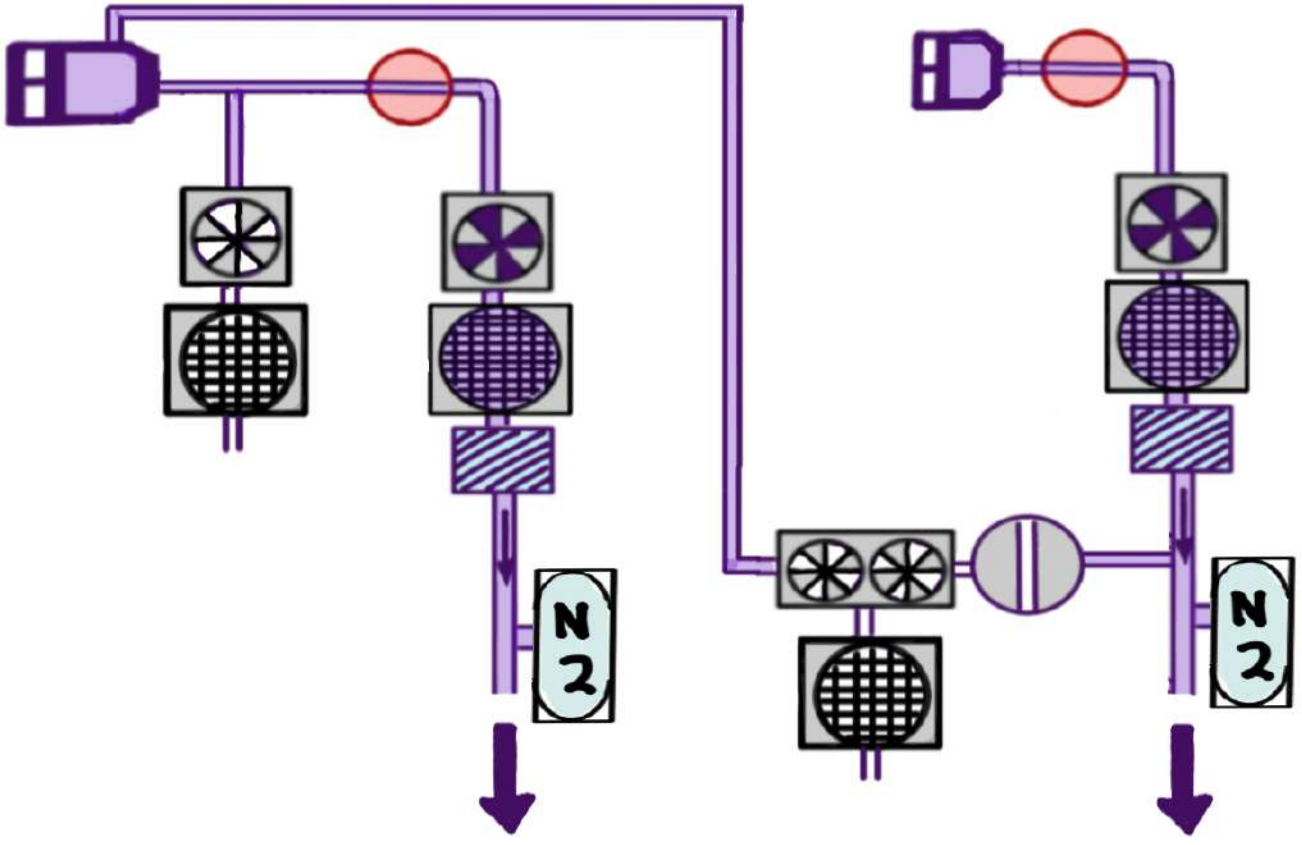
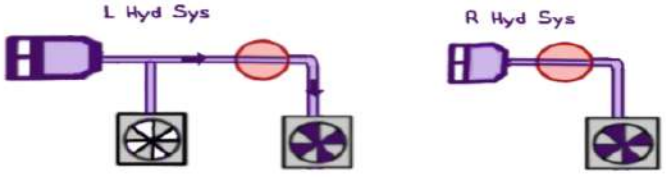
G650 HydRAULiC SysTEM



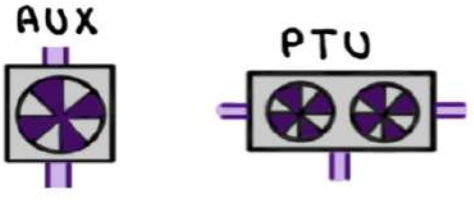
For study purposes only

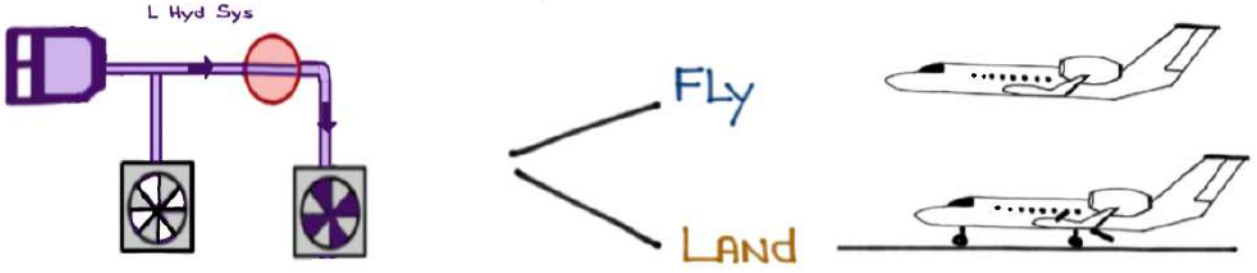
The Hydraulic System is about the <u>storage</u> and <u>delivery</u> of hydraulic fluid (Skydrol) under high pressure to actuate various systems

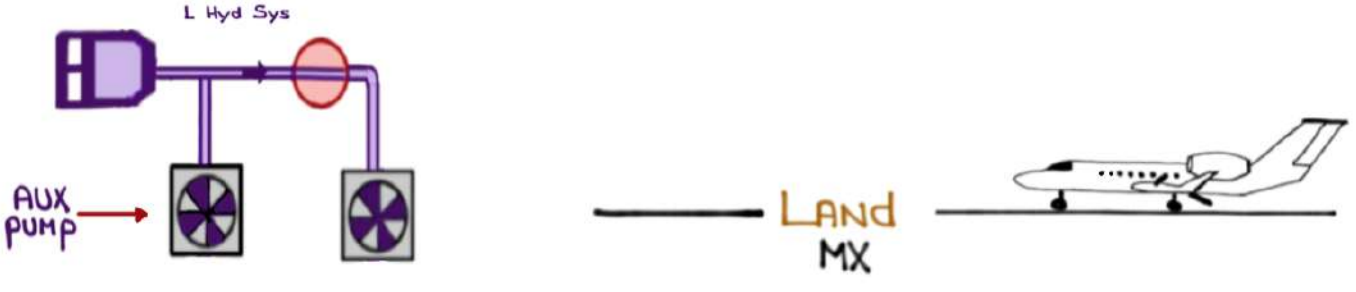
Two (2) main systems



Supported by Two (2) sub-systems



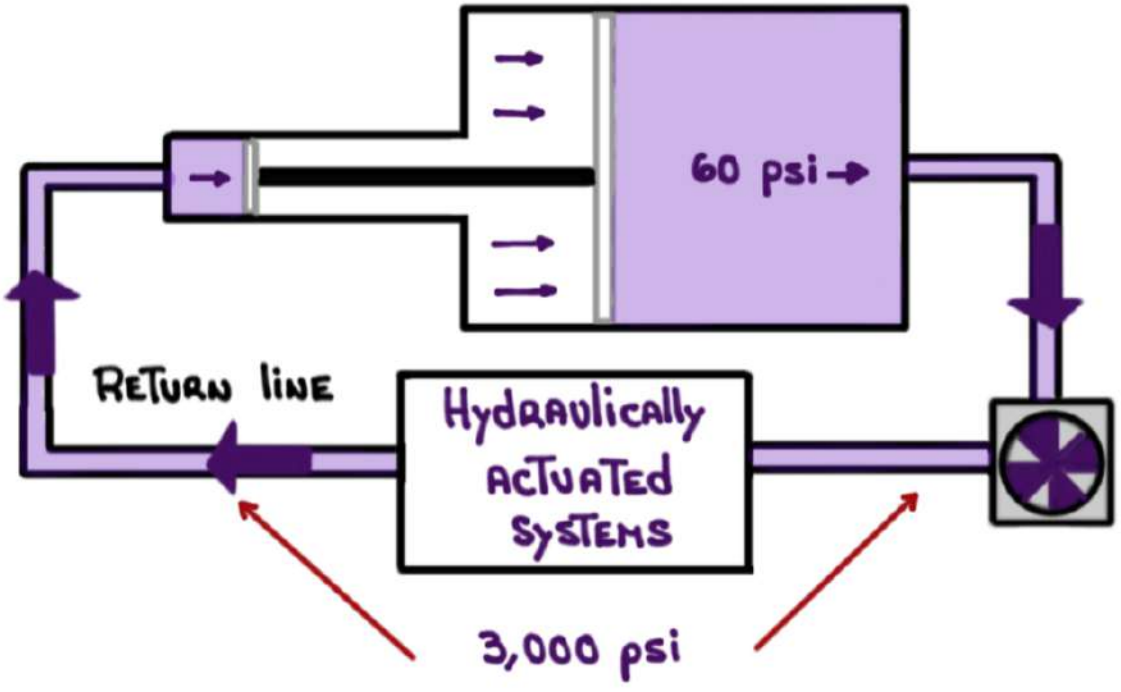


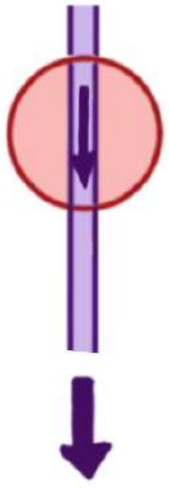


Hydraulic System Components

Reservoir: To store fluid

- Compressed by bootstrap to prevent hydraulic pump cavitation
- Located in the tail compartment
- System must be pressurized for accurate quantity checks
- Single chamber





