



TECHSAVIATION

Training Center

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Hydraulics

General Description

There are three hydraulic systems designated left, center, and right. The systems do not share fluid and can operate up to 5,000 pounds per square inch.

Six hydraulic pumps create pressure for three independent airplane hydraulic systems.

The primary pumps for the left and right systems are Engine Driven Pumps (EDP). The demand pumps are the EMPs.

The primary pump for the center system is one of the EMPs based on calendar days. The other EMP acts as the demand pump.

The center system can also receive Ram Air Turbine (RAT) hydraulic pressure in non-normal situations.

The left system supplies hydraulic power for these components and systems:

- Left wing aileron
- Spoilers: left wing 3, right wing 12
- Left elevator
- Left rudder actuator
- Left and right wing flaperons
- Left thrust reverser.

The right system supplies hydraulic power for these components and systems:

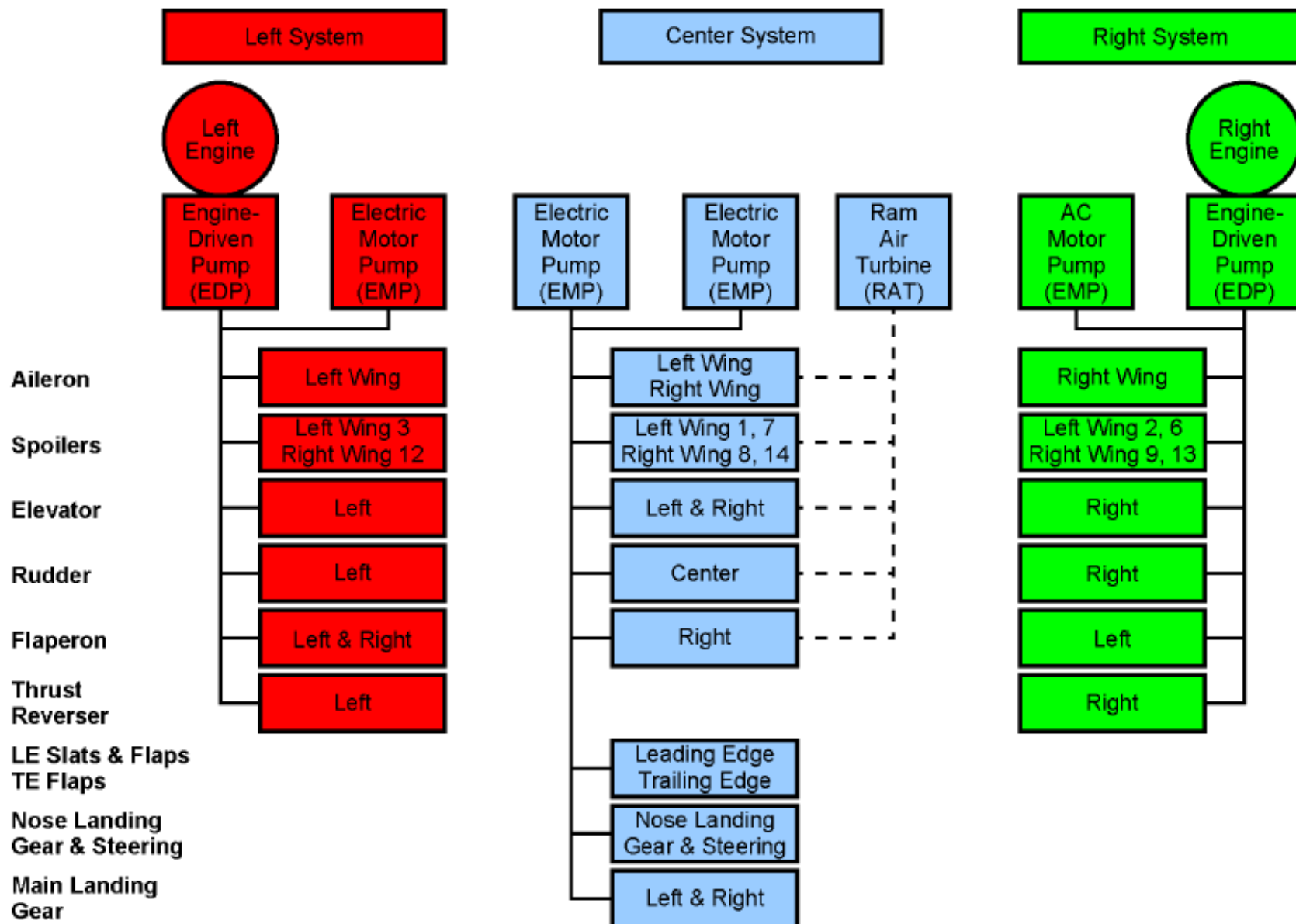
- Right wing aileron
- Spoilers: left wing 2 and 6, right wing 9 and 13
- Right elevator
- Right rudder actuator
- Left wing flaperon
- Right thrust reverser.

