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- The LTT production process ensures that the Training Manual contains a complete set of all necessary pages in the latest finalized revision.

ATA 36 PNEUMATIC

36–00 GENERAL

PNEUMATIC SYSTEM INTRODUCTION

The pneumatic system supplies high pressure air for:

- Air Conditioning and Pressurization ATA 21
- Hydraulic Tank Pressurization ATA 29
- Wing Anti–Ice Protection ATA 30
- Water Tank Pressurization ATA 38
- Engine Starting System ATA 80

High pressure air is supplied from three sources:

From both engines when in operation (in flight & on GRD).

1. The engine air is taken from:
   - the Intermediate Pressure Stage,
     - IP = 5th. Stage on CFM 56-5 engines

       or
     - IP = 7th. Stage on IAE V2500 engines.
2. the High Pressure Stage,
   - HP = 9th. Stage on CFM 56-5 engines

     or
   - HP = 10th. Stage on IAE V2500 engines.
3. from the APU
   - on ground

     or
   - in flight (air off take is limited depending on Altitude).

on ground using a external air source which can be connected to the 3”–HP ground connection.

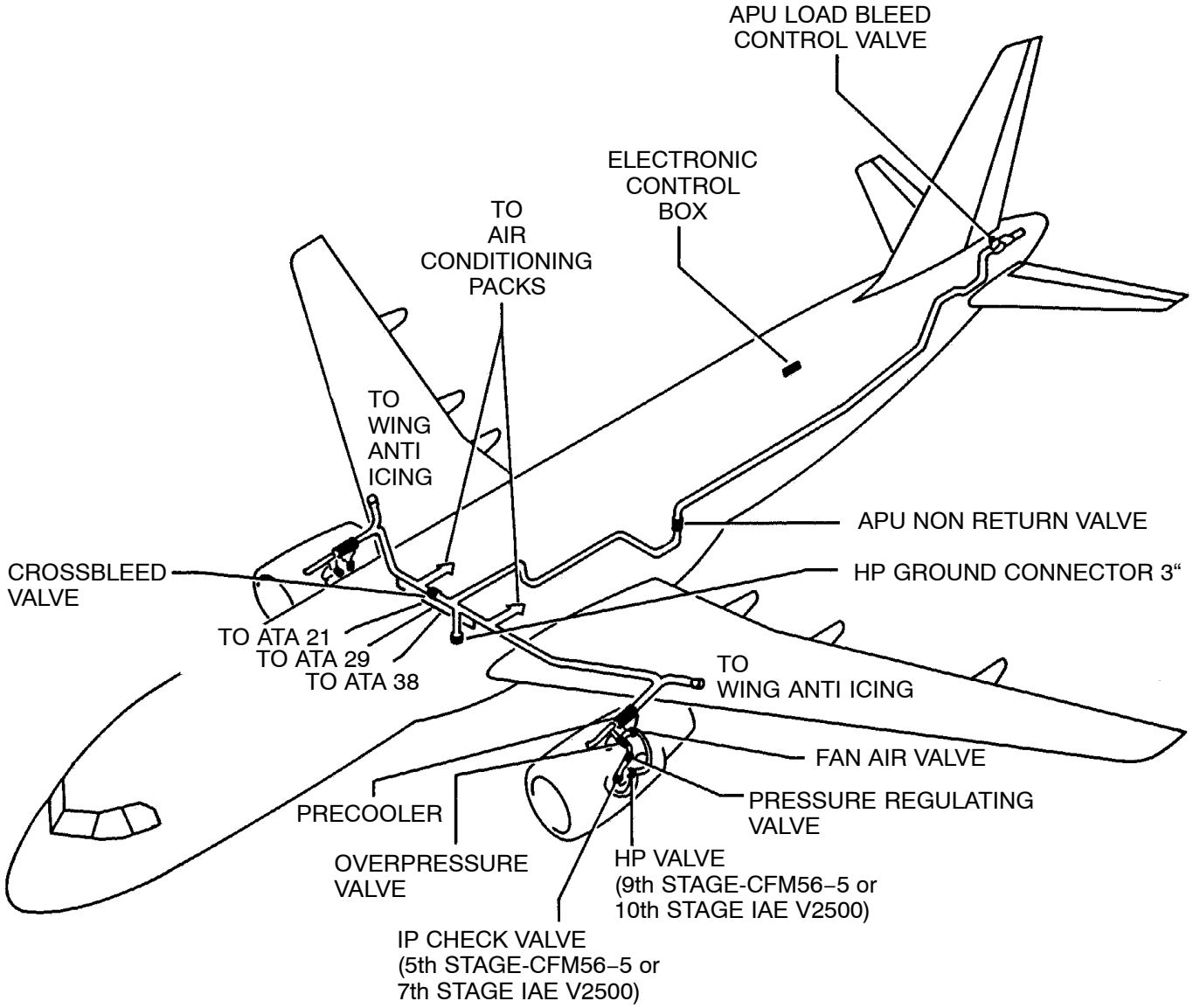


Figure 1 AC Component Location – Fuselage

PNEUMATIC SYSTEM DESCRIPTION

General

Bleed air is used for the following systems:

- Air Conditioning & cabin pressurization.
- Trim air pressure regulator valve muscle pressure.
- Wing anti ice.
- Engine starting.
- Hydraulic reservoir pressurization.
- Water tank pressurization.

APU Air Supply

The air supplied by the APU load compressor is:

- unregulated bleed air
  (Temperature: approx.120°C and pressure approx.30psi)
- air supply is possible on ground and
- in the air up to a altitude of 20000ft. (approx. 6100m)

APU bleed air is controlled by the APU bleed valve which operates as a shut off/surge valve. It is fuel operated. The APU bleed valve is controlled by the APU BLEED SW. on the Air Conditioning Panel.

When the P/BSW is selected ”ON” ,APU bleed air supplies the pneumatic system provided the APU is running (N > 95%). This causes the X-BLEED valve to open and the engine bleed valves to automatically close.

A check valve, located near the crossbleed duct, protects the APU when air is bled from other supply sources.

Engine Bleed Air Supply

Both engines bleed systems are similar. Each system is designed to:

- select the air source compressor stage. (5th or 9th stage on CFM 56-5) or (7th or 10th stage on IAE V2500 engine)
- regulate bleed air pressure to max.45psi.
- regulate bleed air temperature max. 200°C.

Air is normally bled via a check valve from the 5th on the CFM 56-5 (7th IAE V2500) IP (**I**ntermediate **P**ressure stage) of the engine HP compressor, to minimize fuel penalty. The intermediate pressure check valve, is mounted downstream of the IP port and closes to prevent air from HP stage being circulated to the IP stage (5th stage CFM 56) When pressure and temperature from IP are not sufficient (low engine speed), air is bled from the 9th HP (**H**igh **P**ressure) stage on CFM (10th stage on IAE V2500) .The pneumatically operated HP valve regulates the pressure at 36psi. Downstream of the junction of the HP and IP ducting, air is admitted into the bleed valve which acts as a shut off and pressure regulating valve. The delivery pressure is regulated by pneumatically operated bleed valve at 45psi. The temperature regulation of the bleed air is achieved by a precooler, mounted downstream of the bleed valve. The precooler is an air to air heat exchanger which uses cooling air bled from the engine fan, to regulate the temperature to 200°C. The fan air flow is controlled by the fan air valve. When the temperature is below 200°C the valve is closed. If the temperature increases the valve is controlled to open by a CT (**C**ontrol **T**ermostat). The CT is set at 200°C.

Each system is controlled and monitored by one BMC (**B**leed **M**onitoring **C**omputer). Each BMC is provided with bleed pressure, temperature and valve position information and is interconnected to:

- other systems involved with bleed system
- the other BMC

The BMC provides indications and warnings to the ECAM and CFDS.

In case of failure of one BMC, the other takes over most of the monitoring functions.

Cross Bleed

A crossbleed valve, installed on the crossbleed duct, permits the isolation or interconnection of the LEFT HAND (Eng1) and RIGHT HAND (Eng 2) air supply system. The crossbleed valve is electrically controlled from a rotary selector located on the air cond. panel.

In the automatic mode the crossbleed valve opens when APU bleed air is used. It closes when any air leak is detected (except during engine start).

Air Leak Detection

Air leak detection loops detect any ambient overheat in the vicinity of the hot air ducts in the fuselage, pylons and wings. The sensing elements are tied to form a single loop, for pylon and APU, or a double loop for the wing.

The system has identical control logics included in BMC1 and 2.

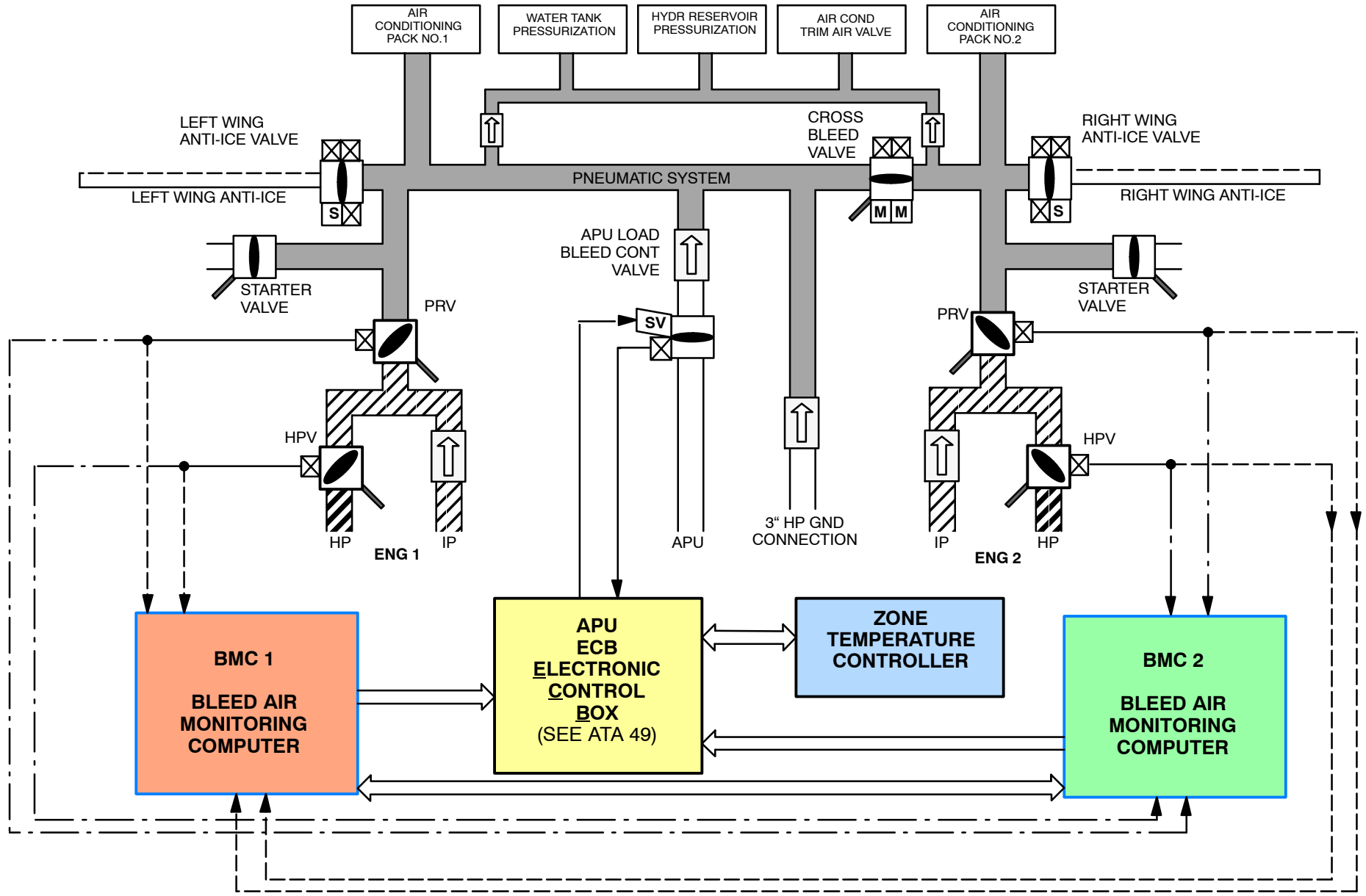


Figure 2 Pneumatic System Schematic

AIR CONDITIONING CONTROLS DESCRIPTION

1 ENG 1 (2) BLEED PB SWITCH

ON (PB SW pressed in)

- BLEED VALVE (PRESS REGULATOR VLV) is OPEN or CLOSED according to the X–BLEED SELECTOR and APU BLEED PB POSTION

- **FAULT**:
  - FAULT-light comes on AMBER, associated with ECAM CAUTION (BLEED), MASTER CAUTION-light and AURAL WARNING (SC) in case of:
    - Overtemperature (≥257°C) downstream of precooler
    - Overpressure (≥57 ± 3psig) downstream of PRV
    - ENG 1 (2) BLEED VALVE (PRV) is not automatically FULLY CLOSED:

      during ENG 1 (2) START OR APU BLEED VLV selected OPEN
    - PYLON or WING (RH OR LH) Overheat detection
  - Light OFF, there for reset action is necessary on ENG BLEED PB and to reactivate the system after failure has been repaired
- **OFF** (PB SW released out)
  - BLEED VALVE ⟨S) (PRV and HPV CLOSED)

2 APU BLEED PB SW

- **ON** (PB SW pressed in) blue on light
  - APU LOAD BLEED CONTROL VALVE opens provided N >95%. ON-light comes on blue associated with ECAM CAUTION
  - ENG 1 and 2 BLEED VALVE (PRV) CLOSED
  - CROSS BLEED VALVE opens if in AUTO-position
- **OFF** (PB SW released out) no light
  - APU LOAD BLEED CONTROL VALVE closes
  - CROSS BLEED VALVE closed if in AUTO-position
  - ENG 1 (2) PRV-position as selected ON/OFF
- **FAULT**
  - FAULT-light comes ON amber. associated with ECAM CAUTION when APU LEAK is detected
  - LIGHT OFF, there for reset action is necessary on APU bleed pb and to reactivate the system after failure repair

3 CROSS BLEED VALVE SELECTOR (X–BLEED VALVE)

- **AUTO:**
  - Valve opens using primary electric motor no.1 when:
    - APU N>95%
    - APU bleed switch is ON and APU bleed valve is not fully closed
    - no left or right pylon or wing leak detection or APU leak detection present. This closing signal will be suppressed during engine start.
- **OPEN**:
  - X–BLEED VALVE opens if closed. Using the secondary motor no.2.
- **SHUT**:
  - Open command will be overridden. Using the secondary motor no.2. (See logic schematic ref.36–12–00)

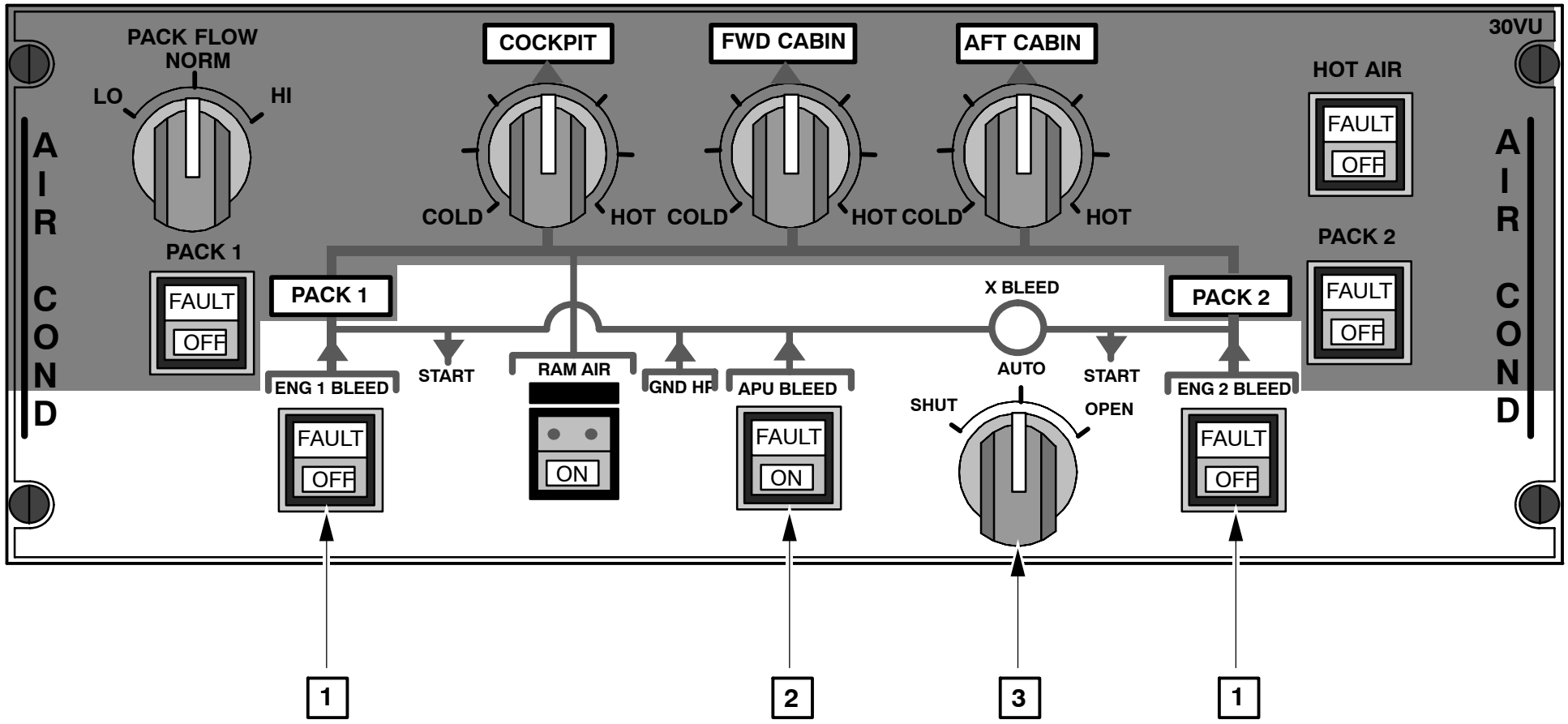


Figure 3 Air Conditioning Panel (30VU)

1 BLEED PUSH BUTTON SW

- to call the bleed page on the lower ECAM display unit

2 CLEAR PUSH BUTTON SW

- to clear the lower ECAM display unit

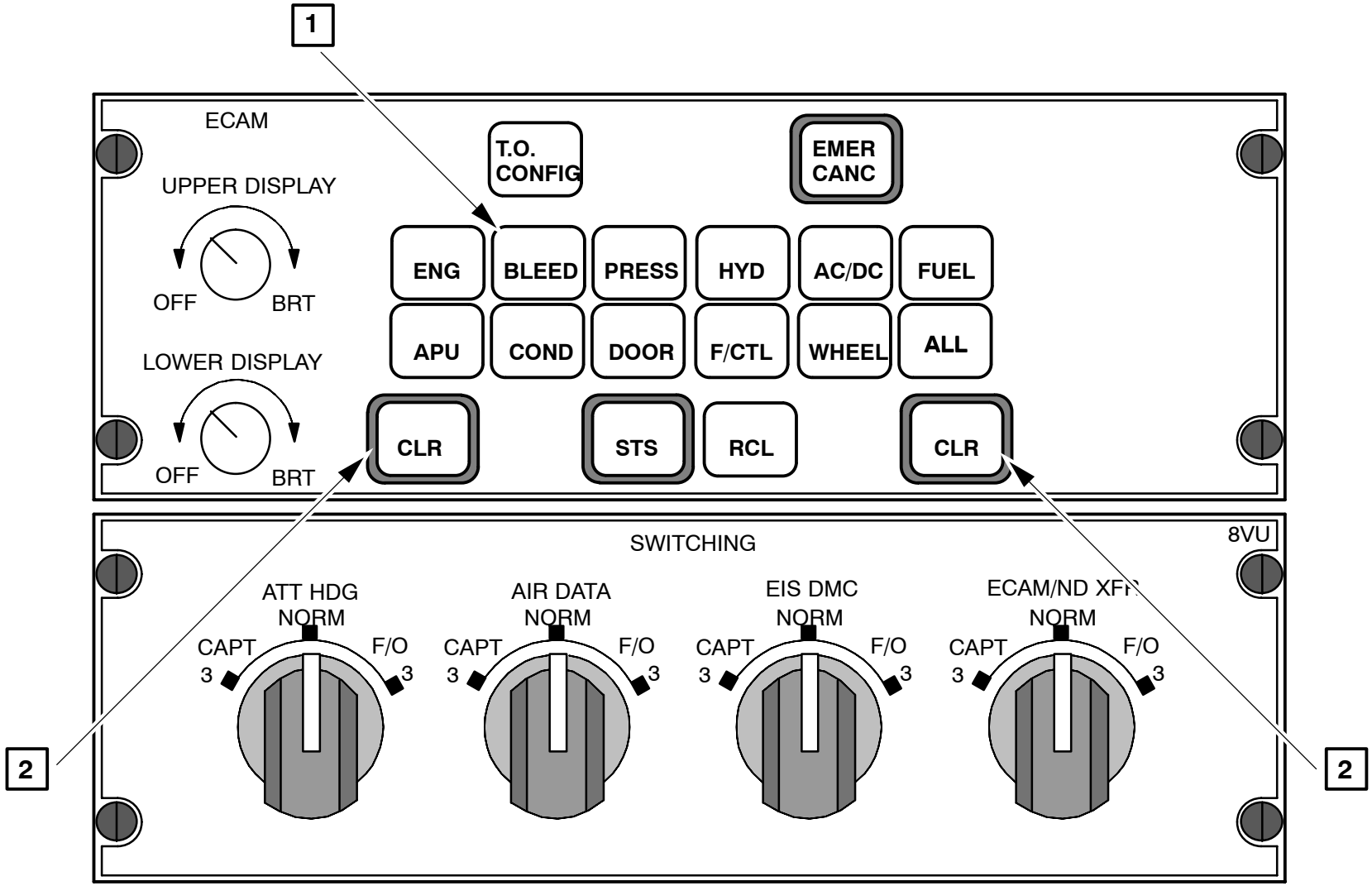


Figure 4 ECAM Control Panel

1 CROSS BLEED VALVE (X–BLEED VALVE)

displayed green: Valve FULLY CLOSED

displayed amber:

Valve CLOSED and DISAGREE (commanded OPEN and NOT OPEN)

displayed green: Valve FULLY OPEN

displayed amber:

Valve OPEN and DISAGREE (commanded CLOSE and NOT CLOSE)

displayed amber: Valve IN TRANSIT

NOTE: the flow bar appears only if the valve open.

2 APU BLEED VALVE

displayed green: Valve FULLY OPEN

displayed green: Valve FULLY CLOSED

displayed amber:

Valve position not available (Valve symbol not visible: APU OFF)

NOTE: The flow bar appears only if the valve open.

3 ENGINE PRECOOLER INLET PRESSURE

Displayed in green: NORMAL PRESSURE.
Displayed amber: Pressure ≤ 4PSI or ≥ 57PSI.
XX in amber: Pressure NOT VALID.

4 ENGINE PRECOOLER OUTLET TEMPERATURE

displayed in green: NORMAL TEMPERATURE
displayed amber:
≥ 290°C for 5sec or more
or
270°C for 15sec or more
or
≥257°C for 55sec or more
or
≤ 150°C
XX in amber: Temperature NOT VALID.

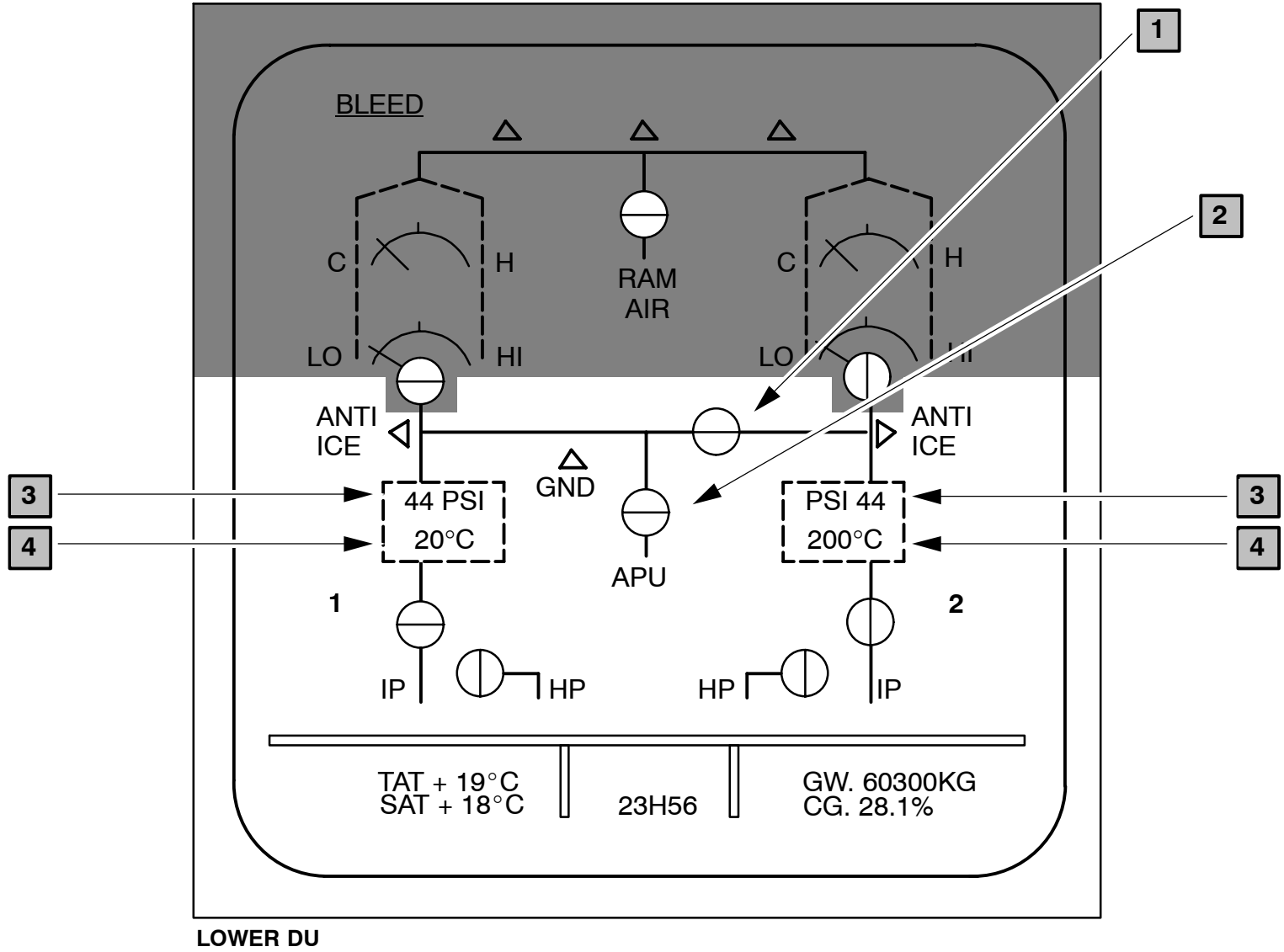


Figure 5 BLEED Page – Lower ECAM Display Unit

1 GROUND SUPPLY

△ displayed in green: Aircraft ON GROUND

Symbol NOT DISPLAYED: Aircraft IN AIR

2 ENGINE BLEED VALVE (or PRESSURE REGULATOR VALVE/PRV)

displayed in green: Valve FULLY OPEN

displayed amber: VALVE OPEN AND DISAGREE

displayed amber: Valve FULLY CLOSED and LOW REGULATION

displayed in green: Valve FULLY CLOSED

(XX) displayed amber: Engine bleed valve information NOT VALID

NOTE: The flow bar appears only if the valve open.

3 ENGINE HIGH PRESSURE VALVE (HP)

displayed in green: Valve FULLY CLOSED

displayed amber: Valve CLOSED and

FAULTY POSITION (e. g. ENG AT IDLE)

displayed in green: Valve FULLY CLOSED

(XX) displayed amber: High pressure valve information NOT VALID

NOTE: The flow bar appears only if the valve open.

4 ENGINE NUMBER 1 AND 2

1 or **2** displayed WHITE: ENGINE RUNNING

1 or **2** displayed AMBER: ENGINE RPM IS BELOW IDLE

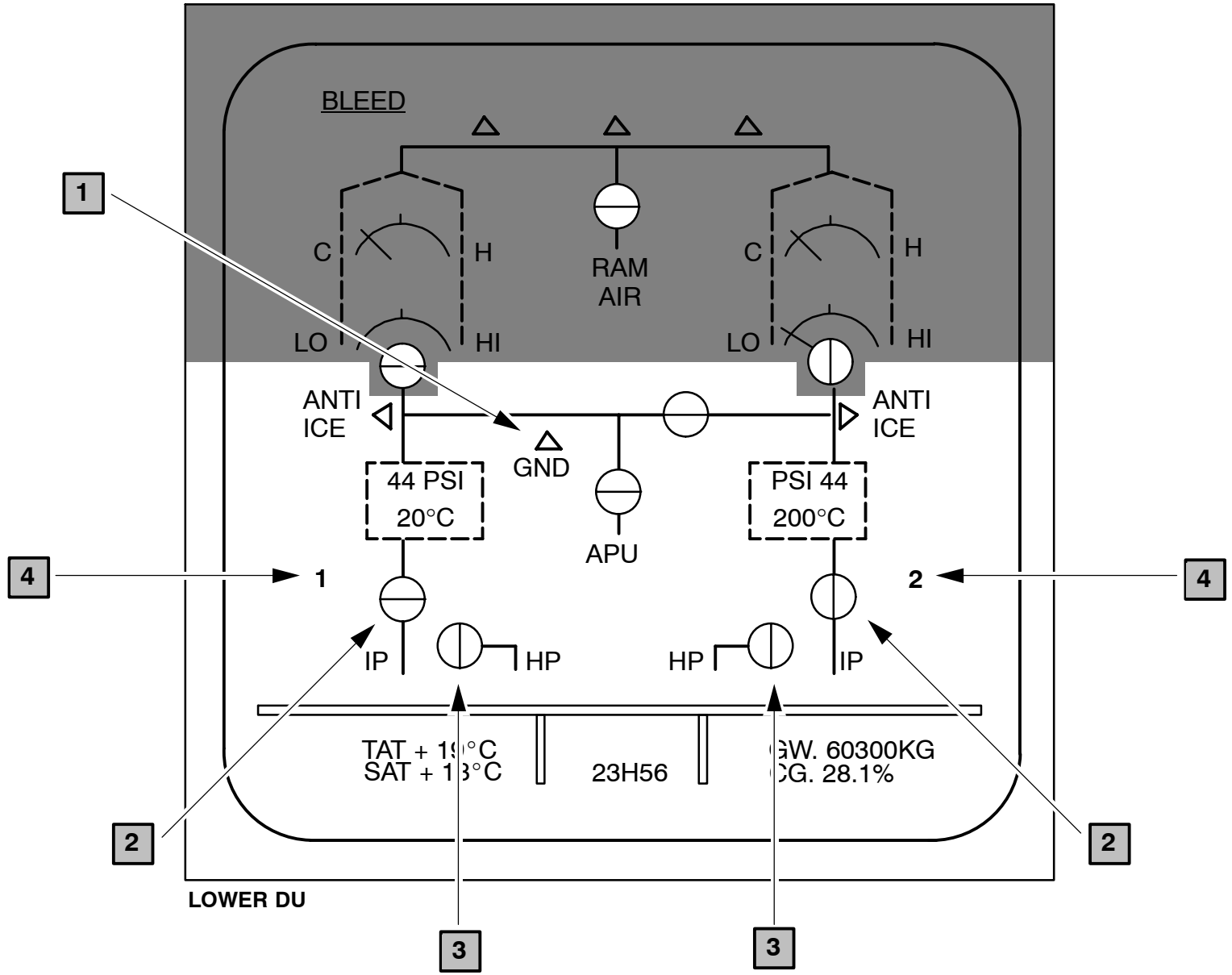
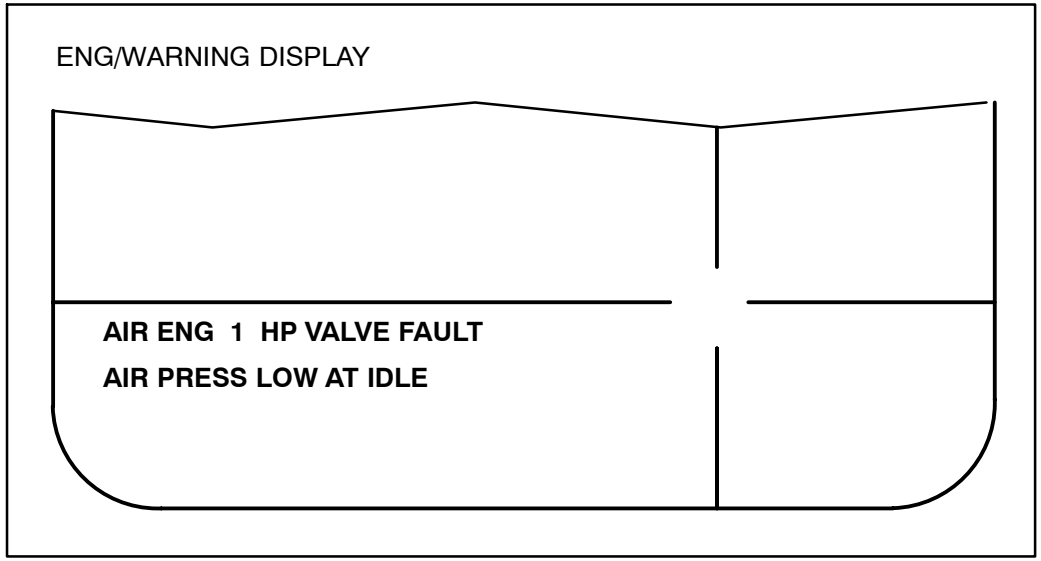


Figure 6 BLEED Page – Lower ECAM Display Unit

ECAM–WARNINGS/MESSAGES

Possible ECAM Warnings on Upper Display Unit
(Engine and Warning Display Unit)

- AIR ENG 1 (2) BLEED FAULT
- AIR ENG 1 (2) HP VALVE FAULT
- AIR ENG 1 (2) BLEED NOT CLOSED
- AIR ENG 1 (2) BLEED ABNORMAL PRESSURE
- AIR BLEED MONITORING FAULT
- AIR PRESSURE LOW AT IDLE
- AIR ENG 1 (2) BLEED LOW TEMPERATURE
- AIR APU BLEED FAULT
- AIR X–BLEED FAULT



UPPER DISPLAY UNIT

Figure 7 Engine and Warning Display Unit

BLEED AIR MONITORING COMPUTER OPERATION

SYSTEM LAYOUT

Two BMCs (**B**leed Air **M**onitoring **C**omputers 1 and 2) are installed in the FWD avionics compartment. Both computers are identical and communicate via an ARINC 429 bus.

They monitor and control the bleed air system permanently when power is supplied to the aircraft.

The BMC monitors the valve positions, the pressure and the temperature of the supplied bleed air.

Additionally they monitor different zones to protect the adjacent systems and components against damages if a duct leaks or bursts (ambient overheat). To get correct limits or to prevent abnormal conditions, the BMC control the valves to the necessary position.

In case one BMC fails, the other BMC takes over some of the functions.

The following list gives the functions which cannot be performed any more if one BMC fails.

BMC No.1

- Pylon leak detection ENG. No.1
- L/H and R/H wing leak detection loops ”A”
- APU leak detection
- Eng. No 1 bleed FAULT light.
- Eng. No.1 PRV automatically closing via CTS solenoid.
- Eng. No.1 bleed leak warning

BMC No.2

- Pylon leak detection ENG. No.2
- L/H and R/H wing leak detection loops ”B”
- Eng. No 2 bleed FAULT light.
- Eng. No.2 PRV automatically closing via CTS solenoid.
- Eng. No.2 bleed leak warning

The BMC‘s receive analog and discrete inputs from interfaced items and systems. The BMC process these inputs and transmit analog and discrete outputs to the interfaced items and systems.

INTERFACE

Discrete Inputs

- AIR COND Overhead Control Panel
- pressure transducers
- Temperature Sensor
- PRV (Pressure Regulating Valve), HPV (**H**igh **P**ressure **V**alve), OPV (**O**ver**P**ressure **V**alve), FAV (**F**an **A**ir **V**alve)
- APU Bleed Valve
- Crossbleed Valve
- overheat detection loops
- FIRE Overhead Control Panel
- ECB (**E**lectronic **C**ontrol **B**ox)
- WAI (**W**ing **A**nti–**I**cing System)

Discrete Outputs

- AIR COND Overhead Control panel
- ECB
- ECS (**E**nvironment **C**ontrol **S**ystem)

Analog Outputs

- BMC (**B**leed Air **M**onitoring **C**omputer) opposite
- CFDIU (**C**entralized **F**ault **D**isplay **I**nterface **U**nit)
- SDAC (**S**ystem **D**ata **A**cquisition **C**oncentrator)

To indicate the system operation, the BMC transmit analog outputs by the SDAC to the ECAM system. The analog outputs generate the system display.

