



SAM/IG/4  
WP/11  
12/10/09

**International Civil Aviation Organization  
South American Regional Office**

**FOURTH WORKSHOP/MEETING OF THE SAM IMPLEMENTATION GROUP (SAM/IG/4)  
REGIONAL PROJECT RLA/06/901**

**Lima, Peru, 19 to 23 October 2009**

**Agenda Item 4: Standards and procedures for performance-based navigation operations approval**

**Progress of work made in the framework of Project RLA/99/901 related to the performance based navigation**

(Presented by SRVSOP)

**Summary**

This working paper presents the proposed Advisory Circulars (AC) related to the approval of aircrafts and operators for RNAV 10 (designated and authorized as RNP 10), RNAV 1 and RNAV 2, and basic RNP 1. It also presents the first revision to the AC: RNAV 5, RNP APCH, RNP AR APCH and APV/baro-VNAV, to incorporate the changes proposed in the SAM/IG/2 and SAM/IG/3 Meetings, respectively.

**References:**

- Regional Project RLA/99/901
- SAM/IG/2 and SAM/IG/3 Report

**1 Background**

1.1 In the Second Workshop/Meeting of the SAM Implementation Group (SAM/IG/2) (Lima, Peru, 3 to 7 November 2008), the Meeting took note on the job program for the development of PBN Advisory Circulars (AC) and on the content of the AC 91-002 related to aircrafts and operators approval for RNAV 5 operations.

1.2 About this matter, the Meeting considered that the work program and guide material presented by the Technical Committee (TC) of the Regional Safety Oversight Cooperation System of Latin America, were adequate to regional requirements, and consequently their contents were approved.

1.3 In the Third Workshop/Meeting of the SAM Implementation Group (SAM/IG/3) (Lima, Peru, 20 to 24 April 2009), the meeting was informed about the development of the ACs regarding the approval of aircraft and operators for RNP APCH, RNP AR APCH and APV/baro-VNAV operations. In this regard, the Meeting agreed the approval with minor modifications.

## **2 Discussion**

2.1 Continuing the job program for the implementation of PBN, the CT of SRVSOP has developed the following ACs for SAM/IG/4:

- ✓ AC 91-001 – Aircraft and operators approval for RNAV 10 operations (designated and authorized as RNP 10);
- ✓ AC 91-003 - Aircraft and operators approval for RNAV 1 and RNAV 2 operations; and
- ✓ AC 91-006 – Aircraft and operators approval for basic RNP 1 operations.

2.2 *The AC 91-001 - Aircraft and operators approval for RNAV 10 operations (designated and authorized as RNP 10),* establishes the RNP 10 approval criteria for aircraft and operations in oceanic or remote airspace. This AC is entitled RNAV 10 in order to be consistent with the criteria set forth in ICAO Doc 9613 – *Performance-based navigation (PBN) manual*. This new designation and version of this document does not change any requirement nor does it affect operators that have already obtained an RNP 10 approval by the Civil Aviation Authority (CAA). RNP 10 operations in oceanic or remote areas with no ground-based navigation aids, except for isolated areas, require aircraft navigation to be based on long-range navigation capability with inertial navigation and/or global positioning systems.

2.3 *The AC 91-003 - Aircraft and operators approval for RNAV 1 and RNAV 2 operations,* provides the RNAV 1 and RNAV 2 approval criteria for aircraft and operations en-route and in terminal area. The guidance material of this AC harmonizes the European and the United States RNAV criteria within a single navigation specification designated as RNAV 1 and RNAV 2 in accordance with ICAO Doc 9613. The navigation specification RNAV 1 and RNAV 2 applies to all ATS routes, including those established in the en-route domain; to standard instrument departures and arrivals (SID / STAR) and to instrument approach procedures up to the final approach fix (FAF)/final approach point (FAP). The criteria for final approach from the FAF to the runway threshold, together with the associated missed approach maneuver, are not considered in the AC 91-003 and will be object of another AC.

2.4 *The AC 91-006 - Aircraft and operators for basic RNP 1 operations,* provides the basic RNP 1 approval criteria for aircraft and operations in terminal area. This navigation specification is used in standard instrument departures and arrivals (SID / STAR) and in approaches up to the final approach fix (FAF) /final approach point (FAP) with no or limited ATS surveillance and with low to medium density traffic. With the use of this navigation specification, it is planned to perform similar operations to RNAV 1 and RNAV 2, but outside radar coverage.

2.5 The implementation in the SAM Region of RNAV 10 (designated and authorized as RNP 10), RNAV 1 and RNAV 2 and Basic-RNP 1, requires the participation of all States and the need to harmonize the requirements and procedures of this type of operations.

2.6 Before authorizing the RNAV 10 (designated and authorized as RNP 10), RNAV 1 and RNAV 2 and Basic-RNP 1, the States should include in their national regulations the requirements for these navigation specifications and develop procedures related to the aircrafts and operators approval .

2.7 Taking into account that ACs for RNAV 5, RNP APCH, RNP AR APCH and APV/baro-VNAV were reviewed by the TC of SRVSOP to incorporate the changes agreed at the SAM/IG/2 and SAM/IG/3 Meetings, respectively, these documents are presented again along with their Job Aids and the ACs related to RNAV 10 (designated and authorized as RNP 10), RNAV 1 and RNAV 2 and basic RNP1 operations, for Meeting's consideration in the following appendices:

- ✓ Appendix A-1: AC 91-001 – Aircraft and operators approval for RNAV 10 operations (designated and authorized as RNP 10)
- ✓ Appendix A-2: RNAV 10 Job Aid
- ✓ Appendix B-1: AC 91-002 - Aircraft and operators approval for RNAV 5 operations
- ✓ Appendix B-2: RNAV 5 Job Aid
- ✓ Appendix C-1: AC 91-003 - Aircraft and operators approval for RNAV 1 and RNAV 2 operations
- ✓ Appendix C-2: RNAV 1 and RNAV 2 Job Aid
- ✓ Appendix D-1: AC 91-006 – Aircraft and operators approval for Basic-RNP 1 operations
- ✓ Appendix D-2: Basic-RNP 1 Job Aid
- ✓ Appendix E-1: AC 91-008 - Aircraft and operators approval for RNP APCH operations
- ✓ Appendix E-2: RNP APCH Job Aid
- ✓ Appendix F-1: AC 91-009 - Aircraft and operators approval for RNP AR APCH operations
- ✓ Appendix F-2: RNP AR APCH Job Aid
- ✓ Appendix G-1: AC 91-010 - Aircraft and operators approval for APV/baro-VNAV operations
- ✓ Appendix G-2: APV/baro-VNAV Job Aid

### 3. **Suggested Action:**

3.1 The Meeting is invited to:

- a) Take note of the information provided in this Working Paper and appendices; and
- b) Review and make the amendments deemed appropriate to the Advisory Circulars and adopt them as guide documents in the region.

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## **APPENDIX A-1**

### **ADVISORY CIRCULAR**

AC	:	91-001
DATE	:	12/10/09
VERSION	:	Original
ISSUED BY	:	SRVSOP

**SUBJECT: AIRCRAFT AND OPERATORS APPROVAL FOR RNAV 10 OPERATIONS  
(DESIGNATED AND AUTHORIZED AS RNP 10)**

## ADVISORY CIRCULAR

AC : 91-001  
DATE : 12/10/09  
VERSION : Original  
ISSUED BY : SRVSOP

### **SUBJECT: AIRCRAFT AND OPERATORS APPROVAL FOR RNAV 10 OPERATIONS (DESIGNATED AND AUTHORIZED AS RNP 10)**

#### **1. PURPOSE**

This advisory circular (AC) establishes RNP 10 approval requirements for aircraft and operations in oceanic or remote airspace.

An operator may use alternate means of compliance, as far as those means are acceptable for the respective Civil Aviation Authority (CAA).

The future tense of the verb or the term "shall" apply to operators who choose to meet the criteria set forth in this AC.

#### **2. RELEVANT SECTIONS OF THE LATIN AMERICAN AERONAUTICAL REGULATIONS (LAR) OR EQUIVALENT**

LAR 91: Sections 91.1015 and 91.1640 or equivalent

LAR 121: Section 121.995 (b) or equivalent

LAR 135: Section 135.565 (c) or equivalent

#### **3. RELATED DOCUMENTS**

Annex 2	Rules of the Air
Annex 6	Operation of aircraft
ICAO Doc 9613	Performance-based Navigation (PBN) manual
ICAO Doc 4444	Procedures for air navigation services – Air traffic management
ICAO Doc 7030	Regional Supplementary Procedures
ICAO Doc 8168	Aircraft operations
	Volume II – Parts I and II – General criteria
FAA Order 8400.12A	Required navigation performance 10 (RNP 10) operational approval
EASA AMC 20-12	Recognition of FAA Order 8400.12A for RNP-10 operations
España DGAC CO 01/01	Aprobación operacional y criterios de utilización de sistemas para la navegación en espacio aéreo designado RNP-10
Australia CAAP RNP 10-1	Required navigation performance 10 operational approval

## 4. DEFINITIONS AND ABBREVIATIONS

### 4.1 Definitions

- a) **Aircraft-based augmentation system (ABAS).**- An augmentation system that augments and/or integrates the information obtained from other GNSS elements with information available on board the aircraft.
- b) **Area Navigation (RNAV).**- A navigation method that allows aircraft to operate on any desired flight path within the coverage of ground- or space-based navigation aids, or within the limits of the capability of self-contained aids, or a combination of these.

Note.- Area navigation includes performance-based navigation as well as other RNAV operations that do not meet the definition of performance-based navigation.

- c) **Area Navigation (RNAV) Specification.**- Area navigation specification that does not include the on-board performance control and alerting requirement, designated by the prefix RNAV; e.g., RNAV 5, RNAV 2, RNAV 1.

**Note 1.-** The Manual on Performance-based Navigation (PBN) (Doc 9613), Volume II, contains detailed guidelines on navigation specifications.

**Note 2.-** The term RNP, formerly defined as “a statement of the navigation performance necessary for operation within a defined airspace”, has been deleted from the Annexes to the Convention on International Civil Aviation because the RNP concept has been replaced by the PBN concept. In said Annexes, the term RNP is now only used within the context of the navigation specifications that require on-board performance control and alerting; e.g., RNP 4 refers to the aircraft and the operational requirements, including a lateral performance of 4 NM, with the requirement for on-board performance control and alerting as described in the PBN Manual (Doc 9613).

- d) **Display errors (screen protection system error).**- These errors may include error components contributed by any input, output or signal conversion equipment used by the display as it presents either aircraft position or guidance commands (e.g. course deviation or command heading) and by any course definition entry device employed. For systems in which charts are incorporated as integral parts of the display, the display system error necessarily includes charting errors to the extent that they actually result in errors in controlling the position of the aircraft relative to a desired path over the ground.

To be consistent, in the case of symbolic displays not employing integral charts, any errors in way-point definition, directly attributable to errors in the reference chart used in determining way-point positions, should be included as a component of this error. This type of error is virtually impossible to handle, and in general practice, highly accurate, published way-point locations are used to the greatest extent possible in setting up such systems to avoid such errors and reduce workload.

- e) **Fault detection and exclusion (FDE).**- Is a function performed by some on board GNSS receivers, which can detect the presence of a faulty satellite signal and automatically exclude it from the position calculation. In addition to the total number of satellites needed for receiver autonomous integrity monitoring (RAIM), at least one more available satellite is required (6 satellites).
- f) **Flight Management System (FMS).**- An integrated system, consisting of an airborne sensor, a receiver and a computer containing both navigation and aircraft performance databases, capable of providing RNAV performance and guidance values to a display and automatic flight control system.

- g) **Flight Technical Error (FTE).**- The FTE is the accuracy with which an aircraft is controlled as measured by the indicated aircraft position, with respect to the indicated command or desired position. It does not include blunder errors.

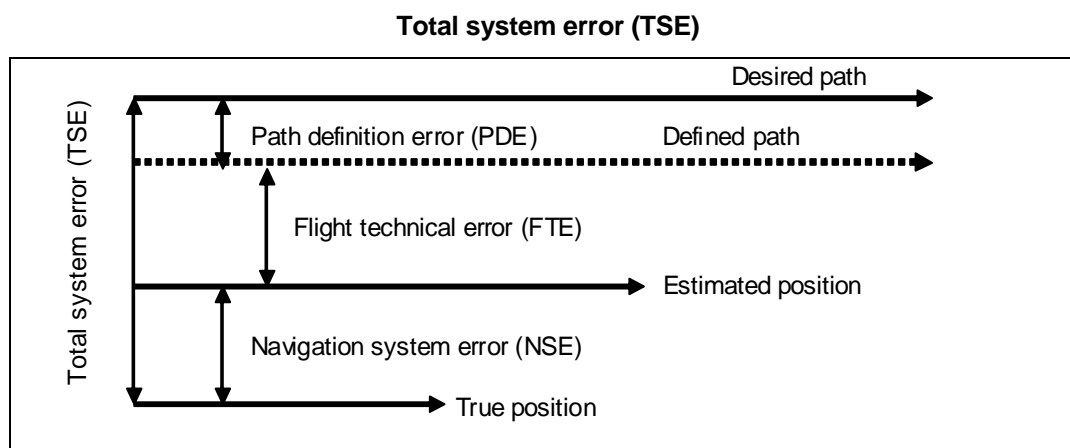
*Note.- For aircraft that are not capable of autopilot or-flight director coupling, an FTE of 3.7 km (2 NM) for-oceanic operations must be taken into account in-determining any limitations.*

- h) **Global Navigation Satellite System (GNSS).**- A generic term used by ICAO to define any global position, speed, and time determination system that includes one or more main satellite constellations, such as GPS and the global navigation satellite system (GLONASS), aircraft receivers and several integrity monitoring systems, including aircraft-based augmentation systems (ABAS), satellite-based augmentation systems (SBAS), such as the wide area augmentation systems (WAAS), and ground-based augmentation systems (GBAS), such as the local area augmentation system (LAAS).

Distance information will be provided, at least in the immediate future, by GPS and GLONASS.

- i) **Global Positioning System (GPS).**- The United States global navigation satellite system (GNSS) is a satellite-based radio navigation system that uses precise distance measurements to determine position, speed, and time anywhere in the world. The GPS is made up by three elements: the spatial, control, and user elements. The GPS space segment is nominally made up by, at least, 24 satellites in 6 orbital planes. The control element consists of 5 monitoring stations, 3 ground antennas, and one main control station. The user element consists of antennas and receivers that provide the user with position, speed, and precise time.
- j) **Navigation System Error (NSE).**- The difference between true position and estimated position.
- k) **Navigation Specifications.**- Set of aircraft and flight crew requirements needed to support performance-based navigation operations in a defined airspace. There are two kinds of navigation specifications:
- l) **Oceanic Airspace.**- The airspace over the oceanic area is considered international airspace in which ICAO procedures and separations apply. The responsibility for providing air traffic services in this airspace is delegated to those States with the greatest geographic proximity and/or that have more resources available.
- m) **Path definition error (PDE).**- The difference between the defined path and the desired path in a given place and time.
- n) **Performance-based Navigation (PBN).**- Performance-based navigation specifies system performance requirements for aircraft operating along an ATS route, on an instrument approach procedure, or in a designated airspace.
- Performance requirements are defined in terms of the precision, integrity, continuity, availability, and functionality necessary to perform the proposed operation within the context of a particular airspace concept.
- o) **Primary Means of Navigation.**- A navigation system approved for a given operation or flight phase, that must meet precision and integrity requirements but not full availability and continuity of service. Safety is guaranteed by limiting flights to specific time periods and through the establishment of timely restrictive procedures.
- p) **Receiver Autonomous Integrity Monitoring (RAIM).**- A technique used in a GNSS receiver/processor to determine the integrity of its navigation signals, using only GPS signals or GPS signals enhanced with barometric upper-air data. This determination is achieved by a consistency check between pseudo-range measurements. At least one additional available satellite is required with respect to the number of satellites that are needed to obtain the navigation solution.

- q) **Required Navigation Performance (RNP) Specification.-** Area navigation (RNAV) specification that includes the on-board performance control and alerting requirement, designated by the prefix RNP; e.g., RNP 4, RNP APCH, RNP AR APCH.
- r) **RNAV Operations.-** Aircraft operations that use area navigation for RNAV applications. RNAV operations include the use of area navigation for operations that are not performed in keeping with the PBN manual.
- s) **RNAV System.-** An area navigation system which permits aircraft operation on any desired flight path within the coverage of ground- or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these. An RNAV system may be included as part of a Flight Management System (FMS)
- t) **Single means of navigation.-** A navigation system approved for a given operation or flight phase, and that allows the aircraft to meet the four navigation criteria: precision, integrity, availability, and continuity of service.
- u) **Stand-alone Global Positioning System (Stand-alone GPS).-** A GPS that is not connected to, or combined with, any other navigation system or sensor.
- v) **Supplementary means of navigation.-** A navigation system that must be used together with a system considered to be a single means of navigation, and that must meet precision and integrity requirements but not availability and continuity conditions.
- w) **Total System Error (TSE).-** Is the difference between the true position and the desired position. This error is equal to the vector sum of path definition error (PDE), flight technical error (FTE) and navigation system error (NSE).





**4.2 Abbreviations**

a)	CAA	Civil Aviation Administration/Civil Aviation Authority
b)	AC	Advisory circular (FAA)
c)	ACAS/TCAS	Airborne collision avoidance system
d)	AF	Flight manual
e)	AFM	Airplane flight manual
f)	AIP	Aeronautical information publication
g)	AP	Autopilot
h)	AIM	Aeronautical information manual
i)	AMC	Acceptable means of compliance
j)	ATC	Air traffic control
k)	ATS	Air traffic services
l)	BRG/DIS	Bearing/distance
m)	CA/AC	<i>Circular de asesamiento</i> – SRVSOP in spanish/Advisory circular
n)	DME	Distance measuring equipment
o)	DV	Flight dispatcher (spanish abbreviation)
p)	EASA	European Aviation Safety Agency
q)	EUR	ICAO European Region
r)	FAA	United States Federal Aviation Administration
s)	FD	Flight director
t)	FDE	Fault detection and exclusion
u)	FIR	Flight Information Region
v)	FL	Flight level
w)	FMS	Flight management system
x)	FTE	Flight technical error
y)	GBAS	Ground-based augmentation system
z)	GNSS	Global navigation satellite system
aa)	GLONASS	Global navigation satellite system
bb)	GPS	Global positioning system
cc)	INS	Inertial navigation system
dd)	IRS	Inertial reference system
ee)	IRU	Inertial reference unit

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ff)		
gg)	LAAS	Local area augmentation system
hh)	LAR	Latin American Regulations
ii)	LAT/LONG	Latitude/longitude
jj)	LNAV	Lateral navigation
kk)	LOA	Letter of authorisation/letter of acceptance
ll)	LRNS	Long-range navigation system
mm)	MEL	Minimum equipment list
nn)	NAV	Navigation
oo)	NAVAIDS	Navigation aids
pp)	NDB	Non-directional radio beacon
qq)	NM	Nautical mile
rr)	NSE	Navigation system error
ss)	ICAO	International Civil Aviation Organization
tt)	OM	Operations manual
uu)	OpSpecs	Operations specifications
vv)	PANS-OPS	Procedures for Air Navigation Services - Aircraft Operations
ww)	PBN	Performance-based navigation
xx)	PDE	Path definition error
yy)	POH	Pilot operating handbook
zz)	POI	Principal operations inspector
aaa)	RAIM	Receiver autonomous integrity monitoring
bbb)	RNAV	Area navigation
ccc)	RNP	Required navigation performance
ddd)	RNP APCH	Required navigation performance approach
eee)	RNP AR APCH	Required navigation performance authorisation required approach
fff)	SAM	ICAO South American Region
ggg)	SAT	South Atlantic
hhh)	SATMA	South Atlantic Monitoring Agency
iii)	SBAS	Satellite-based augmentation system
jjj)	SLOP	Strategic lateral offset procedure
kkk)	SRVSOP	Regional safety oversight cooperation system
lll)	SSR	Secondary surveillance radar
mmm)	STC	Supplementary type certificate
nnn)	TC	Type certificate

ooo)	TSE	Total system error
ppp)	TSO	Technical standard order
qqq)	UIR	Upper flight information region
rrr)	VMC	Visual meteorological conditions
sss)	VOR	Very high frequency omnidirectional radio range
ttt)	WAAS	Wide area augmentation system
uuu)	WATRS	West Atlantic route system
vvv)	WGS	World geodetic system
www)	WPT	Waypoint

## 5. INTRODUCTION

5.1 This AC is entitled RNAV 10 in order to be consistent with the criteria set forth in ICAO Doc 9613 – *Performance-based navigation (PBN) manual*. This new designation and version of this document does not change any requirement nor does it affect operators that have already obtained an RNP 10 approval by the Civil Aviation Authority (CAA).

5.2 The RNAV 10 navigation specification does not require on-board performance monitoring and alerting. However, the designation for airworthiness and operational approvals, as well as airspace and route designations will remain as RNP 10, in order to exempt this publication and the approvals on this matter from complying with the new RNAV 10 designation.

5.3 Recognising that there are airspaces, routes, and airworthiness and operational approvals designated as RNP 10, it is expected that the new denominations of airspace, routes, and aircraft and operator approvals will continue to use such term (RNP 10), while the PBN application will be known as RNAV 10.

5.4 This AC provides orientation and guidance on aspects related to airworthiness and operational approvals. These approvals will allow an operator to obtain a RNP 10 authorisation to operate in oceanic or remote airspaces. Furthermore, this document provides criteria for operators to extend any navigation time limit associated with the RNP 10 approval.

5.5 The implementation of the 50-NM lateral and longitudinal separation minima for oceanic or remote RNP 10 airspaces will result in benefits for the operators in terms of having a greater number of optimum routes, reduced delays, increased flexibility, and cost reduction, without reducing safety. ATS providers will obtain benefits from the efficient use of airspace and increased air traffic flow.

5.6 RNP 10 operations in oceanic or remote areas with no ground-based navigation aids, except for isolated areas, require aircraft navigation to be based on long-range navigation capability with inertial navigation and/or global positioning systems.

5.7 The material described in this AC has been developed base on the following document:

- ✓ ICAO Doc 9613, Volume II, Part B, Chapter 1 – Implementing RNAV 10 (designated and authorized as RNP 10).

5.8 This AC has been harmonised with the following documents:

- ✓ FAA Order 8400.12A - Required navigation performance 10 (RNP 10) operational approval.
- ✓ EASA AMC 20-12 - Recognition of FAA Order 8400.12A for RNP-10 operations
- ✓ España DGAC Circular Operativa 01/01 – Aprobación operacional y criterios de utilización de sistemas para la navegación en espacio aéreo designado RNP-10

## **6. GENERAL INFORMATION**

### **6.1 Navigation aid infrastructure**

- a) RNP 10 was developed for operations in oceanic and remote areas and does not require any ground-based navigation infrastructure or assessment.

### **6.2 ATS communications and surveillance**

- a) This AC does not address communication or air traffic services (ATS) surveillance requirements that may be specified for operation on a particular route or area. These requirements are specified in other documents, such as the aeronautical information publications (AIP) and ICAO Regional Supplementary Procedures (Doc 7030). Operators and flight crews shall take into account all the operational documents related to RNP 10 airspace required by the CAA before conducting flights in said airspace.

### **6.3 Obstacle clearance and route spacing**

- a) Doc 8168 (PANS OPS), Volume II – Procedures for Air Navigation Services: Aircraft Operations provides detailed guidance on obstacle clearance. The general criteria in Parts I and III shall be applied.
- b) The rationale for having chosen the RNP 10 value was to support reduced lateral and longitudinal separation minima for application in oceanic and remote areas where the availability of navigation aids, communication, and surveillance is limited.
- c) The minimum route spacing where RNP 10 is utilized is 50 NM.

### **6.4 Publications**

- a) The AIP should clearly indicate that the navigation application is RNP 10, where reference is to existing routes. The route should identify the minimum segments altitude requirements.
- b) The navigation data published in the AIP for routes and navigation aids must meet the requirements established in Annex 15 – Aeronautical Information Services. All routes must be based on the coordinates of the world geodetic system (WGS-84).

## **7. AIRWORTHINESS AND OPERATIONAL APPROVAL**

7.1 To obtain RNP 10 authorisation, a commercial air transport operator must comply with two types of approvals:

- a) the airworthiness approval granted by the State of registry (see Article 31 of the Chicago Convention and Paragraphs 5.2.3 and 8.1.1 of Annex 6 Part I); and
- b) the operational approval, granted by the State of the operator (See Paragraph 4.2.1 and Attachment F to Annex 6 Part I).

7.2 For general aviation operators, the State of registry will determine whether or not the aircraft meets the applicable RNP 10 requirements and will issue the operation authorisation (e.g., a letter of authorisation– LOA) (see Paragraph 2.5.2.2 of Annex 6 Part II).

7.3 Before submitting the application, operators shall review all aircraft qualification requirements. Compliance with airworthiness requirements or the installation of the equipment alone does not constitute operational approval.

## 8. AIRWORTHINESS APPROVAL

### 8.1 Aircraft requirements

8.1.1 **Navigation systems.-** The RNP 10 navigation specification requires that aircraft operating in oceanic and remote areas be equipped with at least *two independent and servicable long range navigation systems (LRNS)*, comprising an inertial navigation system (INS), an inertial reference system/flight management system (IRS/FMS), or a global navigation satellite system (GNSS) (e.g., the global positioning system (GPS)), with an integrity such that the navigation system does not provide an unacceptable probability of misleading information.

### 8.1.2 System performance, monitoring and alerting

- a) **Accuracy.-** During operations in airspace or on routes designates as RNP 10, the lateral total system error must not exceed  $\pm 10$  NM for at least 95% of the total flight time. This includes positioning error, flight technical error (FTE), path definition error and display error.

The along-track error must also not exceed  $\pm 10$  NM for at least 95% of the total flight time.

**Note 1.-** For RNP 10 operational approval of aircraft capable of coupling the RNAV system to the flight director (FD) or autopilot (AP), the navigation position error is the main contributing factor to transverse and longitudinal error. FTE, the path definition error, and display errors are considered insignificant for purposes of RNP 10 approval.

**Nota 2.-** When data collection method described en Appendix 1 of FAA Order 8400.12A is used as the basis for an RNP 10 operations approval, these error types are included in the analysis. However, when the data collection method described in Appendix 6 of FAA Order 840012.A is used, these errors are not included since that method is more consevative. The Appendix 6 nethod uses radial error instead of cross-track and along-track error.

- b) **Integrity.-** Malfunctioning of the aircraft navigation equipment is classified as a major failure condition according to airworthiness regulations (e.g.,  $10^{-5}$  per hour).
- c) **Continuity.-** The loss of this function is classified as a major failure condition for oceanic and remote navigation. The continuity requirement is met by carrying two independent LRNS systems on board (excluding signal-in-space).
- d) **Signal-in-space.-** If GNSS is used, the aircraft navigation equipment must provide an alert if the probability of signal-in-space errors cause a lateral position error greater than 20 NM to exceed  $10^{-7}$  per hour (Annex 10, Volume I, Table 3.7.2.4.1).

### 8.2 Aircraft groups (aircraft fleets)

8.2.1 **Aircraft group.-** For an aircraft to be considered part of a group for purposes of RNP 10 airworthiness approval, it must meet the following conditions:

- a) the aircraft must have been built following a nominally identical design and must have been approved for the same type certificate (TC), an amendment to a TC, or a supplemental type certificate (STC), as applicable;

**Note.-** For derivative aircraft, data from the original configuration could be used to minimise the amount of additional information needed to indicate conformity. The extent of the additional information needed will depend on the category of the differences between the original aircraft and the derivative one, when an INS/IRU is used to meet RNP 10 requirements.

- b) For the navigation system installed in each aircraft to meet the minimum RNP 10 airworthiness approval, it must have been built with the same manufacturer specifications and have the same part numbers.

- c)
- d) When approval is requested for a group of aircraft, the data package must contain the following information:
- 1) a list of the group of aircraft to which the information package applies;
  - 2) a list of the routes to be operated and the maximum estimated navigation time in navigation from alignment to the time in which the flight will leave Class II navigation airspace;
  - 3) the compliance procedures to be used to ensure that all aircraft sent for approval meet RNP 10 navigation capabilities for the RNP 10 approved time duration; and
  - 4) the engineering data to be used in order to ensure continuity of RNP 10 service for the RNP 10 approved time duration.

*Note.- Aircraft with INS/IRU systems from different manufacturers or with different part numbers may be considered part of the group if it is demonstrated that the navigation equipment provides an equivalent navigation performance.*

**8.2.2 Non-group aircraft.-** Aircraft for which an approval is requested based on the unique characteristics of the navigation system and structure to be used instead of the characteristics common to the group aircraft.

*Note.- The information gathered by one or more operators in accordance with Appendix 6 to FAA Order 8400.12A can be used as the basis for the approval of another operator and may reduce the number of tests required for approval. Appendix 6 to FAA Order 8400.12A contains an example of the data collection procedure and samples of the forms to be used for collecting such information.*

### **8.3 Determining aircraft eligibility for RNP 10 operations**

#### **8.3.1 Aircraft eligibility**

Many of the aircraft and navigation systems currently used for oceanic and remote operations are eligible for RNP 10 operations, based on one or more of the provisions included in the current certification criteria. Therefore, an additional aircraft certification may not be needed for most RNP 10 operational approvals. In these cases, a new aircraft certification will only be needed if the applicant chooses to request additional performance, beyond the original certification or the certification declared in the aircraft flight manual (AFM), and when the desired performance cannot be shown through data collection methods. The following three methods for determining aircraft eligibility have been defined:

**a) Method 1 – Aircraft eligibility through RNP certification (aircraft with RNP airworthiness declaration in the AFM)**

- 1) This method can be used to approve aircraft that have officially been certified and approved for RNP operations.
- 2) RNP Compliance (conformity or capability) will be documented in the AFM or in its approved supplement and normally is not limited to RNP 10. The AFM will indicate the RNP levels that have been demonstrated and any related provision applicable to their use (for example, navaid sensor requirements). Operational approval of these aircraft will be based on the performance declared in the AFM.
- 3) An airworthiness approval that specifically indicates RNP 10 performance can be obtained. The following wording can be used in the AFM, when RNP 10 approval is granted by the CAA aircraft certification office for a modification to the INS/IRU certified performance:

“It has been shown that the XXXX navigation system meets the criteria set forth in (State document or guidelines) as primary means of navigation for flights up to XXXX hours with no update. Determination of the duration of the flight begins when the system is set on navigation mode. For flights that include on-board navigation position update, the operator must address the effect that such update has on the precision of the position and of any time limit associated with RNP operations, relative to updates to NAVAIDS used and to the area, routes, and procedures, which shall be used for the flight. Proof of performance according to the provisions set forth in (State document or guidelines) does not entail approval for conducting RNP operations”.

**Note.-** The AFM wording described above is based on the performance approval by the CAA and is only one of the elements in the approval process. Aircraft whose AFM includes this text shall be eligible for approval through the issuance of OpSpecs or a Letter of Authorisation (LOA), provided all other criteria have been met. The XXXX hours specified in the AFM do not include updates. When the operator proposes to credit the update, the proposal must indicate the effect that the update has on the accuracy of the position and on any time limit associated to RNP operations, relative to the updates of NAVAIDS used and the area, routes, or procedures to be used for the flight.

b) **Method 2 – Aircraft eligibility through prior navigation system certification (aircraft that do not have RNP declaration in the AFM)**

Method 2 can be used to grant approval to aircraft whose level of performance, by virtue of other standards or previous standards, can be used as equivalent to the RNP 10 criteria. The standards listed in Paragraphs a) through g) can be used to classify an aircraft. Other standards can also be used if they are sufficient to ensure that the RNP 10 requirements are met. Should other standards be used, the applicant must propose acceptable means of compliance:

1) **Aircraft equipped with dual GNSS approved as a primary means of navigation in oceanic and remote areas**

- (a) aircraft approved to use GNSS as a primary means of navigation for oceanic and remote operations, in accordance with the appropriate requirements of the CAA, meet RNP 10 requirements without time limitations;
- (b) FAA AC 20-138A or equivalent documents provide an acceptable means of compliance with installation requirements for aircraft that use GNSS, but do not integrate this system with other sensors.
- (c) operators who intend to use GNSS as the only navigation system (without INS or IRS) for RNP 10 routes or airspaces must also comply with the regulations and advisory documentation related to the CAA. The applicant or operator must also comply with the specific requirements described in this AC. This includes the use of a GNSS approved as a primary means of navigation for oceanic and remote areas.
- (d) the AFM must indicate that a particular GNSS facility meets the appropriate CAA requirements. The authorised dual GNSS equipment must be installed by virtue of a technical standard order (TSO) and an approved programme for FDE availability prediction must be used. The maximum allowable time in which it is forecast that FDE capability will not be available is 34 minutes. The maximum service interruption time must be included as a condition for RNP approval.

**Note.-** If the FDE service interruption time for the expected RNP operation is expected to be exceeded, the operation must be re-scheduled for a time when FDE is available or conduct the RNP 10 operation based on an alternate means of navigation.

2) **Multi-sensor systems integrating GNSS with RAIM, FDE or equivalent system functionality**

- (a) multi-sensor systems to which GNSS is integrated with the RAIM, FDE or equivalent system, that have been approved by virtue of the guidance contained in FAA AC 20-130A or equivalent documents, meet the RNP 10 requirements without any limitations of time. In this case, INS or IRU must have been approved in accordance with LAR 121 Appendix G.

- 3) **Transport aircraft eligible for /E suffix, as defined in the United States aeronautical information manual (AIM)**
- (a) Aircraft equipped with INS or IRU, with radio navigation position update and electronic map display, that classify for /E equipment suffix as defined in the United States AIM, meet all of the RNP 10 requirements for up to 6.2 hours of flight time. Timing starts when the system is set on navigation mode or at the last point where the systems were updated. If the systems are updated en route, the RNP time limit of 6.2 hours must be adjusted after the update to account for the update precision.
- Note.- The 6.2-hour flight time is based on an inertial system with a 95% radial position error index (circular error index) of 3.7 km/h (2.0 NM/h), which is statistically equivalent to specific 95% cross-track error indices of 2,9678 km/h (1,6015 NM/h) and 95% along-track position error indices (orthogonal error indices) of 18.5 km (10 NM) each, and 95% cross-track and along-track position error limits of 18.5 km (10 NM) each (for example, 18.5 km (10NM) /2,9678 km/h (1,6015 NM/h) = 6,2 hours).*
- (b) Aircraft equipment with /E suffix is a designation used by the United States; it is not an ICAO designation and should only be used for flights in the continental United States. Only the suffix in this place is defined in order to determine the requirements to meet that stated in this paragraph.
- 4) **Aircraft equipped with INS or IRU that have been approved in accordance with LAR 121 Appendix G or equivalent documents**
- (a) inertial systems approved in accordance with LAR 121 Appendix G or equivalent documents meet the RNP 10 requirements for up to a flight time of 6.2 hours. Timing begins when the systems are set on navigation mode or at the last point where the systems were updated. If the systems are updated en route, the operator must show the impact that update accuracy has on the time limit. INS accuracy, reliability, and maintenance, as well as flight crew training required according to LAR 121 Appendix G, are applicable to the RNP 10 authorisation.
- 5) **Aircraft equipped with dual INS or IRU**
- (a) When dual INS or IRU is provided as the only long-range means of navigation, the systems must be installed in accordance with CAA standards. A basic time limit of 6.2 hours for RNP 10 is applicable after the systems are set on navigation mode (NAV). The basic time limit of 6.2 hours can be extended based on the methods described in paragraph 8.4.
- 6) **Aircraft equipped with dual INS or IRU approved for minimum navigation performance specifications (MNPS) operations or approved for RNAV operations in Australia**
- (a) aircraft equipped with dual INS or IRU that have been approved for MNPS or RNP operations in Australia meet the RNP 10 requirements up to 6.2 hours after the systems have been set on navigation mode or after an en-route update. If systems are updated en route, the operator must show the impact that accuracy has on the time limit.
- 7) **Aircraft equipped with a single INS/IRU and a single GNSS approved as primary means of navigation in oceanic and remote areas**



- (a) aircraft equipped with a single INS or IRU and a single GNSS are considered to meet RNP 10 requirements without any time limitations. INS or IRU must be approved in accordance with LAR 121 Appendix G. GNSS must be authorised in accordance with TSO-C129 and must have an approved programme for predicting fault detection and exclusion (FDE) availability. The maximum allowable time in which it is expected that FDE will not be available is 34 minutes. The maximum service interruption time must be included as a condition for RNP 10 approval. The AFM must indicate that the specific INS/GNSS facility meets the appropriate CAA requirements.
- c) **Method 3 – Eligibility of aircraft through data collection**
- 1) This method requires operators to collect data during a specified period of time in order to obtain RNP 10 approval. The data collection programme must indicate the navigation accuracy requirements appropriate for RNP 10. Data collection must ensure that applicant can prove to the CAA that the aircraft and the navigation system provide the flight crew with navigation awareness concerning the foreseen RNP 10 route. Data collection must also provide a clear understanding of navigation system status and that the indications and procedures in case of failure are consistent with the continuing required navigation performance.
  - 2) There are two data collection methods:
    - (a) **The sequential method.-** This method is a data collection programme that meets the provisions set forth in FAA Order 8400.12A Appendix 1. The sequential method allows operator to collect and plot data in “pass-fail” graphs in order to determine if the aircraft system of the operator will meet RNP 10 requirements as long as needed by the operator; and
    - (b) **The periodic method.-** This data gathering method requires a GNSS manual receiver as the basis for INS data collection, this is described in FAA Order 8400.12A Appendix 6. The collected data are immediately analysed in order to determine whether or not the system is capable of maintaining RNP 10 as long as needed by the operator.
  - 3) The operator must submit documents relevant to the chosen qualification method so that the CAA can determine if the aircraft is equipped with LRNS that meet RNP 10 requirements (for example, the AFM). The applicant must submit a configuration list with details on the relevant components and equipment to be used for long-range navigation and for RNP 10 operations, and will describe the relationships between such components and equipment. The applicant must indicate the proposed time limit for INS or IRU for RNP 10 operations, and must consider the effect of head winds on the area where RNP 10 operations will be carried out in order to determine the feasibility of the proposed operation.

#### **8.4 Obtaining approval with extended time limit for aircraft equipped with INS or IRU systems**

- a) The baseline RNP 10 time limit for aircraft equipped with INS and/or IRU systems, once the equipment is set on navigation mode, is *6.2 hours*, according to the details contained in Paragraphs 8.3.1 b), 3), 4), 5), and 6). The time limit may be extended using any of the following methods:
  - 1) an extended time limit may be established when RNP is integrated to an aircraft navigation system through the documented airworthiness statement in the AFM or its supplement, as described in Paragraph 8.3.1 a). The applicant must submit to the aircraft certification office or equivalent, aircraft certification data showing that the time limit extension for RNP 10 is justified;

- 2) when an INS or IRU has been approved using an existing approval standard, as detailed in Paragraphs 8.3.1 b), 3), 4), 5), and 6), an extended time limit can be established by an applicant who submits supporting data to the CAA aircraft certification office. Aircraft group approvals will be granted with the appropriate restrictions during aircraft certification, if the data collected show that the approval is warranted; and
- 3) an applicant may establish an extended time limit using multiple navigation sensors, by showing that the mixed or average navigation position error justifies such extension (for example, triple mixed INS). If the applicant uses a mixed time limit, then the mixed capacity availability must be operational from the take-off (flight dispatch) for flights in RNP 10 airspace or routes. If the mixed or average functionality is not available at the time of take-off, then the applicant must use a time limit that is not mixed. The extended time limit must be validated through a data collection programme and analysis as specified in the next paragraph;
- 4) when an INS or IRU has been approved using an existing approval standard, operators can establish an extended time limit by applying a data collection programme in accordance with the guidance provided in Appendixes 1 and 6 of FAA Order 8400.12A.

## **8.5 Maintenance aspects**

### **a) Minimum equipment list (MEL)**

If RNP 10 approval is granted based on a given operational procedure, (such as, credit for triple mix), operators must adjust the MEL and specify the required dispatch conditions through the CAA certification and inspection office or equivalent.

### **b) Continuing airworthiness (maintenance requirements)**

The operator must establish and implement a maintenance programme for individual navigation systems. For installed navigation systems, the operator will send the appropriate changes to its existing maintenance manual for review and acceptance.

## **8.6 Certification measures related to RNP 10**

8.6.1 The operator may choose to certify the aircraft navigation performance in accordance with a new standard in order to take advantage of aircraft functions. Credit can be given to an aircraft performance improvement by collecting operational data, in which case certification would not be necessary.

8.6.2 Guidance on the different types of navigation systems is provided in the following paragraphs. The operator will propose an acceptable means of compliance regarding any of the systems that are not indicated below.

- a) **Aircraft with INS.-** Aircraft with INS equipment certified under LAR 121 Appendix G or equivalent document, only need a new certification in the case of operators that choose to certify INS accuracy as better than a radial error of 3.7 km (2 NM) per hour. However, the following conditions must apply:
  - 1) the INS performance certification must address all matters concerning continuing required accuracy, including precision and reliability, acceptance trial procedures, maintenance procedures, and training programmes; and
  - 2) the applicant must determine the standard to be used to demonstrate INS performance. It could be a regulation (*i.e.*, LAR 121 Appendix G or equivalent document) or a specification exclusive to the industry or operator. A statement to the AFM must be added, stating the precision standard used for the certification.

- b) **Aircraft to which GNSS is added.-** Both U.S.A. FAA AC 20-138A and Australia CAAP 35-1 provide acceptable means of compliance of installation requirements for aircraft that use GNSS, but to which other sensors are not added. FAA AC 20-130A or equivalent describes the acceptable means of compliance for multi-sensor navigation systems to which GNSS is added. Operators who wish to use GNSS in their aircraft as single means of navigation (for example, without INS or IRS) along RNP 10 routes or airspace must also comply with CAA regulations and corresponding advisory documentation, except for some GNSS requirements described in this AC.

#### 8.6.3 Equipment configuration

- a) The configuration of the equipment used to show the required accuracy must be identical to the configuration specified in the MEL.
- b) The configuration of the equipment used to show the required accuracy must be consistent with RNP 10 oceanic and remote airspace. For example, the statistical benefit of estimating position using INS position data filtered with DME data will not be taken into account.
- c) The installation design must meet the design standards applicable to the aircraft being modified.

### 9. OPERATIONAL APPROVAL

Airworthiness approval alone does not authorise an applicant or operator to conduct RNP 10 operations. In addition to the airworthiness approval, the applicant or operator must obtain an operational approval to confirm the suitability of normal and contingency procedures in connection to the installation of a given piece of equipment.

Concerning commercial air transportation, the evaluation of an application for RNP 10 operational approval is done by the State of the operator, in accordance with standing operating rules (e.g., LAR 121.995 (b) and LAR 135.565 (c) or equivalent), supported by the criteria described in this AC.

For general aviation, the evaluation of an application for RNP 10 operational approval is done by the State of registry, in accordance with standing operating rules (e.g., LAR 91.1015 and LAR 91.1640 or equivalent), supported by the criteria described in this AC.

#### 9.1 Operational approval requirements

9.1.1 In order to obtain RNP 10 approval, the applicant or operator will take the following steps, taking into account the criteria established in this paragraph and in Paragraphs 10, 11, 12, and 13:

- a) *Airworthiness approval.-* aircraft must have the corresponding airworthiness approvals, pursuant to Paragraph 8 of this AC.
- b) *Application.-* The operator will submit the following documentation to the CAA:
- 1) *RNP 10 operational approval application;*
  - 2) *airworthiness documents concerning aircraft eligibility.-* Documentation showing that the equipment of the proposed aircraft meets the requirements of this AC, as described in Paragraph 8. The operator will submit relevant documentation showing that the aircraft is equipped with long-range navigation systems (LRNS) that meet RNP 10 requirements, for example those parts of the AFM or AFM supplement that contain the airworthiness statement.
  - 3) *description of aircraft equipment.-* The operator will provide a configuration list with details of the relevant components and the equipment to be used in RNP 10 operations. The list must include the manufacturer, model and version of each GNSS, INS/IRU equipment and software of the installed FMS.

- 4) *time limit for RNP 10 with INS/IRU (if applicable).*- The operator must submit documentation that justifies the proposed RNP 10 time limit in connection with the specified INS or IRU. The applicant will take into account the effect of head winds on the area where it plans to conduct RNP 10 operations in order to determine whether or not the proposed operations are viable.
- 5) *Training Programme for flight crews and flight dispatchers (DV), procedures, and operating practices*
  - (a) Commercial operators must submit the training curriculum and other appropriate material to the CAA in order to show that the operational procedures and practices and the training aspects identified in Paragraph 12, related to RNP 10 operations, have been included in the training programmes, where applicable (for example, initial, upgrade or recurrent training programmes for flight crews and flight dispatchers). The operator will develop and standardise procedures and practices according to the guidelines established in Paragraph 11, in the following areas: flight planning, aircraft pre-flight procedures for each flight, procedures before entering an RNP 10 route or airspace and in-flight, contingency, and flight crew qualification procedures.

*Note.- It is not necessary to establish a separate training programme if RNP 10 training, identified in Paragraph 12, has already been included in the operator training programme. However, it should be possible to identify what RNP 10 aspects are covered in a training programme.*
  - (b) General aviation operators must be familiar and show that they will conduct their operations applying the practices and procedures described in Paragraph 11.
- 6) *Operations manual and checklist*
  - (a) LAR 121 and 135 operators.- Commercial operators must review the operations manual (OM) and the checklists in order to include information and guidance on standard operational procedures (SOP) detailed in Paragraph 11 of this AC. The appropriate manuals must contain the operation instructions for navigation equipment and any other procedure established in order to operate in a given operations area (e.g., contingency procedures). The manuals and checklists must be submitted for review along with the formal application in Phase two of the approval process.
  - (b) LAR 91 operators.- General aviation operators must develop operating instructions for navigation equipment and contingency procedures. This information must be available to crews in the OM or in the pilot operations handbook (POH). These manuals and the manufacturer's instructions for the operation of the aircraft navigation equipment, as appropriate, must be submitted as attachments to the formal application for review of the CAA.
- 7) *Minimum equipment list (MEL).*- The operator will send any revision to the MEL that is necessary to conduct RNP 10 operations (e.g., if the approval is based on a "triple mix", the MEL must include the three navigation units that must be operational).
- 8) *Maintenance.*- All operators must establish, maintain, and submit to the CAA the maintenance programme for each navigation system. For other installations, the operator must submit any change to its maintenance manual for review and acceptance. The operator will provide a procedure to withdraw and then restore RNP 10 operational capability to an aircraft.
- 9) *Maintenance personnel training programme.*- The operators will send the corresponding maintenance staff training curricula.

- 10)
- 11) Past performance.- The application will include the operating history of the operator. The applicant will include the events or incidents in relation to navigation errors in Class II airspace, which have been corrected through changes in the training programmes, procedures, maintenance or aircraft navigation systems used.
- 12) *Navigation data validation programme.*- If a database is used, the operator will present details about the navigation data validation programme as described in Appendix 1 to this AC.
- c) *Training programme.*- Once the amendments to manuals, programmes, and documents submitted have been accepted or approved, the operator will provide the required training to its personnel.
- d) *Validation flight.*- The CAA may deem it advisable to perform a validation flight before granting the operational approval. Such validation can be performed on commercial flights. The validation flight will be carried according to the provisions of Chapter 13, Volume II, Part II of the SRVSOP Operations Inspector Manual (MIO).
- e) *Issuance of an authorisation to conduct RNP 10 operations.*- Once the operator has successfully completed the operational approval process, the CAA will grant the operator the authorisation to conduct RNP 10 operations.
  - 1) LAR 121 and/or 135 operators.- For LAR 121 and/or LAR 135 operators, the CAA will issue the corresponding operations specifications (OpSpecs) that will reflect the RNP 10 authorisation.
  - 2) LAR 91 operators.- For LAR 91 operators, the CAA will issue a letter of authorisation (LOA).

## 10. OPERATIONAL REQUIREMENTS

### 10.1 Navigation performance

- a) All aircraft must meet a lateral and longitudinal precision equal to or better than  $\pm 10$  NM for 95% of the flight time in RNP 10 airspace.

### 10.2 Navigation equipment

- a) All aircraft performing RNP 10 operations in oceanic and remote airspace must be equipped with *two LRNS*, independent and operational, made up by one INS, one IRS/FMS or one GNSS (e.g., a GPS), with such an integrity that will prevent the navigation system from providing error-inducing information.
- b) The CAA may approve the use of a single LRNS under specific circumstances (e.g., in the North Atlantic MNPS airspace).

### 10.3 Flight plan designation

- a) Operators must indicate their capability to meet RNP 10 for the route or airspace, in accordance with the *Procedures for Air Navigation Services – Rules of the Air and Air Traffic Services (PANS-RAC Doc 4444)*, Appendix 2, Box 10: equipment. The letter “R” must be inserted in Box 10 of ICAO flight plan to indicate that the pilot has:
  - 1) reviewed the foreseen flight route, including the routes to the alternate aerodrome in order to determine the types of RNP involved;
  - 2) confirmed that operator and aircraft have been approved by the CAA for RNP operations; and
  - 3) confirmed that the aircraft can operate in accordance with RNP (RNAV) requirements in the foreseen flight route, including the routes to the alternate aerodrome.

- b) Operators applying to use WATRS plus airspace will also insert the letter “Z” in Box 10 and “NAV/RNP 10” in Box 18.

#### 10.4 Availability of navigation aids (NAVAIDS)

At the time of dispatch or during flight planning, the operator must ensure NAVAIDS are available en route to enable the aircraft to navigate to RNP 10 for the duration of the planned RNP 10 operation.

#### 10.5 Evaluation of routes for RNP 10 time limits - Aircraft equipped only with INS or IRU

- a) An RNP 10 time limit must be established for aircraft equipped only with INS or IRU. When planning operations in areas where RNP 10 is applied, the operator must establish that the aircraft will comply with the time limits along the routes to be flown.
- b) When performing this evaluation, the operator must take into account the effect of headwinds and, in the case of aircraft not capable of coupling the navigation system or the FD to the AP, the operator may choose to make this evaluation each time or for every flight. During the evaluation, the operator must take into account the following items:
  - 1) **Route evaluation.-** The operator must establish that the aircraft can meet RNP time limits for dispatch or departure to RNP10 airspace.
  - 2) **Star point for calculation.-** The calculation must start when the system is set on navigation mode or at the last point where the system is expected to be updated.
  - 3) **Stop point for calculation.-** The stop point for calculation may be one of the following:
    - (a) the point where the aircraft will begin to navigate by reference to ICAO standard navigation aids (VOR, DME, non-directional beacon (NDB)) or will enter into radar surveillance of an air traffic control (ATC); or
    - (b) the first point where the system is expected to be updated.
  - 4) **Sources of wind component data**

The headwind component to be considered for the route can be obtained from any source deemed acceptable by the CAA. The following sources of wind data are deemed acceptable: the meteorological office of each State, the national weather service, an industry source, such as Boeing winds on world air routes and historical data provided by the operator.
  - 5) **One-time calculation, based on 75 per cent probability wind components**

Some sources of wind data indicate the annual probability of a given wind component occurring along the routes between pair cities. If an operator decides to make RNP 10 time limit compliance calculations every time, the operator may apply the 75% annual probability to calculate the effect of head winds (it has been shown that this level is a reasonable estimation of the intensity of wind components).
  - 6) **Calculation of the time limit for each specific flight**

The operator may decide to evaluate each specific flight, applying flight plan winds to determine whether or not an aircraft will comply with the specified time limit. If it is determined that it will exceed such time limit, the aircraft must then fly an alternate route or delay the flight until it can meet the established time limit. This evaluation is a flight planning or dispatch task.

**10.6 Effect of en-route updates (increased duration of RNP 10 navigation capability)**

- a) Operators may increase the duration of the RNP 10 navigation capability through position updating procedures. Approvals for various updating procedures are based upon the baseline for which they have been approved minus the time factors shown below:
- 1) automatic update using dual distance-measuring equipment (DME/DME) = baseline minus 0.3 hours (for example, an aircraft that has been approved for 6.2 hours can gain another 5.9 hours after an automatic DME/DME update);
  - 2) automatic update using distance-measuring equipment and very high frequency omnidirectional radio beacon (DME/VOR) = baseline minus 0.5 hours; and
  - 3) manual update using a CAA-approved method = baseline minus 1 hour. A method similar to the one shown in Appendix 7 to FAA Order 8400.12A can be used.

**10.7 Conditions under which automatic radio position update is considered acceptable for flights in RNP 10 airspace**

- a) The automatic updating is any updating procedure that does not require the flight crew to manually insert coordinates. Automatic update is considered acceptable for operations in RNP 10 airspace, provided:
- 1) automatic updating procedures are included in the training programme of the operator;
  - 2) flight crews are familiar of the update procedures and the effect of the update on the navigation solution; and
  - 3) an acceptable procedure for automatic update can be used as the basis for an RNP 10 approval with extended time, as indicated by the data submitted to the leader of the CAA team responsible for the approval or to the principal operations inspector (POI). These data must clearly indicate the accuracy of the update and the effect of the update on the navigation capabilities for the remaining flight time.

**10.8 Condition under which manual radio position update is considered acceptable for flights in RNP 10 airspace**

- a) If manual updating has not specifically been approved, manual radio position updates are not allowed for RNP 10 operations. Manual radio position updates may be considered acceptable for RNP 10 airspace operations, provided that:
- 1) the CAA examines the manual update procedures on a case by case basis. FAA Order 8400.12A Appendix 7 describes an acceptable manual update procedure and may be used as the basis for RNP 10 approval for an extended time when the update is supported by acceptable data;
  - 2) operators show that their updating procedures and training procedures include measures/crosschecking to prevent human factors errors, and the CAA determines that the flight crew qualification segment provides them with effective training; and
  - 3) operators provide data to determine the accuracy with which the aircraft navigation system can be updated using manual procedures and navigation aids. Data showing the accuracy achieved during operations must be provided. This factor must be taken into account when establishing the RNP 10 time limit, with INS or IRU.

## 11. OPERATING PROCEDURES

11.1 In order to meet the requirements for RNP 10 operations in oceanic or remote areas, an operator must comply with the relevant requirements contained in Annex 2 – Rules of the Air, to the Convention on International Civil Aviation.

- a) **Flight planning.-** During flight planning, flight crews and flight dispatchers must pay particular attention to conditions that may affect operations in RNP 10 airspace or routes, including:
- 1) verifying if aircraft has been approved for RNP 10 operations;
  - 2) verifying that two LRNS are operational;
  - 3) verifying if the RNP 10 time limit has been taken into account (only aircraft equipped with INS or IRU);
  - 4) verifying the requirements for GNSS, such as FDE, if applicable to the operation;
  - 5) verifying if the letter “R” has been inserted in Box 10 of the ICAO flight plan (also insert the letter Z in that same box, and NAV/RNP 10 in Box 18 for WATRS plus spaces);
  - 6) if required, taking into account any operational restriction related to RNP 10 approval for a specific navigation system; and
  - 7) verifying the planned flight route, including the deviation to any alternate aerodrome, in order to identify the existing RNP types.
- b) **Pre-flight procedures.-** The following actions must be completed during pre-flight:
- 1) review flight technical records (maintenance logs) to ascertain the conditions of the equipment required for flight in RNP 10 airspace or route. Ensure that maintenance actions have been taken to correct defects in the required equipment;
  - 2) during the external inspection of the aircraft, check the condition of the navigation antennas and the condition of the fuselage skin around each of these antennas (this can be done by a competent and authorised person other than the pilot, like, for instance, an on-board mechanic or a maintenance person); and
  - 3) review the emergency procedures for operations in RNP 10 airspace or routes. These are not different from the normal oceanic emergency procedures, with one exception: crews must be capable of recognising, and the ATC must be notified, when the aircraft is no longer capable of flying at its capacity level according to the RNP 10 approval.



c) **En-route procedures.-** The following must be observed:

- 1) at the oceanic point of entry, at least two LRNS must be capable of navigating in RNP 10, otherwise, the crew will consider using an alternate route or initiating a deviation to repair the systems;
- 2) before entering oceanic airspace, aircraft position must be checked as accurately as possible using external navigation aids. This may require DME/DME or VOR checks to identify navigation system errors by comparing displayed and actual positions. If it is necessary to update the system, the appropriate procedures must be followed with the assistance of a prepared checklist;
- 3) operating procedures must include mandatory cross-check procedures in order to identify navigation errors in advance and prevent the aircraft from inadvertently deviating from the routes authorised by the ATC;
- 4) crews must notify the ATC of any degradation or failure of the navigation equipment below the navigation performance requirements, or of any deviation required for a contingency procedure; and
- 5) pilots must use a lateral deviation indicator, an FD or an AP in lateral navigation mode (LNAV) for RNP 10 operations. All pilots are expected to follow the route centreline, as represented on the on-board lateral deviation indicators and/or flight guidance, during all RNP 10 operations, unless authorised by the ATC to deviate or due to an emergency. For normal operations, the cross-track error/deviation (the difference between the path estimated by the RNP system and the position of the aircraft relative to the path) must be limited to  $\pm \frac{1}{2}$  the navigation precision associated with the flight route (e.g., 5 NM). Small lateral deviations from this requirement are allowed (e.g., overshooting or undershooting the path) during or immediately after an en-route turn, up to a maximum of 1 times (1xRNP) the navigation precision (e.g., 10 NM).

**Note.-** Some aircraft do not show or do not estimate a path during turns. Pilots of such aircraft may not be capable of meeting the  $\pm \frac{1}{2}$  precision requirement during en-route turns; however, they are expected to meet interception requirements after the turn or in the straight segments.

d) **Contingency procedures**

- 1) Flight crews and flight dispatchers must become familiar with the following general provisions:
  - (a) if an aircraft cannot continue the flight in accordance with the current ATC authorisation or cannot maintain RNP 10 precision, it will not enter, or continue operations in RNP 10 airspace. In this case, the pilot will obtain a revised authorisation, whenever possible, before beginning any action.
  - (b) in all cases, the flight crew must follow the contingency procedures established for each region or area of operation (e.g., South Atlantic (SAT), West Atlantic Route System (WATRS), Pacific, etc.) and obtain an authorisation from the ATC as soon as possible.
- 2) *Procedures for in-flight contingencies, deviations due to weather, and strategic lateral offset.-* The operator will develop procedures for in-flight contingencies, deviations due to weather conditions, and strategic lateral offset (SLOP), in accordance with Paragraph 15.2 of ICAO Doc 4444 – Special procedures for In-flight contingencies in oceanic airspace. These procedures are of general application in oceanic and remote continental areas of operations. As a minimum, the following aspects will be included:

- (a) Special procedures for in-flight contingencies in oceanic airspace.
  - (1) Introduction.
  - (2) General procedures.
  - (3) Extended range operations by aeroplanes with two turbine power-units (ETOPS).
- (b) Deviation procedures due to weather conditions.
  - (1) General.
  - (2) Measures to be adopted when establishing pilot-controller communications.
  - (3) Measures to be adopted if a revised ATC authorisation cannot be obtained.
- (c) Strategic lateral offset procedure in oceanic and remote continental airspaces.

## 12. TRAINING PROGRAMME

12.1 The following aspects must to be standardised and included in the training programmes for flight crews and flight dispatchers. Some aspects may have already been duly standardised in the existing training programmes. The new technologies may also eliminate the need for certain actions by the flight crew. If this is the case, this paragraph can be deemed fulfilled.

- a) Commercial operators (LAR 121 and 135 or equivalents).- Commercial operators must make sure that flight crews and flight dispatchers are trained on the following aspects:
  - 1) General
    - (a) RNP definition relative to RNP 10 requirements.
    - (b) Knowledge of the airspace where RNP 10 is required.
    - (c) Aeronautical charts and documents that reflect RNP 10 operations.
    - (d) Required equipment and their operation for operations in RNP 10 airspace.
    - (e) Limitations associated with navigation equipment.
    - (f) Impact of updating navigation systems.
    - (g) Use of MEL.
  - 2) Operational procedures
    - (a) Flight planning.
    - (b) Pre-flight procedures.
    - (c) En-route operations.
    - (d) Contingency procedures.
    - (e) Aspects contained in this AC.
- b) Private operators (LAR 91 or equivalent).- Private operators must provide evidence to the CAA that the pilots have knowledge about RNP 10 operations. When determining whether or not the training of a private operator is appropriate, the CAA may:
  - 1) accept a certificate issued by a training centre without any further evaluation;

- 2) assess a training programme before accepting a certificate issued by a given training centre;
- 3) accept a statement in the application of the operator indicating that the operator guarantees and will continue to guarantee that the flight crews have knowledge about RNP 10 operational practices and procedures; and
- 4) accept a statement from the operator in the sense that it has already performed or will perform a specific RNP 10 training programme.

### **13. NAVIGATION DATABASE**

13.1 If there is an on-board database, it must be valid and appropriate for operations and must include navigation aids and waypoints (WPT) required for the route.

- a) The operator must obtain the navigation database from a qualified provider.
- b) Navigation database providers must have a letter of acceptance (LOA) in order to process navigation information (e.g., FAA AC 20-153 or document on conditions for the issuance of letters of acceptance to navigation data providers by the European Aviation Safety Agency (EASA IR 21 Subpart G) or equivalent documents). A LOA recognises as data provider one whose information quality, integrity, and quality management practices are consistent with the criteria in document DO-200A/ED-76. The provider of an operator (e.g., an FMS company) must have a Type 2 LOA and its respective suppliers must have a Type 1 or 2 LOA. The CAA may accept an LOA issued to navigation data providers or may issue its own LOA.
- c) The operator must report to the navigation data provider any discrepancies that invalidate a route, and prohibit the use of the affected procedures affected through a notice to the flight crews.
- d) Operators must consider the need to conduct periodic checks of the navigation databases in order to maintain the existing quality system or safety management system requirements.

### **14. OVERSIGHT, INVESTIGATION OF NAVIGATION ERRORS AND WITHDRAWAL OF RNP 10 AUTHORISATION**

- a) The operator will establish a procedure to receive, analyse, and follow up on navigation error reports in order to determine appropriate corrective actions.
- b) Information showing the potential of repeated errors may require changes to the training programme of the operator.
- c) Information attributing multiple errors to a specific pilot may indicate that that pilot needs additional training or a revision of his/her license.
- d) Repeated navigation errors attributed to a piece of equipment or a specific part of that piece of equipment or to operational procedures can entail the cancellation of an operational approval (withdrawal of RNP 10 authorisation from the OpSpecs or withdrawal of the LOA in the case of private operators).

## APPENDIX 1

### NAVIGATION DATA VALIDATION PROGRAMME

#### 1. INTRODUCTION

The information stored in the navigation database defines the lateral and longitudinal guidance of the aircraft for RNP 10 operations. Navigation database updates are carried out every 28 days. Navigation data used in each update are critical for the integrity of each RNP 10 route. This appendix provides guidance on the procedures applied by the operator to validate the navigation data associated with RNP 10 operations.

#### 2. DATA PROCESSING

- a) The operator will identify in its procedures, the person responsible for the update of the navigation data.
- b) The operator must document a process for accepting, checking, and loading navigation data to the aircraft.
- c) The operator must put its documented data process under configuration control.

#### 3. INITIAL DATA VALIDATION

3.1 The operator must validate each RNP 10 route before flying under instrument meteorological conditions (IMC) to ensure compatibility with its aircraft and to ensure that the resulting paths correspond to the published routes. As a minimum, the operator must:

- a) compare the navigation data of the routes to be loaded in the FMS with a current map containing the published routes.
- b) validate the navigation data loaded for the routes, whether in the flight simulator or in the aircraft, under visual meteorological conditions (VMC). The routes outlined in a map display must be compared to the published routes. The complete routes must be flown to ensure that the paths can be used, that there are no apparent lateral or longitudinal path disconnections, and that they are consistent with the published routes.
- c) after validating the routes, a copy of the validated navigation data must be kept and stored in order to compare them to subsequent data updates.

#### 4. DATA UPDATE

Once the operator receives a navigation data update and before using such data in the aircraft, the operator must compare said update with the validated routes. This comparison must identify and solve any discrepancy in the navigation data. If there are significant changes (any change affecting the path or performance of the routes) in any part of a route, and said changes are checked with the initial data, the operator must validate the amended route in accordance with the initial data validation.

#### 5. NAVIGATION DATA SUPPLIERS

Navigation data suppliers must have a Letter of Acceptance (LOA) in order to process these data (for example: FAA AC 20-153 or the document on conditions for the issuance of letters of acceptance for navigation data providers by the European Air Safety Agency– EASA (EASA IR 21 Subpart G) or equivalent documents). A LOA recognises the data supplier as one whose data quality, integrity and quality management practices are consistent with the criteria of document DO-200A/ED-76. An operator's supplier (for example, an FMS company) must have a Type 2 LOA and their respective suppliers must have a Type 1 or 2 LOA. The CAA may accept a LOA issued to navigation data suppliers or may issue its own LOA.

**6. AIRCRAFT MODIFICATIONS (DATA BASE UPDATE)**

If an aircraft system required for RNP 10 operations is modified (for example, change of software), the operator is responsible for the validation of the RNP 10 routes based on the navigation data and on the modified system. This can be done without any direct evaluation if the manufacturer verifies that the modification has no effect on the navigation database or on path calculations. If there is no such verification by the manufacturer, the operator must carry out an initial validation of the navigation data with the modified system.

## APPENDIX 2

### RNP 10 APPROVAL PROCESS

- a) The RNP 10 approval process consists of two kinds of approvals: the airworthiness and the operational approvals. Although both have different requirements, they must be considered under a single process.
- b) This process is an organised method used by the CAA to ensure that applicants meet the established requirements.
- c) The approval process is made up by the following phases:
  - 1) Phase one: Pre-application
  - 2) Phase two: Formal application
  - 3) Phase three: Documentation evaluation
  - 4) Phase four: Inspection and demonstration
  - 5) Phase five: Approval
- d) In *Phase one - Pre-application*, the CAA invites the applicant or operator to the pre-application meeting. At this meeting, the CAA informs the applicant or operator about all the operational and airworthiness requirements it must meet during the approval process, including the following:
  - 1) the contents of the formal application;
  - 2) the review and evaluation of the application by the CAA;
  - 3) the limitations (if any) applicable to the approval; and
  - 4) the conditions under which the RNP 10 approval could be cancelled.
- e) In *Phase two – Formal application*, the applicant or operator submits the formal application, together with all the relevant documentation, as established in paragraph 9.1.1 b) of this CA.
- f) In *Phase three – Documentation evaluation*, the CAA analyses all the documentation and the navigation system in order to determine its eligibility and what approval method is to be applied regarding the aircraft. As a result of this analysis and evaluation, the CAA may accept or reject the formal application together with the documentation.
- g) In *Phase four – Inspection and demonstration*, the operator will provide training for its personnel and perform the validation flights, if so required.
- h) In *Phase five - Approval*, the CAA issues the RNP 10 authorisation, once the operator has met the airworthiness and operational requirements. For LAR 121 and 135 operators, the CAA will issue the OpSpecs, and for LAR 91 operators, it will issue an LOA.

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## APPENDIX 3

## EXAMPLE OF AN RNP 10 APPROVAL APPLICATION FORM

(company letterhead)

[Date]

Mr./Ms. [Name of DCA]

[Position of DCA]

Dear Mr./Ms.,

This letter is to request RNP 10 operational approval for the South Atlantic (SAT) Corridor based on compliance with the requirements established in CA 91-001. Below you will find detailed information for the requested approval.

a) Aircraft

Make/Model/Series	Registration	Hexadecimal SSR code	Description of RNP 10 equipment (number, make, model, etc). Indicate if aircraft belongs to a group or no group

b) Time limit requested for RNP 10 operation: Hours. .... No limit .....

(attach supporting documentation)

c) Time interval where no FDE will be provided for GNSS equipment (maximum allowed time: 34 minutes)

Minutes..... Not applicable.....

d) The following documentation is attached:

- ☐ Flight Manual/ Supplement containing the RNP 10 airworthiness statement, or equivalent.
- ☐ Request for approval of MEL revision that includes the necessary systems for RNP 10 operations; or
- ☐ MEL that includes the systems necessary for RNP 10 operations, with the approval of the corresponding revision.
- ☐ Proposed modification of the operations manual that includes the RNP 10 operation in the SAT corridor; or
- ☐ Operations manual that includes the operation in the SAT corridor, with the approval of the corresponding revision.
- ☐ Proposed approval of the training programme for the flight crew, flight dispatchers, and maintenance personnel that includes the RNP 10 operation in the SAT corridor; or
- ☐ Training programme for the flight crew, flight dispatchers, and maintenance personnel that includes the RNP 10 operation in the SAT corridor, with the approval of the corresponding revision.
- ☐ Copy of the documentation showing that a maintenance programme has been established for the equipment necessary for the RNP 10 operation.

Note.- This form is only an example. To complete all the documentation required by this AC, please see Paragraph 9.1.1

(Signature)

(Name and position)

Operations Director



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**APPENDIX 4****EXAMPLE OF A LETTER OF RNP 10 OPERATIONAL APPROVAL**

(CAA letterhead)

**RNP 10 OPERATIONAL APPROVAL FOR THE EUROPE/SOUTH AMERICA (EUR/SAM) CORRIDOR***[Date]*Mr. /Ms. *[Name of operator representative]**[Title]*

Dear Mr./Ms.

Upon evaluation of your request, this CAA grants RNP 10 operational approval for the EUR/SAM corridor, pursuant to SRVSOP CA 91-001 dated 18 August 2009 and to ICAO Regional Supplementary Procedures (Doc 7030/4). This approval is only valid for the following aircraft.

Operator	Company
Fleet	Model
Serial number	Serial number
Registration	Registration number
Associated equipment	
Time limit	

(Signature)

(Name and position)

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## APPENDIX 5

## FORM FOR REPORTING NAVIGATION ERRORS IN EUR/SAM CORRIDOR

NAVIGATION ERROR INVESTIGATION FORM				
Type of report PILOT – Flight: ATC CONTROLLER:				
Date/UTC time	Type of error LATERAL (A to G) (*) LATERAL (A to O)			
Reasons METEOROLOGY (see 2 G): Other (Specify):				
Conflict alerting systems:				
DATA	First aircraft		Second aircraft (only vertical error)	
Identification				
Operator				
Type				
Origin				
Destination				
Route segment				
Flight level	Assigned	Current	Assigned	Current
Magnitude and direction of the deviation (NM lateral; feet vertical)				
Duration				
Position where the error was observed (BGR/DIS to fix or LAT/LONG)				
Action by the crew/ATC				
Other comments				

(\*) See deviation classification

Send to the South Atlantic Monitoring Agency (SATMA)

Fax: + 34-928-577052

e-mail: satma@aena.es

**APPENDIX 5 (Continued)**  
**INSTRUCTIONS FOR COMPLETING THE FORM**

- As many boxes as possible must be filled.
- Complementary data may be attached to the form.
- The navigation error notifications, as much as possible, will have the following classification:

**1. Altitude (vertical) deviations**

- A. Contingency due to engine failure
- B. Contingency due to pressurisation failure
- C. Contingency due to other reasons
- D. Failure in the assigned climb/descent
- E. Climb/descent without ATC assignment
- F. Entry into airspace at an incorrect flight level
- G. ATC reallocation of flight level (FL) with loss of longitudinal/lateral separation
- H. Deviation due to the airborne collision avoidance system (ACAS II/TCAS II)
- I. Impossibility to maintain FL
- J. Other

**2. Lateral deviations**

- A. Aircraft without RNP approval
- B. ATC system loop error
- C1. Control equipment error, including unnoticed waypoint (WPT) error
- C2. WPT insertion error due to incorrect position input
- D. Other, with sufficient pre warning to ATC to receive corrective instructions
- E. Other, without enough pre warning to ATC
- F. Other, with failure reported/received by the ATC
- G. Lateral deviations due to weather, with no possibility of receiving ATC authorisation.

Note.- The EUR/SAM corridor includes the Recife (Atlantic), Oceanic Dakar, Oceanic Sal, and the Canary Islands Flight Information Regions/Upper Information Regions (FIRs/UIRs).

**APPENDIX A-2**

**RNAV 10 (DESIGNATED AND AUTHORIZED AS RNP 10) JOB AID**

**APPLICATION TO CONDUCT RNP 10 OPERATIONS**

## **RNAV 10 (DESIGNATED AND AUTHORIZED AS RNP 10) JOB AID**

### **APPLICATION TO CONDUCT RNP 10 OPERATIONS**

#### **1. Introduction**

This Job Aid was developed by the Latin American Regional Safety Oversight Cooperation System (SRVSOP) to provide States, operators, and inspectors with guidance on the process to be followed by an operator in order to obtain an RNP 10 authorisation. RNAV 10 maintains the designation RNP 10, as specified in ICAO Doc 9613 – Performance-based navigation (PBN) manual.

#### **2. Purposes of the Job Aid**

- 2.1 To give operators and inspectors information on the main RNP 10 reference documents.
- 2.2 To provide tables showing the contents of the application, the associated reference paragraphs, the place in the application of the operator where RNP 10 elements are mentioned and columns for inspector comments and follow-up on the status of various RNP 10 elements.

#### **3. Actions Recommended for the inspector and operator**

Some recommendations for use of the Job Aid follow:

- 3.1 At the pre-application meeting with the operator, the inspector reviews the “basic events of the RNP 10 approval process” described in Part 1 of this Job Aid, in order to provide an overview of the approval process events.
- 3.2 The inspector reviews this Job Aid with the operator in order to establish the form and content of the RNP 10 approval application.
- 3.3 The operator uses this Job Aid as a guide to collect the documents/annexes of the RNP 10 application.
- 3.4 The operator inserts in the Job Aid references showing in what part of its documents are the RNP 10 programme elements located.
- 3.5 The operator submits the Job Aid and the application to the inspector (documents/annexes).
- 3.6 The inspector indicates in the Job Aid whether an item is in compliance or needs corrective action.
- 3.7 The inspector informs the operator as soon as possible when a corrective action by the operator is required.
- 3.8 The operator provides the inspector with the revised material when so requested.
- 3.9 The CAA provides the operator with the operational specifications (OpSpecs) or a letter of authorisation (LOA), as applicable, when the tasks and documents have been completed.

#### 4. Structure of the Job Aid

Parts	Topics	Page
Part 1	General information	3
Part 2	Information on aircraft and operator identification	5
Part 3	Operator application (Annexes and documents)	7
Part 4	Contents of the operator application for RNP 10	11
Part 5	Guide to determine the eligibility of RNP 10 aircraft	15
Part 6	Basic pilot procedures for RNP 10 operations	17
Part 7	Procedures for flight contingencies, deviations due to weather, and strategic lateral displacement	23

#### 5. Main sources of documents, information and contacts

Advisory Circular CA 91-001 is available on the ICAO/SAM Regional Office web page ([www.lima.icao.int](http://www.lima.icao.int)) through the SRVSOP link.

#### 6. Main reference documents

Reference Documents	Title
Annex 6	Operation of aircraft
ICAO Doc 9613	Manual on performance-based navigation
FAA Order 8400.12A	Required navigation performance 10 (RNP 10) operational approval
AMC 20-12	Recognition of FAA Order 8400.12A for RNP 10 operations
Spain DGAC CO 01/01	Aprobación operacional y criterios de utilización de sistemas para la navegación en espacio aéreo designado RNP 10
AMC 20-5	Acceptable means of compliance for airworthiness approval and operational criteria for the use of the NAVSTAR Global positioning system (GPS)
AC 20-130()	Airworthiness approval of multi-sensor navigational system for use in the U.S. National Airspace System
AC 20-138A	Airworthiness approval of Global navigation satellite system (GNSS) equipment
AC 25-4	Inertial navigation system (INS)
AC 25-15	Approval of FMS in transport category airplanes
AC 90-45A	Approval of area navigation systems for use in the U.S. National Airspace System



**PART 1: GENERAL INFORMATION****Basic events of the RNP 10 approval process**

	<b>Action by the Operator</b>	<b>Action by the CAA</b>
1	Establishes the need to obtain approval for RNP 10 operations.	
2	Reviews the AFM, AFM supplement or Type Certificate Data Sheet (TCDS), or other appropriate documents (e.g., service bulletins (SB), service letters (SL), etc.) to determine the eligibility of the aircraft for RNP 10 operations. The operator contacts the aircraft or avionics manufacturer, if necessary, to confirm RNP 10 or better eligibility of the aircraft.	
3	Contacts the CAA to schedule a pre-application meeting to discuss the operational approval requirements.	
4		During the pre-application meeting, establishes: <ul style="list-style-type: none"> <li>• the form and contents of the application;</li> <li>• the documents that support RNP 10 approval</li> <li>• the date in which the application will be submitted for evaluation</li> <li>• if necessary, conduct a validation flight observed by the CAA.</li> </ul>
5	Submits the application at least 60 days before the start-up of RNP 10 operations.	
6		Reviews the operator submission
7	Once the amendments to manuals, programmes, and documents have been approved, provides training to flight crews, flight dispatchers, and maintenance personnel, and conduct a validation flight, if required by the CAA.	Only if required, participates in the validation flight.
8		Once the operational and airworthiness requirements have been met, issue the operational approval in the form of OpSpecs for LAR 121 or 135 or equivalent operators, or an LOA for LAR 91 or equivalent operators, as appropriate.

**Notes related to the approval process****1. Responsible authority**

- a. **Commercial air transport (LAR 121 and/or 135 or equivalent regulations).**- The **State of registry** determines that the aircraft meets the airworthiness requirements. The **State of the operator** issues the RNP 10 approval (e.g., OpSpecs).
- b. **General aviation (LAR 91 or equivalent regulations).**- The **State of registry** determines that the aircraft meets the airworthiness requirements and issues the operational approval (e.g., an LOA).

2. The CAA does not need to issue an LOA or an equivalent document for each individual area of operation in the case of LAR 91 operators.

3. LAR 121 and/or 135 operators with RNP 10 approval must list the individual areas of operation in the OpSpecs.

4. Related sections of the Latin American Aeronautical Regulations (LAR) or equivalent regulations

- a. LAR 91        Sections 91.1015 and 91.1640 or equivalents
- b. LAR 121     Section 121.995 (b) or equivalent
- c. LAR 135     Section 135.565 (c) or equivalent

5. Related ICAO Documents

- a. Annex 2 to the Convention on International Civil Aviation – Rules of the Air
- b. Annex 6 to the Convention on International Civil Aviation – Operation of Aircraft
- c. OACI Doc 9613 – Performance-based navigation (PBN) Manual
- d. OACI Doc 4444 – Procedures for air navigation services – Air traffic management.
- e. OACI Doc 7030 – Regional supplementary procedures

**PART 2: INFORMATION ON THE IDENTIFICATION OF AIRCRAFT AND OPERATORS****NAME OF THE OPERATOR:** \_\_\_\_\_

<b>Aircraft manufacturer, model and series</b>	<b>Registration numbers</b>	<b>Serial numbers</b>	<b>Long-range navigation systems (LRNS) Number, manufacturer and model</b>	<b>RNP specification</b>

DATE OF PRE-APPLICATION MEETING \_\_\_\_\_

DATE IN WHICH THE APPLICATION WAS RECEIVED \_\_\_\_\_

DATE IN WHICH THE OPERATOR INTENDS TO BEGIN RNP 10 OPERATIONS \_\_\_\_\_

IS THE CAA NOTIFICATION DATE APPROPRIATE? YES \_\_\_\_\_ NO \_\_\_\_\_

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**PART 3 – OPERATOR APPLICATION (ANNEXES AND DOCUMENTS)**

<b>Annex</b>	<b>Title of Annex/document</b>	<b>Indication of inclusion by the operator</b>	<b>Comments by the Inspector</b>
A	<b>Application for RNP 10 approval</b>		
B	<b>Group of aircraft</b> Statement by the operator as to whether the aircraft and LRNS combinations belong to a group or aircraft or not		
C	<b>Airworthiness documents showing aircraft eligibility for RNP 10.</b> AFM, AFM revision, AFM supplement, or Type certificate data sheet (TCDS) showing LRNS eligibility for RNP 10.		
D	<b>Aircraft modified to meet RNP 10 standards. Documentation on aircraft inspection and/or modification, if applicable.</b> Maintenance records documenting the installation or modification of LRNS and of the aircraft (e.g., FAA Form 337 – major repairs and alterations).		
E	<b>For aircraft equipped only with INS or IRU: RNP 10 time limit and area of operations.</b> Documentation showing RNP 10 time limit and the area of operation or routes for which the navigation system/aircraft is eligible. (Not applicable for aircraft equipped with GNSS.)		
F	<b>Maintenance programme</b> <ul style="list-style-type: none"> <li>For aircraft with established LRNS maintenance practices, the list of references of the document or programme.</li> <li>For recently installed LRNS, the maintenance practices for review.</li> </ul>		
G	<b>Minimum equipment list (MEL) (only for operators conducting operations based on a MEL):</b> MEL showing LRNS provisions.		

Annex	Title of Annex/document	Indication of inclusion by the operator	Comments by the Inspector
H	<b>Training</b> <b>1. LAR 91 operators or equivalent: Training method:</b> Training at home, LAR 142 training centres, or other training courses, course completion records. <b>2. LAR 121 and/or 135 operators or equivalent:</b> Training programmes (training curricula) for flight crews, flight dispatchers, and maintenance personnel.		
I	<b>Operating policies and procedures</b> <b>1. LAR 91 operators or equivalent:</b> Operations manual (OM) or sections to be attached to the application, corresponding to RNP 10 operating procedures and policies. <b>2. LAR 121 and/or 135 operators or equivalents:</b> Operations manual and checklists.		
J	<b>Past performance.</b> If any, previous problems, incidents, path-keeping errors, corrective action will be included.		
K	<b>Withdrawal of RNP 10 approval</b> Indication of the need to follow up on navigation error reports submitted and the possibility of withdrawal of RNP 10 approval.		
	<b>Validation flight plan:</b> Only if required by the CAA.		

**CONTENTS OF THE APPLICATION TO BE SUBMITTED BY THE OPERATOR**

 \_\_\_\_\_ **RNP 10 COMPLIANCE DOCUMENTATION OF THE AIRCRAFT/NAVIGATION SYSTEMS**

 \_\_\_\_\_ **OPERATING PROCEDURES AND POLICIES**

 \_\_\_\_\_ **SECTIONS OF THE MAINTENANCE MANUAL RELATED TO LRNS (if not previously reviewed)**
**Note 1:** Documents may be grouped in a single binder or may be submitted as individual documents.

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## PART 4: CONTENTS OF OPERATOR APPLICATION FOR RNP 10

#	Contents of the RNP 10 application by the operator	Reference paragraphs CA 91-001	In what Annexes/Documents of the operator can the application contents be located <b>Note: The operator must update this column to reflect the contents of the application</b>	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>Operator request letter</b> Statement of the intention to obtain RNP 10 approval.	Paragraph 9.1.1 b) 1) Appendix 2, Paragraph e)	Annex A		
2	<b>Aircraft/ navigation system RNP 10 eligibility method</b> Airworthiness documents that establish the aircraft/navigation system eligibility method, its approval status, and, in a format acceptable to the inspector, a list of airframes included in this method.	Paragraphs 8.2 and 8.3	Annex B Annex C		
2a	<b>Dual LRNS requirement</b> At least two LRNS with displays and functions suitable for oceanic operations are required.	Paragraph 8.1.1 Paragraph 10.2	Annex B Annex C		
3	<b>Time limit only for aircraft equipped with INS or IRU</b> RNP 10 time limit proposed or	Paragraph 8.4	Annex B Annex C		



#	Contents of the RNP 10 application by the operator	Reference paragraphs CA 91-001	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	approved for aircraft with INS or IRU as the only source of long-range navigation (LRN). (Not applicable for aircraft equipped with GNSS.)				
4	<b>RNP 10 area of operation for aircraft equipped only with INS and IRU.</b> Documentation establishing the area of operation or RNP 10 routes for which the navigation system/aircraft is eligible. (Not applicable for aircraft equipped with GNSS.)	Paragraphs 10.5 and 10.9 (Paragraphs 10.10 and 10.11, as applicable)			
5	<b>Training</b>  <b>1. LAR 91 operators or equivalent: Training methods:</b> The following methods are acceptable for these operators: Training at home, LAR 142 training centres, or other training courses.  <b>2. LAR 121 or 135 operators or equivalent: Training programmes:</b> Operators will develop an initial and periodic	Paragraph 12 b)  Paragraph 12 a)	Annex F		

#	Contents of the RNP 10 application by the operator	Reference paragraphs CA 91-001	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	training programme for flight crews, flight dispatchers, if applicable, and maintenance personnel.				
6	<b>Operating policies and procedures</b>  <b>1. LAR 91 operators or equivalent:</b> Operations manual or section of the operator application documenting RNP 10 policies and procedures.  <b>2. LAR 121 and/or 135 operators or equivalent:</b> Operations manual and checklists.	Paragraph 9.1.1 b) 6) (b)  Paragraph 9.1.1 b) 6) (a)	Annex G		
7	<b>Maintenance practices</b> <ul style="list-style-type: none"> <li>For aircraft with established LRNS maintenance practices, the operator will provide document references.</li> <li>For newly installed LRNS systems, the operator will provide maintenance practices for review.</li> </ul>	Paragraph 8.5 b)	Annex D		

#	Contents of the RNP 10 application by the operator	Reference paragraphs CA 91-001	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
8	<b>Minimum equipment list (MEL) update</b>  Applicable to operators conducting operations according to a MEL.	Paragraphs 8.5 a) and 9.1.1 b) 7)	Annex E		
9	<b>Past performance.</b> Performance record identifying previous problems, incidents, track keeping errors and corrective actions.	Paragraph 9.1.1 b) 10)			
10	<b>Withdrawal of RNP 10 operating authority</b>  Indication of the need for follow-up on the navigation error reports and the possibility of withdrawal of the RNP approval.	Paragraph 9.3	Annex H		
11	<b>Validation flight plan, only if required</b>  The validation flight plan will be presented only if required.	Paragraph 9.1.1 d)			

**PART 5 – GUIDE FOR DETERMINING RNP 10 AIRCRAFT ELIGIBILITY**

#	Topics	Reference paragraphs  CA 91-001	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>Group aircraft definition</b>	Paragraph 8.2.1	Annex B		
2	<b>Dual long-range navigation system (LRNS)</b>	Paragraph 10.2	Annex B		
3	<b>Eligibility Method 1.-</b> Eligibility of aircraft through RNP certification (RNP compliance documented in the AFM).	Paragraph 8.3.1 a)	Annex B		
4	<b>Eligibility Method 2.-</b> Eligibility of aircraft through previous certification of the navigation system.	Paragraph 8.3.1 b)	Annex B		
4a	INSs or IRUs approved according to LAR 121, Appendix G (time limit 6.2 hours)	Paragraph 8.3.1 b) 4)	Annex B		
4b	INSs or IRUs approved for MNPS operations in the North Atlantic or RNAV operations in Australia (time limit 6.2 hours)	Paragraph 8.3.1 b) 6)	Annex B		
4c	Obtaining of approval with extended time limit for aircraft equipped with INS or IRU systems	Paragraph 8.4	Annex B		
4d	GNSS (e.g., GPS) approved as primary means of navigation (AC 20-138 or equivalent)	Paragraph 8.3.1 b) 1)	Annex B		

#	Topics	Reference paragraphs <b>CA 91-001</b>	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
4e	Multi-sensor systems into which the GNSS (e.g., GPS) is integrated (AC 20-130 or equivalent)	Paragraph 8.3.1 b) 2)	Annex B		
4f	Equipment with a single GNSS and another approved LRNS (e.g., INS or IRU)	Paragraph 8.3.1 b) 7)	Annex B		
5	<b>Eligibility Method 3 – Eligibility through data collection</b>	Paragraph 8.3.1 c)	Annex B		
5a	Sequential method	Paragraph 8.3.1 c) 2) (a)	Annex B		
5b	Periodic method	Paragraph 8.3.1 c) 2) (b)	Annex B		

**PART 6 - BASIC PILOT PROCEDURES FOR RNP 10 OPERATIONS**

<b>Topics</b>		<b>Reference paragraphs CA 91-001</b>	<b>Location in the Annexes of the operator</b>	<b>Comments and/or recommendations by the CAA</b>	<b>Follow-up by the Inspector: Item status and date</b>
<b>Operating procedures</b>		Paragraph 11	Annex G		
1	<b>Flight planning</b>	Paragraph 11.1 a)			
	Verifying if aircraft has been approved for RNP 10 operations	Paragraph 11.1 a) 1)			
	Verifying that two LRNS are operational	Paragraph 11.1 a) 2)			
	Verifying if the RNP 10 time limit has been taken into account (only aircraft equipped with INS or IRU)	Paragraph 11.1 a) 3)			
	Verifying the requirements for GNSS, such as FDE, if applicable to the operation	Paragraph 11.1 a) 4)			
	Verifying if the letter "R" has been inserted in Box 10 of the ICAO flight plan (also insert the letter Z in that same box, and NAV/RNP 10 in Box 18 for WATRS plus spaces)	Paragraph 11.1 a) 5)			
	If required, taking into account any operational restriction related to RNP 10 approval for a specific	Paragraph 11.1 a) 6)			

Topics		Reference paragraphs CA 91-001	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	navigation system				
	Verifying the planned flight route, including the deviation to any alternate aerodrome, in order to identify the existing RNP types	Paragraph 11.1 a) 7)			
2	<b>Pre-flight procedures</b>	Paragraph 11.1 b)			
	Review flight technical records (maintenance logs) to ascertain the conditions of the equipment required for flight in RNP 10 airspace or route. Ensure that maintenance actions have been taken to correct defects in the required equipment	Paragraph 11.1 b) 1)			
	During the external inspection of the aircraft, check the condition of the navigation antennas and the condition of the fuselage skin around each of these antennas (this can be done by a competent and authorised person other than the pilot, like, for instance, an on-board mechanic or a maintenance person)	Paragraph 11.1 b) 2)			
	Review the emergency procedures for operations in RNP 10 airspace or routes. These are not different from the normal	Paragraph 11.1 b) 3)			

Topics		Reference paragraphs CA 91-001	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	oceanic emergency procedures, with one exception: crews must be capable of recognising, and the ATC must be notified, when the aircraft is no longer capable of flying at its capacity level according to the RNP 10 approval				
3	<b>En-route procedures</b>	Paragraph 11.1 c)			
	At the oceanic point of entry, at least two LRNS must be capable of navigating in RNP 10, otherwise, the crew will consider using an alternate route or initiating a deviation to repair the systems	Paragraph 11.1 c) 1)			
	Before entering oceanic airspace, aircraft position must be checked as accurately as possible using external navigation aids. This may require DME/DME or VOR checks to identify navigation system errors by comparing displayed and actual positions. If it is necessary to update the system, the appropriate procedures must be followed with the assistance of a prepared checklist	Paragraph 11.1 c) 2)			
	Operating procedures must include mandatory cross-check	Paragraph 11.1 c) 3)			



Topics	Reference paragraphs CA 91-001	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
procedures in order to identify navigation errors in advance and prevent the aircraft from inadvertently deviating from the routes authorised by the ATC				
Crews must notify the ATC of any degradation or failure of the navigation equipment below the navigation performance requirements, or of any deviation required for a contingency procedure	Paragraph 11.1 c) 4)			
Pilots must use a lateral deviation indicator, an FD or an AP in lateral navigation mode (LNAV) for RNP 10 operations. All pilots are expected to follow the route centreline, as represented on the on-board lateral deviation indicators and/or flight guidance, during all RNP 10 operations, unless authorised by the ATC to deviate or due to an emergency. For normal operations, the cross-track error/deviation (the difference between the path estimated by the RNP system and the position of the aircraft relative to the path) must be limited to $\pm \frac{1}{2}$ the navigation precision associated with the flight route (e.g., 5 NM). Small	Paragraph 11.1 c) 5)			

Topics		Reference paragraphs CA 91-001	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	lateral deviations from this requirement are allowed (e.g., overshooting or undershooting the path) during or immediately after an en-route turn, up to a maximum of 1 times (1xRNP) the navigation precision (e.g., 10 NM).  <i><b>Note.-</b> Some aircraft do not show or do not estimate a path during turns. Pilots of such aircraft may not be capable of meeting the <math>\pm \frac{1}{2}</math> precision requirement during en-route turns; however, they are expected to meet interception requirements after the turn or in the straight segments.</i>				
4	<b>Update the LRNS position</b>				
	Impact of en-route updates	Paragraph 10.9			
	Update the automatic position (as applicable).	Paragraph 10.10			

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**PART 7 - PROCEDURES FOR IN-FLIGHT CONTINGENCIES, DEVIATIONS DUE TO WEATHER CONDITIONS AND STRATEGIC LATERAL DISPLACEMENT**

Topics		CA 91-001 Reference paragraphs Doc 4444, Paragraph 15.2	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<b>Procedures</b>			Annex G		
1	<b>Special procedures for in-flight contingencies in oceanic airspace</b>	CA 91-001, Paragraph 11.1 d) 2) (a) Doc 4444, Paragraph 15.2			
	Introduction	CA 91-001, Paragraph 11.1 d) 2) (a) (1) Doc 4444, Paragraph 15.2.1			
	General procedures	CA 91-001, Paragraph 11.1 d) 2) (a) (2) Doc 4444, Paragraph 15.2.2			
	Extended range operations by aeroplanes with two turbine power- units (ETOPS)	CA 91-001, Paragraph 11.1 d) 2) (a) (3) Doc 4444, Paragraph 15.2.2.4			
2	<b>Procedures for deviations due to weather conditions</b>	CA 91-001, Paragraph 11.1 d) 2) (b) Doc 4444, Paragraph 15.2.3			
	General aspects	CA 91-001, Paragraph 11.1 d) 2) (b) (1)			

Topics		CA 91-001 Reference paragraphs Doc 4444, Paragraph 15.2	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
		Doc 4444, Paragraph 15.2.3.1			
	Measures to be taken when controller-pilot communications are established.	CA 91-001, Paragraph 11.1 d) 2) (b) (2) Doc 4444, Paragraph 15.2.3.2			
	Measures to be taken in order to obtain a revised ATC clearing.	CA 91-001, Paragraph 11.1 d) 2) (b) (3) Doc 4444, Paragraph 15.2.3.3			
<b>3</b>	<b>Procedures for strategic lateral displacement in oceanic airspace and remote continental areas.</b>	CA 91-001, Paragraph 11.1 d) 2) (c) Doc 4444, Paragraph 15.2.4			

Contacts in the SRVSOP

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Job Aid

RNAV 10 (designated and authorised as RNP 10)

Version:

Original

Date:

12/10/2009

## **RNAV 10 (DESIGNATED AND AUTHORIZED AS RNP 10) JOB AID**

### **APPLICATION TO CONDUCT RNP 10 OPERATIONS**

#### **1. Introduction**

This Job Aid was developed by the Latin American Regional Safety Oversight Cooperation System (SRVSOP) to provide States, operators, and inspectors with guidance on the process to be followed by an operator in order to obtain an RNP 10 authorisation. RNAV 10 maintains the designation RNP 10, as specified in ICAO Doc 9613 – Performance-based navigation (PBN) manual.

