CHAPTER

36

Pneumatic

CHAPTER 36
PNEUMATIC

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A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

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36-EFFECTIVE PAGES

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36-EFFECTIVE PAGES

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CHAPTER 36
PNEUMATIC

36-CONTENTS

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PNEUMATIC - INTRODUCTION

Purpose

The pneumatic system supplies compressed air to the airplane user systems.

General Description

These are the sources of pneumatic power:

- Engine 1 bleed air system
- Engine 2 bleed air system
- Auxiliary power unit (APU) bleed air system
- Pneumatic ground air connection.

The pneumatic manifold collects the compressed air from the sources and supplies it to the user systems.

Valves in the manifold do these things:

- Control the flow of bleed air into the manifold
- Isolate the manifold into left and right sides
- Control the flow of manifold air into the user systems.

These are the airplane systems that use pneumatic power:

- Engine start systems
- Air conditioning and pressurization systems
- Engine inlet cowl anti-ice systems
- Wing thermal anti-ice systems
- Water tank pressurization system
- Inert gas system

SIA 717-999

- Total air temperature probe aspiration

SIA ALL

- Hydraulic reservoir pressurization system.

Pneumatic system controls and indications are on the P5-10 air conditioning panel. The controls and indications use 28v DC and 115v AC.

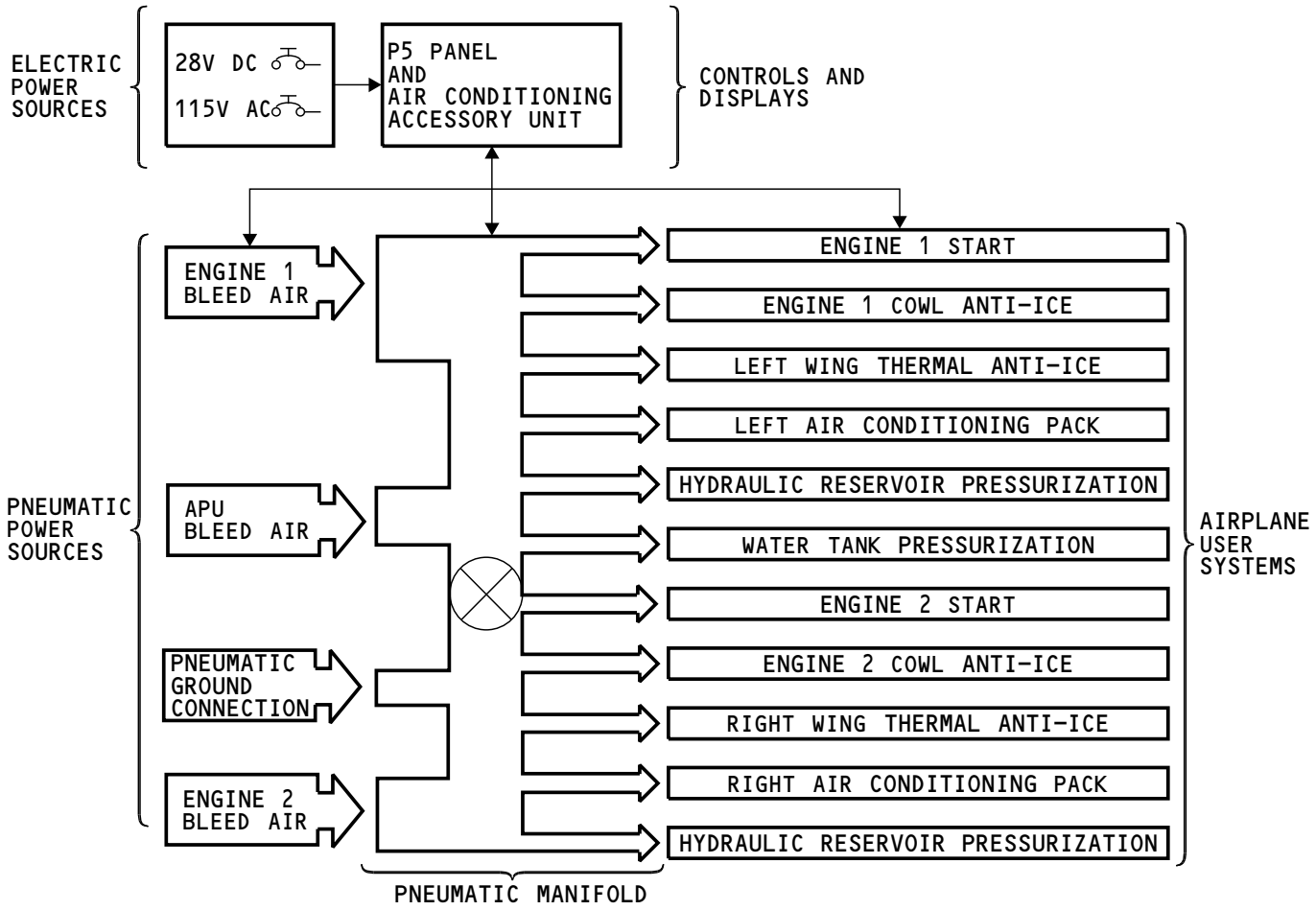
Training Information Point

The air in the pneumatic system is hot and under high pressure. Make sure you depressurize the pneumatic system before you work on it.

Abbreviations and Acronyms

- ACAU - air conditioning accessory unit
- APU - auxiliary power unit
- BAR - bleed air regulator
- BAV - bleed air valve
- C - Celsius
- CTAI - cowl thermal anti-ice
- F - Fahrenheit
- ISO valve - isolation valve
- PRSOV - pressure regulator and shutoff valve
- TAT - total air temperature
- XFER - transfer
- XMTR - transmitter
- WTAI - wing thermal anti-ice

PNEUMATIC - INTRODUCTION



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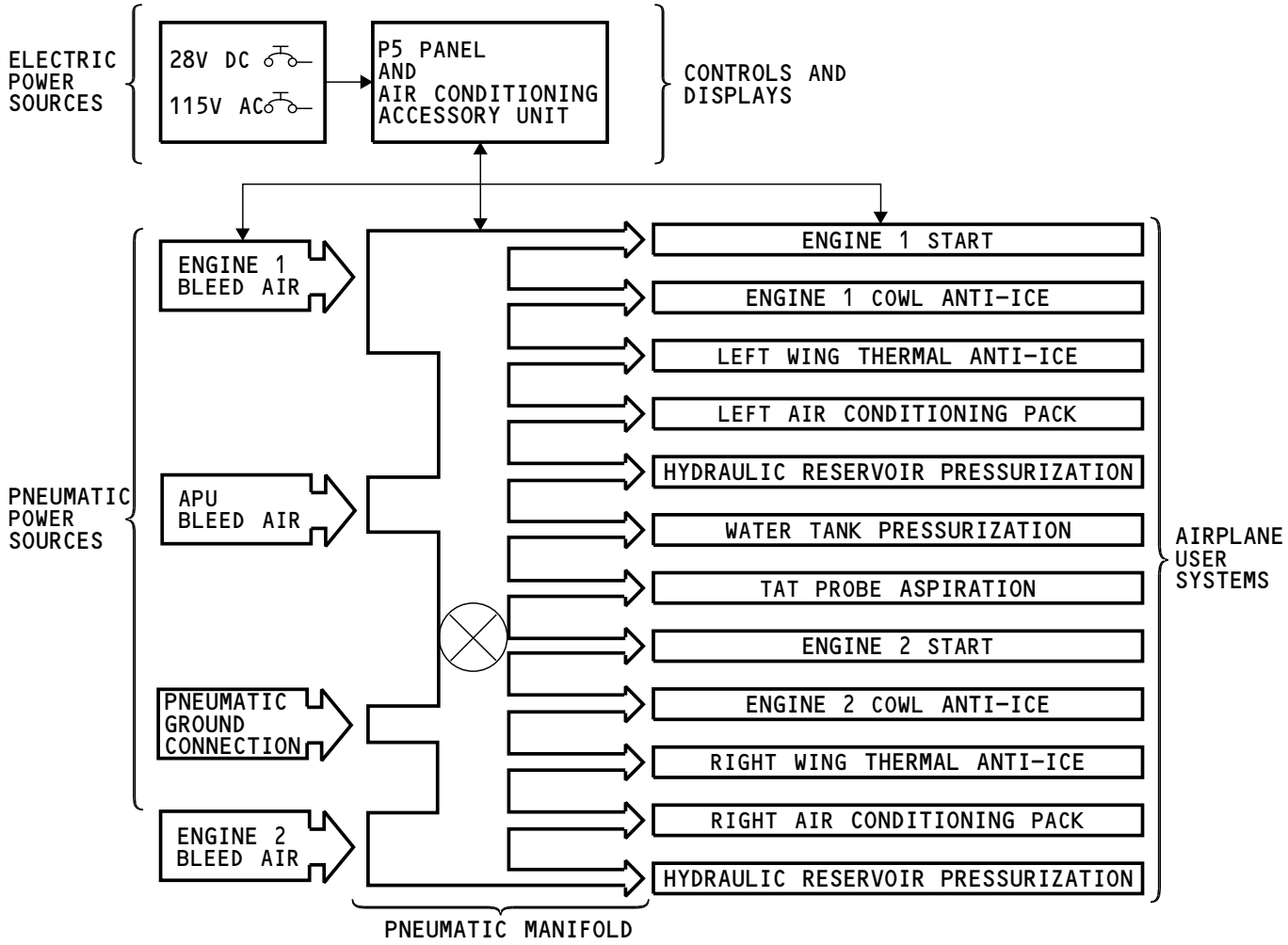
PNEUMATIC - INTRODUCTION

PNEUMATIC - INTRODUCTION



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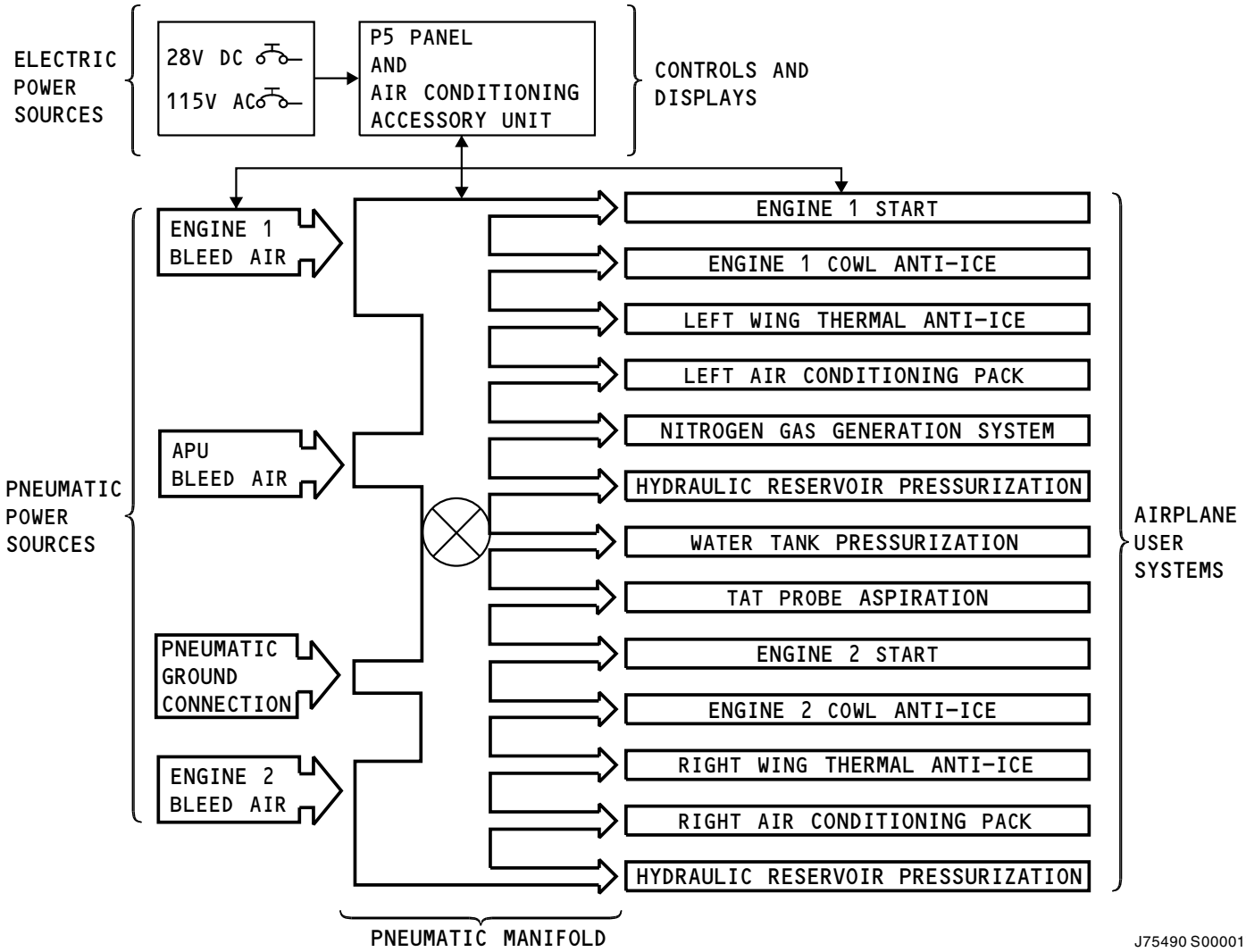
PNEUMATIC - INTRODUCTION

PNEUMATIC - INTRODUCTION



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PNEUMATIC - INTRODUCTION

PNEUMATIC - COMPONENT LOCATIONS

Engine Bleed Air

The engine bleed system components are on the engine compressor cases and in the engine struts.

Pneumatic Manifold

The pneumatic manifold (crossover duct) is in these areas:

- The leading edges of the wing inboard of the engine struts
- The crossover duct is in the forward areas of the air conditioning pack bays
- The keel beam.

APU Bleed Air

The APU and the APU bleed system components are in a torque box in the 48 section.

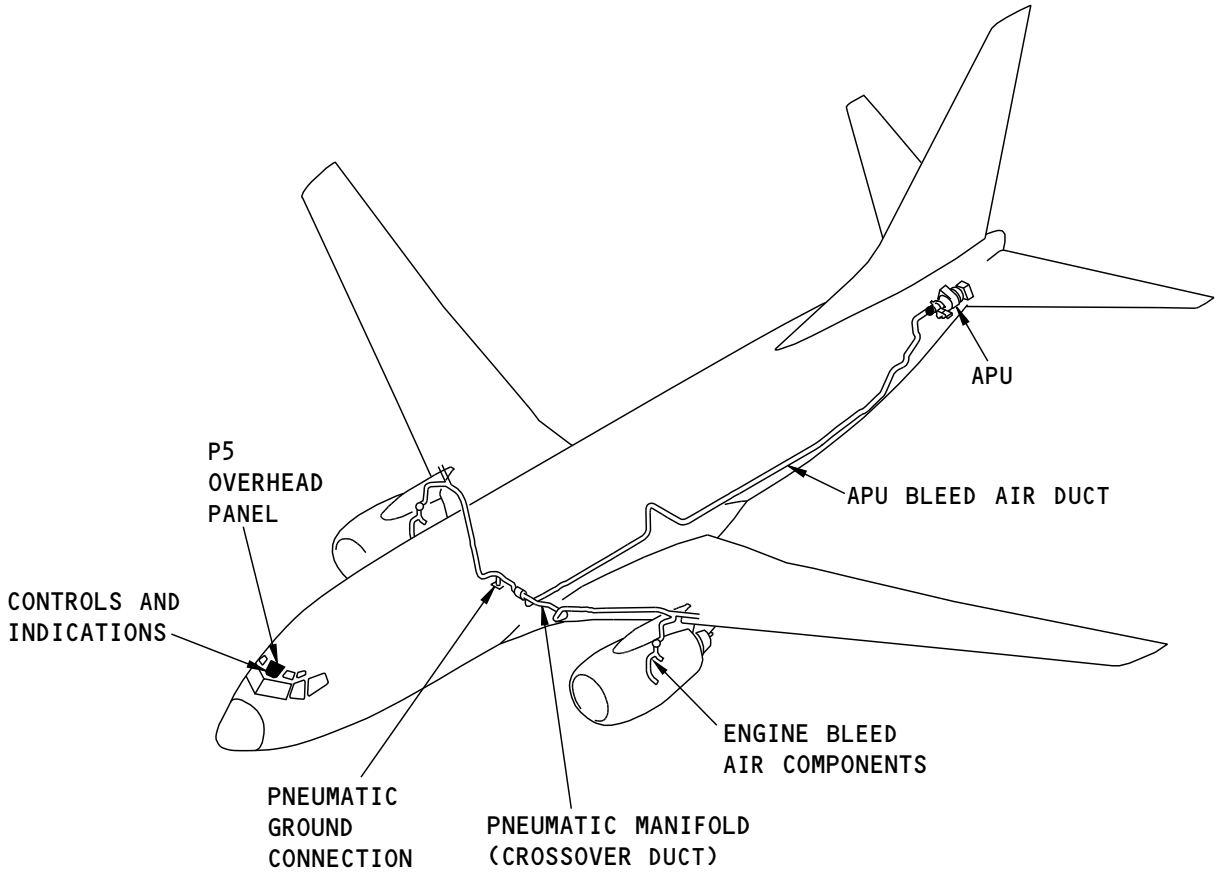
The APU bleed air duct is in these areas:

- Along the right side of the APU torque box
- Through section 48 and the aft pressure bulkhead
- Along the left side and forward bulkhead of the aft cargo compartment
- In the keel beam.

Controls and Indication

The pneumatic system controls and indications are on the air conditioning/bleed air controls panel in the flight compartment.

PNEUMATIC - COMPONENT LOCATIONS



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PNEUMATIC - COMPONENT LOCATIONS

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PNEUMATIC - FUNCTIONAL DESCRIPTION

General

The pneumatic system supplies hot, high pressure air to the systems on the airplane that use air.

These are the sources of pneumatic power:

- Engine bleed air
- APU
- Ground source.

Engine Bleed Air

There is one bleed air system for each engine. The engine bleed system controls bleed air temperature and pressure.

Engine bleed air comes from the 5th and 9th stages of the high pressure compressor. A high stage regulator and high stage valve control the flow of 9th stage bleed air. The 5th stage check valve prevents reverse flow into the 5th stage.

A bleed air regulator and the pressure regulator and shutoff valve (PRSOV) control the flow of bleed air to the pneumatic manifold.

The air conditioning accessory unit (ACAU) contains relays, and is an interface between the air conditioning/bleed air controls panel switches and lights.

Engine Bleed Air Precooler System

The precooler system controls the engine bleed air temperature. The precooler control valve, precooler control valve sensor, and WTAI solenoid valve control the flow of fan air to the precooler.

APU Bleed Air

The APU supplies bleed air to the pneumatic manifold. An APU check valve protects the APU from engine bleed air flow.

Pneumatic Manifold

The pneumatic manifold gets high pressure air from the source systems and supplies it to the user systems. The pneumatic manifold has these features:

- An isolation valve that can separate the manifold into left and right sides
- Two duct pressure transmitters (for left and right manifold pressure indication)
- A ground pneumatic connector with a check valve (for an external source of pneumatic power)
- Pressure taps and interfaces for user system valves.

Controls and Indications

The air conditioning/bleed air controls panel has control switches and lights to control and monitor the pneumatic system.

The DUAL BLEED light is an amber light that comes on when the APU bleed valve is open and:

- Number 1 engine bleed switch on, or
- Number 2 engine bleed switch on and isolation valve open.

The dual duct pressure indicator shows the pressure in the left and right pneumatic manifold.

The isolation valve switch has these three positions:

- CLOSE - isolates left and right pneumatic manifold
- AUTO - the valve opens automatically if any pack or engine bleed switch is put in the OFF position
- OPEN - connects left and right pneumatic systems.

The trip reset switch is used to reset a bleed trip off condition.

The engine bleed switch has these two positions:

- OFF - closes the PRSOV
- ON - opens the PRSOV.

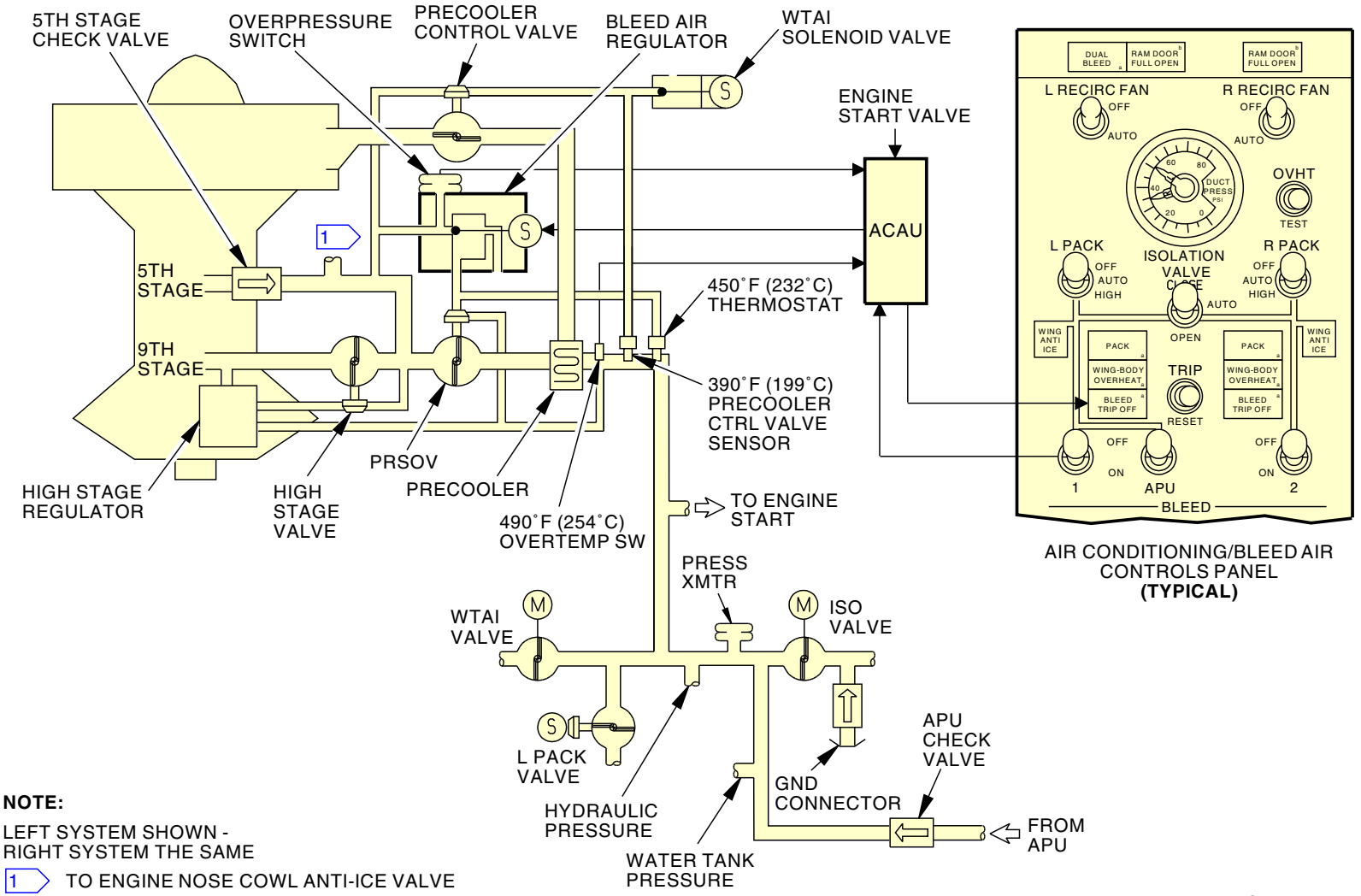
PNEUMATIC - FUNCTIONAL DESCRIPTION

The BLEED TRIP OFF lights are amber lights. There is one BLEED TRIP OFF light for the left and right pneumatic manifold. They turn on when the pneumatic system has an overpressure or overtemperature condition.

The APU bleed switch has these two positions:

- OFF - closes the APU bleed valve
- ON - opens the APU bleed valve.

