

## **12.10 (ATA 29) HYDRAULIC POWER**

### **12.10.1 Introduction**

The Dash 8-Q400 has four hydraulic systems, three main systems, and an auxiliary system.

The No. 1 and No. 2 independent main systems provide power to operate the:

- Flight Controls
- Landing Gear
- Nose Wheel Steering
- Brake Systems.

The No. 3 main hydraulic system supplies pressure to the left and right elevators if the No. 1 and/or No. 2 hydraulic system(s) fail. The auxiliary hand operated hydraulic system provides power to the emergency main landing gear extension system.

# Dash8 - Q400 - Hydraulic Power

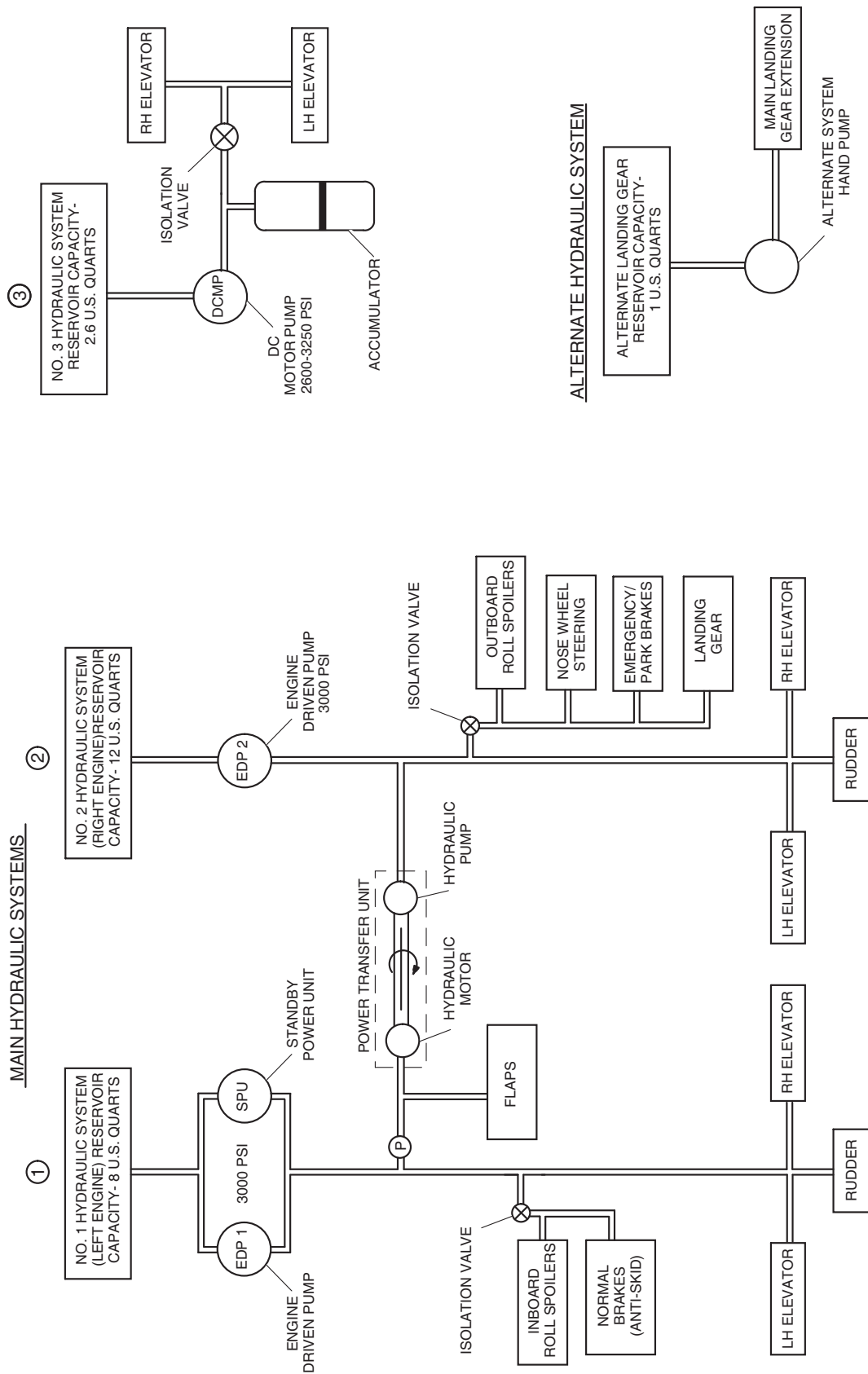


Figure 12.10-1 Hydraulic Power Distribution

### 12.10.2 General

Main hydraulic power is provided by three independent hydraulic systems, designated No. 1 (left), No. 2 (right) and No. 3 (aft) (Figure 12.10-1). The No. 1 and No. 2 hydraulic systems are normally pressurized by a single Engine-Driven Pump (EDP) for each system. System pressure is maintained at 3000 psi.

The No. 3 hydraulic system is powered by an accumulator which is pressurized by a DC-Motor-Driven-Pump (DCMP). A pressure switch controls the DCMP operation to maintain the accumulator pressure within 2600 to 3250 psi.

An electrically driven Standby Hydraulic Pump operates as a backup to the No. 1 hydraulic system. It operates during the take-off and landing phases, or if No.1 engine fails. A Power Transfer Unit (PTU) operates as a backup to the No. 2 hydraulic system. The PTU is powered by the No. 1 hydraulic system. If both engine fail, where both EDPs and the Standby Hydraulic Pump are unavailable, the DCMP in No. 3 hydraulic system provides sufficient hydraulic power to the elevators for pitch control.

#### **The No. 1 system powers the:**

- Flaps
- Rudder (Lower Power Control Unit (PCU))
- Inboard Roll Spoilers
- Elevators (Outboard PCUs)
- Main Wheel Brakes/Anti Skid

#### **The No. 2 system powers the:**

- Landing Gear
- Nose Wheel Steering
- Outboard Roll Spoilers
- Emergency/Parking Brakes
- Rudder (Upper PCU)
- Elevators (Centre PCUs)

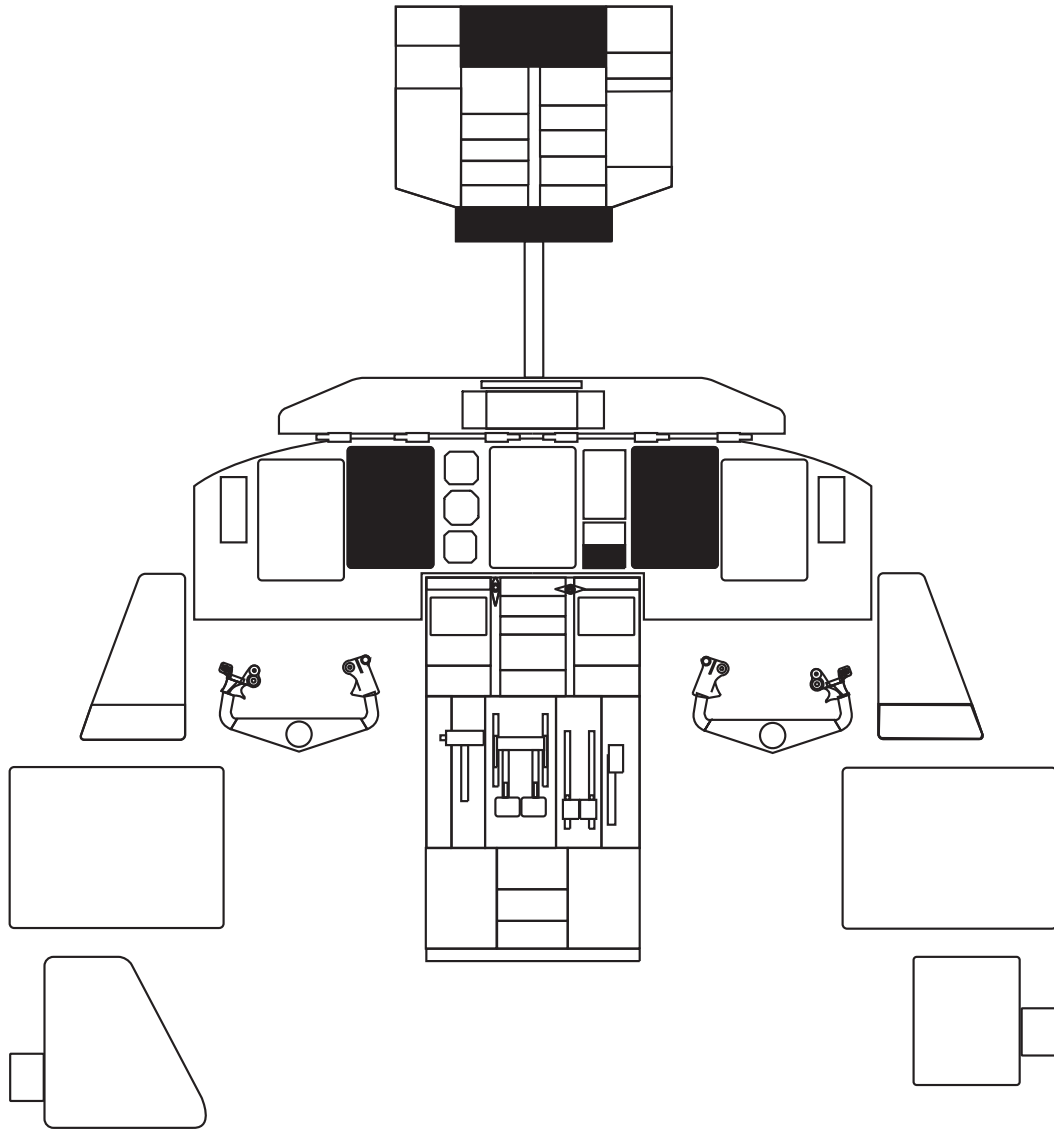
#### **The No. 3 system supplies backup power to:**

