Australian Government
Civil Aviation Safety Authority

Civil Aviation Advisory Publication

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Non-precision Approaches (NPA) & Approaches with Vertical Guidance (APV)

CAAPs provide guidance, interpretation and explanation on complying with the Civil Aviation Regulations (CAR) or Civil Aviation Orders (CAO).

This CAAP provides advisory information to the aviation industry in support of a particular CAR or CAO. Ordinarily, the CAAP will provide additional 'how to' information not found in the source CAR, or elsewhere.

A CAAP is not intended to clarify the intent of a CAR, which must be clear from a reading of the regulation itself, nor may the CAAP contain mandatory requirements not contained in legislation.

Note: *Read this advisory publication in conjunction with the appropriate regulations/orders.*

Contents

The relevant regulations and other references

- AIP Australia
- Regulation 178 of CAR 1988
- Part 173 of CASR 1998 - Instrument Flight Procedure Design and its Manual of Standards (MOS)
- Part 139 of CASR 1998 – Aerodromes and its MOS
- Civil Aviation Order 20.91 – Instructions and Directions for Performance-based Navigation
- ICAO Document 8168, Procedures for Air Navigation – Air Operations DOC 8168-OPS/611 Volume 1 – Flight Procedures
- ICAO Document 8168, Procedures for Air Navigation – Air Operations DOC 8168-OPS/611 Volume II – Construction of Visual and Instrument Flight Procedures
- ICAO Document 9613 Performance-based Navigation (PBN) Manual
- CAAP 179A – 1 Guidelines for Navigation using GNSS

This CAAP will be of interest to

This Civil Aviation Advisory Publication (CAAP) applies to:

- Pilots and operators of aircraft using non-precision approach (NPA) procedures and approaches with vertical guidance (APV);
- Individuals and organisations conducting flight crew training; and
- Aerodrome operators.

Why this publication was written

This CAAP provides guidance on the conduct of NPAs and APVs and compiles the relevant requirements, standards and practices in one document.

This publication also provides information on changes to NPA design and charting.

Status of this CAAP

This is the second issue of this CAAP and replaces CAAP 178-1(1) dated October 2004. This issue has been updated to include reference to Approaches with Vertical Guidance and to include discussion about the Visual Segment Surface. It also includes recent clarification included in the Aeronautical Information Publication (AIP) about circling and missed approach procedures.

For further information

For further information contact your local CASA office or CASA Airways and Aerodromes Regulation Division in Canberra.

1. Acronyms

AIP	Aeronautical Information Publication
AGL	Above Ground Level
AMSL	Above Mean Sea Level
APV	Approach with Vertical Guidance
AWS	Automatic Weather Station
CAAP	Civil Aviation Advisory Publication
CAR	Civil Aviation Regulations 1988
CASR	Civil Aviation Safety Regulations 1998
CFIT	Controlled Flight into Terrain
DA	Decision Altitude
DAP	Departure and Approach Procedures
DH	Decision Height
DME	Distance Measuring Equipment
EMS	Emergency Medical Service
FAF	Final Approach Fix
FMC	Flight Management Computer
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HLS	Helicopter Landing Site
IAL	Instrument Approach & Landing Chart
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
LNAV	Lateral Navigation
LOC	Localiser
LP	Localiser Performance
LPV	Localiser Performance with Vertical Guidance
MAPt	Missed Approach Point
MDA	Minimum Descent Altitude
MOS	Manual of Standards

NDB	Non-Directional Beacon
NPA	Non-Precision Approach
OLS	Obstacle Limitation Surface
PA	Precision Approach
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations (ICAO Doc 8168)
PBN	Performance-based Navigation
RNAV	Area Navigation
RNP	Required Navigation Performance
VAA-H	Visual Approach Area-Helicopter
VHF	Very High Frequency
VNAV	Vertical Navigation
VOR	VHF Omni Directional Radio Range
VSS	Visual Segment Surface

2. Definitions

APPROACH CLASSIFICATION. Approach classifications have traditionally comprised NPAs and PAs. A third classification of APVs is now included. APVs are instrument approach procedures which utilise lateral and vertical guidance but do not meet the accuracy requirements for PAs.

LOCALISER PERFORMANCE (LP). A label used on some IAL charts to denote a minima line associated with NPA procedures that use the lateral navigation component of APV avionics.

LOCALISER PERFORMANCE WITH VERTICAL GUIDANCE (LPV). A label used on some IAL charts to denote a minima line associated with APV procedures.

VISUAL SEGMENT SURFACE (VSS). A surface that extends from the MAPt of NPAs (or the DA location for APVs and PAs) to the threshold to facilitate the identification of and protection from obstacles in this visual segment of the approach.

Baro-VNAV. A version of APV which uses barometric inputs to provide vertical guidance.

