new southern sky

Performance Based Navigation

Interim guidance for Air Transport Operations (121, 125, 135)

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References
AC91-21 rev0.2
ICAO Doc 9613 4th Edition
National Airspace and Air Navigation Plan
Civil Aviation Rules

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Contents

Interim guidance

For Air Transport Operations

Purpose

The CAA intends this document to be used by Air Transport Operators for guidance until new Performance Based Navigation (PBN) rules and Advisory Circulars are finalised. This will be superseded when formal requirements and guidance are published.

Performance Based Navigation within a New Zealand context

Aspects of PBN have been in use in New Zealand for a number of years, in particular the use of Authorisation Required Instrument Approaches at Queenstown and RNAV10 in Oceanic airspace. The National Airspace and Air Navigation Plan (NAANP) envisaged a much wider deployment of PBN.

This guidance is limited to Air Transport Operations and the following navigation specifications - RNAV2 or RNP2 enroute airways, RNAV1 or RNP1 SID/STAR and RNP APCH (with or without BaroVNAV). All of the navigation specifications will be based on ICAO Doc 9613, as applied to meet New Zealand conditions. Note. RNP APCH is the navigation specification which enables the use of instrument approaches that are labelled as RNAV GNSS in the NZ AIP.

The primary difference between RNAV and RNP navigation specifications is that on-board performance monitoring and alerting is required for RNP operations but not for RNAV operations.

In general there is insufficient DME/DME coverage to meet RNAV performance requirements and therefore PBN in NZ will be based on, and dependent upon, GNSS. There may be limited areas where RNAV performance can be achieved with the use of DME/DME updating.

Currently RNP1 and RNP2 position integrity requirements can only be met by GNSS receivers.

Equipment requirements

With regard to CAA Rule Part 121.353 (125.353 & 135.353) there is a requirement that where GNSS is the system providing navigational guidance for the route to be flown that there are at least duplicate independent systems serviceable at despatch.

The rule states:

“the number of instruments and equipment to ensure that the failure of any independent system required for either communication or navigation purposes, or both, does not result in the inability to communicate and navigate safely as required for the route being flown”

In addition, to ensure continuity in the event of a GNSS failure, Civil Aviation Rules require the carriage of dual systems utilising ground based navigation aids suitable for the route being flown. This is to allow the flight to recover to an alternate or continue to destination.

The GNSS equipment installed must meet TSO C145/146 or TSO C196. Note: Some TSO C129 equipment with FDE capability may be acceptable so long as it is able to provide valid data to an ADS-B transponder. CAA AC91-21 rev0.2 contains complete and accurate information for equipment standards and airworthiness requirements for PBN operations, however this now needs to be aligned with future ADS-B requirements which means that TSO C129 equipment without FDE will no longer be sufficient.

ADS-B for surveillance purposes will also require input from a GNSS sensor so it is essential that the GNSS fitted to meet PBN requirements is compatible with an appropriate 1090 MHz mode S extended squitter transponder to enable ADS-B capability in accordance with RTCA DO-260 ( ) standard. Note: RTCA DO-260 ( ) is used in this guidance to denote the various versions and changes of the core standard. Identified GNSS/transponder compatibility issues include timing disparities which result in unacceptable ADS-B transmissions.

ADS-B mandates have not been issued; however this should be planned for and equipment choices should be aligned. The NAANP proposes that all aircraft operating above FL245 must have operational ADS-B capability from 31 December 2018, extending to all aircraft operating in all controlled airspace from the end of 2021.

Space Based Augmentation System (SBAS)

GNSS equipment designed to TSO C145/146 incorporates SBAS, often referred to as Wide Area Augmentation System (WAAS) which is the name given to the United States implementation of SBAS. In some equipment an issue can be created when an SBAS signal is received but the equipment is outside the appropriate service volume and therefore not receiving an appropriate correction message. The GNSS having detected an SBAS signal may automatically deselect satellite vehicles that are lower on the horizon, although still visible, to an extent that a suitable fix cannot be achieved. It is essential that equipment used in New Zealand is designed such that the GNSS automatically manages this scenario or it is possible to disable SBAS/WAAS functionality.

PBN Training elements

Alongside the equipment requirements there are a number of training and procedural requirements that must be met before a PBN approval can be granted. Training and procedural elements will require to be approved by a Flight Operations Inspector as part of the approval process.

The following are an outline of the requirements which are discussed in more detail in the ICAO Doc 9613.

Note: The ICAO Doc 9613 specifies requirements for each individual navigation specification however most of these are common to all navigation specifications.