- Left Elevator (Inboard PCU)
- Right Elevator (Inboard PCU)

#### **The Emergency Hydraulic system powers the:**

- Alternate Landing Gear Extension System.

12.10.3 Controls and Indications - Hydraulic



Dash8 - Q400 - Hydraulic Power

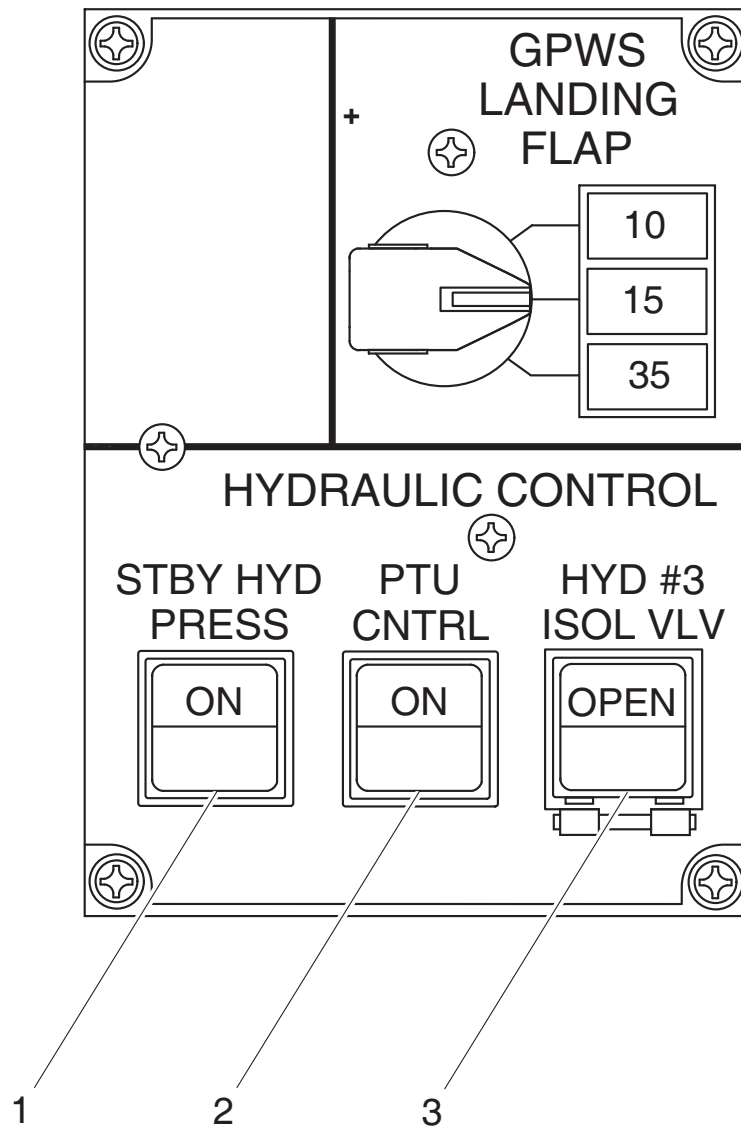
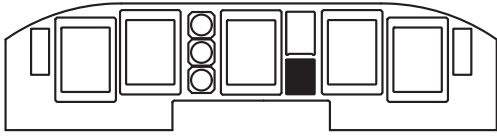


Figure 12.10-2 Hydraulic Control Panel

## HYDRAULIC PANEL CALLOUTS

### 1. STBY HYD PRESS SWITCHLIGHT (green) (alternate action switch)

**PUSH** - ON segment (green)

- turns Standby Hydraulic Pump on manually
- Standby Hydraulic Pump functions as a backup source, providing hydraulic pressure to No. 1 hydraulic system

**PUSH** - ON segment (out)

- turns Standby Hydraulic Pump off manually

**ON** segment (out) - Standby Hydraulic Pump is off or may be operating automatically if:

- No. 1 engine fails, or
- Flaps are selected to positions greater than 0° when park brakes selected off and hydraulic reservoir No. 1 not empty
- confirmation of operation in this case can be made by observing the STBY HYD PRESS indicator on MFD2

### 2. PTU CNTRL SWITCHLIGHT (green) (alternate action switch)

**PUSH** - ON segment (green)

- Power Transfer Unit (PTU) supplies pressure to the No. 2 hydraulic system
- No. 1 hydraulic system must be operating
- No. 2 hydraulic system must have hydraulic fluid

**NOTE:** With #1 ENG HYD PUMP caution light on, do not select PTU CNTRL to ON.

**PUSH** - ON segment (out)

- PTU not operating:

**ON** - segment (green) without pushing

- PTU automatic operation
- the PTU will automatically come on if the:
  - park brake is selected off, and
  - flaps are set to more than 0°, and
  - No. 1 hydraulic pressure is more than 2400 psi, and
  - No. 2 hydraulic reservoir is not empty

**ON** - segment (blank) without pushing

- PTU automatically stopped

**NOTE:** If the PTU is not selected to NORM following the total loss of system #2 fluid, damage to system #2 components may occur, and system #1 pressure may fluctuate about 2100 psi. In this case flaps may become unavailable.

### 3. HYD #3 ISOL VLV Switchlight (amber) (alternate action switch)

**PUSH** - OPEN segment (amber)

- opens isolation valve
- indicates isolation valve is open
- No. 3 hydraulic system is powering the elevators
- when not selected on, the isolation valve will open automatically if No. 1 and No. 2 engines fail

