# CHAPTER

# 29

# Hydraulic Power

# CHAPTER 29
# HYDRAULIC POWER



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

# 29-EFFECTIVE PAGES

## CHAPTER 29
## HYDRAULIC POWER

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# 29-EFFECTIVE PAGES

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# HYDRAULIC POWER



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## CHAPTER 29
## HYDRAULIC POWER



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# HYDRAULIC POWER - INTRODUCTION

## General

There are three independent hydraulic systems that supply hydraulic power for user systems.

The main and auxiliary hydraulic systems supply pressurized fluid to these airplane systems:

- Both thrust reversers
- Power transfer unit (PTU) motor
- Landing gear extension and retraction
- Nose wheel steering
- Main gear brakes
- Primary flight controls
- Secondary flight controls.

These systems make up the hydraulic power system:

- Main hydraulic systems
- Ground servicing system
- Auxiliary hydraulic systems
- Hydraulic indicating systems.

## Main Hydraulic Systems

The main hydraulic systems are A and B. System A has most of its components on the left side of the airplane and system B on the right side.

## Ground Servicing System

The ground servicing system fills all hydraulic reservoirs from one central location.

## Auxiliary Hydraulic Systems

The auxiliary hydraulic systems are the standby hydraulic system and the power transfer unit (PTU) system.

The standby hydraulic system is a demand system that supplies reserve hydraulic power to these components:

- Rudder
- Leading edge flaps and slats
- Both thrust reversers.

The hydraulic power transfer unit (PTU) system is an alternate source of hydraulic power for the leading edge flaps and slats and autoslat system.

## Hydraulic Indicating Systems

These are the indicating systems:

- Hydraulic fluid quantity
- Hydraulic pressure
- Hydraulic pump low pressure warning
- Hydraulic fluid overheat warning.

The hydraulic indicating systems show these indications in the flight compartment:

- System A and B reservoir quantity
- Standby reservoir low quantity
- System A and B pressure
- System A and B engine-driven pump (EDP) low pressure
- System A and B electric motor-driven pump (EMDP) low pressure
- Standby electric motor-driven pump low pressure
- System A and B electric motor-driven pump (EMDP) overheat.

## Abbreviations and Acronyms

- ac - alternating current
- alt - alternate
- APU - auxiliary power unit
- auto - automatically

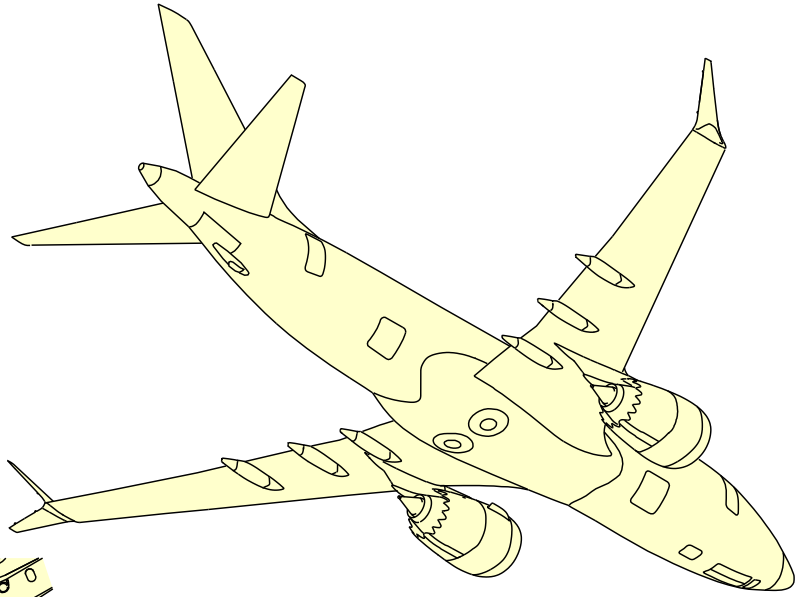
## HYDRAULIC POWER - INTRODUCTION

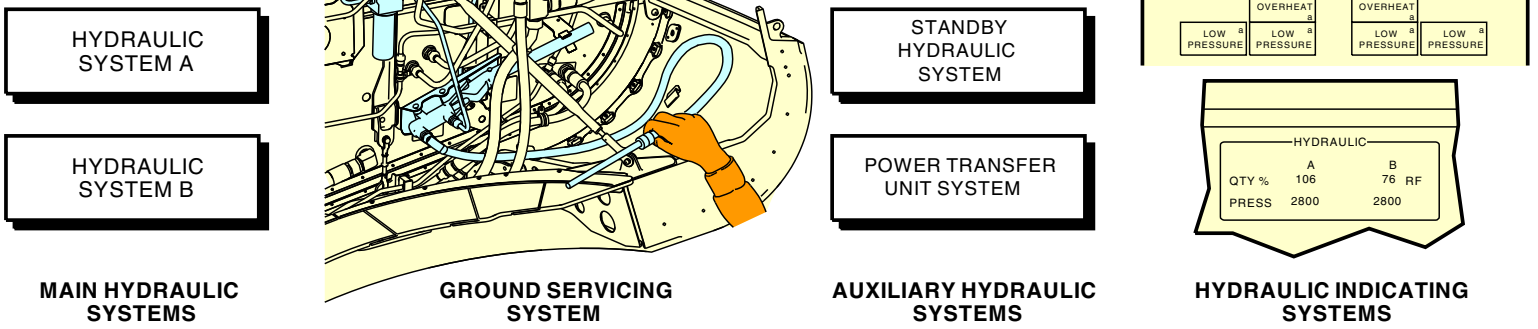
- bat - battery
- clsd - closed
- cont - control
- CT - current transformer
- dc - direct current
- EDP - engine-driven pump
- ELCU - electrical load control unit
- elec - electrical
- elev - elevator
- EMDP - electric motor-driven pump
- eng - engine
- exch - exchanger
- fwd - forward
- GPM - gallons per minute
- hyd - hydraulic
- flt - flight
- gnd - ground
- kg - kilograms
- kts - knots
- LE - leading edge
- lt - left
- MLG - main landing gear
- NLG - nose landing gear
- norm - normal
- press - pressure
- psi - pounds per square inch
- PTU - power transfer unit
- qty - quantity
- rt - right
- rud - rudder
- stby - standby
- sw - switch
- sys - system
- TE - trailing edge
- vlv - valve
- xfr - transfer
- xmfr - transformer
- xmtr - transmitter

## HYDRAULIC POWER - INTRODUCTION

HYDRAULIC POWER USER SYSTEMS:

- BOTH THRUST REVERSERS
- POWER TRANSFER UNIT (PTU) MOTOR
- LANDING GEAR EXTENSION AND RETRACTION
- NOSE WHEEL STEERING
- MAIN GEAR BRAKES
- PRIMARY FLIGHT CONTROLS
- SECONDARY FLIGHT CONTROLS



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## HYDRAULIC POWER - INTRODUCTION

## HYDRAULIC POWER - GENERAL DESCRIPTION

### Pressurization

Air pressure from the reservoir pressurization system maintains head pressure on hydraulic system A, system B, and the standby hydraulic system reservoirs.

The pressurized reservoirs supply a constant flow of fluid to the hydraulic pumps.

### Hydraulic System A

Hydraulic system A supplies pressure to these airplane systems:

- Power transfer unit motor
- Left thrust reverser
- Landing gear extension and retraction
- Nose wheel steering
- Alternate brakes
- Aileron
- Autopilot A
- Elevators
- Elevator feel
- Flight spoilers 2, 4, 9, and 11
- Ground spoilers 1, 6, 7, and 12
- Rudder.

### Hydraulic System B

Hydraulic system B supplies pressure to these airplane systems:

- Right thrust reverser
- Alternate landing gear retraction
- Alternate nose wheel steering
- Normal brakes
- Aileron
- Autopilot B
- Elevators
- Elevator feel
- Flight spoilers 3, 5, 8, and 10
- Rudder
- Trailing edge flaps
- Leading edge flaps and slats.

### Standby Hydraulic System

The standby hydraulic system supplies alternative hydraulic pressure to these airplane systems:

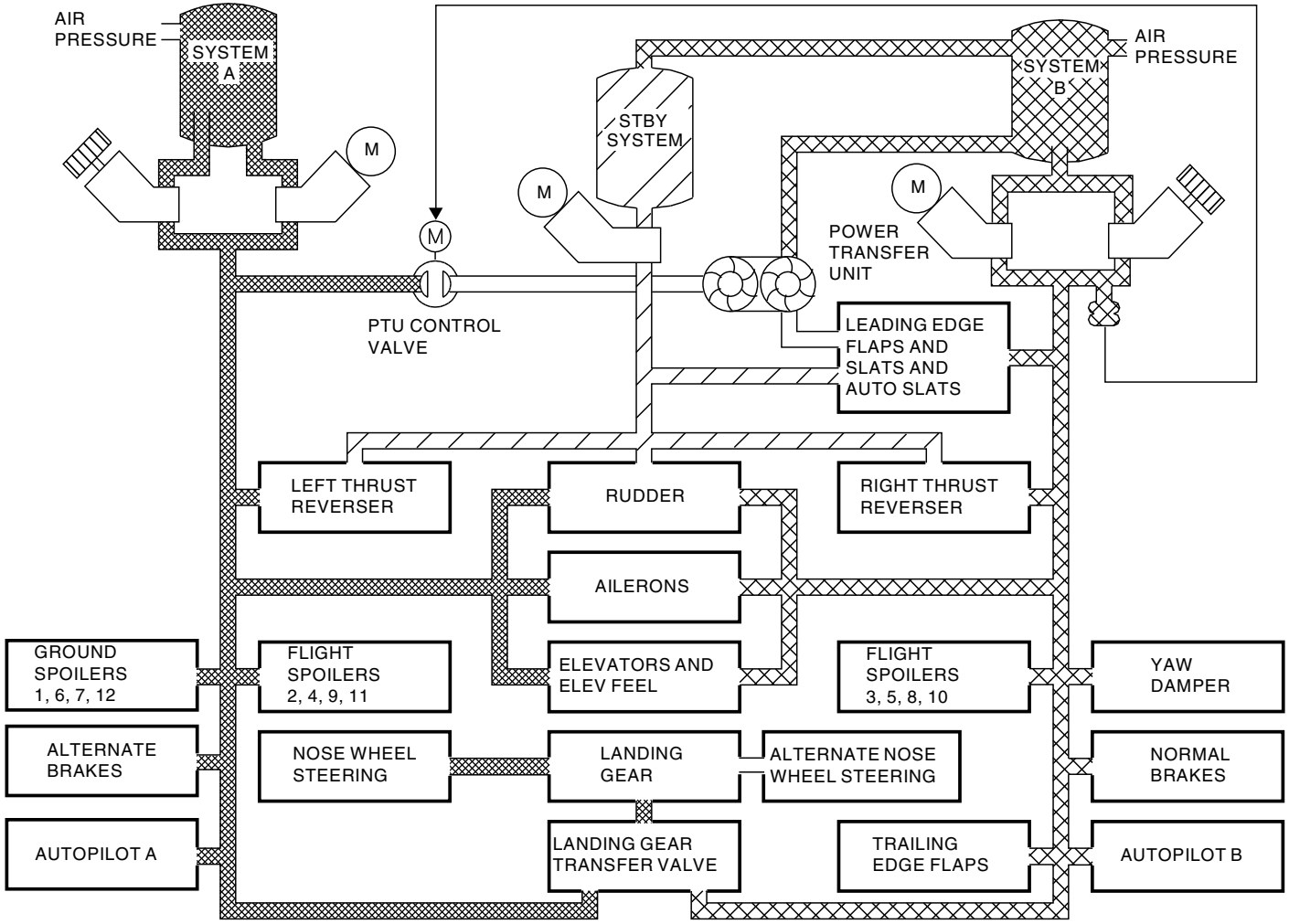
- Both thrust reversers
- Standby rudder
- Leading edge flaps and slats.

### Hydraulic Power Transfer Unit (PTU) System

The PTU system is a hydraulic motor-pump assembly that supplies alternative pressure to leading edge flaps and slats and autoslat system if system B is de-pressurized. The PTU is controlled by the PTU control valve.

System A pressurizes the motor when the PTU control valve is open. System B supplies the fluid to the pump.

## HYDRAULIC POWER - GENERAL DESCRIPTION

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HYDRAULIC POWER - GENERAL DESCRIPTION

## HYDRAULIC POWER - CONTROL AND INDICATIONS

### General

These are the hydraulic indications in the flight deck for hydraulic systems A and B:

- Quantity
- System pressure
- Pump low pressure
- Overheat (EMDPs only)
- Master Caution.

These are the indications for the standby hydraulic system:

- Low quantity
- Low pressure
- Stby Rud On.

### Hydraulic Pressure Indication

Hydraulic pressure shows on the lower center display unit systems display for systems A and B.

### Hydraulic Fluid Quantity Indication

Hydraulic fluid quantity shows in percent of full, on the lower center display unit systems display for systems A and B reservoirs.

The LOW QUANTITY amber light to the right of the FLT CONTROL switches on the flight control panel comes on when the hydraulic fluid quantity decreases to less than normal in the standby hydraulic system reservoir.

### Hydraulic Pump Low Pressure Warning Indication

The amber LOW PRESSURE lights come on for each pump when the output pressure is less than normal.

The hydraulic systems A and B LOW PRESSURE lights are above the HYD PUMP control switches on the hydraulic panel.

The standby system LOW PRESSURE light is to the right of the FLT CONTROL switches on the flight control panel.

### Hydraulic Fluid Overheat Warning Indication

The amber OVERHEAT lights for the hydraulic system A and B EMDPs come on when the pump case drain hydraulic fluid temperature is more than normal. These lights are above each HYD PUMP control switch on the hydraulic panel.

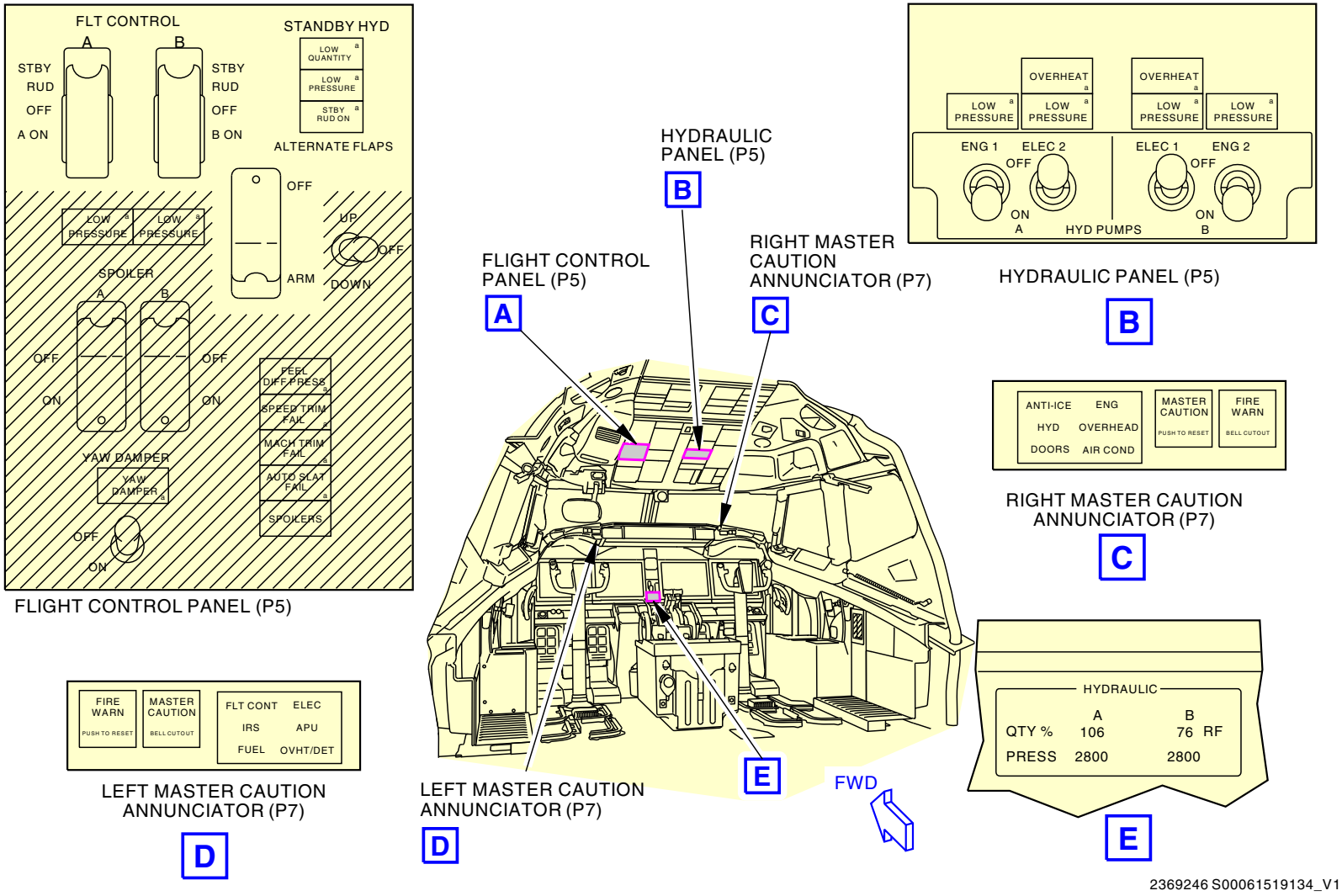
The standby hydraulic system does not have an overheat indicator.

### Master Caution Indication

When any of the amber lights on the hydraulic control panel come on, the MASTER CAUTION light and the HYD light on the system annunciator panel (P7) also come on.

When any of the amber lights on the flight control panel come on, the MASTER CAUTION light and FLT CONT light on the system annunciator panel (P7) also come on.

# HYDRAULIC POWER - CONTROL AND INDICATIONS

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## HYDRAULIC POWER - CONTROL AND INDICATIONS

# HYDRAULIC POWER - COMPONENT LOCATIONS

## General

The components for the main, auxiliary, and ground servicing hydraulic systems are in these locations:

- Engine accessory gearbox
- Main landing gear wheel well
- Main fuel tanks
- Aft wing-to-body fairing.

## Main Hydraulic Systems

Hydraulic system A, and system B components are almost the same. System A components are on the left side of the airplane. System B components are on the right side of the airplane.

These are the components on the engines:

- The system A engine-driven pump (EDP) and case drain filter module are on the left engine
- The system B engine-driven pump (EDP) and case drain filter are on the right engine.

These are the components in the main landing gear wheel well:

- Reservoir (2)
- Engine driven-pump (EDP) supply shutoff valve (2)
- Electric motor-driven pump (EMDP) (2)
- Pressure module (2)
- EMDP Case drain filter module (2)
- Return filter module (2).

These are the components in the main fuel tanks:

- System A heat exchanger in main fuel tank 1
- System B heat exchanger in main fuel tank 2.

These are the components in the ram air bays:

- System A ground service disconnect module in the left ram air bay
- System B ground service disconnect module in the right ram air bay.

## Standby Hydraulic System

These are the components in the main landing gear wheel well:

- Reservoir
- Standby hydraulic system module
- Case drain filter module.

The standby system electric motor-driven pump (EMDP) is in the aft wing-to-body fairing.

## Hydraulic Power Transfer Unit (PTU) System

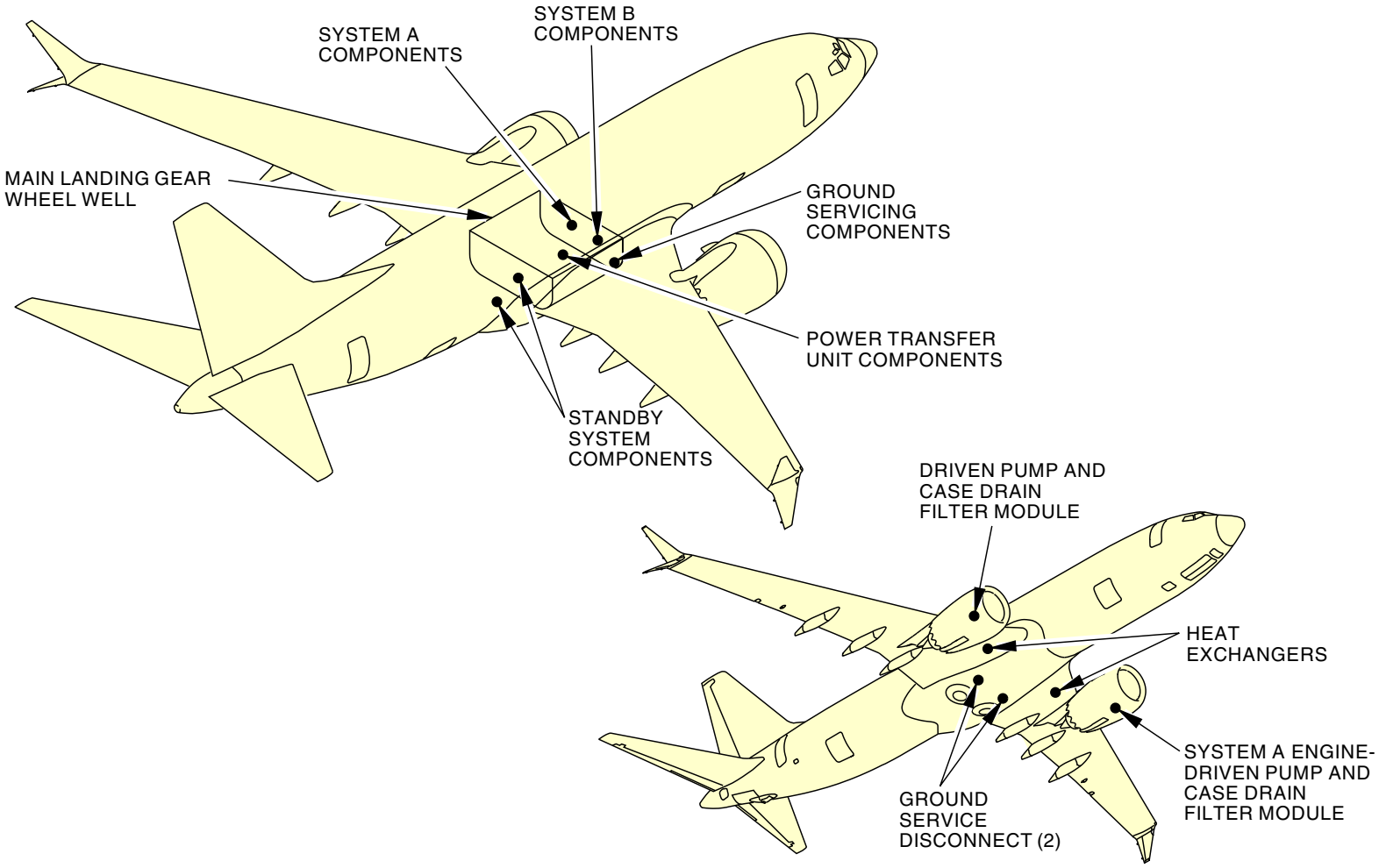
These are the components in the main landing gear wheel well:

- Power transfer unit
- PTU pressure filter module
- PTU flow limiter
- PTU control valve
- EDP pressure switch autoslat system.

## Ground Servicing System

The ground servicing system components are in the right forward corner of the main wheel well.

## HYDRAULIC POWER - COMPONENT LOCATIONS

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HYDRAULIC POWER - COMPONENT LOCATIONS

# HYDRAULIC POWER - OPERATION

## General

You pressurize the hydraulic systems with the hydraulic pumps or a ground service cart.

## Hydraulic Pump Pressurization

You use the hydraulic panel on the P5 forward overhead panel to monitor and turn on system A and B hydraulic pumps.

You use the flight control panel on the P5 forward overhead panel to monitor and turn on the standby pump.

You can pressurize system A and system B with either an engine-driven pump (EDP) or an electric motor-driven pump (EMDP). The ELEC 1 and ELEC 2 switches on the hydraulic panel let you control the EMDPs. The hydraulic LOW PRESSURE light is off when the hydraulic pressure is normal.

Usually, the ENG 1 and ENG 2 switches are in the ON position. When the engines are on, the EDPs come on to also pressurize systems A and B. If you move the ENG switches to the OFF position, this will stop pump output pressure.

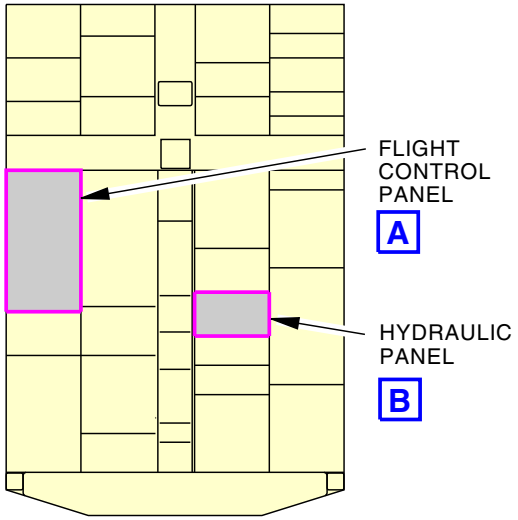
An OVERHEAT light monitors system A and system B only. The standby hydraulic system does not have an overheat light.

## Ground Service Cart Pressurization

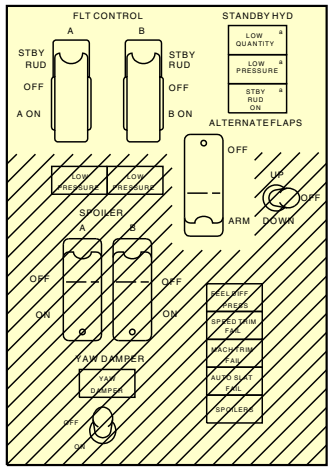
To pressurize hydraulic system A, connect a ground service cart to the left ground service disconnect. To pressurize hydraulic system B, connect a ground service cart to the right ground service disconnect.

You do not pressurize the standby system from a ground service cart.

## HYDRAULIC POWER - OPERATION

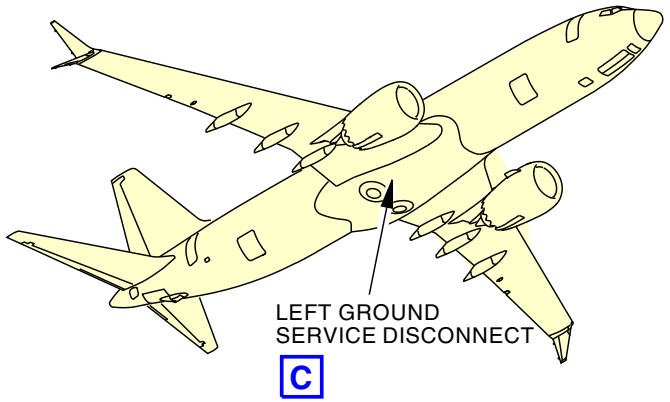


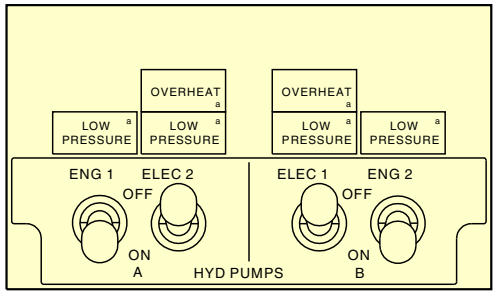

FORWARD OVERHEAD PANEL, P5




FLIGHT CONTROL PANEL

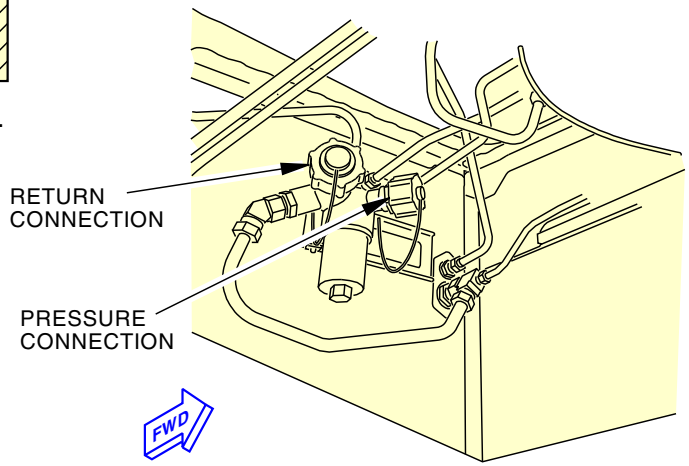
A




HYDRAULIC PANEL

B




LEFT GROUND SERVICE DISCONNECT
(RIGHT GROUND SERVICE DISCONNECT IS EQUIVALENT)

C

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## HYDRAULIC POWER - OPERATION

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## HYDRAULIC POWER - FUNCTIONAL DESCRIPTION

### General

Two independent hydraulic systems supply power to airplane systems. The standby hydraulic system supplies an alternative source of power.

### Hydraulic Reservoir Pressurization System

The hydraulic reservoir pressurization system supplies air from the pneumatic system to the reservoir. This pressurizes the supply hydraulic fluid for the pumps.

### Hydraulic System A

The pressure sources for hydraulic system A are an engine-driven pump (EDP) on engine 1 and an electric motor-driven pump (EMDP) in the main wheel well. Both pumps supply pressure to these airplane systems:

- Left thrust reverser
- Landing gear extension and retraction
- Nose wheel steering
- Alternate brakes
- Primary flight controls
- Flight spoilers (4)
- Ground spoilers (4).

### Hydraulic System B

The pressure sources for hydraulic system B are an engine-driven pump (EDP) on engine 2 and an electric motor-driven pump (EMDP) in the main wheel well. Both pumps supply pressure to these airplane systems:

- Right thrust reverser
- Normal brakes
- Primary flight controls
- Flight spoilers (4)
- Trailing edge flaps
- Leading edge flaps and slats.

System B supplies an alternative hydraulic power source for landing gear retraction and nose wheel steering.

### Ground Servicing System

The ground servicing system fills all hydraulic reservoirs from one central location.

### Standby Hydraulic System

The pressure source for the standby hydraulic system is an electrical motor-driven pump (EMDP). The standby hydraulic system operates as an alternate system to supply hydraulic power for these systems:

- Thrust reversers
- Rudder
- Leading edge flaps and slats.

You operate the standby system manually with the FLT CONTROL switches or the ALTERNATE FLAPS arm switch.

The standby system operates automatically if all of these conditions are true:

- One FLT CONTROL switch to ON
- Trailing edge flaps not up
- Airplane in the air or wheel speed more than 60 knots
- Low flight control pressure.

### Hydraulic Power Transfer Unit (PTU) System

The hydraulic power transfer unit (PTU) system is a hydraulic motor pump assembly that supplies an alternative source of power for the leading edge flaps and slats. The PTU system operates automatically when these conditions occur:

- Airplane in the air
- Trailing edge flaps not up
- System B EDP low pressure.

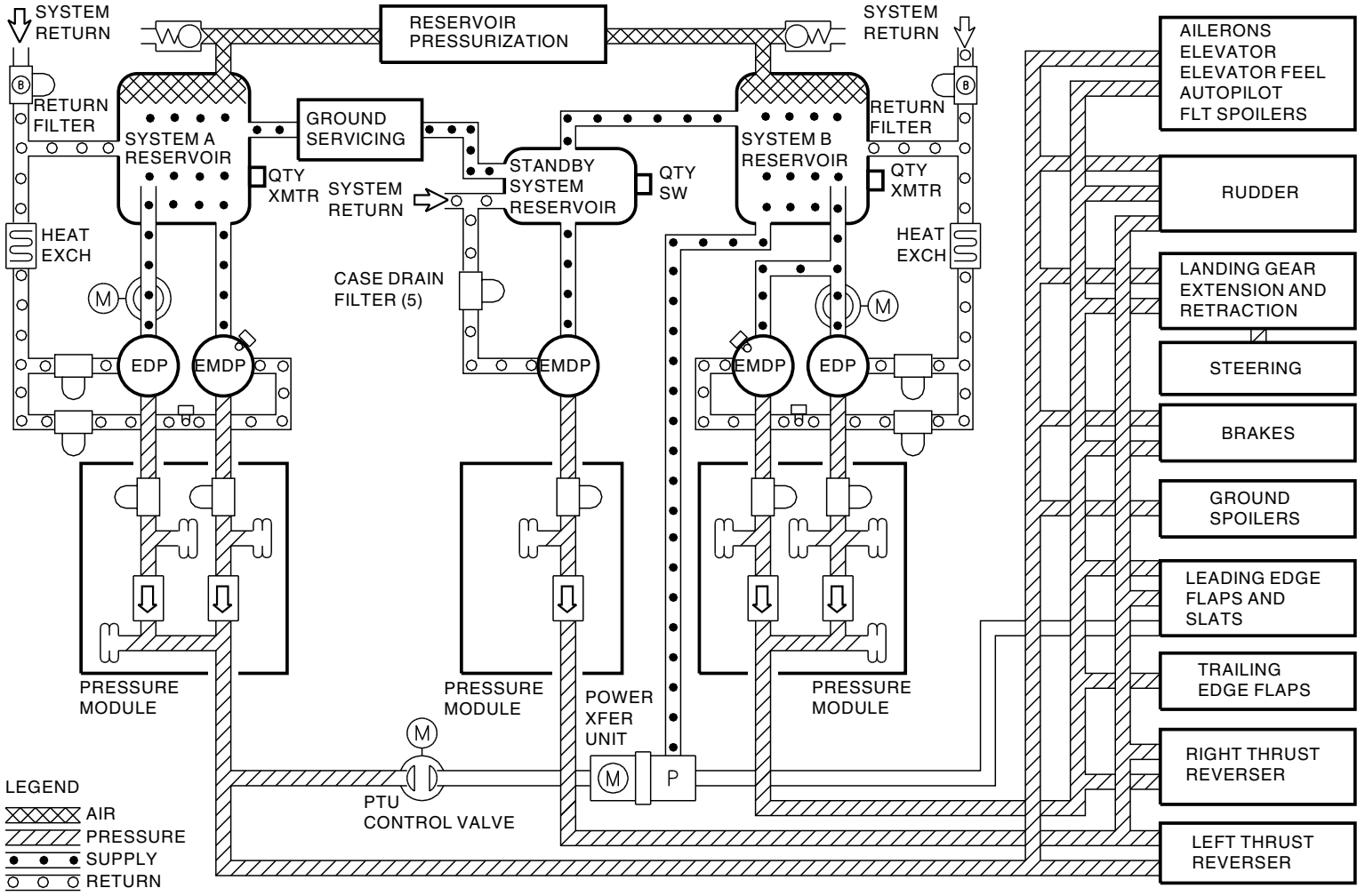
## HYDRAULIC POWER - FUNCTIONAL DESCRIPTION

### Hydraulic Indicating System

The hydraulic indicating system shows these indications in the flight compartment:

- System A and B reservoir quantity
- Standby reservoir low quantity
- System A and B pressure
- System A and B engine-driven pump (EDP) low pressure
- System A and B electric motor-driven pump (EMDP) low pressure
- Standby electric motor-driven pump low pressure
- System A and B electric motor-driven pump (EMDP) overheat.

## HYDRAULIC POWER - FUNCTIONAL DESCRIPTION

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HYDRAULIC POWER - FUNCTIONAL DESCRIPTION

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# HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM - GENERAL DESCRIPTION

## General

The hydraulic reservoir pressurization system supplies pressurized filtered bleed air from the airplane's pneumatic system (left/right engine bleed air, APU bleed air, or external ground air) to the main hydraulic systems A and B reservoirs.

The reservoirs can also be manually pressurized using an external ground air source (via connection to air charging valve) without the need of pressurizing the pneumatic system crossover manifold.

The system provides a positive supply of hydraulic fluid to the pumps, maintains normal return pressure in the hydraulic system, and also helps to prevent foaming in the reservoirs. A constant pressure of approximately 45-50 psi is normally supplied to the reservoirs by the pneumatic system. Overpressurization protection for the reservoirs is provided by pressure relief valves which are set to relieve between 60-65 psi.