#### **2. Purposes of the Job Aid**

- 2.1 To give operators and inspectors information on the main RNP 10 reference documents.
- 2.2 To provide tables showing the contents of the application, the associated reference paragraphs, the place in the application of the operator where RNP 10 elements are mentioned and columns for inspector comments and follow-up on the status of various RNP 10 elements.

#### **3. Actions Recommended for the inspector and operator**

Some recommendations for use of the Job Aid follow:

- 3.1 At the pre-application meeting with the operator, the inspector reviews the “basic events of the RNP 10 approval process” described in Part 1 of this Job Aid, in order to provide an overview of the approval process events.
- 3.2 The inspector reviews this Job Aid with the operator in order to establish the form and content of the RNP 10 approval application.
- 3.3 The operator uses this Job Aid as a guide to collect the documents/annexes of the RNP 10 application.
- 3.4 The operator inserts in the Job Aid references showing in what part of its documents are the RNP 10 programme elements located.
- 3.5 The operator submits the Job Aid and the application to the inspector (documents/annexes).
- 3.6 The inspector indicates in the Job Aid whether an item is in compliance or needs corrective action.
- 3.7 The inspector informs the operator as soon as possible when a corrective action by the operator is required.
- 3.8 The operator provides the inspector with the revised material when so requested.
- 3.9 The CAA provides the operator with the operational specifications (OpSpecs) or a letter of authorisation (LOA), as applicable, when the tasks and documents have been completed.

#### 4. Structure of the Job Aid

Parts	Topics	Page
Part 1	General information	3
Part 2	Information on aircraft and operator identification	5
Part 3	Operator application (Annexes and documents)	7
Part 4	Contents of the operator application for RNP 10	11
Part 5	Guide to determine the eligibility of RNP 10 aircraft	15
Part 6	Basic pilot procedures for RNP 10 operations	17
Part 7	Procedures for flight contingencies, deviations due to weather, and strategic lateral displacement	23

#### 5. Main sources of documents, information and contacts

Advisory Circular CA 91-001 is available on the ICAO/SAM Regional Office web page ([www.lima.icao.int](http://www.lima.icao.int)) through the SRVSOP link.

#### 6. Main reference documents

Reference Documents	Title
Annex 6	Operation of aircraft
ICAO Doc 9613	Manual on performance-based navigation
FAA Order 8400.12A	Required navigation performance 10 (RNP 10) operational approval
AMC 20-12	Recognition of FAA Order 8400.12A for RNP 10 operations
Spain DGAC CO 01/01	Aprobación operacional y criterios de utilización de sistemas para la navegación en espacio aéreo designado RNP 10
AMC 20-5	Acceptable means of compliance for airworthiness approval and operational criteria for the use of the NAVSTAR Global positioning system (GPS)
AC 20-130()	Airworthiness approval of multi-sensor navigational system for use in the U.S. National Airspace System
AC 20-138A	Airworthiness approval of Global navigation satellite system (GNSS) equipment
AC 25-4	Inertial navigation system (INS)
AC 25-15	Approval of FMS in transport category airplanes
AC 90-45A	Approval of area navigation systems for use in the U.S. National Airspace System

**PART 1: GENERAL INFORMATION****Basic events of the RNP 10 approval process**

	<b>Action by the Operator</b>	<b>Action by the CAA</b>
1	Establishes the need to obtain approval for RNP 10 operations.	
2	Reviews the AFM, AFM supplement or Type Certificate Data Sheet (TCDS), or other appropriate documents (e.g., service bulletins (SB), service letters (SL), etc.) to determine the eligibility of the aircraft for RNP 10 operations. The operator contacts the aircraft or avionics manufacturer, if necessary, to confirm RNP 10 or better eligibility of the aircraft.	
3	Contacts the CAA to schedule a pre-application meeting to discuss the operational approval requirements.	
4		During the pre-application meeting, establishes: <ul style="list-style-type: none"> <li>• the form and contents of the application;</li> <li>• the documents that support RNP 10 approval</li> <li>• the date in which the application will be submitted for evaluation</li> <li>• if necessary, conduct a validation flight observed by the CAA.</li> </ul>
5	Submits the application at least 60 days before the start-up of RNP 10 operations.	
6		Reviews the operator submission
7	Once the amendments to manuals, programmes, and documents have been approved, provides training to flight crews, flight dispatchers, and maintenance personnel, and conduct a validation flight, if required by the CAA.	Only if required, participates in the validation flight.
8		Once the operational and airworthiness requirements have been met, issue the operational approval in the form of OpSpecs for LAR 121 or 135 or equivalent operators, or an LOA for LAR 91 or equivalent operators, as appropriate.



**Notes related to the approval process****1. Responsible authority**

- a. **Commercial air transport (LAR 121 and/or 135 or equivalent regulations).**- The **State of registry** determines that the aircraft meets the airworthiness requirements. The **State of the operator** issues the RNP 10 approval (e.g., OpSpecs).
- b. **General aviation (LAR 91 or equivalent regulations).**- The **State of registry** determines that the aircraft meets the airworthiness requirements and issues the operational approval (e.g., an LOA).

2. The CAA does not need to issue an LOA or an equivalent document for each individual area of operation in the case of LAR 91 operators.

3. LAR 121 and/or 135 operators with RNP 10 approval must list the individual areas of operation in the OpSpecs.

4. Related sections of the Latin American Aeronautical Regulations (LAR) or equivalent regulations

- a. LAR 91        Sections 91.1015 and 91.1640 or equivalents
- b. LAR 121     Section 121.995 (b) or equivalent
- c. LAR 135     Section 135.565 (c) or equivalent

5. Related ICAO Documents

- a. Annex 2 to the Convention on International Civil Aviation – Rules of the Air
- b. Annex 6 to the Convention on International Civil Aviation – Operation of Aircraft
- c. OACI Doc 9613 – Performance-based navigation (PBN) Manual
- d. OACI Doc 4444 – Procedures for air navigation services – Air traffic management.
- e. OACI Doc 7030 – Regional supplementary procedures

**PART 2: INFORMATION ON THE IDENTIFICATION OF AIRCRAFT AND OPERATORS****NAME OF THE OPERATOR:** \_\_\_\_\_

<b>Aircraft manufacturer, model and series</b>	<b>Registration numbers</b>	<b>Serial numbers</b>	<b>Long-range navigation systems (LRNS) Number, manufacturer and model</b>	<b>RNP specification</b>

DATE OF PRE-APPLICATION MEETING \_\_\_\_\_

DATE IN WHICH THE APPLICATION WAS RECEIVED \_\_\_\_\_

DATE IN WHICH THE OPERATOR INTENDS TO BEGIN RNP 10 OPERATIONS \_\_\_\_\_

IS THE CAA NOTIFICATION DATE APPROPRIATE? YES \_\_\_\_\_ NO \_\_\_\_\_

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**PART 3 – OPERATOR APPLICATION (ANNEXES AND DOCUMENTS)**

<b>Annex</b>	<b>Title of Annex/document</b>	<b>Indication of inclusion by the operator</b>	<b>Comments by the Inspector</b>
A	<b>Application for RNP 10 approval</b>		
B	<b>Group of aircraft</b> Statement by the operator as to whether the aircraft and LRNS combinations belong to a group or aircraft or not		
C	<b>Airworthiness documents showing aircraft eligibility for RNP 10.</b> AFM, AFM revision, AFM supplement, or Type certificate data sheet (TCDS) showing LRNS eligibility for RNP 10.		
D	<b>Aircraft modified to meet RNP 10 standards. Documentation on aircraft inspection and/or modification, if applicable.</b> Maintenance records documenting the installation or modification of LRNS and of the aircraft (e.g., FAA Form 337 – major repairs and alterations).		
E	<b>For aircraft equipped only with INS or IRU: RNP 10 time limit and area of operations.</b> Documentation showing RNP 10 time limit and the area of operation or routes for which the navigation system/aircraft is eligible. (Not applicable for aircraft equipped with GNSS.)		
F	<b>Maintenance programme</b> <ul style="list-style-type: none"> <li>For aircraft with established LRNS maintenance practices, the list of references of the document or programme.</li> <li>For recently installed LRNS, the maintenance practices for review.</li> </ul>		
G	<b>Minimum equipment list (MEL) (only for operators conducting operations based on a MEL):</b> MEL showing LRNS provisions.		

Annex	Title of Annex/document	Indication of inclusion by the operator	Comments by the Inspector
H	<b>Training</b> <b>1. LAR 91 operators or equivalent: Training method:</b> Training at home, LAR 142 training centres, or other training courses, course completion records. <b>2. LAR 121 and/or 135 operators or equivalent:</b> Training programmes (training curricula) for flight crews, flight dispatchers, and maintenance personnel.		
I	<b>Operating policies and procedures</b> <b>1. LAR 91 operators or equivalent:</b> Operations manual (OM) or sections to be attached to the application, corresponding to RNP 10 operating procedures and policies. <b>2. LAR 121 and/or 135 operators or equivalents:</b> Operations manual and checklists.		
J	<b>Past performance.</b> If any, previous problems, incidents, path-keeping errors, corrective action will be included.		
K	<b>Withdrawal of RNP 10 approval</b> Indication of the need to follow up on navigation error reports submitted and the possibility of withdrawal of RNP 10 approval.		
	<b>Validation flight plan:</b> Only if required by the CAA.		

**CONTENTS OF THE APPLICATION TO BE SUBMITTED BY THE OPERATOR**

 \_\_\_\_\_ **RNP 10 COMPLIANCE DOCUMENTATION OF THE AIRCRAFT/NAVIGATION SYSTEMS**

 \_\_\_\_\_ **OPERATING PROCEDURES AND POLICIES**

 \_\_\_\_\_ **SECTIONS OF THE MAINTENANCE MANUAL RELATED TO LRNS (if not previously reviewed)**
**Note 1:** Documents may be grouped in a single binder or may be submitted as individual documents.

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## PART 4: CONTENTS OF OPERATOR APPLICATION FOR RNP 10

#	Contents of the RNP 10 application by the operator	Reference paragraphs CA 91-001	In what Annexes/Documents of the operator can the application contents be located <b>Note: The operator must update this column to reflect the contents of the application</b>	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>Operator request letter</b> Statement of the intention to obtain RNP 10 approval.	Paragraph 9.1.1 b) 1) Appendix 2, Paragraph e)	Annex A		
2	<b>Aircraft/ navigation system RNP 10 eligibility method</b> Airworthiness documents that establish the aircraft/navigation system eligibility method, its approval status, and, in a format acceptable to the inspector, a list of airframes included in this method.	Paragraphs 8.2 and 8.3	Annex B Annex C		
2a	<b>Dual LRNS requirement</b> At least two LRNS with displays and functions suitable for oceanic operations are required.	Paragraph 8.1.1 Paragraph 10.2	Annex B Annex C		
3	<b>Time limit only for aircraft equipped with INS or IRU</b> RNP 10 time limit proposed or	Paragraph 8.4	Annex B Annex C		

#	Contents of the RNP 10 application by the operator	Reference paragraphs CA 91-001	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	approved for aircraft with INS or IRU as the only source of long-range navigation (LRN). (Not applicable for aircraft equipped with GNSS.)				
4	<b>RNP 10 area of operation for aircraft equipped only with INS and IRU.</b> Documentation establishing the area of operation or RNP 10 routes for which the navigation system/aircraft is eligible. (Not applicable for aircraft equipped with GNSS.)	Paragraphs 10.5 and 10.9 (Paragraphs 10.10 and 10.11, as applicable)			
5	<b>Training</b>  <b>1. LAR 91 operators or equivalent: Training methods:</b> The following methods are acceptable for these operators: Training at home, LAR 142 training centres, or other training courses.  <b>2. LAR 121 or 135 operators or equivalent: Training programmes:</b> Operators will develop an initial and periodic	Paragraph 12 b)  Paragraph 12 a)	Annex F		



#	Contents of the RNP 10 application by the operator	Reference paragraphs CA 91-001	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	training programme for flight crews, flight dispatchers, if applicable, and maintenance personnel.				
6	<b>Operating policies and procedures</b>  <b>1. LAR 91 operators or equivalent:</b> Operations manual or section of the operator application documenting RNP 10 policies and procedures.  <b>2. LAR 121 and/or 135 operators or equivalent:</b> Operations manual and checklists.	Paragraph 9.1.1 b) 6) (b)  Paragraph 9.1.1 b) 6) (a)	Annex G		
7	<b>Maintenance practices</b> <ul style="list-style-type: none"> <li>For aircraft with established LRNS maintenance practices, the operator will provide document references.</li> <li>For newly installed LRNS systems, the operator will provide maintenance practices for review.</li> </ul>	Paragraph 8.5 b)	Annex D		

#	Contents of the RNP 10 application by the operator	Reference paragraphs CA 91-001	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
8	<b>Minimum equipment list (MEL) update</b>  Applicable to operators conducting operations according to a MEL.	Paragraphs 8.5 a) and 9.1.1 b) 7)	Annex E		
9	<b>Past performance.</b> Performance record identifying previous problems, incidents, track keeping errors and corrective actions.	Paragraph 9.1.1 b) 10)			
10	<b>Withdrawal of RNP 10 operating authority</b>  Indication of the need for follow-up on the navigation error reports and the possibility of withdrawal of the RNP approval.	Paragraph 9.3	Annex H		
11	<b>Validation flight plan, only if required</b>  The validation flight plan will be presented only if required.	Paragraph 9.1.1 d)			

**PART 5 – GUIDE FOR DETERMINING RNP 10 AIRCRAFT ELIGIBILITY**

#	Topics	Reference paragraphs  CA 91-001	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>Group aircraft definition</b>	Paragraph 8.2.1	Annex B		
2	<b>Dual long-range navigation system (LRNS)</b>	Paragraph 10.2	Annex B		
3	<b>Eligibility Method 1.-</b> Eligibility of aircraft through RNP certification (RNP compliance documented in the AFM).	Paragraph 8.3.1 a)	Annex B		
4	<b>Eligibility Method 2.-</b> Eligibility of aircraft through previous certification of the navigation system.	Paragraph 8.3.1 b)	Annex B		
4a	INSs or IRUs approved according to LAR 121, Appendix G (time limit 6.2 hours)	Paragraph 8.3.1 b) 4)	Annex B		
4b	INSs or IRUs approved for MNPS operations in the North Atlantic or RNAV operations in Australia (time limit 6.2 hours)	Paragraph 8.3.1 b) 6)	Annex B		
4c	Obtaining of approval with extended time limit for aircraft equipped with INS or IRU systems	Paragraph 8.4	Annex B		
4d	GNSS (e.g., GPS) approved as primary means of navigation (AC 20-138 or equivalent)	Paragraph 8.3.1 b) 1)	Annex B		

#	Topics	Reference paragraphs <b>CA 91-001</b>	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
4e	Multi-sensor systems into which the GNSS (e.g., GPS) is integrated (AC 20-130 or equivalent)	Paragraph 8.3.1 b) 2)	Annex B		
4f	Equipment with a single GNSS and another approved LRNS (e.g., INS or IRU)	Paragraph 8.3.1 b) 7)	Annex B		
5	<b>Eligibility Method 3 – Eligibility through data collection</b>	Paragraph 8.3.1 c)	Annex B		
5a	Sequential method	Paragraph 8.3.1 c) 2) (a)	Annex B		
5b	Periodic method	Paragraph 8.3.1 c) 2) (b)	Annex B		

**PART 6 - BASIC PILOT PROCEDURES FOR RNP 10 OPERATIONS**

<b>Topics</b>		<b>Reference paragraphs CA 91-001</b>	<b>Location in the Annexes of the operator</b>	<b>Comments and/or recommendations by the CAA</b>	<b>Follow-up by the Inspector: Item status and date</b>
<b>Operating procedures</b>		Paragraph 11	Annex G		
1	<b>Flight planning</b>	Paragraph 11.1 a)			
	Verifying if aircraft has been approved for RNP 10 operations	Paragraph 11.1 a) 1)			
	Verifying that two LRNS are operational	Paragraph 11.1 a) 2)			
	Verifying if the RNP 10 time limit has been taken into account (only aircraft equipped with INS or IRU)	Paragraph 11.1 a) 3)			
	Verifying the requirements for GNSS, such as FDE, if applicable to the operation	Paragraph 11.1 a) 4)			
	Verifying if the letter "R" has been inserted in Box 10 of the ICAO flight plan (also insert the letter Z in that same box, and NAV/RNP 10 in Box 18 for WATRS plus spaces)	Paragraph 11.1 a) 5)			
	If required, taking into account any operational restriction related to RNP 10 approval for a specific	Paragraph 11.1 a) 6)			

Topics		Reference paragraphs CA 91-001	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	navigation system				
	Verifying the planned flight route, including the deviation to any alternate aerodrome, in order to identify the existing RNP types	Paragraph 11.1 a) 7)			
2	<b>Pre-flight procedures</b>	Paragraph 11.1 b)			
	Review flight technical records (maintenance logs) to ascertain the conditions of the equipment required for flight in RNP 10 airspace or route. Ensure that maintenance actions have been taken to correct defects in the required equipment	Paragraph 11.1 b) 1)			
	During the external inspection of the aircraft, check the condition of the navigation antennas and the condition of the fuselage skin around each of these antennas (this can be done by a competent and authorised person other than the pilot, like, for instance, an on-board mechanic or a maintenance person)	Paragraph 11.1 b) 2)			
	Review the emergency procedures for operations in RNP 10 airspace or routes. These are not different from the normal	Paragraph 11.1 b) 3)			

Topics		Reference paragraphs CA 91-001	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	oceanic emergency procedures, with one exception: crews must be capable of recognising, and the ATC must be notified, when the aircraft is no longer capable of flying at its capacity level according to the RNP 10 approval				
3	<b>En-route procedures</b>	Paragraph 11.1 c)			
	At the oceanic point of entry, at least two LRNS must be capable of navigating in RNP 10, otherwise, the crew will consider using an alternate route or initiating a deviation to repair the systems	Paragraph 11.1 c) 1)			
	Before entering oceanic airspace, aircraft position must be checked as accurately as possible using external navigation aids. This may require DME/DME or VOR checks to identify navigation system errors by comparing displayed and actual positions. If it is necessary to update the system, the appropriate procedures must be followed with the assistance of a prepared checklist	Paragraph 11.1 c) 2)			
	Operating procedures must include mandatory cross-check	Paragraph 11.1 c) 3)			

Topics	Reference paragraphs CA 91-001	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
procedures in order to identify navigation errors in advance and prevent the aircraft from inadvertently deviating from the routes authorised by the ATC				
Crews must notify the ATC of any degradation or failure of the navigation equipment below the navigation performance requirements, or of any deviation required for a contingency procedure	Paragraph 11.1 c) 4)			
Pilots must use a lateral deviation indicator, an FD or an AP in lateral navigation mode (LNAV) for RNP 10 operations. All pilots are expected to follow the route centreline, as represented on the on-board lateral deviation indicators and/or flight guidance, during all RNP 10 operations, unless authorised by the ATC to deviate or due to an emergency. For normal operations, the cross-track error/deviation (the difference between the path estimated by the RNP system and the position of the aircraft relative to the path) must be limited to $\pm \frac{1}{2}$ the navigation precision associated with the flight route (e.g., 5 NM). Small	Paragraph 11.1 c) 5)			



Topics		Reference paragraphs CA 91-001	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	lateral deviations from this requirement are allowed (e.g., overshooting or undershooting the path) during or immediately after an en-route turn, up to a maximum of 1 times (1xRNP) the navigation precision (e.g., 10 NM).  <i><b>Note.-</b> Some aircraft do not show or do not estimate a path during turns. Pilots of such aircraft may not be capable of meeting the <math>\pm \frac{1}{2}</math> precision requirement during en-route turns; however, they are expected to meet interception requirements after the turn or in the straight segments.</i>				
4	<b>Update the LRNS position</b>				
	Impact of en-route updates	Paragraph 10.9			
	Update the automatic position (as applicable).	Paragraph 10.10			

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**PART 7 - PROCEDURES FOR IN-FLIGHT CONTINGENCIES, DEVIATIONS DUE TO WEATHER CONDITIONS AND STRATEGIC LATERAL DISPLACEMENT**

Topics		CA 91-001 Reference paragraphs Doc 4444, Paragraph 15.2	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<b>Procedures</b>			Annex G		
1	<b>Special procedures for in-flight contingencies in oceanic airspace</b>	CA 91-001, Paragraph 11.1 d) 2) (a) Doc 4444, Paragraph 15.2			
	Introduction	CA 91-001, Paragraph 11.1 d) 2) (a) (1) Doc 4444, Paragraph 15.2.1			
	General procedures	CA 91-001, Paragraph 11.1 d) 2) (a) (2) Doc 4444, Paragraph 15.2.2			
	Extended range operations by aeroplanes with two turbine power-units (ETOPS)	CA 91-001, Paragraph 11.1 d) 2) (a) (3) Doc 4444, Paragraph 15.2.2.4			
2	<b>Procedures for deviations due to weather conditions</b>	CA 91-001, Paragraph 11.1 d) 2) (b) Doc 4444, Paragraph 15.2.3			
	General aspects	CA 91-001, Paragraph 11.1 d) 2) (b) (1)			

Topics		CA 91-001 Reference paragraphs Doc 4444, Paragraph 15.2	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
		Doc 4444, Paragraph 15.2.3.1			
	Measures to be taken when controller-pilot communications are established.	CA 91-001, Paragraph 11.1 d) 2) (b) (2) Doc 4444, Paragraph 15.2.3.2			
	Measures to be taken in order to obtain a revised ATC clearing.	CA 91-001, Paragraph 11.1 d) 2) (b) (3) Doc 4444, Paragraph 15.2.3.3			
<b>3</b>	<b>Procedures for strategic lateral displacement in oceanic airspace and remote continental areas.</b>	CA 91-001, Paragraph 11.1 d) 2) (c) Doc 4444, Paragraph 15.2.4			

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Job Aid

RNAV 10 (designated and authorised as RNP 10)

Version:

Original

Date:

12/10/2009

**APPENDIX B-1**

**ADVISORY CIRCULAR**

AC	:	91-002
DATE	:	12/10/09
REVISION	:	1
ISSUED BY	:	SRVSOP

**SUBJECT: AIRCRAFT AND OPERATORS APPROVAL FOR RNAV 5 OPERATIONS**

## ADVISORY CIRCULAR

AC : 91-002  
DATE : 12/10/09  
REVISION : 1  
ISSUED BY : SRVSOP

### SUBJECT: AIRCRAFT AND OPERATORS APPROVAL FOR RNAV 5 OPERATIONS

#### 1. PURPOSE

This advisory circular (AC) provides acceptable means of compliance (AMC) concerning aircraft and operators approval for RNAV 5 operations.

An operator may use alternative means of compliance, as far as those means are acceptable for their respective Civil Aviation Authority (CAA).

The use of the verb in future or the word "must", is applied to an applicant or operator choosing to fulfill the criteria described in this AC.

This AC also provides guidelines to operators when the stand-alone global positioning system (GPS) is used as the means of navigation in RNAV 5 operations (where the stand-alone GPS equipment provides the only RNAV capability installed on board the aircraft).

#### 2. LATIN AMERICAN AERONAUTICAL REGULATIONS (LAR) RELATED SECTIONS OR EQUIVALENT REGULATIONS

LAR 91: Sections 91.1015 and 91.1640 or equivalents

LAR 121: Section 121.995 (b) or equivalent

LAR 135: Section 135.565 (c) or equivalent

#### 3. RELATED DOCUMENTS

ICAO Doc 9613 Performance-based navigation (PBN) manual and its related documentation

EASA AMC 20-4 Airworthiness approval and operational criteria for the use of navigation systems in European airspace designated for Basic RNAV operations and its related documentation

FAA AC 90-96A Approval of U.S. operators and aircraft to operate under instrument flight rules (IFR) in European airspace designated for basic area navigation (B-RNAV) and precision area navigation (P-RNAV) and its related documentation

Spain DGAC CO 1/98 Resolution for operational approval and criteria for the use of navigation systems in European airspace designated for Basic RNAV operations

## 4. DEFINITIONS AND ABBREVIATIONS

### 4.1 Definitions

- a) **Navigation specifications.-** A set of aircraft and air crew requirements, needed to support performance based navigation operations within a defined airspace. There are two kinds of navigation specifications: RNAV and RNP. A RNAV specification does not include requirements for on-board performance monitoring and alerting. A RNP specification includes requirements for on-board performance monitoring and alerting.
- b) **Performance based navigation (PBN).-** Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.  
  
Note.— Performance requirements are expressed in navigation specifications (RNAV specification, RNP specification) in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept.
- c) **Area navigation (RNAV).-** A method of navigation which permits aircraft operation on any desired flight path within the coverage of ground or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these.  
  
Note.- Area navigation includes performance-based navigation as well as other operations that do not meet the definition of performance-based navigation.
- d) **RNAV operations.-** Aircraft operations using area navigation for RNAV applications. RNAV operations include the use of area navigation for operations which are not developed in accordance with the PBN manual.
- e) **Area navigation route.-** An Air traffic services (ATS) route established for the use of aircraft capable of employing area navigation.
- f) **Global positioning system (GPS).-** The United States Global navigation Satellite System (GNSS) is a satellite-based radio navigation system which utilizes precise range measurements to determine position, velocity and time in anywhere in the world. The GPS is composed by three elements: space, control, and user. The space element is formed of at least 24 satellites in 6 orbital planes. The control element consists of 5 monitor stations, 3 ground antennas, and a master control station. The user element consists of antennas and receivers that provide positioning, velocity and precise timing to the user.
- g) **RNAV System.-** Area navigation system, which permits aircraft operation on any desired flight path within the coverage of ground or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these. A RNAV system may be included as part of the Flight Management System (FMS)
- h) **Receiver Autonomous Integrity Monitoring (RAIM).-** A technique used within a GPS receiver/processor to determine the integrity of its navigation signals using only GPS signals, or GPS signals augmented with barometrical altitude data. This determination is achieved by a consistency check among redundant pseudo-range measurements. At least one additional satellite needs to be available in respect to the number of satellites that are needed to obtain the navigation solution.

## 4.2 Abreviaturas

a)	CAA	Civil Aviation Authority
b)	ADF	Automatic direction finder
c)	AIRAC	Aeronautical information regulation and control
d)	AC	Advisory circular (FAA)
e)	AFM	Aircraft flight manual
f)	AMC	Acceptable means of compliance
g)	ATS	Air traffic services
h)	CA	Advisory circular (SRVSOP)
i)	CDI	Course deviation indicator
j)	CDU	Control display unit
k)	CO	Operacional Circular (Spain)
l)	DME	Distance measuring equipment
m)	DOP	Dilution of precision
n)	EASA	European Aviation Safety Agency
o)	FAA	Federal Aviation Administration
p)	FDE	Fault detection and exclusion
q)	FTE	Flight technical error
r)	GNSS	Global navigation satellite system
s)	GPS	Global positioning system
t)	HSI	Heading situation indicator
u)	IFR	Instrument flight rules
v)	INS	Inertial navigation system
w)	IRS	Inertial reference system
x)	IRU	Unidad de referencia inercial
y)	LAR	Latin American Aeronautical Regulations
z)	LORAN C	Long range navigation
aa)	MEL	Minimum equipment list
bb)	NDB	Non-directional beacon
cc)	ND	Navigation display
dd)	NOTAM	Notice to airmen
ee)	ICAO	Internacional Civil Aviation Organization
ff)	OM	Operations manual
gg)	PBN	Performance based navigation
hh)	PF	Pilot flying



ii)	PNF	Pilot not flying
jj)	POH	Pilot operating handboock
kk)	RAIM	Receiver autonomous integrity monitoring
ll)	RNAV	Area navigation
mm)	SA	Selective availability
nn)	TACAN	Tactical air navigation
oo)	TCDS	Type certificate data sheet
pp)	TLS	Target level of safety
qq)	TSO	Technical standard order
rr)	VOR	Very high frequency (VHF) omni-directional radio range

## **5. INTRODUCTION**

5.1 In January 1998, the European Air Safety Agency (EASA) published the document related to the acceptable means of compliance (AMC 20-4) which replaced the Temporary guidance Leaflet No. 2 (TGL No. 2) issued by former JAA. This AMC contains acceptable means of compliance related to airworthiness approval and operational criteria for the use of navigation systems in European air space designated for basic area navigation operations (Basic RNAV or B-RNAV).

5.2 In the same manner, the Federal Aviation Administration (FAA) of the United States (U.S.) replaced the AC 90-96 of March 1998 by AC 90-96A issued in January 2005. This new circular provides guidance material in regards to the airworthiness and operational approval for operators of U.S. registered civil aircraft operating in European air space designated for Basic area navigation (B-RNAV) and Precision area navigation (P-RNAV).

5.3 Both current documents, AMC 20-4 and AC 90-96A, require similar operational and functional requirements.

5.4 In the context of the terminology adopted in the Performance based navigation manual (PBN manual) of the International Civil Aviation Organization (ICAO), B-RNAV requirements are termed RNAV 5.

5.5 The basis of specifications developed by EASA and FAA are supported on the capacity of RNAV equipments incorporated in the early 70s.

5.6 Since RNAV 5 operations implementation is accomplish in areas where there is no surveillance, such implementation requires an increase in route spacing to assure compliance of the Target level of safety (TLS).

5.7 RNAV 5 specification does not require an alert to the pilot in the event of excessive navigation errors, neither requires two RNAV Systems, thus, the potential for loss of RNAV capability requires the aircraft to be provided of an alternative navigation source.

5.8 The performance level selected for RNAV operations allows a wide range of RNAV systems to be approved for these operations, including INS with a two hour limit after its last alignment/position update performed on the ground, when they do not have a function for automatic radio updating of aircraft position.

5.9 Although RNAV 5 specification does not include requirements for on-board performance monitoring and alerting, it does require that the on-board equipment keeps a lateral and longitudinal navigation accuracy on route of  $\pm 5$  NM or better during 95% of the total flight time.

## **6. NAVAID INFRASTRUCTURE**

6.1 RNAV 5 systems allow an aircraft to navigate along any desired flight path within the coverage of ground or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of both methods.

6.2 RNAV operations are based in the use of RNAV equipment that automatically determines aircraft position in the horizontal plane using inputs from one or a combination of the following types of position sensors, together with the means to establish and follow a desired path:

- a) VOR/DME;
- b) DME/DME;
- c) INS or IRS;
- d) LORAN C; and
- e) GNSS or GPS

*Note.- the application of the sensors is subject to the limitations contained in this AC.*

6.3 It is acceptable to exist gaps in the navigation aid coverage, although, if this occurs, it must be considered route spacing and obstacle clearance surfaces for the expected increase in lateral track keeping errors during the “dead reckoning” phase of flight.

## **7. AIRWORTHINESS AND OPERATIONAL APPROVAL**

7.1 In order to the operator receives an RNAV 5 authorization, this must comply with two types of approval:

- a) Airworthiness approval in charge of the State of registry; (See Art. 31, Chicago Convention, Paragraph 5.2.3 and 8.1.1 of Annex 6, Part I; and
- b) Operational approval required by the State of the operator (See Paragraph 4.2.1 and Attachment F of Annex 6 Part I).

7.2 For general aviation operators, the State of registration (See Paragraph 2.5.2.2 of Annex 6 Part II) will submit a Letter of Appointment (LOA) once determined that the aircraft accomplishes all applicable requirements of this document for RNAV 5 operations.

7.3 Compliance with airworthiness requirements by themselves does not constitute the operational approval.

## **8. AIRWORTHINESS APPROVAL**

### **8.1 Aircraft equipment**

- a) An aircraft may be considered eligible for an RNAV 5 approval if it is equipped with one or more navigation systems approved and installed in accordance with the guide included in this document.
- b) An aircraft capacity to perform RNAV 5 operations can be demonstrated or reached in the following cases
  - 1) First case: Demonstrated capacity in the manufacturing process and declared in the Aircraft flight manual (AFM) or in the AFM supplement or in the Type certificate data sheet (TCDS) or in the Pilot operating handbook (POH).
  - 2) Second case: Capacity reached in-service:
    - (a) Through an evaluation of the navigation system of the aircraft which allows to determine its eligibility.

**8.2 Eligibility based on AFM or AFM supplement or TCDS or POH.** To determine eligibility of the aircraft in function of AFM or AFM supplement, TCDS or POH, aircraft RNAV 5 capacity must have been demonstrated in production (aircraft in manufacturing process or new construction).

a) **Aircraft RNAV 5 systems eligibility.**

- 1) An aircraft may be considered eligible for RNAV 5 operations, if AFM or AFM supplement or TCDS or POH shows the appropriate instruments flight rules (IFR) navigation system installation has received airworthiness approval in accordance with this AC or AMC 20-4 or with one of the following FAA documents:
  - (a) AC 90-96, AC 90-45A, AC 20-121A, AC 20-130, AC 20-138 o AC 25-15
- 2) Airworthiness approval guidance included in this AC provides aircraft navigation performance equivalent to EASA AMC 20-4 and FAA AC 90-96A.
- 3) Once aircraft eligibility has been established, operator approval will proceed, according to paragraph 9 of this AC.

b) **LAR 91 aircraft approval**

- 1) LAR 91 operators should revise the AFM or AFM supplement or TCDS or POH to assure that the aircraft navigation system is eligible to perform RNAV 5 operations, according to describe on paragraph 8.2 a) 1) of this AC.
- 2) After having determined eligibility of the navigation system, LAR 91 operators will present respective documents to the AAC.
- 3) In case LAR 91 operators are not able to determine, based on the AFM or AFM supplement or TCDS or POH, whether the Aircraft system has been installed and approved according with an appropriate CA or AC or AMC, they will proceed according to paragraph 8.3. of this document.

c) **LAR 121 and/or 135 aircraft approval**

- 1) LAR 121 and/or 135 operators will present the following documents to AAC:
  - (a) Sections of the AFM or AFM supplement or TCDS that document airworthiness approval in accordance with this AC or with guidance materials mentioned in Paragraph 8.2 a) 1) of the this document.
- 2) These operators will ensure that the aircraft navigation system will meet the functions required in paragraph 8.6 of this CA.

- 3)
- 4) In case a LAR 121 and/ or 135 operator is not able to determine, based on the AFM or AFM supplement or TCDS, whether the system has been installed and approved according to an appropriate CA or AC or AMC, it will proceed in accordance with the steps established in the following paragraph.

**8.3 Eligibility not based on AFM or TCDS or AFM Supplement or POH – RNAV 5 capacity reached during service.**

a) *Determination of the aircraft eligibility through evaluation of its navigation equipment.*

- 1) The operator makes a request for assessment of aircraft RNAV equipment for eligibility to the airworthiness inspection Direction or equivalent CAA entity. The operator, together with the request, will provide the following:
  - (a) RNAV system make, model and part number;
  - (b) evidence that the equipment meets lateral and longitudinal navigation accuracy on route of  $\pm 5$  NM or better during 95% of the total flight time. This can be determined through the evaluation of system design. Evidence of meeting the requirements of another AC can be used for this purpose.
  - (c) proof that the system meets the required functions for RNAV 5 operations described in this CA on paragraph 8.6.
  - (d) crew operating procedures and bulletins; and
  - (e) any other pertinent information required by the CAA.
- 2) in case the airworthiness inspection Direction or CAA equivalent entity is not able to determine RNAV equipment eligibility, evaluation request together with supporting documents will be forward to the aircraft certification Direction or equivalent entity from the State of registry. In any case, aircraft certification Division or equivalent will inform to airworthiness inspection Direction or CAA equivalent entity about the eligibility of the proposed equipment to perform RNAV 5 operations.
- 3) *LAR 91 Operators.*- Once the CAA has determined the aircraft equipment is eligible for RNAV 5 operations, the airworthiness inspection Direction or CAA equivalent entity will issue a letter of finding documenting that the aircraft RNAV equipment is eligible to perform those operations.
- 4) *LAR 121 or 135 operators.*- The CAA will verify aircraft RNAV system eligibility including the required functions on paragraph 8.6 of this AC.

**8.4 Limitations on the design and/or use of navigation systems.**- Although the following navigation systems offer RNAV capability, these present limitations for their use in RNAV 5 operations.

a) **Inertial navigation systems/Inertial reference systems (INS/IRS)**

- 1) Inertial systems may be used either as a stand alone inertial navigation system (INS) or as an inertial reference (IRS) acting as part of a multi-sensor RNAV system where inertial sensors provides augmentation to the basic position sensors as well as a reversionary position data source when out of cover of radio navigation sources.

- 2)
  - 3) INS without a function for automatic radio updating of aircraft position and approved in accordance with FAA AC 25-4, when complying with the functional criteria of paragraph 8.6 of this AC, may be used only for a maximum of two (2) hours from the last alignment/position update performed on ground. Consideration may be given to specific INS configurations (e.g. triple mix) where either equipment or aircraft manufacturer's data justifies extended use from the last position update.
  - 4) INS without automatic radio updating of aircraft position, including those systems where manual selection of radio channels is performed in accordance with flight crew procedures, must be approved in accordance with FAA AC 90-45A or AC 20-130A or any other equivalent document.
- b) **VHF omni-directional radio range (VOR)**
- 1) VOR accuracy can typically meet accuracy requirements for RNAV 5 up to 60 NM from the navigation aid and Doppler VOR up to 75 NM. Specific regions within the VOR coverage may experience larger due to propagation effect (e.g. multipath). Where such errors exist this can be accommodated by prescribing areas where the affected VOR may not be used.
- c) **Distance measuring equipment (DME)**
- 1) DME signals are considered sufficient to meet requirements of RNAV 5 wherever the signals are received and there is no closer DME on the same channel, regardless of the published coverage volume. Where the RNAV 5 system does not take account of published "Designated operational coverage" of the DME, the RNAV system must execute data integrity checks to confirm that the correct DME signal is being received.
- d) **Long Range Navigation (LORAN C)**
- 1) Use of Loran-C, in compliance with FAA AC 20-121A, is considered an acceptable means to comply with RNAV 5 in those areas and on routes with acceptable Loran-C coverage. Loran-C users must refer to the AFM or POH to determine if operational use of the Loran system is limited to a specified Loran-C Operational Area.
- e) **Global navigation satellite system (GNSS)**
- 1) **Global positioning system (GPS)**
    - (a) The use of GPS to perform RNAV 5 operations is limited to equipment approved in accordance with the TSO-C 129(), TSO-C-145() and TSO-C-146() from FAA or ETSO-129(), ETSO-145() and ETSO-146() from EASA or equivalent documents which include the minimum systems functions specified in the present CA on Paragraph 8.6.
    - (b) The integrity of GPS system must be provided by the receiver autonomous integrity monitoring (RAIM) or an equivalent means within a multi-sensor navigation system. The equipment must be approved in accordance with the AMC 20-5 or equivalent document. In addition, stand-alone GPS equipment must include the following functions according to the TSO-C 129A or ETSO-129A criteria:
      - Pseudorange step detection; and
      - Health word checking
    - (c) Compliance with these two requirements can be determined the following way:

- A statement in the AFM or POH indicating the GPS equipment meets the criteria for primary means of navigation in oceanic and remote airspace; or
  - a placard on the GPS receiver certifying it meets TSO-C 129A, TSO-C-145A and TSO-C-146A from FAA or ETSO-129A, ETSO-145A and ETSO-146A from EASA; or
  - a CAA letter of design approval for the applicable equipment. Operators should contact the avionics equipment's manufacturer to determine if the equipment complies with these requirements and ask if a letter of design approval is available. Manufacturers may obtain this letter by submitting appropriate documentation to the certification offices of the States of aircraft design or manufacturer. Operators will keep the letter of design approval within the AFM or POH as evidence of the RNAV 5 eligibility. Any limitations included in the letter of design approval should be reflected in a letter of finding to LAR 91 operators or in the operations specifications (OpSpecs) for LAR 121 and/or 135 operators.
- (d) Traditional navigation equipment (e.g., VOR, DME and automatic direction finder (ADF)) must be installed and operative, so as to provide an alternative navigation means of navigation.
- (e) Where approval for RNAV 5 requires the use of traditional navigation equipment as a back up in the event of loss of GPS, the required navigation aids as defined in the approval (e.g. VOR, DME and/or Non directional beacon (NDB)) must be installed and serviceable.

## 2) Stand-alone GPS equipment

- i. Stand-alone GPS equipment approved in accordance with guidance provided in this AC, may be used in RNAV 5 operations, subject to the limitations included in this document. Such equipment must be operated in accordance with procedures acceptable to the CAA. The flight crew must receive appropriate training for use the stand-alone GPS equipment regarding normal and contingency procedures detailed in the Paragraph 10 of this AC.

## 8.5 RNAV-5 system requirements

### a) Accuracy

- 1) The navigation performance of aircraft approved for RNAV 5 requires a track keeping accuracy equal to or better than  $\pm 5$  NM during the 95% of the flight time. This value includes signal source error, airborne receiver error, display system error and flight technical error (FTE).
- 2) This navigation performance assumes the necessary coverage provided by satellite or ground based navigation aids is available for the intended route to be flown.

### b) Availability and integrity

The minimum level of availability and integrity required for RNAV 5 systems can be met by a single installed system comprising by:

- 1) one sensor or a combination of the following sensors: VOR/DME, DME/DME, INS or IRS, LORAN C and GNSS or GPS;

- 2)
- 3) RNAV computer;
- 4) control display unit (CDU); and
- 5) navigation display(s) [(e.g. navigation display (ND), horizontal situation indicator (HSI) or course indicator deviation (CDI)].

provided that the system is monitored by the flight crew and that in the event of a system failure the aircraft retains the capability to navigate relative to ground based navigation aids (e.g. VOR, DME and NDB).

## 8.6 Functional requirements

- a) *Required Functions.*- The following system functions are the minimum required to conduct RNAV 5 operations:
  - 1) Continuous indication of the aircraft position relative to track to be displayed to the pilot flying (PF) on a navigation display situated in his primary field of view;
  - 2) In addition, where the minimum flight crew is two pilots, indication of the aircraft position relative to track to be displayed to the pilot not flying (PNF) on a navigation display situated in his primary field of view.
  - 3) Display of distance and bearing to the active (To) waypoint;
  - 4) Display of ground speed or time to active (To) waypoint;
  - 5) Storage of a minimum of 4 waypoints; and
  - 6) Appropriate failure indication of the RNAV system, including the sensors failure.
- b) *RNAV 5 navigation displays*
  - 1) Navigation data must be available for display either on a display forming part of the RNAV equipment or on a lateral deviation display (e.g. CDI, (E)HSI, or a navigation map display).
  - 2) These displays must be used as primary flight instruments for the navigation of the aircraft, for maneuver anticipation and for failure/status/integrity indication. They should meet the following requirements:
    - (a) The displays must be visible to the pilot when looking forward along the flight path.
    - (b) The lateral deviation display scaling should be compatible with any alerting and annunciation limits, where implemented.
    - (c) The lateral deviation display must have a scaling and full-scale deflection suitable for the RNAV 5 operation.

## 9. OPERATIONAL APPROVAL

- 9.1 *Requirements to obtain the operational approval.*- To obtain the operational approval, the operator will comply with the following steps considering the operational procedures established in Paragraph 10 of this AC.
  - a) *Airworthiness approval.*- The Aircraft must have the corresponding airworthiness approvals as mentioned in Paragraph 8 of this CA.
  - b) *Documentation.*- The operator will present to the AAC the following documents:

- c)
- 1) The application for RNAV 5 operational approval;
  - 2) Amendments to the operations manual (OM) which must include operations procedures according to what is described in Paragraph 10 of this CA, for crews and dispatchers, if applicable;
  - 3) Amendments, when applicable, of maintenance manuals and programs which must have the maintenance procedures for the new equipment, as well as the training of the maintenance associated personnel;
  - 4) A copy of the AFM parts, or AFM supplement or TCDS or POH, to verify the airworthiness approval for RNAV 5 for each affected aircraft;
  - 5) The amendments to the Minimum Equipment List (MEL), which must identify the minimum necessary equipment to comply with RNAV 5; and
  - 6) Training programs or amendments to the operator's training program for crews and flight dispatchers, if applicable, according to what is described in Paragraph 11 of this document;
- d) *Training.*- Once the amendments to manuals, programs and documents have been accepted or approved, the operator will provide required training to its personnel.
- e) *Validation flights.*- The AAC may perform a validation flight, if determines it is necessary in the interest of safety.
- 9.2 *Authorization issuance to perform RNAV 5 operations.*- Once the operator has successfully completed the operational approval process, the AAC will issue the operator, when applicable, the corresponding authorization to perform RNAV 5 operations.
- a) *LAR 91 operators.*- For LAR 91 operators, the AAC does will issue a letter of authorization (LOA).
  - b) *LAR 121 and/or 135 operators.*- For LAR 121 and/or LAR 135 operators, the AAC will issue the corresponding OpSpecs, which will show RNAV 5 authorization.

## 10. OPERATION PROCEDURES

### 10.1 *Flight planning.*

- a) Before operating on a RNAV 5 route, the operator will ensure that:
  - 1) The aircraft counts on a RNAV 5 approval;
  - 2) Routes correspond to the authorization;
  - 3) The necessary equipment to operate RNAV 5 work correctly and are not degraded;
  - 4) Navigation aids based on space or ground are available;
  - 5) The crews check the contingency procedures.
- b) *Stand-alone GPS equipment.* During the planning phase the following procedures must be accomplish in regards to the stand-alone GPS equipment:
  - 1) An aircraft can depart without further action in the following cases, when:
    - (a) all satellites are scheduled to be in service; or



- (b) one satellite is scheduled to be out of service in case of GPS equipment that includes barometrical altitude.
  - 2) The availability of GPS integrity RAIM shall be confirmed for the intended flight (route and time) through the use of a prediction program either ground-based or incorporated in the on-board system, following the criteria established in Appendix 1 of the CAA, when:
    - (a) any satellite is scheduled to be out of service; or
    - (b) more than one satellite is scheduled to be out of service in case of GPS equipment that includes barometric altitude.
  - 3) This prediction is required for any route and route segment RNAV 5 based upon the use of GPS.
  - 4) The specified route of flight, including trajectory to any alternative aerodrome will be defined by a series of waypoints and by the estimated time of pass over them for a speed or series of speed, which at the same time will be in function of the intensity and previous wind direction.
  - 5) Taking in consideration that during flight may occur deviations in regards to the specified ground speed, prediction must be done using different speeds within the predictable margin for them.
  - 6) Prediction program must be executed with a maximum anticipation of two hours preview to the flight departure. The operator will confirm that data about the state of the constellation and GPS ephemerides, have been updated with the latest information distributed by notice to airmen (NOTAM).
  - 7) In order to get exact prediction, the program will allow manual de-selection of satellites considered non operative, as well as selection of those back to service condition during the flight time.
  - 8) The operator will not dispatch or release a flight in case of continuous prediction loss of RAM higher than 5 minutes to any part of the previewed route. In this event, flight can be delayed, cancelled or re-routed in which RAM requirements may be accomplished.
- c) *ATS – ICAO flight plan.*- At the time to file the ATS flight plan, authorized aircraft operators on RNAV 5 route, will insert corresponding code on flight plan form's box 10 (equipment), as defined within ICAO Doc 7030 for these operations.
- 10.2 Preview flight procedures at the aircraft.- The crew will perform on the aircraft the following procedures preview to the flight:
- a) check registrations and forms to be sure that maintenance actions have been taken in order to correct defects in the equipment; and
  - b) check data base validation (current AIRAC cycle), if it is installed.
- 10.3 *En route operations.*
- a) The crew will assure the aircraft correct functioning of its navigation system during its operation in a RNAV 5 route, confirming that:
    - 1) necessary RNAV 5 equipment have not degraded during flight;
    - 2) route corresponds to the authorization;

- 3) aircraft navigation accuracy is pertinent for RNAV 5, assuring this through pertinent cross check; and
- 4) others navigation aids (for example VOR, DME y ADF) must be selected in a way to permit a cross check or immediate reversion in the event of a RNAV capacity loss.

#### 10.4 Contingency procedures.

- a) Flight crews must familiarize with the following general provisions:
  - 1) An aircraft must not enter or continue the operations in airspace designated as RNAV 5, according to the present ATC authorization, if because of a failure or degradation the navigation systems falls under RNAV 5 requirements, the pilot will obtain as soon as possible an amended authorization;
  - 2) According to ATC instructions, operations will continue in regards to the present ATC authorization, or when not possible, will be requested a revised authorization to return to the VOR/DME conventional navigation;
  - 3) in the event of communications failure, the flight crew must continue with the flight plan, in accordance with the published lost communication procedures; and
  - 4) in any case, the crew must follow contingency procedures established for every operation region, and obtain an ATC authorization as soon as possible.
- b) Stand-alone GPS equipment.
  - 1) The operating procedures must identify the flight crew actions required in the event of RAIM function loss or exceedance of integrity alarm limit (erroneous position). This procedures must include:
    - (a) In case of loss of the RAIM detection function.- The flight crew may continue navigating with the GPS equipment. The flight crew should attempt to cross-check the aircraft position with the information provided for the ICAO conventional nav aids: VOR, DME and ADF, in order to confirm the existence of a required level of precision. In other case, the crew must revert to an alternative navigation means;
    - (b) In the event of an observed failure (including the failure of a satellite impacting the performance of the navigation systems based on GPS), the flight crew must revert to an alternative means of navigation.
    - (c) In case of exceedance of the alarm limit.- The flight crew must revert to an alternative means of navigation.
  - 2) *On-board equipment availability VOR, DME, TACAN or ADF.*- The operator must have installed on the aircraft the VOR, DME, TACAN or ADF on-board equipment capacity according to the applied rules of operation LAR 91, 121 and 135. This capacity must be available along the intended route of flight to assure the availability of navigation alternative means in case of a GPS/RNAV system failure.
- c) Any incidence registered in flight must be notified to the AAC in a maximum time of seventy two hours, unless justified cause.

**11. NAVIGATION ERROR REPORTS FOLLOW UP PROCESS**

- a) The operator will establish a process to receive, analyze and do a follow up of the navigation error reports which allow determine the appropriate corrective action.
- b) Repetitive navigation error occurrences, attributed to a specific part of the navigation equipment must be analyzed in order to correct its cause.
- c) The nature and severity of the error may result in temporary withdrawn of the authorization to use the navigation equipment until the cause of the problem has been identified and rectified.

**12. INSTRUCTION PROGRAM**

- a) The training programs for flight crews and flight dispatchers, if correspond, must be reviewed and approved by the AAC. The operator will included at least the following modules:
  - 1) Required equipments, capacities, limitations and operation of these equipments in RNAV 5 airspace.
  - 2) The routes and airspace for which the RNAV system is approved to operate.
  - 3) The navaid limitations in respect of the operation of the RNAV system to be used for the RNAV 5 operation.
  - 4) Contingency procedures for RNAV failures.
  - 5) The Radio/Telephony Phraseology for the airspace in accordance to Doc 4444 and Doc 7030 as appropriate.
  - 6) The flight planning requirements for the RNAV operation.
  - 7) RNAV requirements as determined from chart depiction and textual description.
  - 8) RNAV 5 en route procedures;
  - 9) Methods to reduce navigation errors through dead-reckoning techniques.
  - 10) RNAV system-specific information, including:
    - (a) Levels of automation, mode annunciations, changes, alerts, interactions, reversions, and degradation.
    - (b) Functional integration with other aircraft systems.
    - (c) Monitoring procedures for each phase of flight (for example, monitor PROG or LEGS page).
    - (d) Types of navigation sensors (for example, DME, IRU, GNSS) utilized by the RNAV system and associated system prioritization/weighting/logic.
    - (e) Turn anticipation with consideration to speed and altitude effects.
    - (f) Interpretation of electronic displays and symbols.
  - 11) RNAV equipment operating procedures, as applicable, including how to perform the following actions:
    - (a) Verify currency of aircraft navigation data.
    - (b) Verify successful completion of RNAV system self-tests.

- (c) Initialize RNAV system position.
  - (d) Fly direct to a waypoint.
  - (e) Intercept a course/track.
  - (f) Be vectored off and rejoin a procedure.
  - (g) Determine cross-track error/deviation.
  - (h) Remove and reselect navigation sensor input.
  - (i) When required, confirm exclusion of a specific navigation aid or navigation aid type.
  - (j) Perform gross navigation error check using conventional navigation aids.
- b) Training program on the GPS as a primary means of navigation.
- 1) Besides the training modules describe on the previous paragraphs, operators' training programs which use RNAV systems based on GPS as a primary navigation means will include modules described in Appendix 2.

## Appendix 1

### GPS integrity monitoring (RAIM) prediction program

Where a GPS integrity monitoring (RAIM) prediction program is used as a means of compliance with paragraph 5.2 (a) of this document, it should meet the following criteria:

- a) The program should provide prediction of availability of the integrity monitoring (RAIM) function of the GPS equipment, suitable for conducting RNAV 5 operations in designated European airspace.
- b) The prediction program software should be developed in accordance with at least RTCA DO 178B/EUROCAE 12B, Level D guidelines.
- c) The program should use either a RAIM algorithm identical to that used in the airborne equipment or an algorithm based on assumptions for RAIM prediction that give a more conservative result.
- d) The program should calculate RAIM availability based on a satellite mask angle of no less than 5 degrees, except where use of lower mask angle has been demonstrated to be acceptable to the authority.
- e) The program should have the capability to manually designate GPS satellites which have been notified as being out of service for the intended flight.
- f) The program should allow the user to select:
  - 1) the intended route and declared alternates; and
  - 2) the time and duration of the intended flight.

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## Appendix 2

### Training program on the GPS as a primary means of navigation

The training programs for flight crews that use RNAV 5 systems based on the GPS as a primary means of navigation, will include a segment with the following training modules:

- a) GPS system components and operating principles.- Understanding of the GPS system and its operating principles:
  - 1) GPS system components: control segment, user segment, and space segment;
  - 2) on-board equipment requirements;
  - 3) GPS satellite signals and pseudo-random code;
  - 4) positioning principle;
  - 5) receiver clock error;
  - 6) masking function;
  - 7) performance limitations of the different types of equipment;
  - 8) WGS84 coordinate system;
- b) Navigation system performance requirements.- Define the following terms in relation to the navigation system and evaluate the degree of compliance by the GPS system of the requirements associated with the following terms:
  - 1) precision;
  - 2) integrity;
    - (a) means to improve GPS integrity: RAIM and fault detection and exclusion (FDE)
  - 3) availability;
  - 4) service continuity
- c) Authorizations and documentation.- Requirements applicable to pilots and navigation equipment for GPS operation:
  - 1) pilot training requirements;
  - 2) aircraft equipment requirements;
  - 3) AFM system certification criteria and limitations;
  - 4) GPS-related NOTAMs.
- d) GPS system errors and limitations.- Cause and magnitude of typical GPS errors:
  - 1) ephemerides;
  - 2) clock;
  - 3) receiver;
  - 4) atmospheric/ionospheric;
  - 5) multi-reflection;

- 6) selective availability (SA);
  - 7) total typical error associated to the C/A code;
  - 8) effect of the dilution of precision (DOP) on the position;
  - 9) susceptibility to interference;
  - 10) comparison of vertical and horizontal errors; and
  - 11) path-tracking precision. Collision avoidance.
- e) Human factors and GPS.- Limitations on the use of GPS equipment due to human factors. Operating procedures that offer protection against navigation errors and loss of awareness of the real situation due to the following causes:
- 1) mode errors;
  - 2) data entry errors;
  - 3) data checks and validation, including independent cross-checking procedures;
  - 4) automation-induced relaxation;
  - 5) lack of standardization of GPS equipment;
  - 6) information processing by humans and situational awareness.
- f) GPS equipment – Specific navigation procedures.- Knowledge of the appropriate operating procedures for GPS in the typical navigation tasks for each specific type of equipment in each type of aircraft that includes:
- 1) selection of the appropriate operating mode;
  - 2) review of the different types of information contained in the navigation database;
  - 3) forecast of the availability of the RAIM function;
  - 4) procedure for entering and checking the waypoints defined by the user;
  - 5) procedure for entering, retrieving and checking flight plan data;
  - 6) interpretation of the typical information shown on the GPS navigation display: LAT/LONG, distance and heading to the waypoint, CDI;
  - 7) interception and maintenance of the GPS-defined routes;
  - 8) in-flight determination of ground speed (GS), estimated time of arrival (ETA), time and distance to the waypoint;
  - 9) indication of waypoints over flight;
  - 10) use of the “DIRECT TO” function;
  - 11) use of the “NEAREST AIRPORT” function;
  - 12) use of the GPS in GPS or DME/GPS arrival procedures.
- g) Verification of GPS equipment.- For each type of equipment in each aircraft, the following operational and start-up checks must be conducted at the appropriate time:
- 1) constellation status;



- 2) RAIM and FDE functional status;
  - 3) dilution of precision (DOP) status;
  - 4) currency of the instrument flight rules (IFR) database;
  - 5) receiver operating condition;
  - 6) CDI sensitivity;
  - 7) position indication.
- h) GPS messages and warnings.- For each type of equipment in each aircraft, timely action must be recognized and taken in face of GPS messages and warnings, including the following:
- 1) loss of RAIM function;
  - 2) 2D/3D navigation;
  - 3) dead-reckoning navigation mode;
  - 4) database not updated;
  - 5) loss of the database;
  - 6) GPS equipment failure;
  - 7) barometric data entry failure;
  - 8) power failure;
  - 9) prolonged parallel displacement; and
  - 10) satellite failure.

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### Appendix 3

#### RNAV 5 approval process

- a) The RNAV 5 approval process is comprised of two types of approvals: the airworthiness approval and the operational approval, even though, they have different requirements, both must be considered under one process only.
- b) This process constitutes a well-arrange method, which is used by the CAA to ensure the applicants comply with the established requirements.
- c) The approval process is conformed by the following phases:
  - 1) Phase one: Pre-application
  - 2) Phase two: Formal application
  - 3) Phase three: Analysis of the documentation
  - 4) Phase four: Demonstration and inspection
  - 5) Phase five: Approval
- d) *In Phase One - Pre-application*, the CAA holds a meeting with the operator (the pre-application meeting), in which the operator will be informed about all the requirements that he needs to comply during the approval process.
- e) *In Phase Two - Formal application*, the operator submits the formal application with all applicable documents.
- f) *In Phase Three - Analysis of the documentation*, the CAA reviews the submission and evaluates the navigation equipment in order to determine the method of approval (aircraft equipment eligibility). As a result of this evaluation the CAA may accept or return the Formal Application with the documentation.
- g) *In Phase Four - Demonstration and inspection*, the operator will accomplish the training program and the validation flight if this is required by the CAA, otherwise the process will advance to the next phase.
- h) *In phase Five - Approval*, the CAA issues the RNAV 5 authorization, once the operator has completed the airworthiness and operations requirements. For LAR 121 and/or 135 operators, the AAC will issue the OpSpecs and for LAR 91 operators will issue a LOA.

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**APPENDIX B-2**

**RNAV 5 JOB AID**

**OPERATOR APPLICATION TO CONDUCT RNAV 5 OPERATIONS**

## **RNAV 5 JOB AID**

### **OPERATOR APPLICATION TO CONDUCT RNAV 5 OPERATIONS**

#### **1. Introduction**

This job Aid was developed by the Regional Cooperation System for Safety Oversight (SRVSOP) to provide guidance to States, operators and inspectors on the process for operators to obtain RNAV 5 authorization.

#### **2. Purposes of this Job Aid**

- 2.1 Provide RNAV 5 reference documents for operators and inspectors.
- 2.2 Provide a series of tables that show: the content of an application, related reference paragraphs, location in operator application where RNAV 5 elements are addressed and columns for the inspector to comment on, and track the status of various RNAV 5 elements.

#### **3. Recommended inspector and operator actions**

The following are suggestions on how the Job Aid can be used:

- 3.1 Inspector reviews the basic events in the RNAV 5 approval process in Part 1 with the operator in the pre-application meeting to provide an overview of approval process events.
- 3.2 Inspector reviews this Job Aid with the operator to establish the form and content of the operator application for RNAV 5 authority.
- 3.3 Operator uses the Job Aid as guide to assemble documents/exhibits for its application for RNAV 5.
- 3.4 Operator annotates Job Aid to show location of RNAV 5 program elements in the operator exhibits/documents.
- 3.5 Operator submits Job Aid and RNAV 5 operator application (exhibits/documents) to inspector
- 3.6 Inspector annotates Job Aid to show task or document “complete/satisfactory” or “open/further operator action required”.
- 3.7 Inspector informs the operator as soon as possible, when further operator action is required.
- 3.8 Operator provides inspector, when requested, with revised material.
- 3.9 The CAA issues the operations specifications (OpSpecs) or a letter of authorization (LOA) as applicable, to operator when required tasks and documents are completed.

#### 4. Job Aid organization

Parts	Subjects	Page
Part 1	General information	4
Part 2	Operator and aircraft identification information	6
Part 3	Content of operator application for RNAV 5 authorization	7
Part 4	Operator application for RNAV 5 authority (documents to be sent to the AAC)	10
Part 5	Guide for determining RNAV 5 aircraft eligibility	13
Part 6	Basic flight crew procedures for RNAV 5 operations	16

#### 5. Primary source of documents, information and contacts

For accessing to the Advisory Circular CA 91-002, enter to the ICAO/SAM Regional Office Webpage ([www.lima.icao.int](http://www.lima.icao.int)) under SRVSOP.

#### 6. Primary documents of reference

Documents of reference	Subjects
ICAO Doc 9613	Performance based navigation manual
AMC 25-11	Electronic display system
AMC 20-5	Acceptable means of compliance for airworthiness approval and operational criteria for the use of the NAVSTAR Global positioning system (GPS)
AC 20-121A	Airworthiness approval of LORAN C for use en the U.S National Airspace System
AC 20-130()	Airworthiness approval of multi-sensor navigational system for use in the U.S. National Airspace System
AC 20-138A	Airworthiness approval of Global navigation satellite system (GNSS) equipment
AC 25-4	Inertial navigation system (INS)
AC 25-15	Approval of FMS in transport category airplanes
AC 90-45A	Approval of areas navigation systems for use in the U.S. National Airspace System
ETSO-C115b	Airborne area navigation equipment using multi sensor input
ETSO-C129A	Airborne supplemental navigation equipment using the Global positioning system (GPS)
ETSO-C145	Airborne navigation sensors using the Global positioning system (GPS) augmented by wide area augmentation system (WAAS)
ETSO-C146	Stand-alone airborne navigation equipment using the Global positioning system (GPS) augmented by the wide area augmentation system (WAAS)
TSO-C115, any version	Airborne area navigation equipment using multi-sensor inputs
TSO-C129/C129A	Airborne supplemental navigation equipment using the global positioning system (GPS)
TSO-C145A	Airborne navigation sensors using the Global positioning system (GPS) augmented by the wide area

	augmentation system (WAAS)
TSO-C146A	Stand-alone airborne navigation equipment using the Global positioning system (GPS) augmented by the wide area augmentation system (WAAS)
RTCA/DO-200A	Standards for processing aeronautical data
RTCA/DO-201A	Standards for aeronautical information
RTCA/DO-208	Minimum operational performance standards for airborne supplemental navigation equipment using Global positioning system (GPS)
RTCA/DO-229C	Minimum operational standards for Global positioning system/Wide area augmentation system airborne equipment
RTCA/DO-236A	Minimum aviation system performance standards: Required navigation performance for area navigation
RTCA/DO-178B	Software consideration in airborne systems and equipment certification



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**PART 1: GENERAL INFORMATION****Basic events in RNAV 5 authorization process**

	<b>Operator actions</b>	<b>CAA actions (inspectors)</b>
1	Establishes need to obtain authority for RNAV 5 operations.	
2	Reviews AFM, AFM Supplement or Type Certificate Data Sheet (TCDS) or others appropriate documents (e.g., Service Bulletins, Service Letters) to determine Aircraft eligibility for RNAV 5. Operator contacts airplane or avionics manufacturer, if necessary, to confirm airplane eligibility for RNAV 5.	
3	Contacts to the AAC to arrange a pre-application meeting to discuss requirements for operational approval. .	
4		During pre-application meeting, establishes: <ul style="list-style-type: none"> <li>• form and content of operator application;</li> <li>• the date when operator application should be submitted for evaluation</li> </ul>
5	Submits operator application to the AAC at least 60 days in advance of the planned start of RNAV 5 operations.	
6		Reviews operator application
7	Once the amendments to the manuals, programs and documents have been accepted or approved, the operator provides training to the flight crew, flight dispatchers and maintenance personnel and performs a validation flight in case of that flight is required by the AAC.	
8		Issues operational approval in the form of OpSpecs for LAR 121 and/or 135 or a letter of authorization (LOA) for LAR 91 operators.

**Notes related with the approval process****1. Responsible Authority.**

- a. **Commercial Air Transport - LAR 121 and/or 135 or equivalent regulations operators.- The State of registry** makes the determination that the Aircraft meets the applicable RNAV 5 requirements. The State of Operator issues operating authority (e.g., OpSpecs).

- b. **General aviation - LAR 91 or equivalent regulations operators.-** The **State of registry** makes determination that aircraft meets the applicable RNAV 5 requirements and issues a LOA.
- 2. Sections related to the Latin American Aeronautical Regulations (LAR) or equivalents.
  - a. LAR 91        Section 91.1015 and 91.1640 or equivalents
  - b. LAR 121      Section 121.995 (b) or equivalent
  - c. LAR 135      Section 135.565 (c) or equivalent
- 3. Others related ICAO documents
  - a. Annex 2 – Rules of the air
  - b. Doc 4444 – Procedures for Air Navigation Services – Air Traffic Management.

**PART 2: AIRCRAFT AND OPERATORS IDENTIFICATION INFORMATION**

OPERATOR NAME: \_\_\_\_\_

Aircraft make, model and series	Registration number(s)	Serial number(s)	RNAV navigation systems: Number, manufacturer and model	Navigation specification requested

DATE OF PRE-APPLICATION MEETING \_\_\_\_\_

DATE APPLICATION RECEIVED: \_\_\_\_\_

DATE OPERATOR PLANS TO START RNAV 5 OPERATIONS \_\_\_\_\_

¿IS THE NOTIFICATION TIME TO CAA ADEQUATE? YES \_\_\_\_ NO \_\_\_\_

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## PART 3: CONTENT OF OPERATOR APPLICATION FOR RNAV 5

#	Content of operator application for RNAV 5	Reference paragraphs CA 91-002	Where found in operator exhibit/documents Note: operator should update this column to reflect the content of its application	Inspector recommendation and /or comments	Inspector Tracking: Item status and date
1	<b>Application letter</b> Application letter to obtain RNAV 5 authority	Paragraph 9.1 b) 1) Appendix 3, Paragraph e)	Exhibit A		
2	<b>Airworthiness documents to determine Aircraft eligibility</b> Airworthiness documents that establish the aircraft and the navigation system have been approved for RNAV 5 operations.	Paragraphs 8.1, 8.2 y 8.3	Exhibit B Exhibit C		
3	<b>RNAV 5 system requirements</b> Documents that show the aircraft equipment 1. One (1) RNAV system comprising of: <ul style="list-style-type: none"> <li>• one or a combination of the following navigation sensors: VOR/DME, DME/DME, INS o IRS, LORAN C y GNSS o GPS;</li> <li>• an area navigation (RNAV) computer;</li> <li>• a control display unit (CDU); and</li> <li>• a navigation display(s) or</li> </ul>	Paragraph 8.5 b)	Exhibit B Exhibit C		

#	Content of operator application for RNAV 5	Reference paragraphs CA 91-002	Where found in operator exhibit/documents Note: operator should update this column to reflect the content of its application	Inspector recommendation and /or comments	Inspector Tracking: Item status and date
	instrument(s) (e. g., navigation display (ND), heading situation indicator (HSI) o course deviation indicator (CDI).				
4	<p><b>Availability of the conventional navigation equipment on board the aircraft when the GPS stand-alone is used</b></p> <p>Documents that show the availability of the conventional navigation equipment on board the aircraft when the GPS stand-alone is used</p> <p>When GPS stand-alone equipment is used, the traditional navigation equipment (e. g., VOR, DME, TACAN o ADF), must be installed and operational in the aircraft, so as to provide an alternative means of navigation.</p>	Paragraph 8.4 e) 1) iv.	Exhibit B Exhibit C		
5	<p><b>Training</b></p> <p><b>1. LAR 91 operators: Methods of training:</b> The following methods are acceptable for these operators: In-house training, LAR 142 training center or others courses of training.</p> <p><b>2. LAR 121 or 135 operators: Training program:</b> The LAR 121 or 135 operators shall develop an initial and recurrent training</p>	<p>Paragraphs 9.1 b) 6), 9.1 c)</p> <p>Paragraph 11</p>	Exhibit F		

#	Content of operator application for RNAV 5	Reference paragraphs CA 91-002	Where found in operator exhibit/documents Note: operator should update this column to reflect the content of its application	Inspector recommendation and /or comments	Inspector Tracking: Item status and date
	<p>program for flight crew, flight dispatchers and maintenance personnel.</p> <p><b>3. GPS stand-alone:</b> When the operator used a GPS stand-alone to conduct RNAV 5 operations, shall developed an initial and a recurrent training program for flight crew, flight dispatchers and maintenance personnel, if required.</p>	Paragraph 8.4 e) 2)			
6	<p><b>Operational policies and procedures</b></p> <p><b>1. LAR 91 operators:</b> Operations manual or sections of operator's application, documenting RNAV 5 operational policies and procedures.</p> <p><b>2. LAR 121 and/or 135 operators:</b> Operations manual and check list.</p> <p><b>3. GPS stand-alone used as a primary means of navigation:</b> Operations manual</p>	<p>Paragraph 9.1 b) 2)</p> <p>Paragraph 10</p> <p>Paragraph 10. b)</p>	Exhibit G		
7	<p><b>Maintenance practices</b></p> <ul style="list-style-type: none"> <li>For Aircraft with established RNAV or GPS stand-alone maintenance practices, the operator shall provide document references.</li> <li>For newly installed RNAV or GPS</li> </ul>	Paragraph 9. b) 3)	Exhibit D		



#	Content of operator application for RNAV 5	Reference paragraphs CA 91-002	Where found in operator exhibit/documents Note: operator should update this column to reflect the content of its application	Inspector recommendation and /or comments	Inspector Tracking: Item status and date
	stand-alone, the operator shall provide maintenance practices for review.				
8	<b>Minimum equipment list (MEL) updates, if applicable</b>  Only applicable if operator conducts operations under an MEL	Paragraph 9. b) 5)	Exhibit E		
9	<b>Removal of RNAV 5 operating authority</b>  Indication of the necessity to follow up action after navigation error reports, and the potential for removal of RNAV 5 operating authority.	Paragraph 12	Exhibit H		

**PART 4 – OPERATOR APPLICATION (EXHIBITS/DOCUMENTS)**

<b>Exhibit</b>	<b>Document title</b>	<b>Operator indication of inclusion</b>	<b>Inspector comments</b>
A	<b>Application letter for RNAV 5 authorization</b>		
B	<b>1. For aircraft manufactured RNAV 5 compliant: Airworthiness documents that show RNAV 5 approval:</b> <ul style="list-style-type: none"> <li>• AFM, AFM Supplement, TCDS o POH.</li> </ul> <b>2. For in-service aircraft which eligibility can not be determined based on the AFM, AFM Supplement; TCDS o POH:</b> <ul style="list-style-type: none"> <li>• Operator letter requesting assessment of aircraft RNAV equipment.</li> </ul>		
C	<b>For INS or IRU only equipped aircraft: RNAV 5 time limit and area of operation.</b> <ul style="list-style-type: none"> <li>• Documentation establishing the RNAV 5 time limit and area of operations or routes for which the specific aircraft/navigation system is eligible. (Not applicable to GPS equipped aircraft).</li> </ul>		
D	<b>Maintenance program</b> <ul style="list-style-type: none"> <li>• For aircraft with established RNAV 5 or GPS stand-alone maintenance practices, provide list of document or program references.</li> </ul>		
E	<b>Minimum Equipment List (MEL) (Only for operators operating under an MEL):</b> <ul style="list-style-type: none"> <li>• MEL showing provisions for RNAV 5 equipment or GPS stand-alone.</li> </ul>		
F	<b>Training</b> <b>1. LAR 91 operators: Methods of training:</b> The following		

Exhibit	Document title	Operator indication of inclusion	Inspector comments
	<p>methods are acceptable for these operators: In-house training, LAR 142 training center or others courses of training.</p> <p><b>2. LAR 121 or 135 operators: Training program:</b> The LAR 121 or 135 operators shall provide initial and recurrent training program for flight crew, flight dispatchers and maintenance personnel.</p> <p><b>3. GPS stand-alone:</b> When the operator used a GPS stand-alone to conduct RNAV 5 operations, shall provide an initial and a recurrent training program for flight crew, flight dispatchers and maintenance personnel, if required.</p>		
G	<p><b>Operational policies and procedures</b></p> <p><b>1. LAR 91 operators:</b> Operations manual or sections of operator's application, documenting RNAV 5 operational policies and procedures.</p> <p><b>2. LAR 121 and/or 135 operators:</b> Operations manual and check list.</p> <p><b>3. GPS stand-alone used as a primary means of navigation:</b> Operations manual</p>		
H	<p><b>Removal of RNAV 5 operating authority</b></p> <p>Indication of the necessity to follow up action after navigation error reports, and the potential for removal of RNAV 5 operating authority.</p>		
I	<p><b>Plan for validation flight:</b> Only if required by the CAA</p>		

#### APPLICATION CONTENT TO BE SUBMITTED BY THE OPERATOR

\_\_\_\_\_ AIRCRAFT/RNAV 5 SYSTEM COMPLIANCE DOCUMENTATION

\_\_\_\_\_ OPERATIONAL POLICY/PROCEDURES

\_\_\_\_\_ **MAINTENANCE MANUAL SECTIONS RELATED TO RNAV 5 SYSTEM OR GPS STAND-ALONE (if not previously reviewed)**

**Note 1:** Exhibits/documents may be included in a binder or submitted as a stand-alone documents

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**PART 5 – GUIDE FOR DETERMINING AIRCRAFT ELIGIBILITY**

#	Subjects	Reference paragraphs <b>CA 91-002</b>	Location in operator exhibits	CAA Recommendations and comments	Inspector tracking item status and date
1	RNAV system requirement	Paragraphs 5.7, 6.2, 8.1 a) y 8.5 b).	Exhibit B		
2	Aircraft eligibility 1. For aircraft manufactured RNAV 5 compliant 2. For in-service aircraft which eligibility can not be determined based on the AFM, AFM Supplement; TCDS o POH:	Paragraphs 8.2  Paragraph 8.3 a)	Exhibit B		
3	GPS stand-alone used as a primary means of navigation	Paragraph 8.4 e) 1) iii. (first paragraph)	Exhibit B		
4	Multi-sensor navigation system that incorporate GPS with integrity provided by RAIM or equivalent means	Paragraph 8.4 e) 1) ii.	Exhibit B		
5	GPS stand-alone with integrity provided by RAIM	Paragraph 10. b) 2.	Exhibit B		
6	GPS stand-alone that include the following functions: • Pseudorange step detection; and • Health word cheking	Paragraph 8.4 e) 1) ii.	Exhibit B		
7	Availability of conventional navigation equipments when GPS stand-alone is	Paragraph 8.4 e) 1) iv.	Exhibit B		

#	Subjects	Reference paragraphs CA 91-002	Location in operator exhibits	CAA Recommendations and comments	Inspector tracking item status and date
	used				
8	Aircraft requirements: RNAV 5 navigation systems	Paragraph 8.4	Exhibit B		
9	RNAV 5 system requirement <ul style="list-style-type: none"> <li>Precision</li> <li>Availability and integrity</li> </ul>	Paragraph 8.5	Exhibit B		
10	RNAV 5 system functional requirements <ul style="list-style-type: none"> <li>Required functions</li> <li>RNAV 5 navigation displays</li> </ul>	Paragraph 8.6	Exhibit B		
11	Navigation data base	Paragraph 10. d)	Exhibit B		

## PART 6 – BASIC PILOT PROCEDURES FOR RNAV 5 OPERATIONS

<b>Subjects</b>	<b>Reference paragraphs</b>  <b>CA 91-002</b>	<b>Locations in operator exhibit</b>	<b>CAA recommendations and/or comments</b>	<b>Inspector tracking: Item status and date</b>
<b>Operating procedures</b>	Paragraph 10	Exhibit G		
<b>Flight planning</b>	Paragraph 10.1			
Verify aircraft is approved for RNAV operation	Paragraph 10.1 a) 1)			
Verify RNAV system required to meet RNAV 5 navigation specifications for the route and area are operational	Paragraph 10.1 a) 3)			
Verify that space-based or ground-based navigation aids required for RNAV 5 operations are available	Paragraph 10.1 a) 4)			
Revise i.e. contingencia procedures	Paragraph 10.1 a) 5)			
Indicate approval for RNAV 5 operations by annotating block 10 (Equipment) of the ICAO flight plan as defined within ICAO Doc 7030 for these operations	Paragraph 10. c)			
Verify the availability of GPS integrity RAIM for the intended flight (route and time), through the use of a prediction program either ground-based or provided as an equipment function or from an alternative method that is acceptable to the authority, in the	Paragraph 10 b)			



<b>Subjects</b>	<b>Reference paragraphs</b>  <b>CA 91-002</b>	<b>Locations in operator exhibit</b>	<b>CAA recommendations and/or comments</b>	<b>Inspector tracking: Item status and date</b>
following cases: <ul style="list-style-type: none"> <li>• when any GPS satellites are scheduled to be out of service; or</li> <li>• more than one satellite is scheduled to be out of service for GPS equipment that incorporate pressure altitude aiding.</li> </ul>				
The operator shall not dispatch or release a flight in the event of predicated continuous loss of RAIM of more than 5 minutes for any part of the intended flight. In this case the flight may be delayed, cancelled or re-routed.	Paragraph 10 b) 7)			
<b>Pre-flight procedures at the aircraft</b>				
Review maintenance logs and forms for RNAV 5 status.	Paragraph 10.2 a)			
Verify navigation data base currency (current AIRAC cycle), if this data base is installed.	Paragraph 10.2 b)			
<b>En route procedures</b>				
Verify RNAV equipment required for RNAV 5 operation has not been degraded in flight	Paragraph 10.3 a) 1)			

<b>Subjects</b>	<b>Reference paragraphs</b>  <b>CA 91-002</b>	<b>Locations in operator exhibit</b>	<b>CAA recommendations and/or comments</b>	<b>Inspector tracking: Item status and date</b>
Verify the route of flight correspond to the clearance	Paragraph 10.3 a) 2)			
Verify aircraft precision navigation is suitable for RNAV 5 operations through pertinent cross-checks.	Paragraph 10.3 a) 3)			
Verify others navigation aids (e. g., VOR, DME and ADF) are selected, so as to allow immediate cross-checking or reversion in the event of loss of GPS navigation capability.	Paragraph 10.3 a) 4)			
<b>Contingency procedures</b>	Paragraph 10.4			
The aircraft must not enter or continue operations in an airspace designated as RNAV 5, in accordance with a current clearance of ATC, if due to a failure or degradation, the navigation system is downgraded under the RNAV 5 requirements, in this event, the pilot will obtain when it is possible a amended clearance.	Paragraph 10.4 a) 1)			
In accordance with ATC instructions, the operations may continue in compliance with ATC current authorization or when it is not possible, the pilot may request an amended clearance to return to conventional VOR/DME navigation.	Paragraph 10.4 a) 2)			

<b>Subjects</b>	<b>Reference paragraphs</b>  <b>CA 91-002</b>	<b>Locations in operator exhibit</b>	<b>CAA recommendations and/or comments</b>	<b>Inspector tracking: Item status and date</b>
In all cases, the flight crew must follow the contingency procedures establish for each region and obtain an ATC clearance as soon as possible.	Paragraph 10.4 a) 3)			
<b>Contingency procedures in the event of loss of GPS navigation capability</b>				
The contingency procedures should identify the flight crew actions required in the event of the GPS stand-alone equipment indicating a loss of the integrity monitoring detection (RAIM) function or exceedance of integrity alarm limit (erroneous position).	Paragraph 10.4 b) 1)			
Whatever contingency registered in flight must be notify to the AAC within 72 hours, unless the delay is justify.	Paragraph 10.4 b) 3)			

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Job Aid:      RNAV 5  
 Revision:    1  
 Date:        12/10/2009

**APPENDIX C-1**

**ADVISORY CIRCULAR**

AC	:	91-003
DATE	:	12/10/09
VERSION	:	Original
ISSUED BY	:	SRVSOP

**SUBJECT: AIRCRAFT AND OPERATORS APPROVAL FOR RNAV 1 AND RNAV 2  
OPERATIONS**

## ADVISORY CIRCULAR

AC : 91-003  
DATE : 12/10/09  
VERSION : Original  
ISSUED BY : SRVSOP

### SUBJECT: AIRCRAFT AND OPERATORS APPROVAL FOR RNAV 1 AND RNAV 2 OPERATIONS

#### 1. PURPOSE

This advisory circular (AC) establishes the RNAV 1 and RNAV 2 approval requirements for aircraft and en-route and terminal area operations.

An operator may use alternate means of compliance, as long as such means are acceptable to the Civil Aviation Authority (CAA).

The future tense of the verb or the term "shall" apply to operators who choose to meet the criteria set forth in this AC.

#### 2. RELEVANT SECTIONS OF THE LATIN AMERICAN AERONAUTICAL REGULATIONS (LAR) OR EQUIVALENTS

LAR 91: Sections 91.1015 and 91.1640 or equivalents

LAR 121: Section 121.995 (b) or equivalent

LAR 135: Section 135.565 (c) or equivalent

#### 3. RELATED DOCUMENTS

Annex 6	Operation of aircraft Part I – International commercial air transport – Aeroplanes Part II – International general aviation - Aeroplanes
Annex 10	Aeronautical communications
Annex 15	Aeronautical information services
ICAO Doc 9613	Performance-based navigation (PBN) manual
ICAO Doc 8071	Manual on testing of radio navigation aids
ICAO Doc 7030	Regional supplementary procedures
ICAO Doc 8168	Aircraft operations Volume I: Flight procedures Volume II: Construction of visual and instrument flight procedures
JAA TGL - 10	Airworthiness and operational approval for precision RNAV operations in designated European airspace
FAA AC 90-100A	U.S. Terminal and en route area navigation (RNAV) operations
FAA AC 90-96A	Approval of U.S. operators and aircraft to operate under instrument flight rules (IFR) in European airspace designated for basic area navigation (B-RNAV) and precision area navigation (P-RNAV)

Spain DGAC CO 03/01 Aprobaciones de aeronavegabilidad y operacionales para operaciones RNAV de precisión (P-RNAV) en el espacio aéreo Europeo designado

#### 4. DEFINITIONS AND ABBREVIATIONS

##### 4.1 Definitions

- a) **Aircraft-based augmentation system (ABAS).**- an augmentation system which augments and/or integrates the information obtained from the other GNSS elements with information available on board the aircraft. The most common form of ABAS is receiver autonomous integrity monitoring (RAIM).
- b) **Area navigation (RNAV).**- A navigation method that allows aircraft to operate on any desired flight path within the coverage of ground- or space-based navigation aids, or within the limits of the capability of self-contained aids, or a combination of these.  
  