PNEUMATIC - FUNCTIONAL DESCRIPTION



AIR CONDITIONING/BLEED AIR CONTROLS PANEL **(TYPICAL)**

NOTE:

LEFT SYSTEM SHOWN - RIGHT SYSTEM THE SAME

1 TO ENGINE NOSE COWL ANTI-ICE VALVE

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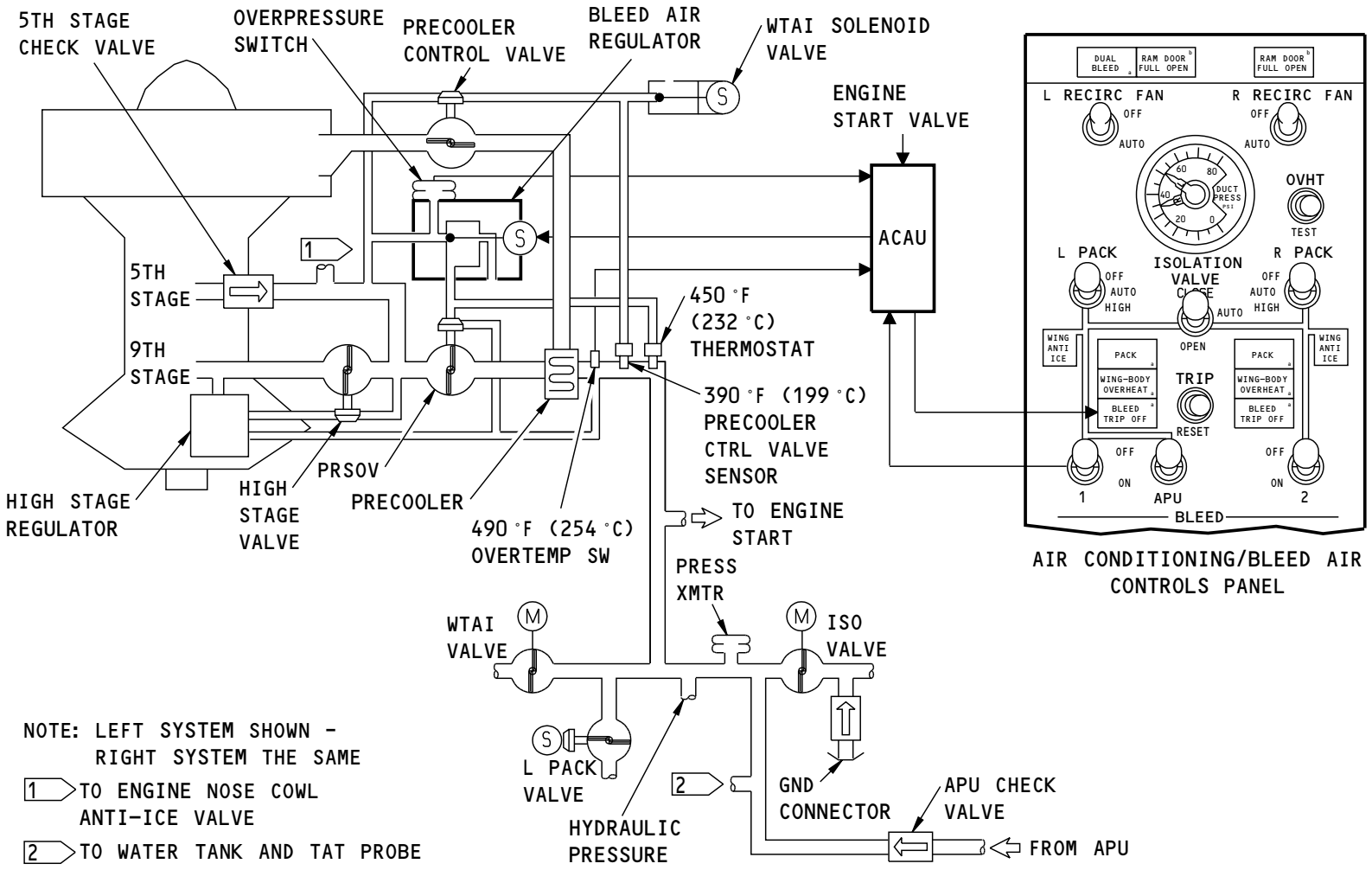
PNEUMATIC - FUNCTIONAL DESCRIPTION

PNEUMATIC - FUNCTIONAL DESCRIPTION



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PNEUMATIC - FUNCTIONAL DESCRIPTION

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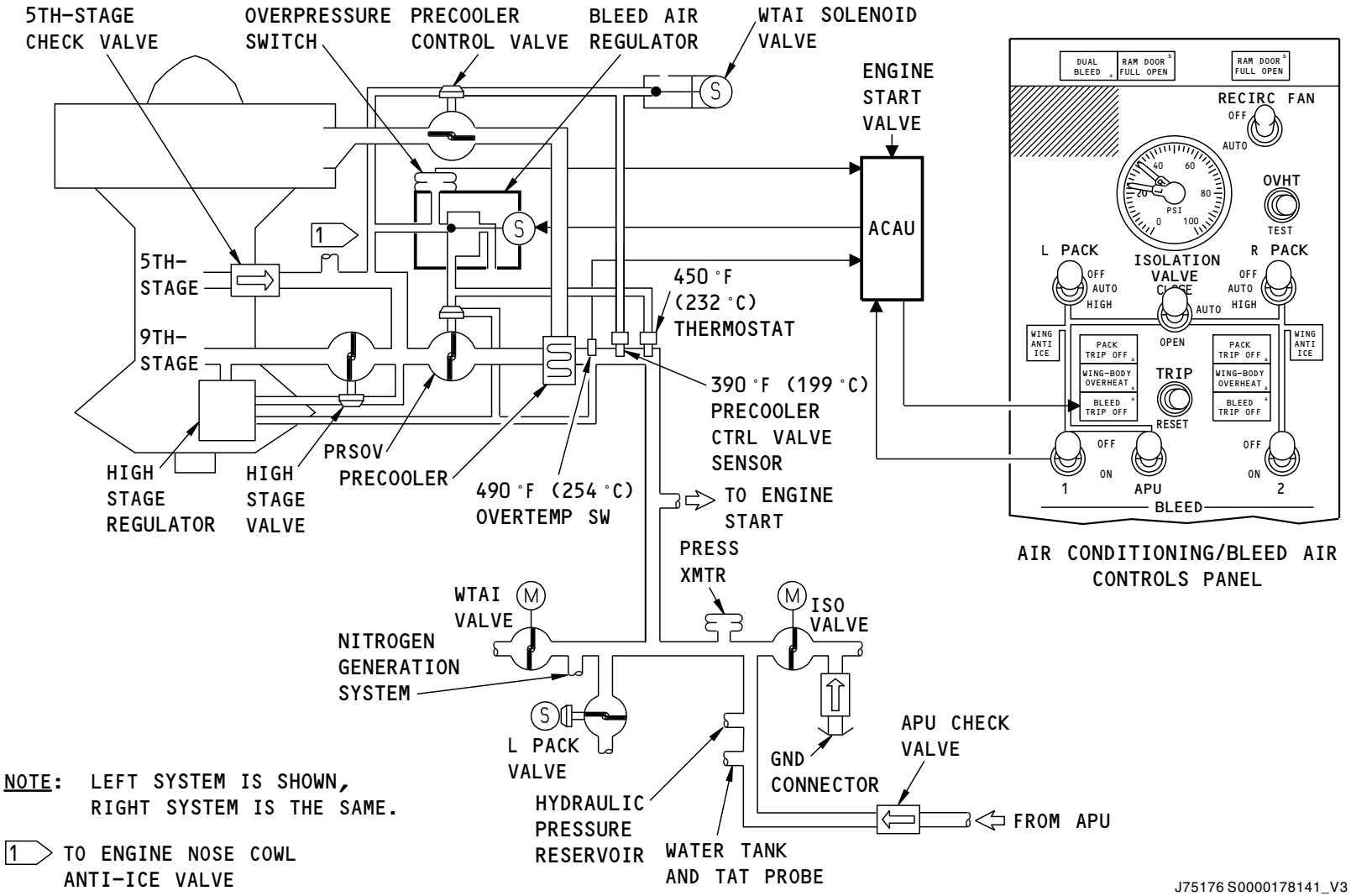

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PNEUMATIC - FUNCTIONAL DESCRIPTION

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PNEUMATIC - DISTRIBUTION - INTRODUCTION

Purpose

The pneumatic distribution system supplies compressed air to the user systems.

General Description

The distribution system has these subsystems:

- Engine bleed air system
- APU bleed air system
- Pneumatic ground air connection
- Pneumatic manifold system.

Engine Bleed Air System

There are two engine bleed air systems, one for each engine.

Engine bleed air is from the 5th and 9th stages of the engine high pressure compressors. At low engine speeds, bleed air comes from the 9th stage. At high engine speeds, bleed air comes from the 5th stage.

APU Bleed Air System

The APU load compressor supplies bleed air on the ground and in the air.

Pneumatic Ground Air Connection

The pneumatic ground air connection provides for the connection of a ground pneumatic cart. The pneumatic cart can supply bleed air for engine start and ground use of the air conditioning system.

Pneumatic Manifold System

The pneumatic manifold system gets bleed air from the engines, APU, or pneumatic ground cart.

A bleed air isolation valve divides the pneumatic manifold into left and right sides. The normal position of this valve is closed. Because of this, a single duct failure cannot cause a loss of pressure to the whole pneumatic manifold.

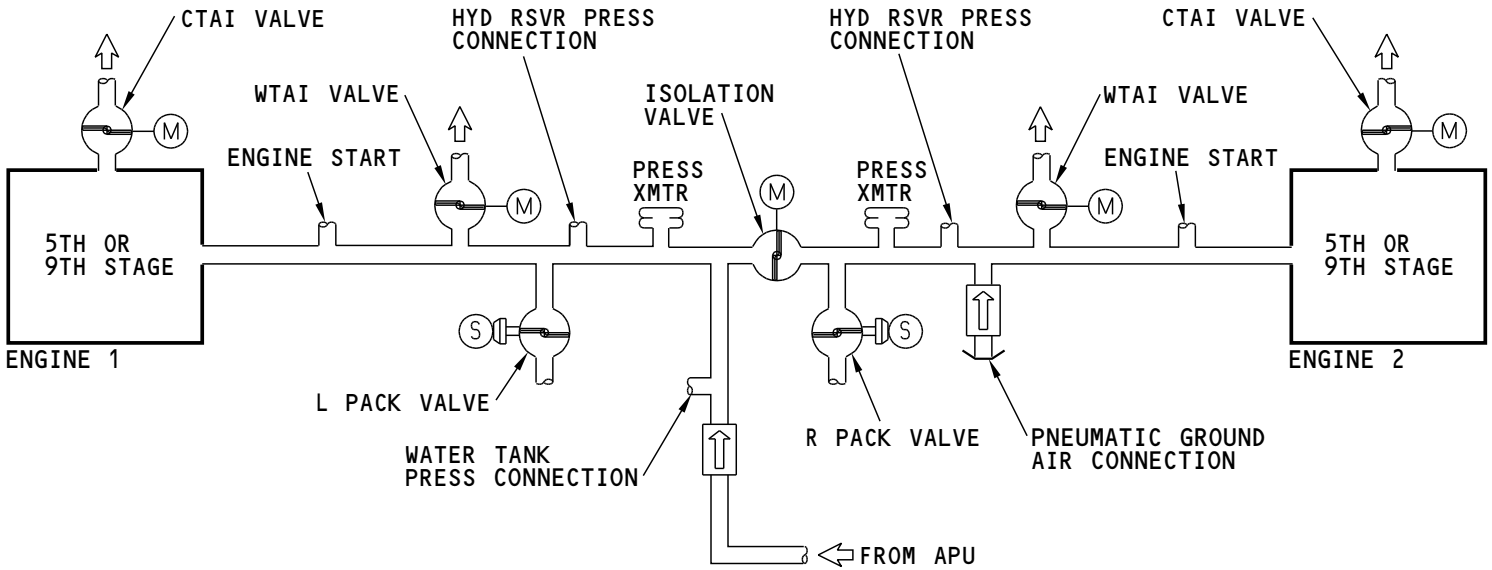
The pneumatic manifold has two pressure transmitters. One transmitter is on the right side of the manifold and the other is on the left side. They measure the manifold pressures. Pressure indication is on the air conditioning panel.

The right side of the manifold has a pneumatic ground air connector.

Valves on the pneumatic manifold control the flow of air to the user systems. The user systems control the operation of these valves.

Training Information Point

Do not supply more than 75 psi of pressure to the pneumatic system. If you supply too much pressure, damage to equipment and injuries to personnel can occur.



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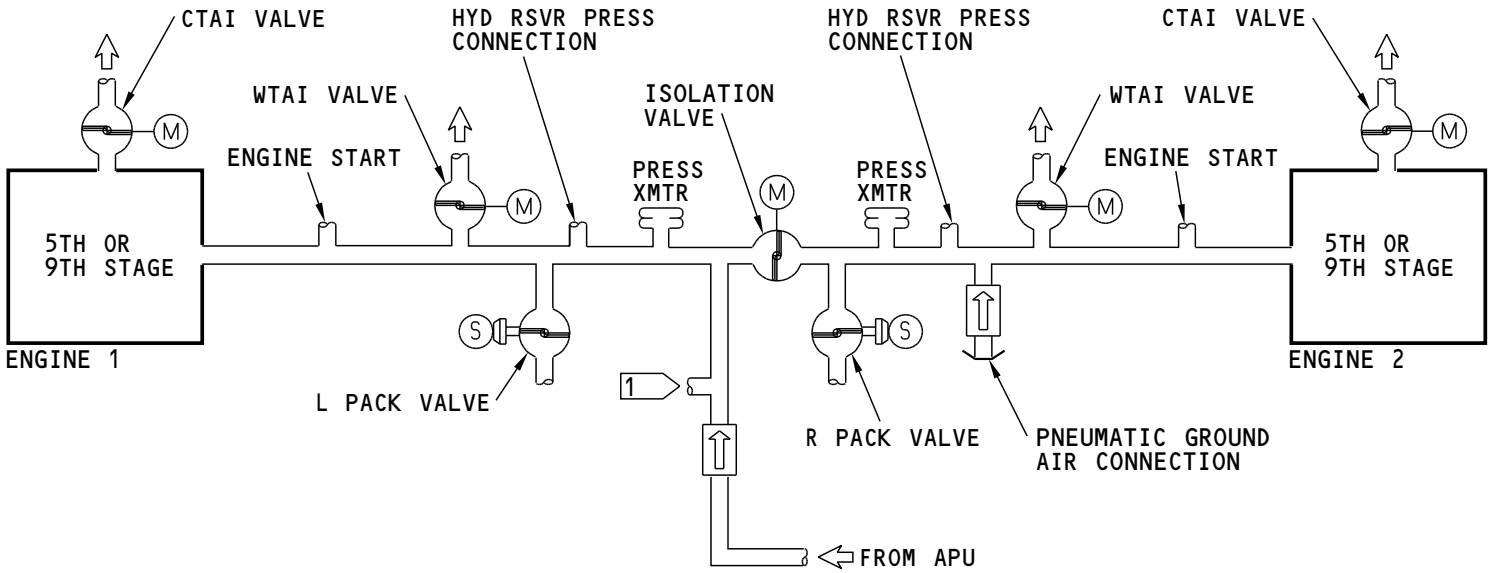
PNEUMATIC - DISTRIBUTION - INTRODUCTION



1 TO WATER TANK AND TAT PROBE

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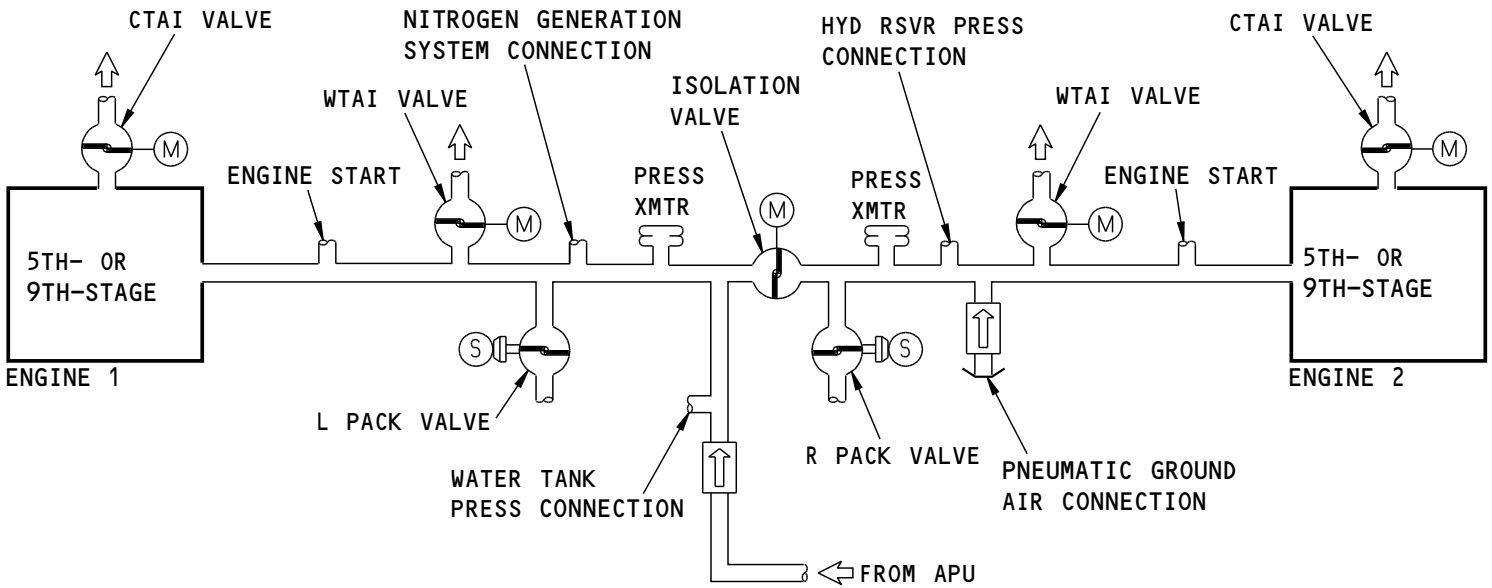

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PNEUMATIC - ENGINE BLEED AIR - INTRODUCTION

Purpose

The engine bleed air distribution system supplies pressure regulated air to the pneumatic manifold.

General Description

Bleed air comes from the 9th and 5th stages of the engine high stage compressors. At low engine speed, the pneumatic system uses 9th stage bleed air. 5th stage air is not sufficient for pneumatic system demands at low engine speeds.

At low engine speed the high stage regulators and high stage valves control the pressure of the engine bleed air.

At low engine speed the 5th stage check valves prevent reverse flow. At high engine speed the high stage valves close and the 5th stage check valves open to supply bleed air to the pressure regulating shutoff valves.

The air conditioning bleed air controls panel has engine bleed switches to control the pressure regulating shutoff valves. Also, there are BLEED TRIP OFF lights to show overpressure or overtemperature.

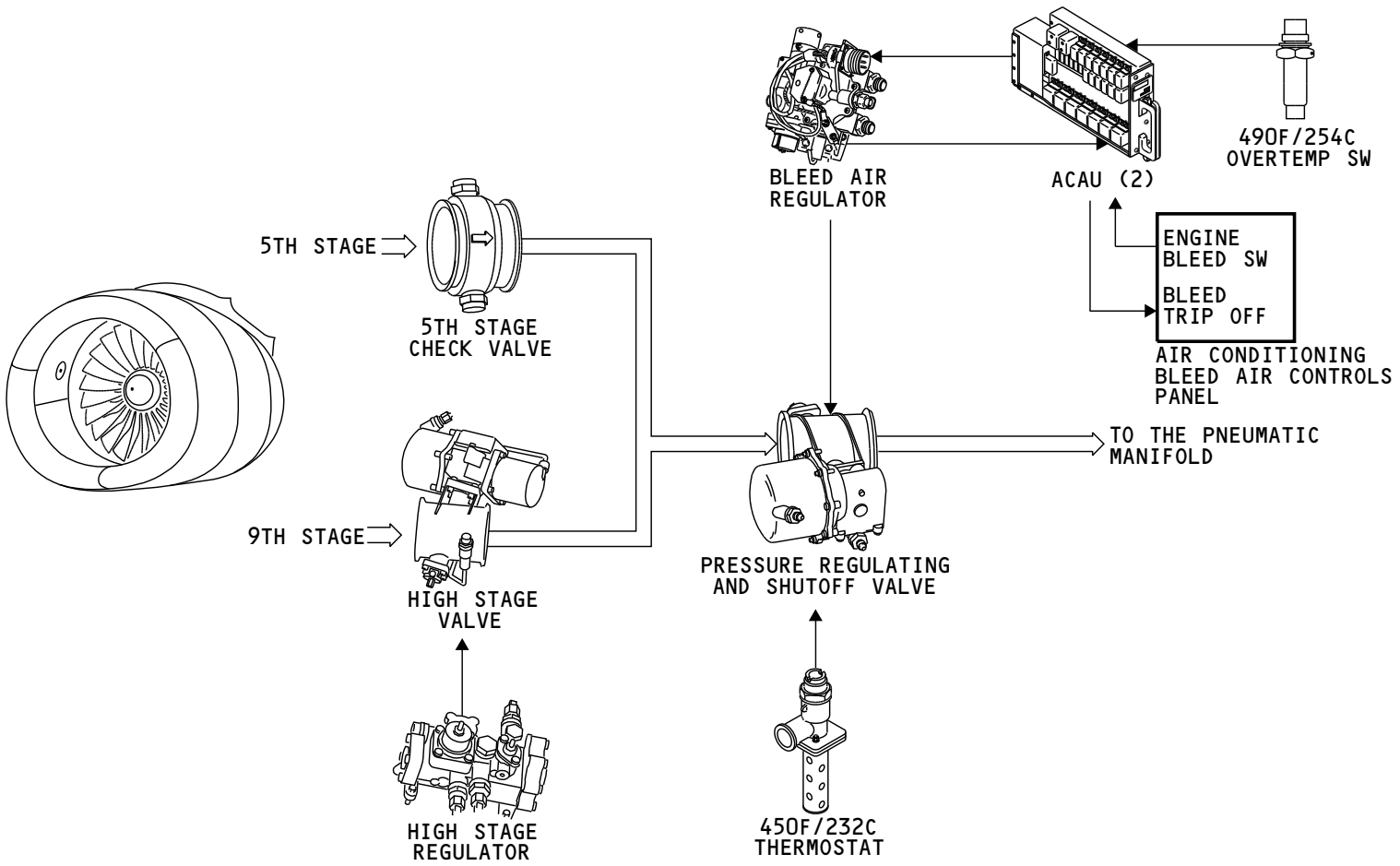
The bleed air regulators and pressure regulator and shutoff valves control the flow of engine bleed air to the pneumatic manifold. The bleed air regulators have overpressure switches to prevent overpressure conditions and turn on the BLEED TRIP OFF lights.

The 450F (232C) thermostats make the pressure regulating and shutoff valves move towards closed when the temperature gets to 450F (232C).

The air conditioning accessory unit (ACAU) is an interface between the air conditioning bleed air controls panel and the pressure regulating shutoff valves.

The 490F (254C) overheat switches turn on the BLEED TRIP OFF lights and close the pressure regulating shutoff valves. This prevents overheat damage to the pneumatic manifold and user systems.

PNEUMATIC - ENGINE BLEED AIR - INTRODUCTION



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PNEUMATIC - ENGINE BLEED AIR - INTRODUCTION

PNEUMATIC - ENGINE BLEED AIR - BLEED AIR CHECK VALVE (5TH STAGE)

Purpose

The 5th stage bleed air check valve prevents 9th stage bleed air flow into the 5th stage bleed port.

Physical Description

The bleed air check valve is a split-flapper check valve.

Location

The bleed air check valve is part of the engine bleed air manifold. It is on the left side of the engine high pressure compressor case.

Functional Description

The valve lets air flow go in the direction of the arrow. It stops air flow in the opposite direction.

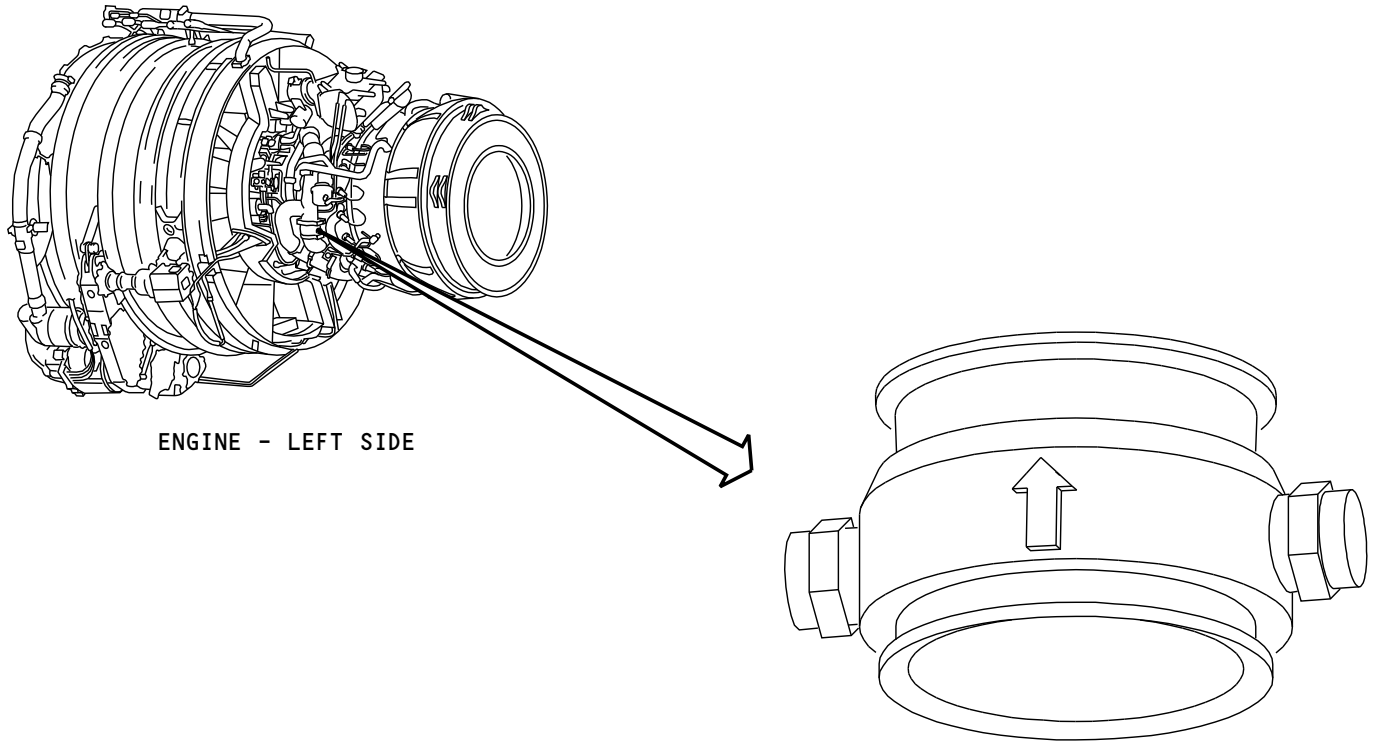
Two semicircular flappers control air flow. Normal airflow opens the flappers. Reverse airflow closes the flappers.

