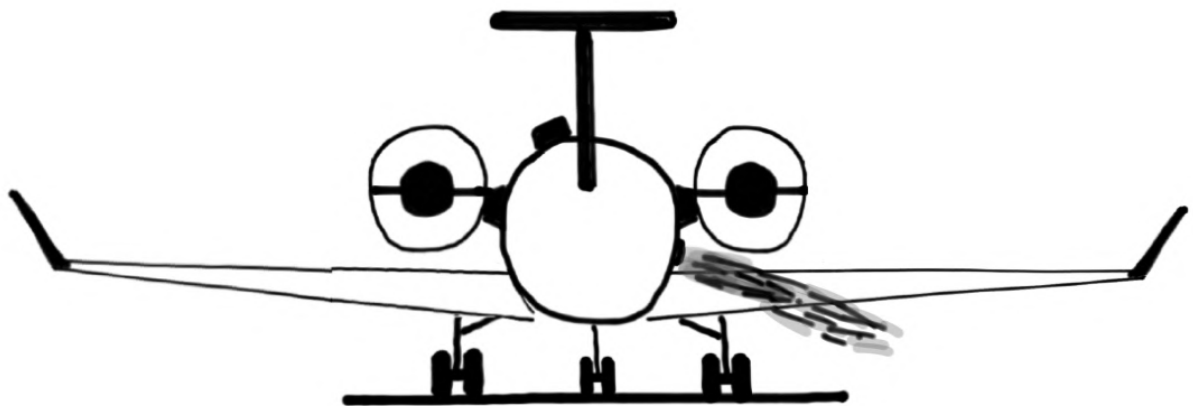


# G650

## Auxiliary Power Unit



For study purposes only

# HONEYWELL RE220

The purpose of The APU is To supply AN AUXILIARY SOURCE of:



① ELECTRICAL AC POWER > ON GROUND  
② PNEUMATIC BLEED AIR

① BACKUP ELECTRICAL AC POWER > In flight  
② PNEUMATIC BLEED AIR FOR ENGINE AIR START

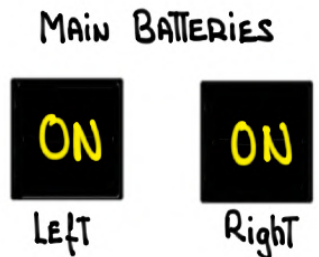
- APU is POWERED by A DEDICATED SINGLE SHAFT, CONSTANT SPEED GAS TURBINE
- APU is CONTROLLED by AN ELECTRONIC CONTROL UNIT (ECU)

ECU


- APU is SELF MONITORING AND will PROTECT ITSELF AGAINST FAULTS WITH AN AUTOMATIC SHUTDOWN
- APU is ENCLOSED in A FIREPROOF TITANIUM CASE

- MINIMUM AMBIENT TEMPERATURE for ground start is  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ )
- APU has a fully AUTOMATIC START SEQUENCE
- The APU can be started with   POWER
- MINIMUM MAIN BATTERIES VOLTAGE for APU START: 22 Volts

(APU STARTER USES  ONLY but both switches must be selected ON)



#### - APU STARTER Limits:

- THREE (3) CONSECUTIVE START ATTEMPTS followed by A ONE (1) HOUR COOLING PERIOD
- Six (6) SUCCESSFUL AND CONSECUTIVE STARTS with A TEN (10) MINUTE INTERVAL BETWEEN STARTS
- Use of  To START THE APU is prohibited





# APU MASTER Switch

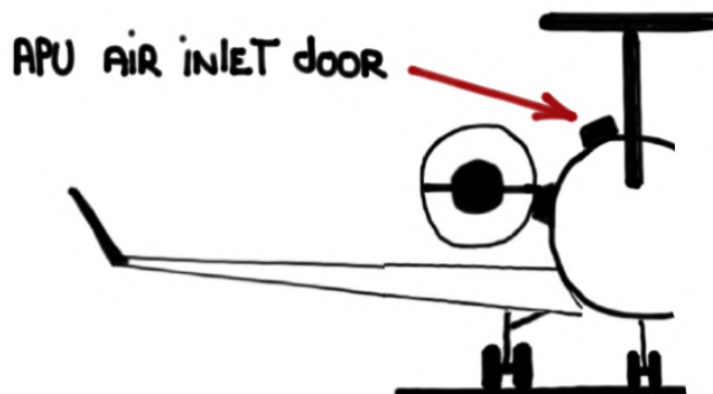
① MASTER switch illuminates **MASTER ON** when pressed in

- The ELECTRONIC CONTROL UNIT **ECU** is POWERED

- PRE-START Build-in-TEST (BIT) is PERFORMED
- APU oil TEMPERATURE is SENSED
- APU fuel shutoff VALVE OPENS
- APU AIR INLET DOOR (**L** side) OPENS

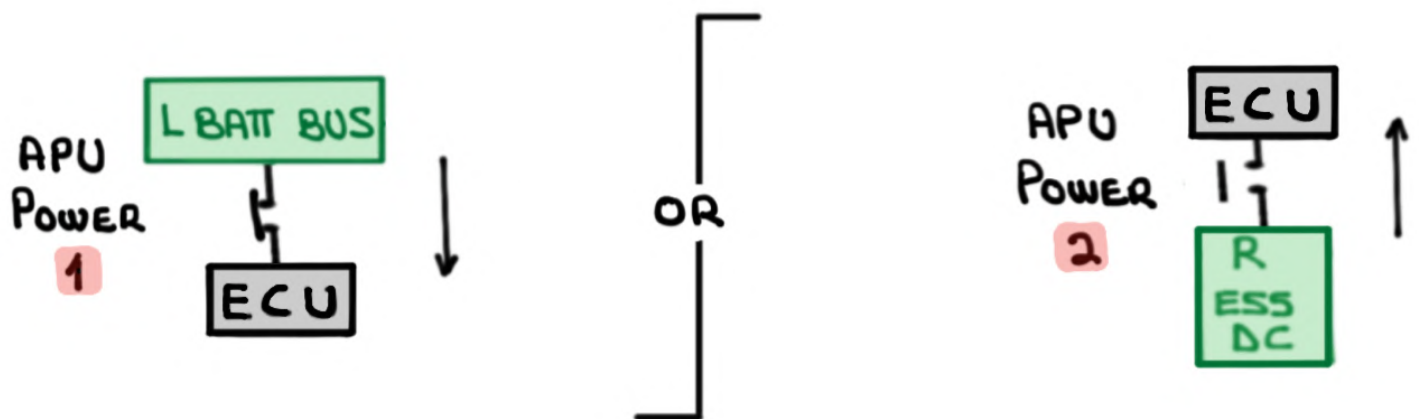
- If all PARAMETERS **OK** the APU **READY** illuminates

IT IS STILL POSSIBLE TO START THE APU IN THE ABSENCE OF AN APU **READY** light PROVIDED THE APU AIR INLET DOOR IS VISUALLY CONFIRMED AS OPEN



# ELECTRONIC CONTROL UNIT (ECU)

- The **ECU**, The brains of The APU, is a microprocessor with embedded software
- IT automatically controls The APU and interfaces with subsystems
- IT is located in The Baggage Electronic Equipment Rack (BEER)
- IT is powered Through The **MASTER ON** switch



The **ECU** selects one of the two power sources if both are available

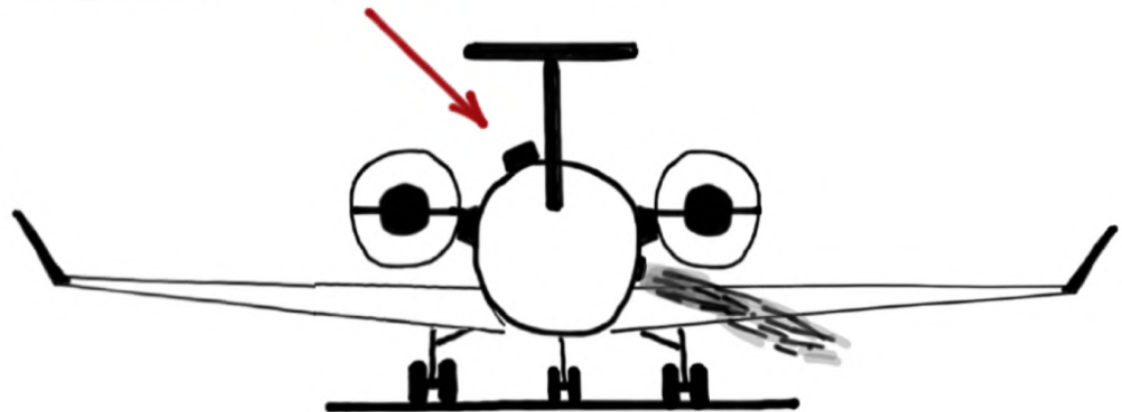
## - The **ECU**

① MAINTAINS REQUIRED RPM AND SAFE EGT DURING:

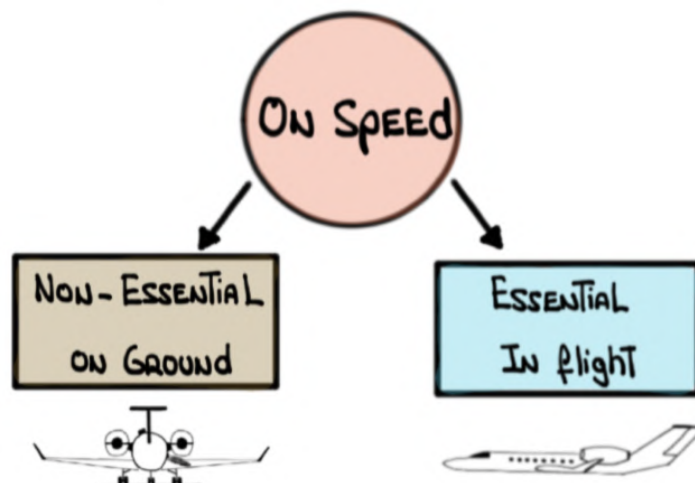
- START
- ACCELERATION
- Idle
- Full load OPERATION

② MONITORS OPERATIONAL limits

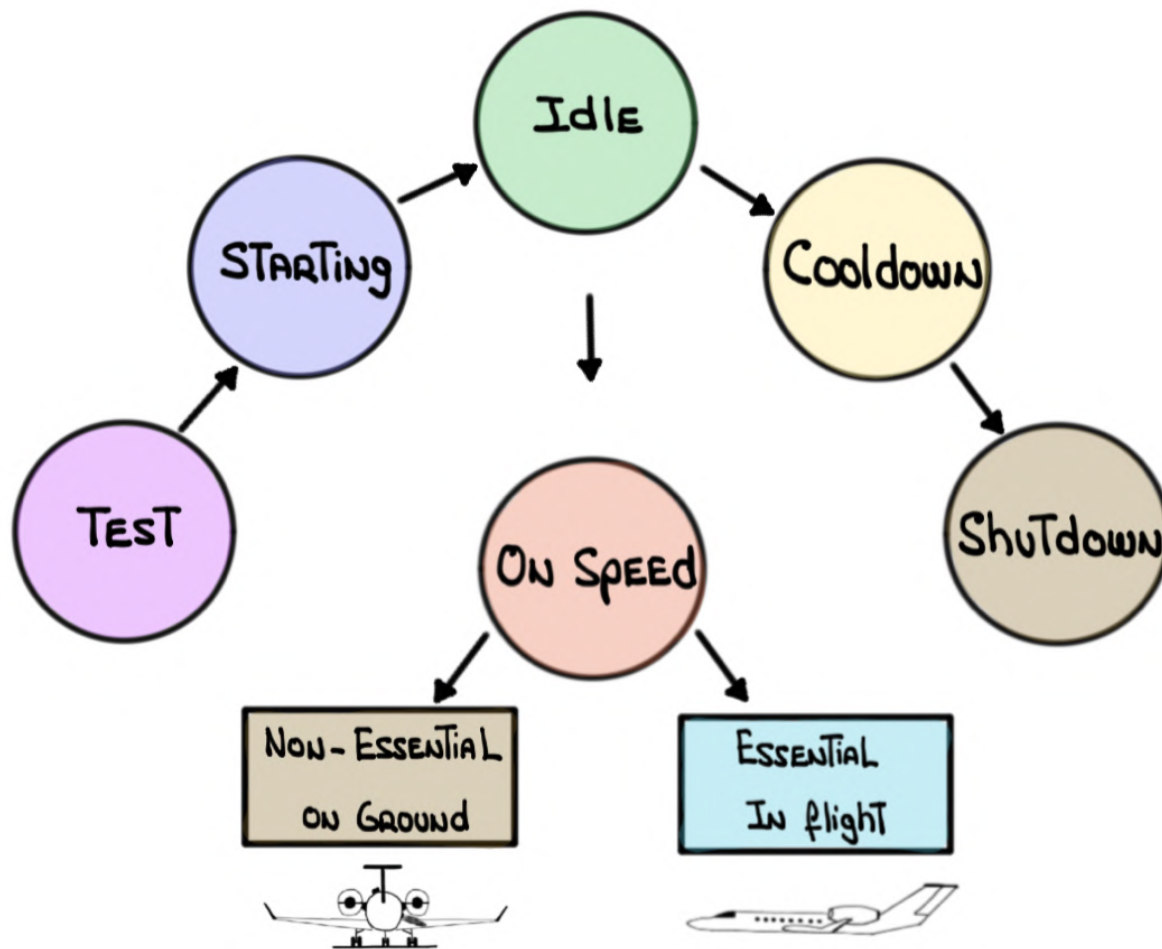
③ CONTROLS AIR INLET door



④ CONTROLS protective shutdowns



## - Six (6) OPERATIONAL Modes:



## - Auto PROTECTive Shutdowns:

The **ECU** provides OPERATIONAL PROTECTION for THE APU by shutting it down if OPERATING PARAMETERS ARE EXCEEDED OR if A **FIRE** is DETECTED WITHIN THE APU housing



The **ECU** uses Two (2) sets of operating limits:

Non-Essential  
On Ground



Essential  
In flight



### ① Non-Essential (On Ground):


The APU will automatically shutdown in order to protect itself in the event of any discrepancies

- Cool-down mode is bypassed
- APU's fuel shutoff valve is closed
- APU shuts down

### ② Essential (In flight):

**APU Essential**

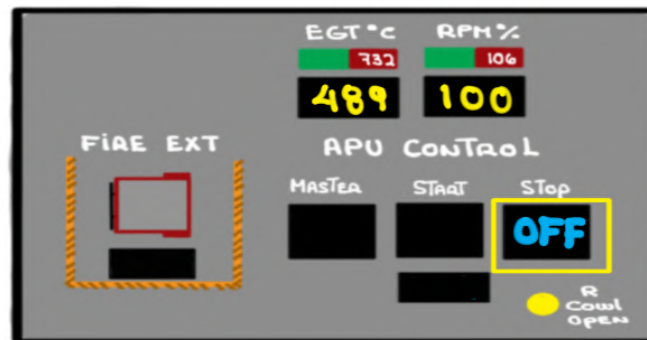
In Essential mode the APU will not automatically shutdown for certain failures. The safe condition of the aircraft takes precedence over any possible damage to the APU

- APU OPERATING **In flight** 
- FAULT DETECTED
- CREW NOTIFIED VIA CAS MESSAGE



If THE APU is NOT NEEDED:

- SHUT IT DOWN WITH THE STOP SWITCH



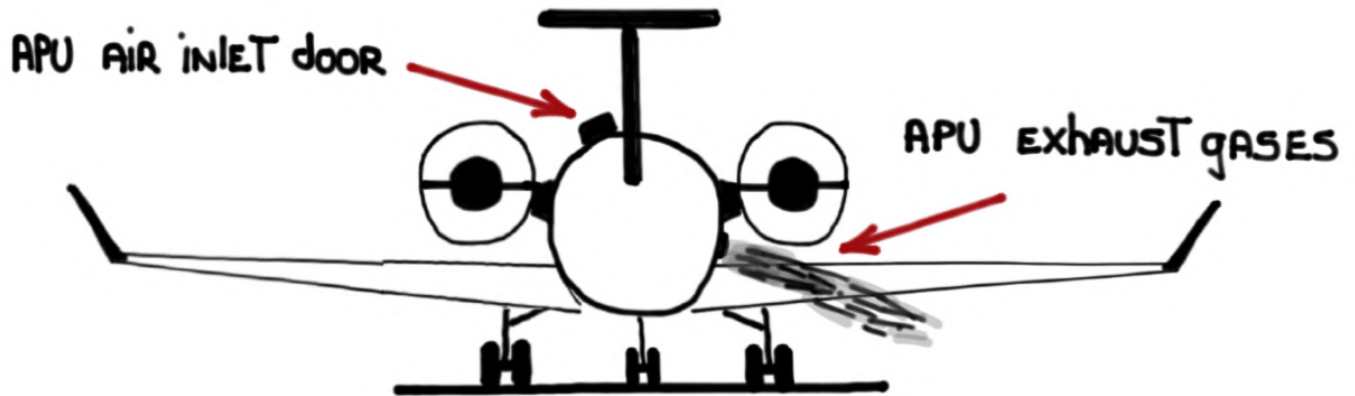
- RESTART IS POSSIBLE IF STILL AIRBORNE

If THE APU is NEEDED:

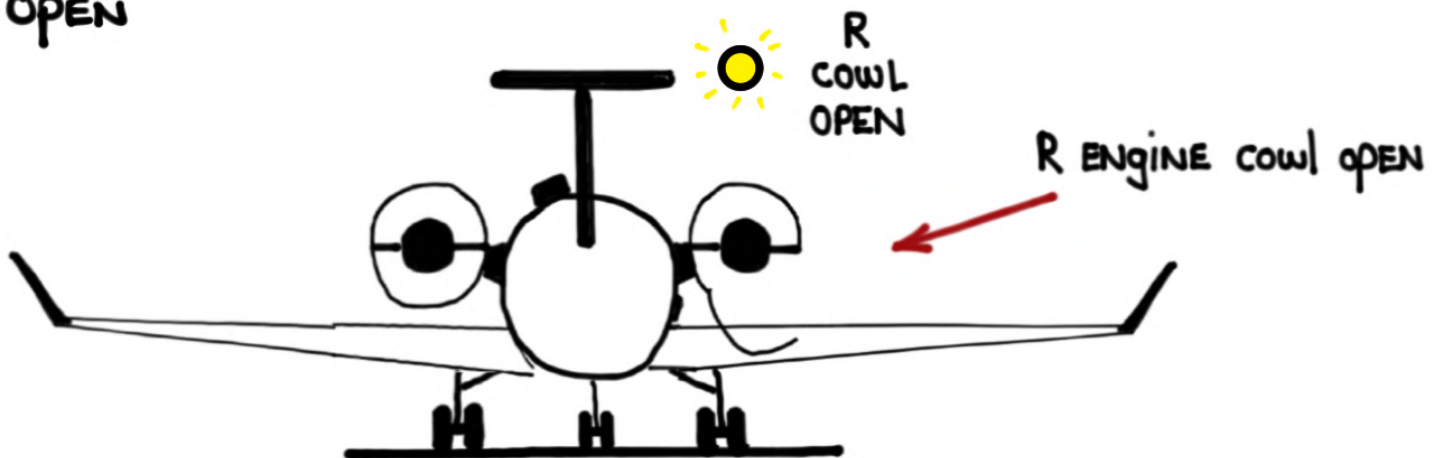
- ALLOW APU TO CONTINUE RUNNING
- AFTER LANDING THE APU REMAINS IN ESSENTIAL MODE FOR FIFTEEN (15) MINUTES BEFORE THE **ECU** SHUTS IT DOWN. IF NOT NEEDED SHUT IT DOWN

# R Cowl OPEN Light

APU EXHAUST IS EXHAUSTED OVERBOARD ON THE AFT LOWER RIGHT SIDE OF THE FUSELAGE UNDER THE ENGINE PYLON

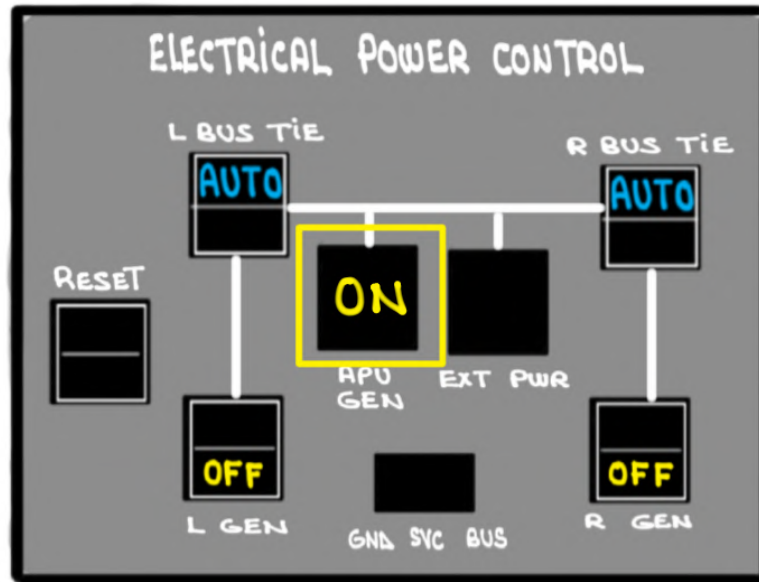


TO PREVENT DAMAGE TO THE ENGINE COWL DURING MAINTENANCE THE STARTER IS INHIBITED WITH THE COWL OPEN

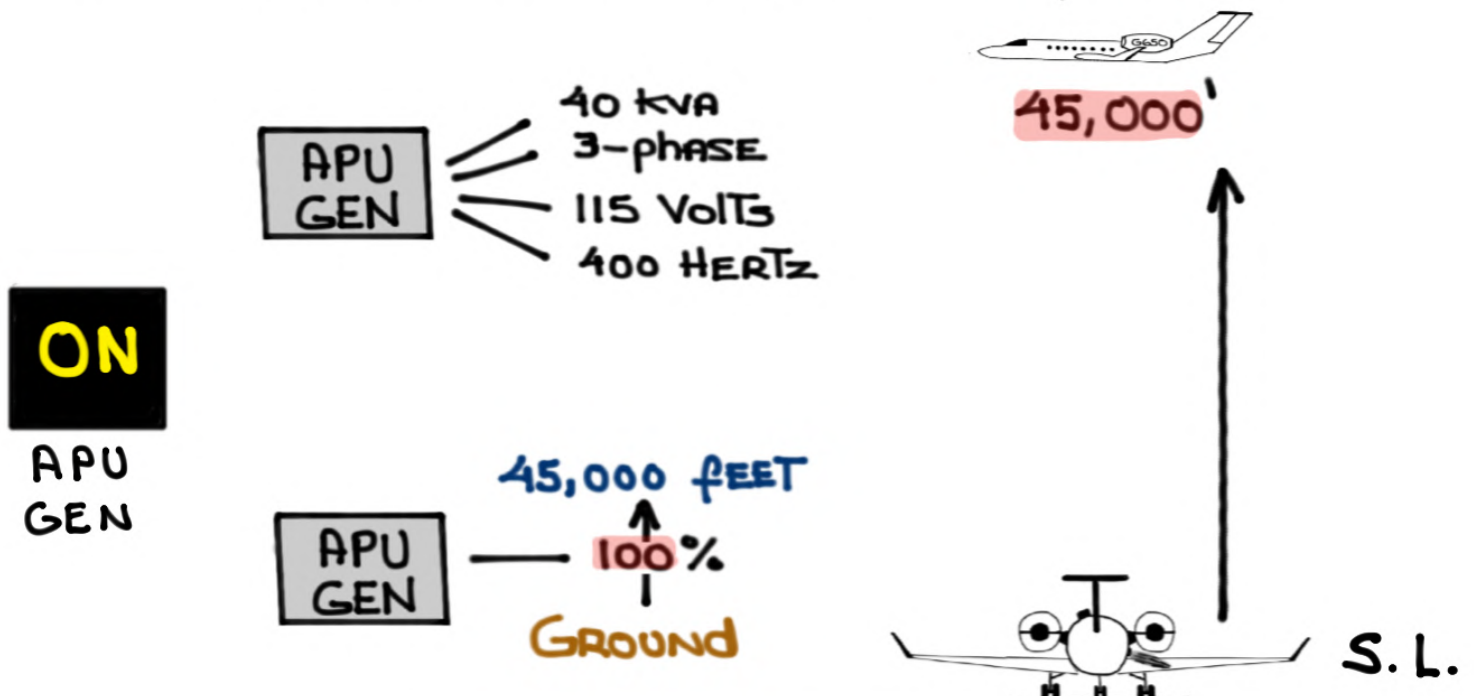


STARTER IS NOT inhibited in flight

# APU GENERATOR



- The APU provides an auxiliary source of:
  - ① Electrical **AC** power - **On Ground**
  - ② Backup Electrical **AC** power - **In flight**
- The APU GEN runs at a constant speed

