

DCA22LA133

OPERATIONAL FACTORS

Attachment 6

United 737 Flight Manual [Excerpts]

November 10, 2022



737

FLIGHT MANUAL

20 MAY 22

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Chapter 3**Section 172****NORMALS****RNAV (GPS/GNSS) AND RNAV (RNP)
APPROACHES****GENERAL**

This section contains the requirements and procedures for flying FMS-based non-ILS/GLS approaches.

Note: *If conducting a VOR or NDB final approach segment substitution, comply with the RNAV (GPS) procedures. For specific requirements, see FOM>Navigation>General Approach Procedures>Nonprecision Approach>RNAV Substitution (AC 90-108)>VOR and NDB Final Approach Segment Substitution (OpSpec C085).*

Note: *For RNAV (PRM) approaches, see Normals>PRM Approaches.*

REQUIRED NAVIGATION PERFORMANCE

Note: *ICAO recently introduced approaches titled RNP and RNP (AR). An RNP approach is equivalent to an RNAV (GPS) or RNAV (GNSS) approach. An RNP (AR) approach is equivalent to an RNAV (RNP) approach. These terms may be used interchangeably in the Flight Manual.*

RNAV (GPS) Approaches RNP is 0.30.

RNAV (RNP) Approaches Use charted RNP minimums.

AUTOPILOT USE

Autopilot use is required if the weather is less than 1000/3.

RNAV (RNP) Approaches Use of the autopilot is mandatory from IAF to DA regardless of reported weather conditions, except:

- The autopilot may be disconnected once the runway is in sight and can be kept in sight throughout the approach and landing. Autopilot should be used while on an RF leg. Fly the published lateral and vertical path.
- When conducting an RNAV (RNP) approach to parallel runways, the autopilot may be disconnected once the runway is in sight and the aircraft is aligned with the runway centerline.

LATERAL MODE

LNAV must be used.

VERTICAL MODE

RNAV (GPS) VNAV is the preferred vertical mode. If VNAV is unavailable, plan to use V/S.

RNAV (RNP) VNAV must be the vertical mode.

When conducting an RNAV (RNP) approach, VNAV PTH must be annunciated on the FMA by the FAP.

RNAV (GPS/GNSS) AND RNAV (RNP) APPROACH PROCEDURES

- [PF, PM] FMC Verify/set
Verify the FMC is correctly programmed. Line select the approach and verify all waypoint and altitude constraints on the LEGS page match the approach chart. Altitude constraints must be in large font.
 - Ensure GPS is updating prior to IAF (FMC NAV STATUS page 1). There is no requirement to monitor the FMC update source, only to monitor appropriate FMC messages listed below.
 - ANP must be less than or equal to RNP.
 - RNAV (GPS): Manually set RNP 0.30.
 - RNAV (RNP): Manually set RNP per approach plate.
 - One pilot displays PROG page 4/4 to verify ANP/RNP/XTK ERROR. Other pages may be momentarily displayed for situational awareness.
- [PF, PM] Radios Verify/set
Raw data not required. It is recommended that 108.00 be tuned in order to avoid false navigational guidance.
Inhibit all VOR and DME updating from NAV OPTIONS page 2 prior to initial approach fix.
- [PF, PM] EFIS control panel Set
Both pilots display MAP mode. At least one pilot in 10 NM scale or less, no later than the FAF/FAP/GP Intcpt.
- [PF, PM] Altimeter setting and tolerance Verify
Local altimeter required for RNAV (RNP) approach. Prior to reaching the FAF/FAP, crosscheck the Captain's and First Officer's altimeters to ensure a difference of 100 feet or less. If there is greater than a 100-foot difference between the primary altimeters, RNAV (RNP) approaches are not authorized.

WARNING: *The lowest altitude that may be set in the MCP is the FAF/FAP/GP Intcpt altitude until the requirements listed in Approach>Approach Procedure are complied with.*

WARNING: *Do not change vertical mode from VNAV without resetting MCP altitude to the next altitude constraint.*

Note: Do not request or accept a vector:

- Direct to any waypoint beginning or within an RF leg.
- To intercept a leg preceding an RF leg.
- Direct to the FAF/FAP/GP Intcpt.

