CHAPTER

47

INERT GAS SYSTEM

CHAPTER 47
INERT GAS SYSTEM

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

47-EFFECTIVE PAGES

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

47-EFFECTIVE PAGES

CHAPTER 47
INERT GAS SYSTEM

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CHAPTER 47
INERT GAS SYSTEM

47-CONTENTS

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NITROGEN GENERATION SYSTEM - INTRODUCTION

Purpose

The Nitrogen Generation System (NGS) reduces the oxygen content of the air mixture in the center tank to a level which will not support combustion.

General

The system does these functions:

- Controls the air pressure into the system
- Changes the ozone in the air to oxygen
- Decreases the temperature of the air
- Removes contamination from the air
- Removes oxygen from the air
- Supplies nitrogen enriched air to the center tank
- Does a check of system performance.

The Nitrogen Generation System has these subsystems:

- Thermal control unit (TCU)
- Nitrogen generation
- Distribution
- Control
- Indication

The TCU has components in the left ECS compartment and in the left ram air duct compartment.

The nitrogen generation components are in the left ram air duct compartment.

The nitrogen enriched air distribution system (NEADS) has components in the left ram air duct compartment, in the center tank, in the right surge tank, and in the left wheel well.

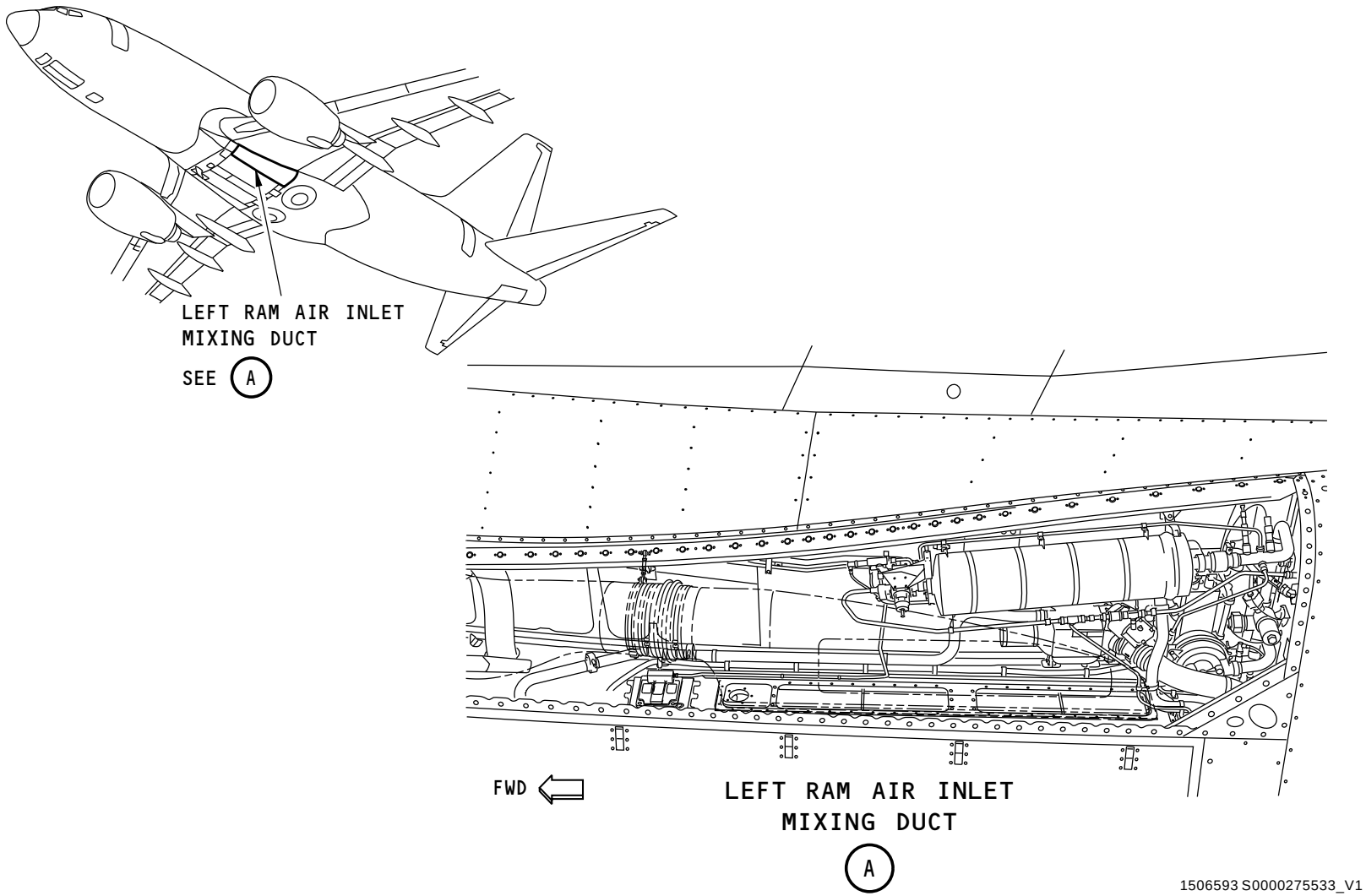
The controller is installed in the aft forward cargo area.

The BITE display unit is in the right ECS compartment.

The operability indicator is in the right wheel well, adjacent to the APU shutoff switch.

Abbreviations and Acronyms

- ASM - air separation module
- BDU - BITE display unit
- BITE - built in test equipment
- CWT - center wing tank
- GSE - ground support equipment
- NEA - nitrogen enriched air
- NEADS - nitrogen enriched air distribution system
- NGS - nitrogen generation system
- PRSOV - pressure regulating and shutoff valve
- OEA - oxygen enriched air
- OTSOV - overtemperature shutoff valve
- RAV - ram air valve
- TCU - thermal control unit



NITROGEN GENERATION SYSTEM

NITROGEN GENERATION SYSTEM - FUNCTIONAL DESCRIPTION

General

The nitrogen generation system uses bleed air from the left side of the pneumatic manifold. The NGS shutoff valve controls the airflow from the manifold. The NGS controller uses system pressure and voltage to control the NGS shutoff valve.

Operation

The nitrogen generation system gets bleed air from the left side of the pneumatic manifold. A sensor on the bleed air duct sends pressure data to the NGS controller. The controller adjusts the NGS shutoff valve. The NGS shutoff valve controls the pressure that comes into the system.

Bleed air goes through the catalytic converter to change the ozone in the air to oxygen. Ozone can decrease the performance and mechanical properties of the air separation module.

The heat exchanger uses ram air to decrease the bleed air temperature to 160 degrees +/- 10 deg F. The ram air valve adjusts the quantity of cool air that goes through the heat exchanger. The temperature sensor sends temperature data to the controller. The controller adjusts the ram air valve.

The filter removes contamination before the air goes into the air separation module. A differential pressure sensor monitors the filter.

The air separation module decreases the oxygen in the air below the quantity necessary to support combustion. The air separation module removes oxygen from the air and releases it overboard.

Nitrogen enriched air (NEA) goes through the high flow valve to the center tank. The high flow valve controls the quantity of NEA that goes to the center tank. The controller uses data from the altitude sensor, differential pressure sensor, and airplane systems to open or close the valve.

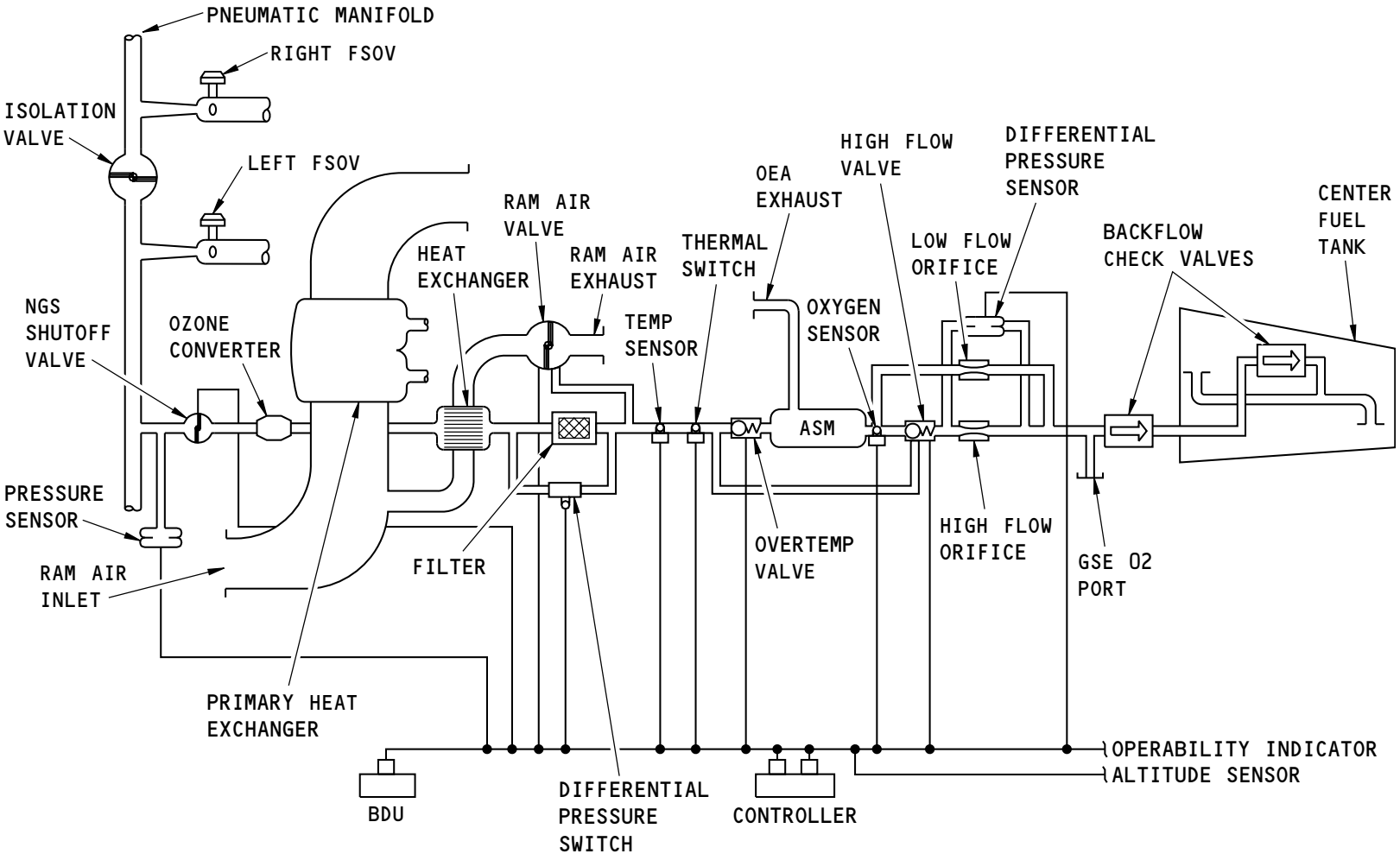
The NEA distribution system (NEADS) sends NEA to the center wing tank. NEA goes into the tank through an ejector nozzle in the climb vent in the left part of the tank. A float valve in the right part of the tank makes sure that the concentration of NEA is constant. A cross vent check valve makes sure that ambient air does not dilute the nitrogen concentration in the center tank during the descent.

The controller monitors and controls system operating temperatures and pressures.

An operability indicator gives a visual indication of the condition of the system.

You use the BITE display unit to do a test of the system.

You use the GSE connection to do a test of the oxygen quantity of the air downstream of the ASM.



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NITROGEN GENERATION SYSTEM - GENERAL DESCRIPTION

NITROGEN GENERATION SYSTEM - COMPONENT LOCATION - 1

Thermal Control Unit

These thermal control unit components are in the forward part of the left side air conditioning compartment:

- Pressure sensor
- NGS shutoff valve
- Ozone converter

These thermal control unit components are in the left ram-air duct bay. They are outboard of the left air conditioning compartment:

- Heat exchanger
- Ram-air valve
- Filter
- Filter differential pressure switch
- Temperature sensor
- Thermal switch
- Overtemperature shutoff valve (OTSOV)

Nitrogen Generation System

These NGS components are in the left ram-air duct compartment.

- Air Separation Module (ASM)
- High Flow Valve (HFV)
- Oxygen Sensor

Bite Display Unit (BDU)

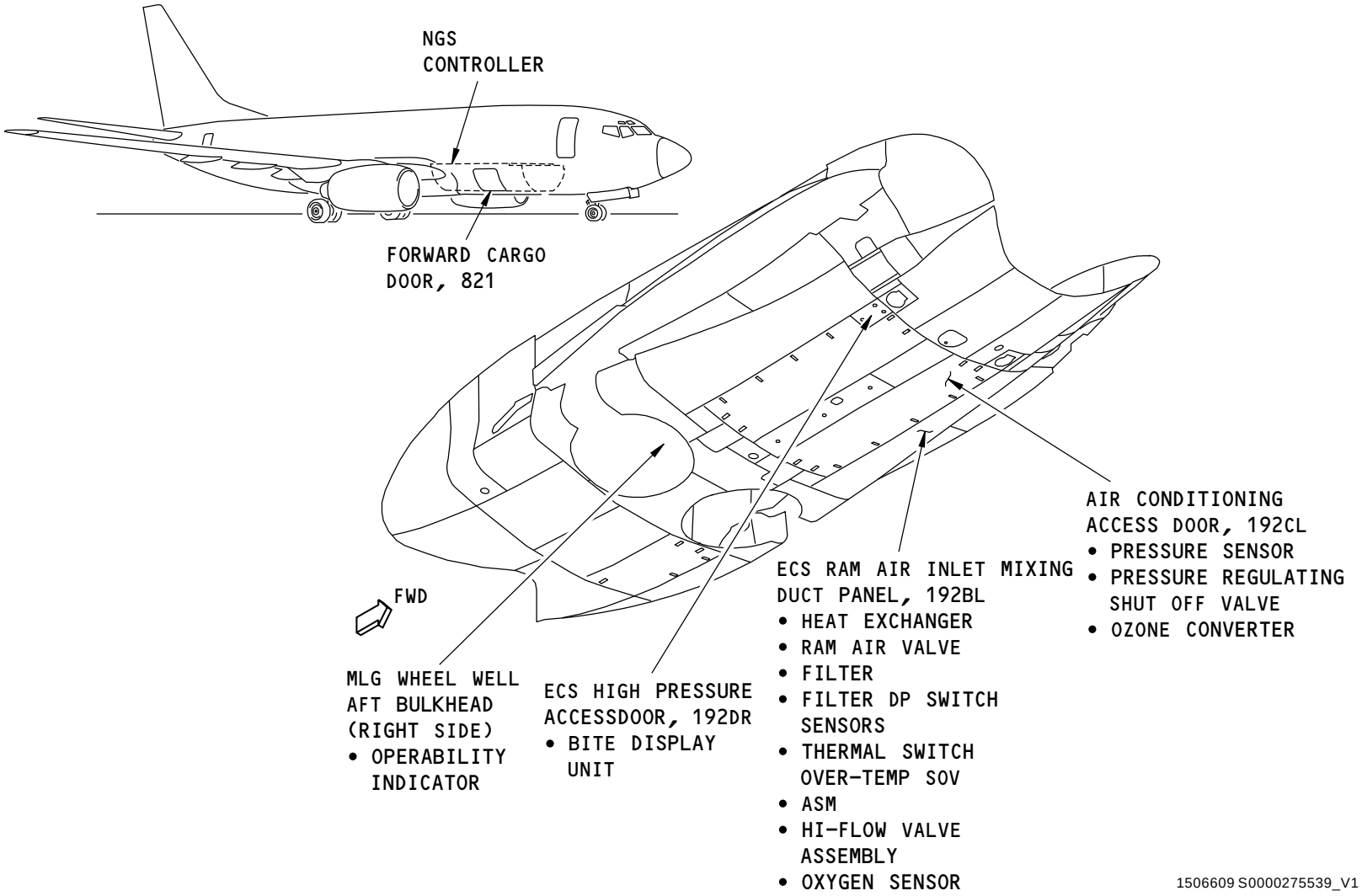
The BITE display unit is on the right 41 beam adjacent to the forward wall of the air conditioning compartment. You can get access to it through the right air conditioning bay door.

Operability Indicator

The NGS operability indicator is on the aft bulkhead in the right wheel well, adjacent to the APU fire control panel.

NGS Control System

The NGS controller is in the pressurized mix bay aft of the forward cargo compartment.



NITROGEN GENERATION SYSTEM - COMPONENT LOCATION - 1

Nitrogen Enriched Air Distribution System (NEADS) - Ram Air Duct Compartment

These NEADS components are in the left ram-air duct compartment:

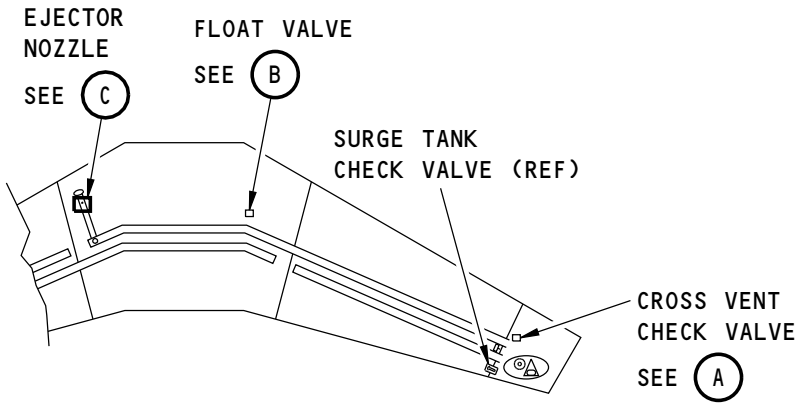
- Secondary backflow prevention check valve
- Drain cap
- O2 GSE port.

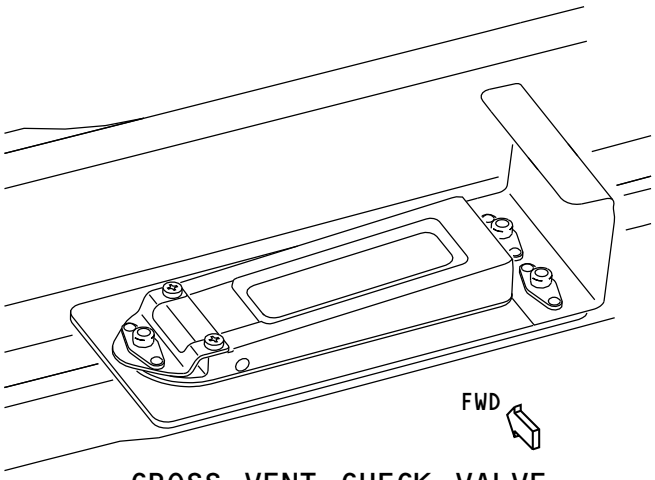
Nitrogen Enriched Air Distribution System (NEADS) - Center Tank and Wing Structure

These NEADS components are in the center tank:

- Flame arrestor
- Primary backflow prevention check valve
- Ejector nozzle
- Float valve.

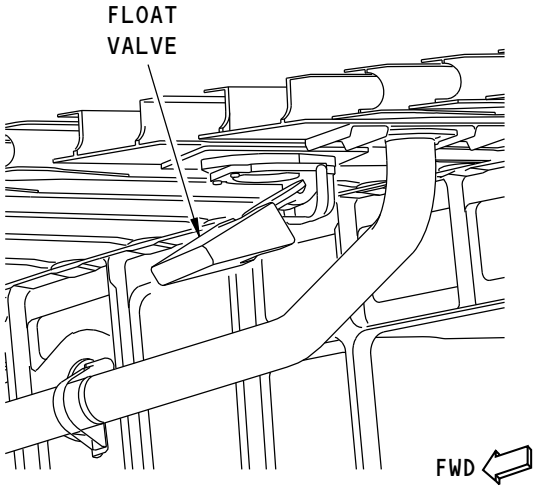
The cross vent check valve is in the right surge tank.





