

ICAO PBN Workshop Tanzanie

PBN oversight Exercise

A/C eligibility
determination



A/C eligibility

- 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

- **BUT**

- 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.
- 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.

- Purpose is to determine : A/C eligibility to PBN nav specifications in the proposed material
- We propose to use the following Guidance Material for this work.

GM to determine RNAV 1/RNAV2 eligibility

- GM – Extract RNAV 1 eligibility

Terminal operations

RNAV 1/RNAV 2

A statement of compliance with any or the following specifications or standards is found in the documentation (AFM, POH or referenced documentation):

Specification/Standard	Yes	No
RNAV 1or PRNAVor US RNAV type A		
EASA CS-ACNS for the appropriate navigation specification,or FAA AC 20-138() for the appropriate navigation specification,or FAA AC 90-100A		

A 'Yes' in any of the rows confirms the aircraft's eligibility for RNAV-1/RNAV 2 operations.

Alternatively:

If a statement of compliance with any or the following specifications or standards is found in the acceptable documentation as listed above

Specification/Standard	Yes	No
JAA TEMPORARY GUIDANCE MATERIAL, LEAFLET NO. -10 Rev1 (TGL-10),or FAA AC 90-100		

And if position determination is accomplished through GNSS or DME/DME, possibly combined with inertial data then the aircraft is eligible to operate RNAV 1/RNAV 2 procedures

If however, position determination is exclusively computed based on VOR-DME, the aircraft is NOT eligible to operate RNAV 1/RNAV 2 procedures.

GM to determine RNP 1 eligibility

RNP 1/ RNP 2 Continental

A statement of compliance with any or the following specifications or standards is found in the acceptable documentation as listed above:

Specification/Standard	Yes	No
Advanced RNP		
EASA CS-ACNS for the appropriate navigation specification, or FAA AC 20-138() for the appropriate navigation specification or FAA AC 90-105		

Alternatively:

If a statement of compliance with any or the following specifications or standards is found in the acceptable documentation as listed above

Specification/Standard	Yes	No
JAA TEMPORARY GUIDANCE MATERIAL, LEAFLET NO. 10 (TGL 10) (Any revision), or; FAA AC 90-100()		

And if position determination is primarily based on GNSS, then the aircraft is eligible to operate RNP 1 / RNP 2 operations.

Note: Consequently, loss of GNSS implies loss of RNP 1 / RNP 2 capability.

GM to determine RNAV 10 and RNP 4 eligibility

RNAV 10:

A statement of compliance with any or the following specifications or standards is found in the acceptable documentation as listed above:

Specification/Standard	Yes	No
RNAV 10 (AFM may mention RNP 10 instead of RNAV-10)		
EASA CS-ACNS for the appropriate navigation specification, or; FAA AC 20-138C or D for the appropriate navigation specification, or; EASA AMC 20-12, or; FAA Order 8400.12A (or later revision)		

RNP 4:

A statement of compliance with any or the following specifications or standards is found in the acceptable documentation as listed above:

Specification/Standard	Yes	No
RNP 4		
EASA CS-ACNS for the appropriate navigation specification, or; FAA AC 20-138C or D for the appropriate navigation specification, or; FAA Order 8400.33		

GM to determine RNP APCH LNAV eligibility

RNP APCH - LNAV minima

A statement of compliance with any or the following specifications or standards is found in the acceptable documentation as listed above:

Specification/Standard	Yes	No
RNP-APCH – LNAV or; Advanced RNP		
EASA CS-ACNS for the appropriate navigation specification, or; EASA AMC 20-27, or; EASA AMC 20-28, or; FAA AC 20-138C or D for the appropriate navigation specification, or; AC 90-105 for the appropriate navigation specification.		