Other Interfaces incl. Power Supply

The indicating system gets electrical power from the DC system of the aircraft. It supplies 28V DC by circuit breakers to:

- the BMC1 and BMC2
- the relays of the AIR COND Overhead Control Panel
- the FIRE Overhead Control Panel (Ref. 26–00–00)
- the Pressure Transducers
- the Temperature Thermostats.

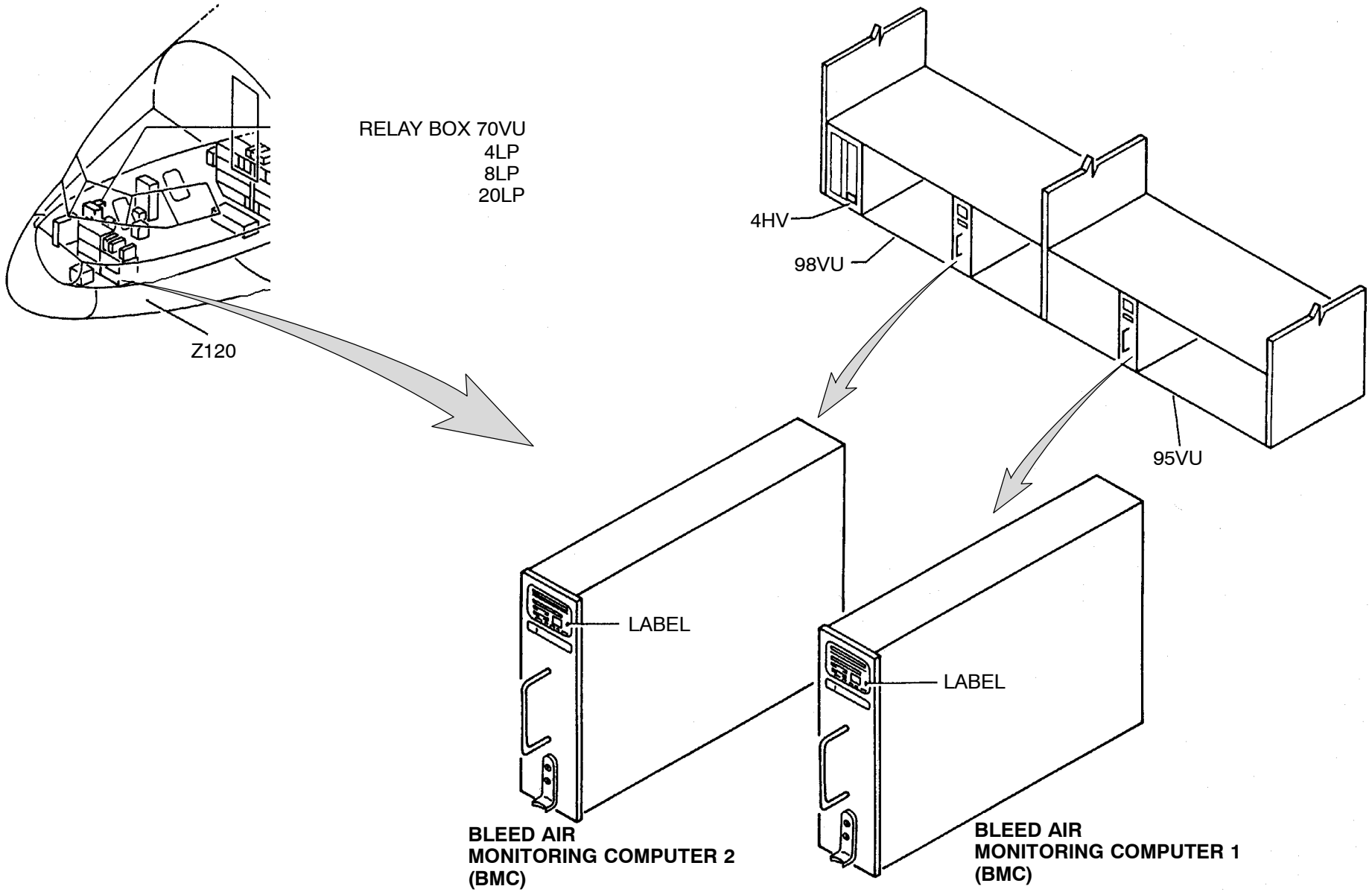


Figure 8 BMC Location

BMC CONTROL/MONITORING FUNCTION

Both BMC control by energizing the CTS solenoid the automatic closing of the PRV at:

- Engine start (Starter valve not closed)
- APU bleed supply.
- Engine bleed FAULT warning

They also control and monitor the automatic x-bleed valve operation with APU bleed supply.

The computers are equipped with BITE (**B**uilt–**I**n **T**est **E**quipment). They receive and transmit information from/to the CFDIU. This permits a self–test of the computers which is called up the MCDU menu.

BMC No.1 monitors:

- wing leak detection loops ”A” from the L/H and R/H wing.
- Pylon loop Eng 1
- APU duct from the APU fire wall to the APU bleed check valve

BMC No.2 monitors:

- wing leak detection loops ”B” from the L/H and R/H wing.
- Pylon loop Eng 2

BMC FAULT Condition

BMC Failure:

If one BMC is failed the adjacent BMC takes over monitoring of the Bleed system and ensures the following ECAM warnings:

- overpressure,
- overtemperature
- wing leak.

Nevertheless the associated FAULT light on the air cond. panel is lost, and the associated Bleed Valve does not close automatically.

ENG BLEED LEAK warning is lost for the associated engine as well as APU BLEED LEAK warning if BMC1 is failed.

Bleed FAULT indications:

The messages and the associated action appear on ECAM with amber FAULT and MASTER CAUTION light and single chime:

- when the pressure downstream of the PRV gets to 57 ± 3psig
- after a 55 sec delay when the temperature downstream of the precooler gets to $257 \pm 3°C$
- when overheat in pylon, wing and fuselage duct adjacent areas occurs
- when PRV position disagree during start position

with amber MASTER CAUTION light and single chime but without amber FAULT light:

- when bleed system supply low pressure to downstream systems (wing anti–icing and air conditioning packs)
- when X–BLEED valve fails

without amber FAULT and MASTER CAUT light and single chime:

- when HP valve is abnormally closed (lack of bleed pressure during idle)
- when dual loop of leak detection in the wing fails
- when dual BMC fails (no signal from BMC)
- when APU BLEED valve disagree

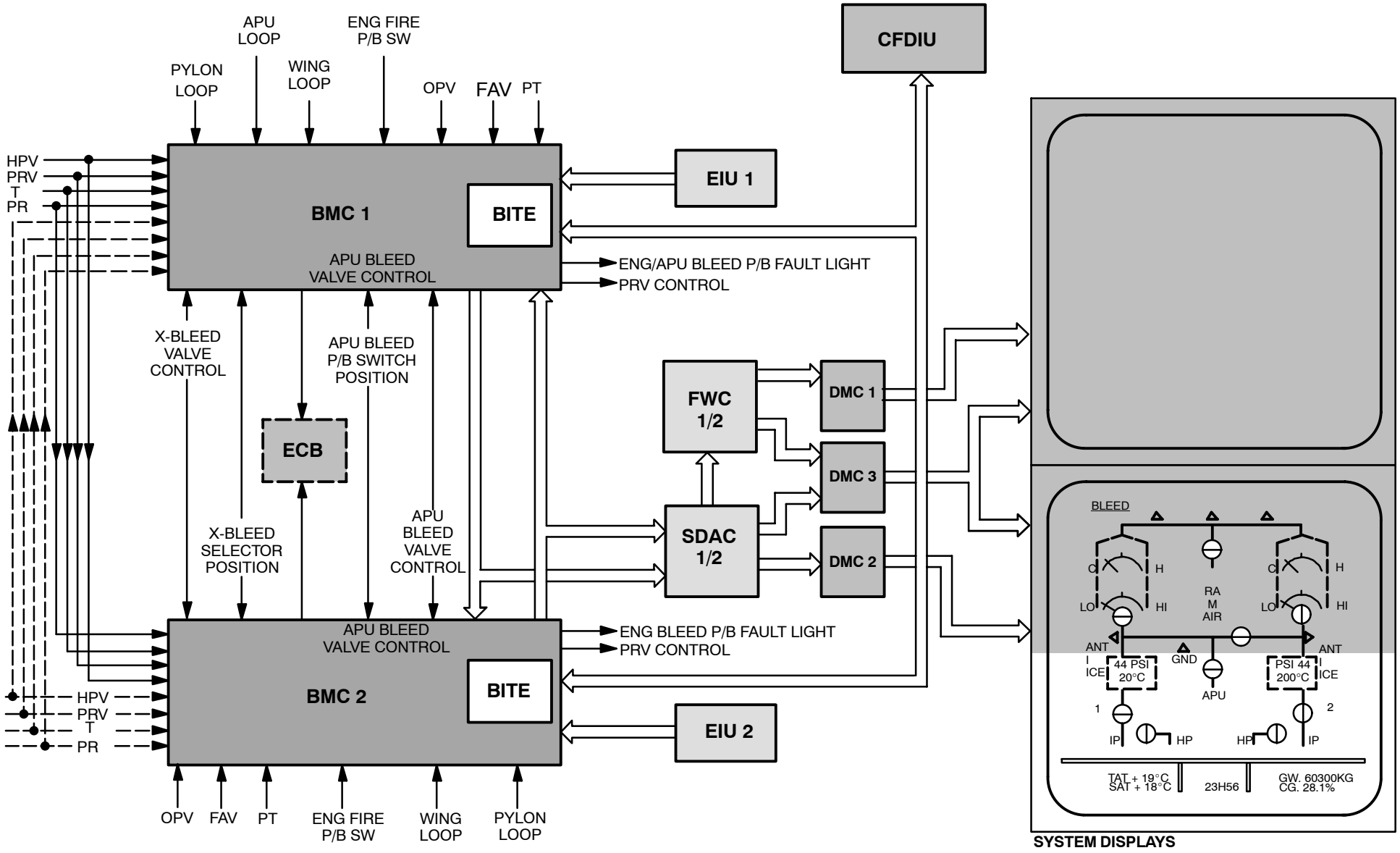


Figure 9 BMC Architecture

PNEUMATIC SYSTEM DESCRIPTION

High Pressure Valve (HPV)

- is electrically controlled pneumatic operated,
- is a Shut-off and pressure regulating valve,
- is normal spring loaded closed,
- has 2 micro switches (open/closed position),
- regulates 9th stage air to 36psi,
- has a manual override to close the valve mechanically.

Intermediate Pressure Check Valve (IPC)

- prevents 9th stage air return flow to the 5th stage.

Pressure Regulating Valve (PRV)

- is electrically controlled,
- is pneumatic operated,
- has 2 micro switches (open/closed position),
- regulates bleed air to approx. 44psi,
- is normal spring loaded closed,
- closes under the following conditions:
  - Bleed OVHT >257°C
  - Bleed OVERPRESS. >57 psi
  - Leak (Wing/Pylon)
  - Starter valve not closed
  - ENG Fire pb. sw. activated
  - ENG bleed pb. sw. ”OFF”
  - Bleed reverse flow
  - X-bleed valve selected ”AUTO” or ”OPEN” & APU bleed ”OPEN”
- has a manual override to close the valve mechanically.

Control Thermostat Solenoid(CTS)

The thermostat has a solenoid valve.

When the solenoid is energized the open pressure of the PRV and HPV is bleeded and the valves close

The solenoid is energized when:

- Bleed pb. sw is in ”OFF”-position.
- ENG Fire pb. sw activated
- APU bleed ”ON”-position
- Starter valve not closed
- Leak (Wing/Pylon)
- Bleed temperature >257°C
- Bleed OVERPRESS >57 psi.

It has a pneumatic function to bleed the open pressure of the PRV and HPV in the case of:

- reverse flow
- limiting of bleed air temperature to approx. 235°C

Overpressure Valve (OPV)

- protects the pneumatic system form overpressure
- normal spring loaded ”OPEN”
- one micro switch for the open position
- closing >75psi (at 85psi fully closed)
- opens again with spring force when pressure drops to approx.35psi

Precooler

The precooler is a air to air heat exchanger and cools the bleed air from the 5th or 9th stage with fan air.

REFER TO DIN A3 PAGE

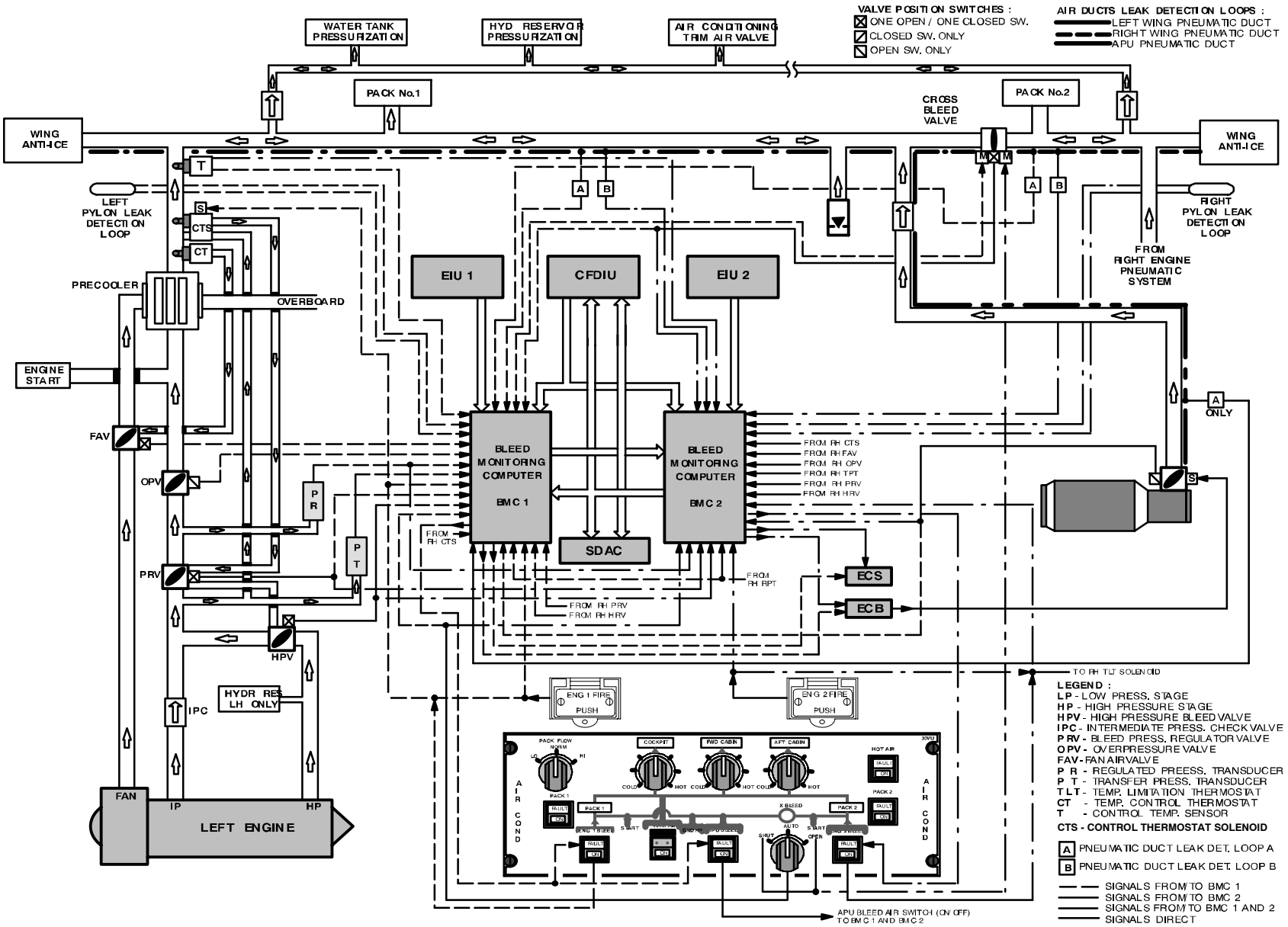


Figure 10 Pneumatic System Schematic

Fan Air Valve (FAV)

- regulates the downstream precooler exchanger bleed temperature to 200°C,
- is pneumatically controlled via the CT (**C**ontrol **Thermostat**),
- it has 2 micro switches (open/closed position),
- has a manual override to close the valve mechanically,
- and is normal spring loaded closed.

Control Thermostat (CT)

- regulates pneumatically the downstream precooler exchanger bleed temperature through the fan air valve to 200°C,
- is installed downstream of the precooler exchanger.

Transfer Pressure Transducer (PT)

The TPT measures the pressure behind the HPV to monitor its function and sends the pressure signal to the BMC

Regulated Pressure Transducer (PR)

- measures the pressure behind the PRV to monitor its function,
- sends the pressure signal to both BMC‘s,
- sends the pressure signal to ECAM for indication.

Temperature Sensor (T)

- measures the temperature downstream the precooler,
- sends the temperature signal to ECAM for temp. indication,
- sends the temperature signal to both BMC‘s.

Cross Bleed Valve

The Valve has 2 electro motors (one for ”MANUAL” and one for the ”AUTO” Mode) and allows a separation the L/H from the R/H pneumatic system.

It can be operated via BMC when the SW is in AUTO:

- ”OPEN” when APU Bleed Supply
- ”SHUT” when ENG supply and APU Bleed OFF

  or
- manual via X–Bleed Switch on the Overhead Panel in ”OPEN” or ”SHUT”

APU Load Bleed Control Valve (APS 3200)

- is electrically controlled, fuel pressure operated,
- is a Shut-off valve,
- is normal spring loaded closed,
- has a micro switch for closed position.

NOTE: On Honeywell APU‘s seperate Load Control Valves and Surge Control Valves are used. These valves are either pneumatically or fuel pressure operated.

APU Check Valve

This Valve prevents bleed air reverse flow.

Pneumatic Duct Leak Detection Loops

The system consists of two independent loops for the L/H Wing and two loops for the R/H Wing:

- The BMC No 1 monitors the Wing Leak Detection Loops ” A ” from the L/H and R/H wing.
- The BMC No 2 monitors the Wing Leak Detection Loops ” B ” from the L/H and R/H wing.

APU Duct Leak Detection Loop

The APU leak detection is a single loop system and monitors the APU Duct for leaks between APU compartment and Check Valve.

This monitoring is done by BMC 1.

REFER TO DIN A3 PAGE

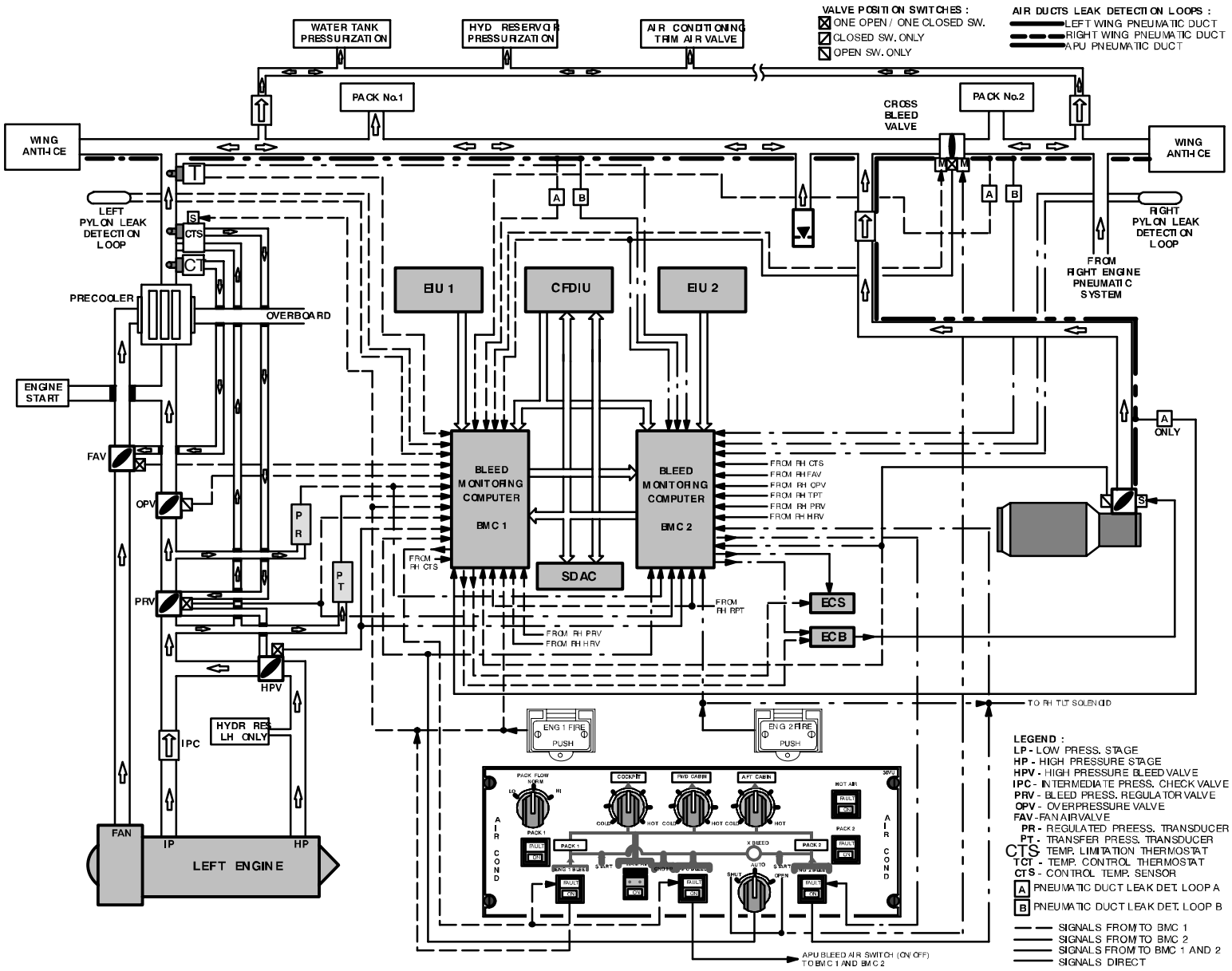


Figure 11 Pneumatic System Schematic

36–11 ENGINE BLEED AIR SYSTEM

COMPONENT LOCATION

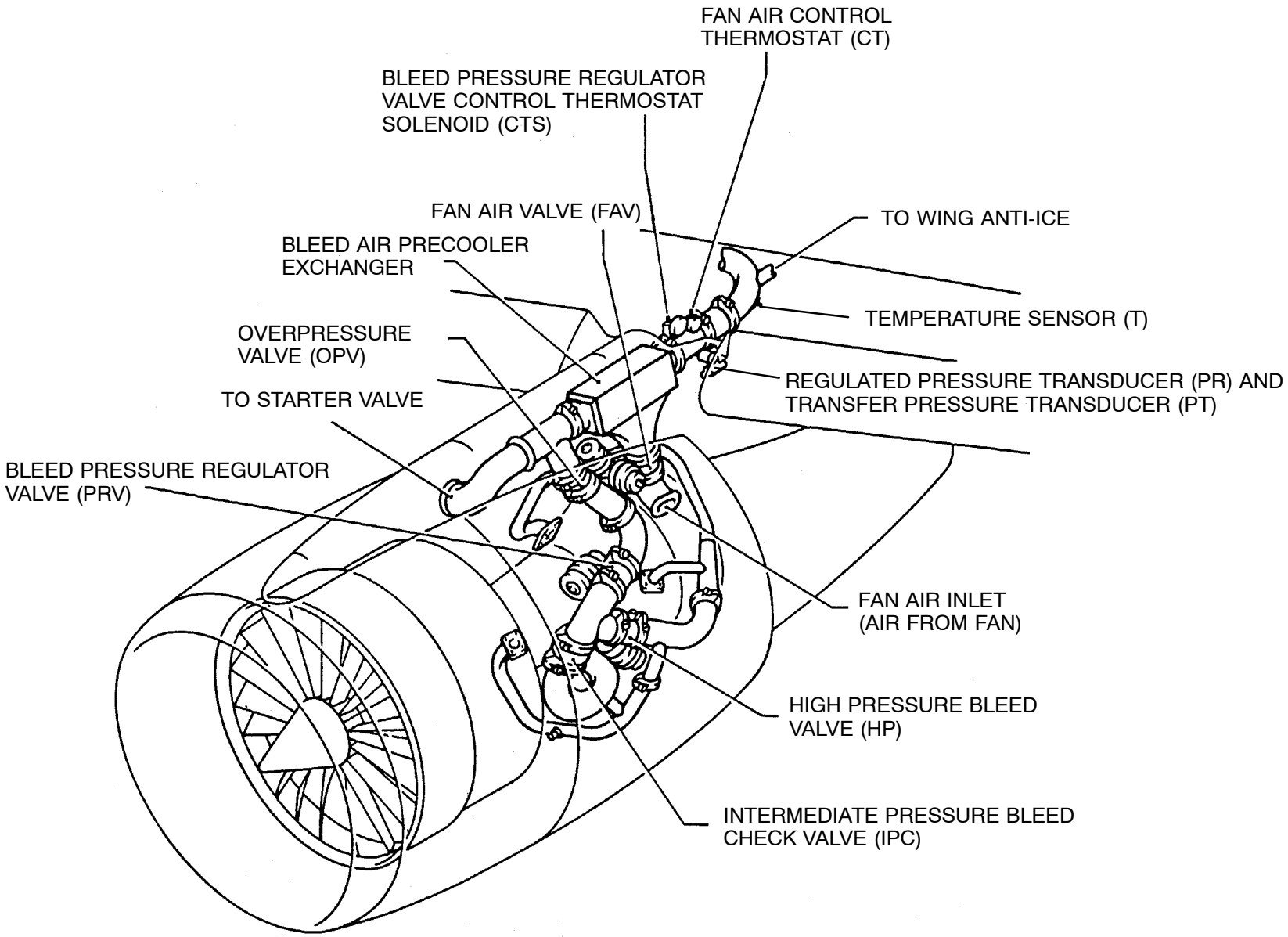


Figure 12 Engine Bleed Air System Components

HPV SYSTEM DESCRIPTION

HIGH PRESSURE BLEED VALVE (HPV)

Purpose

The HP bleed valve pneumatically limits the downstream static pressure to 36 ± 1.5psig.

Description

The HP Bleed Valve is a 4in. dia. butterfly–type valve which operates as a shut–off and pressure regulating valve.

The HP bleed valve is normally spring–loaded closed in the absence of upstream pressure.

A minimum pressure of 8psig is necessary to open the valve.

It closes fully pneumatically when the upstream static pressure reaches 100 ± 5psig.

A pneumatic sense line connects the HP bleed valve with the bleed pressure regulator valve (PRV) in order to make sure that the HP bleed valve will close when bleed pressure regulator valve is controlled closed.

The two microswitches in the valve signal the fully open and closed positions of the butterfly plate.

The HP bleed valve contains three main parts:

- a valve body
- a pneumatic actuator
- a regulator assembly

Valve Testing

The HP bleed valve is equipped with a downstream pressure test port which serves to perform an ”in situ” test.

Controls and Indicating

HP bleed valve operation is fully pneumatic. The lower ECAM display unit indicates its position (open or closed) on the BLEED page

The two BMCs monitor the operation of the HP bleed valve (close/open microswitch signals, and transfer pressure level).

They receive and process the signals and transmit the information per data bus by the System Data Acquisition Concentrator (SDAC) to the ECAM system which generates the system display.

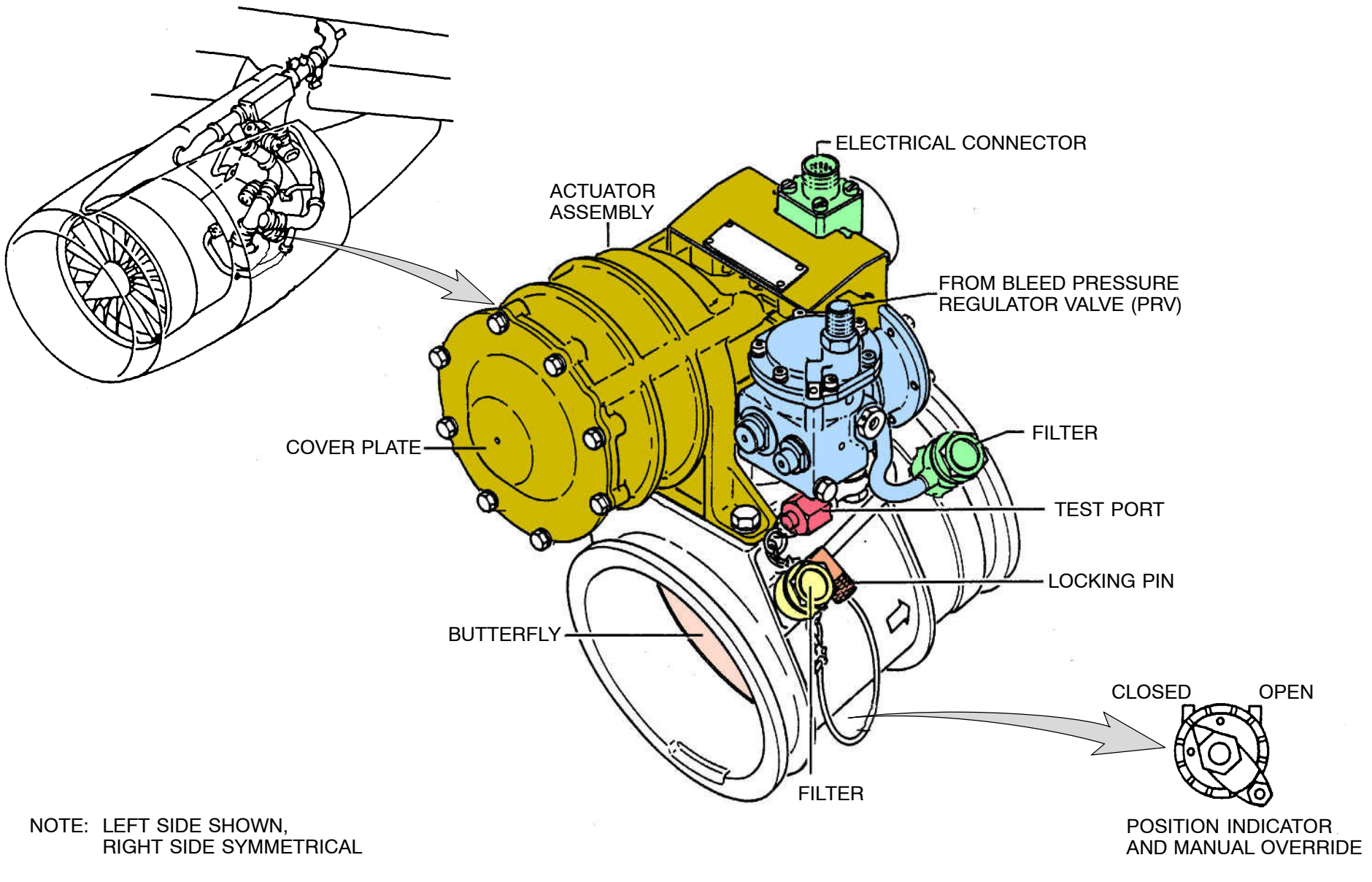


Figure 13 High Pressure Bleed Valve (HPV)

HIGH PRESSURE BLEED VALVE OPERATION

Pneumatic actuating pressure is supplied via the filter (1) and the check valve (2) into the chamber A.

The check valve (2) is operated by the diaphragm (3). This operation regulates a constant pressure in the chamber B of the pneumatic actuator.

The HPV opens.

Via filter (4) and check valve (5) regulated pressure enters the chamber C.

ATTENTION: The valve regulation is based upon a constant pressure in chamber B and a increasing/decreasing pressure in chamber C.

- The HPV is more closing if the pressure increases behind the valve.
- The HPV is more opening if the pressure decreases behind the valve.

The valve closing is achieved by the CTS(**C**ontrol **T**emperature **S**olenoid) The CTS is bleeding the open pressure of the HPV/PRV sensing line.

The result is a decreasing pressure in the chamber D. The check valve (6) and the diaphragm (7) are moving upwards. This movement allows to vent the pressure from chamber B.

A overpressure check valve (8) opens when the 9th stage pressure is >100psi.

This closes the HPV by venting the open pressure of the chamber D.

A Fuse in the valve body will melt and close the valve if there is a high temperature (>450°C) .

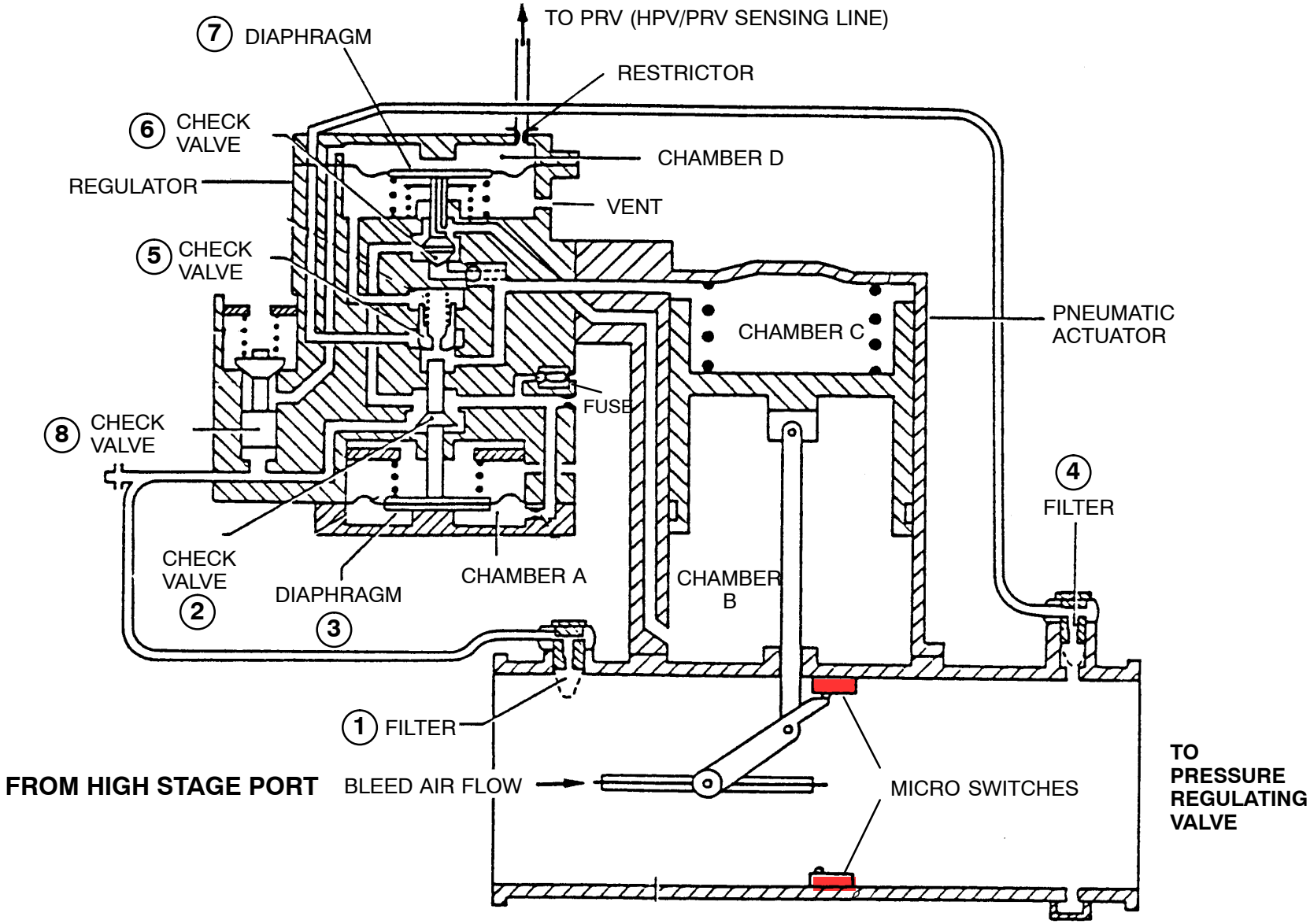


Figure 14 High Pressure Bleed Valve Schematic

IP CHECK VALVE DESCRIPTION

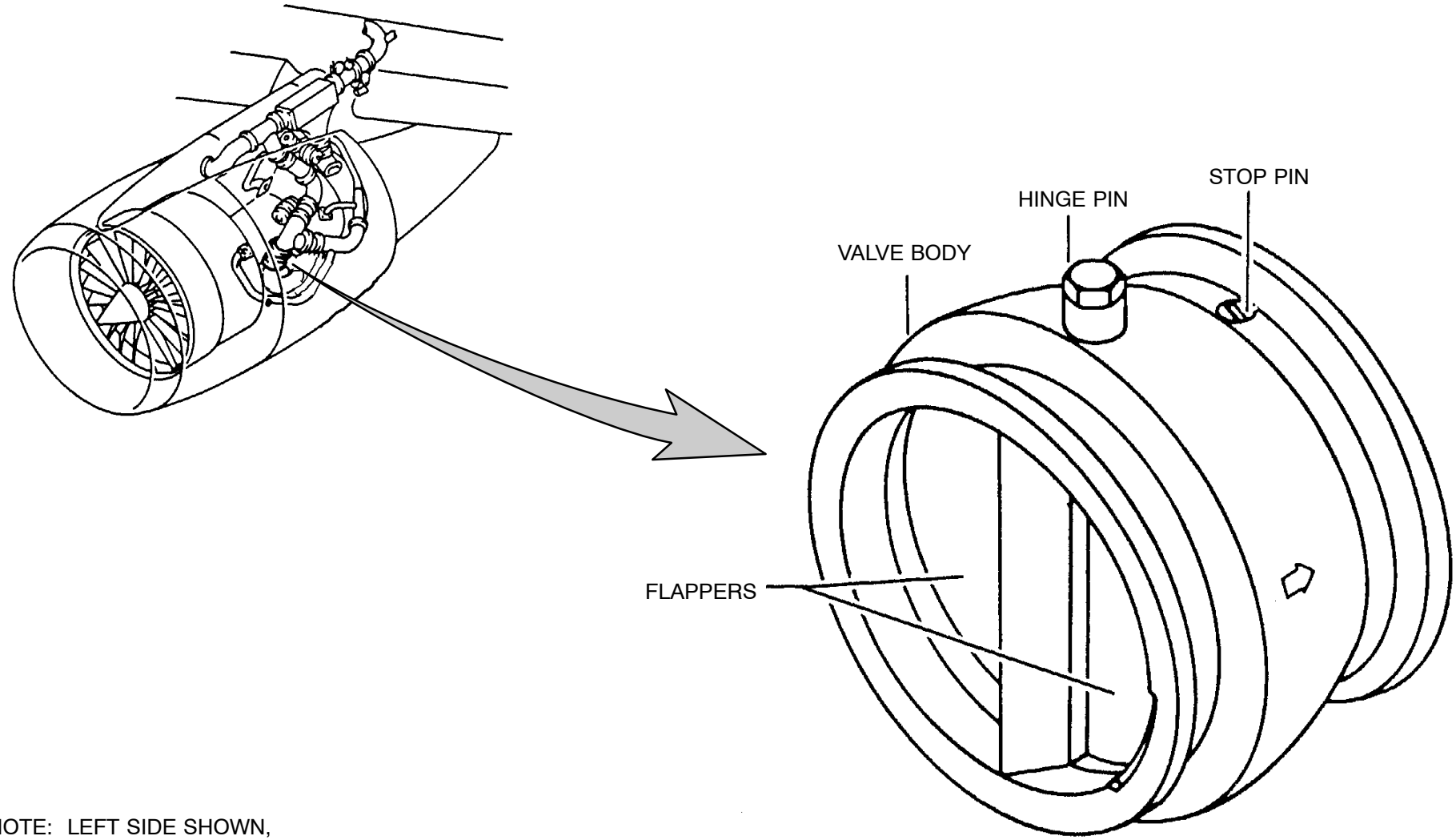
INTERMEDIATE PRESSURE CHECK VALVE (IPV)

Purpose

It prevents a reverse flow into the 5th stage.

