# B737 NG CBT - FMS - GENERAL DESCRIPTIONS

## 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.

## FLIGHT MANAGEMENT SYSTEM- GENERAL DESCRIPTION

2-This part provides a general description of the Flight Management system, its organization and functions. Here is the section outline: * Overview * Flight management computer * Control display unit * Data entry * Data copy * Data delete * FMS flight phases

## OVERVIEW

3-The purpose of flight management system, FMS, is to perform the automatic navigation function, compute performance parameters, guide the aircraft along a pre-planned route, and thus, reduce the cockpit workload

4-The flight management system consists of two Flight Management Computers, FMCs, which are located in the electronic equipment compartment.

5-In the cockpit, two Control Display Units, CDUs, let the flight crew control the functions of the FMCs.

6-The EFIS navigation displays provide visual interface between the flight crew and the flight management system.

7-Each pilot has an EFIS control panel to select the desired information for the navigation displays.

8-Other flight crew interface with the flight management system is the Mode Control Panel, MCP, which is used to select the autothrottle, autopilot, and flight director operating modes.

9-The flight management system determines the position of the airplane using several aircraft navigation sensors. Then it uses flight crew entered flight plan and information from its own databases to compute the autopilot flight director system and thrust commands required to fly an optimum flight profile.

## FLIGHT MANAGEMENT COMPUTER

10-The two flight management computers, designated as FMC left and FMC right, do all the calculations necessary to perform navigation, performance and guidance functions.

11-The FMC navigation function computes and updates the airplane position, automatically tunes radio navaids and calculates the actual navigation performance.

12-The performance function provides optimum values for airspeed and engine thrust to let the airplane fly at the most economical altitudes and speeds for the conditions.

13-The guidance function computes data for the lateral and vertical flight paths and supplies flight path and steering commands to the autopilot flight director system and the autothrottle

14-The other function of the FMC is the display function. This function sends route and position data to the navigation displays.

15-The display data also includes command bugs on the airspeed indicators and N1 indicators.

16-The FMC also has the ACARS function which controls the messages sent to and received from the ground with ACARS, if installed.

17-With the dual FMC installation, the airplane is certified to operate outside radio navaid coverage.

18-In dual FMC installation, one FMC is always designated as primary. If the primary FMC fails, the second FMC serves as a backup providing complete navigational functions.

19-The primary FMC selects the navaids for tuning for both FMCs, controls the navigation update function, ensures synchronization between FMCs, controls CDU displays and supplies input to autopilot and autothrottle system

20-The FMC Source Select switch on the forward overhead panel lets you select the primary FMC.

21-When the source select switch is in the NORMAL position, dual mode operation is enabled and the left FMC is the primary.

22-When the switch is set to BOTH ON LEFT position, the left FMC is again the primary; but the dual mode is lost. The left FMC controls all FMC operations.

23-With the switch in BOTH ON RIGHT position, the right FMC is the primary; the dual mode is lost. The right FMC controls all FMC operations.

**Flight management computer databases**

24-Each FMC contains a navigation database and a performance database.

25-The Navigation database contains standard navigation data which includes navaids, waypoints, airports runways, holding patterns, Standard instrument departures, or SIDs, Standard terminal arrival routes (STARs), approach procedures and company routes. The navigation database is updated every 28 days to cover changes in navigational data and procedures

26-The FMC contains two sets of navigation data: the current navigation data which is effective until a specified expiration date and a set of navigation data for the next period of effectivity.

27-The navigational database also incorporates supplemental and temporary databases for crew created navigational

data. These databases allow manual entry of 40 navaids, 6 airports and 20 waypoints. The temporary database also has an exclusive storage space reserved for additional twenty waypoints.

28-The temporary navigation database is automatically erased at flight completion.

29-The information in the supplemental navigation database remains stored until erased by specific crew action.

30-The performance database stores the data related to engine model and aerodynamic model. The FMC uses this database to calculate pitch and thrust commands.

## CONTROL DISPLAY UNIT

31-The Control Display Unit, or CDU, lets you communicate with the FMC.

