EASA
European Union Aviation Safety Agency

PBN Operational Approvals Workshop

Javier Cabrera Espinós

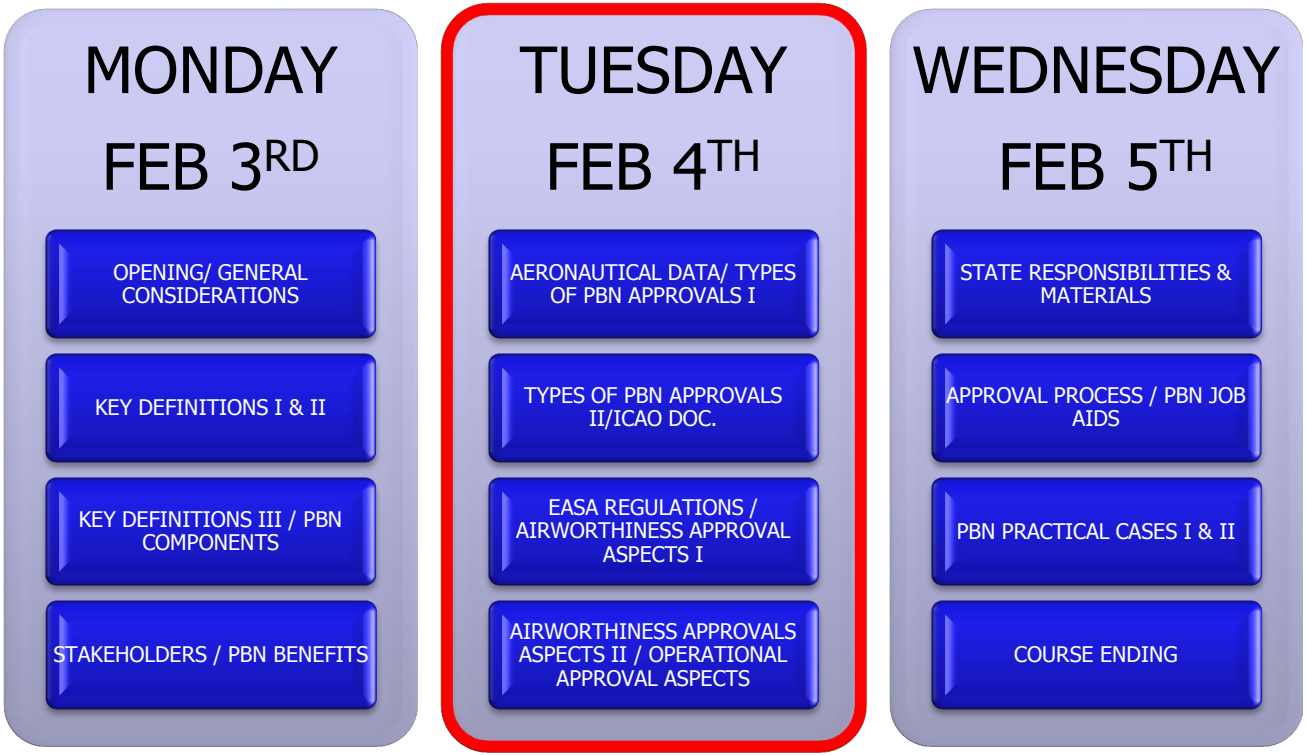
Bangkok, 3rd to 5th of February, 2020

Your safety is our mission.

An Agency of the European Union

EU-South East Asia Aviation Partnership Project (EU-SEA APP)
This project is funded by the European Union and implemented by the European Union Aviation Safety Agency - EASA

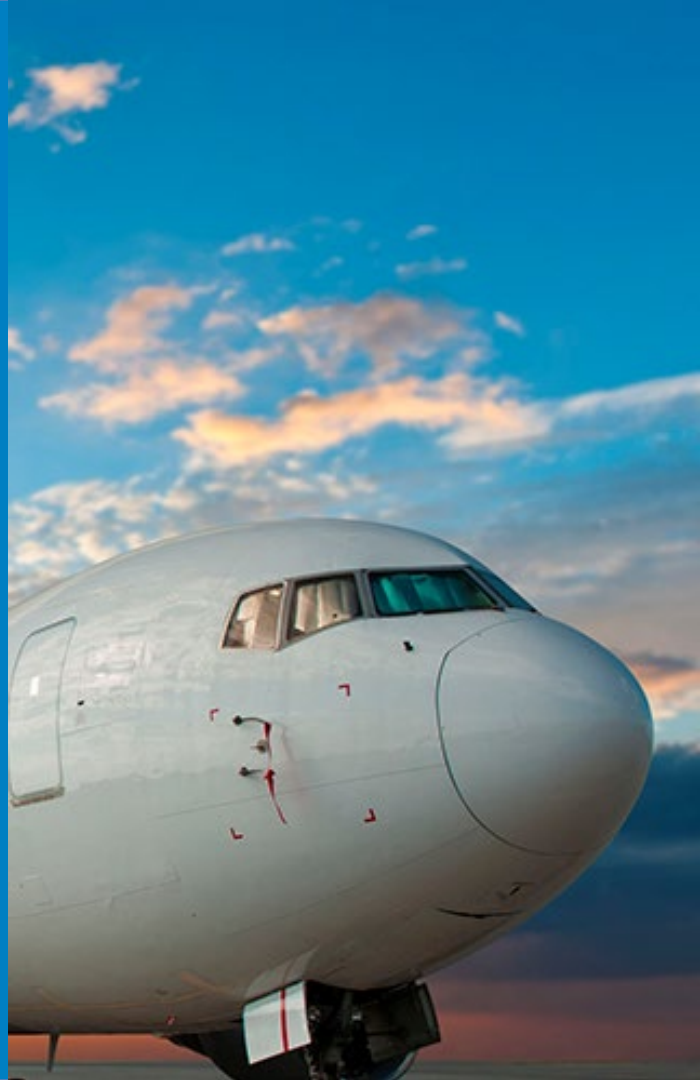
Agenda


MONDAY
FEB 3RD
OPENING/ GENERAL CONSIDERATIONS
KEY DEFINITIONS I & II
KEY DEFINITIONS III / PBN COMPONENTS
STAKEHOLDERS / PBN BENEFITS
TUESDAY
FEB 4TH
AERONAUTICAL DATA/ TYPES OF PBN APPROVALS I
TYPES OF PBN APPROVALS II/ICAO DOC.
EASA REGULATIONS / AIRWORTHINESS APPROVAL ASPECTS I
AIRWORTHINESS APPROVALS ASPECTS II / OPERATIONAL APPROVAL ASPECTS
WEDNESDAY
FEB 5TH
STATE RESPONSIBILITIES & MATERIALS
APPROVAL PROCESS / PBN JOB AIDS
PBN PRACTICAL CASES I & II
COURSE ENDING

EASA
European Union Aviation Safety Agency

Aeronautical Data

PBN Operational Approvals Workshop



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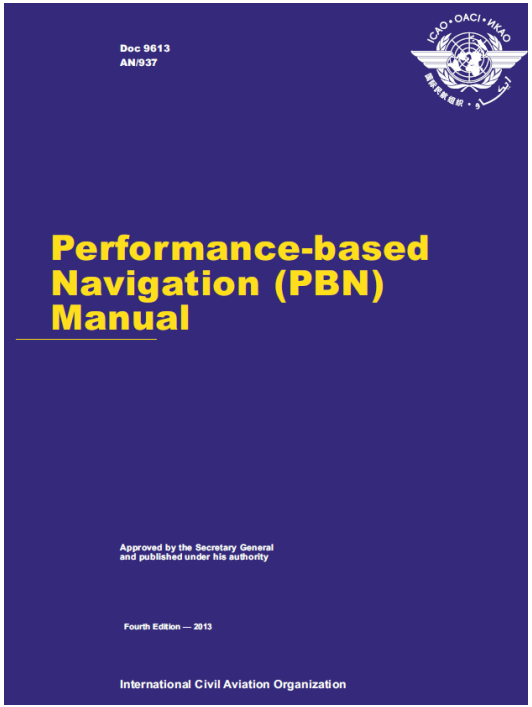
Aeronautical Data



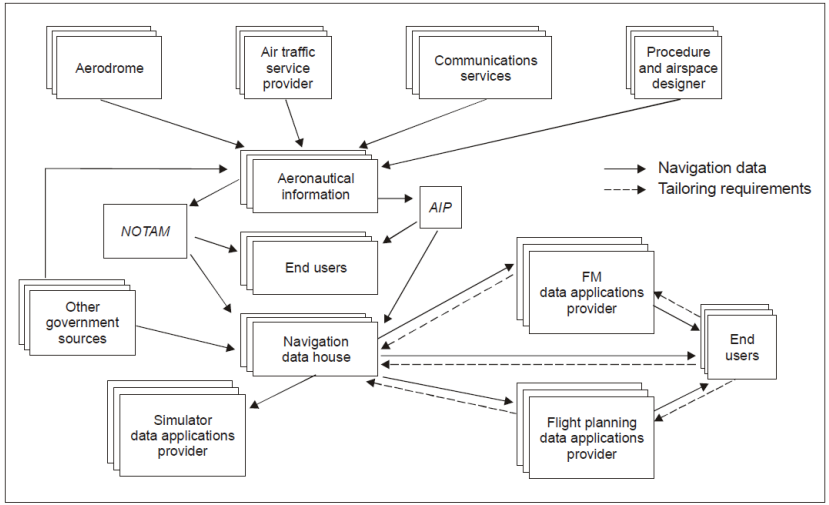
Attachment B. Data processes.....

1. Aeronautical data .....
2. Data accuracy and integrity ....
3. Provision of aeronautical data
4. Altering aeronautical data .....

Aeronautical Data

1. Aeronautical Data

→ An aeronautical data chain is a conceptual representation of the path that a set, or element, of aeronautical data takes from origination to end use. A number of different aeronautical data chains may contribute to a collection of data that are used by a RNAV application.



Aeronautical Data

2. Data Accuracy and Integrity

- Annex 15 — Aeronautical Information Services
  - The accuracy, resolution and integrity requirements of individual data items processed by the aeronautical data chain are detailed in this annex, which requires each Contracting State to take all necessary measures to ensure that the aeronautical information/data it provides is adequate, of required quality (accuracy, resolution and integrity), and is provided in a timely manner for the entire territory for which the State is responsible.
- Annex 15 — Aeronautical Information Services
  - Requires each Contracting State to introduce a properly organized quality system in conformance with the ISO 9000 series of quality standards.

Aeronautical Data

2. Data Accuracy and Integrity

- Annex 6 — Operation of Aircraft
  - Requires that the operators don't employ electronic navigation data products, unless the State of the Operator has approved the operator's procedures for ensuring that the process applied and the products delivered have met acceptable standards of integrity, and that the products are compatible with the intended function of the equipment. Additional guidance is provided in RTCA document DO-200A and EUROCAE document ED76, both entitled "Standards for Processing Aeronautical Data"..
- Annex 15 — Aeronautical Information Services
  - Requires each Contracting State to introduce a properly organised quality system in conformance with the ISO 9000 series of quality standards.

Aeronautical Data

3. Provision of Aeronautical Data

- Data provision
  - It is incumbent upon the national aviation authority in each State to arrange for the timely provision of required aeronautical information to the aeronautical information service (AIS) associated with aircraft operations.
  - Information provided under the AIRAC process must be distributed at least 42 days prior to the effective date and major changes should be published at least 56 days prior to the effective date.

Aeronautical Data

3. Provision of Aeronautical Data

- → Data processing cycle
  - → Requires that the database is delivered to the end user at least seven days before the effective date. The RNAV or RNP system provider requires at least eight days to pack the data prior to delivery to the end user, and the navigation data houses generally exercise a cut-off 20 days prior to the effective date in order to ensure that the subsequent milestones are met.
  - → Data supplied after the 20 day cut-off will generally not be included in the database for the next cycle.

Aeronautical Data

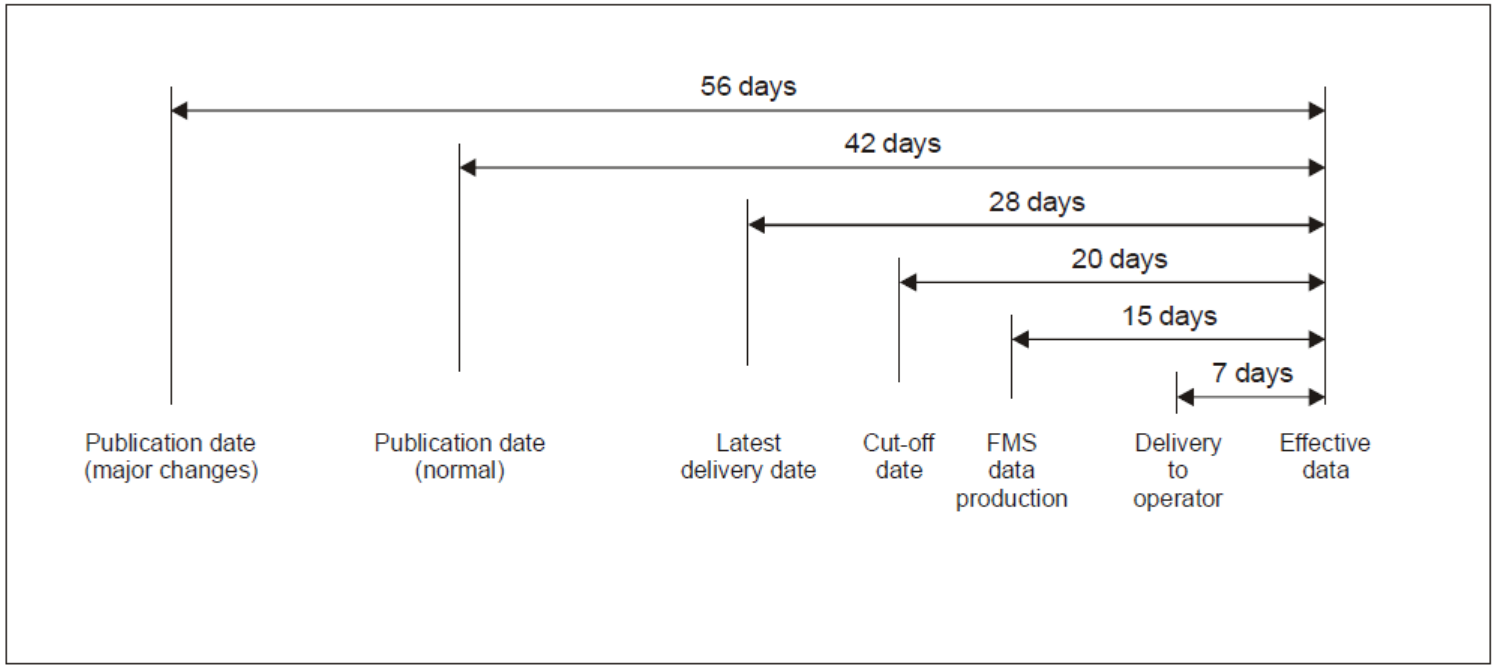


Figure I-Att B-2. Data processing timeline

Aeronautical Data

3. Provision of Aeronautical Data

- → Data quality / validations
  - → The quality of data obtained from another link in the aeronautical data chain must be either validated to the required level or guaranteed through an assurance of data quality from the supplier. In most cases, there is no benchmark against which the quality of such data can be validated and the need to obtain assurance of the data quality will generally flow back through the system until it reaches the originator of each data element.
  - → Consequently, reliance must be placed upon the use of appropriate procedures at every point along the aeronautical data chain.

Aeronautical Data

3. Provision of Aeronautical Data

→ Data sources I

→ Navigation data may originate from survey observations, from equipment specifications/settings or from the airspace and procedure design process. Whatever the source, the generation and the subsequent processing of the data must take account of the following:

a) all coordinate data must be referenced to the World Geodetic System — 1984 (WGS-84);

b) all surveys must be based upon the International Terrestrial Reference Frame;

c) all data must be traceable to their source;

d) …

Aeronautical Data

3. Provision of Aeronautical Data

→ Data sources II

d) equipment used for surveys must be adequately calibrated;

e) software tools used for surveys, procedure design or airspace design must be suitably qualified;

f) standard criteria and algorithms must be used in all designs;

g) surveyors and designers must be properly trained;

h) comprehensive verification and validation routines must be used by all data originators;

i) procedures must be subjected to ground validation and, where necessary, flight validation and flight inspection prior to publication.

Aeronautical Data

3. Provision of Aeronautical Data

→ Instrument validation

a) aeronautical navigation data must be published in a standard format, with an appropriate level of detail and to the required resolution; and

b) all data originators and data processors must implement a quality management process which includes:

i. a requirement to maintain quality records;

ii. a procedure for managing feedback and error reporting from users and other processors in the data chain.

Aeronautical Data

3. Provision of Aeronautical Data

- Data alteration
  - A data processor or data user shall not alter any data without informing the originator of the alteration and receiving concurrence. Altered data shall not be transmitted to a user if the originator rejects the alteration. Records shall be kept of all alterations and shall be made available upon request.
  - Wherever possible, data handling processes should be automated and human intervention should be kept to a minimum. Integrity-checking devices such as CRC algorithms should be used wherever possible throughout the navigation data chain.

Aeronautical Data

CAT.IDE.A.355 Electronic navigation data management

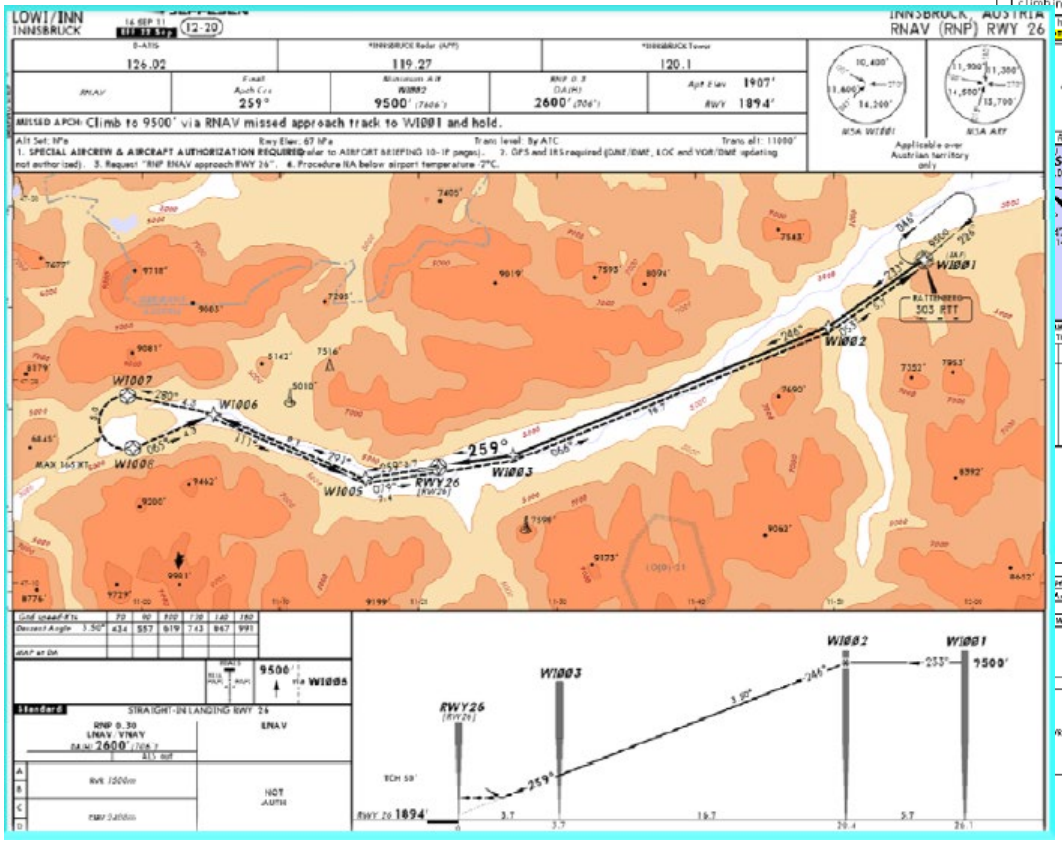
(a) The operator shall only use electronic navigation data products that support a navigation application meeting standards of integrity that are adequate for the intended use of the data.

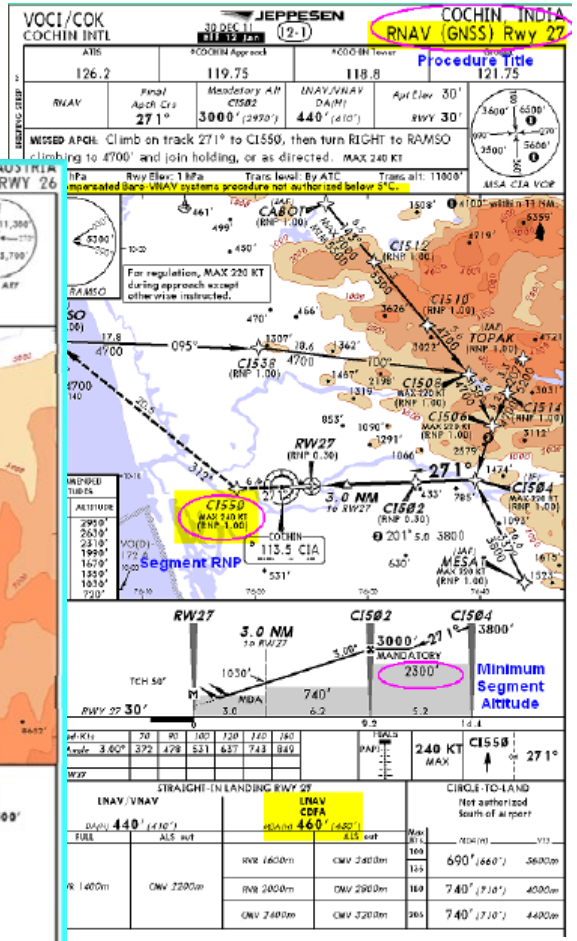
(b) When the electronic navigation data products support a navigation application needed for **an operation for which Annex V (Part-SPA) requires an approval**, the operator shall demonstrate to the competent authority that the process applied and the delivered products meet standards of integrity that are adequate for the intended use of the data.

(c) The operator shall continuously monitor the integrity of both the process and the products, either directly or by monitoring the compliance of third party providers.

(d) The operator shall ensure the timely distribution and insertion of current and unaltered electronic navigation data to all aeroplanes that require it.

Aeronautical Data





Aeronautical Data

AMC1 CAT.IDE.A.355 Electronic navigation data management

ELECTRONIC NAVIGATION DATA PRODUCTS

(a) When the operator of a complex motor-powered aeroplane uses a navigation database whichthat supports an airborne navigation application as a primary means of navigation, the navigation database supplier should hold a Type 2 letter of acceptance (LoA), or equivalent.

(b) If this airborne navigation application is needed for an operation requiring a specific approval in accordance **with Annex V (Part-SPA,),** the operator's procedures should be based upon the **Type 2 LoA acceptance process.**

Aeronautical Data

Navigation Databases
Letters of Acceptance

- Integrity (LOA or equivalent)
  - The European Aviation Safety Agency (EASA) is responsible for the accreditation of navigation data base suppliers in Europe. A Supplier will be issued, by EASA, with a Letter of Acceptance (LOA) when the supplier has demonstrated compliance with a number of defined conditions.
  - The FAA will issue a LOA to suppliers in the United States and
  - For Canadian Suppliers the function is managed by Transport Canada and is known as an Acknowledgement Letter (AL).
  - It has been agreed in principle there will be mutual recognition of accreditations.

There are two types of LOA to ensure that data is compatible with its intended use.

Aeronautical Data

Navigation Databases
Letters of Acceptance

- Type 1 LOA.
  - Letter of Acceptance is granted where a navigation database supplier complies with ED-76/DO-200A with no identified compatibility with an aircraft system
  - **A Type 1 LOA Supplier may not release navigation databases directly to end users**
- Type 2 LOA
  - A Type 2 LOA confirms that the processes for producing navigation data comply with these Conditions and also the requirements for installing them in specific avionics equipment are fulfilled.
  - **A Type 2 LOA Supplier may release navigation databases directly to end users.** The Canadian AL is equivalent to a Type 2 LOA.

EASA

Aeronautical Data

Navigation Databases
Letters of Acceptance

- → Type 1 LOA vs. Type 2 LOA
- → **What is the difference?**

Aeronautical Data

Navigation Databases
Letters of Acceptance

- → Type 1 acceptance letters are based on generic data requirements agreed between the data supplier and the customer and are for data suppliers **that are data service providers.**
- → Type 2 acceptance letters are based on requirements that **ensure compatibility with particular systems** or equipment and are for data suppliers that are avionics manufacturers/application integrators.

Type 2 acceptance letters are intended to facilitate the operational approval process or approved maintenance program, and eliminate the operator's need to re-evaluate compatibility if the data supplier has already assured compatibility.

Aeronautical Data

Navigation Databases - Letters of Acceptance

- EASA, Letters of Acceptance (LOA1)
  - EAG
  - Lufthansa Flight Nav
  - Jeppesen (Germany)
- FAA, Letters of Acceptance (LOA2) & Canadian Acknowledgement Letter
  - Jeppesen Sanderson (United States of America)
  - Honeywell Aerospace
  - Smiths Aerospace
  - CMC (Canada).
  - UNIVERSAL AVIONICS SYS.
  - GARMIN INTERNATIONAL

Aeronautical Data

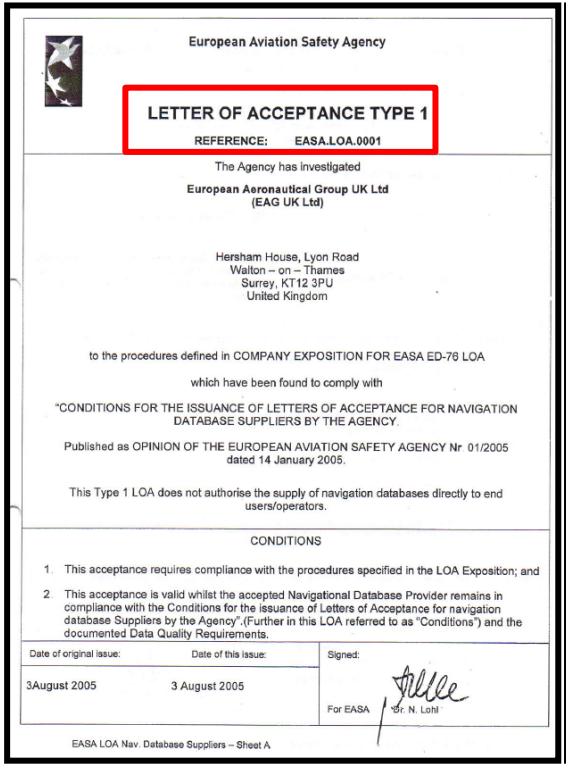
RNAV 5 (B RNAV)

Navigation Databases - Letters of Acceptance

→ ATR72-212A

Aeronautical Data

Navigation Databases - Letters of Acceptance



European Aviation Safety Agency

LETTER OF ACCEPTANCE TYPE 1

REFERENCE: EASA.LOA.0001

The Agency has investigated

European Aeronautical Group UK Ltd
(EAG UK Ltd)

Hersham House, Lyon Road
Walton – on – Thames
Surrey, KT12 3PU
United Kingdom

to the procedures defined in COMPANY EXPOSITION FOR EASA ED-76 LOA

which have been found to comply with

"CONDITIONS FOR THE ISSUANCE OF LETTERS OF ACCEPTANCE FOR NAVIGATION DATABASE SUPPLIERS BY THE AGENCY.

Published as OPINION OF THE EUROPEAN AVIATION SAFETY AGENCY Nr 01/2005 dated 14 January 2005.

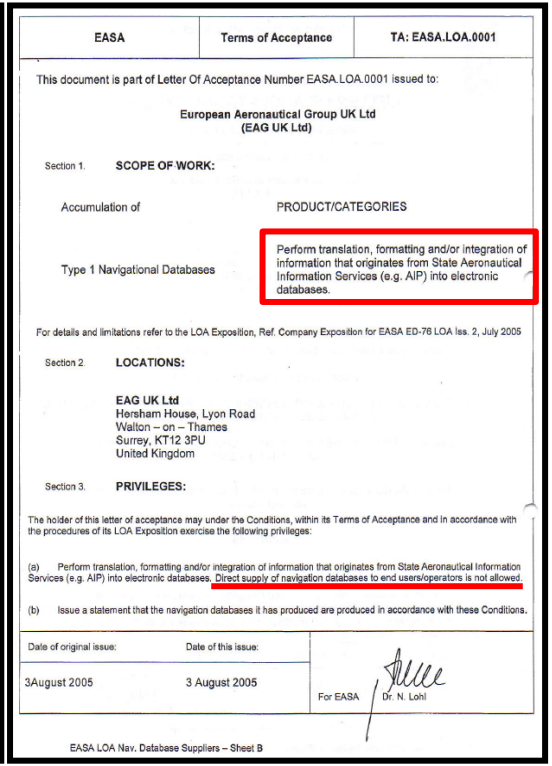
This Type 1 LOA does not authorise the supply of navigation databases directly to end users/operators.

CONDITIONS

1. This acceptance requires compliance with the procedures specified in the LOA Exposition; and
2. This acceptance is valid whilst the accepted Navigational Database Provider remains in compliance with the Conditions for the issuance of Letters of Acceptance for navigation database Suppliers by the Agency".(Further in this LOA referred to as "Conditions") and the documented Data Quality Requirements.

Date of original issue:	Date of this issue:	Signed:
3August 2005	3 August 2005	For EASA Dr. N. Lohl

EASA LOA Nav. Database Suppliers – Sheet A



EASA	Terms of Acceptance	TA: EASA.LOA.0001

This document is part of Letter Of Acceptance Number EASA.LOA.0001 issued to:

European Aeronautical Group UK Ltd
(EAG UK Ltd)

Section 1. **SCOPE OF WORK:**

Accumulation of	PRODUCT/CATEGORIES
Type 1 Navigational Databases	Perform translation, formatting and/or integration of information that originates from State Aeronautical Information Services (e.g. AIP) into electronic databases.

For details and limitations refer to the LOA Exposition, Ref. Company Exposition for EASA ED-76 LOA Iss. 2, July 2005

Section 2. **LOCATIONS:**

EAG UK Ltd
Hersham House, Lyon Road
Walton – on – Thames
Surrey, KT12 3PU
United Kingdom

Section 3. **PRIVILEGES:**

The holder of this letter of acceptance may under the Conditions, within its Terms of Acceptance and in accordance with the procedures of its LOA Exposition exercise the following privileges:

(a) Perform translation, formatting and/or integration of information that originates from State Aeronautical Information Services (e.g. AIP) into electronic databases. Direct supply of navigation databases to end users/operators is not allowed.

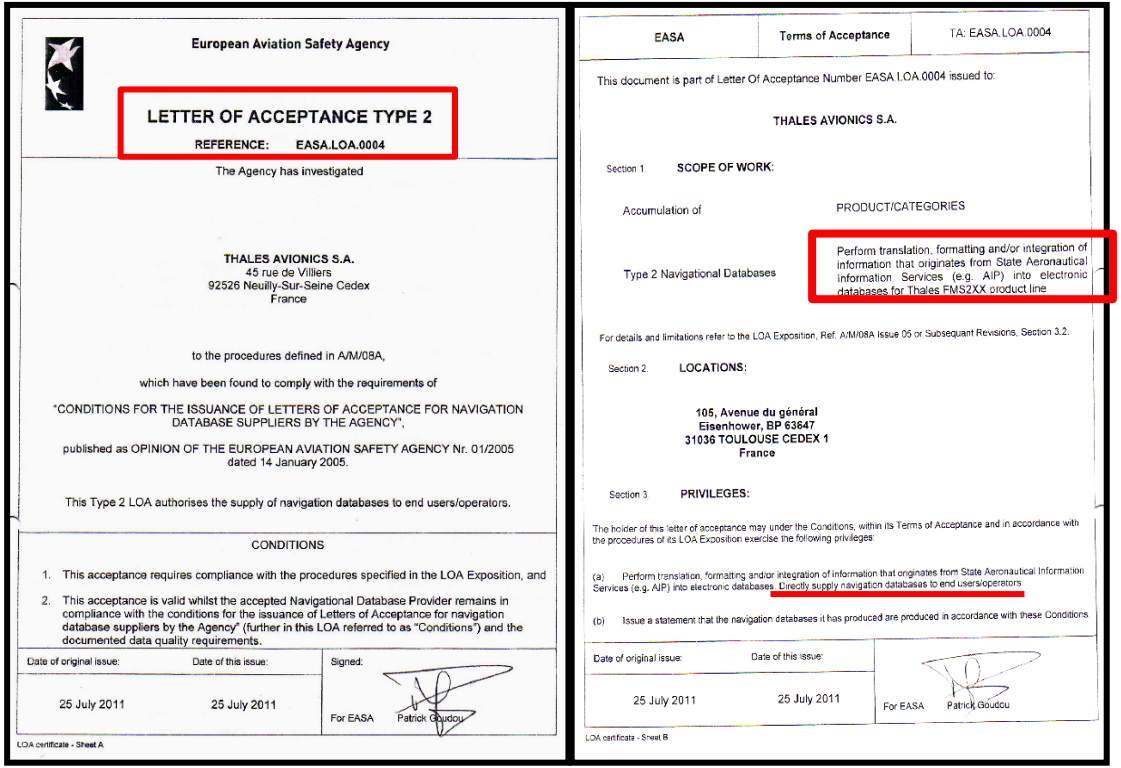
(b) Issue a statement that the navigation databases it has produced are produced in accordance with these Conditions.

Date of original issue:	Date of this issue:	
3August 2005	3 August 2005	For EASA Dr. N. Lohl

EASA LOA Nav. Database Suppliers – Sheet B

Aeronautical Data

Navigation Databases - Letters of Acceptance



European Aviation Safety Agency

LETTER OF ACCEPTANCE TYPE 2

REFERENCE: EASA.LOA.0004

The Agency has investigated

THALES AVIONICS S.A.
45 rue de Villiers
92526 Neuilly-Sur-Seine Cedex
France

to the procedures defined in A/M/08A,

which have been found to comply with the requirements of

"CONDITIONS FOR THE ISSUANCE OF LETTERS OF ACCEPTANCE FOR NAVIGATION DATABASE SUPPLIERS BY THE AGENCY",

published as OPINION OF THE EUROPEAN AVIATION SAFETY AGENCY Nr. 01/2005 dated 14 January 2005.

