॥ नमस्ते ॥

CABIN PRESSURIZATION MODES

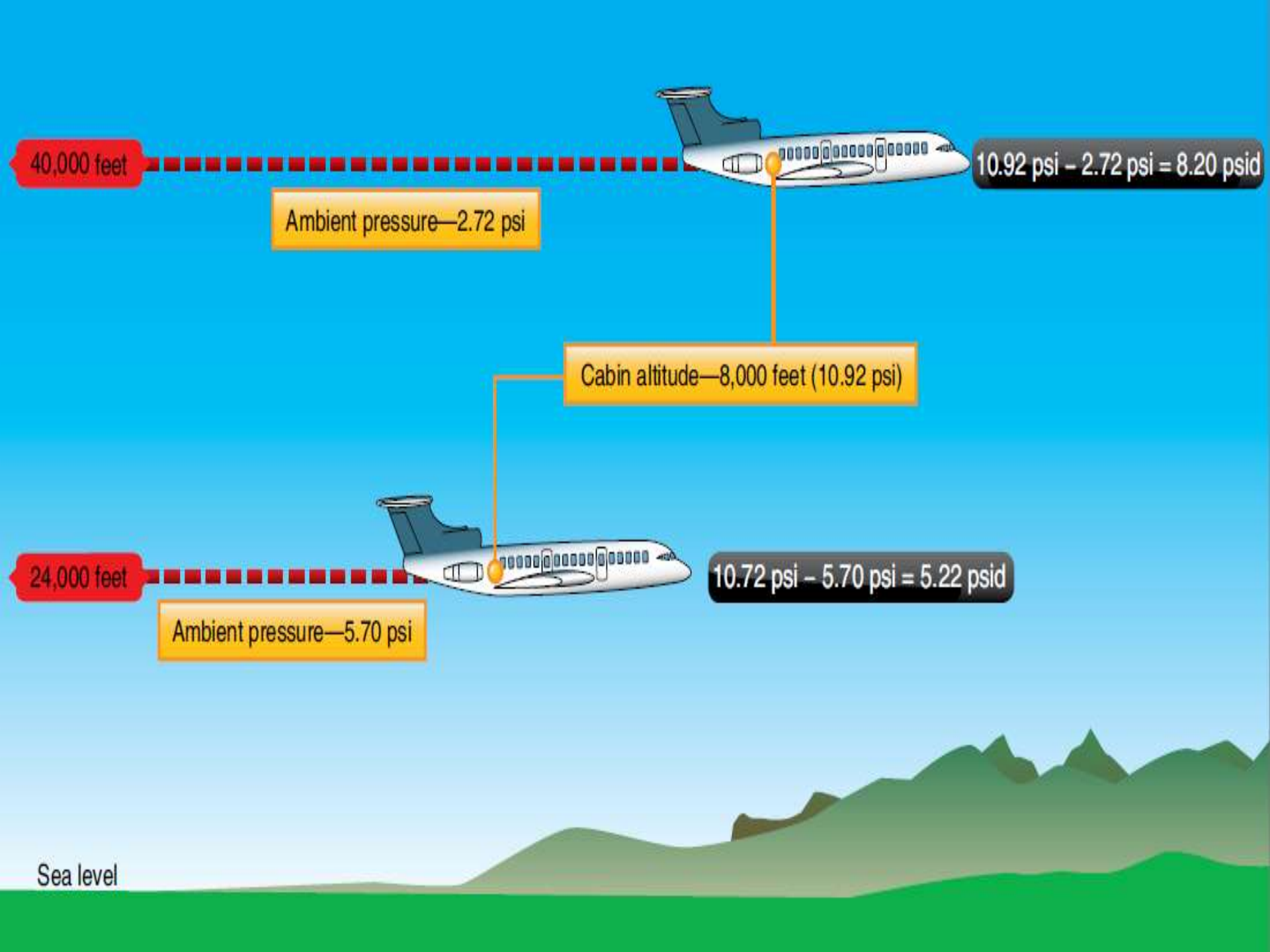
Pressurization Modes

Aircraft cabin pressurization can be controlled via two different modes of operation.

