HOLDING

TYPE OF RNAV HOLDING

- One holding waypoint
- RNAV system with holding functionality
  - RNAV application to be developed
- RNAV system without holding functionality
  - Available for RNAV1 and 2, Basic RNP, RNP APCH, RNP AR APCH

BASE POINT TOLERANCE

- Holding point is Flyover WP
- Tolerance of the waypoint according to
  - the RNAV navigation application
  - the sensor (s)
  - the distance to ARP
  - For this type of holding the outbound leg is defined by its length. The outbound length shall be published on the approach chart expressed in kilometres (nautical miles).

WHAT IS AN RNAV HOLDING PROCEDURE?

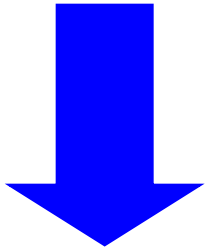
Flying holding procedure

Manually with WP

By the RNAV system

Flying HOLDING procedure

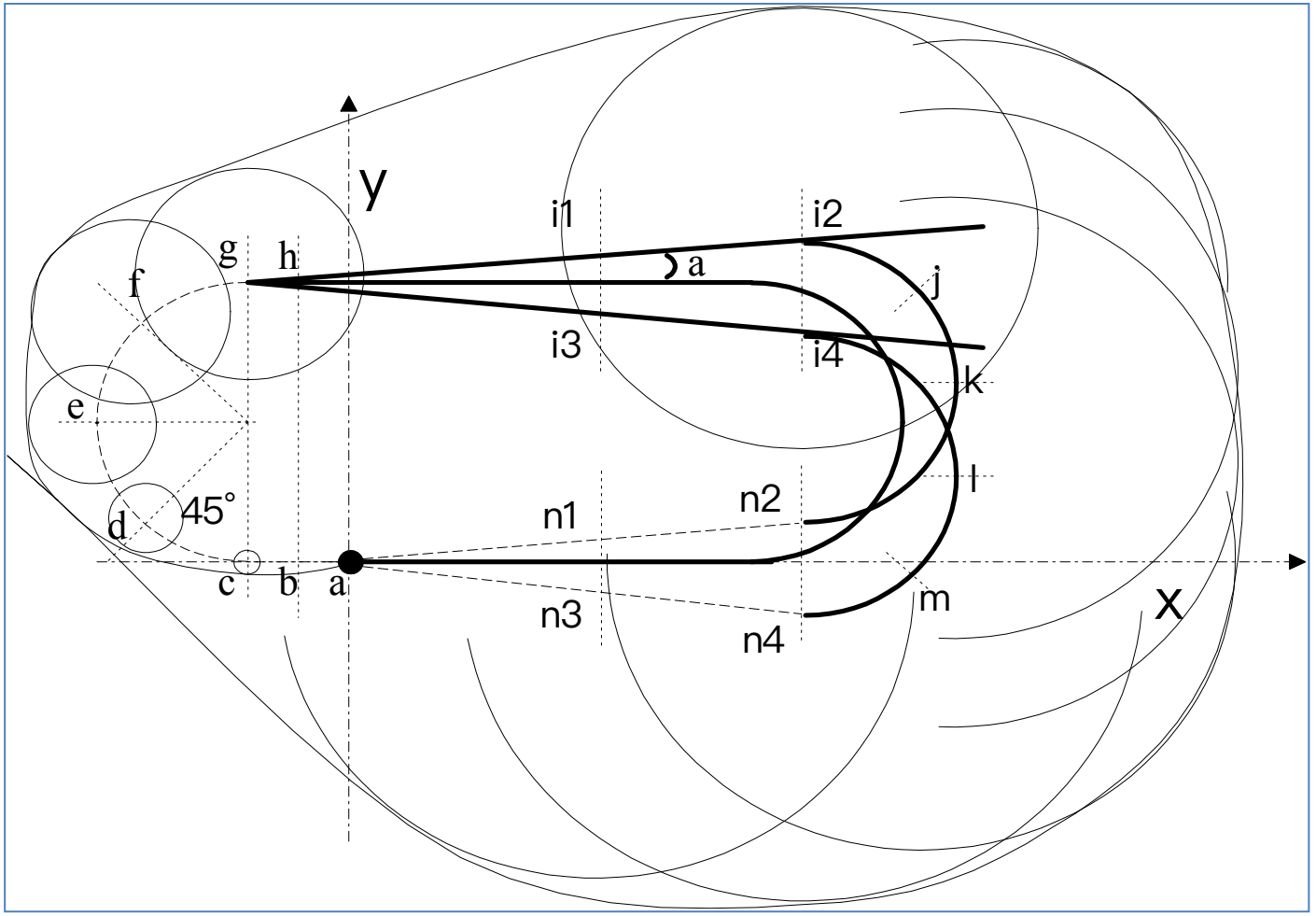
On a WP manually



Outbound timing

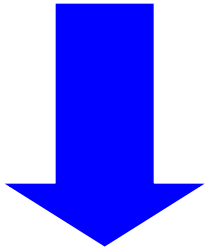
- Protection with
  - holding template as described in
    - Part 1 section 4 chapter 3 attachment C
  - using tolerance of holding WP according to sensor

HOLDING TEMPLATE



Flying HOLDING procedure

On a WP manually



Outbound leg defined by a distance
from the holding waypoint : **WD**

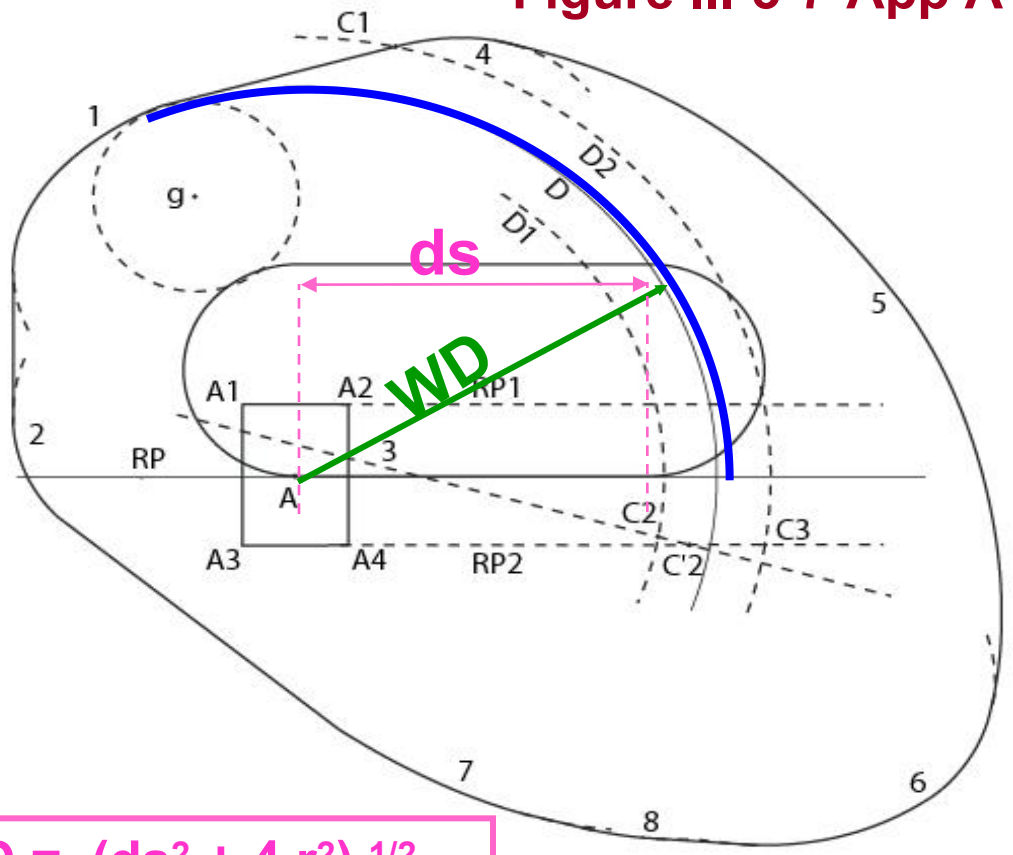
- Protection with
  - holding template as described in
    - Part III, Section 3, Appendix A to Chapter 7 § 3.2.2.2