# Dash8 - Q400 - Hydraulic Power

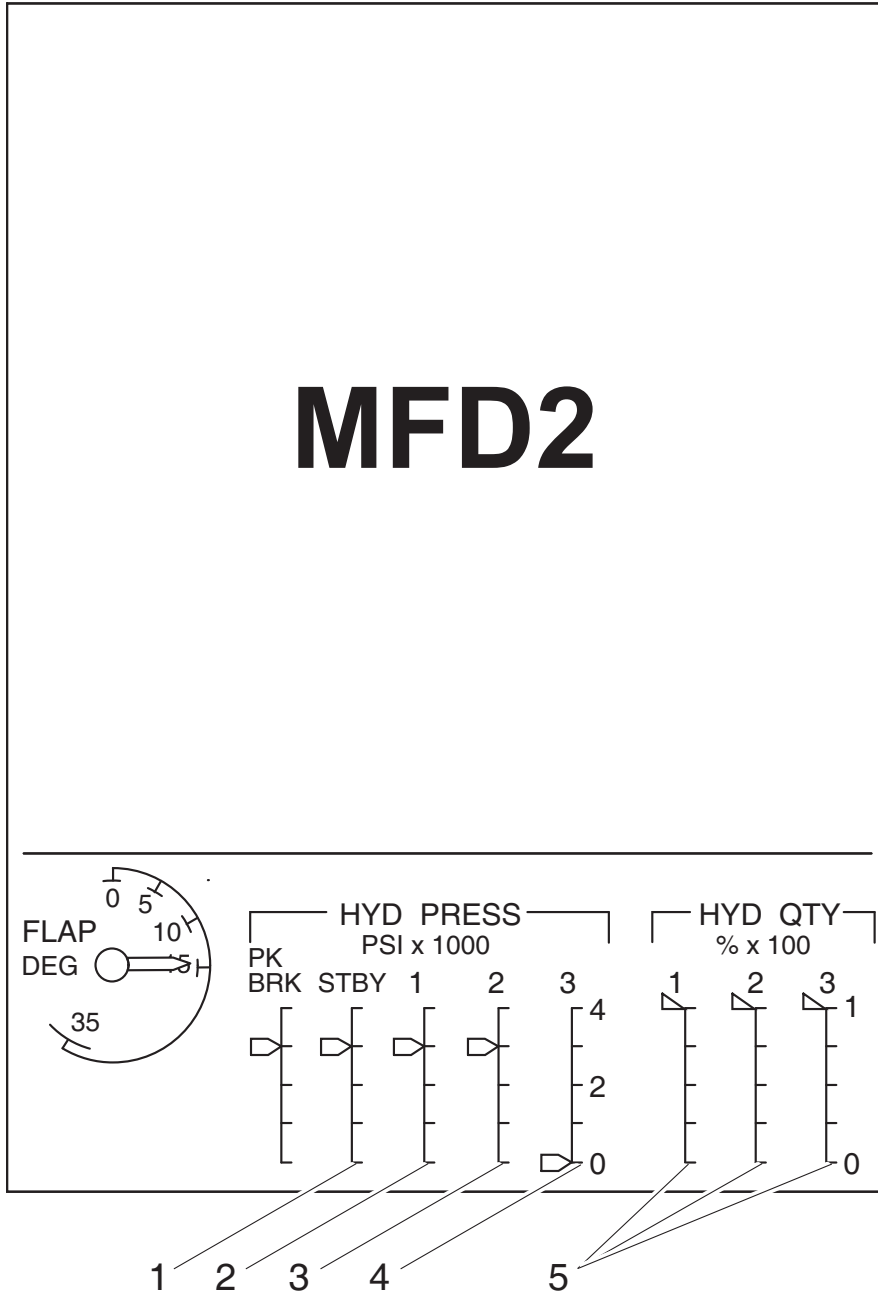
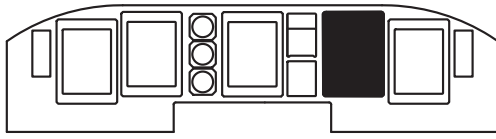


Figure 12.10-3 MFD2 (analog)

**HYDRAULIC PRESSURES AND QUANTITY ANALOG CALLOUTS**

**1. STANDBY HYDRAULIC PRESSURE INDICATOR**

- indicates pressure available from electrically-operated standby hydraulic pump
- scale marked every 1000 psi. from 0 to 4 and indicated in white
- reverts to white line when parameter no longer valid

**2. NO. 1 MAIN HYDRAULIC PRESSURE INDICATOR**

- indicates pressure in No.1 hydraulic system regardless of pressure source
- scale is marked every 1000 psi. from 0 to 4 and indicated in white
- reverts to white line when parameter no longer valid

**3. NO. 2 MAIN HYDRAULIC PRESSURE INDICATOR**

- indicates pressure in No.2 hydraulic system regardless of pressure source
- scale is marked every 1000 psi. from 0 to 4 and indicated in white
- reverts to white line when parameter no longer valid

**4. NO. 3 MAIN HYDRAULIC PRESSURE INDICATOR**

- indicates pressure in No.3 hydraulic system when ISOL VLV is open
- scale is marked every 1000 psi. from 0 to 4 and indicated in white
- reverts to white line when parameter no longer valid
- digital values 0,2,4 are displayed on the right side of the No. 3 system scale only

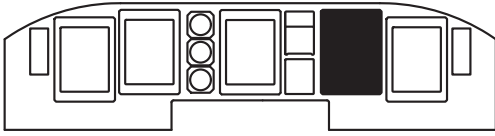
**5. NO. 1, 2 and 3 HYDRAULIC QUANTITY INDICATORS**

- indicates quantity available in the No. 1, 2 and 3 system reservoirs
- scale is marked every 25% from 0 to 1

**Minimum Quantities:**

- No. 1 system – 50%
- No. 2 system – 50%
- No. 3 system – 50%





# MFD 1 or MFD 2

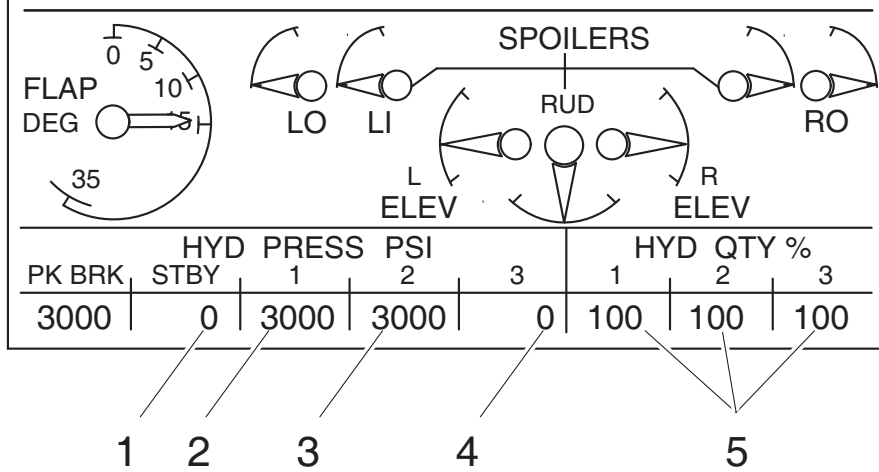


Figure 12.10-4 MFD2 Composite Display (digital)

**HYDRAULIC PRESSURES AND QUANTITY DIGITAL CALLOUTS**

**1. STANDBY HYDRAULIC PRESSURE INDICATOR**

- indicates pressure in No. 1 hydraulic system available from electrically-operated standby pump
- pressures shown in psi. (0 psi.) and indicated in white. Digits are replaced by white dashes when parameter is no longer valid

**2. NO. 1 MAIN HYDRAULIC PRESSURE INDICATOR**

- indicates pressure in No.1 hydraulic system regardless of pressure source
- pressures shown in psi. (3000 psi.) and indicated in white. Digits are replaced by white dashes when parameter is no longer valid

**3. NO. 2 MAIN HYDRAULIC PRESSURE INDICATOR**

- indicates pressure in No. 2 hydraulic system regardless of pressure source
- pressures shown in psi. (3000 psi.) and indicated in white. Digits are replaced by white dashes when parameter is no longer valid

**4. NO. 3 MAIN HYDRAULIC PRESSURE INDICATOR**

- indicates pressure in No. 3 hydraulic system
- pressures shown in psi. (0 psi.) and indicated in white. Digits are replaced by white dashes when parameter is no longer valid

**5. NO. 1, 2 and 3 hydraulic quantity indicators**

- indicates quantity available in the No. 1, 2 and 3 system reservoirs
- quantities shown in %