1. **Isobaric mode**
2. **Constant differential mode**

1.Isobaric Mode

- **It works to maintain cabin altitude at a single pressure despite the changing altitude of the aircraft.**
- **In the isobaric mode, the cabin pressure is established at the 8 000 foot level and remains at this level, even as the altitude of the aircraft fluctuates.**


40,000 feet
Ambient pressure—2.72 psi
10.92 psi – 2.72 psi = 8.20 psid
Cabin altitude—8,000 feet (10.92 psi)
24,000 feet
Ambient pressure—5.70 psi
10.72 psi – 5.70 psi = 5.22 psid
Sea level

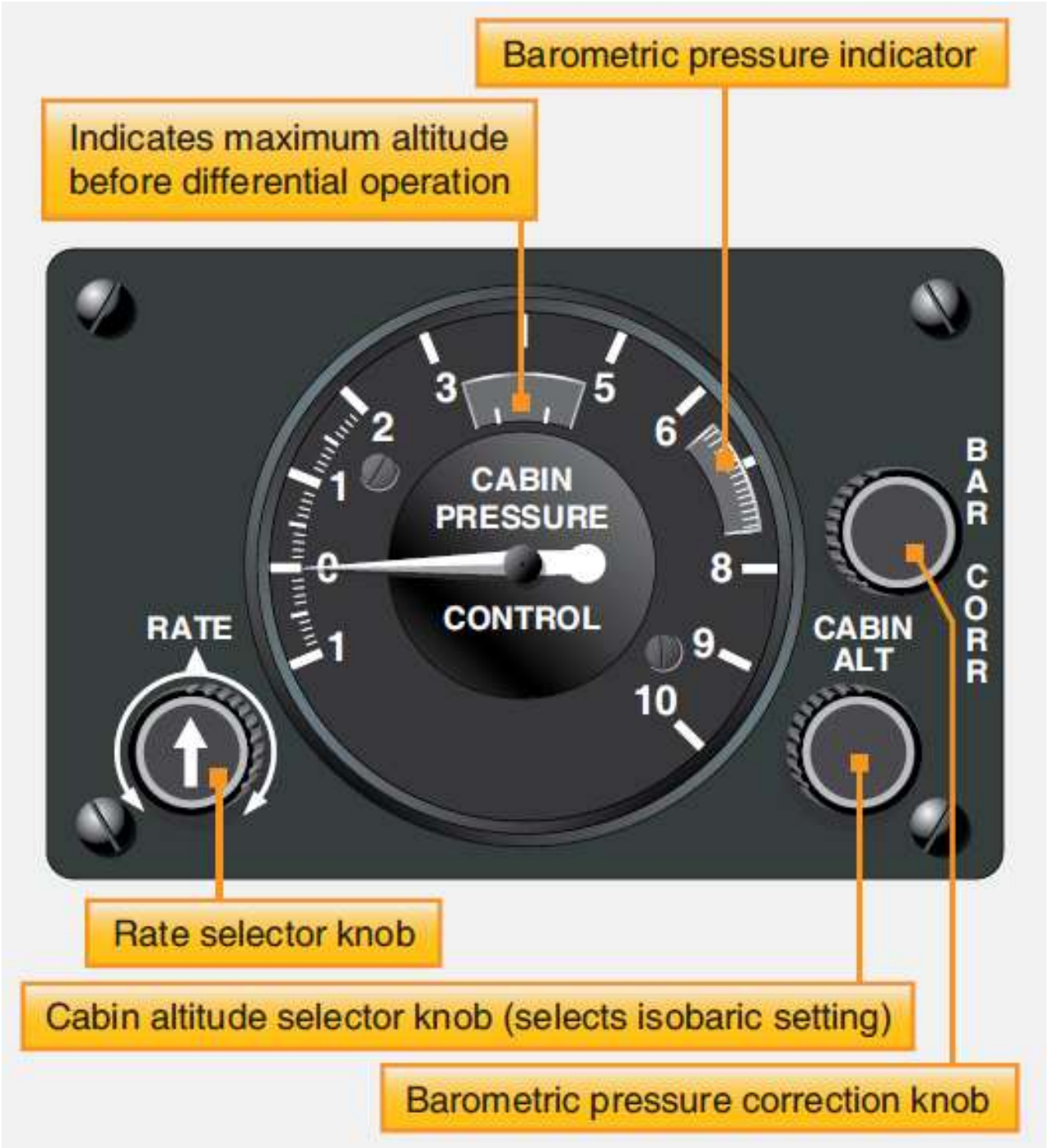
2.Constant differential mode

- The second mode of pressurization control is the constant differential mode, which controls cabin pressure to maintain a constant pressure difference between the air pressure inside the cabin and the ambient air pressure, regardless of aircraft altitude changes.
- The constant differential mode pressure differential is lower than the maximum differential pressure for which the airframe is designed, keeping the integrity of the pressure vessel intact.

- When in isobaric mode, the pressurization system maintains the cabin altitude selected by the crew.
- This is the condition for normal operations. But when the aircraft climbs beyond a certain altitude, maintaining the selected cabin altitude may result in a differential pressure above that for which the airframe was designed.
- In this case, the mode of pressurization automatically switches from isobaric to constant differential mode.
- This occurs before the cabin's max differential pressure limit is reached.
- A constant differential pressure is then maintained, regardless of the selected cabin altitude.
- In addition to the modes of operation described above, the rate of change of the cabin pressure, also known as the cabin rate of climb or descent, is also controlled.
- This can be done automatically or manually by the flight crew. Typical rates of change for cabin pressure are 300 to 500 fpm.
- Also, note that modes of pressurization may also refer to automatic versus standby versus manual operation of the pressurization system.

CABIN PRESSURE CONTROLLERS

- **The cabin pressure controller is the device used to control the cabin air pressure.**
- **Selections for the desired cabin altitude, rate of cabin altitude change, and barometric pressure setting are all made directly to the pressure controller from pressurization panel in the cockpit.**

