



B737 NG CBT - LANDING GEAR

COURSE OUTLINES

Ref	AC8021
Page	2 / 11
Rev	4.0
Date	2023-08-29

TABLE OF CONTENT

COURSE START	3
LANDING GEAR	3
INTRODUCTION	3
MAIN LANDING GEAR AND DOORS	3
NOSE LANDING GEAR AND DOORS	3
LANDING GEAR EXTENSION AND RETRACTION SYSTEMS	3
NOSE WHEEL STEERING SYSTEM	5
BRAKE SYSTEMS	6
ANTISKID SYSTEM	7
AUTOBRAKE SYSTEM	8
PARKING BRAKE SYSTEM	9
AIR-GROUND SYSTEM	10
LANDING GEAR CONTROLS AND INDICATIONS REVIEW	10
Control And Indications For Landing Gear Extension-Retracti	10
Autobrake And Antiskid Controls	10
Parking Brake	11
Hydraulic Brake Pressure Indicator	11
Rudder/Brake Pedals	11
Nose Wheel Steering Switch	11
Nose Wheel Steering Wheel And Indicator	11
COURSE END	11

COURSE START

1-The material contained in this training program is based on the information obtained from current national, international 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.

LANDING GEAR

2-This chapter introduces you to the airplane landing gear system and provides an overview of its organization, operation, controls and indications. Here is the chapter outline: * Introduction * Main landing gear and doors * Nose landing gear and doors * Landing gear extension and retraction systems * Nose wheel steering system. * Brake system * Antiskid system * Autobrake system * Parking brake system * Air/Ground System * Landing gear controls and indications review

INTRODUCTION

3-The 737 airplane has a tricycle type landing gear with two main landing gear and a single nose gear. Each gear has two wheels.

4-Landing gear system primarily consists of main landing gear and doors, nose landing gear and doors, landing gear extension and retraction systems and nose wheel steering system.

MAIN LANDING GEAR AND DOORS

5-The functions of two main landing gear are to support most of the airplane weight on the ground, absorb landing forces and transmit the braking loads to the airplane structure.

6-The main landing gear doors open to permit gear extension. When the main gear are retracted, the doors close to cover the wing and fuselage openings. The rubber seals around the openings in the bottom of the main gear wheel well provide an aerodynamic seal around the outboard tire.

NOSE LANDING GEAR AND DOORS

7-The nose landing gear supports the forward part of the airplane weight on the ground and absorbs part of the landing forces during landing operations.

8-The two nose landing gear doors open mechanically to permit gear extension. The nose wheel doors remain open when the gear is down. When the nose gear is retracted, the doors close mechanically and aerodynamically seal the nose landing gear wheel well to decrease drag.

LANDING GEAR EXTENSION AND RETRACTION SYSTEMS

9-The landing gear extension and retraction systems hydraulically extend and retract the main and nose landing gear.

10-Hydraulic power for retraction and extension is normally supplied by hydraulic system A. Hydraulic system B can

Ref	AC8021
Page	4 / 11
Rev	4.0
Date	8/29/23 12:00

supply pressure through the landing gear transfer unit for retraction only. A manual landing gear extension system is also provided.

11-The landing gear are normally controlled by the LANDING GEAR lever which is located on the center instrument panel.

12-The landing gear lever has three positions with detents: (1) DOWN, (2) OFF and (3) UP. You must pull the lever out so that you can move it.

13-Landing gear speed limit placard indicates limit speeds while operating landing gear and after gear extension. Landing gear extension and retraction operation affects aircraft's trim and drag requirements and deserves extra care.

14-To prevent any inadvertent gear retraction on the ground, the control lever assembly also incorporates a lever lock mechanism. The lever lock prevents accidental movement of the landing gear lever to the up position when the airplane is on the ground. After the airplane takes off, a solenoid gets electrical power and releases the lever lock, allowing the gear lever for being placed in the "UP" position.

15-If the solenoid fails to unlock the lever after takeoff, an override trigger on the lever can be used to bypass the landing gear lever lock. You need to pull and hold the override trigger to move the lever UP position and retract the landing gear.

16-The position lights on center panel indicates the status of the landing gear. There is also a set of the auxiliary position lights on the aft overhead panel for redundancy.

