European Aviation Safety Agency

EXPLANATORY NOTE

EXECUTIVE SUMMARY

The scope of this Decision is to contribute to enabling PBN operations by providing requirements for airworthiness approval and operational criteria for aircraft, as outlined in the Terms of Reference (ToR) 20.006, Issue 3, of 9 February 2009. In the Rulemaking Programme 2012-15 the task has been renumbered as RMT.0444.

The purpose of NPA 2009-04 was in fact to amend AMC 20 to introduce the Airworthiness Approval and Operational Criteria for Area Navigation (RNAV) for Global Navigation Satellite System (GNSS) approach operation to Localiser Performance with Vertical guidance (LPV) minima using a Satellite Based Augmentation System (SBAS).

150 comments were received from 26 commentators. In principle stakeholders agreed to this amendment in order enable safe LPV approach operations.

In conclusion the Agency intends to adopt in 2012 this amendment 9 to AMC 20.

AMC-20 Amendment 9

Executive Director Decision 2012/014/R amends Executive Director Decision No. 2003/12/RM of 05 November 2003 on General acceptable means of compliance for airworthiness of products, parts and appliances ('AMC-20').

This Amendment 9 of AMC-20 incorporates the output from the following EASA rulemaking task:

Rulemaking Task No.	TITLE	NPA No.
RMT.0444 (20.006 (c))	Airworthiness Approval and Operational Criteria for on board equipment related to Area Navigation for Global Navigation Satellite System approach operation to Localiser Precision with Vertical guidance minima using Satellite Based Augmentation System	2009-04

This NPA has been subject to consultation in accordance with Article 52 of the Basic Regulation[1] and Article 5(3) and 6 of the rulemaking procedure established by the Management Board[2]. The Agency has addressed and responded to the comments received on the NPA. The responses are contained in a comment-response document (CRD) which has been produced for the NPA and which is available on the Agency's website.

Detailed changes incorporated in the NPA are summarised in the following pages for ease of reference.

[1] Regulation (EC) No 216/2008 of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L79, of 19.3.2008, p.1.)

[2] EASA MB Decision 01-2012 of 13 March 2012 amending and replacing MB Decision 08-2007 concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications and guidance material ('Rulemaking Procedure').

TITLE:	AMC-20 Amendment 9
Rulemaking Task No.:	RMT.0444 (20.006(c))
Title:	Airworthiness Approval and Operational Criteria for on board equipment related to Area Navigation for Global Navigation Satellite System approach operation to Localiser Precision with Vertical guidance minima using Satellite Based Augmentation System
NPA No.:	NPA 2009-04
CRD No.:	CRD 2009-04

LIST OF PARAGRAPHS AFFECTED

- Cover + Contents
- New AMC 20-28 added

In response to CRD 2009-04, the Agency received several reactions, which are reproduced below together with the Agency's responses:

Commenter / Reference	Reaction	EASA Response
DGAC	All reactions concern appendix A and associated appendix 3 (from page 65 onward) Some of the changes we propose for the following paragraphs result from a simple and straight consistency check with AMC 20-27: - Appendix 3 - 1.1 Pre-flight planning: selection of non RNAV procedures -§ 6.5 Continuity of function -§ 6.2.1 GNSS SBAS stand-alone navigation system Yet they are of the utmost importance as they have direct consequences on acceptability of equipment and flexibility/scope of operations. DGAC wishes the Agency pay special attention to the associated proposals.	Noted The Agency thanks the DGAC for your reactions. The response to the individual reaction can be found in the corresponding row later in this table.
Garmin International	Page 70, Section 6.2.2 Note. Refers to "Chapter 2.3 of RTCA DO-229C". The preceding text has been revised to reference ETSO-C145c. ETSO-C145c references RTCA DO-229D as its minimum performance standard. Suggest changing "DO-229C" to "DO-229D".	Accepted. Text amended
Garmin International	Page 70, Section 6.3.1 Note. Refers to "RTCA DO-229C Appendix J". The subsequent text has been	Partially Accepted.