Location

The check valve is installed in the duct of the 5th stage.



NOTE: LEFT SIDE SHOWN,
RIGHT SIDE SYMMETRICAL

Figure 15 Intermediate Pressure Bleed Check Valve (IPV)

PRV SYSTEM DESCRIPTION

Purpose

The PRV (**P**ressure **R**egulating **V**alve) pneumatically regulates the downstream pressure to 44 ± 1.75 psig.

Description

The PRV is a 4in. dia. butterfly–type valve, normally spring–loaded closed in absence of upstream pressure.

The two microswitches in the valve signal the extreme positions (open/closed) of the butterfly plate.

A minimum upstream pressure of 8psig is necessary to open the valve.

Control and Indicating

PRV operation is fully pneumatic. The PRV can be controlled in close position from the AIR COND overhead control panel. The pushbutton switches (ENG 1 (2) BLEED) energize/de–energize the CTS solenoid.

The PRV closes pneumatically in case of impending reverse flow to the engine. The Overpressure Valve (OPV) installed downstream of the PRV protects the system against damage if overpressure occurs.

A sense line (1/4 in. dia.) connects the PRV to the HP Bleed Valve in order to close the HP Bleed Valve if the PRV is closed or controlled to close.

The thermal fuse installed in the valve body causes the valve to close at 450° ± 25C.

The lower ECAM display unit indicates its position on the BLEED page.

The two BMCs monitor the operation of the PRV (closed/open,microswitch signals and regulated pressure level). They receive and process the signals and transmit the information per data bus by the SDAC to the ECAM system which generates the system display.

Additionally, they transmit the information to the CFDIU. The CFDIU generates maintenance information which is displayed on the MCDU if the MCDU MENU is selected.

Valve Testing

The PRV bleed valve is equipped with a downstream pressure test port which serves to perform an ”in situ” test.

Manual override

A manual override serves to close the valve mechanically on the ground, it is secured by the locking pin. When the locking pin is removed also the open pressure is vented.

Procedure:

- use a hexagonal wrench to set the manual override control to the CLOSED position.
- use the locking pin to lock this override control (the valve is vented when the locking pin is removed from its storage port.)
- put a warning notice in the cockpit to tell the crew that the PRV is closed and deactivated.

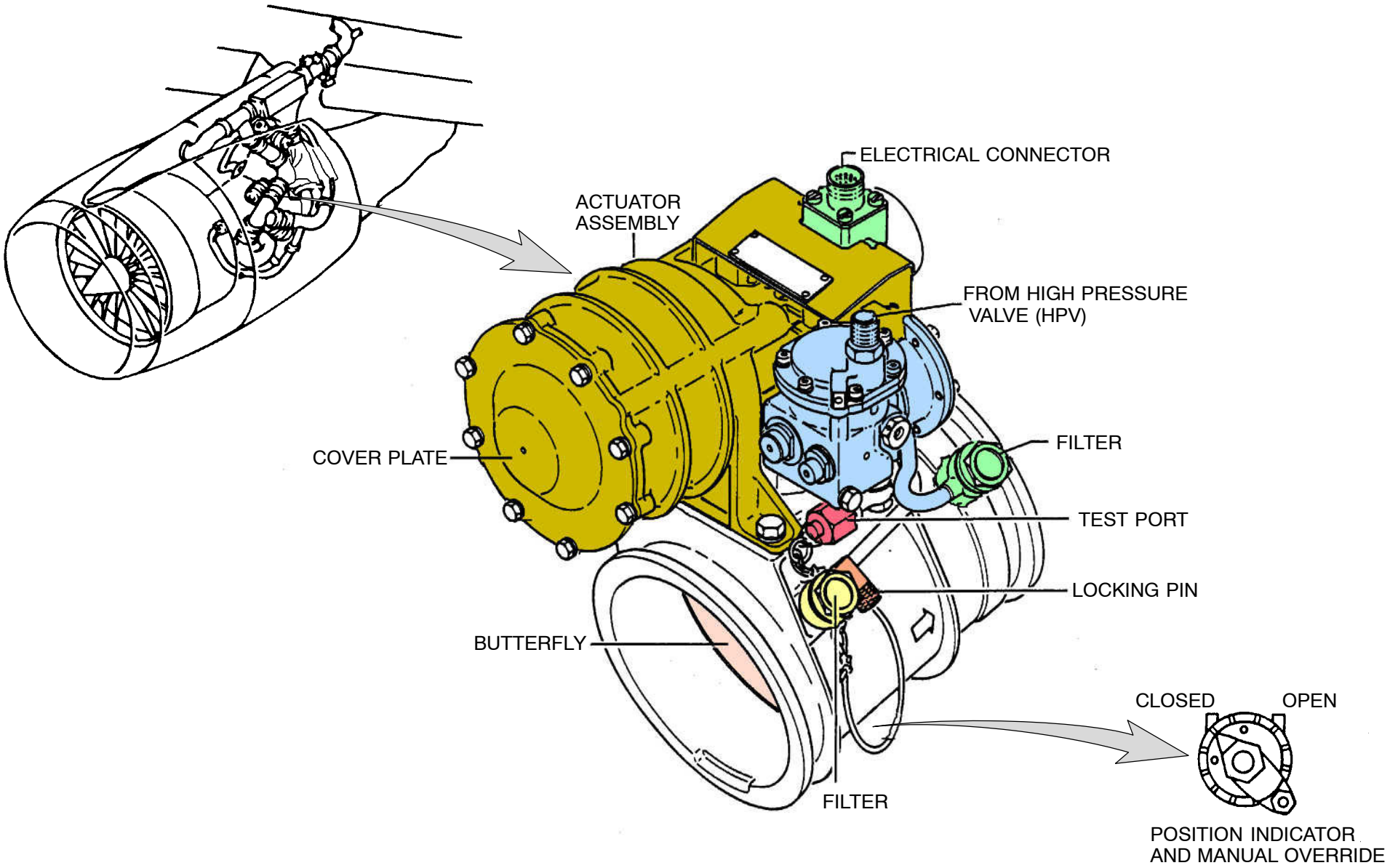


Figure 16 Bleed Pressure Regulator Valve (PRV)

PRESSURE REGULATING VALVE OPERATION

PRV Cross Section

Pneumatic actuating pressure is supplied via the filter (1) and the check valve (2) into the chamber A and chamber E.

The check valve (2) is operated by the diaphragm (3). This operation regulates a constant pressure in the chamber B of the pneumatic actuator.

The PRV opens. Via the filter (4) and the check valve (5) regulated pressure enters the chamber C.

ATTENTION: The valve regulation is based upon a constant pressure in chamber B and a increasing or decreasing pressure in chamber C.

- The PRV is more closing if the regulated pressure increases behind the valve.
- The PRV is more opening if the regulated pressure decreases behind the valve.

The valve closing is achieved by the energized solenoid on the Control thermostat (CTS). The CTS is bleeding the open pressure of the CTS sensing line.

The result is a decreasing pressure in the chamber D and chamber E.

The check valve (6) and the diaphragm (7) are moving upwards. This movement allows to vent the open pressure from chamber B.

The check valve (2) supports the closing action because the diaphragm (8) keeps the check valve in the closed position.

A thermal fuse (9) closes the PRV by venting the open pressure when the valve temperature reaches > 450°C.

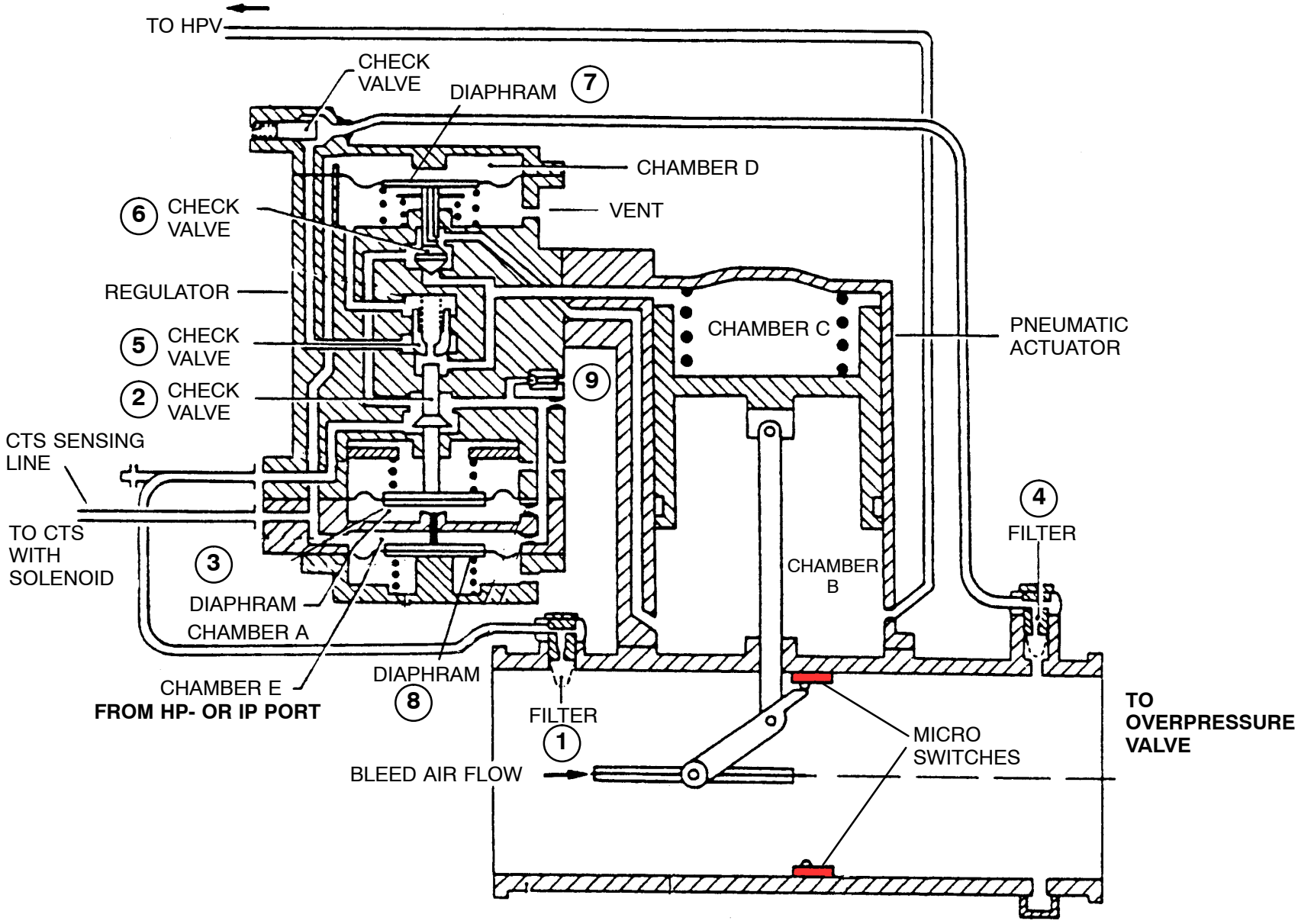


Figure 17 Pressure Regulator Valve Schematic

Functional Operation

It is controlled in closed position by crew action on:

- ENG FIRE pushbutton switch,
- ENG BLEED pushbutton switch.

It closes automatically in the following cases:

- overtemperature downstream of the precooler exchanger (257 ± 3°C) (55sec. delay),
- overpressure downstream of the PRV (57 ± 3psig),
- ambient overheat in pylon/wing/fuselage ducts surrounding areas,
- APU bleed valve not closed,
- corresponding starter valve not closed.

Legend:

- CTS:
  CONTROL THERMOSTAT SOLENOID
- PR:
  REGULATED PRESSURE TRANSDUCER
- T:
  TEMPERATURE SENSOR

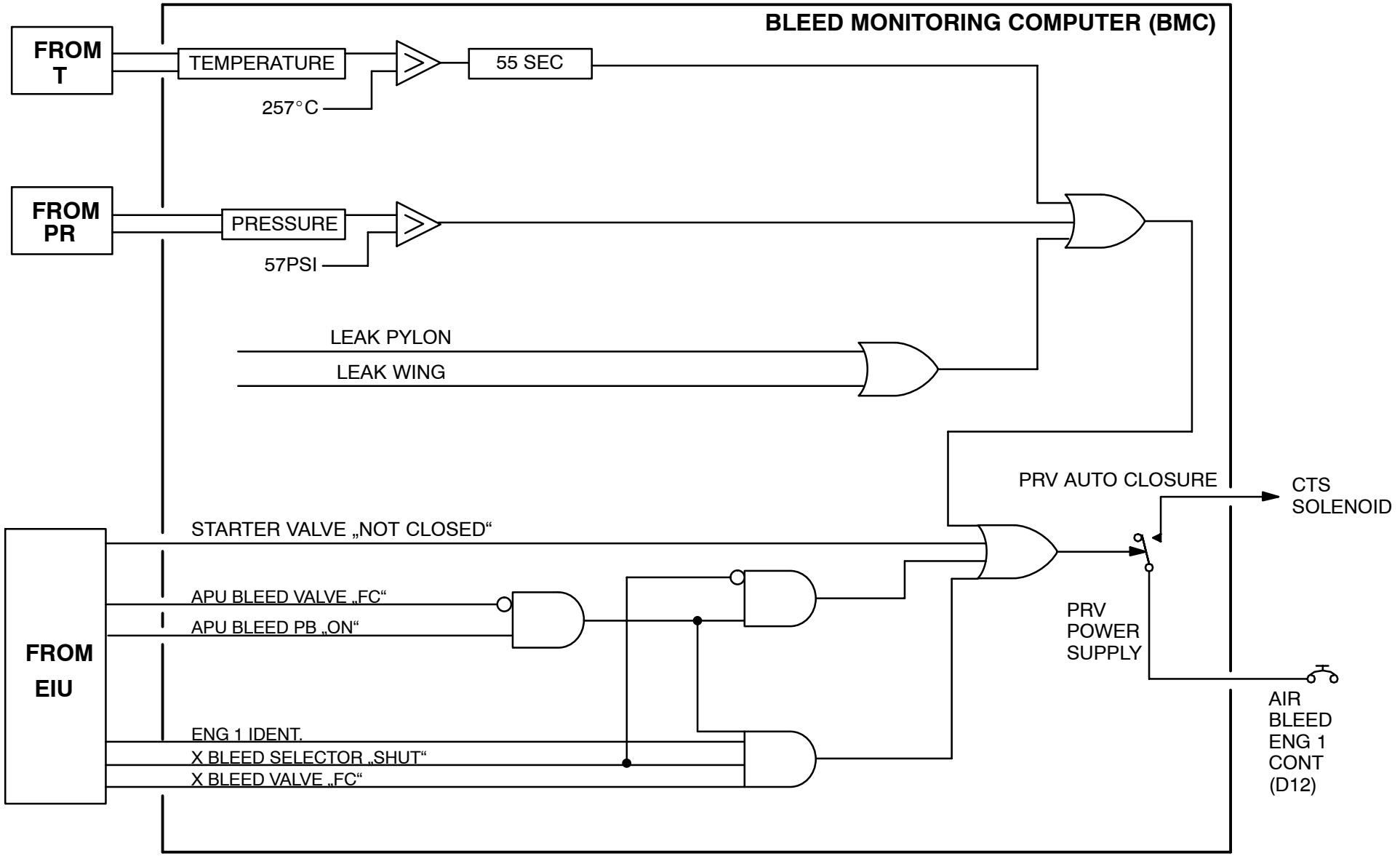


Figure 18 PRV Control (1/2)

Engine Bleed Fault Warning

Legend:

- T:
  TEMPERATURE SENSOR
- PR:
  REGULATED PRESSURE TRANSDUCER
- CTS:
  CONTROL THERMOSTAT SOLENOID

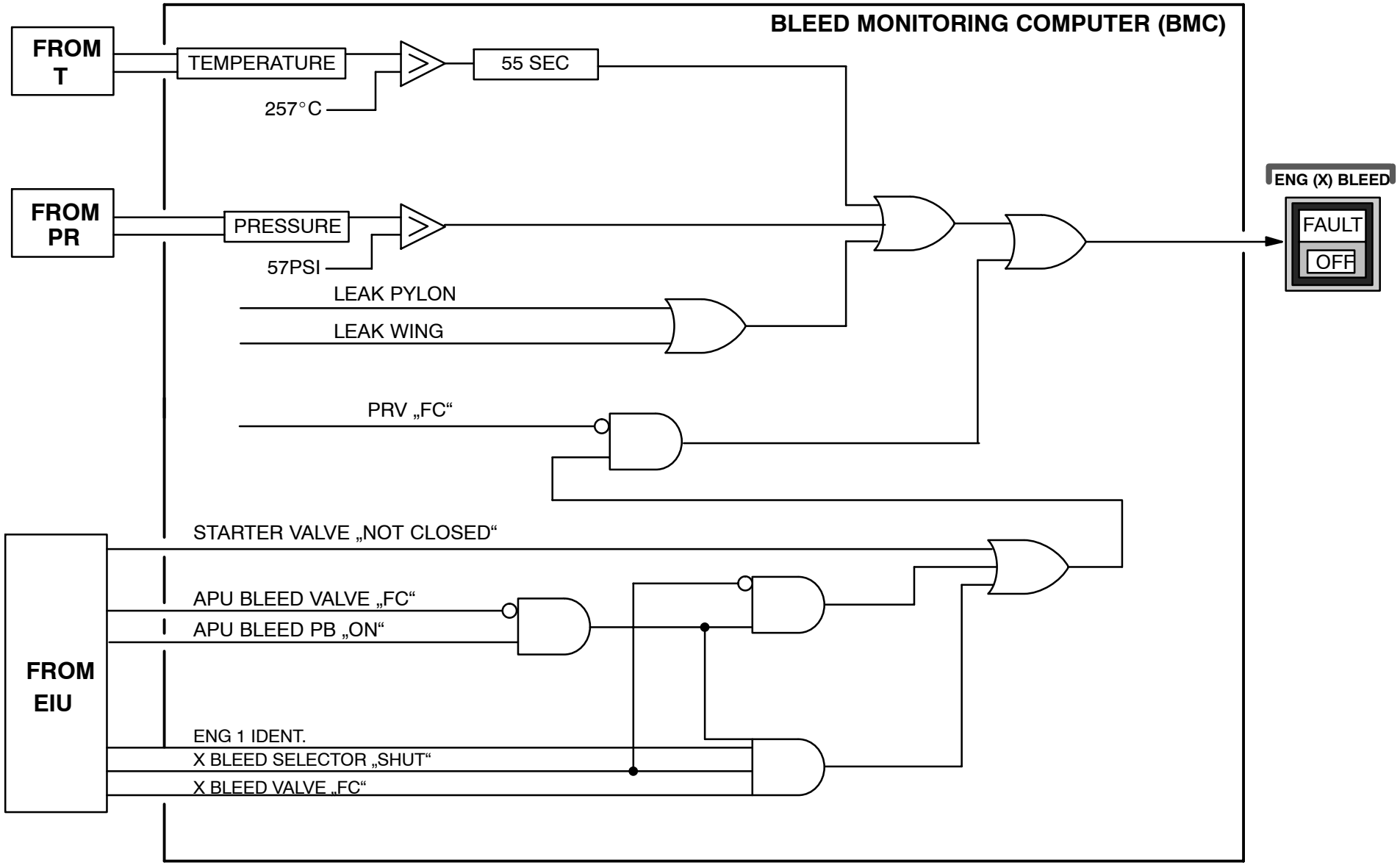


Figure 19 PRV Control (2/2)

CONTROL THERMOSTAT SOLENOID

Purpose

When the temperature downstream of bleed air precooler exchanger increases and reaches 235°C, the INVAR rod in the sensing tube starts to open the rod valve by differential dilatation. This cause a modification of the butterfly position of the bleed pressure regulator valve which tends to close to reduce the downstream pressure.

If the temperature increases up to 245°C, the rod valve will be full open and the bleed pressure limited to 17.5psig.

Closure of Bleed Pressure Regulator Valve

When the solenoid is energized, its valve moves away from its seal and vents the bleed pressure regulator valve which closes.

When the solenoid is not energized, the solenoid valve is spring–loaded closed.

NOTE: The Bleed Pressure Regulator Valve Control Solenoid has no direct effect on the HP Bleed Valve (HPV) operation. The HP Bleed Valve would also close because the Bleed Valve (PRV) closure would vent to ambient the signal pressure in the sense line between the Bleed Valve and the HP Bleed Valve.

Non–Return Function

The regulator diaphragm detects a differential pressure between downstream precooler exchanger and upstream pressure regulator valve.

When the difference between upstream and downstream pressure (Delta P) is lower than or equal to 10mb, the diaphragm moves and opens the solenoid valve, causing the closure of the bleed pressure regulator valve.

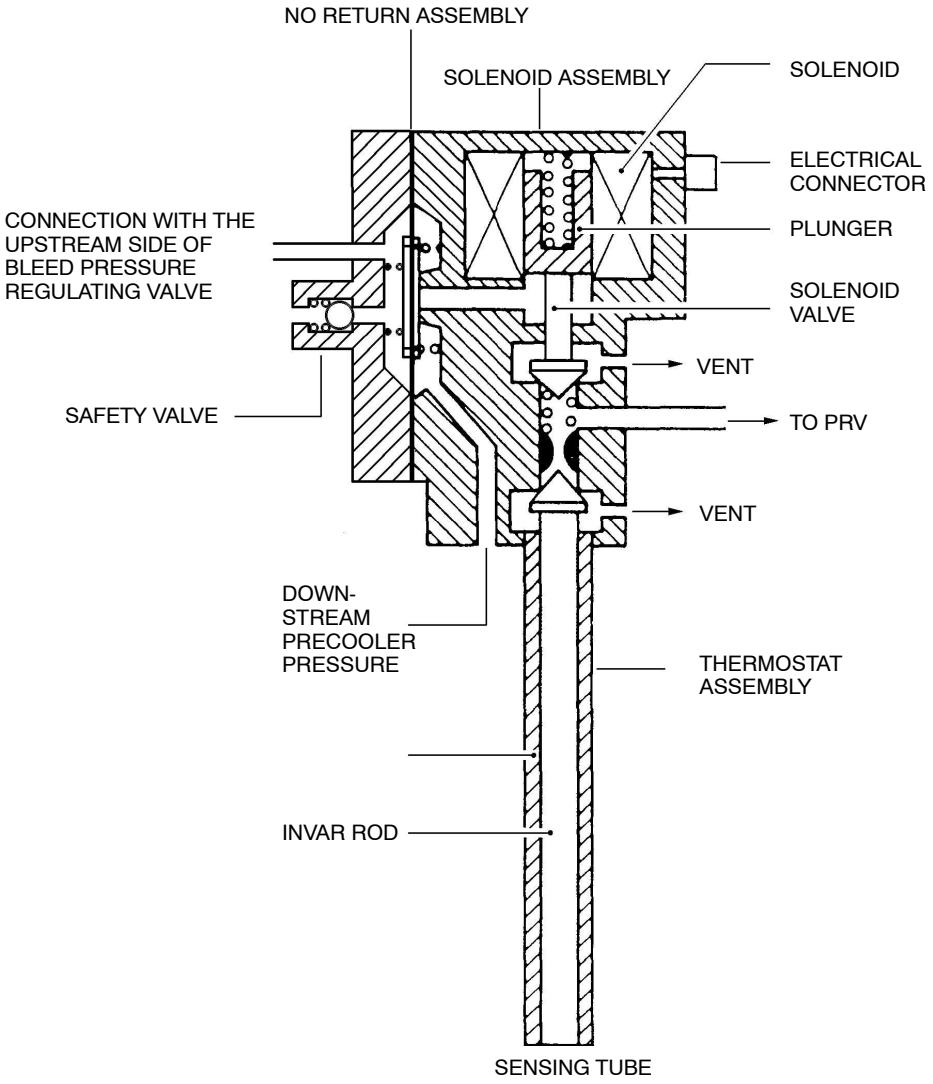
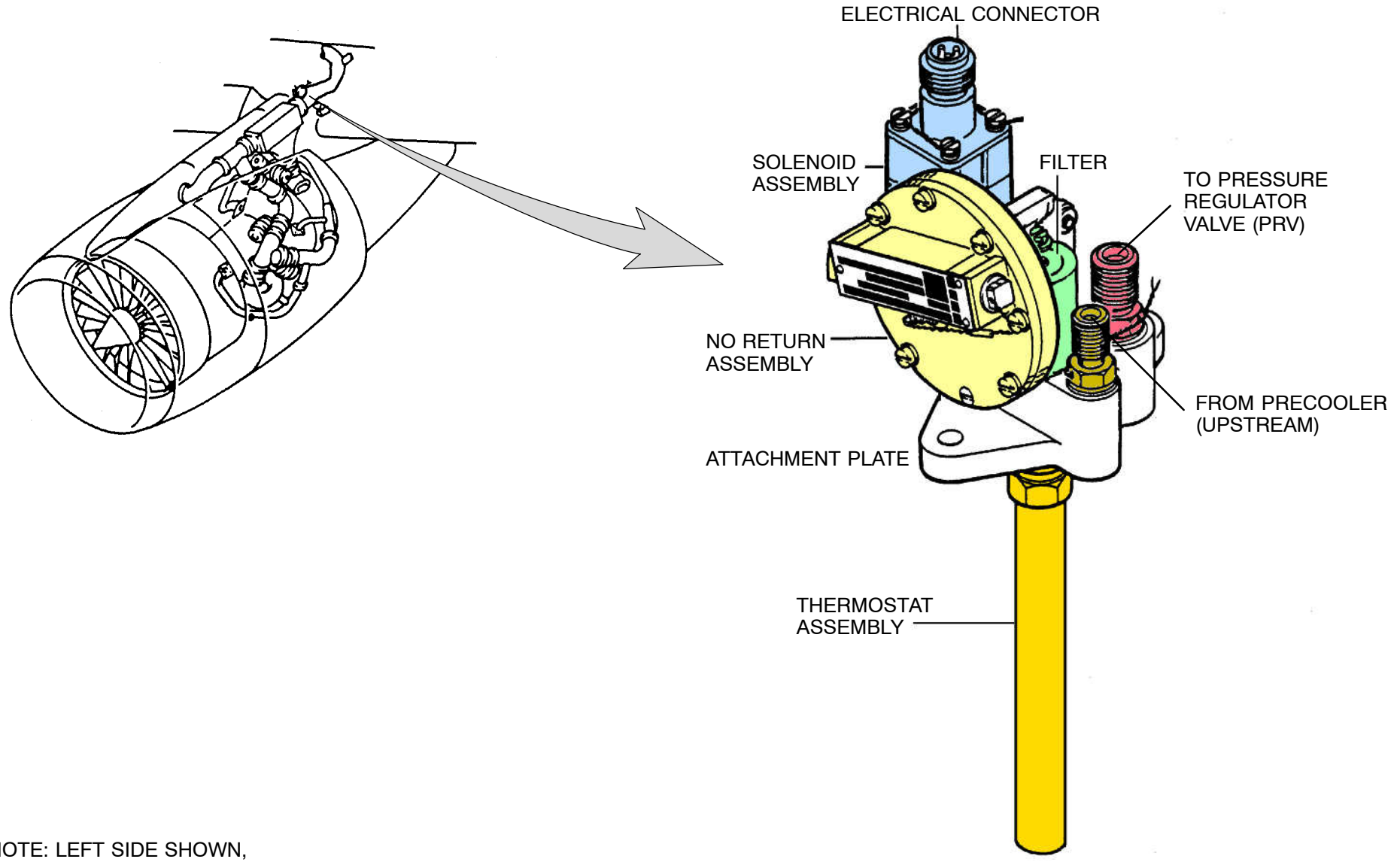


Figure 20 Control Thermostat Solenoid (CTS)



NOTE: LEFT SIDE SHOWN,
RIGHT SIDE SYMMETRICAL.

Figure 21 Control Thermostat Solenoid

OVERPRESSURE VALVE DESCRIPTION

Purpose

It protects the bleed system from overpressure.

Description

The OPV is a 4 in. dia. butterfly–type valve,

whose operation is fully pneumatic. In normal conditions the valve is spring–loaded open.

A microswitch in the OPV signals the extreme open position.

The OPV contains two main parts:

- a valve body
- an actuator assembly.

Regulation

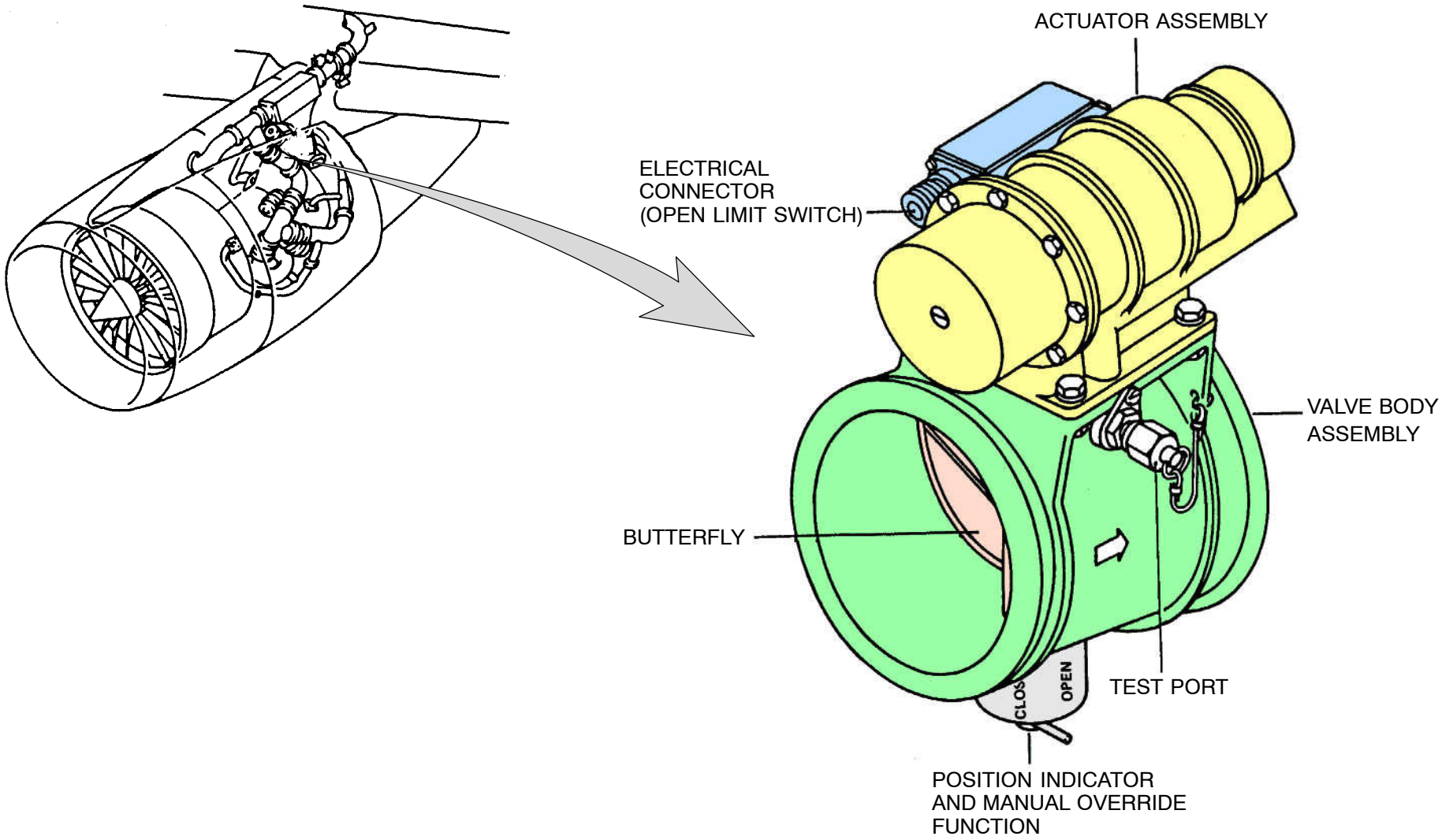
When the upstream pressure increases and reaches 75 psig, the OPV starts to close (pressure on the piston overcomes the spring force). This decreases the air flow and so reduces the downstream pressure. At 85 psig upstream pressure the OPV is fully closed, it opens again when the upstream pressure has decreased to less than or equal to 35psig.

Valve Testing

The OPV bleed valve is equipped with a downstream pressure test port which serves to perform an ”in situ” test.

Controls and Indicating

OPV operation is fully pneumatic. It cannot be controlled from the cockpit.



NOTE: LEFT SIDE SHOWN,
RIGHT SIDE IS SYMMETRICAL.

