AUSTRALIA

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AERONAUTICAL INFORMATION CIRCULAR (AIC)

AIRAC

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PERFORMANCE-BASED NAVIGATION (PBN) IN AUSTRALIA

1. INTRODUCTION

1.1 This AIC cancels and replaces AIC H13/17 with CASA EX06/16 replaced with CASA EX158/17.

1.2 This Circular describes the application of ICAO's **P**erformance-**B**ased **N**avigation (PBN) provisions in Australian Airspace. This Circular should be considered alongside the CASA Civil Aviation Orders (CAO) 20.18 and (CAO) 20.91, CASR Subpart 91.U and Manual of Standards (MOS) and CASR Part 61 where further information and applicable requirements for aircraft equipment, pilot qualifications and training, and continuing airworthiness criteria is set out.

1.3 This AIC provides information concerning Australia's transition to PBN as primary means of navigation in line with the global aviation industry. Advances in navigation performance have enabled changes in airspace design, separation minima, route spacing, airport access, instrument procedure design and air traffic management. These changes form a significant part of the overall modernisation of Australia's airspace system and deliver improvements in safety and operational efficiency.

1.4 Australia has transitioned from navigation based on ground-based navaids such as VOR and NDB to Area Navigation using the ICAO PBN framework with Global Navigation Satellite Systems (GNSS) as the enabling technology. **GNSS is therefore the key enabler for PBN in Australia.**

1.5 GNSS currently comprises of the USA GPS, European GALILEO, Chinese BEIDOU and Russian GLONASS systems. Australia's PBN implementation utilises the GPS system, and equipage with a suitable GNSS receiver has been mandated for all IFR flights from February 2016 (see *AIP GEN 1.5, Section 2*)

1.6 PBN provides a framework for defining the performance requirements for aircraft operating either:

- Along an ATS Route,
- On an Instrument Approach Procedure, or
- Within a Designated Airspace.

1.7 Through the application of RNAV and RNP specifications, PBN provides a basis for the design and implementation of automated, optimised and environmentally friendly flight paths, and serves as an enabler for efficient airspace design and refined terrain clearance.

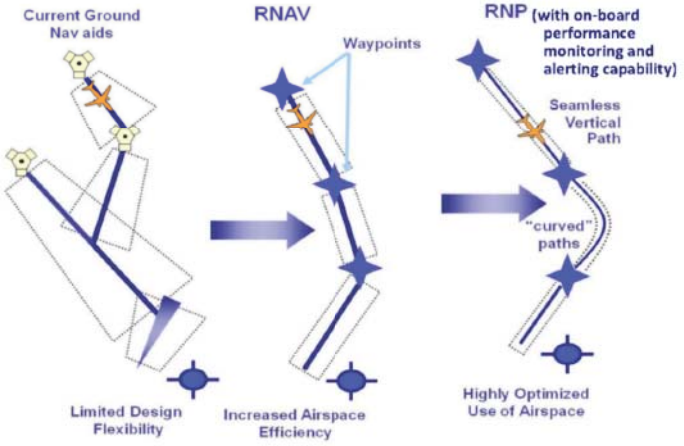


Figure 1

2. BACKGROUND

2.1 ICAO's PBN concept, as set out in ICAO Doc 9613 (Performance– based Navigation (PBN) Manual), identifies a component known as the Navigation Application, which is enabled by two sub components:

- The NAVAID Infrastructure, and
- Navigation Specification.

2.2 The Navigation Application identifies the navigation requirements for ATS Routes and Instrument Approach Procedures, used by pilots and air traffic controllers. The Navigation Application is dependent on the NAVAID Infrastructure.

2.3 The NAVAID Infrastructure refers to ground-based, self-contained and space-based navigation aids. GNSS is a space-based NAVAID Infrastructure and is the enabling technology for PBN in Australian airspace. The ground-based NAVAID Infrastructure in Australia, a network of NDBs, VORs and DMEs does not support PBN, but rather forms the Backup Navigation Network (BNN).

2.4 The Navigation Specification is a technical and operational specification that identifies the capabilities of the area navigation equipment required. It also identifies how the equipment is expected to operate in order to meet the operational need for each Navigation Application. Therefore, a PBN Navigation Application is defined by the implementation of a Navigation Specification and its supporting NAVAID Infrastructure, as applied to ATS Routes, Instrument Approach Procedures and/or Defined Airspace volumes.

2.5 RNAV Specifications, except **Oceanic and Remote RNAV 10 (RNP 10)**, are not implemented or used in Australian airspace.

