B737 NG CBT - PRESSURIZATION SYSTEM

COURSE OUTLINES

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COURSE START

1-The material contained in this training program is based on the information obtained from current state, local and company regulations and it is to be used for training purposes only. At the time of designing this program contained then current information. In the event of conflict between data provided herein and that in publications issued by the authority, the authority shall take precedence.

PRESSURIZATION SYSTEM

2-This chapter looks at the cabin pressurization system and provides an overview of its organization, operation, controls and indications. Here is the chapter outline: * Introduction * Main components * Controls and indications * System operation * Off schedule descent and diversion to alternate airport * Manual mode test

INTRODUCTION

3-The function of pressurization system is to maintain a cabin pressure safe and compatible with crew and passenger comfort. To have a better understanding of the system, let’s take a look at a few terms related to pressurization.

CABIN ALTITUDE

4-Cabin altitude is the term which is used to express air pressure in the cabin. It is expressed in feet which corresponds to the atmospheric pressure equivalent to that altitude in standard atmosphere. For instance a cabin altitude of 4,000 ft. represents a cabin pressure of 12.7 psi. A cabin altitude of 8000 ft. is equivalent to a cabin pressure of about 10.9 psi. Thus, as the cabin altitude increases, cabin pressure decreases or vice versa.

DIFFERENTIAL PRESSURE

5-Differential pressure, which is usually called Delta p, and is the difference between the cabin pressure and ambient air pressure outside the aircraft.

CABIN VERTICAL SPEED

6-Cabin vertical speed ,or cabin rate of climb, is the rate of pressure change inside the cabin and is expressed in feet per minute. Cabin vertical speed should not exceed a certain value as the ears need time to compensate the pressure change.

7-On the ground, the pressurization system ensures that the cabin pressure is the same as the ambient air pressure. During takeoff, cabin pressure increases to avoid a surge in cabin pressure during rotation. In flight, cabin altitude and rate of change is adjusted as necessary to provide passengers with a comfortable flight. After touchdown, the system gradually depressurizes the aircraft to release residual cabin overpressure.

8-In normal condition, the system operation is fully automatic, which is achieved by two identical, independent, automatic controllers. Manual mode permits full pressurization control in case of failure of both automatic systems.

MAIN COMPONENTS

9-Pressurization system uses conditioned air provided by air conditioning system. The system consists of: two cabin pressure controllers (CPCs), one outflow valve, two positive pressure relief valves, one negative pressure relief valve and an overboard exhaust valve.

CABIN PRESSURE CONTROLLERS (CPCs)

10-The system incorporates two independent and identical controllers.

11-The controllers receive the following data as input from the Air Data Inertial Reference units (ADIRUs): ambient static pressure, baro corrected altitude, non-corrected altitude and calibrated airspeed. The stall management computers provide the throttle position. The proximity switch electronics unit provide the on ground/in flight status data.

12-The pressure controllers automatically control the cabin altitude and cabin vertical speed, and limit the differential pressure as necessary for providing safe and proper cabin pressure by adjusting the position of the outflow valve and the overboard exhaust valve. In automatic or alternate mode the system is operated by one controller. The second controller is in hot stand-by with automatic change over after each flight or in case of failure of the active one.

OUTFLOW VALVE

13-The outflow valve is used to regulate the cabin pressure by controlling the amount of air leaving the cabin.

14-When the outflow valve moves toward the open position, more air flows out of the cabin. The cabin altitude increases and the cabin pressure decreases.

15-When the valve moves toward the closed position, cabin altitude decreases and cabin pressure increases.

16-The outflow valve is located on the right-hand side of the aft fuselage. The valve is driven by three independent electrical motors; two automatic mode motors and one manual mode motor. In the automatic mode, either of the two automatic motors operates the valve. The manual DC motor allows manual operation of valve even when only standby DC power is available.

OVERBOARD EXHAUST VALVE

17-The overboard exhaust valve controls the amount of equipment cooling exhaust air that flows overboard, which helps to control pressurization.

18-When the airplane is on the ground, the valve is normally open until the airplane pressurizes.

19-When the airplane is in pressurized flight, the normal position for the overboard exhaust valve is closed. The warm exhaust air flows under the forward cargo compartment floor.

POSITIVE PRESSURE RELIEF VALVES

20-The pressurization system incorporates two positive pressure relief valves which provide protection against over

pressure damage to the airplane structure. They are located on the lower, aft airplane fuselage, on each side of the aft outflow valve.

21-The valves prevent cabin pressure from going too much above ambient pressure. When the differential pressure is 9.1 psi, the valves open to reduce the cabin pressure to an allowable value.

