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OPERATION OF AIRCRAFT

NAVIGATION AND LANDING AIDS

PERFORMANCE BASED NAVIGATION (PBN) NAVIGATION SPECIFICATIONS TO BE USED IN SOUTH AFRICA

INTRODUCTION

1. *The continuing growth of aviation places increasing demands on airspace capacity and emphasises the need for the optimum utilisation of the available airspace. Together with improved operational efficiency derived from the application of Area Navigation (RNAV) techniques, this has resulted in the development of navigation applications in various regions and for all phases of flight.*

2. *In setting out requirements for navigation applications on specific routes or within a specific airspace, it is necessary to define requirements in a clear and concise manner. This is to ensure that both flight crew and ATC are aware of the on-board area navigation (RNAV) system capabilities and to ensure that the performance of the RNAV system is appropriate for the specific airspace requirements.*

3. *The early use of RNAV systems arose in a manner similar to conventional ground-based routes and procedures. A specific RNAV system was identified and its performance was evaluated through a combination of analysis and flight testing. For domestic operations the initial systems used VOR and DME for their position estimation. For oceanic operations, inertial navigation systems (INS) were employed. These 'new' systems were developed, evaluated and certified. Airspace and obstacle clearance criteria were developed on the basis of available equipment performance. Requirements specifications were based upon available capabilities and, in some implementations, it was necessary to identify the individual models of equipment that could be operated within the airspace concerned. Such prescriptive requirements result in delays to the introduction of new RNAV system capabilities and higher costs for maintaining appropriate certification. To avoid such prescriptive specifications of requirements, this aeronautical information circular (AIC) specifies an alternative method for defining equipage requirements by specification of the performance requirements. This is termed Performance Based Navigation (PBN).*

PERFORMANCE BASED NAVIGATION

4. *The PBN concept specifies aircraft RNAV system performance requirements in terms of accuracy, integrity, availability, continuity and functionality needed for the proposed operations in the context of a particular Airspace Concept. The PBN concept represents a shift from sensor-based to performance-based navigation. Performance requirements are identified in navigation specifications, which also identify the choice of navigation sensors and equipment that may be used to meet the performance requirements. These navigation specifications are defined at a sufficient level of detail to facilitate global harmonization by providing specific implementation guidance for the State, air navigation service providers (ANSP) and operators.*

5. *Under PBN, generic navigation requirements are defined based on the operational requirements. Operators are then able to evaluate options in respect of available technologies and navigation services that could allow these requirements to be met. The chosen solution would be the most cost effective for the operator, rather than a solution being imposed as part of the operational requirements. Technologies can evolve over time without requiring the operation itself to be revisited, as long as the requisite performance is provided by the RNAV system. It is anticipated that other means for meeting the requirements of the Navigation Specifications will be evaluated and may be included in the applicable Navigation Specifications, in the future, as appropriate.*

6. *PBN offers a number of advantages over the sensor-specific method of developing airspace and obstacle clearance criteria:*

   a. *Reduces need to maintain sensor-specific routes and procedures, and their associated costs.*

   b. *Avoids need for development of sensor-specific operations with each new evolution of navigation systems, which would be cost-prohibitive.*

c. *Allows more efficient use of airspace (route placement, fuel efficiency, noise abatement).*

d. *Clarifies the way in which RNAV systems are used.*

e. *Facilitates the operational approval process for operators by providing a limited set of navigation specifications intended for global use.*

7. *Within an Airspace Concept, PBN requirements will be affected by the communication, surveillance and ATM environment, as well as the Navaid infrastructure and the functional and operational capabilities needed to meet the ATM application. PBN performance requirements will also depend on what reversionary, non-RNAV means of navigation are available and hence what degree of redundancy is required to ensure an adequate continuity of function.*

8. *The development of the Performance Based Navigation Concept recognizes that advanced aircraft RNAV systems are achieving a predictable level of navigation performance accuracy which, together with an appropriate level of functionality, allows a more efficient use of available airspace. It also takes account of the fact that RNAV systems have developed over a 40 year period and as a result there are a large variety of implementations. PBN primarily identifies navigation requirements irrespective of the means by which these are met.*

9. *This aeronautical information circular (AIC) specifies the Navigation Specifications to be utilised in the implementation of PBN in South Africa.*

10. *The list of Navigation Specifications contained in the table below have been extracted from ICAO Document 9613, Performance Based Navigation (PBN) Manual. This manual provides more detail as to the concept and implementation requirements as well as detailing all the requirements for the implementation of a specific Navigation Specification by a State, ANSP's and Operators.*

