

Certification Memorandum

Helicopter Terrain Awareness and Warning System and Ground Proximity Warning System alerting functions for Offshore Operations

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Regulatory requirement(s): SPA.HOFO.160(c), CS-29.

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Log of issues

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1. Introduction

1.1. Purpose and scope

The purpose of this Certification Memorandum is to specify EASA policy for the installation and certification of Helicopter Terrain Awareness and Warning System (HTAWS) functions to be used in offshore Commercial Air Transport (CAT) operations in compliance with SPA.HOFO.160(c).

Moreover, until an ETSO standard will be defined (see paragraph 2.3), this Certification Memorandum is presented to give guidance on the voluntary implementation of GPWS functions for offshore operations and on the certification activities related to their approval on new and existing helicopter types.

1.2. References

It is intended that the following reference materials be used in conjunction with this Certification Memorandum:

Reference	Title	Code	Issue	Date
[1]	CAA UK CAP 1519 - Offshore Helicopter Terrain Awareness Warning System Alert Envelopes		V1.3	28.09.2018
[2]	CAA UK CAP 1538 - Class A Terrain Awareness Warning System (TAWS) for Offshore Helicopter Operations		V1.1	05.06.2017
[3]	Certification Specifications and Acceptable Means of Compliance for Large Rotorcraft	CS-29	Any	
[4]	MG 18 – Helicopter Terrain Awareness and Warning System	AC 29-2C	Chg 1 to 7 included	04.02.2016
[5]	ETSO-C194 - Helicopter Terrain Awareness and Warning System	CS-ETSO	Amdt. 7	05.07.2012
[6]	DO-309 - Minimum Operational Performance Standard (MOPS) for Helicopter Terrain Awareness and Warning System (HTAWS) Airborne Equipment.			13.03.2008
[7]	ETSO-C151c - Terrain Awareness and Warning System	CS-ETSO	Amdt. 11	05.08.2016
[8]	Commission Regulation (EU) No 965/2012, laying down technical requirements and administrative procedures related to air operations (and subsequent amendments)			05.10.2012
[9]	Commission Regulation (EU) No 748/2012 laying down implementing rules for the airworthiness and environmental certification of aircraft and related	Part-21		03.08.2012



Reference	Title	Code	Issue	Date
	products, parts and appliances, as well as for the certification of design and production organisations (and subsequent amendments)			

1.3. Abbreviations

AC	Advisory Circular
AFCS	Automatic Flight Control System
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAT	Commercial Air Transport
CFIT	Controlled Flight into Terrain
CM	Certification Memorandum
C of A	Certificate of Airworthiness
EUROCAE	European Organisation for Civil Aviation Electronics
ETSO	European Technical Standard Order
ETSOA	European Technical Standard Order Authorisation
FAQ	Frequently Asked Questions
FAS	Final Approach Segment
FLTA	Forward-Looking Terrain Avoidance
FMS	Flight Management System
GM	Guidance Material
GPS	Global Positioning System
GS	Glide Slope
GPWS	Ground Proximity Warning System
HTAWS	Helicopter Terrain Awareness and Warning System
MG	Miscellaneous Guidance
MOPS	Minimum Operating Performance Specification
MOPSC	Maximum Operating Seating Configuration
RA	Radar Altimeter
TAWS	Terrain Awareness and Warning System

1.4. Definitions

Alert: a visual or aural stimulus presented either to attract attention or to convey information regarding system status, a condition, situation, or event.



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Aural Alert: an auditory tone and/or verbal statement used to announce a condition, situation, or event.

Caution Alert: an alert requiring flight crew awareness. Subsequent corrective action will normally be necessary.

Controlled Flight into Terrain (CFIT): an occurrence when an airworthy aircraft under the complete control of the pilot is inadvertently flown into terrain, water, or an obstacle.

Forward-Looking Terrain Avoidance: a system/function that looks ahead of the aircraft along and below the aircraft's lateral and vertical flight path and provides suitable alerts if a potential CFIT hazard exists.

GPWS function: alerting function, distinct from Forward Looking Terrain Avoidance, providing caution and warning alerts of imminent contact with ground/water.