NEGATIVE PRESSURE RELIEF VALVES

22-The negative pressure relief valve provides protection against negative differential pressure damage to the airplane structure. The negative differential pressure may develop during a rapid descent.

23-The valve is on the lower aft fuselage, near the aft service door.

24-The negative pressure relief valve prevents cabin pressure from falling too much below ambient pressure. When pressure outside of the airplane is 1.0 psi more than the pressure inside of the airplane, the valve opens allowing ambient air to flow into the cabin.

CONTROLS AND INDICATIONS

25-You can control and monitor the operation of pressurization system through cabin altitude panel and cabin pressurization panel on the forward overhead panel

26-Cabin altitude panel has cabin altitude/differential pressure indicator and cabin rate of climb indicator

27-The large needle on the cabin altitude/differential pressure indicator shows differential pressure between cabin and ambient in 0.2 psi differential increments. The small needle shows cabin altitude in 1,000 ft. increments.

28-Cabin rate of climb indicator shows cabin rate of climb or descent in feet per minute.

29-When cabin altitude reaches 10,000 feet, the aural warning unit makes an intermittent horn alarm. The ALT HORN CUTOUT switch is used to stop the intermittent cabin altitude warning horn.

30-On the cabin pressurization panel you find a mode selector which lets you select the mode of pressurization.

31-The mode selector is normally in the AUTO position. With the switch selected AUTO, the automatic pressurization is active and the outflow valve is automatically controlled by one of the two controllers.

32-When the controller in command fails, you set the selector to alternate position to select the alternate controller for automatic operation.

33-In the event of the failure of both automatic systems, you normally select MANUAL mode. Manual position lets you manually control the pressurization system through outflow valve switch.

34-With the MODE SELECTOR selected MANUAL, the outflow valve switch lets you manually control the outflow valve

position.

35-The switch is spring loaded to the Neutral position. When the switch is pushed OPEN, the outflow valve moves toward the open position. Pushing the switch CLOSE causes the outflow valve to move toward the closed position.

36-You should move the switch for short periods to obtain the targeted cabin vertical speed rate and to avoid rapid pressure changes.

37-The outflow valve position indicator shows the outflow valve position in all modes of operation.

38-The landing altitude selector is used to set the landing field elevation.

39-The selector sets landing field elevation from -1,000 to 14,000 ft. in increments of 50 feet. You must set the landing field altitude before takeoff.

40-Landing altitude indicator shows elevation of the landing field that you set through landing altitude selector.

41-You will see “88888” or all dashes on the indicator, if a panel failure is detected after a DC power interruption. However, if the cabin altitude and cabin rate of climb are normal, automatic control of cabin pressure is not affected by the failure.

42-Flight altitude selector lets you set planned cruise altitude from -1,000 to 42,000 ft. in increments of 500 feet. You must set the flight altitude before takeoff.

43-Flight altitude indicator shows cruise altitude that you set through flight altitude selector.

44-You will see “88888” or all dashes on the indicator, if a panel failure is detected after a DC power interruption. However, if the cabin altitude and cabin rate of climb are normal, automatic control of cabin pressure is not affected by the failure.

45-There are four system status lights above the cabin pressurization panel.

46-The auto fail light illuminates with alternate light when either controller 1 or controller 2 fail. The light illuminates alone when both controllers have failed. Whenever the auto fail light comes on, the master caution and air conditioning annunciator lights illuminate

47-The off schedule descent light illuminates, when you start to descend before reaching the planned cruise altitude set in the flight altitude indicator.

48-The alternate light illuminates when the AUTO FAIL light illuminates to indicate the failure of either controller. The light also illuminates alone when the pressurization system is operating in the alternate automatic mode.

49-Manual light illuminates when the pressurization system is operating in manual mode.

50-Placards on the control panel are a reference for the manual mode operations. They provide a reference for flight altitude to cabin altitude conversions.

SYSTEM OPERATION

51-Cabin pressurization system operates in three different modes: automatic, alternate and manual. The automatic mode and alternate mode are the same except that in alternate mode there is no automatic backup.

AUTOMATIC OPERATION

52-When the cabin pressurization is operating in the automatic and alternate modes is controlled by one of the two cabin pressure controllers. Let’s study automatic operation of the system, at different phases of normal flight.

53-During preflight set the planned flight altitude on the cabin pressurization control panel. Then set the landing field elevation. Next, verify that the pressurization mode is set to AUTO and the AUTO FAIL light is extinguished.

54-While the aircraft is parked on the ground and during taxi, the cabin pressure controller commands the outflow valve to the fully open position to prevent unintended cabin pressurization. Thus, the aircraft and the cabin altitude are the same as the airfield elevation, which is 100 ft. in this example.

