



B737 NG CBT - FIRE PROTECTION

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.

FIRE PROTECTION

2-FIRE PROTECTION This chapter introduces you to the airplane fire protection system and provides an overview of its organization, operation, controls and indications. Here is the chapter outline: •

INTRODUCTION

3-INTRODUCTION The purpose of the fire protection systems is to monitor the airplane for fire, smoke and overheat conditions. A fire protection system may consist of any or all of the subsystems: •

4-The airplane is equipped fire protection systems for engines, APU, main wheel wells, cargo compartments and lavatories. A wing/body fire protection system which will be discussed in air conditioning system section is also available.

ENGINE FIRE PROTECTION SYSTEM

5-ENGINE FIRE PROTECTION SYSTEM Engine fire protection is made of engine overheat and fire detection system, and engine fire extinguishing system.

Engine Overheat And Fire Detection System

6-ENGINE OVERHEAT AND FIRE DETECTION SYSTEM The engine overheat and fire detection system uses continuous detector loops powered by the battery bus. Each engine has two independent and identical detector loops, denoted as loop 'A' and loop 'B', which monitor the fan and core sections for overheat and fire conditions. The use of dual detector loops provides redundancy, prevents false overheat and fire alerts and allows to detect a loop failure.

7-As the temperature of a loop detector increases to a preset limit, the detector senses an overheat condition. When the temperature reaches a higher preset value, the detector senses a fire condition.

8-An overheat detector switch for each engine on the engine and APU fire control panel permits you to select the mode of operation of the engine detector loops. Each switch has three positions: NORMAL, 'A' and 'B'.

9-In normal operation, both detector loops are functional and both loops must sense an overheat condition to trigger an engine overheat alert.

10-Similarly, in normal mode of operation, both detector loops must sense a fire condition to trigger an engine fire alert.

11-If the overheat detector switch is selected to position A or B, the system operates as a single loop system. For instance, if you select position A, the loop A becomes the only sense authority to monitor the related engine for overheat

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and fire conditions.

12-The system also incorporates a fault monitoring circuit.Let's see how the fault logic works.

13-When the overheat detector switch is in normal position, if one loop fails to operate, the system automatically shifts to single loop operation. The remaining detector loop can trigger all overheat or fire alerts. There is no indication in the flight deck of single loop failure.

14-If both loops fail on an engine with the overheat detector switch in NORMAL, the FAULT light illuminates on the engine and APU fire control panel, indicating that the overheat/fire detection system for the related engine is not operative.

15-With the overheat selector switch either in A or B position, if the selected loop fails the FAULT light illuminates and the overheat/fire detection system for the related engine is not operative.

16-When an overheat condition is detected in an engine, say engine number 1, both MASTER CAUTION lights illuminate, overheat detector annunciator lights come on,related engine overheat light illuminates and related engine fire handle switch unlocks.

17-You must push the master caution light in order to extinguish the light and reset the master caution system. Then retard the thrust lever of the affected engine to reduce the engine temperature. When the engine temperature drops below the overheat alert temperature level, the overheat indication will be removed.

18-When a fire condition is detected in an engine, say engine number 1, the fire warning bell sounds, both red fire warning lights illuminate, the related engine fire switch light illuminates and all related engine overheat alert indications stay ON.

Engine Fire Extinguishing System

19-ENGINE FIRE EXTINGUISHING SYSTEM The purpose of engine fire extinguishing system is to put out fire in the engine compartments.

20-The engine fire extinguisher system is powered by the hot battery bus and consists of two engine fire extinguisher bottles, and two engine fire switches and two BOTTLE DISCHARGE lights on the engine and APU fire control panel.

21-The spherical extinguisher bottles contain halon in liquid form as extinguishing agent. The bottles are pressurized by nitrogen to ensure complete discharge of the agent. A cartridge in the discharge head contains explosive powder which is fired by heating up a wire, called squip, electrically. The explosion of cartridge ruptures a thin disk at the bottom of the bottle and releases the agent. Each bottle can be discharged into either engine. Both bottles can also be discharged into the same engine.

22-The engine fire switches are normally locked down to prevent an inadvertent engine shutdown. When there is an

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overheat or fire condition which causes illumination of an engine overheat light or engine fire switch, the fire switch for that engine automatically unlocks.

23-You can also use the override button under the handle to unlock the engine fire switch manually.