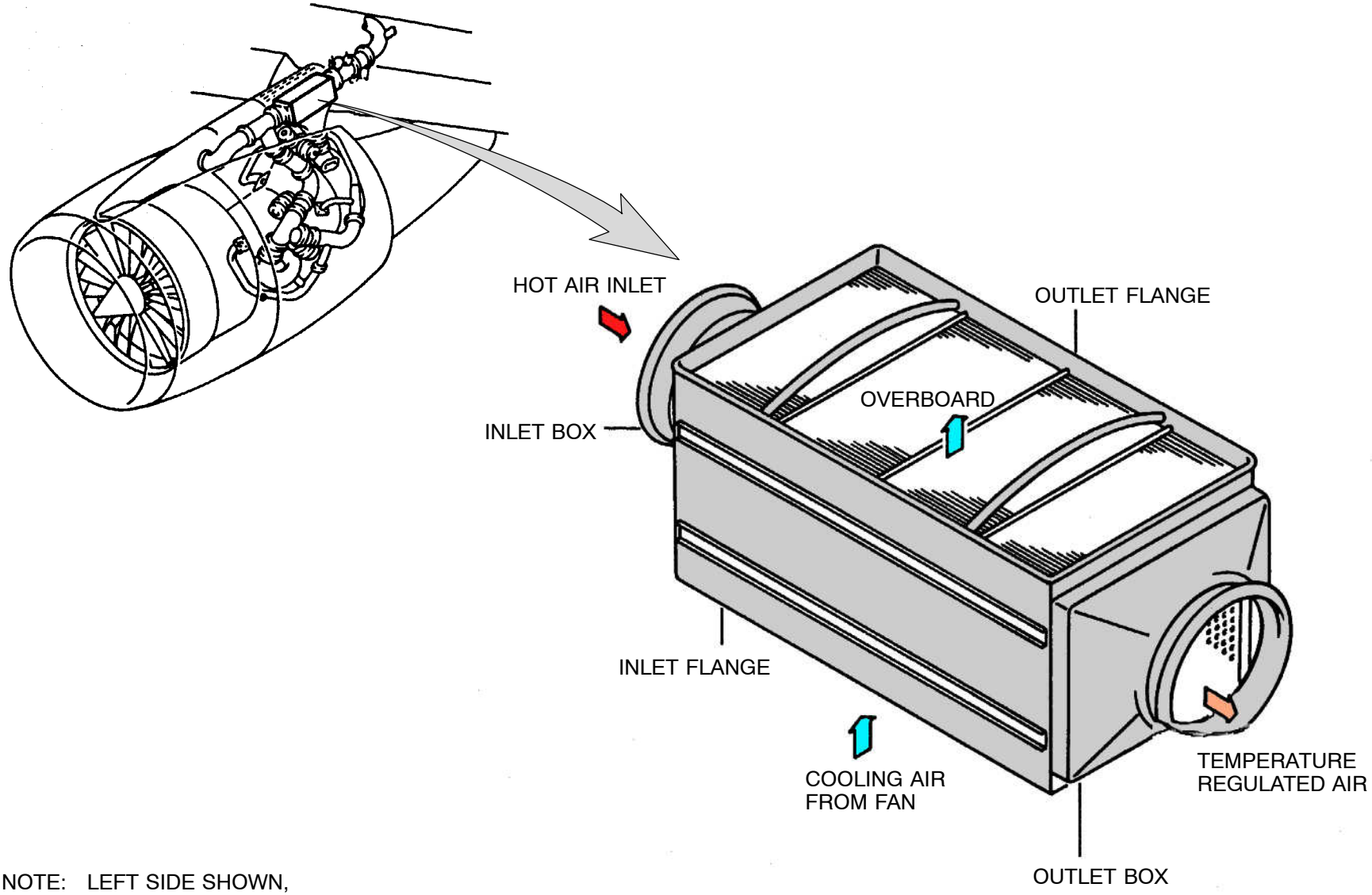
Figure 22 Overpressure Valve (OPV)

PRECOOLER EXCHANGER DESCRIPTION

Purpose

The precooler assures cooling of the hot air bled from the engine compressors by a heat exchange process using cold air from the engine fan.

The precooler exchanger is a tubular steel assembly with crossflow air routing configuration.



NOTE: LEFT SIDE SHOWN,
RIGHT SIDE IS SYMMETRICAL.

Figure 23 Bleed Air Precooler Exchanger

FAN AIR VALVE DESCRIPTION

Purpose

The FAV regulates the downstream precooler exchanger temperature to 200 ± 15°C.

Description

The FAV is a 5.5in. dia. butterfly–type valve, normally spring–loaded closed in the absence of pressure. A minimum upstream pressure of 8psig is necessary to open the valve.

Two microswitches in the valve signal the full open and full closed positions of the butterfly. A thermal fuse installed on the valve body closes the valve if the nacelle temperature reaches 450 ± 25°C.

The FAV contains two main parts

- Valve Body
- Actuator Assembly

Regulation

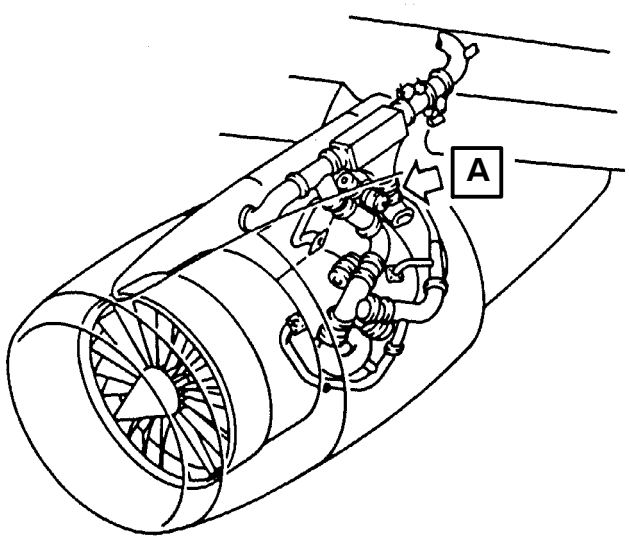
A thermostat installed downstream of the precooler exchanger senses the hot air temperature and sends to the valve a pressure signal corresponding to precooler cooling air demand. The FAV butterfly takes a position from fully closed to fully open to maintain the temperature value of air bled within limits.

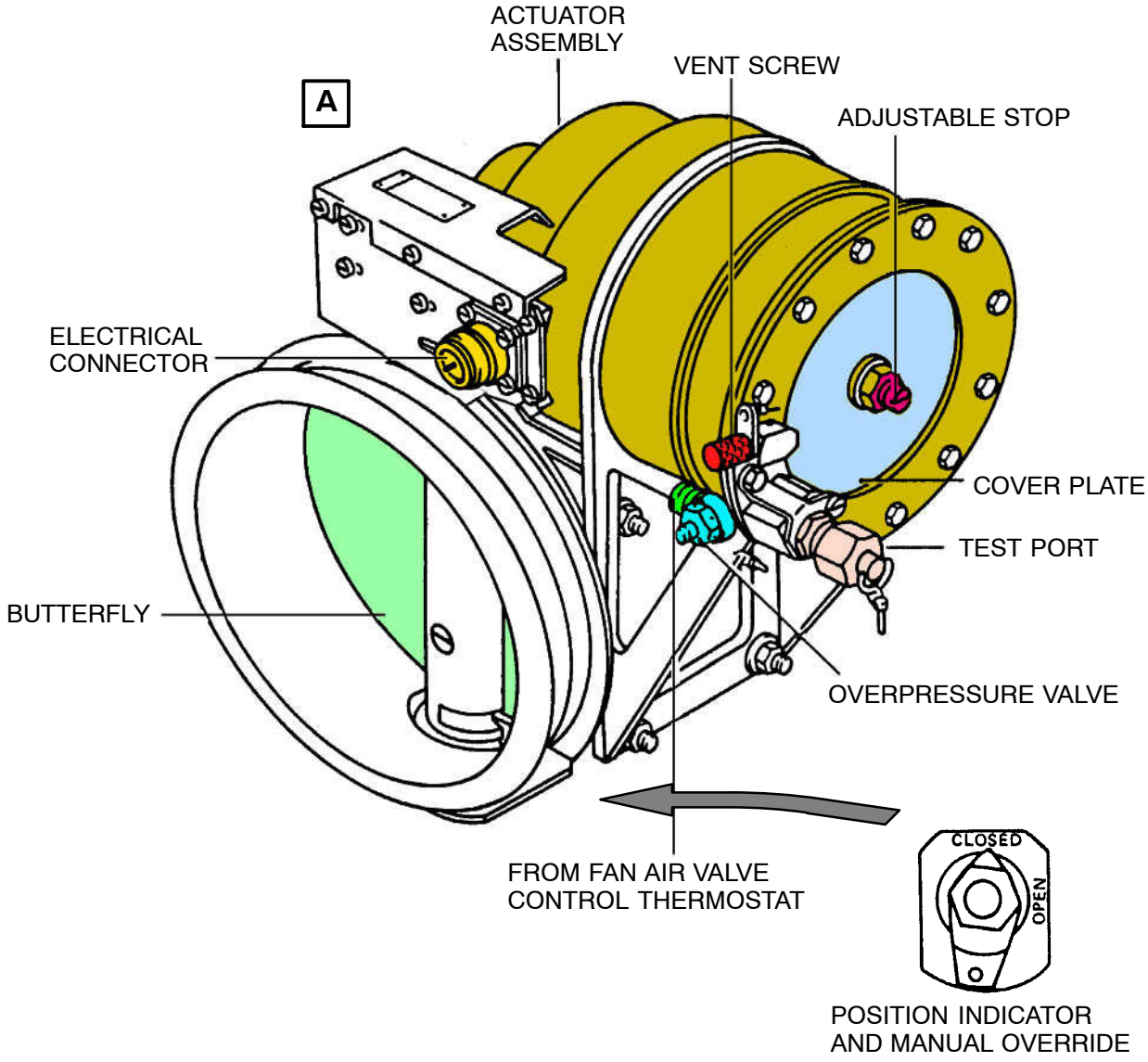
Valve Testing

The FAV bleed valve is equipped with a downstream pressure test port which serves to perform an ”in situ” test.

Manual Override

A manual override serves to close the valve mechanically on the ground, it is secured by the locking pin. When the locking pin is removed also the open pressure is vented.





NOTE: LEFT SIDE SHOWN,
RIGHT SIDE IS SYMMETRICAL

Figure 24 Fan Air Valve (FAV)

BLEED SYSTEM SENSORS DESCRIPTION

CONTROL THERMOSTAT (CT)

Purpose

It controls, through the fan air valve, the engine fan cooling airflow in order to maintain the bleed air temperature to 200 ± 15°C.

Location

The fan air valve control thermostat is installed downstream of the bleed air precooler exchanger.

The fan air valve control thermostat contains two main parts:

- an assembly composed of a control sensing element and an anticipation sensing element
- a pressure regulator.

Operation

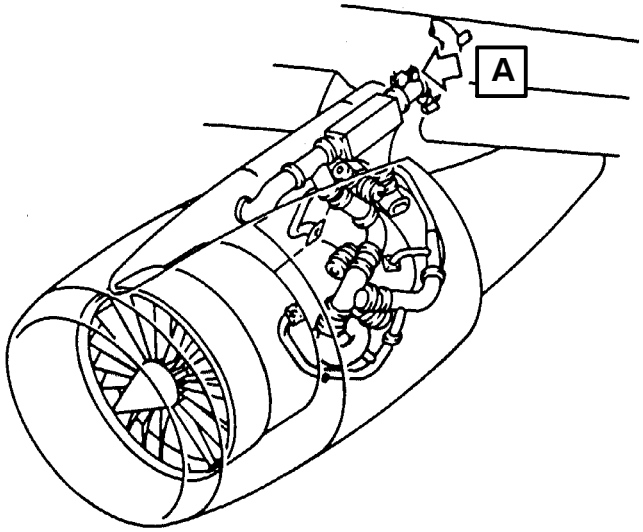
When the temperature downstream of the precooler exchanger is below the required value:

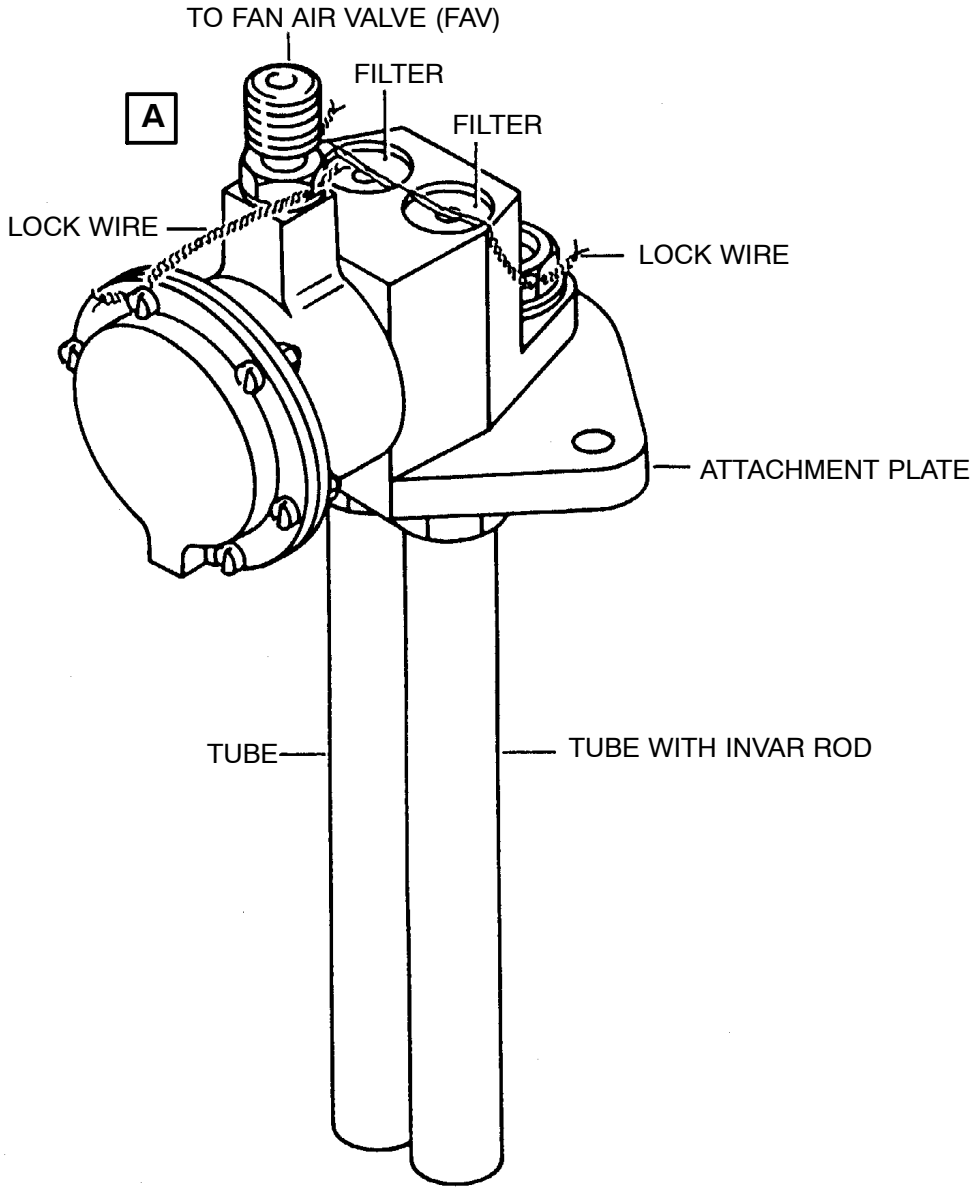
- the INVAR rod valve remains on its seat
- no air flows through the limiter
- the FAV remains closed.

When the temperature is over the required value differential dilatation between the INVAR rod and the stainless steel sensing tube opens the rod valve causing the venting of the FAV and thus its opening.

Between both values the FAV butterfly has an intermediate position.

When the temperature downstream of the precooler increases suddenly, the anticipation sensing element reacts before the thermostat tube causing the opening of the FAV to prevent any overtemperature.





NOTE: LEFT SIDE SHOWN,
RIGHT SIDE IS SYMMETRICAL

Figure 25 Fan Air Valve Control Thermostat (CT)

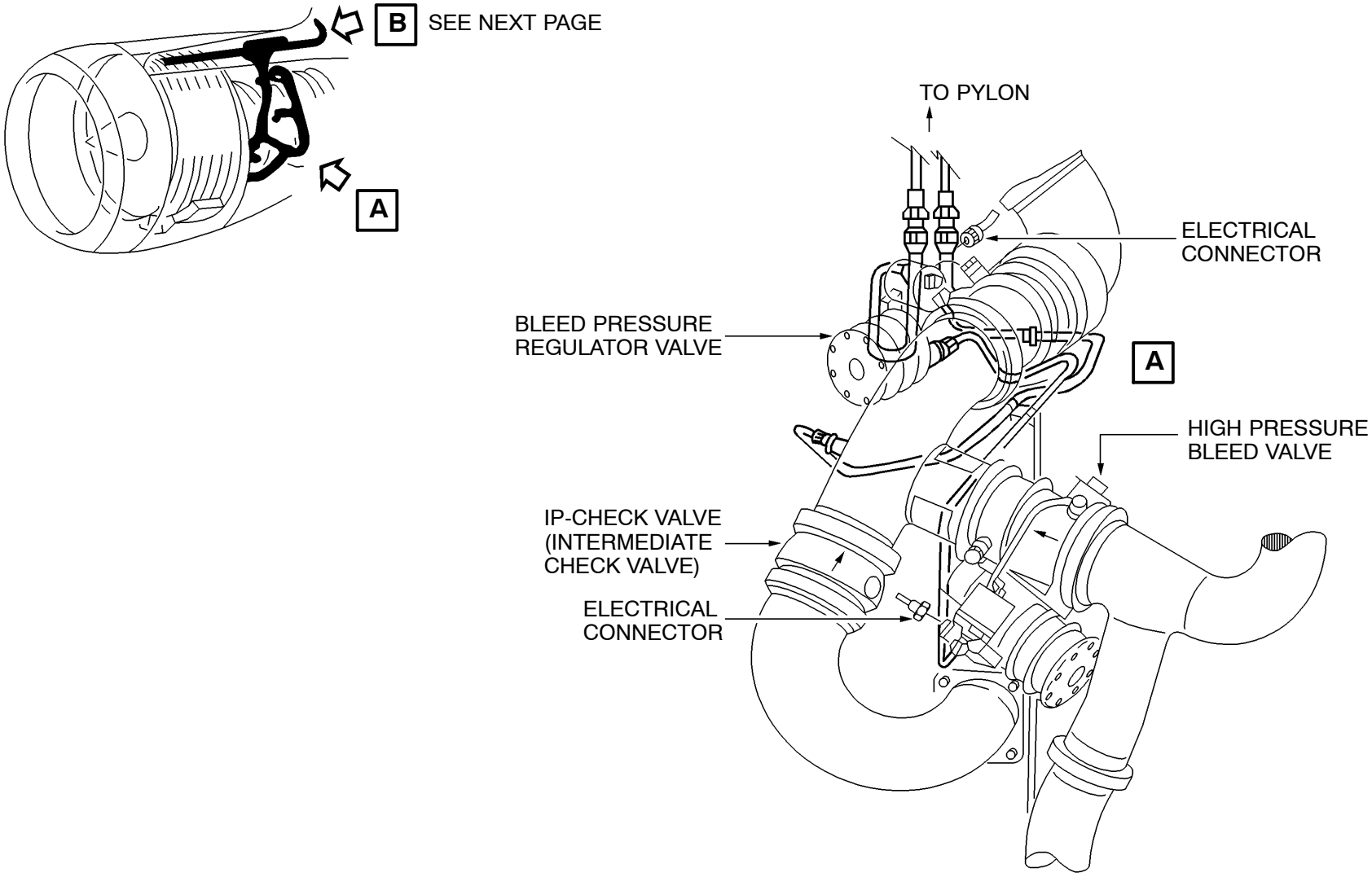


Figure 26 Engine Sense Line Routing

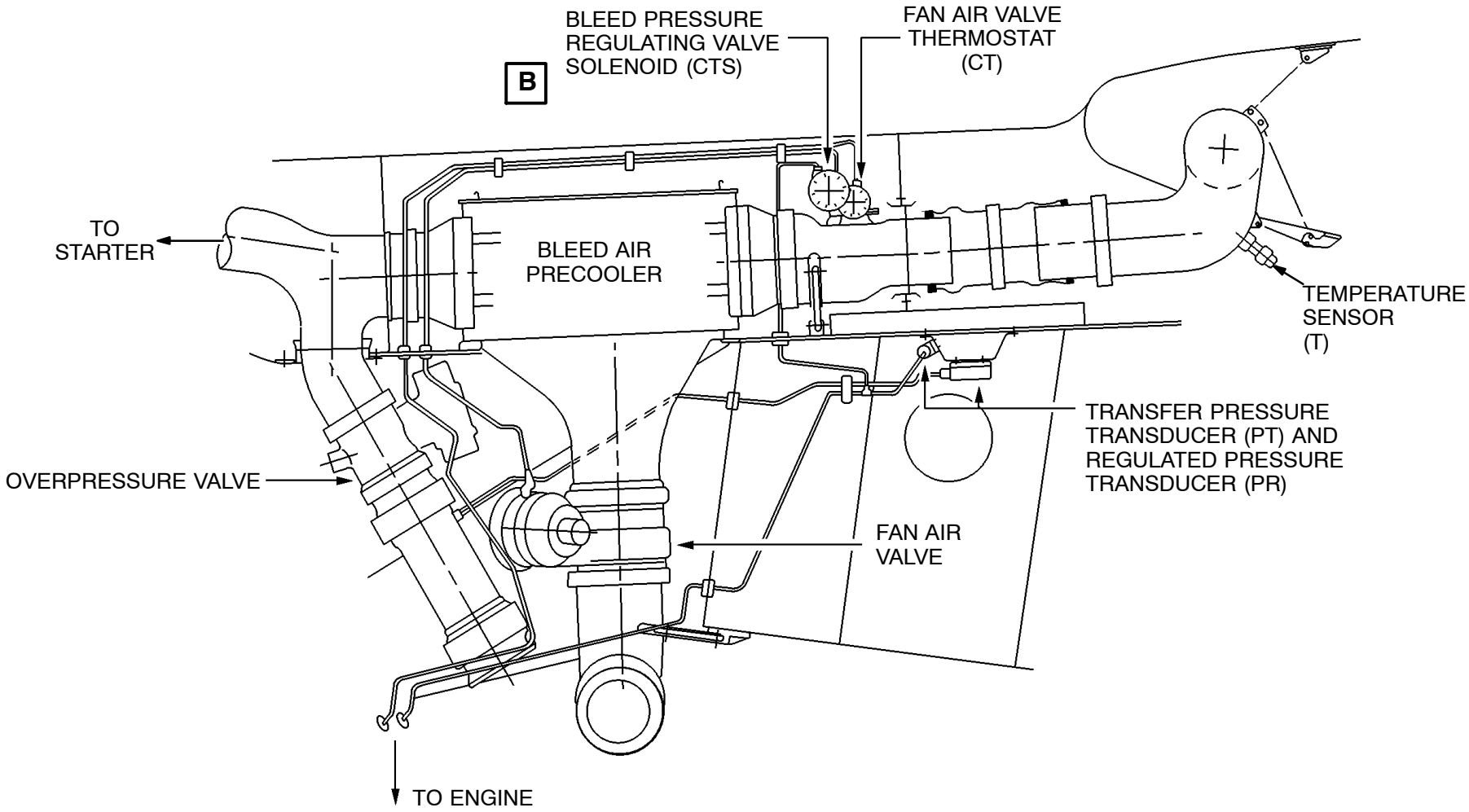


Figure 27 Pylon Sense Line Routing

TRANSFER PRESSURE TRANSDUCER (PT)

Purpose

It senses the bleed transfer pressure behind the HPV and transforms it into a proportional current voltage. The pressure is used to monitor the function of the HPV. The pressure transducer is a piezo–resistive type cell.

Each pressure transducer consists of :

- a body with attachment plate
- a measuring electronic cell
- an electrical connector
- a pressure port.

Operation

The pressure to be measured is ducted to the transducer via a sense line.

It acts on the integrated strain gage of the piezo–resistive cell to generate an electrical signal proportional to the pressure variation.

The signal is transmitted to the bleed monitoring computer.

REGULATED PRESSURE TRANSDUCER (PR)

Purpose

It senses the bleed regulated pressure behind the PRV and transforms it into a proportional current voltage. The pressure sensed is indicated on ECAM. The pressure signal is also used to monitor the function of the PRV.

The pressure transducer is a piezo–resistive type cell.

Each pressure transducer consists of:

- a body with attachment plate
- a measuring electronic cell
- an electrical connector
- a pressure port.

Operation

The pressure to be measured is ducted to the transducer via a sense line.

It acts on the integrated strain gage of the piezo–resistive cell to generate an electrical signal proportional to the pressure variation.

The signal is transmitted to the bleed monitoring computer.

TEMPERATURE SENSOR (T)

Purpose

The sensor monitors the temperature downstream of the precooler. This temperature is indicated on ECAM. The temperature is also send to the BMC‘s.

It is a double platinum winding type.

The sensor consists of:

- a housing with a threaded part for installation
- a sensing element
- an electrical connector.

Operation

The temperature of the bleed air is sensed by the sensing element, transformed into an electrical signal and transmitted to the bleed monitoring computer.

LEGEND:

- CTS:CONTROL THERMOSTAT SOLENOID
- CT: CONTROL THERMOSTAT

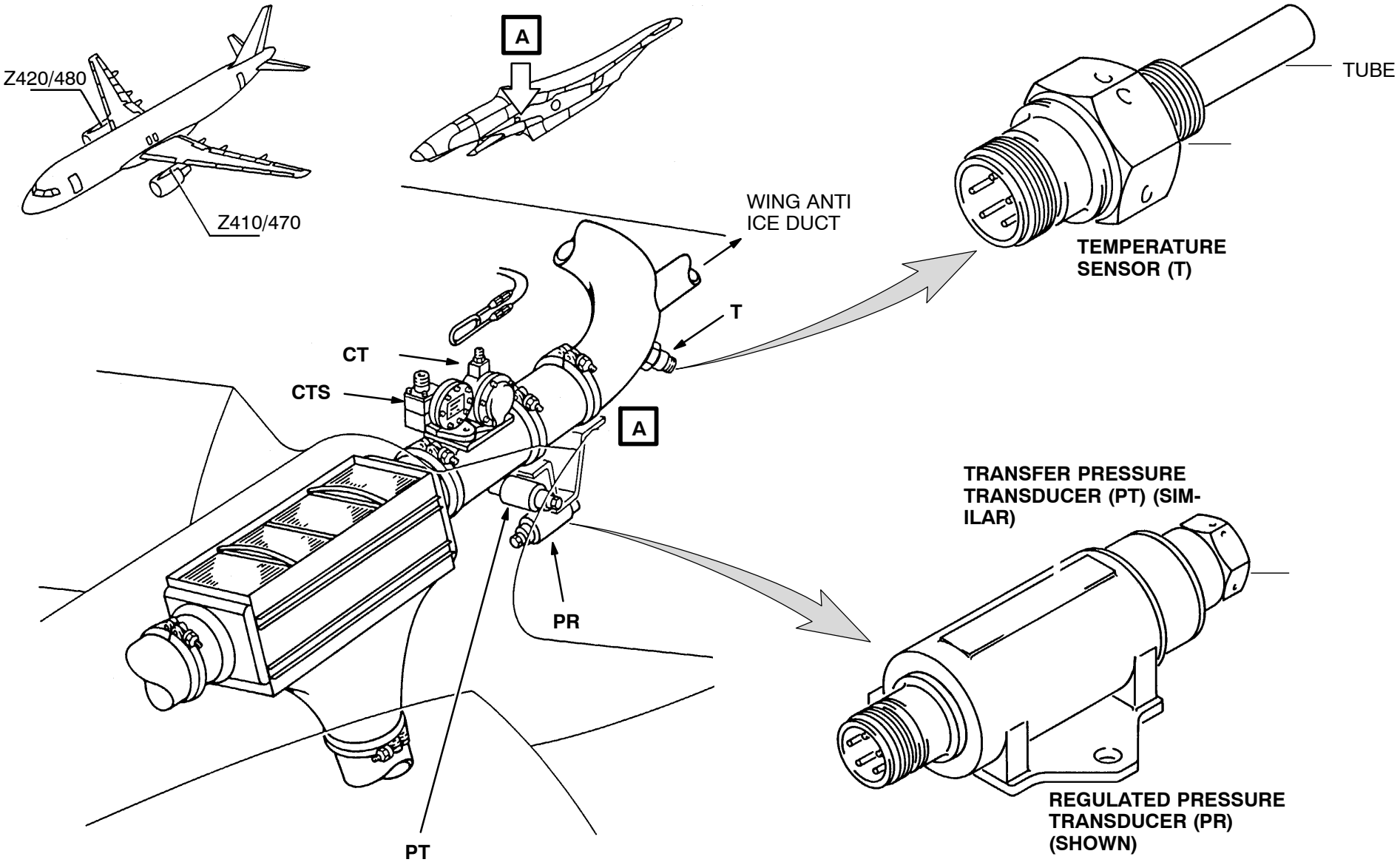


Figure 28 Transducer and Sensor

36–12 APU BLEED AIR SUPPLY AND CROSSBLEED SYSTEMS

SYSTEM OPERATION

APU Bleed Air Supply

The start sequence of the APU is complete when the APU acquires 95% speed (Ref. ATA 49).

Above the acquired 95% speed the APU is obtainable for the supply of bleed–air and electrical power.

When the APU is available you can push the APU BLEED P/B SW on the overhead panel 25VU to start the APU bleed–air supply.

When you push the APU BLEED P/BSW:

- the blue ON legend on the P/BSW comes on
- the P/BSW sends a signal to the BMC
- the BMC starts a test of the sensing elements on the APU bleed–air duct and the left wing bleed–air ducts.

If the test is correct the BMC tells the ECB to open the APU bleed valve.

NOTE: If the BMC 1 finds a leak in the APU bleed–air ducts, while there is a Main Engine Start (MES) signal from the engines, it ignores the leak signal and tells the ECB to keep the APU bleed valve open.

Stop of the APU Bleed–Air Supply

To stop the APU bleed–air supply you push the APU BLEED P/BSW again:

- the blue ON legend on the APU BLEED P/BSW goes off,
- the APU BLEED P/B SW removes the ground signal from the BMCs,
- the BMCs send an OFF signal to the ECB,
- the ECB stops the supply of electrical power to the rotary actuator of the APU bleed control valve,
- the APU bleed valve closes and stops the bleed air supply,
- on the BLEED and APU pages of the SD, the green APU bleed–valve symbol is shown in the closed position.

X-Bleed Valve Automatic Control

The crossbleed valve selector–switch 3HV is usually in the AUTO position. In this position the coil of the crossbleed–valve auto–control relay is connected to the essential bus. When you push the APU BLEED pushbutton–switch to the ON position the BMCs send a ground signal to the crossbleed–valve auto–control relay if:

- the APU bleed load valve is in the fully open position,
- there is no leak warning (the leak warning will be ignored during the main engine start).

The crossbleed–valve auto–control relay supplies electrical power to the crossbleed valve motor 1 and the crossbleed valve opens. On the BLEED page of the SD the green crossbleed–valve symbol is shown in the open position.

X-Bleed Valve Manual Control

When you set the crossbleed–valve selector switch to the OPEN position:

- the motor 2 opens the crossbleed valve,
- on the BLEED page of the SD the green crossbleed–valve symbol is shown in the open position.

You should only use this procedure in the subsequent cases:

- the cross supply of the air–conditioning packs (the left engines supply air to the right pack or the right engines supply air to the left pack),
- the start of an engine with bleed air from an engine on the other wing (but not during flight. Start by self–rotation is possible),
- an engine bleed–air failure and WAI condition,
- start of the right engine on the ground through the ground connectors or with the APU bleed–air supply.

When you set the crossbleed valve selector switch to the CLOSE position:

- the motor 2 closes the crossbleed valve.
- on the BLEED page of the SD the green crossbleed–valve symbol is shown in the the closed position.

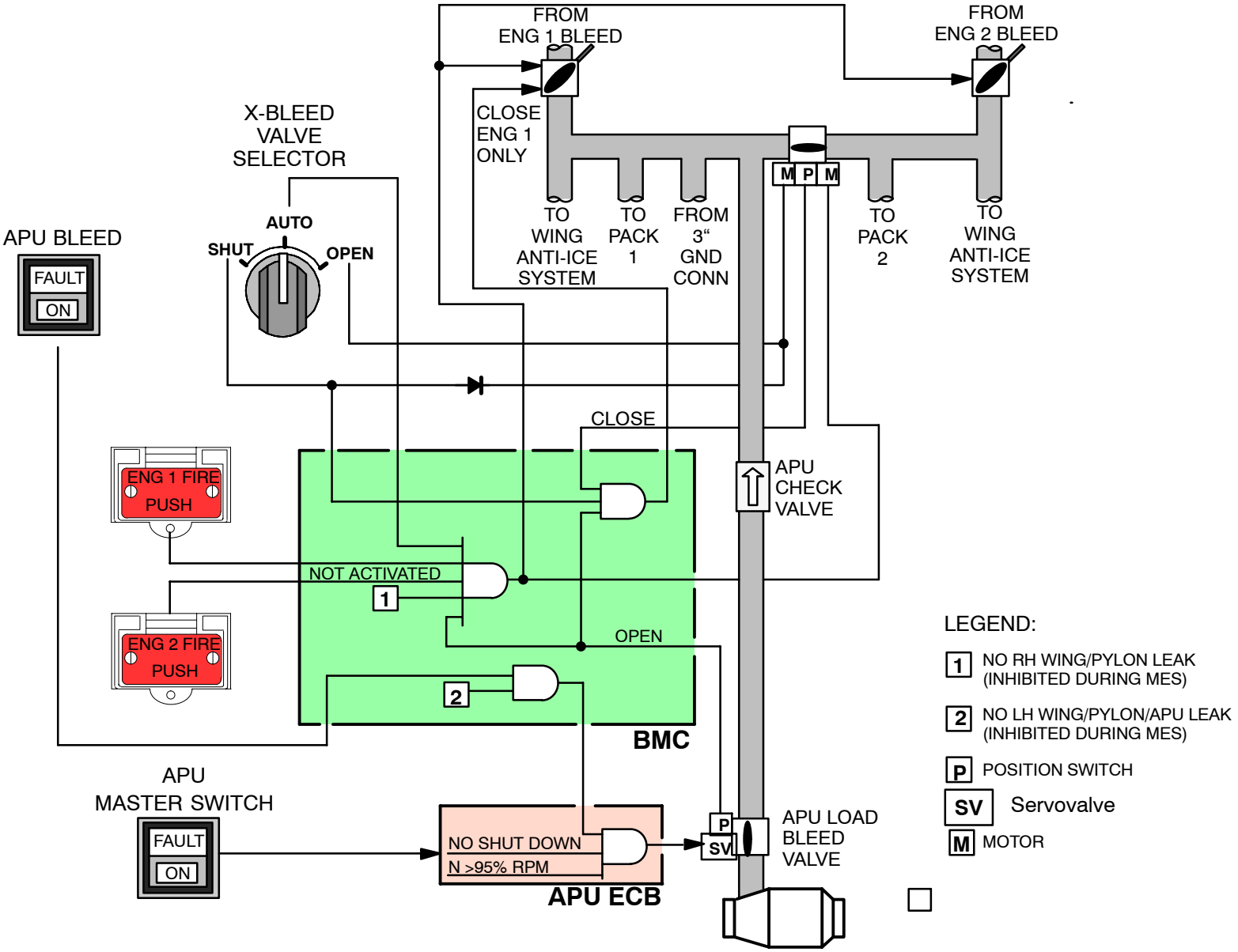


Figure 29 APU Bleed- & X-Bleed Valve Logic

CROSS BLEED VALVE DESCRIPTION

Purpose

The crossbleed duct has a crossbleed valve which controls the bleed - air supply to the left and right bleed - air systems.

Valve Construction

The crossbleed valve is an electrical butterfly shut-off valve (4.5in. dia.) controlled by the BMC for automatic operation.

It is also possible top operate it manually fom the cockpit using the rotary selector switch.

The main components of the valve are:

- the valve body
- the butterfly plate
- the double motor actuator
- the manual override lever

The double motor actuator has two electrical motors which are designated as the motor 1 and motor 2.

These two motors work independently.

The motors opens and closes the valve,

- motor 1 (primary) controls the automatic
  - (X-bleed selector switch in ”Auto”)
- motor 2 (secondary) controls the manual operation.
  - (X-bleed selector switch in ”open” or ”shut”)

A brake system in each motor locks the butterfly plate in position when the electrical power supply stops.

When the valve is in its fully open or closed position, limit switches in the actuator automatically stop the electrical power supply to the motors.

The valve also has a manual override lever which permits the operation of the butterfly plate without electrical power.

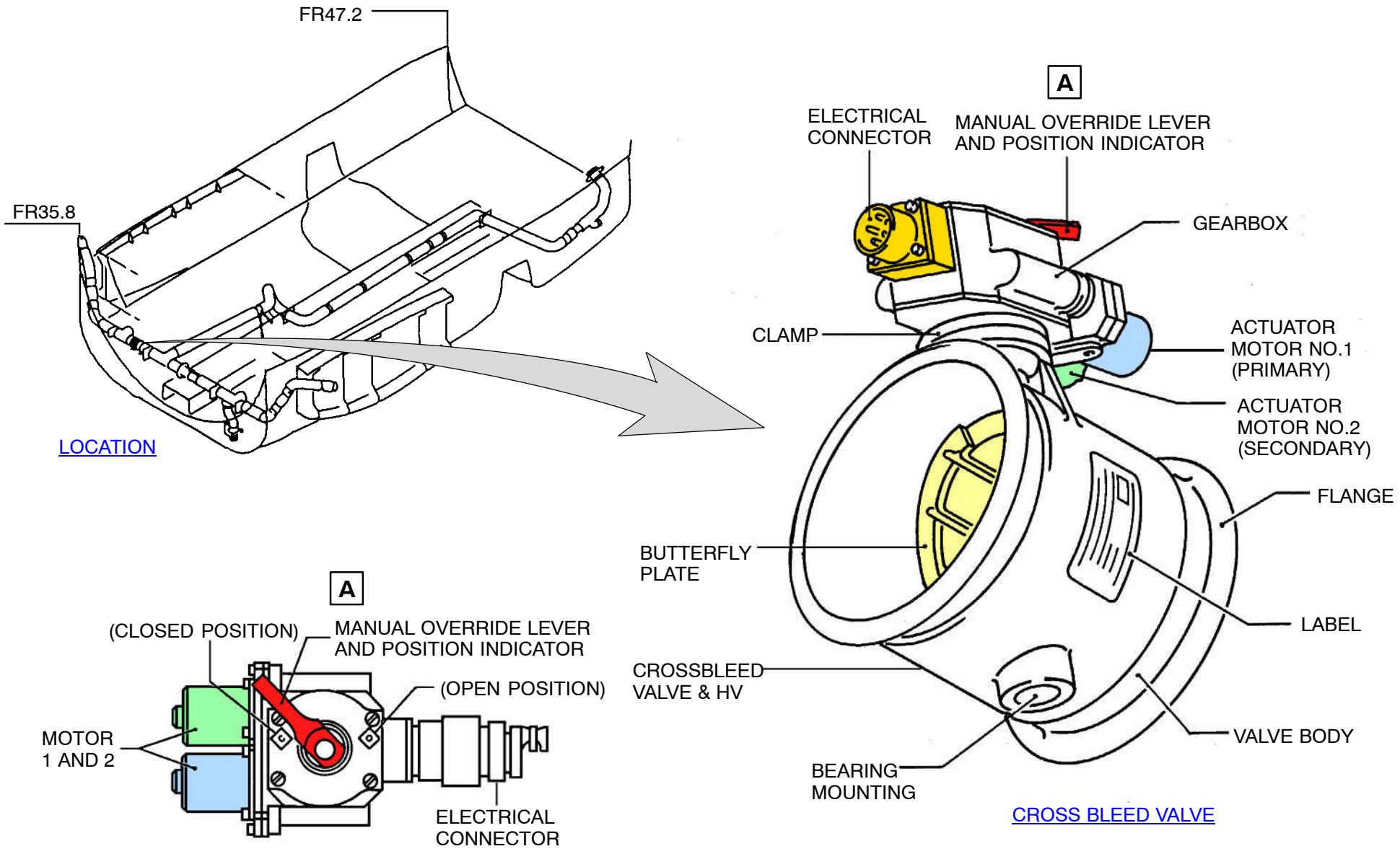


Figure 30 Cross Bleed Valve

APU LOAD BLEED CTL VALVE DESCRIPTION

Description

The supply of the APU bleed air is controlled by the ECB via APU bleed control valve and inlet guide vanes. When the APU Bleed Control Valve is in the open position the engine PRV (**P**ressure **R**egulator **V**alves), also named engine bleed valves, closes and shuts off the engine bleed air (energizing of the TLT solenoids).

