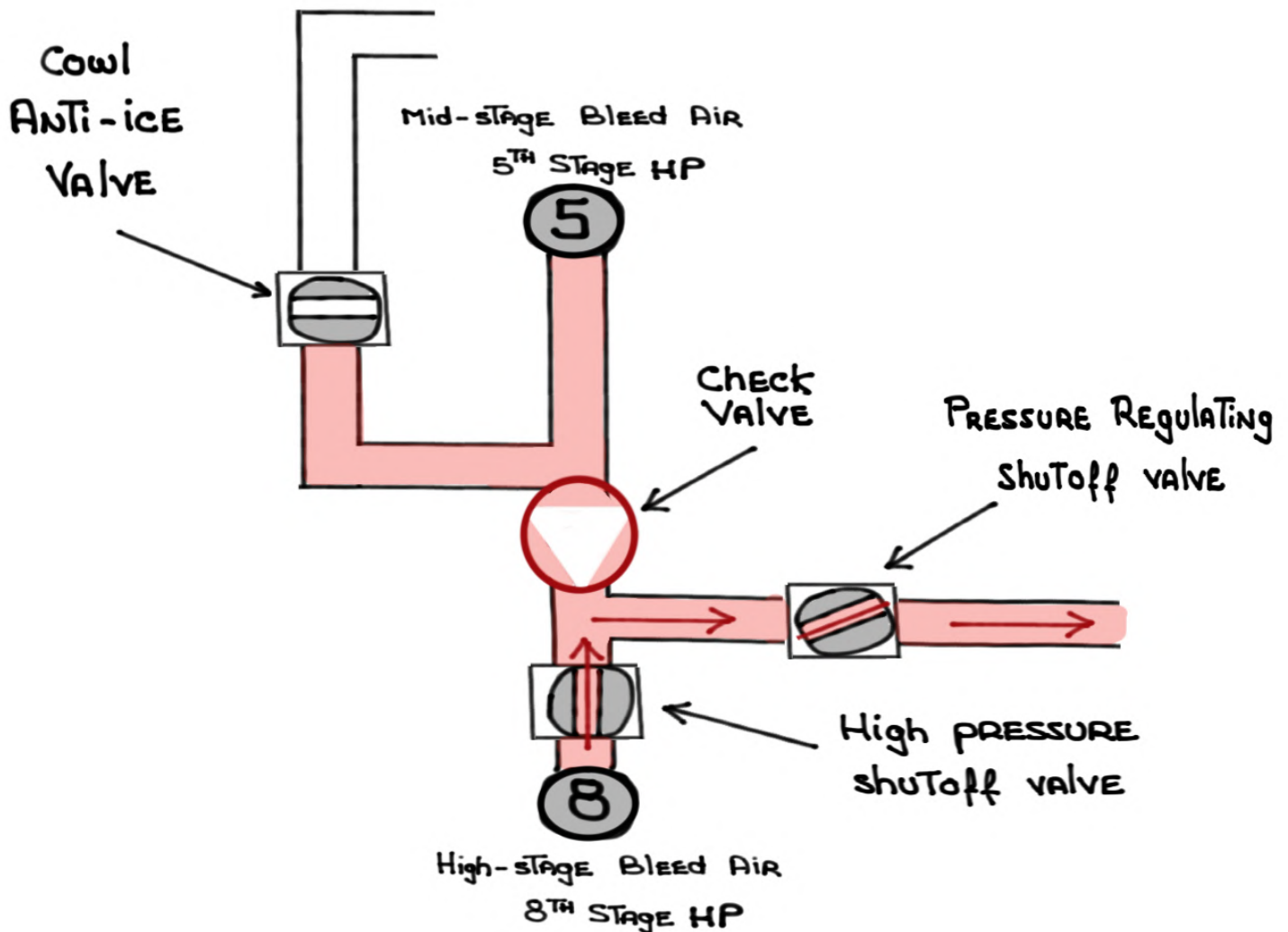
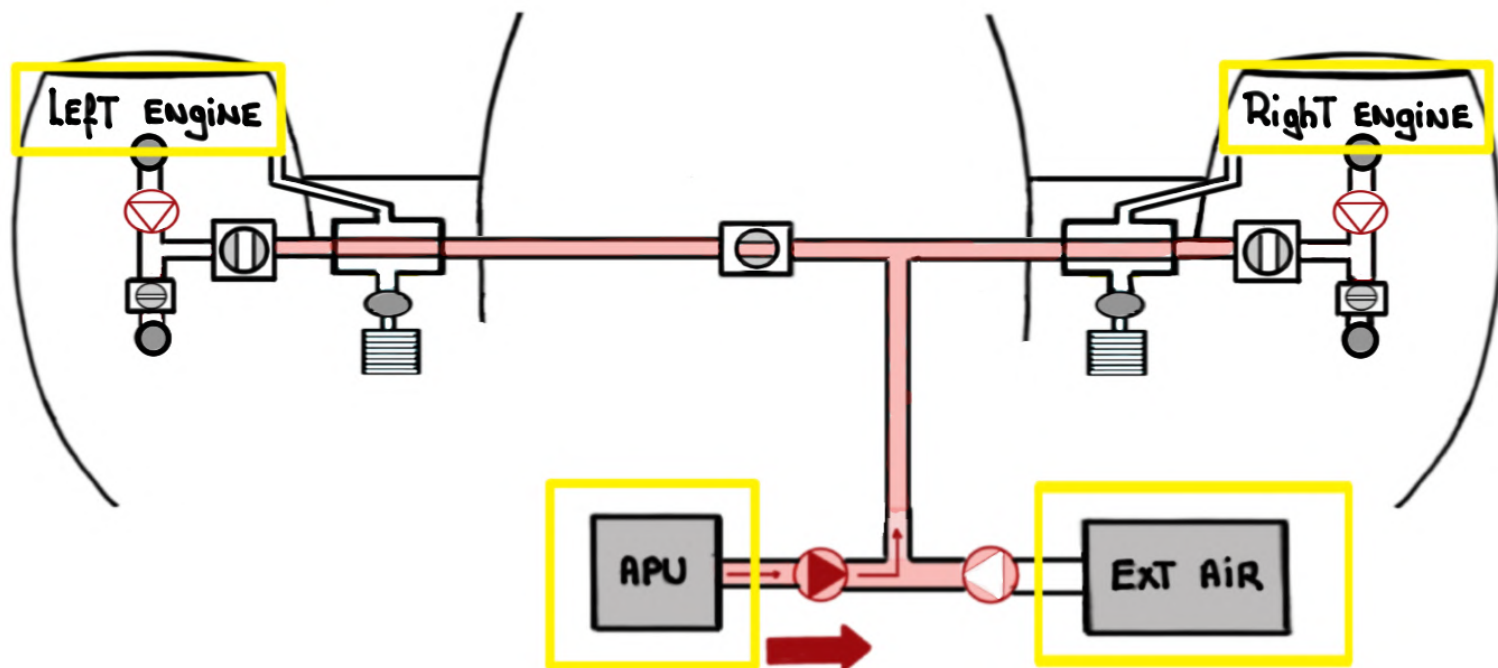


# G650 PNEUMATIC System



For study purposes only

The PNEUMATIC System is about The generation of **High PRESSURE/TEMPERATURE** air from:

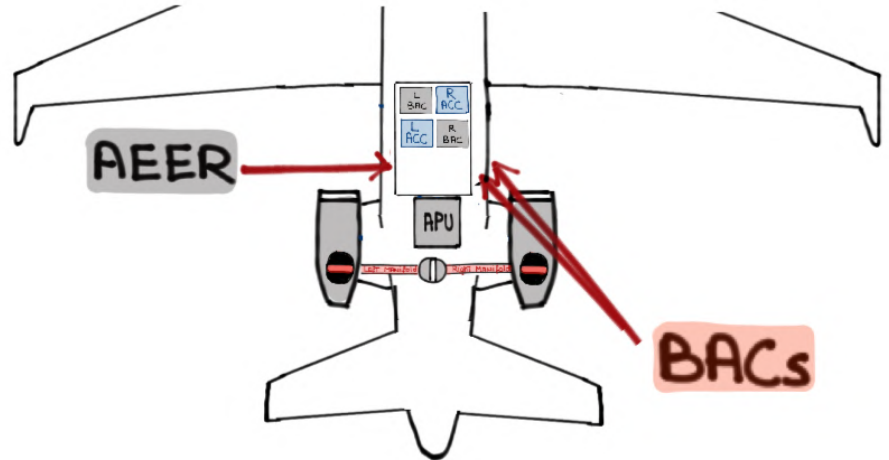
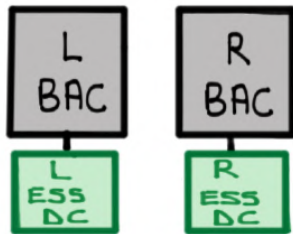


High **PRESSURE/TEMPERATURE** air is utilized by:

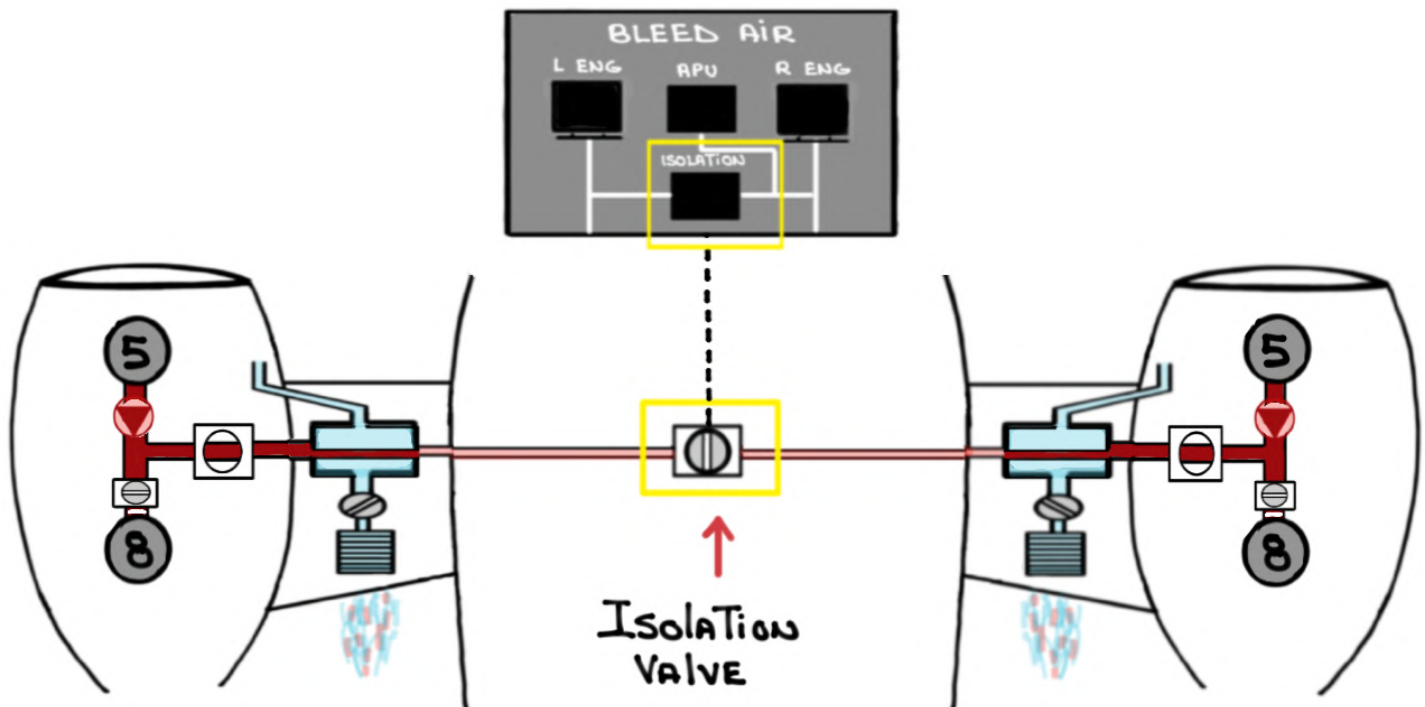
- ENGINE STARTING SYSTEM
- Cowl/Wing anti-ice systems
- Air Conditioning/PRESSURIZATION SYSTEMS
- POTABLE WATER SYSTEM
- TAT probe airflow (**ground only**)
- OTHER SYSTEMS

