

Section - III SYSTEMS DESCRIPTION

Sub-section 5 HYDRAULICS

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GENERAL

Hydraulic power is provided by independent Main and Auxiliary systems for operation of the following services:

MAIN HYDRAULIC SYSTEM

- Normal extension and retraction of the landing gear
- Normal and emergency operation of the wheel brakes
- Nosewheel steering
- Normal operation of the flaps
- Operation of the airbrakes
- Stall identification (stick push)
- Operation of the thrust reversers

AUXILIARY HYDRAULIC SYSTEM

- Emergency extension of the landing gear
- Emergency operation of the flaps

This Sub-section only covers the generation of hydraulic power.

Refer to the following Sub-sections for details of the hydraulic services:

- Sub-section 2 ENGINES (for thrust reversers)
- Sub-section 6 FLIGHT CONTROLS (Flaps, Airbrakes and Stall identification)
- Sub-section 8 LANDING GEAR (also wheel brakes and nosewheel steering)

MAIN SYSTEM

Table 1: Indicators and Annunciators		
<i>Item</i>	<i>Location</i>	<i>Parameter</i>
Combined BRAKES (2) and SUPPLY indicator	Center instrument panel	psi Brakes: 2000 Supply: 3000
HYD OVHT	Main MWS panel	Hydraulic fluid overheat warning 90° C
HYD 1 LO PRESS	Main MWS panel	Main supply low pressure warning ≤1500 psi
EMRG BRK LO PRESS	Main MWS panel	Emergency brakes accumulator low pressure warning ≤ 2250 psi
Accumulator pressure indicators (main and wheel brakes)	Rear equipment bay	Initial charge at 1000 psi
Accumulator pressure indicators (thrust reversers)	Rear equipment bay	Initial charge at 1500 psi
Main reservoir contents level tube	Rear equipment bay	Parameters stated on label next to reservoir
Main reservoir air pressure gauge	Rear equipment bay	0 to 30 psi is normal

FLUID STORAGE

System fluid is stored in a spherical shaped reservoir located in the rear equipment bay. Fluid contents are displayed in a level indicator tube, integral with the reservoir.

Air, tapped from both engines is used to pressurize the reservoir to make sure a supply is fed to the pumps under all flight conditions.

The air is supplied to the reservoir via check valves and a pressure reducing valve.

The reservoir has an inward and outward relief valve as well as a pressure gauge.

POWER GENERATION

Fluid is supplied from the reservoir through a suction filter to the two variable-delivery engine driven pumps, one per engine.

An on/off valve in each suction line is interconnected to the related HP cock lever. Isolation of the hydraulic fluid supply is therefore simultaneous with engine shut-down. When an on/off valve is closed, a closed-circuit via the valve provides a full volume supply to the pump for lubrication.

Each pump delivers fluid at a nominal pressure of 3000 psi via a low pressure switch, snubber and check valve, to the pressure filter in the main delivery line to the airplane systems.

A capacitor is installed in the delivery line from the No. 1 pump.

High Pressure Relief

Two full-flow relief valves are located in tappings off the delivery line from each pump and are provided to limit the maximum pump pressure in the event of the failure of the pump pressure control.

Should the pump delivery pressure rise above 3750 psi, the relief valve operates to pass fluid into the return line.

Low Pressure Indication

The low pressure switch operates if the pump pressure falls to 1500 psi. A time delay prevents the associated HYD # LO PRESS annunciator illuminating until the timed period has elapsed. This prevents a spurious annunciation due to temporary low pressure conditions caused by system fluctuations. Once the annunciation is illuminated, it remains so until the pressure rises above 1850 psi.

Hand Pump

The Main system can be pressurized for ground servicing purposes by a hand pump located in the rear equipment bay. The hand pump inlet is connected to the line from the suction filter. When operated, the pump passes pressurized fluid through a check valve, into the main system.

MAINTAINED PRESSURE PATHS

Fluid passes through a Pressure Maintaining Valve (PMV) to the normal wheel brake and stall identification paths.

