Guidance Material for
Operations Specifications

Performance-Based Navigation (PBN)

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Military Aviation Authority
Royal Thai Air Force

ISSUE APPROVAL

This Guidance Material (GM) contains the standards, policies, procedures, and guidelines concerning Royal Thai Air Force Regulation (AFR) – Operation of Aircraft and is published for use by the Military Aviation Authority (MAA) personnel delegated with the responsibility of certifying Air Operators shall comply with all provisions in this GM during the certification process.

In addition, this GM contains instruction in respect of certification to be eligible to conduct by Air Operator/Squadrons for guidance to reach the Royal Thai Air Force Flight Operational Standardization Regulations B.E.2564 ; Item 37.6.

Air Vice Marshal Jukkrawat J.

(Jukkrawat Jongsuebsook)

Director of Military Aviation Authority

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RECORDS OF REVISION

Revision No.	Issue Date	Date Inserted	Inserted by
Original	14 Dec 2022	14 Dec 2022	MAA

REVISION HIGHLIGHTS

Section	Description of Change
All	New issue

GENERAL

Guidance material (GM) are issued by The Military Aviation Authority of Royal Thai Air force (MAA) and contain information about standards, practices, and procedures acceptable to the Authority.

PURPOSE

The intention of this Guidance Material (GM) to provide :

(a) Information on the approvals process.

(b) Guidance on the arrangements and need for monitoring.

RELATED READING MATERIAL

a) International Civil Aviation Organization (ICAO).
Document 9613, Performance-based Navigation (PBN) Manual.

b) International Civil Aviation Organization (ICAO).
Annex 6, Operation of Aircraft.

LIST OF ABBREVIATION

AAIM	Aircraft Autonomous Integrity Monitoring
AC	Advisory Circular
ACCUR	Accuracy
AFARP	As far as Reasonably Practical
AFM	Aircraft Flight Manual
AGL	Above Ground Level
AHRS	Attitude and Heading Reference System
AIP	Aeronautical Information Publication
AIRAC	Aeronautical Information Regulation and Control
ALARP	As Low as Reasonably Practical
AMC	Acceptable Means of Compliance
AMM	Aircraft Maintenance Manual
ANPE	Actual Navigation Performance Error
ANSP	Air Navigation Service Provider
AO	Air Operator
AOC	Air Operator Certificate
AP	Auto Pilot
AR	Authorization Required
A-RNP	Advanced RNP
ARP	Aerodrome Reference Point
ASE	Altimetry System Error
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATIS	Automatic Terminal Information Service
Baro-VNAV	Barometric VNAV
B-RNAV	Basic RNAV
BG	Body Geometry
CA	Certificating Authority
CAANZ	Chartered Accountants Australia and New Zealand
CCA	Civil Aviation Authority
CAAP	Civil Aviation Advisory Publication
CASA	Civil Aviation Safety Authority (Australia)

CCF	Common Cause Failure
CDI	Course Deviation Indicator
CDU	Control Display Unit
CPM	Corporate Project Manager
CS	Certification Specification
DA	Decision Altitude
DA/H	Decision Altitude/height
DF	Direct to a Fix
DGCA	Directorate General of Civil Aviation
DME	Distance Measuring Equipment
DOP	Dilution of Precision
DR	Dead Reckoning
EASA	European Aviation Safety Agency
EGPWS	Enhanced Ground Proximity Warning System
ENR	En-route
EPE	Estimated Position Error
ETSO	European Technical Standards Order
EUROCAE	European Organization for Civil Aviation Equipment
FA	Fix to an Altitude
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FAP	Final Approach Point
FCOM	Flight Crew Operations Manual
FD	Flight Director
FDE	Fault Detection and Exclusion
FGS	Flight Guidance System
FM	Fix to a Manual Termination
FMS	Flight Management System
FOSA	Flight Operational Safety Assessment
FPA	Flight Path Angle
FPL	Flight Plan
FRT	Fixed Radius Transition
FSD	Full-scale Deflection

FSTD	Flight Simulation Training Device
FTE	Flight Technical Error
GA	General Aviation
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HA	Holding/racetrack to an Altitude
HAL	Horizontal Alert Limit
HF	Holding/racetrack to a Fix
HFOM	Horizontal Figure of Merit
HI	Heading to an Intercept
HIL	Horizontal Integrity Limit
HM	Holding/racetrack to a Manual Termination
HPL	Horizontal Protection Limit
HSI	Horizontal Situation Indicator
IAF	Initial Approach Fix
IF	Initial Fix
IFR	Instrument Flight Rules
INS	Inertial Navigation System
IRS	Inertial Reference System
IRU	Inertial Reference Unit
ISAD	ISA Deviation
L/DEV	Lateral Deviation
LCD	Liquid Crystal Display
LNAV	Lateral Navigation
LOA	Letter of Authorization
LP	Localizer Performance
LPV	Localizer Performance with Vertical Guidance
LRNS	Long Range Navigation System
MAA	Military Aviation Authority
MAPT	Missed Approach Point
MASPS	Minimum Aviation System Performance Standard
MCDU	Multifunction Control Display Unit
MDA	Minimum Descent Altitude

MDA/H	Minimum Descent Altitude/Height
MEL	Minimum Equipment List
MMEL	Master Minimum Equipment List
MOC	Minimum Obstacle Clearance
MOPS	Minimum Operational Performance Standards
MSA	Minimum Sector Altitude
NAS	National Airspace System (USA)
NAV	Navigation
NAVAID	Navigation Aid
NDB	Non-directional Radio Beacon
NM	Nautical Mile
NOTAM	Notice to Airmen
NPS	Navigation Performance Scales
NSE	Navigation System Error
OCA/H	Obstacle Clearance Altitude/Height
OEI	One-engine Inoperative
OEM	Original Equipment Manufacturer
OM	Operations Manual
OPS-SPEC	Operations Specifications
PA	Precision Approach
PBN	Performance-based Navigation
PDE	Position Definition Error
PFD	Primary Flight Display
PIC	Pilot in Command
PM	Pilot Monitoring
P-RNAV	Precision RNAV
QRH	Quick Reference Handbook
RAIM	Receiver Autonomous Integrity Monitoring
RF	Radius to Fix
RNAV	Area Navigation
RNP	Required Navigation Performance
RNP APCH	RNP Approach
RNP AR	RNP Authorization Required

RSS	Root Sum Squared
RVSM	Reduced Vertical Separation Minimum
SAAAR	Special Aircraft and Aircrew Authorization Required South American
SB	Service Bulletin
SBAS	Space-based Augmentation System
SID	Standard Instrument Departure
SL	Service Letter
SOP	Standard Operating Procedure
STAR	Standard Arrival Route
STC	Supplemental Type Certificate
TAS	True Airspeed
TAWS	Terrain Awareness Warning System
TC	Type Certificate
TCDS	Type Certificate Data Sheets
TF	Track to a Fix
TGL	Temporary Guidance Leaflet
TLS	Target Level of Safety
TOGA	Take-off/go-around
TSE	Total System Error
TSO	Technical Standard Order
US-RNAV	United States RNAV
VAE	Vertical Angle Error
V/DEV	Vertical Deviation
VEB	Vertical Error Budget
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VNAV	Vertical Navigation
VOR	VHF Omni-Directional Range
WAAS	Wide Area Augmentation System
WDM	Wiring Diagram Manual
WPR	Waypoint Resolution Error
WPT	Waypoint

GUIDANCE MATERIAL FOR PBN

1. Introduction

Purpose of this Guidance Material

1.1 MAA requires the RTAF Squadrons to ensure that their aircrafts meet all relevant requirements for the navigation specification(s) for the airspace in which the aircraft is operating.This Guidance Material provides guidance for personnel assessing, applicant/squadron and aircraft for compliance with the requirements of the Performance-based Navigation (PBN) Manual (ICAO Doc 9613).

1.2 Early PBN implementations have shown that the applications submitted to Authority/Regulator for approval have required substantial rework in order to meet the relevant requirements. By carrying out detailed self-assessment prior to submitting their application for approval, applicant/squadron can prevent the need for application rework. This GM is intended to be used by applicants/squadrons preparing PBN Ops Approval applications and for MAA assessing applications.

1.3 The material within this GM is based on the content of relevant ICAO documents, particularly Performance-based Navigation (PBN) Manual (ICAO Doc 9613).

1.4 The benefit of this GM to applicant/squadron and assessor is that it provides the detailed of the various aspect of PBN Ops Approvals that need to be addressed and will:

a) Improved assessment consistency and efficiency.
b) Standardize PBN performance and implement it across RTAF with consistent protocols and processes.
c) Identify trends that reveal areas for improvement and best practices.
d) Drive compliance and performance.
e) Ensure requirement, policy and standard compliance.
f) Utilize our easy to use the checklist to ensure the applicant/squadron meets PBN requirements.
g) identify non-compliance and risk and immediately address them with correction action.

1.5 For applicant/Squadron, this GM will enable them to carry out a self-assessment to verify and demonstrate that they meet all relevant requirements.By completing detailed self-assessment, the applicant/squadron is more likely to achieve MAA Ops Approval without rework, reducing time with obtaining an approval.

2. Overview of PBN Operational Approval Process

2.1 The PBN concept requires that:

a) the aircraft meet certain airworthiness certification standards, including the necessary navigation system performance and functionality, to be eligible for particular navigation application; and

b) the applicant/squadron to have operational approval form MAA before the system can be used.

2.2 A PBN navigation specification operational approval

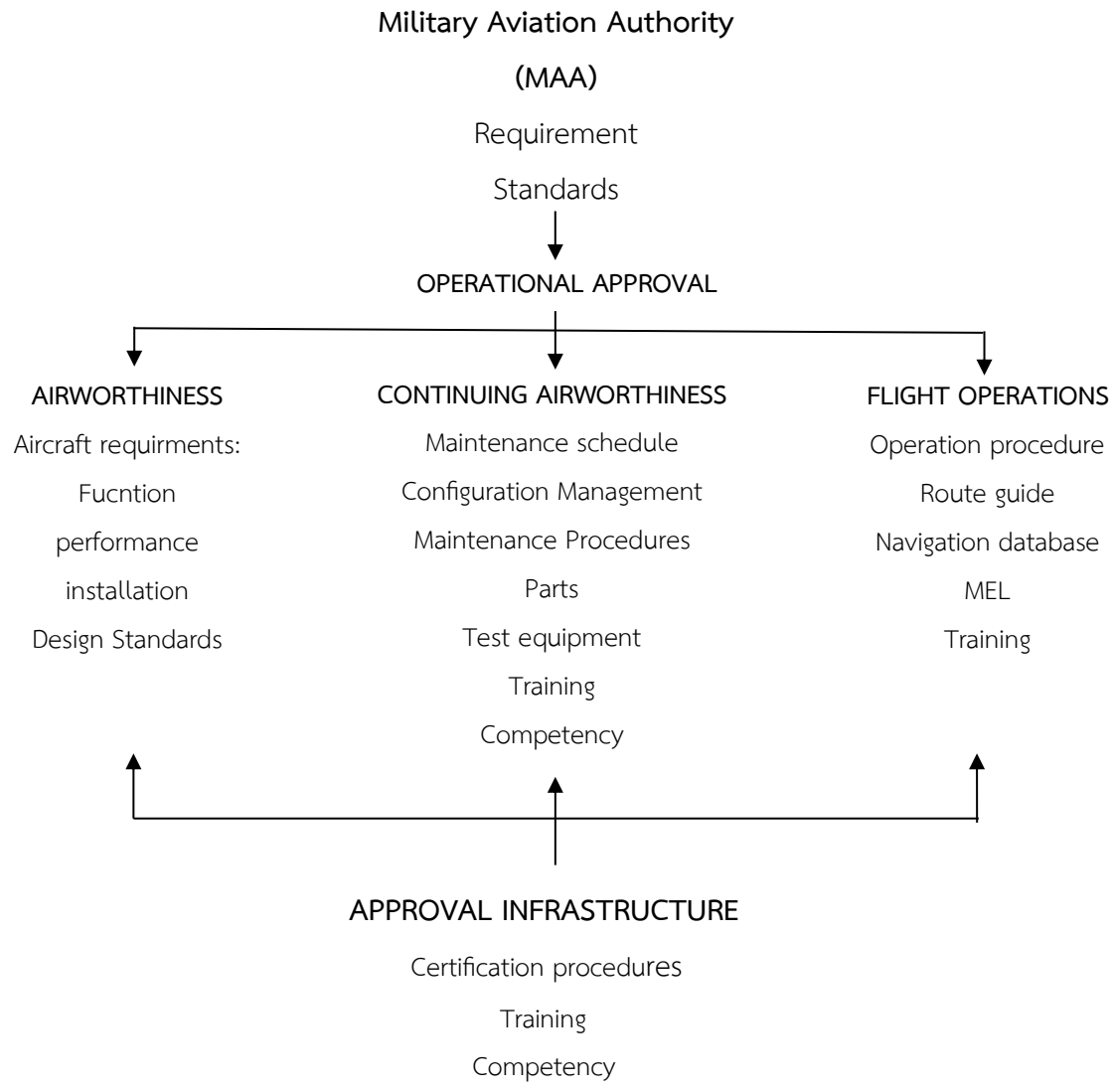
A PBN navigation specification operational approval is an approval that authorizes applicant/squadron to carry out defined PBN operations with specific aircraft in PBN designated airspace. The operational approval for applicant/squadron may be issued when the applicant/squadron has demonstrated to MAA that the specific aircraft are in compliance with the relevant airworthiness standards and that the continuing airworthiness and flight operations requirements are satisfied. This structure is shown in Figure 1:

a) The airworthiness element ensures that the aircraft meets the aircraft eligibility and safety requirement for the functions and performance defined in the navigation specifications (or other referenced certification standards) and installation meets relevant airworthiness standards (e.g. US 14 CFR part 25, EASA CS-25 and applicable AC/AMC). The AC/AMC may also include other non-navigation equipment required to conduct the intended operation such as communication and surveillance equipment.

b) The continuing airworthiness element of the operational approval is not directly address in the PBN Manual (ICAO Doc9613) since it is inherent in the aircraft airworthiness approval through the airworthiness requirement (e.g US 14 CFR 25.1529, EASA CS-25.1529) and under the aircraft operating rules that require each aircraft to be maintained in airworthy condition. The applicant/squadron is expected to be able to demonstrate that the navigation system will be maintained compliance with the aircraft type design. For navigation system installations there are few specific continuing airworthiness requirements other than database and configuration management, system modification and software revisions, but the element is included for completeness and consistency with other CNS/ATM operational approval, (e.g. RVSM, MNPS, PBCS).

c) Flight Operations element considers the applicant/squadron's infrastructure for conducting PBN operations and flight crew operating procedures, training, and competency demonstrations. This element also considers the MEL, Operations Manual, Checklist, instrument flight procedure approval process, navigation database validation procedures, dispatch procedure, etc

Figure 1: Operational Approval Responsibilities



2.3 Military Aviation Authority (MAA) Responsibilities

2.3.1 MAA is responsible for the approval and oversight of aircraft and operations of the RTAF's aircrafts.

2.3.2 When aircraft operate in foreign airspace, the aircraft and squadron or PIC must comply with all the relevant and applicable requirements of the home state as well as any relevant and applicable requirements for the airspace in which the aircraft operates.

2.4 Operational Approvals

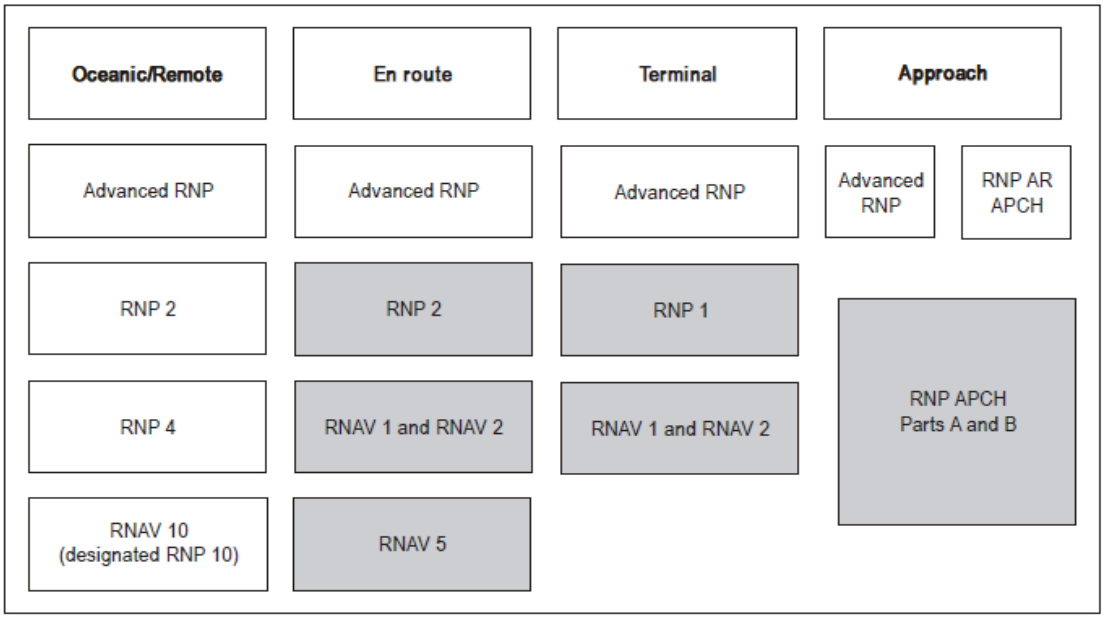
2.4.1 MAA is the authority that is responsible to approve all PBN operations in the RTAF scheme, and to issue a Specific Approval.

2.4.2 For clarity and consistency, this GM has been written with the assumption that all PBN navigation specifications require MAA issued Ops Approval in line with the requirement of ICAO Annex 6.

2.4.3 Within PBN navigation specifications there are a number of requirements that are common to multiple specifications, particularly for the airworthiness element. In the more demanding specifications there are requirements that are more stringent than those for less demanding specifications. By identifying the common requirements, it is possible to carry out a single detailed assessment that addresses the requirement for multiple specifications. RNP AR APCH is retained as a separate assessment because of the specific requirement for this specification.

2.4.4 Figure 2 Shown the means by which bundling of navigation specifications can expedite the assessment process.

Figure 2: Bundling of Navigation Applications



2.5 Documents Required

An Ops Approval requires documentation that demonstrates compliance with the relevant requirements. Commonly required documents are;

a) Airworthiness:

i) aircraft equipment list (make/model/part number/ hardware and software);

ii) Aircraft Flight Manual (AFM) or other manufacturer document that defines the approved PBN airworthiness capabilities of the aircraft;

iii) installation compliance evaluation report;

iv) A brief description of the aircraft's system and the installation of major components.

b) Continuing airworthiness:

i) identification of the maintenance organization responsible for maintaining the aircraft (e.g. in-house maintenance, maintenance service provider);

ii) maintenance schedule reference for the relevant systems;

iii) aircraft configuration and management procedure (e.g. software configuration);

iv) Aircraft Maintenance Manual (AMM) or detailed references to relevant sections thereof;

v) part management;

vi) test equipment required and management and

vii) maintenance personnel training and competency.

c) Flight Operations

i) flight operations procedures;

ii) route guide (or equivalent) documents;

iii) reporting navigation errors/system failure procedures;

iv) flight crew training syllabus;

v) training means of delivery;

vi) synthetic training devices to be used (if applicable);

vii) flight crew competency assessment;

viii) continued competency procedure (e.g. recurrent training);

ix) a copy of the navigation database supplier;

x) letter of Acceptance (LOA);

xi) navigation database validation procedures;

xii) aircraft navigation database updating management procedures; and

xiii) MEL

2.6 Applicant/Squadron Assessment

2.6.1 Each Ops Approval application must be evaluated for compliance with all relevant requirements. The formal evaluation cannot commence until the application is complete and all substantiating documentation has been completed and compiled.