HTAWS: an alerting system that provides the flight crew with sufficient information and time to detect potentially hazardous terrain or obstacle.

Nuisance Alert: an alert generated by a system that is functioning as designed but which is inappropriate or unnecessary for the particular condition.

Offshore GPWS function or Offshore mode GPWS function: GPWS function specifically designed for Offshore operations.

Offshore Mode: Set of Offshore GPWS functions grouped under a single mode.

Visual Alert: the use of projected or displayed information to present a condition, situation, or event.

Warning Alert: the level or category of alert for conditions that require immediate flight crew awareness and immediate flight crew response.

2. Background

2.1. Regulatory background

Advisory Circular (AC) 29-2C Miscellaneous Guidance (MG) 18 provides specific guidance for the certification of Helicopter Terrain Awareness and Warning Systems (HTAWS) installed on-board helicopters to be certified in accordance with CS-29 or any equivalent airworthiness code. Regarding equipment qualification, paragraph b (2) of MG 18 clarifies that:

"...TSO-C194 specifies HTAWS equipment requirements and prescribes, by reference to RTCA specification DO-309, the minimum performance standards that a HTAWS must meet for approval. RTCA DO-309 defines specific Minimum Operational Performance Standards (MOPS) for HTAWS equipment. Compliance with RTCA DO-309 provides a method of compliance for qualification of HTAWS equipment. ..."

Requirement SPA.HOFO.160 (c), contained in the Air Operations Regulation 965/2012, states:

"... Helicopters used in CAT operations with a maximum certificated take-off mass of more than 3 175 kg or a MOPSC of more than 9 and first issued with an individual C of A after 31 December 2018 shall be equipped with an HTAWS that meets the requirements for class A equipment as specified in an acceptable standard."

Currently, there is no "acceptable standard" or formal definition for "Class A HTAWS" provided to meet this requirement. The only formal standard for HTAWS equipment qualification is constituted by ETSO-C194, whose technical requirements are included in DO-309. However, as apposed to ETSO-C151c which is valid for fixed wing TAWS, ETSO-C194 does not contain any categorisation in classes for HTAWS.

The following Table 1 provides a summary comparison the ETSO C-151c with ETSO C-194 requirements.



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It can be noted that the requirements of ETSO-C194 HTAWS are equal to neither Class B nor Class A ETSO C-151c TAWS. Moreover, for HTAWS:

- There is no mandatory function for premature descent along the Final Approach Segment (FAS)
- There is no specific indication for the altitude source. The source used for both vertical and horizontal positions shall be such so as to provide the required level of accuracy for its intended function
- Ground Proximity Warning System (GPWS) functions and envelopes are not required.

In addition, it should be noted that there are currently no different certification or design requirements for HTAWS functions that are designed to be used in different types of operations.

Requirement		ETSO C-151c Class A TAWS	ETSO C-151c Class B TAWS	ETSO C-194 HTAWS
Forward looking terrain avoidance (FLTA)		M	M	M
Terrain display information		M	O	M
Premature Descent along the FAS		M	M	
Altitude source		GPS, RA	GPS	Any
GPWS functions	(1) Excessive rate of descent	M	M	
	(2) Excessive closure rate to terrain	M		
	(3) Negative climb rate or altitude loss after T/O	M	M	
	(4) Flight into terrain when not in landing config	M		
	(5) Excessive downward deviation from ILS GS	M		
	(6) Altitude callout	M	M	
Legend: M = mandatory, O = optional				

Table 1 – Comparison between ETSO C-151 Class A and Class B TAWS and ETSO C-194 HTAWS

2.2. Current fleet situation

Many helicopter types currently operated in offshore CAT operations are equipped with HTAWS in various level of integration with other avionic systems (e.g. AFCS, FMS). Most of these HTAWS also include GPWS functions. However due to a lack of any MOPS or ETSO, these functions are considered to be non-TSO compliant, and therefore are not standardised. Each helicopter manufacturer designs the GPWS envelopes in agreement with the HTAWS supplier, in compliance with the certification requirements, and with the aim to satisfy the customer's needs. This has resulted in differences in approach to the certification of HTAWS between helicopter manufacturers and also between helicopter types produced by the same manufacturer. In some cases, the alerting envelopes were simply derived from the analogous aeroplanes functions and therefore were not optimized for helicopter operations.