The PMV shuts off if the pressure upstream of it falls to 2300 psi. This makes sure the pressure in the main accumulator is sufficient for several operations of the stall identification system and operation of the normal wheel brakes when landing.

Thrust Reversers

Fluid stored in the thrust reverser accumulator is prevented from leaking back to the main system by a check valve.

Wheel Brakes Emergency Path

Main system pressure is distributed through a check valve to the emergency brake accumulator and the emergency brake reducing valve.

Should the main system pressure fail, the check valve retains the pressure stored in the emergency brakes accumulator. For details of the number of brake applications available using the fluid from the accumulator, refer to Sub-section 8 LANDING GEAR.

Low pressure (below 2250 psi) in the path or accumulator is indicated by the illumination of the EMRG BRK LO PRESS annunciator on the main MWS panel.

Accumulators

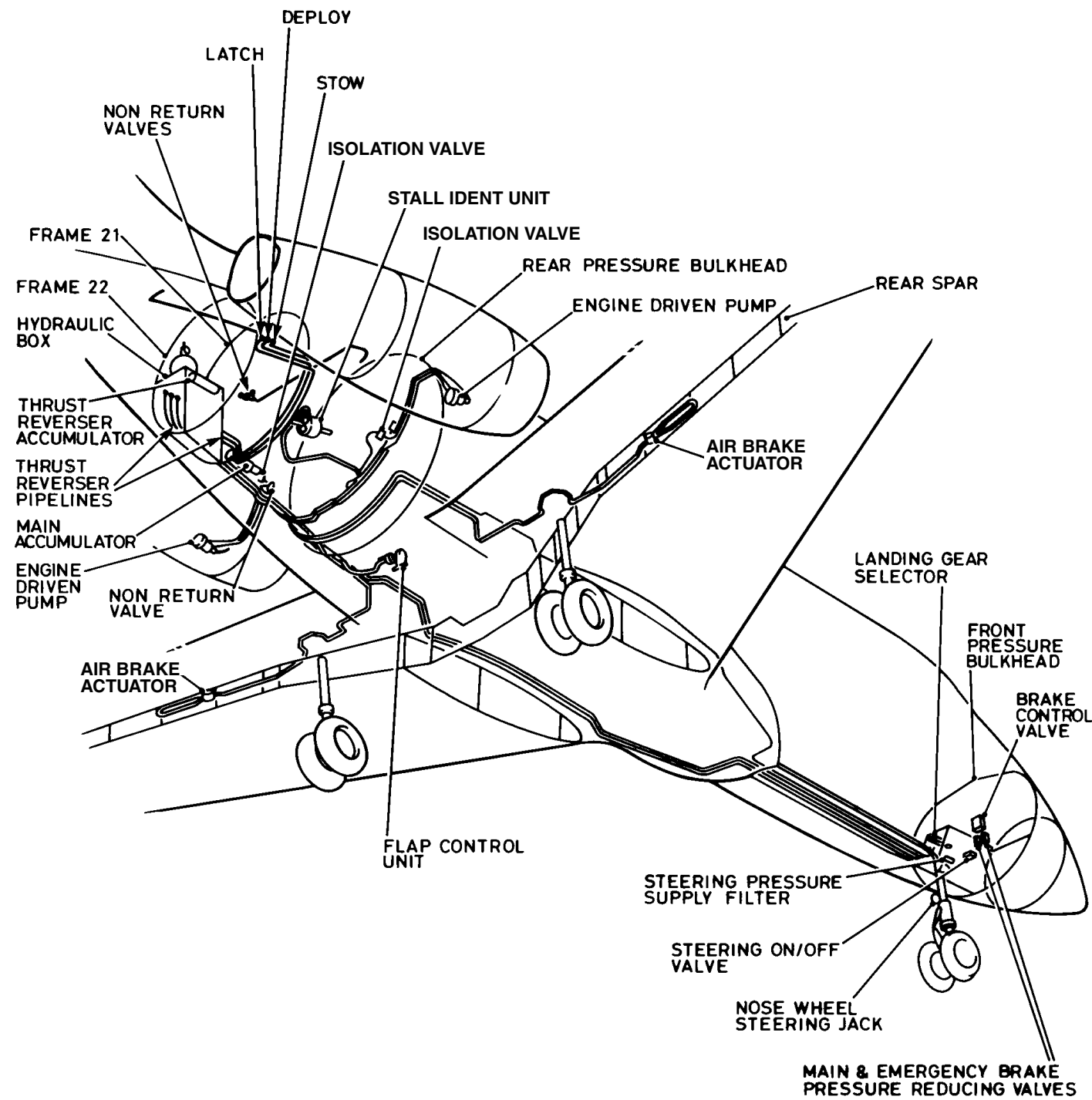
Three piston-type accumulators, each installed with a pressure indicator and a gas charging valve, are located in the rear equipment bay. The piston separates charges of gas from the hydraulic fluid.