RNAV system without holding functionality Outbound leg limited by distance from WP

- Calculation of WD limiting outbound distance :
  - $WD = (ds^2 + 4\ r^2)^{1/2}$
- Protection with
  - holding template as described in
    - Part III, Section 3, Appendix A to Chapter 7 § 3.2.2.2
  - choice of the outbound length: ds
  - ds ≥ vt where t is the outbound timing, v is max TAS
  - r radius of turn

RNAV system without holding functionality Outbound leg limited by distance from WP

Figure III-3-7-App A-5.



$$WD = (ds^2 + 4\,r^2)^{1/2}$$

RNAV system without holding functionality Outbound leg limited by distance from WP

- Minimum value for WD
  - avoid that the WD distance crosses the area containing the end of the outbound turn

RNAV system without holding functionality Outbound leg limited by distance from WP

- Minimum value for WD
  - avoid that the WD distance crosses the area containing the end of the outbound turn

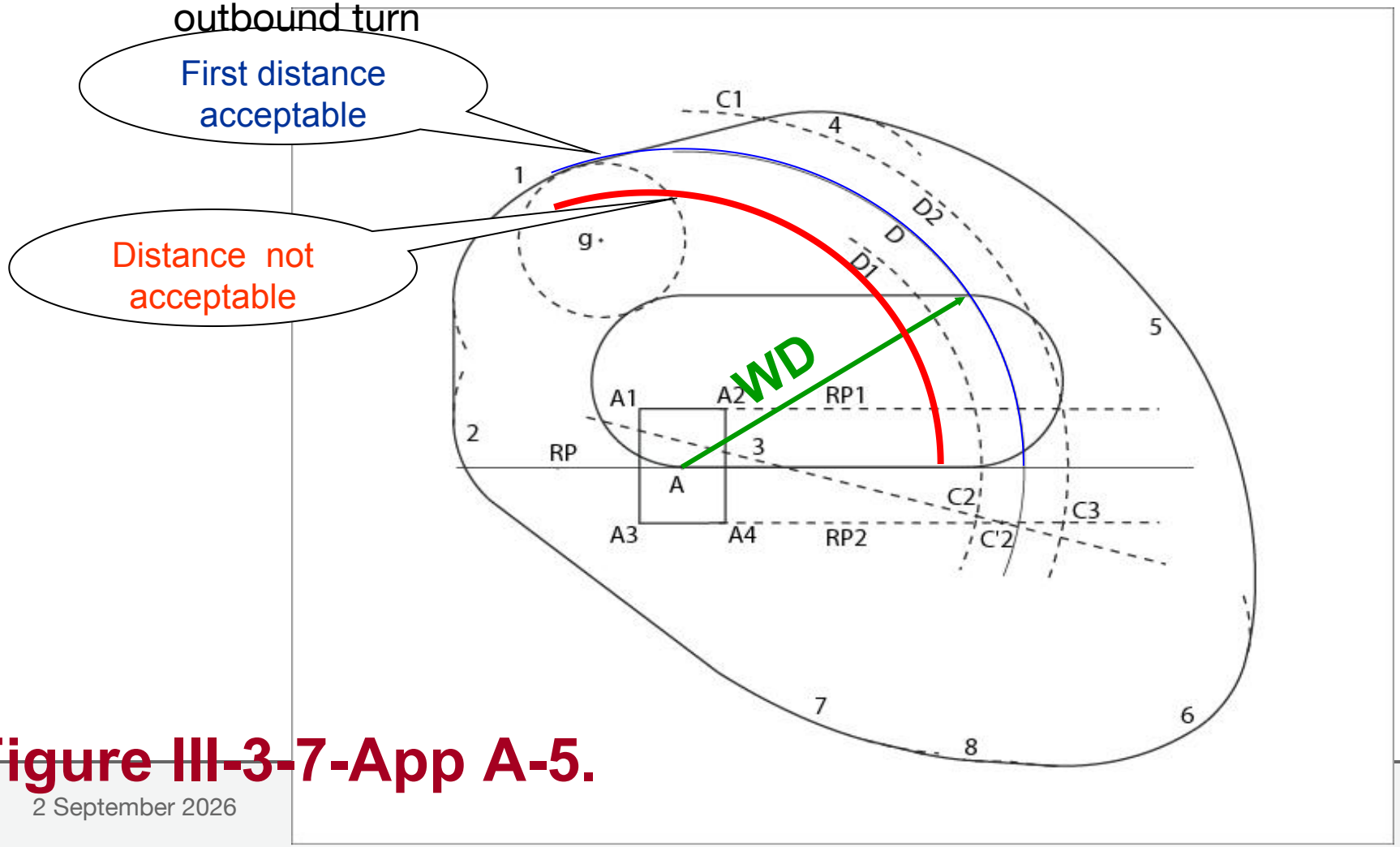
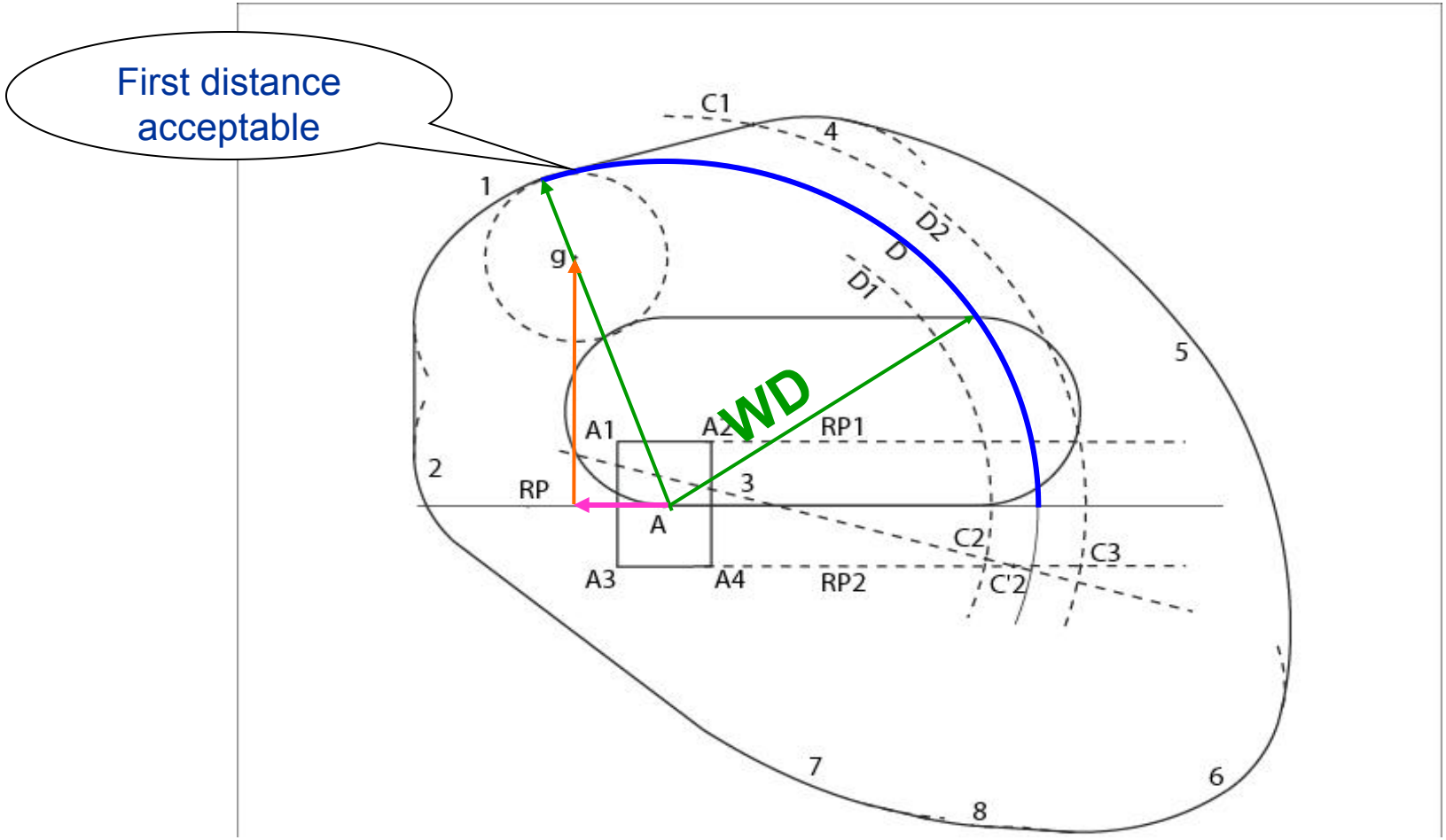


