Guidance material

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ISSUED BY : EUR PBN TF

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

1. PURPOSE

This guidance material establishes RNAV 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).

2. RELATED DOCUMENTS

Annex 2 Rules of the Air
Annex 6 Operation of aircraft
Annex 10 Aeronautical telecommunications
ICAO Doc 9613 Performance-based navigation (PBN) manual
ICAO Doc 9997 PBN operational approval manual
ICAO Doc 4444 Procedures for air navigation services – Air traffic management
ICAO Doc 7030 Regional Supplementary Procedures
ICAO Doc 8168 Aircraft operations
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

3. DEFINITIONS AND ABBREVIATIONS

3.1 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.

c) 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.

d) **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).

e) **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.

f) **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.

g) **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).

h) **Global navigation satellite system (GLONASS).**- The satellite navigation system operated by the Russian Federation.

i) **Global positioning system (GPS).**- The satellite navigation system operated by the United States.

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) **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.
o) **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.

p) **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.

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) **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).

s) **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.

t) **Stand-alone global positioning system (Stand-alone GPS)**. - A GPS that is not connected to, or combined with, any other navigation system or sensor.

u) **Supplementary means of navigation**. - A navigation system that must be used together with a system considered being a sole means of navigation, and that must meet precision and integrity requirements but not availability and continuity conditions.

v) **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).

![Diagram of Total system error (TSE)]

3.2 **Abbreviations**

a) CAA  
   Civil Aviation Administration/Civil Aviation Authority

b) AC  
   Advisory circular (FAA)

c) ACAS  
   Airborne collision avoidance system

d) AF  
   Flight manual

e) AFM  
   Airplane flight manual

f) AIP  
   Aeronautical information publication
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<thead>
<tr>
<th>Code</th>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>g)</td>
<td>AP</td>
<td>Autopilot</td>
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<td>h)</td>
<td>AMC</td>
<td>Acceptable means of compliance</td>
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<td>i)</td>
<td>ATC</td>
<td>Air traffic control</td>
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<td>j)</td>
<td>ATS</td>
<td>Air traffic services</td>
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<td>k)</td>
<td>BRG/DIS</td>
<td>Bearing/distance</td>
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<td>l)</td>
<td>DME</td>
<td>Distance measuring equipment</td>
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<td>m)</td>
<td>DV</td>
<td>Flight dispatcher (spanish abbreviation)</td>
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<td>n)</td>
<td>EASA</td>
<td>European Aviation Safety Agency</td>
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<td>o)</td>
<td>EUR</td>
<td>ICAO European Region</td>
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<td>p)</td>
<td>FAA</td>
<td>United States Federal Aviation Administration</td>
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<td>q)</td>
<td>FD</td>
<td>Flight director</td>
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<td>r)</td>
<td>FDE</td>
<td>Fault detection and exclusion</td>
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<td>s)</td>
<td>FIR</td>
<td>Flight Information Region</td>
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<td>t)</td>
<td>FL</td>
<td>Flight level</td>
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<td>u)</td>
<td>FMS</td>
<td>Flight management system</td>
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<td>v)</td>
<td>FTE</td>
<td>Flight technical error</td>
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<td>w)</td>
<td>GBAS</td>
<td>Ground-based augmentation system</td>
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<td>x)</td>
<td>GNSS</td>
<td>Global Navigation Satellite System</td>
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<td>y)</td>
<td>GLONASS</td>
<td>GLObal NAvigation Satellite System</td>
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<td>z)</td>
<td>GPS</td>
<td>Global positioning system</td>
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<td>aa)</td>
<td>INS</td>
<td>Inertial navigation system</td>
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<td>bb)</td>
<td>IRS</td>
<td>Inertial reference system</td>
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<td>cc)</td>
<td>IRU</td>
<td>Inertial reference unit</td>
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<td>dd)</td>
<td>LAAS</td>
<td>Local area augmentation system</td>
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<tr>
<td>ee)</td>
<td>LAT/LONG</td>
<td>Latitude/longitude</td>
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<td>ff)</td>
<td>LNAV</td>
<td>Lateral navigation</td>
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<td>gg)</td>
<td>LOA</td>
<td>Letter of authorisation/letter of acceptance</td>
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<td>hh)</td>
<td>LRNS</td>
<td>Long-range navigation system</td>
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<td>ii)</td>
<td>MEL</td>
<td>Minimum equipment list</td>
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<td>jj)</td>
<td>NAV</td>
<td>Navigation</td>
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<td>kk)</td>
<td>NAVAIDS</td>
<td>Navigation aids</td>
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<td>ll)</td>
<td>NDB</td>
<td>Non-directional radio beacon</td>
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<td>mm)</td>
<td>NM</td>
<td>Nautical mile</td>
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<td>nn)</td>
<td>NSE</td>
<td>Navigation system error</td>
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<tr>
<td>oo)</td>
<td>ICAO</td>
<td>International Civil Aviation Organization</td>
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<tr>
<td>pp)</td>
<td>OM</td>
<td>Operations manual</td>
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<tr>
<td>qq)</td>
<td>OpSpecs</td>
<td>Operations specifications</td>
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4. INTRODUCTION