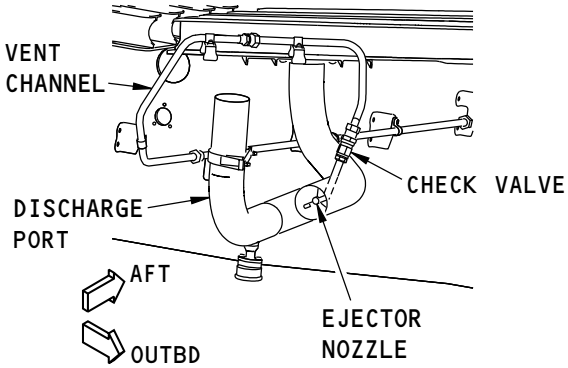
CROSS VENT CHECK VALVE

A



FLOAT VALVE

B



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NITROGEN GENERATION SYSTEM - COMPONENT LOCATION - 2

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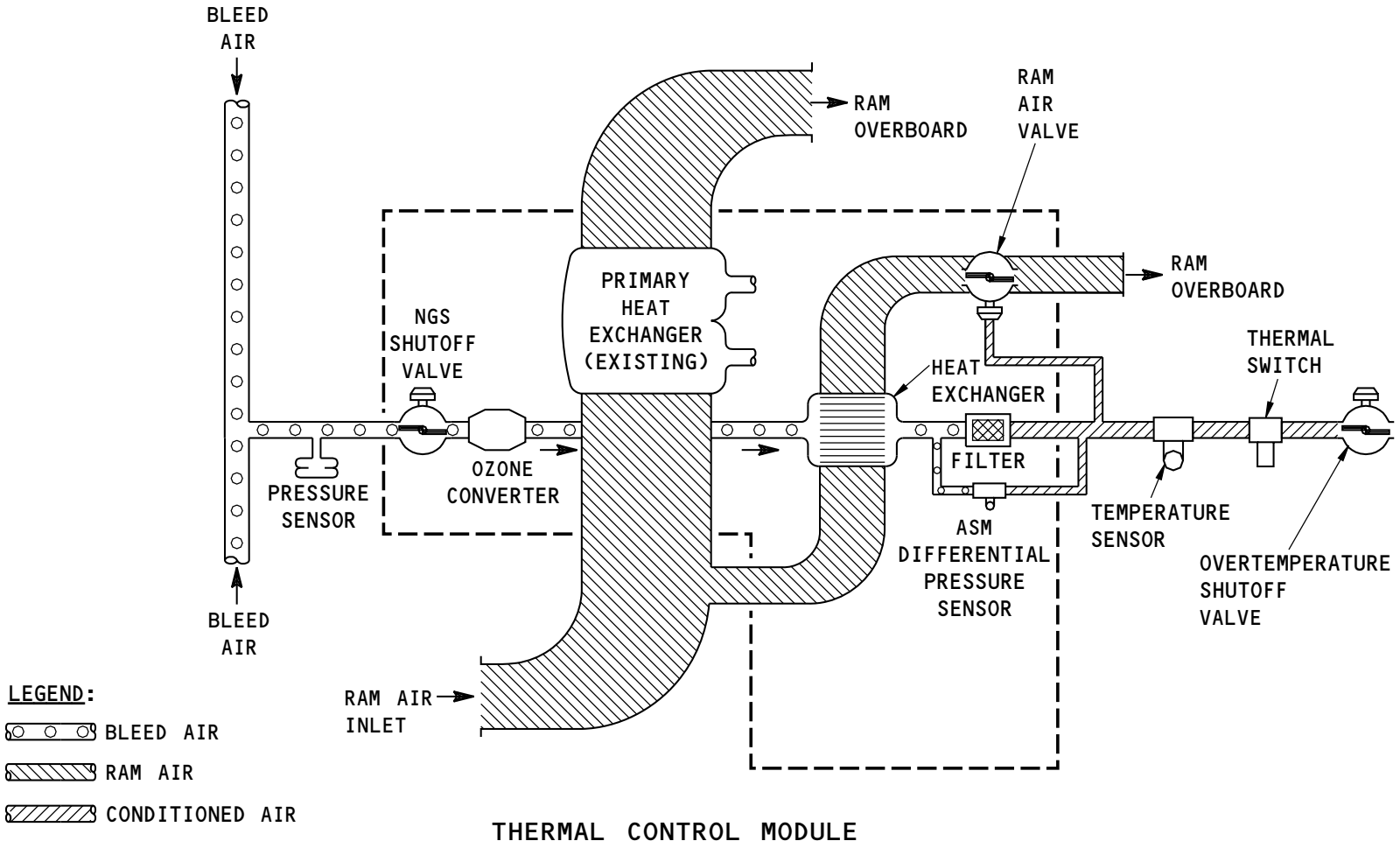
THERMAL CONTROL UNIT - INTRODUCTION

General

The Nitrogen Generation System (NGS) uses hot bleed air to make Nitrogen Enriched Air (NEA) for the center tank. The Thermal Control Unit (TCU) controls the bleed air pressure and temperature. The filter removes contamination that can damage the NGS and fuel system components. These are the components of the TCU:

- Pressure Sensor
- NGS shutoff valve
- Ozone converter
- Heat exchanger
- Ram air valve
- NGS Filter
- Filter differential pressure switch
- Temperature sensor
- Thermal switch
- Overtemperature Shutoff Valve (OTSOV).



THERMAL CONTROL MODULE

J35813 S0000169883_V3

THERMAL CONTROL UNIT

BLEED PRESSURE SENSOR

Purpose

The bleed pressure sensor monitors the bleed air inlet pressure by an airtight sealed electronic circuitry.

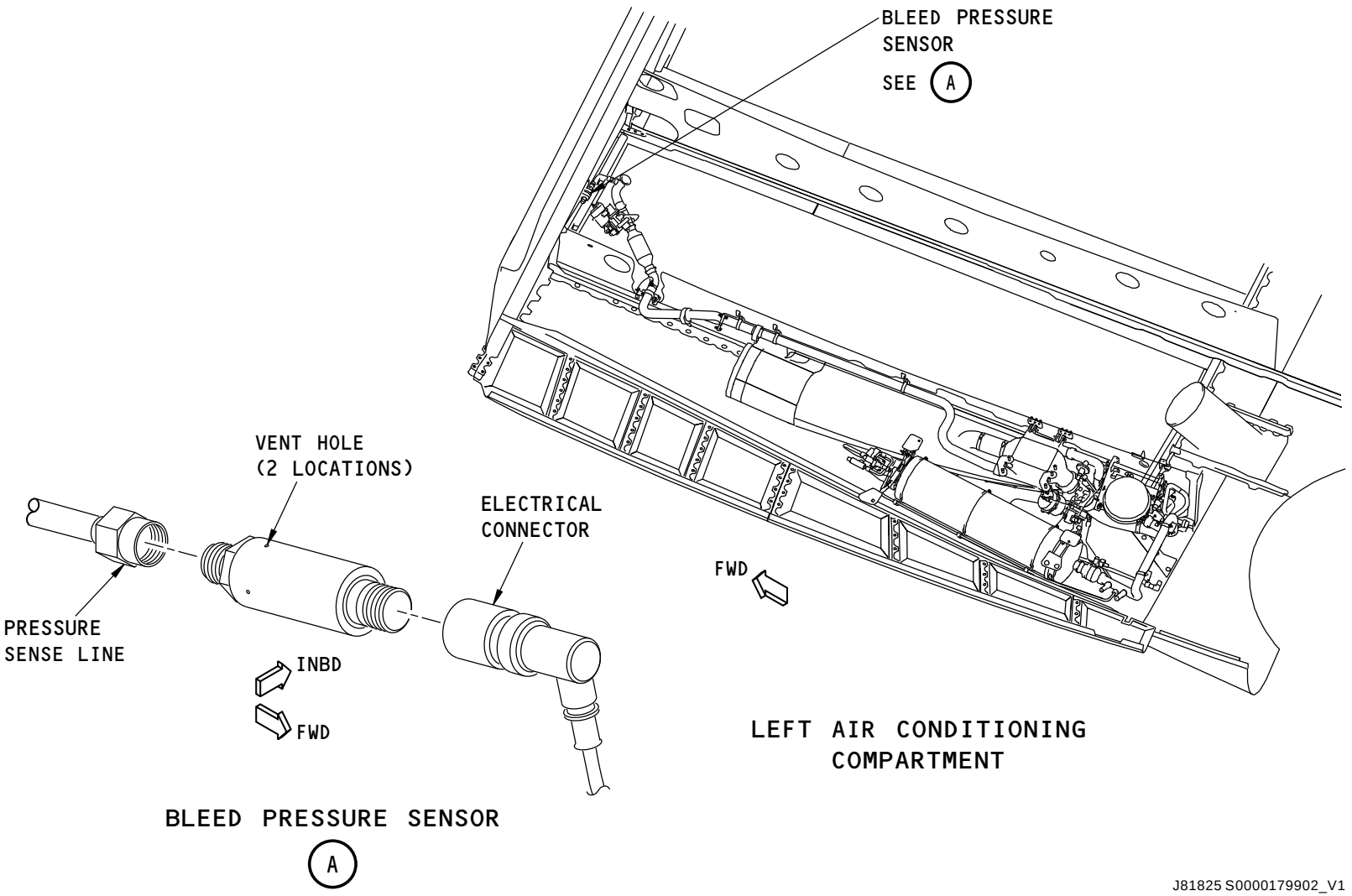
Location

The bleed pressure sensor is on the forward bulkhead of the left air conditioning compartment.

General Description

The bleed pressure sensor has an airtight sealed electronic circuitry housed within a corrosion-resistant steel shell. Bleed air comes from the pressure sense line and goes into the sensor. The NGS controller supplies power to the sensor which then monitors the bleed air pressure.

When the bleed air pressure goes above 67 psig (462 kPa), a signal is sent to the NGS controller. The NGS controller then commands the NGS shutoff valve and the over-temperature shutoff valve (OTSOV) to close. Damage is prevented to the air separation module (ASM) and the center tank.



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BLEED PRESSURE SENSOR

NITROGEN GENERATION SYSTEM SHUTOFF VALVE - INTRODUCTION

Purpose

The Nitrogen Generation System (NGS) shutoff valve controls bleed air flow for the NGS.

Location

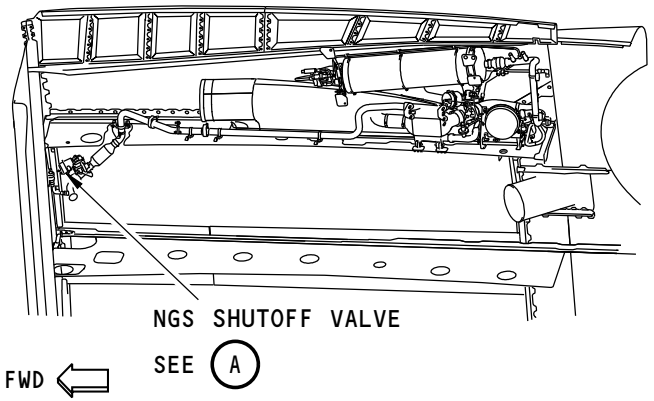
The NGS shutoff valve is in the forward section of the left air conditioning compartment.

Physical Description

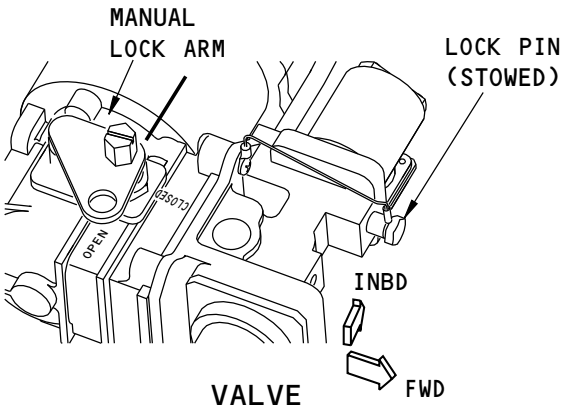
The NGS shutoff valve is an electrically commanded, pneumatically actuated pressure regulating and shutoff valve. The reference pressure regulator establishes a constant gage pressure. The butterfly closure element is spring-loaded closed. A double acting, dual area, diaphragm-piston actuator positions the butterfly by comparing reference pressure to the downstream bleed air pressure admitted through a downstream sense tube. The solenoid controls the shutoff. The NGS shutoff valve includes a manual override.

These are the parts of the NGS shutoff valve:

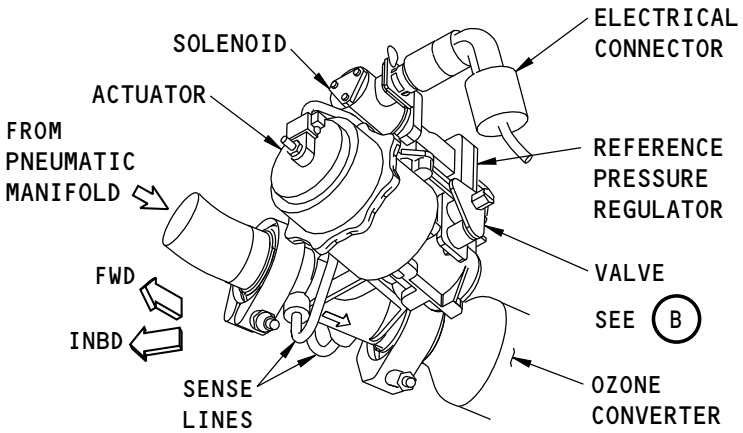
- Solenoid
- Electrical connector
- Sense lines
- Reference pressure regulator
- Actuator
- Manual override and position indicator
- Manual lock arm
- Lock pin



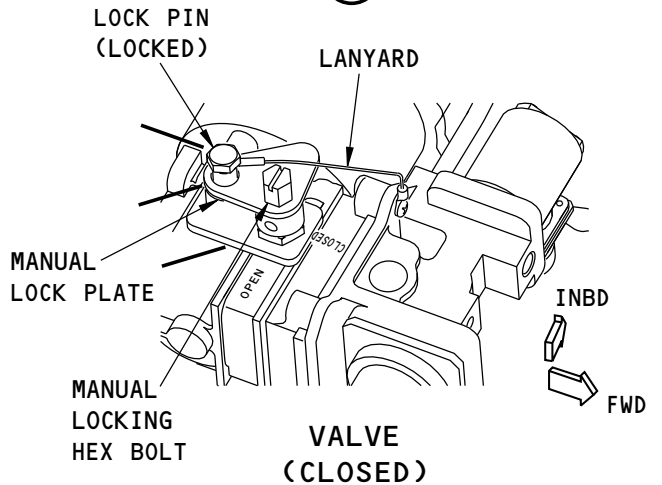
LEFT AIR CONDITIONING COMPARTMENT



VALVE
(OPEN)
B



NGS SHUTOFF VALVE
A



VALVE
(CLOSED)
B

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NITROGEN GENERATION SYSTEM SHUTOFF VALVE

NITROGEN GENERATION SYSTEM SHUTOFF VALVE - FUNCTIONAL DESCRIPTION

Functional Description

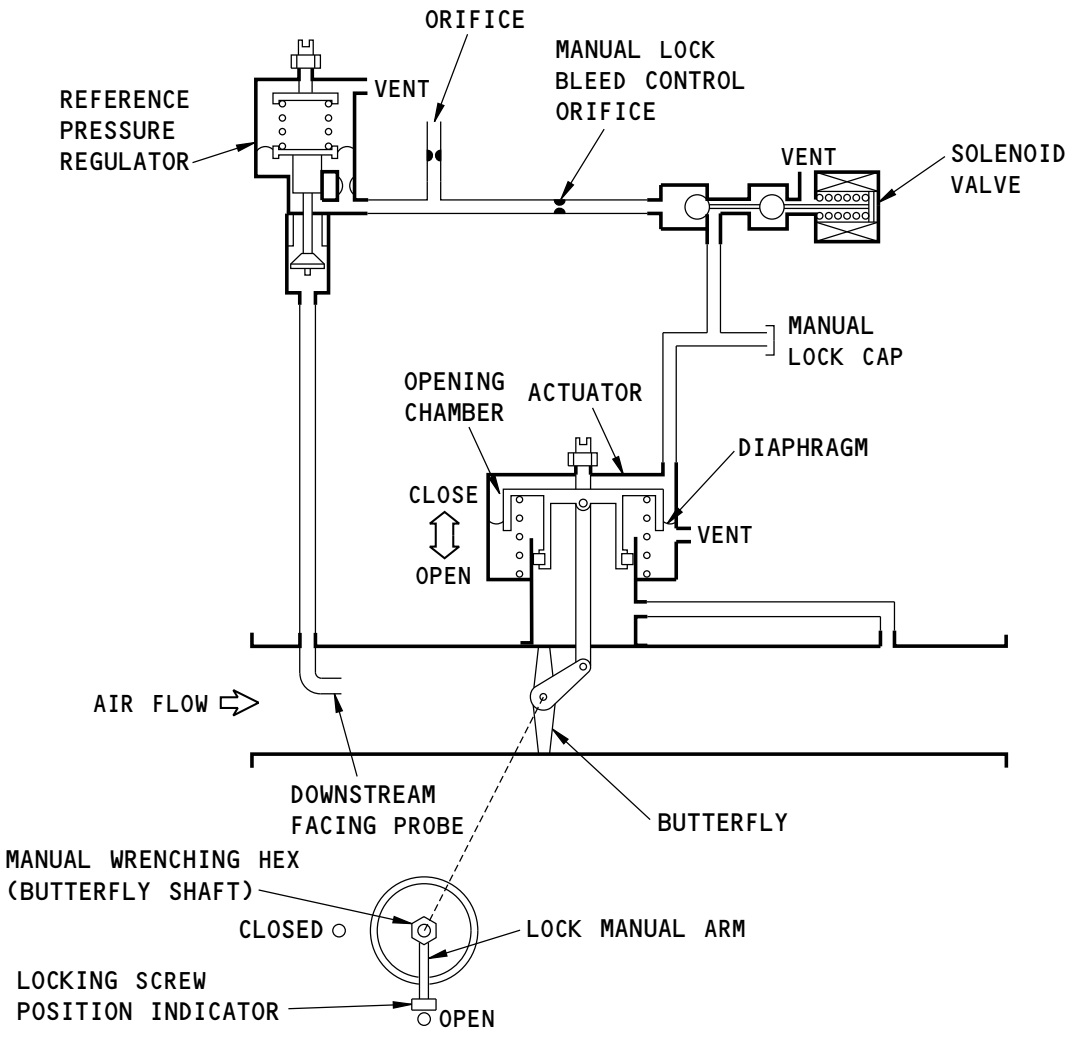
The NGS receives bleed air from the pneumatic manifold. The bleed air travels through the NGS shutoff valve, into reference pressure regulator. The reference pressure regulator controls the valve operating pressure to 10 psig (69 kPa). This reference pressure then flows to the solenoid, which then flows to the opening chamber or is vented.

When the controller sends a signal to close the NGS shutoff valve, the solenoid is de-energized, which closes the butterfly valve. The de-energized solenoid blocks the reference pressure to the opening chamber of the actuator. The existing pressure in the opening chamber is vented through the solenoid vent. With the reference pressure blocked to the opening chamber, the spring keeps the butterfly valve closed

When the controller sends a signal to open the butterfly valve, the NGS shutoff valve is energized. This supplies 28V DC power to the solenoid valve. The energized solenoid closes the solenoid vent and allows the reference pressure into the opening chamber of the actuator. The reference pressure acting on the diaphragm overcomes the spring force and causes the butterfly valve to turn to the open position.

When an over-temperature occurs in the NGS, the controller sends a command to close the NGS shutoff valve. This protects the sensitive equipment downstream from damage.

The manual override allows you to disable the NGS shutoff valve. To manually lock the valve, the manual lock cap is removed to vent the opening chamber. The butterfly valve is manually overridden and the cap is placed at the manual override location to lock the valve in the closed position only.



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NITROGEN GENERATION SYSTEM SHUTOFF VALVE - FUNCTIONAL DESCRIPTION

OZONE CONVERTER

Purpose

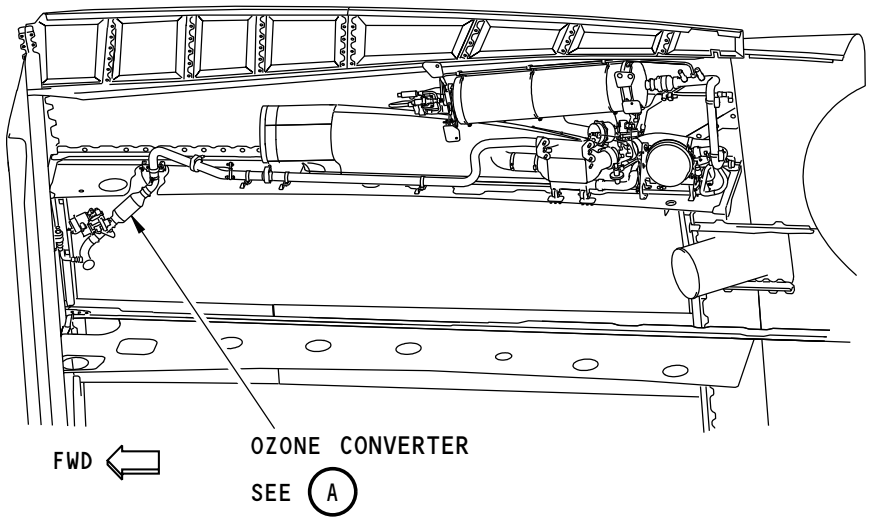
The ozone converter removes ozone from the engine bleed air by a catalytic process that converts ozone to oxygen. This process protects the air separation module (ASM) from oxidation of the membrane materials by ozone.

Location

The ozone converter is in the forward section of the left air conditioning compartment.

General Description

The ozone converter uses a stainless steel mantle shell. The catalytic reactor core features a straight-channel tin configuration to minimize pressure drop. Hot bleed air that contains ozone enters the ozone converter through the inlet. As the air comes in contact with the heated catalytic reactor core the ozone is converted to oxygen. The bleed air then exits the converter through the outlet.



OZONE CONVERTER

HEAT EXCHANGER

Purpose

The primary function of the heat exchanger is to condition the bleed air to 160.0 ±10.0°F (71.1 ±5.6°C). Hot, compressed air, bled from the bleed air system, is cooled by the heat exchanger on its way to the air separation module (ASM). In addition, the heat exchanger is designed to prevent hot bleed air from entering the fuel tank in the event of a system double failure.