- [PF] Autopilot As required
- [Auto] “2500” Announce
- [PF, PM] “___ in/hPa” Announce

After cleared for the approach:

- [PF/PM] LNAV Engage/arm
Monitor PROG page 4/4 for XTK ERROR inside the IAF.
- [PF] “Set ___” (altitude) Announce
- [PM] MCP altitude Set
- [PF/PM] Vertical mode Engage/arm
Track progress along the final approach vertical path and ensure compliance with any charted step down altitude restrictions.

In the event VNAV is not available, plan to use vertical speed.

For RNAV (RNP) approaches, VNAV is required and the use of V/S is not authorized. Monitor PROG page 4/4 for the VERT DEV error inside the FAF. If the deviation approaches the limit, an immediate correction back to path is needed. Monitor the vertical NPS (as installed) inside the FAF/FAP/GP Intcpt. If the deviation approaches the limit, an immediate correction back to path is needed. VERT DEV error is not to exceed 75 feet inside the FAF/FAP/GP Intcpt. If the deviation exceeds the limit, an NPS amber vertical deviation alert occurs. VTK is not to exceed 75 feet from the VNAV path deviation indication on the map display inside the FAF/FAP/GP Intcpt.

CAUTION: *There may be some RNAV (RNP) procedures with RF legs that have speed restrictions depicted on the approach plate. These speed restrictions must not be exceeded. Failure to adhere to these restrictions places the aircraft outside of the obstacle evaluation area for that approach. Plan deceleration to comply with charted speed restrictions.*

- [PF/PM] MCP speed Set, as installed
RNAV (RNP): Do not exceed speed restrictions on RF legs, whether charted or as found in FOM>Navigation>General Approach Procedures>Nonprecision Approach>RNAV Approach>Radius-to-Fix (RF) Legs.

Speed intervention (as installed) may be used at the crew's discretion outside the FAF to comply with operational constraints. Inside the FAF fix, the speed window should be closed unless operationally necessary to use MCP speed instead of FMC speed.

- [PM] FMA Confirm
- [PF] Set TDZE Announce
- [PM] MCP altitude Set TDZE
Set MCP altitude to TDZE (rounded up to nearest 100 feet) when established on a published segment with VNAV as the active pitch mode.

By 1500 feet or the FAF/FAP/GP Intcpt, whichever occurs later:

- [PF] Gear down Announce
- [PM] Landing gear lever Down

By 1000 feet RA:

- [PF/PM] Speed brake Arm
The Captain normally arms the speed brake.
- [PF] Flaps ____, Landing Checklist Announce
- [PM] Flaps Set
- [PM] Landing Checklist Accomplish
- [PF] Target speed Set, when appropriate

At 1000 feet RA:

- [Auto] "1000" Announce
- [PF] "Set missed approach altitude. Cleared to land." or
"Set missed approach altitude. No landing clearance." Announce
- [PM] Missed approach altitude Set

At 500 feet RA:

- [Auto] "500" Announce
- [PF] "Stable" or "Unstable, going around" Announce
If required, the PM directs a go-around and the PF must execute the go-around. See FOM>Navigation>Common Approach Procedures.

At 100 feet above minimums:

- [Auto] "Approaching minimums" Announce

At minimums:

- [Auto] "Minimums" Announce

If the runway environment is in sight and continuing the approach:

- [PF] “Landing” Announce
At minimums, the “Landing” callout implies that the PF has sufficient visual references to proceed to landing.
- [PF] Autopilot Off
Disconnect the autopilot no later than required by aircraft limitations.

WARNING: *If a missed approach is initiated prior to the missed approach point, follow the published approach track until reaching the missed approach point, then comply with the missed approach procedure. Level off at or initiate climb to missed approach altitude.*

WARNING: *If a missed approach is executed when flying an RF leg, fly the depicted curved track, even if disengagement of the autopilot and manual control is required. This may also include disregarding the flight director if LNAV is not the engaged lateral mode.*

If the runway environment is not in sight or the approach cannot be continued:

- [PF] Missed approach/go-around Execute
Fly the missed approach procedure for the instrument approach just flown unless otherwise specified by ATC.

**RNAV (GPS/GNSS) AND RNAV (RNP) APPROACHES
CONSIDERATIONS**

For additional requirements regarding RNAV (GPS/GNSS) and RNAV (RNP), see FOM>Navigation>General Approach Procedures>RNAV Approach.