APU bleed air has priority of engine bleed air.

It is not necessary to regulate the temperature, pressure and flow of the APU bleed air because they agree with the user demand.

The APU can supply bleed air on ground as well in flight up to an altitude of 20.000 ft. Above that flight level the IGV (**I**nlet **G**uide **V**anes) will be driven closed.

The APU bleed control valve is a part of the APU.

The ECB monitors the bleed - air supply and also controls the APU bleed control valve.

For more description refer to ATA 49.

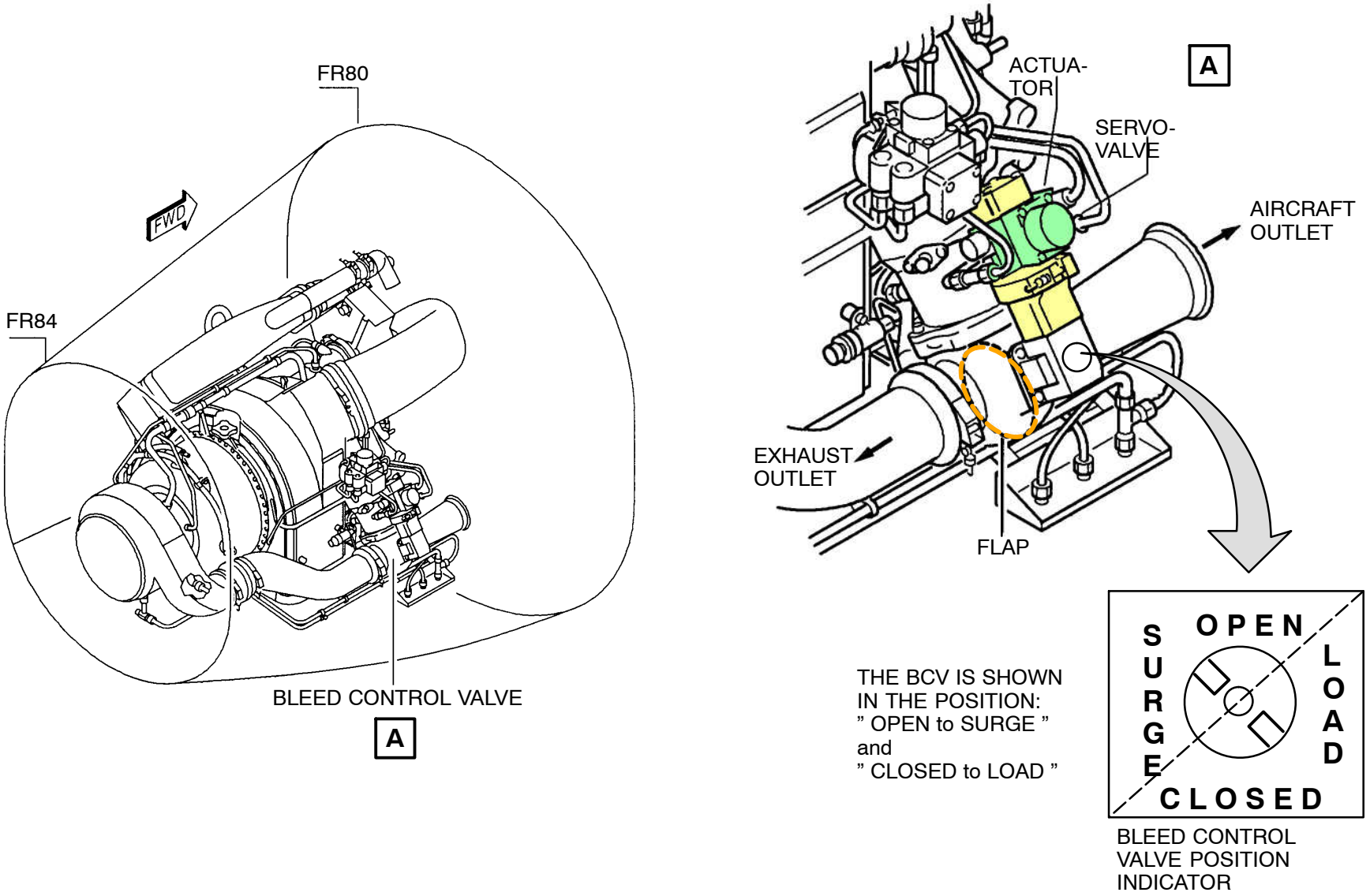


Figure 31 APS3200 APU Bleed Control Valve

APU BLEED CONTROL VLV COMPONENT DESCRIPTION

ECB Interface

The APU ECB (**E**lectronic **C**ontrol **B**ox) receives the signals of the bleed air demand (ECS; MES). The ECB monitors the bleed air supply and also controls the APU BCV (**B**leed **C**ontrol **V**alve).

Valve Construction

The APU Bleed Control Valve consists of the subsequent components:

- Valve Section with Butterfly Flap
- Servo Valve
- Fuel operated Actuator
- LVDT (**L**inear **V**ariable **D**ifferential **T**ransducer)

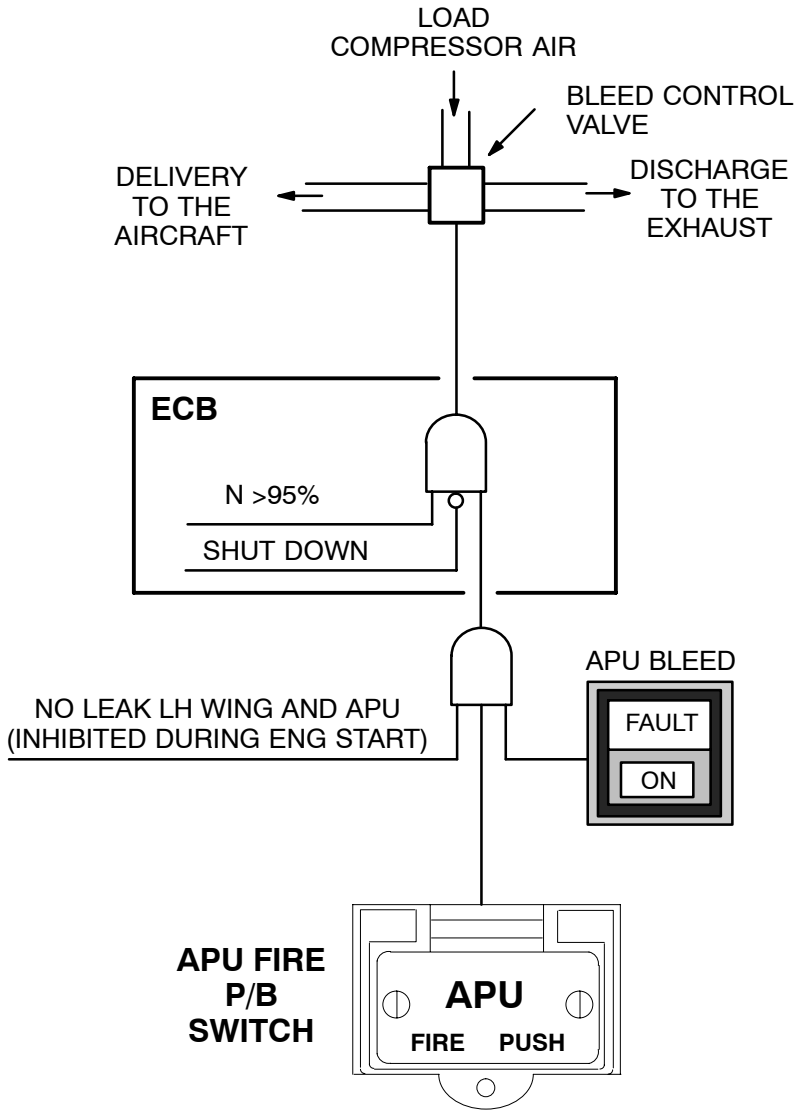


Figure 32 **APU Bleed Control Valve Logic**

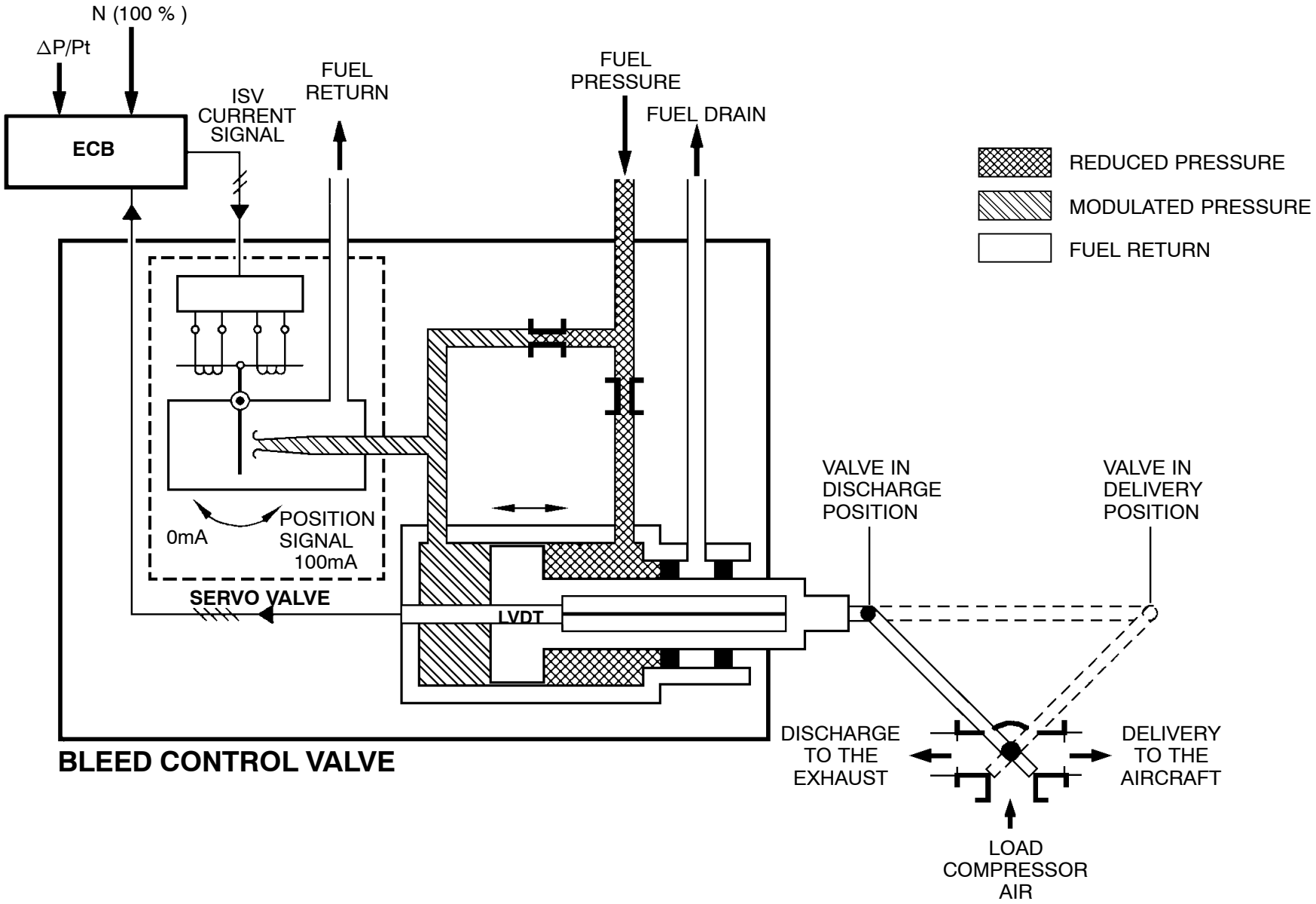


Figure 33 APU Bleed Control Valve Schematic

APU BLEED CHECK VALVE DESCRIPTION

General

The APU bleed - air duct connects the APU to the crossbleed duct.

Purpose

The check valve installed in the APU bleed - air duct protects the APU when a different source supplies bleed air with a higher pressure.

Valve Construction

The APU bleed check valve is a 101.6mm diameter flapper-type air valve.

The main components of the valve are the:

- Valve Housing
- Valve Flaps
- Valve Shaft

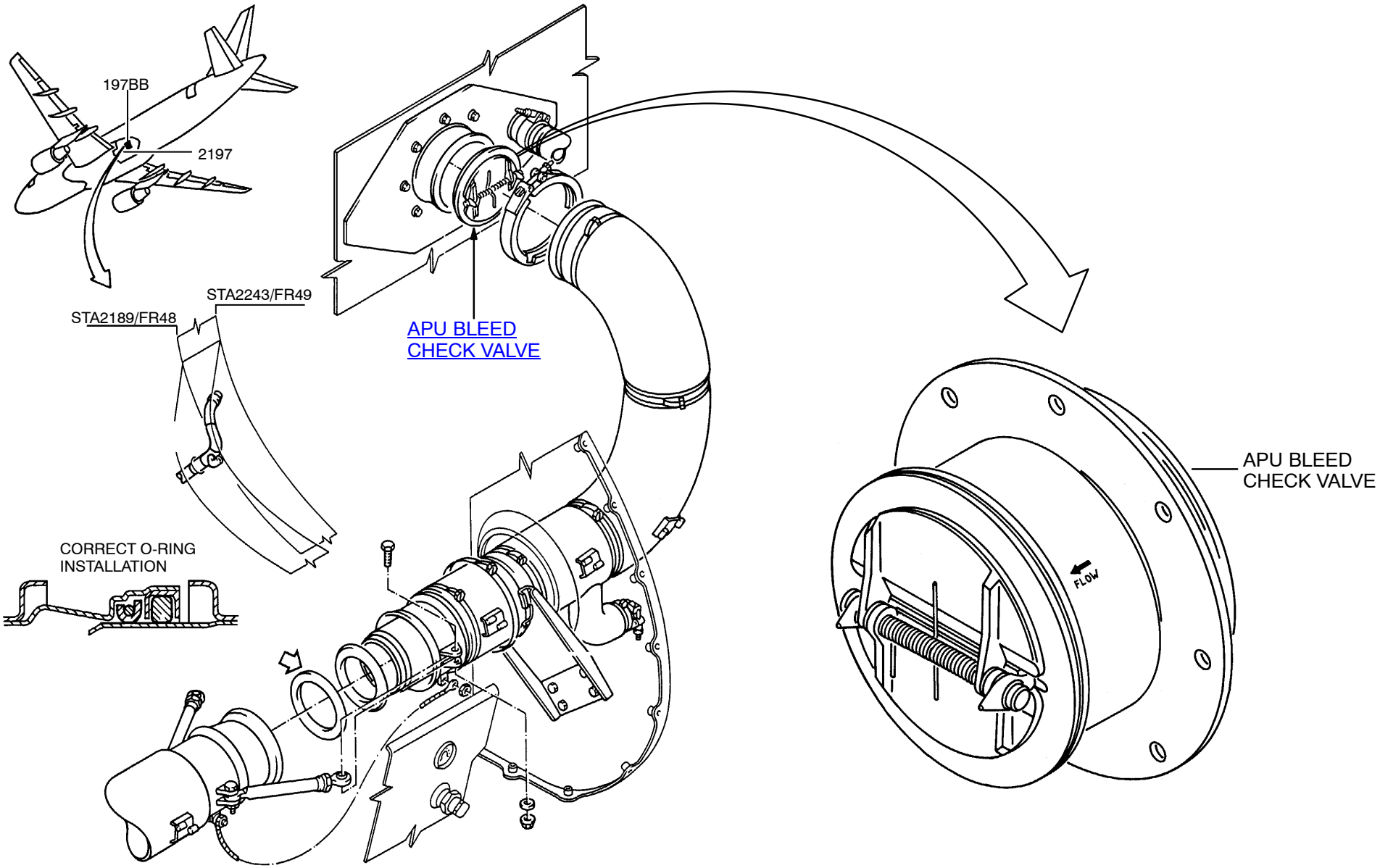


Figure 34 APU Bleed Check Valve

HIGH PRESSURE GRD CONNECTOR DESCRIPTION

3” High Pressure Ground Connector

This connector is installed in the lower mid fuselage on the left side and includes a check valve which stops the loss of air when the ground supply unit is not connected.

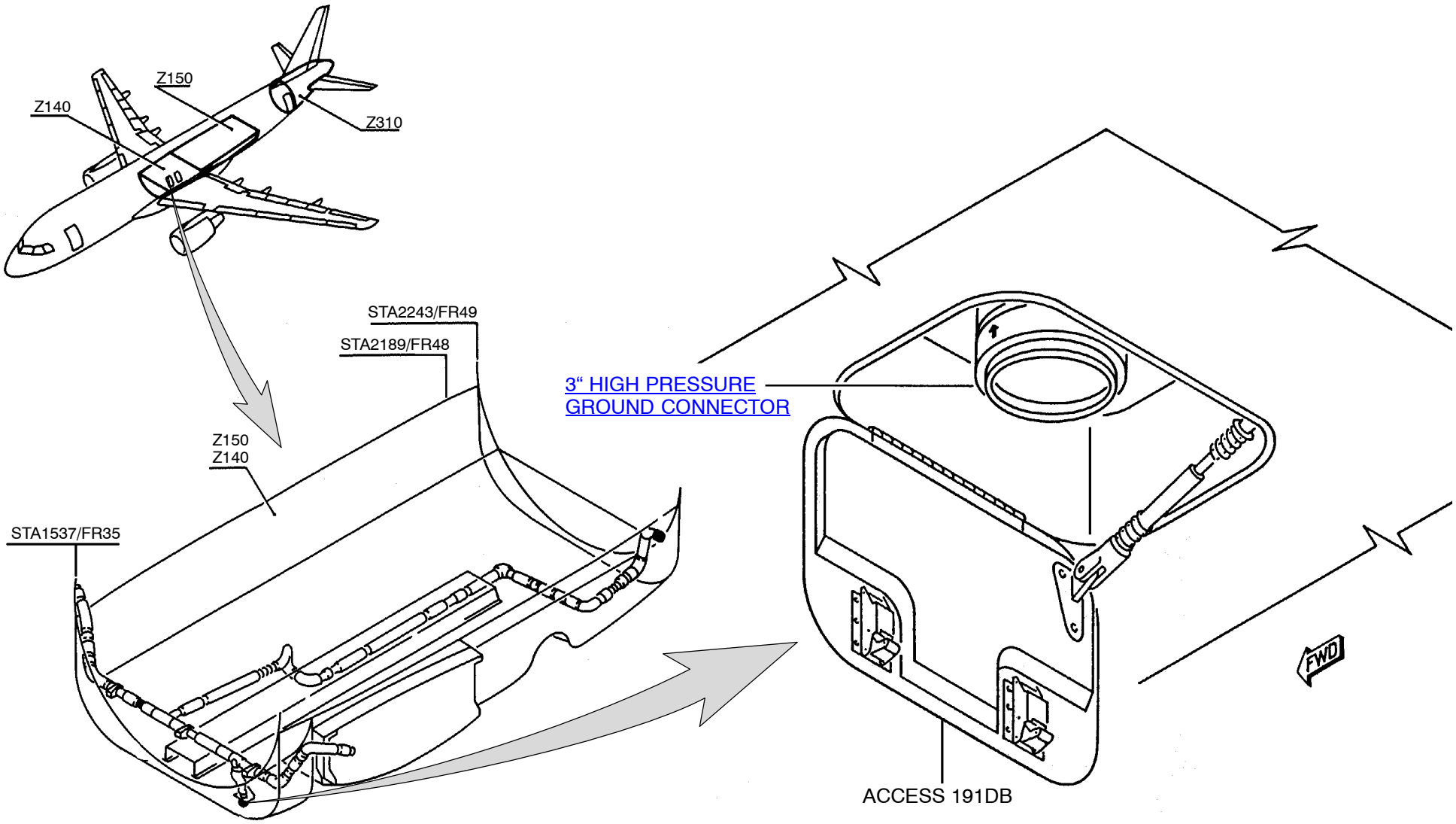


Figure 35 3” High Pressure Ground Connector

36–10 ENGINE BLEED AIR SYSTEM

PRESSURE SERVICING DESCRIPTION

Pressure Service

Air for Pressurization is used for:

- Potable Water Tank,
- Hydraulic Tank and
- for the Hot Air regulation
  - Trim Air Pressure Regulator Valve

the air is taken from the Pneumatic Crossover duct.

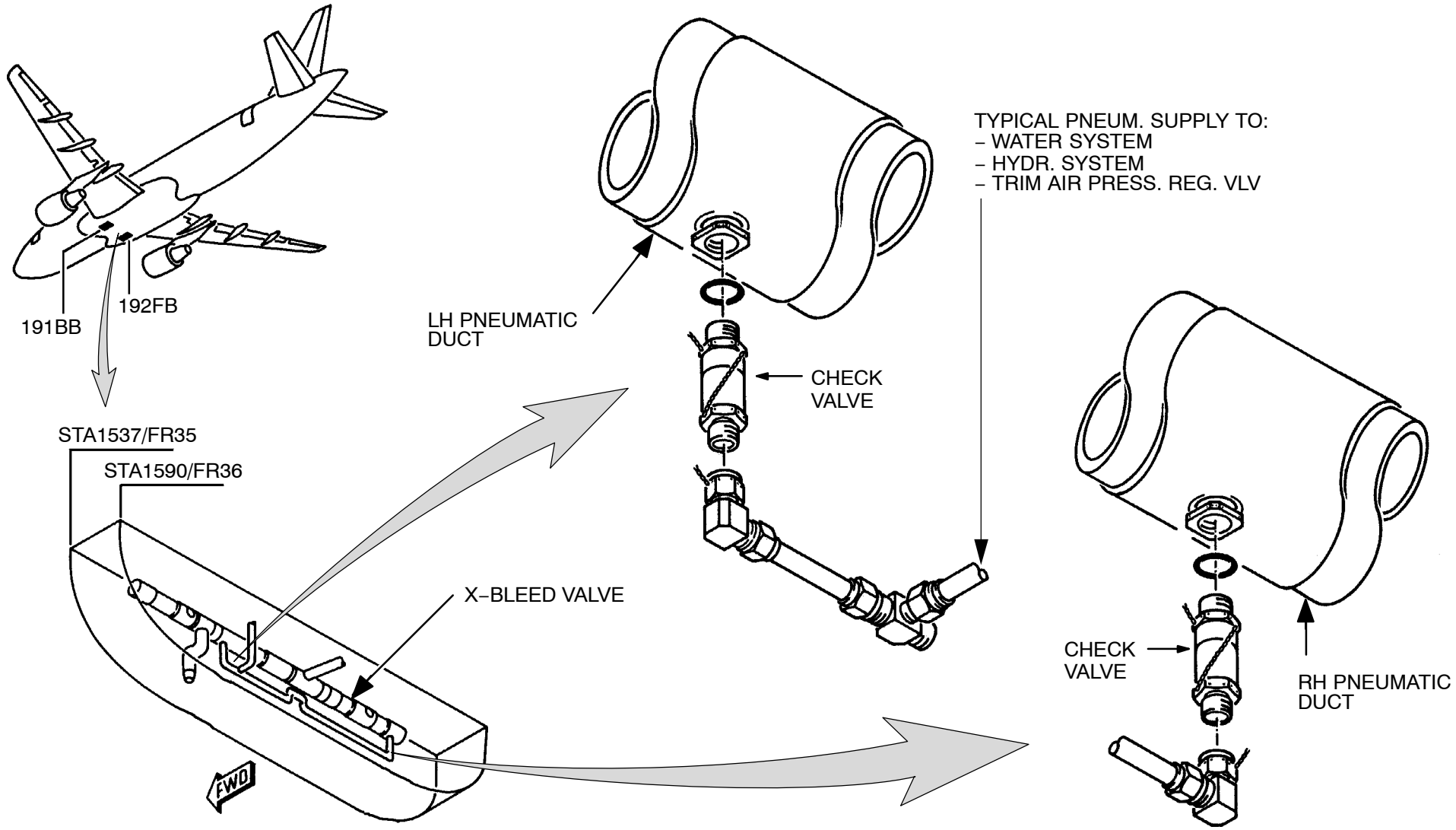


Figure 36 Pressure Service

36–14 ENVIRONMENT PROTECTION

WING LEADING EDGE VENTILATION DESCRIPTION

ATTENTION: Installed on the first few produced aircraft only.

General

The system is installed in the wing leading edge between fuselage and pylon on left and right hand side.

For the system exists no monitoring system and it has no manual control.

The wing ventilation system supplies sufficient air to the leading edge to make sure that:

- the fuel vapor comes out correctly,
- the temperature in the leading edge is safe for the leading edge structure and system,
- over duct extension and through rib 7 air passes to the low pressure fuel valve. Air been also supplied to the space above the pylon.

The system consist mainly of:

- NACA ram air inlet and and
- seven piccolo ducts.

Only during Aircraft movement a ventilation takes place. In the skin of the lower wing leading edge forward of the frontspar are drainage and bleed holes

Leading Edge Outboard of the Pylon

The Ventilation of the short leading edge section between RIB 12 and RIB 13 only removes the fuel Vapor. Ram Air for the Ventilation comes in through the gaps around the Slat Tracks. It departs through the Drainage and Exhaust holes.

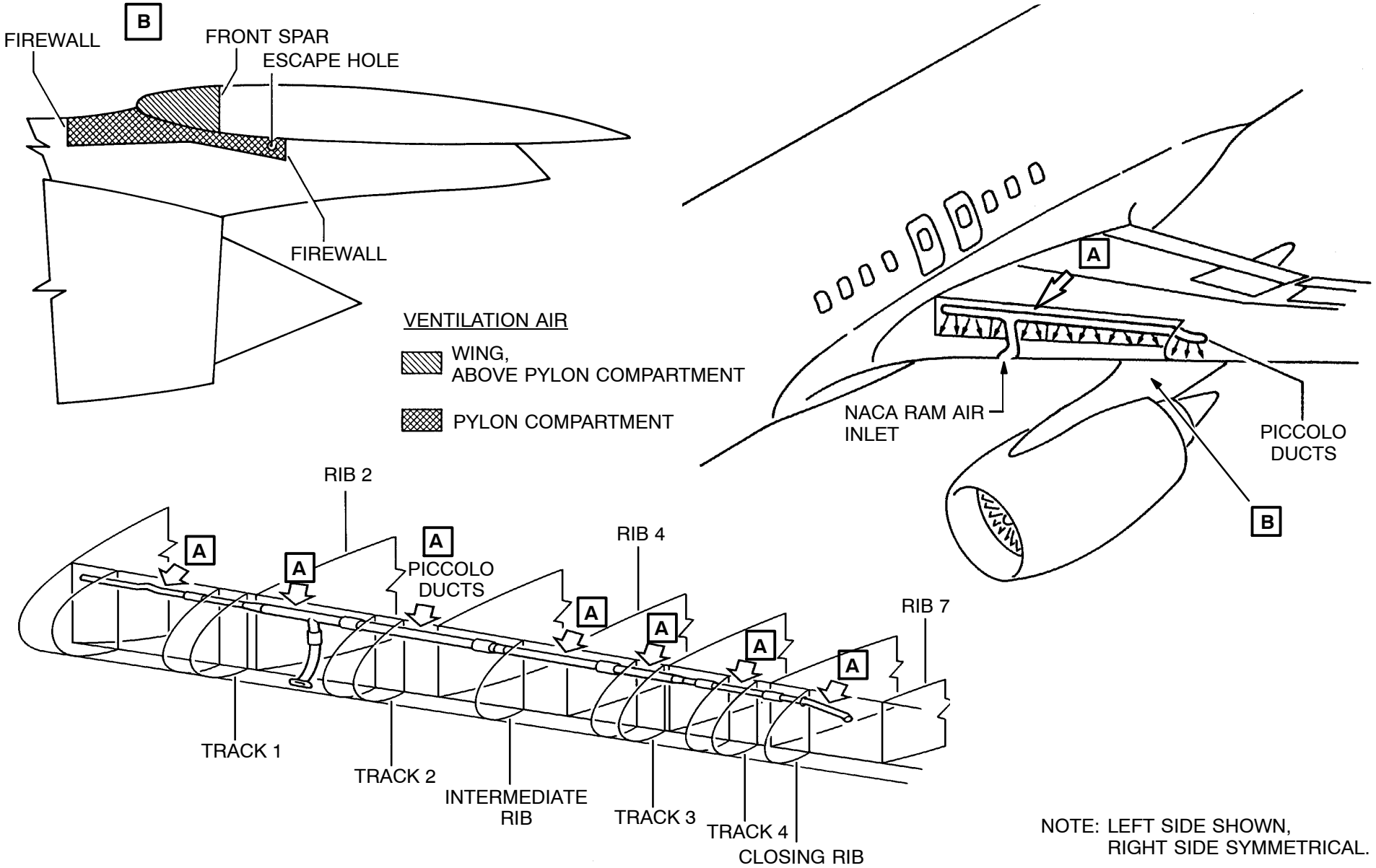


Figure 37 Wing and Pylon Ventilation

General

The access panels prevent on excessive pressure increase.

You find them in:

- the applicable bay (s) of the fixed leading edges of the wing,
- the wing leading edge of the pylon fairing,
- the leading edge of the fuselage fairing.

Protection of Wing Leading Edge

This System has a Protection Function of the Wing Leading Edge Structure. It operates when a Duct of the Pneumatic or Wing Anti Ice System Bursts or shows major Leaks.

The access panels in the fixed leading edge of the wing pressure relief panels of the 'blow down' type.

There are five panels on each underwing between the fuselage and the anti–icing telescopic duct.

Panels 1, 2 and 3 are inboard of the engine pylon.

Panels 4 and 5 are outboard of the pylon.

They are a protection against too much overpressure caused by leaks in the anti–icing duct.

Operation

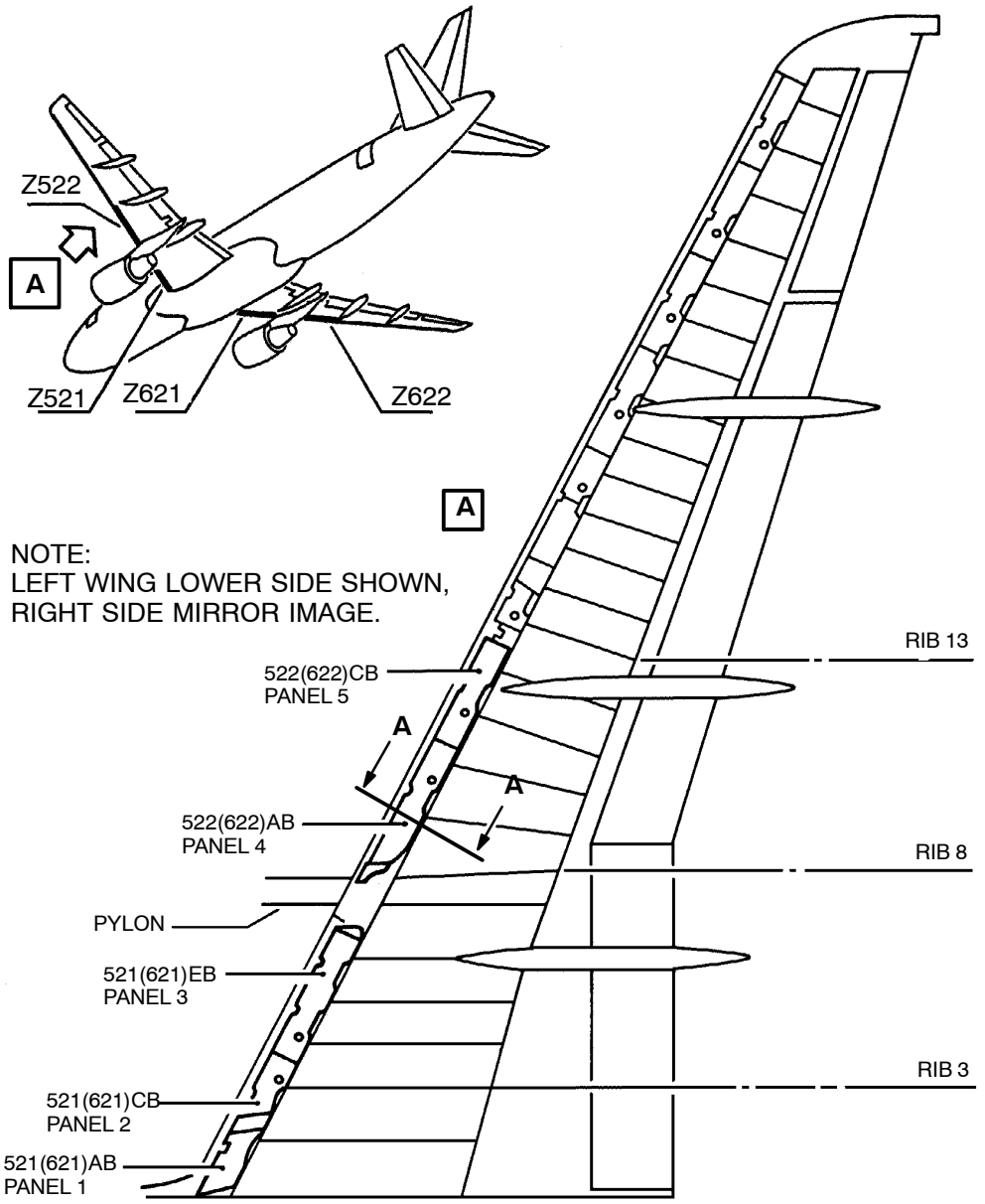
When a pneumatic or anti–icing duct leak occurs, the pressure in the wing fixed leading edge bay (s) of the wing (s) increases. This continues until the rivets which attach the two angles of the landing shear. To shear the rivets, a pressure of approximately 0.48bar (7psi) is necessary.

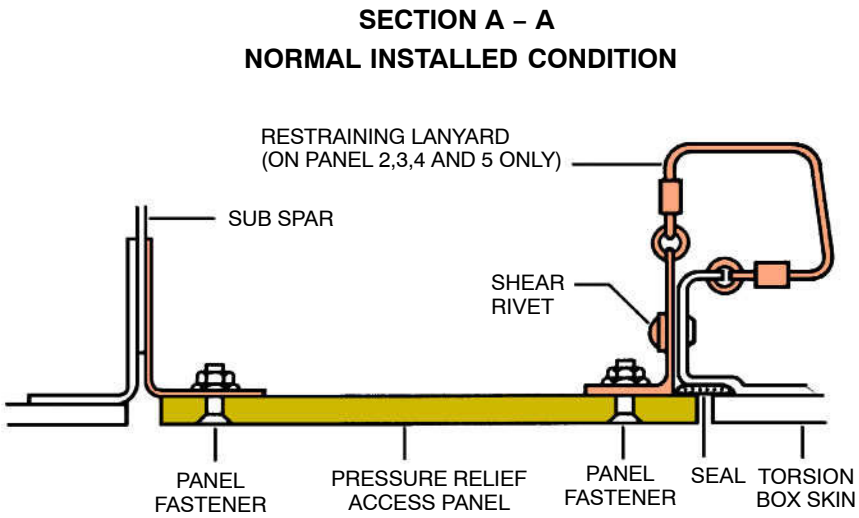
Then the trailing edge of the access panel moves and the air flows overboard.

The pressure at which the rivets shear depend on:

- the shape and the size of the access panel,
- the number of rivets which hold the panel,
- the rivet shear strength.

