

1. GENERAL.**Description.**

Hydraulic power is used to operate the following aircraft systems:

- Landing Gear Extension/Retraction (including Emergency Extension)
- Flaps
- Wheel Brakes (including Parking Brake)
- Nose Wheel Steering
- Rudder
- Elevators
- Emergency Pitch Trim.

The Hydraulic System is divided into three separate systems.

Left System.

(LH system) Hydraulic Power Supply Equipment is located in the LH Nacelle and also in the LH side of the wing-to-fuselage fairing; it provides pressure to the:

- Landing Gear Emergency Extension (uplock release)
- Outboard Wheel Brakes
- Rudder Servo Actuator #1.
- LH Outboard Elevator Servo Actuator
- RH Inboard Elevator Servo Actuator
- LH Elevator Emergency Pitch Trim Actuator

Right System.

(RH system) Hydraulic Power Supply Equipment is located in the RH Nacelle and also in the RH side of the wing-to-fuselage fairing; it provides pressure to the:

- Landing Gear Extension/Retraction
- Nose Wheel Steering
- Inboard Wheel Brakes
- Flaps
- Rudder Servo Actuator #2.
- RH Outboard Elevator Servo Actuator
- RH Elevator Emergency Pitch Trim Actuator

Center System.

Hydraulic Power Supply Equipment are located in the RH side of the wing-to-fuselage fairing, it provides pressure to the:

- LH Inboard Elevator Servo Actuator

System operation.

In normal operation Left and Right System are supplied with pressure from engine driven pumps located on the propeller gear box. Center System is supplied with pressure from a pump driven by an electric AC motor.

System redundancy.**Left system.**

Left System has a DC powered pump located in the LH wing-to-fuselage fairing, that will be energized if the main pump fails.

The DC pump can also be used as power source during ground operation with both engines inoperative (e.g. towing).

During towing operation the DC pump is controlled by a pressure switch sensing the Left System utility pressure.

Right and Center system.

Right and Center System have one hydraulic pump each which is driven by one common electric AC motor. The pumps for Right and Center System and their common AC motor are located in the Integrated Hydraulic Packages (IHP) in the RH wing-to-fuselage fairing. The IHP is utilized as a back-up hydraulic power source for Right System, and as main power source for Center System. The IHP will normally run continuously with Right System back-up pump running in idling mode and Center System pump fully operational. The IHP can drive both systems if needed. The IHP is also used for ground and service operations when the Engine Driven Pump (EDP) is not running. The AC motor can be driven by AC power from the APU, or external power on the ground or by either engine in flight.

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Hydraulic power is used to operate the following aircraft systems:

- Landing Gear Extension/Retraction (including Emergency Extension)
- Flaps
- Wheel Brakes (including Parking Brake)
- Nose Wheel Steering
- Rudder Control
- Elevator Control (including emergency pitch control)

The Hydraulic System is in normal mode operation divided into two hydraulically separated systems. Each of the system includes a main and a stand-by power source. Main power source in each system are the engine gearbox driven pumps (LH EDP for Left System and RH EDP for Right System). The stand-by pumps are driven by electric motors (DC powered for Left System and AC powered for Right and Center System). Should there be a failure in the Right hydraulic system, it will be divided into two separated subsystems (each with its own stand-by pump driven by a common A/C electrical motor) to ensure maximum redundancy.

Left System.

LH system Hydraulic Power Supply Equipment are located in the LH Nacelle and also in the LH side of the wing-to-fuselage fairing; it provides pressure to the:

- Landing Gear Emergency Extension (uplock release)
- Outboard Wheel Brakes
- LH Rudder Servo Actuator
- LH Outboard Elevator Servo Actuator
- RH Inboard Elevator Servo Actuator
- LH Elevator Emergency Pitch Trim Actuator

An engine gearbox driven hydraulic pump serves as main power source and a DC powered hydraulic pump serves as stand-by power source in left system. The system also includes two accumulators:

- One serving as designated power supply for emergency extension and wheel brakes
- One serving as system power source during peak power consumption (surge damping) and also as buffer until stand-by pump starts, if the main pump fails.

Right System.

RH system Hydraulic Power Supply Equipment are located in the RH Nacelle and also in the RH side of the wing-to-fuselage fairing; it provides pressure to:

- Landing Gear Extension/Retraction
- Nose Wheel Steering
- Inboard Wheel Brakes
- Flaps
- RH Rudder Servo Actuator
- RH Outboard Elevator Servo Actuator
- RH Elevator Emergency Pitch Trim Actuator
- LH Inboard Elevator Servo Actuator during normal operation (Center System)

An engine gearbox driven hydraulic pump serves as main power source and a AC powered electric motor driven hydraulic pump serves as stand-by power source in Right System. Should there be a failure in the Right System it will be divided into two separated subsystems (Right System and Center System) each subsystem will be powered by an hydraulic pump driven by a common A/C electric motor. The system also includes three accumulators:

- One serving as designated power supply for landing gear control, nose wheel steering, flap control and wheel brakes,
- One serving as designated power supply for flight control servos
- One serving as system power source during peak power consumption (surge damping) and also as buffer until stand-by pump starts, if the main pump fails.

