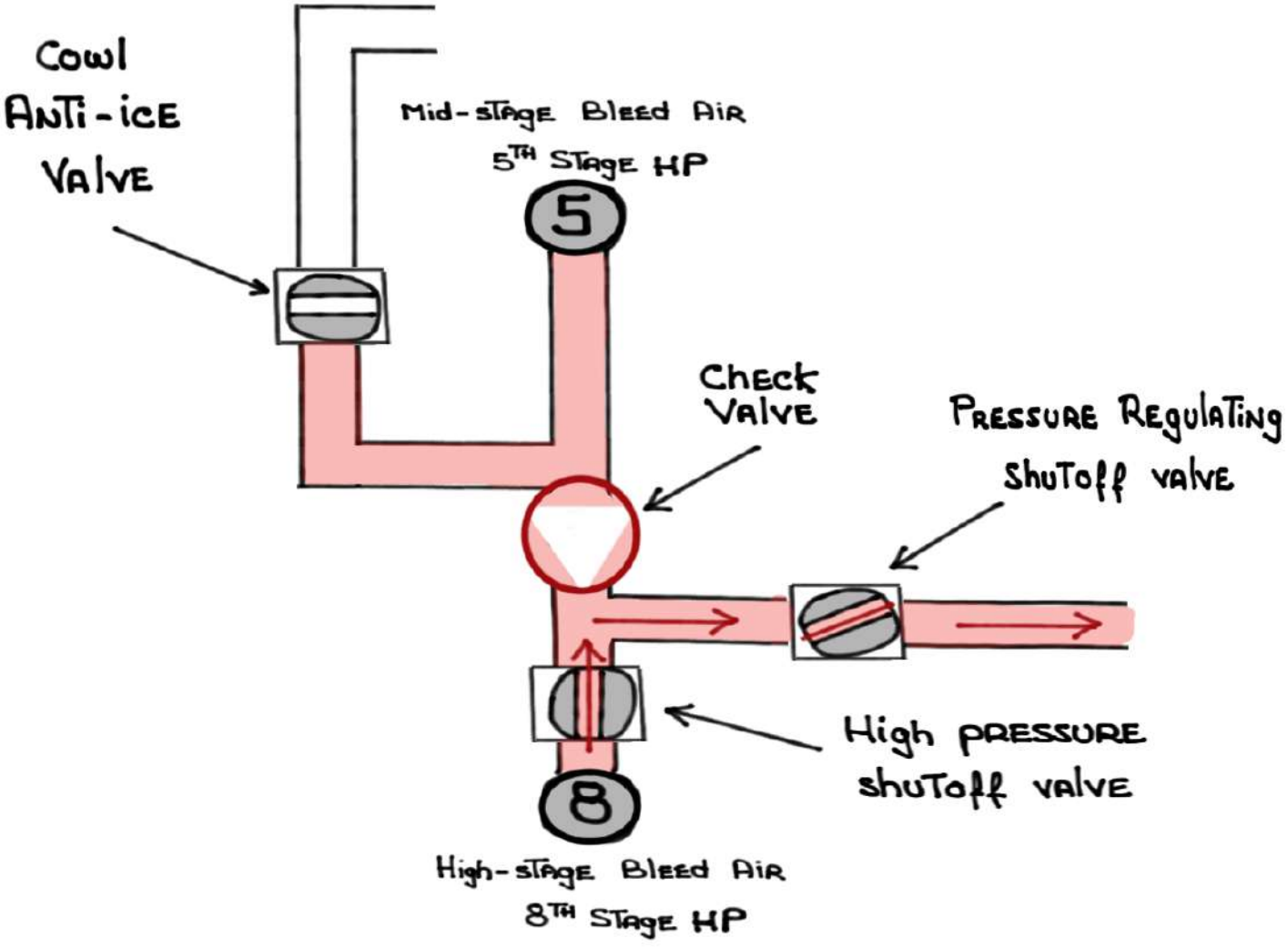
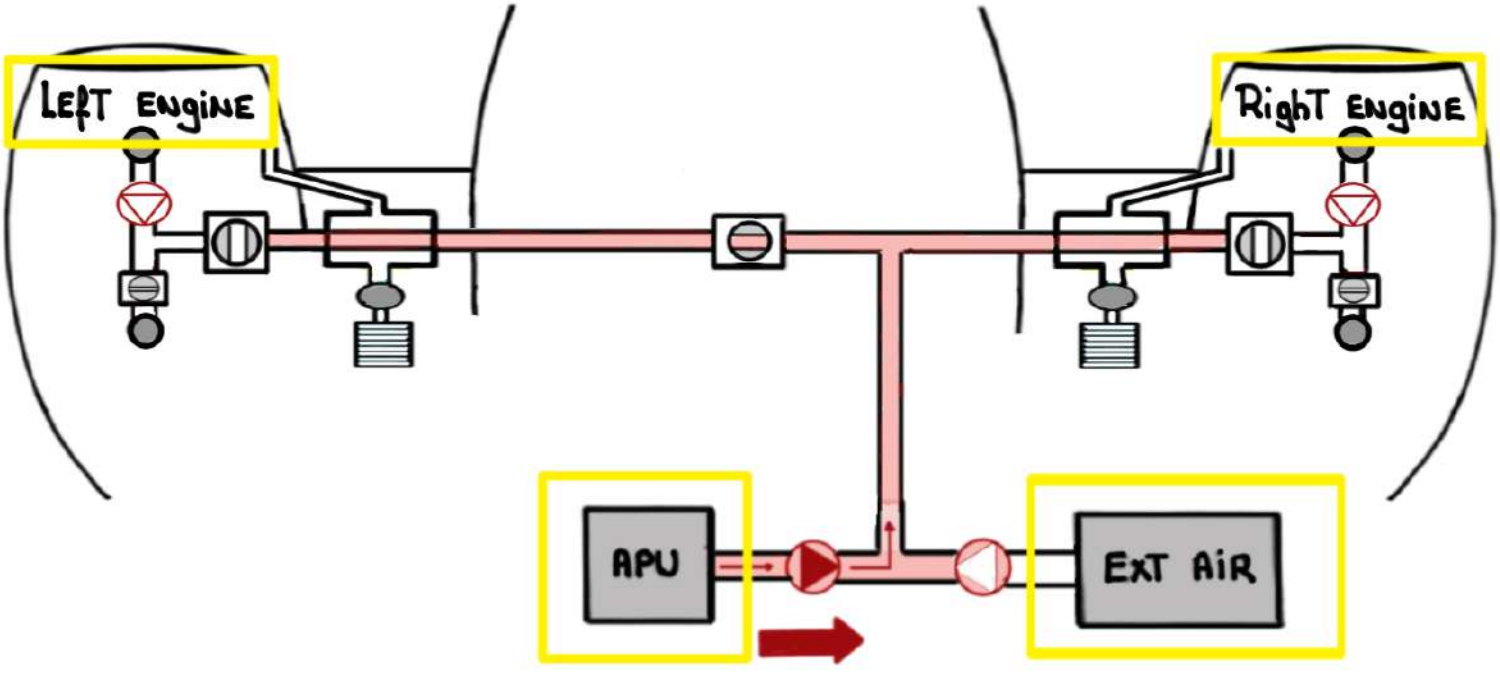
G650 Pneumatic System



For study purposes only

The Pneumatic System is about the generation of High pressure/temperature air from:

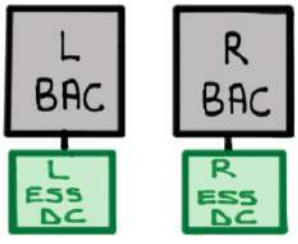


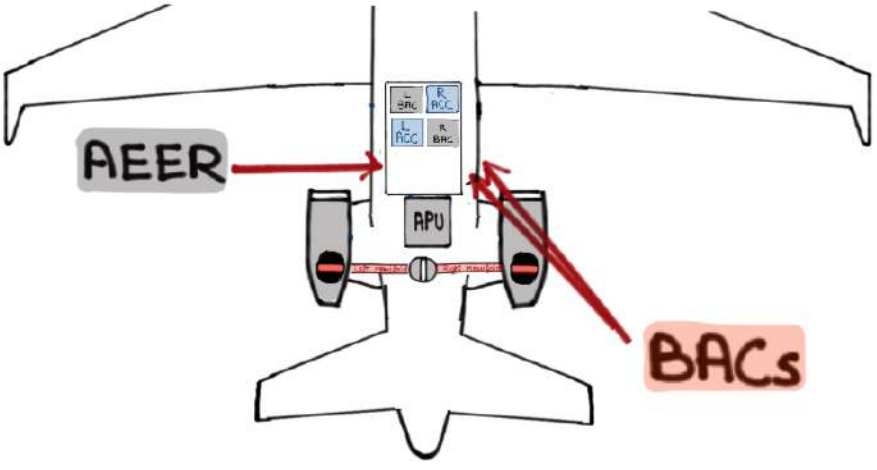
High Pressure/temperature air is utilized by:

- Engine Starting System
- Cowl/Wing anti-ice systems
- Air Conditioning/Pressurization Systems
- Potable Water System
- TAT probe airflow (ground only) to eliminate radiant heat
- Other systems

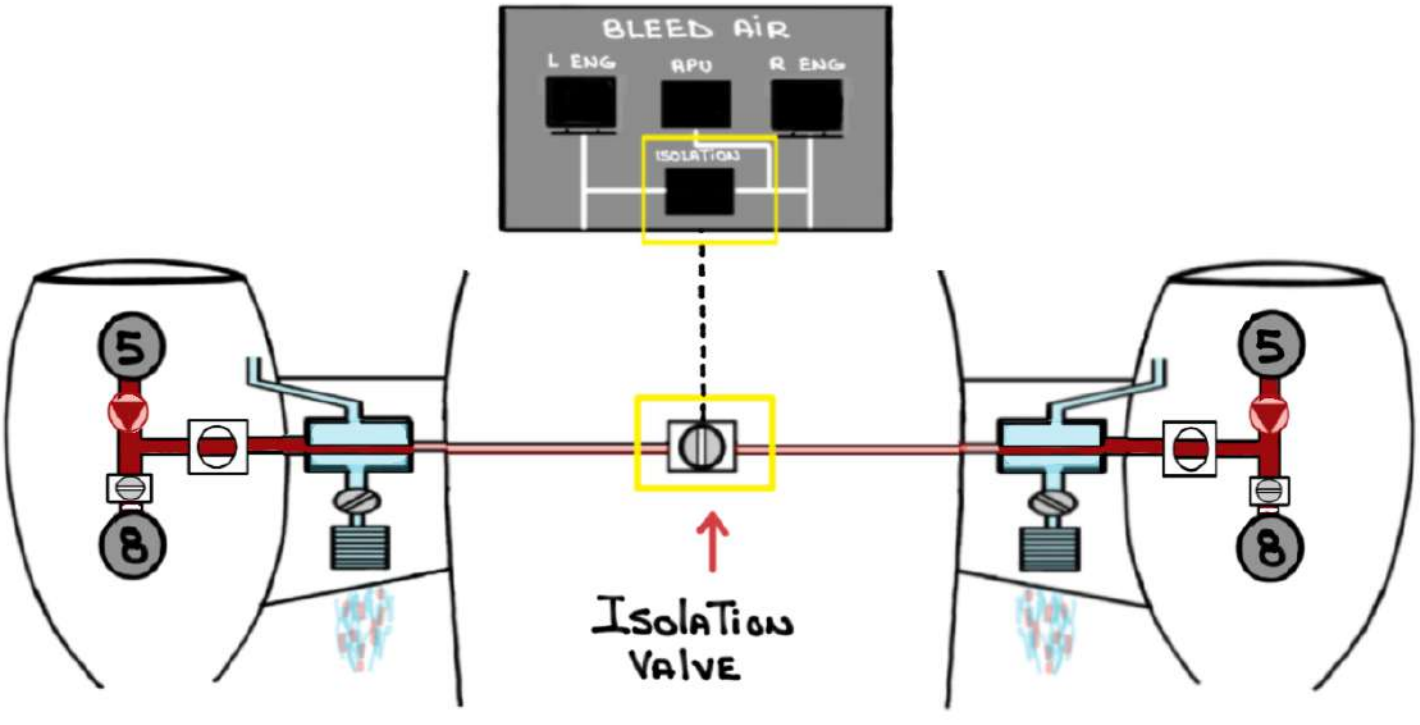
Pneumatic System Sub-components

- Bleed Air Controllers (BACs)