Shutoff valve: To shutoff hydraulic fluid to the engine in the event of engine FIRE or failure

- Located in the tail compartment and activated via FIRE HANDLES

Pump: To pressurize system

- Engine-driven pump
- Located in the engine's gearbox
- 3,000 ± 300 Psi

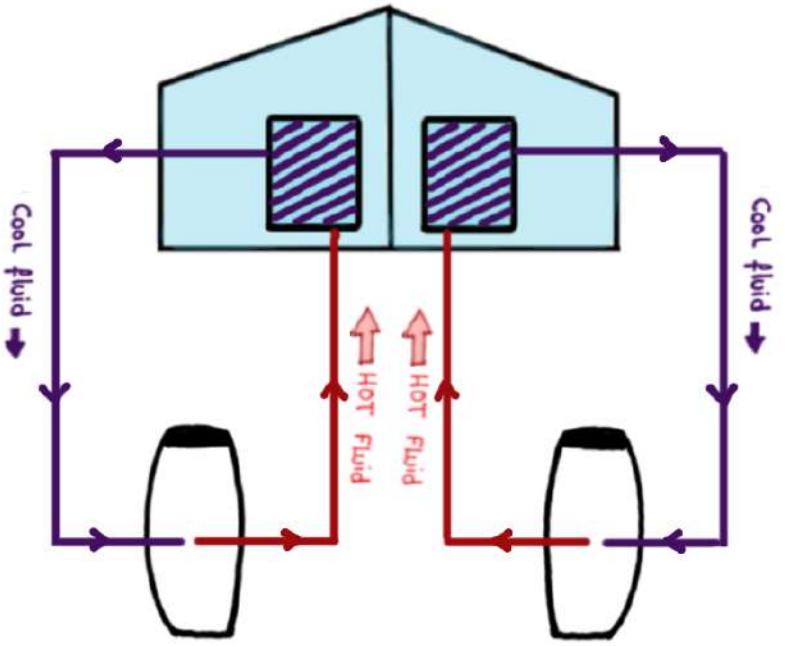
Filter Manifold: To filter hydraulic fluid and control direction of flow

- Located in the tail compartment
- Left Hydraulic System: Six (6) filters
- Right Hydraulic System: Three (3) filters

Hydraulic fluid-To-fuel Heat exchanger:

To cool hydraulic fluid and To warm up cold fuel

- Located in The on-side fuel Hopper
- Continuous flow



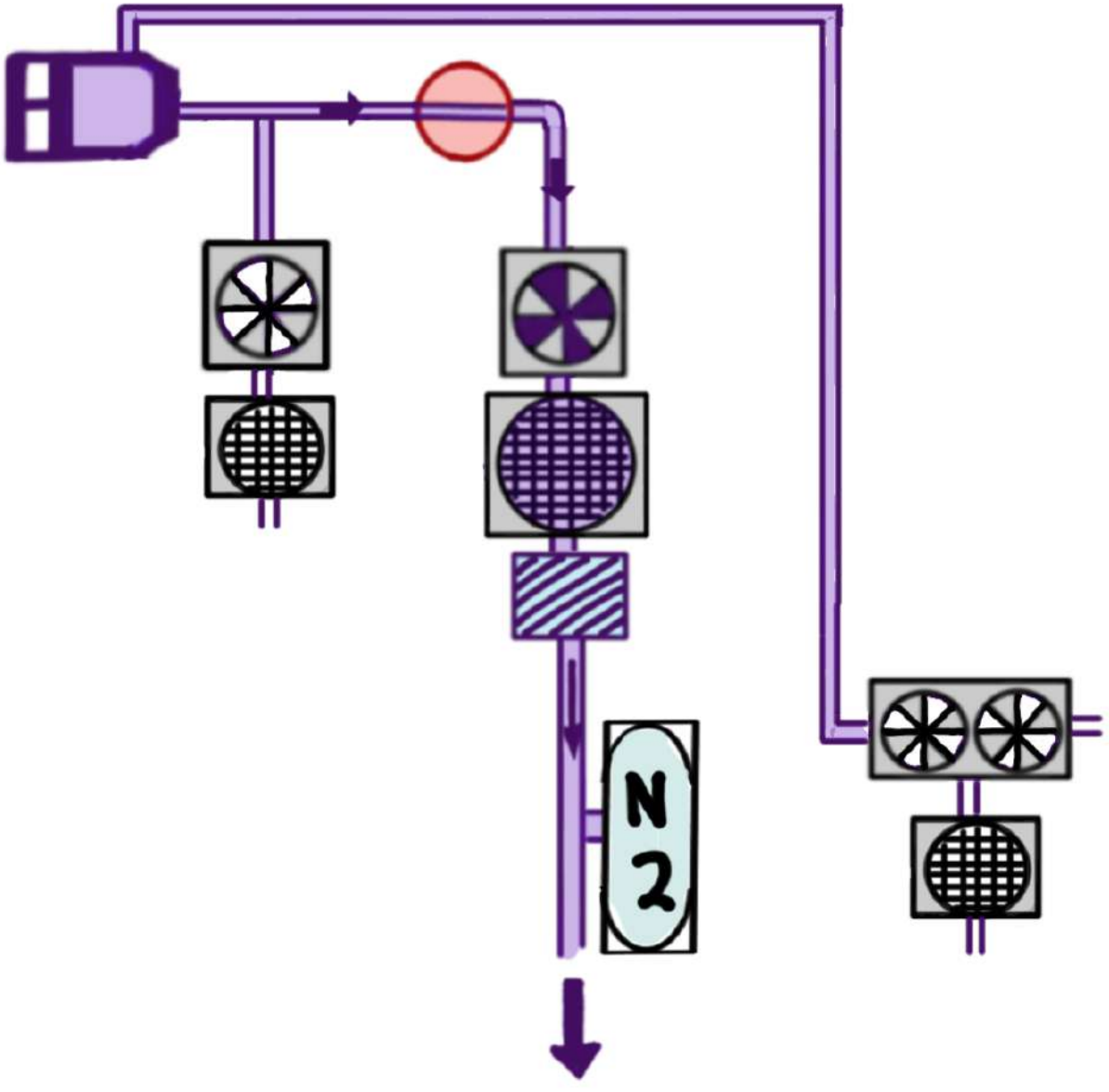
To Hydraulically-powered Systems

Accumulator: To absorb System shocks

- Pre-charged To 1,200 Psi @ 70°F
- Absorbs fluid shocks within The system
- Serviced with Nitrogen
- Located in The Tail compartment
- No CAS message if < 1,200 Psi

L Hydraulic System

- Independent and isolated from Right Hydraulic System
- Supported by the AUX pump and PTU sub-systems



To Hydraulically-powered systems

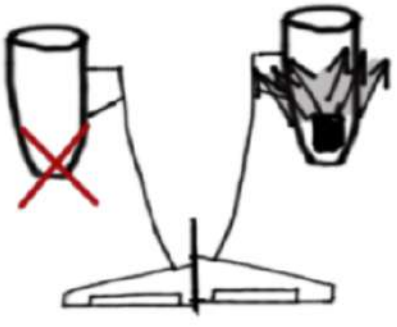
- Total capacity: 19.38 gallons
- Largest reservoir: 4.55 gallons
  Considered full at: 3 gallons *

  * To account for thermal and air expansion

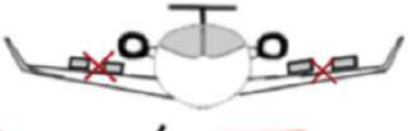
- Six (6) filters (electronically monitored via CMC)
  - Four (4) non-bypassable
  - Two (2) bypassable

Hydraulic Filter Maint Reqd

- Powered by the <u>Left Engine-driven pump</u> (EDP)
  - Mounted on engine gearbox
  - Constant pressure, variable volume pump
  - Pressurizes fluid to 3,000 ± 300 Psi
  - Flow rate varies based on power setting
  - Failure of EDP results in loss of:



① Left Thrust Reverser
① Mid spoiler panels

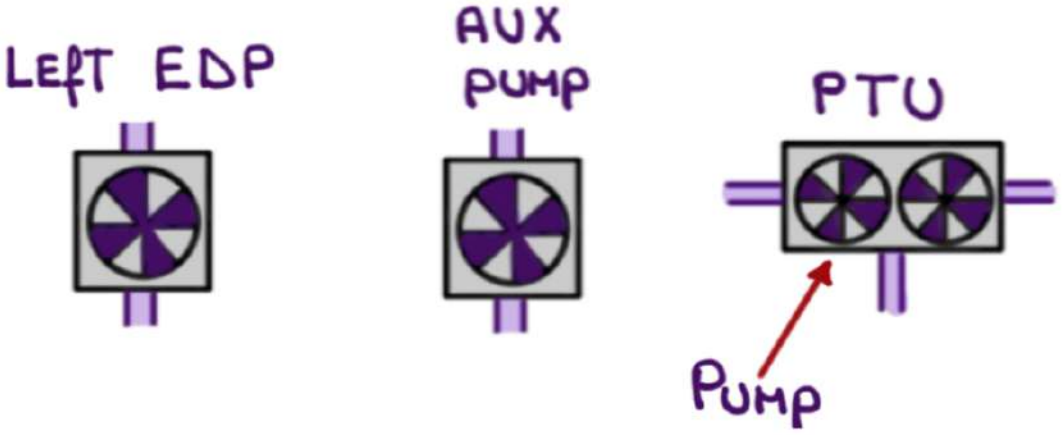


(285 KCAS/M0.90 maximum)

