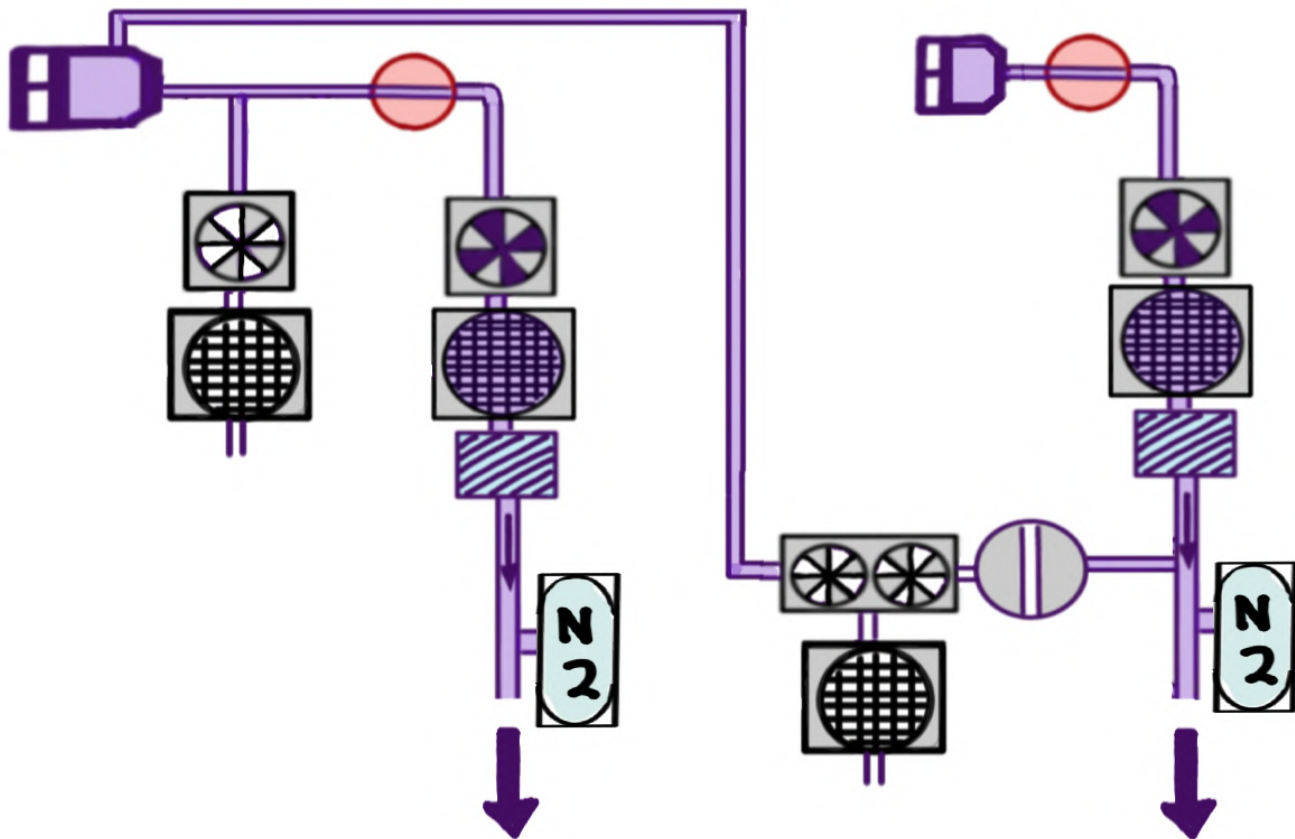


G650

HYDRAULIC

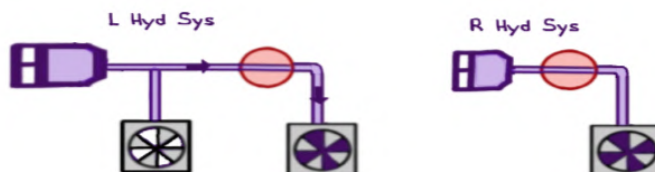
System



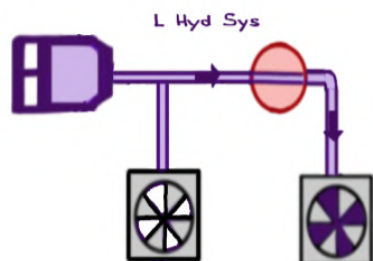
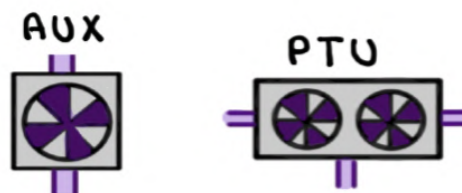
For study purposes only

The Hydraulic System is about the STORAGE AND DELIVERY of hydraulic fluid (Skydrol) under high pressure to actuate various systems

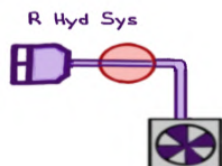
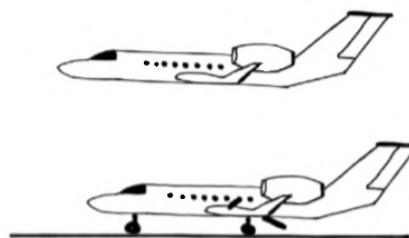
Two (2) MAIN systems