2.6 Australia is implementing the following Navigation Specifications:

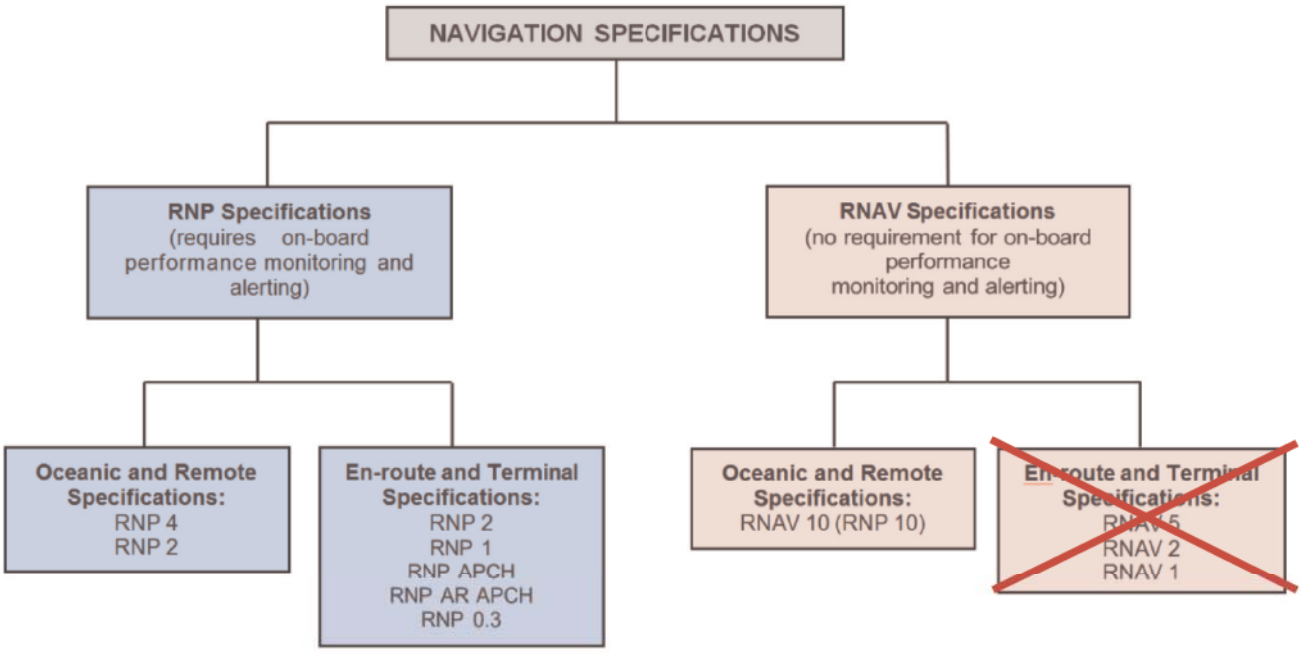


Figure 2

Australia has chosen to use the following ICAO PBN Navigation Specifications:

Specification	Intended Use
RNAV 10 (RNP 10) Oceanic Operations *Supported in Australia*	• Supports 50NM lateral and longitudinal separations in oceanic/remote continental airspace.
RNP 4 Oceanic Operations Preferred in Australia	• Supports 30NM lateral and longitudinal separations in oceanic/remote continental airspace.
RNP 2 En route Operations	• Oceanic and en route use.
RNP 1 Terminal Operations	• Provides connectivity between en route airspace and Instrument Flight Procedures in terminal airspace (SIDs and STARs).
RNP APCH Approach Operations *Charted "RNAV GNSS"*	• Provides RNAV GNSS approach operations: • NPA = LNAV (MDA/H) and APV = LNAV/VNAV (DA/H)
RNP AR APCH Approach Operations *Charted "RNAV RNP"*	• Authorisation Required (AR) for such operation. • Supports RNP 0.3—0.1 and curved paths.

2.7 Australia has developed a framework to enable PBN through a range of regulatory measures which, when combined, provide for the necessary aircraft equipment, operational and airworthiness requirements to meet applicable ICAO Navigation Specifications. CASA Civil Aviation Orders (CAO) 20.18 and (CAO) 20.91, CASR Subpart 91.U and Manual of Standards (MOS) and CASR Part 61 contain the applicable requirements for aircraft equipment, pilot qualifications and training, and continuing airworthiness.