2.6.2 Following the initial MAA evaluation for compliance authorization, comments will be provided to the applicant/squadron to provide revised information where compliance can not be found.

2.6.3 When the initial assessment has been completed, the MAA will determine any further activities needed to complete the approval, These activities may include any or all of;

a) site visits;

b) interview with personnel;

c) observation of training classes;

d) analysis of test data;

e) observation of flights (actual flight or simulator) ; or

f) witnessing flight tests.

2.7 Compliance by similarity

2.7.1 Demonstrating compliance with the relevant requirements for an operational or airworthiness approval on the basis of similarity with another previously approved example is a common and legitimate method. However, for the similarity to be valid, the examination must show that the comparison is both relevant and applicable to the item being examined.

2.7.2 Being relevant and applicable means that the comparison is being made “like for like”. For example, if the navigation system installation in one aircraft is being approved by comparing it with another aircraft that already has an approved installation, the relevant and applicable test will only be valid if the aircraft make/model are the same, the equipment installed is the same (including software) and the installation configuration is the same.

2.7.3 When completing airworthiness approvals by similarity, care must be taken to ensure that the airworthiness standards applicable to the aircraft that is already approved are still current for the aircraft to be approved. For example, electrical wiring installation requirements have changed in recent years so older approved installation may not meet the current installation requirements for approval.

2.7.4 When compliance has been demonstrated by similarity, the assessment carried out to determine the relevance and applicability of the comparison between the approved item and that to be approved must be recorded as part of the assessment records.

3. Carrying Out a Assessment

3.1 This section describes the procedures needed to complete a PBN Ops Approval. The PBN Ops Approval Assessment Worksheet/Ops Approval Job Aid provides a checklist for the various navigation specifications, with guidance to lead the assessor through the Ops Approval assessment and provides a record of the assessment and the finding made. The Ops Approval Assessment Worksheet is a companion to this manual that provides a more comprehensive worksheet with interactive guidance and is intended to provide an electronic means of recording PBN Ops Approval assessments for both applicant/squadron and inspector/assessor.

3.2 The overall assessment process is shown in Figure 3 but for reasons of practicality it is divided into two parts: a preliminary review (Step 1 through 9) and a final assessment process (Step 10 through 15); each of the steps is detailed in section 4. The preliminary review process should normally be completed by the applicant/squadron unless the applicant is unable to do this, in which case both preliminary review and final assessment should be accomplished by MAA with information provided by the applicant/squadron as required. The final assessment process should, where possible, be completed as a final check by the operator prior to submitting the completed application to MAA. The MAA inspectors should complete the final assessment process to step 15 before issuance of PBN approval.

3.3 Operator PBN Preliminary Review

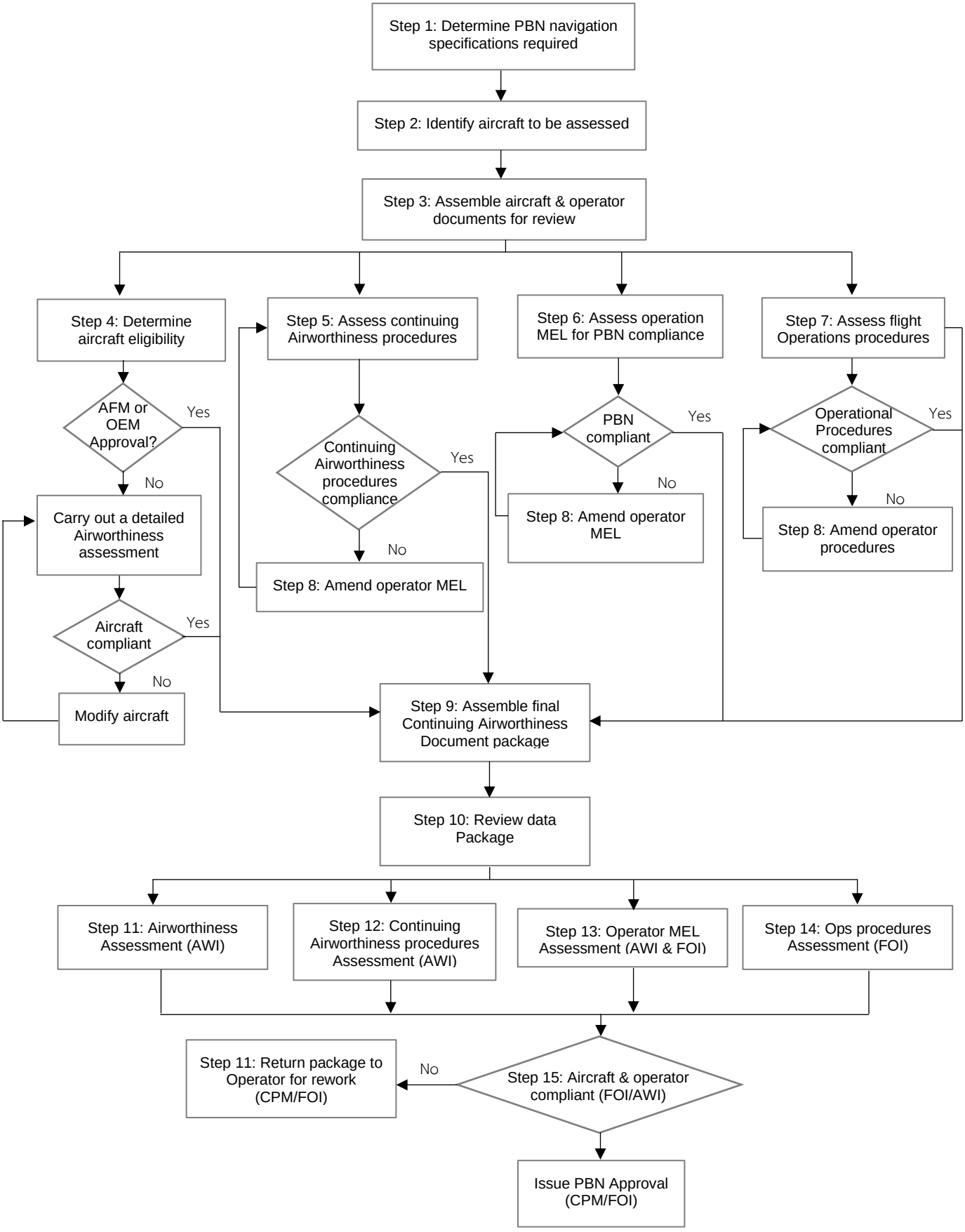
3.3.1 Steps 1 through 9 listed section 4, and the process shown in Figure 3 comprise a summary of the PBN Ops Approval review that should normally be undertaken by the applicant/squadron. Where the applicant/squadron is unable to manage this process the MAA may conduct steps 1 through 9 in conjunction with the applicant/squadron.While some steps will, by necessity, be sequential, other steps can be carried out as parallel activities, this is particularly relevant for the airworthiness and flight operations specialist areas.

3.3.2 It is recommended that Job Aid in associate PBN Ops Approval Assessment Checklist be used to help with this task and record the assessment finding.

3.4 Approval Assessment

The approval assessment is similar to the preliminary review except that it is primarily a detailed examination of the evidence presented to demonstrate compliance with the relevant and applicable requirements. The approval assessment will always be carried out by MAA. Steps 10 through 15 listed section 4, and the process shown in Figure 3 comprise a summary of the Approval Assessment.

Figure 3 : PBN Ops Approval Process



4. The Step-by-Step Operations Approval Process

4.1 The following steps are designed for the approval processes of the large aircraft, typically with a MTOW of more than 5,700 kgs (e.g. A320, A340, B737). Steps 1 through 9 form the operator preliminary review. Steps 10 through 15 form the final assessment process.

4.2 Step 1: Determining the Required PBN Navigation Specifications

4.2.1 This step is for the applicant/squadron to assess their operations and determine the navigation specifications that are required to support them. In carrying out this assessment, the applicant/squadron should consider planned further development in the areas of their operations rather than just the immediate needs- PBN Ops Approvals involve an amount of work so completing all required approval as a single activity is more efficient.

4.2.2 The operational requirements review needs to consider the en-route (continental or oceanic/remote continental), terminal procedures (arrivals and departures) and approach requirements. Further consideration must include the NAVAID infrastructure needed to support current operations and any planned future developments. For example, with many States transitioning to GNSS based navigation structure (e.g. Australia), conventional NAVAIDs are being withdrawn from service. The withdrawal of these NAVAIDs may affect the operator's operations through the availability of alternate aerodromes, when required.

4.2.3 Developing the operational requirements and identifying all the navigation specifications needed enables the required approvals to be obtained in single cohesive application. Section 6 contains details of the PBN navigation specifications and their intended application (refer to Table 3 for details of the navigation specifications and to Table 4 for their intended application by flight phase.)

4.2.4 Table 5 identifies the capabilities of TSO approved GNSS for the navigation specifications and identifies the operational classes the area acceptable. Table 6 summarizes the acceptable sensor requirement for each navigation specification.

4.2.5 Section 8, Table 7 identify GNSS equipment that is not compliant with the requirement of FAA AC 90-100A; the limitations of not being compliant with AC 90-100A requirement will significantly limit the PBN capability of the listed system and will exclude approach operations.

4.3 Step 2: Identify the Aircraft to be Assessed and Approved

4.3.1 To enable the aircraft assessment to proceed, the applicant/squadron needs to identify each aircraft to be approved by its make and model, registration mark an serial number plus any other means used to identify the aircraft in the documentation (e.g. OEM Line number or variation Number).

4.3.2 The exact configuration of each aircraft to be assessed must also be known and available. The aircraft modification status is important since the aircraft capability is often determined by modifications embodied (STC, OEM, SB, etc.).

4.3.3 In identifying the aircraft to be assessed and approved, the assessor needs to verify that the aircraft has a current Certificate of Airworthiness (C of A). If the aircraft does not have a current C of A, the assessment can proceed but the assessors must be confident that the configuration being assessed will be the exact configuration when the aircraft is issued with its C of A. Any PBN Ops Approval issued will not be valid until the C of A is issued.

4.3.4 For aircraft that do not operate with C of A (e.g. a permit to fly or equivalent document) the same provisions apply for aircraft that have C of A.

4.4 Step 3: Assemble the Documents Required.

4.4.1 Having identified PBN navigation specification required for applicant/squadron's operations, the applicant/squadron needs to gather the documents listed in Section 2.5, with the exception of compliance reports (these will be completed later). These documents form the basis upon which any Ops approval may be issued. Many of the items required for a PBN Ops Approval will require references to these documents in order to demonstrate compliance with the requirements.

4.4.2 Having assembled the documents and verified that they are applicable to the aircraft to be included in the Ops approval, make a detailed list of them, including the revision status of each.

4.5 Step 4: Preliminary Aircraft Airworthiness Review

4.5.1 The preliminary aircraft review is primarily an applicant activity but may also include interaction with MAA personnel in determining acceptable means of compliance.

4.5.2 The purpose of the preliminary aircraft review is to determine its eligibility for the issue of a PBN Ops Approval for the required navigation specifications. If the required navigation specifications are listed in the AFM, AFM supplement or other aircraft OEM document then it is likely to be compliant provided that aircraft has not been modified and the modification(s) have not compromised the PBN navigation

specification compliance. Section 8 contains details of airworthiness assessment considerations, assessors should be familiar with the detailed information in this chapter prior to commencing the airworthiness review.

4.5.3 The assessment does not necessarily require a detailed examination of the aircraft for each navigation specification if its eligibility has already been determined. The assessment process is to commence the examination by reviewing the AFM to determine if the navigation specifications being sought are included in an OEM's airworthiness approval. AFMs commonly have a statement that the aircraft complies with airworthiness requirements of the navigation specification with an additional statement that the AFM entry does not constitute an Operational approval.

4.5.4 The AFM has an entry that states that the aircraft is compliant with one or more PBN navigation specification, it should specify the document that was used to determine compliance (e.g. FAA AC 20-138D or EASA CS-ANCS). If the AFM does not specify the document used to determine compliance, clarification should be sought from the OEM or installation designer, as applicable.

4.5.5 The navigation capability statements in the aircraft AFM are often not up to date with the correct ICAO terminology-compliance may not be simple clear statements. In some cases the AFM will use legacy navigation specification terminology such as RNP 10, B-RNP, P-RNAV, etc. In other cases, the AFM compliance statement may specify combinations of aircraft serial numbers with certain Service Bulletins embodied as being compliant with the requirements for certain navigation specifications. Different serial numbers and Service Bulletin combinations can have quite different navigation capabilities.

4.5.6 The applicant/squadron may use the airworthiness compliance statement as a means of demonstrating compliance with the navigation specification airworthiness requirement but must still obtain an Ops Approval to address the continuing airworthiness and flight operations aspects of the approval.

4.5.7 If the AFM does not contain the required PBN navigation specification airworthiness approval, an approval in AFM supplement or other acceptable OEM document will be an acceptable means of demonstrating compliance for the navigation specifications listed in the relevant document.

4.5.8 where the PBN compliance is not included in the AFM or other acceptable OEM document, an aircraft examination will be required. It is recommended that the applicant/squadron assesses the aircraft using the PBN Ops Approval Assessment

Worksheet detailed Airworthiness Assessment Job Aid. This activity will enable the applicant/squadron to identify the actual compliance status of the aircraft.

4.5.9 If a detailed examination of aircraft is required, the complete installation is subject to examination and not just the primary navigation computer system. Many of the requirements in each of the PBN navigation specification ase addressed under equipment TSO approvals such as TSO C146 for stand-alone GNSS based navigation system or TSO C115 for flight management system with GNSS sensor being addressed under TSO C145. Table 5 lists the TSO requirements for each of the various PBN navigation specifications.

4.5.10 If the aircraft is not compliant with the requirement for the needed PBN navigation specifications, the applicant/squadron needs to undertake a detailed study of the means of achieving compliance and the associated cost, Updating aircraft is expensive and complex; the installation of new navigation systems is a major design changes and requires the modification to be subject to major design change procedures (typically a Supplemental Type Certificate (STC) approval process). Further advice on upgrading aircraft is beyond the scope of this manual.

Note: Modifying the legacy aircraft for PBN compliance needs to be a well-considered decision since there is more to the PBN Ops Approval than just the immediate aircraft considerations, When installing new system into older aircraft, It is common for the new system to not interface to the old system already installed. This flow-on effect can mean that a simple navigation system upgrade can easily become more a major cockpit refurbishment-with cost to match.

A further compliance with upgrading aircraft is that any synthetic training devices (e.g. flight simulator) must accurately replicate the actual aircraft, Installing an modern “glass-cockpit” into an aircraft will also require any simulator to be upgraded to the same standard, Upgrading legacy aircraft may initially appear to be a cost-effective solution to meet PBN requirements, However, when all aspects are considered, just the opposite is often the reality.

4.5.11 If the aircraft require(s) modification to become compliant with the PBN navigation specification airworthiness requirements, advice should be sought from the MAA on the certification requirements for the change. If the change needed is minor, MAA may accept a local modification but equally MAA may determine the change is a major design change and requires a STC. Seeking MAA advice at this early stage is important if later complications are to be avoided.

4.5.12 Status if TSO C129 Equipment

4.5.12.1 On 13 October 2011, the US cancelled TSO-C129 and TSO-C129a. Since these TSOs have been cancelled, no new approval under TSO-C129 or TSO-C129a will be issued. Although these TSO have been cancelled, TSO approval holders are still able to manufacture equipment under any approvals they may hold. Similarly, TSO-C129 and TSO-C129a equipment may still be installed in aircraft and used. However, since TSO-C145, C146 and C196 equipment have a number of significant enhancement incorporated through the later TSO approval, it is recommended that applicant/squadron/user install either (E)TSO-C145, C146 or C196 GNSS equipment, as applicable to the intended application.

4.5.12.2 The impact for PBN Ops Approval is that TSO-C129 equipment is eligible for applications where the PBN navigation specification performance and functional requirements are met. However, since the TSO-C129 equipment on-board performance monitoring and alerting function (usually RAIM) addresses only fault detection under the TSO approval, unless there is an additional aircraft level approval, TSO-C129 equipped aircraft will be required to carry an alternate means of avigation suitable to the intended route that is nor GNSS.

Note: Under the TSO-C129 approval, the equipment is qualified for only fault detection RAIM. Therefore, there is the potential for the aircraft to lose the area navigation function though a single satellite failure (e.g. single point of failure where all TSO-C129 system will fail because of the single satellite failure) This single point of failure risk is mitigated by the aircraft being equipped with an alternate means of navigation suitable to the intended route (typically VOR or ADF).

4.5.12.3 TSO-C129 equipment used for oceanic / remote continental operations must be TSO-C129a approved and also have supplemental approval under FAA Notice 8110.60 or AC 20-138A Appendix 1 (or later version).

4.6 Step 5: Preliminary Continuing Airworthiness Review

4.6.1 The preliminary continuing airworthiness review is primarily an applicant activity to determine that all the continuing airworthiness requirements listed in Section 9 are addressed.

4.6.2 The key underlying principle of continuing airworthiness is that the aircraft operator is responsible for the overall maintenance of the aircraft, which also includes configuration management, Therefore, the operator’s maintenance management procedures need to reflect the important aspect of their operation.

4.6.3 The continuing airworthiness assessment is a multi-faceted task that addresses not only the aircraft configuration management and maintenance tasks but also the interfaces to flight operations and training systems. It is the continuing airworthiness assessment that has caused the most problems for operators in the past.

4.6.4 A substantial part of the continuing airworthiness assessment involves a detailed review of the operator/squadron's procedures. Common problems found in these assessments stem from procedures that were developed some time ago that, while adequate at the time, do not reflect the requirements for the management and assurance of continuing airworthiness of modern aircraft with software-based highly integrated systems.

4.6.5 Section 9 contains the details of the various aspects of the continuing airworthiness assessment. For each of the requirements in Section 9, the assessor should be able to locate an operator/squadron's procedure that addresses, in detail, how the operator/squadron accomplishes the required objectives.

4.6.6 Within the assessment checklist/worksheet, the assessor must record the specific document reference to the applicant/squadron's procedures where each of the requirements is specified.

4.6.7 Historically the following continuing airworthiness items have help up Ops Approvals:

a) Maintenance Programme: The applicant/squadron must have a maintenance programme for the aircraft that includes the PBN navigation systems within it. Refer to Section 9.3 for further information.

b) Maintenance Documentation: The applicant/squadron must have maintenance documentation to ensure that the aircraft is maintained compliant with its type design. Refer to Section 8, and 9.4 for further information.

c) Aircraft Configuration Management: The applicant/squadron must have procedures to manage the configuration of each aircraft and to ensure that design changes are not made to the aircraft without specific authorization from the applicant/squadron. Refer to Section 9.5 for further information.

d) Software Configuration Management: Software changes quite often in aircraft to the extent that the normal parts listing are unable to keep up with changes. The applicant/squadron needs to have processes to manage the software installed in each aircraft and ensure that the software configuration is compatible and compliant. Refer to Section 9.6 for further information.

e) Synthetic Training Devices Configuration Management: Synthetic training devices (typically flight simulators) must be maintained so that they accurately replicate the actual aircraft. The applicant/squadron's procedures need to ensure that when aircraft are modified, any changes needed to synthetic training devices are also made so that the simulator continues to accurately replicate the actual aircraft. Refer to Section 9.7 for further information.

f) Electrical Load Analysis (ELA): Each aircraft must have a current ELA that accurately reflects the aircraft configurations and is compliant. The applicant/squadron must have prosedures for revising the ELA when the aircraft is modified. Refer to Section 9.8 for further information.

g) Sub-contractor Oversight: Since the applicant/squadron is responsible for all maintenance activity related to their aircraft, applicant/squadron need to have detailed procedures to ensure that all subcontractors are qualified for the work undertaken and that only work authorized by the applicant/squadron is carried out. Refer to Section 9.2 for further information.

h) Manufacturer Service Information: Manufacturers provide applicant/squadrons with service information related to the operation and maintenance of the equipment they manufacture. While some of this information is purely engineering related (modification), manufacturers also distribute information related to the operational use of equipment, Applicant/Squadron therefore need to have procedures to routinely obtain this information and ensure that it is normally distributed to all relevant parts of the organization. Refer to Section 9.2 for further information.

i) Maintenance Training: The applicant/squadron must have a training programme so that personnel maintaining the aircraft and its PBN system are qualified and competent to do so. Refer to Section 9.10 for further information.

