



SECTION 2-11

HYDRAULIC

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**AIRPLANE
OPERATIONS
MANUAL**



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JANUARY 21, 2002

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GENERAL

The airplane is equipped with two independent hydraulic systems, each powered by one engine driven-pump and one electric motor-driven pump. Both hydraulic systems are identical, except for the services each system provides and a priority valve installed in the hydraulic system 1.

There are ground connections for refilling and ground tests purposes. Indications of hydraulic system parameters are provided on the MFD and EICAS displays.

The services provided by each hydraulic system are presented below:

SYSTEM	HYDRAULIC POWER SUPPLY
Ailerons	SYSTEM 1 and 2
Rudder	SYSTEM 1 and 2
Landing Gear	SYSTEM 1
Main door	SYSTEM 1
Steering	SYSTEM 1
Brakes (Outboard Wheels)	SYSTEM 1
Brakes (Inboard Wheels)	SYSTEM 2
Emergency/Parking Brake	SYSTEM 2
Thrust Reverser 1	SYSTEM 1
Thrust Reverser 2	SYSTEM 2
Outboard Spoilers	SYSTEM 2
Inboard Spoilers	SYSTEM 1

SYSTEM DESCRIPTION

Each hydraulic system consists of a hydraulic fluid reservoir, a manifold, one engine-driven pump, one electric motor-driven pump, one shutoff valve, one accumulator and a priority valve installed in the hydraulic system 1.

RESERVOIR

The hydraulic fluid stored in the reservoir is pressurized, to avoid pump cavitation. This pressurization function is performed by fluid drained from the pressure line. The reservoir is equipped with a quantity indicator which transmits information to the MFD and EICAS displays for indication and warning purposes. A thermal switch is responsible for the high temperature message, if the fluid temperature increases above 90°C.

SHUTOFF VALVE

A shutoff valve is installed between the reservoir and the engine-driven pump. It cuts the hydraulic fluid supply to the engine-driven pump, if there is a fire on the related engine or in case of hydraulic fluid overheat. This valve may be closed either through the engine fire extinguishing handle or through a dedicated button on the overhead panel.

ENGINE-DRIVEN PUMP

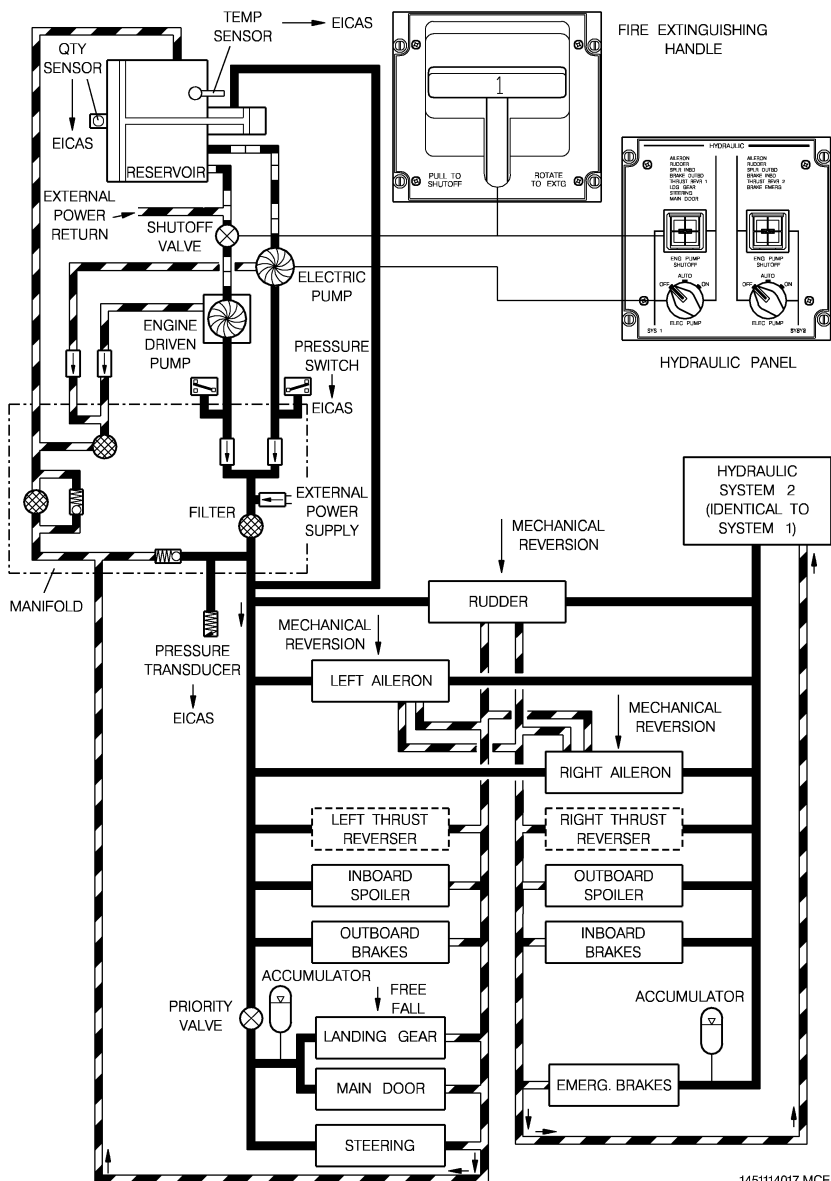
The engine-driven pump provides continuous fluid flow at 3000 psi for operation of the various airplane hydraulically-powered systems. The pump is connected to the engine accessory gearbox and, as long as engine is running, it generates hydraulic pressure. During engine start, the fluid remaining in the suction line is sufficient to avoid pump cavitation and provide reservoir pressurization.