Location

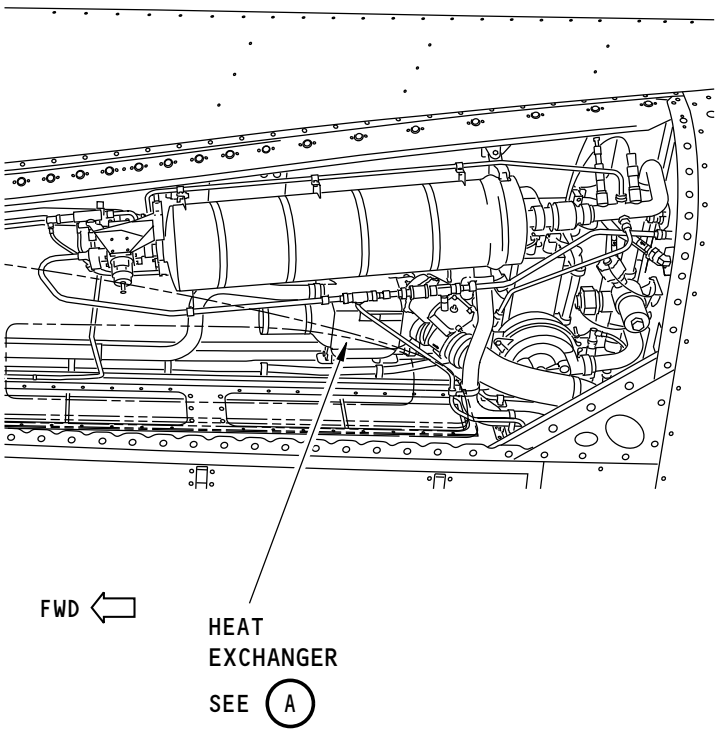
The heat exchanger is in the left ram air duct compartment, inboard of the ASM.

General Description

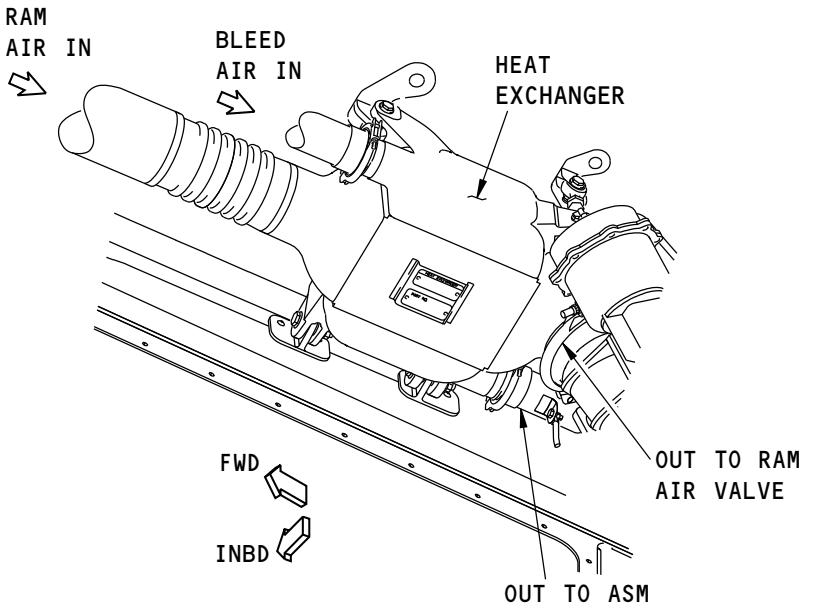
The heat exchanger is an aluminum plate-fin, single-pass, crossflow, air-to-air heat exchanger. Both bleed air and ram air fins are made from aluminum alloy sheet.

Training Information Point

The heat exchanger uses small openings with thin walls and cooling fins for satisfactory performance. If the openings become dirty or blocked, the performance of the heat exchanger is decreased. Keep the heat exchanger clean for maximum performance.



LEFT RAM AIR INLET MIXING DUCT



HEAT EXCHANGER

A

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HEAT EXCHANGER

RAM AIR VALVE

Purpose

The ram air valve controls the ram air exhaust that leaves the airplane. This indirectly controls the heat exchanger. With this method, the bleed air keeps a constant temperature to the air separation module (ASM).

Location

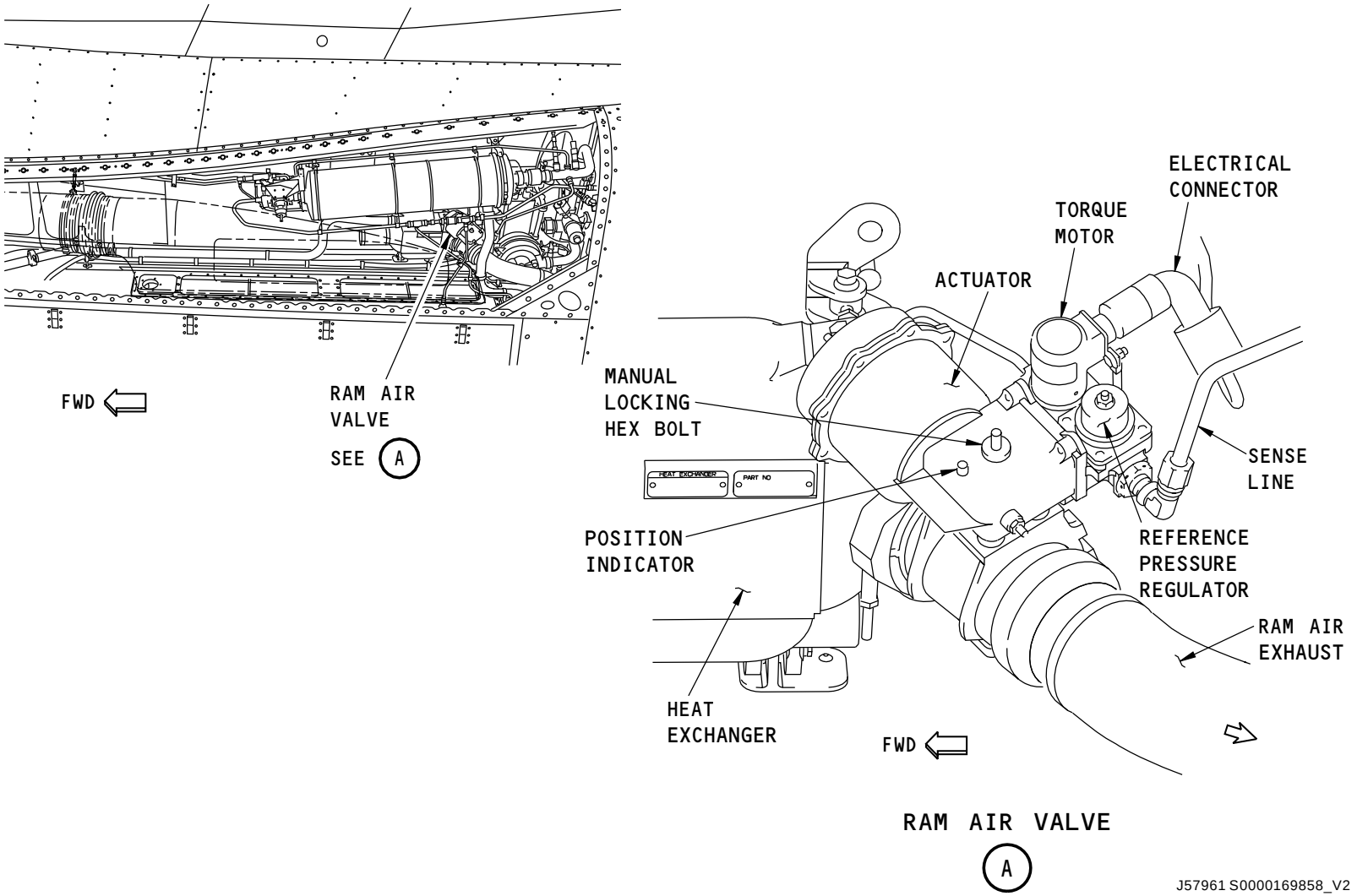
The ram air valve is in the left ram air duct compartment behind the ram air access panel.

Physical Description

The ram air valve is electrically controlled and pneumatically actuated butterfly type valve that modulates airflow as a function of the torque motor. A remote temperature sensor and electronic controller give a signal to the valve torque motor to position the butterfly closure element. The valve has a visual position indicator and can be manually wrenched and locked in the open position.

These are the main components of the ram air valve:

- Torque motor
- Electrical connector
- Sense line
- Reference pressure regulator
- Actuator
- Position indicator
- Manual locking hex bolt



RAM AIR VALVE

RAM AIR VALVE - FUNCTIONAL DESCRIPTION

Functional Description

Operation of Reference Pressure Regulator:

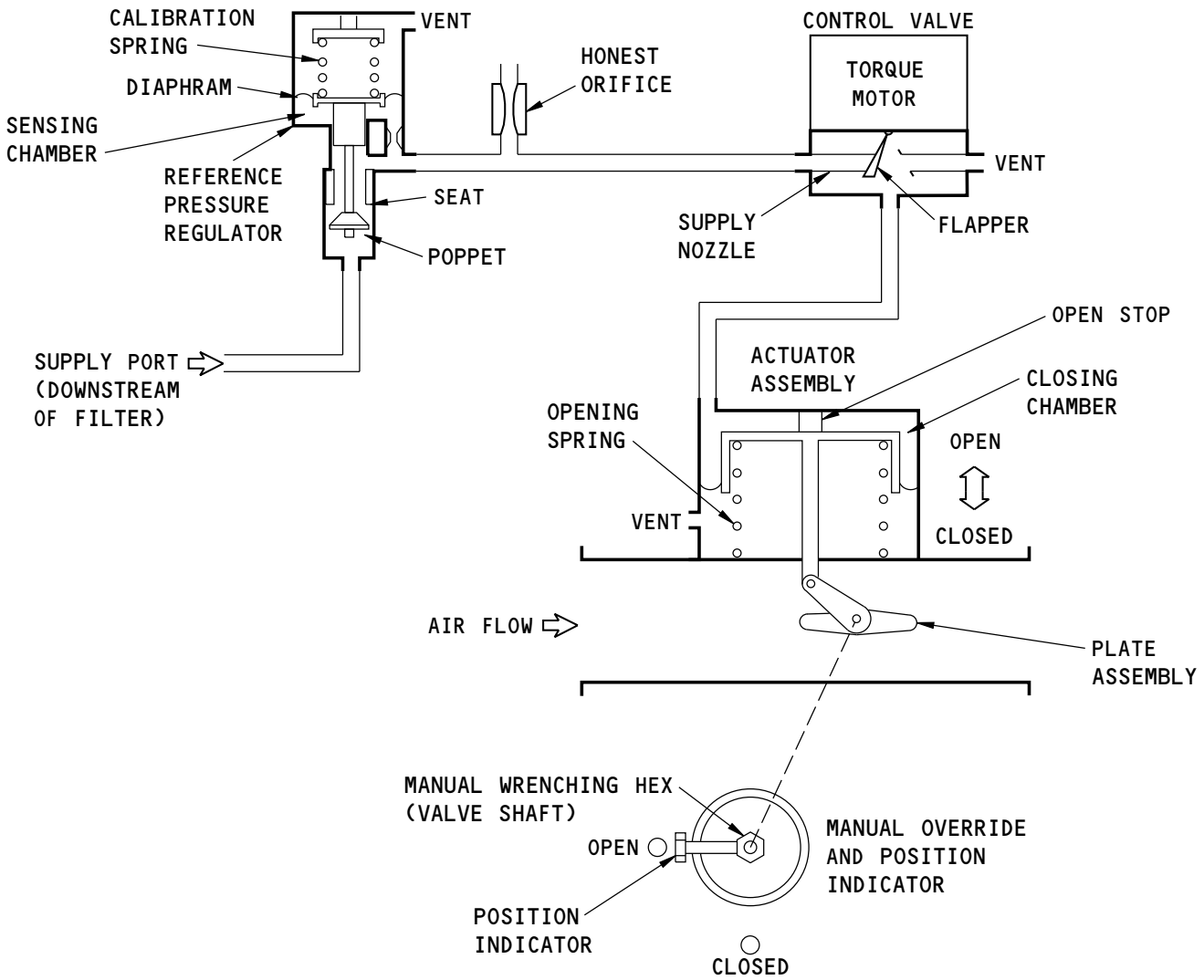
- The pressure sense line supplies pressure to the reference pressure regulator through the supply port. Air flows pasts the poppet and seat of the reference pressure regulator into the sensing chamber. When the pressure downstream of the reference pressure regulator reaches the desired level, the force created by this pressure on the reference pressure regulator diaphragm tends to counteract the calibration spring force and the poppet moves toward the seat until a force equilibrium is achieved. The reference pressure regulator thus produces a regulated output pressure of 10 psig (68.9 kPa) (reference pressure) which is independent of supply pressure. The reference pressure is then routed past the honest orifice to the torque motor.

Operation with Torque Motor De-Energized:

- With the torque motor de-energized (zero electrical current), the flapper blocks the supply nozzle and the closing chamber of the actuator is vented to ambient through the torque motor vent as shown. The opening spring maintains the butterfly closure element in the open position.

Operation with Torque Motor Energized:

- With increasing electrical current to the torque motor, the flapper will swing away from the supply nozzle toward the vent, opposite that shown. The open supply nozzle will admit reference pressure to the closing chamber of the actuator. As torque motor current varies, the valve butterfly will be driven by the actuator to an intermediate position to modulate the airflow. This airflow varies inversely with the applied torque motor current.



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RAM AIR VALVE - FUNCTIONAL DESCRIPTION

AIR FILTER

Purpose

The air filter removes solid and aerosol material that can be in the bleed air. It prevents contamination of the air separation module (ASM).

Location

The air filter is in the left ram air duct compartment behind the ram air duct access panel.

Functional Description

The NGS air filter assembly is of a two stage design. There is an inner pleated coalescer filter pack and downstream, an outer high efficiency pleated filter pack.

The coalescer stage is manufactured from layers of high efficiency glass fibre, polyester and stainless steel, all pleated together into a filter pack. This layer provides the particulate and fluidic separation requirements to remove large drops, for example, water and hydrocarbon fuels. This layer uses a repulsion coalescence mechanism coupled with a wicking action, to provide high efficient coalescence. Fluids are drained through the secondary port.

The outer pleated filter pack consists of layers of very high efficiency glass fibre, polyester and stainless steel, all pleated together into a filter pack. This layer makes sure that the whole filter element gives high efficiency particulate and fluidic protection to the downstream system components.

Separated fluidic contamination is then bled from the system through screened bleed orifices.

Both pleated filter packs are supported by perforated stainless steel and aluminium shrouds and found in aluminium end caps. The filter medias and support cores are potted into the end caps using an epoxy resin based compound.

The integrated element assembly, which incorporates the high efficiency filter and the coalescer is found inside a filter housing which is split using a V-band closure to permit access for maintenance. The housing also provides the inlet/outlet port interfaces, location for the bleed orifices and the aircraft insulation features.

The filter assembly also includes an insulation jacket, which covers the bowl. This jacket is manufactured from polyimide foam and in wire locked to the main assembly using eyelets that are punched into the jacket.

A differential pressure switch is on the inlet duct to the filter. The differential pressure switch monitors the condition of the filter.

EFFECTIVITY

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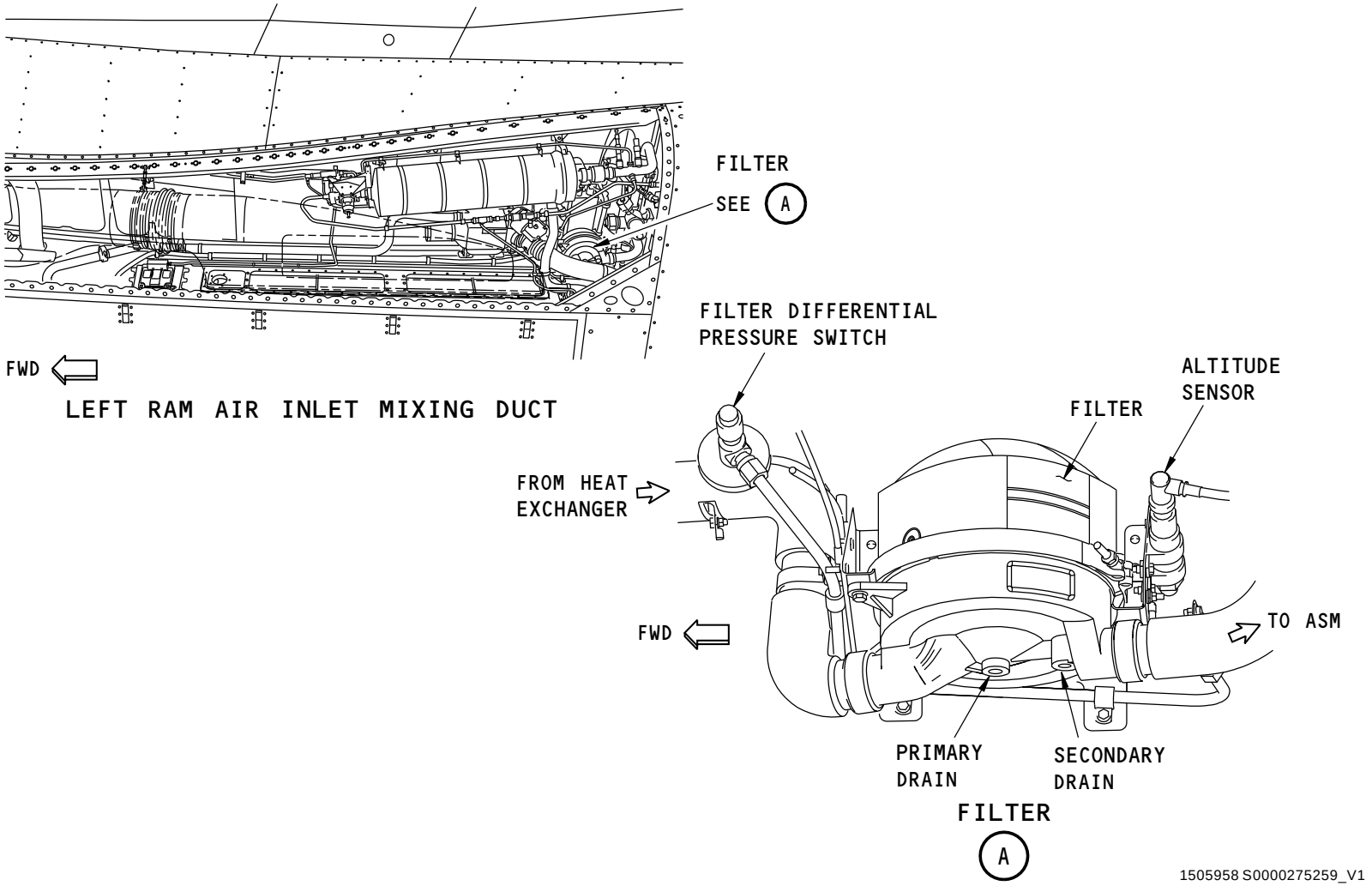


AIR FILTER

FILTER DIFFERENTIAL PRESSURE SWITCH

Purpose

The filter differential pressure switch shows when service is necessary for the air filter.

Location

The filter differential pressure switch is in the left ram air duct compartment behind the ram air duct access panel.

Physical Description

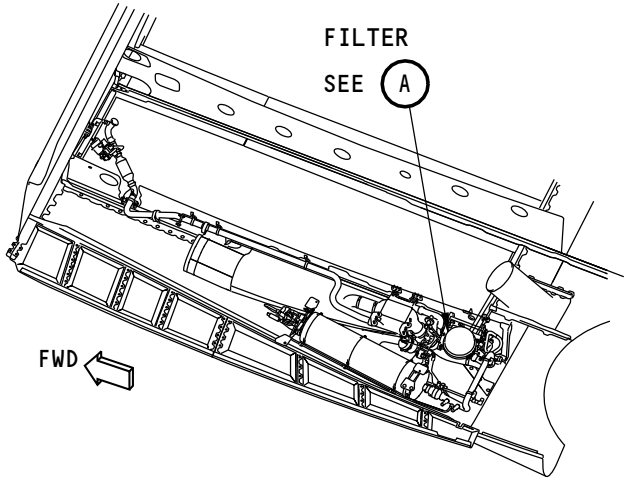
The pressure switch is a snap action, diaphragm type switch with an electrical connector. This is attached directly to the air filter's inlet air duct. A sense line from the outlet side of the air filter is also connected to the pressure switch.

Functional Description

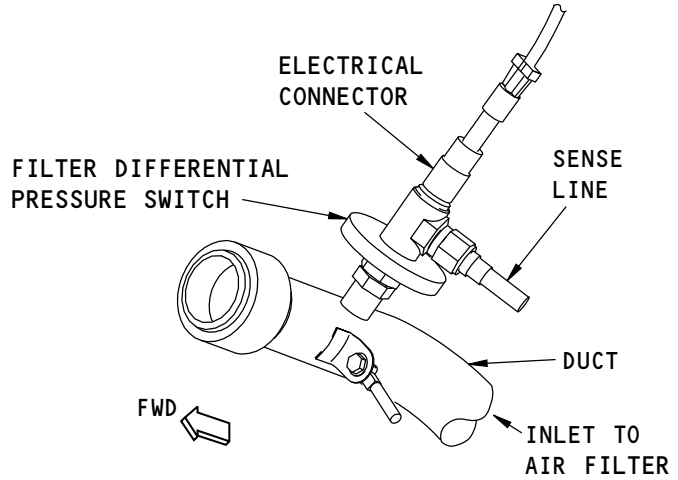
The filter differential pressure switch closes when there is a pressure drop of 1.2 ±0.1 psid (8.3 ±0.7 kPa) across the filter. This sends a signal to the NGS controller that the NGS filter must be replaced. The NGS controller sends a signal to the BITE display unit (BDU) and the operability indicator.

When the pressure difference decreases to 0.3 psid (2.1 kPa), the pressure switch opens, and the indication does not show.