## Components

These are the components of the hydraulic reservoir pressurization system:

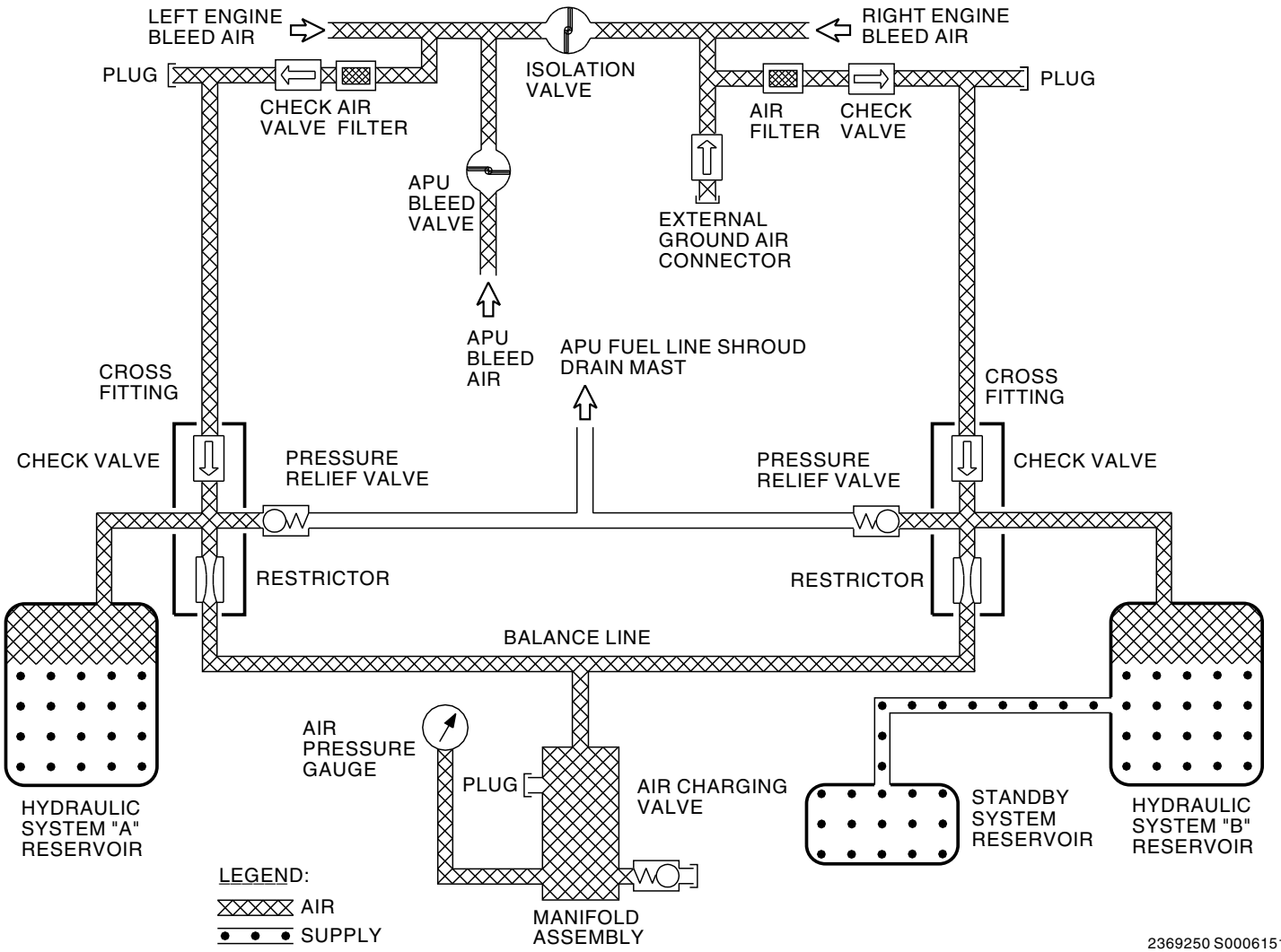
- Air filter assembly (2)
- Secondary check valve (2)
- Cross fitting assembly (2)
- Check valve (2)
- Restrictor/orifice (2)
- Pressure relief valve (2)
- Air charging valve (1)
- Manifold assembly (1)
- Air pressure gauge (1)
- Plug (3)
- Air supply line (2)
- Reservoir balance line (1)
- Reservoir overpressurization vent line (1)

## Component Locations

The air filter assemblies of the reservoir pressurization system are in the left and right environmental control system (ECS) pack bays adjacent to the pneumatic system crossover manifold duct.

The other components of the reservoir pressurization system are in the right main landing gear wheel well between the main hydraulic systems A and B reservoirs adjacent to the forward bulkhead (rear spar).

## HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM - GENERAL DESCRIPTION

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HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM - GENERAL DESCRIPTION

## HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM - COMPONENT LOCATION - ECS PACK BAYS

### General

An inline air filter assembly is installed in the left and right Environmental Control System (ECS) pack bays adjacent to the pneumatic system's crossover manifold duct.

The air filter assembly removes foreign material from the bleed air to prevent blockage and downstream contamination of the reservoir pressurization system components and hydraulic systems A and B reservoirs.

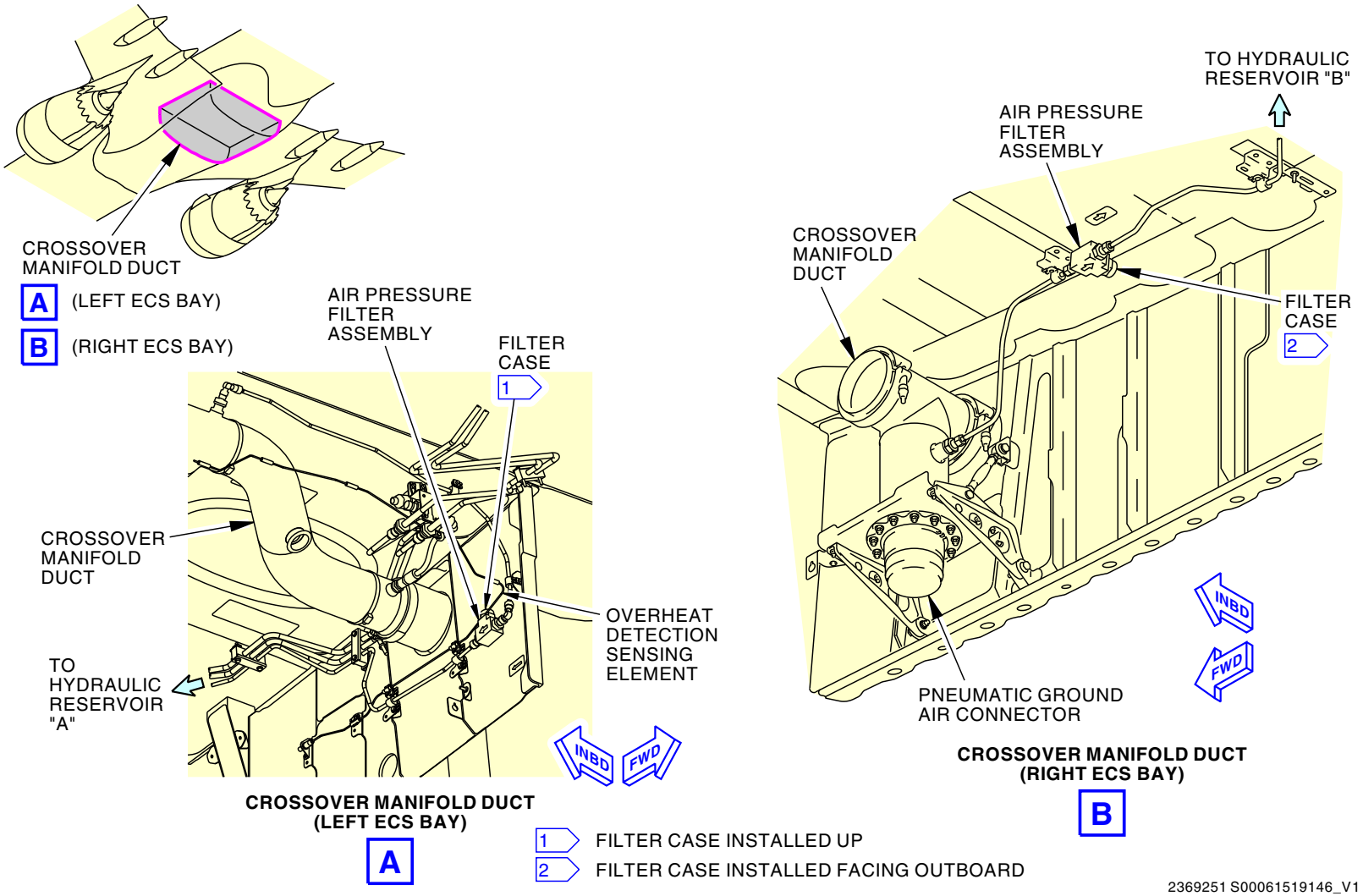
### Air Filter Assembly

The air filter assembly consists of a wire-wound metal filter element, a filter case, a filter head (housing), packings (O-rings), a reducer in the inlet port, and a check valve in the outlet port.

The check valve is supplied as a part of the filter assembly, but it can be removed and replaced as a separate unit.

The metal filter element is cleanable via ultrasonic methods.

## HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM - COMPONENT LOCATION - ECS PACK BAYS

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## HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM - COMPONENT LOCATION - ECS PACK BAYS

# HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM - COMPONENT LOCATION - MLG WHEEL WELL

## General

These components of the reservoir pressurization system are located in the main landing gear wheel well (right side) at the forward bulkhead between the main hydraulic systems A and B reservoirs:

- Cross fitting, check valve, and restrictor (orifice)
- Pressure relief valve
- Balance line
- Air charging valve and manifold assembly
- Air pressure gauge

## Cross Fitting, Check Valve, and Restrictor (Orifice)

A cross fitting is installed between each hydraulic systems A and B reservoirs and the pressure relief valves. A check valve and a restrictor (orifice) are attached to each cross fitting to isolate the left and right engine bleed systems and to prevent loss of pneumatic pressure if either engine bleed fails. The check valve is connected to the bleed air supply line. The restrictor (orifice) is connected to the balance line between each cross fitting.

## Pressure Relief Valve

A pressure relief valve is installed between the hydraulic systems A and B reservoirs and connect to each cross fitting. The pressure relief valve opens when the air pressure in the reservoir increases to 60-65 psi to protect the reservoir from overpressurization. Maximum flow thru the relief valve is approximately 20 gpm.

The excess air pressure from the reservoirs is vented thru the pressure relief valve and out through the APU fuel line shroud drain mast.

The pressure relief valve closes (reseats) when the reservoir overpressurization condition has been relieved which is approximately 90% of the relieving pressure (minimum 55 psi reseat pressure).

## Air Charging Valve and Manifold Assembly

The air charging valve and manifold assembly are installed below the cross fittings and the balance line. The air charging valve permits manual depressurization of the hydraulic systems A and B reservoirs for ground maintenance. The air pressure in both hydraulic system A and B reservoirs is released (depressurized) when the air charging valve is opened.

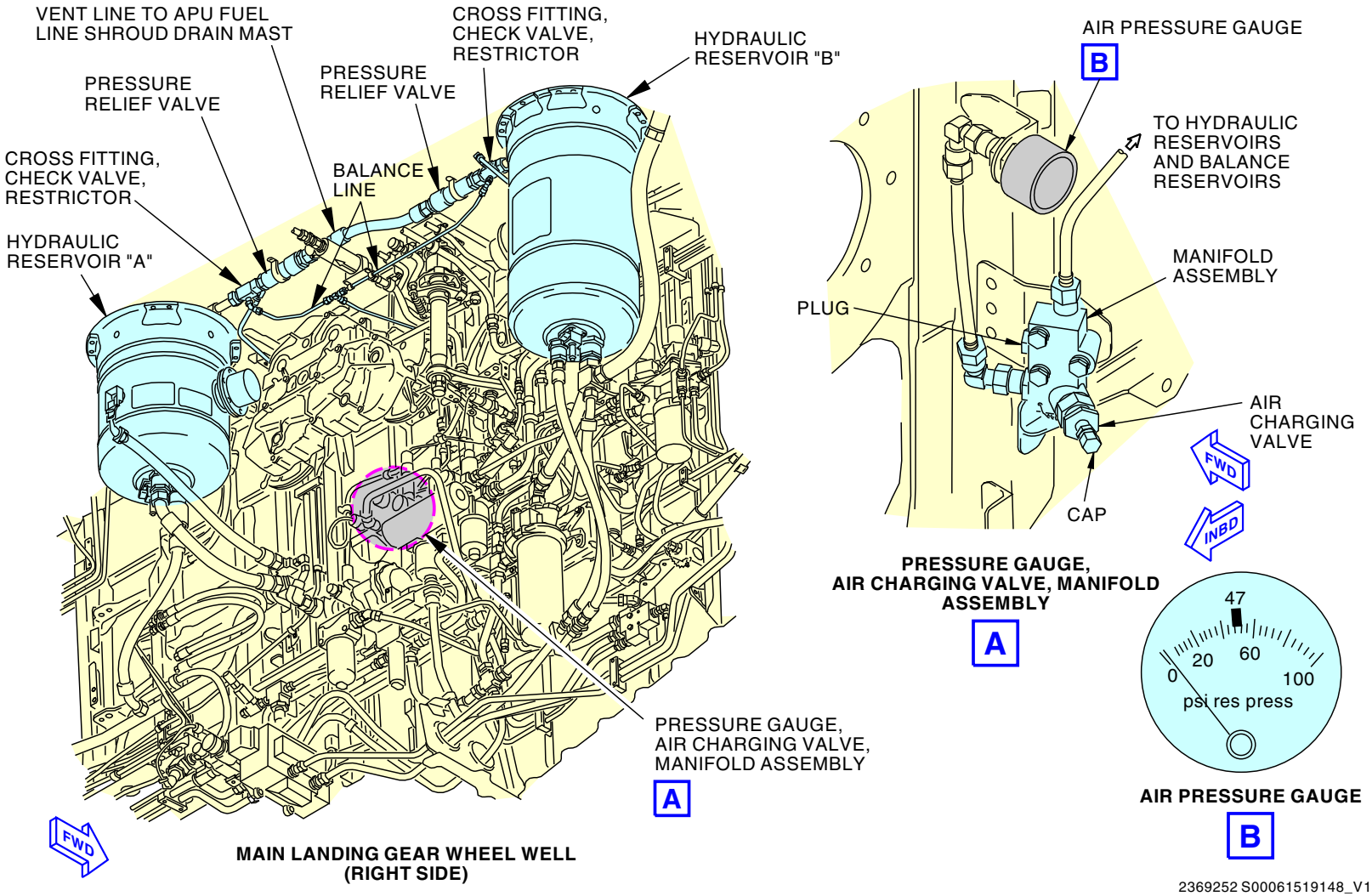
The air charging valve can also be connected to an external air source to permit manual pressurization of both hydraulic systems A and B reservoirs for ground maintenance without need of pressurizing the pneumatic system crossover manifold.

The air charging valve is opened/closed by turning the swivel nut clockwise/counterclockwise. A dust cap is installed on the valve stem of the air charging valve.

## Air Pressure Gauge

An air pressure gauge is connected to the air charging valve and manifold assembly to show the air pressure in the hydraulic systems A and B reservoirs. The pressure gauge is calibrated in pounds per square inch (psi).

## HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM - COMPONENT LOCATION - MLG WHEEL WELL




HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM - COMPONENT LOCATION - MLG WHEEL WELL

## HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM - FUNCTIONAL DESCRIPTION

### General

Under normal operations the pneumatic system pressurizes the hydraulic systems A and B reservoirs to 45-50 psi. This pressurizes the supply fluid flow from the reservoirs to the pumps and pressurizes the return fluid in the hydraulic system.

The reservoirs can also be pressurized by connection of an external air source to the air charging valve without the need of pressurizing the pneumatic system crossover manifold.

### Pressurization (crossover manifold)

The bleed air from the pneumatic system crossover manifold duct is first routed through an air filter assembly that consists of a filter element and a check valve, and then through a check valve in the cross fitting assembly.

The majority of the bleed air is then routed to the system reservoir to pressurize the supply fluid in the reservoir for distribution to the pumps. Some of the bleed air is routed through the restrictor (orifice) in the cross fitting, through a balance line to the other restrictor (orifice) and cross fitting, and then to the other reservoir until the air pressure in both reservoirs is equalized. The bleed air in the balance line is also routed to the air charging manifold assembly and air pressure gauge.

In the event the reservoir pressure increase to 60-65 psi, the pressure relief valve will open to vent the excess air pressure out through APU fuel line shroud drain mast.

The reservoirs will remain pressurized after the pneumatic system has been depressurized.

### Pressurization (air charging valve)

The air charging valve can be used to connect an external air source for pressurizing the hydraulic systems A and B reservoirs when the pneumatic system crossover manifold is not pressurized.

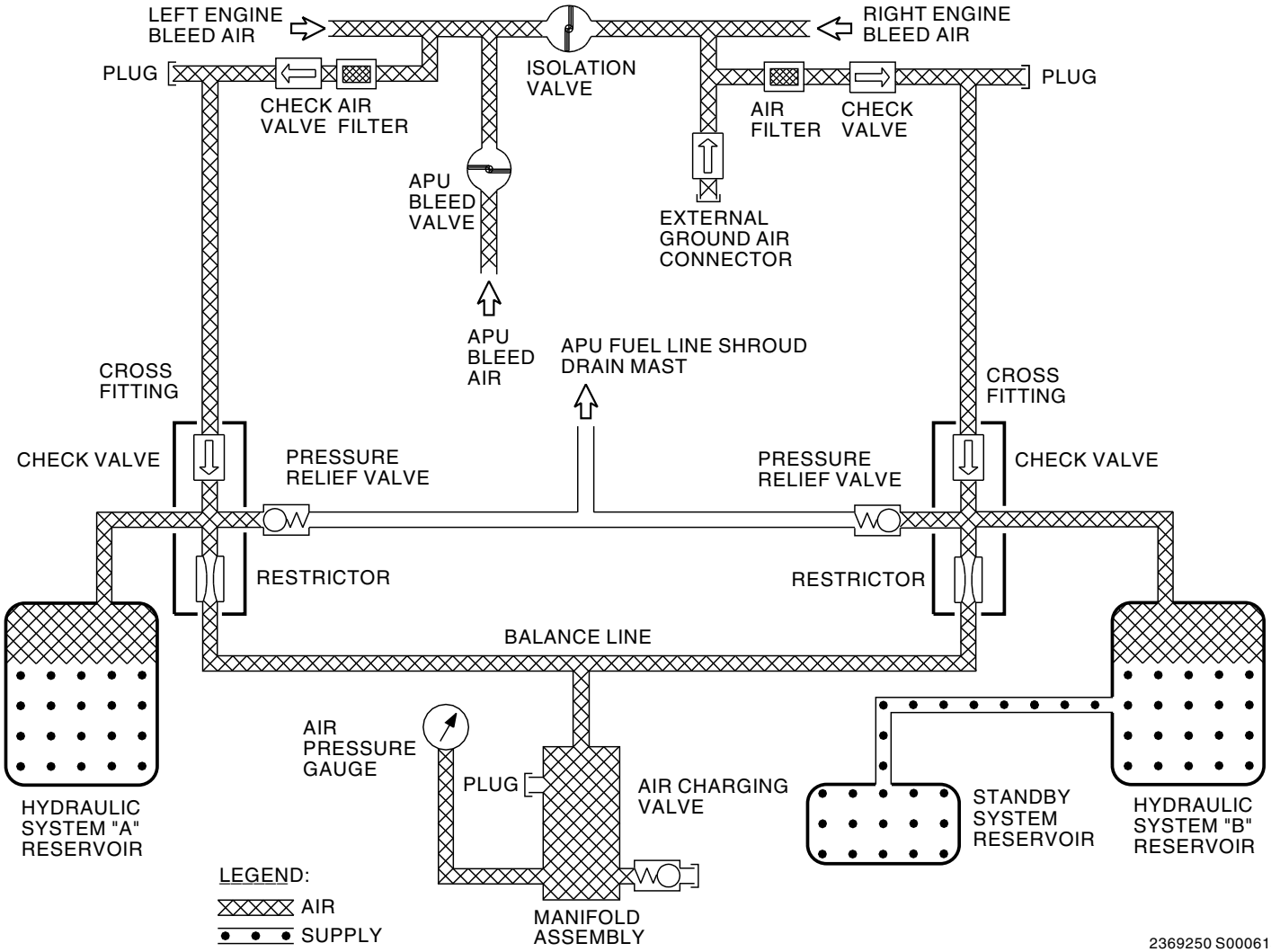
The dust cap on the air charging valve is removed, the external air source is connected to the valve stem and the swivel nut turned (2-1/4 turns) to open the air charging valve. External air is then supplied to pressurize the reservoirs to 45-50 psi. The swivel nut is then turned in the opposite direction (2-1/4 turns) to close the air charging valve. The reservoirs will remain pressurized until the air charging valve is opened.

### Depressurization

The reservoirs are depressurized by opening the air charging valve on the manifold assembly.

To depressurize the hydraulic systems A and B reservoirs, you must first shutdown all pneumatic sources (engines, APU, or external air) before opening the air charging valve.

## HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM - FUNCTIONAL DESCRIPTION

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## HYDRAULIC RESERVOIR PRESSURIZATION SYSTEM - GENERAL DESCRIPTION

# MAIN HYDRAULIC SYSTEMS - GENERAL DESCRIPTION

## General

Hydraulic systems A and B operate independently to supply hydraulic power to the airplane systems. Both systems operate at 3000 psi normal pressure and are almost the same.

A hydraulic reservoir pressurization system supplies pressurized filtered air from the pneumatic system crossover manifold to the main hydraulic system reservoirs in order to supply hydraulic fluid under pressure to the hydraulic pumps.

## Components

The main hydraulic systems have these components:

- Reservoir (2)
- Overheat/fire protection panel
- Engine-driven pump (EDP) shutoff valve (2)
- Hydraulic panel
- EDP (2)
- Electric motor-driven pump (EMDP) (2)
- Pressure module (2)
- Case drain filter module (2)
- Heat exchanger (2)
- Return filter module (2).

## Reservoir

The pneumatic system supplies air to the hydraulic reservoir pressurization system which pressurizes the reservoirs to supply hydraulic fluid to the system A and System B electric motor-driven pumps (EMDP) and engine-driven pumps (EDP).

## Overheat/Fire Protection Panel

The overheat/fire protection panel controls the EDP supply shutoff valves.

## EDP Supply Shutoff Valve

EDP supply shutoff valves for each system control hydraulic fluid to the engine-driven pump (EDP).

## Hydraulic Panel

The hydraulic panel controls the engine-driven pump (EDP) and the electric motor-driven pump (EMDP). The hydraulic panel also controls the LOW PRESSURE lights for each pump and the EMDP OVERHEAT lights.

## Pumps

The EDP and EMDP pumps in each system supply pressure continuously to a pressure module. Case drain fluid is used to cool internal components of the pump and goes to a case drain filter from each pump.

## Pressure Module

The pressure module cleans, monitors, and distributes the fluid pressure from each pump. The pressure module also protects the system from over pressure.

## Case Drain Filter Module

A case drain filter module cleans the case drain fluid from each pump before it goes to the heat exchanger.

## Heat Exchanger

The heat exchanger cools the case drain fluid before it goes through the top of the return filter module.

## Return Filter Module

Each return filter module cleans return fluid before it goes back to the reservoir.

## MAIN HYDRAULIC SYSTEMS - GENERAL DESCRIPTION

### Main Hydraulic System A

Hydraulic system A supplies pressure for these airplane systems:

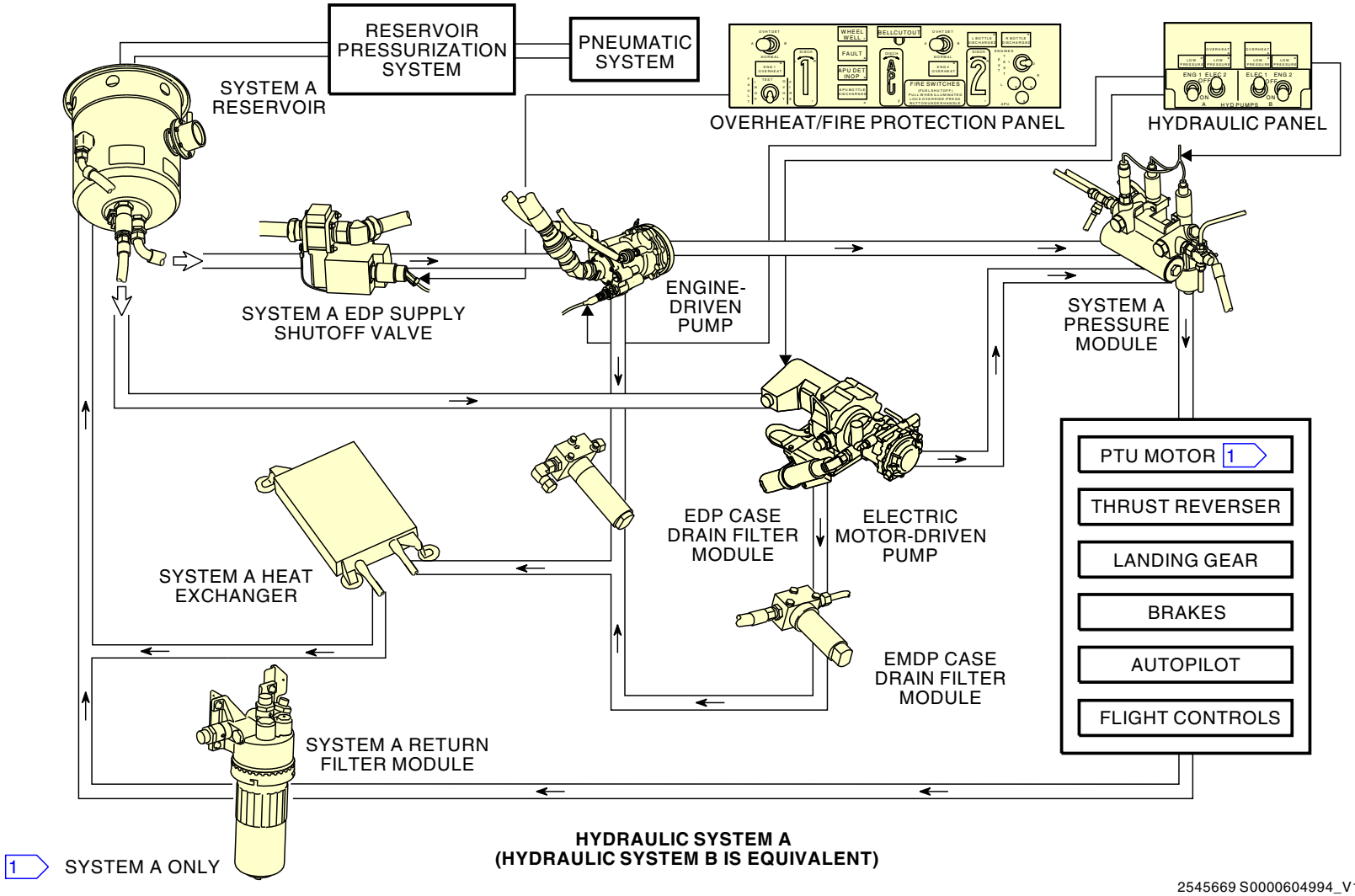
- Left thrust reverser
- Power transfer unit (PTU) motor
- Landing gear extension and retraction
- Nose wheel steering
- Alternate brakes
- Ailerons
- Autopilot A
- Elevators
- Elevator feel
- Flight spoilers 2, 4, 9, and 11
- Ground spoilers 1, 6, 7, and 12
- Rudder.

### Main Hydraulic System B

Hydraulic system B supplies pressure for these airplane systems:

- Right thrust reverser
- Alternate landing gear retraction
- Alternate nose wheel steering
- Normal brakes
- Ailerons
- Autopilot B
- Elevators
- Elevator feel
- Flight spoilers 3, 5, 8, and 10
- Rudder
- Trailing edge flaps
- Leading edge flaps and slats.

## MAIN HYDRAULIC SYSTEMS - GENERAL DESCRIPTION

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MAIN HYDRAULIC SYSTEMS - GENERAL DESCRIPTION

# MAIN HYDRAULIC SYSTEMS - CONTROLS AND INDICATIONS

## General

The controls for the main hydraulic system pumps are on the hydraulic panel. This panel is on the P5 forward overhead panel.

The engine fire switches on the P8 aft electronics panel control the fluid supply to the engine-driven pump (EDPs).

## Hydraulic Pump Controls

The EDP and the electric motor-driven pump (EMDP) each have a switch on the hydraulic panel. The switches have two positions, ON and OFF.

The ENG 1 HYD PUMP switch controls the EDP for system A. The ENG 2 HYD PUMP switch controls the EDP for system B. Each pump has a depressurization solenoid valve. The valve blocks pump output pressure to the main hydraulic power system when the ENG 1 or ENG 2 HYD PUMP switch is in the OFF position.

The ELEC 2 HYD PUMP switch controls the EMDP for system A. The ELEC 1 HYD PUMP switch controls the EMDP for system B.

## Engine Fire Switches

The engine fire switches isolate the engine if there is an engine fire. Each engine fire switch controls the supply shutoff valve for its related EDP.

When you operate one of the engine fire switches, the pump LOW PRESSURE amber light is disarmed and the hydraulic fluid supply to the related EDP stops.

## Hydraulic Pump Low Pressure Warning Indications

Pressure switches on the pressure module monitor the EDP and the EMDP for low pressure. LOW PRESSURE amber lights for each EDP and EMDP come on when the pump output pressure is less than normal. The LOW PRESSURE amber lights are above each HYD PUMP switch.

See the hydraulic indicating system section for more information about the hydraulic pump low pressure indication. (SECTION 29-30)

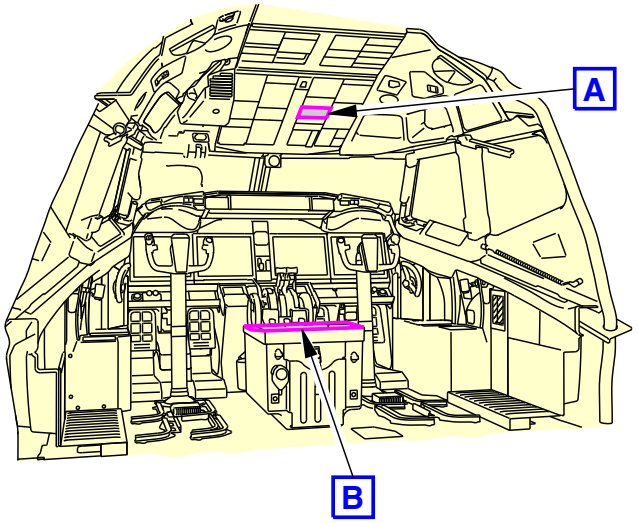
## Hydraulic Pump Overheat Warning Indications

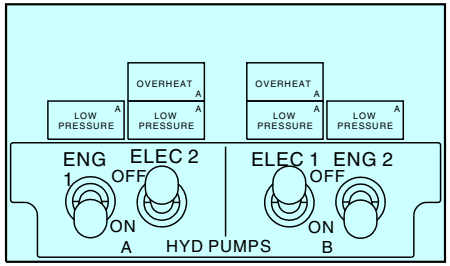
A temperature switch in each case drain line downstream of the pump monitors the EMDP case drain fluid for overheat. An amber OVERHEAT light for each EMDP comes on when the case drain fluid temperature increases to more than normal. The OVERHEAT lights are above the EMDP LOW PRESSURE lights.

A temperature switch in each EMDP monitors the temperature of the EMDP electric motor. This switch stops the pump when the temperature of the EMDP increases to more than normal, but it is not used for overheat indication.

See the hydraulic indicating system section for more information about the hydraulic overheat warning indication. (SECTION 29-30)

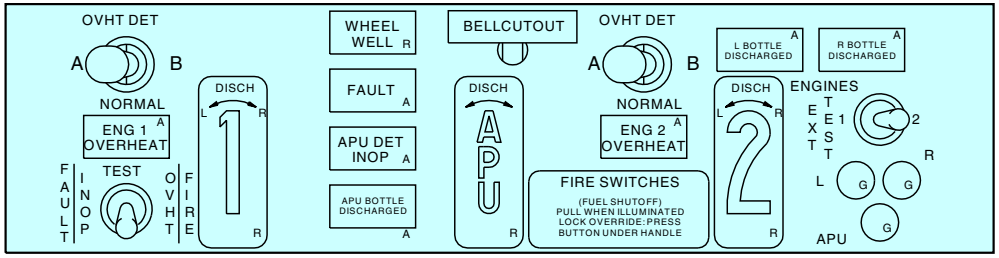
## MAIN HYDRAULIC SYSTEMS - CONTROLS AND INDICATIONS




**HYDRAULIC PANEL (P5)**

**A**




**OVERHEAT/FIRE PROTECTION PANEL (P8)**

**B**

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MAIN HYDRAULIC SYSTEMS - CONTROLS AND INDICATIONS

## MAIN HYDRAULIC SYSTEMS - RESERVOIR

### Purpose

The hydraulic reservoirs supply hydraulic fluid under pressure to the hydraulic pumps. The reservoirs also get return fluid from the airplane systems that use hydraulic power.

### Location

The hydraulic system A reservoir is in the center of the main wheel well on the forward bulkhead.

The hydraulic system B reservoir is on the right forward bulkhead of the main wheel well.

### Physical Description

The hydraulic system A reservoir has a total volume capacity of 6.8 gallons (25.8 liters).

The hydraulic system B reservoir has a total volume capacity of 10.7 gallons (40.6 liters).

Each reservoir is an airtight metal shell that contains these components:

- Air pressure port
- EDP and EMDP supply line port
- Return line port
- Drain valve
- Hydraulic fluid quantity transmitter/indicator.

### Functional Description

The reservoirs are pressurized by the reservoir pressurization system.

The hydraulic system A reservoir has a standpipe for the engine-driven pump (EDP). A port at the bottom of the reservoir supplies fluid to the electric motor-driven pump (EMDP). The reservoir drain valve at the bottom is manually operated.

The hydraulic system B reservoir has a standpipe for the EDP and EMDP. A port at the bottom of reservoir supplies fluid to the power transfer unit (PTU) pump. The reservoir drain valve at the bottom is a manually operated valve.

The fill and balance line connects the system B reservoir to the standby reservoir. System B reservoir pressure also pressurizes the standby hydraulic system reservoir.

See the standby hydraulic system section for more information for the standby hydraulic system reservoir. (SECTION 29-22)

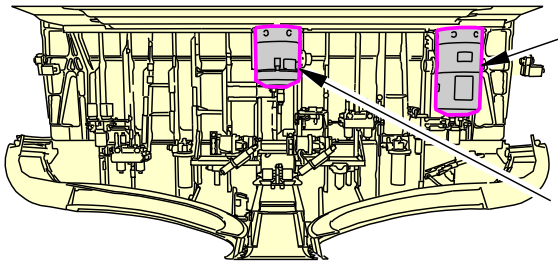
The quantity indicator shows O for empty, RFL for refill, and F for full.

See the hydraulic indicating system section for more information for the hydraulic fluid quantity transmitter/indicator. (SECTION 29-30)

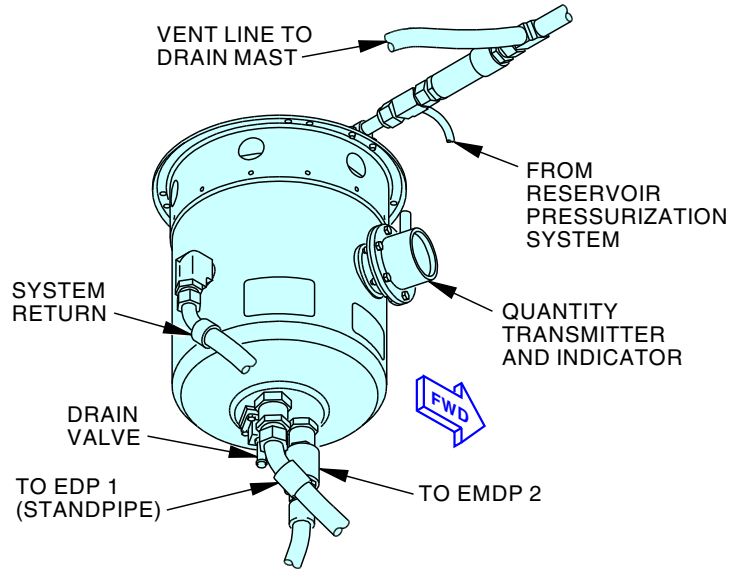
This table shows nominal quantities at different levels in the reservoirs.

| RESERVOIRS | | QUANTITY (GAL/L) | QUANTITY SHOWN ON UPPER CENTER DISPLAY UNIT |
|---|---|---|---|
| A | FULL LEVEL | 5.7 / 21.6 | 100% |
| | REFILL | 4.7 / 17.7 | 76% |
| | EDP STANDPIPE | 2.3 / 8.5 | 20% |
| | OVERFILL | MORE THAN 5.7 / 21.6 | 101-106% |
| B | FULL LEVEL | 8.2 / 31.1 | 100% |
| | REFILL | 6.9 / 26.0 | 76% |
| | FILL & BALANCE | 6.6 / 25.1 | 72% |
| | EDP/EMDP STANDPIPE | 1.3 / 4.9 | 0% |
| | OVERFILL | MORE THAN 8.2 / 31.1 | 101-106% |

## MAIN HYDRAULIC SYSTEMS - RESERVOIR

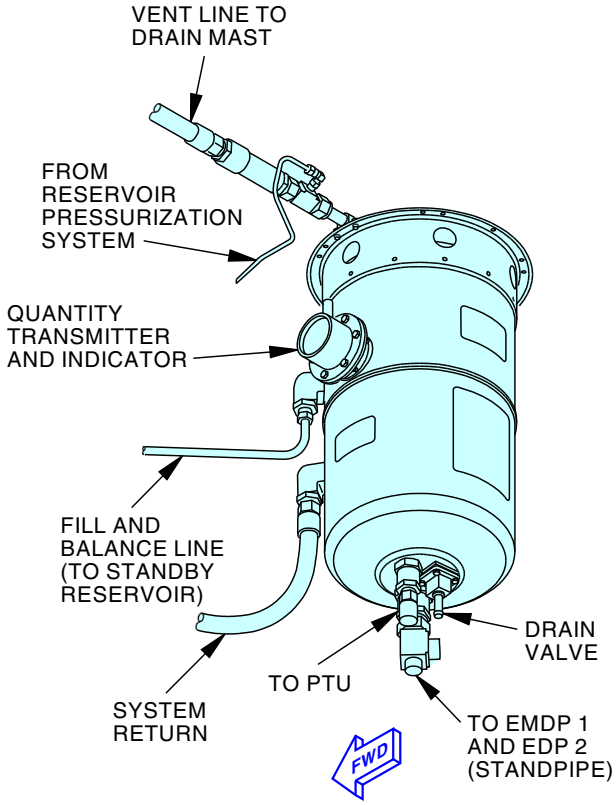



**MAIN GEAR WHEEL WELL (VIEW IN THE FORWARD DIRECTION)**




**HYDRAULIC SYSTEM A RESERVOIR**

**A**




**HYDRAULIC SYSTEM B RESERVOIR**

**B**

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## MAIN HYDRAULIC SYSTEMS - RESERVOIR

## MAIN HYDRAULIC SYSTEMS - EDP SUPPLY SHUTOFF VALVE

### Purpose

The EDP supply shutoff valve for hydraulic system A stops hydraulic fluid flow from the reservoir to the hydraulic system A EDP when you move the No. 1 engine fire switch to the up position.

The EDP supply shutoff valve for hydraulic system B stops hydraulic fluid flow from the reservoir to the hydraulic system B EDP when you move the No. 2 engine fire switch to the up position.