24-Let's see what happens when you pull the engine fire switch up in case of an engine fire. There is a fire in engine number 1 and all fire alerts are given. Push the master fire warning light or fire warning bell cutout switch to stop the fire bell and reset the system. Push the master caution light to reset the master caution system. Pull the engine 1 fire switch up.

25-When you pull the engine 1 fire switch up, the following occurs: both the engine fuel shutoff valve and the spar fuel shutoff valve closes, engine driven hydraulic pump shutoff valve closes and hydraulic system low pressure indication is deactivated, generator trips off, the engine bleed air valve closes resulting in loss of wing anti-ice to the affected wing, thrust reverser for the related engine is disabled, one discharge squib on each engine fire extinguisher bottle is armed.

26-When you rotate the engine 1 fire switch counter-clockwise, the squip at the bottom of the left bottle is electrically fired and the extinguishing agent in the bottle discharges into engine number 1. The left bottle DISCHARGE light illuminates a few seconds after the engine fire switch is rotated, indicating the bottle has discharged.

27-If you rotate the same engine fire handle switch in opposite direction, the squip in the right bottle is fired and this bottle also discharges into engine number 1. After a few seconds, the other bottle DISCHARGE light illuminates.

28-The red light in the engine fire switch goes off when the temperature decreases below fire alert activation threshold. The engine overheat light extinguishes when the temperature drops below overheat alert activation threshold.

APU FIRE PROTECTION SYSTEM

29-APU FIRE PROTECTION SYSTEM APU fire protection consists of APU fire detection system powered from battery bus and APU fire extinguishing system powered from the hot battery bus. There is no overheat detection system.

Apu Fire Detection System

30-APU FIRE DETECTION SYSTEM The APU fire detection system operates the same as the engine system; but it uses a single fire detection loop.

31-The loop detector monitors the APU for a fire condition. As the temperature of the detector increases to a preset limit, the detector senses a fire condition and alarm indications operate in the flight compartment.

32-When a fire condition is detected in the APU, followings take place: aural fire warning bell sounds, both red FIRE warning lights illuminate, APU fire switch light comes on and the switch unlocks, and the APU automatically shuts down and isolates from other systems.

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33-A remote control panel in the right main wheel well also gives aural and visual indications of an APU fire. A horn and red light operate alternately at a one per second rate. The horn does not operate in flight.

Apu Fire Extinguishing System

34-APU FIRE EXTINGUISHING SYSTEM The purpose of the APU fire extinguishing system is to extinguish fires in the APU compartment.

35-The APU fire extinguisher system consists of one APU fire extinguisher bottle, one APU fire switch and one BOTTLE DISCHARGE light on the engine and APU fire control panel, and APU remote control panel.

36-The APU fire extinguisher bottle is the same as those used in engine fire extinguishing system. It discharges extinguishing agent into the APU compartment in the event of a fire.

37-The APU fire switch is normally locked down to prevent an inadvertent APU shutdown. When there is an APU fire condition the fire switch automatically unlocks.

38-You can also use the override button under the handle to unlock the APU fire switch manually.

39-Let's see what happens when you pull the APU fire switch up in the event of an APU fire. All APU fire alerts are indicated. Push the master fire warning light or fire warning bell cutout switch to stop the fire bell and reset the system. Pull the APU fire switch up.

40-When you pull the APU fire switch up, the following occurs: APU fuel shutoff valve closes and the APU shuts down, the APU bleed air valve closes, the APU generator breaker opens, the APU air inlet door closes and the APU fire extinguisher bottle squib arms.

41-When you turn the APU fire switch right or left, the bottle discharges into APU compartment. After a few seconds, APU bottle DISCHARGE light illuminates, indicating the bottle has discharged. APU fire switch light extinguishes when the temperature in APU drops below the fire alert activation threshold.

42-On the ground, the APU fire can also be extinguished from the remote control panel in the right main wheel well. When there is a fire in the APU, the horn and light operate alternately and the APU shuts down. When you push the horn cutout button, the horn stops and the red light remains on continuously as long as APU is on fire. When you pull down the APU fire control handle, the APU fire extinguisher bottle squib arms the APU stops and isolates from other systems as if you pulled APU fire switch in the flight compartment. Now you can use the toggle switch to discharge the APU fire extinguisher bottle to the APU compartment. APU fire switch light extinguishes when the temperature in APU drops below the fire alert activation threshold.

WHEEL WELL FIRE PROTECTION SYSTEM

43-WHEEL WELL FIRE PROTECTION SYSTEM Fire protection for the main wheel well consists of a fire detection system

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powered by the AC transfer bus 2. There is no fire extinguishing system for the main wheel well.