The center system supplies hydraulic power for these components and systems:

- Left and right wing ailerons
- Spoilers: left wing 1 and 7, right wing 8 and 14
- Center rudder actuator
- Right flaperon
- Leading edge slats, flaps, and trailing edge flaps
- Nose landing gear and steering
- Left and right main landing gear.

The RAT deploys automatically during flight and gives backup hydraulic power for flight control surfaces:

- Left and right wing ailerons
- Spoilers: left wing 1 and 7, right wing 8 and 14
- Center rudder actuator
- Right wing flaperon.



Hydraulic Component Locations

Three isolated hydraulic systems give power to airplane systems.

Hydraulic system components and lines are routed as far away from each other as possible. This system separation minimizes damage or failures to more than one of the three hydraulic systems.

The hydraulic system lines have a blue, yellow, and white colored tape band to show that they are hydraulic lines.

Location

The two Engine Driven Pumps (EDP) mount directly on the engine accessory gearbox.

The left and right system Electric Motor Pumps (EMP) are in their engine strut aft fairings.

The two center system EMPs are in the left aft wing-to-body fairing and are designated C1 and C2.

The left and right system reservoirs are in their engine aft strut fairings.

The center system reservoir is in the left aft wing-to-body fairing.

There are four heat exchangers, two for the center system and one each for the left and right systems.