NOTE: If, after the access panel has 'blow down', a close inspection shows no damage, the panel and the landing can be used again. To install the access panel replace the attachment angle of the leading edge and the shear rivets.





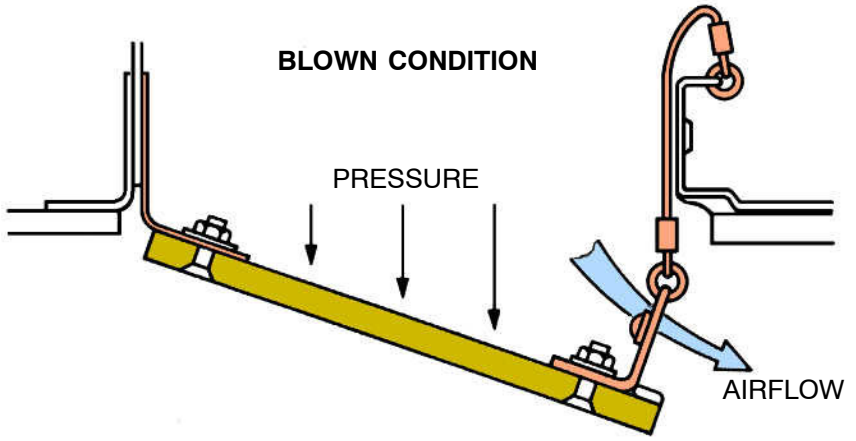


Figure 38 Pressure Relief Access Panel Installation

PYLON PROTECTION DESCRIPTION

General

This system is for the protection of the pylon. It operates if a duct of the pneumatic system breaks open or shows large leaks so that this can not endanger safe flight and landing of the aircraft.

The system keeps the pressure to a limit. This prevents damage to the pylon structure and the components installed in the pylon.

The leading edge of the pylon fairing and the pylon/wing interface have each one pressure relief door. The overpressure in this area is limited to 0.2 bar (2.9psi) by the pressure relief doors.

Component Description

Two types of pressure relief doors are installed:

- the one in the leading edge of the pylon (413BL,423BL) is spring loaded and made from titanium.
- the one in the pylon/wing interface (471BL,482BR) is installed with shear rivets, a latch and a piano hinge. It is made of carbon honey comb core in sandwich construction.

Operation

When a pneumatic duct in any area of the pylon breaks open or leaks, the pressure increases in this area. It continues up to a differential pressure of 0.2bar (2.9psi).

This causes:

- the pressure to overcome the force of the spring on the doors 413BL and 432BL.
- the rivets to shear on the doors 471BL and 482BR.

The doors open and stay open to allow the overpressure to flow overboard.

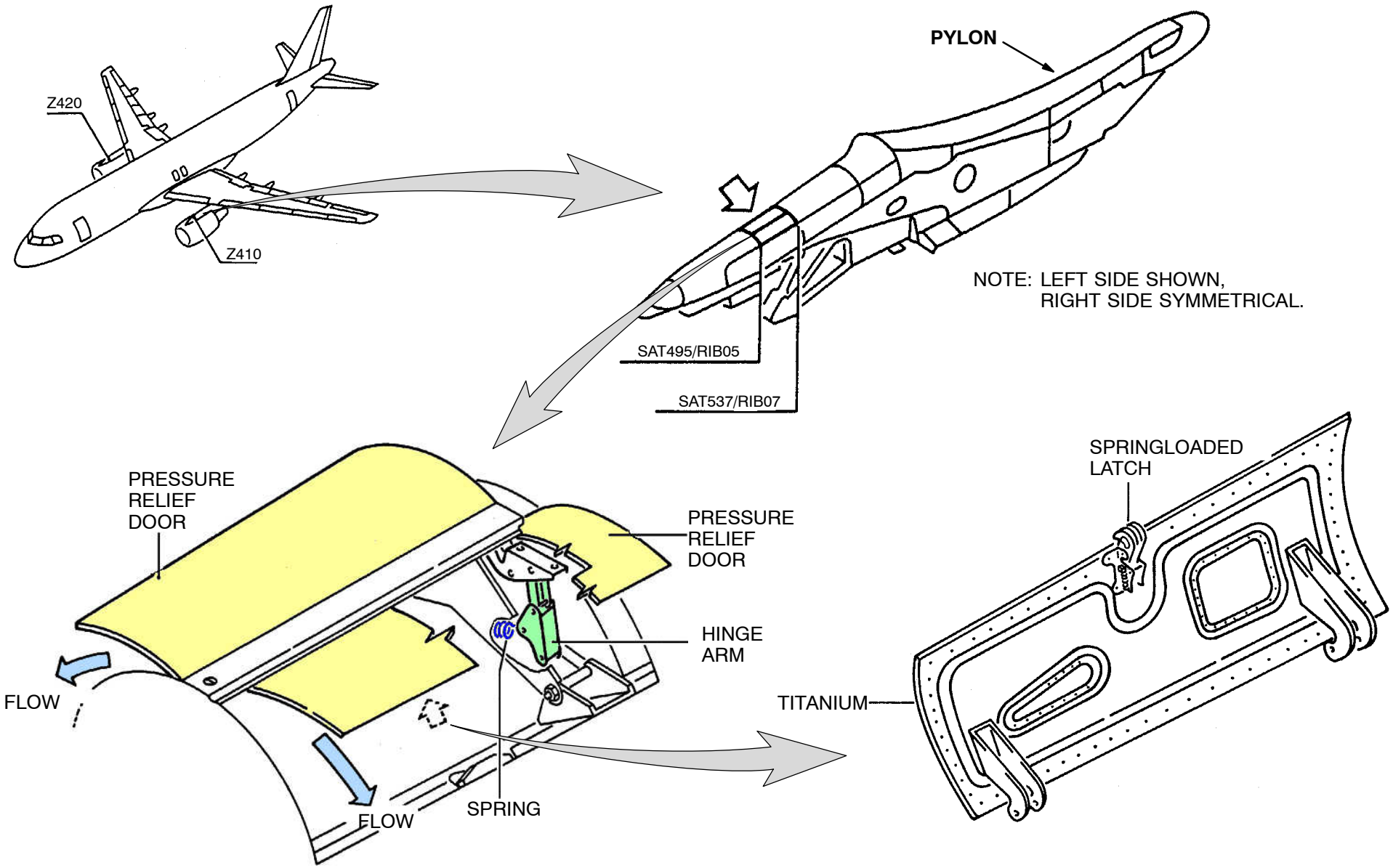


Figure 39 Pressure Relief Door – Pylon Leading Edge

Pylon Pressure Relief Doors

The panel in the pylon/wing interface (471BL, 482BR) is installed with shear rivets, a latch and a piano hinge. It is made of carbon honey comb core in sandwich construction.

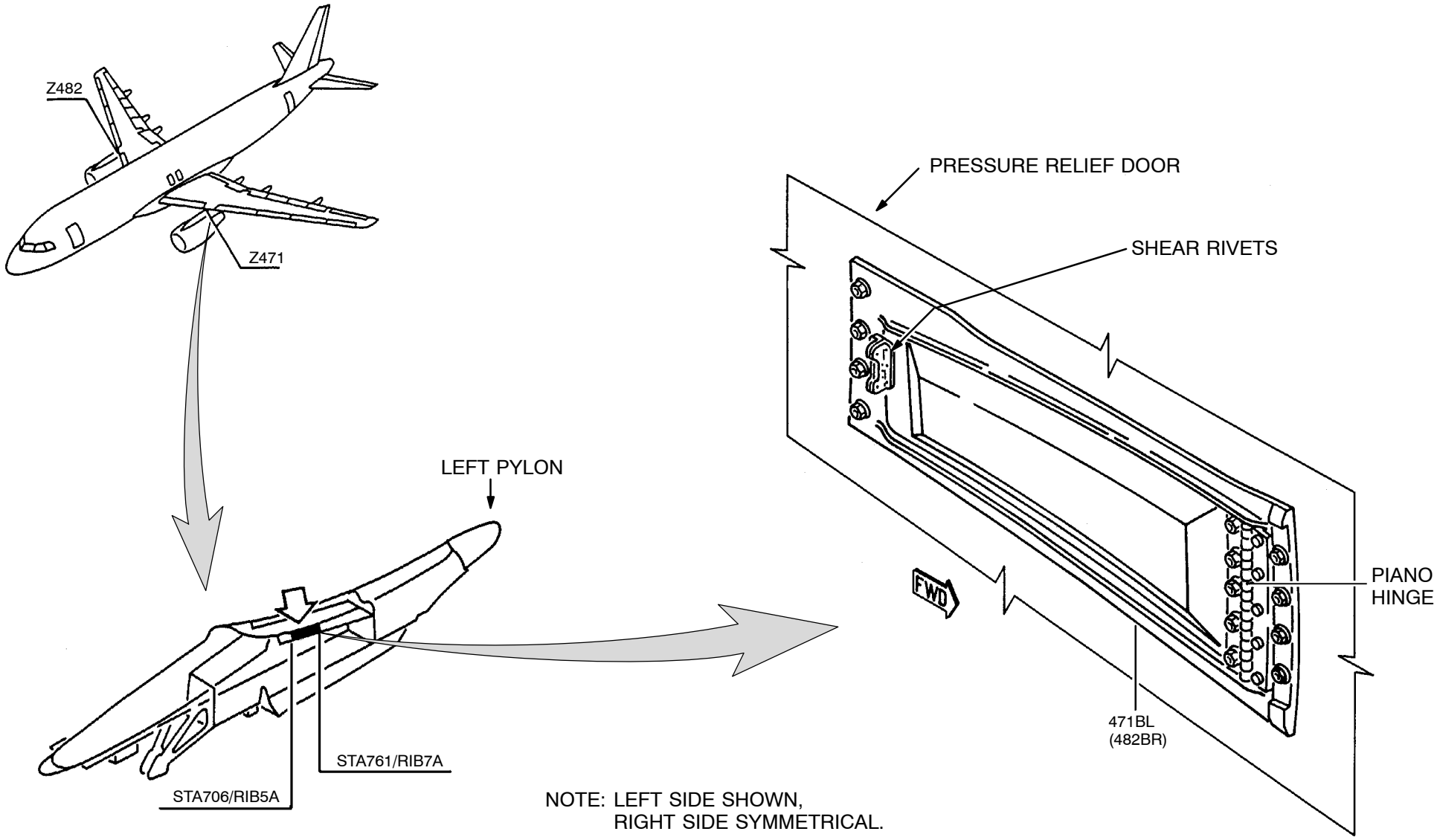


Figure 40 Pressure Relief Door – Pylon/Wing Interface

NACELLE PROTECTION DESCRIPTION

System Layout

This system is made to protect the nacelle. It operates if a pneumatic duct breaks or has a large leak. The system keeps the pressure to a limit. This prevents damage to the nacelle structure and the components installed in the nacelle.

A pressure relief door made of aluminum honeycomb is installed in the right fan cowl of the left and right engine. It protects the fan compartment against a differential overpressure of 0.2 bar (2.9psi).

Two annealed lanyards limit the door travel and keep the door on the fan cowl if it opens. The door is manually latched. When the door opens during flight after an overpressure occurs, it does not latch again automatically if the overpressure decreases. You can see on the ground that the door is open.

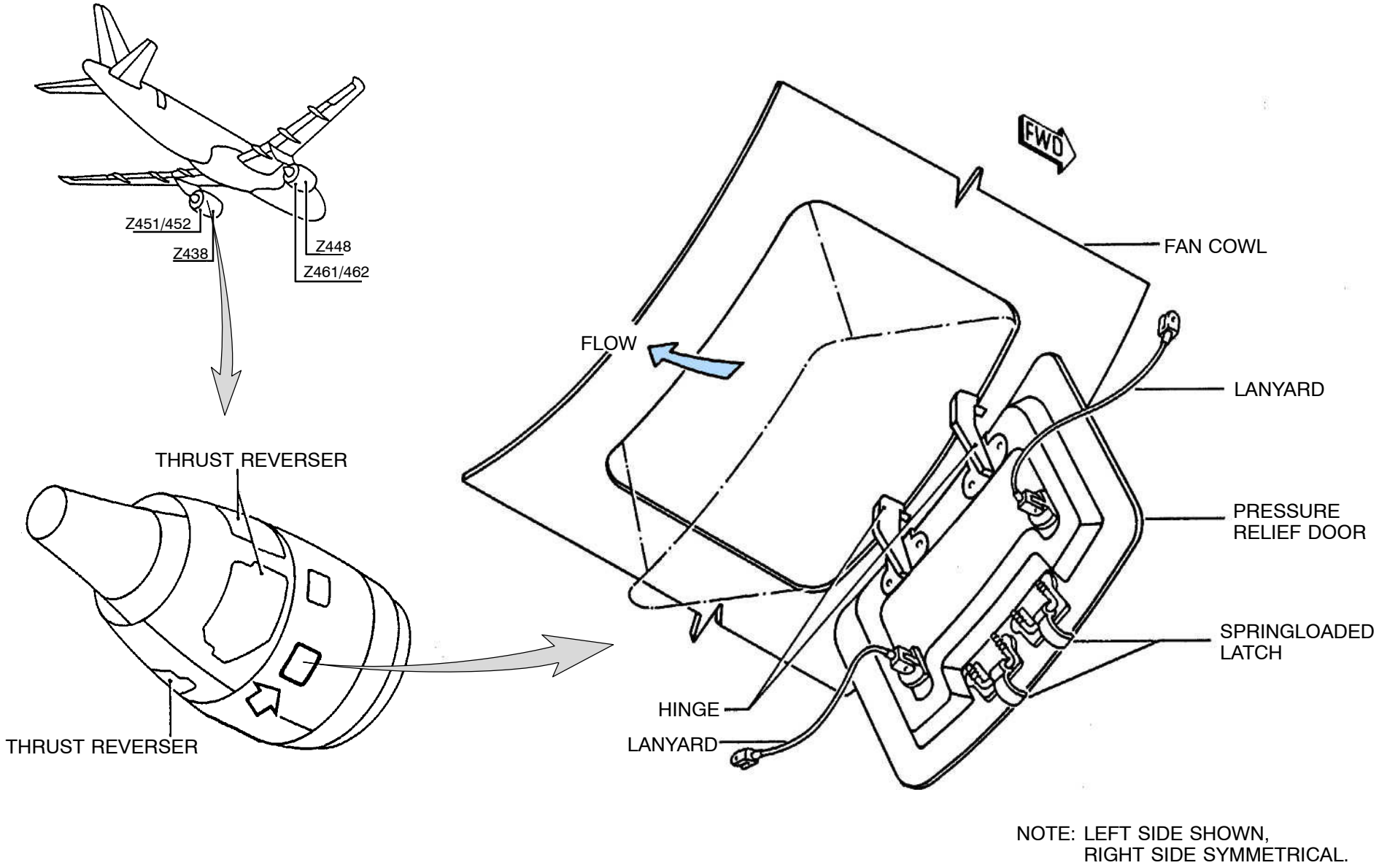


Figure 41 Pressure Relief Door – Nacelle

36–22 AIR LEAK DETECTION SYSTEM

SYSTEM DESCRIPTION

System Layout

The two Bleed air Monitor Computers monitor the seven detection loops (Loop A and B LH wing, Loop A and B RH wing, LH and RH pylon loop and fuselage loop). This continuous monitoring system is designed to detect, by means of detection loops, any ambient overheat. This is to protect the structures and components in the vicinity of the hot air ducts in the fuselage, pylons and wings, on which leaks or bursts may possibly occur.

System Description

- The aircraft leak detection system is divided into the LH and RH zones.
- The division of this zones is the crossfeed valve in the crossfeed duct at STA1537 (FR35).
- Each leak detection system operates independently.
- A single loop system is installed along the bleed air duct between the APU check valve and the APU bleed valve.
- In each of the pylons there is a single loop installed.
- Each loop is located near the pylon ventilation duct.

Both wing/fuselage leak detection system are made up of twin loops (A and B) of overheat sensing elements. This eliminates the possibility of incorrect warnings, due to an ”and” logic.

The overheat sensing elements are installed in each wing along the forward face of the front spar. Clamps and rubber grommets attach the overheat sensing elements at regular intervals along the whole length.

In the fuselage the elements are installed at STA1537 (FR35) and close to the crossover bleed air duct. They continue (LH side elements only) up to the APU check valve on the pressurized fuselage between STA2189 and STA2243.

- For the wing and fuselage the alarm temperature is 124 ± 7°C.
- The pylon alarm temperature quantity is 204 ± 12°C.

The impedance between the conductor and the outer tubing decreases suddenly when the alarm temperature is reached. At this temperature, the center conductor grounds and gives an alarm signal.

Leak Detector Logic RH

The overheat sensing elements continuously monitor the surrounding areas for overheat conditions. They are connected in series and detect overheat conditions at any point along the length of the elements. When only a few inches of the elements are heated to the pre–determined temperature, an alarm is caused. If this occurs, the bleed air supply is shut off automatically.

If one loop is inoperative (loop A or B), the remaining loop takes over. If hot air escapes from the bleed air duct and heats an element of the operative loop, a signal is given.

The signal causes:

- the amber FAULT light on the AIR COND overhead panel to come on
- the activation of the ECAM system.

When the ECAM system is activated:

- the MASTER CAUT light on the panels 131VU and 130VU come on amber
- a single chime gong sounds
- the message on the upper ECAM display unit comes on
- the BLEED page on the lower ECAM display unit comes on.

ATTENTION: The fault light stays on as the overheat condition exists.

The valves associated with the loop close automatically. If the overheat condition is corrected, the circuit must be reset to open the valves.

The different FAULT warnings on the AIR COND overhead panel 30VU are:

- the FAULT legend on ENG 1 BLEED pushbutton switch which comes on if there is an overheat condition in the LH zone (LH pylon, LH wing and LH MID fuselage)
- the FAULT legend on ENG 2 BLEED pushbutton switch which comes on if there is an overheat condition in the RH zone (RH pylon, RH wing and RH MID fuselage)
- the FAULT legend on APU BLEED pushbutton switch which comes on if there is an overheat condition in the MID and AFT fuselage (APU duct)

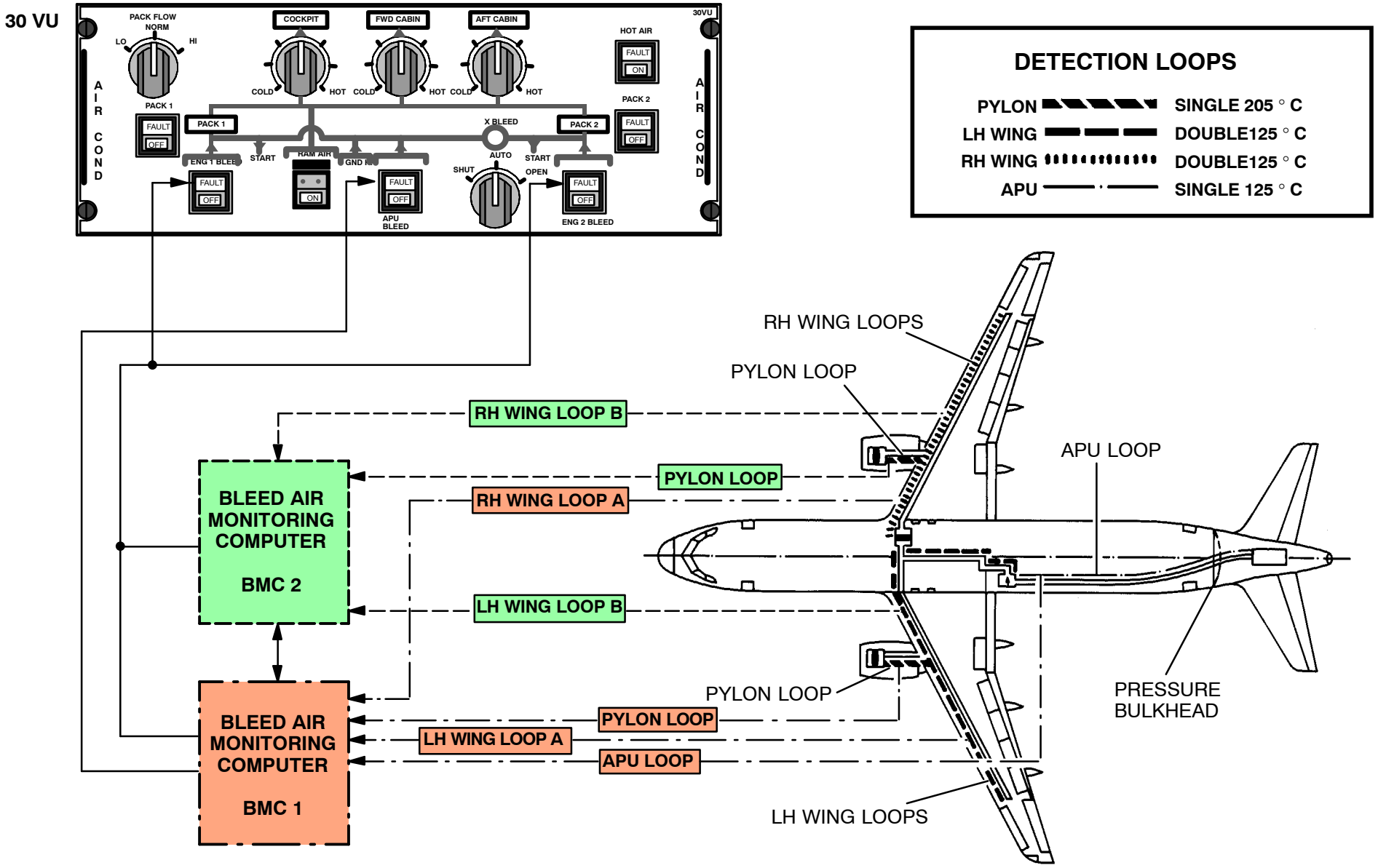


Figure 42 Leak Detection Loops Arrangement

Leak Consequences

At the same time as the FAULT legend on the ENG 1 BLEED pushbutton switch comes on, the following valves close automatically:

- the LH pressure regulating valve
- the LH wing anti–icing (if wing anti–icing system is operative) valve
- the APU bleed valve (APU pushbutton switch is in ON position)
- the crossbleed valve (selector is in AUTO position).

When the FAULT legend on the ENG 2 BLEED pushbutton switch comes on, the following valves close automatically:

- the RH pressure regulating valve
- the RH wing anti–icing valve (if wing anti–icing system operative).

When the FAULT legend on the APU BLEED pushbutton switch comes on, the APU bleed valve closes automatically (the APU pushbutton switch is in ON position).

Engine start sequence prevents that the APU bleed valve and the crossbleed valve (selector is in AUTO position) close.

A functional test can only be carried out on the ground by automatic control activation. It checks the outputs or status of each leak detection loop in–turn. The maintenance test permits the maintenance crew to check a specific function of the system. Additionally, the maintenance test finds a failed LRU (**L**ine **R**eplaceable **U**nit).

ECAM Warnings

- AIR ENG 1 (2) BLEED LEAK
- AIR APU BLEED LEAK
- AIR L (R) WING LEAK
- AIR L (R) WING LEAK DETECTION FAULT

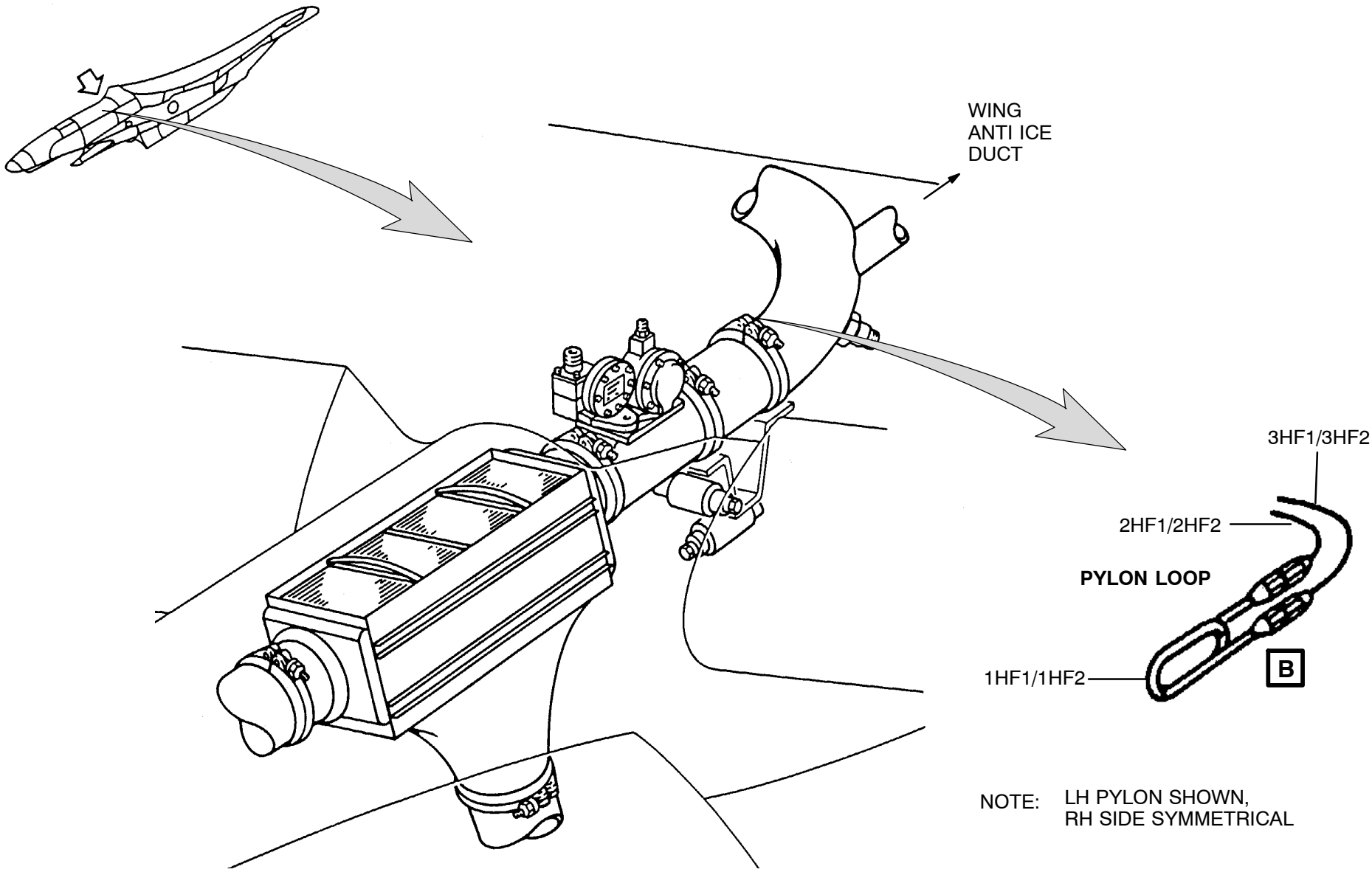


Figure 43 Leak Detection Pylon Loops

36–11 ENGINE BLEED AIR SUPPLY

BMC BITE

BMC POWER UP TEST

Initialization of Power-Up Test

When the aircraft electrical network is energized and the circuit breakers are closed the BMC‘s start a power - up test for 10sec.

During this test all electrical inputs and outputs are monitored, also a integrity test of the computer is performed.

In case of a abnormal behavior of the BMC‘s a reset can be tried by opening/closing the circuit breakers. The BMC‘s then start a new power - up test if they were deenergized longer than 1sec.

Results of Power-Up Test

- TEST PASSED:

  normal indication.
- TEST FAILED:

  none because the opposite BMC is taking over the functions of the faulty one.

  To isolate the fault use CFDS, if both BMC failed, the following messages are displayed:
  - ECAM: Bleed Monitoring Fault
  - ECAM BLEED PAGE: xx are displayed in place of temperature, pressure indication and valve positions.

SYSTEM REPORT/TEST BMC

The bleed system can be tested using the CFDS System Report/Test menu.

Six CFDS PNEU. menu functions are available:

- LAST LEG REPORT
- PREVIOUS LEGS REPORT
- LRU IDENTIFICATION
- CURRENT STATUS
- CLASS 3 FAULTS
- TEST

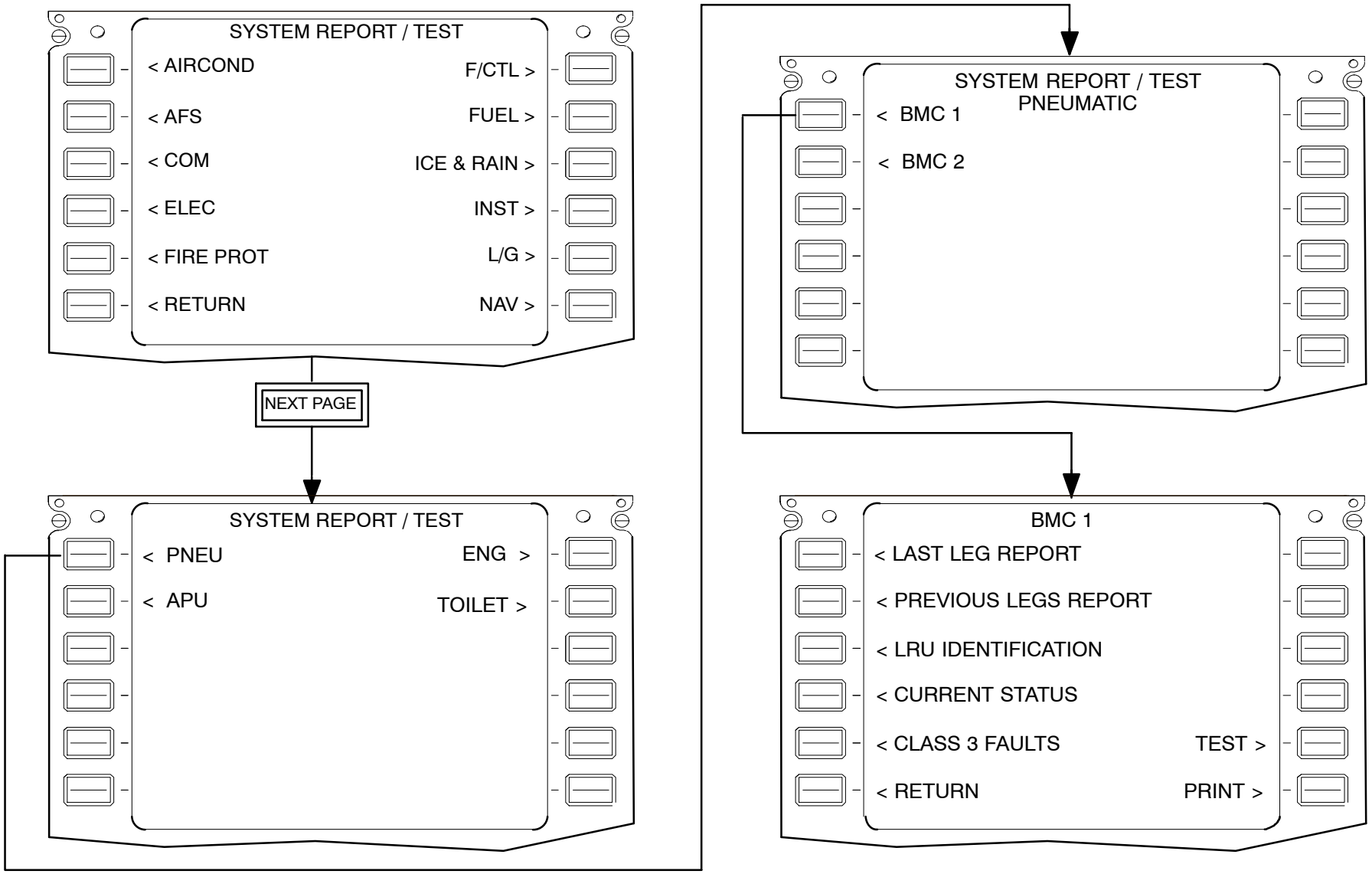


Figure 44 MCDU Utilization

LAST LEG REPORT

This report shows all faults during the last flight leg.

PREVIOUS LEGS REPORT

This report presents all faults which occurred during the last 64 flight legs

LRU IDENTIFICATION

This menu shows the partnumber of the BMC1 (2)

TEST

When the test is activated via the MCDU, a electrical operational test of the bleed system is carried out through the BMC.

The test program includes:

- BMC integrity test
- check of sensors
- check of interfaces
- check of APU, engine and wings leak detection system.

NOTE: Only a test of the electrical components is carried out. The test does not operate the pneumatic valves.

CURRENT STATUS

When the Current Status is activated the BMC 1 (2) sends a snapshot of the current system status.

This system status is displayed in numerical codes for five labels from BIT 11 to 29.

