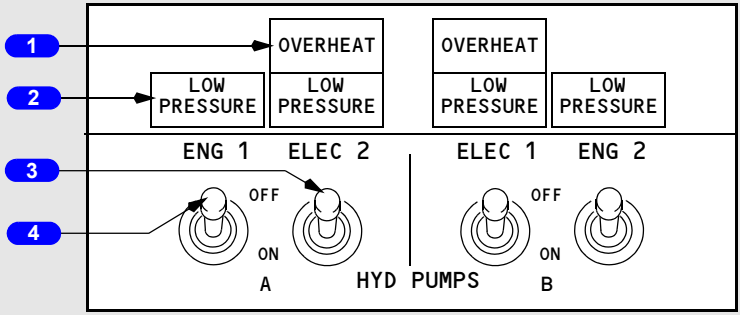
Hydraulic Panel



FORWARD OVERHEAD PANEL

1 Electric Hydraulic Pump OVERHEAT Lights

Illuminated (amber) – associated electric motor–driven pump has overheated.

2 Hydraulic Pump LOW PRESSURE Lights

Illuminated (amber) – output pressure of associated pump is low

Note: When an engine fire switch is pulled, the associated engine-driven pump low pressure light is deactivated.

3 ELECTRIC HYDRAULIC PUMPS Switches

ON – provides power to associated electric motor–driven pump.

OFF – electrical power removed from pump.

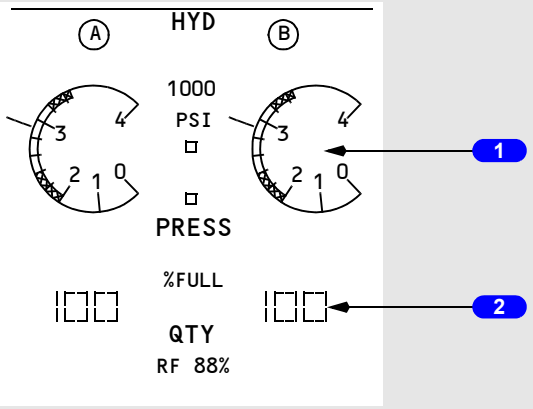
4 ENGINE HYDRAULIC PUMPS Switches

ON – de–energizes blocking valve in pump to allow pump pressure to enter system.

Note: Should remain ON at shutdown to prolong solenoid life.

OFF – energizes blocking valve to block pump output.

Hydraulic Indications



CENTER INSTRUMENT PANEL

1 HYDRAULIC System PRESSURE Indications

Indicates system pressure:

- Normal pressure (green) – 3000 psi
- Maximum pressure (red) – 3500 psi.

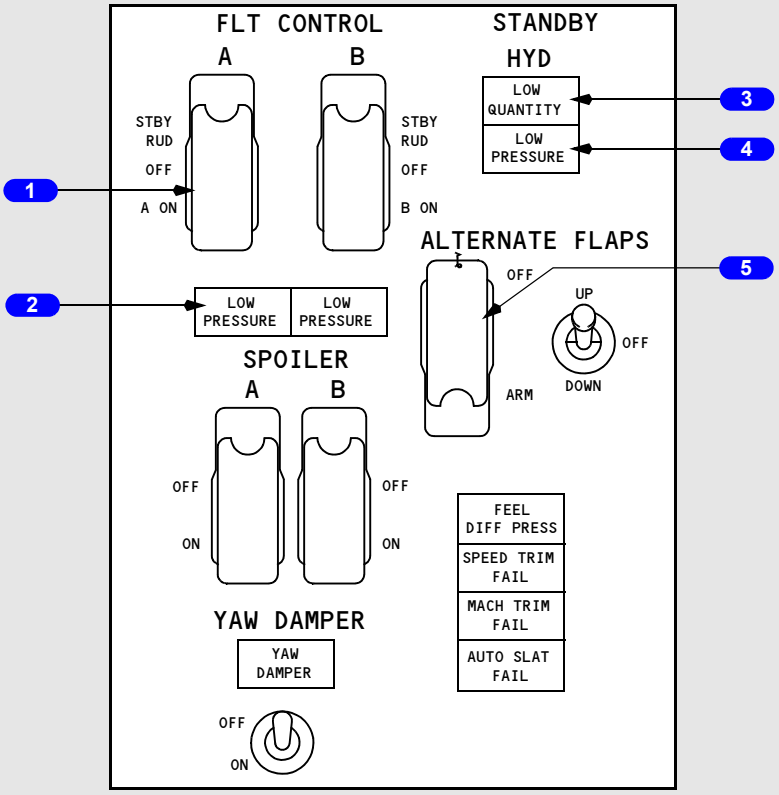
Note: When both pumps for a system are OFF, respective pointer reads zero.