APPROACH CONSTRUCTION

For RNAV (GPS/GNSS) and RNAV (RNP) procedures, the approach must be line-selectable in the FMC database. No lateral or vertical modifications or waypoint additions/deletions from the FAF to the missed approach point are allowed except as follows:

- Altitude modifications other than cold temperature corrections are not authorized. At or above altitudes up to and including the FAF may be set as hard altitudes if desired. For cold temperature altitude corrections, see FOM>Navigation>Altimetry.
- Speed modifications outside the FAF/FAP/GP Intcpt are allowed as long as the maximum published speed is not exceeded.
- If any inadvertent modifications occur, the entire approach must be reselected.

- If an additional waypoint reference is desired, consider using the FIX page.

TRANSITION TO VISUAL CONDITIONS

Descent path created by the FMC may not coincide with VASI/PAPI.

The flight director continues to provide guidance with reference to VNAV PTH.

The guidance provided by the VASI/PAPI and other visual cues takes precedence over flight director guidance below minimums.

MANDATORY MISSED APPROACH

Unless able to continue visually and land, execute a missed approach for the following:

- Inside the IAF, the nose of the aircraft symbol no longer touches the active course line using the 10-mile scale or XTK ERROR exceeds RNP (PROG 4/4).
- An NPS amber deviation alert, a NAV UNABLE RNP message, or a VERIFY POSITION FMC scratchpad message. VTK ERROR outside of the FAF does not apply. In the event of a missed approach, continue to make corrections back to and maintain the required course.
- VERT DEV exceeds 75 feet above or below the path inside the FAF/FAP/GP Intcpt (PROG 4/4).
- UNABLE REQD NAV PERF – RNP, FMC DISAGREE, or any VERIFY POSITION alert message inside the IAF.
- Inside the FAF/FAP/GP Intcpt and the FMA does not display VNAV PTH.
- RNAV (RNP): PROG (4) XTK ERROR exceeds RNP.

RNAV (GPS/GNSS) AND RNAV (RNP) APPROACHES BRIEFING GUIDE

Note: If conducting a VOR or NDB approach using Final Approach Segment Substitution, comply with RNAV (GPS) requirements below.

Note: ICAO is in the process of renaming RNAV (GPS) or RNAV (GNSS) approaches to RNP (e.g., RNP Rwy XX).

Note: Some foreign states renamed RNAV (RNP) approaches to RNP (AR).

Requirements to Conduct an RNAV (GPS), RNAV (GNSS), or RNP Approach	
	• Approach is line selectable from FMC database • RNP 0.3 • Autopilot required if weather <1000/3 • LNAV required • GPS updating required prior to commencing the approach • If “Uncompensated Baro-VNAV” is listed in chart notes, must have local altimeter setting - no remote or QFE altimetry authorized • OAT within charted values. If not specified, $\geq -15^{\circ}\text{C}$

Requirements to Conduct an RNAV (RNP) or RNP (AR) Approach	
	• Approach is line selectable from the FMC database • Published RNP, no less than 0.10 • Autopilot required • LNAV and VNAV required • GPS updating required prior to commencing the approach • Local altimeter setting. No remote or QFE altimetry authorized • Altimeters cross checked within 100 feet, prior to FAF/FAP/GP Intcpt

FMC Setup	
DEP/ARR	• Approach must be line selectable.
LEGS	• Manually set RNP. • Do not add or delete waypoints between the FAF/FAP/GP Intcpt and the RWY/MAP inclusive. • For the final approach segment, altitude modifications other than cold temperature altitude corrections are not authorized. • Speed modifications are allowed. • If any inadvertent modifications occur, reselect the approach.

FMC Setup	
NAV STATUS Page 1	Check that GPS is updating prior to IAF.
NAV OPTIONS Page 2	Inhibit VOR/DME updating prior to IAF

Determine Descent Mode
VNAV required for RNAV (RNP) or RNP (AR) Use V/S when any of the following apply: - No FMC coded GP (GPx.xx). - VNAV is not available. Note: Availability of VNAV may be verified by presence of VNAV path pointer and deviation scale, T/D circle, or small font speed at RWY/MAP. Reset cruise altitude and/or select DES NOW, if required (e.g., after missed approach).