Figure III-3-7-App A-5.

RNAV system without holding functionality
Outbound leg limited by distance from WP

- Min WD = $[(ATT+11v)^2 +(2r+XTT)^2]^{1/2}$ + Wg
  - Wg is wind effect after 180 ° of outbound turn
  - r is radius of turn in still air at max TAS
- WD rounded up to the next tenth of km (or NM).

RNAV system without holding functionality Outbound leg limited by distance from WP



(MinWD - Wg)² = (XTT + 2r)² + (ATT + 11 sec of flight)²

Min WD= ((XTT+2r)² + (ATT + 11 sec of flight)²) ½ + Wg

HOLDING FOR SYSTEM WITH HOLDING FUNCTIONALITY

Maneuvers for holding

CODING : Hx

Regulatory reference :

part III section 3 Chapter 7

WHAT ASSUMPTIONS ?

HOLDING FOR SYSTEM WITH HOLDING FUNCTIONALITY

- Compensate for wind effect
- Outbound leg = 2R
- Drift correction
- No heading tolerance

HOLDING TEMPLATE

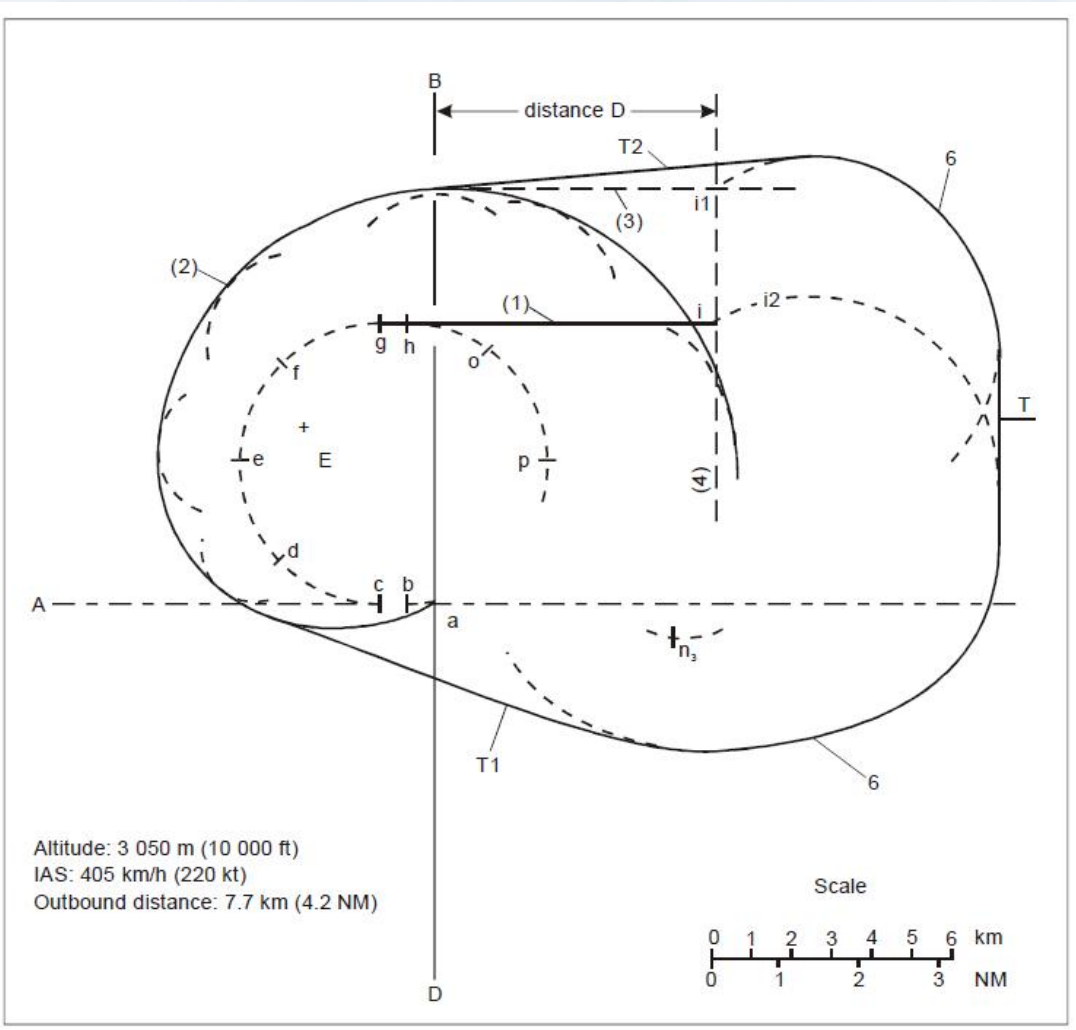


Figure III-3-7-App A-1. RNAV template for RNAV system with holding functionality

HOLDING AREA

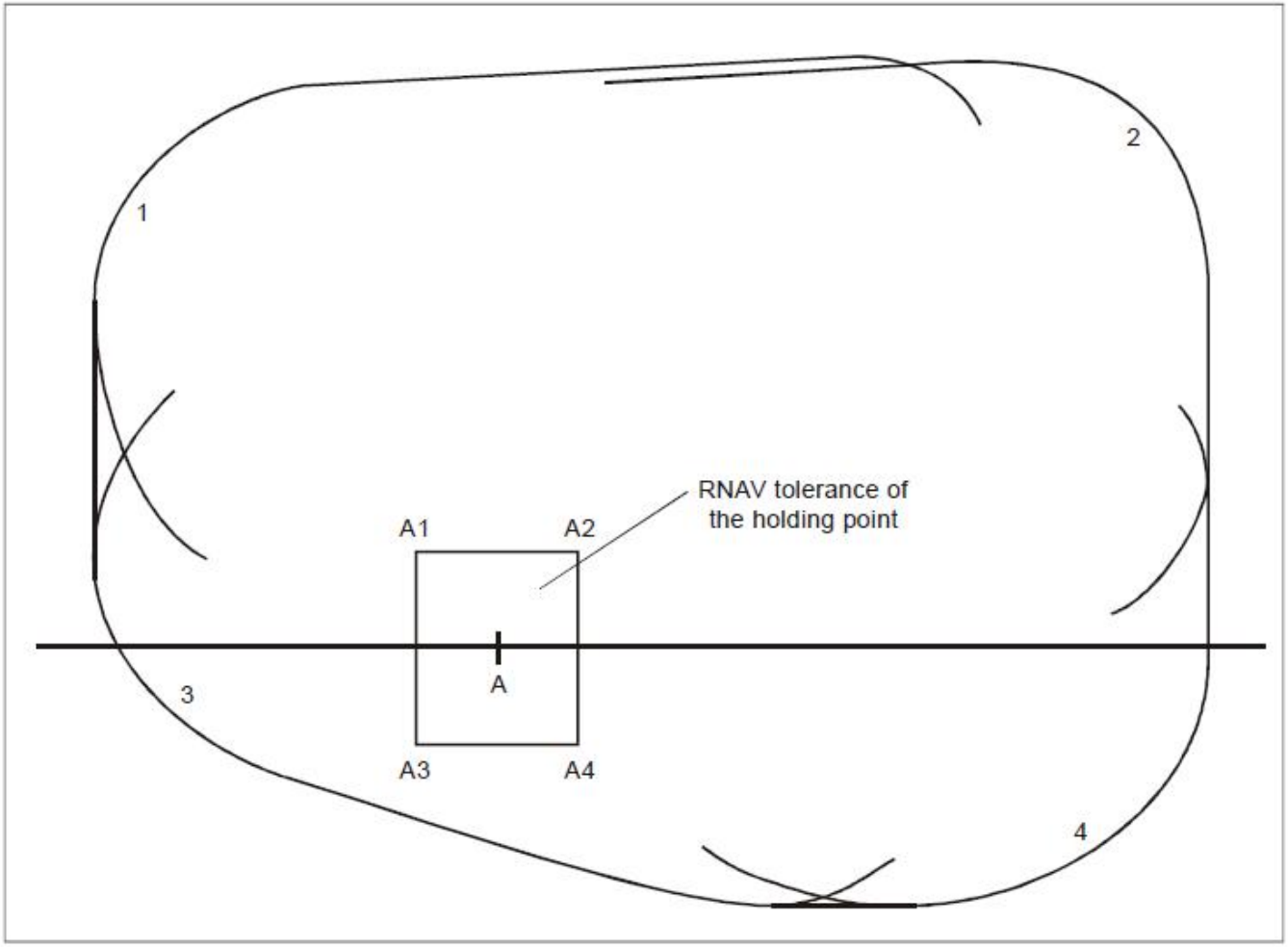


Figure III-3-7-App A-3. RNAV basic area for RNAV system with holding functionality

ENTRY AND MOC

- MOC as in conventional procedure
  - Base + entry : 300 m
  - Buffer 1 to 5 : 300 , 150 ,120, 90 , 60 (m)

- Entry as in conventional procedure

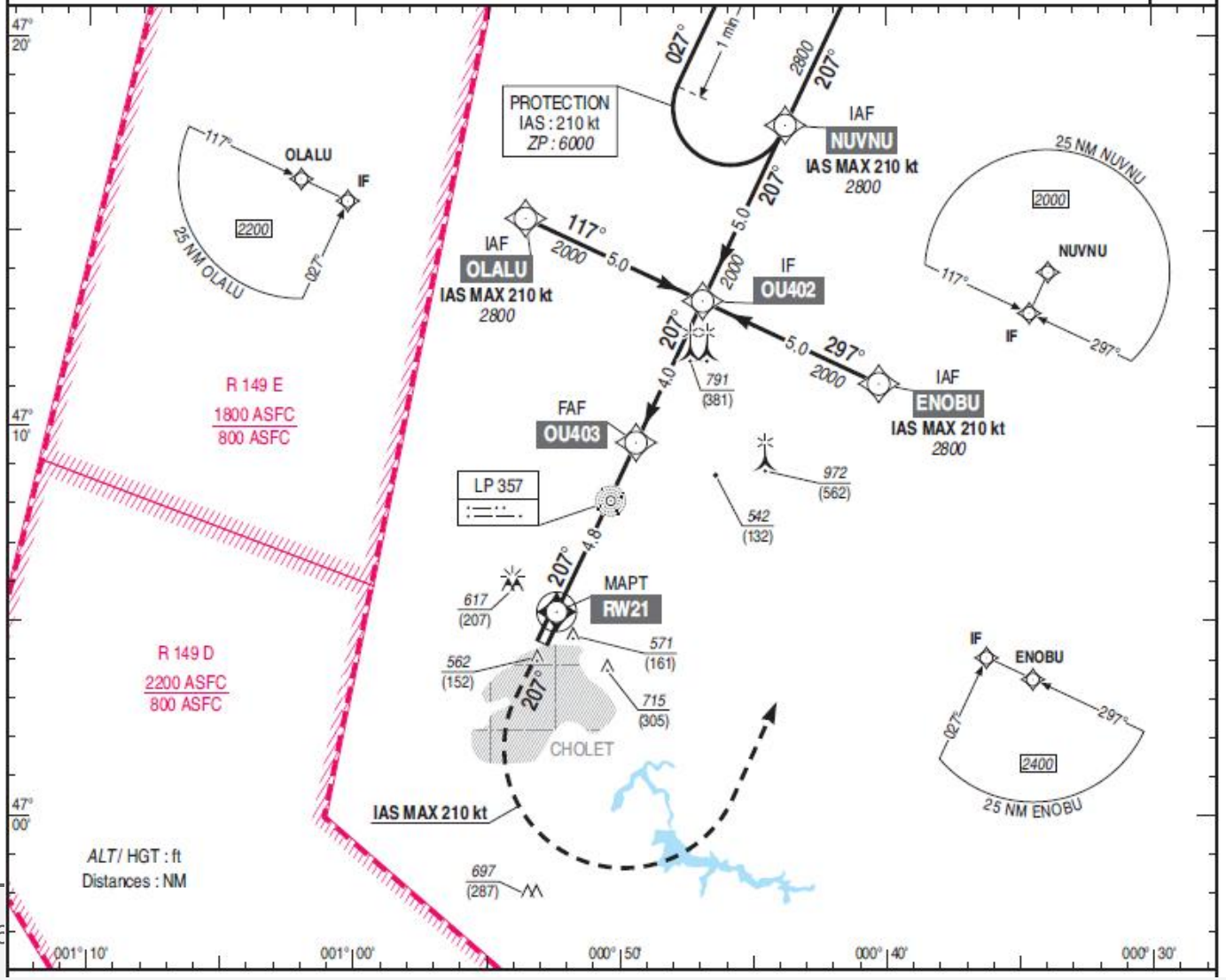
- Base point coordinates
- Magnetic inbound track
- Outbound distance
- IAS max
- Min Altitude

