

Approval Guidance Information

Edition 2 - September 2005

REFERENCE DOCUMENTATION & GUIDANCE INFORMATION

WARNING

The following material has been created by EUROCONTROL in order to familiarise operators, industry and flight crew with the P-RNAV implementation and the associated certification and operational issues.

This material is meant for information only and does not replace any certification procedure or requirement as recommended or mandated by a State authority.

EUROCONTROL does not assume any legal liability or responsibility for the accuracy or completeness of this information.

P-RNAV APPROVAL INFORMATION FOR OPERATORS

CONTENTS

1 P-RNAV

This section is written to give a basic introduction to Precision Area Navigation (P-RNAV).

2 Airworthiness and Operational Approval

The diagram in section 2 is to assist operators in the process to achieve P-RNAV airworthiness & operational approval on aircraft where the Original Equipment Manufacturer has stated that its range of aircraft models & variants are compliant with TGL10. EUROCONTROL will maintain a record of aircraft types which have been notified as P-RNAV compliant by the aircraft manufacturer. In addition, avionics compliance will also be recorded on advice from the equipment manufacturer.

This information will be available on the P-RNAV pages of www.ecacnav.com.

3 Navigation Database Integrity

The navigation database should be obtained from a supplier which has a Letter of Acceptance (LoA) from EASA which confirms the data supplier conforms with the data quality process requirements of EUROCAE ED 76. This requirement is equally met by buying data from a supplier which has gained a LoA from the FAA confirming compliance with RTCA DO 200A. In the unlikely event that data is supplied directly to an operator by a company which does not possess a LoA as outlined above, the operator must implement alternative data integrity checking. A flow diagram has been provided which may assist an operator to satisfy the appropriate regulator that data integrity is being assured.

4 JAA TGL10 Interpretative Material

TGL10 criteria specify a number of functions for a P-RNAV aircraft installation. Diagrams in section 4 illustrate how these functions may be distributed within the aircraft navigation system.

5 FAQ

The JAA CNS/ATM working group have compiled a list of frequently asked questions (FAQs) together with appropriate responses. These FAQs are intended to help OEM, Installers, Operators & State Regulators in forming judgements on acceptability of some aircraft installations and operations.

The FAQs can also be considered as TGL10 interpretative material.

BASIC INFORMATION FOR STATES, AIRCRAFT OPERATORS AND VENDORS

Background

Precision-RNAV is the natural progression from Basic RNAV which became mandatory in European airspace in April 1998.

Initial application is in the terminal area and P-RNAV track keeping accuracy equates to cross track accuracy of RNP 1 ($\pm 1\text{NM}$).

P-RNAV Procedures are designed to a common set of design principles specific to RNAV equipped aircraft. These P-RNAV Procedures will replace the current multitude of overlay Procedures many of which are unsuitable for a wide range of aircraft types.

What is RNAV

A method of navigation which permits aircraft operation on any desired flight path within the coverage of referenced navigation aids or within prescribed limits of self contained aids.

RNAV operations permit flight in any airspace without the need to fly directly over ground based aids. Aircraft P-RNAV equipment automatically determines aircraft desired flight path by a series of way points held in a database.

What is the difference between B-RNAV and P-RNAV

Basic Area Navigation (B-RNAV) was the forerunner of the RNAV implementation in ECAC. It was introduced to enable en route capacity gains to be achieved with minimal aircraft capability. It requires aircraft conformance to a track-keeping accuracy of $\pm 5\text{NM}$ for at least 95% of flight time to ensure that benefits are achieved whilst meeting the required safety targets. B-RNAV can be achieved using inputs from VOR/DME, DME/DME or GNSS and/or INS.

Precision Area Navigation (P-RNAV) is being introduced for RNAV applications in terminal airspace. It requires aircraft conformance to a track-keeping accuracy of $\pm 1\text{NM}$ for at least 95% of flight time, together with advanced functionality, high integrity navigation databases. P-RNAV capability can be achieved using inputs from DME/DME or GNSS and/or INS. Many existing aircraft can achieve P-RNAV capability without additional onboard equipment.

P-RNAV procedures are designed, validated and flight checked to a common standard. All aircraft are certified to the same criteria and have the same functional capability. In addition ATC procedures and RT phraseology will be standard. This harmonised approach will enable all aircraft to fly accurate and consistent flight paths in the terminal area.

Is there a mandate for P-RNAV

An ECAC wide mandate for the carriage of P-RNAV is not foreseen. However European States will progressively introduce P-RNAV requirements for Terminal RNAV procedures. It is expected that, increasingly, from November 2005, P-RNAV procedures will be implemented across the Terminal Areas of the ECAC States, although a limited provision of conventional procedures will enable some access to the airports in those areas. Basic RNAV will be limited to RNAV procedures above MSA that are designed according to en route principles.

Where will P-RNAV be used

Initial use of RNAV equipment approved for P-RNAV operations will be in the terminal area.

What is RNP-RNAV

RNP-RNAV will be the final step toward achieving an area navigation system with functionality and integrity for all phases of flight with track keeping accuracy applicable to prescribed RNP values, typically RNP 0.3NM and RNP 0.1 NM.

No mandate is foreseen before 2015.

Headline Benefits

P-RNAV will make a significant contribution to safety by introducing predictable and repeatable flight paths for all aircraft types with :

- Approach procedures designed to common set of parameters
- Aircraft flying consistently to those parameters
- Pilots and controllers with same knowledge of intended flight path

What are the Requirements

The authoritative guidance material for achieving aircraft airworthiness and operational approval is provided in the **JAA Temporary Guidance Leaflet 10** known as TGL10.

What about my aircraft

Most modern aircraft can meet the airworthiness requirements for P-RNAV based on the criteria of TGL10. The Aircraft Flight Manual may already contain the required statements of accuracy, integrity and continuity required for P-RNAV operation.

What else is involved

Operators will need to provide pilot training, review Standard Operating Procedures, and may need to update aircraft MELs to accommodate additional features of P-RNAV procedures.