The research published in CAA UK CAP 1538 highlighted that, specifically for offshore operators, the GPWS alerting functions of HTAWS that are installed on certain helicopters have proven to provide insufficient time to the crew to take corrective action in a number of CFIT occurrences. In addition, the FLTA function creates an unacceptable level of nuisance alert.

2.3. The CAA UK CAP 1519

In response to a number of UK AAIB recommendations that aim at preventing CFIT and obstacle strike accidents, the CAA UK working with the industry, conducted a research activity for the improvement of HTAWS that are installed on helicopters used in CAT offshore operations in support of oil and gas exploitation. The research activity was published in CAP 1538 and showed that for offshore oil and gas operations existing HTAWS did not perform as expected both in terms of insufficient warning time and excessive nuisance alert



rate. This has resulted in a lower level of trust in the installed HTAWS by the crew, up to the point that the alerts were inhibited or the system was switched off.

These results were used to generate a proposed standard for HTAWS installed on helicopters to be used in offshore oil and gas operations, which was then published in CAP 1519. This document proposes to implement a new offshore mode in the HTAWS, which includes a set of GPWS functions and is specifically designed for offshore operations with the objective of maximising warning times while preventing excessive nuisance alert rates.

The new offshore mode proposed in CAP 1519 does not replace or supersede any existing requirements for HTAWS, i.e. it does not affect any of the TSO functions included in TSO/ETSO-C194 and its MOPS contained in DO-309.

EASA considers the proposed standard to be a considerable improvement in the safety of offshore oil and gas operations. The EUROCAE Working Group 110 has been established with the objective to transpose, to the largest possible extent, the proposed offshore functions into an industry standard, which could be adopted as MOPS for a future ETSO.

3. EASA Certification Policy

3.1. Compliance with SPA.HOFO.160(c)

Clarification on compliance to the SPA.HOFO.160(c) requirement is given in the EASA Frequently Asked Question (FAQ) published on the EASA website <https://www.easa.europa.eu/the-agency/faqs/air-operations#category-helicopter-operations>.

For helicopters with CofA issued after 31.12.2018, compliance with SPA.HOFO.160(c) can be demonstrated with certified installations of HTAWS equipment that are granted with an ETSO-C194 authorisation or that, alternatively, are demonstrated to be compliant with the technical requirements set in DO-309.

Helicopters with CofA issued before 31.12.2018 are not required to have an HTAWS for offshore operations. However, it is recognized the safety benefit brought by the availability of such systems and retrofit of the existing fleet in these respect is highly recommended. It is also suggested, albeit not required, that HTAWS installed on these helicopters are ETSO-C194 compliant.

3.2. GPWS functions

On a voluntary basis, helicopters may be equipped with GPWS functions that provide caution and warning alerts, with both visual and aural indication, of imminent contact with the ground/water.

The GPWS functions may be designed to fit any type of mission, including offshore, or may be specific for offshore CAT operations.

When Offshore GPWS functions are implemented in addition to other generic GPWS functions, they should be grouped together under a “mode” and properly named. In this document, the set of GPWS functions designed for offshore operations will be called « offshore mode ».

3.3. Minimum performance of the offshore mode GPWS functions

When fitted, the following subparagraphs describe the minimum performance that offshore mode GPWS functions implemented in the helicopter should provide. Albeit not mandatory, until a further standard is developed, it is highly recommended that the minimum performance specifications below are followed during the implementation of the offshore mode GPWS functions.



3.3.1. Design and installation

The offshore mode GPWS functions should be designed and installed to meet the installation and certification requirements of the category of aircraft for which they are intended.

The systems should provide the pilot with timely and accurate alerts that will allow the pilot to make the necessary inputs/actions to keep the aircraft within a safe flight envelope and not impair or impede other system functions.