4.6.8 Airworthiness Compliance Review

4.6.8.1 As part of the continuing airworthiness review, the applicant/squadron need to verify that all inspections, test and calibration required in accordance with the aircraft maintenance programme to maintain the aircraft compliant with its type design have been accomplished. When the required work has been accomplished, the work record reference should be noted in the assessment record as part of the compliance demonstration.

4.7 Step 6: MEL

4.7.1 The MEL must be approved by MAA. To be approved for PBN operations, the applicant/squadron's MEL will require revision and then approval by MAA. Revising the MEL is best accomplished through both the airworthiness and flight operations personnel working closely together.

4.7.2 Early PBN implementation identified that there are latent safety issues in the MMEL for a number of aircraft, particularly legacy aircraft. The MEL needs to be revised to address these latency safety concerns and to include PBN relevant information into the MEL. The problems that need to be addressed in the applicant/squadron's MEL are detailed in Section 10.12

4.8 Step 7: Preliminary Flight Operations Review

4.8.1 Section 10 contains information on the operational procedures required for PBN Ops Approvals. In many cases, applicants will already have procedures that address the topics identified in Chapter 10. In these instances, the review needs to ensure that all items required for PBN Ops approval have been addressed. It is recommended that PBN Ops Approval Assessment Worksheet Assessment, PBN Ops Approval job Aid be used as a guide and to record any deficiencies.

4.8.2 Flight Operations items that have historically caused approval delays are:

a) Third Party Training Service Providers: The applicant/squadron is responsible for ensuring that their flight crew are trained and competent to conduct the intended operations. When training is provided by a third party service provider, the applicant/squadron must have procedures to ensure that the training provided by the training service provider meets the MAA requirements.

b) Flight Crew Training Devices: This topic is associated with the synthetic training device configuration management addressed under chapter 9.7. All Training devices need to accurately reflect the actual aircraft installation and have their configuration managed so that changes to the aircraft are also incorporated into the training device. When an applicant/squadron uses third party synthetic training devices, the visual display systems should be for the applicant/squadron's area of operations. Similarly, a navigation database should be that used in the applicant/squadron's actual aircraft.

c) Navigation Database Management: The intent of the navigation database validation requirements is for the applicant/squadron to carry out sufficient checks that for their operation, the database is unlikely to contain major errors.

Section 10.7 has the detailed requirements for the management of navigation databases.

4.9 Step 8: Develop Procedure Amendment

Having completed the preliminary review, the applicant/squadron must then address each of the non-compliant items identified in the review using their standard internal processes.

4.10 Step 9: Assemble the final Document package for Assessment

4.10.1 Having completed the preliminary review, the applicant/squadron's assessment team should assemble in the final assessment and be submitted to MAA for review and approval.

4.10.2 As part of this activity, any compliance reports required should be prepared (e.g. Statement of compliance, Installation Compliance Report.).

4.10.3 Once the final document package has been assembled, the applicant/squadron should review the package to ensure that all required documents and information have been included. When submitting the data package, an inventory of the documents included should be provided so that the MAA can readily ascertain that all submitted information has been received.

4.10.3.1 Applicant/Squadron should remain a copy of the assessment documentation package as an auditable document so long as they have the relevant aircraft in their fleet.

4.11 Step 10: Data Package Review

The data package review is a review of PBN Ops Approval data package to check that:

a) All required documents listed in Section 2.5 are included.

b) The details of the aircraft being assessed are complete and correct.

c) The PBN navigation specifications being included in the assessment have been correctly identified.

d) The PBN Ops Approval Job Aids/Checklists have been completed.

4.12 Step 11: Airworthiness Assessment

4.12.1 The purpose of the airworthiness compliance assessment is to determine the aircraft compliance with the requirements of each navigation specification for which approval is being sought and that compliance has been satisfactorily demonstrated.

4.12.2 The Airworthiness assessor(s) needs to review the PBN Ops Approval Assessment Worksheet Job Aid/Checklist and determine that, for each item, the evidence presented is valid and that compliance has been demonstrated. The assessment can be accomplished through a document review, aircraft

examination or combination of these. For further information, refer to Section 4.5 Step 4 Preliminary Aircraft Airworthiness Review.

4.13 Step 12: Continuing Airworthiness Assessment

The continuing airworthiness compliance assessment will have a strong focus on reviewing the applicant/squadron's procedures to verify that they adequately address all the continuing airworthiness topics included in Section 9 of this guidance and PBN Ops Approval Assessment Worksheet/ Job Aid and determine that, for each item, the evidence presented is valid and that compliance has been demonstrated. Where evidence of continuing airworthiness compliance is required, these assessments will review the evidence provided by the applicant/squadron. For further information, refer to Section 4.6 Step 5: Preliminary Continuing Airworthiness.

4.14 Step 13: MEL Assessment

The MEL compliance assessment will determine that all entries pertaining to PBN operations have been addressed and that the topics addressed in Section 10.12 have been addressed. For further information, refer to Section 4.7 Step 6: MEL. The MEL compliance is assessed in PBN Ops Approval Assessment Worksheet/ Job Aid.

4.15 Step 14: Flight operations Assessment

The final flight operations review is to determine that the applicant/squadron complies with the operational and training requirements of each navigation specification for which approval is being sought and that compliance has been satisfactorily demonstrated. Each of the topics included in Section 10. For further information, refer to Section 4.8 Step 7 preliminarily Flight Operations Review.

4.16 Step 15: Completion

4.16.1 Having Completed their assessments, the MAA assessors must determine whether or not the applicant/squadron has demonstrated compliance with all the relevant and applicable PBN requirements. Since there are elements that involve both airworthiness and flight operations, the determination of compliance should be the joint view of the assessors rather than being isolated airworthiness and flight operations decisions.

4.16.2 If the assessor determines that rework is required, this needs to be communicated to the applicant/squadron with the reason the applicant's means of compliance is unsatisfactory.The applicant then needs to correct the deficiency and submit the revised information to the MAA for assessment.

4.16.3 When MAA assessors are satisfied that compliance has been demonstrated, a PBN Ops Approval can be issued to the applicant/squadron in accordance with MAA's standard procedures.

4.16.4 Each aircraft assessed for PBN Ops Approval needs to have the assessment and findings recorded as an auditable document. Where MAA has completed the assessment, their procedures will cover this need.

4.16.5 The assessment records need to detail the specific reference to the documents that were used to demonstrate compliance with the PBN navigation specification requirements. To avoid the need to store a large number of documents. It is acceptable to record the references only provided that the documents referred to, at the specific revision status used in the assessment, will remain available. If there is no assurance that superseded versions will be available, a copy of the version used needs to be archived.

5. Light Aircraft PBN Ops Approval

5.1 In the context of this Section, light aircraft are considered to be US 14 CFR / EASA Part 23 or Part 27 aircraft with MTOW of 5,700 kgs or less.

5.2 The area navigation installations in light aircraft tend to be relatively simple GNSS based navigation systems that are TSO approved stand-alone or integrated avionics systems. These installations commonly equip the aircraft for en-route, terminal and approach operations using GNSS; many of these systems also include VOR and ILS integral to the equipment.

5.3 With less complex aircraft using GNSS based PBN, simplified procedures can be used to reduce the burden of PBN Ops Approval on light aircraft. This Section provides alternate means of compliance to reduce that burden but provides assurance that the aircraft and flight crew are qualified to undertake PBN operations.

5.4 The combination of compliant aircraft and pilots are appropriately trained to operate with simpler qualification procedures. The procedures below will enable less onerous PBN Ops Approval. Simplified Assessment Checklist for Light aircraft has primarily been provided to assist applicants undertaking continental operations. This Section: Simplified Assessment Checklist for Light aircraft do not include approvals for RNAV10, RNP4, RNP2 oceaninc/remote continental operations or A-RNP.

5.5 Simplified Assessment Checklist for Light aircraft there are requirements for operating procedures, applicant/squadron are expected to include procedures that meet the requirements within their operating manual suite. Where subcontracting tasks are permitted as an alternate means of compliance.

5.6 Applicable PBN Navigation Specifications

5.6.1 Detailed analysis of the RNP 2 navigation specification with the requirement for RNAV 5 navigation specification shows the RNAV 5 requirements are met.

5.6.2 Detailed analysis of the RNP 2 and RNP 1 navigation specifications with the requirement for the RNAV 1 & RNAV 2 navigation specifications shows that requirement are met for GNSS base navigation (e.g. DME/DME or VOR updating is not used.)

5.6.3 RNP 0.3 Ops Approval may be addressed under this Section and but applicant/squadron need to verify that their aircraft meet the requirement for RNP 0.3 operations specified in ICAO Doc 9613 Vol II part C Ch.7. To meet the FTE requirements, a Flight Guidance System (FGS) is usually required to avoid FTE substantiation through an airworthiness demonstration.

5.7 Light Aircraft PBN Qualification

5.7.1 The criteria in this section are only applicable to unpressurised US 14 CFR / EASA Part 23 or Part 27 aircraft with a MTW of 5,700 kg or less conducting continental PBN Operations. The installed navigation system must be either:

a) TSO C129 or TSO-C146 stand-alone GNSS system; or

b) integrated avionics systems that use TSO-C129 or TSO-C145 GNSS sensors as the only primary navigation sensor input to the area navigation function.

Note: The integrated avionics system referred to are those systems typically installed in US 14 CFR / EASA CS Part 23 or Part 27 aircraft that combine flight displays, communications, radio navigation (VOR and ILS) and area navigation into a single integrated system. TSO-C115 multi-sensor systems that utilise independent discrete sensor inputs are excluded because of the increased installation complexity.

5.7.2 To qualify for PBN operations the aircraft must meet the:

a) airworthiness criteria of Section 5.7.3;

b) the continuing airworthiness criteria of Section 5.7.3.6; and

c) the navigation database requirements of Section 5.7.5

5.7.3 Airworthiness Qualification

5.7.3.1 This section identifies the criteria that the aircraft must meet to qualify for PBN operations without being examined under the procedures detailed in Section 4.7, 4.8, 4.9, 4.14 and 4.15.

5.7.3.2 Aircraft with approved TSO-C145 or C146 installations with the requirement listed in Table 1: (E)TSO-C145 & C146 GNSS light aircraft capability column (1) that have AFM or AFM supplement entries stating that the aircraft is

approved for the operations listed in column (2) will meet the requirements for the PBN operations listed in column (3).

5.7.3.3 Aircraft with approved TSO-C129 installation with the equipment listed in Table 2 column (1) that have AFM or AFM supplement entries stating that the aircraft is approved for operations listed in column (2) will meet the requirement for the PBN operations listed in column (3).

5.7.3.4 For aircraft with TSO-129 equipment, the AFM or AFM supplement entry is likely to state that the aircraft is approved for GNSS en-route, terminal and non-precision approach operations. In these cases, applicant/squadrons need to check that the equipment installed is not listed in Table 7: if the equipment is listed a detailed assessment is required in accordance with Section 4.

Table 1:(E)TSO-C145&C145 GNSS Light Aircraft Capability

Equipment Installed (1)	**AFM approval (2)**	**Navigation Specifications Compliant with (3)**
(E)TSO-C146 Class Gamma & Operational Class1,2 or 3: stand-alone GNSS Or (E)TSO-C145 Class 1,2 or 3 GNSS sensor	RNP 2 RNP 1 RNP APCH-LNAV	RNAV 5 RNAV 1 & RNAV 2 RNP 2 RNP 1 RNP APCH-LNAV
(E)TSO-C146 Class Gamma & Operational Class 2 or 3 stand-alone GNSS Or (E)TSO-C145 Class 2 or 3 GNSS sensor	RNP 2 RNP 1 RNP APCH-LNAV RNP APCH-LNAV/VNAV	RNAV 5 RNAV 1 & RNAV 2 RNP 2 RNP 1 RNP APCH-LNAV RNP APCH-NAV/VNAV
(E)TSO-C146 Class Gamma & Operational Class 3 stand-alone GNSS Or (E)TSO-C145 Class 3 GNSS sensor	RNP 2 RNP 1 RNP APCH-LNAV RNP APCH-LNAV/VNAV RNP APCH-LP & LPV	RNAV 5 RNAV 1 & RNAV 2 RNP 2 RNP 1 RNP APCH-LNAV RNP APCH-NAV/VNAV RNP APCH-LP & LPV

Table 2:(E)TSO-C129 GNSS Light Aircraft Capability

Equipment Installed (1)	AFM approval (2)	Navigation Specifications Compliant with (3)
TSO-C129 Class A1 stand-alone GNSS	RNAV 1 & RNAV 2	RNAV 5 RNAV 1 & RNAV 2
TSO-C129 B1, B3, C1 or C3 GNSS sensor	RNAV 1 & RNAV 2 RNP APCH-LNAV	RNAV 5 RNAV 1 & RNAV 2 RNP APCH-LNAV
(E)TSO-C129 C129a Class A1 stand-alone GNSS or (E)TSO Class B1, B3, C1 or C3 GNSS sensor	RNP 2 RNP 1 RNP APCH-LNAV	RNAV 5 RNAV 1 & RNAV 2 RNP 2 RNP 1 RNP APCH-LNAV

5.7.3.5 The applicant/squadron must also have an electrical load analysis for the aircraft that is current and shows that the aircraft meets regulatory requirements and any system limits specified by the aircraft OEM.

5.7.3.6 GNSS Installation Check provides procedures that applicant/ squadron may use to verify the functionality and serviceability installed in light aircraft.

5.7.4 Continuing Airworthiness Qualification.

5.7.4.1 Where aircraft maintenance is subcontracted to external service providers. This subcontracted maintenance can include the aircraft configuration management for the aircraft and its system, including software.

5.7.4.2 For the aircraft to meet the continuing airworthiness requirements for PBN operations, the applicant/squadron may subcontract this activity; however, the applicant/squadron still remains responsible for the whole of continuing airworthiness requirements. For subcontracted continuing airworthiness to be acceptable as a means of meeting the PBN Ops Approval requirements, there must be documentary evidence showing

the details of the activities subcontracted and the means by which the applicant/squadron will maintain oversight of the subcontractors.

5.7.4.3 For PBN systems, software configuration has been a source of numerous problems and is an important consideration within the continuing airworthiness environment. The management of the aircraft software configuration can be subcontracted to another competent person or organization, typically the avionics maintenance service provider. CAANZ AC 91-18 Aircraft Software Configuration Management provides guidance on the management of aircraft software and includes guidance on subcontracting configuration management.

5.7.5 Navigation Database

5.7.5.1 To conduct most PBN operations the aircraft must be equipped with a valid navigation database. To meet the navigation database requirements for PBN operations, applicant/squadron must obtain their navigation database form suppliers holder a Type 2 Letter of Acceptance, recognize the data supplier's compliance with RTCA DO-200A/EUROCAE ED-76 and the compatibility of its delivered data with particular avionic system that are identified in the LOA letter.

5.7.5.2 For each AIRAC cycle, the applicant/squadron must update the navigation database in the aircraft. To meet the database validation requirements specified in the PBN Manual, the applicant/squadron needs to carry out checks on a sample of routes and procedures by comparing the navigations database with current maps and charts.

5.8 Pilot Knowledge and Training

5.8.1 Flight Crew Knowledge and Training Requirements Summary identifies all the pilot training requirements for each of the PBN navigation specifications. To qualify for PBN operations, pilots must meet these requirements in accordance with MAA procedures.

5.8.2 When the pilot is appropriately trained and the aircraft meets the airworthiness, continuing airworthiness and navigation database requirements, the combination is qualified for PNB operations using the navigation specifications for which both the pilot and aircraft are qualified.

6. PBN Navigation Specifications

6.1. A summary of the PBN navigation specification and their intended application are shown in Table 3: PBN navigation specifications. Table 4 shows the PBN navigation specifications and the associated accuracy value for each phase of flight.

6.2. Table 5 provides a summary of the GNSS approved for PBN applications. Table 6 provides a summary of the sensor eligibility requirements for PBN applications.

Table 3: PBN Navigation Specifications.

Nav Spec	Intended Application	Optional Function & Comments
RNAV 10	To support 50 NM lateral and 50 NM longitudinal distance-based separation minima in oceanic or remote area airspace	Requires dual independent systems.
RNAV 5	Enroute phase of flight in airspace where the carriage of RNAV meeting 5 NM lateral accuracy is required.	
RNAV 1 & RNAV 2	The RNAV 1 and RNAV 2 specification is applicable to all ATS routes, including routes in the en-route domain, SIDs and STARs, and IAPs up to FAF. This specification is primarily for use in a radar environment.	Baro-VNAV is optional.
RNP 4	RNP 4 was developed to support 30 NM lateral and the 30 NM longitudinal distance-based separation minima in oceanic or remote area airspace.	Requires dual independent systems.
RNP 2	RNP 2 is intended for en-route operations in oceanic/remote continental or continental airspace, particularly in areas where there is little or no ground NAVAID infrastructure, limited or no ATS surveillance and low to medium density traffic.	Requires dual independent systems for oceanic/remote continental airspace operations. Fixed Radius Transitions and Parallel Offset capabilities are optional.

RNP 1	RNP 1 is intended for routes connecting the en-route structure and terminal airspace with little or no ATS surveillance, with low or medium density traffic including SIDs and STARs, and IAPs up to the FAF.	Baro-VNAV and RF path terminators are optional.
A-RNP	A-RNP is designed for operation in oceanic/remote airspace, on the continental en-route structure as well as on arrival and departure routes and approaches.	Requires dual independent systems for oceanic/remote continental airspace to meet the higher continuity requirement.RF path terminator is required. Fixed Radius Transitions, Parallel Offset, Baro-VNAV, RNP Scalability and Time of Arrival Control capabilities are optional.
RNP APCH	RNP APCH Section A addresses approach applications based on GNSS and gives access to minima designated as LNAV or LNAV/VNAV. RNP APCH Section B addresses approach applications based on augmented GNSS (SBAS) and gives access to minima designated as LP or LPV.	RF Path terminators are optional.
RNP AR APCH	RNP AR APCH is intended for approach operations to airports where limiting obstacles exist and/or significant operational efficiencies can be gained.	Requires specific operator regulatory approval.Aircraft qualified for RNP AP APCH do not meet all requirements for A-RNP.
RNP 0.3	RNP 0.3 is intended for helicopter operations where benefit can be gained from a single accuracy or 0.3 NM lateral phases of flight.	
Radius to Fix Path	The Radius to Fix path terminator (RF Leg) enables aircraft to fly a curved path of defined radius	RF Leg capability is a reuired function for A-RNP but optional

Terminator	between two waypoints. This functionality can be used in the initial and intermediate approach segment. The final phase of the missed approach, SIDs and STARs.	for RNP 1, RNP 0.3 and RNP APCH.
Fixed Radius Transition	The FRT is intended to define transitions along airways in the case where separation between parallel routes is also required in the transition, and the fly-by transition is not compatible with the separation criteria. The default turn radius is 15 NM below FL195 and 22.5 NM above FL195; the turn radius can also be set to value loaded from the navigation database.	FRT is an optional function. At present this has not been developed for operational use but it remains an option should the operational requirement arise.
Time of Arrival Control	This function is still under development.	
Barometric Vertical Navigation	Barometric vertical navigation (Baro-VNAV) enables the use of barometric altitude and area navigation information in the definition of vertical flight paths, and vertical tracking to path.	Baro-VNAV is an optional function.