	revised to reference ETSO-C145c/C146c. ETSO-C145c/C146c reference RTCA DO-229D as its minimum performance standard. Suggest changing "DO-229C" to "DO-229D".	The inconsistency in the revision status observed has been noted, however, the text of paragraph 6.3.1 has been further amended to ensure consistency with paragraph 6.2 and has resulted in the reference to RTCA D-229 being deleted.
Garmin International	Page 70, Section 6.3.2 includes the statement: "Lateral guidance from 1 000 ft HAT to DA(H) should be stable within 1/3 FSD where FS is defined as a 2 degree wedge with the origin located 305 m past the MAWP." The "2 degree wedge with the origin located 305 m past the MAWP" is only certain for LNAV/VNAV standalone approaches not LPV approaches. The course width and FPAP location are defined in the FAS data block and can vary for LPV approaches. The quoted statement should be revised to be consistent with what is allowed for LPV approaches per DO-229D Appendix D. Suggest removing the phrase "where FS is defined as a 2 degree wedge with the origin located 305 m past the MAWP".	Partially Accepted The Agency concurs with the comment pertaining to the origin of the 2 degree wedge. On further review of the text and in particular with respect to stability during the approach paragraph 6.3.2 and paragraph 8.5 have been rationalised.
Garmin International	Page 73, Section 7.1, item 2, Note 2 includes the statement: "The display may be located in the normal field of view subject to Agency agreement. "AC 20-138B removed the normal field of view definition in favor of a single primary field of view definition. However, the AC 20-138B Appendix 7 paragraph A7-1.r primary field of view definition	Not accepted The display may be located in the normal field of view subject to the Agency agreement permits the applicant to demonstrate that display locations such as those found on CS-23 aircraft are suitable.

	includes the following clarification: "The primary field of view definition should be broad enough to include the center radio stack on 14 CFR part 23 airplanes with "classic", analog basic 'T' instrumentation" Suggest that AMC 20-28 7.1 item 2, Note 2 include this clarifying statement with respect to the primary field of view in lieu of the proposed normal field of view statement.	
Garmin International	Page 73, Section 7.1, item 3 includes the statement: "Capability to continuously display the distance to the Landing Threshold Point/Fictitious Threshold Point (LTP/FTP) from passing the Final Approach Point in the primary field of view." Garmin equipment displays the distance to the next waypoint, not necessarily the distance to the LTP/FTP. In most cases this is the same after the Final Approach Point. While acknowledging that Europe is generally opposed to stepdown fixes, there are still several examples of European RNAV (GNSS) approaches such as LOWW RNAV 11 that include a stepdown fix after the Final Approach Point. TSO-C146 allows Garmin's implementation as RTCA DO-229D allows for the moving map to "obviate" the requirement to continuously display distance to the LTP/FTP. Suggest adding a note acknowledging that equipment with a moving map display may obviate the need for continous display of distance to the	Partially accepted, With regards to the reaction pertaining to the use of stepdown fixes. It should be noted that this AMC is only applicable to approach to LPV minima from the FAF to the LTP/FTP or MAPT as applicable, which is normally the next waypoint after the FAF. To improve clarity MAPT has been added to the text. The requested addition of a note to permit the use of a moving map to display the distance to go is not accepted by the Agency as an acceptable means as the distance to go as distance is not necessarily displayed. Editorial change accepted "from passing" to "after passing".

	LTP/FTP after passing the Final Approach Point. Also suggest changing the phrase "from passing" to "after passing" in the quoted Section 7.1, item 3 statement.	
Garmin International	Page 73, Section 7.1, item 3, Note includes the statement: "The display may be located in the normal field of view subject to Agency agreement. "AC 20-138B removed the normal field of view definition in favor of a single primary field of view definition. However, the AC 20-138B Appendix 7 paragraph A7-1.r primary field of view definition includes the following clarification: "The primary field of view definition should be broad enough to include the center radio stack on 14 CFR part 23 airplanes with "classic", analog basic 'T' instrumentation." Suggest that AMC 20-28 7.1 item 3, Note include this clarifying statement with respect to the primary field of view in lieu of the proposed normal field of view statement.	Not accepted The display may be located in the normal field of view subject to the Agency agreement permits the applicant to demonstrate that display locations such as those found on CS-23 aircraft are suitable.
Garmin International	Page 86, Appendix 3, Section 1.3 includes the statement: "The crew must check that the GNSS approach mode indicates LPV (or an equivalent annunciation) 2 NM before the FAP."	Accepted, Text amended so that the Approach Mode should be indicated prior to the FAP.