This Type 2 LOA authorises the supply of navigation databases to end users/operators.

CONDITIONS

1. This acceptance requires compliance with the procedures specified in the LOA Exposition, and
2. This acceptance is valid whilst the accepted Navigational Database Provider remains in compliance with the conditions for the issuance of Letters of Acceptance for navigation database suppliers by the Agency" (further in this LOA referred to as "Conditions") and the documented data quality requirements.

Date of original issue:	Date of this issue:	Signed:
25 July 2011	25 July 2011	For EASA Patrick Goudou

LOA certificate - Sheet A

EASA	Terms of Acceptance	TA: EASA.LOA.0004

This document is part of Letter Of Acceptance Number EASA.LOA.0004 issued to:

THALES AVIONICS S.A.

Section 1 **SCOPE OF WORK:**

Accumulation of	PRODUCT/CATEGORIES
Type 2 Navigational Databases	Perform translation, formatting and/or integration of information that originates from State Aeronautical Information Services (e.g. AIP) into electronic databases for Thales FMS2XX product line

For details and limitations refer to the LOA Exposition, Ref. A/M/08A Issue 05 or Subsequent Revisions, Section 3.2.

Section 2 **LOCATIONS:**

105, Avenue du général Eisenhower, BP 63647 31036 TOULOUSE CEDEX 1 France

Section 3 **PRIVILEGES:**

The holder of this letter of acceptance may under the Conditions, within its Terms of Acceptance and in accordance with the procedures of its LOA Exposition exercise the following privileges:

(a) Perform translation, formatting and/or integration of information that originates from State Aeronautical Information Services (e.g. AIP) into electronic databases. Directly supply navigation databases to end users/operators

(b) Issue a statement that the navigation databases it has produced are produced in accordance with these Conditions.

Date of original issue:	Date of this issue:	
25 July 2011	25 July 2011	For EASA Patrick Goudou

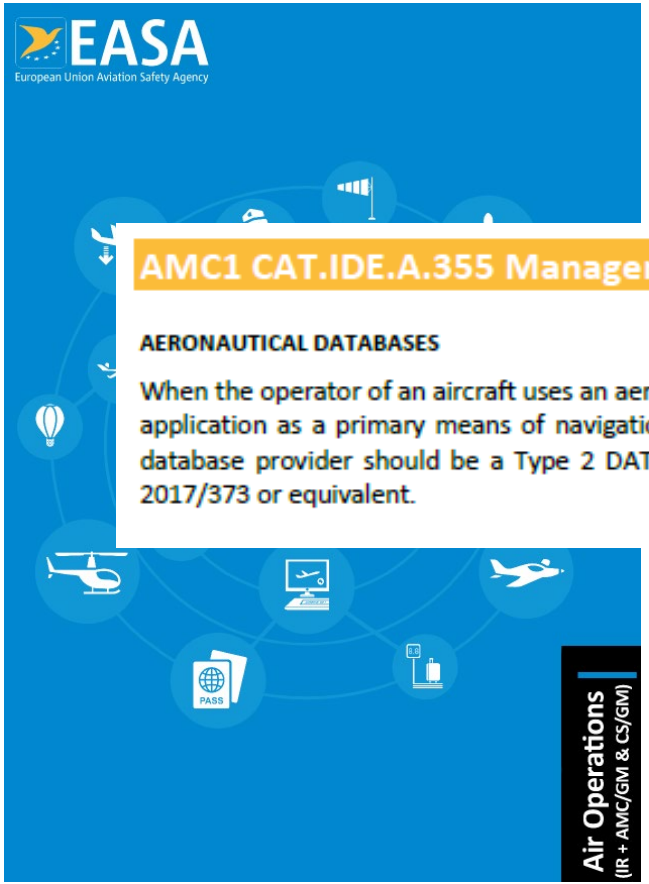
LOA certificate - Sheet B

Aeronautical Data

With the publication of **Commission Implementing Regulation (EU) 2017/373** on 1st March 2017, the practice on issuing voluntary Letters of Acceptance (LOA) has been replaced by the introduction of certification by EASA as competent authority for the providers of data services (DAT).

This requirement for certification of organizations processing aeronautical data for use on aircraft (DAT providers) applies from 1st January 2019.

Aeronautical Data



EASA

Easy Access Rules for Air Operations

AMC1 CAT.IDE.A.355 Management of aeronautical databases

ED Decision 2017/003/R

AERONAUTICAL DATABASES

When the operator of an aircraft uses an aeronautical database that supports an airborne navigation application as a primary means of navigation used to meet the airspace usage requirements, the database provider should be a Type 2 DAT provider certified in accordance with Regulation (EU) 2017/373 or equivalent.

he EASA

rules. It will offer

easy (online) access to all rules and regulations as well as new and innovative applications such as rulemaking process automation, stakeholder consultation, cross-referencing, and comparison with ICAO and third countries' standards.

To achieve these ambitious objectives, the EASA eRules project is structured in ten modules to cover all aviation rules and innovative functionalities.

The EASA eRules system is developed and implemented in close cooperation with Member States and aviation industry to ensure that all its capabilities are relevant and effective.

Published October 2019[1]

Aeronautical Data

Two types of DAT providers are identified:

- Type 1 DAT providers
  - process aeronautical data for use on aircraft and provide an aeronautical database meeting the Data Quality Requirements (DQRs), under controlled conditions, for which no corresponding airborne application/equipment compatibility has been determined
- Type 2 DAT providers
  - process aeronautical data and provide an aeronautical database for use on certified aircraft application/equipment meeting the Data Quality Requirements (DQRs), for which compatibility with that application/equipment has been determined.

Aeronautical Data

- Type 2 DAT providers
  - A Type 2 DAT provider's certificate confirms that the processes for producing aeronautical databases comply with the referenced applicable requirements and the documented DQRs for the avionics systems specified, i.e. certified aircraft application/equipment. The DQRs must be provided by or agreed with the relevant equipment design organisation in a formal arrangement. A Type 2 DAT provider is authorised to supply aeronautical databases to the end users directly (e.g. aircraft operators) for the airborne application/equipment, for which compatibility has been demonstrated.

Aeronautical Data

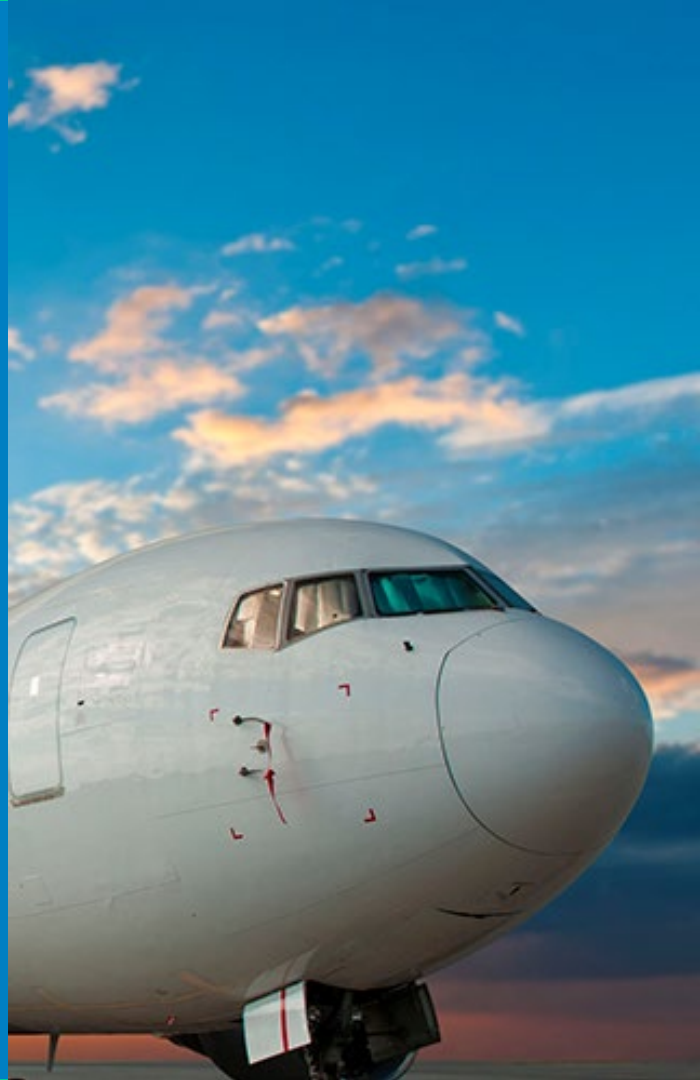
List of approved ATM/ANS organisations under the oversight of EASA

CERTIFICATE REFERENCE	ORGANISATION NAME	COUNTRY	SCOPE	ISSUE DATE
EASA.AOA.DAT.014	Lufthansa Systems FlightNav Inc.	Switzerland	Data Services (DAT) Type 1 & 2	11/12/2019
EASA.AOA.DAT.017	NAVBLUE SAS	France	Data Services (DAT) Type 1 & 2	07/10/2019
EASA.AOA.DAT.019	Jeppesen GmbH	Germany	Data Services (DAT) Type 1	07/12/2018
EASA.AOA.DAT.020	THALES AVS FRANCE SAS	France	Data Services (DAT) Type 2	19/12/2018
EASA.AOA.DAT.022	LEONARDO S.p.A. - Helicopters	Italy	Data Services (DAT) Type 2	15/10/2019
EASA.AOA.DAT.023	NAVBLUE Ltd	United Kingdom	Data Services (DAT) Type 1	19/12/2018

EASA
European Union Aviation Safety Agency

Types of PBN Approvals I

PBN Operational Approvals Workshop



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Types of PBN Approvals I

RNAV 10

(03) Oceanic / remote phases of flight

- Without on-board performance monitoring and alerting function, even when operationally approved as “RNP 10”
- Lateral TSE must be within ±10 NM for at least 95 per cent of the total flight time
- 50NM lateral and 50NM longitudinal separation
- Based on INS, IRS FMS or GNSS

Types of PBN Approvals I

RNP 4

(03) Oceanic / remote phases of flight

- With on-board performance monitoring and alerting function (usually RAIM)
- Lateral TSE must be within ±4 NM for at least 95 per cent of the total flight time
- 30 NM lateral and 30 NM longitudinal separation
- Primarily based on GNSS

Types of PBN Approvals I

RNAV 5*

(04) En-route and arrival** phases of flight

- Without on-board performance monitoring and alerting function
- Lateral TSE must be within ±5 NM for at least 95 per cent of the total flight time
- Route spacing may vary among regional implementations
- Based on VOR/DME, DME/DME, INR, IRS or GNSS

Types of PBN Approvals I

RNAV 2

(07) En-route continental, arrival and departure phases of flight

- Without on-board performance monitoring and alerting function
- Lateral TSE must be within ±2 NM for at least 95 per cent of the total flight time
- Based on DME/DME, DME/DME/IRU and GNSS

RNP 2

(06) En-route and oceanic/remote phases of flight

- With on-board performance monitoring and alerting function (usually RAIM)
- Lateral TSE must be within ±4 NM for at least 95 per cent of the total flight time
- Based on GNSS

Types of PBN Approvals I

RNAV 1*	RNP 1
(08) Arrival and departure phases of flight	(08) Arrival and departure phases of flight
• Without on-board performance monitoring and alerting function	• With on-board performance monitoring and alerting function (usually RAIM)
• Lateral TSE must be within ±1 NM for at least 95 per cent of the total flight time	• Lateral TSE must be within ±1 NM for at least 95 per cent of the total flight time
• Based on DME/DME, DME/DME/IRU and GNSS	• For terminal airspace with no or limited ATS surveillance, with low to medium density traffic
	• Based on GNSS

**Almost equivalent to Precision RNAV (P-RNAV) within ECAC*

Types of PBN Approvals I

RNP APCH	RNP AR
(09) Approach phase of flight	(10) Approach phase of flight
• With on-board performance monitoring and alerting function (usually RAIM or SBAS) • Lateral TSE varies with minima and approach segment (initial, intermediate, final missed) • Based on: ○ GNSS for LNAV minimum ○ GNSS + barometric VNAV for LNAV/VNAV minimum* ○ GNSS augmented by SBAS for LP and LPV minima	• With on-board performance monitoring and alerting function (usually RAIM) • Cross-track error must be lower than the lateral applicable accuracy value for 95 per cent of flight time • For terminal airspace with no or limited ATS surveillance, with low to medium density traffic • Based on GNSS + (usually) barometric-based VNAV

**GNSS-based vertical guidance may be used*

Types of PBN Approvals I

RNP 0.3

(11) All phases of flight except oceanic/remote and final approach

- With on-board performance monitoring and alerting function (usually RAIM or SBAS)
- Lateral TSE must be within ±0.3 NM for at least 95 per cent of the total flight time
- Primarily for helicopters
- Based GNSS

Helicopter Operations

(12) RNAV 1, RNP 1 and RNP 0.3 may also be used in en-route phases of **low-level** instrument flight rule (IFR) helicopter flights.

Types of PBN Approvals I

CE 965/2012

Table 1: Overview of PBN specifications

	FLIGHT PHASE							
	En-route		Arrival	Approach				Departure
	Oceanic	Continental		Initial	Intermediate	Final	Missed	
RNAV 10	10							
RNAV 5		5	5					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1	1
RNP 4	4							
RNP 2	2	2						
RNP 1			1	1	1		1	1
A-RNP	2	2 or 1	1–0.3	1–0.3	1–0.3	0.3	1–0.3	1–0.3
RNP APCH (LNAV)				1	1	0.3	1	
RNP APCH (LNAV/VNAV)				1	1	0.3	1	
RNP APCH (LP)				1	1		1	
RNP APCH (LPV)				1	1		1	
RNP AR APCH				1–0.1	1–0.1	0.3-0.1	1–0.1	
RNP 0.3 (H)		0.3	0.3	0.3	0.3		0.3	0.3

Numbers specify the accuracy level no specific approval required specific approval required

Types of PBN Approvals I

SPA.PBN.100 PBN operations

a) An approval is required for each of the following PBN specifications:

(1) RNP AR APCH; and

(2) RNP 0.3 for helicopter operation.

(b) An approval for RNP AR APCH operations shall allow operations on public instrument approach procedures which meet the applicable ICAO procedure design criteria.

(c) A procedure-specific approval for RNP AR APCH or RNP 0.3 shall be required for private instrument approach procedures or any public instrument approach procedure that does not meet the applicable ICAO procedure design criteria, or where required by the Aeronautical Information Publication (AIP) or the competent authority.

Types of PBN Approvals I

Performance based navigation

CE 965/2012

Table 1: Overview of PBN specifications

	FLIGHT PHASE							
	En-route		Arrival	Approach				Departure
	Oceanic	Continental		Initial	Intermediate	Final	Missed	
RNAV 10	10							
RNAV 5		5	5					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1	1
RNP 4	4							
RNP 2	2	2						
RNP 1			1	1	1		1	1
A-RNP	2	2 or 1	1–0.3	1–0.3	1–0.3	0.3	1–0.3	1–0.3
RNP APCH (LNAV)				1	1	0.3	1	
RNP APCH (LNAV/VNAV)				1	1	0.3	1	
RNP APCH (LP)				1	1		1	
RNP APCH (LPV)				1	1		1	
RNP AR APCH				1–0.1	1–0.1	0.3-0.1	1–0.1	
RNP 0.3 (H)		0.3	0.3	0.3	0.3		0.3	0.3

Numbers specify the accuracy level no specific approval required specific approval required

Types of PBN Approvals I

RNP AR APCH (approach)

- → Acceptable Means of Compliance for RNP AR are provided in **AMC 20-26**
- → The vertical performance is defined by a vertical error based upon Baro VNAV. (See later)
- → Lateral error down to 0.1NM TSE 95% in the final approach phase.
- → Each RNP AR approach requires a special approval.

Types of PBN Approvals I

AR, which stands for Authorization Required, refers specifically to RNP Instrument Approach Procedures that are amongst the most modern and precise instrument approach options available today.

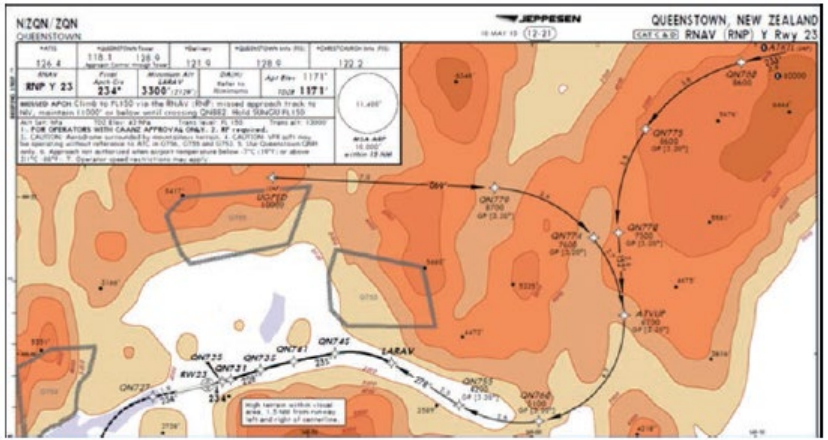
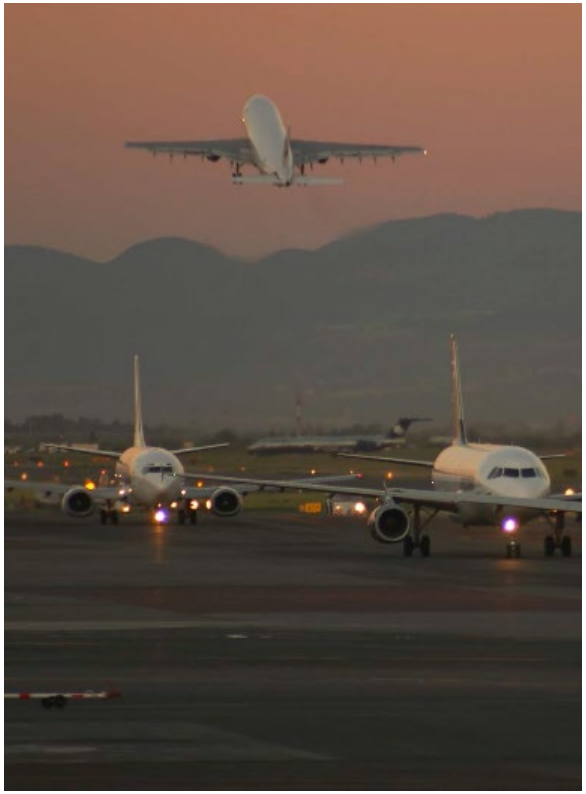
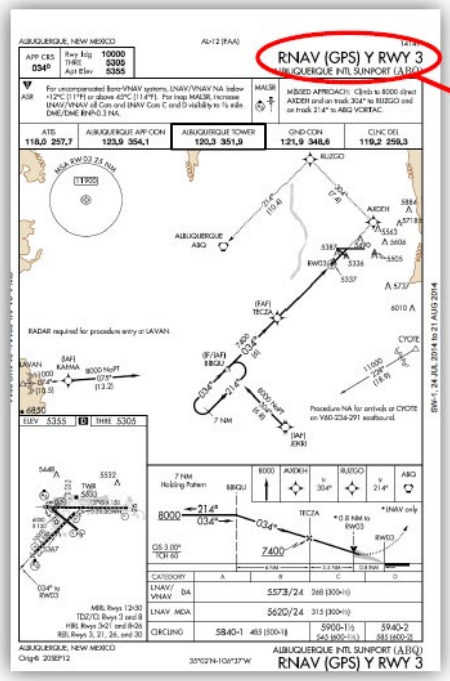


Fig. 3. RNAV RNP Approach with RF Legs



Types of PBN Approvals I

An RNP APCH shall not be flown unless it is retrievable by procedure name from the on-board navigation database and conforms to the charted procedure.



Source: Bendix King by Honeywell

Types of PBN Approvals I

RNP AR APCH

AMC 20-26 Effective: 23/12/2009
Annex II to ED Decision 2009/019/R of 16/12/2009

AMC 20-26 Airworthiness Approval and Operational Criteria for RNP Authorisation Required (RNP AR) Operations

This AMC provides a means of compliance for applicants for an airworthiness approval to conduct Required Navigation Performance Authorisation Required (RNP AR) Operations and the applicable criteria to obtain an operational approval. It relates to the implementation of area navigation within the context of the Single European Sky[1], in particular in relation to the verification of conformity of the airborne constituents, per Article 5 of EC Regulation 552/2004. Additional guidance material can be found in the ICAO Performance Based Navigation Manual, Document 9613, Volume II, Chapter 6, as contained in ICAO State Letter AN 11/45-07/22.

Types of PBN Approvals I

Operations RNP AR APCH

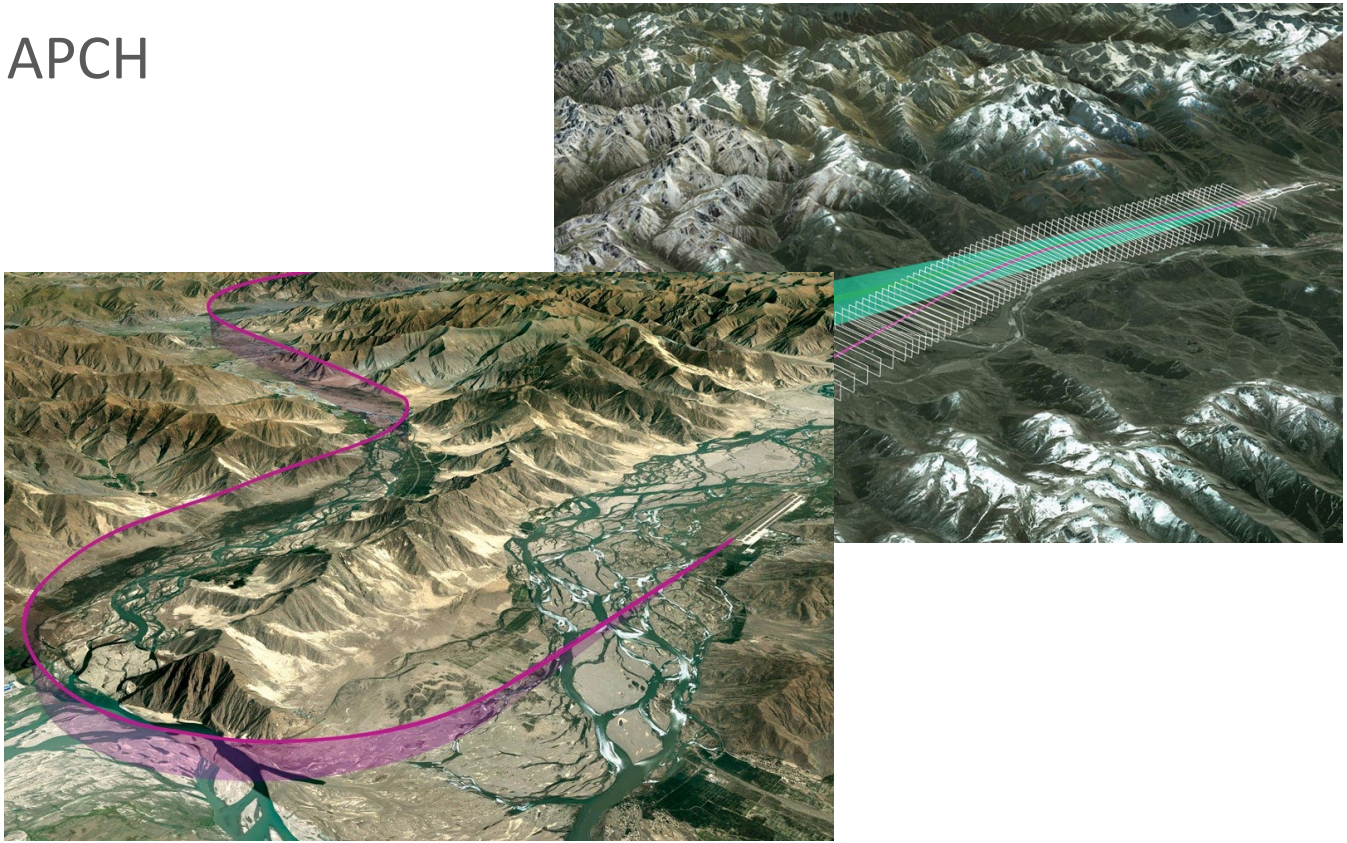
Most common RNP AR APCH applications:

→ Approach to airports with very limiting obstacles

→ Approach to airports with important operational advantages (curved trajectories)

Types of PBN Approvals I

RNP AR APCH



Types of PBN Approvals I

PBN.RNP AR APCH APPLICATION

B. DATA THE APPLICATION-SPECIFIC

Here are some tables which includes the requirements of airworthiness and operational requirements for the issuance of an operational approval PBN RNP AR APCH. Shall be ticked in the column of compliance if the requirement is fulfilled or not and if not satisfied you must indicate the reason. Additionally in the reference column must be specified document or documents of the organization where we gather information that enables compliance with the requirement requested, specifying clearly the chapter and section in each case.

1. **The proposed aircraft identification**

Manufacturer	Model	Serial number	Registration

Airports requested	Chosen approaches

Prompted RNP AR APCH initial approval for a new aircraft.	☐ Yes ☐ No ☐ In process
Apply for approval of new maneuvers of RNP AR APCH approximation based on GM1 SPA. PBN.100 (c) (8) for aircraft that already have approval RNP AR APCH.	☐ Yes ☐ No ☐ In process

2.- **Specific AIRWORTHINESS requirements**

In relation to the Declaration of the onboard equipment this should be done as specified in the relevant annex of the format of Declaration of compliance with the requirements of equipment for aircraft (F-DSO-AOC-100 To) that the operator shall be attached to this application. To meet the other requirements of airworthiness must be filled, the following paragraph enclosing the required supporting documentation. Additionally in the reference column must be specified document or documents of the organization where we gather information that enables compliance with the requirement requested, specifying clearly the chapter and section in each case.

NO.	REFERENCE	DESCRIPTION	COMPLIANCE (YES, NO, N/A)	DOCUMENTARY REFERENCE
2.1	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (8) and (d) SPA. PBN.105 (a) AMC 20-26 5 6, 8.3, 8.4, 8.5, 8.6, 8.7 NCC. IDE. A.250	The operator has attached the Declaration of equipment shipped to AR RNP APCH operations as specified in the relevant annex of the format of Declaration of compliance with the requirements of equipment for aircraft (F-DSO-AOC-100 (A).		
2.2	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (8) and (d) SPA. PBN.105 (a) AMC 20-26 6.1	Demonstration of the accuracy requirements for RNP AR APCH operations.		
2.3	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (8) and (d) SPA. PBN.105 (a) AMC 20-26 6.2	Demonstration of integrity for AR RNP APCH operations requirements.		

PBN.RNP AR APCH APPLICATION

NO.	REFERENCE	DESCRIPTION	COMPLIANCE (YES, NO, N/A)	DOCUMENTARY REFERENCE
2.4	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (8) and (d) SPA. PBN.105 (a) AMC 20-26 6.3	Demonstration of the requirements of continuity of the function for AR RNP APCH operations.		
2.5	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (8) and (d) SPA. PBN.105 (a) AMC 20-26 7.1	Demonstration of the functions required for RNP AR APCH operations.		
2.6	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (8) and (d) SPA. PBN.105 (a) AMC 20-26 7.1	Demonstration of the functions recommended for AR RNP APCH operations.		
2.7	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (8) and (d) SPA. PBN.105 (a) AMC 20-26 8.1, 9, Appendix 4	Explicit statement of compliance in the AFM/POH with AR RNP APCH operations Guidebook material.		
2.7	SPA. PBN.105 (c) (6) CAT. IDE. A.355 NCC. IDE. A.250 AMC 20-26 8.2	Electronic navigation data management		

Types of PBN Approvals I

CE 965/2012

Table 1: Overview of PBN specifications

	FLIGHT PHASE							
	En-route		Arrival	Approach				Departure
	Oceanic	Continental		Initial	Intermediate	Final	Missed	
RNAV 10	10							
RNAV 5		5	5					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1	1
RNP 4	4							
RNP 2	2	2						
RNP 1			1	1	1		1	1
A-RNP	2	2 or 1	1–0.3	1–0.3	1–0.3	0.3	1–0.3	1–0.3
RNP APCH (LNAV)				1	1	0.3	1	
RNP APCH (LNAV/VNAV)				1	1	0.3	1	
RNP APCH (LP)				1	1		1	
RNP APCH (LPV)				1	1		1	
RNP AR APCH				1–0.1	1–0.1	0.3-0.1	1–0.1	
RNP 0.3 (H)		0.3	0.3	0.3	0.3		0.3	0.3

Numbers specify the accuracy level no specific approval required specific approval required

Types of PBN Approvals I

Operations RNP 0.3 (Helicopters)

- RNP 0.3 Most Common Uses:
  - **Reduced protected areas** (allowing simultaneous fixed-wing transit operations without interference in the dense terminal area)
  - **Routes at low altitude** (in environments with many obstacles reducing exposure to icing environments)
  - **Homogeneous transition** from "en-route" to "terminal route"
  - **More efficient terminal paths** in many obstacle / noise sensitive terminal environments (IFR operations of helicopter emergency services between hospitals)
  - **Transitions to point-in-space** approximations and outputs
  - **En-route operations** (limited by distance and speed and of similar dimensions to fixed wing terminal operations)

Types of PBN Approvals I

Performance based navigation

CE 965/2012

Table 1: Overview of PBN specifications

	FLIGHT PHASE							
	En-route		Arrival	Approach				Departure
	Oceanic	Continental		Initial	Intermediate	Final	Missed	
RNAV 10	10							
RNAV 5		5	5					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1	1
RNP 4	4							
RNP 2	2	2						
RNP 1			1	1	1		1	1
A-RNP	2	2 or 1	1–0.3	1–0.3	1–0.3	0.3	1–0.3	1–0.3
RNP APCH (LNAV)				1	1	0.3	1	
RNP APCH (LNAV/VNAV)				1	1	0.3	1	
RNP APCH (LP)				1	1		1	
RNP APCH (LPV)				1	1		1	
RNP AR APCH				1–0.1	1–0.1	0.3-0.1	1–0.1	
RNP 0.3 (H)		0.3	0.3	0.3	0.3		0.3	0.3

Numbers specify the accuracy level no specific approval required specific approval required

Types of PBN Approvals I

Oceanic/Remote, RNAV10 (designated and authorised as RNP10)

- Acceptable means of compliance for RNAV10 (RNP10) are provided in EASA AMC 20-12

- Requirements:
  - Two independent long range navigation systems (LRNSs).
  - Each LRNS should in principle have a flight management system (FMS) that utilizes positional information from either an approved global navigation satellite system (GNSS) or an approved inertial reference system (IRS) or mixed combination.

Types of PBN Approvals I

Oceanic/Remote, RNAV10 (designated and authorised as RNP10)

- → RNAV (RNP10) despite the name, RNP10 is an RNAV System without performance monitoring and alert capacity.
- → The ICAO elected to retain RNP10 because many areas of the world adopted RNP10 before the RNP specification was made.
- → The affected regions complained it would be too costly to change all the manuals and charts, so the ICAO made this exception.

Types of PBN Approvals I

Admissibility of aircraft (IFR Helicopters):

- → Approved GNSS systems E / TSO C145a and FMS E / TSO C115b, installed in accordance with FAA AC 20-130A
- → E/TSO C146a approved GNSS systems installed in accordance with FAA AC 20-138
- → Aircraft with RNP 0.3 capability certified or approved with equivalent standards (e.g. TSO C193)
- → Presentations of "moving map" + Autopilot
- → Functional requirements (ICAO Doc 9613, paragraph 7.3.3.5)

Types of PBN Approvals I

PBN RNAV 10 (RNP 10) APPLICATION

B. DATA THE APPLICATION-SPECIFIC

Here are some tables which includes the requirements of airworthiness and operational requirements for the issuance of an operational approval PBN 10 RNAV (RNP 10). Shall be ticked in the column of compliance if the requirement is fulfilled or not and if not satisfied you must indicate the reason. Additionally in the reference column must be specified document or documents of the organization where we gather information that enables compliance with the requirement requested, specifying clearly the chapter and section in each case.

1. **THE PROPOSED AIRCRAFT IDENTIFICATION**

Manufacturer	Model	Serial number	Registration

2. **SPECIFIC AIRWORTHINESS REQUIREMENTS**

In relation to the Declaration of the onboard equipment this should be done as specified in the relevant annex of the format of Declaration of compliance with the requirements of equipment for aircraft (F-DSO-AOC-100 To) that the operator shall be attached to this application. To meet the other requirements of airworthiness must be filled, the following paragraph enclosing the required supporting documentation. Additionally in the reference column must be specified document or documents of the organization where we gather information that enables compliance with the requirement requested, specifying clearly the chapter and section in each case.

NO.	REFERENCE	DESCRIPTION	COMPLIANCE (YES, NO, N/A)	DOCUMENTARY REFERENCE
2.1	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (1) and (d) SPA. PBN.105 (a) CAT. IDE. A.345 (d) NCC. IDE. A.250 AMC 20-12 4.1; 4.2	Definition of onboard navigation and communications equipment and the certification statement of the equipment for operations RNAV10 (RNP10).		
2.2	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (1) and (d) SPA. PBN.105 (a) ICAO Doc. 9613 vol. II, part B, Chapter 1.3.4.1	Demonstration of the accuracy requirements for operations 10 RNAV (RNP 10).		
2.3	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (1) and (d) SPA. PBN.105 (a) ICAO Doc. 9613 vol. II, part B, Chapter 1.3.4.1	Demonstration of the requirements of integrity for operations 10 RNAV (RNP 10) when using equipment GNSS.		
2.4	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (1) and (d) SPA. PBN.105 (a) ICAO Doc. 9613 vol. II, part B, Chapter 1.3.4.1	Demonstration of the requirements of continuity of operations 10 RNAV (RNP 10) function.		