Training Information Point

Install the bleed air check valve so that the flow arrow points away from the 5th stage bleed port.

Align the flange clamps correctly and torque to specifications. Improperly aligned or loose clamps may interfere with engine components or the inner thrust reverser cowls.

PNEUMATIC - ENGINE BLEED AIR - BLEED AIR CHECK VALVE (5TH STAGE)



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PNEUMATIC - ENGINE BLEED AIR - BLEED AIR CHECK VALVE (5TH STAGE)

PNEUMATIC - ENGINE BLEED AIR - HIGH STAGE REGULATOR/VALVE

Purpose

The high stage regulator controls the high stage valve.

The high stage valve controls the flow of bleed air from the 9th stage engine bleed air manifold.

Physical Description

The high stage regulator has these parts:

- Supply pressure port
- Downstream sense port
- Control pressure port
- Reverse flow mechanism
- Pressure regulator mechanism
- Relief valve
- Pneumatic shutoff mechanism.

The high stage valve is a butterfly valve, spring loaded to the closed position. The valve has these parts:

- Pneumatic actuator
- Valve flow body with direction of flow arrow
- Relief valve
- Manual override and position indicator.

Location

The high stage regulator is on the engine core area at the 10:00 position.

The high stage valve is on the engine core area at the 8:00 position.

Operation

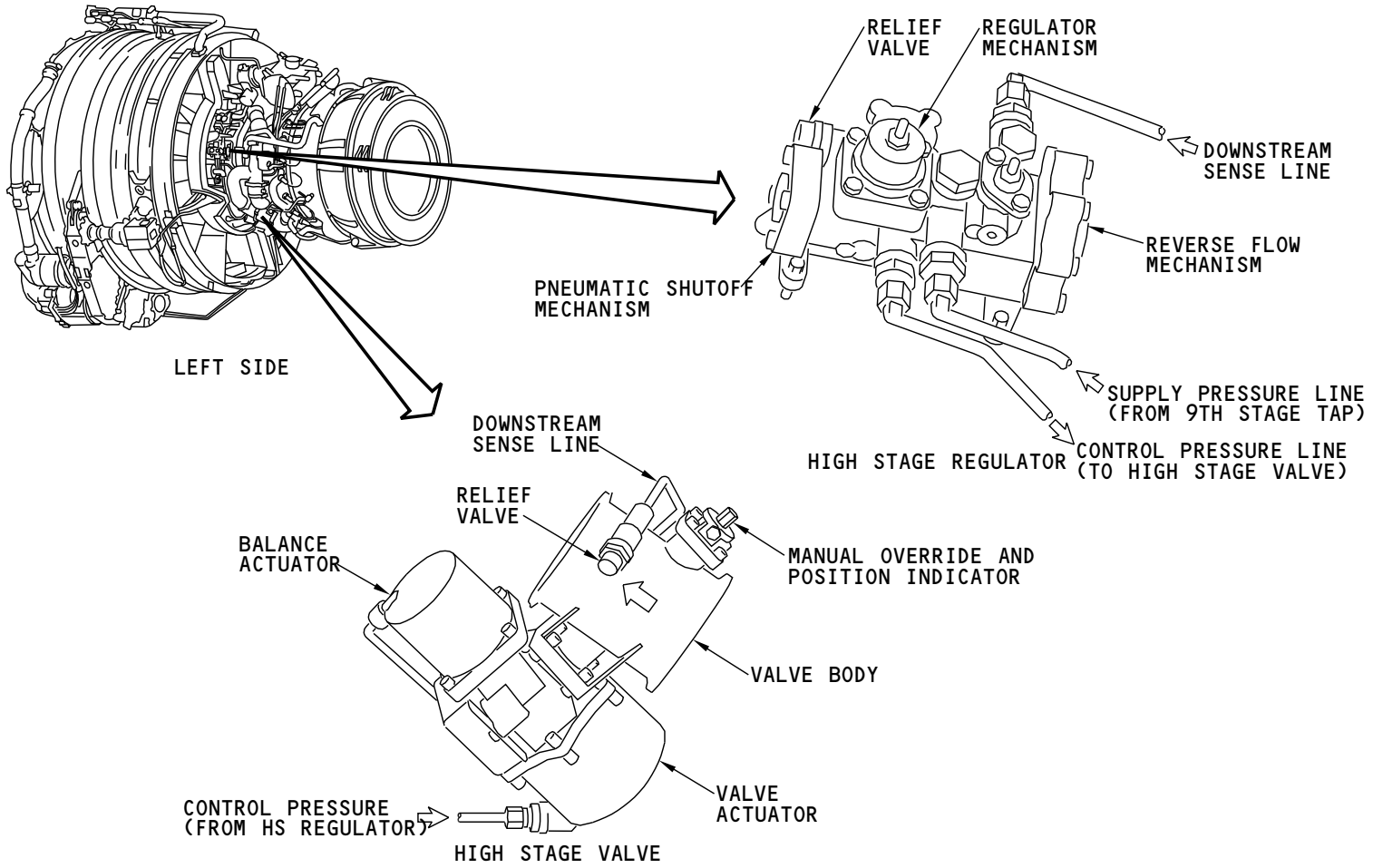
The operation of the high stage regulator is automatic. There are no operational controls.

The operation of the high stage valve is automatic. Also there is a manual override to lock the valve in the closed position.

Training Information Point

The high stage regulator and high stage valve can be tested using external test equipment.

PNEUMATIC - ENGINE BLEED AIR - HIGH STAGE REGULATOR/VALVE



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PNEUMATIC - ENGINE BLEED AIR - HIGH STAGE REGULATOR/VALVE

PNEUMATIC - ENGINE BLEED AIR - HIGH STAGE REGULATOR/VALVE - FUNCTIONAL DESCRIPTION

Purpose

The high stage regulator and valve control the supply of high stage engine bleed air.

The high stage regulator operates the high stage valve.

The high stage valve controls the flow of bleed air from the 9th stage bleed air manifold.

Functional Description

The high stage regulator gets unregulated air from a tap on the 9th stage bleed air manifold. The unregulated air goes through the pneumatic shutoff mechanism to the reference pressure regulator.

The reference pressure regulator decreases the pressure to a constant control pressure. A relief valve prevents damage to the high stage valve if the reference pressure regulator fails.

The control pressure from the high stage regulator goes to chamber A of the high stage valve. The actuator opens the valve against spring force and pressure in chamber B. The combination of forces that operate on the actuator cause the valve to regulate the downstream pressure to 32 psi (nominal).

During normal operation, the high stage valve closes for these reasons:

- Downstream pressure is more than 9th stage pressure
- The 5th Stage pressure is greater than the high stage regulated pressure

When downstream pressure is more than 9th stage pressure, the reverse flow mechanism in the high stage regulator opens and bleeds off the control pressure to the high stage valve. The high stage valve then closes.

When 5th stage manifold pressure is greater than the high stage regulated pressure (nominal 34 psi), the high stage valve closes because the force in chamber B, combined with the spring force, is greater than the force in chamber A. This causes the high stage valve to close.

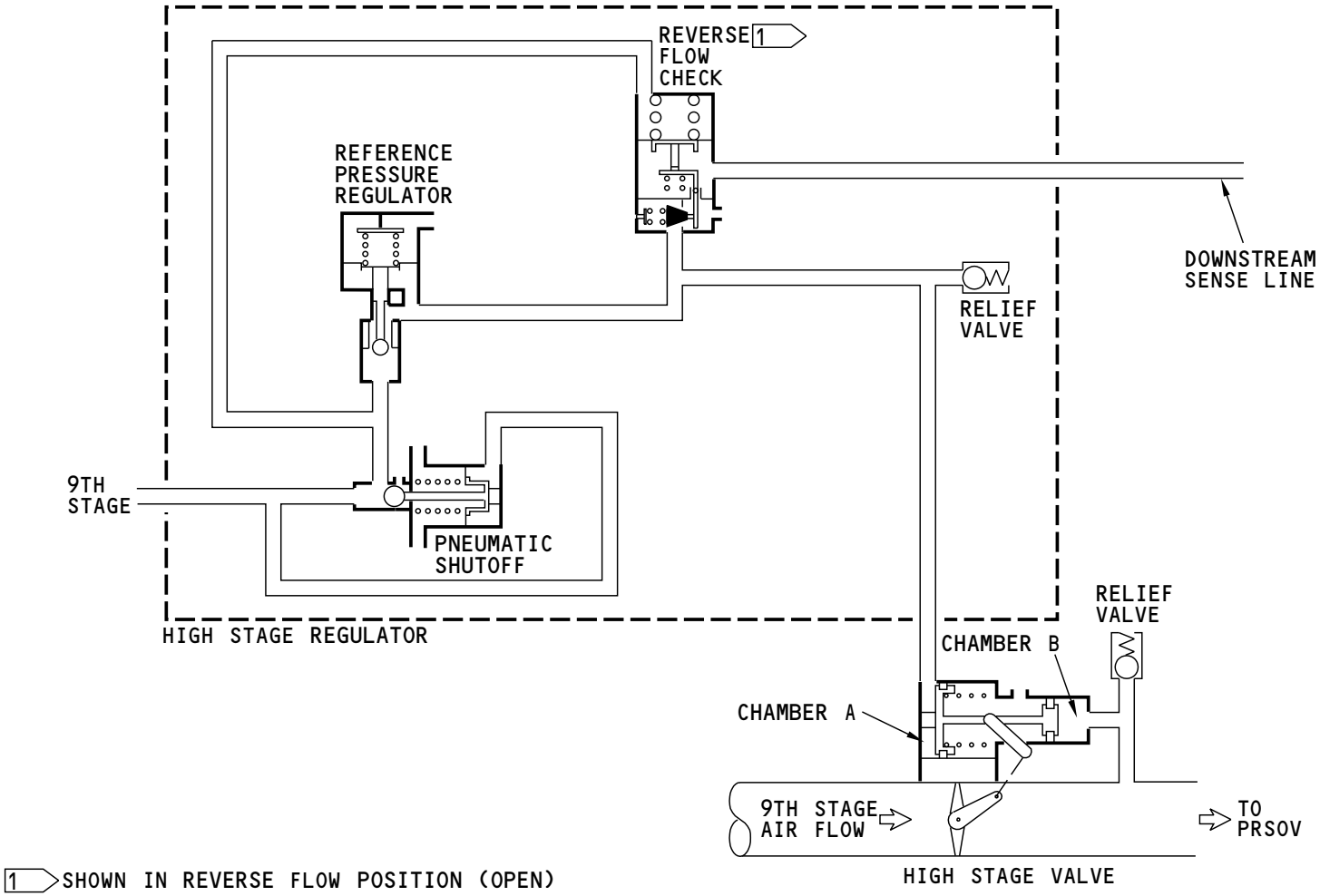
The pneumatic shutoff mechanism increases the life of the high stage regulator. The shutoff operates after the shift to 5th stage engine supply occurs. High pressures (110 psig) in the supply port operate a shutoff mechanism. The shutoff mechanism closes the supply to the regulator inlet and vents the regulator. This reduces the duty cycle of the regulator and exposure to extreme pressures and temperatures during high engine power operation.

A relief valve in the high stage valve decreases downstream pressure in the interstage duct when the pressure regulator and shutoff valve (PRSOV) is closed.

Operational Controls

The operation of the high stage bleed system is automatic and self-regulating. There are no external controls.

PNEUMATIC - ENGINE BLEED AIR - HIGH STAGE REGULATOR/VALVE - FUNCTIONAL DESCRIPTION



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PNEUMATIC - ENGINE BLEED AIR - HIGH STAGE REGULATOR/VALVE - FUNCTIONAL DESCRIPTION

PNEUMATIC - ENGINE BLEED AIR - BAR AND PRSOV

Purpose

The bleed air regulator (BAR) operates the pressure regulator and shutoff valve (PRSOV).

The PRSOV controls the flow of bleed air from the engine. These are the PRSOV control functions:

- Shutoff of engine bleed air
- Pressure regulation of engine bleed air (42 psi nominal)
- Temperature limitation of engine bleed air (450F/232C).

Physical Description

The BAR has these parts:

- Mechanical latching solenoid valve
- Pressure relief valve
- 220 psi overpressure switch
- Ports for supply and control air lines.

The PRSOV is a butterfly valve that is spring-loaded closed. The valve has these parts:

- Pneumatic actuator
- Manual override and position indicator
- Control air port
- Downstream sense port.

Location

The BAR is at the 11:00 position on the engine core area and immediately aft of the fan frame.

The PRSOV is at the 10:00 position on the engine core area and below the precooler.

Operation

The BAR has electrical control by signals from these devices:

- Engine BLEED switch (through the ACAU)
- Engine fire switch
- ACAU.

During normal operations, when the engine BLEED switch is set to ON, a signal goes through the ACAU to command the BAR solenoid valve to open. When the engine BLEED switch is set to OFF, a signal goes to command the BAR solenoid valve to close.

When the fire switch is up, a signal goes directly to the BAR solenoid valve to close the valve.

Relays in the ACAU control the BAR solenoid valve to close for these conditions:

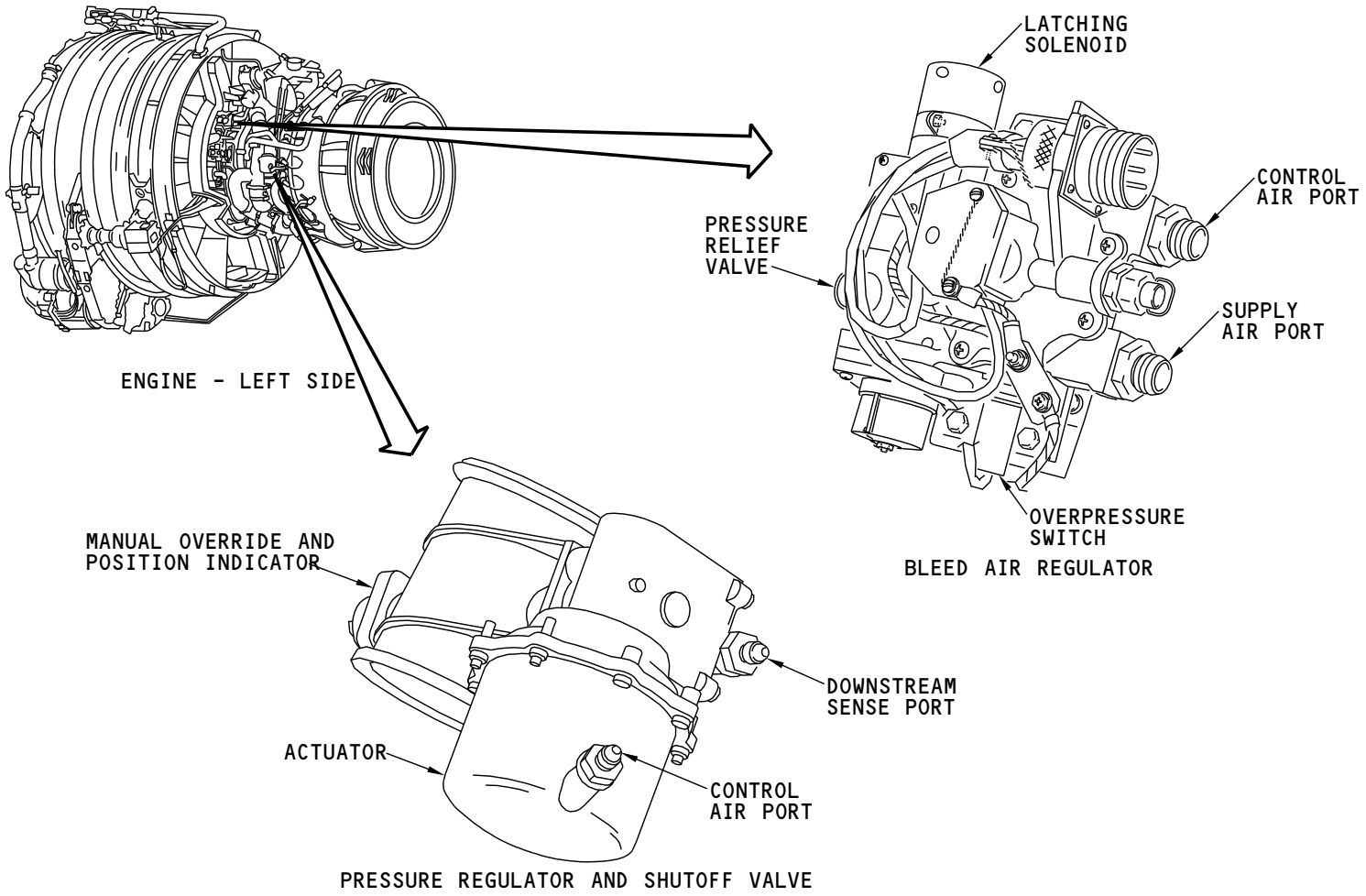
- Engine start valve not closed (reverse flow protection)
- Engine bleed trip off conditions (490F/254C overheat or 220 psi overpressure protection).

The PRSOV is pneumatically controlled by the BAR.

Training Information Point

The PRSOV has a manual override and position indicator. You can manually lock the valve in the closed position only.

PNEUMATIC - ENGINE BLEED AIR - BAR AND PRSOV



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PNEUMATIC - ENGINE BLEED AIR - BAR AND PRSOV

PNEUMATIC - ENGINE BLEED AIR - 450F THERMOSTAT

Purpose

The 450F (232C) thermostat bleeds off pressure that operates the pressure regulator and shutoff valve (PRSOV). This occurs when engine bleed air temperature is more than 450F (232C).

The 450F (232C) thermostat supplies the PRSOV a temperature control function.

Physical Description

The 450F (232C) thermostat has these parts:

- Ball valve assembly with a sense line connection
- Mounting flange with index pin
- Shielded sensor.

Location

The 450F (232C) thermostat is in the engine bleed air duct. Access is through a strut access panel.

Functional Description

The 450F (232C) thermostat operates by thermal expansion of a fluid. The thermostat sensor is in the bleed air duct downstream of the precooler. This portion of the thermostat has oil filled coils. As the oil expands, it pushes the ball valve open. The higher the duct temperature, the more the oil expansion, and the more the ball valve opens. The 450F (232C) thermostat starts to open at 450F (232C) and is full open by 490F (254C).

When the ball valve is open, control pressure is bled from the PRSOV. The reduction in control pressure causes the PRSOV to move toward closed and reduces the flow of bleed air. The lower flow of bleed air has these effects:

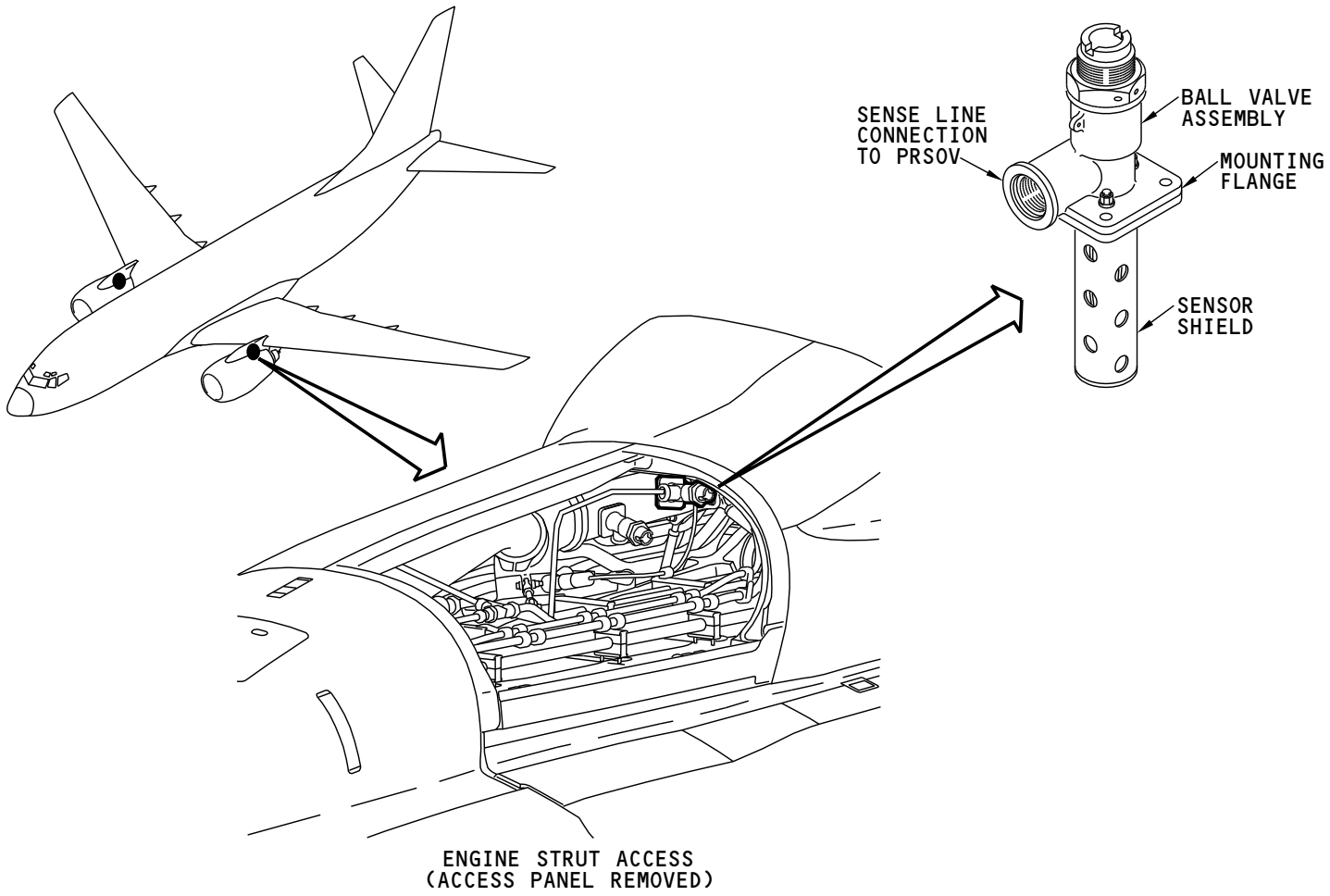
- Decreases the thermal load on the precooler
- Delays a 490F (254C) overtemperature bleed trip off condition
- Decreases duct pressure.

The precooler system normally controls engine bleed air temperature to 390-440F (199-227C). The 450F (232C) thermostat supplies a temperature limit function to the PRSOV.

Training Information Point

Nonstop operation of the 450F (232C) thermostat (and the resultant low duct pressures) can result from a dirty or clogged precooler. Nonstop operation can also be caused by a defective precooler control system.

PNEUMATIC - ENGINE BLEED AIR - 450F THERMOSTAT



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PNEUMATIC - ENGINE BLEED AIR - 450F THERMOSTAT

PNEUMATIC - ENGINE BLEED AIR - BAR, 450F THERMOSTAT, AND PRSOV - FUNCTIONAL DESCRIPTION

Purpose

The BAR, PRSOV, and 450F thermostat regulate bleed air pressure and temperature.

Functional Description

The BAR gets unregulated air from the interstage manifold. The unregulated air goes to the overpressure switch and to the reference pressure regulator.

The reference pressure regulator decreases the pressure to a constant control pressure. The control pressure then goes to a relief valve and a latching solenoid.