2 HYDRAULIC System QUANTITY Indications

Indicates digital percentage of hydraulic quantity (green).

Note: Refill condition of 88% is valid only when airplane is on the ground.

Flight Control Panel (before Rudder System Enhancement Program (RSEP) modification)



FORWARD OVERHEAD PANEL

1 FLIGHT CONTROL Switches

STBY RUD – activates standby pump and opens standby rudder shutoff valve to pressurize standby rudder power control unit.

OFF – closes flight control shutoff valve isolating ailerons, elevators and rudder from associated hydraulic system pressure.

ON (guarded position) – normal operating position.

2 Flight Control LOW PRESSURE Lights

Illuminated (amber) –

- indicates low hydraulic system (A or B) pressure to ailerons, elevator and rudder
- deactivated when associated FLT CONTROL switch is positioned to STBY RUD and standby rudder shutoff valve opens
- the A system light indicates A system pressure is low when the rudder pressure reducer is commanding normal system pressure.

Note: The A system light will remain illuminated for approximately five seconds after A hydraulic system is activated.

3 STANDBY HYDRAULIC LOW QUANTITY Light

Illuminated (amber) –

- indicates low quantity in standby hydraulic reservoir
- always armed.

4 STANDBY HYDRAULIC LOW PRESSURE Light

Illuminated (amber) –

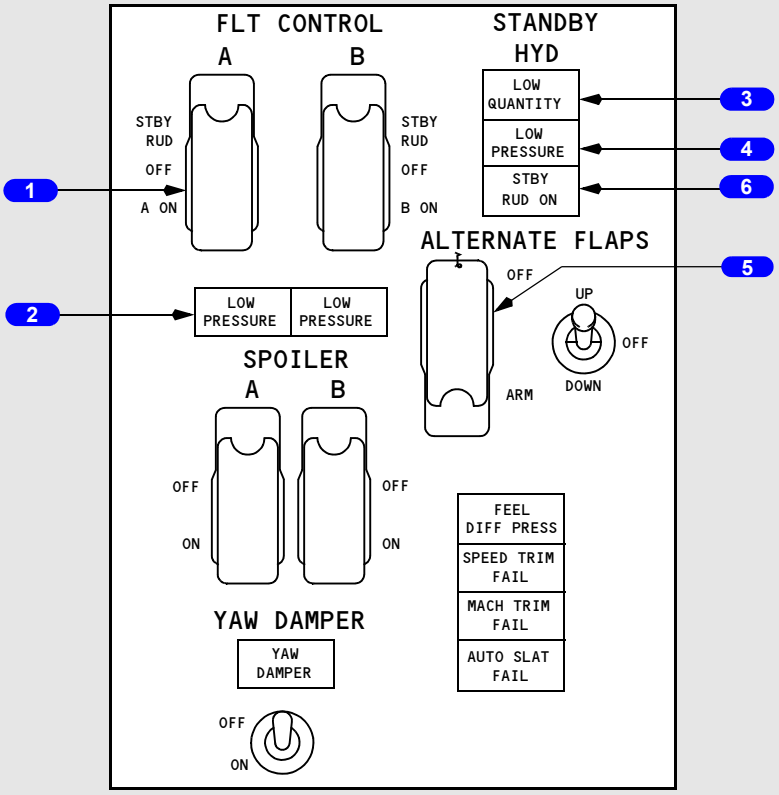
- indicates output pressure of standby pump is low
- armed only when standby pump operation has been selected or automatic standby function is activated.

5 ALTERNATE FLAPS Master Switch

OFF (guarded position) – normal operating position.

ARM – closes trailing edge flap bypass valve, activates standby pump, and arms ALTERNATE FLAPS position switch.

