B737 NG CBT - BLEED AIR SYSTEMS

COURSE OUTLINES

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COURSE START

1-LEGAL CAUTION 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.

BLEED AIR SYSTEM

2-BLEED AIR SYSTEM This chapter deals with the airplane bleed air system and provides an overview of its organization,operation, controls and indications. Here is the chapter outline: Introduction Engine bleed air APU bleed air External air source Controls and indications Bleed air use on ground No engine bleed operations Trip off condition Wing-body overheat.

INTRODUCTION

3-INTRODUCTION The bleed air system collects and supplies high pressure air to the systems on the airplane that use air.

4-There are three sources of bleed air: The engines, the APU and an external air cart.

5-The systems that use bleed air for operation are: Air conditioning/pressurization, engine starter, wing and engine thermal anti-icing, hydraulic reservoirs pressurization and potable water tank pressurization.

6-The APU or external air cart can supply bleed air for engine start and ground use of the air conditioning system. After engine start, air for the bleed air system is normally supplied by the engines.

7-Figure indicates simplified schematic of bleed air supply system. The system consists of two sides separated by an isolation valve: Left and right. The left side of the bleed air system is supplied from the left engine and the APU. The bleed air consumers on the left side are: Left engine starter, hydraulic reservoir pressurization, potable water tank pressurization, left engine and wing thermal anti-ice system and left air conditioning system. The right side of the bleed air system is supplied from the right engine and the ground source. The consumers on the right side include: right engine starter, hydraulic reservoir pressurization, right engine and wing thermal anti-ice system and right air conditioning system.

ENGINE BLEED AIR

8-ENGINE BLEED AIR Engines can supply bleed air system with bleed air in flight or on the ground. There are two engine bleed air systems, one for each engine. Engine bleed air comes from the 5th and 9th stages of the engine high pressure compressors.

9-At high engine speeds, bleed air is obtained from the 5th stage. At low engine speed, when 5th stage bleed air pressure is not sufficient for system demands, bleed air from the 9th stage is used.

10-The engine bleed system consists of high stage valves, 5th stage check valves, bleed air pressure regulating and

shutoff valves, overpressure and over temperature switches, isolation valve and duct pressure transmitters.

11-The high stage valves operate automatically to control the flow of the 9th stage bleed air. At low engine speeds, the high stage valves open appropriately to maintain proper bleed air pressure. However, during takeoff, climb, and most cruise conditions, low pressure bleed air from the 5th stage is adequate and the high stage valves remain closed.

12-The 5th stage check valve prevents reverse flow into the 5th stage when the high stage valves open.

13-The bleed air pressure regulating and shutoff valves control the flow of engine bleed air to the bleed air distribution duct. The valves are electrically activated and pressure operated.

14-Each bleed air valve incorporates an overpressure switch and an over temperature switch, called bleed trip sensors, to prevent bleed air overpressure or overheat conditions which will cause a bleed trip off condition and turn on the respective BLEED TRIP OFF lights.

15-The bleed air isolation valve isolates the left and right sides of the bleed air distribution duct or connects them when necessary for crossbleed operation. The valve operates on AC power.

16-Two bleed air duct pressure transmitters supply bleed air pressure signals to the bleed air duct pressure indicator in the flight deck.

APU BLEED AIR

17-APU BLEED AIR The APU bleed air system supplies bleed air to the bleed air duct on the ground and in the air up to 17,000 feet. However, the primary use of APU bleed air is for air conditioning and engine starts during ground operations.

18-The APU bleed air valve controls APU bleed air flow to the left side of the bleed air duct. The valve is DC activated and pressure operated. When the APU is shut down, the valve closes automatically. An APU check valve in the APU duct protects the APU from engine bleed air flow.

EXTERNAL AIR SOURCE

19-EXTERNAL AIR SOURCE The external air connection provides for the connection of a ground cart to the right side of the bleed air duct. The cart can supply bleed air for engine starting and ground use of the air conditioning system.

CONTROLS AND INDICATIONS

20-CONTROLS AND INDICATIONS Bleed air controls and indicators are on the forward overhead panel.

21-There are two engine BLEED air switches which control the pressure regulating shutoff valves. When the switch is in OFF position, related engine bleed air valve is closed. When you set the switch to ON, the valve opens when the respective engine is running.

22-The APU BLEED air switch controls the APU bleed air valve. When the switch is in OFF position, the APU bleed air valve

is closed. When you set the switch to ON, the valve opens when the APU is running.

23-A three-position ISOLATION VALVE toggle switch lets you control the bleed air isolation valve. With the switch in CLOSE position, the valve closes to separate the right and left sides of the bleed air duct.

24-When the switch is set to OPEN position, the valve opens to connect the right and left sides of the bleed air duct.