**Minimum Quantities:**

- No. 1 system – 50%
- No. 2 system – 50%
- No. 3 system – 50%

# Dash8 - Q400 - Hydraulic Power

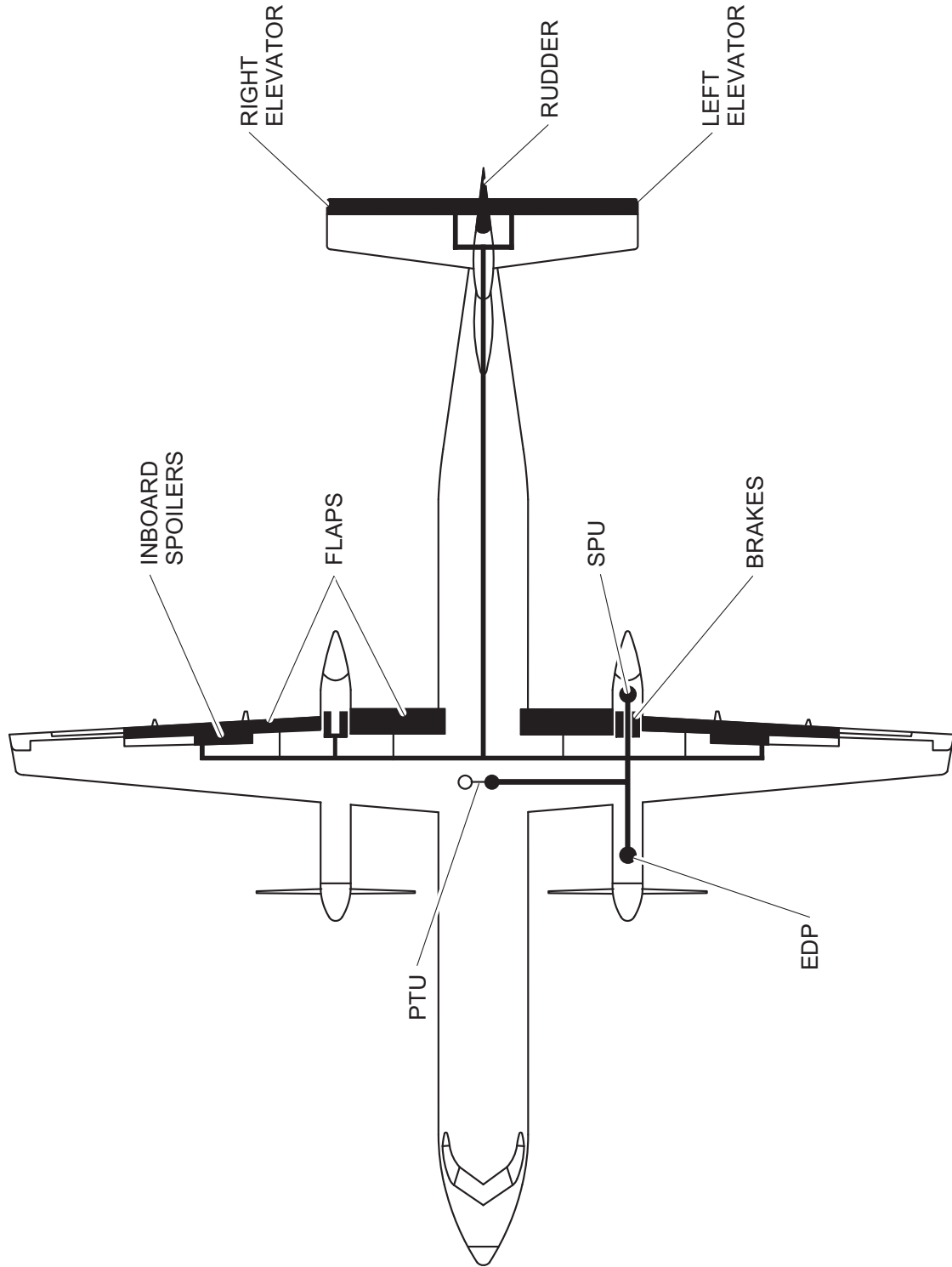


Figure 12.10-5 No. 1 Hydraulic System Overview

### 12.10.4 No. 1 And No. 2 Hydraulic Systems

#### 12.10.4.1 Hydraulic Reservoirs

The hydraulic system reservoirs store hydraulic fluid and supply the necessary fluid volume to the hydraulic systems. The No. 1 hydraulic system reservoir is installed in the left engine nacelle (Figure 12.10-6) while the No. 2 reservoir is installed in the right engine nacelle (Figure 12.10-8). The reservoir uses system output pressure (3000 psi) to pressurize itself and provide a 55 psi suction pressure to the EDPs. Hydraulic fluid overtemperature in each reservoir, is indicated by No. 1 or No. 2 HYD FLUID HOT caution light coming on.

- The volume of the No. 1 system reservoir is 8 U.S. Quarts (7.55 litre).
- The volume of the No. 2 system reservoir is 12 U.S. Quarts (11.34 litre).

#### 12.10.4.2 System Operation

Hydraulic fluid, is supplied by the pressurized reservoir through the Firewall Shutoff Valve to the EDP (Figure 12.10-6 and 12.10-8). Fluid under pressure is now directed to its subsystems at a nominal pressure of 3000 psi. before returning to the reservoir.

Individual hydraulic pressure and quantity indicators are provided to monitor No. 1, No. 2 and No. 3 hydraulic systems. Park brake and standby hydraulic pressure are also monitored. All indicators are presented on the co-pilot's Multi-Function-Display (MFD). If an EDP fails, the #1 or #2 ENG HYD PUMP caution light comes on.

#### 12.10.4.3 Firewall Shutoff Valves

The No. 1 and No. 2 hydraulic systems each have a firewall shut-off valve which, when closed, stops the flow of hydraulic fluid to the EDPs (Figures 12.10-6 and 12.10-7). Two HYD advisory lights for each firewall shutoff valve are provided on the Fire Protection Panel, one green and one white. The green advisory light turns on when the firewall valve is OPEN and the white when the valve is closed. If an engine is shutdown due to an engine fire, hydraulic fluid is shutoff to the EDP by pulling the ENGINE 1 or ENGINE 2, PULL FUEL/HYD OFF handle out to its stop. The green advisory light will go out and the white advisory light will turn on.

The Firewall Shutoff Valve which is powered by the battery bus will close when:

- ENGINE 1 or ENGINE 2 PULL FUEL/HYD OFF handle is pulled
- No. 1 or No. 2 Hydraulic reservoir fluid quantity is low
- Hydraulic fluid over-temperature condition has occurred

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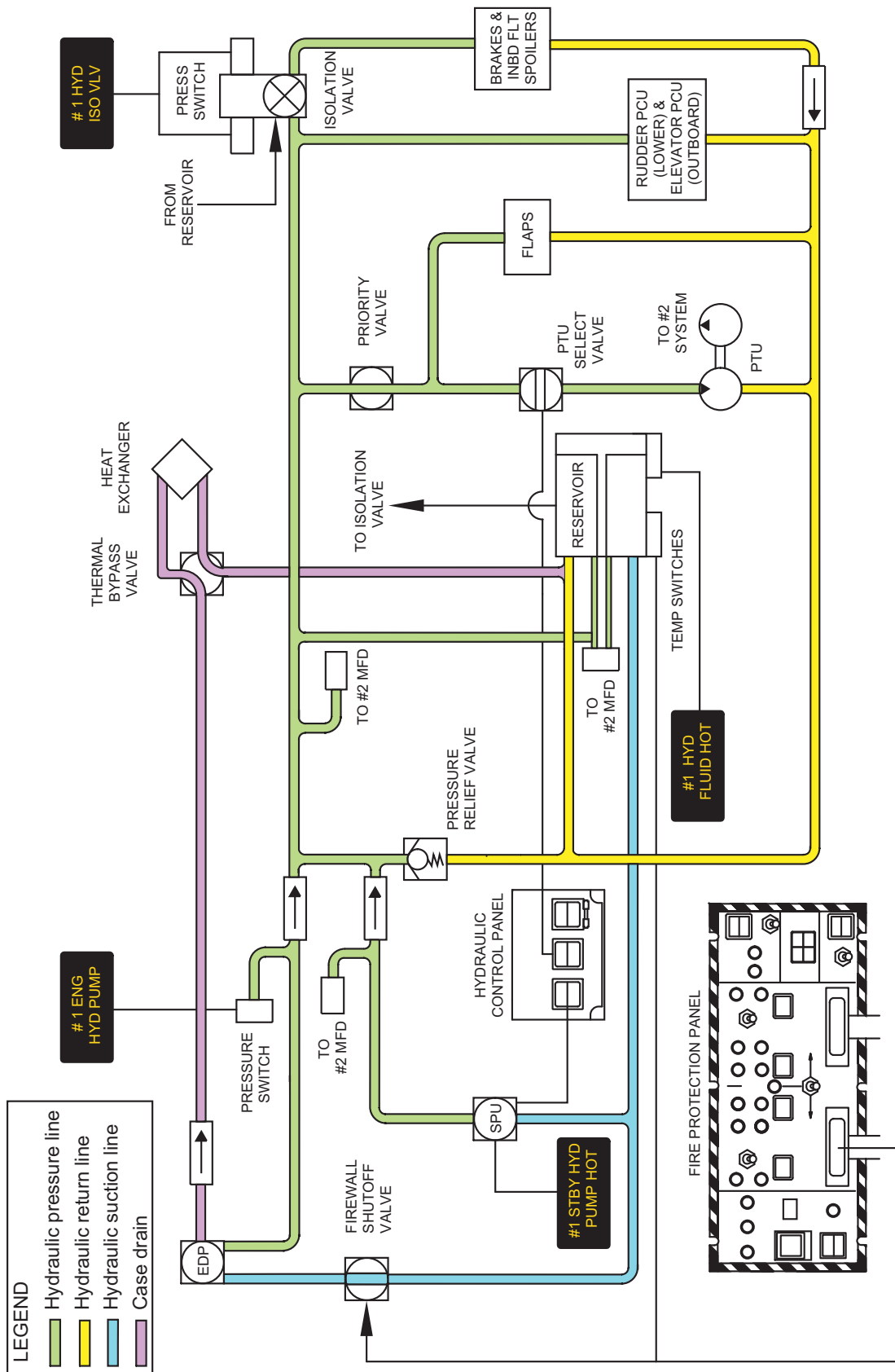