Will magnetic conversion tables require to be upgraded

Operators should check to ensure the True to Magnetic conversion table, held in the FMS or RNAV equipment, is in date. Out of date conversion tables may give inaccurate headings leading to unacceptable track errors.

Any special requirements for navigation database

While the level of accuracy and thoroughness of the source material on which the database depends is the responsibility of the State, commercial database suppliers have a responsibility to ensure they accurately reproduce the source data.

The navigation database should be obtained from a supplier possessing a Letter of Acceptance (LoA) from EASA or the FAA (as appropriate) demonstrating compliance with the data quality requirements set out in EUROCAE ED 76, or RTCA DO 200A (as appropriate). The award of a LoA equates to the term 'approved' as used in JAA TGL-10 Para 10.6.1 relating to data integrity. Operators obtaining their data in this manner are therefore deemed to satisfy the requirements of TGL10 Para. 10.6.1.

Unless this is the case, operators applying for P-RNAV approval must demonstrate to the appropriate regulator that data integrity checking is being implemented using software tools or acceptable manual procedures.

What assumptions do I make concerning safe guards taken by the airspace authority

The TGL10 identifies a number of assumptions for P-RNAV procedures in the terminal area.

The ATS provider and the airspace authority will have addressed these assumptions before publishing any P-RNAV procedures.

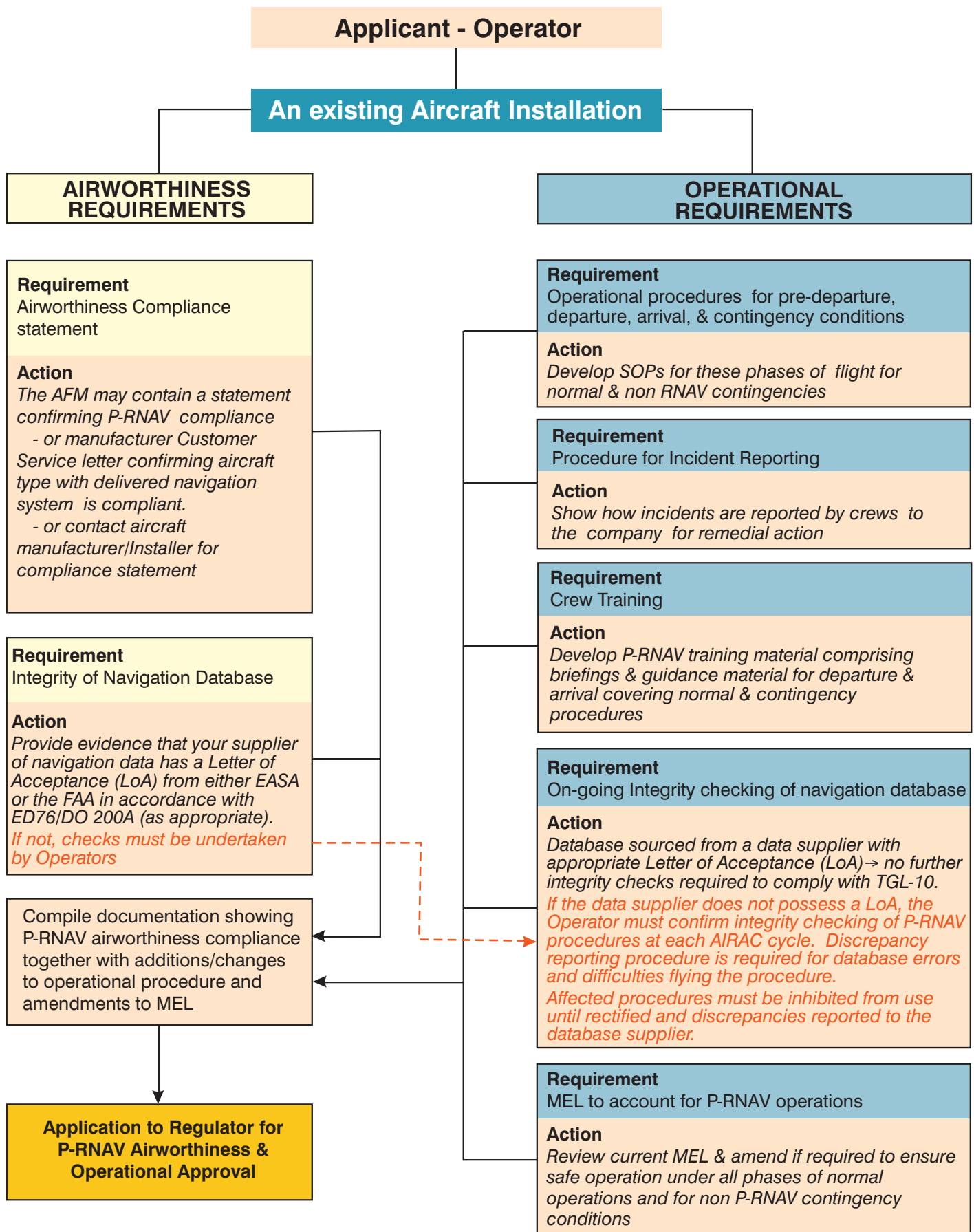
Who gives the Approval

The aircraft operator is required to submit to the responsible State authority a compliance statement that shows how the airworthiness certification criteria and operational requirements have been satisfied.

Approval must be obtained before commencing P-RNAV operations.

2

AIRWORTHINESS & OPERATIONAL APPROVAL FOR P- RNAV OPERATIONS FOR EXISTING AIRCRAFT INSTALLATIONS



3

DATABASE INTEGRITY CHECKING GUIDELINES (COMPLIANCE WITH JAA TGL10)

For the purposes of precision navigation, TGL10 lays down specific guidelines with regard to the need for integrity checking of the navigation database.