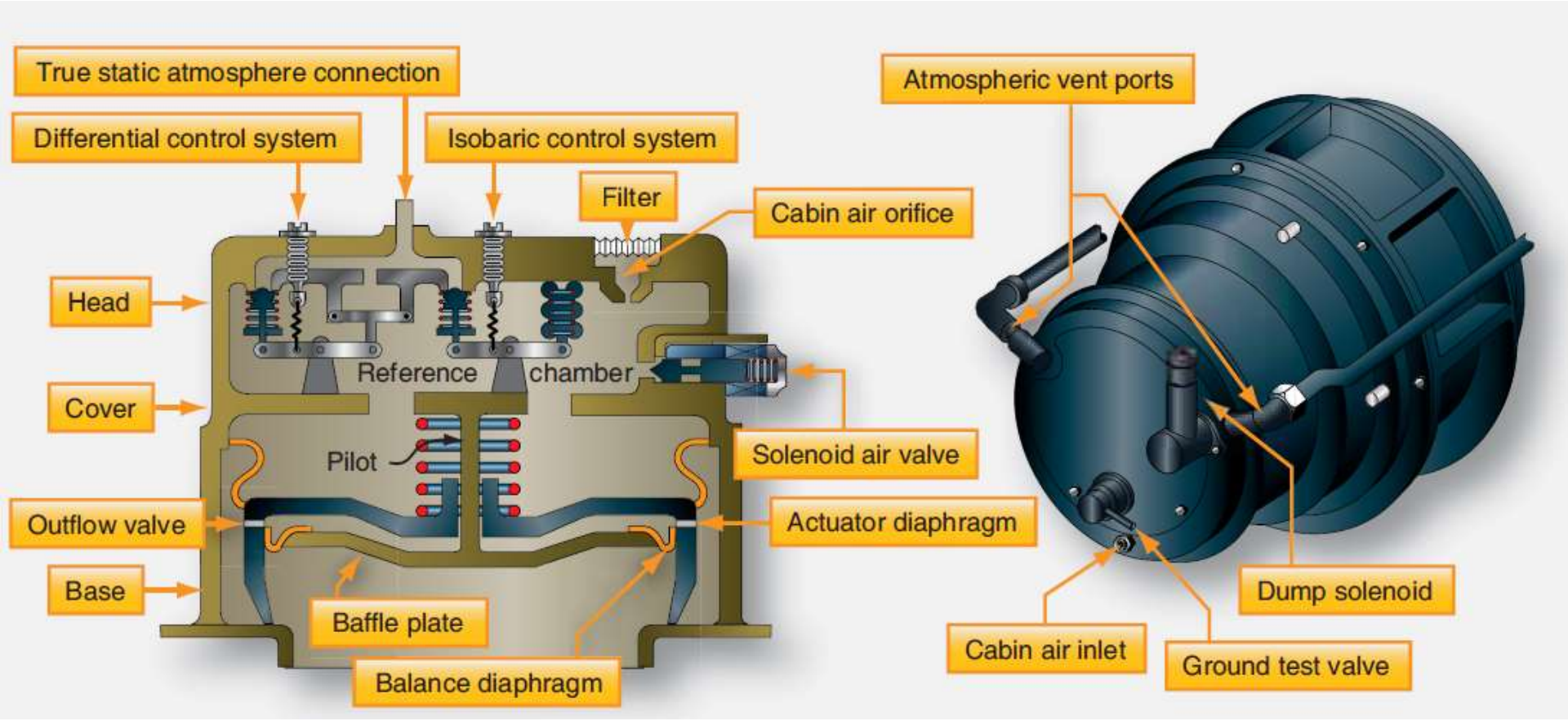

Barometric pressure indicator
Indicates maximum altitude before differential operation
CABIN PRESSURE CONTROL
RATE
CABIN ALT
BAR CORR
Rate selector knob
Cabin altitude selector knob (selects isobaric setting)
Barometric pressure correction knob

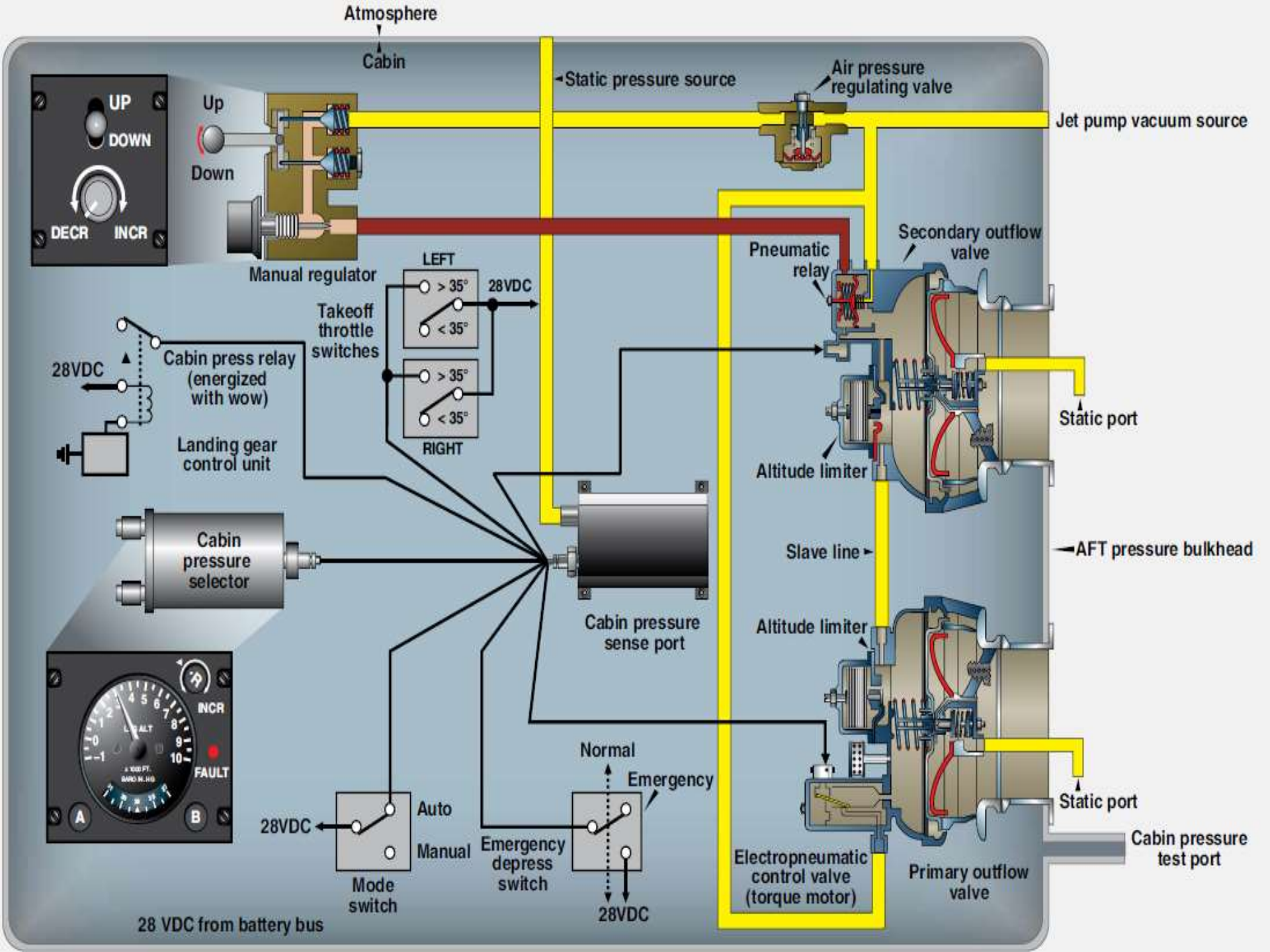
- The regulator controls the position of the outflow valve(s) normally located at the rear of the aircraft pressure vessel.
- Valve position determines the pressure level in the cabin.
- Modern aircraft often combine pneumatic, electric, and electronic control of pressurization.
- Cabin altitude, cabin rate of change, and barometric setting are made on the cabin pressure selector of the pressurization panel in the cockpit.
- Electric signals are sent from the selector to the cabin pressure controller, which functions as the pressure regulator.
- Cabin pressure and ambient pressure are also input to the controller, as well as other inputs