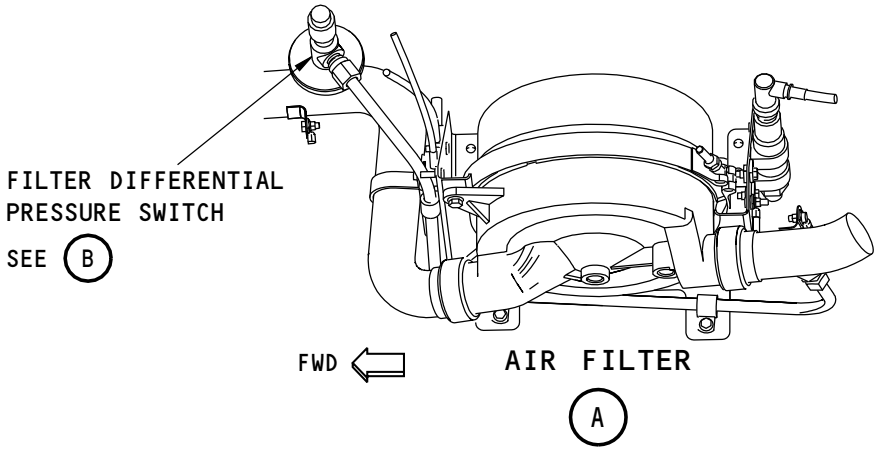
The pressure switch is for indication. There are no nuisance trips.



NITROGEN GENERATION SYSTEM LAYOUT
(VIEW IN THE DOWN DIRECTION)



FILTER DIFFERENTIAL
PRESSURE SWITCH
B



J38156 S0000169861_V2

FILTER DIFFERENTIAL PRESSURE SWITCH

TEMPERATURE SENSOR

Purpose

The temperature sensor is the primary means of measuring and controlling the air temperature before it goes into the air separation module (ASM).

Location

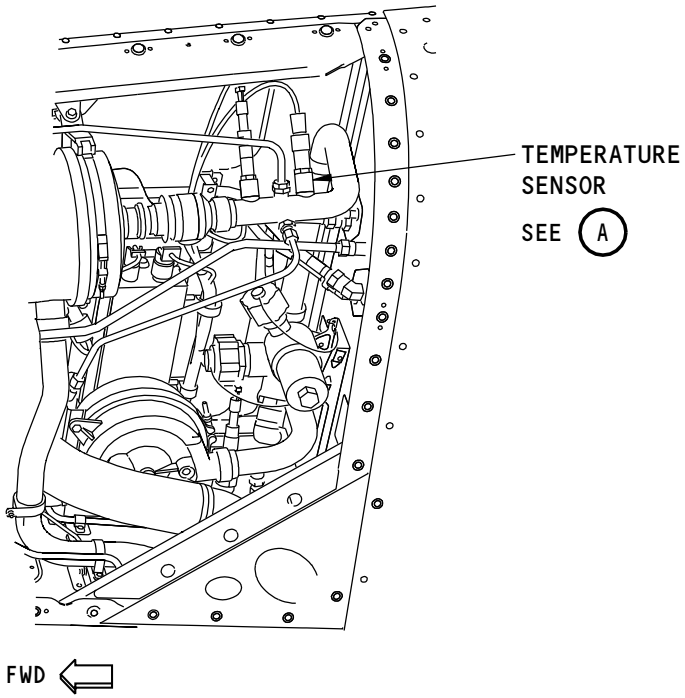
The temperature sensor is in the left ram air duct compartment behind the ram air duct access panel. It is attached to the inlet duct upstream of the ASM.

Physical Description

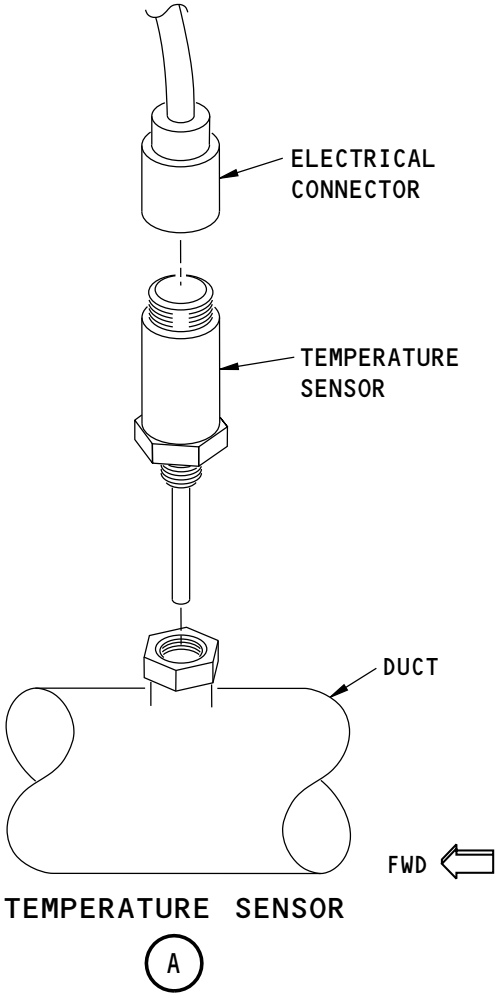
The temperature sensor is a dual element probe type unit with an electrical connector. It is sealed in a corrosion-resistant stainless steel probe.

Functional Description

The temperature sensor monitors the air temperature going out of the thermal control unit. It sends temperature data to the NGS controller. The NGS controller sends a signal to the ram air valve (RAV) torque motor. The RAV modulates to control the air temperature to 160 ±10°F (71 ±6°C). If the air temperature exceeds 225 ±10°F (107 ±6°C), the NGS controller removes power to the NGS shutoff valve and overtemperature shutoff valve. The NGS shutoff valve and overtemperature shutoff valve close and deactivate the system.



LEFT RAM AIR INLET MIXING DUCT



TEMPERATURE SENSOR

A

J38347 S0000170813_V2

TEMPERATURE SENSOR

THERMAL SWITCH

Purpose

The thermal switch is a backup device to prevent an overtemperature condition in the air separation module (ASM).

Location

The thermal switch is in the left ram air duct compartment behind the ram air duct access panel. It is adjacent to the temperature sensor upstream of the air separation module.

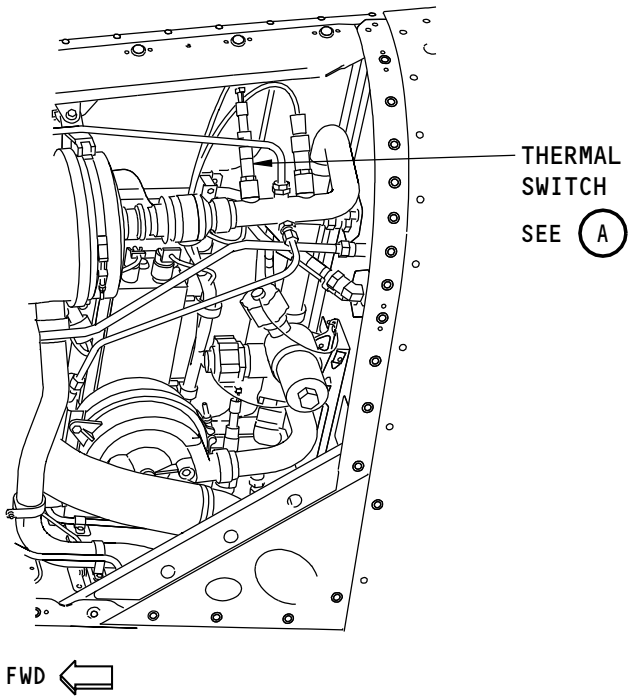
Physical Description

The thermal switch has a probe body and an electrical connector. It is sealed in a metal housing

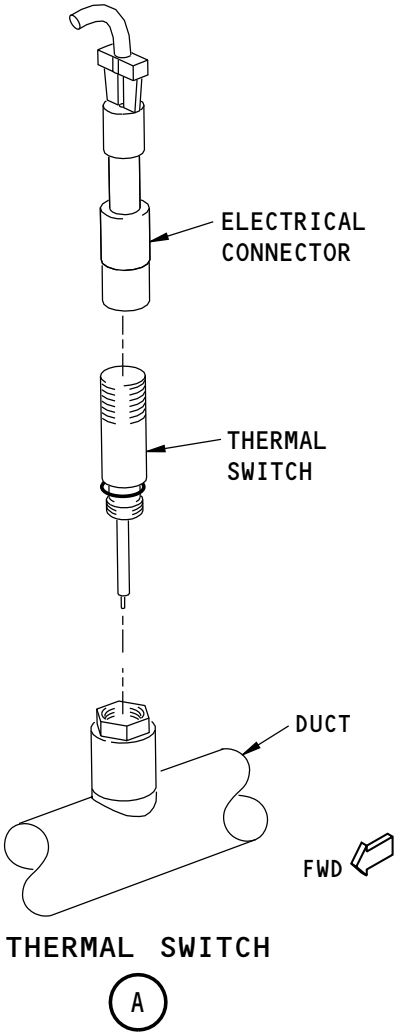
Functional Description

The thermal switch is normally closed. When the air temperature reaches 270 ±10°F (132 ±6°C), the thermal switch opens. The NGS controller receives a signal to remove the ground status and commands the overtemperature shutoff valve to close.

When the temperature decreases, the thermal switch closes and restores the ground to open the overtemperature shutoff valve.



LEFT RAM AIR INLET MIXING DUCT



THERMAL SWITCH

A

J38388 S0000169874_V2

OVERTEMPERATURE SHUTOFF VALVE

Purpose

The overtemperature shutoff valve gives backup protection for the air separation module if the controller fails. This is controlled by the thermal switch.

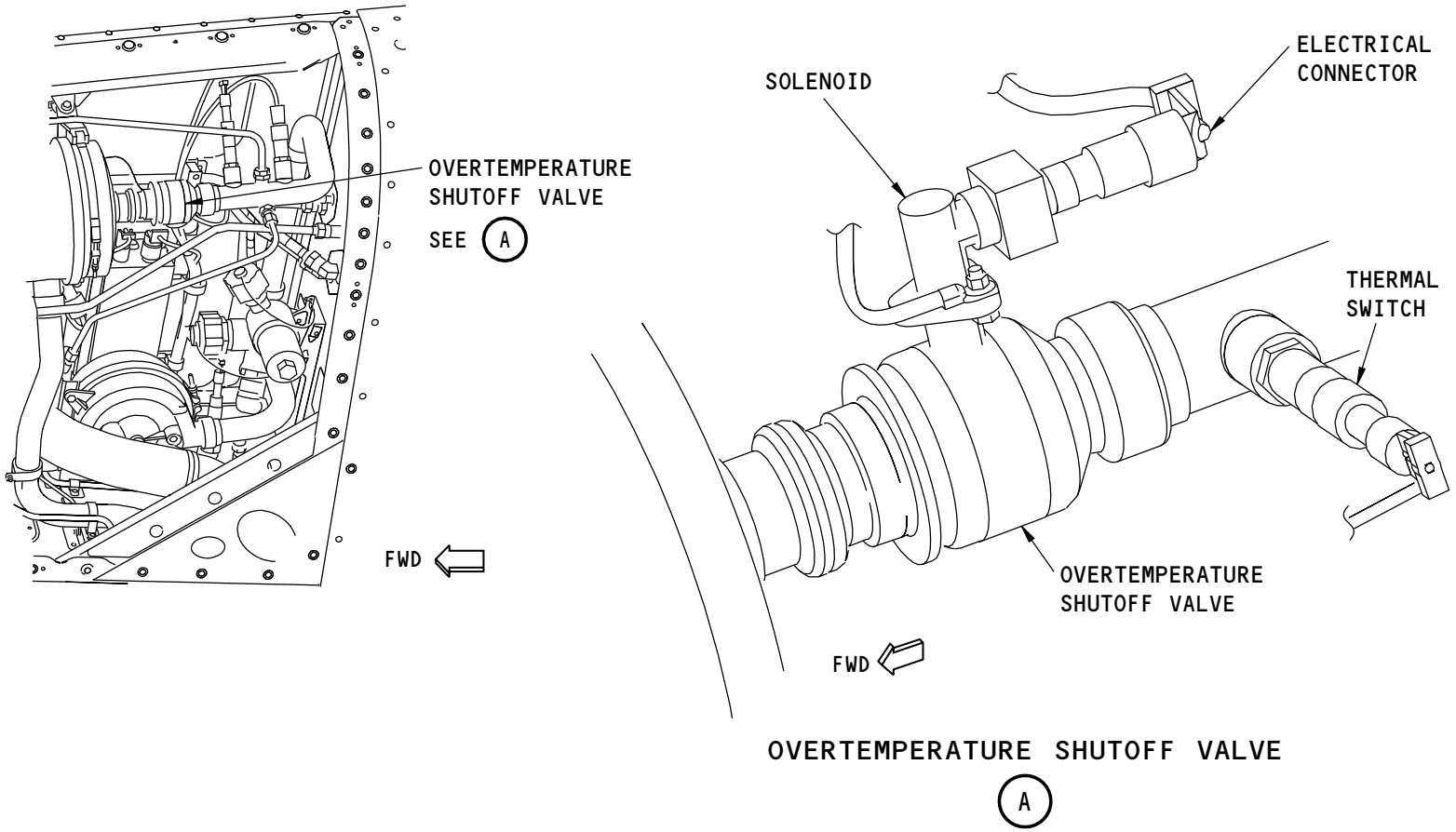
Location

The overtemperature shutoff valve is in the left ram air duct compartment behind the ram air duct access panel.

Physical Description

The overtemperature shutoff valve is electrically controlled and pneumatically operated. It is spring loaded to the closed position. These are the components of the overtemperature shutoff valve:

- Electrical connector
- Solenoid
- Valve body



J38458 S0000169879_V2

OVERTEMPERATURE SHUTOFF VALVE

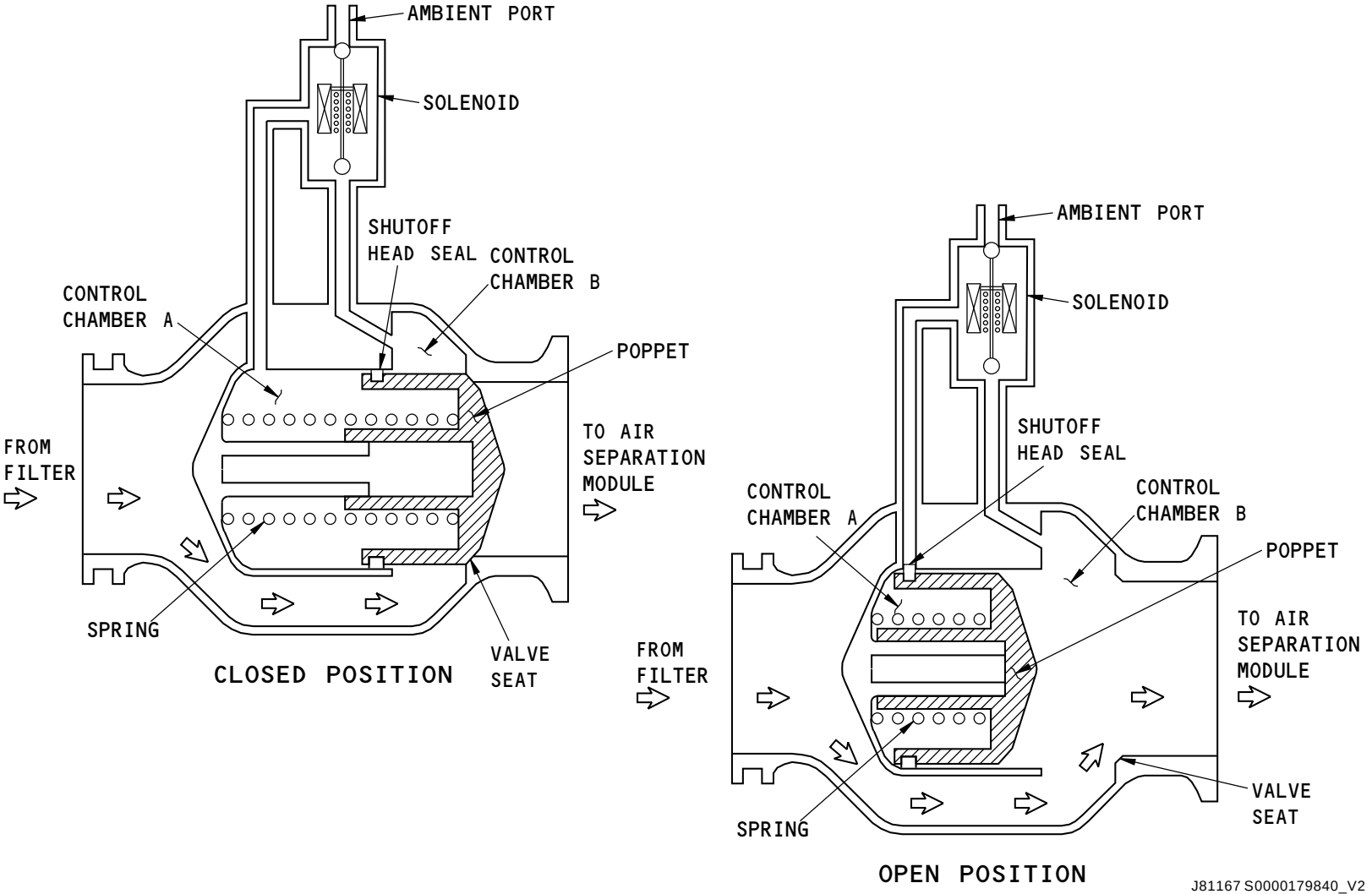
OVERTEMPERATURE SHUTOFF VALVE - FUNCTIONAL DESCRIPTION

Functional Description

The overtemperature shutoff valve is electrically controlled and operated by differential pressure. The valve is normally closed. The controller gives a closed ground path when power is on the airplane. The ground path is open if there is no power to the system or the thermal switch is open.

When the solenoid is de-energized the ambient port is blocked. The pressures in chambers A and B are equal and the spring keeps the valve closed.

When the solenoid is energized, control chamber A is open to ambient. Pressure in control chamber B pushes on the differential area between the valve seat and the valve shutoff head seal. This pressure is more than the spring force and the valve starts to open. When the valve starts to open, the pressure pushes on the full area of the poppet. This moves the valve to the full open position.



OVERTEMPERATURE SHUTOFF VALVE - FUNCTIONAL DESCRIPTION

AIR SEPARATION MODULE

Purpose

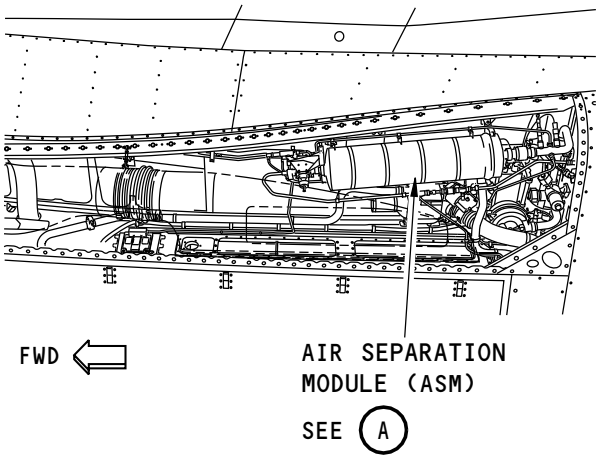
The air separation module (ASM) makes Nitrogen Enriched Air (NEA) to send to the center tank. The NEA mixes with tank air to decrease the oxygen percent to a level which will not support combustion.

Location

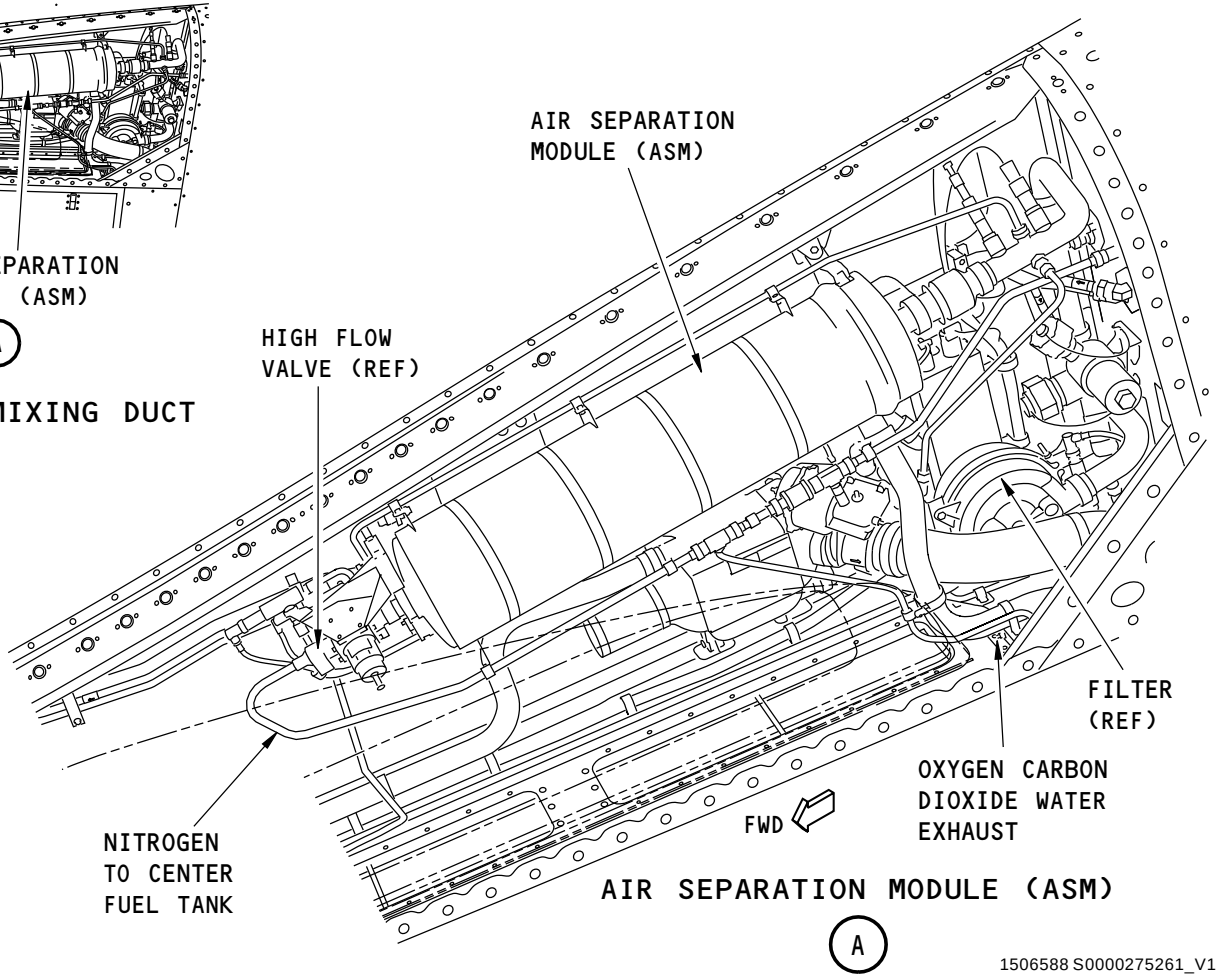
The ASM is in the left ram air duct compartment behind the ram air duct access panel.