ELECTRIC MOTOR-DRIVEN PUMP

The electric motor-driven pump has the same connections as the engine-driven pump, but has a lower flow capacity. The pump normally operates in the automatic setting mode, turning on when the associated hydraulic pressure drops below 1600 psi or the associated engine N2 drops below 56.4%.

If the pump starts operating in the automatic mode, it will be turned off after the pressure or N2 are reestablished to normal values. The electric pump may be turned on at pilot command, through the selector knob on the overhead panel, furnishing continuous fluid flow at 2900 psi.

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HYDRAULIC SYSTEM SCHEMATIC

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MANIFOLD

The manifold provides the following functions:

- Fluid filtering (pressure and return lines).
- Overpressure relief (main and electrical pumps).
- Pressure indications (main and electrical pumps).

Fluid leaving the pump flows to the manifold, where it is filtered and then routed to the airplane systems. Inside the manifold, a check valve prevents the fluid from returning to the pump, while a relief valve diverts the excess fluid to the return line. The return line is supplied by the fluid coming from the airplane systems, fluid drained from the pump, fluid from the relief valve, and fluid refilled by the maintenance personnel. Under any situation the fluid is filtered and returned to the reservoir. The manifold incorporates two pressure switches to detect low hydraulic pressure, and a pressure transducer to indicate system pressure. Signals from the pressure switches and pressure transducer are sent to the MFD and EICAS displays.

PRIORITY VALVE

The hydraulic system 1 incorporates a priority valve. If the system is powered by the electric motor-driven pump and the landing gear is commanded to retract, the valve will provide minimum flow to the landing gear system and give priority to the flight control services. In this case, the landing gear will operate through the accumulator pressure.

ACCUMULATOR

Each hydraulic system has one accumulator. The function of the accumulator is to keep the surges of the hydraulic pumps at a minimum, and to keep a 3000 psi pressure available for operation of the landing gear and main door (system 1) or operation of the emergency parking brake (system 2).

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EICAS MESSAGES

TYPE	MESSAGE	MEANING
CAUTION	HYD SYS 1 (2) FAIL	Associated hydraulic system is not pressurized (inhibited when the airplane is on the ground, engine is shut down and parking brake is applied).
	HYD SYS 1 (2) OVHT	Associated hydraulic system fluid temperature is above 90°C.
ADVISORY	E1 (2) HYD PUMP FAIL	Engine-driven pump is not generating pressure with associated engine running.
	E1 (2) HYDSOV CLSD	Associated hydraulic shutoff valve is closed.
	HYD1 (2) LO QTY	Fluid level in the associated reservoir is below one liter. Report to the maintenance personnel if the hydraulic reservoir operates empty.
	HYD PUMP SELEC OFF	Associated electric pump selected OFF with the parking brake released.