Offshore mode GPWS functions can be implemented either in the HTAWS equipment or through functions provided by means of other integrated avionic equipment that are installed on the rotorcraft. In any case, care should be exercised in ensuring that the availability of offshore GPWS functions are ensured in any normal operating conditions and in any configuration for which the aircraft can be dispatched for CAT offshore operations.

3.3.2. Alert envelopes

Caution and warning alerts, with both visual and aural indication, of imminent contact with the ground/water should be provided at least for the following conditions:

- a) Excessive rates of descent
- b) Loss of airspeed or height after take-off
- c) Flight into terrain when not in a landing configuration

The definition of the alert envelopes for the alert functions listed above is left to the equipment supplier and helicopter STC/TC holder to account for different aircraft performance, system architecture and specific operational requirements.

For the Offshore mode, alert envelopes defined in Appendix A can be used, if found suitable by the applicant. It should be noted that all these envelopes are designed taking into account that a radar altimeter input source is available. This is considered feasible since, in compliance with CAT.IDE.H.145 and SPA.HOFO.160(a)(2), the radar altimeter shall be installed on board all helicopters flying offshore operations under CAT, NCC or SPO.

Additional envelopes may be included. In such case, manufacturers should take care to ensure that excessive nuisance alert rates are not generated.

3.3.3. Aural and visual alerts

Aural and visual alerts should be provided for each of the functions described in paragraph 3.3.2.

The alerts should be continuously provided until the condition for alerting the crew no longer exists. The system should remove both the visual and the aural alerts once the situation has been resolved.

Alerts for offshore GPWS functions should be properly prioritised with respect to other alerts from HTAWS and other systems. The prioritisation scheme should be consistent with the prioritisation schemes and requirements of the HTAWS, if such a system is already installed in the aircraft, and other aircraft systems.

Each aural alert should identify the reason for the alert, such as “too low - terrain”, or another acceptable annunciation. Appendix A provides a proposal for the type of aural alert for each envelope in the offshore mode.

Visual alerts should be consistent with the design philosophy of the aircraft cockpit. In any case, it is expected that:

- 1) A caution alert is indicated with an amber/yellow text message that is obvious, concise, and consistent with the aural message and/or an amber indicator.



- 2) A warning alert is indicated with a red text message that is obvious, concise, and consistent with the aural message and/or a red indicator.

3.3.4. Nuisance alerts

The occurrence of nuisance alerts should always be minimized. The maximum nuisance alert rate should be determined and demonstrated during the certification process.

The interface of the offshore GPWS functions with other helicopter systems should be designed so that the status of specific aircraft systems (e.g. OEI conditions) or flight conditions (e.g. autorotation) are recognized. If the system would normally generate an expected alert in specific circumstances or operational conditions, but the aircraft status would not permit the crew to alter the flight path and escape the alert boundary, the alert should be inhibited. A typical example for such a case, but not the only one, would be an alert generated by a high rate of descent during an autorotation.

In case this cannot be achieved, specific instructions should be included in the RFM to warn the crew of the system behaviour. However, this should be limited to extreme corner portions of the envelope proposed for the system certification and discussed on a case by case basis with the EASA certification team.

3.3.5. Segregation

The offshore GPWS functions should be properly segregated. They should not affect any of the certified ETSO functions and therefore should not invalidate the existing ETSOA.

When Offshore GPWS functions are implemented in addition to generic GPWS functions, they should be grouped together, named “Offshore mode”, and properly segregated from any other GPWS function modes.

3.3.6. Transition to and from the “Offshore mode”

Automatic transition from the “Offshore mode” to any other mode and vice versa mode may be provided, through the recognition of the type of surface. However, manual selection should also always be provided.

It should always be possible for the pilot to override the automatic transition, by manually selecting the desired mode.

A clear indication should be given to the pilot when the Offshore mode is selected.

3.4. Certification

3.4.1. Classification of the design change

The installation of a new HTAWS on a helicopter, as well as implementation of new GPWS functions (including offshore mode) into an existing HTAWS or in an aircraft avionics architecture is considered to be a Major change to a Type Certificate. Therefore a Major Change Approval or a Supplemental Type Certificate is to be granted upon successful certification.

The design change is not to be considered significant, unless other design characteristics of the project require a different classification in accordance with requirement 21.A.101 of Part-21.