- Offload feature:
  - Automatically controlled by Electronic Engine Controller (ECC)
  - Reduces pump outlet pressure in flight when engine drops below idle (< 55% N_2)
  - Reduces drag on engine to maximize airstart capability
  - No windmilling pressure

- Largest Reservoir:

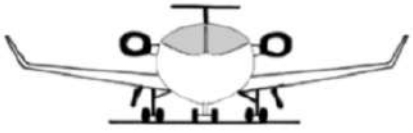
  - Must be pressurized for accurate reading
  - Supplies Hydraulic fluid To:



  - L Hydraulic Quantity Low : < 1.98 gallons

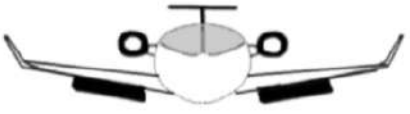
- Majority of aircraft Hydraulic functions:

- Landing gear

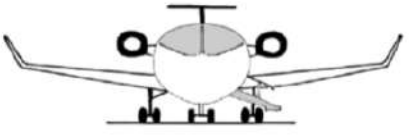


- Brakes

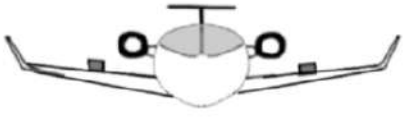
- Flaps



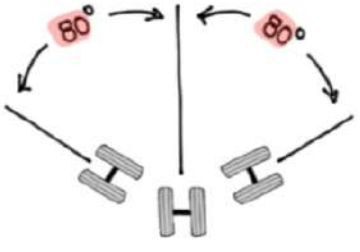
- Main Door



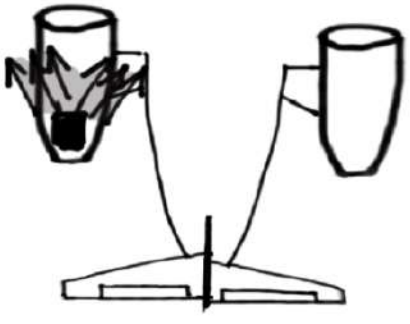
- Mid spoiler panels



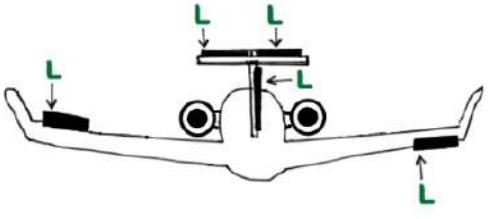
- Nose Wheel Steering



- Left Thrust Reverser

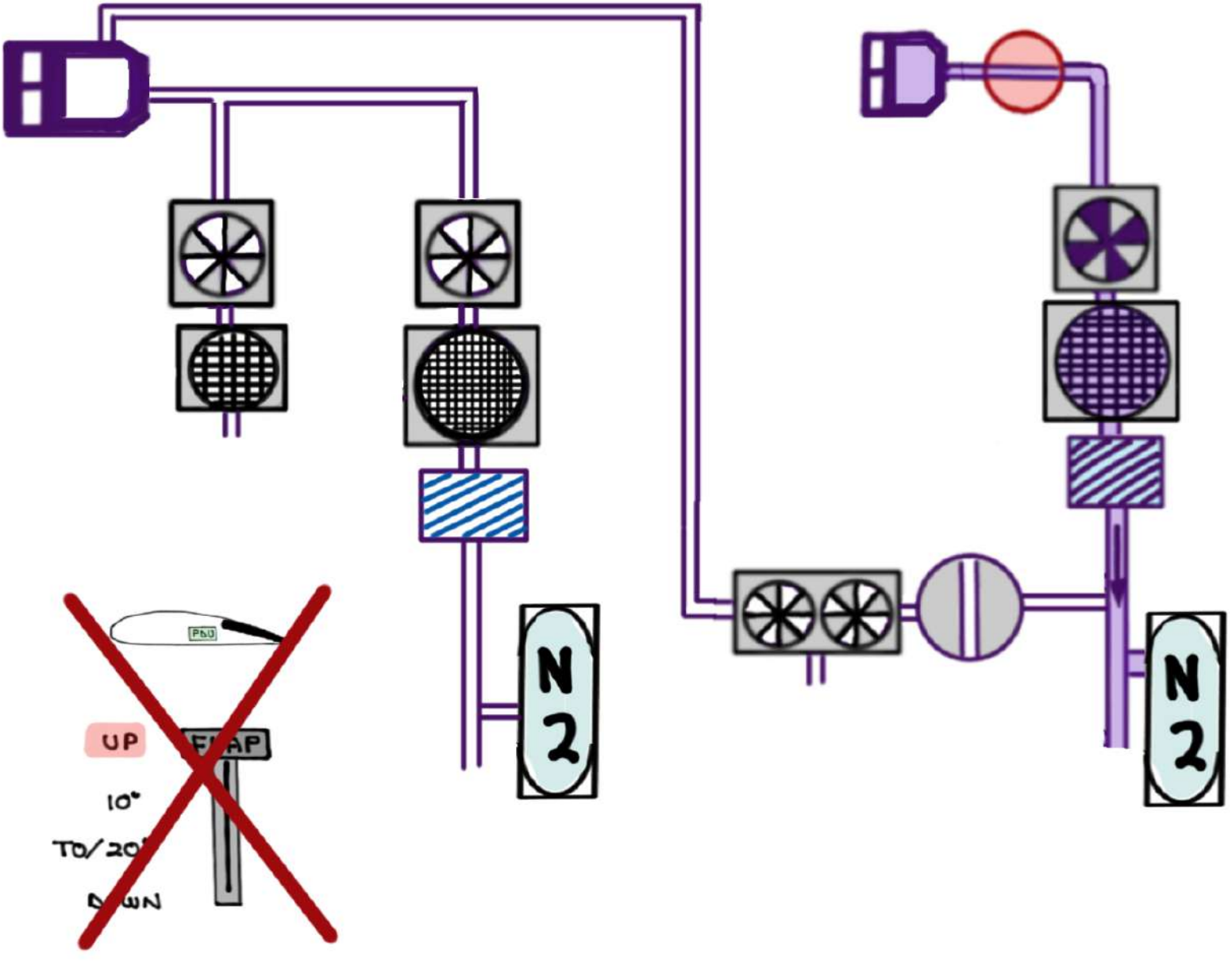


- Flight Controls



L Hyd System Fail

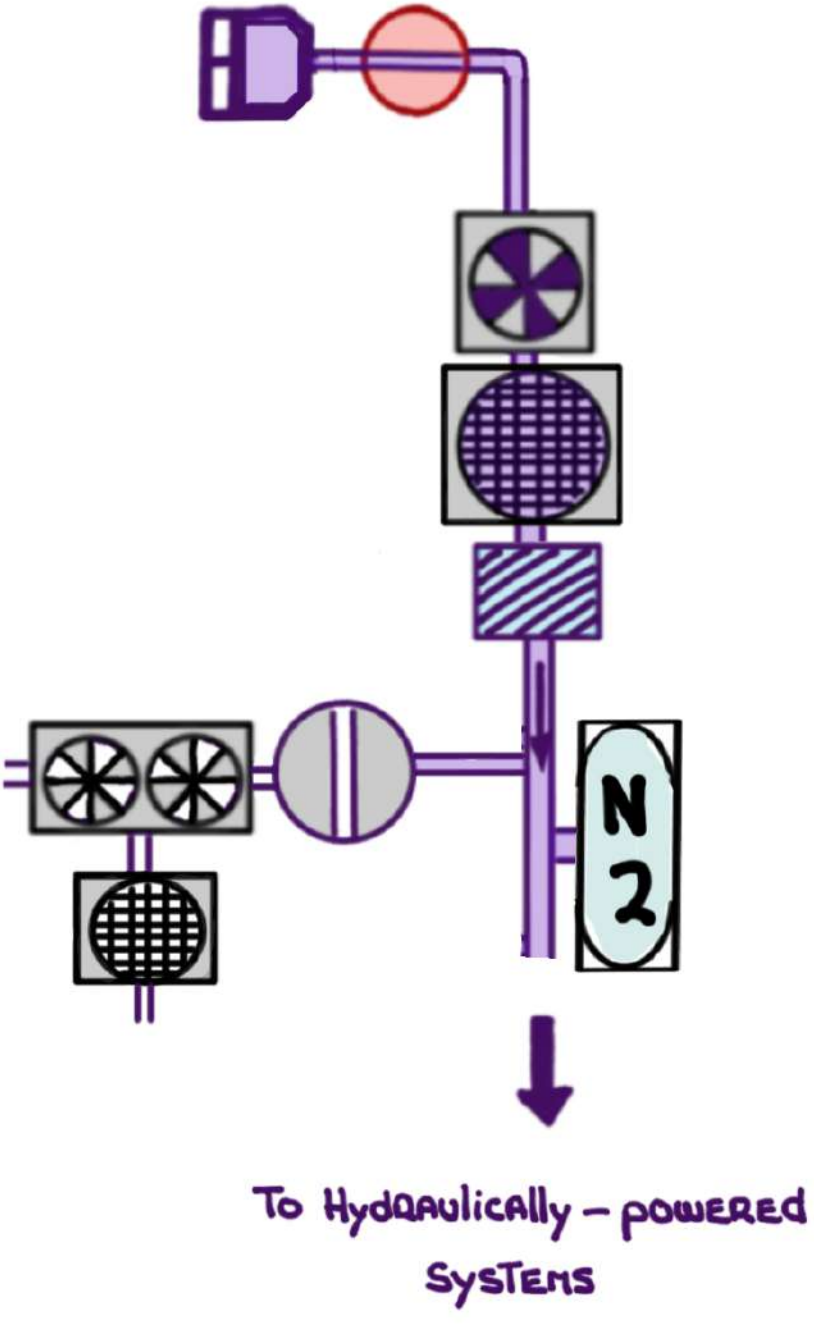
Left Hydraulic System



Flaps are not available. With any flight control surface failure a "Pan, Pan" is required