APPROCHE AUX INSTRUMENTS
Instrument approach
CAT A B C
ALT AD : 443, ***THR : 410 (15 hPa)***

CHOLET LE PONTREAU
RNAV (GNSS) y RWY 21
(R 149 D - E actives/*active*)

APP : NANTES Approche / *Approach* 124.425 - 119.4 (s)
TWR : NIL
AFIS : CHOLET Information 120.4
Absence ATS : **A/A** FR seulement. Obtenir le QNH de NANTES sur ATIS NANTES 126.925 ou NANTES Information 120.125
A/A *FR only. Obtain QNH NANTES on ATIS NANTES 126.925 or NANTES Information 120.125.*

VAR
2°W
(05)



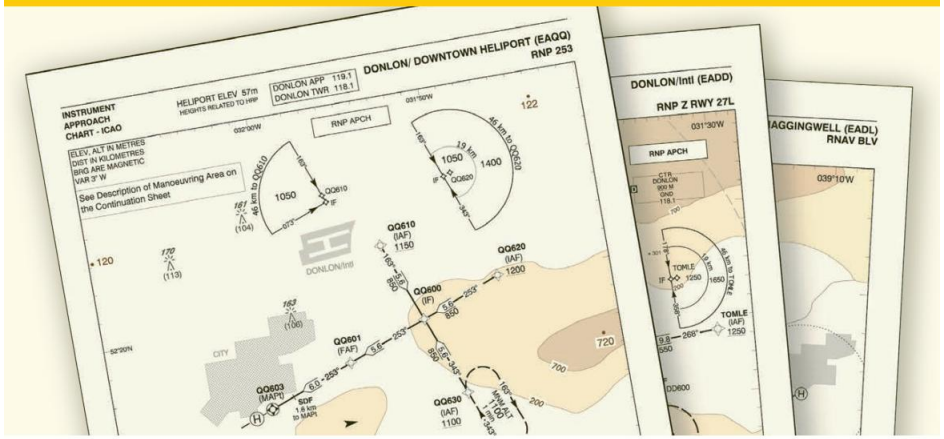
CHARTING PRINCIPLE

ICAO

Doc 8697

Aeronautical Chart Manual

Third Edition, 2016



Approved by and published under the authority of the Secretary General

INTERNATIONAL CIVIL AVIATION ORGANIZATION

International Standards
and Recommended Practices

Annex 4
to the Convention on
International Civil Aviation

Aeronautical Charts

This edition incorporates all amendments adopted by the Council prior to 5 March 2009 and supersedes, on 19 November 2009, all previous editions of Annex 4.

For information regarding the applicability of Standards and Recommended Practices, *see* Chapter 1 and the Foreword.

Eleventh Edition
July 2009

International Civil Aviation Organization

General Concepts

- All waypoints have
  - ONE identification,
  - UNIQUE coordinates published in WGS 84

- Convention for procedure identification
  - ONE identification per " Final + Missed APProach", SID, STAR

- Publication of PROCEDURE ALTITUDES and sometimes minimum altitudes for obstacles clearance (MOCA)

General Concepts

- Description in a PROFILE view
  - IAC
- Description in a PLAN view
  - SID, STAR, IAC
- TEXTUAL description
  - Missed approach, SID and STAR
- Tabular description for CODING information
  - SID, STAR, IAC
- Minimum Boxes
  - IAC

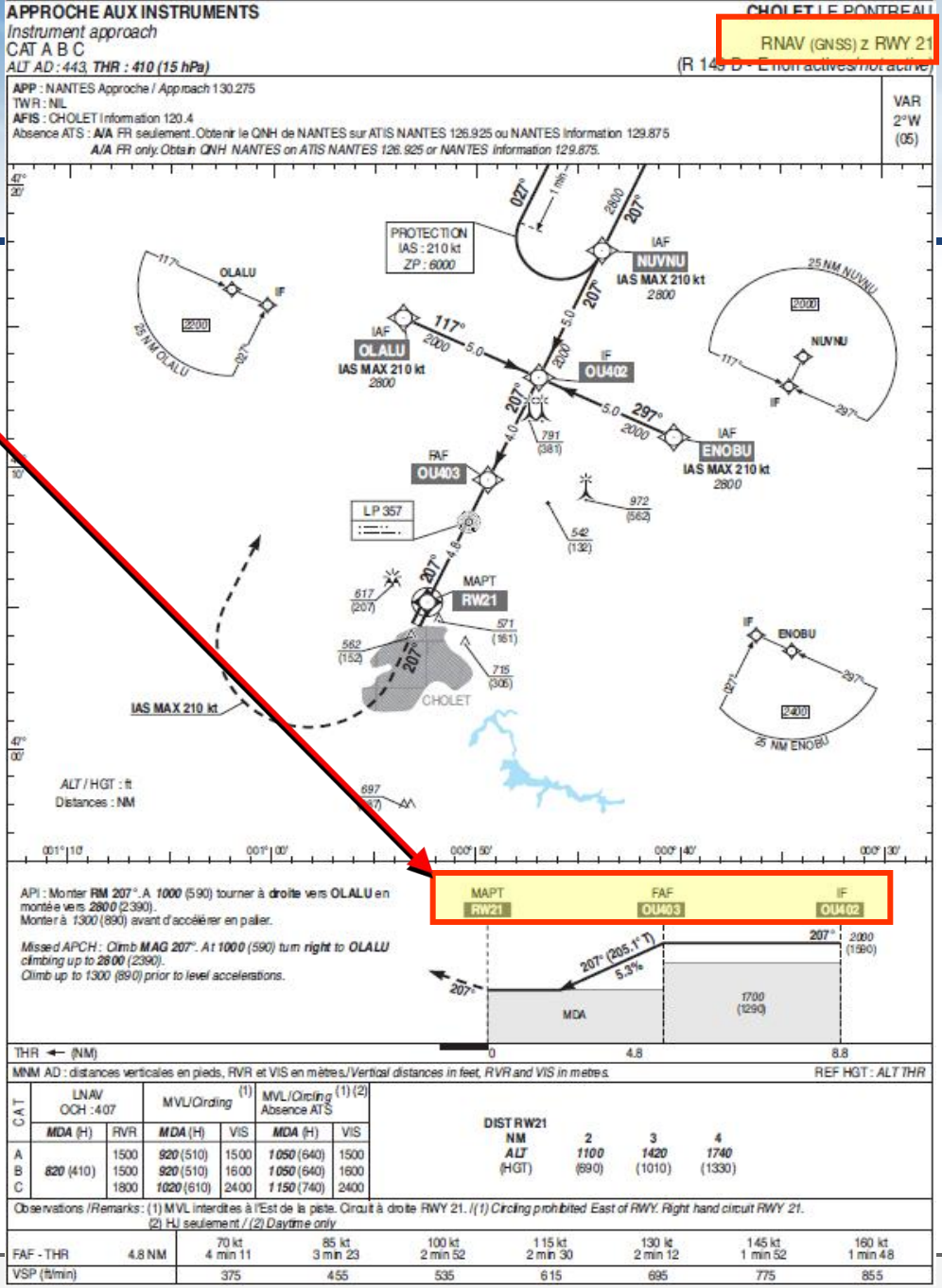
aypoint Naming Convention

- Format
  - AAXNN
  - 5 alphanumeric characters
  - Threshold : RWNNA RW36L

- Five-Letter UNIQUE ICAO name code (5LNC)
  - En-route
  - Final waypoint of a SID
  - First waypoint of a STAR
  - Waypoints shared by more than one TMA or aerodromes
  - Waypoints used by ATC purposes
    - Called « STRATEGIC TERMINAL WAYPOINTS »