### Location

The EDP supply shutoff valve for hydraulic system A is in the supply line between the reservoir and the No. 1 engine EDP, on the left side of the upper bulkhead of the main landing gear wheel well.

The EDP supply shutoff valve for hydraulic system B is in the supply line between the reservoir and the No. 2 engine EDP, on the right side of the upper bulkhead of the main landing wheel well.

### Physical Description

The EDP supply shutoff valve is a two-position, 28v dc motor-operated, normally open valve.

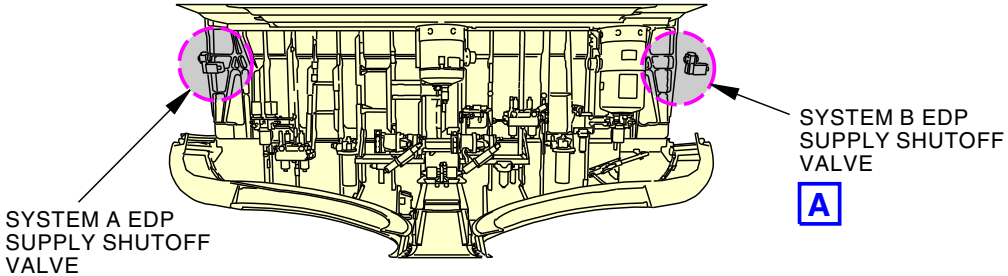
A position indicator on the valve shows valve position, OPEN or CLSD. You can not use the position indicator to open or close the EDP supply shutoff valve manually.

### Functional Description

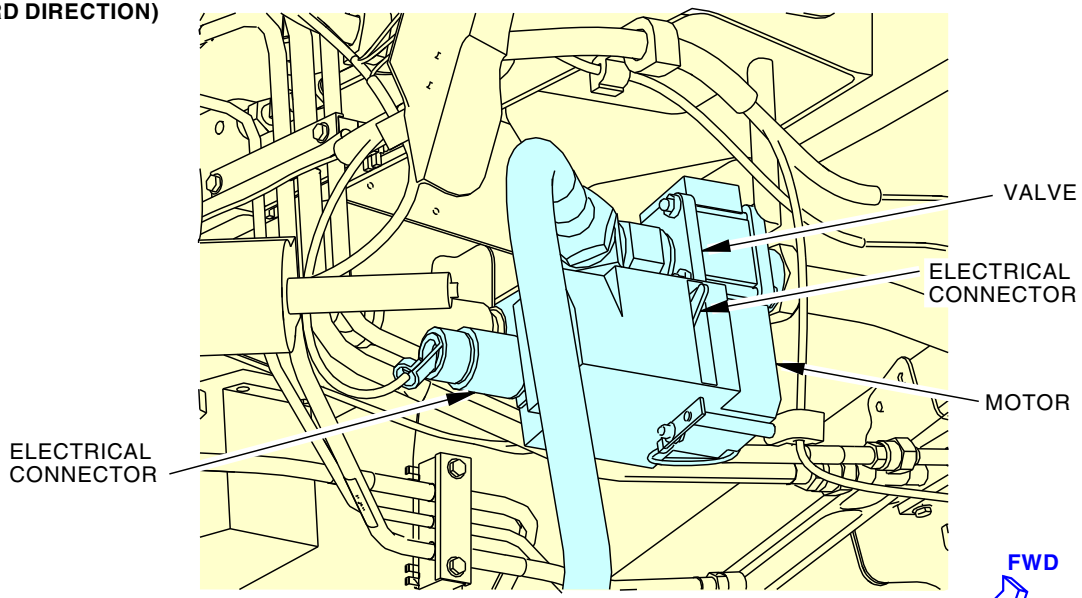
When you pull the engine fire switch, the EDP supply shutoff valve moves to the closed position. This stops the supply of hydraulic fluid to the EDP.

The EDP supply shutoff valve moves to the open position when you move the engine fire switch to the down or normal position.

## MAIN HYDRAULIC SYSTEMS - EDP SUPPLY SHUTOFF VALVE




**MAIN GEAR WHEEL WELL**
**(VIEW IN THE FORWARD DIRECTION)**




**EDP SUPPLY SHUTOFF VALVE**
**A**

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## MAIN HYDRAULIC SYSTEMS - EDP SUPPLY SHUTOFF VALVE

## MAIN HYDRAULIC SYSTEMS - ENGINE-DRIVEN PUMP

### Purpose

The engine-driven pumps (EDPs) supply hydraulic pressure for the hydraulic systems A and B.

### Location

The EDP mounts with a pump attach clamp to the front face of the engine accessory gearbox on the left side of the engine.

### Physical Description

The EDP is an axial-piston, variable-displacement, yoke-actuated, pressure compensated hydraulic pump with a solenoid-operated depressurization valve.

The pump has these three lines that attach to it:

- Hydraulic fluid supply line
- Output pressure line
- Case drain line.

The pressure and supply hydraulic line connections at the pump have a self-sealing, quick release disconnect to prevent leakage and keep air out of the hydraulic system. The case drain lines are threaded type fitting.

Quick disconnects on the engine service disconnect panel support beam permit engine maintenance or removal.

The pump weight (wet) is 32 lb (15 kg).

### Functional Description

The pump has a rotating cylinder barrel that has nine pistons. The pistons ride on an inclined yoke surface. As the barrel rotates, the pistons reciprocate within the barrel. Change to the incline of the yoke changes the stroke of each piston and changes the variable-displacement of the pump.

During the intake stroke of each piston, hydraulic fluid is drawn in the top of the barrel and into the piston cylinder bores.

During the discharge stroke of each piston, hydraulic fluid is forced out of the piston cylinder bores and into the output pressure line.

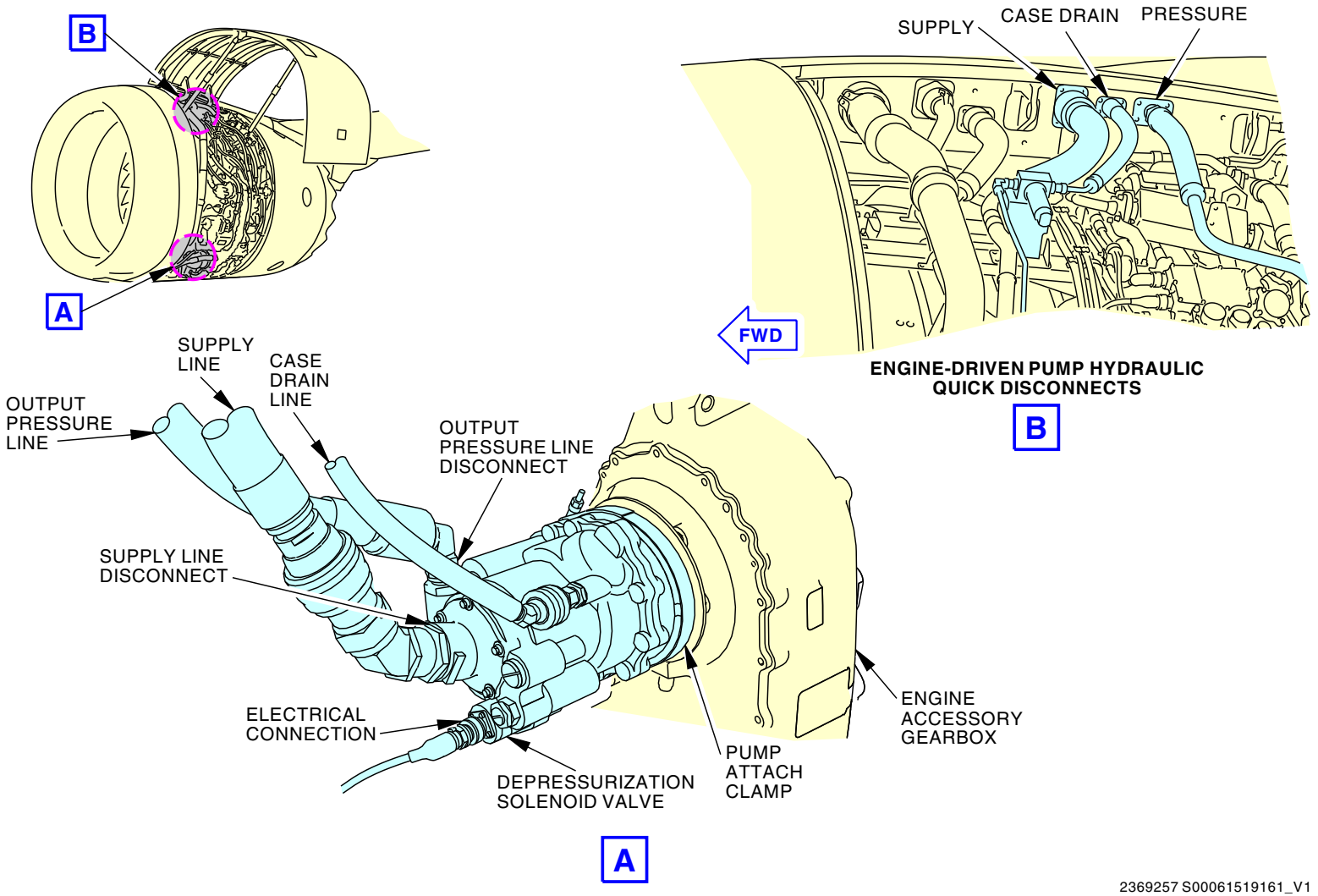
Some of the supply fluid in the pump becomes case drain fluid. The case drain fluid cools and lubricates the pump before it goes to the heat exchanger and reservoir through the case drain connection.

A pressure compensator in the pump maintains a preset pressure by control of the fluid flow out of the pump in response to changes in system demands.

The pump operates in the pressurized or depressurized mode. In the depressurized mode, the pump is isolated from the hydraulic system and runs at a zero output flow. The solenoid operated depressurization valve controls the pressurized or depressurized modes of the pump.

Both EDPs are rated at 36 gpm (136 l/min) at 3000 psi (20,684 kPa).

## MAIN HYDRAULIC SYSTEMS - ENGINE-DRIVEN PUMP




MAIN HYDRAULIC SYSTEMS - ENGINE-DRIVEN PUMP

## MAIN HYDRAULIC SYSTEMS - ELECTRIC MOTOR-DRIVEN PUMP

### Purpose

The electric motor-driven pumps (EMDPs) supply hydraulic pressure for hydraulic systems A and B.

### Location

The EMDPs are attached to a vibration absorbing mount in the center of the main wheel well on the forward bulkhead.

### Physical Description

The EMDP assembly has these components:

- Oil-cooled, three-phase, 115v ac motor
- Temperature switch
- Centrifugal pump
- Single-stage, variable-displacement, pressure-compensated hydraulic pump.

The EMDP has these connections:

- Supply (with a quick disconnect at the system A reservoir, and a quick disconnect between the EMDP and the system B reservoir)
- Pressure
- Case drain.

The pump weight (dry) is 30 lb (14 kg).

An acoustic filter is in the pressure line connected to the EMDP.

### Functional Description

Hydraulic fluid goes into the electric motor housing to cool the electric motor before it goes into the centrifugal pump. The centrifugal pump pushes the fluid into the single-stage, variable-displacement, pressure compensated hydraulic pump.

The hydraulic pump has a rotating cylinder barrel that has nine pistons. The piston rod ends ride on an inclined yoke surface. As the barrel rotates, the pistons reciprocate within the barrel. Change to the incline of the yoke changes the stroke of each piston and changes the variable-displacement of the pump.

During the intake stroke of each piston, hydraulic fluid is drawn in the top of the barrel and into the piston cylinder bores.

During the discharge stroke of each piston, hydraulic fluid is forced out of the piston cylinder bores and into the output pressure line.

A pressure compensator in the hydraulic pump maintains a preset pressure by control of the fluid flow out of the pump in response to changes in system demands.

Some of the supply fluid in the hydraulic pump becomes case drain fluid. The case drain fluid cools and lubricates the pump before it goes to the heat exchanger and reservoir through the case drain connection.

An internal temperature sensor in the EMDP monitors the temperature of the EMDP electric motor. When the temperature is 255°F (124°C) or more, the temperature switch opens to remove electrical power and stop the EMDP. The temperature switch is not used for overheat indication. The temperature switch resets at temperatures between 140°F (60°C) and 160°F (71°C).

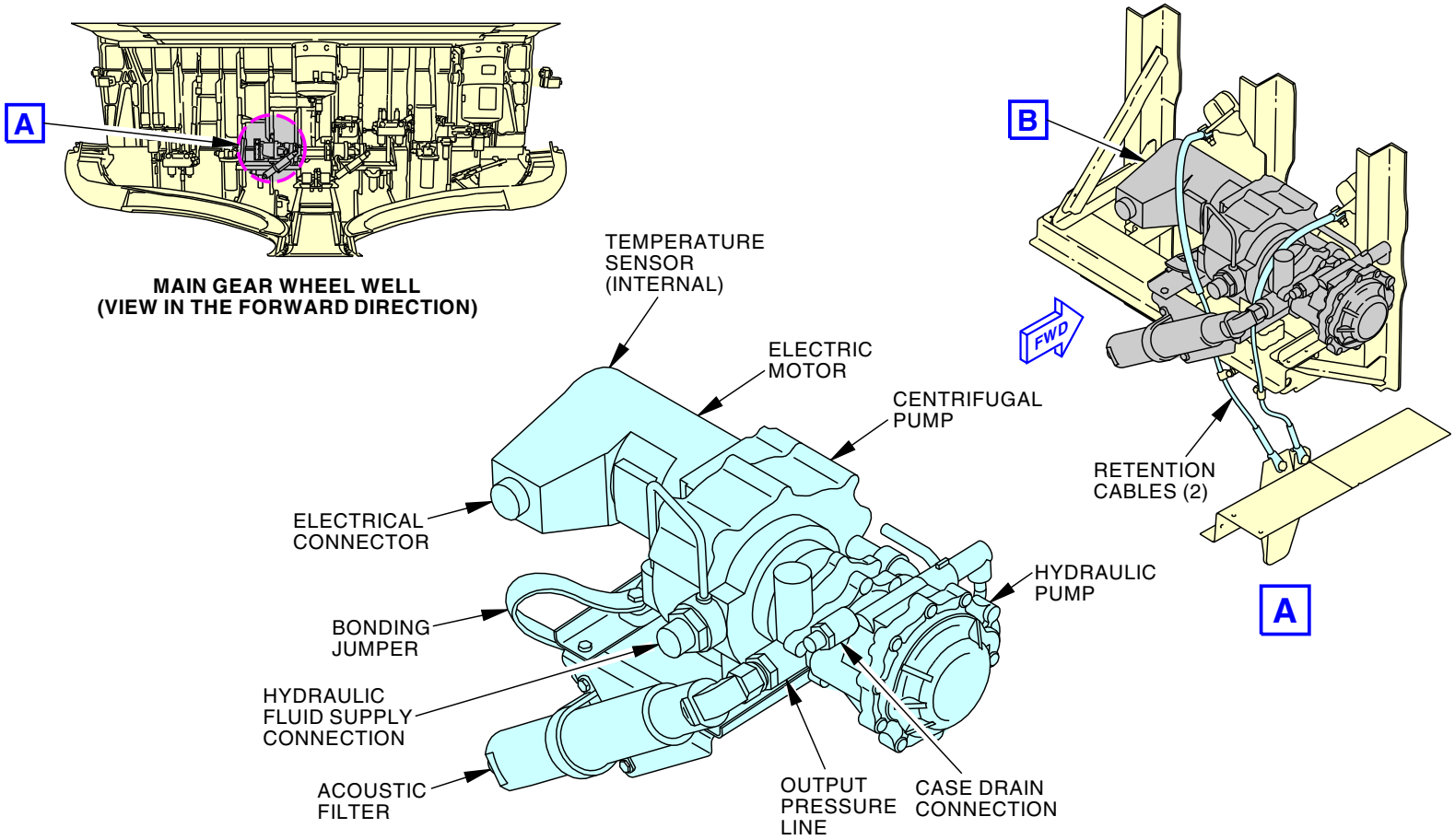
The acoustic filter decreases the noise and vibration from the EMDP.

Safety cables prevent damage to the aileron components if the EMDP breaks away from its mount.

Bonding jumpers provide a ground from the pump to the airplane structure.

The EMDP is rated at 5.7 gpm (21.6 l/min) at 2700 psi (18,616 kPa).

## MAIN HYDRAULIC SYSTEMS - ELECTRIC MOTOR-DRIVEN PUMP




**MAIN GEAR WHEEL WELL**
**(VIEW IN THE FORWARD DIRECTION)**

**SYSTEM A ELECTRIC MOTOR-DRIVEN PUMP**
**(SYSTEM B SIMILAR)**

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MAIN HYDRAULIC SYSTEMS - ELECTRIC MOTOR-DRIVEN PUMP

## MAIN HYDRAULIC SYSTEMS - PRESSURE MODULE

### Purpose

The pressure module does these functions for hydraulic system A and B:

- Distributes hydraulic pump pressure to user systems
- Cleans pressure fluid from EDP and EMDP
- Monitors EDP and EMDP pressure
- Monitors system pressure
- High pressure system protection.

### Location

The system A pressure module is on the left side of the forward bulkhead of the main gear wheel well.

The system B pressure module is near the center of the forward bulkhead of the main gear wheel well.

### Physical Description

The pressure module has these components:

- Pressure filter (2)
- Pump low pressure switch (2)
- EDP pressure switch auto slat system (system B only)
- Check valve (2)
- Pressure transmitter
- Pressure relief valve.

The pressure modules are interchangeable.

### Functional Description

Hydraulic pressure from the EDP and EMDP goes through the non-bypass, non-cleanable, 5-15 micron cartridge-type pressure filters to the user systems.

Pump low pressure switches send signals to the hydraulic panel when the EDP or EMDP pressure decreases to less than normal.

See the hydraulic indicating system section for more information about the hydraulic pump low pressure warning indication (SECTION 29-30).

The EDP pressure switch auto slat system (system B pressure module only) sends a signal to the hydraulic power transfer unit (PTU) system when system B EDP pump pressure decreases to less than 2350 psi.

See the hydraulic power transfer unit (PTU) system section for more information about the EDP pressure switch auto slat system (SECTION 29-25).

The check valves prevent hydraulic backflow through the pressure filters. They also isolate the pump low pressure switches from user system pressure and ground service disconnect pressure.

A pressure transmitter monitors system pressure and sends signals to the display processing computer (DPC) in the electronics equipment compartment. The DPC sends the data to the multi display system in the flight compartment.

See the hydraulic indicating system section for more information about the hydraulic pressure indication (SECTION 29-30).

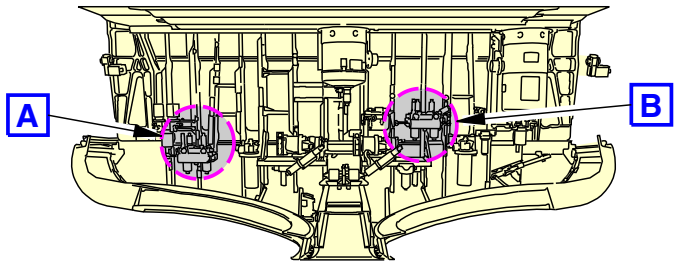
The pressure relief valve starts to open at 3500 psi to protect the system when the system pressure increases to more than normal.

### Filter Element Replacement

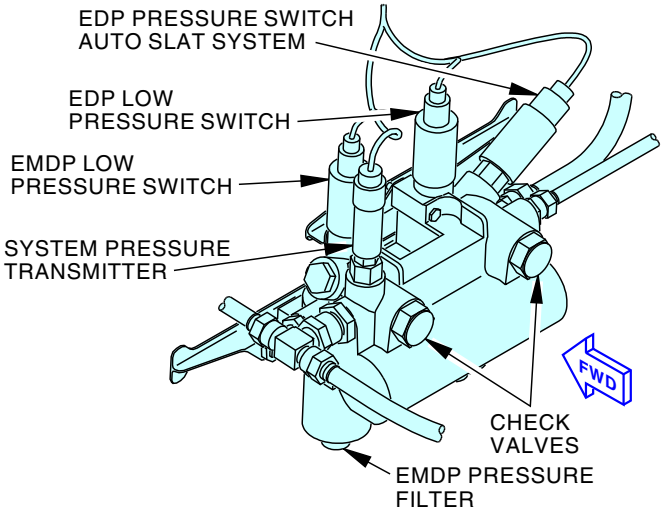
**NOTE:** You can not clean the pressure and case drain filter elements and use them again.

If you replace the pressure filter element, you must do the pressure filter element installation test.

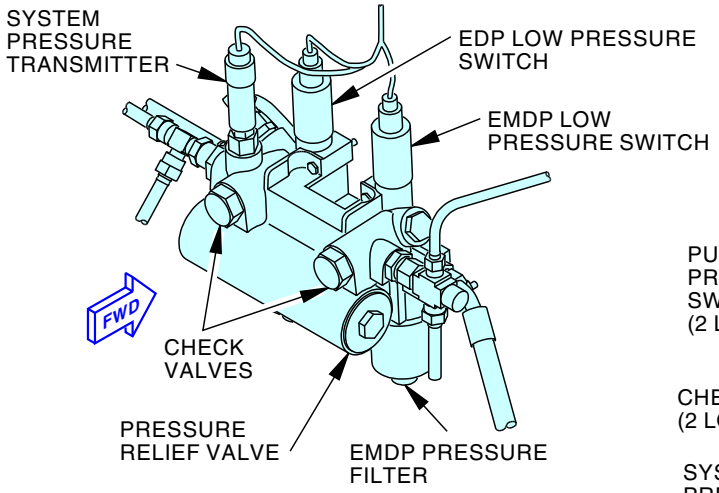
## MAIN HYDRAULIC SYSTEMS - PRESSURE MODULE




**MAIN GEAR WHEEL WELL**
**(VIEW IN THE FORWARD DIRECTION)**

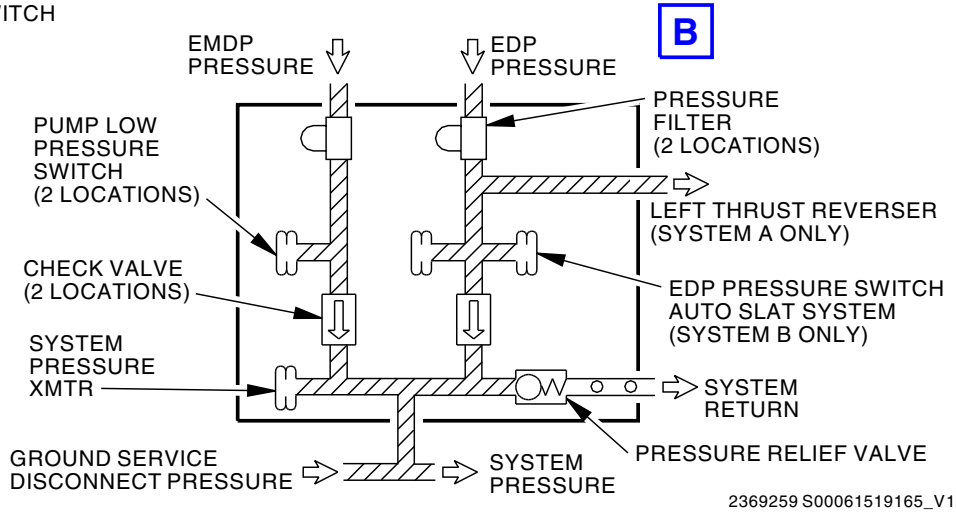



**SYSTEM B PRESSURE MODULE**




**SYSTEM A PRESSURE MODULE**

**A**




**LEGEND:**

PRESSURE

RETURN

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## MAIN HYDRAULIC SYSTEMS - PRESSURE MODULE

## MAIN HYDRAULIC SYSTEMS - CASE DRAIN FILTER MODULE

### Purpose

The case drain filter module cleans the case drain fluid from the Engine Driven Pump (EDP) and Electric Motor-Driven Pump (EMDP) before it goes through the heat exchangers and back to the reservoirs.

### Location

The EDP case drain filter modules are on each engine in the case drain line between the EDP and the hydraulic disconnects on the engine strut.

The EMDP case drain filter modules are in the case drain line just below their related pump, in the main landing gear wheel well on the forward bulkhead.

### Physical Description

The case drain filter module is non-bypass type with a 10-20 micron, non-cleanable, cartridge type filter element.

The case drain filter module has these components:

- Filter module head
- Filter bowl
- Replaceable filter element.

### Functional Description

An arrow on the filter module shows the direction of flow through the filter module.

A check valve on the outlet of the filter module prevents backflow from the other pump in the system.

### EDP

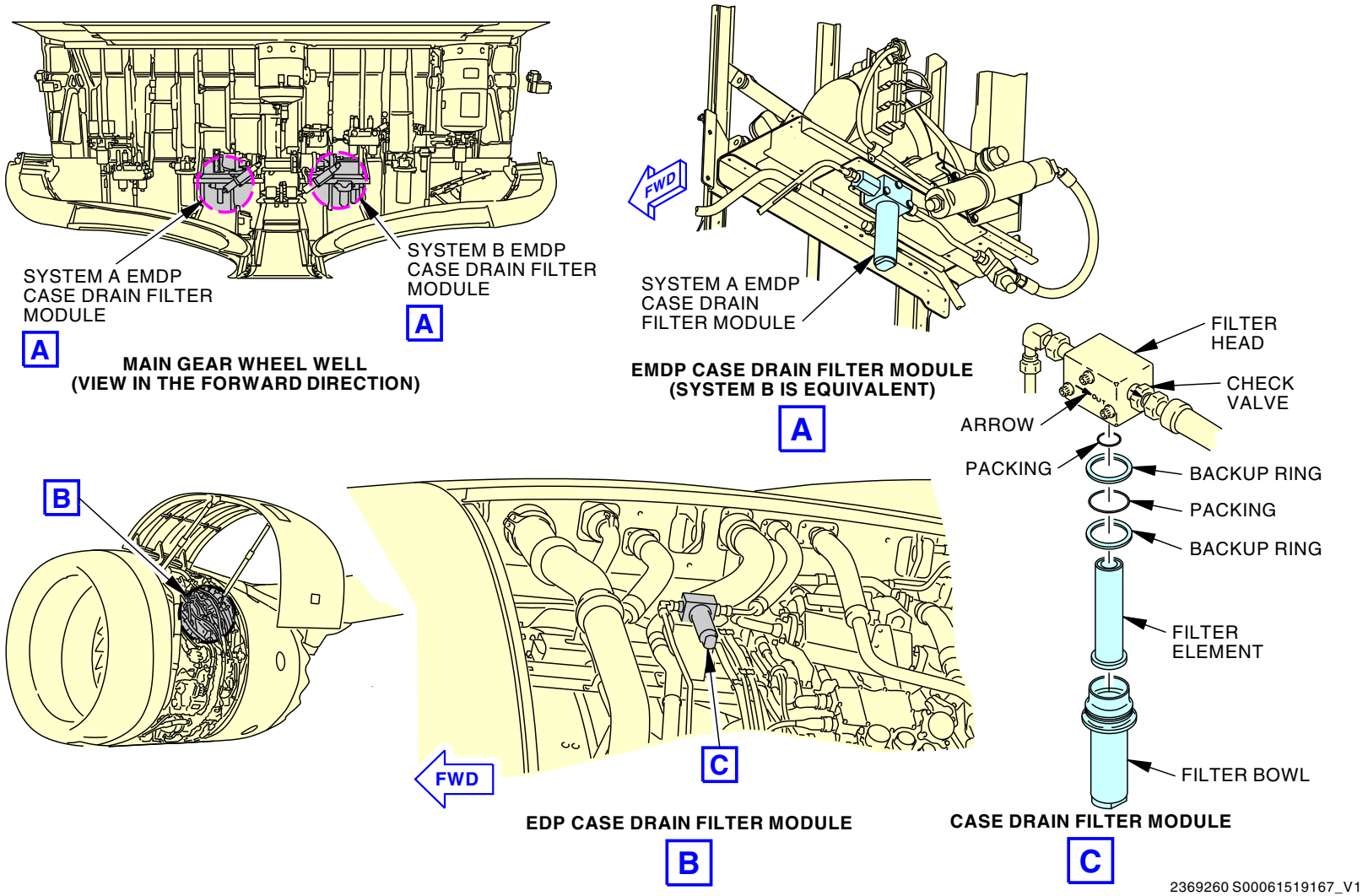
If you operate the engine fire switch and the EDP runs for five minutes, you must inspect the EDP case drain filter for pump damage and replace the filter.

### EMDP

A contaminated EMDP case drain filter can cause the EMDP to overheat and turn on the OVERHEAT light, the MASTER CAUTION light, and the HYD light on the systems annunciator panel.

If metal contamination is found in the EMDP case drain filter, you must do an EMDP case drain filter metal contamination check.

## MAIN HYDRAULIC SYSTEMS - CASE DRAIN FILTER MODULE




## MAIN HYDRAULIC SYSTEMS - CASE DRAIN FILTER MODULE

## MAIN HYDRAULIC SYSTEMS - HEAT EXCHANGER

### Purpose

The heat exchangers cool the hydraulic case drain fluid from the pumps before the fluid goes back to the reservoir.

### Location

The system A heat exchanger is in the case drain line common to both the engine-driven pump and the electric motor-driven pump. The heat exchanger is in the bottom of the number one fuel tank.

The system B heat exchanger is in the case drain line common to both the engine-driven pump and the electric motor-driven pump. The heat exchanger is in the bottom of the number two fuel tank.

### Physical Description

The heat exchanger is a fin-tube type assembly that has these components:

- Fin-tube core
- Inlet port
- Outlet Port
- Bracket assembly.

The heat exchanger weight is 7.6 lbs.

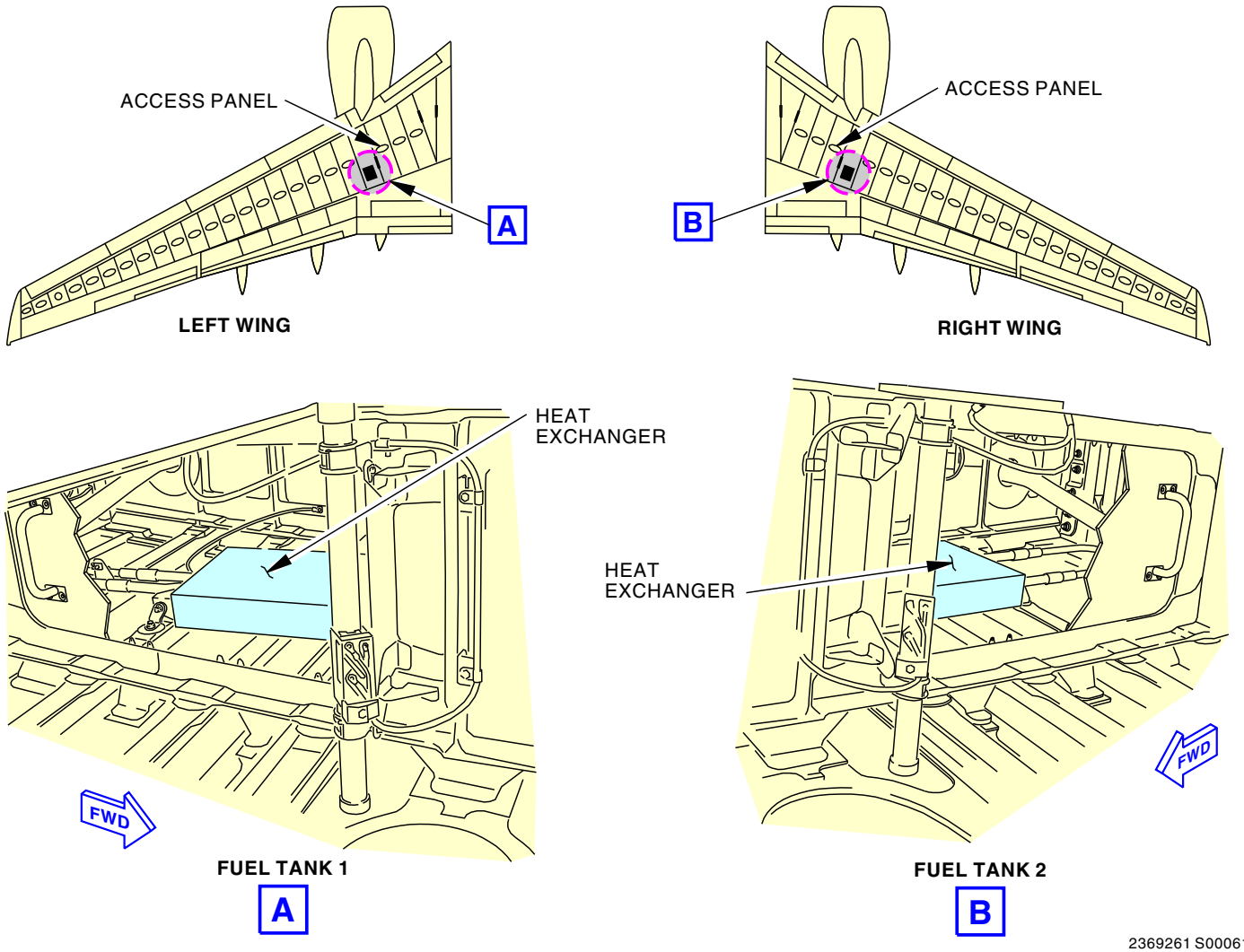
The heat exchangers are interchangeable.

### Functional Description

The heat exchanger for each system receives case drain fluid from the EDP and the EMDP. Case drain fluid flows through the heat exchanger when either pump operates.

The heat exchanger transfers heat from the hydraulic fluid to the fuel in the tank.

## MAIN HYDRAULIC SYSTEMS - HEAT EXCHANGER

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MAIN HYDRAULIC SYSTEMS - HEAT EXCHANGER

## MAIN HYDRAULIC SYSTEMS - RETURN FILTER MODULE

### Purpose

The return filter modules clean the return hydraulic fluid from:

- System actuators
- System modules
- System valves
- Power transfer unit (PTU) (System A only).

### Location

The return filter module for systems A and B are on the forward bulkhead of the main gear wheel well, below the reservoirs.

### Physical Description

The return filter is a bypass type, with a 15 micron, non-cleanable, cartridge type filter element.

The return filter module has these parts:

- Filter module head
- Filter bowl
- Replaceable filter element.

The filter head has these parts:

- Bypass valve
- Differential pressure indicator
- Check valve (2)
- Shutoff valve.

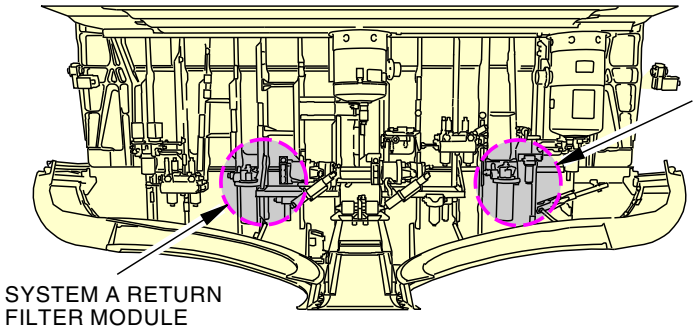
### Functional Description

When a clogged return filter causes a differential pressure across the filter element of 65 psi, the red differential pressure indicator will move up and you can see it. The differential pressure indicator does not move if the temperature is less than 36F (2C).

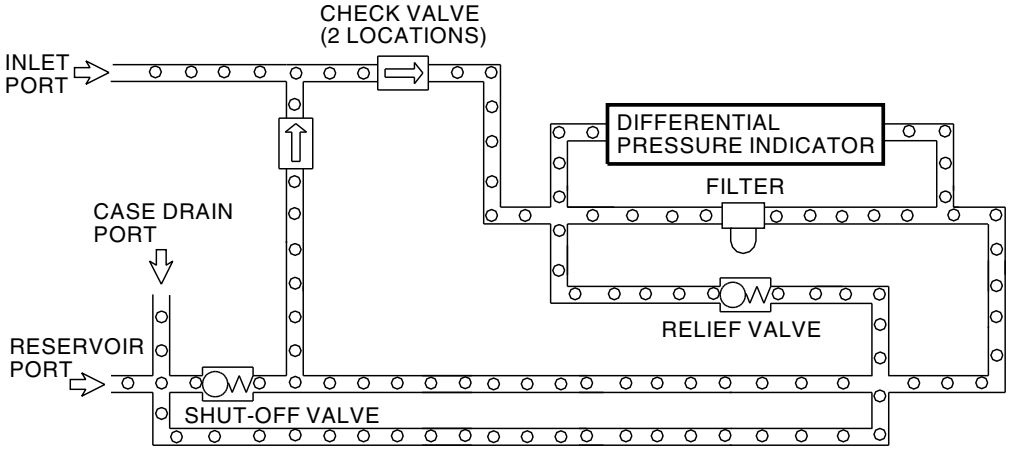
If the differential pressure is 100 psi or more, the bypass valve opens and lets the fluid bypass the filter and flow directly into the reservoir.