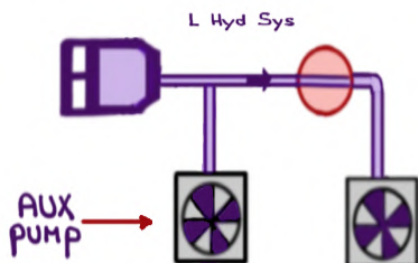
SUPPORTED by Two (2) sub-systems



FLY
LAND



FLY



LAND
MX

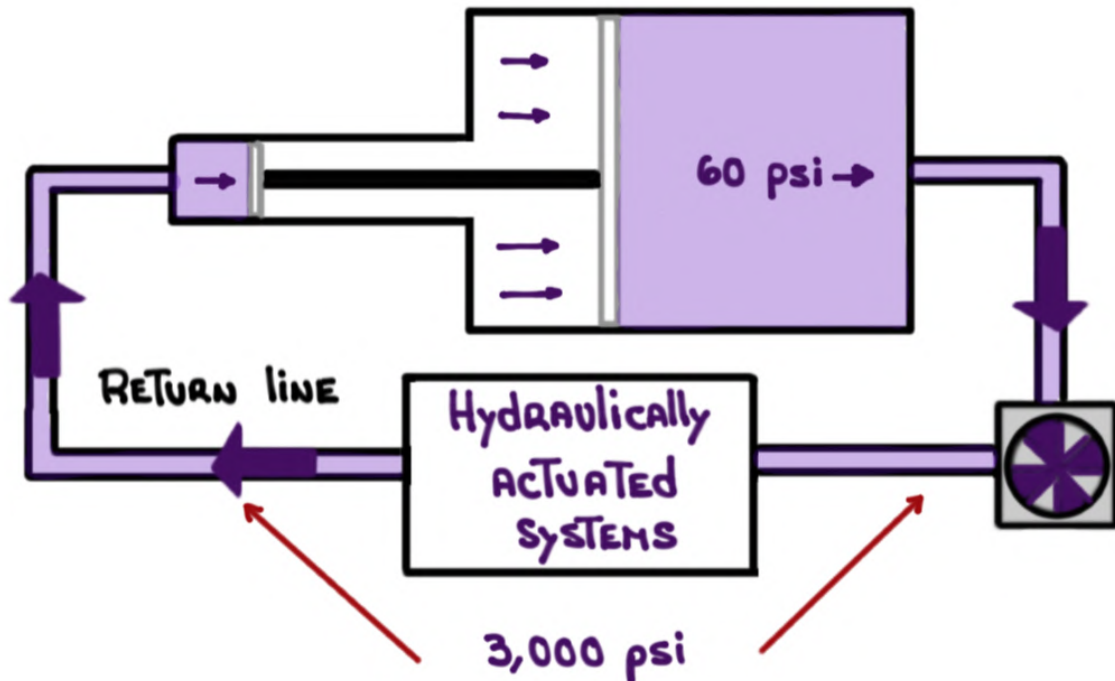


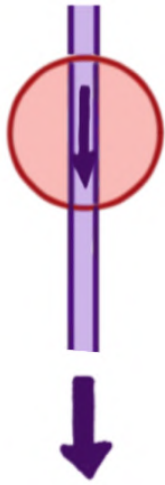
Hydraulic System Components

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 \pm 300 Psi



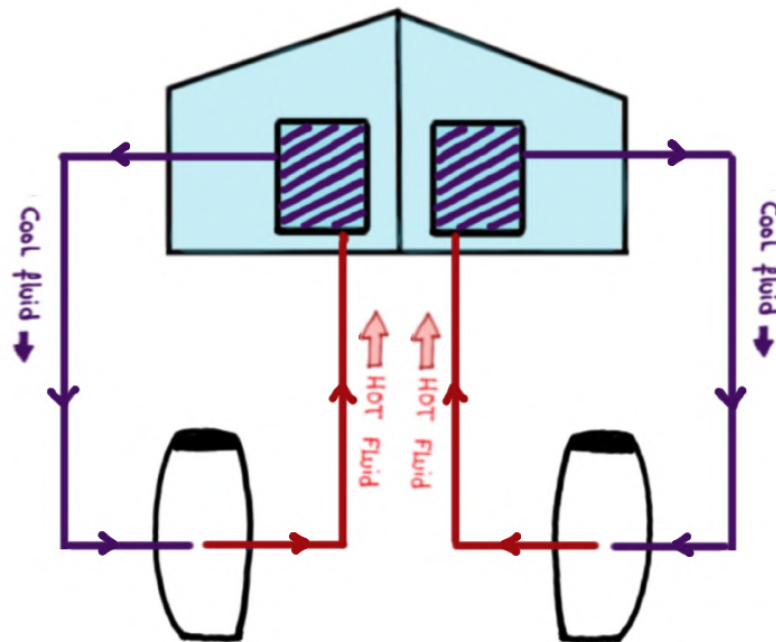
FILTER MANIFOLD: To filter hydraulic fluid AND CONTROL direction of flow

- LOCATED IN THE TAIL COMPARTMENT
- LEFT HYDRAULIC SYSTEM: Six (6) filters
- RIGHT HYDRAULIC SYSTEM: THREE (3) filters

Hydraulic fluid-To-fuel HEAT EXCHANGER:

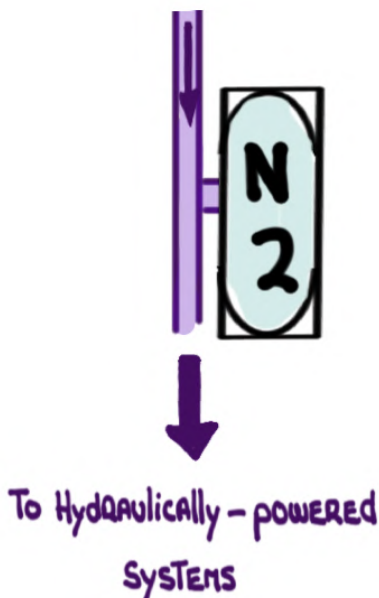
To cool hydraulic fluid AND To warm up cold fuel

- LOCATED IN THE ON-SIDE fuel Hopper
- CONTINUOUS flow



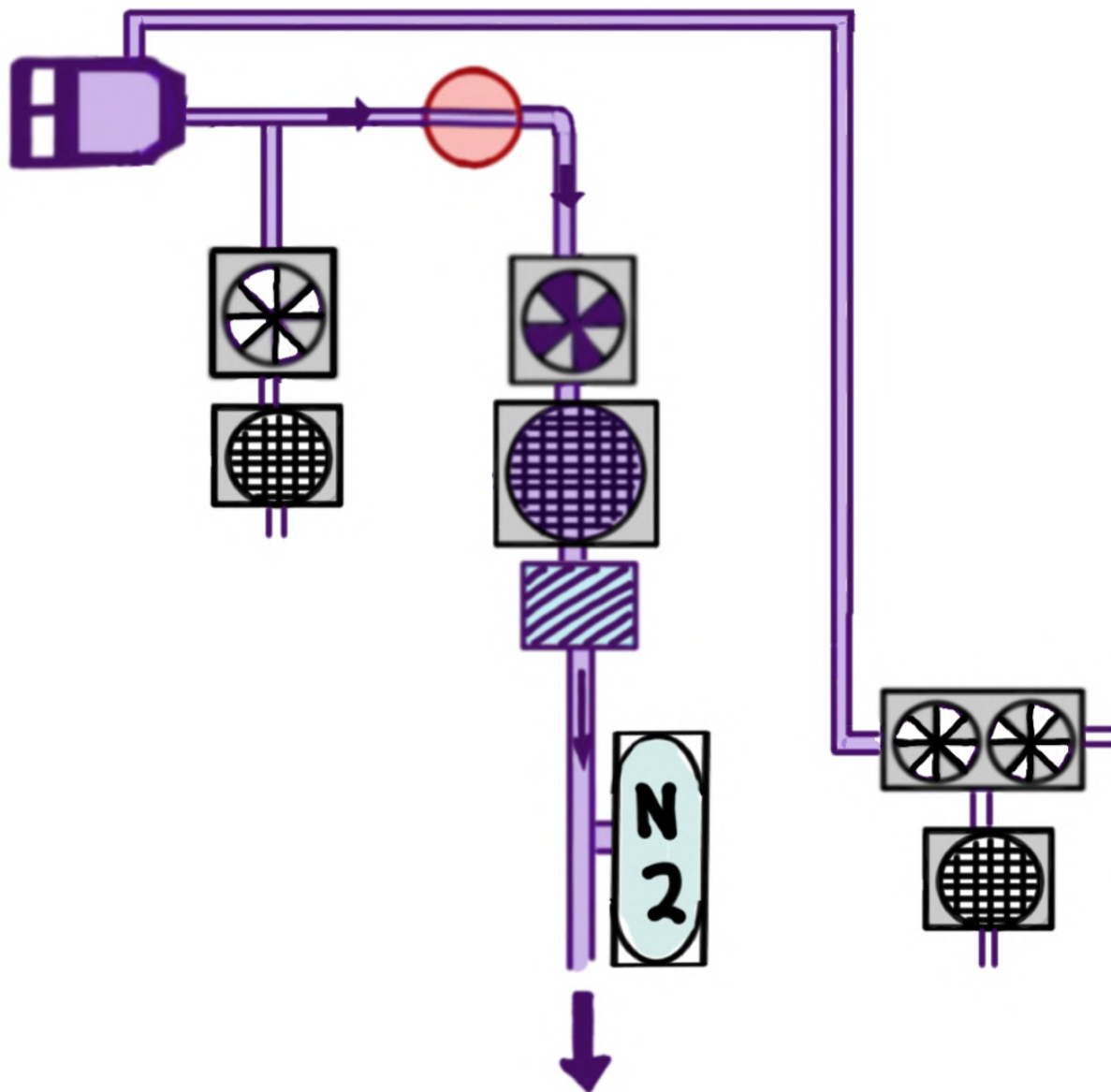
ACCUMULATOR: To absorb system shocks

- PRE-CHARGED To 1,200 Psi @ 70°F
- Absorbs fluid shocks within the system
- SERVICED with Nitrogen
- LOCATED IN THE TAIL COMPARTMENT



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 *

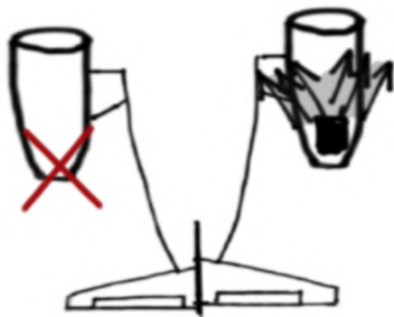
* To account for Thermal and air expansion

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

Hydraulic Filter Maint Req'd

- Powered by the Left Engine-driven pump (EDP)

- Mounted on engine gearbox
- Constant pressure, variable volume pump
- Pressurizes fluid to 3,000 \pm 300 Psi
- Flow rate varies based on power setting
- Failure of EDP results in loss of:



- ① Left Thrust Reverser
- ② Mid spoiler panels



(185 KCAS/M0.90 maximum)

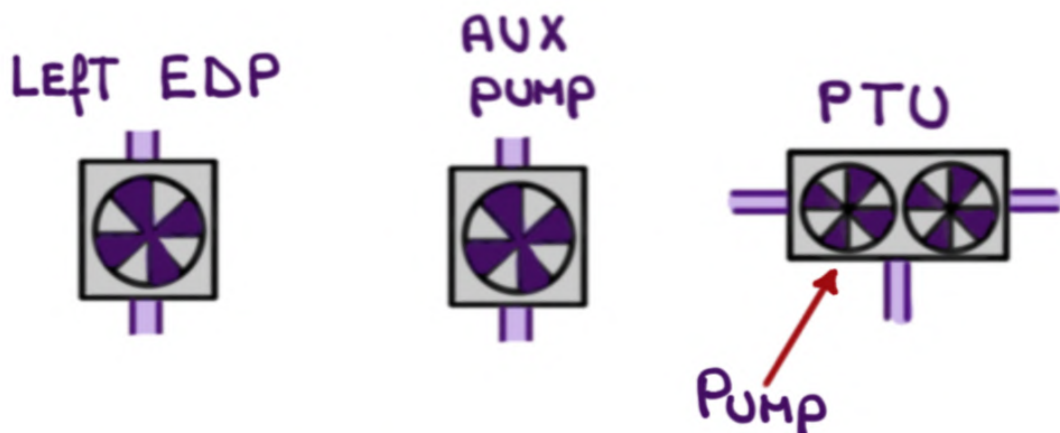
- Offload feature:

- 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:



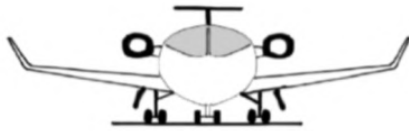
- MUST BE PRESSURIZED FOR ACCURATE READING
- SUPPLIES HYDRAULIC FLUID TO:



- **L HYDRAULIC QUANTITY LOW** : < 1.98 gallons

- Majority of AIRCRAFT Hydraulic functions:

- LANDING GEAR



- BRAKES



- FLaps



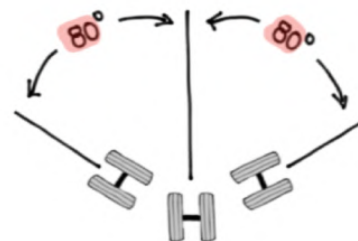
- MAIN DOOR



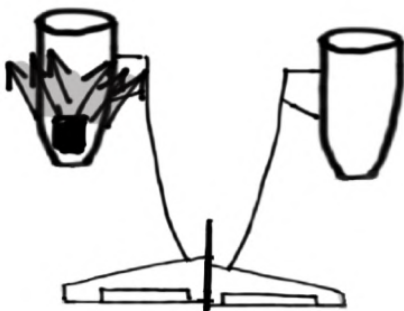
- MID SPOILER PANELS



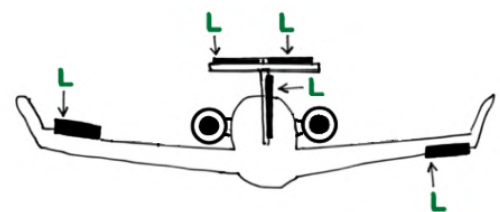
- NOSE WHEEL STEERING



- LEFT THRUST REVERSE

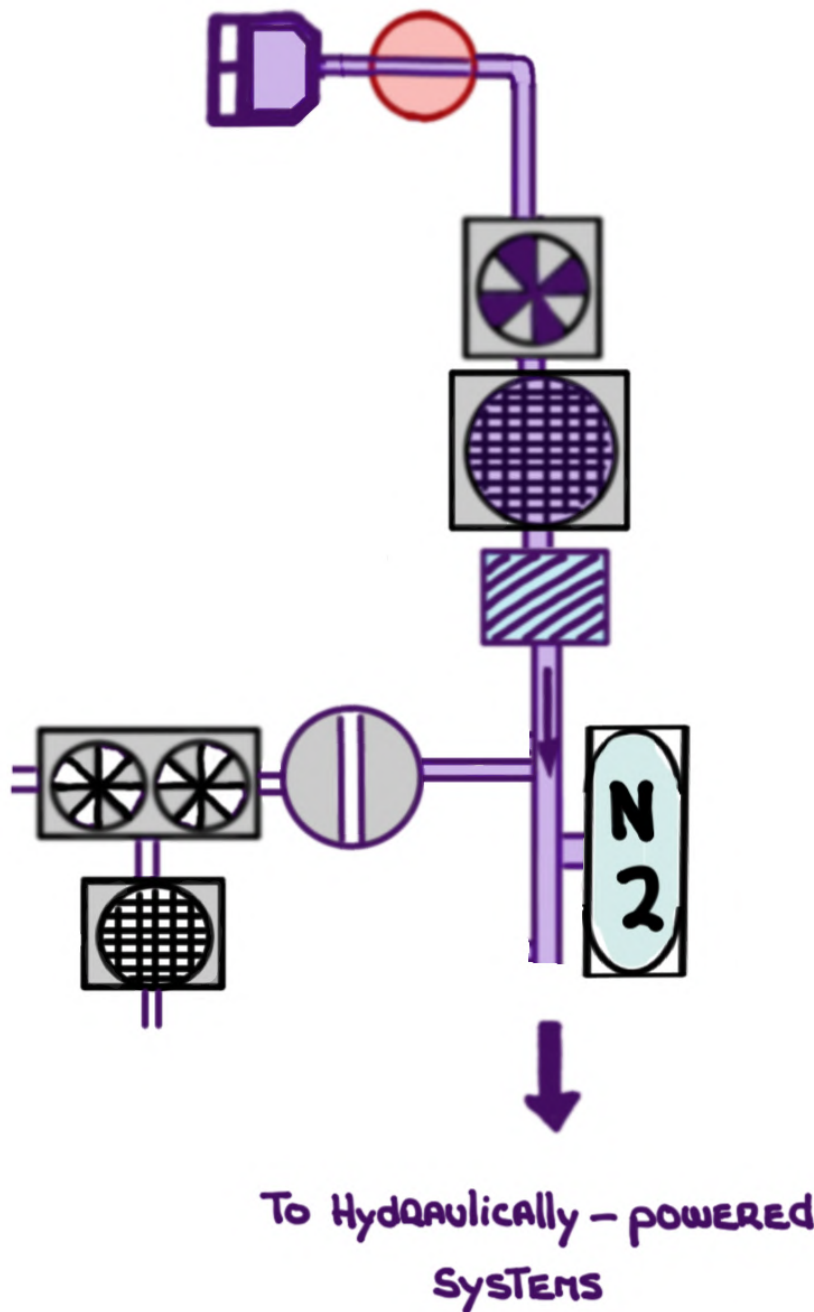


- FLIGHT CONTROLS



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

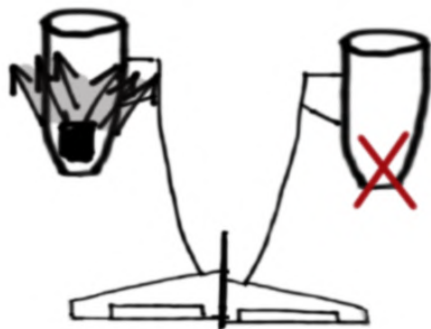
- Three (3) filters (electronically monitored via CMC)

- Two (2) non-bypassable
- One (1) bypassable

Hydraulic Filter Maint Req

- Powered by the Right Engine-driven pump (EDP)

- Mounted on engine gearbox
- Constant pressure, variable volume pump
- Pressurizes fluid to 3,000 \pm 300 Psi
- Flow rate varies based on power setting
- Failure of EDP results in loss of:



① Right Thrust Reverser

② Inboard and outboard 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

- Smallest Reservoir:

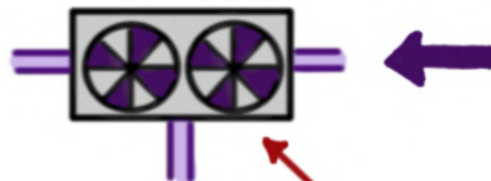


- Must be pressurized for accurate reading
- Supplies Hydraulic fluid To:

Right EDP



PTU



MOTOR

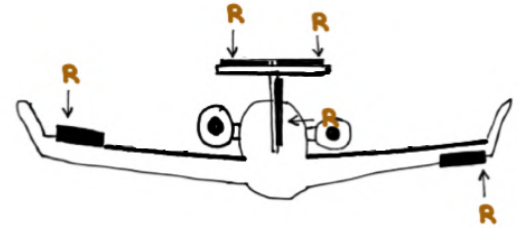
- R Hydraulic Quantity Low : < 0.80 gallons

- ACTUATES THE FOLLOWING AIRCRAFT HYDRAULIC FUNCTIONS:

- BRAKES



- FLIGHT CONTROLS



- INBOARD/OUTBOARD PANELS

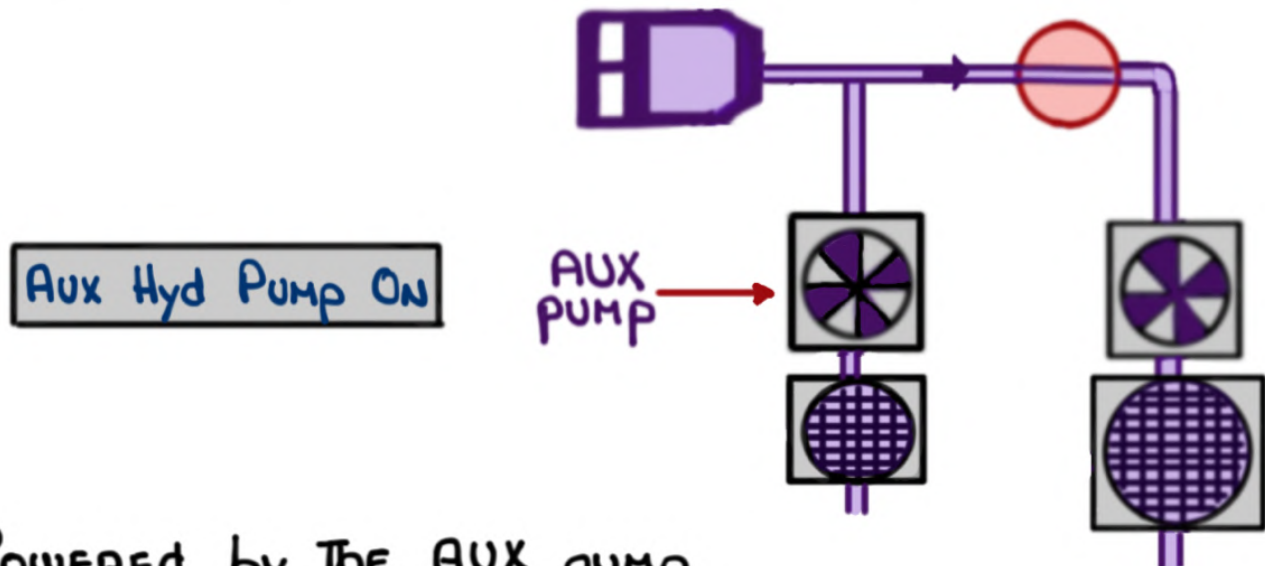


- RIGHT THRUST REVERSE

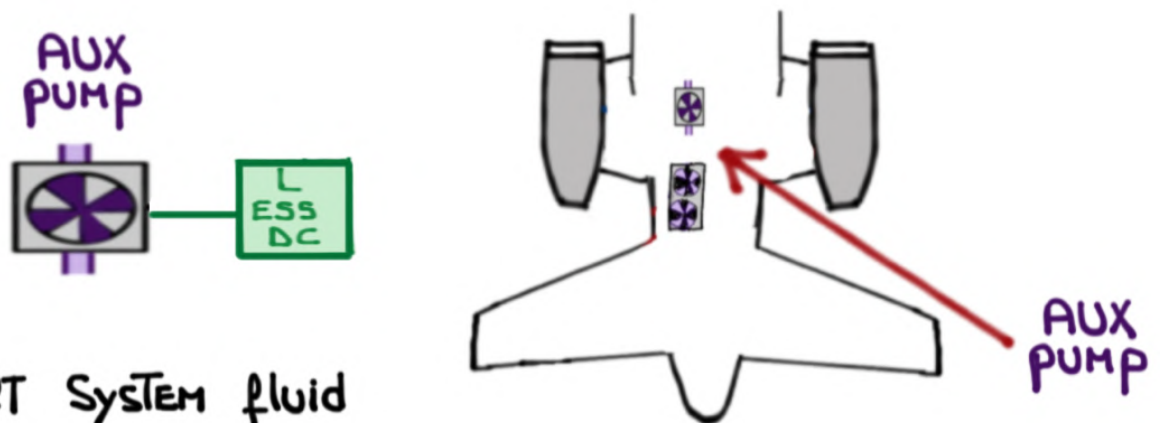


AUXILIARY (AUX) Hydraulic System

- SUPPLEMENTS The LEFT Hydraulic System



- Powered by The AUX pump
 - LOCATED in THE TAIL COMPARTMENT below THE LEFT Hydraulic RESERVOIR
 - ELECTRICALLY powered by LESS DC bus

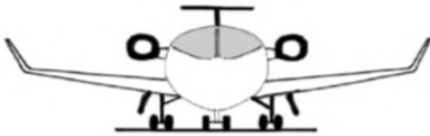


- Uses LEFT System fluid
- OPERATES EITHER AUTOMATICALLY OR MANUALLY
- 3,000 Psi @ Two (2) gallons PER MINUTE

- PRIMARY function :

Hydraulic PRESSURE for utility systems during **ground** AND MAINTENANCE ACTIVITIES

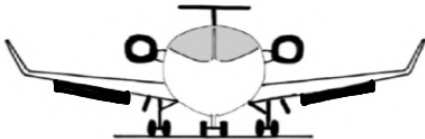
- LANDING GEAR



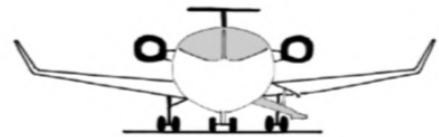
- BRAKES



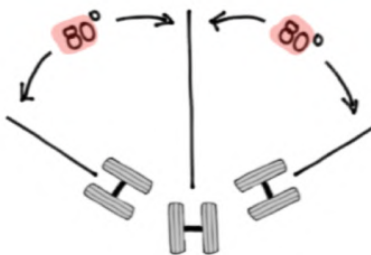
- FLAPS




- MAIN DOOR



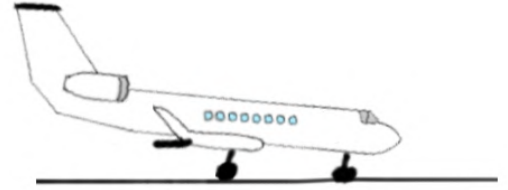
- NOSE WHEEL STEERING



- SECONDARY function:

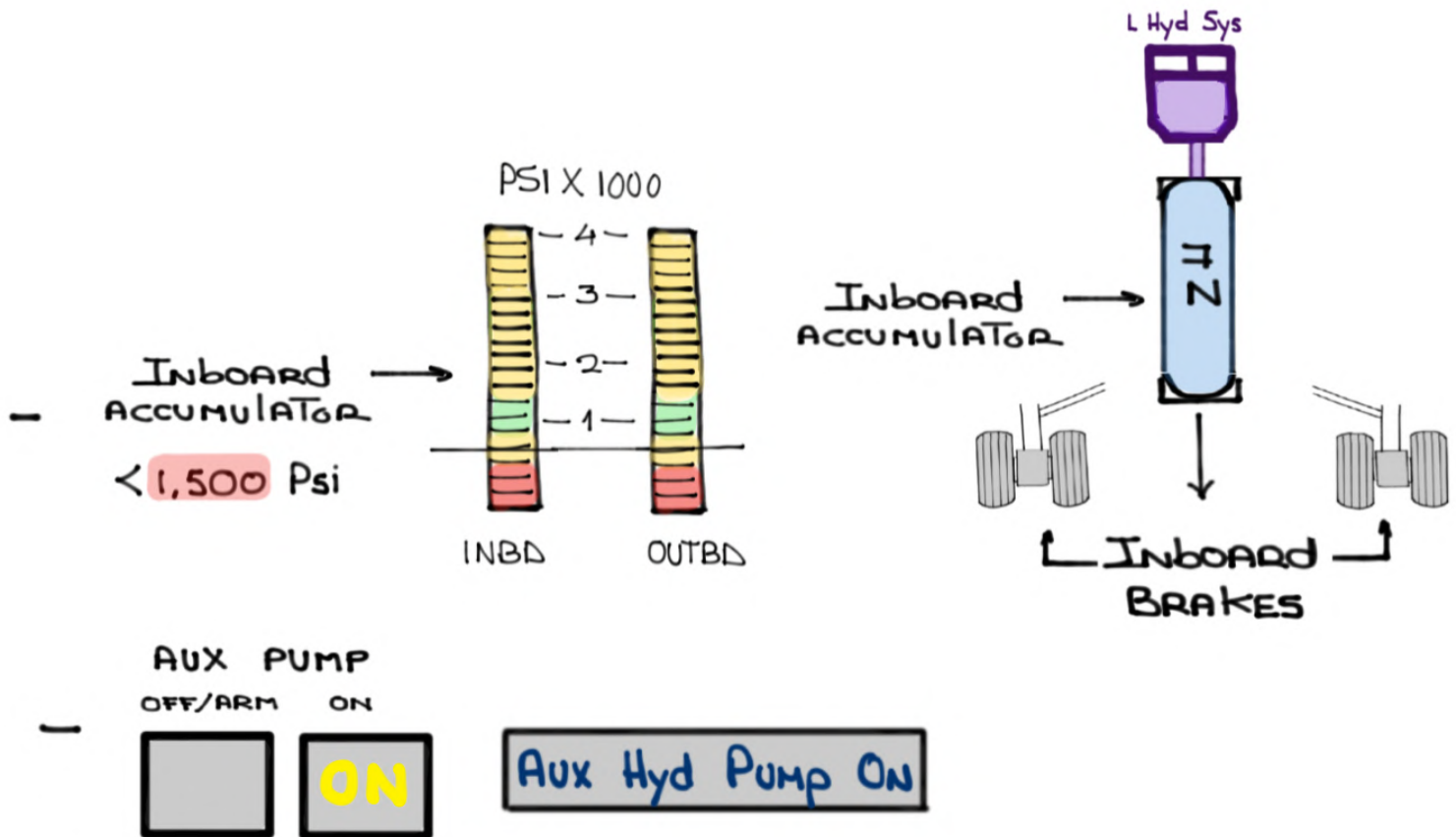
In flight back up to assist the  if NECESSARY