R Hydraulic System

- Independent and isolated from Left Hydraulic System



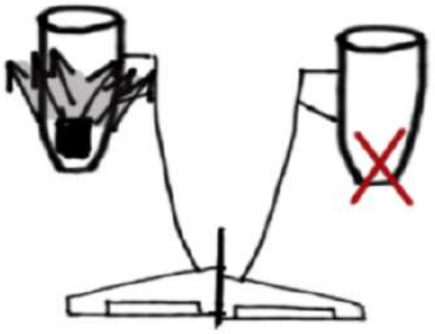
- Total capacity: 14.59 gallons
- Smallest reservoir: 2.77 gallons
  considered full at: 1.5 gallons *

* To account for thermal and air expansion

- Three (3) filters (electronically monitored via CMC)
  - Two (2) non-bypassable
  - One (1) bypassable

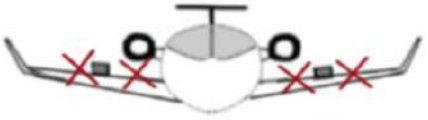
Hydraulic Filter Maint Reqd

- Powered by the <u>right engine-driven pump</u> (EDP)
  - Mounted on engine gearbox
  - Constant pressure, variable volume pump
  - Pressurizes fluid to 3,000 ± 300 Psi
  - Flow rate varies based on power setting
  - Failure of EDP results in loss of:



① Right Thrust Reverser

① Inboard spoiler panel

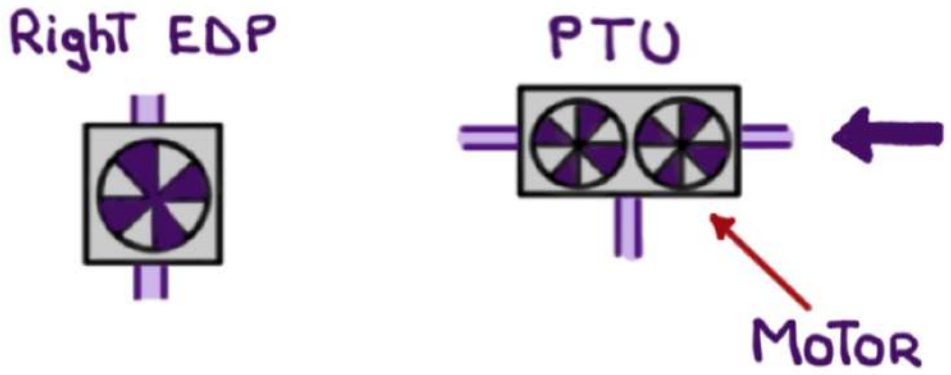


(285 kCAS/M0.90 maximum)

- Offload feature:
  - Automatically controlled by Electronic Engine Controller (ECC)
  - Reduces pump outlet pressure in flight when engine drops below idle (< 55% N_2)
  - Reduces drag on engine to maximize airstart capability
  - No windmilling pressure

- Smallest Reservoir:

  - Must be pressurized for accurate reading
  - Supplies Hydraulic fluid to:

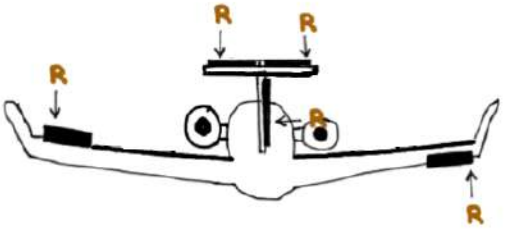


  - R Hydraulic Quantity Low : < 0.80 gallons

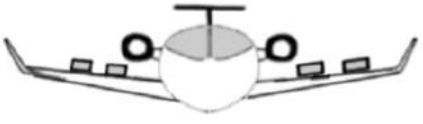
- ACTUATES THE following AIRCRAFT Hydraulic functions:

- **BRAKES**

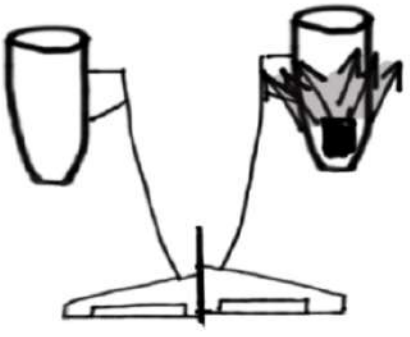
- **FLIGHT CONTROLS**



- **INBOARD/OUTBOARD PANELS**

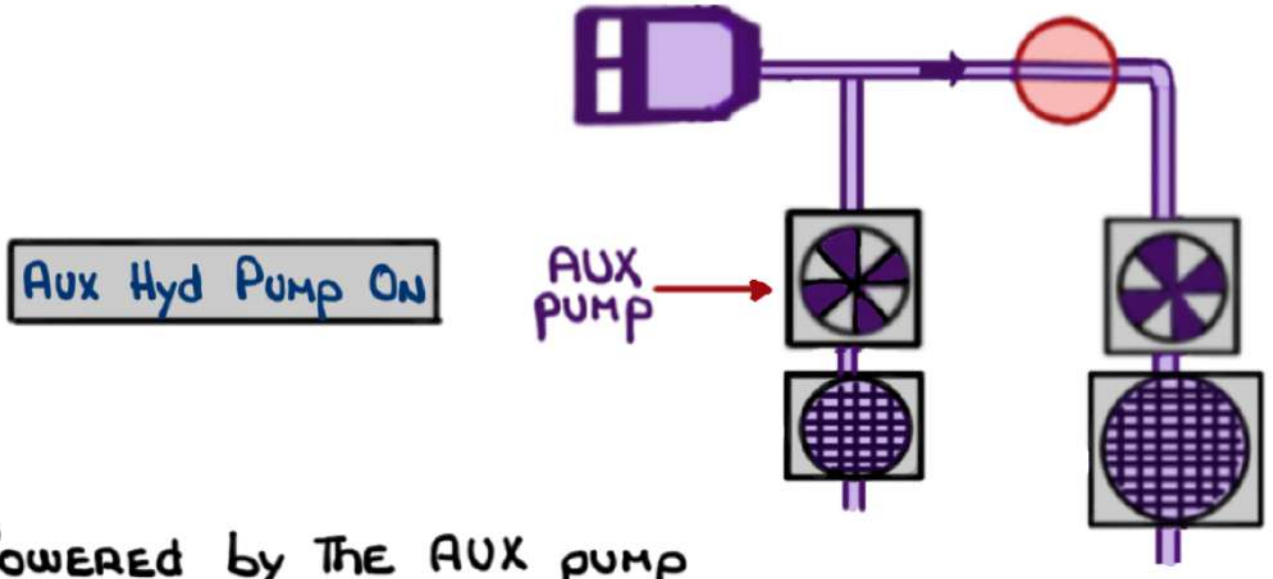


- **RIGHT THRUST REVERSER**

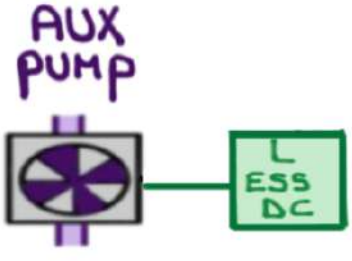


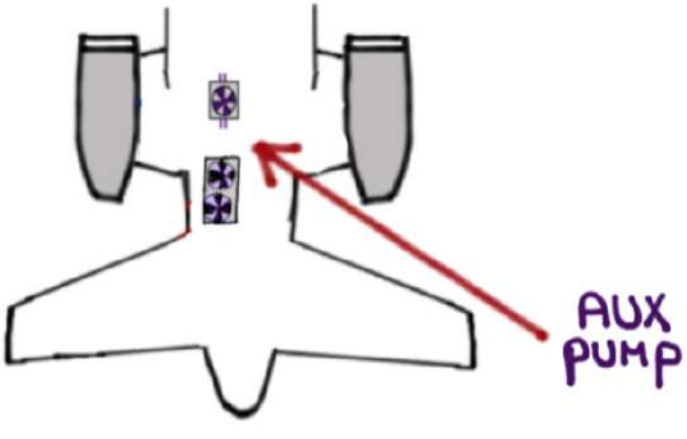
Auxiliary (AUX) Hydraulic System

- Supplements the Left Hydraulic System



- Powered by the AUX pump
  - Located in the Tail compartment below the Left Hydraulic reservoir
  - Electrically powered by L ESS DC bus