3.4.2. Eligibility

Given the extensive breadth of compliance demonstration activities, only DOAs with appropriate Terms of Approval can apply for such a design change. The scope of work should include at least the following disciplines:

- Avionics - Indicating, alerting systems
- Flight Testing



Moreover, in case the applicant is not the TC holder of the helicopter, this design change should be considered as Group 1 STC as per Part 21.A.112 and GM1 to the same requirement.

3.4.3. Compliance demonstration

Compliance to the applicable type certification basis of the rotorcraft should be demonstrated as indicated in the AC 29– 2C MG 18. Particular emphasis should be given to the demonstration of compliance of the proposed installation to requirements CS.29.1301 and 1309 or equivalent requirement, as applicable in the type certification basis of the aircraft.

In particular, flight testing, in combination with simulation and operational flight data analysis, will be required in order to show proper functionality of the alert envelopes within the entire rotorcraft certified envelope and to evaluate the impact of the HTAWS functions on the basic crew procedures.

In addition, the applicant should demonstrate that nuisance alerts are minimized during aircraft operations. This should at least include flight evaluation in the most critical conditions of all normal and emergency manoeuvres applicable to offshore operations included in the Rotorcraft Flight Manual.

Flight test categorisation should be in accordance with the Part 21 Appendix XII¹.

3.5. Who this Certification Memorandum affects

TC/STC holders or DOA holders willing to implement GPWS functions or to install new HTAWS systems with the GPWS functions on helicopters involved in offshore missions.

4. Remarks

1. Suggestions for amendment(s) to this EASA Certification Memorandum should be referred to the Certification Policy and Safety Information Department, Certification Directorate, EASA. E-mail CM@easa.europa.eu.
2. For any question concerning the technical content of this EASA Proposed Certification Memorandum, please contact:

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¹ See also the related Frequently Asked Questions on the EASA website: <https://www.easa.europa.eu/the-agency/faqs/rotorcraft>



Appendix A

Offshore mode alert envelopes and aural alerts



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1. Excessive rates of descent

This mode provides protection against excessive descent rate at low altitude.

The descent rate parameter can be defined by the applicant using the most suitable sensor or a combination of inputs. Here the ALTRATE is proposed, which is defined as the vertical speed parameter from the Attitude & Heading Reference System (AHRS,) comprising a hybrid of barometric and inertial data with long term error elimination provided by rate of change of pressure altitude, performed within the AHRS using Air Data Computer (ADC) data.

As explained in CAP 1538 at paragraph 5.2.4, the selection of the ALTRATE parameter is driven by the need to avoid two problems in the measurement of the descent rate calculated from pressure altitude or radar altitude. In fact, when flying at low speed, both the rates of change of pressure altitude and airspeed data below 30-40 knots are not reliable due to the downwash from the main rotor affecting the pressure at the pitot and static vents. Also, when operating offshore, the radio altitude measurement is subject to a 'step change' as the aircraft crosses the edge of the helideck.

1.1. Alert envelopes and aural alert

Alert envelopes are provided in Table 2 and Figure 1.

ALTRATE (ft/min)	Radar Altitude (ft)
Caution envelope	
-600	0
-1000	750
-10000	1000
Warning envelope	
-700	0
-1200	500
-10000	600