The requirements are set out in para. 10.6 and are reproduced in full below:

- 10.6.1 The navigation database should be obtained from an approved supplier who has complied with EUROCAE ED-76/RTCA DO-200A Standards for Processing Aeronautical Data.
- 10.6.2 Unless the navigation database is obtained from a supplier holding a Letter of Acceptance (LoA) demonstrating compliance with the requirements of ED76/DO 200A (as appropriate), the Operator must implement navigation database integrity checks using appropriate software tools or approved manual procedures to verify data relating to waypoints below the minimum applicable obstacle clearance altitude. Such checks are in addition to any checks previously performed by the Aeronautical Information Service, unapproved navigation database suppliers or navigation equipment manufacturers. The integrity checks need to identify any discrepancies between the navigation database and the published charts/procedure. Integrity checks may be performed by an approved third party.

Note: For the purposes of the check, the term 'minimum obstacle clearance altitude' may be interpreted as the relevant 'Minimum Safe Altitude (MSA)' for the P-RNAV procedure.

Once a database supplier has been approved in accordance with para. 10.6.1, then the Operator is not compelled to carry out its own database checking in order to demonstrate compliance with TGL10.

However, if a database is purchased from a non-approved supplier, an Operator has to demonstrate compliance using para. 10.6.2. This could become an unmanageable, time-consuming and costly exercise.

EUROCONTROL has recognised that such a burden may be unacceptable for some Operators and has therefore examined the minimum checks necessary to comply with para. 10.6.2 and has developed a process (shown in the flowchart which follows) which could be used as a guide to help Operators demonstrate such compliance.

Note: Operators are reminded that AMC OPS 1.035 to JAR-OPS Quality Systems requires audits to ensure safe operational practices. Such audits should monitor the quality of received data, but need not be carried out as frequently as each 28-day AIRAC cycle. This requirement applies whether or not data is purchased from a supplier approved in accordance with ED-76/DO-200A.

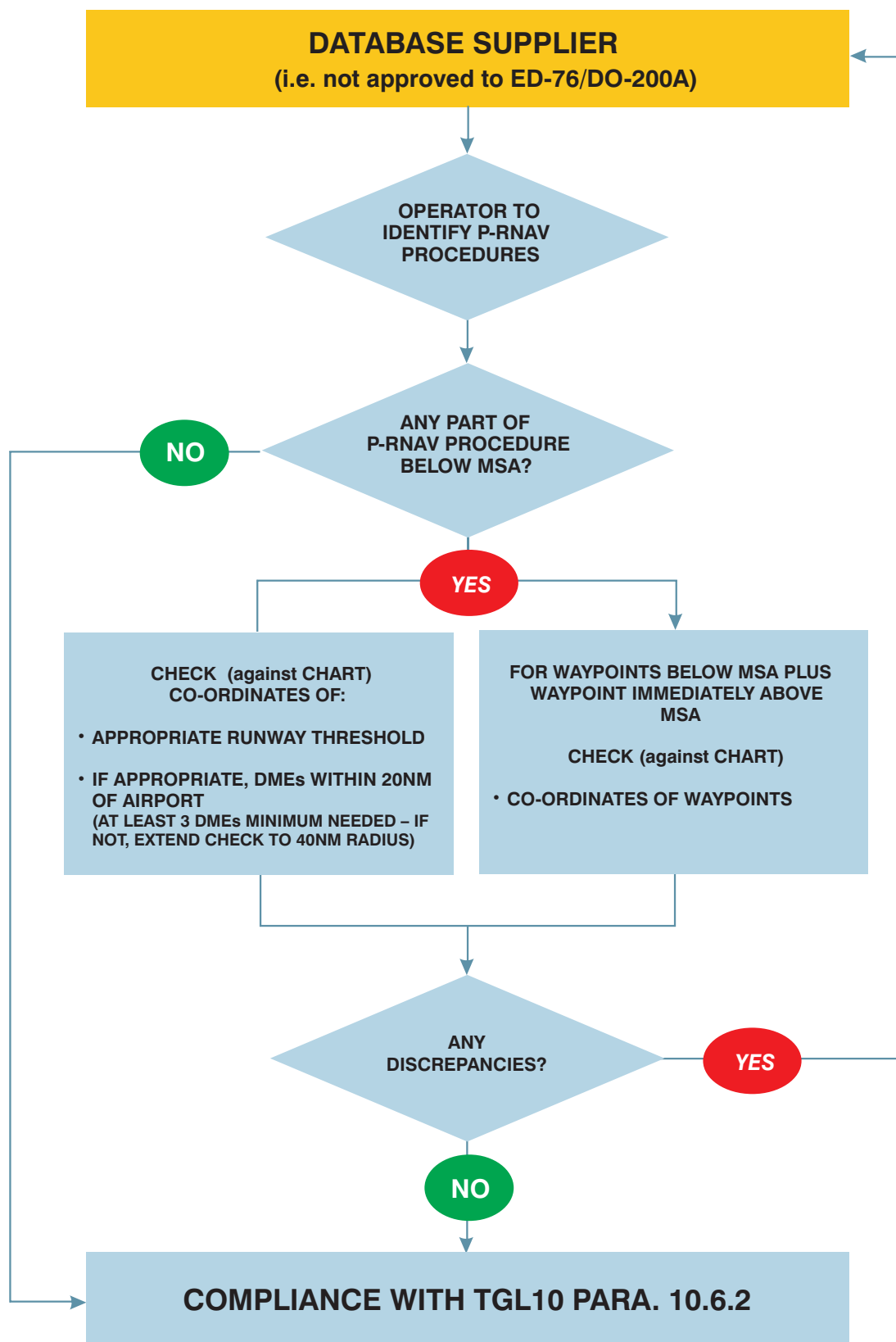
IMPORTANT CAVEATS

OPERATORS SHOULD NOTE THAT THIS FLOWCHART IS PRODUCED SOLELY AS GUIDANCE WHICH MAY ASSIST WHEN SETTING UP A DATA CHECKING PROCESS.