Flight Control Panel (after Rudder System Enhancement Program (RSEP) modification)



FORWARD OVERHEAD PANEL

1 FLIGHT CONTROL Switches

STBY RUD – activates standby pump, opens standby rudder shutoff valve to pressurize standby rudder power control unit, and illuminates amber STBY RUD ON light.

OFF – closes flight control shutoff valve isolating ailerons, elevators and rudder from associated hydraulic system pressure.

ON (guarded position) – normal operating position.

2 Flight Control LOW PRESSURE Lights

Illuminated (amber) –

- indicates low hydraulic system (A or B) pressure to ailerons, elevator and rudder
- deactivated when associated FLT CONTROL switch is positioned to STBY RUD and standby rudder shutoff valve opens
- the A system light indicates A system pressure is low when full RPR pressure is commanded.

Note: The A system light will remain illuminated for approximately five seconds after A hydraulic system is activated.

3 STANDBY HYDRAULIC LOW QUANTITY Light

Illuminated (amber) –

- indicates low quantity in standby hydraulic reservoir
- always armed.

4 STANDBY HYDRAULIC LOW PRESSURE Light

Illuminated (amber) –

- indicates output pressure of standby pump is low
- armed only when standby pump operation has been selected or automatic standby function is activated.

5 ALTERNATE FLAPS Master Switch

OFF (guarded position) – normal operating position.

ARM – closes trailing edge flap bypass valve, activates standby pump, and arms ALTERNATE FLAPS position switch.

6 STBY RUD ON Light

Illuminated (amber) - indicates the standby hydraulic system is commanded on to pressurize the standby rudder power control unit.

Introduction to Hydraulics

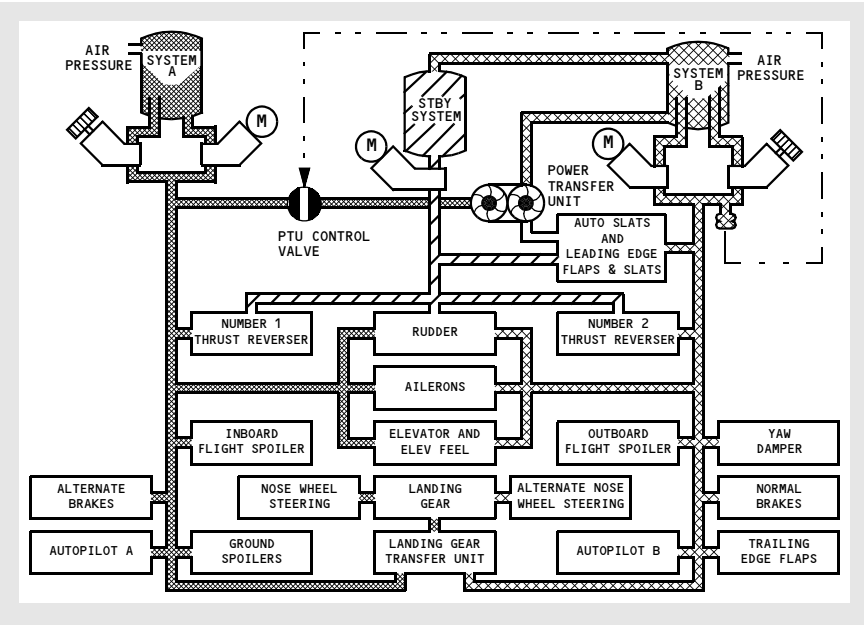
The airplane has three hydraulic systems: A, B and standby. The standby system is used if system A and/or B pressure is lost. The hydraulic systems power the following airplane systems:

- flight controls
- leading edge flaps and slats
- trailing edge flaps
- landing gear
- wheel brakes
- nose wheel steering
- thrust reversers
- autopilots

Either A or B hydraulic system can power all flight controls with no decrease in airplane controllability.

Each hydraulic system has a fluid reservoir located in the main wheel well area. System A and B reservoirs are pressurized by bleed air. The standby system reservoir is connected to the system B reservoir for pressurization and servicing. Pressurization of all reservoirs ensures positive fluid flow to all hydraulic pumps.