- FUNCTIONS ON THE GROUND:



① AUTO latch FEATURE (ASC 902)

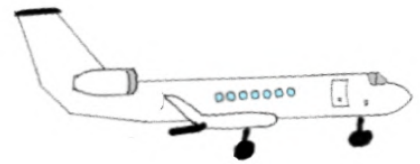
- Low hydraulic PRESSURE
- WOW GROUND AND BRAKE PEDAL Application



② MAINTENANCE OPERATIONS (GEAR SWING while The AIRCRAFT is ON JACKS)

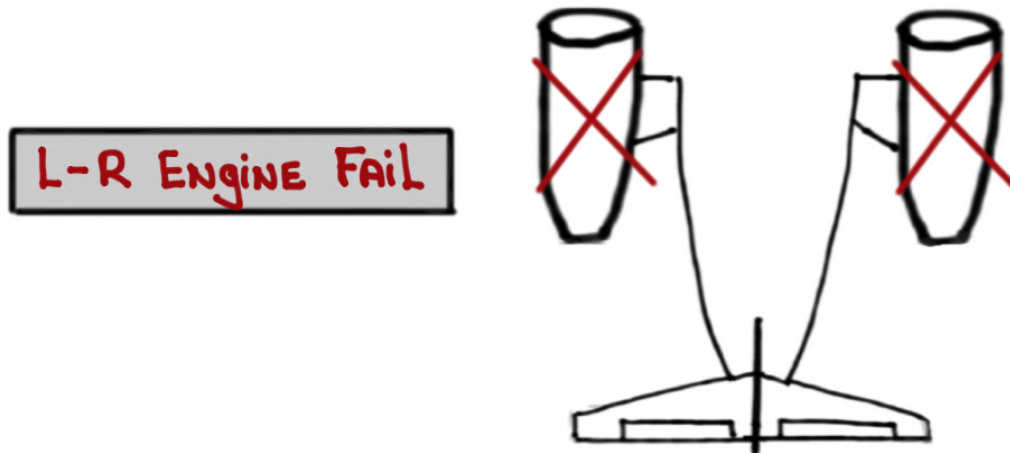
③ EXTERIOR PRE-flight INSPECTION (OPENING/closing of GEAR DOORS)

- Auto Operation In flight:

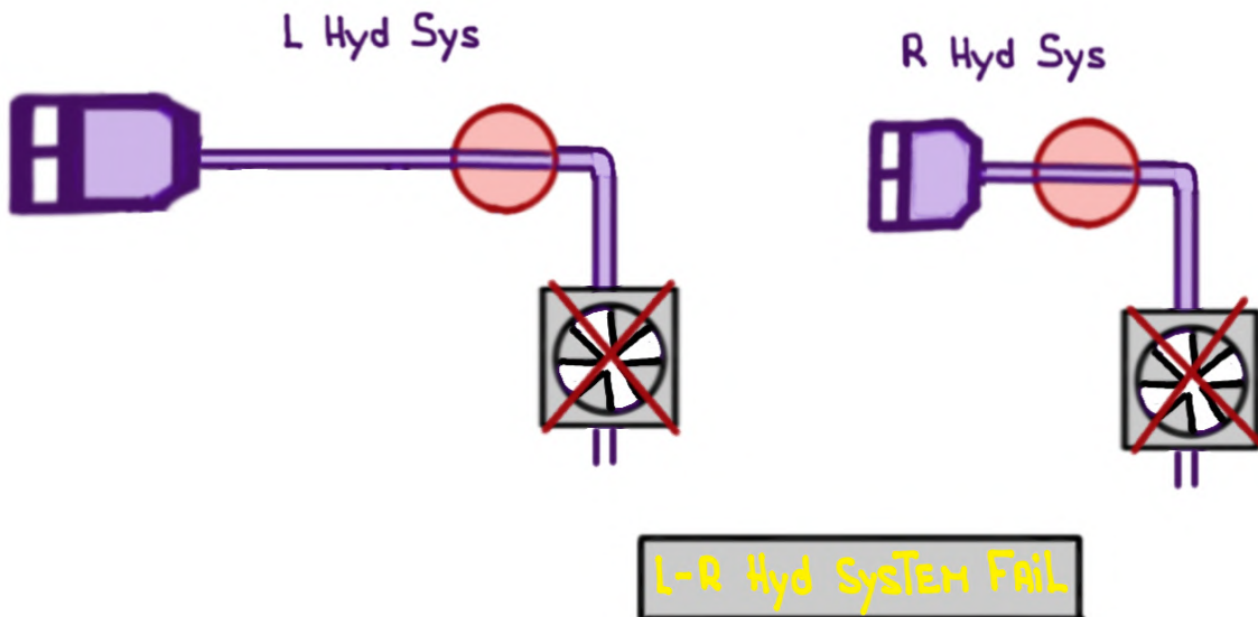


NORMALLY INACTIVE in flight BUT will power **ON** AUTOMATICALLY FOR THE OPERATION of landing gear AND flaps

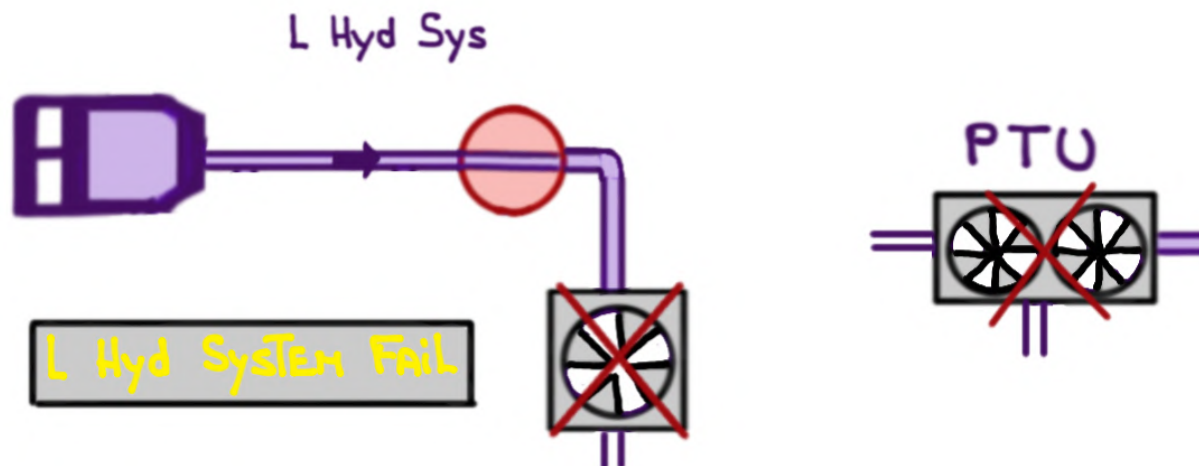
① DUAL ENGINE FAILURE



② DUAL ENGINE-DRIVEN PUMP FAILURE



③ LEFT ENGINE-driven Pump AND PTU FAILURE



- REQUIREMENTS FOR AUTO ON 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**