Physical Description

The ASM is a permeable fiber membrane bundle contained in an aluminum housing. The housing is wrapped within an insulation foam, which protects the ASM from overheating.



LEFT RAM AIR INLET MIXING DUCT

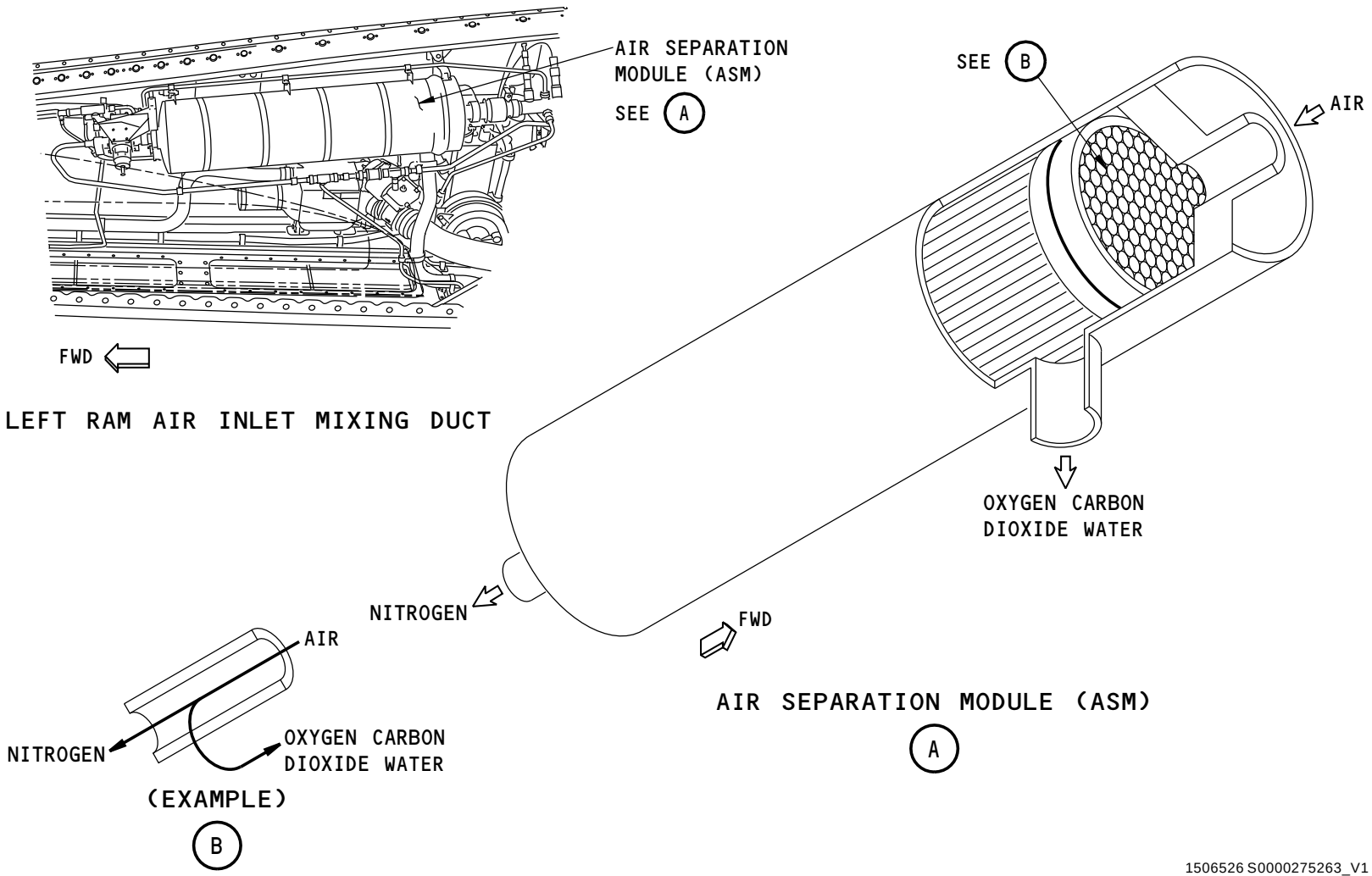


AIR SEPARATION MODULE

AIR SEPARATION MODULE - FUNCTIONAL DESCRIPTION

Functional Description

The air separation module (ASM) has a membrane of thousands of thin polymer fibers. Cooled (160 ±10°F (71 ±6°C)) bleed air goes into the ASM through the inlet manifold. The air goes through the membrane, which removes oxygen molecules, carbon dioxide molecules, and water from the air. The oxygen enriched air (OEA) flows out of the module to the OEA exhaust duct. The remaining nitrogen enriched air (NEA) flows out of the air separation module to the center tank.



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AIR SEPARATION MODULE - FUNCTIONAL DESCRIPTION

HIGH FLOW VALVE

Purpose

The high flow valve supplies low flow volume and high flow volume to the center tank.

The valve is closed in low flow mode during climb and cruise phases of flight. This conserves bleed air, gives protection to the heat exchanger, and extends the ASM operation life.

The valve is open in high flow mode during the descent phase of flight. It supplies the nitrogen enriched air (NEA) flow necessary to pressurize the center tank with nitrogen enriched air. The higher nitrogen flow decreases the quantity of ambient air that comes in through the surge tank vent.

Location

The high flow valve is in the left ram air duct compartment. It is behind the ram air duct access panel.

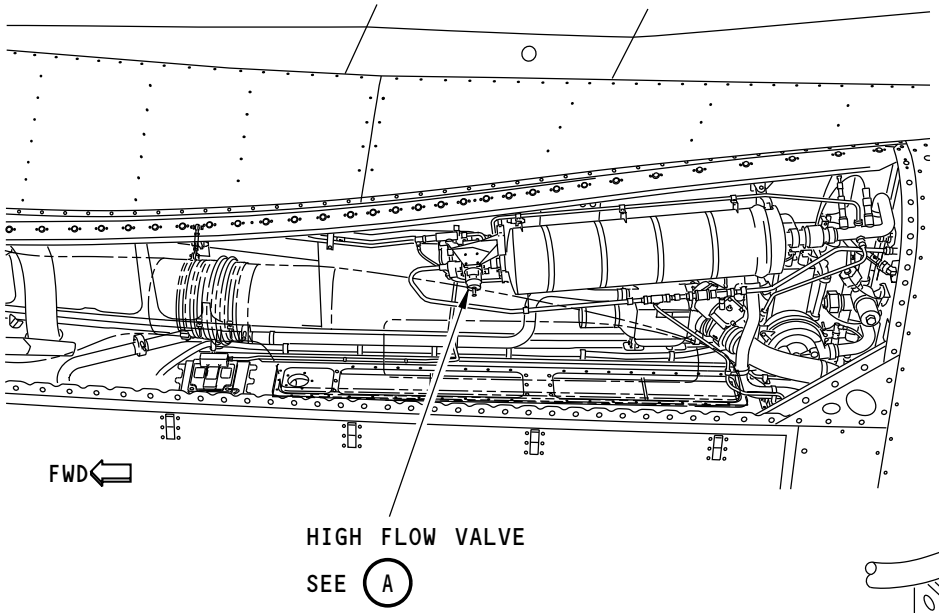
Physical Description

The high flow valve is an electrically controlled and pneumatically operated gate valve. It is spring loaded to the low flow position (closed) and open for high flow operation gets.

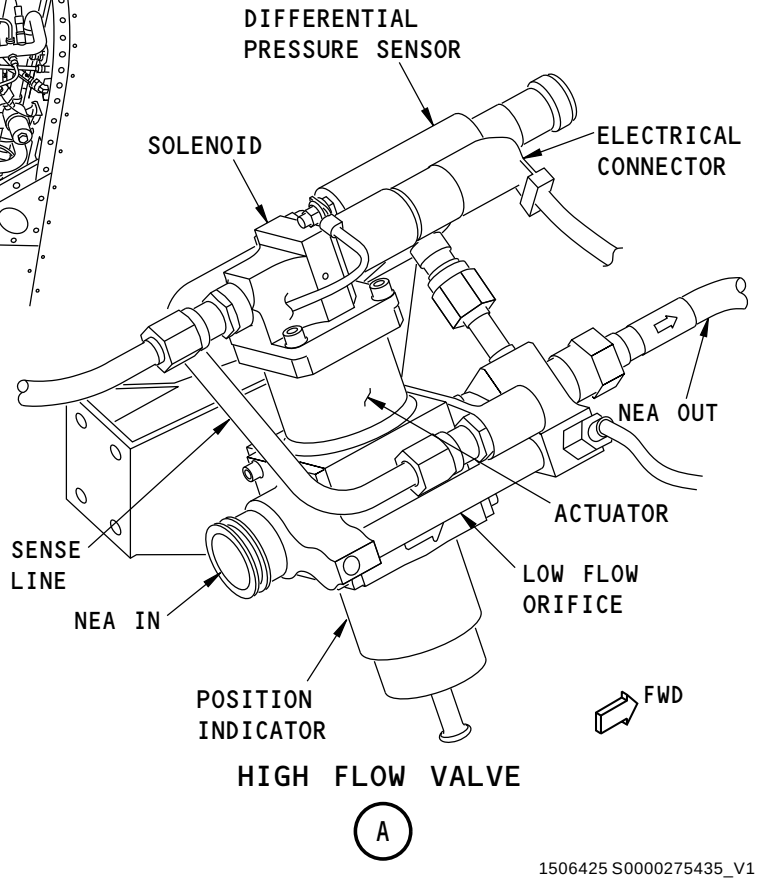
These are the components of the high flow valve:

- Solenoid
- Electrical connector
- Sense line
- Actuator
- Valve position indicator
- Low flow orifice.
- Oxygen sense line

A differential pressure sensor is connected to the high flow valve. It senses pressure differences between the inlet and outlet ports of the valve. The controller uses this data, altitude, and airplane systems data to set the valve position.



LEFT RAM AIR INLET MIXING DUCT



1506425 S0000275435_V1

AIR SEPARATION MODULE - HIGH FLOW VALVE

HIGH FLOW VALVE - FUNCTIONAL DESCRIPTION

Functional Description

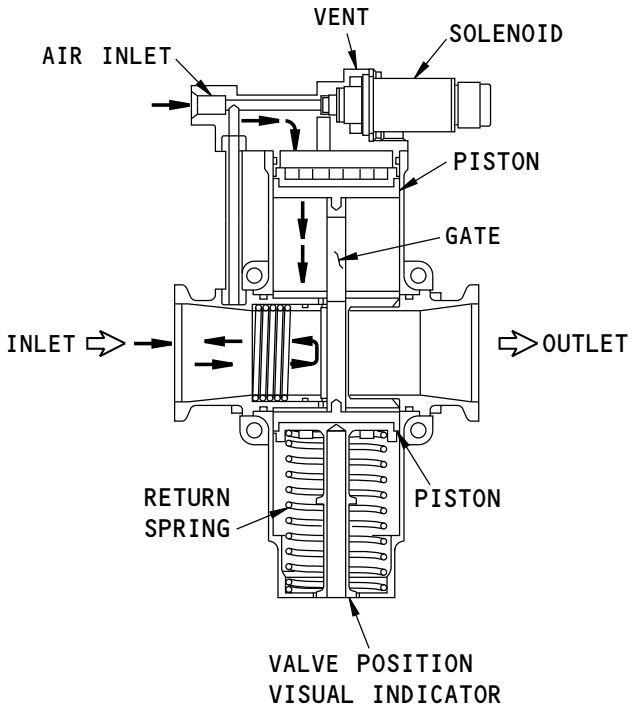
The high flow valve is electrically controlled and pneumatically operated.

When the solenoid is de-energized, the valve sends air pressure behind the piston, and through the solenoid to ambient air. The spring moves the valve gate closed. Air passes around the valve gate through the low flow orifice.

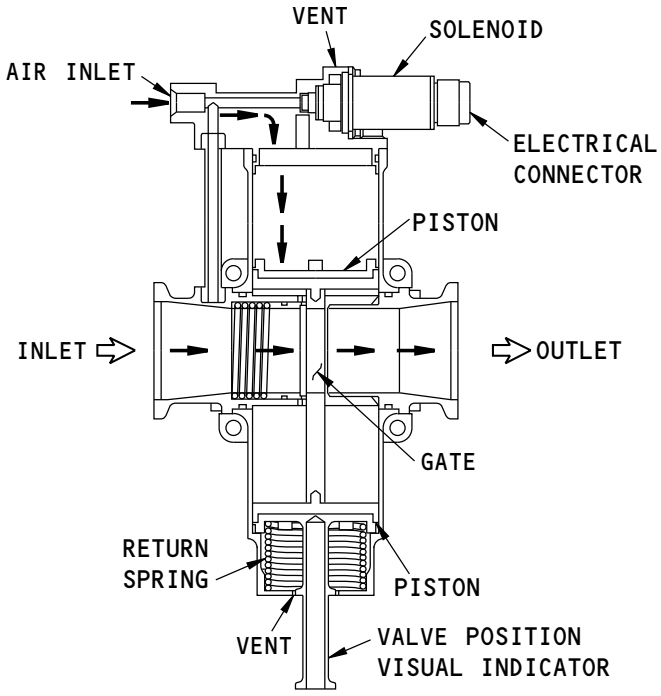
When the solenoid is energized, air pressure at the inlet side of the valve is sent through the solenoid. The pressure on the piston is sufficient to overcome the spring and open the valve.

The valve's visual position indicator retracts when the valve is closed and extends when the valve is open.

There is an oxygen sense line on the line side of the high flow valve.



LOW FLOW
(CLOSED POSITION)



HIGH FLOW
(OPEN POSITION)

J91799 S0000179878_V1

HIGH FLOW VALVE - FUNCTIONAL DESCRIPTION

NGS OXYGEN SENSOR

General

The NGS oxygen sensor is a self-contained, solid state gas analyzer and pressure sensor. The NGS oxygen sensor is designed to measure the oxygen content and absolute pressure from the Air Separation Module (ASM). The data gathered is then supplied to the NGS controller for system status monitoring. The oxygen sensor is intended to operate for each flight leg on command from the NGS controller.

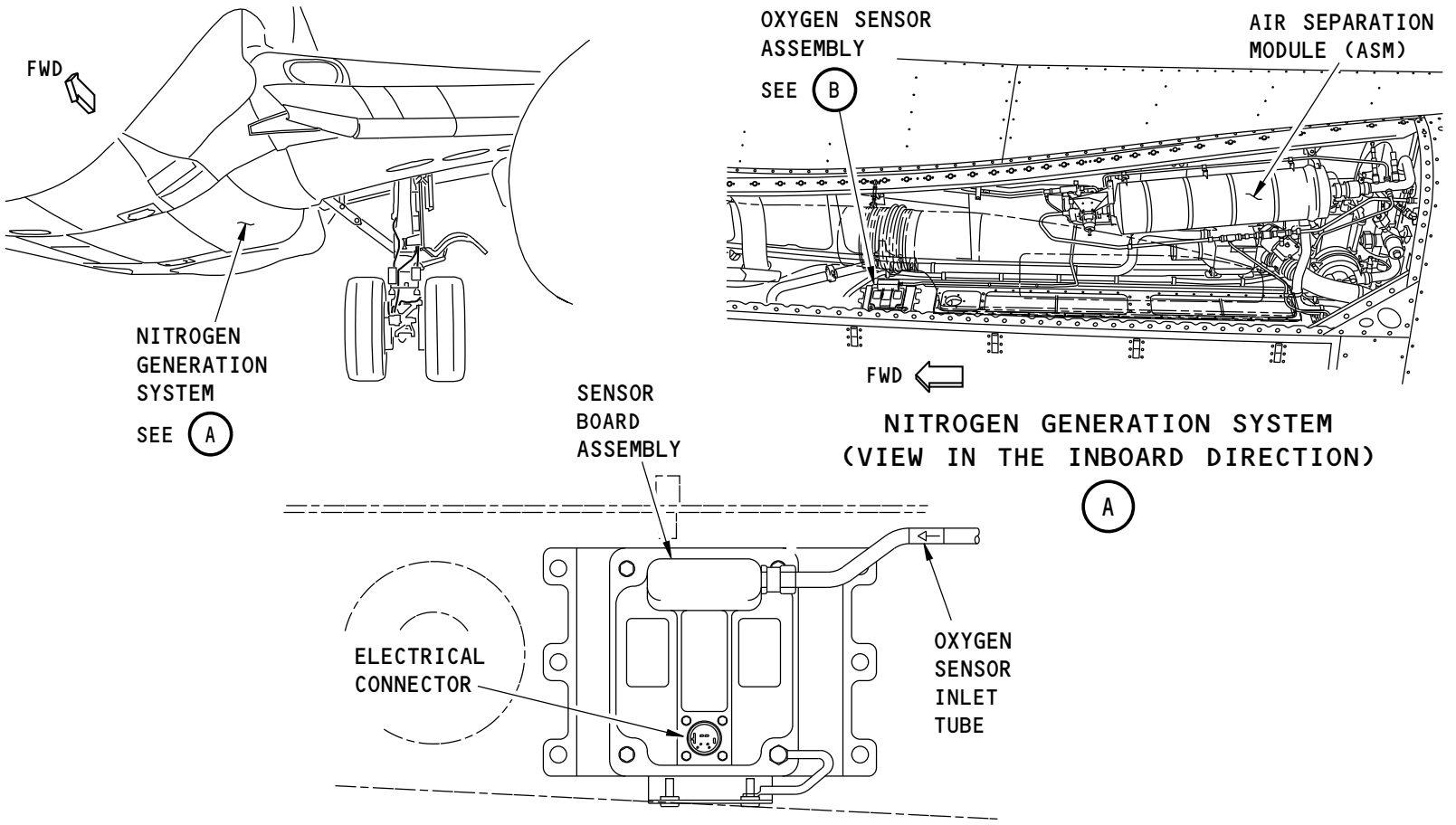
Location

The NGS oxygen sensor is installed in the forward-left ram air duct compartment.

Operation

The NGS oxygen sensor monitors the ASM outlet oxygen concentration and sends a signal to the NGS controller in the form of a current output of 4 to 20 mA proportional to the concentration level. The NGS absolute pressure sensor monitors the ASM outlet pressure and sends a signal to the NGS controller in the form of a current output of 4 to 20 mA proportional to the absolute pressure.

The NGS oxygen sensor does a self-check and outputs 2 mA to show a fault. When a fault occurs, the output is set at the last valid output state until the fault is confirmed. If the fault clears in 10 seconds, the output returns to normal operation.



1544441 S0000276109_V1

NGS OXYGEN SENSOR

NEADS - GENERAL DESCRIPTION

Purpose

The Nitrogen Enriched Air Distribution System (NEADS) supplies nitrogen enriched air from the nitrogen generation system (NGS) to the center tank.

Description

These are the components of the NEADS:

- Drain Cap
- Float Valve
- Cross Vent Check Valve (CVCV)
- Backflow Prevention Check Valve (BPCV)
- NEADS tubing
- Dielectric Isolator Hose
- Flame Arrestor
- Ejector Nozzle

Drain Cap

The drain cap is below the air separation module (ASM). The drain cap lets you do a check for fuel or other fluid in the NEADS. You can get access to the drain cap through the left ECS ram bay panel.

Float Valve

The float valve is in the right side (cheek) of the center tank. It closes when the center tank is full of fuel. It opens to make sure that the NEA is in specification when there is air volume in the center tank. The float valve is attached to the number 12 stringer. You get access to it through the center tank access door in the right wing.

Cross Vent Check Valve

The cross vent check valve (CVCV) is in the right surge tank and is usually closed. During descent, the air pressure in the center tank must be equal to ambient air pressure. The CVCV prevents ambient air from going into the center tank from the right surge tank. This lets the NGS pressurize the center tank with NEA. The CVCV opens to let fuel flow to the surge tank if there is an overfill event.