Hydraulic Power Distribution Schematic



A and B Hydraulic Systems

Components powered by hydraulic systems A and B are:

System A

- ailerons
- rudder
- elevator and elevator feel
- flight spoilers (one on each wing)
- ground spoilers
- alternate brakes
- No. 1 thrust reverser
- autopilot A
- normal nose wheel steering
- landing gear
- power transfer unit (PTU)

System B

- ailerons
- rudder
- elevator and elevator feel
- flight spoilers (one on each wing)
- leading edge flaps and slats
- normal brakes
- No. 2 thrust reverser
- autopilot B
- alternate nose wheel steering
- landing gear transfer unit
- autoslats
- yaw damper
- trailing edge flaps

A and B Hydraulic System Pumps

Both A and B hydraulic systems have an engine–driven pump and an AC electric motor–driven pump. The system A engine–driven pump is powered by the No. 1 engine and the system B engine–driven pump is powered by the No. 2 engine. An engine–driven hydraulic pump supplies approximately four times the fluid volume of the related electric motor–driven hydraulic pump.

The ENG 1 (system A) or ENG 2 (system B) pump ON/OFF switch controls the engine–driven pump output pressure. Positioning the switch to OFF isolates fluid flow from the system components. However, the engine–driven pump continues to rotate as long as the engine is operating. Pulling the engine fire switch shuts off the fluid flow to the engine–driven pump and deactivates the related LOW PRESSURE light.

The ELEC 2 (system A) or ELEC 1 (system B) pump ON/OFF switch controls the related electric motor–driven pump. If an overheat is detected in either system, the related OVERHEAT light illuminates.

Note: Loss of the system A, engine-driven hydraulic pump and a heavy demand on system A may result in an intermittent LOW PRESSURE light for the remaining electric hydraulic pump. The system A flight controls LOW PRESSURE light, Master Caution light, and the FLT CONT and HYD system annunciator lights also illuminate.

Hydraulic fluid used for cooling and lubrication of the pumps passes through a heat exchanger before returning to the reservoir. The heat exchanger for system A is located in main fuel tank No. 1 and for system B is in main fuel tank No. 2.

CAUTION: Minimum fuel for ground operation of electric pumps is 760 Kgs (1675 Lbs) in the related main tank.

Pressure switches, located in the engine–driven and electric motor–driven pump output lines, send signals to illuminate the related LOW PRESSURE light if pump output pressure is low. A check valve, located in each output line, isolates the related pump from the system. The related system pressure transmitter sends the combined pressure of the engine–driven and electric motor–driven pumps to the related hydraulic system pressure indication.

System A Hydraulic Leak

If a leak develops in the engine–driven pump or its related lines, a standpipe in the reservoir prevents a total system fluid loss. With fluid level at the top of the standpipe, the reservoir quantity displayed indicates approximately 22% full. System A hydraulic pressure is maintained by the electric motor–driven pump.

If a leak develops in the electric motor–driven pump or its related lines, or components common to both the engine and electric motor–driven pumps, the quantity in the reservoir steadily decreases to zero and all system pressure is lost.

System B Hydraulic Leak

The system B reservoir has two standpipes. One standpipe supplies fluid to the engine–driven pump and the other to the electric motor–driven pump. If a leak develops in the engine–driven pump or its associated lines, the system B quantity decreases until it indicates approximately 40% full. System pressure is maintained by the electric motor–driven pump. If a leak develops in the electric motor–driven pump or its associated lines, system B pressure is lost. However, fluid remaining in the system B reservoir is sufficient for power transfer unit operation.

A leak in system B does not affect the operation of the standby hydraulic system.

Power Transfer Unit

The purpose of the PTU is to supply the additional volume of hydraulic fluid needed to operate the autoslats and leading edge flaps and slats at the normal rate when system B engine–driven hydraulic pump volume is lost. The PTU uses system A pressure to power a hydraulic motor–driven pump, which pressurizes system B hydraulic fluid. The PTU operates automatically when all of the following conditions exist:

- airborne
- system B engine–driven pump hydraulic pressure drops below limits
- flaps are less than 15 but not up.

Landing Gear Transfer Unit

The purpose of the landing gear transfer unit is to supply the pressurized hydraulic fluid needed to raise the landing gear at the normal rate when system A is lost due to No. 1 engine RPM loss. The system B engine–driven pump supplies the pressurized hydraulic fluid needed to operate the landing gear transfer unit when all of the following conditions exist:

- airborne
- No. 1 engine RPM drops below a limit value
- LANDING GEAR lever is positioned UP
- either main landing gear is not up and locked.