Figure 12.10-6 No. 1 Hydraulic System Schematic

# Dash8 - Q400 - Hydraulic Power

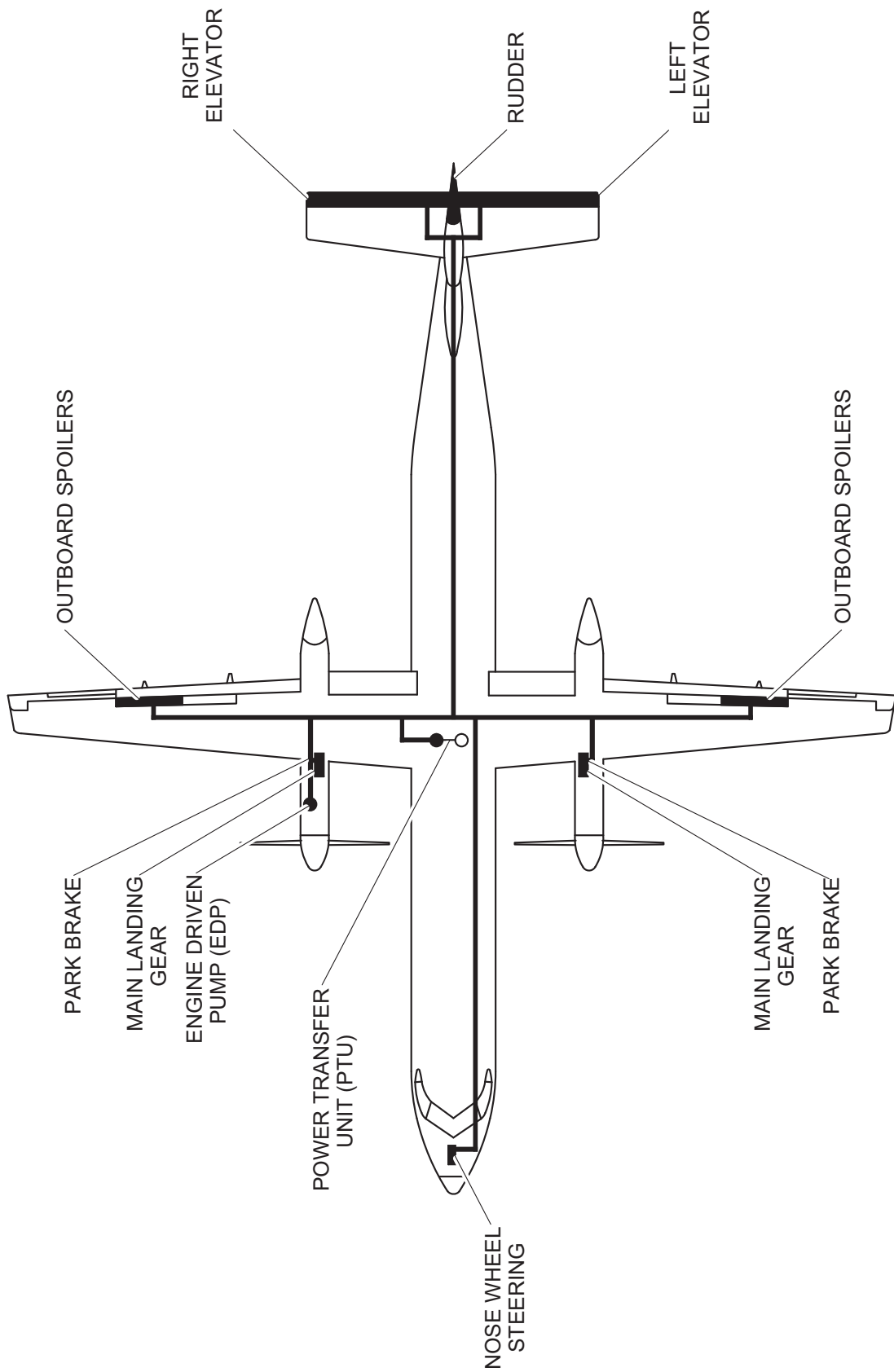


Figure 12.10-7 No. 2 Hydraulic System Overview

# Dash8 - Q400 - Hydraulic Power

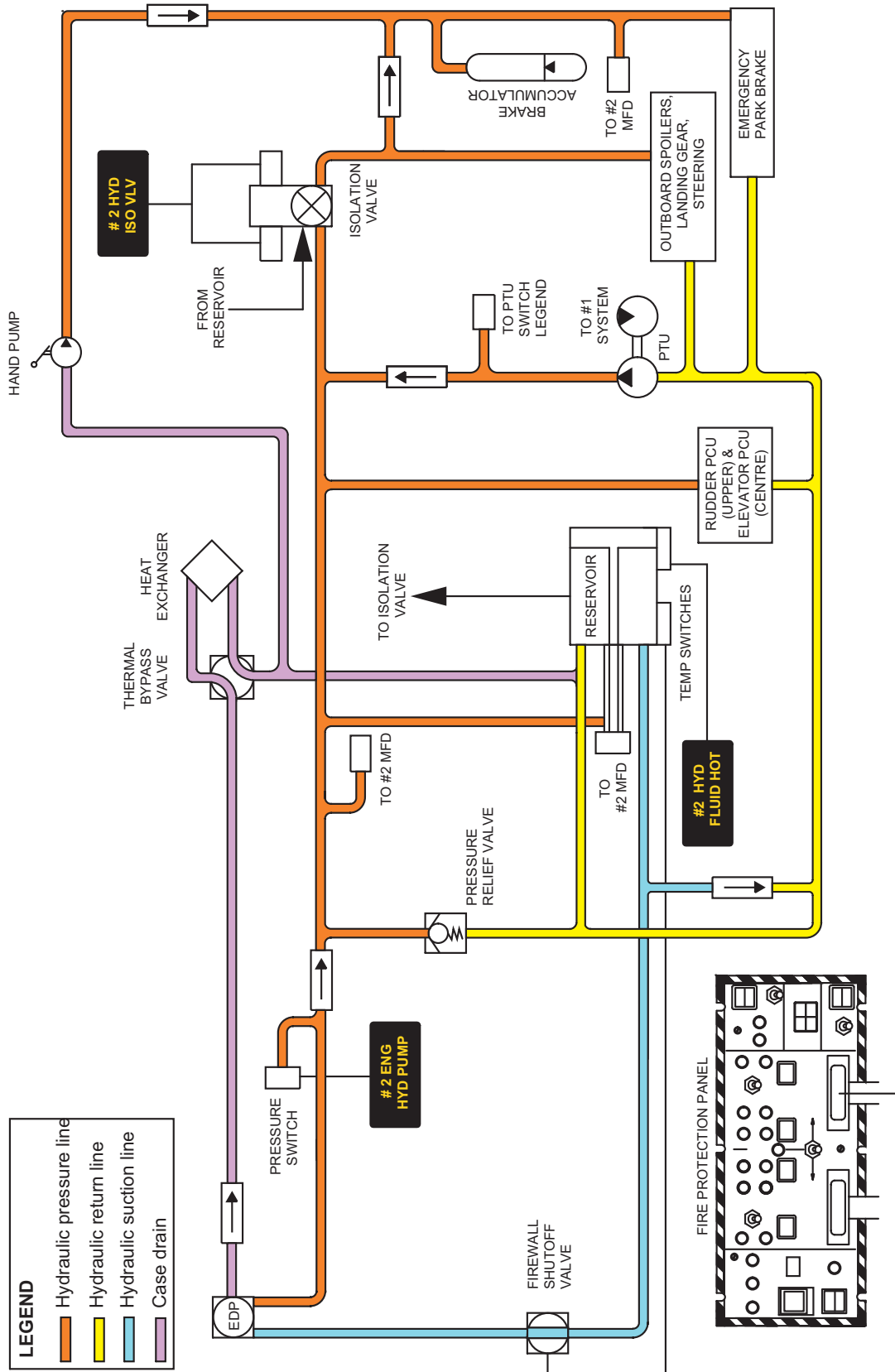


Figure 12.10-8 No. 2 Hydraulic System Schematic

#### **12.10.4.4 Hydraulic System Heat Exchangers**

The No. 1 and No. 2 hydraulic systems each include an oil-to-fuel heat exchanger, located in the fuel tank that is used to cool the hydraulic fluid of each system. Hydraulic fluid from the EDP, flows through the heat exchanger before returning to the hydraulic reservoir. A heat exchanger bypass valve, controls the flow of hydraulic fluid to and from the heat exchanger.