2.8 The following terminology is important for clarity:

a) **Area Navigation** (not abbreviated) is a generic term used to describe navigation that does not rely on flying beacon to beacon.

b) **RNAV (aRea NAVigation)** under PBN is used in reference to RNAV specifications or systems. RNAV is a method of navigation that enables aircraft to fly on any desired flight path within the coverage of referenced ground-based navaids or within the limits of the capability of self-contained systems and/or space-based systems (i.e. GNSS and associated waypoints), or a combination of these capabilities.

c) **RNP** (Required Navigation Performance) is used only in reference to RNP specifications or systems. RNP requires the use of GNSS area navigation systems with Onboard Performance Monitoring and Alerting (OBPMA). The key difference between the RNAV and RNP specifications is Onboard Performance Monitoring and Alerting (OBPMA).

d) **On Board Performance Monitoring and Alerting (OBPMA)** is the ability of the aircraft's navigation system in combination with the pilot to monitor its achieved navigation performance, and to identify to the pilot whether the operational requirement is, or is not being met (or not likely to be met in the near future). This allows the pilot to change to an alternate means of navigation or abandon the operation in a safe manner. The alerting is not related to the actual position of the aircraft relative to the desired track, rather to the Estimated Position Uncertainty (EPU) exceeding the alerting threshold. The alert will be triggered when the radius of this circle exceeds the RNP value for the route segment.

e) **R**eceiver **A**utonomous **I**ntegrity **M**onitoring **(RAIM)** is the process whereby the navigation system makes use of information from the navigation system satellites as a check on the integrity of the navigation solution. RAIM therefore provides integrity by detecting the failure of a GNSS satellite. It is a software function incorporated into GPS receivers designed to meet (E)TSO C129( ), (E)TSO C145( ), (E)TSO C146( ) or (E)TSO C196a or later versions of these standards. GNSS with RAIM is the most common Onboard Performance Monitoring and Alerting (OBPMA) system. **OBPMA is a critical component of RNP.**

f) Certain RNP approach operations require advanced features of the onboard navigation function and approved training and crew procedures. These operations require an operational approval that are characterised as **RNP Authorisation Required (RNP AR) Operations.**

3. AUSTRALIA'S BACKUP NAVIGATION NETWORK (BNN)

3.1 In Australia, Airservices Australia and the Royal Australian Air Force (Australia's ANSPs) are responsible for the provision of Air Traffic Services in accordance with ICAO Annex 11. ATC application of separation standards between aircraft is dependent on the navigation performance of each aircraft as notified in the flight plan. When an IFR flight notification indicates GNSS equipage in Item 10 of the flight plan, and unless the pilot advises otherwise, ATC will apply separation standards that are dependent on the aircraft navigating by reference to GNSS. To reduce controller/pilot workload and to introduce more certainty around the application of separation standards, controllers must know what navigation system or aid aircraft are using to navigate. Where pilots indicate GNSS equipage in their flight notification and are not navigating by reference to GNSS, they must advise ATC immediately so that alternative separation standards can be applied.

3.2 Aircraft conducting an instrument approach operation should navigate in accordance with the requirements of the procedure.

3.3 The existing network of ground-based navaids in Australia forms the Backup Navigation Network (BNN), which pilots may use to safely end the flight in progress in the case of the breakdown of the GNSS service.

3.4 Airservices maintain and monitor the BNN. The BNN will be available as a contingency mode, if an aircraft is unable to access the GNSS service.

4. PBN NAVIGATION SPECIFICATIONS FOR ROUTES AND PROCEDURES

4.1 In accordance with Civil Aviation Order (CAO) 20.91 and CAO 20.18, from 4 Feb 2016 all Australian registered aircraft operating under the IFR are required to be equipped with GNSS navigation equipment capable of operating to the applicable PBN Navigation Specification. RNP APCH, RNP 1 and RNP 2 Navigation

Specifications have been developed on the basis of the aircraft carriage of applicable equipment and the flight crew qualified, so the mandate has the effect that all IFR aircraft are RNP APCH LNAV, RNP 1 and RNP 2 capable. IFR aircraft must be equipped with an (E)TSO C129( ), (E)TSO C145( ), (E)TSO C146( ) or (E)TSO C196a GNSS system.

