Advisory Circular

AC 91U-II-C-2(0) SEPTEMBER 2012

NAVIGATION AUTHORISATIONS – RNP 2

CONTENTS
1. References
2. Purpose
3. Status of this AC
4. Acronyms
5. Background
6. Applicability
7. Related Publications
8. Navigation Authorisation
9. Navigation Authorisation Process
10. Application
11. Aircraft Eligibility
12. System Performance, Monitoring and Alerting
13. System Functionality
14. Operating Standards
15. Flight Crew Knowledge and Training
16. Minimum Equipment List
17. Navigation Data Base
18. Navigation Errors

1. REFERENCES

- CAO 20.91 Navigation Authorisations Appendix 3, Requirements for use of RNP 2.
- CASA Form 1307: Reduced Vertical Separation Minimum and Required Navigation Performance Application Form.

Advisory Circulars are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.

Where an AC is referred to in a ‘Note’ below the regulation, the AC remains as guidance material.

ACs should always be read in conjunction with the referenced regulations.

This AC has been approved for release by the Executive Manager Standards Division.

September 2012
2. **PURPOSE**

2.1 This Advisory Circular (AC) provides information for operators of Australian registered aircraft who wish to gain approval to conduct Performance Based Navigation (PBN) operations in Australian airspace. These operations are consistent with the navigation specifications described in International Civil Aviation Organization (ICAO) Document 9613 Performance-based Navigation Manual (ICAO Doc 9613 PBN Manual) and include area navigation (RNAV) and Required Navigation Performance (RNP) navigation specifications.

3. **STATUS OF THIS AC**

3.1 This is the first AC relating to RNP 2 navigation authorisations and is based on information contained in Volume II, Part C, Chapter 2, of ICAO Doc 9613 PBN Manual and Appendix 3 Requirements for use of RNP 2 *Civil Aviation Order (CAO) 20.91 Navigation Authorisations*. The numbering convention used in the title of this AC is also aligned to the relevant part of the PBN manual.

4. **ACRONYMS**

- **AC** Advisory Circular
- **AFM** Aircraft Flight Manual
- **ANSP** Air Navigation Service Provider
- **ATC** Air Traffic Control
- **CASA** Civil Aviation Safety Authority
- **CASR** Civil Aviation Safety Regulations
- **CDI** Course Deviation Indicator
- **EASA** European Aviation Safety Agency
- **FAA** Federal Aviation Administration
- **FMS** Flight Management System
- **GNSS** Global Navigation Satellite System
- **GPS** Global Positioning System
- **ICAO** International Civil Aviation Organization
- **LOA** Letter of Acceptance
- **MEL** Minimum Equipment List
- **NAVAID** Navigation Aid
- **NOTAM** Notice to Airmen
- **OEM** Original Equipment Manufacturer
- **Ops Specs** Operations Specifications
- **PBN** Performance Based Navigation
- **QRH** Quick Reference Handbook
- **RNAV** Area Navigation
RNP  Required Navigation Performance
SBAS  Space Based Augmentation System
TSO   Technical Standard Order

5. BACKGROUND

5.1 RNP 2 is a navigation specification primarily intended to provide a means to develop routes in areas with little or no ground-based navigation aid (NAVAID) infrastructure.

5.2 The RNP 2 navigation specification is applicable to fixed or flexible routes in Continental En-route and Oceanic/Remote flight phases.

5.3 RNP 2 requires Global Navigation Satellite System (GNSS) as the primary navigation sensor, either as a stand-alone navigation system or as part of a multi-sensor system. Where multi-sensor systems incorporating GNSS are used, positioning data from non-GNSS navigation sensors may be integrated with the GNSS data provided the non-GNSS data do not cause position errors exceeding the total system error budget. Otherwise a means should be provided to deselect the non-GNSS navigation sensor types.

5.4 RNP 2 operations in Oceanic and Remote airspace require dual independent long-range navigation systems. RNP 2 operations in Continental En-route airspace may use a single GNSS area navigation system providing an alternate means of navigation is available if required by the category of operation.