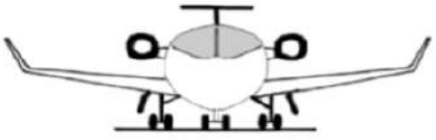


- Uses Left System fluid
- Operates either automatically or manually
- 3,000 Psi @ Two (2) gallons per minute

- Primary function:

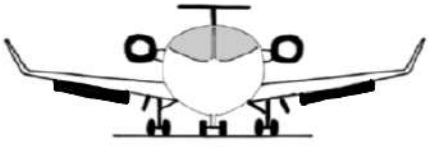
  Hydraulic pressure for utility systems during ground and maintenance activities

- **Landing gear**

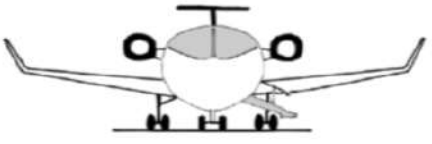


- **Brakes**

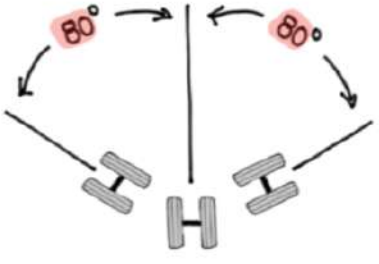
- **Flaps**



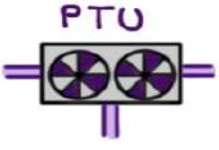
- **Main Door**



- **Nose Wheel Steering**

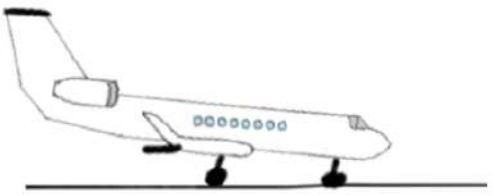


- Secondary function:

  In flight back up to assist the 

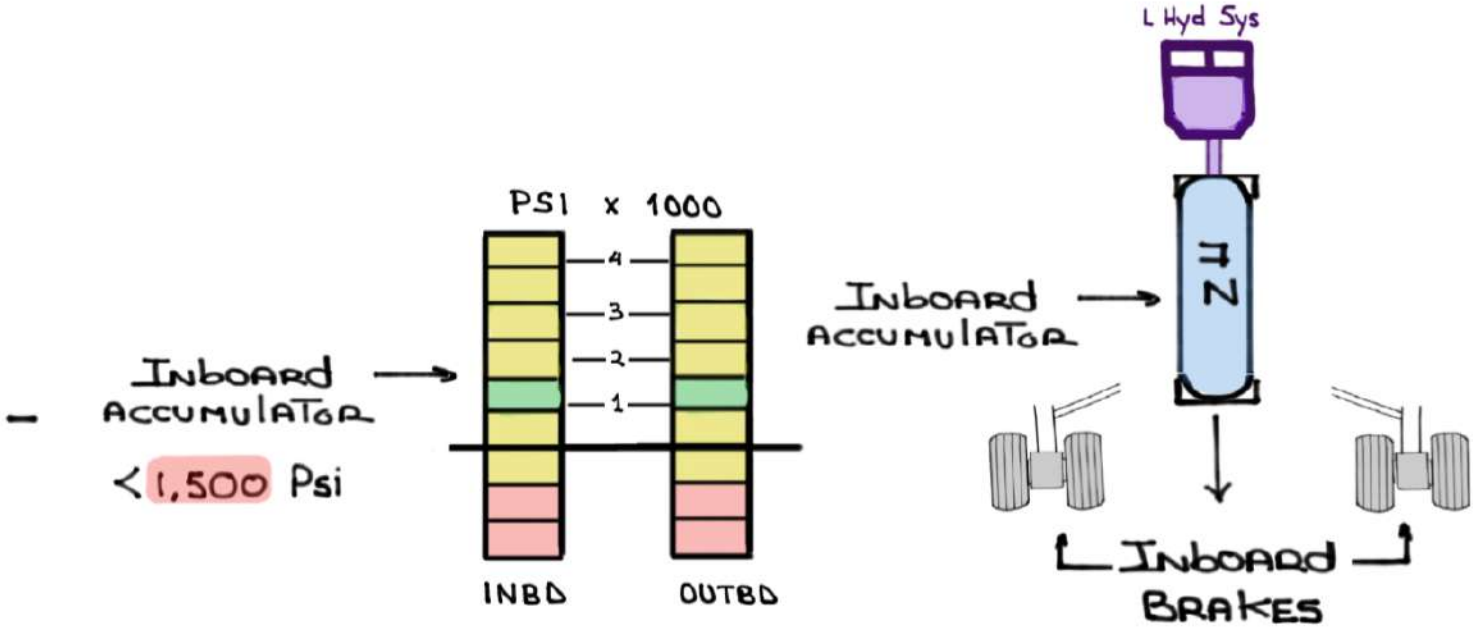
 if necessary

- FUNCTIONS ON THE **GROUND**:



① AUTO LATCH FEATURE (ASC 902)

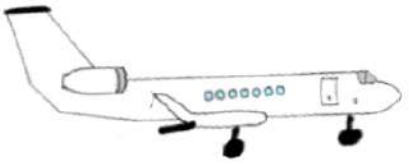
- LOW HYDRAULIC PRESSURE
- WOW **GROUND** AND BRAKE PEDAL APPLICATION



② MAINTENANCE OPERATIONS (GEAR SWING WHILE THE AIRCRAFT IS ON JACKS)

③ EXTERIOR PRE-FLIGHT INSPECTION (OPENING/CLOSING OF GEAR DOORS)

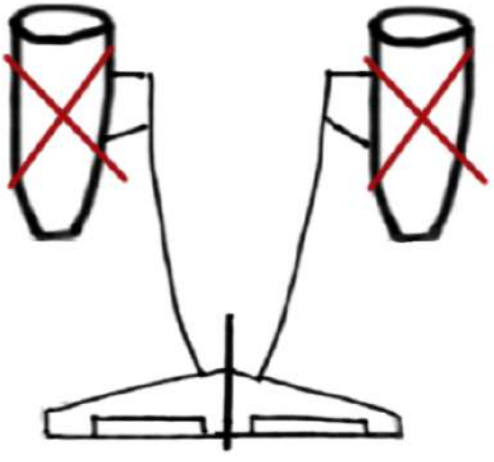
- Auto Operation **In flight**:



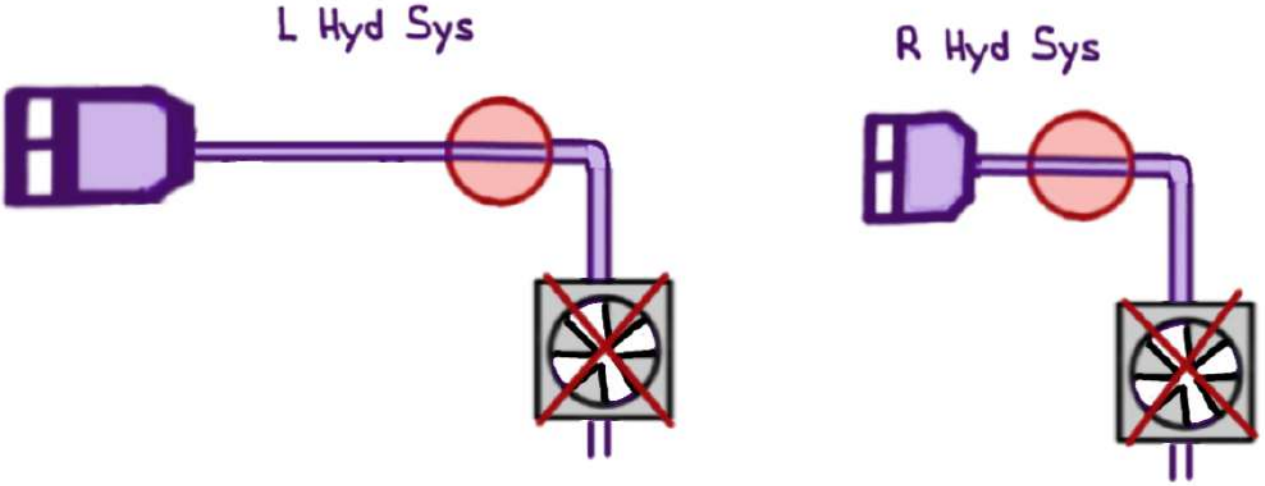
Normally inactive in flight but will power **ON** automatically for the operation of landing gear and flaps