32-The crew may put data into the FMC using either CDU. However, simultaneous data entry is not recommended.

33-The CDU consists of a display screen, line select keys, alphanumeric and miscellaneous keys, function keys and page select keys.

34-It also incorporates an execute key, annunciators and brightness control.

**Cdu display**

35-The liquid crystal CDU display contains 14 lines, each having 24 characters. The display is divided into three functional areas.

36-The first line is used as the page title line that gives the name of the current page. An example of a page title is PERFORMANCE INITIALIZATION.

37-The page title shows active, or ACT, indication when the page contains an active route or performance data.

38-The page title displays modified, or MOD, indication in reverse video when a modification is made to the active route or performance data.

39-The last character spaces in the page title line show the page number and the total number of pages.

40-The data field contains 6 data lines on the left and right side of the display. The data lines show either data from the FMC or data entered by the flight crew. The line titles show the type of the data just below it. Here are some examples of data lines and these are the associated line titles.

41-The bottom line is the scratchpad. It is used by the flight crew to enter data. It also shows line-selected data or FMC messages.

**Screen prompts**

42-The CDU display shows various prompts to help the flight crew in performing a task.

43-The dashes in a data line indicate that the data entry is optional in that line. However, you should enter the data if it is available to improve the capability of the FMC.

44-If there are boxes in a dataline, then the data entry is mandatory in the corresponding dataline to make the FMC operate correctly.

45-A caret symbol in a data line indicates that if you push the adjacent line select key, the FMC will activate a specific function or show another page.

## Line select keys

46-There are six line select keys on each side of the display. The left keys are identified as 1L through 6L and the right keys are identified as 1R through 6R.

47-You use the line select keys to enter data written in the scratchpad in the adjacent data line.

48-Alternately, you can push the line select key to copy data from the related data line to scratchpad.

49-If a prompt is displayed on the adjacent data line, you can use line select key to activate a specific function or access another page.

50-When DELETE is shown in the scratchpad, the line select key also lets you delete data from selected line.

## Alphanumeric keys

51-The alphanumeric keys allow you to write data on the scratchpad.

52-The plus/minus key is normally used to enter negative figures, such as outside air temperature. Number entries are assumed positive unless a minus sign is used. Minus is selected when pressing once; plus is selected when pressing twice.

53-The slash key is used to separate data when multiple entries are written on the scratchpad for the same dataline.

## Miscellaneous keys

54-The CDU also incorporates several keys with special functions.

55-The space key is used to generate a space in a specific message. It is usually used for free text type of messages in ACARS applications.

56-When the DELETE key is pushed, the word DELETE appears in the scratchpad if it is empty. This lets the flight crew delete a data line with the line select key next to the data line provided that the data line permits delete function.

## Clear key

57-The clear key is used to remove data or messages from the scratchpad.

58-Push the clear key shortly to remove the last character entered onto the scratchpad. A longer press of the key removes the entire scratchpad entry.

59-To remove a scratchpad message, push the clear key once. You don't have to hold the clear key. Your entry stays in the scratchpad after the message clears.

## Function keys

60-The function keys let you access to CDU main pages.

61-The INITIALIZATION REFERENCE key provides access to a selection of data pages used for FMC initialization and aircraft position initialization through ADIRU during preflight. You can also access navigation data and maintenance pages.

62-The ROUTE key selects the route page that you use to enter origin, destination, or route data.

63-Pushing the CLIMB key calls up the climb page. The page lets you modify climb data or monitor airplane climb performance.

64-The CRUISE key selects the cruise page which can be used to change or monitor the cruise data.

65-Likewise, the DESCENT key calls up the descent page which can be used to change or monitor the descent data.

66-The MENU key lets you display the CDU MENU page. The page lists the different subsystems which can be accessed through the CDU. You push the key beside the name of a subsystem to select that subsystem.

67-In some B737s, the MENU key is replaced by DIRECT INTERCEPT key. You use the key to modify the route to fly directly to any waypoint or to intercept any course to any waypoint.