5.5 The standards applicable to RNP 2 en-route also meet the requirements for:
- RNAV 5; and
- RNAV 1 and RNAV 2.

5.5 The standards applicable to RNP 2 oceanic / remote also meet the requirements for:
- RNP 4, and
- RNAV 5; and
- RNAV 1 and RNAV 2.

Note: RNP 2 is applicable to area navigation routes defined by straight segments. Fixed Radius Transitions may be applied to RNP 2 routes.

6. APPLICABILITY

6.1 This AC is applicable to operators of Australian registered aircraft and their flight crews. An RNP 2 navigation authorisation is not mandatory in order to gain access to Australian ‘PBN airspace’. However, authorisation must be obtained from the Civil Aviation Safety Authority (CASA) for RNP 2 operations to be conducted by the operator.

7. RELATED PUBLICATIONS

7.1 For further information refer to the following publications:
- CASA AC 21-37(0) Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors.

September 2012
8. NAVIGATION AUTHORISATION

8.1 An operator should carry out the following steps so that CASA has sufficient information to issue an RNP 2 navigation authorisation:

- Demonstrate Aircraft Eligibility:
  - Aircraft equipment eligibility requirements for RNP 2 are described in the PBN Manual and may be demonstrated through an Aircraft Flight Manual (AFM) compliance statement, AFM supplement or Original Equipment Manufacturer (OEM) service letter; however where aircraft equipment varies from these requirements subsequent eligibility will be determined by CASA;

- Describe Training and Operating Procedures:
  - Flight crew training and operating procedures for the navigation systems to be used must be described by the operator in a syllabus of training and an aide-memoir e.g. Quick Reference Handbook (QRH), checklist etc.; and

- Document Training and Operating Procedures:
  - Methods of control for flight crew training, operational procedures and database management must be identified in the operations manual.

9. NAVIGATION AUTHORISATION PROCESS

9.1 Navigation authorisations for all PBN navigation specifications and Reduced Vertical Separation Minimum operations are as follows:

- An aircraft operator applies for a navigation authorisation through the CASA Permission Application Centre using Form 1307 Reduced Vertical Separation Minimum and Required Navigation Performance Application Form;

- The CASA Permission Application Centre registers the Form 1307 and forwards it to the relevant Certificate Management Team for assessment;

- The Certificate Management Team conducts the navigation authorisation assessment:
  - Where the application meets the criteria listed in the PBN Manual and this AC, the Certificate Management Team approves the application and returns it to the Permission Application Centre;
  - Where the application does not meet the criteria listed in the PBN Manual and this AC (e.g. a non-standard application due to specific aircraft equipment functionality or training requirements) the Certificate Management Team seeks further information from the applicant. Once sufficient information has been received such that CASA may assess the application as ‘equivalent’ to the requirements of the PBN Manual and this AC the Certificate Management Team approves the application and returns it to the Permission Application Centre; and

- The CASA Permission Application Centre registers the approved navigation authorisation application in the operator’s Operations Specifications (Ops Specs) and issues an updated Ops Specs to the operator.

Note: Ops Specs are yet to be provided with a legislative head of power through Subpart 91U of the Civil Aviation Safety Regulations 1998 (CASR 1998). This will occur in the future through the Subpart 91U of CASR 1998 update and rewrite process which will align all navigation authorisations with the ICAO PBN Manual. Until such time, RNP 2 navigation authorisations will be issued under CAO 20.91.
10. APPLICATION

10.1 Content of an application for a RNP 2 navigation authorisation:

- Aircraft airworthiness documents (e.g. the AFM, AFM Supplement, OEM service letters) that establish that the aircraft is equipped with RNAV equipment that meets the requirements of RNP 2;
- A description of aircraft equipment including a configuration list which details pertinent components and equipment to be used for RNP 2 operations;
- A description of the proposed flight crew training, including the training syllabus.

Note: Course material, lesson plans and other training products are subject to CASA approval of the operator’s Regulation 217 Training and Checking organisation of the Civil Aviation Regulations 1988.

- Details of the operating procedures to be used, including:
  - relevant sections of the company operations manual;
  - checklists;
  - contingency procedures, QRH etc.;
- Sections of the Minimum Equipment List (MEL) applicable to RNP 2 operations; and
- Details of the method to be used to ensure the continuing integrity of the airborne navigation database.