PBN RNAV 10 (RNP 10) APPLICATION

NO.	REFERENCE	DESCRIPTION	COMPLIANCE (YES, NO, N/A)	DOCUMENTARY REFERENCE
2.5	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (1) and (d) SPA. PBN.105 (a) AMC 20-12 4.3.1 ICAO Doc. 9613 vol. II, part B, Chapter 1.3.3.1.2	Demonstration of compliance with the requirements of airworthiness for operation 10 RNAV (RNP 10), regarding the use of data of the inertial navigation system for the equipment of Group 1.		
2.6	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (1) and (d) SPA. PBN.105 (a) AMC 20-12 4.3.2 ICAO Doc. 9613 vol. II, part B, Chapter 1.3.3.1.3	Demonstration of compliance with the requirements of airworthiness for operation 10 RNAV (RNP 10), regarding the use of data of the inertial navigation system for the equipment of Group 2a		
2.7	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (1) and (d) SPA. PBN.105 (a) AMC 20-12 4.3.2 ICAO Doc. 9613 vol. II, part B, Chapter 1.3.3.1.3	Demonstration of compliance with the requirements of airworthiness for operation 10 RNAV (RNP 10), regarding the use of data from the system of inertial navigation to the equipment of the Group 2b.		
2.8	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (1) and (d) SPA. PBN.105 (a) AMC 20-12 4.3.2 ICAO Doc. 9613 vol. II, part B, Chapter 1.3.3.1.3	Demonstration of compliance with the requirements of airworthiness for operation 10 RNAV (RNP 10), regarding the use of data from the system of inertial navigation to the equipment of the Group 2 c		
2.9	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (1) and (d) SPA. PBN.105 (a) AMC 20-12 4.3.3 ICAO Doc. 9613 vol. II, part B, Chapter 1.3.3.1.4	Demonstration of compliance with the requirements of airworthiness operations 10 RNAV (RNP 10), for the equipment of Group 3.		
2.10	SPA. GEN.105 SPA. PBN.100 GM1 SPA. PBN.100 (c) (1) and (d) SPA. PBN.105 (a) AMC 20-12 4.4.1	Explicit statement of compliance in the AFM/POH with material reference guide for operations 10 RNAV (RNP 10).		
2.11	SPA. PBN.105 (c) (6) CAT. IDE. A.355 NCC. IDE. A.250 AMC 20-12 4.3.3.	Electronic navigation data management.		

Types of PBN Approvals I

RNAV 10 (RNP 10):

ED Decision 2006/12/R
22/12/2006
Annex I
AMC 20-12

AMC 20-12 **Recognition Of FAA Order 8400.12a For RNP-10 Operations.**

1. PURPOSE

This AMC calls attention to the FAA Order 8400.12A "Required Navigation Performance 10 (RNP-10) Operational Approval", issued 9th February 1998. FAA Order 8400.12A addresses RNP-10 requirements, the operational approval process, application principles, continuing airworthiness and operational requirements. This AMC explains how the technical content and the operational principles of the Order may be applied as a means, but not the only means, to obtain EASA approval for RNP-10 operations.

RNP containment integrity/continuity, as defined in EUROCAE ED-75( ) (or RTCA DO-236( ) "MASPS for RNP Area Navigation"), are not required functions for RNP-10 operations.

Types of PBN Approvals I

CE 965/2012

Table 1: Overview of PBN specifications

	FLIGHT PHASE							
	En-route		Arrival	Approach				Departure
	Oceanic	Continental		Initial	Intermediate	Final	Missed	
RNAV 10	10							
RNAV 5		5	5					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1	1
RNP 4	4							
RNP 2	2	2						
RNP 1			1	1	1		1	1
A-RNP	2	2 or 1	1–0.3	1–0.3	1–0.3	0.3	1–0.3	1–0.3
RNP APCH (LNAV)				1	1	0.3	1	
RNP APCH (LNAV/VNAV)				1	1	0.3	1	
RNP APCH (LP)				1	1		1	
RNP APCH (LPV)				1	1		1	
RNP AR APCH				1–0.1	1–0.1	0.3-0.1	1–0.1	
RNP 0.3 (H)		0.3	0.3	0.3	0.3		0.3	0.3

Numbers specify the accuracy level no specific approval required specific approval required

Types of PBN Approvals I

Oceanic/Remote, RNP4

- RNP4 is the oceanic/remote navigation specification to support 30 NM track spacing with ADS-C and CPDLC required.
- To meet this navigation requirement, two independent LRNS 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).
- Additional aircraft requirements include two long range communication systems (LRCSs) in order to operate in RNP4 designated airspace.
- Guidance for this RNP standard is provided in **ICAO Doc 9613.**

Types of PBN Approvals I

Performance based navigation

CE 965/2012

Table 1: Overview of PBN specifications

	FLIGHT PHASE							
	En-route		Arrival	Approach				Departure
	Oceanic	Continental		Initial	Intermediate	Final	Missed	
RNAV 10	10							
RNAV 5		5	5					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1	1
RNP 4	4							
RNP 2	2	2						
RNP 1			1	1	1		1	1
A-RNP	2	2 or 1	1–0.3	1–0.3	1–0.3	0.3	1–0.3	1–0.3
RNP APCH (LNAV)				1	1	0.3	1	
RNP APCH (LNAV/VNAV)				1	1	0.3	1	
RNP APCH (LP)				1	1		1	
RNP APCH (LPV)				1	1		1	
RNP AR APCH				1–0.1	1–0.1	0.3-0.1	1–0.1	
RNP 0.3 (H)		0.3	0.3	0.3	0.3		0.3	0.3

Numbers specify the accuracy level no specific approval required specific approval required

Types of PBN Approvals I

RNAV2

→ This is a non-European en-route standard.

→ Guidance for this RNP standard is provided in ICAO Doc 9613

Types of PBN Approvals I

CE 965/2012

Table 1: Overview of PBN specifications

	FLIGHT PHASE							
	En-route		Arrival	Approach				Departure
	Oceanic	Continental		Initial	Intermediate	Final	Missed	
RNAV 10	10							
RNAV 5		5	5					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1	1
RNP 4	4							
RNP 2	2	2						
RNP 1			1	1	1		1	1
A-RNP	2	2 or 1	1–0.3	1–0.3	1–0.3	0.3	1–0.3	1–0.3
RNP APCH (LNAV)				1	1	0.3	1	
RNP APCH (LNAV/VNAV)				1	1	0.3	1	
RNP APCH (LP)				1	1		1	
RNP APCH (LPV)				1	1		1	
RNP AR APCH				1–0.1	1–0.1	0.3-0.1	1–0.1	
RNP 0.3 (H)		0.3	0.3	0.3	0.3		0.3	0.3

Numbers specify the accuracy level no specific approval required specific approval required

Types of PBN Approvals I

RNAV1 (P-RNAV)

- Acceptable means of compliance for RNAV1 (P-RNAV) are provided in JAA TGL-10 ‘Airworthiness and Operational approval for precision RNAV operations in designated European Airspace’,
- Planned to be replaced by AMC 20 material / CS material

Types of PBN Approvals I

RNAV1 (P-RNAV)

JAA Administrative & Guidance Material
Section One: General Part 3: Temporary Guidance Leaflets

LEAFLET NO 10 Rev 1: AIRWORTHINESS AND OPERATIONAL APPROVAL FOR PRECISION RNAV OPERATIONS IN DESIGNATED EUROPEAN AIRSPACE

This leaflet provides guidance material for the approval of aircraft and operations in the European region where Precision Area Navigation (P-RNAV) is required. It relates to the implementation of area navigation within the context of the European Air Traffic Management Programme (EATMP) and should be read in conjunction with EUROCONTROL document 003-93 (), Area Navigation Equipment: Operational Requirements and Functional Requirements.

REVISIONS

Revision 1 (JUN 05): Amendment to section 10.6 and Annex B:
This revision includes an amended paragraph 10.6 Database Integrity, introducing the EASA/FAA Type 2 Letter Of Acceptance (LOA).

Types of PBN Approvals I

CE 965/2012

Table 1: Overview of PBN specifications

	FLIGHT PHASE							
	En-route		Arrival	Approach				Departure
	Oceanic	Continental		Initial	Intermediate	Final	Missed	
RNAV 10	10							
RNAV 5		5	5					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1	1
RNP 4	4							
RNP 2	2	2						
RNP 1			1	1	1		1	1
A-RNP	2	2 or 1	1–0.3	1–0.3	1–0.3	0.3	1–0.3	1–0.3
RNP APCH (LNAV)				1	1	0.3	1	
RNP APCH (LNAV/VNAV)				1	1	0.3	1	
RNP APCH (LP)				1	1		1	
RNP APCH (LPV)				1	1		1	
RNP AR APCH				1–0.1	1–0.1	0.3-0.1	1–0.1	
RNP 0.3 (H)		0.3	0.3	0.3	0.3		0.3	0.3

Numbers specify the accuracy level no specific approval required specific approval required

Types of PBN Approvals I

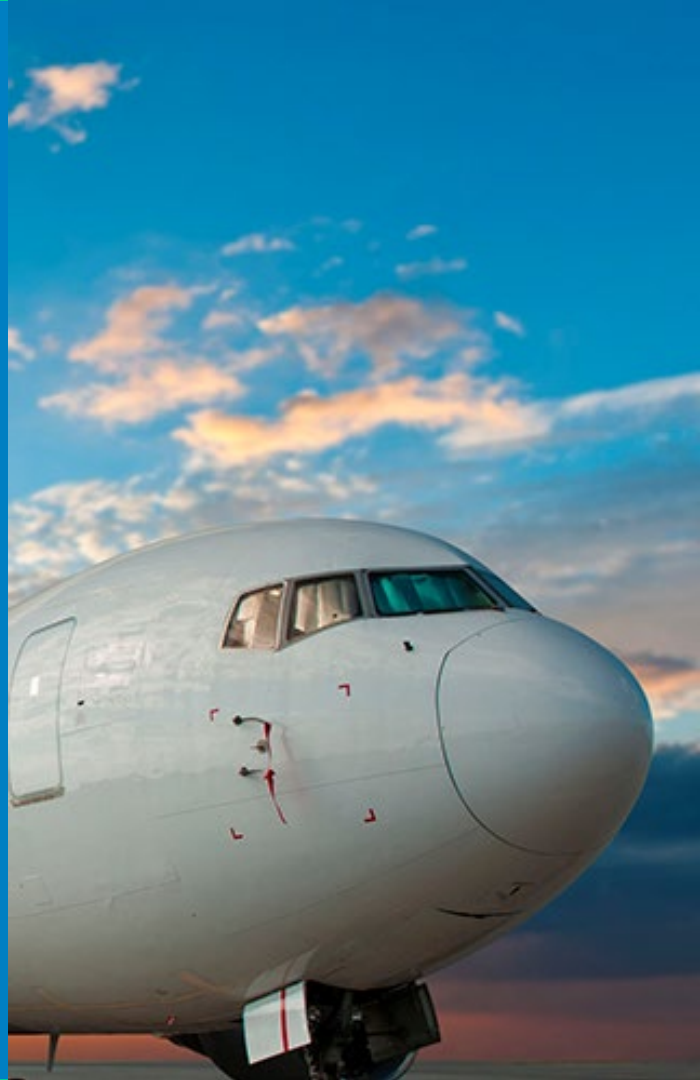
Basic–RNP1

→ This is a future standard that is in process to be implemented. Guidance material is provided in **ICAO Doc 9613.**

EASA
European Union Aviation Safety Agency

Types of PBN Approvals II

PBN Operational Approvals Workshop



An Agency of the European Union

Types of PBN Approvals II

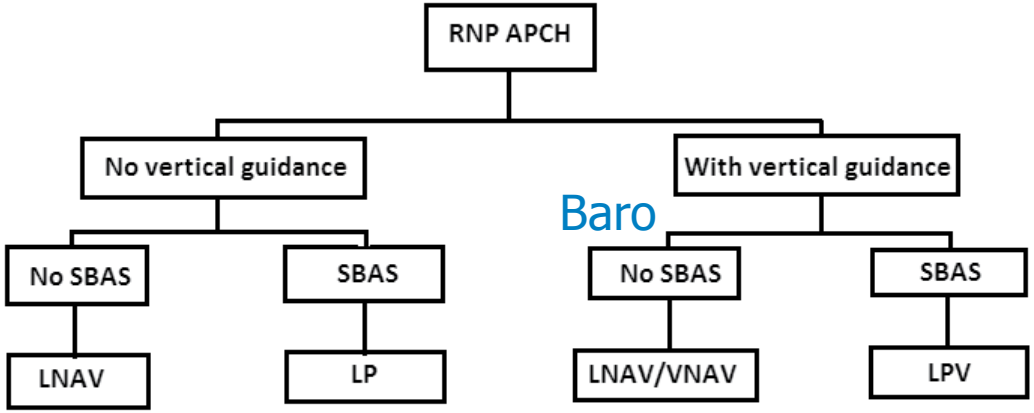
CE 965/2012

Table 1: Overview of PBN specifications

	FLIGHT PHASE							
	En-route		Arrival	Approach				Departure
	Oceanic	Continental		Initial	Intermediate	Final	Missed	
RNAV 10	10							
RNAV 5		5	5					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1	1
RNP 4	4							
RNP 2	2	2						
RNP 1			1	1	1		1	1
A-RNP	2	2 or 1	1–0.3	1–0.3	1–0.3	0.3	1–0.3	1–0.3
RNP APCH (LNAV)				1	1	0.3	1	
RNP APCH (LNAV/VNAV)				1	1	0.3	1	
RNP APCH (LP)				1	1		1	
RNP APCH (LPV)				1	1		1	
RNP AR APCH				1–0.1	1–0.1	0.3-0.1	1–0.1	
RNP 0.3 (H)		0.3	0.3	0.3	0.3		0.3	0.3

Numbers specify the accuracy level no specific approval required specific approval required

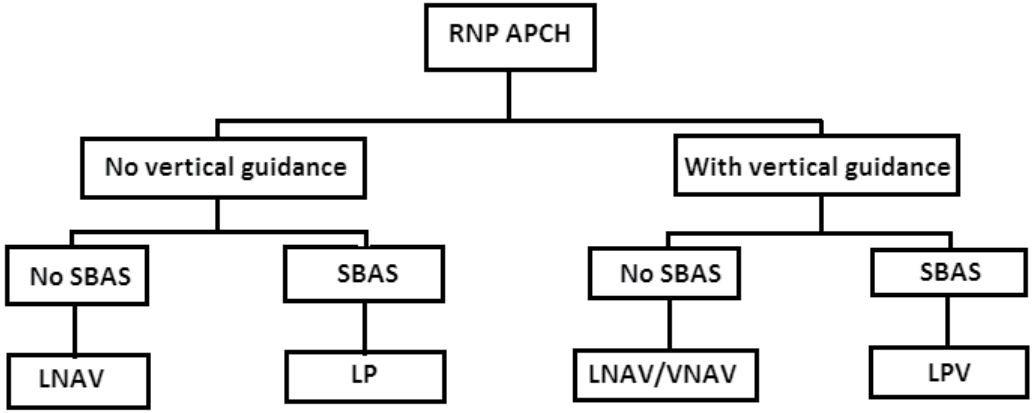
Types of PBN Approvals II



The 4 types of RNP approaches described in the ICAO PBN Manual

Just to clarify, LPV vs LNAV/VNAV vs LNAV are <u>not</u> ***types of approaches*** *they are* ***minimums within RNAV approaches*****.**

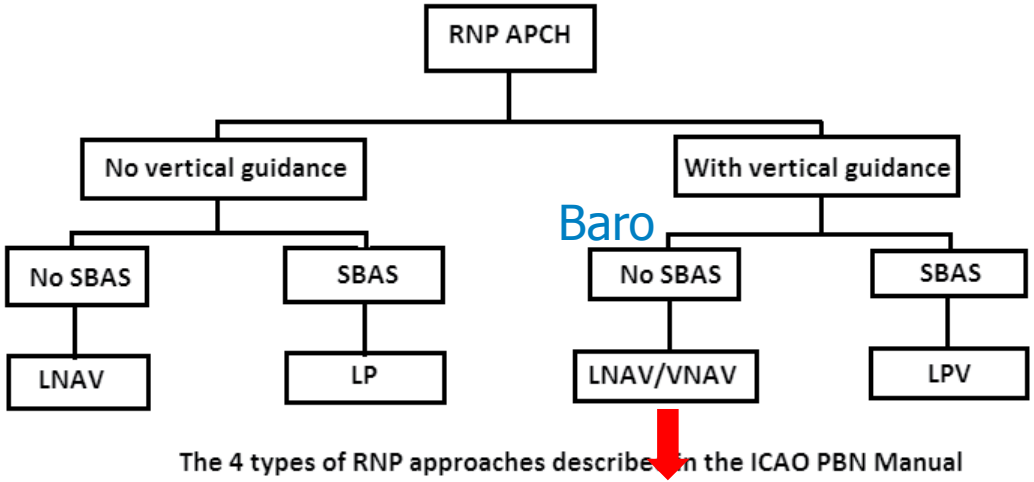
Types of PBN Approvals II



The 4 types of RNP approaches described in the ICAO PBN Manual

LNAV refers to navigating over a ground track with guidance from an electronic device which gives the pilot (or autopilot) error indications in the lateral direction only and not in the vertical direction.

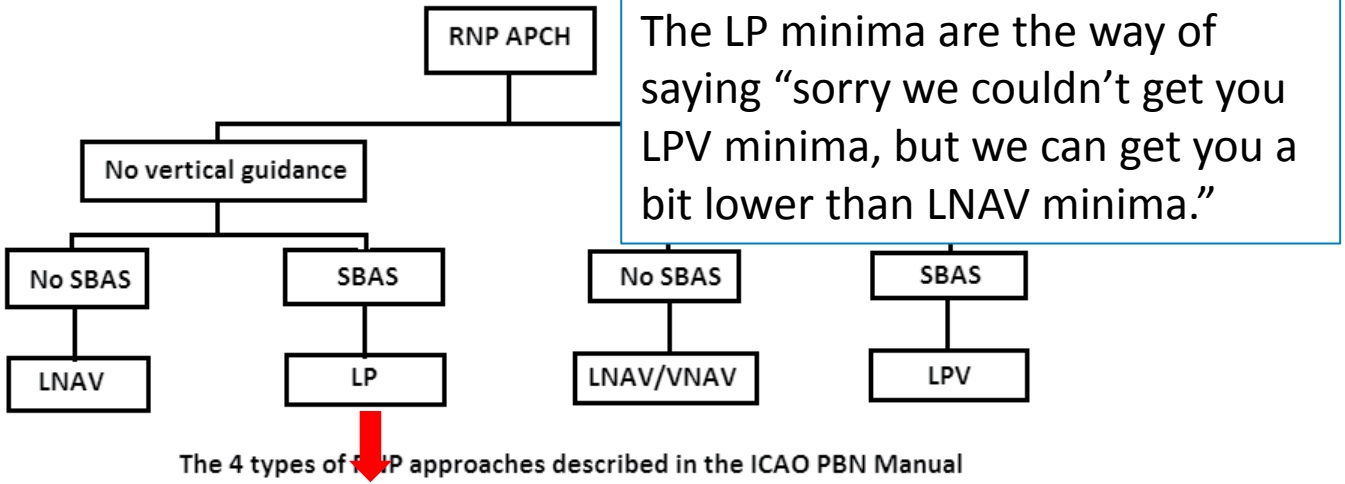
Types of PBN Approvals II



The 4 types of RNP approaches described in the ICAO PBN Manual

A LNAV/VNAV approach is a GPS version of an ILS approach. It will give you a glidepath indication on your attitude display. LNAV/VNAV approaches are for aircraft with vertical navigation capability (hence the "VNAV"). The vertical guidance is internally generated by barometric settings

Types of PBN Approvals II

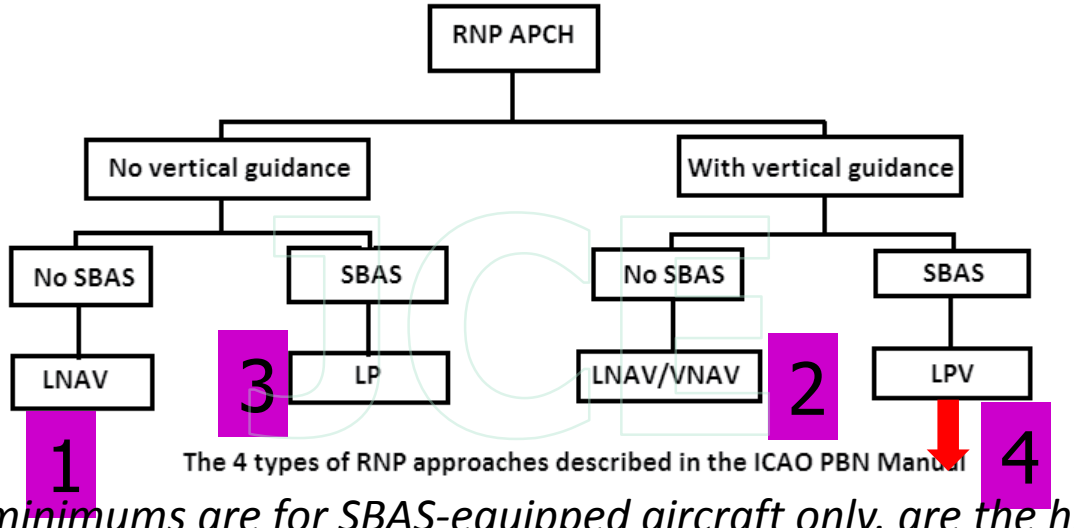


The LP minima are the way of saying “sorry we couldn’t get you LPV minima, but we can get you a bit lower than LNAV minima.”

The 4 types of RNP approaches described in the ICAO PBN Manual

Localizer Performance: An RNAV function requiring SBAS, that computes, displays, and provides horizontal approach navigation using the horizontal accuracy and integrity of LPV without vertical guidance. The LP line of minima is provided at locations where issues prevent the use of LPV vertical guidance, and provides a higher probability of achieving the lowest minimum at these locations.

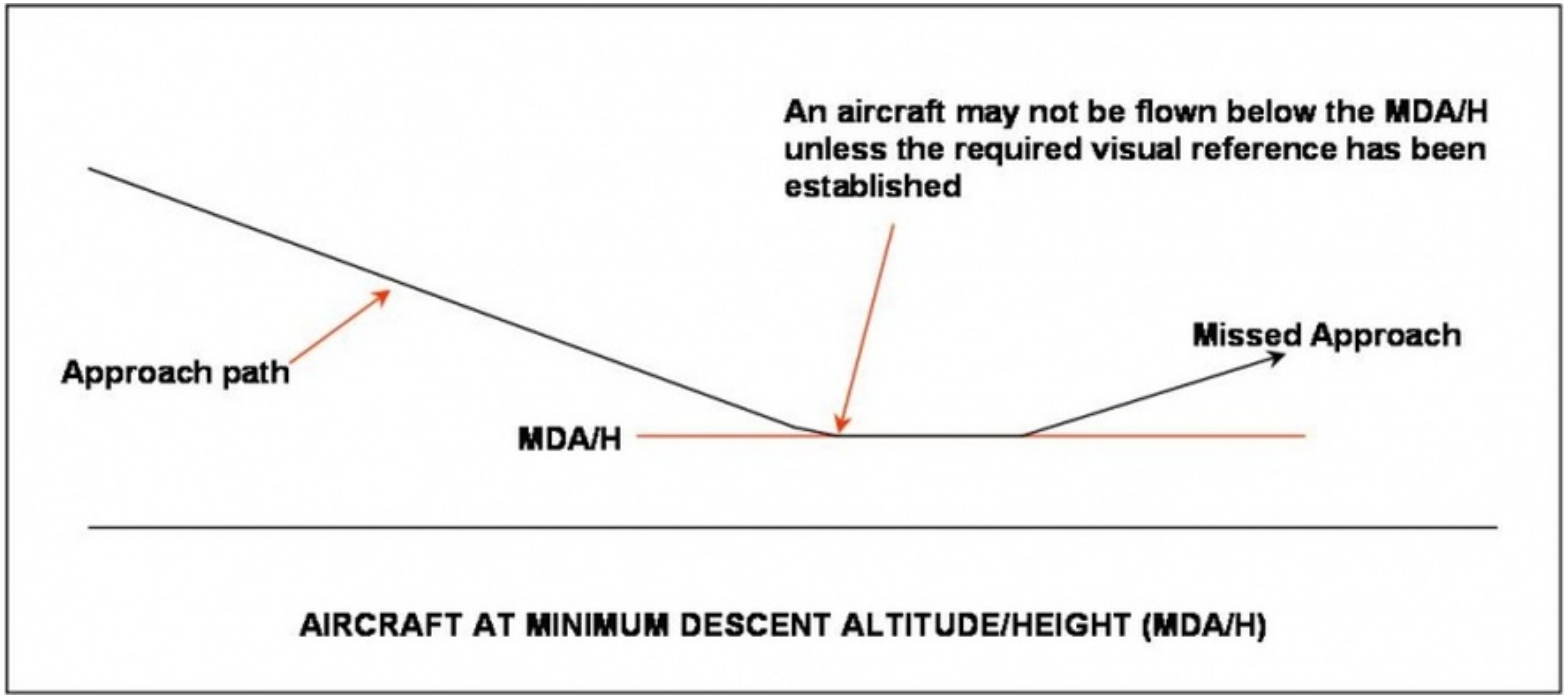
Types of PBN Approvals II



The 4 types of RNP approaches described in the ICAO PBN Manual

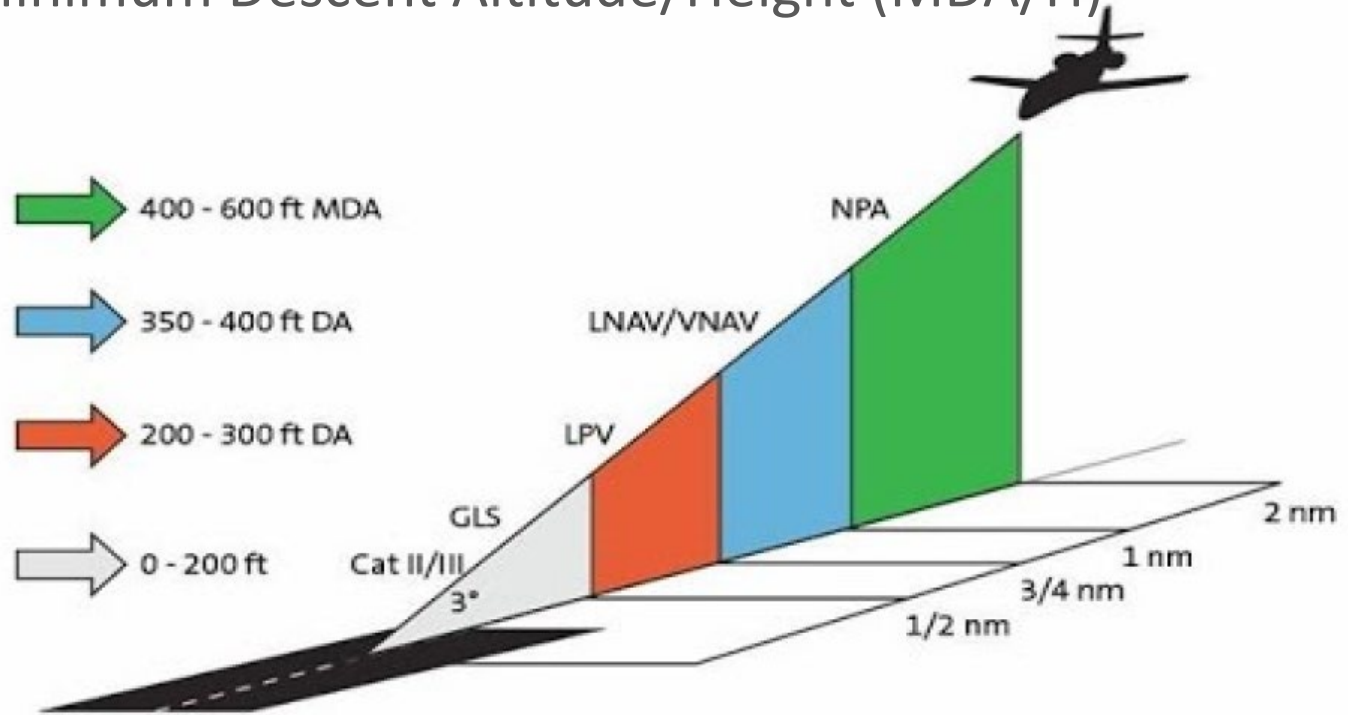
LPV approach minimums are for SBAS-equipped aircraft only. are the highest precision GPS (SBAS enabled) aviation instrument approach procedures currently available. Landing minima are usually similar to those of a Cat I instrument landing system (ILS), that is, a decision height of 200 feet (61 m) and visibility of 800 m. Although precise and accurate, it is still considered a Non-Precision approach

Types of PBN Approvals II

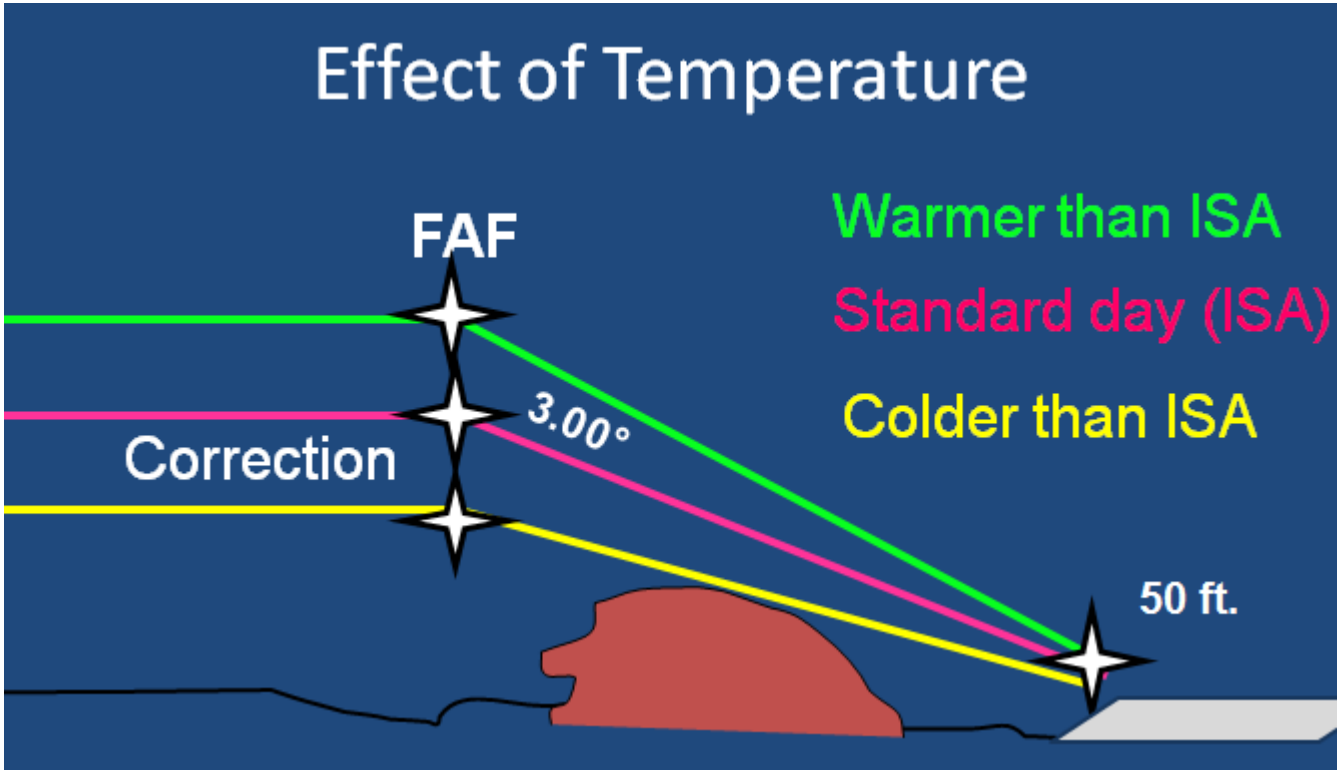


Types of PBN Approvals II

MDA: Minimum Descent Altitude/Height (MDA/H)



Types of PBN Approvals II



Types of PBN Approvals II

AMC2 CAT.OP.MPA.126 Performance-based navigation

(2) Temperature compensation

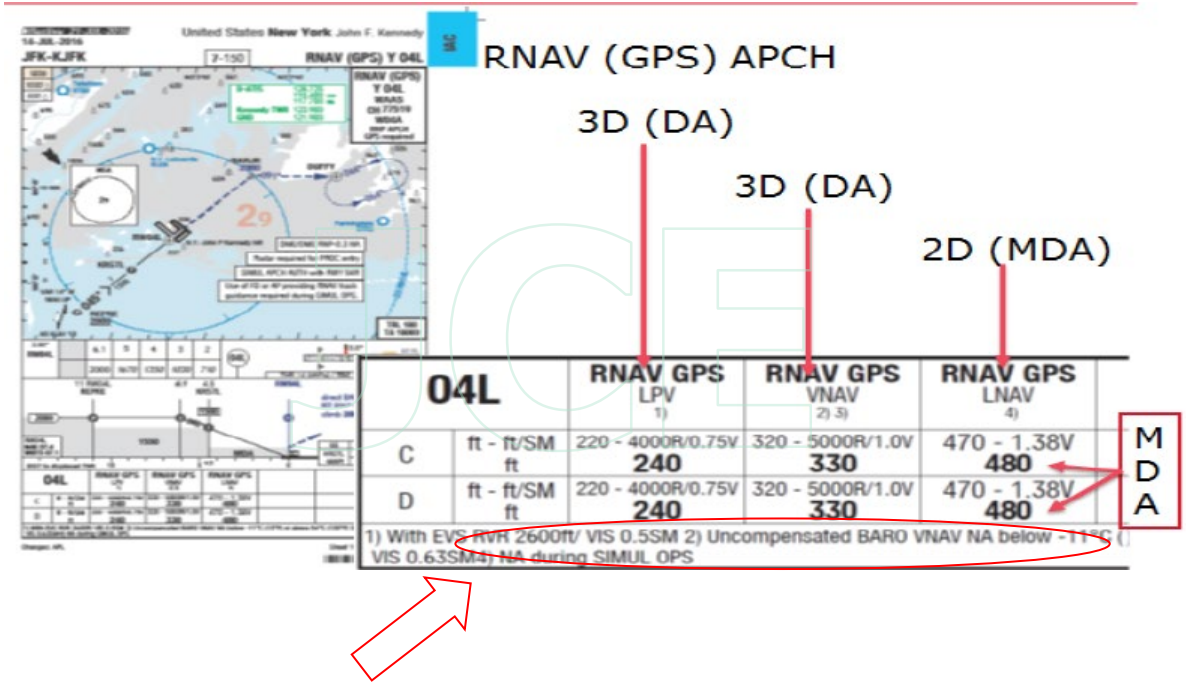
(i) For RNP APCH operations to LNAV/VNAV minima using Baro VNAV:

(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;

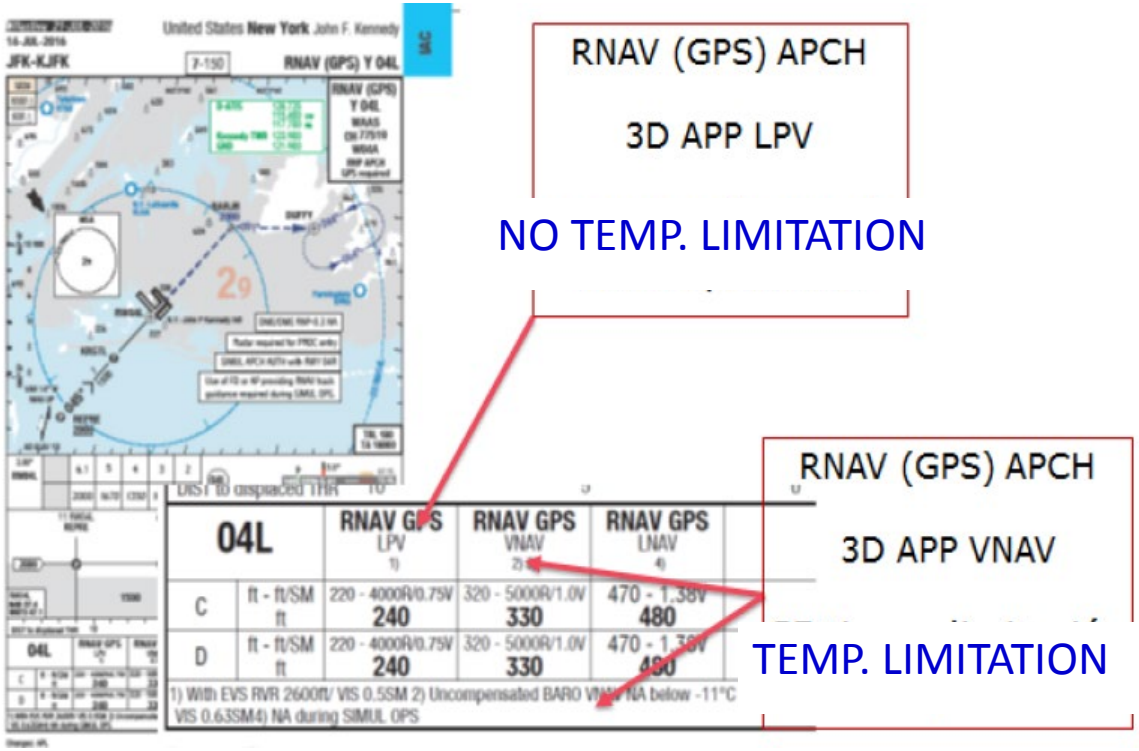
(C) since only the final approach segment is protected by the promulgated aerodrome temperature limits, the flight crew should consider the effect of temperature on terrain and obstacle clearance in other phases of flight.