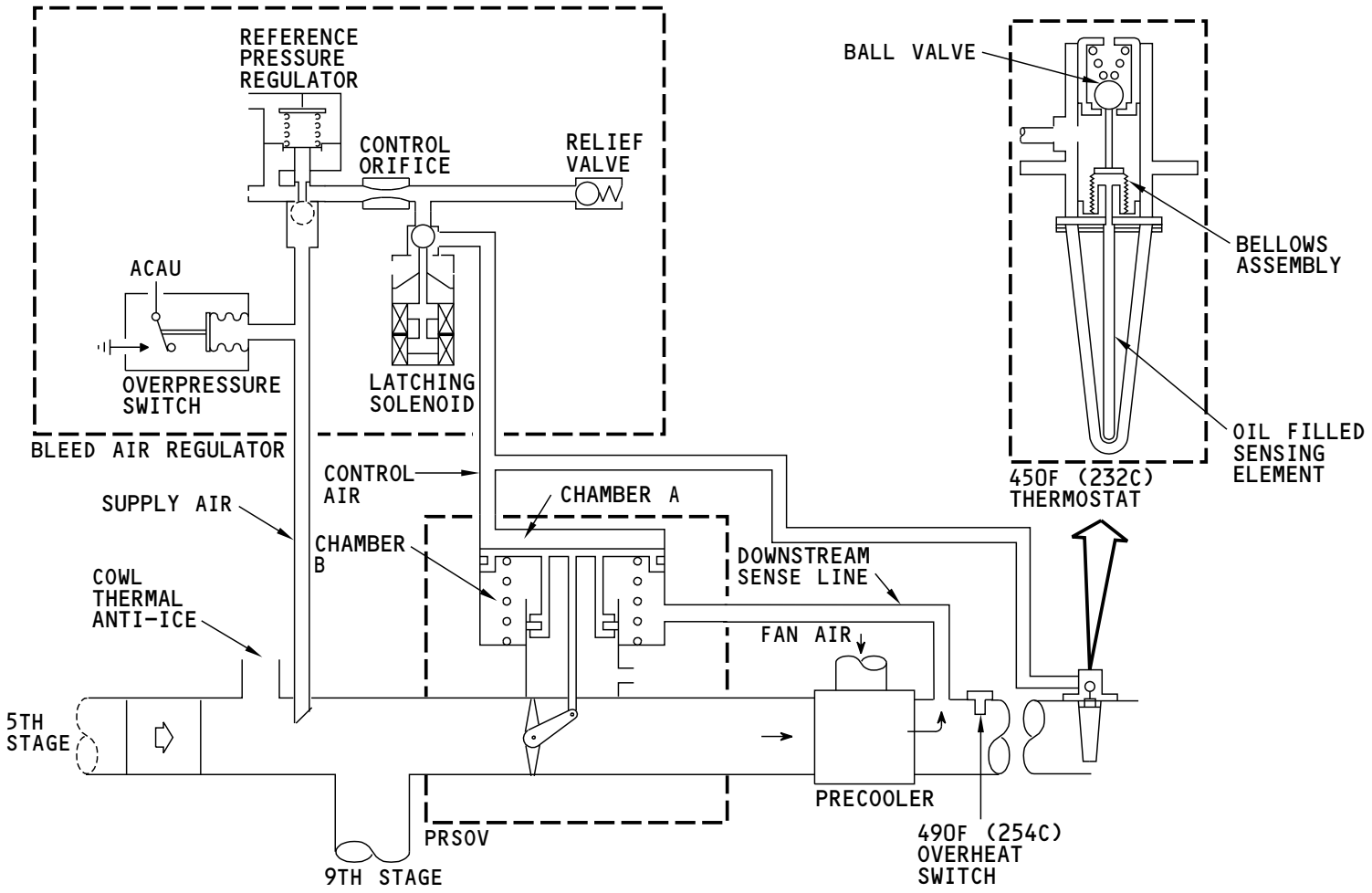
The relief valve prevents damage to the PRSOV if the reference pressure regulator fails.

The latching solenoid controls the flow of air to chamber A of the PRSOV actuator and the 450F thermostat. The PRSOV actuator opens the valve against spring force and pressure in chamber B. The combination of forces on the actuator cause the valve to regulate the downstream pressure to 42 psi (nominal).

The 450F thermostat monitors the temperature of the engine bleed air. If the temperature increases to 450F (232C), the 450F thermostat opens and bleeds off control pressure to the PRSOV. The decrease in control pressure causes the PRSOV to move towards closed and decreases the flow of bleed air.

The overpressure switch is a safety device. If supply air to the BAR gets to 220 psi, the switch closes and causes a bleed trip off condition.

PNEUMATIC - ENGINE BLEED AIR - BAR, 450F THERMOSTAT, AND PRSOV - FUNCTIONAL DESCRIPTION



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PNEUMATIC - ENGINE BLEED AIR - BAR, 450F THERMOSTAT, AND PRSOV - FUNCTIONAL DESCRIPTION

PNEUMATIC - ENGINE BLEED AIR - 490F OVERTEMPERATURE SWITCH

Purpose

The 490F (254C) overtemperature switch protects the pneumatic manifold from overheat conditions.

Physical Description

The 490F (254C) overtemperature switch has these parts:

- Wrench flats
- Electric connector.

Location

The 490F (254C) overtemperature switch is on the engine bleed air strut duct, downstream of the precooler.

Functional Description

The 490F (254C) overtemperature switch operates by thermal expansion. As the temperature of the sensor increases, internal parts expand. If the temperature is more than 490°F (254°C), the expansion of the internal parts closes switch contacts. When the switch cools, the contacts open.

The 490°F (254°C) overtemperature switch monitors the temperature of the engine bleed air downstream of the precooler. Normally the precooler system cools engine bleed air to 390°-440°F (199°-227°C). At 450°F (232°C), the 450°F (232°C) thermostat reduces engine bleed air flow to reduce the precooler load. If the temperature downstream of the precooler is more than 490°F (254°C), the 490°F (254°C) overtemperature switch operates. The switch supplies a ground to an overheat relay in the air conditioning accessory unit (ACAU). The contacts of the energized relay cause these operations:

- Bleed air regulator solenoid valve closes
- Air conditioning/bleed air controls panel BLEED TRIP OFF light comes on
- P7 MASTER CAUTION and AIR COND annunciator lights come on
- Latching circuit connects through the air conditioning panel TRIP RESET push-button switch.

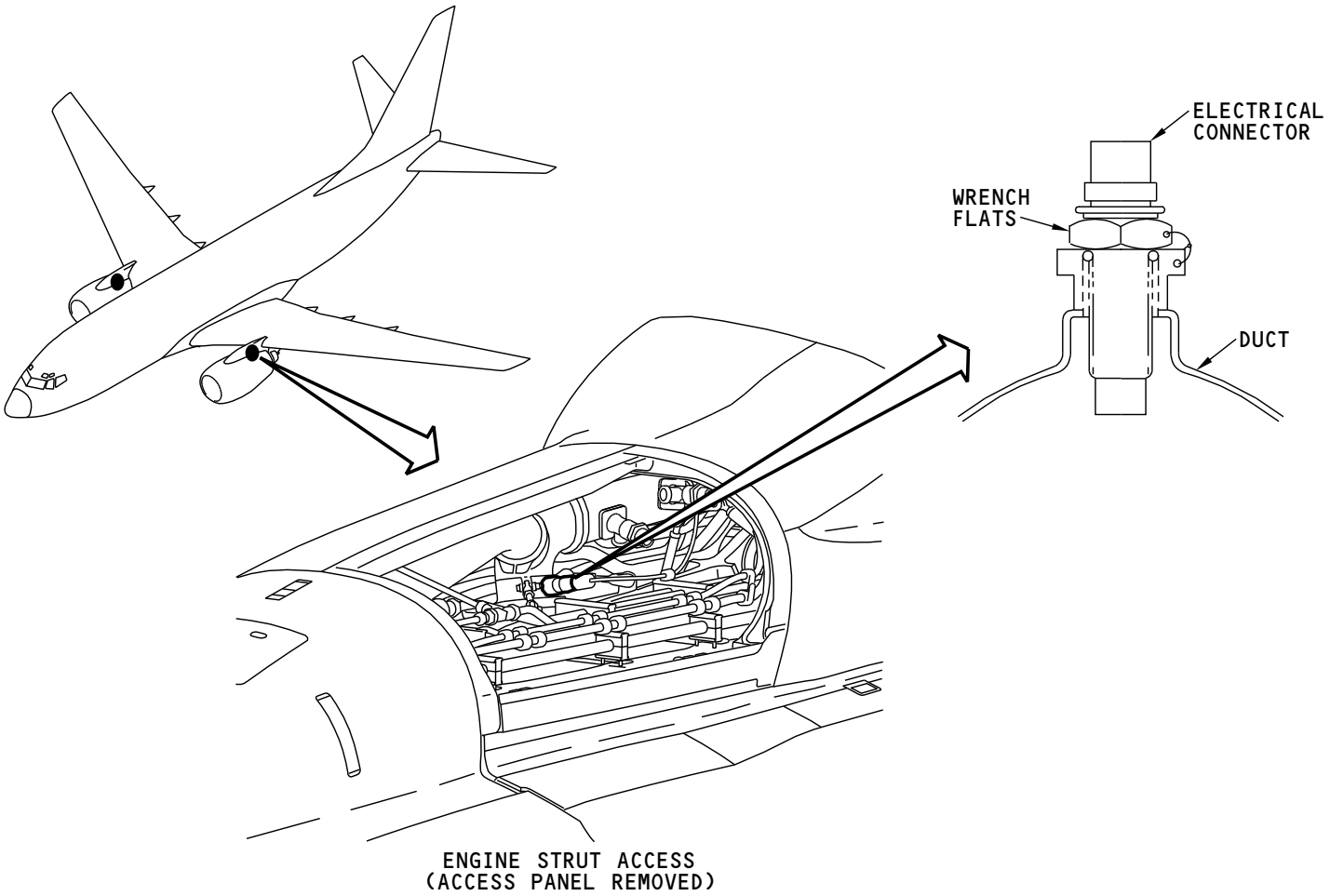
If the ACMS is equipped with custom software (provided by the customer), the 490°F overtemperature switch is capable of transmitting precooler outlet temperatures to the ACMS. The ACMS can record precooler outlet temperatures to aid in performing bleed system preventative maintenance. If the ACMS does not have the custom software needed, the 490° F switch functions only as an overtemperature switch.

Training Information Point

Replace the old switch packing ring with a new ring when you replace the switch.

Apply a thin layer of anti-seize compound to the mounting threads of the switch before you install it. The combination of mounting thread forces and high duct temperatures can cause uncoated valve mounting threads to seize in their mounting boss.

PNEUMATIC - ENGINE BLEED AIR - 490F OVERTEMPERATURE SWITCH



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PNEUMATIC - ENGINE BLEED AIR - 490F OVERTEMPERATURE SWITCH

PNEUMATIC - ENGINE BLEED AIR - BLEED AIR CONTROL CIRCUIT - FUNCTIONAL DESCRIPTION

General

The engine bleed air control and indication circuits use 28v DC.

The engine fire switch has the override authority in the control circuit. If the handle is up (fire condition), the bleed air control signal closes the bleed air regulator solenoid valve. If the engine fire switch is down (normal condition), it arms the engine BLEED switch on the air conditioning/bleed air controls panel.

When the engine BLEED switch is OFF, the control signal closes the bleed air regulator solenoid valve. When the engine BLEED switch is ON, the control signal goes through relaxed relays (normal conditions) in the air conditioning accessory unit (ACAU). This opens the bleed air regulator solenoid valve.

The relays in the ACAU protect the bleed air system during these conditions:

- Engine start operations
- Engine bleed air interstage duct overpressure
- Engine bleed air overtemperature.

The start relay energizes when the engine start valve opens. The energized relay contacts send a signal to close the bleed air regulator solenoid valve.

The overheat relay energizes when a bleed trip off condition exists. These conditions cause a bleed trip off:

- 220 psi overpressure switch operation
- 490F (254C) overtemperature switch operation.

The contacts of an energized ACAU overheat relay cause these operations:

- The bleed air control signal closes the bleed air regulator solenoid valve
- The air conditioning/bleed air controls panel BLEED TRIP OFF light comes on
- The P7 MASTER CAUTION and AIR COND annunciator lights come on
- A holding circuit connects through the air conditioning panel TRIP RESET push-button switch.

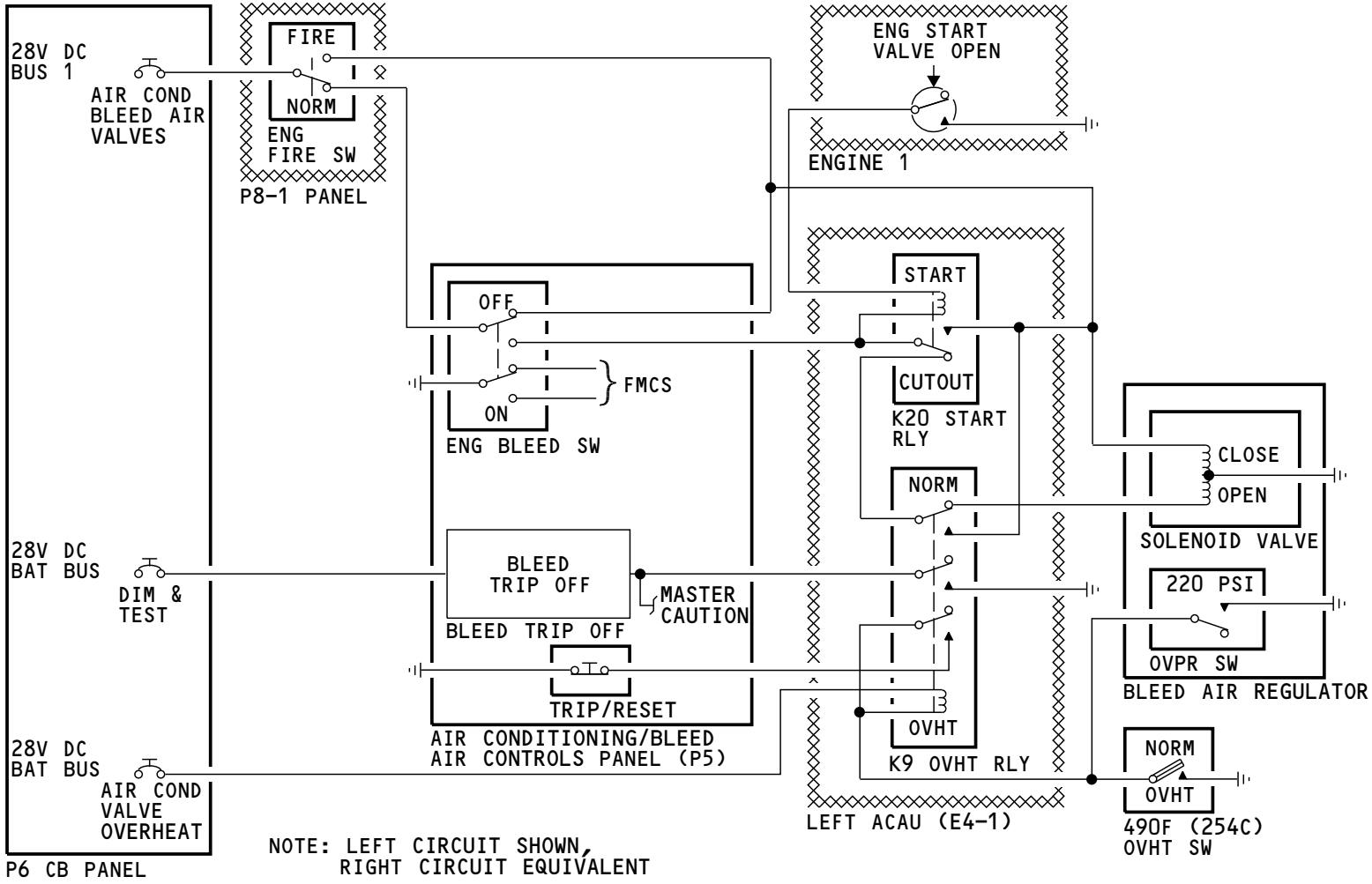
To get control of the engine bleed system after a bleed trip off, these conditions must occur:

- The overpressure or overtemperature switch must return to its normal (open) condition
- You must push the air conditioning panel TRIP RESET push-button switch (to break the holding circuit).

The air conditioning panel engine BLEED switch has multiple poles. One set of poles controls the solenoid valve circuit. Another set of poles supplies discrete signals to the flight management computer.

The open and close coils on the bleed air regulator solenoid valve are constant duty coils. The solenoid valve also has a mechanical latch. When there is a loss of electric power, the solenoid valve will stay in the last electrically commanded position.

PNEUMATIC - ENGINE BLEED AIR - BLEED AIR CONTROL CIRCUIT - FUNCTIONAL DESCRIPTION



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PNEUMATIC - ENGINE BLEED AIR - BLEED AIR CONTROL CIRCUIT - FUNCTIONAL DESCRIPTION

PNEUMATIC - ENGINE BLEED AIR - FUNCTIONAL DESCRIPTION

Purpose

The engine bleed air distribution system supplies temperature and pressure regulated air to the bleed air manifold.

Functional Description

The pressure regulator and shutoff valve (PRSOV) controls the flow of engine bleed air to the pneumatic manifold.

The bleed air regulator (BAR) operates the PRSOV with control pressure. The source of pressure for the BAR is the engine bleed interstage duct. The BAR gets electrical control from a 28v dc signal. This signal comes from the air conditioning accessory unit (ACAU). When the BAR solenoid valve opens electrically, it supplies control pressure to open the PRSOV against spring force. When the BAR closes electrically, it bleeds the control pressure from the PRSOV. Spring force closes the PRSOV.

The ACAU gets inputs from these controls and sensors:

- The engine fire switch
- Engine bleed switch
- Engine start valve
- The BAR 220 psi overpressure (OVPR) switch
- The 490F (254C) overheat switch (engine strut duct).

Usually, the engine bleed switch controls the BAR. In the ON position, the switch supplies a signal through the ACAU to open the solenoid valve in the BAR. In the OFF position, the switch supplies a signal to close the solenoid valve in the BAR.

When the engine fire switch is in the normal (down) position, it arms the engine bleed switch. When the engine fire switch is in the FIRE (up) position, it sends a signal to close the BAR solenoid valve. This causes the PRSOV to close. This happens regardless of the bleed switch position.

There is protection so that the engine bleed air manifold will not have reverse flow during engine starts. The engine start valve sends a signal to the ACAU during engine start. This causes the ACAU to send a close signal to the BAR solenoid valve, regardless of the bleed switch position.

There is protection for the pneumatic manifold from overpressure or overtemperature conditions. Operation of either the 220 psi overpressure switch or the 490F (254C) overheat switch will cause a bleed trip off condition. A bleed trip off condition sends a signal from the ACAU to close the BAR solenoid valve regardless of bleed switch position.

5th and 9th Stage Engine Bleeds

Bleed air comes from the 5th and 9th stages of the engine high stage compressor. At low engine speed, 5th stage air is not sufficient for the pneumatic system demands and the 9th stage supplies bleed air. At high engine speed the high stage valve closes, and the 5th stage supplies bleed air. The high stage regulator controls the high stage valve. High stage valve operation is automatic.

Engine Bleed Air Cooling Functional Description

A precooler system cools engine bleed air. The precooler system is automatic. The precooler system keeps engine bleed air temperatures between 390F (199C) and 440F (229C). The precooler is a cross flow heat exchanger. It uses engine fan air to cool the engine bleed air.

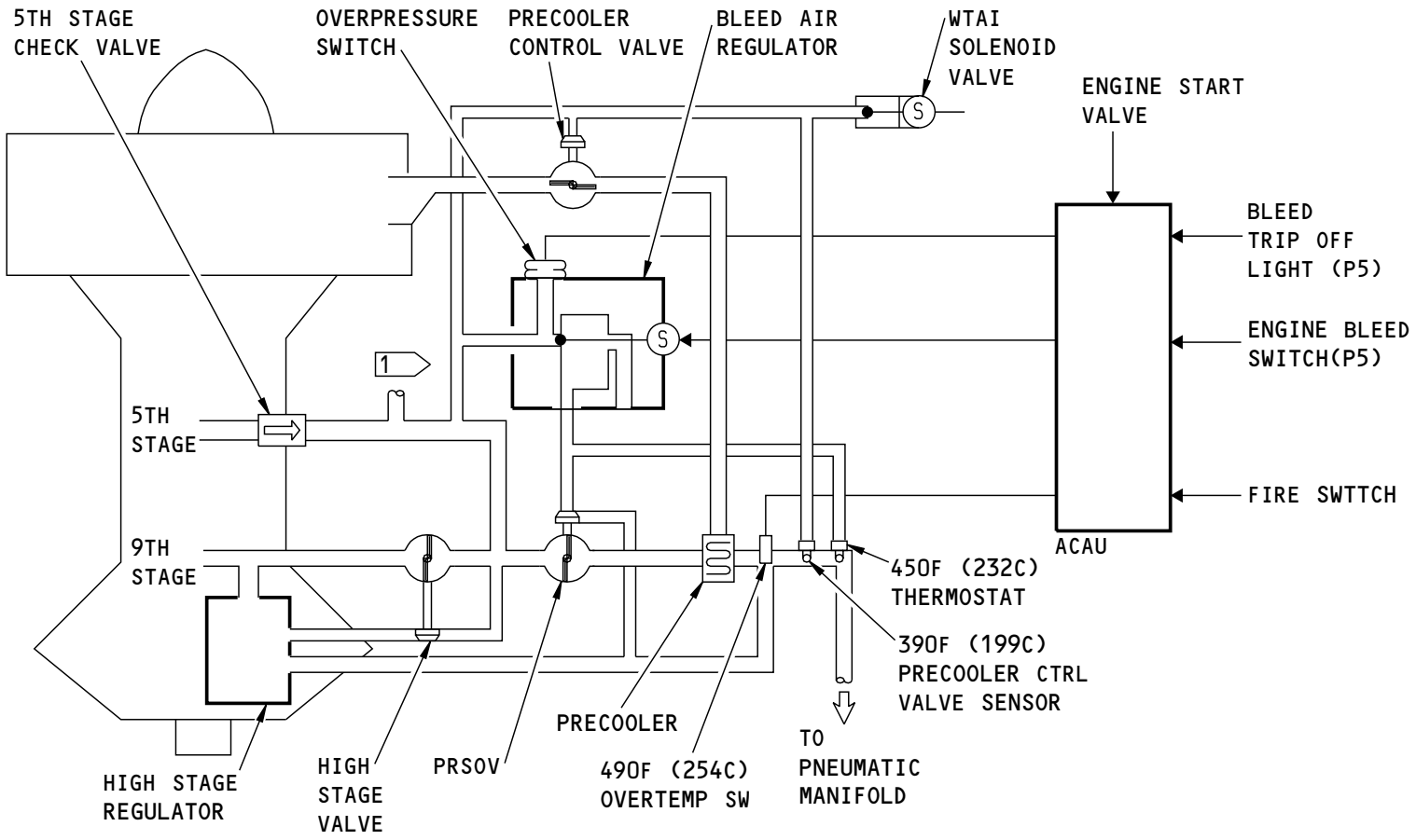
The precooler control valve controls fan air flow to the precooler. The precooler control valve modulates in response to these components:

- The precooler control valve sensor
- The wing thermal anti-ice (WTAI) solenoid valve.

The 450F (232C) thermostat bleeds control pressure from the PRSOV if engine bleed air downstream of the precooler is 450F (232C) or higher. This causes the PRSOV to modulate toward closed. The reduced airflow through the PRSOV has these effects:

- Prevents bleed trip off conditions
- A drop in pneumatic manifold pressure.

PNEUMATIC - ENGINE BLEED AIR - FUNCTIONAL DESCRIPTION



NOTE: LEFT SYSTEM SHOWN - RIGHT SYSTEM THE SAME

1 TO ENGINE NOSE COWL ANTI-ICE VALVE

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PNEUMATIC - ENGINE BLEED AIR - FUNCTIONAL DESCRIPTION

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PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - INTRODUCTION

Purpose

The bleed air precooler system controls the temperature of the engine bleed air before it goes into the pneumatic manifold.

General Description

Each engine has a precooler system. The two precooler systems are identical.