17-The green landing gear position lights illuminate when the related landing gear is down and locked. Note that it is not necessary to see green lights illuminated on both panels to ensure the landing gear is down and locked. Landing gear is down and locked when at least one green landing gear indicator light on center panel or overhead panel for each gear is illuminated.

18-The red primary position lights illuminate when the position of the control lever is not the same as the position of the landing gear or when landing gear is not down and locked. Now let's see the retraction sequence for the landing gear.

19-When you move the LANDING GEAR lever to UP position, hydraulic system A pressurizes the landing gear and the landing gear begins to retract. Green lights extinguish and the red lights illuminate indicating that landing gear are in transit.

20-During retraction, the brakes automatically stop rotation of the main gear wheels before the landing gear retracts. After retraction, the main gear are held in place by mechanical uplocks.

21-The nose wheels retract forward into the wheel well and its rotation is stopped by snubbers in the wheel well. The nose gear is held in place by an overcenter lock.

22-When the landing gear are up and locked the red position lights extinguish. When you move the landing gear level to

Ref	AC8021
Page	5 / 11
Rev	4.0
Date	8/29/23 12:00

OFF position, hydraulic pressure is removed from the landing gear system.

23-If a main landing gear tire is damaged during takeoff, this damaged spinning tire must be prevented from entering the wheel well or it can cause damage to components in the wheel well.

24-A frangible fitting in the wheel well ring opening removes hydraulic pressure from the affected main landing gear when a damaged, spinning tire moves into the main landing gear wheel well. Main landing gear, that has the damaged tire, free falls back to the extended position. The affected gear cannot be retracted until the fitting is replaced.

25-Hydraulic system B supplies alternate power for landing gear retraction through the landing gear transfer valve. The landing gear transfer valve changes the pressure source of the landing gear from hydraulic system A to hydraulic system B when all of the following conditions occur: the airplane is in the air, landing gear lever is UP, either main landing gear is not up and locked and left engine N2 speed is less than a limit value.

26-When you position the landing gear lever to the DOWN position, hydraulic system "A" pressure releases the mechanical uplocks and the gear starts to extend by hydraulic force, landing gear weight, and air loads. The red position lights illuminate indicating that landing gear are in transit. Overcenter mechanical and hydraulic locks activate to lock the gear in the extended position. The nose wheel doors remain open when the gear is down. When the landing gear are down and locked the red position lights extinguish and green lights illuminate.

27-If hydraulic system "A" pressure is not available for extension of the gear, the manual extension system lets you lower the landing gear.

28-Manual gear extension handles are on the cockpit floor. You get access to the manual extension handles through an access door. There are three manual extension handles. One is for the nose landing gear and one for each main landing gear.

29-When the access door to the manual extension control mechanism is open, manual landing gear extension is possible regardless of the LANDING GEAR lever position, normal landing gear extension is possible if hydraulic system "A" pressure is available and landing gear retraction is disabled.

30-When a handle is pulled to its limit, the related gear up lock is released and the gear extends by air loads and its own weight.

31-Following a manual extension, you may retract the landing gear normally by accomplishing the following procedures: close the manual extension access door, position the LANDING GEAR lever to DOWN with hydraulic system "A" pressure available, and then move the LANDING GEAR lever to UP. This allows the landing gear to retract.

NOSE WHEEL STEERING SYSTEM

32-The nose wheel steering system provides the ground directional control of the airplane. You can steer the airplane on

Ref	AC8021
Page	6 / 11
Rev	4.0
Date	8/29/23 12:00

the ground with nose wheel steering wheel and rudder pedals when the nose gear is in the down position and compressed by weight of the airplane.

33-The nose wheel steering wheel is the primary steering control. When you move the steering wheel full travel, the nose wheels turn a maximum of 78 degrees in the left or right direction.

34-The rudder pedals provide another means for nose wheel steering. However, the rudder pedals provide a limited steering control and are used to make small changes in the direction. Full travel of the rudder pedals turns the nose wheels a maximum of 7 degrees in the left or right direction. The steering wheel always overrides rudder pedal steering.

35-The rudder pedal steering engages when the airplane is on the ground and is disabled when the airplane is in the air.

36-Hydraulic system A normally supplies pressure for nose wheel steering. The nose wheel steering wheel and rudder pedals are linked to the steering control valve through cables. When you make a control input on steering wheel or rudder pedals, the valve directs the hydraulic fluid onto one side of the steering cylinders which turn the nose wheel appropriately.