Notes:

1) *Aircraft that are qualified for A-RNP need no further airworthiness examination for navigation accuracy or functional requirements for the RNAV5 RNAV1 & RNAV2, RNP2, RNP1 and RNP APCH navigation specification.*
2) *Aircraft that are qualified for RNP AR APCH need no further airworthiness examination for Baro-VNAV.*
3) *Aircraft that are qualified for RNP AR APCH with RF path terminators need no further airworthiness examination for RF path terminators.*

Table 4: Application of Navigation Specification by Flight Phase.

Navigation Specification	Flight Phase							
	En route oceanic/ remote	En route continantal	Arrival	Approach				Departure
				initial	Intermediate	Final	Missed[1]	
RNAV 10	10							
RNAV 5[2]		5	5					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1	1
RNP 4	4							
RNP 2	2	2						
RNP 1[3]			1	1	1		1	1
A-RNP 4	2[5]	2 or 1	1	1	1	0.3	1	1
RNP APCH[6]				1	1	0.3[7]	1	
RNP AR APCH				1-0.1	1-0.1	0.3-0.1	1-0.1	
RNP 0.3[8]	0.3	0.3	0.3	0.3	0.3	0.3		0.3

1) *The area of application is from the start of climb and along missed approach segment (intermediate and final)*
2) *RNAV 5 is an en-route navigation specification which may be used for the initial part of the STAR outside 30 NM and above MSA.*
3) *The RNP 1 specification is limited to use on STARs, SIDs, the initial and intermediate segment of IAOs and the missed approach after the initial climb phase. Beyond 30 NM from the ARP, the accuracy values for alerting become 2 NM.*
4) *A-RNP also permits a range of scalable RNP lateral navigation accuracies - see Doc 9613 Volume II, Part C, Chapter 4, 4.3.3.7.4*
5) *Optional - requires higher continuity.*
6) *There are two sections to the RNP APCH specification: Section A is enabled by GNSS and Baro-VNAV. section B is enabled by SBAS.*
7) *RNP 0.3 is applicable to RNP APCH Section A. Difference angular performance requirements are applicable to RNP APCH Section B only.*
8) *The RNP 0.3 specification is primarily intended for helicopter operations.*

Table 5: Approved GNSS Equipment for PBN Applications.

	RNAV 10 (RNP 10) Oceanic & remote	RNAV 5 En-route & Terminal[1] navigation	RNAV 2 En-route & Terminal[1] navigation	RNAV 1 En-route & Terminal[1] navigation	RNP 4 Oceanic & remote navigation	RNP 2 Oceanic & remote, En-route &	RNP 1 En-route & Terminal[1] navigation	RNP APCH[5] Section A Non precision
TSO-C129[3,4]	Acceptable	Acceptable	Class A1or Class B[2] or C[2]	Class A1or Class B[2] or C[2]	Not Acceptable	Not Acceptable	Not Acceptable	Class B1, B3, C1 & C3
(E)TSO-C129a[3]	Acceptable	Acceptable	Class A1or Class B[2] or C[2]	Class A1or Class B[2] or C[2]	Acceptable	Class A1 or Class B[2] or C[2]	Class A1 or Class B[2] or C[2]	Class A1, B1, B3, C1 & C3
(E)TSO-C145(AR)	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Class 1[2],2[2] or 3[2]	Class 1[2],2[2] or 3[2]	LNAV-Classes 1,2,3 LNAV/NNAV Classes 2,3 LP/LPV Class 3
(E)TSO-C146(AR)	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Class Gamma &Operational Class 1,2 or 3	Class Gamma &Operational Class 1,2 or 3	LNAV-Classes 1,2,3 LNAV/NNAV Classes 2,3 LP/LPV Class 3
(E)TSO-C196(AR)	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	LNAV

1) 'Terminal' navigation is terminology is included to enable operators with equipment classified in that manner to identify its capability.

2) Also requires a E/TSO-C115b FMS installed IAW with FAA AC 20-138D(E)TSO-C129 equipment used in the oceanic /remote continental airspace (RNAV 10, RNP 4 or RNP)

3) must have approved for FDE per FAA Notice 8110.60 or AC 20-138A Appendix 1 (or latera Version

4) For RNAV 5, RNAV 2 and RNAV 1 operations, TSO-C129 equipment requires pseudo- range step detection and health word checking; these functions must be implemented in accordance with TSO-C129a

5) RNP APCH section B (LP/LPV approach) requires the use of (E)TSO C146a GNSS sensors

Table 6: Aircraft Navigation Sensor Eligibility Criteria for PBN Applications.

Note: Refer to the PBN Manual Doc 9613 for full details of eligibility requirements.

Navigation Specifications	Sensor Eligibility Criteria	ICAO Doc 9613 Vol II Reference
RNAV 10	Dual independent LRNS requires: INS, IRS + FMS or GNSS	B.1.3.4
RNAV 5	Automatically updated area navigation system using input from one or a combination of VOR/DME, DME/DME, INS or IRS, or GNSS.	B.2.3.3
RNAV 1 & RNAV 2	Automatically updated area navigation system using input from GNSS, DME/DME, or DME/DME/IRU.	B.3.3.3
RNP 4	Dual independent LRNS that includes GNSS. GNSS must be used and can be either a stand-alone system or as one of the sensors in multi-sensor systems.	C.1.3.3
RNP 2	GNSS must be used and can be either a stand-alone system or as one of the sensors in a multi-sensor system. Aircraft operating in oceanic / remote continental airspace require dual independent systems to meet the continuity requirements. The following systems meet the accuracy and integrity requirement of these criteria: a) aircraft with E/TSO-C129a sensor (Class B or C), E/TSO-C145and the requirements of E/TSO-C115b FMS, installed for IFR use in accordance with FAA AC 20-130A (or letter version); oraircraft with E/TSO-C129a Class A1 or E/TSO-C146 equipment installed for IFR use in accordance with FAA AC 20-138A (or letter version).	C.2.3.3
RNP 1	GNSS must be used and can be either a stand-alone system or as one of the sensors in a multi-sensor system.Aircraft operating in oceanic/remote continental airspace require dual independent	C.3.3.3

	systems to meet the continuity requirements. The following systems meet the accuracy and integrity requirement of these criteria: a) aircraft with E/TSO-C129a sensor (Class B or C), E/TSO-C145 and the requirements of E/TSO-C115b FMS, installed for IFR use in accordance with FAA AC 20-130A (or letter version); or b) aircraft with E/TSO-C129a Class A1 or E/TSO-C146 equipment installed for IFR use in accordance with FAA AC 20-138A (or letter version); and aircraft with RNP capability certified or approved to equivalent standards.	
A-RNP	GNSS must be used and comply with the guidelines in FAA AC 20-138. IRS must meet the criteria if 14 CFR 121 Appendix G; improved inertial performance can be demonstrated in accordance with FAA order 8400.12A. Refer to PBN manual for details of eligibility requirements.	C.4.3.3
RNP APCH - LNAV	GNSS must be used and the following systems must meet the accuracy, integrity and continuity requirements of these criteria: a) GNSS stand-alone system, equipment should be approved in accordance with TSO-C129a/ETSO-C129a ClassA, E/TSO-C146 Class Gamma and operational class 1, 2 or 3, or TSO-C196; b) GNSS sensors used in multi-sensor system (e.g. FMS) equipment should be approved in accordance with TSO-C129/ETSO-C129 Class B1, C1, B3 or E/TAO-C145 class 1, 2 or 3, or TSO-C1960. For GNSS receivers approved in accordance with E/TSO-C129, capability for satellite FDE is recommended to improve continuity of function; and	C.5 Sect B 5.3.3

	c) multi-sensor systems using GNSS should be approved in accordance with AC 2202-130A or TSO-C115b, as well as having been demonstrated for RNP APCH capability.	
RNP APCH-LP/LPV	GNSS must be used and the following systems must meet the accuracy, integrity and continuity requirements of these criteria: a) GNSS SBAS stand-alone equipment approved in accordance with E/TSO-C146a (or subsequent version). Application of this standard guarantees that the equipment is at least compliant with RTCA DO 229C. The equipment should be a class gamma. operational class 3. b) for an integrated navigation system (r.g. FMS) incorporating a GNSS SBAS sensor. E/TSO-C115b and AC 20-130A provide an acceptable means of compliance for the approval of this navigation system when augmented by the following guidelines; i) the performance requirements of E/TSO-C146a (or sequent version) that apply to the functional class gamma, operational class 3 or delta 4 is demonstrated; and ii) The GNSS SBAS sensor is approved in accordance with E/TSO-C145a class beta, operational class3; c) approach system incorporating a class delta GNSS SBAS equipment approved in accordance with E/TSO-C146a (or subsequent version). This standard guarantees that the equipment is at least compliant with RTCA DO 229C. The equipment should be a class delta 4; and d) further augmented GNSS systems are also expected to meet these requirements.	

RNP AR APCH	Refer to the PBN Manual (Doc 9613) for all RNP AR requirements.	RNP AR APCH
RNP 0.3	GNSS must be used and the following systems meet the accuracy, integrity and continuity requirement of these criteria : aircraft with E/TSO-C145a and requirement of E/TSO-C115b FMS, installed for IFR use in accordance with FAA AC 20-130A; aircraft with E/TSO-C146a equipment installed for IFR use in.	C 7.3.3

7. PBN Ops Approval Personnel Requirements

7.1 The personnel carrying out PBN Ops Approvals must be trained and competent for the task. Most PBN Ops Approval will require an airworthiness engineering person and flight operations person. These two people should work together as a team and assess each application jointly rather than specifically in their own specialist areas. Both should be experts in their fields. paragraph 7.3 below lists the topic that each should have covered in their training.

7.2 The PBN assessment tasks are divided into airworthiness tasks and flight operations tasks. However, many need to be assessed by both airworthiness assessors and flight operations assessors from the perspective of their own speciality. When assessors have common PBN training and have a good understanding of each other's speciality, assessment can be completed more efficiently since a single review can identify deficiency in either the airworthiness areas or in the flight operations areas. The assessors are more effective when working together as a cohesive team.

7.3 Assessor Training Requirements

7.3.1 Personnel undertaking PBN ops Approval assessment must have a sound understanding of PBN. The topics below should be covered in assessor training:

a) ICAO Global Air Navigation Plan.

b) Airspace concept and relationship of Communications, Navigation, Surveillance and Air Traffic Management in determining airspace capability.

c) Area Navigation principles.

d) PBN fundamentals:

i) Path Terminators and the basic characteristics of each.

ii) Waypoint transitions and the characteristics of each.

iii) Navigation Specifications and their intended application.

iv) Fundamental requirements for each navigation specification.

v) The difference between RNAV and RNP navigation specifications.

vi) Basic navigation system performance and functional requirements.

e) Navigation database:

i) Compilation of navigation database.

ii) Database integrity and quality assurance.

iii) Letter of Acceptance (LOA).

f) Area navigation equipment functions and operations:

i) Understanding the functional block diagram of an area navigation system.

ii) Understand the statistical basis of PBN and performance monitoring.

iii) Understand the RNAV and RNP error models and the terms used: RNP, EPE, TSE, NSE, PDE, PEE.

g) GNSS fundamentals:

i) ABAS, GBAS and SBAS principles and characteristics.

ii) FD and FDE methods.

iii) RAIM prediction and requirements.

h) Inertial Reference System installations:

i) Fundamental of inertila navigations.

ii) Use of IRS as primary attitude reference sensors and as navigation sensors.

i) Navigation system updating:

i) Principle of navigation system radio updating.

ii) Effect of NAVAID station geometry

iii) Integration of IRS and GNSS systems.

j) Navigation system installations:

i) TSO equipment approvals.

ii) Installation requirements.

iii) Human factors and safety considerations.

k) Approach Operations:

i) Instrument approach procedures:

1) 2D and 3D procedures.

2) Type A and Type B procedures.

ii) Understand the difference between Vertical Guidance and Advisory Vertical Guidance.

iii) RNP APCH-LNAV:

1) Basic RNP APCH design characteristics.

2) The link between the procedure name, chart name, FMS procedure name and radio telephony.

iv) RNP APCH-LNAV/VNAV:

1) Baro-VNAV principles and procedures.

2) LP and LPV procedures.

3) Understand when SBAS vertical guidance can be used in lieu of Baro-VNAV.

l) Alternate and Substitute means of navigation (overlays):

i) Use of overlay procedures.

ii) Overlay verification requirements.

m) Continuing Airworthiness requirements:

i. Maintenance requirements.

ii. Aircraft configuration management.

iii) Software configuration management.

iv) Electrical load analysis,

n) Flight Operations:

i. flight Crew training.

ii. Syllabus.

iii. Mean of delivery.

iv. Synthetic training devices.

v. Configuration of training devices.

vi. Competency and continued competency.

o) Operating procedure:

v) Route guides.

vi) Contingency procedures.

vii) Flight examiners.

viii) MEL.

8. Airworthiness Assessment Considerations

8.1 The airworthiness assessment considers the aircraft and navigation system installation capability to meet the airworthiness requirements in the PBN Manual.

8.2 Airworthiness

8.2.1 The PBN airworthiness assessment will examine the aircraft for compliance with the airworthiness requirements of the PBN navigation specifications. For aircraft where the navigation system(s) are OEM installed and have statements of the PBN approval status in the AFM, the airworthiness examination will primarily be oriented to ensuring that the installation conforms to the type design data.

8.2.2 For legacy aircraft that have been modified post manufacture, the airworthiness examination will of necessity be much more detailed. Experience has shown that where aircraft have been modified prior to PBN being formally adopted by ICAO and the standards published in the PBN Manual (ICAO Doc9613), there is reasonably high risk that these installations are not fully compliant with the PBN requirements, even though there may be AFM supplement that indicate compliant. Legacy AFM Supplements have been found to be difficult to interpret easily and correctly.

8.3 Aircraft Eligibility

8.3.1 Evidence of aircraft eligibility is typically provided through an Aircraft Flight Manual (AFM) compliance statement, AFM supplement or aircraft Original Equipment manufacturer (OEM) service letter or other document certifying the aircraft meets the relevant airworthiness requirements for the intended operation.

8.3.2 Where the aircraft eligibility is not covered by the method described above, the applicant/squadron will need to demonstrate eligibility by other means. Typically, evidence may include: STC, modification data (Engineering Orders) that may include conformity inspections, compliance testing and/or inspection certification, and appropriate maintenance certifications.

8.3.3 Previous navigation authorizations may be used as evidence of aircraft eligibility and should be supplied where available. To establish aircraft eligibility by similarity, the relevant and applicable test must be met This means that the aircraft are the same make/model, and that the equipment installation is the same make/model and configuration has no significant differences.

8.3.4 Details of the equipment to be used for the intended operations must be provided. This evidence would typically be an aircraft equipment list that includes

the equipment make, model, hardware part number (and version number or mod status) and software (part number and version) for the principal system components of the navigation, automation and radio system. The supplies list should be certified as corrected by or on behalf of the applicant or by an approved maintenance organization.

8.3.5 Evidence that appropriate system and calibration checks have been conducted and appropriately certified must be provided. This evidence would typically be a certification statement form the applicant or approved maintenance organization or an extract from the maintenance log to the same effect.

8.3.6 Evidence must be provided that there are no structural repairs or damage that would affect the authorization. This would typically be a certified statement from the applicant or approved maintenance organization that state any structural repairs in areas that could affect navigation sensor input or any damage in these areas have been repaired or are within tolerances prescribed in the Structural Repair Manual (SRM) or any other applicable continuing airworthiness document.

8.3.7 If there are any conditions or limitations in the aircraft eligibility documentation that may affect PBN operations, these conditions and limitations need to be reflected in the PBN Ops Approval.

8.4 Aircraft Assessment

8.4.1 The aircraft assessment examines the aircraft for compliance with the relevant airworthiness standards. For aircraft with OEM installations there should be few problems found. However, legacy aircraft modified outside the manufacturer's environment often have installation deficiencies that render them non-compliant with the PBN navigation specification requirements.

8.4.2 If applicant is unable to provide information on the installation, test reports and other document that may demonstrate compliance with the PBN requirements and eligibility for the issue of PBN Ops Approval, a detailed assessment will be required, if there is no record of the installation being inspected for conformity with the installation design data, a conformity inspection will be required.

Table 7: Equipment requirement per navigation specifications

Navigation specification	NAV	COM	Surveillance
RNAV 10	2x INS; 2x GNSS; INS & GNSS	HF	Periodic Pilot Position Report (PPR)
RNP 4	2x GNSS; INS & GNSS	Data link (CPDLC); HF	ADS-C(14-min PPR)
RNAV 5	GNSS (VOR/DME) (DME/DME) (INS) (DME/DME/IRU)	HF VHF	No
RNP 2	GNSS (2xGNSS-Oceanic /remote)	VHF DataLink(Oceanic/remote)	No ADS-C (Oceanic/remote)
RNAV 1	GNSS(DME/DME) (DME/DME/IRU)	VHF	Yes
RNAV 2	GNSS (DME/DME) (DME/DME/IRU)	VHF	Yes
RNP 1	GNSS	VHF	No
RNP APCH (LNAV&LNAV/VNAV)	GNSS(On-board Performance Monitoring and Alerting-RAIM)		
RNP APCH (LP&LPV)	GNSS (& SBAS service)		

9. Continuing Airworthiness

9.1 The applicant/squadron must demonstrate their ability to maintain the aircraft in conformity to its type design and compliant with the functional and performance requirements for all navigation authorizations applicable to each aircraft. The subjects below provide more detail and items for consideration when conforming to the regulations and supplying evidence in applications for authorizations.

9.2 Subcontractor Oversight

9.2.1 The applicant/squadron is responsible for maintenance of the aircraft, even though the maintenance activity may be subcontracted to internal or external suppliers. Evidence that the applicant/squadron maintains (and will continue to maintain) the aircraft compliant with PBN Ops Approval requirements and in conformity to its type design must be provided.

9.2.2 Where maintenance functions are subcontracted, the applicant/squadron must identify the maintenance organization(s) that will be responsible for carrying out maintenance on the aircraft and that the maintenance organization(s) has the required capability to maintain the aircraft. This would typically be a contract document with an approved maintenance organization and a copy of the organization's approval including (where applicable) the capability list. There may be multiple maintenance organizations, particularly if an avionic organization provides separate maintenance. Evidence should also include the operator processes for oversight of those organizations and include the point(s)-of-contact and work authorization procedures.

9.2.3 The operator's audit programme must include subcontractors and demonstrate that subcontractors have the training and capability for the work to be carried out.

9.3 Aircraft Maintenance programmer

9.3.1 A key element in operating an aircraft is for it to be maintained so that it remains compliant with its type design. Each aircraft must have a maintenance programme for the Ops approvals. The system associated with PBN navigation systems require maintenance to maintain them compliant with the navigation specifications. An example is an aircraft's altimetry system and an associated Baro-VNAV approval.

9.3.2 The documentation submitted in an Ops Approval application must provide evidence that the navigation related systems are included in the maintenance programme and that any periodic checks and inspections are included.

9.3.3 Evidence that the Maintenance Programme covers the required equipment at the required intervals and within the required calibration parameters is required.

This Would typically be relevant extracts from the maintenance programme for the required equipment/systems and may include various task cards and copy of the relevant sections of the maintenance schedule.

9.3.4 Aircraft configuration management processes (any changes to the aircraft) are duly considered, authorized, and managed by the operator. This would typically include:

a. relevant processes for assessing, recording and incorporating OEM instructions (SBs and alike from the aircraft and relevant component manufacturers).
b. processes for ensuring compatibility of changes within the aircraft and the fleet (which may include testing procedures).
c. processes for maintaining configuration lists (which would necessarily include the aircraft equipment list).
d. processes for ensuring the changes singular and in combination are reviewed to ensure the aircraft remains compliant with the type design criteria.
e. software configuration management processes to ensure that the software in each system is maintained in a configuration that is compatible with interfacing systems and has no significant operational differences between systems in the same aircraft. For further detail on the requirements see 9.6; and
f. Electrical Load Analysis management procedure: this would typically be evidenced by a current ELA and an extract from the continuing airworthiness management system (applicant/squadron or approved maintenance organization) as to the processes of review and authorization for the ELA. Further information is provided in 9.8.