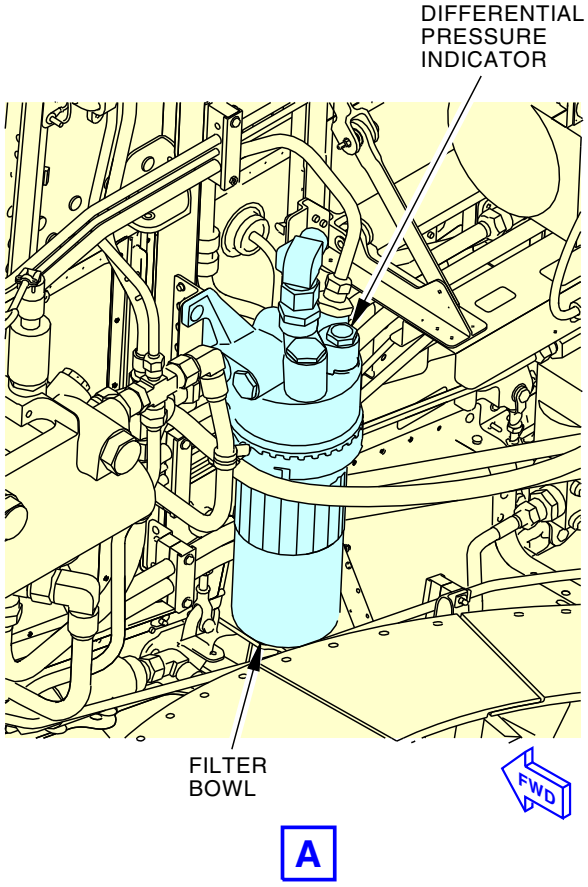
Two check valves in the return filter module head create a negative pressure loop. The negative pressure loop allows backward flow of hydraulic fluid from the reservoir to the system without backflush of the filter element.

## MAIN HYDRAULIC SYSTEMS - RETURN FILTER MODULE




**MAIN GEAR WHEEL WELL**
**(VIEW IN THE FORWARD DIRECTION)**




**LEGEND:**

RETURN

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MAIN HYDRAULIC SYSTEMS - RETURN FILTER MODULE

## MAIN HYDRAULIC SYSTEMS - GROUND SERVICE DISCONNECT MODULE

### Purpose

The ground service disconnect module lets you pressurize the hydraulic systems A and B from a ground service cart.

### Location

The hydraulic system A ground service disconnect module is on the aft bulkhead of the left ram air bay.

The hydraulic system B ground service disconnect module is on the aft bulkhead of the right ram air bay.

### Physical Description

The ground service disconnect module has these components:

- Pressure connection
- Return connection
- Pressure filter.

The pressure and return connections are a quick-disconnect type fitting.

The pressure filter is a non-bypass type with a non-cleanable, 5-15 micron, cartridge-type filter element.

### Functional Description

Hydraulic system operation from a ground power cart is the same for both systems A or B. Pressure from the cart is cleaned before use by the user systems.

Pressurized fluid enters either system A or B and goes to the system A or B pressure module check valves and the user systems.

With electrical power and ground hydraulic power on the airplane, pressure for either system shows on a pressure indicator in the flight compartment.

See the hydraulic indicating system section for more information about hydraulic pressure indication. (SECTION 29-30)

Return fluid from the user systems goes back to the cart through the ground service disconnect return connection.

### Filter Element Replacement

**NOTE:** You can not clean the pressure filter element and use it again.

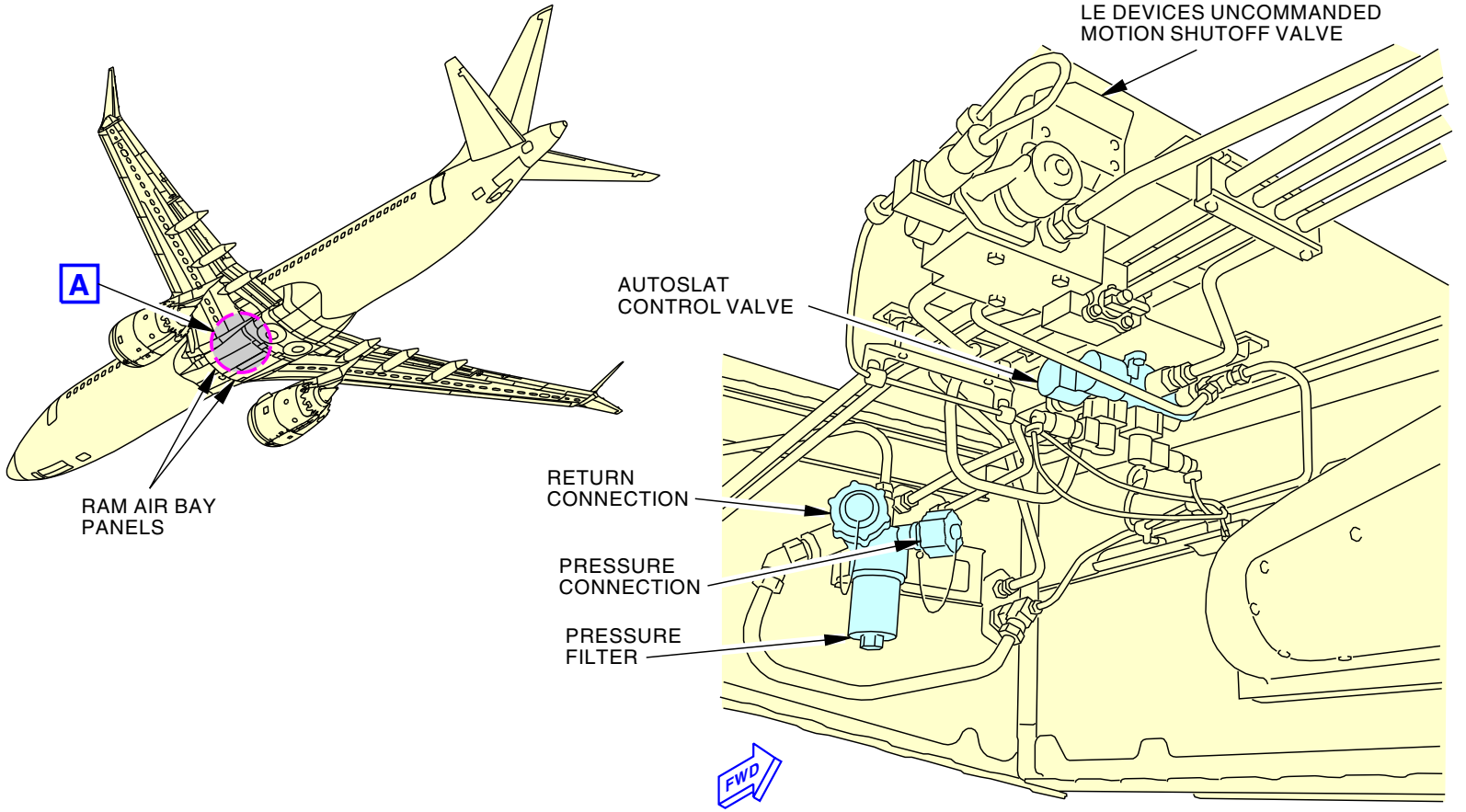
If you replace the pressure filter element, you must do the pressure filter element installation test.

### Hydraulic System A or B Pressurization With a Portable Hydraulic Cart

See the landing gear system section for more information about the landing gear downlock pins. (SECTION 32-00)

**NOTE:** Do not operate the EDPs or EMDPs with the portable hydraulic cart return and pressure lines connected. This may prevent the pumps from receiving enough hydraulic fluid from their respective reservoirs and cavitate the pump.

## MAIN HYDRAULIC SYSTEMS - GROUND SERVICE DISCONNECT MODULE




**SYSTEM B GROUND SERVICE DISCONNECT MODULE**
**(RIGHT RAM AIR BAY)**
**(VIEW IN THE AFT DIRECTION)**
**(SYSTEM A IS EQUIVALENT)**

**A**

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MAIN HYDRAULIC SYSTEMS - GROUND SERVICE DISCONNECT MODULE

## MAIN HYDRAULIC SYSTEMS - ENGINE-DRIVEN PUMP - FUNCTIONAL DESCRIPTION - HYDRAULIC

### General

The Engine Driven Pump (EDP) operates when the related engine turns.

To stop output flow from the EDP, move the ENG 1 HYD PUMP or ENG 2 HYD PUMP switch on the hydraulic panel to the OFF position. This does not stop the rotation of the pump or the internal pressure in the pump.

### Functional Description

The pump can operate in a normal mode or in a depressurized mode. In the normal mode, the pump is rated at a maximum of 37.5 gpm (142.0 l/min) and 3030 psi (20,891 kPa) at 3750 rpm. Maximum discharge pressure is rated at 2900 psi (19,995 kPa) at 0 flow.

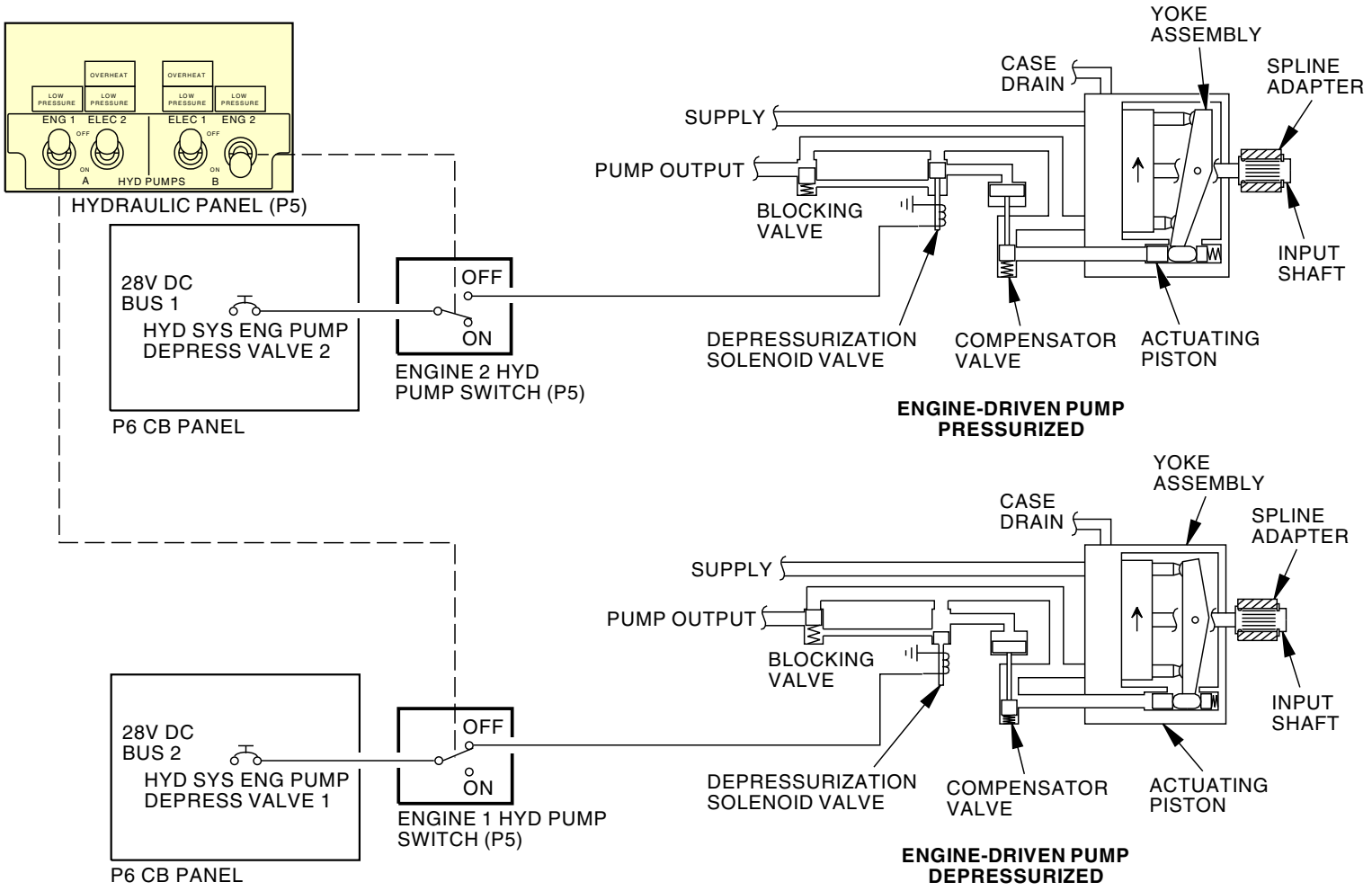
A depressurization solenoid valve in the pump controls the EDP output pressure when you move the ENG HYD PUMP switch on the hydraulic panel to the OFF position. This completes a 28v dc electrical circuit and energizes the valve to the closed position.

When the depressurization solenoid valve is open, EDP output pressure goes to these valves:

- The blocking valve closes and blocks output pressure downstream from the depressurization solenoid valve.
- The compensator valve opens and allows output pressure upstream from the depressurization solenoid valve to go to an actuating piston. This controls a yoke assembly. When the actuating piston moves, the yoke assembly moves to a 0 displacement position. This stops output pressure to the hydraulic system downstream.

When the pump operates in the normal or depressurized modes, case drain fluid is used for lubrication and cooling. The case drain fluid circulates through the pump and back to the EDP case drain filter and heat exchanger before it goes to the related reservoir.

## MAIN HYDRAULIC SYSTEMS - ENGINE-DRIVEN PUMP - FUNCTIONAL DESCRIPTION - HYDRAULIC

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MAIN HYDRAULIC SYSTEMS - ENGINE-DRIVEN PUMP - FUNCTIONAL DESCRIPTION - HYDRAULIC

## General

The Engine Driven Pump (EDP) operates when the related engine turns.

To stop output flow from the EDP, move the ENG 1 HYD PUMP or ENG 2 HYD PUMP switch on the hydraulic panel to the OFF position. This does not stop the rotation of the pump or the internal pressure in the pump.

## EDP HYD PUMP Switch Operation

When the ENG 1 HYD PUMP or ENG 2 HYD PUMP switch is in the ON position, the depressurization solenoid valve is not energized. This lets the pressure output of the EDP go to the hydraulic system.

When the ENG 1 HYD PUMP or ENG 2 HYD PUMP switch is in the OFF position, power from 28v dc bus 2 (for hydraulic system A EDP) or 28v dc bus 1 (for hydraulic system B EDP) energizes the EDP depressurization solenoid valve. This closes the valve to stop the pump output.

The case drain flow continues inside the pump when the depressurization solenoid valve is in the closed position.

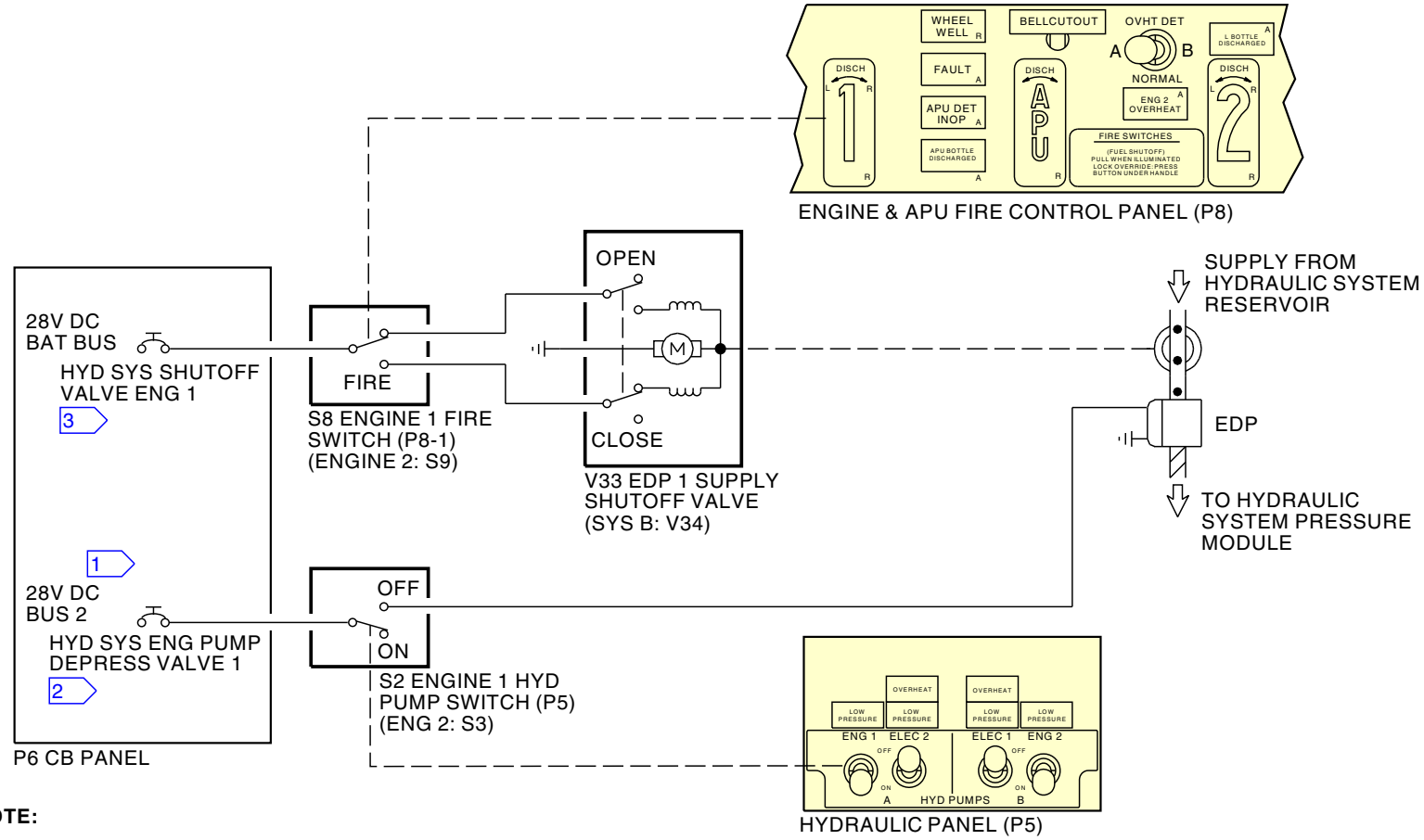
## EDP Supply Shutoff Valve Operation

When you pull the engine fire switch, the EDP supply shutoff valve moves to the closed position. This stops the supply of hydraulic fluid to the EDP. There is no case drain flow in this condition.

When you operate one of the engine fire switches, the pump LOW PRESSURE amber light is disarmed.

The EDP supply shutoff valve moves to the open position when you move the engine fire switch to the stowed position.

## MAIN HYDRAULIC SYSTEMS - ENGINE-DRIVEN PUMP - FUNCTIONAL DESCRIPTION - ELECTRICAL




**NOTE:**

HYDRAULIC SYSTEM A IS SHOWN, HYDRAULIC SYSTEM B IS EQUIVALENT

1. BUS 1 FOR HYDRAULIC SYSTEM B EDP
2. VALVE 2 FOR HYDRAULIC SYSTEM B EDP
3. ENGINE 2 FOR HYDRAULIC SYSTEM B EDP

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MAIN HYDRAULIC SYSTEMS - ENGINE-DRIVEN PUMP - FUNCTIONAL DESCRIPTION - ELECTRICAL

## General

The ELEC HYD PUMP switches on the hydraulic panel control the electric motor-driven pumps (EMDPs). A protection circuit turns the electric motor off when a ground fault or overcurrent is detected.

## Pump Control

When the ELEC HYD PUMP switch is ON, 28v dc energizes the electric hydraulic pump relay which closes three contacts. These contacts let 115v ac power go to the EMDP electric motor. When the ELEC HYD PUMP switch is in the OFF position, the electric hydraulic pump relay has no power and the contacts open to stop the EMDP motor.

The EMDP hydraulic pump relay gets a ground through the temperature switch on the EMDP. Contacts in the hydraulic pump relay control 115v ac power to the EMDP. When the temperature of the pump is normal, the temperature switch is closed. This sends a ground to the hydraulic pump relay. When the temperature of the EMDP increases to more than 255°F (124°C), the temperature switch opens. This removes the ground from the hydraulic pump relay and stops the EMDP. The temperature switch resets when the pump temperature decreases to less than 140°F (60°C).

## Circuit Protection

The ELEC HYD PUMP switches get 28v dc power from the ground fault detectors. The ground fault detector for system A EMDP is in the P92 power distribution panel in the EE compartment. The ground fault detector for system B EMDP is in the P91 panel in the electronics equipment compartment.

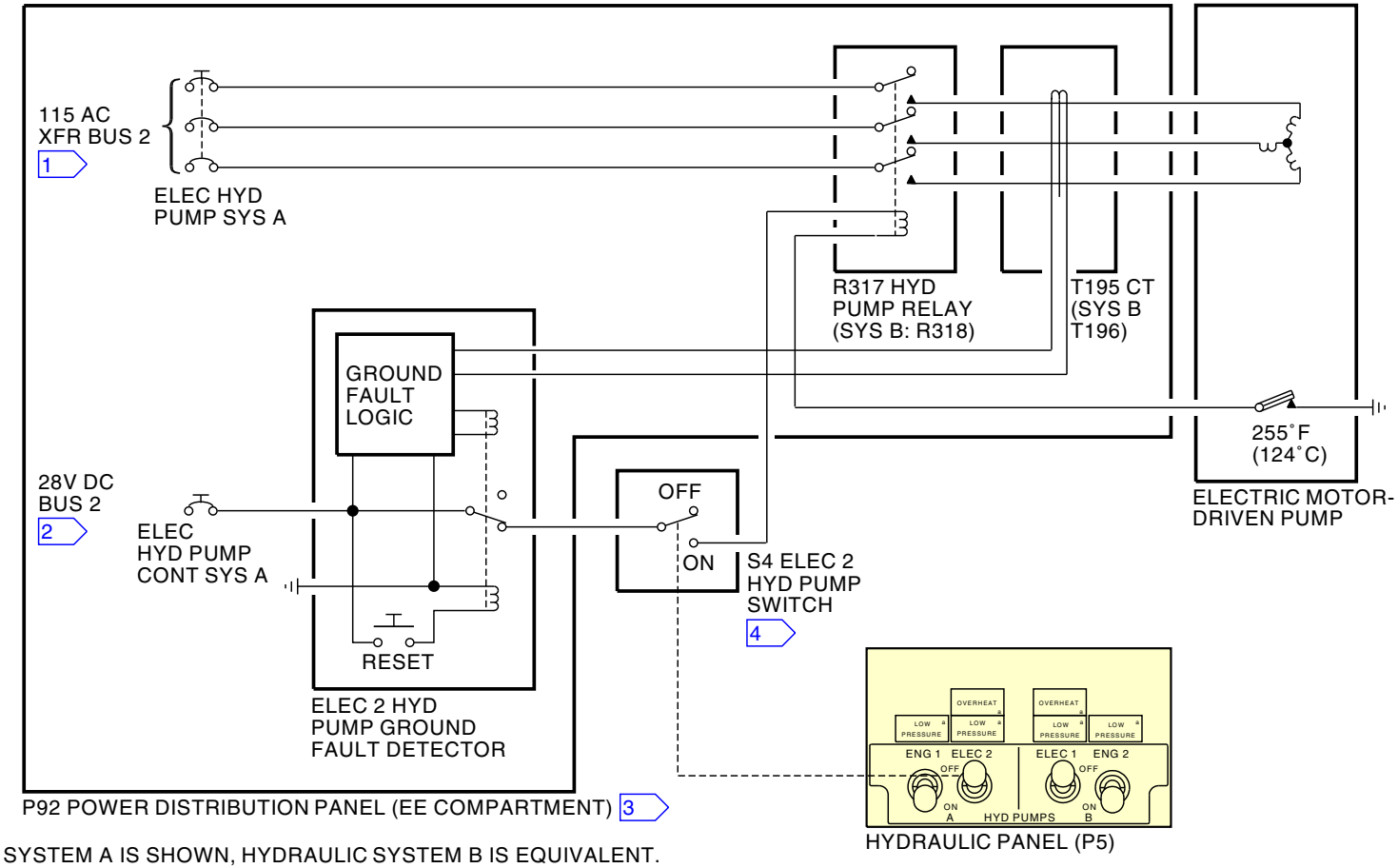
The ground fault detector has these components:

- Trip coil
- Reset switch.

The trip coil in the ground fault detector energizes when a ground fault occurs. If the detector gets an input differential of 2 to 4 amps or more between two coils, the trip coil energizes.

When the trip coil energizes, the electric hydraulic pump relay has no power. The contacts on the hydraulic pump relay open to remove 115v ac power to the EMDP.

## MAIN HYDRAULIC SYSTEMS - ELECTRIC MOTOR-DRIVEN PUMP - FUNCTIONAL DESCRIPTION - ELECTRICAL




**NOTE:**

HYDRAULIC SYSTEM A IS SHOWN, HYDRAULIC SYSTEM B IS EQUIVALENT.

1 FOR SYS B: 115V AC XFR BUS 1

2 FOR SYS B: 28V DC BUS 1

3 FOR SYS B: P91

4 FOR SYS B: S5 ELECT 1 HYD PUMP SWITCH

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MAIN HYDRAULIC SYSTEMS - ELECTRIC MOTOR-DRIVEN PUMP - FUNCTIONAL DESCRIPTION - ELECTRICAL

## MAIN HYDRAULIC SYSTEMS - SYSTEM A - FUNCTIONAL DESCRIPTION

### General

Hydraulic system A supplies pressurized fluid to these systems:

- Left thrust reverser
- Power transfer unit (PTU) motor
- Landing gear extension and retraction
- Nose wheel steering
- Alternate brake
- Ailerons
- Autopilot A
- Elevators
- Elevator feel
- Flight spoilers 2, 4, 9, and 11
- Ground spoilers 1, 6, 7, and 12
- Rudder.

### Fluid Supply

Air from the pneumatic system pressurizes the reservoir.

The reservoir supplies pressurized fluid to the EDP and EMDP hydraulic pumps. The reservoir supplies fluid to the EDP through a standpipe.

The EDP supply shutoff valve controls supply fluid to the EDP.

### Pressurization

The EDP and EMDP supply pressure continuously.

The PTU motor receives pressure and supplies an emergency source of hydraulic power to the leading edge flaps and slats.

The ground service disconnect module allows pressurization of hydraulic system A from a ground service cart.

### Filtration

The system pressure module filters clean the output pressure fluid from the pumps.

Case drain filter modules clean the case drain fluid from the EDP and EMDP pumps.

A return filter module cleans the return flow of hydraulic fluid from the user systems. The module can be bypassed.

### Fluid Cooling

The heat exchanger cools the fluid from the case drains of the pumps before the fluid goes back to the reservoir.

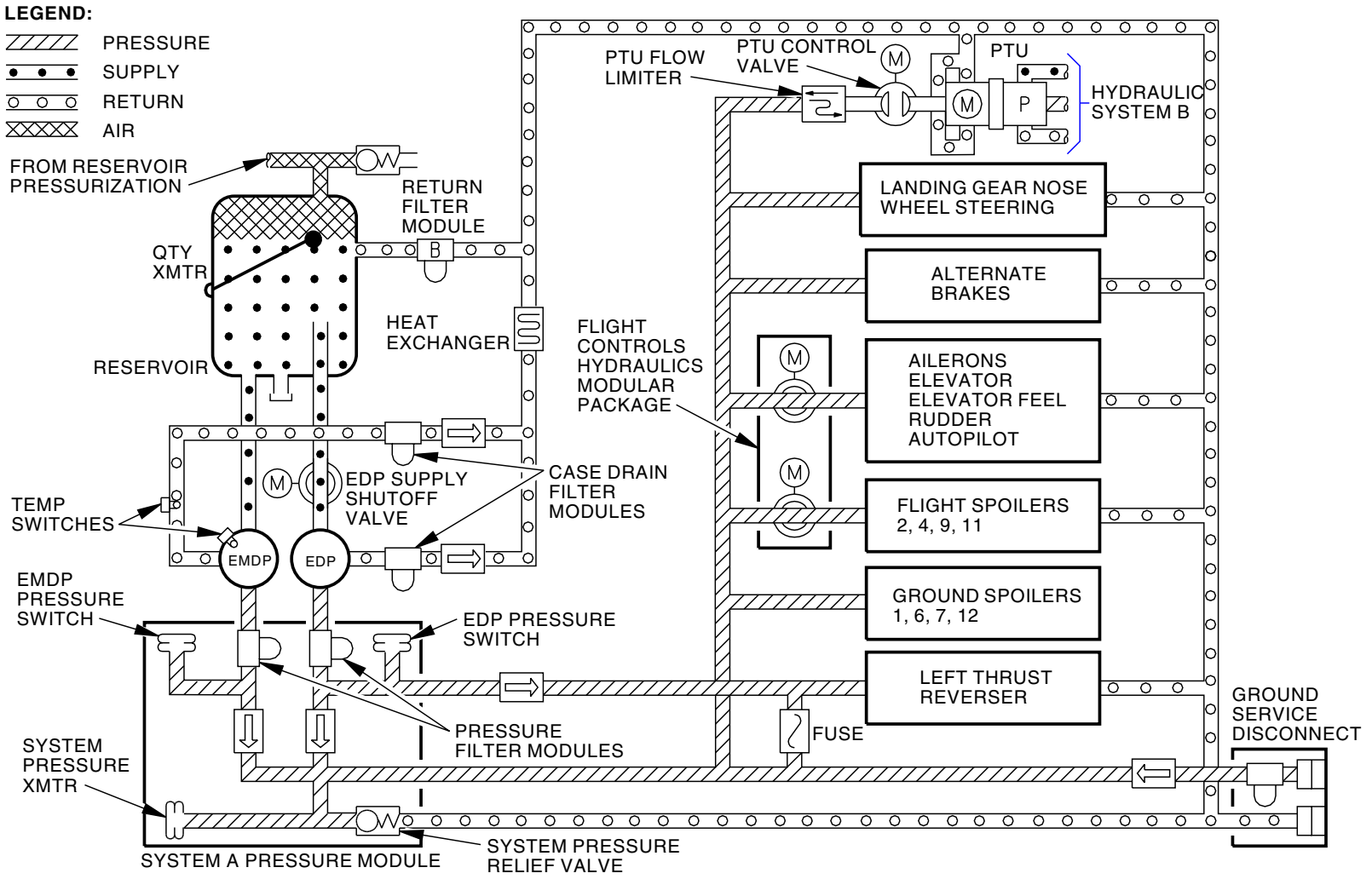
### Indication

Temperature switches monitor the EMDP electric motor and the EMDP case drain fluid temperatures.

Pump pressure switches monitor the EMDP and EDP pump pressures.

The system pressure transmitter monitors the system pressure.

## MAIN HYDRAULIC SYSTEMS - SYSTEM A - FUNCTIONAL DESCRIPTION

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MAIN HYDRAULIC SYSTEMS - SYSTEM A - FUNCTIONAL DESCRIPTION

## MAIN HYDRAULIC SYSTEMS - SYSTEM B - FUNCTIONAL DESCRIPTION

### General

Hydraulic system B supplies pressurized fluid to these systems:

- Right thrust reverser
- Power transfer unit (PTU) pump
- Alternate landing gear retraction
- Alternate nose wheel steering
- Normal brakes
- Ailerons
- Autopilot B
- Elevators
- Elevator feel
- Flight spoilers 3, 5, 8, and 10
- Rudder
- Trailing edge flaps
- Leading edge flaps and slats.

### Fluid Supply

Air from the pneumatic system pressurizes the reservoir.

The reservoir supplies pressurized fluid to the EDP and EMDP hydraulic pumps through a standpipe. The EDP supply shutoff valve controls supply fluid to the EDP.

The PTU pump receives fluid from the bottom of the reservoir.

### Pressurization

The EDP and EMDP supply pressure continuously.

The PTU pump supplies an emergency source of hydraulic power to the leading edge flaps and slats.

The ground service disconnect module allows pressurization of hydraulic system B from a ground service cart.

### Filtration

The system pressure module filters clean the output pressure fluid from the pumps.

Case drain filter modules clean the case drain fluid from the EDP and EMDP pumps.

The return filter module cleans the return flow of hydraulic fluid from the user systems.

### Fluid Cooling

The heat exchanger cools the fluid from the case drains of the pumps before the fluid goes back to the reservoir.

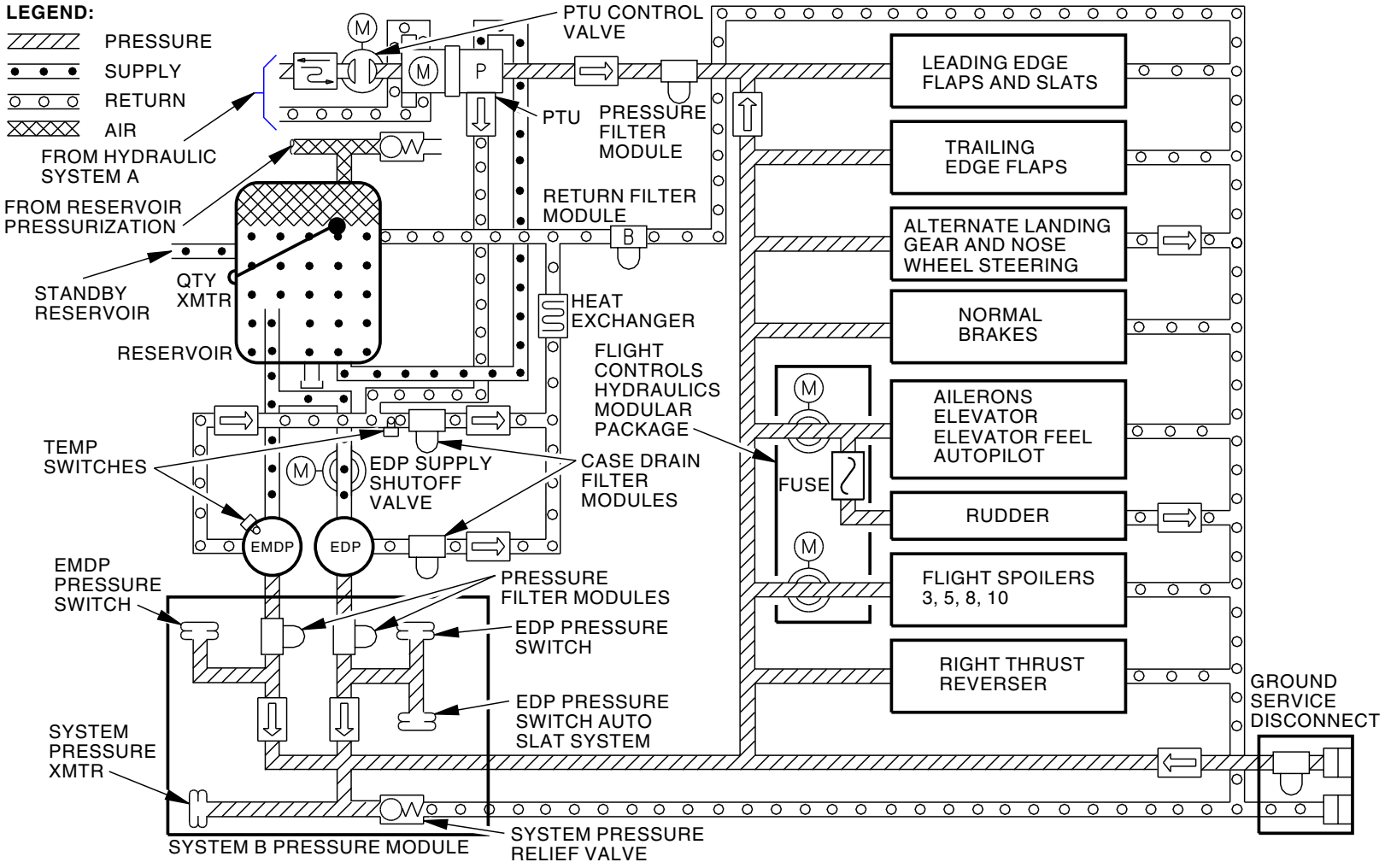
### Indication

Temperature switches monitor the EMDP electric motor and the EMDP case drain fluid temperatures.

Pump pressure switches monitor the EMDP and EDP pump pressures.

The system pressure transmitter monitors the system pressure.

## MAIN HYDRAULIC SYSTEMS - SYSTEM B - FUNCTIONAL DESCRIPTION

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MAIN HYDRAULIC SYSTEMS - SYSTEM B - FUNCTIONAL DESCRIPTION

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## MAIN HYDRAULIC SYSTEMS - GROUND SERVICING SYSTEM

### General

The ground servicing system fills all hydraulic reservoirs from one central location.

### Location

The system components are in the right main gear wheel well on the lower outboard area of the forward bulkhead.

### Physical Description

These are the ground servicing system components:

- Reservoir fill selector valve
- Reservoir fill filter module
- Reservoir manual fill pump
- Pressure fill connection.

The reservoir fill selector valve is a manually-operated, three-position selector valve.

The reservoir fill filter module is a non-bypass type with a non-cleanable, 0-3 micron, cartridge type filter element.

The reservoir manual fill pump is a double acting, piston-type pump. The pump has a spring-loaded one-way check valve in the piston head and another in the suction port. The pump also has a manual handle.

### Functional Description

The reservoir fill selector valve lets you select which reservoir will receive hydraulic fluid.

These are the three positions:

- Port A
- Port B
- Closed.

The reservoir fill filter module cleans the hydraulic fluid before it goes into either of the hydraulic system reservoirs.

The reservoir manual fill pump lets you service all the hydraulic system reservoirs manually when pressure service equipment is not available. A suction hose is connected to the pump and is stowed in brackets when not in use.

The pressure fill connection lets you fill the hydraulic system reservoirs from a ground servicing cart. A cap covers the connection when not in use.

### Operation

You fill the reservoirs with either of these two procedures:

- Manual fill pump
- Ground service cart.

You use the reservoir fill selector valve to send hydraulic fluid from the manual fill pump or a ground service cart.

- Port A sends hydraulic fluid to the system A reservoir.
- Port B sends hydraulic fluid to system B and the standby reservoirs.

Move the valve to the closed position after servicing.

You use the manual pump suction hose during the manual fill operation. One end of the hose connects to the manual fill pump. The other end of the hose goes in the hydraulic fluid container. When not in use, put the end of the suction hose in a protective cover.

