



# **CIVIL AVIATION PUBLICATION**

## **CAP 12**

## **BRNAV**

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### CAP 12

### BRNAV

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## CIVIL AVIATION PUBLICATIONS

### 1. PURPOSE

This CAP provides acceptable means of compliance for airworthiness approval and operational criteria for the use of navigation systems in European airspace designated for Basic RNAV operations and operations to RNP 5 in other airspace. This CAP is based directly on EASA AMC 20-4.

*Note: Refer also to CAP 11 Area Navigation (RNAV) for all RNAV general requirements and definitions.*

There are major changes in the near future such as the Single European Sky legislation and the ICAO Performance Based Navigation Manual, as well as and RNP AR (Authorisation Required) and RNP APCH (Approach). These operations are addressed in CAP 14 and 15 respectively.

### 2. SCOPE

This document provides guidance related to navigation systems intended to be used for Basic RNAV operations and operations to RNP 5 in other airspace and considers existing airworthiness approval standards as providing acceptable means of compliance. The content is limited to general certification considerations including navigation performance, integrity, functional requirements and system limitations.

Compliance with the guidance in this CAP does not constitute an operational authorisation/approval to conduct Basic RNAV operations. Aircraft operators should apply to the CAA for such an authorisation/approval.

### 3. SYSTEMS CAPABILITY

Area navigation (RNAV) is a method which permits aircraft navigation along any desired flight path within the coverage of either station referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of both methods.

In general terms, RNAV equipment operates by automatically determining aircraft position from one, or a combination, of the following together with the means to establish and follow a desired path:

VOR/DME

DME/DME

INS\* or IRS

LORAN C\*

GPS\*

*Note: Equipment marked with an asterisk \*, is subject to the limitations contained in paragraph 4.4.2.*



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### 4. AIRWORTHINESS APPROVAL

#### 4.1 Criteria for Basic RNAV System

##### 4.1.1 Accuracy

The navigation performance of aircraft approved for Basic RNAV operations within European airspace requires a track keeping accuracy equal to or better than  $\pm 5$  NM for 95% of the flight time. This value includes signal source error, airborne receiver error, display system error and flight technical error.

This navigation performance assumes the necessary coverage provided by satellite or ground based navigation aids is available for the intended route to be flown.

##### 4.1.2 Availability and Integrity

The minimum level of availability and integrity required for Basic RNAV systems for use in designated European airspace can be met by a single installed system comprising one or more sensors, RNAV computer, control display unit and navigation display(s) (e.g. ND, HSI or 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).

#### 4.2 Functional Criteria

##### 4.2.1 Required Functions

The following system functions are the minimum required to conduct Basic RNAV operations.

- (a) Continuous indication of aircraft position relative to track to be displayed to the pilot flying on a navigation display situated in his primary field of view. In addition where the minimum flight crew is two pilots, indication of aircraft position relative to track to be displayed to the pilot not flying on a navigation display situated in his primary field of view
- (b) Display of distance and bearing to the active (To) waypoint
- (c) Display of ground speed or time to the active (To) waypoint
- (d) Storage of waypoints; minimum of 4
- (e) Appropriate failure indication of the RNAV system, including the sensors.

##### 4.2.2 Recommended Functions

In addition to the requirements of paragraph 4.2.1, the following system functions and equipment characteristics are recommended:

- (a) Autopilot and/or Flight Director coupling



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- (b) Present position in terms of latitude and longitude
- (c) "Direct To" function
- (d) Indication of navigation accuracy (e.g. quality factor)
- (e) Automatic channel selection of radio navigation aids
- (f) Navigation data base
- (g) Automatic leg sequencing and associated turn anticipation

### **4.3 Aircraft Flight Manual - MMEL (Master Minimum Equipment List)**

The basis for certification should be stated in the Aircraft Flight Manual (AFM), together with any RNAV system limitations. The AFM may also provide the appropriate RNAV system operating and abnormal procedures applicable to the equipment installed, including, where applicable, reference to required modes and systems configuration necessary to support an RNP capability.

The (Master) Minimum Equipment List MMEL/MEL should identify the minimum equipment necessary to satisfy the Basic RNAV criteria defined in paragraphs 4.1 and 4.2. These must be incorporated into the operator's MEL and submitted as part of the application.

### **4.4. Basic RNAV Systems - Acceptable Means Of Compliance**

#### **4.4.1 Acceptable Means of Compliance**

Navigation systems which are installed on aircraft in accordance with the advisory material contained within FAA AC 90-45A, AC 20-130(), AC 20-138 or AC 25-15, are acceptable for Basic RNAV operations. Where reference is made in the AFM to either of the above advisory material or the specific levels of available navigation performance (RNP), no further compliance statements will be required.