4.2 As of 26 May 2016 and where specifically promulgated, ATS Routes, Terminal Procedures and Instrument Approach Procedures should be flown to the following standard PBN Navigation Specifications:

a) Routes in Oceanic Control Area (OCA) – **RNP 4** where capable, otherwise **RNAV 10 (RNP 10)**.

b) Continental routes (routes other than those in OCA) – **RNP 2**.

c) Terminal Procedures (SIDs and STARs) – **RNP 1**.

d) Non-precision Instrument Approach Procedures (NPA) – **RNP APCH** (titled as "RNAV GNSS").

e) PBN Non-precision Approaches (**NPA**) and RNAV Approaches with Vertical Guidance (**APV**) are published in Australia as "**RNAV (GNSS)**" and based on the following criteria and minima:

i) RNP APCH = LNAV = NPA

- LNAV minima is equivalent to the existing "S-I GNSS" minima for NPA without vertical guidance. The minima are expressed as **MDA/H** and associated visibility, see Figure 3.

ii) RNP APCH + Baro/VNAV = LNAV/VNAV = APV

- An LNAV/VNAV minimum is applicable to APV. The minima is expressed as **DA/H** and associated visibility. The LNAV/VNAV minima box will always be unshaded, refer *AIP ENR 1.5, para 5.3.2*. This indicates actual aerodrome QNH is always required in order to fly to the LNAV/VNAV minima, see Figure 3.

CATEGORY	A	B	C	D
LNAV/VNAV	**1020** (460-2.6)			
LNAV	**1250** (688-3.9)			
CIRCLING	**1440** (878-2.4)		**1670** (1108-4.0)	**1670** (1108-5.0)
ALTERNATE	(1378-4.4)		(1608-6.0)	(1608-7.0)

Figure 3

iii) An LNAV/VNAV landing minima can only be used by an aircraft that is fitted with an aircraft navigation system that provides VNAV guidance derived from a barometric source and is certified for Baro-VNAV approach operations which is stated in the AFM or AFM Supplement. Such VNAV guidance should not be confused with a navigation system that only provides advisory vertical guidance derived from its navigation system (e.g. LNAV+V). Use of advisory vertical guidance does not permit descent below the MDA (LNAV landing minima) and when conducting a constant angle descent pilots must monitor and stay above the minimum safe altitude steps.

iv) An APV Instrument Approach Procedure will also include temperature limits to ensure the aircraft retains the separation standards from obstacles as the barometric derived vertical path will change with variation in temperature from ISA. The use of the APV Instrument Approach Procedure outside the authorised temperature range will not assure the required terrain and obstacle clearance. The prescribed temperature range ensures the final descent path is adequately protected against obstacles as well as excessively steep approach angles while flown using a certified Baro-VNAV system. Aircraft using Baro-VNAV with temperature compensation or aircraft using an alternative means of vertical guidance (e.g. SBAS) may disregard the temperature restrictions depicted on the Instrument Approach Procedure. **It remains the operator's responsibility to apply the necessary cold temperature corrections to all published limiting altitudes and minima.**

v) If local QNH and temperature are temporarily unavailable a Baro-VNAV aircraft can fly to the LNAV minima. The standard NPA utilising LNAV MDA remains available regardless of aerodrome temperature. Cold temperature correction remains the operator's responsibility.

vi) The approach requirements box in the upper right corner of the chart depicting an APV approach procedure will contain the following information, see Figure 4:

- Requirement for aerodrome QNH and temperature to be available to the pilot as a prerequisite for Baro-VNAV operation.

- Temperature limits for the APV (LNAV/VNAV) procedure. APV procedures cannot be used outside the authorised temperature limits prescribed on the chart, unless the aircraft is equipped with a Baro-VNAV system that provides temperature compensation in the determination of the vertical path.

ATIS 114.1 118.0	APP 132.0	TWR 120.5	SMC 121.7		LNAV/VNAV RQ: • Y_ _ _QNH and TEMP RQ • PROC TEMP RANGE -5°C to +60°C

Figure 4

vii) Use of "S-I GNSS" label (Figure 5) for approach minima on RNAV (GNSS) charts is being discontinued and will be replaced by "LNAV" label, see Figure 3. Airservices will gradually update charts to show only LNAV/VNAV and LNAV minima lines, as applicable, on all RNAV (GNSS) approach charts in DAP.

CATEGORY	A	B	C	D
S-I GNSS	**640** (611-3.5)			NOT APPLICABLE
CIRCLING	**710** (681-2.4)		**810** (781-4.0)	
ALTERNATE	(1181-4.4)		(1281-6.0)	

Figure 5

4.3 Australia is actively transitioning to RNP 1 for Terminal Operations (SIDs & STARs) and RNP 2 for Continental/Remote En route Operations. New routes and procedures (SIDs, STARs and RNP APCHs) are being developed that will rely on the RNP Navigation Specification to provide safer and more efficient separation between aircraft.