#### **12.10.4.5 Hydraulic System Isolation Valves**

The No. 1 and No. 2 hydraulic systems each include an isolation valve which is normally open (Figures 12.10-6 and 12.10-8). When there is inadequate fluid quantity due to hydraulic fluid loss, the isolation valve closes and the #1 or #2 HYD ISO VLV caution light turns on. Hydraulic power is available only to the following components:

No. 1 system:

- Rudder
- Elevators
- Flaps
- PTU

No. 2 system:

- Rudder
- Elevators

#### **12.10.4.6 Standby Hydraulic Pump**

No.1 hydraulic System, uses a variable frequency AC motor-driven pump (Figure 12.10-6) which functions as a backup source for providing pressurized hydraulic fluid in response to system demand. The Standby Hydraulic Pump supplies backup power to the No. 1 hydraulic system and is selected on for take-off and landing. The Standby Hydraulic Pump is electrically powered by the right 115 V variable AC bus. Backup electrical power to the Standby Hydraulic Pump is supplied by the left 115 V variable AC bus. The Standby Hydraulic Pump is installed in the No. 1 engine nacelle.

#### **12.10.4.7 Normal Operation**

The Standby Hydraulic Pump is normally selected on for take-off and landing. When the STBY HYD PRESS switchlight on the HYDRAULIC CONTROL panel is pushed, the Standby Hydraulic Pump is energized on. A green ON legend in the switchlight turns on. When the Standby Hydraulic Pump is activated on automatically, the green ON legend in the switchlight will not turn on. After take-off, the STBY HYD PRESS switch is selected off to deactivate the SPU. Nominal system pressure is 3000 psi.

If not selected on, the SPU will automatically turn on if:

- No. 1 engine fails during flight, or
- Flaps are selected to positions greater than 0° when parking brake is selected off and hydraulic reservoir No. 1 not empty.

When the STBY HYD PRESS switchlight is pushed, the green legend in switchlight shows ON. If the SPU pump windings should overheat, the #1 STBY HYD PUMP HOT caution light will come on.



# Dash8 - Q400 - Hydraulic Power

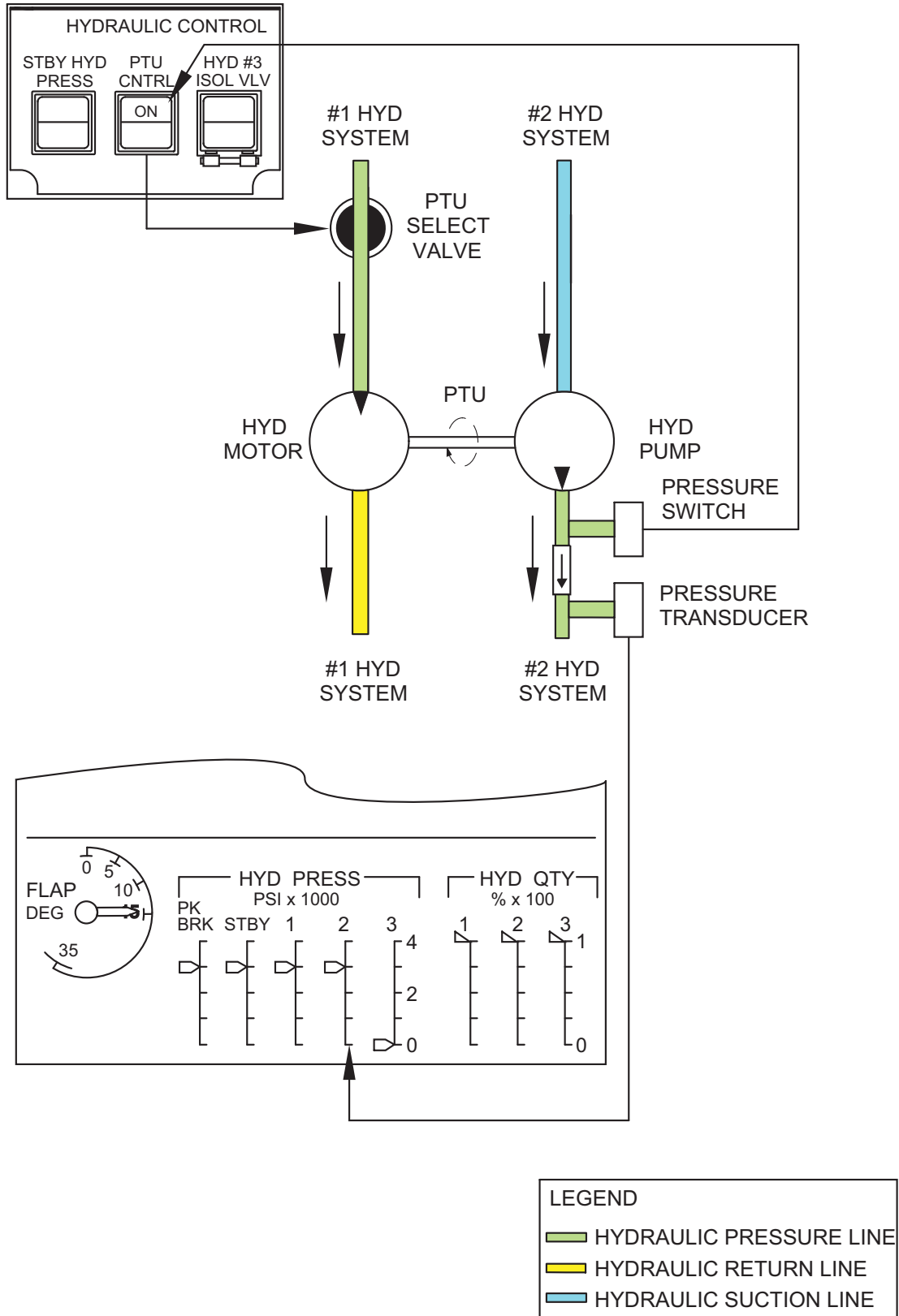


Figure 12.10-9 Power Transfer Unit Schematic

### 12.10.4.8 Priority Valve

A priority valve is included in the No. 1 hydraulic system (Figure 12.10-7) and is normally open. If the hydraulic pressure in No. 1 system decreases below 2100 psi because of system demand, the priority valve closes. This shuts off hydraulic power to the flaps and PTU. Hydraulic pressure is maintained to the elevators, rudder, inboard spoilers and brakes.

### 12.10.4.9 Power Transfer Unit (Ptu)

A Power Transfer Unit (PTU) operates as a backup hydraulic pressure to the No. 2 hydraulic system. The PTU uses hydraulic pressure from the No. 1 system to power a hydraulic motor (Figure 12.10-9). The motor then operates a hydraulic pump to pressurize the No. 2 system. Hydraulic fluid is not shared or transferred between No. 1 and No. 2 hydraulic systems during PTU operation. Hydraulic fluid must be available in the No. 2 system for PTU operation.

#### System Operation

The PTU may be selected on manually, or is actuated automatically. Manual selection of the PTU is achieved by pushing the PTU CNTRL switchlight on the HYDRAULIC CONTROL panel. A green ON legend in the switchlight turns on when the PTU generates hydraulic pressure.

