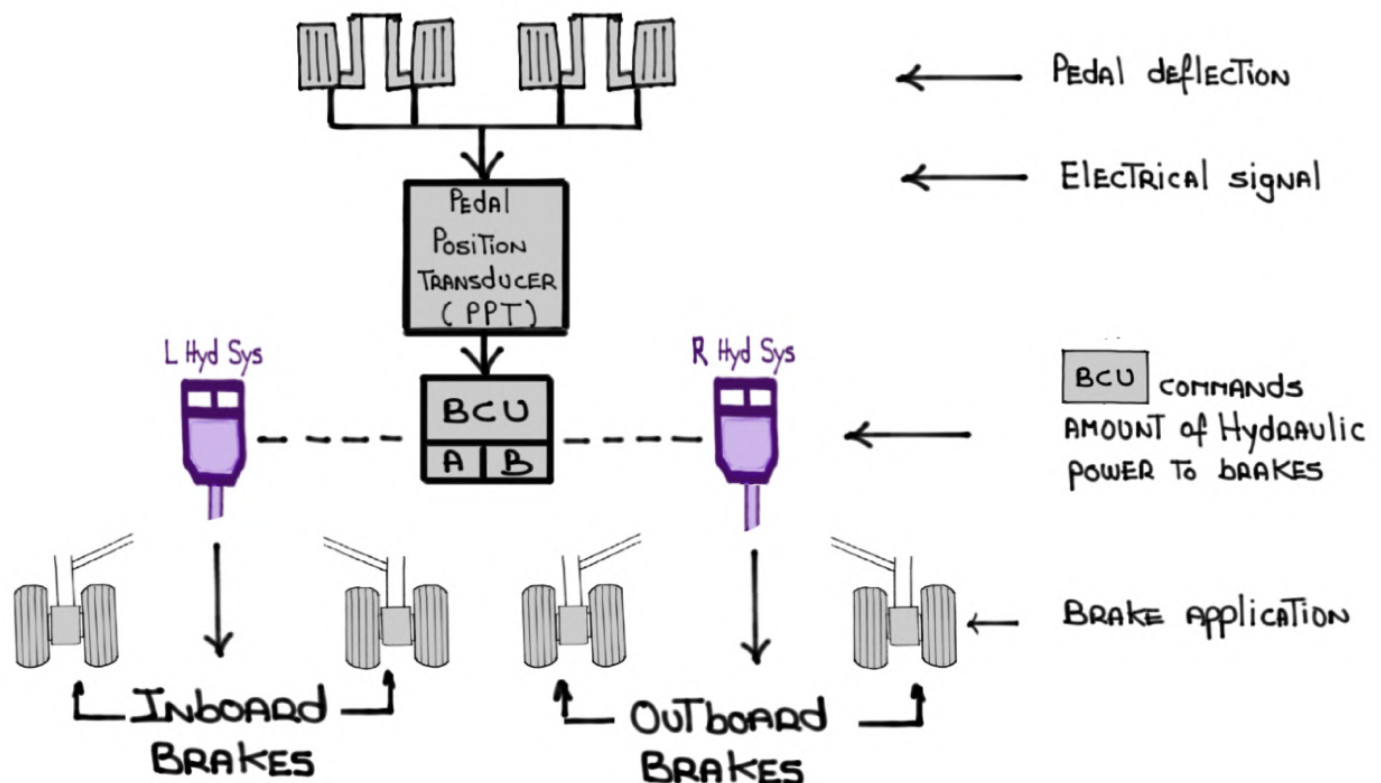


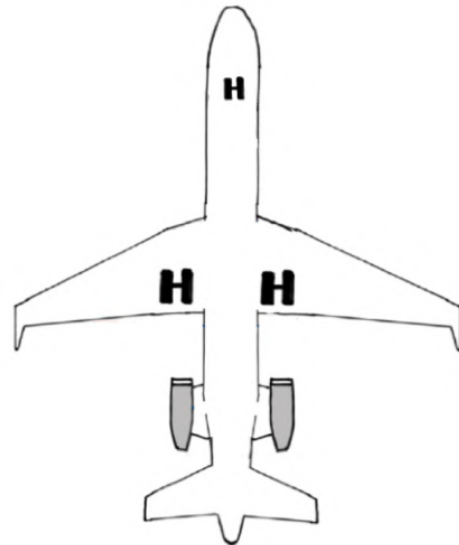
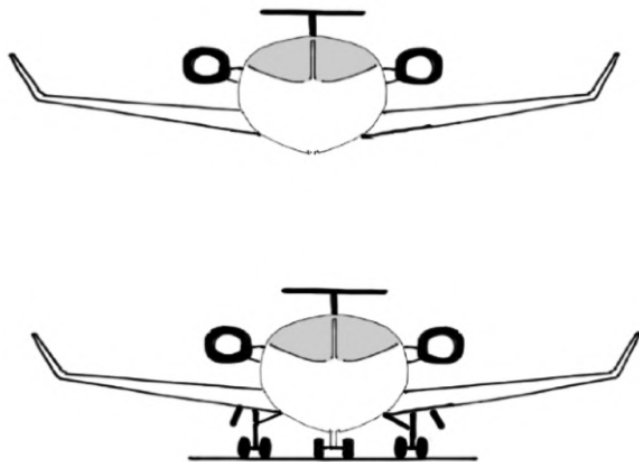
# G650

## LANDING GEAR & BRAKES SYSTEM



For study purposes only

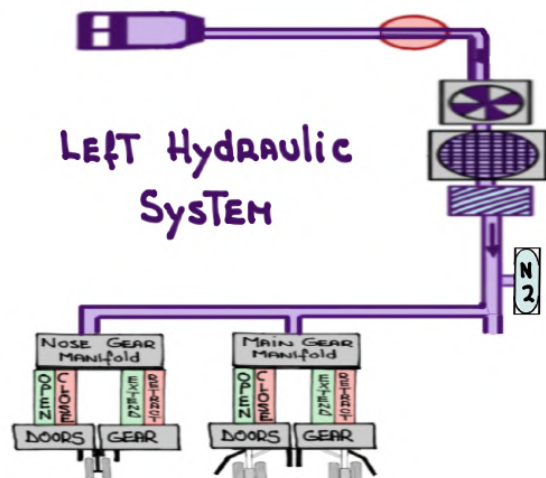
- Fully RETRACTABLE Tricycle landing gear



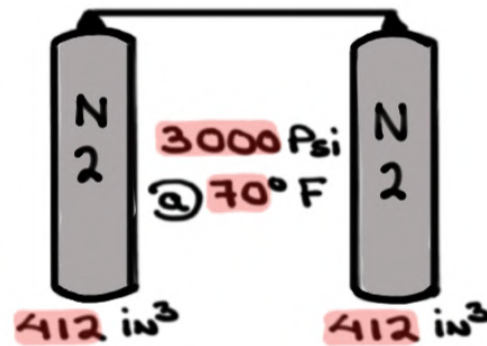
- SEQUENCING AND OPERATION of gear and gear doors ARE controlled by a MICROPROCESSOR called THE LANDING GEAR CONTROL UNIT (LGCU)

LGCU

- The landing gear is ELECTRICALLY controlled/SEQUENCED AND HYDRAULICALLY OPERATED

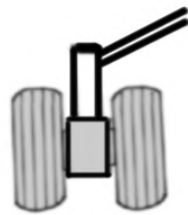


- If **hydraulic** pressure is NOT available the landing gear can be extended via compressed nitrogen stored in two **(2)** bottles located in the nose wheel well

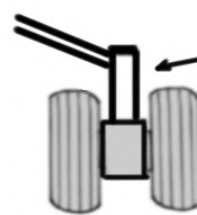


- Each gear incorporates a conventional oleo-pneumatic shock strut with dual wheels and tires

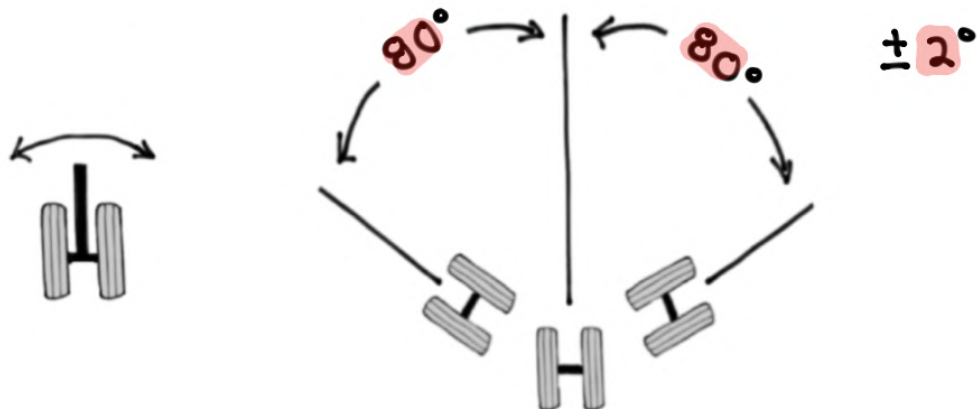
Tires:  
Nitrogen



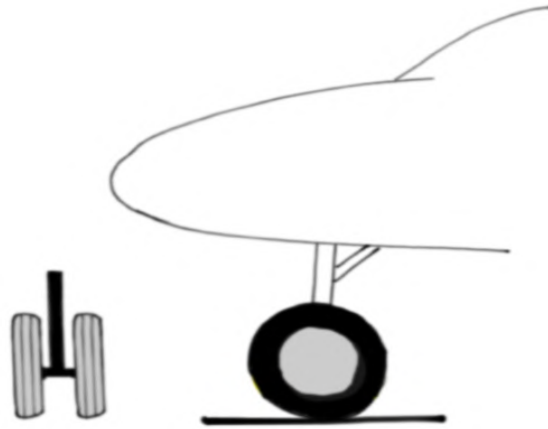
Struts:  
MIL-H-5606



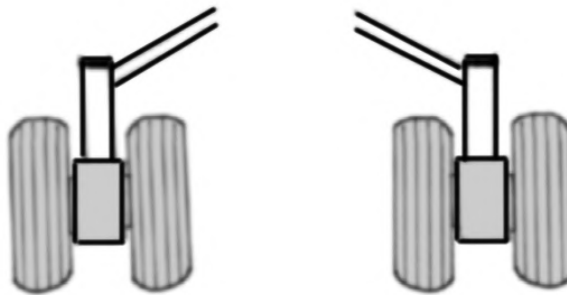
- The nose gear steering system is **Electrically** controlled and **hydraulically** driven by a STEER-by-wire system



- ONE SET of Two (2) NOSE wheel TIRES (GoodyEAR)



- Two SETs of Two (2) MAIN TIRES EACH (GoodyEAR)



- RATED AT: 195 KTs (GROUND SPEED)
- TIRE PRESSURE: 216 Psi + 2 (All weights)

MEASURED WHEN THE AIRCRAFT HAS BEEN STATIONARY  
FOR AT LEAST TWO (2) HOURS

- LANDINGS: APPROXIMATELY 220



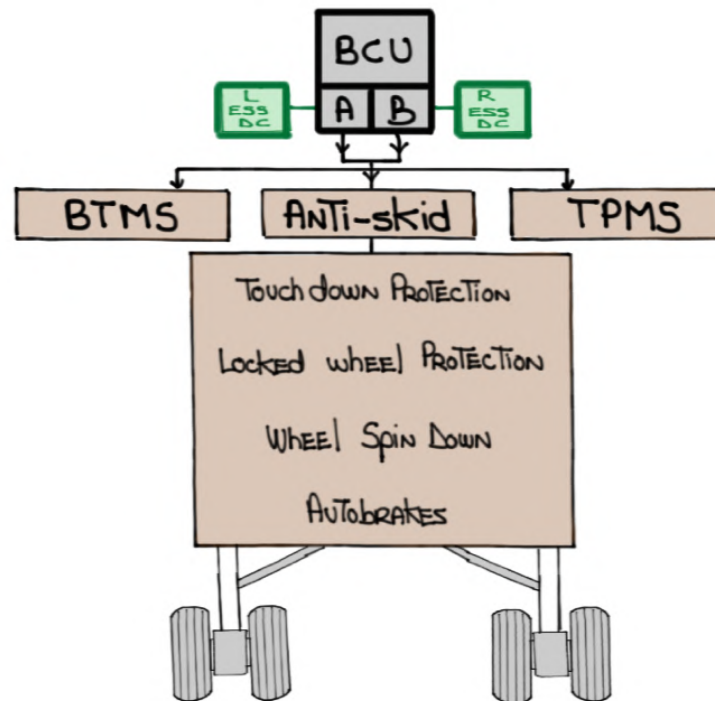
## Nose Tires and wheels:

- A) Nose Wheel Tires are designed to deflect water away from the fuselage and the engine inlets
- B) Each wheel has one (1) safety plug to deflate the tire if the internal pressure exceeds  $375 \pm 25$  psi due to over inflation of the tires

## Main Tires and wheels:

- A) Each wheel has one (1) fusible plug to deflate the tire if the internal temperature exceeds  $415^{\circ}\text{F}$  due to over heated wheel brakes
- B) Each wheel has one (1) safety plug to deflate the tire if the internal pressure exceeds  $515$  psi  $\pm 40$  due to over inflation of the tires
- C) Each wheel has individual braking via a brake-by-wire system with anti-skid protection down to ten (10) knots

- Each of The four (4) main gear wheels has individual braking via a BRAKE-by-WIRE system

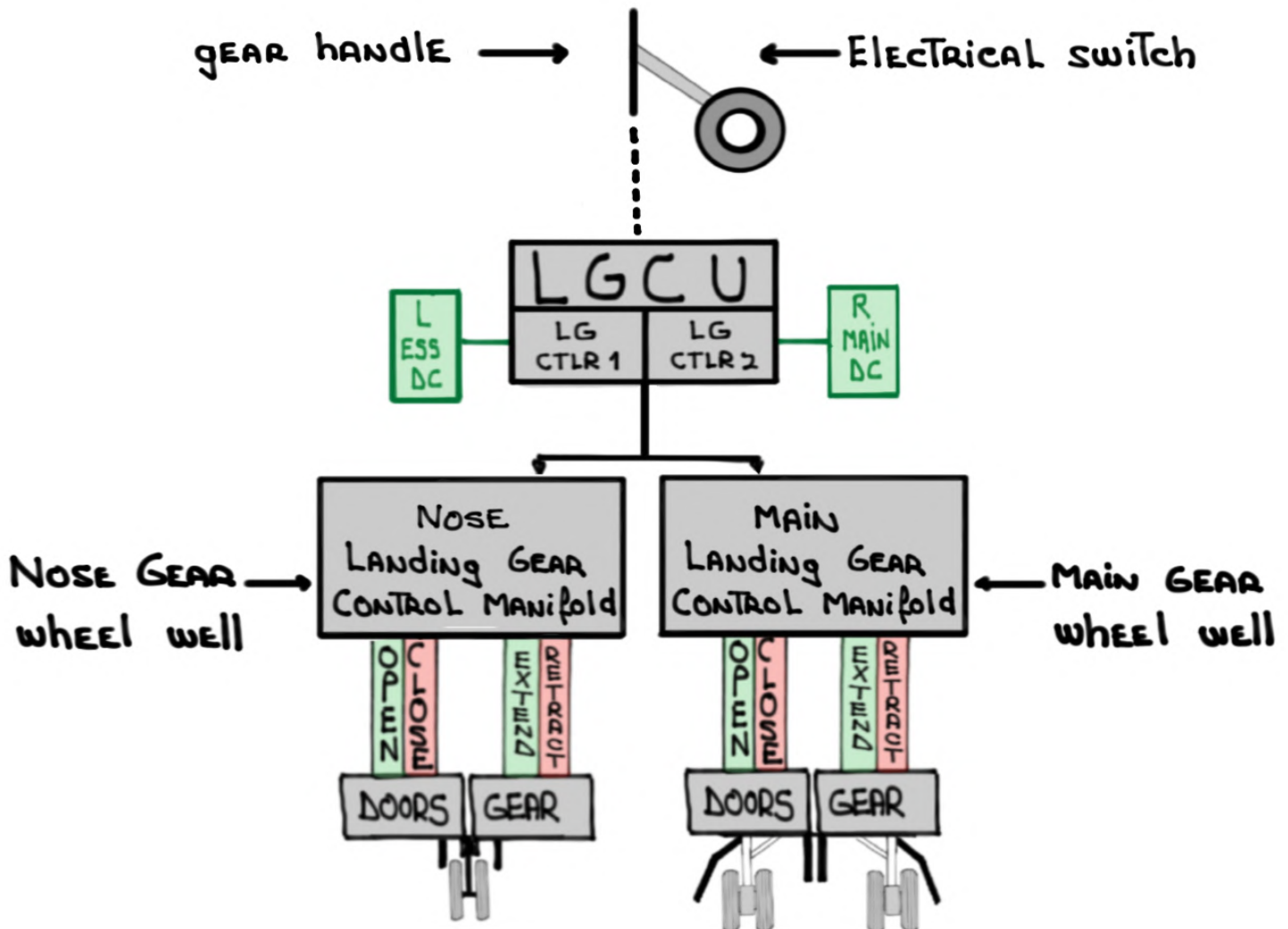


- Proximity sensors provide:
  - WOW Air or Ground mode status
  - Gear position
  - Gear door position
- A Landing Gear Maintenance Control Panel (LGMCP) allows retraction/extension of the landing gear on the ground while the aircraft is on jacks. The LGMCP can also be used to open the gear doors during the preflight inspection

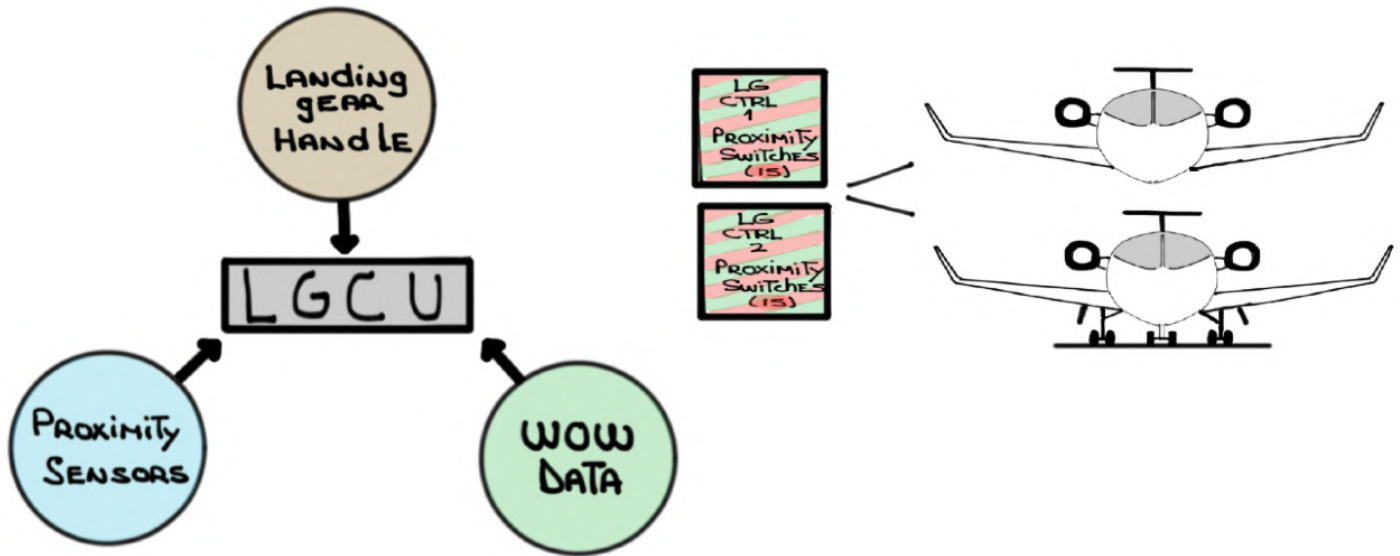


# LANDING GEAR CONTROL UNIT (LGCU)

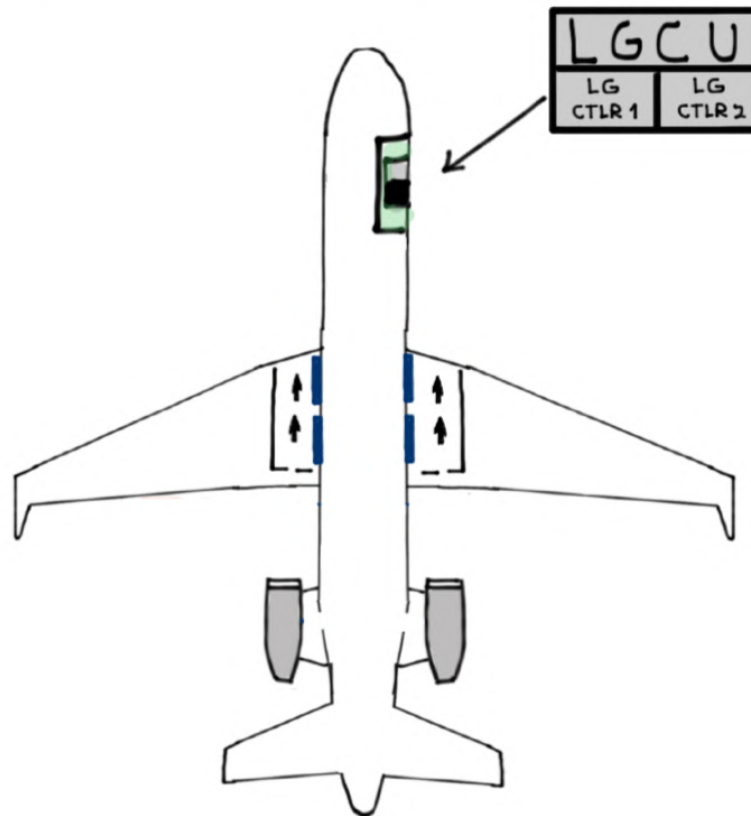
- The LGCU is the brains of the system
- The LGCU controls the electrical sequencing and operation of the landing gear and gear doors
- The LGCU contains two (2) control lanes and one (1) monitor lane. Either control lane is capable of controlling the landing gear system and has a different power source



- The LGCU RECEIVES input from:



- The LGCU is located in the REER





- EXTENSION AND RETRACTION REQUIRES:

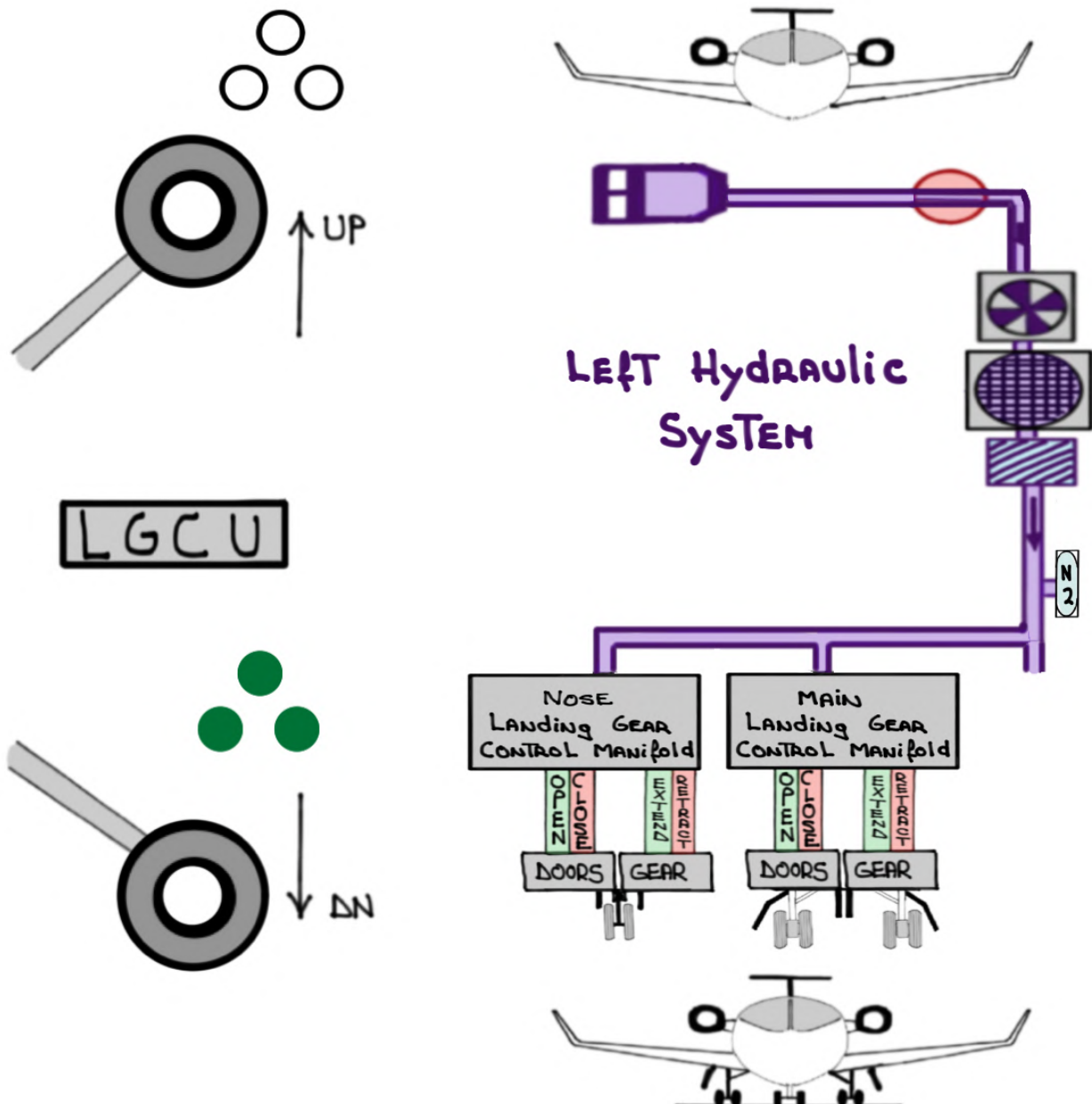
① ELECTRICAL power TO OPERATE

L  
ESS  
DC

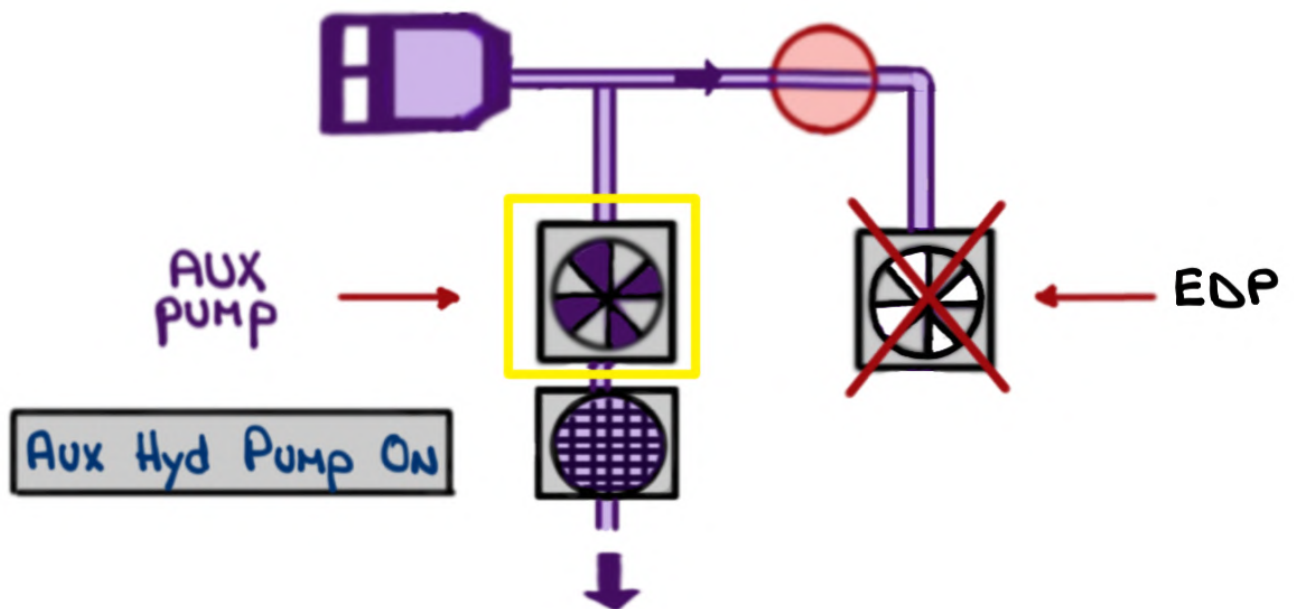
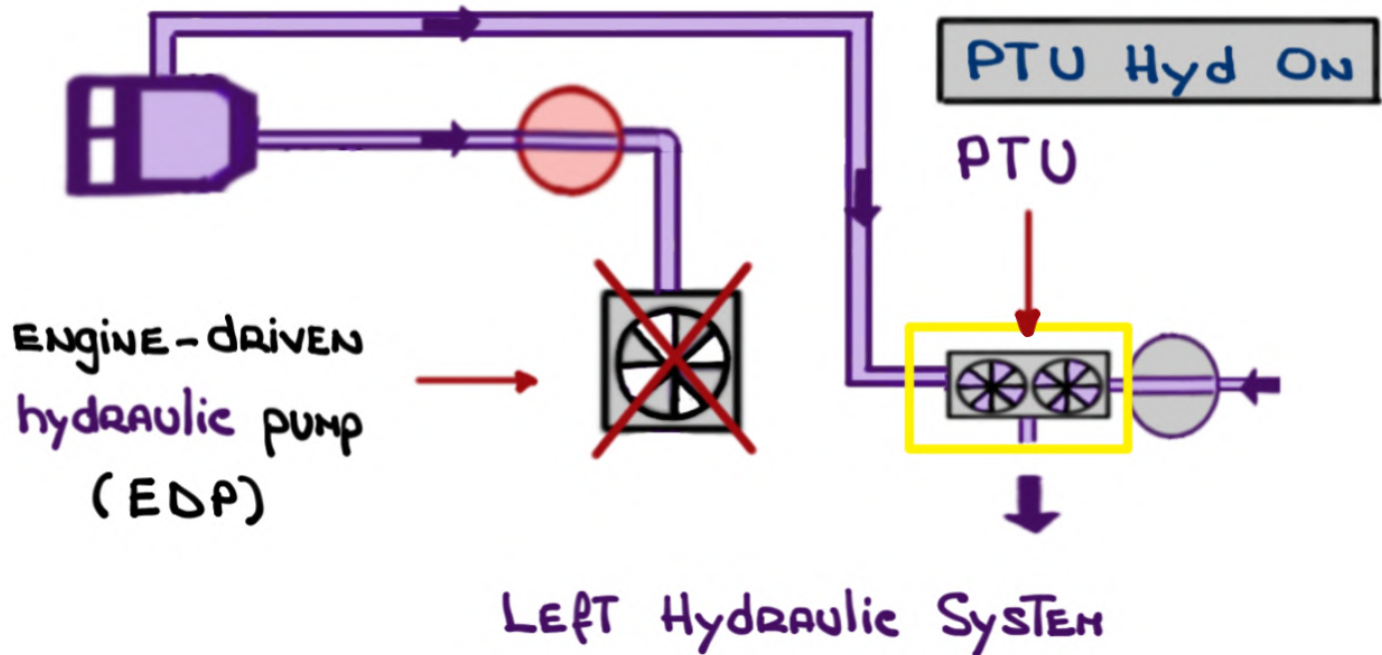
R  
MAIN  
DC

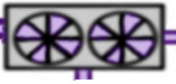
② HYDRAULIC PRESSURE TO ACTUATE

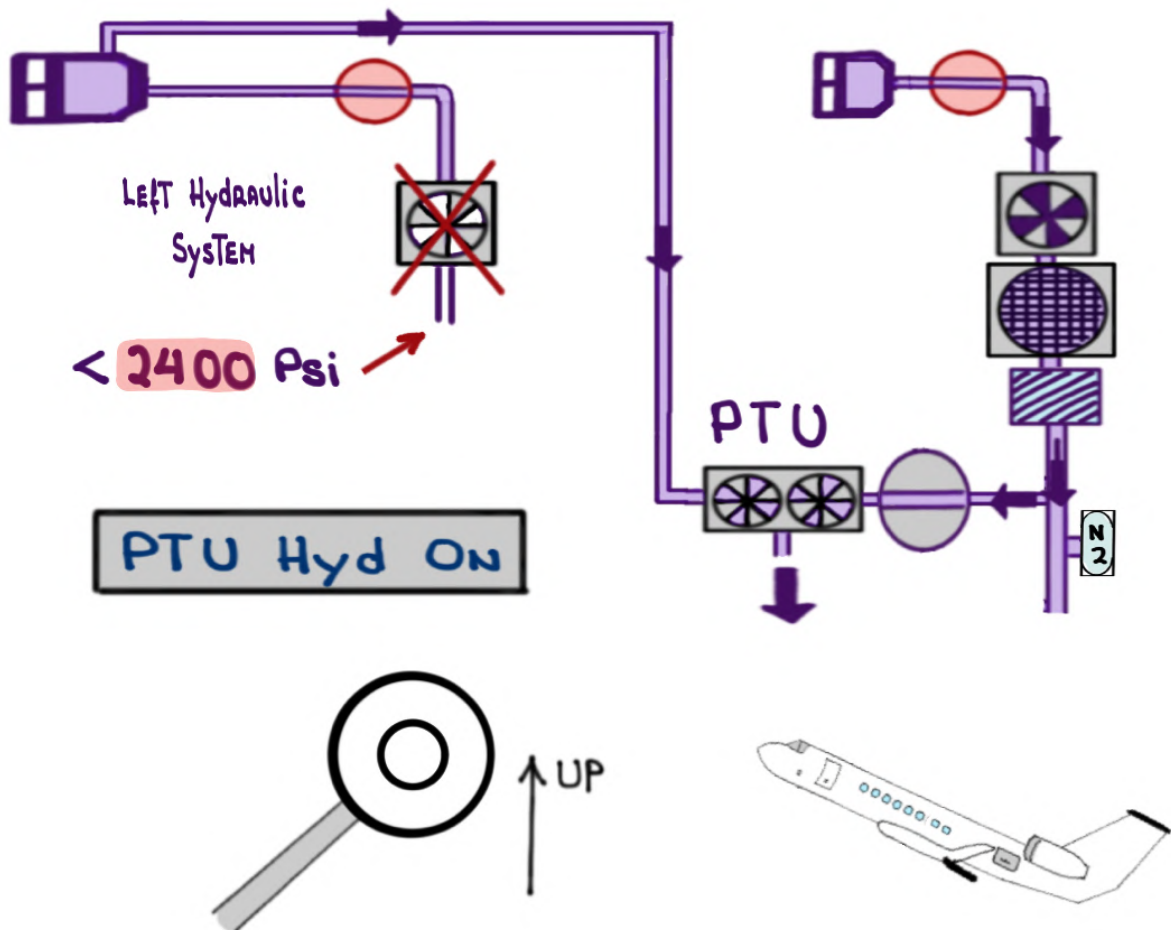
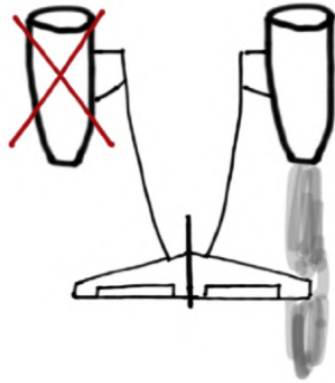
NORMALLY PROVIDED BY THE LEFT HYDRAULIC SYSTEM