OPERATORS ARE REMINDED THAT ACCEPTANCE OF ANY OPERATOR'S DATA INTEGRITY CHECKING PROCESS REMAINS UNDER THE FULL JURISDICTION OF THE APPROPRIATE STATE REGULATION AUTHORITY. CONSEQUENTLY, OPERATORS ARE STRONGLY RECOMMENDED TO SEEK GUIDANCE FROM THAT AUTHORITY BEFORE COMMITTING RESOURCES TO THE CHECKING PROCESS.

ATTENTION IS ALSO DRAWN TO TGL10 Para. 10.2 NORMAL PROCEDURES, WHICH DETAILS THE REQUIREMENTS TO BE CARRIED OUT BY OPERATORS AND PILOTS BEFORE A P-RNAV PROCEDURE IS PLANNED OR FLOWN.

SUGGESTED ALTERNATIVE DATA CHECKING GUIDELINES IF DATA SUPPLIER DOES NOT POSSESS LETTER OF ACCEPTANCE (LoA) FROM EASA/FAA



4

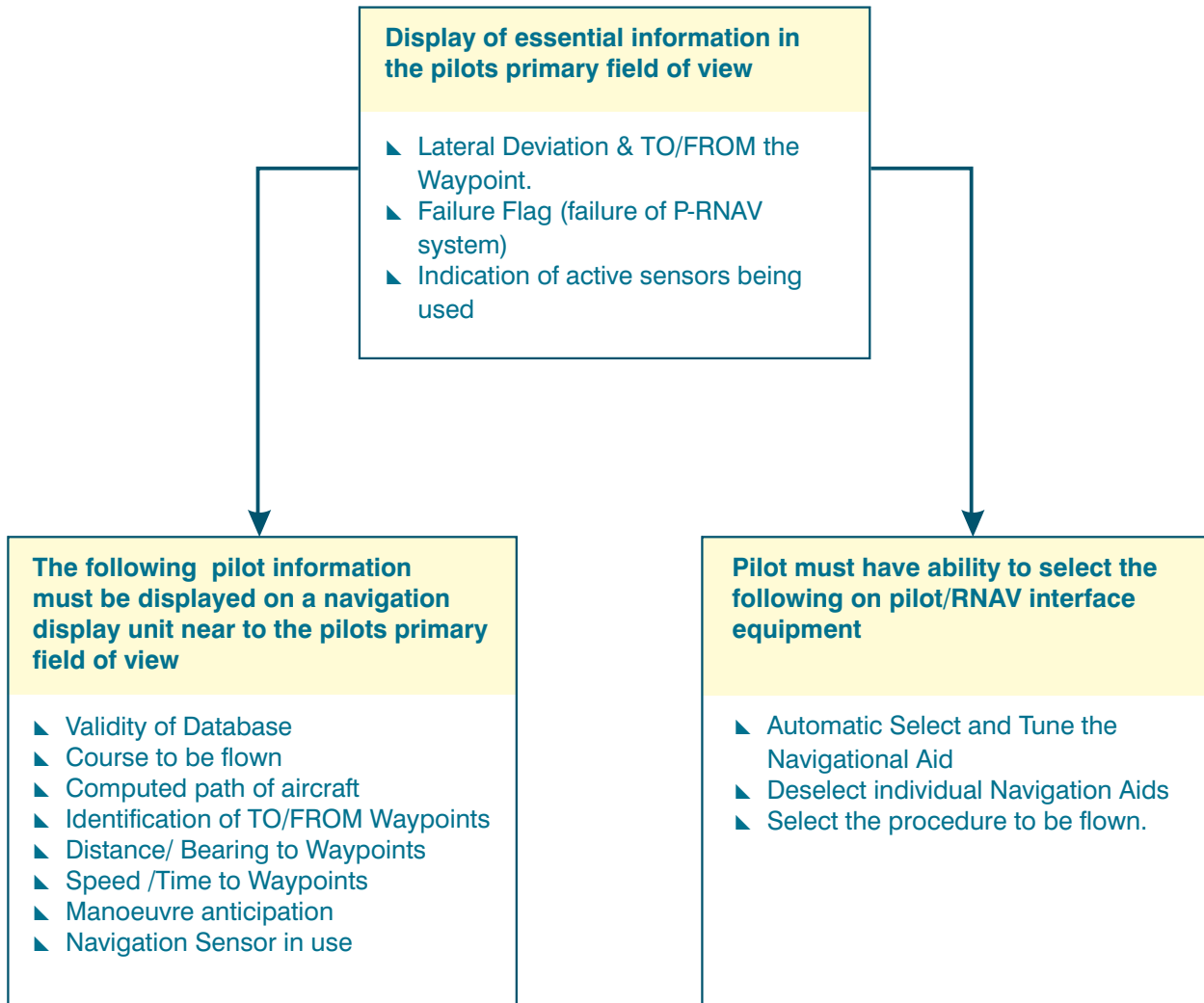
TGL10

INTERPRETATIVE MATERIAL

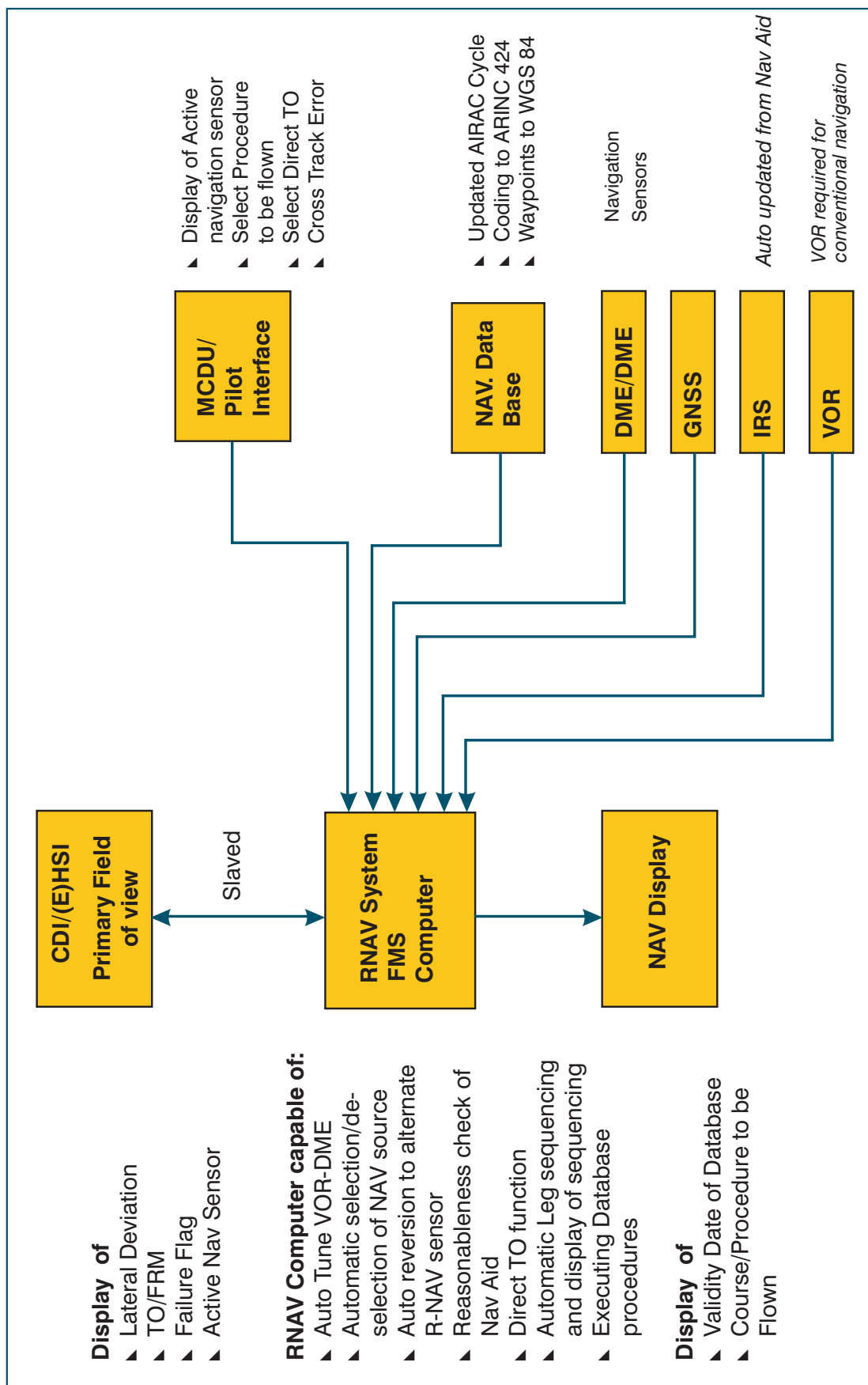
TGL10 CRITERIA

TGL10 requirement and recommended functions consist of RNAV functions to be performed, the display of information relevant to the path being flown and annunciation of warnings