DEPARTMENT OF AEROSPACE ENGINEERING

19ASB303 AIRCRAFT MAINTENANCE ENGINEERING

UNIT II - GROUND SERVICING OF VARIOUS SUB SYSTEMS
Air Conditioning and Pressurization System in Aircraft

The air conditioning and pressurization systems in an aircraft ensure passenger comfort and safety during flight by maintaining the cabin's temperature, humidity, and pressure. These systems are critical for high-altitude operations, where external atmospheric conditions are unsuitable for human survival.

Components of Air Conditioning and Pressurization Systems

1. **Air Conditioning System Components:**
   - **Air Cycle Machine (ACM):** A turbine-driven machine that cools and conditions air supplied to the cabin.
   - **Heat Exchangers:** Removes excess heat from the bleed air before entering the ACM.
   - **Pack Valves:** Controls airflow into the air conditioning packs.
   - **Mixing Chamber:** Combines conditioned air with recirculated cabin air to achieve the desired temperature.
   - **Ducting System:** Distributes air throughout the cabin.
   - **Temperature Sensors and Controllers:** Monitors and adjusts the cabin temperature.
2. **Pressurization System Components:**
   - **Cabin Pressure Controller:** Regulates cabin pressure by controlling the outflow valves.
   - **Outflow Valve:** Releases air from the cabin to maintain desired pressure levels.
   - **Safety Valves:** Protects the cabin from over-pressurization or rapid depressurization.
   - **Pressure Sensors:** Continuously monitor the cabin and ambient pressure.
   - **Bleed Air Supply:** Provides pressurized air from the engine or Auxiliary Power Unit (APU).

Working Principle
Air Conditioning System Working:

1. **Bleed Air Supply:**
   - Air is extracted from the aircraft engines or the APU as "bleed air."
   - The bleed air is very hot (around 200°C) and requires cooling before use.
2. **Cooling Process:**
   - The bleed air passes through primary heat exchangers where ram air cools it.

- The air then enters the ACM, where it is compressed, further cooled in secondary heat exchangers, and expanded in the turbine to reduce temperature and pressure.

3. **Temperature Regulation:**
   - Conditioned air is mixed with recirculated cabin air in the mixing chamber.
   - The temperature is adjusted based on input from sensors and controllers.
4. **Air Distribution:**
   - The conditioned air is distributed through ducts into the cabin, ensuring even temperature and humidity levels.

Pressurization System Working:

1. **Bleed Air for Pressurization:**
   - Pressurized air from the engines or APU is directed into the cabin to maintain pressure.
2. **Pressure Control:**
   - The cabin pressure controller adjusts the outflow valve to maintain a pressure differential between the cabin and the outside atmosphere.
3. **Maintaining Cabin Pressure:**
   - At cruising altitudes (30,000–40,000 feet), the cabin pressure is maintained at an equivalent altitude of 6,000–8,000 feet for passenger comfort and safety.
4. **Safety Mechanisms:**
   - Safety valves prevent over-pressurization or rapid depressurization by releasing excess air or sealing the cabin.

Significance during Flight

1. **Passenger Comfort:**
   - The air conditioning system ensures a comfortable cabin environment with regulated temperature and humidity levels.
2. **Safety at High Altitudes:**
   - Pressurization prevents hypoxia (low oxygen levels), decompression sickness, and other health risks by maintaining breathable air pressure.
3. **Structural Integrity:**
   - Proper pressurization prevents excessive stress on the aircraft's fuselage, reducing the risk of structural failure.
4. **Operational Reliability:**
   - These systems allow aircraft to fly at high altitudes, reducing fuel consumption and avoiding turbulent weather.
5. **Compliance with Regulations:**
   - Aircraft must meet strict regulatory requirements for air conditioning and pressurization systems to ensure passenger and crew safety.