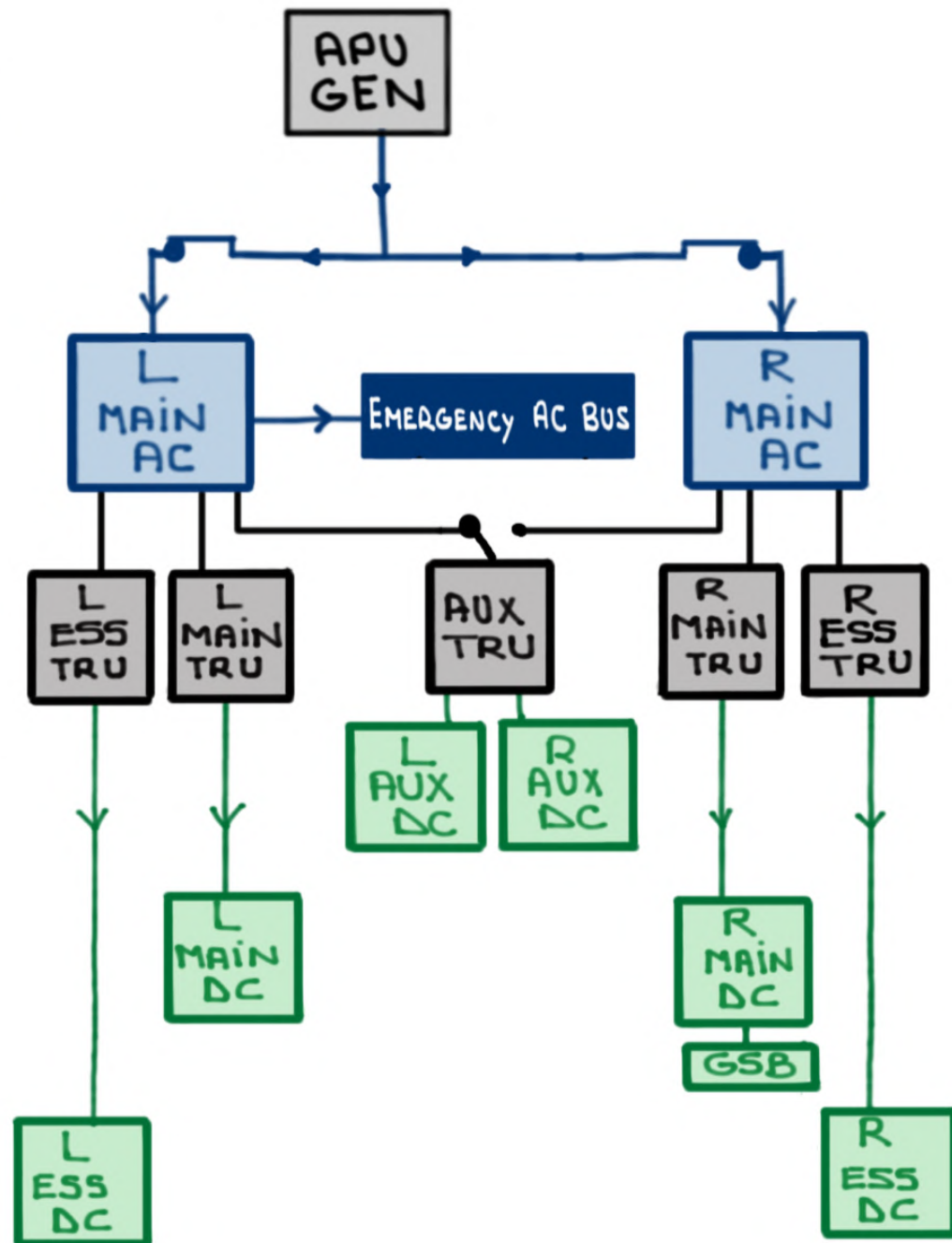




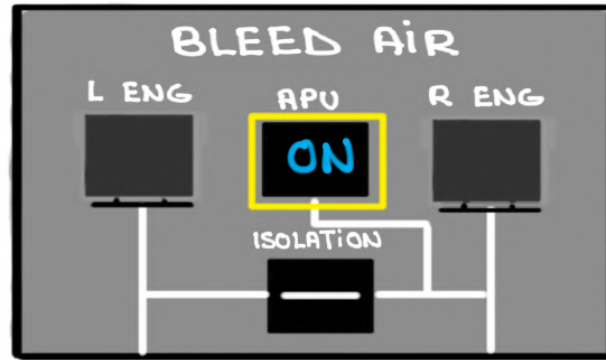
- When The APU REACHES 99% RPM plus Two (2) SECONDS THE APU GENERATOR COMES ONLINE AND CAN POWER ALL AC AND DC BUSES

ON

APU  
GEN



# APU BLEED AIR

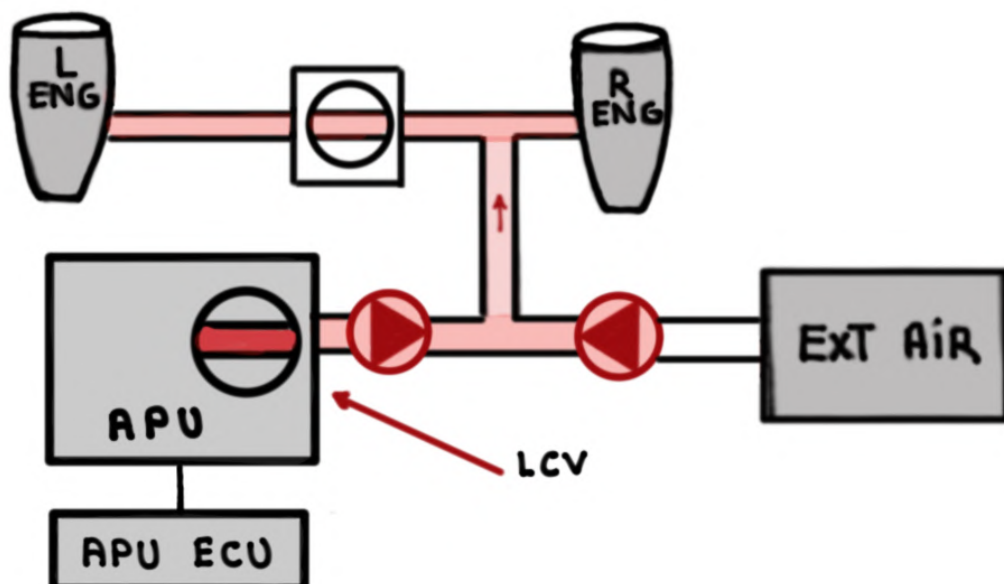


-The APU provides:

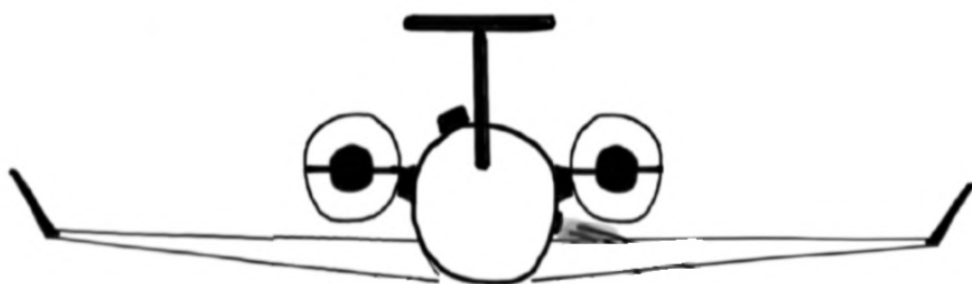
- **On ground:** bleed air for air conditioning and engine start
- **In flight:** bleed air for assisted air starts

-The APU's Load Control Valve (LCV) allows

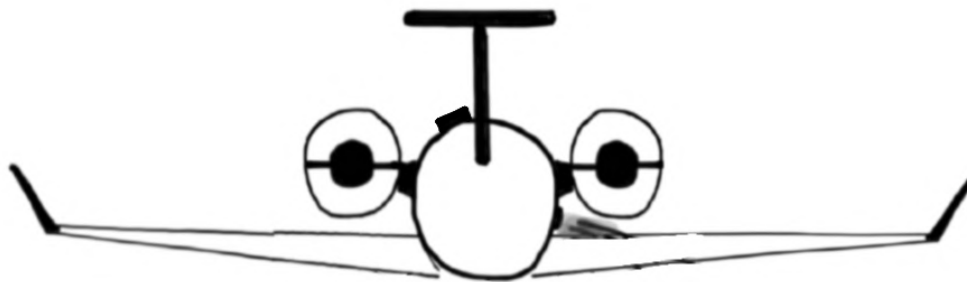
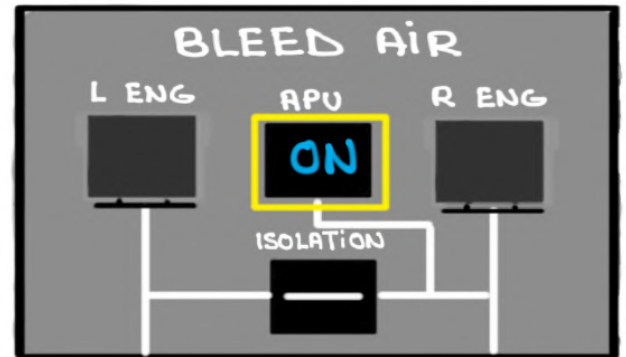
**High pressure/TEMPERATURE** air into the left and right pneumatic manifolds



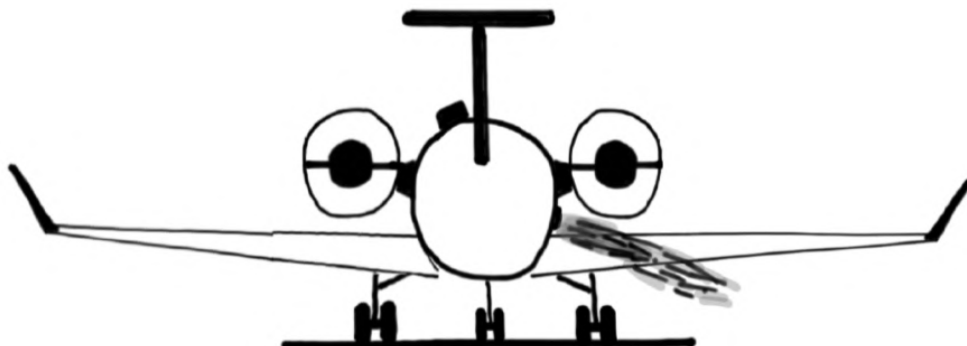
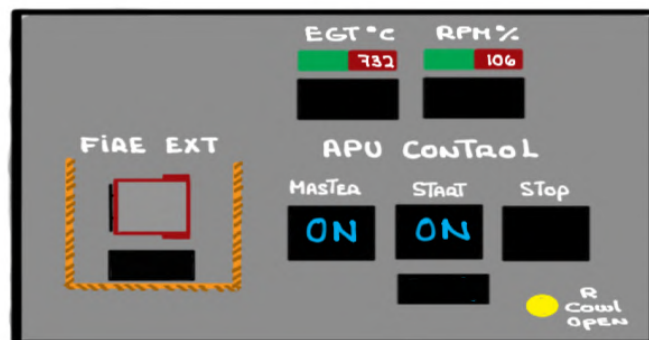
- APU bleed air plumbing connects directly to the **R** manifold
- After the APU is started on the ground the LCV will not open for sixty (**60**) seconds to allow the APU to operate in a lightly loaded condition (low EGT)
- Selection of APU bleed air automatically opens the isolation valve to allow bleed air to enter the **L** manifold
- If the EGT is warm ( $> 149^{\circ}\text{C}$ ) the sixty (**60**) second time delay is removed and APU pneumatic air will be available immediately
- APU bleed air is available immediately to restart an engine **In flight**