and failures. These functions are distributed within the aircraft navigation and display system that is dedicated to primary information. Other information to be displayed is centred around the pilot's RNAV interface unit. There is no one defined equipment configuration that meets the TGL10 P-RNAV requirements. For example the RNAV function and database requirements may be consolidated as part of an integrated navigation system as is the case where an FMS is installed and a Multi Control Display Unit is used as the pilot RNAV interface. Other configurations may have a separate conventional navigation system with an additional RNAV computer and display unit.

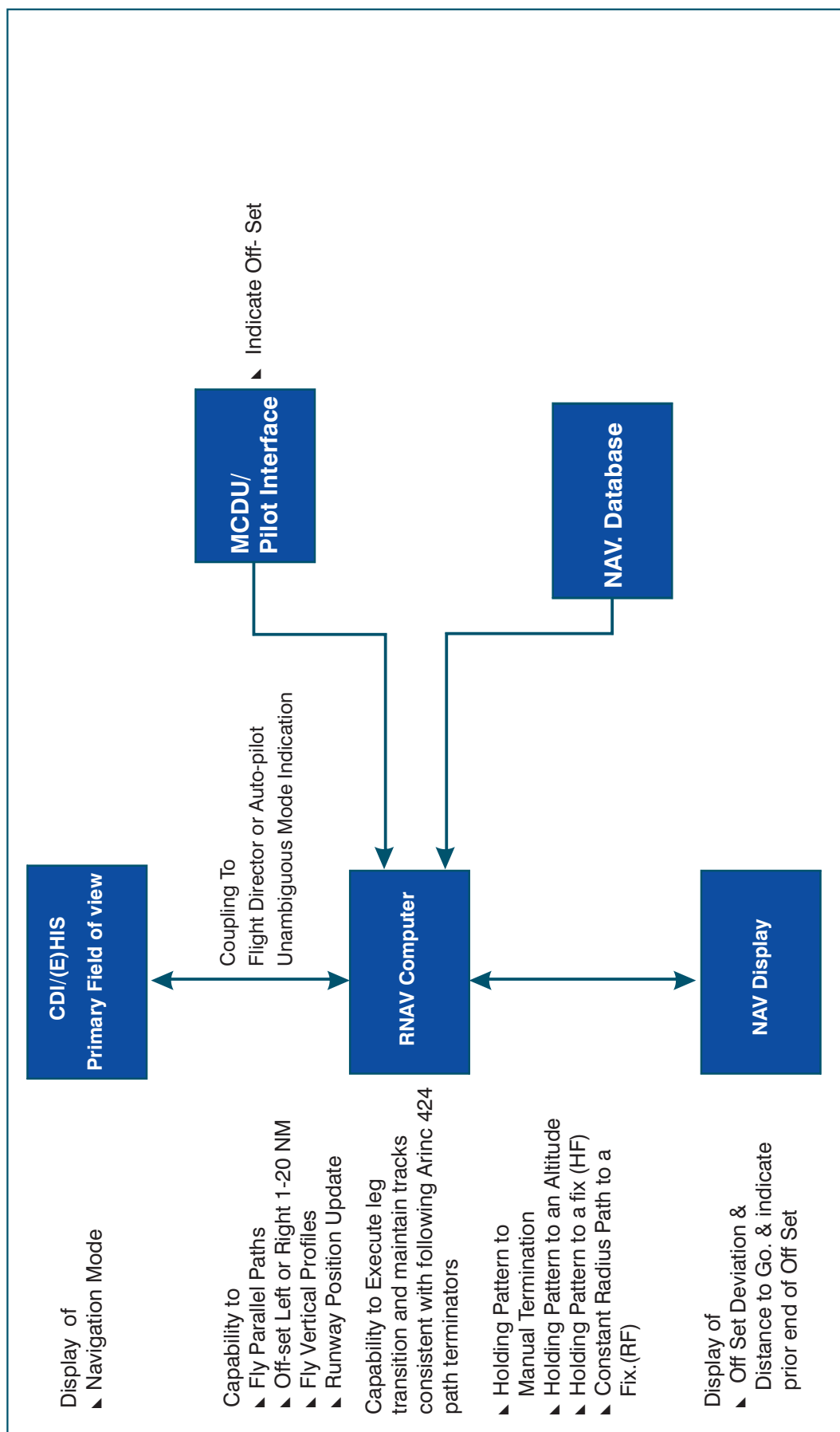
The following diagrams show functions and the display of information compliant with TGL10. The system design and equipment to obtain compliance may be achieved by a number of different configurations of equipment.