### Servicing

To get the correct results when you do a check of the hydraulic fluid quantities or fill the reservoirs, the airplane should be in this condition:

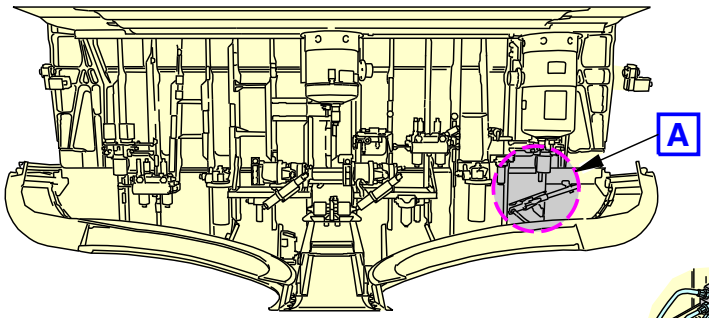
- Flight controls - neutral
- LE flaps and slats - up
- TE flaps - up
- Spoilers - down

- Landing gear - down
- Thrust reversers - closed
- Hydraulic system A and system B - off
- Brake accumulator pressure - 2850 psi or more.

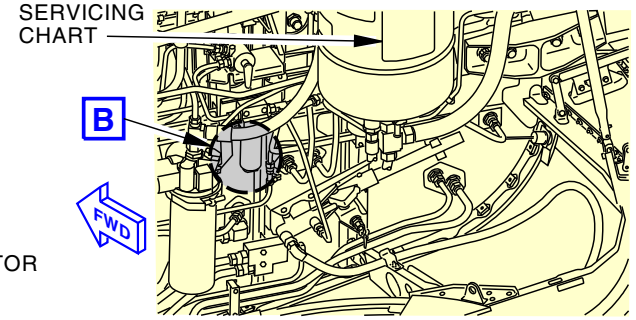
If the ambient temperature on the ground is 20F (-6C) or lower at an arrival location and a fluid level is below REFILL, service the reservoir to just above REFILL to avoid the overflow of fluid at the next warmer location.

See the servicing section in chapter 12 in Part II of the maintenance manual for more information about hydraulic reservoir servicing.

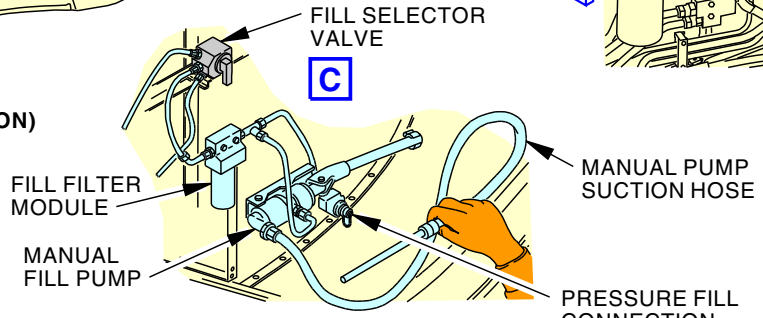
## MAIN HYDRAULIC SYSTEMS - GROUND SERVICING SYSTEM




MAIN GEAR WHEEL WELL
(VIEW IN THE FORWARD DIRECTION)

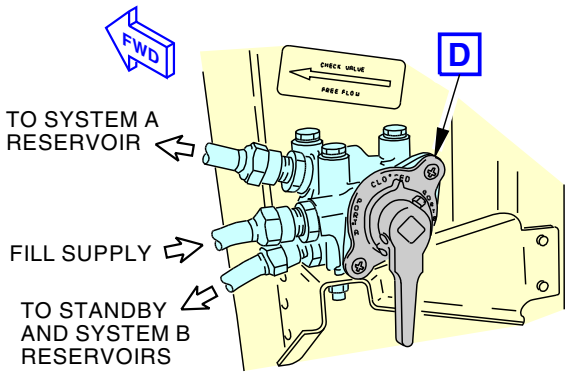



A



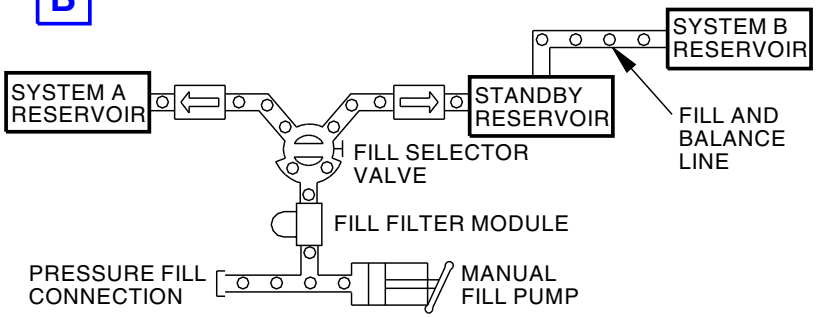

GROUND SERVICING SYSTEM

B




FILL SELECTOR VALVE

C




GROUND SERVICING SYSTEM COMPONENTS

D

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MAIN HYDRAULIC SYSTEMS - GROUND SERVICING SYSTEM

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# AUXILIARY HYDRAULIC SYSTEMS - INTRODUCTION

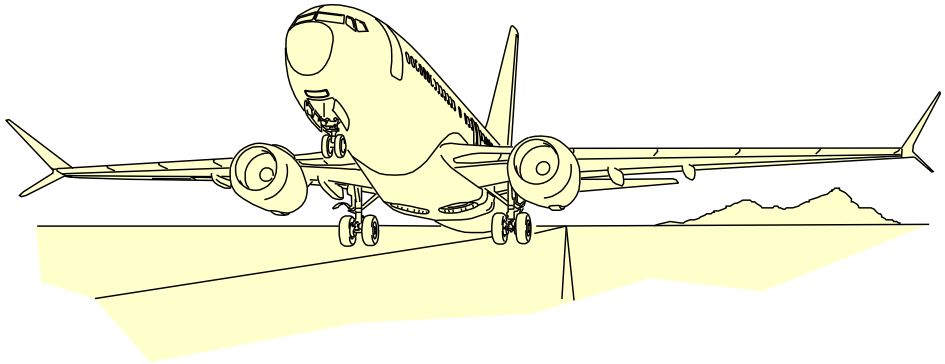
## General

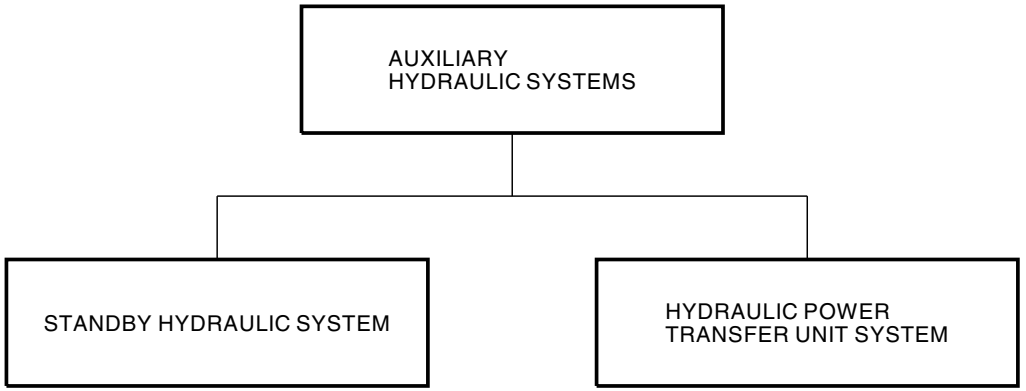
The auxiliary hydraulic systems supply alternative pressure sources to hydraulic systems A and B.

These are the auxiliary hydraulic systems:

- Standby hydraulic system
- Hydraulic power transfer unit (PTU) system.

## AUXILIARY HYDRAULIC SYSTEMS - INTRODUCTION



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AUXILIARY HYDRAULIC SYSTEMS - INTRODUCTION

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## STANDBY HYDRAULIC SYSTEM - INTRODUCTION

### Purpose

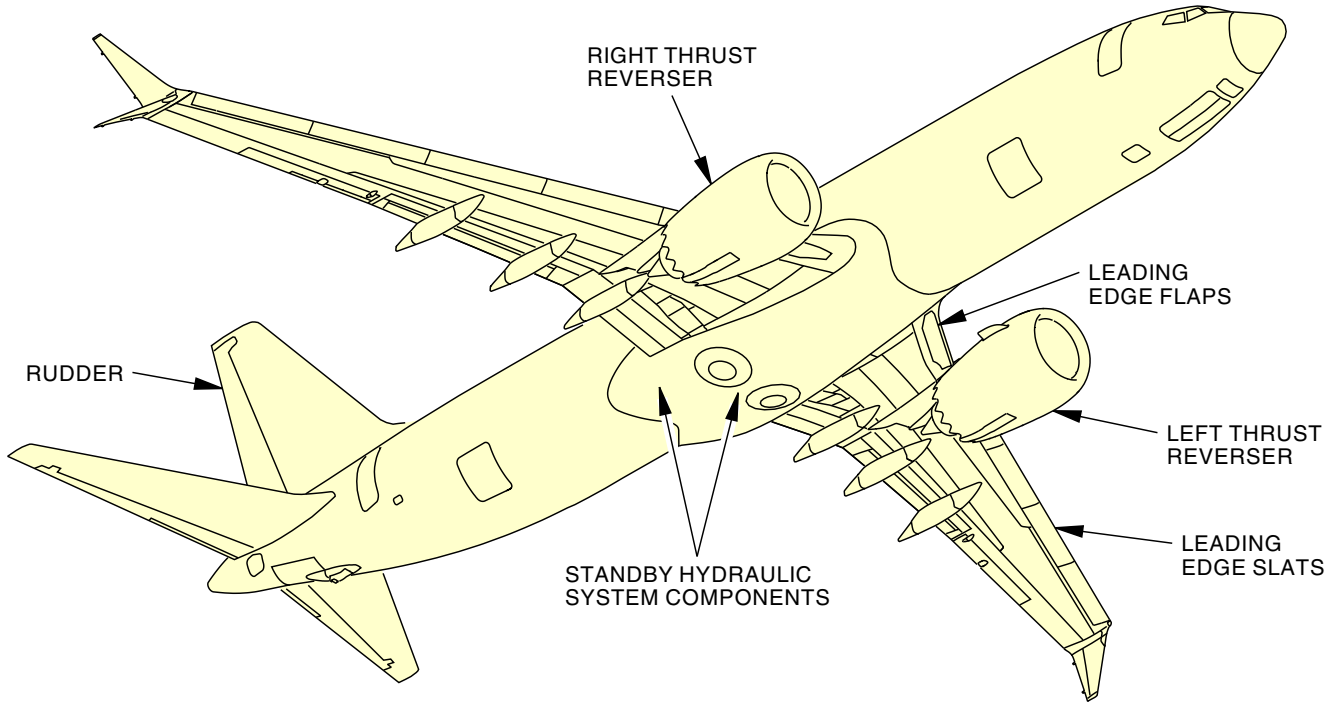
The standby hydraulic system supplies alternate hydraulic pressure to these systems:

- Thrust reversers
- Leading edge flaps and slats
- Rudder.

The standby hydraulic system has these two modes of operation:

- Manual for the leading edge devices and thrust reversers
- Automatic for the rudder.

## STANDBY HYDRAULIC SYSTEM - INTRODUCTION

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STANDBY HYDRAULIC SYSTEM - INTRODUCTION

# STANDBY HYDRAULIC SYSTEM - GENERAL DESCRIPTION

## Purpose

The standby hydraulic system supplies alternate hydraulic pressure for these systems:

- Thrust reversers
- Leading edge flaps and slats
- Rudder.

## Components

The standby hydraulic system has these components:

- Flight control panel
- Reservoir
- Electric motor-driven pump (EMDP)
- Standby hydraulic system module
- Case drain filter module.

## Flight Control Panel

The flight control panel controls these components:

- Standby rudder shutoff valve
- Leading edge flaps and slats shutoff valve
- EMDP
- Standby hydraulic LOW QUANTITY light
- Standby hydraulic LOW PRESSURE light.

## Reservoir

The standby hydraulic system reservoir supplies hydraulic fluid to the EMDP. The reservoir also gets the return hydraulic fluid.

## Electric Motor-Driven Pump

The EMDP has an electric motor that mechanically connects to a hydraulic pump. The EMDP is the only source of hydraulic pressure in the standby hydraulic system.

## Standby Hydraulic System Module

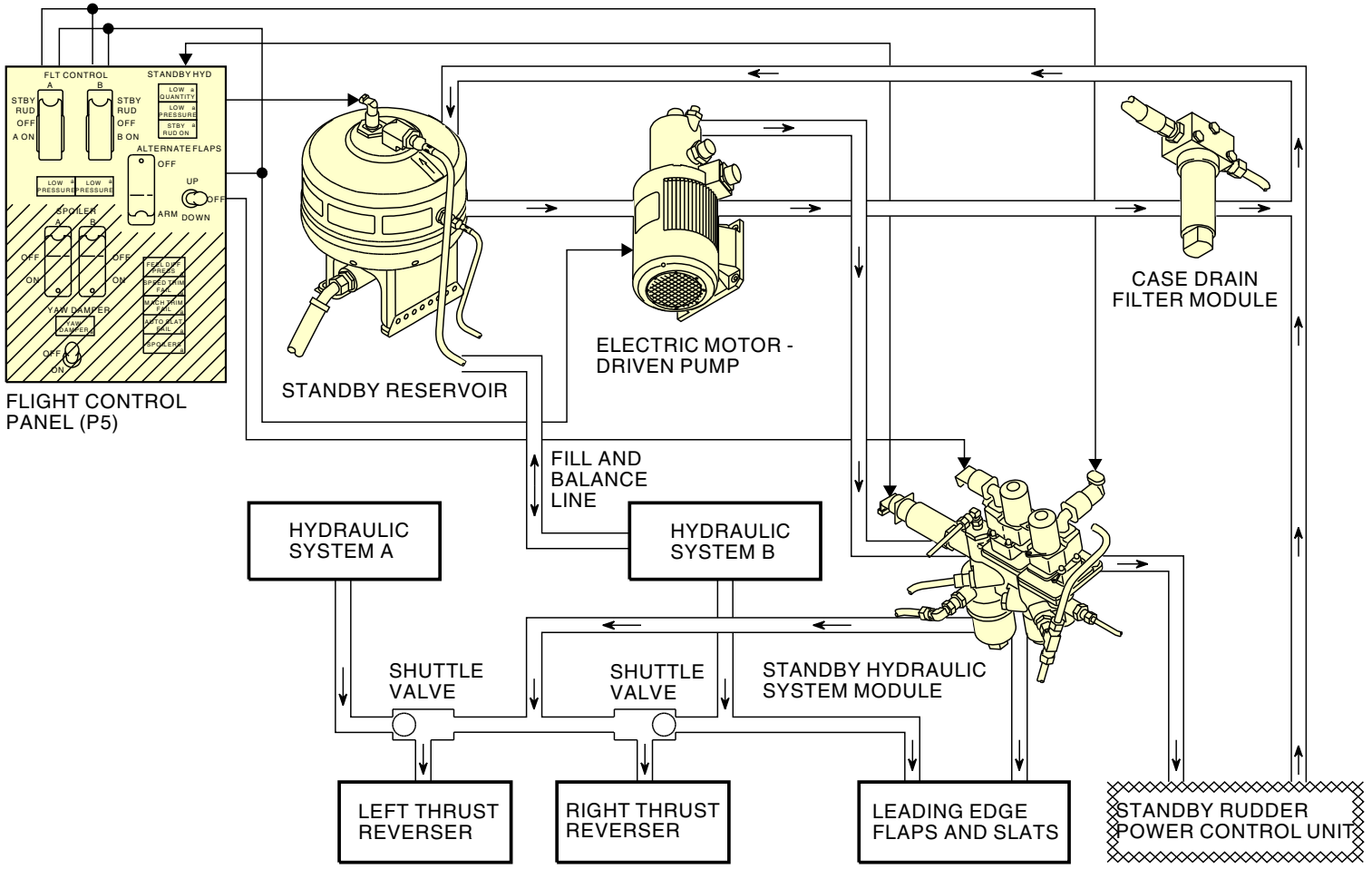
The standby hydraulic system module does these functions:

- Cleans the pressure fluid from the standby EMDP
- Controls pressure to the leading edge flaps and slats
- Controls pressure to the standby rudder power control unit (PCU)
- Supplies metered pressure to the thrust reversers
- Monitors system pressure
- Protects system from over pressure.

## Case Drain Filter Module

The case drain filter module cleans the case drain fluid that comes from the EMDP.

## STANDBY HYDRAULIC SYSTEM - GENERAL DESCRIPTION

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**STANDBY HYDRAULIC SYSTEM - GENERAL DESCRIPTION**

## STANDBY HYDRAULIC SYSTEM - CONTROLS AND INDICATIONS

### General

The controls and indications for the standby hydraulic system are on the flight control panel. The flight control panel is on the P5 forward overhead panel in the flight compartment.

### Controls

These switches operate components in the standby hydraulic system:

- FLT CONTROL A and B switches
- ALTERNATE FLAPS arm switch
- ALTERNATE FLAPS control switch.

Move one of the two FLT CONTROL A or B switches to the STBY RUD position to start the standby hydraulic system EMDP and open the standby rudder shutoff valve in the standby system module.

Move the ALTERNATE FLAPS arm switch to the ARM position to start the standby hydraulic system EMDP.

Move the ALTERNATE FLAPS control switch to the down position momentarily to open the leading edge flaps and slats shutoff valve in the standby system module.

### Indications

These are the three caution indications on the flight control panel for the standby hydraulic system:

- STANDBY HYD LOW QUANTITY light
- STANDBY HYD LOW PRESSURE light.
- STANDBY HYD STBY RUD ON light.

The amber STANDBY HYD LOW QUANTITY light comes on when the hydraulic fluid in the standby reservoir decreases to less than 50 percent.

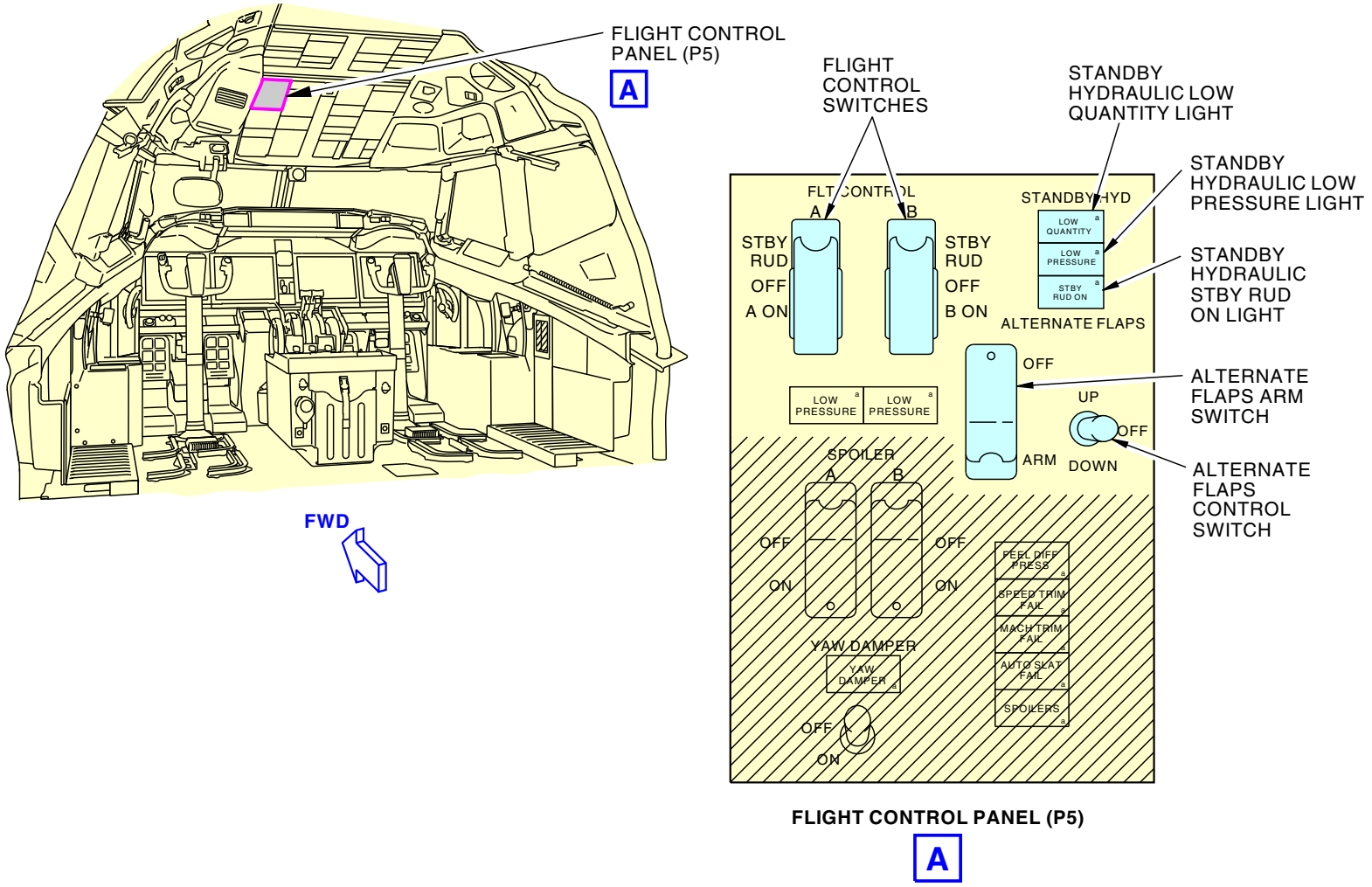
See the hydraulic indicating system section for more information about the hydraulic fluid quantity indicating system. (SECTION 29-30)

The amber STANDBY HYD LOW PRESSURE light comes on when the pressure from the standby hydraulic system EMDP decreases to less than normal during automatic or manual operation of the EMDP.

See the hydraulic indicating system section for more information about the hydraulic pump low pressure warning system. (SECTION 29-30)

The amber STANDBY HYD STBY RUD ON light comes on whenever the standby hydraulic system is turned on. The standby hydraulic system is turned on when the FLT CONTROL A or B switches are set to STBY RUD or when automatic standby activation is commanded through either the auto standby system or the main rudder PCU force fight monitor.

## STANDBY HYDRAULIC SYSTEM - CONTROLS AND INDICATIONS




**FLIGHT CONTROL PANEL (P5)**

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STANDBY HYDRAULIC SYSTEM - CONTROLS AND INDICATIONS

## STANDBY HYDRAULIC SYSTEM - RESERVOIR

### Purpose

The standby hydraulic system reservoir supplies hydraulic fluid under pressure to the standby hydraulic system EMDP. The reservoir also receives the return hydraulic fluid from the standby rudder power control unit and the B system reservoir balance line.

### Location

The standby hydraulic system reservoir is on the keel beam in the main landing gear wheel well.

### Physical Description

The standby hydraulic system reservoir is an airtight metal shell that contains 3.6 gallons (13.3 liters) of hydraulic fluid.

The reservoir has these components and connections:

- Ground service line
- Fill and balance line
- EMDP supply line
- Low quantity switch.

The standby hydraulic system reservoir has no drain valve.

### Functional Description

The ground service connection permits fluid servicing from the ground servicing system to the standby and system B reservoirs.

The fill and balance connection connects the standby reservoir to the hydraulic system B reservoir. The fill and balance line does these functions:

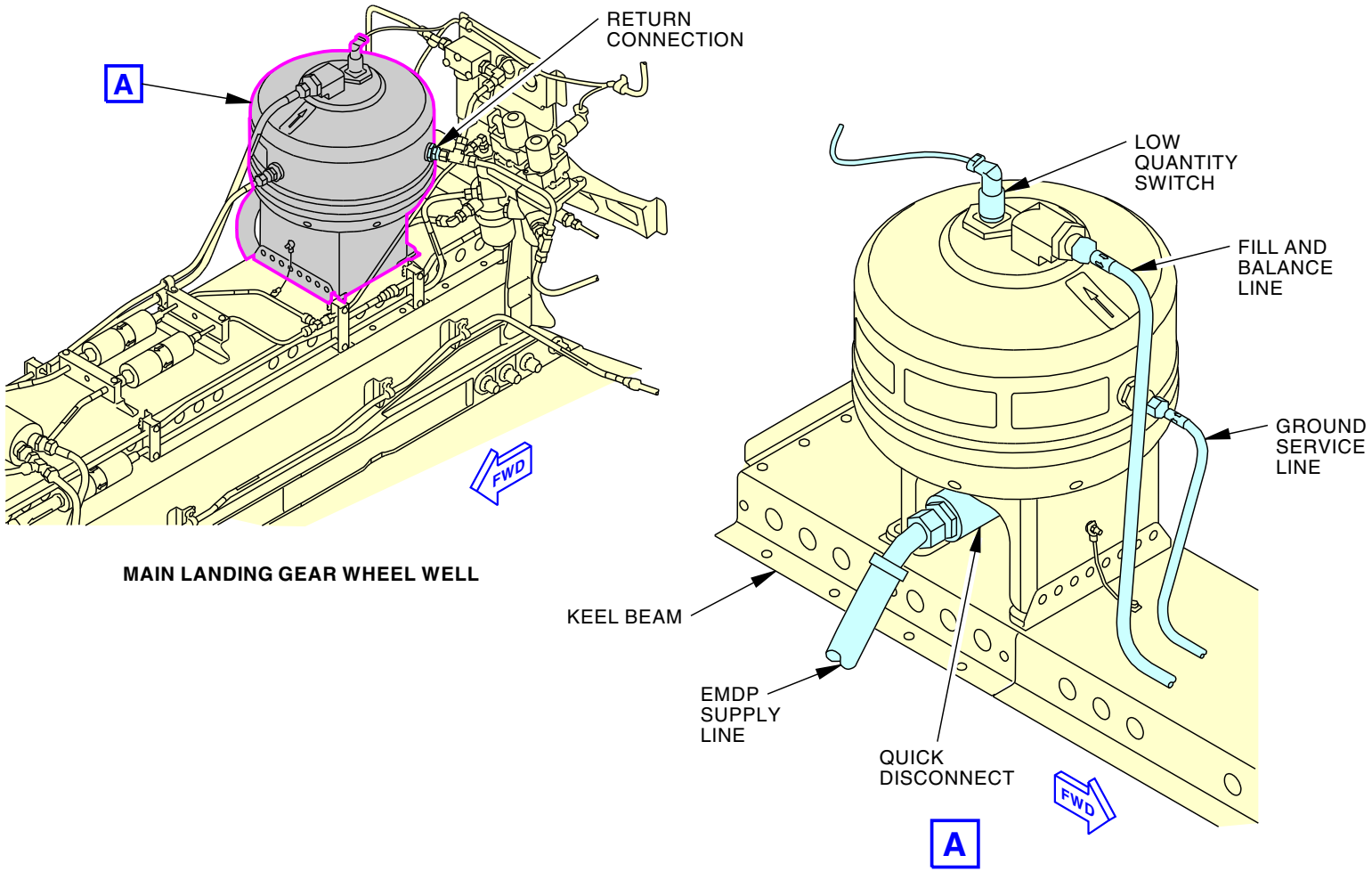
- Overfill from the servicing system to the system B reservoir
- Thermal expansion of the standby hydraulic system reservoir
- Supply pressure from the hydraulic system B reservoir.

The EMDP supply line connection permits hydraulic fluid supply to the pump, and purging of the reservoir.

The reservoir low quantity switch sends a signal to the amber STANDBY HYD LOW QUANTITY light on the flight control panel in the flight compartment when the fluid level in the reservoir is less than 50 percent.

See the hydraulic indicating system section for more information about hydraulic fluid quantity indicating system. (SECTION 29-30)

## STANDBY HYDRAULIC SYSTEM - RESERVOIR




STANDBY HYDRAULIC SYSTEM - RESERVOIR

## STANDBY HYDRAULIC SYSTEM - ELECTRIC MOTOR-DRIVEN PUMP

### Purpose

The standby hydraulic system electric motor-driven pump (EMDP) supplies hydraulic pressure to the standby hydraulic system.

### Location

The standby hydraulic system EMDP is in the right aft wing to body fairing, inboard of the brake accumulator.

### Physical Description

The EMDP assembly has these components:

- Three-phase, 400 hertz, 115v ac electric motor
- Variable-delivery, positive-displacement hydraulic pump.

The motor mounts to airplane structure and the pump mounts to the motor.

The EMDP has these connections:

- Supply
- Pressure
- Case drain.

The EMDP is rated at 3.7 gpm at 2700 psi.

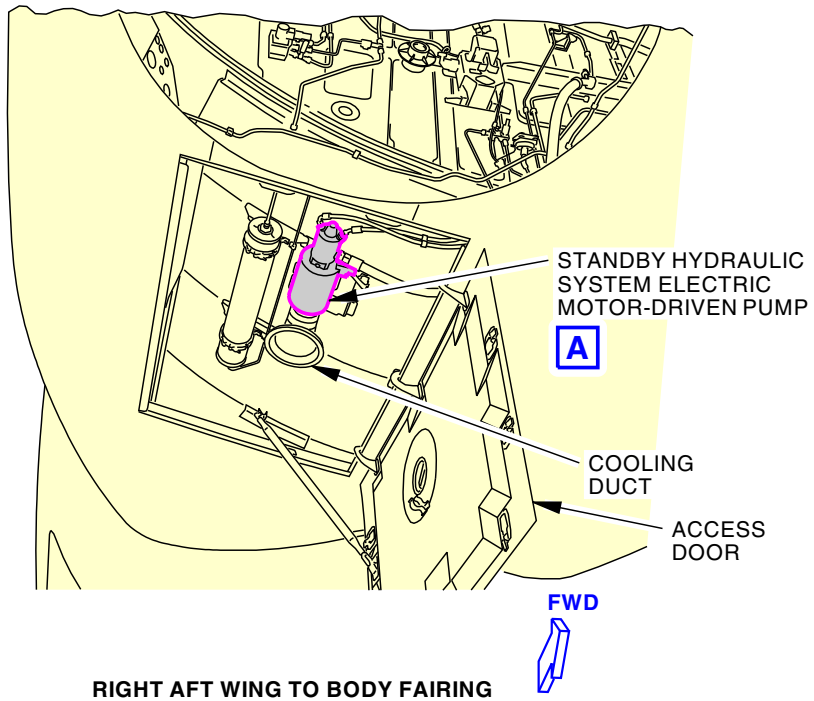
### Functional Description

Pressurized hydraulic fluid from the standby hydraulic reservoir enters the pump through the supply connection. The pump maintains a supply of pressure to the standby hydraulic system pressure module.

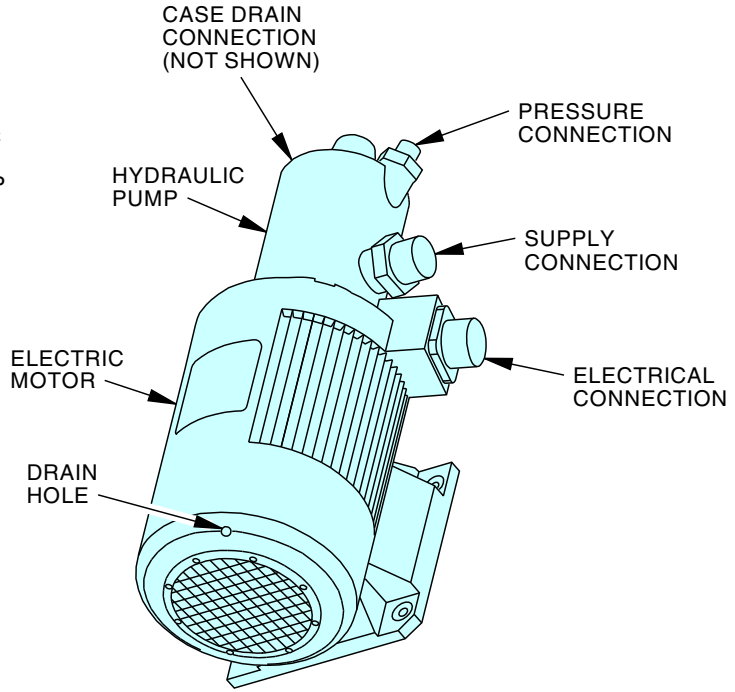
Some of the supply fluid in hydraulic pump becomes case drain fluid. The case drain fluid cools and lubricates the pump and then goes through the case drain filter before it enters the reservoir.

The motor is air cooled through a cooling duct. Air flows from outside the airplane and goes thru a vent in the right aft wing to body fairing access panel to the EMDP cooling duct. Air then goes thru the EMDP plenum and into the compartment. There is a hole in the left aft wing to body fairing on the other side of the fuselage for a vent.

## STANDBY HYDRAULIC SYSTEM - ELECTRIC MOTOR-DRIVEN PUMP




RIGHT AFT WING TO BODY FAIRING




STANDBY HYDRAULIC SYSTEM ELECTRIC MOTOR-DRIVEN PUMP

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STANDBY HYDRAULIC SYSTEM - ELECTRIC MOTOR-DRIVEN PUMP

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## STANDBY HYDRAULIC SYSTEM - STANDBY HYDRAULIC SYSTEM MODULE AND CASE DRAIN FILTER MODULE

### General

The standby hydraulic system module does these functions:

- Cleans the pressure flow from the standby EMDP
- Controls pressure to the leading edge flaps and slats
- Controls pressure to the standby rudder power control unit (PCU)
- Supplies metered pressure to the thrust reversers
- Monitor system pressure
- Protect system from over pressure.

The case drain filter module cleans the case drain flow from the standby pump.

### Location

The standby hydraulic system module and the case drain filter module are on the aft bulkhead of the main landing gear wheel well.

### Physical Description

The standby hydraulic system module has these components:

- Leading edge flaps and slats shutoff valve
- Standby rudder shutoff valve
- Pressure filter module
- Pressure relief valve
- Case drain filter module
- EMDP low pressure switch.

The leading edge flaps and slats shutoff valve and standby rudder shutoff valve are identical 28v dc, motor-operated valves. Each valve has a manual override lever.

The pressure filter module is non-bypass type with a 5-15 micron, non-cleanable, cartridge type filter element.

The pressure filter module has these components:

- Filter head in the standby hydraulic system module
- Filter bowl
- Replaceable filter element.

The case drain filter module is non-bypass type with a 10-20 micron, non-cleanable, cartridge type filter element.

The case drain filter module has these components:

- Filter module head
- Filter bowl
- Replaceable filter element.

The EMDP low pressure switch is a sealed assembly with a piston, disc spring and electrical switch.

### Functional Description

Hydraulic pressure from the EMDP goes through the pressure filter to the standby rudder shutoff valve and the leading edge flaps and slats shutoff valve.

The EMDP pump low pressure switch sends signals to the STANDBY HYD LOW PRESSURE light on the flight control panel in the flight compartment when the pressure is less than normal.

See the hydraulic indicating system section for more information about hydraulic pump low pressure warning indication. (SECTION 29-30)

The standby rudder shutoff valve operates electrically to control standby pressure to the standby rudder power control unit. A lever on the valve shows the valve position. You use the lever to move the valve to the open or closed position.

The leading edge flaps and slats shutoff valve operates electrically to control standby pressure to the leading edge flaps and slats. The valve opens during alternate operation of the leading edge flaps and slats. A lever on the valve shows the valve position. You use the lever to move the valve to the open or closed position.

The pressure relief valve prevents high pressure in the standby hydraulic system. The valve opens at 3500 psi and vents the pressure to the return line. The valve closes at 3400 psi.

The case drain filter module cleans the case drain fluid from the EMDP before it goes back to the reservoir.

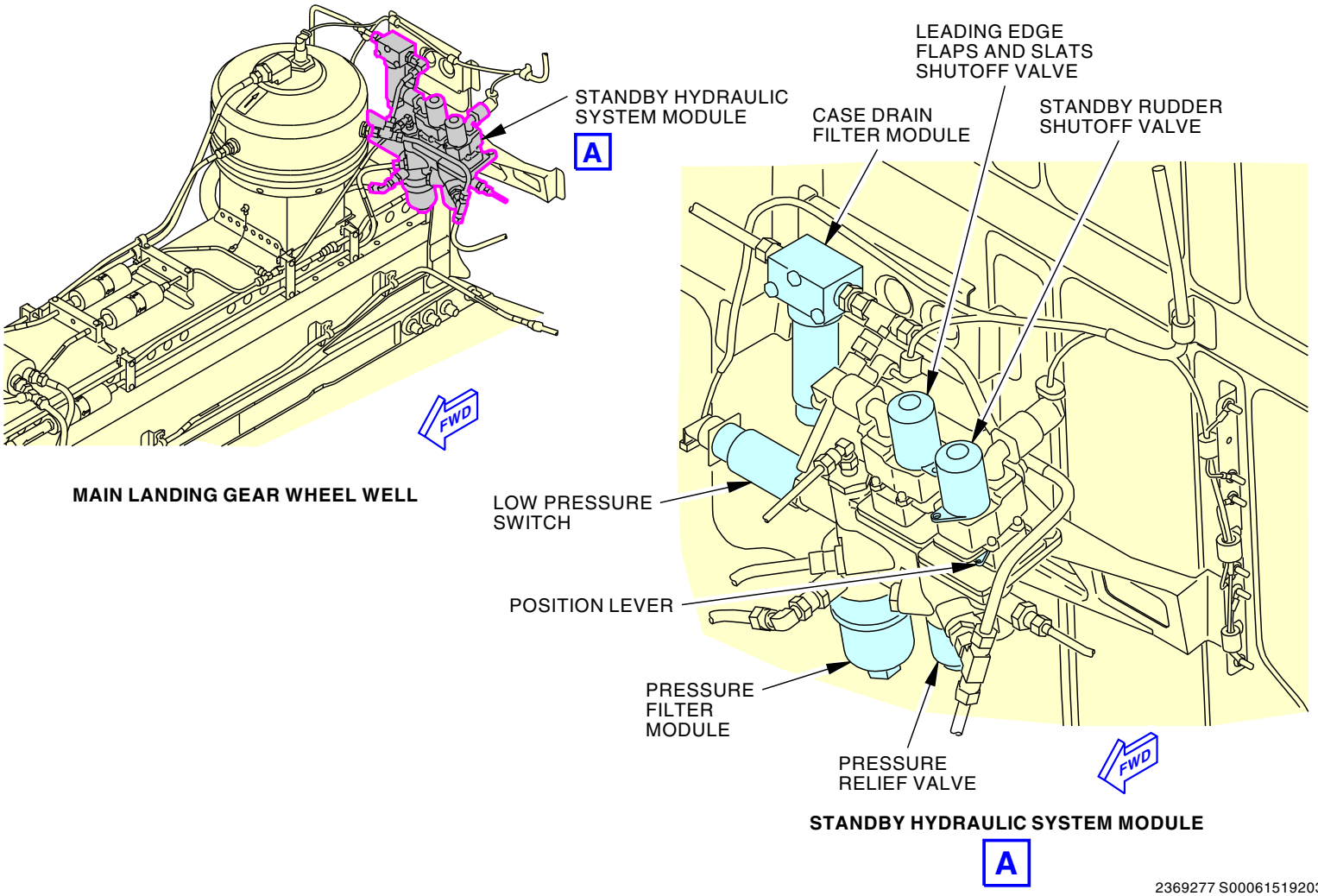
**Filter Element Replacement**

**NOTE:** You can not clean the pressure and case drain filter elements and use them again.

If you replace the pressure filter element, you must do the pressure filter element installation test.