With no hydraulic pressure in the system, the main system and the emergency brake accumulators are initially charged with nitrogen at 1000 psi.

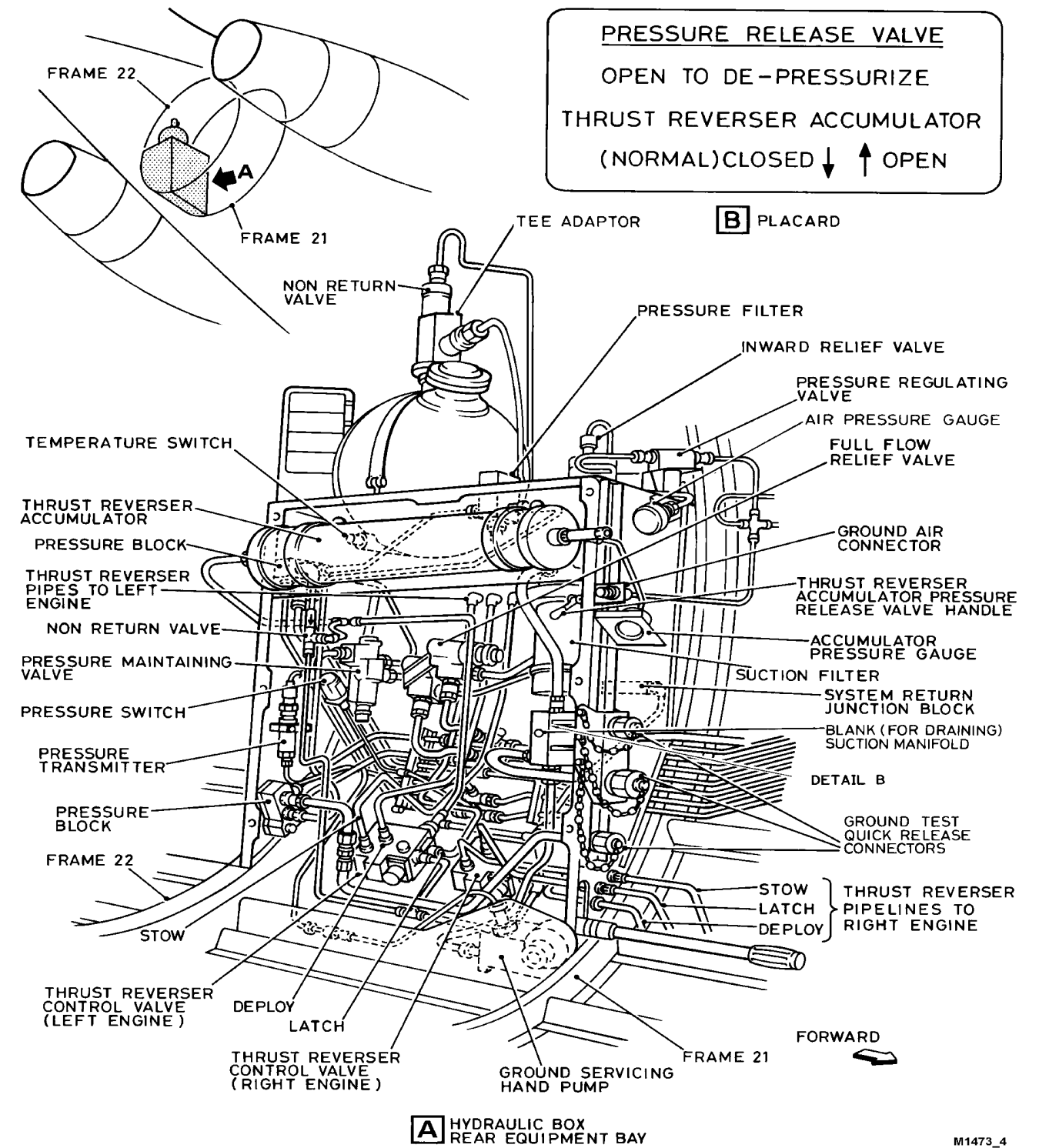
The initial charge for the thrust reverser accumulator is 1500 psi.