Alternatively:

If a statement of compliance with RNP 0.3 GNSS approaches in accordance with any of the following specifications or standards is found in the acceptable documentation as listed above

Specification/Standard	Yes	No
JAA TEMPORARY GUIDANCE MATERIAL, LEAFLET NO. 3 (TGL 3), or; EASA AMC 20-4, or; FAA AC 20-130A, or; FAA AC 20-138 A or B,		

Note: any limitation such as “within the US National Airspace” may be ignored since RNP APCH procedure should meet the same ICAO criteria

GM to determine RNP APCH LNAV/VNAV eligibility

RNP APCH - LNAV/VNAV minima

A statement of compliance with any or the following specifications or standards is found in the acceptable documentation as listed above:

Specification/Standard	Yes	No
RNP APCH LNAV/VNAV, or; Advanced RNP		
EASA CS-ACNS for the appropriate navigation specification, or; EASA AMC 20-27 with Baro-VNAV or; EASA AMC 20-28, or FAA AC 20-138C or D for the appropriate navigation specification,		

Alternatively:

If a statement of compliance with FAA AC 20-129 is found in the acceptable documentation as listed above, and the aircraft complies with the requirements and limitations of EASA SIB 2014-04, then the aircraft is considered eligible for operations to LNAV/VNAV minima.

RNP APCH LNAV/VNAV – A/C eligibility – DGAC position

RNP APCH LNAV / VNAV – DGAC position

- The A/C has to be eligible for RNP APCH LNAV
- For the VNAV performance, AC 20-129 is acceptable provided that :
- Vertical deviation is clearly shown either on PFD or ND (monitoring on MCDU or CDU of numeric vertical deviation not accepted)
- See the 2 following examples

RNP APCH LNAV/VNAV – A/C eligibility

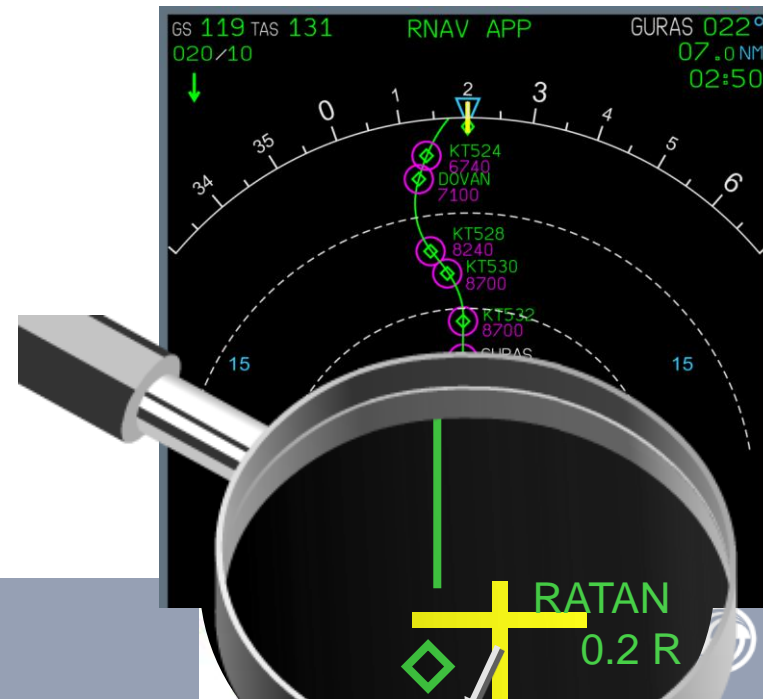


Example of Management of lateral and vertical deviations

- Vertical
 - PNF announces “VDEV” when 1/2 dot of deviation (50’)
 - PNF announces “go around” when 3/4 dot of deviation (75’)
- Use of the FD is mandatory
- Use of AP is recommended