If you replace the case drain filter element, you must do the case drain filter element installation test.

## STANDBY HYDRAULIC SYSTEM - STANDBY HYDRAULIC SYSTEM MODULE AND CASE DRAIN FILTER MODULE

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STANDBY HYDRAULIC SYSTEM - STANDBY HYDRAULIC SYSTEM MODULE AND CASE DRAIN FILTER MODULE

## STANDBY HYDRAULIC SYSTEM - FUNCTIONAL DESCRIPTION - HYDRAULIC

### General

The standby hydraulic system operates automatically or manually as a backup to the hydraulic systems A and B.

The standby hydraulic system supplies hydraulic fluid under pressure to operate these components:

- Leading edge flaps and slats
- Standby rudder power control unit.
- Left and right thrust reversers

### Fluid Supply

The standby reservoir contains the hydraulic fluid supply for the standby hydraulic EMDP.

The fill balance line connects the standby reservoir to the system B reservoir. The system B reservoir can supply fluid and pressurization to the standby reservoir.

The ground servicing system lets you add fluid to the standby reservoir. This also adds fluid to the system B reservoir through the fill and balance line.

### Pressurization

The EMDP supplies pressure to the standby hydraulic system. The EMDP can operate either manually or automatically.

A pump low pressure switch sends a signal to a flight compartment STANDBY HYD LOW PRESSURE light. This occurs when the EMDP pressure decreases to less than normal.

### Distribution

The pressurized fluid from the EMDP goes to the standby hydraulic system module. The standby hydraulic system module cleans, monitors, and distributes the pressurized fluid.

The leading edge flap and slat shutoff valve controls pressure to the leading edge flaps and slats.

The standby rudder shutoff valve controls pressure to the standby rudder power control unit.

A volume fuse in the standby system pressure line to the leading edge flaps and slats closes when hydraulic fluid flow increases to 270-350 cubic inches. A flow limiting valve downstream of the volume fuse limits the standby hydraulic fluid flow to 2.1 gallons per minute.

See the leading edge flaps and slat control system for more information about the flow limiting valve and hydraulic fuses. (SECTION 27-81)

A check valve in the standby pressure line upstream of the left thrust reverser shuttle valve prevents transfer of system A fluid into system B.

Volume fuses in the standby system pressure lines to the thrust reversers close when hydraulic fluid flow increase to 175 cubic inches. This prevents hydraulic fluid loss if there is a leak in the system.

See the thrust reverser control system for more information about the volumetric hydraulic fuses. (SECTION 78-34)

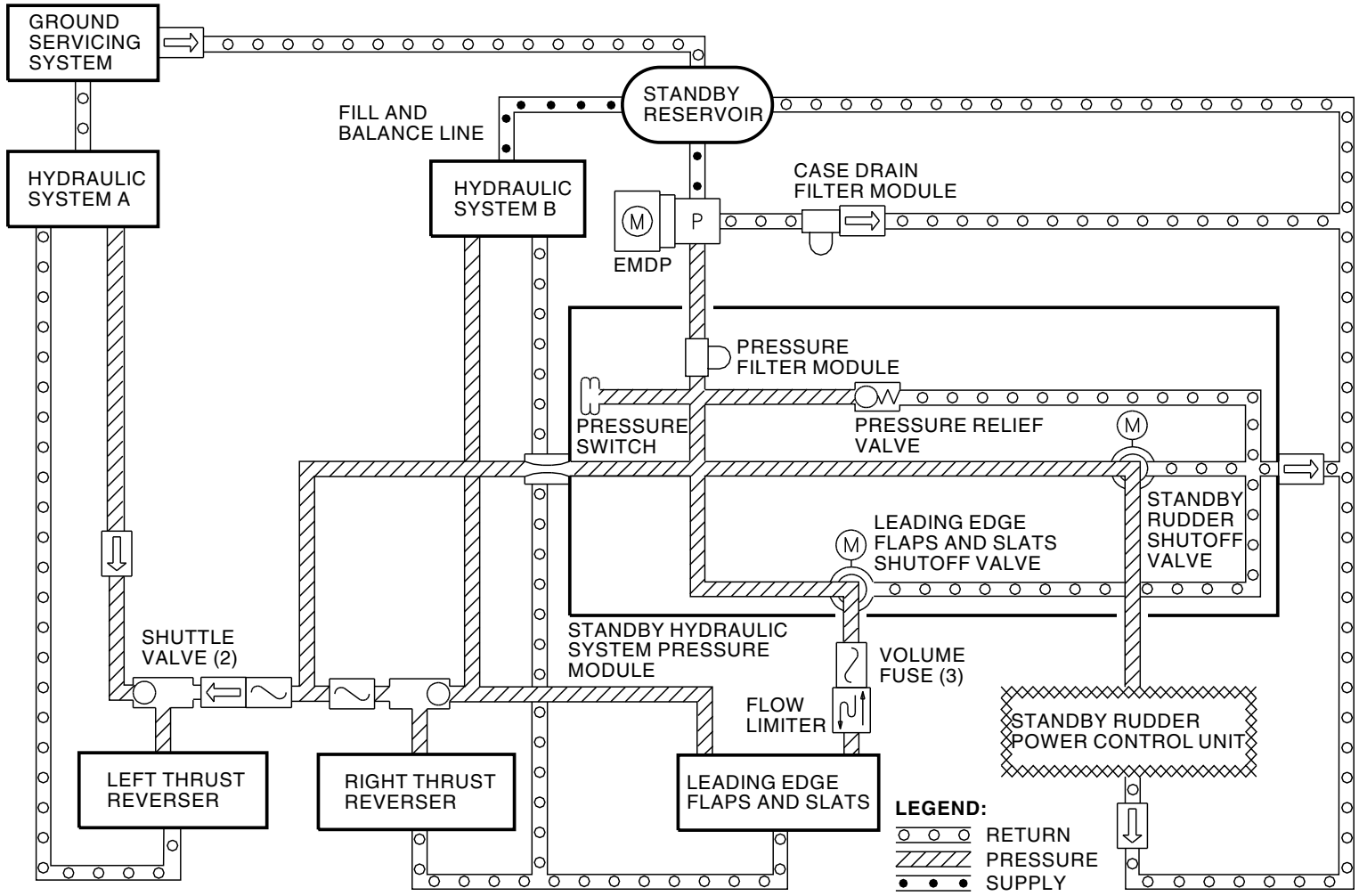
Shuttle valves make a selection between system A and B pressure or standby pressure, to supply the thrust reversers.

### Filtration

A pressure filter in the standby hydraulic system module cleans the pressure flow to the EMDP.

A case drain filter module cleans the case drain flow from the EMDP.

## STANDBY HYDRAULIC SYSTEM - FUNCTIONAL DESCRIPTION - HYDRAULIC

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STANDBY HYDRAULIC SYSTEM - FUNCTIONAL DESCRIPTION - HYDRAULIC

## STANDBY HYDRAULIC SYSTEM - FUNCTIONAL DESCRIPTION - ELECTRICAL - PUMP

### General

You operate the standby system hydraulic electric motor-driven pump (EMDP) manually with one of these switches on the flight control panel:

- FLT CONTROL A switch to STBY RUD
- FLT CONTROL B switch to STBY RUD
- ALTERNATE FLAPS arm switch to ARM.

The standby pump operates automatically if all of these conditions are true:

- Either FLT CONTROL A or B switch to ON
- ALTERNATE FLAPS arm switch to OFF
- Trailing edge flaps not up
- Airplane in the air or wheel speed more than 60 kts
- Low flight control pressure.

### Manual Functional Description

Either FLT CONTROL switch to STBY RUD sends 28v dc to energize these components:

- The standby hydraulic pump relay. When the relay is energized, 115v ac goes through the relay contacts and turns on the standby hydraulic system EMDP.
- The standby rudder shutoff valve. When the valve opens, hydraulic pressure from the standby hydraulic system EMDP goes to the standby rudder power control unit (PCU). Also, electrical power goes to the valve position relay.

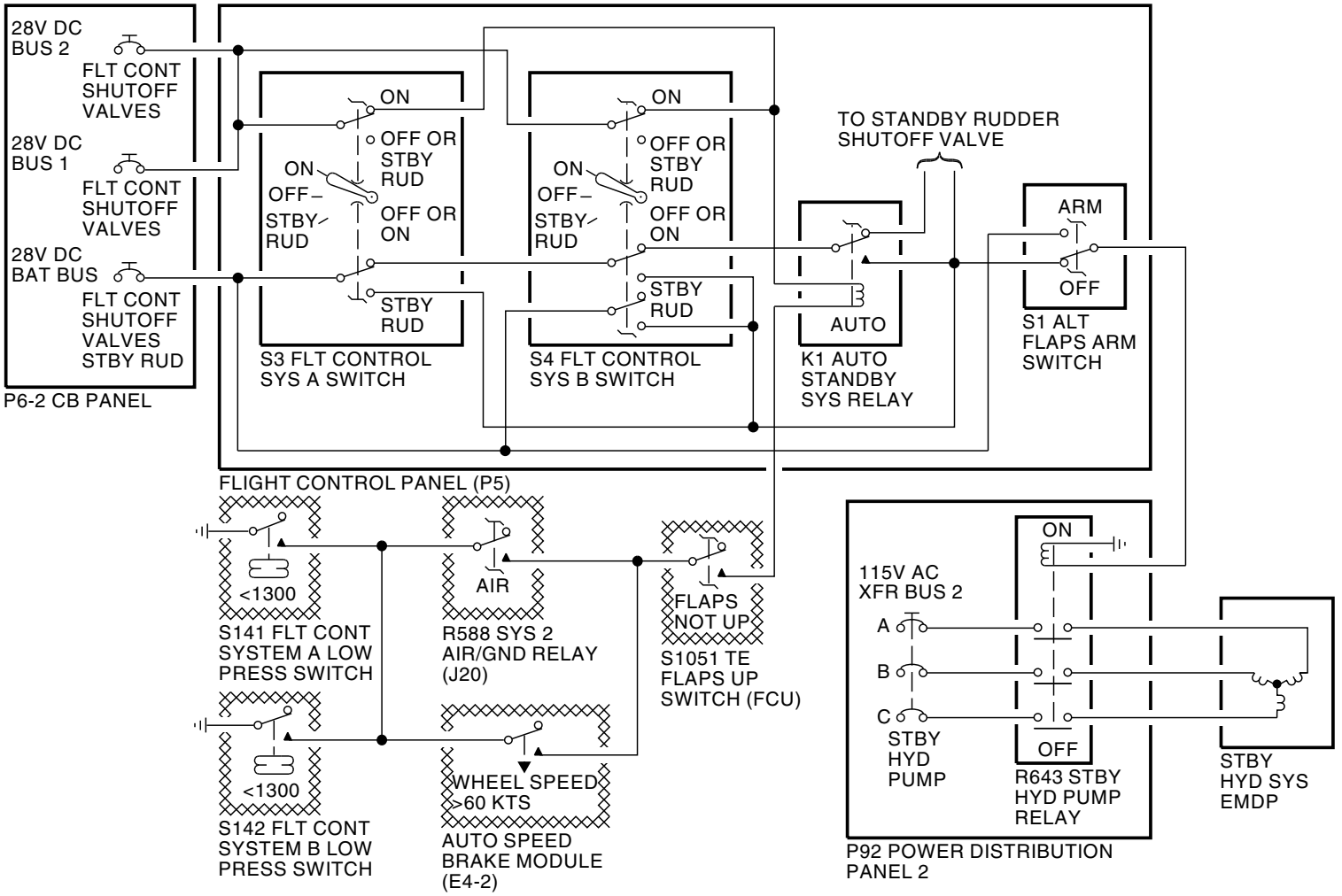
See the flight controls multiple use systems/units section for more information about the valve position relay. (SECTION 27-09)

The ALTERNATE FLAPS arm switch to the ARM position energizes only the standby hydraulic pump relay. This turns on the standby hydraulic pump.

### Automatic Functional Description

When all the conditions for automatic operation are correct, the auto standby system relay energizes. This lets 28v dc energize the same components as the manual function of operation.

## STANDBY HYDRAULIC SYSTEM - FUNCTIONAL DESCRIPTION - ELECTRICAL - PUMP

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STANDBY HYDRAULIC SYSTEM - FUNCTIONAL DESCRIPTION - ELECTRICAL - PUMP

## STANDBY HYDRAULIC SYSTEM - FUNCTIONAL DESCRIPTION - ELECTRICAL - VALVES

### General

The standby rudder shutoff valve operates manually or automatically. In the automatic mode, the standby hydraulic system supplies enough control of the rudder during takeoff, approach, and landing if either or both of the main systems fail. The leading edge flaps and slats shutoff valve only operate manually.

### Standby Rudder Shutoff Valve

Manual operation of either FLT CONTROL switch to the STBY RUD position sends 28v dc power to open the standby rudder shutoff valve and control the FLT CONTROL LOW PRESSURE light through the standby rudder valve position relay. When the relay energizes, the ground for the FLT CONTROL LOW PRESSURE lights is removed. If the valve does not open, the respective FLT CONTROL LOW PRESSURE light stays on.

See the flight control multiple use systems/units section for more information about the FLT CONTROL LOW PRESSURE light. (SECTION 27-09)

See the flight control multiple use systems/units section for more information about the standby rudder valve position relay. (SECTION 27-09)

The standby rudder shutoff valve moves to the closed position when both FLT CONTROL switches are moved to the OFF or ON positions.

Automatic operation of the standby pump energizes the auto standby system relay in the flight control panel. This sends 28v dc power to open the standby rudder shutoff valve and control the FLT CONTROL LOW PRESSURE light through the standby rudder valve position relay.

The standby rudder shutoff valve closes when the standby hydraulic system EMDP stops automatic operation.

### Leading Edge Flaps And Slats Shutoff Valve

Move the ALTERNATE FLAPS arm switch to the ARM position and the ALTERNATE FLAPS control switch the DOWN position. This sends 28v dc power to operate the leading edge flaps and slats shutoff valve to the open position and energize the K3 LE standby drive shutoff valve relay.

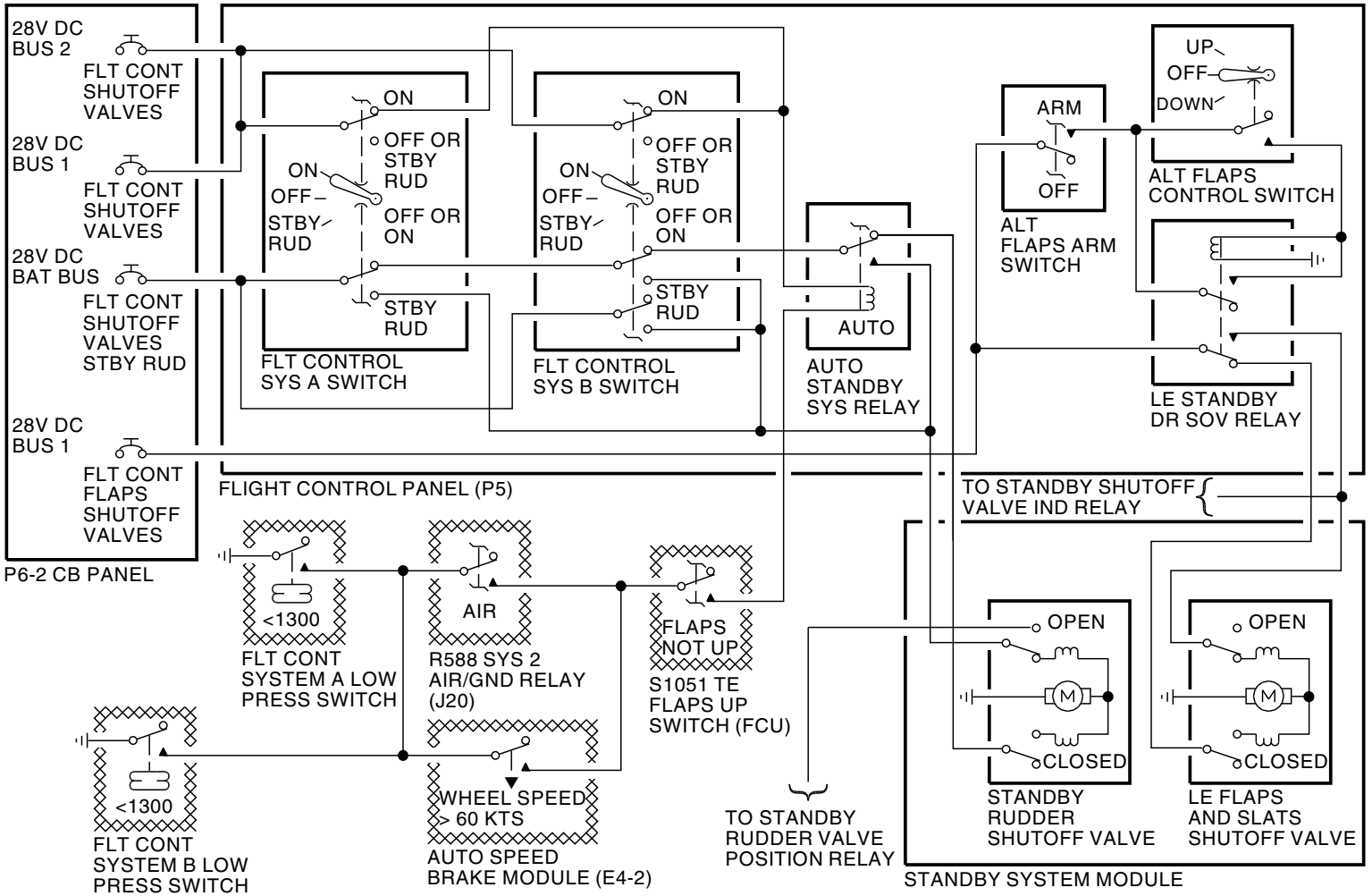
When the K3 relay is energized, a signal goes to the R625 standby shutoff valve indication relay. This controls electrical power from the TE flap landing warning switch to close the PTU control valve in the main landing gear wheel well.

See the hydraulic power transfer unit system section for more information about the standby shutoff valve indication relay. (SECTION 29-25)

The LE standby drive shutoff valve relay has a hold circuit. The hold circuit holds the relay in the energized position when the ALTERNATE FLAPS control switch releases and moves to the OFF position. The ALTERNATE FLAPS arm switch must be in the ARM position.

The leading edge flaps and slats shutoff valve operates to the closed position when the ALTERNATE FLAPS arm switch moves to the OFF position. This de-energizes the LE standby drive shutoff valve relay hold circuit. This also removes 28v dc to the leading edge flaps and slats shutoff valve.

## STANDBY HYDRAULIC SYSTEM - FUNCTIONAL DESCRIPTION - ELECTRICAL - VALVES

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STANDBY HYDRAULIC SYSTEM - FUNCTIONAL DESCRIPTION - ELECTRICAL - VALVES

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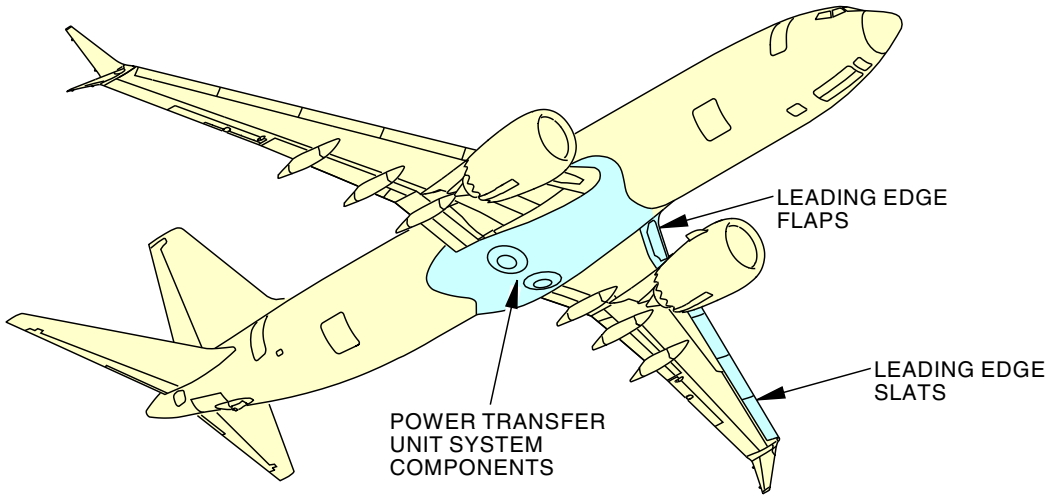
## HYD POWER TRANSFER UNIT SYSTEM - INTRODUCTION

### Purpose

The hydraulic power transfer unit (PTU) system supplies alternate hydraulic pressure to the leading edge flaps and slats when hydraulic system B engine-driven pump (EDP) pressure is below normal.

## HYD POWER TRANSFER UNIT SYSTEM - INTRODUCTION

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HYD POWER TRANSFER UNIT SYSTEM - INTRODUCTION

## HYD POWER TRANSFER UNIT SYSTEM - GENERAL DESCRIPTION

### Purpose

The hydraulic power transfer unit (PTU) system supplies alternative hydraulic pressure to the leading edge flaps and slats only. PTU pressure can be used for normal operation or for autoslat operation when system B engine-drive pump (EDP) pressure is below normal.

### Components

The hydraulic PTU system has these components:

- Power transfer unit
- Check valve (2)
- PTU pressure filter module
- Flow limiter
- PTU control valve
- EDP pressure switch auto slat system.

### Power Transfer Unit

The PTU assembly has a hydraulic motor and a hydraulic pump connected by a common shaft. The motor receives pressure from hydraulic system A through the PTU control valve to turn the motor. The pump receives fluid supply from the hydraulic system B reservoir and supplies alternative pressure to the leading edge flaps and slats.

### PTU Pressure Filter Module

The PTU pressure filter module cleans the pressurized fluid from the pump of the power transfer unit.

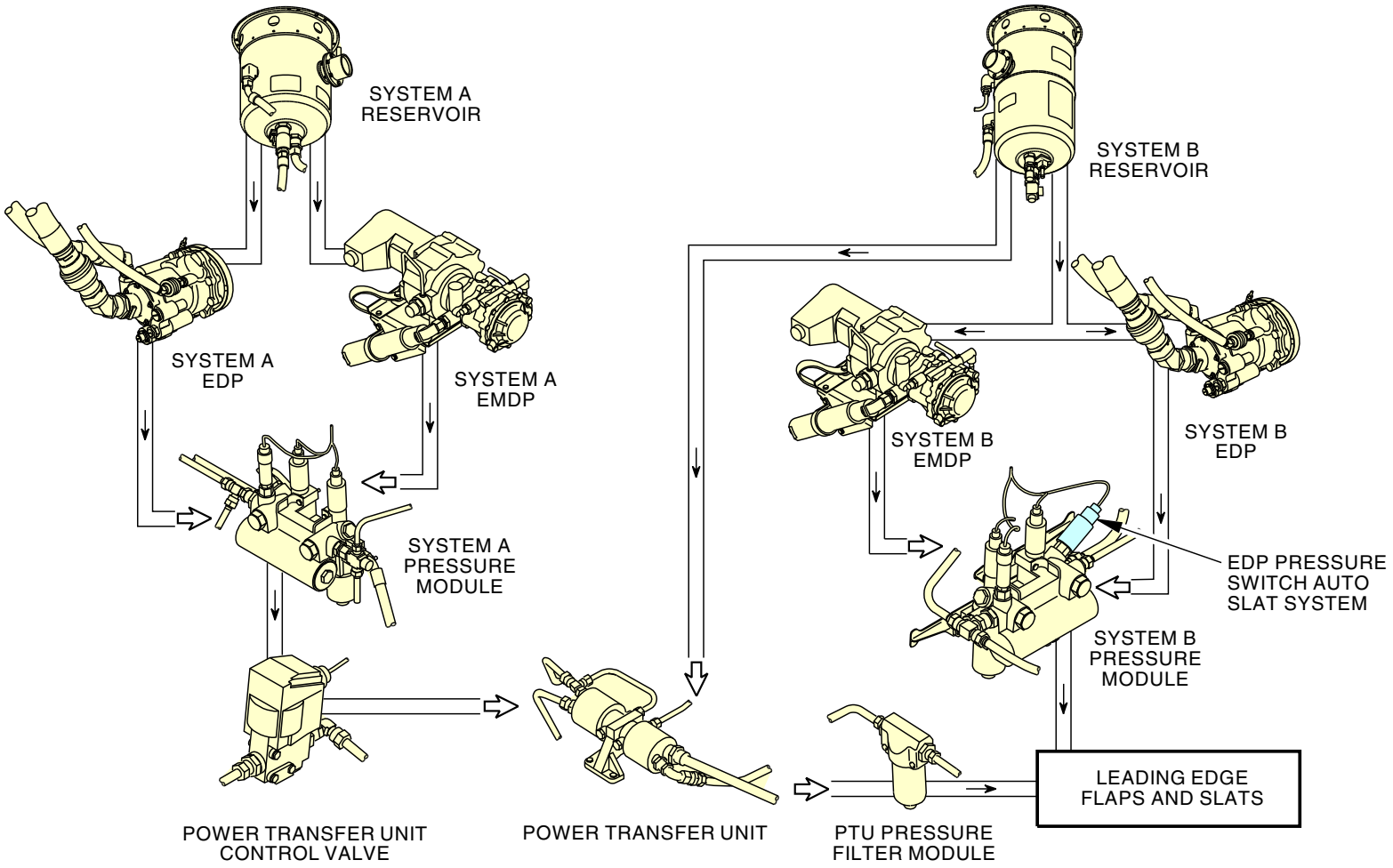
### PTU Control Valve

The PTU control valve controls the hydraulic system A pressure that goes to the motor of the power transfer unit.

### EDP Pressure Switch Auto Slat System

The EDP pressure switch auto slat system monitors the pressure from the hydraulic system B engine-driven pump. The signal from the switch goes to the control circuit for the PTU control valve.

## HYD POWER TRANSFER UNIT SYSTEM - GENERAL DESCRIPTION

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HYD POWER TRANSFER UNIT SYSTEM - GENERAL DESCRIPTION

## HYD POWER TRANSFER UNIT SYSTEM - POWER TRANSFER UNIT, PTU PRESSURE FILTER MODULE

### Purpose

The power transfer unit (PTU), supplied with fluid from the system B reservoir, provides an alternate source of pressure to the lead edge flaps and slats.

The PTU pressure filter module cleans the pressurized fluid from the PTU pump.

### Location

The PTU is on top of the keel beam in the main gear wheel well.

The PTU pressure filter is in the main gear wheel well below the bracket for the system B EMDP.

The PTU flow limiter is upstream of the PTU control valve on the forward bulkhead in the main gear wheel well.

### Physical Description

The PTU assembly has these components:

- A fixed displacement, piston type motor. The motor is limited to 13.7 gpm by a flow limiter.
- A fixed displacement, inline piston type pump. The pump is rated at 11.6 gpm.

The PTU pressure filter module is non-bypass type with a 5-15 micron, non-cleanable, cartridge type filter element.

The PTU pressure filter module has these components:

- Filter module head
- Filter bowl
- Replaceable filter element.

### Functional Description

The PTU motor uses system A pressure to drive the system B supplied pump without a transfer of fluid between the two systems.

Case drain fluid cools and lubricates the motor and pump. The case drain fluid for the motor returns to the system A reservoir through the return filter module. Case drain fluid from the pump returns to the system B reservoir through the electric motor-driven pump case drain filter module. If case drain fluid from the pump temperature is above normal, the hydraulic fluid overheat warning switch turns on the system B OVERHEAT light.

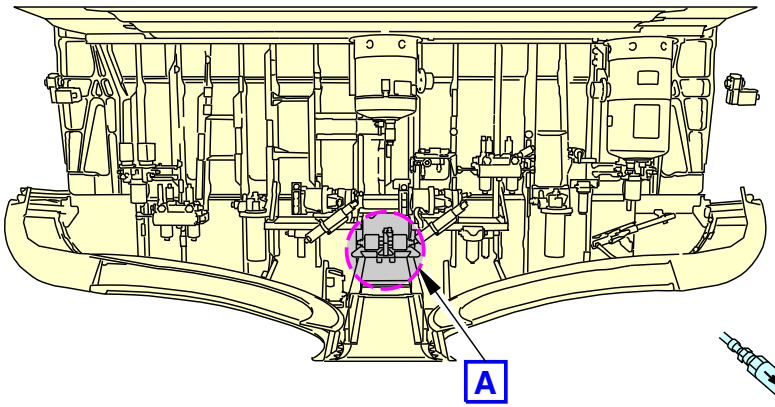
See the hydraulic indicating system for information about the hydraulic fluid overheat warning switches. (SECTION 29-30)

Check valves in the pressure line and case drain line of the PTU pump prevent backflow from system B.

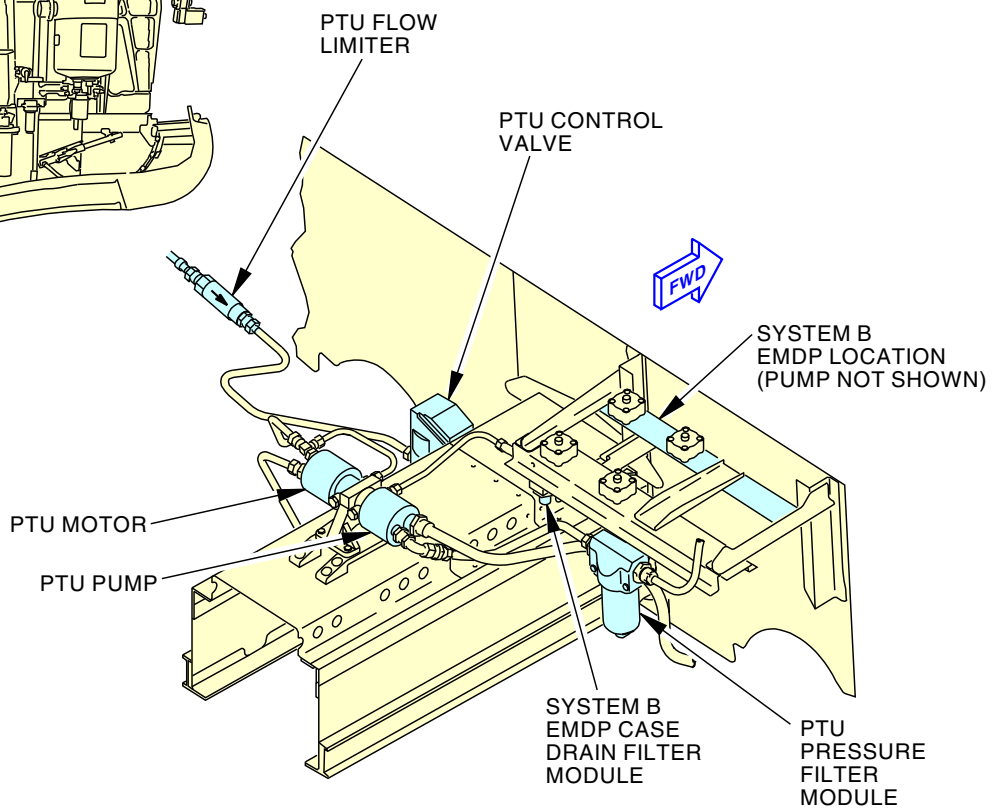
The PTU pressure filter cleans the PTU pump fluid before it enters system B and goes to the leading edge flaps and slats.

The PTU flow limiter limits the flow of hydraulic fluid from system A that goes through the PTU control valve. The hydraulic fluid flow limit is 13.7 gpm.

## HYD POWER TRANSFER UNIT SYSTEM - POWER TRANSFER UNIT, PTU PRESSURE FILTER MODULE




MAIN GEAR WHEEL WELL
(LOOKING FORWARD)




POWER TRANSFER UNIT COMPONENTS

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HYD POWER TRANSFER UNIT SYSTEM - POWER TRANSFER UNIT, PTU PRESSURE FILTER MODULE

## HYD POWER TRANSFER UNIT SYSTEM - PTU CONTROL VALVE, EDP PRESSURE SWITCH AUTO SLAT SYSTEM

### General

The PTU control valve opens to send hydraulic system A pressure to the power transfer unit (PTU) motor.

The EDP pressure switch auto slat system sends a signal to the control circuit for the PTU control valve.

### Location

The valve is on the forward bulkhead below the hydraulic system A EMDP in the main gear wheel well.

The EDP pressure switch auto slat system is on the hydraulic system B pressure module.

### Physical Description

The PTU control valve is a 28v dc motor-operated, two-position shutoff valve. A manual position indicator arm on the valve shows valve position, OPEN or CLOSED.

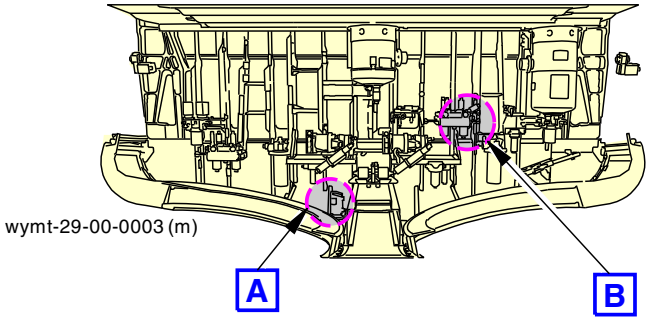
### Functional Description

The PTU control valve lets system A pressure go to the PTU motor automatically or manually. You use the position indicator to open or close the PTU control valve manually.

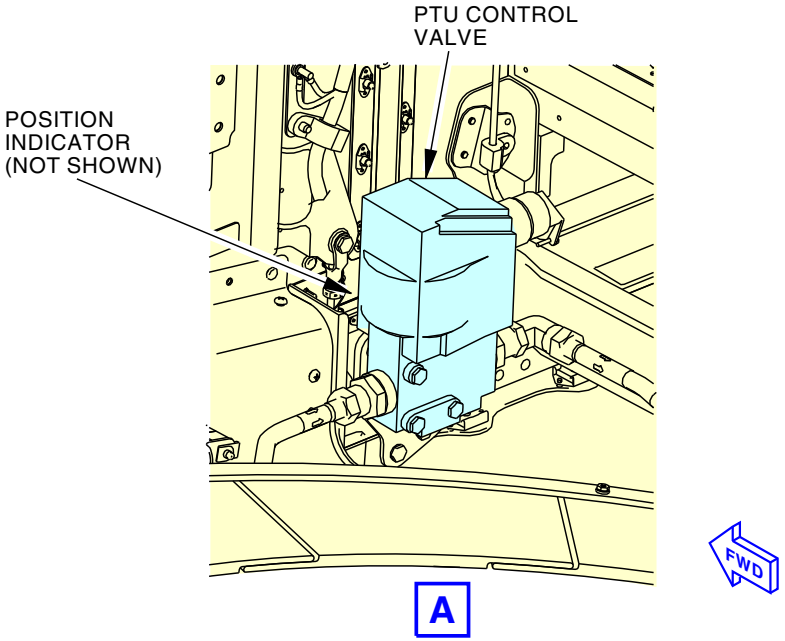
The position indicator arm points to the OPEN marking on the nameplate when the valve is open, and to the CLOSED marking when closed.

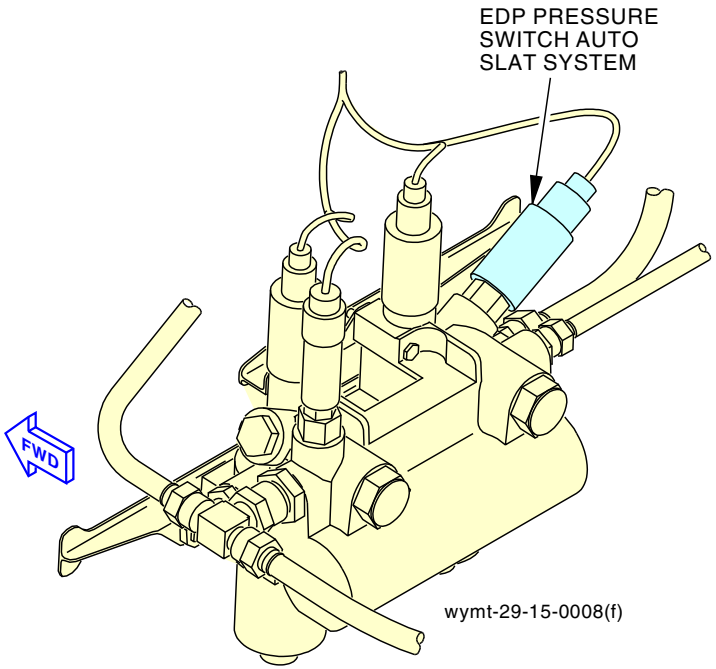
The EDP pressure switch auto slat system sends a ground to the control circuit for the PTU control valve when the system B EDP pressure decreases to less than 2350 psi.

