the crew checklist and passenger emergency brief and emergency procedures stored in the seats. By doing so, it is of utmost importance to inform the appropriate ATC unit allowing them to clear other traffic below that may conflict with the emergency descent path. Moreover, one shall bear in mind the minimum sector altitudes when performing such a manoeuvre.

8.2 Air Conditioning System

Conditioned air for the cabin comes from either the aeroplane conditioning system or a preconditioned ground source. In general, an air conditioning system provides temperature controlled air by processing bleed air from the engines. This temperature controlled air is mixed in a chamber for distribution to the cockpit and passengers' cabin.

The air conditioning system illustrated in *fig. AS 8.6,* includes two independent conditioning systems which supply the

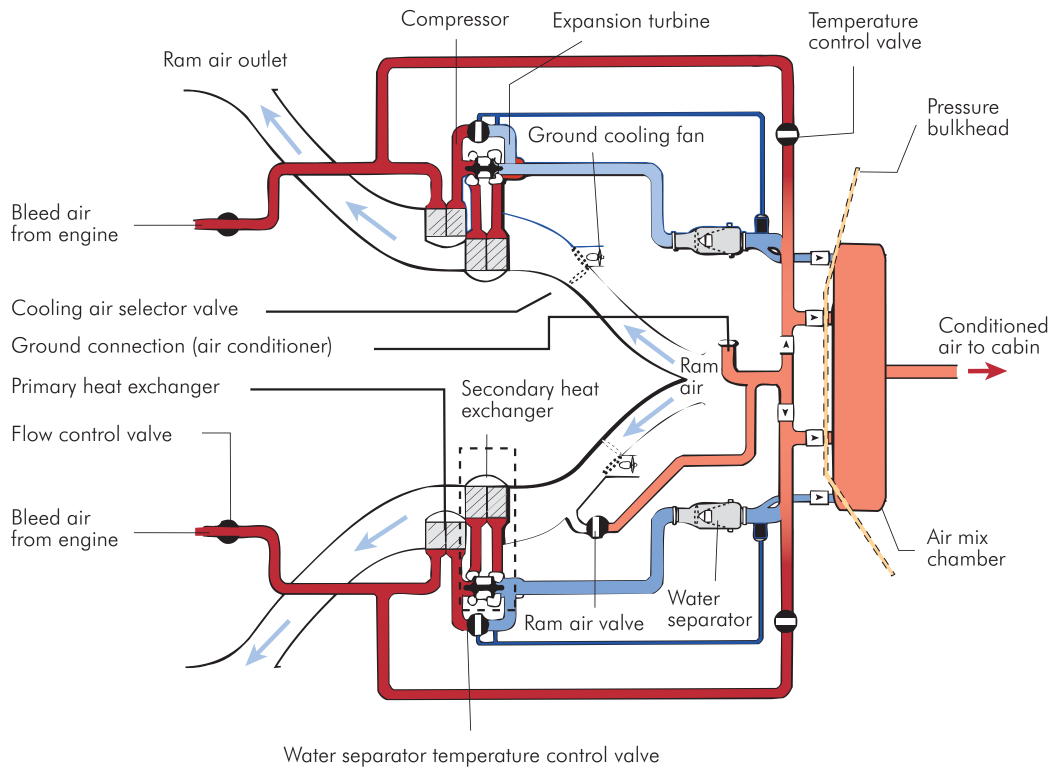
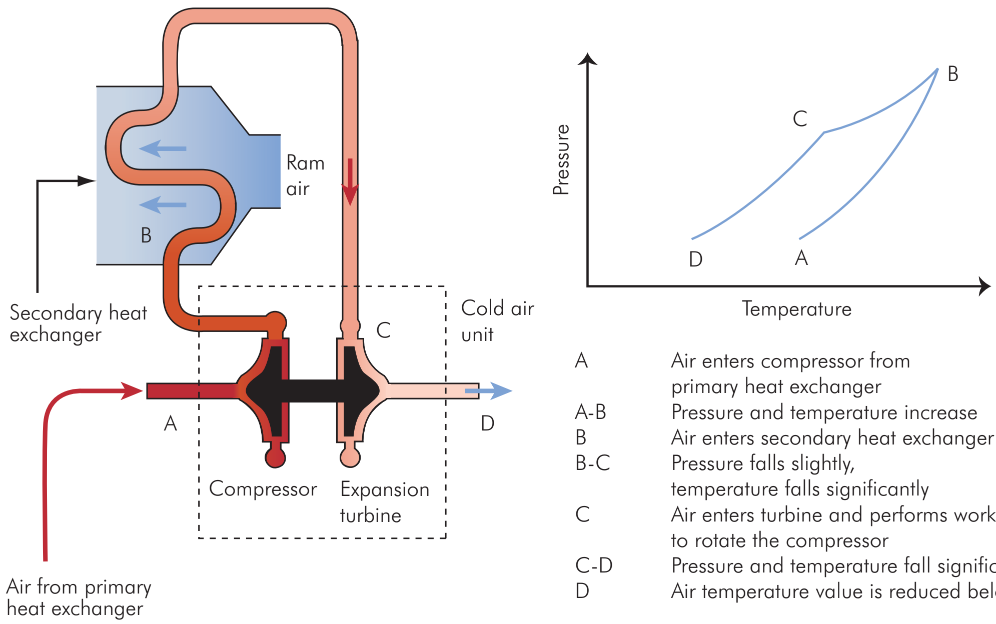