# PNEUMATIC SYSTEM Sub-COMPONENTS

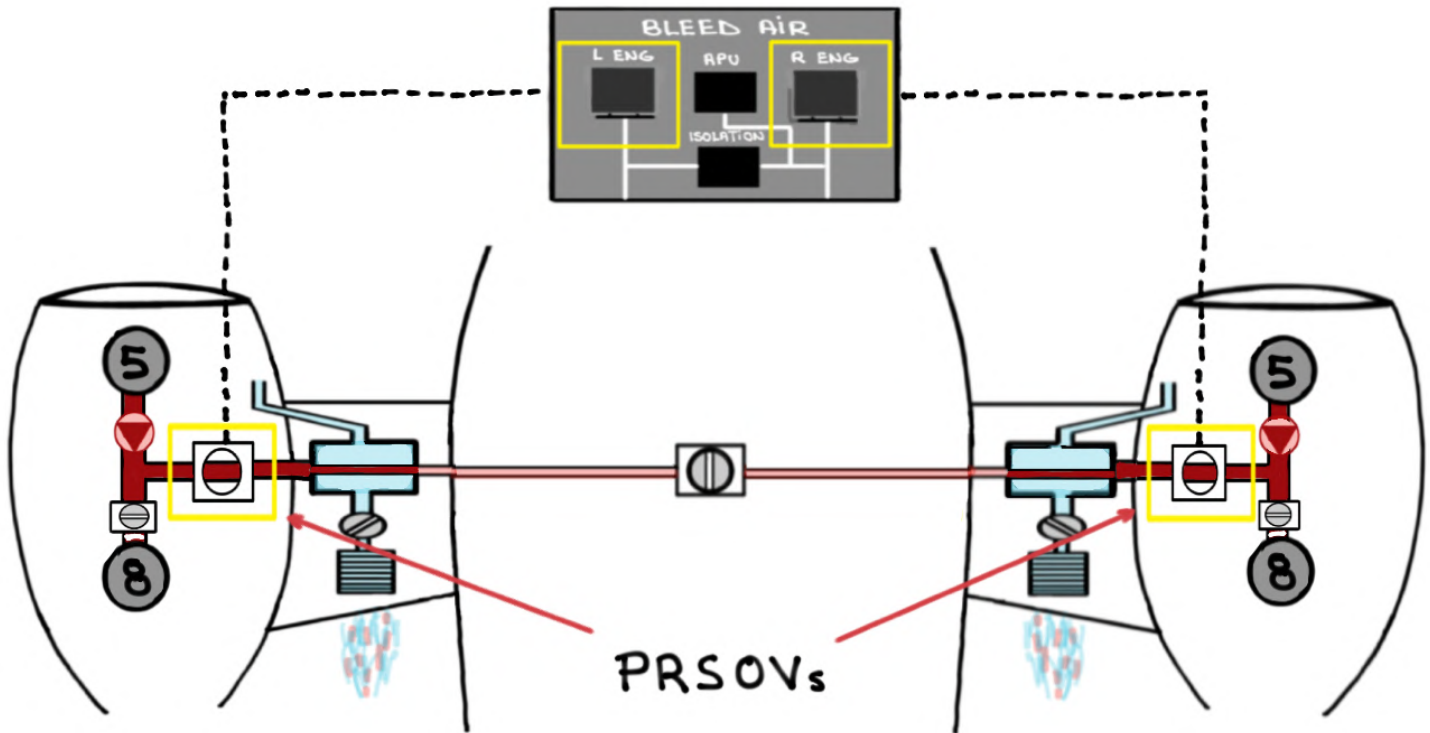
## - BLEED AIR CONTROLLERS (BACs)



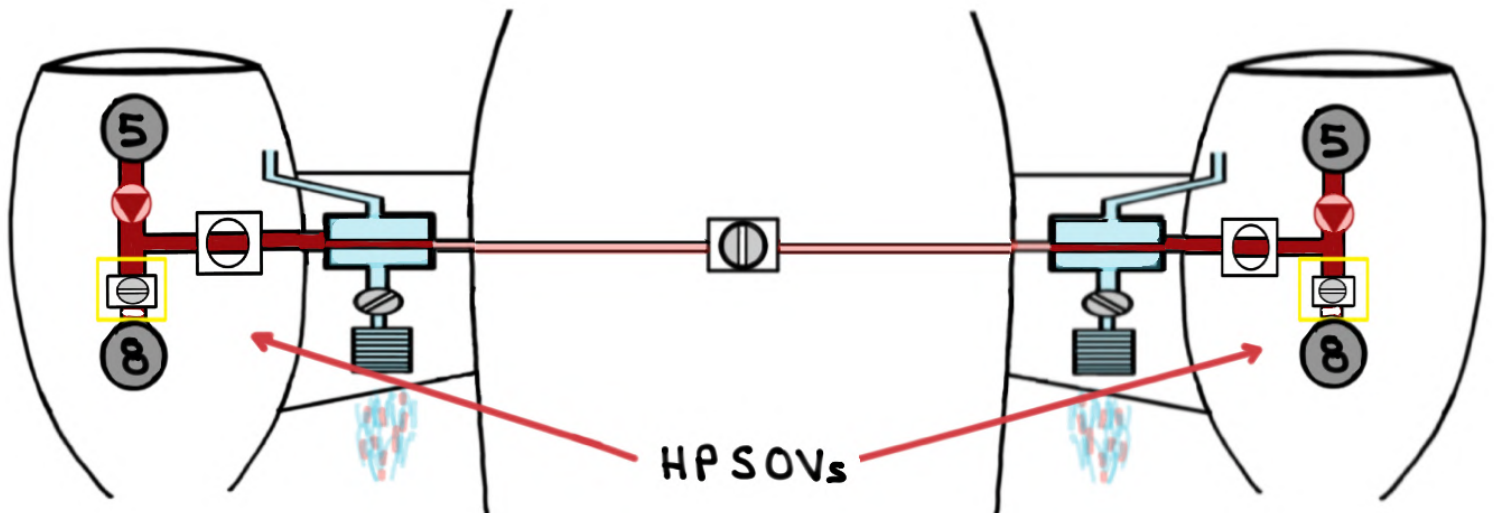
## - ISOLATION VALVE



## - PRESSURE REGULATING/ShUTOff valves (PRSOV)

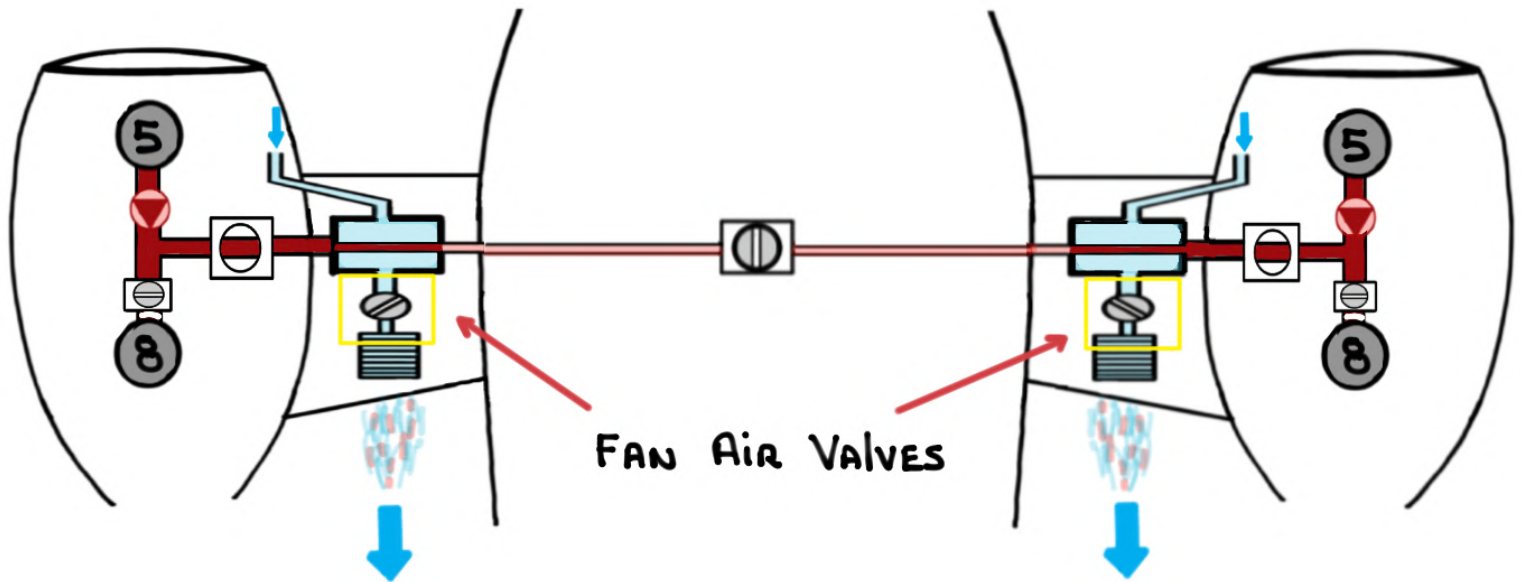


## - High-PRESSURE ShUTOff Valves (HPSOV)

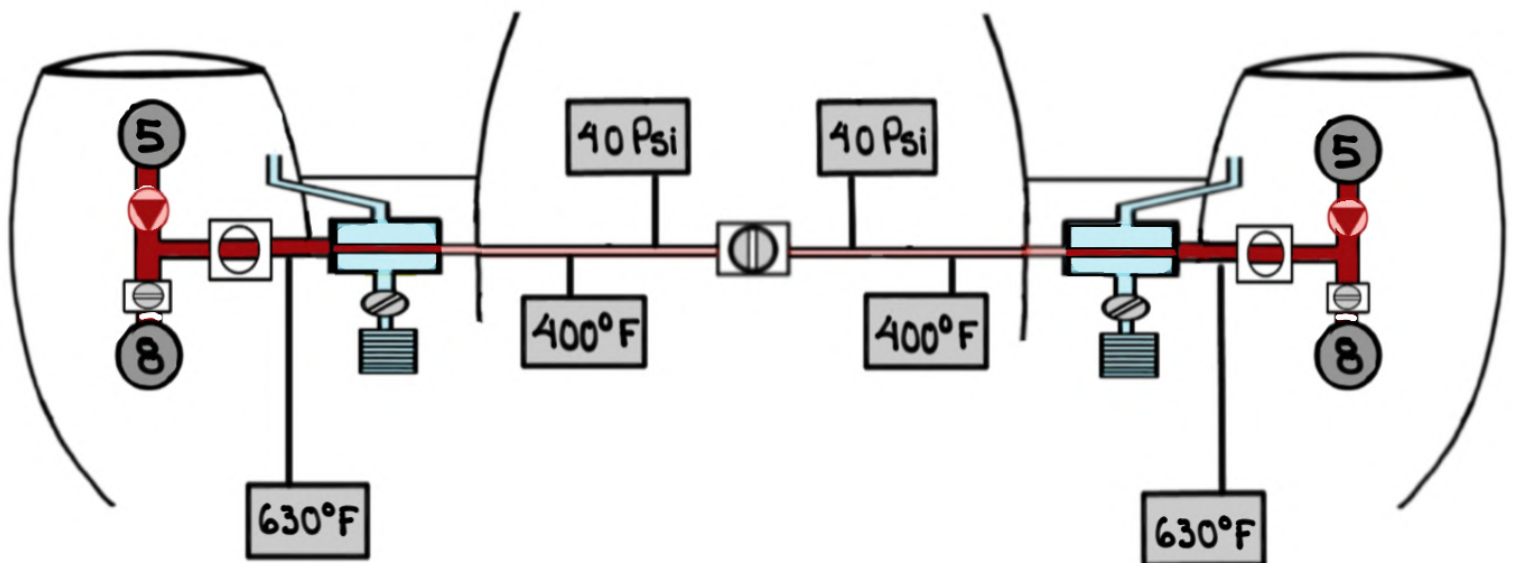




## - FAN Air VALVES



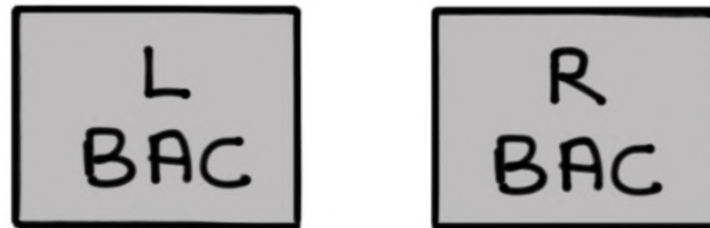
## - PRESSURE/TEMPERATURE SENSORS



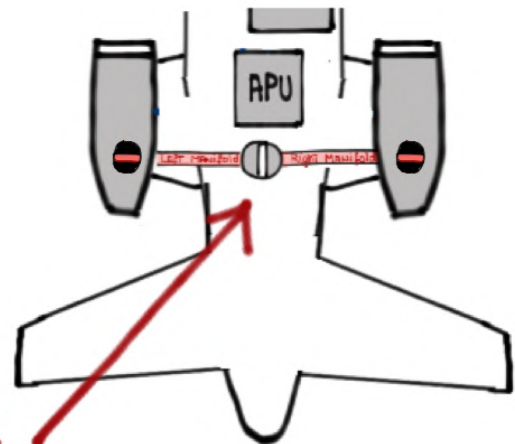
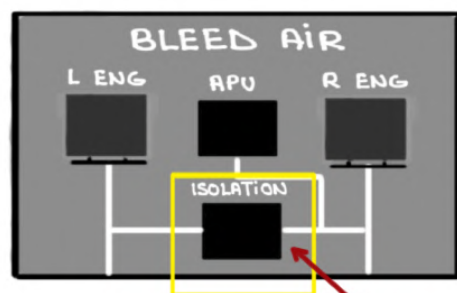