Determine Minimums	
Published DA	Set published DA when the final approach segment is flown in VNAV PTH. Apply cold temperature altitude corrections when required.
DDA	Calculate and set a DDA for any of the following: - Published MDA(H). - VNAV not available (V/S used). Apply cold temperature altitude corrections when required.

When Cleared for the Approach	
<u>L</u> ateral	Select LNAV.
<u>A</u> ltitude	Select/verify next MCP altitude restriction: - No lower than FAF/FAP/GP Intcpt altitude until TDZE requirements are met - Set TDZE when: - Established on a published segment of the approach, and - VNAV engaged (or level at FAF/FAP/GP Intcpt altitude)
<u>V</u> ertical	Select/verify appropriate vertical mode: - VNAV: Verify PTH no later than FAF/FAP/GP Intcpt. - Verify crossing restrictions as required.



When Cleared for the Approach	
<u>S</u> peed	- Speed intervention (if installed) may be used at the pilot's discretion outside the FAF to comply with operational constraints. Inside the FAF fix, the speed window should be closed unless operationally necessary to use MCP speed instead of FMC speed. - RNAV (RNP) or RNP (AR): - On RF legs, do not exceed charted speed. - Max allowable RF leg speed FAF to DA: ♦ CAT C – 140 KIAS ♦ CAT D – 165 KIAS
<u>F</u> MAs	Confirm FMAs.
<u>T</u> DZE	Set touchdown zone elevation rounded up to nearest 100 feet once established on the approach.

Lateral and Vertical Performance Limits	
Lateral	- RNAV (GPS) (GNSS) or RNP: - NoUNABLE REQD NAV PERF - RNP, FMC DISAGREE, VERIFY POSITION FMC message. - MAP mode, 10 NM scale or less, no later than the FAF/FAP/GP Intcpt.. - RNAV (RNP) or RNP AR additional requirement: - PROG (4) XTK ERROR ≤ RNP
Vertical	- VNAV: - VNAV PTH FMA FAF inbound - VNAV path pointer and deviation scale displayed - VTK ERROR ≤ 75 - V/S: - On vertical profile, bracketing maneuvers not to exceed: ♦ ±300 FPM or 1° ♦ Sustained vertical speed >1200 FPM

RNAV Aircraft Required Equipment		
Equipment	RNAV (GPS), RNAV (GNSS), RNP	RNAV (RNP), RNAV (AR)
	Coupled/Manual	Coupled
AFDS FMA	1	1
Autopilot	1/0	1
Autopilot disengaged light	0	1
Autopilot yoke disconnect switch	0	2
CDU	1 ²	2
PFD/ND displays/DEUs	2	2 ¹
EGPWS	0	1
Electrical busses	N/A	All powered
Engines	1	1
FMC	2 ²	2
Flight directors	0/1	2
Flight control computer (FCC)	1	2
Generators	1/0	2
GPS	1 ²	2
Hydraulic system	A or B / 0	A or B
IRS (NAV)	2	2
Radio altimeter	0 ³	2
TO/GA button/function	0	1

¹ Must be supplied by separate display electronics unit, if installed.

² Required for all approaches selected from the database without raw data.

³ Use of autopilot or autothrottle on approach with associated radio altimeter inoperative is prohibited.

Chapter 3
Section 180

NORMALS
VISUAL APPROACHES

GENERAL

A visual approach is conducted under an IFR flight plan and allows the pilot to proceed visually to the airport. See FOM>Navigation>Visual Approach Procedures.

VISUAL APPROACHES PROCEDURE

- [PF, PM] FMC, radios Verify/set
Line select an appropriate approach.

WARNING: *When cleared for the visual approach, do not set a lower MCP altitude or begin descent until approaching a normal visual or electronic glidepath and terrain and obstacle clearance can be assured throughout the approach. An early descent may compromise terrain/obstacle and/or Class B vertical limits.*

- [Auto] “2500” Announce
- [PF, PM] “___ in/hPa” Announce

After cleared for the approach:

- [PM] MCP altitude Set (as required)
- [PF] Approach guidance Select
Select appropriate lateral and vertical guidance to aid in flying the approach.