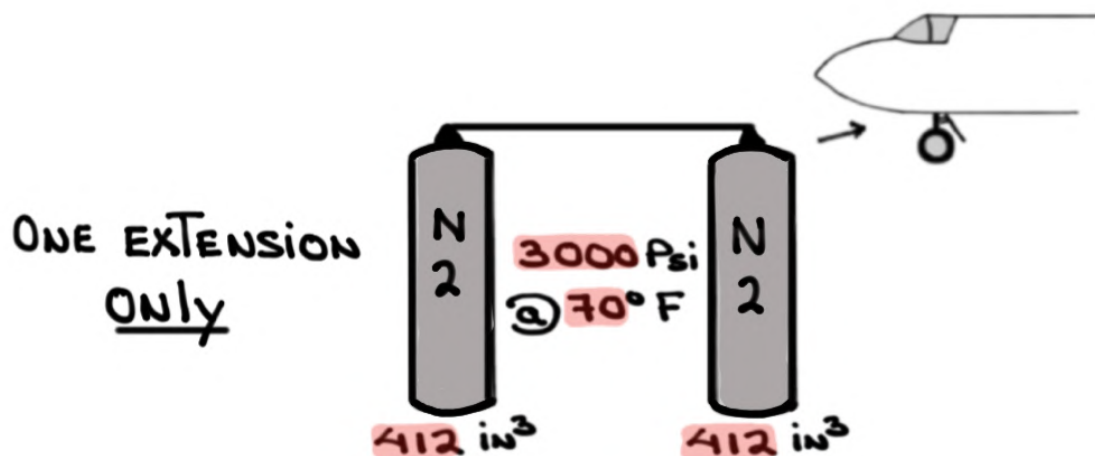
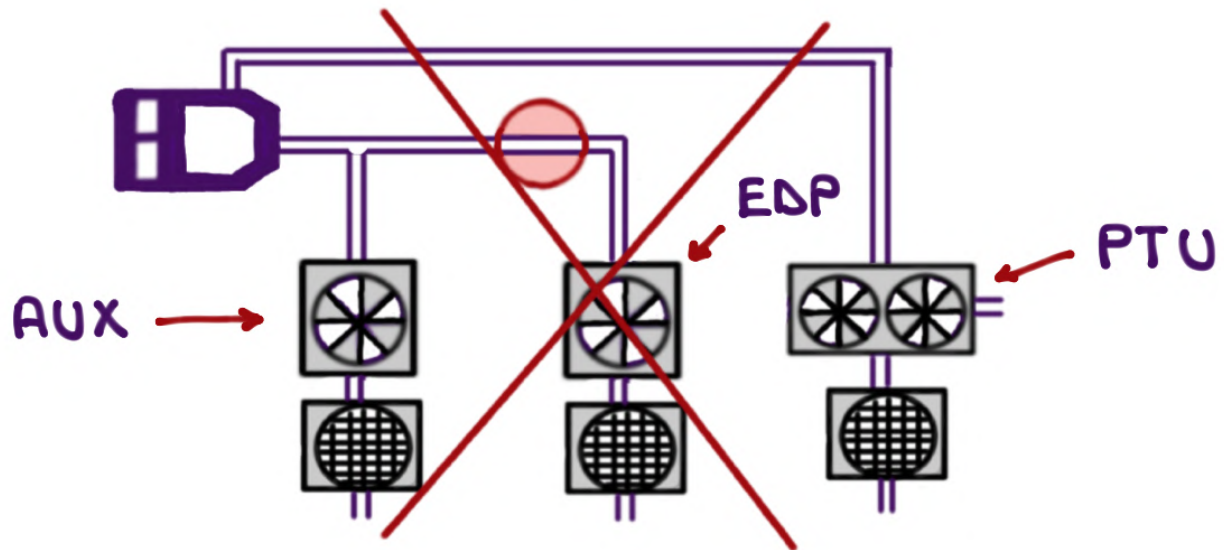
- In the event of failure of the engine-driven hydraulic pump The landing gear can be extended or retracted by the PTU or AUX pumps



- The **PTU**  ACTIVATES AUTOMATICALLY (< **2400** psi) AND helps RETRACT THE landing gear following a LEFT ENGINE FAILURE AFTER V<sub>1</sub> (REGULATORY REQUIREMENT)



- In The EVENT of TOTAL failure of The **LEFT Hydraulic System** The landing gear can be EXTENDED via Two (2) NITROGEN bottles located in The NOSE gear wheel well

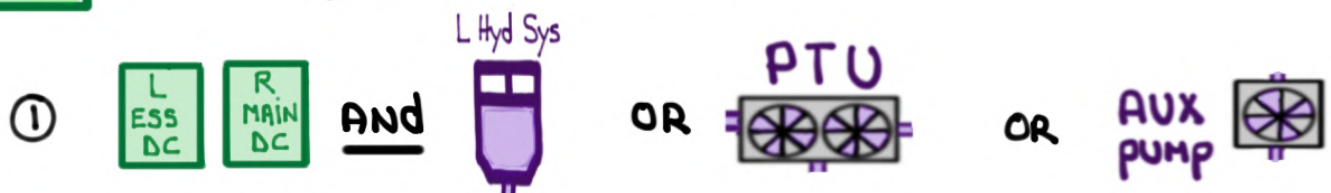


- The ALTERNATE GEAR EXTENSION SYSTEM PORTS high PRESSURE NITROGEN To The GEAR EXTENSION SYSTEM To EXTEND The GEAR. The NITROGEN REPOSITIONS The NOSE AND MAIN GEAR dump valves To a dump position

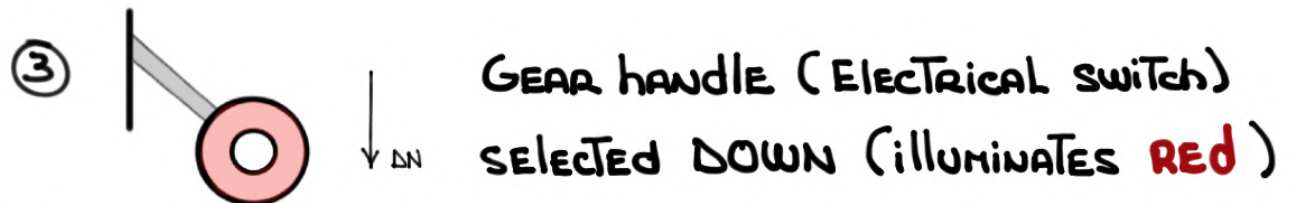


# NORMAL

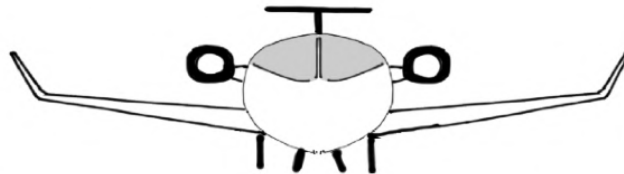
## LANDING GEAR EXTENSION



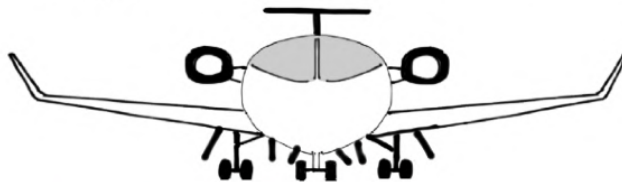
②  $\leq V_{LO}$  (225 KCAS)



④ GEAR doors open fully

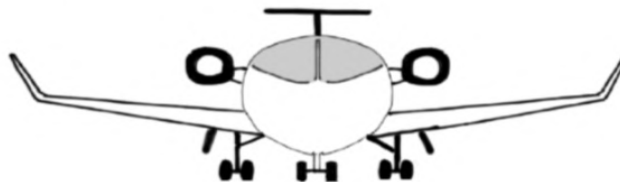


⑤ LANDING GEAR EXTENDS AND LOCKS

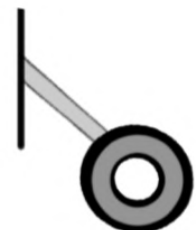


⑥ THREE GREEN  (DOWN AND LOCKED)

⑦ LANDING GEAR doors close

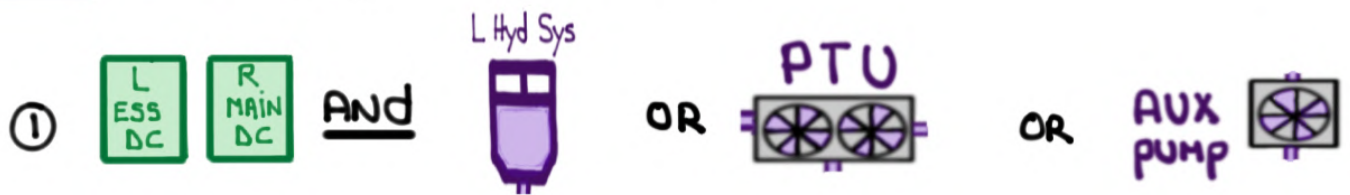


⑧ GEAR handle light EXTINGUISHES

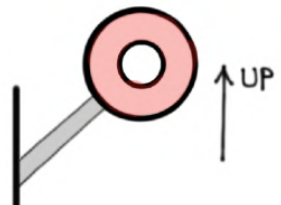


# NORMAL

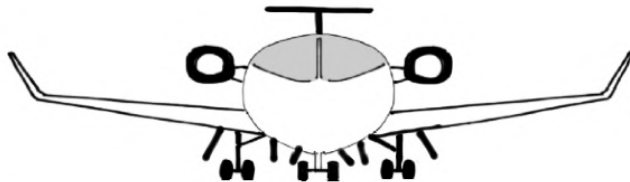
## LANDING GEAR RETRACTION



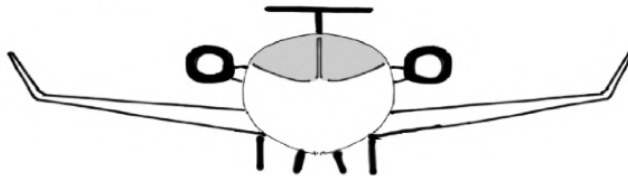
②  $\leq V_{LO}$  (225 KCAS)

③  GEAR HANDLE (ELECTRICAL SWITCH)  
SELECTED UP (ILLUMINATES RED)

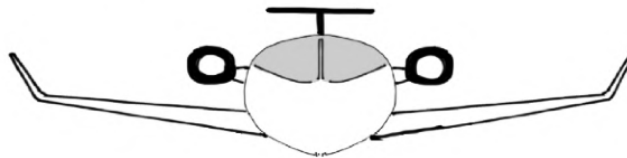
④ GEAR DOORS OPEN FULLY



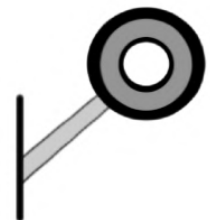
⑤ LANDING GEAR RETRACTS INTO THE UPLOCKS



⑥ LANDING GEAR DOORS CLOSE



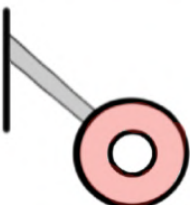
⑦ GEAR HANDLE LIGHT EXTINGUISHES



# ALTERNATE

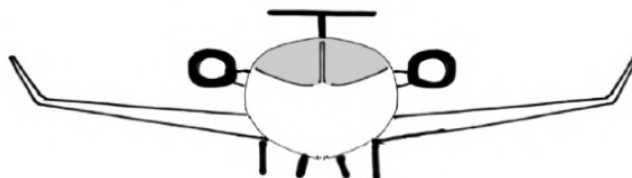
## LANDING GEAR EXTENSION (NITROGEN)

①  $\leq 175$  KCAS

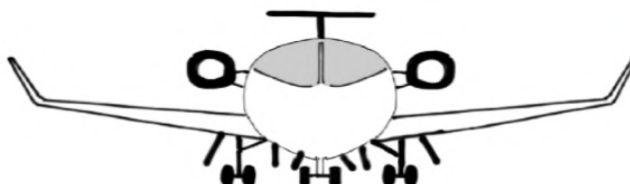
②  GEAR handle (ELECTRICAL switch)  
SELECTED DOWN (ILLUMINATES RED)

③  Pull EMER LDG GEAR handle

④ GEAR doors open fully AND REMAIN OPEN



⑤ LANDING GEAR EXTENDS IN SIX (6) SECONDS



⑥ THREE GREEN  (DOWN AND LOCKED)

⑦ GEAR handle light EXTINGUISHES

⑧ LANDING gear doors REMAIN OPEN



NOSE GEAR DOOR OPEN

L-R MAIN GEAR DOOR OPEN

# LANDING GEAR WARNINGS

- < 500' AGL
- < 190 KTS



"Too low, gear"

VOICE  
ORIDE



= SILENCES AURAL WARNING

- Flaps < 22°
- < 350' AGL
- NEAR idle



GEAR UNSAFE  
WARNING HORN  
will sound  
(KLAXON TONE)

HORN  
SILENCE



= SILENCES AURAL WARNING

Flaps > 22°



GEAR UNSAFE  
WARNING HORN  
will sound  
(KLAXON TONE)

HORN  
SILENCE



= Will NOT SILENCE  
WARNING HORN



# Limitations

Maximum altitude to extend the landing gear or fly with the gear extended: 20,000'

EMER LG GEAR

175 KCAS



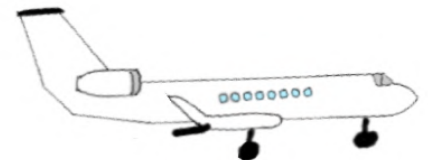
V<sub>LO</sub>

225 KCAS

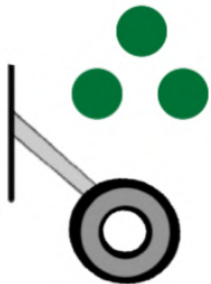


V<sub>LE</sub>

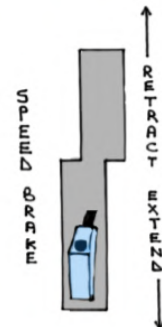
250 KCAS



Speed brakes AND gear down in flight



prohibited



Maximum Tire Speed: 195 knots (ground speed)