Wheel Well Fire Detection System

44-WHEEL WELL FIRE DETECTION SYSTEM The main wheel well fire detection uses a single detector loop to monitor the wheel well for fire condition. When the detector senses a fire condition, alarm indications operate in the flight compartment.

45-These are the flight compartment indications of a wheel well fire: the Fire warning bell sounds, both red FIRE WARNING lights illuminate, and red WHEEL WELL light on engine and APU fire control panel comes on.

46-Since there is no fire extinguisher for the wheel well, you can extinguish a wheel well fire by air flow. After resetting the master fire warning system, extend the landing gear to let the air flow through the wheel well. Make sure that the airspeed is below the maximum gear extension speed before lowering the landing gear. When the temperature in the wheel well drops below the fire alert activation threshold, the wheel well fire warning light extinguishes.

CARGO COMPARTMENT FIRE PROTECTION SYSTEM

47-CARGO COMPARTMENT FIRE PROTECTION SYSTEM

48-The function of cargo compartment smoke detection system is to give warnings in the flight deck when there is smoke in the cargo compartment. The system consists of smoke detectors and cargo electronic units.

49-The photoelectric smoke detectors are located in the ceiling of the compartments. They monitor air in the cargo compartments for smoke and heat.

50-There are four smoke detectors in the forward cargo compartment. The aft cargo compartment has six smoke detectors. The detectors are in a dual loop configuration. In order to trigger a warning, normally, both loops must detect smoke.

51-There is one cargo electronic unit in each cargo compartment. If the detector senses smoke or heat, a signal goes to the cargo electronic unit which sends a signal to the flight compartment for indications.

52-You can set the mode of operation of the smoke detector loops through detector switches on the cargo fire control panel. There are two switches: One for the detector loops in the forward cargo compartment and one for the detector loops in the aft cargo compartment. Each switch has three positions: NORMAL, A and B.

53-In normal operation, both loops must sense a smoke or overheat condition to trigger a fire indication. In the event of a failure in one loop, the system automatically shifts to single-loop detection mode.

54-If the detector switch is selected to position A or B, the system operates as a single loop system and only selected loop is necessary to sense a smoke or overheat condition for a fire indication.

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55-The indications of a cargo compartment fire are: The fire warning bell sounds, both master fire warning lights illuminate and forward or aft cargo fire light on the cargo fire control panel illuminates.

56-The cargo compartment fire extinguishing system puts out fires in the forward and aft cargo compartments.

57-The cargo compartment fire extinguishing system consists of two fire extinguishing bottles and five discharge nozzles.

58-The bottles are installed in the air conditioning mix bay and contain halon as extinguishing agent. Tubing connects the bottles to the discharge nozzles in the cargo compartment ceilings.

59-When a cargo compartment fire alert is given, after resetting the master fire warning system, you must do followings to operate the cargo compartment fire extinguishing system. Push the related cargo fire warning switch, lift the discharge switch protective cover, and push the discharge switch for a minimum of 1 second.

60-When you push the discharge switch, two things happen: The first bottle starts to discharge into the selected compartment and a 60 - minute timer starts to operate. When the first bottle is totally discharged, the discharge switch illuminates.

61-You may wonder the function of the 60-minute timer which has started when you push the discharge switch. The timer provides the system with input to determine for the second discharge. If the airplane is in flight, after 60 minutes, the second bottle starts to discharge at a reduced flow into the same compartment. The second discharge is inhibited if the airplane lands before the timer 60 minutes are over.

LAVATORY FIRE PROTECTION SYSTEM

62-LAVATORY FIRE PROTECTION SYSTEM Lavatory fire protection consists of lavatory smoke detection system and lavatory fire extinguishing system.

Lavatory Smoke Detection System

63-LAVATORY SMOKE DETECTION SYSTEM The lavatory smoke detection system monitors the lavatory for smoke. There is a smoke detector in the ceiling of each lavatory. A green light stays on when a detector has power.

64-When smoke is detected in a lavatory the red alarm light illuminates on the sensor and an internal horn sounds. The horn stays ON until you push the interrupt switch or the sensor no longer detects smoke. The alarm LED will go out when the smoke sensor no longer detects smoke.

Lavatory Fire Extinguishing System

65-LAVATORY FIRE EXTINGUISHING SYSTEM The lavatory fire extinguishers are installed in the lavatories under the wash basin. A temperature indicator placard is placed next to the extinguisher bottle.