Naming

- Fix acronymes : IAF, IF, FAF, MAPt, MAHF
- Waypoint naming: Format AAXXX
  - AA : last two CHRs of aerodrome designator
  - XXX : numeric code [361…999]
- Are UNIQUE within an airport



Naming Convention for Procedure
Vol II Part I Section 4 chapter 9

Procedure Identification: General Requirements

Material relating to the publication of charts is contained in Annex 4 as follows:

a) Standard Departure Chart — Instrument (SID) — ICAO, in Annex 4, Chapter 9;

b) Standard Arrival Chart — Instrument (STAR) — ICAO, in Annex 4, Chapter 10; and

c) Instrument Approach Chart — ICAO, in Annex 4, Chapter 11

Altitude/flight level "Window"	17 000 10 000	FL220 10 000
"At or above" altitude/flight level	7 000	FL060
"At or below" altitude/flight level	5 000	FL050
"At" altitude/flight level	3 000	FL030
"Recommended" altitude/flight level	5 000	FL050
"Expected" altitude/flight level	Expect 5 000	Expect FL050

Altitu ffic. In doing ociated with parting air traffi -4-9-1. The r ure may differ

9.3 ARRIVAL

In some cases it is necessary to designate arrival routes from the en-route structure to the initial approach fix. Only those routes which provide an operational advantage shall be established and published. These should take local air traffic flow into consideration.

9.4 APPROACH

9.4.1 General

9.4.1.1 Optimum and maximum descent gradients and angles are specified depending on the type of procedure and the segment of the approach. The descent gradient(s)/angles used in the construction of the procedure shall be published for the final approach segment. It is preferable that they also be published for the other approach segments, where appropriate.

9.4.1.2 *Fix identification.* The IAF, IF, FAF, MAPt, TP and other essential fixes or points where established are published on the approach chart.

Procedure Requirements

9.4.1.3 *Aeronautical database requirements.* For non-RNAV approaches the following data shall be published:

a) final approach fixes/points and other essential fixes/points comprising the instrument approach procedure identified with their geographical coordinates in degrees, minutes, seconds and tenths of seconds;

b) instrument approach procedure fix formation bearings to the nearest hundredth of a degree;

c) instrument approach procedure fix formation distance to the nearest hundredth of a nautical mile; and

d) for non-precision approaches, the final approach descent angle to the nearest hundredth of a degree.

9.4.2 Initial approach segment

9.4.2.1 Separate procedures shall be published when:

a) different minimum altitudes;

b) different timings; or

c) different outbound tracks are specified for different categories of aircraft.

9.4.2.2 Speeds below the minimum value for initial approach in a given aircraft category shall not be specified (see Chapter 1). If procedures are developed which exclude specific aircraft categories due to speed, this must be stated explicitly.

9.4.3 Final approach segment

9.4.3.1An OCA and/or an OCH shall be published for each instrument approach and circling procedure. For non precision approach procedures, values shall be expressed in 5-m or 10-ft increments by rounding up as appropriate.

9.4.3.2A straight-in OCA/H shall not be published where final approach alignment or descent gradient criteria are not met. In this case, only circling OCA/H shall be published.

9.4.3.3Procedures which require the use of forecast altimeter setting shall be suitably annotated on the approach charts.

9.4.3.4 *Steep angle approach*. For procedures with a final descent gradient/angle greater than the maximum value specified in Chapter 5, "Final Approach Segment", a warning note shall be published on the instrument approach chart.

9.4.3.5 *Vertical guidance.* Where distance information is available, to facilitate a continuous descent final approach (CDFA), descent profile advisory information for the final approach should be provided to assist the pilot in maintaining the calculated descent gradient. This information should consist of a table showing altitudes/heights through which the aircraft should be passing at each 2 km or 1 NM as appropriate.

9.4.4 Missed approach segment

9.4.4.1 If the MAPt is defined by a facility or fix at the MAPt only, the procedure must be annotated "timing not authorized for defining the MAPt".

9.4.4.2 If the MAPt is defined by a combination of timing over the distance from the nominal FAF to the nominal MAPt, in addition to a facility or fix at the missed approach point, the OCA/Hs for both timing and fix shall be published if an operational advantage can be obtained in this way. Alternatively a single OCA/H shall be published (which shall be the higher of the two).

9.4.4.3 The OCA/H for the nominal 2.5 per cent must always be published on the instrument approach chart. If additional climb gradients are specified in the construction of the missed approach procedure, they and their associated OCA/H values must be published as alternative options.

9.4.4.4 The speed for final missed approach is shown in Chapter 1. However, where operationally required to avoid obstacles, reduced speeds as slow as the IAS for intermediate missed approach may be used, provided the procedure is annotated "Missed approach turn limited to _____ km/h (kt) IAS maximum."

9.4.4.5 When a gradient other than the nominal gradient is used in the construction of the missed approach procedure this must be indicated in the instrument approach chart and, in addition to the OCA/H for the specific gradient, the OCA/H applicable to the nominal gradient must also be shown.

9.4.5 Visual manoeuvring

9.4.5.1 A sector in the circling area where a prominent obstacle exists may be ignored for OCA/H calculations if it meets the criteria listed in Chapter 7, 7.4.1, “Area which can be ignored”.

9.4.5.2 When this option is exercised, the published procedure must prohibit the pilot from circling within the total sector where the obstacle exists.

9.4.6 Visual manoeuvring with prescribed track

9.4.6.1 The length and magnetic orientation of the diverging segment must be published.

9.4.6.2 The length and magnetic orientation of the “downwind” leg must be published.

9.4.6.3 *Radius of turn.* If necessary (because constraining obstacles have to be avoided) the indicated airspeed may be reduced to not less than the maximum indicated airspeed for the final segment (Chapter 1) for the aircraft category. In such a case, the maximum indicated speed must be published on the chart.

9.5 PROCEDURE NAMING FOR ARRIVAL AND APPROACH CHARTS

9.5.1 Instrument flight procedure naming convention

This paragraph describes the general aspects of instrument procedure naming. Specific aspects are covered in the appropriate chapters. A standardized naming convention is required to avoid ambiguity between charts, electronic cockpit displays and ATC clearances. This convention affects the following charting aspects.

a) procedure identification;

b) additional equipment requirements; and

c) minima boxes.