Center System.

Center system Hydraulic Power Supply Equipment are located in the RH Nacelle and backup power in the RH side of the wing-to-fuselage fairing, it provides pressure to the:

- LH Inboard Elevator Servo Actuator should there be a failure in the RH system

This system is during normal operation a sub-system to the Right System with the RH engine gearbox driven hydraulic pump serving as primary power source in center system. With the stand-by pump operational the system is automatically isolated from Right System. Should the right engine driven hydraulic pump fail the Center System is automatically isolated from Right System and is supplied by a separate hydraulic pump powered by the same AC pump motor as the Right System.

Electrical Pump Control.

The electrical motor driven pumps are controlled by three position toggle-switches on the OH-panel in the cockpit.

- L DC PUMP switch–OFF/AUTO/OVRD: controls the electric motor driving Left stand-by pump.
- C/R AC PUMP switch–OFF/AUTO/OVRD: controls the electric motor driving Center and Right system stand-by pump.

The switches are normally positioned in AUTO position (guarded) to activate the control logic for the respective pump.

Left stand-by pump powered by a DC motor is in normal flight mode controlled by Left system main pump pressure switch in such way that if the main pump pressure switch indicates low pressure the logic will start the DC pump motor enabling the pump to pressurize the system.

On ground at start-up the logic is deactivated until LH AC GEN and RH AC GEN and/or APU GEN is on line, after being activated the logic remains active as long as battery power is available or until the Parking Brake handle is engaged. In ground operation mode (ground handling switch engaged) the DCMP is controlled by a utility pressure switch (UPS) located in the wing to fuselage fairing, in order to minimize the load on the batteries. The pilot can at any time bypass the control logic by selecting L DC PUMP switch to OVRD.

The AC motor powering Center and Right system stand-by pumps is in normal flight mode controlled by Right system main pump pressure switch in such way that if the main pump pressure switch indicates low pressure the logic will start the AC pump motor enabling the stand-by pumps to pressurize the respective system.

On ground at start-up, the logic is deactivated until LH AC GEN and RH AC GEN and/or APU GEN is on line, after being activated the logic remains active as long as any AC generator remains on line or until the Parking Brake handle is engaged. The pilot can at any time bypass the control logic by selecting C/R AC PUMP switch to OVRD.

The function of pump control circuitry and components are tested prior to each flight. The test is automatically activated when LH AC GEN and RH AC GEN and/or APU GEN is on line.

On ground at start-up the logic is deactivated until LH AC GEN and RH AC GEN and/or APU GEN is on line, after being activated the logic remains active as long as any AC generator remains on line or until the Parking Brake handle is engaged.

The electric pumps can be individually selected on the hydraulic overhead panel.

Hydraulic fluid is mineral based MIL-H-5606. The fluid is red for identification and easy detection of leaks.

Total capacity Left System is 19L

(22,5L capacity is available as an option)

Total capacity Right System is 24.5L

Total capacity Center System is 2.3L.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Hydraulic reservoirs.

Main reservoirs.

Left and Right System have one hydraulic reservoir each. The reservoirs are functionally identical, the only difference is the size as Right System reservoir has 25% bigger capacity than Left System reservoir (the large reservoir is available as an option for the Left System), same as Right System.

The hydraulic reservoirs are mounted in the respective engine nacelle hydraulic bays. The reservoir pressure supports the pump suction flow. A spring loads the low pressure piston to provide positive suction pressure to the EDPs at system start-up.

Any leakage in the reservoir piston seal is collected on the air side of the reservoir cylinder and drained to a collector tank. The hydraulic reservoir has a direct reading visual fluid level indicator accessible from the Main Wheel Well, in addition to the remote electrical indicator in the cockpit.

2.2. Integrated oil reservoirs.

Right System Integrated oil reservoir.

The pump is mounted inside an oil reservoir, which under normal conditions is an integral part of the hydraulic system return flow circuit. In the event of a failure of the main hydraulic reservoir in the system (e.g. tube rupture), the integrated oil reservoir will serve as a reservoir for the Right System backup pump. The integrated oil reservoir is sized to accommodate oil for LDG operation, flap operation, elevator and rudder control.

Center System Integrated oil reservoir.