- APU bleed air is available To start The engines  
On ground or In flight from S.L. To 30,000'



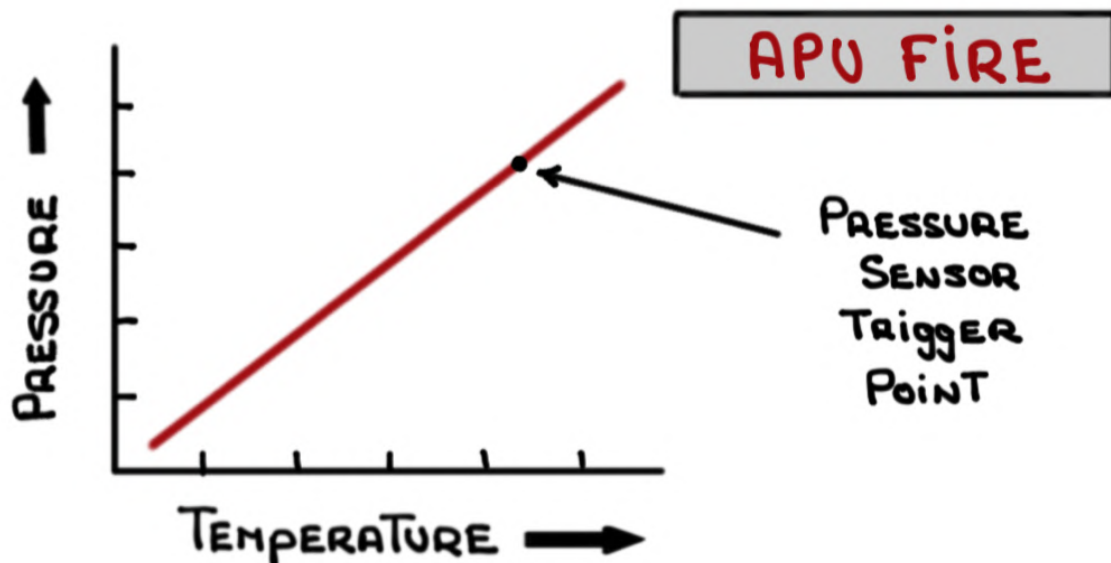
30,000'



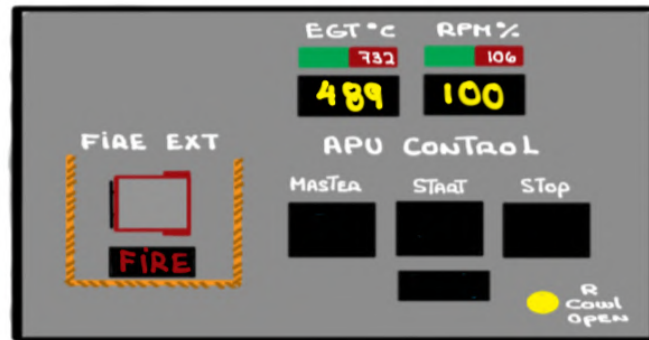


# APU FIRE DETECTION SYSTEM

- The APU is ENCLOSED in a TITANIUM CASE capable of CONTAINING A FIRE FOR FIFTEEN (15) MINUTES. BEYOND THIS PERIOD DAMAGE TO OTHER SYSTEMS WILL OCCUR
- The APU OVERHEAT/FIRE DETECTION SYSTEM CONSISTS OF A HERMETICALLY SEALED HELIUM-FILLED TUBE SECURED TO THE TOP OF THE APU ENCLOSURE
- AS THE TEMPERATURE INSIDE THE ENCLOSURE INCREASES THE GAS IN THE TUBE EXPANDS AND THE PRESSURE INCREASES



- A large TEMPERATURE INCREASE ON A small length of Tube indicates a FIRE



▲ FIRE BELL (On ground only)

▲ APU ECU

- CLOSES APU fuel supply valve
- CLOSES LOAD CONTROL VALVE
- SHUTS off APU GENERATOR
- CLOSES APU INLET door

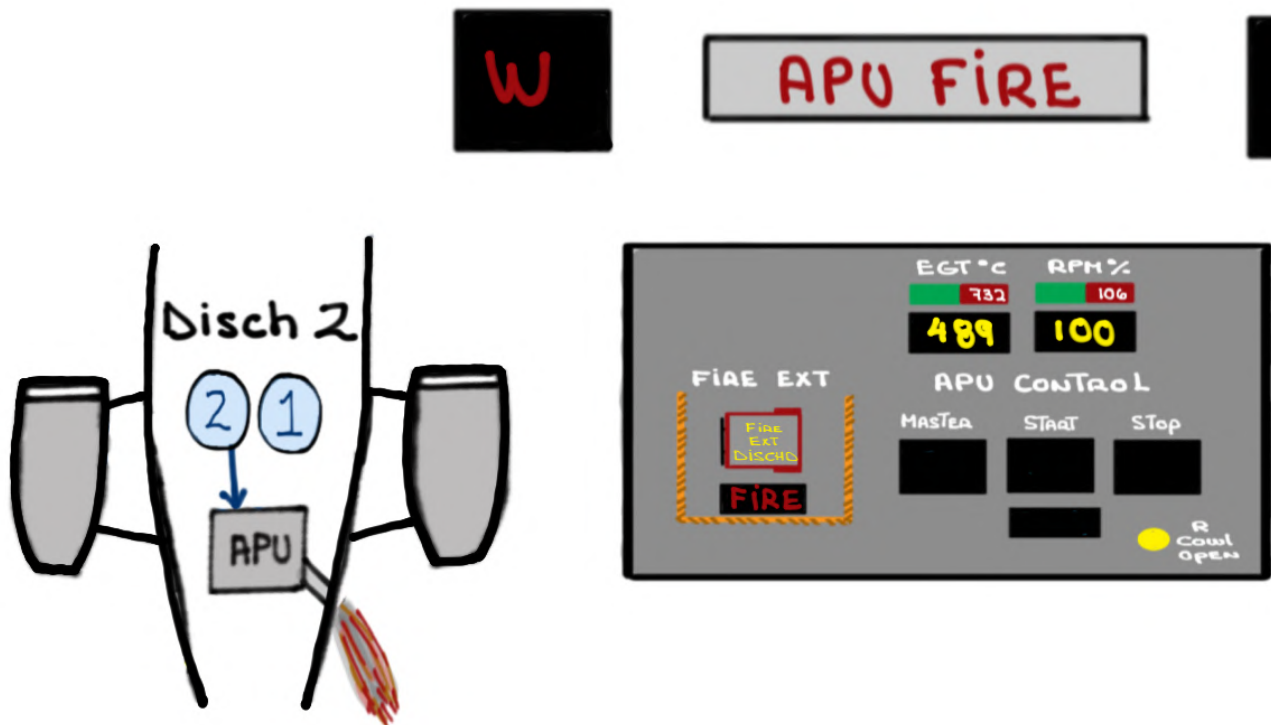
# APU FIRE EXTinguishing SYSTEM

- The APU FIRE EXtinguishing SYSTEM is POWERED by THE



bus (down To MAIN BATTERIES)

- FIRE EXtinguishing discharge switch (GUARDED) is located ON THE APU CONTROL PANEL



- Discharges LEFT fire bottle HALON INTO APU COMPARTMENT. Only ONE SHOT is AVAILABLE
- Discharge GENERATES The following CAS MESSAGE:

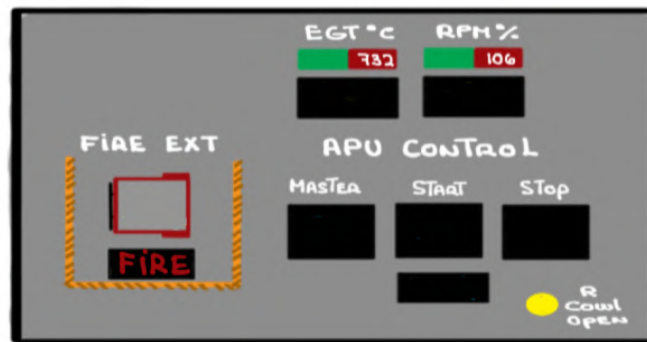
L FIRE BOTTLE Discharge

# APU FIRE TEST

- PROPER TEST - Eight (8) indications

APU

TEST



W

APU FIRE

W

C

APU FIRE DETECTOR FAIL

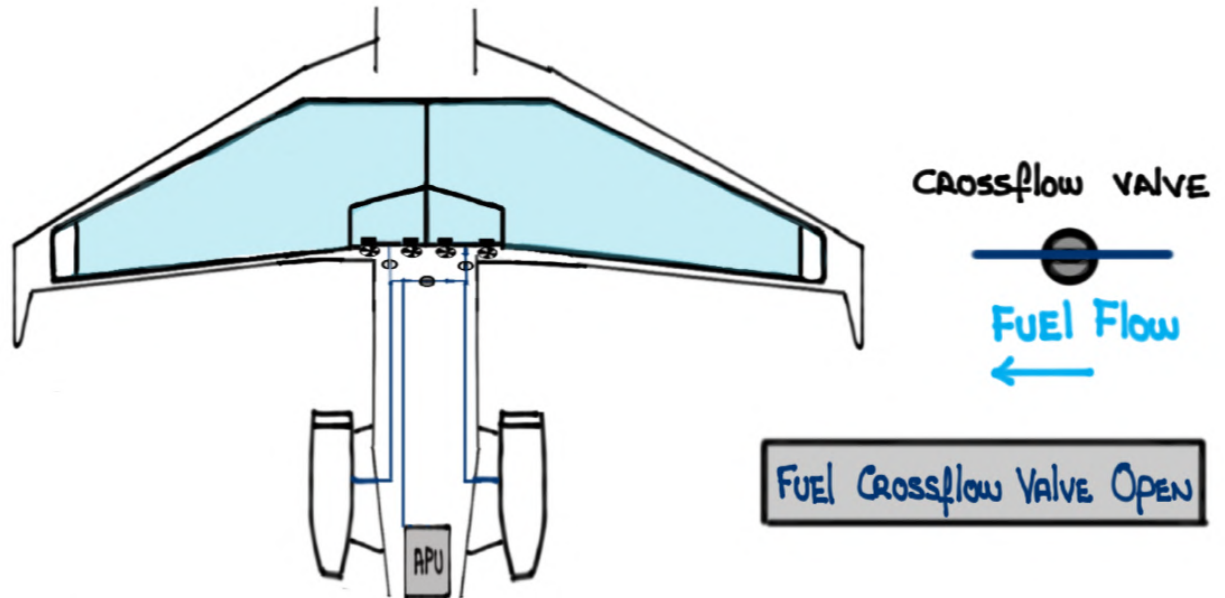
C

If on the ground a Fire Bell (located in the nose wheel well) will sound

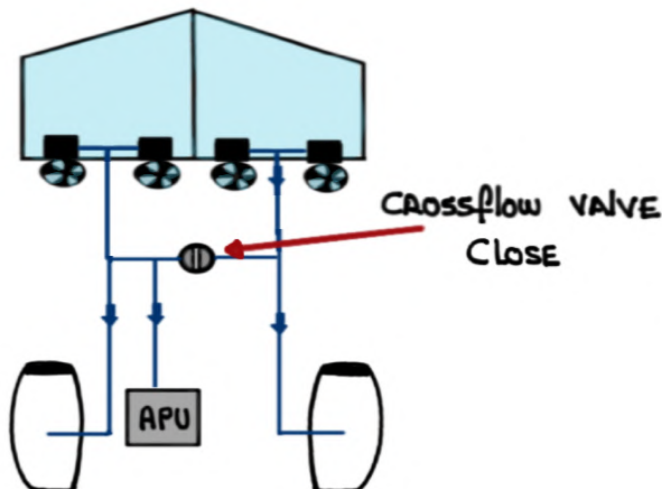


# APU fuel supply

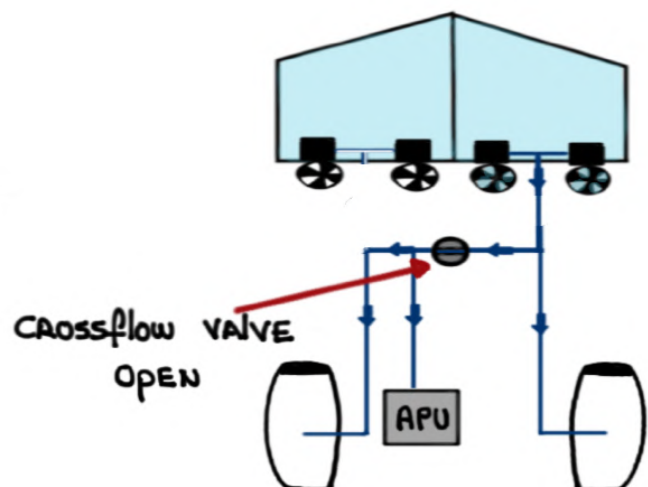
FUEL IS NORMALLY SUPPLIED FROM THE LEFT FUEL MANIFOLD BUT CAN ALSO BE SUPPLIED FROM THE RIGHT MANIFOLD BY TEMPORARILY OPENING THE CROSSFLOW VALVE



L MANifold  
To  
APU



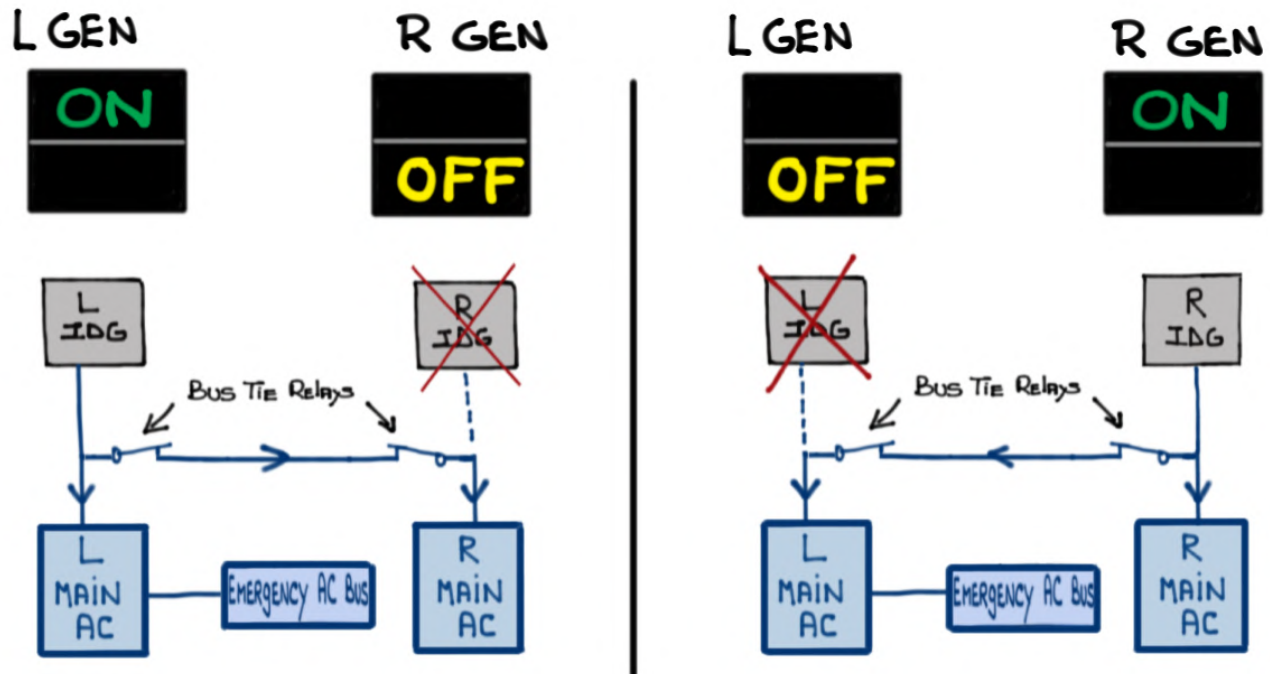
R MANifold  
To  
APU



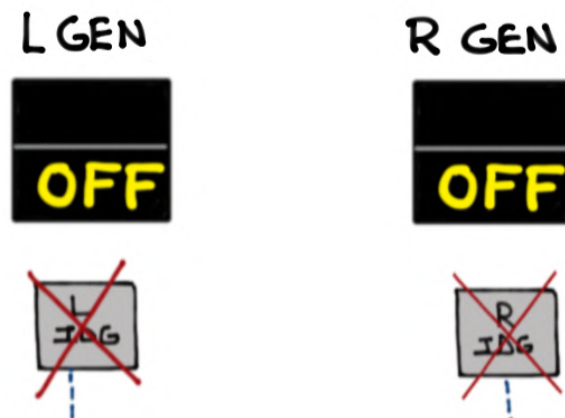
# APU - In flight operation

In flight operation of the APU is prohibited EXCEPT:

- Single IDG failure

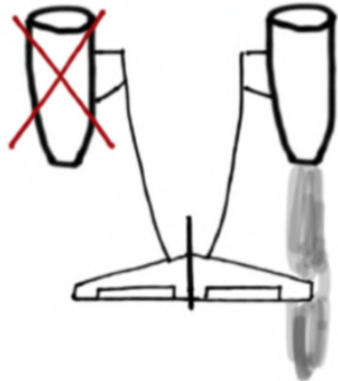


- DUAL IDG failure

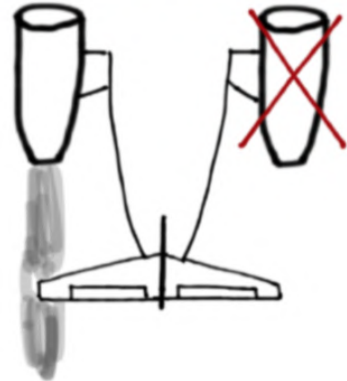


- SINGLE ENGINE failure

L ENGINE FAIL

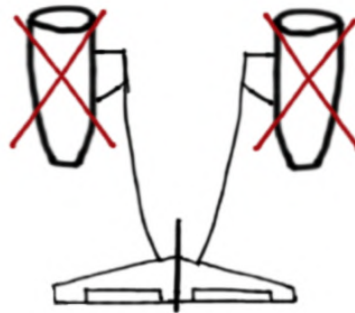


R ENGINE FAIL



- DUAL ENGINE failure

L-R ENGINE FAIL



Refer to AFM OIS **G650ER-2016-03** APU SEALANT

AIRCRAFT SERVICE CHANGE (ASC) **095** :