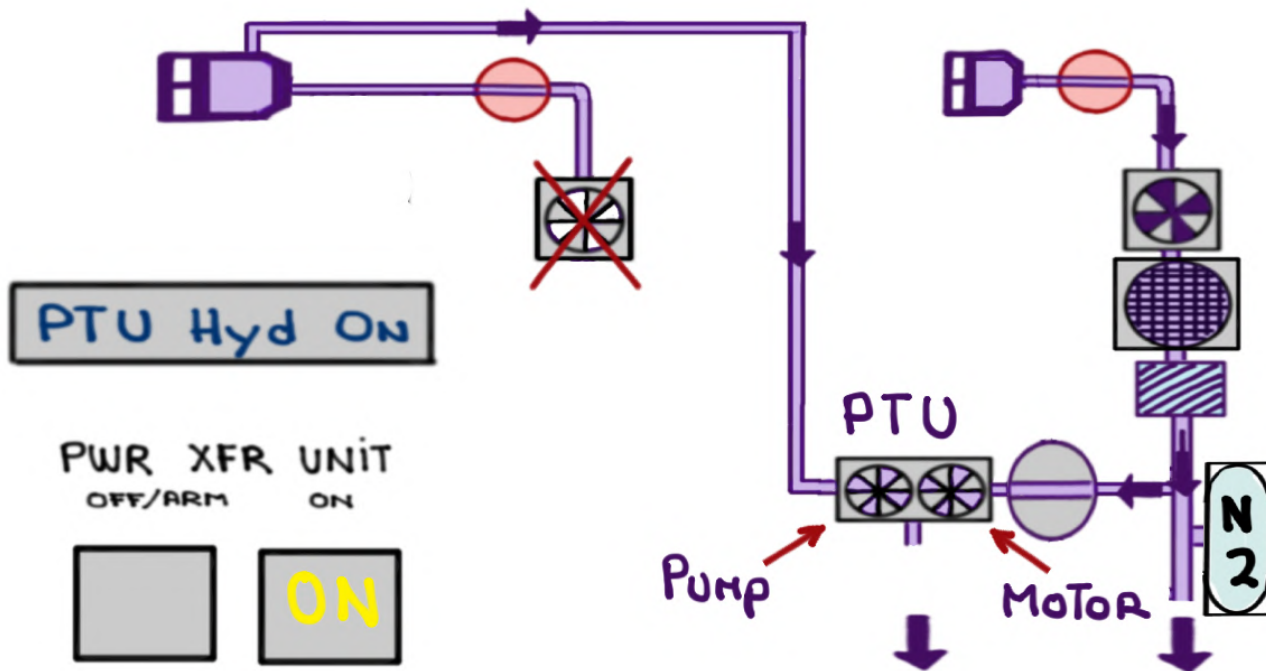
- OPERATION LIMITATIONS:

- 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
 - 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 Req'd

POWER TRANSFER UNIT (PTU)

- Back up To The LEFT Hydraulic System engine-driven pump (OPERATIONAL REDUNDANCY)



PTU

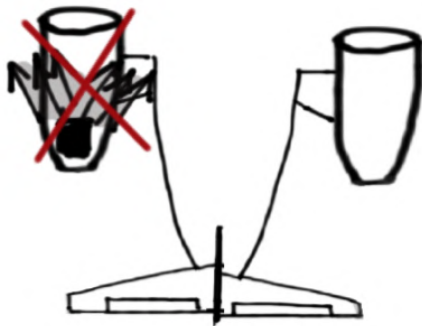
- The  is a MOTOR/PUMP ASSEMBLY

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

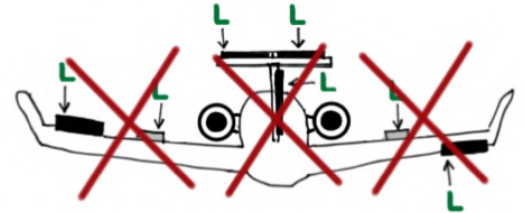
- IT COMES ON AUTOMATICALLY if L Hydraulic System PRESSURE is $< 2,400$ PSI

- IT CANNOT ACTUATE:

LEFT THRUST REVERSE



Flight Controls AND Mid spoilers



PTU

- The  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)

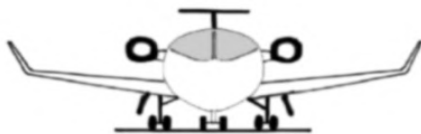
PTU = "Pick TIRES Up"

- IT USES:

- ① Right system PRESSURIZED fluid, AND
- ② LEFT SYSTEM fluid

- IT CAN ACTUATE:

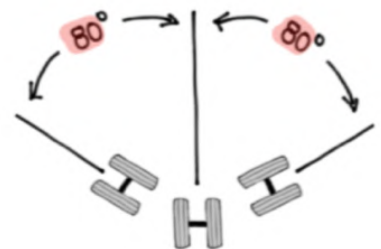
LANDING GEAR



FLAPS



NOSE WHEEL STEERING




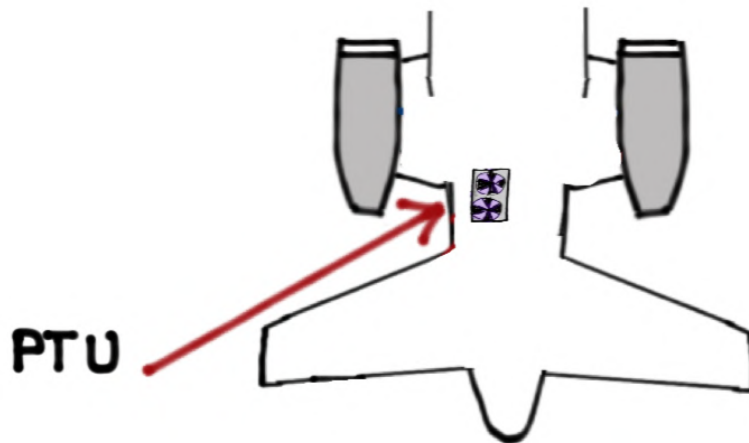
BRAKES



MAIN DOOR



- The **PTU**  is located in the Tail compartment

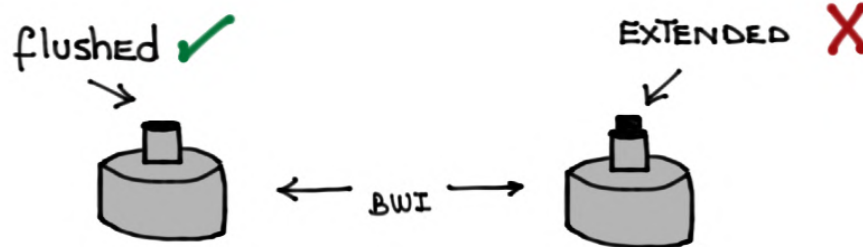


- When ARMED it has a SEVEN (7) second debounce. This means that it will run at least SEVEN (7) seconds to prevent intermittent operation with fluctuating Left System pressure.

DEACTIVATION:

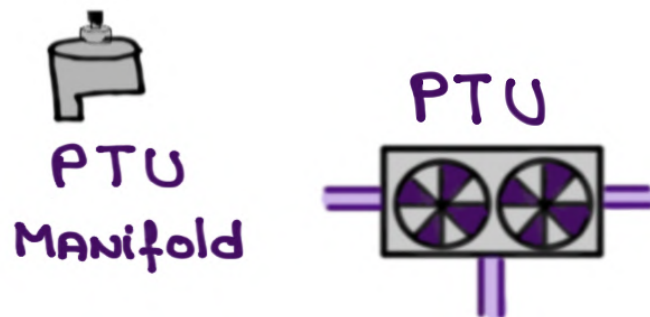
- ▶ SEVEN (7) seconds after Left System pressure recovers \geq 2,750 Psi
- ▶ Immediately if Right System pressure drops $<$ 2,849 Psi

- ONE ① BEARING WEAR INDICATOR (BWI)
- INSPECTED FOR CONDITION (flushed VERSUS EXTENDED) DURING THE EXTERIOR PREFLIGHT INSPECTION



IT CAN BE RESET by THE CREW

(AFM 02-01-20 EXTERIOR PREFLIGHT INSPECTION)