# BLEED AIR CONTROLLERS (BACs)

The PNEUMATIC SYSTEM is REGULATED by Two (2) IDENTICAL AND INTERCHANGEABLE MICROPROCESSORS

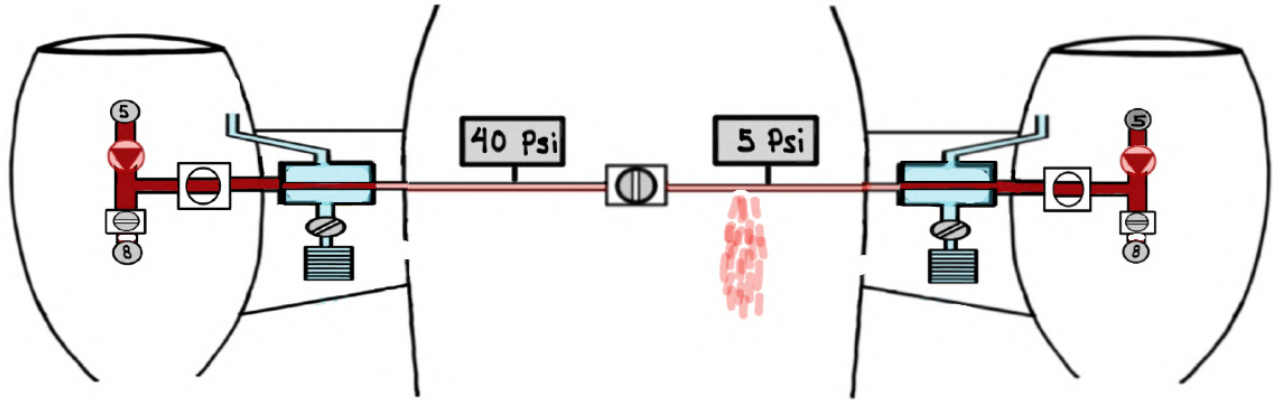


- THE BACs ARE THE brains of THE system
- THE BACs CONTROL MOST PNEUMATIC functions VIA TWO (2) SEPARATE AND INDEPENDENT MANIFOLDS
- PNEUMATIC MANIFOLDS CAN BE CONNECTED BUT ARE NORMALLY OPERATED IN ISOLATION VIA AN ISOLATION VALVE

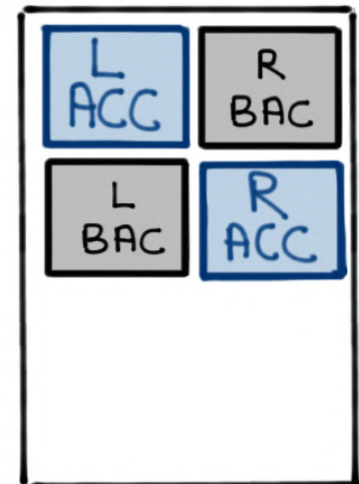
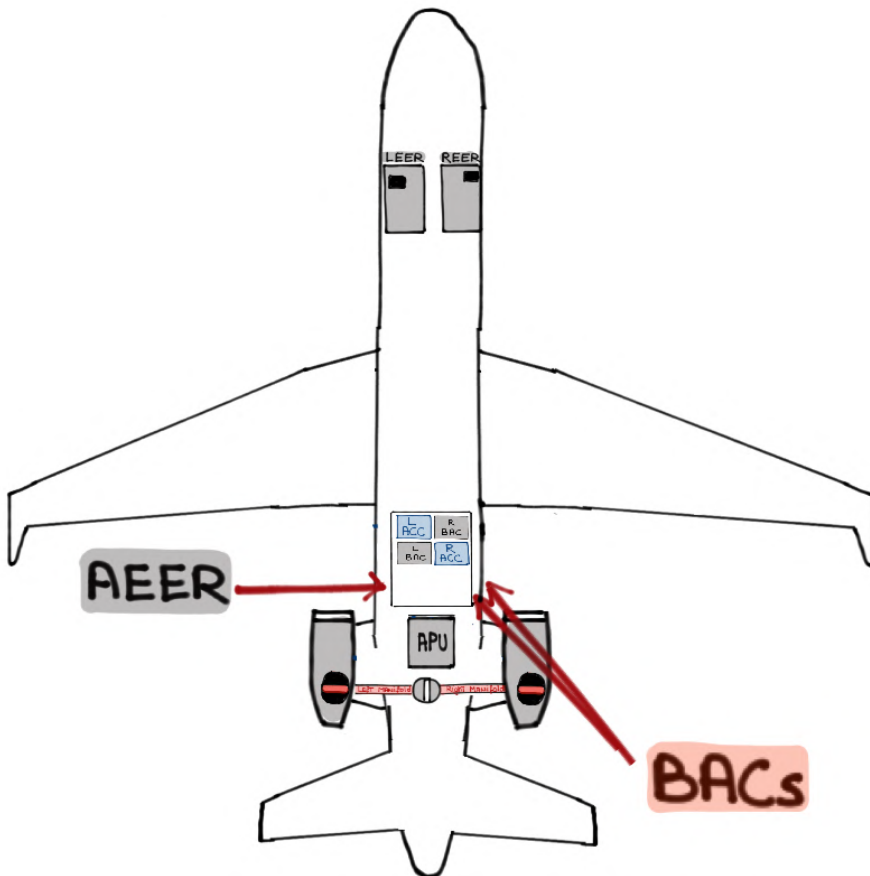


ISOLATION VALVE  
CLOSED

- This design PREVENTS TOTAL loss of PNEUMATIC AIR in THE EVENT of A LEAK in ONE of THE MANIFOLDS



- The BACs ARE LOCATED in THE AEER

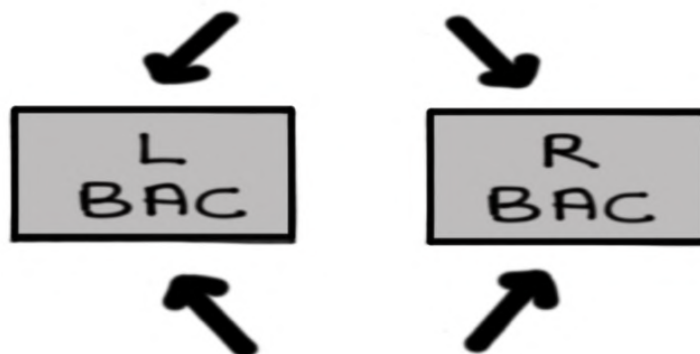




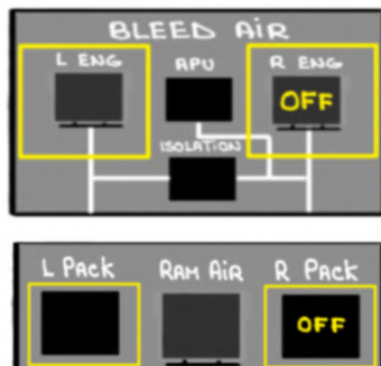
- The L  
BAC R  
BAC RECEIVE DATA AND Cockpit input  
from The following SOURCES:

### DATA input:

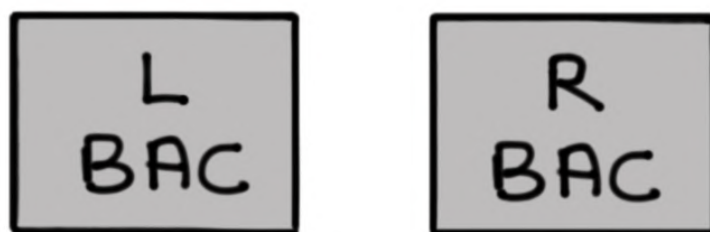
- Aircraft ALTitude
- Static Air TEMPERATURE (SAT)
- Engine LP RPM
- PRECOOLER INLET TEMPERATURE
- PRECOOLER OUTLET TEMPERATURE
- BLEED MANifold PRESSURE
- Wing ANTI-ICE TEMPERATURE



### Cockpit input:



- The L  
BAC R  
BAC PROCESS DATA AND Cockpit input  
AND BASED ON SYSTEM REQUIREMENTS COMMAND  
THE following VALVES TO MODULATE AS REQUIRED:

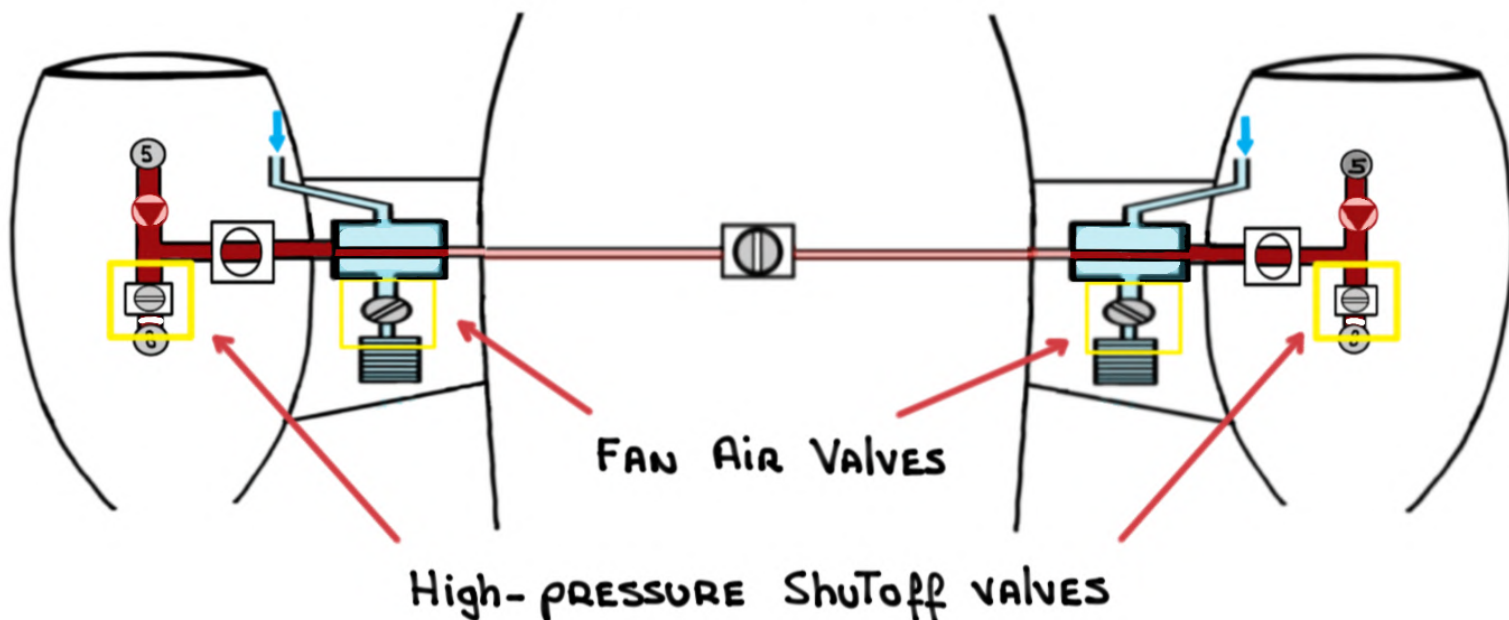


MODULATE:

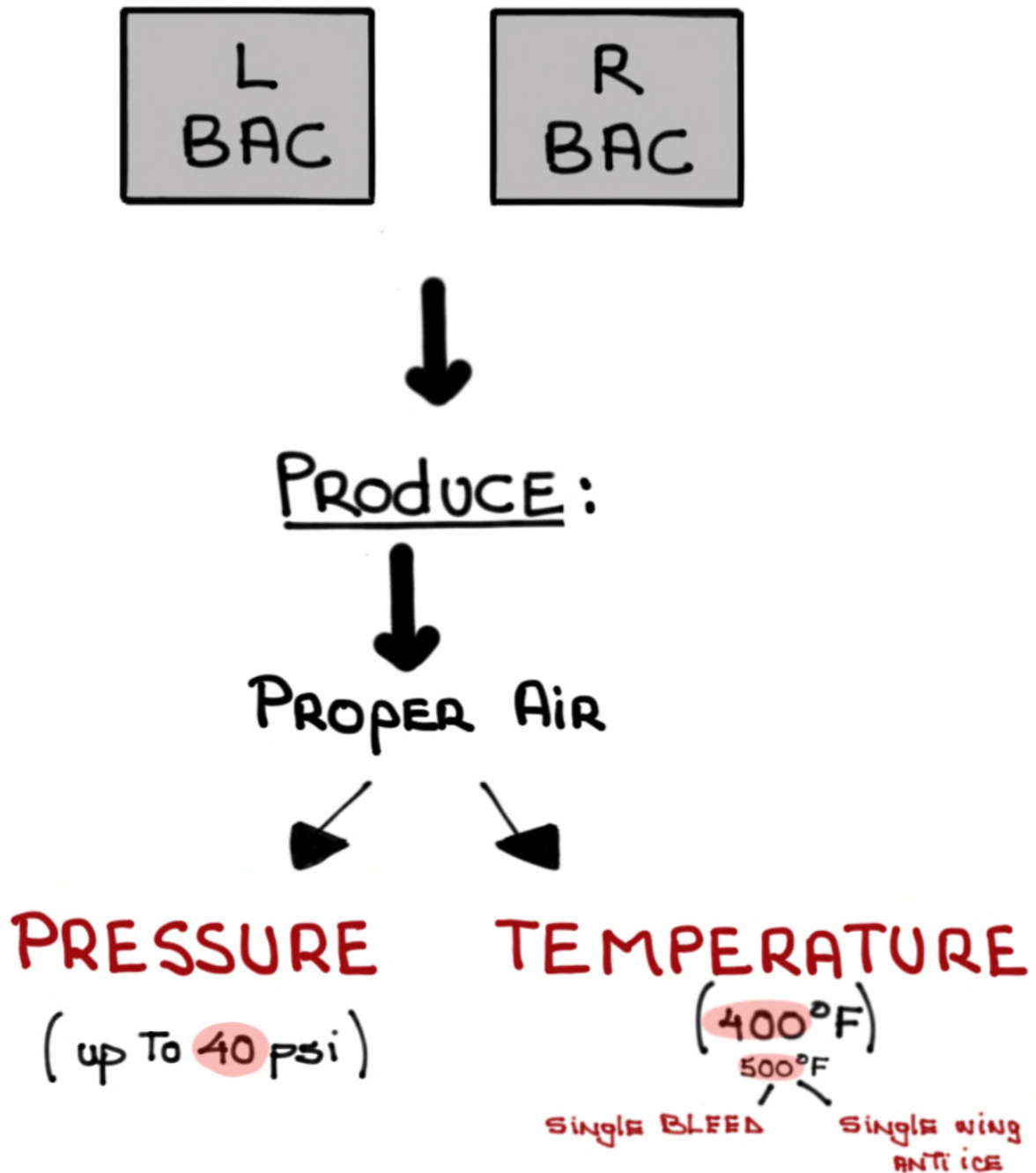
High-PRESSURE ShutOff VALVES (HPSOV)

X

FAN Air VALVES

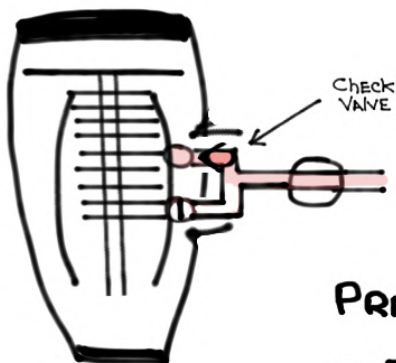
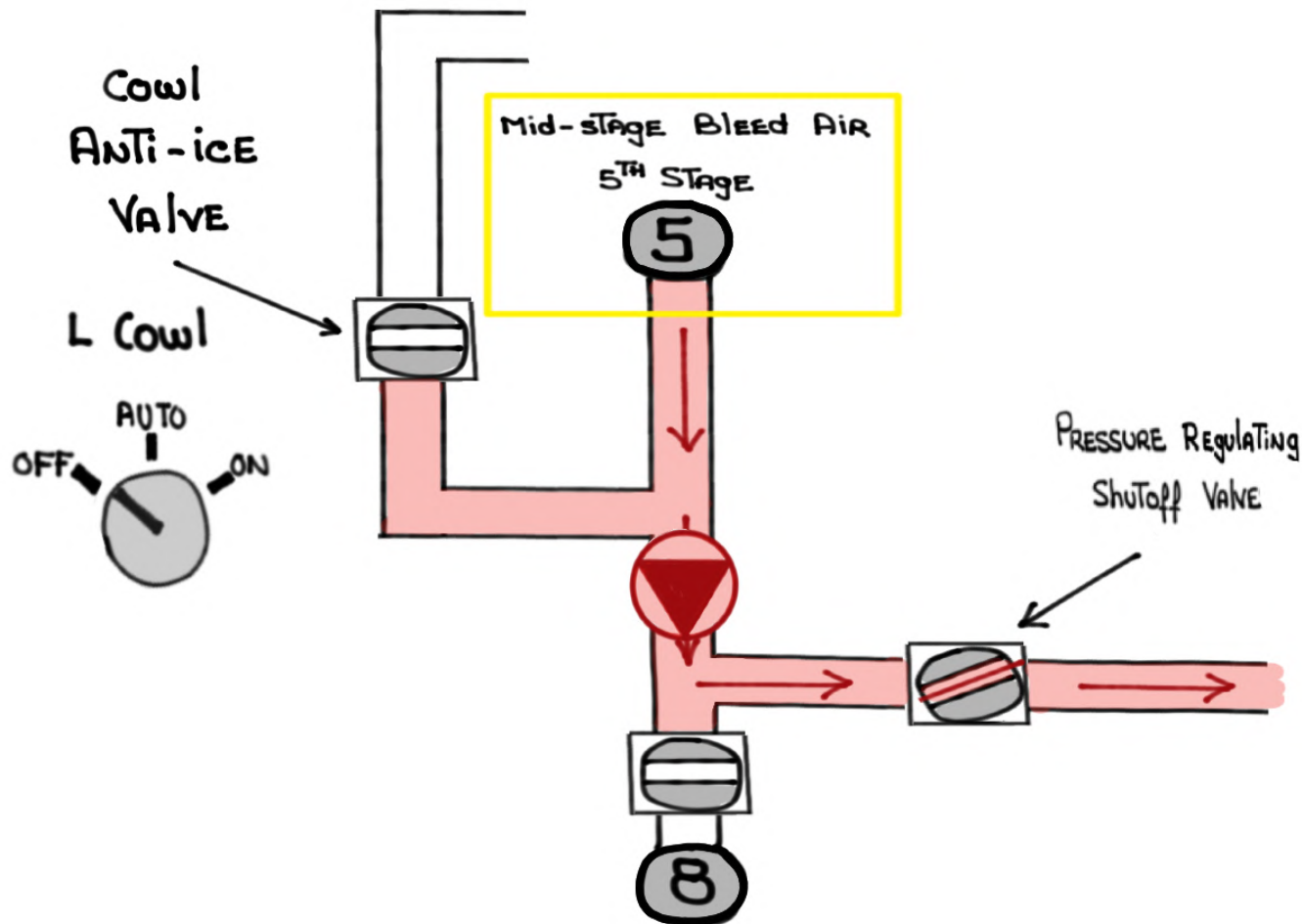


- The L  
BAC R  
BAC MODULATE THESE VALVES IN ORDER  
TO PRODUCE PROPER AIR BASED ON SPECIFIC SYSTEM  
REQUIREMENTS



# MAIN ENGINES BLEED AIR

- ① Mid-STAGE bleed (5<sup>TH</sup> STAGE of HP COMPRESSOR).  
If INSUFFICIENT, in TERMS of **PRESSURE** AND **TEMPERATURE**, will use High-STAGE bleed air INSTEAD

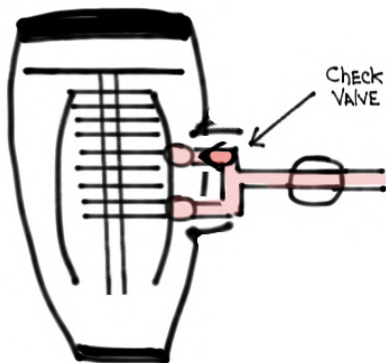
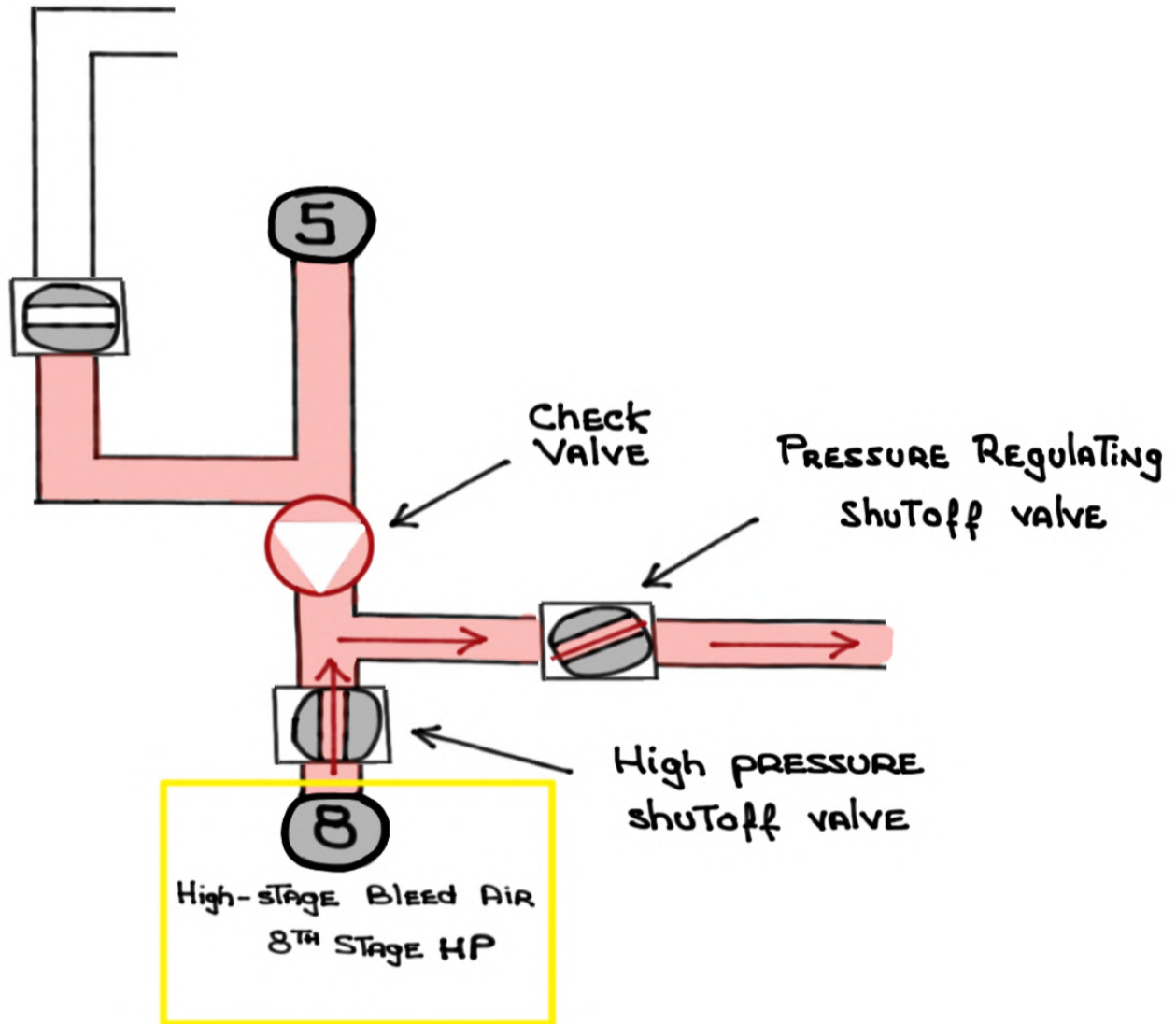


- 5<sup>TH</sup> STAGE port
- 5<sup>TH</sup> STAGE check valve

PREVENTS higher PRESSURE 8<sup>TH</sup> STAGE bleed FROM ENTERING THE 5<sup>TH</sup> STAGE port