37-If the hydraulic system "A" pressure is lost, you can activate alternate nose wheel steering through the NOSE WHEEL STEERING switch which is located in the flight compartment

38-The switch provides you with manual control of the landing gear transfer valve. The switch is guarded in normal position. With this position of the switch, the transfer valve supplies system "A" pressure for nose wheel steering. When you select alternate, the landing gear transfer valve changes the pressure supply of nose wheel steering from hydraulic system A to hydraulic system B.

39-Alternate nose wheel steering activates when all of the following conditions exist: nose wheel steering switch is selected to the alternate position, normal quantity of fluid is available in system B reservoir and airplane is on the ground.

40-In the event of a hydraulic leak downstream of the Landing Gear Transfer Unit, which results in a loss of fluid in the hydraulic system B reservoir, the landing gear transfer valve closes and alternate steering will not be available.

41-The nose wheel steering system can be depressurized through a lockout pin installed in the towing lever. This allows airplane pushback or towing without depressurizing the hydraulic system A.

BRAKE SYSTEMS

42-Brakes are used for slowing, stopping and holding the aircraft on the ground. They transform kinetic energy of the moving aircraft, into the heat energy by friction in the brake unit during the process working.

43-Each main landing gear is fitted with multiple-disk brake operated by hydraulic power. The brake pedals provide independent control of the left and right brakes. The nose wheels do not have brakes.

44-The 737 brake system consist of normal brake system, alternate brake system, brake accumulator, anti-skid system, auto-brake system and parking brake system.

45-Hydraulic B system supplies power for normal brake system. When there is a failure of hydraulic system "B", hydraulic system A automatically supplies pressure to the alternate brake system.

46-Brake system also incorporates a brake accumulator which is pressurized by the hydraulic system B. When normal brake system pressure and alternate brake system pressure are lost, hydraulic pressure trapped in the brake accumulator supplies a limited amount of brake energy which provides several braking applications or parking brake application.

47-The brake accumulator pressure transmitter sends the pressure signal to the brake pressure indicator in the flight compartment. This allows you to monitor the brake accumulator pressure.

ANTISKID SYSTEM

48-The brake system is also fitted with antiskid protection.

49-When brakes are applied, main wheels roll slower than aircraft ground speed. This may cause the wheels to slide over the surface of the runway. The antiskid system monitors the wheel deceleration and controls the brake pressure to prevent wheel skids during brake application.

50-Anti-skid protection is provided for both normal and alternate brake systems.

51-If the normal brake system has pressure, the antiskid protection is available for each wheel. When a wheel skids, antiskid system reduces pressure for that wheel. This permits wheel speed to increase and stop the skid condition.

52-If the alternate hydraulic brake system has pressure, the antiskid system operates almost the same as the normal system. However antiskid protection is applied to brakes on both wheels on that main gear instead of individual wheels. If a wheel on one main landing gear skids, the antiskid valve in the alternate hydraulic brake system reduces the brake pressure to the both wheel brakes on that main landing gear.

53-Note that antiskid protection is available even with loss of both hydraulic systems.

54-In addition to providing maximum braking performance with skid protection, anti-skid system also provides three important functions: locked wheel protection, touchdown protection and hydroplane protection.

55-Locked wheel protection completely releases the brake pressure at the wheel that has entered a deep skid condition until the wheel spins up again, preventing the wheel lock-up. Then the brake pressure is re-applied.

56-The touchdown protection feature provides protection against brake pressure application before touchdown. It prevents the pilot from inadvertently landing the airplane with brakes applied.

57-Hydroplane protection is an additional safeguard which enhances braking performance on icy or flooded runways.

58-The antiskid INOP light on the center forward panel illuminates in amber when a system malfunction occurs.

AUTOBRAKE SYSTEM

59-The brake system incorporates autobrake function which can be used for landing and rejected takeoff.

60-The autobrake system uses the hydraulic system B pressure and is available only with the normal brake system. It does not operate with the alternate brake system. The antiskid protection is available during autobrake operation.

61-Let's first take a look at autobrake operation in landing mode. In landing mode, the autobrake system controls brake pressure to stop the airplane at a preselected deceleration rate.

62-You can use the auto brake select switch on the center forward panel to select a rate of deceleration. There are four deceleration rates available: one, two, three and maximum.