	It may be possible for an LPV approaches to have a fix closer than 2 NM to the FAP. In such a case, LPV is not indicated until the FAP becomes active. Suggest revising that AMC 20-28 Appendix 3, 1.3 to allow for this possibility.	
UK CAA	Please see comment below from the UK CAA. This comment has been added as a general reaction since the CRT did not allow the comment to be added to the relevant segment of the CRD. **Page No:** 85 **Paragraph No:** Appendix 3, 1.1(c) **Comment:** This paragraph now implies that a destination aerodrome cannot be equipped with an LPV approach only; there must be a non RNAV procedure available. This is not acceptable as many aerodromes will only have an RNAV Approach. **Justification:** Use of an aerodrome that has only an RNAV procedure is acceptable providing an alternate aerodrome is available and equipped with a non RNAV procedure. **Proposed Text:** "c) The Flight Crew should ensure sufficient means are available to navigate and land at the destination or at an alternate aerodrome in the case of loss of LPV airborne capability. In particular, the Flight Crew should check that: · at least one non RNAV GNSS based procedure is available at the destination aerodrome **unless a non RNAV GNSS based procedure is available at a nominated alternate**."	Partially Accepted. The text has been revised to reflect the intent of the comment.

Garmin International	Garmin originally commented on the Section 9 item a) phrase: "including the airborne equipment software version" that a minimum software version should be sufficient to avoid having to update the AFM or POH due solely to a software version change. EASA did not accept this comment because: "The Agency is of the opinion that software part-numbering conventions allow for minor changes to be accomplished without having to roll the part number." Garmin agrees that TSOA/ETSOA letters are flexible in this regard by allowing for open brackets on the software part number for minor software changes. However, FAA AC 20-138B Appendix 5 Sample A/RFM section 2 includes the following statement: "2. The system must use at least software version *<insert version identification>* as the minimum version." To be consistent, Garmin suggests that the Section 9 item a) text be revised to: "including the airborne equipment minimum software version"	Agreed. Text amended to reflect the requirement to stipulate the minimum software version.
DGAC	**5.1 Navigation Aid infrastructure (2)** *The acceptability of the risk of loss of LPV approach capability for multiple aircraft due to satellite failure*	Partially accepted. The text has been amended to reflect the assumption that an ANSP will address the possibility of aircraft

	or SBAS system failure, loss of the on board monitoring and alerting function (e.g. RAIM holes)… will be considered… We propose to delete "loss of the on board monitoring and alerting function". This sentence is confusing indeed: this loss is either linked to the equipment itself, which means a single aircraft is concerned (not the scope of this paragraph), or linked to the SBAS system itself, in which case it is already addressed ("SBAS system failure").	losing navigational capability due to the non-availability of the GNSS/SBAS signal during the approach.
DGAC	**§ 6.2.1 GNSS SBAS stand-alone navigation system** GNSS SBAS stand-alone equipment should be approved in accordance with E/TSO C146c. We maintain that approval in accordance with TSO C146a, TSOC146b or E/TSO C146c should all be allowed. <u>Justification</u>: Equipment certified in accordance with one of the preceding standard would be discarded while many have been installed. This waste of resources it is not technically justified: PBN provisions, adopted last year (after publication of the NPA!), allow approval on the basis of these Technical Standard Orders. We just propose the same thing. In these conditions, we really do not understand the absence of grand-fathering provisions	Noted. The valid European Standard that is fit for purpose is only ETSO-C146c. The ETSO-C146a and ETSO-C146b were not issued. However the Agency recognises the associated limitation, therefore, notes have been added to paragraph 6.2.1 and 6.2.2 recognising that equipment approved to ETSO-C145/146 could be eligible for acceptance provided that a positive deviation of compliance with RTCA DO-229C including the amendments of Appendix 1 to FAA TSO-C145a/C146a has been documented in the DDP.
DGAC	**§ 6.3.2.1 FTE** *FTE should be contained within the following criteria:* *· Lateral guidance from 1 000 ft HAT to DA(H) should*	Partially accepted The Agency concurs with the reaction with respect to