Knowledge – subject areas to understand and demonstrate include:

- Area navigation principles including charting symbols and waypoint types
- Navigation requirements and system principles
- Equipment types, sensors, operation, functionality, and integration
- Flight planning (including training of dispatchers)
- Operating procedures and limitations
- Effects of temperature on vertical path (BARO VNAV)
- Autoflight modes, interactions, annunciations, reversions, degradations
- Performance monitoring and alerting (RNP)
- Alternate navigation aid requirements

Procedures

- Flight planning
- Minimum aircraft equipment required
- Minimum navaid infrastructure, including RAIM, required
- Database version validity check
- Aircraft position initialization
- Route entry/modification/verification
- Procedure selection (Dep/Arr)
- Navigation database integrity validation
- Procedure modification ban
- Navaid/sensor selection or deselection
- RNP input selection capability (when applicable)
- System self-test verification
- Contingency procedures – equipment failures airborne or off-aircraft
- GPWS, TAWS, alert/warning procedures
- Data error/omission notification procedures

Flight training

- Flight planning
- Pre-flight procedures (simulator or aircraft)
- Departure and Arrival procedures
- Holding, parallel offsets, direct to, intercept course to, discontinuities resolution
- Interpretation of electronic displays and symbols
- Raw navigation data, where available and required
- Confirmation of primary navigation sensor (RNP APCH)
- Altimeter setting procedures
- Instrument approach procedures (RNP or RNAV) and specific limitations (wind, temperature, aircraft speeds)
- APCH (stand-alone GNSS equipment), or
- APCH (FMS-equipped aircraft)
- Lateral display scaling and deviation limits
- Vertical display and deviation limits (BARO VNAV)
- Track deviation tolerance, speed, and altitude constraint adherence
- Turn anticipation with consideration to speed and altitude effects
- Runway change procedures
- Arrival airport and alternate airport change procedures
- Contingency, non-normal, emergency management
- Autopilot modes and engagement/disengagement
- Monitoring, cross-checking, and standardized callouts
- R/T phraseology
- Regular currency training for all above

Minimum Equipment List (MEL)

The operators MEL should contain provision for dispatch relief from Communications, PBN and ADS-B equipment faults if available. The MEL and any amendments will be approved by CAA Airworthiness in accordance with the existing process.

Frequently Asked Questions

What is the background to the New Southern Sky?

Review the NSS document on the CAA website at: The Plan

Other NSS specific FAQ are at: FAQ

Communications

What communication equipment do I require for PBN?

Currently there are no anticipated changes.

Datalink is not envisioned to be necessary due to the limited communication density in NZ airspace to date.

Digital Departure Clearance (DCL) of ATC clearances provides an advantage to operators and ANSP alike in terms of accuracy and significant reduction of ATC delivery frequency congestion on the ground. The service is in use for flights departing from Auckland, Wellington and Christchurch that have a compatible (ED85a) communication systemWhat is the background to the New Southern Sky?

PBN

What Navigation equipment do I require for New Southern Sky?

Read this document and research the Advisory Circular AC91-21.

Do we have to do any special training for PBN operations in general?

Yes. Each Navigation Specification (RNAV 2, RNP 1, etc.) in Doc 9613 has detailed requirements for training. Refer to the Training elements above.

What about currency (recency) requirements?

Regular Non-Precision Approach recurrent training can be substituted with RNAV/RNP approaches. Knowledge training and checking should form part of the regular training cycle.

I already have GPS installed in my aircraft, can I use it?

Possibly, however it must meet the airworthiness requirements of AC91-21. Existing GPS IFR approvals may not have met the equipage requirements for PBN. Also see question regarding ADS-B.

ADS-B

What Surveillance equipment do I require for New Southern Sky?

A mode S extended squitter transponder which meets the ADS-B requirements of RTCA DO-260 ( ), and a compatible GNSS position source.

What are the differences between ADS-B in New Zealand and the USA?

New Zealand will implement ADS-B on 1090 megahertz (MHz) extended squitter. This is the same frequency used by ATC transponders and hence allows the use of transponders and GPS already installed in many air transport aircraft. The 1090MHz extended squitter system has been adopted by the ICAO as the world standard for ADS-B. It is being, or will be used, by Europe, Canada, USA and Australia as well as the Asia – Pacific nations. The USA has adopted a dual system using both 1090MHz extended squitter and Universal Access Transceiver (UAT). The FAA has adopted 1090MHz extended squitter for all flight levels, and UAT only for operations below 18,000 feet. UAT operates on 978 MHz and requires an entirely separate ground-based receiver system. UAT is not compatible with the New Zealand system and will not meet the Civil Aviation Authority requirements for ADS-B equipage.

Do I need ADS-B IN and/or OUT?

Mandatory requirements for ADS-B OUT fitment are proposed for inclusion in the Civil Aviation Rules. It is anticipated that this will require rule-compliant fitment for operations above FL245 from the end of 2018 and in all controlled airspace from the end of 2021.

CAA does not intend to mandate ADS-B IN in the foreseeable future.

How can we be confident that if we install ADS-B now, we will comply with the legal requirements when mandatory fitment becomes effective?

New Zealand will adopt international technical standard DO-260 ( ) for ADS-B technology. The ADS-B equipment selected must be certified to the relevant Technical Standard Orders and this will then be satisfactory for use in New Zealand.

