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Advisory Circular

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NAVIGATION AUTHORISATIONS – RNAV 5

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1. REFERENCES

- ICAO Doc 9613 Performance-based Navigation Manual, Volume II, Part B, Chapter 2 - Implementing RNAV 5.
- CAO 20.91 Navigation Authorisations, Appendix 1, Requirements for use of RNAV 5.
- EASA AMC 20-4 Airworthiness Approval and Operational Criteria For the Use of Navigation Systems in European Airspace Designated For Basic RNAV Operations.
- FAA AC 90-96A Approval of U.S. Operators and Aircraft to Operate under instrument flight rules (IFR) in European airspace designated for Basic Area Navigation (B-RNAV) and Precision Area Navigation (P-RNAV).
- FAA AC 20-138A Airworthiness Approval of Global Navigation Satellite System (GNSS) Equipment
- FAA AC 20-138B Airworthiness Approval of Positioning and Navigation Systems
- 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 Development and Future Technology Division.

2. PURPOSE

2.1 This Advisory Circular (AC) provides information for operators of Australian, or foreign 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 RNAV 5 navigation authorisations and is based on information contained in Volume II, Part B, Chapter 2, of ICAO Doc 9613 PBN Manual and Appendix 1, Requirements for use of RNAV 5 *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
AMC	Acceptable Means of Compliance
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
B-RNAV	Basic Area Navigation
CAR	Civil Aviation Regulations 1988
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulations 1998
CDI	Course deviation Indicator
CDU	Control and Display Unit
DME	Distance Measuring Equipment
EASA	European Aviation Safety Agency
E/HSI	Electronic Horizontal Situation Indicator
EUROCAE	European Organisation for Civil Aviation Equipment
FAA	Federal Aviation Administration
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
INS	Inertial Navigation Systems
IRU	Inertial Reference Unit

MASPS	Minimum Aviation System Performance Specifications
MEL	Minimum Equipment List
NDB	Non-Directional Beacon
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
RTCA	Radio Technical Commission for Aeronautics
RVSM	Reduced Vertical Separation Minimum
SBAS	Space Based Augmentation System
TSO	Technical Standard Order
VOR	Very High Frequency (VHF) Omni Range

5. BACKGROUND

5.1 RNAV 5 is a navigation specification which is applicable to the en-route phase of flight and replaces the European Basic RNAV (B-RNAV) navigation specification under the ICAO PBN concept and rationalisation of navigation specifications. Air Operators Certificate holders with a B-RNAV navigation authorisation are deemed to hold an RNAV 5 navigation authorisation.

5.2 RNAV 5 systems permit navigation along any desired flight path within the coverage of station referenced nav aids (space or terrestrial) or within the limits of the capability of self-contained aids, or a combination of both methods.

5.3 RNAV 5 does not require the carriage of a navigation database. Because of the specific limitations (e.g. pilot workload and potential for data input errors) associated with manual insertion of waypoint coordinate data, RNAV 5 is restricted to the en-route phase of flight only.

5.4 RNAV 5 operations are based on the use of RNAV equipment that automatically determines aircraft position in the horizontal plane using inputs from one or a combination of the following types of position sensors, together with the means to establish and follow a desired path:

- VOR/DME;
- DME/DME;
- INS or IRS; and
- GNSS.

5.5 RNAV 5 does not require the carriage of dual RNAV systems therefore the potential for loss of RNAV capability requires an alternative means of navigation.

6. APPLICABILITY

6.1 This AC is applicable to operators of Australian and foreign registered aircraft and their flight crews. An RNAV 5 navigation authorisation (or equivalent approval from another State) 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 RNAV 5 operations to be conducted by the operator.

7. RELATED PUBLICATIONS

7.1 For further information on this topic, operators are advised to view the following regulations/publications:

- CASA AC 21-36(0) Global Navigation Satellite System (GNSS) Equipment: Airworthiness Guidelines;
- FAA AC 25-4 Inertial Navigation Systems;
- CASA AC 21-37(0) Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors;
- AC 90-45A Approval of Area Navigation Systems for use in the U.S. National Airspace System;
- AC 20-130 Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors;
- AC 20-138 Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for use as a VFR and IFR Supplemental Navigation System;
- AC 25-15 Approval of Flight Management Systems in Transport Category Airplanes;
- RTCA DO-236B Minimum Aviation System Performance Standards: Required Navigation Performance for Area Navigation; and
- European Organisation for Civil Aviation Equipment (EUROCAE) ED-75B MASPS Required Navigation Performance for Area Navigation.