9.5.3 Duplicate procedure identification

The single letter suffix shall be used when:

a) two or more navigation aids of the same type are used to support different approaches to the same runway;

b) two or more missed approaches are associated with a common approach, each approach being identified by a single letter suffix;

c) different approach procedures using the same radio navigation type are provided for different aircraft categories;

d) two or more arrivals are used to a common approach and are published on different charts, each approach being identified by a single letter suffix. If additional radio navigation aids are required for the arrival they shall be specified on the chart's plan view. For example:

ILS y RWY 20 (“CAB VOR Arrival” shown in the plan view)

ILS z RWY 20 (“DNA VOR Arrival” shown in the plan view)

Procedure Identification: General Requirements

- Title of NPA procedure will be the same as LAST navaid TYPE providing final approach LATERAL guidance.

- Title of PA will be identified by the SYSTEM name
  - Eg ILS RWY 08

- Title of RNAV procedure contains word “RNAV”

- ADDITIONAL requirement will be specified in the PLAN VIEW or in NOTES but not in the title

DME Procedure Notes

- Displayed as a procedure note to indicate equipment requirement for execution of procedure

  - “GNSS required “ or “GNSS or DMEDME /IRU” required
  - “ RNAV 1 operation”
  - Critical navaid for DME sensor “xxx”
  - Caution: Simultaneous close parallel operations

Title of Procedure

- RNAV or RNP procedure are charted with RNAV in the TITLE

- Type of PBN Application is added as note in the plan view or as general policy in the AIP
    - e.g. : RNP1 or RNAV2….

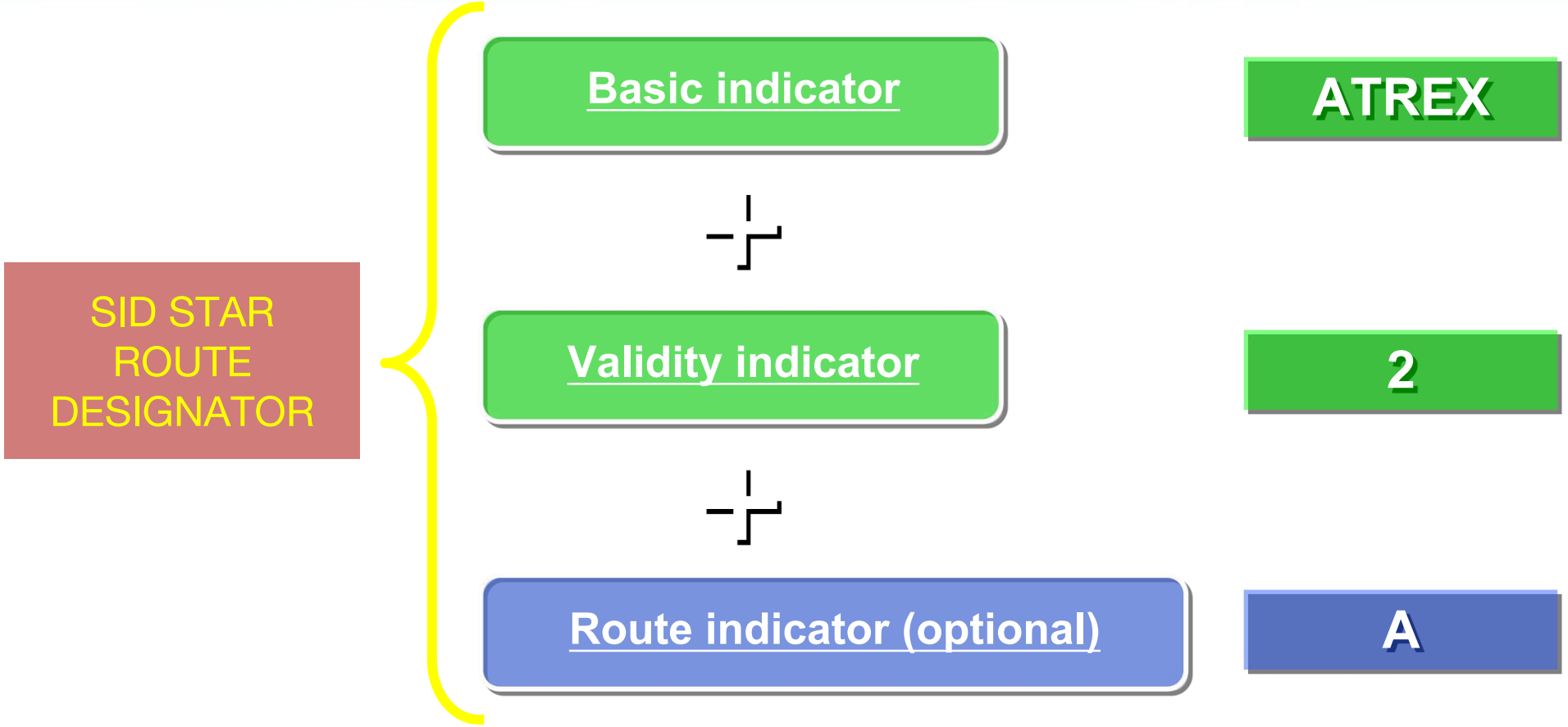
- Where necessary, type of SENSOR required are specified in a NOTE in the PLAN VIEW, NOT in parenthesis in the TITLE

Title of RNAV SID STAR

- Chart identification should include
  - An identifier with reference to RWY or Fix or navaid
  - And RNAV

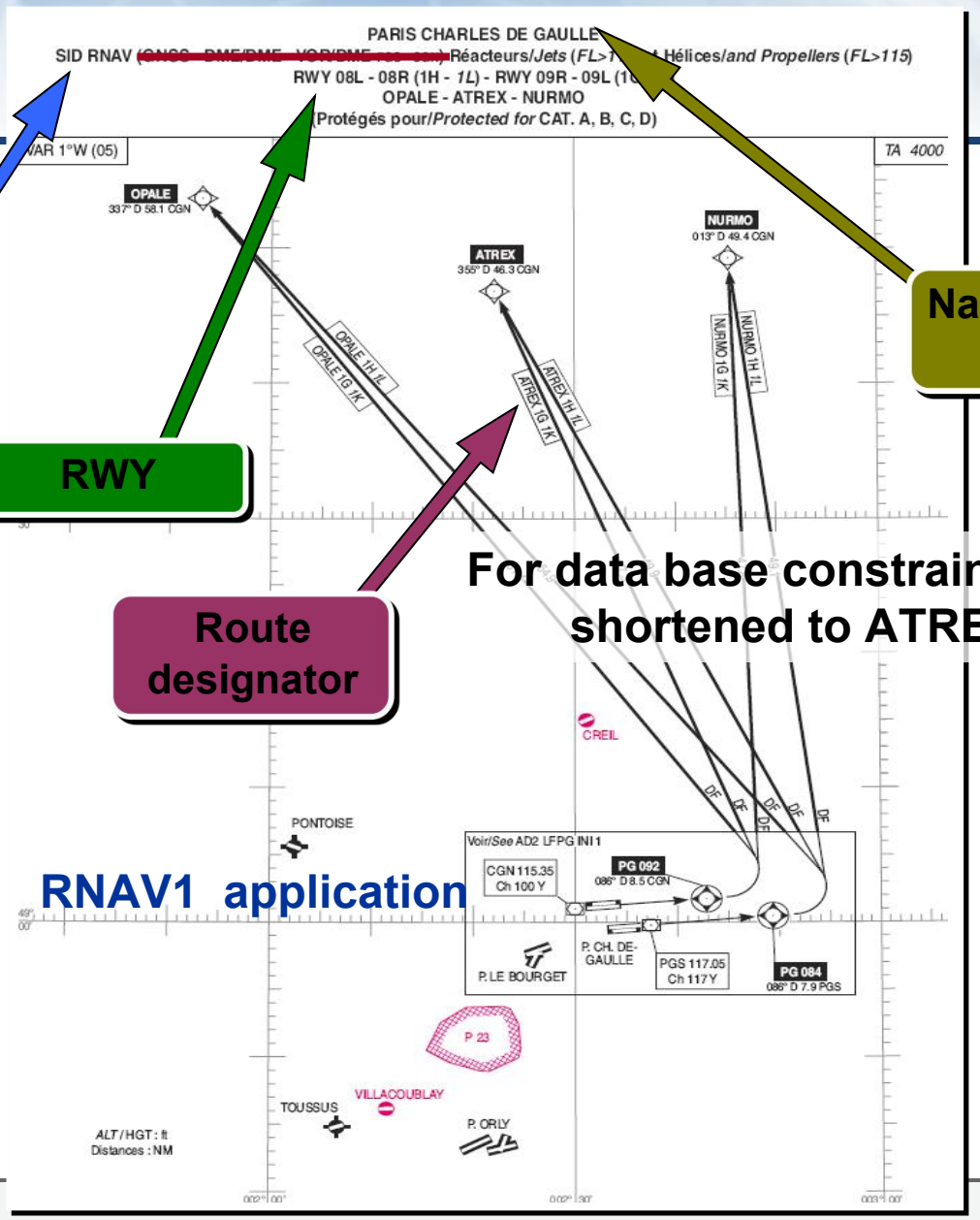
- Route designator
  - UNIQUE
  - The first 4 letters of any 5LNC used in the route designator is unique for the aerodrome
    - If BABEL is used BABET cannot be used on the same airport
    - When the route DESIGNATOR is LONGER than 6 characters, the FIFTH one is NOT CODED in the data base