	be stable within 1/3 FSD where FS is defined as a 2 degree wedge with the origin located 305 m past the MAWP. *· Vertical guidance from 700 ft HAT to DA(H) should be stable within 1/2 FSD where FSD=±0.25(glide path angle).* ("FS" is written instead of "FSD") Why are these figures repeated when already provided in the MOPS to which system have to comply with (e.g. DO 229D). We propose to be consistent with the way preceding paragraphs are written: in said paragraphs, ad hoc certification documents are only referred to. Moreover, this chapter is not clear. Is it trying to convey that the flight crew must maintain FTE within 1/3 FSD laterally and 1/2 scale vertically? If so, it has nothing to do in this chapter but should be written in appendix 3 (dedicated to ops procedure). Moreover it is not clear what "stable" means. Stability of the guidance may refer to the way the tracking performance should be done when FD or AP are activated	repeating data that is already a referenced in the MOPS. On further review of the text and in particular with respect to stability during the approach paragraph 6.3.2 and paragraph 8.5 have been rationalised.
DGAC	**§ 6.5 Continuity of function** Continuity of function should not be modified as proposed in the CRD: Come back to the previous version. <u>Justification:</u> There is a change of the failure condition regarding the loss of the function, whereas no comment had been made to have this value changed. The NPA 2009-04 has been used for several years before issuance of this CRD. This is not the way such	Not accepted. Based on comment 137 of the CRD, the hazard classification was reassessed by the Agency and this resulted in the change to the major hazard classification as shown in the resulting text. EASA considers that approaches to LNAV/VNAV minima are different to those to LPV minima and as such considers the hazard classification is appropriate to this type of operation.

	a critical modification should be handled. Moreover, the AMC 20-28 is no more consistent with AMC 20-27 and PBN which clearly states that Loss of the RNP APCH functions with or without BAROVNAV guidance is considered a minor failure condition if the operator can revert to a different navigation system and proceed to a suitable airport. For RNP APCH operations at least one RNAV system is required. The LPV should be handled exactly in the same way, if there is a loss of the function there is a reversion to an other approach procedure as it is today with ILS, LNAV, LNAV/VNAV,VOR/DME,....in case of the loss of one radionavigation system.	
DGAC	**Appendix 3** **1.1 Pre-flight planning** The text of point c) was modified even though the proposition issued during the NPA process seemed satisfactory : it was not commented at all. It is proposed to re-instate the initial text of the NPA. It will be consistent with AMC 20-27. <u>Justification</u>: The proposal can not be accepted since it would require maintaining a non precision approach on all runways accessible with a SBAS procedure. It would not comply neither with ICAO resolution nor PBN requirements. As written, two non RNAV GNSS based procedures are required when an alternate is required: at destination and for the alternate. This is more demanding than for LNAV operations (as stated in AMC 20-27) without being justified.	Partially Accepted. The text has been revised to reflect the intent of the comment.