Area navigation includes performance-based navigation as well as other RNAV operations that do not meet the definition of performance-based navigation.
- c) **Area navigation route.**- ATS route established to be used by aircraft with the capability of applying area navigation.
- d) **Area navigation system (RNAV system).**- An area navigation system that permits aircraft operation on any desired flight path within the coverage of ground- or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these. An RNAV system may be included as part of the Flight Management System (FMS).
- e) **Critical DME.** A distance-measuring equipment (DME) facility that, when not available, results in navigation service which is insufficient for DME/DME- and DME/DME//IRU-based operations along a specific route or procedure. For example, standard instrument departures and arrivals (SID/STAR) may be published with only two DMEs, in which case, both DMEs are critical.
- f) **DME/DME (D/D) RNAV.** - Area navigation that uses the line of sight of at least two DME facilities to determine aircraft position.
- g) **DME/DME/Inertial (D/D/I) RNAV.** - Area navigation that uses the line of sight of at least two DME facilities to determine aircraft position, along with an inertial reference unit (IRU) that provides sufficient position information in areas without DME coverage (DME gaps).
- h) **Flight technical error (FTE).**- The FTE is the accuracy with which an aircraft is controlled as measured by the indicated aircraft position with respect to the indicated command or desired position. It does not include blunder errors.
- i) **Global navigation satellite system (GNSS).**- A generic term used by the International Civil Aviation Organization (ICAO) to define any global position, speed, and time determination system that includes one or more main satellite constellations, such as GPS and the global navigation satellite system (GLONASS), aircraft receivers and several integrity monitoring systems, including aircraft-based augmentation systems (ABAS), satellite-based augmentation systems (SBAS), such as the wide area augmentation systems (WAAS) and ground-based augmentation systems (GBAS), such as the local area augmentation system (LAAS). Distance information will be provided, at least in the immediate future, by GPS and GLONASS.
- j) **Global positioning system (GPS).**- The United States global navigation satellite system (GNSS) that uses precise distance measurements to determine position, speed, and time anywhere in the world. GPS is made up by three elements: space, control, and user. The GPS spatial segment nominally consists of, at least, 24 satellites in 6 orbital planes. The control element consists of 5 monitoring stations, 3 ground antennas, and one master control station. The user element consists of antennas and receivers that provide the user with position, speed, and precise time.

- k) **Navigation specifications.-** Set of aircraft and flight crew requirements needed to support performance-based navigation operations in a defined airspace. There are two kinds of navigation specification:

*Required Navigation Performance (RNP) Specification.* Area navigation specification that includes the performance control and alerting requirement, designated by the prefix RNP; e.g., RNP 4, RNP APCH, RNP AR APCH.

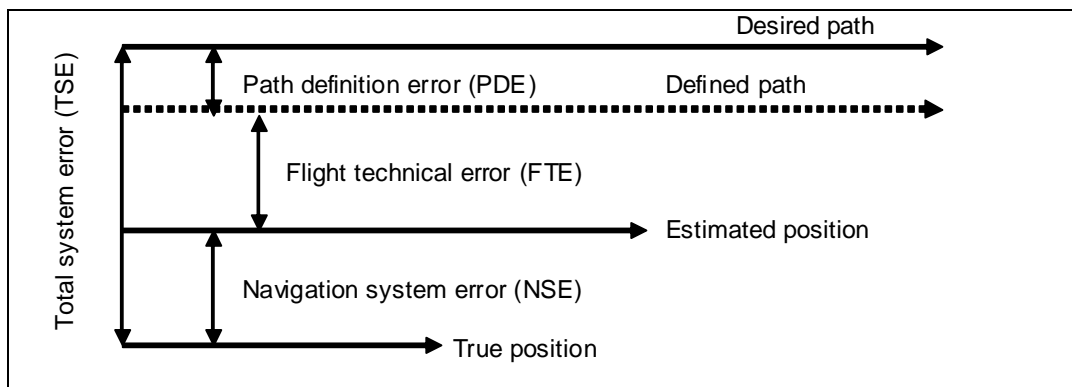
*Area Navigation (RNAV) Specification.-* Area navigation specification that does not include the performance control and alerting requirement, designated by the prefix RNAV; e.g., RNAV 5, RNAV 2, RNAV 1.

**Note 1.-** The Manual on Performance-based Navigation (PBN) (Doc 9613), Volume II, contains detailed guidelines on navigation specifications.

**Note 2.-** The term RNP, formerly defined as “a statement of the navigation performance necessary for operation within a defined airspace”, has been deleted from the Annexes to the Convention on International Civil Aviation because the RNP concept has been replaced by the PBN concept. In said Annexes, the term RNP is now only used within the context of the navigation specifications that require on-board performance control and alerting; e.g., RNP 4 refers to the aircraft and the operational requirements, including a lateral performance of 4 NM, with the requirement for on-board performance control and alerting as described in the PBN Manual (Doc 9613).

- l) **Navigation system error (NSE).-** The difference between the true position and the estimated position.
- m) **Path definition error (PDE).-** The difference between the defined path and the desired path at a given place and time.
- n) **Performance-based navigation (PBN).-** Performance-based area navigation requirements for aircraft operating along an ATS route, on an instrument approach procedure, or in a designated airspace.
- Performance requirements are defined in navigation specifications (RNAV and RNP specifications) in terms of the precision, integrity, continuity, availability, and functionality necessary to perform the proposed operation within the context of a particular airspace concept.
- o) **Position estimation error (PEE).-** Difference between true position and estimated position.
- p) **Receiver autonomous integrity monitoring (RAIM).-** A technique used in a GPS receiver/processor to determine the integrity of its navigation signals, using only GPS signals or GPS signals enhanced with barometric altitude data. This determination is achieved by a consistency check between pseudo-range measurements. At least one additional available satellite is required with respect to the number of satellites that are needed for the navigation solution.
- q) **RNAV operations.-** Aircraft operations that use area navigation for RNAV applications. RNAV operations include the use of area navigation for operations that are not performed in keeping with the PBN manual.
- r) **Standard instrument arrival (STAR).-** A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.
- s) **Standard instrument departure (SID).-** A designated instrument flight rules (IFR) departure route linking the aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en-route phase of the flight commences.
- t) **Total system error (TSE).-** The difference between the true and the desired position. This error is equal to the sum of the vector of the path definition error (PDE), the flight technical error (FTE), and the navigation system error (NSE).

*Note.-* Sometimes the FTE is referred to as the path steering error (PSE) and the NSE is referred to as the position estimation error (PEE).



## 4.2 Abbreviations

a)	CAA	Civil Aviation Administration /Civil Aviation Authority
b)	ABAS	Aircraft-based augmentation system
c)	AC	Advisory circular (FAA)
d)	AFE	Field elevation
e)	AFM	Aircraft flight manual
f)	AHRS	Attitude and heading reference system
g)	AIP	Aeronautical information publication
h)	AIRAC	Aeronautical information regulation and control
i)	AP	Automatic pilot
j)	ANSP	Area navigation service providers
k)	ATC	Air traffic control
l)	ATM	Air traffic management
m)	ATS	Air traffic services
n)	baro-VNAV	Barometric vertical navigation
o)	B-RNAV	Basic area navigation
p)	CA	Advisory circular in Spanish (SRVSOP)
q)	CA	Course to an altitude
r)	CDI	Course deviation indicator
s)	CF	Course to a fix
t)	CNS/ATM	Communications, navigation, and surveillance/air traffic management
u)	OC	Operations circular (Spain)
v)	D/D	DME/DME
w)	D/D/I	DME/DME/IRU
x)	DF	Direct to a fix
y)	DOC	Designated operational coverage
z)	DME	Distance-measuring equipment
aa)	FD	Flight dispatcher



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bb)	EASA	European Aviation Safety Agency
cc)	EHSI	Enhanced vertical status indicator
dd)	FAA	United States Federal Aviation Administration
ee)	FAF	Final approach fix
ff)	FAP	Final approach point
gg)	FD	Flight director
hh)	FM	Course from a fix to a manual termination
ii)	FMC	Flight management computer
jj)	FMS	Flight management system
kk)	FOM	Figure of merit
ll)	FTE	Flight technical error
mm)	GBAS	Ground-based augmentation system
nn)	GNSS	Global navigation satellite system
oo)	GLONASS	Global navigation satellite system
pp)	GPS	Global positioning system
qq)	GS	Ground speed
rr)	HAL	Horizontal alert limit
ss)	HSI	Horizontal status indicator
tt)	IF	Initial fix
uu)	IFR	Instrument flight rules
vv)	INS	Inertial navigation system
ww)	ILS	Instrument landing system
xx)	IRS	Inertial reference system
yy)	IRU	Inertial reference unit
zz)	LAAS	Local area augmentation system
aaa)	LAR	Latin American Aeronautical Regulations
bbb)	LNAV	Lateral navigation
ccc)	LOA	Letter of authorisation/acceptance letter
ddd)	LOC	Locator
eee)	MCDU	Multi-function control display
fff)	MEL	Minimum equipment list
ggg)	OIM	Operations inspector manual
hhh)	MLS	Microwave landing system
iii)	MP	Monitoring pilot
jjj)	MVA	Minimum vectoring altitude
kkk)	NAVAIDS	Navigation aids
lll)	NDB	Non-directional radio beacon

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mmm)	NOTAM	Notice to airmen
nnn)	NSE	Navigation system error
ooo)	ICAO	International Civil Aviation Organization
ppp)	OEM	Original equipment manufacturer
qqq)	OM	Operations manual
rrr)	OpSpecs	Operations specifications
sss)	PANS-OPS	Procedures for Air Navigation Services - Aircraft Operations
ttt)	PBN	Performance-based navigation
uuu)	PDE	Path definition error
vvv)	PEE	Position estimation error
www)	PF	Pilot flying
xxx)	PNF	Pilot not flying
yyy)	POH	Pilot operating handbook
zzz)	P-RNAV	Precision area navigation
aaaa)	PSE	Path steering error
bbbb)	RAIM	Receiver autonomous integrity monitoring
cccc)	RNAV	Area navigation
dddd)	RNP	Required navigation performance
eeee)	RNP APCH	Required navigation performance approach
ffff)	RNP AR APCH	Required navigation performance approval required approach
gggg)	RTCA	Radio Technical Commission for Aviation
hhhh)	SBAS	Satellite-based augmentation system
iiii)	SID	Standard Instrument Departure
jjjj)	SL	Service letter
kkkk)	SRVSOP	Regional safety oversight cooperation system
llll)	STAR	Standard instrument arrival
mmmm)	TC	Type certificate
nnnn)	TF	Track to a fix
oooo)	TGL	Transitional guidance material
pppp)	TO/FROM	To/from
qqqq)	TSE	Total system error
rrrr)	TSO	Technical standard order
ssss)	VA	Heading to an altitude
tttt)	VI	Heading to an intercept
uuuu)	VMC	Visual meteorological conditions
vvvv)	VM	Heading to a manual termination
wwwv)	VOR	VHF omnidirectional radio range

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xxxx)	WAAS	Wide area augmentation system
yyyy)	WGS	World geodetic system
zzzz)	WPT	Waypoint

## 5. INTRODUCTION

5.1 On 1 November 2000, the European Joint Aviation Authorities (JAA) published transitional guidance material No. 10 (TGL-10) - Airworthiness and operational approval for precision RNAV (P-RNAV) operations in designated European airspace.

5.2 On 7 January 2005, the United States Federal Aviation Administration (FAA) published advisory circular (AC) 90-100 - U.S. En-route and terminal area navigation (RNAV) operations. This AC was superseded by AC 90-100A, published on 1 March 2007.

5.3 Although TGL-10 and AC 90-100A establish similar functional requirements, there are some differences between these documents.

5.4 The guidance material in this AC harmonises the European and the United States RNAV criteria under a single navigation specification called RNAV 1 and RNAV 2, in accordance with Doc 9613 – Performance based navigation (PBN) manual of the International Civil Aviation Organization (ICAO).

5.5 Operators approved under AC 90-100A meet the requirements of this CA, while operators approved under TGL-10 must confirm whether or not their aircraft systems meet the criteria set forth in this document (see Table 3-1 Appendix 6).

5.6 Current systems that comply with the two documents (TGL-10 and AC 90-100A), automatically comply with the RNAV 1 and RNAV 2 requirements set forth in this guidance material.

5.7 An operational approval issued by virtue of this document allows an operator to conduct RNAV 1 and RNAV 2 operations worldwide.

5.8 The RNAV 1 and RNAV 2 navigation specification applies to:

- all ATS routes, including those established in the en-route domain;
- standard instrument departures and arrivals (SID/STAR); and
- instrument approach procedures up to the final approach fix (FAF)/final approach point (FAP).

5.9 The final approach criteria, from the FAF to the runway threshold, along with the associated missed approach manoeuvre are not considered in this document and will be the subject of another AC.

5.10 The RNAV 1 and RNAV 2 navigation specification was mainly developed for RNAV operations in radar environments (SIDs are expected to have radar coverage prior to the first RNAV course change); however, these operations can be used in a non-radar environment or below the minimum vectoring altitude (MVA), if the CAA that implement these operations can ensure an appropriate safety system and justifies the lack of performance monitoring and alerting.

5.11 The *basic RNP 1* navigation specification is expected to be used for similar operations but outside radar coverage.

5.12 It is foreseen that en-route RNAV 1 and RNAV 2 operations will be conducted in direct controller-pilot communication environments.

5.13 Since barometric vertical navigation (baro-VNAV) is not a requirement for RNAV 1 and RNAV 2 operations, this AC does not establish approval criteria for baro-VNAV systems. RNAV 1 and RNAV 2 operations are based on normal descent profiles and identify minimum altitude requirements in the segments.

**Note 1.-** Pilots operating aircraft with a baro-VNAV system can continue using this system in routes, SIDs, STARs, and approaches to the FAF. Operators will guarantee compliance with all of the limitations published in the procedure, using the barometric altimeter as reference.

**Note 2.-** Use of the aircraft barometric vertical navigation capability will be subject to the level of familiarisation and training of the flight crew, and on any other operational approval requirement.

5.14 This AC does not include all of the requirements that may be specified for a particular operation. These requirements are established in other documents, such as, the aeronautical information publication (AIP) and ICAO Doc 7030 – Regional Supplementary Procedures.

5.15 Although operational approval is normally related to airspace requirements, operators and flight crews shall take into consideration the operational documents required by the CAA before conducting flights in RNAV 1 and RNAV 2 airspace.

5.16 The material described in this AC has been developed based on the following document:

- ✓ ICAO Doc 9613, Volume II, Part B, Chapter 3 – Implementing RNAV 1 and RNAV 2.

5.17 Where possible, this AC has been harmonised as much as possible with the following documents:

- ✓ JAA TGL - 10 - Airworthiness and operational approval for precision RNAV operations in designated European airspace; y
- ✓ FAA AC 90-100A - U.S. Terminal and en route area navigation (RNAV) operations.

**Note.-** Despite harmonisation efforts, operators must take note of the existing differences between this AC and the aforementioned documents when requesting an approval from the corresponding Administrations.

## 6. GENERAL INFORMATION

### 6.1 Navigation aid infrastructure

a) This AC defines the criteria for the following RNAV systems:

- GNSS;
- DME/DME; and
- DME/DME/IRU.

b) Route design shall take into account the navigation performance that can be achieved with the navigation aid (NAVAID) infrastructure available. Although the requirements for RNAV 1 and RNAV 2 systems are identical, the NAVAID infrastructure can affect the required performance.

c) When DME is used as the only navigation service for updating position, gaps in DME coverage may prevent such update. With the inclusion of IRUs in the aircraft navigation system, an adequate level of performance can be maintained through all such gaps.

**Note.-** Based on IRU performance assessment, it is expected that the increase in the position error will be less than 2NM for 15 minutes, after reverting to this system.

d) When there is no IRU on board the aircraft, the aircraft may revert to dead reckoning navigation. In such cases, additional protection is required according to Doc 8168, Volume II – Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) in order to compensate for the increased error.

e) According to the ICAO global air navigation plan for communications, navigation, and surveillance/air traffic management (CNS/ATM) systems (Doc 9750), the use of GNSS should be authorised whenever possible and the limitations on the use of specific system elements should be avoided.

*Note.- Most modern RNAV systems give priority to GNSS input and then DME/DME positioning. Although VOR/DME positioning is usually performed in the flight management computer (FMC) when there is no DME/DME positioning criteria, avionics and infrastructure variability pose serious challenges to standardisation and harmonisation. Therefore, this document only deals with GNSS, DME/DME, and DME/DME/IRU systems. This does not prevent the conduction of operations with systems that use VHF omni-directional radio range (VOR), provided they meet the criteria set forth in this AC.*

- f) NAVAID infrastructure should be validated by modelling, while the expected performance should be assessed and verified through flight inspections. Assessments should consider the aircraft capabilities described in this AC. For example, a DME signal can be used if the aircraft is between 3 NM and 160 NM from the facility, below 40 degrees above the horizon (as seen from the DME facility) and if the DME/DME include angle is between 30 and 150 degrees.
- g) The DME infrastructure assessment is simplified when using a screening tool which accurately matches ground infrastructure and aircraft performance, as well as an accurate representation of the terrain. Guidance material on this assessment can be found in Doc 8168, Volume II – PANS-OPS and Doc 8071 – Manual on testing of radio navigation aids.
- h) It is considered that DME signals meet signal-in-space precision tolerances when these signals are received, regardless of the published coverage volume.
- i) Field strength below the minimum requirement or where co-channel or adjacent channel interference may exist, are considered receiver errors. Air navigation service providers (ANSPs) shall identify errors resulting from multiple DME signal paths. When these errors exist and are not acceptable to the operation, the ANSPs can identify such NAVAIDs as not appropriate for RNAV 1 and RNAV 2 applications (so that they can be inhibited by the flight crew) or, not authorise the use of DME/DME or DME/DME/IRU systems.
- j) The individual components of the navigation infrastructure must meet the performance requirements described in Annex 10 to the Chicago Convention – Aeronautical Telecommunications. Navigation aids that do not meet the requirements of Annex 10 should not be published in the State AIPs. When significant performance differences are identified in a published DME facility, RNAV 1 and RNAV 2 operations in the airspace affected by such facility should be limited to GNSS.
- k) During RNAV operations based on the inertial reference system (IRS), some aircraft navigation systems revert to VOR/DME-based navigation before reverting to IRS autonomous navigation (inertial coasting). ANSPs must assess the impact of VOR radial precision when the VOR is within 40 NM of the route/procedure and when the DME/DME navigation infrastructure is not enough to ensure that aircraft position accuracy will not be affected.
- l) ANSPs shall guarantee that operators of aircraft equipped with GNSS and, where applicable, with satellite-based augmentation system (SBAS), have access to a means of predicting the availability of fault detection using the aircraft-based augmentation system (ABAS) (e.g., RAIM). This prediction system can be provided by an ANSP, airborne equipment manufacturers or other entities.
- m) Prediction services can only be for receivers that meet the minimum performance of a technical standard order (TSO) or be specific to the receiver design. The prediction service shall use the current information from GNSS satellites and a horizontal alert limit (HAL) that is appropriate to the operation (1 NM for RNAV 1 and 2 NM for RNAV 2).
- n) Outages shall be identified in case of a predicted, continuous loss of ABAS fault detection of more than 5 minutes for any part of the RNAV 1 and RNAV 2 operations. If the prediction system is temporarily unavailable, ANSPs may still allow RNAV 1 and RNAV 2 operations to be conducted, taking into account the operational repercussions of such interruptions on the aircraft or the potential risk associated with an undetected satellite failure when fault detection is not available.

- o) Since DME/DME and DME/DME/IRU systems must only use DME facilities identified in the AIPs of each State, the CAAs will list in such publications the facilities that are not appropriate for RNAV 1 and RNAV 2 operations, including facilities associated to an instrument landing system (ILS) or a microwave landing system (MLS) that uses a range offset.

***Note 1.-** Database suppliers may exclude specific DME facilities when the RNAV routes are within the reception range of these facilities, which could have a deleterious effect on the navigation solution.*

***Note 2.-** When temporary restrictions occur, the publication of restrictions on the use of DME should be accomplished by use of a notice to airmen (NOTAM) to identified the need to exclude the DME.*

## 6.2 **ATS communications and surveillance**

- a) When radar is used to assist in contingency procedures, its performance must be adequate for this purpose, e.g., radar coverage, precision, continuity, and availability shall be adequate to ensure separation in the RNAV 1 and RNAV 2 ATS route structure, and provide contingency in case several aircraft are not capable of achieving the navigation performance established in the RNAV 1 and RNAV 2 navigation specification.

## 6.3 **Obstacle clearance and route spacing**

- a) Doc 8168 (PANS OPS), Volume II, provides detailed guidance about obstacle clearance. The general criteria contained in Parts I and III of said document, will apply.
- b) The CAA may prescribe either an RNAV 1 route or an RNAV 2 route. En-route spacing for RNAV 1 and RNAV 2 depends on route configuration, air traffic density, and intervention capability.
- c) Until specific standards and air traffic management (ATM) procedures are developed, RNAV 1 and RNAV 2 applications can be implemented based on ATS surveillance radar.

## 6.4 **Publications**

- a) The AIP should clearly indicate whether the navigation application is RNAV 1 or RNAV 2.
- b) RNAV 1 and RNAV 2 routes, SIDs, and STARs must be based on the normal descent profiles and identify the minimum altitude requirements of the segments.
- c) The available navigation infrastructure shall be clearly designated on all appropriate charts (e.g., GNSS, DME/DME or DME/DME/IRU).
- d) The navigation standard (e.g., RNAV 1 or RNAV 2) required for all RNAV procedures and routes will be clearly designated in all of the appropriate charts.
- e) Any DME facility that is critical to RNAV 1 and RNAV 2 operations shall be identified in the relevant publications.
- f) All routes must be based on the coordinates of the World Geodetic System - 84 (WGS-84).
- g) The navigation information published in the AIP for routes and NAVAIDs must meet the requirements set forth in Annex 15 – Aeronautical Information Services.

## 6.5 **Additional considerations**

- a) For procedure design and infrastructure assessment, it is assumed that 95% of the normal limit values of the FTE, defined in the operating procedures, are:
  - 1) RNAV 1: 0.5 NM.
  - 2) RNAV 2: 1 NM
- b) Many aircraft have the capability of flying parallel paths displaced to the left or to the right of the original active route. The purpose of this function is to allow lateral movements for tactical operations authorised by air traffic control (ATC).
- c) Likewise, many aircraft have the capability to perform a holding pattern manoeuvre using their RNAV systems. The purpose of this function is to give ATC flexibility for the designation of RNAV operations.

## 7. AIRWORTHINESS AND OPERATIONAL APPROVAL

7.1 For a commercial air transport operator to be granted an RNAV 1 and RNAV 2 approval, it must comply with two types of approvals:

- a) the airworthiness approval, which is issued by the State of registry (see Article 31 of the Chicago Convention, and Paragraphs 5.2.3 and 8.1.1 of Annex 6 Part I); and
- b) the operational approval, which is issued by the State of the operator (see Paragraph 4.2.1 and Attachment F to Annex 6 Part I).

7.2 For general aviation operators, the State of registry will determine whether or not the aircraft meets the applicable RNAV 1 and RNAV 2 requirements and will issue the operational approval (e.g., letter of authorisation – LOA) (see Paragraph 2.5.2.2 of Annex 6 Part II).

7.3 Before filing the application, operators shall review all aircraft qualification requirements. Compliance with airworthiness requirements or equipment installation alone does not constitute operational approval.

## 8. AIRWORTHINESS APPROVAL

### 8.1 Aircraft requirements

#### 8.1.1 Description of the RNAV navigation system

##### a) Lateral navigation (LNAV)

- 1) In LNAV, the RNAV equipment allows the aircraft to fly in accordance with the appropriate route instructions along a path defined by waypoints (WPTs) contained in an on-board navigation database.

*Note.- LNAV is normally a mode of flight guidance systems, in which the RNAV equipment provides path steering commands to the flight guidance system, which controls the FTE through the manual pilot control on a path deviation display or through the coupling of the flight director (FD) or automatic pilot (AP).*

- 2) For purposes of this AC, RNAV operations are based on the use of RNAV equipment that automatically determines the position of the aircraft on the horizontal plane, using data input from the following types of position sensors (not listed in a specific order of priority):

- (a) GNSS in accordance with TSO-C145 (), TSO-C146 (), and TSO-C129 ()

Position data from other types of navigation sensors can be combined with GNSS data, provided they do not cause position errors that exceed total system precision requirements. Use of GNSS equipment approved by TSO-C129 () is limited to those systems that include the minimum system functions specified in Paragraph 8.4 of this CA. As a minimum, integrity should be provided by ABAS. In addition, TSO-C129 equipment must include the following additional functions:

- ✓ pseudo-range step detection; and
- ✓ health word checking.

- (b) DME/DME RNAV equipment that meets the criteria listed in Paragraph 8.3.2; and
- (c) DME/DME/IRU RNAV equipment that meets the criteria listed in Paragraph 8.3.4.

#### 8.1.2 System performance, monitoring and alerting

##### a) Accuracy

- 1) **RNAV 1.-** For operations in RNAV 1 designated airspace or routes, total lateral system error must not exceed  $\pm 1$  NM for at least 95% of the total flight time. Likewise, along-track error must not exceed  $\pm 1$  NM for at least 95% of the total flight time.

- 2) **RNAV 2.-** For operations in RNAV 2 designated airspace or routes, total lateral system error must not exceed  $\pm 2$  NM for at least 95% of the total flight time. Likewise, along-track error must not exceed  $\pm 2$  NM for at least 95% of the total flight time.
- b) **Integrity.-** Malfunctioning of the aircraft navigation equipment is classified as a major failure according to airworthiness regulations (e.g.,  $10^{-5}$  per hour).
- c) **Continuity.-** Loss of function is classified as a minor failure if the operator can revert to a different navigation system and proceed to an appropriate aerodrome.
- d) **Signal-in-space**
  - 1) **RNAV 1.-** If GNSS is used for operations in RNAV 1 designated airspace or routes, the aircraft navigation equipment must provide an alert if the probability of signal-in-space errors causing a lateral position error greater than 2 NM exceeds  $10^{-7}$  per hour (Annex 10, Volume I, Table 3.7.2.4.1).
  - 2) **RNAV 2.-** If GNSS is used for operations in RNAV 2 designated airspace or routes, the aircraft navigation equipment must provide an alert if the probability of signal-in-space errors causing a lateral position error greater than 4 NM exceeds  $10^{-7}$  per hour (Annex 10, Volume I, Table 3.7.2.4.1).

## 8.2 RNAV system eligibility

**8.2.1 Aircraft with a statement of compliance with the criteria set forth in this CA.-** Aircraft with a statement of compliance with the criteria set forth in this CA or equivalent document in the AFM, the pilot operations handbook (POH), or avionics operating manual, meet the performance and functional requirements of this AC.

**8.2.2 Aircraft approved under TGL-10 and AC 90-100A.-** Aircraft approved according to both documents (TGL-10 and AC 90-100A) meet the criteria set forth in this AC.

**8.2.3 Aircraft that comply with TGL-10.-** Operators approved according to TGL-10 must confirm whether or not their aircraft systems meet the requirements set forth in this AC (see Table 3-1 of Appendix 6).

**8.2.4 Aircraft that comply with AC 90-100A.-** Aircraft that meet the criteria of AC 90-100A comply with this document.

**8.2.5 Aircraft with a statement by the manufacturer.-** Aircraft that have a statement by the manufacturer documenting compliance with the criteria of this AC or equivalent document meet the performance and functional requirements set forth in this document. This statement must include the substantiation of airworthiness compliance. The operator will determine compliance with RNAV system requirements described in Paragraph 8.3 and with the functional requirements described in Paragraph 8.4.

**Note 1.-** Aircraft with demonstrated RNP capability will announce when they can no longer meet the performance requirements associated to the operations. However, for procedures based on DME/DME/IRU, the operator will determine whether or not it complies with the criteria set forth in Paragraphs 8.3.2 and 8.3.4 (DME/DME and DME/DME/IRU).

**Note 2.-** Aircraft equipped with a TSO-C129 GNSS sensor and a TSO-C115 FMS or C115a FMS might not meet the requirements set forth in this CA. The operator must assess such equipment in accordance with the performance and functional requirements set forth in this document.

## 8.2.6 Aircraft flight manual, pilot operations handbook or avionics operating manual

- (a) **Newly manufactured or modified aircraft.-** For new (capability shown in production) or modified aircraft, the AFM, POH or avionics operating manual, whichever is applicable, shall provide a statement identifying the equipment and the certified construction or modification standard for RNAV 1 and RNAV 2 operations or that the aircraft has RNP 1 capability or better.
- (b) **Aircraft in use.-** For aircraft in use that are already equipped with RNAV systems but for which the AFM or POH or avionics operating manual does not define or clarify the system capability, the operator can submit documentation or a statement by the manufacturer that meets the requirements of this AC in accordance with Paragraph 8.2.4 above.



### 8.3 Criteria for the approval of RNAV 1 and RNAV 2 system

#### 8.3.1 Criteria for GNSS

- a) The following systems meet the precision requirements of these criteria:
- 1) Aircraft with TSO-C129/C129a sensor (Class B or C) and FMS that meets the criteria established in TSO-C115b, installed for IFR use in accordance with AC 20-130A;
  - 2) Aircraft with TSO-C145 () sensor and FMS that meets the criteria established in TSO-C115b, installed for IFR use in accordance with AC 20-130A or AC 20-138A;
  - 3) Aircraft with Class A1 TSO-C129/C129a (without deviation from the functional requirements described in Paragraph 8.4 of this document), installed for IFR use in accordance with AC 20-138 or AC 20-138A; and
  - 4) Aircraft with TSO-C146 () (without deviation from the functional requirements described in Paragraph 8.4 of this document), installed for IFR use in accordance with AC 20-138A.
- b) For route and/or aircraft approvals that require GNSS, operators must develop procedures to check the correct operation of the GNSS when the navigation system does not automatically alert the crew about loss of such equipment.
- c) The operator can integrate position information from other types of navigation sensors with the GNSS data, provided such information does not cause position errors that exceed the TSE budget; otherwise, means to cancel the selection of other types of navigation sensors shall be provided.
- d) The RAIM prediction programme shall meet all the criteria established in Paragraph 12 of AC-138A.

#### 8.3.2 Criteria for the RNAV DME/DME system

The criteria for assessing the DME/DME RNAV system are described in Appendix 1 to this document.

#### 8.3.4 Criteria for the RNAV DME/DME/IRU system

The DME/DME/IRU RNAV system must comply with Appendix 2 to this document.

### 8.4 Functional requirements – Navigation displays and functions

The requirements contained in Appendix 3 help to guarantee that the aircraft RNAV system performance complies with the design criteria of the procedure.

### 8.5 Maintenance aspects

#### a) Minimum equipment list (MEL)

The CAA must approve any revision to the minimum equipment list (MEL) that is necessary to incorporate RNAV provisions.

#### b) Continuing airworthiness (maintenance requirements)

LAR 91, 121, and 135 operators must establish and maintain an approved maintenance programme.

## 9. OPERATIONAL APPROVAL

Airworthiness approval alone does not authorise an applicant or operator to conduct RNAV 1 and RNAV 2 operations. In addition to the airworthiness approval, the applicant or operator must obtain an operational approval to confirm the suitability of normal and contingency procedures in connection to the installation of a given piece of equipment.

Concerning commercial air transport, the assessment of an application for RNAV 1 and RNAV 2 operational approval is done by the State of the operator, in accordance with standing operating rules (e.g., LAR 121.995 (b) and LAR 135.565 (c) or equivalent) supported by the criteria described in this CA.

For general aviation, the assessment of an application for RNAV 1 and RNAV 2 operational approval is carried out by the State of registry, in accordance with standing operating rules (e.g., LAR 91.1015 and LAR 91.1640 or equivalent) supported by the criteria described in this CA.

## **9.1 Requirements to obtain operational approval**

9.1.1 In order to obtain RNAV 1 and RNAV 2 approval, the applicant or operator will take the following steps, taking into account the criteria established in this paragraph and in Paragraphs 10, 11, 12, and 13:

- a) *Airworthiness approval.*- aircraft shall have the corresponding airworthiness approvals, pursuant to Paragraph 8 of this AC.
- b) *Application.*- The operator shall submit the following documentation to the CAA:
  - 1) *RNAV 1 and RNAV 2 operational approval application;*
  - 2) *Description of aircraft equipment.*- The operator shall provide a configuration list with details of the relevant components and the equipment to be used for RNAV 1 and RNAV 2 operations. The list shall include each manufacturer, model, and equipment version of GNSS, DME/DME, DME/DME/IRU equipment and software of the installed FMS.
  - 3) *Airworthiness documents related to aircraft eligibility.*- The operator shall submit relevant documentation, acceptable to the CAA, showing that the aircraft is equipped with RNAV systems that meet the RNAV 1 and RNAV 2 requirements set forth in this CA, as described in Paragraph 8, for example, the parts of the AFM or AFM supplement that contain the airworthiness statement.
  - 4) *Training programme for flight crews and flight dispatchers (FD)*
    - (a) Commercial operators (e.g., LAR 121 and LAR 135 operators) must submit to the CAA the RNAV 1 and RNAV 2 training syllabus to show that the operational procedures and practices and the training aspects described in Paragraph 11 have been included in the initial, promotional or periodic training programmes for flight crews and FDs.

*Note.- It is not necessary to establish a separate training programme if the RNAV 1 and RNAV 2 training identified in Paragraph 11 has already been included in the training programme of the operator. However, it must be possible to identify what aspects of RNAV are covered in the training programme.*
    - (b) Private operators (e.g., LAR 91 operators) shall be familiar with and demonstrate that they will perform their operations based on the practices and procedures described in Paragraph 11.
  - 5) *Operations manual and checklists*
    - (a) Commercial operators (e.g., LAR 121 and 135 operators) must review the operations manual (OM) and the checklists in order to include information and guidance on the standard operational procedures detailed in Paragraph 10 of this AC. The appropriate manuals must contain the operation instructions for navigation equipment and contingency procedures. The manuals and checklists must be submitted for review along with the formal application in Phase two of the approval process.
    - (b) Private operators (e.g., LAR 91 operators) must operate their aircraft based on the practices and procedures identified in Paragraph 10 of this AC.

- 6) *Minimum Equipment List (MEL).*- The operator will send to the CAA for approval any revision to the MEL that is necessary for the conduction of RNAV 1 and RNAV 2 operations. If an RNAV 1 and RNAV 2 operational approval is granted based on a specific operational procedure, operators must modify the MEL and specify the required dispatch conditions.
- 7) *Maintenance.*- The operator will submit for approval a maintenance programme for the conduction of RNAV 1 and RNAV 2 operations.
- 8) *Training programme for maintenance personnel.*- Operators will send the training curriculum that corresponds to maintenance personnel.
- 9) *Navigation data validation programme.*- Operators will present details about the navigation data validation programme as described in Appendix 4 to this CA.
- c) *Training programme.*- Once the amendments to manuals, programmes, and documents submitted have been accepted or approved, the operator will provide the required training to its personnel.
- d) *Validation flight.*- The CAA may deem it advisable to perform a validation flight before granting the operational approval. Such validation can be performed on commercial flights. The validation flight will be carried out according to the provisions of Chapter 13, Volume II, Part II of the SRVSOP Operations Inspector Manual (MIO).
- e) *Issuance of the approval to conduct RNAV 1 and RNAV 2 operations.*- Once the operator has successfully completed the operational approval process, the CAA will grant the operator approval to conduct RNAV 1 and RNAV 2 operations.
  - 1) *LAR 121 and/or 135 operators.*- For LAR 121 and/or LAR 135 operators, the CAA will issue the corresponding operations specifications (OpSpecs) that will reflect the RNAV 1 and RNAV 2 approval.
  - 2) *LAR 91 operators.*- For LAR 91 operators, the CAA will issue a letter of authorisation (LOA).

## 10. OPERATING PROCEDURES

10.1 Operators and flight crews will become familiar with the following operating and contingency procedures associated with RNAV 1 and RNAV 2 operations.

### a) Pre-flight planning

- 1) Operators and pilots intending to conduct operations on RNAV 1 and RNAV 2 routes must fill out the appropriate boxes in the ICAO flight plan.
- 2) On-board navigation data must be current and appropriate for the region of intended operations and will include NAVAIDS, WPTs, and the relevant ATS route codes for arrivals, departures, and alternate aerodromes. RNAV STAR procedures can be designated using multiple runway transitions. Operators that lack this function will provide an alternate means of compliance (for example, a navigation database adjusted for these operations). If there is no alternate means of compliance to fly an RNAV designated procedure that contains multiple runway transitions, operators will not submit or accept an approval for these procedures.

**Note.**- It is expected that the navigation database will be up to date during the operation. If the AIRAC cycle expires during the flight, operators and pilots shall establish procedures to ensure the precision of navigation data, including the suitability of navigation facilities used to determine the routes and procedures for the flight. Normally, this is done comparing electronic data with written documents. An acceptable means of compliance is to compare aeronautical charts (new and old) to check navigation reference points before dispatch. If an amended chart is published for the procedure, the database must not be used to conduct the operation.

- 3) The availability of the navigation infrastructure required for the intended routes, including any non-RNAV contingency, must be confirmed for the foreseen period of the operation, using all available information. Since Annex 10 Volume I requires GNSS integrity (RAIM or SBAS), it is also necessary to confirm adequate availability of these devices.
- 4) Aircraft not equipped with GNSS.- Aircraft not equipped with GNSS shall be capable of updating the DME/DME and DME/DME/IRU position for RNAV 1 and RNAV 2 routes and for SIDs and STARs.
- 5) If only TSO-C129 equipment is used to meet RNAV 1 and RNAV 2 requirements, it is necessary to confirm RAIM availability for the flight route (route and time) foreseen, using current GNSS satellite information.
- 6) If only TSO-C145/C146 equipment is used to meet RNAV requirements, the pilot/operator does not need to make any prediction if it is confirmed that the wide area augmentation system (WAAS) coverage is available along the entire flight route.

*Note.- For areas where WAAS coverage is not available, operators that use TSO-C145/C146 receivers must confirm the GNSS RAIM availability.*

- 7) RAIM (ABAS) availability
  - (a) The RAIM levels required for RNAV 1 and RNAV 2 operations may be verified, either through NOTAMs (when available) or through prediction services. Operators must become familiar with the prediction information available for the intended route.
  - (b) The available RAIM prediction must take into account the latest usable NOTAMs and the avionics model (if available). The RAIM prediction service can be provided through the ANSPs, the avionics manufacturers, other entities, or through an on-board RAIM prediction receiver.
  - (c) In the event of a predicted, continuous loss of appropriate level of fault detection of more than five (5) minutes for any part of the RNAV 1 and RNAV 2 operation, the flight plan shall be revised (e.g., delaying the departure or planning a different departure procedure).
  - (d) The RAIM availability prediction software does not guarantee the service. This software is rather a tool for assessing the expected capacity to meet the required navigation performance. Due to unplanned failures of some GNSS elements, pilots and ANSPs must understand that both RAIM and GNSS navigation can be lost while the aircraft is on flight, which may require reversal to an alternate means of navigation. Therefore, pilots must assess their navigation capabilities (potentially to an alternate aerodrome) in case of failure of GNSS navigation.
- 8) DME availability
  - (a) For DME-based navigation, it is necessary to check the NOTAMs to confirm the status of critical DMEs. Pilots must assess their navigation capabilities (potentially to an alternative aerodrome) if a critical DME fails while the aircraft on flight.

**b) General operating procedures**

- 1) Operators and pilots shall not apply for or submit RNAV1 and RNAV 2 routes, SIDs or STARs in the flight plan, unless they meet all the criteria set forth in this AC. If an aircraft that does not meet these criteria is cleared by the ATC to conduct an RNAV procedure, the pilot will notify the ATC that it cannot accept such clearance and will request alternate instructions;
- 2) The pilot will comply with any instruction or procedure identified by the manufacturer, as necessary, to meet the performance requirements set forth in this section;
- 3) At system initialization, pilots must:

- (a) confirm that the navigation database is up-to-date;
  - (b) verify the current position of the aircraft;
  - (c) verify the appropriate entry of the assigned ATC route once they receive the initial clearance, and of any subsequent change in route; and
  - (d) ensure that the sequence of WPTs as depicted in their navigation system matches the route drawn in the appropriate charts and the assigned route.
- 4) Pilots shall not fly an RNAV 1 or RNAV 2 SID or STAR, unless it can be retrieved from the on-board navigation database using the name of the procedure, and coincides with the procedure in the chart. However, the route can be modified afterwards by inserting or deleting specific WPTs in response to ATC clearance. Manual entry or the creation of new WPTs through manual insertion of latitude and longitude or rho/theta values is not permitted. Likewise, pilots must not change any RNAV SID or STAR database WPT type from a fly-by WPT to a flyover WPT or *vice versa*.
- 5) Whenever possible, RNAV 1 or RNAV 2 routes must be obtained from the database as a whole, instead of individually loading the route WPTs from the database to the flight plan. However, the individual selection and insertion of designated fixes and WPTs from the navigation database is permitted, provided all the fixes along the published route to be flown are inserted. Likewise, the route can be modified afterwards through the insertion or deletion of specific WPTs in response to ATC clearance. Manual entry or the creation of new WPTs through the manual insertion of latitude and longitude or rho/theta values is not permitted.
- 6) Flight crews shall cross-check the cleared flight plan by comparing charts or other applicable resources to the navigation system text displays and aircraft chart displays, as applicable. If required, the exclusion of specific NAVAIDs must be confirmed. A procedure shall not be used if there are any doubts about the validity of the procedure in the navigation database.

**Note.-** Pilots may note a small difference between the navigation information described in the chart and the primary navigation display. Differences of 3° or less may result from the equipment manufacturer's application of magnetic variation and are operationally acceptable.

- 7) During the flight, whenever feasible, the flight crew must use the information available from the NAVAIDs ground-based to confirm navigation reasonableness.
- 8) For RNAV 2 routes, pilots must use a lateral deviation indicator, an FD or an AP on lateral navigation mode. Pilots may use a navigation chart display with functionality equivalent to a lateral deviation indicator without an FD or AP.
- 9) For RNAV 1 routes, pilots must use a lateral deviation indicator, an FD or an AP on lateral navigation mode.
- 10) Pilots of aircraft with a lateral deviation display must make sure that the lateral deviation scale is suitable for the navigation accuracy associated to the route/procedure (e.g., full-scale deflection:  $\pm 1$  NM for RNAV 1,  $\pm 2$  NM for RNAV 2 or  $\pm 5$  NM for TSO-C129 () equipment in RNAV 2 routes).
- 11) All pilots are expected to follow the route centreline, as represented on the on-board lateral deviation indicators and/or flight guidance, during all RNAV 1 and RNAV 2 operations, unless cleared by the ATC to deviate or due to an emergency. For normal operations, the cross-track error/deviation (the difference between the RNAV system computed path and the aircraft position relative to the path) must be limited to  $\pm \frac{1}{2}$  the navigation precision associated with the route or flight procedure (e.g., 0.5 NM for RNAV 1 and 1.0 NM for RNAV 2). Small lateral deviations from this requirement are allowed (e.g., overshooting or undershooting the path) during or immediately after an en-route turn/procedure, up to a maximum of 1 times (1xRNP) the navigation precision (e.g., 1 NM for RNAV 1 and 2 NM for RNAV 2).

**Note.-** Some aircraft do not display or do not estimate a path during turns. Pilots of such aircraft may not be capable of meeting the  $\pm \frac{1}{2}$  precision requirement during en-route turns; however, they are expected to meet interception requirements after the turn or in straight segments.

- 12) If the ATC issues a heading assignment that places the aircraft out of the route, the pilot shall not modify the flight plan in the RNAV system until a new clearance is received allowing the aircraft to return to the route or until the controller confirms a new route clearance. When the aircraft is not on the published route, the specified precision requirements will not apply.
- 13) Manual selection of functions that limit the banking angle of the aircraft can reduce the ability of the aircraft to maintain its desired track and is not recommended. Pilots should acknowledge that manual selection of functions that limit the banking angle of the aircraft could reduce their ability to meet ATC path expectations.
- 14) Pilots operating aircraft with RNP approval in accordance with the provisions of this AC do not need to modify the predetermined RNP values of the manufacturer established in the FMC.

c) **RNAV SIDs specific requirements**

- 1) Before beginning take-off, the pilot must verify that the airborne RNAV system is available and operating correctly, and that the appropriate aerodrome and runway data have been loaded. Before the flight, pilots must verify that the airborne navigation system is operating correctly and that the appropriate runway and departure procedure (including any applicable en-route transition) have been loaded and are duly displayed.
- 2) *Altitude for connecting the RNAV equipment.-* The pilot must be capable of connecting the RNAV equipment in order to follow the flight guidance in the RNAV lateral navigation mode before reaching 153 m (500 ft) above the aerodrome elevation. The altitude at which the RNAV guidance on a route begins can be higher (e.g., climb to 304 m (1 000 ft) then direct to...)
- 3) Pilots must use an authorised method (lateral deviation indicator/navigation chart display /FD/AP) to achieve appropriate level of performance for RNAV 1.
- 4) *DME/DME aircraft.-* Pilots of aircraft without GNSS that use DME/DME sensors without inertial input cannot use their RNAV systems until the aircraft is under the appropriate DME coverage. The ANSP will make sure that adequate DME coverage is available in every (DME/DME) RNAV SID.
- 5) *DME/DME/IRU aircraft.-* Pilots of aircraft without GNSS that use DME/DME RNAV systems with an IRU (DME/DME/IRU) must make sure that the position in the inertial navigation system (INS) is within 304 m (1 000 ft/0.17 NM) from a known position at the starting point of the take-off roll. This is usually achieved through the use of a manual or automatic runway updating function. The navigation chart can also be used to confirm the position of the aircraft if the pilot procedures and the display resolution allow compliance with the 304 m (1 000 ft) tolerance requirement.

**Note.-** Based on the assessment of IRU performance, the increase of the position error after reverting to IRU can be expected to be less than 2 NM per 15 minutes.

- 6) *GNSS aircraft.-* When a GNSS is used, the signal must be obtained before starting the take-off roll. For aircraft using TSO-C129/C129a equipment, the take-off aerodrome must be loaded in the flight plan in order to achieve monitoring and the appropriate navigation system sensitivity. For aircraft using TSO-C145a/C146a avionics, if the departure begins at a runway waypoint, then the departure airport does not need to be in the flight plan to obtain appropriate monitoring and sensibility.

d) **RNAV STARs specific requirements**

- 1) Before the arrival phase, the flight crew shall verify that the correct terminal route has been loaded. The active flight plan shall be checked, comparing the charts to the chart

display (if applicable) and the MCDU. This includes confirmation of WPT sequence, the reasonableness of track angles and distances, any altitude or speed constraints, and, whenever possible, which are fly-by WPTs and which are flyover WPTs. If required by a route, it will be necessary to confirm that the update will exclude a particular NAVAID. A route will not be used if there are any doubts about its validity in the navigation database.

*Note.- As a minimum, verifications in the arrival phase could consist of simple inspections of an appropriate chart display that will meet the objectives of this paragraph.*

- 2) The creation of new WPTs by the flight crew through manual entries into the RNAV system will invalidate any route, and is not permitted.
  - 3) When contingency procedures require reverting to a conventional arrival route, the flight crew must make the necessary preparations before starting the RNAV route.
  - 4) Route modification in the terminal area may take the form of radar headings or "direct to" clearances. In this sense, the flight crew must be capable of reacting in time. This may include the insertion of tactical WPTs loaded from the database. The flight crew is not allowed to make manual entries or to modify a loaded route, using temporary WPT or fixes not provided in the database.
  - 5) Pilots must verify that the aircraft navigation system is operating properly and that the correct arrival procedure and runway are properly inserted and displayed.
  - 6) Although a specific method has not been established, any altitude or speed constraints shall be observed.
- e) **Contingency procedures**
- 1) The pilot must notify the ATC of any loss of RNAV capability, together with the proposed course of action. If it is not possible to meet the requirements of an RNAV route, pilots must notify the ATS as soon as possible. Loss of RNAV capability includes any failure or event that causes the aircraft to be unable to meet the RNAV requirements of the route.
  - 2) In case of a communication failure, the flight crew must continue on the RNAV route, according to the established procedure for lost communication.

## 11. TRAINING PROGRAMME

11.1 The training programme for flight crews and flight dispatchers (DV) shall provide sufficient training (e.g., using flight training devices, flight simulators, and aircraft) on the RNAV system to the extent necessary. The training programme will include the following topics:

- a) information about this CA;
- b) the meaning and proper use of aircraft equipment and navigation suffixes;
- c) the characteristics of procedures, as determined in chart displays and in the text description;
- d) the representation of the types of WPTs (fly-by and fly-over) and ARINC 424 path terminations provided in Paragraph 8.4 and any other type used by the operator, as well as those associated with the aircraft flight paths;
- e) the navigation equipment required to operate in RNAV 1 and RNAV 2 routes, SIDs and STARs (e.g., GNSS, DME/DME and DME/DME/IRU).
- f) specific information on the RNAV system:
  - 1) levels of automation, annunciation modes, changes, alerts, interactions, reversals, and degradation;
  - 2) integration of functions with other aircraft systems;
  - 3) the meaning and convenience of en-route discontinuities, as well as procedures related to the flight crew;

- 4) pilot procedures consistent with the operation;
  - 5) types of navigation sensors (e.g., GNSS, DME, IRU) used by the RNAV system and establishment of priorities, weighting, and consistency with associated systems;
  - 6) turns anticipation taking into account the effects of speed and altitude;
  - 7) interpretation of electronic displays and symbols;
  - 8) understanding aircraft configuration and the operating conditions required to support RNAV operations, e.g., appropriate selection of CDI scale (lateral deviation display scale);
- g) operating procedures for RNAV equipment, as applicable, including how to carry out the following:
- 1) verify currency and integrity of aircraft navigation data;
  - 2) verify the successful completion of RNAV system self-test;
  - 3) initialize RNAV system position;
  - 4) retrieve and fly a SID or STAR with the appropriate transition;
  - 5) adhere to speed and altitude constraints associated with a SID or STAR;
  - 6) select the appropriate SID or STAR for the active runway and become familiar with the procedures to deal with a runway change;
  - 7) perform a manual or automatic update (with take-off point shift, if applicable);
  - 8) verify the WPTs and flight plan programming;
  - 9) fly direct to a WPT;
  - 10) fly a course/track to a WPT;
  - 11) intercept a course/track;
  - 12) fly radar vectors and return to an RNAV route from a "heading" mode;
  - 13) determine cross-track errors and deviations;
  - 14) resolve en-route discontinuities (insert and delete/eliminate en-route discontinuities);
  - 15) remove or reselect the navigation sensor inputs;
  - 16) when required, confirm the exclusion of a specific NAVAID or any type of navigation aid;
  - 17) when required by the CAA, performs gross navigation errors checks using conventional NAVAIDs;
  - 18) change the arrival and alternate aerodromes;
  - 19) perform parallel offset functions if that capability is available. Pilots must know how offset are applied, the functionality of the particular RNAV system, and the need to advise the ATC if this functionality is not available; and
  - 20) perform RNAV holding functions (e.g., insert or delete a holding pattern).
- h) levels of automation recommended by the operator for each flight phase and workload, including the methods to minimise cross-track error that permit the aircraft to follow the route centreline;
- i) radiotelephony phraseology used for RNAV applications; and
- j) contingency procedures for RNAV failures.



**12. NAVIGATION DATABASE**

- a) The operator must obtain the navigation database from a supplier that complies with document RTCA DO 200A/EUROCAE ED 76 – Standards for aeronautical data processing. Navigation data must be compatible with the intended function of the equipment (see Annex 6 Part I paragraph 7.4.1). A letter of acceptance (LOA) issued by the appropriate regulatory authority to each participant in the data chain shows compliance with this requirement (*e.g.*, FAA LOA issued in accordance with FAA AC 20-153, or EASA LOA issued in accordance with EASA IR 21 Subpart G).
- b) The operator must advise the navigation data supplier of discrepancies that invalidate a route, and prohibit the use of the affected procedures through a notice to flight crews.
- c) Operators should consider the need to check the navigation database periodically in order to maintain the existing requirements of the quality system or safety management system.
- d) DME/DME RNAV systems must only use the DME facilities identified in CAA AIPs.
- e) Systems must not use the facilities indicated by the CAA as inappropriate for RNAV 1 and RNAV 2 operations in the AIP, or facilities associated with an ILS or MLS that uses a range offset. This can be done excluding the specific DME facilities known to have a detrimental effect on the navigation solution from the aircraft database, when RNAV routes are within the receiving range of such DME facilities.

**13. OVERSIGHT, INVESTIGATION OF NAVIGATION ERRORS, AND WITHDRAWAL OF RNAV 1 and RNAV 2 APPROVAL**

- a) The operator will establish a procedure to receive, analyse, and follow up on navigation error reports in order to determine appropriate corrective action.
- b) Information indicating a potential for repetitive errors may require the modification of the training programme of the operator.
- c) Information attributing multiple errors to a pilot in particular may call for additional training or a license review for that pilot.
- d) Repetitive navigation errors attributed to the equipment or a specific part of the navigation equipment or to operating procedures can be the cause of cancellation of an operational approval (withdrawal of RNAV 1 and RNAV 2 IPsec authorisation or withdrawal of the LOA in the case of private operators).

## APPENDIX 1

### CRITERIA FOR THE APPROVAL OF RNAV SYSTEMS THAT USE DME

#### (DME/DME RNAV SYSTEM)

#### 1. PURPOSE

The CAA is responsible for assessing DME coverage and availability in accordance with the minimum standards of the DME/DME RNAV system for each route and procedure. Detailed criteria are needed to define DME/DME RNAV system performance, since that system is related to DME infrastructure. This Appendix describes the minimum DME/DME RNAV system performance and functions required to support the implementation of RNAV 1 and RNAV 2 routes, SIDs, and STARs. These criteria must be used for the airworthiness approval of new equipment or can be used by manufacturers for the certification of their existing equipment.

#### 2. MINIMUM REQUIREMENTS FOR DME/DME RNAV SYSTEMS

Paragraph	Criteria	Explanation
a)	Accuracy is based on the performance standards set forth in TSO-C66c	
b)	Tuning and updating position of DME facilities	<p>The DME/DME RNAV system must:</p> <ol style="list-style-type: none"> <li>1) update its position within 30 seconds of tuning on DME navigation facilities;</li> <li>2) auto-tune multiple DME facilities; and</li> <li>3) provide continuous DME/DME position updating. If a third DME facility or a second pair has been available for at least the previous 30 seconds, there must be no interruption in DME/DME positioning when the RNAV system switches between DME stations/pairs.</li> </ol>
c)	Use of facilities contemplated in State AIPs	<p>DME/DME RNAV systems must only use the DME facilities identified in the State AIPs. Systems must not use the facilities that States list in their AIPs as not appropriate for RNAV 1 and/or RNAV 2 operations, or facilities associated to an ILS or MLS that uses a range offset. This can be done through:</p> <ol style="list-style-type: none"> <li>1) Excluding specific DME facilities which are known to have a deleterious effect on the navigation solution from the aircraft navigation database when RNAV routes are within the reception range of said DME facilities.</li> <li>2) the use of an RNAV system that conducts reasonableness checks to detect errors in all of the DME facilities and excludes those facilities from the navigation position solution as appropriate (e.g., preclude tuning on co-channel signal facilities when the DME facilities signal-in-space overlap).</li> </ol>

Paragraph	Criteria	Explanation
d)	DME facilities relative angles	When it is necessary to generate a DME/DME position, the RNAV system must use, as a minimum, DMEs with a relative angle between 30° and 150°.
e)	Use of DMEs through the RNAV system	<p>The RNAV system may use any valid (listed in the AIP) DME facility, regardless of its location. A valid DME facility:</p> <ol style="list-style-type: none"> <li>1) issues a precise signal that identifies the facility;</li> <li>2) meets the minimum signal intensity requirements; and</li> <li>3) is protected against interference from other DME signals, in accordance with co-channel and adjacent channel requirements.</li> </ol> <p>When needed to generate a DME/DME position, as a minimum, the RNAV system must use an available and valid low altitude and/or high altitude DME anywhere within the following region around the DME facility:</p> <ol style="list-style-type: none"> <li>1) greater than or equal to 3 NM from the facility; and</li> <li>2) less than 40° above the horizon when viewed from the DME facility and at a distance of 160 NM.</li> </ol> <p><b>Note.-</b> The use of a figure-of-merit (FOM) in approximating the designated operational coverage (DOC) of particular facilities is acceptable, provided precautions are taken to ensure that the FOM is coded in such a way that the aircraft can use the facility anywhere within the DOC. The use of DMEs associated with ILS or MLS is not required..</p>
f)	No requirement to use VOR, NDB, LOC, IRU or AHRS	There is no requirement to use VOR, non-directional radio beacon (NDB), localizer (LOC), IRU or attitude and heading reference system (AHRS) during normal operation of the DME/DME RNAV system.
g)	Position estimation error (PEE)	<p>When using a minimum of two DME facilities that meet the criteria contained in Paragraph e) above and any other valid facility that does not meet such criteria, the position estimation error during 95% of the time must be better than or equal to the following equation:</p> $2\sigma_{DME/DME} \leq 2 \frac{\sqrt{(\sigma_{1,air}^2 + \sigma_{1,sys}^2) + (\sigma_{2,air}^2 + \sigma_{2,sys}^2)}}{\sin(\alpha)}$ <p>where: <math>\sigma_{sys} = 0.05</math> NM  <math>\sigma_{air}</math> is MAX {(0.085 NM, (0.125% of the distance))}  <math>\alpha</math> = angle of inclusion (30° to 150°)</p> <p><b>Note.-</b> This performance requirement can be met by any navigation system that uses two DME facilities simultaneously, limits the DME inclusion angle between 30° and 150° and uses DME sensors that meet TSO-C66c precision requirements. If the RNAV system uses DME facilities outside of the published designated operational coverage, it can still be assumed that the DME signal-in-space error of valid facilities is <math>\sigma_{ground} = 0.05</math> NM.</p>
h)	Preventing	The RNAV system must ensure that the use of facilities

Paragraph	Criteria	Explanation
	erroneous guidance from other facilities	outside the service volume (where field intensity and common or adjacent interference requirements cannot be met) do not cause misguidance. This could be achieved by including reasonableness checks when initially tuning on a DME facility, or by excluding a DME facility when there is a co-channel DME within line-of-sight.
i)	Preventing erroneous VOR signals-in-space	The RNAV system can use a VOR. However, the RNAV system must make sure that an erroneous VOR signal-in-space does not affect the position error when the system is within DME/DME coverage. This can be achieved by monitoring the VOR signal with DME/DME to make sure that it does not mislead position results (e.g., through reasonableness checks).
j)	Ensuring RNAV systems use operational facilities	The RNAV system must use operational DME facilities. DME facilities listed in the NOTAMS as inoperative (for example, being tested or undergoing maintenance) could still reply to on-board interrogation. Consequently, inoperative facilities must not be used. An RNAV system can exclude inoperative DME facilities by verifying the identification code or inhibiting the use of facilities identified as inoperative.
k)	Operational mitigation	<p>Operational mitigations, such as the monitoring by pilots of the sources to update the RNAV navigation system, or time scheduling, or the exclusion of multiple DME facilities, should be performed before any period of intensive workload or any critical flight phase.</p> <p><b>Note.-</b> The exclusion of individual facilities listed in the NOTAMS as out of service and/or the programming of a route/procedure defined as critical DME is acceptable when such mitigation does not require action by the pilot during a critical phase of the flight. Likewise, a programming requirement does not imply that the pilot should manually enter the DME facilities that are not in the navigation database.</p>
l)	Reasonableness checks	<p>Many RNAV systems perform reasonableness checks to verify the validity of DME measurements.- Reasonableness checks are very effective against database errors or erroneous system inputs (such as, inputs from co-channel DME facilities) and normally can be divided into two classes:</p> <ol style="list-style-type: none"> <li>1) the ones the RNAV system uses after a new DME has been captured, where the system compares the aircraft's position before using the DME with the range of the aircraft to that DME; and</li> <li>2) the ones the RNAV system continuously uses, based on redundant information (for example, additional DME signals or IRU information).</li> </ol> <p><b>General requirements</b></p> <p>Reasonableness checks are intended to prevent navigation aids from being used for navigation updating in areas where data can lead to errors in the radio position fix due to co-channel interference, multipath, and direct signal screening.</p>

Paragraph	Criteria	Explanation
		<p>Instead of using the service volume of NAVAIDs, the navigation system must provide checks that preclude the use of duplicate frequencies of the NAVAIDs within range, over-the-horizon NAVAIDs, and NAVAIDs with poor geometry.</p> <p><b>Assumptions.-</b> Under certain conditions, reasonableness checks can be invalid.</p> <p>1) A DME signal will not remain valid just because it was valid when captured.</p> <p>2) <i>Additional DME signals might not be available.</i> The intent of this specification is to support operations where infrastructure is minimal (for example, when only two DMEs are available for en-route segments).</p> <p><b>Use of stressing conditions to test the effectiveness of the verification.-</b> When a reasonableness check is used to meet any requirement of these criteria, the effectiveness of the check must be tested under extreme conditions. An example of this condition is when a DME signal, valid when captured, becomes distorted during the test, when there is only one supporting DME or two signals of equal strength.</p>

### 3. PROCESS TO CONFIRM THE PERFORMANCE OF RNAV SYSTEMS THAT USE DME

New systems may demonstrate compliance with these criteria as part of the airworthiness approval. For existing systems, operators shall determine compliance with the equipment and aircraft criteria set forth in this AC based on the information provided by aircraft and equipment manufacturers. Manufacturers that have achieved compliance with the requirements of paragraph (8.3.2) above and of this paragraph (8.3.3) shall provide this information through a letter to their customers. Operators may use this approval as the basis for their operations. Manufacturers will also be required by the CAA to provide a copy of the aforementioned letter in order to facilitate making this information available to all operators. Guidance is provided below for aircraft and FMS and DME manufacturers.

- a) **Aircraft manufacturers (type certificate (TC) holders that incorporating FMS and DME/DME positioning).**- The manufacturer shall review the available data on the integrated navigation system and shall obtain additional data, as appropriate, to determine compliance with the criteria set forth in this AC. Manufacturers that have achieved compliance with these criteria shall provide this information by letter to their customers. Manufacturers are also requested to provide a copy of this letter to the CAA in order to facilitate making this information available to all operators.
- b) **Equipment manufacturers (normally individual DME and/or FMS TSO holders)**
  - 1) **DME sensor.**- The only requirement in this paragraph (8.3.3) that needs to be considered for a DME sensor is accuracy. DME sensors have been tested for a variety of performance requirements of TSO-C66 – Distance-measuring equipment (DME) that operates within the radio frequency range of 960-1215 megahertz and documents of the Radio Technical Commission for Aeronautics (RTCA).
    - (a) TSO-C66 performance standards have evolved as follows:
      - (1) TSO-C66: (August 1960) RTCA/DO99.
      - (2) TSO-C66a: (September 1965) RTCA/DO151, accuracy requirement of a total error of 0.1 NM attributed to the ground facility, an accuracy of 0.5 NM for

airborne equipment or 3% distance, whichever is greater, with a maximum of 3 NM.

- (3) TSO-C66b: (November 1978) RTCA/DO151a, accuracy requirement of a total error of 0.1 NM attributed to the ground facility, an accuracy of 0.5 NM for airborne equipment or 1% of the distance, whichever is greater, with a maximum of 3 NM.
- (4) TSO-C66c: (September 1985) RTCA/DO189, accuracy requirement as total error for the airborne equipment of 0.17 NM or 0.25% of distance, whichever is greater.

- (b) **TSO-C66c required precision.-** The accuracy required by TSO-C66c is adequate to support the criteria of this section and AC, and DME equipment manufacturers under this TSO version do not need to further assess their equipment for RNAV 1 and RNAV 2 operations. DME sensor manufacturers may use the following process to establish a more precise performance than originally credited:

- (1) **Determination of the precision achieved.-** Rather than relying on the originally demonstrated performance, the applicant may choose to make a revision under the original TSO, TC data, or TC supplement to determine proven accuracy, and/or make any appropriate changes to qualification tests to determine the precision achieved.

*Note.- When conducting the precision analysis, the DME signal-in-space error can be assumed to be 0.1 NM 95% of the time. If accuracy is demonstrated on a test bench or under flight test conditions, the accuracy of the test bench equipment or ground facility must be considered.*

- (2) **Accomplishing new testing.-** New tests must be conducted under the same conditions used to demonstrate compliance with the original TSO-C66 standard.
- (3) Manufacturers who have demonstrated a more precise DME performance shall indicate the demonstrated accuracy in a letter to their customers. Manufacturers shall also provide copy of this letter to the CAA to facilitate making this information available to all operators.

- 2) **Multi-sensor systems.-** The manufacturer shall review the data on the integrated navigation system and obtain additional data, as appropriate, to comply with the criteria contained in Paragraphs 8.3.2 and 8.3.3 of this AC. Manufacturers that have achieved compliance with such criteria shall provide this information in a letter to their customers, along with any operational limitation (for example, if the pilot must manually inhibit the use of facilities listed as unavailable in the NOTAM). The certification of the manufacturer may limit compliance to specific DME systems, or may reference any DME to TSO-C66c requirements. Manufacturers shall also provide a copy of the letter to the CAA.

- (a) **FMS accuracy.-** FMS accuracy depends on a number of factors, including latent effects, the selection of DME facilities, the method of combining information from multiple DMEs, and the effects of other sensors used for positioning. For FMSs that use two or more DMEs at the same time and that limit the DME inclusion angle to between 30° and 150°, the precision requirement can be met if the DME sensors meet the precision requirements of TSO-C66c. For FMSs that lack these characteristics, precision shall be assessed under inadequate DME geometry scenarios and shall consider the demonstrated precision of the DME sensor. Inadequate geometry scenarios may include angles at the previously specified limits, with or without additional DME facilities available outside these conditions.
- (b) **Identification of conditions.-** The conditions that might prevent compliance with precision requirements and the means to avoid them shall be identified.

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**APPENDIX 2****CRITERIA FOR APPROVAL OF RNAV SYSTEMS THAT USE DME AND IRU****(DME/DME/IRU RNAV SYSTEM)****1. PURPOSE**

This paragraph defines the minimum performance for the DME/DME/IRU (D/D/I) RNAV system. Performance standards for DME/DME positioning are detailed in Appendix 1. The minimum requirements set forth in Appendix 1 are applicable to this appendix and, thus, are not repeated, unless additional performance is required.

**2. MINIMUM REQUIREMENTS FOR DME/DME/IRU RNAV SYSTEMS (INERTIAL SYSTEM PERFORMANCE)**

Paragraph	Criteria	Explanation
a)	Inertial system performance must meet the criteria set forth in Appendix G to LAR 121 or equivalent.	
b)	Automatic position updating capability is required from the DME/DME solution.	<i>Note.- Operators/pilots must contact manufacturers to discern if any annunciation of inertial coasting is suppressed following loss of radio updating.</i>
c)	Since some aircraft systems revert to VOR/DME-based navigation before reverting to inertial coasting, the impact of VOR radial accuracy when the VOR is greater than 40 NM from the aircraft, must not affect aircraft position accuracy.	A method to comply with this objective is to exclude from the RNAV system the VORs that are more than 40 NM away from the aircraft



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## APPENDIX 3

## FUNCTIONAL REQUIREMENTS – NAVIGATION FUNCTIONS AND DISPLAYS

Paragraph	Functional requirements	Explanation
a)	Navigation data, including the to/from indication and a failure indicator, must be shown on a lateral deviation display [e.g., a course deviation indicator (CDI), an enhanced horizontal situation indicator (E)HSI) and/or a navigation chart display]. These lateral deviation displays will be used as primary means of navigation of the aircraft, for manoeuvre anticipation, and for indication of failure/status/integrity. They shall meet the following requirements:	<p>Non-numeric lateral deviation displays (e.g., CDI, (E)HSI), with to/from indication and failure warning, for use as primary means of navigation of the aircraft, manoeuvre anticipation, and indication of failure/status/integrity, with the following five attributes:</p> <ol style="list-style-type: none"> <li>1) Displays will be visible to the pilot and will be located in the primary field of view (<math>\pm 15</math> degrees from the normal line of sight of the pilot) when looking forward along the flight path;</li> <li>2) The lateral deviation display scale must be consistent with all alerting and advisory limits, if implemented;</li> <li>3) The lateral deviation display must also have a full-scale deflection suitable for the flight phase and must be based on the total system precision required;</li> <li>4) The display scale may be automatically adjusted by default logic, or set to a value obtained from the navigation database. The full-scale deflection value must be known or must be available for display to the pilot, and must be consistent with the values for en-route, terminal, and approach operations; and</li> <li>5) The lateral deviation display must be automatically slaved to the RNAV calculated path. The course selector of the lateral deviation display shall be automatically adjusted to the RNAV calculated path.</li> </ol> <p><b>Note.-</b> The normal functions of the stand-alone GNSS meet this requirement.</p> <p>As an alternate means, a navigation chart display must provide a function equivalent to a lateral deviation display, as described in Paragraph a) 1) from (a) to (e), with appropriate chart scales; which may be manually adjusted by the pilot.</p> <p><b>Note.-</b> A number of modern aircraft eligible for this specification uses a chart display as an acceptable means to meet the prescribed requirements.</p>
b)	The following RNAV 1 and RNAV 2 system functions are required as a minimum:	<ol style="list-style-type: none"> <li>1) The capability to continuously display to the pilot flying (PF), on the primary flight navigation instruments (primary navigation displays), the calculated desired RNAV path and the position of the aircraft relative to that path. For</li> </ol>

Paragraph	Functional requirements	Explanation
		<p>operations where the minimum flight crew is two pilots, means will be provided for the pilot not flying (PNF) the aircraft or monitoring pilot (MP) to check the desired path and the position of the aircraft relative to that path;</p> <p>2) A navigation database containing current navigation data officially issued for civil aviation, which can be updated in accordance with the aeronautical information regulation and control (AIRAC) cycle and from which ATS routes can be retrieved and loaded into the RNAV system. The stored resolution of the data must be sufficient to achieve negligible path definition error (PDE). The database must be protected against flight crew modification of the stored data;</p> <p>3) The means to display to the flight crew the period of validity of the navigation database;</p> <p>4) The means to retrieve and display the data stored in the navigation database relating to individual waypoints and NAVAIDs, to enable the flight crew to verify the route to be flown; and</p> <p>5) The capability to load on the RNAV system, from the navigation database, the complete RNAV segment of the SIDs or STARs to be flown.</p> <p><b>Note.-</b> Due to variability in RNAV systems, this document defines the RNAV segment from the first occurrence of a named WPT, track or course up to the last occurrence of a named WPT, track or course. Legs or segments prior to the first named WPT or after the last named WPT must not be loaded from the navigation database.</p>
c)	The means to show the following items, either on the primary field of view of the pilots, or on a readily accessible page display [e.g., on a multi-function control display unit (MCDU)]:	<p>1) The active navigation sensor type;</p> <p>2) The identification to the active (TO) waypoint;</p> <p>3) The ground speed or time to the active (TO) waypoint; and</p> <p>4) The distance and bearing to the active (TO) waypoint.</p> <p><b>Note.-</b> When the CDU/MCDU is used to support precision checks by the pilot, said CDU/MCDU must have the capability of displaying lateral deviation with a resolution of at least 0.1 NM.</p>
d)	The capability to execute the "direct to" function.	
e)	The capability for automatic leg sequencing, displaying the sequence to the flight	

Paragraph	Functional requirements	Explanation
	crew.	
f)	The capability of executing ATS routes retrieved from the on-board database, including the capability of performing fly-by and flyover turns.	
g)	<p>The aircraft must have the capability to automatically execute leg transitions and maintain tracks consistent with the following ARINC 424 path terminators or their equivalent:</p> <ul style="list-style-type: none"> <li>➤ Initial fix (IF);</li> <li>➤ Course to a fix (CF);</li> <li>➤ Direct to a fix (DF); and</li> <li>➤ Track to a fix (TF).</li> </ul>	<p><b>Note 1.-</b> Path terminators are defined in ARINC 424 specification, and their application is described in more detail in RTCA documents DO-236B and DO-201A and in EUROCAE ED-75B and ED-77</p> <p><b>Note 2.-</b> Numeric values for courses and tracks must be automatically loaded from the RNAV system database.</p>
h)	The aircraft must have the capability to automatically execute leg transitions consistent with the following ARINC 424 path terminators: heading to an altitude (VA), heading to a manual termination (VM), and heading to an intercept (VI), or must be capable of being manually flown on a heading to intercept a course or to fly direct to another fix after reaching an altitude of a specified procedure.	
i)	The aircraft must have the capability to automatically execute leg transitions consistent with the following ARINC 424 path terminators: course to an altitude (CA) and course from a fix to a manual termination (FM), or the RNAV system must permit the pilot to readily designate a waypoint and select a desired course to or from a designated waypoint.	

Paragraph	Functional requirements	Explanation
j)	The capability to load an RNAV ATS route from the database into the RNAV system by its name is a recommended function. However, if all or part of an RNAV route (not SID or STAR) is entered by manual entry of WPTs from the database, the paths between the manual entry of WPTs and the preceding or subsequent WPTs must be flown in the same way as a TF leg in terminal airspace.	
k)	The capability of showing an indication of RNAV system failure, including the associated sensors, in the primary field of view of the pilots.	
l)	For multi-sensor systems, the capability for automatic reversion to an alternate RNAV sensor if the primary RNAV sensor fails. This does not preclude the provision of a means for manual selection of the navigation source.	
m)	Database integrity	Navigation database suppliers must comply with RTCA DO-200/EUROCAE document ED 76 - Standards for processing aeronautical data. A Letter of acceptance (LOA) issued by the appropriate regulatory authority to each of the participants in the data chain shows compliance with this requirement. Discrepancies that invalidate a route must be reported to database providers, and the affected routes must be prohibited through a notice from the operator to its flight crews. Aircraft operators must consider the need to conduct periodic checks of the navigation databases in order to meet the requirements of the existing safety system.

Paragraph	Functional requirements	Explanation
n)	It is recommended that the RNAV systems provide lateral guidance so that aircraft remain within the lateral boundaries of the fly-by transition area.	

## **APPENDIX 4**

### **NAVIGATION DATA VALIDATION PROGRAMME**

#### **1. INTRODUCTION**

The information stored in the navigation database defines the lateral and longitudinal guidance of the aircraft for RNAV1 and RNAV 2 operations. Navigation database updates are carried out every 28 days. The navigation data used in each update are critical to the integrity of every RNAV 1 and RNAV 2 route, SID, and STAR. This appendix provides guidance on operator procedures to validate the navigation data associated with the RNAV 1 and RNAV 2 operations.

#### **2. DATA PROCESSING**

- a) The operator will identify in its procedures the person responsible for the navigation data updating process.
- b) The operator must document a process for accepting, verifying, and loading navigation data into the aircraft.
- c) The operator must place its documented data process under configuration control.

#### **3. INITIAL DATA VALIDATION**

3.1 The operator must validate every RNAV 1 and RNAV 2 route, SID and STAR before flying under instrument meteorological conditions (IMC) to ensure compatibility with the aircraft and to ensure that the resulting paths are consistent with the published routes, SIDs and STARs. As a minimum, the operator must:

- a) compare the navigation data of RNAV 1 and RNAV 2 routes, SIDs, and STARs to be loaded into the FMS with valid charts and maps that contain the published routes, SIDs, and STARs.
- b) validate the navigation data loaded for RNAV 1 and RNAV 2 routes, SIDs, and STARs, either on the flight simulator or on the aircraft, under visual meteorological conditions (VMC). RNAV 1 and RNAV 2 routes, SIDs, and STARs outlined on a chart display must be compared to the published routes, SIDs, and STARs. Complete RNAV 1 and RNAV 2 routes, SIDs, and STARs must be flown in order to ensure that the paths can be used, that they have no apparent lateral or longitudinal discrepancies, and that they are consistent with the published routes, SIDs, and STARs.
- c) Once the RNAV 1 and RNAV 2 routes, SIDs, and STARs are validated, a copy of the validated navigation data shall be kept and maintained in order to compare them with subsequent data updates.

#### **4. DATA UPDATING**

After receiving a navigation data update and before using such data on the aircraft, the operator must compare the update with the validated routes. This comparison must identify and resolve any discrepancy in the navigation data. If there are significant changes (any change affecting route path or performance) in any part of a route and if those changes are verified through the initial data, the operator must validate the amended route in accordance with the initial validation data.

#### **5. NAVIGATION DATA SUPPLIERS**

Navigation data suppliers must have a letter of acceptance (LOA) in order to process these data (e.g., FAA AC 20-153 or the document on the conditions for the issuance of letters of acceptance to navigation data providers by the European Aviation Safety Agency – EASA (EASA IR

21 Subpart G) or equivalent documents). A LOA recognises the data supplier as one whose data quality, integrity and quality management practices are consistent with the criteria set forth in document DO-200A/ED-76. The supplier of an operator (e.g., an FMS company) must have a Type 2 LOA and its respective suppliers must have a Type 1 or 2 LOA. The CAA may accept a LOA issued to navigation data suppliers or issue its own LOA.

## **6. AIRCRAFT MODIFICATIONS (DATABASE UPDATE)**

If an aircraft system necessary for RNAV 1 and RNAV 2 operations is modified (e.g., change of software), the operator is responsible for validating the RNAV 1 and RNAV 2 routes, SIDs, and STARs with the navigation database and the modified system. This can be done without any direct assessment if the manufacturer confirms that the modification has no effect on the navigation database or on path calculation. If there is no such confirmation by the manufacturer, the operator must perform an initial validation of the navigation data with the modified system.



## APPENDIX 5

### RNAV 1 and RNAV 2 APPROVAL PROCESS

- a) The RNAV 1 and RNAV 2 approval process consists of two types of approvals, airworthiness and operational. Although the two have different requirements, they must be considered in one single process.
- b) This process is an orderly method used by the CAA to make sure that the applicants meet the established requirements.
- c) The approval process is made up by the following phases:
  - 1) Phase one: Pre-application
  - 2) Phase two: Formal application
  - 3) Phase three: Documentation evaluation
  - 4) Phase four: Inspection and demonstration
  - 5) Phase five: Approval
- d) In *Phase one - Pre-application*, the CAA calls the applicant or operator to a pre-application meeting. At this meeting, the CAA informs the applicant or operator of all the operational and airworthiness requirements that it must meet during the approval process, including the following:
  - 1) the contents of the formal application;
  - 2) the review and evaluation of the application by the aviation administration;
  - 3) the limitations (if any) applicable to the approval; and
  - 4) conditions under which the RNAV 1 and RNAV 2 approval could be cancelled.
- e) In *Phase two – Formal Application*, the applicant or operator submits the formal application along with all the relevant documentation, as established in paragraph 9.1.1 b) of this CA.
- f) In Phase three – *Documentation evaluation*, the CAA evaluates all the documentation and the navigation system to determine their eligibility and the approval method to be followed in connection with the aircraft. As a result of this analysis and evaluation, the CAA may accept or reject the formal application along with the documentation.
- g) In *Phase four – Inspection and demonstration*, the operator will provide training to its personnel and will carry out the validation flight, if required.
- h) In *Phase five - Approval*, the CAA issues the RNAV 1 and RNAV 2 approval once the operator has met the airworthiness and operational requirements. For LAR 121 and 135 operators, the CAA will issue the OpSpecs, and for LAR 91 operators, a LOA.

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## APPENDIX 6

## TRANSITION ROUTE TO RNAV 1 AND RNAV 2 OPERATIONS

- a) The following steps identify the transition route to obtain RNAV 1 and RNAV 2 approval:
- 1) **Operators with no RNAV 1 and RNAV 2 approval.-** An operator wishing to operate in RNAV 1 and RNAV 2 designated airspace:
    - (a) must obtain the RNAV 1 and RNAV 2 approval based on this AC or equivalent document.
    - (b) An operator approved based on the criteria of this AC is eligible to operate in RNAV 1 and RNAV 2 routes in the United States and in European P-RNAV routes. No additional approval is required.
    - (c) An operator wishing to operate in P-RNAV designated airspace must obtain a P-RNAV approval in accordance with TGL-10.
  - 2) **Operators with P-RNAV approval.-** An operator that maintains a P-RNAV approval according to TGL-10:
    - (a) is eligible to operate in the routes of any State where routes are based on TGL-10 criteria; and
    - (b) must obtain an RNAV 1 and RNAV 2 operational approval, with evidence of compliance with the differences that exist between TGL-10 and this AC or equivalent document, in order to operate in RNAV 1 and RNAV 2 designated airspace. This can be achieved by using Table 3-1.

**Table 3-1 – Additional requirements to obtain an RNAV 1 and RNAV 2 approval based on a TGL-10 approval**

Operator holding a TG-10 approval	Needs to confirm the following RNAV 1 and RNAV 2 performance capabilities in connection with this CA	Notes
If the approval includes use of DME/VOR equipment (the DME/VOR equipment may be used as the only positioning input where is explicitly allowed)	RNAV 1 does not include any DME/VOR RNAV-based route	RNAV system performance must be based on GNSS, DME/DME or DME/DME/IRU. However, DME/VOR input must not be inhibited or deselected
If approval includes use of DME/DME	No action is required if the RNAV system performance meets the specific navigation service criteria of this AC: DME/DME or DME/DME/IRU	The operator can ask the manufacturer or check the *FAA website for the system compliance list
RNAV SID specific requirement for with DME/DME aircraft	RNAV guidance available before reaching 500 ft above field elevation (AFE)	The operator must add this operational requirement
If approval includes use of GNSS	No action is required	

\*[http://www.faa.gov/about/office\\_org/headquarters\\_offices/avs/offices/afs/afs400/afs410/policy\\_guidance/](http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/afs/afs400/afs410/policy_guidance/)

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**APPENDIX C-2**

**RNAV 1 AND RNAV 2 JOB AID**

**APPLICATION TO CONDUCT RNAV 1 AND RNAV 2 OPERATIONS**

## **RNAV 1 AND RNAV 2 JOB AID**

### **APPLICATION TO CONDUCT RNAV 1 AND RNAV 2 OPERATIONS**

#### **1. Introduction**

This Job Aid was developed by the Latin American Regional Safety Oversight Cooperation System (SRVSOP) to provide States, operators, and inspectors with guidance on the process to be followed by an operator in order to obtain an RNAV 1 and RNAV 2 approval.

#### **2. Purpose of the Job Aid**

- 2.1 To give operators and inspectors information on the main RNAV 1 and RNAV 2 reference documents.
- 2.2 To provide tables showing the contents of the application, the associated reference paragraphs, the place in the application of the operator where RNAV 1 and RNAV 2 elements are mentioned and columns for inspector comments and follow-up on the status of various RNAV 1 and RNAV 2 elements.

#### **3. Actions Recommended for the Inspector and Operator**

Some recommendations for use of the Job Aid follow:

- 3.1 At the pre-application meeting with the operator, the inspector reviews the “basic events of the RNAV 1 and RNAV 2 approval process” described in Part 1 of this Job Aid, in order to provide an overview of the approval process events.
- 3.2 The inspector reviews this Job Aid with the operator in order to establish the form and content of the RNAV 1 and RNAV 2 approval application.
- 3.3 The operator uses this Job Aid as a guide to collect the documents/annexes of the RNAV 1 and RNAV 2 application.
- 3.4 The operator inserts in the Job Aid references showing in what part of its documents are the RNAV 1 and RNAV 2 programme elements located.
- 3.5 The operator submits the Job Aid and the application to the inspector (documents/annexes).
- 3.6 The inspector indicates in the Job Aid whether an item is in compliance or needs corrective action.
- 3.7 The inspector informs the operator as soon as possible when a corrective action by the operator is required.
- 3.8 The operator provides the inspector with the revised material when so requested.
- 3.9 The CAA provides the operator with the operational specifications (OpSpecs) or a letter of authorisation (LOA), as applicable, once the tasks and documents have been completed.

#### 4. Structure of the Job Aid

Parts	Topics	Page
Part 1	General information	3
Part 2	Information on aircraft and operator identification	5
Part 3	Operator application (Annexes and documents)	7
Part 4	Contents of the operator application for RNAV 1 and RNAV 2	9
Part 5	Guide to determine the eligibility of RNAV 1 and RNAV 2 aircraft	13
Part 6	Basic pilot procedures for RNAV 1 and RNAV 2 operations	15

#### 5. Main sources of documents, information, and contacts

To access the RNAV 1 and RNAV 2 Job Aid, enter to the Web page of the ICAO/SAM Regional Office ([www.lima.icao.int](http://www.lima.icao.int)) under the SRVSOP link.

#### 6. Main reference documents

Reference document	Title
Annex 6	Operation of aircraft
ICAO Doc 9613	Performance-based navigation (PBN) manual
FAA AC 90-100A	U.S. Terminal and en route area navigation (RNAV) operations
TGL 10	Airworthiness and operational approval for precision RNAV operations in designated European airspace
España DGAC CO 03/01	<i>Aprobaciones de aeronavegabilidad y operacionales para operaciones RNAV de precisión (P-RNAV) en el espacio aéreo Europeo designado</i>
AMC 20-5	Acceptable means of compliance for airworthiness approval and operational criteria for the use of the NAVSTAR Global positioning system (GPS)
AC 20-130()	Airworthiness approval of multi-sensor navigational system for use in the U.S. National Airspace System
AC 20-138A	Airworthiness approval of Global navigation satellite system (GNSS) equipment
AC 25-4	Inertial navigation system (INS)
AC 25-15	Approval of FMS in transport category airplanes
AC 90-45A	Approval of areas navigation systems for use in the U.S. National Airspace System

**PART 1: GENERAL INFORMATION****Basic events of the RNAV 1 and RNAV 2 approval process**

	<b>Action by the operator</b>	<b>Action by the CAA</b>
1	Establish the need to obtain approval for RNAV 1 and RNAV 2 operations.	
2	Review the AFM, AFM supplement or Type Certificate Data Sheet (TCDS), or other appropriate documents (e.g., service bulletins (SB), service letters (SL), etc.) to determine the eligibility of the aircraft for RNAV 1 and RNAV 2 operations. The operator contacts the aircraft or avionics manufacturer, if necessary, to confirm RNAV 1 and RNAV 2 or higher eligibility of the aircraft.	
3	Contact the CAA to schedule a pre-application meeting to discuss the operational approval requirements.	
4		During the pre-application meeting, establish: <ul style="list-style-type: none"> <li>• the form and contents of the application;</li> <li>• the documents that support RNAV 1 and RNAV 2 approval</li> <li>• the date in which the application will be submitted for evaluation</li> <li>• if necessary, conduct a validation flight observed by the CAA</li> </ul>
5	Send the application at least 60 days before the start-up of RNAV 1 and RNAV 2 operations.	
6		Review the request of the operator.
7	Once the amendments to manuals, programmes, and documents have been approved, provide training to flight crews, flight dispatchers, and maintenance personnel, and conduct a validation flight, if required by the CAA.	Only if required, participate in the validation flight.
8		Once the operational and airworthiness requirements have been met, issue the operational approval in the form of OpSpecs for LAR 121 or 135 or equivalent operators, or an LOA for LAR 91 or equivalent operators, as appropriate.



**Notes related to the approval process****1. Responsible authority**

- a. **Commercial air transport (LAR 121 and/or 135 or equivalent regulations).**- The **State of Registry** determines that the aircraft meets the airworthiness requirements. The **State of the Operator** issues the RNAV 1 and RNAV 2 approval (e.g., OpSpecs).
- b. **General Aviation (LAR 91 or equivalent regulations).**- The **State of Registry** determines that the aircraft meets the airworthiness requirements and issues the operational approval (e.g., an LOA).

2. The CAA does not need to issue an LOA or an equivalent document for each individual area of operation in the case of LAR 91 operators.