Backflow Prevention Check Valves

The backflow prevention check valve prevents fuel flow back into the ASM. The vent channel is open to the air bubble in the tank. Fuel can go into the channel during these conditions:

- The system fills the tank to VTO and is inactive for long periods of time
- Warm weather expands fuel in the tank
- You refuel the airplane when it is not level
- Rejected takeoff
- Ground maneuvers

The primary backflow prevention check valve is in the left cheek of the center tank. You get access to it through the center tank access door in the left wing.

The secondary backflow prevention check valve is in the left ram air duct bay behind the ram air access panel. It is in the NEADS duct between the drain valve and the O2 GSE port.

NEADS Duct

The NEADS duct consists of aluminum tubes and fittings. It moves the NEA from the NGS to the center tank.

Dielectric Isolator Hose

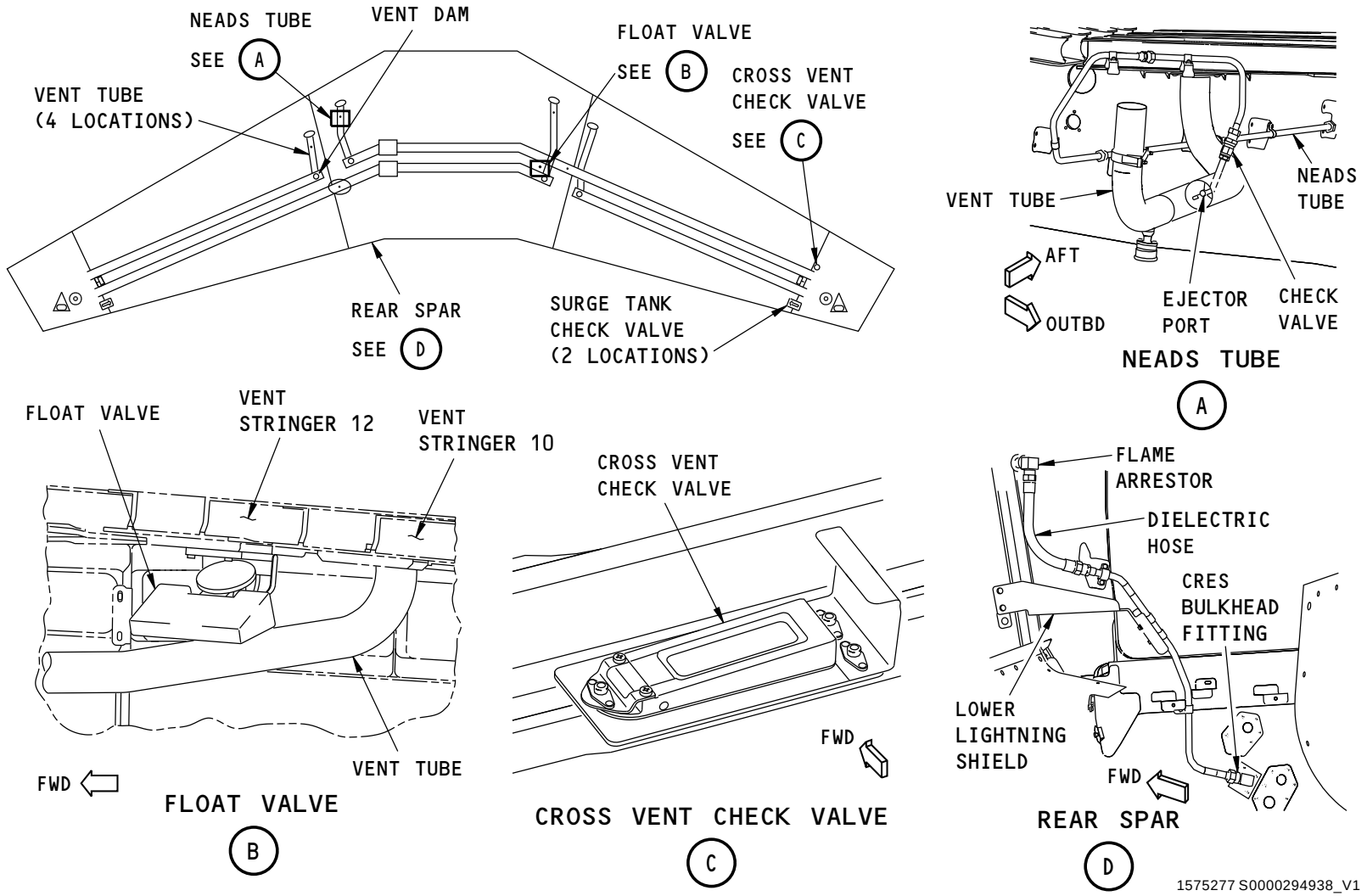
The dielectric isolator hose gives protection to the center tank from electrostatic discharge and lightning strike. It is in the left main wheel well and is attached to the flame arrestor at the rear spar.

Flame Arrestor

The flame arrestor is an in-line honeycomb unit. It gives protection against lightning caused ignition. It is installed into a bulkhead fitting and attached to the rear spar of the center tank. You get access to the flame arrestor from the left main wheel well and the left cheek of the center tank.

Ejector Nozzle

The ejector nozzle is welded into the vent tube in the left cheek of the center tank. The nozzle is the source of NEA for the tank. The nozzle and the float valve work together. They mix the air into a satisfactory oxygen decreased atmosphere that will not support combustion.



NEADS - GENERAL DESCRIPTION

NEADS - COMPONENT LOCATION - 1

General

The components of NEADS are in the left ram air compartment and in the fuel distribution system.

Components - Left Ram Air Compartment

These components are in the left ram air bay (View C):

- Ground service equipment (GSE) O2 test port
- Secondary backflow prevention check valve
- Drain cap

Components - Left Wheel Well

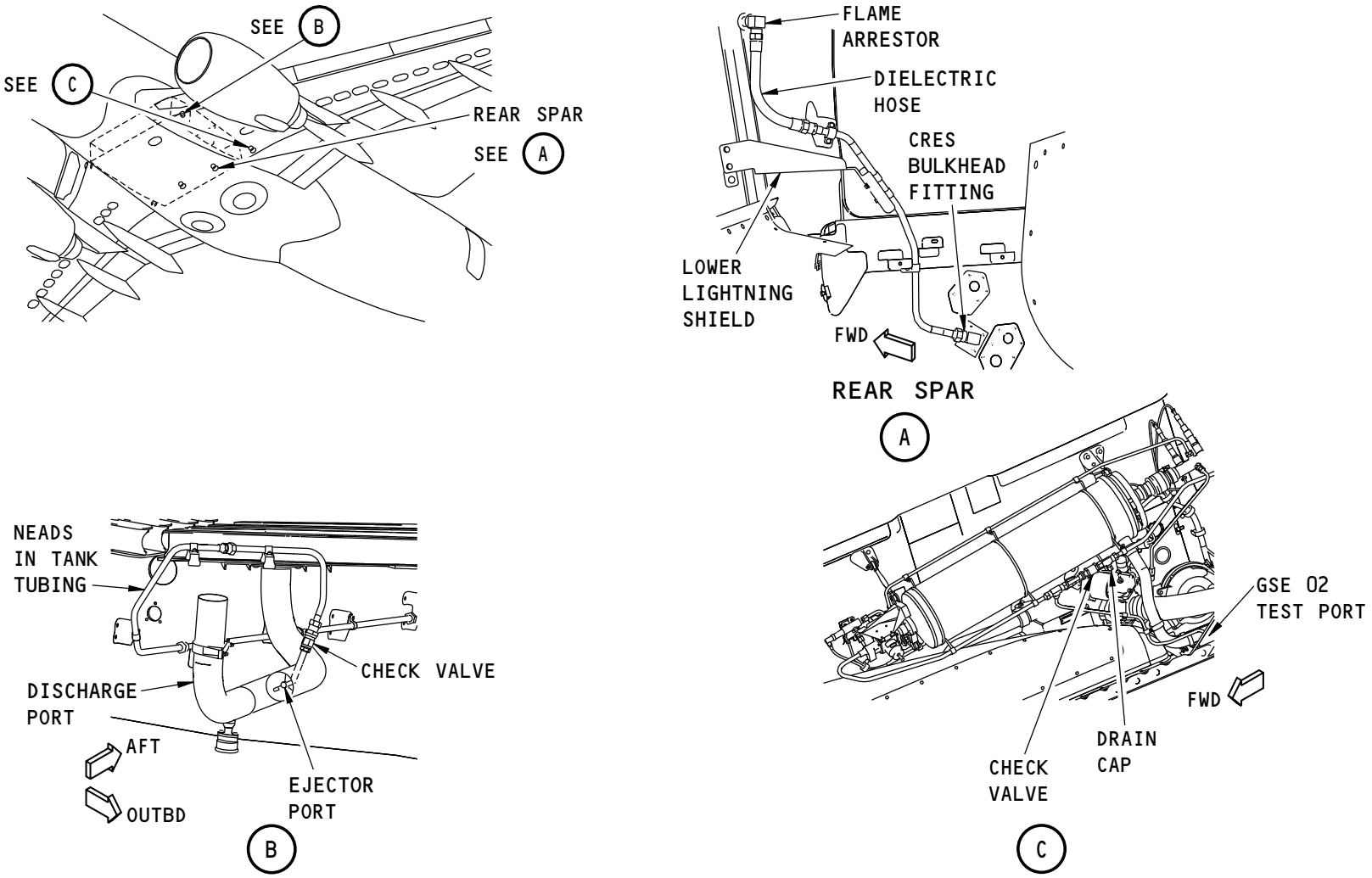
These components are in the left wheel well attached to the center tank rear spar (View A):

- NEA 1/2 inch supply line
- Di-electric hose
- Flame arrestor

Components - Center Tank - Left Cheek

These components are in the left cheek of the center tank (View B):

- Primary backflow prevention check valve
- Ejector nozzle



1506652 S0000275331_V3

NEADS - COMPONENT LOCATION -1

NEADS - COMPONENT LOCATION - 2

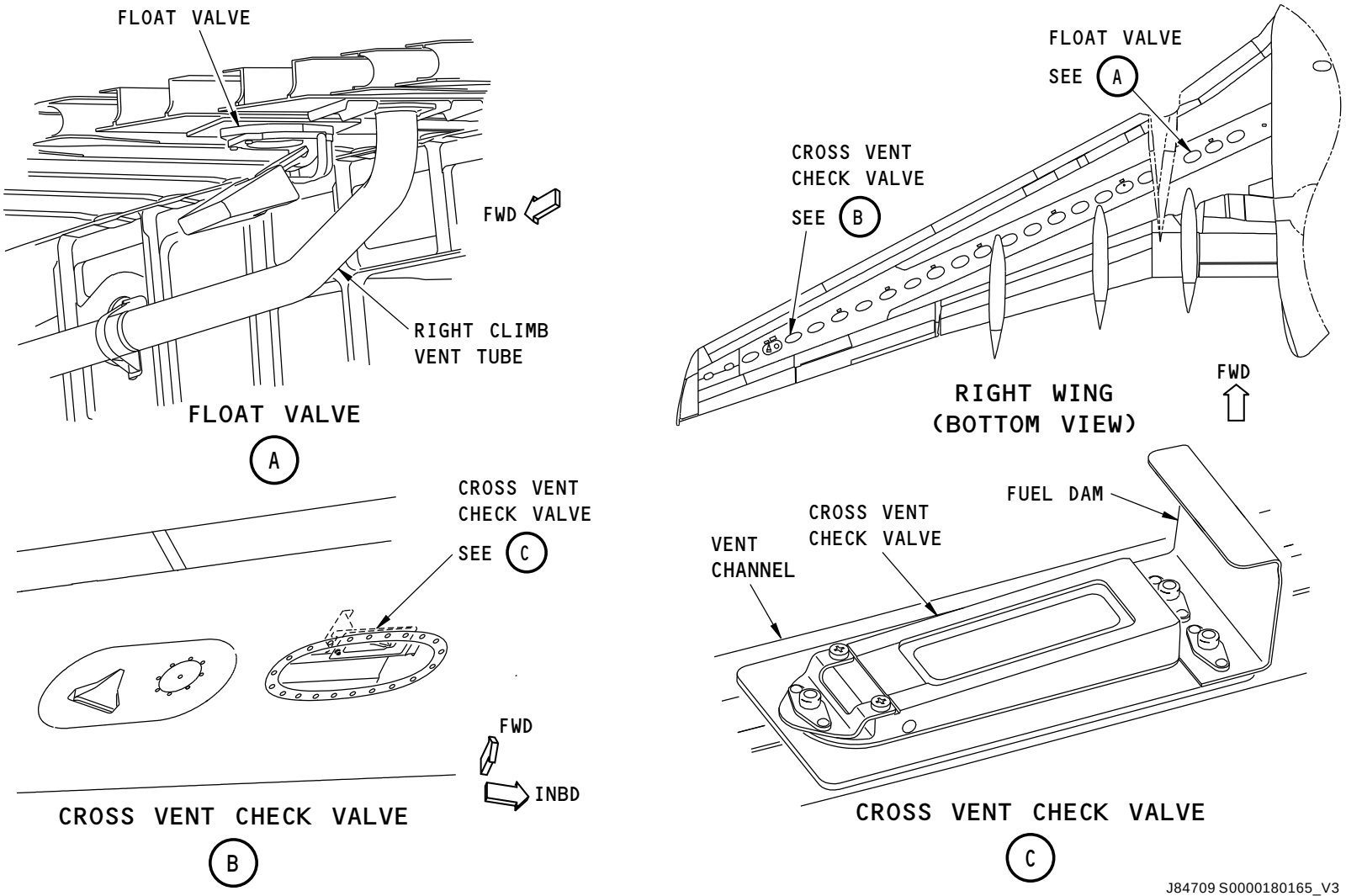
General

The right cheek (side) of the center tank has these components:

- Vent channel
- Float valve

The right surge tank has these components:

- Vent channel
- Cross vent check valve (CVCV)



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NEADS - COMPONENT LOCATION - 2

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NITROGEN GENERATION SYSTEM CONTROLLER

Purpose

The NGS controller collects data from the airplane systems and sends signals to operate the components of the Nitrogen Generation System (NGS).

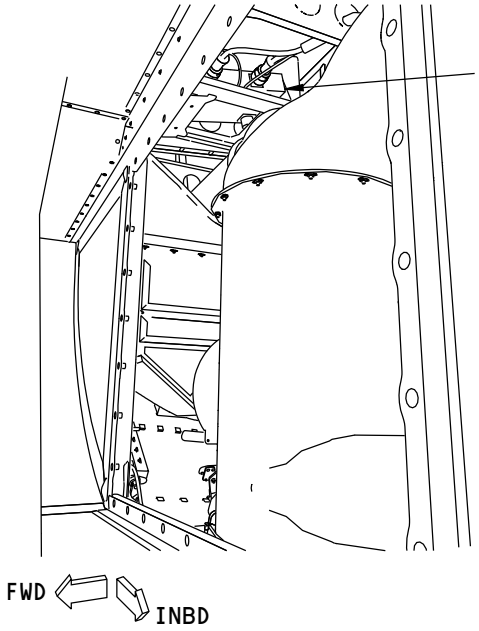
Location

The NGS controller is aft of the forward cargo compartment.

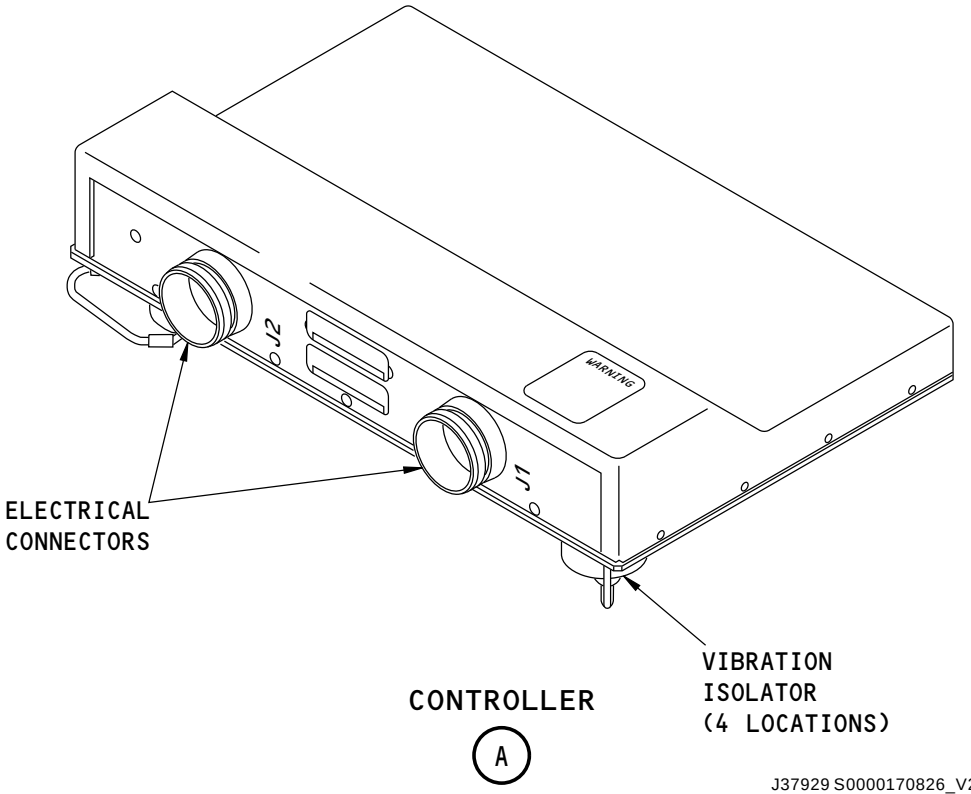
Physical Description

The controller has a one card assembly with an integrated power supply and a microcontroller. These installed components are in a metal chassis. The chassis is attached to the airplane structure by vibration isolators.

The controller has two electrical connectors on the front of the case.



AIR CONDITIONING
MIX BAY



CONTROLLER
A

J37929 S0000170826_V2

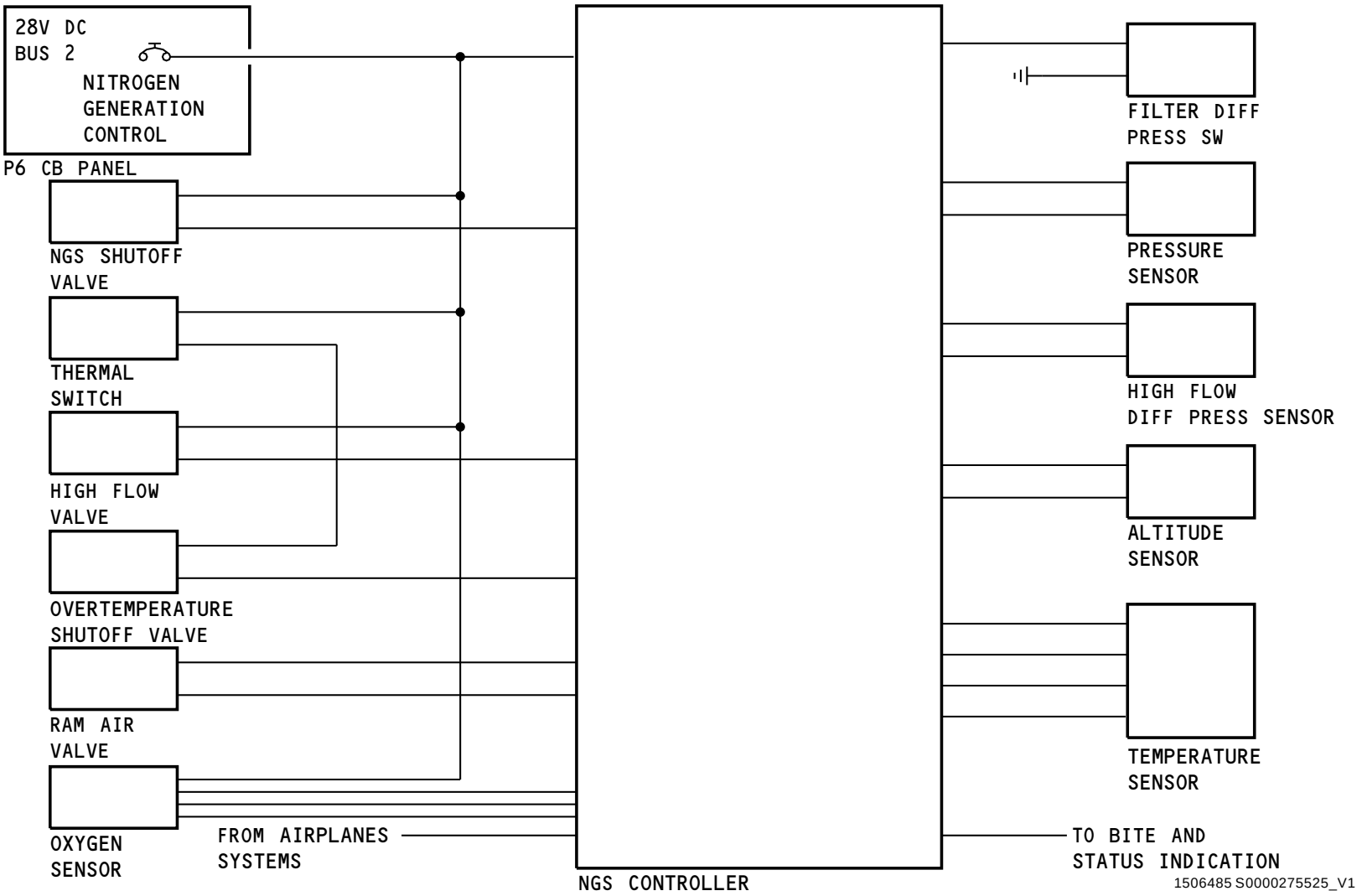
NITROGEN GENERATION SYSTEM - CONTROLLER

NGS CONTROLLER - FUNCTIONAL DESCRIPTION

Functional Description

The NGS controller does these functions:

- Modulates the ram air valve to control the temperature of the air that goes into the air separation module
- Commands the NGS shutoff valve to open or close
- Commands the overtemperature shutoff valve to open or close
- Monitors overtemperature conditions
- Sends indications to the BITE display unit
- Senses decreased flow
- Gets data from the differential pressure sensor
- Does the electrical built-in-test
- Supplies RS422 communication to download software and monitor controller data
- Provides the operability indicator interface for the system status indication
- Records flight data in non-volatile memory
- Monitors ASM performance testing by oxygen sensor



NITROGEN GENERATION SYSTEM - NGS INTERFACE

NGS CONTROLLER - DISCRETE INPUTS

General

The NGS controller gets discrete inputs from these airplane sources to regulate when and how the system works:

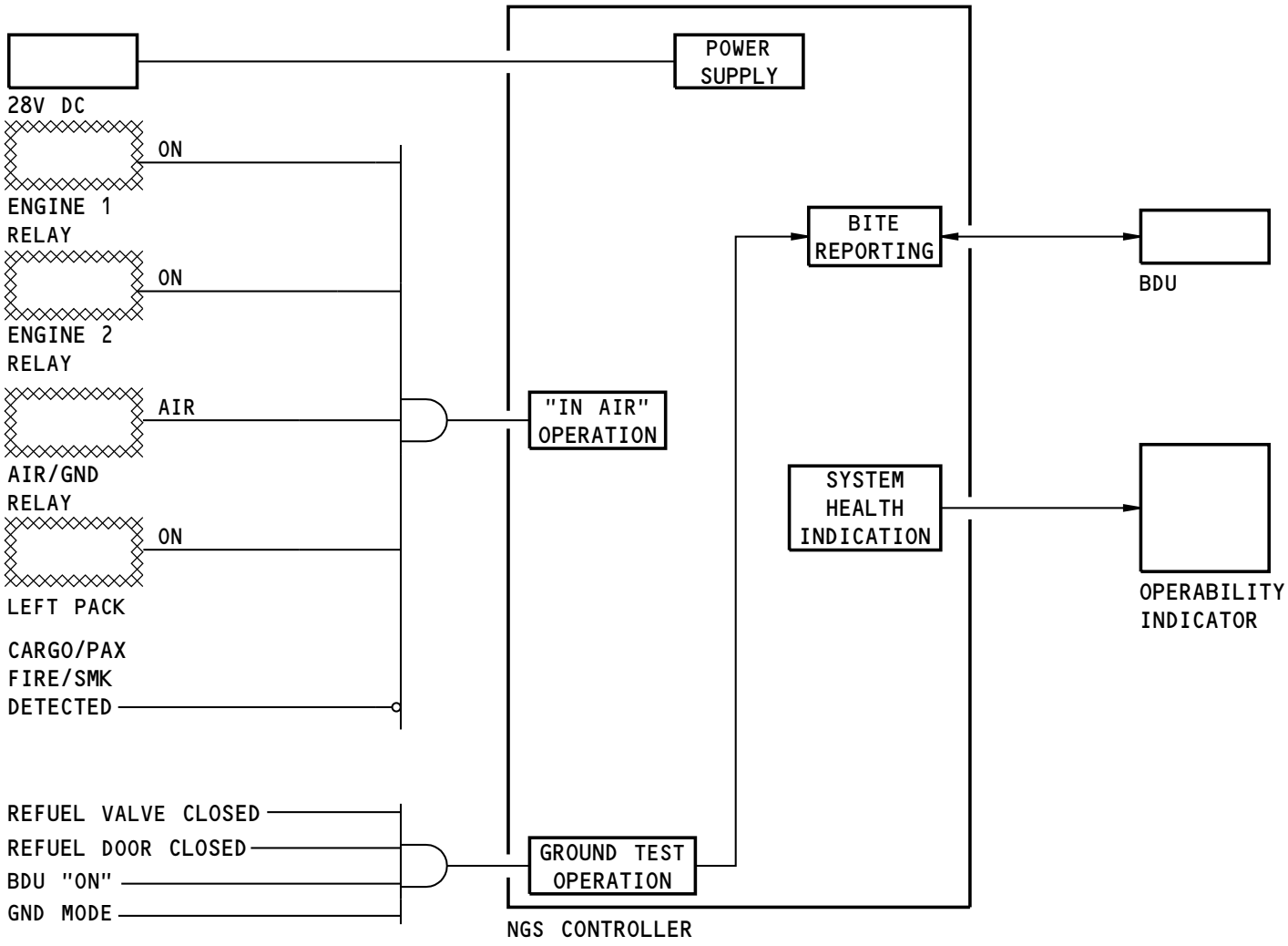
Module/System	Monitors	NGS Operating Mode
Cargo Smoke Detection and Fire Suppression Module	Cargo and /or Main Deck for Smoke and/or Fire	True = OFF
Left Pack Flow Control and Shutoff Valve	Left AC pack for an overheat condition	True = OFF
Air Conditioning Relays	Flap Position for Mode of Flight	High or Low Flow
System 1 Air Ground Relay	Weight on Wheels - On Ground	True = OFF
Engines 1 and 2 Running Relays	If either engine shut down in flight	True = OFF
Center Tank Refuel Valve	Valve Position - Open	True = OFF

Analog discrete inputs tell the NGS Controller the position of an airplane system valve or the electrical condition of a connection from a sensor (open or ground). The controller opens the NGS PRSOV during flight normal conditions and lets bleed air into the system. The NGS controller opens the NGS PRSOV when all of these conditions are met:

- Airplane is in the air
- Both engines are running
- Cargo smoke detection and suppression module is normal
- The air conditioning packs are not overheated
- The center tank refuelling valve is closed.

When the NGS PRSOV is closed, the system is OFF. The NGS PRSOV is closed if any one of these conditions exist:

- Airplane on the ground and not in test mode
- Either engine is OFF in flight
- Fire or smoke detection in cargo or main deck areas
- Left air conditioning pack overheat
- The center tank refuelling valve is open



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NGS CONTROLLER - DISCRETE INPUTS

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NGS INDICATION - OPERABILITY INDICATOR

Purpose

The operability indicator shows the condition of the nitrogen generation system. It gets signals from the controller.

Location

The operability indicator is on the aft bulkhead of the right main landing gear wheel well. It is adjacent to the APU remote control panel (P28).

Physical Description

The indicator has these three lights that show the condition of the nitrogen generation system:

- OPERATIONAL - Green light
- DEGRADED - Blue light
- INOP - Amber light

The green OPERATIONAL light shows that the system operates correctly, and no maintenance is necessary.

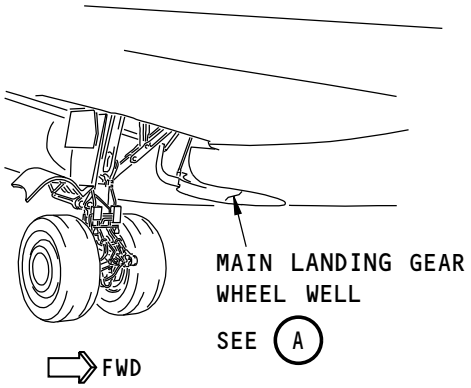
The blue DEGRADED light shows that the system is serviceable, but at a decreased capacity. No maintenance is necessary, but you must record the fault before you can release the airplane.

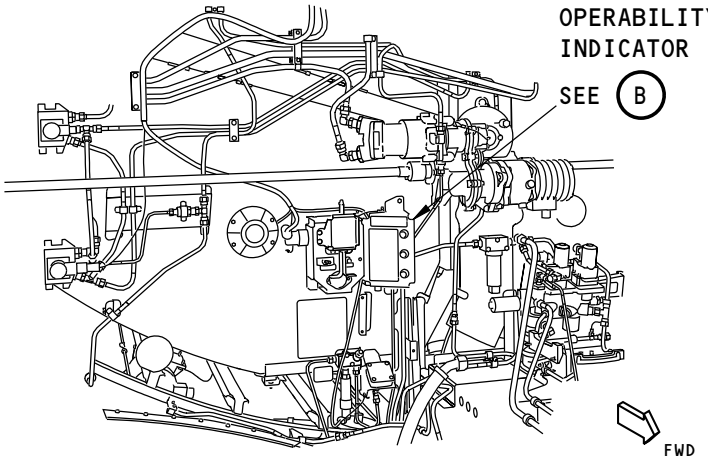
The amber INOP light shows that the system is not serviceable. You must manually close and lock the NGS SOV. Record the fault before you can release the airplane.

When none of the lights show, the operability indicator is not serviceable. You can use the BITE display unit to find the cause of the problem.

Training Information Point

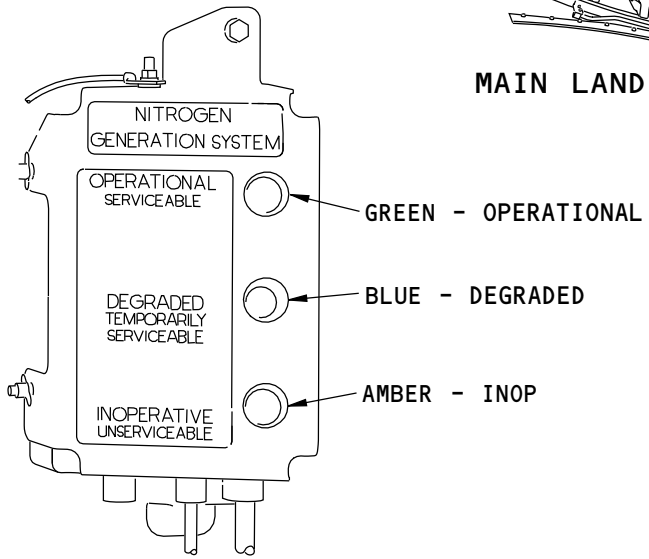
When operation is DEGRADED or INOP, you have ten days to repair the system.





MAIN LANDING GEAR WHEEL WELL

A



OPERABILITY INDICATOR

B

J63237 S0000172213_V1

OPERABILITY INDICATOR

NGS INDICATION - BITE DISPLAY UNIT

Purpose

You use the BITE display unit to troubleshoot the nitrogen generation system components.

Location

The BITE Display Unit (BDU) is in the forward bulkhead of the right ECS air conditioning compartment. You can get access to the BITE display unit through the access door to the pneumatic ground connector.

Physical Description

The BITE display unit has these items:

- BITE instruction plate
- Two line vacuum florescent display
- Six pushbuttons.

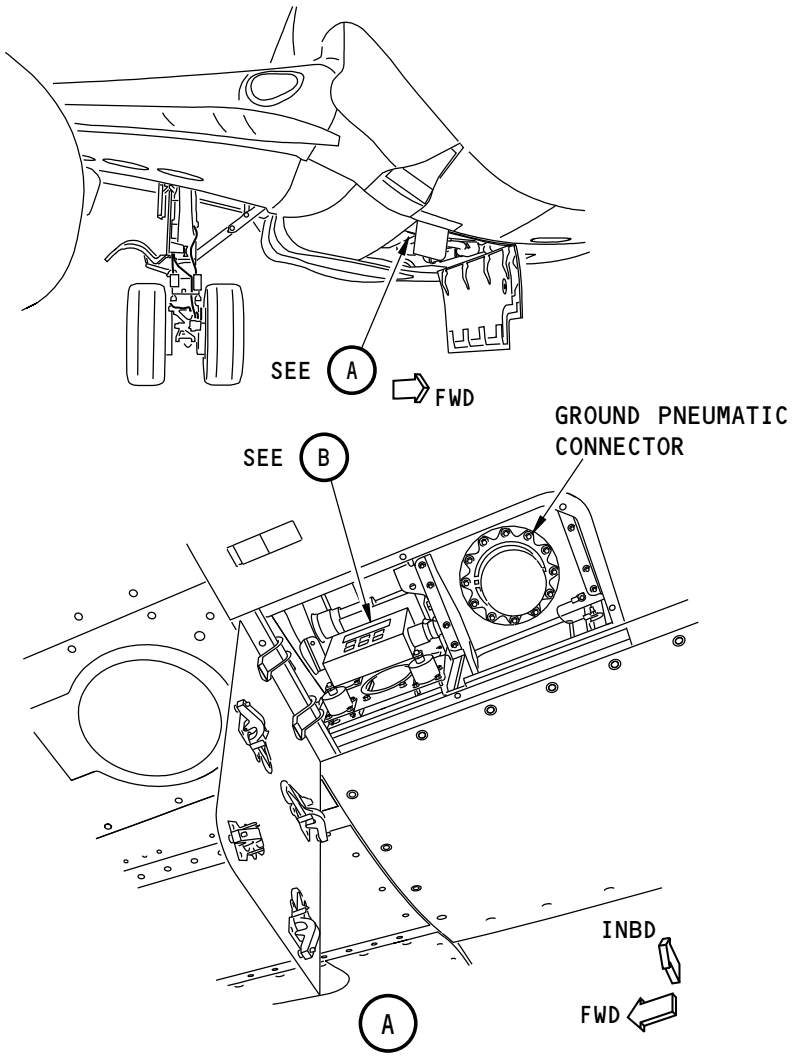
BITE

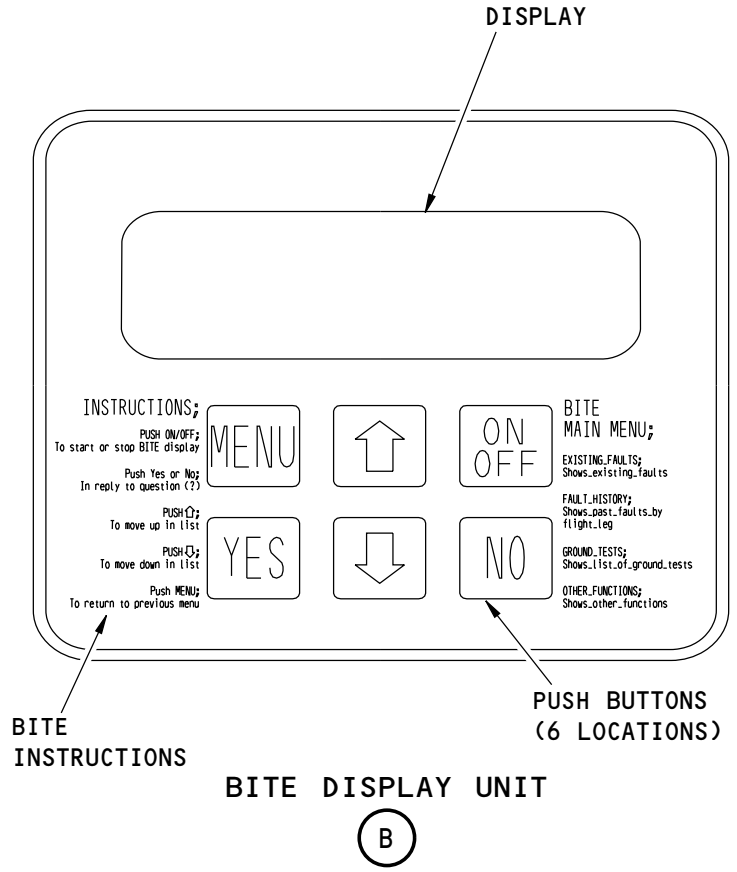
The BITE DISPLAY Unit gives you access to these menus:

- EXISTING FAULTS?
- FAULT HISTORY?
- GROUND TESTS?
- OTHER FUNCTIONS?.

These are the functions of the BITE display unit pushbuttons:

- You use the ON/OFF button to start or stop the BITE display unit.
- You use the MENU button to start the BITE menus. You can push the MENU button to move up one level in the menus. The MENU button is also used to immediately stop a test.
- You use the YES button to respond to a question. The YES button also starts a test.
- You use the NO button to respond to a question.
- You use the Up arrow to move up through a menu or the result of a test.
- You use the Down arrow to move down through a menu or the result of a test.





J84746 S0000181034_V1

NGS INDICATION - BITE DISPLAY UNIT

NGS INDICATION - BITE

General

The nitrogen generation system does these BITE functions:

- Continuous monitor
- BITE tests

Continuous Monitor

The continuous monitor function monitors the controller for correct operation. When the controller has an internal failure, the event is kept in fault history.

BITE Tests

BITE does tests on components and sensors that have an interface with the nitrogen generation system. It has these functions:

- Quick system test
- NGS LRU self-test
- Does tests of sensors that have an interface with the nitrogen generation system
- It does tests to show that functions are in specification.
- Aid for fault isolation

The BITE display unit has a key pad with six buttons. It has a vacuum fluorescent display with two lines of sixteen characters for each line.

BITE Operation

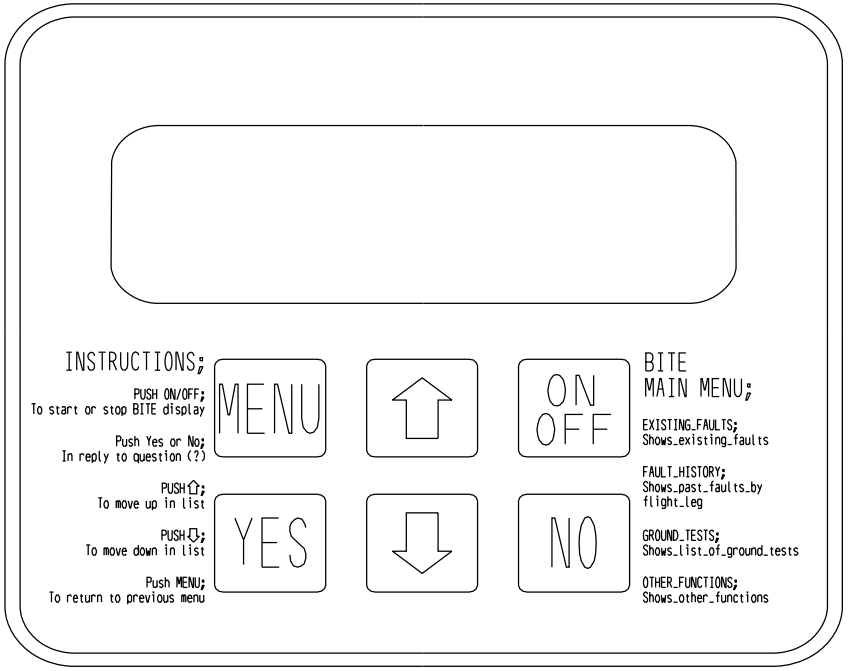
To start the BITE, push the ON/OFF key on the BITE display unit. EXISTING FAULTS? shows as the first menu item. Push the YES key to answer questions and to move down in the selected menu item on the display. Push the NO or down arrow key to see the next menu item. In some lists, TOP OF LIST or END OF LIST shows when you move to the top or bottom of the list. Push the MENU key to go out of a menu and to move up one level to the previous menu.

Main Menu

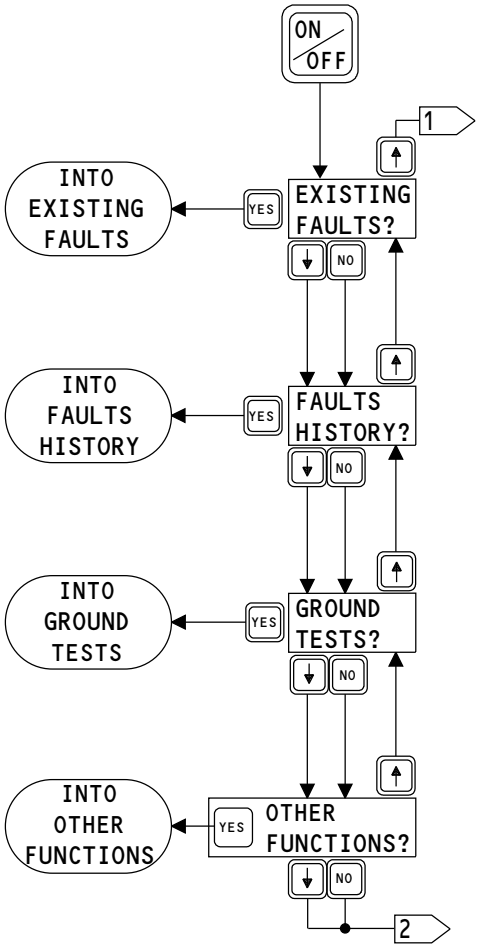
These are the BITE main menu selections:

- EXISTING FAULTS?
- FAULTS HISTORY?
- GROUND TESTS?
- OTHER FUNCTIONS?

When BITE starts, EXISTING FAULTS? shows. Push the YES button to select this menu. Use the NO key on the down arrow key to move to the next menu selection.