9.3.5 Aircraft maintenance documents that provide instruction for continuing airworthiness of the aircraft and equipment. This evidence would typically include extracts from and/or detailed references to the AMM, IPC, SRM, wiring diagram (WDM), and CMMs that demonstrate:

a. appropriate maintenance tasks and scheduling.
b. system configurations.
c. system testing.
d. part management; and
e. component repair management for the affected systems further information is provided in 9.4.

9.3.6 Evidence that the required test equipment is available, calibrated and maintained. This would typically include a list of test equipment (including part number and mod status) with associated calibration schedule and certifications and copy of the management procedures for the equipment. This may include evidence of contracts with third party providers (Avionic organizations, Specialized maintenance providers etc.)

9.3.7 Part management procedures must ensure that only parts approved for the installation in the aircraft are permitted to be used in its maintenance. Similarly, the operator's procedure must ensure that components sent to subcontractors for repair have the work to be carried out and the required return configuration specified. Subcontractors, such as equipment manufacturer’s repair facilities, are not permitted to make changes to equipment without authorization from the operator.

9.3.8 Evidence that personnel maintaining or involved in the continuing airworthiness of the aircraft are appropriately trained in the maintenance of the affected systems. This training is normally over and above typical type rating training. However, evidence may include extracts from appropriate syllabi for type training. The maintenance training should include maintenance controls, dispatchers, and aircraft cleaning personnel to an appropriate degree. Evidence is typically provided by:

a. syllabi of training;
b. training programme (including currency, when required);
c. testing methods. Testing methods should establish both knowledge and competency aspects as appropriate for each type of personnel; and
d. records of training and competency of individual trained. Records should be kept by the operator. However, if maintenance is provided by a third party, the operator must be able to demonstrate appropriate oversight of the organization(s) to ensure appropriate maintenance training, competency and recording is in place.

9.3.9 Procedures for managing navigation databases. Typically, evidence would include contracts/subscriptions with appropriate suppliers, a Letter of Acceptance (LOA) form an appropriate regulatory authority (usually EASA or FAA) and details of their process for ensuring its integrity (including alignment with the AIRAC cycle). Further information is included in 9.4.

9.4 Maintenance Documentation

9.4.1 The aircraft maintenance publication suite is a key element to continuing airworthiness of the aircraft and its systems. Aircraft that are manufactured with the navigation systems installed will have the system information included in the publication suite. Where aircraft are modified to install the equipment, then the maintenance information has to be added to the suite. 14 CFR/EASA CS Part 25.1529 requires manufacturers and aircraft modifier/installer to provide the operator with instructions for continued airworthiness. The paragraph below describes the information that needs to be provided and available to the aircraft maintenance personnel.

9.4.2 Aircraft maintenance documents that provide instructions for the continuing airworthiness of the aircraft and equipment. This evidence would typically include extracts form and/or detailed references to the AMM, IPS, SRM, wiring diagram, and CMMs that demonstrate:

a. appropriate maintenance tasks and scheduling;
b. system configurations;
c. system testing;
d. part management; and
e. component repair management for the affected system (typically navigation, automation & radio systems).

9.4.3 Aircraft Maintenance Manual (AMM)

9.4.3.1 The aircraft maintenance manual (supplemental manual) must contain the instructions for maintaining the systems installation for which a navigation authorization is sought. The content described below should be included in the AMM:

a. System Description: A description of the system installation and briefly how it operates. An important part of the system description is the location of components.
b. Maintenance activity instructions: There must be instructions for the removal, and installation of system components. Where access has to be gained to otherwise inaccessible parts of the aircraft to reach system components, instructions for gaining access must be included in the procedures. Instructions for system maintenance such as “...maintain in accordance with (system) Component Maintenance Manual (CMM)...” are not acceptable.

c. System configuration: Many modern systems are configured to meet system interface requirements on installation. Since this configuration is defined as part of the system design, the installation instructions must define the configuration setting to be used for each installation. Leaving this for maintenance engineers to work out for themselves in no acceptable.

d. System Testing: Instructions must be provided for testing the installed systems to determine that they are functioning correctly. When tests will require lengthy transcribing of equipment manufacturer procedures into AMM (or supplement), it is acceptable for tests to be carried out in accordance with the relevant Component Maintenance Manual (CMM) or other similar applicable manual provided that the reference is specific to the procedure to be used.

e. Wiring diagrams: Wiring installation diagrams that show the actual aircraft installation(s) are required. Wiring diagrams that are applicable to multiple aircraft, are acceptable provided that they are clearly annotated to show where the configuration between aircraft differs.

f. Parts management: Only parts approved for use on the specific aircraft may be used in the maintenance of the aircraft. For most aircraft there is an Illustration Parts Catalog (IPC) or other similar document. When an aircraft has been modified, the IPC either needs to be revised or supplemental documents provided.

g. Some navigation authorization requires the system to have specific hardware or software parts installed in the aircraft, in these cases, the operator must be able to show that only the parts approved for the particular aircraft will be used in its maintenance.

h. Component repair management: When components are sent to repair facilities, the operator procedure must specify the configuration in which the component must be returned. It is acceptable for repair shops to decide to include modifications or software updates without instruction from the operator. The requirement for this strict protocol arises from aircraft systems having to be at specific configuration states to interface correctly with other systems. Operator parts management procedure need to specify the means by which the return configuration is specified, typically repair instructions provided with the purchase order for the repair.

i. Tools and Test equipment: Tools and test equipment will be required for maintaining systems subject to navigation authorizations. Operators must be able to show that they have the equipment required, that it is maintained and calibrated as required by regulatory requirements.

j. Maintenance training and competency: personnel who will be carrying out maintenance on systems that are subject to navigation authorizations must be trained to maintain the aircraft and these systems in accordance with the aircraft maintenance procedures and requirements. Personnel undertaking maintenance on aircraft systems that are subject to navigation authorization must be certified as competent to do so. Record of training and competency assessment should be kept by the operator.

9.4.3.2 When an operator subcontracts maintenance to another authorized service provider, it is the operator's responsibility to ensure that the service provider is qualified to carry out the work. In demonstrating compliance with the continuing airworthiness requirement where maintenance will be subcontracted, the operator must be able to demonstrate an oversight regime through such things as defined authorities for the service provider, lines of communication between the parties and an audit programme.

9.5 Aircraft Configuration Management

9.5.1 Each operator is responsible for the configuration of their aircraft in service. This means that no change may be made to the aircraft unless the operator has accepted the change and authorized its incorporation in the aircraft, which include all modification sources including aircraft and equipment OEM Service Bulletins. Each modification document should be reviewed by the operator for applicability and determination as to whether or not it will be incorporated; the details of this review should be documented and retained in the operator's records.

9.5.2 When an aircraft is fitted with dual installations that use the same equipment, the installations should have the same configuration. Minor installation differences are acceptable provided there is no significant operational impact.

9.6 Software Configuration Management

9.6.1 The operator needs to have aircraft configuration management procedures that ensure the aircraft software configuration is managed and compliant with its type design. Where the aircraft is fitted with multiple installation of a system, the software

in each system must be maintained in a configuration that is compatible and has no significant operational differences between systems in the same aircraft.

9.6.2 For more systems, one or two minor version differences will be acceptable but major version differences will not be acceptable. When an aircraft or equipment manufacturer prescribes a software configuration limitation, this must be observed by operators.

9.6.3 When assessing aircraft software modification documents, operators must ensure that the change is applicable to their aircraft and that they will meet the software compatibility requirements for the system installed in the aircraft. Aircraft systems commonly have a range of software versions between interfacing systems that are acceptable. If incompatible software version are installed, aircraft that were previously compliant may become non-compliant.

9.6.4 The aircraft software configuration has three states:

a. Approved Aircraft Software Configuration: The approved aircraft software configuration defines the status of all software approved for installation in the aircraft. This software has Regulatory Approval and is usually issued by the aircraft or equipment manufacturer or a STC holder. Not all approved software will be installed in every aircraft since software is often modified for particular operators of aircraft type. Most operational system software installed is approved but operational data is often supplied under a regulatory authorization.

b. Authorized Aircraft Software Configuration: The authorized aircraft software configuration defines the status of all software accepted by and authorized by the operator for installation in the aircraft. Each operator is responsible for the configuration maintenance of the aircraft, this responsibility includes the software configuration. As with hardware modifications, particularly those from manufacturers, not all changes are applicable to all aircraft. Some are optional, allowing the operator to determine whether or not to make the change. For operators maintaining the software configuration of their aircraft, the authorized aircraft software configuration is the configuration that they have authorized for installation by accepting or rejecting modifications or Service Bulletins. The authorized configuration does not necessarily reflect the manufacturer's latest approved configuration (due to optional compliance or customer options) but it must be an approved configuration. The authorized configuration will often allow

several different versions of software to be installed in a system. With modification programs, it is usual for the pre-modification and the post modification software to be authorized. Once the programme is completed, the pre-modification software is removed from the authorized list.

c. Actual Aircraft Software Configuration: The actual aircraft software configuration is as it says, the actual configuration. The actual aircraft configuration does not have to have the latest manufacturer authorized software version installed but the configuration of the software installed must be authorized by the operator's most recent applicable authorized aircraft software configuration specification.

9.6.5 Since software changes relatively frequently and aircraft of nominally the same make/model have different equipment and software installed, operators need robust methods of ensuring that maintenance personnel are aware of the acceptable software configuration applicable to each aircraft. Ideally, each aircraft will have a list of the software that is acceptable for readily available to maintenance personnel wherever the aircraft may be.

9.6.6 As part of their overall software configuration management processes, operators should include maintenance tasks to audit all the software installed in each aircraft at least annually. Any discrepancies found must be resolved prior to return to service.

9.6.7 If configuration management of aircraft's software is sub-contracted, details of the arrangements must be included in the aircraft configuration management document.

9.6.8 ARINC 666 Electronic Distribution of Software and ARINC 667 Guidance for the Management of Field Loadable Software provide details on the management of aircraft software.

9.7 Synthetic Training Device Configuration Management

9.7.1 ICAO PBN Manual (COD 9613) explicitly requires that training devices must accurately replicate the actual aircraft. Since modifications embodied in an aircraft change its configuration, the operator must have procedures to ensure that all training devices are maintained so that they accurately replicate the aircraft.

9.7.2 The engineering function personnel responsible for managing the aircraft configuration need to have a direct link to the functional personnel managing the configuration of training devices, particularly flight simulators. Similarly, there must also be a direct link to the flight operations department since aircraft changes to flight crew training syllabi and/or procedures.

9.8 Electrical Load Analysis

9.8.1 Whenever an aircraft is modified and electrical load is changed, the Electrical Load Analysis (ELA) need to be revised to include the load change and to ensure that regulatory requirement and any OEM limits are met for each aircraft.

9.8.2 Operators need to ensure that they have an updated ELA for each aircraft whenever an aircraft has had modification incorporated with the potential to affect the electrical system capability.

9.8.3 SAE F2490-05 Standard Guide for Aircraft Electrical Load and Power Source Capacity Analysis and other advisory information provides guidance on the completion of electrical load analysis.

9.9 Manufacturer Service Information

9.9.1 In addition to maintenance and modification documentation, equipment manufacturers regularly publish information to assist operators and maintenance organizations. Often, when a problem is found during the operation of the aircraft and/or equipment, the manufacturer will publish information for the operator or be aware of system problem/issues and means of managing or mitigating the effects.

9.9.2 An important part of monitoring the OEM information sources is for the information to be distributed within the operator's organization so that technical and flight operations personnel are aware of matter relevant to their operations.

9.9.3 Operators therefore need a process to regularly monitor OEM information sources for support information applicable to their aircraft/systems. If the operator subcontracts the configuration management of their aircraft, this contract should include requirement for OEM service information to be monitored and distributed to the operator in accordance with their agreed procedures.

9.10 Maintenance Personnel Training

All maintenance personnel must be trained to ensure that aircraft are maintained compliant to their type design for PBN operations, the following knowledge requirements are applicable for PBN:

a. Area Navigation Principles. Area navigation is the basic for all PNB operations, and the same general knowledge is applicable to all navigation specifications.
b. PBN fundamentals. Personnel should have a sound knowledge of the PBN fundamental including the navigation specifications and their intended application]s and the difference between RNAV and RNP navigation specifications.

c. Navigation system principles. Personnel should have a detailed knowledge of the navigation system(s) installed in the operator's fleet. This section should include the operation of the system with GNSS and radio updating.

d. Navigation database management. Procedures, verification requirements and updating aircraft navigation databases.

e. Maintenance practices. This section needs to address maintenance practices and the importance of aircraft configuration management, particularly in relation to software.

f. MEL Provision. Maintenance personnel must be aware of the MEL provisions related to PBN operations and their application.

10. Flight operations

10.1 this section provides guidance to operators on the contents required in their operating procedures documents to meet the requirements for the issuing of PBN approval. Since there are wide range of operations, each operator needs to tailor the content of their procedures to their particular operating environment.

10.2 Operator must have operating procedures for the conduct of the PBN operations. Theses operational procedures should include:

a. Route guide or similar document that defines the requirements and provides operational guidance for each route they operate.

b. An implementation program, including the method to monitor RNAV/RNP operations, to identify, report and investigate any failure or potential failure in the aircraft systems or operating procedure.

c. Procedure to manage the navigation database that include:

i. Validation of navigation databases

ii. Reporting of navigation database errors

iii. Managing the updating of the navigation databases on each aircraft.

10.3 Route Guide

10.3.1 The operator's route guide, or equivalent document, should provide information to the flight crew on the operations being conducted related to the operator's route and destinations. The route guide may also include details of aircraft equipment and procedures required in order to operate on specified routes or to designated destinations.

10.3.2 To prevent operator MELs becoming too complex with specific destination or route requirements, it is acceptable for these to be included in the route guide and

referenced to the MEL items. The provisos in the MEL, plus any associated operating or maintenance procedures for each item, must be complied with.

10.3.3 for each destination, the route guide should include the operational contingency procedures to be used at the location; particularly if instrument approach procedures do not include them.

10.4 Flight Crew Knowledge and Training

10.4.1 The flight crew training program must be defined and include:

a) The syllabus of training.

i. Relevant sections of the operator operations manual;

ii. Review of the relevant AFM limitations/supplement relating to PBN operations;

iii. Checklist; and

iv. Contingency procedures with QRH content.

b) Means of delivery (classroom, computer based training (CBT), synthetic device, etc.);

c) Detail of training exercises and competency assessment to be undertaken.

d) Arrangements to manage recurrent training; and

e) Description of training programs for dispatcher and any other relevant personnel training detailing the procedures to be used.

10.4.2 The specific pilot knowledge and training requirement for each navigation specification are detailed in each chapter of the PBN manual (Doc 9613).

10.4.3 Flight dispatcher training for PBN should address the same topics as flight crew training with a detailed emphasis on the flight planning and pre-flight segments. The training should also include application of the MEL provision for PBN system with cognizance of the operator's route network.

10.4.4 Third party Training providers:

10.4.4.1 Operator may elect to use the services of third party training provider. Details of these provider's should be included in Operator's check and training manual. When assessing these courses for suitability operator should ensure the course meets the training requirement for each navigation specification that are detailed in each chapter of the PBN manual.

10.4.4.2 The operator is responsible for the oversight of the training provided by subcontractor. The operator should have details of their oversight provisions in their manual with the subcontractors being included in the operator's audit program

10.5 Flight Crew Training Devices

10.5.1 The details of the use of any synthetic training devices in flight crew training program must be detailed.

10.5.2 When the training and assessment of flight crew requires the use of synthetic devices, the devices must be configured so that they accurately reflect the configuration of the aircraft to which the PBN Ops approval will be applicable.

10.5.3 When the foreign synthetic devices are used for flight crew training, they must be equipped with navigation database for the region in which the flight crew will be operating. Likewise, if they are equipped with visual system, the visual displays should have the displays for the destinations to which the crew will be operating to be available and have a high degree of integrity for the location.

10.5.4 If crew are required to carry out training using synthetic training devices that do not have the visual displays for the intended destination available, there may be a requirement for the crew to be complete in the actual aircraft at those destinations.

10.5.5 Synthetic training devices must be maintained so that they continue to represent accurately the relevant aircraft configuration and system operation. If the synthetic training devices do not match the aircraft configuration, they are likely to be downgraded and so limited in the extent to which they may be used for qualification training.

10.6 Flight Crew Operating Procedures

10.6.1 Most of the flight crew operating procedures requirements are clearly defined in each of the PBN navigation specification. The operating procedures requirement are similar to the airworthiness requirements in that there are requirements common to most navigation specifications with additional requirements specific to particular navigation specifications. The procedure for the navigations specifications that Ops Approval is being sought need to be included in the operator’s procedures.

10.6.2 flight Preparation for PBN Operations

10.6.2.1 The flight crew should ensure that RNAV 1, RNAV 2, RNP 1 RNP 2, and RNP APCH routes or procedures to be used for the intended flight, including for any alternate aerodromes, are selectable from the navigation database and are not prohibited by NOTAM.

10.6.2.2 The flight crew should take account of any NOTAMs or operator briefing material that could adversely affect the aircraft system operation along its flight plan including any alternate aerodromes.

10.6.2.3 When PBN relies on GNSS systems for which RAIM is required for integrity, its availability should be verified during the preflight planning. In the event of a predicted continuous loss of fault detection of more than five minutes, the flight planning should be revised to reflect the lack of full PBN capability for that period.

10.6.2.4 For RNP 4 operations with only GNSS sensors, a fault detection and exclusion (FDE) check should be performed. The maximum allowable time for which FDE capability is projected to be unavailable on any one event is 25 minutes. If predictions indicate that the maximum allowable FDE outage will be exceeded, the operation should be rescheduled to a time when FDE is available.

10.6.2.5 For RNAV 10 operations, the flight crew should take account of the RNAV 10-time limit declared for the inertial system, if applicable, also considering the effect of weather conditions that could affect flight duration in RNAV 10 airspace. Where an extension to the time limit is permitted, the flight crew will need to ensure that en route radio facilities are serviceable before departure, and to apply radio updates in accordance with any AFM limitation.

10.6.3 Preflight and general considerations

10.6.3.1 At navigation system initialization, the flight crew should confirm that the navigation database is current and verify that the aircraft position has been entered correctly, if required.

10.6.3.2 The active flight plan, if applicable, should be checked by comparing the charts or other applicable documents with navigation equipment and displays. This includes confirmation of the departing runway and the waypoint sequence, reasonableness of track angles and distances, any altitude or speed constraints, and, where possible, which waypoints are fly-by, and which are fly-over. Where relevant, the RF leg arc radii should be confirmed.

10.6.3.3 The flight crew should check that the navigation aids critical to the operation of the intended PBN procedure are available.

10.6.3.4 The flight crew should confirm the navigation aids that should be excluded from the operation, if any.

10.6.3.5 An arrival, approach or departure procedure should not be used if the validity of the procedure in the navigation database has expired.

10.6.3.6 The flight crew should verify that the navigation systems required for the intended operation are operational.

10.6.4 Departure

10.6.4.1 Prior to commencing a take-off on a PBN procedure, the flight crew should check that the indicated aircraft position is consistent with the actual aircraft position at the start of the take-off.

10.6.4.2 Where GNSS is used, the signal should be acquired before the take-off.

10.6.4.3 Unless automatic updating of the actual departure point is provided, the flight crew should ensure initialization on the runway by means of a manual runway threshold or intersection update, as applicable. This is to preclude any inappropriate or inadvertent position shift after take-off.