tle of RNAV SID STAR



Title of RNAV SID STAR

- Basic Indicator :
  - Significant point name:
    - » Ending point for departure
    - » Starting point for arrival
- Validity Indicator :
  - Number from 1 to 9
- Route Indicator :
  - Optional : 1 letter except « I » or « O »



Departure + RNAV

RWY

Route designator

Name of city + airport

For data base constraint can be shortened to ATRE 1H

RNAV1 application

Title of approach procedure

- For all RNP APCH procedure (NPA and APV)
  - Tittle is RNAV (GNSS)
  - Ref part III section 5 § 1.4.2.2

Duplicate Procedure Identification

- To avoid ambiguity add a suffix letter
  - For Same name
  - On same RWY
  - Regardless the final approach type
- Example of title on a same airport
  - When RNAV (GNSS) approach (LNAV and LNAV/VNAV) with 3 ° slope exists and a second RNAV (GNSS) approach (LNAV and LPV) with 3.1 ° slope exist :
    - **RNAV (GNSS) z RWY29** - for first RNAV (GNSS)
    - **RNAV (GNSS) y RWY 29** - for second RNAV (GNSS)
  - When no suffix letter
    - **RNAV (GNSS) RWY 11**

Where and how to indicate the type of approach?

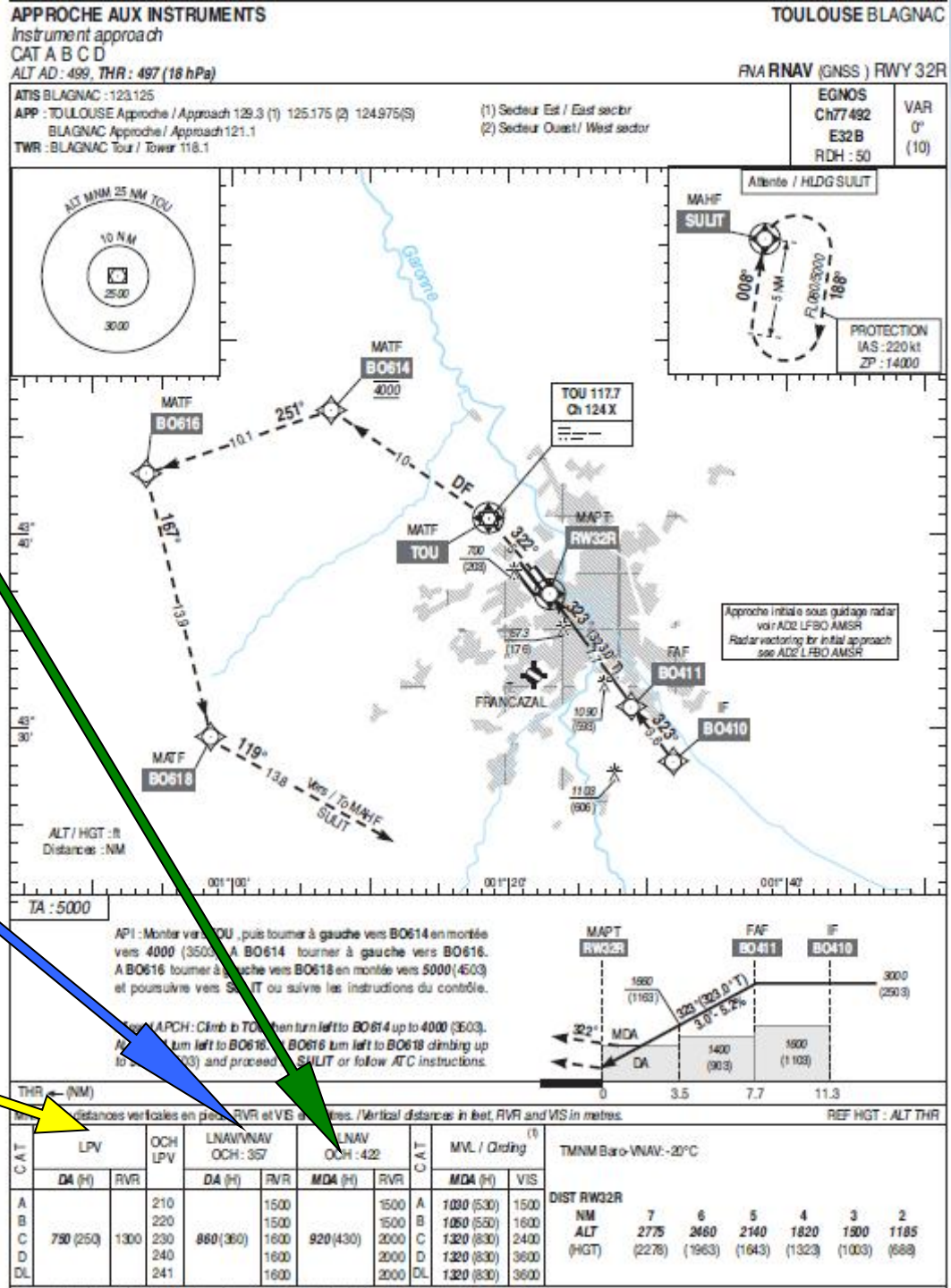
- NPA procedure ➔ LNAV
- BaroVNAV procedure ➔ LNAV/ VNAV
- APV SBAS procedure ➔ LPV

Publication

NPA Minimum Line

BaroVNAV Minimum Line

SBAS Minimum Line



Any questions?