	If the amended text was confirmed, it could even end with a pilot/operations "ignoring" the SBAS capability of an aircraft and just relying on the RNP APCH capability in order to achieve more flexibility when both destination and alternate aerodromes are required! This would be nonsensical; we must avoid this and come back to the initial NPA text	
Dassault Aviation	Dassault Aviation comment on CRD resulting text page # 70 §6.3.2 FTE For FSD definition, placement of the FSD wedge origin at 305m after the MAWP (generally the runway threshold) should be corrected to be in line with the DO 229C/D that places the origin 305m after the FPAP (i.e., on the other side of the runway)	Partially accepted The Agency concurs with the comment pertaining to the FSD definition. On further review of the text and in particular with respect to stability during the approach paragraph 6.3.2 and paragraph 8.5 have been rationalised.
EUROCOPTER	3 (Page 66) "*This document is only applicable to RNAV GNSS approaches conducted down to LPV minima. It does not address RNP approaches with Authorisation Required (RNP AR APCH) nor Basic RNP approaches (RNP APCH). These types of approaches are addressed by AMC 2026* *and AMC 2027*" Since the definition of RNP APCH in the AMC 20-27 is according to PBN manual, please consider adding a reference to the AMC or equivalent defining RNAV (GNSS) approach. Anyhow the AMC 20-27 definition is not 100% correct: "*RNP AProaCH. A RNP approach defined in the ICAO Performance Based Navigation (PBN) Manual. An approach equivalent to the RNAV (GNSS) one*" RNP-APCH is not equivalent to RNAV (GNSS). Monitoring and Alert are different.	Noted The Agency is aware of the chart naming convention issues and this is currently under review by the appropriate ICAO panels. Once this has been accepted and published by ICAO the Agency will amend the documentation accordingly.

EUROCOPTER	§ 6.3.2 (Page 70): "*FTE should be contained within the following criteria:* *· Lateral guidance from 1 000 ft HAT to DA(H) should be stable within 1/3 FSD where FS is defined as a 2 degree wedge with the origin located 305 m past the MAWP."* FS is not defined; please add its definition in Appendix 1. We guess it means Full Scale. If yes, this definition of the Full Scale is not coherent at all with the full scale defined in the FAS datablock. The MAWP, defined in the procedure, is independent from the FPAP, defined in the FAS. Please correct this definition to have the same definition as in the FAS.	Partially accepted The Agency concurs with the comment pertaining to the FSD definition. On further review of the text and in particular with respect to stability during the approach paragraph 6.3.2 and paragraph 8.5 have been rationalised.
EUROCOPTER	§ 6.5 (Page 71): "*Loss of the system that provides LPV approach capability is considered a major failure condition. For LPV approach operation at least one system is required*". This failure classification is not in line with the AC 20-138B. In the AC 20-138B, only the loss of GNSS is classified major (one can loss LPV capability but still have GNSS capability). And the loss of GNSS is classified as minor if other applicable navigation systems are installed in the aircraft. Please correct it as *'Loss of the system that provides the LPV approach capability is considered minor.*" in order to	Not accepted. Based on comment 137 the CRD, the hazard classification was reassessed by the Agency and this result the change to the major hazard classification as shown in the resulting text. EASA consider that approaches to LNAV/VNAV minima different to those to LPV minima and as such consider the hazard classification is appropriate to this type of operation.

	ensure coherency with AC 20-138B.	
EUROCOPTER	§ 7 (Page 72): "*If the installed system (e.g. RNAV system) is also able to fly the initial, intermediate and missed approach segments of the approach it must be approved in accordance with the corresponding requirement (e.g. AMC 2027 RNP APCH)".* The AMC 20-27 RNP APCH is for RNP and not for RNAV. The accuracy requirements of AMC 20-27 are stricter (limit on the TSE) than the ones of AMC 20-28 (limits on the NSE and separately on the FTE). Change the reference to P-RNAV / TGL 10 or equivalent.	Noted. Reference to AMC 20-27 is an example of the approval to the other navigation specification that could be applicable depending upon the operation to be undertaken. However to avoid additional confusion the reference to AMC 20-27 has been deleted.
EUROCOPTER	§ 7.1 -Item 3 (Page 73): *"Capability to continuously display the distance to the Landing Threshold Point/Fictitious Threshold Point (LTP/FTP) from passing the Final Approach Point in the primary field of view.* *Note: The display may be located in the normal field of view subject to Agency agreement."* Displaying the distance to the LTP/FTP to the crew does not add any value for them as the LTP/FTP is not on the paper chart and not part of the approach procedure. So that neither the crew nor the ATC knows to which position this distance could correspond. LTP/FTP sometimes coincides with the MAWP but they are 2 separated points. Typically, at	Partially accepted, With regards to the reaction on the use of stepdown fixes. It should be recognised that this AMC is only applicable to approach to LPV minima from the FAF to the LTP/FTP or MAPT as applicable, which is normally the next waypoint after the FAF. For clarity MAPT has been added to the text.

