

Advisory Circular

OPERATIONAL APPROVAL FOR AREA NAVIGATION RNAV-2 AND RNAV-1

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GENERAL

Advisory Circulars (ACs) are issued by the Director-General of Civil Aviation (DGCA) from time to time to provide practical guidance or certainty in respect of the statutory requirements for aviation safety. ACs contain information about standards, practices and procedures acceptable to CAAS. An AC may be used, in accordance with section 3C of the Air Navigation Act (Cap. 6) (ANA), to demonstrate compliance with a statutory requirement. The revision number of the AC is indicated in parenthesis in the suffix of the AC number.

PURPOSE

This AC provides guidance to demonstrate compliance with the requirements regarding, and information related to an application for, an approval for specified navigation performance operations in accordance with ANR-98.

APPLICABILITY

This AC is applicable to the operator seeking an approval for RNAV-2 operations.

RELATED REGULATIONS

This AC relates specifically to Division 2 in Part 2 of ANR-98.

RELATED ADVISORY CIRCULARS

- AC 98-1-1 Application for an Approval to Conduct a Special Operation

CANCELLATION

This AC supersedes AC AOC-24.

EFFECTIVE DATE

This AC is effective from 1 October 2018.

OTHER REFERENCES

- ICAO Doc 9613 Performance-based navigation (PBN) Manual
- FAA AC 90-100A U.S. Terminal and en-route area navigation (RNAV) operations
- EASA/JAA TGL 10 (Rev 1) Airworthiness and operational approval for precision RNAV operations in designation European airspace
- RTCA DO-200A/EUROCAE ED-76 Standards for processing aeronautical data
- ETSO C129(A)/FAA TSO C129(A) Airborne supplemental navigation equipment using Global Positioning Systems (GPS)
- FAA AC 20-153B Acceptance of aeronautical data processes and associated databases
- EASA Part-DAT Specific requirements for providers of data services

1 INTRODUCTION

- 1.1 In November 2000, JAA published TGL 10 to guide regulators to grant operational approval for air operators to conduct Precision RNAV (P-RNAV) to ease congestion due to converging traffic in the terminal area in Europe. For the same reason, the FAA in 2005 promulgated AC 90-100 for US-RNAV Type A and Type B operations.
- 1.2 While similar in functional requirements, these two documents bear some differences which are harmonised by ICAO RNAV 1 and RNAV 2 navigation criteria covering GNSS, DME/DME and DME/DME/IRU only.

2 OPERATIONAL REQUIREMENTS

- 2.1 To meet RNAV 1 and RNAV 2 requirements, the aircraft must maintain track-keeping accuracy for 95% of flight time of ± 1 nm and ± 2 nm respectively.
- 2.2 A summary of RNAV 1 and 2 requirements is as follows:
- (a) Only one RNAV system
 - (b) The RNAV system may be based on:
 - (i) DME/DME
 - (ii) DME/DME/IRU
 - (iii) GNSS (including GNSS/IRU)
 - (c) Navigation database complying with RTCA DO-200A/EUROCAE ED-76
 - (d) Navigation display in pilot's FOV (field of view) must be sufficient for track following and manoeuvring
 - (e) Maximum permitted cross-track error/deviation is ($\frac{1}{2}$ navigation accuracy)
 - (i) 0.5 nm for RNAV 1
 - (ii) 1.0 nm for RNAV 2
 - (f) An indication for RNAV system failure is required

Note 1: Refer to FAA AC90-100A Compliance Table for use of DME/DME and DME/DME/IRU.

Note 2: Must have procedure to inhibit DME stations indicated in a NOTAM as unserviceable or unreliable.

- 2.3 GNSS certified under ETSO C129(A)/FAA TSO C129(A), or later, meets requirements for RNAV 1 and 2. Stand-alone ETSO C129/FAA TSO C129 GNSS receivers are acceptable provided they include pseudo-range step detection and health checking functions. For GNSS-based operations, GNSS availability prediction is required for the route.

Note: PBN manual makes reference to potential need to deselect navigation sensors due to possibility of position error caused by integration of GNSS data and other position data. This method of updating is commonly associated with IRS/GNSS systems and the weighting given to radio updating is such that any potential erosion of accuracy is unlikely to be insignificant in proportion to RNAV 1 and 2 navigation accuracy.

3 FUNCTIONALITY

- 3.1 Aircraft equipped with flight management systems (FMS) normally comply with required functionalities for RNAV 1 and 2 operations except for provision of a non-numeric lateral deviation display system. These aircraft are normally provided with numeric indication of cross-track error in 1/10th nm and some cases not within the FOV e.g. CDU. For these aircraft lateral track-keeping accuracy may be maintained by the use of autopilot or flight director system.
- 3.2 Aircraft installed with stand-alone GNSS navigation systems should provide track guidance via a CDI or HSI as the unit display is not of sufficient size or suitably positioned to allow either pilot to adequately maintain cross-track deviation.
- 3.3 For stand-alone GNSS systems the operating procedures and training should include limitations in respect of ARINC 424 path terminators which involve an altitude termination. Due to lack of integration of the lateral navigation system and altimetry system, pilot intervention is required.