- **Cabin altitude, rate of climb, and barometric setting are automatic through built-in logic and communication with the ADC and the flight management system (FMS).**
- **The controllers process the information and send electric signals to motors that directly position the outflow valve(s).**

CONTROL VALVE (OUTFLOW VALVE)

- Controlling cabin pressurization accomplished through regulating the amount of air that flows out of the cabin.
- A cabin outflow valve opens, closes, or modulates to establish the amount of air pressure maintained in the cabin.
- Diaphragms, springs, metered orifices, jet pumps, bellows, and poppet valves are used to sense and manipulate cabin and ambient air pressures to correctly position the outflow valve without the use of electricity.
- Signals are sent to electric motors to move the valve as needed.


True static atmosphere connection
Differential control system
Isobaric control system
Filter
Cabin air orifice
Head
Reference
chamber
Cover
Pilot
Solenoid air valve
Outflow valve
Actuator diaphragm
Base
Baffle plate
Balance diaphragm
Atmospheric vent ports
Dump solenoid
Cabin air inlet
Ground test valve


Atmosphere
Cabin
Static pressure source
Air pressure regulating valve
Jet pump vacuum source
UP
DOWN
DECR
INCR
Up
Down
Manual regulator
LEFT
> 35°
< 35°
28VDC
Takeoff throttle switches
> 35°
< 35°
RIGHT
Pneumatic relay
Secondary outflow valve
Static port
Altitude limiter
28VDC
Cabin press relay (energized with wow)
Landing gear control unit
Cabin pressure selector
Slave line
AFT pressure bulkhead
Cabin pressure sense port
Altitude limiter
INCR
FAULT
A
B
Static port
Cabin pressure test port
Normal
Emergency
28VDC
Auto
Manual
Mode switch
Emergency depress switch
28VDC
Electropneumatic control valve (torque motor)
Primary outflow valve
28 VDC from battery bus

CABIN AIR PRESSURE SAFETY VALVE OPERATION

- A means for preventing over pressurization is incorporated to ensure the structural integrity of the aircraft if control of the pressurization system is lost.
- A cabin air safety valve is a pressure relief valve set to open at a predetermined pressure differential.
- It allows air to flow from the cabin to prevent internal pressure from exceeding design limitations.
- On most aircraft, safety valves are set to open between 8 and 10 psi.
- Pressurization safety valves are used to prevent the over pressurization of the aircraft cabin.
- They open at a preset differential pressure and allow air to flow out of the cabin. Wide-body transport category aircraft cabins may have more than one cabin pressurization safety valve.