NON-MAINTAINED PRESSURE PATHS

The landing gear, flaps, airbrakes and nose wheel steering paths are directly fed with system pressure with no provision to cover delivery pressure failure.



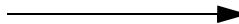
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A HYDRAULIC BOX REAR EQUIPMENT BAY







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Figure 1
Main Hydraulic System Components

KEY TO FIGURE 2 

Component Identification

Pipeline Colors

1. Capacitor	Air.....	
2. Pressure switch and snubber	Suction	
3. Full flow relief valves	Pressure	
4. Ground servicing hand pump	Return	
5. Emergency brakes reducing valve	Emergency Brakes	
6. Normal brakes reducing valve	Maintained Pressure	
7. Pressure transmitter		
8. Thrust reverser release valve		
9. Pressure relief valve, thrust reverser and nose wheel steering		

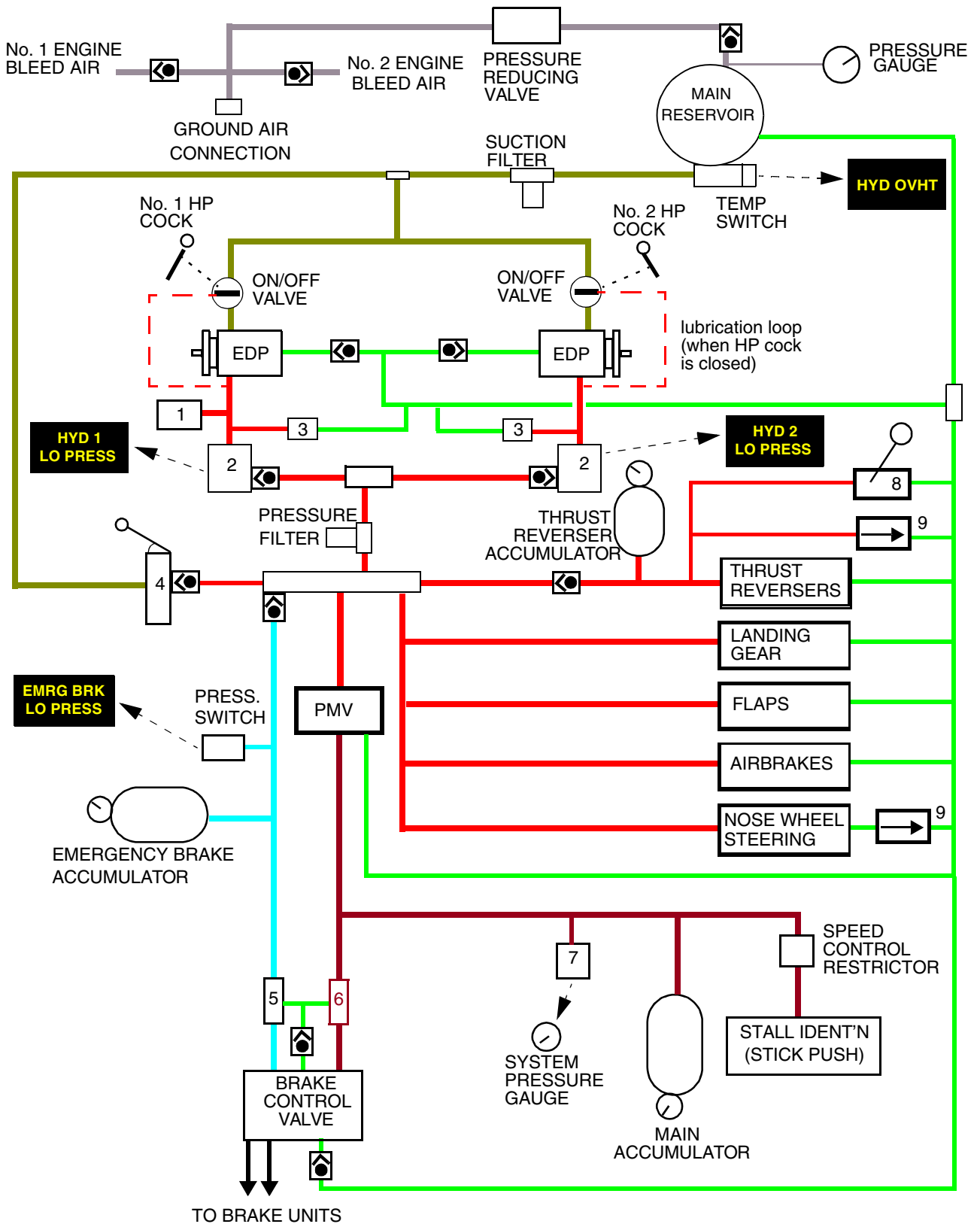


Figure 2
Main Hydraulic System

AUXILIARY SYSTEM

The auxiliary hydraulic system provides an alternative source of hydraulic power for landing gear lowering and flaps operation. The system is hand-operated, and when selected, is independent of the main system.

The following notes must be observed:

NOTES:

1. Emergency lowering of the landing gear is available regardless of the setting of the landing gear selector lever but the flaps must be selected to the required setting.
2. When using the auxiliary system, lowering of the landing gear always occurs before operation of the flaps.
3. The system cannot be used to raise the landing gear.
4. Following the selection of the auxiliary system, it must be reset manually before the main system can be used to operate the landing gear.

CAUTION: IF A SELECTION OF THE AUXILIARY SYSTEM HAS BEEN MADE FOLLOWING A MAIN SYSTEM FAILURE, THE AUXILIARY SYSTEM MUST NOT BE RESET IN FLIGHT. IGNORING THIS CAUTION COULD RESULT IN THE LANDING GEAR COLLAPSING ON TOUCHDOWN.