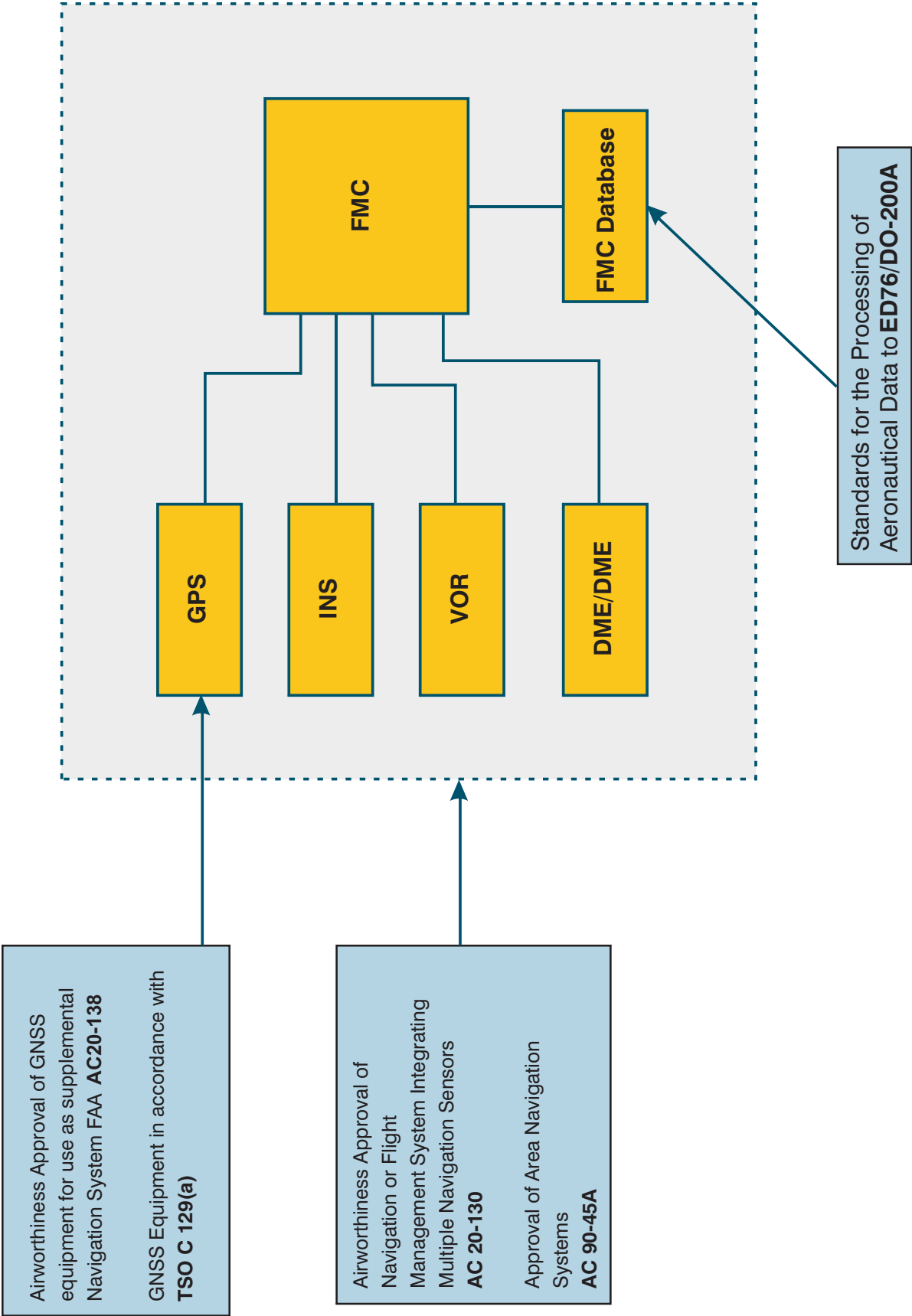
TGL10 FUNCTIONAL REQUIREMENTS



TGL10 RECOMMENDED FUNCTIONS



AIRWORTHINESS APPROVAL CRITERIA



FREQUENTLY ASKED QUESTIONS



Following the publication on 1st November 2000 of JAA Guidance Leaflet TGL 10, *Airworthiness and Operational Approval for Precision RNAV Operations in Designated European Airspace*, a number of aircraft operators sought further advice on the means of compliance with the certification criteria of the leaflet.

This FAQ information collates the questions raised and provides responses from the JAA / CNS-ATM committee to aid understanding of the intent of the leaflet.