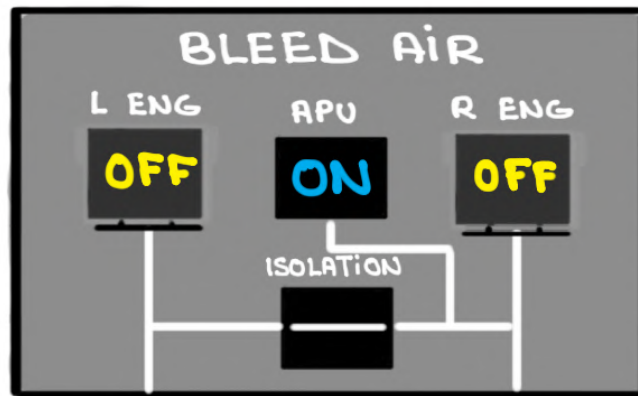


## ② High-STAGE bleed (8<sup>TH</sup> STAGE of HP COMPRESSOR)

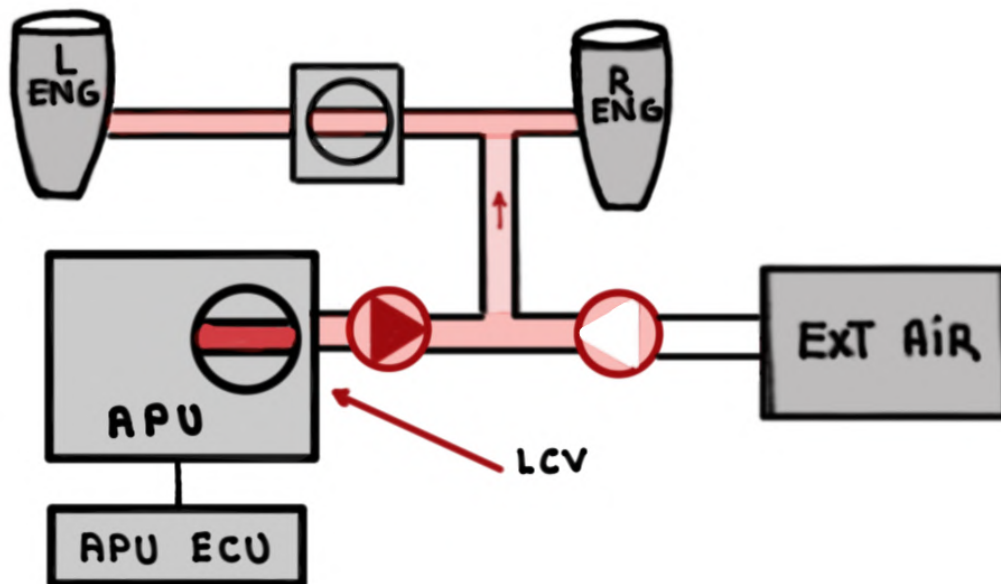


- 8<sup>TH</sup> STAGE PORT
- 8<sup>TH</sup> STAGE VALVE

# APU BLEED AIR



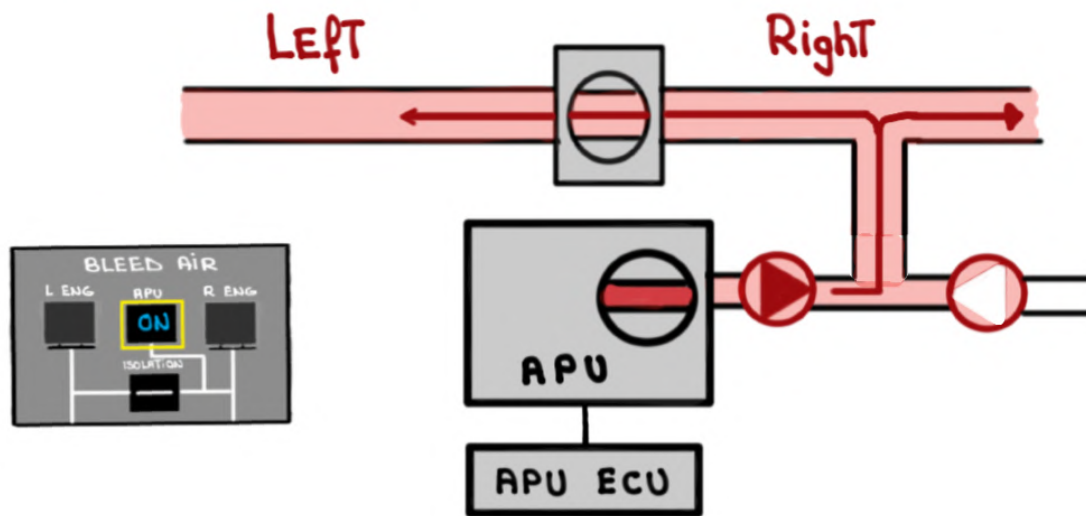
The APU's Load Control Valve (LCV) allows High PRESSURE/TEMPERATURE AIR INTO THE LEFT AND RIGHT PNEUMATIC MANIFOLDS




APU bleed air plumbing CONNECTS directly To The **R** MANifold

SELECTION of APU bleed air OPENS The Isolation VALVE. This allows bleed air TO ENTER THE **L** MANifold

- WOW-**G**
- APU stabilized AT **100%** RPM
- ONE **(1)** MINUTE delay if EGT < **149°C**



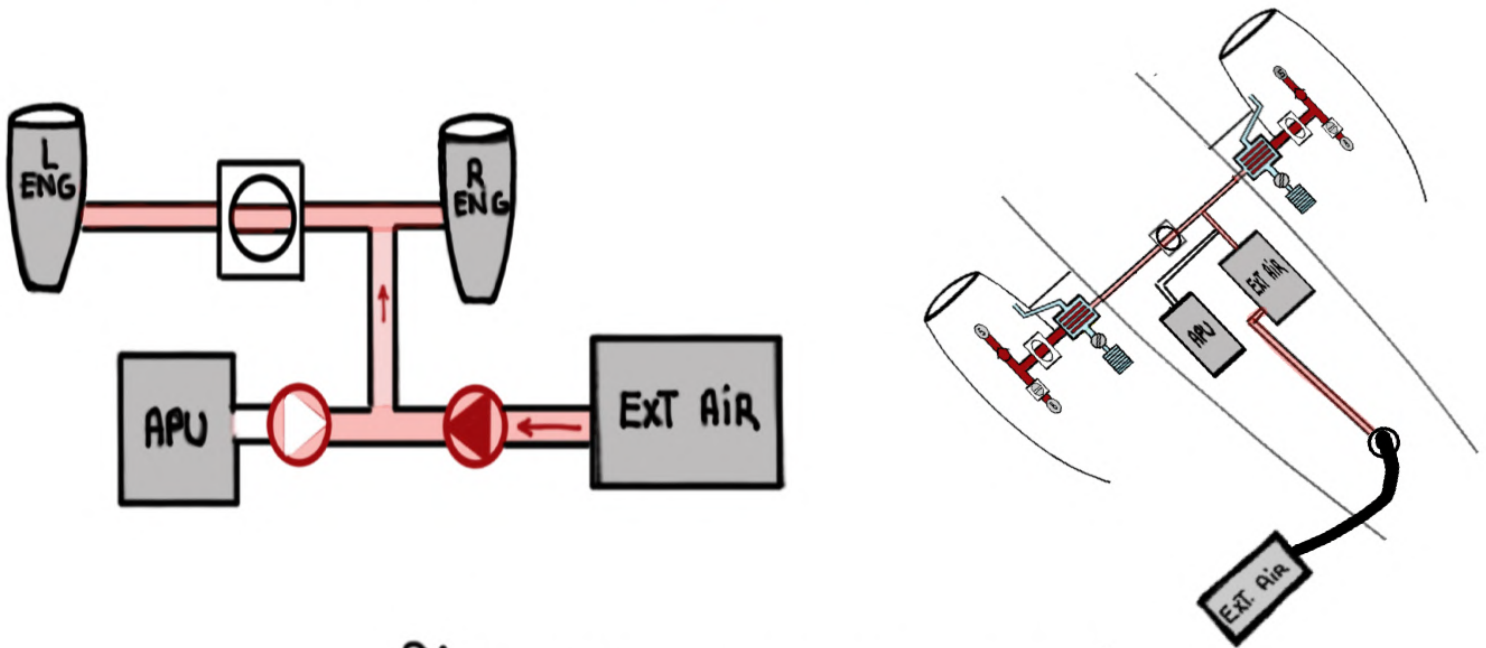
APU bleed air is AVAILABLE IMMEDIATELY TO RESTART AN ENGINE in flight – WOW-**A**

A flapper-Type check valve  OPENS when APU OR EXTERNAL Air PRESSURE is GREATER THAN manifold PRESSURE. This allows The APU OR EXTERNAL Air SOURCE To PRESSURIZE The PNEUMATIC manifold

The check valve  PROTECTS The APU FROM REVERSE flow ORIGINATING FROM The ENGINE

# EXTERNAL AIR

- PROVIDES AIR FOR MAIN ENGINE START WHEN THE APU IS UNAVAILABLE
- CONNECTS TO THE **Right** bleed air manifold



PLACARD ON ACCESS PANEL:

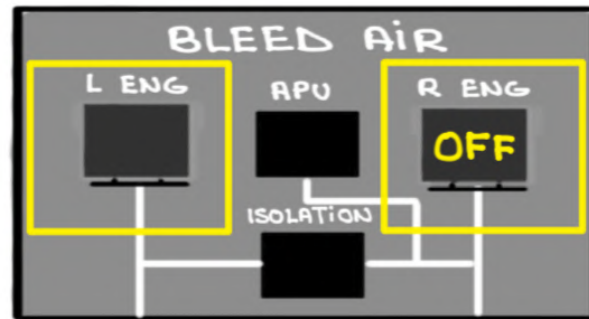
DO NOT CONNECT WITHOUT  
ELECTRICAL POWER ON

- DC POWER IS REQUIRED TO OPEN THE ISOLATION VALVE AND THE **L PACK** **R PACK**
- PREVENTS DAMAGE TO THE PACKS DUE TO UNREGULATED AIR



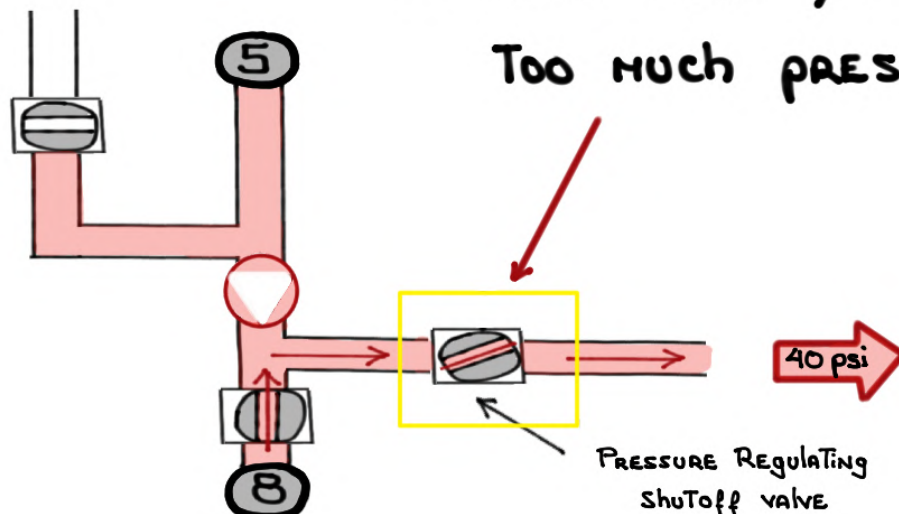
# PRESSURE REGULATING/shutoff VALVE (PRSOV)

- LOCATED ON EACH ENGINE
- FUNCTION AS ON/OFF VALVES TO THE PNEUMATIC MANIFOLD
- CONTROLLED BY THE LEFT AND RIGHT BLEED AIR SWITCHES



- MODULATE AS NEEDED IN ORDER TO MAINTAIN  
up To **40 Psi**

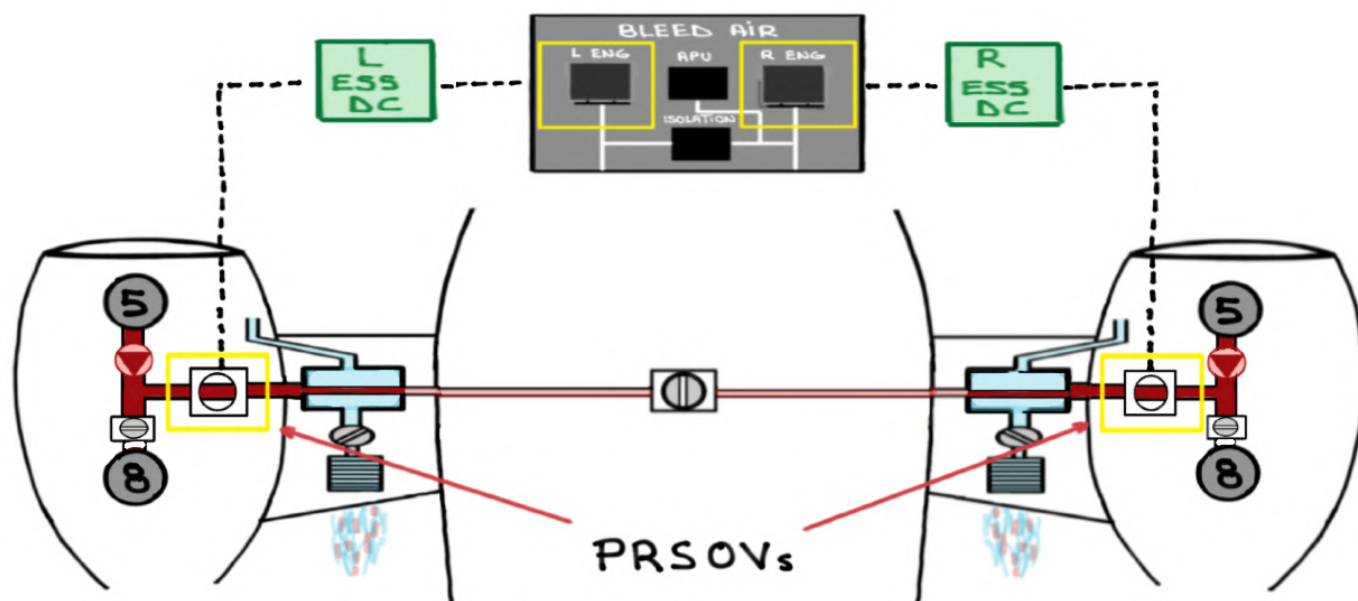
"TO MAKE SURE YOU DON'T HAVE  
TOO MUCH PRESSURE"