# NOSE WHEEL STEERING SYSTEM (NWS)



ELECTRICALLY - CONTROLLED



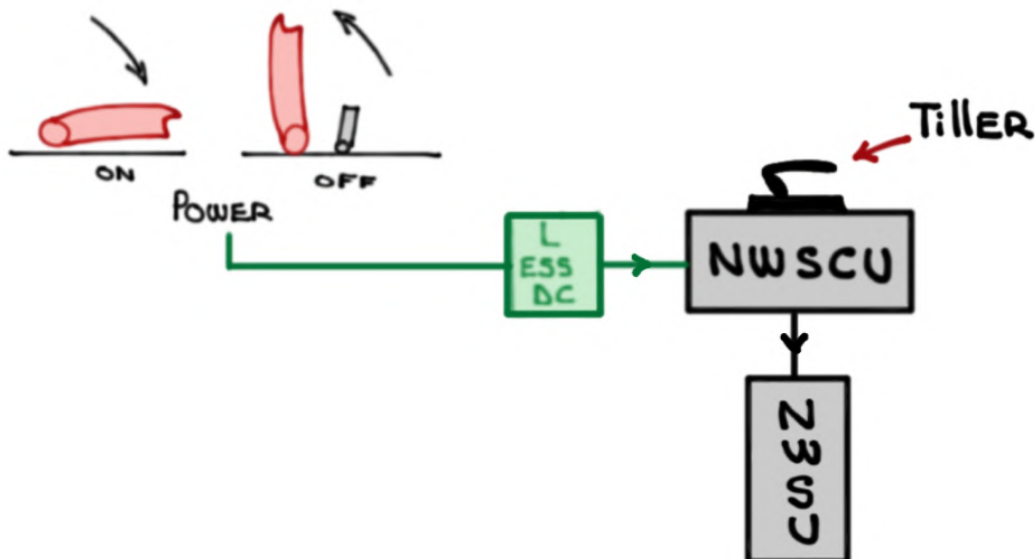
HYDRAULICALLY - DRIVEN



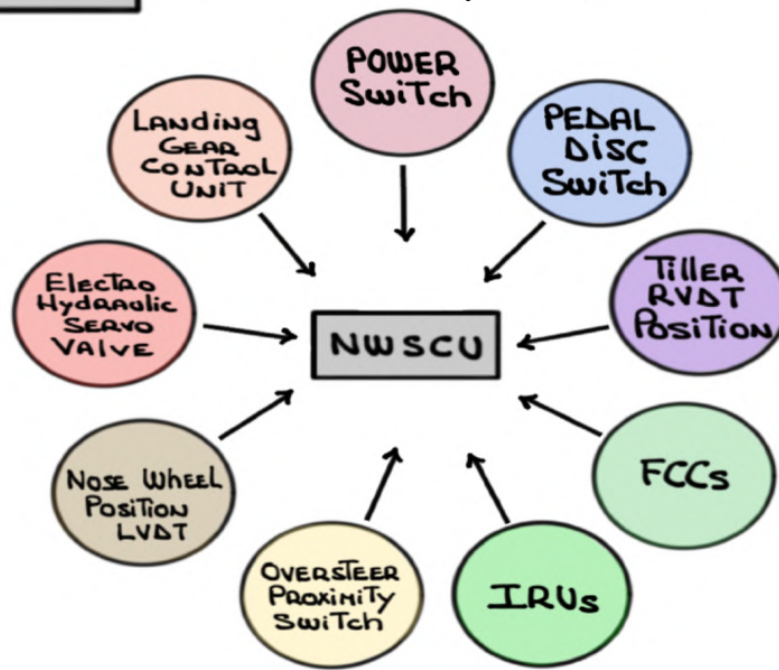
MECHANICALLY - ACTUATED

by a STEER-by-WIRE SYSTEM

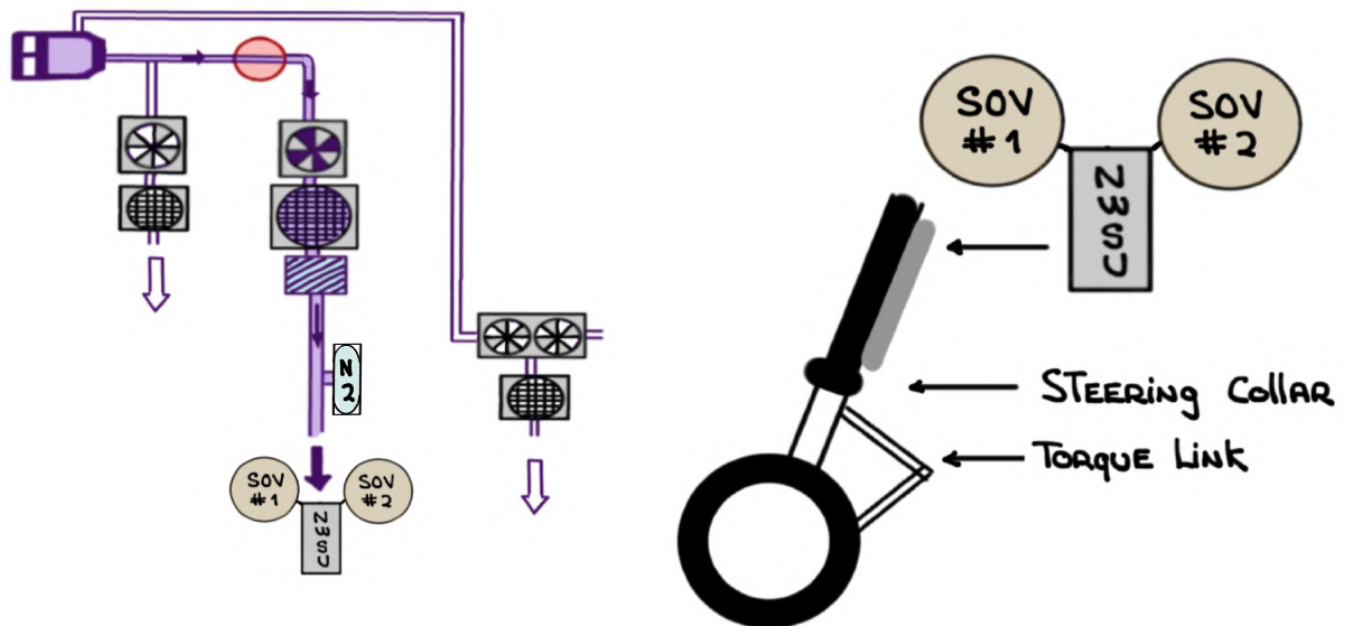
- The NOSE WHEEL STEERING CONTROL Unit (NWSCU) is a MICROPROCESSOR-BASED CONTROL UNIT LOCATED INSIDE THE CONTROL HOUSING PANEL
- The NWSCU is POWERED by 28 VDC
- PROVIDES STEER-by-WIRE inputs TO THE NOSE WHEEL STEERING Unit (NWSU)



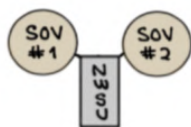
- The **NWSCU** RECEIVES input from:



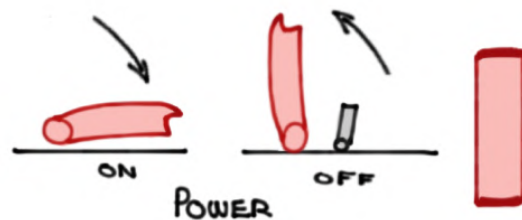
- The NOSE WHEEL STEERING Unit (NWSU) CONVERTS **hydraulic** PRESSURE INTO TORQUE TO ROTATE NOSE WHEELS VIA THE STEERING COLLAR WHICH TRANSFERS TORQUE TO THE TORQUE LINKS



- NWS = **RED** guarded switch  
"Clunks"



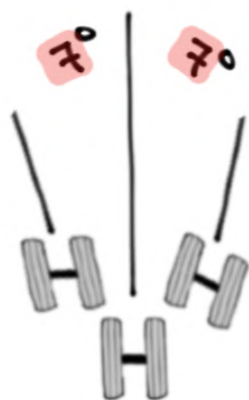
opening



- **SPEED SENSITIVE STEERING:**

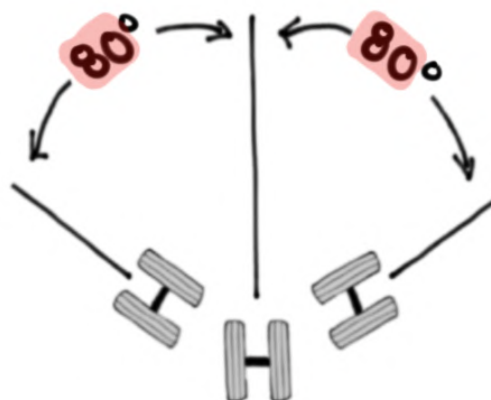
PEDAL STEERING:

Left **7°** / Right **7°**



TILLER STEERING:

**80° ± 2°**



- PEDAL STEERING (NWS FAILURE) = Left **16°** / Right **16°**
- PEDAL STEERING + TILLER STEERING = NW deflection

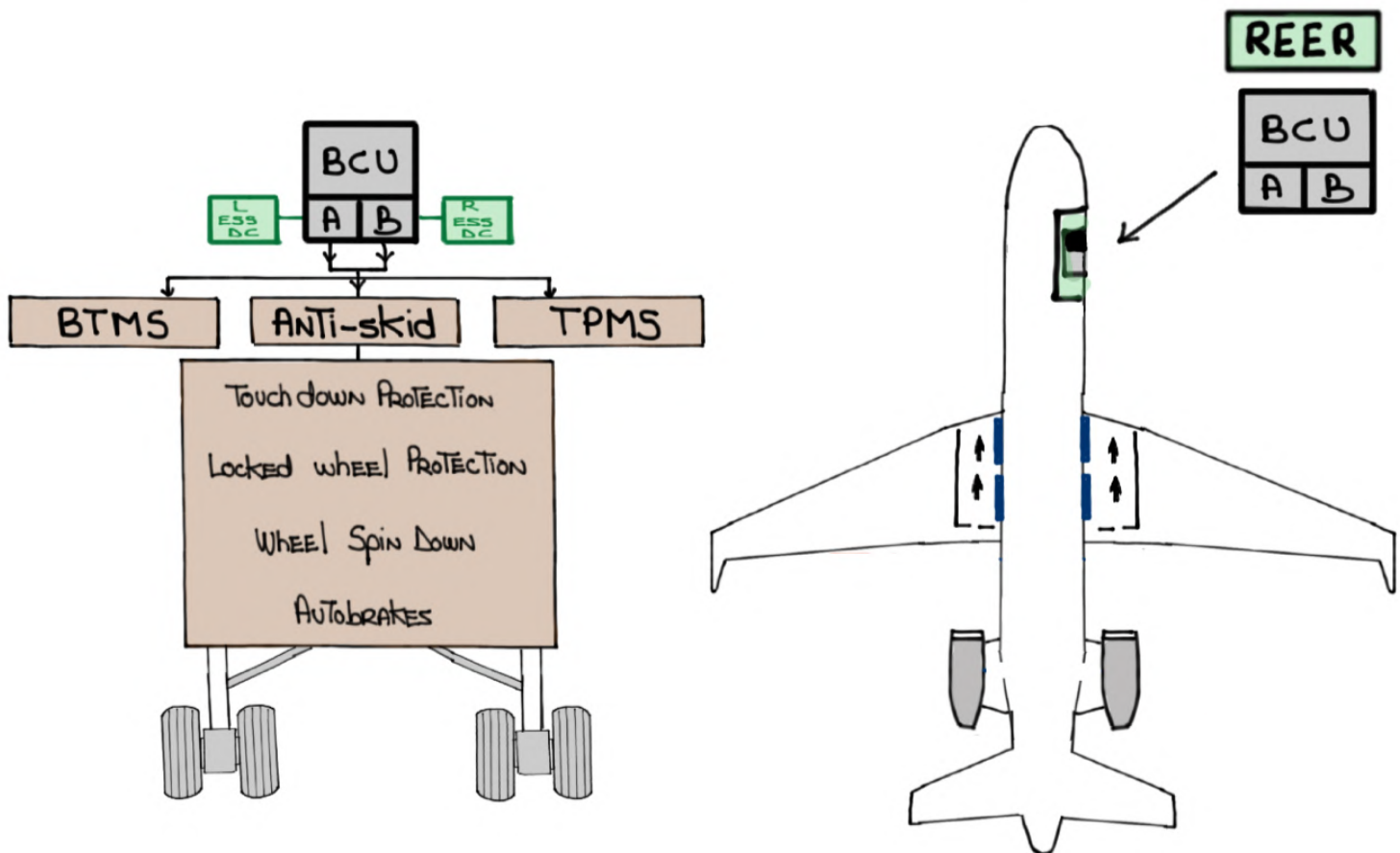
- NWS OVERTRAVEL INDICATOR:



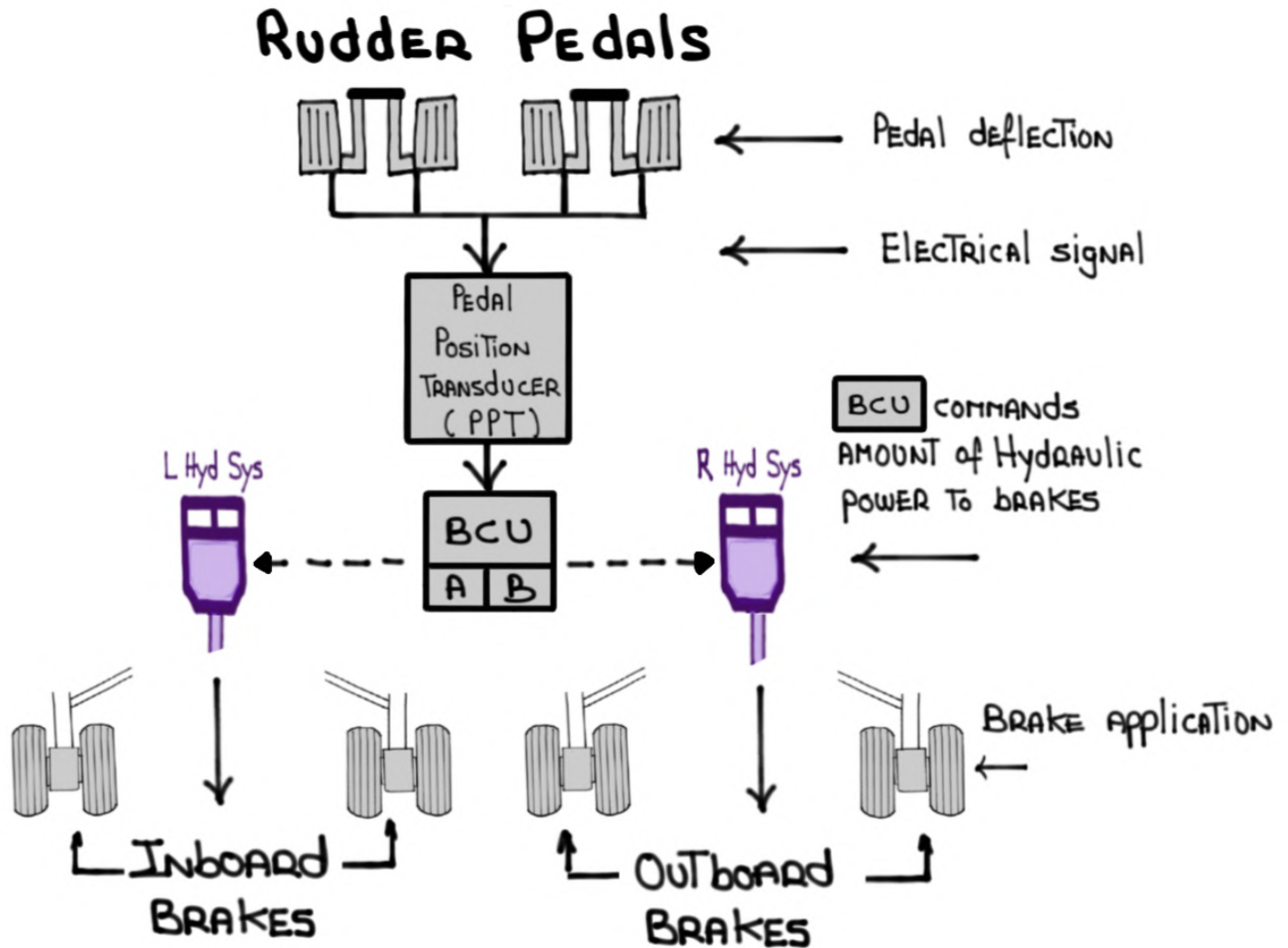


# MAIN WHEEL BRAKES

- A digital two-channel microprocessor called BRAKE CONTROL UNIT (BCU) controls the BRAKE-by-WIRE system
- The BCU is located in the **REER** and it contains two identical circuit card assemblies, each of which controls either the inboard or outboard systems
- The two **(2)** identical brake control system channels, operating simultaneously from independent **hydraulic** and **electrical** systems, control normal braking



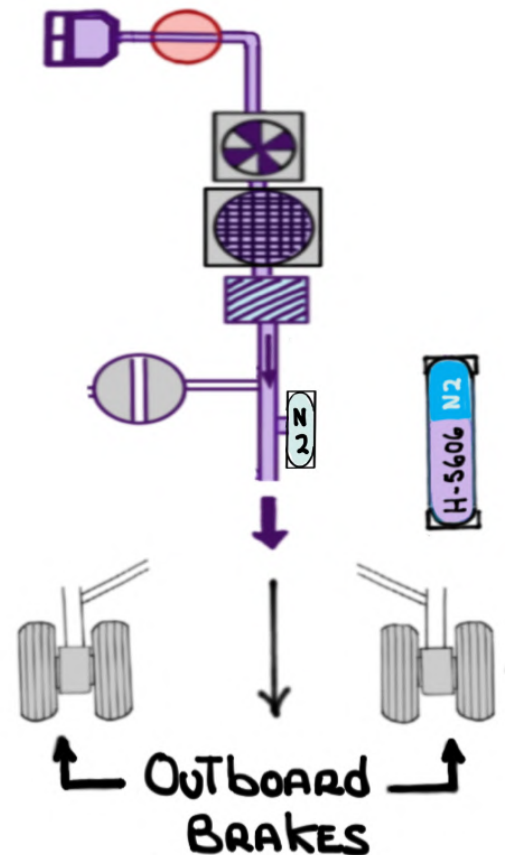
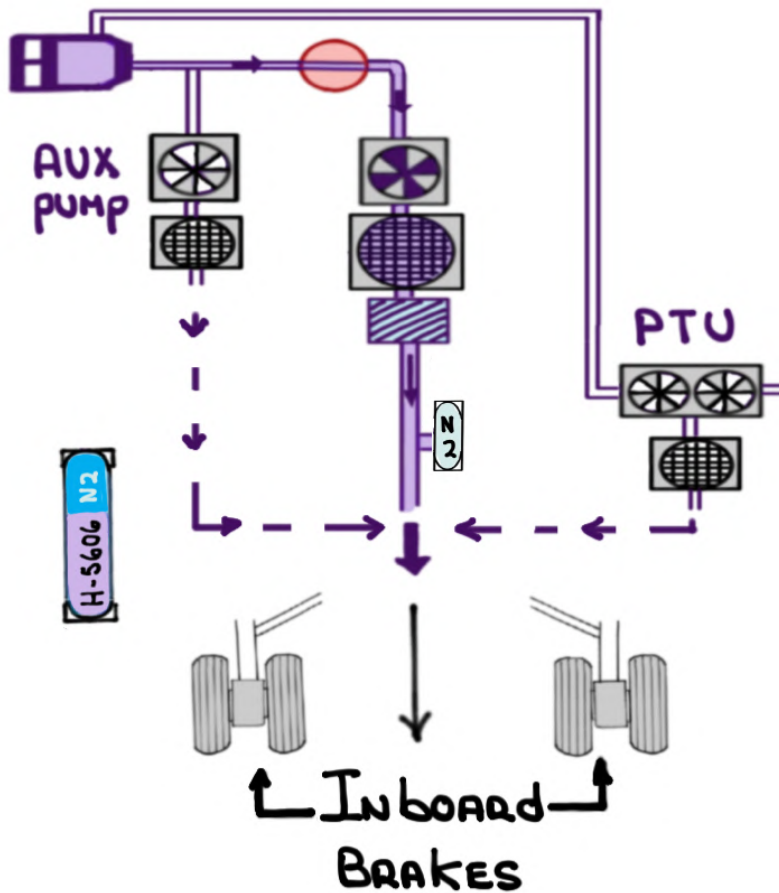
- The purpose of the BCU is To PREVENT TIRE damage or failure CAUSED by skidding or locked wheels during landing OR A REJECTED TAKEOFF



- The brakes ARE hydraulically powered by:

- Left Hydraulic System
- Power Transfer Unit (PTU)
- AUX pump
- Inboard accumulator

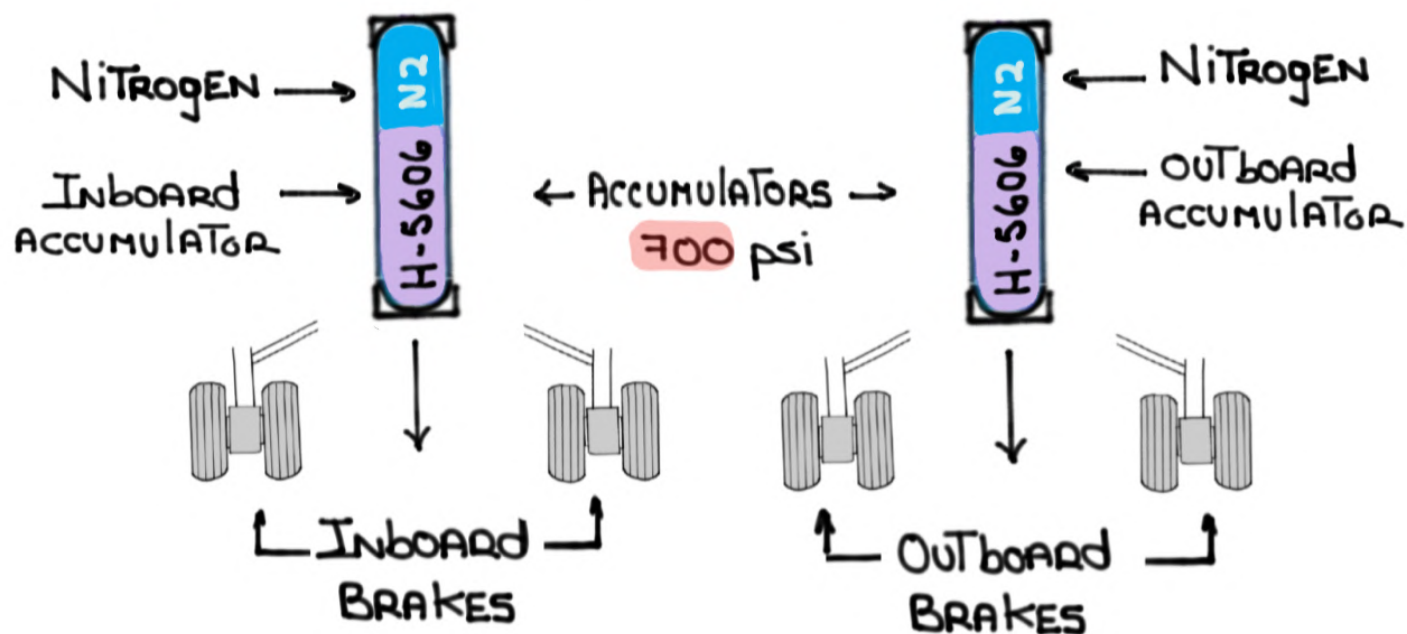
- Right Hydraulic System
- Outboard accumulator



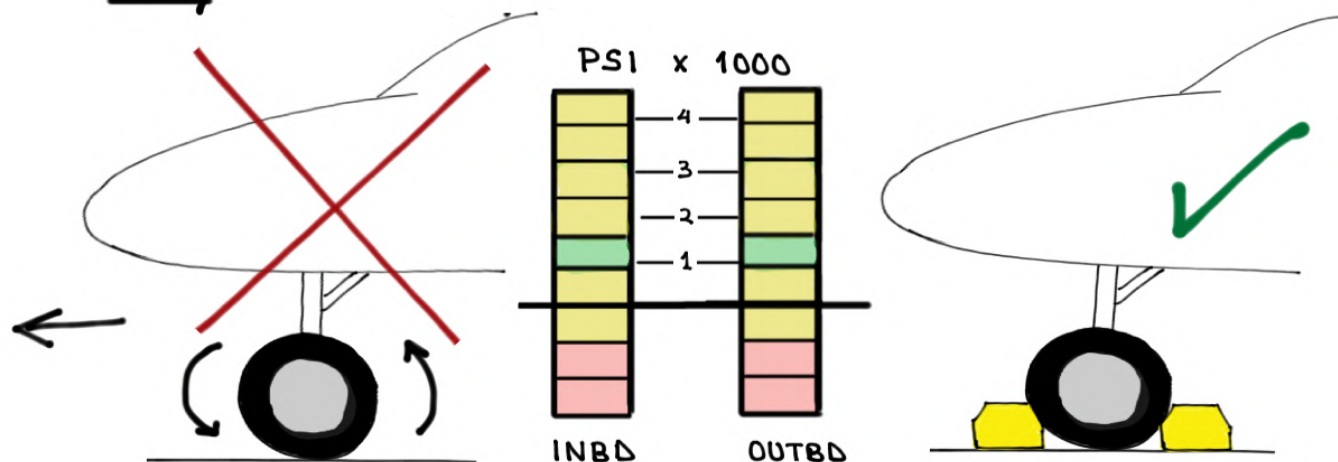
If <sup>AUX</sup> pump is selected ON during ground operations with ENGINES NOT RUNNING only the inboard accumulator is charged