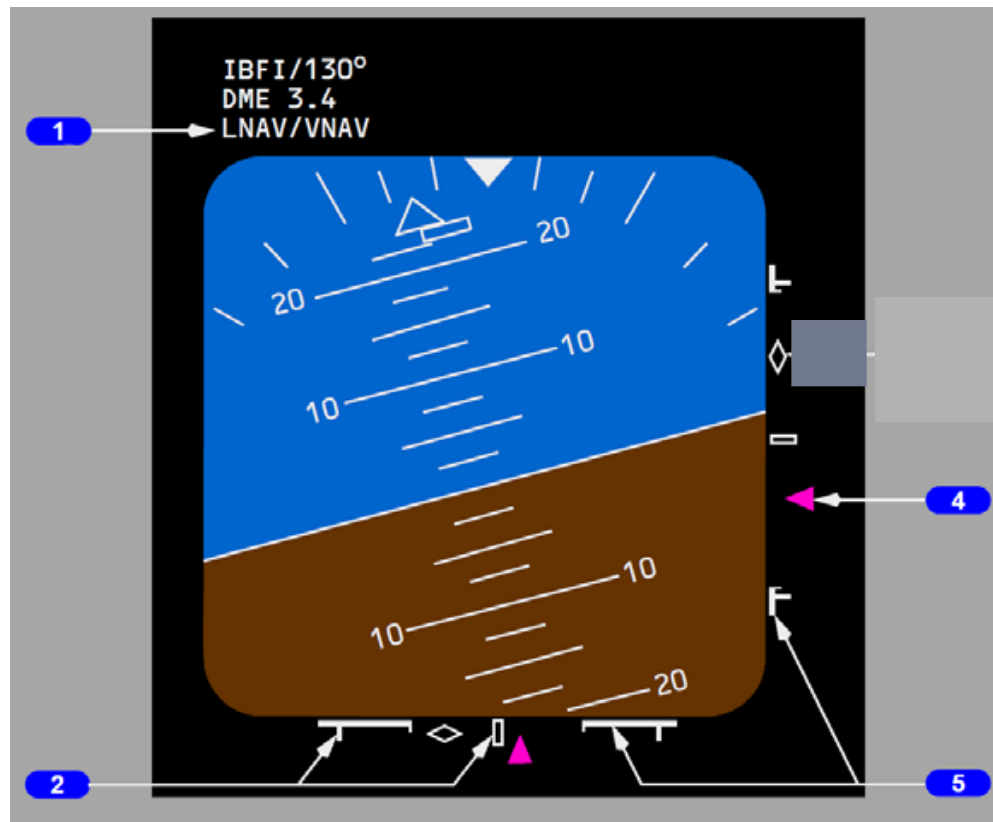
Lateral

- PNF announces “cross track” when 0.2Nm of deviations
- PNF announces “go around” when 0.3Nm of deviations



RNP APCH LNAV /VNAV – A/C eligibility

1 : Mode selected



4 : NPS deviation Pointer
Indicates the navigation path relative to airplane position

2 and 5 : Deviation scale

- Lateral and Vertical Scales
- Outer white lines represent RNP. Center white line represents position
- Bars represent ANP
- Area between bars indicates margin available to remain within RNP criteria

Example of Boeing and Airbus AFM

A/C eligibilty – AFM example

EASA APPROVED

r1 Id.: AFM/LIM/22/FMS/00009509.0001001 / 14 Dec 07
Criteria: DD
Applicable to: MSN 0033, 0040, 0043, 0049

AIRWORTHINESS STANDARDS COMPLIANCE

The FMS has been demonstrated to comply with applicable airworthiness requirements, including FAA AC 20–130A, for a navigation system integrating multiple navigation sensors, when operating with IRS, updated by radio or GPS.

The FMS also complies with the airworthiness part of:

- EASA AMC 20-4 (or JAA TGL 2 REV 1) for Basic RNAV.
- JAA TGL 10 for Precision RNAV (compliance with paragraph 8.2 has not been demonstrated).
- FAA Advisory circular 20–129 for baro VNAV.
- FAA Advisory circular 90–100 for terminal and en route RNAV operations.
- FAA Order 8400.33 for RNP 4 in oceanic and remote area.
- FAA Order 8400.12A for RNP 10 in oceanic and remote area. RNP 10 oceanic/remote area operations are approved:
 - with GPS PRIMARY
 - without GPS PRIMARY (GPS deselected or inoperative), provided time limitations in IRS only navigation, acceptable to the operational authorities, are established.
- EUROCAE ED75A/DO236A, apart from vertical performance.