The Center System pump is equipped with a reservoir connected to the pump. The reservoir provides required suction pressure, and is sized to accommodate oil for system cooling/expansion and elevator control. Excess oil from the relief valve outlet is drained overboard.

2.3. Hydraulic pumps.

Left and Right System have one Engine Driven Pump (EDP) each. The EDP is the main hydraulic power source at all normal operating conditions, and is mounted on and driven by the engine gear box.

2.4. AC driven stand-by pumps.

A backup system (IHP) includes an electrical AC driven motor pump for Right and Center System, as described previously.

2.5. DC driven stand-by pump.

Left System includes an DC driven pump as backup power source.

2.6. Hydraulic accumulators.

The accumulators in the system are located aft of the wing in the wing to fuselage fairing and in the forward fuselage in the NLG bay. The accumulators are sized to meet flight control demands during take-off and initial climb, and to provide wheel braking capability should for some reason total loss of hydraulic power occur.

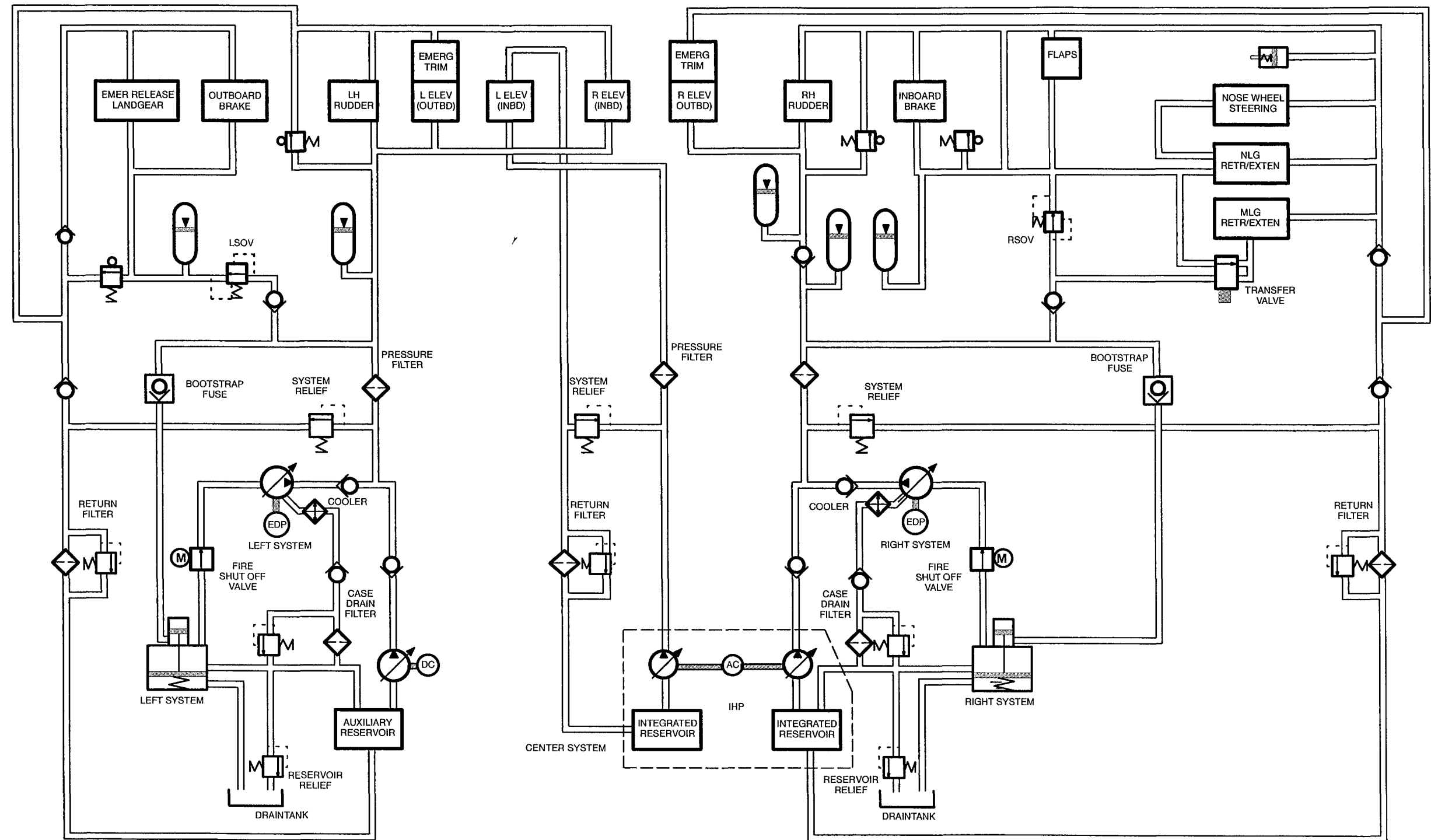
2.7. Shutoff Valves (SOV).