Fig. AS 8.6 Air conditioning system

cabin with heated and cooled air. These are mixed to produce air at the correct temperature. The system is provided with hot compressed air, which is bled from the engine compressors or from the auxiliary power unit. This bleed air is fed through pressure regulating and shut-off valves, flow limiters, and flow control valves to the air cycle machines (ACM), where it is cooled. To obtain the correct temperature, some of the hot air is bled off before it reaches the cooler, and is mixed with the cold air by a temperature control valve. The cold air for cooling the aeroplane is produced by the primary and secondary heat exchangers. From the compressor, 'bleed air' flows into the primary heat exchanger where it gives up some of its heat to the ram air that flows through the duct. After leaving the primary heat exchanger, the air is further compressed in the air cycle machine, see detailed outline in *fig. AS 8.7.* Because of this compression, the temperature of the air rises. This allows even more heat energy to be removed when the air flows through the secondary heat exchanger. The air also loses much of its heat energy as it spins the expansion turbine, which drives the air cycle machine compressor. Still more heat is extracted in the last stage of cooling, as the air expands upon leaving the turbine. When it leaves the expansion turbine, it is cold. A water separator collects the moisture condensed as a result of the air being cooled.



A	Air enters compressor from primary heat exchanger
A-B	Pressure and temperature increase
B	Air enters secondary heat exchanger
B-C	Pressure falls slightly, temperature falls significantly
C	Air enters turbine and performs work to rotate the compressor
C-D	Pressure and temperature fall significantly
D	Air temperature value is reduced below A

Fig. AS 8.7 Air cycle machine - principle of operation (Bootstrap arrangement)

The compressor-turbine combination renders the secondary heat exchanger more effective, because it increases the temperature difference between the cooling air and the cooled air. On top of that this is the only way it is possible to cool the air to a temperature value below the temperature of the cooling air. This is necessary when supplying air-conditioned air when the aeroplane is sitting on the platform on a hot day.

Consequently, an air conditioning system consists of a system that separates cold and hot air, and by mixing this in a mixing chamber, the cabin is supplied with air at the temperature required to maintain a pre-set temperature. Modern systems contain pressure and temperature safety devices to ensure that the air conditioning distribution system is not over pressurised and the temperature of the air in the distribution system is not too hot.

Pressure control systems shut off the air supply from the engine compressor discharge when the pressure limit is reached indicating a failure of the pressure regulator and shut off-valve.

In the temperature control system, the high temperature in the distribution system closes the temperature control valve to stop the supply of hot air. The position of the temperature control valve is normally controlled by inputs of the set desired temperature, the temperature present in the cabin or flight deck and the temperature of the air in the distribution system.

The cockpit is usually equipped with warning lights that illuminate when any of these safety devices are operating.

Re-circulation fans illustrated in *fig. 8.8,* are fitted to many aeroplanes to re-circulate cabin air. The prime reason for fitting recilculating fans is to achieve a reduction in specific fuel consumption. In the event of a failure of the air conditioning system or to provide some ventilation by air movement before the air conditioning is available, the re-circulation fan is selected ON. This re-circulates the air in the cabin through ceiling level or side panel ducting and into the cabin. To remove impurities and odours from the re-circulated air, filters are fitted to the inlet and outlet points of the fan system.

8.2.1 Control and Indication

Fig. AS 8.9 illustrates a typical air conditioning control system for a turbo-prop aeroplane. This example incorporates separate primary distribution systems from the engines. In the event of an engine and system failure there will either be a manual control to link the flight deck and cabin distribution system to the remaining supply or the distribution system is designed to automatically distribute the single supply source to both areas.
Also in the system illustrated is a control, which directs the flight deck supply to either foot warmers or windscreen de-mist. Later turbo-prop aeroplanes provide one of these controls to both pilots.