3. LAR 121 and/or 135 operators with RNAV 1 and RNAV 2 approval must list this approval in the OpSpecs.

4. Related sections of the Latin American Aeronautical Regulations (LAR) or equivalent regulations

- a. LAR 91        Sections 91.1015 and 91.1640 or equivalents
- b. LAR 121     Section 121.995 (b) or equivalent
- c. LAR 135     Section 135.565 (c) or equivalent

5. Related ICAO Documents

- a. Annex 6 to the Convention on International Civil Aviation – Operation of Aircraft
- b. Annex 10 to the Convention on International Civil Aviation – Aeronautical Telecommunications
- c. Annex 15 to the Convention on International Civil Aviation – Aeronautical Information Services
- d. ICAO Doc 9613 – Manual on performance-based navigation (PBN)
- e. ICAO Doc 7030 – Regional supplementary procedures

**PART 2: INFORMATION ON THE IDENTIFICATION OF AIRCRAFT AND OPERATORS****NAME OF THE OPERATOR:** \_\_\_\_\_

<b>Aircraft manufacturer, model, and series</b>	<b>Registration numbers</b>	<b>Serial numbers</b>	<b>Area navigation systems (RNAV) Number, manufacturer, and model</b>	<b>RNAV specification</b>

DATE OF PRE-APPLICATION MEETING \_\_\_\_\_

DATE ON WHICH THE APPLICATION WAS RECEIVED \_\_\_\_\_

DATE ON WHICH THE OPERATOR INTENDS TO BEGIN RNAV 1 and RNAV 2 OPERATIONS \_\_\_\_\_

IS THE CAA NOTIFICATION DATE APPROPRIATE? YES \_\_\_\_ NO \_\_\_\_

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**PART 3 – OPERATOR APPLICATION (ANNEXES AND DOCUMENTS)**

<b>Annex</b>	<b>Title of Annex/document</b>	<b>Indication of inclusion by the operator</b>	<b>Comments by the Inspector</b>
A	<b>Application for RNAV 1 and RNAV 2 approval</b>		
B	<b>Airworthiness documents showing aircraft eligibility for RNAV 1 and RNAV 2</b> AFM, AFM revision, AFM supplement, or Type certificate data sheet (TCDS) showing that RNAV systems are eligible for RNAV 1 and RNAV 2 or RNP 1 or above.  Statement by the manufacturer.- Aircraft that have a statement by the manufacturer documenting compliance with the criteria of SRVSOP CA 91-003 or equivalent meet the performance and functional requirements of said document.		
C	<b>Aircraft modified to meet RNAV 1 and RNAV 2 standards. Documentation on aircraft inspection and/or modification, if applicable.</b> Maintenance records documenting the installation or modification of aircraft systems (e.g., FAA Form 337 – major repairs and alterations).		
D	<b>Maintenance programme</b> <ul style="list-style-type: none"> <li>For aircraft with established RNAV 1 and RNAV 2 system maintenance practices, the list of references of the document or programme.</li> <li>For recently installed RNAV 1 and RNAV 2 systems, the maintenance practices for their review.</li> </ul>		
E	<b>Minimum equipment list (MEL) (only for operators conducting operations based on a MEL):</b> MEL showing provisions for RNAV 1 and RNAV 2.		
F	<b>Training</b> <b>1. LAR 91 operators or equivalent: Training method:</b> Training at home, LAR		

	142 training centres, or other training courses, course completion records. <b>2. LAR 121 and/or 135 operators or equivalent:</b> Training programmes (training curriculums) for flight crews, flight dispatchers, and maintenance personnel.		
G	<b>Operating policies and procedures</b> <b>1. LAR 91 operators or equivalent:</b> Operations manual (OM) or sections to be attached to the application, corresponding to RNAV 1 and RNAV 2 operating procedures and policies. <b>2. LAR 121 and/or 135 operators or equivalent:</b> Operations manual and checklists.		
H	<b>Navigation database</b> Details of the navigation data validation programme.		
I	<b>Withdrawal of RNAV 1 and RNAV 2 approval</b> Indication of the need to follow up on navigation error reports submitted and the possibility of withdrawal of RNAV 1 and RNAV 2 approval.		
J	<b>Validation flight plan:</b> Only if required by the CAA.		

#### CONTENTS OF THE APPLICATION TO BE SUBMITTED BY THE OPERATOR

\_\_\_\_\_ **DOCUMENTATION SHOWING RNAV 1 AND RNAV 2 COMPLIANCE BY AIRCRAFT/NAVIGATION SYSTEMS**

\_\_\_\_\_ **OPERATING PROCEDURES AND POLICIES**

\_\_\_\_\_ **SECTIONS OF THE MAINTENANCE MANUAL RELATED TO RNAV SYSTEMS (if not previously reviewed)**

**Note 1:** Documents may be grouped in a single folder or may be sent as individual documents.

#### PART 4: CONTENTS OF THE RNAV 1 AND RNAV 2 APPLICATION BY THE OPERATOR

#	Contents of the RNAV 1 and RNAV 2 application by the operator	Reference paragraphs CA 91-003	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>Operator request letter</b> Statement of the intention to obtain RNAV 1 and RNAV 2 approval.	Paragraph 9.1.1 b) 1) Appendix 5, Paragraph e)	Annex A		
2	<b>Aircraft equipment description</b>	Paragraph 9.1.1 b) 2)			
3	<b>RNAV 1 and RNAV 2 systems eligibility</b> Airworthiness documents establishing the eligibility of RNAV navigation systems, their approval status, and a list of the aircraft for which the approval is being requested.	Paragraph 9.1.1 b) 3) Paragraph 8.3	Annex B Annex C		
4	<b>Training programmes</b>  <b>1. LAR 121 or 135 operators or equivalent: Training programmes:</b> Operators will develop an initial and recurrent training programme for flight crews, flight dispatchers, if applicable, and maintenance personnel.  <b>2. LAR 91 operators or equivalent: Training methods:</b> The following methods are acceptable for these operators: Training at home, LAR 142 training centres, or other training	Paragraph 9.1.1 b) 4) (a) Paragraph 11 For maintenance Paragraph 9.1.1 b) 8) Paragraph 9.1.1 b) 4) (b) Paragraph 11	Annex F		

#	Contents of the RNAV 1 and RNAV 2 application by the operator	Reference paragraphs CA 91-003	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	courses.				
5	<b>Operating procedures</b> <b>1. LAR 121 and/or 135 operators or equivalent:</b> Operations manual and checklists. <b>2. LAR 91 operators or equivalent:</b> Operations manual or section of the operator application documenting RNAV 1 and RNAV 2 policies and procedures.	Paragraph 9.1.1 b) 5) (a) Paragraph 10  Paragraph 9.1.1 b) 5) (b) Paragraph 10	Annex G		
6	<b>Maintenance practices</b> <ul style="list-style-type: none"> <li>For aircraft with established RNAV 1 and RNAV 2 maintenance practices, the operator will provide references of the documents.</li> <li>For newly installed RNAV 1 and RNAV 2 systems, the operator will provide maintenance practices for review.</li> </ul>	Paragraph 8.5 b) Paragraph 9.1.1 b) 7)	Annex D		
7	<b>Update of the minimum equipment list (MEL)</b> Applicable to operators conducting operations according to a MEL.	Paragraphs 8.5 a) and 9.1.1 b) 6)	Annex E		

#	Contents of the RNAV 1 and RNAV 2 application by the operator	Reference paragraphs CA 91-003	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
8	<b>Navigation data validation programme</b>	Paragraph 9.1.1 b) 9)	Annex F		
9	<b>Withdrawal of RNAV 1 and RNAV 2 approval</b>  Indication of the need for follow-up on the navigation error reports and the possibility of withdrawal of the RNAV 1 and RNAV 2 approval.	Paragraph 13	Annex H		
10	<b>Validation flight plan, only if required</b>  The validation flight plan will be presented only if required.	Paragraph 9.1.1 d)	Annex I		



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## PART 5 – GUIDE TO DETERMINE THE ELIGIBILITY OF RNAV 1 and RNAV 2 AIRCRAFT

#	Topics	Reference paragraphs CA 91-003	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>RNAV system requirement</b> The RNAV system use inputs from the following types of sensors (not listed in a specific order of priority):	Paragraph 8.1.1	Annex B		
1a	GNSS according to TSO-C145 (), TSO-C146 () and TSO-C129()	Paragraph 8.1.1 a) 2) (a)			
1b	DME/DME	Paragraph 8.1.1 a) 2) (b)			
1c	DME/DME/IRU	Paragraph 8.1.1 a) 2) (c)			
2	<b>Performance, monitoring and alerting requirements</b>	Paragraph 8.1.2	Annex B		
3	<b>Aircraft eligibility</b> 1. Aircraft that have a statement of compliance with SRVSOP CA 91-003 criteria. 2. Aircraft approved under TGL-10 and AC 90-100A. 3. Aircraft that meet TGL-10. 4. Aircraft that comply with AC 90-100A.	Paragraph 8.2 Paragraph 8.2.1  Paragraph 8.2.2  Paragraph 8.2.3	Annex B		

#	Topics	Reference paragraphs CA 91-003	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	5. Aircraft with a statement by the manufacturer. 6. Information to be included in the AFM, POH or avionics operating manual	Paragraph 8.2.4 Paragraph 8.2.5 Paragraph 8.2.6			
4	<b>Criteria for RNAV 1 and RNAV 2 systems</b>	Paragraph 8.3	Annex B		
4a	GNSS RNAV system	Paragraph 8.3.1	Annex B		
4b	DME/DME RNAV system	Paragraph 8.3.2 Appendix 1 Paragraph 2	Annex B		
4c	Confirmation of the performance of RNAV systems that use DME	Paragraph 8.3.3 Appendix 1 Paragraph 3	Annex B		
4d	DME/DME/IRU RNAV system	Paragraph 8.3.4 Appendix 2 Paragraph 2	Annex B		
5	<b>Functional requirements and their explanation</b>	Paragraph 8.4 Appendix 3	Annex B		
6	<b>Maintenance requirements</b>	Paragraph 8.5	Annex B		
7	<b>Navigation database</b> Details of the navigation data validation programme.	Paragraph 12 Appendix 4	Annex B		

**PART 6 - BASIC PILOT PROCEDURES FOR RNAV 1 AND RNAV 2 OPERATIONS**

<b>Topics</b>		<b>Reference paragraphs CA 91-003</b>	<b>Location in the Annexes of the operator</b>	<b>Comments and/or recommendations by the CAA</b>	<b>Follow-up by the Inspector: Item status and date</b>
<b>Operating procedures</b>		Paragraph 10	Annex G		
1	<b>Pre-flight planning</b>	Paragraph 10.1 a)			
	Operators and pilots intending to conduct RNAV 1 and RNAV 2 operations must fill in the appropriate boxes of the ICAO flight plan.	Paragraph 10.1 a) 1)			
	On-board navigation data must be current and be appropriate for the intended operating region, and will include NAVAIDS, WPTs, and the relevant ATS route codes for departures, arrivals and alternate aerodromes. RNAV STAR procedures may be designated using multiple runway transitions. Operators that do not have this function will provide an alternate means of compliance (for example, a navigation database adjusted to these operations). If there is no alternate means of compliance to fly an RNAV procedure containing multiple runway transitions, the operators will not submit or accept an approval for these procedures.	Paragraph 10.1 a) 2)			
	Using all the information available, the availability of the required navigation infrastructure for the projected routes,	Paragraph 10.1 a) 3)			

Topics		Reference paragraphs CA 91-003	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	including any non-RNAV contingency, must be confirmed for the foreseen period of operation. Since Annex 10 Volume I requires GNSS (RAIM or SBAS) integrity, it must be determined that the availability of these devices is also appropriate.				
	Aircraft not equipped with GNSS.- Aircraft not equipped with GNSS must be capable of updating the DME/DME and DME/DME/IRU position for RNAV 1 and RNAV 2 routes, as well as for SIDs and STARs.	Paragraph 10.1 a) 4)			
	If only the TSO-C129 equipment is used to meet RNAV 1 and RNAV 2 requirements, RAIM availability for the intended route of flight (route and time) must be confirmed using current GNSS satellite information.	Paragraph 10.1 a) 5)			
	If TSO-C145/C146 equipment is used to meet the RNAV requirement, the pilot/operator does not need to do the prediction if it is confirmed that the coverage of the wide area augmentation system (WAAS) will be available throughout the flight route.	Paragraph 10.1 a) 6)			
	Availability of RAIM (ABAS)	Paragraph 10.1 a) 7)			
	Availability of DME	Paragraph 10.1 a) 8)			

Topics		Reference paragraphs CA 91-003	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
2	<b>General operating procedures</b>	Paragraph 10.1 b)			
	Operators and pilots shall not request, or present in the flight plan, RNAV 1 and RNAV 2 routes, SIDs or STARs, unless they meet all the CA 91-003 criteria. If an aircraft that does not meet these criteria receives an authorisation from the ATC to conduct an RNAV procedure, the pilot will notify the ATC that it cannot accept the authorisation and will request alternate instructions;	Paragraph 10.1 b) 1)			
	The pilot shall follow any instruction or procedure identified by the manufacturer, as necessary, to meet the performance requirements of this section;	Paragraph 10.1 b) 2)			
	At system initialization, pilots must: (a) confirm the validity of the navigation database; (b) verify the current position of the aircraft; (c) verify the proper entry of the assigned ATC route once the initial clearance is received, and of any subsequent route changes; and (d) ensure that the WPT sequence displayed on the navigation system coincides with the route shown in the	Paragraph 10.1 b) 3)			

Topics		Reference paragraphs CA 91-003	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	appropriate charts and with the assigned route.				
	Pilots shall not fly an RNAV 1 or RNAV 2 SID or STAR unless it can be retrieved from the on-board navigation database using the procedure name and is consistent with the procedure in the chart. However, the route can be modified afterwards by inserting or deleting specific WPTs based on an ATC clearance. Manual entry or the creation of new WPTs by manually entering latitude and longitude or rho/theta values is not allowed. Furthermore, pilots must not change an RNAV SID or STAR WPT from a fly-by WPT to a flyover WPT or <i>vice versa</i> .	Paragraph 10.1 b) 4)			
	Whenever possible, RNAV 1 or RNAV 2 routes must be obtained from the database as a whole, instead of loading route WPTs individually from the database to the flight plan. However, designated WPTs and fixes can be individually selected and inserted from the navigation database provided all the fixes along the published route to be flown are inserted. Furthermore, the route can be modified afterwards by inserting or deleting specific WPTs based on ATC clearances. Manual entry or the creation of new WPTs by manually entering latitude and longitude or rho/theta values is not	Paragraph 10.1 b) 5)			

Topics		Reference paragraphs CA 91-003	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	allowed.				
	Flight crews must verify the cleared flight plan by comparing the charts or other applicable resources to the navigation system text displays and aircraft chart displays, as applicable. If required, the exclusion of specific NAVAIDs must be confirmed. A procedure must not be used if there is any doubt about the validity of the procedure in the navigation database.	Paragraph 10.1 b) 6)			
	During the flight, when feasible, the flight crew must use the information available from ground NAVAIDs to confirm that navigation is reasonable.	Paragraph 10.1 b) 7)			
	For RNAV 2 routes, pilots must use a lateral deviation indicator, an FD or an AP in lateral navigation mode. Pilots may use a navigation chart display with a functionality equivalent to a lateral deviation indicator without an FD or AP.	Paragraph 10.1 b) 8)			
	For RNAV 1 routes, pilots must use a lateral deviation indicator, an FE or an AP in the lateral navigation mode.	Paragraph 10.1 b) 9)			
	Pilots of aircraft with lateral deviation display must make sure that the lateral deviation scale is appropriate for the navigation precision associated to the route/procedure (e.g., full-scale deflection:	Paragraph 10.1 b) 10)			



Topics	Reference paragraphs CA 91-003	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
$\pm 1$ NM for RNAV 1, $\pm 2$ NM for RNAV 2 or $\pm 5$ NM for TSO-C129() equipment in RNAV 2 routes.				
<p>All pilots are expected to maintain the route centrelines represented on the on-board lateral deviation indicators and/or flight guide during all RNAV 1 and RNAV 2 operations, unless cleared by the ATC to deviate or in response to an emergency. For normal operations, the cross-track error/deviation (the difference between the path calculated by the RNAV system and the position of the aircraft relative to the path) shall not exceed <math>\pm \frac{1}{2}</math> the navigation precision associated to the route or flight procedure (e.g., 0.5 NM for RNAV 1 and 1.0 NM for RNAV 2). Small lateral deviations from this requirement are allowed (e.g., overshooting or undershooting the path) during or immediately after an en-route turn/procedure, up to a maximum of 1 times the navigation precision (1xRNP) (e.g., 1 NM for RNAV 1 and 2 NM for RNAV 2).</p>	Paragraph 10.1 b) 11)			
<p>If the ATC assigns a course that places the aircraft outside the route, the pilot shall not modify the flight plan in the RNAV system, until a new clearance is received that allows the aircraft to resume the route or the</p>	Paragraph 10.1 b) 12)			

Topics		Reference paragraphs CA 91-003	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	controller confirms a new route clearance. When the aircraft is not in the published route, the specified precision requirements do not apply.				
	Manual selection of functions that limit the bank angle of the aircraft may reduce the ability of the aircraft to maintain its desired track and is not recommended. Pilots should recognise that manual selection of functions that limit the bank angle of the aircraft could reduce its ability to meet ATC path expectations.	Paragraph 10.1 b) 13)			
	Pilots operating aircraft with RNP approval according to the CA 91-003 provisions do not need to modify the pre-determined RNP values of the manufacturer, as established in the FMC.	Paragraph 10.1 b) 14)			
3	<b>Specific RNAV SID requirements</b>	Paragraph 10.1 c)			
	Prior to commencing take-off, the pilot must verify that the RNAV system of the aircraft is available, is operating properly, and that the appropriate aerodrome and runway data have been loaded. Before the flight, pilots must verify that the navigation system of the aircraft is operating properly and that the appropriate departure procedure (including any applicable en-route transition) has been entered and is duly displayed. Pilots assigned to an RNAV	Paragraph 10.1 c) 1)			

Topics	Reference paragraphs CA 91-003	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
departure procedure and subsequently receive a change of runway, procedure or transition, must verify that the appropriate changes have been entered and are available for navigation before take-off. A final check of proper runway entry and correct route depiction, shortly before take-off, is recommended.				
<i>RNAV equipment engagement altitude.</i> - The pilot must be able to connect the RNAV equipment in order to follow the flight guide in the RNAV lateral navigation mode before reaching 153 m (500 ft) over the aerodrome elevation. The altitude at which the RNAV guide starts in a given route can be higher (e.g., climb to 304 m (1 000 ft) then straight to...)	Paragraph 10.1 c) 2)			
Pilots must use an authorised method (lateral deviation indicator/navigation map display/FD/AP) to reach an appropriate level of performance for RNAV 1.	Paragraph 10.1 c) 3)			
<i>DME/DME aircraft.</i> - Pilots of aircraft without GNSS, that use DME/DME sensors without inertial input, cannot use their RNAV systems until the aircraft has entered the appropriate DME coverage. The ANSP will make sure that there is appropriate DME coverage available in each RNAV SID (DME/DME).	Paragraph 10.1 c) 4)			

Topics		Reference paragraphs CA 91-003	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	<i>DME/DME/IRU aircraft.</i> - Pilots or aircraft without GNSS, that use DME/DME RNAV systems with an IRU (DME/DME/IRU), must make sure that the position of the inertial navigation system (INS) is confirmed within 304 m (1 000 ft/0.17 NM), from a know position, at the starting point of the take-off roll. This is usually achieved by using a manual or automatic runway update function. A navigation chart can also be used to confirm the position of the aircraft, if the pilot procedures and display resolution permit compliance with the 304 m (1 000 ft) tolerance requirement.	Paragraph 10.1 c) 5)			
	<i>GNSS aircraft.</i> - When a GNSS is used, the signal must be obtained before commencing the take-off roll. For aircraft using TSO-C129/C129a equipment, the take-off aerodrome must be loaded in the flight plan in order to achieve the appropriate navigation system monitoring and sensitivity. For aircraft using TSO-C145a/C146a avionics, if the departure begins at a runway waypoint, then the departure airport does not need to be in the flight plan to obtain appropriate monitoring and sensibility.	Paragraph 10.1 c) 6)			
4	<b>Specific RNAV STAR requirements</b>	Paragraph 10.1 d)			
	Before the arrival phase, the flight crew	Paragraph 10.1 d) 1)			

Topics		Reference paragraphs CA 91-003	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	must check that the correct terminal route has been loaded. The active flight plan shall be checked, by comparing the charts to the map display (if applicable) and the MCDU. This includes confirmation of WPT sequence, the reasonableness of track angles and distances, any altitude or speed restriction, and, when feasible, which are fly-by WPTs and which are flyover WPTs. If the route so requires, a check must be done to confirm that the update will exclude a particular NAVAID. A route will not be used if there is any doubt about its validity in the navigation database.				
	The creation of new WPTs by the flight crew through manual entry in the RNAV system will invalidate any route and is not allowed.	Paragraph 10.1 d) 2)			
	Where contingency procedures require reversion to a conventional arrival route, the flight crew must complete the necessary preparations before commencing the RNAV route.	Paragraph 10.1 d) 3)			
	Route modifications in the terminal area may take the form of radar headings or "direct to" clearances. In this regard, the flight crew must be capable of reacting in time. This may include entering tactical WPTs from the database. The flight crew is not allowed to enter manually or modify a	Paragraph 10.1 d) 4)			

Topics		Reference paragraphs CA 91-003	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	loaded route using provisional WPTs or fixes not provided in the database.				
	Pilots must verify that the aircraft navigation system is operating properly and the correct arrival procedure and runway are properly entered and depicted.	Paragraph 10.1 d) 5)			
	Although no particular method is mandated, any published altitude and speed constraints must be observed.	Paragraph 10.1 d) 6)			
<b>5</b>	<b>Contingency procedures</b>	Paragraph 10.1 e)			
	The pilot must notify the ATC of any loss of RNAV capability, and the proposed course of action. If the requirements of an RNAV route cannot be met, pilots must notify the ATS as soon as possible. Loss of RNAV capability includes any failure or event that causes the aircraft to be unable to meet the RNAV requirements of the route.	Paragraph 10.1 e) 1)			
	In case of a communication failure, the flight crew must continue with the RNAV route, in accordance with the procedure established for lost communications.	Paragraph 10.1 e) 2)			

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Job Aid RNAV 1 and RNAV 2  
Version: Original  
Date: 12/10/2009

**APPENDIX D-1**

**ADVISORY CIRCULAR**

CA	:	91-006
DATE	:	12/10/09
REVISION	:	Original
ISSUED BY	:	SRVSOP

**SUBJECT: AIRCRAFT AND OPERATOR APPROVAL FOR BASIC-RNP 1 OPERATIONS**



## ADVISORY CIRCULAR

CA : 91-006  
DATE : 12/10/09  
REVISION : Original  
ISSUED BY : SRVSOP

### **SUBJECT: AIRCRAFT AND OPERATOR APPROVAL FOR BASIC-RNP 1 OPERATIONS**

#### **1. PURPOSE**

This Advisory Circular (AC) establishes Basic-RNP 1 approval requirements for aircraft and operators.

An operator may use alternate means of compliance, provided those means are acceptable to the Civil Aviation Administration (CAA).

The future tense of the verb or the term "shall" apply to operators who choose to meet the criteria set forth in this CA.

#### **2. RELEVANT SECTIONS OF THE LATIN AMERICAN AERONAUTICAL REGULATIONS (LAR) OR EQUIVALENT**

LAR 91: Sections 91.1015 and 91.1640 or equivalents

LAR 121: Section 121.995 (b) or equivalent

LAR 135: Section 135.565 (c) or equivalent

#### **3. RELATED DOCUMENTS**

Annex 6	Operation of aircraft Part I – International commercial air transport – Aeroplanes Part II – International general aviation - Aeroplanes
Annex 10	Aeronautical communications Volume I: Radio navigation aids
Annex 15	Aeronautical information services
ICAO Doc 9613	Performance based navigation (PBN) manual
ICAO Doc 4444	Procedures for air navigation services – Air traffic management (PANS-ATM)
ICAO Doc 8168	Aircraft operations Volume I: Flight procedures Volume II: Construction of visual and instrument flight procedures
FAA AC 90-105 Appendix 2	Qualification criteria for RNP 1 (terminal) operations

## 4. DEFINITIONS AND ABBREVIATIONS

### 4.1 Definitions

- a) **Aircraft-based augmentation system (ABAS).**- A system which augments and/or integrates the information obtained from the other GNSS elements with information available on board the aircraft. The most common form of ABAS is the receiver autonomous integrity monitoring (RAIM).
- b) **Area navigation (RNAV).**- A navigation method that allows aircraft to operate on any desired flight path within the coverage of ground- or space-based navigation aids, or within the limits of the capability of self-contained aids, or a combination of both methods.

Area navigation includes performance-based navigation as well as other operations that are not contemplated in the definition of performance-based navigation.

- c) **Flight technical error (FTE).**- The FTE is the accuracy with which an aircraft is controlled as measured by the indicated aircraft position with respect to the indicated command or desired position. It does not include blunder errors.
- d) **Global navigation satellite system (GNSS).**- A generic term used by the International Civil Aviation Organization (ICAO) to define any global position, speed, and time determination system that includes one or more main satellite constellations, such as GPS and the global navigation satellite system (GLONASS), aircraft receivers and several integrity monitoring systems, including aircraft-based augmentation systems (ABAS), satellite-based augmentation systems (SBAS), such as the wide area augmentation systems (WAAS), and ground-based augmentation systems (GBAS), such as the local area augmentation system (LAAS).  
  
Distance information will be provided, at least in the immediate future, by GPS and GLONASS.
- e) **Global positioning system (GPS).**- The global positioning system (GNSS) of the United States is a satellite-based radio navigation system that uses precise distance measurements to determine the position, speed, and time in any part of the world. The GPS is made up by three elements: the spatial, the control, and the user elements. The GPS spatial segment nominally consists of, at least, 24 satellites in 6 orbital planes. The control element consists of 5 monitoring stations, 3 ground antennas, and one main control station. The user element consists of antennas and receivers that provide the user with position, speed, and precise time.
- f) **Navigation specifications.**- Set of aircraft and flight crew requirements needed to support performance-based navigation operations in a defined airspace. There are two kinds of navigation specifications:

*Required Navigation Performance (RNP) Specification.*- Area navigation specification that includes the performance control and alerting requirement, designated by the prefix RNP; e.g., RNP 4, RNP APCH, RNP AR APCH.

*Area Navigation (RNAV) Specification.*- Area navigation specification that does not include the performance control and alerting requirement, designated by the prefix RNAV; e.g., RNAV 5, RNAV 2, RNAV 1.

**Note 1.-** The Manual on Performance-based Navigation (PBN) (Doc 9613), Volume II, contains detailed guidelines on navigation specifications.

**Note 2.-** The term RNP, formerly defined as "a statement of the navigation performance necessary for operation within a defined airspace", has been deleted from the Annexes to the Convention on International Civil Aviation because the RNP concept has been replaced by the PBN concept. In said Annexes, the term RNP is now only used within the context of the navigation specifications that require on-board performance control and alerting; e.g., RNP 4 refers to the aircraft and the operational requirements, including a lateral performance of 4 nautical miles (NM), with the requirement for on-board performance control and alerting as described in the PBN Manual of the International Civil Aviation Organization (ICAO) (Doc 9613).

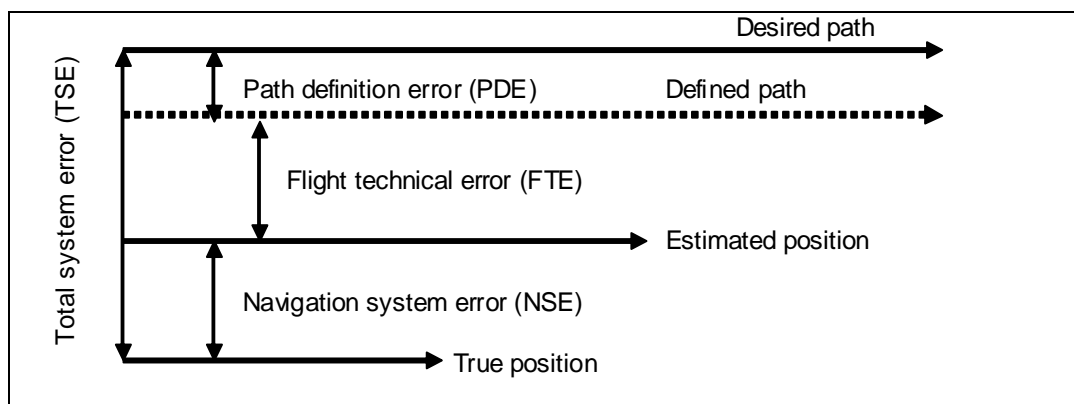
- g) **Navigation system error (NSE).**- The difference between the true position and the estimated position.
- h) **Path definition error (PDE).**- The difference between the defined path and the desired path at a given place and time.
- i) **Performance-based navigation (PBN).**- Performance-based area navigation requirements applicable to aircraft conducting operations on an ATS route, on an instrument approach procedure, or in a designated airspace.

Performance requirements are expressed in navigation specifications (RNAV and RNP specifications) in terms of the precision, integrity, continuity, availability, and functionality necessary to perform the proposed operation within the context of a particular airspace concept.

- j) **Receiver autonomous integrity monitoring (RAIM).**- A technique used in a GPS receiver/processor to determine the integrity of its navigation signals, using only GPS signals or GPS signals enhanced with barometric altitude data. This determination is achieved by a consistency check between redundant pseudo-range measurements. At least one additional available satellite is required with respect to the number of satellites that are needed for the navigation solution.
- k) **RNP operations.**- Aircraft operations that use an RNP system for RNP applications.
- l) **RNP system.**- An area navigation system that supports on-board performance control and alerting.
- m) **Standard instrument arrival (STAR).**- A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an air traffic service (ATS) route, with a point from which a published instrument approach procedure can be commenced.
- n) **Standard instrument departure (SID).**- A designated instrument flight rule (IFR) departure route linking the aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en-route phase of a flight commences.
- o) **Total system error (TSE).**- The difference between the true position and the desired position. This error is equal to the sum of the vectors of the path definition error (PDE), the flight technical error (FTE), and the navigation system error (NSE).

**Note.**- On occasions, the FTE is known as path steering error (PSE), and the NSE as position estimation error (PEE).

#### Total system error (TSE)



- a) **Way-point (WPT).** A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Way-points are identified as either:

**Fly-by way-point.**- A way-point which requires turn anticipation to allow tangential interception of the next segment of a route or procedure.

*Fly over way-point.* - A way-point at which a turn is initiated in order to join the next segment of a route or procedure.

## 4.2 Abbreviations

a)	AAC	Civil Aviation Administration/Civil Aviation Authority
b)	ABAS	Aircraft-based augmentation system
c)	AC	Advisory circular (FAA)
d)	AFM	Aircraft flight manual
e)	VM	Heading of the aircraft to a normal termination
f)	AIP	Aeronautical information publication
g)	AIRAC	Aeronautical information regulation and control
h)	ANSP	Air navigation service providers
i)	AP	Automatic pilot
j)	APV	Approach procedure with vertical guidance
k)	ARP	Aerodrome reference point
l)	ATC	Air traffic control
m)	ATM	Air traffic management
n)	ATS	Air traffic service
o)	baro-VNAV	Barometric vertical navigation
p)	CA	Advisory circular (SRVSOP)
q)	CA	Course to an altitude
r)	CDI	Course deviation indicator
s)	CDU	Control display
t)	CF	Course to a fix
u)	Doc	Document
v)	DF	Direct to a fix
w)	DME	Distance-measuring equipment
x)	DV	Flight dispatcher
y)	EASA	<i>Agencia Europea de Seguridad Aérea</i> (European Air Safety Agency)
z)	EHSI	Enhanced vertical status indicator
aa)	FAA	United States Federal Aviation Administration
bb)	FAF	Final approach fix
cc)	FAP	Final approach point
dd)	FD	Flight director
ee)	FM	Course from a fix to a manual termination
ff)	Fly-by WPT	Fly-by way-point
gg)	Flyover WPT	Flyover way-point

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hh)	FMS	Flight management system
ii)	FTE	Flight technical error
jj)	GBAS	Ground-based augmentation system
kk)	GNSS	Global navigation satellite system
ll)	GLONASS	Global navigation satellite system
mm)	GPS	Global positioning system
nn)	GS	Ground speed
oo)	HAL	Horizontal alerting limit
pp)	HSI	Vertical status indicator
qq)	IF	Initial fix
rr)	IFR	Instrument flight rules
ss)	IMC	Instrument meteorological conditions
tt)	LAAS	Local area augmentation system
uu)	LAR	Latin American Aeronautical Regulations
vv)	LNAV	Lateral navigation
ww)	LOA	Letter of authorisation/letter of acceptance
xx)	MCDU	Multi-function control display
yy)	MEL	Minimum equipment list
zz)	MIO	Manual of the operations inspector
aaa)	NM	Nautical miles
bbb)	MP	Monitoring pilot
ccc)	NAVAIDS	Navigation aids
ddd)	NOTAM	Notice to airmen
eee)	NPA	Non-precision approach
fff)	NSE	Navigation system error
ggg)	LNAV	Lateral navigation
hhh)	OACI	International Civil Aviation Organization
iii)	OM	Operations manual
jjj)	OEM	Original equipment manufacturer
kkk)	OpSpecs	Operations specifications
lll)	PA	Precision approach
mmm)	PANS-ATM	Procedures for Air Navigation Services - Air traffic management
nnn)	PANS-OPS	Procedures for Air Navigation Services - Aircraft Operations
ooo)	PBN	Performance-based navigation
ppp)	PDE	Path definition error
qqq)	PEE	Position estimation error
rrr)	PF	Pilot flying

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sss)	PNF	Pilot not flying
ttt)	POH	Pilot operations handbook
uuu)	P-RNAV	Precision area navigation
vvv)	PSE	Path direction error
www)	RAIM	Receiver autonomous integrity monitoring
xxx)	RNAV	Area navigation
yyy)	RNP	Required navigation performance
zzz)	RNP APCH	Required navigation performance approach
aaaa)	RNP AR APCH	Required navigation performance authorisation required approach
bbbb)	RTCA	Radio Technical Commission for Aviation
cccc)	SBAS	Satellite-based augmentation system
dddd)	SID	Standard instrument departure
eeee)	SRVSOP	Regional Safety Oversight Cooperation System I
ffff)	STAR	Standard instrument arrival
gggg)	STC	Supplementary type certificate
hhhh)	TF	Track to a fix
iiii)	TO/FROM	To/from
jjjj)	TSE	Total system error
kkkk)	TSO	Technical standard order
llll)	VA	Heading to a given altitude
mmmm)	VI	Heading to an intercept
nnnn)	VM	Heading to a normal termination
oooo)	VMC	Visual meteorological conditions
pppp)	WAAS	Wide area augmentation system
qqqq)	WGS	World geodetic system
rrrr)	WPT	Waypoint

## 5. INTRODUCTION

5.1 According to Doc 8168 – Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) Volume II, the Basic-RNP 1 navigation specification is used in standard instrument departures and arrivals (SIDs and STARs) and in approaches to the final approach fix (FAF)/final approach point (FAP) with or without air traffic service (ATS) surveillance and with low to medium traffic density.

5.2 This AC does not establish all the requirements that may be specified for a given operation. These requirements are established in other documents, such as the aeronautical information publication (AIP) and ICAO Doc 7030 – Regional Supplementary Procedures.

5.3 Although the operational approval is normally related to airspace requirements, the operators and flight crews must consider the operational documents required by the CAA before conducting flights in Basic-RNP 1 airspace.

- 5.4 The material described in this CA has been developed based on the following document:
- ✓ ICAO Doc 9613, Volume II, Part C, Chapter 3 – Implementing Basic-RNP 1.

- 5.5 To the extent possible, this CA has been harmonised with the following guidance material:

- ✓ FAA AC 90-105 Appendix 2 - Qualification criteria for RNP 1 (terminal) operations

*Note.- Despite harmonisation efforts, operators shall take note of the differences between this CA and the aforementioned document when applying for an approval from the corresponding Administration.*

## 6. GENERAL CONSIDERATIONS

### 6.1 General information

- a) **Performance-based navigation concept.-** The performance-based navigation (PBN) concept represents a change from sensor-based navigation to PBN. The PBN concept specifies the performance requirements of the aircraft RNP system in terms of the precision, integrity, availability, continuity, and functionality required for operations in a given airspace. Performance requirements are identified in the navigation specifications (e.g., the requirements of this AC), which also identify options in terms of navigation sensors, navigation equipment, operating procedures, and training needs to meet performance requirements.
- b) RNP procedures and routes require the use of RNP systems with onboard performance monitoring and alerting. A critical component of RNP is the ability that must have the aircraft navigation systems in combination with the pilot to monitor its achieved navigation performance, and to identify for the pilot whether the operational requirement is or is not met during an operation.

*Note.- Compliance with the performance control and alerting requirements does not imply automatic monitoring of the flight technical error (FTE). The on-board performance monitoring and alerting function should consist at least of a navigation system error (NSE) monitoring and alerting algorithm and a lateral navigation display that allow the flight crew to monitor the FTE. To the extent operational procedures are used to control the FTE, the flight crew procedures, equipment characteristics and the facilities are assessed for effectiveness and equivalence, as described in the functional requirements and operating procedures. The path definition error (PDE) is considered negligible due to the quality assurance process and crew procedures.*

- c) **Operations with RNP systems.-** RNP operations:
- 1) do not require the pilot to monitor the ground-based navigation aids (NAVAIDs) used for position updating, unless required by the aircraft flight manual (AFM);
  - 2) base obstacle clearance assessments on the associated required system performance;
  - 3) Rely on conventional compliance with descent profiles and altitude requirements;
- Note.- Pilots operating aircraft with an approved barometric vertical navigation (baro-VNAV) system can continue using said system while operating on routes SIDs, and STARs. Operators must ensure compliance with all altitude limitations as published in the procedure in reference to the pressure altimeter.*
- 4) all routes and procedures must be based on the world geodetic system (WGS) of coordinates 84; and
  - 5) the navigation data published for the routes, procedures and supporting NAVAIDs must meet the requirements of Annex 15 to the Convention on International Civil Aviation.

### 6.2 Navigation aid infrastructure

- a) The GNSS is the main navigation system that supports Basic-RNP 1 operations.
- b) Although RNP systems based on DME/DME are capable of providing Basic-RNP 1 accuracy, the use of this navigation specification has been foreseen mainly for environments where DME infrastructure cannot support DME/DME area navigation with the required performance.
- c) The increased complexity in the DME infrastructure requirements and assessment make Basic-RNP 1 operations based on DME/DME impractical and unprofitable for a general application.

- d) Route design should take into account the navigation performance that can be achieved with the available navigation aid (NAVAID) infrastructure. Although the requirements of RNAV 1 and RNAV 2 navigation systems are identical, NAVAID infrastructure can affect the required performance.
- e) Air navigation service providers (ANSPs) shall ensure that the operators of GNSS equipped aircraft have a means available to predict fault detection using an aircraft-based augmentation system (ABAS) [e.g., receiver autonomous integrity monitoring (RAIM)].
- f) When applicable, the ANSPs shall also ensure that the operators of aircraft equipped with a satellite-based augmentation system (SBAS) have a means to predict fault detection.
- g) The prediction services may be provided by the ANSP, airborne equipment manufacturers other entities.
- h) Prediction services can only be for receivers that meet the minimum performance of a technical standard order (TSO) or be specific to the receiver design. The prediction service shall use status information on GNSS satellites and a horizontal alerting limit (HAL) appropriate for the operation (1 NM within 30 NM from the aerodrome and 2 NM otherwise).
- i) Outages shall be identified in the event of a predicted, continuous loss of ABAS fault detection of more than 5 minutes for any part of the Basic-RNP 1 operation.
- j) ANSPs must undertake an assessment of the NAVAIDS infrastructure. It must be demonstrated that the assessment is sufficient for the proposed operations, including reversionary modes.

### 6.3 Communications and ATS surveillance

- a) The Basic-RNP 1 navigation specification is intended in environments where ATS surveillance is limited or not available and in low to medium traffic density.
- b) Basic-RNP 1 SIDs and STARs are primarily intended to be conducted in direct controller-pilot communication environments.

### 6.4 Obstacle clearance and horizontal separation

- a) Doc 8168 (PANS OPS), Volume II, provides detailed guidance on obstacle clearance. The general criteria contained in Parts I and III of said document shall apply.
- b) The obstacle clearance criteria for SIDs, STARs, initial and intermediate approach, final missed approach, holding pattern, and route of the basic RNP 1 navigation specification are described in Doc 8168 (PANS-OPS), Volume II, Part III, Section 1, Chapter 2 and Section 3, Chapters 1, 2, 7 and 8.
- c) Obstacle clearance criteria for final approach and for initial and intermediate missed approach are specific to the classification of non-precision approaches (NPA), approaches with vertical guidance (APV) and precision approaches (PA).
- d) En-route spacing for basic RNP 1 depends on route configuration, air traffic density, and intervention capacity. Horizontal separation standards are published in Doc 4444 – Procedures for air navigation services – Air traffic management (PANS-ATM).

### 6.5 Publications

- a) SIDs, STARs and Basic-RNP 1 procedures must be based on normal descent profiles and must identify minimum altitude requirements of the segments.
- b) The navigation information published in the AIP for support procedures and NAVAIDs must meet the requirements of Annex 15 - Aeronautical information services.
- c) All procedures must be based on the coordinates of the world geodetic system - 84 (WGS-84).
- d) The AIP should clearly indicate whether the navigation application is Basic-RNP 1.
- e) The available navigation infrastructure shall be clearly designated in all the appropriate charts (e.g., GNSS).



- f) The required navigation standard (e.g., Basic-RNP 1) for all Basic-RNP 1 procedures shall be clearly designated in all the appropriate charts.

#### 6.6 Additional considerations

- a) For procedure design and infrastructure evaluation, it is assumed that 95% of the normal limit value of the FTE, defined in the operating procedures, is 0.5 NM for the Basic-RNP 1 navigation specification.
- b) The default value of the alerting functionality of a TSO-C129a sensor (stand-alone or integrated) switches between terminal alerting ( $\pm 1$  NM) and en-route alerting ( $\pm 2$  NM) at 30 miles from the airport reference point (ARP).

### 7. AIRWORTHINESS AND OPERATIONAL APPROVAL

7.1 For a commercial air transport operator to be granted a Basic-RNP 1 approval, it must comply with two types of approvals:

- a) the airworthiness approval, issued by the State of registry (see Article 31 of the Chicago Convention, and Paragraphs 5.2.3 and 8.1.1 of Annex 6 Part I); and
- b) the operational approval, issued by the State of the operator (see paragraph 4.2.1 and Attachment F to Annex 6 Part I).

7.2 For general aviation operators, the State of registry will determine whether or not the aircraft meets the applicable basic RNP 1 requirements and will issue the operational approval (e.g., letter of authorisation – LOA) (see Paragraph 2.5.2.2 of Annex 6 Part II).

7.3 Before filing the application, operators shall review all aircraft qualification requirements. Compliance with airworthiness requirements or equipment installation alone does not constitute operational approval.

### 8. AIRWORTHINESS APPROVAL

#### 8.1 System and aircraft requirements

##### 8.1.1 Description of the RNP navigation system

##### a) Lateral navigation (LNAV)

- 1) In LNAV, the RNP equipment allows the aircraft to fly in accordance with the appropriate route instructions along a path defined by waypoints (WPTs) contained in an on-board navigation database.

*Note.- LNAV is normally a mode of flight guidance systems, in which the RNP equipment provides path steering commands to the flight guidance system, which controls the FTE through the manual pilot control on a path deviation display or through the coupling of the flight director (FD) or automatic pilot (AP).*

- 2) For purposes of this AC, Basic-RNP 1 operations are based on the use of RNP equipment that automatically determines the position of the aircraft on the horizontal plane, using data input from the GNSS.

##### 8.1.2 System performance, control, and alerting

- a) **Accuracy.-** For operations in Basic-RNP 1 designated airspace or routes, total lateral system error must not exceed  $\pm 1$  NM during at least 95% of total flight time. Likewise, along-track error must not exceed  $\pm 1$  NM during at least 95% of total flight time. In order to meet the accuracy requirement, 95% of the flight technical error (FTE) must not exceed 0.5 NM.

*Note.- The use of a deviation indicator with a full-scale deflection of 1 NM constitutes an acceptable means of compliance. The use of a flight director (FD) or an automatic pilot (AP) also represents an acceptable means of compliance (roll stabilization systems do not meet the requirements).*

- b) **Integrity.-** Malfunctioning of the aircraft navigation equipment is classified as a major failure according to airworthiness regulations (e.g.,  $10^{-5}$  per hour).
- c) **Continuity.-** Loss of function is classified as a minor failure if the operator can revert to a different navigation system and proceed to an appropriate aerodrome.
- d) **Performance monitoring and alerting.-** The RNP system or the RNP system in combination with the pilot will provide an alert if the accuracy requirement is not met, or if the probability that the lateral total system error (TSE) exceeds 2 NM is greater than  $10^{-5}$ .
- e) **Signal-in-space.-** If GNSS is used, the aircraft navigation equipment will provide an alert if the probability of signal-in-space errors causing a lateral position error greater than 2 NM exceeds  $10^{-7}$  per hour (Annex 10, Volume I, Table 3.7.2.4.1).

#### 8.1.3 Aircraft eligibility requirements for Basic-RNP 1 operations in terminal area

The following systems installed in the aircraft meet the requirements defined in this AC. This equipment requires evaluation by the manufacturer and operator against all the functional and performance requirement established in this AC.

- a) Aircraft with E/TSO-C129a Class A1 system or E/TSO-C146 () system installed for IFR use in accordance with FAA AC 20-138 or AC 20-138A;
- b) Aircraft with E/TSO-C129/C129a sensor (Class B or C) installed in a flight management system (FMS) that meets the criteria of TSO-C115b and installed for IFR use in accordance with AC 20-130A;
- c) Aircraft with E/TSO-C145 () sensor installed in an FMS that meets TSO-C115b requirements and installed for IFR use in accordance with FAA AC 20-130A or AC 20-138A; and
- d) Aircraft with certified RNP capability, or approved based on equivalent standards.

#### 8.1.4 System eligibility requirements for Basic-RNP 1 operations

- a) **Stand-alone systems.-** Stand-alone E/TSO-C129 Class A1 or A2 systems (without deviation from AC 91-008 functional requirements) or E/TSO-C146 Class 1, 2 or 3 systems (without deviation of functional requirements establish in this AC) meet aircraft qualification requirements for Basic-RNP 1 operations. GNSS systems must be approved in accordance with AC 20-138A.
- b) **Multi-sensor systems.-** Multi-sensor systems using E/TSO-C129 Class B or C sensors or E/TSO-C145 Class 1, 2 and 3 sensors, meet aircraft qualification requirements for Basic-RNP 1 operations, provided that the installations comply with the criteria of this AC. RNP systems must be installed in accordance with AC 20-138A and the associated FMS must comply with E/TSO-C115b and AC 20-130A.

#### 8.2 Qualification documentation

##### a) Aircraft qualification documentation

- 1) Aircraft or avionics manufacturers must produce aircraft qualification documentation showing compliance with the applicable criteria, as appropriate. For aircraft not approved for flying Basic-RNP 1 procedures, aircraft and avionics manufacturers must develop aircraft qualification documentation showing compliance with this AC, provided the equipment is properly installed and operated. The necessary documentation shall also define the appropriate maintenance procedures. This documentation is not required for aircraft that have an AFM or AFM supplement that explicitly states that the RNP system is approved for operations with values of RNP 1 or lower, and that the equipment meets the reliability and performance requirements of the following documents: AC 20-138A, AC 20-130A, E/TSO-C115b and AC 20-129, as applicable.
- 2) Operators will submit this documentation, together with the formal application, in Phase 2 of the approval process.

b) **Acceptance of documentation by the CAA**

- 1) *For new aircraft/equipment (capability shown in production).*- The new aircraft/equipment qualification documentation may be approved as part of an aircraft certification project, and will be reflected in the AFM and related documents.
- 2) *For aircraft/equipment in use.*- Previous approvals to conduct RNAV 1 procedures using the GNSS (GPS), according to AC 91-003 or AC 90-100/AC 90-100A, do not require an additional assessment, provided it is shown that the RNAV equipment meets the on-board performance monitoring and alerting requirements. For installations/equipment that are not eligible for conducting Basic-RNP 1 procedures, the operator shall send the Basic-RNP 1 and aircraft qualification documentation to the corresponding bodies of the CAA (e.g., Aircraft certification division or Airworthiness inspection division, or equivalents).
- 3) The corresponding bodies of the CAA, as appropriate, will accept the data package for Basic-RNP 1 operations. This acceptance will be documented in a letter to the operator.

8.3 **Aircraft and systems eligibility for Basic-RNP 1 operations in terminal area**

8.3.1 **Aircraft that have a statement of compliance with respect to the criteria of this AC.**- Aircraft that have a statement of compliance with respect to the criteria set forth in this AC or equivalent document (e.g., FAA AC 90-105 Appendix 2) in the AFM, AFM supplement, pilot operating handbook (POH) or avionics operating manual, meet the performance and functional requirements of this CA.

8.3.2 **Aircraft with a statement by the manufacturer.**- Aircraft that have a statement by the manufacturer documenting compliance with the criteria set forth in this AC or equivalent meet the performance and functional requirements of this document. This statement must include the airworthiness basis for compliance. The aircraft or equipment manufacturer will determine compliance with sensor requirements, while the operator will determine, through inspection, compliance with the functional requirements of this document.

8.3.3 For modified aircraft, the original equipment manufacturer (OEM) or the holder of the aircraft installation approval, e.g., the holder of a supplemental type certificate (STC), will demonstrate compliance to the CAA, and the approval can be submitted in the documentation of the manufacturer (e.g., service letters).

8.3.4 Stand-alone GNSS systems must be approved according to E/TSO-C129a Class A1 or E/TSO-C146 and operational Class 1, 2 or 3 (with no deviation from the functional requirements described in this AC), and installed for IFR use in accordance with AC 20-138A.

8.3.5 Aircraft with E/TSO-C129a sensor(s) Class B or C or E/TSO-C145 sensor(s) and FMS that meet E/TSO-C115b requirements and are installed for IFR use according to FAA AC 20-130A.

8.3.6 Aircraft/equipment approved under SRVSOP AC 91-003 or equivalent (e.g., FAA AC 90-100A) for the use of GNSS, are approved under this AC for Basic-RNP 1 operations.

8.3.7 RNP aircraft with P-RNAV approval based on GNSS capability meet the functional requirements of this AC for Basic-RNP 1 operations, such as SIDs y STARs. The GNSS system approved according to E/TSO-C129 and satisfying the step-detection and health word checking contained in E/TSO-C129A, meets P-RNAV performance requirements.

**Note.-** Basic-RNP 1 operations are based on GNSS positioning. Positioning data from other navigation sensors can be integrated into GNSS data provided they do not cause position errors that exceed the total system error (TSE) budget. Otherwise, means to deselect or cancel the other types of navigation sensors must be provided.

8.4 **Functional requirements**

Appendix 1 contains the functional requirements that meet the criteria of this document.

## 8.5 Maintenance aspects

### a) Minimum equipment list (MEL)

The CAA must approve any revision to the minimum equipment list (MEL) that is necessary to incorporate Basic-RNP 1 provisions.

### b) Continuing airworthiness (maintenance requirements)

LAR 91, 121, and 135 operators must establish and maintain an approved maintenance programme.

## 9. OPERATIONAL APPROVAL

Airworthiness approval alone does not authorise an applicant or operator to conduct basic RNP 1 operations. In addition to the airworthiness approval, the applicant or operator must obtain an operational approval to confirm the suitability of normal and contingency procedures in connection to the installation of a given piece of equipment.

Concerning commercial air transport, the assessment of an application for Basic-RNP 1 operational approval is done by the State of the operator, in accordance with standing operating rules (e.g., LAR 121.995 (b) and LAR 135.565 (c) or equivalents) supported by the criteria described in this AC.

For general aviation, the assessment of an application for Basic-RNP 1 operational approval is carried out by the State of registry, in accordance with standing operating rules (e.g., LAR 91.1015 and LAR 91.1640 or equivalents) supported by the criteria established in this AC.

### 9.1 Requirements to obtain operational approval

9.1.1 In order to obtain Basic-RNP 1 approval, the applicant or operator will take the following steps, taking into account the criteria established in this paragraph and in Paragraphs 10, 11, 12, and 13:

- a) *Airworthiness approval.*- Aircraft shall have the corresponding airworthiness approvals, pursuant to Paragraph 8 of this CA.
- b) *Application.*- The operator shall submit the following documentation to the CAA:
  - 1) *Basic-RNP 1 operational approval application;*
  - 2) *Description of aircraft equipment.*- The operator shall provide a configuration list with details of the relevant components and the equipment to be used for Basic-RNP 1 operations. The list shall include each manufacturer, model, and equipment version of GNSS equipment and software of the installed FMS.
  - 3) *Airworthiness documents related to aircraft eligibility.*- The operator shall submit relevant documentation, acceptable to the CAA, showing that the aircraft is equipped with RNP systems that meet the Basic-RNP 1 requirements, as described in Paragraph 8 of this AC. For example, the operator will submit the parts of the AFM or AFM supplement that contain the airworthiness statement.
  - 4) *Training programme for flight crews and flight dispatchers (DV)*
    - (a) Commercial operators (e.g., LAR 121 and LAR 135 operators) will present to the CAA the Basic-RNP 1 training curriculums to show that the operational procedures and practices and the training aspects described in Paragraph 11 have been included in the initial, upgrade or recurrent training curriculums for flight crews and DV.

**Note.**- It is not necessary to establish a separate training programme if the Basic-RNP 1 training identified in Paragraph 11 has already been included in the training programme of the operator. However, it must be possible to identify what aspects of Basic-RNP 1 are covered in the training programme.

- (b) Private operators (e.g., LAR 91 operators) shall be familiar with and demonstrate that they will perform their operations based on the practices and procedures described in Paragraph 11.
- 5) *Operations manual and checklists*
  - (a) Commercial operators (e.g., LAR 121 and 135 operators) must review the operations manual (OM) and the checklists in order to include information and guidance on the operating procedures detailed in Paragraph 10 of this AC. The appropriate manuals must contain the operating instructions for navigation equipment and contingency procedures. The manuals and checklists must be submitted for review along with the formal application in Phase 2 of the approval process.
  - (b) Private operators (e.g., LAR 91 operators) must operate their aircraft based on the practices and procedures identified in Paragraph 10 of this CA.
- 6) *Minimum Equipment List (MEL).*- The operator will send to the CAA for approval any revision to the MEL that is necessary to conduct Basic-RNP 1 operations. If a Basic-RNP 1 operational approval is granted based on a specific operational procedure, operators must modify the MEL and specify the required dispatch conditions.
- 7) *Maintenance.*- The operator will submit for approval a maintenance programme to conduct Basic-RNP 1 operations.
- 8) *Training programme for maintenance personnel.*- Operators will send the training curriculum that correspond to maintenance personnel.
- 9) *Navigation data validation programme.*- The operator will present the details about the navigation data validation programme as described in Appendix 2 to this AC.
- c) *Training.*- Once the amendments to manuals, programmes, and documents submitted have been accepted or approved, the operator will provide the required training to its personnel.
- d) *Validation flight.*- The CAA may deem it advisable to perform a validation flight before granting the operational approval. Such validation can be performed on commercial flights. The validation flight will be carried out according to the provisions of Chapter 13, Volume II, Part II of the SRVSOP Operations Inspector Manual (MIO) of the Regional Safety Oversight Cooperation System (SRVSOP).
- e) *Issuance of the approval to conduct Basic-RNP 1 operations.*- Once the operator has successfully completed the operational approval process, the CAA will grant the operator the authorization to conduct Basic-RNP 1 operations.
  - 1) *LAR 121 and/or 135 operators.*- For LAR 121 and/or LAR 135 operators, the CAA will issue the corresponding operations specifications (OpSpecs) that will reflect the basic RNP 1 approval.
  - 2) *LAR 91 operators.*- For LAR 91 operators, the CAA will issue a letter of authorization (LOA).

## 10. OPERATING PROCEDURES

10.1 The operator and the flight crews will become familiar with the following operating and contingency procedures associated with Basic-RNP 1 operations.

### a) Pre-flight planning

- 1) Operators and pilots intending to conduct Basic-RNP 1 SIDs and STARs must fill out the appropriate boxes in the ICAO flight plan.
- 2) On-board navigation data must be current and include appropriate procedures.

**Note.-** It is expected that the navigation database will be up to date during the operation. If the AIRAC cycle expires during the flight, operators and pilots shall establish procedures to ensure the precision of navigation data, including the suitability of navigation facilities used to determine the routes and procedures for the flight. Normally, this is done comparing electronic data with written documents. An acceptable means of compliance is to compare aeronautical charts (new and old) to check navigation reference points before dispatch. If an amended chart is published for the procedure, the database must not be used to conduct the operation.

- 3) The availability of the NAVAID infrastructure required for the intended routes, including any non-RNP contingency, must be confirmed for the period of intended operations, using all available information. Since Annex 10 Volume I requires GNSS integrity (RAIM or SBAS), it is also necessary to confirm appropriate availability of these devices. For aircraft that navigate with SBAS receivers [all TSO-C145 () / C146 () receivers], operators shall confirm appropriate availability of the GNSS RAIM in areas where the SBAS signal is not available.
- 4) RAIM (ABAS) availability
  - (a) RAIM levels required for Basic-RNP 1 can be verified either through NOTAMs (where available) or through prediction services. Operators must be familiar with the prediction information available for the intended route.
  - (b) For systems whose integrity is based on RAIM, RAIM prediction must be done before departure. This capability can be provided by a ground service or through the RAIM prediction capability of the aircraft on-board receiver.
  - (c) The prediction of RAIM availability must take into account the last NOTAMs of the GPS constellation and the avionics model (if available). The RAIM prediction service can be provided through the ANSPs, the avionics manufacturers, other entities, or through the RAIM prediction capability of the aircraft on-board receiver. RAIM availability can be confirmed using a model-specific RAIM prediction software.
  - (d) The predictive capability must account for known and predicted outages of GPS satellites or other effects on the navigation system sensors. The prediction programme should not use a mask angle below 5 degrees, since operational experience indicates that satellite signals on low elevations are not reliable. RAIM availability prediction should take into account the latest GPS constellation notices to airmen (NOTAMs) issued by the CAA or by the ANSPs, and use an identical algorithm to that used in the airborne equipment or an algorithm based on assumptions for RAIM prediction that provides a more conservative result.
  - (e) In the event that a continuous loss of the appropriate failure detection level is forecast for more than five (5) minutes for any portion of the Basic-RNP 1 operation, the flight plan shall be revised (e.g., delaying the departure or planning a different departure procedure).
  - (f) The RAIM availability prediction software does not guarantee the service. This software is rather a tool for assessing the expected capacity to meet the required navigation performance. Due to unplanned failures of some GNSS elements, pilots and ANSPs must understand that both RAIM and GNSS navigation can be lost while the aircraft is on flight, which may require reversal to an alternate means of navigation. Therefore, pilots must assess their navigation capabilities (potentially to an alternate aerodrome) in case of failure of GNSS navigation. If system integrity needs to be verified, the RAIM prediction programme shall meet the criteria of FAA AC 20-138, Paragraph 12.

**b) General operating procedures**

- 1) The pilot shall comply with any instruction or procedure identified by the manufacturer, as necessary, to meet the performance requirements of this section.

**Note.-** Pilots must adhere to any AFM limitation or operating procedure required to maintain Basic-RNP 1 performance.

- 2) Operators and pilots shall not request or file Basic-RNP 1 routes, SIDs or STARs, unless they meet all the criteria set forth in this AC. If an aircraft that does not meet these criteria and is cleared by the ATC to conduct a Basic-RNP 1 procedure, the pilot will notify the ATC that it cannot accept such clearance and will request alternate instructions;
- 3) At system initialization, pilots must:
  - (a) confirm that the navigation database is current;
  - (b) verify that the aircraft position has been entered correctly;
  - (c) verify the appropriate entry of the assigned ATC route once they receive the initial clearance, and of any subsequent change in route; and
  - (d) ensure that the sequence of WPTs as depicted in their navigation system matches the route drawn in the appropriate charts and the assigned route.
- 4) Pilots shall not fly a Basic-RNP 1 procedure, unless it can be retrievable from the on-board navigation database by its name, and conforms with the procedure in the chart. However, the procedure can be modified afterwards by inserting or deleting specific WPTs in response to ATC clearance. Manual entry or the creation of new WPTs through manual insertion of latitude and longitude or rho/theta values is not permitted. Likewise, pilots must not change any type of WPT from a fly-by WPT to a flyover WPT or *vice versa*.
- 5) Flight crews shall cross-check the cleared flight plan by comparing charts or other applicable resources to the navigation system text displays and aircraft map displays, as applicable. If required, the exclusion of specific NAVAIDs must be confirmed. A procedure shall not be used if there are any doubts about the validity of the procedure in the navigation database.

**Note.-** Pilots may note a small difference between the navigation information described in the chart and the primary navigation display. Differences of 3° or less may result from applying the magnetic variation to the equipment of the manufacturer, and these are operationally acceptable.

- 6) A cross-check is not required for conventional NAVAIDs, since the absence of integrity alert is considered sufficient to meet integrity requirements. However, it is suggested that the navigation reasonableness be checked, and any loss of RNP capability must be reported to the ATC.
- 7) For Basic-RNP 1 procedures, pilots must use a lateral deviation indicator, an FD or an AP in lateral navigation mode (LNAV). Pilots of aircraft with a lateral deviation display must make sure that the lateral deviation scale is appropriate for the navigation precision associated to the route/procedure (e.g., full-scale deflection:  $\pm 1$  NM for Basic-RNP 1).
- 8) All pilots are expected to follow the route centreline, as represented on the on-board lateral deviation indicators and/or flight guidance, during all Basic-RNP 1 operations, unless cleared by the ATC to deviate or due to an emergency. For normal operations, the cross-track error/deviation (the difference between the path estimated by the RNP system and the position of the aircraft relative to the path, e.g. FTE) must be limited to  $\pm \frac{1}{2}$  the navigation precision associated with the procedure (e.g., 0.5 NM for basic RNP 1). Small lateral deviations from this requirement are allowed (e.g., overshooting or undershooting the path) during or immediately after a turn, up to a maximum of 1 times the navigation precision (1xRNP) (e.g., 1 NM for basic RNP 1).

**Note.-** Some aircraft do not display or do not estimate a path during turns. Pilots of such aircraft may not be capable of meeting the  $\pm \frac{1}{2}$  precision requirement during en-route turns; however, they are expected to meet interception requirements after the turn or in straight segments.

- 9) If the ATC issues a course assignment that places the aircraft out of the route, the pilot shall not modify the flight plan in the RNP system until a new clearance is received allowing the aircraft to return to the route or until the controller confirms a new route

clearance. When the aircraft is not on the published Basic-RNP 1 route, the specified precision requirements do not apply.

- 10) Manual selection of functions that limit the banking angle of the aircraft can reduce the ability of the aircraft to maintain its desired track and is not recommended. Pilots should acknowledge that manual selection of functions that limit the banking angle of the aircraft could reduce their ability to meet ATC path expectations, especially when turns with large banking angles are performed. This cannot be construed as a requirement to deviate from AFM procedures. Pilots must be encouraged to select such functions only within accepted procedures.
- 11) Pilots operating aircraft that have a barometric vertical navigation system (baro-VNAV) can continue using said system while conducting Basic-RNP 1 SID and STAR procedures. Operators must ensure compliance with all altitude limitations, as published in the procedure, using the barometric altimeter as reference. Use of the barometric vertical navigation capability of the aircraft will be subject to the level of familiarisation and training of the flight crew, and on any other operational approval requirement.
- 12) Before starting a Basic-RNP 1 procedure, flight crews must:
  - (a) confirm that the correct procedure has been selected. This process includes verifying WPT sequence, the reasonableness of track angles, distances, and of any other parameter that can be modified by the pilot, such as altitude or speed constraints; and
  - (b) for multi-sensor systems, verify that the correct sensor is being used for position computation.

c) **Aircraft with RNP selection capability**

Pilots of aircraft with the capability of selecting RNP input must select RNP 1 or lower for Basic-RNP 1 SIDs, STARs or procedures.

d) **Basic-RNP 1 SID specific requirements**

- 1) Before beginning take-off, the pilot must verify that the airborne Basic-RNP 1 system is available and operating correctly, and that the appropriate aerodrome and runway data have been loaded. Before the flight, pilots must verify that the airborne navigation system is operating correctly and that the appropriate runway and departure procedure (including any applicable en-route transition) have been loaded and are properly displayed. Pilots assigned to a Basic-RNP 1 departure procedure and subsequently receive a change of runway, procedure or transition, must verify that the appropriate changes have been entered and are available for navigation before take-off. A final check of proper runway entry and correct route depiction, shortly before take-off, is recommended.
- 2) *Altitude for engagement the RNAV equipment.*- The pilot must be capable of connecting the RNP equipment in order to follow the flight guidance in the RNP lateral navigation mode before reaching 153 m (500 ft) above the aerodrome elevation.
- 3) Pilots must use an authorised method (lateral deviation indicator/navigation map display/FD/AP) to achieve an appropriate level of performance for Basic-RNP 1.
- 4) *GNSS aircraft.*- When a GNSS is used, the signal must be obtained before starting the take-off roll. For aircraft using E/TSO-C129a equipment, the take-off aerodrome must be loaded into the flight plan in order to achieve the appropriate navigation system monitoring and sensitivity. For aircraft using E/TSO-C145 ()/C146 () equipment, if the departure starts at a runway waypoint (WPT), then the departure aerodrome does not need to be in the flight plan in order to obtain the appropriate monitoring and sensitivity mentioned above. If a Basic-RNP 1 SID extends beyond 30 NM from the aerodrome and a lateral deviation indicator is used, its full-scale sensitivity must be set to a value not



greater than 1 NM between 30 NM from the aerodrome and the termination of the Basic-RNP 1 SID.

- 5) For aircraft using a lateral deviation display (e.g., a navigation map display), the scale must be adjusted for the Basic-RNP 1 SID and FD or AP must be used.

e) **Basic-RNP 1 STAR specific requirements**

- 1) Before the arrival phase, the flight crew shall verify that the correct terminal route has been loaded. The active flight plan shall be checked, comparing the charts to the map display (if applicable) and the multi-function control display unit (MCDU). This includes confirmation of WPT sequence, the reasonableness of track angles and distances, any altitude or speed constraints, and, whenever possible, which are fly-by WPTs and which are flyover WPTs. If required by a route, a check will need to be made to confirm that updating will exclude a particular NAVAID. A route will not be used if there are doubts about its validity in the navigation database.

*Note.- As a minimum, verifications in the arrival phase could consist of a simple inspection of a suitable map display that will meet the objectives of this paragraph.*

- 2) The creation of new WPTs by the flight crew through manual entries into the Basic-RNP 1 system will invalidate any route, and is not permitted.
- 3) When contingency procedures require reverting to a conventional arrival route, the flight crew must make the necessary preparations before starting the Basic-RNP 1 procedure.
- 4) Modification made to a route in the terminal area may take the form of radar headings or "direct to" clearances. In this sense, the flight crew must be capable of reacting in time. This may include the insertion of tactical WPTs loaded from the database. The flight crew is not allowed to make manual entries or to modify a loaded route, using temporary WPT or fixes not provided in the database.
- 5) Pilots must verify that the aircraft navigation system is operating properly and that the correct arrival procedure and runway are properly entered and displayed.
- 6) Although a particular method is not mandated, any published altitude and speed constraints must be observed.
- 7) Aircraft with E/TSO-C129a GNSS RNP systems: If a Basic-RNP 1 STAR begins beyond 30 NM from the aerodrome and a lateral deviation indicator is used, its full-scale sensitivity must be set to a value not greater than 1 NM before commencing the STAR. For aircraft that use a lateral deviation display (e.g., a navigation map display), the scale must be adjusted to the Basic-RNP 1 STAR and the FD or AP must be used.

f) **Contingency procedures**

- 1) The pilot must notify the ATC of any loss of RNP capability (integrity alerts or loss of navigation), together with the proposed course of action. If, for any reason, it is not possible to meet the requirements of a Basic-RNP 1 SID or STAR, pilots must notify the ATC as soon as possible. Loss of RNP capability includes any failure or event that causes the aircraft to be unable to meet the Basic-RNP 1 requirements of the route.
- 2) In case of a communication failure, the flight crew must continue with the established procedure for loss of communication.

## 11. TRAINING PROGRAMMES

11.1 The training programme for flight crews and flight dispatchers (DV) shall provide sufficient training (e.g., using flight training devices, flight simulators and aircraft) on the RNP system to the extent necessary. The training programme will include the following topics:

- a) information about this AC;

- b) the meaning and proper use of aircraft equipment and navigation suffixes;
- c) the procedures characteristics as determined from chart depiction and textual description;
- d) the depiction of WPTs types (fly-by and flyover) and ARINC 424 path terminators provided in Appendix 1 to this AC and any other types used by the operator, as well as those associated with the aircraft flight paths;
- e) the navigation equipment required to conduct Basic-RNP 1 SIDs and STARs.
- f) specific information on the RNP system:
  - 1) levels of automation, annunciation modes, changes, alerts, interactions, reversals, and degradation;
  - 2) integration of functions with other aircraft systems;
  - 3) the meaning and appropriateness of route discontinuities as well as related flight crew procedures;
  - 4) pilot procedures consistent with the operation;
  - 5) types of navigation sensors (e.g., GNSS) used by the RNP system and associated system prioritization, weighting and logic;
  - 6) turns anticipation, taking into account the effects of speed and altitude;
  - 7) interpretation of electronic displays and symbols;
  - 8) understanding aircraft configuration and operational conditions required to support Basic RNP 1 operations; e.g., appropriate selection of the lateral deviation indicator (CDI) scaling;
- g) operating procedures for RNP equipment, as applicable, including how to perform the following:
  - 1) verify currency and integrity of aircraft navigation data;
  - 2) verify the successful completion of RNP system self-tests;
  - 3) initialize RNP system position;
  - 4) retrieve and fly a Basic-RNP 1 SID or STAR with the appropriate transition;
  - 5) adhere to speed and altitude constraints associated with a Basic-RNP 1 SID or STAR;
  - 6) select the appropriate Basic-RNP 1 SID or STAR for the active runway and become familiar with the procedures to deal with a runway change;
  - 7) verify WPTs and flight plan programming;
  - 8) fly direct to a WPT;
  - 9) fly a course/track to a WPT;
  - 10) intercept a course/track;
  - 11) fly radar vectors and rejoining a Basic-RNP 1 route from a "heading" mode;
  - 12) determine cross-track errors and deviations; specifically, the maximum allowable deviations to support Basic-RNP 1 must be understood and respected;
  - 13) resolve route discontinuities (insert and delete/eliminate en-route discontinuities);
  - 14) remove or reselect the navigation sensor inputs;
  - 15) when required, confirm the exclusion of a specific NAVAID or a type of navigation aid;
  - 16) change the arrival and alternate aerodromes;

- 17) perform parallel offset if that capability is available. Pilots must know how to apply offsets, the functionality of the particular RNP system, and the need to advise the ATC if this functionality is not available; and
- 18) perform RNP holding pattern functions (e.g., insert or delete a holding pattern).
- h) levels of automation recommended by the operator for each flight phase and workload, including the methods to minimise cross-track error that will permit the aircraft to follow the route centreline;
- i) radiotelephony phraseology used for RNP applications; and
- j) RNP failure contingency procedures.

## **12. NAVIGATION DATABASE**

- a) The operator must obtain the navigation database from a supplier that complies with RTCA (Radio Technical Commission for Aeronautics) document DO 200A/EUROCAE ED 76 – Standards for aeronautical data processing. Navigation data must be compatible with the foreseen function of the equipment (see Annex 6 Part I paragraph 7.4.1). A letter of acceptance (LOA) issued by the appropriate regulatory authority to each participant in the data chain shows compliance with this requirement (e.g., FAA LOA issued in accordance with FAA AC 20-153 or EASA LOA issued in accordance with EASA IR 21 Subpart G).
- b) The operator must advise the navigation data supplier of discrepancies that invalidate a SID or STAR, and prohibit their use through a notice to flight crews.
- c) Operators should consider the need to check the navigation database periodically in order to maintain the requirements of the existing quality system or safety management system.

***Note.** - In order to minimise the path definition error (PDE), the database shall comply with DO 200A or there must be an equivalent operational means available to ensure database integrity for the Basic-RNP 1 SIDs or STARs.*

## **13. OVERSIGHT, INVESTIGATION OF NAVIGATION ERRORS, AND WITHDRAWAL OF BASIC-RNP 1 APPROVAL**

- a) The operator will establish a procedure to receive, analyse, and follow up on navigation error reports in order to determine appropriate corrective action.
- b) Information indicating a potential for repetitive errors may require the modification of the training programme of the operator.
- c) Information attributing multiple errors to a pilot in particular may call for additional training or a license revision for that pilot.
- d) Repetitive navigation errors attributed to the equipment or a specific part of the navigation equipment or to operating procedures can be the cause of cancellation of an operational approval (withdrawal of Basic-RNP 1 OpSpecs authorisation or withdrawal of the LOA in the case of private operators).

## APPENDIX 1

## FUNCTIONAL REQUIREMENTS

Paragraph	Functional requirements	Explanation
a)	Navigation data, including the to/from indication and a failure indicator, must be displayed on a lateral deviation display [e.g., a course deviation indicator (CDI), an enhanced horizontal situation indicator (E)HIS) and/or a navigation map display]. These lateral deviation displays will be used as primary flight instruments for the navigation of the aircraft, for manoeuvre anticipation, and for indication of failure/status/integrity. They must meet the following requirements:	<p>1) Non-numeric lateral deviation display (e.g. CDI, (E)HSI)), with a to/from indication and a failure annunciation, for use as primary flight instruments for navigation of the aircraft, for manoeuvre anticipation, and for failure/status/integrity indication, with the following five attributes:</p> <ul style="list-style-type: none"> <li>(a) The displays must be visible to the pilot and located in the primary field of view (<math>\pm 15</math> degrees from the pilot's normal line of sight) when looking forward along the flight path.</li> <li>(b) The lateral deviation display scaling should agree with any alerting and annunciation limits, if implemented.</li> <li>(c) The lateral deviation display must also have a full-scale deflection suitable for the current phase of flight and must be based on the required total system accuracy.</li> <li>(d) The display scaling may be set automatically by default logic or set to a value obtained from a navigation database. The full-scale deflection value must be known or must be available for display to the pilot commensurate with en-route, terminal, or approach values.</li> <li>(e) The lateral deviation display must be automatically slaved to the RNP computed path. The course selector of the deviation display should be automatically slewed to the RNP computed path.</li> </ul> <p><b>Note.-</b> The normal functions of the autonomous GNSS meet this requirement.</p> <p>2) As an alternate means, a navigation map display should give equivalent functionality to a lateral deviation display as described in Paragraph a) 1) from (a) to (e), with appropriate map scales which may be set manually by the pilot.</p> <p><b>Note.-</b> A number of modern aircraft eligible for this specification use a map display as an acceptable means to meet the prescribed requirements.</p>

Paragraph	Functional requirements	Explanation
b)	The following functions of the basic RNP 1 system are required as a minimum:	<ol style="list-style-type: none"> <li>1) The capability to continuously display to the pilot flying (PF), on the primary flight navigation instruments (primary navigation displays), the RNP calculated desired path and the position of the aircraft relative to that path. For operations where the minimum flight crew consists of two pilots, the means for the pilot not flying (PNF) the aircraft or monitoring pilot (MP) to verify the desired path and the aircraft position relative to that path must also be provided;</li> <li>2) A navigation database containing current navigation data officially issued for civil aviation, which can be updated in accordance with the aeronautical information regulation and control (AIRAC) cycle and from which ATS routes can be retrieved and loaded into the RNP system. The resolution of the stored data must be sufficient to achieve an insignificant path definition error (PDE). The database must be protected against any modification of the stored data by the flight crew;</li> <li>3) The means to display to the flight crew the period of validity of the navigation database;</li> <li>4) The means to retrieve and display the data stored in the navigation database relating to individual waypoints and NAVAIDs, to enable the flight crew to verify the route to be flown; and</li> <li>5) The capability to load on the Basic-RNP 1 system, from the navigation database, the complete RNP segment of the SIDs or STARs to be flown.</li> </ol> <p><b>Note.-</b> Due to the variability of RNP systems, this document defines the RNP segment from the first occurrence of a named WPT, track or course up to the last occurrence of a named WPT, track or course. Legs or segments prior to the first named WPT or after the last named WPT must not be loaded from the navigation database. Heading legs prior to the first named WPT or after the last named WPT do not have to be loaded from the navigation database. The complete SID will be considered in the Basic-RNP 1 procedure.</p>
c)	The means to display the following items, either on the primary field of view of the pilots, or on a readily accessible display page [e.g., on a multi-function control display unit	<ol style="list-style-type: none"> <li>1) The active navigation sensor type;</li> <li>2) The identification of the active (to) waypoint;</li> <li>3) The ground speed or time to the active (to) waypoint; and</li> </ol>

Paragraph	Functional requirements	Explanation
	(MCDU)]:	4) The distance and bearing to the active (to) waypoint.
d)	The capability of execute a "direct to" function.	
e)	The capability for automatic leg sequencing with the display of sequencing to the flight crew.	
f)	The capability to execute Basic-RNP 1 terminal procedures extracted from the on-board database, including the capability to execute flyover and fly-by turns.	
g)	<p>The aircraft must have the capability to automatically execute leg transitions and maintain tracks consistent with the following ARINC 424 path terminators or their equivalent:</p> <ul style="list-style-type: none"> <li>➤ Initial fix (IF);</li> <li>➤ Course to a fix (CF);</li> <li>➤ Direct to a fix (DF); and</li> <li>➤ Track to a fix (TF).</li> </ul>	<p><b>Note 1.-</b> Path terminators are defined in the ARINC 424 specification, and their application is described in more detail in RTCA documents DO-236B and DO-201A and in EUROCAE ED-75B and ED-77</p> <p><b>Note 2.-</b> Numeric values for courses and tracks must be automatically loaded from the RNP system database.</p>
h)	The aircraft must have the capability to automatically execute leg transitions consistent with the following ARINC 424 path terminators: heading to an altitude (VA), heading to a manual termination (VM) and heading to an intercept (VI), or must be able to be manually flown on a heading to intercept a course or to fly direct to another fix after reaching an altitude of a specific procedure.	
i)	The aircraft must have the capability to automatically execute leg transitions consistent with the following ARINC 424 path terminators: course to an altitude (CA) and course from a fix to a manual	

Paragraph	Functional requirements	Explanation
	termination (FM), or the RNP system must permit the pilot to readily designate a waypoint and select a desired course to or from a designated waypoint.	
j)	The capability to load an Basic-RNP 1 procedure from the database into the RNP system by its name.	
k)	The capability to display an indication of the Basic-RNP 1 system failure in the pilot's primary field of view.	
l)	Database integrity	The navigation database suppliers must comply with RTCA DO-200/EUROCAE document ED 76 - Standards for processing aeronautical data. A Letter of acceptance (LOA) issued by the appropriate regulatory authority to each of the participants in the data chain demonstrates compliance with this requirement. Discrepancies that invalidate a route must be reported to database suppliers and the affected routes must be prohibited through a notice from the operator to its flight crews. Aircraft operators must consider the need to conduct periodic checks of the navigation databases in order to meet existing safety system requirements.

## **APPENDIX 2**

### **NAVIGATION DATA VALIDATION PROGRAMME**

#### **1. INTRODUCTION**

The information stored in the navigation database defines the lateral and longitudinal guidance of the aircraft for Basic-RNP 1 operations. Navigation database updates are carried out every 28 days. The navigation data used in each update are critical to the integrity of every basic RNP 1 procedure, SID and STAR. This appendix provides guidance on operator procedures to validate the navigation data associated with the Basic-RNP 1 operations.

#### **2. DATA PROCESSING**

- a) The operator will identify in its procedures the person responsible for the navigation data updating process.
- b) The operator must document a process for accepting, verifying, and loading navigation data into the aircraft.
- c) The operator must place its documented data process under configuration control.

#### **3. INITIAL DATA VALIDATION**

3.1 The operator must validate every Basic-RNP 1 procedure, SID and STAR before flying under instrument meteorological conditions (IMC) to ensure compatibility with the aircraft and to ensure that the resulting paths are consistent with the published procedures, SIDs and STARs. As a minimum, the operator must:

- a) compare the navigation data of Basic-RNP 1 procedures, SIDs, and STARs to be loaded into the FMS with valid charts and maps containing the published procedures, SIDs, and STARs.
- b) validate the navigation data loaded for Basic-RNP 1 procedures, SIDs, and STARs, either on the flight simulator or on the aircraft, under visual meteorological conditions (VMC). Basic-RNP 1 procedures, SIDs, and STARs outlined on a map display must be compared to the published procedures, SIDs, and STARs. Complete Basic-RNP 1 procedures, SIDs, and STARs must be flown in order to ensure that the paths can be used, that they have no apparent lateral or longitudinal discrepancies, and that they are consistent with the published routes, SIDs, and STARs.
- c) Once the Basic-RNP 1 procedures, SIDs, and STARs are validated, a copy of the validated navigation data shall be kept and maintained in order to compare them with subsequent data updates.

#### **4. DATA UPDATING**

Upon receiving a navigation data update and before using such data on the aircraft, the operator must compare the update with the validated procedures, SIDs or STARs. This comparison must identify and resolve any discrepancy in the navigation data. If there are significant changes (any change affecting the path or the performance of the procedures, SIDs and STARs) in any part of the procedure, SID, and STAR, and if those changes are verified through the initial data, the operator must validate the amended route in accordance with the initial validation data.

#### **5. NAVIGATION DATA SUPPLIERS**

Navigation data suppliers must have a letter of acceptance (LOA) in order to process these data (e.g., FAA AC 20-153 or the document on the conditions for the issuance of letters of acceptance to navigation data suppliers by the European Aviation Safety Agency – EASA (EASA IR



21 Subpart G) or equivalent documents). A LOA recognises the data supplier as one whose data quality, integrity and quality management practices are consistent with the criteria of DO-200A/ED-76. The supplier of an operator (e.g., an FMS company) must have a Type 2 LOA and its respective suppliers must have a Type 1 or 2 LOA. The CAA may accept a LOA issued to navigation data suppliers or issue its own LOA.

## **6. AIRCRAFT MODIFICATIONS (DATABASE UPDATE)**

If an aircraft system necessary for Basic-RNP 1 operations is modified (e.g., change of software), the operator is responsible for validating the Basic-RNP 1 procedures, SIDs, and STARs with the navigation database and the modified system. This can be done without any direct assessment if the manufacturer confirms that the modification has no effect on the navigation database or on path calculation. If there is no such confirmation by the manufacturer, the operator must perform an initial validation of the navigation data with the modified system.

### APPENDIX 3

#### BASIC-RNP 1 APPROVAL PROCESS

- a) The Basic-RNP 1 approval process consists of two types of approvals, airworthiness and operational. Although the two have different requirements, they must be considered in one single process.
- b) This process is an orderly method used by the CAA to make sure that the applicants meet the established requirements.
- c) The approval process is made up by the following phases:
  - 1) Phase one: Pre-application
  - 2) Phase two: Formal application
  - 3) Phase three: Documentation evaluation
  - 4) Phase four: Inspection and demonstration
  - 5) Phase five: Approval
- d) In *Phase one - Pre-application*, the CAA calls the applicant or operator to a pre-application meeting. At this meeting, the CAA informs the applicant or operator of all the operational and airworthiness requirements that it must meet during the approval process, including the following:
  - 1) the contents of the formal application;
  - 2) the review and evaluation of the application by the CAA;
  - 3) the limitations (if any) applicable to the approval; and
  - 4) conditions under which the Basic-RNP 1 approval could be cancelled.
- e) In *Phase two – Formal Application*, the applicant or operator submits the formal application along with all the relevant documentation, as established in Paragraph 9.1.1 b) of this AC.
- f) In *Phase three – Documentation evaluation*, the CAA evaluates all the documentation and the navigation system to determine their eligibility and the approval method to be followed in connection with the aircraft. As a result of this analysis and evaluation, the CAA may accept or reject the formal application along with the documentation.
- g) In *Phase four – Inspection and demonstration*, the operator will provide training to its personnel and will carry out the validation flight, if required.
- h) In *Phase five - Approval*, the CAA issues the Basic-RNP 1 approval once the operator has met the airworthiness and operational requirements. For LAR 121 and 135 operators, the CAA will issue the OpSpecs, and for LAR 91 operators, a LOA.

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**APPENDIX D-2**

**BASIC-RNP 1 JOB AID**

**REQUEST TO CONDUCT BASIC-RNP 1 OPERATIONS**

## **BASIC-RNP 1 JOB AID**

### **REQUEST TO CONDUCT BASIC-RNP 1 OPERATIONS**

#### **1. Introduction**

This Job Aid was developed by the Latin American Regional Safety Oversight Cooperation System (SRVSOP) to provide States, operators, and inspectors with guidance on the process to be followed by an operator in order to obtain a Basic-RNP1 approval.

#### **2. Purpose of the Job Aid**

- 2.1 To give operators and inspectors information on the main reference documents of Basic-RNP 1.
- 2.2 To provide tables showing the contents of the application, the associated reference paragraphs, the place in the application of the operator where Basic-RNP 1 elements are mentioned and columns for inspector comments and follow-up on the status of various elements of Basic-RNP 1.

#### **3. Actions Recommended for the Inspector and Operator**

Some recommendations for use of the Job Aid follow:

- 3.1 At the pre-application meeting with the operator, the inspector reviews the “basic events of the Basic-RNP 1 approval process ”described in Part 1 of this Job Aid, in order to provide an overview of the approval process events.
- 3.2 The inspector reviews this Job Aid with the operator in order to establish the form and content of the Basic-RNP 1 approval application.
- 3.3 The operator uses this Job Aid as a guide to collect the documents/annexes of the Basic-RNP 1 application.
- 3.4 The operator inserts in the Job Aid references showing in what part of its documents are the Basic-RNP 1 programme elements located.
- 3.5 The operator submits the Job Aid and the application to the inspector (documents/annexes).
- 3.6 The inspector indicates in the Job Aid whether an item is in compliance or needs corrective action.
- 3.7 The inspector informs the operator as soon as possible when a corrective action by the operator is required.
- 3.8 The operator provides the inspector with the revised material when so requested.
- 3.9 The CAA provides the operator with the operational specifications (OpSpecs) or a letter of authorisation (LOA), as applicable, when the tasks and documents have been completed.

#### 4. **Structure of the Job Aid**

<b>Parts</b>	<b>Topics</b>	<b>Page</b>
Part 1	General information	3
Part 2	Information on aircraft and operator identification	5
Part 3	Operator application (Annexes and documents)	7
Part 4	Contents of the operator application for Basic-RNP 1	9
Part 5	Guide to determine the eligibility of Basic-RNP 1 aircraft	13
Part 6	Basic pilot procedures for Basic-RNP 1 operations	17

#### 5. **Main sources of documents, information, and contacts**

To access the Basic RNP 1 Job Aid, enter to the Web page of the ICAO/SAM Regional Office ([www.lima.icao.int](http://www.lima.icao.int)) under the SRVSOP link.

#### 6. **Main reference documents**

<b>Reference Document</b>	<b>Title</b>
Annex 6	Operation of aircraft
ICAO Doc 9613	Performance based navigation (PBN) manual
FAA AC 90-105 Appendix 2	Qualification criteria for RNP 1 (terminal) operations
AMC 20-5	Acceptable means of compliance for airworthiness approval and operational criteria for the use of the NAVSTAR Global positioning system (GPS)
AC 20-130A	Airworthiness approval of navigation or flight management systems integrating multiple navigation sensors
AC 20-138A	Airworthiness approval of Global navigation satellite system (GNSS) equipment
TSO-C115b	Airborne area navigation equipment using multi-sensor inputs
TSO-C129a	Airborne supplemental navigation equipment using the global positioning system (GPS)
TSO-C145a	Airborne navigation sensors using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)
TSO-C146a	Stand-Alone airborne navigation equipment using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)

**PART 1: GENERAL INFORMATION****Basic events of the Basic-RNP 1 approval process**

	<b>Action by the Operator</b>	<b>Action by the CAA</b>
1	Establish the need to obtain approval for Basic-RNP 1 operations.	
2	Review the AFM, AFM supplement or Type Certificate Data Sheet (TCDS), or other appropriate documents (e.g., service bulletins (SB), service letters (SL), etc.) to determine the eligibility of the aircraft for Basic-RNP 1 operations. The operator contacts the aircraft or avionics manufacturer, if necessary, to confirm Basic-RNP 1 or higher eligibility of the aircraft.	
3	Contact the CAA to schedule a pre-application meeting to discuss the operational approval requirements.	
4		During the pre-application meeting, establish: <ul style="list-style-type: none"> <li>• the form and contents of the application;</li> <li>• the documents that support Basic-RNP 1 approval</li> <li>• the date in which the application will be submitted for evaluation</li> <li>• if necessary, conduct a validation flight observed by the CAA.</li> </ul>
5	Send the application at least 60 days before start-up of Basic-RNP 1 operations.	
6		Review the request of the operator.
7	Once the amendments to manuals, programmes, and documents have been approved, provide training to flight crews, flight dispatchers, and maintenance personnel, and conduct a validation flight, if required by the CAA.	Only if required, participate in the validation flight.
8		Once the operational and airworthiness requirements have been met, issue the operational approval in the form of OpSpecs for LAR 121 or 135 or equivalent operators, or an LOA for LAR 91 or equivalent operators, as appropriate.

**Notes related to the approval process****1. Responsible authority**

- a. **Commercial air transport (LAR 121 and/or 135 regulations or equivalent).**- The **State of Registry** determines that the aircraft meets the airworthiness requirements. The **State of the Operator** issues the Basic-RNP 1 approval (e.g., OpSpecs).
- b. **General Aviation (LAR 91 regulations or equivalent).**- The **State of Registry** determines that the aircraft meets the airworthiness requirements and issues the operational approval (e.g., an LOA).