① Dual Engine Failure

L-R Engine Fail

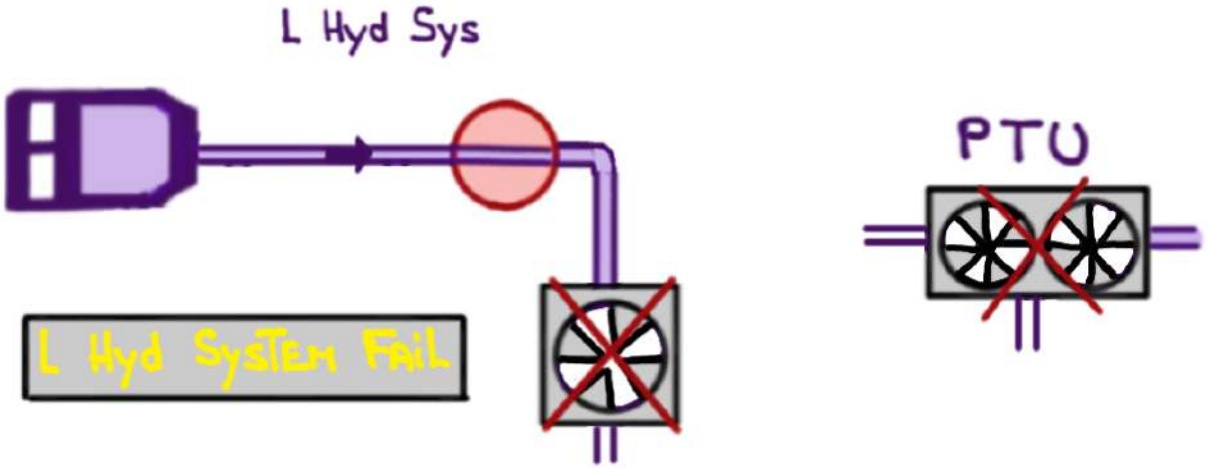


② Dual Engine-driven Pump Failure



L-R Hyd System Fail

③ Left Engine-driven Pump and PTU Failure



- Requirements for <u>AUTO ON</u> operation:
  - AUX pump ARMED
  - AUX pump not overloaded/overheated
  - Left system pressure < 1,500 Psi
  - Left system fluid available and not hot
    (> 0.36 gallons and < 107°C)
  - Flaps or gear position does not match handle position > 100 KCAS

- After the flaps or gear reaches its selected position
  The AUX pump switches itself **OFF**

- Operation Limitations:

- In flight, when the AUX pump has been manually selected ON, it will go OFF after two (2) minutes of operation. The timer can be reset by turning the AUX pump OFF then back ON

  On some **EMERGENCY** checklists the AUX pump is manually selected ON one (1) minute before landing. This provides a backup for the brakes and nose wheel steering. This leaves one (1) minute of operation as a backup to retract the landing gear & flaps during a go-around

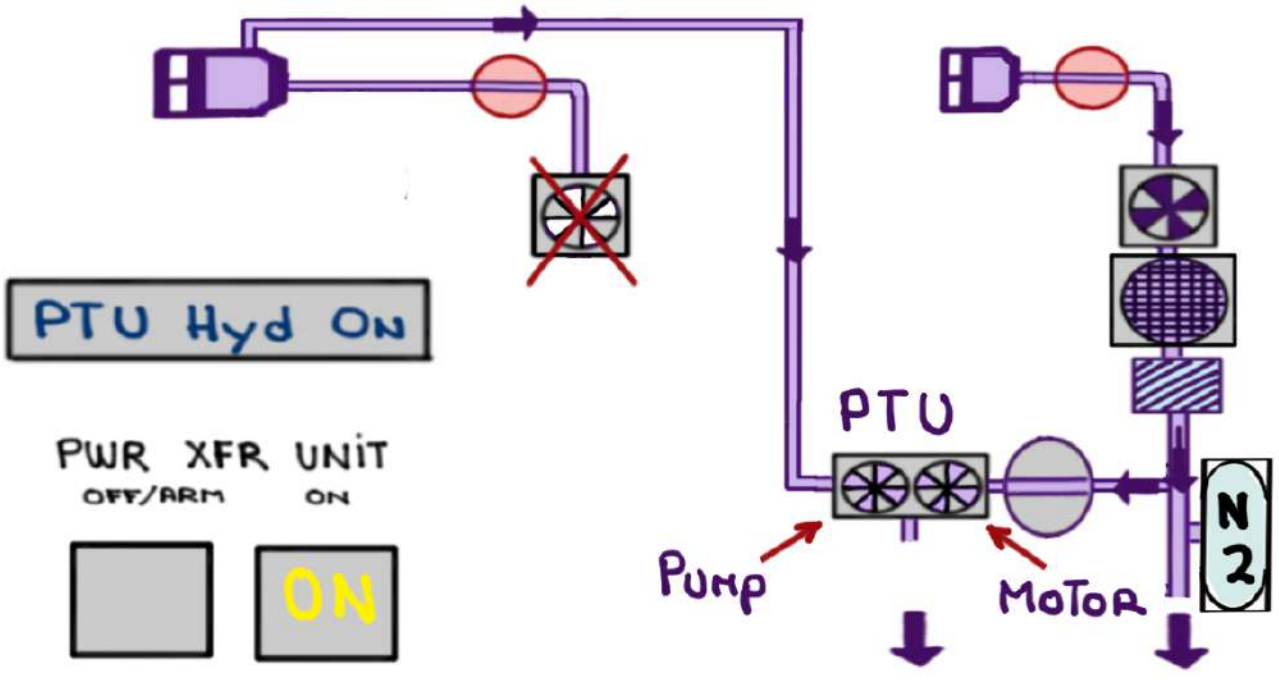
- There are no time limitations on the ground

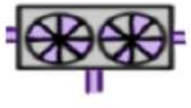
- Two (2) filters (electronically monitored via CMC)
  - One (1) on the pump itself
  - One (1) on the left Hyd System manifold

Hydraulic Filter Maint Reqd

Power Transfer Unit (PTU)

- Back up To The Left Hydraulic System engine-driven pump (operational redundancy)



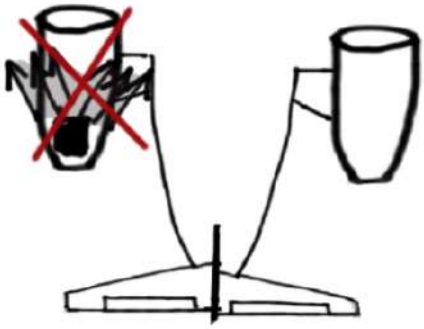
- The PTU  is a motor/pump assembly

  The motor is driven by Right System pressurized fluid. The pump is driven by the motor and its job is to pressurize Left System fluid

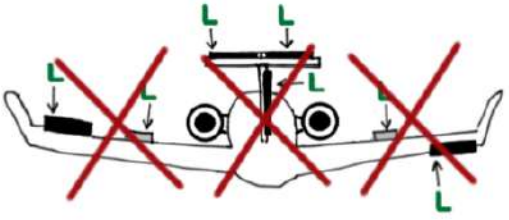
- It comes **ON** automatically if **L** Hydraulic System pressure is < 2,400 psi

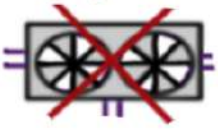
- IT CANNOT ACTUATE:

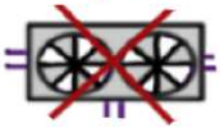
LEFT THRUST REVERSER



FLIGHT CONTROLS AND MID SPOILERS



- THE PTU  CANNOT OPERATE WITHOUT:
  - **L** HYDRAULIC SYSTEM FLUID
  - **R** HYDRAULIC SYSTEM FLUID AND PRESSURE

- PTU  PREVENTED FROM COMING **ON** AUTOMATICALLY IF:

L Hyd Sys

< 0.36 g

L HYDRAULIC QUANTITY LOW

R Hyd Sys

> 107°C

R HYDRAULIC RESERVOIR HOT

< 2,850 psi

- Operates either automatically or manually
- 3,000 Psi @ 22 gallons per minute
- Helps retract the landing gear following a failure of the left engine after takeoff (regulatory requirement)

  PTU = "Pick Tires Up"

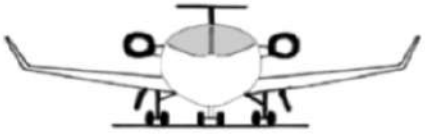
- It uses:

  ① Right system pressurized fluid, and

  ② Left System fluid

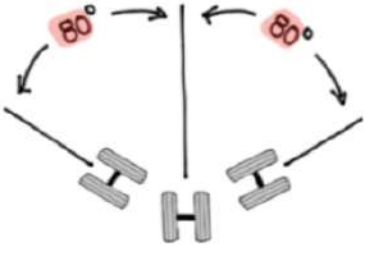
- It can actuate:

Landing gear



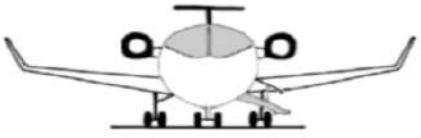
Flaps

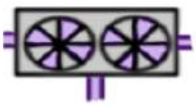
Nose Wheel Steering

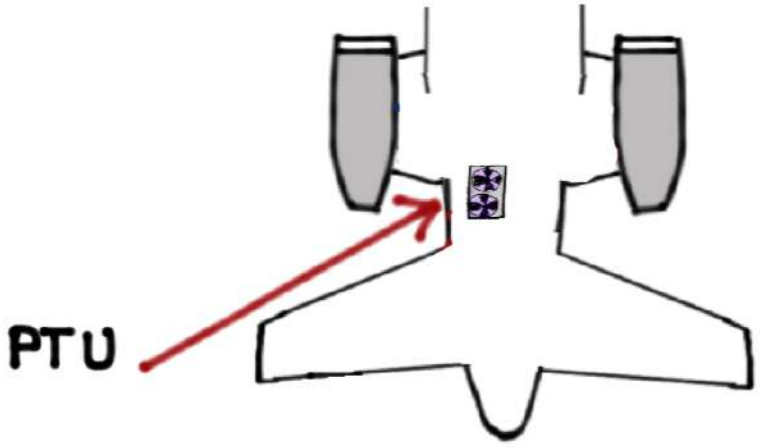


Brakes

Main Door



- The PTU  is located in the tail compartment

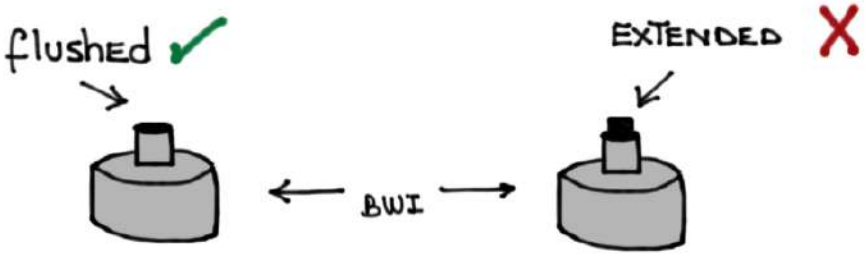


- When armed it has a seven (7) second debounce. This means that it will run at least seven (7) seconds to prevent intermittent operation with fluctuating left system pressure.