4.1 This guidance material is developed to assist in obtaining RNAV 10 authorisation to operate in oceanic or remote airspaces and is consistent with the criteria set forth in ICAO Doc 9613 – Performance-based navigation (PBN) manual. Furthermore, this document provides criteria for operators to extend any navigation time limit associated with the RNP 10 approval. This document does not change any requirement nor does it affect operators that have already obtained an RNP 10 approval by the appropriate authority.

4.2 The implementation of 50 NM lateral and longitudinal separation minima for oceanic or remote airspaces results in benefits for the operators in terms of having a greater number of optimum routes, reduced delays, increased flexibility, cost reduction and improve safety.

4.3 RNAV 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.

4.4 This guidance material has been developed based on ICAO Doc 9613 and harmonised with the FAA Order 8400.12A - Required navigation performance 10 (RNP 10) operational approval and EASA AMC 20-12 - Recognition of FAA Order 8400.12A for RNP-10 operations.

5. GENERAL INFORMATION
5.1 Navigation aid infrastructure

5.1.1. RNAV 10 was developed for operations in oceanic and remote areas and does not require any ground-based navigation infrastructure.

5.2 ATS communications and surveillance

5.2.1. This guidance material 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 airspace requirements as promulgated by the appropriate authorities.

5.3 Obstacle clearance and route spacing

5.3.1. 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.

5.3.2. The rationale for having chosen the RNAV 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.

5.3.3. The minimum route spacing where RNAV 10 is utilized is 50 NM.

5.4 Publications

5.4.1. The AIP should clearly indicate that the navigation application is RNAV 10. The route should identify the minimum segments altitude requirements.

5.4.2. 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).

6. AIRWORTHINESS AND OPERATIONAL APPROVAL

6.1 To obtain RNAV 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).

6.2 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).

6.3 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.

7. AIRWORTHINESS APPROVAL

7.1 Aircraft requirements
7.1.1 Navigation systems.- The RNAV 10 navigation specification requires that aircraft operating in oceanic and remote areas be equipped with at least two independent and serviceable 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.

7.1.2 System performance, monitoring and alerting

a) Accuracy.- During operations in airspace or on routes designates as RNAV 10, the lateral total system error must not exceed ± 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 ± 10 NM for at least 95% of the total flight time.

Note 1. - For RNAV 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 RNAV 10 approval.

Note 2. - When data collection method described in Appendix 1 of FAA Order 8400.12A is used as the basis for an RNAV 10 operations approval, these error types are included in the analysis. However, when the data collection method described in Appendix 6 of FAA Order 8400.12A is used, these errors are not included since that method is more conservative. The Appendix 6 method 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., 10⁻⁷ 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, and Table 3.7.2.4.1).