Compliance may be based also on the lateral navigation standards defined in ETSO-C115b, ETSO-C129a, ED-27/28, ED-39/40, DO-187/ED-58 or DO-180. However, qualification of the equipment to these standards, in itself, is not considered as sufficient for the airworthiness approval.

#### **4.4.2 Limitations on the Use of Navigation Systems**

The following navigation systems, although offering an RNAV capability, have limitations for their use in Basic RNAV operations.

##### **4.4.2.1 INS**

INS without a function for automatic radio updating of aircraft position and approved in accordance with AC 25-4, when complying with the functional criteria of paragraph 4.2.1, may be used only for a maximum of 2 hours from the last alignment/position update performed on the ground.



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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 on-ground position update. INS with automatic radio updating of aircraft position, including those systems where manual selection of radio channels is performed in accordance with flight crew procedures, should be approved in accordance with AC 90-45A or equivalent material.

### 4.4.2.2 LORAN C

No EASA advisory material currently exists for operational or airworthiness approval of LORAN C system within European airspace. Where LORAN C coverage within European Airspace permits use on certain Basic RNAV routes, AC 20-121A may be adopted as a compliance basis.

### 4.4.2.3 GPS

The use of GPS to perform Basic RNAV operations is limited to equipment approved to ETSO-C129a, ETSO-C 145, or ETSO-C 146 and which include the minimum system functions specified in paragraph

### 4.4.3 Integrity

Integrity should be provided by Receiver Autonomous Integrity Monitoring (RAIM) or an equivalent means within a multi-sensor navigation system. The equipment should be approved in accordance with the EASA AMC 20-5.

In addition, GPS stand-alone equipment should include the following functions:

- (a) Pseudorange step detection
- (b) Health word checking.

These two additional functions are required to be implemented in accordance with TSO-C129a criteria. Traditional navigation equipment (e.g. VOR, DME and ADF) will need to be installed and be serviceable, so as to provide an alternative means of navigation.

*Note: Where GPS stand-alone equipment provides the only RNAV capability installed onboard the aircraft, this equipment, on its own, may be incompatible with a future airspace infrastructure such as Precision RNAV routes, terminal procedures, and where implementation of an augmented satellite navigation system will allow, the decommissioning of traditional ground based radio navigation aids.*

## 5. OPERATIONAL CRITERIA FOR USE OF GPS STAND-ALONE EQUIPMENT

### 5.1 General Criteria

GPS stand-alone equipment approved in accordance with the guidance provided in this CAP, may be used for the purposes of conducting Basic RNAV operations, subject to the operational limitations contained herein. Such equipment should be operated in accordance with procedures acceptable to the Authority. The flight crew should receive appropriate training for use of the GPS stand-alone equipment for the normal and abnormal operating procedures detailed in paragraphs 5.2 and 5.3.





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*Note: Refer to Appendix 1 for training requirements*

### 5.2 Normal Procedures

The procedures for the use of navigational equipment on Basic RNAV routes should include the following:

- (a) During the pre-flight planning phase, given a GPS constellation of 23 satellites or less (22 or less for GPS stand-alone equipment that incorporate pressure altitude aiding), the availability of GPS integrity (RAIM) should be confirmed for the intended flight (route and time). This should be obtained from a prediction programme either ground-based, or provided as an equipment function (see Annex 1), or from an alternative method that is acceptable to the Authority. Dispatch should not be made in the event of predicted continuous loss of RAIM of more than 5 minutes for any part of the intended flight.

*Note: Where a GPS Integrity Monitoring (RAIM) Prediction Programme is used, it should meet the following criteria:*

1. *The programme should provide prediction of availability of the integrity monitoring (RAIM) function of the GPS equipment, suitable for conducting Basic RNAV operations in designated European airspace.*
2. *The prediction programme software should be developed in accordance with at least RTCA DO178B/EUROCAE 12B, level D guidelines.*
3. *The programme 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.*
4. *The programme should calculate RAIM availability based on a satellite mask angle of not less than 5 degrees, except where use of a lower mask angle has been demonstrated to be acceptable to the Authority.*
5. *The programme should have the capability to manually designate GPS satellites which have been notified as being out of service for the intended flight.*
6. *The programme should allow the user to select:*
  - (i) *the intended route and declared alternates;*
  - (ii) *the time and duration of the intended flight.*
  - (iii) *Where a navigation data base is installed, the data base validity (current AIRAC cycle) should be checked before the flight;*



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- (iv) *Traditional navigation equipment (e.g. VOR, DME and ADF) should be selected to available aids so as to allow immediate cross-checking or reversion in the event of loss of GPS navigation capability.*

### 5.3 Abnormal Procedures in the event of loss of GPS navigation capability

The operating 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). The operating procedures should include the following:

- (a) In the event of loss of the RAIM detection function, the GPS stand-alone equipment may continue to be used for navigation. The flight crew should attempt to cross-check the aircraft position, where possible with VOR, DME and NDB information, to confirm an acceptable level of navigation performance. Otherwise, the flight crew should revert to an alternative means of navigation.
- (b) In the event of exceedance of the alarm limit, the flight crew should revert to an alternative means of navigation.