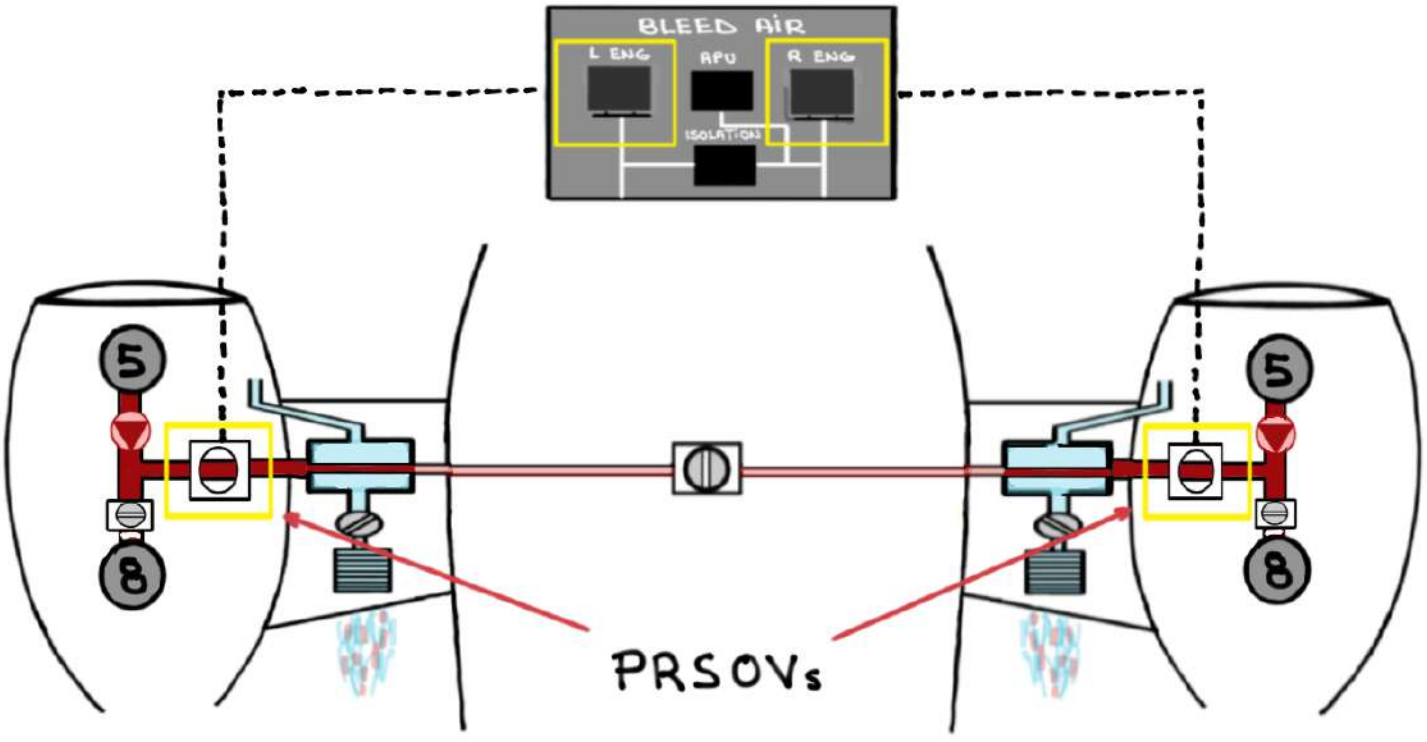




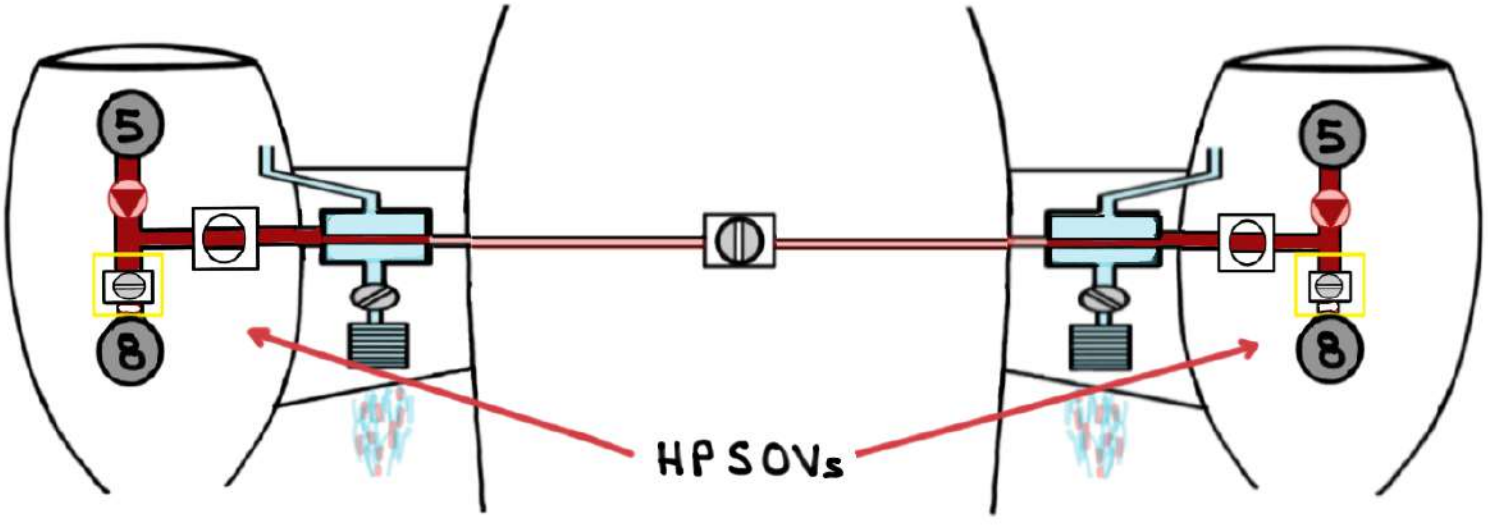
- Isolation Valve



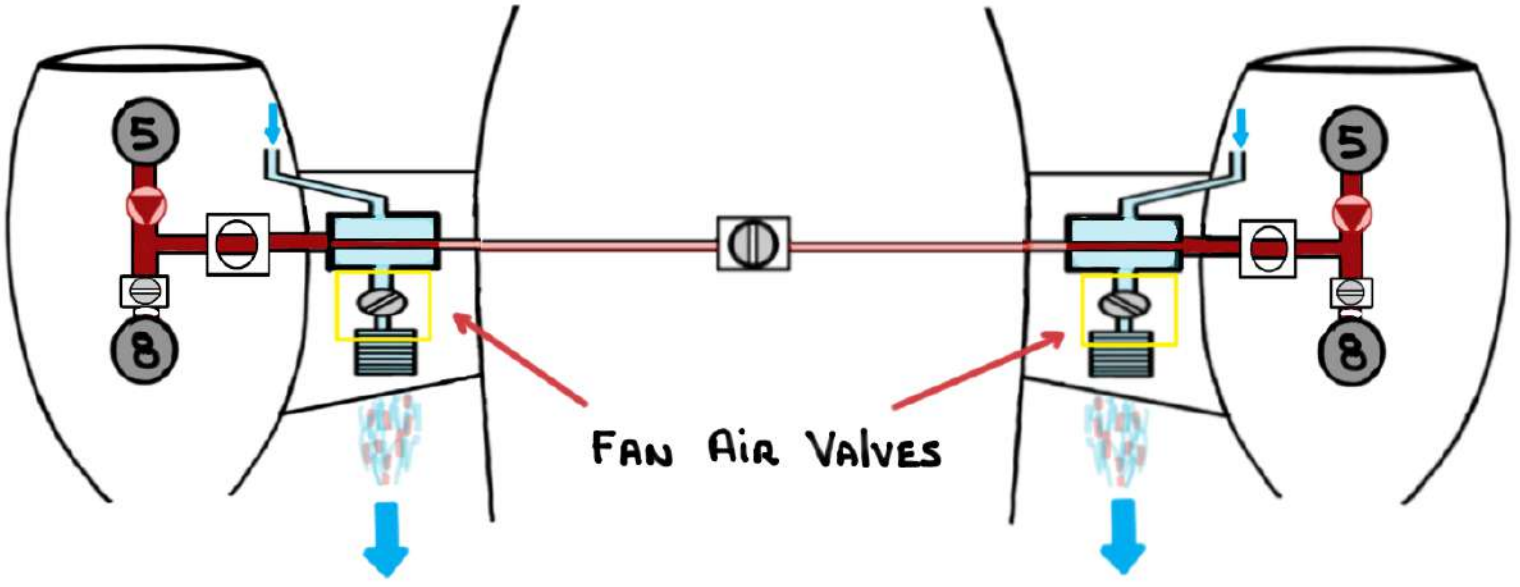
- Pressure Regulating / Shutoff valves (PRSOV)



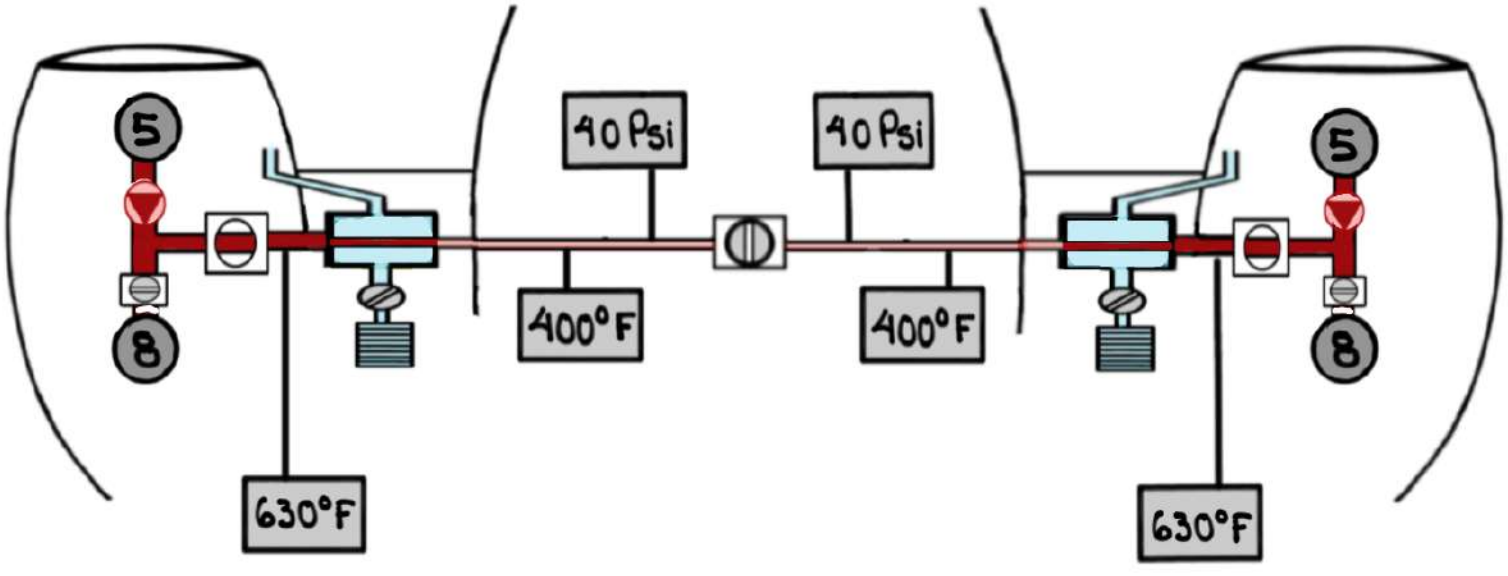
- High-Pressure Shutoff Valves (HPSOV)