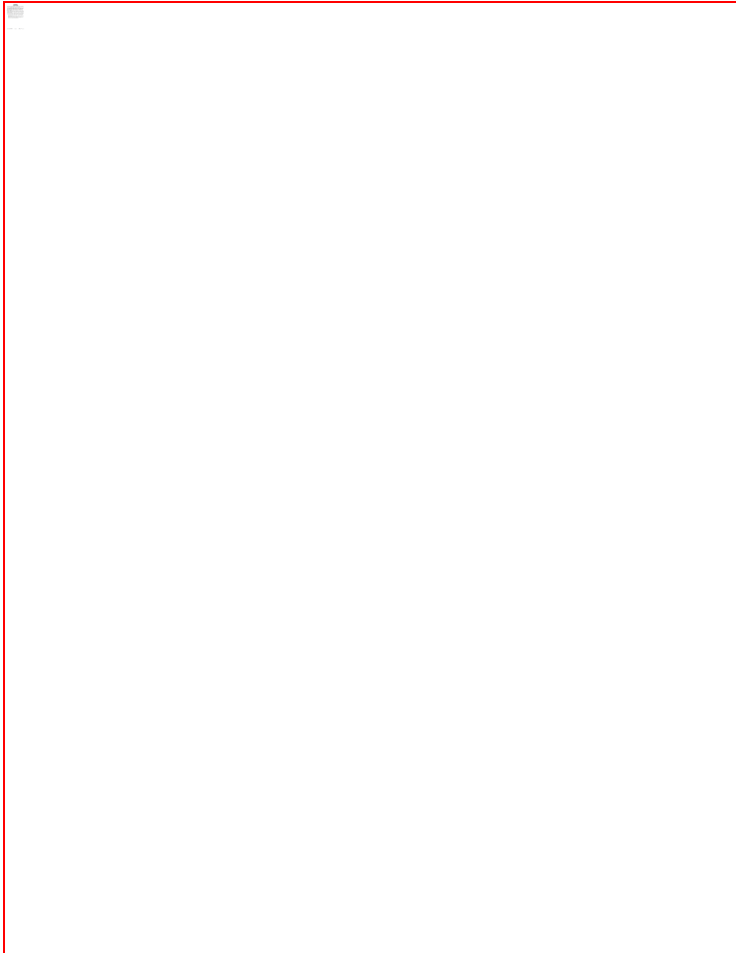
Note: Compliance with the applicable airworthiness requirements does not constitute an operational approval.

// END

HIGHLIGHTS:

r1 Solution's actual effectivity changed: MSN 0043 0049 added.

A/C eligibilty - AFM other example



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SERVICE LETTER

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717-SL-02-102-C 777-SL-02-006-C
737-SL-02-022-C MD-10-SL-02-102-C
747-SL-02-017-C MD-11-SL-02-102-C
757-SL-02-021-C MD-80-SL-02-102-C
767-SL-02-014-C MD-90-SL-02-102-C

ATA: 0200-00
17 July 2007

SUBJECT: STATEMENT OF AIRCRAFT CAPABILITY IN REFERENCE TO
TERMINAL AND EN-ROUTE AREA NAVIGATION IN UNITED
STATES NATIONAL AIRSPACE

MODEL: 717, 737, 747, 757, 767, 777, MD10, MD11, MD80, MD90 Series

APPLICABILITY: All 717, 737-300-900 and BBJ, 747-400, 757, 767, 777, MD10, MD11,
MD80, MD90 Airplanes

REFERENCE: FAA Advisory Circular No. 90-100A "U.S. Terminal and En-Route Area
Navigation (RNAV) Operations" dated 1 March, 2007

SUMMARY:

This service letter provides information to operators regarding Boeing aircraft capability with respect to the recently revised FAA Advisory Circular addressing Area Navigation (RNAV) standards. Operators may consider this information in support of their decision to apply the criteria of this FAA Advisory Circular as part of their application for regulatory approval.

BACKGROUND:

The FAA's plan for RNAV implementation, "Roadmap for Performance based Navigation" (see web site: http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/sf/sf400/rnp) describes FAA's RNAV operational goals and milestones for RNAV and Required Navigation Performance (RNP).