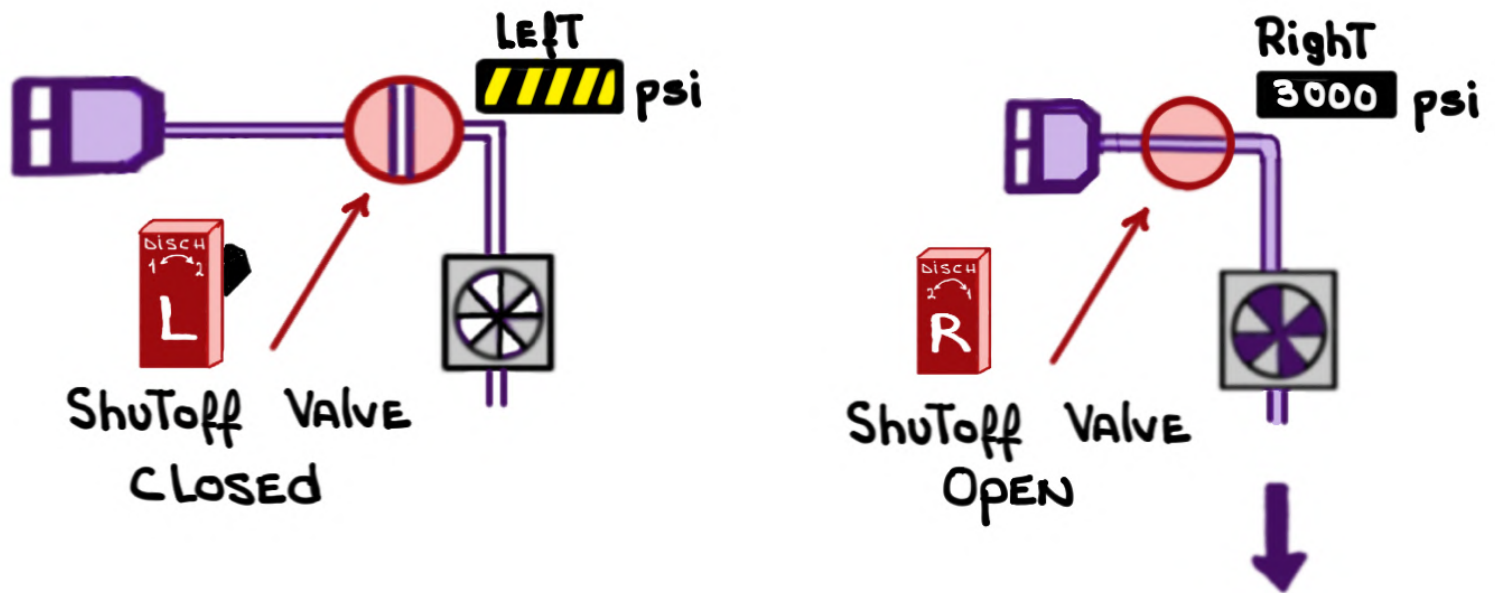


If EXTENDED:

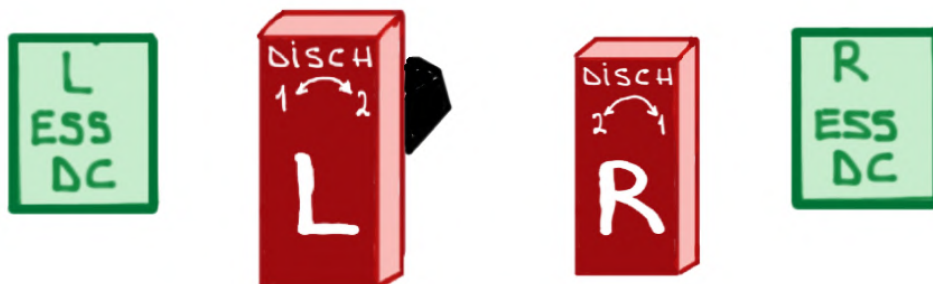
- ① RESET BWI
- ② MAKE AN ENTRY IN THE TECHLOG
- ③ CONTINUED OPERATION IS PERMITTED FOR fifty (50) HOURS

Hydraulic ShutOff VALVES

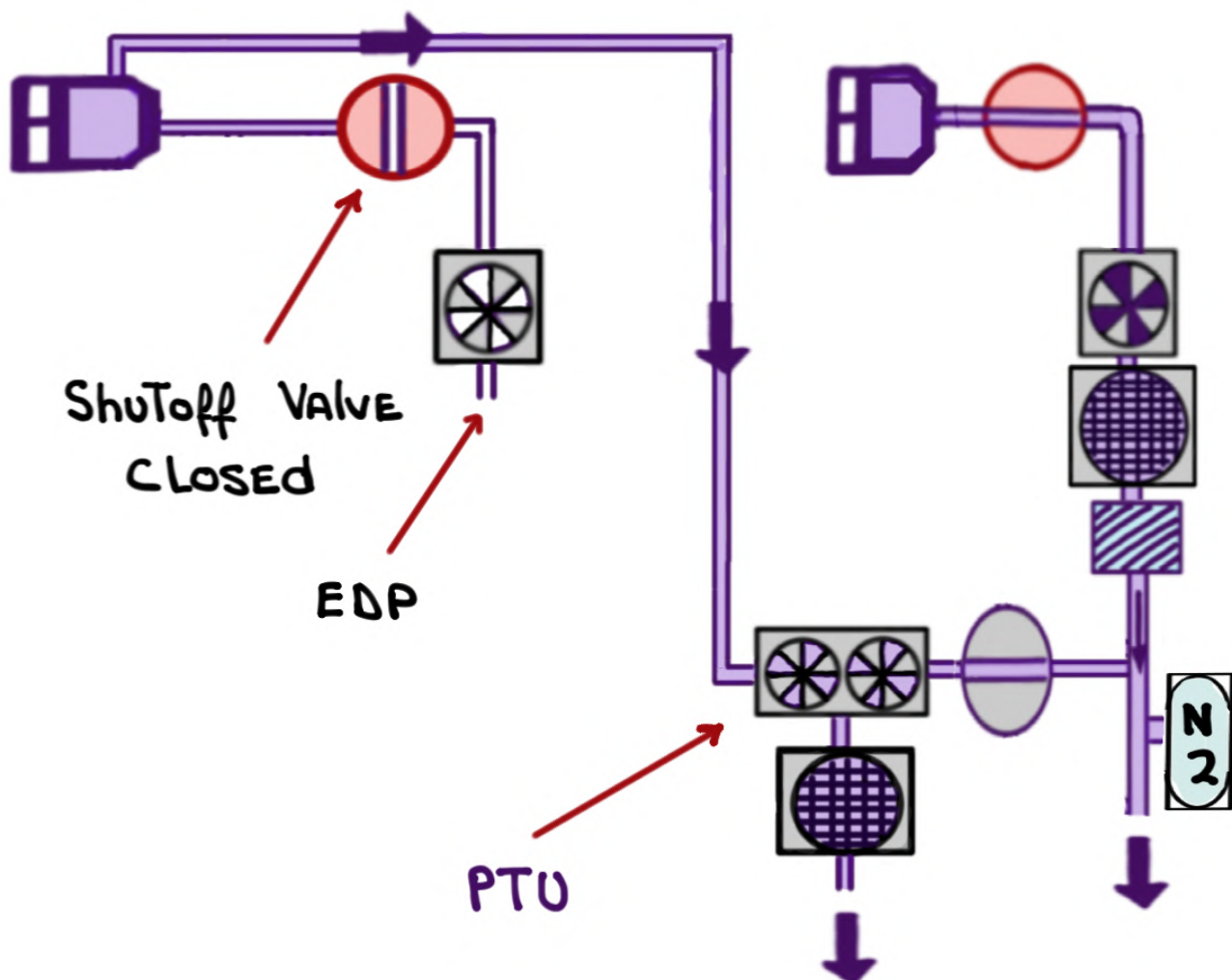
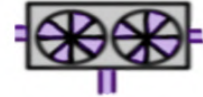
The hydraulic shutOff valves ARE located in The Tail compartment AND isolate The hydraulic fluid from The engine-driven pumps



The hydraulic shutOff valves ARE motor-operated AND ENERGIZED only when The **ENGINE fire handles** in The cockpit ARE pulled