## HYD POWER TRANSFER UNIT SYSTEM - PTU CONTROL VALVE, EDP PRESSURE SWITCH AUTO SLAT SYSTEM




**MAIN GEAR WHEEL WELL (LOOKING FORWARD)**




**SYSTEM B PRESSURE MODULE**

B

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HYD POWER TRANSFER UNIT SYSTEM - PTU CONTROL VALVE, EDP PRESSURE SWITCH AUTO SLAT SYSTEM

## HYD POWER TRANSFER UNIT SYSTEM - FUNCTIONAL DESCRIPTION - HYDRAULIC

### General

The hydraulic power transfer unit (PTU) system uses hydraulic system A pressure through a power transfer unit to pressurize hydraulic system B for leading edge flaps and slats.

### Control

The power transfer unit motor receives pressure from hydraulic system A through the PTU control valve.

The EDP pressure switch auto slat system on the hydraulic system B pressure module monitors for low pressure from the system B EDP.

The control valve is a 28v dc hydraulic shutoff valve. A flow limiter in the hydraulic system A pressure line to the control valve limits the flow to the PTU motor to 13.7 gpm. This limits the maximum speed of the motor.

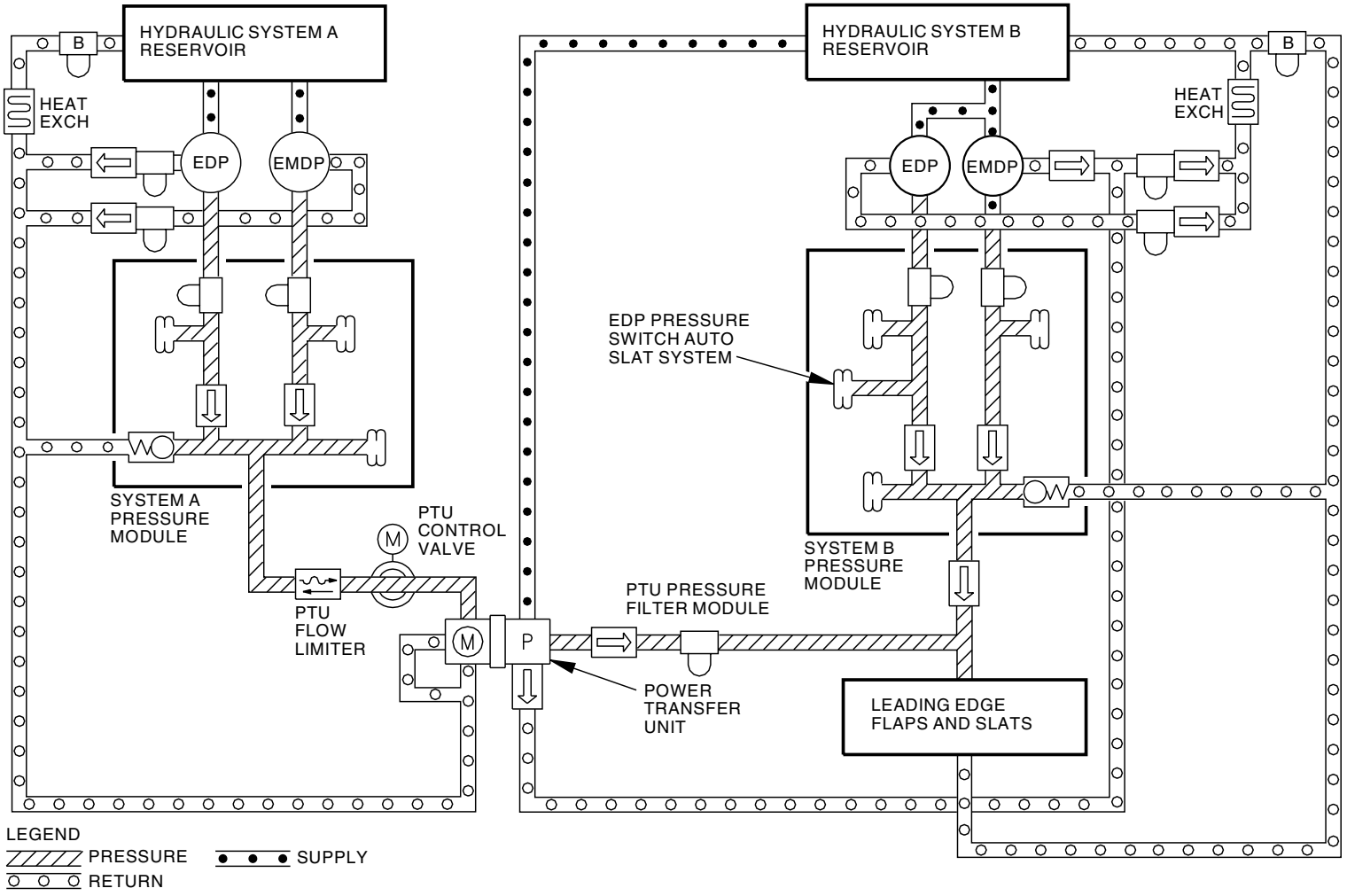
### Pressurization

When pressure goes to the PTU motor, the motor turns the PTU pump through a common shaft. The PTU pump gets fluid supply from the hydraulic system B reservoir. Pressure from the PTU pump goes through a check valve and the PTU pressure filter module. Pressure then goes to the leading edge flaps and slats.

### Case Drain

The case drain fluid from the PTU pump goes through a check valve and the hydraulic system B EMDP case drain filter before it goes to the system B reservoir.

## HYD POWER TRANSFER UNIT SYSTEM - FUNCTIONAL DESCRIPTION - HYDRAULIC

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HYD POWER TRANSFER UNIT SYSTEM - FUNCTIONAL DESCRIPTION - HYDRAULIC

## HYD POWER TRANSFER UNIT SYSTEM - FUNCTIONAL DESCRIPTION - ELECTRICAL

### General

The PTU control valve controls pressure to the PTU motor.

The PTU control valve opens for these conditions:

- Airplane in the air
- Trailing edge flaps not up
- System B EDP low pressure.

### Inputs

Two air/ground relays supply air/ground information.

These two flap position switches on the flap control unit in the main landing gear wheel well supply flap position signals:

- TE FLAPS UP switch
- TE FLAPS LANDING WARNING switch.

The EDP pressure switch is on the hydraulic system B pressure module. It supplies a system B EDP low pressure signal when the pump pressure is less than 2350 psi for more than 0.5 seconds.

### Control

The PTU control circuit receives power from two 28v dc circuit breakers. The control circuit can use power from one or the other circuit breaker. Each of these power inputs go through an air/ground relay.

Both signals from the air/ground relays combine and supply input to flap position switches. If the trailing edge flaps are not up, the flap landing warning switch sends a signal to the HYD SYS B EDP relay.

When the pressure from system B EDP is less than 2350 psi, a ground goes to the HYD SYS B EDP relay. When the relay energizes (0.5 seconds after the relay receives power and a ground), power goes to the PTU control valve. This opens the valve and system A hydraulic pressure operates the PTU motor.

The HYD SYS B EDP relay has a hold-on circuit after the ground from the low pressure switch energizes the relay. The hold-on circuit maintains the ground on the relay after the system B EDP pressure goes high again. The hold-on circuit also stops intermittent operation of the PTU system if the EDP B pressure increases more than or decreases less than 2350 psi.

### PTU Automatic Shutoff and Inhibit

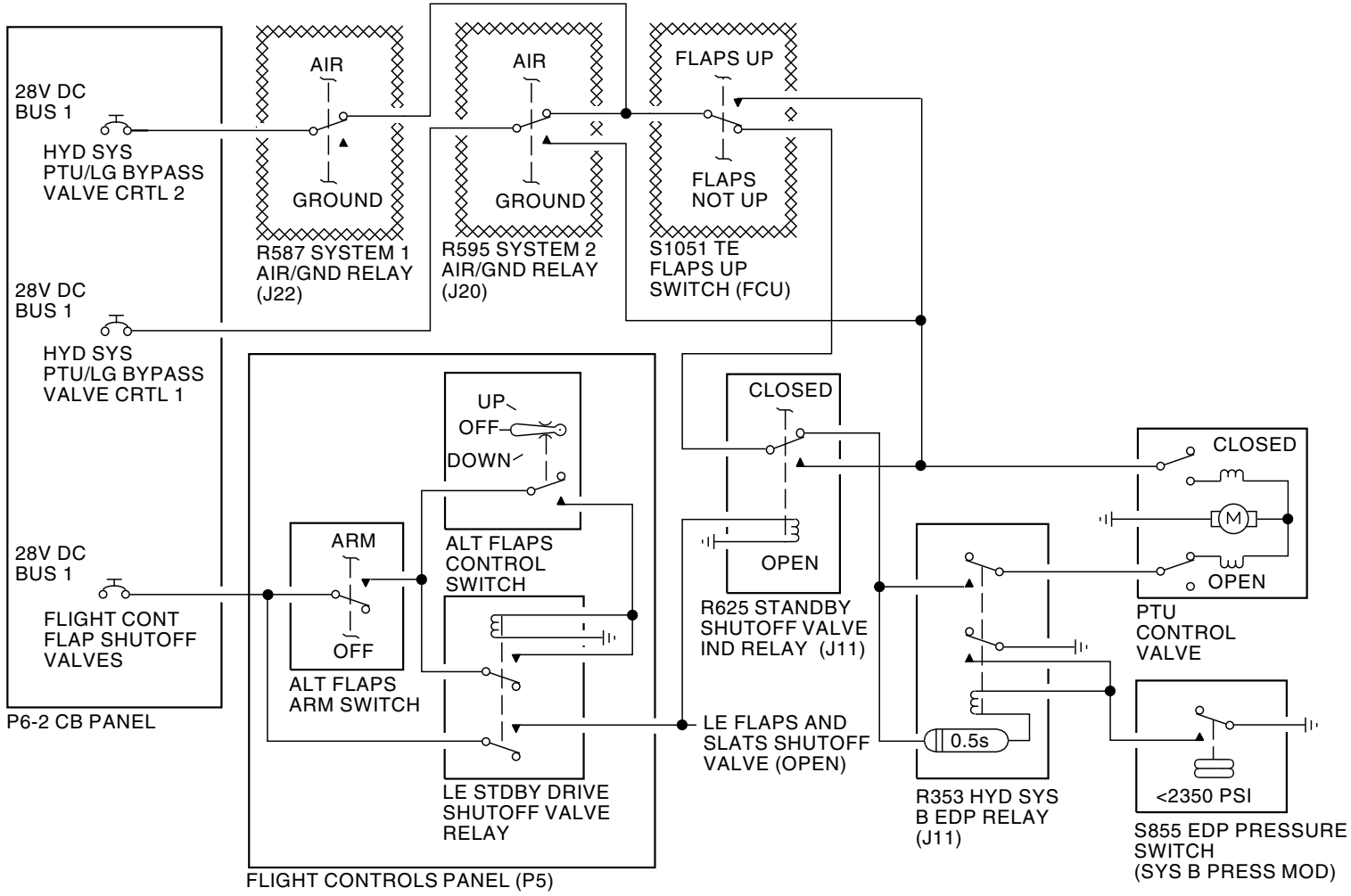
The PTU control valve moves to the closed position for either of these conditions:

- Airplane is on the ground
- Trailing edge flaps up.

### PTU Manual Shutoff And Inhibit

The PTU control valve moves to the close position when the ALTERNATE FLAPS arm switch is moved to the ARM position and the ALTERNATE FLAPS control switch is moved to the DOWN position. This energizes the LE standby drive shutoff valve relay and sends 28v dc to the standby shutoff valve indication relay. When the standby shutoff valve indication relay is energized, power to the hydraulic system B EDP relay is removed. This stops operation of the PTU.

## HYD POWER TRANSFER UNIT SYSTEM - FUNCTIONAL DESCRIPTION - ELECTRICAL

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**HYD POWER TRANSFER UNIT SYSTEM-FUNCTIONAL DESCRIPTION-ELECTRICAL**

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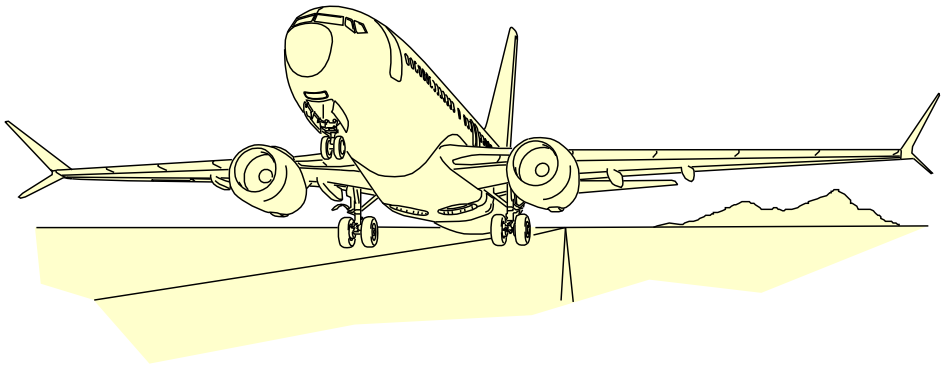
## HYD INDICATING SYS - INTRODUCTION

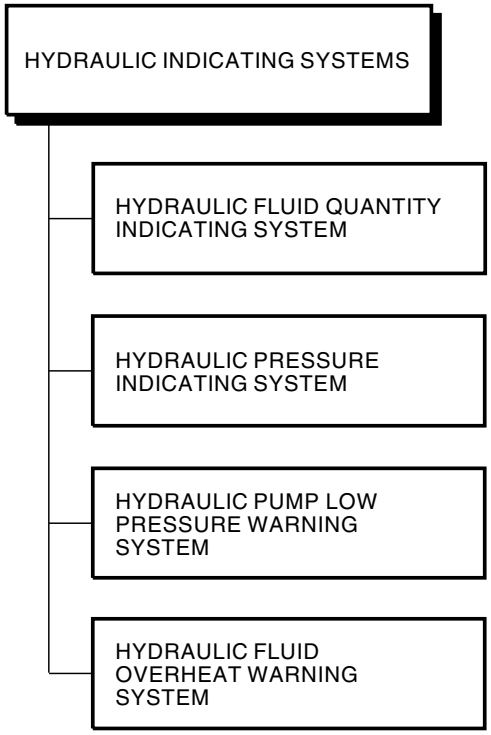
### General

These hydraulic indicating systems show fluid quantity, system pressure, pump low pressure, and fluid overheat:

- Hydraulic fluid quantity indicating system
- Hydraulic pressure indicating system
- Hydraulic pump low pressure indicating system
- Hydraulic fluid overheat warning system.

## HYD INDICATING SYS - INTRODUCTION



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HYD INDICATING SYS - INTRODUCTION

## Hydraulic Fluid Quantity Indicating System

The hydraulic fluid quantity indicating system gives indications of fluid quantity in the hydraulic system A, B and standby reservoirs. The system uses quantity transmitters at the system A and B reservoirs to send signals to the multi function display system. The quantity for system A and system B show as a percentage of full on the systems display.

The system uses a quantity switch in the standby reservoir to send signals to the STANDBY HYD LOW QUANTITY light on the flight control panel.

## Hydraulic Pressure Indicating System

The hydraulic pressure indicating system gives indication of system pressure in the flight compartment. The system uses pressure transmitters on the hydraulic system A and B pressure modules to send signals to the multi function display system. The pressure for each system shows on the systems display.

## Hydraulic Pump Low Pressure Warning System

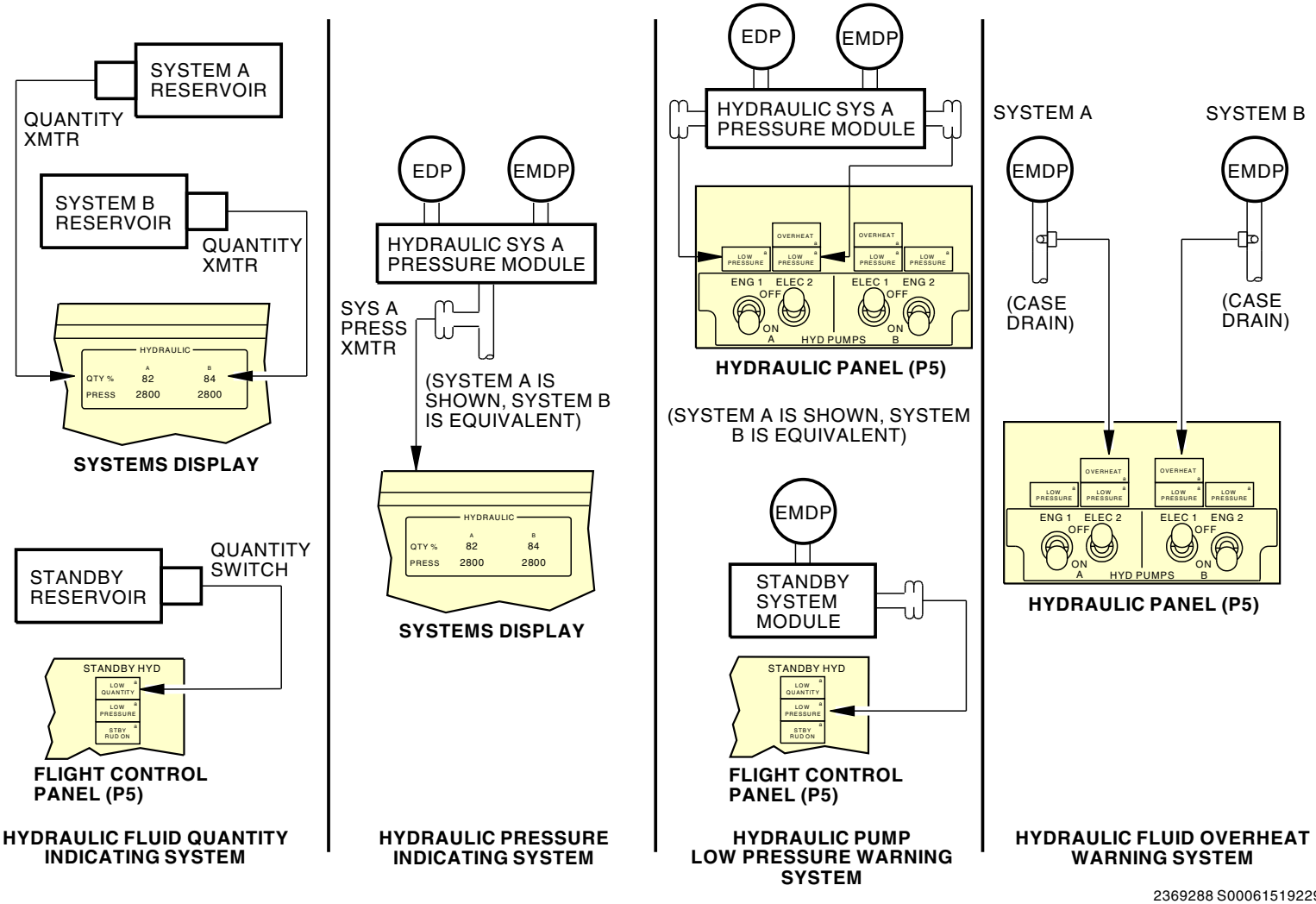
The hydraulic pump low pressure warning system gives indications when the pressure of any hydraulic pump on the airplane decreases to less than normal. The system uses pressure switches on the hydraulic system A and system B pressure modules to send signals to the HYD PUMP LOW PRESSURE light on the hydraulic panel.

The system uses a pressure switch on the standby hydraulic system module to send a signal to the STANDBY HYD LOW PRESSURE light on the flight control panel.

## Hydraulic Fluid Overheat Warning System

The hydraulic fluid overheat warning system gives indications when the temperature of hydraulic system A or system B electric motor-driven pump (EMDP) is more than normal. The system uses temperature switches in the pump case drain lines to send signals to the HYD PUMP OVERHEAT lights on the hydraulic panel.

## HYD INDICATING SYS - GENERAL DESCRIPTION

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HYD INDICATING SYS - GENERAL DESCRIPTION

## HYD INDICATING SYS - HYD FLUID QTY INDICATING SYS - HYD FLUID QTY TRANSMITTER/INDICATOR

### Purpose

The hydraulic fluid quantity transmitter/indicators show the hydraulic fluid level in the hydraulic systems A and B reservoirs.

### Location

The hydraulic fluid quantity transmitter/indicators are on the hydraulic systems A and B reservoirs in the main gear wheel well.

### Physical Description

Each hydraulic fluid quantity transmitter/indicator is a float-type, level-quantity transmitter with a direct-reading indicator. The indicator has these marks:

- O for empty
- RFL for refill
- F for full.

The hydraulic fluid quantity transmitter/indicators include these components:

- Float
- Indicator
- Transmitter.

The fluid quantity transmitters are not interchangeable. The mounting bolt holes are arranged so that system A cannot be used on system B. Internal calibrations are different due to different reservoir size.

### Functional Description

The float moves up and down on the fluid in the reservoir and pivots on the transmitter body. The float lever operates the transmitter and the indicator.

The indicator shows the fluid quantity on a mechanical indicator on the reservoir in the main landing gear wheel well.

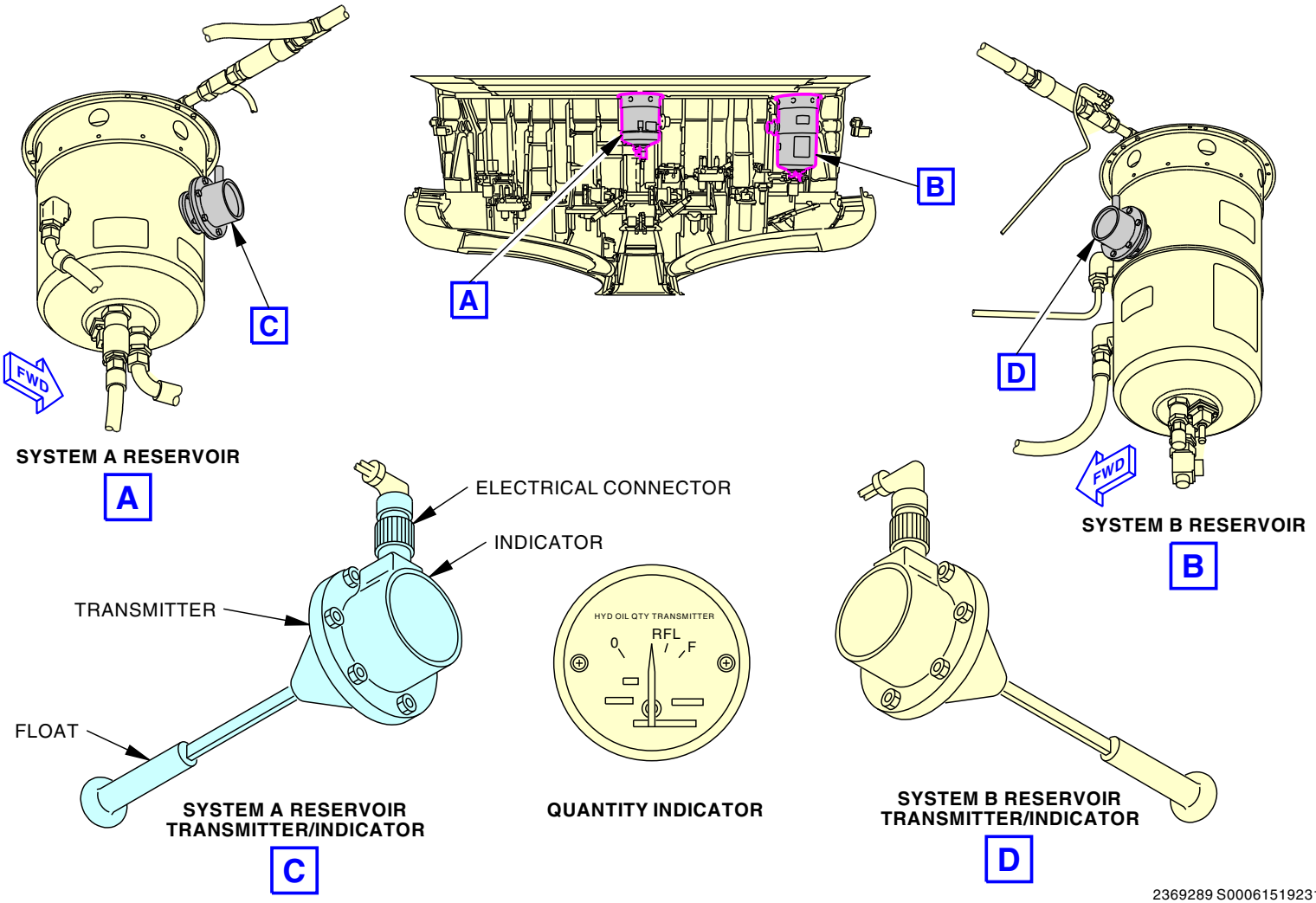
The transmitters send signals to the display processing computer (DPC). The DPC sends a signal to the multi-function display unit (DU). The DU shows fluid quantity on the systems display in percent of full.

See the multi-function display system for more information about the DPC. (SECTION 31-65)

The system B quantity transmitter has a low quantity switch. When the system B hydraulic fluid quantity is less than 21%, the switch opens. This inhibits alternate nose wheel steering.

See the nose wheel steering system for more information about the alternate nose wheel steering. (SECTION 32-51)

## HYD INDICATING SYS - HYD FLUID QTY INDICATING SYS - HYD FLUID QTY TRANSMITTER/INDICATOR

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HYD INDICATING SYS - HYD FLUID QTY INDICATING SYS - HYD FLUID QTY TRANSMITTER/INDICATOR

## HYD INDICATING SYS - HYD FLUID QTY INDICATING SYS - STBY HYD SYS RESERVOIR LOW QTY SWITCH

### Purpose

The standby hydraulic system reservoir low quantity switch monitors low fluid level in the standby hydraulic system reservoir.

### Location

The quantity switch is on the top of the standby hydraulic system reservoir in the main landing gear wheel well.

### Physical Description

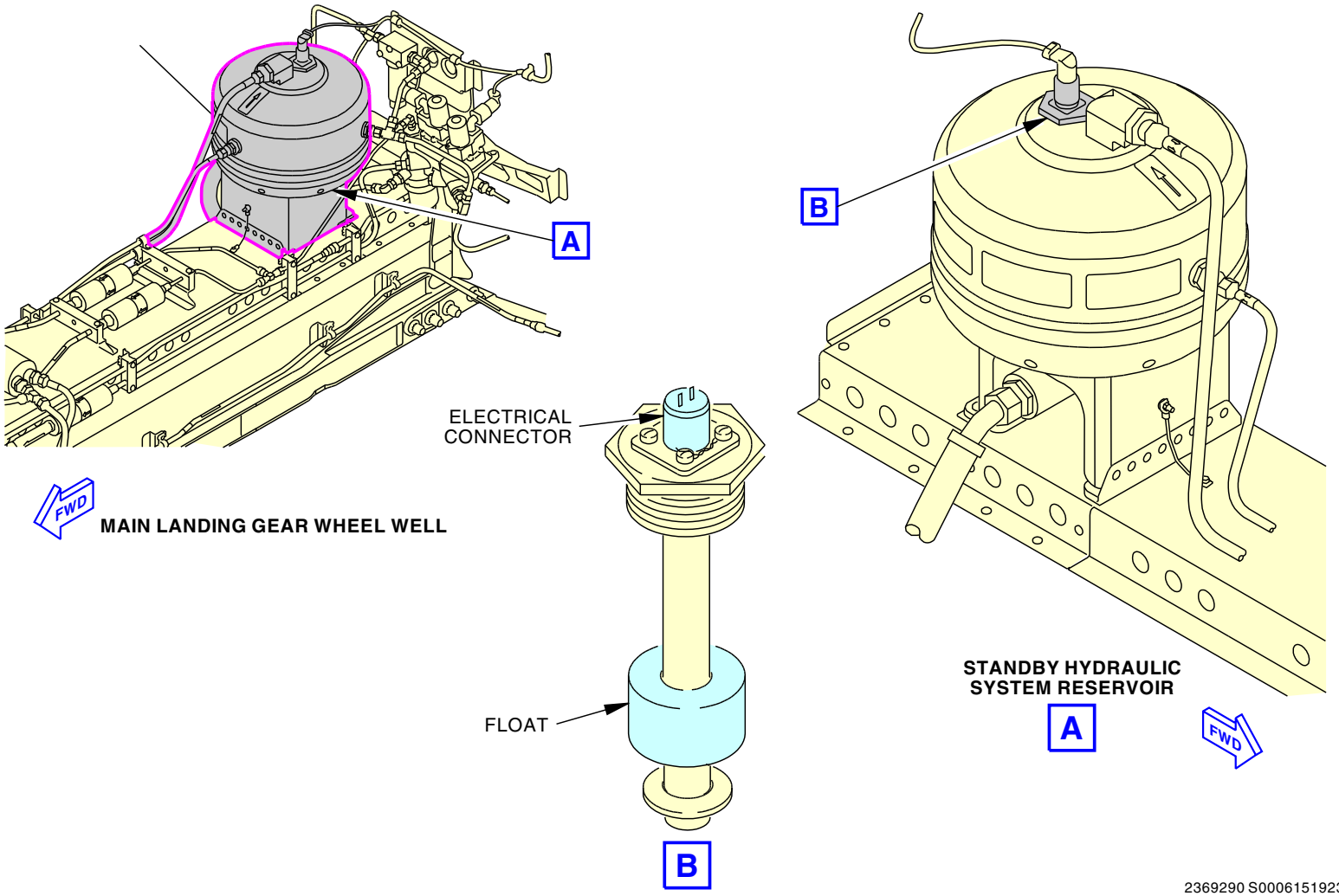
The standby hydraulic system reservoir low quantity switch is a magnetic reed switch.

### Functional Description

The mechanical float moves up and down on the surface of the fluid in the reservoir. The float operates a magnetic reed switch.

The reed switch sends a signal when the fluid level is less than 50%. The signal goes to the standby hydraulic LOW QUANTITY amber light on the flight control panel.

## HYD INDICATING SYS - HYD FLUID QTY INDICATING SYS - STBY HYD SYS RESERVOIR LOW QTY SWITCH

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HYD INDICATING SYS - HYD FLUID QTY INDICATING SYS - STBY HYD SYS RESERVOIR LOW QTY SWITCH

## General

Quantity transmitters on hydraulic system A and B reservoirs measure hydraulic fluid quantity.

## Quantity Transmitters

These transmitters send signals to the display processing computer (DPC). The fluid quantity then shows on the systems display.

See the multi-function display system for more information about the DPC. (SECTION 31-65)

The system B quantity transmitter has a low quantity switch which monitors for low fluid quantity in the system B reservoir.

## Hydraulic System Quantity Indication

The quantity transmitters send signals for quantities between empty and overfill (106 percent). Both quantity transmitters send signals to both DPC.

The quantity information shows as a percent of full on the systems display above the pressure indication for hydraulic systems A and B.

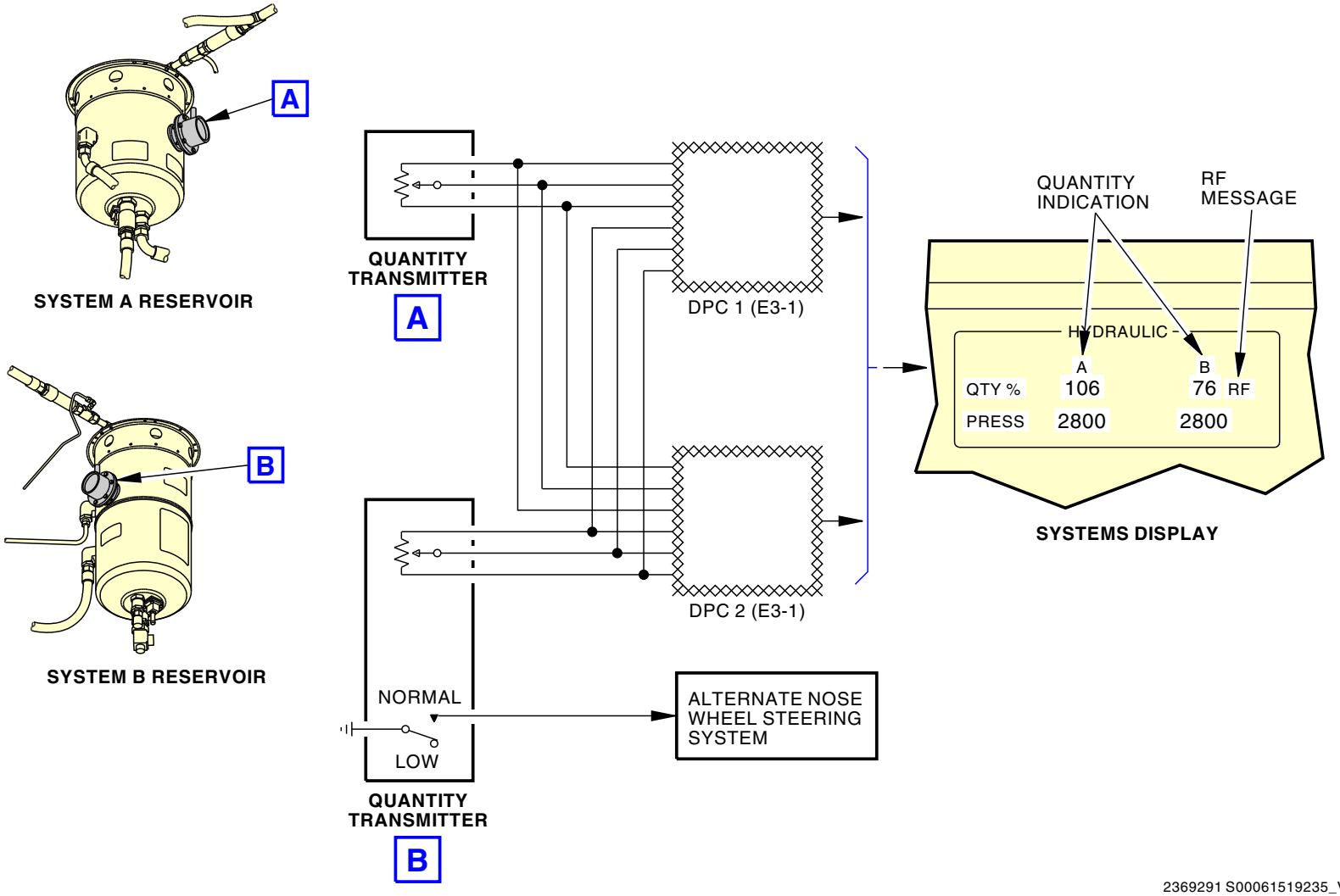
When the quantity in a reservoir is less than 76 percent, a white RF message shows on the display adjacent to the quantity indication. The RF message can show only when the airplane is on the ground and either the trailing edge flaps are retracted or both engines are not running.

## System B Quantity Transmitter Low Quantity Switch

The low quantity switch in the system B transmitter opens when the quantity is less than 21 percent. This switch is used for the alternate nose wheel steering system.

See the nose wheel steering system section for more information on the alternate nose wheel steering system. (SECTION 32-51)

## HYD INDICATING SYS - HYD FLUID QTY INDICATING SYS - FUNCTIONAL DESCRIPTION - MAIN HYD SYS

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HYD INDICATING SYS - HYD FLUID QTY INDICATING SYS - FUNCTIONAL DESCRIPTION - MAIN HYD SYS

## HYD INDICATING SYS - HYD FLUID QTY INDICATING SYS - FUNCTIONAL DESCRIPTION - STBY HYD SYS

### General

A standby hydraulic system reservoir low quantity switch monitors the quantity of hydraulic fluid in the standby hydraulic system reservoir. The flight control panel in the flight compartment shows low hydraulic fluid quantity with a standby hydraulic LOW QUANTITY amber light.

### Standby Hydraulic System Reservoir Low Quantity Indication

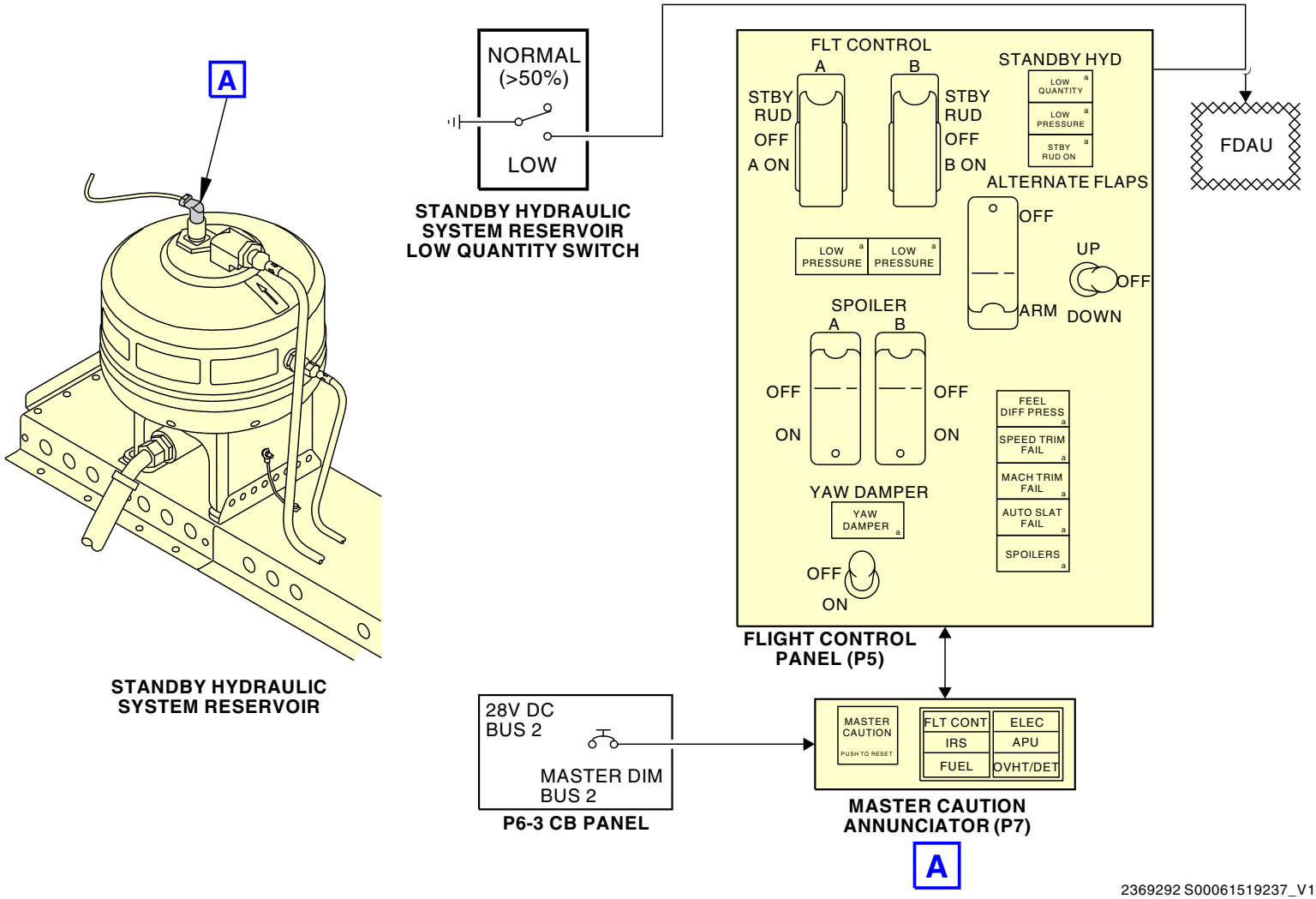
The standby hydraulic system reservoir low quantity switch closes and supplies a ground when the fluid quantity in the standby hydraulic reservoir is less than 50%. This lets 28v dc from bus 2 go through the master dim and test system to the flight control panel and turn on the STANDBY HYD LOW QUANTITY light.