4.4 CAO 20.91 includes all of the Navigation Specifications for RNAV 5, RNAV 1 & 2, RNP 1, RNP 2, RNP APCH, RNP AR etc. Oceanic RNP 4 and RNP 10 (RNAV 10) Navigation Specifications are contained in CASR Subpart 91.U. Further information on PBN navigation authorisations is contained in AC 91.U-01 and airworthiness requirements in AC 91.U-04.

4.5 For foreign aircraft, CAO 20.91 (clause 7.2) stipulates that foreign registered aircraft must have navigation authorisations equivalent to those for Australian registered aircraft, e.g. RNP AR.

4.6 Additionally, and importantly, CAO 20.91 (clause 8.1) requires Australian aircraft to operate in accordance with the particular ICAO PBN Navigation Specification in any airspace for which that PBN specification is required – this obliges Australian aircraft to comply with ICAO PBN requirements in foreign States.

5. AUSTRALIAN REGISTERED AIRCRAFT

5.1 Under the Australian PBN implementation strategy, as of 4 February 2016, all aircraft operating under the IFR must be equipped with an approved GNSS receiver as per *AIP GEN 1.5, Section 2*.

5.2 The RNP 1, RNP 2 and RNP APCH Navigation Specifications have been developed on the basis of the FAA and European TSOs for GNSS-systems. Hence, aircraft fitted with CAO 20.18 GNSS equipment have the RNP 1, RNP 2 and RNP APCH LNAV capability already contained "in the equipment". Therefore, Australian registered aircraft and Australian qualified pilots are automatically deemed RNP 1, RNP 2 and RNP APCH LNAV compliant. Accordingly:

a) Australian pilots are eligible for RNP 1 or RNP 2 if:

i) The aircraft is fitted with radio navigation equipment that meet the requirements of CAO 20.18 and the navigation equipment will be used, and

ii) The pilot is authorised to conduct a flight under the IFR using GNSS and competent in the use of the radio navigation equipment according to CASR Part 61 requirements.

- The pilot should maintain the aircraft as close as practicable to the route centreline, and correct cross track errors in excess of ½ the RNP or RNAV value, for any PBN operation.
- If the aircraft cannot be maintained to within ½ of the RNP or RNAV value, the pilot should immediately notify ATC.

b) Australian pilots, operating under IFR and the holder of a current 2D Instrument Approach Procedure endorsement or ATPL-A, are automatically eligible to conduct an RNP APCH LNAV (charted as "RNAV GNSS").

c) The LNAV/VNAV APV (Baro-VNAV) requirements for use in conjunction with RNP APCH operations are detailed in CAO 20.91 Appendix 8 and AIC H28/16. Australian pilots operating under IFR and conducting an RNP APCH LNAV/VNAV (Baro-VNAV) Instrument Approach Procedure, must be the holder of a current 3D Instrument Approach Procedure endorsement or ATPL-A, and the aircraft requirements must include, but are not limited to:

i) A barometric VNAV system that meets the technical requirements;

ii) A current navigational database that permits the lateral and vertical path to be defined.

iii) A Baro-VNAV system functionality that includes but is not limited to:

- The system must be able to load the entire procedure to be flown into the navigation system from the on-board navigation database.
- The vertical path must be defined by a waypoint and an approach path angle.

d) For conducting an RNP APCH LNAV/VNAV (Baro-VNAV) the operating standards must include but are not limited to:

i) The operations must be conducted using an approved local barometric pressure source.

ii) A constant angle descent flown to a DA/H indicated on an approach chart by an LNAV/VNAV minima.

iii) Temperature limitations, as published on the relevant approach chart, must be applied (where the on-board systems do not compensate for temperature).

iv) Flight crew are also required to have knowledge of and completed training in Baro-VNAV APV approach operations.

6. FOREIGN REGISTERED AIRCRAFT

6.1 CASA and Airservices will facilitate the operation of foreign registered Operators that are unable to comply with RNP 1 and RNP 2 Navigation Specifications in Australian airspace. This may require special CASA assistance to both the foreign registered Operator, and the applicable National Aviation Administration, such that the National Aviation Administration can issue a “no technical objection” for RNP operations, for that particular Operator in Australian Continental and Terminal Airspace.

6.2 CASA recognises that RNP 2, in particular, is a relatively new Navigation Specification and consequently many States have not yet established processes for authorising RNP 2 operations.