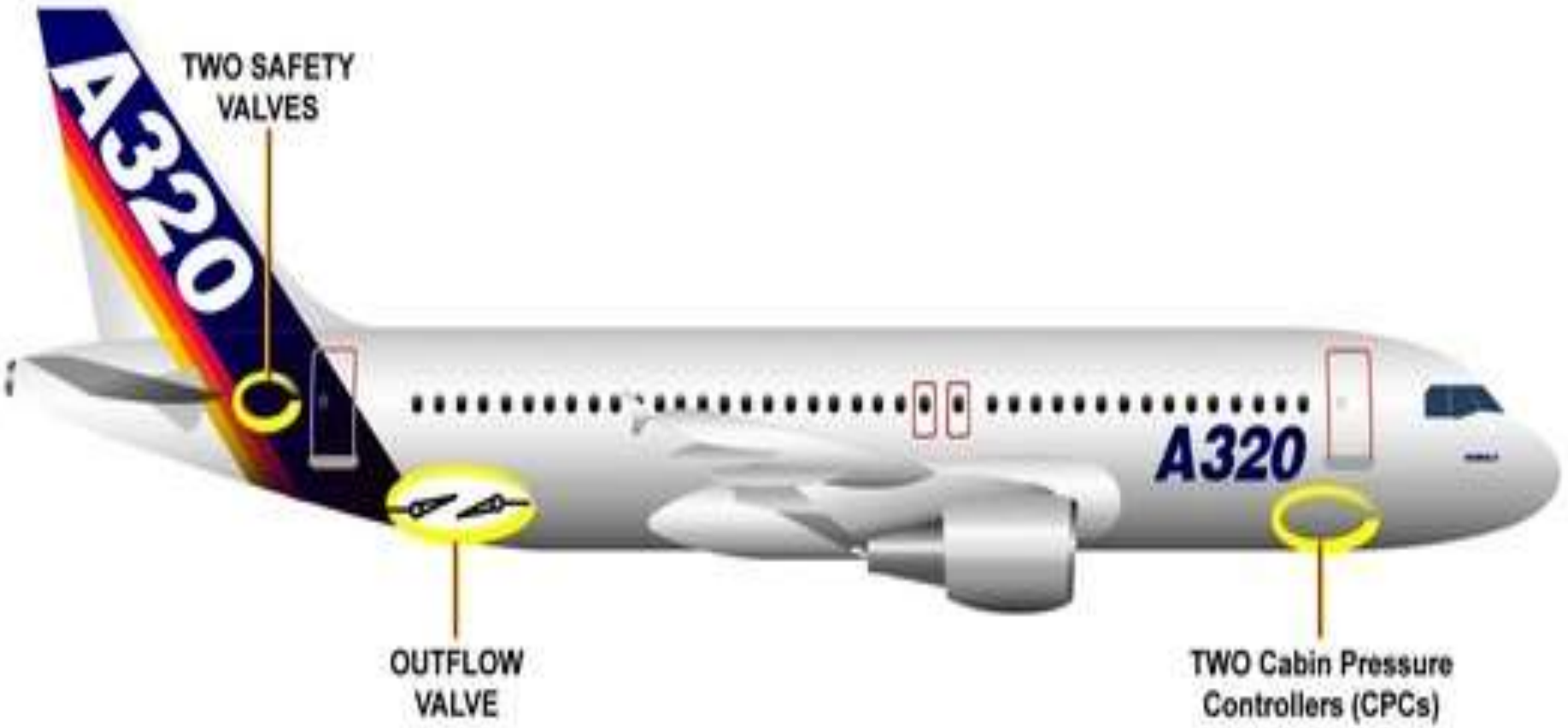
Safety Valve

Cabin Altitude Limiters

- These close the outflow valves when the pressure in the cabin drops well below the normal cabin altitude range, preventing a further increase in cabin altitude. Some limiter functions are built into the outflow valve(s).
- Other limiters are independent bellows units that send input to the outflow valve or are part of the cabin pressurization controller logic.
- A negative pressure relief valve is included on pressurize aircraft to ensure that air pressure outside the aircraft does not exceed cabin air pressure.
- The spring loaded relief valve opens inward to allow ambient air to enter the cabin when this situation arises.
- Too much negative pressure can cause difficulty when opening the cabin door.
- If high enough, it could cause structural damage since the pressure vessel is designed for cabin pressure to be greater than ambient.