One shutoff valve is installed in each system to prevent loss of hydraulic fluid should a rupture occur on the hydraulic supply lines. Right System differs somewhat from Left System regarding the logic. If a rapid change in flow is sensed by the RSOV in Right System, the RSOV will close and activate a transfer valve (XFER) to ensure supply pressure to main landing gear operation. All other systems dependent on Right System will not be supplied including nose landing gear. This is shown on the Secondary EICAS Hydraulic page display.

2.8. PECS related EICAS messages.

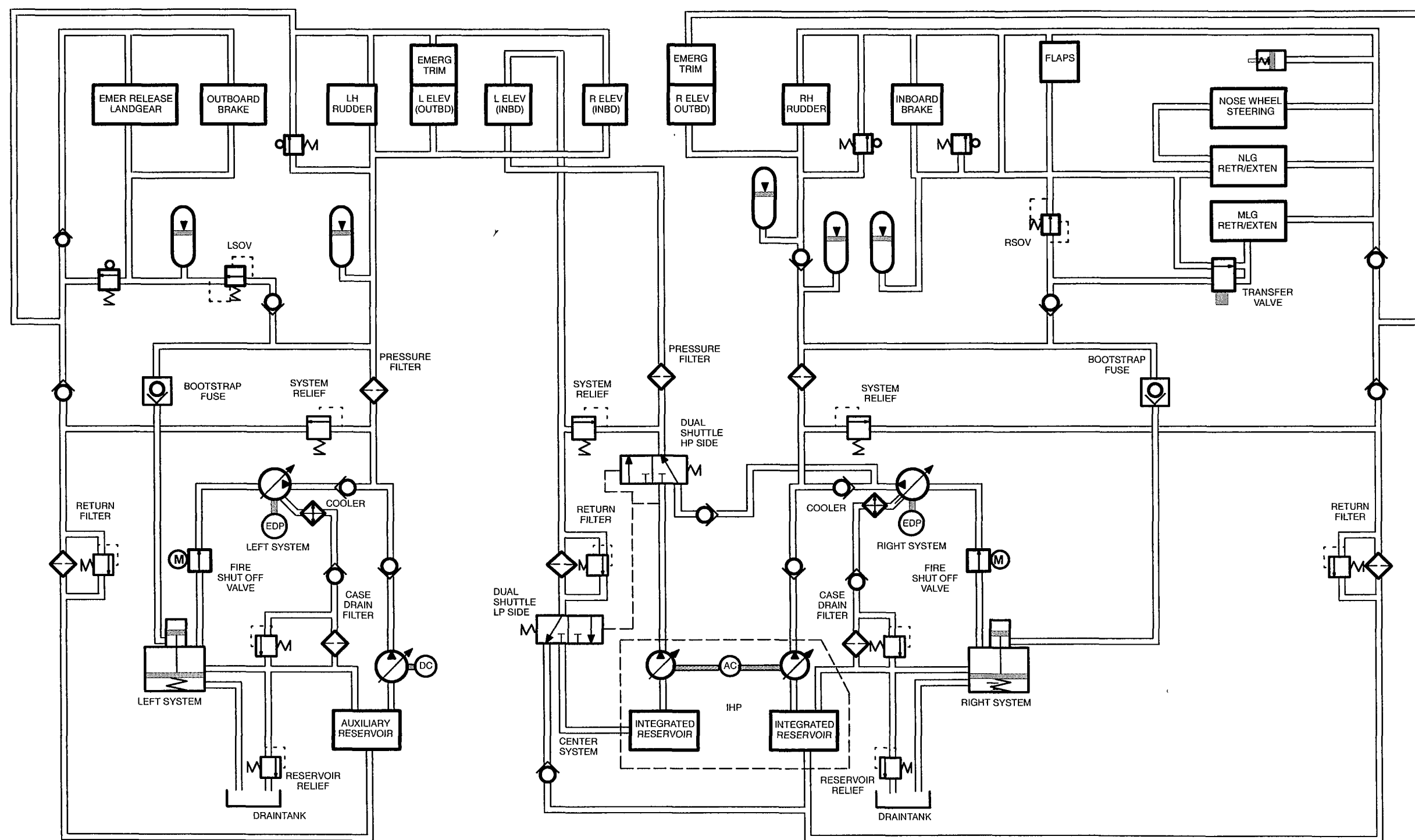
The following EICAS messages may be displayed during normal operation:

- C BAT FAULT engines shut down and GPU on line
 - always activated when running L DC PUMP in OVRD, typically to increase pressure in the hydraulic system.
- L HYD DC PUMP FAULT and/or R HYD AC PUMP FAULT and/or C HYD AC PUMP FAULT during engine shut down after landing
 - activated and latched when engine/engines spools down if the hydraulic pressure decay slow. The master caution can be removed by placing applicable hydraulic pump switch to OFF and then to AUTO.