Types of PBN Approvals II



Temperature limitation for aircraft without automatic temperature compensation

Types of PBN Approvals II



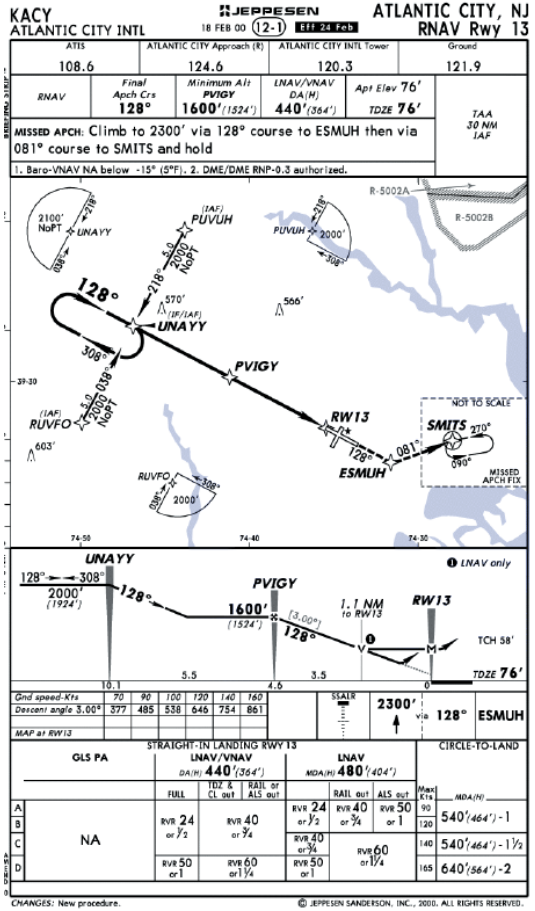
Types of PBN Approvals II

The altimeter does not compensate for extreme low temperatures away from the airport even with a correctly set local altimeter setting.

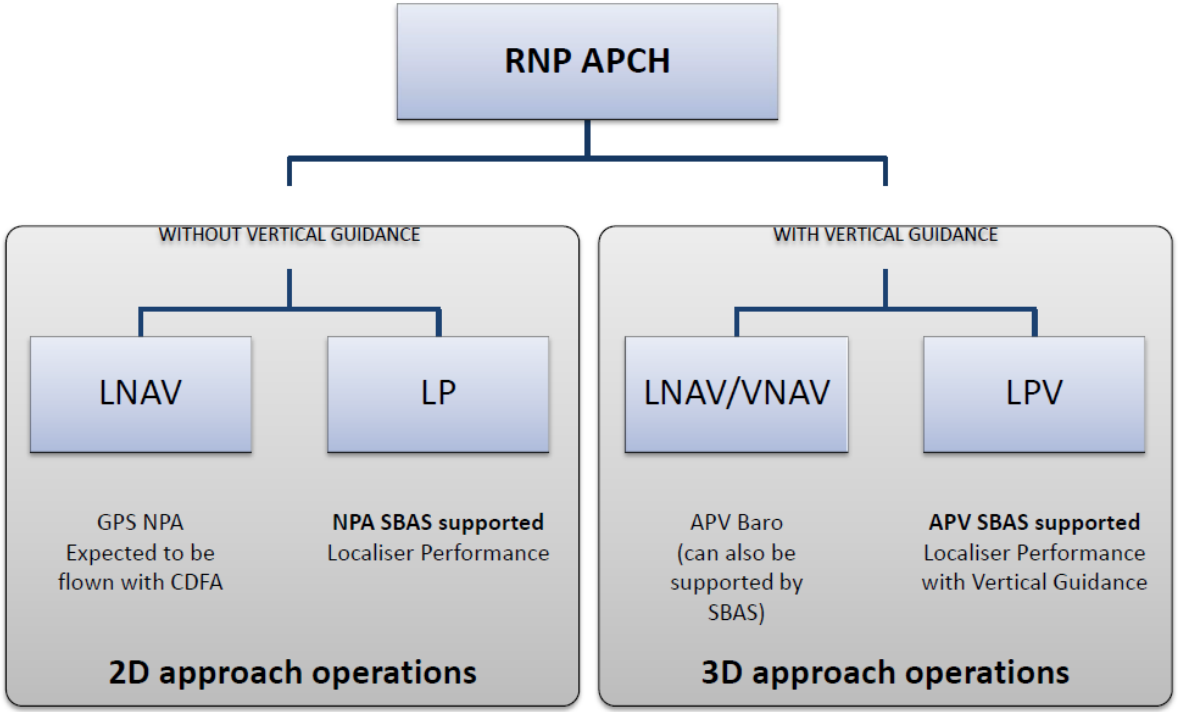
With a temperature at the airport that is -30° C,

your true altitude at the final approach fix could

be more than 200 feet lower than your altimeter indicates you are. And with the required obstacle clearance of 500 feet approaching the FAF, you have already used up much of the safety margin of the approach obstacle clearance protection.

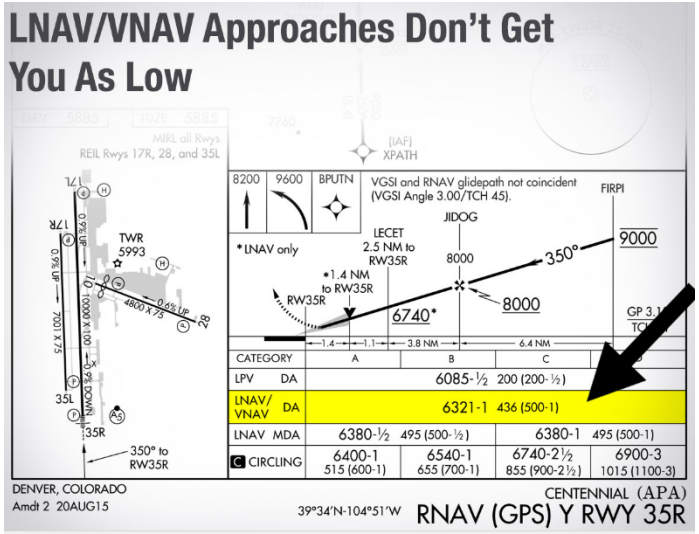


Types of PBN Approvals II



Types of PBN Approvals II

Because the final approach course is linear the entire way to the runway, the lowest an LNAV/VNAV approach can get you is 250' above touchdown. And because the sensitivity isn't as high as LPV with WAAS, the obstacle trapezoid (the area the FAA draws to make sure you have safe obstacle clearance on an approach) is much larger for an LNAV/VNAV. Because of that, you typically see LNAV/VNAV minimums higher than 250' above touchdown for most approaches.

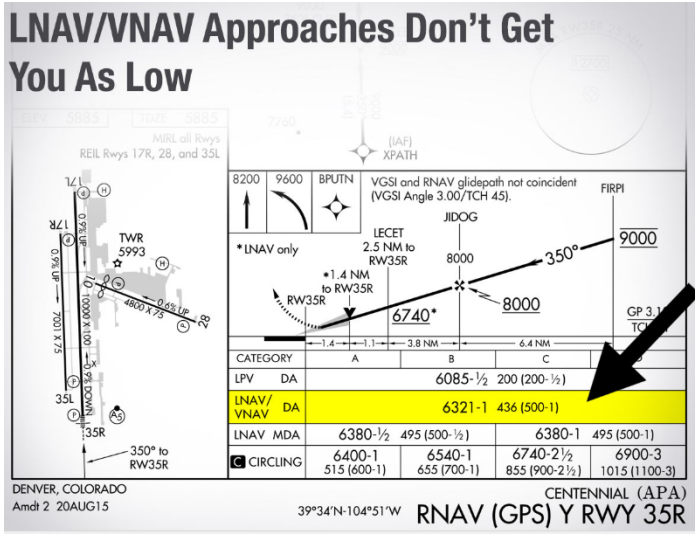


Types of PBN Approvals II

At some airports, the FAA isn't able to design LPV or LNAV/VNAV approaches because of terrain and obstacles. When that happens, you're stuck with the old-school LNAV only approach, complete with step-down altitudes. But when they can, the FAA adds "advisory vertical guidance", which you see on a WAAS-capable GPS system as "LNAV+V".

You won't see the "+V" listed on a chart, but you will see it listed on your GPS unit's display when you load the approach. That's because +V capability is specific to the type of GPS unit you have in your plane.

What About LNAV +V?



Types of PBN Approvals II

(02) **LNAV minima**

- *Non Precision Approach*
- *2D operation*
- *Linear lateral guidance based on GNSS*
- *Expected to be flown using CDFA technique*
- *Integrity provided by RAIM, unless SBAS is available*

LP minima

- *Non Precision Approach*
- *2D operation*
- *SBAS required:*
  - *angular lateral guidance based on GNSS augmented by SBAS*
  - *Integrity provided by SBAS*
- *Expected to be flown using CDFA technique*
- ***LP Final Approach Segment specially coded into a Data Block** inside the on-board navigation database.*
- *Not published at runways with LPV minima*

Types of PBN Approvals II

(03) **LNAV/VNAV minima**

- *APproach with Vertical guidance (APV)*

(07) 3D operation

- *Linear lateral guidance based on GNSS*

(04) Vertical guidance based on Baro-VNAV or SBAS. In any case, the used angular vertical guidance must be certified for the purpose

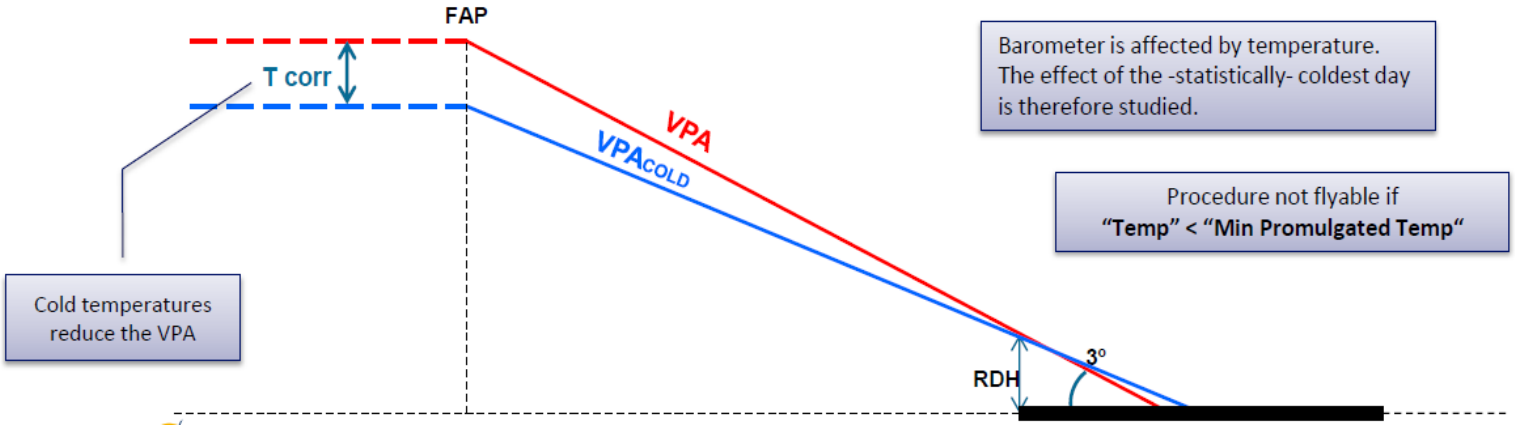
- *Integrity provided by RAIM, unless SBAS is available*

Types of PBN Approvals II

LNAV/VNAV minima

Considerations about the use of the **Barometric sensor**

- **Affected by temperature variation → LNAV/VNAV based on Baro-VNAV can only be flown when aerodrome temperature is within a promulgated range**, unless a/c has an approved temperature compensation system
- **Altimeter setting is critical →** to safe conduct LNAV/VNAV based on Baro-VNAV, remote altimeter setting is prohibited



Types of PBN Approvals II

LPV minima

- *Precision Approach CAT-I or APproach with Vertical guidance (APV)*

(08) 3D operation

(10) SBAS required:

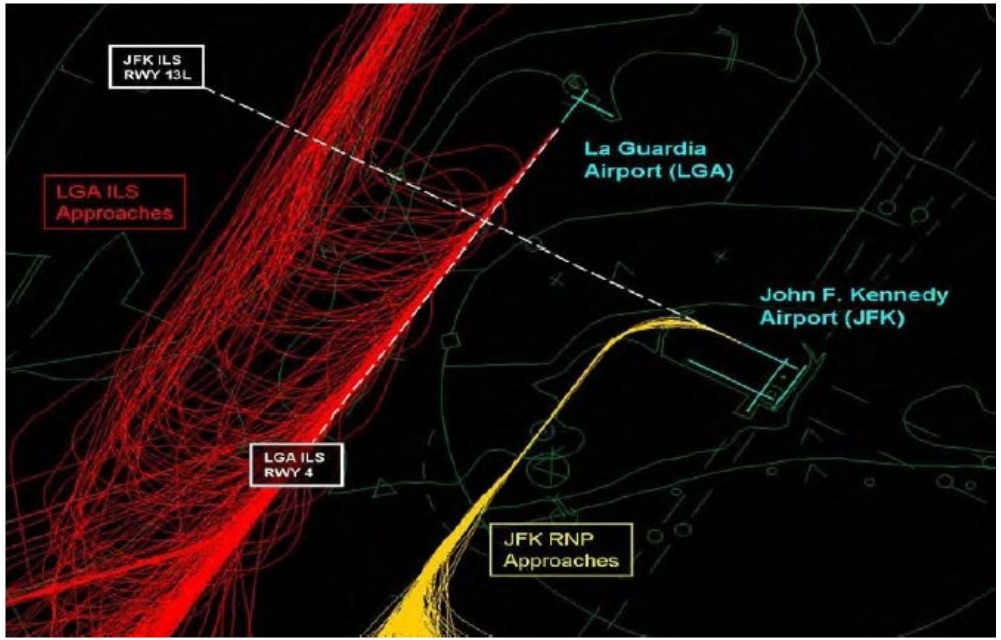
- *angular lateral and vertical guidance based on GNSS augmented by SBAS*
- *Integrity provided by SBAS*

(09) ***LPV Final Approach Segment is specially coded into a Data Block*** *inside the on-board navigation database. It is known as the FAS DB*

Types of PBN Approvals II

RNP APCH (PBN) vs ILS APCH

Performance based navigation



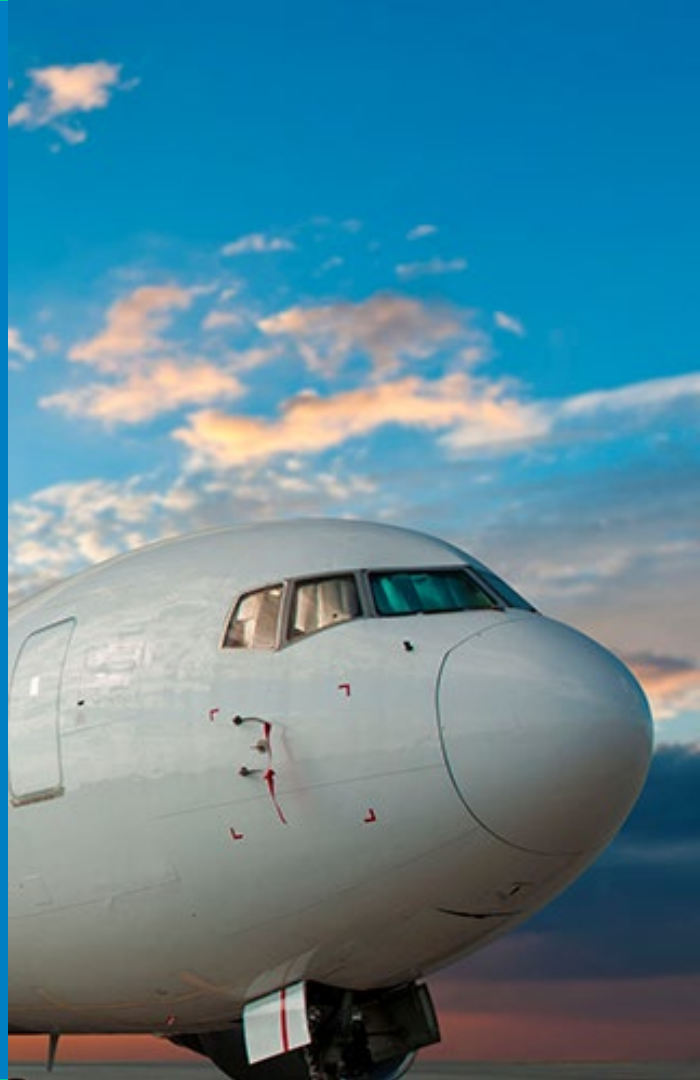
Types of PBN Approvals II

Surrounded by 1,000-foot-high mountains, landing at the Isafjordur Airport (BIIS) in Iceland means you'll be flying one of the most scenic and challenging approaches in the world.

EASA
European Union Aviation Safety Agency

ICAO DOCUMENTS 9613 & 9997

PBN Operational Approvals Workshop



An Agency of the European Union

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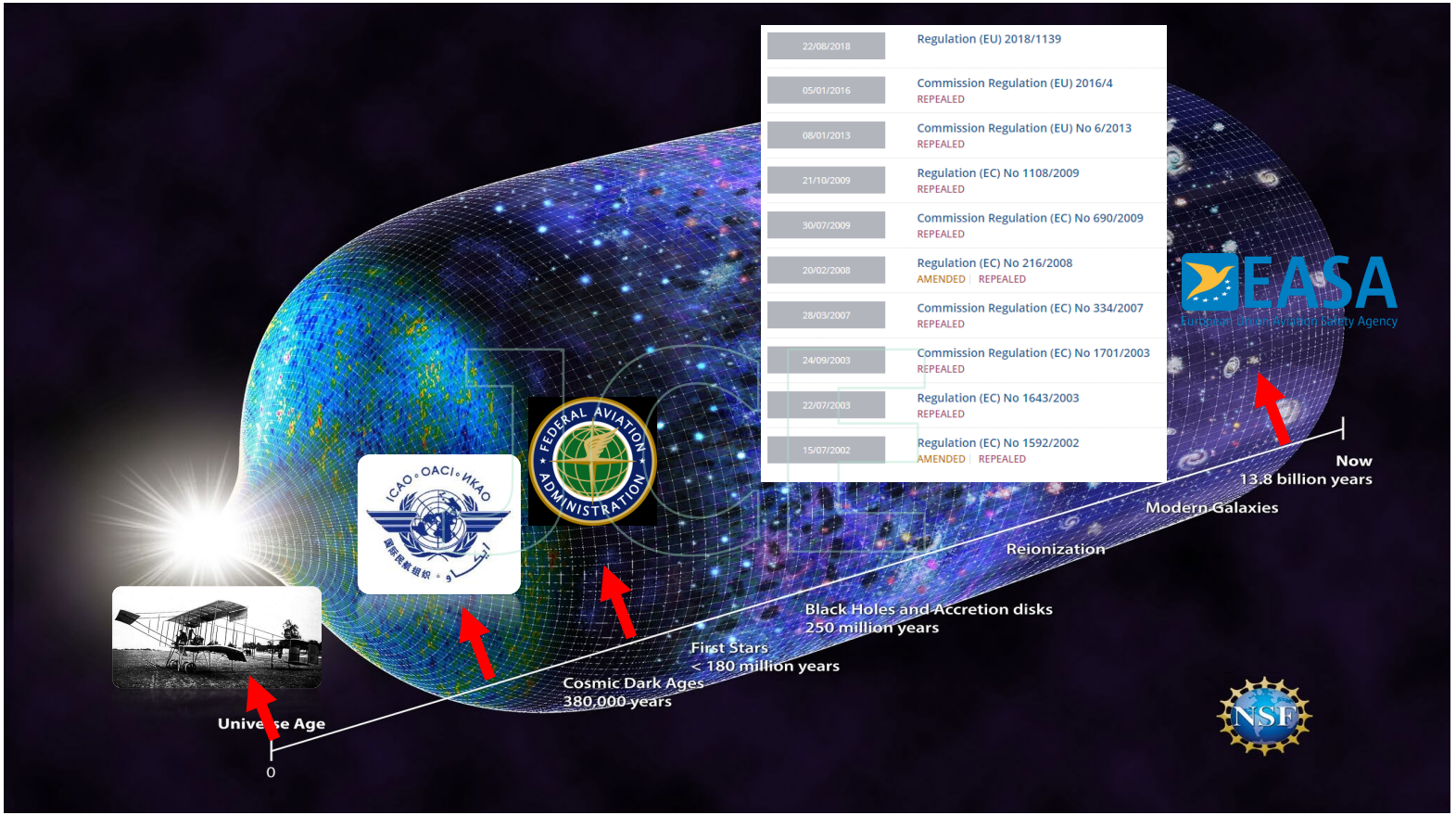

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RNAV 5 (B RNAV)

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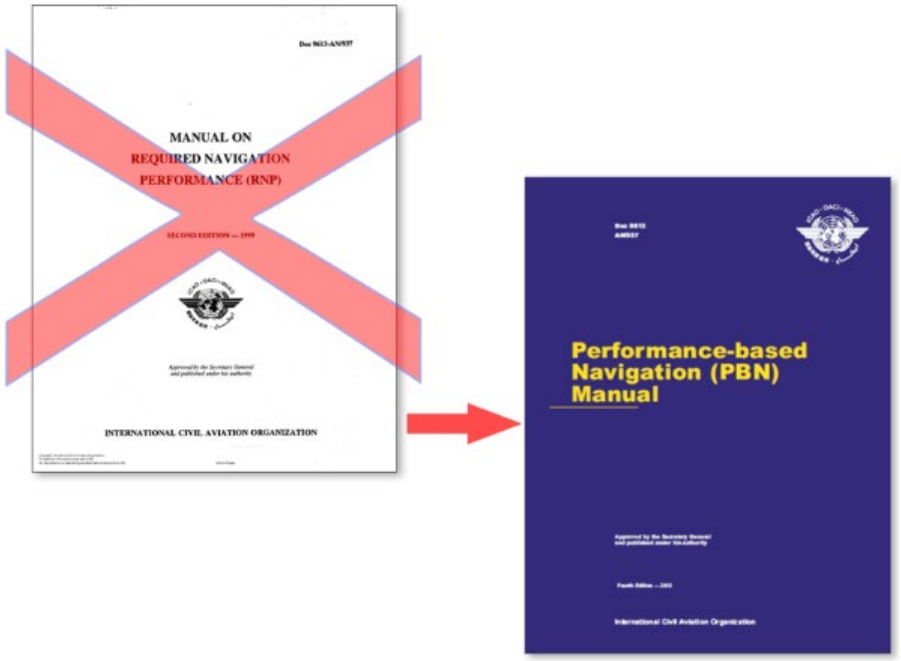

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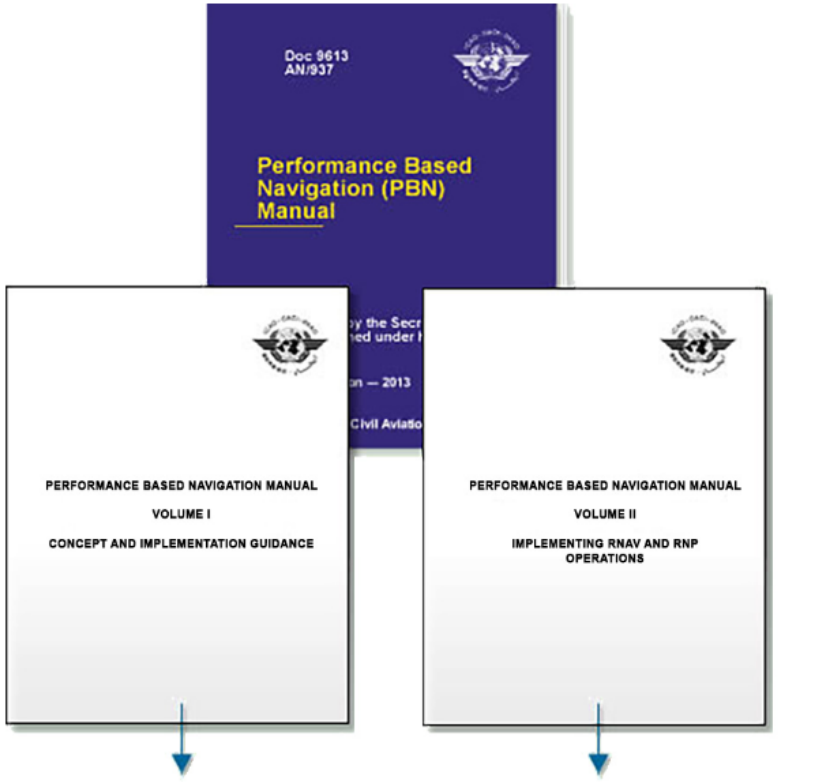

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ICAO DOC.9613-AN/937 (PBN MANUAL)

The PBN Manual

The PBN Manual ICAO DOC 9613 comprises two Volumes.

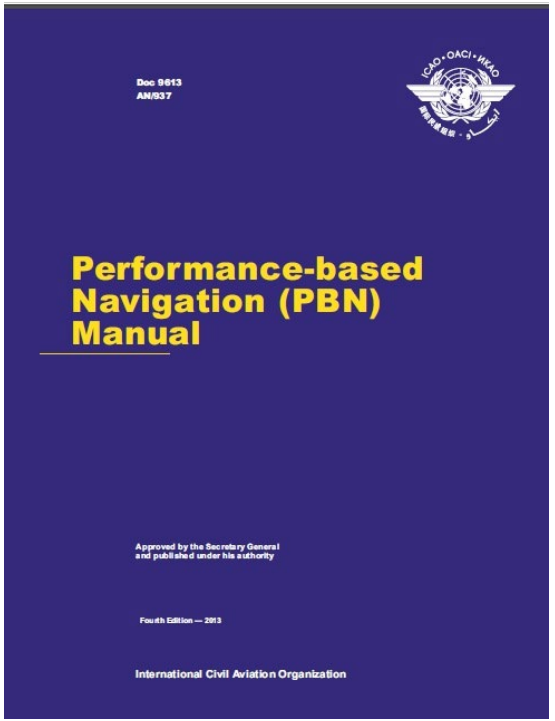
Volume I of the PBN Manual is made up of two parts:

1. Part A
2. Part B

Volume II of the PBN Manual is also made up of three parts.

Part A describes on-board performance monitoring and alerting and Safety Assessments, whilst

Parts B and C contain ICAO's RNAV and RNP specifications which are to be used by States as a basis for certification and operational approval.



EASA

ICAO DOCUMENTS 9613 & 9997

Part A describes the PBN Concept, The Airspace Concept and how the PBN Concept is used in practice.

VOLUME I

CONCEPT AND IMPLEMENTATION GUIDANCE

PART A — THE PERFORMANCE-BASED NAVIGATION (PBN) CONCEPT

ICAO DOCUMENTS 9613 & 9997

Part B provides Implementation Guidance for ANSPs in the form of three processes

VOLUME I

CONCEPT AND IMPLEMENTATION GUIDANCE

PART B — IMPLEMENTATION GUIDANCE

ICAO DOCUMENTS 9613 & 9997

ATTACHMENTS TO VOLUME I

ICAO DOCUMENTS 9613 & 9997

VOLUME II IMPLEMENTING RNAV AND RNP OPERATIONS

Describes on-board performance monitoring and alerting and Safety Assessments.

PART A — GENERAL

ICAO DOCUMENTS 9613 & 9997

VOLUME II IMPLEMENTING RNAV AND RNP OPERATIONS

Parts B ICAO's RNAV specifications which are to be used by States as a basis for certification and operational approval.

PART B — IMPLEMENTING RNAV OPERATIONS

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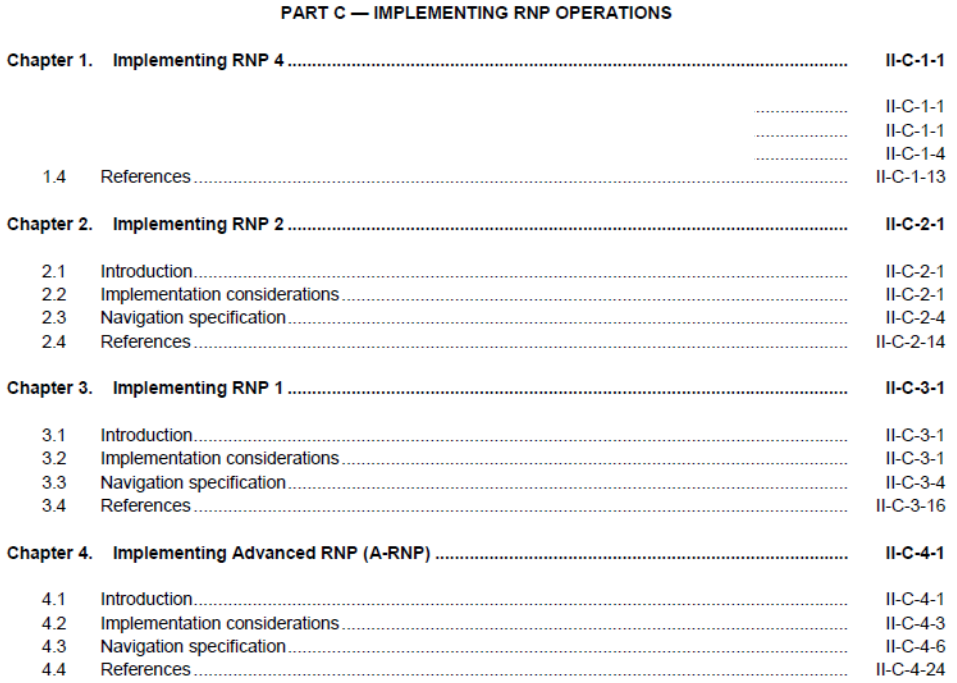
VOLUME II IMPLEMENTING RNAV AND RNP OPERATIONS

and C contain ICAO's RNP specifications which are to be used by States as a basis for certification and operational approval.