Standby Hydraulic System

The standby hydraulic system is provided as a backup if system A and/or B pressure is lost. The standby system can be activated manually or automatically. It uses a single electric motor–driven pump to power:

- thrust reversers
- rudder
- leading edge flaps and slats (extend only).

Manual Operation

Positioning either FLT CONTROL switch to STBY RUD:

- activates the standby electric motor–driven pump
- shuts off the related hydraulic system pressure to ailerons, elevators and rudder by closing the flight control shutoff valve
- opens the standby rudder shutoff valve
- deactivates the related flight control LOW PRESSURE light when the standby rudder shutoff valve opens
- allows the standby system to power the rudder and thrust reversers.
- (after RSEP modification) illuminates the STBY RUD ON, Master Caution, and Flight Controls (FLT CONT) lights.

Positioning the ALTERNATE FLAPS master switch to ARM, (see the Flight Controls chapter for a more complete explanation):

- activates the standby electric motor–driven pump
- closes the trailing edge flap bypass valve
- arms the ALTERNATE FLAPS position switch
- allows the standby system to power the leading edge flaps and slats and thrust reversers.

Automatic Operation

Automatic operation is initiated when the following conditions exist:

- loss of system A or B, or rudder pressure reducer system fails in low pressure mode, and
- flaps extended, and
- airborne, or wheel speed greater than 60 kts, and
- FLT CONTROL switch A or B Hydraulic System ON

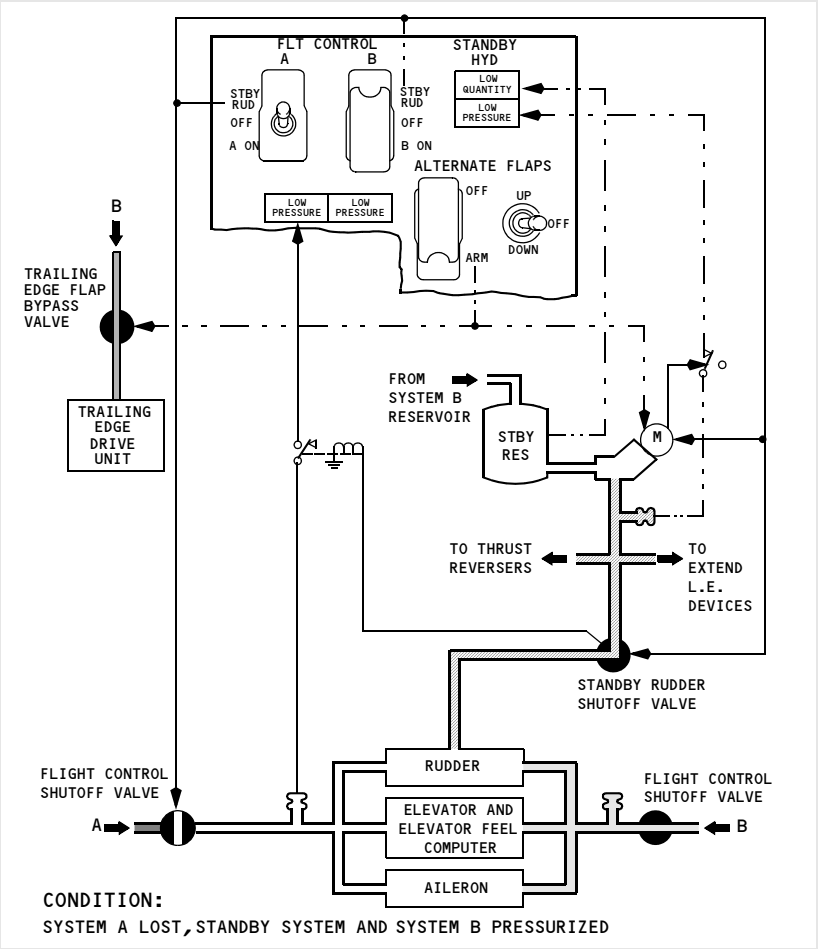
OR (after RSEP modification)

- The main PCU Force Fight Monitor (FFM) trips.