2. The CAA does not need to issue an LOA or equivalent document for each individual area of operation in the case of LAR 91 operators.

3. LAR 121 and/or 135 operators with Basic-RNP 1 approval must list this approval in the OpSpecs.

4. Related sections of the Latin American Aeronautical Regulations (LAR) or equivalent regulations

- a. LAR 91        Sections 91.1015 and 91.1640 or equivalents
- b. LAR 121     Section 121.995 (b) or equivalent
- c. LAR 135     Section 135.565 (c) or equivalent

5. Related ICAO Documents

- a. Annex 6 to the Convention on International Civil Aviation – Operation of Aircraft
- b. Annex 10 to the Convention on International Civil Aviation – Aeronautical telecommunications
- c. Annex 15 to the Convention on International Civil Aviation – Aeronautical information services
- d. ICAO Doc 9613 – Performance-based navigation (PBN) manual
- e. ICAO Doc 4444 – Procedures for air navigation services – Air traffic management



**PART 2: INFORMATION ON THE IDENTIFICATION OF AIRCRAFT AND OPERATORS****NAME OF THE OPERATOR:** \_\_\_\_\_

<b>Aircraft manufacturer, model, and series</b>	<b>Registration numbers</b>	<b>Serial numbers</b>	<b>Basic-RNP 1 system Number, manufacturer, and model</b>	<b>RNP specification</b>

DATE OF PRE-APPLICATION MEETING \_\_\_\_\_

DATE ON WHICH THE APPLICATION WAS RECEIVED \_\_\_\_\_

DATE ON WHICH THE OPERATOR INTENDS TO BEGIN BASIC-RNP 1 OPERATIONS \_\_\_\_\_

IS THE CAA NOTIFICATION DATE APPROPRIATE? YES \_\_\_\_\_ NO \_\_\_\_\_

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**PART 3 – OPERATOR APPLICATION (ANNEXES AND DOCUMENTS)**

Annex	Title of Annex/Document	Indication of inclusion by the operator	Comments by the Inspector
A	<b>Application for Basic-RNP 1 approval</b>		
B	<b>Airworthiness documents showing aircraft eligibility for Basic-RNP 1.</b> AFM, AFM revision, AFM supplement, or Type certificate data sheet (TCDS) showing RNP system eligibility for Basic-RNP 1 or less. Statement by the manufacturer.- Aircraft that have a statement by the manufacturer documenting compliance with SRVSOP CA 91-006 criteria or equivalent, meet the performance and functional requirements of said document.		
C	<b>Aircraft modified to meet Basic-RNP 1 standards. Documentation on aircraft inspection and/or modification, if applicable.</b> Maintenance records documenting the installation or modification of aircraft systems (e.g., FAA Form 337 – major repairs and alterations).		
D	<b>Maintenance programme</b> <ul style="list-style-type: none"> <li>For aircraft with established Basic-RNP 1 system maintenance practices, the list of references of the document or programme.</li> <li>For recently installed Basic-RNP1 systems, the maintenance practices for their review.</li> </ul>		
F	<b>Minimum equipment list (MEL) (only for operators conducting operations based on a MEL):</b> MEL showing provisions for Basic-RNP 1 systems.		
G	<b>Training</b> <b>1. LAR 91 operators or equivalent: Training method:</b> Training at home, LAR 142 training centres, or other training courses, course completion records.		

Annex	Title of Annex/Document	Indication of inclusion by the operator	Comments by the Inspector
	<b>2. LAR 121 and/or 135 operators or equivalent:</b> Training programmes (training curricula) for flight crews, flight dispatchers, and maintenance personnel.		
H	<b>Operating policies and procedures</b> <b>1. LAR 91 operators or equivalent:</b> Operations manual (OM) or sections to be attached to the application, corresponding to Basic-RNP 1 operating procedures and policies. <b>2. LAR 121 and/or 135 operators or equivalent:</b> Operations manual and checklists.		
I	<b>Navigation database</b> <b>Details of the navigation data validation programme.</b>		
J	<b>Withdrawal of Basic-RNP 1 approval</b> Indication of the need to follow up on navigation error reports submitted and the possibility of withdrawal of Basic-RNP 1 approval.		
K	<b>Validation flight plan:</b> Only if required by the CAA.		

#### CONTENTS OF THE APPLICATION TO BE SUBMITTED BY THE OPERATOR

\_\_\_\_\_ **BASIC-RNP 1 COMPLIANCE DOCUMENTATION OF THE AIRCRAFT/NAVIGATION SYSTEMS**

\_\_\_\_\_ **OPERATING PROCEDURES AND POLICIES**

\_\_\_\_\_ **SECTIONS OF THE MAINTENANCE MANUAL RELATED TO THE BASIC-RNP 1 SYSTEM (if not previously reviewed)**

**Note 1:** Documents may be grouped in a single folder or may be sent as individual documents.

## PART 4: CONTENTS OF THE OPERATOR APPLICATION FOR BASIC-RNP 1 OPERATIONS

#	Contents of the Basic-RNP 1 application by the operator	Reference paragraphs CA 91-006	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>Letter of application of the operator</b> Statement of the intention to obtain Basic-RNP 1 approval.	Paragraph 9.1.1 b) 1) Appendix 3, Paragraph e)	Annex A		
2	<b>Description of aircraft equipment.</b>	Paragraph 9.1.1 b) 2)			
3	<b>Eligibility of Basic-RNP 1 systems.</b> Airworthiness documents establishing the eligibility of the Basic-RNP 1 navigation system, its approval status, and a list of the aircraft for which the approval is being requested.	Paragraph 9.1.1 b) 3) Paragraph 8.3	Annex B Annex C		
4	<b>Training programme</b> <b>1. LAR 121 or 135 operators or equivalent: Training programmes:</b> Operators will develop an initial and periodic training programme for flight crews, flight dispatchers, if applicable, and maintenance personnel.	Paragraph 9.1.1 b) 4) (a) Paragraph 11 For maintenance, paragraph 9.1.1 b) 8)	Annex F		

#	Contents of the Basic-RNP 1 application by the operator	Reference paragraphs CA 91-006	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	<b>2. LAR 91 operators or equivalent: Training methods:</b> The following methods are acceptable for these operators: Training at home, LAR 142 training centres, or other training courses.	Paragraph 9.1.1 b) 4) (b) Paragraph 11			
5	<b>Operating procedures</b> <b>1. LAR 121 and/or 135 operators or equivalent:</b> Operations manual and checklists. <b>2. LAR 91 operators or equivalent:</b> Operations manual or section of the operator application documenting Basic-RNP 1 policies and procedures.	Paragraph 9.1.1 b) 5) (a) Paragraph 10  Paragraph 9.1.1 b) 5) (b) Paragraph 10	Annex G		
6	<b>Maintenance practices</b> <ul style="list-style-type: none"> <li>For aircraft with established maintenance practices for Basic-RNP 1 navigation systems, the operator will provide document references.</li> <li>For newly installed Basic-RNP 1 systems, the operator will provide maintenance practices for their review.</li> </ul>	Paragraph 8.5 b) Paragraph 9.1.1 b) 7)	Annex D		

#	Contents of the Basic-RNP 1 application by the operator	Reference paragraphs CA 91-006	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
7	<b>Update of the minimum equipment list (MEL)</b>  Applicable to operators conducting operations according to a MEL.	Paragraphs 8.5 a) and 9.1.1 b) 6)	Annex E		
8	<b>Navigation data validation programme</b>	Paragraph 9.1.1 b) 9)	Annex F		
9	<b>Withdrawal of Basic-RNP 1 approval</b>  Indication of the need for follow-up on the navigation error reports and the possibility of withdrawal of the Basic-RNP 1 approval.	Paragraph 13	Annex H		
10	<b>Validation flight plan, only if required</b>  The validation flight plan will be presented only if required.	Paragraph 9.1.1 d)	Annex I		

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## PART 5 – GUIDE TO DETERMINE THE ELIGIBILITY OF BASIC-RNP 1 AIRCRAFT

#	Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>Aircraft eligibility requirements for Basic-RNP 1 operations in terminal area RNP systems that use GNSS data input.</b> The following systems installed in the aircraft meet the requirements defined in AC 91-006. This equipment requires evaluation by the manufacturer and operator against all the functional and performance requirement established in that AC:	Paragraph 8.1.3	Annex B		
1a	Aircraft with E/TSO-C129a Class A1 system or E/TSO-C146 () system installed for use of IFR according to FAA AC 20-138 or AC 20-138A	Paragraph 8.1.3 a)			
1b	Aircraft with E/TSO-C129a sensor (Class B or C) installed in a flight management system (FMS) that meets TSO-C115b requirements and is installed for use of IFR according to FAA AC 20-130A	Paragraph 8.1.3 b)			
1c	Aircraft with E/TSO-C145 () sensor installed in an FMS that meets TSO-C115b requirements and is installed for use of IFR according to FAA AC 20-130A or AC 20-138A	Paragraph 8.1.3 c)			

#	Topics	Reference paragraphs  CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1d	Aircraft with RNP capability certified or approved with equivalent standards.	Paragraph 8.1.3 d)			
2	<b>Performance, control, and alerting requirements</b>	Paragraph 8.1.2	Annex B		
3	<b>Aircraft and systems eligibility for Basic-RNP 1 operations in terminal area</b>  1. Aircraft with a statement of compliance with SRVSOP CA 91-006 requirements or equivalent document  2. Aircraft with a statement by the manufacturer  3. Modified aircraft.  4. Stand-alone GNSS systems must be approved according to E/TSO-C129a Class A1 or E/TSO-C146 and operational Class 1, 2 or 3 (with no deviation from the functional requirements described in the AC 91-006), and installed for IFR use in accordance with AC 20-138A.  5. Aircraft with E/TSO-C129a sensor(s) Class B or C or E/TSO-C145 sensor(s) and FMS that meet E/TSO-C115b requirements and are installed for IFR use according to FAA AC 20-130A  6. Aircraft/equipment approved under SRVSOP CA 91-003 or equivalent	Paragraph 8.3  Paragraph 8.3.1  Paragraph 8.3.2  Paragraph 8.3.3  Paragraph 8.3.4  Paragraph 8.3.5  Paragraph 8.3.6	Annex B		

#	Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	<p>(e.g., FAA AC 90-100A) for use of GNSS, are approved for Basic-RNP 1 operations under this CA.</p> <p>7. RNP aircraft with P-RNAV approval based on GNSS capability meet the functional requirements of this AC for Basic-RNP 1 operations, such as SIDs y STARs. The GNSS system approved according to E/TSO-C129 and satisfying the step-detection and health word checking contained in E/TSO-C129A, meets P-RNAV performance requirements.</p> <p><i>Note.- Basic-RNP 1 operations are based on GNSS positioning. Positioning data from other types of navigation sensors can be integrated with GNSS data, provided they do not cause position errors that exceed the total system error (TSE)). Otherwise, means must be provided to annul or cancel the other types of navigation sensors.</i></p>	Paragraph 8.3.7			
5	<b>Functional requirements and their explanation</b>	Paragraph 8.4 Appendix 1	Annex B		
6	<b>Maintenance requirements</b>	Paragraph 8.5	Annex B		
7	<b>Navigation database</b> Details of the navigation data validation programme	Paragraph 12 Appendix 2	Annex B		

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## PART 6 - BASIC PILOT PROCEDURES FOR BASIC-RNP 1 OPERATIONS

Topics		Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
Operating procedures		Paragraph 10	Annex G		
1	Pre-flight planning	Paragraph 10.1 a)			
	Operators and pilots intending to conduct Basic-RNP 1 SIDs and STARs must fill out the appropriate boxes in the ICAO flight plan.	Paragraph 10.1 a) 1)			
	On-board navigation data must be current and include appropriate procedures.  <i><b>Note.-</b> It is expected that the navigation database will be up to date during the operation. If the AIRAC cycle expires during the flight, operators and pilots shall establish procedures to ensure the precision of navigation data, including the suitability of navigation facilities used to determine the routes and procedures for the flight. Normally, this is done comparing electronic data with written documents. An acceptable means of compliance is to compare aeronautical charts (new and old) to check navigation reference points before dispatch. If an amended chart is published for the procedure, the database must not be used to conduct the operation.</i>	Paragraph 10.1 a) 2)			
	The availability of the NAVAID infrastructure required for the intended routes, including any	Paragraph 10.1 a) 3)			

Topics		Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	non-RNP contingency, must be confirmed for the period of intended operations, using all available information. Since Annex 10 Volume I requires GNSS integrity (RAIM or SBAS), it is also necessary to confirm appropriate availability of these devices. For aircraft that navigate with SBAS receivers [all TSO-C145 () / C146 () receivers], operators shall confirm appropriate availability of the GNSS RAIM in areas where the SBAS signal is not available.				
	RAIM (ABAS) availability	Paragraph 10.1 a) 4)			
<b>2</b>	<b>General operating procedures</b>	Paragraph 10.1 b)			
	<p>The pilot shall comply with any instruction or procedure identified by the manufacturer, as necessary, to meet the performance requirements of this section.</p> <p><b>Note.-</b> Pilots must adhere to any AFM limitation or operating procedure required to maintain Basic-RNP 1 performance.</p>	Paragraph 10.1 b) 1)			
	Operators and pilots shall not request or file Basic-RNP 1 routes, SIDs or STARs, unless they meet all the criteria set forth in this AC. If an aircraft that does not meet	Paragraph 10.1 b) 2)			

Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
these criteria and is cleared by the ATC to conduct a Basic-RNP 1 procedure, the pilot will notify the ATC that it cannot accept such clearance and will request alternate instructions;				
<p>At system initialization, pilots must:</p> <ul style="list-style-type: none"> <li>(a) confirm that the navigation database is current;</li> <li>(b) verify that the aircraft position has been entered correctly;</li> <li>(c) verify the appropriate entry of the assigned ATC route once they receive the initial clearance, and of any subsequent change in route; and</li> <li>(d) ensure that the sequence of WPTs as depicted in their navigation system matches the route drawn in the appropriate charts and the assigned route.</li> </ul>	Paragraph 10.1 b) 3)			
Pilots shall not fly a Basic-RNP 1 procedure, unless it can be retrievable from the on-board navigation database by its name, and conforms with the procedure in the chart. However, the	Paragraph 10.1 b) 4)			

Topics		Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	procedure can be modified afterwards by inserting or deleting specific WPTs in response to ATC clearance. Manual entry or the creation of new WPTs through manual insertion of latitude and longitude or rho/theta values is not permitted. Likewise, pilots must not change any type of WPT from a fly-by WPT to a flyover WPT or <i>vice versa</i> .				
	<p>Flight crews shall cross-check the cleared flight plan by comparing charts or other applicable resources to the navigation system text displays and aircraft map displays, as applicable. If required, the exclusion of specific NAVAIDs must be confirmed. A procedure shall not be used if there are any doubts about the validity of the procedure in the navigation database.</p> <p><i><b>Note.-</b> Pilots may note a small difference between the navigation information described in the chart and the primary navigation display. Differences of 3° or less may result from applying the magnetic variation to the equipment of the manufacturer, and these are operationally acceptable.</i></p>	Paragraph 10.1 b) 5)			
	A cross-check is not required for conventional NAVAIDs, since the	Paragraph 10.1 b) 6)			



Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
absence of integrity alert is considered sufficient to meet integrity requirements. However, it is suggested that the navigation reasonableness be checked, and any loss of RNP capability must be reported to the ATC.				
For Basic-RNP 1 procedures, pilots must use a lateral deviation indicator, an FD or an AP in lateral navigation mode (LNAV). Pilots of aircraft with a lateral deviation display must make sure that the lateral deviation scale is appropriate for the navigation precision associated to the route/procedure (e.g., full-scale deflection: $\pm 1$ NM for Basic-RNP 1).	Paragraph 10.1 b) 7)			
All pilots are expected to follow the route centreline, as represented on the on-board lateral deviation indicators and/or flight guidance, during all Basic-RNP 1 operations, unless cleared by the ATC to deviate or due to an emergency. For normal operations, the cross-track error/deviation (the difference between the path estimated by the RNP system and the position of the aircraft relative to the path,	Paragraph 10.1 b) 8)			

Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<p>e.g. FTE) must be limited to <math>\pm \frac{1}{2}</math> the navigation precision associated with the procedure (e.g., 0.5 NM for basic RNP 1). Small lateral deviations from this requirement are allowed (e.g., overshooting or undershooting the path) during or immediately after a turn, up to a maximum of 1 times the navigation precision (1xRNP) (e.g., 1 NM for basic RNP 1).</p> <p><b>Note.-</b> Some aircraft do not display or do not estimate a path during turns. Pilots of such aircraft may not be capable of meeting the <math>\pm \frac{1}{2}</math> precision requirement during en-route turns; however, they are expected to meet interception requirements after the turn or in straight segments.</p>				
<p>If the ATC issues a course assignment that places the aircraft out of the route, the pilot shall not modify the flight plan in the RNP system until a new clearance is received allowing the aircraft to return to the route or until the controller confirms a new route clearance. When the aircraft is not on the published Basic-RNP 1 route, the specified precision requirements do not apply.</p>	Paragraph 10.1 b) 9)			

Topics		Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	Manual selection of functions that limit the banking angle of the aircraft can reduce the ability of the aircraft to maintain its desired track and is not recommended. Pilots should acknowledge that manual selection of functions that limit the banking angle of the aircraft could reduce their ability to meet ATC path expectations, especially when turns with large banking angles are performed. This cannot be construed as a requirement to deviate from AFM procedures. Pilots must be encouraged to select such functions only within accepted procedures.	Paragraph 10.1 b) 10)			
	Pilots operating aircraft that have a barometric vertical navigation system (baro-VNAV) can continue using said system while conducting Basic-RNP 1 SID and STAR procedures. Operators must ensure compliance with all altitude limitations, as published in the procedure, using the barometric altimeter as reference. Use of the barometric vertical navigation capability of the aircraft will be subject to the level of familiarisation and training of the	Paragraph 10.1 b) 11)			

Topics		Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	flight crew, and on any other operational approval requirement.				
	<p>Before starting a Basic-RNP 1 procedure, flight crews must:</p> <p>a) confirm that the correct procedure has been selected. This process includes checking WPT sequence, the reasonableness of track angles, distances, and any other parameter that can be modified by the pilot, such as altitude or speed limitations; and</p> <p>b) for multi-sensor systems, check that the correct sensor is being used for position computation.</p>	Paragraph 10.1 b) 12)			
3	<p><b>Aircraft with RNP selection capability</b></p> <p>Pilots of aircraft capable of selecting RNP input must select RNP 1 or lower for Basic-RNP 1 SIDs, STARs or procedures.</p>	Paragraph 10.1 c)			
4	<b>Basic-RNP 1 SID specific requirements</b>	Paragraph 10.1 d)			
	Before beginning take-off, the pilot must verify that the airborne Basic-	Paragraph 10.1 d) 1)			

Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<p>RNP 1 system is available and operating correctly, and that the appropriate aerodrome and runway data have been loaded. Before the flight, pilots must verify that the airborne navigation system is operating correctly and that the appropriate runway and departure procedure (including any applicable en-route transition) have been loaded and are properly displayed. Pilots assigned to a Basic-RNP 1 departure procedure and subsequently receive a change of runway, procedure or transition, must verify that the appropriate changes have been entered and are available for navigation before take-off. A final check of proper runway entry and correct route depiction, shortly before take-off, is recommended.</p>				
<p><i>Altitude for engagement the RNAV equipment.</i>- The pilot must be capable of connecting the RNP equipment in order to follow the flight guidance in the RNP lateral navigation mode before reaching 153 m (500 ft) above the aerodrome elevation.</p>	Paragraph 10.1 d) 2)			

Topics		Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	Pilots must use an authorised method (lateral deviation indicator/navigation map display/FD/AP) to achieve an appropriate level of performance for Basic-RNP 1.	Paragraph 10.1 d) 3)			
	<i>GNSS aircraft.</i> - When a GNSS is used, the signal must be obtained before starting the take-off roll. For aircraft using E/TSO-C129a equipment, the take-off aerodrome must be loaded into the flight plan in order to achieve the appropriate navigation system monitoring and sensitivity. For aircraft using E/TSO-C145 ()/C146 () equipment, if the departure starts at a runway waypoint (WPT), then the departure aerodrome does not need to be in the flight plan in order to obtain the appropriate monitoring and sensitivity mentioned above. If a Basic-RNP 1 SID extends beyond 30 NM from the aerodrome and a lateral deviation indicator is used, its full-scale sensitivity must be set to a value not greater than 1 NM between 30 NM from the aerodrome and the termination of the Basic-RNP 1 SID.	Paragraph 10.1 d) 4)			

Topics		Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	For aircraft using a lateral deviation display (e.g., a navigation map display), the scale must be adjusted for the Basic-RNP 1 SID and FD or AP must be used.	Paragraph 10.1 d) 5)			
5	<b>Basic-RNP 1 STAR specific requirements</b>	Paragraph 10.1 e)			
	<p>Before the arrival phase, the flight crew shall verify that the correct terminal route has been loaded. The active flight plan shall be checked, comparing the charts to the map display (if applicable) and the multi-function control display unit (MCDU). This includes confirmation of WPT sequence, the reasonableness of track angles and distances, any altitude or speed constraints, and, whenever possible, which are fly-by WPTs and which are flyover WPTs. If required by a route, a check will need to be made to confirm that updating will exclude a particular NAVAID. A route will not be used if there are doubts about its validity in the navigation database.</p> <p><b>Note.-</b> As a minimum, verifications in the arrival phase could consist of a simple</p>	Paragraph 10.1 e) 1)			

Topics		Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	<i>inspection of a suitable map display that will meet the objectives of this paragraph.</i>				
	The creation of new WPTs by the flight crew through manual entries into the Basic-RNP 1 system will invalidate any route, and is not permitted.	Paragraph 10.1 e) 2)			
	When contingency procedures require reverting to a conventional arrival route, the flight crew must make the necessary preparations before starting the Basic-RNP 1 procedure.	Paragraph 10.1 e) 3)			
	Modification made to a route in the terminal area may take the form of radar headings or "direct to" clearances. In this sense, the flight crew must be capable of reacting in time. This may include the insertion of tactical WPTs loaded from the database. The flight crew is not allowed to make manual entries or to modify a loaded route, using temporary WPT or fixes not provided in the database.	Paragraph 10.1 e) 4)			
	Pilots must verify that the aircraft navigation system is operating properly and that the correct arrival procedure and runway are	Paragraph 10.1 e) 5)			



Topics		Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	properly entered and displayed.				
	Although a particular method is not mandated, any published altitude and speed constraints must be observed.	Paragraph 10.1 e) 6)			
	Aircraft with E/TSO-C129a GNSS RNP systems: If a Basic-RNP 1 STAR begins beyond 30 NM from the aerodrome and a lateral deviation indicator is used, its full-scale sensitivity must be set to a value not greater than 1 NM before commencing the STAR. For aircraft that use a lateral deviation display (e.g., a navigation map display), the scale must be adjusted to the Basic-RNP 1 STAR and the FD or AP must be used.	Paragraph 10.1 e) 7)			
<b>6</b>	<b>Contingency procedures</b>	Paragraph 10.1 f)			
	The pilot must notify the ATC of any loss of RNP capability (integrity alerts or loss of navigation), together with the proposed course of action. If, for any reason, it is not possible to meet the requirements of a Basic-RNP 1 SID or STAR, pilots must notify the ATS as soon as	Paragraph 10.1 f) 1)			

Topics		Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	possible. Loss of RNP capability includes any failure or event that causes the aircraft to be unable to meet the Basic-RNP 1 requirements of the route.				
	In case of a communication failure, the flight crew must continue with the established procedure for loss of communication.	Paragraph 10.1 f) 2)			

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Job Aid: Basic-RNP 1  
Version: Original  
Date: 12/10/2009

**APPENDIX E-1**

**ADVISORY CIRCULAR**

AC	:	91-008
DATE	:	12/10/09
REVISION	:	1
ISSUED BY	:	SRVSOP

**SUBJECT: AIRCRAFT AND OPERATORS APPROVAL FOR RNP APPROACH (RNP APCH)  
OPERATIONS**

## ADVISORY CIRCULAR

AC : 91-008  
DATE : 12/10/09  
REVISION : 1  
ISSUED BY : SRVSOP

### SUBJECT: AIRCRAFT AND OPERATORS APPROVAL FOR RNP APPROACH (RNP APCH) OPERATIONS

#### 1. PURPOSE

This advisory circular (AC) establishes RNP APCH approval requirements (lateral navigation only) for aircraft and operators. The requirements for barometric vertical navigation (baro-VNAV) of a RNP APCH approach are detailed on CA 91-010 (APV/baro-VNAV). Criteria of this AC together with criteria of AC 91-010 establish the requirements for RNP APCH with baro-VNAV operations.

An operator may use other means of compliance, provided they are acceptable for the civil aviation administration (CAA).

Use of the future tense of the verb or use of the term "must" applies to an operator that chooses to meet the criteria established in this AC.

#### 2. SECTIONS RELATED TO THE LATIN AMERICAN AERONAUTICAL REGULATIONS (LARs) OR EQUIVALENT

LAR 91: Sections 91.1015 and 91.1640 or equivalents

LAR 121: Section 121.995 (b) or equivalent

LAR 135: Section 135.565 (c) or equivalent

#### 3. RELATED DOCUMENTS

Annex 6 Aircraft operations

Annex 10 Aeronautical telecommunications

Volume I: Radio navigation aids

Doc 9613 Performance-based navigation manual (PBN)

Doc 8168 Aircraft operations

Volume I: Flight procedures

Volume II: Construction of visual and instrument flight procedures

AMC 20-27 Airworthiness approval and operational criteria for RNP APPROACH (RNP APCH) operations including APV BARO-VNAV operations

FAA AC 90-105 Approval guidance for RNP operations and barometric vertical navigation in the U.S. National Airspace System

#### 4. DEFINITIONS AND ABBREVIATIONS

##### 4.1 Definitions

- a) **Primary field of view.-** For the purposes of this AC, the primary field of view is within 15 degrees of

the primary line of sight of the pilot.

- b) **Navigation specifications.-** A set of aircraft and flight crew requirements needed to support performance based navigation operations within a defined airspace. There are two kinds of navigation specifications:

*Required navigation performance (RNP) specification.-* A navigation specification based on area navigation that includes the requirement for on-board performance monitoring and alerting, designated by the prefix RNP, e.g., RNP 4, RNP APCH, RNP AR APCH.

*Area navigation (RNAV) specification.-* A navigation specification based on area navigation that does not include the requirement for on-board performance monitoring and alerting, designated by the prefix RNAV, e.g., RNAV 5, RNAV 2, RNAV 1.

*Note 1.-* The Performance-based Navigation (PBN) Manual (Doc 9613), Volume II, contains detailed guidance on navigation specifications.

*Note 2.-* The term RNP as previously defined as “a statement of the navigation performance, necessary for operation within a defined airspace”, has been removed from the Annexes to the Convention on International Civil Aviation as the concept of RNP has been overtaken by the concept of PBN. The term RNP in such Annexes is now solely used in context of navigation specifications that require performance monitoring and alerting, e.g., RNP 4 refers to the aircraft and operating requirements, including a 4 NM lateral performance with on board performance monitoring and alerting that are detailed in the PBN Manual (Doc 9613).

- c) **Performance based navigation (PBN).-** Performance based navigation specifies system performance requirements for aircraft operating along an ATS route, on an instrument approach procedure, or in a designated airspace.

Performance requirements are defined in terms of accuracy, integrity, continuity, availability, and functionality needed for the proposed operation in the context of a particular airspace concept.

- d) **Area navigation (RNAV).-** A method of navigation which permits aircraft operation on any desired flight path within the coverage of ground or space-based navigation aids or within the limits of the capabilities of self-contained navigation aids, or a combination of these.

*Note.-* Area navigation includes performance based navigation as well as other RNAV operations that do not meet the definition of performance based navigation.

- e) **RNP operations.-** Aircraft operations using a RNP system for RNP applications.

- f) **Waypoint (WPT).-** A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Waypoints are identified as either:

*Fly-by waypoint.-* A waypoint that requires turn anticipation to allow tangential interception of the next segment of a route or procedure.

*Flyover waypoint.-* A waypoint at which a turn is initiated in order to join the next segment of a route or procedure.

- g) **Initial approach fix (IAF).-** Fix that marks the beginning of the initial segment and the end of the arrival segment, if applicable. In RNAV application, this fix is normally defined as a “fly-by fix”.

- h) **Flight management system (FMS).-** An integrated system, consisting of an airborne sensor, receiver and computer with both navigation and aircraft performance databases, which provides performance and RNAV guidance to a display and automatic flight control system.

- i) **Global positioning system (GPS).-** The U.S. global navigation satellite system (GNSS) is a satellite based radio navigation system that uses precise distance measurements to determine the position, velocity and time anywhere in the world. The GPS is composed of space, control and user elements. The space element consists of at least 24 satellites in 6 orbiting planes. The control element consists of 5 monitoring stations, 3 ground antennas, and one main control station. The user element consists of antennas and receivers that provide the user with position, speed, and precise time information.

- j) **Global navigation satellite system (GNSS).**- Generic term used by ICAO to define any worldwide position, velocity and time determination system, which consists of one or more main satellite constellations, such as the GPS and the global navigation satellite system (GLONASS), aircraft receivers, and several integrity monitoring systems, including aircraft-based augmentation systems (ABAS), satellite-based augmentation systems (SBAS), such as the wide area augmentation system (WAAS) and ground-based augmentation systems (GBAS), such as the local area augmentation system (LAAS).
- Distance information will be provided, at least in the immediate future, by GPS and GLONASS.
- k) **RNP system.**- An area navigation system which supports on-board performance monitoring and alerting.
- l) **RNP value.**- The RNP value designates the lateral performance requirement associated with a procedure. Examples of RNP values are: RNP 0.3 and RNP 0.15.
- m) **Receiver autonomous integrity monitoring (RAIM).**- Technique used in a GPS receiver/processor to determine the integrity of its navigation signals, using only GPS signals or GPS signals augmented with barometric altitude data. This determination is achieved by a consistency check among redundant pseudo-range measurements. At least one additional satellite to those required must be available to obtain the navigation solution.

#### 4.2 Abbreviations

a)	AAC	Civil Aviation Administration
b)	ABAS	Aircraft-based augmentation system
c)	AIP	Aeronautical information publication
d)	AP	Autopilot
e)	APCH	Approach
f)	APV	Approach procedure with vertical guidance
g)	APV/baro-VNAV	Approach operations with vertical guidance/Barometric vertical navigation
h)	AR	Authorisation required
i)	AIRAC	Aeronautical information regulation and control
j)	AC	Advisory circular (FAA)
k)	AFM	Aircraft flight manual
l)	AMC	Acceptable means of compliance
m)	ANSP	Air navigation service provider
n)	ATC	Air traffic control
o)	ATS	Air traffic service
p)	baro-VNAV	Barometric vertical navigation
q)	CA	Advisory circular (SRVSOP)
r)	CDI	Course deviation indicator
s)	CDU	Control display unit
t)	DME	Distance measuring equipment
u)	DME/DME	Distance measuring equipment/distance measuring equipment
v)	DME/DME/IRU	Distance measuring equipment/distance measuring equipment/inertial reference unit

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w)	DTK	Desired track
x)	EASA	European Aviation Safety Agency
y)	EHSI	Enhanced horizontal situation indicator
z)	ETA	Estimated time of arrival
aa)	FAA	United States Federal Aviation Administration
bb)	FAF	Final approach fix
cc)	FD	Flight director
dd)	FDE	Fault detection and exclusion
ee)	FMS	Flight management system
ff)	Fly-by WPT	Fly-by waypoint
gg)	Flyover WPT	Flyover waypoint
hh)	FSD	Maximum deflection
ii)	FTE	Flight technical error
jj)	GBAS	Ground-based augmentation system
kk)	GNSS	Global navigation satellite system
ll)	GLONAS	Global navigation satellite system
mm)	GPS	Global positioning system
nn)	IAF	Initial approach fix
oo)	IAP	Instrument approach procedure
pp)	IFR	Instrument flight rules
qq)	IRU	Inertial reference unit
rr)	LAAS	Local area augmentation system
ss)	LAR	Latin American Aeronautical Regulations
tt)	LNAV	Lateral navigation
uu)	LOA	Letter of authorisation/letter of acceptance
vv)	LP	Localizer performance
ww)	LPV	Localizer performance with vertical guidance
xx)	MAPt	Missed approach point
yy)	MEL	Minimum equipment list
zz)	NAVAIDS	Navigation aids
aaa)	2D navigation	2D area navigation that only uses the capabilities on the horizontal plane
bbb)	NDB	Non-directional beacon
ccc)	NPA	Non-precision approach
ddd)	NSE	Navigation system error
eee)	NOTAM	Notice to airmen
fff)	OACI	International Civil Aviation Organization
ggg)	OCA/H	Obstacle clearance altitude/height

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hhh)	OEM	Original equipment manufacturer
iii)	OM	Operations manual
jjj)	OpSpecs	Operational specifications
kkk)	PANS-OPS	Procedures for air navigation services – Aircraft operations
III)	PBN	Performance-based navigation
mmm)	PDE	Path definition error
nnn)	PF	Pilot flying the aircraft
ooo)	PFD	Primary flight display
ppp)	POH	Pilot operations handbook
qqq)	PM	Pilot monitoring the aircraft
rrr)	PNF	Pilot not flying the aircraft
sss)	RAIM	Receiver autonomous integrity monitoring
ttt)	RF	Constant radius arc to a fix
uuu)	RNAV	Area navigation
vvv)	RNAV <sub>(GNSS)</sub>	GNSS (GPS)-based RNP APCH approaches
www)	RNP	Required navigation performance
xxx)	RNP APCH	Required navigation performance approach
yyy)	RNP AR APCH	Required navigation performance authorization required approach
zzz)	SBAS	Satellite-based augmentation system
aaaa)	SL	Service letters
bbbb)	SOP	Standard operating procedures
cccc)	SRVSOP	Regional Safety Oversight Cooperation System
dddd)	STC	Supplemental type certificate
eeee)	TCDS	Type certificate data sheet
fff)	TSE	Total system error
gggg)	TSO	Technical standard order
hhhh)	VMC	Visual flight meteorological conditions
iiii)	VNAV	Vertical navigation
jjjj)	VOR	VHF omnidirectional radio range
kkkk)	VPA	Vertical path angle
IIII)	WAAS	Wide area augmentation system
mmmm)	WGS	World geodetic system
nnnn)	WPT	Waypoint
oooo)	XTK	Cross-track

## 5. INTRODUCTION

5.1 According to Doc 9613 of the International Civil Aviation Organization (ICAO) - Performance-based navigation manual (PBN), there are two types of navigation specifications for approach operations:



RNP approach (RNP APCH) and RNP authorisation required approach (RNP AR APCH).

5.2 This AC establishes only the requirements for lateral navigation (2D navigation) of RNP APCH approaches designed with straight segments. This navigation specification includes present RNAV<sub>(GNSS)</sub> or GNSS approaches.

5.3 The requirements for approaches with curved segments or *published arcs*, also known as segments with constant radius arc to a fix (*RF segments*), are specified in AC 91-009 of the Regional Safety Oversight Cooperation System (SRVSOP) – Aircraft and operators approval for RNP authorization required approach operations (RNP AR APCH).

5.4 The criteria for barometric vertical navigation (baro-VNAV) of a RNP APCH approach, are described in SRVSOP AC 91-010 – Aircraft and operators approval for approach operations with vertical guidance/barometric vertical navigation (APV/baro-VNAV).

5.5 According to Annex 6 to the Convention on International Civil Aviation (also known as Chicago Convention), when RNP APCH approaches do not include barometric vertical guidance, they are classified as non-precision approach (NPA) operations. On the other hand, when RNP APCH operations include barometric vertical guidance, they are classified as approach procedures with vertical guidance (APV).

5.6 Baro-VNAV systems are optional capabilities that do not constitute a minimum requirement for flying RNAV<sub>(GNSS)</sub> or GNSS approaches using the LNAV line of minima.

5.7 Operations with localizer performance (LP) and localizer performance with vertical guidance (LPV) are not covered by this AC and will be the subject of another SRVSOP AC.

5.8 This document also provides general considerations on the approval of stand-alone and multi-sensor aircraft systems, including their functional requirements, accuracy, integrity, continuity of function, and limitations, together with operational considerations.

5.9 Stand-alone and multi-sensor RNP systems that use GNSS (GPS) and that comply with AMC 20-27 of the European Aviation Safety Agency (EASA) and with the advisory circulars (AC) of the United States Federal Aviation Administration (FAA): AC 90-105, AC 20-138A, AC 20-130A or TSO C 115b/ETSO C 115b, meet the ICAO RNP APCH navigation specification.

**Note.-** The multi-sensor systems may use other sensors combinations, such as distance measuring equipment/distance measuring equipment (DME/DME) or distance measuring equipment/distance measuring equipment/inertial reference unit (DME/DME/IRU), that provide the navigation performance acceptable for RNP APCH operations; however, such cases are limited due to the increased complexity in the navigation aid (NAVAID) infrastructure requirements and assessment, and are not practical or cost effective for widespread application.

5.10 The material described in this AC has been developed based on the following document:

- ✓ ICAO Doc 9613, Volume II, Part C, Chapter 5 – Implementing RNP APCH.

5.11 Where possible, this AC has been harmonised with the following guidance documents:

- ✓ EASA AMC 20-27 - Airworthiness approval and operational criteria for RNP APPROACH (RNP APCH) operations including APV BARO-VNAV operations; and
- ✓ FAA AC 90-105 - Approval guidance for RNP operations and barometric vertical navigation in the U.S. National Airspace System.

**Note.-** Notwithstanding harmonisation efforts, operators shall note the differences between this AC and the aforementioned documents when requesting an authorisation from the corresponding Administrations.

## 6. GENERAL CONSIDERATIONS

### 6.1 Navaid infrastructure

- a) The global navigation satellite system (GNSS) is the primary navigation system to support RNP APCH procedures.
- b) For baro-VNAV RNP APCH operations, the procedure design is based upon the use of a barometric

altimetry by an airborne RNP system whose capabilities support the required operation. The procedure design must take into account the performance and functional capabilities required in SRVSOP AC 91-010 – Aircraft and operators approval for APV/baro-VNAV operations or in equivalent documents.

- c) The acceptability of the risk of loss of RNP APCH capability for multiple aircraft due to satellite failure or loss of on-board monitoring and alerting function (for example, spaces with no receiver autonomous integrity monitoring (RAIM) coverage), must be considered by the responsible airspace authority.

## 6.2 Obstacle clearance

### 6.2.1 RNP APCH operations without baro-VNAV guidance.-

- a) Detailed guidance on obstacle clearance is provided by ICAO Doc 8168 (PANS-OPS), Volume II – Construction of visual and instrument flight procedures. The missed approach procedure may be supported by either RNAV or by conventional segments (e.g., segments based on VHF omnidirectional radio range (VOR), distance measuring equipment (DME), or non-directional radio beacon (NDB)).
- b) Procedure designs must take into account of the absence of the vertical navigation (VNAV) capability of the aircraft.

### 6.2.2 RNP APCH operations with baro-VNAV guidance.-

- a) Baro-VNAV is applied where vertical guidance and information is provided to the flight crew during instrument approach procedures containing a vertical path defined by a vertical path angle (VPA).
- b) Detailed guidance on obstacle clearance is provided in Doc 8168 (PANS-OPS), Volume II – Construction of visual and instrument flight procedures. The missed approach procedure may be supported by either RNAV or conventional segments (e.g., segments based on VOR, DME, NDB).

## 6.3 Publications

- a) The instrument approach charts will clearly identify the RNP APCH application as RNAV<sub>(GNSS)</sub>.
- b) For RNP APCH operations without baro-VNAV, the procedure design will be based on normal descent profiles, and the charts will identify minimum altitude requirements for each segment, including a lateral navigation obstacle clearance altitude/height (LNAV OCA/H).
- c) For RNP APCH operations with baro-VNAV, the charts will follow the standards of Annex 4 to the Convention on International Civil Aviation for the designation of an RNAV procedure where the vertical path is specified by a glide path angle. The chart designation will be consistent with said Annex and a lateral and vertical navigation obstacle clearance altitude/height will be issued (LNAV/VNAV OCA/H).
- d) When the missed approach segment is based on conventional means, the navaid facilities or the airborne navigation means that are necessary to conduct the missed approach will be identified in the relevant publications.
- e) The navigation information published in the applicable aeronautical information publication (AIP) for the procedures and the supporting NAVAIDs will meet the requirements of Annexes 15 and 4 to the Convention on International Civil Aviation (as appropriate). Procedure charts will provide sufficient data to support navigation data base checking by the flight crew (including waypoint names (WPT), tracks, distances for each segment and the VPA).
- f) All procedures will be based on the 1984 World Geodetic Coordinates (WGS 84).

## 6.4 Air traffic service (ATS) communication and surveillance

- a) RNP APCH operations do not include specific requirements for communication and ATS surveillance. Adequate obstacle clearance is achieved through aircraft performance and operating procedures. Where reliance is placed on the use of radar to assist contingency procedures, it must be demonstrated that its performance is adequate for this purpose. The radar service requirement will be

identified in the AIP.

- b) Appropriate radio phraseology will be published for RNP APCH operations.
- c) It is expected that Air traffic control (ATC) to be familiar with aircraft VNAV capabilities, as well as with aspects concerning altimetry setting and the effect of temperature that could potentially affect the integrity of baro-VNAV RNP APCH operations.
- d) The particular hazards of a terminal and approach area and the impact of contingency procedures following a multiple loss of RNP APCH capability must be assessed.

#### 6.5 Navigation accuracies associated with the flight phases of a RNP APCH approach

- a) According to ICAO Doc 9613, navigation accuracies associated with the flight phases of a RNP APCH approach are the following:
  - 1) initial segment: RNP 1.0
  - 2) middle segment: RNP 1.0
  - 3) final segment: RNP 0.3
  - 4) missed approach segment: RNP 1.0

#### 6.6 Additional considerations

- a) It will be consider that many aircraft have the capability to excecute a holding pattern manoeuvre using an RNP system.

### 7. DESCRIPTION OF THE NAVIGATION SYSTEM

- a) **Lateral navigation (LNAV).**- In LNAV, the RNP equipment enables the aircraft to be navigated in accordance with appropriate routing instructions along a path defined by WTP held in an on-board navigation database.

***Note.**- LNAV is typically a flight guidance systems mode, where the RNP equipment provides path steering commands to the flight guidance system, which then controls flight technical error (FTE) through either manual pilot control with a path deviation display or through coupling to the FD or AP.*

### 8. AIRWORTHINESS AND OPERATIONAL APPROVAL

- 8.1 In order to get an RNP APCH authorization, a commercial air transport operator shall obtain two types of approval:

- a) an airworthiness approval from the State of registry; (see Article 31 of the Chicago Convention and paragraphs 5.2.3 and 8.1.1 of Annex 6, Part I); and
- b) an operational approval from the State of the Operator (see paragraph 4.2.1 and Attachment F to Annex 6, Part I).

- 8.2 For general aviation operators, the State of registry will determine if the aircraft meets the applicable RNP APCH requirements and will issue the operational authorisation (e.g., a letter of authorization – LOA) (see paragraph 2.5.2.2 of Annex 6, Part II).

- 8.3 Before submitting the application, operators shall review all the aircraft qualification requirements. Compliance with airworthiness requirements or the installation of the equipment, by themselves do not constitute operational approval.

### 9. AIRWORTHINESS APPROVAL

#### 9.1 General

- a) The following airworthiness criteria are applicable to the installation of RNP systems required for RNP APCH operations:

- 1) This AC uses FAA AC 20-138/AC 20-138A (GPS stand-alone system) or AC 20-130A (multi-sensors systems) as a basis for the airworthiness approval of an RNP system based on GNSS.
- 2) For APV/baro-VNAV operations, AC 20-129 will be used, as established in SRVSOP AC 91-010.

## 9.2 Aircraft and system requirements

- a) Aircraft approved to conduct RNAV<sub>(GNSS)</sub> or GNSS approaches meet the performance and functional requirements of this AC for RNP APCH instrument approaches without radius to fix segments (without RF segments).
- b) Aircraft that have a statement of compliance with respect to the criteria contained in this AC or equivalent documents in their flight manual (AFM), AFM supplement, pilot operations handbook (POH), or the operating manual for their avionics meet the performance and functional requirements of this AC.
- c) Aircraft that have a statement from the manufacturer documenting compliance with the criteria of this AC or equivalent documents meet the performance and functional requirements of this document. This statement will include the airworthiness basis for such compliance. Compliance with the sensor requirements will have to be determined by the equipment or aircraft manufacturer, while compliance with the functional requirements may be determined by the manufacturer or through an inspection by the operator.
- d) If the RNP installation is based on GNSS stand-alone system, the equipment must be approved in accordance with technical standard order (TSO) C129a/ETSO-C129a Class A1 (or subsequent revisions) or with TSO-C146a/ETSO-C146a Class Gamma, Operational Class 1, 2, or 3 (or subsequent revisions) and meet the functionality requirements of this document.
- e) If the RNP installation is based on GNSS sensor equipment used in a multi-sensor system (e.g., flight management system (FMS)), the GNSS sensor must be approved in accordance with TSO-C129 (J)/ETSO-C129 (J) Class B1, C1, B3, C3 (or subsequent revisions) or TSO-C145 (J)/ETSO-C145 (J) Class Beta, Operational Class 1, 2 or 3 (or subsequent revisions) and meet the functionality requirements of this document.
- f) Multi-sensor systems using GNSS must be approved in accordance with AC 20-130A or TSO-C115b/ETSO-C115b and meet the functionality requirements of this document.

**Note 1.-** The GNSS equipment approved in accordance with TSO-C129a/ETSO-C129a must meet the system functions specified in this document. In addition, integrity should be provided through an aircraft-based augmentation system (ABAS). It is recommended that GNSS receivers include the capability of fault detection and exclusion (FDE) to improve continuity of function.

**Note 2.-** Multi-sensor systems that use DME/DME or DME/DME/IRU as the only means of RNP compliance are not authorised to conduct RNP APCH operations.

## 9.3 Performance and functional requirements for RNP APCH systems

### a) Accuracy

- 1) The total system error (TSE) in the lateral and longitudinal dimensions of the on-board navigation equipment must be within:
  - (a)  $\pm 1$  NM for at least 95 percent of the total flight time in the initial and intermediate approach segments and for the missed approach of a RNP APCH procedure.
 

**Note.-** There is no specific RNP accuracy requirement for the missed approach if this segment is based on conventional NAVAIDs (VOR, DME, NDB) or on dead reckoning.
  - (b)  $\pm 0.3$  NM for at least 95 percent of the total flight time in the final approach segment of the procedure.
- 2) To satisfy the accuracy requirement, the flight technical error (FTE) (95%) shall not exceed:

- (a) 0.5 NM in the initial, intermediate, and missed approach segments of a RNP APCH procedure; and
- (b) 0.25 NM in the final approach segment of the procedure.

**Note .-** The use of a deviation indicator with 1 NM full-scale deflection (FSD) on the initial, intermediate and missed approach segment and 0.3 NM FSD on the final approach segment is considered to be an acceptable means of compliance. The use of an autopilot or flight director is considered to be an acceptable means of compliance (roll stabilization do not qualify).

- 3) An acceptable means of compliance with the accuracy requirements described in the previous paragraphs is to have an RNP system approved for RNP APCH approaches in accordance with the 2D navigation accuracy criteria of FAA AC 20-138, AC 20-138A or AC 20-130A.
  - b) **Integrity.-** Malfunction of the aircraft navigation equipment that causes the TSE to exceed 2 times the RNP value is classified as a major failure condition under airworthiness regulations (e.g.,  $10^{-5}$  per hour). In the horizontal plane (lateral and longitudinal), the system must provide an alert if the accuracy requirement is not met, or if the probability that the TSE exceeds 2 NM for initial, intermediate and missed approach segments or 0.6 NM for the final approach segment is greater than  $10^{-5}$  per hour.
  - c) **Continuity.-** Loss of the RNP APCH functions is classified as a minor failure condition if the operator can revert to a different navigation system and safely proceed to a suitable airport. If the missed approach procedure is based on conventional NAVAIDs (e.g., VOR, DME, NDB), the associated navigation equipment must be installed and operational. For RNP APCH operations, at least one RNP navigation system is required.
- Note.-** From an operational point of view, the operator must develop contingency procedures in case of loss of the RNP APCH capability during approach.
- d) **Performance monitoring and alerting.-** During operations in the initial, intermediate and the missed approach segments of a RNP APCH procedure, the RNP system or the RNP system in combination with the pilot, shall provide an alert if the accuracy requirement is not met or if the probability that the lateral TSE exceeds 2 NM is greater than  $10^{-5}$ . During operations on the final approach segment, the RNP system or the RNP system in combination with the pilot shall provide an alert if the accuracy requirement is not met or if the probability that the lateral TSE exceeds 0.6 NM is greater than  $10^{-5}$ .
  - e) **Signal-in-space.-** During operations in the initial, intermediate, and missed approach segments of an RNP APCH procedure, the aircraft navigation equipment shall provide an alert if the probability of signal-in-space errors causing a lateral position error greater than 2 NM exceeds  $10^{-7}$  per hour (Chicago Convention Annex 10, Table 3.7.2.4-1). During operations in the final approach segment of a RNP APCH procedure, the aircraft navigation equipment shall provide an alert if the probability of signal-in-space errors causing a lateral position error greater than 0.6 NM exceeds  $10^{-7}$  per hour (Chicago Convention Annex 10, Table 3.7.2.4-1).

**Note.-** Compliance with the performance monitoring and alerting requirement does not imply an automatic monitor of FTE. The on board performance monitoring and alerting function must consist at least of a navigation system error (NSE) monitoring and alerting algorithm, and a lateral deviation display enabling the flight crew to monitor the FTE. To the extent operational procedures are used to monitor the FTE, the flight crew procedure, equipment characteristics and installation are evaluated for their effectiveness and equivalence as described in the functional requirements and operational procedures. The path definition error (PDE) is considered negligible due to the quality assurance process and flight crew procedures.

- f) **Path definition.-** Aircraft performance is evaluated around the path defined by the published procedure and by document RTCA/DO-236B Sections 3.2.5.4.1 and 3.2.5.4.2
- g) **Functional requirements of navigation displays.-** The following navigation displays and functions are required, according to FAA AC 20-130 and AC 20-138 or equivalent advisory material. Navigation data, including a to/from indication and a failure indicator must be displayed on a lateral deviation display (course deviation indicator (CDI), enhanced horizontal situation indicator (EHSI)) and/or a navigation map display. These displays must be used as primary flight instruments for the navigation of the aircraft, manoeuvre anticipation and for failure/status/integrity indication. The aforementioned non-numerical lateral deviation displays must have the following attributes:

- 1) the displays must be visible to the pilot and located in the primary field of view when looking forward along the flight path.
- 2) the lateral deviation display scaling must agree with any alerting and annunciation limits.
- 3) the lateral deviation display must also have an FSD suitable for the current phase of flight and must be based on the TSE requirement. Scales of  $\pm 1$  NM for the initial, intermediate, and missed approach segments and  $\pm 0.3$  NM for the final segment are acceptable.
- 4) the scale of the display may be set automatically by default logic or set to a value obtained from a navigation database. The FSD value must be known or must be available for display to the pilot commensurate with approach values.
- 5) as an alternate means, a navigation map display must provide equivalent functionality to a lateral deviation display with appropriate map scales (scales may be set manually by the pilot) and provide equivalent functionality to a lateral deviation display. To be approved, the navigation map display must show compliance with TSE requirements and be located in the primary field of view of the pilot.
- 6) the lateral deviation display must be automatically slaved to the RNP computed path. It is recommended that the course selector of the deviation display be automatically slewed to the RNP computed path.

**Note.-** This does not apply for installations where an electronic map display contains a graphical display of the flight path and path deviation.

- 7) enhanced navigation displays (e.g., *electronic map displays* or enhanced HSI) to improve lateral situational awareness, navigation monitoring and approach verification (flight plan verification) could become mandatory if the RNP installation does not support the display of information necessary for the accomplishment of these crew tasks.
- h) **System capabilities.-** The following system capabilities are required as a minimum:
- 1) the capability to continuously display to the pilot flying (PF) the aircraft, on the primary flight instruments for navigation of the aircraft (primary navigation display), the RNP computed desired path and aircraft position relative to the path. For operations where the required minimum flight crew is two pilots, a means for the pilot not flying (PNF) the aircraft (pilot monitoring (PM) ) to verify the desired path and the aircraft position relative to the path must also be provided.
  - 2) a navigation database, containing current navigation data officially promulgated by the CAA, which can be updated in accordance with the aeronautical information regulation and control (AIRAC) cycle and from/into which approach procedures can be retrieved and entered in the RNP system. The stored resolution of the data must be sufficient to achieve the required track keeping accuracy. The database must be protected against pilot modification of the stored data.
  - 3) the means to display the validity period of navigation data to the pilot.
  - 4) the means to retrieve and display data stored in the navigation database relating to individual waypoints and NAVAIDs, to enable the pilot to verify the route to be flown.
  - 5) the capability to load from the database into the RNP system, the whole approach to be flown. The approach must be loaded by its name from the database to the RNP system.
  - 6) the means to display the following items, either in the primary field of view of the pilot or on a readily accessible display page:
    - (a) the identification of the active (to) WPT;
    - (b) the distance and bearing to the active (to) WPT; and
    - (c) the ground speed or time to the active (to) WPT.
  - 7) the means to display the following items on a readily accessible display page:

- (a) the display of distance between the operational flight plan WPTs;
  - (b) the display of distance to go;
  - (c) the display of along track distances; and
  - (d) the active navigation sensor type, if there is another type of sensor in addition to the GNSS sensor.
- 8) the capability to execute the "direct to" function.
- 9) the capability for automatic leg sequencing with the display of sequencing to the pilot.
- 10) the capability to execute RNP instrument approach procedures (IAP) extracted from the on board aircraft database, including the capability to execute flyover and fly-by turns.
- 11) the capability to automatically execute leg transitions and maintain tracks consistent with the following ARINC 424 path terminators or their equivalent:
  - (a) initial fix (IF)
  - (b) track to fix (TF)
  - (c) direct to fix (DF)

***Note.**- Path terminators are defined in ARINC Specification 424 and their application is described in more detail in RTCA documents DO-236B and DO-201A.*

***Note.**- Numerical values for tracks must be automatically entered from the RNP system database.*
- 12) the capability to display an indication of the RNP system failure, including the associated sensors, in the primary field of view of the pilot.
- 13) the capability to indicate to the flight crew when the NSE alert limit is exceeded (alert provided by the on board performance monitoring and alerting function).
- i) **Flight director/autopilot.-** It is recommended that the flight director (FD) and/or autopilot (AP) remain coupled for RNP approaches. FD or AP coupling is mandatory when lateral TSE cannot be demonstrated without these systems. In this case, operational procedures must indicate that FD and/or AP coupling from the RNP system is mandatory for RNP APCH approaches.
- j) **Database integrity.-** the navigation database suppliers must comply with RTCA DO-200A. A letter of acceptance (LOA), issued by the appropriate regulatory authority to each one of the participants in the data chain, demonstrates compliance with this requirement. Positive compliance with this requirement will be considered for those LOAs Type 2 issued prior to the publication of this AC.

#### 9.4 System eligibility and approval of RNP APCH operations

- a) **Introduction.-** The original equipment manufacturer (OEM) or the holder of installation approval for the aircraft (e.g., the holder of the supplementary type certificate (STC)), must demonstrate to the CAA that it complies with the appropriate provisions of this AC. The approval can be recorded in the documentation of the manufacturer (e.g., service letters (SL), etc.). Provided the CAA accepts manufacturer documentation, AFM entries shall not be required.
- b) **Eligibility for RNP APCH operations.-** Systems that meet the requirements of Paragraph 9.2 of this AC are eligible for RNP APCH operations. Aircraft qualified in accordance with SRVSOP AC 91-009 or equivalent, e.g., FAA AC 90-101 or EASA AMC 20-26 are considered qualified for RNP APCH operations without further examination.
- c) **System eligibility for RNP APCH operations**
  - 1) **LNAV Line of minima qualification**
    - (a) **Stand-alone systems.-** Stand-alone systems that comply with TSO-C129/ETSO-C129 Class A1 or TSO-C146/ETSO-C146 Classes 1, 2, or 3 meet the aircraft qualification requirements for RNP APCH operations using the LNAV line of minima,

provided the IFR equipment installations have been performed in accordance with FAA AC 20-138. RNP systems must be approved in accordance with AC 20-138 or equivalent.

(b) **Multi-sensor systems.-**

- (1) Multi-sensor systems that use TSO-C129/ETSO-C129 Classes B1, B3, C1, or C3 sensors meet the aircraft qualification requirements for RNP APCH operations using the LNAV line of minima, provided:
  - the equipment installations meet the criteria of this AC; and
  - the associated flight management system (FMS) complies with TSO-C115b/ETSO-C115b and are installed in accordance with FAA AC 20-130.
- (2) Multi-sensor systems that use TSO-C145/ETSO-C145 Classes 1, 2, or 3 sensors meet the aircraft qualification requirements for RNP APCH operations using the LNAV line of minima, provided:
  - the equipment installations meet the criteria of this AC; and
  - are installed in accordance with FAA AC 20-138.

2) **LNAV/VNAV Line of minima qualification**

(a) **Stand-alone systems**

- (1) Stand-alone TSO-C146/ETSO-C146 Classes 2 or 3 systems meet the aircraft qualification requirements for RNP APCH operations using the LNAV/VNAV line of minima, provided that the installations meet at least the performance and functional requirements of this AC and AC 91-010 or equivalent.
- (2) The systems that meet TSO-C129/ETSO-C129 can be used for RNP APCH operations using the LNAV/VNAV line of minima if they meet the criteria of this AC and AC 91-010 or equivalent.
- (3) RNP systems must be approved in accordance with FAA AC 20-138 or equivalent, and those systems that utilize conventional baro-VNAV must provide vertical navigation system performance that meets or exceeds the criteria of AC 91-010 or equivalent.

(b) **Multi-sensor systems**

- (1) Multi-sensor systems that use TSO-C129/ETSO-C129 Classes B1, B3, C1, or C3 sensors or TSO-C145/ETSO-C145 Classes 1, 2, or 3 sensors meet the aircraft qualification requirements for RNP APCH operations using the LNAV/VNAV line of minima, provided the installations meet the requirements of this AC and AC 91-010 or equivalents.
- (2) RNP systems that utilize conventional baro-VNAV must provide a vertical navigation system performance that meets or exceeds the criteria of AC 91-010 or equivalent.
- (3) RNP systems must be installed in accordance with FAA AC 20-138 or equivalent and/or the associated FMS must comply with TSO-C115b/ETSO-C115b and must be installed in accordance with AC 20-130 or equivalent.

**9.5 Aircraft modification**

- a) If any system required for RNP APCH operations is modified (e.g., changes in the software or hardware), the aircraft modification must be approved.
- b) The operator must obtain a new operational approval that is supported by updated aircraft operational and qualification documentation.



## 10. OPERATIONAL APPROVAL

The airworthiness approval, by itself, does not authorise the operator to conduct RNP APCH operations. In addition to the airworthiness approval, the operator must obtain an operational approval confirming that the installation of the specific equipment is consistent with normal and contingency procedures.

### 10.1 Operational approval requirements

To obtain the RNP APCH authorisation, the operator will take the following steps, taking into account the criteria established in this paragraph and in Paragraphs 10.2 to 10.10 of this AC.

- a) *Airworthiness approval.*- Aircraft shall have the corresponding airworthiness approvals as established in Paragraph 9 of this AC.
- b) *Application.*- The operator will submit the following documentation to the CAA:
  - 1) *the RNP APCH operational approval application;*
  - 2) *Aircraft eligibility and qualification documentation.*- Airworthiness documentation showing that the aircraft and system proposed meet the requirements of this AC, as described in Paragraphs 9 and 10.3. To avoid unnecessary regulatory activity, the determination of eligibility for existing systems should consider acceptance of manufacturer documentation of compliance. Systems qualified for RNP AR APCH operations are considered qualified for RNP APCH operations without further examination.
  - 3) *Type of aircraft and description of the aircraft equipment to be used.*- The operator will provide a configuration list describing in detail the relevant components and the equipment to be used in the operation. The list shall include each manufacturer, model and version of the GPS equipment and the FMS software installed.
  - 4) *Operational procedures and practices.*- Operator manuals shall properly indicate the navigation operating practices and procedures identified in Paragraphs 10.4, 10.6, and 10.7 of this AC. LAR 91 operators shall confirm that they will operate using identified practices and procedures.
  - 5) *Navigation data validation programme.*- Details of the navigation data validation programme are provided in Appendix 1 to this AC.
  - 6) *Training programmes for the flight crew and flight dispatchers*
    - (a) Commercial operators (e.g. LAR 121 and 135 operators) must provide a training programme addressing the operational practices, procedures and training items related to RNP APCH operations (e.g. initial, upgrade or recurrent training for flight crew and dispatchers).

**Note.**- It is not required to establish a separate training program or regime if RNP APCH training, identified in Paragraph 10.8, is already integrated in the operator's training program. However, it must be possible to identify what aspects of RNP APCH are covered within a training program.
    - (b) Private operators (e.g. LAR 91 operators) must be familiar with the practices and procedures identified in Paragraph 10.8 "training program" of this AC.
  - 7) *Training programme for maintenance personnel.*- Operators will send instruction syllabus corresponding to maintenance personnel.
  - 8) *Operations manual (OM) and checklists*
    - (a) Operations manual and checklists of commercial operators (e.g. LAR 121 and 135 operators) must address information and guidance on the standard operating procedures (SOP) detailed in Paragraph 10.6. The appropriate manuals should contain navigation operating instructions and contingency procedures described in Paragraph 10.7 of this AC, where specified. Manuals and checklists must be submitted for review as part of the approval process.

- (b) Private operators (e.g. LAR 91 operators) must operate using the practices and procedures identified in Paragraphs 10.6 and 10.7 “operating procedures and contingency procedures” of this AC.
- 9) *Maintenance procedures.*- The operator will submit the maintenance procedures containing airworthiness and maintenance instructions for the systems and equipment to be used in the operation. The operator will provide a procedure to remove and restore RNP APCH operational capability in the aircraft.
- 10) *Minimum equipment list (MEL).*- The operator will submit any revision to the MEL needed to conduct RNP APCH operations.
- c) *Training.*- Once the amendments to manuals, programmes and documents submitted have been accepted or approved, the operator will provide the necessary training to its personnel.
- d) *Validation flights.*- The CAA may conduct validation flights if it deems it necessary for safety purposes. Validation flights will be conducted according to Chapter 13, Volume II, Part II of the SRVSOP Operation Inspector Manual (MIO).
- e) *Issuance of the authorisation to conduct RNP APCH operations.*- Once the operator has successfully completed the operational approval process, the CAA will issue, as appropriate, the authorisation to the operator to conduct RNP APCH operations.
  - 1) *LAR 91 operators.*- For operators LAR 91, the CAA will issue a letter of authorisation (LOA).
  - 2) *LAR 121 and/or 135 operators.*- For LAR 121 and/or LAR 135 operators, the CAA will issue the corresponding operational specifications (OpSpecs) reflecting the RNP APCH authorisation.

## 10.2 Description of the aircraft equipment

- c) The operator must establish and have available a configuration list detailing the components and equipment to be used for RNP APCH operations.
- d) The list of required equipment shall be established during the operational approval process, taking into account the AFM. This list shall be used for updating the MEL for each type of aircraft that the operator intends to operate.
- e) The details of the equipment and its use in accordance with the approach characteristics appear in this AC and in AC 91-010.

## 10.3 Aircraft qualification documentation

- a) *For aircraft currently conducting RNAV (GPS) or GPS approaches under FAA AC 90-94 or equivalent.*- Documentation is not required for aircraft that have an AFM or AFM supplement which states the aircraft is approved to fly RNAV (GPS) or GPS approaches, to the LNAV line of minima.
- b) *For aircraft without approval to fly RNAV (GPS) or GPS instrument approach procedures.*- Operators will submit to the CAA the RNP qualification documentation showing compliance with this AC, provided the equipment is properly installed and operated.

**Note.-** Before requesting an RNP APCH authorisation, operators shall review all equipment performance requirements. Equipment installation by itself does not guarantee operational approval nor permit its operational use.

## 10.4 RNP APCH operational documentation

- a) The operator will develop RNP APCH operational documentation for using the equipment, based on the aircraft or avionics manufacturer documentation.
- b) The operational documentation of the aircraft or avionics manufacturer will consist of recommended operational procedures and training programmes for the flight crew, in order to assist operators meet the requirements of this AC.

## 10.5 Acceptance of documentation

- a) **New aircraft/equipment (aircraft/equipment in the process of being manufactured or recently**

**manufactured).**- The aircraft/equipment qualification documentation can be approved as part of an aircraft certification project and be reflected in the AFM and related documents.

- b) **aircraft/equipment in service (capacity achieved in service).**- Previous approvals issued to conduct RNAV (GPS) or GPS instrument approaches according to AC 90-94 or equivalent do not require further evaluations. For installations/equipment not eligible to conduct RNAV (GPS) or GPS instrument approaches, the operator will submit aircraft or avionics qualification documentation to the CAA.
- c) The relevant CAA organisation will review the RNP APCH application package. Acceptance will be documented by means of a letter to the operator.

## 10.6 Operating procedures

### a) Pre-flight planning

- 1) Operators and pilots planning to conduct RNP APCH operations must file the appropriate flight plan suffixes.
- 2) At system initialization, pilots must confirm the navigation database is current and includes appropriate procedures. Likewise, pilots must also verify that the aircraft position is correct.

**Note.-** Navigation databases are expected to be current for the duration of the flight. If the AIRAC cycle changes during the flight (becomes due), the operators and pilots shall establish procedures to ensure the precision of navigation data, including the capacity of navigation facilities to define routes and flight procedures. Traditionally, this has been done by comparing electronic data with printed documents. An acceptable method is to compare aeronautical charts (new and old) in order to verify navigation fixes before dispatch. If an amended letter for the procedure is published, the database must not be used for conducting the operation.

- 3) Pilots must verify the proper entry of their ATC assigned route once they have received the initial clearance and following any subsequent changes of the route. Likewise, pilots must ensure the WPT sequence depicted by their navigation system matches their assigned route and the route depicted on the appropriate charts.

**Note.-** Pilots may notice a slight difference between the navigation information portrayed on the chart and the heading shown on the primary navigation display. A difference of 3 degrees or less may be due to a magnetic variation applied by the equipment manufacturer and may be operationally acceptable.

**Note.-** Manual selection of functions that limit the aircraft bank angle can reduce the aircraft's ability to maintain the desired track and is not recommended.

- 4) The aircraft RNP capability depends on the aircraft operational equipment. The flight crew must be able to assess the impact of equipment failure on the anticipated RNP APCH operation and take appropriate action. When a flight dispatch is predicated on flying an RNP APCH procedure that requires the use of the AP or FD at the destination and/or alternate aerodrome, the operator must determine that the AP and/or FD are installed and operational.
- 5) Pilots must ensure that the approaches which may be used for the intended flight (including the approaches in alternates aerodromes):
  - (a) can be selected from a valid navigation data base (current AIRAC cycle);
  - (b) have been verified through an appropriate process (navigation database integrity process); and
  - (c) have not been prohibited by any NOTAM issued by the CAA or by the air navigation service providers or by an operational instruction of the company.
- 6) Pilots must ensure that there are sufficient means available to fly and land at the destination or alternate aerodrome in case of loss of RNP APCH capability.
- 7) Operators and flight crews must take account of any NOTAM issued by the CAA or by the ANSP, or by an operational instruction of the company that might adversely affect aircraft system operation or the availability or suitability of the procedures at the destination aerodrome or at any alternate aerodromes.
- 8) For missed approach procedures based on conventional NAVAIDs (VOR, NDB), pilots must

verify that the appropriate airborne equipment required to fly such procedures is installed and operational in the aircraft. Likewise, they must verify that the associated ground based NAVAIDs are operational.

- 9) The availability of the NAVAID infrastructure, required for the intended routes and RNP APCH operations, including any non-RNP contingency, must be confirmed for the period of intended operations, using all available information. Since GNSS integrity (receiver autonomous integrity monitoring (RAIM) or satellite-based augmentation system (SBAS) signal) is required by Annex 10, the availability of such signals must also be determined as appropriate. For aircraft navigating with SBAS receivers (all TSO-C145()/C146()/ETSO-C145()/C146()), operators must check appropriate GPS RAIM availability in areas where SBAS signal is unavailable.
- 10) RAIM prediction must be performed prior to departure.
  - (a) The predictive capability must account for known and predicted outages of GPS satellites or other impacts on the navigation system's sensors. The prediction programme should not use a mask angle below 5 degrees, as operational experience indicates that satellite signals at low elevations are not reliable. RAIM availability prediction should take into account the latest GPS constellation notices to airmen (NOTAMs) issued by the CAA or by the ANSP, and use the identical algorithm to that used in the airborne equipment, or an algorithm based on assumptions for RAIM prediction that give a more conservative result. The service may be provided by the ANSP, avionics manufacturer, other entities or through an airborne receiver RAIM prediction capability. RAIM availability may be confirmed by using a model-specific RAIM prediction software.
  - (b) The RAIM availability prediction software does not guarantee the service. The software is rather a tool to assess the expected capability to meet the required navigation performance. Because of unplanned failures of some GPS elements, pilots must realize that RAIM or GPS navigation may be lost while in flight which may require reversion to an alternative means of navigation. Therefore, pilots must assess their capability to navigate to an alternate aerodrome in case of failure of GPS navigation.
  - (c) In the event of a predicted, continuous loss of RAIM of more than 5 minutes for any part of the intended RNP APCH operation, the flight should be delayed, canceled, or re-routed where RAIM requirements can be met.
- 11) For aircraft navigating with SBAS receivers (all TSO-C145/C146/ ETSO-C145/C146 systems), operators shall take into account the latest GPS constellation and SBAS NOTAMs issued by the CAA or ANSP. If the NOTAMs indicate the SBAS signal is not available over the intended flight route, operators should check appropriate GPS RAIM availability.

**b) Prior to commencing the procedure**

- 1) In addition to normal procedures, prior to commencing the approach (before the initial approach fix (IAF)), the flight crew must verify the correct procedure has been loaded, by comparing said procedure with the approach charts. This check must include:
  - (a) the WPT sequence;
  - (b) the integrity of the tracks and distances of the approach legs, the accuracy of the inbound course and the length of the final approach segment.

*Note.- As a minimum, this check could be a simple inspection of a map display that permits the achievement of the objectives of this paragraph.*
- 2) The flight crew must also check from the published charts, map display or control display unit (CDU), which WPT are fly-by and which are flyover.
- 3) For multi-sensor systems, the flight crew must verify during the approach that GNSS sensor is used for position computation.
- 4) For a RNP system with aircraft-based augmentation system (ABAS) requiring barometric

corrected altitude, the current aerodrome barometric altimeter setting, must be set at the appropriate time and location, consistent with the performance of the flight operation.

- 5) When the operation is based on ABAS availability, the flight crew must perform a new RAIM availability check if the estimated time of arrival (ETA) is more than 15 minutes different from the ETA used during the flight planning. This check is also processed automatically 2 NM before the final approach fix (FAF) for a TSO-C129a/ ETSO-C129a Class A1 receiver.
- 6) In the terminal area, ATC tactical interventions may include radar headings, "direct to" clearances which by-pass the initial approach legs, interception of an initial or intermediate approach segment, or the insertion of WPT loaded from the database. In complying with ATC instructions, the flight crew must be aware of the implications for the RNP system.
  - (a) The manual entry of coordinates into the RNP system by the flight crew for operations within the terminal area is not permitted.
  - (b) "Direct to" clearances may be accepted up to the intermediate fix (IF), provided that the resulting track change at the IF does not exceed 45°.

**Note.-** "Direct to" clearance to the FAF is not acceptable.

- 7) The lateral definition of the flight path between the FAF and the missed approach point (MAPt) must not be revised by the flight crew under no circumstances.

c) **During the procedure**

- 1) Pilots must comply with the instructions or procedures identified by the operator, as necessary, to meet the performance requirements of this AC.
- 2) Before starting the descent, the aircraft must be established on the final approach course no later than the FAF to ensure obstacle and terrain clearance.
- 3) Pilots must check that the navigation system is in approach mode within 2 NM prior to the FAF.

**Note.-** This check does not apply for certain RNP systems (e.g., for aircraft that have been approved with a demonstrated RNP capability). For such systems, other means are available, including electronic map display, flight guidance mode indications, etc., which clearly indicate to the flight crew that the approach mode is activated.

- 4) The appropriate displays must be selected so that the following information can be monitored by the flight crew:
  - (a) the RNP computed desired track (DTK); and
  - (b) the aircraft position relative to the path cross track deviation (XTK) for the flight technical error (FTE) monitoring.
- 5) A RNP APCH procedure must be discontinued:
  - (a) if the navigation display is announcing a failure (flagged invalid); or
  - (b) in case of loss of the integrity alerting function; or
  - (c) if the integrity alerting function is annunciated not available before passing the FAF; or
  - (d) if the FTE is excessive.
- 6) A missed approach must be flown in accordance with the published procedure. Use of the RNP system during the missed approach is acceptable, provided:
  - (a) the RNP system is operational (e.g., there is no loss of function, no NSE alert, no failure indication, etc.).
  - (b) the whole procedure (including the missed approach) is loaded from the navigation data base.
- 7) During the RNP APCH procedure, pilots must use a lateral deviation indicator, FD and/or AP in the lateral navigation mode. Pilots of aircraft with lateral deviation indicator (e.g., CDI) must ensure that lateral deviation indicator scaling (full-scale deflection) is suitable for the navigation

accuracy associated with the different procedure segments (e.g.,  $\pm 1.0$  NM for the initial, intermediate, and missed approach segments, and  $\pm 0.3$  NM for the final approach segment).

- 8) All pilots are expected to maintain procedure centrelines, as depicted by onboard lateral deviation indicators and/or flight guidance during all the approach procedure unless authorized to deviate by ATC or in emergency conditions.
- 9) For normal operations, the cross-track error/deviation (the difference between the RNP system computed path and the aircraft position relative to the path) must be limited to  $\pm \frac{1}{2}$  of the navigation accuracy associated with the procedure (e.g., 0.5 NM for the initial, intermediate and missed approach segments and 0.15 NM for the final approach segment). Brief deviations from this standard (e.g., overshoots or undershoots) during and immediately after turns, up to a maximum of one (1) times the navigation accuracy (e.g., 1.0 NM for the initial and intermediate segments), are allowable.
- 10) When baro-VNAV is used for vertical path guidance during the final approach segment, deviations above and below the baro-VNAV path must not respectively exceed + 100/-50 ft.
- 11) Pilots must execute a missed approach if the lateral or vertical deviations exceed the criteria of the previous paragraph, unless the pilot has in sight the visual references required to continue the approach.
- 12) For aircraft requiring two pilots, the flight crew must verify that each pilot's altimeter has the current setting before beginning the final approach of a RNP APCH approach procedure. The flight crew must also observe any operational limitations associated with altimeter setting sources and the latency of checking and setting the altimeters when approaching the FAF.
- 13) Although the scale should change automatically, the pilots of an aircraft with lateral deviation indicator (e.g., CDI) must make sure that the scale of the lateral deviation indicator (maximum deflection) is consistent with the different segments of the procedure (e.g.,  $\pm 1.0$  NM for the initial, intermediate, and missed approach segments, and  $\pm 0.3$  NM for the final approach segment).
- 14) RNP APCH procedures require flight crew monitoring of lateral and, if installed, vertical track deviations on the pilot's primary flight displays (PFD) to ensure the aircraft remains within the bounds defined by the procedure.

## **10.7 Contingency procedures**

- a) The pilots must notify ATC of any loss of the RNP APCH capability, together with the proposed course of action.
- b) If the pilots cannot meet the requirements of a RNP APCH procedure, they must notify the air traffic service (ATS) as soon as possible.
- c) The loss of RNP APCH capability includes any failure or event causing the aircraft to no longer satisfy the RNP APCH requirements of the procedure.
- d) The operators must develop contingency procedures in order to react safely following the loss of the RNP APCH capability during the approach.
- e) In the event of communication failure, the flight crew must continue with the RNP APCH procedure in accordance with the published lost communication procedure.
- f) The operator's contingency procedures must address at least the following conditions:
  - 1) failure of the RNP system components, including those affecting lateral or vertical deviation performances (e.g., failures of a GPS sensor, FD or AP); and
  - 2) loss of navigation signal-in-space (loss or degradation of the external signal).
- g) The pilot must ensure the capability to navigate and land at an alternate aerodrome if loss of RNP APCH capacity occurs.

## 10.8 Training programme

- a) The training programme must provide sufficient training on the aircraft's RNP systems (e.g., training in flight simulators, flight training devices or in the aircraft). The training programme will cover at least the following aspects:
- 1) the information about this AC.
  - 2) the meaning and proper use of RNP systems.
  - 3) the characteristics of the procedures, as determined from chart depiction and textual description.
  - 4) depiction of WPT types (fly-by and flyover waypoints), required path terminators (IF, TF, and DF) and any other types used by the operator as well as associated aircraft flight paths.
  - 5) navigation equipment required to conduct a RNP APCH operation (at least one RNP system based on GNSS).
  - 6) specific information on RNP systems:
    - (a) automation levels, annunciation modes, changes, alerts, interactions, reversions and degradation;
    - (b) functional integration with other aircraft systems;
    - (c) the meaning and appropriateness of route discontinuities, as well as related flight crew procedures;
    - (d) monitoring procedures for each flight phase;
    - (e) types of navigation sensors utilized by the RNP and associated systems, prioritization/weighting/logic;
    - (f) turn anticipation, taking into account the effect of speed and altitude; and
    - (g) interpretation of electronic displays and symbols.
  - 7) the operating procedures for RNP equipment, as applicable, including how to perform the following actions:
    - (a) verify currency of aircraft navigation data;
    - (b) verify successful completion of RNP system self-tests;
    - (c) initialize RNP system position;
    - (d) retrieve and fly an RNP APCH procedure;
    - (e) adhere to speed and/or altitude constraints associated with an approach procedure;
    - (f) Fly interception of an initial or intermediate segment of an approach following air traffic control (ATC) notification;
    - (g) verify WPTs and flight plan programming;
    - (h) fly direct to a WPT;
    - (i) determine cross-track error/deviation;
    - (j) insert and delete route discontinuity;
    - (k) when required by the CAA, perform gross navigation error check using conventional NAVAIDs; and
    - (l) change destination and alternate aerodromes.
  - 8) the automation levels recommended for the flight phases and workload, including methods to minimize cross-track error to maintain procedure centreline.

- 9) radio communication phraseology for RNP applications.
- 10) ability to conduct contingency procedures following RNP system failures.

#### **10.9 Navigation database**

- a) The operator must obtain the navigation databases from a qualified supplier.
- b) Navigation data suppliers must have a letter of acceptance (LOA) in order to process the navigation information (e.g., FAA AC 20-153 or document on the conditions for the issuance of letters of acceptance for navigation data suppliers by the European Aviation Safety Agency – EASA (EASA IR 21 Sub-part G) or equivalent documents). A LOA recognises the data supplier as one whose data quality, integrity, and quality management practices are consistent with the criteria of document DO-200A/ED-76. An operator's supplier (e.g., an FMS company) must have a Type 2 LOA and their respective suppliers must have a Type 1 or 2 LOA. The CAA may accept a LOA issued to the navigation data suppliers or issue its own LOA.
- c) The operator must report to the navigation data supplier on the discrepancies that invalidate a procedure, and prohibit the use of the affected procedures by means of a notice to flight crews.
- d) Operators should consider the need to conduct periodic verifications of navigation databases to ensure continued compliance with the existing requirements of the quality system or safety management system.

#### **10.10 Follow-up of navigation error reports**

- a) The operator will establish a process to receive, analyse, and do the follow-up of navigation error reports that will help him determine the appropriate corrective action.
- b) Repetitive occurrences of navigation errors attributed to a specific part of the navigation equipment may result in the cancellation of the approval for using the equipment.
- c) The information that indicates the potential for repetitive errors may require the modification of the operator's training programme.
- d) The information that attributes multiple errors to a particular pilot may require additional training or licence review.



## APPENDIX 1

### NAVIGATION DATA VALIDATION PROGRAMME

#### 1. INTRODUCTION

The procedure stored in the navigation database defines the aircraft lateral and vertical guidance. The navigation database is updated every 28 days. The navigation data used in each update are critical for the integrity of each RNP APCH procedure. Bearing in mind the reduced obstacle clearance associated to these approaches, the validation of navigation data requires special consideration. This appendix provides guidance on the procedures to be followed by the operator to validate navigation data associated with RNP APCH procedures.

#### 2. DATA PROCESSING

- a) In its procedures, the operator will identify the person responsible for the navigation data updating process.
- b) The operator must document a process for accepting, verifying, and loading navigation data into the aircraft.
- c) The operator must place their documented data process under configuration control.

#### 3. INITIAL DATA VALIDATION

The operator must validate each RNP APCH procedure before flying the procedure in instrument meteorological conditions (IMC) to ensure compatibility with their aircraft and to ensure the resulting paths matches the published procedure. As a minimum, the operator must:

- a) compare the navigation data of the procedure or procedures to be loaded on the FMS with a published procedure.
- b) validate the loaded navigation data for the procedure, either in a flight simulator or in the aircraft in visual meteorological conditions (VMC). The depicted procedure on the map display must be compared to the published procedure. The entire procedure must be flown to ensure the path can be used, does not have any apparent lateral or vertical path disconnections, and is consistent with the published procedure.
- c) once the procedure is validated, a copy of the validated navigation data must be kept and maintained to be compared with subsequent data updates.

#### 4. DATA UPDATING

Whenever the operator receives a navigation data update and before using such data on the aircraft, the update must be compared with the validated procedure. This comparison must identify and resolve any discrepancy in the navigation data. If there are any significant changes (any changes affecting the approach path or performance) to any part of a procedure, or if such changes are verified through initial information data, the operator must validate the amended procedure in accordance with the initial validation of the data.

#### 5. NAVIGATION DATA SUPPLIERS

Navigation data suppliers must have a letter of acceptance (LOA) to process these data (e.g., FAA AC 20-153 or document on the conditions for the issuance of letters of acceptance for navigation data suppliers by the European Aviation Safety Agency – EASA (EASA IR 21 Sub-part G) or equivalent document). A LOA recognises the data supplier as one whose data quality, integrity, and quality management practices are consistent with the criteria of document DO-200A/ED-76. The operator's

supplier (e.g., a FMS company) must have a Type 2 LOA, and their respective suppliers must have a Type 1 or 2 LOA. The CAA may accept a LOA issued to the navigation data suppliers or issue its own LOA.

#### **6. AIRCRAFT MODIFICATIONS (UP DATE OF THE DATA BASE)**

If an aircraft system required for RNP APCH operations is modified (e.g., a change in the software), the operator is responsible for validation of RNP APCH procedures with the navigation database and the modified system. This may be accomplished without any direct evaluation if the manufacturer verifies that the modification has no effect on the navigation database or path computation. If this verification is not done by the manufacturer, the operator must carry out an initial validation of the navigation data with the modified system.

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**APPENDIX 2****RNP APCH APPROVAL PROCESS**

- a) The RNP APCH approval process consists of two types of approvals: the airworthiness and the operational approval. Although the two have different requirements, they must be considered within a single process.
- b) This process constitutes an orderly method used by the CAAs to ensure that applicants meet the established requirements.
- c) The approval process consists of the following phases:
  - 1) Phase one: Pre-application
  - 2) Phase two: Formal application
  - 3) Phase three: Analysis of the documentation
  - 4) Phase four: Inspection and demonstration
  - 5) Phase five: Approval
- d) In *Phase one - Pre-application*, the CAA meets with the applicant or operator (pre-application meeting), who is advised of all the requirements it must meet during the approval process.
- e) In *Phase two - Formal application*, the applicant or operator submits the formal application, accompanied by all the relevant documentation, as established in Paragraph 10.1 of this AC.
- f) In *Phase three – Analysis of the documentation*, the CAA evaluates the documentation and the navigation system to determine their eligibility and the approval method to be applied with respect to the aircraft. As a result of this review and evaluation, the CAA may accept or reject the formal application together with the documentation.
- g) In *Phase four - Inspection and demonstration*, the operator will train its personnel and conduct validation flights, if required.
- h) In *Phase five - Approval*, the CAA issues the RNP APCH authorisation once the operator has met the airworthiness and operational requirements. For LAR 121 and 135 operators, the CAA will issue the OpSpecs, and for LAR 91 operators, it will issue a LOA.

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**APPENDIX E-2**

**RNP APCH JOB AID**

**APPLICATION TO CONDUCT RNP APCH OPERATIONS**

## RNP APCH JOB AID

### APPLICATION TO CONDUCT RNP APCH OPERATIONS

#### 1. Introduction

This Job Aid was developed by the Latin American Regional Safety Oversight Cooperation System (SRVSOP) to provide States, operators, and inspectors with guidance on the process to be followed by an applicant in order to obtain an RNP APCH approval.

#### 2. Purpose of the Job Aid

- 2.1 To give operators and inspectors information on the main RNP APCH reference documents.
- 2.2 To provide tables showing the contents of the application, the associated reference paragraphs, the place in the application of the operator where RNP APCH elements are mentioned and columns for inspector comments and follow-up on the status of various elements of RNP APCH.

#### 3. Actions Recommended for the Inspector and Operator

Some recommendations for use of the Job Aid follow:

- 3.1 At the pre-application meeting with the operator, the inspector reviews the “basic events of the RNP APCH approval process” described in Part 1 of this Job Aid, in order to provide an overview of the approval process events.
- 3.2 The inspector reviews this Job Aid with the operator in order to establish the form and content of the RNP APCH approval application.
- 3.3 The operator uses this Job Aid as a guide to collect the documents/RNP APCH Job Aides of the RNP APCH application.
- 3.4 The operator inserts in the Job Aid references showing in what part of its documents are the RNP APCH programme elements located.
- 3.5 The operator submits the Job Aid and the application to the inspector (documents/Annexes).
- 3.6 The inspector indicates in the Job Aid whether an item is in compliance or needs corrective action.
- 3.7 The inspector informs the operator as soon as possible when a corrective action by the operator is required.
- 3.8 The operator provides the inspector with the revised material when so requested.
- 3.9 The CAA provides the operator with the operational specifications (OpSpecs) or a letter of authorisation (LOA), as applicable, when the tasks and documents have been completed.

#### 4. Structure of the Job Aid

Parts	Topics	Page
Part 1	General information	3
Part 2	Information on aircraft and operator identification	5
Part 3	Operatr application (Annexes and documents)	7
Part 4	Contents of the application for RNP APCH	9
Part 5	Guide to determine the eligibility of RNP APCH aircraft	13
Part 6	Basic pilot procedures for RNP APCH operations	15

#### 5. Main Sources of Documents, Information, and Contacts

To access the RNP APCH, enter to the Web page of the ICAO/SAM Regional Office ([www.lima.icao.int](http://www.lima.icao.int)) under the SRVSOP link.

#### 6. Main Reference Documents

Documentos de referencia	Títulos
Annex 6	Operation of aircraft
ICAO Doc 9613	Performance-based navigation (PBN) manual
FAA AC 90-105 Appendix 1	Qualification criteria for RNP approach operations
EASA AMC 20-27	Airworthiness approval and operational criteria for RNP APPROACH (RNP APCH) operations including APV BARO-VNAV operations
FAA AC 20-130A	Airworthiness approval of navigation or flight management systems integrating multiple navigation sensors
FAA AC 20-138A	Airworthiness approval of Global navigation satellite system (GNSS) equipment
TSO-C115b	Airborne area navigation equipment using multi-sensor inputs
TSO-C129a	Airborne supplemental navigation equipment using the global positioning system (GPS)
TSO-C145a	Airborne navigation sensors using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)
TSO-C146a	Stand-Alone airborne navigation equipment using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)

### PART 1: GENERAL INFORMATION



**Basic events of the RNP APCH approval process**

	<b>Action by the operator</b>	<b>Action by the CAA</b>
1	Establish the need to obtain approval for RNP APCH operations.	
2	Review the AFM, AFM supplement or Type Certificate Data Sheet (TCDS), or other appropriate documents (e.g., service bulletins (SB), service letters (SL), etc.) to determine the eligibility of the aircraft for RNP APCH operations. The operator contacts the aircraft or avionics manufacturer, if necessary, to confirm RNP APCH eligibility of the aircraft.	
3	Contact the CAA to schedule a pre-application meeting to discuss the operational approval requirements.	
4		During the pre-application meeting, establish: <ul style="list-style-type: none"> <li>• the form and contents of the application;</li> <li>• the documents that support RNP APCH approval</li> <li>• the date in which the application will be submitted for evaluation</li> <li>• if necessary, conduct a validation flight observed by the CAA</li> </ul>
5	Submits the application at least 60 days in advance of the planned start of RNP APCH operations.	
6		Reviews operator submissions
7	Once the amendments to manuals, programmes, and documents have been approved or accepted, provide training to flight crews, flight dispatchers, and maintenance personnel, and conduct a validation flight, if required by the CAA.	Only if required, participate in the validation flight.
8		Once the operational and airworthiness requirements have been met, issue the operational approval in the form of OpSpecs for LAR 121 or 135 or equivalents, or an LOA for LAR 91 or equivalents, as appropriate.