11. AIRCRAFT ELIGIBILITY

11.1 An aircraft is eligible for a RNP 2 navigation authorisation if:

- The AFM, an AFM supplement, or OEM service letter states that the aircraft navigation system is approved for RNP 2 operations; or
- The aircraft is equipped with GNSS stand-alone system certified by the manufacturer for en-route operations in accordance with AC 21-36(0) (utilising either TSO-C129 Class A1 or A2 or TSO-C146 / ETSO-C146 Class Gamma and Operational Class 1, 2 or 3) or equivalent;
- The aircraft is equipped with a multi-sensor system (e.g. FMS) with GNSS equipment certified by the manufacturer for en-route operations in accordance with AC 21-37 (0) (utilising either TSO/ETSO-C129(a) sensor Class B or C, TSO/ETSO-C145 Class 1, 2 or 3 or TSO-C196) and the requirements of ETSO-C115b FMS or equivalent;
- The aircraft is demonstrated to comply with the requirements for RNP 2 contained in ICAO Doc 9613 PBN Manual, Volume II, Part C, Chapter 2, Implementing RNP 2.

12. SYSTEM PERFORMANCE, MONITORING AND ALERTING

12.1 System performance, monitoring and alerting requirements for RNP 2 operations are as stated in ICAO Doc 9613 PBN Manual, Volume II, Part C, Chapter 2, Implementing RNP 2.
13. SYSTEM FUNCTIONALITY

13.1 System functionality requirements for RNP 2 operations are as stated in ICAO Doc 9613 PBN Manual, Volume II, Part C, Chapter 2, Implementing RNP 2.

*Note:* Guidance in CASA AC 21-36(0) also applies to the application of the following functionality requirements.

14. OPERATING STANDARDS

14.1 Flight Planning

14.1.1 Prior to flight, consider conditions that may affect RNP 2 operations, including:

- Verify that the aircraft and operating crew are approved for RNP 2;
- Confirm that the aircraft can be operated in accordance with the RNP 2 requirements for the planned route(s) including the route/s to any alternate aerodrome(s) and minimum equipment requirements;
- Check availability of the NAVAID infrastructure required for the intended routes, including any non-RNAV contingencies, for the period of the intended operation;
- Confirm that the navigational database is current and appropriate for the region of intended operation and includes the NAVAIDs and waypoints required for the route; and
- Consider any operating restrictions, including time limits if applicable.

14.1.2 Insert the appropriate identifier in the flight plan to indicate RNP 2 as set out in the Aeronautical Information Publication.

14.2 GNSS Integrity Availability

14.2.1 GNSS navigation systems are equipped with a means of monitoring the integrity of the position solution. Integrity may be assured by a number of methods including Receiver Autonomous Integrity Monitor and proprietary hybrid inertial / GNSS systems.

14.2.2 The availability of the integrity monitoring function can be predicted and can be obtained from a variety of sources such as Notice to Airmen (NOTAM), and prediction services. Operators should be familiar with the prediction information available for the intended route. Prediction services are available from Air Navigation Service Provider (ANSPs), avionic manufacturers, other entities or through an on-board prediction capability.

14.2.3 Integrity availability prediction should take into account the latest satellite constellation NOTAM and the integrity system used by the aircraft avionics.

14.2.4 In the event of a predicted, continuous loss of the integrity function more than 5 minutes for any part of the RNP 2 operation, the flight plan should be revised (i.e. delaying the departure or planning a different route).
Note: Some RNP systems, typically multi-sensor systems with tightly coupled GNSS/IRS, provide a global RNP capability based on a minimum number of available GPS satellites and IRS coasting capability e.g.: ‘For instrument approach procedures requiring GPS PRIMARY...GPS PRIMARY is available worldwide if 24 satellites or more are operative. If the number of satellites is 23 or less check GPS PRIMARY availability using an approved ground based prediction software’. This equates to a global RNP capability of RNP 0.3 provided there is a minimum number of 24 serviceable GPS satellites. In such cases a prediction is not required unless operations below the stated RNP value are planned or the minimum number of serviceable satellites is reached.