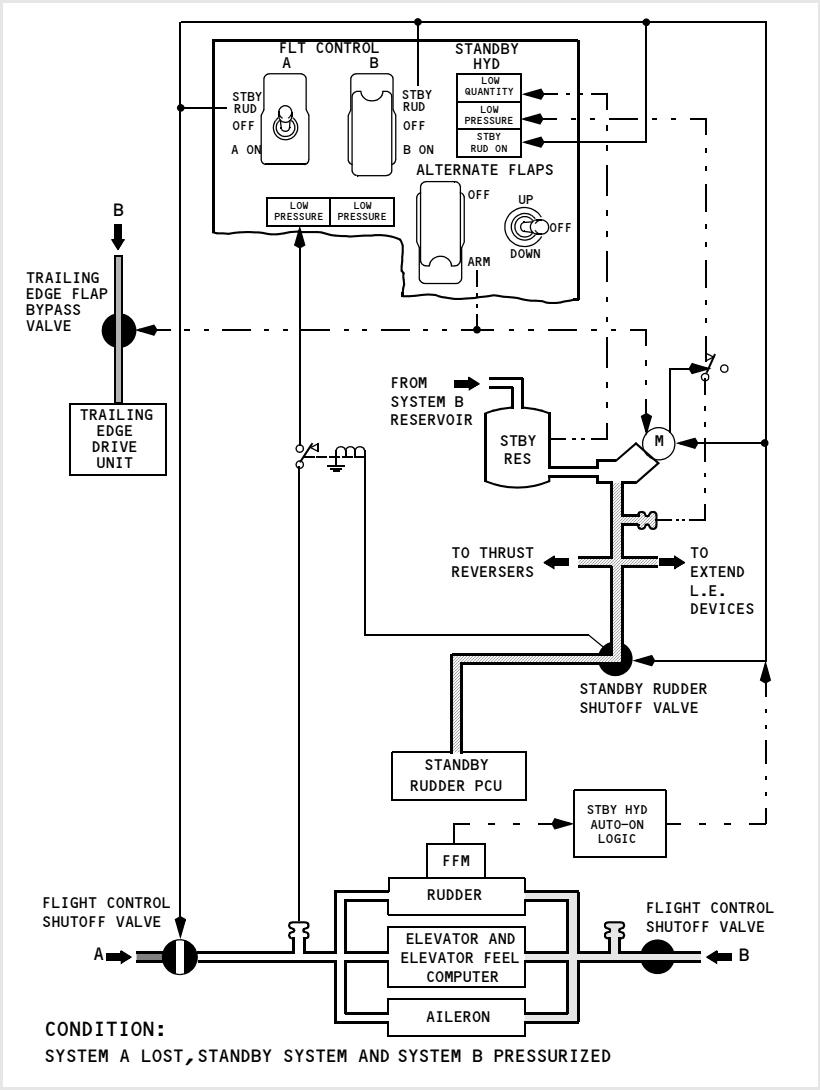
Automatic operation:

- opens the standby rudder shutoff valve
- activates the standby electric motor–driven pump
- allows the standby system to power the rudder and thrust reversers.
- (after RSEP modification) illuminates the STBY RUD ON, Master Caution, and Flight Controls (FLT CONT) lights

Standby Hydraulic System Schematic (before RSEP modification) and (after RSEP modification)



(before RSEP modification)



(after RSEP modification)

Standby Hydraulic System Leak

If a leak occurs in the standby system, the standby reservoir quantity decreases to zero. The LOW QUANTITY light illuminates when the standby reservoir is approximately half empty. System B continues to operate normally, however, the system B reservoir fluid level indication decreases and stabilizes at approximately 64% full.

Variations in Hydraulic Quantity Indications

During normal operations, variations in hydraulic quantity indications occur when:

- the system becomes pressurized after engine start
- raising or lowering the landing gear or leading edge devices
- cold soaking occurs during long periods of cruise.

These variations have little effect on systems operation.

If the hydraulic system is not properly pressurized, foaming can occur at higher altitudes. Foaming can be recognized by pressure fluctuations and the blinking of the related LOW PRESSURE lights. The MASTER CAUTION and HYD annunciator lights may also illuminate momentarily.