Additionally, aircraft manufacturers may not have provided their AFM, AFM Supplement or OEM service letters specifying the available PBN Navigation Specification capability. For these reasons CASA has put in place arrangements applicable to foreign registered aircraft. In order to facilitate RNP 1 SIDs and/or STARs in Terminal Airspace and RNP 2 Continental En route Operations within Australian, an Acceptable Means of Compliance (AMC) has been provided. The AMC requirements are reflected in Regulatory Instrument CASA EX158/17. **This exemption is not available to Australian registered aircraft.**

6.3 The AMC will allow a combination of RNAV 1, RNAV 2 and PBN Navigation Specifications issued by the State of Registry or State of Operator, together with GNSS equipment complying with ICAO Doc 9613 (Performance-based Navigation (PBN) Manual), to be accepted as equivalent to RNP 1 and RNP 2 authorisations for the purposes of operations on Australian RNP 2 Continental Routes and RNP 1 Terminal Procedures (SIDs and/or STARs) for the duration of the transition arrangements.

6.4 All flights operating in accordance with the AMC CASA EX158/17 are required to enter RMK/CASA RNP AMC in Item 18 of the flight plan.

6.5 Foreign registered aircraft intending to take advantage of the AMC should register their intent with CASA by completing Form 0667 (Notification to operate aircraft on RNP 2 Routes and/or RNP 1 Terminal Procedures using equivalent navigation authorisations – foreign registered aircraft), providing all details called for by CASA EX158/17. Fleet operators are encouraged to identify, at first submission, all aircraft types expected to be operated in Australia under the AMC.

6.6 Operations under PBN Navigation Specifications other than RNAV 1, RNAV 2, RNP 1 and RNP 2 are permitted, but are subject to the Operating Standards requirements defined for the PBN Navigation Specifications in CAO 20.91. In some cases, advance coordination may be necessary with Airservices. This is facilitated through the appropriate Navigation Specification annotated on the ICAO flight plan. Such flights will not receive the benefits of RNP 1 and/or RNP 2 Air Traffic Services, but instead will receive a service commensurate with the navigation capability notified in the flight plan.

6.7 To obtain approval for required PBN authorisations (i.e. RNP AR), the Operator must demonstrate that the aircraft, equipment and flight crew meet ICAO performance standards for that PBN Navigation Specification. Foreign operators should not include any RNP AR capability in the flight plan until authorised by CASA, *AIP ENR 1.10 Section 3.3.3* refers.

6.8 CASA will assess the RNP AR application, taking into account the Operator's National Aviation Authority's approved Operations Specification and RNP Navigation Specification compliance. Upon completion of an acceptable assessment, CASA will then notify the Operator in writing, providing an Instrument of Acceptance along with a revised Operation Specification for Foreign Air Transport AOC holders.

6.9 A CASA Acceptance Instrument is required for approved operators to conduct RNP AR and RNP 0.3 (helicopters) operations.

6.10 Foreign operators must contact CASA International Operations: (international_ops@casa.gov.au) in the application for RNP AR and RNP 0.3 (helicopters) operations in Australian airspace.

7. TRACK KEEPING

7.1 For RNP operation the lateral Total System Error (TSE) must be 1 x RNP for at least 95% of the total flight time.

7.2 Separation standards and terrain avoidance are based on the pilot maintaining route or track as close as practicable to the route centreline at all times. Cross track tolerance corrections to remain within a Flight Technical Error (FTE) of ½ RNP.

7.3 These values must not be interpreted as tolerances within which deviations from route or track without clearance are permitted (*AIP ENR 1.1 – para 3.3.7*). If the aircraft cannot be maintained to within ½ of the RNP or RNAV value, the pilot should notify ATC.

7.4 The pilot must immediately notify ATC when the RNP value exceeds the promulgated RNP Navigation Specification so that alternative separation standards or terrain clearance requirements can be applied. The pilot must therefore notify ATC in cases where they have to deviate from the route or track centreline more than ½ of the RNP value, or an alert is received from the system of inability to maintain the RNP for the route.

7.5 During RNP operations, pilots are advised to maintain the aircraft within as close as practicable to the route centreline, deviations up to ½ RNP should be corrected back to the centreline. Reaching 1 x RNP is potentially unsafe, and, if conducting an approach, discontinuing the approach would be prudent. Pilots are therefore advised to execute the missed approach before reaching a lateral cross track deviation of 1 x RNP.