- LABEL 064/066 = ENGINE 2
- LABEL 065/067 = ENGINE 1
- LABEL 055 = APU

A decoding table is in the AMM 36-11-00

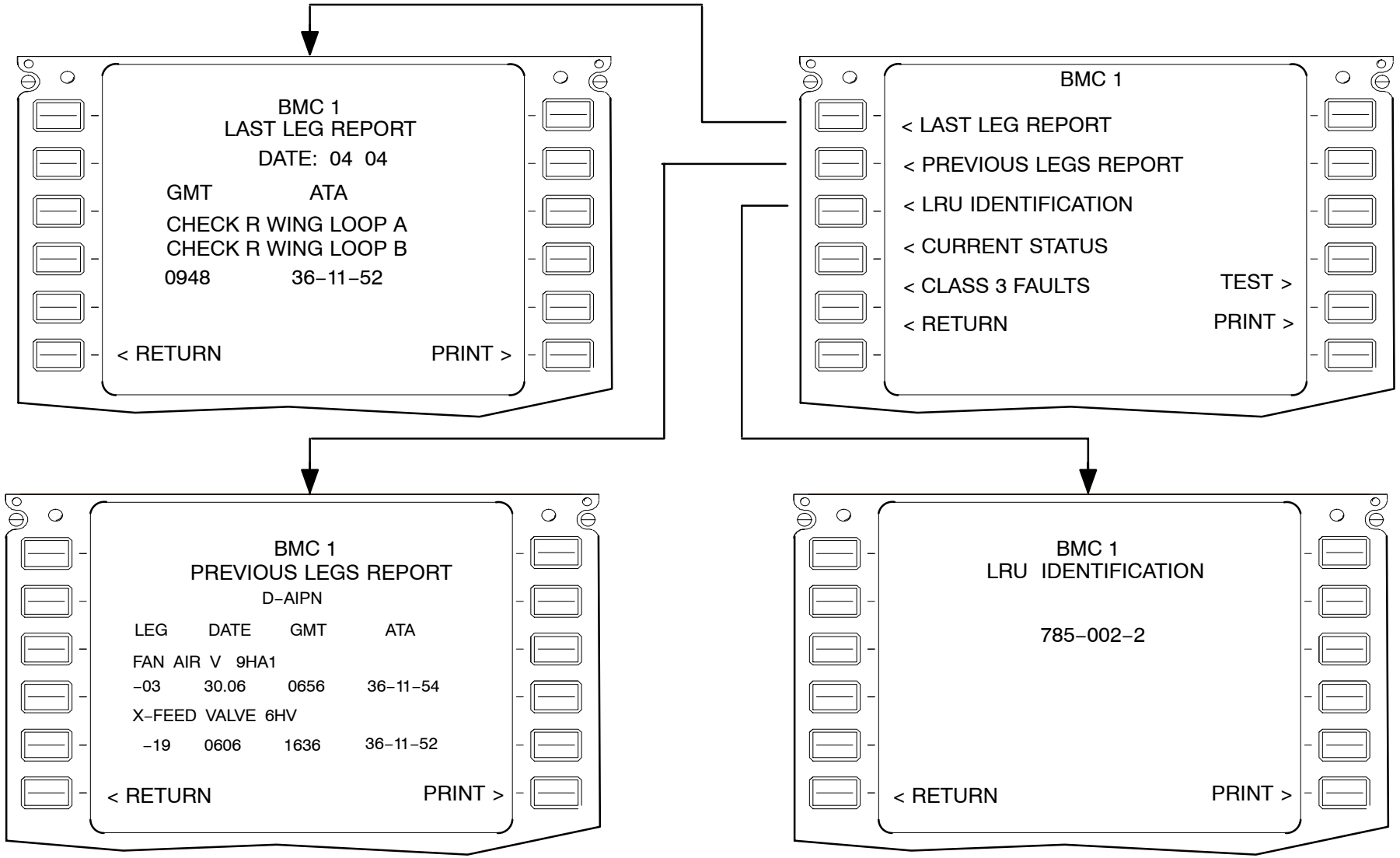


Figure 45 BMC Reports & LRU Identification

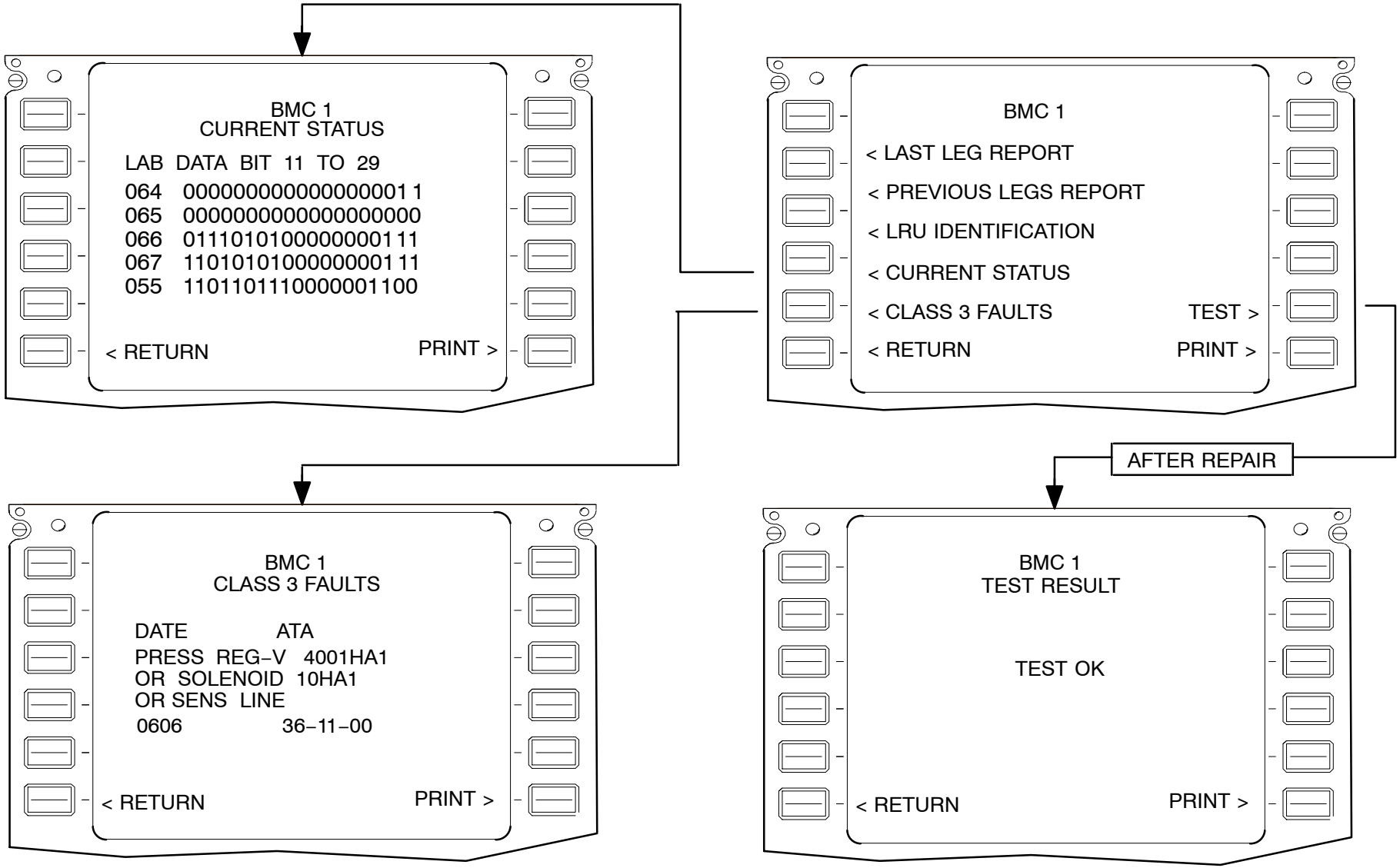
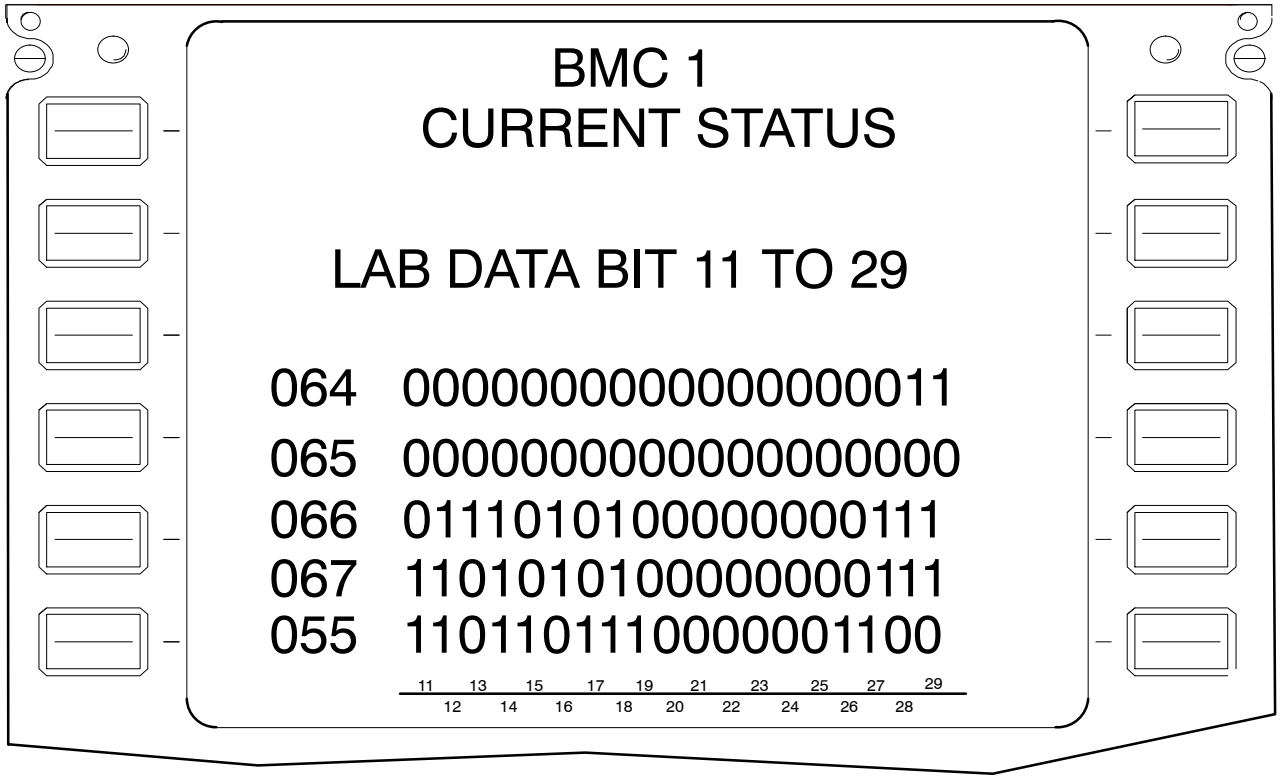


Figure 46 BMC Class 3 Faults & BMC Test



NOTE: BMC 1 CURRENT STATUS IS IDENTICAL TO BMC 2 CURRENT STATUS

Figure 47 BMC 1 (BMC 2) Current Status

36–10 ENGINE BLEED AIR

COMPONENTS LOCATION V2500

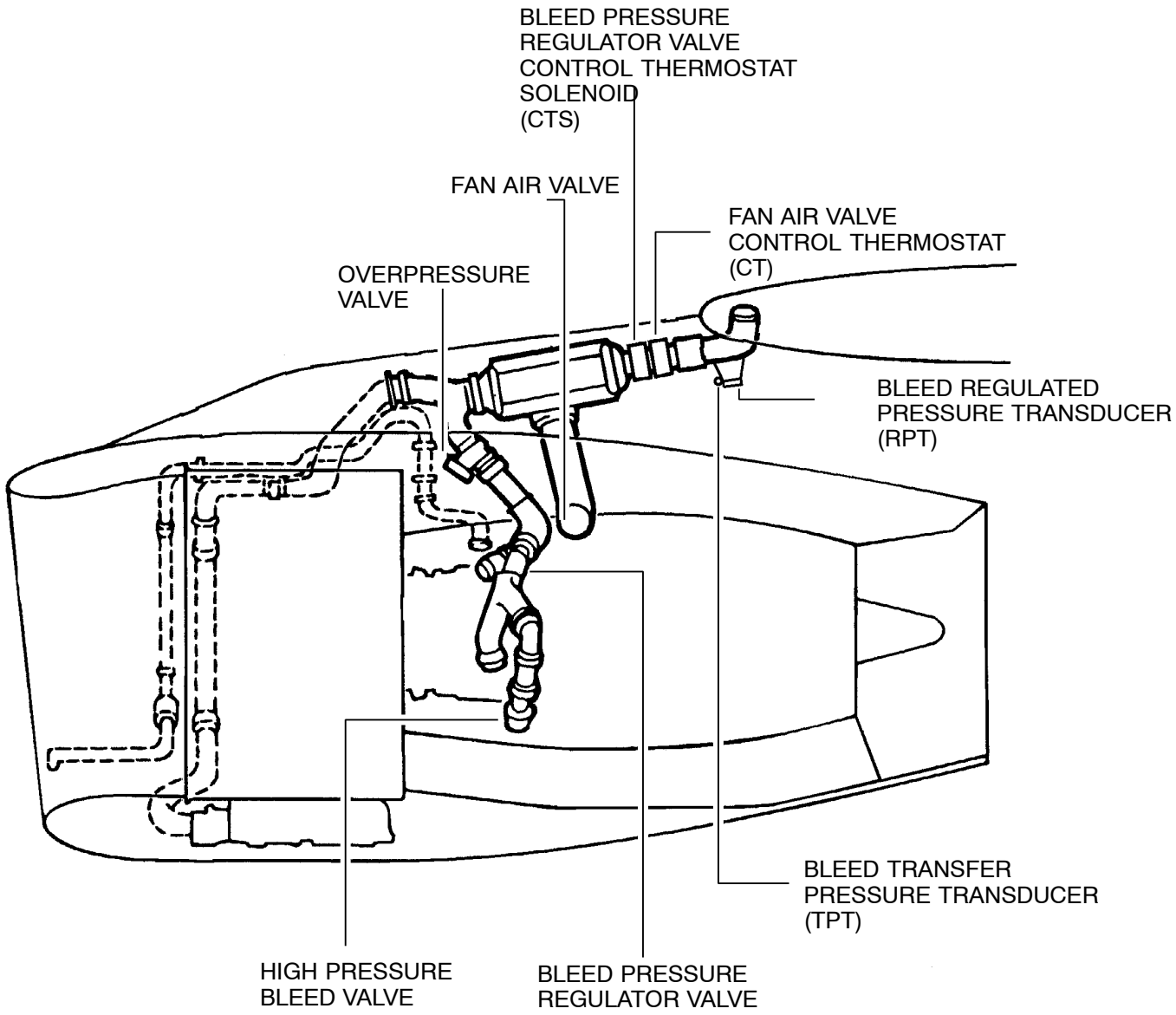


Figure 48 Engine V2500 Bleed Components Location

HP BLEED VALVE OPERATION (V2500)

Function

To avoid an unscheduled opening of the high pressure bleed valve during normal bleed operation in flight, the high pressure bleed solenoid valve will be energized above a PS3 pressure of 110psi and will vent the actuating opening pressure of the high pressure bleed valve. Thus the high pressure bleed valve will close.

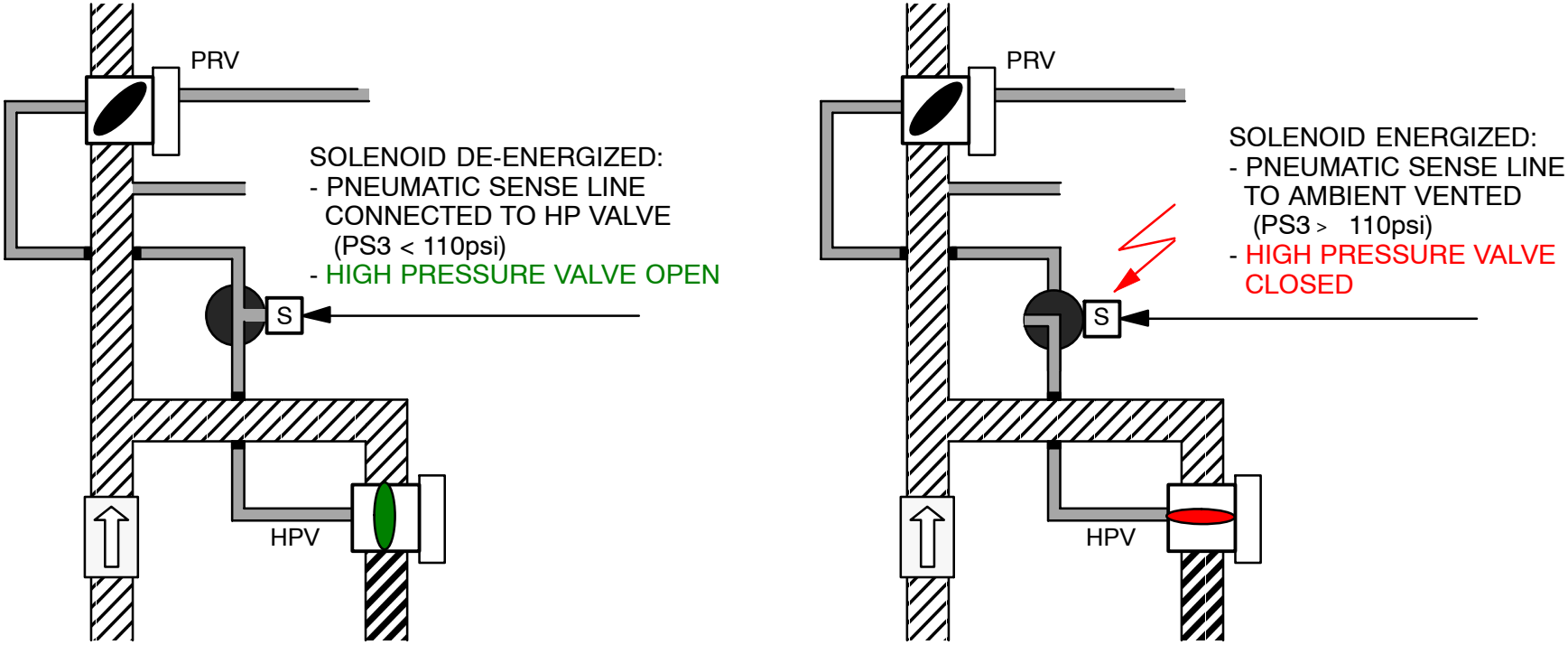


Figure 49 High Pressure Bleed Valve Control

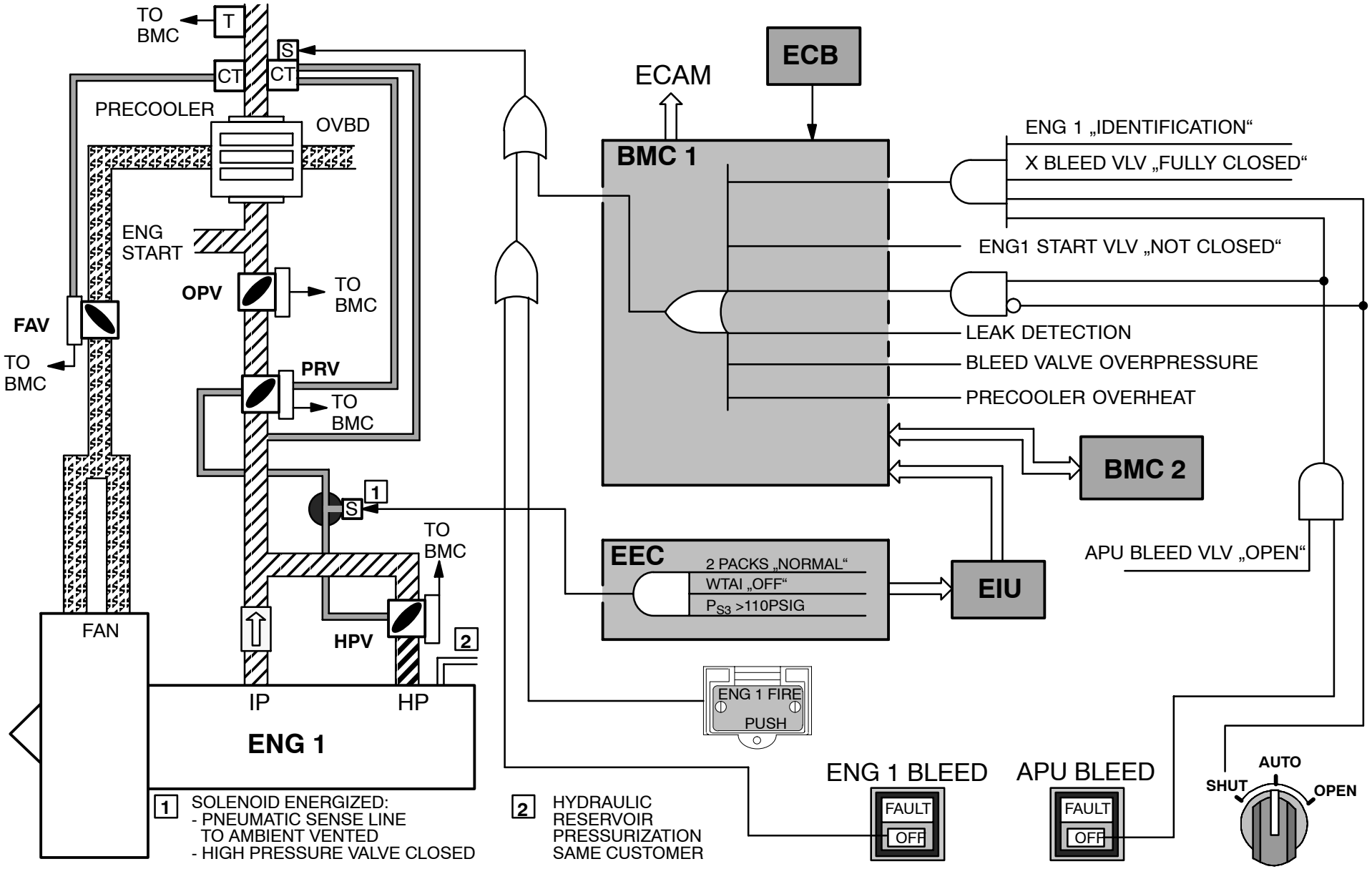


Figure 50 IP/HP Bleed Switching Override Schematic

HPV SOLENOID LOCATION (V2500)

The high pressure bleed valve solenoid valve is located on the right side of the V2530 engine fan case.

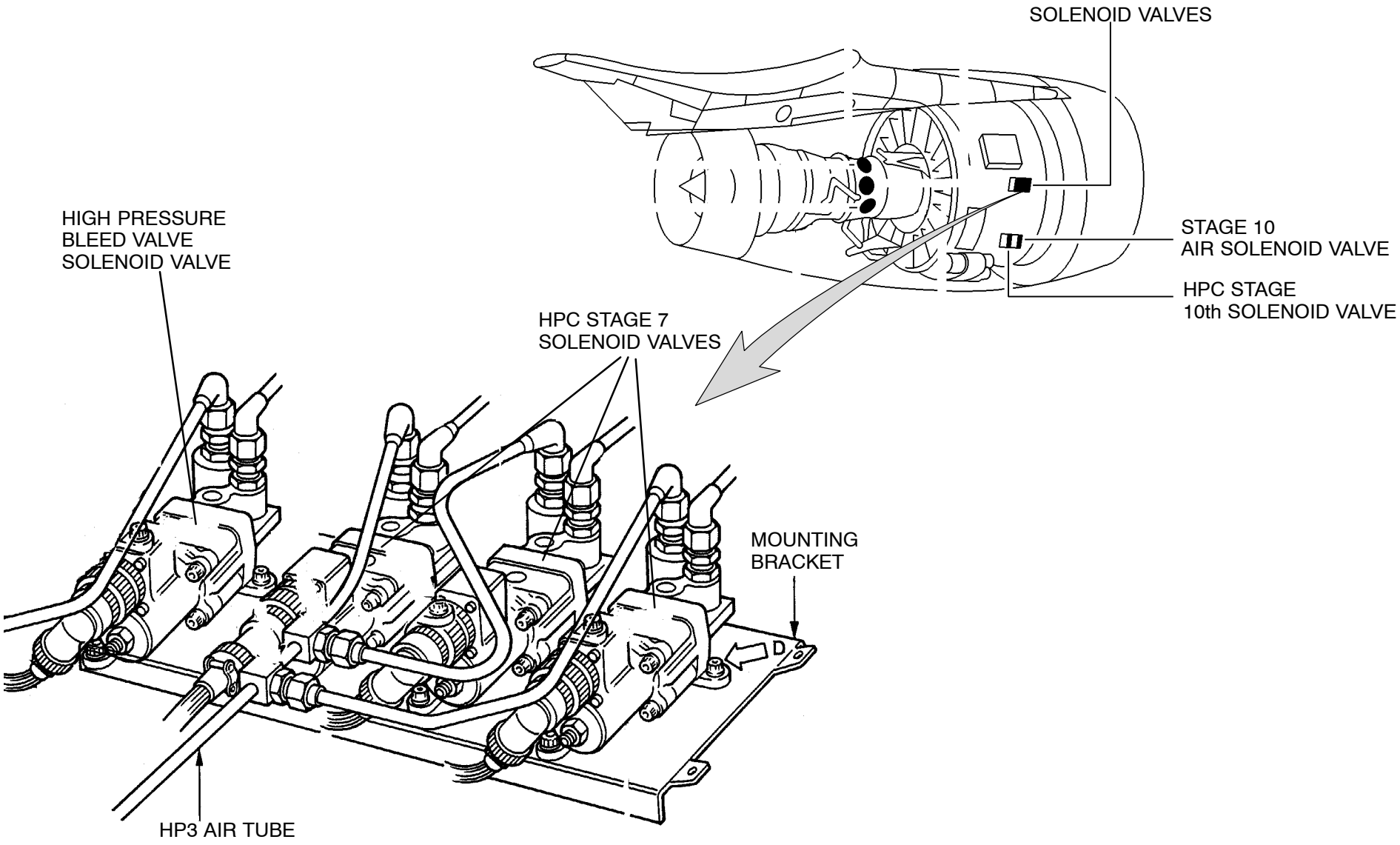


Figure 51 High Pressure Bleed Solenoid Valve

36–11 ENGINE BLEED AIR SUPPLY

IP/HP BLEED SW OVRD OPERATION (A319 CFM56)

NOTE: This system is only installed on A319 powered by CFM56-5A or CFM 56-5B engines.

System Layout

In order to avoid any risk of having A319 high altitude cruise (35000 - 39000ft) with cabin bleed air from the HP bleed port of the engine an IP/HP bleed switching override system has been installed.

The High Pressure Valve (HPV) is controlled to the closed position using the sense line between the HPV and the Pressure Regulating Valve (PRV) by venting it to ambient through a solenoid valve.

The solenoid valve is installed on the engine pylon and commanded upon a BMC signal through the relay. The solenoid is energized to open (bleed) by the BMC.

System Function

The opening of the solenoid is possible when:

- Engine Rating is above Idle
- The Wing Anti–Icing System is selected OFF
- A/C Altitude >15000 ft
- Pack Configuration is Normal (X–Bleed Valve is Closed)
- Ps3–P0 >80psig

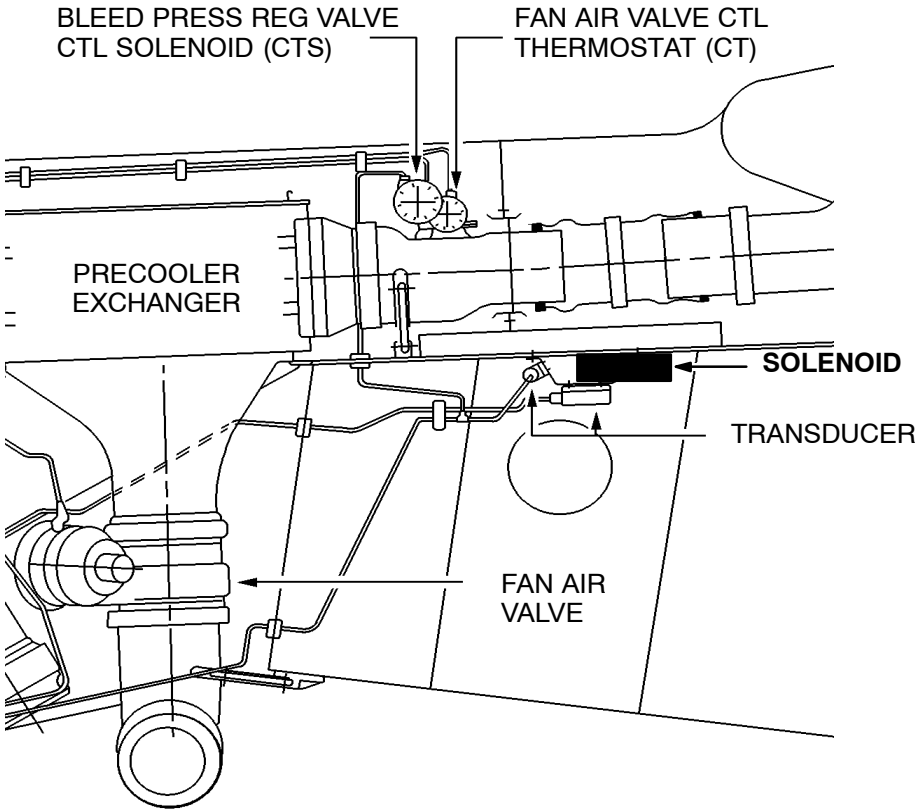


Figure 52 Solenoid Location

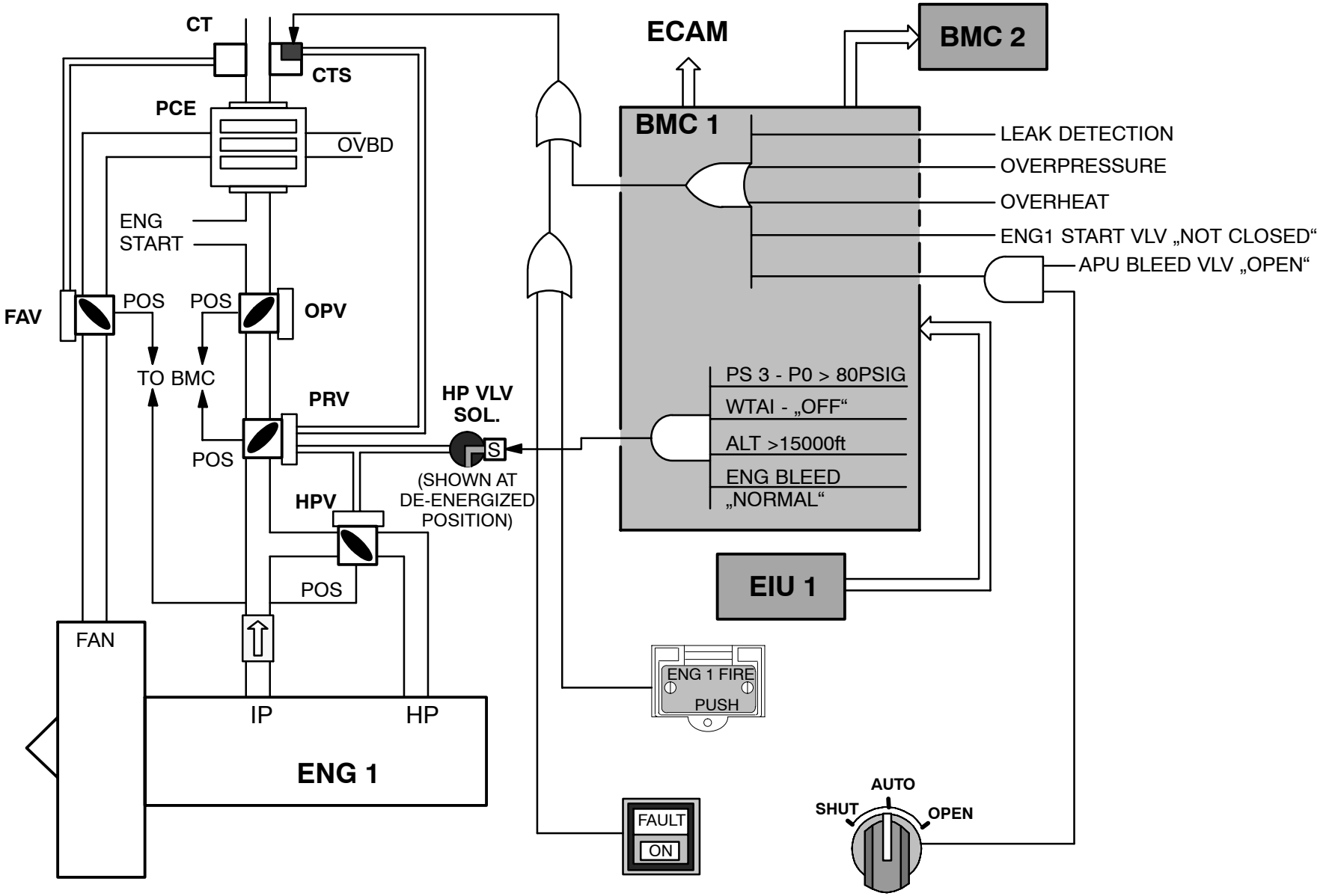


Figure 53 IP/HP Bleed Switching Override Schematic

ATA 30 ICE & RAIN PROTECTION

30–11 WING ICE PROTECTION

SYSTEM DESCRIPTION

General

The wings are the only airfoil sections to be protected against icing conditions. The leading edge slats 3, 4 and 5 are thermally anti–iced by a manually selected hot air system which directs engine bleed air into the leading edges of the slats.

Air for ice protection is supplied by the pneumatic system; the flow being controlled by a pressure control/shut–off valve. The pneumatically powered control/shut–off valves are selected open when power is supplied to the electrical circuit. Airflow trimming restrictors are fitted downstream of each valve.

The air leaving the control valves passes through ducts in the wing fixed leading edge to a telescopic duct which routes the air to the inboard end of the piccolo duct in slat 3. Air is distributed along slats 3, 4 and 5 by piccolo ducts interconnected by flexible couplings.

The leading edge surfaces of the relevant slats are heated with air discharged from the piccolo duct on to the inner surface of the slat skin.

Slots in the upper surface of the slat spar direct the air to the upper surface of the rear of the slat. The air is exhausted through vents situated along the rear skin of the slat, and then discharged overboard through the gap between the slat lower surface trailing edge and the fixed leading edge.

When only one engine is available to supply hot air, the pneumatic system crossfeed duct is used to supply both wings from one engine.

The wing ice protection system can only be operated continuously while the aircraft is flying, but can be tested on the ground for a limited period (30 sec.).

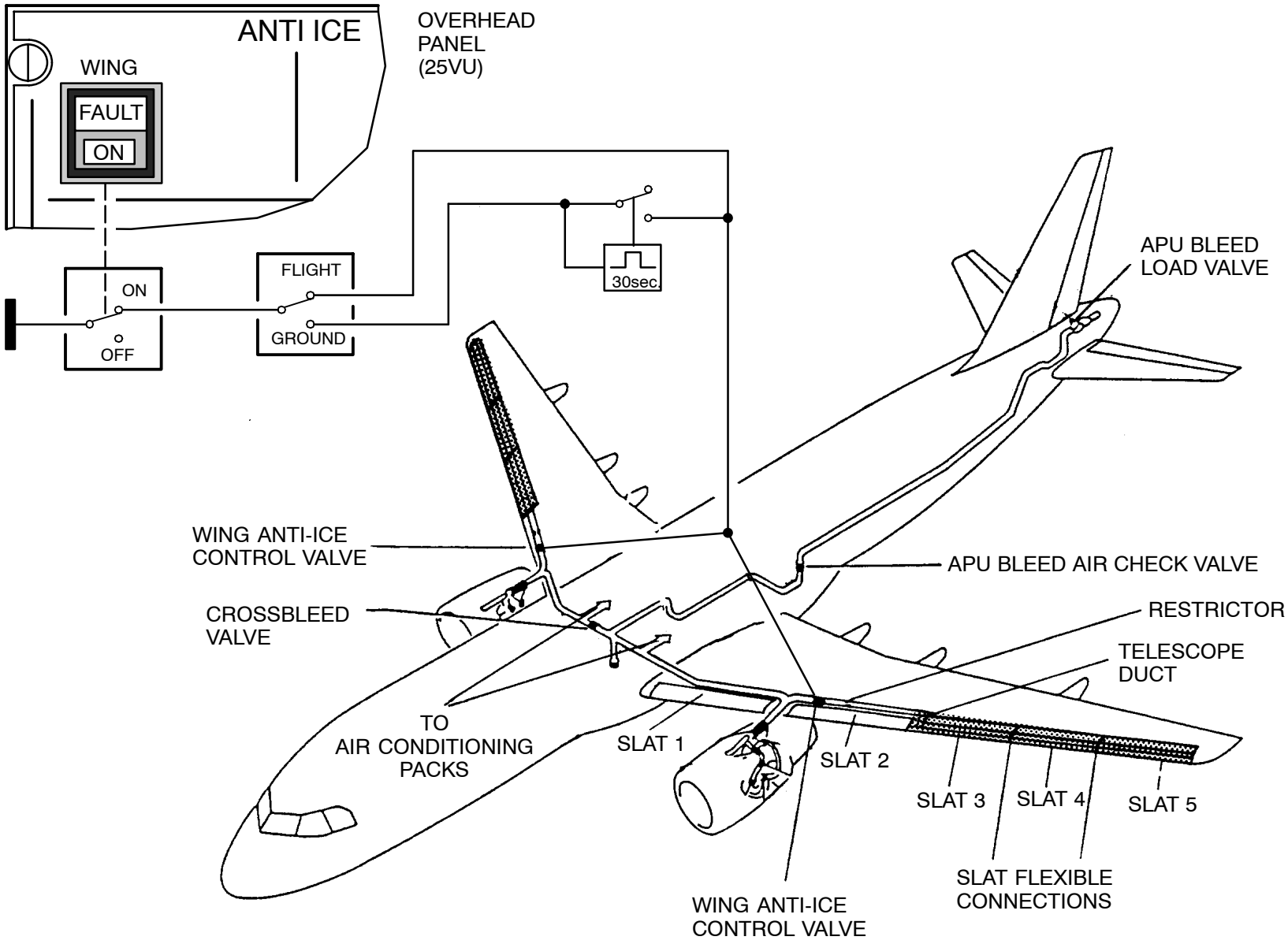


Figure 54 Wing Anti Ice System

CONTROL AND INTERFACES

General

These components interface with, or are in, the wing ice protection system:

- the anti–ice valve control–switch,
- the SDAC (**S**ystem **D**ata **A**cquisition **C**oncentrator) /ECAM (**E**lectronic **C**entralized **A**ircraft **M**onitoring),
- the Environmental Control System Zone Control and Bleed Status Computer (ECS computer),
- the CFDS (**C**entralized **F**ault **D**isplay **S**ystem),
- the landing–gear oleo proximity–switches.

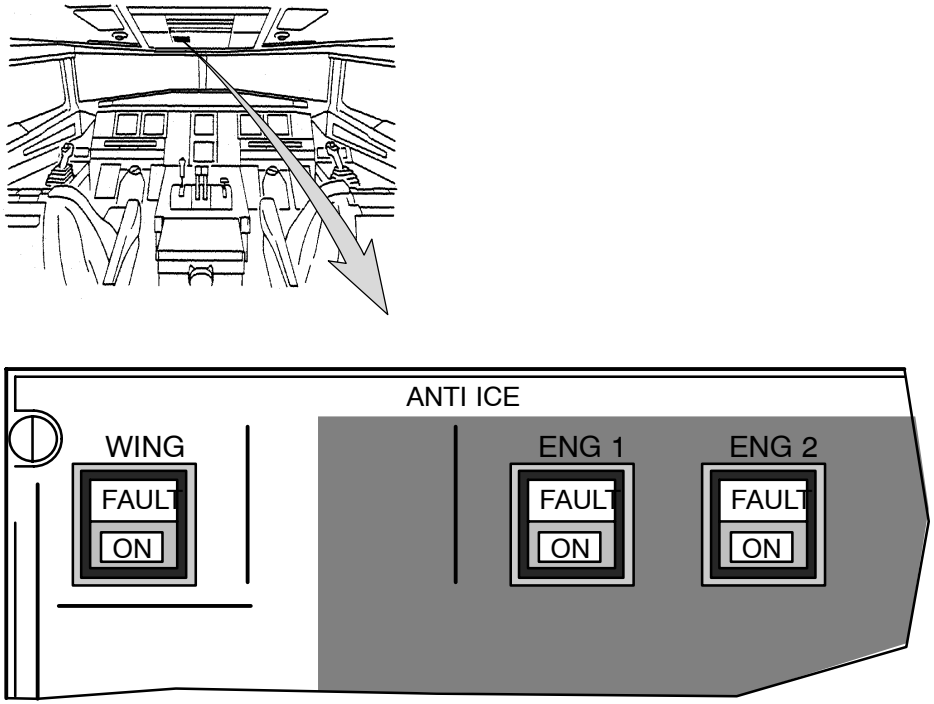


Figure 55 OVHD Panel (25VU)

Wing Anti-Ice P/BSW

ON:

(P/B switch in) the ON light illuminates blue

- The P/B ”ON” signal is send via the EIU to the FADEC of both engines and both engines will increase the N2 RPM to the bleed idle demand value. (approx 68% N2)
- both wing anti ice valves open (solenoid energized) when the pneumatic pressure is >10 psi. The open signal from the wing anti ice valves is also send via the EIU to the FADEC of both engines.