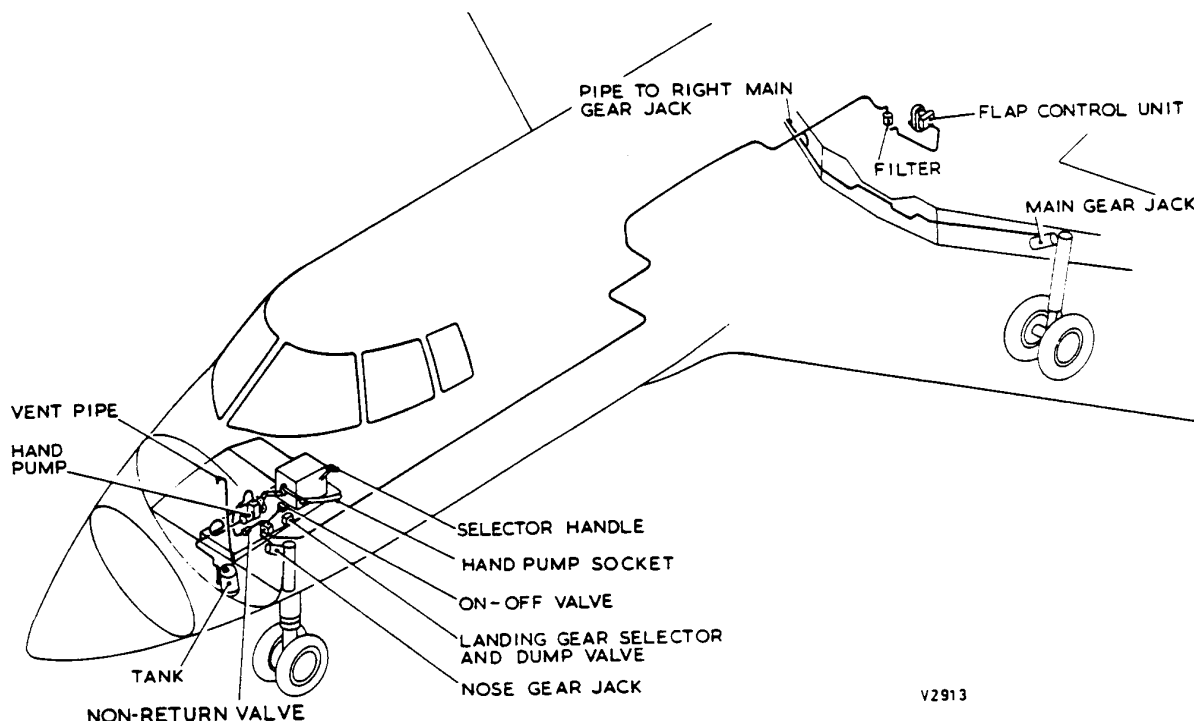


Figure 3
Auxiliary Hydraulic System Components

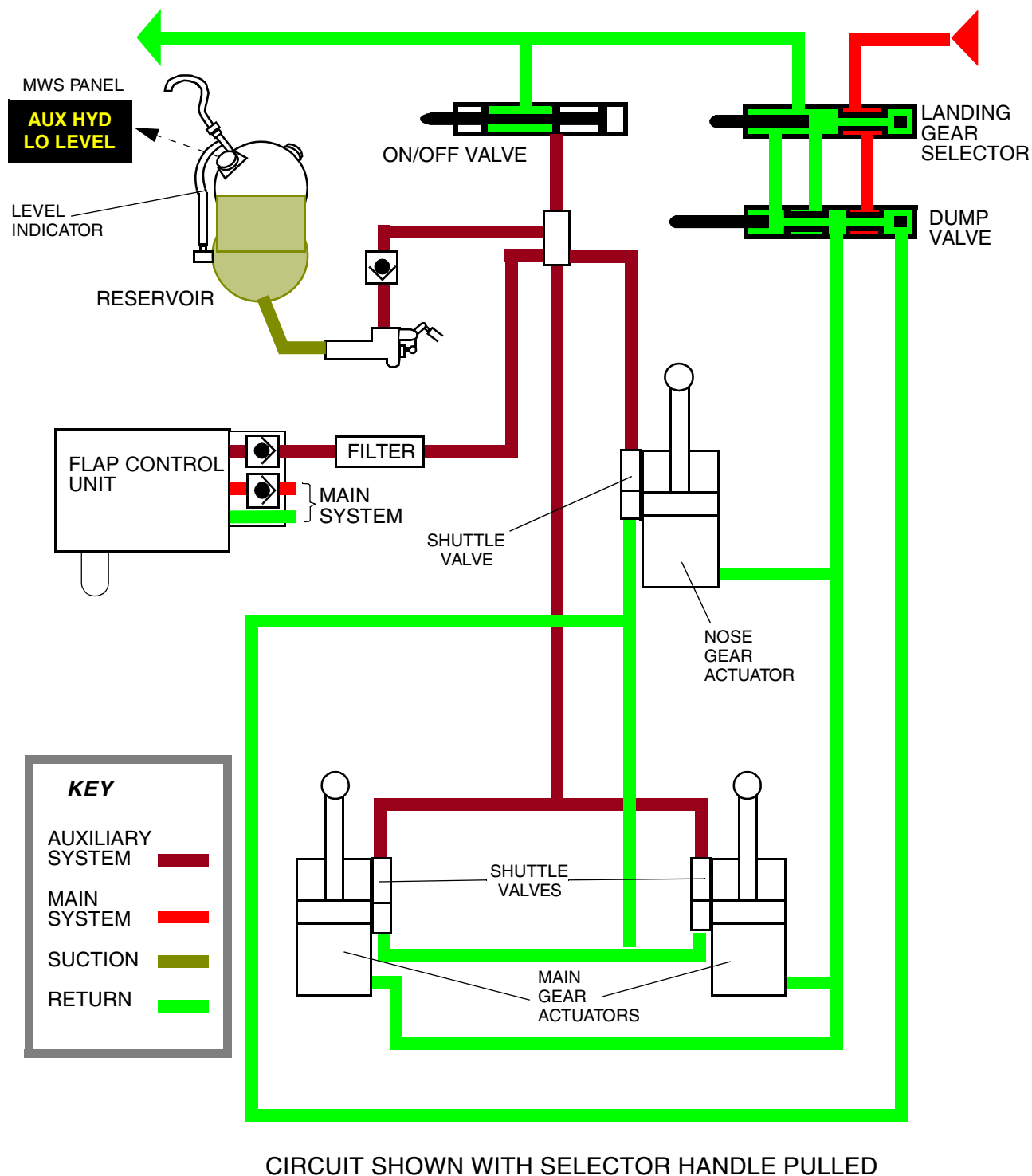


Figure 4
Auxiliary Hydraulic System

CONTROLS and INDICATIONS

<i>CONTROL</i>	<i>LOCATION</i>
AUX HYD SYSTEM PULL selector handle	Left side of center instrument panel, adjacent to FMS No. 1 display
EMERG HYD PUMP operating handle socket	Pilot's floorboard, adjacent to the center pedestal
AUX HYD LO LEVEL annunciator	MWS main panel
Auxiliary reservoir contents level indicator tube	Visible from nose gear bay

FLUID STORAGE

The fluid supply for the auxiliary system is contained in a 6.01 U.S. pints (2.84 liter) reservoir located adjacent to the nose gear bay.

A float switch in the reservoir is connected to an AUX HYD LO LEVEL annunciator. The annunciator will illuminate when approximately 0.6 U.S. pint (0.28 liter) of fluid has been drawn out of the reservoir.

A full reservoir provides sufficient fluid for at least one emergency lowering of the landing gear, and followed by at least one extension of the flaps to the landing position.

OPERATION