A precooler control valve controls the amount of fan air that flows through the precooler. These two devices control the precooler control valve:

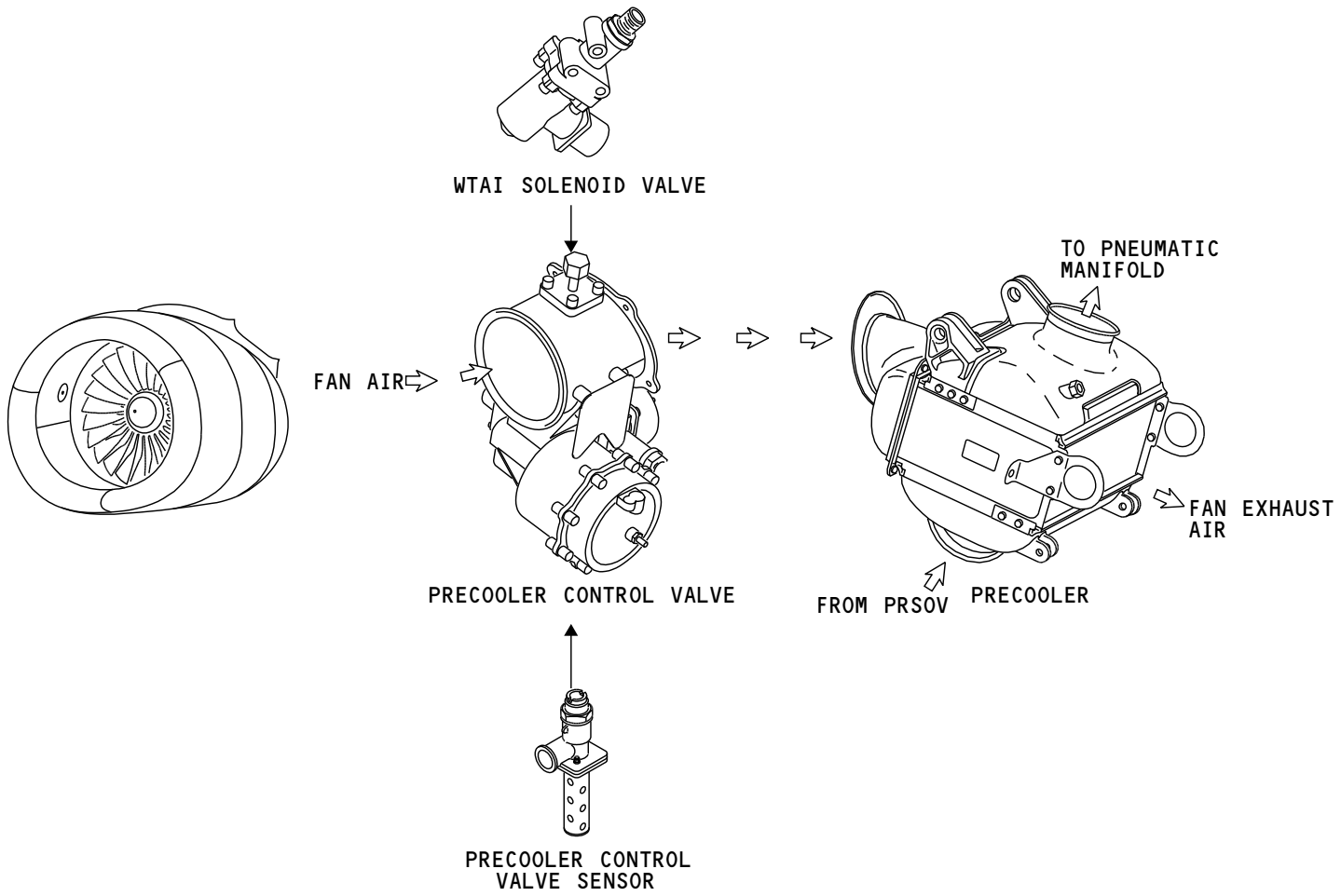
- The precooler control valve sensor
- Wing thermal anti-ice (WTAI) solenoid valve.

When the pressure regulating and shutoff valve (PRSOV) is open, bleed air goes through the precooler and to the pneumatic manifold. While the bleed air goes through the precooler, fan air removes the heat and discharges as fan exhaust air. The fan exhaust air flows over the engine core.

Operation of the precooler systems is automatic.

See the ice and rain chapter for more information on the WTAI solenoid valve (CHAPTER 30).

PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - INTRODUCTION



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PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - INTRODUCTION

Purpose

The precooler cools engine bleed air before it goes to the pneumatic manifold.

Physical Description

The precooler is an air to air heat exchanger.

Location

The precooler is on the top of the engine high pressure compressor case.

Functional Description

The precooler supplies a large surface area for efficient heat transfer from the bleed air to the fan air (heat sink).

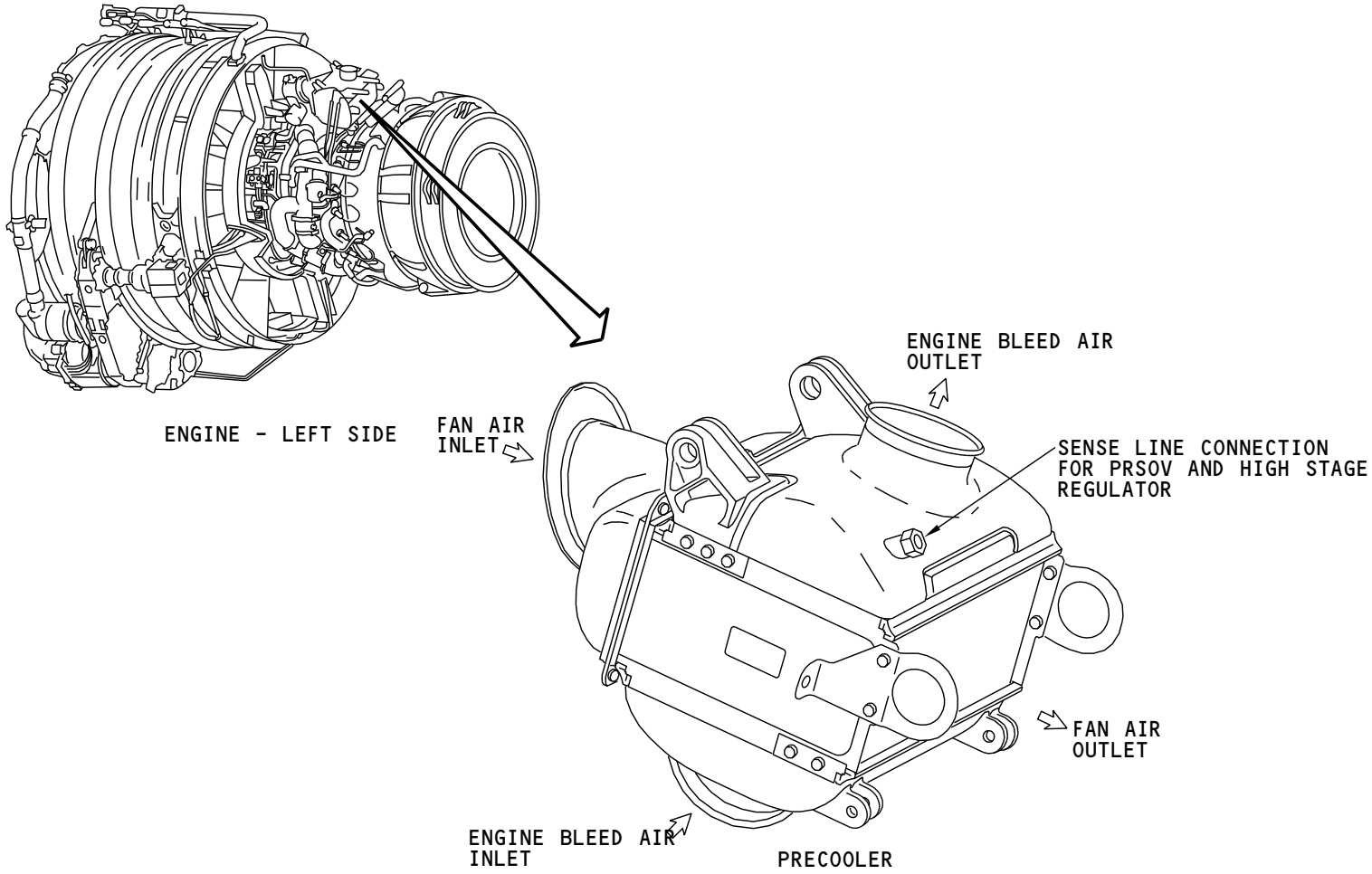
As the engine bleed air moves through the precooler, the bleed air gives up heat to the walls of the precooler. The walls are made of plates and fins. Engine fan air that goes through the precooler on the other side of the walls, removes the heat and carries it away. Heat transfer goes from the bleed air, to the precooler walls, to the fan air. The fan air then flows over the engine case and overboard through the case vents.

A sense line connection connects to the pressure regulating and shutoff valve and the high stage regulator. See the engine bleed air section for more information on the pressure regulating and shutoff valve and high stage regulator (SECTION 36-11).

Training Information Point

The precooler uses narrow passages with thin walls and cooling fins for efficient heat exchange. Contamination or obstruction of the precooler passages decreases or prevents airflow and heat transfer. Keep the precooler clean for maximum performance.

PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - PRECOOLER



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PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - PRECOOLER

PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - PRECOOLER CONTROL VALVE

Purpose

The precooler control valve controls the flow of fan air to the precooler.

Physical Description

The precooler control valve is a spring-loaded open butterfly valve. It is pneumatically controlled and actuated valve. These are the parts of the precooler control valve.

- Manual override and position indicator
- Sense line to precooler control valve sensor
- Sense line to wing thermal anti-ice solenoid valve
- Supply pressure line (from interstage manifold)
- Actuator.

SIA 717-999

- Pneumatic lockout for MEL dispatch

SIA ALL

Location

The precooler control valve is on top of the engine forward of the precooler.

Training Information Point

The precooler control valve has a manual override and position indicator. The override is used to verify the valve is spring loaded open.

SIA 717-999

The pneumatic lockout is on the bottom of the valve as installed to be accessible on wing.

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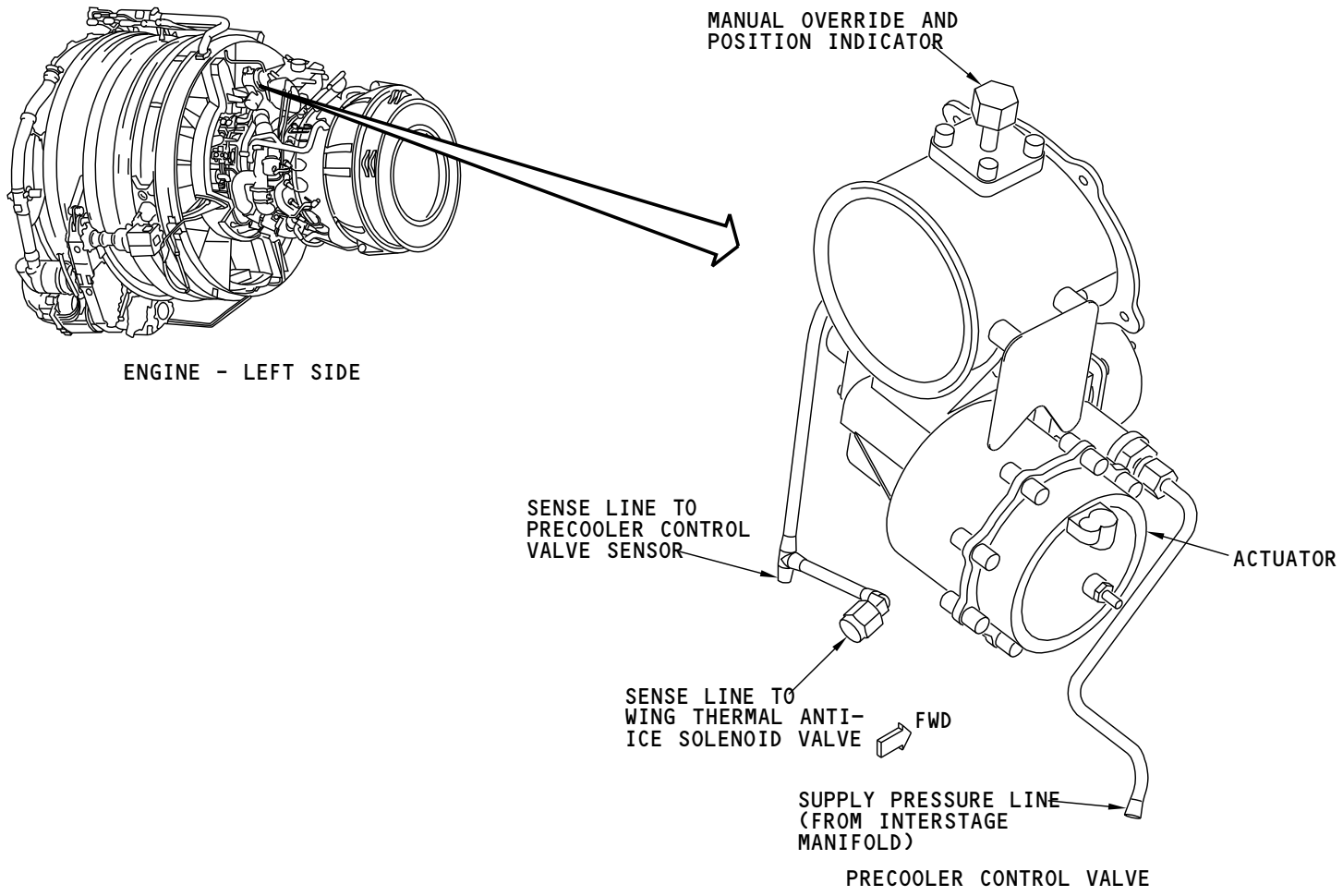
PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - PRECOOLER CONTROL VALVE



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PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - PRECOOLER CONTROL VALVE

PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - PRECOOLER CONTROL VALVE SENSOR 390F

Purpose

The precooler control valve sensor 390F (199C) controls the movement of the precooler control valve.

Physical Description

The precooler control valve sensor is a bleed-off thermostat.

The precooler control valve sensor 390F (199C) has these parts:

- Ball valve assembly
- Sense line connection
- Mounting flange with indexing pin
- Shielded sensor section.

Location

The sensor is in the engine bleed air strut duct. Access is through a strut access panel.

Functional Description

The operation of the precooler control valve sensor is automatic.

The lower part of the sensor is in the bleed air duct downstream of the precooler. This portion of the sensor has oil-filled sense coils. As heat causes the oil to expand, it pushes a ball valve in the upper part of the sensor to open. The higher the duct temperature, the more the oil expansion, and the more the ball valve opens.

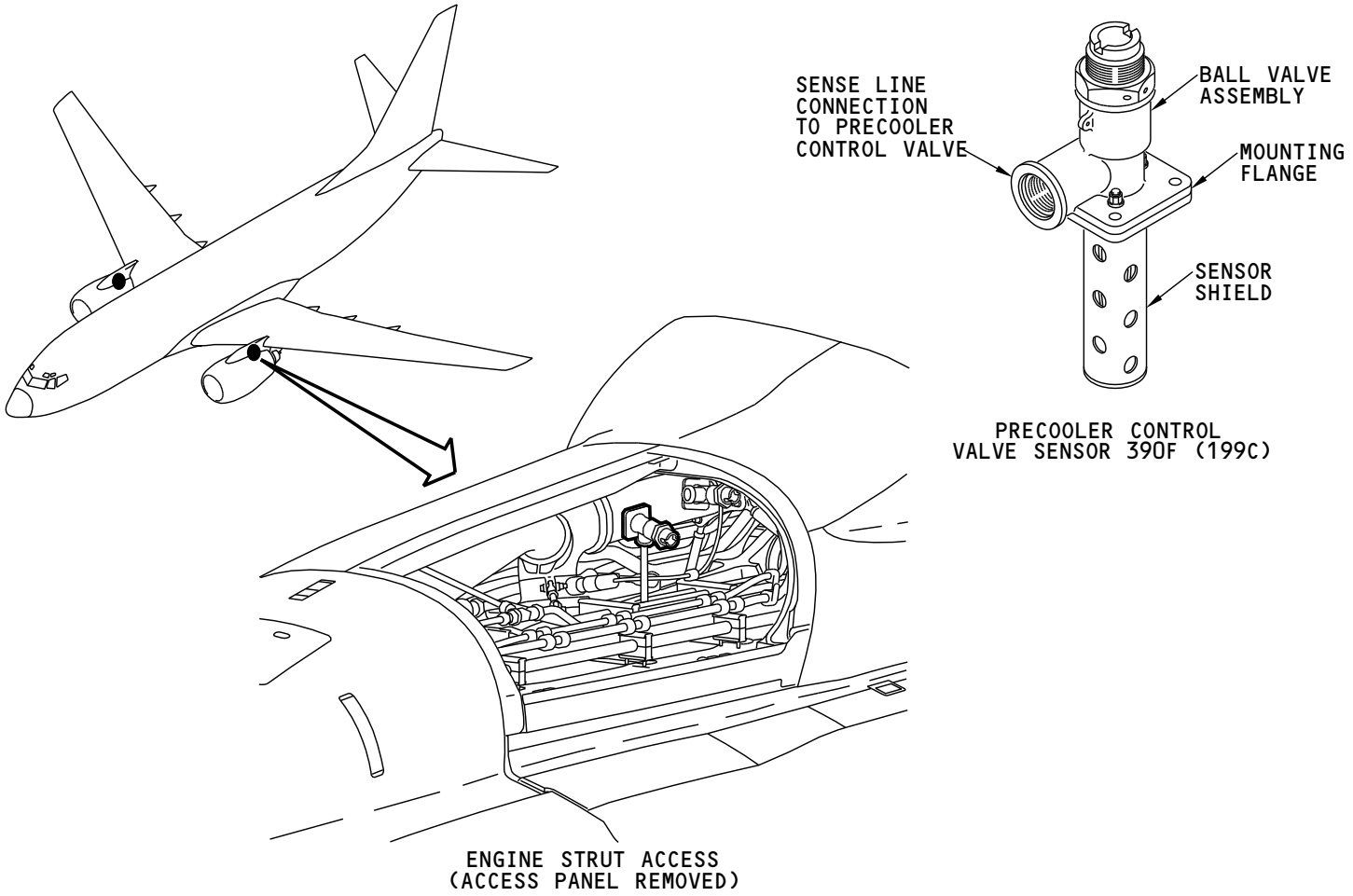
The sensor ball valve starts to open at 390F (199C) and is full open at 440F (227C) (nominal values).

The open sensor ball valve bleeds off pressure to operate the precooler control valve actuator. This causes the precooler control valve to move toward open by spring force.

The precooler control valve sensor operates in parallel with the WTAI solenoid valve to control the precooler control valve. The energized WTAI solenoid valve bleeds off all of the pressure that operates the precooler control valve. The sensor does not have any effect for this operation. The WTAI makes sure that bleed air will receive maximum cooling for ground operations of the WTAI system.

See the ice and rain chapter for more information on the WTAI solenoid valve (SECTION 30-11).

PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - PRECOOLER CONTROL VALVE SENSOR 390F



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PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - PRECOOLER CONTROL VALVE SENSOR 390F

PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - WTAI SOLENOID VALVE

Purpose

The wing thermal anti-ice (WTAI) solenoid valve bleeds actuator pressure from the precooler control valve. The WTAI solenoid valve operates when you use the wing thermal anti-icing system on the ground.

Physical Description

The WTAI solenoid valve has these parts:

- Control pressure port
- Bolt mounting bosses
- Electrical connector.

Location

There are two WTAI solenoid valves, one for each bleed air precooler system. The valves are on top of the compressor section of each engine.

General

The wing thermal anti-icing system prevents ice formation on the wing leading edge during ground operations and in flight. During flight there is a large airflow over the wing. This airflow has a cooling effect on the leading edges. The wing thermal anti-icing system heat output is enough to overcome this cooling effect.

When the wing thermal anti-icing system is used on the ground, there is very little cooling airflow over the wing. In these conditions, the wing thermal anti-icing system heat output can overheat the wing leading edges. This can do damage to the temper of the leading edges devices. The precooler system gives maximum cooling to the engine bleed air during ground operations to prevent overheat damage.

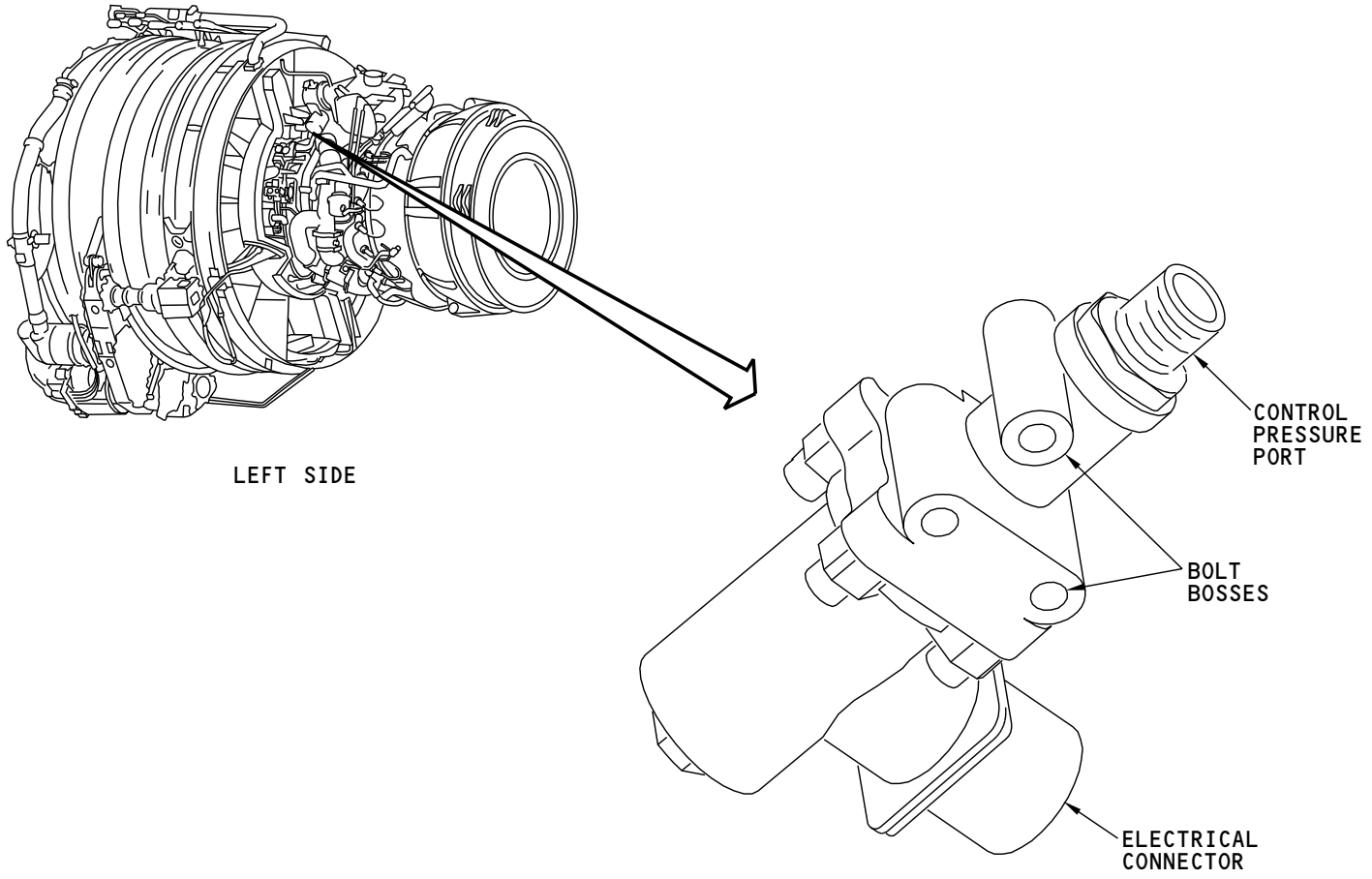
Functional Description

During ground operations of the wing thermal anti-icing system, the anti-ice panel energizes the WTAI solenoid valves. This opens the solenoid valves. The solenoid valves bleed actuating pressure from the precooler control valve. This causes the precooler control valves to go wide open.

The wide open precooler control valve gives maximum cooling to the engine bleed air. This protects the wing leading edges from overheat damage.

See the ice and rain chapter for more information on the WTAI solenoid valve (SECTION 30-11).

PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - WTAI SOLENOID VALVE



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PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - WTAI SOLENOID VALVE

PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - FUNCTIONAL DESCRIPTION

Purpose

The precooler system controls the temperature of the bleed air to the pneumatic manifold.

Functional Description

The precooler control valve gets unregulated air pressure from the interstage manifold. The unregulated air pressure goes to the actuator reference pressure regulator and the servo reference pressure regulator.

The actuator reference pressure regulator reduces the pressure to a constant control pressure. Control pressure then goes to chamber A and the nozzle.

The servo reference pressure regulator reduces the pressure to a constant control pressure. Control pressure then goes to chamber B of the servo, precooler control valve sensor, and WTAI solenoid valve.

The control pressure in chamber A opens and closes the precooler control valve. When pressure increases, the precooler control valve moves towards close. When pressure decreases, the precooler control valve moves towards open.

The control pressure in chamber B moves the lever on the servo. When control pressure increases, the lever closes the nozzle. When control pressure decreases, the lever opens the nozzle.

The control pressure in chamber B decreases when the precooler control valve sensor opens, or the WTAI solenoid valve opens.

The precooler control valve sensor starts to open when the temperature in the pneumatic duct is 390F and is full open at 440F. This decreases the pressure in chamber B. As pressure in chamber B decreases, the lever on the servo opens the nozzle. The open nozzle decreases pressure in chamber A and the spring in the precooler control valve actuator moves the valve to open. As the precooler control valve opens, a feedback spring starts to move the lever to close the nozzle. This prevents rapid movement of the precooler control valve.

The WTAI solenoid valve is open when the airplane is on the ground and the wing thermal anti-ice system is on. This decreases all the pressure in chamber B, and moves the lever to open the nozzle. The open nozzle then decreases all the pressure in chamber A. Then the spring in the actuator opens the precooler control valve full open.