Reference Data: JAA Guidance Leaflet TGL10: *Airworthiness and Operational Approval for Precision RNAV Operations in Designated European Airspace*, 1st November 2000.

FAQs

2.0-1	Is airworthiness certification and operational approval for P-RNAV operations mandatory?	To fly an instrument procedure published in the AIP and notified as P-RNAV, the aircraft must have a certified P-RNAV capability. Commercial aircraft operators will need to comply with TGL10 and be approved under the terms of their AOC for such operations. General aviation operators will need to satisfy TGL10 and be authorised for such operations in airspace where required by the relevant AIP.
2.0-2	Can the JAA consider how GA & Aerial Work operations could meet the P-RNAV requirements given the limitations of GA cockpits?	The P-RNAV criteria of TGL10 are derived from airspace requirements. Therefore, to safely operate on P-RNAV instrument procedures, compliance is required with all sections of the TGL except those specifically applicable to commercial operations.
4.0-1	Is it a responsibility of aircraft operators to ensure those assumptions and measures, as described in paragraph 4 of TGL10, have been taken into account?	No. It is the responsibility of the air traffic service provider to take account of those assumptions and put in place the necessary measures to safeguard P-RNAV operations prior to publication of P-RNAV procedures.
6.1-1	My aircraft was equipped for RNAV at original build but the aircraft documents do not define the applicable accuracy standard. What should I do?	A request should be made to the aircraft constructor or the relevant modification centre to provide a statement of compliance against the criteria of TGL10. The responsible certification authority will accept such a statement from the aircraft constructor.
6.1-2	My aircraft is equipped with a GPS compliant with (J)TSO-C129a. Is this enough for compliance? What about compliance with TSO-C115, AC20-138 or AC25-15?	(J)TSO-C129a satisfies the positioning accuracy requirement and no further evidence or demonstration is required. However, the equipment standard by itself is not sufficient to show compliance with other criteria of TGL10 such as required functions of Table 7.1 and integration with flight deck displays. Similarly, compliance with the other standards contributes to the evidence but this must be supplemented by a review of the system against the criteria of TGL10.
6.1-3	Some widely used receivers were certified before the A version of TSO C129 was issued, but they satisfy the same accuracy requirements.	GPS positioning accuracy is not the only requirement to meet compliance for P-RNAV. A review of the receiver must be made against the requirements of TGL10 paragraph 8.3.
6.1-4	The AFM for my aircraft states "RNP1" capability. Is this sufficient for P-RNAV?	Provided the aircraft is compliant with RNP-1 RNAV criteria of EUROCAE ED-75() or RTCA DO-236(), it would satisfy the P-RNAV requirement.
6.1-5	Is it possible to meet the 1NM accuracy with an assumed flight technical error (FTE) associated with manual flight, i.e. is there an implied requirement for flight director or autopilot coupling?	For manual flight, a default FTE value of 0.8 NM may be assumed (ref. RTCA DO-283, 2.2.5.1). Therefore, in the case of GPS positioning, assuming that the path definition and display errors can be shown to be negligible, manually flown GPS based navigation can achieve the required accuracy. In other (non-GPS) cases where the positioning error is likely to be more significant, flight director or autopilot coupling will be needed to minimise FTE such that the total system can achieve the required accuracy. Use of a navigation map display is another means of reducing FTE although this would need to be confirmed by an assessment taking into account factors such as the size and location of the display, its range scaling, and suitability for P-RNAV.

FAQs

6.1-6	Are the accuracy requirements met if the aircraft has been certified to the 2D navigation accuracy criteria of FAAAC 20-130() or AC 90-45A?	The JAA has accepted that the 2D performance associated with the FAA AC's, when assuming a P-RNAV navigation infrastructure (e.g. DME/DME density) yields navigation accuracy compatible with the P-RNAV requirement.
6.2-1	My aircraft was equipped at original build with RNAV as a fully integrated primary navigation system but the aircraft documents do not show compliance with the integrity criteria. What should I do?	As the integrity requirements applied at initial build for primary navigation systems are the same as those for P-RNAV, no further investigation is required. Compliance may be claimed on the basis of the original certification.
6.2-2	An aircraft was modified previously to add RNAV to supplement the primary navigation systems but the aircraft documents do not show compliance with the integrity criteria. What should I do?	A request should be made to the relevant modification centre to provide a statement of compliance against the criteria of section 6.2 of TGL10. The responsible certification authority will accept such a statement from an approved centre.
6.3-1	My aircraft was equipped at original build with RNAV fully integrated with the primary navigation systems but the aircraft documents do not show compliance with the continuity criteria. What should I do?	The continuity requirements applied at initial build for primary navigation and communication systems satisfy the requirement; hence no further investigation is required. Compliance may be claimed on the basis of the original certification.
6.3-2	My aircraft was modified previously to add RNAV to supplement the primary navigation systems but the aircraft documents do not show compliance with the continuity criteria. What should I do?	The continuity requirements applied at initial build or modification of primary navigation and communication systems satisfy the requirement; hence no further investigation is required. Compliance may be claimed on the basis of the original and modification certifications.
7.1-1	The course selectors in my aircraft are not automatically slaved to the RNAV computed path and manual selections have to be made. Why is this not acceptable?	For performance and safety reasons, automatic slaving is necessary to ensure accurate track keeping with an acceptable crew workload in situations that can occur during a complex P-RNAV procedure. The automatic slaving function will need to be provided in all new installations. However, where this function is not provided in existing installations, an assessment of track keeping performance & crew workload will need to be made on a case-by-case basis by the approving authority. This assessment will take account of compensating factors such as the flying characteristics of the aircraft. The approving authority may apply operating restrictions if workload or track keeping at certain locations is unacceptable. Particular attention will need to be given to track keeping accuracy for curved paths.
7.1-2	In my aircraft, navigation sources cannot be deselected manually. Why is this not acceptable?	A navigation source, such as a malfunctioning VOR station or a station under test or an offset DME, can seriously corrupt the area navigation computation, particularly when the navigation infrastructure is limited such as initial entry from an oceanic area. According to ED-75A/ DO-236A, paragraph 3.7.3.1, the system "...shall be capable of manual or automatic navigation source selection. The system shall provide the capability to inhibit individual navigation aids from the automatic selection process". Thus, in lieu of a manual deselection capability, a robust automatic deselection capability will need to be demonstrated.