Selection of the auxiliary system is by pulling the red-handled AUX HYD SYSTEM PULL selector handle.

Prior to selection, the system valves are set for normal main hydraulic system operation, i.e:

- On/off valve - open to relieve fluid seepage from the Auxiliary system.
- Dump valve - set to connect Main system pressure and system return to the main and nose gear lines.
- Shuttle valves - With no pressure in the auxiliary system, the shuttle valves close the auxiliary system supply ports on the landing gear jacks, allowing main system pressure to operate the jacks.

With the lever in the normal position, a baulk prevents operation of the auxiliary system hand pump. The system is prepared for use by first inserting the rudder gust lock handle into the AUX HYD SYSTEM hand pump socket and then firmly pulling the red-handled PULL handle. This action operates the system valves as follows:

- On/off valve - closed to prevent the auxiliary system fluid passing to the return line.
- Dump valve - set to cut-off the main system pressure and remove any main system pressure in the landing gear path by interconnecting the normal up and down lines of the main and nose gear jacks to the return line.

Pulling the control lever also releases the baulk and permits operation of the hand pump. The control lever is held in the selected position by a spring unit.

Manual operation of the hand pump draws fluid from the auxiliary reservoir. The fluid is delivered via the check valve and the shuttle valves to the down side of the main and nose gear jacks. Fluid from the check valve is also delivered to the flap control unit.

NOTE: Shortly after the commencement of emergency lowering, hand pump resistance decreases (when the gear uplocks release) and the AUX HYD LO LEVEL annunciator is illuminated.

Continued operation of the hand pump locks the gear down.

CAUTION: WHEN OPERATING THE AUXILIARY HYDRAULIC SYSTEM TO LOWER THE LANDING GEAR, THE HAND PUMP ACTION MUST BE CONTINUED, AFTER 3 GREENS ARE ACHIEVED, UNTIL POSITIVE RESISTANCE IS FELT TO MAKE SURE THE LANDING GEAR IS DOWN AND LOCKED.

Selection of the flaps and operation of the hand pump will move the flaps to the required position.