63-The maximum setting is the highest autobrake setting for landing. You must pull on the select switch momentarily to move it to the maximum position. You should note that, even in the maximum setting of autobrake, the deceleration rate is less than that produced by full pedal braking on dry runways.

64-When you move the AUTO BRAKE select switch to select a deceleration rate, the system starts a turn-on self-check. While the turn-on self-check operates, the AUTO BRAKE DISARM light illuminates for 1 or 2 seconds. If the turn-on self-check fails, the autobrake system does not arm and the AUTO BRAKE DISARM light stays on.

65-When the turn-on self-check is successful, AUTO BRAKE DISARM light extinguishes and autobrake system arms.

66-The autobrake applies the brakes on touchdown when both thrust levers are retarded to idle and main wheels spin-up. While autobrake application occurs during landing roll, you can change the rate of deceleration.

67-You can also select the landing autobrake settings after touchdown provided that the ground speed is more than 30 knots. The autobraking starts immediately if the conditions mentioned previously are met.

68-If thrust reversers and/or spoilers are applied to slow the airplane down during landing, autobrake system reduces brake pressure to maintain the selected landing deceleration rate.

69-The autobrake system brings the airplane to a complete stop unless disengaged by the pilot.

70-You may disarm the autobrake system by moving auto brake select switch to OFF position. This method of disarming does not cause the autobrake disarm light to illuminate.

71-After braking has started, you can also disarm the autobrake system by taking any of these actions: moving the SPEED BRAKE lever from UP position to DOWN position, or advancing one forward thrust lever out of the idle position 3 seconds

Ref	AC8021
Page	9 / 11
Rev	4.0
Date	8/29/23 12:00

after the touchdown or pushing the brake pedals. When the autobrake disarms, the AUTO BRAKE DISARM light illuminates. You can turn off the light by moving the auto brake select switch to OFF position.

72-Now, let's see autobrake operation in rejected takeoff mode. The autobrake system controls brake pressure to provide maximum deceleration for rejected takeoff.

73-The RTO mode can be selected only when on the ground before takeoff. When you move the AUTO BRAKE select switch to the rejected takeoff position, the AUTO BRAKE DISARM light illuminates for one to two seconds and then extinguishes, indicating that turn-on self-check has been successfully completed and the system is armed.

74-The RTO autobrake function arms when all of the these turn-on self-check conditions exist: Airplane on the ground, AUTO BRAKE select switch to the RTO position, no fault in the antiskid and autobrake systems, wheel speed less than 60 knots, both forward thrust levers positioned to idle.

75-You may wonder when the autobrake function applies brakes with RTO selected.

76-If you reject the takeoff prior to wheel speed reaching 88 knots, autobraking does not engage. The AUTO BRAKE DISARM light remains extinguished and the RTO autobrake function remains armed.

77-If the takeoff is rejected at a wheel speed of 88 knots or more, the autobrake function applies brakes with maximum pressure when you retard the forward thrust levers to IDLE.

78-When two air/ground systems are in the air mode, the autobrake system automatically disarms the rejected takeoff autobrakes. The AUTO BRAKE DISARM light does not illuminate and the AUTO BRAKE select switch stays in the rejected takeoff position.

79-After takeoff, you must position the auto brake selector to OFF to reset or disarm the autobrake system.

80-If a landing is made with RTO selected, autobrake does not engage and the AUTO BRAKE DISARM light illuminates two seconds after touchdown.

PARKING BRAKE SYSTEM

81-Parking brake is used to set brakes during parking. The parking brake allows either system A or system B hydraulic pressure applied to the wheel brakes and holds the brake pressure on the wheels. If "A" and "B" hydraulic systems are not available, parking brake pressure is maintained by the brake accumulator

82-You can control the parking brake with the brake pedals and the parking brake lever on the control stand.

83-To set the parking brake you must depress both brake pedals fully while at the same time pulling the parking brake lever up until it locks in position. When the parking brake is set, a red parking brake warning light illuminates. Note that if there is a fault in the parking brake system, it may cause the antiskid INOP light to illuminate. This is because the antiskid

Ref	AC8021
Page	10 / 11
Rev	4.0
Date	8/29/23 12:00

system does not operate with parking brake set.

84-To release the parking brakes, push and hold the brake pedals until the PARKING BRAKE lever releases. When the parking brake is released, the parking warning light extinguishes.

