

# European Aviation Safety Agency

## European Technical Standard Order

**Subject:** REQUIRED NAVIGATION PERFORMANCE (RNP) EQUIPMENT USING MULTI-SENSOR INPUTS

### 1 - Applicability

This ETSO provides the requirements which required navigation performance (RNP) equipment using multi-sensor inputs that is designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

This ETSO supports performance-based operations using RNP values from RNP 0.3 through RNP 4.0 and advanced RNP functions.

This ETSO does not address RNP operations with authorisation required (RNP AR), localizer performance without vertical guidance/localizer performance with vertical guidance (LP/LPV), ground-based augmentation system landing system (GLS) approach operations or the positioning requirements to support ADS-B out capability.

### 2 - Procedures

#### 2.1 - General

Applicable procedures are detailed in CS-ETSO, Subpart A.

#### 2.2 - Specific

None.

### 3 - Technical Conditions

#### 3.1 - Basic

##### 3.1.1 - Minimum Performance Standard

Standards set forth in RTCA DO-283B, Minimum Operational Performance Standards for Required Navigation Performance for Area Navigation, dated December 15, 2015, section 2, as modified by Appendix 1 of this ETSO. Section 1.8 of this standard defines 2 classes, A and B, of equipment. Requirements applicable to Class A and Class B equipment are specified in RTCA DO-283B, Table 2-13.

The applicant shall state the minimum RNP supported by the equipment, as well as the equipment class, in the DDP.

##### 3.1.2 - Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1.

##### 3.1.3 - Software

See CS-ETSO, Subpart A, paragraph 2.2.

### **3.1.4 - Airborne Electronic Hardware**

See CS-ETSO, Subpart A, paragraph 2.3.

### **3.2 - Specific**

For databases that are used in the ETSO article but are not part of the ETSO article, the configuration number of the data quality requirements (DQR) shall be defined and provided to the user.

DQR documentation shall be in a form available to the Type 2 Database Provider (refer to Regulation (EU) 2017/373 Article 2(5)(b) for the definition of a Type 2 Database Provider).

#### **3.2.1 - Failure Condition Classification**

See CS-ETSO, Subpart A, paragraph 2.4.

Design the system to the appropriate failure condition classification(s) as detailed in the guidance material for the different types of navigation specification (for instance RNP1, Advanced RNP, RNP-APCH ...).

### **4 - Marking**

#### **4.1 - General**

Marking as detailed in CS-ETSO, Subpart A, paragraph 1.2.

#### **4.2 - Specific**

None.

### **5 - Availability of Referenced Document**

See CS-ETSO, Subpart A, paragraph 3.

## Appendix 1- MODIFICATIONS TO RTCA DO-283B REQUIREMENTS

### Scope

This Appendix describes modifications and additions to the requirements found in RTCA DO-283B that the RNP equipment shall meet for compliance with this ETSO. EASA expects the RNP equipment to execute published instrument procedures designed to provide maximum efficiency, flexibility, and aircraft eligibility. These instrument procedure designs may include RNAV components and/or leg types associated with conventional procedures. The modifications and additions below are necessary to ensure RNP equipment can properly execute current and future instrument procedure designs. The modifications below refer to or add chapters in reference to RTCA DO-283B.

#### 2.2.1.2.1 Leg Types

Add the following required leg types to Table 2-1:

FM	Fix to Manual Termination
VA	Heading to Altitude Leg
VI	Heading to Intercept
VM	Heading to Manual Termination
CA	Course to Altitude Leg

Add the following requirement and note after the sentence 'Refer to Appendix D for additional details for each of the leg types':

The equipment shall have the ability to use an IF that is a fly-by waypoint, fly-over waypoint, or the initial fix defining an RF leg segment. Additionally, the equipment shall have the ability to proceed 'direct to' an IF.

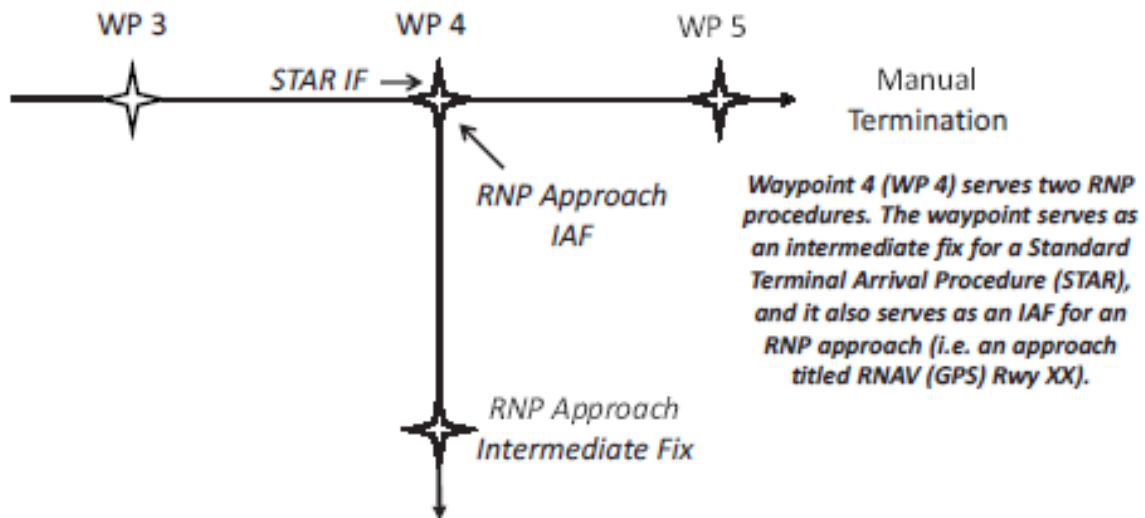
*Note: This requirement is needed to support RNP departure procedures, particularly those with an RF leg as the first leg segment, where the IF defines the beginning of the RF leg. With LNAV available immediately after take-off, the equipment should provide guidance direct to the IF and sequence the next leg; particularly when the IF is the initial fix of an RF leg.*