PERFORMANCE-BASED NAVIGATION. Area navigation based on navigation performance requirements for aircraft operating along an air route, instrument procedure or in designated airspace. Navigation performance is expressed in terms of the accuracy, integrity, continuity and functionality needed for the proposed operation in a particular airspace concept.

3. Introduction

Relevant documents

3.1 Aeronautical Information Publication Australia

3.1.1 AIP ENR Section 1.5 contains the rules and procedures for instrument approach procedures including NPAs.

3.2 ICAO Procedures for Air Navigation — Air Operations, DOC 8168-OPS/611

3.2.1 This document is commonly referred to as PANS-OPS and contains the criteria used in the design of instrument approaches in Australia. Volume I – Flight Procedures is published for the information of pilots and aircraft operators. Volume II is intended for use by persons engaged in the design of instrument flight procedures.

3.3 ICAO Performance-based Navigation Manual, DOC 9613

3.3.1 This document is commonly referred to as the PBN Manual and contains material to describe the operational criteria and associated aircraft and training requirements associated with various airspace concepts.

3.4 Part 173 of CASR 1998 - Instrument Flight Procedure Design and its Manual of Standards (MOS)

3.4.1 Part 173 of CASR 1998 regulates the design of instrument flight procedures. Additional rules for the design of instrument procedures are contained in the Part 173 MOS in cases where rules differ from or are additional to those contained in PANS-OPS.

3.5 Part 139 of CASR 1998 - Aerodromes and its Manual of Standards (MOS)

3.5.1 The standards for aerodromes that are serviced by NPAs and APVs are contained in the Part 139 MOS.

4. General

4.1 Performance-based Navigation

4.1.1 The International Civil Aviation Organization has adopted the concept of Performance-based Navigation. This concept is a type of area navigation that moves the identification of navigation systems away from one associated with the underlying navigation aid (NDB, VOR, ILS, etc) to one that is referenced to the necessary navigation performance to operate on a particular instrument procedure or piece of airspace (termed an airspace concept in the PBN Manual). For example, if a piece of airspace calls for a navigation performance of 4NM, only aircraft whose across-track navigation performance of 4NM or better will be able to operate in that airspace. The means used to achieve the specified across-track navigation performance are not specified.

4.1.2 Airspace navigation performance requirements are specified as RNP or RNAV values. For example, RNP1 calls for and across-track navigation performance of 1NM and RNAV4 would require 4NM.

4.1.3 The term RNP is used to designate an aircraft navigation system that incorporates on-board performance monitoring and alerting. Whereas, in the PBN concept, the term RNAV refers to navigation systems that do not incorporate on-board performance monitoring and alerting. Guidance about the choice of RNP or RNAV designations for air space is contained in the PBN Manual. RNP and RNAV avionics need to match the airspace designation.

4.1.4 For NPAs, the introduction of PBN has two implications:

- The term GNSS is used to describe the global navigation service provided from satellites. The United States' GPS satellite constellation provides one such service. In this CAAP, the term GNSS will be used to refer to satellite-based navigation.
- The term RNP APCH (abbreviation for RNP Approach) has been adopted in the PBN Manual to refer to $RNAV_{(GNSS)}$ approaches. However, the formal renaming of these procedures on IALs is still under discussion within ICAO. Therefore, in this CAAP the term $RNAV_{(GNSS)}$ will continue to be used.

4.1.5 At the time of writing, ICAO was also considering a revision to the instrument approach classification system. Although the details are still under discussion, the new system will likely include reference to 2 dimensional (2D) and 3D approaches. The former refer to procedures that do not have vertical guidance and the latter to those that do. NPAs will fall into the former group and PAs and APVs into the latter.

4.2 What is a Non-Precision Approach?

4.2.1 The term NPA has been traditionally used to describe an instrument approach procedure other than an APV or PA. The PA system currently in general use in Australia is ILS.

4.2.2 An NPA is characterised by an MDA, a MAPt and a lack of externally referenced electronic vertical course guidance, and may use any number of navigation systems for course guidance including NDB, VOR, LOC or GNSS. Some avionics may provide vertical path advisory information, but this is not externally referenced and does constitute an APV or PA. The minima line on the procedure chart is indicated by either:

- the navigation aid that provides the navigation service (NDB, VOR etc.); or
- LNAV or LP for $RNAV_{(GNSS)}$ procedures. Australian charts currently show S-I but are progressively being amended to replace this term with LNAV. The use of the term LP will be dependent upon the introduction of an augmented GNSS service in Australia.

4.2.3 NPAs are designed to permit safe descent to an MDA, and further descent must not be made unless the pilot is able to proceed visually. Unlike a DA associated with an APV or PA, where loss of height during the initial stage of a missed approach is taken into account, obstacle clearance is not assured if descent below the MDA occurs, and pilots need to ensure that descent is arrested prior to reaching the MDA.