THIS ASC PROVIDES AN ALTERNATE METHOD  
OF COMPLIANCE (AMOC) WITH FAA

AIRWORTHINESS DIRECTIVE 2017-20-08

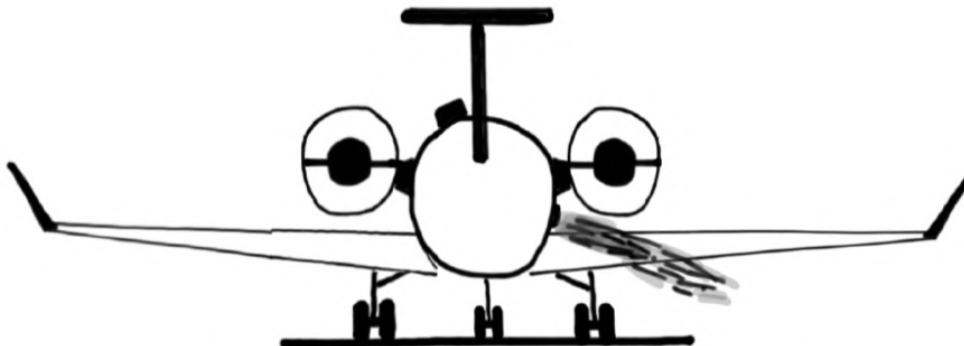
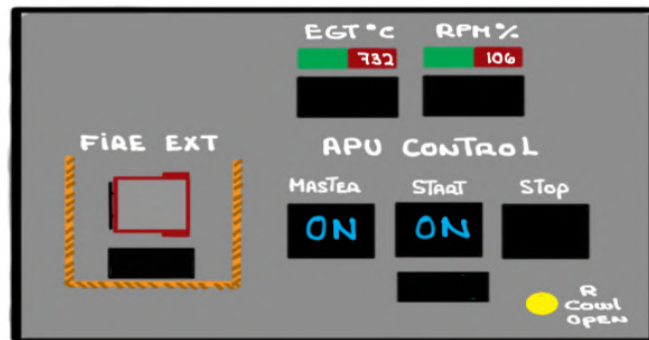
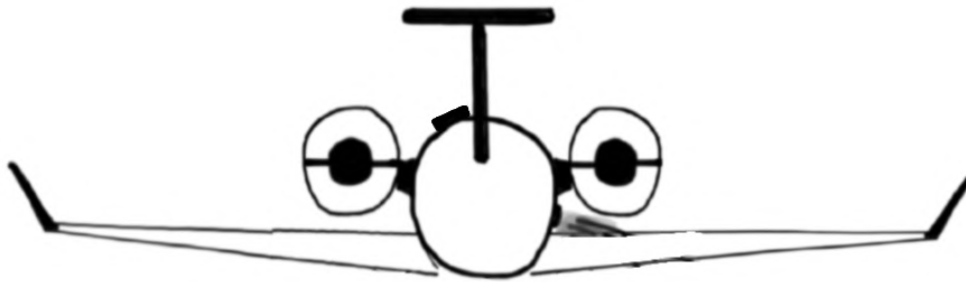
# MAXIMUM ALTITUDE for START

Non ASC 123:

STARTS ARE POSSIBLE FROM

30,000' To 39,000'

GUARANTEED START  $\leq$  30,000'





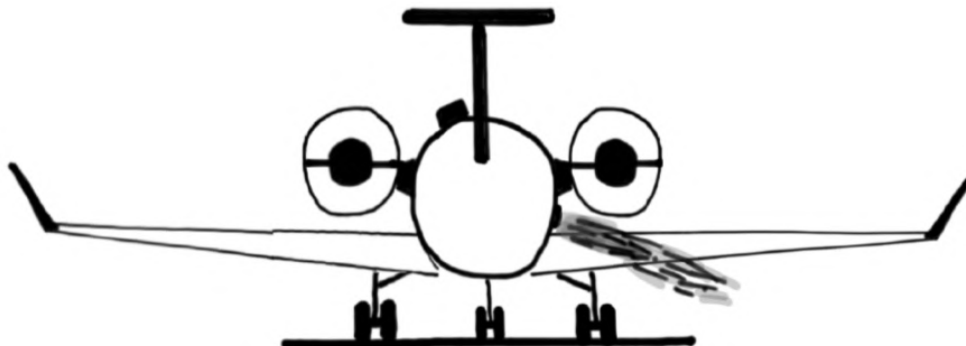
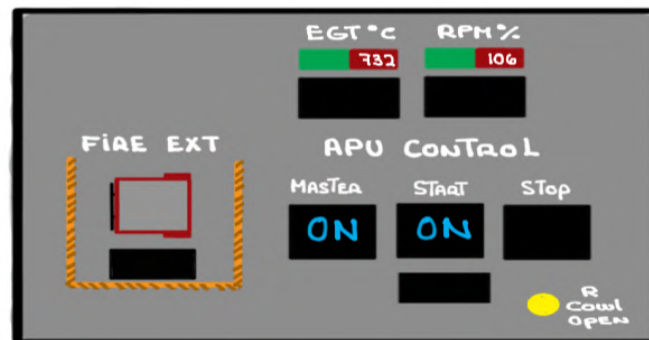
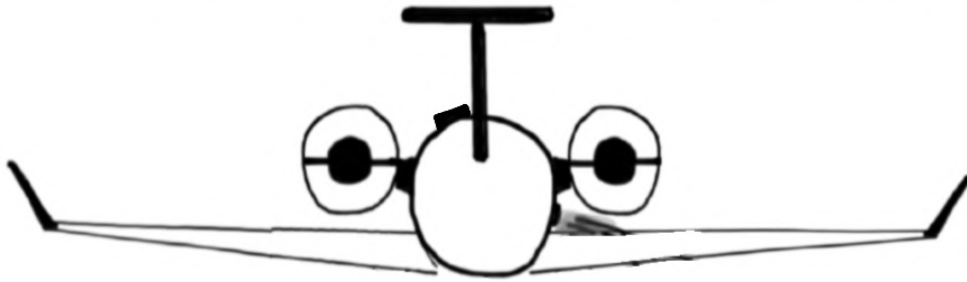
# MAXIMUM ALTITUDE for START

ASC 123:

STARTS ARE POSSIBLE FROM

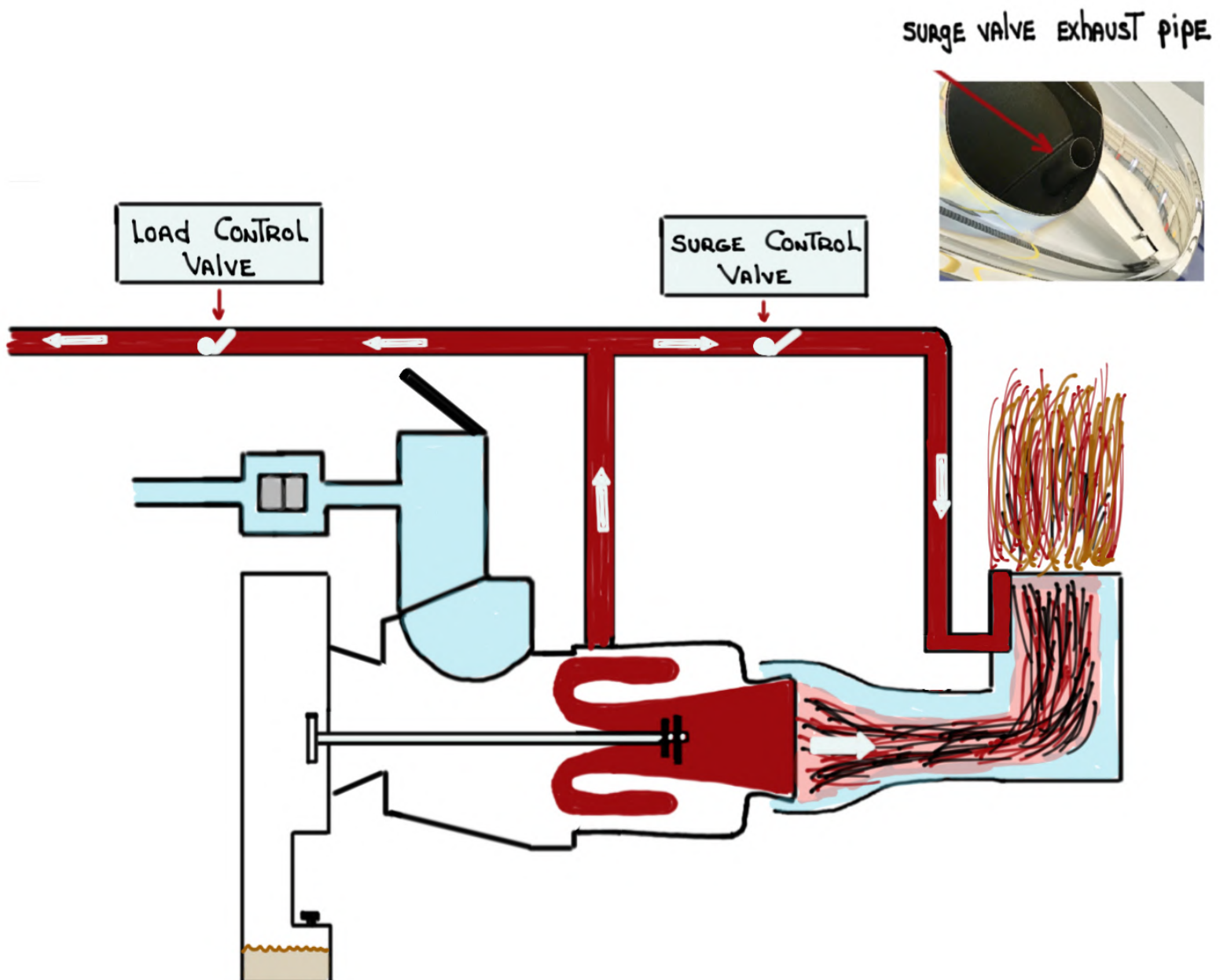
37,000' TO 39,000'