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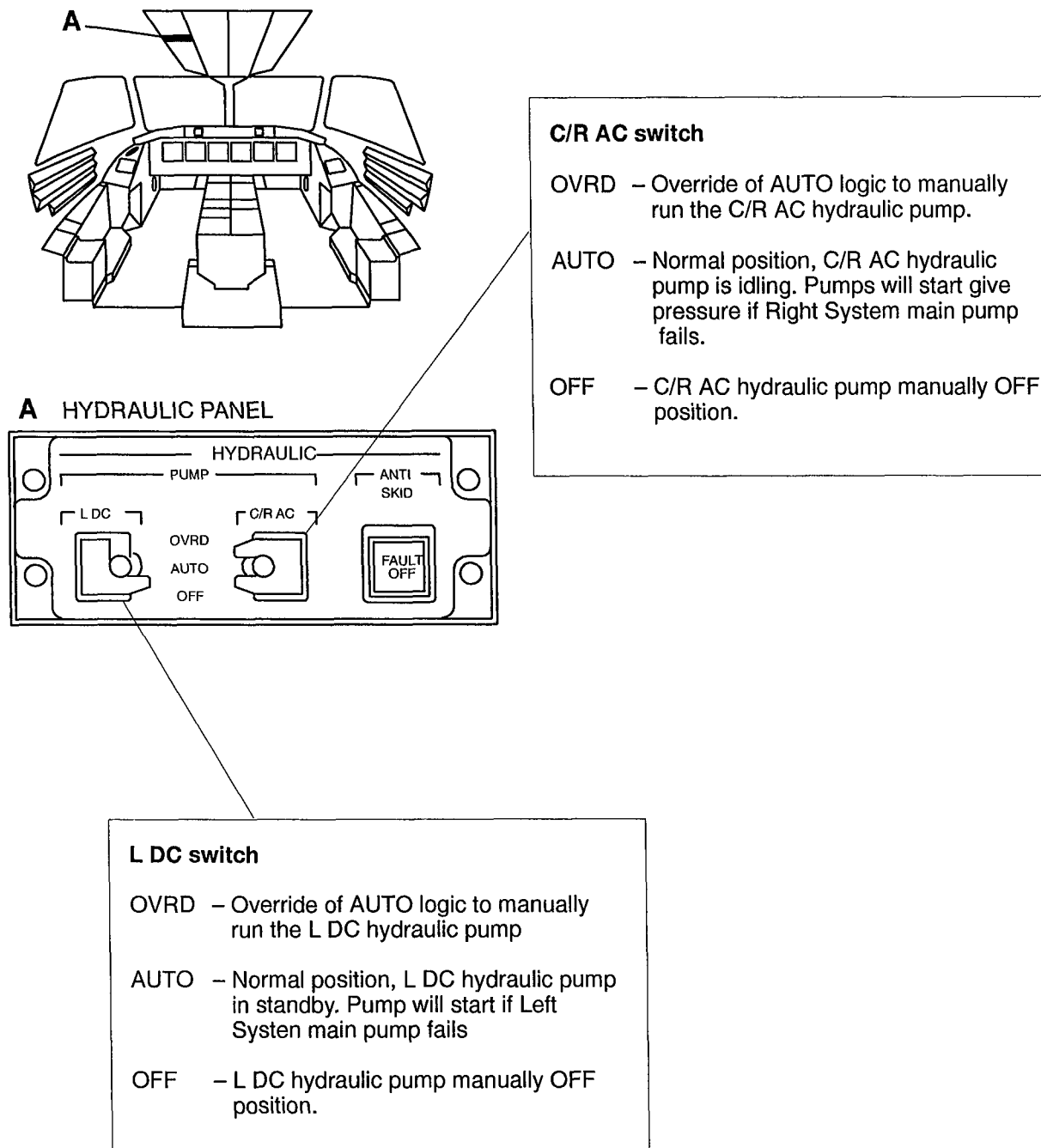
FIG. 1. Hydraulic system – schematic.



NOTE
The Dual Shuttle valve is divided into separate LP and HP symbols to clarify.