Large modern transport aeroplanes have fully automatic temperature control systems which are digitally set by the pilot as one of

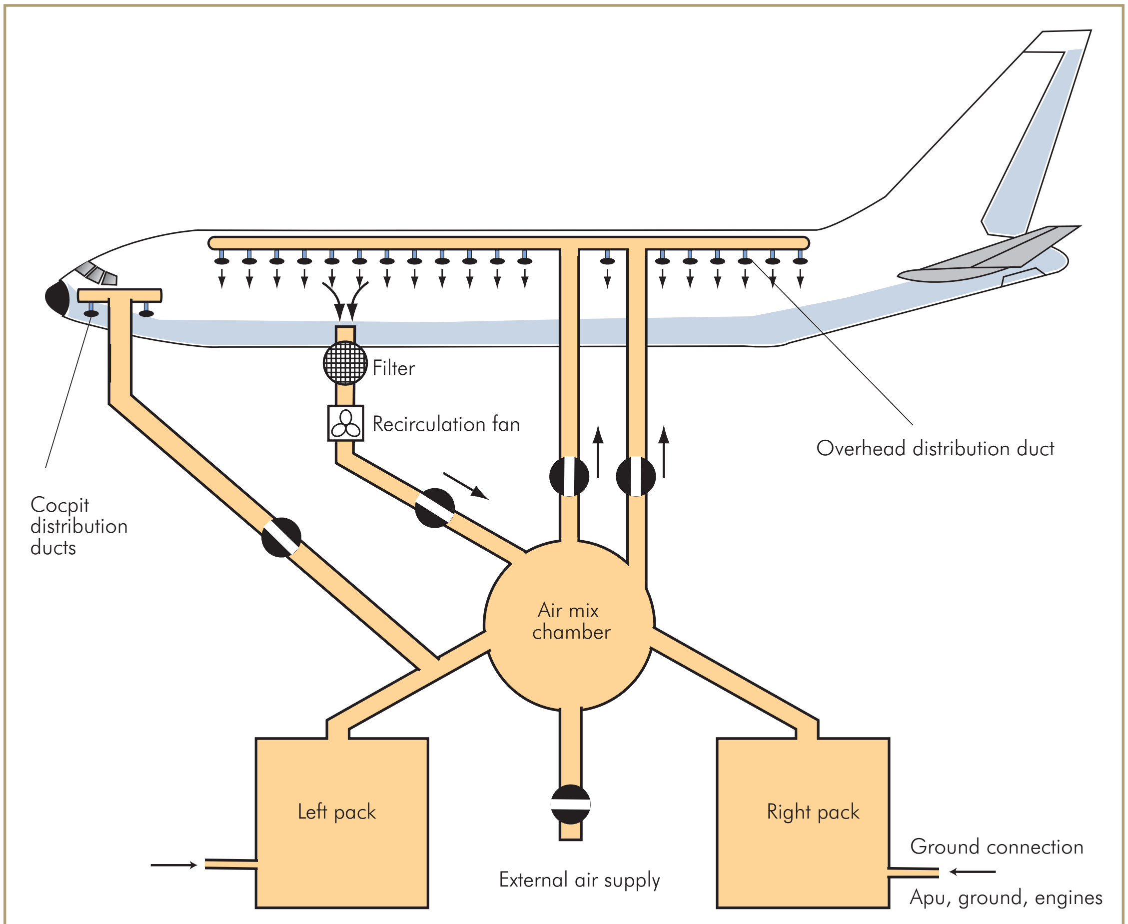


Fig. AS 8.8 Cabin air recirculation

the functions of multi-function displays in a "glass cockpit".

Indications are normally limited to the actual temperature in the separately controlled compartments of the aeroplane, especially cargo bays of aeroplanes designed for purely cargo operations.

Warnings include indications of air supply failure or shutting down of the shut-off bleed valves in the engine, leaks of hot bleed air from the ducting in vital areas (including landing gear bay, wing span areas, fuel tank areas) and high temperature to the distribution system downstream from the temperature control valve. In the system illustrated at *fig. AS 8.6 and fig. AS 8.8,* these indications provide amber captions labelled AIR OFF for engine supply failure, DUCT FAIL for leakage in vital areas and TEMP for high temperature to the distribution system. Systems have built in automatic

