Air system

The engine air system includes

- The engine bleed air supply system-The compressed air is bleed from bleed valves on engine compressors. The air is then supplied at 45 PSI to connected engine and aircraft user systems.

- The external engine air services-The external engine air services are supplied from the engine bleed air supply system. These include – the inlet cowl thermal anti-icing system, the engine cross-starting system and in some cases the pneumatic thrust reverser system.

- The internal cooling and sealing air systems-The engine internal air systems provide cooling air flows, bearing chamber sealing air, compressor and turbine inter –stage sealing air

- The Accessory cooling system-The accessory cooling system provides ventilation airflows in the engine under-cowling zones to maintain their temperatures at an except able level. The system also supplies cooling air for various engine mounted accessories.

- The compressor bleed controls system-The compressor bleed control system maintains the engine compressor surge margin during low rpm operation and during engine acceleration and deceleration.

- The effect of bleeding air from the engine depends on the mass of air used by the aircraft and engine pneumatic services.

- The effects are a lower mass airflow with a reduction in thrust, an increase in EGT and in specific fuel consumption.

- The increase in fuel flow is required to raise the engine rpm to maintain the air mass flow and thrust and this will increase the EGT and SFC of the engine.
- Environmental system re-circulate a proportion of the air conditioning – air from the cabin to meet the pneumatic demand and save fuel.

❑AIRCRAFT LOW PRESSURE PNEUMATIC SYSTEM

- Aircraft LP pneumatic system is supplied with compressed air at 45 PSI to provide a ready air supply for aircraft
- Air-conditioning and Cabin Pressurization
- Engine starting
- Wing thermal anti-icing
- Nacelle inlet anti-icing
- Hydraulic reservoir and water tank pressurization
- In some cases wing leading edge slat operation
- Thrust reverser operation and air-driven hydraulic pump operation

- The air is normally supplied from either of two bleed points on the compressor on each engine but the air can also be obtained from the APU or from a low pressure air trolley via a ground service connection.

- The main air supply is normally taken from an intermediate or early HP compressor bleed point.

- During engine start up and at low engine rpm operations this supply is not sufficient so the air is taken from later HP compressor stage bleed point until the engine rpm reaches a value where the low pressure bleed air can meet the demand of pneumatic system.

- high pressure or hi-stage air supply is normally terminated as its temperature becomes too high for the system.
- The aircraft pneumatic manifold consists of insulated ducts of about 4” diameter made of titanium

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- The aircraft pn
consists of insulat
4” diameter made

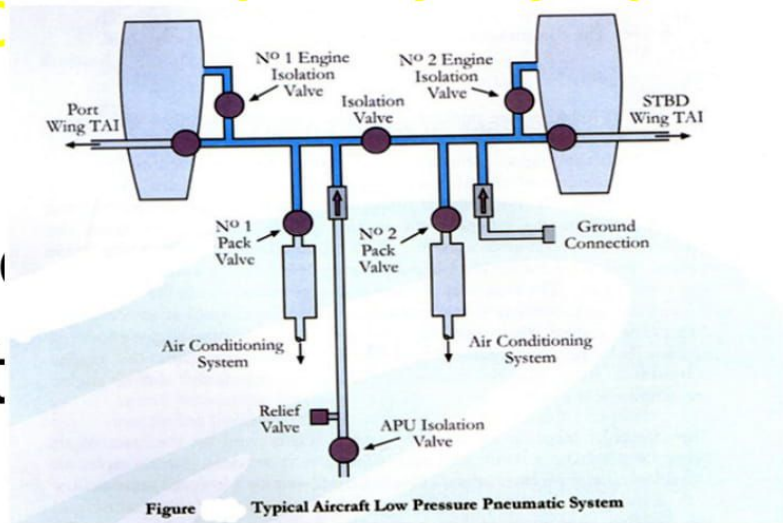

Figure Typical Aircraft Low Pressure Pneumatic System

- During maintenance
  ground connection and a e

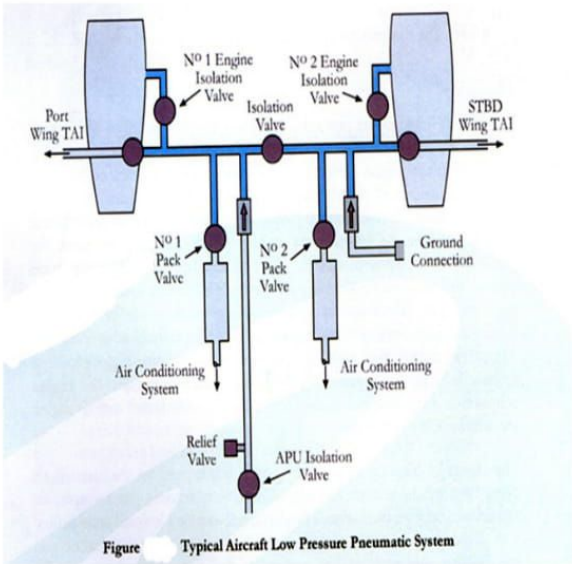

Figure Typical Aircraft Low Pressure Pneumatic System

ENGINE AIR SERVICES

intake thermal anti-icing engine cross starting system

engine air start valve anti-ice control valve Both the valves are

HOT AIR ANTI-ICE CONTROL SYSTEM

objective of the anti-ice system is to prevent ice from forming at the engine intake also compressor inlet guide

system is normally switched on whenever the outside air temperature falls below $10^{0}C$ and there is a visible moisture present in the air

risk of ice highest when
at high rpm on the ground

air temperature falls below 5°C.

hot HP compressor air

upto around 200°C intak
cowl.