When in a position to begin final descent to the runway:

- [PF] Set TDZE Announce
- [PM] MCP altitude Set TDZE
Set MCP altitude to TDZE (rounded up to nearest 100 feet).

By 1500 feet or the FAF/FAP/GP Intcpt equivalent, whichever occurs later:

- [PF] Gear down Announce
- [PM] Landing gear lever Down

By 1000 feet RA:

- [PF/PM] Speed brake Arm

The Captain normally arms the speed brake.

- [PF] Flaps _____ Announce
- [PM] Flaps _____ Set
- [PM] Landing Checklist _____ Accomplish
- [PF] Target speed. _____ Set, when appropriate

At 1000 feet RA:

- [Auto] “1000” _____ Announce
- [PF] “Set missed approach altitude. Cleared to land.” or
“Set missed approach altitude. No landing clearance.” _____ Announce
- [PM] Missed approach altitude. _____ Set
Set missed approach altitude for the backup approach briefed or as
assigned by ATC.

At 500 feet RA:

- [Auto] “500” _____ Announce
- [PF] “Stable” or “Unstable, going around” _____ Announce
If required, the PM directs a go-around and the PF must execute the
go-around. See FOM>Navigation>Common Approach Procedures.

If continuing the approach to land:

- [PF] Autopilot _____ Off
Disconnect the autopilot no later than required by aircraft limitations.

If the runway environment is not in sight or the approach cannot be continued:

- [PF] Go-around _____ Execute
Initiate a go-around if an approach cannot be continued to a landing.
Remain in VMC. Published instrument missed approach procedures do not
apply to visual approaches. Follow ATC instructions or fly the published
visual missed approach procedures. If an FMC course is available, TOGA to
LNAV will automatically command steering to follow that course. Select an
appropriate roll mode to remain in VMC.

VISUAL APPROACHES CONSIDERATIONS/PLANNING

Plan the approach to arrive at or before the FAF (or an equivalent point) within stabilized approach parameters. Planning may begin with a published arrival fix that is 30-40 NM from the airport, at an appropriate altitude. If no such fix exists, consider building a fix that represents a similar altitude/distance and energy relationship.

Certain airports or conditions may dictate slight variances. These may include high density altitude airports where approach speeds result in higher true airspeeds, approaches with a tailwind component near the maximum permissible level, or non-normal configurations. These conditions may result in high energy approaches.

VISUAL APPROACH CONSTRUCTION

A visual approach should be flown using an approximate 3° descent path while aligned with the extended centerline of the runway. Back up the visual approach with a line-selectable instrument approach or charted visual approach if it is available. If an approach with glideslope guidance is not available (e.g., a LOC approach), load the approach and extend a fix on the approach or the runway itself. If no charted approach is available, consider loading and extending the runway to provide lateral and vertical guidance.

In the absence of a suitable line-selectable approach, other options include selecting the arrival runway and inserting appropriate waypoints and altitudes (as required) along the inbound course to the runway. This provides lateral guidance and a vertical profile to the runway threshold. Manually tune and display backup raw data, as required. The visual approach may be flown using LNAV/VNAV when programmed.

If a published approach is not available for the desired runway, the runway and a runway extension may be loaded. The FMS creates a path, inline with the runway centerline, beginning at a point 50 feet above the runway threshold and extending upward at a default flight path angle (FPA) of 3°. A different FPA may be entered as desired.

LATERAL NAVIGATION

The runway is the primary lateral reference on a visual approach. Displaying the MAP mode with terrain selected enhances situational awareness. The localizer provides accurate course information.

VERTICAL NAVIGATION

Plan to fly the visual approach with a constant, stable descent from traffic pattern altitude through the landing. To ensure adequate main gear clearance over the threshold, the visual descent profile should be approximately 3°. Plan to cross the runway threshold at 50 feet RA.

Two general techniques exist to determine a point to start the descent:

- Load an approach and extend a fix on the approach. When cleared for the visual approach, descend to the FAF/FAP/GP Intcpt altitude with reference to intermediate fixes, surrounding terrain, obstacles, and Class B airspace vertical limits. Once established at FAF/FAP/GP Intcpt altitude, start the final descent at the published FAF/FAP/GP Intcpt.
- Select and extend the runway. This technique provides the pilot with lateral course guidance and runway distance to go information. Divide the height above touchdown by 300 feet per nautical mile. This provides a distance

in nautical miles from the end of the runway to begin the descent on a 3° glidepath.