14.2.5 Operators, pilots and ANSPs need to be aware, that a prediction of integrity availability, an unplanned failure of GNSS elements can result in a loss of integrity monitoring capability, and in some cases a complete loss of the navigation function whilst airborne, which may require reversion to an alternative means of navigation. Pilots should, therefore, assess their capability to navigate (potentially to an alternate destination) in the case of failure of GNSS navigation.

14.2.6 For aircraft navigating with Space Based Augmentation System (SBAS) receivers (all TSO-C145/C146), check GPS INTEGRITY availability in areas where SBAS is unavailable.

14.3 Flight Procedures

14.3.1 Comply with any instructions or procedures identified by the manufacturer as being necessary to comply with the performance requirements of the navigation specification.

14.3.2 At system initialisation, confirm the navigation database is current and verify that the aircraft position has been entered correctly. Verify proper entry of the Air Traffic Control (ATC) assigned route upon initial clearance from ATC to conduct the relevant RNAV route. Ensure the waypoints sequence, depicted by the navigation system, matches the route depicted on the appropriate chart/s and the assigned route.

14.3.3 Cross-check the cleared flight plan by comparing charts or other applicable resources with the navigation system textural display and the aircraft map display, if applicable. If required, confirm the exclusion of specific navigation aids.

Note: Small differences between charted navigation information and displayed navigation data may be noted. Differences of 3 degrees or less due to the equipment manufacturer’s application of magnetic variation and are operationally acceptable.

14.3.4 During flight, where feasible, confirm navigation reasonableness by cross-reference to available data from ground-based aids.

14.3.5 For RNP 2 routes, a lateral deviation indicator, navigation map display, flight director or autopilot in the lateral navigation mode is recommended.

14.3.6 In lieu of a lateral deviation indicator, a navigation map display with equivalent functionality to a lateral deviation indicator, as described in ICAO Doc 9613, Volume II, Part C, Chapter 2, Implementing RNP 2 is acceptable for RNP 2 operations.

14.3.7 Select lateral deviation display scaling suitable for the navigation accuracy associated with the route (e.g. full scale deflection ±2 NM for RNP 2 or ± 5 NM for TSO-C129 equipment).
14.3.8 Select navigation map scale to enable monitoring of tracking accuracy applicable to RNP 2.

*Note:* Map scaling selection is dependent upon a number of factors including display size, resolution, any numeric cross-track indications and route complexity. Typically a 10 NM display scaling may be used.

14.3.9 Maintain route centrelines, as depicted by lateral deviation indicators and/or flight guidance, unless authorised to deviate by ATC or under emergency conditions.

14.3.10 The standard for limitation of cross-track error/deviation (the difference between the computed path and the displayed aircraft position) is \( \frac{1}{2} \) the navigation accuracy (i.e. 1 NM for RNP 2).

*Note:* Brief deviations from this standard during and immediately after turns, are normally considered acceptable. As accurate cross-track information may not be provided during turns, crew procedures and training need to emphasise observance of turn anticipation commands and management of rate of turn.

14.3.11 If ATC issues a heading assignment taking the aircraft off a route, do not modify the flight plan until clearance is received to rejoins the route or the controller confirms a new clearance.

14.3.12 Manually selecting aircraft bank-liming functions may reduce the aircraft’s ability to maintain its desired track and is therefore not recommended. Pilots should recognise that manually selectable aircraft bank-liming functions might reduce their ability to satisfy ATC flight path expectations, especially when executing large angle turns. This should not be construed as a requirement to deviate from approved aircraft flight manual procedures; rather pilots should be encouraged to limit the selection of such functions within accepted procedures.