Automatic actuation of the PTU occurs when:

- The park brake is selected off, and
- Flaps are selected greater than 0°, and
- No. 1 EDP pressure is greater than 2400 psi, and
- Hydraulic No. 2 reservoir is not empty.

# Dash8 - Q400 - Hydraulic Power

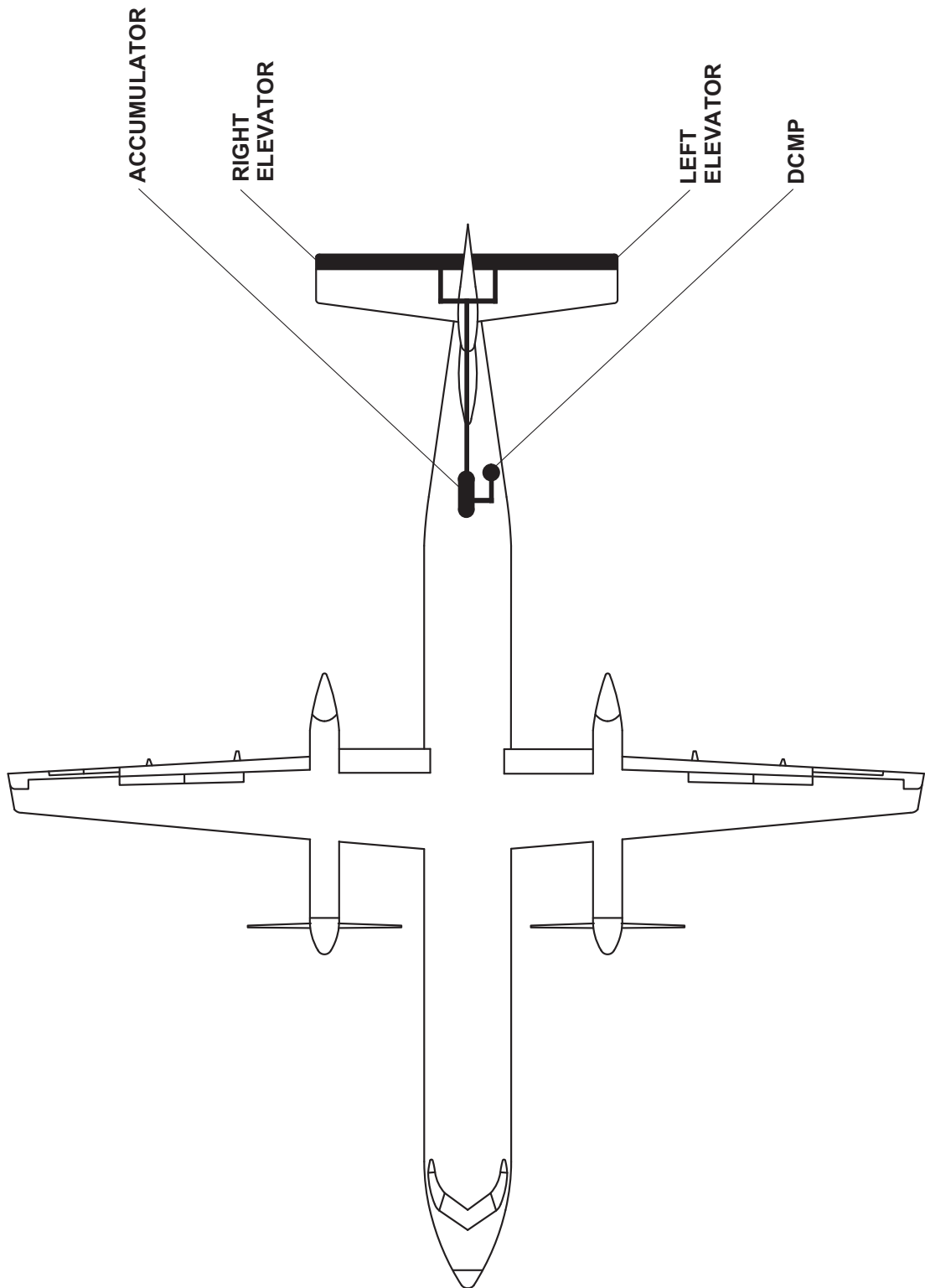


Figure 12.10-10 No. 3 Hydraulic System Schematic

### 12.10.5 No. 3 Hydraulic System

The No. 3 hydraulic system is an independent system (Figure 12.10-10). The system operates automatically. During an emergency condition the left and right inboard elevator PCU's are powered when the No. 1 and/or No. 2 hydraulic systems fail, or if a dual engine failure occurs. The No. 3 hydraulic system can also be engaged manually by pushing the HYD #3 ISOL VLV switchlight on the HYDRAULIC CONTROL panel. Once pushed, an amber OPEN legend on the switchlight will turn on. An accumulator and an isolation valve are also installed in the No. 3 hydraulic system.

A 28 volt DC Motor Driven Pump (DCMP) operates automatically to pressurize the accumulator and keep the accumulator pressurized between 2600 to 3250 psi. When the DCMP is not operating, the accumulator holds a reserve of pressure. The volume of the No.3 system reservoir is 2.6 quarts (2.46 litre).

The DCMP operates intermittently and is controlled by two pressure switches installed on the accumulator isolation valve. One switch signals the DCMP to operate if system pressure drops to 2600 psi and commands the DCMP to turn off when system pressure reaches 3250 psi. The other switch turns on the #3 STBY HYD PUMP caution light if system pressure falls to 900 psi, or the DCMP has been operating for longer than 60 seconds on the ground. Electrical power is supplied to the DCMP by the standby battery.

#### 12.10.5.1 System Operation

##### Accumulator Isolation Valve

The isolation valve is used in the No. 3 hydraulic system to isolate the elevators from No. 3 hydraulic system pressure. During normal flight operation, the system is in an active standby mode with the accumulator isolation valve (energized) closed. When open, the isolation valve allows hydraulic pressure from the No. 3 hydraulic system to power the elevators (Figure 12.10-11). The isolation valve will open in flight if No 1 and/or No. 2 hydraulic system pressure is lost, or, if No. 1 and No. 2 engines fail.

The isolation valve can be manually opened when the HYD #3 ISOL VLV switchlight is pushed, shown by an amber OPEN legend on the switchlight.

An additional pressure switch is installed downstream of the isolation valve. It turns on the ELEVATOR PRESS caution light if No. 1, No. 2 and No. 3 hydraulic systems are supplying pressure to all six elevator actuators. If this occurs, airspeed should be reduced to 200 KIAS.

If the isolation valve malfunctions open, the No. 3 hydraulic system will supply hydraulic power to the elevators, even though No. 1 and No. 2 hydraulic systems are operative. The ELEVATOR PRESS caution light will turn on. The OPEN legend in the switchlight will not turn on.

The No. 3 hydraulic system supplies hydraulic pressure to both elevators when:

- No. 1 and/or No. 2 hydraulic systems fail
- No. 1 and No. 2 engines fail.