25 PSI by th

control valve

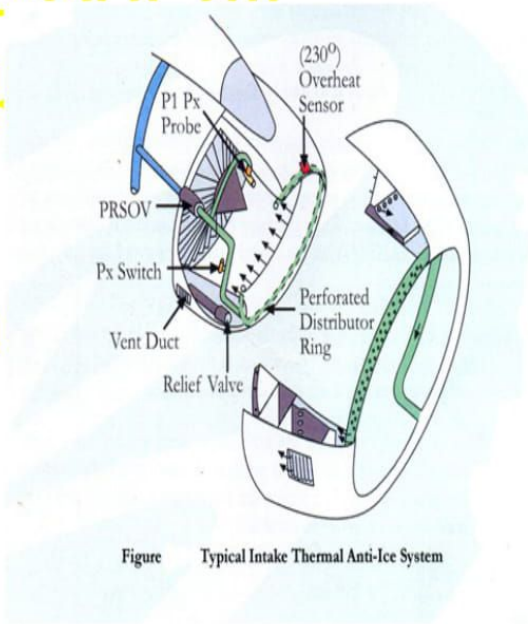

Figure Typical Intake Thermal Anti-Ice System

ejected forward

exhausted through vent

spinner and the fan or front rotating stages of the compressor are not prone to ice formation as this is prevented by the centrifugal forces

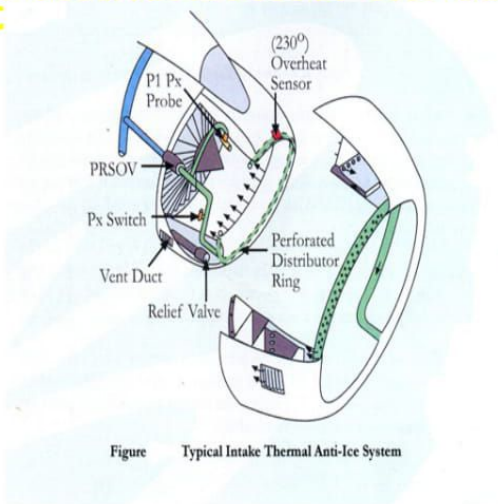

Figure Typical Intake Thermal Anti-Ice System

hot air entering the engine will

effect the mass air flow cause a reduction in thrust

up to 30% in extreme

cases.

- The SFC will also increase and EGT will increase by around $10^{0}C$.

cause operating restrictions in flight

engine idling speed will be reset to the higher flight idle

igniters will be selected on to continuous ignition.

INTERNAL COOLING AND SEALING AIR SYSTEM

labyrinth type air seals rely on a pressure differential to pass air across the seals into the chambers.

clearance between the engine stators and rotors preventing leakage of hot gas into the cavities between the turbine discs and the engine static casings.

HP and LP turbine blade tip clearances are maintained by active clearance control ACC the rotor casings are cooled using a regulated supply of air to control expansion and thus blade tip clearance.

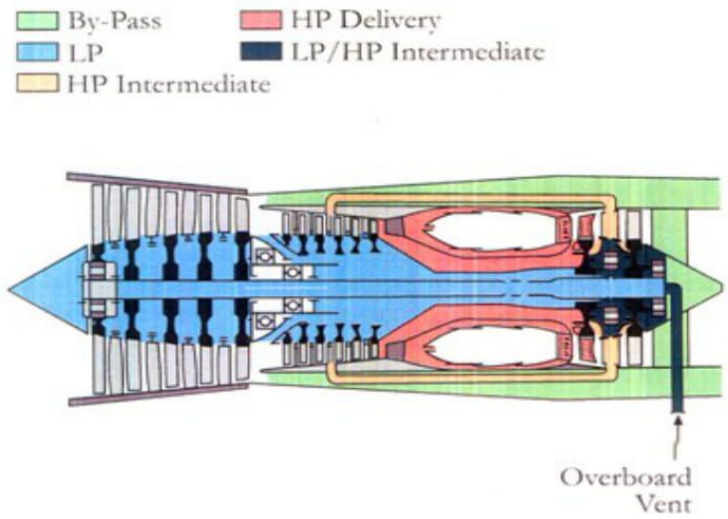

Figure **Typical Internal Airflows**

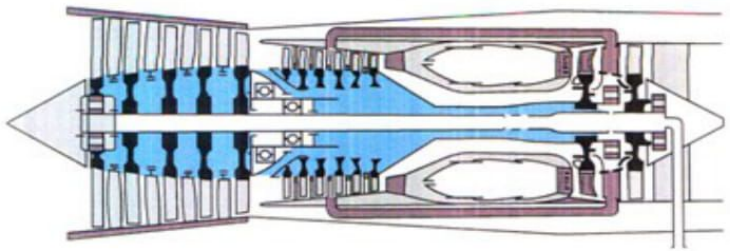

Figure **LP Cooling and Sealing Airflow**

INTERNAL AIR FLOW

active clearance control ACC