NOTE: On ground always the Wing Anti Test sequence is initiated and the valves open only for 30 sec.

- On the ECAM memo page the ”WING ANTI ICE” message appears in green.
- On the ECAM bleed page the ”ANTI ICE ” message appears.

OFF:

(P/B switch out) Wing anti ice valves close

- both engines return to minimum idle
- The ECAM messages disappear.

FAULT - LIGHT

- illuminates during valves transit
- illuminates if the valves position disagree.

NOTE: As long as the wing anti ice P/B is pressed in or a anti ice valve remains open when the wing anti ice P/B is released, both engines get the bleed demand signal (increased Idle RPM).

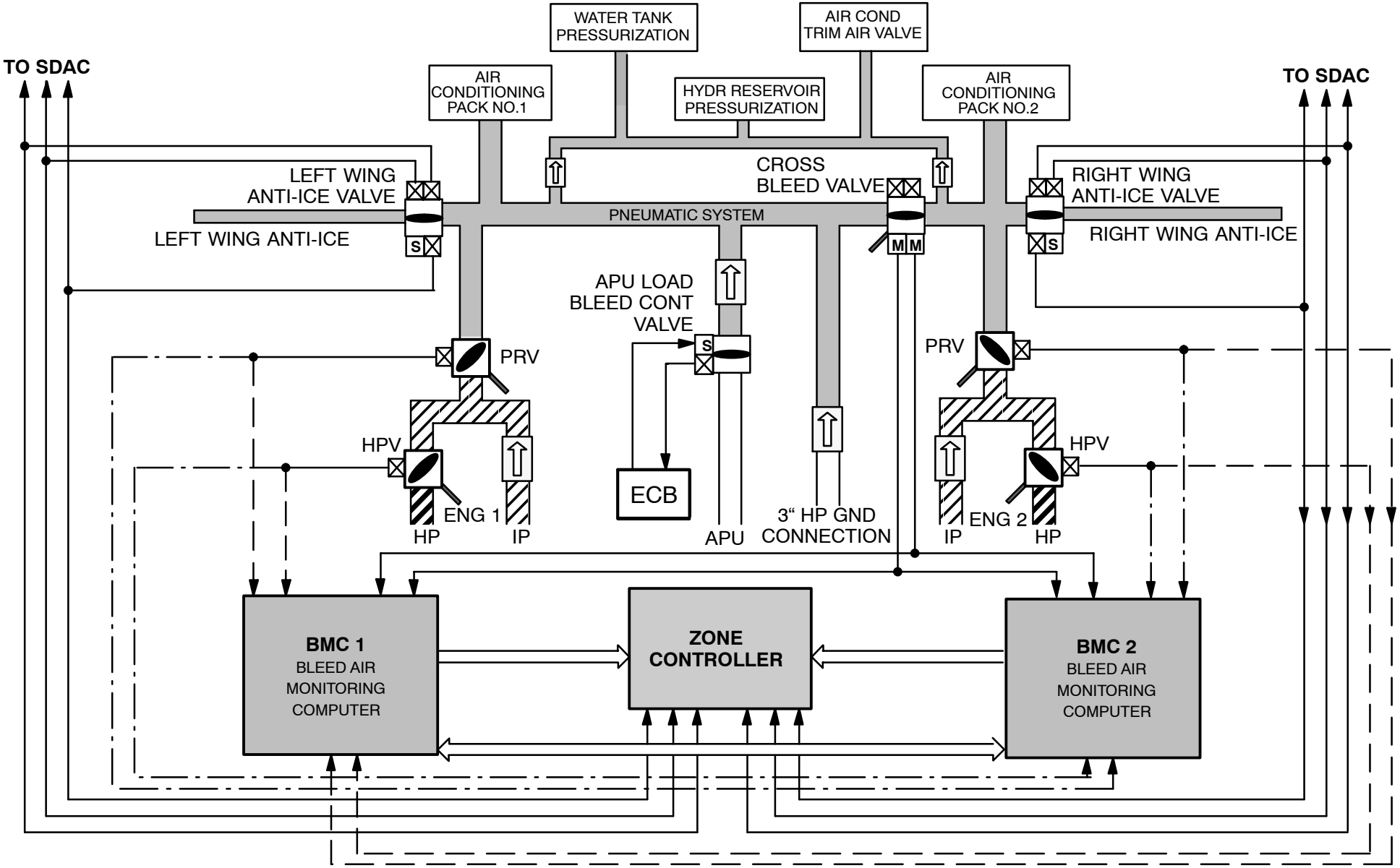


Figure 56 Wing Anti Ice Schematic

WING ICE PROTECTION INDICATION

Anti Ice

Displayed in **WHITE** when the Wing Anti Ice system is switched ON.

LH and RH Wing symbols are shown.

Anti Ice Symbol

No Symbol Displayed:

- Wing Anti Ice Valves Closed (WTAI OFF).

Symbol Displayed in **GREEN** when:

- LH/RH Wing Anti Ice Valve Open.

Symbol (s) Displayed in **Amber** when:

- Switch/Valve Position Disagree,
- the Valve is Open and Air Pressure (Valve Down Stream Pressure) LH or RH is to Low (≤ 13psi) or to High (≥ 32psi),
- the Valve is Open for more than 10sec on GRD.

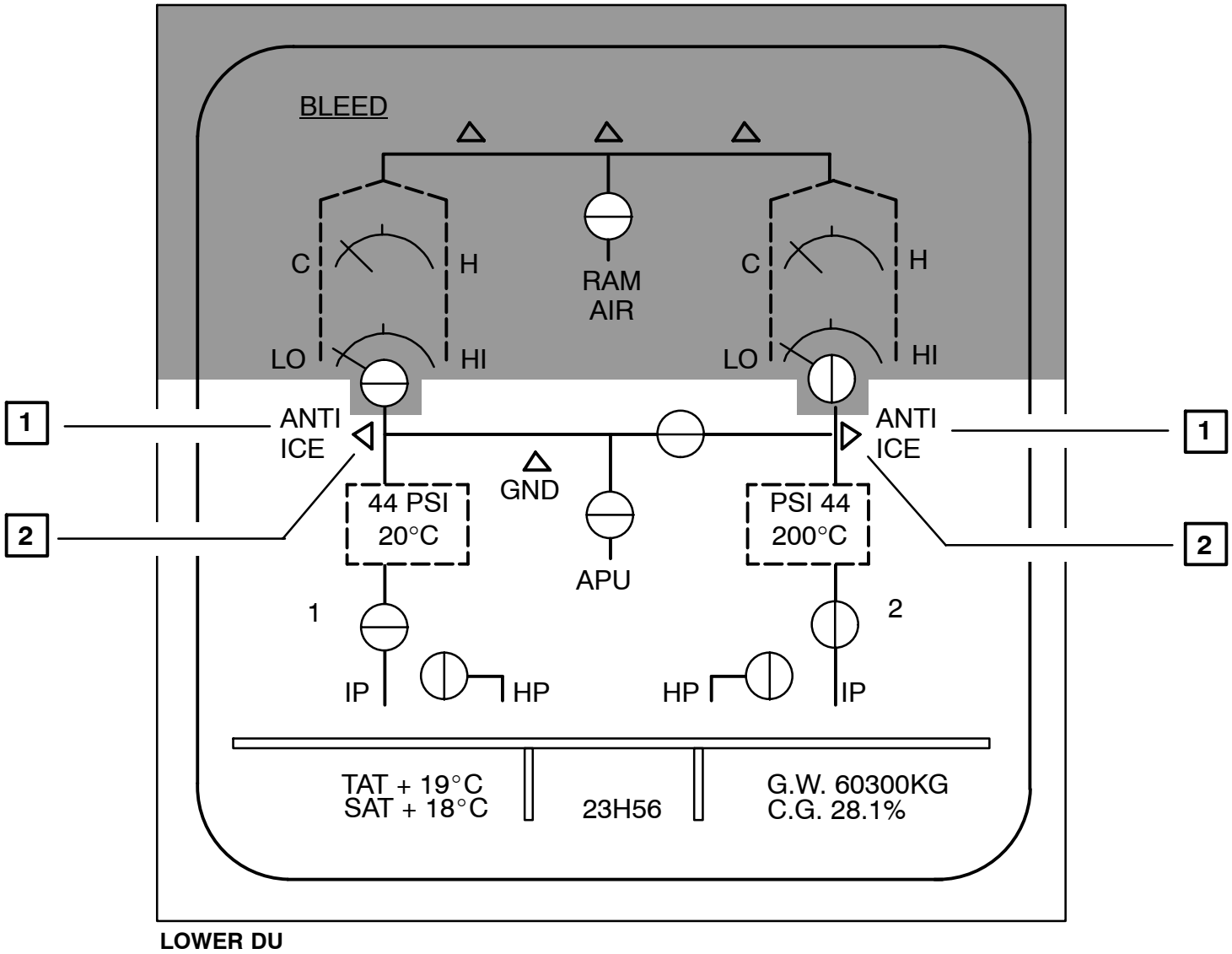


Figure 57 WAI Protection Indication (1/2)

WING ANTI-ICE ECAM WARNINGS AND MESSAGES

ECAM–Warnings/Messages

Possible ECAM Warnings are presented on Upper Display Unit.

(Engine and Warning Display Unit)

Wing Anti Ice on GND

Message appears If the Valve (s) remains Open on GRD for more than 35 s after Wing Anti Ice is selected on.

System Fault

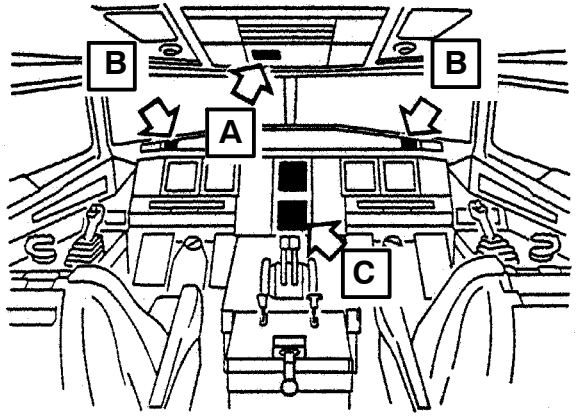
Appears if Valve is not Open when Wing Anti Ice Selected ON.

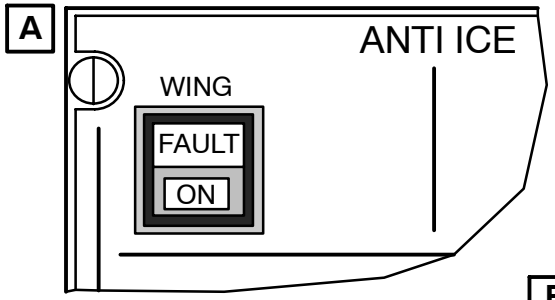
LH (RH) Valve open

The Valve not Closed message is presented when Wing Anti Ice selected Off.

HI PR

HI PR advice appears if VLV Down Stream Pressure is $\geq$ 32 psi.





130 VU

131 VU

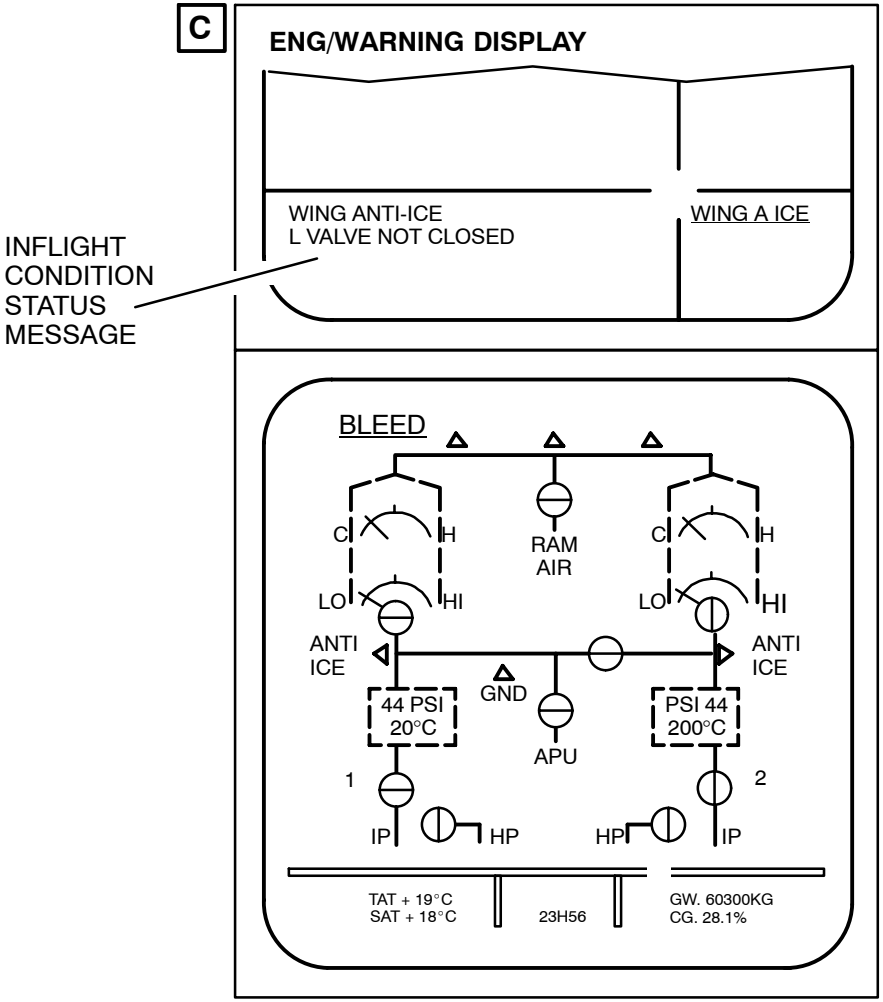


Figure 58 WAI Protection Indication (2/2)

WING ANTI ICE VALVE DESCRIPTION

Description

Two wing anti–icing control–valves are fitted to the aircraft, one in each wing leading–edge outboard of the engine pylons.

A single ON/OFF switch on the cockpit overhead panel (25VU) operates both valves.

The wing anti–icing control–valve has these primary components:

- an actuator assembly,
- a butterfly control,
- a pilot–valve assembly,
- a solenoid valve,
- a valve position microswitch,
- two pressure switches,
- two ground test connections.

Isolates the anti–icing hot–air supply from the pneumatic system when the anti–icing is not required.

Regulates the pressure of the hot air tapped from the pneumatic system for wing anti–icing to 20 psi.

Is an electrically–controlled, pneumatically–operated valve.

it opens when the solenoid is energized and the pneumatic pressure is >10 psi

In the event of an electrical failure, the valve will automatically fail to the closed position.

The valve has a high pressure switch which will trigger a ECAM warning if the downstream pressure is > 32psi.

The valve has a low pressure switch which will trigger a ECAM and a wing anti ice FAULT warning if the downstream pressure is <13 psi.

A visual/mechanical indicator of determining the valve position.

A microswitch in the anti–icing valve senses when the valve is closed and provides a CLOSED/NOT CLOSED signal to the Environmental Control System Zone Control and Bleed Status Computer (ECS computer) and the Electronic Centralized Aircraft Monitoring (ECAM) system.

Automatic Test and Test Monitoring

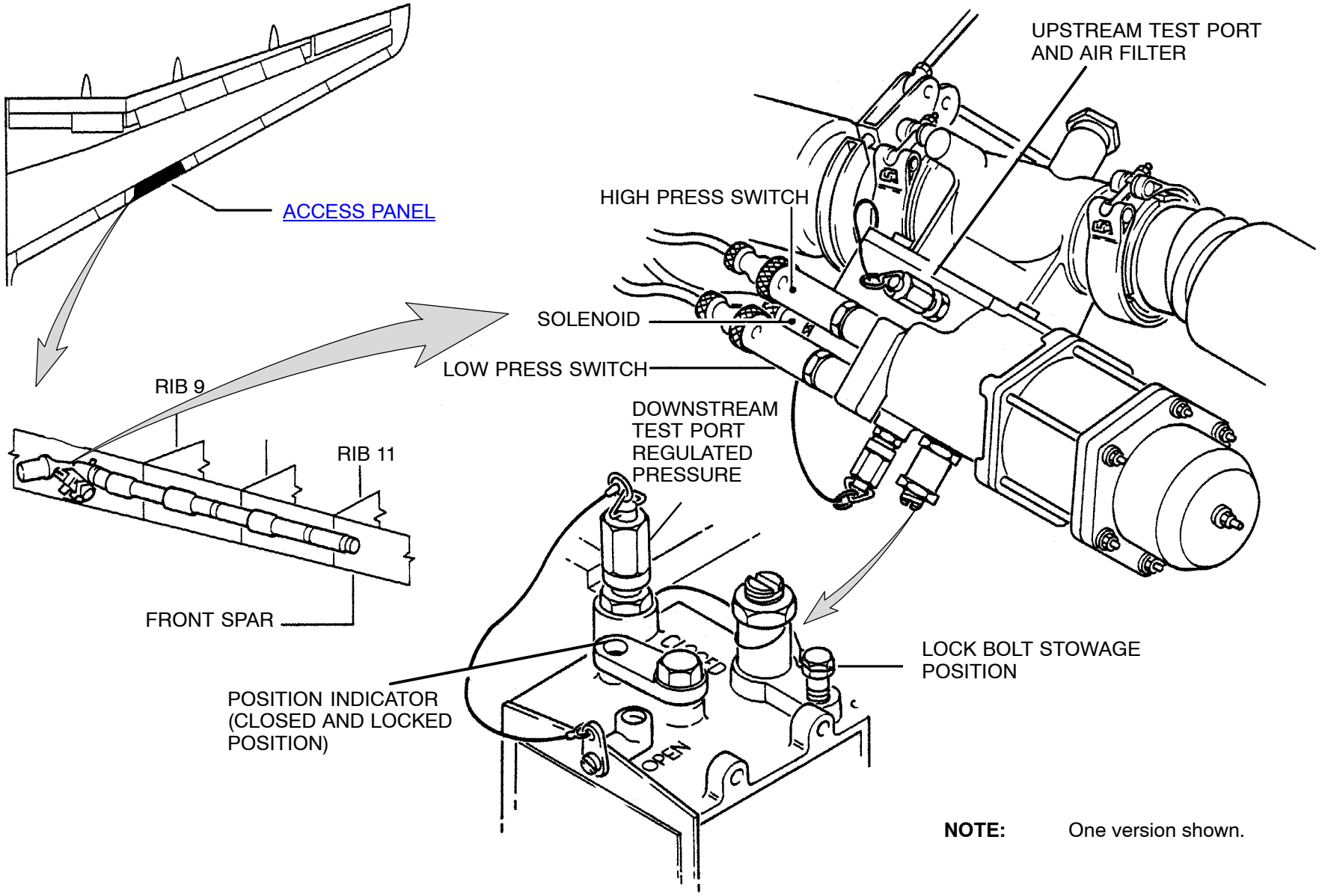
When the aircraft is on the ground, the automatic test facility is initiated whenever the control switch (3DL) is selected ON and is terminated after 30 seconds by the time delay relay.

SDAC/ECAM monitors the test function and in the event of the test running for 35sec or more, the ECAM signals a SHUT DOWN PNEUMATIC SYSTEM warning message, to prevent overheat damage to the slats.

At the start of the test sequence, the amber warning light on the glareshield will be illuminated until the pressure in the system has risen above the low pressure setting.

In the event of a power failure to the electrical control system, the amber fault light will be illuminated whenever power is available to the aircraft 5V warning–light system.

Access to the wing anti–ice system on the CFDS is via TEMP CTL of the air–conditioning class 3 faults.



NOTE: One version shown.

Figure 59 Wing Anti Ice Valve

AIR SUPPLY DUCTS DESCRIPTION

Flow Restrictor

The flow restrictor is in the anti-ice duct, downstream of the anti ice control valve. The internal diameter of the flow restrictor is smaller than that of the duct to control the airflow to the wings.

Telescopic Duct

The telescopic duct is at track 7.It connects the anti ice duct to the piccolo duct in lat 3.

Piccolo Ducts

Three piccolo ducts are in each wing, one in each of the slats 3,4 and 5.

Each piccolo duct has holes that face the leading edge skin of the slat. The holes release the hot air on to the inner surface of the slat leading edge slat.

Flexible Ducts

The flexible ducts connect the piccolo ducts in the slats 3,4 and 5.

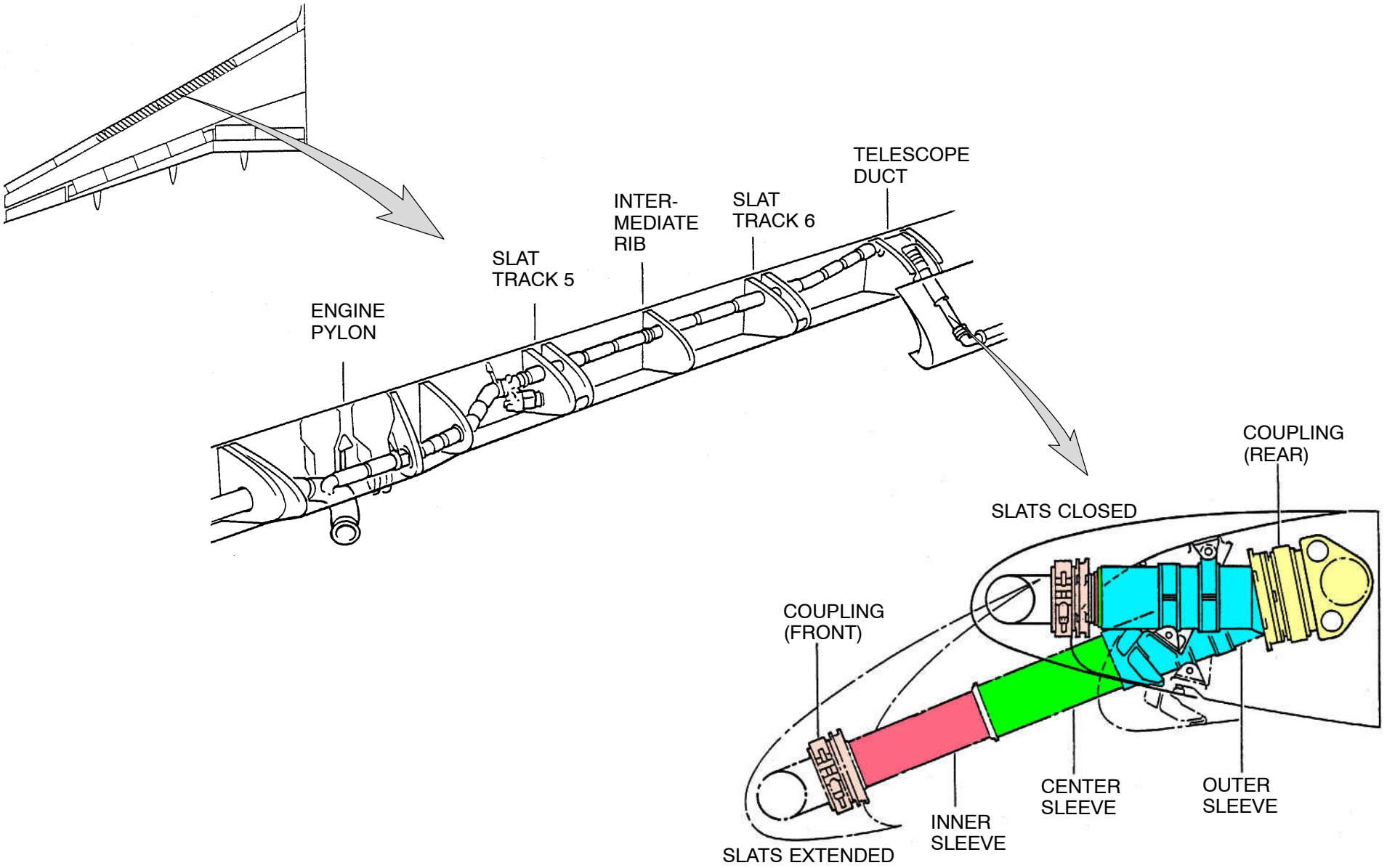


Figure 60 Wing Anti Ice Air Ducts

CFDS SYSTEM REPORT/TEST

Wing Anti Ice System Fault Detection

Only wing anti ice class 3 faults can be indicated on the CFDS via TEMP CTL.

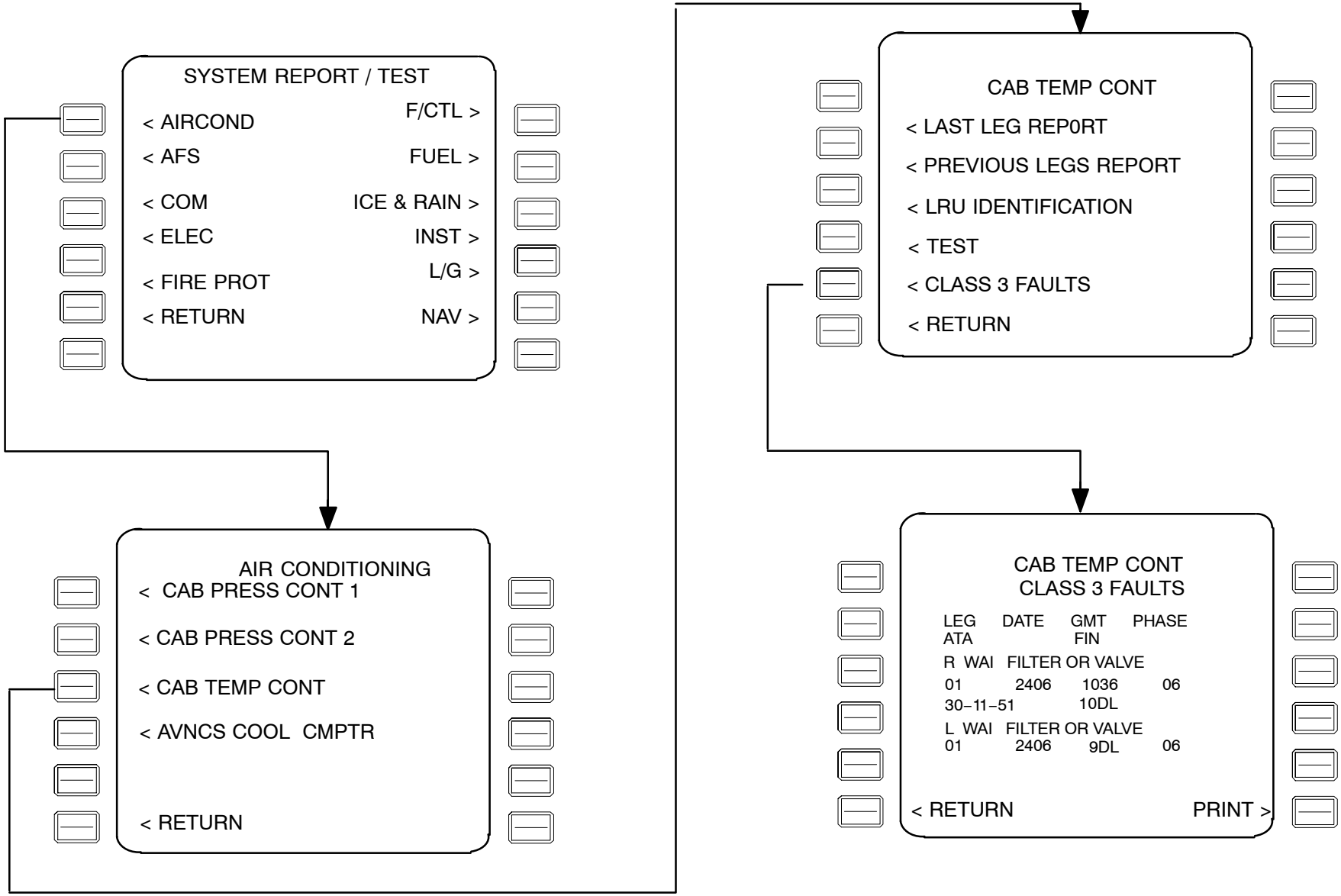


Figure 61 Wing Anti Ice System T/S

36–00 PNEUMATIC - GENERAL

SYSTEM DESCRIPTION (ENHANCED TECHNOLOGY)

Differences between Enhanced and Non Enhanced Technology

The differences between enhanced and basic aircrafts on engine bleed system with CFM56–5B engines are:

- The CTS (**C**ontrol **T**hermostat **S**olenoid) is replaced.
  - For enhanced aircraft the CTS does not include a thermostatic rod.
- The Precooler is replaced.
  - The installed PCE (**P**re**C**ooler **E**xchanger) is an enhanced compact type exchanger.

These modifications have no impact on the components physical interface and A/C location.

Temperature Control Description and Operation

To improve the operation of the engine bleed air, the temperature limitation function of the CTS has been deleted.

When 235°C (455°F) is reached, the PRV (**P**ressure **R**egulating **V**alve) no longer decreases the pressure to reduce the temperature downstream.

To replace the CTS function, the thermal efficiency of the PCE has been improved and the high outlet temperature threshold has been reduced.

If the PCE outlet temperature reaches 240°C (464°F), the BMC (**B**leed **M**onitoring **C**omputer) generates a class 2 maintenance message “AIR BLEED“ on the ECAM STATUS page.

An associated maintenance message:

- THRM (Thermostat),
- FAV (Fan Air Valve)

  or
- Sense line

can be indicated on the MCDU.

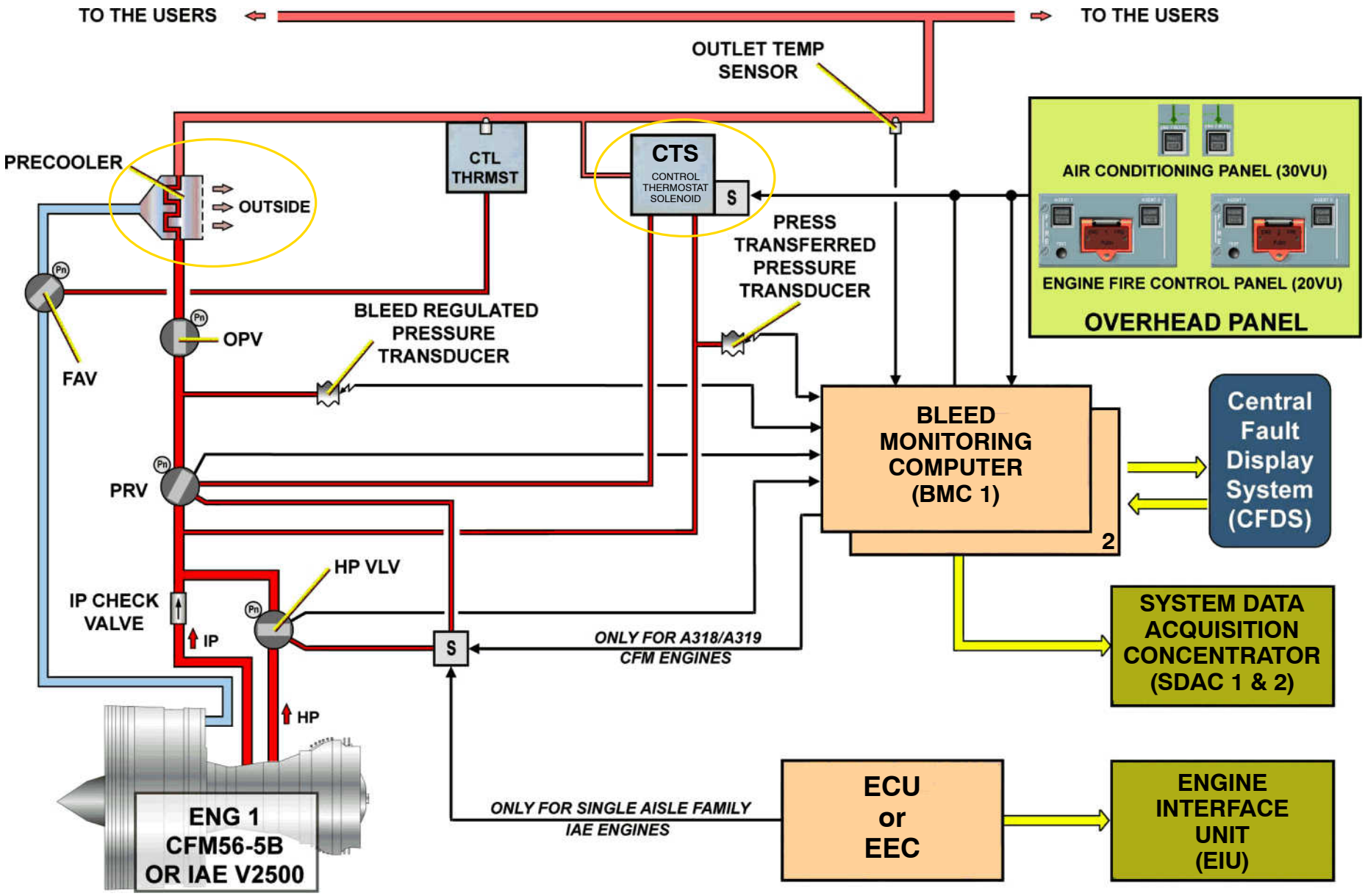


Figure 62 Bleed System Differences

CFDS MCDU Pages

On the SYSTEM REPORT/TEST menu page:

- AIR BLEED key is replaced by PNEU key.

On the SYSTEM REPORT/TEST AIR BLEED page:

- AIR BLEED title is replaced by PNEU

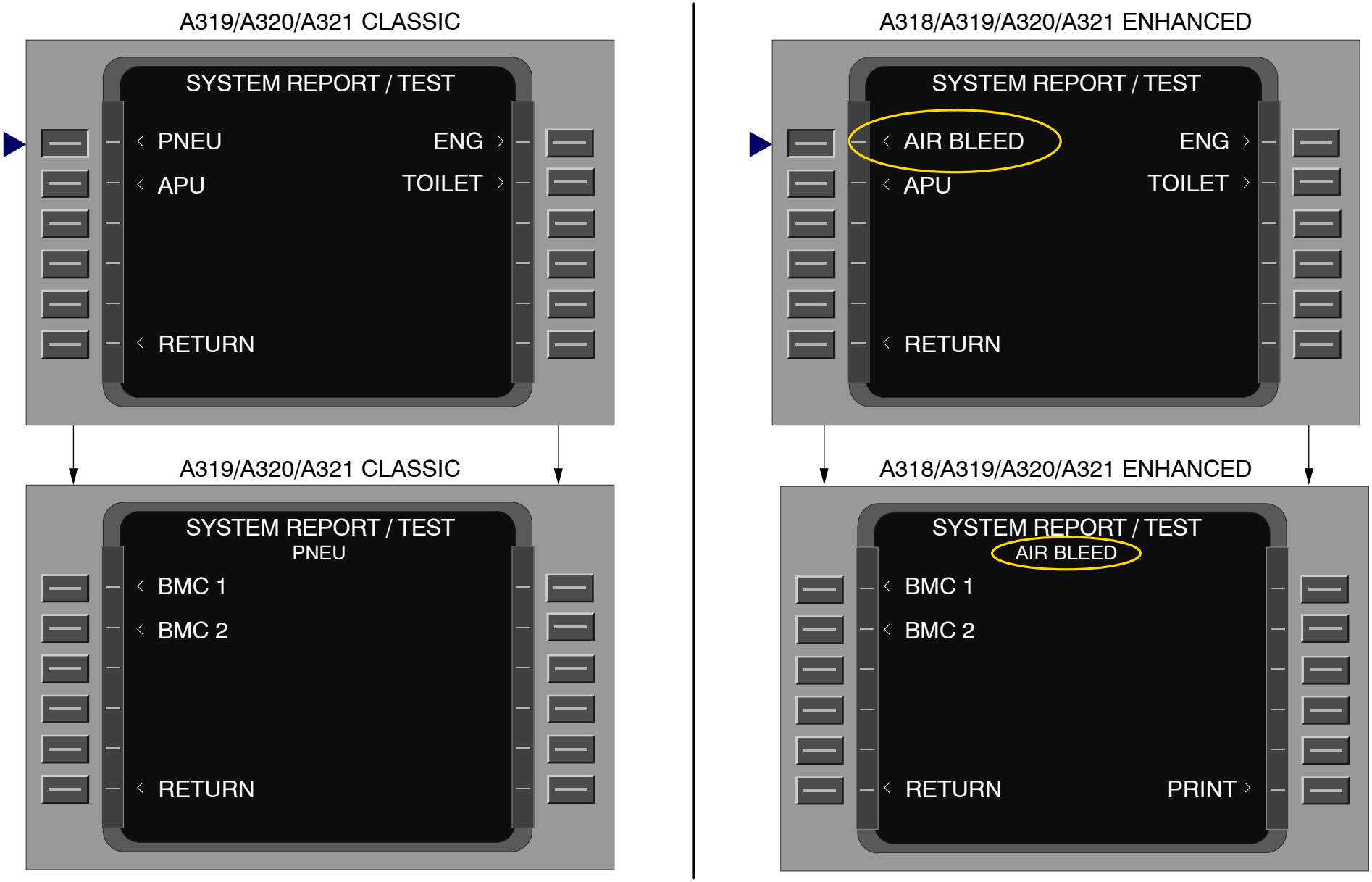


Figure 63 Pneumatic and Air Bleed CFDS Menu

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