8. FLIGHT PLAN NAVIGATION CODES

8.1 ATS Flight Notification Forms and flight planning procedures advise ATC of the pilot's intent and the aircraft/pilot capabilities (AIP ENR 1.10 – Flight Planning). ATC clearances are provided consistent with these capabilities. Therefore it is important to complete the ATS Flight Notification Form correctly.

8.2 The ATS Flight Notification Form and PBN descriptors used in the various fields are:

a) Item 10 - "Equipment", of the flight plan form indicates that:

i) Designated equipment is fitted to the aircraft and is serviceable.

ii) Flight crew are qualified for the intended operation.

iii) The AOC holder holds the required navigation authorisations.

8.3 For an aircraft with a (E)TSO-C129 or (E)TSO-C145/146 stand-alone GNSS navigation system, the standard codes used in the flight plan form are:

a) Item 10 - "Equipment":

i) G for GNSS; R for PBN and Z for other equipment or capability (i.e. RNP 2).

b) Item 18 - "Other Information":

i) PBN/O2S1 for RNP 1 and RNP APCH.

ii) NAV/RNP2 for RNP 2.

Note: There is currently no ICAO code for RNP 2 Navigation Specification.

8.4 All flights conducted by foreign registered aircraft in accordance with the CASA AMC CASA EX158/17 will be required to enter **RMK/CASA RNP AMC** in Item 18 of the ATS Flight Notification Form.

8.5 When an IFR flight notification indicates a PBN Navigation Specification in Item 18 of the ATS Flight Notification Form, unless the pilot advises otherwise, ATC will apply separation standards that rely on the aircraft navigating to the Navigation Specification that corresponds with the following routes and procedures:

Route or procedure	PBN Navigation Specification
Oceanic Routes *(routes in Oceanic Control Area (OCA))*	RNP 4 or RNAV 10 (RNP 10)
Continental Routes *(routes other than those in OCA)*	RNP 2
Terminal Procedures *(SIDs and STARs)*	RNP 1
Instrument Approach Procedures	RNP APCH, RNP AR APCH, RNP 0.3

8.6 If Item 18 of a filed flight plan indicates both RNP 4 and RNAV 10 (RNP 10), ATC will apply separation standards based on RNP 4, provided the required communication capability of CPDLC and ADS-C is met.

8.7 Aircraft conducting a published Terminal, Approach or Departure Procedure must navigate in accordance with the requirements of such promulgated Instrument Approach Procedures.

8.8 Notification of PBN capabilities, indicating available navigation capability, requires a combination of entries in Item 10 (Equipment and Capabilities) and Item 18 of the ATS Flight Notification Form, as per the following:

Operation	PBN Capability	Item 10:	Item 18:
	GNSS navigation	G	
	PBN approved	R	
	NAV capability	Z	
	GBAS	A	
Oceanic	RNAV10 (RNP10)	GR and I (if appropriate)	PBN/A1
	RNP4	GR	PBN/L1
Continental	RNP 2	GZ	NAV/RNP2
Terminal	RNP1, all permitted sensors	GRDI	PBN/O1
Terminal	RNP1, GNSS	GR	PBN/O2
Approach	RNP APCH without Baro-VNAV	GR	PBN/S1
	RNP APCH with Baro-VNAV	GR	PBN/S2
	RNP AR APCH with RF	GRI	PBN/T1 OPR/(name)
Precision Approach	GBAS	AGZ	NAV/GLS

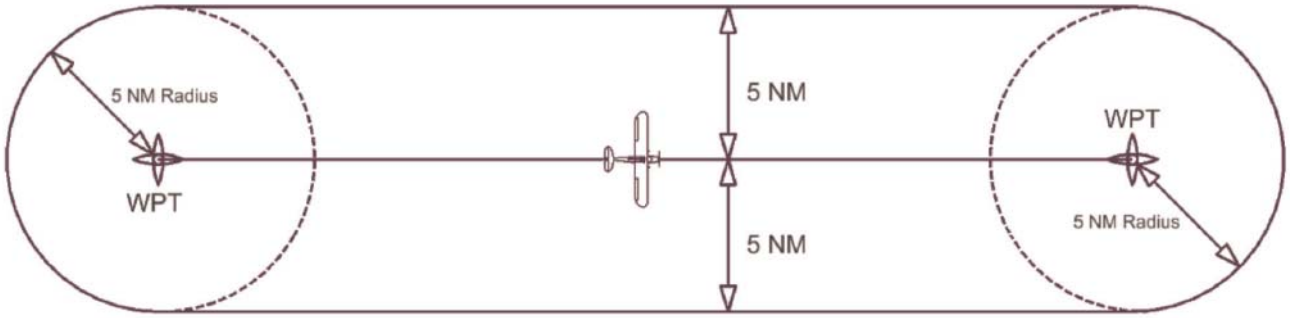
9. ROUTE LOWEST SAFE ALTITUDES (LSALT)

9.1 The LSALT specified for a published route segment on Australian ERCs and TACs is only valid for RNP 2. For operations other than RNP 2 operations, pilots must use a Grid LSALT or pilot calculated route LSALT (*AIP GEN 3.2 Section 2.2* – Lowest Safe Altitude).