10.6.5 Arrival and approach

10.6.5.1 The flight crew should verify that the navigation system is operating correctly, and the correct arrival procedure and runway (including any applicable transition) are entered and properly depicted.

10.6.5.2 Any published altitude and speed constraints should be observed.

10.6.5.3 The flight crew should check approach procedures (including alternate aerodromes if needed) as extracted by the system (e.g., CDU flight plan page) or presented graphically on the moving map, in order to confirm the correct loading and the reasonableness of the procedure content.

10.6.5.4 Prior to commencing the approach operation (before the IAF), the flight crew should verify the correctness of the loaded procedure by comparison with the appropriate approach charts. This check should include:

i. the waypoint sequence;

ii. reasonableness of the tracks and distances of the approach legs and the accuracy of the inbound course; and

iii. the vertical path angle, if applicable.

10.6.6 Altimetry settings for RNP APCH operations using Baro VNAV

10.6.6.1 Barometric settings

i. The flight crew should set and confirm the correct altimeter setting and check that the two altimeters provide altitude values that do not differ more than 100 ft at the most at or before the final approach fix (FAF).

ii. The flight crew should fly the procedure with:

a) a current local altimeter setting source available - a remote or regional altimeter setting source should not be used; and

b) the QNH/QFE, as appropriate, set on the aircraft's altimeters.

10.6.6.2 Temperature compensation

i. For RNP APCH operations to LNAV/VNAV minima using Baro VNAV:

a) the flight crew should not commence the approach when the aerodrome temperature is outside the promulgated aerodrome temperature limits for the procedure unless the area navigation system is equipped with approved temperature compensation for the final approach.

b) when the temperature is within promulgated limits, the flight crew should not make compensation to the altitude at the FAF and DA/H.

c) since only the final approach segment is protected by the promulgated aerodrome temperature limits, the flight crew should consider the effect of temperature on terrain and obstacle clearance in other phases of flight.

ii. For RNP APCH operations to LNAV minima, the flight crew should consider the effect of temperature on terrain and obstacle clearance in all phases of flight, in particular on any step-down fix.

10.6.7 Sensor and lateral navigation accuracy selection

10.6.7.1 For multi-sensor systems, the flight crew should verify, prior to approach, that the GNSS sensor is used for position computation.

10.6.7.2 Flight crew of aircraft with RNP input selection capability should confirm that the indicated RNP value is appropriate for the PBN operation.

10.7 Management of The Navigation Database

10.7.1 For RNAV 1, RNAV 2, RNP 1, RNP 2, and RNP APCH, the flight crew should neither insert nor modify waypoints by manual entry into a procedure (departure, arrival or approach) that has been retrieved from the database. User-defined data may be entered and used for waypoint altitude/speed constraints on a procedure where said constraints are not included in the navigation database coding.

10.7.2 For RNP 4 operations, the flight crew should not modify waypoints that have been retrieved from the database. User-defined data (e.g., for flex-track routes) may be entered and used.

10.7.3 The lateral and vertical definition of the flight path between the FAF and the missed approach point (MAPt) retrieved from the database should not be revised by the flight crew.

10.8 Display and Automation

10.8.1 For RNAV 1, RNP 1, and RNP APCH operations, the flight crew should use a lateral deviation indicator, and where available, flight director and/or autopilot in lateral navigation mode.

10.8.2 The appropriate displays should be selected so that the following information can be monitored:

i. the computed desired path.

ii. aircraft position relative to the lateral path (cross-track deviation) for FTE monitoring.

iii. aircraft position relative to the vertical path (for a 3D operation).

10.8.3 The flight crew of an aircraft with a lateral deviation indicator (e.g., CDI) should ensure that lateral deviation indicator scaling (full-scale deflection) is suitable for the navigation accuracy associated with the various segments of the procedure.

10.8.4 The flight crew should maintain procedure centerlines unless authorized to deviate by air traffic control (ATC) or demanded by emergency conditions.

10.8.5 Cross-track error/deviation (the difference between the area-navigation-system-computed path and the aircraft-computed position) should normally be limited to ± ½ time the RNAV/RNP value associated with the procedure. Brief deviations from this standard (e.g., overshoots or undershoots during and immediately after turns) up to a maximum of 1 time the RNAV/RNP value should be allowable.

10.8.6 For a 3D approach operation, the flight crew should use a vertical deviation indicator and, where required by AFM limitations, a flight director or autopilot in vertical navigation mode.

10.8.7 Deviations below the vertical path should not exceed 75 ft at any time, or half-scale deflection where angular deviation is indicated, and not more than 75 ft above the vertical profile, or half-scale deflection where angular deviation is indicated, at or below 1,000 ft above aerodrome level. The flight crew should execute a missed

approach if the vertical deviation exceeds this criterion, unless the flight crew has in sight the visual references required to continue the approach.

10.9 Vectoring and Positioning

10.9.1 ATC tactical interventions in the terminal area may include radar headings, 'direct to' clearances which bypass the initial legs of an approach procedure, interceptions of an initial or intermediate segments of an approach procedure or the insertion of additional waypoints loaded from the database.

10.9.2 In complying with ATC instructions, the flight crew should be aware of the implications for the navigation system.

10.9.3 'Direct to' clearances may be accepted to the IF provided that it is clear to the flight crew that the aircraft will be established on the final approach track at least 2 NM before the FAF.

10.9.4 'Direct to' clearance to the FAF should not be acceptable. Modifying the procedure to intercept the final approach track prior to the FAF should be acceptable for radar-vectored arrivals or otherwise only with ATC approval.

10.9.5 The final approach trajectory should be intercepted no later than the FAF in order for the aircraft to be correctly established on the final approach track before starting the descent (to ensure terrain and obstacle clearance).

10.9.6 'Direct to' clearances to a fix that immediately precede an RF leg should not be permitted.

10.9.7 For parallel offset operations en route in RNP 4 and A-RNP, transitions to and from the offset track should maintain an intercept angle of no more than 45° unless specified otherwise by ATC.

10.10 Alerting and Abort

10.10.1 Unless the flight crew has sufficient visual reference to continue the approach operation to a safe landing, an RNP APCH operation should be discontinued if:

i. navigation system failure is annunciated (e.g., warning flag).

ii. lateral or vertical deviations exceed the tolerances.

iii. loss of the on-board monitoring and alerting system.

10.10.2 Discontinuing the approach operation may not be necessary for a multi-sensor navigation system that includes demonstrated RNP capability without GNSS in accordance with the AFM.

10.10.3 Where vertical guidance is lost while the aircraft is still above 1,000 ft AGL, the flight crew may decide to continue the approach to LNAV minima, when supported by the navigation system.

10.11 Contingency procedures

10.11.1 The flight crew should make the necessary preparation to revert to a conventional arrival procedure where appropriate. The following conditions should be considered:

i. failure of the navigation system components including navigation sensors, and a failure effecting flight technical error (e.g., failures of the flight director or autopilot);

ii. multiple system failures affecting aircraft performance;

iii. coasting on inertial sensors beyond a specified time limit; and

iv. RAIM (or equivalent) alert or loss of integrity function.

10.11.2 In the event of loss of PBN capability, the flight crew should invoke contingency procedures and navigate using an alternative means of navigation.

10.11.3 The flight crew should notify ATC of any problem with PBN capability.

10.11.4 In the event of communication failure, the flight crew should continue with the operation in accordance with published lost communication procedures.

10.12 Minimum Equipment List (MEL)

10.12.1 MELs based on the content of the relevant Master MEL (MMEL), are tailored to the operator's operation and their aircraft configuration. An MEL may be more stringent than MMEL however, any entry that is less stringent must be supported by a safety analysis to show that the alternate provision is acceptable, and that safety is not degraded.

10.12.2 Within the MMELs, for many systems the provisos contain statement such as "As required by regulations" or another equivalent phrase. Where these entries appear, the operator must replace the MMEL term with the requirements for their operation that meet the applicable regulatory requirement.

10.12.3 In many cases, the actual requirement for MEL will vary with route or specific operation being carried out. To prevent multiple documents containing the same or similar information, where there is route or other operation specific criterion, it is acceptable for the operator MEL to refer to the document that contains the specific requirement; such a document is often the Route Guide or other similar document.

10.12.4. In the MEL, the 'M' and 'O' procedure form part of the approved MEL since they are part of the means of achieving the equivalent level of safety. It is the

operator's responsibility to develop these procedures; the procedure may be in the MEL or may be included into another document with specific reference to that document included in MEL.

10.12.5 Effect of Failures

10.12.5.1 In modern aircraft where many systems are interconnected. It is not always obvious which systems in the aircraft will be affected by another system or component failure. For this reason, MELs need to identify other systems that will be affected by a failure or when the operational capability of the aircraft may be degraded. Using GNSS as an example: GNSS is used as a primary navigation sensor, it provides position and other information to any installed ADS-B system, it is the primary position sensor for Terrain Awareness and Warning System (TAWS) and, in some aircraft, it aids SATCOM antenna steering.

10.12.5.2 Similarly, many systems have multiple inputs that in some circumstances may have little operational impact but in other may be significant.

10.12.5.3 For clarify, it is recommended that the MEL entries for the failed system and the other systems affected are both annotated to identify impact of the failure.

10.12.6 System connected o Reversionary Power Sources.

10.12.6.1 A recent change in emphasis in MMEL has been considerations of the source of electrical power for systems that are essential for the continued safe flight and landing of the aircraft. For this reason, it is now common for the remarks associated with equipment to require any system connected to high priority busses. Such as essential or battery busses, to be operative on departure.

10.12.6.2 When developing MELs, operators need to be aware of the needs to preserve the electrical power to essential systems for as long as practicable in the event of an electrical power system failure.

10.12.6.3 Operator may be operating to destinations where there is no support capability for aircraft; any repairs or replacement would require maintenance personnel to be flown in. In such case, if a system connected to a high priority electrical power source fail, the most practicable option is to fly the aircraft to a location where repairs or replacement can be affected.

10.12.6.4 To facilitate such flights, the operator MEL need to specify the condition governing the flight with the period off the aircraft operating in the condition being limited to the minimum necessary. Under the FAA/EASA MMEL structure, such a

provision will be a Repair Category A item and must be repaired within the time interval specified in the “Remarks or Exceptions” column of the operator’s MEL.

10.12.6.5 In situation where aircraft should not be operated in IMC, it is recommended that the operating limitation not prohibited IFR operations. If IFR operations were prohibited, the aircraft would have to operate VFR, which could mean that it will be unable to operate or cause it to operate at lower altitudes where it will be closer to terrain, possibly in adverse weather, and may be more inefficient. It is recommended that the MEL provisions limit the aircraft to day VMC operations to provide the operational flexibility.

10.13 Reportable Event of PBN operations

10.13.1 A reportable event should be an event that adversely affects the safety of the operation and may be caused by actions or events external to the functioning of the aircraft navigation system.

10.13.2 Technical defects and the exceedance of technical limitations, including:

a) significant navigation errors attributed to incorrect data or a database coding error.

b) unexpected deviations in lateral/vertical flight path not caused by flight crew input or erroneous operation of equipment.

c) significant misleading information without a failure warning.

d) total loss or multiple navigation equipment failure; and

e) loss of integrity, e.g., RAIM function, whereas integrity was predicted to be available during preflight planning,should be considered a reportable event.

10.13.3 The operator should have in place a system for investigating a reportable event to determine if it is due to an improperly coded procedure or a navigation database error. The operator should initiate corrective actions for such an event.

Appendix I: RNAV 10 (RNP 10) Technical & Operational Criteria

Although RNAV 10 airspace is, for historical reasons, also called RNP 10 airspace, there is no requirement for onboard monitoring and alerting systems.

1. Accuracy

A track-keeping accuracy equal to or better than +/- 10 NM for 95% of the flight time without regular updates from ground-based navigation aids.

RNAV 10 can support 50 NM track spacing.

2. Category & Area of Operation

RNAV 10 is for operations in oceanic and remote areas and does not require any ground-based NAVAID infrastructure or assessment.

3. Minimum Navigation Equipment

For an aircraft to operate in RNAV 10 (RNP 10) airspace it needs to be equipped with a minimum of two independent long range navigation systems (LRNS).

Each LRNS should in principle have a flight management system (FMS) that utilises positional information from either an approved global navigation satellite system (GNSS) or an approved inertial reference system (IRS) or mixed combination.

The mix of sensors (pure GNSS, pure IRS or mixed IRS/GNSS) determines pre-flight and in-flight operation and contingencies in the event of system failure.

4. Minimum Communication & ATS Surveillance

Minimum communication and ATS surveillance is not established globally by ICAO. The operating crew must ensure the minimum communication requirements are met by reviewing the appropriate Aeronautical Information Publication (AIP).

5. Minimum Equipment List

The MEL should specify the required dispatch conditions for RNAV 10 operations.

6. Training Requirements

The applicant/squadron must ensure, and continue to ensure that pilots are knowledgeable of the RNAV 10 operating practices and procedures.

7. Navigation Database

The navigation database must be current and appropriate for the operations and must include the NAVAIDs and waypoints required for the route.

8. Acceptable Means of Compliance for Approval of RNAV 10 (RNP 10)

Documentary evidence to demonstrate that the aircraft is suitably equipped for RNAV 10 must be provided to support the application.

If a statement of compliance with any of the following specifications or standards is found in the acceptable documentation as listed above, the aircraft is eligible for RNAV 10 operations.

a. RNP 10;

b. FAA AC 20-138 for the appropriate navigation specification;

c. EASA AMC 20-12;

d. FAA Order 8400.12 (or later revision); and

e. FAA AC 90-105.

Appendix II: RNP 4 Technical & Operational Criteria

RNP 4 was developed for operations in oceanic and remote airspace; therefore, it does not require any ground-based NAVAID infrastructure. GNSS is the primary navigation sensor to support RNP 4, either as a stand-alone navigation system or as part of a multi-sensor system.

1. Accuracy

RNP 4 provides a track-keeping accuracy equal to or better than +/- 4 NM for 95% of the flight time without regular updates from ground-based navigation aids.

2. Category & Area of Operation

RNP 4 is for operations in oceanic and remote areas and does not require any ground-based NAVAID infrastructure or assessment.

3. Minimum Navigation Equipment

To meet the accuracy of RNP 4, two independent LRNSs are required for which GNSS sensors are mandatory. If GNSS is used as a stand-alone LRNS, an integrity check is foreseen (fault detection and exclusion: FDE). RNP 4 shall not be used in areas of known GNSS signal interference.

The maximum allowable time for which FDE capability is projected to be unavailable on any one event is 25 minutes. This maximum outage time must be included as a condition of the RNP 4 operational approval. If predictions indicate that the maximum allowable FDE outage will be exceeded, the operation must be rescheduled to a time when FDE is available.

4. Minimum Communication & ATS Surveillance

Additional aircraft requirements include two long range communication systems (LRCSs) in order to operate in RNP 4 designated airspace. The appropriate Aeronautical Information Publication (AIP) should be consulted to assess coverage of HF and SATCOM. The MAA requires evidence of automatic dependent surveillance-contract (ADS-C) and controller pilot data link communication (CPDLC) equipment before a request for RNP 4 approval can be considered.

5. Minimum Equipment List

The MEL must specify the required dispatch conditions for RNP 4 operations.

6. Training Requirements

Applicants/Squadron must ensure that pilots are trained and have appropriate knowledge of the topics contained in this guidance material, the limits of their RNP 4 navigation capabilities, the effects of updating, and RNP 4 contingency procedures.

In determining whether training is adequate, MAA might evaluate a training course before accepting a training center certificate from a specific center.

7. Navigation Database

The navigation database should be obtained from a supplier that complies with RTCA DO 200A/EUROCAE document ED 76, Standards for Processing Aeronautical Data. An LOA issued by the appropriate regulatory authority demonstrates compliance with this requirement (e.g. FAA LOA issued in accordance with FAA AC 20-153 or EASA LOA issued in accordance with EASA Opinion Nr. 01/2005.

The applicant/squadron must report any discrepancies invalidating an ATS route to the navigation database supplier, and the applicant/squadron must take actions to prohibit their pilots from flying the affected ATS route.

Applicant/squadron may conduct periodic checks of the operational navigation databases in order to meet existing quality system requirements.

Note. - To minimize Path definition error (PDE), the database should comply with DO-200A/ED-76, or an equivalent operational means must be in place to ensure database integrity for the RNP 4.

8. Acceptable Means of Compliance for Approval of RNP 4

Documentary evidence to demonstrate that the aircraft is suitably equipped for RNP 4 must be provided to support the application.

If a statement of compliance with any of the following specifications or standards is found in the acceptable documentation as listed above, the aircraft is eligible for RNP 4 operations.

a. FAA AC 20-138B or later, for the appropriate navigation specification;

b. FAA Order 8400.33; and

c. FAA AC 90-105 for the appropriate navigation specification.

Appendix III: RNP 2 Technical & Operational Criteria

RNP 2 is primarily intended for a diverse set of en-route applications, particularly in geographic areas with little or no ground NAVAID infrastructure, limited or no ATS surveillance, and low to medium density traffic. Use of RNP 2 in continental applications requires a lower continuity requirement than used in oceanic/remote applications.

1. Accuracy

RNP 2 provides a track-keeping accuracy equal to or better than +/- 2 NM for 95% of the flight time without regular updates from ground-based navigation aids.Unlike RNP 4 there is no standard track spacing for RNP 2.

2. Category & Area of Operation

There are 2 types of RNP 2, Continental and Oceanic/Remote:

- RNP 2 Continental, one LRNS is required for which GNSS sensors are mandatory: and
- RNP 2 Oceanic/Remote for which two independent LRNSs are required. for which GNSS sensors are mandatory,

Note: Applicant/Squadron of aircraft with a single LRNS can only apply for RNP 2 Continental. Operators of aircraft with 2 LRNSs can apply for RNP 2 Oceanic/Remote and Continental approval.

3. Minimum Navigation Equipment

The RNP 2 specification is based upon GNSS.

Operators relying on GNSS are required to have the means to predict the availability of GNSS fault detection (e.g. RAIM) to support operations along the RNP 2 ATS route. The on-board RNP system, GNSS avionics, the ANSP or other entities may provide a prediction capability. The AIP should clearly indicate when prediction capability is required and an acceptable means to satisfy that requirement.

In the event of a predicted, continuous loss of appropriate level of fault detection of more than five (5) minutes for any part of the RNP 2 operation, the operator should revise the flight plan (e.g. delay the departure or plan a different route).

4. Minimum Communication & ATS Surveillance

Communication performance on RNP 2 routes will be commensurate with operational considerations such as route spacing, traffic density, complexity and contingency procedures. The operating crew must ensure the minimum communication requirements are met by reviewing the appropriate Aeronautical Information Publication (AIP).

5. Minimum Equipment List

The MEL should specify the required dispatch conditions for RNP 2 operations.

6. Training Requirements

The training requirements should be in accordance with the ICAO PBN Manual (Doc 9613) for RNP 2**.**

7. Navigation Database

The operator must obtain the navigation database from a supplier complying with RTCA DO 200A/EUROCAE document ED 76, Standards for Processing Aeronautical Data, and the database must be compatible with the intended function of the equipment. Regulatory authorities recognize compliance to the referenced standard using a LOA or other equivalent document.

The operator must report any discrepancies invalidating an ATS route to the navigation database supplier, and the operator must take actions to prohibit their pilots from flying the affected ATS route.

The operators should consider the need to conduct periodic checks of the operational navigation databases in order to meet existing quality system requirements.

8. Acceptable Means of Compliance for Approval of RNP 2

RNP 2 oceanic

a. If a statement of compliance with FAA AC 90-105 for the appropriate navigation specification is found in the acceptable documentation as listed above, the aircraft is eligible for RNP 2 oceanic operations.

b. If the aircraft has been assessed eligible for RNP 4, the aircraft is eligible for RNP 2 oceanic.