BITE DISPLAY UNIT



1 SHOWS TOP OF LIST

2 SHOWS END OF LIST

J84659 S0000179925_V2

NITROGEN GENERATION SYSTEM - BITE

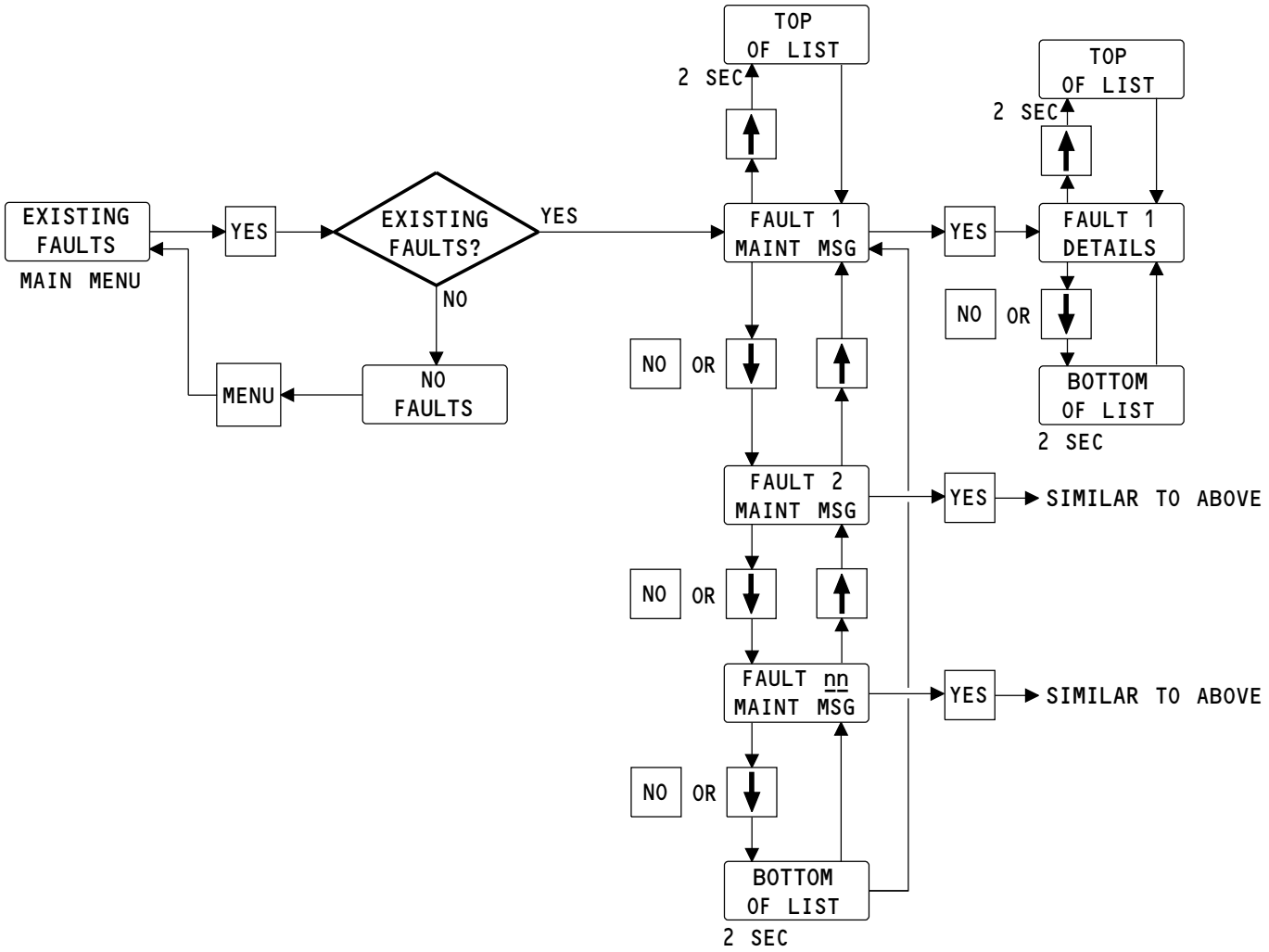
Existing Faults

The EXISTING FAULTS? menu shows faults that are present in the system. From the EXISTING FAULTS? menu you can select faults to examine. Faults are maintenance messages. Fault details give more data about the problem.

From the EXISTING FAULTS? menu, push the YES button. If there are no faults, the display shows NO FAULTS. Push the MENU button to go back to the main menu.

If there are faults, the newest one shows on the display. To see the next previous fault, push the NO or the down arrow button. After the last (or only) fault, the display shows BOTTOM OF LIST for 2 seconds.

To see the fault details for one of the faults, push the YES button. The display shows the details for that fault. If you push the NO button, or the down arrow, you see the next detail for that fault. If there are no more details, the display shows BOTTOM OF LIST for 2 seconds.



J84482 S0000179929_V2

NGS INDICATION - BITE - EXISTING FAULTS

Fault History

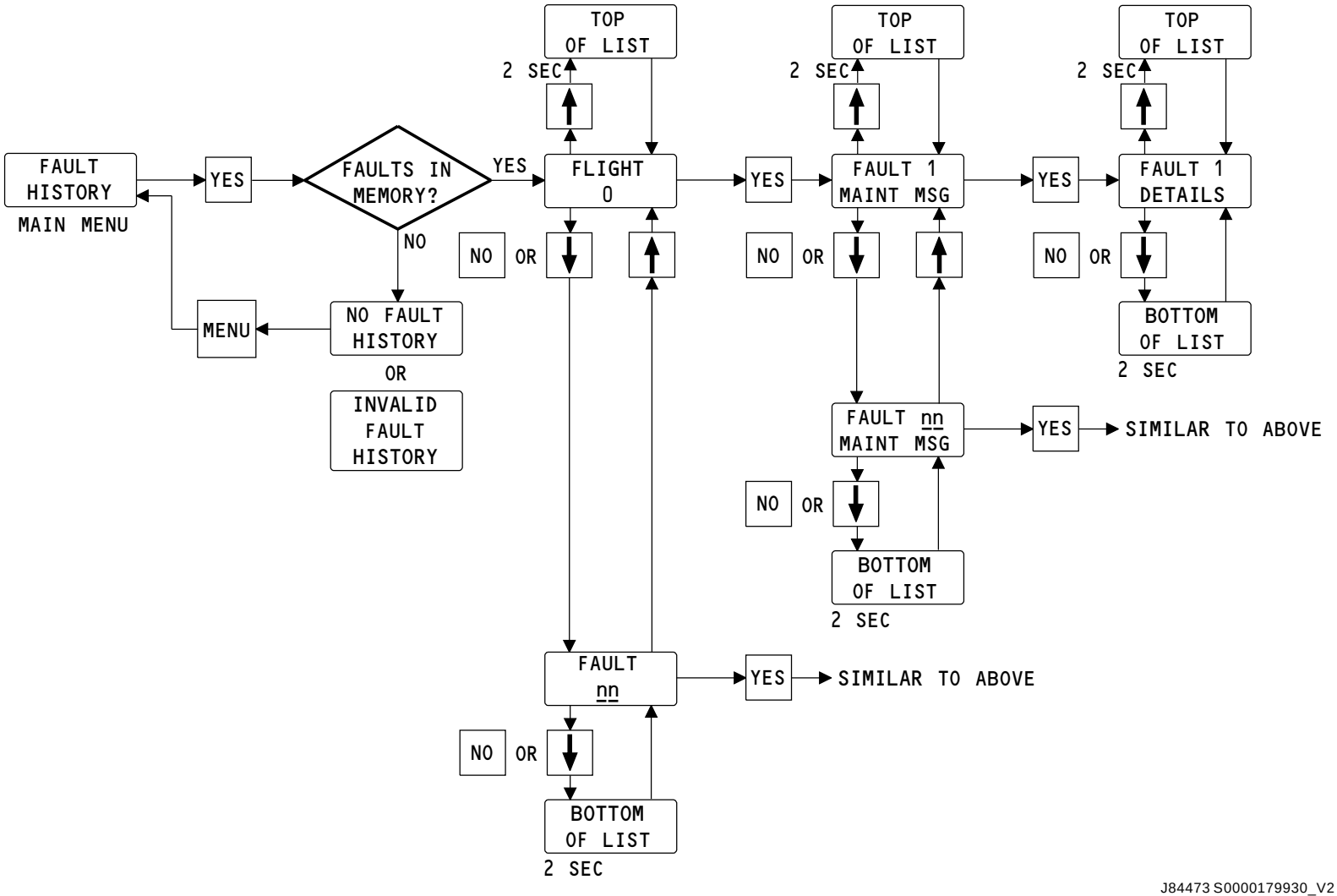
FAULT HISTORY? shows the faults that are in the memory, and that have not been cleared.

From the FAULT HISTORY? menu, push the YES button. If there are no faults in memory, NO FAULT HISTORY shows on the display. Push the MENU button to go back to the main menu.

If there are faults, the display shows 00 for the most recent fault. To show the next previous flight leg, push the NO button or the down arrow. The display shows 01 as the next previous flight leg. If there are no more faults in memory, the display shows BOTTOM OF LIST for 2 seconds. The controller can have as many as 1000 flight legs in memory.

Each flight leg can have faults and details. To show a fault for a flight leg, push the YES button. The display shows the fault. If you push the NO button or the down arrow, the display shows the next fault. If there are no more faults, the display shows BOTTOM OF LIST for 2 seconds

To show the details for each fault, push the YES button. If you want to see more fault details, push the NO or the down arrow button. If there are no more fault details, the display shows BOTTOM OF LIST for 2 seconds.



J84473 S0000179930_V2

NGS INDICATION - BITE - FAULT HISTORY

Ground Test

GROUND TEST? does a series of tests on the nitrogen generation system.

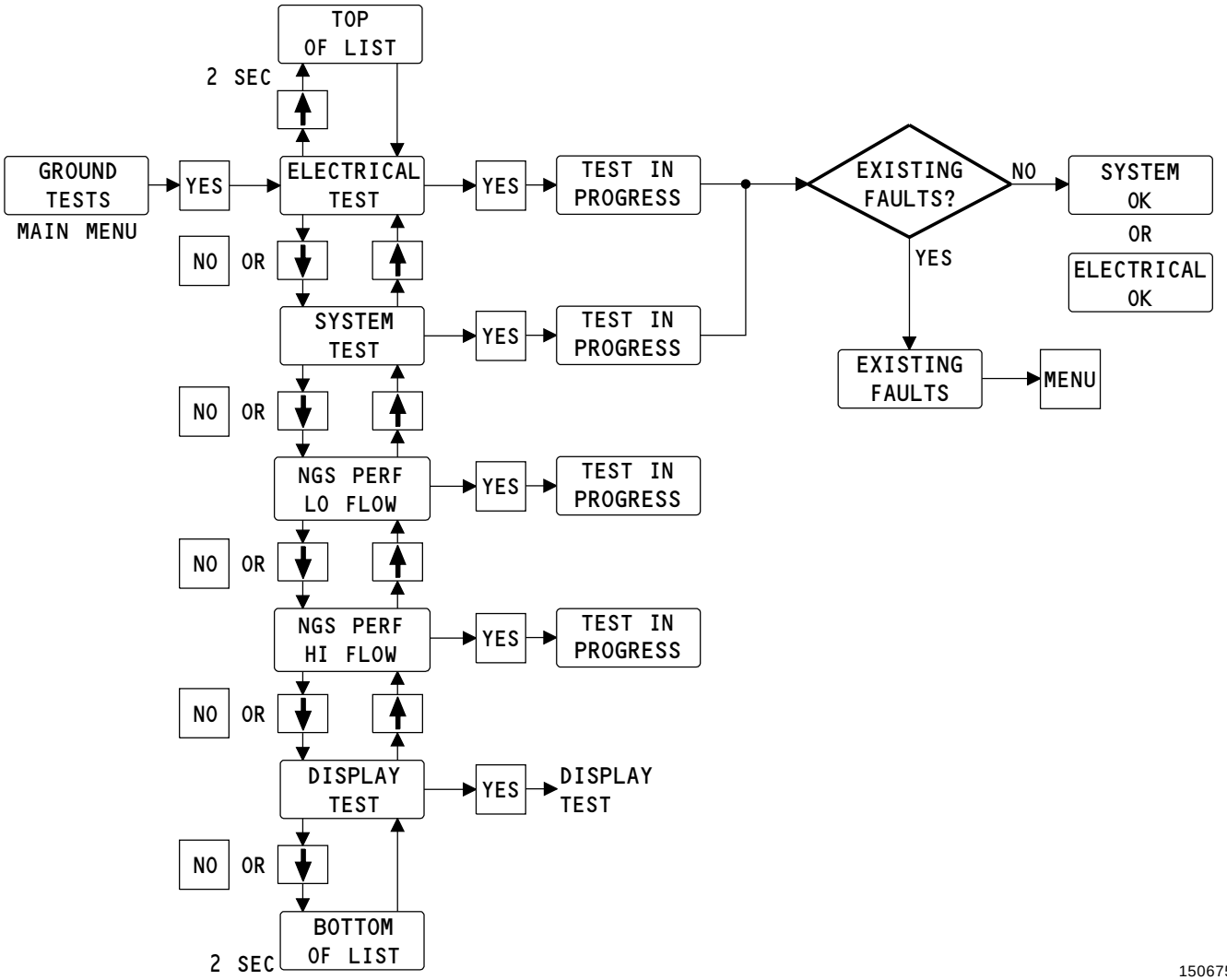
From the GROUND TEST? menu push the NO or the down arrow button. The display shows these tests:

- ELECTRICAL TEST
- SYSTEM TEST
- GSE PRI (low flow mode)
- GSE ALL (high flow mode)
- DISPLAY TEST

When you select a test, the display shows TEST IN PROGRESS.

If there is no fault, the display shows SYSTEM OK.

I If there is a fault after TEST IN PROGRESS, the display shows nn EXIST FAULTS for 2 seconds. It then goes to the EXISTING FAULTS? menu.



1506757 S0000275557_V1

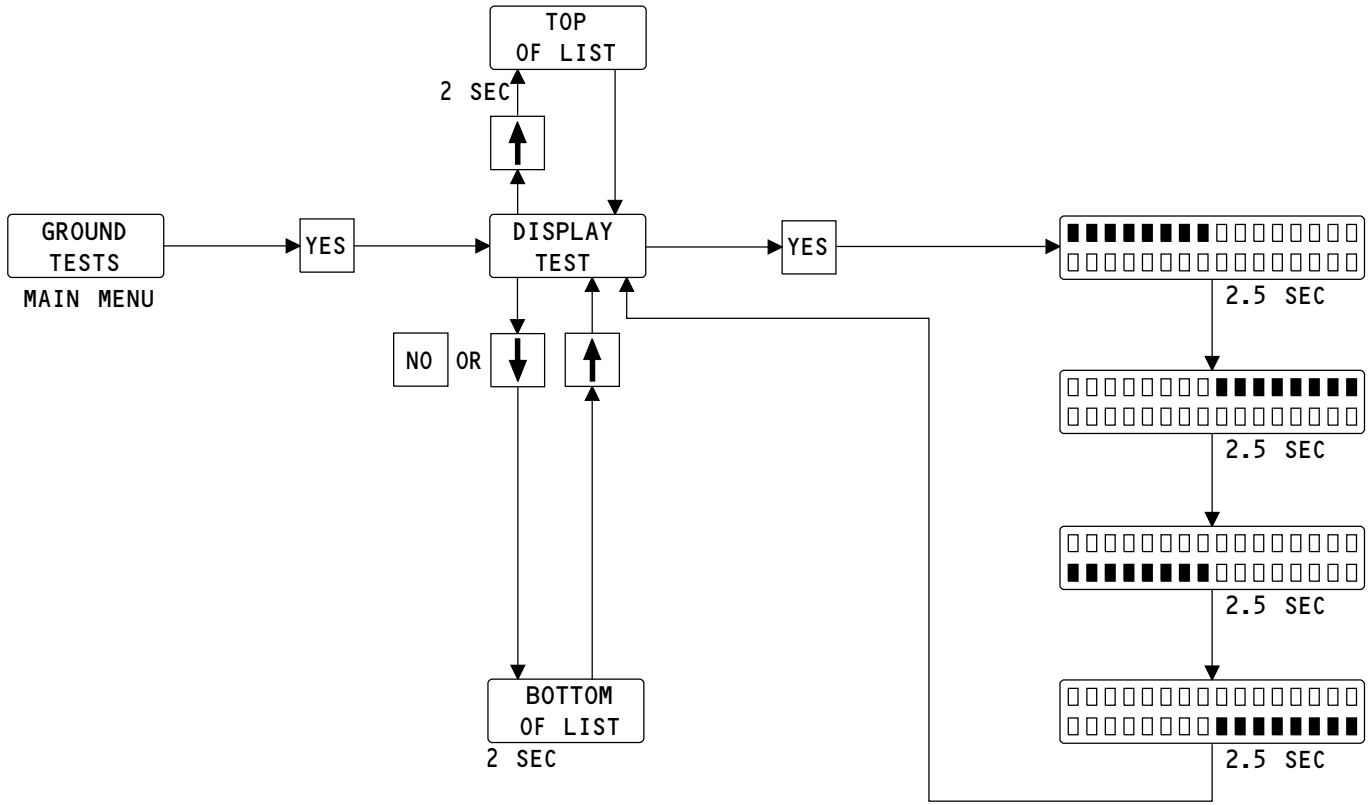
NGS INDICATION - BITE GROUND TESTS

NGS INDICATION - BITE - DISPLAY TEST

Display Test

DISPLAY TEST does a test of all 32 digits of the vacuum florescent display (VFD).

From the GROUND TEST menu, push the YES button. The display shows DISPLAY TEST. Push the YES button to start the test. Four digits at a time come on for 2.5 seconds. After the test is complete, the display shows DISPLAY TEST.



LEGEND:

■ BDU LIGHT ON
□ BDU LIGHT OFF

J84374 S0000179941_V2

NGS INDICATION - BITE - DISPLAY TEST

NGS INDICATION - BITE - OTHER FUNCTIONS

Other Functions

OTHER FUNCTIONS shows special details of the nitrogen generation system.

From the OTHER FUNCTIONS menu, push the NO or the down arrow button. The display shows these selections:

- SYSTEM CONFIGURATION
- I/O MONITOR

SYSTEM CONFIGURATION

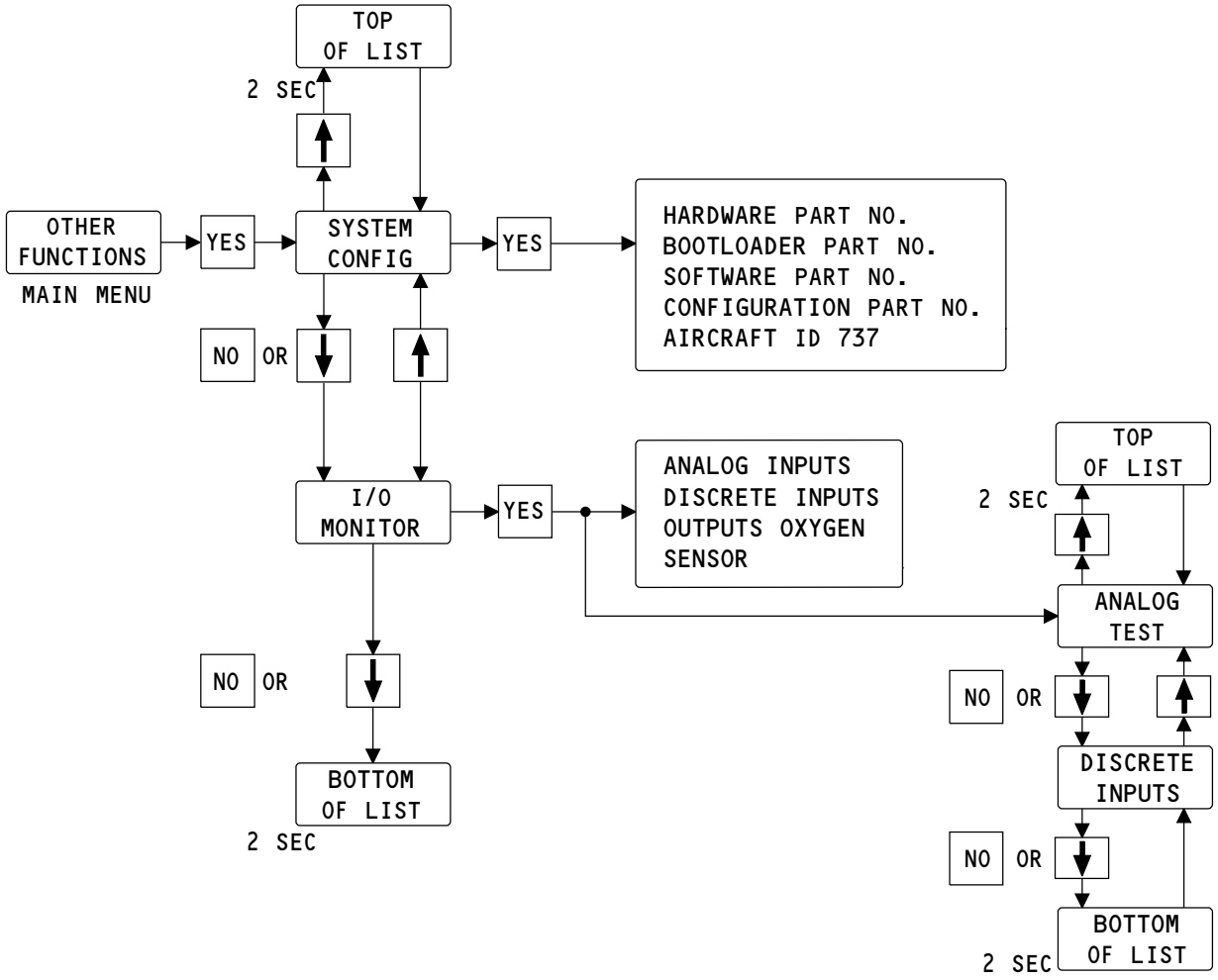
The system configuration menu gives these selections:

- Hardware part number
- Bootloader part number
- Software part number
- Configuration part number
- Aircraft ID 737.

I/O MONITOR

The I/O MONITOR gives this data:

- Analog inputs
- Discrete inputs
- Oxygen sensor.



1506779 S0000275560_V1

NGS INDICATION - BITE - OTHER FUNCTIONS