABLE
- ENGINES OFF

After all of the conditions are satisfied, push the RETURN LSK.

NOTE: PROBE HEAT R TEST IS EQUIVALENT TO PROBE HEAT L TEST.

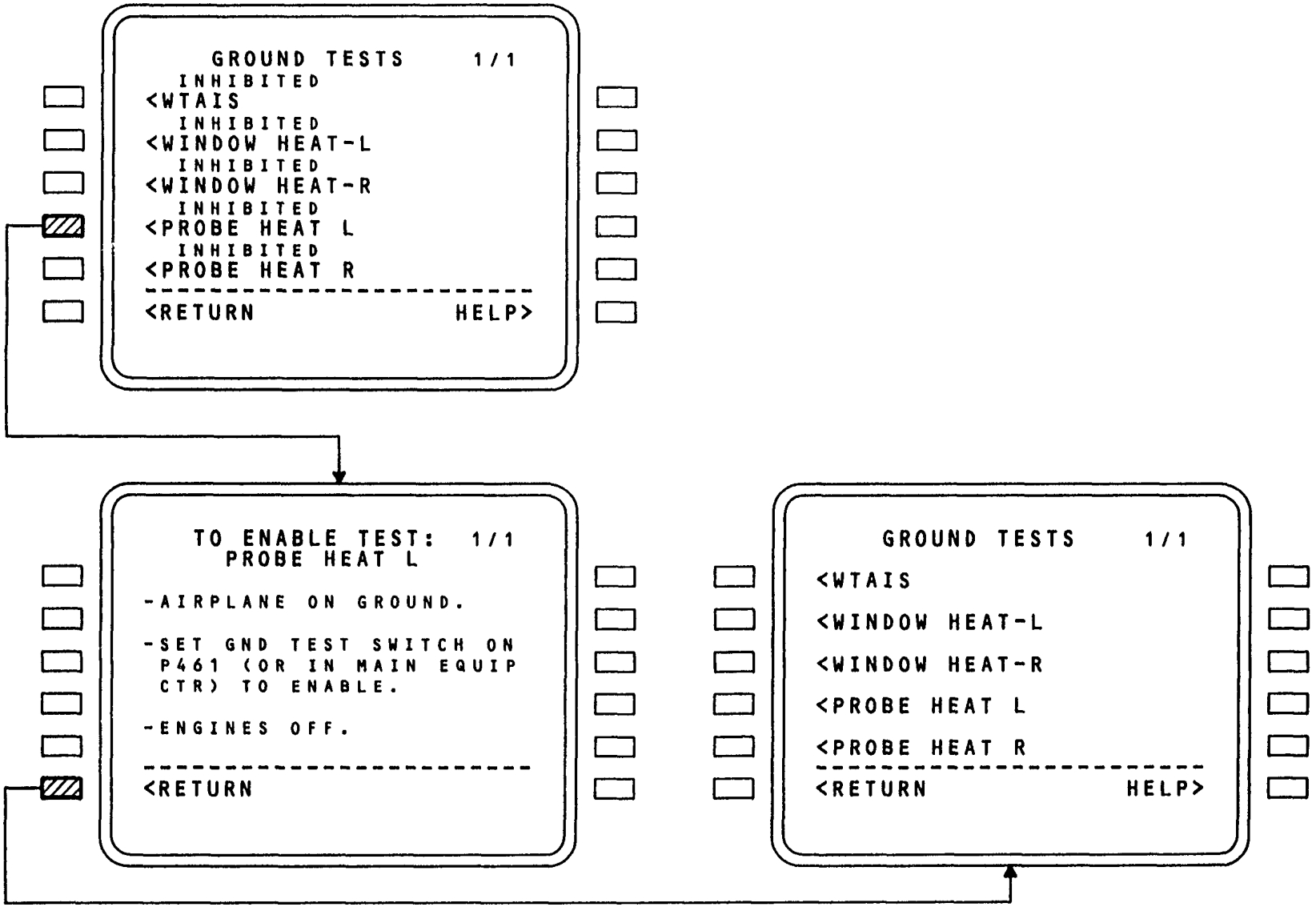

Figure 13 P/S PROBE HEAT - GROUND TEST-1

P/S PROBE HEAT - GROUND TEST-2

Ground Tests

Show the CMC GROUND TEST menu (chapter 30 Ice & Rain). If not inhibited, then:

- Push the PROBE HEAT L LSK.
- Observe TEST PRECONDITIONS page.
- Push START TEST LSK.

Ground Tests Results

Upon completion of a ground test using the CDU, the word PASS will appear on the same line if there are no detected faults. The word FAIL shows a failure of the ground test. Push the adjacent line select key to show the GROUND TEST MSG page to see more data about the test failure.

NOTE: PROBE HEAT R TEST IS EQUIVALENT TO PROBE HEAT L TEST.

Figure 14 P/S PROBE HEAT - GROUND TEST-2

FLIGHT DECK EFFECTS AND CMC MESSAGES

Flight Deck Effect

Pitot-Static failures are detected thru Chapter 34-12 ADC and Chapter 30 Ice & Rain Protection Indications. The flight deck effects associated with pitot-static are:

- P/S XFR VLV (status): pitot-static transfer valve fails to switch when commanded
- Heat P/S CAPT (status & advisory): loss of captain's main pitot probe heat
- Heat P/S F/O (status & advisory): loss of F/O main pitot probe heat
- Heat P/S X AUX (status & advisory): loss of AUX Pitot probe heat

CMC Messages

CMC messages that show for the pitot-static system are:

- CAPTAINS PITOT HEAT FAIL
- FIO PITOT HEAT FAIL
- X AUX PROBE HEAT FAIL
- CAPTAINS PITOT HEAT DETECTION SYSTEM FAIL
- F/O PITOT HEAT DETECTION SYSTEM FAIL
- X AUX PROBE HEAT DETECTION SYSTEM FAIL
- X PITOT PROBE TEST RELAY OR HIGH/LOW RELAY FAIL
- X PITOT PROBE POWER RELAY FAIL

NOTE: X - L (LEFT) OR R (RIGHT)

FLIGHT DECK EFFECT	TYPE	DESCRIPTION
P/S XFR VLV	STATUS	PITOT-STATIC TRANSFER VALVE FAILS TO SWITCH WHEN COMMANDED
HEAT P/S CAPT	STATUS & ADVISORY	LOSS OF CAPTAIN'S MAIN PITOT PROBE HEAT
HEAT P/S F/O	STATUS & ADVISORY	LOSS OF F/O MAIN PITOT PROBE HEAT
HEAT P/S X AUX 1	STATUS & ADVISORY	LOSS OF AUX PITOT PROBE HEAT

CMC MESSAGES

CAPTAIN'S PITOT HEAT FAIL
F/O PITOT HEAT FAIL
X AUX PROBE HEAT FAIL
CAPTAIN'S PITOT HEAT DETECTION SYSTEM FAIL 1
F/O PITOT HEAT DETECTION SYSTEM FAIL
X AUX PROBE HEAT DETECTION SYSTEM FAIL
X PITOT PROBE TEST RELAY OR HIGH/LOW RELAY FAIL
X PITOT PROBE POWER RELAY FAIL

1 X = (L)LEFT OR (R)RIGHT

Figure 15 FLIGHT DECK EFFECTS AND CMC MESSAGES

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TABLE OF FIGURES