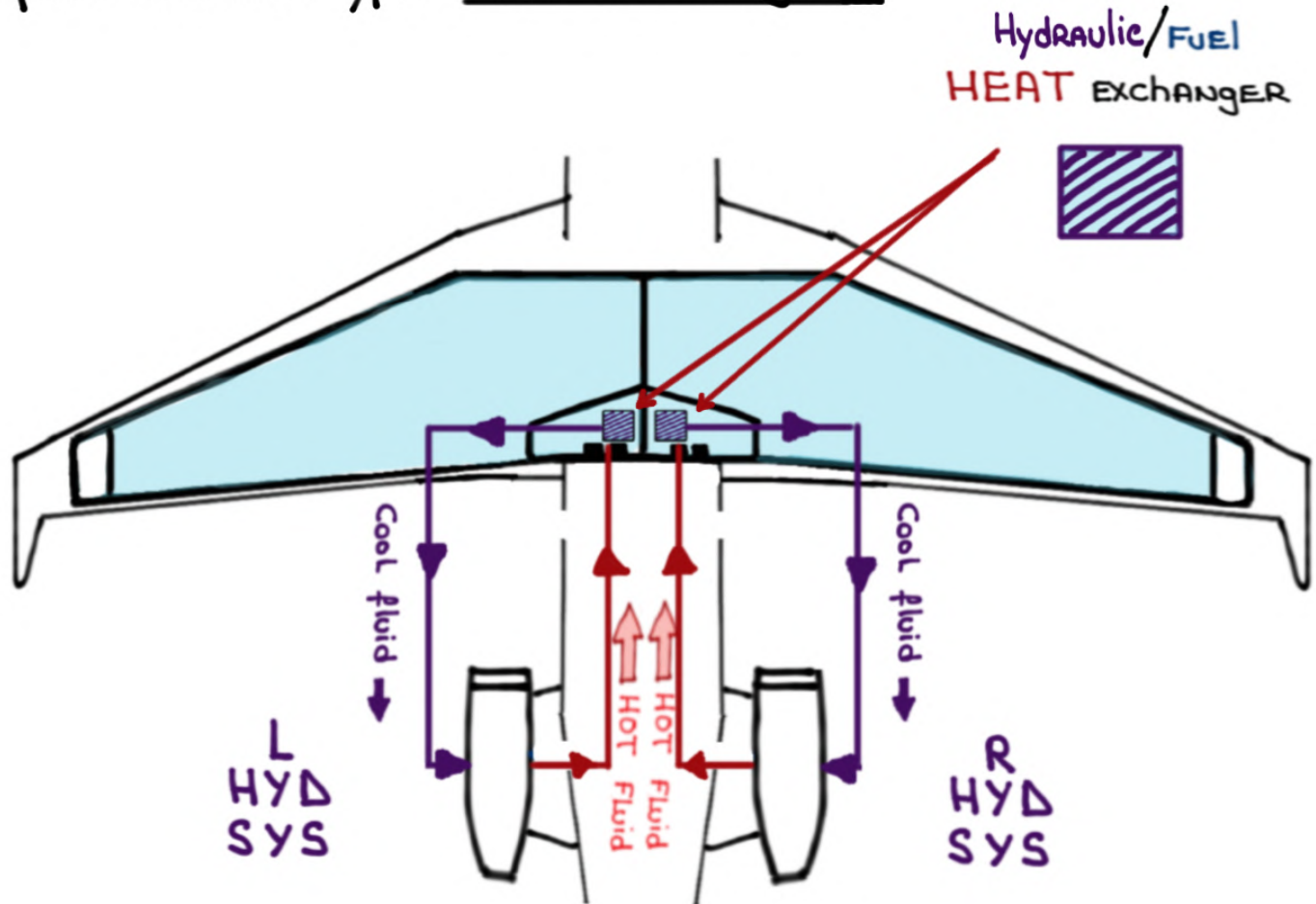


- Pulling The **LEFT FIRE HANDLE** does NOT shut off The supply of LEFT SYSTEM fluid To The PTU



Hydraulic fluid **HEAT** EXCHANGER

- The HOPPER TANKS CONTAIN THE Hydraulic fluid-To-fuel RADIATOR Type HEAT EXCHANGERS



The HEAT EXCHANGER UNIT is INSIDE THE ONSIDE fuel Hopper. **HOT** hydraulic fluid flows CONTINUOUSLY THROUGH THE HEAT EXCHANGER 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

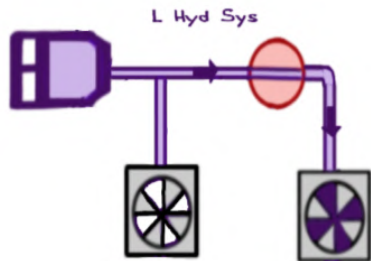
① FAILURE OCCURS WITHIN ONE (1) HOUR AFTER
TAKEOFF:

- MAXIMUM ALTITUDE: 27,000'
- LAND WITHIN ONE AND A HALF (1 1/2) HOURS
AFTER hydraulic failure

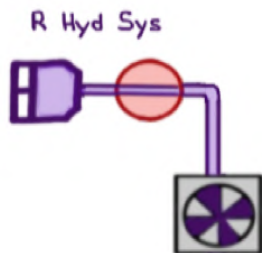
② FAILURE OCCURS MORE THAN ONE (1) HOUR AFTER
TAKEOFF:

- LAND WITHIN NINE (9) HOURS AFTER 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 \pm 300
-

AUX Hyd Syst
Pump output

- 2 gallons per minute
 - 3,000 Psi \pm 300
-

PTU Hyd Syst
Pump output

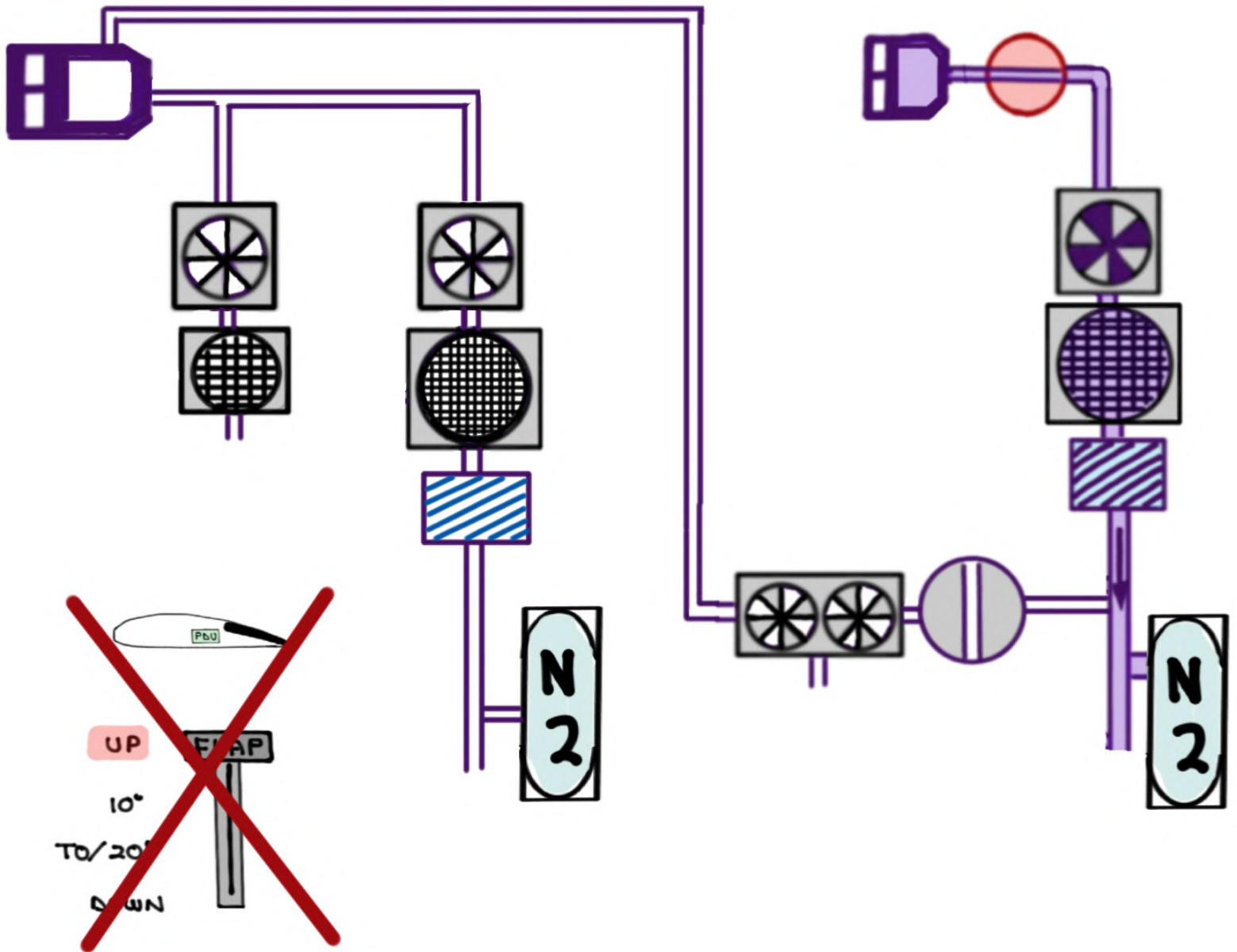
- 22 gallons per minute
 - 3,000 Psi + 300 / - 400
-

L And R Hyd Syst Accumulator Precharge

1,200 Psi @ 70°F

L Hyd SYSTEM Fail

LEFT Hydraulic SYSTEM

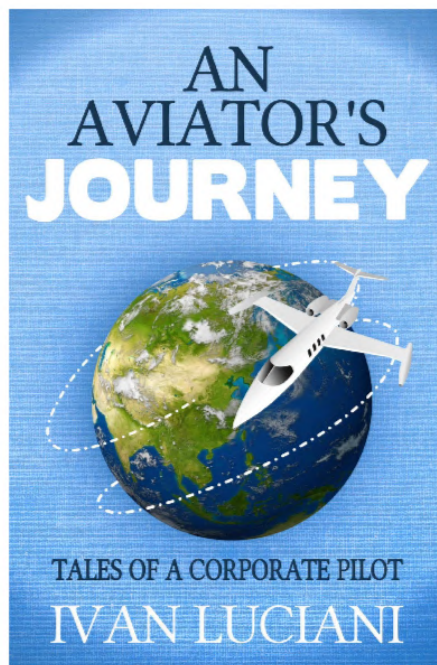


FLAPS ARE NOT AVAILABLE. With any flight control surface failure a "PAN, PAN" is required

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@code7700.com



Thank you!