- The parking brake system has two (2) independent accumulators pre-charged to 700 psi with Nitrogen and hydraulically charged to 3,000 psi

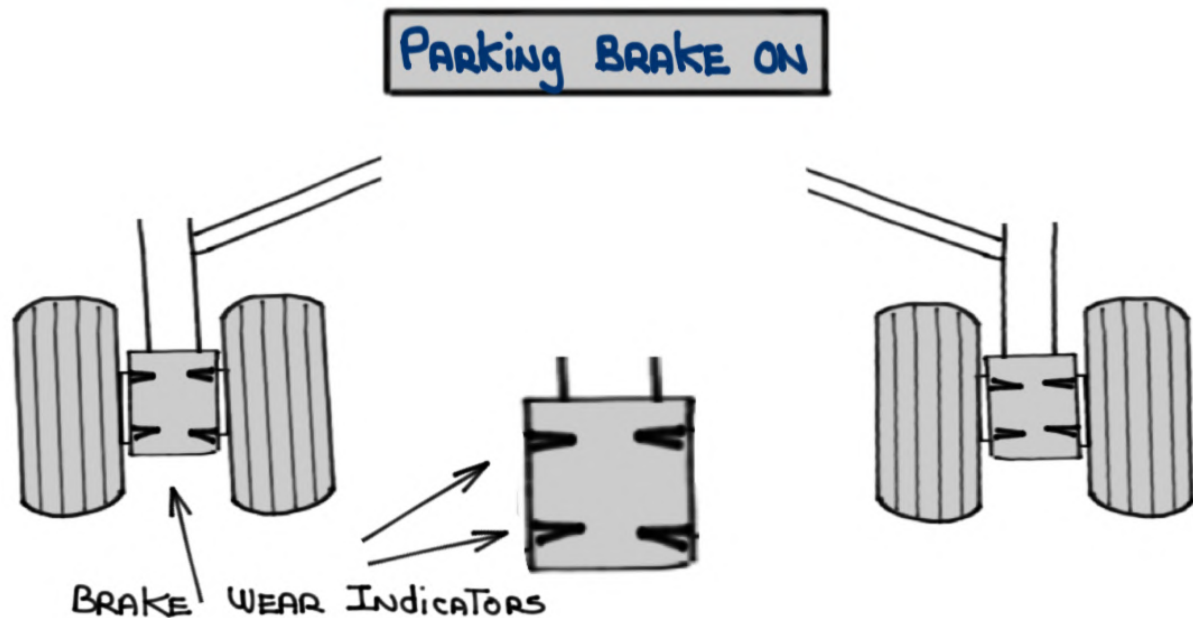


PARKING BRAKE ACCUMULATOR PRESSURE will DECREASE CONTINUOUSLY OVER A SHORT TIME. Always chock aircraft UNTIL READY for ENGINE START. OTHERWISE IT MAY ROLL...  
... AWAY!





- PARKING BRAKE MUST BE SET PRIOR TO CHECKING THE BRAKE WEAR INDICATORS (BWI) - "Life REMAINING"

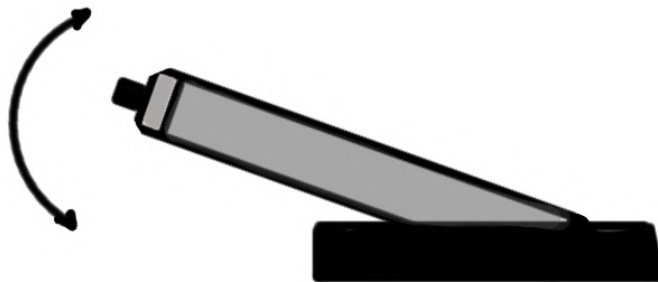


- Two (2) BWI PER BRAKE ASSEMBLY
- AMOUNT of PROTRUSION INDICATES "Life REMAINING"
- No protrusion: MX
- DURING ground operations with only AUX Hydraulic pump available: inboard brakes BWI only
- BRAKES: APPROXIMATELY 1,400 LANDINGS

If The **NORMAL** parking brake system fails The parking brake system can be used as an **EMERGENCY brake** To stop the aircraft. This system is completely independent of the **NORMAL** brake system

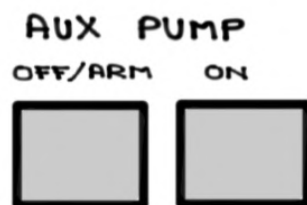
### Brake by Wire Fail

**EMERGENCY braking** is accomplished using the parking brake handle. Braking is modulated in direct proportion to the amount the parking brake handle is pulled

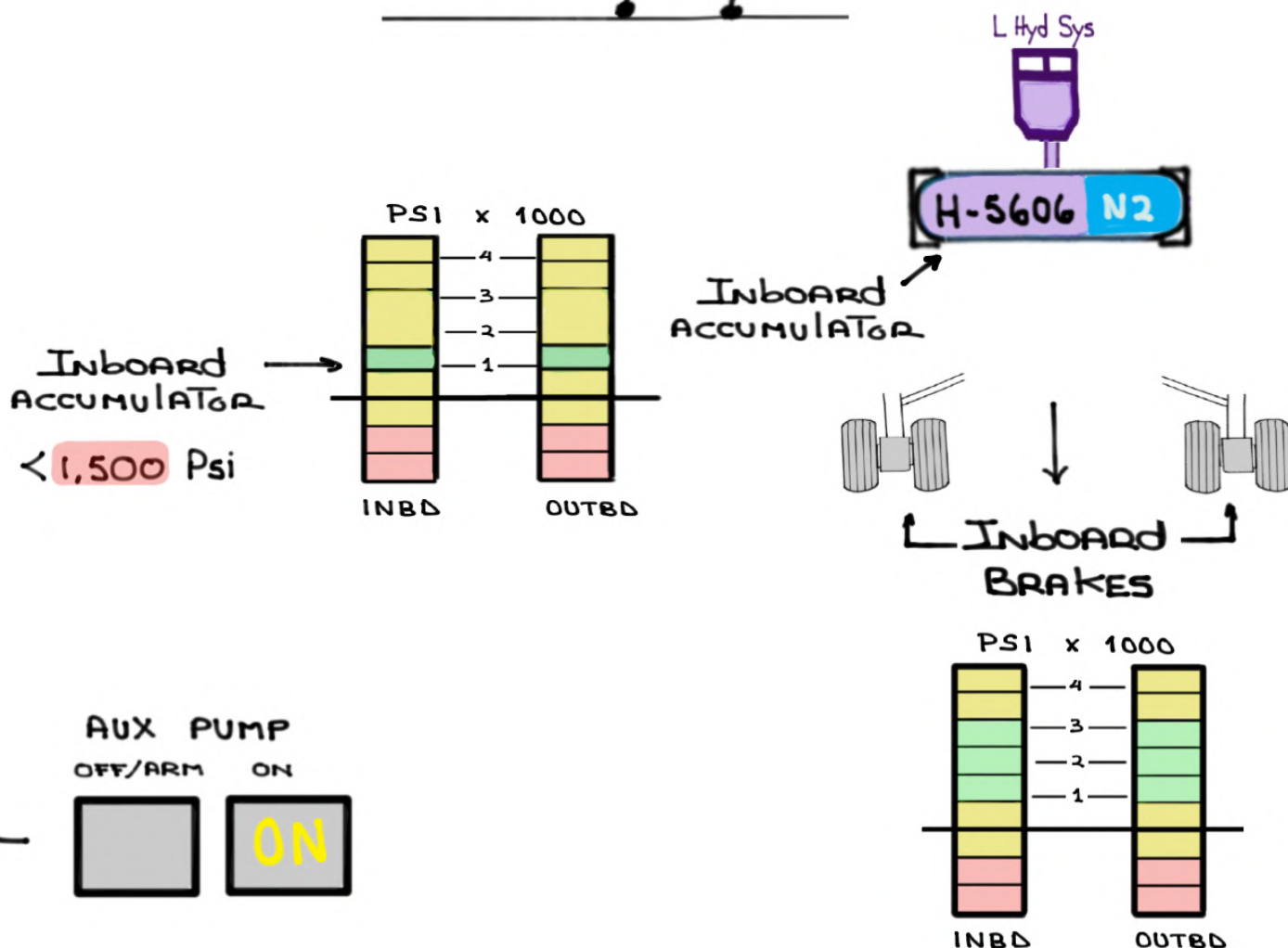


Anti-skid protection is NOT available so care must be exercised not to exceed a brake pressure of **600 Psi**

If The brake pedals ARE applied AND inboard accumulator pressure is low the AUX pump Auto Latch feature will command the AUX pump, if ARMED, to come ON



- WOW - **GROUND** AND brake pedal application

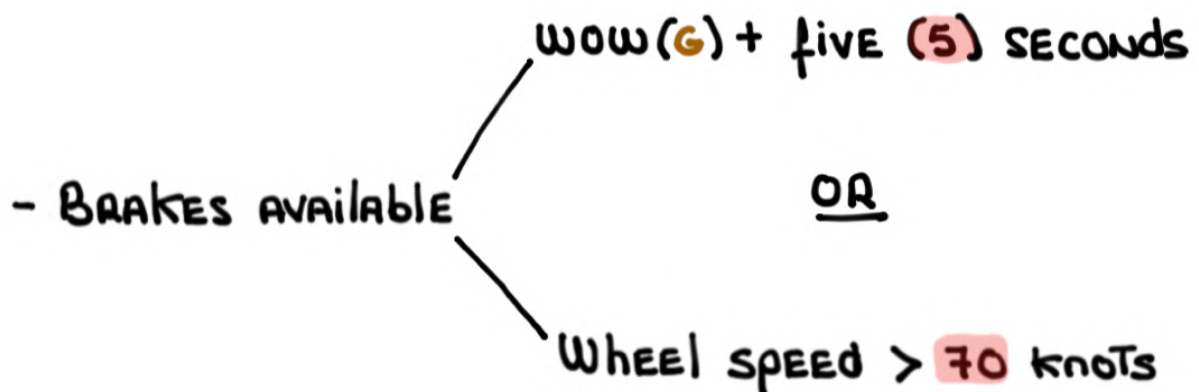
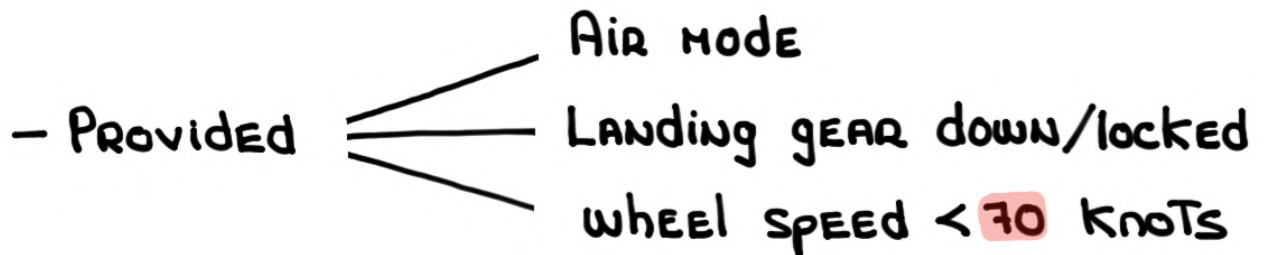


## - ANTI-skid SYSTEM:

- DESIGNED TO SAFELY MINIMIZE STOPPING DISTANCE
- MODULATES **hydraulic** PRESSURE TO THE MAIN WHEEL BRAKES WHEN A SKID IS DETECTED
- ANTI-skid PROTECTION IS AVAILABLE DOWN TO TEN (10) KNOTS
- BELOW TEN (10) KNOTS TIGHT TURNS WITH DIFFERENTIAL BRAKING CAN BE MADE
- THE ANTI-skid SYSTEM PROVIDES THE FOLLOWING PROTECTIONS:

### ① Touchdown PROTECTION:

- PREVENTS LANDING WITH BRAKES ON





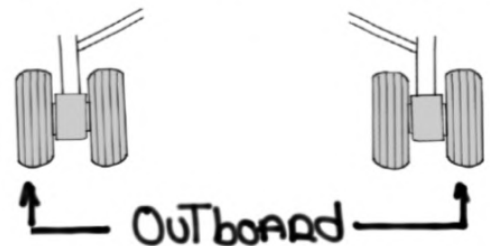
## ② Locked wheel protection:

- COMPARES wheel speeds

LEFT VERSUS RIGHT



LEFT VERSUS RIGHT



- If Thirty (30%) < Than its PAIRED wheel BRAKE PRESSURE IS RELEASED ON THAT WHEEL
- BRAKE PRESSURE REMAINS MODULATED UNTIL SPEED RECOVERS

## ③ Controlled wheel spin down:

- BRAKE PRESSURE IS APPLIED DURING GEAR RETRACTION/EXTENSION
- CONTROLS RATE OF WHEEL SPIN DOWN DURING RETRACTION BY APPLYING 500-800 PSI OF BRAKE PRESSURE FOR 4.5 SECONDS
- CHECKS SYSTEM HEALTH DURING EXTENSION AND APPLIES 1,500 PSI OF PRESSURE FOR 4 SECONDS

## - AUTOBRAKES SYSTEM:

- AUTOMATIC application of BRAKES during a REJECTED Takeoff or during landing
- THERE ARE THREE (3) levels of deceleration on landing - Low, Medium and High, AND a single REJECTED Takeoff (RTO) mode selected via four (4) position rotary switch

- Landing:

- initial brake application assists in de-rotation
- deceleration braking ramps in over THREE (3) SECS
- THREE (3) RATES of deceleration:

**AUTOBRAKE - LOW** 7'/SEC<sup>2</sup>

**AUTOBRAKE - MEDIUM** 10'/SEC<sup>2</sup>

**AUTOBRAKE - HIGH** MAXIMUM ANTI-skid braking

- AUTOBRAKES ARE disconnected by application of TOE BRAKES (RUDDER PEDALS)

- Takeoff: **AUTOBRAKE - RTO**

- THRUST LEVERS To idle
- BRAKE PRESSURE application:

600 psi < 80 KTS > MAXIMUM ANTI-skid braking

## - BRAKE TEMPERATURE MONITORING SYSTEM (BTMS):

THE BTMS MONITORS CURRENT BRAKE TEMPERATURES  
SENSED ON ALL MAIN WHEEL BRAKES

**BRAKE OVERHEAT** = V speeds will NOT box

> 600°C SENSED IN ONE OR MORE BRAKE ASSEMBLIES

IN THE EVENT OF DANGEROUSLY OVERHEATING BRAKES:  
PARK AIRCRAFT FAR AWAY AND DEPLANE PASSENGERS

## - TIRE PRESSURE MONITORING SYSTEM (TPMS):

THE TPMS ALERTS THE CREW OF IMPROPER PRESSURES ON  
ALL SIX (6) TIRES

≤ 186 psi **TIRE PRESSURE LOW**

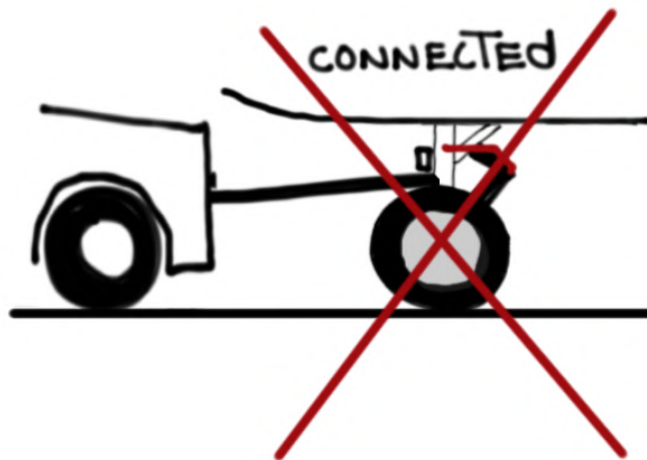
≤ 100 psi **TIRE PRESSURE LOW**

RECOMMENDED 216 psi FOR ALL WEIGHTS MEASURED  
AFTER STATIONARY FOR > TWO (2) HOURS

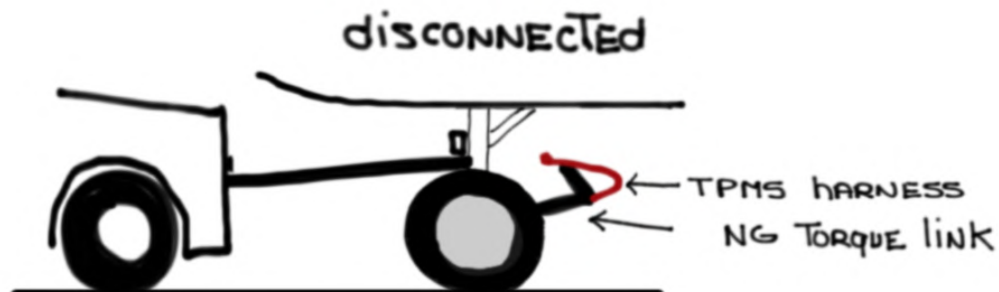
TIRE PRESSURE is indicated on:

- STANdbY MULTIfUNCTION CONTROLLER (SMC) UTILITY PAGE
  - GROUNd SERVICE SYNOpTIC 1/6 PAGE
- 

PRIOR TO TOWING THE NOSE wheel TPMS HARNESS AND THE NOSE GEAR TORQUE LINK MUST BE DISCONNECTED



TPMS MAINTENANCE REQD

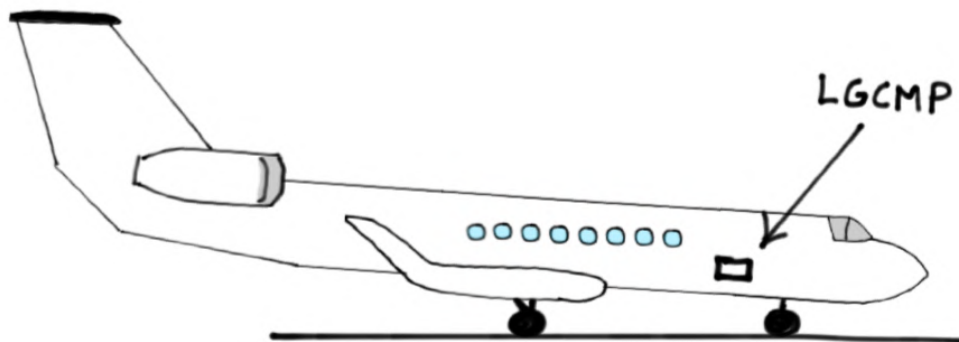





# LANDING GEAR CONTROL MAINTENANCE PANEL (LGCMP)

The LGCMP is located on the right side of the fuselage and is used to:

- ① Change WOW mode LG MAINTENANCE Mode
- ② RETRACT/EXTEND the landing gear while the aircraft is on jacks (MAINTENANCE function only)
- ③ Open/close landing gear doors (EXPANDED EXTERIOR pre-flight inspection)



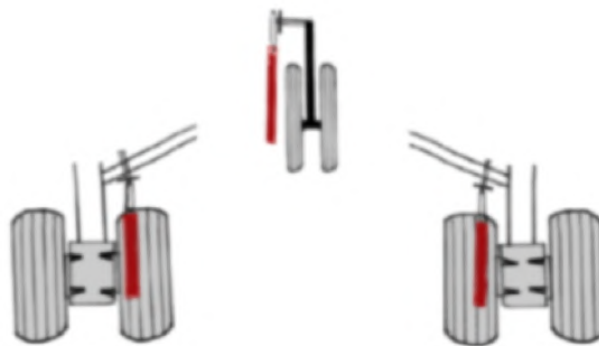
AUX  pump is the normal source of hydraulic fluid and pressure for these activities

# Safety Pins (8)

Each pin has a "REMOVE BEFORE flight" STREAMER

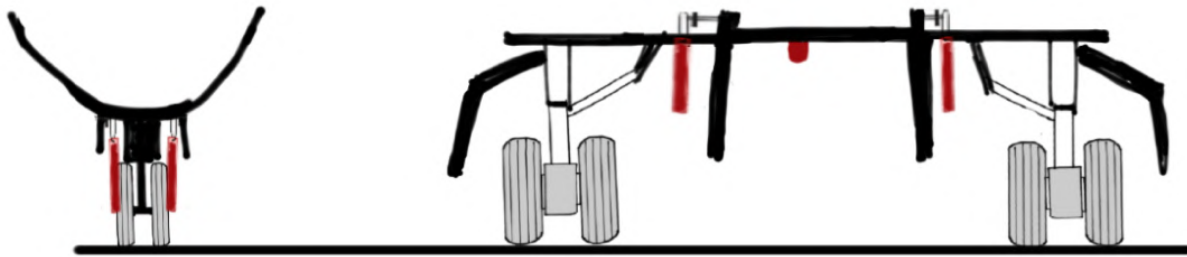


- THREE (3) GEAR PINS ARE INSTALLED AS PART OF THE Post-flight inspection. The pins must also be installed prior to Towing. Pins must be removed for flight



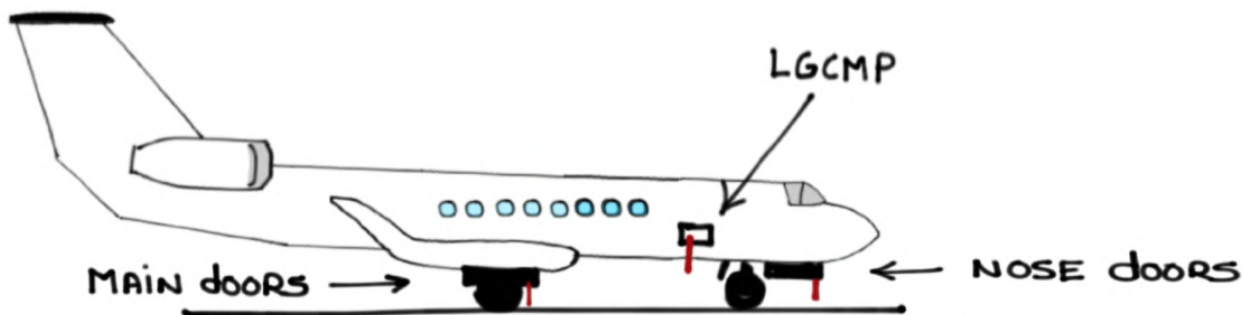
Both pilots should confirm all pins have been removed; if NOT, you'll get to run the QRH's "ATTEMPTED LANDING GEAR RETRACTION WITH SAFETY PINS INSTALLED."

- Two (2) NOSE GEAR AND TWO (2) MAIN GEAR door pins ARE INSTALLED AFTER OPENING THE GEAR DOORS VIA THE LGCMP



\* WHOEVER OPENS THE GEAR DOORS SHOULD BE THE ONLY ONE CLOSING THE DOORS

- ONE (1) LG MODE PiP PIN IS INSTALLED IN THE LGCMP WHEN CHANGING MODES - **NORMAL** → MAINTENANCE



A CAS MESSAGE WILL ALERT THE CREW WHEN THE LGCMP IS SET TO MAINTENANCE MODE

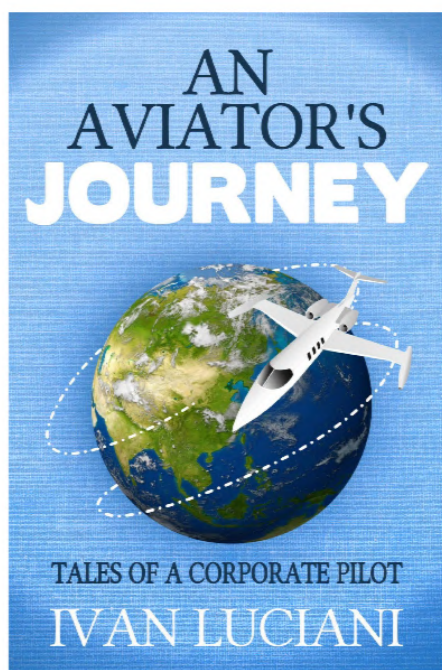
**LG MAINTENANCE MODE**

RETURNING TO **NORMAL** MODE REQUIRES REMOVAL OF THE PIN

**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](mailto:ivan@code7700.com)



Thank you!