Table 2 – Excessive rate of descent alert envelopes



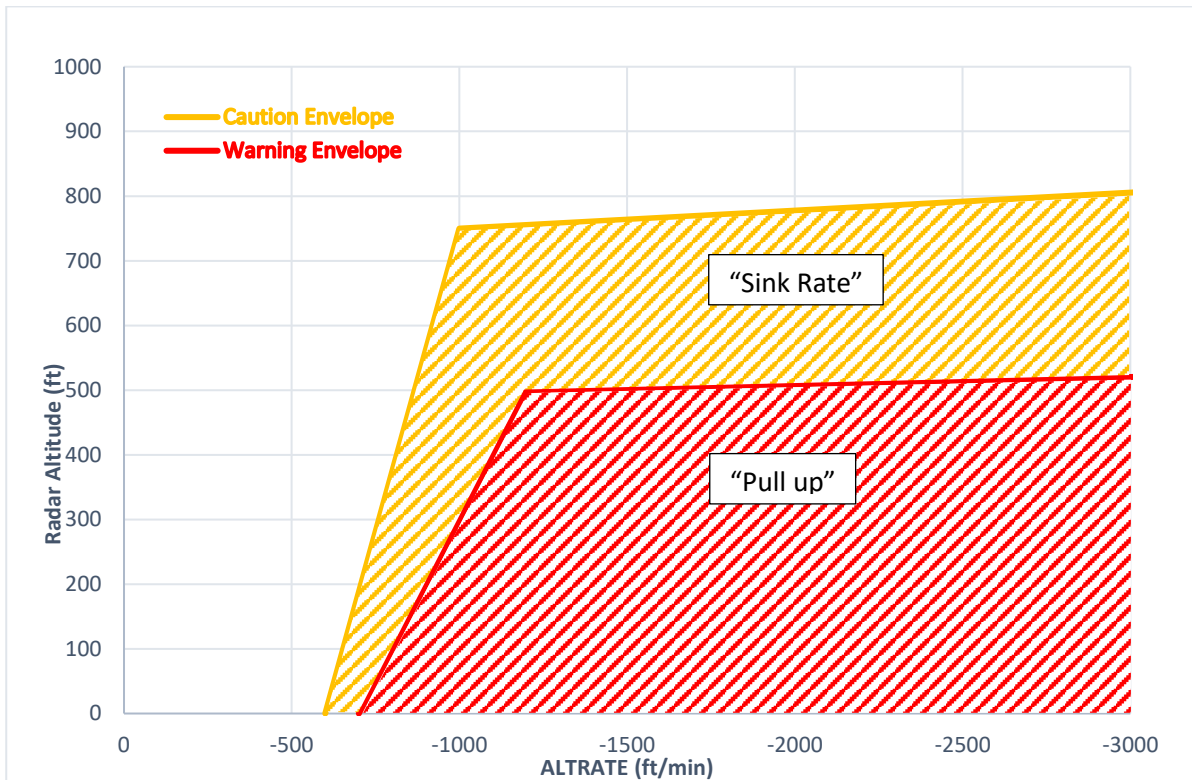


Figure 1 – Excessive rate of descent alert envelopes

When the combination of altitude and descent rate is within the caution envelope, the aural caution “Sink Rate” is produced. In case the warning envelope is entered, the aural warning is “Pull Up” is generated.

2. Loss of airspeed or height after take-off

This function provides protection against inadvertent loss of height or airspeed after take-off using input parameters of Radio Height and Indicated Airspeed (IAS). This function is enabled after take-off or go-around when the landing gear is not in the landing configuration, or when the airspeed exceeds a given threshold of 50 kts. Different airspeed thresholds may be defined by the applicant taking into account helicopter specific performance and take-off and landing procedure.

2.1. Alert envelopes and aural alert

The function should remain enabled for the take-off phase of flight, which is assumed to cease 60 seconds after activation of the envelope.

There are two alert envelopes:

- loss of height after take-off
- loss of airspeed after take-off

2.1.1. Loss of height after take-off

A height loss in excess of 20% of the maximum radio height (or equivalent alternative trigger, such as barometric altitude) will generate the aural caution “Don’t Sink”. The caution will remain active until sufficient altitude is regained.



2.1.2. Airspeed loss after take-off

A reduction in airspeed to below 55kts after having attained 60kts will generate the aural caution “Check Airspeed”. The caution will remain active until airspeed is increased again to at least 60kts.

3. Flight into terrain when not in landing configuration

Provides protection against unsafe terrain clearance using input parameters of radio height, indicated airspeed (IAS) and landing gear position.

There are two alert envelopes:

- low height with landing gear retracted
- low height with landing gear extended or in case of fixed landing gear.

3.1. Low height with landing gear retracted

This function is active when the landing gear is retracted. Below a given altitude, it will generate an aural caution, depending if the aircraft is at low or high speed.