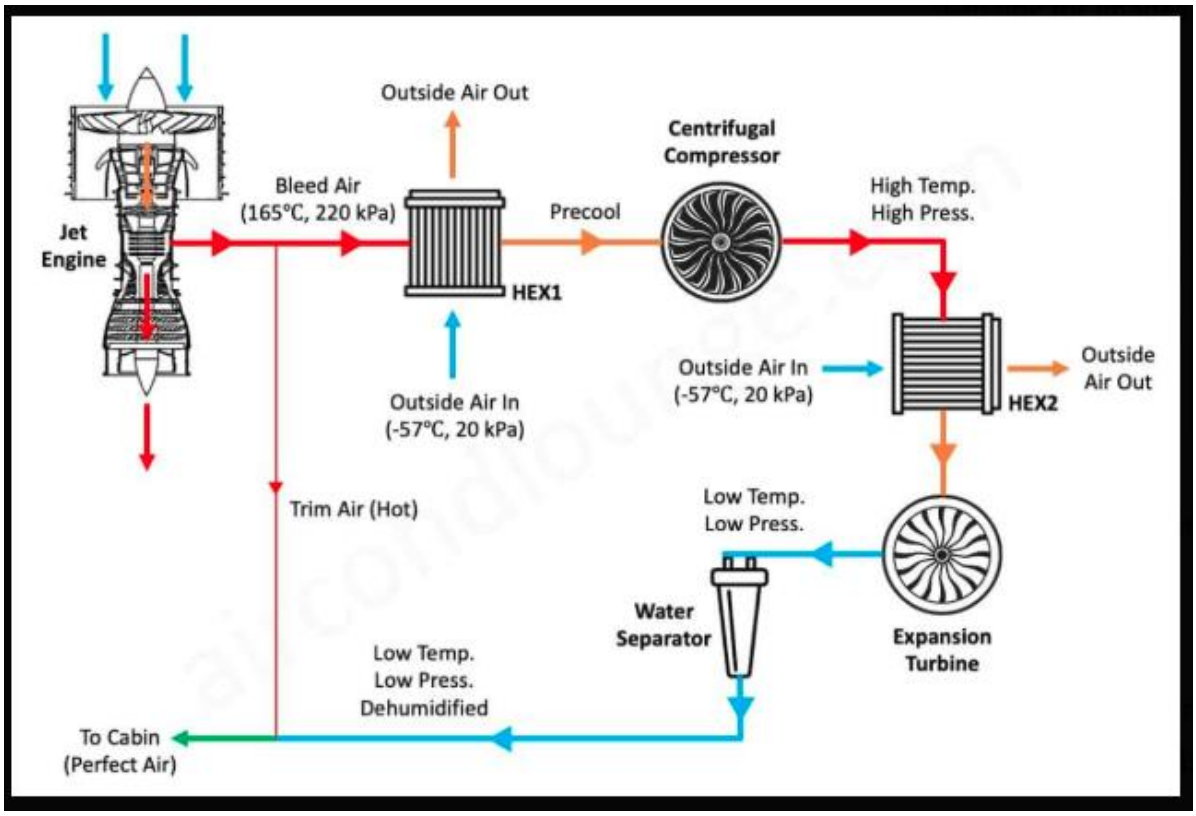
Challenges and Maintenance

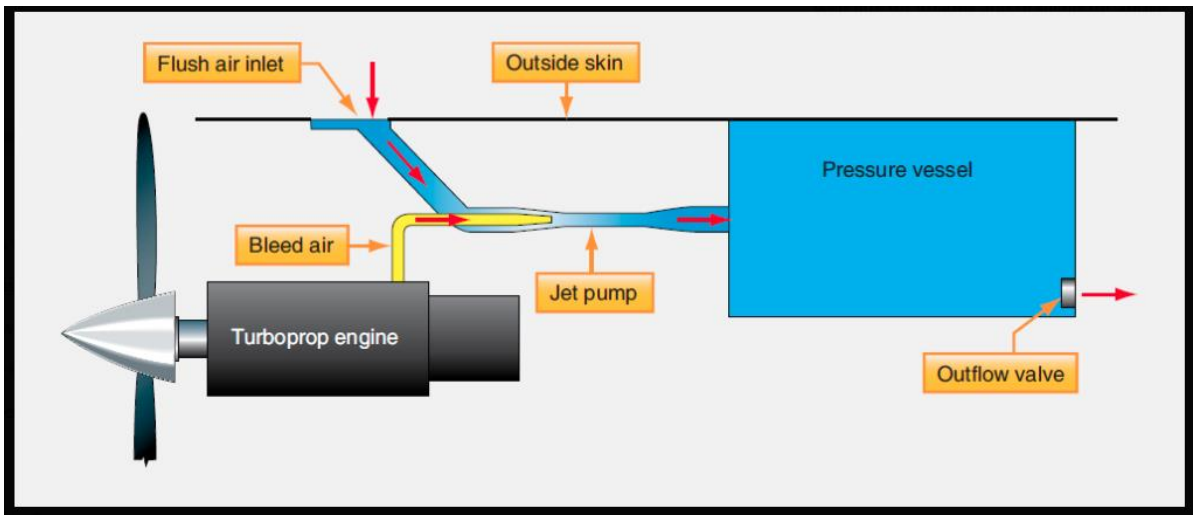
1. **Challenges:**
   - Faulty sensors or controllers can lead to improper temperature or pressure regulation.
   - Leaks in the ducting or valves can reduce system efficiency.
2. **Maintenance:**
   - Regular inspections of bleed air sources, valves, and heat exchangers are necessary.

- Functional tests of cabin pressure controllers and outflow valves ensure reliability.
- Routine cleaning and testing of filters and ducts prevent contamination.

Conclusion

The air conditioning and pressurization systems are indispensable for modern aircraft, enabling safe and comfortable flights at high altitudes. Their efficient functioning depends on regular maintenance and troubleshooting to address potential issues promptly. These systems not only ensure passenger comfort but also contribute to the aircraft's operational safety and reliability.





Aircraft Pressurization System