PART C — IMPLEMENTING RNP OPERATIONS

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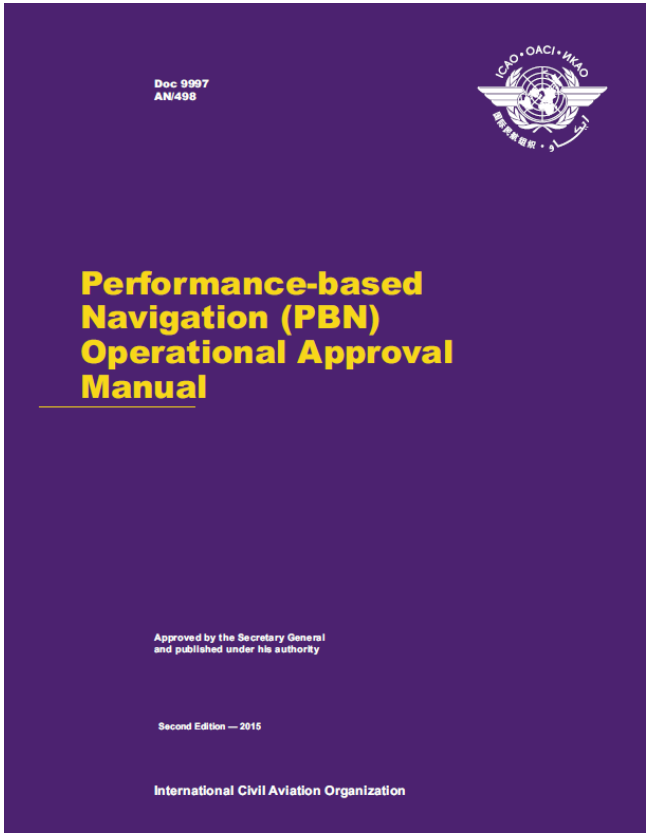
EASA

ICAO DOCUMENTS 9613 & 9997

- Doc 9997 published by ICAO

- Provide guidance on the **operational approval process** for PBN
  - Introduction on PBN principles
  - Certification and Operational approval
  - Operational approval guideline
  - Navigation specification



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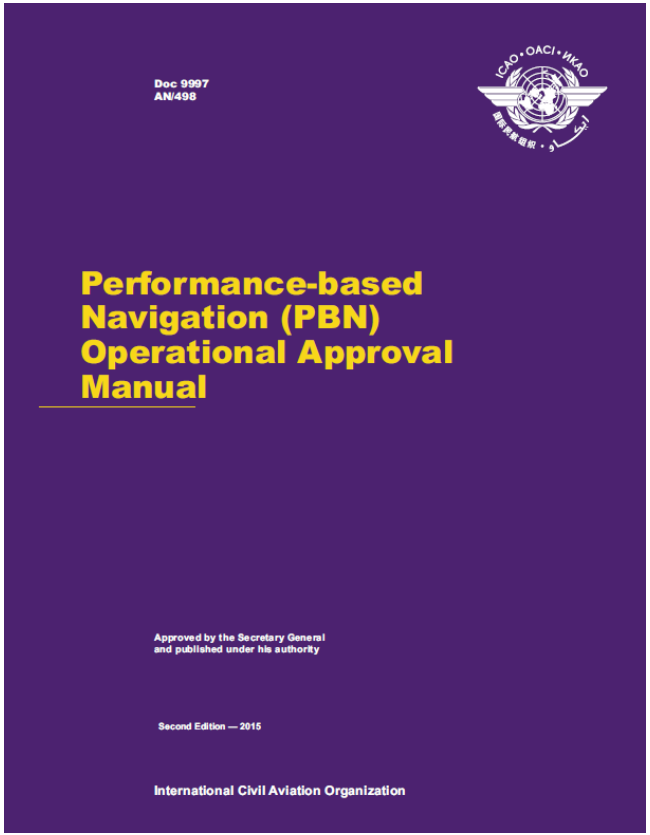

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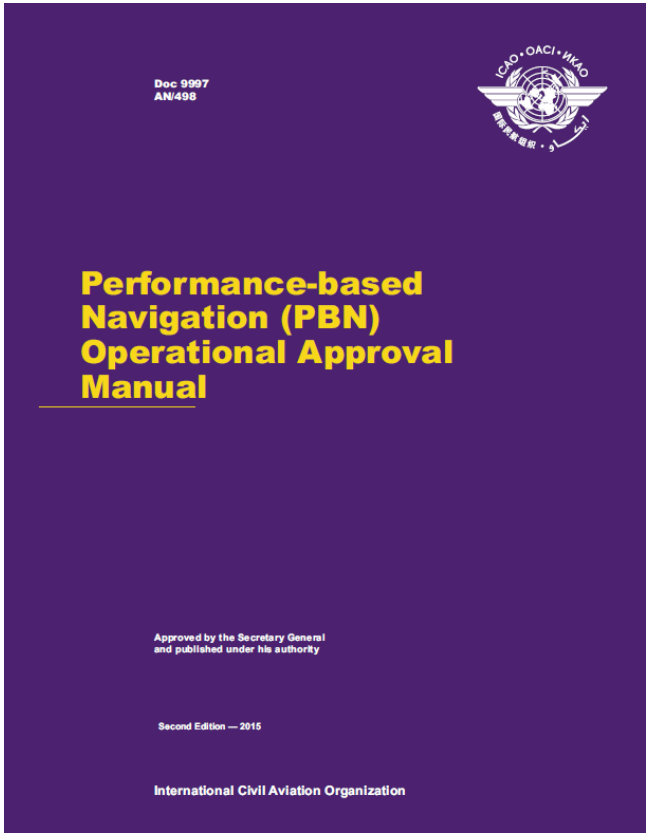
Chapter 1. Performance-based navigation.



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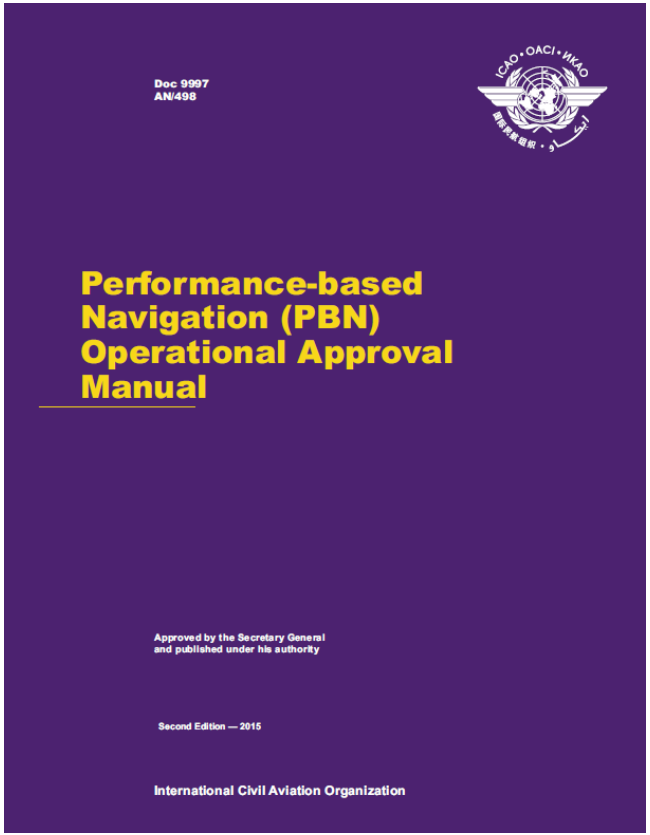
Chapter 2. Certification and operational approval.



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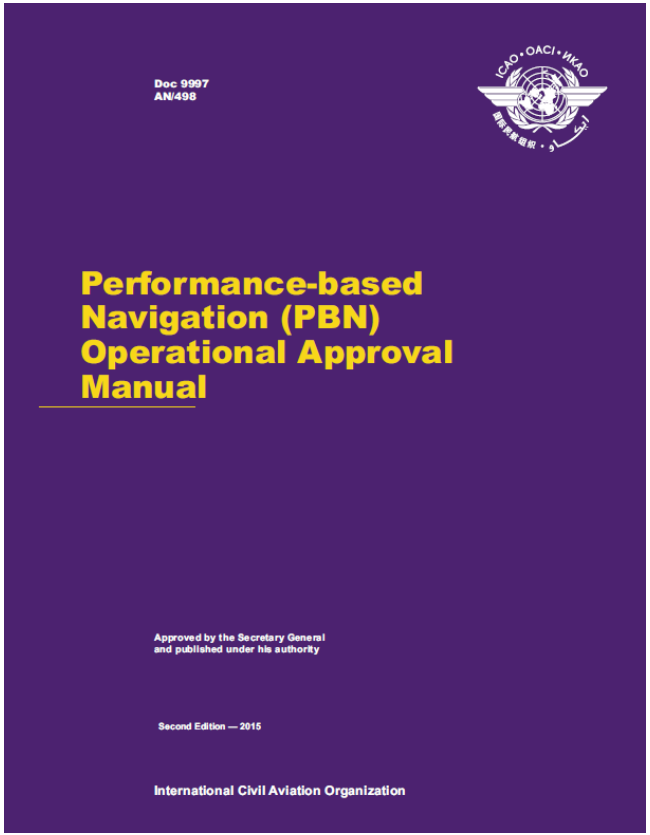
Chapter 2

CERTIFICATION AND OPERATIONAL APPROVAL

The PBN concept requires that the aircraft meets certain airworthiness certification standards, including the necessary navigation system performance and functionality, to be eligible for a particular application and that the operator has operational approval from an appropriate regulatory body before the system can be used.



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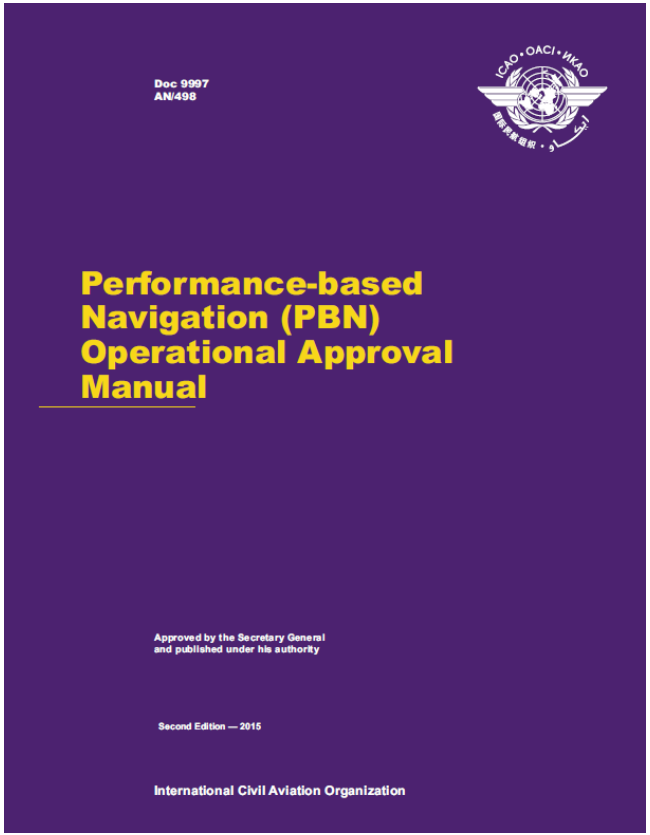
Chapter 2

CERTIFICATION AND OPERATIONAL APPROVAL

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



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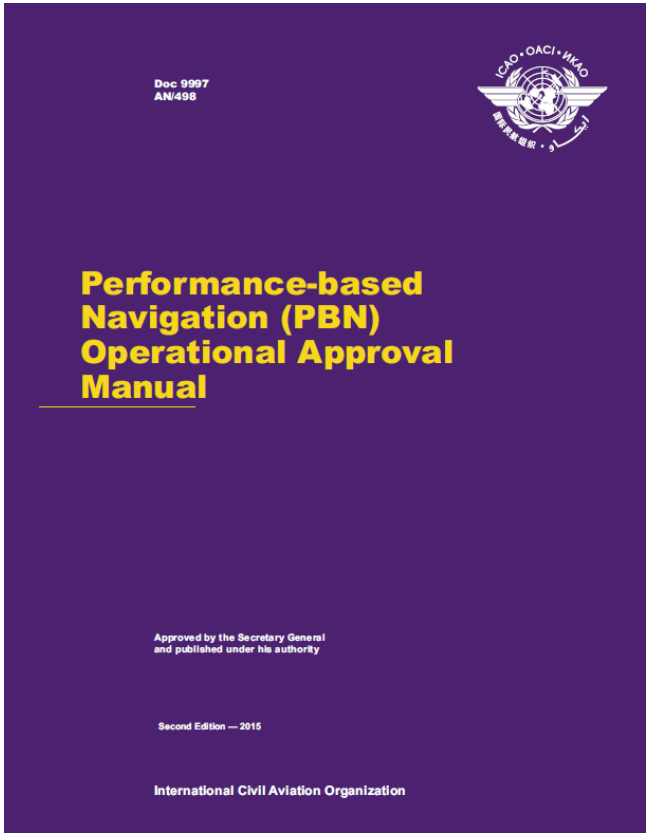
Chapter 2

CERTIFICATION AND OPERATIONAL APPROVAL

b) The continued airworthiness element of the operational approval is not directly addressed in the PBN manual since it is inherent in the aircraft airworthiness approval through the airworthiness requirements, i.e. U.S. 14 CFR 25.1529/EASA CS-25.1529, but the operator is expected to be able to demonstrate that the navigation system will be maintained compliant with the type design. For navigation system installations there are few specific continued airworthiness requirements other than database and configuration management, systems modifications and software revisions, but the element is included for completeness and consistency with other CNS/ATM operational approvals, e.g. RVSM.



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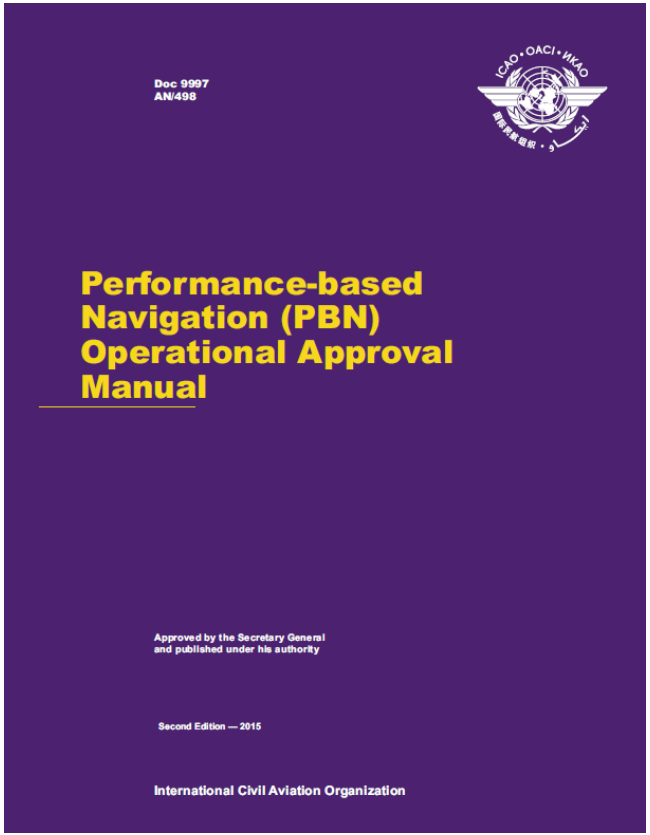
Chapter 2

CERTIFICATION AND OPERATIONAL APPROVAL

c) The flight operations element considers the operator's infrastructure for conducting PBN operations and flight crew operating procedures, training and competency demonstrations. This element also considers the operator's MEL, operations manual, checklists, instrument flight procedure approval processes, navigation database validation procedures, dispatch procedures, etc.



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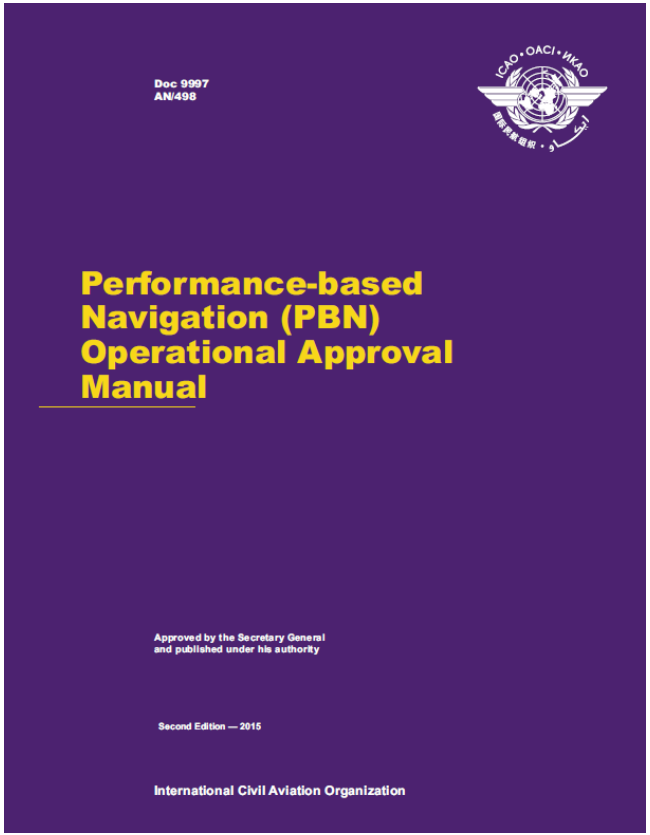
Chapter 3. Operational approval guidelines..



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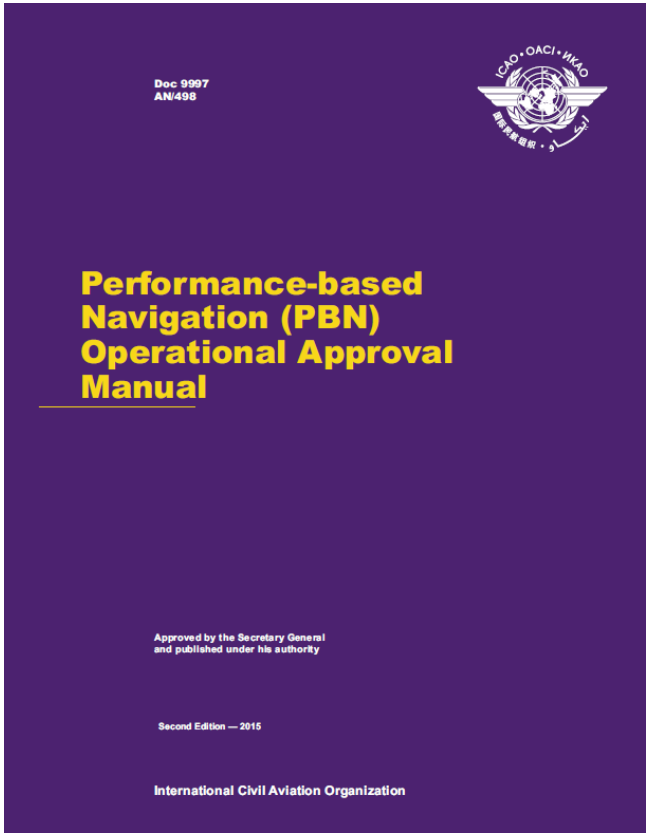
Chapter 3

OPERATIONAL APPROVAL GUIDELINES

3.1 AIRCRAFT ELIGIBILITY

The first step in assessing an application for PBN operational approval is to establish that the aircraft and its systems are suitable for the specific operation



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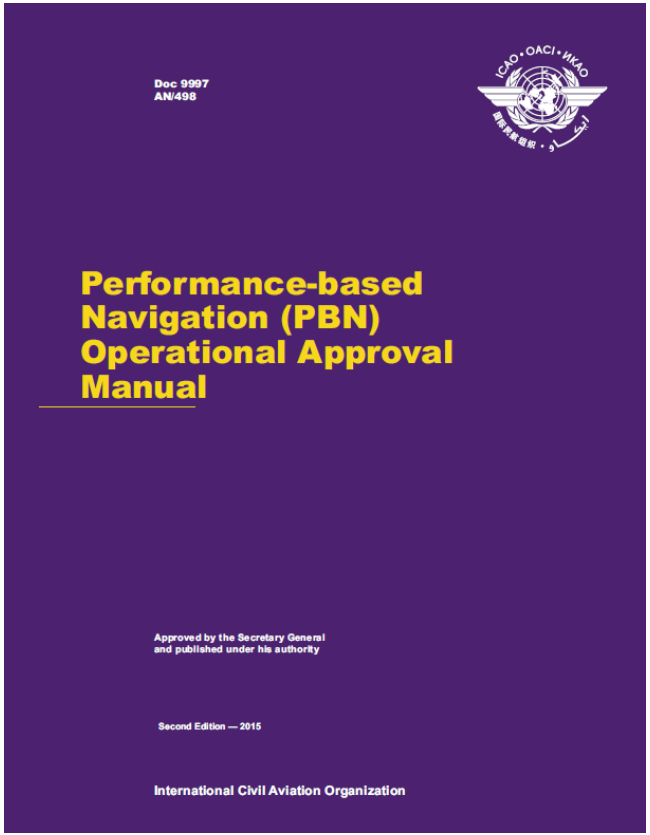
Chapter 3

OPERATIONAL APPROVAL GUIDELINES

3.2 STANDARD OPERATING PROCEDURES

Standard operating procedures (SOPs) must be developed to cover both normal and non-normal (contingency) procedures for the systems used in the PBN operation.

- → *Preflight planning requirements*
  - → Prior to commencing the PBN operation
    - → During the PBN operation:
      - → In the event of a contingency
      - → *After-flight procedures*



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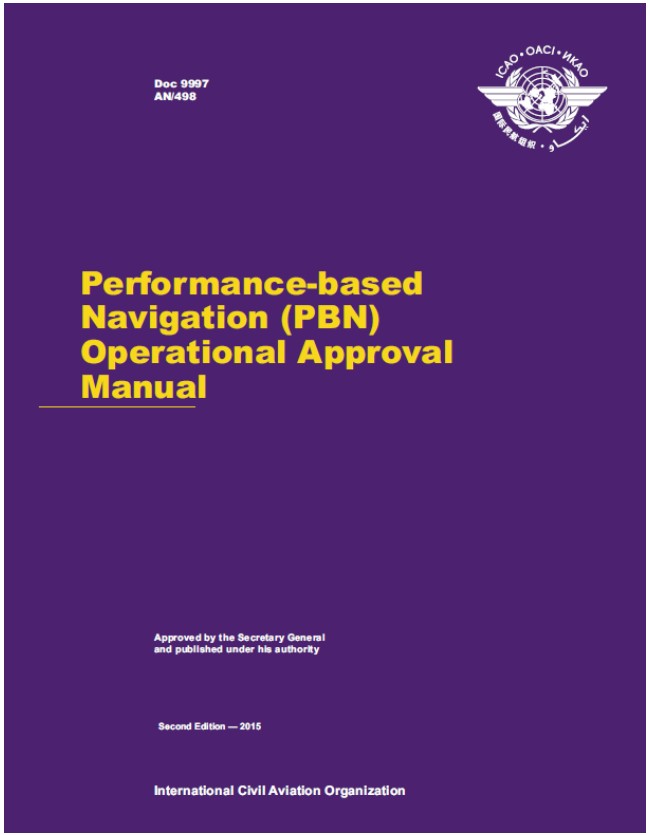
Chapter 3

OPERATIONAL APPROVAL GUIDELINES

3.3 TRAINING

The navigation specifications cover a wide range of operations, and training needs to be appropriate to the particular circumstances. Moreover, although each navigation specification includes guidance on flight crew training, the guidance is not consistent, in detail or scope, across the range of navigation specifications, and there is much duplication.



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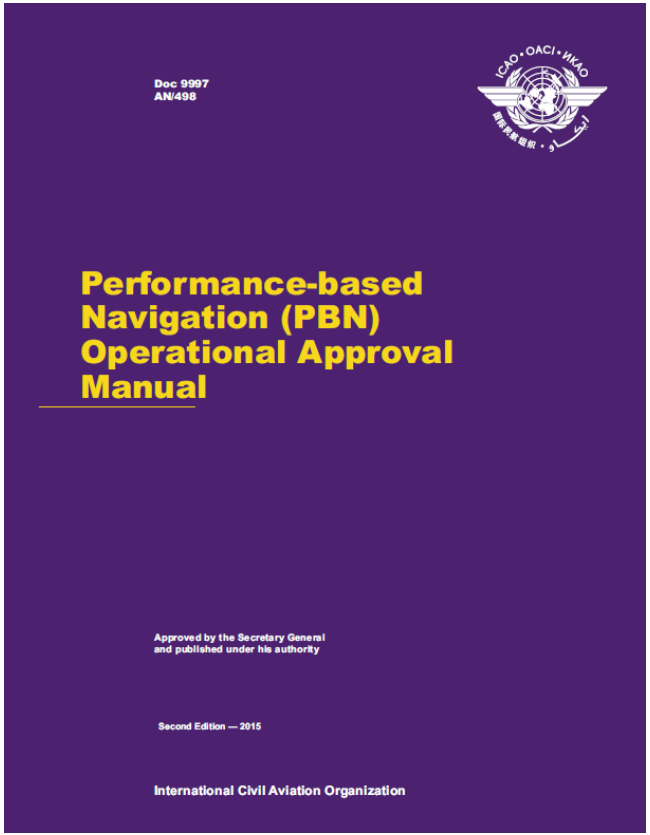
Chapter 3

OPERATIONAL APPROVAL GUIDELINES

For en-route operations, ground training is usually sufficient to provide crews with the necessary knowledge.

Delivery methods will vary, but classroom training, computer-based training or, in some cases, desktop simulation training is normally sufficient.

Arrival and departure operations and approach operations, in particular, also require the use of flight simulation training devices in addition to ground training and briefings.

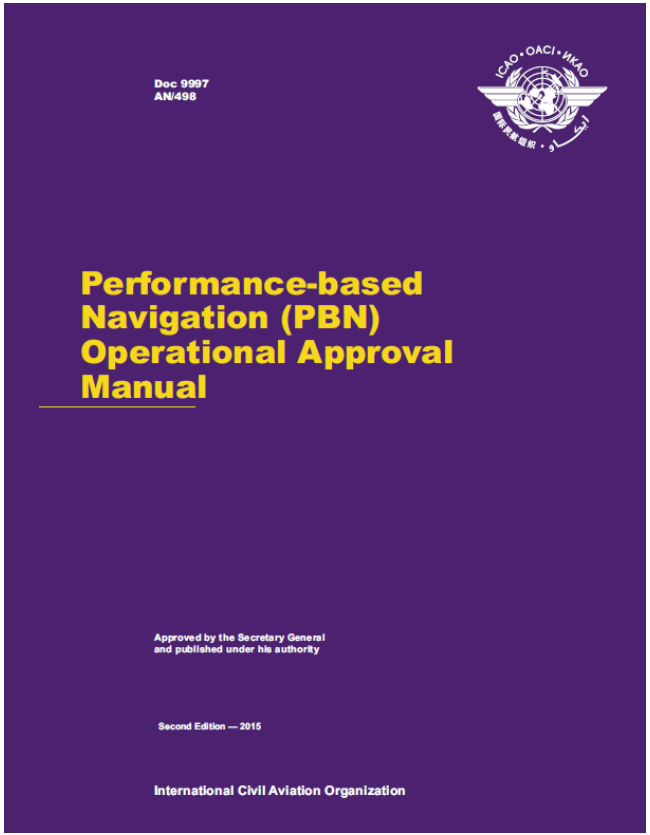


ICAO DOCUMENTS 9613 & 9997

Chapter 3

OPERATIONAL APPROVAL GUIDELINES

- Dispatcher training, as applicable, should be implemented to achieve the necessary competency in dispatch procedures related to PBN operations.
- Consideration should also be given to the need for flight crews to demonstrate that competency standards are achieved and maintained and the means by which the operator documents the qualification.



ICAO DOCUMENTS 9613 & 9997

Chapter 3

OPERATIONAL APPROVAL GUIDELINES

3.4 NAVIGATION DATABASES

The operator should have procedures in place for ensuring that:

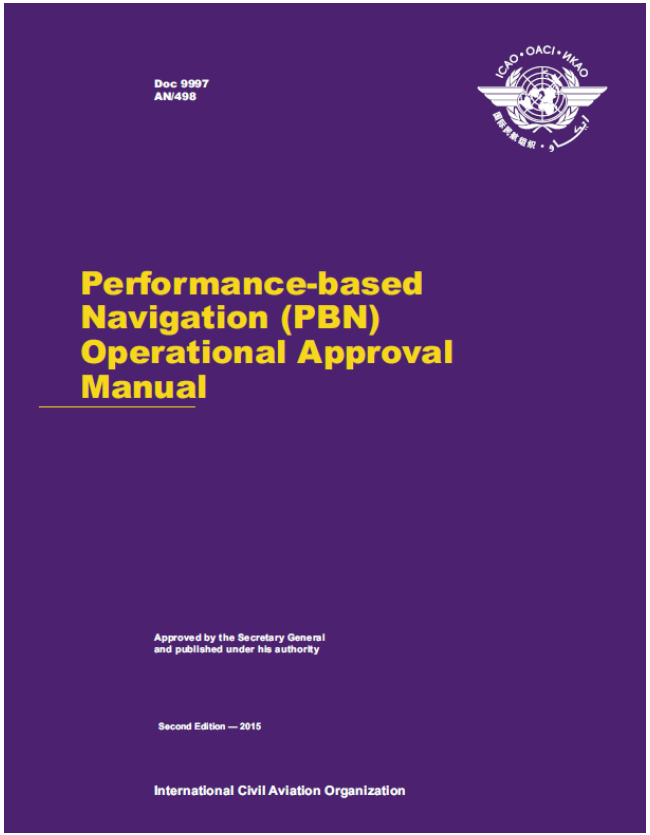
a) the correct version of the navigation database is loaded on the aircraft;

b) any database errors/omissions reported by the suppliers are addressed expeditiously by flight crew briefing/removal of procedures, etc.;

c) any database errors/omissions reported by the flight crew are addressed expeditiously by flight crew briefing/removal of procedures and reported back to the database suppliers;

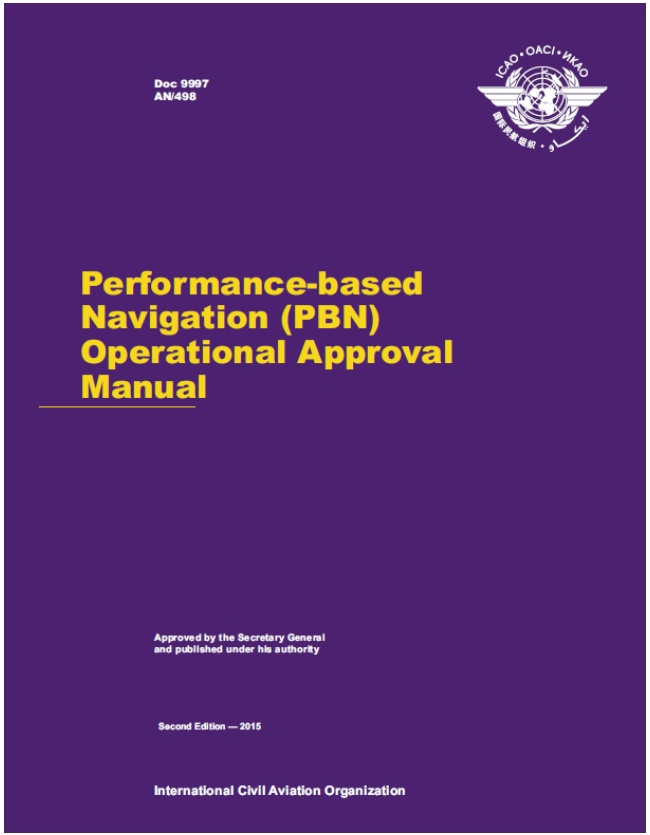
d) the version of the loaded navigation database is checked for validity by the flight crew prior to departure;

e) prior to use after being loaded into the area navigation system, the procedure is checked against the chart, by the flight crew, for waypoint sequence, waypoint transition, leg length, magnetic bearing, altitude constraint and speed constraint.



ICAO DOCUMENTS 9613 & 9997

Chapter 4. Navigation specification job aids ..



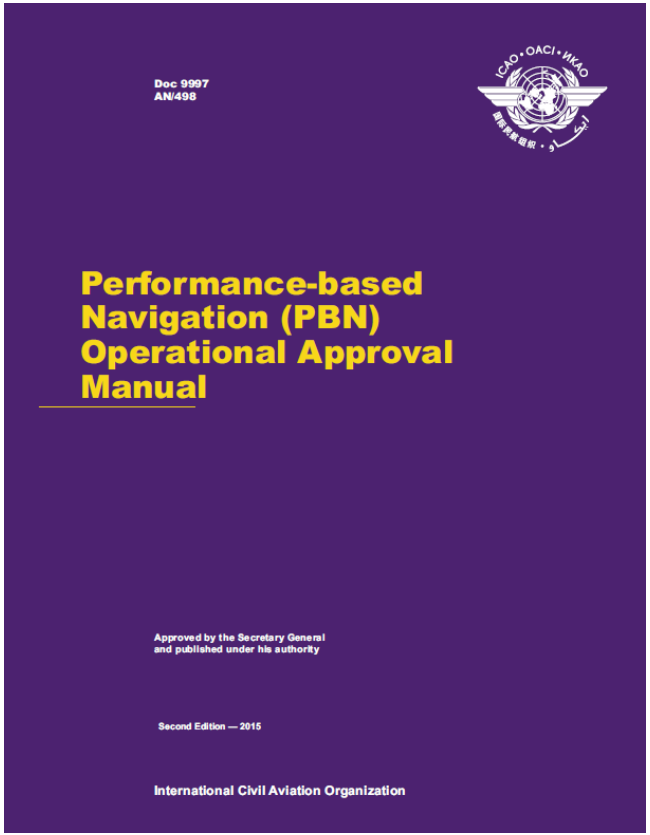
ICAO DOCUMENTS 9613 & 9997

Chapter 4

NAVIGATION SPECIFICATION JOB AIDS

- In order to facilitate a standardized approach to the process of applying for PBN approval, a structured form, known as a “job aid”, has been developed.

- In the absence of national pro forma, the job aid can be used by the operator to detail the application for approval and to demonstrate that the specific requirements with respect to aircraft eligibility, operating procedures, training and database management have been met.