66-When there is an overheat or fire condition, temperature indicators change color from white to black, the plug at the

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discharge port melts and extinguisher automatically releases halon to stop the fire. There is no flight deck indication of extinguisher discharge.

FIRE PROTECTION SYSTEMS TEST

67-FIRE PROTECTION SYSTEMS TEST Fire and overheat detection systems are tested during the normal preflight. You can do following tests: FAULT/INOP test, overheat/fire test, fire extinguishers test and cargo fire system test.

Fault - Inoperative Test

68-FAULT/ INOPERATIVE TEST The FAULT/INOP test does a check of the module fault detection circuits and the related flight compartment indications for the engines and the APU. You can do FAULT/INOP test by selecting the test switch to FAULT/INOP position. The indications of a successful FAULT/INOP test are: Both MASTER CAUTION lights come on; the overheat/detector annunciator lights illuminate; amber FAULT light comes on and amber APU DETECTOR INOP light illuminates.

Overheat - Fire Test

69-OVERHEAT/FIRE TEST The overheat/fire test does a check of the overheat and fire detection loops on both engines, the APU, the fire detector in the wheel well and the related flight compartment indications. You can do overheat/fire test by selecting the test switch to overheat/fire position. The indications of a successful overheat/fire test are: Fire warning bell operates, two master FIRE WARN lights illuminate, both MASTER CAUTION lights come on; the overheat/detector annunciator lights illuminate; ENG 1, ENG 2, and APU fire handle switch lights illuminate and switches unlock, amber ENG 1 and ENG 2 OVERHEAT lights come on, APU remote control panel horn and red light operate if AC power is available, red WHEEL WELL light also illuminates.

Fire Extinguisher Test

70-FIRE EXTINGUISHER TEST The engine and APU fire extinguisher test does a check for fire extinguisher bottle squib continuity. You can do extinguisher test with extinguisher test switch. To test the number 1 discharge squip circuits for all three extinguisher bottles, you set the EXT TEST switch to the 1 position. If all three green lights illuminate, the test is satisfactory. When you set the switch to the 2 position, number 2 discharge squip circuits for all three extinguishers are tested. If all three green lights illuminate, the test is satisfactory.

Cargo Fire System Test

71-CARGO FIRE SYSTEM TEST Cargo fire system test does a check of the cargo smoke detectors and the extinguishing system. You do cargo fire system test by pushing the test switch on the cargo fire control panel. The indications of a successful cargo fire system test are: both master FIRE WARN lights illuminate, fire warning bell operates, forward and aft fire extinguisher lights illuminate to verify the fire bottle discharge squib circuit continuity is normal, the forward and aft cargo fire warning switch lights illuminate when all detectors in selected loops respond to the fire test and the cargo fire bottle DISCH light illuminates.

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72-Note that if one or more detectors in the selected loop has failed, the DETECTOR fault light will illuminate. All test indications clear when the TEST switch is released; but, up to a four second delay may occur to allow the system to reset before all applicable indications to extinguish at the same time.

FIRE PROTECTION SYSTEMS CONTROLS AND INDICATIONS REVIEW

73-FIRE PROTECTION SYSTEMS CONTROLS AND INDICATIONS REVIEW We have covered several fire protection system controls and indicators throughout this chapter. Do you remember what they were?

Engine And APU Fire Control Panel

74-ENGINE AND APU FIRE CONTROL PANEL Overheat Detector Switch: NORMAL – detection loop A and loop B must agree to trigger an alert. A – Detection loop A is the only sense authority to trigger an alert. B – Detection loop B is the only sense authority to trigger an alert.

75-Fire Warning BELL CUTOFF Switch: when pushed, it extinguishes both master FIRE WARN lights, stops the fire warning bell, stops the remote APU fire warning horn and resets the system for additional warnings.

76-APU Fire Switch: Illuminated in red: indicates fire in APU and unlocks APU fire switch. IN is normal position. UP: Arms APU extinguisher circuit, shuts down APU and isolates APU from other systems. Rotate (left or right): Discharges APU fire bottle.

77-Engine Fire Switch: Illuminated in red: Indicates fire in associated engine and unlocks related engine fire switch. IN is normal position. UP: Arms one discharge squib on each engine fire extinguisher and isolates related engine systems from other systems. Rotate (left or right): Discharges related engine fire bottle. Fire Switch Override: Unlocks fire switch manually.