If vertical information is programmed in the FMC, the VNAV path pointer and deviation scale provides vertical path information. Once stabilized on the descent, if TDZE is set, the green arc should be close to the runway threshold on the ND.

CHARTED VISUAL FLIGHT PROCEDURES

Charted visual flight procedures (CVFPs) are established for environmental, noise abatement, and traffic efficiency purposes. Unless indicated as a Class B airspace floor, all depicted altitudes are for noise abatement only. The approach charts depict prominent landmarks, courses, and recommended altitudes to specific runways.

See FOM>Navigation>Charted Visual Flight Procedures for more information.

RNAV VISUAL APPROACH PROCEDURES

RNAV visual approaches should be utilized when line selectable from the FMS. When conducting an RNAV visual, utilize RNAV approach procedures. See Normals>RNAV (GPS/GNSS) and RNAV (RNP) Approaches. The autopilot may be disconnected at any point on the approach if desired.

RUNWAY AWARENESS AND ADVISORY SYSTEM (RAAS) (MAX)

System Overview

The Runway Awareness and Advisory System (RAAS) is an enhancement to the GPWS system. RAAS provides aural callouts along with visual alerts on the navigation display (ND) to assist the pilots with situational awareness during ground operations, approach to landing, and go-around.

RAAS requires the following databases or systems for proper operation:

- Terrain and airport runway database is in the GPWS computer,
- Aircraft is on or approaching an airport in the RAAS airport runway database,
- Global positioning system (GPS) and other required signals are available and accuracy meets minimum requirements.

When enabled, RAAS callouts operate without any action required from the pilots. If desired, RAAS availability can be verified on the ground. There is no automatic display of RAAS functionality. Visual display of RAAS callouts and alerts on the ND requires the selection of the terrain feature. RAAS callouts and alerts may be inhibited by the runway inhibit switch.

Assumptions, Limitations, and Constraints

Defined nominal runway length for landing and advisory hold times are options specified by an operator.

In flight callouts and alerts are based on an algorithm that numerically subtracts the landing runway TDZE in the GPWS database from the pressure altitude of the aircraft. The term "above field elevation" is used in the system description for these altitudes.

- Note:**
- *RAAS callouts and alerts are based on RAAS airport runway database details and GPS position.*
 - *RAAS does not include knowledge of ATC clearances or pilots intent.*
 - *RAAS does not take into account aircraft performance factors such as aircraft weight, wind, runway conditions, slope, air temperature, or airport altitude.*
 - *Absence of a RAAS annunciation does not ensure that the that a runway is appropriate for takeoff or landing.*
 - *RAAS annunciations do not ensure that a runway can, or cannot, be safely used for takeoff or landing.*
 - *Pilot is responsible by other means to ensure correct runway selection. RAAS does not include knowledge of Notice to Airmen (NOTAM) or Automatic Terminal Information Service (ATIS).*
 - *RAAS callouts and alerts are not intended for navigation purposes.*
 - *RAAS is not designed to enhance traffic awareness.*

RAAS callouts and alerts have a lower priority than any GPWS alert, including radio altitude callouts. Some may reoccur, depending on aircraft position, when the higher priority advisory clears.

CALLOUTS, ALERTS, AND ND MESSAGES DURING TAXI AND TAKEOFF (MAX)

Callouts, Alerts, and ND Messages	Description
Callout: CAUTION ON TAXIWAY, ON TAXIWAY ND amber message: ON TAXIWAY	Sounds once each time the aircraft: - Is on a surface other than a runway, and - Ground speed is greater than 40 knots.
APPROACHING (RUNWAY IDENTIFIER of runway end closest to aircraft position) ND green message: APP XX	Sounds once each time the aircraft: - Approaches a runway, and - Ground speed is less than 40 knots.
ON RUNWAY (RUNWAY IDENTIFIER) ND green message: ON XX	Sounds once when the aircraft: - Enters a runway, and - Heading is within 20° of the runway heading.
ON RUNWAY (RUNWAY IDENTIFIER) (LENGTH REMAINING) ND amber message: ON XX YYYY	Sounds once when the aircraft: - Enters a runway with available runway length for takeoff less than 5000 feet, and - Heading is within 20° of the runway heading.
Voice annunciation: CAUTION SHORT RUNWAY, SHORT RUNWAY ND amber message: SHORT RUNWAY	Sounds once when the aircraft: - Is on a runway with available runway length for takeoff less than 5000 feet, and - Heading is within 20° of the runway heading, and - Ground speed is greater than 40 knots.