Appendix IV: RNAV 5 Technical & Operational Criteria

RNAV 5, also known as B-RNAV in Europe is a basic area navigation capability.

1. Accuracy

A track-keeping accuracy equal to or better than +/- 5 NM for 95% of the flight time.

2. Category & Area of Operation

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

3. Minimum Navigation Equipment

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

a. VOR/DME;

b. DME/DME;

c. INS or IRS; and

d. GNSS.

4. Minimum Communication & ATS Surveillance

Direct pilot to ATC (voice) communications is required.Radar monitoring by ATS may be used to mitigate the risk of gross navigation errors, provided the route lies within the ATS surveillance and communications service volumes and the ATS resources are sufficient for the task.

5. Minimum Equipment List

The MEL should specify the required dispatch conditions for RNAV 5 operations

6. Training Requirements

The training requirements should be in accordance with the ICAO PBN Manual (Doc 9613) for RNAV 5

7. Navigation Database

Where a navigation database is carried and used, it should be current and appropriate for the intended operations and must include the NAVAIDs and waypoints required for the route.

8. Acceptable Means of Compliance for Approval of RNAV 5

If a statement of compliance with any of the following specifications or standards is found in the acceptable documentation as listed below, the aircraft is eligible for RNAV 5 operations.

a. B-RNAV;

b. RNAV 1;

c. RNP APCH;

d. RNP 4;

e. A-RNP;

f. EASA AMC 20-4;

g. JAA TEMPORARY GUIDANCE MATERIAL, LEAFLET NO. 2 (TGL 2);

h. JAA AMJ 20X2;

i. FAA AC 20-130A for en route operations;

j. FAA AC 20-138 for en route operations; and

k. FAA AC 90-96.

Appendix V: RNAV 1 and RNAV 2 Technical & Operational Criteria

The RNAV 1 and 2 standards resulted from the harmonization of US and European standards. Aircraft requirements for RNAV 1 and RNAV 2 are identical, whilst some operating procedures are different.

1. Accuracy

RNAV 1 provides a track-keeping accuracy equal to or better than +/- 1 NM for 95% of the flight time.

RNAV 2 provides a track-keeping accuracy equal to or better than +/- 2 NM for 95% of the flight time.

2. Category & Area of Operation

The RNAV 1 & RNAV 2 specification is applicable for area navigation operations globally. RNAV 1 and RNAV 2 are suitable for en-route continental operations and Departure and Arrival routes.

RNAV 1 is also suitable for Initial, Intermediate and Missed Approach

3. Minimum Navigation Equipment

RNAV 1 and RNAV 2 operations are based upon the use of RNAV equipment that automatically determines the aircraft position in the horizontal plane using input from the following types of position sensors (no specific priority):

(a) GNSS in accordance with FAA TSO-C145, TSO-C146, or TSO-C129. Positioning data from other types of navigation sensors may be integrated with the GNSS data provided other position data does not cause position errors exceeding the total system accuracy requirements. The use of GNSS equipment approved to TSO-C129 is limited to those systems which include the minimum functions specified in 3.3.3.3. of the ICAO PBN Manual. As a minimum, integrity should be provided by an ABAS. In addition, TSO-C129 equipment should include the following additional functions;

(b) pseudo-range step detection;

(c) health word checking;

(d) DME/DME RNAV equipment; and

(e) DME/DME/IRU RNAV equipment.

Note: Refer to ICAO PBN Manual (Doc 9613) for further details.

4. Minimum Communication & ATS Surveillance

Where reliance is placed on the use of radar to assist contingency procedures, its performance should be adequate for that purpose, i.e., radar coverage, its accuracy, continuity and availability should be adequate to ensure separation on the RNAV 1 and RNAV 2 ATS route structure and provide contingency in cases where several aircraft are unable to achieve the navigation performance prescribed in this navigation specification.

5. Minimum Equipment List

The MEL should specify the required dispatch conditions for RNAV 1 and RNAV 2 operations.

6. Training Requirements

The training requirements should be in accordance with the ICAO PBN Manual (Doc 9613) for RNAV 1 and RNAV 2.

7. Navigation Database

The navigation database should be obtained from a supplier that complies with RTCA DO 200A/EUROCAE document ED 76, Standards for Processing Aeronautical Data and should be compatible with the intended function of the equipment (Annex 6, Part 1, Chapter 7). An LOA, issued by the appropriate regulatory authority to each of the participants in the data chain, demonstrates compliance with this requirement (e.g. FAA LOA issued in accordance with FAA AC 20-153 or EASA LOA issued in accordance with EASA Opinion Nr. 01/2005.

Discrepancies that invalidate a route must be reported to the navigation database supplier and affected routes must be reported to the pilots.

8. Acceptable Means of Compliance for Approval of RNAV 1 RNAV 2

If a statement of compliance with any of the following specifications or standards is found in the acceptable documentation as listed above, the aircraft is eligible for RNAV 1/RNAV 2 operations.

a. RNAV 1;
b. P-RNAV;
c. US RNAV type A;
d. FAA AC 20-138 for the appropriate navigation specification;
e. FAA AC 90-100A;
f. JAA TEMPORARY GUIDANCE MATERIAL, LEAFLET NO. 10 Rev1 (TGL 10); and
g. FAA AC 90-100.

However, if position determination is exclusively computed based on VOR-DME, the aircraft is not eligible for RNAV 1/RNAV 2 operations.

Appendix VI: RNP 1 Technical & Operational Criteria

The RNP 1 specification provides a means to develop routes for connectivity between the en-route structure and terminal airspace with no or limited ATS surveillance, with low to medium density traffic.

RNP 1 specification is based upon GNSS. While DME/DME-based RNAV systems are capable of RNP 1 accuracy, this navigation specification is primarily intended for environments where the DME infrastructure cannot support DME/DME area navigation to the required performance. The increased complexity in the DME infrastructure requirements and assessment means it is not practical or cost-effective for widespread application.

1. Accuracy

RNP 1 provides a track-keeping accuracy equal to or better than +/- 1 NM for 95% of the flight time for the following segments:

a. arrival*

b. initial approach

c. intermediate approach

d. missed approach**

e. departure*

* Beyond 30nm from the ARP, the accuracy value for alerting becomes +/-2 NM.

** Area of application can only be used after the initial climb of a missed approach phase.

2. Category & Area of Operation

RNP 1 is primarily intended for arrival and departure capability in terminal areas for use at aerodromes with low traffic density where ATS radar surveillance is limited or not available, and is limited to STARs and SIDs.

3. Minimum Navigation Equipment

The following systems meet the accuracy, integrity and continuity requirements of these criteria:

a. aircraft with E/TSO-C129a sensor (Class B or C), E/TSO-C145 and the requirements of E/TSOC115b FMS, installed for IFR use in accordance with FAA AC 20-130A;

b. aircraft with E/TSO-C129a Class A1 or E/TSO-C146 equipment installed for IFR use in accordance with FAA AC 20-138 or AC 20-138A; and

c. aircraft with RNP capability certified or approved to equivalent standards.

Note: For RNP procedures, the RNP system may only use DME updating when authorized by the State (this is not applicable in Thailand).

RNP 1 shall not be used in areas of known navigation signal (GNSS) interference.

4. Minimum Communication & ATS Surveillance

This navigation specification is intended for environments where ATS surveillance is either not available or limited.

RNP 1 SIDs/STARs are primarily intended to be conducted in Direct controller/pilot communication (DCPC) environments.

5. Minimum Equipment List

The MEL should specify the required dispatch conditions for RNP 1 operations.

6. Training Requirements

The training requirements should be in accordance with the ICAO PBN Manual (Doc 9613) for RNP 1.

7. Navigation Database

The navigation database must be obtained from a supplier that complies with RTCA DO 200A/EUROCAE document ED 76, Standards for Processing Aeronautical Data. An LOA issued by the appropriate regulatory authority to each of the participants in the data chain demonstrates compliance with this requirement (e.g. FAA LOA issued in accordance with FAA AC 20-153 or EASA LOA issued in accordance with EASA Opinion Nr. 01/2005.

Discrepancies that invalidate a SID or STAR must be reported to the navigation database supplier, and the affected SID or STAR must be prohibited by an operator's notice to its pilots.

Aircraft operators may conduct periodic checks of the operational navigation databases in order to meet existing quality system requirements.

Note: To minimize Path definition errorPDE, the database should comply with DO 200A, or an equivalent operational means must be in place to ensure database integrity for the RNP 1 SIDs or STARs.

8. Acceptable Means of Compliance for Approval of RNP 1

If a statement of compliance with any of the following specifications or standards is found in the acceptable documentation as listed above, the aircraft is eligible for RNP 1 operations.

a. A-RNP;
b. FAA AC 20-138 for the appropriate navigation specification; and
c. FAA AC 90-105.

Alternatively, if a statement of compliance with any of the following specifications or standards is found in the acceptable documentation as listed above and position determination is primarily based on GNSS, the aircraft is eligible for RNP 1 operations:

a. JAA TEMPORARY GUIDANCE MATERIAL, LEAFLET NO. 10 (TGL 10) (any revision);
b. FAA AC 90-100.

However, these specifications are RNAV specifications and allow for a DME/DME position determination, if the system with this specification uses both DME/DME and GNSS, loss of GNSS implies loss of RNP 1 capability.

Appendix VII: RNP APCH Technical & Operational Criteria

The RNP APCH includes LNAV, LNAV/VNAV, LPV & LP approaches.

2D Approach Operations - LNAV and LP use lateral guidance only;

LP approaches are available at few aerodromes and many aircraft types are not equipped to carry them out. These are also known as RNP Approach in the United States of America.

3D Approach Operations - LNAV/VNAV and LPV use both lateral and vertical guidance.

LNAV/VNAV is also known as APV-Baro VNAV.

LPV is also known as APV SBAS.

1. Accuracy

Refer to Table 4: Application of Navigation Specification by Flight Phase.

2. Category & Area of Operation

RNP APCH is for use during approach and missed-approaches.

3. Minimum Navigation Equipment

The following systems meet the accuracy, integrity and continuity requirements of these criteria:

a. GNSS stand-alone systems, equipment should be approved in accordance with TSO-C129a/ ETSO-C129a Class A, E/TSO-C146 Class Gamma and operational class 1, 2 or 3, or TSO-C196;

b. GNSS sensors used in multi-sensor system (e.g. FMS) equipment should be approved in accordance with TSO-C129 / ETSO-C129 Class B1, C1, B3, C3 or E/TSO-C145 class 1, 2 or 3, or TSO-C196. For GNSS receiver approved in accordance with E/TSO-C129, capability for satellite FDE is recommended to improve continuity of function; and

c. multi-sensor systems using GNSS should be approved in accordance with AC20-130A or TSO-C115b, as well as having been demonstrated for RNP APCH capability.

4. Minimum Communication & ATS Surveillance

RNP APCH does not include specific requirements for communication or ATS surveillance.

Adequate obstacle clearance is achieved through aircraft performance, operating procedures and procedure design. Where reliance is placed on the use of radar to assist contingency procedures, its performance will be shown to be adequate for that purpose, and the requirement for a radar service will be identified in the AIP.

RT phraseology appropriate to RNP APCH operations will be promulgated.

5. Minimum Equipment List

The MEL should specify the required dispatch conditions for RNP APCH operations to LNAV, LNAV/VNAV, LPV and/or LP minima as appropriate.

6. Training Requirements

The training requirements should be in accordance with the ICAO PBN Manual (Doc 9613) for RNP APCH to LNAV, LNAV/VNAV, LPV and/or LP minima.

7. Navigation Database

The Operator should implement procedures that ensure timely distribution and insertion of current and unaltered electronic navigation data to all aircraft that require it.

The Operator must hold a valid copy of the Navigation Database Management Type 2 LOA, or equivalent, issued by EASA, FAA or Transport Canada.

Note:

a) *EASA Type 2 LoA is issued by EASA in accordance with EASA OPINION Nr. 01/2005 on "The Acceptance of Navigation Database Suppliers" dated 14 Jan 05, or*
b) *The FAA Type 2 LoA in accordance with AC 20-153A.*
c) *Transport Canada (TCCA) issues an acknowledgement letter of an Aeronautical Data Process using the same basis.*

Discrepancies that invalidate a procedure must be reported to the navigation database supplier and affected procedures must be prohibited by an operator's notice to its pilots.

The Operator may wish to conduct ongoing checks of the operational navigation databases in order to meet existing quality system requirements.

8. Acceptable Means of Compliance for Approval of RNP APCH

Any limitation such as 'within the US National Airspace' may be ignored since RNP APCH procedures are assumed to meet the same ICAO criteria around the world.

RNP APCH – LNAV Minima

Documentary evidence to demonstrate that the aircraft is suitably equipped for RNP APCH – LNAV must be provided to support the application.

Alternatively, if a statement of compliance with any of the following specifications or standards is found in any of the documents listed in 3.0.1 Acceptable Document for Demonstration of Compliance, the aircraft is eligible for RNP APCH – LNAV operations:

a. AMC 20-27;
b. AMC 20-28;
c. FAA AC 20-138 for the appropriate navigation specification; and
d. FAA AC 90-105 for the appropriate navigation specification.

Or, if a statement of compliance with RNP 0.3 GNSS approaches in accordance with any of the following specifications or standards is found in the acceptable documentation as listed below, the aircraft is eligible for RNP APCH-LNAV operations. Any limitation such as 'within the US National Airspace' may be ignored since RNP APCH procedures are assumed to meet the same ICAO criteria around the world.

a. JAA TEMPORARY GUIDANCE MATERIAL, LEAFLET NO. 3 (TGL 3);

b. AMC 20-4;

c. FAA AC 20-130A; and

d. FAA AC 20-138.

RNP APCH – LNAV/VNAV minima

Documentary evidence to demonstrate that the aircraft is suitably equipped for RNP APCH-LNAV/VNAV must be provided to support the application.

If a statement of compliance with any of the following specifications or standards is found in the acceptable documentation as listed above, the aircraft is eligible for RNP APCH-LNAV/VNAV operations.

a. A-RNP;

b. AMC 20-27 with Baro VNAV;

c. AMC 20-28;

d. FAA AC 20-138; and

e. FAA AC 90-105 for the appropriate navigation specification.

Alternatively, if a statement of compliance with FAA AC 20-129 is found in the acceptable documentation as listed above, and the aircraft complies with the requirements and limitations of EASA SIB 2014-041, the aircraft is eligible for RNP APCH - LNAV/VNAV operations. *Any limitation such as 'within the US National Airspace' may be ignored since RNP APCH procedures are assumed to meet the same ICAO criteria around the world.*

RNP APCH - LPV minima

If a statement of compliance with any of the following specifications or standards is found in the acceptable documentation as listed above, the aircraft is eligible for RNP APCH-LPV operations.

a. AMC 20-28;

b. FAA AC 20-138 for the appropriate navigation specification; and

c. FAA AC 90-107.

For aircraft that have a TAWS Class A installed and do not provide Mode-5 protection on an LPV approach, the DH is limited to 250 ft.

RNP APCH - LP Minima

Documentary evidence to demonstrate that the aircraft is suitably equipped for RNP APCH-LP must be provided to support the application.

Alternatively, if a statement of compliance with any of the following specifications or standards is found in any of the documentation listed in 3.0.1 Acceptable Document for Demonstration of Compliance, the aircraft is eligible for RNP APCH – LP operations:

a. FAA AC 20-138 for the appropriate navigation specification; and

b. FAA AC 90-107.

9. Operational Criteria

Before planning a flight to an aerodrome (destination or alternate) with the intent to use an RNP APCH procedure contained in the Navigation Database, the operator should give consideration to an evaluation of any new or modified RNP APCH procedures.

Particular attention may be paid to procedures:

- in mountainous environments,
- within the proximity of well-known obstacles,
- in the absence of radar coverage,
- have a missed approach trajectory involve turns, especially at low altitudes, or
- are subject to a declared exemption to the procedure design rules specified by the ICAO PANS OPS.

An operational evaluation of a RNP APCH procedure of the above mentioned operational characteristics may include, at operator discretion, an approach conducted with the aircraft in VMC or the use of a full flight simulator (FFS) in order to evaluate if the procedure is correctly executed by the navigation system and fly-able with the aircraft type. Based on the results of the assessment, the appropriate information should be given to the operating crew.

Temperature Limits (when using Barometric VNAV)

Barometric VNAV (Baro-VNAV) operations may be subject to temperature limitation. When the aerodrome temperature is 0°C or colder, the temperature error correction must be taken into consideration in accordance the manufacturer's instructions.

Operators using Baro-VNAV in an aircraft with an airworthiness approval for automatic temperature compensation, or in an aircraft using an alternate means for vertical guidance e.g. Satellite-Based Augmentation Systems (SBAS), may disregard the temperature limits (high temperature limit still applies if the system only compensates for low temperature).

Performance-Based-Navigation (PBN)
Assessment Checklist

1. INTRODUCTION

1.1 This Checklist is provided to assist assessors carrying out PBN Approval assessments for the continental an oceanic/remote continental operation and to provide method of recording the assessment and the finding made.

1.2 The checklist addresses all PBN navigation specifications, with the exception of RNP AR APCH, so that the aircraft operation is assessed in a single activity. Where an operator will not be using all navigation specifications, the section of the checklist that are not applicable should be marked accordingly.