AIR-GROUND SYSTEM

85-The air/ground system is used to detect whether the airplane is on the ground or in the air. The system receives air/ground logic signals from six sensors, two on each landing gear and supplies these signals to many airplane systems to configure those systems to the appropriate air or ground status.

LANDING GEAR CONTROLS AND INDICATIONS REVIEW

86-We have covered several landing gear controls and indicators throughout this chapter. Do you remember what they were?

Control And Indications For Landing Gear Extension-Retraction

87-Landing gear panel: Position lights: the lights illuminate in red when any of the following conditions occur; related landing gear is not down and locked with either or both forward thrust levers retarded to idle and below 800 feet above ground level, or related landing gear is not the same as the position of control lever which occurs when the landing gear is in transit or unsafe. The lights illuminate green when the related landing gear is down and locked.

88-Control lever: UP position retracts the related landing gear. The OFF position removes hydraulic pressure from landing gear system. The Down position extends the related landing gear.

89-Override Trigger allows LANDING GEAR lever to be raised, bypassing the landing gear lever lock. Landing gear speed limit placard indicates limit speeds while operating landing gear and after gear extension.

90-Auxiliary position lights: a separate set of landing gear indicator lights at aft overhead panel provide redundancy. The lights illuminate in green when related gear is down and locked. The landing gear is down and locked when at least one green landing gear indicator light on center panel or overhead panel for each gear is illuminated.

91-Manual Gear Extension Access Door: When the door is open; manual landing gear extension is possible with landing gear lever in any Position, normal landing gear extension is still possible if hydraulic system "A" pressure is available, and landing gear retraction is not operative. When the door is closed landing gear operate normally. The Manual Gear Extension Handles: there is one handle for each gear; right main, nose and left main gear. When a handle is pulled to its limit, the related gear uplock is released and the gear extends.

Autobrake And Antiskid Controls

92-AUTO BRAKE DISARM Light: When any of the following conditions occur, the light illuminates in amber and remains illuminated until autobrake select switch is moved to OFF: The light illuminates for one to two seconds when rejected takeoff mode selected on ground. AUTO BRAKE DISARM Light extinguishes when AUTO BRAKE select switch set to OFF or

Ref	AC8021
Page	11 / 11
Rev	4.0
Date	8/29/23 12:00

autobrake is armed.

93-AUTO BRAKE Select Switch. There are six positions available: OFF position deactivates the autobrake system. 1, 2, 3, or MAX position selects desired deceleration rate for landing. RTO automatically applies maximum brake pressure when thrust levers are retarded to idle at or above 88 knots.

94-Antiskid Inoperative Light: The light illuminates in amber when there is a fault in the antiskid system. The light is extinguished when antiskid system is operating normally.

Parking Brake

95-PARKING BRAKE Lever: DOWN: Parking brakes are released. UP: Parking brakes are set when either captain's or first officer's brake pedals are fully depressed. In some airplanes: If either forward thrust lever is advanced for takeoff while the parking brake is set, the takeoff configuration warning horn sounds. In some airplanes, If either forward thrust lever is advanced for takeoff while the parking brake is set, the TAKEOFF CONFIGURATION lights on the forward panel illuminate and the takeoff configuration warning horn sounds. Parking Brake Warning Light: Illuminates in red when parking brake is set. The light extinguishes when parking brake is released.

Hydraulic Brake Pressure Indicator

96-Hydraulic Brake Pressure Indicator indicates brake accumulator pressure: Normal pressure is 3000 psi. Maximum pressure is 3500 psi and normal pre-charge pressure is 1000 psi.

Rudder/Brake Pedals

97-Rudder/Brake Pedals: Pushing on the full pedal turns nose wheel maximum of 7 degrees in the left or right direction. Pushing on top of the pedal only activates wheel brakes.

Nose Wheel Steering Switch

98-NORMAL (guarded) position: Nose wheel steering is provided by hydraulic system A pressure. ALTERNATE position: Nose wheel steering is provided by hydraulic system B pressure.

Nose Wheel Steering Wheel And Indicator

99-Nose Wheel Steering Wheel: Full rotation: The nose wheels turn a maximum of 78 degrees in the left or right direction. It always overrides rudder pedal steering. Nose Wheel Steering Indicator CENTER: Normal straight ahead position. LEFT: Indicates nose wheel steering movement left of center position. RIGHT: Indicates nose wheel steering movement right of center position.

COURSE END

100-End of the course. ?