68-The LEGS key calls up the route legs page which can be used to evaluate or change the route data. The page also lets you to control PLAN mode display.

69-The DEPARTURE ARRIVAL key provides access to a selection of departure and arrival pages that can be used to input or modify departure and arrival runways and procedures.

70-The HOLD key lets you create holding patterns or view holding pattern data.

71-Pushing the PROGRESS key displays the current flight information corresponding to the phase of the active flight plan that is in progress.

72-The N1 key selects the N1 LIMIT page that is used to view or modify the FMC calculated N1 thrust limits.

73-The FIX key provides access to FIX INFO page which can be used to create reference positions on the navigation display.

## Page select keys

74-If a function consists of more than one page, you use the page select keys to move to the next or previous page.

75-You push the NEXT PAGE key to advance the display to the next higher number page. You push the PREVIOUS PAGE key to move the display to the next lower number page.

## Execute key

76-When you modify an active data on a page, the EXECUTE light illuminates. In this case, you must push the EXECUTE key to make data modifications active.

## Brightness control

77-The brightness control lets you adjust the display brightness.

## Annunciators

78-The CDU also has annunciators on both sides of the keyboard.

79-The CALL light illuminates when a user other than the FMC requests the display.

80-Whenever a scratchpad message is displayed, the MESSAGE light comes on. The light stays on until you clear the message.

81-When a parallel offset is active, the OFFSET light illuminates.

82-The FAIL light is for test purposes only. It does not show an FMC failure.

## Scratchpad messages

83-The scratchpad provides various messages for flight crew information.

84-The messages are prioritized by importance to the flight crew as alerting messages, entry error messages and advisory messages.

85-The alerting messages have the highest priority. These messages are related to significant conditions which affect FMC operation.

86-When an FMC alerting message is displayed in the scratchpad, the message lights on both CDUs illuminate. The amber FMC alert light on each pilot's instrument panel comes on.

87-You can remove an alerting message by pushing the CLEAR key.

88-An alerting message can also be cleared by correcting the condition which causes the message to appear.

89-If you write new data over an alerting message, the message is temporarily removed from the scratchpad. However, the message reappears when the data is removed from the scratchpad.

90-Entry error messages are displayed as a result of incorrect scratchpad entries.

91-In this example, the pilot makes an error while entering the identifier for the origin airport. The INVALID ENTRY message temporarily overwrites data in the scratchpad. The message light illuminates only on the affected CDU.

92-You may use the CLEAR key to remove the message. The data that you have previously entered is once again displayed. You can now correct the entry.

93-Alternatively, you can write a new data directly over the message. In this case, the message and the data previously entered are removed.

94-Advisory messages are generated to show the FMC status and certain flight profile parameters and requirements.

95-When an advisory message appears in the scratchpad, the message lights on both CDUs illuminate.

96-You can remove a message by either using the CLEAR key or correcting the condition which causes the message to appear. Note that entering a new data in the scratchpad will remove advisory message temporarily only.

97-When multiple messages have been generated, they will be stacked for display in priority sequence or in the order of their occurrence if of the same priority. As each message is cleared, the next message in the queue is displayed.

98-In airplanes with datalink capability, the FMC also generates datalink alerting messages and advisory messages.

99-The datalink alerting messages show the status of the current uplink data.

100-When a datalink alerting message is displayed in the scratchpad, the message lights on both CDUs and the FMC alert lights on each pilot's instrument panel come on.

101-The datalink advisory message shows when a fault occurs in receiving the uplink message. The message lights on both CDUs come on.

## DATA ENTRY

102-Now we look at how to enter data in the CDU. Let's put in the destination airport.

103-Type the ICAO airport identifier for the destination on the scratchpad. Check your entry carefully to ensure that it is correct. Next, push the related line select key to load the data from the scratchpad into the data line. That completes the destination airport entry.

104-If your entry is in an incorrect format or not within the specified range, the INVALID ENTRY message shows on the scratchpad. Clear the message and check your data entry.