7.2 Aircraft groups (aircraft fleets)

7.2.1 Aircraft group.- For an aircraft to be considered part of a group for purposes of RNAV 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 RNAV 10 requirements.

b) the navigation system installed in each aircraft must have been built with the same manufacturer specifications and have the same part numbers;

c) 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 RNAV 10 navigation capabilities are met for the approval’s validity period; and

4) The engineering data to be used in order to ensure continuity of RNAV 10 service for the approval’s validity period.

**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.

### 7.2.2 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.

### 7.3 Determining aircraft eligibility

#### 7.3.1 Aircraft eligibility

The following three methods for determining aircraft eligibility have been defined:

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

- RNAV 10 Compliance (conformity or capability) will be documented in the AFM or in its approved supplement and normally is not limited to RNAV 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.

- An airworthiness approval that specifically indicates RNAV 10 performance can be obtained. The following wording can be used in the AFM, when RNAV 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 RNAV 10 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 RNAV 10 operations”.

**7.3.1.2. Method 2 – Aircraft eligibility through prior navigation system certification (aircraft without RNP declaration in the AFM)**

- 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 RNAV 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.
Operators who intend to use GNSS as the only navigation system (without INS or IRS) for RNAV 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 guidance material. This includes the use of a GNSS approved as a primary means of navigation for oceanic and remote areas.

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 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.

### 7.3.1.2.2. Multi-sensor systems integrating GNSS with RAIM, FDE or equivalent system functionality

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 RNAV 10 requirements without any limitations of time.

### 7.3.1.2.3. Aircraft equipped with dual INS or IRU

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 is applicable after the systems are set on navigation mode (NAV). The basic time limit of 6.2 hours may be extended based on the methods described in paragraph 7.4.

### 7.3.1.2.4. Aircraft equipped with dual INS or IRU approved for minimum navigation performance specifications (MNPS) operations

Aircraft equipped with dual INS or IRU that have been approved for MNPS meet the RNAV 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.

### 7.3.1.2.5. Aircraft equipped with a single INS/IRU and a single GNSS approved as primary means of navigation in oceanic and remote areas

Aircraft equipped with a single INS or IRU and a single GNSS are considered to meet RNAV 10 requirements without any time limitations. 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 approval. The AFM must indicate that the specific INS/GNSS facility meets the appropriate CAA requirements.

### 7.3.1.3. Method 3 – Eligibility of aircraft through data collection

This method requires operators to collect data during a specified period of time in order to obtain RNAV 10 approval. The data collection programme must indicate the navigation accuracy requirements appropriate for RNAV 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 RNAV 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.

7.3.1.3.2. 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 RNAV 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 RNAV 10 as long as needed by the operator.

7.3.1.3.3. 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 RNAV 10 operations, and will describe the relationships between such components and equipment. The applicant must indicate the proposed time limit for INS or IRU, and must consider the effect of head winds in the area where RNAV 10 operations will be carried out in order to determine the feasibility of the proposed operation.

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

7.4.1. The baseline RNAV 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 Paragraph 7.3.1. The time limit may be extended using any of the following methods:

a) An extended time limit may be established when RNAV 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 RNAV 10 is justified;

b) when an INS or IRU has been approved using an existing approval standard, as detailed in Paragraphs 8.3.1 b), 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

c) 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 RNAV 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;

d) 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.

7.5 **Continued airworthiness**
7.5.1. The operators of aircraft approved to perform RNAV 10 operations, must ensure the continuity of the technical capacity of them, in order to meet technical requirements established in this guidance material.

7.5.2. Each operator who applies for RNAV 10 operational approval shall submit to the CAA of State of registry, a maintenance and inspection program that includes all those requirements of maintenance necessary to ensure that navigation systems continue fulfilling the approval criteria.

7.5.3. The following maintenance documents must be revised, as appropriate, to incorporate RNAV 10 aspects:
   a) Maintenance control manual (MCM);
   b) Illustrated parts catalogs (IPC); and
   c) Maintenance program.