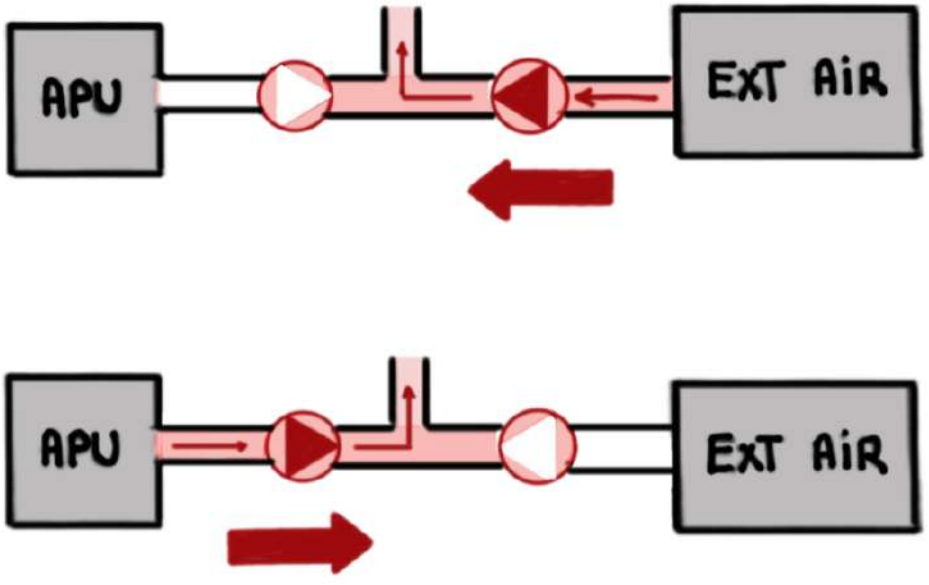
- FAN AIR VALVES



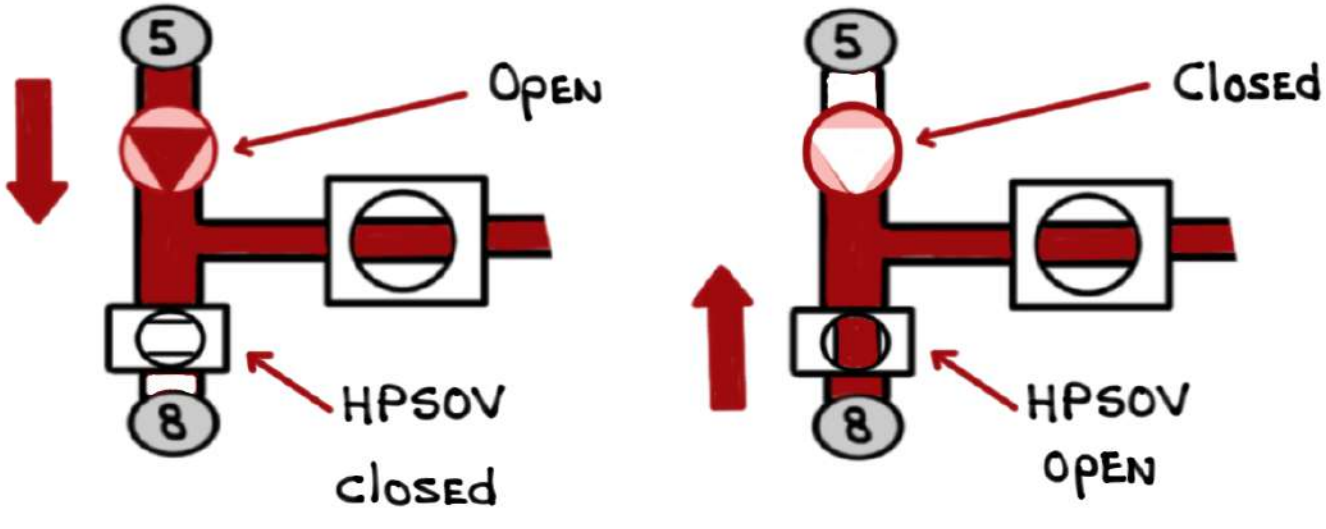
- PRESSURE/TEMPERATURE SENSORS



- Check valves (one-way flow) →



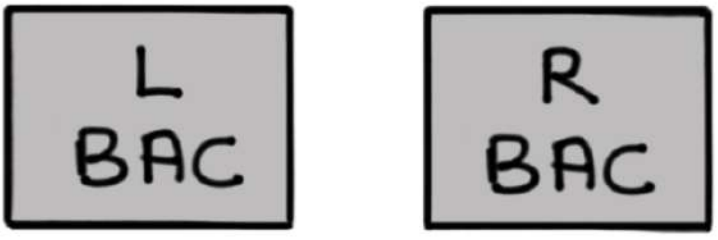
- High-Pressure Stage 5 (HPS) Air Non-return Valves



HPSOV, if open, allows higher pressure from the 8TH stage port to close the 5TH stage check valve

BLEED AIR CONTROLLERS (BACs)

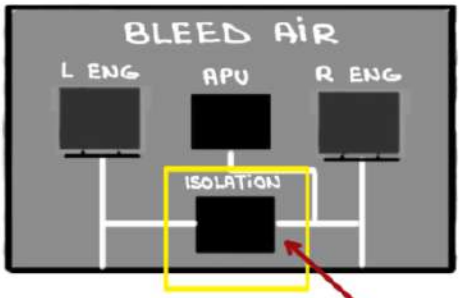
THE PNEUMATIC SYSTEM IS REGULATED BY TWO (2) IDENTICAL AND INTERCHANGEABLE MICROPROCESSORS

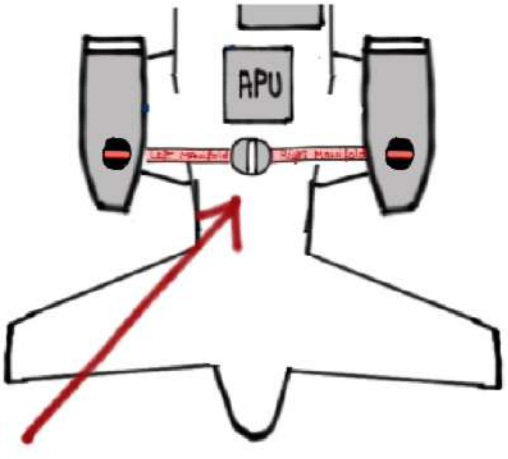


- THE BACs ARE THE <u>BRAINS</u> OF THE SYSTEM

- THE BACs CONTROL MOST PNEUMATIC FUNCTIONS VIA TWO (2) SEPARATE AND INDEPENDENT MANIFOLDS

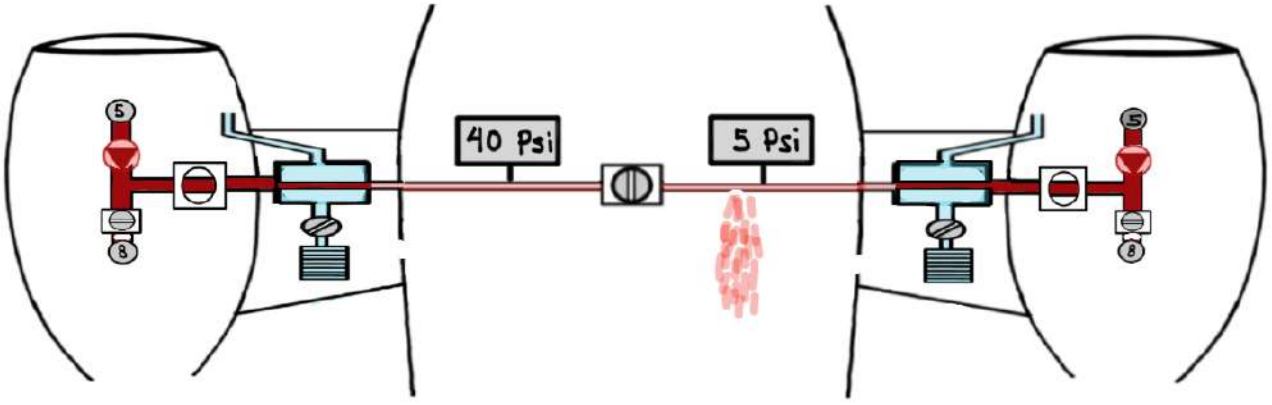
- PNEUMATIC MANIFOLDS CAN BE CONNECTED BUT ARE NORMALLY OPERATED IN ISOLATION VIA AN ISOLATION VALVE



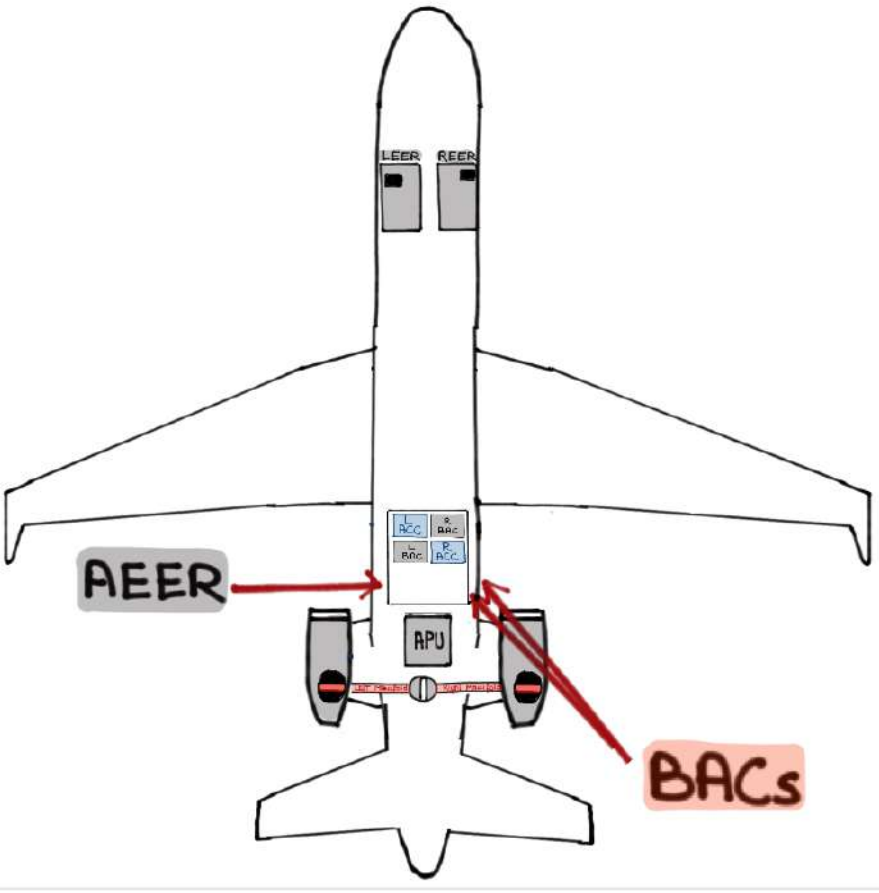


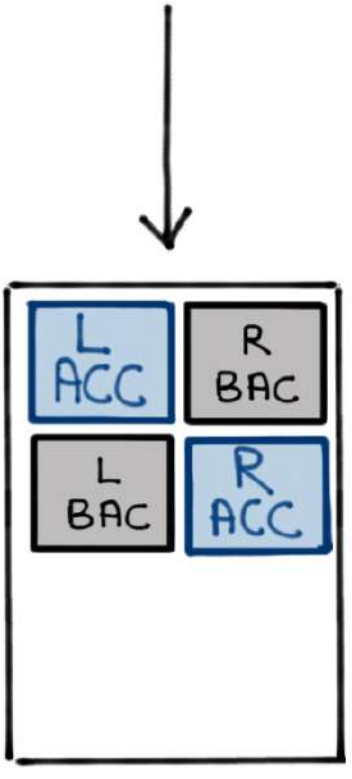
ISOLATION VALVE CLOSED

- 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

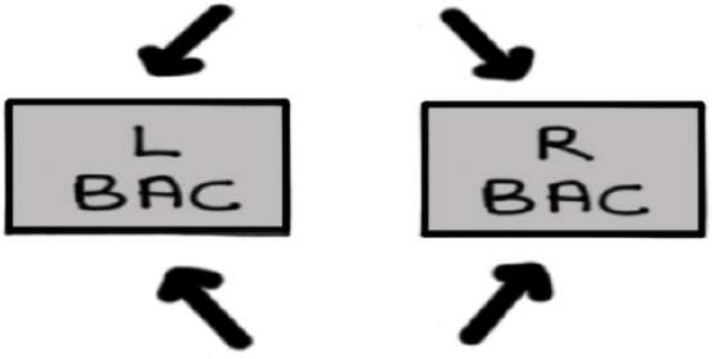




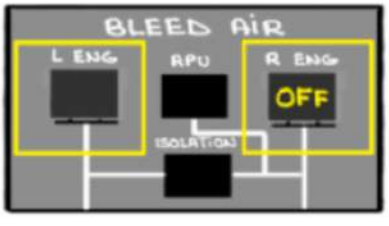
- The L BAC R BAC <u>RECEIVE</u> DATA and Cockpit input from the following sources:

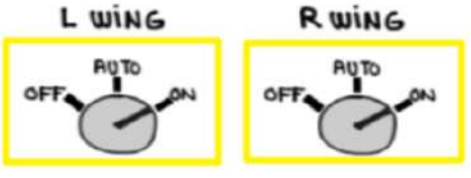
DATA input:

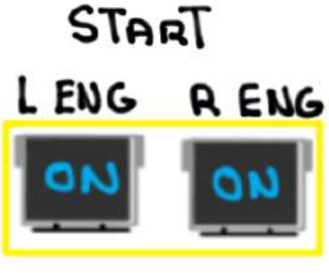
- Aircraft ALTitude
- STATic Air TEMPERATURE (SAT)
- Engine LP RPM
- PRECOOLER inlet TEMPERATURE
- PRECOOLER outlet TEMPERATURE
- BLEED MANIFOLD PRESSURE
- Wing anti-ice TEMPERATURE



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:

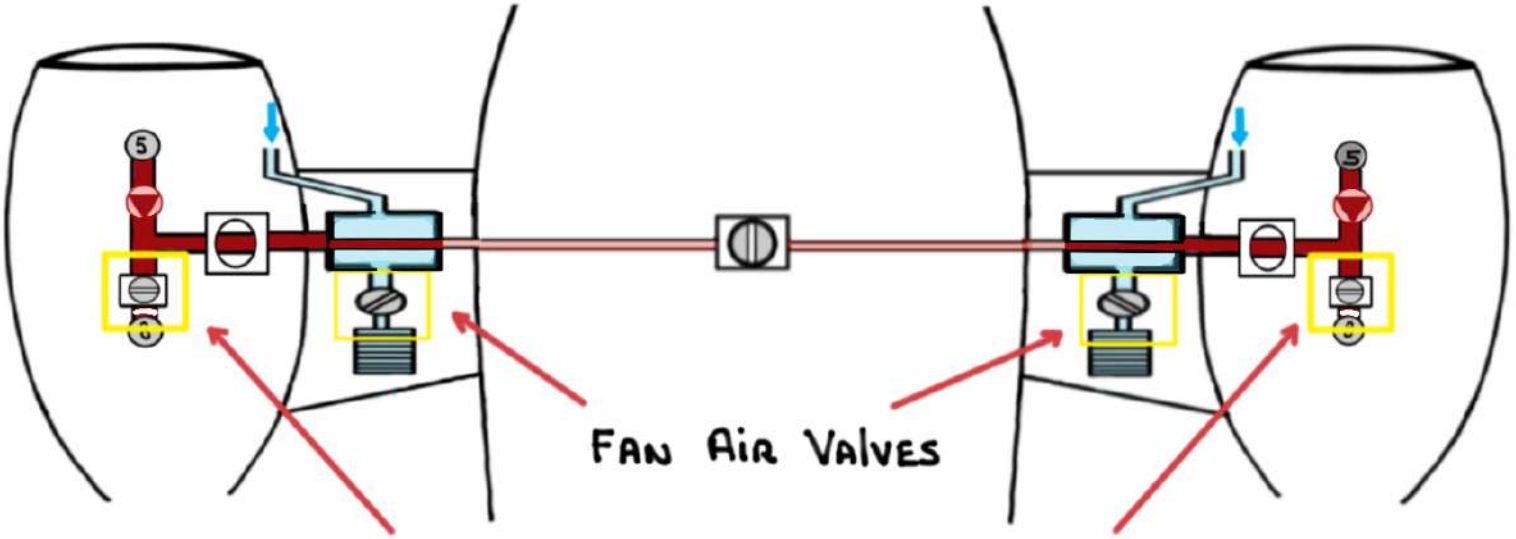
L BAC R BAC

MODULATE:

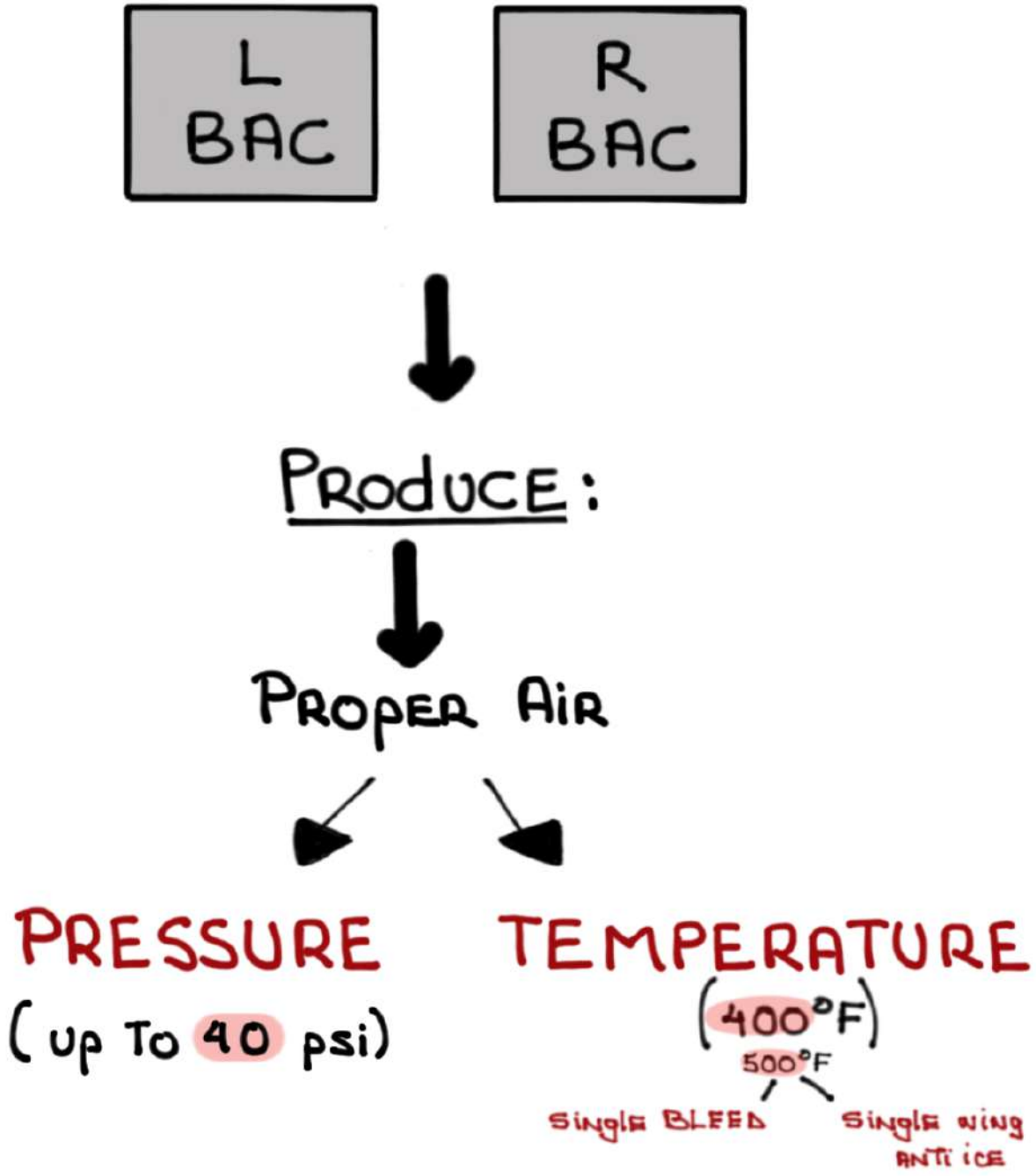
High-Pressure Shutoff Valves (HPSOV)

&

Fan Air Valves

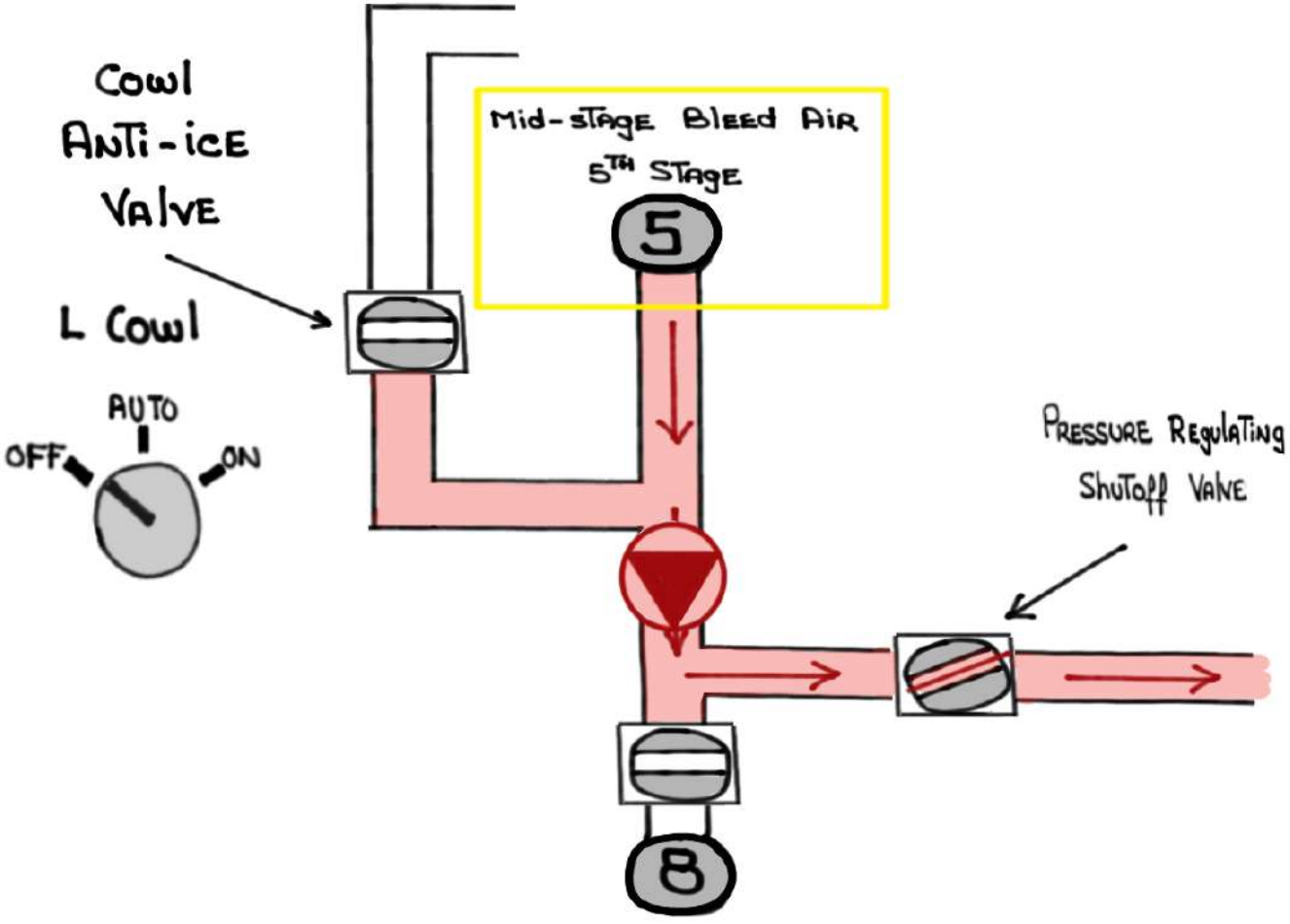


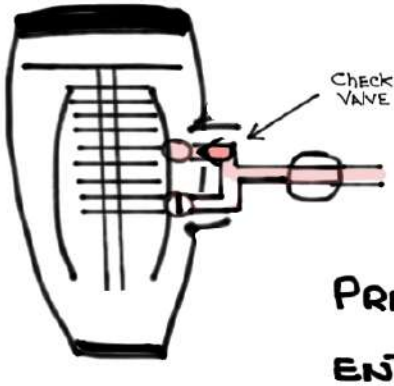
- The L BAC R BAC <u>modulate</u> these valves in order to <u>produce</u> proper air based on specific system requirements



Main Engines Bleed Air

① Mid-stage bleed (5TH stage of HP compressor).
If insufficient, in terms of Pressure and Temperature, will use High-stage bleed air instead