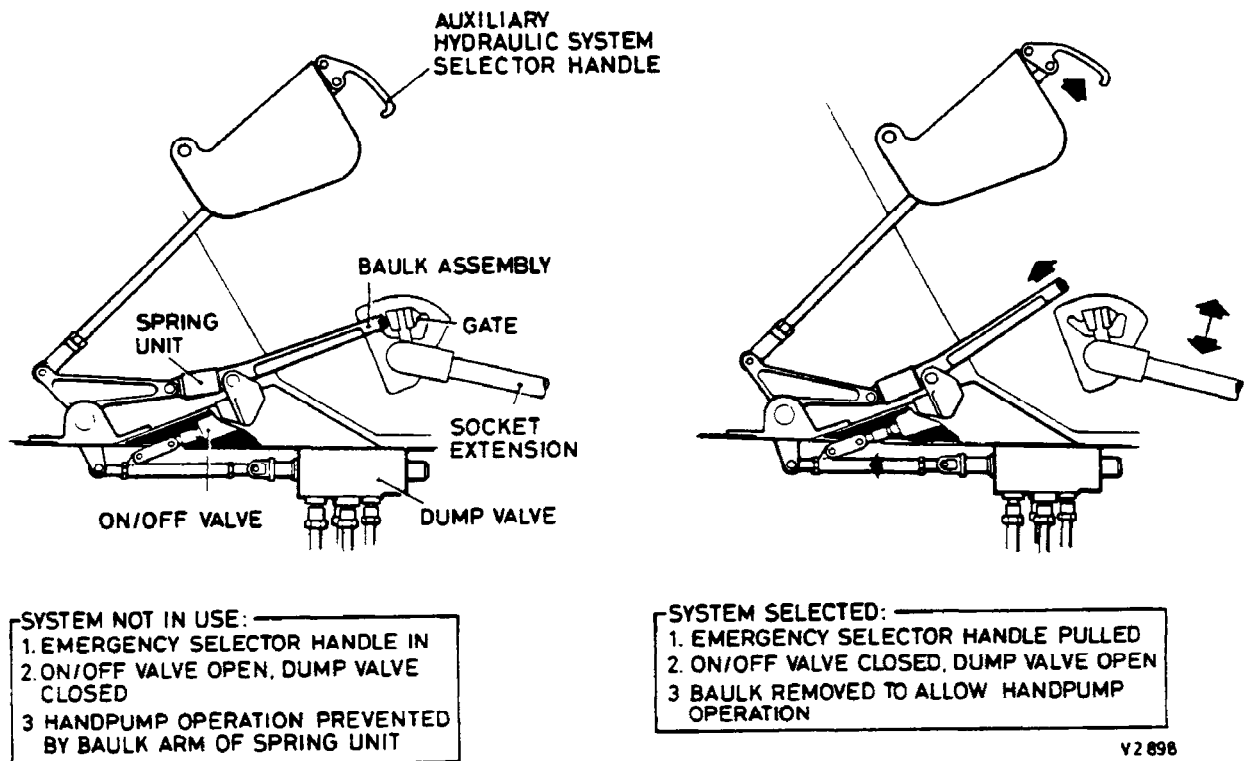


Figure 5
Operation of Auxiliary Hydraulic System Selector Handle

RESETTING THE MAIN SYSTEM

Following use of the auxiliary system, the main system must be reset before normal operation of the landing gear.

NOTES:

1. *With the main system pressurized normally, the setting of the AUX HYD SYSTEM PULL control lever has no effect on flaps operation.*
2. *If a selection is made to demonstrate or exercise the auxiliary system, operation of the flaps will be from the main system.*

To reset the system, first make sure the LANDING GEAR selector lever is in the down position, then push the AUX HYD SYSTEM PULL lever fully in. This action opens the on/off valve to vent fluid pressure in the auxiliary system lines to the return. The shuttle valves move back to connect the main system to the down side of the gear jacks.

With the on/off valve open the check valve prevents normal pressure from the main system return line draining the auxiliary reservoir and the baulk is repositioned by the spring unit to prevent movement of the hand pump socket.