14.4 Contingency Procedures

14.4.1 Notify ATC when the RNP performance ceases to meet the requirements for RNP 2.

15. FLIGHT CREW KNOWLEDGE AND TRAINING

15.1 Flight crew knowledge elements include:

- The meaning and proper use of aircraft equipment/navigation suffixes;
- The capabilities and limitations of the RNP system installed;
- The operations and airspace for which the RNP system is approved to operate;
- The NAVAID limitations with respect to the RNP system to be used for RNP 2 operations;
- Required navigation equipment for operation on RNP 2 routes;
- The flight planning requirements for the RNP 2 operation;
- The radio/telephony phraseology for the airspace, in accordance with ICAO Doc 4444 - Procedures for Air Navigation Services – Air Traffic Management (PANS/ATM) and Doc 7030 - Regional Supplementary Procedures, as appropriate;
- Contingency procedures for RNP system failures;
RNP system-specific information, including:

- Levels of automation, mode annunciations, changes, alerts, interactions, reversions and degradation;
- Functional integration with other aircraft systems;
- Types of navigation sensors (e.g. Distance Measuring Equipment, Inertial Reference Unit and GNSS) utilised by the RNP system and associated system prioritisation/weighting/logic;
- Aircraft configuration and operational conditions required to support RNP 2 operations i.e. appropriate selection of lateral deviation display scaling;
- Pilot procedures consistent with the operation;
- The meaning and appropriateness of route discontinuities and related flight crew procedures;
- Monitoring procedures for each phase of the flight (e.g. monitor PROG or LEGS page);
- Turn anticipation with consideration to speed and altitude effects; and
- Interpretation of electronic displays and symbols.

15.2 Flight crew training elements include:

- Verify that the aircraft navigation data is current and valid;
- Verify the successful completion of RNP system self-tests;
- Initialise RNP system position;
- Perform a manual or automatic update (with take-off point shift, if applicable);
- Verify waypoints and flight plan programming;
- Resolve route discontinuities;
- Fly direct to waypoint;
- Fly a course/track to waypoint;
- Intercept a course/track;
- Vector off track and rejoin a procedure;
- Fly radar vectors and re-joining an RNP 2 route from a ‘heading’ mode;
- Determine cross-track error/deviation;
- Determine allowable deviation limits and maintain flight within those limits;
- Remove and reselect navigation sensor input;
- Perform gross navigation error checks using conventional aids;
- Confirm exclusion of a specific navigation aid or navigation aid type;
- Change arrival airport and alternate airport;
- Perform parallel offset function if capability exists. Advise ATC if this functionality is not available; and
Contingency procedures for RNP 2 failures.

**Note:** Where crews have the required standard of knowledge based on previous training or experience a separate training course may not be necessary, provided the applicant details the relevant knowledge and training elements that are contained in other training programmes.

## 16. MINIMUM EQUIPMENT LIST

### 16.1 The operator’s MEL must identify any unserviceability that affects the conduct of a RNP 2 operation.

## 17. NAVIGATION DATA BASE

### 17.1

A navigation database should be obtained from a supplier that complies with Radio Technical Commission for Aeronautics DO-200A/ European Organisation for Civil Aircraft Equipment document ED-76, Standards for Processing Aeronautical Data and should be compatible with the intended function of the equipment (see ICAO Annex 6, Part 1, Chapter 7). A Letter of Acceptance (LOA), issued by an appropriate regulatory authority to each of the participants in the data chain, demonstrates compliance with this requirement (e.g. Federal Aviation Administration (FAA) LOA issued in accordance with FAA AC 20-153 or European Aviation Safety Agency (EASA) LOA issued in accordance with EASA Implementing Rule 21 subpart G).

**Note:** While a LOA provides assurance of minimum standards for the supply of a navigation data, errors may still occur and all operators should consider the need to conduct periodic checks to ensure database integrity.

### 17.3

Any discrepancy in data is to be reported to the navigation database supplier and resolved prior to operational use by:

- re-issue of the navigation database;
- prohibition of the route; or
- instructions to flight crew.

## 18. NAVIGATION ERRORS

### 18.1

It is the responsibility of the operator to take immediate action to rectify any condition that has led to navigation error.

### 18.2

A report to CASA and Airservices Australia, including an initial analysis of the causal factors and the measures being taken to prevent a recurrence is due within 72 hours.

### 18.3

Navigation errors exceeding the following limits are reportable:

- a lateral navigational error of at least 2 NM for RNP 2;
- a longitudinal navigational error of at least 2 NM for RNP 2; or
- a navigation system failure. A navigation system failure is defined as meaning that the aircraft cannot meet the required performance for the current route.

---

Executive Manager  
Standards Division  
September 2012