CALLOUTS, ALERTS, AND ND MESSAGES DURING APPROACH, LANDING, AND REJECTED TAKEOFF (MAX)

Voice Callouts, Alerts, and ND Messages	Description
(3000 FEET) REMAINING - RTO ND display message not available.	Sounds during RTO when the aircraft is on the ground: - Is on a defined minimum length from the runway end - With ground speed greater than 40 knots, <i>and</i>

	After ground speed decreases by seven knots from the maximum ground speed achieved.
(2000 FEET) REMAINING ND display message not available.	Distance Remaining Sounds once each time the aircraft is: 2000 feet from the runway end; <i>and</i> - During rollout with airspeed greater than 40 knots.
ONE HUNDRED REMAINING ND display message not available.	Sounds once each time the aircraft: - Is within 20° of the runway heading, <i>and</i> - Is within 100 feet of the end of a runway, <i>and</i> - Ground speed is less than 40 knots.
Callout: CAUTION TAXIWAY CAUTION TAXIWAY ND amber message: TAXIWAY	Sounds once each time the aircraft: - Aircraft is airborne between 150 and 250 feet AGL; <i>and</i> - Aircraft climb rate is less than 450 FPM; <i>and</i> - Aircraft is within 5 NM of a runway and is not lined up with a runway.
Callout: FLAPS FLAPS (with pause between) ND amber message: FLAPS	Sounds once when the aircraft: - Flaps are not in landing configuration, at 600 feet AFE; <i>and</i> - Aircraft is not required to be aligned with runway.
Callout: FLAPS - FLAPS (no pause) ND amber message: FLAPS	Sounds once when the aircraft: - Flaps are not in landing configuration, at 600 feet AFE; <i>and</i> - Aircraft is aligned with runway.
Callout: TOO HIGH - TOO HIGH ND amber message: TOO HIGH	Sounds once when the aircraft: - At 950 feet AFE if gear is down, landing flaps set; <i>or</i> At 600 feet AFE aligned with runway. - Regardless of flaps/gear.
Callout: TOO FAST - TOO FAST ND amber message: TOO FAST	Sounds once when the aircraft: - At 950 feet AFE if gear is down, landing flaps set; <i>or</i> At 600 feet AFE aligned with runway. - Regardless of flaps/gear.



Callout: UNSTABLE ND amber message: UNSTABLE	Active at 450 feet AFE. Provided one of the approach monitors is active at the time.
Callout: LONG LANDING ND amber message: LONG LANDING	Aircraft is airborne above 5 feet AGL, but below 100 feet AGL. And aircraft has passed 3000 feet from approach end of runway.
Callout: ALTIMETER SETTING ND amber message: ALTM SETTING	The aircraft has been above the transition altitude (from database) for more than 30 seconds, but not more than 5 minutes. Aircraft has descended below the transition altitude (from database) for more than 30 seconds or height above field is less than 1500 feet.
Callout: ALTIMETER SETTING ND amber message: ALTM SETTING	Aircraft has descended below the transition altitude (from database) for more than 30 seconds or height above field is less than 1500 feet.

BANK ANGLE ALERT (MAX)

The GPWS provides the aural alert BANK ANGLE, BANK ANGLE when there is excessive roll of the aircraft. Once sounded, the alert is silent for that bank angle until the system is reset by decreasing the bank angle to 30° or less.

The alert is based on radio altitude and bank angle:

- From 5 feet to 30 feet AGL, the alert sounds when the bank angle exceeds 10°.
- From 30 feet to 130 feet AGL, when the alert sounds varies linearly from a bank angle of 10° at 30 feet AGL, to a bank angle of 35° at 130 feet AGL.
- Above 130 feet AGL, the alert sounds when the bank angle exceeds 35, 40 or 45°.