If you are considering new equipment, we strongly advise purchasing TSO-C145/146 GNSS receiver(s), and an ADS-B transponder that is compliant with RTCA DO-260(b) or has an upgrade path to that standard. This equipment will be compatible with the ADS-B and PBN system requirements now and in the foreseeable future.

Note: The CAA will be considering a forward fit requirement as part of the ADS-B mandate and PBN implementation, to ensure that new aircraft coming into New Zealand meet the system requirements. We will be basing discussions on the forward fit requirements on the TSOs and DO listed above.

OK so what equipment will I need for ADSB?

The ADS-B transmitter needs to comply with the minimum performance standards detailed in RTCA DO-260 ( ) with a compatible GNSS position source.

My son has an App on his iPad with a plug in ADS-B receiver he got off eBay – can I use that?

It will be non-certified and therefore cannot be used for Certificated Operators. It will not provide ADS-B transmissions and it will not have the integrity checks required to avoid receipt of erroneous data transmission.

What about "Flightradar24" on my iPhone?

No, it is also non-certified. It doesn't transmit your position to ATC.

I already have a Mode S transponder. Isn't that enough?

Not necessarily. Not all Mode S transponders are able to transmit ADS-B – you need a Mode S transponder that has the 'extended squitter' hardware and software to transmit ADS-B data, or one that can be upgraded to deliver that capability. Secondly, you need a positional source that has RAIM based integrity. Integrity is the ability of the device to detect when it is not being presented with consistent GPS data, so that it can warn the ATC system that the accuracy of the position it is sending may be affected by equipment failure, satellite faults, ranging errors or poor satellite geometry.

Will my mode A/C transponder be acceptable?

Mode A/C transponders will not meet the ADS-B performance requirements and cannot be upgraded to meet these requirements.

I already have an IFR approved GPS. Will that work with ADS-B?

Not all IFR GPS units are able to output the required positional data and integrity data to a transponder. The GPS and the transponder need to be interconnected and able to work together in combination. If you are buying a new GNSS (GPS), be certain that it complies with TSO C145 or C146, revision A or later, or TSO C196. With some exceptions, TSO C129A avionics are incapable of producing the integrity parameters needed for ADS-B, they also may not have FDE (Fault Detection and Exclusion) which is necessary. In all cases it is important to check with your maintenance provider to confirm that the GNSS can provide a valid data set to the ADS-B transponder.

So, what standards or approvals should I look for in the product literature or manual?

For transponders – a transponder that complies with:

TSO-C166 (based on the RTCA DO 260 design standard) or

TSO-C166a or ETSO-C166a (based on the RTCA DO 260A design standard) or

TSO-C166b, ETSO-C166b (& ~b A1) (based on the RTCA DO 260B design standard).

Models that comply with the later versions have additional features; the b versions are preferred.

For GNSS – a GNSS receiver that complies with:

TSO C145, revision A or later, or

TSO C146, revision A or later, or

TSO C196.

Note: TSO compliance alone may not be sufficient, the two systems must be compatible. Refer to CASA 21-45 and FAA for proven combinations. Note: The FAA site includes UAT devices that will not be acceptable in NZ.

Should I check what revisions of software or firmware are being supplied with my new equipment?

Yes. Some products do not support ADS-B unless you have the correct software version. Ask an accredited supplier to verify that your new equipment's software configuration is correct.

What are they doing in Australia in regard to ADS-B?

The New Zealand ADS-B implementation will be aligned with that of Australia, see CASA 21-45 and Airservices Australia ADS-B Project for some useful information regarding their implementation.

Do I need an operational approval for my ADS-B OUT?

It is not expected that a specific operator approval will be required, however the aircraft flight manual or equivalent will require a statement of ADS-B capability and the installation will need to be approved.

As in other states using ADS-B, we will require operators to make sure their ADS-B system transmits valid data, and make it a requirement for operators to fix reported problems with ADS-B data.

What about an endorsement on my licence or Instrument Rating for ADS-B?

Not required, but you have to know how to use it and you can expect that correct use of the required equipment will be observed during licence and rating renewals.

How do I use it?

Read the owner's manual or your Operations Manual.

Specific training by your operator with assistance from maintenance.

ALWAYS enter the FLIGHT ID exactly as per your flight plan. See some common errors that have occurred in Australia.

Do I still need to use a transponder squawk code?

Current ATC systems still require the four-digit transponder codes. Even in Europe where Flight ID is mandatory, aircraft squawk a discrete Mode A code in most areas.

What do I do if it fails in-flight?

Advise ATC.

Apply your Operations Manual procedures.

After landing consider your MEL provisions and/or repair.

ATC may allow you to operate without ADS-B on your next flight but that could include restrictions.

What are some of the advantages of ADS-B?

Greater geographical coverage than radar.

You are more accurately identified.

In an emergency you are more easily tracked and supported.

Does it require maintenance?

Yes, the same as your transponder in accordance with approved data by an appropriately licensed and rated LAME.

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