2. EXAMPLE OF Performance-Based-Navigation (PBN) Assessment Checklist

Part I Identification of Required PBN Ops Approvals & Aircraft

Has the operator identified the PBN navigation specifications for which an Ops Approval is required?	Yes ☐ No ☐ N/A ☐
Has the operator identified the aircraft to be assessed?	Yes ☐ No ☐ N/A ☐

Part 2 Identification of Documents Detailing Compliance with Requirements

Has the operator provided copies of the following documents? If Yes, note the details in the comments field.	
If the operator currently holds PBN Ops Approvals, copies of the approvals?	Yes ☐ No ☐ N/A ☐
Airworthiness documents showing aircraft eligibility for PBN operations. AFM, AFM revision, AFM Supplement or Type Certificate Data Sheet (TCDS) that show the RNAV/RNP navigation system is eligible for each of the intended PBN operations.	Yes ☐ No ☐ N/A ☐
Aircraft modified to meet PBN standards. Documentation on aircraft inspection and/or modification, if applicable. Maintenance records documenting the installation or modification of aircraft systems. *Note: If aircraft were not delivered in a PBN operations compliant configuration for each of the navigation specifications intended to be used, details as to how each aircraft was modified to become compliant with each applicable navigation specification are required. Where possible, reference should be made to aircraft OEM documentation.*	Yes ☐ No ☐ N/A ☐
Continuing Airworthiness Documentation to show that the aircraft will be maintained compliant with its type design.	Yes ☐ No ☐ N/A ☐
Minimum equipment list (MEL), If applicable, showing provisions for PBN systems.	Yes ☐ No ☐ N/A ☐
Training Training program for flight crews and flight dispatchers, as applicable. Training program for engineering and maintenance personnel, as applicable.	Yes ☐ No ☐ N/A ☐

Operating policies and procedures Operations Manual (OM) and checklists or sections to be attached to the application, corresponding to PBN operating procedures and policies.	Yes ☐ No ☐ N/A ☐
Navigation database Details of the navigation database management and validation programmed.	Yes ☐ No ☐ N/A ☐

Part 3 Determine Aircraft Eligibility

Does the aircraft have a current Certificate of Airworthiness (C of A)? If not, determine the intended configuration of the aircraft and its certification status.	Yes ☐ No ☐ N/A ☐
Does the operator hold PBN Ops Approvals for other aircraft of the same make/model as applied for in the application? **If yes,** has the operator submitted evidence of these previous Ops Approvals? Note the Ops Approvals held in the Comments field**.**	Yes ☐ No ☐ N/A ☐
Does the AFM, AFM Supplement, TCDS, OEM SIL, OEM certification or STC(s) applicable to the aircraft demonstrate eligibility for the navigation specifications for which Ops Approval is required? If yes, please note details in the comments field.	Yes ☐ No ☐ N/A ☐
If oceanic / remote continental operations Ops Approval is required, is the aircraft equipped with:	Yes ☐ No ☐ N/A ☐
Dual independent navigation systems that are qualified for oceanic / remote continental use? If yes, please note details in the comments field.	Yes ☐ No ☐ N/A ☐
If the aircraft eligibility is established through data collection, has the operator provided substantiation in accordance with the provisions of the PBN Manual Doc 9613 Ed 4 Vol II Part B Ch. 1?	Yes ☐ No ☐ N/A ☐
Has a detailed airworthiness assessment been completed? If Yes, please note details in the Comments field.	Yes ☐ No ☐ N/A ☐
Are there any modification documents (SIL, SB, EO or STC) applicable to the aircraft to demonstrate installation or approval of applicable navigation equipment with a statement that the aircraft, if fitted, is eligible for the required navigation authorizations?	Yes ☐ No ☐ N/A ☐
If Yes, has the operator attached a statement/certification indicating that any modifications (however authorized) have been successfully installed and tested?	Yes ☐ No ☐ N/A ☐
If a Baro-VNAV Ops Approval required, the aircraft must comply with the requirements of ICAO Doc 9613 Ed 4 Vol II Attachment 1:	Yes ☐ No ☐ N/A ☐
Does the AFM, AFM revision, AFM Supplement or Type Certificate Data Sheet (TCDS) show that the aircraft is approved for Baro-VNAV operations?	Yes ☐ No ☐ N/A ☐
Have the appropriate systems and calibration checks been carried out and certified?	Yes ☐ No ☐ N/A ☐
Are there any structural or skin repairs that would affect static source? Does the aircraft configuration drawing ("dent & buckle chart") show any repairs within the vicinity of the static source?	Yes ☐ No ☐ N/A ☐

If Yes, is there evidence to show that the aircraft altimetry system is compliant with Baro-VNAV requirements?	Yes ☐ No ☐ N/A ☐
Does the operator's supplied description of installed major components (equipment list for hardware and software) match the eligibility documents as noted above and/or the required equipment for the authorization?	Yes ☐ No ☐ N/A ☐
If the aircraft is fitted with dual installations, is the equipment identical (including software versions)? If not, are the differences minor only?	Yes ☐ No ☐ N/A ☐
Are there any aircraft limitations and conditions included in the aircraft eligibility documentation that will need to be reflected in the Ops Approvals? If Yes, please elaborate in the comments field.	Yes ☐ No ☐ N/A ☐

Part 4 : Continuing Airworthiness

Aircraft Maintenance	
Has the operator identified the documents that define the maintenance program for the aircraft and the PBN navigation systems?	Yes ☐ No ☐ N/A ☐
Does the operator have procedures for the oversight of maintenance subcontractors?	Yes ☐ No ☐ N/A ☐
Providing oversight of maintenance subcontractors;	Yes ☐ No ☐ N/A ☐
Ensuring that maintenance subcontractors are qualified to carry out the required maintenance; and	Yes ☐ No ☐ N/A ☐
Maintenance subcontractors have the required test equipment and tooling, and the equipment is maintained to the required accuracy.	Yes ☐ No ☐ N/A ☐
Maintenance subcontractors have the required training for personnel undertaking the subcontracted work.	Yes ☐ No ☐ N/A ☐
Has the operator provided evidence that all inspections, tests and calibration required in accordance with the aircraft maintenance program have been accomplished?	Yes ☐ No ☐ N/A ☐
Ensuring that only specific authorization compliant parts (including software) are able to be fitted to the aircraft?	Yes ☐ No ☐ N/A ☐
For aircraft modified to install a PBN navigation system(s), are the Instructions for Continued Airworthiness held by the operator and readily available to maintenance personnel?	Yes ☐ No ☐ N/A ☐
For aircraft modified to install a PBN navigation system(s), do the Instructions for Continued Airworthiness contain: • system description • system removal and installation instructions • system configuration set-up tables • system test and adjustment instructions • list of parts approved for maintaining the installation • wiring diagrams • list of any test equipment or tooling needed to maintain the installation	Yes ☐ No ☐ N/A ☐

Configuration Management	
Does the aircraft configuration management process have the appropriate elements for considering, authorizing, and managing aircraft configuration changes?	Yes ☐ No ☐ N/A ☐
Does the software configuration management process ensure that the software in each system is maintained in a configuration that is compatible with the aircraft installation and has no significant operational differences?	Yes ☐ No ☐ N/A ☐
Does the software configuration list clearly identify the operator authorized software configuration(s) and the actual aircraft software configuration?	Yes ☐ No ☐ N/A ☐
Does the operator have procedures to ensure that? - Training devices are maintained so that they accurately replicate the actual aircraft configuration; and - The flight operations department are advised of any aircraft changes in case changes are required to operating procedures and/or training syllabi?	Yes ☐ No ☐ N/A ☐
Is the ELA current and has it considered any postproduction modifications?	Yes ☐ No ☐ N/A ☐
Does the equipment list accord with the ELA?	Yes ☐ No ☐ N/A ☐
Does the operator have documented procedures to ensure the ELA is maintained and the aircraft remains compliant with regulatory requirements and any manufacturer's limits?	Yes ☐ No ☐ N/A ☐
Does the operator have documented procedures to ensure that manufacturer service information is obtained and distributed within the organization so that technical and flight operations personnel are aware of matters relevant to their operation?	Yes ☐ No ☐ N/A ☐
Maintenance Training	
Is there evidence of initial and recurrent training of maintenance personnel appropriate to the authorizations sought?	Yes ☐ No ☐ N/A ☐

Part 5 : Minimum Equipment List (MEL)

Is the equipment used to demonstrate the required navigation accuracy identical to the configuration specified in the MEL and AFM?	Yes ☐ No ☐ N/A ☐
Do the submitted MEL extracts include provisions for the Ops Approvals sought? *In the Comments section, note the revision status of the MMEL used for the MEL preparation and the version of the MEL.*	Yes ☐ No ☐ N/A ☐
Does any proviso less stringent than that of the Master MEL have adequate substantiation to establish an equivalent level of safety?	Yes ☐ No ☐ N/A ☐
Do the MEL 'O' procedures reflect the required navigation equipment and systems are required to be serviceable for planned operations along the intended route including any designated alternates?	Yes ☐ No ☐ N/A ☐
Do the MEL 'M' procedures provide either the actions to be taken or references to the maintenance procedures for the action required?	Yes ☐ No ☐ N/A ☐

Where a system interfaces to other systems, are there notes or references to those other systems? For example, GNSS interfaces to ADS-B and TAWS, therefore GNSS being inoperative makes those systems inoperative	Yes ☐ No ☐ N/A ☐
Does the MEL permit the aircraft to depart with systems connected to high priority electrical power sources inoperative?	Yes ☐ No ☐ N/A ☐
If 'Yes', does the MEL limit the aircraft operation to the minimum required for it to be flown to a place where repairs or replacements can be made?	Yes ☐ No ☐ N/A ☐
Is the aircraft equipped with inertial reference systems?	Yes ☐ No ☐ N/A ☐
If 'Yes', has the inertial reference system installation been independently assessed as a primary attitude reference system and a navigation sensor system and is this reflected in the MEL?	Yes ☐ No ☐ N/A ☐

Part 6 : Operational Procedures

Flight Planning	
Does the operator have procedures to?	
File an ICAO flight plan with the appropriate codes used in Items 10 and 18.	Yes ☐ No ☐ N/A ☐
Confirm the availability of NAVAID infrastructure required for the intended routes.	Yes ☐ No ☐ N/A ☐
The navigation database is current and appropriate for the intended route.	Yes ☐ No ☐ N/A ☐
Verify approaches that may be used are in the navigation database and available for use.	Yes ☐ No ☐ N/A ☐
Determine the aircraft has an alternate means of navigation to fly to suitable aerodrome and land in case of loss of the RNP APCH capability.	Yes ☐ No ☐ N/A ☐
Account for any NOTAMs	Yes ☐ No ☐ N/A ☐
For missed approaches based on conventional NAVAIDs, verify the appropriate equipment is installed in the aircraft and operative	Yes ☐ No ☐ N/A ☐
Verify that the RNAV 10 (RNP 10) time limits have been taken into account (aircraft equipped with only INS/IRS).	Yes ☐ No ☐ N/A ☐
Verify requirements for GNSS, such as FDE, if applicable to the operation.	Yes ☐ No ☐ N/A ☐

If required, take into account any operational restriction related to RNAV 10 (RNP 10) approval for a specific navigation system.	Yes ☐ No ☐ N/A ☐
Confirm the availability of ABAS/SBAS for the intended route and time.	Yes ☐ No ☐ N/A ☐
Pre-Flight Procedures - Oceanic / Remote Continental Operations (if applicable)	
Does the operator have procedures to?	
Verify the LRNS to meet the required navigation specification are operative.	Yes ☐ No ☐ N/A ☐
Review the contingency procedures for oceanic / remote continental operations.	Yes ☐ No ☐ N/A ☐
General Operating Procedures	
Does the operator have procedures to:	
Direct pilots not to request or flight plan for routes or procedures unless all relevant and applicable requirements are met.	Yes ☐ No ☐ N/A ☐
Direct pilots to comply with any instructions and procedure the OEM of the aircraft or navigation system specify.	Yes ☐ No ☐ N/A ☐
Ensure that FTE is limited to ±½ the navigation accuracy associated with the route or procedure.	Yes ☐ No ☐ N/A ☐
Require monitoring flight progress and navigation reasonableness.	Yes ☐ No ☐ N/A ☐
Define system initialization procedures and requirements	Yes ☐ No ☐ N/A ☐
Retrieve SIDs/STARs from the navigation database by name.	Yes ☐ No ☐ N/A ☐
Retrieve RNP 2, RNAV 2 or RNAV 1 routes by name from the navigation database.	Yes ☐ No ☐ N/A ☐
Require pilots to cross-check the cleared flight plan by comparing charts with the aircraft navigation system and aircraft displays.	Yes ☐ No ☐ N/A ☐
Instruct pilots to not modify the flight plan in the navigation system in the event of ATC issuing a heading assignment taking the aircraft off an ATS route until cleared to re-join the ATS route (or a new ATS route).	Yes ☐ No ☐ N/A ☐
Instruct pilots on the impact of manually selecting bank angle limits and the need to avoid using such functions.	Yes ☐ No ☐ N/A ☐

Specific RNAV/RNP SID Requirements	
Does the operator have procedures to:	
Prior to flight, pilots must verify the aircraft navigation system is operating correctly.	Yes ☐ No ☐ N/A ☐
Require lateral flight guidance engagement procedure and requirements.	Yes ☐ No ☐ N/A ☐
Require the use of an authorized method of lateral guidance to achieve the required level of performance	Yes ☐ No ☐ N/A ☐
Specific RNAV/RNP STAR Requirements	
Does the operator have procedures to:	
Require pilots to verify the correct terminal route has been loaded prior to the arrival phase commencing	Yes ☐ No ☐ N/A ☐
Prohibit pilots creating new waypoints by manual entry.	Yes ☐ No ☐ N/A ☐
Where contingency procedures require reversion to conventional procedures, the pilot must complete all necessary preparation for such reversion prior to commencing any portion of the IAP.	Yes ☐ No ☐ N/A ☐
Require pilots to react to ATC assigned modifications to procedures	Yes ☐ No ☐ N/A ☐
Pilots to verify that the navigation system is operating correctly and the correct arrival procedure and runway are entered and correctly depicted.	Yes ☐ No ☐ N/A ☐
Require altitude and speed constraints to be observed.	Yes ☐ No ☐ N/A ☐
For aircraft using TSO C129a GNSS systems, if the procedure begins beyond 30 NM from the ARP and a lateral deviation indicator is used, the full scale sensitivity should be selected to not greater than 1 NM prior to commencing the STAR. For aircraft used lateral deviation display (i.e. a map display), the scale must be set for the RNP 1 STAR and the flight director or autopilot should be used.	Yes ☐ No ☐ N/A ☐
Approach Procedures - Prior to Commencing the Procedure	
Does the operator have procedures to:	
Require the flight crew to verify the correct procedure has been loaded by comparing the procedure with the approach charts prior to commencing the approach.	Yes ☐ No ☐ N/A ☐
Require flight crew to verify that a GNSS sensor is used for position computation when using multi-sensor systems.	Yes ☐ No ☐ N/A ☐
For a RNP system with aircraft-based augmentation system (ABAS) requiring barometric aiding, set the current aerodrome barometric altimeter setting	Yes ☐ No ☐ N/A ☐

Check GNSS availability.	Yes ☐ No ☐ N/A ☐
Have pilots react to ATC assigned modifications to procedures.	Yes ☐ No ☐ N/A ☐
Require the pilot to not revise the lateral flight path between the FAF and MAPT under any circumstance	Yes ☐ No ☐ N/A ☐
Approach Procedures - During the Procedure	
Does the operator have procedures to:	
Require the aircraft to be established on course prior to FAF.	Yes ☐ No ☐ N/A ☐
Require pilots to check the approach mode is active prior to FAF.	Yes ☐ No ☐ N/A ☐
Require pilots to select appropriate displays so that desired track and cross track deviation can be monitored.	Yes ☐ No ☐ N/A ☐
Specify the conditions that require the approach to be discontinued: - equipment failure indication; - loss of the integrity alerting function; - integrity alert; or - excessive FTE	Yes ☐ No ☐ N/A ☐
Require the missed approach to be flown in accordance with the published procedure and to use the RNP system during the missed approach.	Yes ☐ No ☐ N/A ☐
Require pilots to use a lateral deviation indicator, flight director and/or autopilot in the lateral navigation mode to limit the FTE to within ±½ the required navigation accuracy required for the particular segment of the procedure.	Yes ☐ No ☐ N/A ☐
Require the vertical deviations to not exceed the vertical FTE limits when Baro-VNAV is used for vertical path guidance during the FAS.	Yes ☐ No ☐ N/A ☐
Require altitude and speed constraints to be observed.	Yes ☐ No ☐ N/A ☐
En Route Procedures - Oceanic/Remote Continental Operations	
Does the operator have procedures to:	
Verify two LRNS meeting the minimum RNP specified are operating before the oceanic entry point.	Yes ☐ No ☐ N/A ☐
Perform navigation accuracy check and position update (if necessary) using an accepted method before entering oceanic airspace.	Yes ☐ No ☐ N/A ☐
Cross-check aircraft navigation in order to identify navigation errors in advance and prevent the aircraft from inadvertently deviating from the routes authorized by the ATC.	Yes ☐ No ☐ N/A ☐

Advise ATC of loss of long-range navigation capability and operate in accordance with procedures applicable to the airspace.	Yes ☐ No ☐ N/A ☐
Use automatic and manual radio updating of position functions.	Yes ☐ No ☐ N/A ☐
Contingency Procedures	
Does the operator have procedures to:	
Advise ATC of any loss of the RNAV/RNP capability (integrity alerts or loss of navigation), together with the proposed course of action.	Yes ☐ No ☐ N/A ☐
Continue with the flight plan in accordance with the published “lost communications” procedure in the event of communications failure.	Yes ☐ No ☐ N/A ☐
Report navigation errors.	Yes ☐ No ☐ N/A ☐
RF Leg Procedures (if applicable)	
Does the operator have procedures to:	
Require the pilot to use either a flight director or autopilot when flying an RF leg.	Yes ☐ No ☐ N/A ☐
Verify the requirement for RF legs by reviewing the appropriate chart	Yes ☐ No ☐ N/A ☐
Require the dispatcher/pilot to determine that the installed autopilot/flight director is operational when the dispatch of a flight is predicated on flying an RNP procedure with an RF leg.	Yes ☐ No ☐ N/A ☐
Not authorize a pilot to fly a published RNP procedure unless it is retrievable by the procedure name from the aircraft navigation database and conforms to the charted procedure. The lateral path must not be modified, with the exception of complying with ATC clearances/instructions.	Yes ☐ No ☐ N/A ☐
Require the aircraft to be established on the procedure prior to the beginning of the RF leg.	Yes ☐ No ☐ N/A ☐
Require the pilot to maintain the center line of the desired path on RF legs. For normal operations, the FTE should be limited to within ±½ the required navigation accuracy associated with the procedure.	Yes ☐ No ☐ N/A ☐
Require the pilot to not exceed maximum airspeeds associated with the fly-ability (design) of the RF leg. where published.	Yes ☐ No ☐ N/A ☐
Require the pilot to maintain the current bank and roll out on the charted RF exit course, if an aircraft system failure results in the loss of capability to follow an RF leg. The pilot should advise ATC as soon as possible of the system failure.	Yes ☐ No ☐ N/A ☐

Baro-VNAV Procedures (if applicable)	
Does the operator have procedures to:	
Recommend pilots to use a flight director or autopilot when flying a vertical path based on Baro-VNAV	Yes ☐ No ☐ N/A ☐
Require the pilot to comply with any instructions or procedures identified by the manufacturer as necessary to comply with the performance requirements for each applicable navigation specification	Yes ☐ No ☐ N/A ☐
Set the aircraft altimeters setting using local barometric settings at an appropriate time or location during the procedure.	Yes ☐ No ☐ N/A ☐
Operate using Baro-VNAV in cold temperatures within the approved temperature range for the aircraft.	Yes ☐ No ☐ N/A ☐
Require pilots, where the contingency procedure requires reversion to a conventional procedure, to complete the necessary preparations before commencing the RNAV procedure, consistent with operator practices.	Yes ☐ No ☐ N/A ☐

Part 7 : Operational Training

Flight Crew & Despatcher Knowledge and Training	
Does the operator have procedures to ensure that flight crew and despatchers are trained in the use and application of PBN?	Yes ☐ No ☐ N/A ☐
Does the operators flight crew and despatcher training syllabus cover each of the topics identified for each navigation specification to be used?	Yes ☐ No ☐ N/A ☐
When training is sourced from third party service providers, does the operator have procedures for the operator to oversight the supplier and ensure the required training is provided in accordance with operator and State requirements.	Yes ☐ No ☐ N/A ☐
Does the operator have procedures to ensure that training devices will accurately replicate the actual aircraft, navigation, and flight guidance systems?	Yes ☐ No ☐ N/A ☐
Do the operator's procedures ensure that training devices are modified to replicate the aircraft when aircraft are modified?	Yes ☐ No ☐ N/A ☐

Part 8 : Navigation Database Management

Does the operator have a nominated person responsible for the navigation database updating process?	Yes ☐ No ☐ N/A ☐
Is the operator’s data process under configuration control?	Yes ☐ No ☐ N/A ☐
Does the operator obtain their navigation database(s) from a supplier(s) holding a Letter of Acceptance for processing navigation data? For approach operations the LOA should be a LOA Type 2 (specific to the navigation system installed in their aircraft). If a LOA Type 2 is not held, they must hold a LOA Type 1.	Yes ☐ No ☐ N/A ☐

Does the operator have a documented process for:	
Accepting, verifying and loading navigation databases into aircraft.	Yes ☐ No ☐ N/A ☐
Ensuring that the navigation database loaded into an aircraft either: i) does not contain procedures for which the aircraft is not qualified; or ii) the navigation system will not load and execute such procedures.	Yes ☐ No ☐ N/A ☐
Reporting navigation database errors to the supplier. *The process needs to include reporting navigation database errors that may cause a loss of separation between aircraft or between an aircraft and terrain to the Authority under the Requirement on "occurrence reporting procedures".*	Yes ☐ No ☐ N/A ☐
The assessment of conventional routes and procedures to enable operations on these routes and procedures using PBN systems as alternate or substitute means of navigation (**Overlay operations/procedures**), when permitted by the Authority	Yes ☐ No ☐ N/A ☐