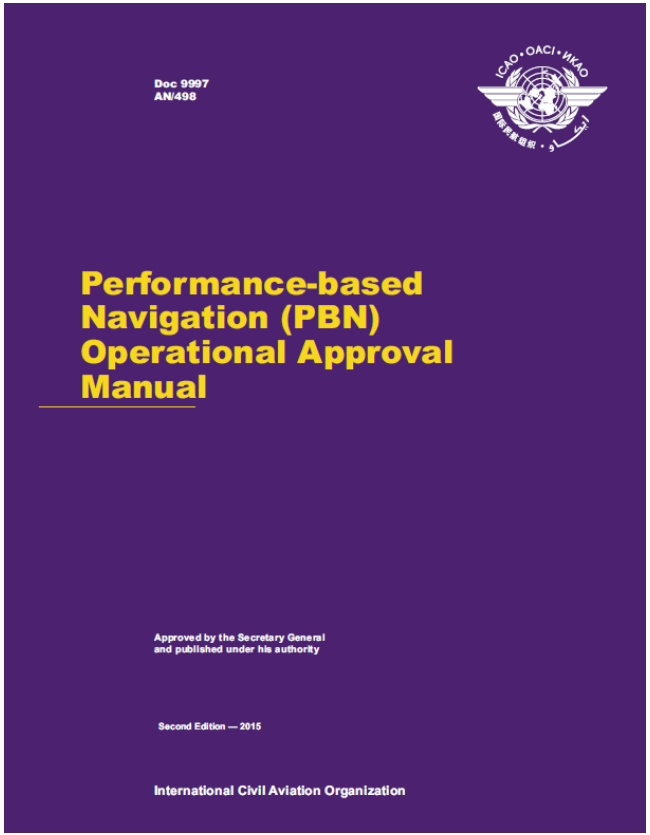


ICAO DOCUMENTS 9613 & 9997

Chapter 4

NAVIGATION SPECIFICATION JOB AIDS

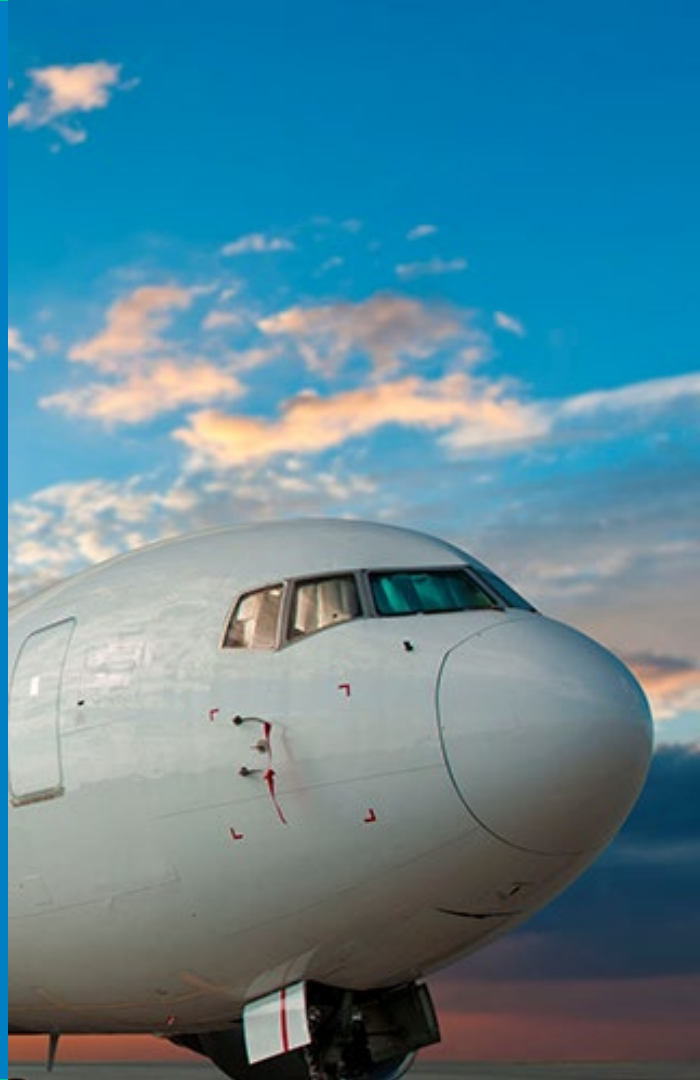
- Much of the application process is common to all navigation specifications but each specification has specific elements that must be addressed.



EASA
European Union Aviation Safety Agency

EASA PBN Regulations

PBN Operational Approvals Workshop



An Agency of the European Union

EASA PBN Regulations

RNAV 5 (B RNAV)

FAA Advisory Circulars

AC 20-121 A	Airworthiness Approval of LORAN C for use in the U.S. National Airspace System
AC 20-130()	Airworthiness Approval of Multi-sensor Navigation Systems for use in the U.S. National Airspace System
AC 20-138	Airworthiness Approval of NAVSTAR Global Positioning System (GPS) for use as a VFR and IFR Supplemental Navigation System
AC 25-4	Inertial Navigation Systems (INS)
AC 25-15	Approval of FMS in Transport Category Airplanes
AC 90-45 A	Approval of Area Navigation Systems for use in the U S. National Airspace System

ETSOs

ETSO-C115b	Airborne Area Navigation Equipment Using Multi Sensor Inputs
ETSO-C129a	Airborne Supplemental Navigation Equipment Using the Global Positioning System (GPS)
ETSO-C145	Airborne Navigation Sensors Using the Global Positioning System (GPS) Augmented by the Wide Area Augmentation System (WAAS).
ETSO-C146	Stand-Alone Airborne Navigation Equipment Using the Global Positioning System (GPS) Augmented by the Wide Area Augmentation System (WAAS)

EUROCAE/RTCA documents

ED-27	Minimum Operational Performance Requirements (MOPR) for Airborne Area Navigation Systems, based on VOR and DME as sensors
ED-28	Minimum Performance Specification (MPS) for Airborne Area Navigation Computing Equipment based on VOR and DME as sensors
ED-39	MOPR for Airborne Area Navigation Systems, based on two DME as sensors
ED-40	MPS for Airborne Computing Equipment for Area Navigation System using two DME as sensors.
ED-58	Minimum Operational Performance Specification (MOPS) for Area Navigation Equipment using Multi-Sensor Inputs
ED-72()	MOPS for Airborne GPS Receiving Equipment
DO-180()	Minimum Operational Performance Standards (MOPS) for Airborne Area Navigation Equipment Using a Single Collocated VOR/DME Sensor Input
DO-187	MOPS for Airborne Area Navigation Equipment Using Multi Sensor Inputs
DO-200	Preparation, Verification and Distribution of User-Selectable Navigation Data Bases
DO-201	User Recommendations for Aeronautical Information Services
DO-208	MOPS for Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS)

Related specifications

CS/FAR 25.1301, 25.1307, 25.1309, 25.1321, 25.1322, 25.1431

CS/FAR 23.1301, 23.1309, 23.1311, 23.1321, 23.1322, 23.1431

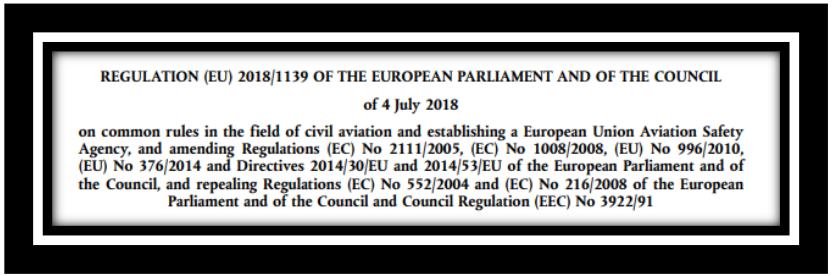
CS/FAR 27.1301, 27.1309, 27.1321, 27.1322

CS/FAR 29.1301, 29.1309, 29.1321, 29.1322, 29.1431

operating requirements

EASA PBN Regulations

NEW BASE REGULATION

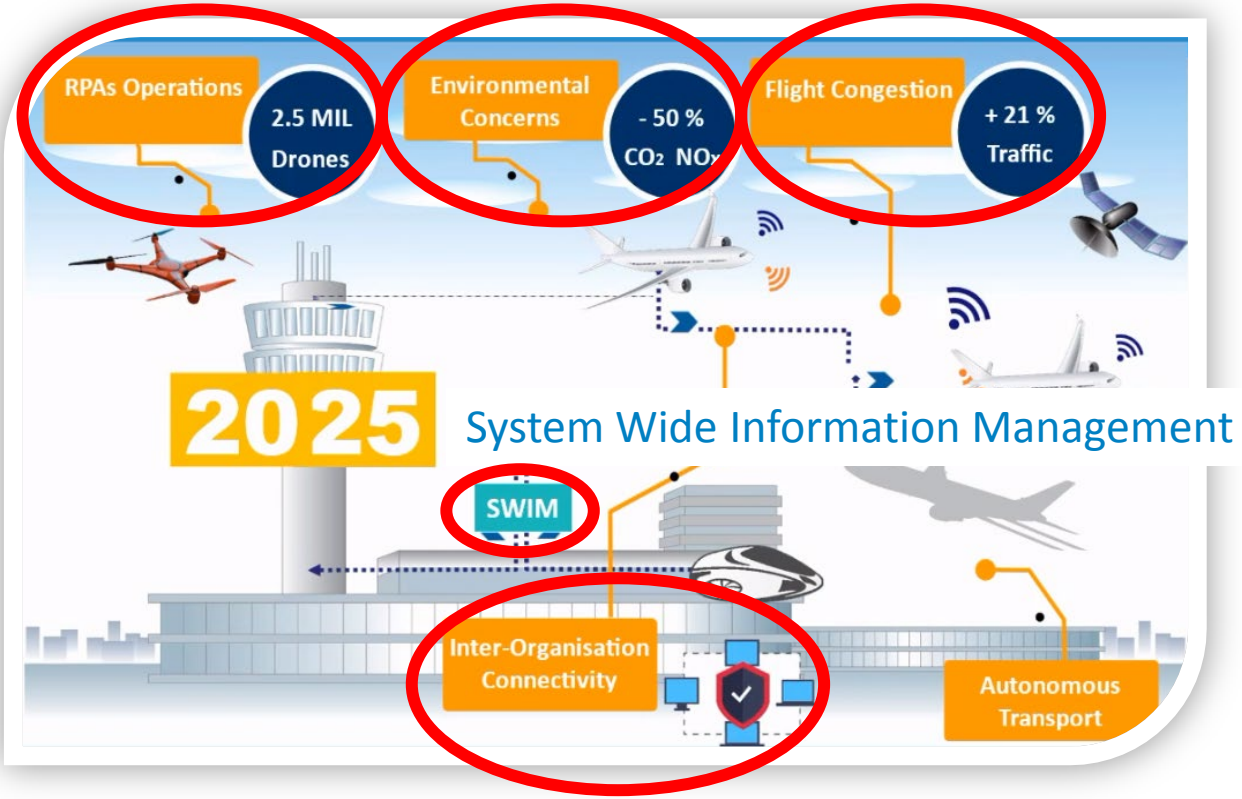


REGULATION (EU) 2018/1139 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 4 July 2018

on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91

EASA PBN Regulations



EASA PBN Regulations

Easy Access Rules for Air Operations (Regulation (EU) No 965/2012)

EASA eRules: aviation rules for the 21st century

Rules and regulations are the core of the European Union civil aviation system. The aim of the **EASA eRules** project is to make them **accessible** in an efficient and reliable way to stakeholders.

EASA eRules will be a comprehensive, single system for the drafting, sharing and storing of rules. It will be the single source for all aviation safety rules applicable to European airspace users. It will offer easy (online) access to all rules and regulations as well as new and innovative applications such as rulemaking process automation, stakeholder consultation, cross-referencing, and comparison with ICAO and third countries' standards.

To achieve these ambitious objectives, the **EASA eRules** project is structured in ten modules to cover all aviation rules and innovative functionalities.

The **EASA eRules** system is developed and implemented in close cooperation with Member States and aviation industry to ensure that all its capabilities are relevant and effective.

Published October 2019[1]

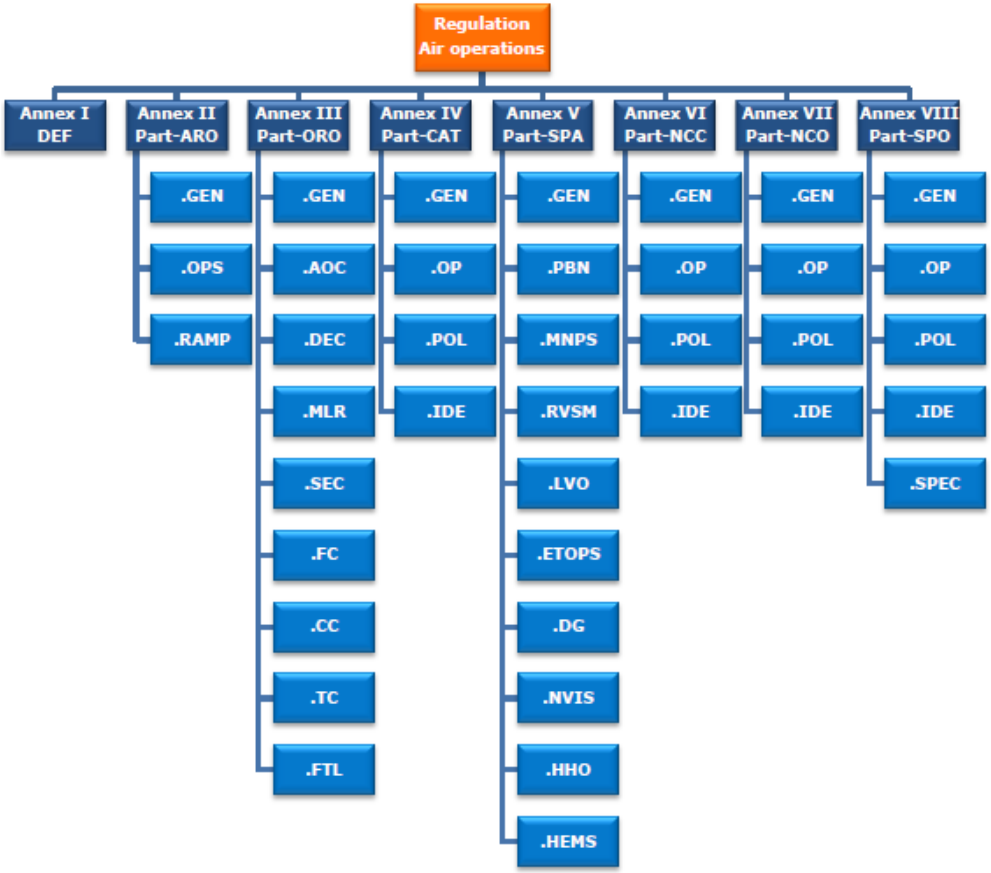
EASA PBN Regulations

Air Operations - General

Commission Regulation (EU) No 965/2012 (the so-called 'Air Ops Regulation') contains provisions for the following types of air operations with aeroplanes and helicopters:

1. commercial air transport (CAT) operations,
2. non-commercial operations with complex motor-powered aircraft (NCC),
3. non-commercial operations with other-than complex motor-powered aircraft (NCO), and
4. specialised operations (e.g. aerial work), both commercial and non-commercial (SPO).

EASA PBN Regulations



EASA PBN Regulations

Part-ARO – Authority Requirements for Air Operations

- Subpart Gen: General Requirements
- Subpart Ops: Air Operations
- Subpart Ramp: Ramp Inspections of Aircraft of Operators under the Regulatory Oversight of another State

EASA PBN Regulations

ARO.GEN.200 Management system

Regulation (EU) No 379/2014

(a) The competent authority shall establish and maintain a management system, including as a minimum:

(1) documented policies and procedures to describe its organisation, means and methods to achieve compliance with Regulation (EC) No 216/2008 and its Implementing Rules. The procedures shall be kept up to date and serve as the basic working documents within that competent authority for all related tasks;

(2) a sufficient number of personnel to perform its tasks and discharge its responsibilities. Such personnel shall be qualified to perform their allocated tasks and have the necessary knowledge, experience, initial and recurrent training to ensure continuing competence. A system shall be in place to plan the availability of personnel, in order to ensure the proper completion of all tasks;

(3) adequate facilities and office accommodation to perform the allocated tasks;

(4) a function to monitor compliance of the management system with the relevant requirements and adequacy of the procedures including the establishment of an internal audit process and a safety risk management process. Compliance monitoring shall include a feedback system of audit findings to the senior management of the competent authority to ensure implementation of corrective actions as necessary; and

(5) a person or group of persons, ultimately responsible to the senior management of the competent authority for the compliance monitoring function.

EASA PBN Regulations

Part-ORO – Organisation Requirements for Air Operations

- Subpart GEN (general requirements);
- Subpart AOC (air operator certification);
- Subpart DEC (declaration);
- Subpart SPO (commercial specialised operations);
- Subpart MLR (manuals, fogs and records);
- Subpart SEC (security);
- Subpart FC (flight crew);
- Subpart CC (cabin crew);
- Subpart TC (technical crew in HEMS. HHO or NVIS operations); and
- Subpart FTL (flight and duty time limitations and rest requirements (commercial A only)).

EASA PBN Regulations

ORO.GEN.005 Scope

Regulation (EU) No 379/2014

This Annex establishes requirements to be followed by an air operator conducting:

(a) commercial air transport operations (CAT);

(b) commercial specialised operations;

(c) non-commercial operations with complex motor-powered aircraft;

(d) non-commercial specialised operations with complex motor-powered aircraft.

EASA PBN Regulations

Part-CAT – Commercial Air Transport Operations

- → Subpart A (general requirements (GEN));
- → Subpart B (operating procedures (OP));
- → Subpart C (aircraft performance and operating limitations (POL): performance classes A, B and C (A) and performance classes 1, 2 and 3 (H); mass and balance: motor-powered aircraft, sailplanes (S) and balloons (B)); and
- → Subpart D (instruments, data and equipment (IDE)).

EASA PBN Regulations

Part-SPA – Operations requiring Specific Approvals

- Subpart A (general requirements (GEN));
- Subpart B (performance-based navigation (PBN) operations);
- Subpart C (operations with specified minimum navigation performance (MNPS));
- Subpart D (operations in airspace with reduced vertical separation minima (RVSM));
- Subpart E (low visibility operations (LVO));
- Subpart F (extended range operations with two-engined aeroplanes (ETOPS));
- Subpart G (transport of dangerous goods (DG));
- Subpart H (helicopter operations with night vision imaging systems (NVIS));
- Subpart I (helicopter hoist operations (HHO));
- Subpart J (helicopter emergency medical service operations (HEMS)).

EASA PBN Regulations

Non-commercial operations with complex motor-powered aircraft (NCC)

- → Subpart A (general requirements (GEN));
- → Subpart B (operational procedures (OP));
- → Subpart C (aircraft performance and operating limitations (POL));
- → Subpart D (instruments, data and equipment (IDE)).

EASA PBN Regulations

Part-NCO – Non-commercial operations with other than complex-motor-powered aircraft

- → Subpart A (general requirements (GEN));
- → Subpart B (operational procedures (OP));
- → Subpart C (aircraft performance and operating limitations (POL));
- → Subpart D (instruments, data and equipment (IDE), including requirements for sailplanes and balloons);
- → Subpart E (specific requirements (SPEC): helicopter extern sling load operations, human external cargo operations (HEC), parachuter operations (PAR), aerobatic flights (ABF)).

EASA PBN Regulations

Difference between NCO and NCC

EASA developed two different sets of rules for non-commercial operations, depending on the complexity of the aircraft:

- → for the operation of non-complex aircraft, basic safety rules apply (Part-NCO). The term NCO stands for **n**on-**c**ommercial **o**perations with other-than-complex aircraft;
- → for the operation of complex aircraft, more complex safety rules apply (Part-NCC and partly Part-ORO), particularly taking into account that complex aircraft may carry a larger number of passengers and usually require professional teams for their operations. The term NCC stands for **n**on-**c**ommercial operations with **c**omplex motor-powered aircraft.

EASA PBN Regulations

“complex motor-powered aircraft shall mean:

(ii) a helicopter certificated:

→ for a maximum take-off mass exceeding 3175kg, or

→ for a maximum passenger seating configuration of more than nine, or

→ for operation with a minimum crew of at least two pilots, or

(iii) a tilt rotor aircraft;”

EASA PBN Regulations

“complex motor-powered aircraft shall mean:

(i) an aeroplane:

- → with a maximum certificated take-off mass exceeding 5700 kg, or
- → certificated for a maximum passenger seating configuration of more than nineteen, or
- → certificated for operation with a minimum crew of at least two pilots, or
- → equipped with (a) turbojet engine(s) or more than one turboprop engine, or

Different from this definition, ICAO defines a large aeroplane (in Annex 6 Part II) as ‘an aeroplane of a maximum certificated take-off mass of over 5700 kg’.

EASA PBN Regulations

Specialised operations (SPO)

Specialised operations (SPO) means any operation other than commercial air transport where the aircraft is used for specialised activities such as:

- → agriculture
- → construction
- → photography
- → surveying
- → observation and patrol
- → aerial advertisement

EASA PBN Regulations

Specialised operations (SPO)

- → Subpart A (general requirements (GEN));
- → Subpart B (operational procedures (OP));
- → Subpart C aircraft performance and operating limitations (POL));
- → Subpart D (instruments data and equipment (IDE), including requirements for sailplanes and balloons).
- → Subpart E (specific requirements (SPEC): helicopter external sling load operations (HESLO), human external cargo operations (HEC), parachute operations (PAR), aerobatic flights (ABF)).

EASA PBN Regulations

			I DEF	II ARO	III ORO	IV CAT	V SPA	VI NCC	VII NCO	VIII SPO
Non-specialised	Commercial	Complex	Y	N	Y	Y	Y	N	N	N
		Other-than complex	Y	N	Y	Y	Y	N	N	N
	Non-commercial	Complex	Y	N	Y	N	Y	Y	N	N
		Other-than complex	Y	N	N	N	Y	N	Y	N
Specialised	Commercial	Complex	Y	N	Y	N	Y	N	N	Y
		Other-than complex	Y	N	Y	N	Y	N	N	Y
	Non-commercial	Complex	Y	N	Y	N	Y	N	N	Y
		Other-than complex	Y	N	N	N	Y	N	Y	N

EASA PBN Regulations

EASA PBN Regulations

Performance based navigation

Article 5
Air operations

1. Operators shall only operate an aircraft for the purpose of commercial air transport (hereinafter 'CAT') operations as specified in Annexes III and IV.

1a. Operators engaged in CAT operations starting and ending at the same aerodrome/operating site with Performance class B aeroplanes or non-complex helicopters shall comply with the relevant provisions of Annexes III and IV.

2. Operators shall comply with the relevant provisions of Annex V when operating:

(a) aeroplanes and helicopters used for:

(i) operations using performance-based navigation (PBN);

(ii) operations in accordance with minimum navigation performance specifications (MNPS);

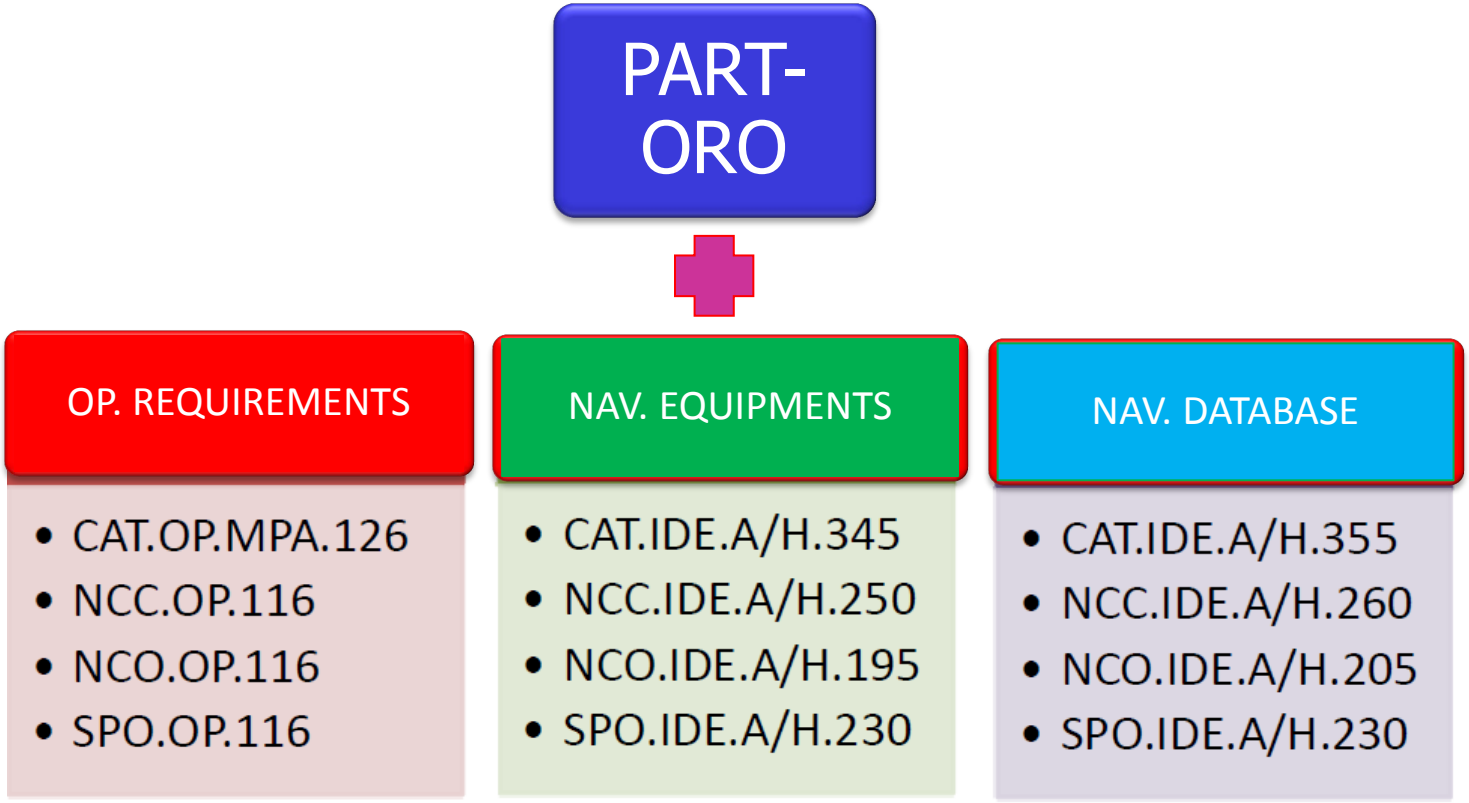
(iii) operations in airspace with reduced vertical separation minima (RVSM);

(iv) low visibility operations (LVO);

Commission Regulation (EU) No 965/2012 on air operations

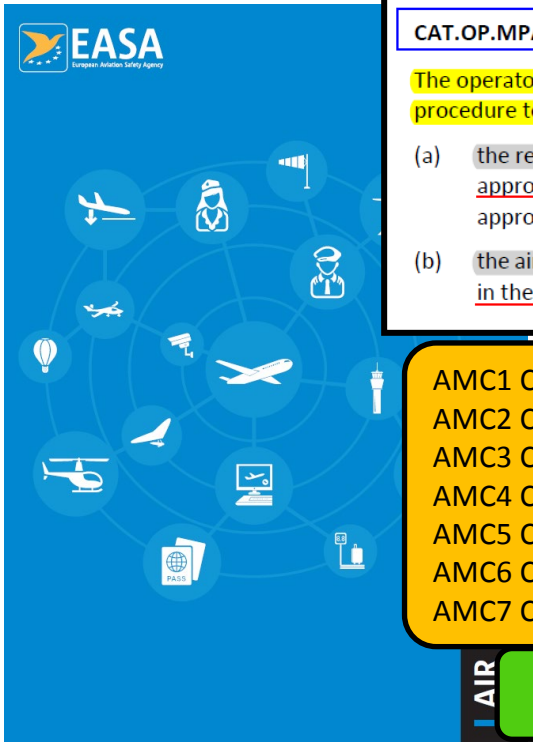
and related EASA Decisions (AMC & GM and CS-FTL.1)

EASA PBN Regulations



EASA PBN Regulations

Performance based navigation



CAT.OP.MPA.126 Performance-based navigation

The operator shall ensure that, when performance-based navigation (PBN) is required for the route or procedure to be flown:

(a) the relevant PBN navigation specification is stated in the AFM or other document that has been approved by the certifying authority as part of an airworthiness assessment or is based on such approval; and

(b) the aircraft is operated in conformance with the relevant navigation specification and limitations in the AFM or other document referred above.

AMC1 CAT.OP.MPA.126 – PBN Operations
AMC2 CAT.OP.MPA.126 – Monitoring & Verification
AMC3 CAT.OP.MPA.126 – Managament of the Navigation Database
AMC4 CAT.OP.MPA.126 – Displays & Automation
AMC5 CAT.OP.MPA.126 – Vectoring & Positioning
AMC6 CAT.OP.MPA.126 – Alerting & Abort
AMC7 CAT.OP.MPA.126 – Contingency Procedures

GM1 CAT.OP.MPA.126 - Description

EASA PBN Regulations

AMC1 CAT.OP.MPA.126 Performance-based navigation

ED Decision 2016/015/R

PBN OPERATIONS

For operations where a navigation specification for performance-based navigation (PBN) has been prescribed and no specific approval is required in accordance with SPA.PBN.100, the operator should:

(a) establish operating procedures specifying:

(1) normal, abnormal and contingency procedures;

(2) electronic navigation database management; and

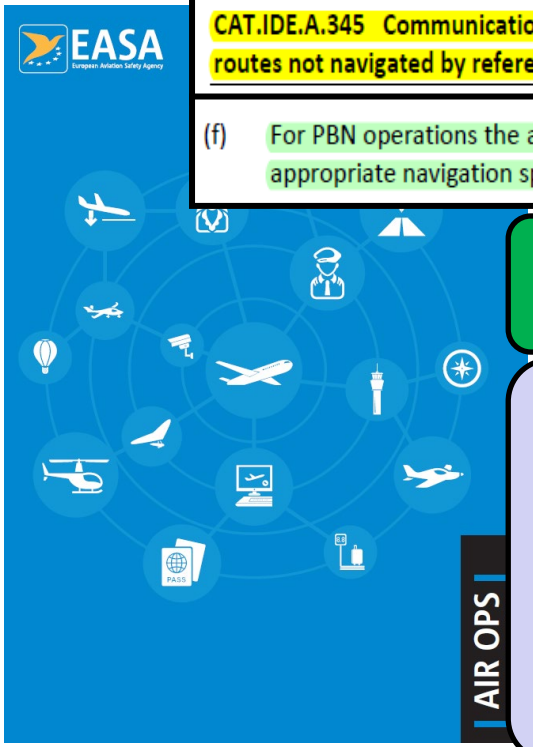
(3) relevant entries in the minimum equipment list (MEL);

(b) specify the flight crew qualification and proficiency constraints and ensure that the training programme for relevant personnel is consistent with the intended operation; and

(c) ensure continued airworthiness of the area navigation system.

EASA PBN Regulations / FAA AC

Performance based navigation



CAT.IDE.A.345 Communication and navigation equipment for operations under IFR or under VFR over routes not navigated by reference to visual landmarks

(f) For PBN operations the aircraft shall meet the airworthiness certification requirements for the appropriate navigation specification.

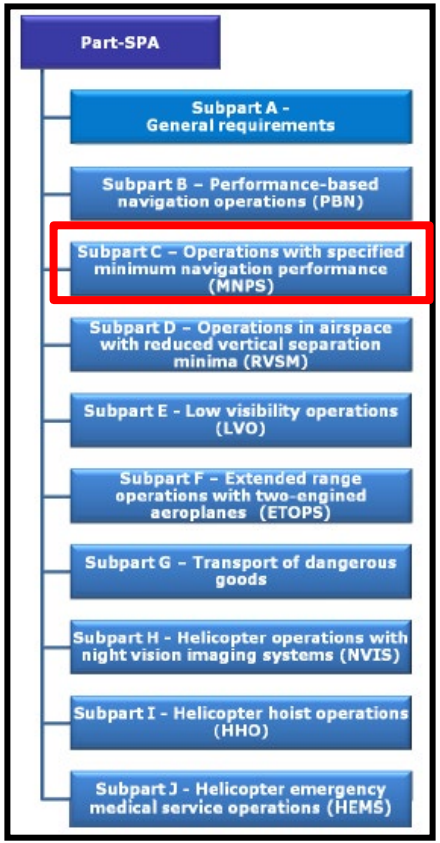
GM2 CAT.IDE.A.345 - Aircraft Eligibility for PBN Specification NOT Requiring Specific Approval

Annex V - Specific Approvals [Part-SPA]

- SUBPART A: GENERAL REQUIREMENTS
  - SPA.GEN.100 Competent Authority
- SUBPART B: PBN Operations
  - SPA.PBN.100 PBN Operations
  - SPA.PBN.105 PBN Operational Approval

EASA PBN Regulations

UE 965/2012



EASA PBN Regulations

GM1 SPA.PBN.100 PBN operations

ED Decision 2016/020/R

GENERAL

(a) PBN operations are based on performance requirements, which are expressed in navigation specifications (RNAV specification and RNP specification) in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept.

Table 1 provides a simplified overview of:

(1) PBN specifications and their applicability for different phases of flight; and

(2) PBN specifications requiring a specific approval.

(b) More detailed guidance material for the operational use of PBN applications can be found in ICAO Doc 9613 Performance-Based Navigation (PBN) Manual.

(c) Guidance material for the design of RNP AR APCH procedures can be found in ICAO Doc 9905 RNP AR Procedure Design Manual.

(d) Guidance material for the operational approval of PBN operations can be found in ICAO Doc 9997 Performance-Based Navigation (PBN) Operational Approval Manual.

EASA PBN Regulations

Table 1: Overview of PBN specifications

	FLIGHT PHASE							
	En-route		Arrival	Approach				Departure
	Oceanic	Continental		Initial	Intermediate	Final	Missed	
RNAV 10	10							
RNAV 5		5	5					
RNAV 2		2	2					2
RNAV 1		1	1	1	1		1	1
RNP 4	4							
RNP 2	2	2						
RNP 1			1	1	1		1	1
A-RNP	2	2 or 1	1–0.3	1–0.3	1–0.3	0.3	1–0.3	1–0.3
RNP APCH (LNAV)				1	1	0.3	1	
RNP APCH (LNAV/VNAV)				1	1	0.3	1	
RNP APCH (LP)				1	1		1	
RNP APCH (LPV)				1	1		1	
RNP AR APCH				1–0.1	1–0.1	0.3-0.1	1–0.1	
RNP 0.3 (H)		0.3	0.3	0.3	0.3		0.3	0.3

Numbers specify the accuracy level

no specific approval required

specific approval required

EASA PBN Regulations

Conclusions

→ Main outcomes and conclusions:

- → Full integration of PBN into the European regulatory framework for pilot training and air operations
- → Most PBN specifications are treated as a normal mode of navigation
- → The requirement for specific (operational) approvals was removed for most PBN specifications and replaced by improved pilot training, testing and checking rules and performance-based and proportionate operating rules
- → A specific approval remains only for complex PBN specifications and operations which cannot (yet) be trained sufficiently during initial pilot training: RNP AR APCH and RNP 0.3 (helicopter operations)

EASA PBN Regulations

SPA.PBN.100 PBN operations

Regulation (EU) 2016/1199

(a) An approval is required for each of the following PBN specifications:

(1) RNP AR APCH; and

(2) RNP 0.3 for helicopter operation.