7.5.4. The approved maintenance program for the affected aircrafts should include maintenance practices listed in maintenance manuals of the aircraft manufacturer and its components, and must consider:
   a) that equipment involved in RNAV 10 operations should be maintained according to directions given by manufacturer's components;
   b) that any amendment or change of navigation system affecting in any way RNAV 10 initial approval, must be forwarded and reviewed by the CAA for its acceptance or approval of such changes prior to its implementation; and
   c) That any repair that is not included in the approved/accepted maintenance documentation, and that could affect the integrity of navigation performance, should be forwarded to the CAA for acceptance or approval thereof.

7.5.5. Within the RNAV 10 maintenance documentation should be presented the training program of maintenance personnel, which inter alia, should include:
   a) PBN concept;
   b) RNAV 10 application;
   c) equipment involved in a RNAV 10 operation; and
   d) MEL use.

7.6 Certification measures

7.6.1. 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.

7.6.1.1. 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 RNAV 10 routes or airspace must also comply with CAA regulations and corresponding advisory documentation, except for some GNSS requirements described in this guidance material.

7.7 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 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.

8. OPERATIONAL APPROVAL

8.1. Airworthiness approval alone does not authorise an applicant or operator to conduct RNAV 10 operations. In addition to the airworthiness approval, the applicant 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.

8.2. Operational approval requirements

8.2.1. In order to obtain RNAV 10 approval, the operator should submit the following documentation to the appropriate authority:

8.2.1.1. Airworthiness documents

a) Airworthiness documents concerning aircraft eligibility. - Documentation showing that the equipment of the proposed aircraft meets the requirements of this document. The operator shall submit relevant documentation showing that the aircraft is equipped with long-range navigation systems (LRNS) that meet RNAV 10 requirements, for example those parts of the AFM or AFM supplement that contain the airworthiness statement.

b) Description of aircraft equipment. - The operator shall provide a configuration list with details of the relevant components and the equipment to be used in RNAV 10 operations. The list must include the manufacturer, model and version of each GNSS, INS/IRU equipment and software of the installed FMS.

c) Time limit for RNAV 10 with INS/IRU (if applicable). - The operator must submit documentation that justifies the proposed RNAV 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 RNAV 10 operations in order to determine whether or not the proposed operations are viable.

8.2.1.2. 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 this document.

8.2.1.3. Operations manual and checklist
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 document. 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.

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.

8.2.1.4. 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).

8.2.1.5. 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.

8.2.1.6. Maintenance personnel training programme. - The operators will submit the corresponding maintenance staff training curricula in accordance with Paragraph 8.5 e).

8.2.1.7. 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.

8.2.1.8. 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 document.

8.2.2. 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.

8.2.3. 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.

8.2.4. Issuance of an authorisation to conduct RNAV 10 operations. - Once the operator has successfully completed the operational approval process, the CAA will grant the operator the authorisation to conduct RNAV 10 operations.

9. OPERATIONAL REQUIREMENTS

9.1. Navigation performance

9.1.1. All aircraft must meet a lateral and longitudinal precision equal to or better than ± 10 NM for 95% of the flight time in RNP 10 airspace.

9.2. Navigation equipment

9.2.1. 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.

9.2.2. The CAA may approve the use of a single LRNS under specific circumstances (e.g., in the North Atlantic MNPS airspace).

9.3. Flight plan
9.3.1. Operators must indicate their capability to meet RNAV 10 for the route or airspace, in accordance with the Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM, Doc 4444), Appendix 2, to indicate that the pilot has:

a) reviewed the foreseen flight route, including the routes to the alternate aerodrome in order to determine the types of RNP involved;

b) confirmed that operator and aircraft have been approved by the CAA for operations; and

c) Confirmed that the aircraft can operate in accordance with RNP (RNAV) requirements in the foreseen flight route, including the routes to the alternate aerodrome.

9.3. **Availability of navigation aids (NAVAIDS)**

9.3.1 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 RNAV 10 for the duration of the planned RNAV 10 operation.

9.4. **Evaluation of routes for RNAV 10 time limits - Aircraft equipped only with INS or IRU**

9.4.1. An RNAV 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.

9.4.2. 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:

a) **Route evaluation.** - The operator must establish that the aircraft can meet RNP time limits for dispatch or departure to RNAV10 airspace.

b) **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.

c) **Stop point for calculation.** - The stop point for calculation may be one of the following:

1) 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

2) The first point where the system is expected to be updated.

d) **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.