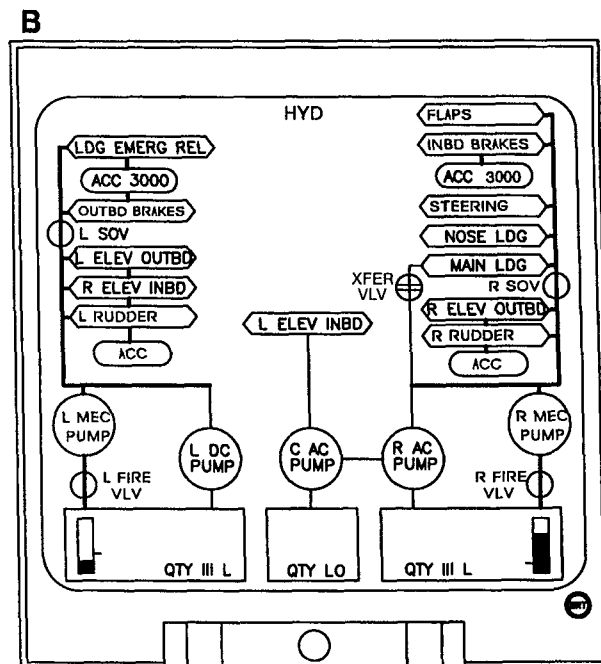
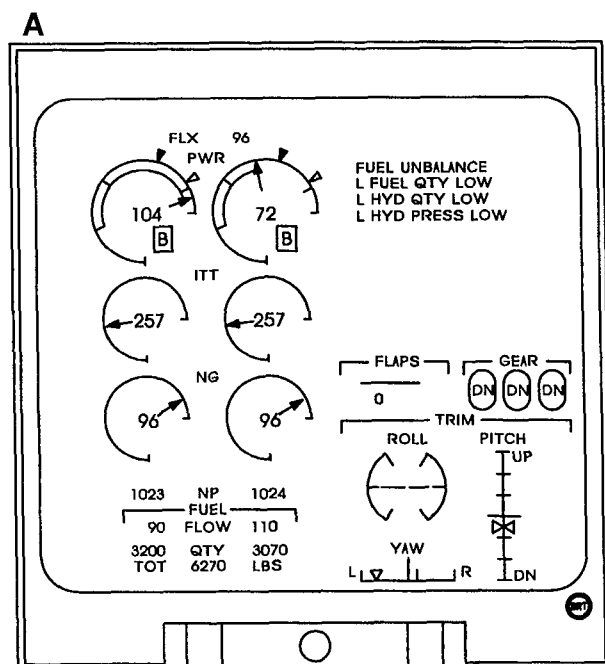
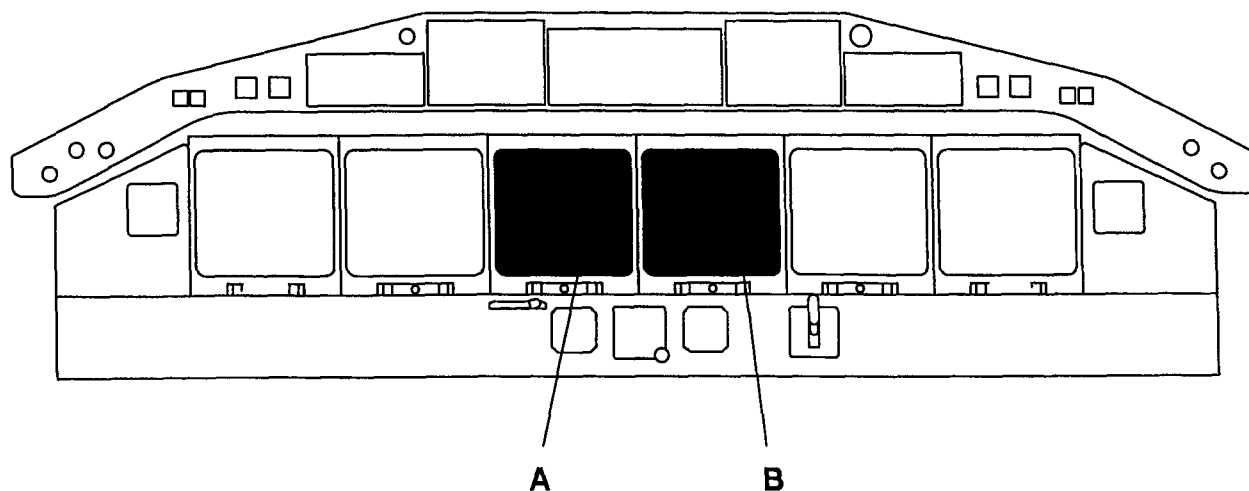
FIG. 1. Hydraulic system – schematic.