8. NAVIGATION AUTHORISATION

8.1 An operator should carry out the following steps so that CASA has sufficient information to issue a RNAV 5 navigation authorisation:

- Demonstrate Aircraft Eligibility:
 - ° Aircraft equipment eligibility requirements for RNAV 5 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-mémoire e.g. Quick Reference Handbook (QRH), checklist etc.; and
- Document Training and Operating Procedures:
 - Methods of control for flight crew training, operational procedures and data base 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 (RVSM) 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 *Reduced Vertical Separation Minimum and Required Navigation Performance* 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, Certificate Management Team approves the application and returns it to the Permission Application Centre; or
 - 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 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, RNAV 5 navigation authorisations will be issued under CAO 20.91.*

10. APPLICATION

10.1 Content of an application for an RNAV 5 navigation authorisation:

- Aircraft airworthiness documents (e.g. the AFM, AFM Supplement or OEM service letters) that establish that the aircraft is equipped to meet the requirements for RNAV 5;

Note: Under some circumstances, the operator may not be able to determine the aircraft's equipment eligibility from the AFM, or may require an RNAV 5 time limit extension for non-radio updated Inertial Navigation Systems (INS)-based RNAV systems beyond two hours from alignment. In this case the operator's application needs to provide details of the equipment proposed to be used, evidence of its performance, crew operating procedures, bulletins and any other pertinent information, sufficient for CASA to make a determination of the equipment eligibility.

- A description of aircraft equipment including a configuration list which details pertinent components and equipment to be used for RNAV 5 operations;
- A description of the proposed flight crew training, including:
 - 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 (CAR 1988).

- Details of the operating procedures to be used, including:
 - relevant sections of the company operations manual;
 - checklists;
 - contingency procedures, QRH etc.; and
- Sections of the Minimum Equipment List (MEL) applicable to RNAV 5 operations.

Note: The manuals, the aircraft navigation equipment and the manufacturer's checklist, as appropriate, form part of the package to be submitted as part of the application process.

- Maintenance provisions to ensure the continuing airworthiness of aircraft for RNAV 5 operations; and
- Details of the method to be used to ensure the continuing integrity of the airborne navigation database if carried.

11. AIRCRAFT ELIGIBILITY

11.1 An aircraft is eligible for an RNAV 5 navigation authorisation if:

- The AFM, an AFM supplement, or OEM service letter states that the aircraft navigation system is approved for RNAV 5 or B-RNAV operations in accordance with:
 - AMC 20-4 Airworthiness Approval and Operational Criteria For the Use of Navigation Systems in European Airspace Designated For Basic RNAV Operations; or

- Any of the following Federal Aviation Administration (FAA) documents:
 - AC 90-96A Approval of U.S. Operators and Aircraft to Operate under instrument flight rules (IFR) in European airspace designated for Basic Area Navigation (B-RNAV) and Precision Area Navigation (P-RNAV);
 - AC 90-45A Approval of Area Navigation Systems for use in the U.S. National Airspace System;
 - AC 20-130 Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors;
 - AC 20-138 Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for use as a VFR and IFR Supplemental Navigation System; and
 - AC 25-15 Approval of Flight Management Systems in Transport Category Airplanes;
- The requirements of ICAO Doc 9613 Performance Based Navigation Manual Volume II Part B Chapter 2 Implementing RNAV 5 are demonstrated to be met.

12. SYSTEM PERFORMANCE, MONITORING AND ALERTING

12.1 System performance, monitoring and alerting requirements for RNAV 5 operations are stated in ICAO Doc 9613 Volume II Part B Chapter 2 Implementing RNAV 5.

13. SYSTEM FUNCTIONALITY

13.1 The following system functions are the minimum required for RNAV 5 operations:

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

13.2 The following standards apply to navigation displays:

- Navigation data available on either a display forming part of the RNAV equipment or on a lateral deviation display (e.g. Course Deviation Indicator (CDI), Electronic Horizontal Situation Indicator ((E/HSI), or a navigation map display); and
- Suitable for use as the primary flight instruments for the navigation of the aircraft, for manoeuvre anticipation and for failure/status/integrity indication:
 - Visible to the pilot when looking forward along the flight path;
 - Lateral deviation display scaling compatible with any alerting and annunciation limits, where implemented; and
 - Lateral deviation display scaling and full-scale deflection suitable for RNAV 5 operations.

14. OPERATING STANDARDS

14.1 General

14.1.1 The operator's manuals, checklists and guidance material will detail standard operating procedures applicable to RNAV 5 operations.

14.1.2 Where an aircraft is not equipped with GNSS an evaluation of the capability of the aircraft to satisfy the RNAV 5 time limits for the route to be flown is required.

Note: An acceptable means of evaluation is contained in ICAO Doc 9613 Performance Based Navigation Manual.

14.2 Flight Planning

14.2.1 Prior to flight, consider conditions that may affect RNAV 5 operations, including;

- Verify that the aircraft and operating crew are approved for RNAV 5;
- Confirm that the aircraft can be operated in accordance with the RNAV 5 requirements for the planned route(s) including the route(s) to any alternate aerodrome 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;
- Where a navigation database is used, confirm it is current and appropriate for the region of intended operation and includes the navigation aids and waypoints required for the route; and
- Consider any operating restrictions, including time limits if applicable.