NAVIGATION SPECIFICATION	**FLIGHT PHASE**							
	En-Route Oceanic/Remote	**En Route Continental**	**ARR**	**APPROACH**				**DEP**
				Initial	**Interim**	**Final**	**Missed**	
RNAV 10	*10*							
RNAV 5		*5*	*5*					
RNAV 2		*2*	*2*					*2*
RNAV 1		*1*	*1*	*1*	*1*		*1[b]*	*1*
RNP 4	*4*							
Basic RNP 1			*1[a,c]*	*1[a]*	*1[a]*		*1[a,b]*	*1[a,c]*
RNP APCH				*1*	*1*	*0.3*	*1*	
RNP AR APCH				*1 – 0.1*	*1 – 0.1*	*0.3 – 0.1*	*1 – 0.1*	

Table 10-1: Application of Navigation Specification by Flight Phase

Notes:

a. *The numbers given in the table refer to the 95% accuracy requirements (NM);*
b. *RNAV 5 is an en-route navigation specification which may be used for the initial part of the STAR outside 30NM and above MSA;*
c. *RNP 2 and Advanced-RNP 1 are expected to be included in a future revision of the PBN Manual;*
d. *1^a means that the navigation application is limited to use on STARs and SIDs only;*
e. *1^b means that the area of application can only be used after the initial climb of a missed approach phase;*
f. *1^c means that beyond 30 NM from the airport reference point (ARP), the accuracy value for alerting becomes 2 NM.*

11. *The above table shows the navigation specifications and their associated navigation accuracies published in ICAO Document 9613, Performance Based Navigation (PBN) Manual, Parts B and C of Volume II. It demonstrates, for example, that the designation of an oceanic/remote, en route or terminal navigation specification includes an indication of the required navigation accuracy, and that the designation of navigation specifications used on Final Approach is different.*

Note: Detailed information with respect to each of the navigation specifications contained in the above table can be obtained in ICAO Document 9613, Performance Based Navigation (PBN) Manual, Parts B and C of Volume II.

12. *Most important, the above table shows that for any particular PBN operation, it is possible that a sequence of RNAV and RNP applications may be used. A flight may commence in an airspace using a Basic RNP 1 SID, transit through En Route then Oceanic airspace requiring RNAV 2 and RNP 4, respectively, and culminate with Terminal and Approach operations requiring Advanced RNP 1 and RNP AR APCH.*

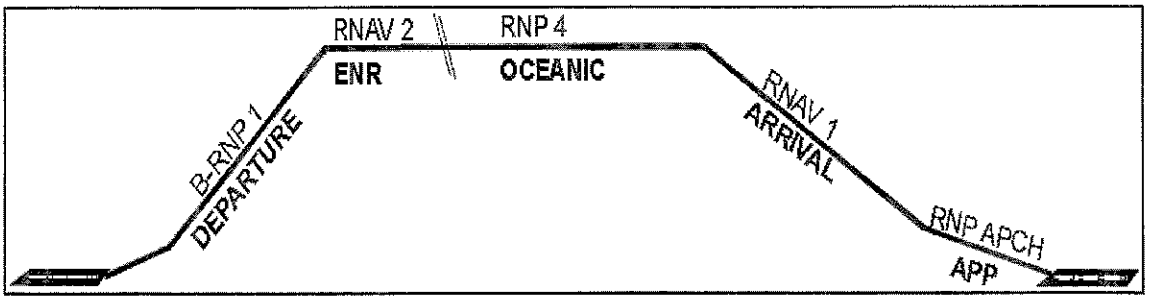

Figure 12-1: Example of an Application of RNAV and RNP Specifications to ATS Routes and Instrument Procedures.

Table 12-1 identifies for example in the Approach and Missed approach phases of flight, a number of instances where different Navigation Specifications can be applied on the same phases of flight providing identical Total System Errors (TSE). This does not imply that all of the specifications provide identical functional capability. As a result, in the design of the procedures, it is important to call up only that capability which is provided by the appropriate Navigation Specification and that the procedure is appropriately identified.

This AIC must be read in conjunction with AICs 25.9 Airworthiness Approval and Operational Criteria for RNP Approach (RNP APCH) Operations including APV BAROVNAV Operations and AIC 25-10 Airworthiness Approval and Operational Criteria for RNP Authorisation Required (RNP AR) Operations.

Further notices in respect of implementation will follow.

DIRECTOR OF CIVIL AVIATION