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Functional Description

The precooler control valve (PCCV) gets unregulated air pressure from the interstage manifold. When there is no supply pressure, the PCCV is in the open position. The unregulated air pressure goes to the servo pressure regulator. The unregulated air pressure is ported through a manually operated pneumatic shutoff device, which when engaged, locks the PCCV in the open position.

The servo pressure regulator reduces the pressure to a constant control pressure. Control pressure then goes to the PCCV chamber, precooler control valve sensor, and WTAI solenoid valve.

The control pressure in the PCCV chamber opens and closes the precooler control valve. When pressure increases, the precooler control valve moves towards close. When pressure decreases, the precooler control valve moves towards open.

The control pressure in the PCCV chamber decreases when the precooler control valve sensor opens, or the WTAI solenoid valve opens.

The precooler control valve sensor starts to open when the temperature in the pneumatic duct is 390F and is full open at 440F. This prevents rapid movement of the precooler control valve.

The WTAI solenoid valve is open when the airplane is on the ground and the wing thermal anti-ice system is on. This bleeds off the PCCV control pressure then the spring in the actuator opens the precooler control valve full open.

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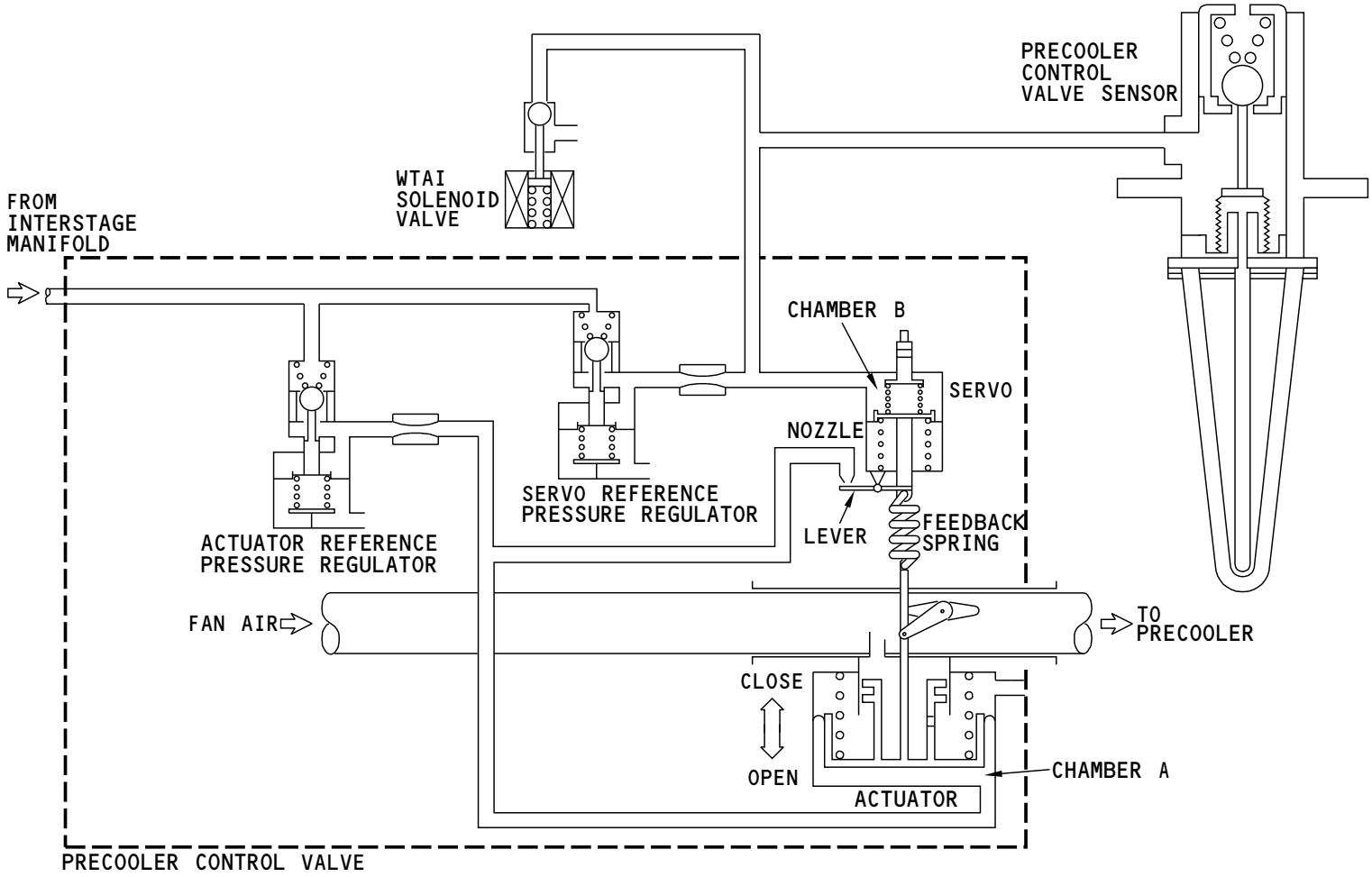
PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - FUNCTIONAL DESCRIPTION



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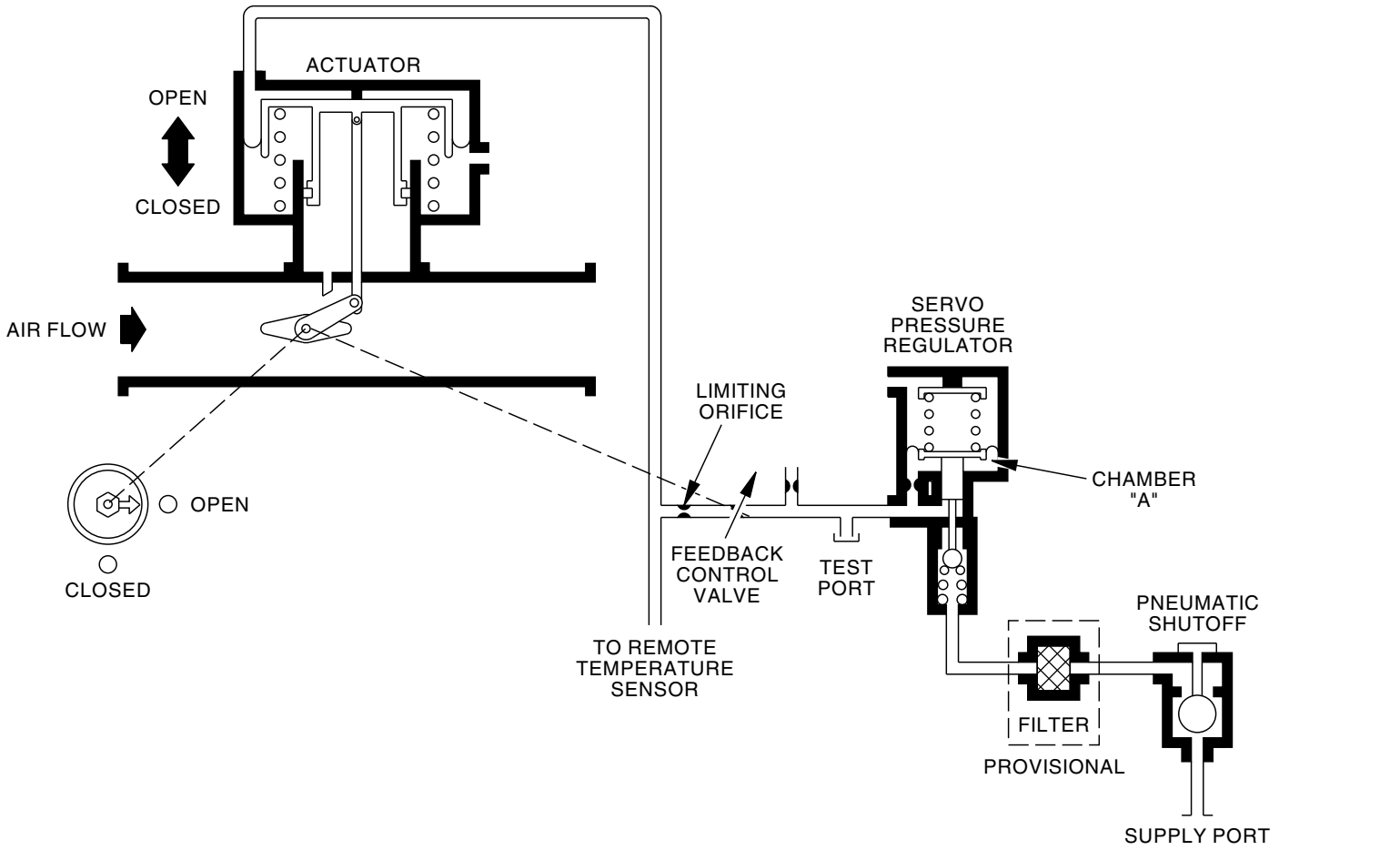
PNEUMATIC - BLEED AIR PRECOOLER SYSTEM - FUNCTIONAL DESCRIPTION



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PNEUMATIC - MANIFOLD SYSTEM - INTRODUCTION

Purpose

The pneumatic manifold has these purposes:

- Sends compressed air from the pneumatic sources to the user systems
- Supplies a valve to isolate the manifold into two separate systems (left and right)
- Supplies a connection for a ground source of pneumatic power.

General Description

The pneumatic manifold ducts are made of strong, corrosion-resistant, light-weight tubing. The pneumatic ducts are supported in tension.

An isolation valve in the center of the crossover duct divides the pneumatic manifold into a left and right side. The right side of the pneumatic manifold has these interfaces/features:

- Engine 2 bleed air system
- Engine 2 start system
- Ground pneumatic connector check valve
- Right air conditioning system
- Right wing thermal anti-ice system
- Hydraulic reservoir pressurization tap
- Isolation valve.

The left side of the pneumatic manifold has these interfaces/features:

- Engine 1 bleed air system
- Engine 1 start system
- APU bleed air system
- Left air conditioning system
- Left wing thermal anti-ice system
- Hydraulic reservoir pressurization tap

SIA 702-714, 716

- Water pressurization system tap

SIA 717-999

- TAT probe, water pressurization system tap

SIA ALL

- Nitrogen gas generation system tap
- Isolation valve.

Location

The manifold is in these areas of the airplane:

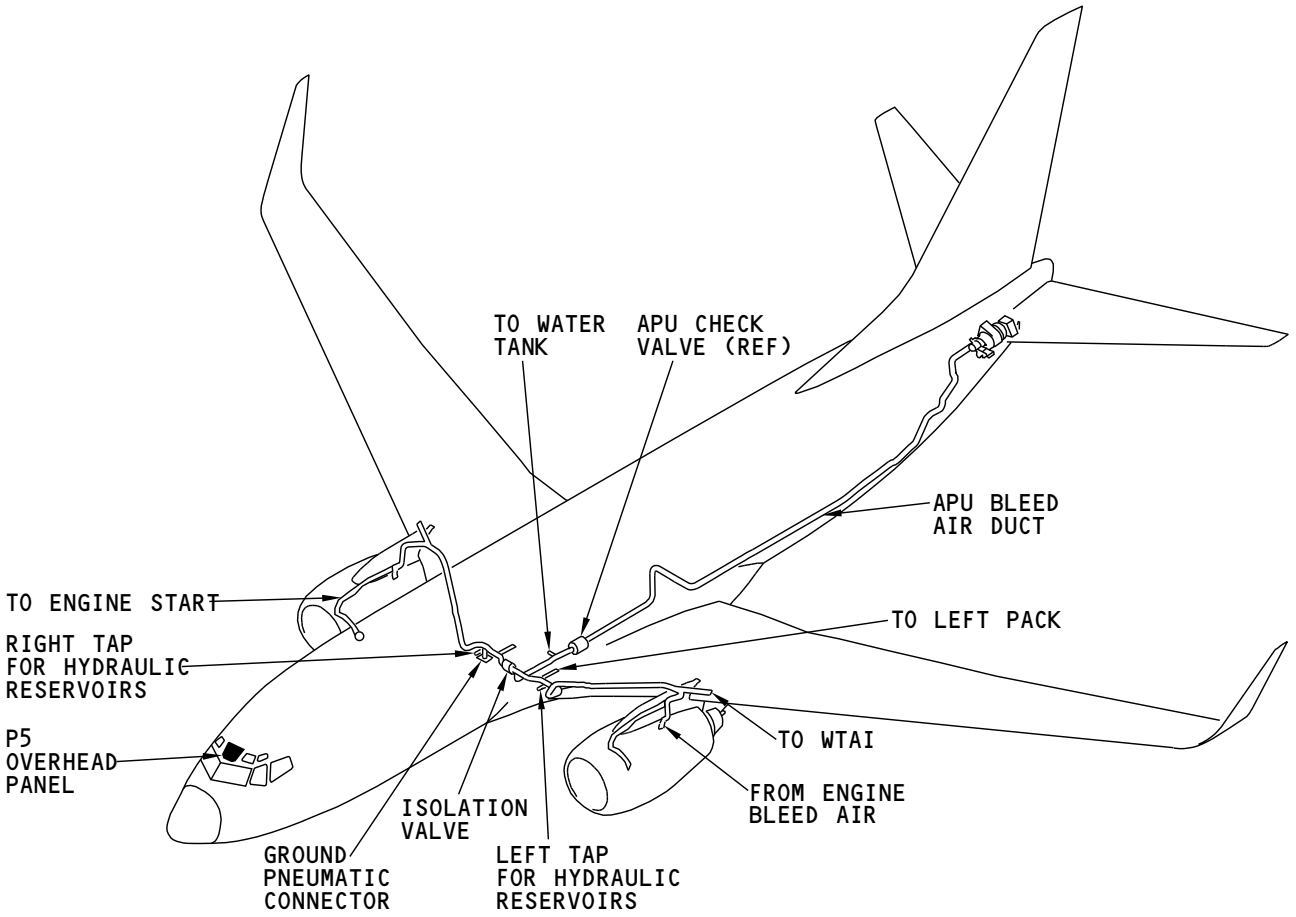
- Engine struts
- Wing leading edges, along the front spars
- Forward air conditioning bays below the center wing (crossover duct)
- Keel beam between the air conditioning pack bays.

Controls and indications for the pneumatic manifold are on the air conditioning bleed air controls panel.

EFFECTIVITY

SIA ALL

PNEUMATIC - MANIFOLD SYSTEM - INTRODUCTION



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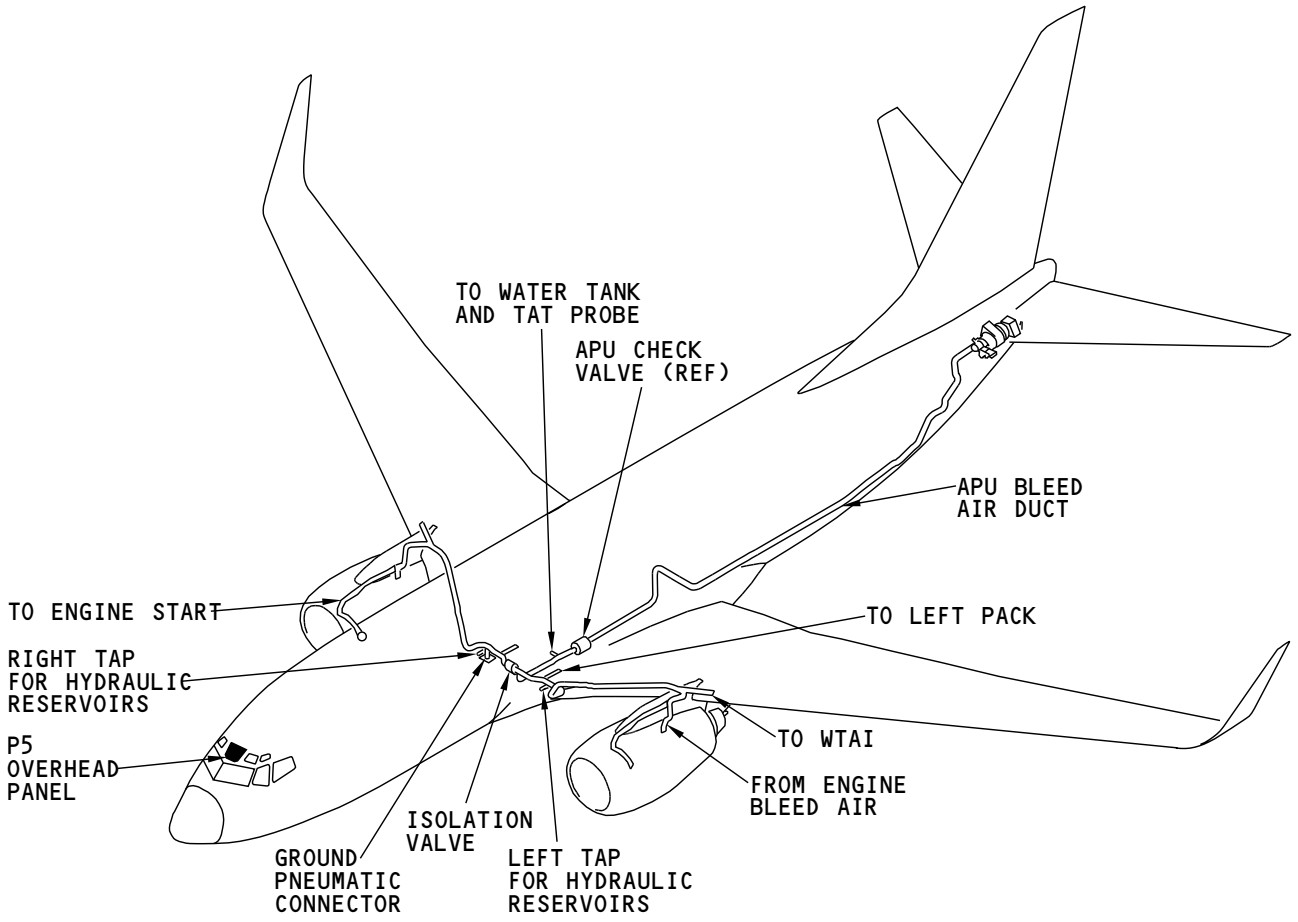
PNEUMATIC - MANIFOLD SYSTEM - INTRODUCTION

PNEUMATIC - MANIFOLD SYSTEM - INTRODUCTION



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PNEUMATIC - MANIFOLD SYSTEM - INTRODUCTION

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PNEUMATIC - MANIFOLD SYSTEM - DUCT

Purpose

The pneumatic manifold sends hot, compressed air through the pneumatic system.

Physical Description

The pneumatic ducts are thin-walled tubes. The ducts have flanges at their ends and join with flange clamps.

The duct sections are made short in length. This lets ducts expand when hot air flows through them. This is thermal expansion.

Tension force holds the ducts between their structural mounts.

Some ducts have a gold coating. The coating has these functions:

- Protects the ducts from the effects of hydrocarbon contamination (hydrogen embrittlement)
- Reduces heat transfer.

Insulation blankets cover some ducts to reduce heat transfer.

Location

Pneumatic ducts are in these areas of the airplane:

- Pneumatic manifold
- Pneumatic systems.

Training Information Point

Overheat detectors are near the pneumatic ducts. These elements operate by the hot air that comes from pneumatic duct leaks. An active element causes a WING-BODY OVERHEAT light on the air conditioning bleed air controls panel to come on.

NOTE: The duct leak overheat protection system uses 115v AC power. Without power, the system will not operate.

See the wing and body overheat detection section for more information (SECTION 26-18).

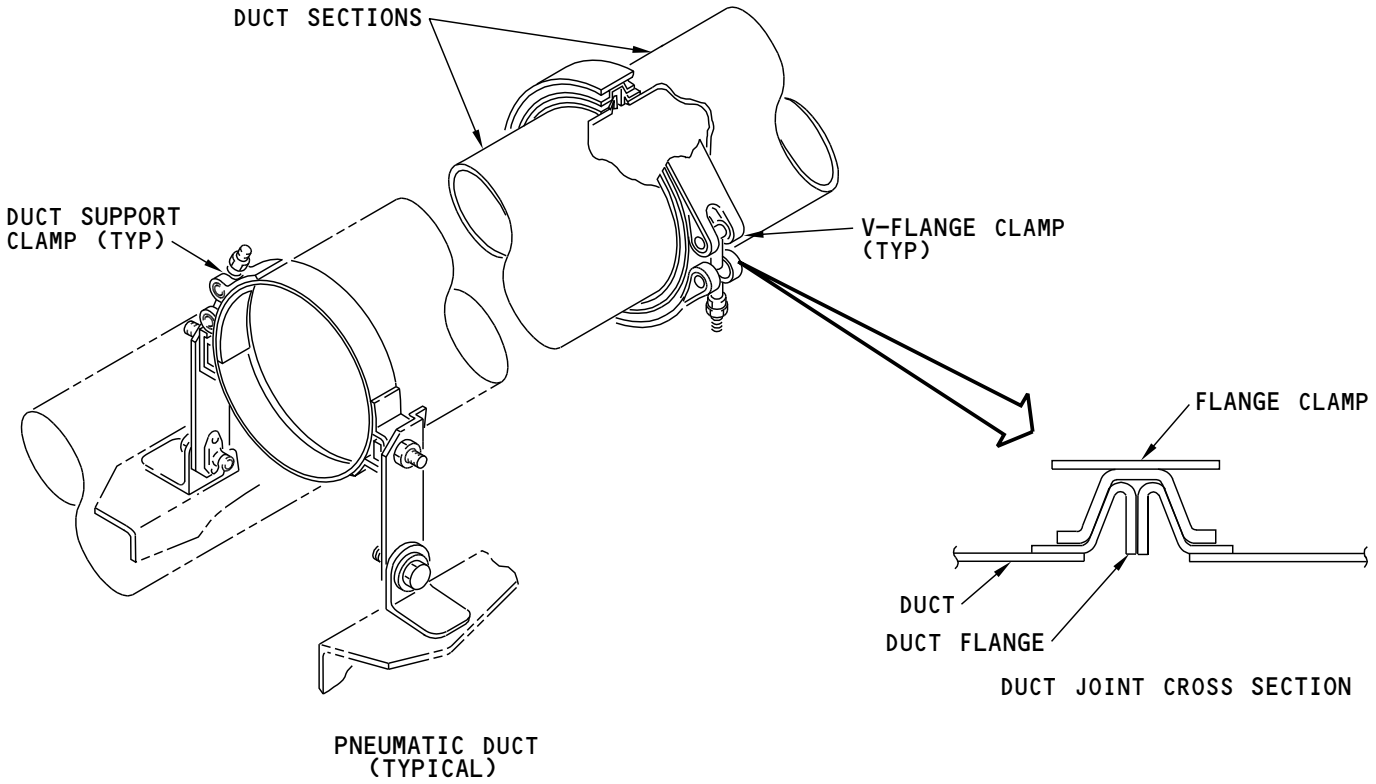
Some duct flange clamps are in areas that contain control cables or other mechanical/electrical devices. Special care must be taken so that the clamps and these components do not touch.

WARNING

DO NOT REMOVE CLAMPS ON PRESSURIZED DUCTS. PERSONAL INJURY OR EQUIPMENT DAMAGE MAY OCCUR.

Keep the pneumatic ducting clean and free from these types of contamination:

- Oil
- Hydraulic fluid
- Fuel
- Other hydrocarbon compounds.



M87299 S0004631105_V1

PNEUMATIC - MANIFOLD SYSTEM - DUCT INSULATION

Purpose

The pneumatic manifold duct insulation decreases the heat flow from the ducts to the adjacent area.

General Description

There are two types of pneumatic insulation on the airplane:

- Soft insulation
- Hard shell insulation.

Soft insulation is a soft, precut, fiberglass pad insulation that is wrapped with a cover and held with tie straps.

Hard shell insulation is a hard, preformed, fiberglass lay-up, air gap insulation that is pre-shaped to fit snugly around the contour of a duct section. The hard shell insulation unit comes in two halves and attaches to the duct section with band clamps or wire lace.