14.2.2 Insert the letter R in item 10 of the flight plan in respect of the flight provided that the aircraft's essential RNAV 5 equipment is functioning properly.

14.3 GNSS Integrity Availability

14.3.1 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 (RAIM) and proprietary hybrid IRS/GPS systems.

14.3.2 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), avionics manufacturers, other entities or through an on-board prediction capability.

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

14.3.4 In the event of a predicted, continuous loss of the integrity function of more than 5 minutes for any part of the RNAV 5 operation, the flight plan should be revised (i.e. delaying the departure or planning a different departure procedure).

14.3.5 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.

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

14.4 Flight Procedures

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

14.4.2 Adhere to any AFM limitations or operating procedures required to maintain the navigation accuracy specified for the procedure.

14.4.3 Where installed, confirm that the navigation database is valid.

14.4.4 Cross-check the cleared flight plan by comparing charts or other applicable resources with the navigation system textual display and the aircraft map display, if applicable. If required, exclude specific navigation aids.

14.4.5 Where feasible, monitor flight progress for navigational reasonableness, by cross-checks with conventional navigation aids using the primary displays in conjunction with the RNAV control and display unit (CDU).

14.4.6 Use a lateral deviation indicator, flight director or autopilot in lateral navigation mode is recommended. A navigation map display without a flight director or autopilot is acceptable. Ensure that the scaling for a lateral deviation display is suitable for the navigation accuracy associated with the route/procedure (e.g. full scale deflection: ± 5 nm).

14.4.7 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. 2.5 nm)

Note: Brief deviations from this standard during and immediately after turns, are normally considered acceptable. 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.

14.4.8 If Air Traffic Control (ATC) issues a heading assignment taking the aircraft off a route, do not modify the flight plan until clearance is received to rejoin the route or the controller confirms a new clearance.

14.5 Contingency procedures

14.5.1 Notify ATC when the RNAV performance ceases to meet the requirements for RNAV 5.

14.5.2 Where stand-alone GNSS equipment is used:

- Following a loss of integrity monitoring function, continue to navigate using GNSS and cross-check the aircraft position, with other sources of position information, (e.g. VOR, DME and/or NDB information) to confirm an acceptable level of navigation performance. If unable to confirm navigation accuracy, revert to an alternative means of navigation and advise ATC accordingly.
- In the event that the navigation display is flagged invalid due to a INTEGRITY alert, revert to an alternative means of navigation and advise ATC accordingly.

15. FLIGHT CREW KNOWLEDGE AND TRAINING**15.1** Flight crews require the following knowledge:

- The capabilities and limitations of the RNAV system installed;
- The operations and airspace for which the RNAV system is approved to operate;
- The navaid limitations with respect to the RNAV system to be used for the RNAV 5 operation;
- Contingency procedures for RNAV failures;
- The radio/telephony phraseology for the airspace, in accordance with ICAO Doc 4444 – PANS/ATM and ICAO Doc 7030 – Regional Supplementary Procedures, as appropriate;
- The flight planning requirements for the RNAV operation;
- RNAV requirements as determined from chart depiction and textual description; and
- RNAV system-specific information, including:
 - Levels of automation, mode annunciations, changes, alerts, interactions, reversions and degradation;
 - Functional integration with other aircraft systems;
 - Monitoring procedures for each phase of the flight (e.g. monitor PROG or LEGS page);
 - Types of navigation sensors (e.g. DME, IRU, GNSS) utilised by the RNAV system and associated system prioritisation/weighting/logic;
 - Turn anticipation with consideration to speed and altitude effects; and
 - Interpretation of electronic displays and symbols.

15.2 Flight crews require training in the following:

- RNAV equipment operating procedures, as applicable, including:
 - Verify that the aircraft navigation data is current;
 - Verify the successful completion of RNAV system self-tests;
 - Initialise RNAV system position;
 - Fly direct to waypoint;
 - Intercept a course/track;
 - Be vectored off and rejoin a procedure;
 -

- Determine cross-track error/deviation;
- Remove and reselect navigation sensor input;
- Confirm exclusion of a specific navigation aid or navigation aid type; and
- Perform gross navigation error checks using conventional aids.

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. MIMIMUM EQUIPMENT LIST

16.1 The operator's minimum equipment list must identify any unserviceability that affects the conduct of an RNAV 5 operation.

17. NAVIGATION ERRORS

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

17.2 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.

17.3 Navigation errors exceeding the following limits are reportable to CASA:

- A lateral navigational error of at least 5 nm;
- A longitudinal navigational error of at least 5 nm;
- A longitudinal navigational error of at least 3 minutes variation between the aircraft's estimated time of arrival at a reporting point and its actual time of arrival; or
- A navigation system failure.

17.4 The Navigation Error Investigation Form is the approved form for reporting a navigation error or an equipment failure.

17.5 CASA and the operator may determine the reasons for the apparent deviation from track or altitude and the steps to be taken to prevent a recurrence.

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Standards Development and Future Technology

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