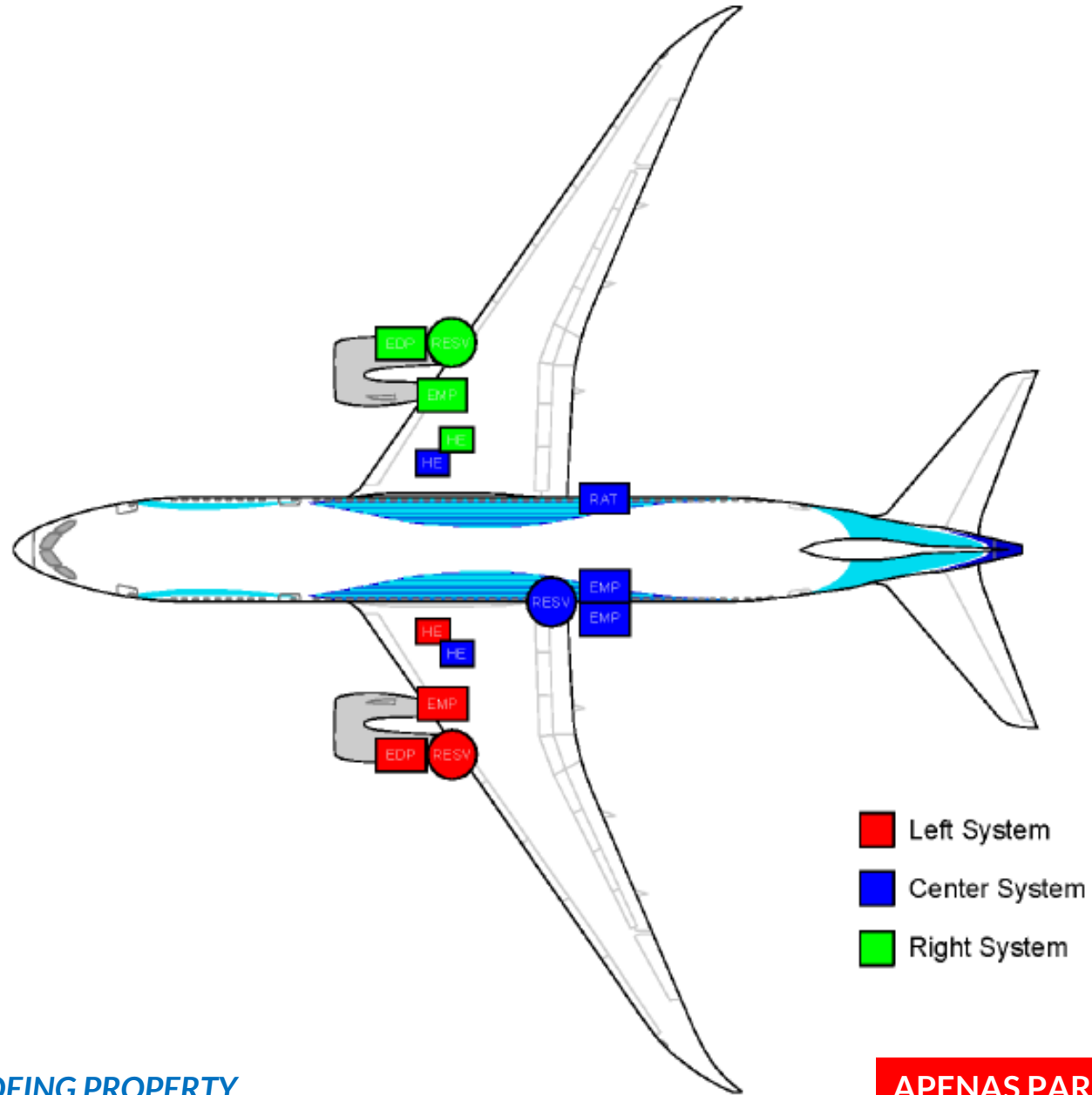
The heat exchangers are in the airplane fuel tanks. One of the center system heat exchangers and the left heat exchanger are in the left fuel tank and the other center and the right heat exchanger are in the right fuel tank.

There are four accumulators for the hydraulic system. The accumulators are pre-charged with nitrogen.

The left, center, and right systems each have an accumulator to maintain pressurization of the bootstrap reservoirs. These accumulators are next to their respective reservoirs.

The center system Nose Landing Gear (NLG) pressure circuit has an additional accumulator to reduce operational pressure spikes. This accumulator is in the nose wheel well.

A Ram Air Turbine (RAT) pump converts mechanical input power into hydraulic power for the center system flight controls. The RAT is in the right aft wing-to-body fairing.



Hydraulic Controls and Indications

The hydraulic controls and indications provide the interface for the flight and maintenance crews to operate the three hydraulic power systems.

The hydraulic system control panel is in the flight deck P5 overhead panel.

The engine fire control panel is in the P8 aisle stand.

Hydraulic Control Panel

The hydraulic control panel gives manual control of:

- The four Electric Motor Pumps (EMP)
- The two Engine Driven Pumps (EDP)
- The Ram Air Turbine (RAT).

The RAT deploy switch is a guarded switch with indication lights. An amber light indicates that the RAT is unlocked and a white light indicates that the RAT is producing pressure.

Two switches control the EDPs. White ON indications show that the switch is in the ON position. The EDP switches normally remain ON all the time.

Four EMP rotary switches give control to set the pumps to the OFF, AUTO, and ON positions. The EMPs are usually in the AUTO position.

Amber FAULT lights give indication for each hydraulic pump.