# Dash8 - Q400 - Hydraulic Power

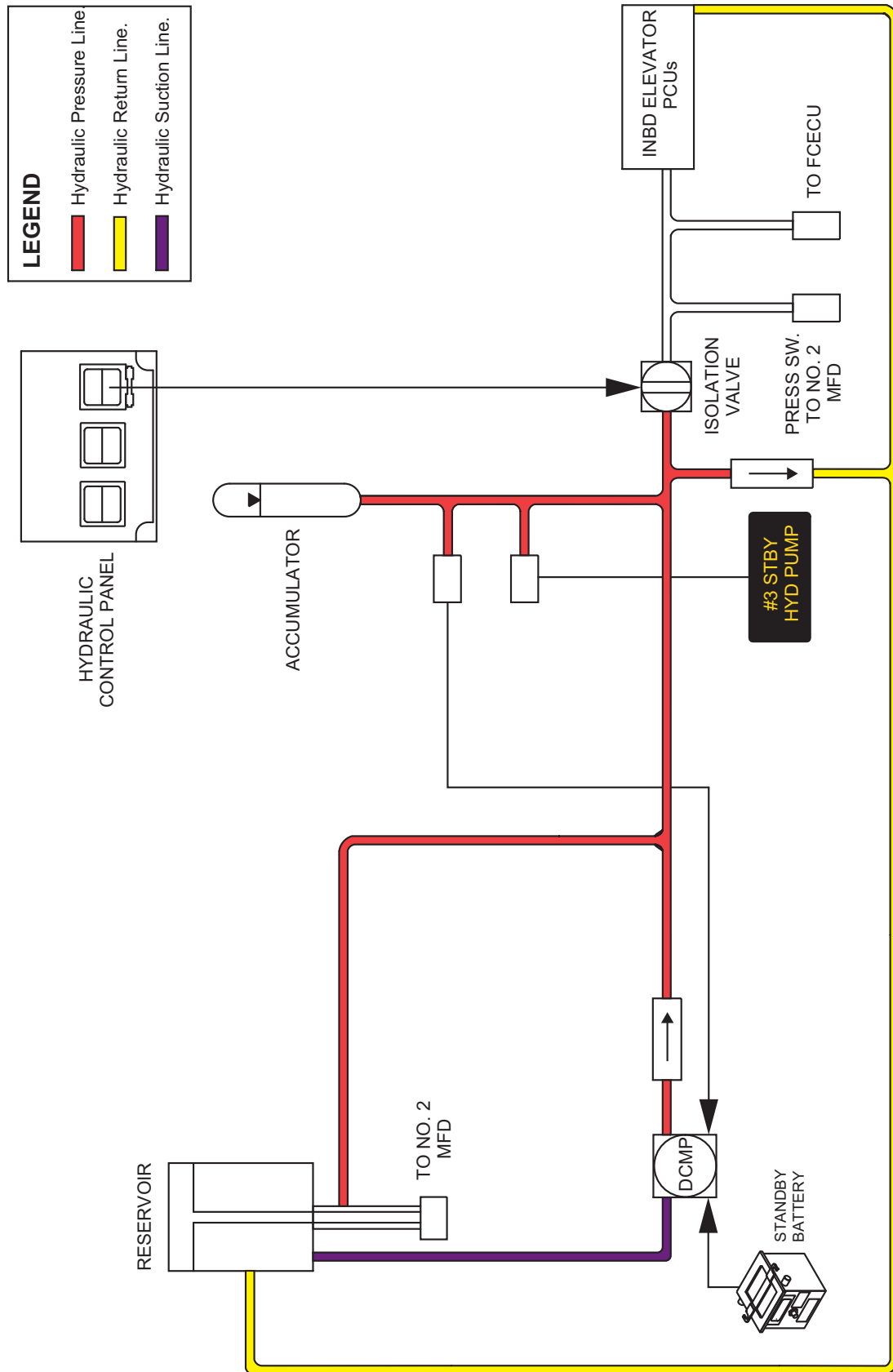


Figure 12.10-11 No. 3 Hydraulic System Schematic

### 12.10.6 Alternate Hydraulic System

#### 12.10.6.1 Alternate Landing Gear System

The alternate landing gear extension system supplies hydraulic power to extend the main landing gears when main hydraulic power is not available.

##### Hand Pump

The system is operated by the alternate landing gear hand pump (Figure 12.10-12). The hand pump is located below the Landing Gear Alternate Extension door in the flight deck floor, adjacent to the co-pilot's seat. A hand pump lever, behind the copilot's seat, must be installed into the hand pump socket to operate and extend the landing gear, following isolation of the No. 2 hydraulic system. The pump draws hydraulic fluid from an auxiliary reservoir.

##### Reservoir

The alternate landing gear system reservoir is located in the nose compartment of the aeroplane. The reservoir supplies the hydraulic fluid to alternate landing gear extension hand pump. The reservoir capacity is 1 U.S. Quart (0.95 litre).

#### 12.10.6.2 System Operation

The Alternate Landing Gear selector valve is located below the flight deck floor and is normally in the open position. Opening the Landing Gear Alternate Extension door fully, closes the MLG selector valve and allows the hand pump lever to be inserted into the hand pump socket. Stroking the hand pump lever, provides pressure to the alternate landing-gear actuators to down-lock the gear to the down and locked position if it did not free fall into position during an alternate release.

##### Indication

Hydraulic system pressure and reservoir quantity information are shown on the Multi Functional Displays (MFD) in the flight deck. The copilot's MFD shows data in analog format during normal configuration. If the copilot's MFD malfunctions, data in digital format is shown on a composite page on the pilot's MFD. System malfunctions are shown on the caution and warning panel in the flight deck.

Hydraulic system pressure and fluid quantity indications are normally shown on the co-pilot's MFD. The indications are:

- No. 1, No. 2 and No. 3 main system pressure
- Standby pressure
- No. 1, No. 2 and No. 3 quantity indications
- Park Brake pressure

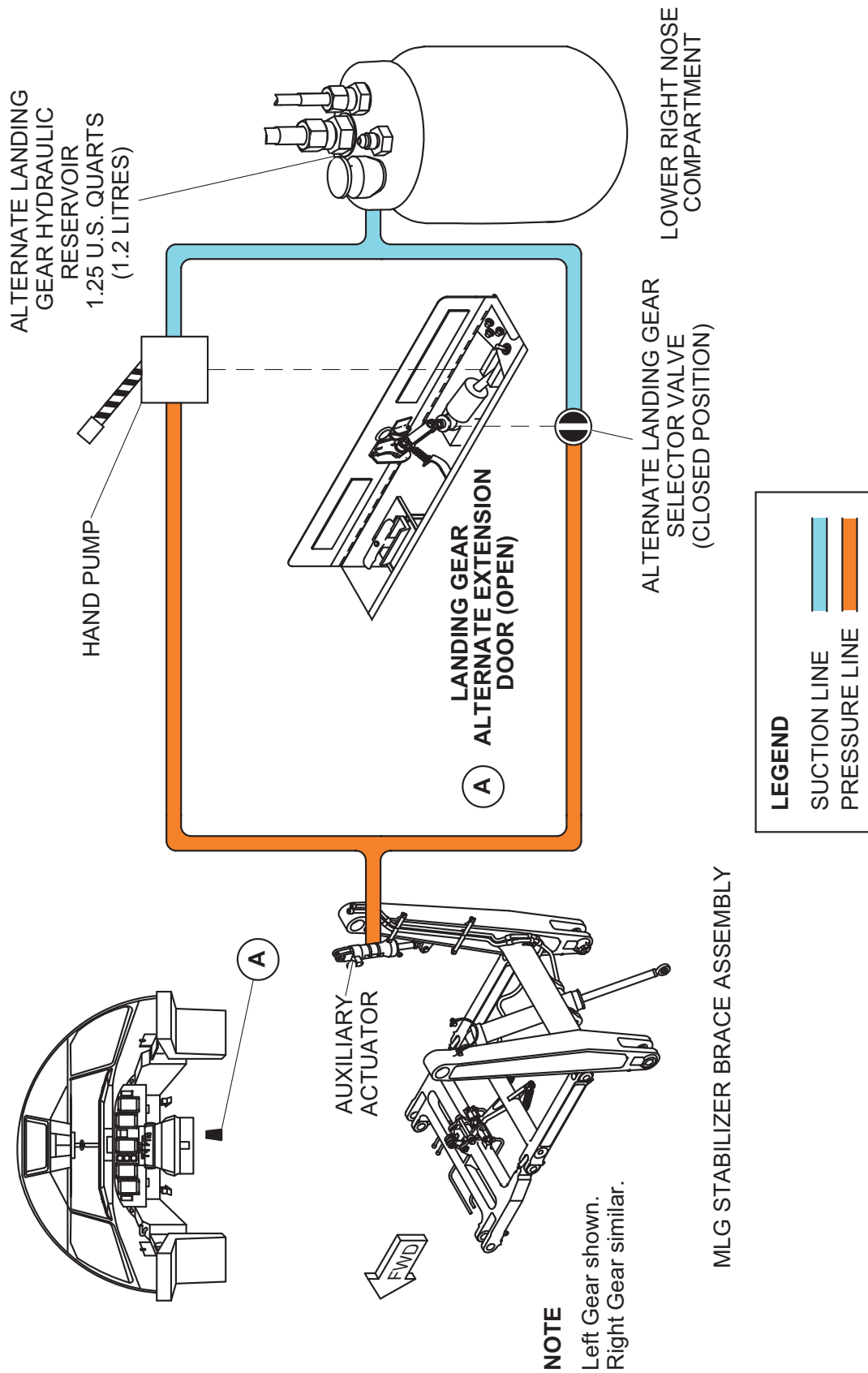


Figure 12.10-12 Alternate Landing Gear Schematic