## 6. APPLICATION & APPROVAL PROCESS

### 6.1 Application

An application for the approval for B-RNAV/RNP approval must be made by the operator using Form ALD/OPS/F062. The appropriate charges must accompany the application, unless specifically exempted.

### 6.2 Supporting Documents

The documents listed below in respect of each aircraft, should normally accompany the application for grant of approval for B-RNAV and/or RNP 5.

- (a) The copies of Supplemental Type Certificates (STC) for each type of RNAV equipment fitted on each aircraft respectively, that cover the following aspects stated in section 5 above:
- (1) minimum level of integrity and availability; and
  - (2) functional criteria.
- (b) Maintenance programme/approved maintenance schedule for each aircraft. (i.e. transit, periodical inspection and test).
- (c) Equipment lists (MMEL and MEL) that identify the minimum equipment necessary for RNAV operations in respect of each aircraft.
- (d) Part of the Aircraft Flight Manuals (AFMs) for each aircraft, that specifies the following:



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- (1) the basis for certification together with any RNAV system limitations; and
- (2) the appropriate RNAV system operating and emergency procedures applicable to the equipment installed:
  - (i) Normal procedure for operating the equipment;
  - (ii) Equipment operating limitations; and
  - (iii) Emergency operating procedures.
- (e) Training programmes in respect of the RNAV equipment installed in each aircraft for:
  - (1) Maintenance personnel; and
  - (2) Flight crew. All operators must submit training syllabi and other appropriate material to show that the operational practices and procedures and training items related to RNP 5 operations are incorporated in training programs where applicable (e.g. initial, upgrade, recurrent).
- (f) Operations Manual/Procedures applicable to the specific RNAV airspace. AOC holders and private operators must revise their operations manual and checklists to include information/guidance on standard operating procedures. Appropriate manuals should include navigation operating instructions and contingency procedures where specified i.e. weather deviation procedures. Manuals and checklists must be submitted for review as part of the application process. Practices and procedures in the following areas must be standardised and include flight planning; pre-flight procedures at the aircraft for each flight; procedures before entry into an RNP 5 route or airspace; in-flight, contingency and flight crew qualification procedures.

### 6.3 Pre-application Meeting

Each individual operator should schedule a pre-application meeting with the CAA. The intent of this meeting is to discuss airworthiness and operational requirements for approval to operate in RNP 5 airspace, including:

- (a) the contents of the operator's application,
- (b) CAA's review and evaluation of the application,
- (c) limitations (if any) on the approval, and
- (d) conditions under which the operational approval may be cancelled by the CAA.
- (e) any other operational or airspace requirements that may be established by European or other authorities for the airspace involved.



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### **6.4 Approval**

Approval to operate in BRNAV airspace will be granted by inclusion in the Operations Specifications of the AOC holder. For private category aircraft a Certificate will be issued.

### **6.5 Cancellation of RNP 5 & B-RNAV Approval**

Operators are reminded that after a BRNAV or RNP 5 approval is issued, the CAA conducts regular surveillance on all operations using performance based navigation. When appropriate, the CAA may consider any navigation error reports in determining remedial action. Repeated navigation error occurrences, attributed to a specific piece of navigation equipment, may result in cancellation of the approval. Information that indicates the potential for repeated errors may require a modification of an operator's training programme. Information that attributes multiple errors to a particular pilot crew may necessitate remedial training.



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### APPENDIX 1

#### BRNAV TRAINING - SPECIFIC

TYPE OF OPERATION	TRAINING REQUIRED	TRAINING METHODS	CHECKING and CURRENCY
<b>B-RNAV</b>	Basic RNAV Concept Training; <u>and</u> training in the following topics: <ul style="list-style-type: none"><li>• Airspace where B-RNAV is required;</li><li>• Changes to charting and documents to reflect B-RNAV;</li><li>• Navigational equipment required to be operational for flight in designated B-RNAV airspace, and the limitations associated with RNAV equipment;</li><li>• Use of lateral navigation mode and associated lateral control techniques;</li><li>• Flight planning requirements;</li><li>• Contingency procedures.</li></ul>	Some or all of: <ul style="list-style-type: none"><li>• Operations Manual content;</li><li>• Handouts (paper or electronic);</li><li>• CBT;</li><li>• Classroom;</li></ul> <u>and</u> Line Training.	B-RNAV procedures to be covered by briefing or during line checks.

Note: Credit may be given/taken for previous Basic RNAV Concept Training when adding a qualification for B-RNAV operations.



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