25-With the switch set to AUTO position, the switch position logic controls the valve as necessary for aircraft operations. When both engine BLEED air switches are ON and both air conditioning PACK switches are AUTO or HIGH, the valve closes. When any one of the engine BLEED or the pack switches is positioned OFF, isolation valve opens automatically. Note that isolation valve position is not affected by the position of APU bleed air switch.

26-BLEED TRIP OFF light illuminates in amber when excessive engine bleed air temperature or pressure is detected. A trip off condition causes the related engine bleed valve to close automatically, but does not change the position of its switch on the panel. It also requires you to reset the system.

27-Bleed air DUCT PRESSURE indicator receives pressure signals from the duct pressure transmitters and shows the pressure in the right and left sides of the bleed air duct. The pressure indicator has two independent needles, left and right, and a single scale between zero and 80 psi. Differences between L and R duct pressure on the bleed air duct pressure indicator are considered normal provided that there is sufficient air for cabin pressurization.

28-The function of DUAL BLEED light is to tell you that an engine, or engines, and the APU both supply pressure to the bleed air duct at the same time. This may happen under two conditions.

29-The DUAL BLEED light comes on when engine 1 bleed air switch is ON and the APU bleed air valve is open.

30-The light also illuminates when engine 2 bleed air switch is ON, the isolation valve is open, and the APU bleed air valve is open.

BLEED AIR USE ON GROUND

31-BLEED AIR USE ON GROUND Now let’s discuss how you can control the operation of bleed air system on the ground for four cases. Before engine start bleed air source transfer from APU to engines, bleed air source transfer from engines to APU and external air cart use.

Bleed air use before engine start

32-BLEED AIR USE BEFORE ENGINE START During preflight, with the recirculation fan switches in AUTO and Air conditioning PACK switches in AUTO or HIGH, set the isolation valve switch to OPEN. Position engine and APU bleed air switches ON. Verify that the DUAL BLEED light is illuminated. With the APU running, APU bleed valve opens and bleed air from the APU is now available for air conditioning and engine starting.

Bleed air source transfer from apu to engines

33-BLEED AIR SOURCE TRANSFER FROM APU TO ENGINES After engine start, engine bleed valves open to supply bleed air to bleed air duct. With engine bleed air available, there is no need for APU bleed air. Select isolation valve switch AUTO and move APU bleed air switch to OFF to close the APU bleed air valve. This completes the bleed air source transfer from APU to the engines.

Bleed air source transfer from engines to apu

34-BLEED AIR SOURCE TRANSFER FROM ENGINES TO APU After parking, you need to transfer the bleed air source from the engines to APU. Set the isolation valve switch to OPEN. Then move the APU bleed air switch to ON. This opens the APU bleed air valve. When the engines are shut down, APU supplies bleed air to bleed air duct for air conditioning.

Use of external air cart

35-USE OF EXTERNAL AIR CART While parking, an external air cart may be used to supply bleed air for engine start and ground use of the air conditioning system. The cart supplies bleed air to the right side of the bleed air duct through an external air connection.

36-Before using the external air cart ensure that the battery switch is ON. Battery supplies power to protective circuits.

37-With the cabin temperature selectors set for desired temperature and trim air switch in ON position, turn off the APU bleed air switch to close the APU bleed air valve. Set the isolation valve switch to OPEN. Select recirculation fan switches AUTO. When external air cart supplies air, you can set pack switches to AUTO or HIGH for ground use of the air conditioning.

38-When the external air cart supplies air, the bleed air duct pressure should be between 20 psi and 25 psi. If the bleed air duct pressure drops below 20 psi, you can use the APU if it is available. Set the isolation valve switch to AUTO. Then move the APU bleed air switch to ON. APU supplies left pack and external air source supplies right pack.

NO ENGINE BLEED OPERATIONS

39-NO ENGINE BLEED OPERATIONS Now let’s see use of bleed air system in the events of no engine bleed takeoff or landing with the APU operating and no engine bleed takeoff or landing with the APU inoperative.

No engine bleed takeoff/landing with apu operating

40-NO ENGINE BLEED TAKEOFF/LANDING WITH APU OPERATING When additional thrust for takeoff is required, you perform a no engine bleed takeoff if the APU is available.

41-To perform a no engine bleed takeoff with the APU available, you need to set the switches to no engine bleed configuration with a letter “C” pattern on the air conditioning/bleed air panel. You should do this just prior to takeoff if anti-ice is required for taxi, or just after engine start if anti-ice is not required for taxi.

42-You start with checking that the right pack switch is set to AUTO. Position the isolation valve switch CLOSE. Make sure that the left pack switch is also in AUTO position. Turn off the Engine 1 bleed air switch. This stops the bleed air supply to

the bleed air duct from the left engine. Then select the APU bleed air switch ON. Now, the APU supplies bleed air to the left side of the duct. Then, turn off the Engine 2 bleed air switch. This stops the bleed air supply from the right engine. You complete the procedure by setting trim air valve to ON and wing anti-ice switch to OFF.