Applicable to A/C with IHP IN STBY,
MOD NO 5952, SB 29-010



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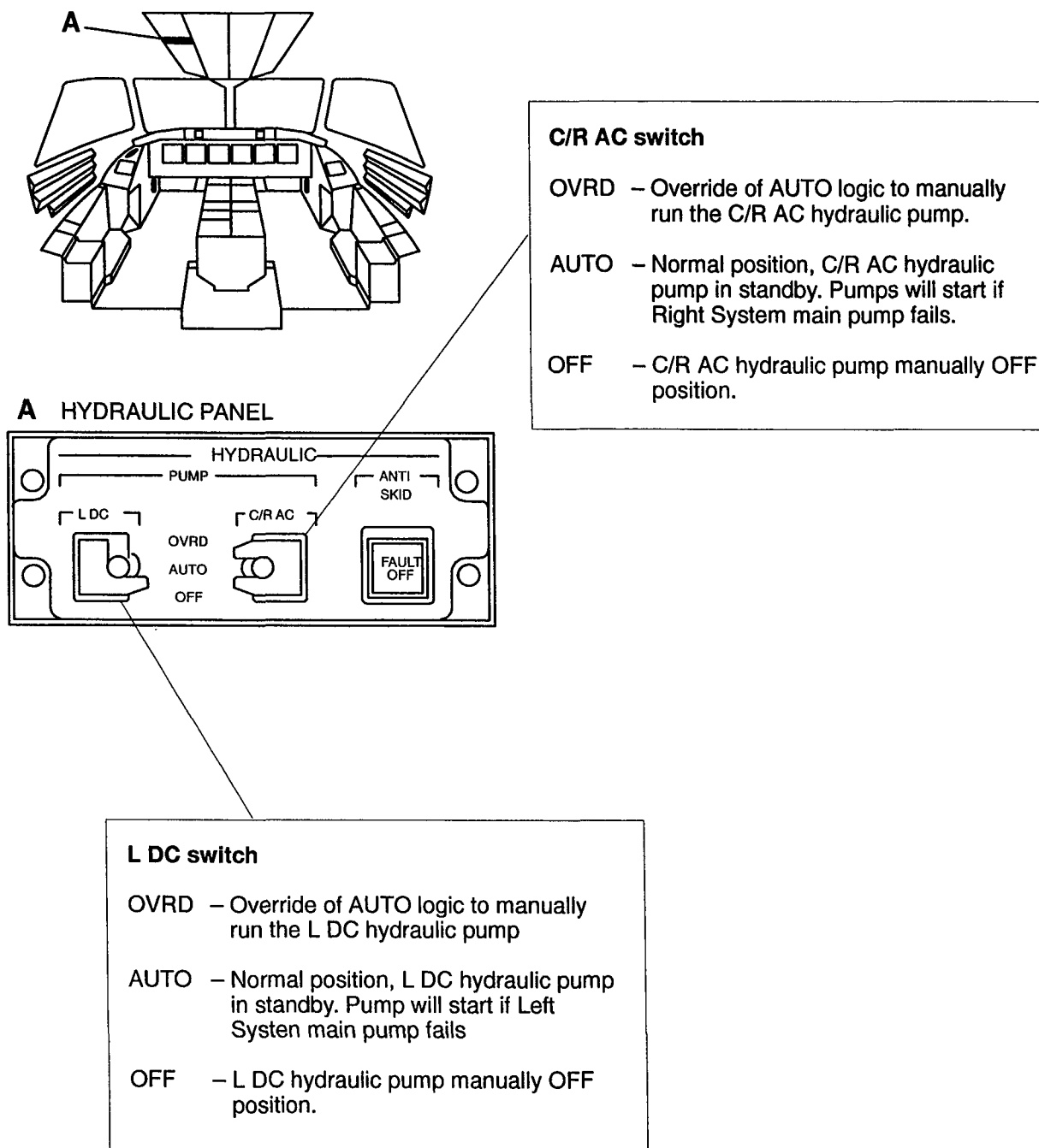
FIG. 2. Hydraulic controls.



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FIG. 3. EICAS hydraulic indications.