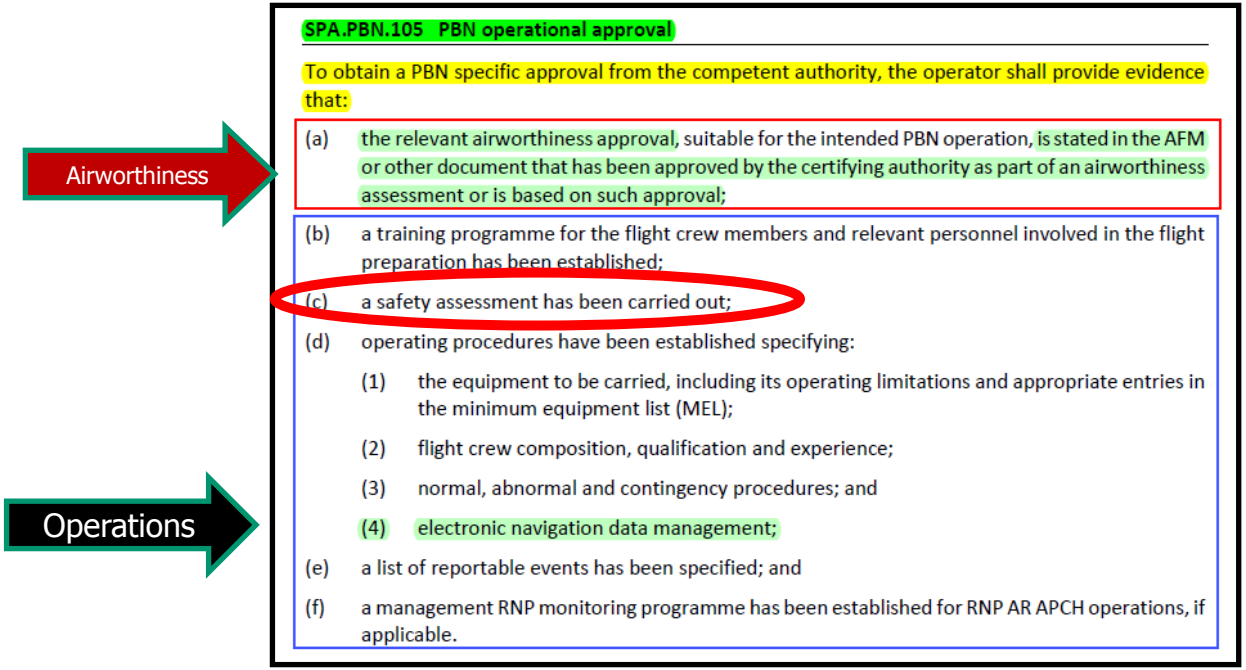
(b) An approval for RNP AR APCH operations shall allow operations on public instrument approach procedures which meet the applicable ICAO procedure design criteria.

(c) A procedure-specific approval for RNP AR APCH or RNP 0.3 shall be required for private instrument approach procedures or any public instrument approach procedure that does not meet the applicable ICAO procedure design criteria, or where required by the Aeronautical Information Publication (AIP) or the competent authority.

EASA PBN Regulations

UE 965/2012

Performance based navigation



EASA PBN Regulations

AMC1 SPA.PBN.105(c) PBN operational approval

ED Decision 2016/020/R

FLIGHT OPERATIONAL SAFETY ASSESSMENT (FOSA)

(a) For each RNP AR APCH procedure, the operator should conduct a flight operational safety assessment (FOSA) proportionate to the complexity of the procedure.

(b) The FOSA should be based on:

(1) restrictions and recommendations published in AIPs;

(2) the flyability check;

(3) an assessment of the operational environment;

(4) the demonstrated navigation performance of the aircraft; and

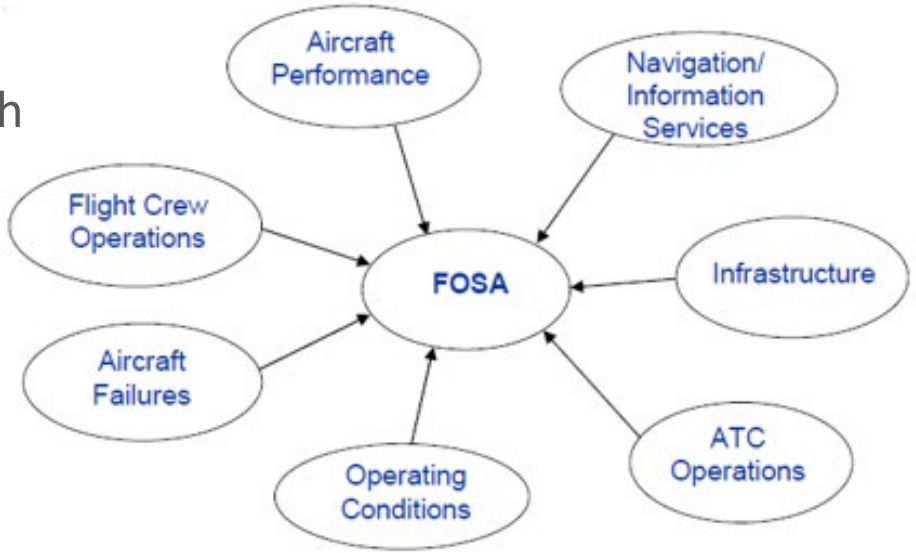
(5) the operational aircraft performance.

(c) The operator may take credit from key elements from the safety assessment carried out by the ANSP or the aerodrome operator.

EASA PBN Regulations

Objectives of a FOSA

- → The FOSA should ensure that for each specific set of operating conditions, aircraft and environment, all failure conditions are assessed and, where necessary, mitigations are implemented to meet safety criteria.
- → The assessment should give proper attention to the interdependence of the elements of procedure design, aircraft capability, crew procedures and operating environment.

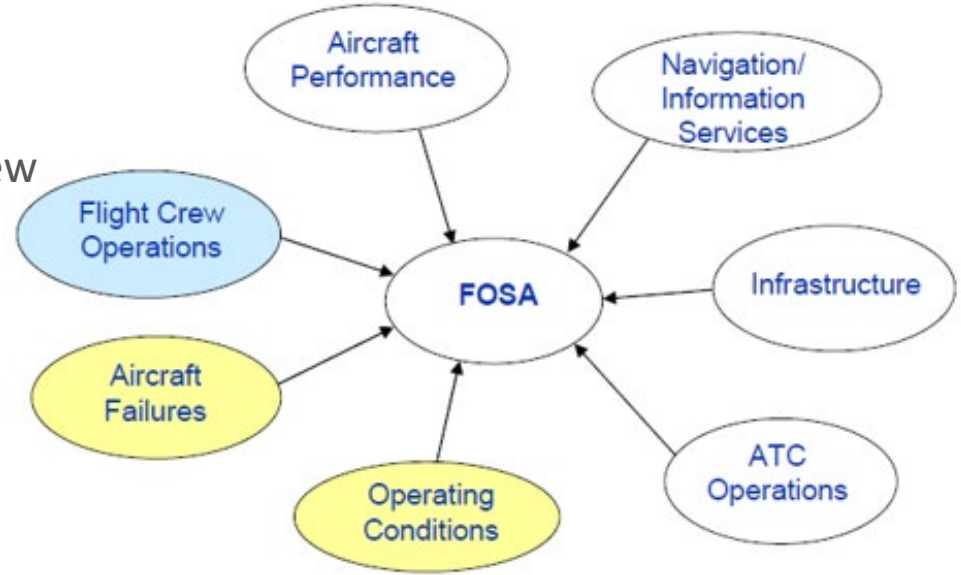


FOSA acts as the glue, ensuring all these elements add up to a safe whole

EASA PBN Regulations

Examples of Dependencies I

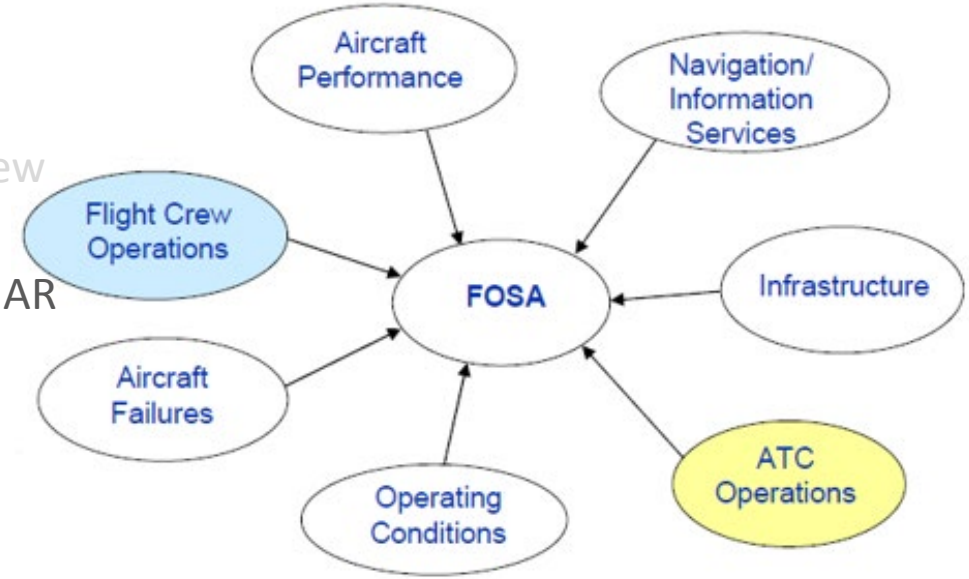
→ If there are aircraft failure or extreme operating conditions – do the flight crew know how to respond?



EASA PBN Regulations

Examples of Dependencies II

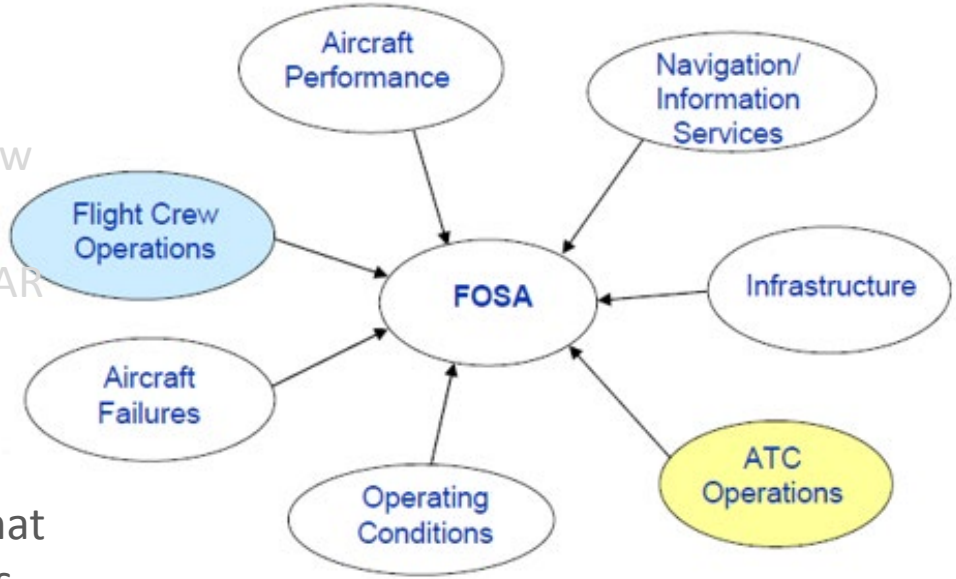
- If there are aircraft failure or extreme operating conditions – do the flight crew know how to respond?
- If ATC provides a clearance for an RNP AR APCH to an aircraft/crew not suitably equipped/approved do the flight crew know what do to?



EASA PBN Regulations

Examples of Dependencies III

- If there are aircraft failure or extreme operating conditions – do the flight crew know how to respond?
- If ATC provides a clearance for an RNP AR APCH to an aircraft/crew not suitably equipped/approved do the flight crew know what do to?
- I there is an infrastructure problem, what information needs to be provided, does ATC know how to react, do flight crews know what the impact will be?



Such dependencies in context of a specific, potentially challenging, procedure where timely decisions could be critical

EASA PBN Regulations

FOSA provides a systematic process for checking that risks are adequately mitigated across the range of hazards.

Example Aircraft Failure Hazard

Failures	Likelihood	Consequences	Extra Mitigations	Risk Acceptability?
Undetected erroneous A/C position calculation in one FMS	SSA evaluated probability as Remote (between 10-5 and 10-7 per approach)	Contained within 0.4NM. Implies RNP $_{\text{non norm}}$ = 0.2NM Demonstrated and documented in accordance with AMC 20-26	TAWS Class A Contingency procedures	Specific procedure significantly less onerous than one used in airworthiness approval for AMC 20-26. Risk acceptable.

EASA PBN Regulations

VI. SPA.PBN: Subpart B – Performance-based navigation operations (PBN)

General

343. This Subpart addresses the specific approval for operations in designated airspace where performance-based navigation (PBN) specifications are established. It includes the following specifications:

- RNAV10;
- RNP4;
- RNAV1;
- Basic-RNP1;
- RNP APCH;
- RNP AR APCH[51].

SPA.PBN.100 PBN operations

345. The Agency requires a specific approval for all PBN operations except for RNAV5 (B-RNAV). The Agency concluded that operations in RNVA5 airspace do not constitute such a safety critical operation that a specific approval would be justified.

346. The Agency concurred with the opinion of some non-commercial operators to make a distinction between commercial and non-commercial operations and to re-assess the necessity and the appropriateness of the concept of operational approvals. The Agency therefore intends to initiate rulemaking task MDM.062 with the following scope:

- develop rules for Part-FCL on the training requirements of PBN operations;
- review the justification for the need of an operational approval for each PBN operation for CAT, NCC and NCO operators and assess if there are alternatives to the operational approval, e.g. requirements in Part-FCL; and
- develop an AMC for the operational approval in SPA.PBN that builds on the existing AMC 20 material.

347. A GM to this requirement will provide further information on the criteria for the approval and the operation as specified in AMC 20 material and/or in ICAO Doc 9613 (PBN Manual).

OLD REGULATIONS

EASA PBN Regulations

RNAV
DECISION NO. 2003/12/RM (AMC 20-4)

AMC-20

GENERAL ACCEPTABLE MEANS OF COMPLIANCE FOR AIRWOR
PRODUCTS, PARTS AND APPLIANCES

AMC 20-115B	RECOGNITION OF EUROCAE ED-12B / RTCA DO-178B
AMC 20-128A	DESIGN CONSIDERATIONS FOR MINIMIZING HAZARDS UNCONTAINED TURBINE ENGINE AND AUXILIARY POW FAILURE
	Appendix 1
AMC 20-1	CERTIFICATION OF AIRCRAFT PROPULSION SYSTEMS I ELECTRONIC CONTROLS
AMC 20-2	CERTIFICATION OF ESSENTIAL APU EQUIPPED WITH EL CONTROLS
AMC 20-3	Reserved
AMC 20-4	AIRWORTHINESS APPROVAL AND OPERATIONAL CRITERIA FOR THE USE OF NAVIGATION SYSTEMS IN EUROPEAN AIRSPACE DESIGNATED FOR BASIC RNAV OPERATIONS
AMC 20-5	AIRWORTHINESS APPROVAL AND OPERATIONAL CRITERIA FOR THE USE OF THE NAVSTAR GLOBAL POSITIONING SYSTEM (GPS)
AMC 20-6	EXTENDED RANGE OPERATION WITH TWO-ENGINE AEROPLANES ETOPS CERTIFICATION AND OPERATION
AMC 20-7	Reserved
AMC 20-8	OCCURRENCE REPORTING

ED Decision 2003/12/RM
Final
05/11/2003

European Aviation Safety Agency

DECISION NO. 2003/12/RM

OF THE EXECUTIVE DIRECTOR OF THE AGENCY

of 5 November 2003

on general acceptable means of compliance for airworthiness of products, parts and appliances (« AMC-20 »)

EASA PBN Regulations

RNAV
DECISION NO. 2003/12/RM (AMC 20-4)

4.2.1 Required Functions

The following system functions are the minimum required to conduct Basic RNAV operations.

(a) Continuous indication of aircraft position relative to track to be displayed to the pilot flying on a navigation display situated in his primary field of view

In addition where the minimum flight crew is two pilots, indication of aircraft position relative to track to be displayed to the pilot not flying on a navigation display situated in his primary field of view

(b) Display of distance and bearing to the active (To) waypoint

(c) Display of ground speed or time to the active (To) waypoint

(d) Storage of waypoints; minimum of 4

(e) Appropriate failure indication of the RNAV system, including the sensors.

ANNEX 1

GPS Integrity Monitoring (RAIM) Prediction Program

Where a GPS Integrity Monitoring (RAIM) Prediction Program is used as a means of compliance with paragraph 5.2(a) of this document, it should meet the following criteria:

1. The program should provide prediction of availability of the integrity monitoring (RAIM) function of the GPS equipment, suitable for conducting Basic RNAV operations in designated European airspace.
2. The prediction program software should be developed in accordance with at least RTCA DO 178B/EUROCAE 12B, level D guidelines.
3. The program should use either a RAIM algorithm identical to that used in the airborne equipment, or an algorithm based on assumptions for RAIM prediction that give a more conservative result.
4. The program should calculate RAIM availability based on a satellite mask angle of not less than 5 degrees, except where use of a lower mask angle has been demonstrated to be acceptable to the Authority.
5. The program should have the capability to manually designate GPS satellites which have been notified as being out of service for the intended flight.
6. The program should allow the user to select:

a) the intended route and declared alternates;

b) the time and duration of the intended flight.

EASA PBN Regulations

European Aviation Safety Agency

Notice of Proposed Amendment 2018-02

Provision of airworthiness requirements in support of

The main purpose of t that will permit EASA to issue airworth ion specifications and functionalities.

Furthermore, the intention is also to cancel the PBN-related AMC-20s with the purpose of making CS-ACNS the only available means to facilitate certification of area navigation systems, thus avoiding duplication within EASA's framework. Similarly, JAA TGL 10 Rev 1 will no longer be used as guidance for RNAV 1 certification

EASA PBN Regulations

ED Decision 2019/011/R

Executive Director Decision

2019/011/R

of 26 April 2019

issuing Certification Specifications for Airborne Communications Navigation and Surveillance (CS-ACNS) and amending General Acceptable Means of Compliance for airworthiness of products, parts and appliances (AMC-20)

'CS-ACNS – Issue 2
and
AMC-20 Amendment 17'

EASA PBN Regulations

Annex I to ED Decision 2019/011/R

European Union Aviation Safety Agency

Certification Specifications
and
Acceptable Means of Compliance

for

Airborne Communications, Navigation and Surveillance

CS-ACNS

Issue 2

26 April 2019[1]

CONTENTS

CS ACNS — Airborne Communications, Navigation and Surveillance

EASA

EASA PBN Regulations

CS-ACNS – Book 1 – Subpart C – Navigation (NAV)

Subpart C – Navigation (NAV)

Sections 1 – Performance-based navigation (PBN)

- Subsection 1 – Applicability – General
- Subsection 2 – Generic specifications for performance-based lateral navigations
- Subsection 4 – Supplementary specifications for vertical navigation
- Subsection 5 – Supplementary specifications for vertical navigation in final approach
- Subsection 7 – Supplementary specifications for applications for advanced RNP (A-RNP)
- Subsection 8 – Supplementary specifications supporting radius to fix (RF)
- Subsection 9 – Supplementary specifications supporting fixed radius transition (FRT)
- Subsection 10 – Supplementary specifications supporting parallel offset

EASA PBN Regulations

System Qualifications Criteria

AMC1 ACNS.C.PBN.205 RNP system approval

For all navigation specifications except RNP 0.3:

(a) Where the RNP system architecture is based on a stand-alone system, the RNP system should be granted a European Technical Standard Order (ETSO) authorisation against the following ETSO:

(1) ETSO-C146c (operational Class 3)

(2) ETSO-C190 active antenna.

EASA PBN Regulations

ETSO-C146
Date : 24.10.03

European
Aviation
Safety
Agency

European Technical Standard Order

Subject: STAND-ALONE AIRBORNE NAVIGATION EQUIPMENT USING THE GLOBAL POS
SYSTEM (GPS) AUGMENTED BY THE WIDE AREA AUGMENTATION SYSTEM (WAAS)

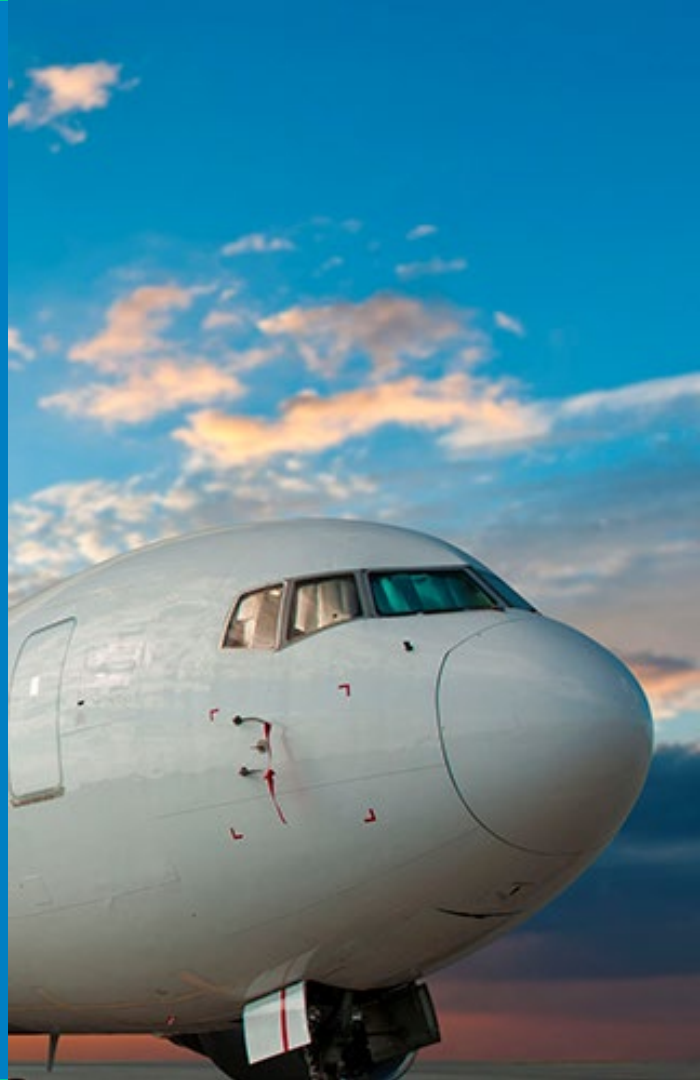
Table 1-5. ETSO Authorization

Models					Function	ETSO	Minimum Performance Standard
GPS 400W	GNC 420W	GNC 420AW	GNS 430W	GNS 430AW			
			•	•	ILS Glideslope	ETSO-2C34f	EUROCAE ED-47B
			•	•	ILS Localizer	ETSO-2C36f	EUROCAE ED-46B
	•	•	•	•	VHF COM Transmitter	ETSO-2C37e	EUROCAE ED-23B Class 4 & 6 for GNC 420W, GNS 430W Class 3 & 5 for GNC 420AW, GNS 430AW
	•	•	•	•	VHF COM Receiver	ETSO-2C38e	EUROCAE ED-23B Class C & E
			•	•	VOR Receiver	ETSO-2C40c	EUROCAE ED-22B
•	•	•	•	•	Multipurpose Display	ETSO-C113	SAE AS 8034
•	•	•	•	•	GPS WAAS	ETSO-C146	RTCA/DO-229C Class 3

EASA
European Union Aviation Safety Agency

Airworthiness Approvals Aspects I

PBN Operational Approvals Workshop



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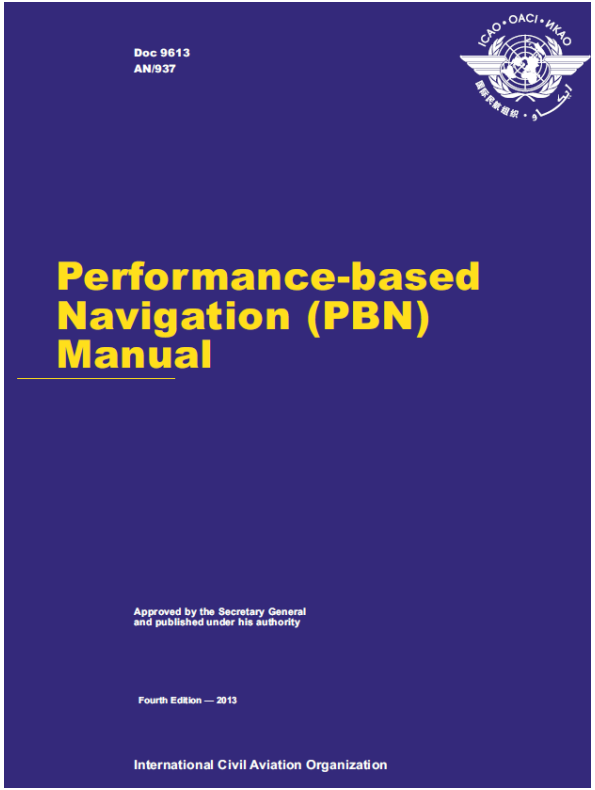
Airworthiness Approvals Aspects I

1. Overview
   - → Airworthiness:
   - → Continued airworthiness
   - → Flight operations:

Attachment C

OPERATIONAL APPROVAL



Airworthiness Approvals Aspects I

	PBN RNAV 5	

B. DATA THE APPLICATION-SPECIFIC

Here are some tables which includes the requirements of airworthiness and operational requirements for operations PBN RNAV 5. In compliance column must be marked as the requirement is met and otherwise shall indicate the reason. Additionally in the reference column must be specified document or documents of the organization where we gather information that enables compliance with the requirement requested, specifying clearly the chapter and section in each case.

1. **THE PROPOSED AIRCRAFT IDENTIFICATION**

Manufacturer	Model	Serial number	Registration

2. **SPECIFIC AIRWORTHINESS REQUIREMENTS**

In relation to the Declaration of the onboard equipment this should be done as specified in the relevant annex of the format of Declaration of compliance with the requirements of equipment for aircraft (F-DSO-AOC-100 To) that the operator shall be attached to this application. To meet the other requirements of airworthiness must be filled, the following paragraph enclosing the required supporting documentation. Additionally in the reference column must be specified document or documents of the organization where we gather information that enables compliance with the requirement requested, specifying clearly the chapter and section in each case.

NO.	REFERENCE	DESCRIPTION	COMPLIANCE (YES, NO, N/A)	DOCUMENTARY REFERENCE
2.1	AMC1 SPA. Gen.105 (a) GM1 SPA. PBN.100 SPA. PBN.105 (a) SPA. PBN.105 (c) (1) CAT. IDE. A.345 (d) AMC 20-4 3, 4 4.4.2.1; 4.4.2.3, Appendix 1	The operator has attached the Declaration of equipment embarked for RNAV 5 operations as specified in the relevant annex of the format of Declaration of compliance with the requirements of equipment for aircraft (F-DSO-AOC-100 (A).		
2.2	AMC1 SPA. Gen.105 (a) GM1 SPA. PBN.100 SPA. PBN.105 (a) AMC 20-4 4.1.1	Demonstration of the accuracy requirements for RNAV 5 operations.		
2.3	AMC1 SPA. Gen.105 (a) GM1 SPA. PBN.100 SPA. PBN.105 (a) AMC 20-4 4.1.2	Demonstration of the requirements of integrity and continuity of the function for the RNAV 5 operations.		
2.4	AMC1 SPA. Gen.105 (a) GM1 SPA. PBN.100 SPA. PBN.105 (a) AMC 20-4 4.2.1	Statement of the functions required for RNAV 5 operations.		
2.5	AMC1 SPA. Gen.105 (a) GM1 SPA. PBN.100 SPA. PBN.105 (a) 4.2.2 20-4 AMC	Statement of the functions recommended for RNAV 5 operations.		
2.6	AMC1 SPA. Gen.105 (a) GM1 SPA. PBN.100 SPA. PBN.105 (a)	Explicit statement of compliance in the AFM/POH with material reference to RNAV 5 operations guide.		

	PBN RNAV 5	

NO.	REFERENCE	DESCRIPTION	COMPLIANCE (YES, NO, N/A)	DOCUMENTARY REFERENCE
2.7	AMC1 SPA. Gen.105 (a) GM1 SPA. PBN.100 (a), (B), (c) (5) SPA. PBN.105 (a) AMC 20-5 5	Demonstration of compliance with the requirements of airworthiness for use of GNSS equipment RNAV 5 operations based exclusively or where GNSS is required.		
2.8	AMC1 SPA. Gen.105 (a) GM1 SPA. PBN.100 SPA. PBN.105 (C) CAT. IDE. A.355 AMC1 CAT. IDE. A.355	Electronic management of the navigation data for the RNAV 5 operations		

Airworthiness Approvals Aspects I

- → Electronic Management Nav. Data
- → Aircraft Flight Manual/T.C/STC
- → List Of Equipment Required
- → Maintenance Program
- → Minimum Equipment List
- → CAMO/P145 Implications

Airworthiness Approvals Aspects I

- MEL STATUS
  - The MEL has to be carefully reviewed for any open discrepancies and it is determined that none of the open items will make the aircraft ineligible for RNAV flights. If a technician is in doubt about the applicability of any given MEL item and its impact on RNAV operations they shall consult with the Director of Maintenance for guidance.
  - Special attention must be paid to any deferred items in the:
    a) ATA 22 – Auto Flight,
    b) ATA 23 – Communications, and
    c) ATA 34 – Navigation areas.

Airworthiness Approvals Aspects I

- Minimum Equipment List (MEL)
  - Should identify the minimum equipment necessary to operate RNAV which must be operational for dispatch of the aircraft
  - Depends on the "avionics architecture" for every type of aircraft - DOC. REFERENCE: MMEL, AFM / S, STC, FCOM and TGL-26

Airworthiness Approvals Aspects I

→ MEL STATUS

→ A deferred discrepancy may be MEL legal for most flights, but would not allow the aircraft into a RNAV airspace!

An example might be a VOR equipment that could be inoperative for non- RNAV operations but must be functional for flights into RNAV airspace.

Airworthiness Approvals Aspects I

- CAMO Implications
  - Amendment of the CAME manual to introduce:
    - Actualisation of the status of Maintenance Programs (ICA's, additional maintenance tasks, etc.)
    - Development of new procedures to manage the continuing airworthiness of the specific approval (usually in the form of appendixes)
    - Additional auditing areas performed by the Quality System in areas affected (maintenance contracts, aircraft survey, specific operational approvals procedures, etc.)
    - Incident / Occurrence reporting

Airworthiness Approvals Aspects I

- CAMO Implications
  - Development of new maintenance program.
  - Development of new MEL
  - Configuration and equipment control vinculated to special approval
  - Control of Modifications and structural repairs.
  - Access to approved data (maintenance data, STC's, etc)
  - Development of new maintenance contracts.
  - Postholder's competence assessment.
  - LOA Type 2 Document
  - Navigation database contract (i.e. Jeppensen)

Airworthiness Approvals Aspects I

- Aircraft Specific Maintenance Requirements
  - Maintenance requirements that are specific to individual aircraft are detailed in the Aircraft-Specific chapters of the Maintenance Manuals
  - Note that while there are standard RNAV maintenance procedures for each aircraft, even for the same manufacturer and model, some aircraft may have been certified RNAV compliant in different ways—i.e., by SB compliance, or different STCs on the same series of aircraft.
  - It is important that the technicians working on the aircraft pay attention to differences in the Aircraft-Specific chapter for a given aircraft.

Airworthiness Approvals Aspects I

- Factory RNAV Compliant Aircraft
  - Most of these aircraft will have the RNAV related items as part of the factory inspection list and will not require any special consideration other than following the inspection list in a timely and compliant manner.
- Other Aircraft
  - Aircraft that are RNAV-compliant either by compliance with a SB or STC usually need to modify the inspection program to ensure that the RNAV items, usually items incorporated in the Instructions for Continuous Airworthiness (ICAs), are followed and performed in a timely and compliant manner.

Airworthiness Approvals Aspects I

- CAMO Implications
  - A deferred discrepancy may be MEL legal for most flights, but would not allow the aircraft into a RNAV airspace!