Location

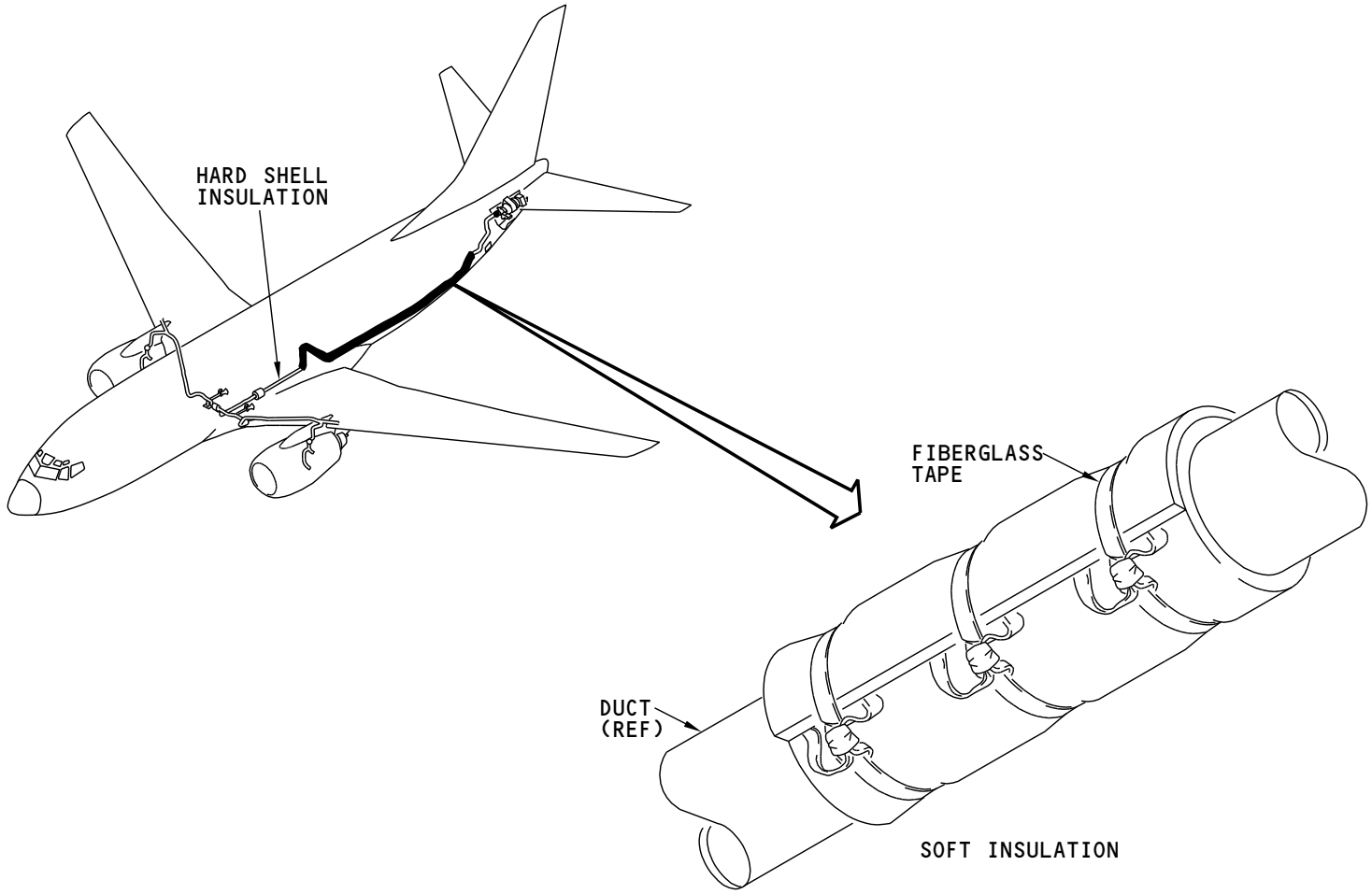
The soft insulation is on the APU duct in the aft cargo compartment areas. The APU duct and soft insulation are behind the sidewall panels in the aft cargo compartments.

The hard shell insulation is on the pneumatic ducts in the keel beam of the airplane.

Functional Description

The duct insulation decreases the heat flow from the ducts they cover. This protects the airplane structure, wiring, and components adjacent to the ducts.

PNEUMATIC - MANIFOLD SYSTEM - DUCT INSULATION



M87300 S0004631107_V1

PNEUMATIC - MANIFOLD SYSTEM - DUCT INSULATION

PNEUMATIC - MANIFOLD SYSTEM - GROUND PNEUMATIC CONNECTOR CHECK VALVE

Purpose

The ground pneumatic connector check valve lets you connect an external source of compressed air to the pneumatic manifold. It prevents flow out of the manifold, and lets flow into the manifold.

General Description

The check valve is a spring-loaded closed split flapper type check valve. Also, it has a standard quick disconnect nipple-type fitting.

The ground pneumatic connector check valve has these parts:

- 3-inch (8-cm) quick disconnect nipple
- Internal check valve.

Location

The ground pneumatic connector check valve is on the right side of the pneumatic manifold crossover duct. Access is through the small panel on the forward outboard corner of the right air conditioning bay access door.

Functional Description

When an external source is pressurizing the pneumatic manifold, the force of the airflow is more than the spring force and the check valve opens. The check valve springs and manifold pressure close the valve when there is no external source. This prevents leakage from the manifold.

Training Information Point

This connector connects directly into the pneumatic manifold and supplies no temperature or pressure regulation. The external pneumatic source must control temperature and pressure within these placard limits on the connector door:

- Maximum temperature 450F (232C)
- Maximum pressure 60 psi.

Before you supply air from an external pneumatic source, these conditions should be met:

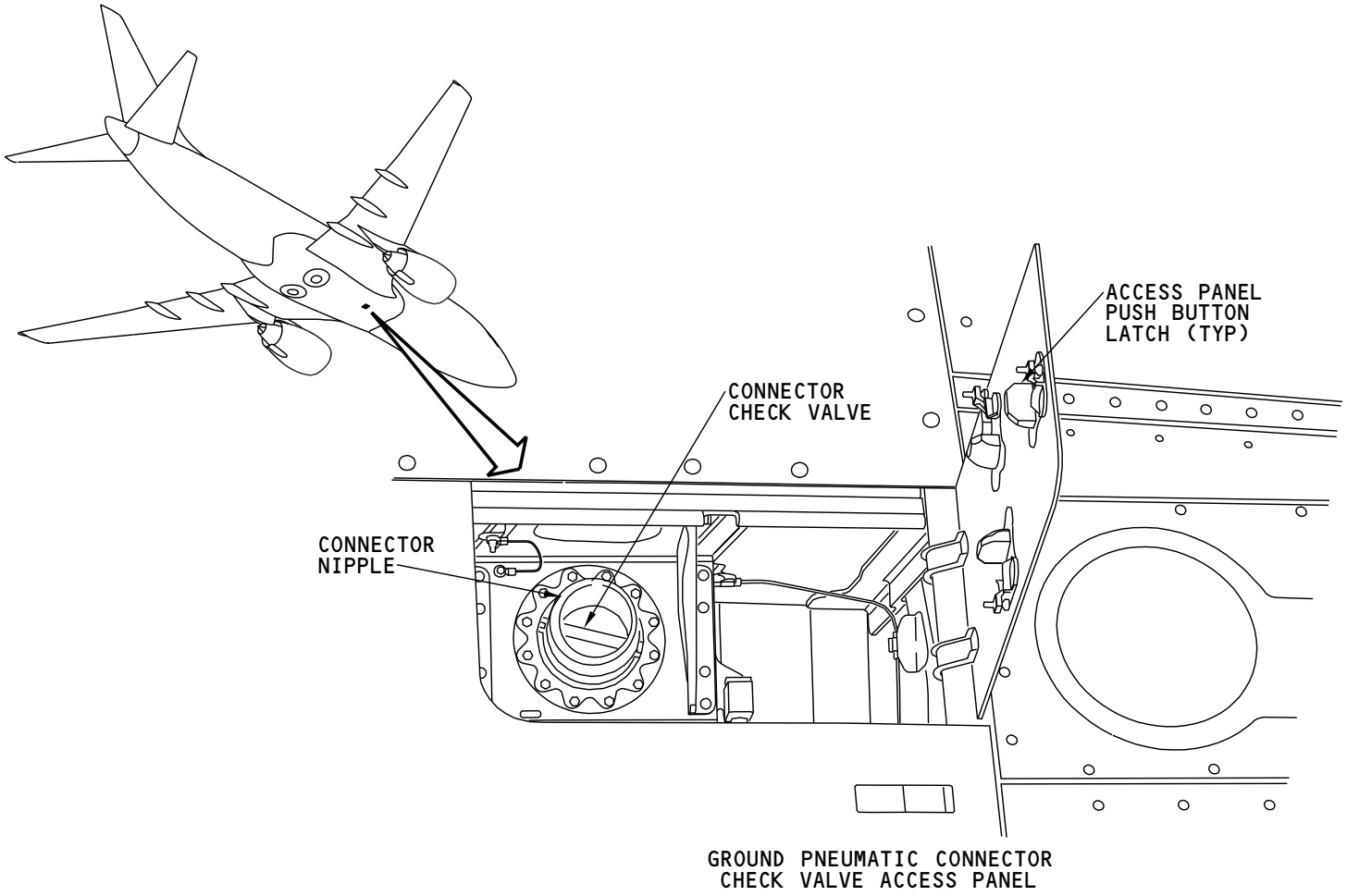
- Battery power on
- Air conditioning pack switches off.

This makes sure that the pack valves will be closed.

CAUTION MONITOR FLIGHT COMPARTMENT WING BODY OVERHEAT SYSTEM DURING ALL OPERATIONS OF THE PNEUMATIC SYSTEM.

115v AC power is necessary to operate the wing body overheat or air conditioning system(s).

PNEUMATIC - MANIFOLD SYSTEM - GROUND PNEUMATIC CONNECTOR CHECK VALVE



M87301 S0004631109_V1

PNEUMATIC - MANIFOLD SYSTEM - GROUND PNEUMATIC CONNECTOR CHECK VALVE

PNEUMATIC - MANIFOLD SYSTEM - BLEED AIR ISOLATION VALVE

Purpose

The bleed air isolation valve has these functions:

- Separates the pneumatic manifold into right and left sides
- Connects the right and left sides of the pneumatic manifold for cross bleed operation.

Physical Description

The isolation valve is a 115-volt, single-phase, motor operated butterfly valve. The bleed air isolation valve has a valve body and an actuator assembly. The actuator assembly has these parts:

- An electric motor and drive assembly
- A manual override handle/position indicator.

Location

The bleed air isolation valve is part of the crossover duct. It is in the keel beam, in the forward area of the air conditioning bays.

Functional Description

The bleed air isolation valve is a butterfly shutoff valve. A 115v AC, single phase motor operates the valve. It is reversible in transit.

The valve has a manual override handle that lets you manually set the position of the valve. The manual override handle is also a position indicator. A flange in front of the lever shows OPEN and CLOSED.

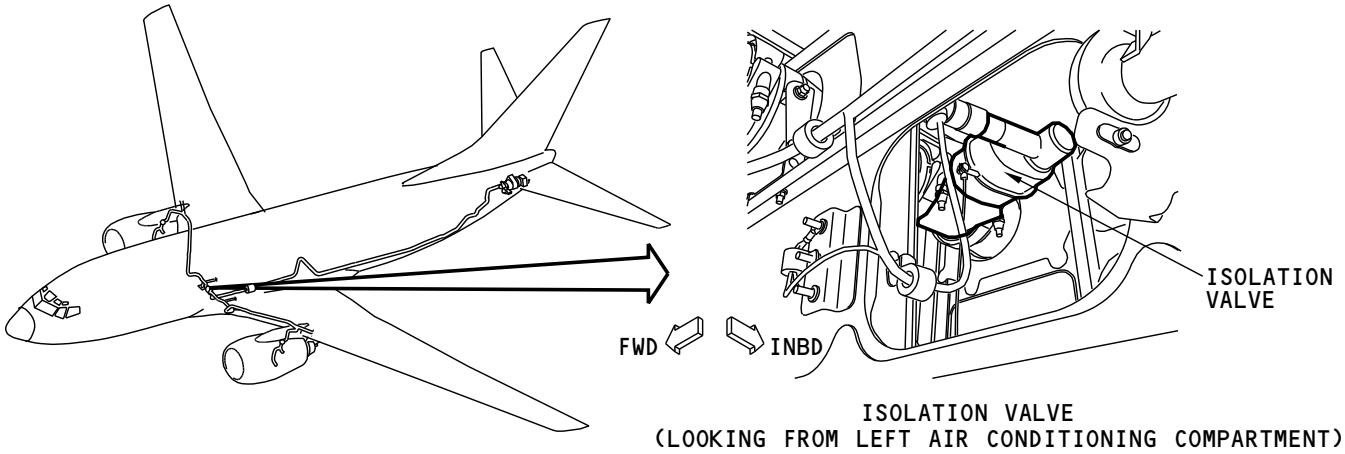
Indications

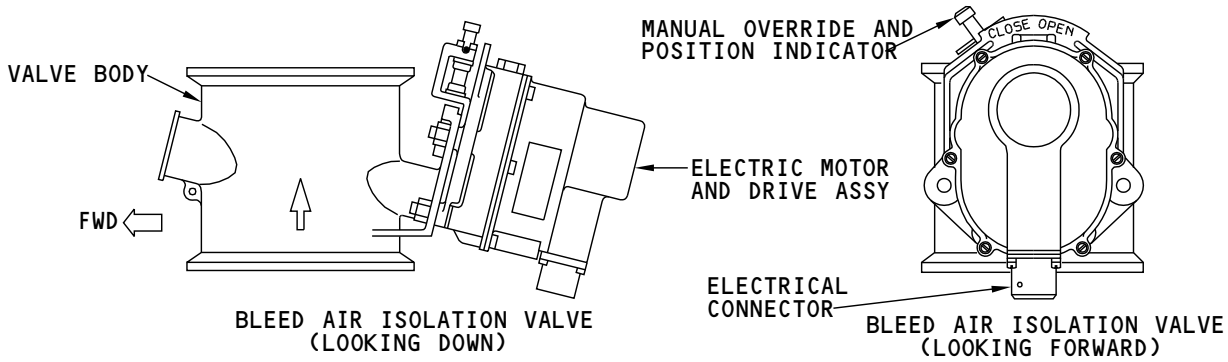
A visual position indicator on the valve shows the valve position.

Operational Controls

A three-position toggle switch on the air conditioning bleed air controls panel controls the bleed air isolation valve. These are the switch positions:

- OPEN - The valve opens to connect the right and left sides of the bleed air manifold
- AUTO - The aircraft switch position logic controls the valve to open and close as necessary for aircraft operations
- CLOSE - The valve closes to separate the right and left sides of the bleed air manifold.





M87303 S0004631112_V1

PNEUMATIC - MANIFOLD SYSTEM - BLEED AIR ISOLATION VALVE - FUNCTIONAL DESCRIPTION

Purpose

The bleed air isolation valve is in the center of the crossover duct to separate the left and right pneumatic systems or to connect them when necessary.

Functional Description

A three-position toggle switch on the air conditioning/bleed air controls panel controls the valve motor and valve position.

When the bleed air isolation valve switch is in the AUTO position, the control of the isolation valve comes from these air conditioning panel switches:

- R PACK switch
- L PACK switch
- ENG 1 BLEED switch
- ENG 2 BLEED switch.

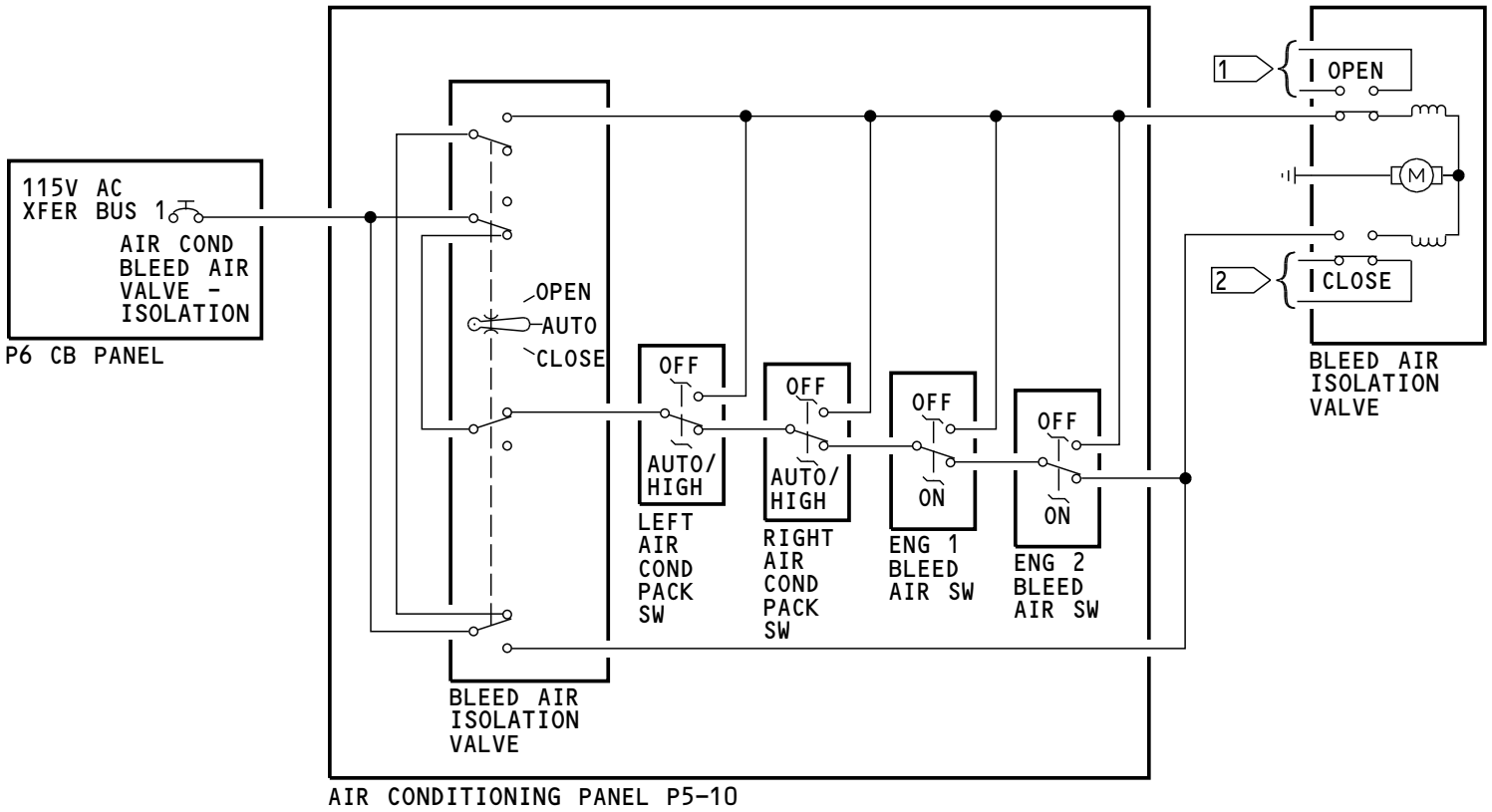
When the isolation valve switch is in AUTO, these switches supply the logic to control the bleed air isolation valve position.

When all the toggle switches are in the AUTO, HIGH, or ON positions, the valve closes.

The control circuit shows a typical cruise condition. The bleed air isolation valve will remain closed. In this configuration, the pneumatic manifold divides into a left and right side. This prevents a single pneumatic duct failure from loss of pressure to all of the manifold.

When any one of the pack or engine bleed switches is in the OFF position, the valve opens.

A trip off condition closes a pack or bleed valve, but does not change the position of its air conditioning panel control switch. The circuit uses switch position logic, not valve position logic.



1 TO DUAL BLEED CIRCUIT

2 TO FMCS

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PNEUMATIC - APU BLEED SYSTEM - INTRODUCTION

Purpose

The APU bleed air system supplies bleed air to the pneumatic manifold:

- On the ground
- In the air (up to 17,000 feet).

The APU can supply bleed air to these systems:

- Engine start systems
- ECS systems.

Location

The APU and bleed air valve are in the APU compartment.

The air conditioning/ bleed air controls panel is in the flight compartment.

The APU bleed air duct is in these areas:

- APU compartment
- Section 48 stabilizer compartment
- Left side and forward bulkhead of the aft cargo compartment
- Inside the keel beam.

The APU check valve is in the keel beam, between the forward air conditioning bays.

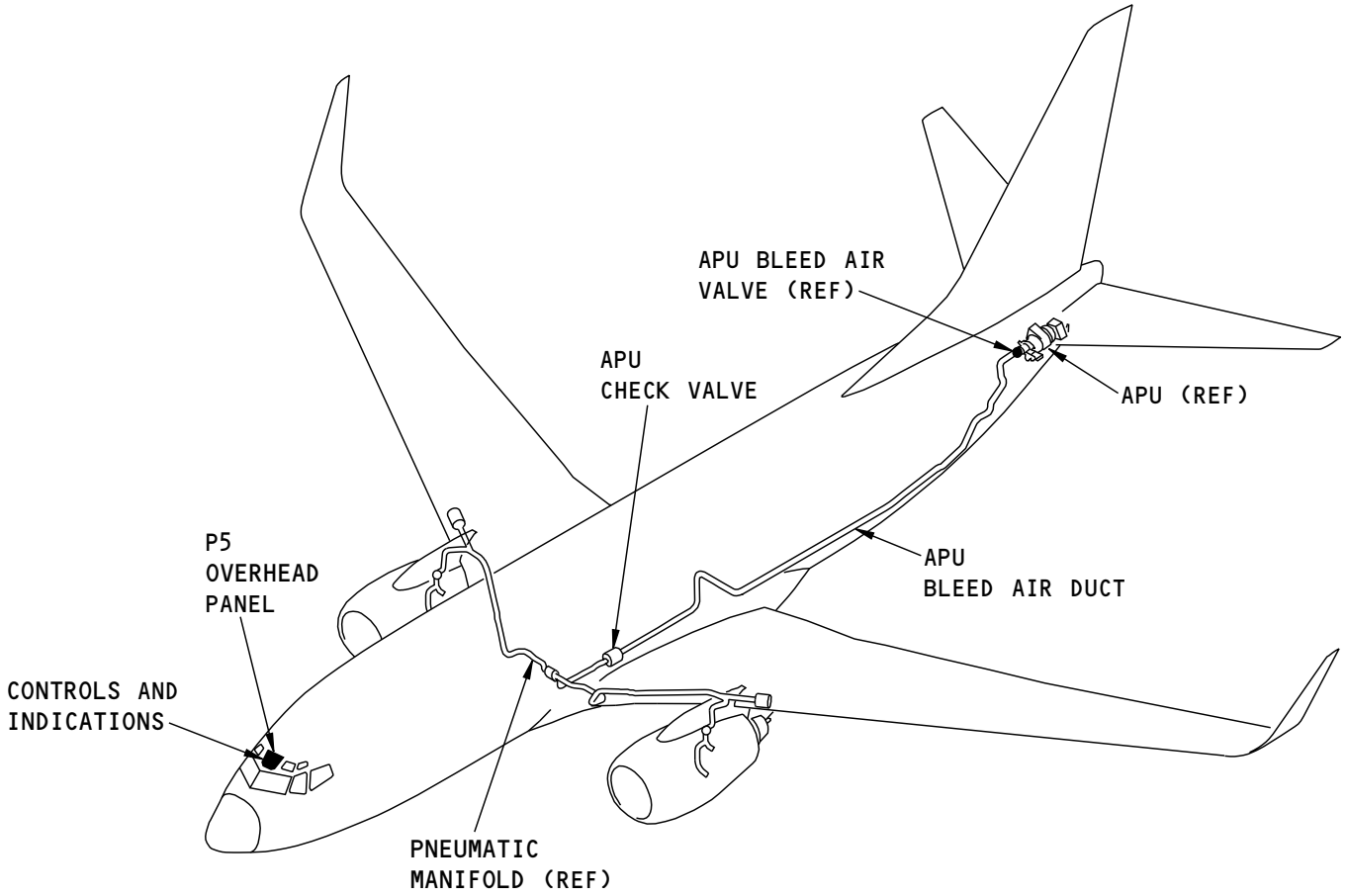
General Description

The APU supplies bleed air to the pneumatic manifold. The APU bleed air duct connects the APU bleed air valve to the pneumatic manifold.

An APU check valve is in the APU duct. This valve protects the APU from engine bleed air flow.

See the APU chapter for more information on the APU bleed air pressure control (SECTION 49-50).

PNEUMATIC - APU BLEED SYSTEM - INTRODUCTION



M87307 S0004631119_V2

PNEUMATIC - APU BLEED SYSTEM - INTRODUCTION

PNEUMATIC - APU BLEED SYSTEM - APU CHECK VALVE

Purpose

The APU check valve prevents engine bleed air flow into the APU load compressor.

Physical Description

The valve is a split flapper type check valve. Two semicircular flappers restrict the air flow.

The bleed air check valve body has a flow direction arrow on it.

Two clamps hold the valve in place.

Location

The APU check valve is part of the APU bleed air duct. It is in the keel beam between the air conditioning compartments. Access is through a lightening hole in the keel beam in the left air conditioning compartment.