105-If the FMC database does not contain the entered identifier, NOT IN DATA BASE message is displayed on the scratchpad. Clear the message and check data entry, or enter the required information into the supplemental or temporary navigation database through the NAVIGATION DATA pages.

106-You may enter the altitude as three digit, four digit, five digit or flight level formats. Note that four digit format can be used only when altitude is less than 9,994 feet.

107-Let's put in the cruise altitude. Enter the cruise altitude in the scratchpad. Push the corresponding line select key. The CDU shows the altitude as flight level regardless of your entry format as long as it is above the transition altitude.

108-In this example, the pilot has entered a flight level which is below the transition altitude. When the line select key is pushed, it is displayed as altitude in the corresponding data line.

109-Now, let's put in the cruise wind data. Note that the CRUISE WIND data line contains two elements separated by a slash. Push the appropriate keys to write the wind direction on the scratchpad. Then push the slash key. Now, enter the wind speed. Push the line select key to move the data from the scratchpad into the related data field.

110-A bearing value must be entered as three digits. In this example, the wind direction is 65 degrees. When entering the wind direction data, if you omit the leading zero, INVALID ENTRY message will appear. Push the CLEAR key to remove the message and correct your entry.

111-Now let's enter the top of climb outside air temperature which is minus 46 degrees Celsius. Push the plus/minus key once. Key in the numbers and load the data in the related data line.

112-The FMC calculates the equivalent Fahrenheit temperature. It also calculates the ISA deviation.

113-Normally, the temperature entry is assumed to be Celsius unless an F letter is used. To enter a temperature in Fahrenheit, insert the letter F after the numbers.

114-We will see more about data entry in other FMC lessons. Now, with the page complete, you must execute the entries to make them active.

115-Push the execute key. The word ACT appears in the page title line to show that the FMC uses the data in the page.

## DATA COPY

116-You can also enter data in the scratchpad by making a copy of a data line.

117-In this example, we initialize the IRS by making a copy of the last FMC computed airplane position. Push the line

select key next to the last position latitude and longitude coordinates. The coordinates show in the scratchpad. Now push the line select key adjacent to the set IRS position data line.

## DATA DELETE

118-Now let's see how you can use delete function to remove data from the CDU.

119-Here is a typical active route legs page. Notice that two sizes of characters are used in the data lines. The FMC predicted values are displayed with small characters. The large characters are used to show the data that is entered by the pilot or is a part of departure or arrival procedure selected.

120-In this example, the ATC cancels an altitude constraint. Push the delete key. The word DELETE appears in the scratchpad.

121-Push the line select key next to the data that you want to delete. The constraint in large characters is replaced by the FMC predicted altitude in small characters.

122-The MOD label in the title line indicates that you have modified the route; but the illuminated execute light tells you that the modified route is not active yet. Push the execute key to make the route modification active.

## FMS FLIGHT PHASES

123-The flight phases of a typical FMS flight profile consists of preflight, takeoff, climb, cruise, descent, approach and flight complete. When a phase is completed, the FMS automatically transitions to the next phase.

124-During preflight, flight plan and load sheet information are entered into the CDU. The flight plan lets the FMC initialize lateral navigation. Flight plan and load sheet information are used to initialize vertical navigation.

125-The takeoff phase begins with selection of TO/GA and continues until the airplane reaches the thrust reduction altitude where climb thrust is normally selected.

126-The climb phase starts at the thrust reduction altitude and extends to the top of climb point.

127-The cruise phase begins at the top of climb point and extends to the top of descent point. Cruise can include step climbs and en route descents.

128-The descent phase begins at the top of descent point or when either a level change or vertical speed descent is initiated. The descent phase ends when the approach phase starts.

129-The approach phase begins on passing two miles from the first waypoint of a published approach or approach transition selected from the ARRIVALS page.

130-After landing, FMC switches from approach to the flight complete phase. The active flight plan and load data are

cleared. Some preflight data fields initialize to default values in preparation for the next flight.

**COURSE END**

131-End of course. ?