43-After a no engine bleed takeoff, you should perform the steps in the reverse order to put the bleed air system in the normal configuration for flight.

44-Set the Engine 2 bleed air switch to ON. This lets the Engine 2 supply bleed air to the right side of the bleed air duct. Then turn off the APU bleed air switch. This closes APU bleed air valve and stops the bleed air supply from the APU. Ensure that cabin rate of climb is stable to verify that the APU bleed air valve is fully closed. Turn on the Engine 1 bleed air switch. Engine 1 now supplies bleed air to the left side of the bleed air duct. Make sure that left and right pack switches are set to AUTO. At last, move the isolation valve switch to AUTO.

45-If additional go–around thrust is required with the APU available, you should configure the switch for a “No Engine Bleed Landing”, when below 10,000 feet.

46-Make sure that the wing anti-ice switch is OFF, and left and right pack switches are in AUTO position. Then the steps for a no engine bleed landing is similar to a no engine bleed takeoff. Position the isolation valve switch CLOSE. Turn off the Engine 1 bleed air switch. This stops the bleed air supply to the bleed air duct from the left engine. Then select the APU bleed air switch ON. Now, the APU supplies bleed air to the left side of the duct. Then, turn off the Engine 2 bleed air switch. This stops the bleed air supply from the right engine.

No engine bleed takeoff/landing with apu inoperative (unpressurized takeoff/landing)

47-NO ENGINE BLEED TAKEOFF/LANDING WITH APU INOPERATIVE (UNPRESSURIZED TAKEOFF/LANDING) When making a no engine bleed takeoff with the APU inoperative, you should follow these steps: Ensure that PACK switches are set to AUTO. Place ISOLATION VALVE switch to CLOSE position. Then turn off Engine 1 and Engine 2 BLEED air switches. Both engine bleed valves close to stop bleed air supply to the system.

48-After takeoff, between 400 feet and 2000 feet above field elevation, set Engine 2 bleed air switch to ON. This lets the Engine 2 supply bleed air to the right side of the bleed air duct. Ensure that cabin rate of climb is stable. Set Engine 1 bleed air switch to ON. Engine 1 now supplies bleed air to the left side of the bleed air duct. At last, move the isolation valve switch to AUTO.

49-Note that after no engine bleed takeoff either with APU operative or inoperative, if engine failure occurs, do not position engine BLEED air switches ON until reaching 1500 feet or until obstacle clearance height has been attained.

50-If you need to perform a no engine bleed landing with APU inoperative, when below 10,000 feet and start turning to final approach. Set the engine bleed air switches to OFF. You should avoid high rates of descent for passenger comfort.

TRIP OFF CONDITION

51-TRIP OFF CONDITION When engine bleed air temperature or pressure exceeds a preset limit, following take place: The respective BLEED TRIP OFF light illuminates, the related engine bleed valve closes automatically. In addition the master caution and air conditioning annunciator lights illuminate.

52-In case of a trip off condition, ensure that wing anti-ice switch is in OFF position. Press the trip reset switch.

53-If the bleed air temperature has cooled below limits, The BLEED TRIP OFF light extinguishes and related engine bleed valve opens. With the system operating normally, set the wing anti-ice switch as needed.

54-If BLEED TRIP OFF light stays illuminated, turn off the pack switch on the affected side. This causes the isolation valve to open and bleed air system supplies air to the right side of wing anti-ice.

55-Note that use of wing anti-ice above approximately FL350 may cause bleed trip off and possible loss of cabin pressure.

WING-BODY OVERHEAT

56-WING-BODY OVERHEAT The purpose of wing and body overheat detection system is to detect overheat condition which is caused by bleed air duct leak. The system uses sensing elements located in the wing and engine strut areas, the air conditioning bays, and the bleed air duct from the APU.

57-The air conditioning/bleed air control panel incorporates two WING-BODY OVERHEAT lights which indicate a bleed air duct leak.

58-The left WING-BODY OVERHEAT light illuminates when a leak is detected in the left side of the system which includes APU bleed air duct.

59-The right WING-BODY OVERHEAT light illuminates when a leak is detected in the right side of the bleed air system.

60-Whenever a WING-BODY OVERHEAT light illuminates, MASTER CAUTION and air conditioning annunciator lights illuminate on the glareshield panel.

Wing-body overheat test

61-WING-BODY OVERHEAT TEST The OVERHEAT TEST switch lets you test the detector circuits of the wing-body overheat system.

62-To perform the test push and hold the OVERHEAT TEST switch for 5 seconds. Check that both WING–BODY OVERHEAT lights, MASTER CAUTION lights and airconditioning system annunciator light illuminate while you hold the switch. Then release the switch. If the lights extinguish, the system is functioning correctly.

COURSE END

63-End of course.