	the first LPV published in Europe at LFBP, the coordinates of the MAWP are not equal to the ones of the LTP/FTP. From a pilot point of view, only the MAPT is relevant for the approach, as there is absolutely no action attached to overflying the LTP/FTP. It is much better from passing the FAP to indicate the distance to the MAPT so that the crew can estimate roughly where they are. Proposed text: "*Capability to continuously display the distance to the active waypoint of the procedure.*" If the Agency has concerns about approaches with waypoints between FAP and MAP (added by the database provider), then please add a note in the appendix 3 §1.1 or §1.2, stating that crew shall check that no step down fixes are between FAF and MAP.	
EUROCOPTER	Appendix 3 § 1.1 c) (Page 85): "*The Flight Crew should ensure sufficient means are available to navigate and land at the destination or at an alternate aerodrome in the case of loss of LPV airborne capability. In particular, the Flight Crew should check that:* *. at least one non RNAV GNSS based procedure is available at the destination* *. a non RNAV GNSS based procedure is available at the alternate (where a destination alternate is required)* A non RNAV GNSS procedure at destination is not necessary when an alternate is available. Moreover,	Partially Accepted. The text has been revised to reflect the intent of the comment.

	developing a non RNAV procedure at destination is not always possible. We propose to precise that a non RNAV procedure is required only when no alternate available; i.e; ". *at least one non RNAV GNSS based procedure is available at the destination (when no alternate available*)". Also, requiring a non RNAV GNSS procedure at the alternate forbids de facto certification of GNSS as sole mean of navigation and is not in line with the AC90-107, thus leading to less interoperability between FAA and EASA.	
EUROCOPTER	Appendix 3 § 1.1 -e) (Page 86): *"If the missed approach procedure is based on RNAV (no conventional or dead reckoning missed approach available) the appropriate airborne equipment required to fly this procedure must be available and serviceable on board the aircraft (e.g. RNP APCH capable system)".* The reference to RNP APCH capable system to fly the RNAV missed approach is a bit excessive; consider replacing it or adding with P-RNAV TGL10 or equivalent.	Noted. Reference to RNP-APCH capable system is an example of another navigation specification which could be applicable depending upon the operation to be undertaken. However to avoid additional confusion the reference to RNP-APCH capable system has been deleted.
EUROCOPTER	§ 7.1 Item 8 (Page 74): We think it would be relevant to keep as a note the deleted text referring to the VTF function because this function is clearly mentioned in DO229-D.	Accepted Text amended to introduce the note as proposed.
EUROCOPTER	§ 10.4.1 (Page 79): EU-OPS 1 being specific to aeroplanes it should be checked that EU-OPS 1.873 is also pertinent for helicopters; otherwise an	Partially accepted Text has amended to account for applicable

	adequate reference for helicopters should be added.	operational regulations.
EUROCONTROL CND	Appendix 3 Section 1.1 Point c) It should not be necessary to have a non RNAV GNSS based procedure available at the destination aerodrome. One reason for implementing RNP approaches is to allow removal of conventional NPA procedures and consequently removal of conventional navaids such as NDB. We suggest that only the second bullet is needed. It doesn't even need to be a bullet anymore. This is already more conservative than the FAA who allow a GNSS approach to LNAV minima at the alternate. The text of the second sentence should then read - In particular, the flight crew should check that a non RNAV GNSS based procedure is available at the alternate (where a destination alternate is required).	Partially accepted. The text has been revised to reflect the intent of the comment.