GUARANTEED START  $\leq$  37,000'




# APU SURGE CONTROL VALVE

The **ECU** opens The SURGE CONTROL VALVE when The APU is STARTED in flight  $\geq 16,500'$ . Its purpose is To PREVENT A COMPRESSOR STALL



# APU Shutdown

- When The STOP switch is pressed The  legend illuminates AND The shutdown sequence commences

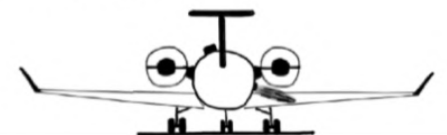


- Unloads electrics and bleed air
- APU enters cool-down mode
  - RPM remains at 100% for 60 seconds
- After cool-down the ECU signals an overspeed condition to shut down the APU
- Any faults detected - CMC and/or CAS
- APU air inlet door closes

> 20,000'

≤ 20,000'

- Unloads electrics and bleed air
- APU enters cool-down mode
  - RPM decreases 1/2 % for 60 seconds (70% RPM)
- After cool-down the ECU signals an overspeed condition to shut down the APU
- Any faults detected - CMC and/or CAS
- APU air inlet door closes



- When The APU MASTER switchlight is pressed in ( $\leq 70\%$  RPM) The following occurs:

A. MASTER Switch legend EXTINGUISHES

B. APU fuel shutOff VALVE closes

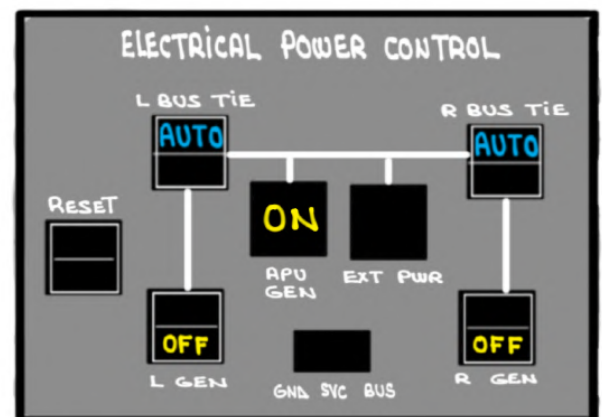
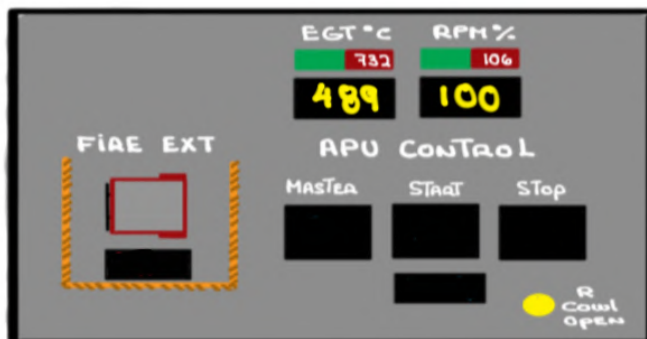
C. APU immediately shuts down

D. INLET door begins to close



If The APU is OPERATING pressing The APU switchlight will shutdown The APU immediately.

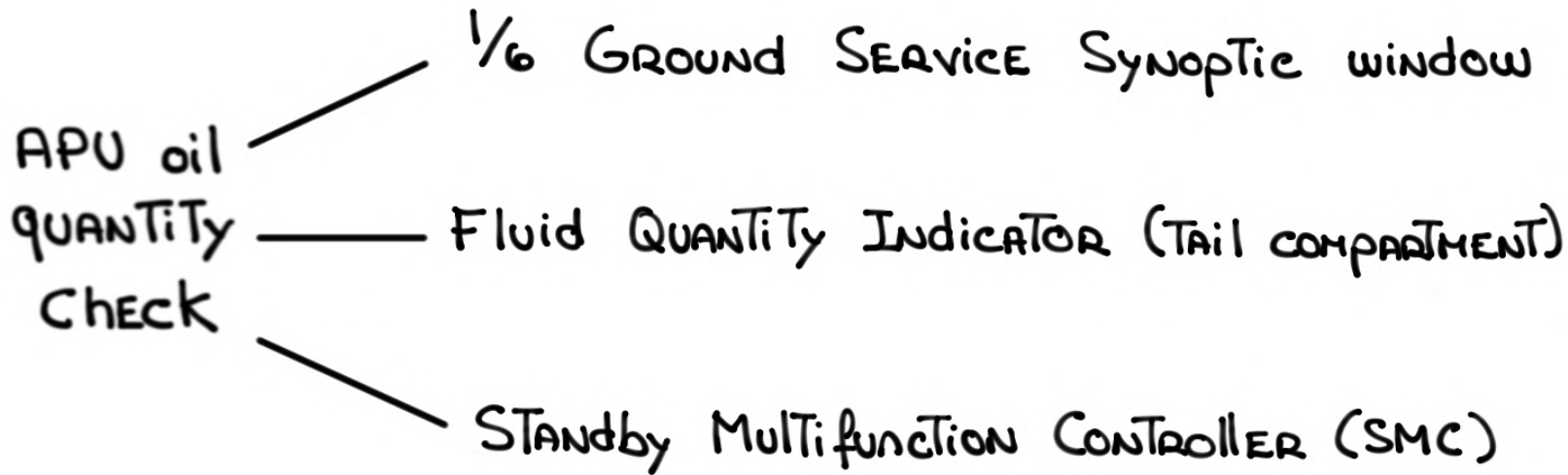
This is NOT RECOMMENDED.





# APU OIL SERVICING

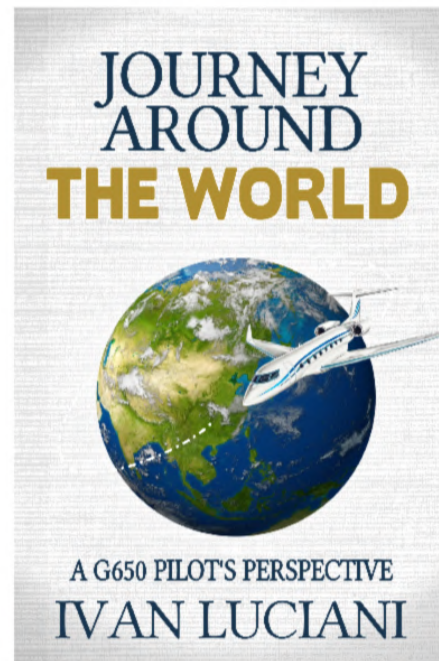
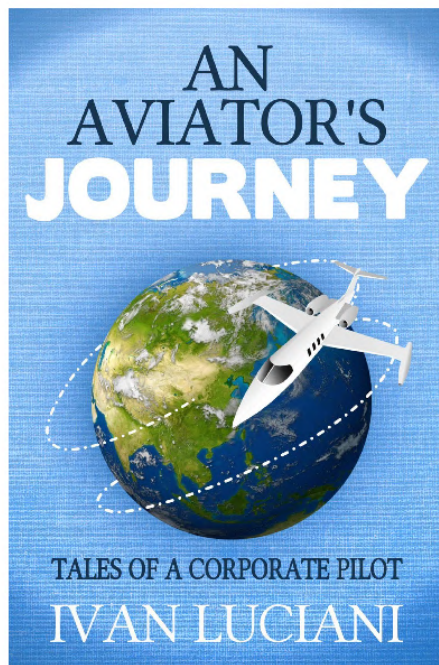
FifTEEN (15) To ThIRTy (30) MINUTES AfTER SHUTDOWN



**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!