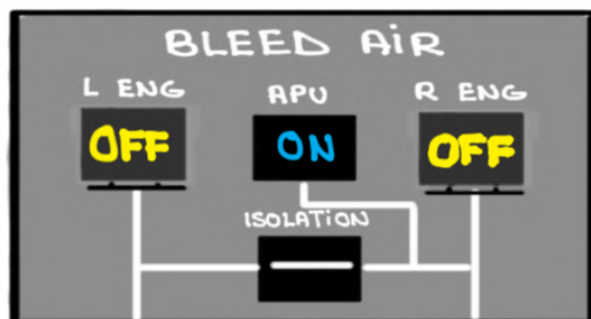
- ELECTRO-PNEUMATIC VALVES. THEY REQUIRE:

- ELECTRICAL power To OPERATE
- PNEUMATIC pressure To OPEN

- Without   bus power will NOT operate

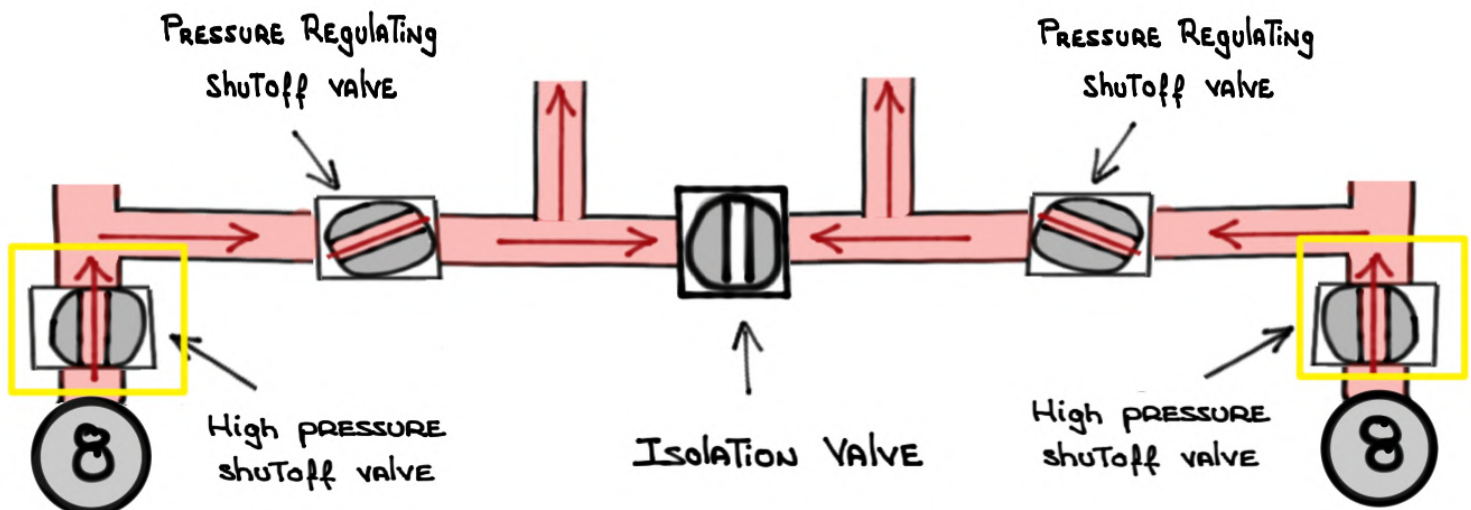
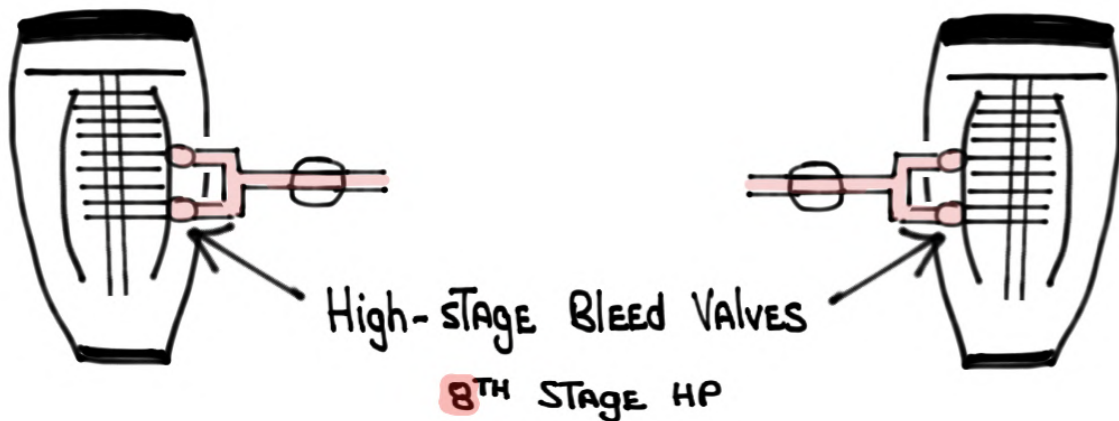
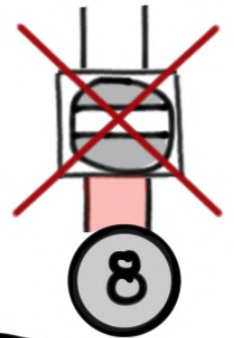


- The bleed air switches MUST BE OFF for ENGINE START TO PREVENT A **HOT** START



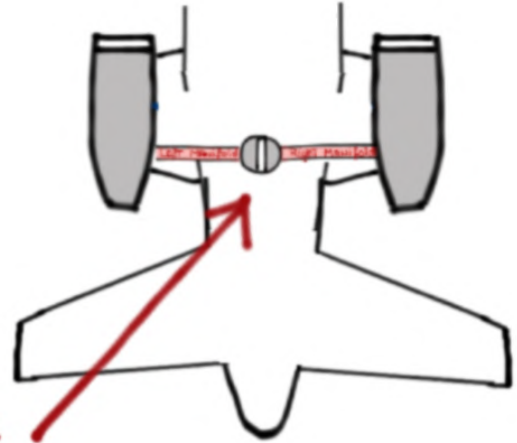
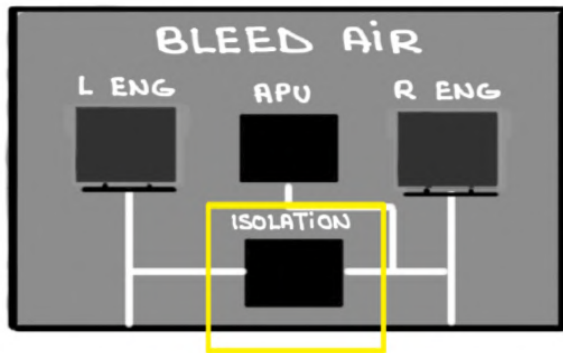
# High-STAGE BLEED AIR VALVES

- High PRESSURE ShutOff Valves (HPSOV)
- LOCATED ON EACH ENGINE
- COMMANDED TO MODULATE AS NEEDED by THE BACs when mid-STAGE bleed air (5<sup>TH</sup>) is insufficient
- Spring-loaded AND fail CLOSED



# ISOLATION VALVE

- LOCATED IN THE TAIL COMPARTMENT



ISOLATION VALVE  
CLOSED

- POWERED by 

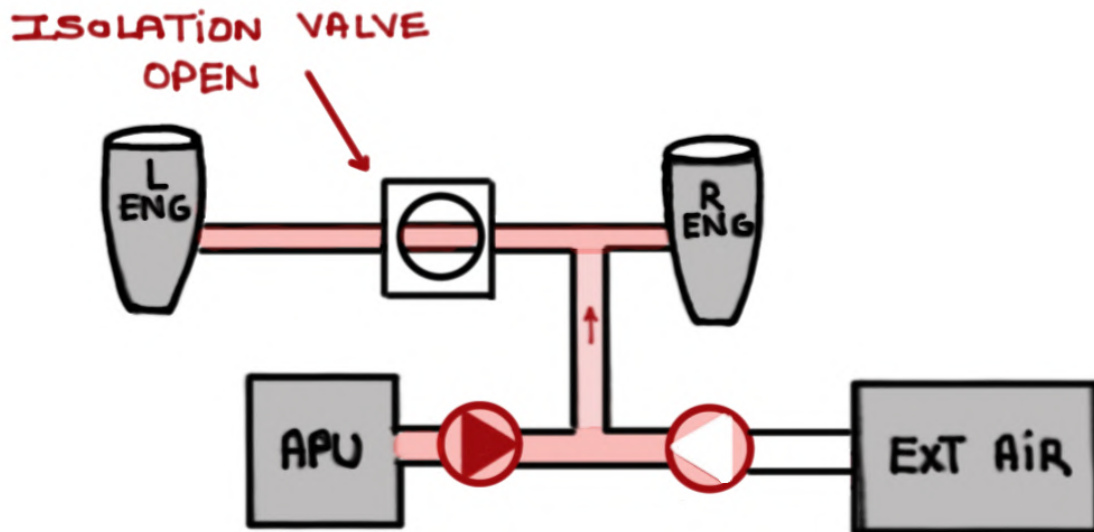
L  
ESS  
DC

 bus
- Without 

L  
ESS  
DC

 bus power will NOT operate
- ELECTRO-PNEUMATIC VALVES. They REQUIRE:
  - ELECTRICAL power to operate
  - PNEUMATIC pressure to open
- FAILS frozen (i.e., its last position)





- The Isolation Valve opens:

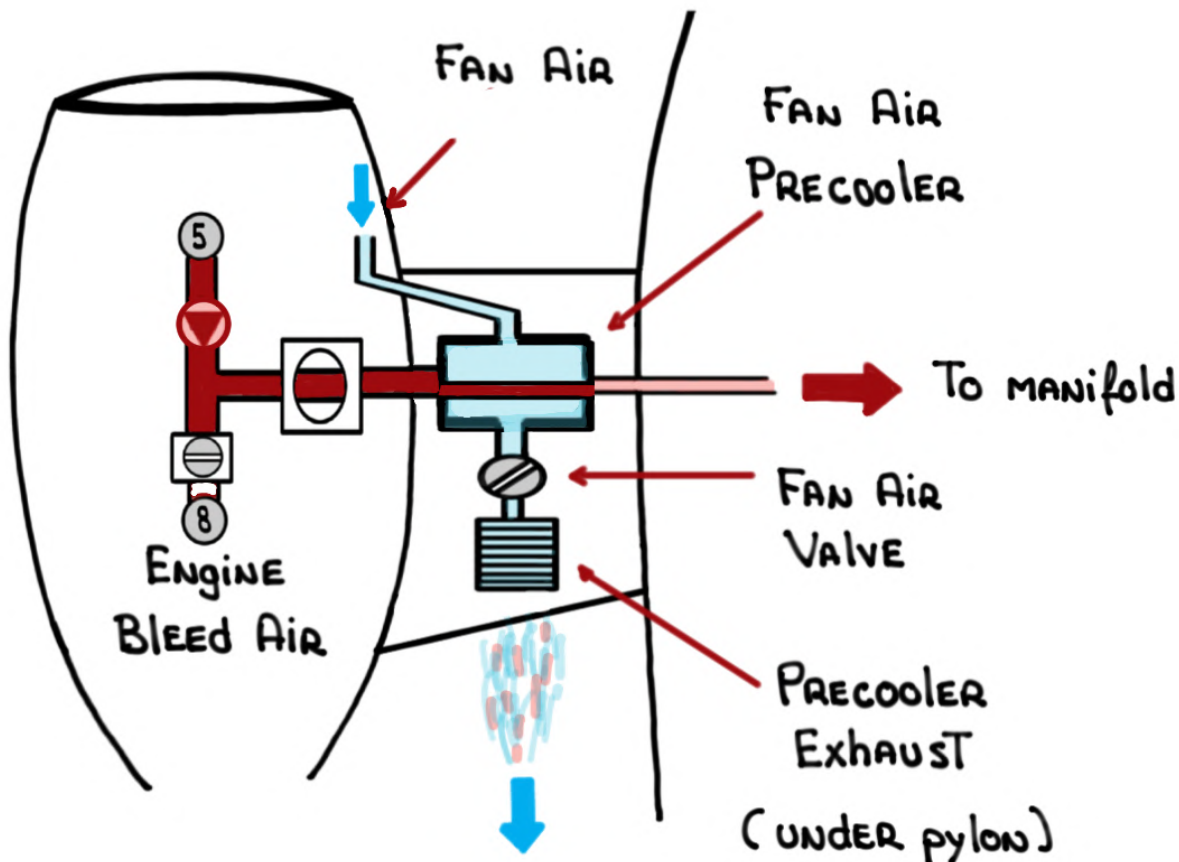


③ APU bleed **ON** (100% RPM / 60 seconds)  
And WOW - **GROUND**

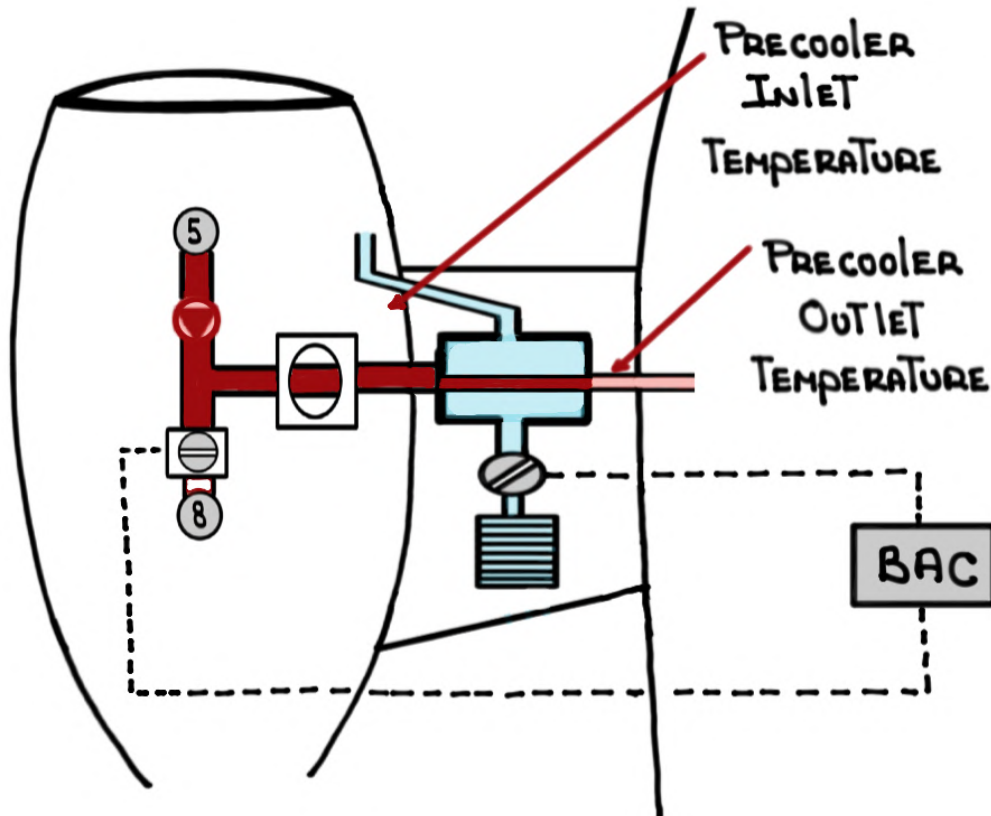
④ Isolation switchlight MANUALLY SELECTED OPEN

# PRECOOLER HEAT EXCHANGER

- ENGINE bleed air is EXTREMELY **HOT** AND would MELT ALUMINUM if it is NOT cooled
- The PRECOOLER USES FAN AIR (LP) AND A HEAT EXCHANGER TO COOL ENGINE BLEED AIR DOWN
- The PRECOOLER HEAT EXCHANGER IS LOCATED IN THE ENGINE PYLON



- The L  
BAC R  
BAC monitor PRECOOLER INLET AND OUTLET TEMPERATURE AND MODULATE The opening of The FAN AIR VALVES AS NECESSARY

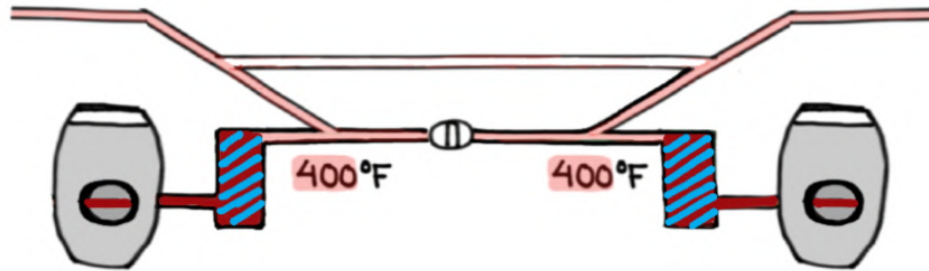


### PRECOOLER INLET TEMPERATURE:

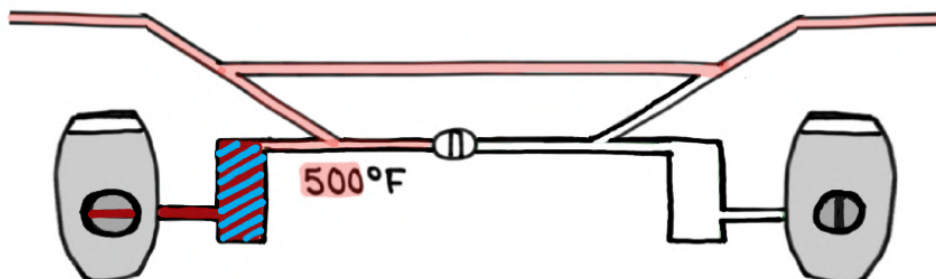
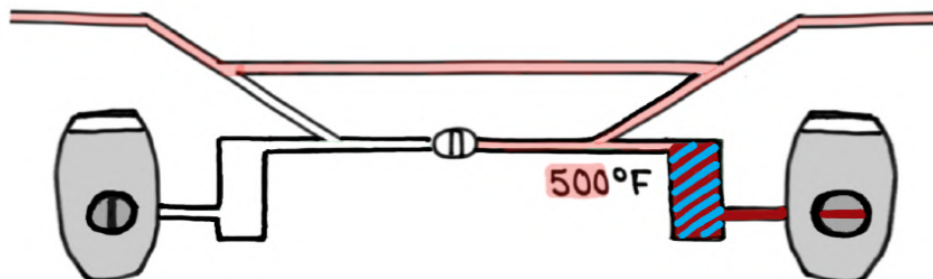
WHATEVER mid-STAGE (5<sup>TH</sup>) OR high-STAGE (8<sup>TH</sup>)  
is producing

## PRECOOLER OUTLET TEMPERATURE:

- **400°F**



- **500°F** when hotter air is needed To TRAVEL Through CROSSOVER duct (LONGER distance) due To wing ANTI-ice ON with A single bleed SOURCE





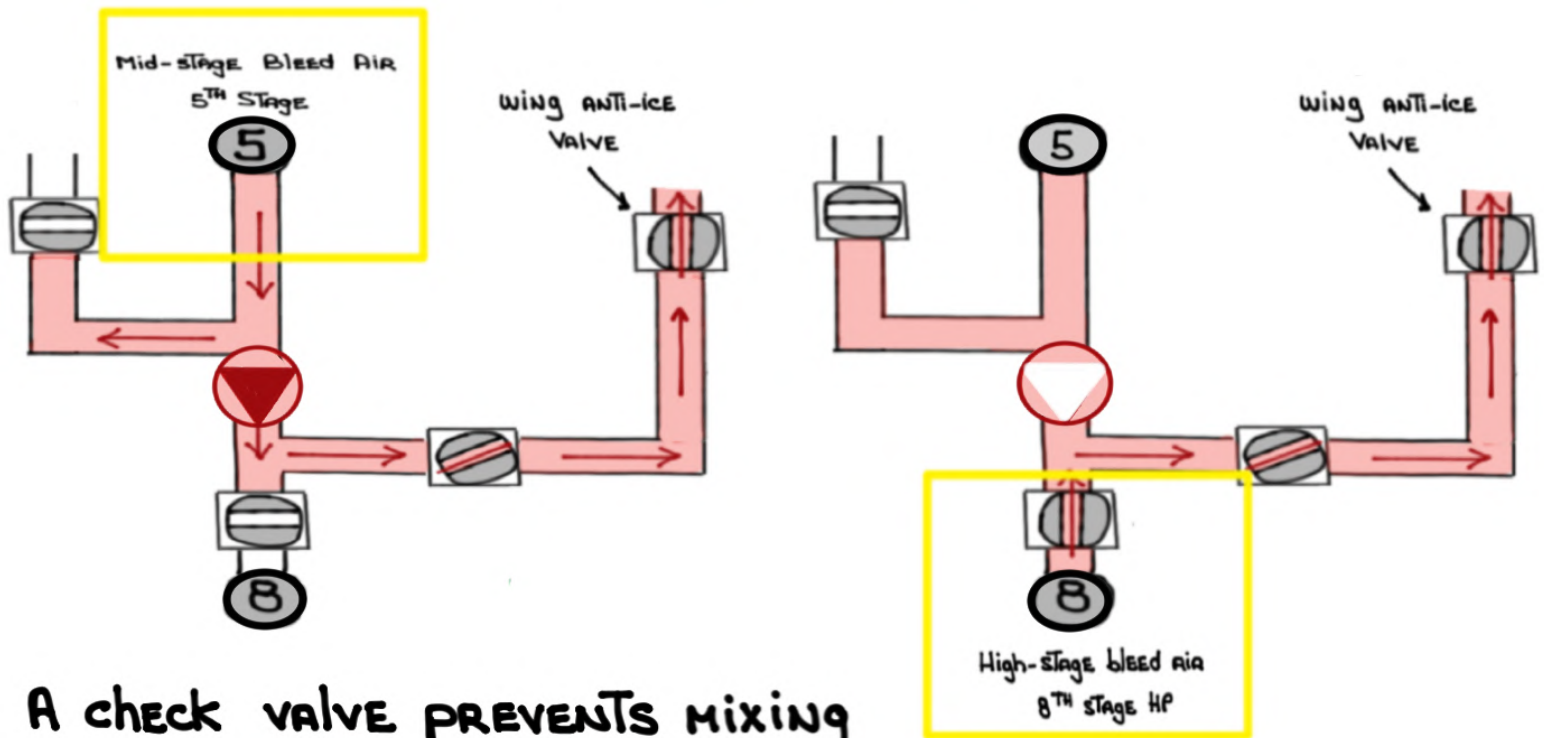
# Wing ANTI-ice SYSTEM

- Wing ANTI-ice VALVES ARE ELECTRO-PNEUMATIC. They REQUIRE:

- ELECTRICAL POWER TO OPERATE
- PNEUMATIC PRESSURE TO CLOSE

- IT USES **HOT** ENGINE BLEED AIR (mid OR high-STAGE)

L-R Wing ANTI-ice ON



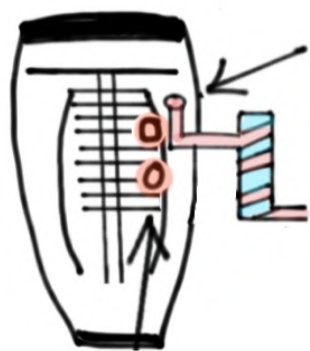
A check valve PREVENTS MIXING  
BETWEEN 5<sup>TH</sup> AND 8<sup>TH</sup> STAGE  
BLEED AIR

The

L  
BAC

R  
BAC

COMMAND:



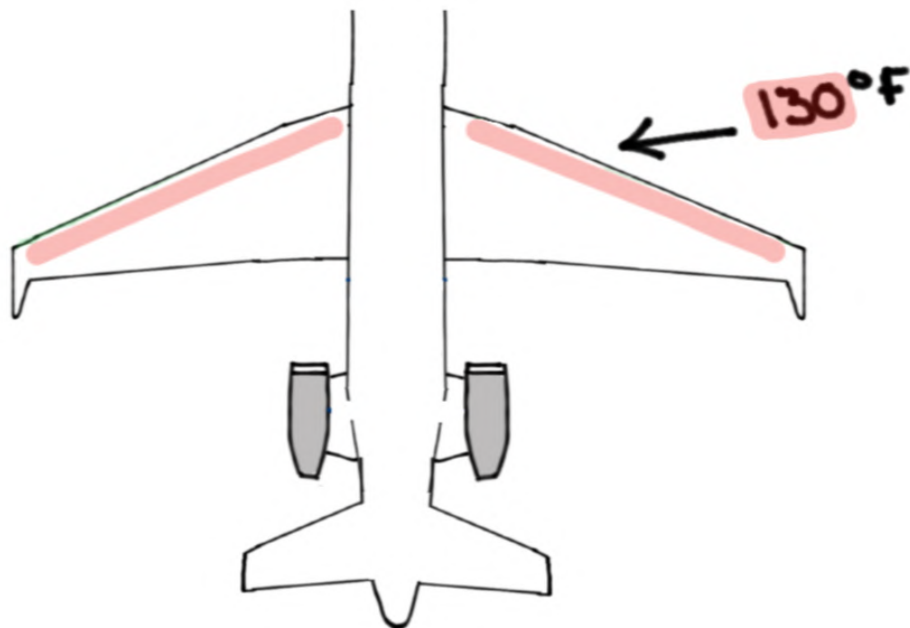
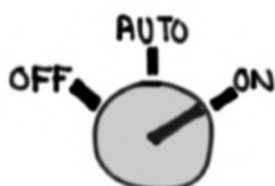
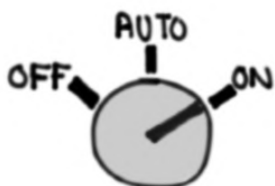
①<sup>ST</sup> FAN AIR VALVES TO MODULATE OPEN