There are two engine fire handles on the control panel. When a fire handle is pulled, the EDP depressurizes, and the EDP shutoff valve closes for the applicable engine.

The Hydraulic Interface Function (HYDIF) controls the flight deck indication, fault monitoring, and automatic control of the hydraulic system.

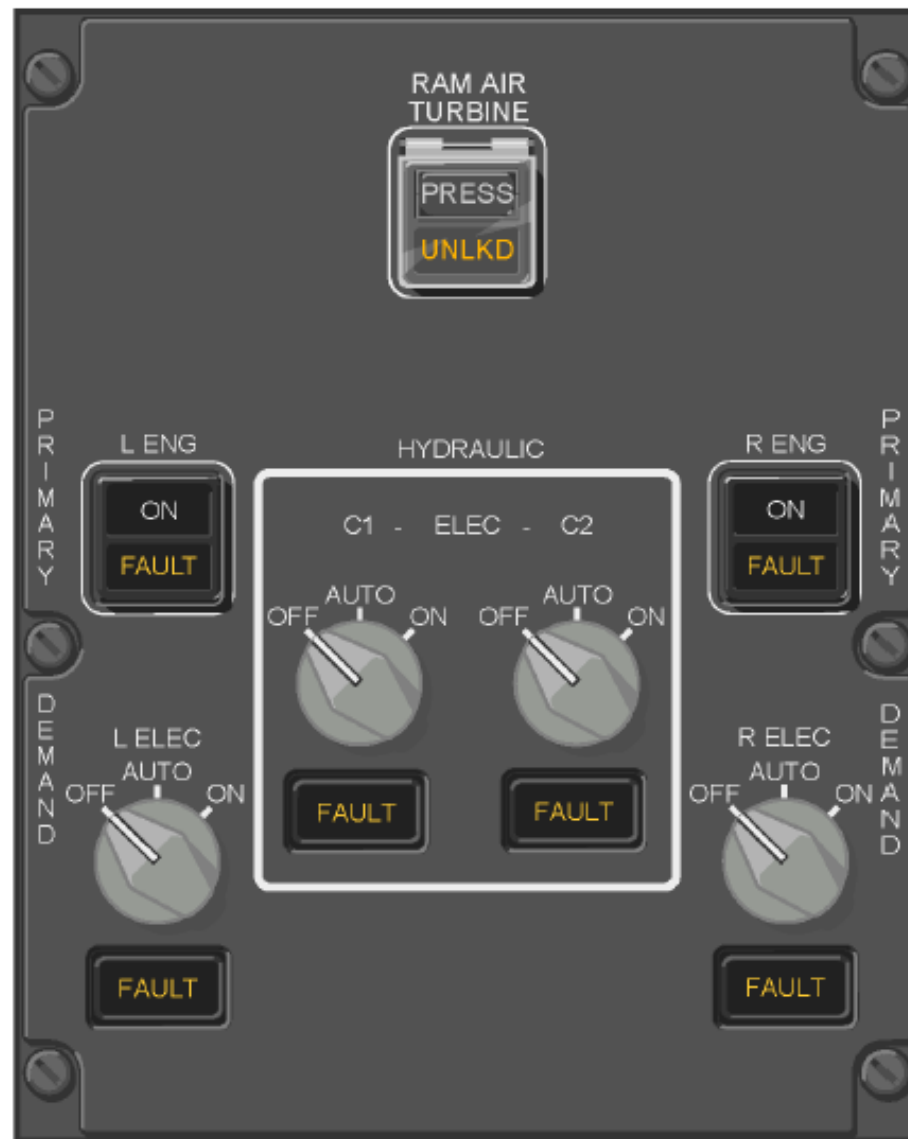
Normal hydraulic pressure comes from the two EDPs and one center EMP that operate continuously.

The two EMPs (C1 and C2) alternate as the primary pump. The left and right system EMPs are demand pumps.

The HYDIFs in the Common Core System (CCS) control the hydraulic system automatically and no crew action is necessary after the pumps have been set before engine start.