**Notes related to the approval process****1. Responsible authority**

- a. **Commercial air transport (LAR 121 and/or 135 regulations or equivalent).**- The **State of registry** determines that the aircraft meets the airworthiness requirements. The **State of the operator** issues the RNP APCH approval (e.g., OpSpecs).
- b. **General Aviation (LAR 91 regulations or equivalent).**- The **State of registry** determines that the aircraft meets airworthiness requirements and issues the operational approval (e.g., an LOA).

2. The CAA does not need to issue an LOA or equivalent document for each individual area of operation in the case of LAR 91 operators.

3. LAR 121 and/or 135 operators with RNP APCH approval must list this approval in the OpSpecs.

4. Related sections of the Latin American Aeronautical Regulations (LAR) or equivalent regulations

- a. LAR 91        Sections 91.1015 and 91.1640 or equivalent
- b. LAR 121     Section 121.995 (b) or equivalent
- c. LAR 135     Section 135.565 (c) or equivalent

5. Related ICAO Documents

- a. Annex 6 to the Convention on International Civil Aviation – Operation of aircraft
- b. Annex 10 to the Convention on International Civil Aviation – Aeronautical telecommunications
- c. Annex 15 to the Convention on International Civil Aviation – Aeronautical information services
- d. ICAO Doc 9613 – Manual on performance-based navigation (PBN)
- e. ICAO Doc 9905 - Required navigation performance authorization required (RNP AR) procedure design manual (final draft)
- f. ICAO Doc 4444 – Procedures for air navigation services – Air traffic management

**PART 2: INFORMATION ON THE IDENTIFICATION OF AIRCRAFT AND OPERATORS**

NAME OF THE OPERATOR: \_\_\_\_\_

Aircraft manufacturer, model and series	Registration numbers	Serial numbers	RNP APCH system Number, manufacturer, and model	RNP specification

DATE OF PRE-APPLICATION MEETING \_\_\_\_\_

DATE ON WHICH THE APPLICATION WAS RECEIVED \_\_\_\_\_

DATE ON WHICH THE OPERATOR INTENDS TO BEGIN RNP APCH OPERATIONS \_\_\_\_\_

IS THE CAA NOTIFICATION DATE APPROPRIATE? YES \_\_\_\_\_ NO \_\_\_\_\_

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**PART 3 – OPERATOR APPLICATION (ANNEXES AND DOCUMENTS)**

Annex	Title of Annex/document	Indication of inclusion by the operator	Comments by the Inspector
A	<b>Application for RNP APCH approval</b>		
B	<b>Airworthiness documents showing aircraft eligibility for RNP APCH.</b> AFM, AFM revision, AFM supplement, or Type certificate data sheet (TCDS) showing that the RNP navigation system is eligible for RNP APCH.  Manufacturer statement.- Aircraft with a manufacturer statement documenting compliance with SRVSOP CA 91-008 criteria or equivalent, meet the performance and functional requirements of said document.		
C	<b>Aircraft modified to meet RNP APCH standards. Documentation on aircraft inspection and/or modification, if applicable.</b> Maintenance records documenting the installation or modification of aircraft systems (e.g., FAA Form 337 – major repairs and alterations).		
D	<b>Maintenance programme</b> <ul style="list-style-type: none"> <li>For aircraft with established maintenance practices for RNP APCH systems, the list of references of the document or programme.</li> <li>For recently installed RNP APCH systems, the maintenance procedures for their review.</li> </ul>		
E	<b>Minimum equipment list (MEL) (only for operators conducting operations based on a MEL):</b>  MEL showing provisions for RNP APCH systems.		
F	<b>Training</b> <ol style="list-style-type: none"> <li><b>LAR 91 operators or equivalent: Training methods:</b> Training at home, LAR 142 training centres, or other training courses, course completion records.</li> <li><b>LAR 121 and/or 135 operators or equivalent:</b> Training programmes (training curricula) for flight crews, flight dispatchers, and maintenance personnel.</li> </ol>		

Annex	Title of Annex/document	Indication of inclusion by the operator	Comments by the Inspector
G	<b>Operating policies and procedures</b> <b>1. LAR 91 operators or equivalent:</b> Operations manual (OM) or sections to be attached to the application, corresponding to RNP APCH operating procedures and policies. <b>2. LAR 121 and/or 135 operators or equivalent:</b> Operations manual and checklists.		
H	<b>Navigation database</b> Details of the navigation database validation programme		
I	<b>Withdrawal of RNP APCH approval</b> Indication of the need to follow up on navigation error reports submitted and the possibility of withdrawal of RNP APCH approval.		
J	<b>Validation flight plan</b> Only if required by the CAA.		

#### CONTENTS OF THE APPLICATION TO BE SUBMITTED BY THE OPERATOR

\_\_\_\_\_ **DOCUMENTATION SHOWING RNP APCH COMPLIANCE OF THE AIRCRAFT/NAVIGATION SYSTEMS**

\_\_\_\_\_ **OPERATING PROCEDURES AND POLICIES**

\_\_\_\_\_ **SECTIONS OF THE MAINTENANCE MANUAL RELATED TO THE RNP APCH SYSTEM (if not previously reviewed)**

**Note 1:** Documents may be grouped in a single folder or may be sent as individual documents.

#### PART 4: CONTENTS OF THE OPERATOR APPLICATION FOR RNP APCH OPERATIONS

#	Contents of the RNP APCH application by the operator	Reference paragraphs CA 91-009	In what Annexes/Documents of the operator can the application contents be located	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>Operator application letter</b> Application letter for obtaining RNP APCH approval.	Paragraph 10.1 b) 1) Appendix 2, Paragraph e)	Annex A		
2	<b>Type of aircraft and description of aircraft equipment</b> A configuration list with details of the relevant components and the equipment to be used in the operation. The list shall include each manufacturer, model and version of the equipment and software of the installed FMS.	Paragraph 10.1 b) 1) Paragraph 10.2			
3	<b>Aircraft and navigation system eligibility and qualification for RNP APCH</b> Airworthiness documents which establish aircraft an navigation system eligibility for RNP APCH operations, their approval status and a list with the aircraft for which the approval is requested.	Paragraph 10.1 b) 2) Paragraphs 9.2 , 9.4 and 10.3	Annex B Annex C		
4	<b>Training programmes</b> a) <b>LAR 121 or 135 operators or equivalent: Training programmes:</b> Operators will develop an initial and periodic training programme for flight crews, flight dispatchers and maintenance personnel. b) <b>LAR 91 operators or equivalent: Training methods:</b> The following methods are acceptable for these operators: Training at home, LAR 142 training centres, or other training courses.	Paragraph 10.1 b) 6) Paragraphs 10.8 For maintainace Paragraph 10.1 b( 7)	Annex F		

#	Contents of the RNP APCH application by the operator	Reference paragraphs CA 91-009	In what Annexes/Documents of the operator can the application contents be located	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
5	<b>Operations Manual (OM) and checklists</b> a) <b>LAR 121 and/or 135 operators or equivalent:</b> Operations manual and checklists. b) <b>LAR 91 operators or equivalent:</b> Operations manual or section of the operator application documenting RNP APCH policies and procedures.	Paragraph 10.1 b) 4) and 8) Paragraphs 10.6 and 10.7			
6	<b>Maintenance procedures</b> <ul style="list-style-type: none"> <li>For aircraft with established maintenance practices for RNP APCH navigation systems, the operator will provide document references.</li> <li>For newly installed RNP APCH systems, the operator will provide maintenance practices for review.</li> </ul>	Paragraph 10.1 b) 9)	Annex D		
7	<b>Minimum equipment list (MEL)</b> The operator will submit any revision to the MEL, necessary to carry out RNP APCH operations.	Paragraph 10.1 b) 10)	Annex E		
8	<b>Navigation data validation programme</b> Details of the navigation data validation programme.	Paragraph 10.1 b) 5)	Annex F		
9	<b>Withdrawal of RNP APCH operation authorization</b> Indication of the need for follow-up on the navigation error reports and the potential of withdrawal of the RNP APCH approval.				
10	<b>Validation test plan, only if required</b>	Appendix 7,	Annex I		



#	Contents of the RNP APCH application by the operator	Reference paragraphs CA 91-009	In what Annexes/Documents of the operator can the application contents be located	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	The validation flight plan will be presented only if required	paragraph b) 14)			

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**PART 5 – GUIDE TO DETERMINE THE ELIGIBILITY OF RNP APCH AIRCRAFT**

#	Topics	Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	Aircraft and system requirements	Paragraph 9.2	Annex B		

#	Topics	Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	a) Aircraft approved to conduct RNAV <sub>(GNSS)</sub> or GNSS approaches.	Paragraph 9.2 a)			
	b) Aircraft that have a statement of compliance with respect to the criteria contained in the AC 91-008 or equivalent document in their flight manual (AFM), AFM supplement, pilot operations handbook (POH), or in the avionics operating manual.	Paragraph 9.2 b)	Annex B		
	c) Aircraft that have a statement from the manufacturer documenting compliance with the criteria of the AC 91-008 or equivalent document.	Paragraph 9.2c)	Annex B		
	d) RNP installation based on GNSS stand-alone system	Paragraph 9.2 d)			
	e) RNP installation is based on GNSS sensor equipment used in a multi-sensor system	Paragraph 9.2 e)			
	f) Multi-sensor systems using GNSS	Paragraph 9.2 f)			
2	<b>Eligibility for RNP APCH operations</b>	Paragraph 9.4 b)			
	a) Systems that meet the requirements of Paragraph 1 above are eligible for RNP APCH operations	Paragraph 9.4 b)			
	b) Aircraft qualified in accordance with SRVSOP AC 91-009 or equivalent, e.g., FAA AC 90-101 or EASA AMC 20-26 are	Paragraph 9.4 b)			

#	Topics	Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	considered qualified for RNP APCH operations without further examination.				
3	<b>System eligibility for RNP APCH operations</b>	Paragraph 9.4 c)			
	a) LNAV Line of minima qualification	Paragraph 9.4 c) 1)			
	1) Stand-alone systems	Paragraph 9.4 c) 1) (a)			
	2) Multi-sensor systems	Paragraph 9.4 c) 1) (b)			
	b) LNAV/VNAV Line of minima qualification	Paragraph 9.4 c) 2)			
	1) Stand-alone systems	Paragraph 9.4 c) 2) (a)			
	2) Multi-sensor systems	Paragraph 9.4 c) 2) (b)			
4	<b>Modified aircraft</b>	Paragraph 9.5	Annex B		
5	<b>Performance and functional requirements for RNP APCH systems</b>	Paragraph 9.3			
5	<b>Navigation database</b> Details of the navigation data validation programme.	Paragraph 10.9 Appendix 1	Annex B		

**PART 6 - BASIC PILOT PROCEDURES FOR RNP APCH OPERATIONS**

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
Operating procedures		Paragraph 10.6	Annex G		
1	Pre-flight planning	Paragraph 10.6 a)			
	Operators and pilots planning to conduct RNP APCH operations must file the appropriate flight plan suffixes.	Paragraph 10.6 a) 1)			
	At system initialization, pilots must confirm the navigation database is current and includes appropriate procedures. Likewise, pilots must also verify that the aircraft position is correct.  <i><b>Note.-</b> Navigation databases are expected to be current for the duration of the flight. If the AIRAC cycle changes during the flight (becomes due), the operators and pilots shall establish procedures to ensure the precision of navigation data, including the capacity of navigation facilities to define routes and flight procedures. Traditionally, this has been done by comparing electronic data with printed documents. An acceptable method is to compare aeronautical charts (new and old) in order to verify navigation fixes before dispatch. If an amended letter for the procedure is published, the database must not be used for conducting the operation.</i>	Paragraph 10.6 a) 2)			
	Pilots must verify the proper entry of their ATC assigned route once they have received the initial clearance and following any subsequent changes of the route. Likewise, pilots must ensure the WPT sequence depicted by their navigation system matches their assigned route and the route depicted on the appropriate charts.  <i><b>Note.-</b> Pilots may notice a slight difference between the navigation information portrayed on the chart and the heading shown on the primary navigation display. A difference of 3 degrees or less may be due to a magnetic variation applied by the equipment manufacturer and may be operationally acceptable.</i>  <i><b>Note.-</b> Manual selection of functions that limit the aircraft bank angle can reduce the aircraft's ability to maintain the desired track and is not recommended.</i>	Paragraph 10.6 a) 3)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	The aircraft RNP capability depends on the aircraft operational equipment. The flight crew must be able to assess the impact of equipment failure on the anticipated RNP APCH operation and take appropriate action. When a flight dispatch is predicated on flying an RNP APCH procedure that requires the use of the AP or FD at the destination and/or alternate aerodrome, the operator must determine that the AP and/or FD are installed and operational.	Paragraph 10.6 a) 4)			
	<p>Pilots must ensure that the approaches which may be used for the intended flight (including the approaches in alternates aerodromes):</p> <ul style="list-style-type: none"> <li>a) can be selected from a valid navigation data base (current AIRAC cycle);</li> <li>b) have been verified through an appropriate process (navigation database integrity process); and</li> <li>c) have not been prohibited by any NOTAM issued by the CAA or by the air navigation service providers or by an operational instruction of the company.</li> </ul>	Paragraph 10.6 a) 5)			
	Pilots must ensure that there are sufficient means available to fly and land at the destination or alternate aerodrome in case of loss of RNP APCH capability.	Paragraph 10.6 a) 6)			
	Operators and flight crews must take account of any NOTAM issued by the CAA or by the ANSP, or by an operational instruction of the company that might adversely affect aircraft system operation or the availability or suitability of the procedures at the destination aerodrome or at any alternate aerodromes.	Paragraph 10.6 a) 7)			
	For missed approach procedures based on conventional NAVAIDs	Paragraph 10.6 a) 8)			

Topics	Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
(VOR, NDB), pilots must verify that the appropriate airborne equipment required to fly such procedures is installed and operational in the aircraft. Likewise, they must verify that the associated ground based NAVAIDs are operational.				
The availability of the NAVAID infrastructure, required for the intended routes and RNP APCH operations, including any non-RNP contingency, must be confirmed for the period of intended operations, using all available information. Since GNSS integrity (receiver autonomous integrity monitoring (RAIM) or satellite-based augmentation system (SBAS) signal) is required by Annex 10, the availability of such signals must also be determined as appropriate. For aircraft navigating with SBAS receivers (all TSO-C145()/C146()/ETSO-C145()/C146()), operators must check appropriate GPS RAIM availability in areas where SBAS signal is unavailable.	Paragraph 10.6 a) 9)			
<p>RAIM prediction must be performed prior to departure.</p> <p>a) The predictive capability must account for known and predicted outages of GPS satellites or other impacts on the navigation system's sensors. The prediction programme should not use a mask angle below 5 degrees, as operational experience indicates that satellite signals at low elevations are not reliable. RAIM availability prediction should take into account the latest GPS constellation notices to airmen (NOTAMs) issued by the CAA or by the ANSP, and use the identical algorithm to that used in the airborne equipment, or an algorithm based on assumptions for RAIM prediction that give a more conservative result. The service may be provide by the ANSP, avionics manufacturer, other entities or through an airborne receiver RAIM prediction capability. RAIM availability may be confirmed by using a model-specific RAIM prediction software.</p>	Paragraph 10.6 a) 10)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	<p>b) The RAIM availability prediction software does not guarantee the service. The software is rather a tool to assess the expected capability to meet the required navigation performance. Because of unplanned failures of some GPS elements, pilots must realize that RAIM or GPS navigation may be lost while in flight which may require reversion to an alternative means of navigation. Therefore, pilots must assess their capability to navigate to an alternate aerodrome in case of failure of GPS navigation.</p> <p>c) In the event of a predicted, continuous loss of RAIM of more than 5 minutes for any part of the intended RNP APCH operation, the flight should be delayed, canceled, or re-routed where RAIM requirements can be met.</p>				
	For aircraft navigating with SBAS receivers (all TSO-C145/C146/ETSO-C145/C146 systems), operators shall take into account the latest GPS constellation and SBAS NOTAMs issued by the CAA or ANSP. If the NOTAMs indicate the SBAS signal is not available over the intended flight route, operators should check appropriate GPS RAIM availability.	Paragraph 10.6 a) 11)			
2	<b>Prior to commencing the procedure</b>	Paragraph 10.6 b)			
	<p>In addition to normal procedures, prior to commencing the approach (before the initial approach fix (IAF)), the flight crew must verify the correct procedure has been loaded, by comparing said procedure with the approach charts. This check must include:</p> <p>a) the WPT sequence;</p> <p>b) the integrity of the tracks and distances of the approach legs, the accuracy of the inbound course and the length of the final approach segment.</p> <p><b>Note.-</b> As a minimum, this check could be a simple inspection of a map display that</p>	Paragraph 10.6 b) 1)			



Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	<i>permits the achievement of the objectives of this paragraph.</i>				
	The flight crew must also check from the publish charts, map display or control display unit (CDU), which WPT are fly-by and which are flyover.	Paragraph 10.6 b) 2)			
	For multi-sensor systems, the flight crew must verify during the approach that GNSS sensor is used for position computation.	Paragraph 10.6 b) 3)			
	For a RNP system with aircraft-based augmentation system (ABAS) requiring barometric corrected altitude, the current aerodrome barometric altimeter setting, must be set at the appropriate time and location, consistent with the performance of the flight operation.	Paragraph 10.6 b) 4)			
	When the operation is based on ABAS availability, the flight crew must perform a new RAIM availability check if the estimated time of arrival (ETA) is more than 15 minutes different from the ETA used during the flight planning. This check is also processed automatically 2 NM before the final approach fix (FAF) for a TSO-C129a/ ETSO-C129a Class A1 receiver.	Paragraph 10.6 b) 5)			
	<p>In the terminal area, ATC tactical interventions may include radar headings, "direct to" clearances which by-pass the initial approach legs, interception of an initial or intermediate approach segment, or the insertion of WPT loaded from the database. In complying with ATC instructions, the flight crew must be aware of the implications for the RNP system.</p> <p>a) The manual entry of coordinates into the RNP system by the flight crew for operations within the terminal area is not permitted.</p> <p>b) "Direct to" clearances may be accepted up to the intermediate fix (IF), provided that the resulting track change at the IF does not</p>	Paragraph 10.6 b) 6)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	exceed 45°. <i>Note.- "Direct to" clearance to the FAF is not acceptable.</i>				
	The lateral definition of the flight path between the FAF and the missed approach point (MAPt) must not be revised by the flight crew under no circumstances.	Paragraph 10.6 b) 7)			
3	<b>During the procedure</b>	Paragraph 10.6 c)			
	Pilots must comply with the instructions or procedures identified by the operator, as necessary, to meet the performance requirements of this AC.	Paragraph 10.6 c) 1)			
	Before starting the descent, the aircraft must be established on the final approach course no later than the FAF to ensure obstacle and terrain clearance.	Paragraph 10.6 c) 2)			
	Pilots must check that the navigation system is in approach mode within 2 NM prior to the FAF. <i>Note.- This check does not apply for certain RNP systems (e.g., for aircraft that have been approved with a demonstrated RNP capability). For such systems, other means are available, including electronic map display, flight guidance mode indications, etc., which clearly indicate to the flight crew that the approach mode is activated.</i>	Paragraph 10.6 c) 3)			
	The appropriate displays must be selected so that the following information can be monitored by the flight crew: a) the RNP computed desired track (DTK); and b) the aircraft position relative to the path cross track deviation (XTK) for the flight technical error (FTE) monitoring.	Paragraph 10.6 c) 4)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	<p>A RNP APCH procedure must be discontinued:</p> <ul style="list-style-type: none"> <li>a) if the navigation display is announcing a failure (flagged invalid); or</li> <li>b) in case of loss of the integrity alerting function; or</li> <li>c) if the integrity alerting function is annunciated not available before passing the FAF; or</li> <li>d) if the FTE is excessive.</li> </ul>	Paragraph 10.6 c) 5)			
	<p>A missed approach must be flown in accordance with the published procedure. Use of the RNP system during the missed approach is acceptable, provided:</p> <ul style="list-style-type: none"> <li>a) the RNP system is operational (e.g., there is no loss of function, no NSE alert, no failure indication, etc.).</li> <li>b) the whole procedure (including the missed approach) is loaded from the navigation data base.</li> </ul>	Paragraph 10.6 c) 6)			
	<p>During the RNP APCH procedure, pilots must use a lateral deviation indicator, FD and/or AP in the lateral navigation mode. Pilots of aircraft with lateral deviation indicator (e.g., CDI) must ensure that lateral deviation indicator scaling (full-scale deflection) is suitable for the navigation accuracy associated with the different procedure segments (e.g., <math>\pm 1.0</math> NM for the initial, intermediate, and missed approach segments, and <math>\pm 0.3</math> NM for the final approach segment).</p>	Paragraph 10.6 c) 7)			
	<p>All pilots are expected to maintain procedure centrelines, as depicted by onboard lateral deviation indicators and/or flight guidance during all the approach procedure unless authorized to deviate by ATC or in emergency conditions.</p>	Paragraph 10.6 c) 8)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	For normal operations, the cross-track error/deviation (the difference between the RNP system computed path and the aircraft position relative to the path) must be limited to $\pm \frac{1}{2}$ of the navigation accuracy associated with the procedure (e.g., 0.5 NM for the initial, intermediate and missed approach segments and 0.15 NM for the final approach segment). Brief deviations from this standard (e.g., overshoots or undershoots) during and immediately after turns, up to a maximum of one (1) times the navigation accuracy (e.g., 1.0 NM for the initial and intermediate segments), are allowable.	Paragraph 10.6 c) 9)			
	When baro-VNAV is used for vertical path guidance during the final approach segment, deviations above and below the baro-VNAV path must not respectively exceed + 100/-50 ft.	Paragraph 10.6 c) 10)			
	Pilots must execute a missed approach if the lateral or vertical deviations exceed the criteria of the previous paragraph, unless the pilot has in sight the visual references required to continue the approach.	Paragraph 10.6 c) 11)			
	For aircraft requiring two pilots, the flight crew must verify that each pilot's altimeter has the current setting before beginning the final approach of a RNP APCH approach procedure. The flight crew must also observe any operational limitations associated with altimeter setting sources and the latency of checking and setting the altimeters when approaching the FAF.	Paragraph 10.6 c) 12)			
	Although the scale should change automatically, the pilots of an aircraft with lateral deviation indicator (e.g., CDI) must make sure that the scale of the lateral deviation indicator (maximum deflection) is consistent with the different segments of the procedure (e.g., $\pm 1.0$ NM for the initial, intermediate, and missed approach segments, and $\pm 0.3$	Paragraph 10.6 c) 13)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	NM for the final approach segment).				
	RNP APCH procedures require flight crew monitoring of lateral and, if installed, vertical track deviations on the pilot's primary flight displays (PFD) to ensure the aircraft remains within the bounds defined by the procedure.	Paragraph 10.6 c) 14)			
4	<b>Contingency procedures</b>	Paragraph 10.7			
	The pilots must notify ATC of any loss of the RNP APCH capability, together with the proposed course of action.	Paragraph 10.7 a)			
	If the pilots cannot meet the requirements of a RNP APCH procedure, they must notify the air traffic service (ATS) as soon as possible.	Paragraph 10.7 b)			
	The loss of RNP APCH capability includes any failure or event causing the aircraft to no longer satisfy the RNP APCH requirements of the procedure.	Paragraph 10.7 c)			
	The operators must develop contingency procedures in order to react safely following the loss of the RNP APCH capability during the approach.	Paragraph 10.7 d)			
	In the event of communication failure, the flight crew must continue with the RNP APCH procedure in accordance with the published lost communication procedure.	Paragraph 10.7 e)			
	The operator's contingency procedures must address at least the following conditions: a) failure of the RNP system components, including those affecting lateral or vertical deviation performances (e.g., failures of a GPS	Paragraph 10.7 f)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	sensor, FD or AP); and b) loss of navigation signal-in-space (loss or degradation of the external signal).				
	The pilot must ensure the capability to navigate and land at an alternate aerodrome if loss of RNP APCH capacity occurs.	Paragraph 10.7 g)			

## SRVSOP contacts:

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Version:  
Date:

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## RNP APCH JOB AID

### APPLICATION TO CONDUCT RNP APCH OPERATIONS

#### 1. Introduction

This Job Aid was developed by the Latin American Regional Safety Oversight Cooperation System (SRVSOP) to provide States, operators, and inspectors with guidance on the process to be followed by an applicant in order to obtain an RNP APCH approval.

#### 2. Purpose of the Job Aid

- 2.1 To give operators and inspectors information on the main RNP APCH reference documents.
- 2.2 To provide tables showing the contents of the application, the associated reference paragraphs, the place in the application of the operator where RNP APCH elements are mentioned and columns for inspector comments and follow-up on the status of various elements of RNP APCH.

#### 3. Actions Recommended for the Inspector and Operator

Some recommendations for use of the Job Aid follow:

- 3.1 At the pre-application meeting with the operator, the inspector reviews the “basic events of the RNP APCH approval process” described in Part 1 of this Job Aid, in order to provide an overview of the approval process events.
- 3.2 The inspector reviews this Job Aid with the operator in order to establish the form and content of the RNP APCH approval application.
- 3.3 The operator uses this Job Aid as a guide to collect the documents/RNP APCH Job Aides of the RNP APCH application.
- 3.4 The operator inserts in the Job Aid references showing in what part of its documents are the RNP APCH programme elements located.
- 3.5 The operator submits the Job Aid and the application to the inspector (documents/Annexes).
- 3.6 The inspector indicates in the Job Aid whether an item is in compliance or needs corrective action.
- 3.7 The inspector informs the operator as soon as possible when a corrective action by the operator is required.
- 3.8 The operator provides the inspector with the revised material when so requested.
- 3.9 The CAA provides the operator with the operational specifications (OpSpecs) or a letter of authorisation (LOA), as applicable, when the tasks and documents have been completed.

#### 4. Structure of the Job Aid

Parts	Topics	Page
Part 1	General information	3
Part 2	Information on aircraft and operator identification	5
Part 3	Operatr application (Annexes and documents)	7
Part 4	Contents of the application for RNP APCH	9
Part 5	Guide to determine the eligibility of RNP APCH aircraft	13
Part 6	Basic pilot procedures for RNP APCH operations	15

#### 5. Main Sources of Documents, Information, and Contacts

To access the RNP APCH, enter to the Web page of the ICAO/SAM Regional Office ([www.lima.icao.int](http://www.lima.icao.int)) under the SRVSOP link.

#### 6. Main Reference Documents

Documentos de referencia	Títulos
Annex 6	Operation of aircraft
ICAO Doc 9613	Performance-based navigation (PBN) manual
FAA AC 90-105 Appendix 1	Qualification criteria for RNP approach operations
EASA AMC 20-27	Airworthiness approval and operational criteria for RNP APPROACH (RNP APCH) operations including APV BARO-VNAV operations
FAA AC 20-130A	Airworthiness approval of navigation or flight management systems integrating multiple navigation sensors
FAA AC 20-138A	Airworthiness approval of Global navigation satellite system (GNSS) equipment
TSO-C115b	Airborne area navigation equipment using multi-sensor inputs
TSO-C129a	Airborne supplemental navigation equipment using the global positioning system (GPS)
TSO-C145a	Airborne navigation sensors using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)
TSO-C146a	Stand-Alone airborne navigation equipment using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)

### PART 1: GENERAL INFORMATION



**Basic events of the RNP APCH approval process**

	<b>Action by the operator</b>	<b>Action by the CAA</b>
1	Establish the need to obtain approval for RNP APCH operations.	
2	Review the AFM, AFM supplement or Type Certificate Data Sheet (TCDS), or other appropriate documents (e.g., service bulletins (SB), service letters (SL), etc.) to determine the eligibility of the aircraft for RNP APCH operations. The operator contacts the aircraft or avionics manufacturer, if necessary, to confirm RNP APCH eligibility of the aircraft.	
3	Contact the CAA to schedule a pre-application meeting to discuss the operational approval requirements.	
4		During the pre-application meeting, establish: <ul style="list-style-type: none"> <li>• the form and contents of the application;</li> <li>• the documents that support RNP APCH approval</li> <li>• the date in which the application will be submitted for evaluation</li> <li>• if necessary, conduct a validation flight observed by the CAA</li> </ul>
5	Submits the application at least 60 days in advance of the planned start of RNP APCH operations.	
6		Reviews operator submissions
7	Once the amendments to manuals, programmes, and documents have been approved or accepted, provide training to flight crews, flight dispatchers, and maintenance personnel, and conduct a validation flight, if required by the CAA.	Only if required, participate in the validation flight.
8		Once the operational and airworthiness requirements have been met, issue the operational approval in the form of OpSpecs for LAR 121 or 135 or equivalents, or an LOA for LAR 91 or equivalents, as appropriate.

**Notes related to the approval process****1. Responsible authority**

- a. **Commercial air transport (LAR 121 and/or 135 regulations or equivalent).**- The **State of registry** determines that the aircraft meets the airworthiness requirements. The **State of the operator** issues the RNP APCH approval (e.g., OpSpecs).
- b. **General Aviation (LAR 91 regulations or equivalent).**- The **State of registry** determines that the aircraft meets airworthiness requirements and issues the operational approval (e.g., an LOA).

2. The CAA does not need to issue an LOA or equivalent document for each individual area of operation in the case of LAR 91 operators.

3. LAR 121 and/or 135 operators with RNP APCH approval must list this approval in the OpSpecs.

4. Related sections of the Latin American Aeronautical Regulations (LAR) or equivalent regulations

- a. LAR 91        Sections 91.1015 and 91.1640 or equivalent
- b. LAR 121     Section 121.995 (b) or equivalent
- c. LAR 135     Section 135.565 (c) or equivalent

5. Related ICAO Documents

- a. Annex 6 to the Convention on International Civil Aviation – Operation of aircraft
- b. Annex 10 to the Convention on International Civil Aviation – Aeronautical telecommunications
- c. Annex 15 to the Convention on International Civil Aviation – Aeronautical information services
- d. ICAO Doc 9613 – Manual on performance-based navigation (PBN)
- e. ICAO Doc 9905 - Required navigation performance authorization required (RNP AR) procedure design manual (final draft)
- f. ICAO Doc 4444 – Procedures for air navigation services – Air traffic management

**PART 2: INFORMATION ON THE IDENTIFICATION OF AIRCRAFT AND OPERATORS**

NAME OF THE OPERATOR: \_\_\_\_\_

Aircraft manufacturer, model and series	Registration numbers	Serial numbers	RNP APCH system Number, manufacturer, and model	RNP specification

DATE OF PRE-APPLICATION MEETING \_\_\_\_\_

DATE ON WHICH THE APPLICATION WAS RECEIVED \_\_\_\_\_

DATE ON WHICH THE OPERATOR INTENDS TO BEGIN RNP APCH OPERATIONS \_\_\_\_\_

IS THE CAA NOTIFICATION DATE APPROPRIATE? YES \_\_\_\_\_ NO \_\_\_\_\_

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**PART 3 – OPERATOR APPLICATION (ANNEXES AND DOCUMENTS)**

Annex	Title of Annex/document	Indication of inclusion by the operator	Comments by the Inspector
A	<b>Application for RNP APCH approval</b>		
B	<b>Airworthiness documents showing aircraft eligibility for RNP APCH.</b> AFM, AFM revision, AFM supplement, or Type certificate data sheet (TCDS) showing that the RNP navigation system is eligible for RNP APCH.  Manufacturer statement.- Aircraft with a manufacturer statement documenting compliance with SRVSOP CA 91-008 criteria or equivalent, meet the performance and functional requirements of said document.		
C	<b>Aircraft modified to meet RNP APCH standards. Documentation on aircraft inspection and/or modification, if applicable.</b> Maintenance records documenting the installation or modification of aircraft systems (e.g., FAA Form 337 – major repairs and alterations).		
D	<b>Maintenance programme</b> <ul style="list-style-type: none"> <li>For aircraft with established maintenance practices for RNP APCH systems, the list of references of the document or programme.</li> <li>For recently installed RNP APCH systems, the maintenance procedures for their review.</li> </ul>		
E	<b>Minimum equipment list (MEL) (only for operators conducting operations based on a MEL):</b> MEL showing provisions for RNP APCH systems.		
F	<b>Training</b> <ol style="list-style-type: none"> <li><b>LAR 91 operators or equivalent: Training methods:</b> Training at home, LAR 142 training centres, or other training courses, course completion records.</li> <li><b>LAR 121 and/or 135 operators or equivalent:</b> Training programmes (training curricula) for flight crews, flight dispatchers, and maintenance personnel.</li> </ol>		

Annex	Title of Annex/document	Indication of inclusion by the operator	Comments by the Inspector
G	<b>Operating policies and procedures</b> <b>1. LAR 91 operators or equivalent:</b> Operations manual (OM) or sections to be attached to the application, corresponding to RNP APCH operating procedures and policies. <b>2. LAR 121 and/or 135 operators or equivalent:</b> Operations manual and checklists.		
H	<b>Navigation database</b> Details of the navigation database validation programme		
I	<b>Withdrawal of RNP APCH approval</b> Indication of the need to follow up on navigation error reports submitted and the possibility of withdrawal of RNP APCH approval.		
J	<b>Validation flight plan</b> Only if required by the CAA.		

#### CONTENTS OF THE APPLICATION TO BE SUBMITTED BY THE OPERATOR

\_\_\_\_\_ **DOCUMENTATION SHOWING RNP APCH COMPLIANCE OF THE AIRCRAFT/NAVIGATION SYSTEMS**

\_\_\_\_\_ **OPERATING PROCEDURES AND POLICIES**

\_\_\_\_\_ **SECTIONS OF THE MAINTENANCE MANUAL RELATED TO THE RNP APCH SYSTEM (if not previously reviewed)**

**Note 1:** Documents may be grouped in a single folder or may be sent as individual documents.

#### PART 4: CONTENTS OF THE OPERATOR APPLICATION FOR RNP APCH OPERATIONS

#	Contents of the RNP APCH application by the operator	Reference paragraphs CA 91-009	In what Annexes/Documents of the operator can the application contents be located	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>Operator application letter</b> Application letter for obtaining RNP APCH approval.	Paragraph 10.1 b) 1) Appendix 2, Paragraph e)	Annex A		
2	<b>Type of aircraft and description of aircraft equipment</b> A configuration list with details of the relevant components and the equipment to be used in the operation. The list shall include each manufacturer, model and version of the equipment and software of the installed FMS.	Paragraph 10.1 b) 1) Paragraph 10.2			
3	<b>Aircraft and navigation system eligibility and qualification for RNP APCH</b> Airworthiness documents which establish aircraft an navigation system eligibility for RNP APCH operations, their approval status and a list with the aircraft for which the approval is requested.	Paragraph 10.1 b) 2) Paragraphs 9.2 , 9.4 and 10.3	Annex B Annex C		
4	<b>Training programmes</b> a) <b>LAR 121 or 135 operators or equivalent: Training programmes:</b> Operators will develop an initial and periodic training programme for flight crews, flight dispatchers and maintenance personnel. b) <b>LAR 91 operators or equivalent: Training methods:</b> The following methods are acceptable for these operators: Training at home, LAR 142 training centres, or other training courses.	Paragraph 10.1 b) 6) Paragraphs 10.8 For maintainace Paragraph 10.1 b( 7)	Annex F		

#	Contents of the RNP APCH application by the operator	Reference paragraphs CA 91-009	In what Annexes/Documents of the operator can the application contents be located	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
5	<b>Operations Manual (OM) and checklists</b> a) <b>LAR 121 and/or 135 operators or equivalent:</b> Operations manual and checklists. b) <b>LAR 91 operators or equivalent:</b> Operations manual or section of the operator application documenting RNP APCH policies and procedures.	Paragraph 10.1 b) 4) and 8) Paragraphs 10.6 and 10.7			
6	<b>Maintenance procedures</b> <ul style="list-style-type: none"> <li>For aircraft with established maintenance practices for RNP APCH navigation systems, the operator will provide document references.</li> <li>For newly installed RNP APCH systems, the operator will provide maintenance practices for review.</li> </ul>	Paragraph 10.1 b) 9)	Annex D		
7	<b>Minimum equipment list (MEL)</b> The operator will submit any revision to the MEL, necessary to carry out RNP APCH operations.	Paragraph 10.1 b) 10)	Annex E		
8	<b>Navigation data validation programme</b> Details of the navigation data validation programme.	Paragraph 10.1 b) 5)	Annex F		
9	<b>Withdrawal of RNP APCH operation authorization</b> Indication of the need for follow-up on the navigation error reports and the potential of withdrawal of the RNP APCH approval.				
10	<b>Validation test plan, only if required</b>	Appendix 7,	Annex I		



#	Contents of the RNP APCH application by the operator	Reference paragraphs CA 91-009	In what Annexes/Documents of the operator can the application contents be located	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	The validation flight plan will be presented only if required	paragraph b) 14)			

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**PART 5 – GUIDE TO DETERMINE THE ELIGIBILITY OF RNP APCH AIRCRAFT**

#	Topics	Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	Aircraft and system requirements	Paragraph 9.2	Annex B		

#	Topics	Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	a) Aircraft approved to conduct RNAV <sub>(GNSS)</sub> or GNSS approaches.	Paragraph 9.2 a)			
	b) Aircraft that have a statement of compliance with respect to the criteria contained in the AC 91-008 or equivalent document in their flight manual (AFM), AFM supplement, pilot operations handbook (POH), or in the avionics operating manual.	Paragraph 9.2 b)	Annex B		
	c) Aircraft that have a statement from the manufacturer documenting compliance with the criteria of the AC 91-008 or equivalent document.	Paragraph 9.2c)	Annex B		
	d) RNP installation based on GNSS stand-alone system	Paragraph 9.2 d)			
	e) RNP installation is based on GNSS sensor equipment used in a multi-sensor system	Paragraph 9.2 e)			
	f) Multi-sensor systems using GNSS	Paragraph 9.2 f)			
2	<b>Eligibility for RNP APCH operations</b>	Paragraph 9.4 b)			
	a) Systems that meet the requirements of Paragraph 1 above are eligible for RNP APCH operations	Paragraph 9.4 b)			
	b) Aircraft qualified in accordance with SRVSOP AC 91-009 or equivalent, e.g., FAA AC 90-101 or EASA AMC 20-26 are	Paragraph 9.4 b)			

#	Topics	Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	considered qualified for RNP APCH operations without further examination.				
3	<b>System eligibility for RNP APCH operations</b>	Paragraph 9.4 c)			
	a) LNAV Line of minima qualification	Paragraph 9.4 c) 1)			
	1) Stand-alone systems	Paragraph 9.4 c) 1) (a)			
	2) Multi-sensor systems	Paragraph 9.4 c) 1) (b)			
	b) LNAV/VNAV Line of minima qualification	Paragraph 9.4 c) 2)			
	1) Stand-alone systems	Paragraph 9.4 c) 2) (a)			
	2) Multi-sensor systems	Paragraph 9.4 c) 2) (b)			
4	<b>Modified aircraft</b>	Paragraph 9.5	Annex B		
5	<b>Performance and functional requirements for RNP APCH systems</b>	Paragraph 9.3			
5	<b>Navigation database</b> Details of the navigation data validation programme.	Paragraph 10.9 Appendix 1	Annex B		

**PART 6 - BASIC PILOT PROCEDURES FOR RNP APCH OPERATIONS**

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
Operating procedures		Paragraph 10.6	Annex G		
1	Pre-flight planning	Paragraph 10.6 a)			
	Operators and pilots planning to conduct RNP APCH operations must file the appropriate flight plan suffixes.	Paragraph 10.6 a) 1)			
	At system initialization, pilots must confirm the navigation database is current and includes appropriate procedures. Likewise, pilots must also verify that the aircraft position is correct.  <i><b>Note.-</b> Navigation databases are expected to be current for the duration of the flight. If the AIRAC cycle changes during the flight (becomes due), the operators and pilots shall establish procedures to ensure the precision of navigation data, including the capacity of navigation facilities to define routes and flight procedures. Traditionally, this has been done by comparing electronic data with printed documents. An acceptable method is to compare aeronautical charts (new and old) in order to verify navigation fixes before dispatch. If an amended letter for the procedure is published, the database must not be used for conducting the operation.</i>	Paragraph 10.6 a) 2)			
	Pilots must verify the proper entry of their ATC assigned route once they have received the initial clearance and following any subsequent changes of the route. Likewise, pilots must ensure the WPT sequence depicted by their navigation system matches their assigned route and the route depicted on the appropriate charts.  <i><b>Note.-</b> Pilots may notice a slight difference between the navigation information portrayed on the chart and the heading shown on the primary navigation display. A difference of 3 degrees or less may be due to a magnetic variation applied by the equipment manufacturer and may be operationally acceptable.</i>  <i><b>Note.-</b> Manual selection of functions that limit the aircraft bank angle can reduce the aircraft's ability to maintain the desired track and is not recommended.</i>	Paragraph 10.6 a) 3)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	The aircraft RNP capability depends on the aircraft operational equipment. The flight crew must be able to assess the impact of equipment failure on the anticipated RNP APCH operation and take appropriate action. When a flight dispatch is predicated on flying an RNP APCH procedure that requires the use of the AP or FD at the destination and/or alternate aerodrome, the operator must determine that the AP and/or FD are installed and operational.	Paragraph 10.6 a) 4)			
	<p>Pilots must ensure that the approaches which may be used for the intended flight (including the approaches in alternates aerodromes):</p> <ul style="list-style-type: none"> <li>a) can be selected from a valid navigation data base (current AIRAC cycle);</li> <li>b) have been verified through an appropriate process (navigation database integrity process); and</li> <li>c) have not been prohibited by any NOTAM issued by the CAA or by the air navigation service providers or by an operational instruction of the company.</li> </ul>	Paragraph 10.6 a) 5)			
	Pilots must ensure that there are sufficient means available to fly and land at the destination or alternate aerodrome in case of loss of RNP APCH capability.	Paragraph 10.6 a) 6)			
	Operators and flight crews must take account of any NOTAM issued by the CAA or by the ANSP, or by an operational instruction of the company that might adversely affect aircraft system operation or the availability or suitability of the procedures at the destination aerodrome or at any alternate aerodromes.	Paragraph 10.6 a) 7)			
	For missed approach procedures based on conventional NAVAIDs	Paragraph 10.6 a) 8)			

Topics	Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
(VOR, NDB), pilots must verify that the appropriate airborne equipment required to fly such procedures is installed and operational in the aircraft. Likewise, they must verify that the associated ground based NAVAIDs are operational.				
The availability of the NAVAID infrastructure, required for the intended routes and RNP APCH operations, including any non-RNP contingency, must be confirmed for the period of intended operations, using all available information. Since GNSS integrity (receiver autonomous integrity monitoring (RAIM) or satellite-based augmentation system (SBAS) signal) is required by Annex 10, the availability of such signals must also be determined as appropriate. For aircraft navigating with SBAS receivers (all TSO-C145()/C146()/ETSO-C145()/C146()), operators must check appropriate GPS RAIM availability in areas where SBAS signal is unavailable.	Paragraph 10.6 a) 9)			
<p>RAIM prediction must be performed prior to departure.</p> <p>a) The predictive capability must account for known and predicted outages of GPS satellites or other impacts on the navigation system's sensors. The prediction programme should not use a mask angle below 5 degrees, as operational experience indicates that satellite signals at low elevations are not reliable. RAIM availability prediction should take into account the latest GPS constellation notices to airmen (NOTAMs) issued by the CAA or by the ANSP, and use the identical algorithm to that used in the airborne equipment, or an algorithm based on assumptions for RAIM prediction that give a more conservative result. The service may be provide by the ANSP, avionics manufacturer, other entities or through an airborne receiver RAIM prediction capability. RAIM availability may be confirmed by using a model-specific RAIM prediction software.</p>	Paragraph 10.6 a) 10)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	<p>b) The RAIM availability prediction software does not guarantee the service. The software is rather a tool to assess the expected capability to meet the required navigation performance. Because of unplanned failures of some GPS elements, pilots must realize that RAIM or GPS navigation may be lost while in flight which may require reversion to an alternative means of navigation. Therefore, pilots must assess their capability to navigate to an alternate aerodrome in case of failure of GPS navigation.</p> <p>c) In the event of a predicted, continuous loss of RAIM of more than 5 minutes for any part of the intended RNP APCH operation, the flight should be delayed, canceled, or re-routed where RAIM requirements can be met.</p>				
	For aircraft navigating with SBAS receivers (all TSO-C145/C146/ETSO-C145/C146 systems), operators shall take into account the latest GPS constellation and SBAS NOTAMs issued by the CAA or ANSP. If the NOTAMs indicate the SBAS signal is not available over the intended flight route, operators should check appropriate GPS RAIM availability.	Paragraph 10.6 a) 11)			
2	<b>Prior to commencing the procedure</b>	Paragraph 10.6 b)			
	<p>In addition to normal procedures, prior to commencing the approach (before the initial approach fix (IAF)), the flight crew must verify the correct procedure has been loaded, by comparing said procedure with the approach charts. This check must include:</p> <p>a) the WPT sequence;</p> <p>b) the integrity of the tracks and distances of the approach legs, the accuracy of the inbound course and the length of the final approach segment.</p> <p><b>Note.-</b> As a minimum, this check could be a simple inspection of a map display that</p>	Paragraph 10.6 b) 1)			



Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	<i>permits the achievement of the objectives of this paragraph.</i>				
	The flight crew must also check from the publish charts, map display or control display unit (CDU), which WPT are fly-by and which are flyover.	Paragraph 10.6 b) 2)			
	For multi-sensor systems, the flight crew must verify during the approach that GNSS sensor is used for position computation.	Paragraph 10.6 b) 3)			
	For a RNP system with aircraft-based augmentation system (ABAS) requiring barometric corrected altitude, the current aerodrome barometric altimeter setting, must be set at the appropriate time and location, consistent with the performance of the flight operation.	Paragraph 10.6 b) 4)			
	When the operation is based on ABAS availability, the flight crew must perform a new RAIM availability check if the estimated time of arrival (ETA) is more than 15 minutes different from the ETA used during the flight planning. This check is also processed automatically 2 NM before the final approach fix (FAF) for a TSO-C129a/ ETSO-C129a Class A1 receiver.	Paragraph 10.6 b) 5)			
	<p>In the terminal area, ATC tactical interventions may include radar headings, "direct to" clearances which by-pass the initial approach legs, interception of an initial or intermediate approach segment, or the insertion of WPT loaded from the database. In complying with ATC instructions, the flight crew must be aware of the implications for the RNP system.</p> <p>a) The manual entry of coordinates into the RNP system by the flight crew for operations within the terminal area is not permitted.</p> <p>b) "Direct to" clearances may be accepted up to the intermediate fix (IF), provided that the resulting track change at the IF does not</p>	Paragraph 10.6 b) 6)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	exceed 45°. <i>Note.- "Direct to" clearance to the FAF is not acceptable.</i>				
	The lateral definition of the flight path between the FAF and the missed approach point (MAPt) must not be revised by the flight crew under no circumstances.	Paragraph 10.6 b) 7)			
3	<b>During the procedure</b>	Paragraph 10.6 c)			
	Pilots must comply with the instructions or procedures identified by the operator, as necessary, to meet the performance requirements of this AC.	Paragraph 10.6 c) 1)			
	Before starting the descent, the aircraft must be established on the final approach course no later than the FAF to ensure obstacle and terrain clearance.	Paragraph 10.6 c) 2)			
	Pilots must check that the navigation system is in approach mode within 2 NM prior to the FAF. <i>Note.- This check does not apply for certain RNP systems (e.g., for aircraft that have been approved with a demonstrated RNP capability). For such systems, other means are available, including electronic map display, flight guidance mode indications, etc., which clearly indicate to the flight crew that the approach mode is activated.</i>	Paragraph 10.6 c) 3)			
	The appropriate displays must be selected so that the following information can be monitored by the flight crew: a) the RNP computed desired track (DTK); and b) the aircraft position relative to the path cross track deviation (XTK) for the flight technical error (FTE) monitoring.	Paragraph 10.6 c) 4)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	A RNP APCH procedure must be discontinued: a) if the navigation display is announcing a failure (flagged invalid); or b) in case of loss of the integrity alerting function; or c) if the integrity alerting function is annunciated not available before passing the FAF; or d) if the FTE is excessive.	Paragraph 10.6 c) 5)			
	A missed approach must be flown in accordance with the published procedure. Use of the RNP system during the missed approach is acceptable, provided: a) the RNP system is operational (e.g., there is no loss of function, no NSE alert, no failure indication, etc.). b) the whole procedure (including the missed approach) is loaded from the navigation data base.	Paragraph 10.6 c) 6)			
	During the RNP APCH procedure, pilots must use a lateral deviation indicator, FD and/or AP in the lateral navigation mode. Pilots of aircraft with lateral deviation indicator (e.g., CDI) must ensure that lateral deviation indicator scaling (full-scale deflection) is suitable for the navigation accuracy associated with the different procedure segments (e.g., $\pm 1.0$ NM for the initial, intermediate, and missed approach segments, and $\pm 0.3$ NM for the final approach segment).	Paragraph 10.6 c) 7)			
	All pilots are expected to maintain procedure centrelines, as depicted by onboard lateral deviation indicators and/or flight guidance during all the approach procedure unless authorized to deviate by ATC or in emergency conditions.	Paragraph 10.6 c) 8)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	For normal operations, the cross-track error/deviation (the difference between the RNP system computed path and the aircraft position relative to the path) must be limited to $\pm \frac{1}{2}$ of the navigation accuracy associated with the procedure (e.g., 0.5 NM for the initial, intermediate and missed approach segments and 0.15 NM for the final approach segment). Brief deviations from this standard (e.g., overshoots or undershoots) during and immediately after turns, up to a maximum of one (1) times the navigation accuracy (e.g., 1.0 NM for the initial and intermediate segments), are allowable.	Paragraph 10.6 c) 9)			
	When baro-VNAV is used for vertical path guidance during the final approach segment, deviations above and below the baro-VNAV path must not respectively exceed + 100/-50 ft.	Paragraph 10.6 c) 10)			
	Pilots must execute a missed approach if the lateral or vertical deviations exceed the criteria of the previous paragraph, unless the pilot has in sight the visual references required to continue the approach.	Paragraph 10.6 c) 11)			
	For aircraft requiring two pilots, the flight crew must verify that each pilot's altimeter has the current setting before beginning the final approach of a RNP APCH approach procedure. The flight crew must also observe any operational limitations associated with altimeter setting sources and the latency of checking and setting the altimeters when approaching the FAF.	Paragraph 10.6 c) 12)			
	Although the scale should change automatically, the pilots of an aircraft with lateral deviation indicator (e.g., CDI) must make sure that the scale of the lateral deviation indicator (maximum deflection) is consistent with the different segments of the procedure (e.g., $\pm 1.0$ NM for the initial, intermediate, and missed approach segments, and $\pm 0.3$	Paragraph 10.6 c) 13)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	NM for the final approach segment).				
	RNP APCH procedures require flight crew monitoring of lateral and, if installed, vertical track deviations on the pilot's primary flight displays (PFD) to ensure the aircraft remains within the bounds defined by the procedure.	Paragraph 10.6 c) 14)			
4	<b>Contingency procedures</b>	Paragraph 10.7			
	The pilots must notify ATC of any loss of the RNP APCH capability, together with the proposed course of action.	Paragraph 10.7 a)			
	If the pilots cannot meet the requirements of a RNP APCH procedure, they must notify the air traffic service (ATS) as soon as possible.	Paragraph 10.7 b)			
	The loss of RNP APCH capability includes any failure or event causing the aircraft to no longer satisfy the RNP APCH requirements of the procedure.	Paragraph 10.7 c)			
	The operators must develop contingency procedures in order to react safely following the loss of the RNP APCH capability during the approach.	Paragraph 10.7 d)			
	In the event of communication failure, the flight crew must continue with the RNP APCH procedure in accordance with the published lost communication procedure.	Paragraph 10.7 e)			
	The operator's contingency procedures must address at least the following conditions: a) failure of the RNP system components, including those affecting lateral or vertical deviation performances (e.g., failures of a GPS	Paragraph 10.7 f)			

Topics		Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	sensor, FD or AP); and b) loss of navigation signal-in-space (loss or degradation of the external signal).				
	The pilot must ensure the capability to navigate and land at an alternate aerodrome if loss of RNP APCH capacity occurs.	Paragraph 10.7 g)			

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**APPENDIX F-1**

**ADVISORY CIRCULAR**

AC	:	91-009
DATE	:	12/10/09
REVISION	:	1
ISSUED BY	:	SRVSOP

**SUBJECT: AIRCRAFT AND OPERATORS APPROVAL FOR RNP AUTHORIZATION  
REQUIRED APPROACH (RNP AR APCH) OPERATIONS**

## ADVISORY CIRCULAR

AC : 91-009  
DATE : 12/10/09  
REVISION : 1  
ISSUED BY : SRVSOP

### **SUBJECT: AIRCRAFT AND OPERATORS APPROVAL FOR RNP AUTHORIZATION REQUIRED APPROACH (RNP AR APCH) OPERATIONS**

#### **1. PURPOSE**

This advisory circular (AC) provides acceptable means of compliance (AMC) concerning aircraft and operators approval for RNP authorization required approach (RNP AR APCH) operations.

An operator may use other means of compliance, provided they are acceptable for the civil aviation administration (CAA).

Use of the future tense of the verb or use of the term “must” applies to an applicant or operator that chooses to meet the criteria established in this AC.

#### **2. RELATED SECTIONS OF THE LATIN AMERICAN AERONAUTICAL REGULATIONS (LARs) OR EQUIVALENT**

LAR 91: Sections 91.1015 and 91.1640 or equivalents

LAR 121: Section 121.995 (b) or equivalent

LAR 135: Section 135.565 (c) or equivalent

#### **3. RELATED DOCUMENTS**

Annex 6 Aircraft Operations

Annex 10 Aeronautical Telecommunications

Volume I: Radio Navigation Aids

Doc 9613 Performance-based Navigation Manual (PBN)

Doc 9905 Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual (final draft)

Doc 8168 Aircraft Operations

Volume I: Flight Procedures

Volume II: Construction of Visual and Instrument Flight Procedures

AMC 20-26 Airworthiness Approval and Operational Criteria for RNP Authorization Required (RNP AR) Operations

FAA AC 90-101 Approval Guidance for RNP Procedures with SAAAR

IFFP/2 WP/5 Instrument flight procedure panel (IFPP) – PBN working group meeting - Working paper 5: Flight operational safety assessment (FOSA) prepared by Dave Nakamura.

#### **4. DEFINITIONS AND ABBREVIATIONS**



#### 4.1 Definitions

- a) **Area navigation (RNAV).**- Navigation method that permits aircraft operations in any desired flight path within the coverage of ground-based or space-based navigation aids, or within the capability limits of autonomous aids, or through a combination of the two.  
  
Area navigation includes performance-based navigation as well as other operations not contemplated in the performance-based navigation definition.
- b) **Authorization required (AR).**- Specific authorization required by the CAA for an operator to be able to conduct RNP approach operations that need mandatory authorization (RNP AR APCH).
- c) **Barometric vertical navigation (baro-VNAV).**- A function of some RNAV systems that displays an estimated vertical guide to the pilot, referred to as a specific vertical path. The estimated vertical guide is based on barometric altitude information and is commonly estimated as a geometric path between two waypoints or as an angle based on a single waypoint.
- d) **Estimated position uncertainty (EPU).**- A measure in nautical miles (NM) based on a defined scale that indicates the estimated performance of the current position of the aircraft, also known as navigation performance (ANP) or estimated position error (EPE) in some aircraft. The EPU is not an estimate of the actual error, but a defined statistical indication.
- e) **Flight management system (FMS).**- Integrated system made up by an on-board sensor, a receiver, and a computer with navigation and aircraft performance databases, capable of providing performance values and RNAV guidance to a display and automatic flight control system.
- f) **Global positioning system (GPS).**- The U.S. global navigation satellite system (GNSS) is a satellite based radio navigation system that uses precise distance measurements to determine the position, velocity and time anywhere in the world. The GPS is composed of space, control and user elements. The space element consists of at least 24 satellites in 6 orbiting planes. The control element consists of 5 monitoring stations, 3 ground antennas, and one main control station. The user element consists of antennas and receivers that provide the user with position, speed, and precise time information.
- g) **Global navigation satellite system (GNSS).**- Generic term used by ICAO to define any global positioning and timing system made up by one or more main satellite constellations, such as the GPS and the global navigation satellite system (GLONASS), aircraft receivers, and several integrity surveillance systems, including aircraft-based augmentation systems (ABAS), satellite-based augmentation systems (SBAS), such as the wide-area augmentation system (WAAS) and ground-based augmentation systems (GBAS), such as the local-area augmentation system (LAAS).
- h) **Initial approach fix (IAF).**- Fix that marks the beginning of the initial segment and the end of the arrival segment, if applicable. In RNAV application, this fix is normally defined as a “fly-by fix”.
- i) **Navigation specifications.**- A set of aircraft and flight crew requirements needed to support performance based navigation operations within a defined airspace. There are two kinds of navigation specifications:

*Required navigation performance (RNP) specification.*- A navigation specification based on area navigation that includes the requirement for on-board performance monitoring and alerting, designated by the prefix RNP, e.g., RNP 4, RNP APCH, RNP AR APCH.

*Area navigation (RNAV) specification.*- A navigation specification based on area navigation that does not include the requirement for on-board performance monitoring and alerting, designated by the prefix RNAV, e.g., RNAV 5, RNAV 2, RNAV 1.

*Note 1.*- The Performance-based Navigation (PBN) Manual (Doc 9613), Volume II, contains detailed guidance on navigation specifications.

*Note 2.*- The term RNP as previously defined as “a statement of the navigation performance, necessary for operation within a defined airspace”, has been removed from the Annexes to the Convention on International Civil Aviation as the concept of RNP has been overtaken by the concept of PBN. The term RNP in such Annexes is now solely used in context of navigation specifications that

require performance monitoring and alerting, e.g., RNP 4 refers to the aircraft and operating requirements, including a 4 NM lateral performance with on board performance monitoring and alerting that are detailed in the PBN Manual (Doc 9613).

- j) **Performance-based navigation (PBN).**- Performance-based area navigation requirements applicable to aircraft conducting operations on an ATS route, in an instrument approach procedure, or a designated airspace.

Performance requirements are expressed in the navigation specifications (RNAV and RNP specifications) in terms of the precision, integrity, continuity, availability, and functionality required for the intended operation within the context of a particular airspace concept.

- k) **Primary field of view.**- For purposes of this AC, the primary field of view is within 15 degrees of the primary line of sight of the pilot.
- l) **Radius to fix (RF) leg.**- An RF leg is defined as any circular path (an arc) with a constant radius around a defined turn centre that starts and ends in a fix.
- m) **Receiver autonomous integrity monitoring (RAIM).**- Technique used in a GPS receiver/processor to determine the integrity of its navigation signals, using only GPS signals or enhanced GPS signals with barometric altitude data. This determination is achieved by a consistency check between redundant pseudo-range measurements. At least one satellite in addition to those required must be available to obtain the navigation solution.
- n) **RNP operations.**- Aircraft operations that use an RNP system for RNP applications.
- o) **RNP system.**- Area navigation system that provides on-board performance control and alert.
- p) **RNP value.**- The RNP value designates the lateral performance requirement associated with a procedure. Examples of RNP values are: RNP 0.3 and RNP 0.15.
- q) **Way-point (WPT).**- A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Way-points are identified as either:

*Fly-by way-point.*- A way-point that requires turn anticipation to allow tangential interception of the next segment of a route or procedure.

*Flyover way-point.*- A way-point at which a turn is initiated in order to join the next segment of a route or procedure.

## 4.2 Abbreviations

- |    |       |   |
|----|-------|---|
| a) | CAA   | Civil aviation administration                   |
| b) | ABAS  | Aircraft-based augmentation system              |
| c) | AGL   | Above ground level                              |
| d) | AP    | Automatic pilot                                 |
| e) | APCH  | Approach  |
| f) | APQ   | Advance qualification program                   |
| g) | APV   | Approach procedure with vertical guide          |
| h) | AR    | Authorization required                          |
| i) | AIP   | Aeronautical information publication            |
| j) | AIRAC | Aeronautical information regulation and control |
| k) | AC    | Advisory circular (FAA)                         |
| l) | AFM   | Aircraft flight manual                          |
| m) | AIM   | Aeronautical information manual                 |

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n)	AMC	Acceptable means of compliance
o)	ANP	Navigation performance
p)	ANSP	Air navigation service provider
q)	ATC	Air traffic control
r)	ATS	Air traffic service
s)	baro-VNAV	Barometric vertical navigation
t)	AC	Advisory circular (SRVSOP)
u)	CDI	Course deviation indicator
v)	CDU	Control display unit
w)	CF	Course to a fix
x)	DA/H	Decision altitude/height
y)	DF	Direct to a fix
z)	DME	Distance-measuring equipment
aa)	EASA	European Aviation Safety Agency
bb)	EGPWS	Enhanced ground proximity warning system
cc)	EPE	Estimated position error
dd)	EPU	Estimated position uncertainty
ee)	EUROCAE	European Organization for Civil Aviation Equipage
ff)	FA	Course from a fix to an altitude
gg)	FAA	United States Federal Aviation Administration
hh)	FAF	Final approach fix
ii)	FD	Flight director
jj)	FMS	Flight management system
kk)	FOSA	Flight operational safety assessment
ll)	FSD	Maximum deflection
mm)	FTD	Flight training devices
nn)	FTE	Flight technical error
oo)	GBAS	Ground-based augmentation system
pp)	GNSS	Global navigation satellite system
qq)	GLONASS	Global navigation satellite system
rr)	GP	Glide path
ss)	GPS	Global positioning system
tt)	GS	Ground speed
uu)	HAL	Horizontal alert limit
vv)	HIL	Horizontal integrity limit
ww)	HPL	Horizontal protection level
xx)	IAC	Instrument approach chart

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yy)	IAF	Initial approach fix
zz)	IFR	Instrument flight rules
aaa)	INS	Inertial navigation system
bbb)	ILS	Instrument landing system
ccc)	IRS	Inertial reference system
ddd)	IRU	Inertial reference unit
eee)	ISA	International standard atmosphere
fff)	LAAS	Local area augmentation system
ggg)	LAR	Latin American Aeronautical Regulations
hhh)	LNAV	Lateral navigation
iii)	LOA	Letter of authorization
jjj)	LOE	Line-oriented evaluation
kkk)	LOFT	Line-oriented flight training
lll)	MEL	Minimum equipment list
mmm)	NAVAIDS	Navigation aids
nnn)	NOTAM	Notice to airmen
ooo)	OACI	International Civil Aviation Organization
ppp)	OEM	Original equipment manufacturer
qqq)	OM	Operations Manual
rrr)	PBN	Performance-based navigation
sss)	PC	Proficiency check
ttt)	PDE	Path definition error
uuu)	PF	Pilot flying the aircraft
vvv)	POH	Pilot operations manual
www)	POI	Principal operations inspector
xxx)	PM	Pilot monitoring the aircraft
yyy)	PT	Proficiency training
zzz)	RA	Radio altimeter
aaaa)	RAIM	Receiver autonomous integrity monitoring
bbbb)	RF	Constant radius arc to a fix
cccc)	RF leg	Constant radius to fix arc leg
dddd)	RF turn	Constant radius to fix turn
eeee)	RNAV	Area navigation
fff)	RNP	Required navigation performance
gggg)	RNP APCH	Required navigation performance approach
hhhh)	RNP AR APCH	Required navigation performance authorization required approach
iiii)	RTCA	Requirements and technical concepts for aviation

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jjjj)	SBAS	Satellite-based augmentation system
kkkk)	SET	Selected event training
llll)	SPOT	Special-purpose operational training
mmmm)	TF	Track to a fix
nnnn)	TLS	Target level of safety
oooo)	TOGA	Take-Off/Go-Around
pppp)	VDI	Vertical deviation indicator
qqqq)	VNAV	Vertical navigation
rrrr)	VOR	VHF omnidirectional radio range
ssss)	VPA	Vertical path angle
tttt)	WAAS	Wide area augmentation system
uuuu)	WPT	Waypoint

## 5. INTRODUCTION

5.1 ICAO Document 9613 - Manual on Required Navigation Performance (PBN), currently establishes two types of RNP navigation specifications for approach operations: RNP approach (RNP APCH) and RNP approach with authorization required (RNP AR APCH).

5.2 RNP AR APCH operations permit a high level of navigation performance and require that the operator meet additional aircraft and flight crew requirements in order to obtain an operational authorization from the CAA.

5.3 These operations can offer significant operational and safety advantages compared to other RNAV procedures, since they introduce additional navigation capabilities in terms of precision, integrity and functions allowing for operations with reduced obstacle clearance allowances that permit approach and departure procedures under circumstances in which other approach and departure procedures are neither possible nor satisfactory from the operational point of view.

5.4 RNP AR APCH operations include particular capabilities that require a special and mandatory authorization similar to that for ILS CAT II and CAT III operations.

5.5 All RNP AR APCH operations have reduced lateral obstacle evaluation areas and vertical obstacle clearance surfaces, based on aircraft and crew performance requirements stated in this AC.

5.6 RNP AR APCH operations are classified as vertical guide approach procedures (APV) according to Annex 6. In addition to lateral guide, this type of operation requires a positive vertical navigation guidance system for the final approach segment.

5.7 An RNP AR APCH procedure is designed when a direct approach is not operationally possible.

5.8 There are three features in procedure design criteria that must only be used when there is a specific operational need or a benefit. Accordingly, an operator may be authorized to any or all of the following sub-sets of these types of procedures:

- ✓ ability to fly a published arc, also referred to as a *radius to fix leg (RF leg)*
- ✓ *reduced obstacle evaluation area on the missed approach, also referred to as a missed approach requiring RNP less than 1.0*
- ✓ *an RNP AR APCH that employs a line of minima less than RNP 0.3 and/or a missed approach requiring an RNP less than 1.0*

5.9 An operator conducting an RNP AR APCH operation using a line of minima less than RNP 0.3 and/or a missed approach that requires an RNP less than 1.0 shall comply with paragraphs 5 and/or 6 of Appendix 2 to this AC.

5.10 The criteria in this AC are based on the use of multi-sensor navigation systems and barometric vertical navigation (baro-VNAV) systems.

5.11 The RNP AR APCH approaches are used for operations with a final approach segment of RNP 0.3 or lower and are designed with straight and/or fixed radius (constant radius arc to a fix) segments.

5.12 According to ICAO Doc 9613, navigation precision associated with flight phases of RNP AR APCH approach are the following:

- |    |                                |                |
|----|--------------------------------|----------------|
| a) | Initial segment:               | RNP 1.0 to 0.1 |
| b) | Middle segment:                | RNP 1.0 to 0.1 |
| c) | Final segment:                 | RNP 0.3 to 0.1 |
| d) | Unsuccessful approach segment: | RNP 1.0 to 0.1 |

5.13 Procedures RNP AR APCH are named as RNAV<sub>(RNP)</sub>. Through Aeronautical Information Publication (AIP) and aeronautical letters will be specified permitted sensors or required RNP value.

5.14 The procedures to be implemented pursuant to this AC will permit the use of high-quality lateral and vertical navigation capabilities to improve safety and reduce the risks of controlled flight into terrain (CFIT).

5.15 The material described in this AC has been developed based on the following documents:

- ✓ ICAO Doc 9613, Volume II, Part C, Chapter 6 – Implementing RNP AR APCH; and
- ✓ Working Paper IFPP/2 WP/5 – Flight operational safety assessment (FOSA) submitted to the ICAO PBN Working Group meeting (22 September to 3 October 2008).

5.16 Where possible, this AC has been harmonized with the following documents:

- ✓ EASA AMC 20-26 - Airworthiness approval and operational criteria for RNP authorization required (RNP AR) operations; and
- ✓ FAA AC 90-101 – Approval guidance for RNP procedures with SAAR.

**Note.-** Notwithstanding harmonization efforts, operators shall note the differences between this AC and the aforementioned documents when requesting an authorization from the corresponding Administrations.

## 6. DESCRIPTION OF THE NAVIGATION SYSTEM

### 6.1 Lateral Navigation (LNAV)

- a) In LNAV, RNP equipment enables the aircraft to navigate in accordance with appropriate routing instructions along a path defined by waypoints maintained in an on-board navigation database.

**Note.-** Normally, LNAV is a mode of flight guidance systems where the RNP equipment provides path steering commands to the flight guidance system that controls flight technical error (FTE) through either manual pilot control with a path deviation display or through FD or AP coupling.

- b) For purposes of this AC, RNP AR APCH operations are based on the use of RNP equipment that automatically determines aircraft position on the horizontal plane using data inputs from the following types of position sensors (listed in no specific order of priority or combination), but whose primary basis for positioning is the GNSS.
- 1) Global navigation satellite system (GNSS).
  - 2) Inertial navigation system (INS) or inertial reference system (IRS), with automatic position updating from suitable radio-based navigation equipment.
  - 3) Distance measuring equipment (DME) that provides measurements from two or more ground

stations (DME/DME)

**Note.-** Depending on DME infrastructure, an operator may use DME/DME position updating as a means of reversal. This function must be assessed on a case-by-case basis and approved at the operational level.

## 6.2 Vertical Navigation (VNAV)

- a) In VNAV, the system enables the aircraft to fly level and descend relative to a linear, point-to-point vertical path that is maintained in an on-board navigation database. The vertical profile will be based on altitude constraints or vertical path angles (VPA) where appropriate, associated with the vertical navigation path waypoints.

**Note.-** Normally, VNAV is a mode of flight guidance systems, where RNP equipment with VNAV capability provides path steering commands to the flight guidance system that controls the flight technical error (FTE) through either manual pilot control with vertical deviation display or through FD or AP coupling.

## 7. AIRCRAFT EQUIPMENT REQUIREMENTS

7.1 The operator must establish and have a configuration list available describing in detail the components and equipment to be used for RNP AR APCH operations.

7.2 The required equipment list shall be established during the operational approval process, taking into account the AFM and available operational mitigation methods. This list shall be used to update the MEL of each type of aircraft for which the operator submits an operational application.

7.3 The details of the equipment and its use in accordance with the characteristic(s) of each approach are described in the appendices to this AC.

## 8. AIRWORTHINESS AND OPERATIONAL APPROVAL

8.1 In order to get an RNP AR APCH authorization, a commercial air transport operator shall obtain two types of approval:

- a) an airworthiness approval from the State of Registry; (see Article 31 of the Chicago Convention and paragraphs 5.2.3 and 8.1.1 of Annex 6, Part I); and
- b) an operational approval from the State of the Operator (see paragraph 4.2.1 and Attachment F to Annex 6, Part I).

8.2 For general aviation operators, the State of Registry (See paragraph 2.5.2.2 of Annex 6 Part II) will determine if the aircraft meets the applicable RNP AR APCH requirements and will issue the operational authorization (e.g., a letter of authorization – LOA).

8.3 An operator that has obtained operational approval can conduct RNP AR APCH operations in the same way as an operator that has been authorized to conduct ILS CAT II and III operations.

8.4 Before submitting the application, manufacturers and operators shall review all the performance requirements. Compliance with airworthiness requirements or the installation of the equipment, by itself, does not constitute operational approval.

8.5 Appendix 1 to this AC contains the RNP AR APCH procedure characteristics that must be taken into account by operators when conducting this type of operations.

8.6 In order to get operational approval, operators shall meet the requirements contained in Appendices 2 to 6 to this AC.

8.7 Appendix 7 contains a summarized list of requirements to obtain RNP AR APCH authorization, including the documents to be included in the application.

8.8 Appendix 8 contains a summarized guide on the approval process to get an RNP AR APCH authorization.

8.9 Appendix 9 provides guidance on the flight operational safety assessment (FOSA).

## **9. AIRWORTHINESS APPROVAL**

### **9.1 Aircraft Qualification Documentation**

- a) Manufactures should develop aircraft qualification documentation showing compliance with Appendix 2 of this AC. This documentation shall identify the optional capabilities (e.g., RF legs and RNP missed approaches), the RNP capability of each aircraft configuration, and the characteristics that may alleviate the need for operational mitigation. This documentation shall also define the recommended RNP maintenance procedures.

### **9.2 Aircraft Acceptability**

- a) *For new aircraft.*- the aircraft qualification documentation can be approved by the CAA as part of an aircraft certification project, and will be reflected in the AFM and related documents.
- b) *For aircraft in service.*- The operator shall submit the aircraft qualification documentation produced by the manufacturers to the corresponding CAA bodies (e.g., aircraft certification division, or airworthiness inspection division, or equivalents). These bodies shall accept, as appropriate, the data package for RNP AR APCH operations. This acceptance will be documented in a letter addressed to the operator.

### **9.3 Aircraft Modification**

- a) If any aircraft system required for RNP AR APCH operations is installed or modified (e.g., software or hardware change), the aircraft installation or modification must be approved.
- b) The operator must obtain a new operational approval supported by the manufacturer's updated aircraft qualification and operational documentation.

## **10. OPERATIONAL APPROVAL**

**10.1** In order to obtain RNP AR APCH authorization, the operator must meet the criteria set forth in this paragraph and in Appendix 7 - Requirements to obtain RNP AR APCH authorization.

### **10.2 RNP AR APCH Operational Documentation**

- a) The operator will submit operational documentation for RNP AR APCH operations in accordance with the following appendices to this AC: Appendix 3 – Navigation data validation program; Appendix 4 – Operational considerations; Appendix 5 – Training programs; and Appendix 6 – RNP monitoring programs.
- b) *For new aircraft.*- The RNP AR APCH operational documentation submitted by the operator will be accepted by the relevant CAA body (for example, the aircraft certification division or flight standard body or equivalent).
- c) *For aircraft in service.*- The operator shall send the RNP AR APCH operational documentation to the corresponding CAA bodies (for example, the aircraft certification division or flight standard body or equivalent). These entities will accept, as appropriate, the RNP AR APCH operational documentation. This acceptance will be documented in a letter addressed to the aircraft operator.

### **10.1 Operator Approval**

- a) LAR 91, 121, and 135 operators shall submit to the flight standard body or equivalent evidence of compliance with the aircraft operational or qualification documentation accepted by the CAA as described in Annex 7 to this AC. This documentation will indicate compliance with Appendices 2 to 9 and will be specific to aircraft equipment and procedures. Once the operator has met the requirements of this AC or equivalent, the CAA will issue the operational specifications (OpSpecs) for LAR 121 or 135 operators or a letter of authorization (LOA) for LAR 91 operators, authorizing RNP AR APCH operations.



**b) Provisional Authorization**

- 1) The operator will be authorized to conduct RNP AR APCH operations using RNP 0.3 minima during the first 90 days of operation or the period stipulated by the CAA, and at least during the first 100 approaches in each type of aircraft.
- 2) For approaches without a line of minima associated with RNP 0.3 (minima under 0.3), the procedure shall be conducted under visual meteorological conditions (VMC).
- 3) The provisional authorization will be withdrawn once the operator has completed the applicable period of time and the required number of approaches and once the CAA has reviewed the RNP AR APCH monitoring program reports.

**Note 1.-** Operators with experience in equivalent RNP AR APCH operations may receive credit to reduce provisional authorization requirements.

**Note 2.-** Operators with experience in RNP AR APCH operations that are applying for new or modified system or aircraft operations, variations of the aircraft type or different aircraft types with identical crew procedures and interface may use reduced periods or approaches in the provisional authorization (for example, periods of less than 90 days and approaches of less than 50), as determined by the CAA.

**Note 3.-** In particular circumstances in which compliance with 50 successful approaches could take a long time due to factors such as the small number of aircraft in the fleet, limited opportunities to use aerodromes with the appropriate procedures, and when an equivalent level of reliability can be obtained, consideration can be given, on a case-by-case basis, to a reduction in the required number of approaches.

**c) Final Authorization**

- 1) The CAA will issue the OpSpecs or the LOA authorizing the use of the lowest applicable minima once the operators have successfully completed the time period and the number of approaches required by the CAA, as established in paragraph b) above.

## APPENDIX 1

### RNP AR APCH INSTRUMENT APPROACH PROCEDURES

#### 1. INTRODUCTION

- a) ICAO Doc 9905 - *Manual for the design of RNP procedures with authorization required (RNP AR)*, provides RNP AR APCH procedure design criteria.
- b) This appendix provides a summary of the key characteristics of approach procedures, and introduces the types of RNP approach operations.

#### 2. PARTICULAR CHARACTERISTICS OF RNP AR APCH APPROACHES

- a) **RNP value.-** Each line of minima published has an associated RNP value; for example, RNP 0.3 or RNP 0.15. A minimum RNP value is documented as part of an RNP AR APCH authorization for each operator, and it may vary depending on aircraft configuration or operational procedures (for example, inoperative GPS, use of FD with or without AP).
- b) **Procedures that include *radius to fix legs (RF legs)*.-** Some RNP procedures have curved paths, known as *radius to fix legs (RF legs)*. Since not all aircraft can fly this type of legs, pilots are responsible for knowing if they can conduct an RNP AR APCH procedure with an RF leg. RNP requirements for RF legs will be indicated in the note section of instrument approach charts (IAC) or in the applicable initial approach fix (IAF).
- c) **Missed approaches that require RNP values of less than 1.0.-** In designated locations, the airspace or the obstacle area will require an RNP capability of less than 1.0 during a missed approach from any location in the procedure. Navigation system reliability must be very high in these locations. These approaches will normally require redundant equipment since no single point-of-failure can cause a loss of RNP capability.
- d) **Non-standard speeds or climb gradients.-** RNP AR APCH procedures are developed on the basis of standard approach speeds and a with climb gradient of 200 ft/NM in the missed approach. Any exception to these standards will be stated in the approach procedure and the operator will ensure compliance with any published limitation before conducting the operation.
- e) **Temperature limits.-**
  - 1) High and low temperature limits are identified in RNP AR APCH procedures for aircraft using barometric vertical navigation (baro-VNAV) without temperature compensation on the approach.
  - 2) Aircraft using baro-VNAV with temperature compensation, or an alternate means of vertical guidance (e.g., SBAS) can ignore temperature restrictions.
  - 3) Since temperature limits established in the charts are assessed only for obstacle clearance in the final approach segment, and taking into account that temperature compensation affects only vertical guidance, the pilot may need to adjust the minimum altitude in the initial and intermediate approach segments and in the decision altitude/height (DA/H)).

**Note 1.-** Temperature affects the indicated altitude. The effect is similar to having high and low pressure changes, but not as significant as those changes. When the temperature is higher than the standard (ISA), the aircraft will be flying above the indicated altitude. When the temperature is lower than the standard, the aircraft will be flying below the altitude indicated in the altimeter. For further information, refer to altimeter errors in the aeronautical information manual (AIM).

**Note 2.-** Pilots are responsible for all low (cold) temperature corrections required at all minimum altitudes/heights published. This includes:

- the altitudes/heights for the initial and intermediate segments;
- the DA/H; and
- the subsequent missed approach altitudes/heights.

**Note 2.-** *The final approach path VPA is protected against the effects of low temperatures by the procedure design.*

- f) **Aircraft size.-** The minima to be obtained may depend on the size of the aircraft. Large aircraft may require higher minima due to the height of the landing gear and/or aircraft wingspan. When appropriate, aircraft size restrictions will be reflected in RNP AR APCH procedure charts.

## APPENDIX 2

### AIRCRAFT QUALIFICATION

#### 1. INTRODUCTION

- a) This appendix describes aircraft performance and the functional criteria for qualifying an aircraft for RNP AR APCH operations.
- b) Applicants may establish compliance with this appendix based on the type certification or supplementary type certification, and document said compliance in the AFM (supplement).
- c) The operator of a previously certified aircraft may document compliance with this aircraft certification criterion without a new airworthiness project (for example, without a change in the AFM) and must report to the aircraft certification division or equivalent any new performance not covered by the original airworthiness approval.
- d) The AFM or other proof of aircraft qualification shall indicate the normal and non-normal flight crew procedures, responses to failure alerts, and any other limitation, including information on the operation modes required for flying an RNP AR APCH procedure.
- e) In addition to the specific RNP AR APCH guide presented in this AC, the aircraft must comply with AC 20-129 – Airworthiness approval of vertical navigation (VNAV) systems for use in the U.S. National Airspace System (NAS) and Alaska and either with AC 20-130 () – Airworthiness approval of navigation or flight management systems integrating multiple navigation sensors or AC 20-138 () – Airworthiness approval of NAVSTAR Global Positioning System (GPS) for use as a VFR and IFR supplemental navigation system, or equivalent documents.

#### 2. PERFORMANCE REQUIREMENTS

This paragraph defines the general performance requirements for aircraft qualification. Paragraphs 3, 4, and 5 of this appendix provide guidance material on acceptable methods of compliance to meet such requirements.

- a) **Path definition.-** Aircraft performance is assessed around the path defined by the published procedure and by Section 3.2 of document RTCA/DO.236B. All flight paths used in conjunction with the final approach segment will be defined by the flight path angle (VPA) (RTCA/DO-236B, Section 3.2.8.4.3) as a straight line to a fix and altitude.
- b) **Lateral precision.-** Any aircraft conducting RNP AR APCH procedures must have a cross-track navigation error not greater than the precision value (0.1 NM to 0.3 NM) applicable to 95% of the flight time. This error includes the position error, the flight technical error (PTE), and the display system error. Likewise, the along-path position error must not be greater than the precision value applicable to 95 % of the flight time.
- c) **Vertical precision.-** The vertical system error includes the altimeter error (assuming international standard atmosphere (ISA) temperature and lapse rates), the along-path effect of the error, the system calculation error, and the flight technical error. 99.7% of the system error in the vertical direction must not be less than (in feet):

$$\sqrt{((6076.115)(1.225)\text{RNP} \cdot \tan \theta)^2 + (60 \tan \theta)^2 + 75^2 + ((-8.8 \cdot 10^{-8})(h + \Delta h)^2 + (6.5 \cdot 10^{-3})(h + \Delta h) + 50)^2}$$

Where  $\theta$  is the vertical navigation path angle,  $h$  is the height of the local altimeter reporting station, and  $\Delta h$  is the height of the aircraft over the reporting station.

- d) **Airspace containment.-** RNP AR APCH approaches are published as performance-based approaches; therefore, they do not require any specific procedure or technology, but rather a

performance level.

- 1) **RNP and baro-VNAV aircraft.-** This AC provides acceptable methods of compliance for aircraft using an RNP system based mainly on GNSS, and a vertical navigation system (VNAV) based on a barometric altimeter. Paragraphs 3, 4, and 5 of this appendix, together with the guide established in Appendices 3 and 4, describe an acceptable method of acceptance to obtain the required navigation performance. Aircraft and procedures that comply with these paragraphs and appendices meet the airspace containment requirement.
- 2) **Other alternate systems or methods of compliance.-** For other alternate systems or methods of compliance, the likelihood of the aircraft exceeding the lateral and vertical limits of the obstacle clearance volume must not exceed  $10^{-7}$  per approach (Doc 9905 - *Manual for the design of navigation required performance procedures with authorization required (RNP AR)*), including approach and missed approach. This requirement can be met through a safety assessment, applying:
  - ✓ appropriate quantitative numerical methods;
  - ✓ operational and procedural qualitative considerations and mitigations; or
  - ✓ an appropriate combination of both quantitative and qualitative methods.

**Note 1.-** This requirement applies to the total likelihood of excursions outside of the obstacle clearance volume, including events caused by latent conditions (integrity) and detected conditions (continuity) if the aircraft does not remain within the obstacle clearance volume after the failure is announced. The alert control limit, the latent status of the alert, the crew response time, and the aircraft response shall be taken into account when ensuring that the aircraft will not go outside the obstacle clearance volume. The requirement applies to a single procedure, considering the exposure time of the operation, the radio aid (NAVAID) geometry, and the navigation performance available for each published approach.

**Note 2.-** This containment requirement is derived from the operational requirement and is particularly different from the requirement specified in Document RTCA/DO-236B. The requirement in Document RTCA/DO-236B was developed to expedite airspace design and is not directly equivalent to obstacle clearance.

- e) **System control.-** A critical component of RNP during approach is the capability of the aircraft navigation system to control the navigation performance obtained and identify for the flight crew whether or not the operational requirement is being met during the operation.

### 3. GENERAL RNP AR APCH REQUIREMENTS

- a) **Navigation Sensors.-** This section identifies the particular features of navigation sensors within the context of RNP AR APCH operations.

#### 1) **Global Positioning System (GPS).-**

- (a) The sensor must meet the criteria of FAA AC 20-138 (.). For systems that comply with this AC, the following sensor precisions can be used in the total system precision analysis without any additional justification:
  - (1) GPS sensor precision better than 36 m (95%); and
  - (2) augmented GPS (GBAS or SBAS) sensor precision better than 2 m (95%).
- (b) In case of latent failure of the GPS satellite and marginal geometry of said satellite (e.g., horizontal integrity limit (HIL) equal to the horizontal alert limit (HAL)), the likelihood of the aircraft remaining within the obstacle clearance volume used to assess the procedure must be greater than 95% (both laterally and vertically).

**Note.-** GNSS-based sensors produce an HIL, also known as horizontal protection level (HPL) (see AC 20-138A, Appendix 1 and document RTCA/DO-229C for an explanation of these terms). The HIL is a measure of the estimated position error, assuming a latent failure is present. Instead of a detailed analysis of the effects of latent failures on the total system error, an acceptable means of compliance for GNSS-based systems is to ensure the HIL remains twice as low as the navigation precision, minus 95% of the flight technical error (FTE), during RNP AR APCH operations.

- 2) **Inertial reference system (IRS).-** An IRS must meet the criteria of LAR 121 Appendix G or

US 14 CFR Part 121 Appendix G or equivalent. While Appendix G defines the 2-NM-per-hour drift rate (95%) requirement for flights up to 10 hours, this rate may not apply to an RNP system after loss of position updating. It is assumed that systems that have demonstrated compliance with LAR 121 Appendix G have an initial drift rate of 8 NM/hour for the first 30 minutes (95%), without further substantiation. Aircraft manufacturers and applicants can demonstrate improved inertial performance in accordance with the methods described in Appendix 1 or 2 of FAA Order 8400.12A.

**Note.-** Integrated GPS/INS position solutions reduce the rate of degradation after loss of position updating. For coupled GPS/IRUs, RTCA/DO-229C Appendix R provides additional guidance.

- 3) **Distance measuring equipment (DME).**- Initiation of all RNP AR APCH procedures is based on GNSS updating. Except where the use of DME in a procedure is specifically designated as “not authorized”, DME/DME updating can be used as a reversal mode during the approach and missed approach when the system complies with the navigation precision. The manufacturer and the operator shall identify any DME infrastructure or procedure limitation preventing an aircraft type from meeting this requirement.
- 4) **VHF omnidirectional radio range (VOR).**- For initial RNP AR APCH implementation, the RNP system may not use VOR updating. The manufacturer and the operator shall identify any constraints on the VOR infrastructure or the procedure for a given aircraft to comply with this requirement.

**Note.-** This requirement does not prohibit the capability of the VOR equipment, provided there is a direct means to inhibit its update. A procedure that allows the flight crew to inhibit VOR updating or to execute a missed approach if the system reverts to VOR updating may meet this requirement.

- 5) **Multi-sensor systems.**- For multi-sensor systems, there must be automatic reversal to an alternate RNAV sensor if the primary RNAV sensor fails. Automatic reversal from one multi-sensor system to another multi-sensor system is not required.
- 6) **Altimetry system error.**- 99.7% of the altimetry system error for each aircraft (assuming international standard atmosphere temperature and lapse rate) must be less or equal to the following, with the aircraft in the approach configuration:

$$ASE = -8.8 \cdot 10^{-8} \cdot H^2 + 6.5 \cdot 10^{-3} \cdot H + 50$$

Where H is the true altitude of the aircraft

- 7) **Temperature compensation systems.**- Systems that provide temperature-based corrections to the barometric VNAV guidance must comply with RTCA/DO-236 Appendix H.2. This applies to the final approach segment. Compliance with this requirement shall be documented to enable the operator to conduct RNP AR APCH approaches when the actual temperature is above or below the published procedure design limit. Appendix H.2 also provides guidance on operational aspects related to temperature compensation systems, such as intercepting compensated paths from non-compensated procedure altitudes.

#### b) **Flight path definition and flight planning**

- 1) **Track-keeping and transition legs.**- The aircraft must be capable of executing transition legs and maintain tracks consistent with the following paths:
  - (a) a geodetic line between two fixes;
  - (b) a direct to fix path;
  - (c) a specific track to a fix, defined by a course; and
  - (d) a specific track to an altitude.

**Note 1.-** The standards for these paths may be found in documents EUROCAE ED-75 / RTCA DO-236B and in ARINC Specification 424 – Navigation database. These standards refer to these paths as path terminators: Track to a fix (TF), Direct to a fix (DF), Course to a fix (CF), Course from a fix to an altitude (FA). Likewise, some procedures require radius to a fix (RF) legs as described in paragraph 4 of this appendix. Documents EUROCAE ED-75A/RTCA DO-236B and ED-77/DO-201A describe in more detail the application of these paths.