55-When the takeoff is initiated, the pressure controller modulates the outflow valve toward the close position, which begins pressurizing the cabin until the delta p reaches 0.1 psi, this is called pre-pressurization. The pre-pressurization of the cabin prevents pressure fluctuations during rotation, and makes the transition to pressurized flight more gradual for the passengers and crew.

56-During climb, pressure controller positions the outflow valve to increase cabin altitude at a rate proportional to the airplane climb rate. This provides a smooth cabin rate throughout the climb.

57-The controller shifts to the cruise phase when the airplane external pressure decreases to within 0.25 psi of the selected cruise altitude. During cruise, the controller maintains the lowest possible cabin altitude based on the differential pressure limits. If the landing elevation is higher than the target cabin altitude determined by the differential pressure limits, the controller maintains cabin altitude slightly below the selected landing elevation.

58-During cruise, as the controller maintains a constant cabin altitude, slight variations in flight altitude can cause differential pressure to vary. However, if the change in airplane altitude causes a differential pressure higher than the maximum, the controller changes the cabin altitude to maintain the differential pressure at the correct limit.

59-The descent phase starts when the airplane external pressure increases to 0.25 psi more than the FLT ALT selection. The controller programs a cabin descent rate so that the cabin pressure is slightly higher than landing field pressure shortly before landing. By landing, with aircraft slightly pressurized, the cabin pressure changes are minimized during

approach.

60-When the airplane lands, the controller switches back to ground mode and drives the outflow valve slowly to fully open position to release any remaining cabin pressure.

MANUAL OPERATION

61-MANUAL mode has priority over automatic and alternate modes even if pressure controllers are operative. However, you normally use manual mode when both controllers fail.

62-Let's assume that aircraft in flight with a stable cabin altitude of 6000 ft. The cabin vertical speed is zero and differential pressure is 7.5 psi. The outflow valve is partially open. If both automatic systems fail, you must select manual operation.

63-For manual operation, set the MODE SELECT switch to MANUAL. The AUTO FAIL light extinguishes and the green MANUAL light illuminates on cabin pressurization control panel. The outflow valve's automatic motors de-energies and manual motor activates.

64-Refer to the placard below the pressurization panel to find the correct cabin altitude for the current cruise altitude. For instance, if your cruise altitude is 25000 feet, the correct cabin altitude is 4000 feet.

65-Push the outflow valve switch to either the close or open position to change the position of the outflow valve as necessary by monitoring the valve position on the outflow valve position indicator and cabin altitude panel.

66-When you need to increase the cabin altitude: push the outflow valve switch to the OPEN position momentarily. The outflow valve moves toward the open position, the cabin altitude increases with a positive cabin vertical speed and differential pressure decreases. Repeat the procedure as necessary until the desired situation is reached.

67-When you need to decrease the cabin altitude: push the switch to the CLOSE position and the outflow valve moves toward closed position, the cabin altitude decreases with a negative cabin vertical speed and differential pressure increases. Repeat the procedure as necessary until the desired situation is reached.

68-Note that full range motion of outflow valve may take up to 20 seconds.

OFF SCHEDULE DESCENT AND DIVERSION TO ALTERNATE AIRPORT

69-Now let's see some abnormal conditions in relation to pressurization control

70-If the pilot interrupts the climb before reaching the cruise altitude and starts to descend for returning the takeoff airport, the following occur: the OFF SCHEDULE DESCENT light comes on; the Master caution and air conditioning annunciator lights illuminate; the controller automatically decreases the cabin altitude to the value of 300 feet below the takeoff airport altitude without further pilot inputs.

71-If you begin to climb again, the off schedule descent light extinguishes and the pressurization system continues to operate as usual. Note that off schedule descent feature works only in the AUTO and the ALTERNATE modes.

DIVERSION TO ALTERNATE AIRPORT

72-If it becomes necessary to divert to an alternate airport, you need to set the alternate airport elevation in the landing altitude window. When you start to descend, the controller decreases cabin altitude slightly below the new landing field elevation in proportion to airplane descent rate.

MANUAL MODE TEST

73-You start the manual mode test with verifying the PACK switches are OFF. Set the pressurization mode selector to manual. Verify that auto fail light is extinguished and manual light is illuminated. Move outflow valve switch to close position. You must observe outflow valve position indicator moves toward the close position. Then move the switch to open position. Observe that valve position indicator moves toward open. Set the pressurization mode selector to AUTO. Verify that the outflow valve position indicator moves toward open and that the manual light is extinguished. The test is completed satisfactorily.

COURSE END

74-End of course.