Engine Fire Control Panel



P5 Hydraulic Control Panel

Hydraulic Indications

Hydraulic operating parameters and conditions are shown on the status page and on the hydraulic synoptic displays on the Multi-Function Displays (MFD).

Status Page

The Hydraulic Interface Function (HYDIF) receives data from the quantity sensor on each hydraulic reservoir and transmits the values to the Display Crew Alerting System (DCAS). Data is also received from system pressure transducers.

The status page shows the reservoir quantities and system pressures. Full is indicated by 1.00 and empty is 0.00. A LO message appears when the reservoir quantity is less than 0.40.

If no data is received, the readout will be blank.

Synoptic Display

The synoptic display is a real-time diagram of hydraulic system operational status. The display shows:

- Engine Driven Pump (EDP) symbols
- Electric Motor Pump (EMP) symbols
- Ram Air Turbine (RAT) symbol
- Valve symbols
- Fluid flow lines
- Reservoir quantity and status
- System pressure.

The primary and demand pump symbols change to show status. Examples of pump status are:

- ON = thick green box
- OFF = thick white box
- Failed = amber box
- Invalid = thin white box
- Load shed = white box with text
- Overheat = amber overheat text.

The synoptic page shows location and status of valves.

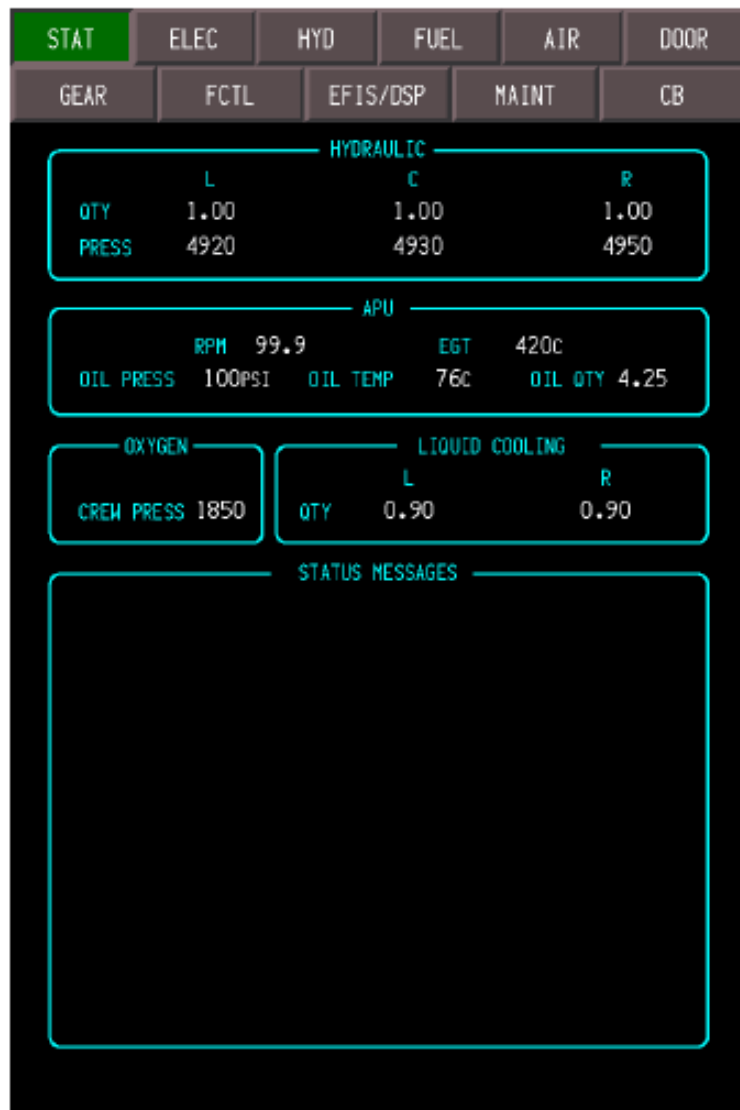
Examples of valve status are:

- Open = thick green circle
- Closed = thick white circle
- Failed closed = amber circle, with two lines and X in the circle
- Failed open = amber circle, with an X in the circle
- Invalid = thin white circle.