The ground from the switch also causes the MASTER CAUTION light and the FLT CONT light on the system annunciator panel to come on. These lights come on when any of the amber lights on the flight control panel come on.

The ground from the switch also sends a signal to the flight data acquisition unit (FDAU).

See the Flight Data Recording System (FDRS) section for more information on the flight data acquisition unit. (SECTION 31-31)

## HYD INDICATING SYS - HYD FLUID QTY INDICATING SYS - FUNCTIONAL DESCRIPTION - STBY HYD SYS

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HYD INDICATING SYS - HYD FLUID QTY INDICATING SYS - FUNCTIONAL DESCRIPTION - STBY HYD SYS

## HYD INDICATING SYS - HYD PRESSURE INDICATING SYS - MAIN HYD SYS PRESSURE TRANSMITTER

### General

System pressure transmitters for hydraulic systems A and B send pressure information to the flight compartment.

### location

The hydraulic systems A and B pressure transmitters are on the hydraulic systems A and B pressure modules in the main landing gear wheel well forward bulkhead.

### Physical Description

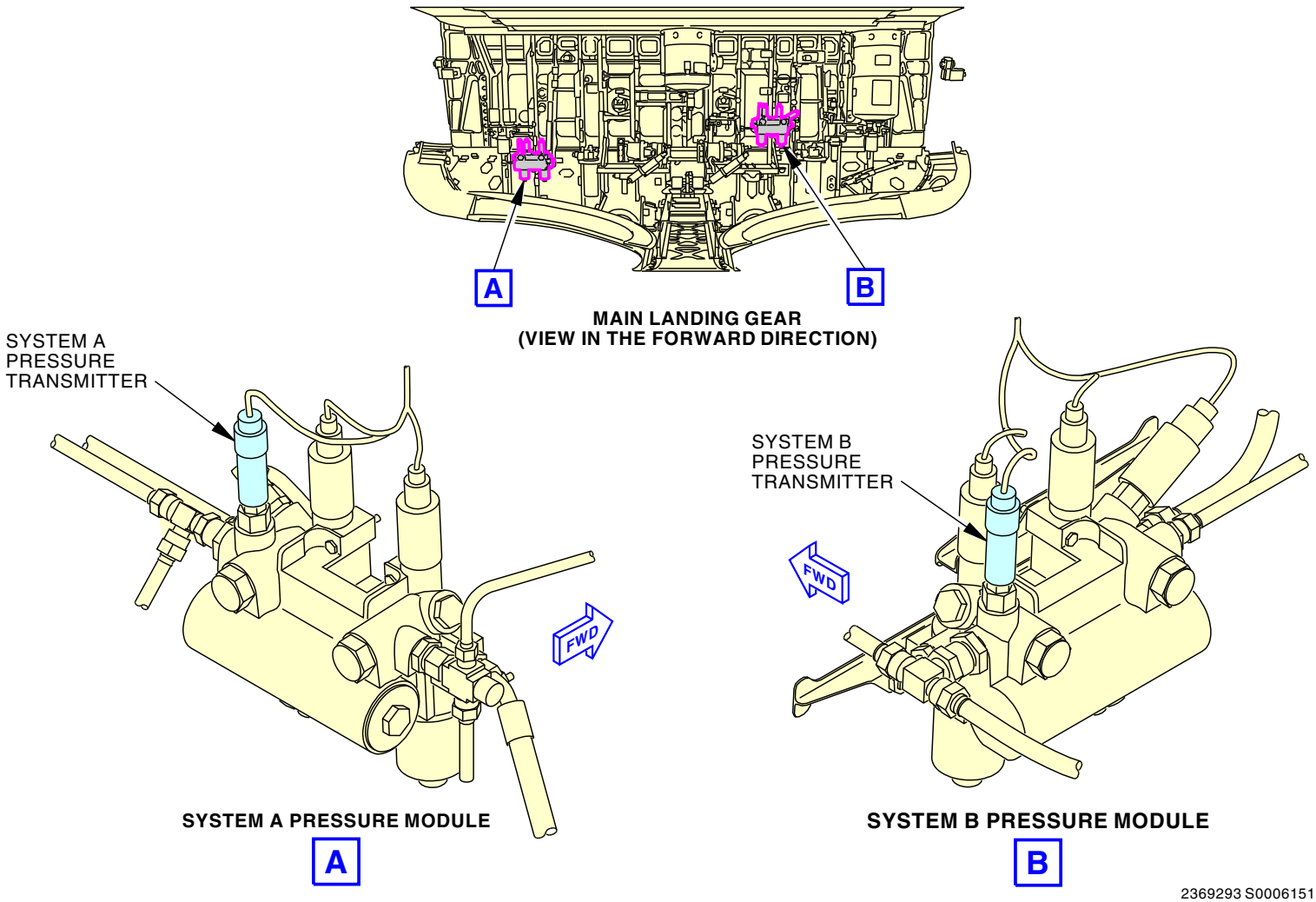
Each hydraulic system pressure transmitter is a sealed assembly with a piston, disc spring and electrical switch.

The system pressure transmitters are interchangeable.

### Functional Description

The system transmitters send pressure data to the lower center multi-function display unit systems display between 0 and 4000 psi.

## HYD INDICATING SYS - HYD PRESSURE INDICATING SYS - MAIN HYD SYS PRESSURE TRANSMITTER

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HYD INDICATING SYS - HYD PRESSURE INDICATING SYS - MAIN HYD SYS PRESSURE TRANSMITTER

## HYD INDICATING SYS - HYD PRESSURE INDICATING SYS - FUNCTIONAL DESCRIPTION

### General

Pressure transmitters monitor the pressure of hydraulic systems A and B. These transmitters send signals to the display processing computer (DPC). The DPC sends signals to the lower center multi-function display unit (MFD) and shows on the systems display in the flight compartment.

### System Pressure Transmitters

Pressure transmitters on each hydraulic systems A and B pressure modules measure system pressure. System pressure is the combined output from both the engine-driven pump (EDPs) and the electric motor-driven pump (EMDPs).

### Hydraulic System Pressure Indication

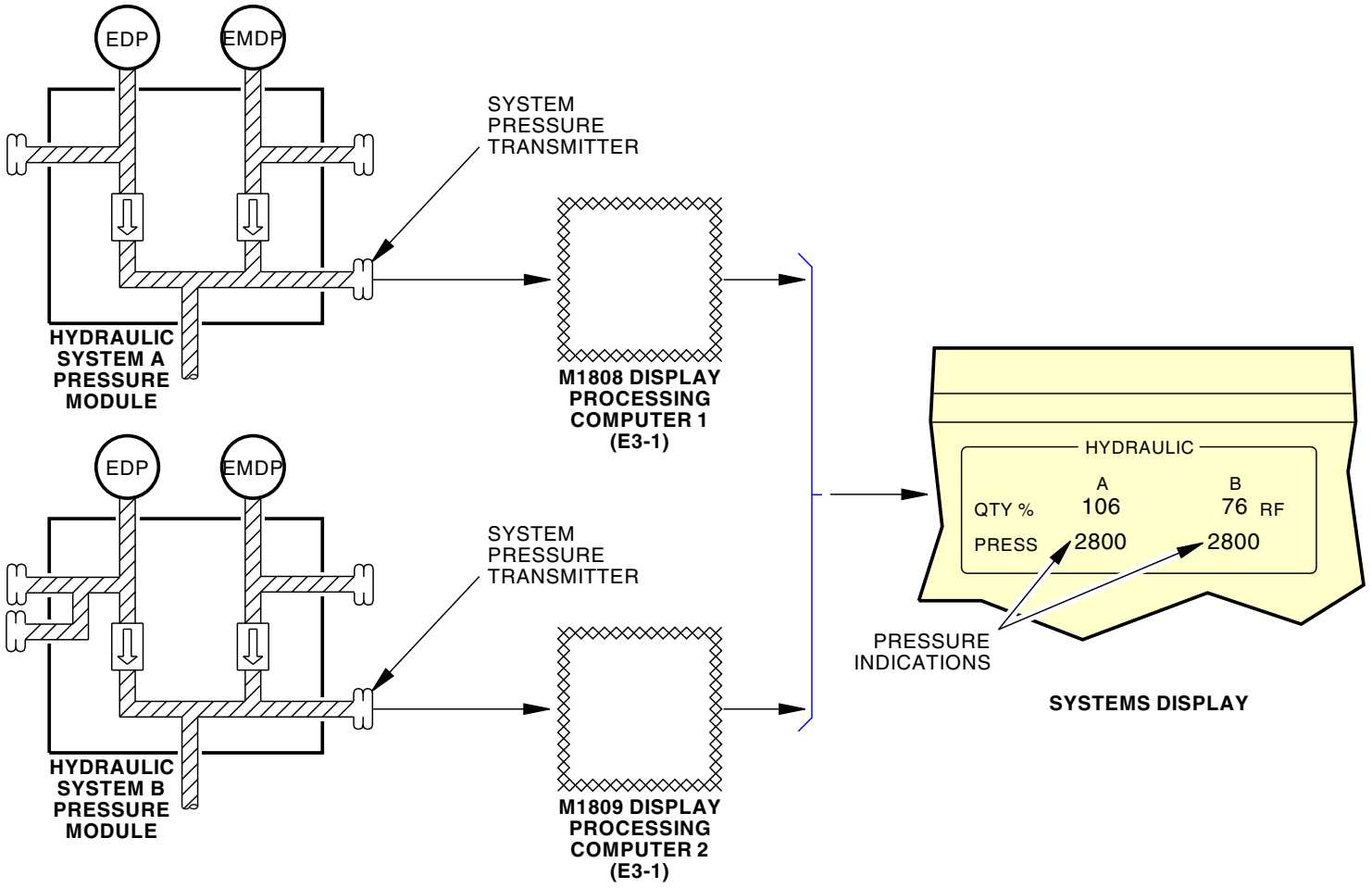
The pressure transmitters send signals for pressures between 0 and 4000 psi. The system A transmitter sends a signal to the DPC 1. The system B transmitter sends a signal to the DPC 2.

Each DPC receives the signal from the pressure transmitters and sends this data to the systems display. The pressure is shown in psi units.

The pressure indications are shown by digital numbers colored white. These numbers are shown inside a rectangular outline label (HYDRAULIC) and colored in cyan. System, quantity and pressure labels (A, B, QTY%, and PRESS) are also shown on the systems display in the color cyan. These indications do not change color as pressure or quantity changes.

See the multi-function display system for more information about the DPC. (SECTION 31-65)

## HYD INDICATING SYS - HYD PRESSURE INDICATING SYS - FUNCTIONAL DESCRIPTION

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HYD INDICATING SYS - HYD PRESSURE INDICATING SYS - FUNCTIONAL DESCRIPTION

## HYD INDICATING SYS - HYD PUMP LOW PRESSURE WARNING SYS - HYD PUMP LOW PRESSURE SWITCHES

### General

Hydraulic system A and system B pump low pressure switches send pressure information to the flight compartment when pump pressure is less than normal.

The standby hydraulic system pump low pressure switch sends pressure information to the flight compartment when the pump pressure is less than normal.

### location

The hydraulic system A and B EDP and EMDP pump low pressure switches are on the hydraulic system A and B pressure modules in the main landing gear wheel well forward bulkhead.

The standby hydraulic pump pressure switch is on the standby hydraulic system module in the main landing gear wheel well aft bulkhead.

### Physical Description

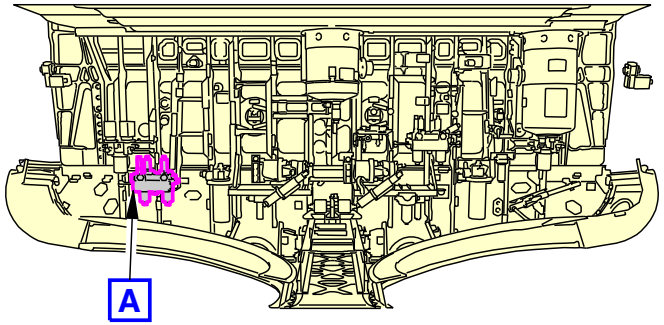
Each hydraulic pump low pressure switch is sealed assembly with a piston, disc spring and electrical switch.

### Functional Description

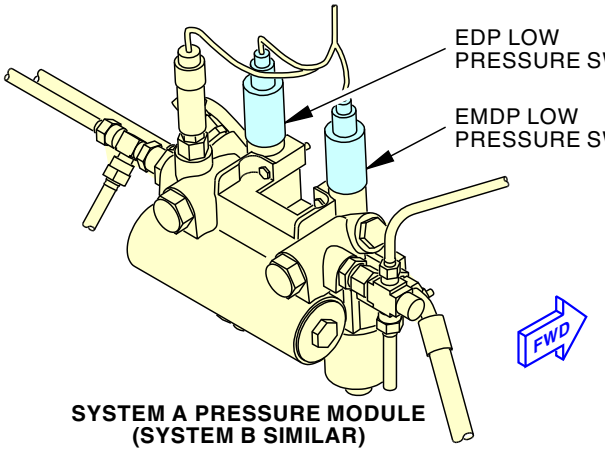
Hydraulic system A and system B engine-driven pumps (EDPs) and electric motor-driven pumps (EMDPs) LOW PRESSURE amber lights come on when the hydraulic pump pressure is less than 1300 psi. The LOW PRESSURE amber lights go off when the hydraulic pressure is more than 1600 psi.

The standby hydraulic LOW PRESSURE amber light comes on when the EMDP pressure is less than 1300 psi and goes off when the hydraulic pressure is more than 1600 psi.

## HYD INDICATING SYS - HYD PUMP LOW PRESSURE WARNING SYS - HYD PUMP LOW PRESSURE SWITCHES

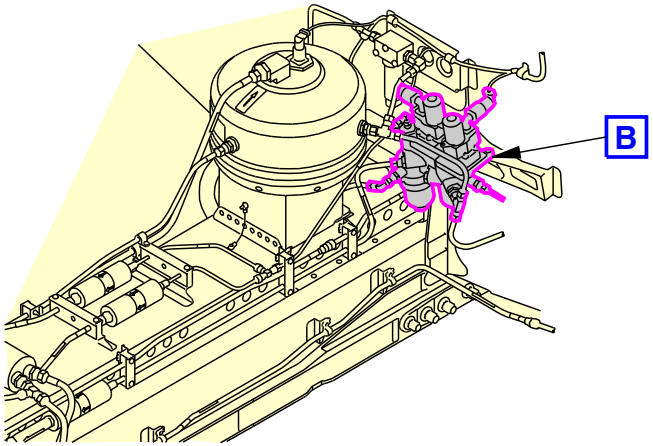



MAIN LANDING GEAR WHEEL WELL
(VIEW IN THE FORWARD DIRECTION)

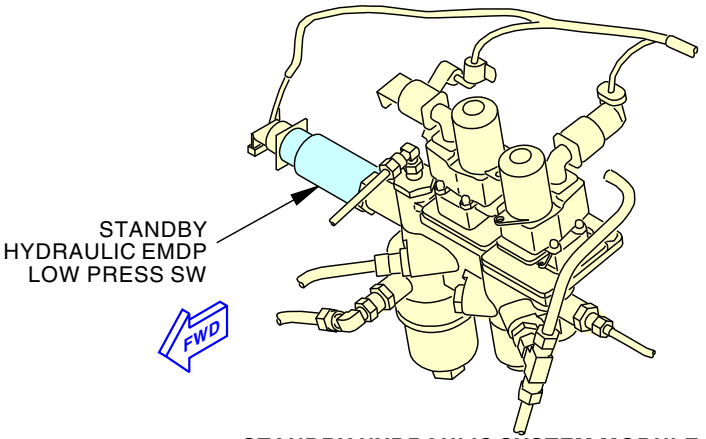



SYSTEM A PRESSURE MODULE
(SYSTEM B SIMILAR)

A




MAIN LANDING GEAR WHEEL WELL




STANDBY HYDRAULIC SYSTEM MODULE

B

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HYD INDICATING SYS - HYD PUMP LOW PRESSURE WARNING SYS - HYD PUMP LOW PRESSURE SWITCHES

## General

Pressure switches monitor the pressure of the engine-driven pumps (EDPs) and electric motor-driven pumps (EMDPs) in hydraulic systems A and B. These switches send a signal to the hydraulic pump LOW PRESSURE amber lights on the hydraulic panel when the pump pressure is less than normal.

## Pump Pressure Switches

One pressure switch for each pump on the system pressure module monitors the pressure output of the pump.

## Hydraulic Pump Pressure Indication

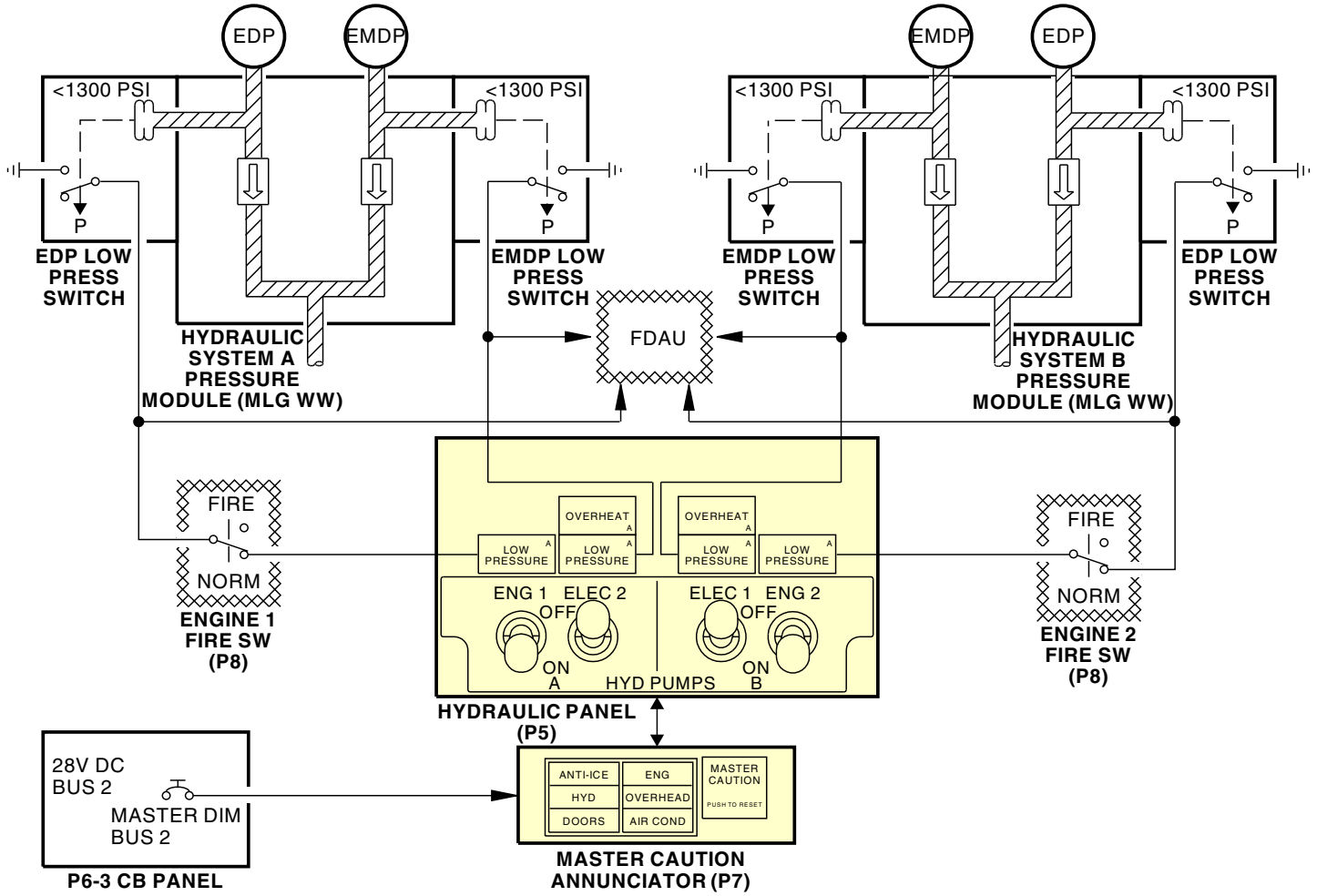
The pump pressure switch closes and supplies a ground when the pump pressure decreases to less than 1300 psi. The ground from the pressure switch causes the HYD PUMP LOW PRESSURE amber light to come on.

The ground from the pressure switch also causes the MASTER CAUTION light and HYD light on the system annunciator panel to come on. These lights come on when any of the amber lights on the hydraulic panel come on.

The LOW PRESSURE amber light, the MASTER CAUTION light and HYD light go off when the hydraulic pressure increases to more than 1600 psi.

The ground from the pressure switches also sends a signal to the flight data acquisition unit (FDAU).

See the Flight Data Recording System (FDRS) section for more information on the flight data acquisition unit. (SECTION 31-31)




2369296 S00061519245_V1

HYD INDICATING SYS - HYD PUMP LOW PRESSURE WARNING SYS - FUNCTIONAL DESCRIPTION - MAIN HYD SYS

## General

A pressure switch monitors the pressure of the electric motor-driven pump (EMDP) in the standby hydraulic system. This switch sends a signal to the STANDBY HYD LOW PRESSURE light on the flight control panel.

## Pump Pressure Switch

The pump pressure switch on the standby module monitors the pressure of the EMDP.

## Hydraulic Pump Pressure Indication

The pump pressure switch closes and supplies a ground when the EMDP pressure decreases to less than 1300 psi.

The STANDBY HYD LOW PRESSURE amber light comes on when pressure decreases and one of these conditions occur:

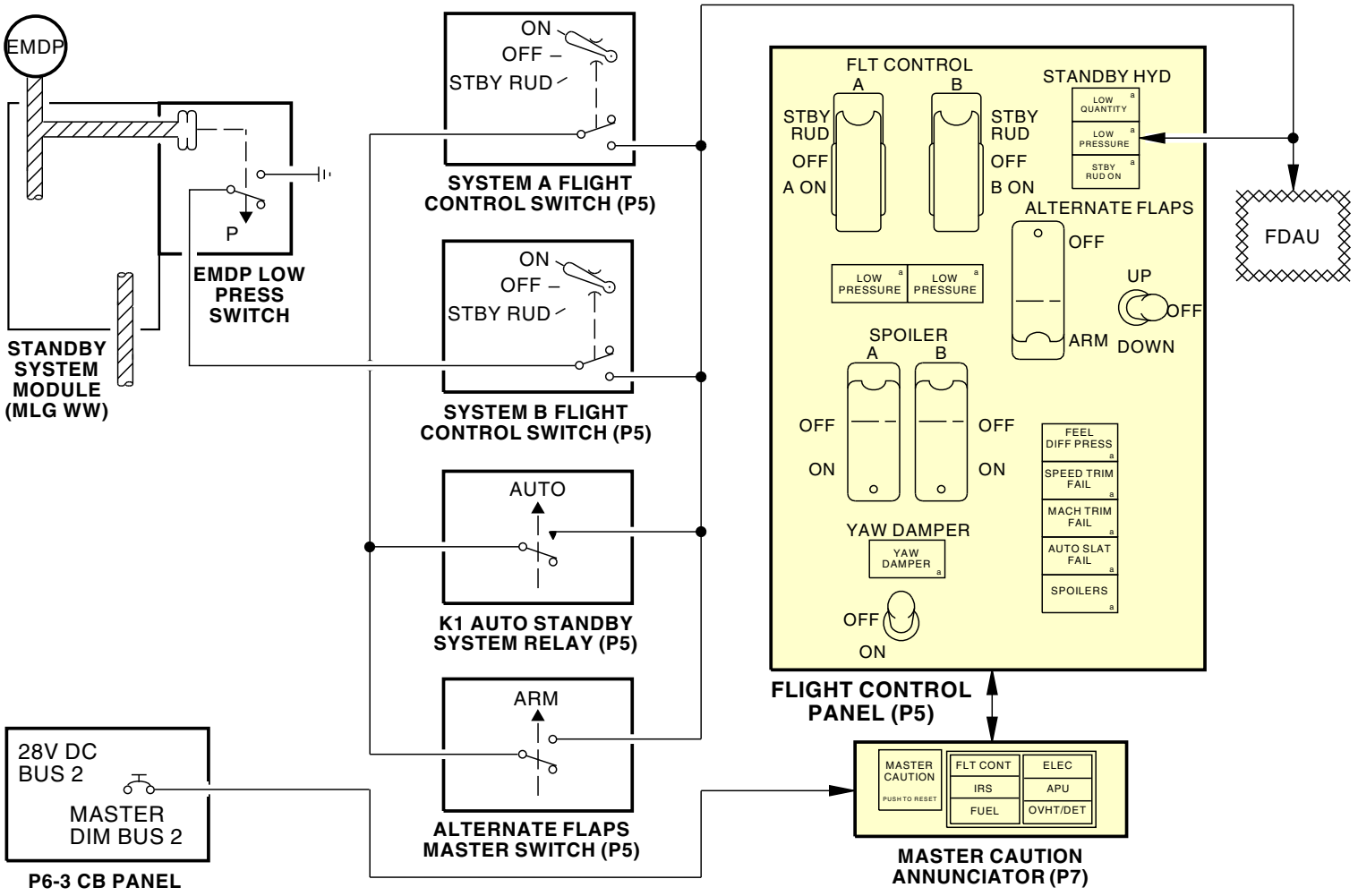
- Either FLT CONTROL switch is in the STBY RUD position
- Auto standby system relay is energized
- ALTERNATE FLAPS arm switch is in the ARM position.

The ground from the pressure switch also causes the MASTER CAUTION light and FLT CONT light on the system annunciator panel to come on. These lights come on when any of the amber lights on the flight control panel come on.

The STANDBY HYD LOW PRESSURE light, the MASTER CAUTION light and the FLT CONT light go off when the EMDP pressure increases to more than 1600 psi.

The ground from the pressure switch also sends a signal to the flight data acquisition unit (FDAU).

See the Flight Data Recording System (FDRS) section for more information on the flight data acquisition unit. (SECTION 31-31)

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## HYD INDICATING SYS - HYD FLUID OVERHEAT WARNING SYS - HYD FLUID OVERHEAT WARNING SWITCH

### Purpose

The hydraulic fluid overheat warning switch monitors the temperature of the electric motor-driven pumps (EMDPs) in the hydraulic systems A and B.

### Location

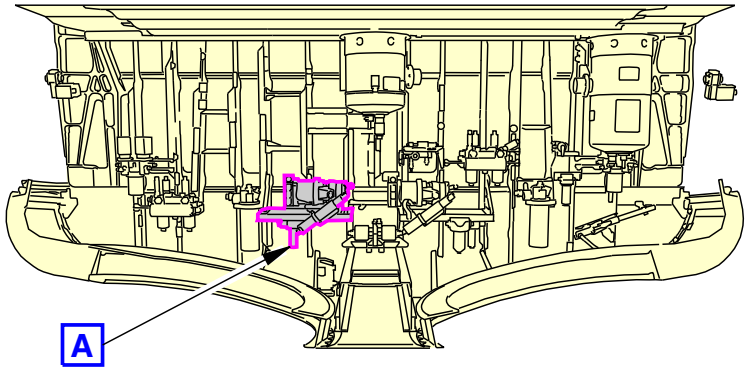
The hydraulic fluid overheat warning switch is in the case drain line between the related EMDP and case drain filter module in the main landing gear wheel well.

### Physical Description

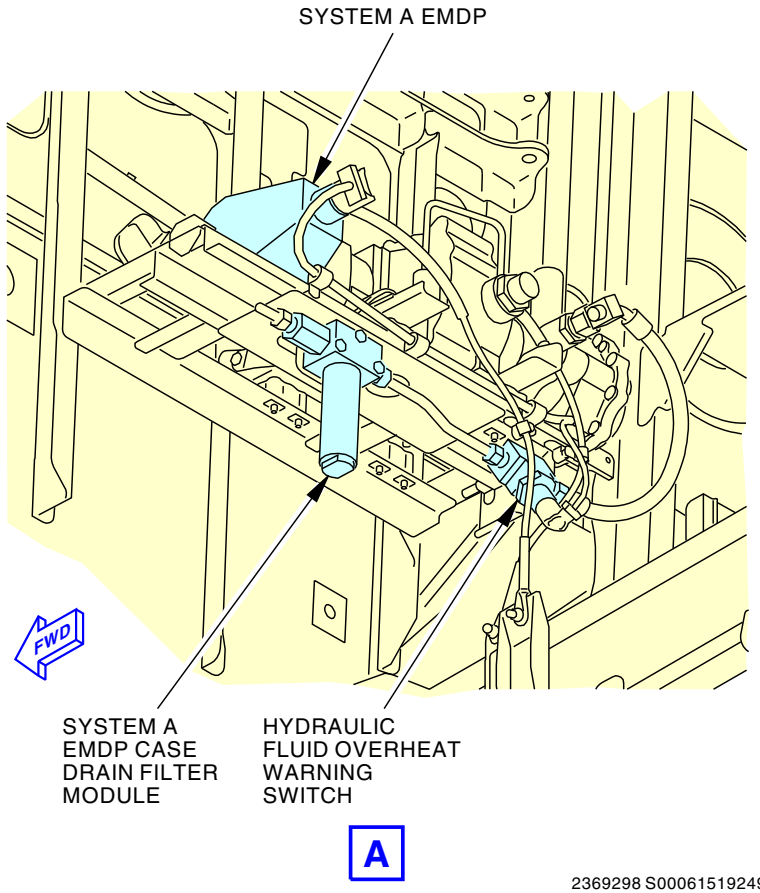
The hydraulic fluid overheat warning switch is a temperature operated electrical switch.

### Functional Description

When the hydraulic fluid temperature in the case drain line from the EMDP increases to 225F or more, the switch sends a signal to the hydraulic panel. This turns on the HYD PUMP OVERHEAT amber light. When the hydraulic temperature in the case drain line decreases to less than 185F (85C), the hydraulic pump OVERHEAT amber light goes off.




MAIN GEAR WHEEL WELL
(VIEW IN THE FORWARD DIRECTION)

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## HYD INDICATING SYS - HYD FLUID OVERHEAT WARNING SYS - FUNCTIONAL DESCRIPTION

### General

Hydraulic fluid overheat warning switches monitor the temperature of the case drain hydraulic fluid in hydraulic systems A and B. These switches send signals to the OVERHEAT lights on the hydraulic control panel when the temperature of the EMDP case drain hydraulic fluid increases to more than normal.

A temperature switch in each electric motor-driven pump (EMDP) for systems A and B, monitors the temperature of the EMDP electric motor. This switch stops the pump when the temperature of the EMDP increases to more than normal, but it is not used for overheat indication.

### Hydraulic Fluid Overheat Warning Switches

The hydraulic fluid overheat warning switches supply a ground for the amber OVERHEAT light when the pump case drain hydraulic fluid temperature increases to more than 225F (107C). This lets 28v dc from bus 2 go through the master dim and test system to the hydraulic panel and turn on the amber OVERHEAT light.

The ground from the hydraulic fluid overheat warning switch also causes the MASTER CAUTION light and HYD light on the system annunciator panel to come on. These lights come on when any of the amber lights on the hydraulic panel come on.

The amber OVERHEAT light, the MASTER CAUTION light, and the HYD light go off when the temperature of the pump case drain hydraulic fluid decreases to less than 185F (85C).

### Hydraulic Pump Temperature Switches

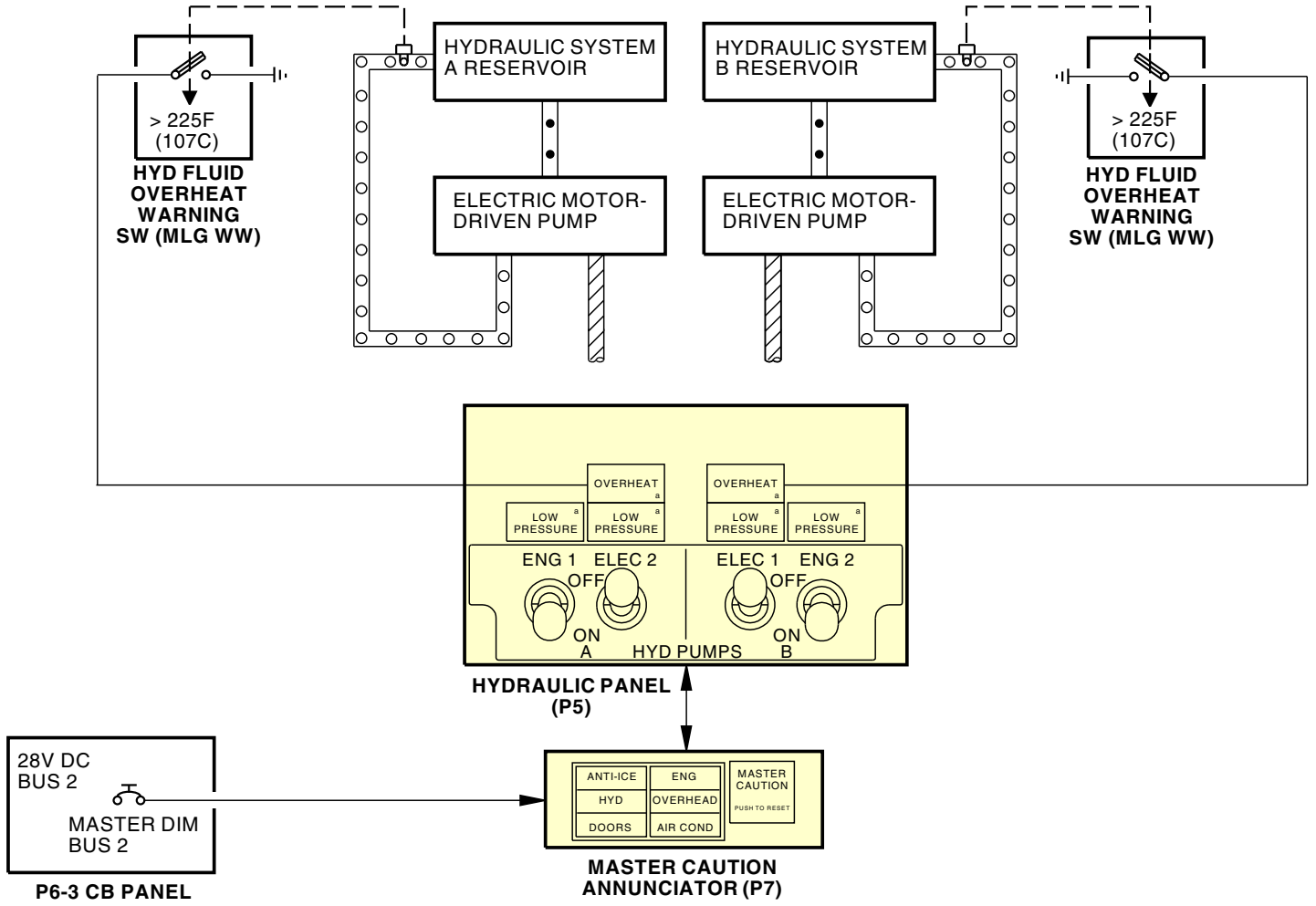
The EMDP temperature switch supplies a ground for the HYD PUMP relay when the hydraulic fluid temperature in the pump electric motor housing is normal. When the temperature increases to more than 255F (124C), the temperature switch opens and removes power from the HYD PUMP relay. This stops the EMDP.

When the pump stops and hydraulic pressure decreases to less than 1300 psi, the amber LOW PRESSURE light on the hydraulic control panel comes on. This also causes the MASTER CAUTION light and HYD light on the systems annunciator panel to come on.

The EMDP can come on again when the hydraulic fluid temperature decreases to less than 160F (60C) and the pump temperature switch closes. This also causes the amber LOW PRESSURE light, the MASTER CAUTION light, and the HYD light to go off.

See the main hydraulic system section for more information about the electric motor-driven pump. (SECTION 29-10)

## HYD INDICATING SYS - HYD FLUID OVERHEAT WARNING SYS - FUNCTIONAL DESCRIPTION

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HYD INDICATING SYS - HYD FLUID OVERHEAT WARNING SYS - FUNCTIONAL DESCRIPTION