4 AIRCRAFT ELIGIBILITY

- 4.1 Aircraft with AFM, STC or manufacturer's documentation, such as service letters, attesting to RNAV 1 and 2 airworthiness compliance are acceptable by the CAAS.
- 4.2 For preparation of application for RNAV 1 and 2 operational approvals the operator may wish to refer to the following best practice documents:
 - (a) ICAO PBN Manual Document 9613 AN/937
 - (b) EASA/JAA TGL 10 (Rev 1)
 - (c) FAA AC 90-100A
- 4.3 An operator holding an operational approval for P-RNAV only under TGL 10 may fly in any State where the routes are predicated on TGL 10. To operate RNAV 1 and 2 the operator must submit application for RNAV 1 and 2 operational approval with evidence of compliance against the differences between TGL 10 and the criteria of RNAV 1 and 2 using Table II-B-3-1 of Volume II of ICAO PBN manual.
- 4.4 An operator holding an operational approval for US-RNAV only under FAA AC 90-100 may fly in any State where the routes are predicated on AC 90-100. To operate RNAV 1 and 2 the operator must submit application for RNAV 1 and 2 operational approval with evidence of compliance against the differences between AC 90-100 and the criteria of RNAV 1 and 2 using Table II-B-3-1 of Volume II of ICAO PBN manual.
- 4.5 An operator holding both RNAV 1 and 2 operational approvals will be eligible to operate on US-RNAV Type A and Type B and European PRNAV route with no further approval requirements.

5 NAVIGATION DATABASE INTEGRITY

- 5.1 The navigation database integrity must comply with RTCA DO-200A / EUROCAE ED-76 standards. The operator must ensure that the navigation database supplier or vendor to the operator hold valid Type LOA (Letter of Approval) issued in accordance with FAA AC 20-153B or EASA Part DAT.

- 5.2 The operator should also conduct additional navigation data check of any new or changed procedures, in particular when operating into areas with terrain.
- 5.3 Any significant errors must be reported to the database supplier and flight crew must be informed immediately to suspend use of the affected procedures until integrity checks are satisfactorily completed.
- 5.4 Notwithstanding paragraph 5.1 above, the operator shall assume sole responsibility for the safety of the operation.

6 OPERATING PROCEDURES

- 6.1 An operator with RNAV experience would generally meet the basic requirements. The operating procedures should focus on RNAV SIDs and STARS.
- 6.2 Pre-flight checks for the pilot should include the following:
 - (a) Appropriate notation in the ATS flight plan
 - (b) Nav Database identity and is current for the duration of flight
 - (c) Nav-sensors NOTAM: GNSS RAIM prediction and critical DME
 - (d) Cross-check flight against nav-system textual and map displays for discrepancy
 - (e) Contingency procedures for loss of navigation or communications capability.
- 6.3 Prior to commencing the take-off the pilot must ensure that the RNAV system is available. The following are conditions for engagement of RNAV:
 - (a) Aircraft with DME/DME but no GPS or IRU must take off in heading mode until entering adequate DME coverage.
 - (b) Aircraft with DME/DME/IRU but no GPS can engage RNAV but should confirm nav position versus the take off point is within 300 m (1000 ft).
 - (c) Aircraft using GNSS only must acquire GNSS signal prior to take off.

Note: Pilots must be mindful of and ensure any last minute changes of runway or SID are properly updated in the navigation system.
- 6.4 In-flight procedures should include:
 - (a) where possible, check of flight navigation data using ground aids;
 - (b) as a minimum, arrival checks using suitable of map display; and
 - (c) review of conventional procedures for possible reversion.

7 PILOT KNOWLEDGE AND TRAINING

- 7.1 The operator should ensure that the flight crew is familiar with RNAV concept and operations, SIDs and STARS as well as the functionality of the equipage and its use. Particular attention should be placed on:
 - (a) ability of the equipment to fly designed flight path and pilot intervention due to limitations in equipment functionality;
 - (b) managing of changes (procedure, runway, track);
 - (c) route modification (insertion/deletion of waypoints, direct to waypoint); and
 - (d) route interception, radar vectors.
- 7.2 Where GNSS is used, flight crews should be trained in GNSS principles related to en-route navigation.

- 7.3 Training for RNAV 1 and 2 can be conducted by classroom briefing, computer based training, followed by flight simulator exercises.
- 7.4 For stand-alone GNSS operations, computer based simulator programs are available from GPS manufacturers who will provide a convenient method for familiarity with programming and operation of stand-alone GNSS systems.

Note: Should VNAV be used for SIDs and STARs the flight crew should pay attention to the management of VNAV specifically the potential for altitude constraints to be compromised in cases where the lateral flight path is changed or intercepted.

8 WITHDRAWAL OF OPERATIONAL APPROVAL

- 8.1 A operational approval is conditional upon compliance with RNAV 1 or 2 operational requirements and promulgations in ICAO Doc 4444, Doc 7030 as well as State AIPs.
- 8.2 Non-compliance, repeated reports of GNE (gross navigation error) or unsatisfactory corrective action may result in CAAS withdrawing the operational approval.