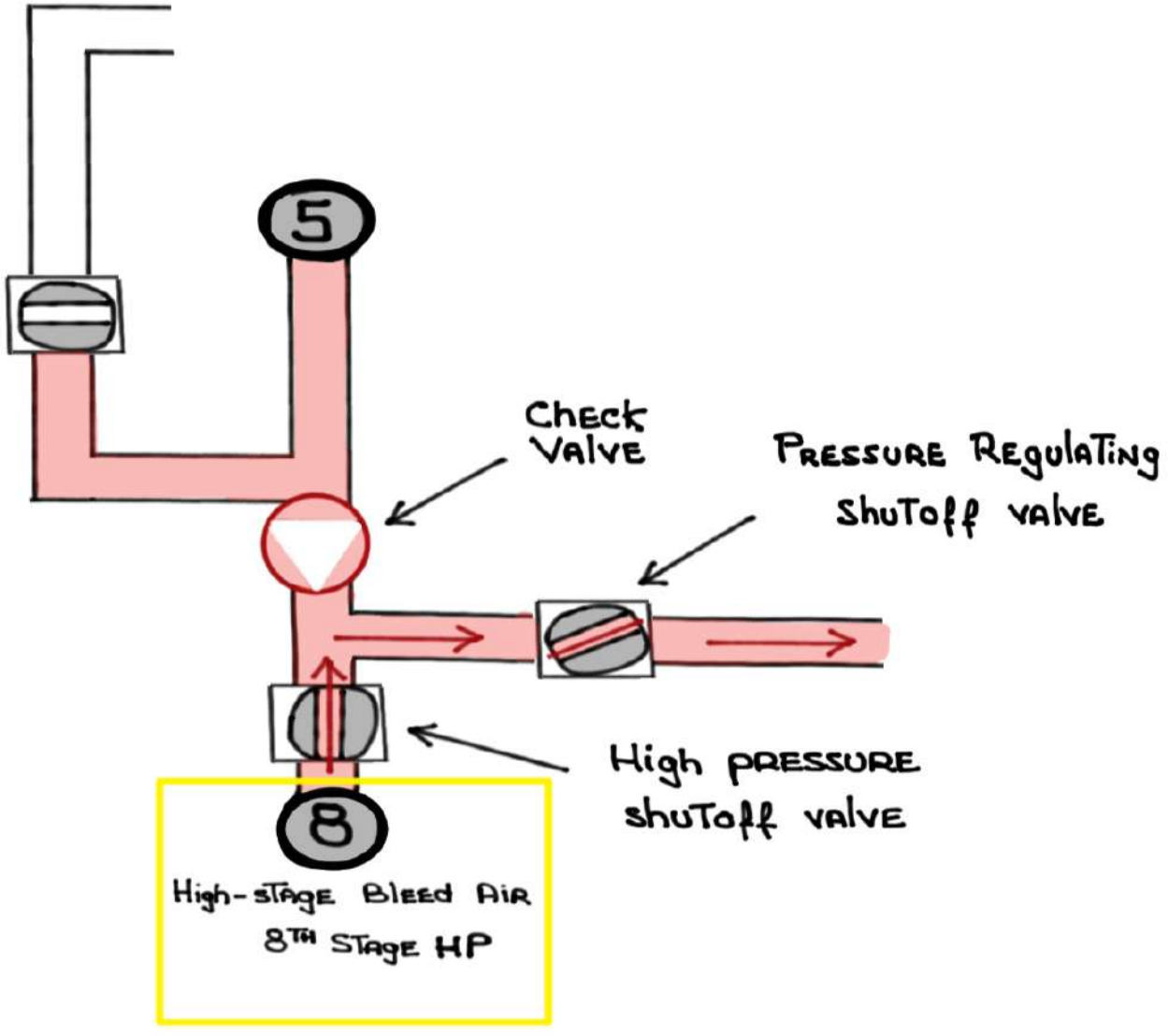


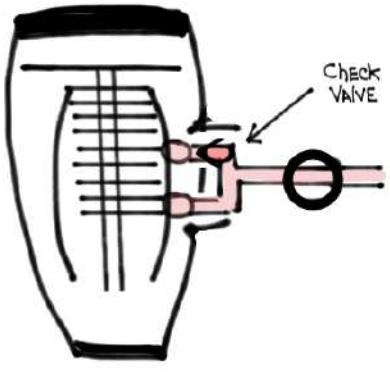


- 5TH Stage port
- 5TH Stage check valve

Prevents higher pressure 8TH stage bleed from entering the 5TH stage port

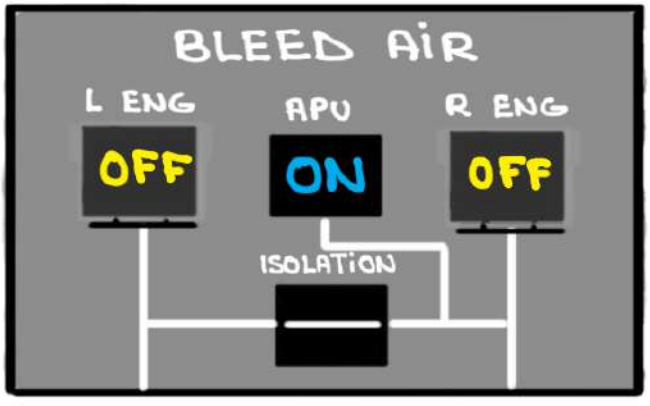
② High-stage bleed (8TH stage of HP compressor)



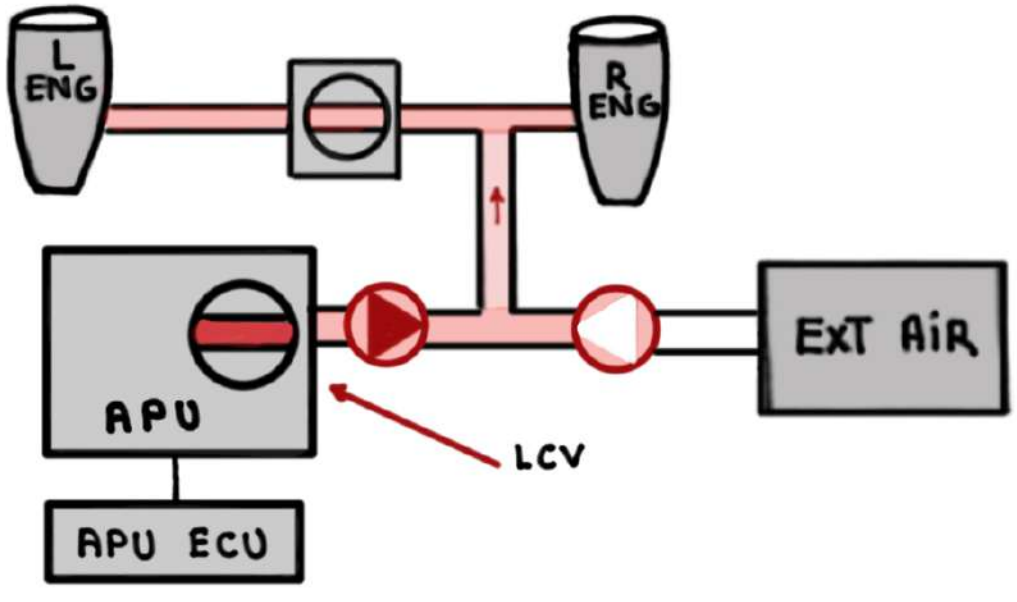


- 8 TH STAGE PORT
- 8 TH STAGE VALVE

APU Bleed Air



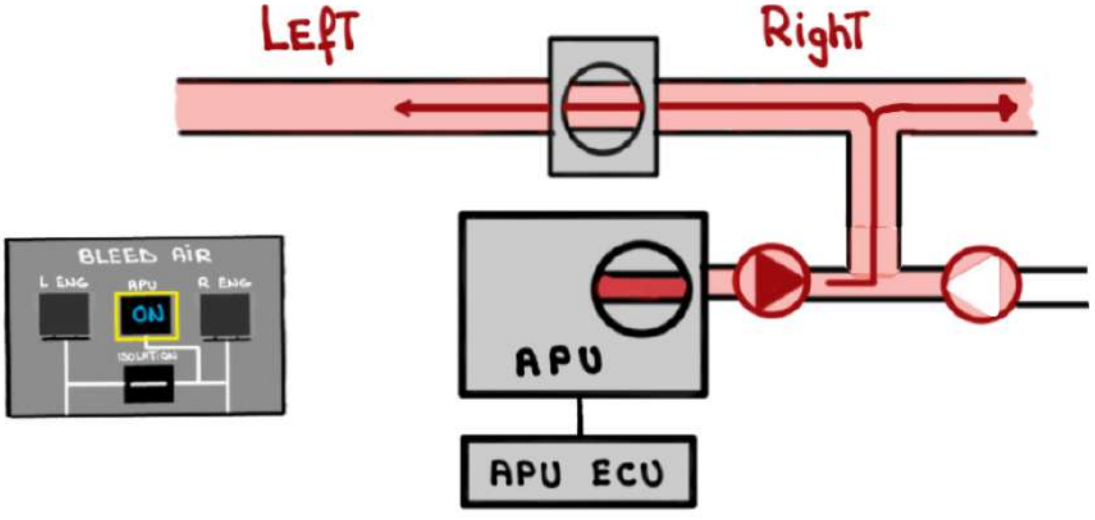
The APU's Load Control Valve (LCV) allows High pressure/temperature air into the Left and Right pneumatic manifolds



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

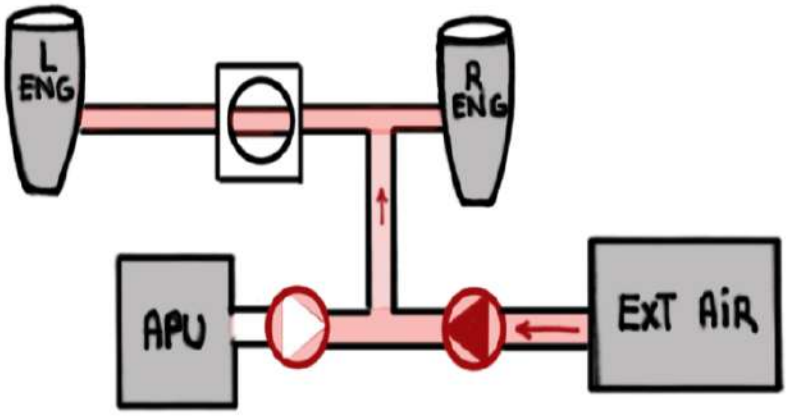
A flapper-type check valve opens when APU or external air pressure is greater than manifold pressure. This allows the APU or external air source to pressurize the pneumatic manifold

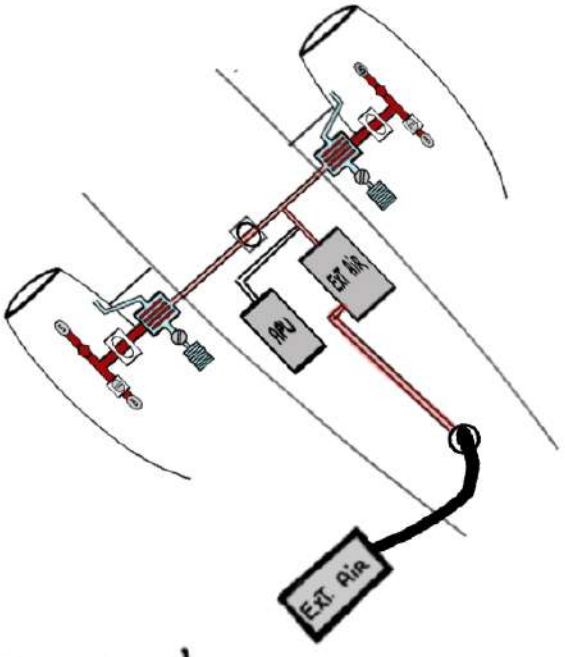
The check valve protects the APU from reverse flow originating from an engine

External Air

- Provides air for main engine start when the APU is unavailable

- Connects to the Right bleed air manifold





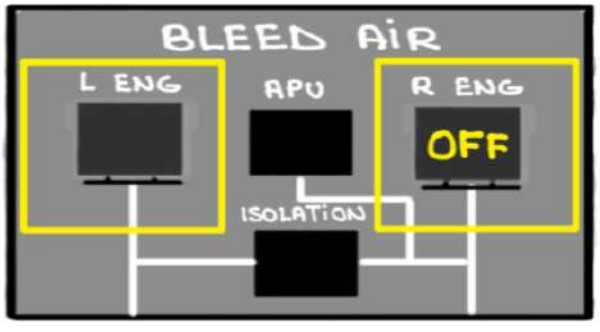
Placard on access panel:

> 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

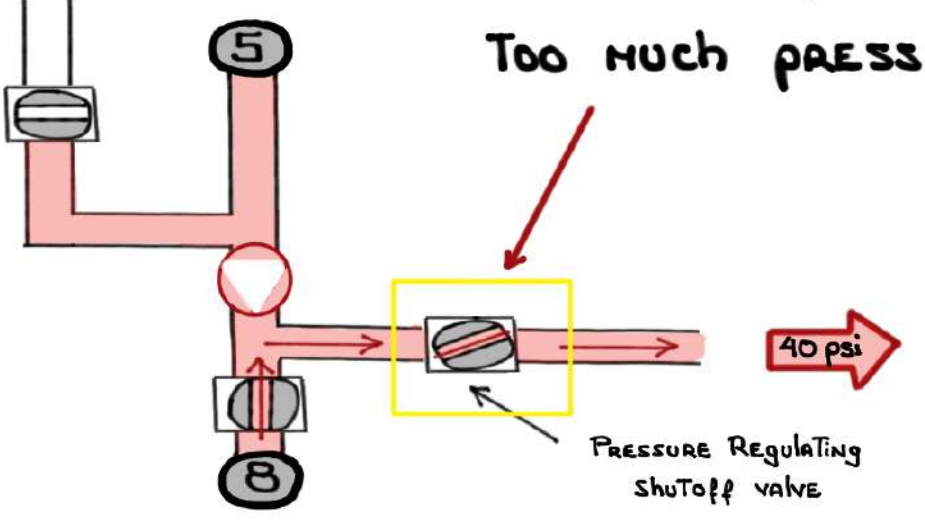
Pressure Regulating / Shutoff Valve (PRSOV)

- Located on each engine
- Function as ON/OFF valves to the pneumatic manifold
- Controlled by the Left and Right bleed air switches



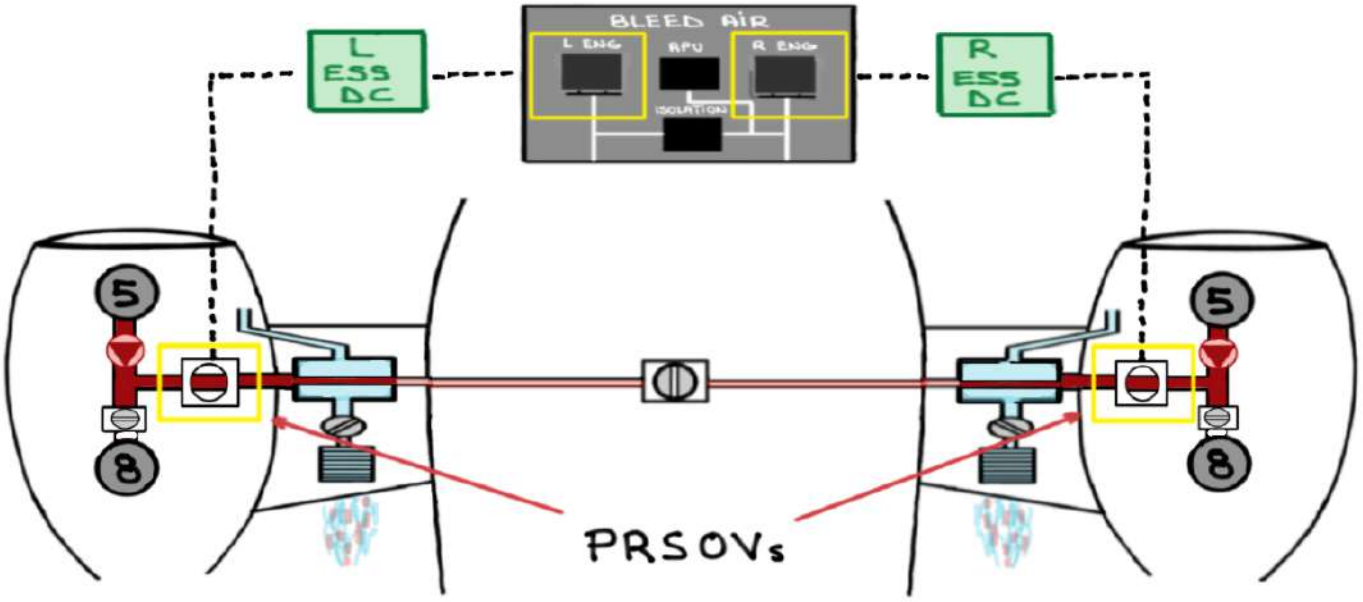
- Modulate as needed in order to maintain up to 40 Psi