Dump Valve

- Some aircraft are equipped with pressurization dump valves. These essentially are safety valves that are operated automatically or manually by a switch in the cockpit.
- They are used to quickly remove air and air pressure from the cabin, usually in an abnormal, maintenance, or emergency situation.
- Incorporation of an emergency pressurization mode is found on some aircraft.
- A valve opens when the air conditioning packs fail or emergency pressurization is selected from the cockpit.
- It directs a mixture of bleed air and ram air into the cabin.
- This combines with fully closed outflow valves to preserve some pressurization in the aircraft.


TWO SAFETY
VALVES
A320
A320
OUTFLOW
VALVE
TWO Cabin Pressure
Controllers (CPCs)

PRESSURIZATION INDICATION

- They are the cabin altimeter, the cabin rate of climb, and the cabin differential pressure indicator.
- These can be separate gauges or combined into one or two gauges.
- All are typically located on the pressurization panel, although sometimes they are elsewhere on the instrument panel.
- Outflow valve position indicator(s) are also common.
- On modern aircraft equipped with digital aircraft monitoring systems with LCD displays.

PRESSURIZATION OPERATION

- The normal mode of operation for most pressurization control systems is the automatic mode.
- A standby mode can also be selected. This also provides automatic control of pressurization, usually with different inputs, a standby controller, or standby outflow valve operation.
- A manual mode is available should the automatic and standby modes fail.
- This allows the crew to directly position the outflow valve through pneumatic or electric control, depending on the system.

- **A weight-on-wheels (WOW) switch attached to the landing gear and a throttle position switch are integral parts of main pressurization control systems.**
- **During ground operations and prior to takeoff, the WOW switch typically _controls the position of the pressurization safety valve, which is held in the open position until the aircraft takes off.**
- **At takeoff, the rate of climb and the pressurization schedule require the outflow valve(s) to fully close.**


DIFF PRESSURE PSI
PSI
ALTITUDE
1000 FT
UP
DN
2
3
4
5
6
7
8
9
10
20
40

- **The pressurization controller automatically controls the sequence of operation of the pressurization components until the aircraft lands.**
- **When the WOW switch closes again at landing, it opens the safety valve(s) and, in some aircraft, the outflow valve(s) makes pressurizing impossible on the ground in the automatic pressurization mode.**

CABIN PRESSURIZATION TROUBLESHOOTING

- A fault, such as failure to pressurize or failure to maintain pressurization, can have many different causes.
- Adherence to the steps in a manufacturer's troubleshooting procedures is highly recommended to sequentially evaluate possible causes.
- Pressurization system test kits are available, or the aircraft can be pressurized by its normal sources during troubleshooting.
- A test flight may be required after maintenance.

SAFETY AND WARNING DEVICES

- **The correct functioning of cabin environmental systems is of obvious importance to passenger and crew safety.**
- **Various protection and warning devices are used to alert the crew of any malfunction that may require attention to insure safety.**

PROTECTION AND WARNING DEVICES

- One of the major concerns with pressurization and air conditioning systems is overheating.
- A leak anywhere in pneumatic system ducting can pose a fire hazard.
- Cabin altitude must be maintained in the range of human survival.
- Failure of the pressurization system could put this in jeopardy. Most pressurized aircraft are fitted with excess cabin altitude sensors.
- When cabin air pressure becomes insufficient at around 10 000 feet cabin altitude, a warning is annunciated on the central warning system.
- The warning may be aural or visual. Flight crew may immediately utilize emergency oxygen to maintain control of the aircraft and to avoid hypoxia.

Research has shown that the Indo-Australian plate moves about 20 mm per year, causing the mountains to continue to increase height 20mm Every year.


ANY
QUESTIONS?

धन्यवाद

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