Deactivation:

- Seven (7) seconds after left system pressure recovers $\geq$ 2,750 Psi
- Immediately if right system pressure drops $<$ 2,849 Psi

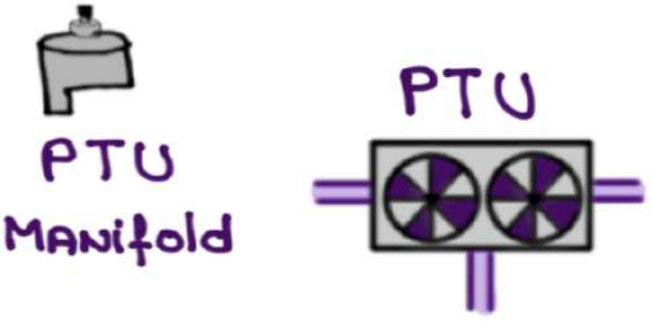
- One (1) Bearing Wear Indicator (BWI)
- Inspected for condition (flushed versus extended) during the Exterior Preflight Inspection



- No CAS message for an extended BWI. It must be visually inspected

- It can be reset by the crew

  (AFM 02-01-20 Exterior Preflight Inspection)

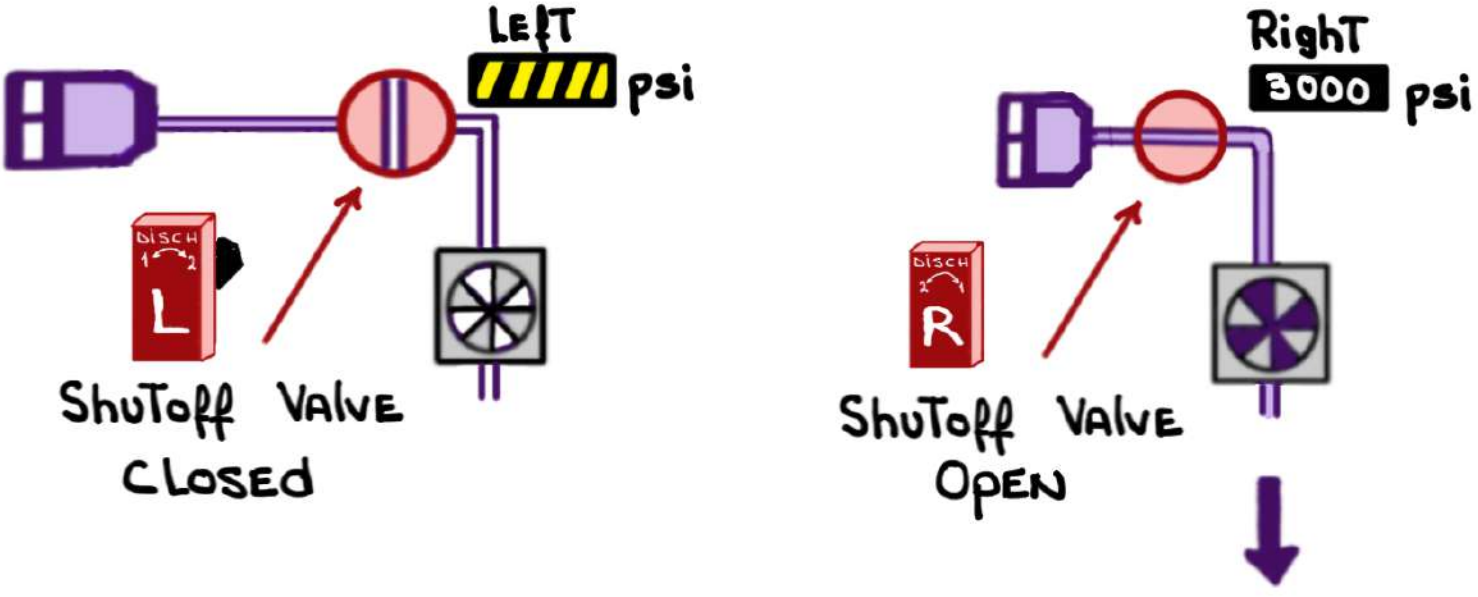


If extended:

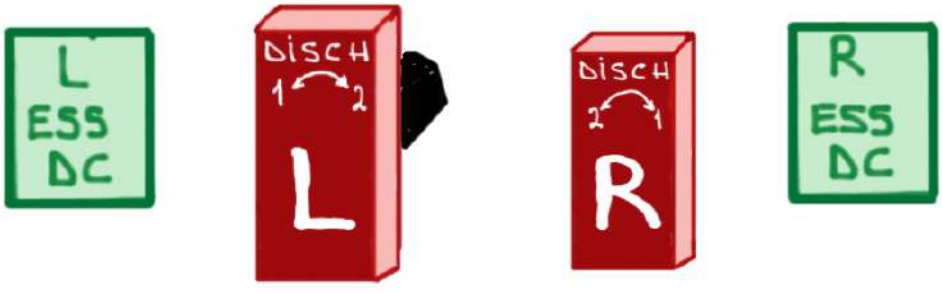
1. Reset BWI
2. Make an entry in the Techlog
3. Continued operation is permitted for fifty (50) hours

Hydraulic Shutoff Valves

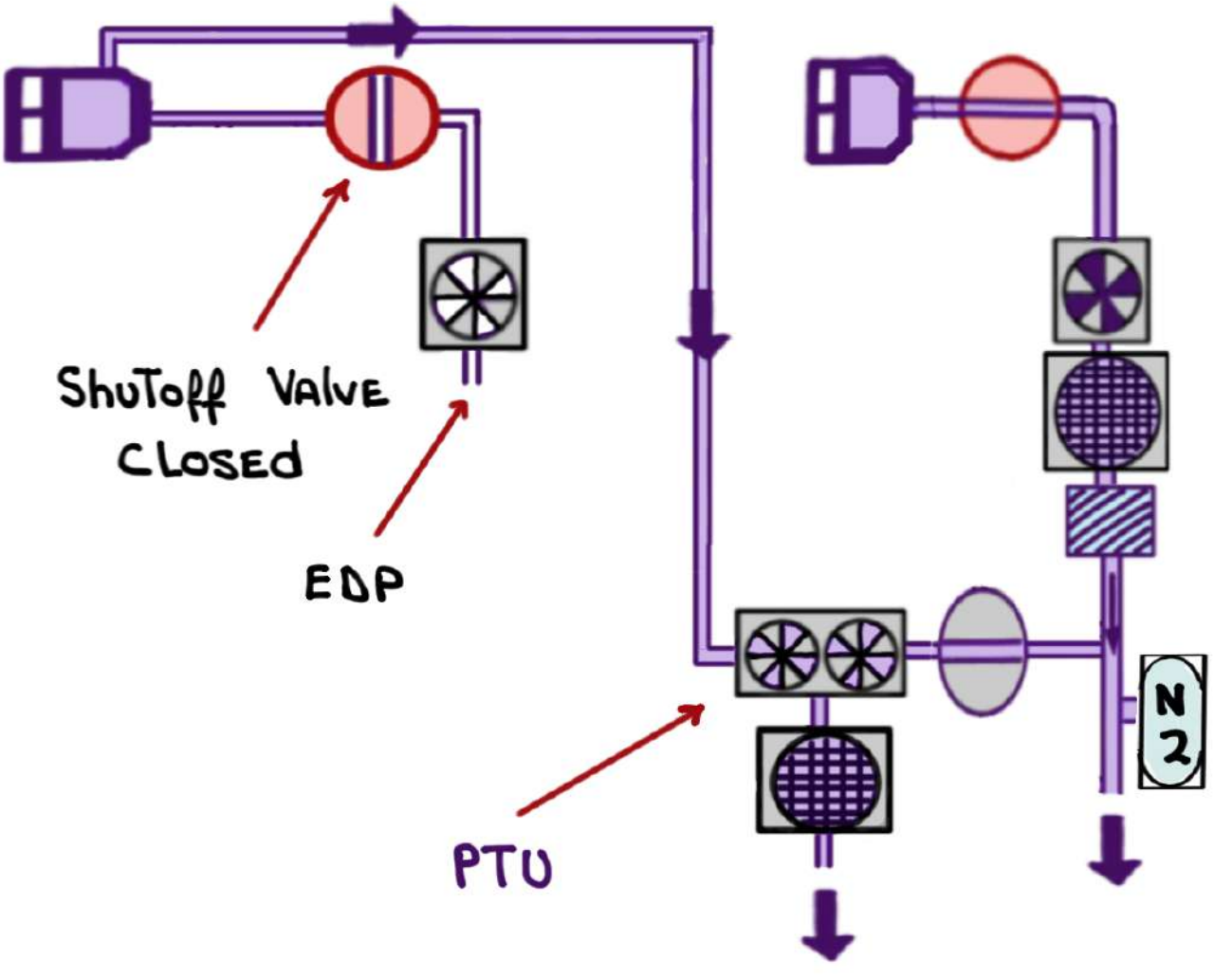
The hydraulic shutoff valves are located in the tail compartment and isolate the hydraulic fluid from the engine-driven pumps