Airworthiness Approvals Aspects I

- CAMO Implications
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Airworthiness Approvals Aspects I

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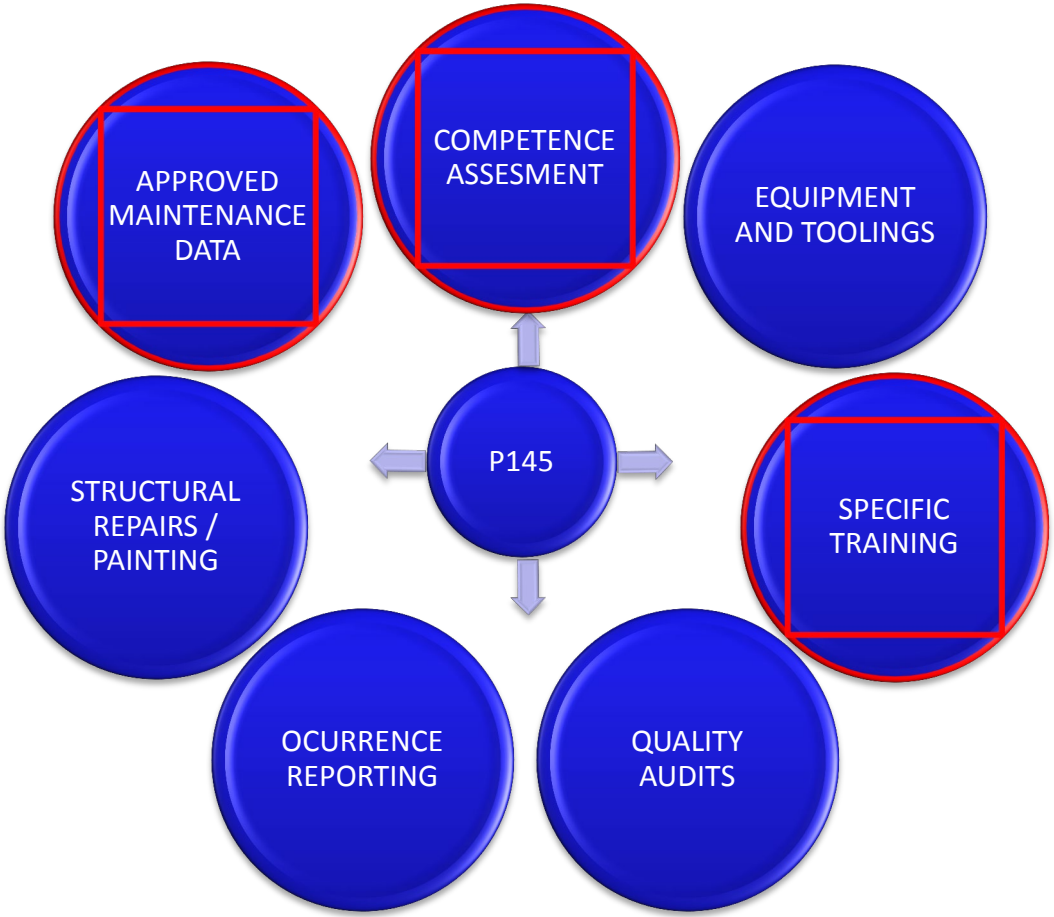
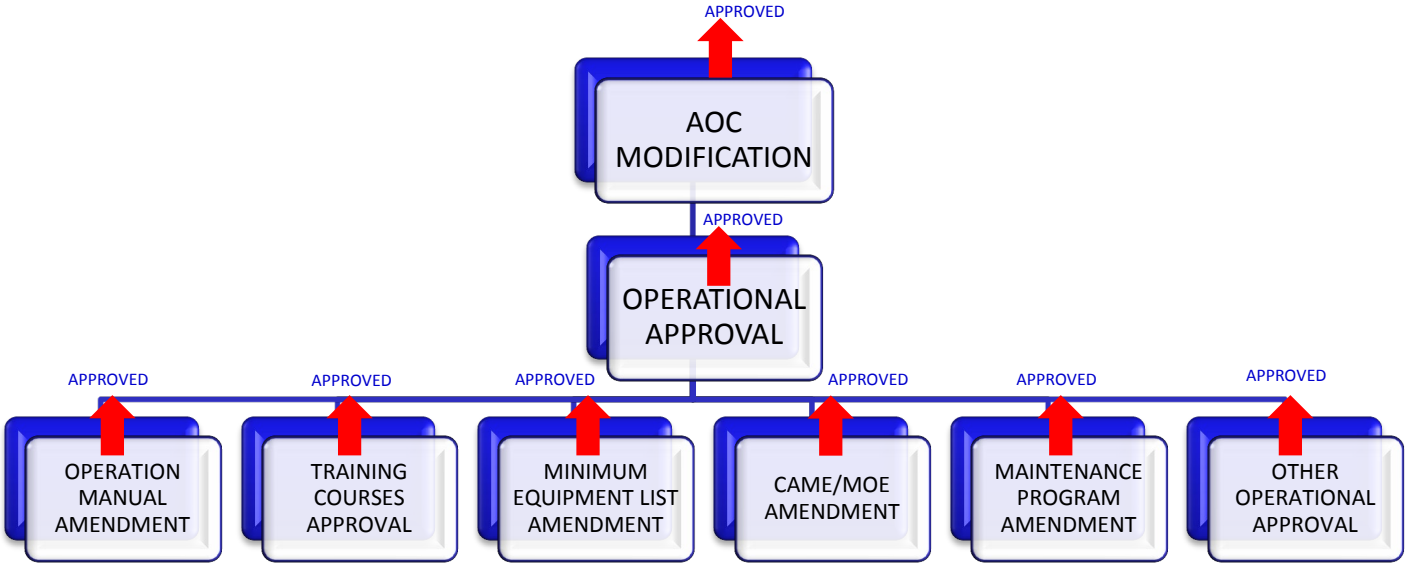
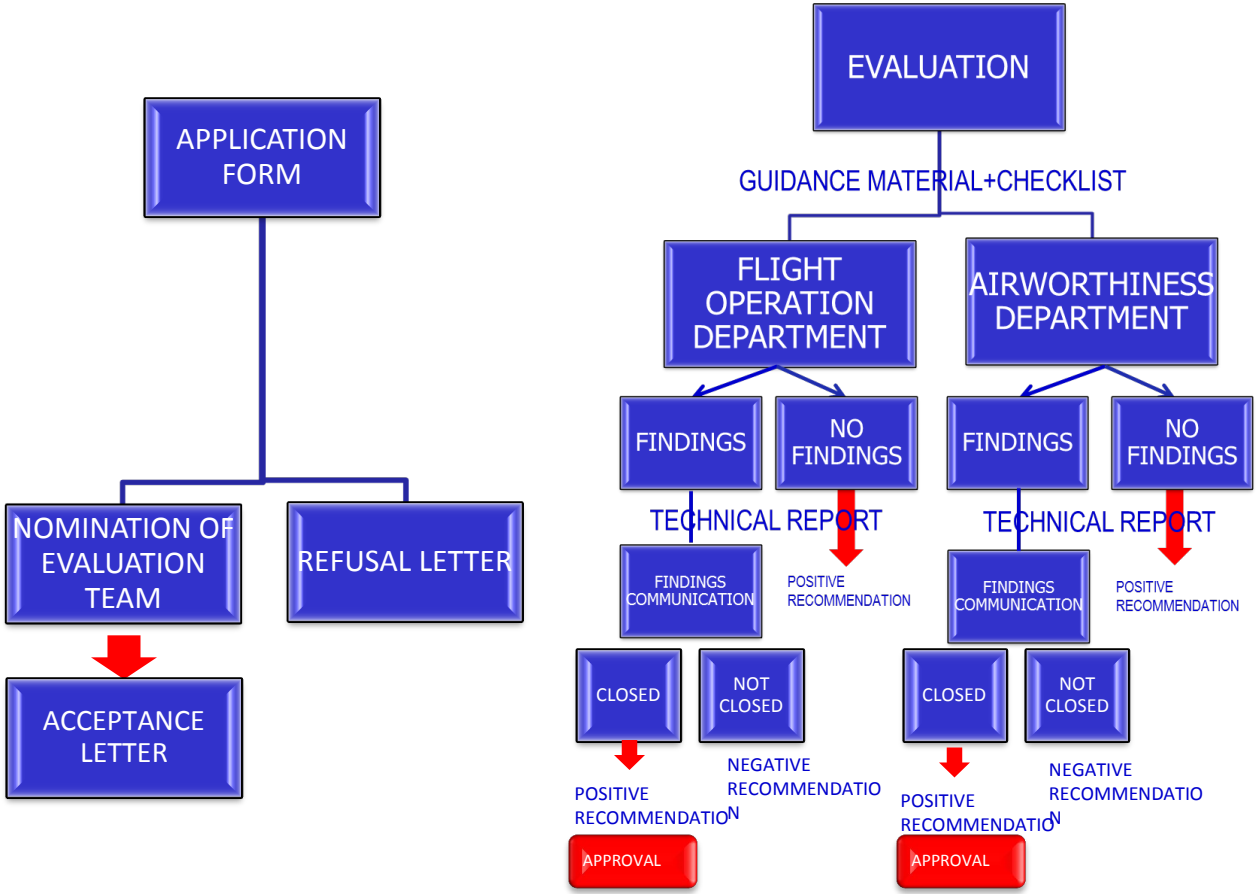
Airworthiness Approvals Aspects I



Airworthiness Approvals Aspects I



Airworthiness Approvals Aspects I



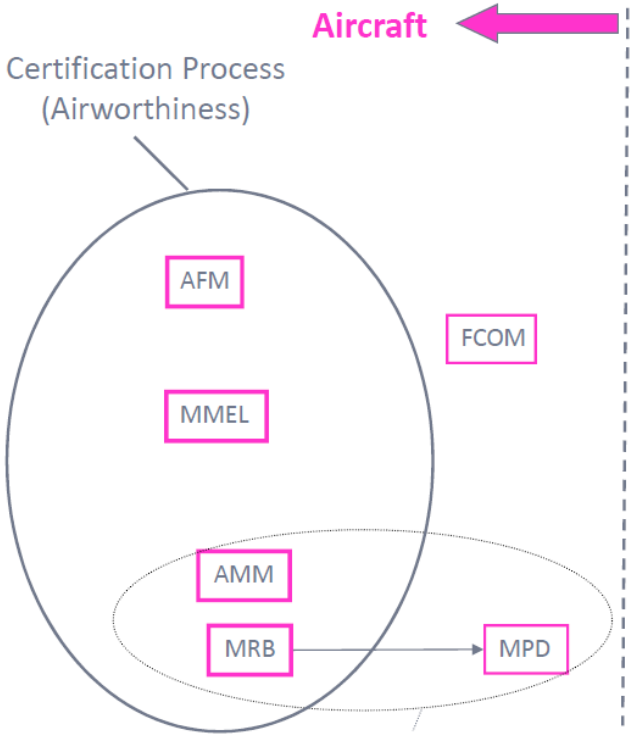
Airworthiness Approvals Aspects I

The airworthiness certification process ensures that the aircraft complies with certain standards (e.g. AC, AMC, CS,…) which guarantees that the level of performance and the functionalities required by the PBN navigation specification are met.

→ Operators (Airline) has to demonstrate to their supervisor inspector that the Aircraft is eligible for the PBN operation.

→ Eligibility is determined by checking that the adequate airworthiness certification has been done.

Airworthiness Approvals Aspects I



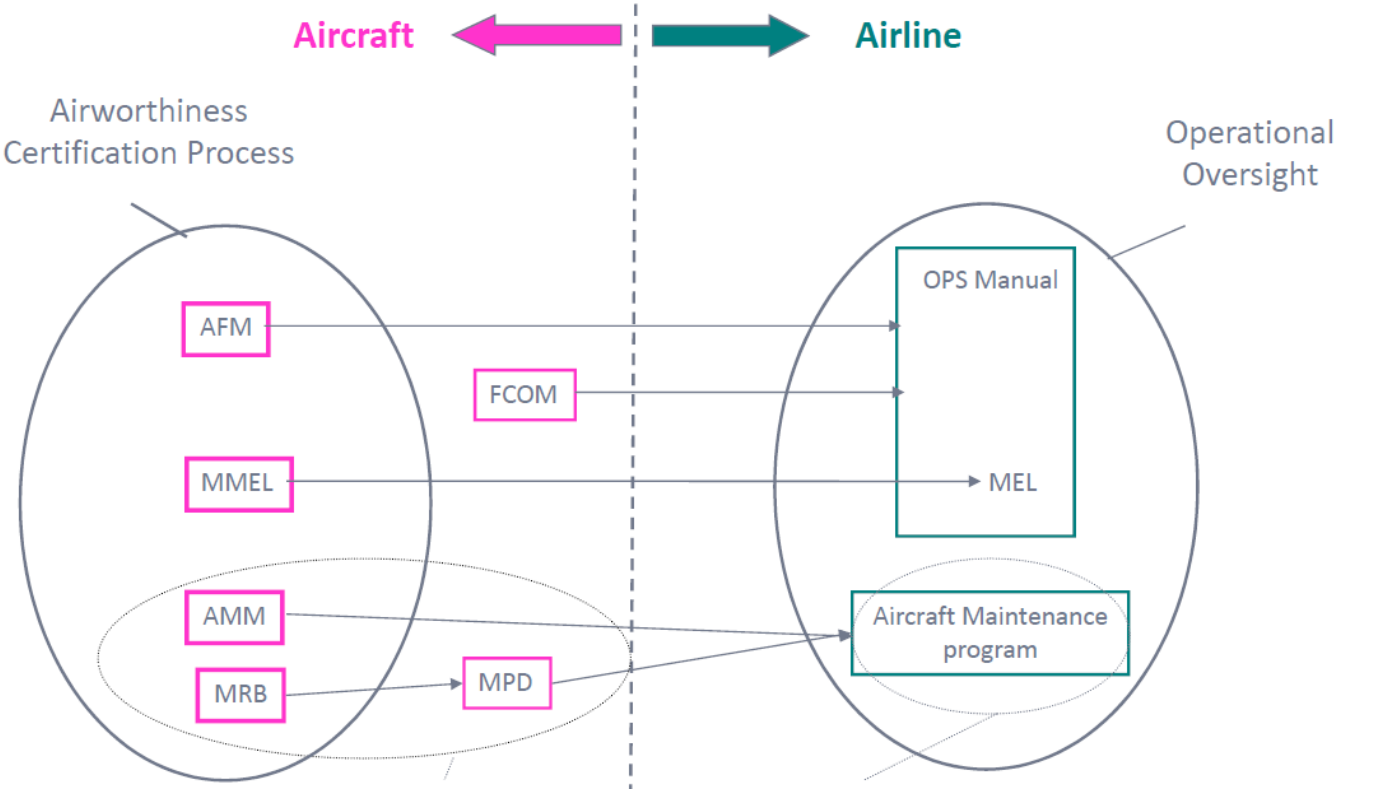
AFM Air Flight Manual
MMEL Master Minimum Equipment List

FCOM Flight Crew Operation Manual

AMM : Aircraft Maintenance Manual
MRB : Maintenance Review Board

MPD : Maintenance Planning Data

Airworthiness Approvals Aspects I



Airworthiness Approvals Aspects I

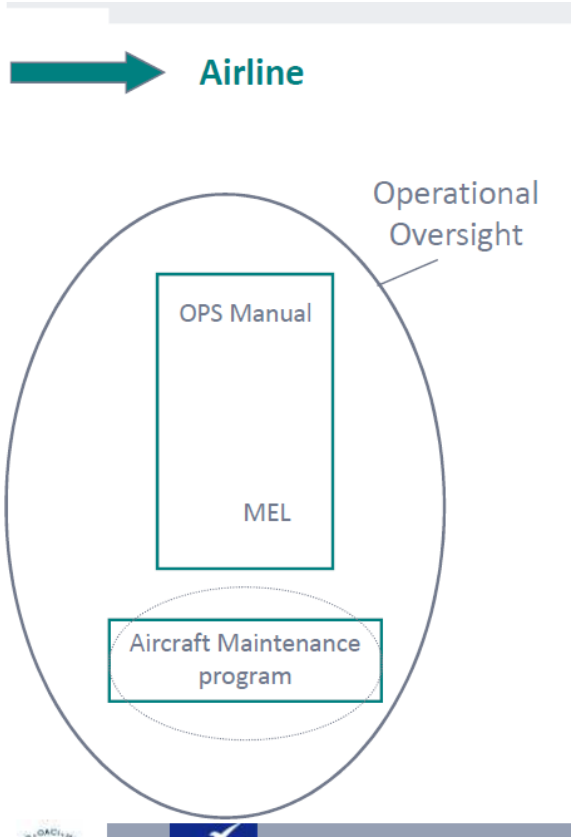
The Operations Manual structure.

Part A: General/Basic
all non type-related operational policies, instructions and procedures
A8.1 Flight Preparation

Part B: Airplane Operating Matters
all type-related instructions and procedures.
- •B1 Limitations
- •B2 Normal /
- •B3 Abnormal / contingency operations
- •B5 Flight Planning
- •B9 MEL
- •B12 Aircraft systems

Part C: Route and Aerodrome Instructions and Information

Part D: Training



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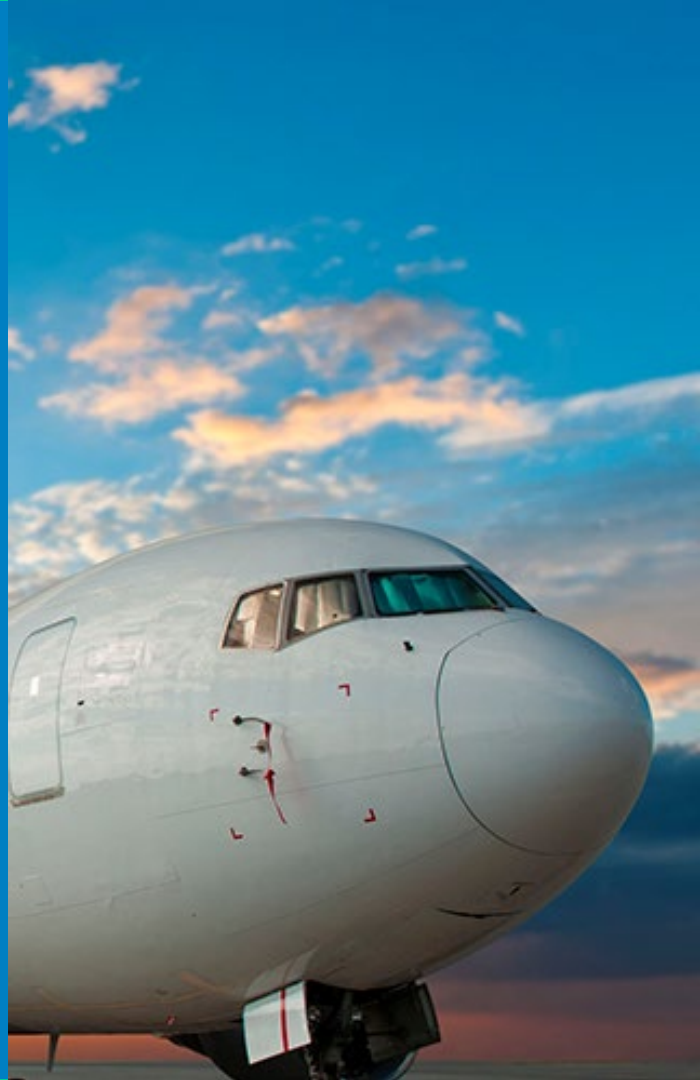
Airworthiness Approvals Aspects II

PBN Operational Approvals Workshop



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Airworthiness Approvals Aspects II

Requirements

- The airline has to demonstrate that its aircraft have the functional capability and performance to fly PBN procedures.
- The performance and functional capability of the aircraft should be typically be confirmed by reference to statements in
  - the Aircraft Flight Manual (AFM) or Pilot Operating Handbook (POH),
  - or any documents referenced in the AFM Where such a reference cannot be found in the AFM or POH : A/C manufacturer / TC Holder, the STC holder or the organisation having a privilege to approve minor changes may be consulted to make the aircraft compliant with the expected performance required by the PBN navigation specification.

Airworthiness Approvals Aspects II

- A/C Elegibility
  - As some RNAV procedures have been developed prior to publication of the PBN manual, it is not always possible to find a clear statement of aircraft capability towards PBN in the AFM or POH.

Airworthiness Approvals Aspects II

- A/C Elegibility
  - Sometimes however, aircraft eligibility for certain PBN navigation specifications can rely on the aircraft performance certified for RNAV procedures prior to publication of the PBN manual.

Airworthiness Approvals Aspects II

- A/C Elegibility
  - A guidance material, developed by EASA, lists the various references which may be found in the AFM, POH or other acceptable documents in order to consider the aircraft's eligibility for a specific PBN navigation specification.

Airworthiness Approvals Aspects II

Description and Limitations of the system

A detailed description of the navigation system should be described in the Operations Manual:

- → Type and number of installed Navigation system
- → Pilot's guide
- → Description of the sensors used by the navigation system to compute the aircraft positioning and associated limitations (time limitation in case of IRS, ..)
- → What are the reversion possibility in case of failure cases of the system (e.g. reversion from GNSS positioning computation to IRS or DME/DME or DME/DME/IRS if applicable)

Airworthiness Approvals Aspects II

MEL Management

- → The operator has to amend MEL to identify the minimum equipment necessary to satisfy PBN operations.
- → The AFM limitations have to be taken into account when establishing the MEL (Use of AP or FD may be required, time limitations of the IRS,..).
- → Database has also to be taken into account in the MEL management (in case of currency issue,…).

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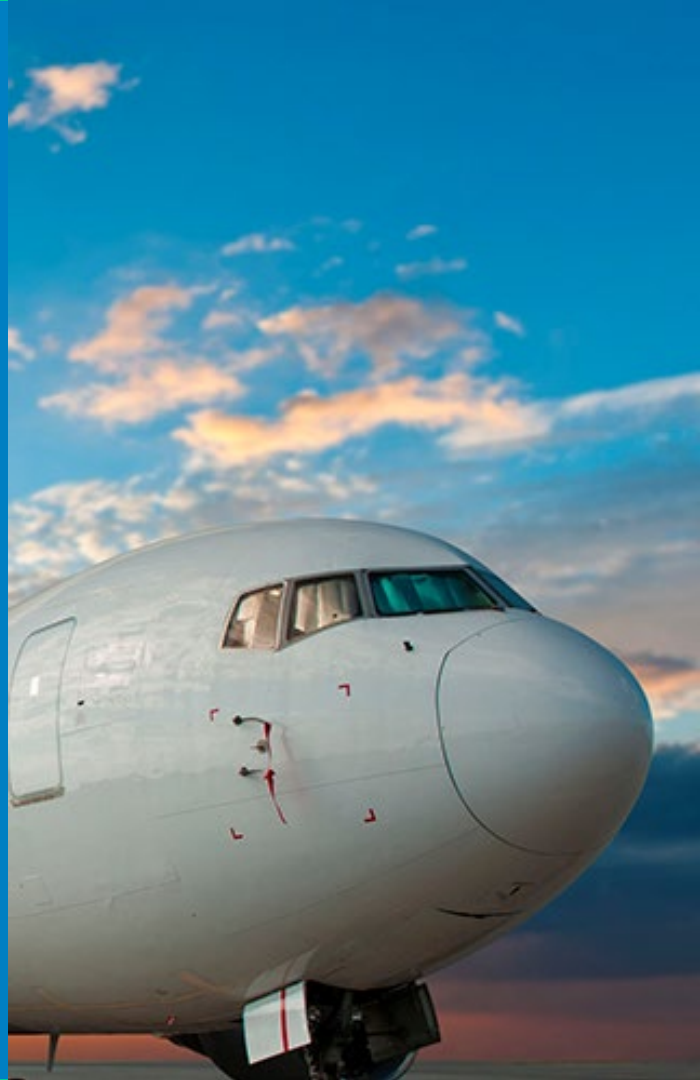
Operational Approvals Aspects

PBN Operational Approvals Workshop



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Operational Approvals Aspects

The structure and content that the manual must have are established in section ORO.MLR.100 and ORO.MLR.101 of the regulation for air operators 965/2012. The main structure that has an operations manual for an air operator that performs commercial air transport is the following:

Operational Approvals Aspects

- Part A:
  - Includes general information describing the basic aspects of the organization and its structure including policies, instructions and operating procedures.
- Part B:
  - Includes information related to aircraft operating matters such as service and maintenance, and normal, abnormal and emergency procedures taking into account the differences between aircrafts.
- Part C:
  - Commercial air transport operations, comprising route/role/area and aerodrome/operating site instructions and information.
- Part D:
  - Includes information about the training such as the instructions of the staff and their evaluation.

Operational Approvals Aspects

5 Operational Procedures And Operational Manual

CR (EU) 2016/1199 [RD-9] lays down the general requirements set for PBN operations such as LPV where the operator (for CAT) or pilot in command (for NCC/NCO) shall ensure that:

- Relevant PBN navigation specification is stated in the AFM and the aircraft is operated according to it;
- Space-based facilities are adequate for the planned operation during flight preparation[4];
- Any navigational database required for performance-based navigation is suitable and current[5];
- Databases shall be adequate and meet quality requirements. Operator shall ensure timely distribution and report occurrences[6]; and
- Sufficient means are available to navigate and land at the destination or at any alternate aerodrome in the case of loss of capability[7].

Operational Approvals Aspects

Table 1–Operational Manual impacted parts chapter and sections.

Chapter		Section	Subsection	Amendments
Part A. General/Basic				
OM-A	**0.** Administration and control of OM	**0.1** Introduction	**(d)** Explanations and definitions of terms	New RNP definitions and abbreviations
		0.2 System of amendment and revision		Revision update
	1. Organisation and responsibilities	**1.3** Responsibilities and Duties		Potential new functions/responsible (See Appendix A): - NAV data handling, quality and control - Routes, flight plans, NOTAM check and occurrence reporting
	2. Operational control and supervision	**2.2** System and responsibility for promulgation of additional operational instructions and information		NOTAMs, AIPs and AICs related information
		2.3 Operational control		- RNP APCH related information distribution process for safe operation. - Aerodrome categorisation
	3 Management system	Quality System – duties and responsibilities		NAV data handling, quality and control processes
	5 Qualification requirements	**5.1** A description of the required licence, rating(s), qualification/competency (e.g. for routes and aerodromes), experience, training, checking and recency for operations personnel to conduct their duties.		Crew Authorisation required/validation (See Section 6).
	8. Operating Procedures	**8.1** Flight preparation instructions.	**8.1.2** Criteria and responsibilities for determining the adequacy of aerodromes to be used	- RNP procedure operational evaluation - Use of NOTAM/RAIM to select destination / alternate aerodrome
			8.1.3 Methods and responsibilities for establishing aerodrome operating minima.	Calculations for RNP APCH operations (e.g. RVR and DA(H))
			8.1.5 Presentation/application of aerodrome operating minima	APCH charts presentation, i.e. RNAV (GNSS)
			8.1.9 ATS flight plan	Explanation on ATS flight plans submission (state RNP APCH capability[9]).
			8.1.10 Operational flight plan	Procedures for elaboration and submission of operational flight plans for RNP APCH.

Operational Approvals Aspects

	Chapter	Section	Subsection	Amendments
OM-A	**8.** Operating Procedures	**8.3** Flight Procedures	**8.3.2** Navigation Procedures. A description of all navigation procedures, relevant to the type(s) and area(s) of operation. Special consideration given to: a. standard navigational procedures; and b. RNP and Minimum Navigation Performance Specification c. in-flight re-planning; d. procedures in the event of system degradation;	Update (see Appendix A): - RNAV/RNP concepts including NOTAM; - Crew qualification - Database (Type 2 LoA) - Normal and abnormal procedures - Radiotelephony, RTF phraseology - Navigation accuracy assessment at dispatch, for destination and alternates;
		8.6 Use of the minimum equipment and configuration deviation list(s).		MEL handling (if changes are necessary).
	11. Handling and reporting occurrences	Procedures for handling, notifying and reporting accidents, incidents and occurrences.		Include procedures for RNP issues reporting (See Section 8.6)
B. Aircraft Operating Matters – Type Related				
OM-B	**1.** Limitations	Description of the certified limitations and the applicable operational limitations: Certification status - EASA (S)TC, Types of approved operations (RNP APCH) and Navigation System limitations		Update STC/TC certification and approved operations
	2. Normal procedures			See Appendix A
	3. Abnormal and/or emergency procedures			See Appendix A
	9. Minimum Equipment List (MEL)			Include MMEL dispatch conditions for RNP APCH.
	12. Aircraft Systems			Update on RNP APCH navigation capability
Part C. Route/Role/Area and Aerodrome/Operating Site Instructions				
OM-C	**1** Instructions and information relating to communications, navigation and aerodromes/operating sites including minimum flight levels and altitudes for each route to be flown and operating minima for each aerodrome/operating site planned to be used, including the following			- Operating minima - Navigation aids and Communications - Charts description
Part D. Training				
OM-D	**1** Description of scope: Training syllabi and checking programmes for all operations personnel assigned to operational duties in connection with the preparation and/or conduct of a flight.			Setup training program (modules): purpose, scope, requirements, conditions, instructors, etc. (See Section 6 and Appendix B).
	2 Training syllabi and checking programmes	**2.1** for flight crew, all relevant items prescribed in Annex IV (Part-CAT), Annex V (Part-SPA) and ORO.FC;		Ground and FSTD/Airplane practical training and checking.
		2.5 for operations personnel other than crew members (e.g. dispatcher, handling personnel etc.)		RNP APCH training for supervisors and other than crew personnel
	3 Procedures	**3.1** Procedures for training and checking.		Include RNP APCH procedures and simulator/training devices selection criteria

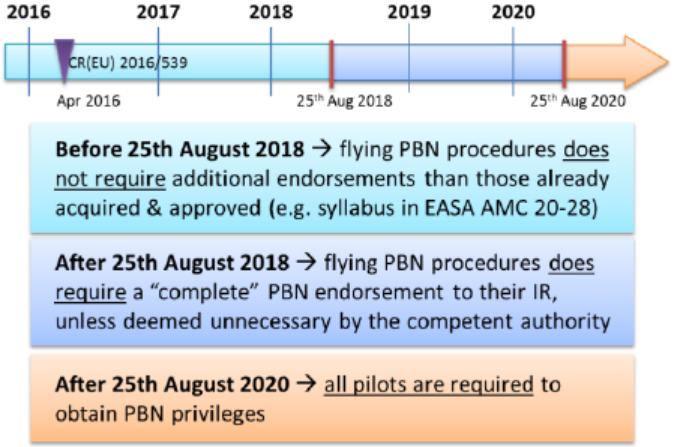
Operational Approvals Aspects

6 CREW Training And Training Package Update

CR (EU) 2016/539 [RD-11] introduced the necessary changes to Air Crew regulations as to incorporate PBN in the regular training and checking requirements for pilots.

Such regulation is requesting **all ATOs to introduce PBN privileges to their IR courses by 25 August 2020 at the latest, date from which PBN will become mandatory to all IR pilots.**

Therefore, IR licenses granted after that date will be automatically entitled to fly LPVs, among other PBN operations,



Operational Approvals Aspects

Changes to Part-FCL:

- Content of IR Skill test (Appendix 7):
  - identification of required navaids for approach procedures, check that the correct PBN procedure has been loaded in the navigation system and cross-check it with the departure and arrival charts.
- Cross-crediting (Appendix 8):
  - flying at least three IFR departures and approaches exercising PBN privileges, including one RNP APCH approach in the preceding 12 months will be sufficient to pass Section 6 (Abnormal and Emergency procedures) of the skill test12.
- Training (Appendix 9):
  - specific requirements for single and multi-pilot set that, to establish or maintain PBN privileges, one approach shall be an RNP APCH. Where an RNP APCH is not practicable, it shall be performed in an appropriately equipped FSTD. Also, references to ILS are replaced by 3D operations.

Operational Approvals Aspects

Flight Preparation

- **MEL:** Any MEL restriction has to be observed
- **Flight Plan:** has to be fill in appropriately in accordance with PBN nav spec for which the airline has been approved.
- **Route and Departure / Arrival selection:** The operator/crew has to check that the RNAV procedure is adequate with its aircraft configuration. (For instance, some RNAV 1 procedures are exclusively protected with GNSS and cannot be flown by aircraft certified for RNAV 1 without GNSS)
- **Destination alternate:** When a destination alternate aerodrome is required, it should not rely on GNSS if the destination is accessible only with a GNSS procedure.

Operational Approvals Aspects

Flight Preparation

- **NOTAM:** The crew must check any NOTAM or instructions which impact the PBN procedure (operator instructions, GPS notam, RAIM notam,..)
- **Navigation Data bases:** The crew has to check that the database is current and covers the selected flight/procedure.
- **RAIM / FDE:** For procedures relying on GNSS, RAIM availability has to be confirmed 15mn before and after the scheduled PBN procedure.
- For certain avionics architecture, RAIM prediction may not be required (refer to AFM limitation section)
- If the RAIM availability cannot be confirmed, the flight has to be delayed or another procedure which does not rely on GNSS has to be selected.
- A FDE prediction may be necessary (RNAV 10 / RNP 4)

Operational Approvals Aspects

Normal procedure

- **Prior to commencing the PBN operation**
  - Procedure check : loaded procedure must be checked against the chart.
  - The waypoint sequence.
  - Reasonableness of the tracks and distances of the approach legs, and the accuracy of the inbound course
  - As a minimum, this check could be a simple inspection of a suitable map display.
  - Confirm that the correct sensor has been selected. Check the Referenced Radio Navaid if applicable.
  - **ATC tactical interventions may include radar headings**, In complying with ATC instructions, ‘direct to’ clearances to waypoints may be necessary. Those Waypoints have to be loaded from the data base (no manual creation).
  - **Contingency procedures** must be reviewed

Operational Approvals Aspects

Normal procedure

→ During the PBN operation

- → Manufacturer’s instruction must be adhered to (SOP)
- → Appropriate display must be displayed
- → Lateral and vertical (if applicable) deviations must not exceed prescribed values
- → Altitude and speed constraints must be observed
- → Monitor the navigation systems alerts
- → The procedure must be discontinued in case of integrity alerts, the navigation accuracy cannot be met (NSE), the deviations exceed the prescribed values (FTE), any doubt on the nav database (PDE)

Operational Approvals Aspects

Abnormal / contingency procedure

- → During the PBN operation
  - → Documented procedures to cover :
    - → Loss of the navigation system (FMS, GNSS “stand alone”)
    - → Integrity alerts, loss of the integrity alerting function (UNABLE RNP, GPS PRIMARY LOST…).
    - → Suspected navigation data base
    - → Lateral / Vertical deviations must not exceed prescribed values.
    - → In case of any loss of PBN capability, ATC must be advised. Phraseology in accordance with Doc 4444 – Unable RNAV due to equipment

Operational Approvals Aspects

Navigation Data Base

- **Navigation data base integrity**
  - Shall comply with ED 76/DO 200A methodology standard or an equivalent approved procedure => LOA type 2 and type 1
- **Quality Monitoring**
  - The operator should continue to monitor both the process and the products in accordance with the quality system required by the applicable operational regulations

Operational Approvals Aspects

Crew gross check

1

REPERES *FIXES*	IDENTIFICATION *IDENTIFICATION*	COORDONNEES *COORDINATES*	CODAGE PROPOSE *PROPOSED CODING*	STATUT *STATUS*
IAF	VAVIT	42° 48' 38.6"N - 008° 55' 09.4"E	IF	Fly By
IAF/IF	BAMDI	42° 46' 34.5"N - 008° 47' 30.4"E	IF/TF	Fly By
FAF	KC408	42° 42' 28.4"N - 008° 47' 31.7"E	TF	Fly By
MAPT	MAPTB	42° 36' 01.31"N - 008° 47' 33.54"E	TF	Fly Over
MATF	BUNAX	42° 39' 16.0" N - 008° 39' 11.0" E	DF	Fly By
MATF	CALNO	42° 47' 58.0" N - 008° 21' 52.0" E	TF	Fly Over
MATF	BAMDI	42° 46' 34.5" N - 008° 47' 30.4" E	DF	Fly Over

LOA type 1
Jeppesen
Lido
…

2

3

LOA type 2
Honeywell
Thales
Collins, Universal,
Garmin,…

Operational Approvals Aspects

Navigation Data Base

- **Data Distribution**
  - The operator should implement procedures that ensure timely distribution and insertion of current and unaltered electronic navigation data to all aircraft that require it.
- **Data Management on Board**
  - The version of the loaded navigation database is checked for validity by the flight crew
  - Prior to use, the procedure is checked against the chart by the flight crew (wpt sequence, transition, leg length, magnetic bearing, altitude and speed constraints)
  - **Feedback and reporting errors found**
    - Any database errors are addressed expeditiously
    - Reported back to the database suppliers

Operational Approvals Aspects

Crew Training

- **Knowledge**
  - Area Navigation Principles
  - PBN principle (performance monitoring, integrity, continuity, functionality) RNP vs RNAV
  - Navigation systems and their limitations
  - Displays, controls
  - SOPs
  - Flight planning

Important:
How to manage FTE and NSE !

- **Flight Training / initial and recurrent training**
  - Depend on operators experience
  - In general flight training not required for en-route operations
  - RNP APCH requires flight training
  - Recurrent training will depend on operator's network.

End slide

PBN Operational Approvals Workshop

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