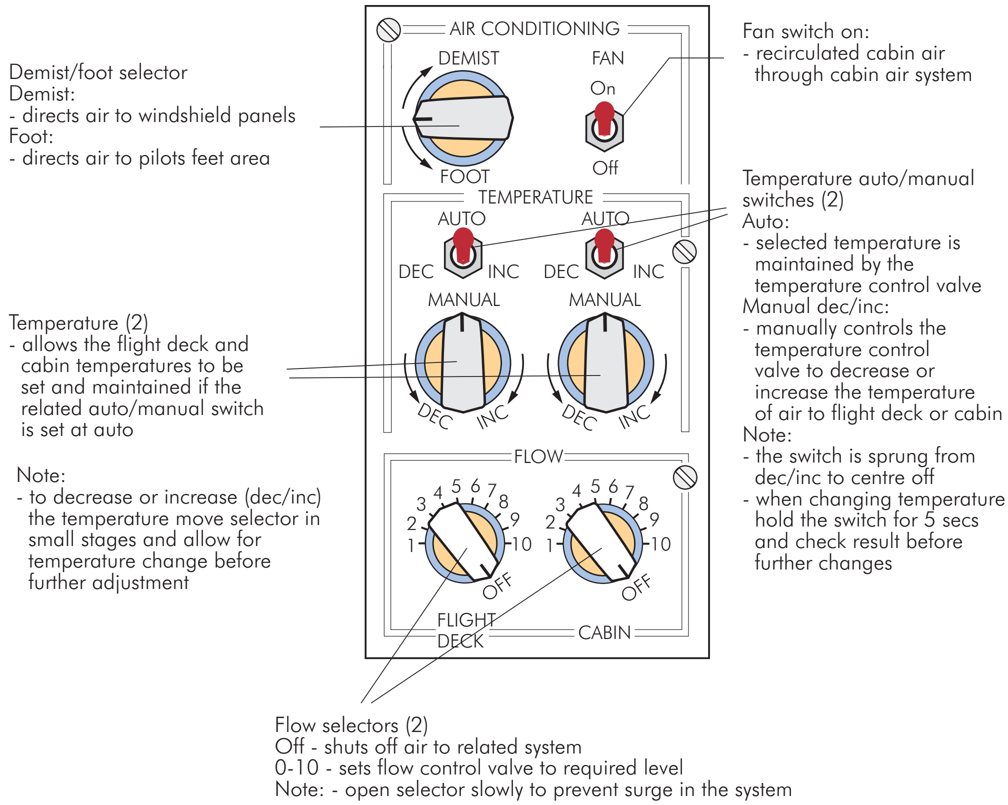


Fig. AS 8.9 Air conditioning control system

circuits which are activated by some of the captions but in all cases pilots should refer to Abnormal Drills when amber captions illuminate.

8.2.3 Ditching Control Valve

A ditching control valve has the purpose of closing the outflow valves in case of landing onwater.

QUESTIONS

1 Normal maximum negative differential pressure is:
a) Where the cabin pressure falls below an aircraft altitude pressure at which time the inward relief valve opens
b) The pressure below which a human is likely to suffer degraded performance
c) When the cabin pressure exceeds the atmospheric pressure by 0.5 psi
d) The pressure at which the duct relief valve is set to operate

2 If the aircraft is in level flight and cabin altitude increases, pressure differential
a) Increases
b) Decreases
c) Stays the same
d) Continues to be manually controlled

3 A cabin humidifier is used:
a) Rarely
b) At high altitude
c) At low altitude
d) On the ground in high ambient temperatures

4 Temperature control is achieved by:
a) Regulating the amount of hot air by-passing the cooling system
b) Varying the ambient airflow to the heat exchanger
c) Controlling the water vapour in the air supply
d) Controlling the air pressure

5 In which pressurisation mode is the pressurisation system operating in if the cabin altitude is the same as the flight altitude?

a) The standard pressure mode
b) The unpressurised mode
c) The isobaric mode
d) The constant differential mode

6 What is the function of a negative pressure relief valve, which often is incorporated in a pressurisation system?

a) To prevent the cabin pressure to become too high
b) To prevent the cabin pressure to become higher than the surrounding air pressure
c) To prevent the cabin pressure to become lower than the surrounding air pressure
d) To regulate the cabin rate of climb to a comfortable rate

7 What pressurization mode is used to maintain the cabin altitude at a constant value as the flight altitude changes?

a) The isobaric mode
b) The unpressurised mode
c) The standard pressure mode
d) The constant differential mode

8 Use the Differential Pressure Graph in figure 8.2a, and find the aircraft maximum operating altitude whilst maintaining a cabin altitude of 6500 ft with the differential pressure at 7 psi:

a) 26 000 ft
b) 27 000 ft
c) 29 000 ft
d) 30 000 ft

9 Use the Differential Pressure Graph in figure 8.2a, and determine the Cabin altitude when the aircraft is cruising at an altitude of 23 000 ft with a differential pressure of 5 psi:

a) 6000 ft

b) 7000 ft

c) 8000 ft

d) 8500 ft

10 Use the Differential Pressure Graph in *fig. AS 8.2a,* and determine the differential pressure, when the aircraft is cruising at an altitude of 25 000 ft with the cabin altitude set to 7000 ft.

a) 6 psi

b) 7 psi

c) 8 psi

d) 9 psi

The answers can be found at the end of the book.