"To make sure you don't have too much pressure"

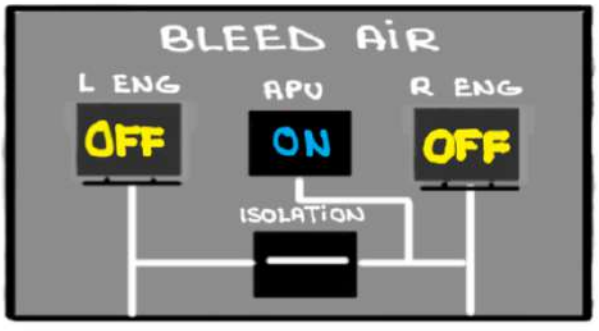


- Electro-pneumatic valves. They require:
  - Electrical power to operate
  - Pneumatic pressure to open

- Without L ESS DC R ESS DC bus power will not operate

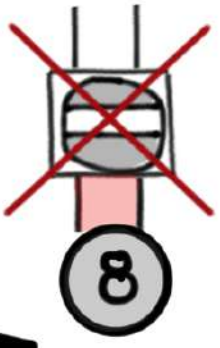


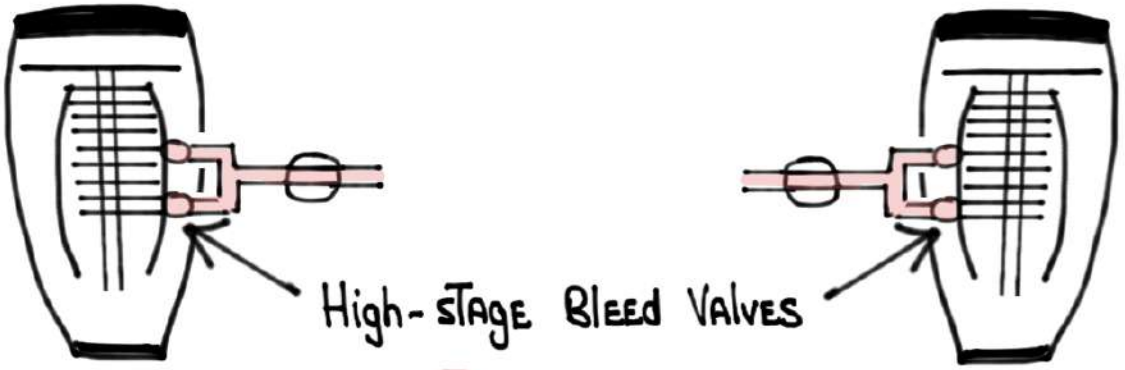
- The bleed air switches must be OFF for engine start to prevent a HOT start

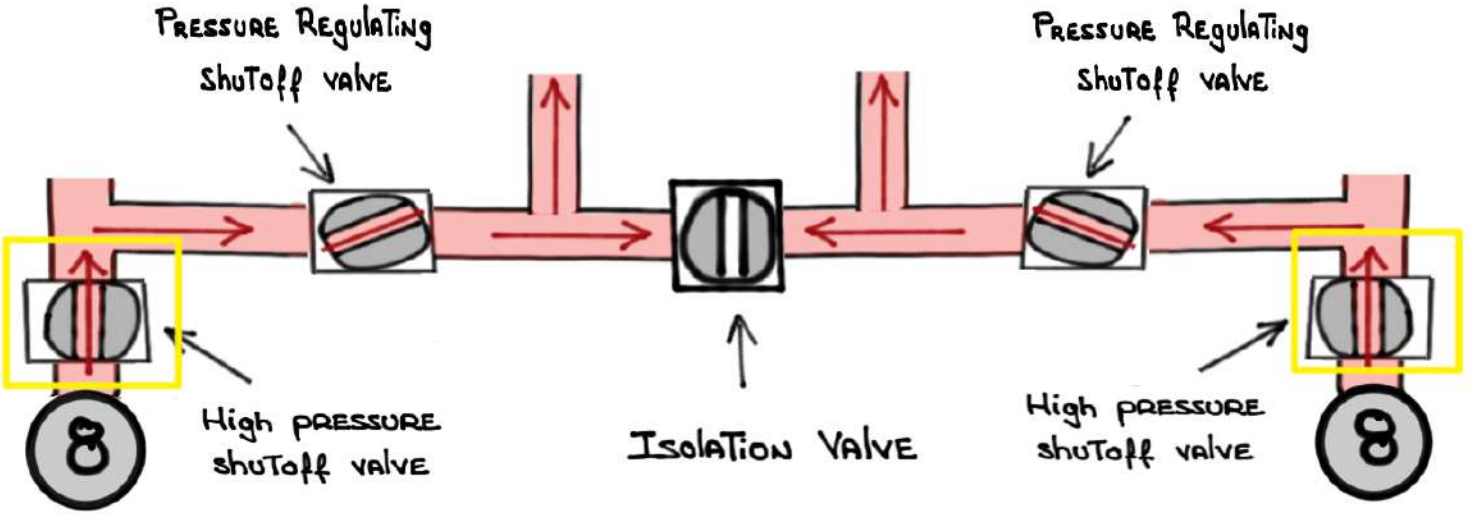


High-Stage Bleed Air Valves

- High Pressure Shutoff Valves (HPSOV)
- Located on each engine
- Commanded To <u>modulate</u> as needed by the BACs when mid-stage bleed air (5TH) is insufficient
- Spring-loaded and fail <u>CLOSED</u>

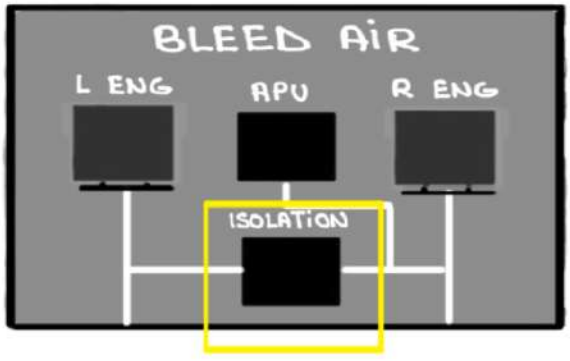


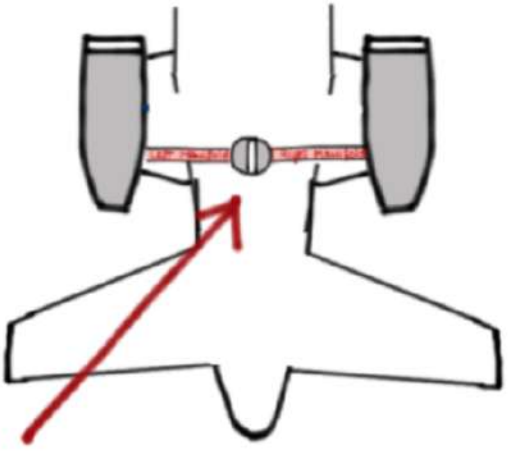




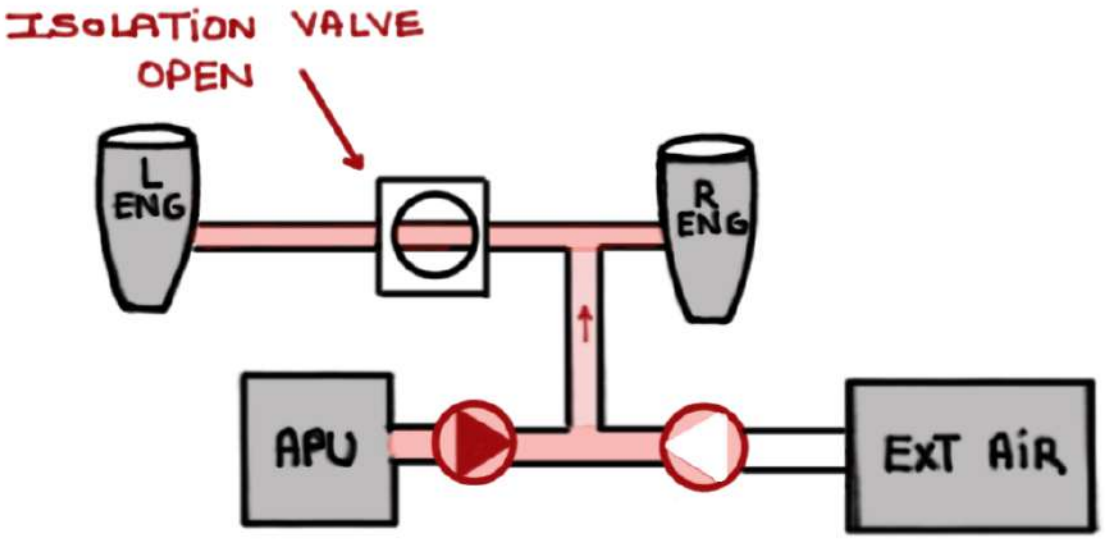
ISOLATION VALVE

- LOCATED IN THE TAIL COMPARTMENT





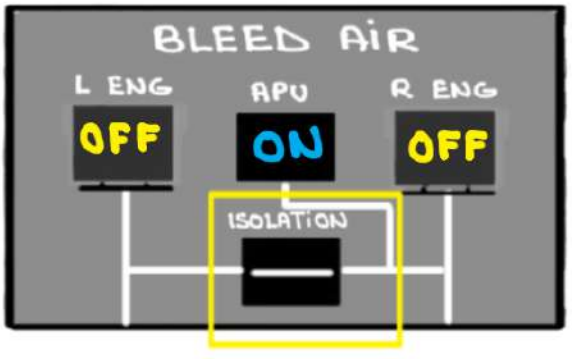
- POWERED BY L ESS DC BUS
- WITHOUT L ESS DC BUS POWER WILL NOT OPERATE
- ELECTRO-PNEUMATIC VALVES. THEY REQUIRE:
  - ELECTRICAL POWER TO OPERATE
  - PNEUMATIC PRESSURE TO OPEN
- FAILS FROZEN (I.E., ITS LAST POSITION)



- The Isolation Valve opens:

① START MASTER **ON**

② CRANK MASTER **ON**



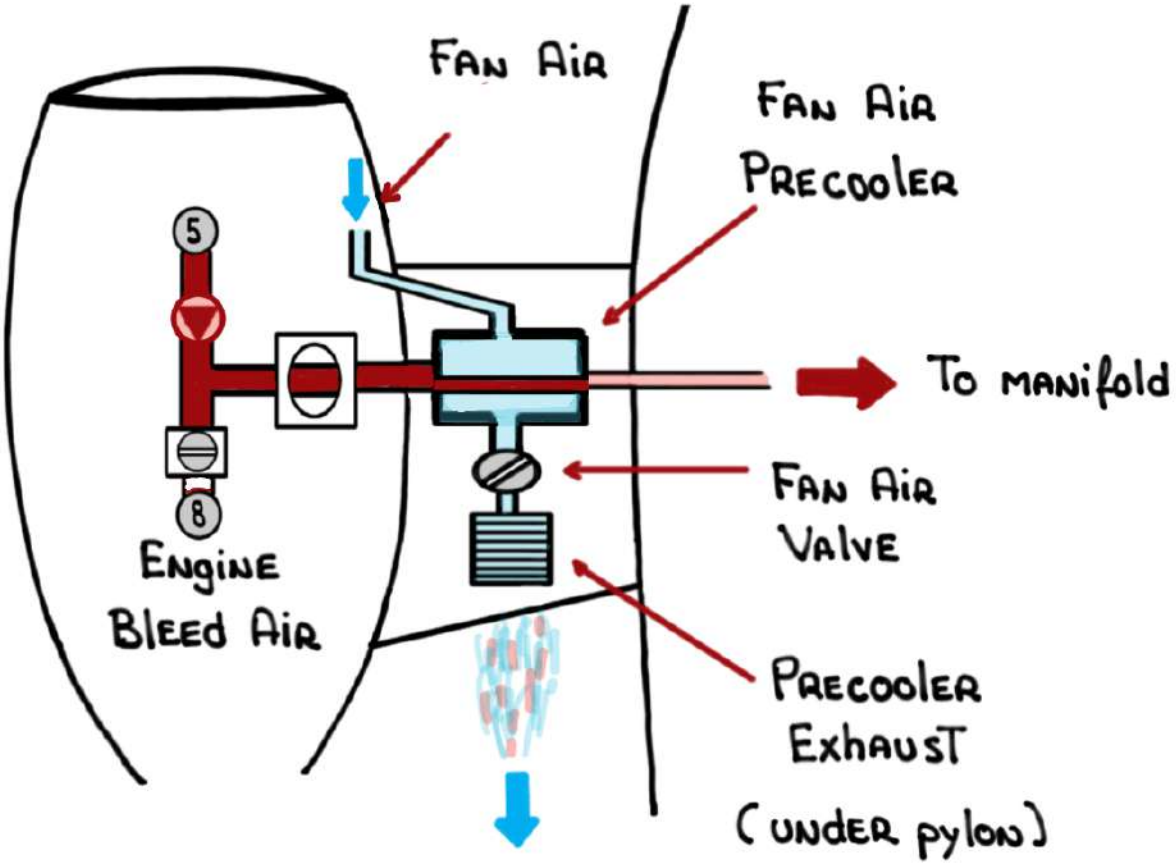
③ APU bleed APU **ON** (100% RPM / 60 seconds)