Functional Description

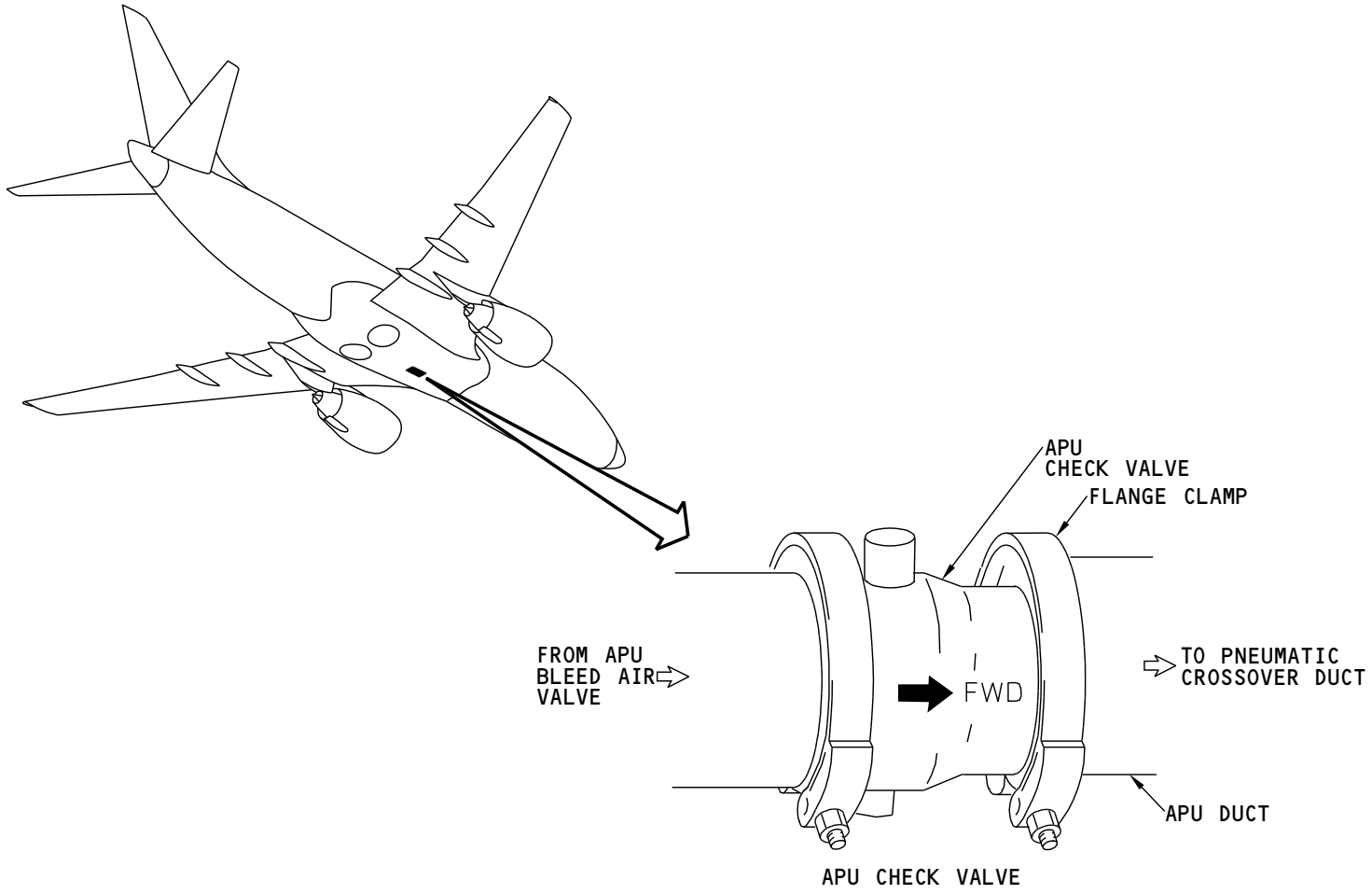
The valve lets air flow in the direction of the arrow and prevents air flow in the opposite direction.

Normal airflow opens the flappers, reverse airflow closes the flappers.

Training Information Point

Install the APU check valve in the proper direction. The flow arrow points forward, toward the crossover duct.

PNEUMATIC - APU BLEED SYSTEM - APU CHECK VALVE



M87309 S0004631124_V1

PNEUMATIC - APU BLEED SYSTEM - APU CHECK VALVE

PNEUMATIC - APU BLEED SYSTEM - DUAL BLEED LIGHT - FUNCTIONAL DESCRIPTION

Purpose

The DUAL BLEED light does these things:

- Tells the crew that an engine (or engines) and the APU both supply pressure to the pneumatic manifold at the same time.
- Reminds the crew to put the thrust levers to the idle position during DUAL BLEED conditions.

Functional Description

The DUAL BLEED indication circuit uses 28v dc electrical power.

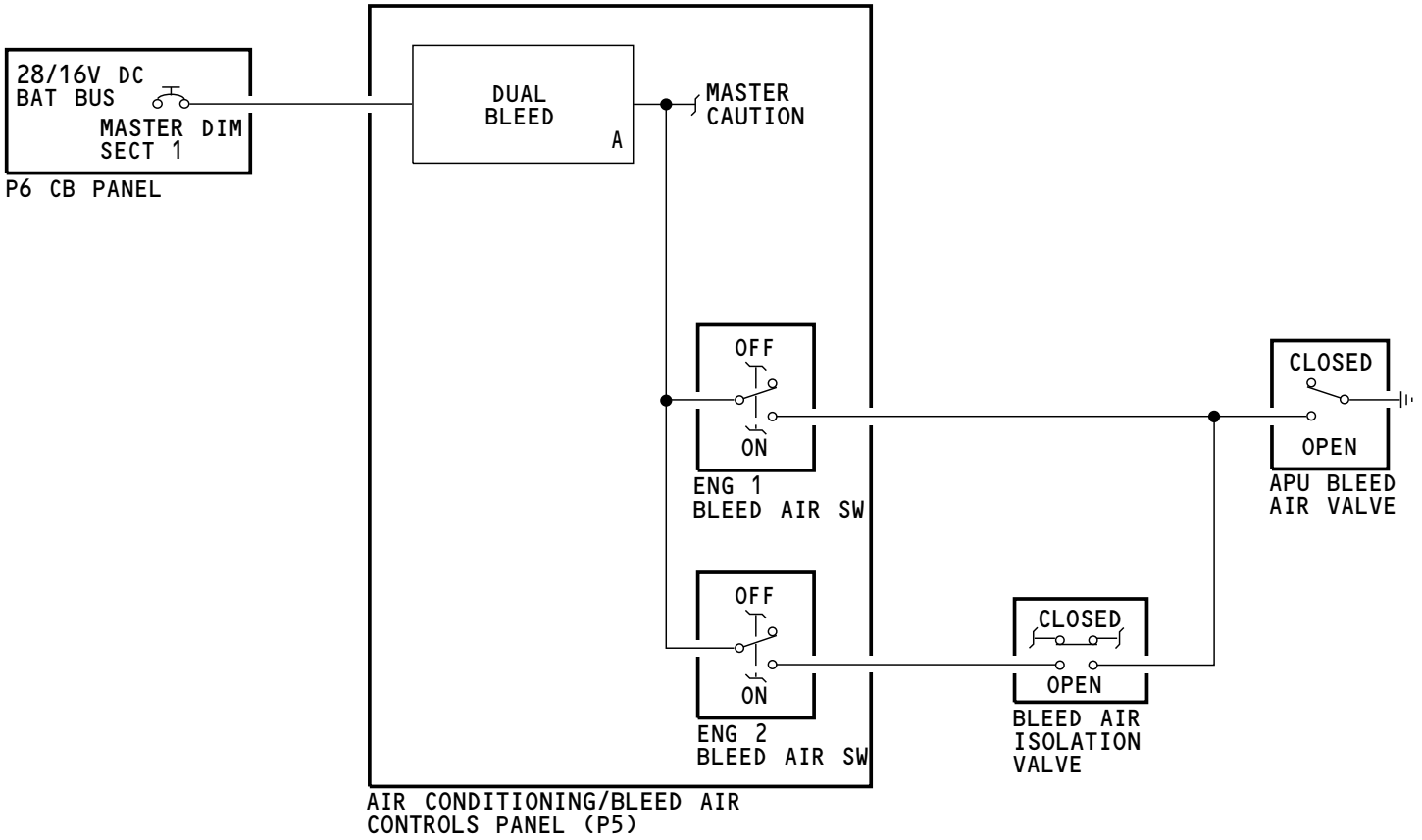
Power goes to the light when the bus has power. When airplane logic supplies a ground to the circuit, the light comes on. The circuit has two paths to ground. Both paths rely on switch and valve position logic.

The DUAL BLEED light comes on for either of these conditions:

- Engine 1 BLEED switch ON and the APU bleed air valve open
- Engine 2 BLEED switch ON, the isolation valve OPEN, and the APU bleed air valve open.

The DUAL BLEED light can make sure that the APU bleed air valve is in the close position. When the APU bleed valve is open and the engine 1 BLEED switch is ON, the DUAL BLEED light shows the valve is not in the close position. When the APU BLEED switch is OFF and the engine 1 BLEED switch is ON, the DUAL BLEED light goes off when the APU bleed air valve closes.

PNEUMATIC - APU BLEED SYSTEM - DUAL BLEED LIGHT - FUNCTIONAL DESCRIPTION



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PNEUMATIC - APU BLEED SYSTEM - DUAL BLEED LIGHT - FUNCTIONAL DESCRIPTION

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PNEUMATIC - INDICATING - INTRODUCTION

Purpose

The indicating system gives the flight crew displays of the pneumatic system status. The displays show this information:

- Right and left pneumatic manifold pressures
- DUAL BLEED conditions.

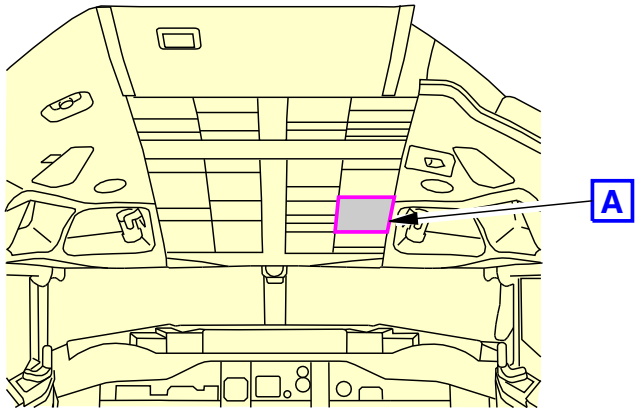
General Description

Pneumatic system indications are on the air conditioning/bleed air controls panel.

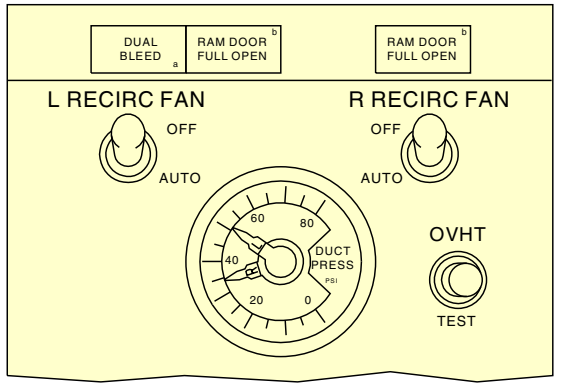
A dual needle (right and left) pressure indicator shows the pressure in the right and left sides of the pneumatic manifold.

A DUAL BLEED light comes on when pneumatic manifold pressure supply comes from the APU and one or both engine bleed systems.

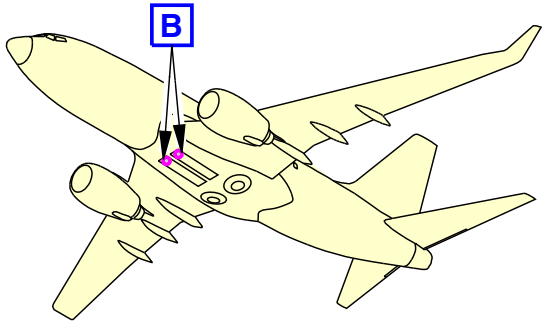
PNEUMATIC - INDICATING - INTRODUCTION



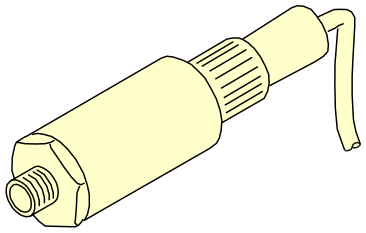
AIRPLANE ACCESS - AIR CONDITIONING BAYS



AIR CONDITIONING/BLEED AIR CONTROLS PANEL (TYPICAL)



DUCT PRESSURE TRANSMITTER 2



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M87320 S0004631136_V2

PNEUMATIC - INDICATING - INTRODUCTION

PNEUMATIC - INDICATING - DUCT PRESSURE TRANSDUCER

Purpose

The duct pressure transmitter supplies pneumatic pressure signals to the P5-10 air conditioning panel pressure gage.

Location

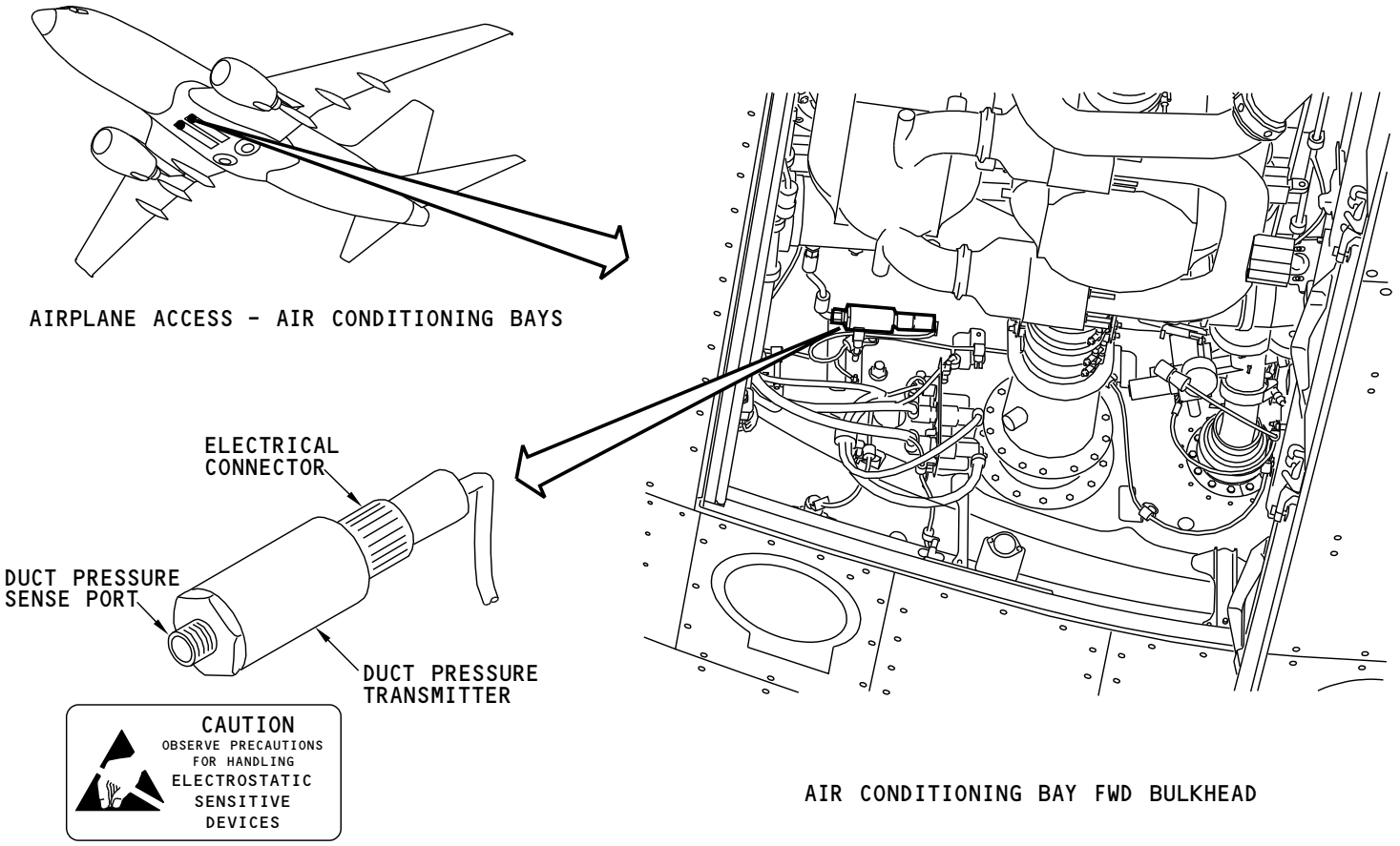
There are two pressure transmitters. One for each side (left and right) of the pneumatic manifold.

The pressure transmitters are on the forward bulkheads of the air conditioning bays near the pneumatic crossover duct.

Physical Description

The pressure transmitters have a pneumatic sense port on one end and an electric connector on the other.

PNEUMATIC - INDICATING - DUCT PRESSURE TRANSDUCER



M87321 S0004631143_V1

PNEUMATIC - INDICATING - DUCT PRESSURE TRANSDUCER

PNEUMATIC - INDICATING - DUAL DUCT PRESSURE INDICATOR

Purpose

The pneumatic duct pressure indicator gives indication of these things:

- Left pneumatic duct pressure
- Right pneumatic duct pressure.

Location

The pneumatic duct pressure indicator is on the air conditioning/bleed air controls panel.

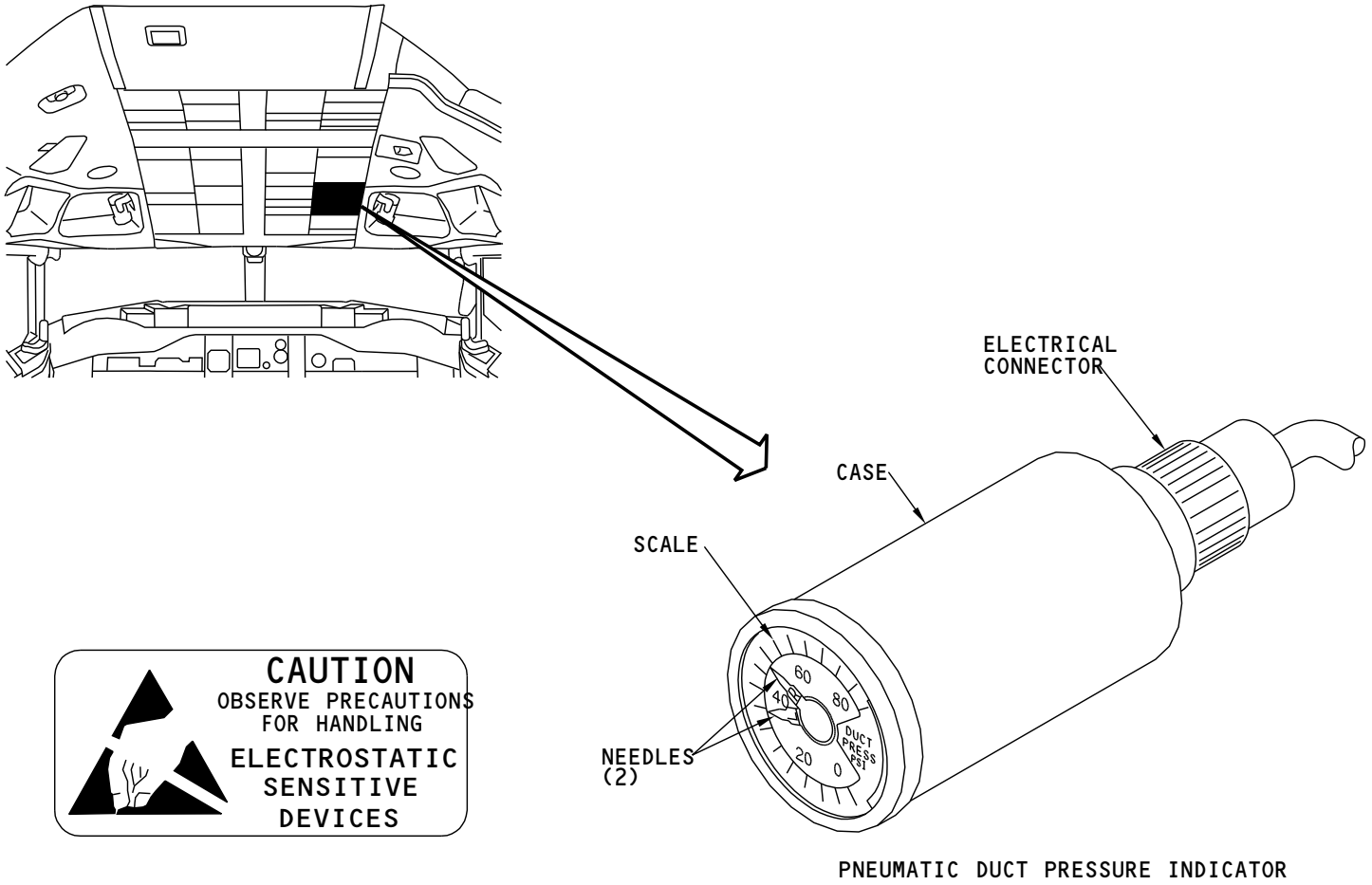
Physical Description

The pressure indicator has two independent needles (L and R), and a single scale (0-80 psi). Integral lamps light the indicator scale. The indicator has a single electrical connector.

Training Information Point

The pressure indicator contains integrated circuits and is an electrostatic discharge sensitive device.

PNEUMATIC - INDICATING - DUAL DUCT PRESSURE INDICATOR



M87326 S0004631145_V1

PNEUMATIC - INDICATING - DUAL DUCT PRESSURE INDICATOR

PNEUMATIC - INDICATING - FUNCTIONAL DESCRIPTION

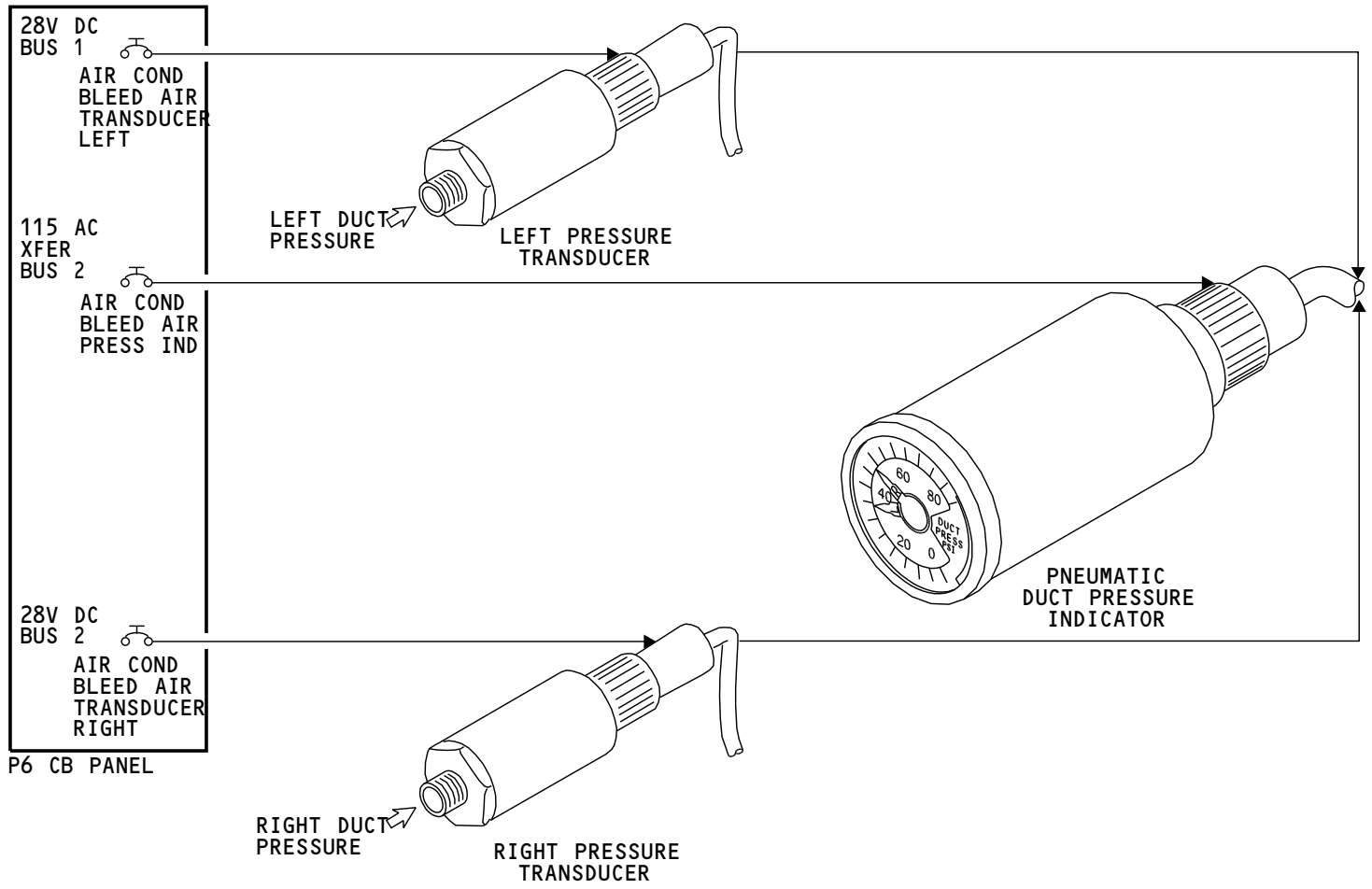
Purpose

The pressure indicating system gives an indication of the pneumatic manifold pressure.

Functional Description

The duct pressure transducers use 28v DC and pneumatic pressure to provide a signal to the pneumatic duct pressure indicator on the air conditioning/bleed air controls panel.

PNEUMATIC - INDICATING - FUNCTIONAL DESCRIPTION



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PNEUMATIC - INDICATING - FUNCTIONAL DESCRIPTION