**Note 2.-** Navigation systems can accommodate other ARINC 424 path terminators (e.g., heading to a manual terminator (VM)). Missed approach procedures may use these types of paths when there is no requirement for RNP containment.

- 2) **Fly-By and Flyover Fixes.-** The aircraft navigation system must be capable of executing fly-by and flyover fixes. For fly-by turns, the navigation system must limit the path definition within the theoretical transition area defined in document EUROCAE ED-75B/RTCA DO-236B under the wind conditions identified in ICAO Doc 9905. The flyover turn is not compatible with RNP flight tracks and will only be used when there is no repetitive path requirement.
- 3) **Waypoint resolution error.-** The navigation database must provide sufficient data resolution to ensure the navigation system achieves the required precision. A waypoint resolution error must be less than or equal to 60 ft, including both the data storage resolution and the RNP system computational resolution used internally for construction of flight plan waypoints. The navigation database must contain vertical angles (flight path angles) stored to a resolution of hundredths of a degree, with a computational resolution such that the system-defined path is within 5 ft of the published path.
- 4) **“Direct to” function capability -** The navigation system must have a “direct to” function that the flight crew can activate at any time. This function must be available for any fix. The navigation system must also be capable of generating a geodetic path “to” the designated fix, without turns and undue delays.
- 5) **Ability to define a vertical path.-** The navigation system must be capable of defining a vertical path for a flight path angle to a fix. The navigation system must also be capable of specifying a vertical path between the altitude constraints of two fixes in the flight plan. Fix altitude constraints must be defined as one of the following:
  - (a) an AT or ABOVE altitude constraint (for example, 2400A) may be appropriate for situations where it is not necessary to limit the vertical path;
  - (b) an AT or BELOW altitude constraint (for example, 4800B) may be appropriate for situations where it is not necessary to limit the vertical path;
  - (c) an AT altitude constraint (for example, 5200); or
  - (d) a WINDOW-type altitude constraint (for example, 2400A3400B).

**Note.-** For RNP AR APCH procedures, any segment with a published vertical path will define that path based on an angle to the fix and altitude.

- 6) **Altitudes and/or speeds.-** Altitudes and speeds associated with published procedures must be extracted from the navigation database.
- 7) **Path construction.-** The system must be capable of constructing a path to provide guidance from current position to a constrained fix.
- 8) **Ability to load procedures from the navigation database.-** The navigation system must be capable of loading the entire procedure(s) to be flown into the RNP system from an on-board database. This includes the approach (including a vertical angle), the missed approach, and the approach transitions for the selected aerodrome and runway.
- 9) **Means to retrieve and display navigation data.-** The navigation system must provide the flight crew the ability to verify the procedures to be flown through a review of the data stored in the on-board navigation database. This includes the ability to review the data for individual waypoints and navigation aids.
- 10) **Magnetic variation.-** For paths defined by a course (path terminators: Course to a fix (CF) and Course from a fix to an altitude (FA)), the navigation system must use the magnetic variation value for the procedure loaded on the navigation database.
- 11) **Changes in the RNP value.-** Changes to lower RNP values must be completed at the fix that defines the leg with the lowest RNP value. Any operational procedure necessary to accomplish this must be identified.

- 12) **Automatic leg sequencing.-** The navigation system must provide the ability to automatically sequence to the next leg and display the sequencing to the flight crew in a readily visible manner.
  - 13) **Display of altitude restrictions.-** A display of altitude restrictions associated to flight plan fixes must be available to the pilot. If there is a particular procedure in the navigation database with a flight path angle associated with any flight plan leg, the equipment must display the flight path angle for that leg.
- c) **Demonstration of path steering performance.-** When the RNP demonstration includes a path steering performance demonstration (flight technical error), the applicant must complete such demonstration in accordance with paragraphs 5.19.2.2 and 5.19.3.1 of FAA AC 120-29A.
- d) **Displays.-**
- 1) **Continuous display of deviation.-** The navigation system must provide the ability to continuously display the aircraft position relative to the defined RNP path (both lateral and vertical deviation) to the pilot flying the aircraft, on the primary flight navigation instruments. The display must allow the pilot to readily distinguish if the cross-track deviation exceeds the navigation precision (or a smaller value) or if the vertical deviation exceeds 75 ft (or a smaller value).
    - (a) It is advisable that a appropriately-scaled non-numeric deviation display (e.g., the lateral deviation indicator or the vertical deviation indicator) be located in the primary field of view of the pilot. A course deviation indicator (CDI) is acceptable provided it demonstrates an appropriate scaling and sensitivity for the intended navigation precision and operation. With a scalable CDI, the scale should be derived from the RNP selection, and does not require a separate selection of the CDI scale. Alerting and annunciation limits must also match the scaling values. If the equipment uses a pre-established navigation precision to describe the operational mode (e.g., en route, terminal area, and approach), then displaying the operational mode is an acceptable means from which the flight crew can derive the CDI scale sensitivity.
    - (b) Normally, a numeric deviation display or the display of a graph on a map without a properly regulated deviation indicator is not acceptable. The use of a numeric display or a map display may be possible depending on the flight crew workload, display characteristics, flight crew procedures and training. Furthermore, initial and recurrent training or on-line experience must be provided to the flight crew, but this solution increases flight crew workload during approach, and imposes additional costs to the operator due to training requirements.
  - 2) **Identification of the active (to) waypoint.-** The navigation system must provide a display identifying the active waypoint, either in the primary field of view of the pilot or on a display that is visible to, and of ready access by the flight crew.
  - 3) **Display of distance and heading.-** The navigation system must provide a display of distance and heading to the active (to) waypoint in the primary field of view of the pilot. Where not viable, an easily accessible page on the control display unit (CDU), readily visible to the flight crew, may display the information.
  - 4) **Display of groundspeed (GS) and time.-** The navigation system must provide a display of groundspeed and time to the active (to) waypoint in the primary field of view of the pilot. Where not viable, an easily accessible page on the control display unit, readily visible to the flight crew, may display the information.
  - 5) **Display of to/from the active fix.-** The navigation system must provide a to/from display in the primary field of view of the pilot.
  - 6) **Desired track display.-** The navigation system must be capable of continuously displaying the desired RNP track to the pilot flying the aircraft. The display must be on the primary flight instruments for aircraft navigation.



- 7) **Display of aircraft track.-** The navigation system must provide a display of the actual aircraft track (or track angle error), either in the primary field of view of the pilot, or on a display that is visible to, and readily accessible by the flight crew.
  - 8) **Failure annunciation.-** The aircraft must provide a means to annunciate failures of any component of the RNP system, including navigation sensors. The annunciation must be visible to the pilot and located in the primary field of view of the pilot.
  - 9) **Enslaved course selector.-** The navigation system must provide a course selector automatically enslaved to the computed RNP path.
  - 10) **RNP path display.-** When the minimum flight crew is two pilots, the navigation system must provide a readily visible means for the pilot monitoring the aircraft to verify the defined RNP path and the aircraft position relative to said path.
  - 11) **Display of distance to go.-** The navigation system must provide the ability to display distance to go to any waypoint selected by the flight crew.
  - 12) **Display of distance between flight plan waypoints.-** The navigation system must provide the ability to display the distance between flight plan waypoints.
  - 13) **Display of deviation.-** The navigation system must provide a numeric display of vertical deviation with a resolution of 10 ft or less, and a lateral deviation with a resolution of 0.01 NM or less.
  - 14) **Display of barometric altitude.-** The aircraft must display barometric altitude from two independent sources, one in the primary field of view of each pilot.

*Note.- This display supports an operational cross-check of altitude sources. If the aircraft altitude sources are automatically compared, the output of the independent altimetry sources, including independent aircraft static air pressure systems, must be analyzed to ensure that they can provide an alert in the primary field of view of the pilot when deviations exceed 75 ft. Such comparator monitor function shall be documented so that it may eliminate the need for an operational mitigation.*
  - 15) **Display of active sensors.-** The aircraft must display the navigation sensor(s) in use. It is recommended that this display be provided in the primary field of view of the pilot.

*Note.- This display is used to support operational contingency procedures. If such display is not provided in the primary field of view of the pilot, flight crew procedures can mitigate the need for this display if the workload is designated as acceptable.*
- e) **Design assurance.-** The system design assurance must be consistent with at least a major failure condition with respect to false lateral or vertical guidance during an RNP AR APCH.

*Note.- The false vertical or lateral RNP guidance display is considered to be a (severe or major) hazardous failure condition for RNP AR APCH with an RNP value of less than 0.3. Systems designated as consistent with this effect should be documented since they can eliminate the need for some aircraft operational mitigation.*
- f) **Navigation database**
- 1) **Navigation database.-** The aircraft navigation system must use a navigation database that:
    - (a) can receive updates in accordance with the AIRAC cycle; and
    - (b) permits the retrieval and loading of RNP AR APCH procedures from and into the RNP system.
  - 2) **Database protection.-** The on-board navigation database must be protected against flight crew modification of stored data.

*Note.- When a procedure is loaded into the database, the RNP system must fly the published procedure. This does not prevent the flight crew from having the means to modify a procedure or route that has been loaded into the RNP system. However, the procedures stored in the navigation database must not be modified and must remain intact in the navigation database for reference and future use.*
  - 3) **Validity period display.-** The aircraft must provide a means to display the validity period of the on-board navigation database to the flight crew.

#### 4. REQUIREMENTS FOR RNP AR APCH PROCEDURES WITH RF LEGS

This section defines the additional requirements for executing approaches with RF legs. The AFM or the aircraft qualification guidance shall state whether or not this capability is provided.

- a) The navigation system must be capable of executing transition legs and maintaining tracks that are consistent with the RF legs between two fixes.
- b) The aircraft must have an electronic map displaying the procedure selected.
- c) The FMC, the flight management system, and the autopilot must be capable of commanding a bank angle of 25° above 400 ft AGL and up to 8° below 400 ft AGL.
- d) Once a missed approach or go-around (through the activation of TOGA or other means) has been initiated, the flight guidance mode must remain in LNAV to enable continuous track guidance during an RF leg.

#### 5. REQUIREMENTS FOR APPROACHES WITH AN RNP OF LESS THAN 0.3

The AFM or aircraft qualification guidance must state whether or not the ability of executing approaches with an RNP of less than 0.3 is provided for each aircraft configuration (e.g., two APs may achieve an RNP capability that is lower to that achieved with two flight directors).

- a) **Single point of failure.-** No single point of failure can cause the loss of guidance compatible with the RNP value of the approach. Typically, the aircraft must have at least the following equipment:
  - 1) two GNSS sensors;
  - 2) two FMS;
  - 3) two air information systems;
  - 4) two AP; and
  - 5) one inertial reference unit (IRU).
- b) **Design assurance.-** The system design assurance must be consistent with at least a severe or major failure condition due to loss of lateral or vertical guidance during an RNP AR APCH where an RNP value of less than 0.3 is required to avoid obstacles and terrain while executing an approach.

***Note.-** The loss of lateral guidance display during RNP AR APCH operations that require an RNP value of less than 0.3 to avoid obstacles or terrain is considered as a hazardous (severe or major) failure condition. The AFM shall document designated systems that are consistent with this effect. This documentation shall describe the specific configuration of the aircraft or the mode of operation to obtain RNP values of less than 0.3. Compliance with this requirement may replace the general requirement for the two pieces of equipment described above.*
- c) **Go-around guidance.-** Once a missed approach or go-around maneuver has been initiated (through activation of TOGA or other means), the flight guidance mode must remain in LNAV to enable continuous track guidance during an RF leg. If the aircraft does not provide this capability, the following requirements apply:
  - 1) If the aircraft provides RF leg capability, the lateral path after initiating a go-around maneuver (TOGA) (taking into account a straight segment of at least 50 seconds between the point where the RF leg ends and the decision altitude (DA)) must fall within 1° of the track defined by the straight segment through the DA point. The previous turn may have an arbitrary angular extension and a turn radius as small as 1 NM, with speeds consistent with the approach conditions and the turn radius.
  - 2) The flight crew must be capable of coupling the AP or DF to the RNP system (connect LNAV) at 400 ft AGL.
- d) **Loss of GNSS.-** After initiating a go-around or missed approach following loss of GNSS, the aircraft must automatically revert to another means of navigation that complies with the RNP value.

## 6. REQUIREMENTS FOR MISSED APPROACHES WITH RNP LESS THAN 1.0

The AFM or the aircraft qualification guidance shall identify if the aircraft can achieve an RNP value of less than 1.0 in a missed approach. The AFM or the aircraft qualification guidance shall also specify the aircraft configuration or operating mode required to obtain RNP values of less than 1.0 (e.g., two APs may achieve an RNP capability that is lower than that achieved with two FDs).

- a) **Single point of failure.**- No single point of failure can cause the loss of guidance compliant with an RNP value associated to a missed approach procedure. Typically, the aircraft must have at least the following equipment:
- 1) two GNSS sensors;
  - 2) dual FMS;
  - 3) two air information systems;
  - 4) two APs; and
  - 5) one IRU.

- b) **Design assurance.**- The system design assurance must be consistent with at least one severe or major failure condition due to loss of lateral or vertical guidance during an RNP AR APCH where an RNP value of less than 1.0 is required to avoid obstacles and terrain while executing a missed approach.

**Note.**- *The loss of lateral guidance display during RNP AR APCH missed approach operations that require an RNP value of less than 1.0 to avoid obstacles or terrain is considered as a hazardous (severe or major) failure condition. The AFM shall document designated systems that are consistent with this effect. This documentation shall describe the specific aircraft configuration or operation mode to obtain RNP values of less than 1.0. Compliance with this requirement may substitute the general requirement for two pieces of equipment described above.*

- c) **Go-around guidance.**- Once initiated a missed approach or go-around (through the activation of TOGA or other means), the flight guidance mode must remain in LNAV to enable continuous track guidance during an RF leg. If the aircraft does not provide this capability, the following requirements apply:
- 1) If the aircraft provides the ability for RF legs, the lateral path after initiating a go-around (TOGA) (taking into account a straight segment of at least 50 seconds between the point where the RF leg ends and the decision altitude (DA)), must be within 1° of the track defined by the straight segment through the DA point. The previous turn may have an arbitrary angular extension and a turn radius as small as 1 NM, with speeds consistent with approach conditions and turn radius.
  - 2) The flight crew must be capable of coupling the AP or DF to the RNP system (connect LNAV) at 400 ft AGL.
- d) **Loss of GNSS.**- After initiating a go-around or a missed approach following a loss of GNSS, the aircraft must automatically revert to another means of navigation that complies with the RNP value.

## APPENDIX 3

### NAVIGATION DATA VALIDATION PROGRAM

#### 1. INTRODUCTION

The procedure stored in the navigation database defines the aircraft lateral and vertical guidance. Navigation database updates are done every 28 days. The navigation data used in each update are critical for the integrity of each RNP AR APCH procedure. Taking into account the reduced obstacle clearance associated with these approaches, navigation data validation requires special consideration. This appendix provides guidance on operator procedures to validate navigation data associated with RNP AR APCH operations.

#### 2. DATA PROCESSING

- a) In its procedures, the operator shall identify the person responsible for the navigation data updating process.
- b) The operator must document a process to accept, verify, and load the navigation data into the aircraft.
- c) The operator must place its documented data process under configuration control.

#### 3. INITIAL DATA VALIDATION

The operator must validate each RNP AR APCH procedure before flying the procedure under instrument meteorological conditions (IMC) to ensure compatibility with the aircraft and make sure that the resulting paths correspond to the published procedure. The operator must at least:

- a) compare the navigation data of the procedure to be loaded into the FMS with a published procedure.
- b) validate the navigation data of the loaded procedure, either in the flight simulator or in the aircraft under visual meteorological conditions (VMC). The procedure outlined in a map display must be compared to the published procedure. The complete procedure must be flown to make sure that the path can be used, has no apparent lateral or vertical path inconsistencies, and is consistent with the published procedure.
- c) Once the procedure is validated, a copy of the validated navigation data must be kept and maintained for comparison with subsequent data updates.

#### 4. DATA UPDATES

Whenever a navigation data update is received and before using such data in the aircraft, the operator must compare the update with the validated procedure. This comparison must identify and resolve any discrepancy in the navigation data. If there are significant changes (any change affecting the approach path or performance) to any part of a procedure, and such changes are verified through the initial information data, the operator must validate the amended procedure in accordance with the initial data validation.

#### 5. NAVIGATION DATA SUPPLIERS

Navigation data providers must have a letter of acceptance (LOA) in order to process these data (e.g., FAA AC 20-153, Conditions for issuance of letters of acceptance for navigation data suppliers by the European Aviation Safety Agency – EASA or equivalent document). An LOA recognizes the data of a supplier as those where the quality of the information, the integrity and quality management practices are consistent with the criteria of document DO-200A/ED-76. An operator supplier (for example, an FMS

company) must have an LOA Type 2 and its respective suppliers must have an LOA Type 1 or 2. AAC may accept a LOA submitted by navigation data providers or submit its own LOA.

**6. AIRCRAFT MODIFICATIONS (DATA BASE UP TO DATE)**

If an aircraft system required for RNP AR APCH operations is modified (e.g., software change), the operator is responsible for validating the RNP AR APCH procedures with the navigation database and the modified system. This may be accomplished without any direct evaluation if the manufacturer verifies that the modification has no effect on the navigation database or path computation. If there is no such verification by the manufacturer, the operator must conduct an initial navigation data validation with the modified system.

## APPENDIX 4

### OPERATING PROCEDURES

#### 1. GENERAL

This appendix provides guidance on the execution of RNP AR APCH operations. In addition to the guidelines provided in this appendix, the operator must ensure continuous compliance with the general RNP AR APCH operating procedures and verification of notices to airmen (NOTAMs), NAVAID availability, aircraft system airworthiness, and flight crew qualification.

#### 2. PRE-FLIGHT CONSIDERATIONS

- a) **Minimum equipment list (MEL).**- The operator MEL must be developed or revised to indicate equipment requirements for instrument RNP AR APCH procedures. Guidance on these equipment requirements is available in the documents of the aircraft manufacturer. The required equipment may depend on the intended navigation precision and whether the missed approach requires an RNP value of less than 1.0. For example, GNSS and AP are normally required for a low navigation precision. Normally, dual equipment is required for approaches when using a line of minima of less than RNP 0.3 and/or when the missed approach has an RNP value of less than 1.0. An operable enhanced ground proximity warning system (EGPWS/TAWS) is required for all RNP AR APCH procedures. It is advisable that the EGPWS/TAWS use local pressure- and temperature-compensated altitudes (e.g., a corrected GNSS and barometric altitude) and that it includes data on significant obstacles and terrain. The flight crew must be aware of the equipment requirement.
- b) **Autopilot (AP) and flight director (FD).**- For procedures with a navigation precision of less than RNP 0.3 or with RF legs, the use of AP and FD driven by the aircraft RNP system is required in all cases. Therefore, the AP and FD must operate with a suitable precision to track the lateral and vertical paths required by a specific RNP AR APCH procedure. When the dispatch or release of a flight is predicated on flying an RNP AR APCH approach that requires the use of AP at the destination and/or alternate aerodrome, the flight dispatcher or pilot in command must make sure that the AP is installed and operational.
- c) **Assessment of an RNP AR APCH dispatch or release.**- The operator must have a predictive performance capability to forecast whether the specific RNP will be available at the location and time of a desired RNP AR APCH operation. This capability can be provided through a ground service and does not need to reside in the aircraft avionic equipment. The operator must establish procedures requiring the use of this capability as a dispatch or release tool and as a flight-tracking tool in case of reported failures. RNP assessment must consider the specific combination of aircraft capabilities (sensors and integration).
  - 1) **Assessment of RNP AR APCH with GNSS updating.**- The predictive capability must take into account known and predicted temporary suspension of GNSS satellite service or other negative effects on navigation system sensors. The prediction program shall not use a masking angle of less than 5°, as operational experience indicates that satellite signals at low elevations are not reliable. The prediction must use the current GPS constellation with an algorithm identical to that used in the on-board equipment. For RNP AR APCH procedures in high terrain, the operator must use a masking angle appropriate to the terrain.
  - 2) From the initiation of the approach, RNP AR APCH procedures require GNSS updating.
- d) **NAVAID exclusion.**- The operator must establish procedures to exclude air navigation facilities in accordance with published NOTAMs (e.g., DMEs, VORs, and localizers). Rationality checks of the internal avionic equipment may not be appropriate for RNP AR APCH operations.
- e) **Validity of the navigation database.**- Upon initiating the system, the pilots of aircraft equipped with certified RNP systems must confirm that the navigation database is valid. The databases are expected to be current for the duration of the flight. If the AIRAC cycle changes during the flight, the operators and pilots must establish procedures to ensure the precision of navigation data,

including the suitability of navigation facilities used for defining routes and flight procedures. Traditionally, this has been accomplished by verifying electronic data against paper documents. One acceptable means is to compare aeronautical charts (new and old) to verify navigation fixes prior to flight dispatch or release. If an amended chart has been published for the procedure, the navigation database must not be used to conduct the operation.

### 3. FLIGHT CONSIDERATIONS

- a) **Flight plan modification.**- Pilots are not authorized to fly a published RNP AR APCH procedure unless it can be retrieved by its name from the navigation database and conforms to the published procedure. The lateral path must not be modified, except that the pilot may accept a clearance to fly direct to a fix located prior the FAF in the approach procedure, and that does not immediately precede an RF leg. The only other acceptable modification to the loaded procedure is to change speed and/or altitude waypoint constraints on the initial, intermediate, or missed approach segments (for example, corrections applied due to cold temperature or to comply with an ATC clearance/instruction).
- b) **Required equipment list.**- The flight crew must have a list of the equipment required to conduct RNP AR APCH procedures or alternate methods for addressing, during the flight, equipment failures that hinder the execution of an RNP AR APCH procedure (e.g., the quick reference handbook - QRH).
- c) **RNP AR APCH management.**- Flight crew operating procedures must ensure that the navigation system uses the appropriate navigation precision during the approach. If the approach chart shows several minima associated to different navigation precision values, the flight crew must confirm that the desired navigation precision has been entered in the RNP system. If the RNP system does not extract and set the navigation precision from the on-board database for each leg of the procedure, then the flight crew operating procedures must ensure that the lowest navigation precision required to complete the approach or missed approach has been selected before starting the approach.
- d) **GNSS updating.**- From the beginning of the approach, all instrument RNP AR APCH procedures require GNSS updating of the navigation position solution. The flight crew must verify that GNSS updating is available before starting the RNP AR APCH procedure. If at any time during the approach GNSS updating is lost and the navigation system does not have the performance to continue the approach, the flight crew must abandon the RNP AR APCH procedure, unless the pilot has in sight the visual references required to continue such approach.
- e) **Radio updating.**- The initiation of any RNP AR APCH procedure is based on GNSS updating. Except where specifically designated in a procedure as not authorized, DME/DME updating can be used as a reversal mode during the approach or missed approach when the system complies with the navigation precision. VOR updating is not authorized at this time. Consequently, the flight crew must follow operator procedures to inhibit specific facilities (see paragraph 2.d) of this appendix).
- f) **Approach procedure confirmation.**- The flight crew must confirm that the correct procedure has been selected. This procedure includes the confirmation of waypoint sequence, the rationality of track angles and distances, and any other parameter that can be modified by the pilot, such as altitude and speed constraints. A procedure must not be used if validity of the navigation database is in doubt. A navigation system text display or a navigation map display can be used.
- g) **Track deviation monitoring.**- Pilots must use a lateral deviation indicator, an FD and/or an AP in lateral navigation mode during RNP AR APCH procedures. Pilots of aircraft with lateral deviation indicators must ensure that indicator scaling (full-scale deflection) is suitable for the navigation precision associated with the various segments of the RNP AR APCH procedure.

All pilots are expected to maintain route centre lines, as depicted by on-board lateral deviation indicators and/or in the flight guidance, during all RNP operations, unless authorized to deviate by the ATC or under emergency conditions.

For normal operations, the cross-track error/deviation (the difference between the path estimated by the RNP system and the aircraft position relative to the path) shall be limited to  $\pm \frac{1}{2}$  the

navigation precision associated with the procedure segment.

Small lateral deviations from this requirement (e.g., overshooting or undershooting the limit) during or immediately after a turn are allowed, up to a maximum of 1 times (1xRNP) the navigation precision of the procedure segment.

The vertical deviation must be within 75 ft during the final approach segment. Lateral deviations shall be monitored above and below the glide path (GP). While being above the glide path provides a margin over the obstacles during the final approach, it can result in the pilot deciding to do a go-around closer to the runway, which reduces obstacle clearance during the missed approach.

Pilots must execute a missed approach if lateral deviation exceeds 1xRNP or if vertical deviation exceeds 75 ft, unless the pilot has in sight the visual references required to continue the approach.

- 1) Some aircraft navigation displays do not incorporate lateral and vertical deviations scaled for each RNP AR APCH operation in the primary field of view of the pilot. When using a moving map, a low-resolution vertical deviation indicator (VDI), or a numeric deviation display, flight crew training and procedures must ensure the effectiveness of these displays. Normally, this implies a demonstration of the procedure with a number of trained crews and the inclusion of this monitoring procedure in the recurrent training program for RNP AR APCH.
  - 2) For aircraft using a CDI for lateral path tracking, the AFM or the aircraft qualification guidance shall indicate which navigation precision (RNP value) and operations the aircraft supports and the effects of the operation on CDI scale. The flight crew must know the CDI full-scale deflection (FSD) value. The avionics system can automatically adjust the CDI scale (depending on the flight phase) or the flight crew can manually adjust such scale. If the flight crew manually selects the CDI scale, the operator must have procedures in place and provide training to ensure that the CDI scale selection is appropriate for the intended RNP AR APCH operation. The deviation limit must be readily visible, considering CDI scale (e.g., full-scale deflection).
- h) **System cross-check.-** For RNP AR APCH procedures with a navigation precision of less than 0.3, the flight crew must monitor the lateral and vertical guidance provided by the RNP navigation system to ensure that this guidance is consistent with other available data and displays provided by an independent means.
- Note.- This cross-check may not be necessary if lateral and vertical guidance systems have been developed taking into account a hazardous (severe or major) failure condition due to false information (see Appendix 2, paragraph 3.e) and if normal system performance supports airspace containment (see Appendix 2, paragraph 2.d).*
- i) **Procedures with RF legs.-** An RNP AR APCH procedure may require that aircraft be capable of executing an RF leg to avoid terrain and obstacles. Since not all aircraft have this capability, flight crews must know whether or not they can conduct these procedures. When flying an RF leg, flight crew compliance with the flight path is essential to maintain the track defined on the ground.

- 1) If a go-around maneuver is initiated during or immediately after an RF leg, the flight crew must be aware of the importance of maintaining the published path as closely as possible. The operator must develop and establish operating procedures for aircraft that do not stay in LNAV when a go-around maneuver is initiated, to ensure that the RNP AR APCH track defined on the ground is maintained.
- 2) Pilots must not exceed the maximum speeds shown in Table 4-1 during the RF leg. For example, an A 320 Category C must slow down to 160 KIAS at the final approach fix (FAF) or can fly as fast as 185 KIAS if using Category D minima. A missed approach prior to the decision altitude (DA) may require a segment speed for that segment to be maintained.



Table 4-1 – Maximum speed by segment and category

Indicated Airspeed (Knots)					
Segment	Indicated airspeed by aircraft category				
	Cat A	Cat B	Cat C	Cat D	Cat E
Initial and intermediate (IAF to FAF)	150	180	240	250	250
Final (FAF to DA)	100	130	160	185	As specified in the IAC
Missed approach (DA to MAHP)	110	150	240	265	As specified in the IAC
Airspeed restriction*	As specified in the IAC				

\* Airspeed restrictions may be used to reduce turn radius regardless of aircraft category.

- j) **Temperature compensation.**- For aircraft with temperature compensation capability as per paragraph 3.a)7) of Appendix 2 to this CA, flight crews may disregard temperature limits for RNP AR APCH procedures if the operator provides flight crews with training on the use of this capability. Temperature compensation through the aircraft system is applicable to VNAV guidance and is no substitute for flight crew compensating for cold temperature effects at minimum altitudes or the decision altitude. Flight crews must be familiar with the effects of temperature compensation when intercepting the compensated path described in documents EUROCAE ED-75B/RTCA DO-236B Appendix H.
- k) **Altimeter setting.**- Due to reduced obstacle clearance inherent to instrument RNP AR APCH procedures, the flight crew must verify that the current local altimeter is set prior to the FAF but not prior to the IAF. The execution of an instrument RNP AR APCH procedure requires that the current altimeter be set for the aerodrome of intended landing. Remote altimeter settings are not allowed.
- l) **Altimeter cross-check.**- Prior to the FAF, but not before the IAF, the flight crew must carry out a cross-check of both pilot altimeters to make sure they agree within  $\pm 100$  ft. If the cross-check fails, the crew must not continue with the approach. If the avionics system provides an automatic altitude comparison warning system for pilot altimeters, flight crew procedures shall indicate the action to be taken in the event of an altimeter comparator warning while executing an RNP AR APCH.
- Note.- This operational cross-check is not required if the aircraft system automatically compares altitudes to within 100 ft (see paragraph 3. d)15) of Appendix 2).*
- m) **VNAV altitude transitions.**- The aircraft VNAV barometric system provides fly-by vertical guidance to ensure a smooth transition when intercepting the glide path prior to the FAF. Small vertical shifts, which may occur in a vertical constraint (e.g., in the FAF), are considered operationally acceptable and desirable since they allow for the capture of a new or the next vertical segment. This temporary deviation below the published minima is acceptable as long as the deviation is limited to no more than 100 ft and is the result of a normal VNAV capture. This applies to both “leveling” and “altitude capture” segments that follow a climb or descent or vertical climb or beginning of a segment with descent, or when climb and descent paths with different slopes come together.
- n) **Non-standard climb gradient.**- When the operator intends to use a DA associated with a missed approach non-standard climb gradient, it must ensure that the aircraft will be able to comply with the climb gradient published for the expected weight (mass) of the aircraft, atmospheric conditions, and operating procedures before conducting the operation. When the operator has performance personnel available to determine whether its aircraft can meet the published climb gradients, such personnel must provide information to pilots about the climb gradients that they must comply with.
- o) **Engine-out procedures.**- Aircraft may demonstrate an acceptable flight technical error (FTE) with one engine inoperative when conducting RNP AR APCH procedures. Otherwise, flight crews are expected to take appropriate action in case of an engine failure during an approach, so no specific aircraft qualification is required in this case. The aircraft qualification must identify any performance limitation in case of engine failure to support the definition of the appropriate flight crew procedures. Operators must pay special attention to published procedures with non-standard climb gradients.

p) **Missed approach or go-around**

- 1) **Missed approach procedure requiring RNP 1.0.-** Where possible, the missed approach will require RNP 1.0. The missed approach of these procedures is similar to the missed approach of an RNP APCH operation.
- 2) **Missed approach procedures requiring RNP of less than 1.0.-** When necessary, RNP values of less than 1.0 will be used in the missed approach. For an operator to be approved to execute these approaches, the equipage and procedures must meet the criteria established in paragraph 6 of Appendix 2 (Requirements for missed approaches with an RNP of less than 1.0).
- 3) In many aircraft, a change may occur in lateral navigation when TOGA is activated during a missed approach or go-around. Also, in many aircraft, TOGA activation disconnects the AP and FD from LNAV guidance, and the FD reverts to track-hold derived from the inertial system. LNAV guidance to the AP and FD shall be re-engaged as quickly as possible.
- 4) Flight crew procedures and training programs must address the impact on navigation capability and flight guidance if the pilot initiates a go-around during a turn. In the event an early missed approach is initiated, the flight crew must follow the approach and missed approach tracks unless otherwise cleared by the ATC. The flight crew shall also be aware that RF legs are designated based on the maximum true speed at normal altitudes, and initiating an early missed approach will reduce the maneuverability margin, and will potentially make it impractical to hold the turn at missed approach speeds.
- 5) Upon loss of GNSS updating, the RNP guidance may begin to navigate on IRU, if installed on the aircraft, but the aircraft will begin to drift, degrading the navigation position solution. Therefore, when RNP AR APCH missed approach operations are based on IRU autonomous navigation, the inertial guidance can only provide RNP guidance for a specific amount of time.

q) **Contingency procedures**

- 1) **Failure while en route.-** The aircraft RNP capability is dependent upon operational equipment and GNSS satellites. Before initiating the approach, the flight crew must be capable of assessing the impact of equipment failure on the RNP AR APCH procedure and take the appropriate corrective action. As stated in paragraph 2.c) of this appendix, the flight crew must also be capable of assessing the impact of changes in GNSS constellation and take appropriate corrective action.
- 2) **Failure on approach.-** The operator contingency procedures must cover at least the following conditions:
  - (a) RNP system components failures, including those affecting lateral and vertical deviation performance (e.g., failures of GPS sensors, AP or FD).
  - (b) Loss of navigation signal-in-space (loss or degradation of external signal).

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## APPENDIX 5

### TRAINING PROGRAM

#### 1. INTRODUCTION

The operator must provide training for key personnel on the use and application of RNP AR APCH procedures (for example, flight crews, flight dispatchers, performance engineers, and maintenance personnel). A full understanding of operating procedures and best practices is crucial for safe aircraft operation during RNP AR APCH procedures. The training program must provide sufficient detail on aircraft navigation and flight control systems to enable the flight crew to identify failures affecting their RNP capability and apply the appropriate normal, non-normal, and emergency procedures. The required training must include both knowledge and evaluation of skills acquired by flight crews, flight dispatchers, performance engineers, and maintenance personnel.

##### a) Flight crew training

- 1) Each operator is responsible for providing flight crews with training on the specific RNP AR APCH operations it conducts. The operator must include training on the various types of RNP AR APCH procedures and the equipment required. Training must include a discussion of regulatory requirements. The operator must include these requirements and procedures in its operating and training manuals as applicable. This material must address all aspects of RNP AR APCH procedures conducted by the operator, including the applicable operational authorization (e.g., operational specifications (OpSpecs)). An individual must have completed the appropriate ground and/or flight training segments before participating in RNP AR APCH procedures.
- 2) Flight training segments must include training and verification modules representative of the type of RNP AR APCH operations the operator conducts during airline activities. Many operators can provide training in RNP AR APCH procedures in accordance with the training provisions and standards established by advanced qualification programs (AQP). Operators can also do assessments in line-oriented flight training (LOFT) and selected-event training (SET) scenarios or in a combination of both. The required flight training modules can be conducted in flight training devices (FTD), flight simulators, and other enhanced training devices, as long as these training media accurately replicate operator equipment and RNP AR APCH operations, and are CAA-approved.

##### b) Qualification training for LAR 91, 121, and 135 flight crews

- 1) Operators must refer to RNP AR APCH training and qualification modules during initial, transition, upgrade, recurrent, discrepancy, re-qualification, and autonomous (self-teaching) training, in accordance with the approved training programs. The skill of each pilot to understand and properly use RNP AR APCH procedures will be assessed based on qualification standards (initial RNP AR APCH assessment). The operator must also develop recurrent qualification standards to ensure its flight crews properly maintain their knowledge of, and proficiency in RNP AR APCH operations (RNP AR APCH recurrent qualification).
- 2) Operators may address RNP AR APCH topics separately or integrated with other curriculum elements. For example, a flight crew qualification may focus on a specific aircraft during transition, upgrade, or discrepancy courses. General training must also address RNP AR APCH qualification (e.g., during recurrent training or verification events such as proficiency checks (PC), proficiency training (PT), line-oriented evaluations (LOE), or special-purpose operational training (SPOT)). A separate, independent RNP AR APCH qualification program can also address RNP AR APCH training (e.g., by completion of a special RNP AR APCH curriculum at an operator training centre or designated crew bases).
- 3) **Credit for using the approved RNP training program of an operator in service.-** Operators intending to receive credit for RNP training, when their proposed program relies on previous RNP training (for example, special instrument approach procedures (IAPs)), must

receive specific authorization from their principal operations inspector (POI). In addition to the current RNP training program, the operator must provide training on discrepancies between the existing training program and RNP AR APCH training requirements.

4) **Flight dispatcher training**

- (a) Training for flight dispatchers must include:
  - (1) training on the different types of RNP AR APCH procedures;
  - (2) the importance of specific navigation and other equipment during RNP AR APCH operations, and regulatory RNP AR APCH procedures and requirements.
- (b) Flight dispatcher procedures and training manuals must include the requirements of paragraph (a) above.
- (c) Training must also cover all aspects of RNP AR APCH operations conducted by the operator, including applicable authorizations (e.g., OpSpecs, operations manual, LOA).
- (d) A dispatcher must have completed the appropriate training course before participating in RNP AR APCH operations.
- (e) Additionally, dispatcher training must address how to determine:
  - (1) RNP AR APCH availability (taking into account equipment capabilities);
  - (2) MEL requirements;
  - (3) aircraft performance; and
  - (4) navigation signal availability (e.g., GPS RAIM, RNP capability predictive tools) for destination and alternate aerodromes.

2. **GROUND TRAINING SEGMENTS**

The ground segment of the RNP AR APCH training program must include modules addressing the following subjects during the initial introduction of RNP AR APCH operations and systems for flight crews. For recurrent training programs, the training curriculum needs only to review the initial curriculum requirements and address new, revised, or emphasized aspects of RNP AR APCH operations.

- a) **General concepts of RNP AR APCH operations.-** RNP AR APCH academic training must address the theory behind RNP AR APCH systems to the extent appropriate to ensure proper operational use. Flight crews must understand the basic operational concepts of RNP AR APCH systems, its classifications and limitations. Training must include general knowledge and operational application of instrument RNP AR APCH procedures. This training module must address the following specific elements:
  - 1) definition of RNAV, RNP, RNP AR APCH;
  - 2) the difference between RNAV and RNP;
  - 3) the types of RNP AR APCH procedures and familiarity with the charts for these procedures;
  - 4) RNP programming and display and aircraft-specific displays (e.g., current navigation performance);
  - 5) how to enable and disable RNP-related navigation updating modes;
  - 6) the appropriate navigation precision for the different flight phases and RNP AR APCH procedures, and how to select it (if required);
  - 7) the use of GPS RAIM (or equivalent) forecasts and the effects of RAIM availability on RNP AR APCH procedures (flight crews and dispatchers);
  - 8) when and how to terminate RNP navigation and transfer to traditional navigation due to loss of RNP and/or the required equipment;

- 9) how to determine database validity and whether it contains the required navigation data for using waypoints;
- 10) explanation of the different components that contribute to the total system error and their characteristics (e.g., the effect of temperature on barometric vertical navigation (baro-VNAV), drift characteristics when using IRU with no radio updating);
- 11) Temperature compensation. Flight crews operating avionics systems with a compensation function may disregard temperature limits on RNP AR APCH procedures if the operator provides flight crew training on the operation of such function and crews use the function. The training must indicate that temperature compensation through the aircraft system is applicable to VNAV guidance and is not a substitute for flight crew compensating for cold temperature effects on minimum altitudes or the decision altitude.

**Note 1.-** Pilots are responsible for all low (cold) temperature corrections required at all published minimum altitudes/heights. This includes:

- altitudes/heights for initial and intermediate legs;
- the DA/H; and
- subsequent missed approach altitudes/heights.

**Note 2.-** The VPA of the final approach path is protected against the effect of low temperatures by the procedure design.

- b) **ATC communications and coordination for conducting RNP AR APCH operations.-** Ground training must instruct the flight crew on flight plan classification, any ATC procedure applicable to RNP AR APCH operations, and the need to advise ATC immediately when the performance of the aircraft navigation system is no longer suitable to support continuation of an RNP AR APCH procedure. The flight crew must know that navigation sensors are part of the basis for RNP AR APCH compliance, and must be capable of assessing the impact of failure of any avionics equipment or ground navigation systems and services on flight plan compliance.
- c) **RNP AR APCH equipment components, controls, displays, and alerts.-** Academic training must cover RNP terminology, symbols, operation, optional controls, and display features, including aspects that are specific to the operator implementation or systems. Training must address applicable alerts and limitations. Flight crews and dispatchers should achieve full understanding of the equipment used in RNP operations and any limitations on the use of the equipment during these operations.
- d) **AFM operating procedures and information.-** The AFM or other evidence of aircraft eligibility must address normal and non-normal flight crew operating procedures, responses to failure alerts, and any limitation, including information related to RNP modes of operation. Training must also address contingency procedures for loss or degradation of RNP capability. The accepted or approved operations manuals, including the aircraft operations manual (AOM/FCOM) and the pilot operations handbook (POH), must contain this information in the corresponding sections.
- e) **MEL provisions.-** Flight crews must have a full understanding of MEL requirements supporting RNP AR APCH operations.

### 3. FLIGHT TRAINING SEGMENTS

In addition to academic training, flight crews must receive appropriate operational training. Training programs must address the proper execution of RNP AR APCH procedures according to the documentation of the original equipment manufacturer (OEM). The operational training must include RNP AR APCH procedures and limitations, standardization of cockpit electronic display configuration during an RNP AR APCH procedure, recognition of aural warning signals, alerts, and other annunciations that can affect compliance of an RNP AR APCH procedure, and timely and effective responses to loss of RNP AR APCH capability in a variety of scenarios embracing the breadth of RNP AR APCH procedures that the operator plans to execute. Flight training may use approved FTDs or flight simulators. This training must include the following specific elements:

- a) procedures for verifying that each pilot altimeter has a valid setting before initiating the final approach in an RNP AR APCH procedure, including any operational limitations associated with the source(s) for altimeter setting and the latency of checking and setting the altimeters upon approaching the FAF;
- b) use of RADAR, EGPWS (TAWS), or other avionics systems to support track monitoring and avoidance of obstacles and adverse weather by the flight crew;
- c) the effect of wind on aircraft performance during RNP AR APCH procedures and the need to remain within the containment area, including any operational limitations due to wind, and the essential aircraft configuration to safely complete an RNP AR APCH procedure;
- d) the effect of ground speed on compliance with RNP AR APCH procedures, and bank angle constraints that hinder the ability to remain on the centre line of the course;
- e) the relationship between RNP and the appropriate line of approach minima on a published RNP AR APCH procedure, and any operational limitation if the available RNP degrades or is not available prior to the approach (this includes flight crew procedures outside the FAF *versus* inside the FAF);
- f) complete and concise flight crew briefings on all RNP AR APCH procedures and the important role cockpit resource management (CRM) plays on successful completion of an RNP AR APCH procedure;
- g) data insertion alerts and use of a wrong navigation precision for a desired segment of an RNP AR APCH procedure;
- h) performance requirements for coupling the AP/FD to the navigation system lateral guidance on RNP AR APCH procedures requiring an RNP of less than 0.3;
- i) the importance of aircraft configuration to ensure that it maintains any required speed during RNP AR APCH procedures;
- j) the events that trigger a missed approach when using aircraft RNP capability;
- k) any bank angle constraint or limitation on RNP AR APCH procedures;
- l) the potentially detrimental effect of reducing flap setting, reducing the bank angle, and increasing airspeed on the ability to comply with an RNP AR APCH procedure.
- m) the knowledge and skills required by the flight crew to properly conduct RNP AR APCH operations;
- n) the programming and operation of the FMC, AP, auto-throttles, RADAR, GPS, INS, EFIS (including a moving map), and EGPWS (TAWS) in support of RNP AR APCH procedures;
- o) the effect of activating TOGA during a turn;
- p) FTE monitoring and its effect on go-around decision and execution;
- q) loss of GNSS during a procedure;
- r) performance aspects associated with reversal to radio position updating, and limitations on the use of DME and VOR updating;
- s) flight crew contingency procedures for loss of RNP capability during a missed approach. Due to lack of navigation guidance, training must emphasize the contingency actions that the flight crew must take to achieve separation from the ground and obstacles. The operator must tailor these contingency procedures to the specific RNP AR APCH procedures;
- t) as a minimum, each pilot must complete two RNP AR APCH procedures using the unique characteristics of the approved procedures of the operator (e.g., RF legs, loss of RNP). One procedure must culminate in a transition to landing and another procedure must culminate in the execution of an RNP missed approach procedure.

#### 4. EVALUATION MODULE

- a) **Initial evaluation of RNP AR APCH procedures and knowledge.-** The operator will evaluate the knowledge that each member of the flight crew has with respect to RNP AR APCH procedures before they use these procedures. As a minimum, this must include a complete evaluation of pilot procedures and the specific performance requirements for RNP AR APCH operations. An acceptable means for this initial evaluation includes one of the following:
- 1) An evaluation by an authorized instructor evaluator or an operator inspector, using an simulator or training device.
  - 2) An evaluation by an authorized instructor evaluator or an operator inspector during on-line operations, training flights, proficiency check (PC) or proficiency training (PT) events, operational experience (OE), en-route checks and/or on-line checks.
  - 3) Line-oriented flight training (LOFT)/line-oriented evaluation (LOE).- LOFT/LOE training programs using an approved simulator that incorporates RNP operations with the unique RNP AR APCH characteristics (e.g., RF legs, loss of RNP) of the approved procedures of the operator.
- b) **Specific elements of the evaluation module.-** The specific elements that must be included in the evaluation module are:
- 1) Demonstrate the use of any RNP limits/minima that might affect various RNP AR APCH operations.
  - 2) Demonstrate the application of position radio updating procedures, such as enabling and disabling FMC ground-based radio updating (e.g., DME/DME and VOR/DME updating), and knowledge of when to use this feature. If aircraft avionics does not include the capability of disabling radio updating of the position, then training must ensure the flight crew is capable of adopting operational measures to mitigate the lack of this feature.
  - 3) Demonstrate the ability to monitor the lateral and vertical flight paths relative to the programmed flight path, and complete the appropriate flight crew procedures when exceeding an FTE lateral or vertical limit.
  - 4) Demonstrate the ability to read and interpret a RAIM (or equivalent) forecast, including forecasts predicting RAIM unavailability.
  - 5) Demonstrate how to properly configure the FMC, the weather RADAR, EGPWS (TAWS), and the moving map for the various RNP AR APCH operations and scenarios that the operator intends to implement.
  - 6) Demonstrate the use of flight crew briefings and checklists for RNP AR APCH operations, with emphasis on CRM.
  - 7) Demonstrate knowledge and skills to conduct an RNP AR APCH missed approach procedure in a variety of operating scenarios (e.g., loss of navigation or failure to obtain visual conditions).
  - 8) Demonstrate speed control during segments requiring speed restrictions to ensure compliance with the RNP AR APCH procedure.
  - 9) Demonstrate proficient use of instrument approach charts (IAC), briefing cards, and checklists.
  - 10) Demonstrate the ability to complete a stable RNP AR APCH procedure: bank angle, speed control, and staying on the centre line of the procedure.
  - 11) Know the operational limit for deviations below the desired flight path on an RNP AR APCH procedure and how to precisely monitor the aircraft position relative to the vertical path.

## 5. RECURRENT TRAINING ON RNP AR APCH KNOWLEDGE AND PROCEDURES

- a) **RNP AR APCH recurrent training.-** In its training program, the operator must incorporate



recurrent RNP training and evaluation covering the unique characteristics of RNP AR APCH operations with respect to the approved procedures.

- b) Each pilot must fly a minimum of two RNP AR APCH procedures in each duty position (pilot flying the aircraft (PF) and pilot monitoring the aircraft (PM)), with one approach culminating in a complete landing and one culminating in a missed approach.

**Note.-** *Equivalent RNP approaches may be credited toward compliance of the requirement for two RNP AR APCH procedures.*

**APPENDIX 6****RNP AR APCH MONITORING PROGRAM**

1. The operator must have an RNP AR APCH monitoring program to ensure continued compliance with the guidelines of this AC and to identify any negative performance trends. As a minimum, the monitoring program will include the following activities: During the provisional approval, the operator must submit the following information every 30 days to the authority that issued the authorization. Subsequently, it will continue collecting information and periodically reviewing it to identify potential safety risks. It will also maintain a summary of the processed information.

- a) Total number of RNP AR APCH procedures executed.
- b) Number of satisfactory approaches per aircraft and system (they are considered satisfactory if completed as planned without any anomalies in the navigation or guidance system).
- c) Reasons for unsatisfactory approaches, such as:
  - 1) UNABLE REQ NAV PERF, NAV ACCUR DOWNGRAD, or other messages activated during the approach;
  - 2) Excessive lateral or vertical deviation;
  - 3) EGPWS (TAWS) warning;
  - 4) Disconnection of the AP system;
  - 5) Navigation data errors; and
  - 6) Reports of anomalies by the pilot.
- d) Comments by the crew.

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**APPENDIX 7****REQUIREMENTS FOR OBTAINING RNP AR APCH AUTHORIZATION**

In order to obtain operational approval, the operator will take the following steps, taking into account the criteria established in paragraphs 7, 8, 9, and 10 and in Appendices 2, 3, 4, 5, 6, 8, and 9 to this AC.

- a) *Airworthiness approval.*- Aircraft shall have the corresponding airworthiness approvals as established in paragraphs 8 and 9 of this AC.
- b) *Application.*- The operator shall submit the following documentation to the CAA:
  - 1) *The application for RNP AR APCH operational approval.*
  - 2) *Aircraft qualification documentation.*- The documentation of the manufacturer demonstrating that the proposed aircraft equipment meets the requirements of this AC as described in Appendix 2. This documentation shall contain hardware and software requirements, procedural requirements, and limitations.
  - 3) *Type of aircraft and description of aircraft equipment to be used.*- The operator will provide a configuration list with details of the relevant components and the equipment to be used in the operation. The list shall include each manufacturer, model, and version of software installed in the FMS.
  - 4) *Operational procedures and practices.*- The operator manuals must properly describe the characteristics of the intended area of operation and operational (navigation) practices and procedures identified in Appendix 4 to this AC. LAR 91 operators shall confirm that they will operate using identified practices and procedures.
  - 5) *Navigation data validation program.*- The details of the navigation data validation program are described in Appendix 3 to this AC.
  - 6) *Flight crew training program.*- According to Appendix 5 to this AC, operators must submit the training syllabi and other appropriate teaching material to demonstrate that operations have been incorporated into their programs. Training programs must properly address the special characteristics of the intended area of operation and (navigation) operational practices and procedures identified in Appendix 4 to this AC.
  - 7) *Flight simulator training.*- Operators must submit a description of the training to be provided using simulation, the credits to be granted to simulation, the simulator qualification, and how this training will be used for on-line pilot qualification. Normally, this training will be included in the flight crew training program.
  - 8) *Training programs for dispatchers and flight trackers.*- Operators will submit the training syllabi and other appropriate teaching material to demonstrate that this personnel has been incorporated into its programs as established in Appendix 5 to this AC.
  - 9) *Instruction program for maintenance program.*- Operators will submit instruction syllabus corresponding to maintenance personnel.
  - 10) *Operation manuals and checklists.*- Operators will submit the operation manuals and checklists containing information and guidance for the operations requested.
  - 11) *Maintenance procedures.*- The operator will submit the maintenance procedures containing airworthiness and maintenance instructions for the systems and equipment to be used in the operation. The operator will provide a procedure for withdrawing and then restoring RNP AR APCH operational capability on the aircraft.
  - 12) *RNP AR APCH monitoring program.*- The operator must submit a program for collecting data on executed RNP AR APCH procedures. Each operation must be recorded and unsatisfactory attempts must include the factors that prevented the successful completion of an operation.
  - 13) *MEL.*- The operator will submit any revision to the MEL that is required for the conduction of

operations.

- 14) *Validation.*- The operator will submit a validation test plan to demonstrate its ability to conduct the intended operation (see Chapter 13 of Volume II, Part II, of the SRVSOP Operations Inspector Manual (OIM)). The validation plan shall at least include the following:

- (a) a statement that the validation plan has been designated to demonstrate the capability of the aircraft to execute RNP AR APCH procedures;
- (b) the operational and dispatch procedures of the operator;
- (c) the effectiveness of the operator training program;
- (d) the effectiveness of maintenance procedures; and
- (e) MEL procedures.

**Note 1.-** The validation plan shall benefit from ground training devices, flight simulators, and aircraft demonstrations. If validation is done on board an aircraft, it must be done during in daytime and in VMC.

**Note 2.-** Validations may be required for each manufacturer, model and version of software installed in the FMS.

- 15) *Conditions or limitations necessary or required for authorizations.*- The operator will submit any condition or limitation necessary or required for the authorizations.

- 16) *Flight operational safety assessment (FOSA).*- The operator will submit the methodology and process developed.

- c) *Training.*- Once the amendments to the manuals, programs, and documents submitted have been accepted or approved, the operator will provide the required training to its personnel.
- d) *Validation flights.*- Validation flights will be conducted in accordance with paragraph b) 13) above.
- e) *Issuance of provisional authorization to conduct RNP AR APCH operations.*- Once the operator has completed the operational approval process, the CAA will issue the provisional authorization for the operator to conduct RNP AR APCH operations.
  - 1) *LAR 91 operators.*- For LAR 91 operators, the CAA will issue a letter of acceptance (LOA) containing a provisional authorization to conduct RNP AR APCH operations according to the guidelines of this AC.
  - 2) *LAR 121 and/or 135 operators.*- For LAR 121 and/or LAR 135 operators, the CAA will issue the corresponding OpSpecs reflecting the RNP AR APCH provisional authorization.
- f) *Issuance of final approval.*- The CAA will issue the amended OpSpecs or the amended LOA authorizing the use of the lowest applicable minima, once the operators have satisfactorily completed the time period and the number of approaches required by the CAA, in accordance with paragraph 9.1 of this AC.

## APPENDIX 8

### RNP AR APCH Approval Process

- a) The RNP AR APCH approval process encompasses the airworthiness and the operational approval. Although the two have different requirements, they must be considered within the same process.
- b) This process constitutes an orderly method used by CAAs to ensure that applicants meet the established requirements.
- c) The approval process is made up by the following phases:
  - 1) Phase one: Pre-application
  - 2) Phase two: Formal application
  - 3) Phase three: Review of documentation
  - 4) Phase four: Inspection and demonstration
  - 5) Phase five: Approval
- d) In *Phase one - Pre-application*, the CAA meets with the applicant or operator (pre-application meeting), who is advised of all the requirements it must meet during the approval process.
- e) In *Phase two - Formal application*, the applicant or operator submits the formal application, accompanied by all the relevant documentation, in accordance with Appendix 7 to this AC.
- f) In *Phase three - Review of documentation*, the CAA evaluates the documentation and the navigation system to determine their admissibility and the approval method to be applied with respect to the aircraft. As a result of this review and evaluation, the CAA may accept or reject the formal application together with the documentation.
- g) In *Phase four - Inspection and demonstration*, the operator will train its personnel and implement the validation plan.
- h) In *Phase five - Approval*, the CAA issues the RNP AR APCH provisional authorization once the operator has met the airworthiness and operational requirements. For LAR 121 and 135 operators, the CAA will issue the OpSpecs, and for LAR 91 operators, it will issue an LOA.

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## APPENDIX 9

### FLIGHT OPERATIONAL SAFETY ASSESSMENT (FOSA)

#### 1. INTRODUCTION

The objective of RNP AR APCH procedures is to provide safe flight operations. Traditionally, safety has been defined by a target level of safety (TLS) and specified as a collision risk of  $10^{-7}$  per approach. For RNP AR APCH operations, a different methodology, known as flight operational safety assessment (FOSA) is used. The FOSA is intended to provide a safety level that is equivalent to the traditional TLS.

With the FOSA, the safety objective is met by taking into account more than just the aircraft navigation system. The FOSA combines quantitative and qualitative analyses and evaluations of the navigation systems, aircraft systems, operational procedures, hazards, failure mitigations, normal, rare-normal and non-normal conditions, and the operational environment.

The FOSA relies on aircraft qualification, operational approval, and instrument procedure design criteria to address mostly the general technique, procedures and factors of the process. Additionally, operational expertise, technique and experience are required to conduct and complete the FOSA.

This appendix provides an overview of hazards and mitigations to assist States in applying these criteria. Safety of RNP AR APCH operations rests with the operator and the air navigation service provider (ANSP), as described in this appendix.

A FOSA must be conducted for RNP AR APCH procedures when the specific aircraft characteristics, operational environment, obstacles, etc., warrant the conduction of an additional assessment to ensure that safety objectives are met. This assessment must give proper attention to the inter-dependence of design, aircraft capability, crew procedure, and operational environment elements.

The FOSA is a key part of the operational authorization for RNP AR APCH procedures. This methodology is associated with a specific type of aircraft or a specific performance, and may be applied to a demanding environment.

#### 2. BACKGROUND

- a) La FOSA is used to make a safety case for RNP AR APCH operations. This methodology was developed in response to the following factors:
  - 1) System and aircraft certification and demonstration to determine their performance and capabilities are related to rules and criteria in force at a given point in time. This condition establishes a safety basis for aircraft operations. As a result, the aircraft is known to be safe if related to known airspace types, operations, and infrastructures.
  - 2) Throughout time, operators and ANSPs have developed new and novel operational solutions to the problems or limitations encountered in general flight operations.
  - 3) The implementation of new and novel procedures allows aircraft and systems to operate in a way that varies from the original design and aircraft capability approvals.
  - 4) In some cases, a new application or operational procedure exposes the aircraft to failures and hazards that were not considered in the basic system design and in the approval.
  - 5) Normally, airworthiness guidelines cannot keep pace with the new and original operational applications. The FOSA helps to address this issue.
- b) The significant difference between the FOSA and other safety analysis tools is that this methodology applies a technical judgment based on combined qualitative and quantitative assessments of aircraft and flight operations. This means that the FOSA is not a safety analysis, or a risk analysis, or a risk model.
- c) While the FOSA must consider risk estimates and exposures due to specific hazards and failures,



the main aspect of the assessment is confidence on the technical judgment to determine acceptable mitigations for hazards or failures.

- d) Although the FOSA has recently been formalized as a process in connection with RNP AR APCH operations, it has been extensively applied to assess particular cases, like the operations of a customer whose procedure design may significantly differ from the standard, and where there is a significant dependence on aircraft capability and performance. What the FOSA really offers is a process that repeats itself and a high level of standardization of case considerations and conditions.

### **3. DOCUMENTATION RELATED TO THE FOSA AND RNP AR APCH OPERATIONS**

The FOSA is part of the total data package that must be compiled or created when an operator wishes to obtain an operational approval for RNP AR APCH procedures. Most of the aspects of the following RNP AR APCH package must be compiled or at least defined before conducting the FOSA.

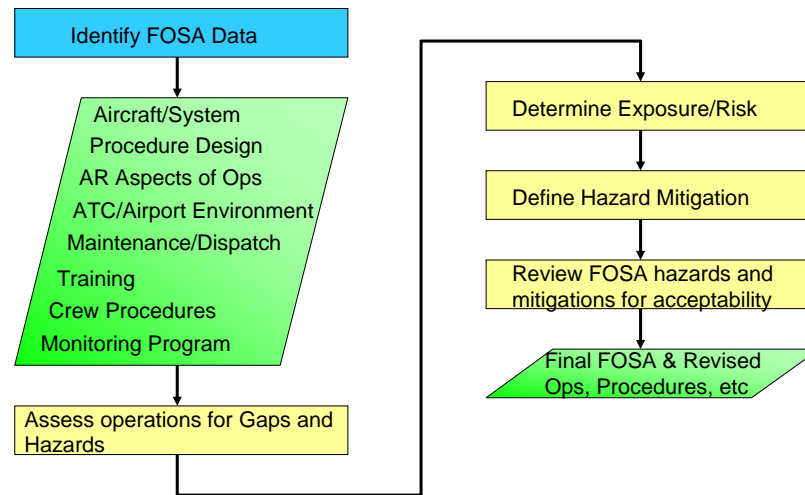
- a) \*Aircraft capability and qualification;
- b) Design of procedures, airspace, and intended operations;
- c) Identification of non-standard aspects of procedure design;
- d) \*Identification of any special aircraft capability or performance requirements;
- e) Description of the aerodrome and operation in the airspace;
- f) Air traffic environment and operations;
- g) \*Maintenance process and procedures;
- h) \*Dispatch guidance and procedures;
- i) \*Training (flight crews, operations, air traffic, dispatch, recurrent training);
- j) \*Flight crew procedures;
- k) \*AR operations monitoring program; and
- l) \*Minimum equipment list

Most of the material with an asterisk (\*) may have been developed to support aircraft type design or as part of the operational approval. In any case, specific acceptable means of compliance have been developed in this AC or in equivalent documents, like FAA AC 90-101 and AMC 20-26.

### **4. THE FOSA PROCESS**

The FOSA process depends on the following factors:

- a) a group of experts that includes;
  - 1) the operator (flight operations, dispatch, maintenance, inspectors, safety, quality system, etc.),
  - 2) air traffic services (ATC controller, airspace planner, principal operations inspectors, safety management, etc.);
  - 3) regulators; and
  - 4) experts on aircraft and system technical support.
- b) a process leader capable of facilitating the guiding the review;
- c) access to, or direct knowledge of the information required in paragraph 3; and
- d) the process steps described in Table 9-1 – FOSA Process Steps:

**Table 9-1 – FOSA Process Steps**

## 5. FOSA PREPARATION

As documents and the data package are being organized and developed, the operator must review specific data or relevant information for the FOSA, including some of the following aspects:

- What are the operational requirements or objectives?
- What is the operational environment?
- How do the aircraft operational and functional capabilities conform to procedure design requirements?
- What specific system performance assessments and analyses have been performed to support aircraft qualification?
- Are services and infrastructure suitable for the RNP AR APCH operation?
- What RNP training is currently provided to flight crews and ATC?
- What are the flight crew procedures for RNP operations?
- How are RNP navigation specifications incorporated into ATS operations?

## 6. FLIGHT OPERATIONAL SAFETY ASSESSMENT (FOSA)

### 6.1 General.-

As part of the application package of the operator for RNP AR APCH operations, the FOSA shall contain:

- An introduction or overview;
- A description of the safety assessment process and criteria used;
- A description of the system and of the RNP AR APCH operation assessed;
- The identification of risk areas, hazards and severity;
- Mitigation of risks; and
- Conclusions and recommendations.

### 6.2 Assessment criteria.-

- The FOSA shall identify the specific conditions or hazards associated with the aircraft, aircraft performance, navigation services, ATC, flight crew, operations of the operator, procedures, etc. In

many cases, the total package of identified potential hazards will include many of the hazards already identified through aircraft certification, operator procedures, and air traffic operations.

- b) Some times, the FOSA may contain several of the hazards contemplated in the aircraft system safety analysis. In this case, the assessment helps to make the safety case rather than to re-analyze aircraft airworthiness. Additionally, this reduces the probability of multiple mitigations for a risk that requires a single mitigation.
- c) The FOSA applies the qualitative technique and operational experience, as well as technical judgment and relevant data availability. The assessment of findings regarding risk severity and likelihood shall follow the criteria contained in Table 9-2 – Risk severity and likelihood of success, which is based on ICAO Doc 9859 – Safety Management Manual.

**Table 9-2 – Risk Severity and Likelihood of Occurrence**

Risk Severity		Likelihood of Occurrence	
Level		Probability	
Catastrophic	Equipment destroyed Multiple casualties	Frequent	Likelihood of occurring many times
Hazardous	Significant reduction of safety margins, physical suffering or workload such that there can be no confidence in the operators precisely or fully performing their tasks. Several casualties or seriously injured. Significant damage to the equipment.	Occasional	Likelihood of occurring some times
Significant (Major)	Significant reduction of safety margins, reduction of operator ability to face adverse operational conditions due to an increased workload or conditions hindering efficiency. Serious incident. Injured individuals.	Remote	Not very likely, but possible.
Of little importance (Minor)	Nuisance. Operational limitations. Use of emergency procedures. Minor incident.	Unlikely	Its occurrence is very unlikely.
Negligible	Of little consequence.	Extremely unlikely	Its occurrence is almost unconceivable.

- d) It is important to note that a risk assessment cannot be assumed to be always the same in each FOSA. A failure or condition considered as “major/unlikely” for an aircraft, procedure, and operational environment could be easily considered as “hazardous/remote” for another aircraft, procedure, and operational environment.

**6.3** The following conditions are examples of the most significant hazards and mitigations associated to a specific aircraft, operational criterion, and RNP AR APCH operational procedures.

- a) **Aircraft**

- 1) This area of the FOSA is derived from the safety analysis of aircraft systems, the documentation describing the system, and operational experience. The aspects to consider are as follows:
  - (a) Failure of the following systems:
    - navigation;
    - flight guidance;
    - flight instruments for approach, missed approach or departure (for example, loss of GNSS updating, receiver failure, auto-pilot disconnect, FMS failure, etc.).

*Note.- Depending on the aircraft, this may be addressed in the aircraft design and operational procedures as cross-check guidance (e.g., dual equipment for lateral errors, use of EGPWS/TAWS).*
  - (b) Malfunction of altimetry or air data systems.- The risk can be mitigated through a cross-check procedure between two independent systems.
- 2) The FOSA must also consider normal, rare-normal, and non-normal conditions.
  - (a) Normal performance.- Lateral and vertical precision and RNP performance are addressed in aircraft requirements, in the aircraft itself, and in the systems normally operated in standard configurations and operating modes, while individual error components are monitored through the design system and crew procedures.
  - (b) Rare-normal and non-normal performance.- RNP lateral and vertical precision is assessed through system failures, as part of aircraft qualification. Additionally, other rare-normal and non-normal conditions, as well as ATC operating conditions, flight crew procedures, NAVAID infrastructure, and the operational environment are also assessed with respect to RNP or 2xRNP, as appropriate. When the results of a failure or condition are not acceptable for continued operations, mitigations must be developed or limitations established for the aircraft, flight crew and/or operation.

**b) Aircraft performance**

- 1) The RNP AR APCH procedure design criteria are linked to general aircraft performance. The result may be conservative in terms of performance margins, depending on the aircraft and the systems that have been assessed. These are the specific parameters that shall be assessed for the deviation as they relate to those in the procedure design, such as bank angle limit, climb, high altitude performance, etc.
- 2) *Inadequate performance to conduct the approach.-* The initial aircraft qualification and operational procedures ensure an adequate performance on each approach, as part of flight planning and to initiate or continue the approach. Consideration shall be given to aircraft configuration and any configuration change associated with a go-around (e.g., engine failure, flap retraction).
- 3) *Loss of engine.-* Loss of an engine while conducting an RNP AR APCH procedure is a rare occurrence due to high engine reliability and the short exposure time during the approach. Operators are expected to develop flight procedures and training allowing them to take appropriate action to mitigate the effects of a loss of engine through a go-around and taking manual control of the aircraft, if necessary.

**c) Navigation services**

- 1) The use and availability of navigation services are critical in RNP AR APCH applications, where small RNP values are required for the approach and possible extraction maneuvers. Multi-sensor navigation systems must be assessed as to use and selection of sensors. The following must be considered:
  - (a) *Use of NAVAIDs outside of their designated coverage or in test mode.* Aircraft requirements and operational procedures have been developed to mitigate this risk.

- (b) *Navigation database errors.*- Procedures must be validated through a validation flight specific to the operator and aircraft, and the operator must have a process defined to maintain validated data through navigation database updates.

*Note.- Navigation database assurance is covered by the letters of authorization issued by the CAAs to database manufacturers, which must be combined with operator procedures to ensure that the correct and updated databases are installed on the aircraft.*

d) **ATC operations**

- 1) Frequently, the ATC is not involved in the implementation of RNP AR APCH operations until it is too late. An early revision of ATC operational aspects is critical to enable RNP AR APCH procedures. In this sense, the following must be considered:
  - (a) Procedures assigned to an aircraft that is not RNP AR APCH capable: Operators are responsible for not accepting the authorization.
  - (b) The ATC provides vector guidance onto an approach whose performance cannot be achieved by the aircraft: ATC procedures and training must ensure obstacle clearance until the aircraft is established on the procedure. The aircraft shall not be guided by the ATC over or towards a point too close to the curved segments of the procedure.

e) **Flight crew operations**

- 1) Human factors in RNP AR APCH operations are related to an increased reliance on ground and air automation to reduce human error exposure and incidents. However, since human action and interaction are required, at least the following must be considered:
  - (a) Incorrect barometric altimeter setting: Is there a flight crew entry and check procedure to mitigate this risk?
  - (b) Incorrect procedure selection or loading.- Is there a flight crew procedure to verify that the loaded approach corresponds to the published procedure? Is there an on board display requirement?
  - (c) Incorrect flight control mode selection: Is there any training on the importance of the flight control mode, and an independent procedure to monitor an excessive path deviation?
  - (d) Incorrect RNP selection: Is there a flight procedure to check if the RNP loaded on the system corresponds to the published value?
  - (e) Go-around and missed approach: Assess the risk of a balked approach at or below the DA (H). Note that this does not respond to procedure design criteria.
  - (f) Unfavorable meteorological conditions: What is the risk of losing or significantly reducing visual reference that might result in, or require a go-around, and what would be the effect?

f) **Infrastructure**

- 1) Support infrastructure and services are an integral part of aircraft performance: Some aspects are already addressed in the aircraft system risk and safety analyses.
- 2) GNSS satellite failure: This condition is assessed during aircraft qualification to ensure that it is possible to maintain obstacle clearance, considering the low probability of failure occurrence.
- 3) Loss of GNSS signals: Relevant independent equipment (e.g., IRU) is required for RNP AR APCH operations with RF legs and approaches where missed approach precision is less than 1 NM. Other approaches use operational procedures to approach a published track or climb over obstacles.
- 4) Testing of ground NAVAIDs in the vicinity of the approach: Aircraft and operational procedures are required to detect and mitigate this event.

g) **Operating conditions**

- 1) Certain aspects of the aerodrome and the airspace environment are reflected on the RNP AR APCH procedure design criteria. In this sense, the following must be considered:
  - (a) Tailwind conditions: Excessive speed on RF legs will result in inability to maintain the track. This must be addressed in the aircraft requirements for command guidance limits, inclusion of a banking maneuverability margin of 5 degrees, consideration of the effect of speed and flight crew procedures on maintenance of speeds below the maximum authorized speed.
  - (b) Crossed wind conditions and the effect of flight technical error: Consider that a nominal flight technical error is assessed under a variety of wind conditions, and that a flight crew procedure to monitor and limit deviations, ensures a reliable operation.
  - (c) Effects of extreme temperature on barometric altitude (e.g., extreme cold temperatures, knowledge of local meteorological or atmospheric phenomena, upper winds, severe turbulence, etc.): The effect of this error on vertical path is mitigated by procedure design and flight crew procedures. Aircraft that have a temperature compensation system can conduct procedures regardless of the published temperature limit. The effect of this error on minimum altitude segments and on the decision altitude is addressed in an equivalent manner for all other approach procedures.

**6.4 Repercussions on the proposed solutions/mitigations**

- a) When assessing different conditions and risks, some may fall on a range where risk or probability is not acceptable. When reviewed by the team of FOSA experts, a range of possible solutions (e.g., system design, procedures, processes, etc.) may be identified, which, turned into mitigations, reduce the level of risk and/or risk incidence in such a way that risks can be considered acceptably safe for RNP AR APCH operations. The following aspects must be considered:
  - 1) **Operations**
    - (a) What are the repercussions/changes for ATC, dispatch, maintenance, flight procedures (e.g., knowledge of aircraft capability, RNP equipment prediction, equipment required, and specific checks, respectively).
  - 2) **Safety/risk**
    - (a) How do main differences in procedure design or operational requirements associated with aircraft or operator qualification compare (e.g., what aircraft or operator exceptions or limitations compare to operational or procedural requirements)?
    - (b) How does the certification basis apply to intended operations? For example, are the demonstrated performance (RNP), functionality, and capabilities, together with safety and risk assessments equivalent or better than that required for the operation?
    - (c) How are rare-normal and non-normal conditions, failures or hazards considered in the procedure design criteria, aircraft and operator qualifications, or in the added procedures or system checks?
    - (d) How is the safe termination of the procedure or extraction affected?
  - 3) **General applicability in RNP AR APCH operations**
    - (a) RNP AR APCH procedures and operational requirements differ and, thus, an applicant must consider the effect of possible mitigations on the general use of RNP aircraft regarding crew training, procedures, equipment, ATC interfaces, etc.
    - (b) The different hazards considered in the FOSA must be summarized, together with the associated hazards and their frequency, mitigations, and the level of the mitigated hazard and its frequency. Significant factors and aspects shall be highlighted in the final recommendations (see the attached example in Table 9-3 – Example of a FOSA work sheet).

**Note.-** While many aspects and questions in this appendix must be considered in the FOSA methodology, this material does not need to be included in the FOSA if reference is made in the package of the applicant.

Table 9-3 – Example of a FOSA work sheet

Hazard identification	ID	Name	Severity	Likelihood	Description	Mitigation	Severity of the mitigation	Frequency of the mitigation	Ref. Doc.
Aircraft/system failure	A1	Engine failure	Significant	Remote	The engine failure can cause loss of separation from the ground.	A performance assessment has been done with a single engine to determine the specific performance conditions for ABC company. The crews must conduct the existing single-engine failure procedures.	Minor	Remote	PBN Manual Ch 5; 5.1
	A2	Failure of one GNSS receiver	Minor	Remote	The failure of one GPS receiver results in loss of navigation capability redundancy.	For RNP AR APCH procedures, two GNSS receivers are required. Flight crew procedures require a go-around upon failure of one GPS within the FAF. Crew procedures require a go-around for all failures within the FAF,	Insignificant	Remote	PBN Manual Ch 5; 5.5



Hazard identification	ID	Name	Severity	Likelihood	Description	Mitigation	Severity of the mitigation	Frequency of the mitigation	Ref. Doc.
						except under visual conditions.			
	A3	Incorrect flap retraction							
	A4	FMC/CDU dual failure under IMC conditions							
	A5	Degradation or loss of GPS signal							
	A6	Loss of all APs/ control mode							
	A7	Failure of two GNSS receivers							
	A8	AP disconnect							
	A9	Loss of equipment, resulting in single-system operation							
	A10	Air data/altimeter failure, resulting in display differences							
Operational environment (e.g., physical conditions, airspace, and route design)	E1	Performance limited by tailwind							
	E2	Environmental temperature							
	E3	Strong cross-winds							
Operators	H1	Incorrect pilot response							
	H2	Poor pilot response or pilot error							
Human-	I1	Incorrect altimeter							

Hazard identification	ID	Name	Severity	Likelihood	Description	Mitigation	Severity of the mitigation	Frequency of the mitigation	Ref. Doc.
machine interface		setting due to error in ATC-to-aircraft communications							
Operational procedures	P1	Temperature compensation							
	P2	Balked or rejected landing							
Maintenance procedure	M1	Incorrect navigation database							
External services	S1	Source-altimeter error							
	S2	ATC							
	S3	NAVAID out of coverage or in test mode							
	S4	Lack of GNSS satellite							

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**APPENDIX F-2**

**RNP AR APCH JOB AID**

**OPERATOR APPLICATION TO CONDUCT RNP AR APCH OPERATIONS**

## **RNP AR APCH JOB AID**

### **OPERATOR APPLICATION TO CONDUCT RNP AR APCH OPERATIONS**

#### **1. Introduction**

This Job Aid was developed by the Latin American Regional Safety Oversight Cooperation System (SRVSOP) to provide States, operators, and inspectors with guidance on the process to be followed by an applicant in order to obtain an RNP AR APCH approval.

#### **2. Purpose of the Job Aid**

- 2.1 To give operators and inspectors information on the main RNP AR APCH reference documents.
- 2.2 To provide tables showing the contents of the application, the associated reference paragraphs, the place in the application of the operator where RNP AR APCH elements are mentioned and columns for inspector comments and follow-up on the status of various elements of RNP AR APCH.

#### **3. Recommended inspector and operator actions**

Some recommendations for use of the Job Aid follow:

- 3.1 At the pre-application meeting with the operator, the inspector reviews the “basic events of the RNP AR APCH approval process” described in Part 1 of this Job Aid, in order to provide an overview of the approval process events.
- 3.2 The inspector reviews this Job Aid with the operator in order to establish the form and content of the RNP AR APCH approval application.
- 3.3 The operator uses this Job Aid as a guide to collect the documents/RNP AR APCH Job Aids of the RNP AR APCH application.
- 3.4 The operator inserts in the Job Aid references showing in what part of its documents are the RNP AR APCH programme elements located.
- 3.5 The operator submits the Job Aid and the application to the inspector (documents/RNP AR APCH Job Aides).
- 3.6 The inspector indicates in the Job Aid whether an item is in compliance or needs corrective action.
- 3.7 The inspector informs the operator as soon as possible when a corrective action by the operator is required.
- 3.8 The operator provides the inspector with the revised material when so requested.
- 3.9 The CAA provides the operator with the operational specifications (OpSpecs) or a letter of authorisation (LOA), as applicable, when the tasks and documents have been completed.

#### 4. Structure of the Job Aid

Parts	Topics	Page
Part 1	General information	3
Part 2	Information on aircraft and operator identification	5
Part 3	Application (RNP AR APCH Job Aids and documents)	7
Part 4	Contents of the application for RNP AR APCH	11
Part 5	Guide to determine the eligibility of RNP AR APCH aircraft	15
Part 6	Basic pilot procedures for RNP AR APCH operations	21

#### Main Sources of Documents, Information, and Contacts

Advisory Circular CA 91-009 - Approval of aircraft and operators for RNP approach procedures with authorisation required (RNP AR APCH) operations, is available on the ICAO/SAM Regional Office web page ([www.lima.icao.int](http://www.lima.icao.int)) through the SRVSOP link.

#### 5. Main Reference Documents

Reference documents	Titles
Annex 6	Operation of aircraft
ICAO Doc 9613	Performance-based navigation (PBN) manual
FAA AC 90-101	Approval guidance for RNP procedures with SAAAR
EASA AMC 20-26	Airworthiness approval and operational criteria for RNP authorization required (RNP AR) operations
FAA AC 20-130A	Airworthiness approval of navigation or flight management systems integrating multiple navigation sensors
FAA AC 20-138A	Airworthiness approval of Global navigation satellite system (GNSS) equipment
TSO-C115b	Airborne area navigation equipment using multi-sensor inputs
TSO-C129a	Airborne supplemental navigation equipment using the global positioning system (GPS)
TSO-C145a	Airborne navigation sensors using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)
TSO-C146a	Stand-Alone airborne navigation equipment using the global positioning system (GPS) augmented by the wide area augmentation system (WAAS)

**PART 1: GENERAL INFORMATION****Basic events of the RNP AR APCH Approval Process**

	<b>Action by the operator</b>	<b>Action by the CAA</b>
1	Establish the need to obtain approval for RNP AR APCH operations.	
2	Review the AFM, AFM supplement or Type Certificate Data Sheet (TCDS), or other appropriate documents (e.g., service bulletins (SB), service letters (SL), etc.) to determine the eligibility of the aircraft for RNP AR APCH operations. The operator contacts the aircraft or avionics manufacturer, if necessary, to confirm RNP AR APCH aircraft eligibility or better.	
3	Contact the CAA to schedule a pre-application meeting to discuss the operational approval requirements.	
4		During the pre-application meeting, establish: <ul style="list-style-type: none"> <li>• the form and contents of the application;</li> <li>• the documents that support RNP AR APCH approval</li> <li>• the date in which the application will be submitted for evaluation</li> <li>• if necessary, conduct a validation flight observed by the CAA</li> </ul>
5	Send the application at least 60 days before start-up of RNP AR APCH operations.	
6		Review the request of the operator
7	Once the amendments to manuals, programmes, and documents have been approved or accepted, provide training to flight crews, flight dispatchers, and maintenance personnel, and conduct a validation flight, if required by the CAA.	Only if required, participate in the validation flight.
8		Once the operational and airworthiness requirements have been met, issue the operational approval in the form of OpSpecs for LAR 121 or 135 or equivalent operators, or an LOA for LAR 91 or equivalent operators, as appropriate.

**Notes related to the approval process****1. Responsible authority**

- a. **Commercial air transport (LAR 121 and/or 135 or equivalent regulations).**- The **State of registry** determines that the aircraft meets the airworthiness requirements. The **State of the operator** issues the RNP AR APCH approval (e.g., OpSpecs).
- b. **General Aviation (LAR 91 or equivalent).**- The **State of Registry** determines that the aircraft meets airworthiness requirements and issues the operational approval (e.g., an L regulation).

2. The CAA does not need to issue an LOA or equivalent document for each individual area of operation in the case of LAR 91 operators.