Web site:

http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/sf/sf400/sf410/policy_guidance/, also provides a list of applicable nav system equipment part numbers known to comply with AC 90-100A. RNAV is one of the baseline elements of navigation based operations in the US National Airspace System. Additionally, RNP concepts will be applied where it is beneficial for safety, capacity and efficiency in airspace operations. The information provided in this service letter is



RNP 4 – Aircraft eligibility

Example of group 1



FLIGHT MANAGEMENT COMPUTER SYSTEM (FMCS) Software update U10 and later versions.

The Flight Management Computer System has been demonstrated to meet the requirements of Advisory Circular 20-130A for a multi-sensor area navigation system when operated with radio or Global Positioning System (GPS) updating. When operated in this configuration, the FMCS may be used for enroute and terminal area operations and instrument approach navigation (excluding ILS, LOC, LOC-BC, LDA, SDF, GLS, and MLS).

One FMCS, one CDU, one VOR, one IRU in NAV mode, and either one DME or GPS (if installed) operational at dispatch are required for RNAV operations (FAA AC20-130A, JAA AMJ 20X2), unless other appropriate procedures are used.

For configurations with a single FMCS installed, the single FMCS may be used as a supplement to other primary means navigation systems.

For configurations with two FMCS installed the following applies:

Two Inertial Reference Systems (IRS) in conjunction with two FMCS meet the requirements of Advisory Circular 25-15 for long range navigation.

Two FMCS, two CDUs, two sensors capable of meeting a selected RNP, and two IRUs in NAV mode operational at dispatch are required for primary means RNP navigation.



NAVIGATION CAPABILITY OF THE FMCS

The navigation capability of the airplane is defined by the navigation signals available at the current airplane location and the operational sensor on the airplane. The following sections define the airplane's navigation capabilities in terms of GPS satellite signal availability to fly a selected RNP and the range and/or typical values of RNP based on the position update mode.

6.1 GPS/FMCS RNP AVAILABILITY

Figure 6.1-1 is a summary of FMCS/GPS/IRS RNP availability. The data is based on the following GPS receiver and satellite configuration assumptions, which apply to the FMCS system:

- 1) No Baro-Aiding (RAIM augmentation), no local area or wide area differential, or GIB (Global Integrity Broadcast) in the GPS receiver.
- 2) A 2.0 degree mask angle in the GPS receiver.
- 3) Dual FMCS, dual GPS receiver installation.

Number of Satellites in GPS Constellation	FMCS/GPS/IRS World-Wide Availability of Selected RNP					
	RNP 12.0	RNP 4.0	RNP 1.0	RNP 0.5	RNP 0.3	RNP 0.15
24 or more	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
23	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
22	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
21	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Note: RNP 4.0, 0.3, 0.15 require manual pilot selection.

Figure 6.1-1 FMCS/GPS/IRS World-Wide Availability of Selected RNP
Based on the above results, the FMCS is capable of providing the levels of navigation with GPS as defined in Figure 6.1-2.

REV C D6-30087-3 20

FAA APPROVED 03-30-07 D631A001 Code 9000 Section 3 Page 8

Example of group 3



FAA APPROVED
FAA Form 7900-1, (Rev. 10-2009)
Change 10, (Rev. 10-2009)
Approved by: MSN 0055, 0043, 0045, 0049

AIRWORTHINESS STANDARDS COMPLIANCE

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The FMS also complies with the airworthiness part of:

- EASA AMC 20-4 (or JAA TGL 2 REV 1) for Basic RNAV.
- JAA TGL 10 for Precision RNAV (compliance with paragraph 8.2 has not been demonstrated).
- FAA Advisory Circular 20-129 for baro VNAV.
- FAA Advisory Circular 80-100 for terminal and en route RNAV operations.
- FAA Order 8400.33 for RNP 4 in oceanic and remote area.
- FAA Order 8400.12A for RNP 10 in oceanic and remote area. RNP 10 oceanic/remote area operations are approved:
 - with GPS PRIMARY
 - without GPS PRIMARY (GPS deselected or inoperative), provided time limitations in IRS only navigation, acceptable to the operational authorities, are established.
- EUROCAE ED75A/DO236A, apart from vertical performance.

Note: Compliance with the applicable airworthiness requirements does not constitute an operational approval.

END

REVISIONS:
1) Solution's actual efficiency changed; MSN 0043 0049 added.