The hydraulic shutoff valves are motor-operated and energized only when the Engine fire handles in the cockpit are pulled

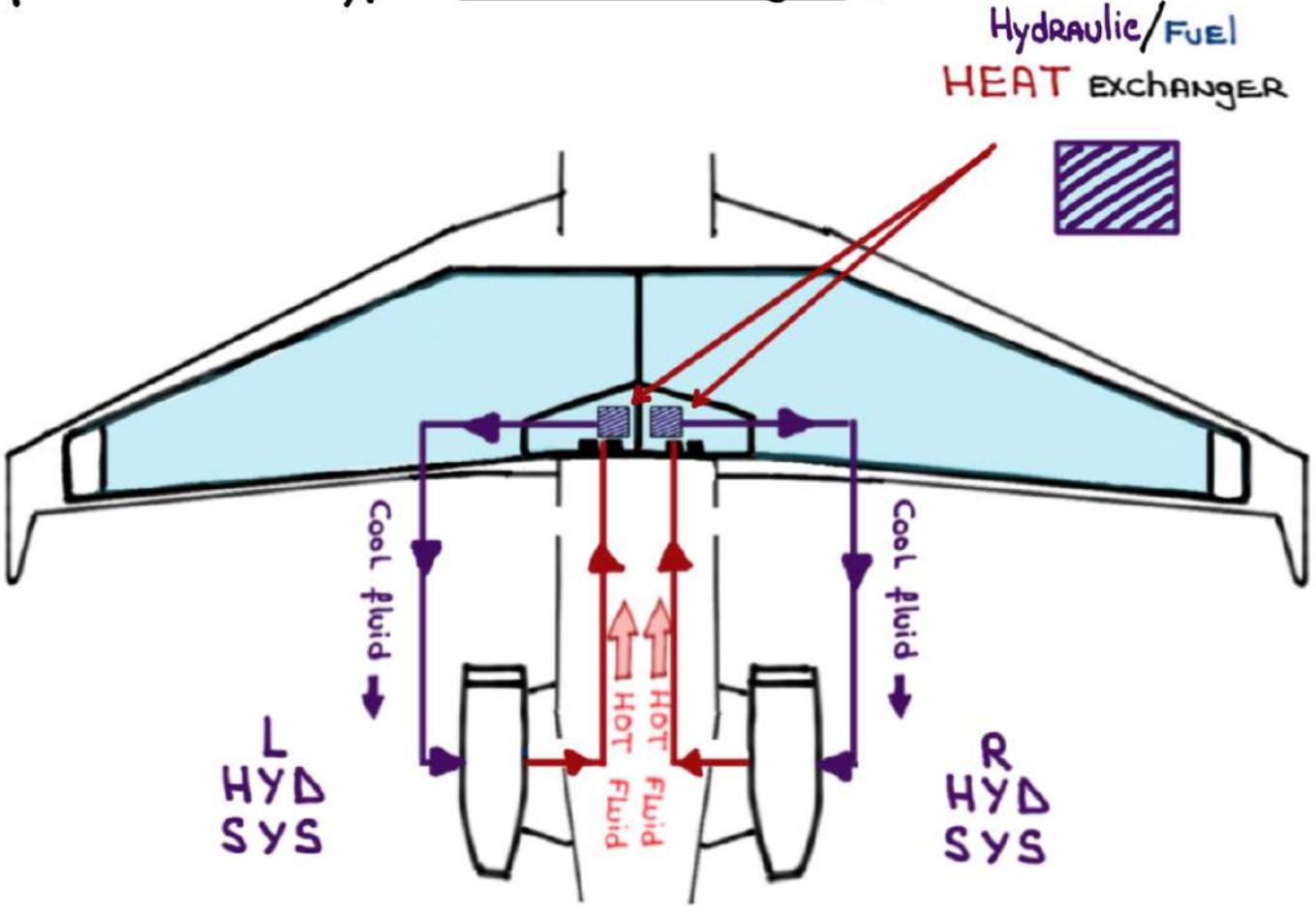


- Pulling the **LEFT FIRE HANDLE** <u>DOES NOT</u> shut off the supply of LEFT System fluid To The PTU



Hydraulic fluid HEAT exchanger

- The Hopper Tanks contain the Hydraulic fluid-to-fuel radiator type <u>HEAT EXCHANGERS</u>



The <u>HEAT Exchanger</u> unit is inside the onside fuel Hopper. HOT hydraulic fluid flows continuously Through the <u>HEAT Exchanger</u> without pilot input

HOT Hydraulic fluid is cooled while COLD fuel in the Hopper is warmed up

Hydraulic System failures

Flight Time Limitations (with ASC 135)

L Hyd System Fail

R Hyd System Fail

L-R Hyd System Fail

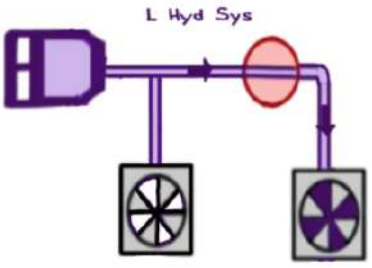
① Failure occurs <u>within</u> one (1) hour after takeoff:

- Maximum altitude: 27,000'
- Land within one and a half (1 ½) hours <u>after</u> hydraulic failure

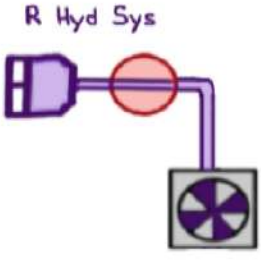
② Failure occurs <u>more than</u> one (1) hour after takeoff:

- Land within nine (9) hours <u>after</u> hydraulic failure

Hydraulic System Quantities/Pressures



- Total capacity: 19.38 gallons
- Largest reservoir: 4.55 gallons
- Considered full at: 3 gallons



- Total capacity: 14.59 gallons
- Smallest reservoir: 2.77 gallons
- Considered full at: 1.5 gallons

L and R Hyd Syst Pump output

- 25-37 gallons per minute (idle - Takeoff)
- 3,000 Psi ± 300

AUX Hyd Syst Pump output

- 2 gallons per minute
- 3,000 Psi ± 300

PTU Hyd Syst Pump output

- 22 gallons per minute
- 3,000 Psi +300/-400

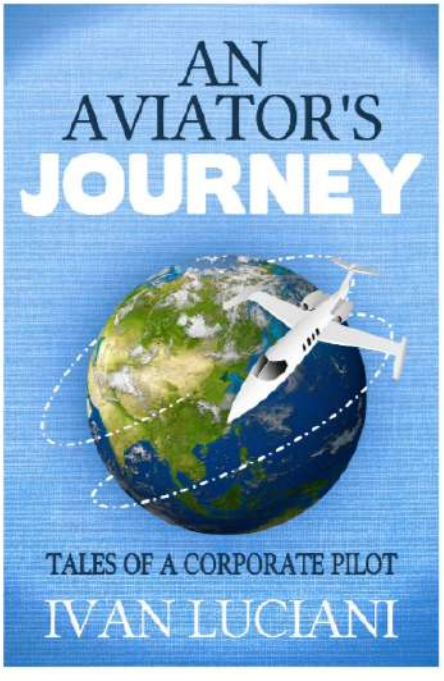
L and R Hyd Syst Accumulator precharge

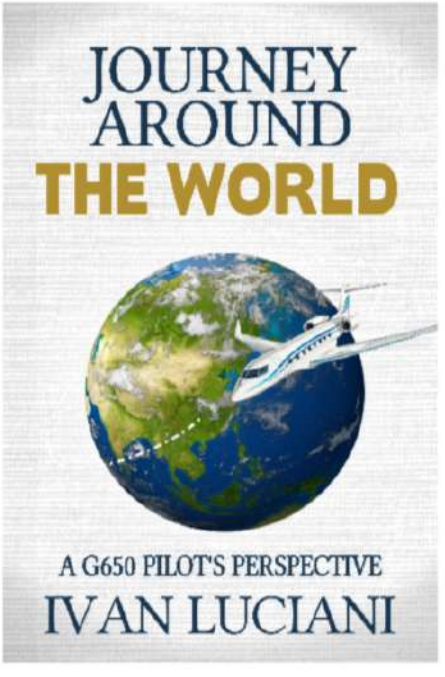
1,200 Psi @ 70°F

REMINDER: these system notes are intended for study purposes only. Always refer to official Gulfstream manuals and other approved references when operating your aircraft.

NOTE: these system notes are updated from time to time and what is posted on Code450.com will always be the most recent version.

Questions, comments or errors...please do send me an email: ivan.luciani@gmail.com





Thank you!