1) **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).

2) **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.

9.4.3. Effect of en-route updates (increased duration of RNAV 10 navigation capability)

a) Operators may increase the duration of the RNAV 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.

9.4.4. Conditions under which automatic radio position update is considered acceptable for flights in RNAV 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 RNAV 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.

9.4.5. Condition under which manual radio position update is considered acceptable for flights in RNAV 10 airspace

a) If manual updating has not specifically been approved, manual radio position updates are not allowed for RNAV 10 operations. Manual radio position updates may be considered acceptable for RNAV 10 airspace operations, provided that:

1) the CAA examines the manual update procedures on a case by case basis;

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.

10. OPERATING PROCEDURES

10.1. In order to meet the requirements for RNAV 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.

10.1.1. Flight planning.- During flight planning, flight crews and flight dispatchers must pay
particular attention to conditions that may affect operations in RNAV 10 airspace or routes, including:

a) verifying if aircraft has been approved for RNP 10 operations;
b) verifying that two LRNS are operational;
c) verifying if the RNP 10 time limit has been taken into account (only aircraft equipped with INS or IRU);
d) verifying the requirements for GNSS, such as FDE, if applicable to the operation;
e) 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);
f) if required, taking into account any operational restriction related to RNP 10 approval for a specific navigation system; and
g) Verifying the planned flight route, including the deviation to any alternate aerodrome, in order to identify the existing RNP types.

10.1.2. Pre-flight procedures.- The following actions must be completed during pre-flight:

a) 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;
b) 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
c) 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.

10.2. En-route procedures.- The following must be observed:

a) 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;
b) 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;
c) 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;
d) 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
e) Pilots must use a lateral deviation indicator, flight director, or autopilot in lateral navigation mode on RNP 10 operations. All pilots are expected to maintain route centrelines, as depicted by on-board lateral deviation indicators and/or flight guidance, during all RNP 10 operations, unless authorized to deviate by ATC or under emergency conditions. For normal operations, cross-track error/deviation (the difference between the RNP system computed path and the aircraft estimated position relative to that path, i.e. FTE) must be limited to ± ½ the navigation accuracy associated with the route (i.e. 5 NM). Brief deviations from this standard (e.g., overshoots or undershoots) during and immediately after route turns, up to a maximum of one-times the navigation accuracy (i.e. 10 NM), are allowable.

Note. - Some aircraft do not display or compute a path during turns. Pilots of these aircraft may not be able to adhere to the ± ½ accuracy standards during route turns, but are still expected to satisfy the standard during intercepts following turns and on straight segments.

10.3. Contingency procedures

10.3.1. 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.

10.3.2. 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.

11. TRAINING PROGRAMME

11.1. 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.

11.2. 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 document.

11.3. 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.

12. NAVIGATION DATABASE

12.1. 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.

12.2. The operator must obtain the navigation database from a qualified supplier.

12.3. Navigation database supplier must have a letter of acceptance (LOA) in order to process navigation information. An LOA recognises as data supplier one whose information quality, integrity, and quality management practices are consistent with the criteria in document DO-200A/ED-76. The data base supplier of an operator 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 suppliers or may issue its own LOA.

12.4. The operator must report to the navigation data suppliers any discrepancies that invalidate a route, and prohibit the use of the affected procedures through a notice to the flight crews.

12.5. 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.
13. OVERSIGHT, INVESTIGATION OF NAVIGATION ERRORS AND WITHDRAWAL OF RNP 10 AUTHORIZATION

13.1. The operator will establish a procedure to receive, analyse, and follow up on navigation error reports in order to determine appropriate corrective actions.

13.2. Information showing the potential of repeated errors may require changes to the training programme of the operator.

13.3. Information attributing multiple errors to a specific pilot may indicate that that pilot needs additional training or a revision of his/her license.

13.4. 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 RNAV 10 authorisation from the OpSpecs or withdrawal of the LOA in the case of private operators).