3. LAR 121 and/or 135 operators with RNP AR APCH approval must list this approval in the OpSpecs.

4. Related sections of the Latin American Aeronautical Regulations (LAR) or equivalent regulations

- a. LAR 91        Sections 91.1015 and 91.1640 or equivalents
- b. LAR 121      Section 121.995 (b) or equivalent
- c. LAR 135      Section 135.565 (c) or equivalent

5. Related ICAO documents

- a. Annex 6 to the Convention on International Civil Aviation – Operation of aircraft
- b. Annex 10 to the Convention on International Civil Aviation – Aeronautical telecommunications
- c. Annex 15 to the Convention on International Civil Aviation – Aeronautical information services
- d. ICAO Doc 9613 – Performance-based navigation (PBN) manual
- e. ICAO Doc 9905 - Required navigation performance authorization required (RNP AR) procedure design manual (final draft)
- f. ICAO Doc 4444 – Procedures for air navigation services – Air traffic management



**PART 2: INFORMATION ON THE IDENTIFICATION OF AIRCRAFT AND OPERATORS****NAME OF THE OPERATOR:** \_\_\_\_\_

<b>Aircraft manufacturer, model, and series</b>	<b>Registration numbers</b>	<b>Serial numbers</b>	<b>RNP AR APCH system Number, manufacturer, and model</b>	<b>RNP specification</b>

DATE OF PRE-APPLICATION MEETING \_\_\_\_\_

DATE ON WHICH THE APPLICATION WAS RECEIVED \_\_\_\_\_

DATE ON WHICH THE OPERATOR INTENDS TO BEGIN RNP AR APCH OPERATIONS \_\_\_\_\_

IS THE CAA NOTIFICATION DATE APPROPRIATE? YES \_\_\_\_\_ NO \_\_\_\_\_

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**PART 3 – OPERATOR APPLICATION (ANNEXES AND DOCUMENTS)**

<b>Annex</b>	<b>Title of annex/document</b>	<b>Indication of inclusion by the operator</b>	<b>Comments by the Inspector</b>
A	<b>Application for RNP AR APCH approval</b>		
B	<p><b>Airworthiness documents showing aircraft eligibility for RNP AR APCH.</b></p> <p>AFM, AFM revision, AFM supplement, or Type certificate data sheet (TCDS) showing that the RNP navigation system is eligible for RNP AR APCH.</p> <p>Documentation produced by the manufacturer.- Aircraft that have documentation by the manufacturer documenting compliance with SRVSOP CA 91-009 criteria or equivalent documents, meet the performance and functional requirements of said document.</p>		
C	<p><b>Aircraft modified to meet RNP AR APCH standards. Documentation on aircraft inspection and/or modification, if applicable.</b> Maintenance records documenting the installation or modification of aircraft systems (e.g., FAA Form 337 – major repairs and alterations).</p>		
D	<p><b>Maintenance programme</b></p> <ul style="list-style-type: none"> <li>For aircraft with established maintenance procedures for RNP AR APCH systems, the list of references of the document or programme.</li> <li>For recently installed RNP AR APCH systems, the maintenance procedures for their review.</li> </ul>		
E	<p><b>Minimum equipment list (MEL) (only for operators conducting operations based on a MEL):</b></p> <p>MEL showing provisions for RNP AR APCH systems.</p>		
F	<p><b>Training</b></p> <p><b>1. LAR 91 operators or equivalent: Training methods:</b> Training at</p>		

Annex	Title of annex/document	Indication of inclusion by the operator	Comments by the Inspector
	<p>home, LAR 142 training centres, or other training courses, course completion records.</p> <p><b>2. LAR 121 and/or 135 operators or equivalents:</b> Training programmes (training curricula) for flight crews, flight dispatchers, and maintenance personnel.</p>		
G	<p><b>Operating policies and procedures</b></p> <p><b>1. LAR 91 operators or equivalents:</b> Operations manual (OM) or sections to be attached to the application, corresponding to RNP AR APCH operating procedures and policies.</p> <p><b>2. LAR 121 and/or 135 operators or equivalents:</b> Operations manual and checklists.</p>		
H	<p><b>Navigation database</b></p> <p>Details of the navigation data validation programme</p>		
I	<p><b>Withdrawal of RNP AR APCH approval</b></p> <p>Indication of the need to follow up on navigation error reports submitted and the possibility of withdrawal of RNP AR APCH approval.</p>		
J	<p><b>Validation flight plan</b></p> <p>Plan showing that the operator is capable of conducting the requested operations.</p>		
K	<p><b>RNP AR APCH approach monitoring programme</b></p> <p>Programme to collect data on the RNP AR APCH procedures to be conducted</p>		

**CONTENTS OF THE APPLICATION TO BE SUBMITTED BY THE OPERATOR**

- \_\_\_\_\_ **DOCUMENTATION SHOWING RNP AR APCH COMPLIANCE OF THE AIRCRAFT/NAVIGATION SYSTEMS**
- \_\_\_\_\_ **OPERATING PROCEDURES AND POLICIES**
- \_\_\_\_\_ **SECTIONS OF THE MAINTENANCE MANUAL RELATED TO THE RNP AR APCH SYSTEM (if not previously reviewed)**

**Note 1:** Documents may be grouped in a single folder or may be sent as individual documents.

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## PART 4: CONTENTS OF THE OPERATOR APPLICATION FOR RNP AR APCH OPERATIONS

#	Contents of the RNP AR APCH application by the operator	Reference paragraphs CA 91-009	In what Annexes/Documents of the operator can the application contents be located	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>Letter of application of the operator</b> Letter of application to request RNP AR APCH approval.	Appendix 7, Paragraph b) 1)	Annex A		
2	<b>Type of aircraft and description of aircraft equipment</b> A configuration list which detail the relevant components and the equipment to be used in the operation. The list shall include each manufacturer, model and version of the equipment and software of the installed FMS.	Appendix 7, Paragraph b) 3)			
3	<b>Aircraft qualification documentation</b> Documentation showing that the equipment of the proposed aircraft meets the requirements of Appendix 2 to CA 91-009 or equivalent documents (e.g., FAA AC 90-101 Appendix 2). This documentation shall contain any requirements in terms of hardware, software, procedures, and limitations.	Appendix 7, Paragraph b) 2)	Annex B Annex C		
4	<b>Training programmes</b> a) <b>LAR 121 or 135 operators or equivalents: Training programmes:</b> Operators will develop an initial and periodic training programme for flight crews, flight dispatchers, if applicable and maintenance personnel. b) <b>LAR 91 operators or equivalent: Training methods:</b> The following methods are acceptable for these operators: Training at home, LAR 142 training centres, or other training courses.	Appendix 7, Paragraph b) 6)	Annex F		

#	Contents of the RNP AR APCH application by the operator	Reference paragraphs CA 91-009	In what Annexes/Documents of the operator can the application contents be located	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
5	<b>Operations manual (OM) and checklists</b> a) <b>LAR 121 and/or 135 operators or equivalents:</b> Operations manual and checklists. b) <b>LAR 91 operators or equivalents:</b> Operations manual or section of the operator application documenting RNP AR APCH policies and procedures.	Appendix 7, Paragraph b) 10)			
6	<b>Maintenance procedures</b> <ul style="list-style-type: none"> <li>For aircraft with established maintenance practices for RNP AR APCH navigation systems, the operator will provide document references.</li> <li>For newly installed RNP AR APCH systems, the operator will provide maintenance practices for review.</li> </ul>	Appendix 7, Paragraph b) 11)	Annex D		
7	<b>Minimum equipment list (MEL)</b> The operator will revise the MEL in order to incorporate the aspects necessary to conduct RNP AR APCH operations.	Appendix 7, Paragraph b) 13)	Annex E		
8	<b>Navigation data validation programme</b> The operator will provide details of the navigation data validation programme.	Appendix 7, Paragraph b) 5)	Annex F		
9	<b>RNP AR APCH monitoring programme</b> The operator will establish a monitoring programme that will collect data on the performed RNP AR APCH procedures. Each operation must be recorded, and unsatisfactory	Appendix 7, Paragraph b) 12)	Annex H		



#	Contents of the RNP AR APCH application by the operator	Reference paragraphs CA 91-009	In what Annexes/Documents of the operator can the application contents be located	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	attempts must include the factors that prevented successful completion of an operation.				
10	<p><b>Validation test plan</b></p> <p>The operator will develop a validation test plan to show that it is capable of conducting the proposed operation. The plan will include, at least, the following:</p> <ul style="list-style-type: none"> <li>a) a statement that the validation plan has been designed to show the capability of the aircraft to carry out RNP AR APCH procedures;</li> <li>b) the operating and dispatch procedures of the operator; and</li> <li>c) MEL procedures.</li> </ul> <p><i><b>Note 1.-</b> The validation plan shall benefit from the ground training devices, flight simulators and aircraft demonstrations. If the validation is conducted on an aircraft, it must be done during the day and under VMC.</i></p> <p><i><b>Note 2.-</b> Validations may be required for each manufacturer, model and version of the software in the installed FMS.</i></p>	Appendix 7, Paragraph b) 14)	Annex I		
11	<p><b>Flight operational safety assessment (FOSA)</b></p> <p>The operator will establish a methodology for the analysis and quantitative and qualitative assessment of navigation systems, aircraft systems, operational procedures, hazards, failure mitigation, normal conditions, abnormal conditions, and operational environment related to safety.</p>	Appendix 7, Paragraph b) 16)			

## PART 5 – GUIDE FOR DETERMINING RNP AR APCH AIRCRAFT ELIGIBILITY

#	Topics	Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>Aircraft eligibility</b>	Paragraph 9.2	Annex B		
	a) <b>For new aircraft.-</b> the aircraft qualification documentation can be approved by the CAA as part of an aircraft certification project, and will be reflected in the AFM and related documents.	Paragraph 9.2 a)			
	b) <b>For aircraft in use.-</b> Documentation produced by the manufacturer.	Paragraph 9.2 b)	Annex B		
	c) <b>Aircraft modified to meet RNP AR APCH standards.-</b> Aircraft inspection and/or modification documentation, if applicable. Maintenance records documenting the installation or modification of aircraft systems (e.g., FAA Form 337 – major repairs and alterations).	Paragraph 9.3	Annex B		
2	<b>Aircraft qualification</b>	Appendix 2			
	a) <b>Previously certified aircraft.-</b> Operators of previously certified aircraft can document compliance with CA 91-009 (RNP AR APCH) or equivalent documents, without a new airworthiness project (e.g., without making a change in the AFM) and will notify the CAA of any new performance not covered by the original airworthiness approval.	Appendix 2 Paragraph 1. c)			
	b) The AFM or other aircraft qualification evidence shall indicate the normal and	Appendix 2			

#	Topics	Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	abnormal flight crew procedures, failure alerting responses, and any other limitation, including information related to the operating modes required for flying an RNP AR APCH procedure.	Paragraph 1. d)			
	c) In addition to the specific RNP AR APCH guide presented in CA 91-009 or equivalent documents (e.g., EASA AMC 20-26 or FAA AC 90-101), the aircraft must comply with AC 20-129 and either AC 20-130 () or AC 20-138 ().	Appendix 2 Paragraph 1. e)			
3	<b>Navigation sensors.-</b> On the horizontal plane, the RNP equipment will use data input from the following types of position sensors, but with the GNSS as primary positioning basis: a) Global navigation satellite system (GNSS). b) Inertial navigation system (INS) or inertial reference system (IRS), with automatic position updating from suitable radio-based navigation equipment. c) Distance-measuring equipment (DME) that provides measurements from two or more ground stations (DME/DME)	Paragraph 6.1 b)			
	<b>Global positioning system (GPS)</b> a) The sensor must meet the FAA AC 20-138 () criteria. For systems that comply with this AC, the following sensor precisions can be used for analysing total system precision	Appendix 2 Paragraph 3. a) 1)			

#	Topics	Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	without any additional justification:  1) precision of the GPS sensor better than 36 m (95%); and  2) precision of the augmented GPS sensor (with GBAS or SBAS) better than 2 m (95%).				
	<b>Inertial reference system (IRS).</b> - An IRS must meet the criteria of Appendix G LAR 121 or Appendix G Part 121 of United States 14 CFR or equivalents. Aircraft manufacturers and applicants can demonstrate improved inertial performance according to the methods described in Appendix 1 or 2 of FAA Order 8400.12A.  <i><b>Note.</b>- Integrated GPS/INS position solutions reduce the degradation ratio following a position update loss. For coupled GPS/IRUs, Appendix R to document RTCA/DO-229C provides additional guidance.</i>	Appendix 2 Paragraph 3. a) 2)			
	<b>Distance measuring equipment (DME).</b> - Initiation of all RNP AR APCH procedures is based on GNSS updating. Except where the use of DME in a procedure is specifically designated as “not authorized”, DME/DME updating can be used as a reversal mode during the approach and missed approach when the system complies with the navigation precision. The manufacturer and the operator shall identify any DME infrastructure or procedure limitation preventing an aircraft type from meeting this requirement	Appendix 2 Paragraph 3. a) 3)			

#	Topics	Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	<p><b>VHF omnidirectional radio range (VOR).</b>- For initial RNP AR APCH implementation, the RNP system may not use VOR updating. The manufacturer and the operator shall identify any constraints on the VOR infrastructure or the procedure for a given aircraft to comply with this requirement.</p> <p><i>Note.- This requirement does not prohibit the capability of the VOR equipment, provided there is a direct means to inhibit its update. A procedure that allows the flight crew to inhibit VOR updating or to execute a missed approach if the system reverts to VOR updating may meet this requirement.</i></p>	Appendix 2 Paragraph 3. a) 4)			
	<p><b>Multi-sensor systems.</b>- For multi-sensor systems, there must be automatic reversal to an alternate RNAV sensor if the primary RNAV sensor fails. Automatic reversal from a multi-sensor system to another multi-sensor system is not required.</p>	Appendix 2 Paragraph 3. a) 5)			
	<p><b>Altimetry system error.</b>- 99.7% of the altimetry system error for each aircraft (assuming the temperature and adiabatic lapse rate of standard atmosphere) must be smaller than, or equal to, the following, with the aircraft in approach configuration:</p> $ASE = -8.8 \cdot 10^{-8} \cdot H^2 + 6.5 \cdot 10^{-3} \cdot H + 50$ <p>where H is the aircraft true altitude.</p>	Appendix 2 Paragraph 3. a) 6)			
	<p><b>Temperature compensation systems.</b>- Systems that provide temperature-based correction for the VNAV barometric guide must comply with Appendix H.2 to document</p>	Appendix 2 Paragraph 3. a) 7)			

#	Topics	Reference paragraphs  CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	RTCA/DO-236. This applies to the final approach segment. Compliance with this requirement must be documented to allow the operator to conduct RNP AR APCH approaches when the real temperature is above or below the design limit of the published procedure. Appendix H.2 also provides guidance on the operational aspects related to temperature compensation systems, such as the interception of compensated paths from non-compensated procedure altitudes.				
4	<b>Performance and functional requirements of RNP AR APCH systems</b>	Appendix 2	Annex B		
5	<b>Navigation database</b> Details of the navigation data validation programme.	Appendix 3	Annex B		

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## PART 6 - BASIC PILOT PROCEDURES FOR RNP AR APCH OPERATIONS

Topics		Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<b>Operating procedures</b>		Appendix 4	Annex G		
1	<b>Pre-flight considerations</b>	Appendix 4 Paragraph 2			
	<b>Minimum equipment list (MEL).</b> - The operator MEL must be developed or revised to indicate equipment requirements for instrument RNP AR APCH procedures. Guidance on these equipment requirements is available in the documents of the aircraft manufacturer. The required equipment may depend on the intended navigation precision and whether the missed approach requires an RNP value of less than 1.0. For example, GNSS and AP are normally required for a low navigation precision. Normally, dual equipment is required for approaches when using a line of minima of less than RNP 0.3 and/or when the missed approach has an RNP value of less than 1.0. An operable enhanced ground proximity warning system (EGPWS/TAWS) is required for all RNP AR APCH procedures. It is advisable that the EGPWS/TAWS use local pressure- and temperature-compensated altitudes (e.g., a corrected GNSS and barometric altitude) and that it includes data on significant obstacles and terrain. The flight crew must be aware of the equipment requirement.	Appendix 4 Paragraph 2 a)			
	<b>Autopilot (AP) and flight director (FD).</b> - For procedures with a navigation precision of less than RNP 0.3 or with RF legs, the use of AP and FD driven by the aircraft RNP system is required in all cases. Therefore, the AP and FD must operate with a suitable precision to track the lateral and vertical paths required by a specific RNP AR APCH procedure. When the dispatch or release of a flight is predicated on flying an RNP AR APCH approach that requires the use of AP at the destination and/or alternate aerodrome, the flight dispatcher or pilot in command must make sure that the AP is installed and operational.	Appendix 4 Paragraph 2 b)			
	<b>Assessment of an RNP AR APCH dispatch or release.</b> - The operator must have a predictive performance capability to forecast	Appendix 4 Paragraph 2			



Topics	Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<p>whether the specific RNP will be available at the location and time of a desired RNP AR APCH operation. This capability can be provided through a ground service and does not need to reside in the aircraft avionic equipment. The operator must establish procedures requiring the use of this capability as a dispatch or release tool and as a flight-tracking tool in case of reported failures. RNP assessment must consider the specific combination of aircraft capabilities (sensors and integration).</p> <p>a) <b>Assessment of RNP AR APCH with GNSS updating.</b>- The predictive capability must take into account known and predicted temporary suspension of GNSS satellite service or other negative effects on navigation system sensors. The prediction program shall not use a masking angle of less than 5°, as operational experience indicates that satellite signals at low elevations are not reliable. The prediction must use the current GPS constellation with an algorithm identical to that used in the on-board equipment. For RNP AR APCH procedures in high terrain, the operator must use a masking angle appropriate to the terrain.</p> <p>b) From the initiation of the approach, RNP AR APCH procedures require GNSS updating.</p>	c)			
<p>NAVAID exclusion.- The operator must establish procedures to exclude air navigation facilities in accordance with published NOTAMs (e.g., DMEs, VORs, and localizers). Rationality checks of the internal avionic equipment may not be appropriate for RNP AR APCH operations.</p>	Appendix 4 Paragraph 2 d)			
<p><b>Validity of the navigation database.</b>- Upon initiating the system, the pilots of aircraft equipped with certified RNP systems must confirm that the navigation database is valid. The databases are expected to be current for the duration of the flight. If the AIRAC cycle changes during the flight, the operators and pilots must establish procedures to ensure the precision of navigation data, including the suitability of navigation facilities used for defining routes and flight procedures. Traditionally, this has been accomplished by verifying electronic data against paper documents. One acceptable means is to compare</p>	Appendix 4 Paragraph 2 e)			

Topics		Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	aeronautical charts (new and old) to verify navigation fixes prior to flight dispatch or release. If an amended chart has been published for the procedure, the navigation database must not be used to conduct the operation				
2	<b>In-flight considerations</b>	Appendix 4 Paragraph 3			
	Flight plan modification.- Pilots are not authorized to fly a published RNP AR APCH procedure unless it can be retrieved by its name from the navigation database and conforms to the published procedure. The lateral path must not be modified, except that the pilot may accept a clearance to fly direct to a fix located prior the FAF in the approach procedure, and that does not immediately precede an RF leg. The only other acceptable modification to the loaded procedure is to change speed and/or altitude waypoint constraints on the initial, intermediate, or missed approach segments (for example, corrections applied due to cold temperature or to comply with an ATC clearance/instruction).	Appendix 4 Paragraph 3. a)			
	<b>Required equipment list.-</b> The flight crew must have a list of the equipment required to conduct RNP AR APCH procedures or alternate methods for addressing, during the flight, equipment failures that hinder the execution of an RNP AR APCH procedure (e.g., the quick reference handbook - QRH)	Appendix 4 Paragraph 3. b)			
	<b>RNP AR APCH management.-</b> Flight crew operating procedures must ensure that the navigation system uses the appropriate navigation precision during the approach. If the approach chart shows several minima associated to different navigation precision values, the flight crew must confirm that the desired navigation precision has been entered in the RNP system. If the RNP system does not extract and set the navigation precision from the on-board database for each leg of the procedure, then the flight crew operating procedures must ensure that the lowest navigation precision required to complete the approach or missed approach has been selected before starting the approach.	Appendix 4 Paragraph 3. c)			

Topics	Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<p><b>GNSS updating.-</b> From the beginning of the approach, all instrument RNP AR APCH procedures require GNSS updating of the navigation position solution. The flight crew must verify that GNSS updating is available before starting the RNP AR APCH procedure. If at any time during the approach GNSS updating is lost and the navigation system does not have the performance to continue the approach, the flight crew must abandon the RNP AR APCH procedure, unless the pilot has in sight the visual references required to continue such approach.</p>	Appendix 4 Paragraph 3 d)			
<p><b>Radio updating.-</b> The initiation of any RNP AR APCH procedure is based on GNSS updating. Except where specifically designated in a procedure as not authorized, DME/DME updating can be used as a reversal mode during the approach or missed approach when the system complies with the navigation precision. VOR updating is not authorized at this time. Consequently, the flight crew must follow operator procedures to inhibit specific facilities (see paragraph 2.d) of this appendix).</p>	Appendix 4 Paragraph 3 e)			
<p><b>Approach procedure confirmation.-</b> The flight crew must confirm that the correct procedure has been selected. This procedure includes the confirmation of waypoint sequence, the rationality of track angles and distances, and any other parameter that can be modified by the pilot, such as altitude and speed constraints. A procedure must not be used if validity of the navigation database is in doubt. A navigation system text display or a navigation map display can be used.</p>	Appendix 4 Paragraph 3 f)			
<p><b>Track deviation monitoring.-</b> Pilots must use a lateral deviation indicator, an FD and/or an AP in lateral navigation mode during RNP AR APCH procedures. Pilots of aircraft with lateral deviation indicators must ensure that indicator scaling (full-scale deflection) is suitable for the navigation precision associated with the various segments of the RNP AR APCH procedure.</p>	Appendix 4 Paragraph 3 g)			

Topics	Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<p>All pilots are expected to maintain route centre lines, as depicted by on-board lateral deviation indicators and/or in the flight guidance, during all RNP operations, unless authorized to deviate by the ATC or under emergency conditions.</p> <p>For normal operations, the cross-track error/deviation (the difference between the path estimated by the RNP system and the aircraft position relative to the path) shall be limited to <math>\pm \frac{1}{2}</math> the navigation precision associated with the procedure segment.</p> <p>Small lateral deviations from this requirement (e.g., overshooting or undershooting the limit) during or immediately after a turn are allowed, up to a maximum of 1 times (1xRNP) the navigation precision of the procedure segment.</p> <p>The vertical deviation must be within 75 ft during the final approach segment. Lateral deviations shall be monitored above and below the glide path (GP). While being above the glide path provides a margin over the obstacles during the final approach, it can result in the pilot deciding to do a go-around closer to the runway, which reduces obstacle clearance during the missed approach.</p> <p>Pilots must execute a missed approach if lateral deviation exceeds 1xRNP or if vertical deviation exceeds 75 ft, unless the pilot has in sight the visual references required to continue the approach.</p> <p>a) Some aircraft navigation displays do not incorporate lateral and vertical deviations scaled for each RNP AR APCH operation in the primary field of view of the pilot. When using a moving map, a low-resolution vertical deviation indicator (VDI), or a numeric deviation display, flight crew training and procedures must ensure the effectiveness of these displays. Normally, this implies a demonstration of the procedure with a number of trained crews and the inclusion of this monitoring procedure in the recurrent training program for RNP AR APCH.</p> <p>b) For aircraft using a CDI for lateral path tracking, the AFM or the aircraft qualification guidance shall indicate which navigation precision (RNP value) and operations the aircraft supports and the effects of the operation on CDI scale. The flight crew must know the CDI full-scale deflection (FSD) value. The avionics system can automatically adjust the CDI scale (depending on</p>				

Topics	Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<p>the flight phase) or the flight crew can manually adjust such scale. If the flight crew manually selects the CDI scale, the operator must have procedures in place and provide training to ensure that the CDI scale selection is appropriate for the intended RNP AR APCH operation. The deviation limit must be readily visible, considering CDI scale (e.g., full-scale deflection).</p>				
<p><b>System cross-check.-</b> For RNP AR APCH procedures with a navigation precision of less than 0.3, the flight crew must monitor the lateral and vertical guidance provided by the RNP navigation system to ensure that this guidance is consistent with other available data and displays provided by an independent means.</p> <p><i>Note.- This cross-check may not be necessary if lateral and vertical guidance systems have been developed taking into account a hazardous (severe or major) failure condition due to false information (see Appendix 2, paragraph 3.e) and if normal system performance supports airspace containment (see Appendix 2, paragraph 2.d).</i></p>	Appendix 4 Paragraph 3 h)			
<p><b>Procedures with RF legs.-</b> An RNP AR APCH procedure may require aircraft to have the capability of executing an RF leg to avoid terrain and obstacles. Since not all aircraft have this capability, flight crews must know if they can or cannot carry out these procedures. When an RF leg is flown, it is essential for the flight crew to follow the flight path in order to maintain the intended track.</p> <p>a) If a go-around is initiated during or immediately after an RF leg, the flight crew must be aware of the importance of maintaining the published path as closely as possible. The operator must develop and establish operating procedures for aircraft that do not remain in LNAV when initiating a go-around, in order to ensure that the intended track of the RNP AR APCH procedure is maintained.</p> <p>b) Pilots must not exceed the maximum speeds shown in Table 4-1 of Appendix 4 to SRVSOP CA 91-009 during the RF leg. For example, a Category C A320 must reduce its speed to 160 KIAS at the final approach fix (FAF) or can fly as fast as 185 KIAS if it uses Category D minima. A missed approach before the decision altitude (DA) may require a segment speed for that</p>	Appendix 4 Paragraph 3 i)			

Topics		Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
	segment to be maintained.				
	<p><b>Temperature compensation.-</b> In aircraft that have temperature compensation capability according to paragraph 3.a)7) of Appendix 2 to SRVSOP CA 91-009, flight crews can do without temperature limits for RNP AR APCH procedures if the operator provides the flight crews with training on the use of this capability. Temperature compensation through the aircraft system is applicable to VNAV guidance and is no substitute for the low-temperature compensation to be applied by the flight crew at minimum altitudes or at the decision altitude. Flight crews must be familiar with temperature compensation effects when intercepting the compensated path described in document EUROCAE ED-75B/RTCA DO-236B Appendix H.</p>	Appendix 4 Paragraph 3 j)			
	<p><b>Altimeter setting.-</b> Due to reduced obstacle clearance inherent to instrument RNP AR APCH procedures, the flight crew must verify that the current local altimeter is set prior to the FAF but not prior to the IAF. The execution of an instrument RNP AR APCH procedure requires that the current altimeter be set for the aerodrome of intended landing. Remote altimeter settings are not allowed.</p>	Appendix 4 Paragraph 3 k)			
	<p><b>Altimeter cross-check.-</b> Prior to the FAF, but not before the IAF, the flight crew must carry out a cross-check of both pilot altimeters to make sure they agree within <math>\pm 100</math> ft. If the cross-check fails, the crew must not continue with the approach. If the avionics system provides an automatic altitude comparison warning system for pilot altimeters, flight crew procedures shall indicate the action to be taken in the event of an altimeter comparator warning while executing an RNP AR APCH.</p> <p><b>Note.-</b> This operational cross-check is not required if the aircraft system automatically compares altitudes to within 100 ft (see paragraph 3. d)15) of Appendix 2).</p>	Appendix 4 Paragraph 3 l)			
	<p><b>VNAV altitude transitions.-</b> The aircraft VNAV barometric system provides fly-by vertical guidance to ensure a smooth transition when intercepting the glide path prior to the FAF. Small vertical shifts, which may occur in a vertical constraint (e.g., in the FAF), are considered operationally acceptable and desirable since they allow for</p>	Appendix 4 Paragraph 3 m)			

Topics	Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
the capture of a new or the next vertical segment. This temporary deviation below the published minima is acceptable as long as the deviation is limited to no more than 100 ft and is the result of a normal VNAV capture. This applies to both “leveling” and “altitude capture” segments that follow a climb or descent or vertical climb or beginning of a segment with descent, or when climb and descent paths with different slopes come together.				
<b>Non-standard climb gradient.</b> - When the operator intends to use a DA associated with a missed approach non-standard climb gradient, it must ensure that the aircraft will be able to comply with the climb gradient published for the expected weight (mass) of the aircraft, atmospheric conditions, and operating procedures before conducting the operation. When the operator has performance personnel available to determine whether its aircraft can meet the published climb gradients, such personnel must provide information to pilots about the climb gradients that they must comply with.	Appendix 4 Paragraph 3 n)			
<b>Engine-out procedures.</b> - Aircraft may demonstrate an acceptable flight technical error (FTE) with one engine inoperative when conducting RNP AR APCH procedures. Otherwise, flight crews are expected to take appropriate action in case of an engine failure during an approach, so no specific aircraft qualification is required in this case. The aircraft qualification must identify any performance limitation in case of engine failure to support the definition of the appropriate flight crew procedures. Operators must pay special attention to published procedures with non-standard climb gradients.	Appendix 4 Paragraph 3 o)			
<b>Missed approach or go-around</b> a) <b>Missed approach procedure requiring RNP 1.0.</b> - Where possible, the missed approach will require RNP 1.0. The missed approach of these procedures is similar to the missed approach of an RNP APCH operation. b) <b>Missed approach procedures requiring RNP of less than 1.0.</b> - When necessary, RNP values of less than 1.0 will be used in the missed approach. For an operator to be approved to	Appendix 4 Paragraph 3 p)			

Topics	Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
<p>execute these approaches, the equipage and procedures must meet the criteria established in paragraph 6 of Appendix 2 (Requirements for missed approaches with an RNP of less than 1.0).</p> <p>c) In many aircraft, a change may occur in lateral navigation when TOGA is activated during a missed approach or go-around. Also, in many aircraft, TOGA activation disconnects the AP and FD from LNAV guidance, and the FD reverts to track-hold derived from the inertial system. LNAV guidance to the AP and FD shall be re-engaged as quickly as possible.</p> <p>d) Flight crew procedures and training programs must address the impact on navigation capability and flight guidance if the pilot initiates a go-around during a turn. In the event an early missed approach is initiated, the flight crew must follow the approach and missed approach tracks unless otherwise cleared by the ATC. The flight crew shall also be aware that RF legs are designated based on the maximum true speed at normal altitudes, and initiating an early missed approach will reduce the maneuverability margin, and will potentially make it impractical to hold the turn at missed approach speeds.</p> <p>e) Upon loss of GNSS updating, the RNP guidance may begin to navigate on IRU, if installed on the aircraft, but the aircraft will begin to drift, degrading the navigation position solution. Therefore, when RNP AR APCH missed approach operations are based on IRU autonomous navigation, the inertial guidance can only provide RNP guidance for a specific amount of time.</p>				
<p><b>Contingency procedures</b></p> <p>a) <b>Failure while en route.-</b> The aircraft RNP capability is dependent upon operational equipment and GNSS satellites. Before initiating the approach, the flight crew must be capable of assessing the impact of equipment failure on the RNP AR APCH procedure and take the appropriate corrective action. As stated in paragraph 2.c) of this appendix, the flight crew must also be capable of assessing the impact of changes in GNSS</p>	<p>Appendix 4 Paragraph 3 q)</p>			



Topics	Reference paragraphs CA 91-009	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector: Item status and date
constellation and take appropriate corrective action. b) <b>Failure on approach.</b> - The operator contingency procedures must cover at least the following conditions: 1) RNP system components failures, including those affecting lateral and vertical deviation performance (e.g., failures of GPS sensors, AP or FD). 2) Loss of navigation signal-in-space (loss or degradation of external signal).				

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**APPENDIX G-1**

**ADVISORY CIRCULAR**

AC	:	91-010
DATE	:	12/10/09
REVIEW	:	1
ISSUED BY	:	SRVSOP

**SUBJECT: AIRCRAFT AND OPERATORS APPROVAL FOR APPROACH OPERATIONS  
WITH VERTICAL GUIDANCE/BAROMETRIC VERTICAL NAVIGATION  
(APV/baro-VNAV)**

## ADVISORY CIRCULAR

AC : 91-010  
DATE : 12/10/09  
REVIEW : 1  
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**SUBJECT: AIRCRAFT AND OPERATORS APPROVAL FOR APPROACH OPERATIONS  
WITH VERTICAL GUIDANCE/BAROMETRIC VERTICAL NAVIGATION  
(APV/baro-VNAV)**

### 1. PURPOSE

This advisory circular (AC) establishes APV/baro-VNAV approval requirements (barometric vertical navigation only) for aircraft and operators. Barometric vertical navigation may be included together with lateral navigation in a RNP APCH approach, as established in CA 91-008. Criteria of this AC together with criteria of AC 91-008, establish requirements for RNP APCH approach with baro-VNAV.

An operator may use alternative means of compliance, provided they are acceptable to the Civil Aviation Administration (CAA).

Use of the future tense of the verb or the term “must” applies to an applicant or operator that chooses to meet the criteria established in this AC.

### 2. RELATED SECTIONS OF THE LATIN AMERICAN AERONAUTICAL REGULATIONS (LARs) OR EQUIVALENT

LAR 91: Sections 91.1015 and 91.1640 or equivalents

LAR 121: Section 121.995 (b) or equivalent

LAR 135: Section 135.565 (c) or equivalent

### 3. RELATED DOCUMENTS

Annex 6 Operation of aircraft

Doc 9613 Performance-based navigation (PBN) manual

Attachment A – Barometric VNAV

Doc 9905 Required navigation performance authorization required (RNP AR) procedure design manual (final draft)

Doc 8168 Aircraft operations

Volume I: Flight procedures

Part II, Section 4, Chapter 1 – APV/baro-VNAV approach procedures

Volume II: Construction of visual and instrument flight procedures

Part III, Section 3, Chapter 4 – APV/baro-VNAV

AMC 20-27 Airworthiness approval and operational criteria for RNP APPROACH (RNP APCH) operations including APV BARO-VNAV operations

FAA AC 90-105 Approval guidance for RNP operations and barometric vertical navigation in the U.S. National Airspace System – Appendix 4 – Use of barometric VNAV

## 4. DEFINITIONS AND ABBREVIATIONS

### 4.1 Definitions

- a) **Approach procedure with vertical guidance (APV).**- An instrument approach procedure which utilizes lateral and vertical guidance but does not meet the requirements established for precision approach and landing operations.
- b) **Barometric vertical navigation (baro-VNAV).**- Is a navigation system that presents to the pilot computed vertical guidance referenced to a specified vertical path angle (VPA), nominally 3°. The computer-resolved vertical guidance is based on barometric altitude and is specified as a VPA from reference datum height (RDH).
- c) **Decision altitude (DA) or decision height (DH).**- A specified altitude or height in the precision approach or approach with vertical guidance at which a missed approach must be initiated if the required visual reference to continue the approach has not been established.

*Note 1.- The decision altitude (DA) is referenced to mean sea level and the decision height (DH) is referenced to the threshold elevation.*

*Note 2.- The required visual reference means that section of the visual aids or of the approach area which should have been in view for sufficient time for the pilot to have made an assessment of the aircraft position and rate of change of position, in relation to the desired flight path. In Category III operations with a decision height the required visual reference is that specified for the particular procedure and operation.*

*Note 3.- For convenience where both expressions are used they may be written in the form "decision altitude/height" and abbreviated "DA/H".*

- d) **Flight management system (FMS).**- Integrated system made up by an on-board sensor, a receiver, and a computer with navigation and aircraft performance databases, capable of providing performance values and RNAV guidance to a display and automatic flight control system.
- e) **Initial approach fix (IAF).**- Fix that marks the beginning of the initial segment and the end of the arrival segment, if applicable. In RNAV application, this fix is normally defined as a "fly-by waypoint".
- f) **Non-precision approach (NPA) procedure.**- An instrument approach procedure which utilizes lateral guidance but does not utilize vertical guidance.
- g) **Precision approach (PA) procedure.**- An instrument approach procedure using precision lateral and vertical guidance with minima as determined by the category of operation.

*Note.- Lateral and vertical guidance refers to the guidance provided either by:*

  - a ground-based navigation aid; or
  - computer-generated navigation data.
- h) **Primary field of view.**- For purposes of this AC, the primary field of view is within 15 degrees of the primary line of sight of the pilot.
- i) **Reference datum height (RDH).**- The height of the extended glide path or a nominal vertical path at the runway threshold.
- j) **RNAV system.**- Area navigation system that allows the aircraft to operate on any desired flight path within the coverage of ground or airspace-based navigation aids or within the limits of the capability of self-contained navigation aids or a combination of both. An RNAV system may be included as part of a flight management system (FMS).
- k) **RNP system.**- Area navigation system which supports on-board performance monitoring and alerting.
- l) **Vertical navigation.**- A navigation method that allows the aircraft to operate on a vertical flight profile using altimetry sources, external flight path references, or a combination of these.

- m) **Vertical path angle (VPA).**- Angle of the published final approach descent in baro-VNAV procedures.
- n) **Waypoint (WPT).** A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Way-points are identified as either:
- Fly-by waypoint (fly-by WPT).*- A waypoint which requires turn anticipation to allow tangential interception of the next segment of a route or procedure, or
- Flyover waypoint (flyover WPT).*- A waypoint at which a turn is initiated in order to join the next segment of a route or procedure.

## 4.2 Abbreviations

a)	AAC	Civil Aviation Administration
b)	AC	Advisory circular (FAA)
c)	AFM	Airplane flight manual
d)	AIM	Aeronautical information manual
e)	AMC	Acceptable means of compliance
f)	AP	Autopilot
g)	APCH	Approach
h)	APV	Approach procedure with vertical guidance
i)	APV/baro-VNAV	Approach procedure with vertical guidance/Barometric vertical navigation
j)	AR	Authorization required
k)	ARINC	Aeronautical radio, Incorporated
l)	ASE	Altimetry system error
m)	ATC	Air traffic control
n)	baro-VNAV	Barometric vertical navigation
o)	CA/AC	Advisory circular (SRVSOP)
p)	CFIT	Controlled flight into terrain
q)	CFR	US Code of Federal Regulations
r)	CS	Certification specifications (EASA)
s)	DA/H	Decision altitude/height
t)	DME	Distance measuring equipment
u)	EASA	European Aviation Safety Agency
v)	EHSI	Enhanced horizontal situation indicator
w)	FAA	US Federal Aviation Administration
x)	FAF	Final approach fix
y)	FAP	Final approach point
z)	FD	Flight director

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aa)	FMS	Flight management system
bb)	FTD	Flight training devices
cc)	FTE	Flight technical error
dd)	GNSS	Global navigation satellite system
ee)	Hg	Inches of mercury
ff)	hPa	Hectopascals
gg)	HSI	Horizontal situation indicator
hh)	IAF	Initial approach fix
ii)	IRU	Inertial reference unit
jj)	ISA	International standard atmosphere
kk)	KIAS	Indicated airspeed
ll)	LAR	Latin American Aeronautical Regulations
mm)	LNAV	Lateral navigation
nn)	LNAV FAF	final approach fix for lateral navigation
oo)	LNAV MDA	Lateral navigation minimum descent altitude
pp)	LOA	Letter of authorization/acceptance
qq)	MAPt	Missed approach point
rr)	MAPt LNAV	Missed approach point for lateral navigation
ss)	MDA/MDH	Minimum descent altitude/height
tt)	MEL	Minimum equipment list
uu)	NPA	Non-precision approach
vv)	ICAO	International Civil Aviation Organization
ww)	OCA/H	Obstacle clearance altitude/height
xx)	OM	Operations Manual
yy)	PANS-OPS	Procedures for air navigation services - Aircraft operations
zz)	PBN	Performance-base navigation
aaa)	PA	Precision approach
bbb)	PDE	Path definition error
ccc)	PF	Pilot flying
ddd)	PM	Pilot monitoring
eee)	PNF	Pilot not flying
fff)	QNE	Standard atmosphere that corresponds to 1013 hPa or 29.92" Hg. This setting indicates the altitude above the isobaric surface of 1013 hPa, if temperature is standard
ggg)	QNH	Pressure at mean sea level. This setting indicates the altitude above the means sea level (MSL), if temperature is standard.

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hhh)	RDH	Reference datum height
iii)	RNAV	Area navigation
jjj)	RNP	Required navigation performance
kkk)	RNP APCH	Required navigation performance approach
lll)	RNP AR APCH	Required navigation performance approach with authorization required
mmm)	SBAS	Satellite-based augmentation system
nnn)	TCH	Obstacle clearance height
ooo)	TSO	Standard technical order
ppp)	VDI	Vertical deviation indicator
qqq)	VNAV	Vertical navigation
rrr)	VNAV DA	Vertical navigation decision altitude
sss)	VPA	Vertical path angle
ttt)	WPT	Waypoint

## 5. INTRODUCTION

5.1 The acceptable means of compliance of this AC are based on the use of barometric vertical navigation (baro-VNAV).

5.2 The baro-VNAV navigation system presents the pilot with estimated vertical guidance referenced to a specified vertical path angle (VPA), nominally of 3°. The computed vertical guide is based on the barometric altitude and is specified as a VPA from the reference datum height (RDH).

5.3 The calculated vertical path is stored in the instrument flight procedure specification in the database of the area navigation (RNAV) system or of the required navigation performance (RNP) system.

5.4 For other flight phases, barometric VNAV offers vertical guidance path information that can be defined by vertical angles or altitudes at the procedure fixes.

5.5 It should be noted that there is no vertical requirement in this AC associated with the use of vertical guidance outside of the final approach segment. Therefore, vertical navigation can be performed without VNAV guidance in the initial and intermediate segments of an instrument procedure.

5.6 Aircraft authorised to conduct RNP authorization required approach (RNP AR APCH) operations are considered eligible for the baro-VNAV operations described in this AC. In this sense, there is no need for a new approval according to the criteria established in this document.

5.7 The procedures to be established pursuant to this AC will permit the use of high-quality vertical navigation capabilities that will improve safety and reduce the risks of controlled flight into terrain (CFIT).

5.8 The material described in this AC has been developed based on the following documents:

- ✓ ICAO Doc 9613, Volume II, Attachment A – Barometric VNAV; and
- ✓ ICAO Doc 8168, Volume I, Part II, Section 4, Chapter 1 – APV/baro-VNAV approach procedures.

5.9 Where possible, this AC has been harmonised with the following guidance documents:

- ✓ EASA AMC 20-27 - Airworthiness approval and operational criteria for RNP APPROACH (RNP APCH) operations including APV BARO-VNAV operations; and

- ✓ FAA AC 90-105 Approval guidance for RNP operations and barometric vertical navigation in the U.S. national airspace system - Appendix 4 – Use of barometric VNAV.

*Note.- Notwithstanding harmonisation efforts, operators shall note the differences that exist between this AC and the aforementioned documents when applying for an authorization from the corresponding Administrations.*

## **6. GENERAL CONSIDERATIONS**

### **6.1 Navaid infrastructure**

The procedure design does not have unique infrastructure requirements. This criteria is based upon the use of barometric altimetry by an airborne RNAV/RNP system whose performance capability supports the required operation. The procedure design will have to take into account the functional capabilities required by this document.

### **6.2 Publications**

Charting must follow the standards of Annex 4 for the designation of an RNAV procedure where the vertical flight path is specific by a glide path angle. The charting designation will remain consistent with the current convention (for example if the lateral procedures is predicated on GNSS, the charting will indicate RNAV<sub>(GNSS)</sub>).

### **6.3 Air traffic control (ATC) coordination**

It is expected that ATC will be familiar with aircraft VNAV capability, as well as issues associated with altimeter setting and temperature data required by the aircraft.

## **7. APV/baro-VNAV APPROACH PROCEDURES CLASSIFICATION**

7.1 Approach procedures with vertical guidance/barometric vertical navigation (APV/baro-VNAV) are classified as instrument approach procedures for approach and landing operations with vertical guidance (see the definition in Annex 6, Part I, to the Chicago Convention). These procedures are published with a decision altitude/height (DA/H) and must not be confused with non-precision approach procedures (NPA), which specify a minimum descent altitude/height (MDA/H) below which the aircraft must not descend.

7.2 The use of APV/baro-VNAV procedures improves the safety of NPA procedures, providing a guided and stabilized descent for landing, thus avoiding an early descent to minimum altitudes.

7.3 Notwithstanding the above, the inherent inaccuracy of barometric altimeters and the certified performance of the specific RNAV/RNP mode used, prevent the systems of these procedures from emulating the accuracy of the systems used in a precision approach (PA). In particular, with some systems it might not be possible to keep the aircraft within the obstacle-free surfaces of Annex 14 to the Chicago Convention. Thus, the pilot must keep this possibility in mind when making the decision to land at the decision altitude/height (DA/H).

7.4 In APV/baro-VNAV approach procedures no final approach fix (FAF) or missed approach fix (MAPt) is identified.

7.5 The lateral part of APV/baro-VNAV criteria is based on non-precision RNAV criteria. However, the FAF is not part of the APV/baro-VNAV procedure and is replaced by a final approach point (FAP), although the RNAV FAF may be used as a final approach course fix in database design. Likewise, the MAPt is replaced by a DA/H, which depends upon the category of the aircraft.

7.6 The LNAV FAF and MAPt are used for coding purposes in the baro-VNAV procedure and are not aimed at inhibiting the descent in the FAP or restricting the DA/H.

7.7 The minimum DH for APV/baro-VNAV is 75 m (246 ft) plus the height loss margin. However, the operator may increase this minimum DH limit to at least 90 m (295 ft) plus a height loss margin, when



the lateral navigation system is not certified to ensure that the aircraft will be within the inner approach, inner transitional, and balked landing surfaces indicated in Annex 14 to the Chicago Convention (extended as necessary above the inner horizontal surface to the obstacle clearance altitude/height (OCA/H)) with a high degree of probability.

## **8. NAVIGATION SYSTEM DESCRIPTION**

### **8.1 Vertical navigation (VNAV)**

- a) In VNAV, the system allows the aircraft to fly level and descent point to point in a vertical linear profile path that is kept in an on board navigation database. The vertical profile will be based upon altitude constraints or VPAs, where appropriate, associated with the lateral navigation (LNAV) path waypoints (WPT).

*Note.- Normally, VNAV is a flight guidance systems mode, where the RNAV/RNP equipment containing the VNAV capability provides path steering commands to the flight guidance system, which controls the flight technical error (FTE) by means of the pilot manual control in the vertical deviation display or through flight director (FD) or autopilot (AP) coupling.*

## **9. AIRWORTHINESS AND OPERATIONAL APPROVAL**

9.1 In order to get an APV/baro-VNAV authorisation, a commercial air transport operator shall obtain two types of approval:

- a) an airworthiness approval from the State of registry; (see Article 31 of the Chicago Convention and Paragraphs 5.2.3 and 8.1.1 of Annex 6, Part I); and
- b) the operational approval from the State of the operator (see Paragraph 4.2.1 and Attachment F to Annex 6, Part I).

9.2 For general aviation operators, the State of registry will determine if the aircraft meets the applicable APV/baro-VNAV requirements (see Paragraph 2.5.2.2 of Annex 6, Part II).

## **10. AIRWORTHINESS APPROVAL**

### **10.1 Equipment requirements**

10.1.1 APV/baro-VNAV procedures are to be used by aircraft equipped with flight management systems (FMS) or other RNAV or RNP systems capable of calculating barometric VNAV paths and, based on these, display deviations on the instrument visual indicator.

10.1.2 Aircraft equipped with APV/baro-VNAV systems that have been approved by the State of registry for the corresponding level of lateral navigation operations (LNAV)/VNAV may use these systems to conduct APV/baro-VNAV approaches, provided:

- a) the navigation system has a certified performance of 0.3 NM or lower, with a 95% probability. This includes:
- 1) global navigation satellite systems (GNSS) certified for approach operations; or
  - 2) multiple-sensor systems that use inertial reference units (IRU) in combination with dual distance measuring equipment (DME/DME) or certified GNSS systems; or
  - 3) RNP systems approved for operations with RNP 0.3 or lower.
- b) the APV/baro-VNAV equipment is operational;
- c) the aircraft and the aircraft systems are properly certified for the planned APV/baro-VNAV approach operations;

- d) the aircraft is equipped with an integrated LNAV/VNAV system with an accurate source of barometric altitude; and
- e) VNAV altitudes and all the relevant procedural and navigation information are obtained from a navigation database whose integrity is supported by appropriate quality assurance measures.

10.1.3 In cases where LNAV/baro-VNAV procedures have been published, the approach area will be assessed in order to identify obstacles invading the inner approach surfaces, the inner transitional surfaces, and the balked landing surface defined of Annex 14 to the Chicago Convention. If obstacles invade these surfaces, a restriction amounting to the minimum value of the allowed OCA/H will be imposed.

10.1.4 APV/baro-VNAV operations are based on RNAV/RNP systems that receive inputs from equipment that may include:

- a) an air data computer: FAA Technical Standard Order (TSO)-C 106.
- b) an air data system: Aeronautical Radio, Incorporated (ARINC) 706, Mark 5 Air Data System.
- c) a barometric altimetry system of the following types: DO-88 altimetry, ED-26 MPS for airborne altitude measurements and coding systems, ARP-942 pressure altimeter systems, ARP-920 design and installation of pitot static systems for transport aircraft.
- d) integrated type-certified systems providing the capabilities of an air data system comparable to the one described in paragraph b).

**Note 1.-** Position data from other sources may be integrated with the barometric altitude information, provided they do not cause position errors exceeding the path-keeping precision requirements.

**Note 2.-** The altimetry system performance will be demonstrated separately through the certification of static pressure systems (e.g., \*14 CFR 25.1325 or \*CS 25.1325 or equivalent sections), where performance must be 30 ft by 100 knots of indicated airspeed (KIAS). Altimetry systems that meet this requirement will meet the altimetry system error (ASE) requirements for baro-VNAV operations. Additional compliance or demonstration is not required.

\*14 CFR 25.1325: Section 1325 of Part 25 of Title 14 of the United States Code of Federal Regulations (CFR).

\*CS 25.1325: Certification Specification (CS) 25.1325 of EASA certification specifications for large aircraft (CS 25).

10.1.5 Continuity of function.- At least one RNAV system is required to conduct baro-VNAV operations.

## 10.2 System accuracy

10.2.1 For instrument approach operations, it must be demonstrated that the on board VNAV equipment error, excluding altimetry, is lower than the values described in Table 10-1, with a probability of 99.7%.

Table 10-1

	Level flight segments and climb/descent intercept altitude region of specified altitudes (ft)	Climbs/descents along the specified vertical profile (angle) (ft)
At or below 5 000 ft	50	100
5 000 ft to 10 000 ft	50	150
Above 10 000 ft	50	220

**Note 1.-** The VNAV equipment error is the error associated with the calculation of the vertical path. This includes the path definition error (PDE) and an approach performed by the VNAV equipment from the construction of the vertical path, if any.

10.2.2 Vertical flight technical errors (FTE).- Using satisfactory displays of vertical guidance information, it must be demonstrated that the flight technical errors are below the values shown in Table 10-2, on a three-sigma basis:

Table 10-2

	Level flight segments and climb/descent intercept altitude region of specified altitudes (ft)	Climbs/descents along the specified vertical profile (angle) (ft)
At or below 5 000 ft	150	200
5 000 ft to 10 000 ft	240	300
Above 10 000 ft	240	300

10.2.3 Regarding the facility, a sufficient number of test flights should be conducted to verify that these values could be maintained. Lower FTE values can be achieved, especially when the VNAV system is coupled to an AP or FD. However, at least the total system vertical precision shown in Table 10-3 must be maintained.

10.2.4 If a facility produces higher FTEs, the total vertical error of the system (excluding altimetry) can be determined by combining the FTEs with the equipment errors using the root sum square method. The result shall be lower than the values listed in Table 10-3:

Table 10-3

	Level flight segments and climb/descent intercept altitude region of specified altitudes (ft)	Climbs/descents along specified vertical profile (angle) (ft)
At or below 5 000 ft	158	224
5 000 ft to 10 000 ft	245	335
Above 10 000 ft	245	372

10.2.5 The approval of the VNAV system in accordance with FAA AC 20-129, and the approval of the altimetry system in accordance with FAR/CS/LAR 25.1325 or equivalent, constitute acceptable means of compliance with the aforementioned precision requirements.

### 10.3 functional requirements for APV/baro-VNAV operations

#### 10.3.1 Required functions

- a) **Displays.** APV/baro-VNAV deviations must be shown on a vertical deviation display (e.g., the horizontal situation indicator (HSI), the enhanced horizontal situation indicator (EHSI), and the vertical deviation indicator (VDI)).

This display must be used as primary flight instrument during the approach. The display must be visible to the pilot and be located in the primary field of view of the pilot.

The deviation display must have an suitable full-scale deflection based on the required vertical track error.

- b) **Continuous deviation display.** The navigation display must provide the capacity of continuously showing the aircraft position relative to the defined vertical path to the pilot flying the aircraft (PF), on the primary navigation flight instruments. The display must permit the pilot to readily note if the vertical deviation exceeds +100/-50 ft. The deviation shall be monitored and the pilot will take the appropriate action to minimise errors.

**Note.** When the minimum crew consists of two pilots, a means shall be provided for the pilot not flying the aircraft (PNF) (pilot monitoring (PM)) to check the desired path and the aircraft position relative to the path.

- 1) It is recommended that a properly graduated non-numerical deviation display (e.g., the vertical deviation indicator) be located on the primary field of view of the pilot. A fixed-scale deviation indicator is acceptable, provided said indicator demonstrates the proper setting and

sensitivity for the planned operation. Alert and annunciation limits must also correspond to scale values.

**Note.-** Current systems incorporate vertical deviation scales in the range of  $\pm 500$  ft. These deviation scales shall be assessed based on the aforementioned requirements.

- 2) Instead of duly graduated vertical deviation indicators, it may be acceptable to have a numeric vertical deviation display, depending on the flight crew workload and display characteristics. The use of a numerical display may require initial and recurrent training for the flight crew.
  - 3) Since the vertical deviation scale and sensitivity vary significantly, an eligible aircraft may also be equipped with an operational FD or AP capable of following a vertical path.
- c) **Definition of the vertical path.-** The navigation system must be capable of defining a vertical path in accordance with the published vertical path. It must also be capable of specifying a vertical path within the altitude constraints at two fixes in the flight plan. Altitude constraints at fixes must be defined as one of the following:
- 1) an AT or ABOVE altitude constraint (for example, 2400A may be appropriate when there is no need to limit the vertical path);
  - 2) an AT or BELOW altitude constraint (for example, 4800B may be appropriate when there is a need to limit the vertical path);
  - 3) an AT altitude limitation (for example, 5200); or
  - 4) a WINDOW-type altitude constraint (for example, 2400A3400B).
- Note.-** For RNP AR APCH procedures, any segment with a published path will define that path based on an angle to the fix and altitude.
- d) **Path construction.-** The system must be capable to construct a path to provide guidance from current position to a vertically constrained fix.
- e) **Capability to load procedures from the navigation database.-** The navigation system must have the capability to load and modify the entire procedures to be flown, based upon ATC instruction, into the RNAV/RNP system from onboard navigation database. This includes the approach (including vertical angle), the missed approach, and the approach transitions for the selected aerodrome and runway. The RNAV/RNP system shall preclude modification of the procedure data contained in the navigation database.
- f) **User interface (control and displays).-** the display readout and entry resolution for vertical navigation information shall be as follows:

Tabla 10-4

Parameters		Display resolution	Entry resolution
Altitude	Above the transition level altitude	Flight level	Flight level
	Below the transition level altitude	1 ft	1 ft
Vertical path deviation		10 ft	Not applicable
Flight path angle		0.1°	0.1°
Temperature		1°	1°

- g) The navigation database must contain the necessary information to fly the APV/baro-VNAV approach. This database must contain the WPTs and associated vertical information (obstacle clearance height (TCH) and flight path angle (VPA)) for the procedure.

Vertical constraints (altitudes and airspeeds) associated with published procedures must be automatically retrieved from the navigation database once the approach procedure has been selected.

- h) The navigation system must be capable of indicating the navigation loss (e.g., system failure) in the pilot's primary field of view through a warning signal (flag) or equivalent indicator on the vertical navigation display.
- i) The aircraft must show barometric altitude from two independent altimetry sources, one in each pilot's primary field of view. When single pilot operation is permitted, the two displays must be visible from the pilot position.

#### 10.3.2 Recommended functions

- a) **Temperature compensation** The baro-VNAV navigation system should be capable of automatically adjusting the vertical flight path for temperature effects. The equipment should provide the capability for entry of altimeter source temperature to compute temperature compensation for the vertical flight path angle. The system should provide clear and distinct indication to the flight crew of this compensation/adjustment.
- b) Capability to automatically intercept the vertical path at the final approach point (FAP), using a vertical fly-by technique.

#### 10.4 Aircraft eligibility

- a) **RNP system capability.-** An aircraft is eligible for RNP operations when it meets the RNP performance and functional requirements described in SRVSOP AC 91-008 (RNP APCH) or AC 91-009 (RNP AR APCH) or equivalents.
- b) **Barometric VNAV capability.-** An aircraft is eligible when it has a flight manual (AFM) or AFM supplement which clearly states that the VNAV system is approved for approach operations in accordance with FAA AC 20-129 or AC 20-138 or equivalents documents. In addition, for a VNAV system to be approved for approach operations according to AC 20-129 or AC 20-138 or equivalents documents, it must have a vertical deviation indicator (VDI). Since VDI sensitivity and setting vary significantly, an eligible aircraft must also be equipped and use either a flight director (FD) or an autopilot (AP) capable of following the vertical path. Pilot deviation of +100/-50 ft is considered acceptable on a published VNAV path.

*Note.- An aircraft with RNP AR APCH authorisation is considered eligible for conducting baro-VNAV operations in accordance with this AC. No further evaluation is required.*

- c) **Database requirements.-** The aircraft database must include the WPTs and the associated VNAV information, e.g., altitudes and vertical angles for the procedure to be flown.

#### 10.5 Aircraft approval

##### a) Eligibility based on the AFM or AFM supplement

###### 1) LAR 91 operators

LAR 91 operators must review the aircraft AFM or AFM supplement in order to establish the eligibility of the navigation system as described in Paragraph 10.4.

###### 2) LAR 121 y 135 operators

(a) LAR 121 and 135 operators must present the following documentation to the CAA:

- (1) the sections of the AFM or AFM supplement that document the RNAV/RNP airworthiness approval for APV/baro-VNAV approach procedures in accordance with Paragraph 10.4 of this AC.

##### b) Eligibility that is not based on the AFM or AFM supplement

- 1) An operator may not be in a position to determine the eligibility of the equipment for conducting APV/baro-VNAV approaches based on the AFM or AFM supplement. In this case, LAR 91, LAR 121 and 135 operators must request that the Airworthiness inspection division of the CAA or equivalent, assess the baro-VNAV equipment to determine its eligibility.
- 2) Together with the request, the operator will provide to the Airworthiness inspection division or equivalent the following information:
  - (a) name of the manufacturer, model, and part number of the RNAV/RNP system;
  - (b) any evidence of IFR approval of the navigation system; and
  - (c) relevant information about flight crew operating procedures.
- 3) If the Airworthiness inspection division or equivalent is not in a position of determining the eligibility of the equipment, it shall send the request, together with the supporting data, to the Aircraft certification division or equivalent.
- 4) The Aircraft certification division or equivalent will verify that the aircraft and the RNAV/RNP system meet the baro-VNAV criteria and that the system can safely fly VNAV paths associated to instrument approach procedures, applying a DA instead of an MDA. The Aircraft certification division or equivalent will provide written documentation (e.g., a report of an amended flight standard bulletin or other official document) to verify the eligibility of the equipment.
- 5) **For LAR 91 operators.-** If the CAA determines that the navigation equipment is eligible for baro-VNAV instrument approach operations, the Airworthiness inspection division or equivalent will provide documentation showing that the aircraft equipment is approved for said operations.
- 6) **For LAR 121 and 135 operators.-** The CAA will try to establish the eligibility of the system and will make sure that training and operation manuals reflect the operational policies of Paragraphs 12, 13 and 14 of this AC.
- 7) Compliance with airworthiness or equipment installation requirements, by itself, does not constitute operational approval.

#### 10.6 Aircraft modification

- a) If any system required for baro-VNAV operations is modified (e.g., change in the software or hardware), the aircraft modification must be approved.
- b) The operator must obtain a new operational approval that is supported by operational and aircraft qualification documentation presented by the operator.

### 11. OPERATIONAL APPROVAL

11.1 To obtain the operational approval, the operator will take the following steps:

- a) *Airworthiness approval.-* aircraft shall have the corresponding airworthiness approvals as established in Paragraph 10.
- b) *Application.-* The operator will submit the following documentation to the CAA:
  - 1) *the APV/baro-VNAV operational approval application;*
  - 2) *aircraft qualification documentation.-* Documentation showing that the equipment of the proposed aircraft meets the requirements described in Paragraph 10 of this AC.
  - 3) *Type of aircraft and description of the aircraft equipment to be used.-* The operator will provide a configuration list describing in detail the relevant components and the equipment to

be used in the APV/baro-VNAV operation. The list shall include each manufacturer, model and version of the FMS software installed.

**Note.** - Barometric altimetry and the associated equipment, such as air data systems, are basic capabilities required for flight operations.

- 4) *Operational procedures.*- Operator manuals shall properly indicate the navigation procedures identified in Paragraphs 12 and 13 of this AC. LAR 91 operators shall confirm that they will operate applying identified practices and procedures.
- 5) *Training programmes.*- LAR 121 and 135 operators will submit the training curriculums in accordance with Paragraph 14 of this AC, which describe the operational and maintenance practices and procedures and training aspects related to VNAV approach operations (e.g., initial, promotion, and recurrent training for flight crews, flight dispatchers, and maintenance personnel).

**Note.** - A separate training programme is not required if RNAV and VNAV training is already part of the training programme of the operator. However, it should be possible to identify the practices and procedures concerning VNAV aspects covered in the training programme. LAR 91 operators should be familiar with the practices and procedures identified in Paragraph 14 of this AC.

- 6) *Operations manual (OM) and checklists.*- Operators will submit the operations manuals and checklists containing information and guidance on APV/baro-VNAV operations.
- 7) *Maintenance procedures.*- The operator will submit the maintenance procedures containing airworthiness and maintenance instructions concerning the systems and equipment to be used in the operation. The operator will provide a procedure to remove and restore the APV/baro-VNAV operational capacity of the aircraft.
- 8) *MEL.*- The operator will submit any revision to the MEL needed to conduct APV/baro-VNAV operations.
- 9) *Validation.*- The CAA will determine the need to conduct validation tests based on the type of operation and operator experience. If validation tests are necessary, the operator will submit a validation test plan to show its capacity to conduct the proposed operation (see Chapter 13 of Volume II, Part II of the SRVSOP Operations Inspector Manual). The validation plan must at least include the following:
  - (a) a statement indicating that the validation plan has been designated to demonstrate the capacity of the aircraft to execute APV/baro-VNAV procedures;
  - (b) operational and dispatch procedures; and
  - (c) MEL procedures.

**Note 1.** - the validation plan shall make use of ground training devices, flight simulators, and aircraft demonstrations. If the demonstration will be conducted in an aircraft, it must be completed during the day and under VMC.

**Note 2.** - validations may be required for each manufacturer, model, and version of the installed FMS software.

- 10) *Navigation data validation program.*- The operator shall submit the details of the navigation data validation program as described in Appendix 1 of this AC.
- c) *Training.*- Once the CAA has accepted or approved the amendments to the manuals, programmes and documents submitted, the operator will provide the respective training to its personnel.
  - d) *Validation flights.*- Validation flights, if required, will be conducted according to Paragraph 11.1 b) 9).
  - e) *Issuance of the authorisation.*- Once all the aforementioned steps have been completed satisfactorily, the CAA will issue the OpSpecs for LAR 121 and 135 operators, or a LOA for LAR 91.

## 12. OPERATIONAL PROCEDURES

12.1 For APV/baro-VNAV operations, the crews must be familiar with the following procedures:

a) **Corrections for cold temperatures.**- Pilots are responsible for any cold temperature correction required at all minimum altitudes/heights published. This includes:

- a) The altitudes/heights for initial and intermediate segments;
- b) The DA/H; and
- c) Subsequent missed approach altitudes/heights.

*Note.- The VPA of the final approach path is protected against the effects of cold temperatures by the procedure design.*

b) **Altimeter setting.**- APV/baro-VNAV operations will only be conducted when:

- 1) a current and local source for altimeter setting is available; and
- 2) the \*QNH/\*QFE is properly selected in the aircraft altimeter.

\*QNH: Pressure at mean sea level. This setting indicates the altitude above mean sea level, (MSL) with standard temperature.

\*QFE: Standard atmosphere that corresponds to 1013 hPa or 29.92" Hg. This setting indicates the altitude above the isobaric surface of 1013 hPa, with standard temperature.

*Note.- A remote source for altimetry setting shall not be used.*

c) **Actions to be taken at the DA.**- The flight crew is expected to operate the aircraft along the published vertical path, and to execute a missed approach procedure once it reaches the DA, unless the required visual references to continue with the approach are in sight.

d) **Temperature limitation.**- Because of the pronounced effect of nonstandard temperature on baro-VNAV operations, instrument approach procedures will contain a temperature limitation below which the use of a vertical navigation decision altitude (VNAV DA) based on baro-VNAV is not authorized. The temperature limitation will be shown through a note in the instrument approach procedure. If the aircraft system is capable of temperature compensation, the crew must follow the operator procedures based on the manufacturer instructions.

e) **VNAV path mode selection.**- The flight crew must know the correct selection of the vertical mode(s) that command vertical navigation via the published flight path. Other vertical modes, such as vertical speed are not applicable to baro-VNAV approach.

f) **Restriction to using a remote source for altimeter setting.**- The use of baro-VNAV up to a DA is not authorised if the altimeter setting is issued from a remote source. For APV/baro-VNAV operations, a current altimetry setting is required for the landing aerodrome. When minima related to a remote altimetry setting are shown, the VNAV function can be used, but only up to the published lateral navigation minimum descent altitude (LNAV MDA).

g) **Manual adjustments.**- If manual adjustments to stored altitude information are necessary, e.g., cold temperature adjustments, the flight crew must make appropriate adjustments to the procedure altitudes and revert to use of the temperature adjusted LNAV MDA.

### 13. TEMPERATURE LIMITATIONS

a) For aircraft using barometric vertical navigation without temperature compensation to conduct the approach, cold temperature limits are reflected in the procedure design and identified along with any high temperature limits on the charted procedure. Cold temperatures reduce the actual glidepath angle, while high temperatures increase the glidepath angle. Aircraft using barometric vertical navigation with temperature compensation or aircraft using an alternate means of vertical guidance (e.g., satellite-based augmentation system (SBAS)) may disregard the temperature restrictions.



- b) Since the temperature limits established in the charts are only assessed for obstacle clearance in the final approach segment, and since temperature compensation only affects vertical guidance, the pilot may need to adjust the minimum altitude on the initial and intermediate approach segments, and at the decision altitude/height (DA/H)).

**Note 1.-** Temperature affects the indicated altitude. The effect is similar to having high and low pressure changes, but not as significant as such changes. When the temperature is higher than standard (temperature under international standard atmospheric (ISA) conditions)), the aircraft will be flying above the indicated altitude. When the temperature is below the standard, the aircraft will be flying below the altitude indicated in the altimeter. For further information, refer to altimetry errors in the aeronautical information manual (AIM)

**Note 2.-** The ISA standard conditions at sea level are:

- The standard temperature is defined as 15° Celsius (centigrades) or 288.15° Kelvin;
- The standard pressure is defined as 29.92126 inches of mercury (Hg) or 1013.2 hectopascals (hPa); and
- The standard density for these conditions is 1.225 kg/m<sup>3</sup> or 0.002377 slugs/cubic ft.

## 14. TRAINING PROGRAMME

14.1 The training programme of the operator shall include sufficient training on aircraft VNAV capabilities for flight crews and flight dispatchers (e.g., ground training, flight simulators, flight training devices (FTD) or aircraft). Training will cover the following areas:

- a) information about this AC;
- b) the meaning and proper use of aircraft systems;
- c) the characteristics of APV/baro-VNAV procedures, as determined from chart depiction and textual description;
  - 1) description of WPT types (fly-by and flyover WPTs), path terminators, and any other type of terminator used by the operator, as well as the associated flight paths of the aircraft;
  - 2) information about the specific RNAV/RNP system;
  - 3) automation levels, annunciation modes, changes, alerts, interactions, reversions, and degradation;
  - 4) functional integration with other aircraft systems;
  - 5) the meaning of vertical path discontinuities and related flight crew procedures;
  - 6) monitoring procedures for each flight phase (e.g., monitoring of "PROGRESS" or "LEGS" pages);
  - 7) turn anticipations, taking into account the effect of airspeed and altitude; and
  - 8) interpretation of electronic displays and symbols.
- d) VNAV equipment operating procedures, where applicable, including how to perform the following actions:
  - 1) adhere to speed and/or altitude constraints associated with an approach procedure;
  - 2) verify WPTs and flight plan programming;
  - 3) fly direct to a WPT;
  - 4) determine vertical track error/deviation;
  - 5) insert and delete route discontinuity;
  - 6) change destination and alternate aerodromes;
  - 7) contingency procedures for VNAV failures;

- e) the functioning of barometric altimeters.- Barometric altimeters are calibrated to indicate the true altitude under ISA atmospheric conditions. If, on a given day, the temperature is warmer than ISA, the true altitude will be higher than indicated altitude. Conversely, on a day colder than ISA, the true altitude will be lower than indicated altitude. These errors increase in magnitude as the altitude above the altimeter setting source increases.
- f) altimetry setting procedures and cold temperatures.
  - 1) Altimeter setting.- Flight crews must take precautions when changing the altimeter setting and will request a current altimeter setting if the reported setting may not be recent, especially when pressure tends to drop quickly. Remote altimeter setting is not permitted for APV/baro-VNAV operations.
  - 2) Cold temperatures.- In case of cold temperatures, the pilot shall verify the instrument approach procedure chart to determine the temperature limit for using the baro-VNAV capability. If the aircraft system has temperature compensation capability, the crew shall follow the procedures established by the operator based on the manufacturer instructions for using the baro-VNAV function.
- g) Knowledge of failures and reversal modes.- The flight crew shall have knowledge of failures and reversal modes that adversely impact the aircraft's ability to conduct baro-VNAV approach operations. In addition, the flight crew must be aware of contingency procedures (e.g., reversal to LNAV MDA following a VNAV failure).
- h) Operational verification of altimeters.- When two pilots are required on an aircraft, the flight crew must complete an altimetry crosscheck ensuring both pilots' altimeters agree within  $\pm 100$  ft prior to the FAF. If the altimeter crosscheck fails, the instrument approach procedure must not be executed, or, if said procedure is in progress, it must not be continued. If the avionics system provides a warning system that compares the pilots' altimeters, flight crew procedures shall indicate the action to be taken in the event of a warning from the pilot altimeter comparator when executing an APV/baro-VNAV operation.

*Note.- This operational crosscheck of the altimeters is not necessary if the aircraft automatically compares the altitudes within 100 ft.*

## **15. NAVIGATION DATABASE**

- a) The operator must obtain the navigation database from a qualified supplier that complies with RTCA document DO-200A / EUROCAE ED- 76, Standards for processing aeronautical data.
- b) Navigation data suppliers must have a letter of acceptance (LOA) in order to process the navigation information (e.g., FAA AC 20-153 or European aviation safety agency (EASA) document on the conditions for the issuance of letters of acceptance for navigation database suppliers by the Agency (EASA IR 21 Sub-part G) or equivalent documents). A LOA recognizes the data of a supplier as those in which information quality, integrity, and quality management practices are consistent with the criteria of document DO-200A/ED-76. An operator supplier (e.g., an FMS company) must have a Type 2 LOA and their respective suppliers must have a Type 1 or 2 LOA.
- c) The operator must report to the navigation data provider any discrepancy that invalidates a procedure, and prohibit the use of the affected procedures by means of a notice to flight crews.
- d) Operators should consider the need to periodically verify the navigation databases, in order to maintain the existing requirements of the quality system or safety management system.

## **16. OVERSIGHT, INVESTIGATION OF NAVIGATION ERRORS AND WITHDRAWAL OF APV/baro-VNAV AUTHORISATION**

- a) The operator will establish a procedure to receive, analyse, and follow up on navigation error reports in order to determine appropriate corrective actions.
- b) Information that indicates the potential of repeated errors may require modification of an operator's training programme.
- c) Information that attributes multiple errors to a particular pilot may required remedial training or license review.
- d) Repeated navigation errors attributed to a piece of equipment or a specific part of that piece of equipment or to operational procedures can entail the cancellation of an operational approval (withdrawal of APV/baro-VNAV authorisation from the OpSpecs or withdrawal of the LOA in the case of private operators).

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## APPENDIX 1

### NAVIGATION DATA VALIDATION PROGRAMME

#### 1. INTRODUCTION

The procedure stored in the navigation database defines the aircraft lateral and vertical guidance. The navigation database is updated every 28 days. The navigation data used in each update are critical for the integrity of each APV/baro-VNAV approach. Taking into account the reduced obstacle clearance associated with these approaches, navigation data validation requires special consideration. This appendix provides guidance on the operator procedures to validate the navigation data associated with APV/baro-VNAV approaches.

#### 2. DATA PROCESSING

- a) The operator will identify the person responsible for updating the navigation data.
- b) The operator must document a process for accepting, verifying, and loading the navigation data into the aircraft.
- c) The operator must place its documented data process under configuration control.

#### 3. INITIAL DATA VALIDATION

3.1 The operator must validate every APV/baro-VNAV procedure before flying the procedure in instrument meteorological conditions (IMC) to ensure compatibility with their aircraft and to ensure the resulting path correspond to the published procedure. As a minimum, the operator must:

- a) compare the navigation data of the procedure to be loaded on the FMS with a published procedure.
- b) validate the navigation data of the loaded procedure, either in the flight simulator or in the actual aircraft under visual meteorological conditions (VMC). The depicted procedure on the map display must be compared to the published procedure. The entire procedure must be flown to ensure that the path can be used, that it has no apparent lateral or vertical path disconnections, and is consistent with the published procedure.
- c) once the procedure is validated, a copy of the validated navigation data must be kept and maintained to be compared with subsequent data updates.

#### 4. DATA UPDATING

Whenever the operator receives a navigation data update and before using such data on the aircraft, the update must be compared with the validated procedure. This comparison must identify and resolve any discrepancy in the navigation data. If there are any significant changes (any change affecting the approach path or performance) to any part of the procedure, the operator must validate the amended procedure in accordance with the initial data validation (Paragraph 3 of this AC).

#### 5. NAVIGATION DATA SUPPLIERS

Navigation data suppliers must have a letter of acceptance (LOA) to process these data (e.g., FAA AC 20-153 or EASA document on the conditions for the issuance of letters of acceptance for navigation data suppliers (EASA IR 21 Sub-part G) or equivalent document). An LOA recognizes the data of a supplier as having an information quality; integrity and quality management practices that are consistent with the criteria of document DO-200A/ED-76. An operator supplier (e.g., an FMS company) must have

a Type 2 LOA and their respective suppliers must have a Type 1 or 2 LOA. The AAC may accept a LOA submitted by navigation data suppliers or issues its own LOA.

**6. AIRCRAFT MODIFICATIONS (DATA BASE UP TO DATE)**

If an aircraft system required for APV/baro-VNAV operations is modified (e.g., a change in the software), the operator is responsible for validation of APV/baro-VNAV procedures with the navigation database and the modified system. This may be accomplished without any direct evaluation if the manufacturer verifies that the modification has no effect on the navigation database or on path computation. If this verification is not accomplished by the manufacturer, the operator must carry out an initial navigation data validation with the modified system.

## APPENDIX 1

### APV/baro-VNAV APPROVAL PROCESS

- a) The APV/baro-VNAV approval process consists of two types of approvals: the airworthiness and operational approvals. Although the two have different requirements, they must be considered under a single process.
- b) This process constitutes an orderly method used by the CAAs to ensure that applicants meet the established requirements.
- c) The approval process consists of the following phases:
  - 1) Phase one: Pre-application
  - 2) Phase two: Formal application
  - 3) Phase three: Review of the documentation
  - 4) Phase four: Inspection and demonstration
  - 5) Phase five: Approval
- d) In *Phase one - Pre-application*, the CAA meets with the applicant or operator (pre-application meeting), who is advised of all the requirements it must meet during the approval process.
- e) In *Phase two - Formal application*, the applicant or operator submits the formal application, accompanied by all the relevant documentation, as established in Paragraph 11 of this AC.
- f) In *Phase three - Review of documentation*, the CAA evaluates the documentation and the navigation system to determine their eligibility and the approval method to be applied with respect to the aircraft. As a result of this review and evaluation, the CAA may accept or reject the formal application together with the documentation.
- g) In *Phase four - Inspection and demonstration*, the operator will train its personnel and conduct validation flights, if required.
- h) In *Phase five - Approval*, the CAA issues the APV/baro-VNAV authorization once the operator has met the airworthiness and operational requirements. For LAR 121 and 135 operators, the CAA will issue the corresponding OpSpecs, and for LAR 91 operators, it will issue a LOA.

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**APPENDIX G-2**

**APV/baro-VNAV JOB AID**

**APPLICATION TO CONDUCT APV/baro-VNAV OPERATIONS**

## APV/baro-VNAV JOB AID

### APPLICATION TO CONDUCT APV/baro-VNAV OPERATIONS

#### 1. Introduction

This Job Aid was developed by the Latin American Regional Safety Oversight Cooperation System (SRVSOP) to provide States, operators, and inspectors with guidance on the process to be followed by an operator in order to obtain an APV/baro-VNAV approval.

#### 2. Purpose of the Job Aid

- 2.1 To give operators and inspectors information on the main APV/baro-VNAV reference documents.
- 2.2 To provide tables showing the contents of the application, the associated reference paragraphs, the place in the application of the operator where APV/baro-VNAV elements are mentioned and columns for inspector comments and follow-up on the status of various elements of APV/baro-VNAV.

#### 3. Actions Recommended for the inspector and operator

Some recommendations for use of the Job Aid follow:

- 3.1 At the pre-application meeting with the operator, the inspector reviews the “basic events of the APV/baro-VNAV approval process” described in Part 1 of this Job Aid, in order to provide an overview of the approval process events.
- 3.2 The inspector reviews this Job Aid with the operator in order to establish the form and content of the APV/baro-VNAV approval application.
- 3.3 The operator uses this Job Aid as a guide to collect the documents/annexes of the APV/baro-VNAV application.
- 3.4 The operator inserts in the Job Aid references showing in what part of its documents are the APV/baro-VNAV programme elements located.
- 3.5 The operator submits the Job Aid and the application to the inspector (documents/annexes).
- 3.6 The inspector indicates in the Job Aid whether an item is in compliance or needs corrective action.
- 3.7 The inspector informs the operator as soon as possible when a corrective action by the operator is required.
- 3.8 The operator provides the inspector with the revised material when so requested.
- 3.9 The CAA provides the operator with the operational specifications (OpSpecs) or a letter of authorisation (LOA), as applicable, when the tasks and documents have been completed.

#### 4. Structure of the Job Aid

Parts	Topics	Page
Part 1	General information	3
Part 2	Information on aircraft and operator identification	5
Part 3	Application (Annexes and documents)	7
Part 4	Contents of the application for APV/baro-VNAV	11
Part 5	Guide to determine the eligibility of APV/baro-VNAV aircraft	15
Part 6	Basic pilot procedures for APV/baro-VNAV operations	19

#### 5. Main sources of documents, information, and contacts

Advisory Circular CA 91-010 - Approval of aircraft and operators for approach procedures with vertical guidance/barometric vertical navigation (APV/baro-VNAV) operations is available on the ICAO/SAM Regional Office web page ([www.lima.icao.int](http://www.lima.icao.int)) through the SRVSOP link.

#### 6. Main reference documents

Reference documents	Titles
Annex 6	Operation of aircraft
ICAO Doc 9613	Performance-based navigation (PBN) manual – Attachment A - Barometric VNAV
ICAO Doc 9905	Required navigation performance authorization required (RNP AR) procedure design manual
ICAO Doc 8168 Volume I	Part II, Section 4, Chapter 1 – APV/baro-VNAV approach procedures
ICAO Doc 8168 Volume II	Part III, Section 3, Chapter 4 – APV/baro-VNAV
EASA AMC 20-27	Airworthiness approval and operational criteria for RNP APPROACH (RNP APCH) operations including APV BARO-VNAV operations
FAA AC 90-105	Approval guidance for RNP operations and barometric vertical navigation en the U.S. National Airspace System - Appendix 4 - Use of barometric VNAV
AC 20-129	Airworthiness approval of vertical navigation (VNAV) systems for use in the U.S. national airspace system (NAS) and Alaska
AC 20-138A	Airworthiness approval of Global navigation satellite system (GNSS) equipment
TSO-C106	Air data computer

**PART 1: GENERAL INFORMATION****Basic events of the APV/baro-VNAV approval process**

	<b>Action by the operator</b>	<b>Action by the CAA</b>
1	Establish the need to obtain approval for APV/baro-VNAV operations.	
2	Review the AFM, AFM supplement or Type Certificate Data Sheet (TCDS), or other appropriate documents (e.g., service bulletins (SB), service letters (SL), etc.) to determine the eligibility of the aircraft for APV/baro-VNAV operations. The operator contacts the aircraft or avionics manufacturer, if necessary, to confirm APV/baro-VNAV or higher eligibility of the aircraft.	
3	Contact the CAA to schedule a pre-application meeting to discuss the operational approval requirements.	
4		During the pre-application meeting, establish: <ul style="list-style-type: none"> <li>• the form and contents of the application;</li> <li>• the documents that support APV/baro-VNAV approval</li> <li>• the date in which the application will be submitted for evaluation</li> <li>• if necessary, conduct a validation flight observed by the CAA</li> </ul>
5	Send the application at least 60 days before start-up of APV/baro-VNAV operations.	
6		Review the application of the operator.
7	Once the amendments to manuals, programmes, and documents have been approved or accepted, provide training to flight crews, flight dispatchers, and maintenance personnel, and conduct a validation flight, if required by the CAA.	Only if required, participate in the validation flight.
8		Once the operational and airworthiness requirements have been met, issue the operational approval in the form of OpSpecs for LAR 121 or 135 or equivalent operators, or an LOA for LAR 91 or equivalent operators, as appropriate.

**Notes related to the approval process****1. Responsible authority**

- a. **Commercial air transport (LAR 121 and/or 135 or equivalent regulations).**- The **State of registry** determines that the aircraft meets the airworthiness requirements. The **State of the operator** issues the APV/baro-VNAV approval (e.g., OpSpecs).
- b. **General aviation (LAR 91 or equivalent regulation).**- The **State of registry** determines that the aircraft meets airworthiness requirements and issues the operational approval (e.g., an LOA).

2. The CAA does not need to issue an LOA or equivalent document for each individual area of operation in the case of LAR 91 operators.

3. LAR 121 and/or 135 operators with APV/baro-VNAV approval must list this approval in the OpSpecs.

4. Related sections of the Latin American Aeronautical Regulations (LAR) or equivalent regulations

- a. LAR 91        Sections 91.1015 and 91.1640 or equivalents
- b. LAR 121     Section 121.995 (b) or equivalent
- c. LAR 135     Section 135.565 (c) or equivalent

5. Related ICAO Documents

- a. Annex 6 to the Convention on International Civil Aviation – Operation of aircraft
- b. Annex 10 to the Convention on International Civil Aviation – Aeronautical telecommunications
- c. Annex 15 to the Convention on International Civil Aviation – Aeronautical information services
- d. ICAO Doc 9613 – Performance-based navigation (PBN) manual
- e. ICAO Doc 8168 Volume I and II – Procedures for air navigation services – Aircraft operations

**PART 2: INFORMATION ON THE IDENTIFICATION OF AIRCRAFT AND OPERATORS****NAME OF THE OPERATOR:** \_\_\_\_\_

<b>Aircraft manufacturer, model, and series</b>	<b>Registration numbers</b>	<b>Serial numbers</b>	<b>APV/baro-VNAV system Number, manufacturer, and model</b>	<b>RNP navigation specification</b>

DATE OF PRE-APPLICATION MEETING \_\_\_\_\_

DATE ON WHICH THE APPLICATION WAS RECEIVED \_\_\_\_\_

DATE ON WHICH THE OPERATOR INTENDS TO BEGIN APV/baro-VNAV OPERATIONS \_\_\_\_\_

IS THE CAA NOTIFICATION DATE APPROPRIATE? YES \_\_\_\_\_ NO \_\_\_\_\_

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## PART 3 – OPERATOR APPLICATION (ANNEXES AND DOCUMENTS)

Annex	Title of Annex/document	Indication of inclusion by the operator	Comments by the Inspector
A	<b>Application for APV/baro-VNAV approval</b>		
B	<p><b>Airworthiness documents showing aircraft eligibility for APV/baro-VNAV.</b></p> <p><b>Eligibility based on the AFM or AFM supplement</b></p> <p>AFM, AFM revision, AFM supplement, or Type certificate data sheet (TCDS) showing that the RNAV/RNP navigation system is eligible for APV/baro-VNAV.</p> <p><b>Eligibility not based on the AFM or AFM supplement</b></p> <p>The applicant will request the CAA to assess the baro-VNAV equipment to determine its eligibility.</p>		
C	<p><b>Aircraft modified to meet APV/baro-VNAV standards. Documentation on aircraft inspection and/or modification, if applicable.</b> Maintenance records documenting the installation or modification of aircraft systems (e.g., FAA Form 337 – major repairs and alterations).</p>		
D	<p><b>Maintenance procedures</b></p> <ul style="list-style-type: none"> <li>For aircraft with established maintenance procedures for APV/baro-VNAV systems, the list of references of the document or programme.</li> <li>For recently installed RNAV/RNP systems, the maintenance procedures for their review.</li> </ul>		
E	<p><b>Minimum equipment list (MEL) (only for operators conducting operations based on a MEL):</b></p> <p>MEL showing provisions for APV/baro-VNAV systems.</p>		



Annex	Title of Annex/document	Indication of inclusion by the operator	Comments by the Inspector
F	<b>Training</b> <b>1. LAR 91 operators or equivalent: Training methods:</b> Training at home, LAR 142 training centres, or other training courses, course completion records. <b>2. LAR 121 and/or 135 operators or equivalent:</b> Training programmes (training curricula) for flight crews, flight dispatchers, and maintenance personnel.		
G	<b>Operating policies and procedures</b> <b>1. LAR 91 operators or equivalent:</b> Operations manual (OM) or sections to be attached to the application, corresponding to APV/baro-VNAV operating procedures and policies. <b>2. LAR 121 and/or 135 operators or equivalent:</b> Operations manual and checklists.		
H	<b>Navigation database</b> Details of the navigation data validation programme.		
I	<b>Withdrawal of APV/baro-VNAV approval</b> Indication of the need to follow up on navigation error reports submitted and the possibility of withdrawal of APV/baro-VNAV approval.		
J	<b>Validation flight plan:</b> Only if required by the CAA.		

#### CONTENTS OF THE APPLICATION TO BE SUBMITTED BY THE OPERATOR

\_\_\_\_\_ **DOCUMENTATION SHOWING APV/baro-VNAV COMPLIANCE OF THE AIRCRAFT/NAVIGATION SYSTEMS**

\_\_\_\_\_ **OPERATING PROCEDURES AND POLICIES**

\_\_\_\_\_ **SECTIONS OF THE MAINTENANCE MANUAL RELATED TO THE RNAV/RNP SYSTEM (if not previously reviewed)**

**Note 1:** Documents may be grouped in a single folder or may be sent as individual documents.

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## PART 4: CONTENT OF THE OPERATOR APPLICATION FOR APV/baro-VNAV OPERATIONS

#	Contents of the APV/baro-VNAV application by the operator	Reference paragraphs CA 91-010	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>Letter of application of the operator</b>  Statement of the intention to obtain APV/baro-VNAV approval. .	Paragraph 11.1 b) 1)  Appendix 2, paragraph e)	Annex A		
2	<b>Description of aircraft equipment</b>	Paragraph 11.1 b) 3)	Annex B		
3	<b>Eligibility of APV/baro-VNAV systems</b>  Airworthiness documents establishing the eligibility of the APV/baro-VNAV navigation systems, their approval status, and a list of the aircraft for which the approval is being requested.	Paragraph 11.1 b) 2)	Annex B Annex C		
4	<b>Training programme</b>  <b>1. LAR 121 or 135 operators or equivalent: Training programmes:</b> Operators will develop an initial and	Paragraph 11.1 b) 5)	Annex F		

#	Contents of the APV/baro-VNAV application by the operator	Reference paragraphs CA 91-010	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	<p>periodic training programme for flight crews, flight dispatchers, if applicable, and maintenance personnel.</p> <p><b>2. LAR 91 operators or equivalent: Training methods:</b> The following methods are acceptable for these operators: Training at home, LAR 142 training centres, or other training courses.</p>	<p>Paragraph 11.1 b) 5)</p> <p>Note</p>			
5	<p><b>Operating procedures</b></p> <p><b>1. LAR 121 and/or 135 operators or equivalent:</b> Operations manual and checklists.</p> <p><b>2. LAR 91 operators or equivalent:</b> Operations manual or section of the operator application documenting APV/baro-VNAV policies and procedures.</p>	<p>Paragraph 11.1 b) 4)</p> <p>Paragraph 11.1 b) 6)</p>	Annex G		
6	<b>Maintenance procedures</b>	Paragraph 11.1 b)	Annex D		

#	Contents of the APV/baro-VNAV application by the operator	Reference paragraphs CA 91-010	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	<ul style="list-style-type: none"> <li>For aircraft with established maintenance practices for APV/baro-VNAV navigation systems, the operator will provide document references.</li> <li>For newly installed APV/baro-VNAV systems, the operator will provide maintenance practices for review.</li> </ul>	7)			
7	<b>Update of the minimum equipment list (MEL)</b> Applicable to operators conducting operations according to a MEL.	Paragraph 11.1 b) 8)	Annex E		
8	<b>Navigation data validation programme</b>	Paragraph 11.1 b) 10) Appendix 1	Annex F		
9	<b>Withdrawal of APV/baro-VNAV approval</b> Indication of the need for follow-up on the navigation error reports and the possibility of withdrawal of the APV/baro-VNAV approval.	Paragraph 16 d)	Annex H		

#	Contents of the APV/baro-VNAV application by the operator	Reference paragraphs CA 91-010	In what Annexes/Documents of the operator can the application contents be located  Note: The operator must update this column to reflect the contents of the application	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
10	<b>Validation flight plan, only if required</b>  The validation flight plan will be presented only if required.	Paragraph 11.1 b) 9)	Annex I		

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## PART 5 – GUIDE TO DETERMINE THE ELIGIBILITY OF APV/baro-VNAV AIRCRAFT

#	Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
1	<b>APV/baro-VNAV equipment requirements</b> RNAV/RNP equipment with a certified performance of 0.3 NM or lower, with 95% probability, which includes:	Paragraph 10.1.2 a)	Annex B		
	a) Global navigation satellite systems (GNSS) certified for approach operations; or	Paragraph 10.1.2 a) 1)			
	b) Multi-sensor systems that use inertial reference units (IRU) in combination with dual distance measuring equipment (DME/DME) or certified GNSS systems; or	Paragraph 10.1.2 a) 2)			
	c) RNP systems approved for RNP 0.3 operations or lower.	Paragraph 10.1.2 a) 3)			
2	<b>Equipment whose input is used by RNAV/RNP systems may include:</b>	Paragraph 10.1.4	Annex B		
	a) An air data computer: FAA Technical Standard Order (TSO)-C 106.	Paragraph 10.1.4 a)			
	b) An air data system: Aeronautical Radio, Incorporated (ARINC) 706, Mark 5 Air Data System.	Paragraph 10.1.4 b)			
	c) A pressure altimeter system of the following types: DO-88 altimetry, ED-	Paragraph 10.1.4 c)			



#	Topics	Reference paragraphs  CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	26 MPS for airborne altitude measurements and coding systems, ARP-942 pressure altimeter systems, ARP-920 design and installation of pilot static systems for transport aircraft.				
	d) Integrated systems with type certification that provide an air data system capability comparable to the one described in paragraph 2 b).	Paragraph 10.1.4 d)			
	<b>Note 1.-</b> Position data from other sources can be integrated with pressure altitude information, provided they do not cause position errors that exceed path-keeping precision requirements.	Paragraph 10.1.4 Note 1			
	<b>Note 2.-</b> Altimetry system performance will be demonstrated separately through certification of static pressure systems (e.g., *14 CFR 25.1325 or *CS 25.1325 or equivalent sections), where performance must be 30 ft per 100 knots of indicated airspeed (KIAS). Altimetry systems that meet such requirement will meet the altimetry system error (ASE) requirement for baro-VNAV operations. Demonstration or additional compliance is not required.  *14 CFR 25.1325: Section 1325 of Part 25 of Title 14 of the United States Code of Federal Regulations (CFR).  *CS 25.1325: EASA Certification specification (CS) 25.1325 for large aircraft (CS 25).	Paragraph 10.1.4 Note 2			
3	Aircraft eligibility	Paragraph 10.4			
	a) RNP system capability Aircraft that meet the performance and	Paragraph 10.4 a)			

#	Topics	Reference paragraphs  CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
	functional requirements of SRVSOP CA 91-008 (RNP APCH) or CA 91.009 (RNP AR APCH) or equivalent are eligible for conducting RNP operations.				
	b) VNAV barometric capability  An aircraft is eligible for baro-VNAV operations when the AFM or AFM supplement indicates that the VNAV system has been approved under AC 20-129 or AC 20-138	Paragraph 10.4 b)			
	c) Aircraft approved to conduct RNP AR APCH operations according to CA 91-009 are eligible for APV/baro-VNAV approaches. No additional assessment is required.	Paragraph 10.4 b) Note			
4	<b>Approval of aircraft</b>  a) Eligibility based on the AFM or AFM supplement  b) Eligibility not based on the AFM or AFM supplement.	Paragraph 10.5  Paragraph 10.5 a)  Paragraph 10.5 b)	Annex B		
5	<b>Modified aircraft</b>	Paragraph 10.6			
6	<b>Functional requirements and their explanation</b>  a) Required functions  b) Recommended functions	Paragraph 10.3  Paragraph 10.3.1  Paragraph 10.3.2	Annex B		

#	Topics	Reference paragraphs CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the inspector	Follow-up by the inspector: Item status and date
7	<b>Maintenance requirements</b>	Paragraph 11.1 7)	Annex B		
8	<b>Navigation database</b> Details of the navigation data validation programme	Paragraph 15 Appendix 1	Annex B		

## PART 6 - BASIC PILOT PROCEDURES FOR APV/baro-VNAV OPERATIONS

Topics		Reference paragraphs  CA 91-006	Location in the Annexes of the operator	Comments and/or recommendations by the CAA	Follow-up by the Inspector
Operating procedures		Paragraph 12	Annex G		
1	<p><b>Cold temperature corrections.-</b> Pilots are responsible for any correction for cold temperature required in all published minimum altitudes/heights. This includes:</p> <ol style="list-style-type: none"> <li>1) Altitudes/heights for initial and intermediate segments;</li> <li>2) The DA/H; and</li> <li>3) Subsequent missed approach altitudes/heights.</li> </ol> <p><i>Note.- The VPA of the final approach path is protected against all effects of cold temperature by the design of the procedure.</i></p>	Paragraph 12.1 a)			
2	<p><b>Altimeter setting.-</b> APV/baro-VNAV operations will only be conducted when:</p> <ol style="list-style-type: none"> <li>1) there is a current and local source for altimeter setting; and</li> <li>2) *QNH/*QFE is properly selected in the altimeter of the aircraft.</li> </ol> <p>*QNH: Pressure at mean sea level. This setting indicates the altitude above mean sea level (MSL), if temperature is standard.</p> <p>*QFE: Standard atmosphere that corresponds to 1013 hPa or 29.92" Hg. This setting indicates the altitude above the isobaric surface of 1013 hPa, if temperature</p>	Paragraph 12.1 b)			

	<p>is standard.</p> <p><b>Note.-</b> A remote source for altimeter setting will not be used.</p>				
3	<p><b>Action to be taken at the DA.-</b> The flight crew is expected to operate the aircraft along the published vertical path, and to execute a missed approach procedure when reaching the DA, unless it has in view the visual references required to proceed with the approach.</p>	Paragraph 12.1 c)			
4	<p><b>Temperature limitation.-</b> Because of the pronounced effect of non-standard temperature on baro-VNAV operations, instrument approach procedures will contain a temperature limitation below which the use of a vertical navigation decision altitude (VNAV DA) based on baro-VNAV is not authorised. The temperature limitation will be shown through a note in the instrument approach procedure. If the aircraft system is capable of temperature compensation, the crew must follow the operator procedures based on the manufacturer instructions.</p>	Paragraph 12.1 d)			
5	<p><b>VNAV path mode selection.-</b> The flight crew must know the correct selection of the vertical mode(s) that command vertical navigation via the published flight path. Other vertical modes, such as vertical speed are not applicable to baro-VNAV approach.</p>	Paragraph 12.1 e)			

6	<b>Restriction to using a remote source for altimeter setting.</b> - The use of baro-VNAV up to a DA is not authorised if the altimeter setting is issued from a remote source. For APV/baro-VNAV operations, a current altimetry setting is required for the landing aerodrome. When minima related to a remote altimetry setting are shown, the VNAV function can be used, but only up to the published lateral navigation minimum descent altitude (LNAV MDA).	Paragraph 12.1 f)			
7	<b>Manual adjustments.</b> - If manual adjustments to stored altitude information are necessary, e.g., cold temperature adjustments, the flight crew must make appropriate adjustments to the procedure altitudes and revert to use of the temperature adjusted LNAV MDA.	Paragraph 12.1 g)			

## SRVSOP contacts:

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