CONTROLS AND INDICATORS

HYDRAULIC SYSTEM PANEL

1- ENGINE PUMP SHUTOFF BUTTON (guarded)

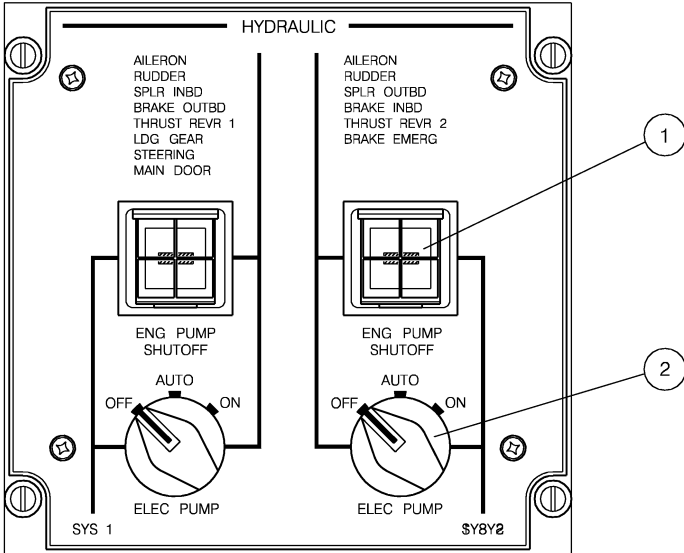
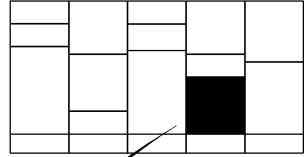
- Closes (pressed) or opens (released) the associated engine pump shutoff valve.
- A striped bar illuminates in the button to indicate that it is pressed.

2- ELECTRIC HYDRAULIC PUMP CONTROL KNOB

- OFF - Associated pump is turned off.
- AUTO - Associated pump is kept in standby mode, ready to operate if the engine-driven pump outlet pressure drops below 1600 psi or the associated engine N2 drops below 56.4%.
- ON - Associated pump is turned on.

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OVERHEAD PANEL



NOTE: For airplanes not equipped with Thrust Reverser, the THRUST REVR 1 and THRUST REVR 2 inscriptions are not presented on the Hydraulic System Panel.

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HYDRAULIC SYSTEM PANEL

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HYDRAULIC PAGE ON MFD

1- FLUID QUANTITY INDICATION

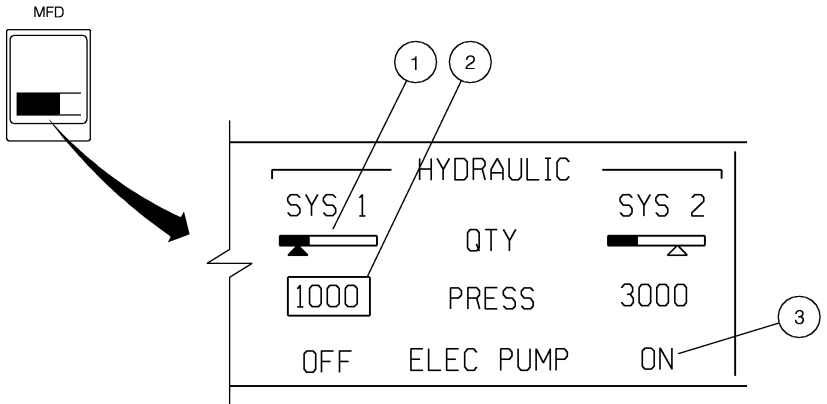
- Ranges from zero to maximum hydraulic fluid quantity.
- Scale (horizontal line) and pointer:
 - green when greater than 1 liter.
 - amber when equal to or less than 1 liter.
- Pointer disappears if data is invalid.

2- PRESSURE INDICATION

- Ranges from 0 to 4000 psi, with a resolution of 100 psi.
- Digits:
 - green from 1300 to 3300 psi.
 - amber and boxed below 1300 and above 3300 psi.
- Digits are replaced by amber dashes if data is invalid.

3- ELECTRIC PUMP STATUS

- Indicated by the green label ON or OFF.



HYDRAULIC PAGE ON MFD