#### 2.2.1.2.2 Flight Planning

Insert a new paragraph and note between the last paragraph and next to last paragraph as follows:

The equipment shall have the ability to use a single waypoint supporting multiple RNP terminal procedures (SID, DP, STAR) and multiple approach procedures using different tracks. When a single waypoint supports an arrival and an RNP instrument approach using different tracks, the equipment shall continue following the arrival procedure to the procedure's termination fix and shall not automatically sequence onto the RNP approach procedure using that same waypoint.

*Note: Some waypoints may serve as: a transition fix for an instrument approach; an initial approach fix (IAF) for an instrument approach; the first fix in a terminal arrival procedure; and an intermediate waypoint on a terminal RNP procedure (SID, DP or STAR) (see Figure 1 below). This requirement ensures the equipment completes RNP procedures as assigned by ATC, and loaded by the flight crew into the active flight plan from the on-board navigation database.*



**Figure 1- Single Waypoint Serving Multiple RNP Procedures**

Add the following requirement and note after the last paragraph in Section 2.2.1.2.2:

The equipment shall not permit the flight crew to select a procedure or route, either manually or automatically, that is not supported by the equipment. For example, a procedure is not supported if it incorporates advanced RNP functions and the equipment does not provide those advanced RNP functions.

*Note: Procedures (approaches, arrivals, departures, routes) are defined by a series of waypoints and leg types.*

#### 2.2.1.2.9 Transitions Between Legs

Change the first paragraph and note 1 as follows:

The navigation system shall provide a means to automatically transition from one leg to another. Three categories of transition between fixed path segments can be defined:

- Fly-by transitions;
- Flyover transitions; and
- Fixed radius transitions.

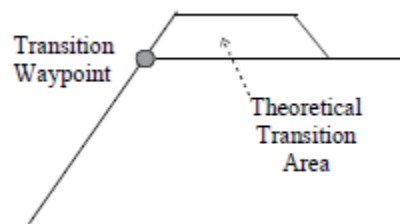
The navigation system shall be capable of accomplishing all three transitions. Fly-by transitions shall be the default transition when the transition type is not specified.

*Note 1: For fly-by and flyover transitions, no predictable and repeatable path is specified because the optimum path varies with airspeed and bank angle. Fly-by and flyover transitions use a transition area. The aircraft should remain within the transition area for fly-by transitions.*

##### 2.2.1.2.9.1.1 Fly-Over Transitions

Insert a new Section 2.2.1.2.9.1.1 after Section 2.2.1.2.9.1 Fly-By Transitions as follows:

The navigation system shall define a path to accomplish fly-over transitions that passes through the transition waypoint. There are no requirements that apply to the transition area, as the equipment provides guidance relative to the two straight segments to and from the transition waypoint (see figure 2-4.1).



**Figure 2-4.1: Fly-Over Theoretical Transition Area**

#### 2.2.1.2.9.2 Fixed Radius Transitions

Change the second paragraph as follows and delete the third paragraph:

The RNP system shall use the discrete, navigation database-specified FRT turn radius associated with an en route waypoint transition to execute a Fixed Radius Transition (FRT) from the airway inbound course to the outbound course. The RNP system shall output lateral guidance commands relative to the FRT path. The discrete turn radius is defined by a 3-digit numeric field representing the radius to one decimal place (tenths, decimal point suppressed) in nautical miles. A blank entry in the database field indicates that no fixed radius transition is required.

#### 2.2.1.4. Displays and System Alerting

Add the following second sentence to the paragraph and Note 2:

If the equipment incorporates an electronic map display to provide a graphical depiction of navigation information, it shall meet the requirements of RTCA/DO-257A 'Minimum Operational Performance Standards for the Depiction of Navigational Information on Electronic Maps'.