9.2 A pilot using Grid LSALT for obstacle clearance is responsible for determining the allowance for navigation error that should be applied. This navigation error allowance must be applied to the proposed track. The highest Grid LSALT falling within the area covered by the calculated LSALT must be used.

9.3 For RNP 2 routes and route segments not shown on Australian aeronautical charts, the LSALT must not be less than calculates as follows:

a) The area to be considered must be within an area of 5NM surrounding and including the departure point, the destination and each side of the nominal track.



10. ALTERNATE PLANNING REQUIREMENTS

10.1 *AIP GEN 3.4, Section 2, paragraph 2.1 (g)*, clearly defines GNSS, including GPS, as an approved **radio aid for navigation** (referred to as "navigation aid"). *AIP ENR 1.1, Section 8.8.3*, thus refer to a destination airport that is served by a radio navigation aid (GNSS, NDB or VOR).

10.2 The GNSS-type equipment to be used, in accordance with the requirements as per CAO 20.18 paragraph 9D.10 is:

a) (E)TSO-C129( );

b) (E)TSO-C145( );

c) (E)TSO-C146( );

d) (E)TSO-C196a.

10.3 Under PBN in Australia, the following equipment types are required (AIP GEN 1.5 Section 2 refers):

a) Onboard navigation equipment for RPT/CHTR:

i) 2 x (E)TSO-C145( ) or 2 x (E)TSO-C146( ) or2 x (E)TSO-C196a; or

ii) 1 x (E)TSO-C145( ) or 1 x (E)TSO-C146( ) or 1x (E)TSO-C196a or (E)TSO-C129 + **1 x ADF or 1 x VOR**.

10.4 For RPT/CHTR Operations, an alternate is not required at the destination, if the destination airport is served by:

a) **One type of Instrument Approach Procedure** (RNAV GNSS or VOR or NDB) and the aircraft is fitted with **2 independent systems** (2 x GNSS or 2 x VOR or 2 x ADF); or

b) **Two different types of Instrument Approach Procedures** ([RNAV GNSS and VOR] or [RNAV GNSS and NDB]) and the aircraft is fitted with **2 separate systems** ([1 x GNSS and 1 x VOR] or [1 x GNSS and 1 x ADF]).

10.5 Instrument Approach Procedures at different runway ends using the same navigation aid do not count as different types of approaches – they are an RNAV GNSS, VOR or NDB Instrument Approach Procedure, and these procedures are reliant on one type of onboard aircraft equipment. The reason for this is that an RPT/CHTR Operation must have systems available at the destination to conduct two types of approaches (i.e. One Instrument Approach Procedure and two independent systems that can use the navigation aid or two different types of Instrument Approach Procedures and the aircraft is equipped with both navigation systems).

In the examples given below 1 RNAV GNSS Instrument Approach Procedure could be the RWY 12 and RWY 30 RNAV GNSS Procedures, as both Instrument Approach Procedures are reliant on one aircraft GNSS equipment.

a) **Example 1:** Aircraft is flying to YOOM (Moomba), which is serviced by 1 x RNAV GNSS and 1 x NDB Instrument Approach Procedure. If the aircraft is equipped with 2 x GNSS or 2 x ADFs then **no alternate required**.

b) **Example 2:** Aircraft is flying to YOOM (Moomba), which is serviced by 1 x RNAV GNSS and 1 x NDB Instrument Approach Procedure. If the aircraft is equipped with 1 x GNSS and 1 x ADF then no alternate required.

c) **Example 3:** Aircraft is flying to YCBB (Coonabarabran), which only has RWY 11 RNAV GNSS and RWY 29 RNAV GNSS Instrument Approach Procedures. If the aircraft is only equipped with 1 x GNSS system then an alternate is required.

11. CANCELLATION

11.1 This AIC provides information of an ongoing nature and has not cancellation date.

12. DISTRIBUTION

12.1 By Airservices Australia website only