And WOW - Ground

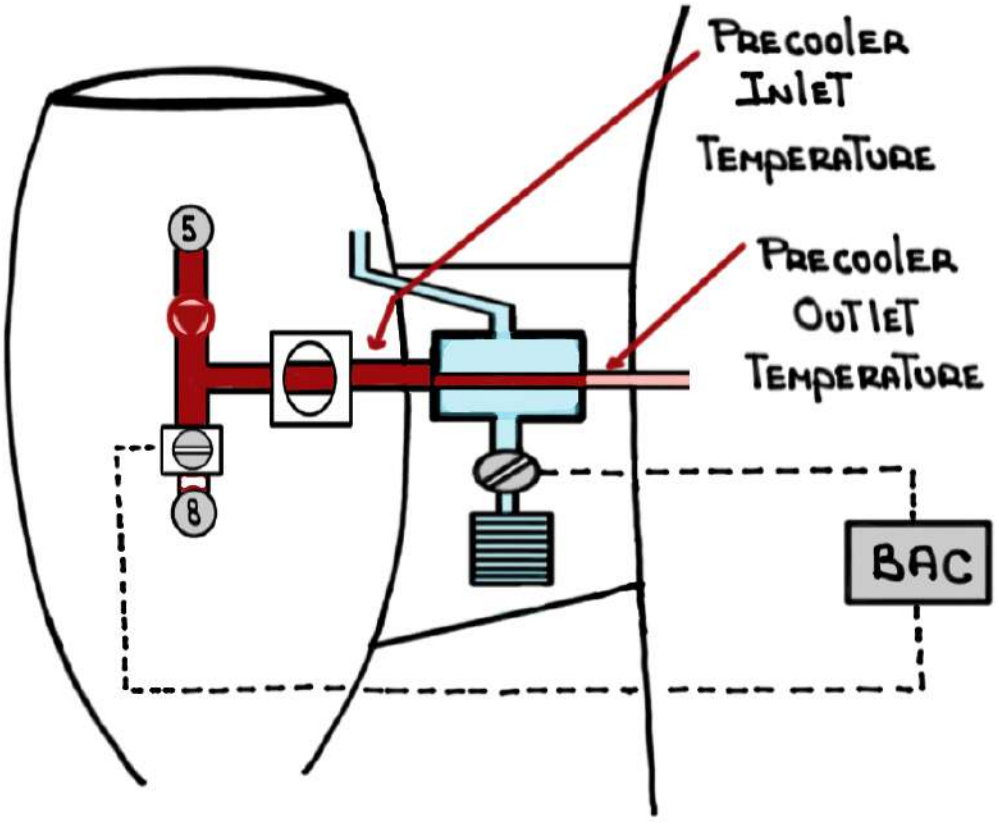
④ Isolation switchlight manually selected OPEN

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 <u>modulate</u> the opening of the Fan Air valves as necessary

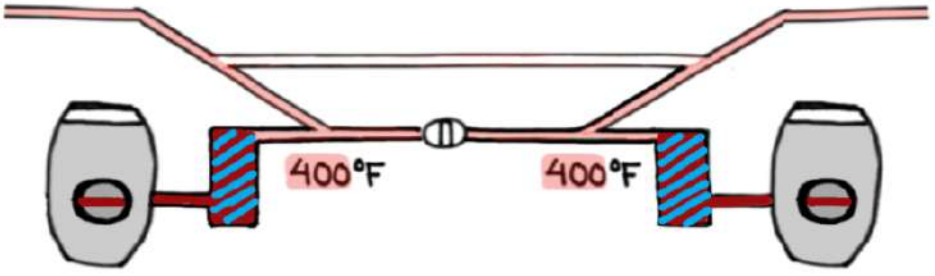


<u>Precooler Inlet Temperature</u>:

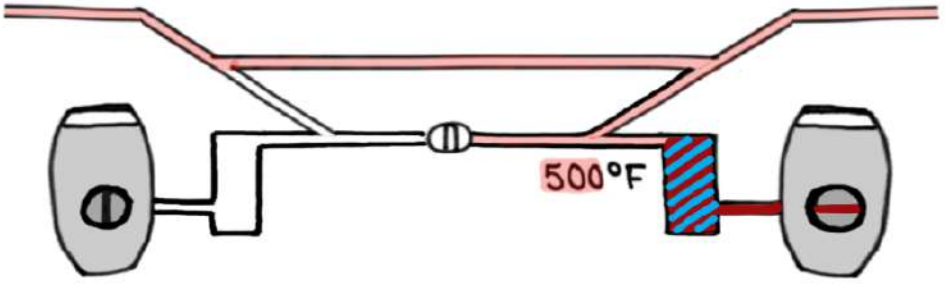
Whatever mid-stage (5TH) or high-stage (8TH) is producing

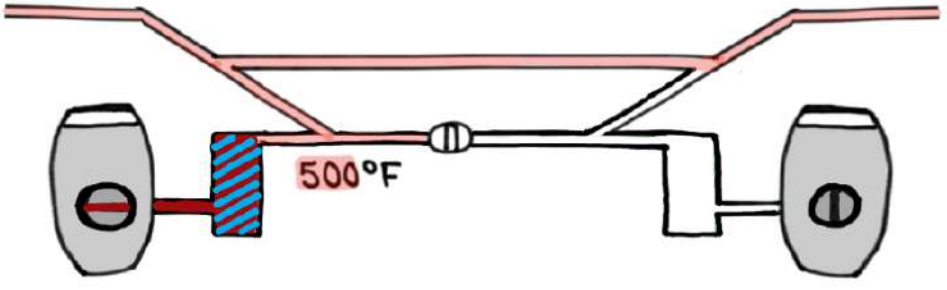
PRECOOLER OUTLET TEMPERATURE:

- 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

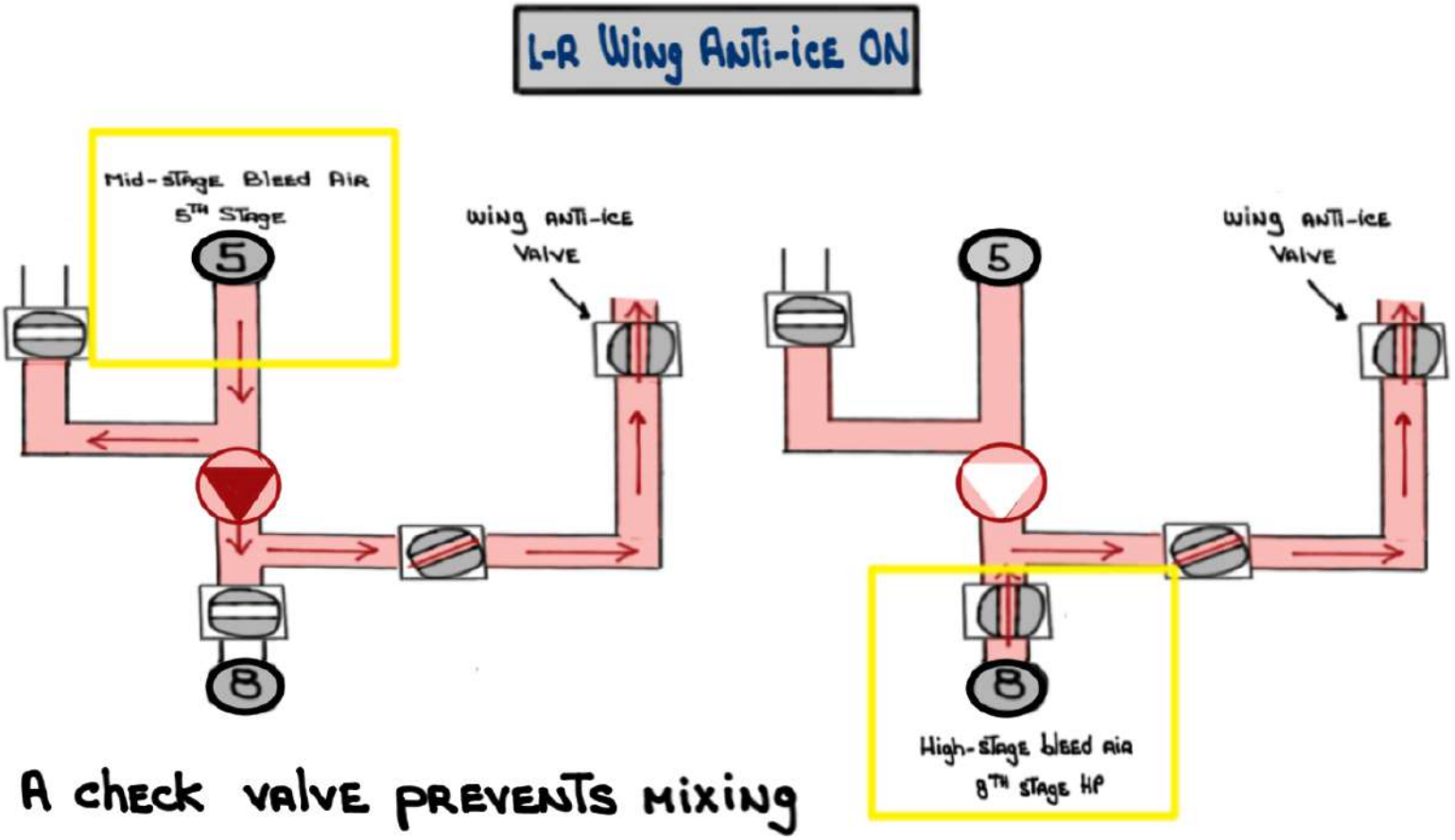




Wing Anti-ice System

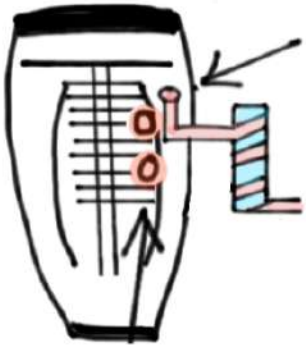
- Wing anti-ice valves are <u>electro-pneumatic</u>. They require:
  - Electrical power to <u>operate</u>
  - Pneumatic pressure to <u>CLOSE</u>

- It uses **HOT** engine bleed air (mid <u>or</u> high-stage)



A check valve prevents mixing between 5TH and 8TH stage bleed air

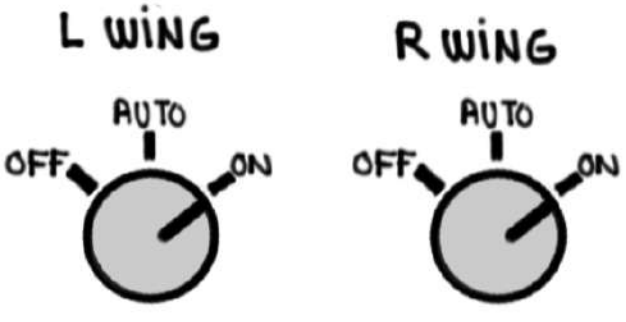
The L BAC R BAC COMMAND:

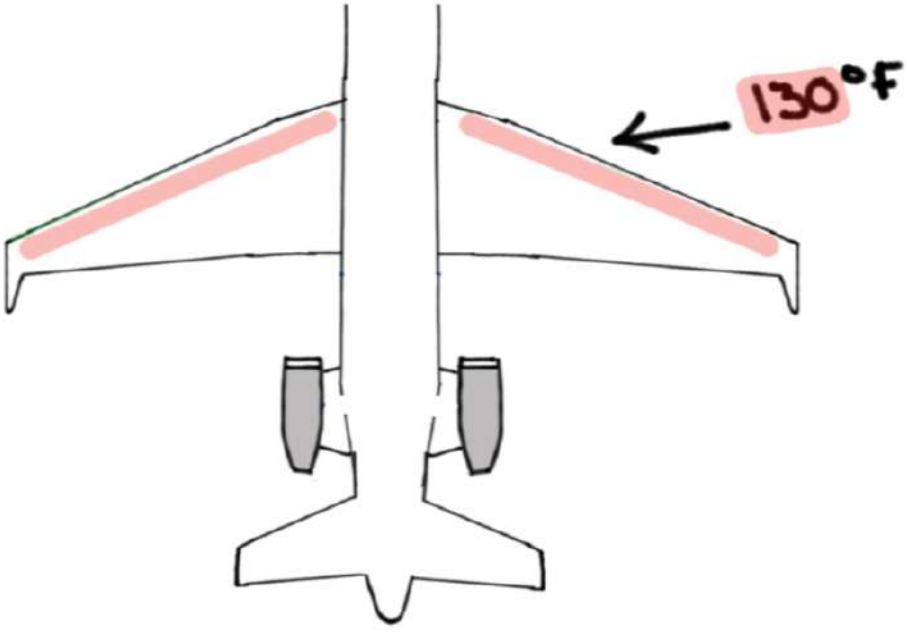


1ST FAN AIR VALVES TO MODULATE OPEN

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

L-R Wing Anti-ice ON

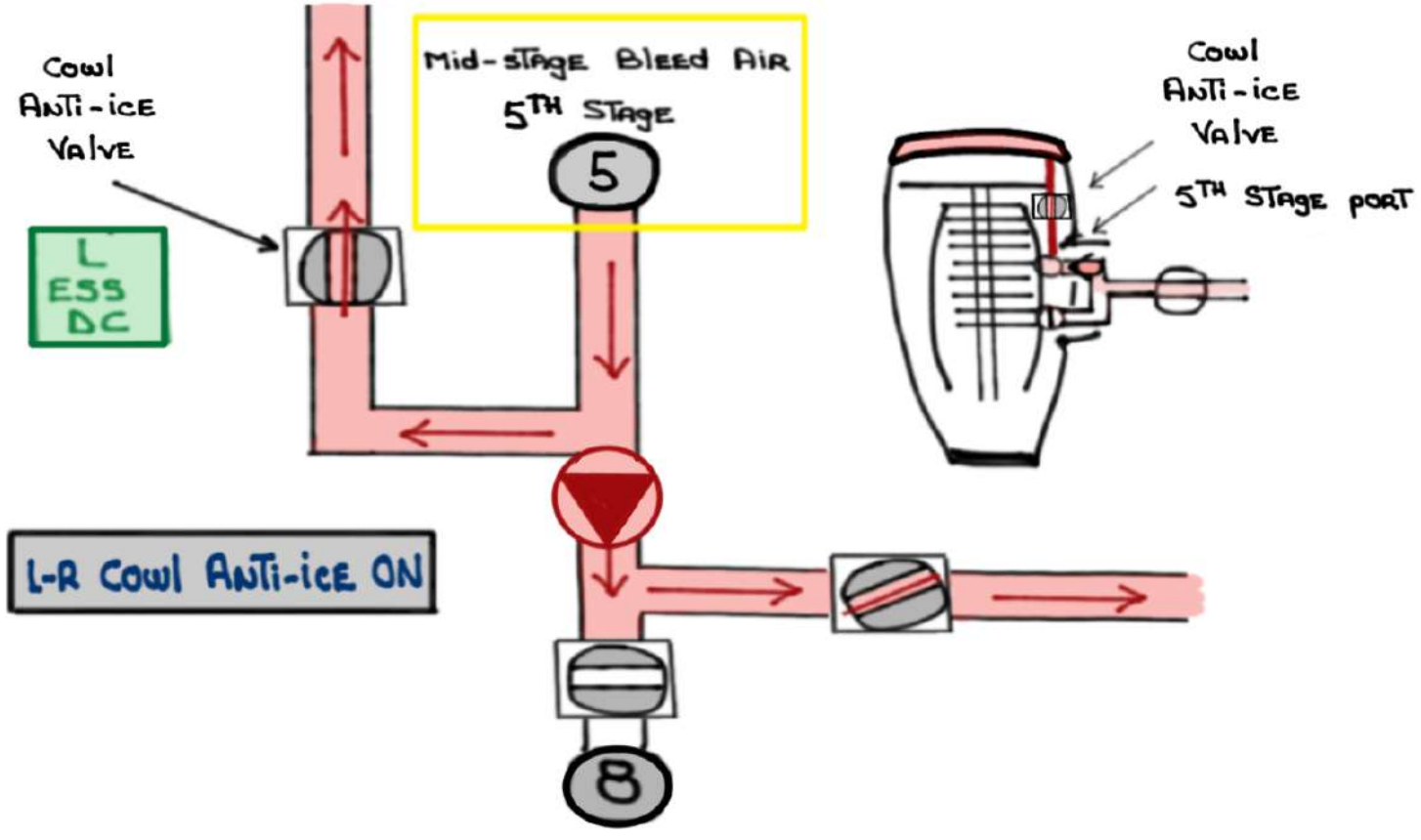




Cowl Anti-ice System

- Cowl anti-ice valves are <u>electro-pneumatic</u>. They require:
  - Electrical power to <u>operate</u>
  - Pneumatic pressure to <u>close</u>

- It uses **HOT** engine bleed air (mid-stage <u>only</u>)



- Cowl anti-ice valves fail <u>OPEN</u> L Cowl Valve Fail Open

SET POINTS

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

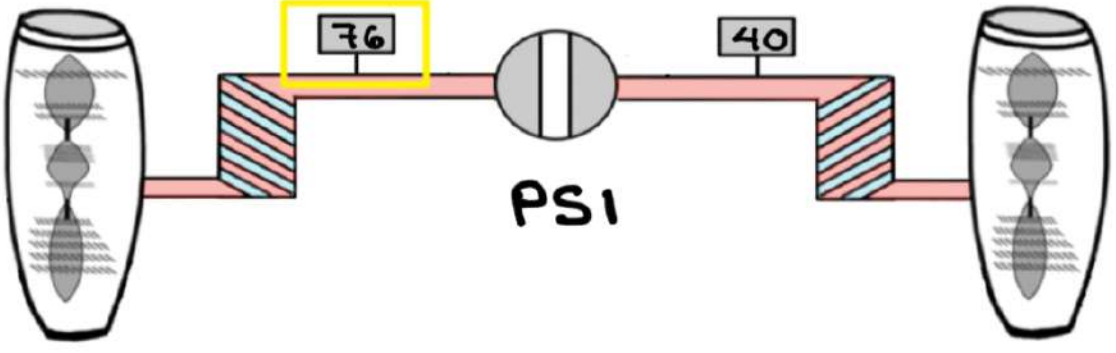
- LOW POWER SETTINGS = 14 - 24 PSI
- SINGLE PACK = 35 PSI

IF MID-STAGE (5TH) IS NOT ENOUGH THE BACS COMMAND THE HIGH-STAGE (8TH) VALVES TO MODULATE OPEN IN ORDER TO PROVIDE UP TO 40 PSI

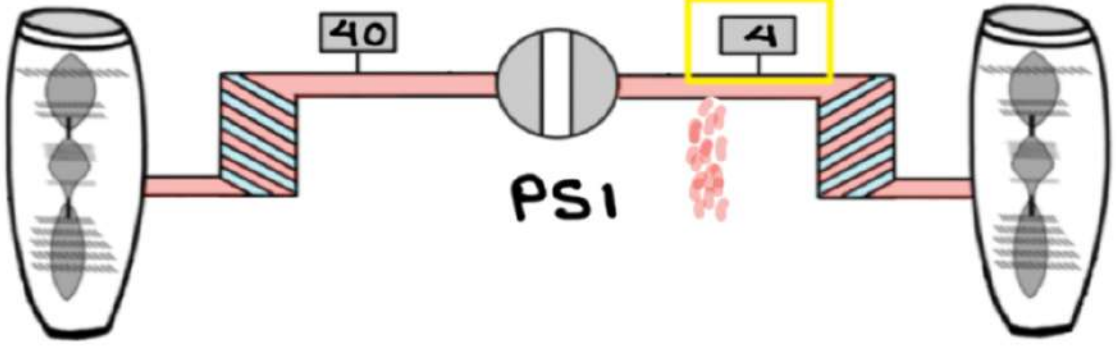
CONDITION	SOURCE	SET POINT PSI
GROUND IDLE	8TH	14
FLIGHT IDLE	8TH	24
THRUST > IDLE	5TH	40 (400°F)
WING ANTI-ICE (2) IDLE	8TH (PRE-COOLER 630°F)	40 (500°F)
WING ANTI-ICE (2) > IDLE	5TH (PRE-COOLER 630°F)	40 (500°F)
WING ANTI-ICE (1) > IDLE	5TH (PRE-COOLER 630°F)	40 (500°F)
SINGLE PACK	8TH	35 (500°F) * INOP PACK OFF

Bleed Air Pressure Sensors

> 75 Psi L Bleed Pressure High

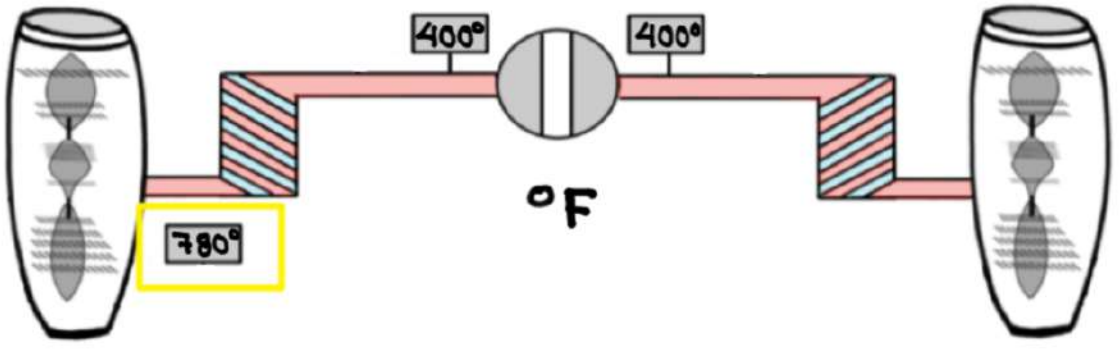


< 5 Psi > 10 seconds R Bleed Pressure Low

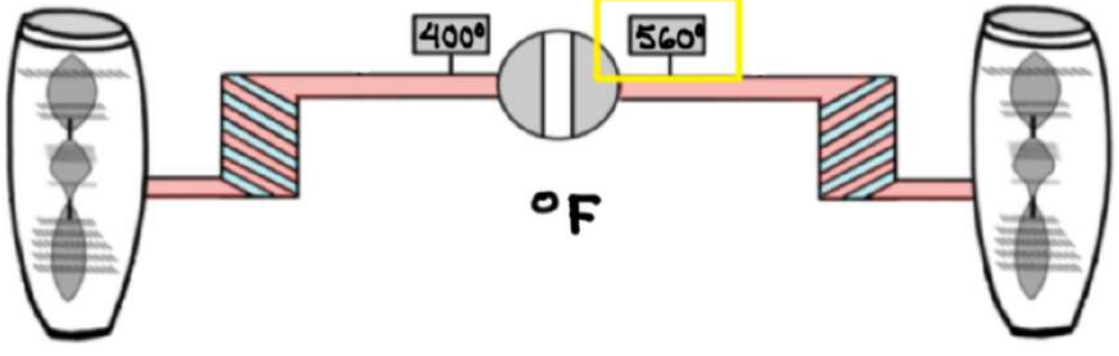


Bleed Air Temperature Sensors

L Bleed Air Hot > 765 °F Inlet



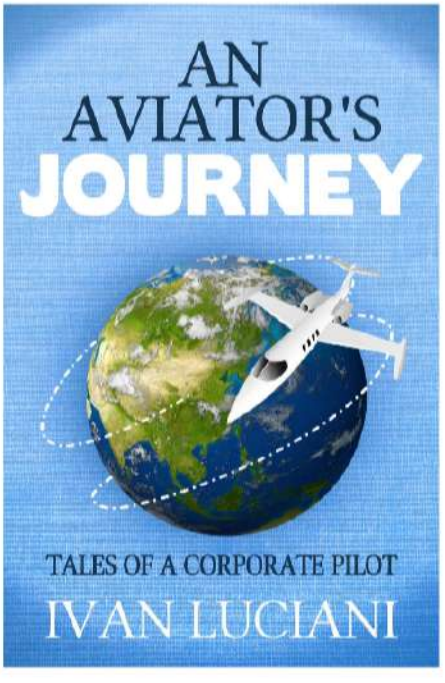
R Bleed Air Hot > 553 °F Outlet

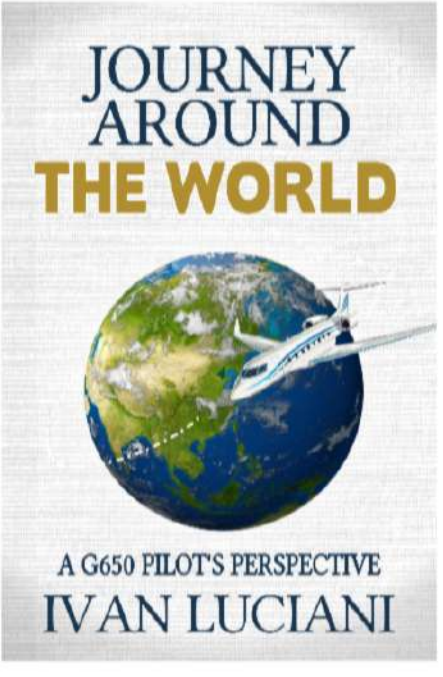


REMINDER: these system notes are intended for study purposes only. Always refer to official Gulfstream manuals and other approved references when operating your aircraft.

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





Thank you!