②<sup>ND</sup> High-STAGE VALVES (8<sup>TH</sup>) TO OPEN  
if Mid-STAGE (5<sup>TH</sup>) is INSUFFICIENT

L-R Wing ANTI-ice ON

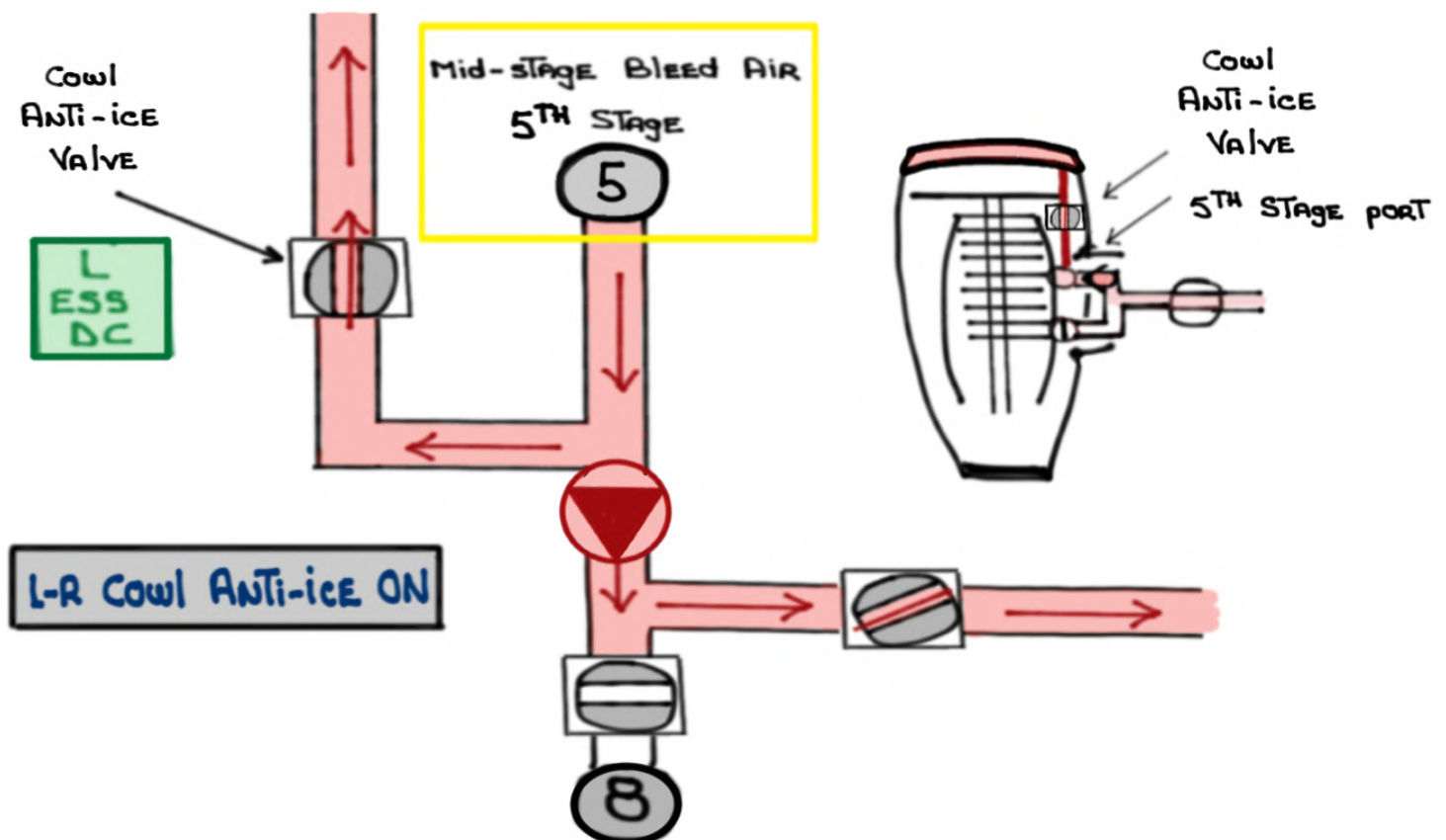
L WING

R WING



# Cowl ANTi-ice System

- Cowl ANTi-ice VALVES ARE ELECTRO-PNEUMATIC. They REQUIRE:
  - ELECTRICAL power To operate
  - PNEUMATIC pressure To CLOSE
- IT USES **HOT** engine bleed air (Mid-STAGE only)



- Cowl ANTi-ice VALVES fail OPEN **L Cowl VALVE FAIL OPEN**



# SET POINTS

SET POINTS ENSURE ADEQUATE PNEUMATIC PRESSURE AND TEMPERATURE AT THE VARIOUS POWER SETTINGS AND BLEED REQUIREMENTS

- Low power settings = 14 - 24 Psi
- Single pack = 35 Psi

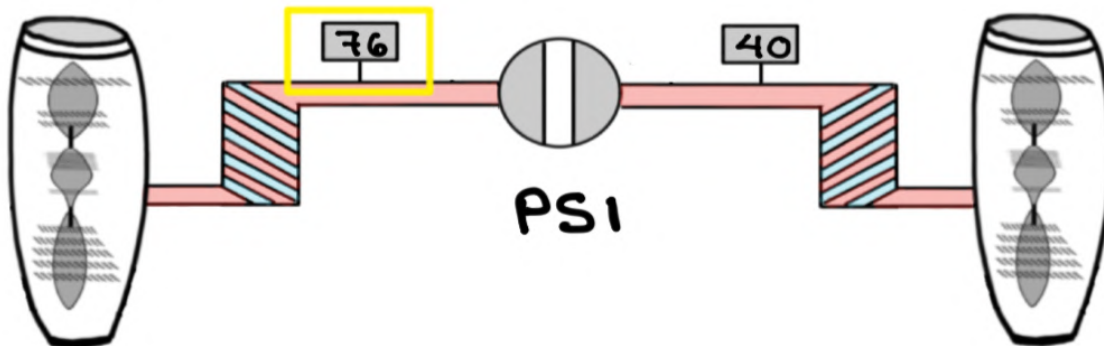
If mid-stage (5<sup>TH</sup>) is NOT ENOUGH The BACS COMMAND The High-stage (8<sup>TH</sup>) valves To modulate open in order To provide up To 40 Psi

Condition	Source	Set Point (PSI)
Ground idle	8 <sup>TH</sup>	14
FLight idle	8 <sup>TH</sup>	24
Thrust > idle	5 <sup>TH</sup>	40 (400°F)
Wing ANTI-ICE (2) idle	8 <sup>TH</sup> (PRE-COOLER 630°F)	40 (500°F)
Wing ANTI-ICE (2) > idle	5 <sup>TH</sup> (PRE-COOLER 630°F)	40 (500°F)
Wing ANTI-ICE (1) > idle	5 <sup>TH</sup> (PRE-COOLER 630°F)	40 (500°F)
Single Pack	8 <sup>TH</sup>	35 (500°F) * inop pack off

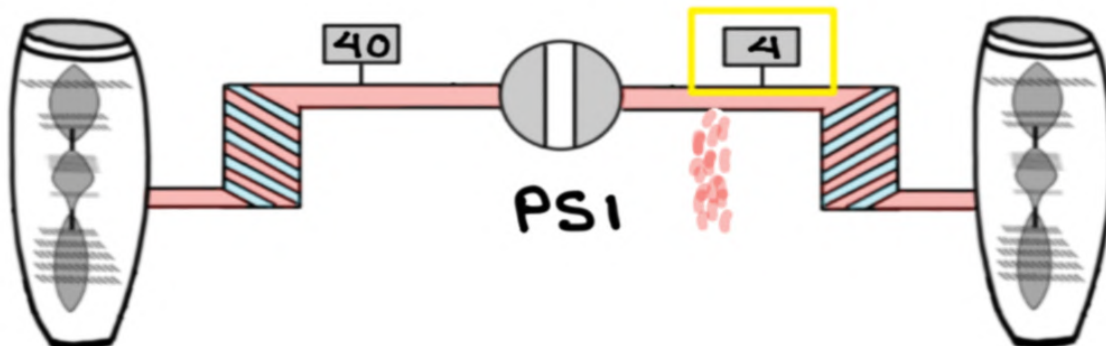


# BLEED AIR PRESSURE SENSORS

> 75 Psi L BLEED PRESSURE High

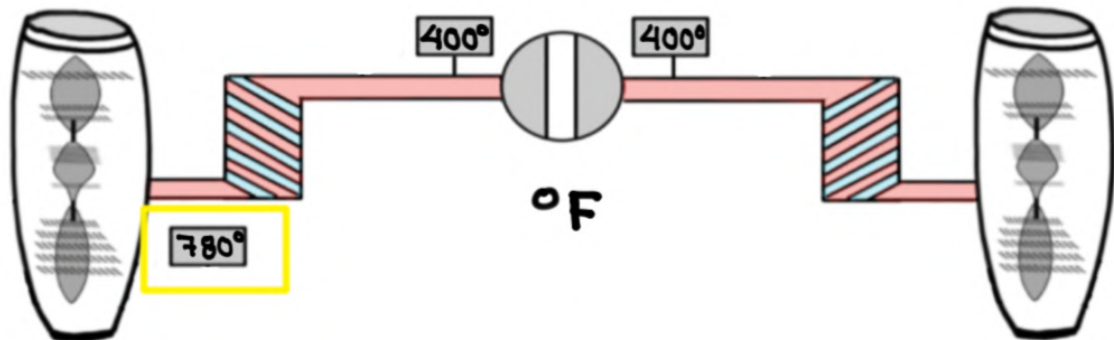


< 5 Psi > 10 seconds R BLEED PRESSURE LOW

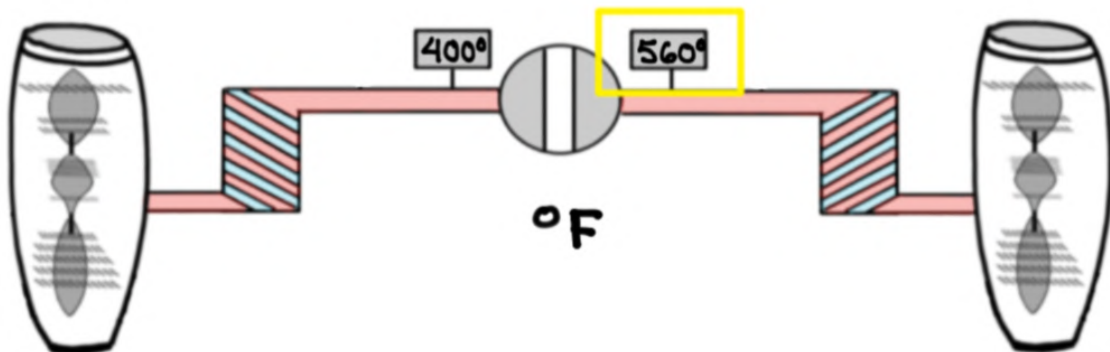


# BLEED AIR TEMPERATURE SENSORS

L BLEED AIR HOT > 765°F INLET



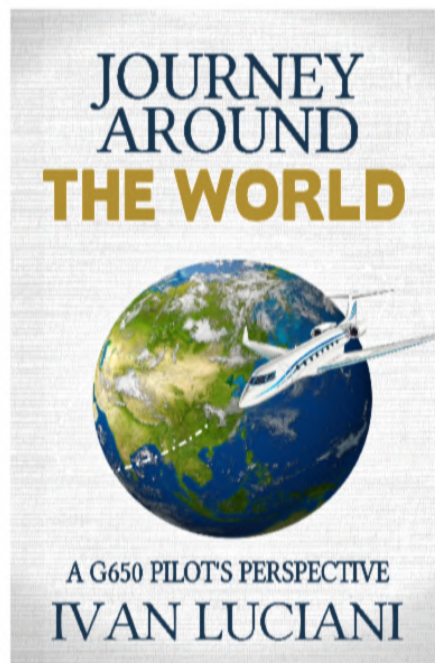
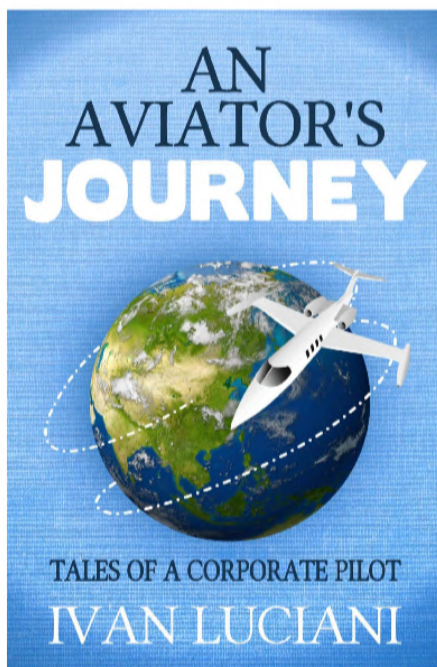
R BLEED AIR HOT > 553°F OUTLET



**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!