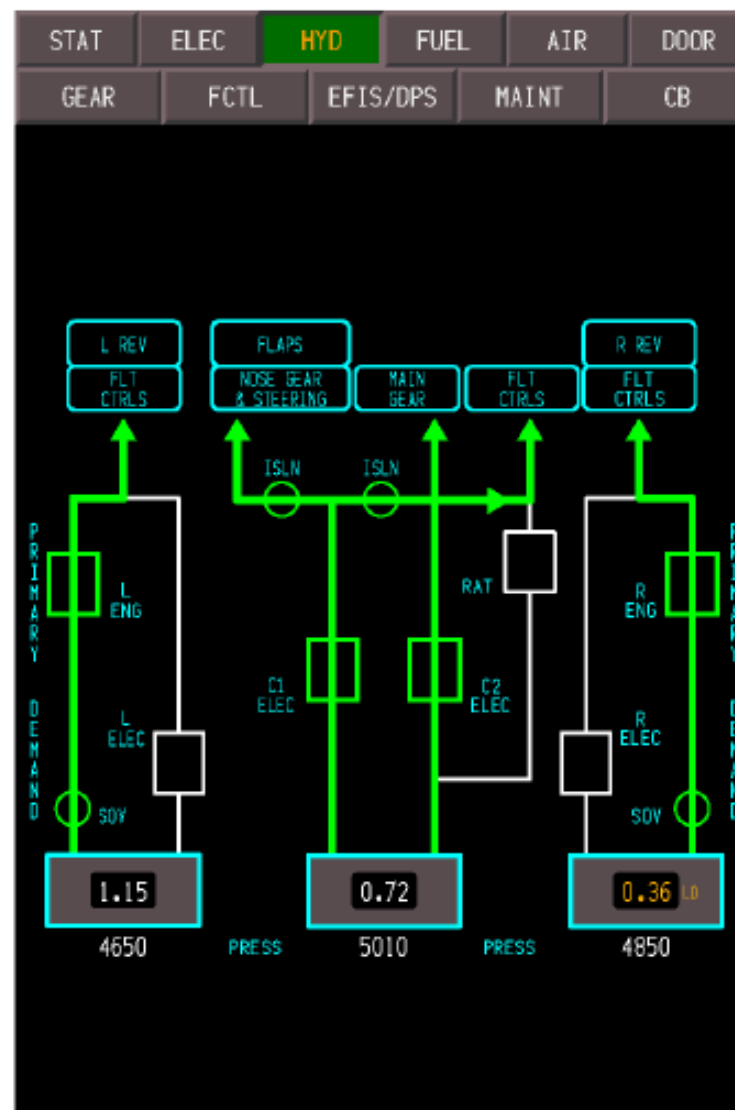
Pressurized fluid flow paths are shown as wide lines and colored green. Non-pressurized flow is shown as narrow lines and colored white.

The reservoir and system pressure indications are white and change to amber when the level is low. Additional information adjacent to the reservoir quantity shows:

- LO in amber for low
- OF in white for overflow
- RF in white for refill.



Status Page



Synoptic Display

Hydraulic Servicing

A system fill station is used to fill each hydraulic system. The system fill station is in the right main gear wheel well.

The system fill station has:

- Hand pump with hose
- Reservoir fill connection
- Fill selector valve
- Quantity indicator gauge
- Fill filter.

A manually operated selector valve routes fluid to the desired reservoir. The selector valve is electrically connected to the Hydraulic Interface Function (HYDIF), which sends a signal to the quantity indicator gauge and the head-down displays for indication.

The selector valve has four positions. One position is for each left, center, and right reservoir fluid routing and quantity indication. The fourth position is for OFF.

Service the desired reservoir with the correct fluid until the quantity indicator gauge reaches F (full).