*Note 2: Manufacturers should use RTCA/DO-257A with RTCA/DO-283A, Appendix K until RTCA/DO-257B is published.*

#### 2.2.2.2.6.1 Descent Path Construction

Add the following requirement and notes to the list of general requirements:

6. The RNP equipment shall always use the procedure-defined flight path angle to define the final approach segment of an RNP instrument approach procedure offering vertical guidance (RNP procedures offering LNAV/VNAV minima).

*Note 1: Some RNP instrument approach procedures define the final approach fix with an 'AT' altitude constraint ('hard altitude') and the intent of this requirement is to use the published FPA, the designated end of the runway (DER) and the threshold crossing height for vertical path construction. The equipment should not generate a geometric, point-to-point vertical path between two 'AT' constraints on a final approach segment.*

*Note 2: This requirement is not intended to prohibit the optional use of baro-VNAV temperature compensation as described in RTCA/DO-283B Appendix H.*

#### 2.4.3.1 Test Scenario(s)

Add the following leg types to the list in paragraph (a):

FM, VA, VI, VM, CA.

## Appendix D

Add the following leg type definitions to Appendix D:

### D.10 Fix to Manual Termination (FM)

An FM leg defines a specified track over the ground from a database fix until a manual termination of the leg.

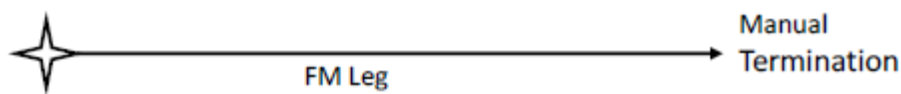


Figure D-6: Fix to Manual Termination (FM) Leg

### D.11 Heading to Altitude (VA)

A VA leg defines a specified heading to a specific altitude termination at an unspecified position. No correction is made for wind.

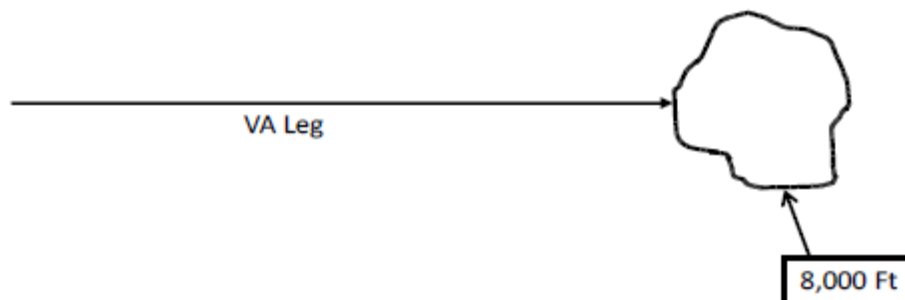


Figure D-7: Heading to Altitude (VA) Leg

### D.12 Heading to Intercept (VI)

A VI leg defines a specified heading to intercept a subsequent leg at an unspecified position. No correction is made for wind.

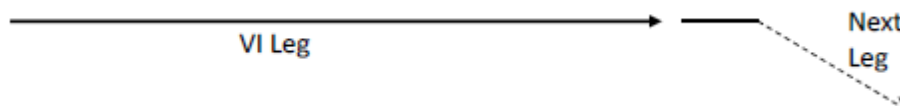


Figure D-8: Heading to Intercept (VI) Leg

### D.13 Heading to Manual Termination (VM)

A VM leg defines a specified heading until a manual termination of the leg. No correction is made for wind.

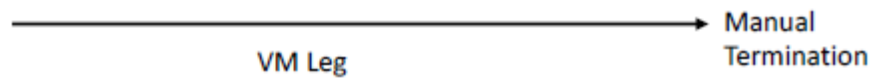


Figure D-9: Heading to Manual Termination (VM) Leg

**D.14 Course to Altitude (CA)**

A CA leg defines a specified course to a specific altitude at an unspecified position. The course is flown making adjustment for wind.

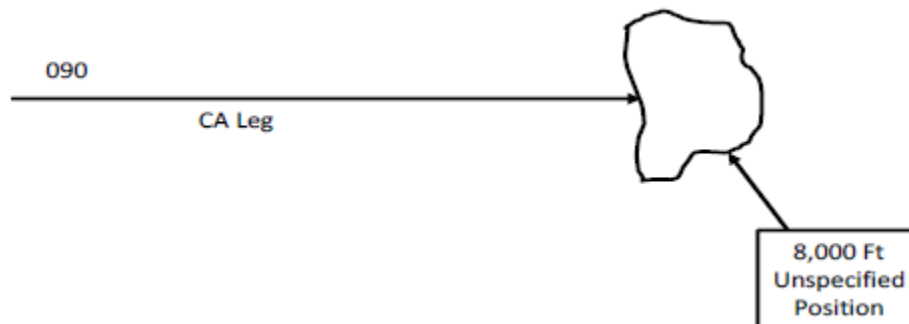


Figure D-10: Course to Altitude (CA) Leg