3.1.1. Alert envelopes and aural alert

The height threshold is set to 350ft in order to provide timely alerts when operating to elevated helidecks offshore. A different height threshold may be adopted where operationally appropriate.

At low airspeed, it will generate the caution “Too Low Gear”, while it will produce the caution “Too Low Terrain” at high speed, as indicated in Table 3 and Figure 2.

The airspeed threshold at which the caution changes from “Too Low Terrain” to “Too Low Gear” is set here for reference at 100 kts. However, it may be adjusted to be compatible with the aircraft’s configuration warning system.

Indicated Airspeed (kts)	Radar Altitude (ft)
“Too Low Gear” Caution envelope	
<100	<350
“Too Low Terrain” Caution envelope	
≥100	<350

Table 3 - Low height with landing gear retracted alert envelopes



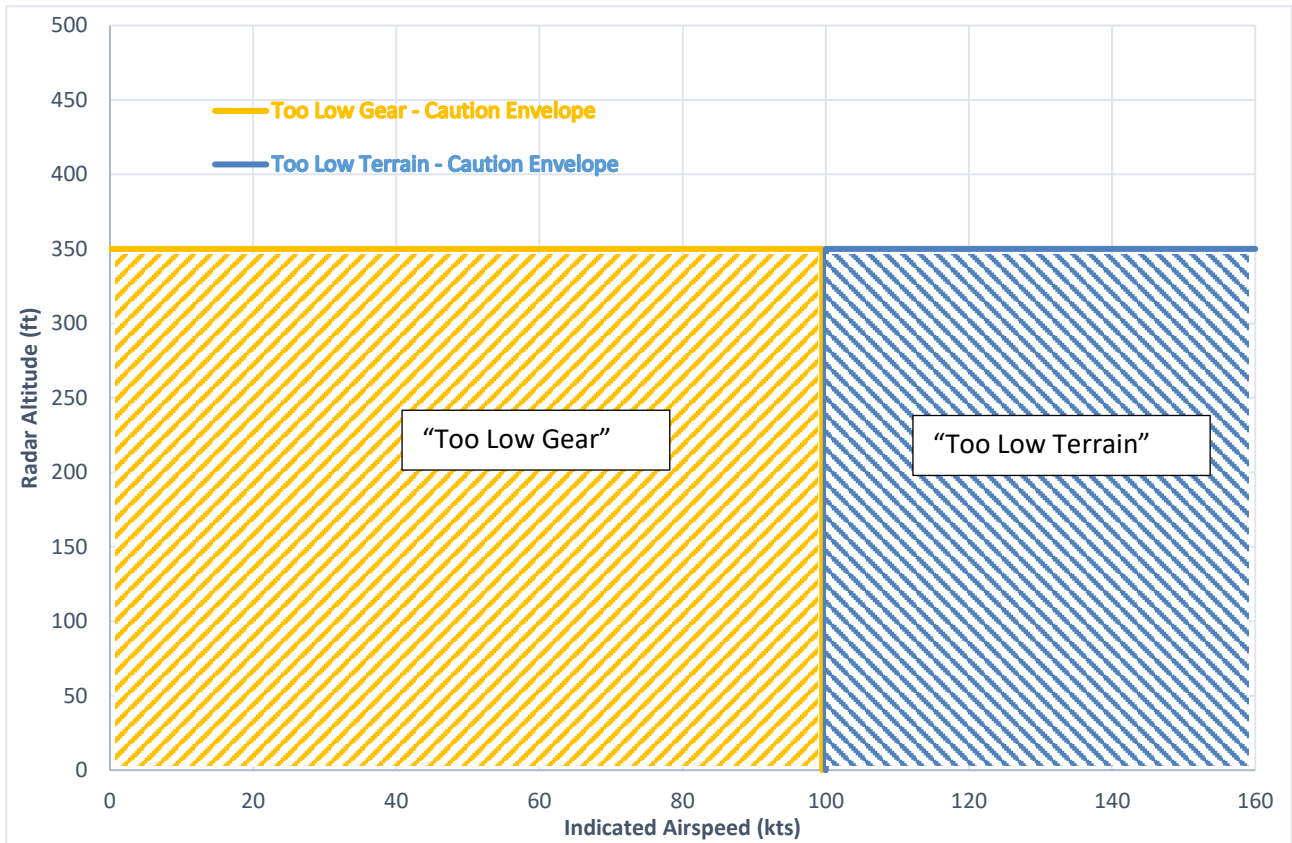


Figure 2 – Low height with landing gear retracted alert envelopes

3.2. Low height with landing gear extended

This function provides a low height aural caution with landing gear deployed or for helicopters with fixed landing gear.