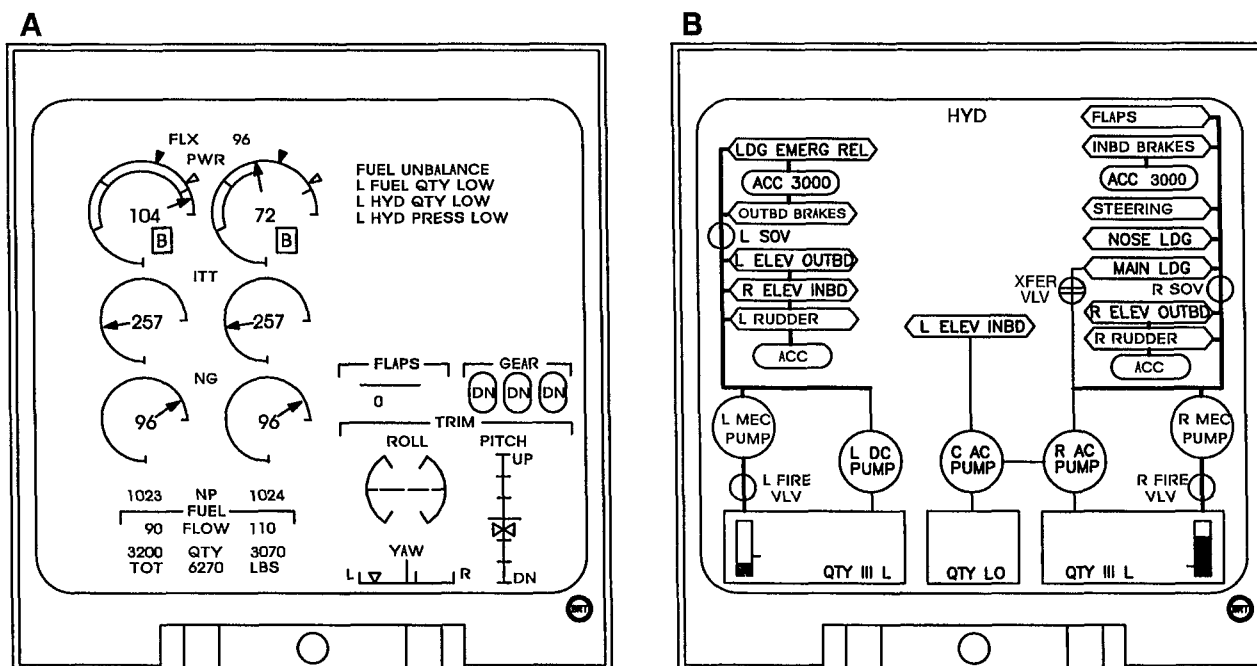
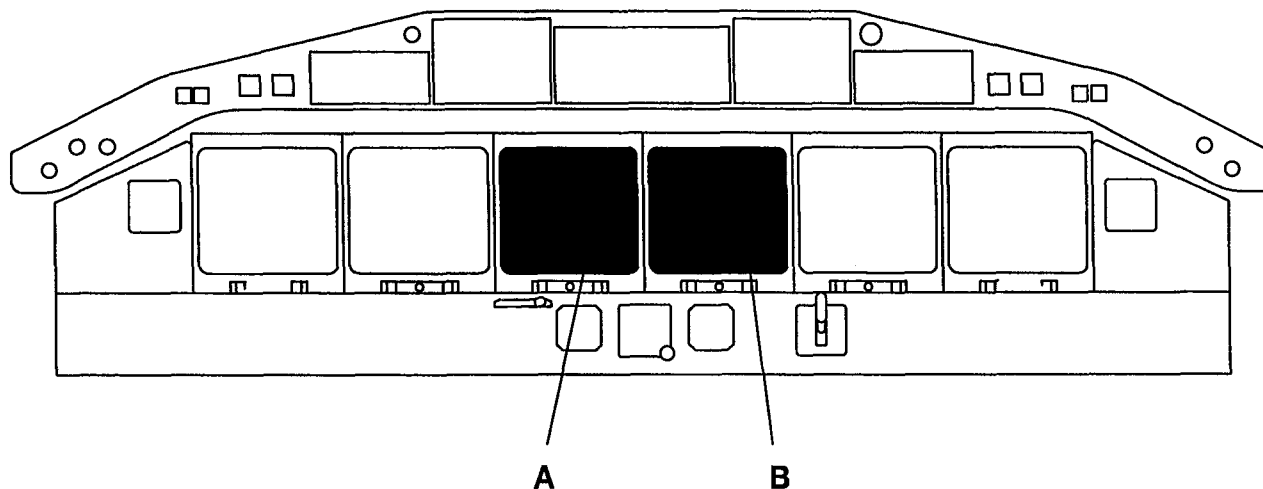
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FIG. 2. Hydraulic controls.

Applicable to A/C with IHP IN STBY,
MOD NO 5952, SB 29-010



B7342

FIG. 3. EICAS hydraulic indications.

9/1

3. ELECTRICAL POWER SUPPLY.**Pumps and control.**

Hydraulic Central/Right AC pump power L REAR AC GEN BUS

M-10 HYDRAULIC C/R AC
PUMP PWR

Hydraulic Central/Right AC pump CTRL R BAT BUS

M-11 HYDRAULIC C/R AC
PUMP CTL**Valves.**

L Hydraulic fire shut off valve L HOT BAT BUS

F-12 HYDRAULIC
L SHUT OFF VLV

R Hydraulic fire shut off valve R HOT BAT BUS

M-12 HYDRAULIC
R SHUT OFF VLV