FAQs

7.1-3	Why is the ARINC 424 Heading to a Manual Termination (VM) path transition not included in the Required or Recommended Functions?	It is recognised that a VM leg type is commonly used today where radar vectors are used by ATC, particularly in an Open STAR. The VM is strictly not part of the P-RNAV definition although a survey has shown that practically all RNAV equipment manufacturers include the capability within their systems.
7.1-4	The TGL requires that, "For multi-sensor systems, automatic reversion to an alternate RNAV sensor if the primary RNAV sensor fails". Does this apply to aircraft where, say, the navigation equipment requirement for an aircraft is met by a single GPS, but the aircraft also happens to have dual DME (because, perhaps, the GPS was an upgrade)?	Yes, the intention is that the navigation system should revert to the next best position-fixing configuration i.e. from GPS to DME/DME updating. Clearly if the system degrades to VOR/DME or to pure inertial, operational constraints such as distance from the VOR station or time will apply, in order to remain within the +/- 1 NM accuracy requirement for P-RNAV.
8.0-1	What certification method will be used for the equipment installed to meet the P-RNAV standard?	Certification will be by means of aircraft Type Certification, amended Type Certificate, or a Supplementary Type Certificate, in accordance with guidance in section 8.0 of TGL10.
8.1.2-1	I have single fit that meets all the requirements of TGL10 and have VOR/DME as back up in the event of RNAV failure. Can I gain P-RNAV operational approval?	A single system is an acceptable means of compliance with TGL10 unless the state where the P-RNAV procedure is published requires dual systems because of local conditions. See TGL10 paragraph 6.3 note 1
8.3.1-1	Is it right that equipment approved under any single of the mentioned (J)TSO's (TSO-C145 or TSO-C146 or JTSC-C129a/TSO-C129()) can be eligible for P-RNAV? Or is it necessary to comply with more than one, or even with all as the conjunction "and" used in 8.3.1 suggests?	The intent was that where compliance to P-RNAV is based on GPS equipment, acceptable standards include either JTSC C-129a or FAA TSO C-129() for the aircraft augmented equipments, and FAA TSO C-145 or C-146 for the SBAS augmented equipments. Therefore the wording in TGL No. 10 paragraph 8.3.1 should be interpreted as an "or" function.
9.4-1	If the AFM contains a statement of compliance with RNP standards, is any further airworthiness demonstration required?	Provided RNP-RNAV standards such as ED-75()/ DO-236() are quoted, no further demonstration of airworthiness compliance is required as these standards exceed the requirements for P-RNAV.
10.1-1	If I am operationally approved for P-RNAV, can I then use my RNAV system to fly conventional SID and STARS?	The P-RNAV system provides assurance of safe interoperability with the P-RNAV instrument procedure design. This does not translate to conventional procedures that need to be flown and monitored against the published nav aids.
10.1-2	Does my P-RNAV approval qualify me to fly RNAV terminal procedures in states outside the ECAC region?	Compliance with the relevant state's AIP is necessary. P-RNAV approval may not be sufficient for this purpose. The advice of the relevant state should be sought.
10.2-1	My system has a database that does not conform to ARINC 424, and the flight plan is constructed on a waypoint-to-waypoint basis that does not use all leg types specified, and may require pilot intervention. Can this be accepted?	Equivalency to ARINC 424 path terminators is permitted provided compliance is shown with criteria item 18 of table 1 of TGL10. Unless specifically authorised, pilot intervention is not permitted. Also, a database update service is essential.
10.2.1.1-1	Does alternate in this context include enroute alternates for ETOPS? Due to limitations in database storage capacity, there may not be sufficient capacity to store all destinations and alternates.	If a P-RNAV procedure is applicable at the alternate then that procedure must be available in the navigation database. If a P-RNAV procedure is not applicable then reversion to a conventional procedure is permissible.

FAQs

10.6 What is an approved supplier?

When TGL-10 was originally drafted it was anticipated that the data integrity process would be assured by some sort of product approval.

This was subsequently found to be inappropriate and EASA and the FAA were urged to develop an alternative means of ensuring the data had been subjected to an effective quality assurance process.

This was done and the requirements of this paragraph of TGL-10 (para. 10.6) are now met by obtaining the data from suppliers who have gained a Letter of Acceptance (LoA) demonstrating that their quality processes are in accordance with EUROCAE ED76/RTCA DO 200A (as appropriate).

It is planned that the term 'approved' will be removed from paragraph 10.6 on future revision of TGL-10.



Reference documentation

JAA Guidance Leaflet TGL 10, *Airworthiness and Operational Approval for Precision RNAV Operations in Designated European Airspace*



www.ecacnav.com/p-rnav

EUROCONTROL AFN USER SUPPORT CELL

prnav@eurocontrol.int
Fax number: +32 2 729 46 34

Manager	+32 2 729 3395
GA/Business aircraft	+32 2 729 4633
Transport aircraft	+32 2 729 4871
Transport aircraft (Eastern build)	+32 2 729 3785
State Liaison	+32 2 729 3041

© European Organisation for the Safety of Air Navigation
EUROCONTROL
September 2005

This document is published by EUROCONTROL in the interests of the exchange of information.

It may be copied in whole or in part, providing that the copyright notice and disclaimer are included. The information contained in this document may not be modified without prior written permission from EUROCONTROL. EUROCONTROL makes no warranty, either implied or express, for the information contained in this document, neither does it assume any legal liability or responsibility for the accuracy, completeness or usefulness of this information.

Produced by:
DAS/AFN&BPS/TOC EUROCONTROL