3.2.1. Alert envelopes and aural alert

The caution envelope is provided in Table 4 and Figure 3.

The height threshold is set to 160ft for airspeeds greater than 120kts. A different height threshold, but not less than 100ft, may be adopted (e.g. via pin programming) where operationally appropriate.

Indicated Airspeed (kts)	Radar Altitude (ft)
Caution envelope	
80	0
120	160
Vne	160

Table 4 - Low height with landing gear extended alert envelope



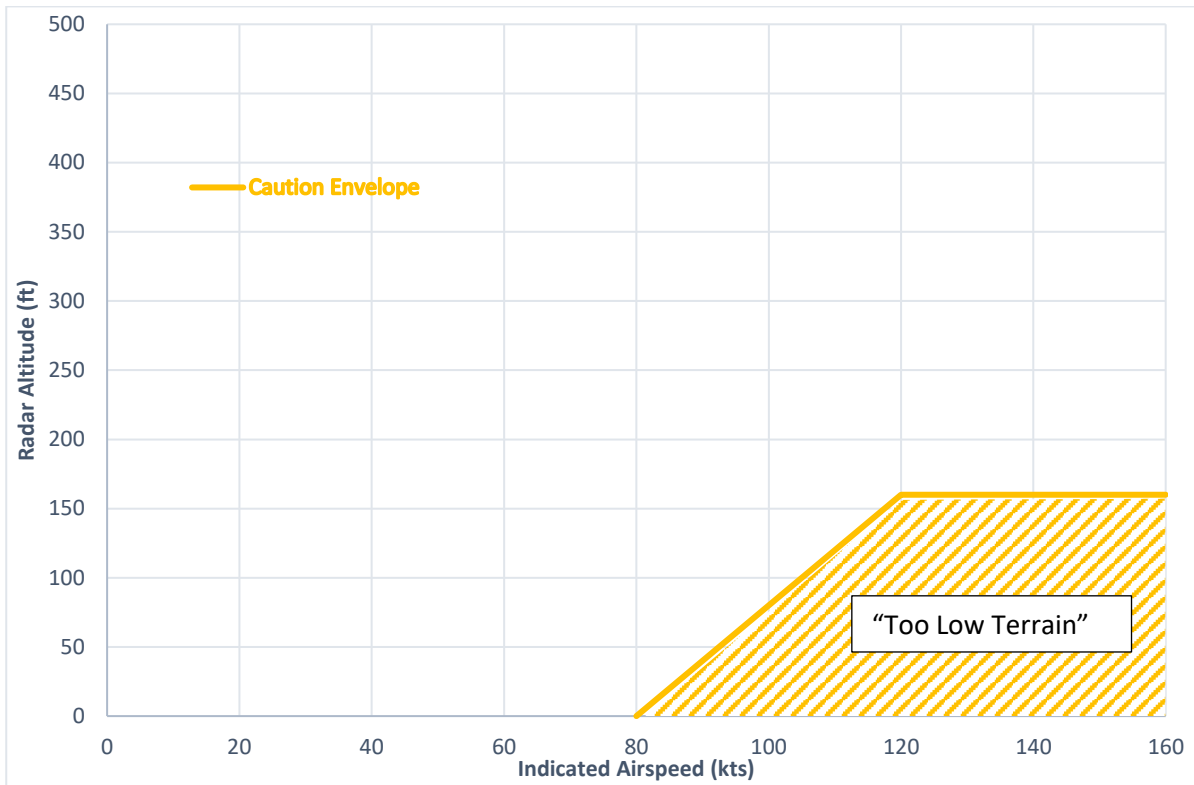


Figure 3 - Low height with landing gear extended alert envelope