78-Fault/inoperative and overheat/fire test switch is spring-loaded to center. FAULT/INOP position: Does a check of fault detection circuits for both engines and the APU. Overheat/fire position: Does a check of fire detection loops on both engines, APU and wheel well fire detector.

79-Extinguisher test switch is spring-loaded to center. 1 and 2 position does a check of number 1 and number 2 fire extinguisher bottle squib circuits for continuity.

80-Engine overheat light: Illuminates in amber to indicate an overheat condition is detected in the related engine.

81-WHEEL WELL Fire Warning Light: Illuminates in red to indicate a fire condition is detected in main gear wheel well.

82-FAULT Light: Illuminates in amber to indicate following: If the overheat detector switch is in NORMAL position: Indicates both detector loops for an engine have failed. If the overheat detector switch is in A or B position: Indicates the selected detector loop for an engine has failed.

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83-APU Detector Inoperative Light: Illuminates in amber to indicate APU detector loop has failed.

84-APU BOTTLE DISCHARGE Light: Illuminates in amber to indicate APU extinguisher bottle has discharged.

85-Engine BOTTLE DISCHARGE Light: Illuminates in amber to indicate the related fire extinguisher bottle has discharged.

86-Extinguisher Test Lights: Illuminate in green to indicate number 1 or number 1 discharge squip circuit test is satisfactory.

Cargo Fire Control Panel

87-CARGO FIRE CONTROL PANEL Detector Select Switches: Allow for selection of mode of operation. NORMAL – detection loop A and loop B must agree to trigger a fire alert. A – Detection loop A is the only sense authority to trigger a fire alert. B – Detection loop B is the only sense authority to trigger a fire alert.

88-Extinguisher Test Lights: Illuminate in green to indicate the fire bottle discharge squib circuit continuity is normal when cargo Fire TEST switch is pushed.

89-DETECTOR FAULT Light: Illuminates in amber to indicate one or more of the selected detector loops in forward or aft cargo compartment has failed.

90-Cargo Fire TEST Switch: You push it to do a check of the cargo smoke detectors and the extinguishing system.

91-Cargo Fire ARM Switches: Airplanes with a single fire extinguisher bottle: When pushed, the word ARMED illuminates in white and the fire extinguisher for related cargo compartment is armed. Airplanes with two fire extinguisher bottles: When pushed, the word ARMED illuminates in white and the fire extinguisher for related cargo compartment is armed. If the first bottle has discharged and the system remains armed, the second discharge is inhibited if the airplane lands before the timer 60 minutes are over. The second bottle discharge timer is disabled when the system is disarmed.

92-Cargo Fire Warning Lights: Illuminate in red when smoke is detected in the related cargo compartment.

93-Cargo Fire Bottle Discharge (DISCH) Light: Illuminates in amber to indicate the fire extinguisher bottle has discharged. Illuminates in amber to indicate either fire extinguisher bottle has discharged.

94-Cargo Fire Discharge Switch: When pushed, it discharges the extinguisher bottle, if system is armed. When pushed - discharges the first extinguisher bottle, if system is armed. A 60-minute timer starts to discharge the second extinguisher bottle.

Apu remote Control Panel

95-APU REMOTE CONTROL PANEL APU Fire Control Handle: Up is normal position. Pulling down the handle arms APU fire bottle discharge switch, stops the APU and isolates APU from other systems.

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96-APU bottle discharge switch: It is spring-loaded to the right and safety wired. Positioning the switch to left discharges APU fire extinguisher, if it is armed.

97-APU Fire Warning HORN CUTOUT Switch: When pushed, the fire alarm bell stops, the fire warning horn sound stops, the red APU fire warning light stops flashing and stays on continuously as long as APU is on fire.

98-APU Fire Warning Light: Illuminates in flashing red to indicate a fire condition is detected in APU. The light becomes steady when APU fire warning HORN CUTOUT switch has been pushed following an APU fire indication.

Lavatory Fire Extinguisher

99-LAVATORY FIRE EXTINGUISHER TEMPERATURE INDICATOR Placard: White indicates normal condition. Black indicates indicator is exposed to high temperatures.

100-Heat Activated Nozzles: Nozzle tips are normally black. An ash gray color indicates extinguisher has discharged.

Lavatory Smoke Detection

101-LAVATORY SMOKE DETECTION LAVATORY SMOKE light on forward overhead panel if installed: Illuminates in amber when smoke is detected in a lavatory or a test is being conducted.

COURSE END

102-End of the course.