4.2.4 NPAs terminate in a visual segment that may provide for:

- a 'straight-in' landing;
- a circling approach that requires manoeuvring to align the aircraft with the landing runway; or
- a visual leg from a point where the MDA is reached to the circling area of the aerodrome.

4.2.5 Instrument approach or departure procedures, including NPAs, can only be published to aerodromes that are registered or certified. In this way obstacle growth is monitored and the aerodrome infrastructure is maintained to the required standards.

4.3 What is an Approach with Vertical Guidance (APV)?

4.3.1 PANS-OPS Volume I defines an APV as '*An instrument approach procedure which utilises lateral and vertical guidance but does not meet the requirements established for precision approach and landing operations'*. As such, APV is a new approach classification that lies between NPA and PA and offers vertical guidance but does not offer the accuracy associated with PA procedures. APVs use GNSS technology to derive the lateral navigation solution and a vertical navigation solution based on either:

- a geometrically calculated vertical path that relies on three dimensional GNSS positioning to indicate deviations from that path (GNSS augmentation is currently required to support these approaches); or
- a geometrically calculated vertical path that relies on barometric information from an air data system to indicate deviations from that path. This system is called Baro-VNAV.

4.3.2 Augmentation of GNSS is enabled through satellite and ground station additions to the GNSS system and is known as the Space Based Augmentation System (SBAS). APVs using SBAS allow approach procedures with localiser-like lateral performance and vertical guidance to a standard close to precision category I – known as LPV. (Approach procedures with localiser-like performance only – known as LP – are also developed but their lack of vertical guidance means they are NPAs.)

4.3.3 An APV is characterised by a DA and does not have a MAPt. It may be:

- an addition to a GNSS-based NPA ($\text{RNAV}_{\text{(GNSS)}}$), in which case the minima line will be indicated by the term LNAV/VNAV (for Baro-VNAV approaches);
- an augmented GNSS based approach in which case the minima line will be indicated by the term LPV; or
- a procedure designed on RNP principles, in which case the minima line will be indicated by the term RNP XX (where XX will be a number from 0.3 to 0.1 to indicate the accuracy to which the procedure is designed). Any instrument procedure with an RNP value less than 0.3 will require special authorisation from CASA. These procedures are called RNP AR but are currently charted as $\text{RNAV}_{\text{(RNP).}}$

4.3.4 Augmentation may also take the form Ground Based Augmentation Systems. These systems use a ground-based transmitter to send correction signals to the aircraft that deliver approach accuracies that are the same as ILS Category I. They are PA systems.

4.4 Vertical Navigation

4.4.1 NPAs are designed as a series of decreasing minimum altitudes to an MDA. A fix is located at each point at which critical obstacles have been passed by an adequate margin, and it is safe to continue descent to the next safe altitude.

4.4.2 While some pilots in the past have flown NPAs as a series of descending steps conforming to the minimum published altitudes, (a technique colloquially referred to as the 'dive and drive'), CASA recommends a constant angle descent in a stabilised configuration. Many Controlled Flight into Terrain (CFIT) accidents have been attributed to the 'dive and drive' technique, due to human errors such as early descent before a step or failing to arrest descent. In addition, the aircraft's descent is more difficult to manage due to changes in airspeed, rate of descent and configuration.

4.4.3 Australian NPAs are published with a constant angle approach path, which clears all minimum altitudes, and facilitates the use of a stabilised descent technique. This method of promulgation is the standard adopted for Australian NPA procedures and the constant angle stabilised approach technique is the recommended flight technique for all aircraft.

4.4.4 Avionics that are capable of APVs will display the vertical path in an ILS-like display. The vertical path displayed by the avionics will be the same as that depicted on the approach chart and the chart will show a line of minima identified by the term LNAV/VNAV or LPV.

4.4.5 Some non-APV (NPA) avionics have a VNAV function that displays the vertical path in an ILS-like fashion. In these instances the vertical information is simply a mechanised representation of the designed approach path angle and is not linked to any external vertical navigation source and does not indicate the aircraft's true relationship with the ground. If the approach chart line of minima indicates S-I or LNAV, then any VNAV indication provided by the avionics is advisory only. If this type of vertical advisory information is used, the pilot is responsible to ensure that the minimum segment altitudes published on the approach chart are adhered to.

4.4.6 APV procedures using Baro-VNAV are bounded by assumed upper and lower temperature limits. These limits will be displayed on the IAL. Use of the procedure at temperatures below the bottom limit will result in the aircraft flying low with a consequent reduction in obstacle clearance. Its use above the top limit will result in the aircraft flying high with consequent excessive rates of descent to reach the runway.

DIST BY DME	2.1	3	4	5	6	7	8	9.1					
ALT (3° APCH PATH)	580	855	1175	1495	1810	2130	2450	2800					

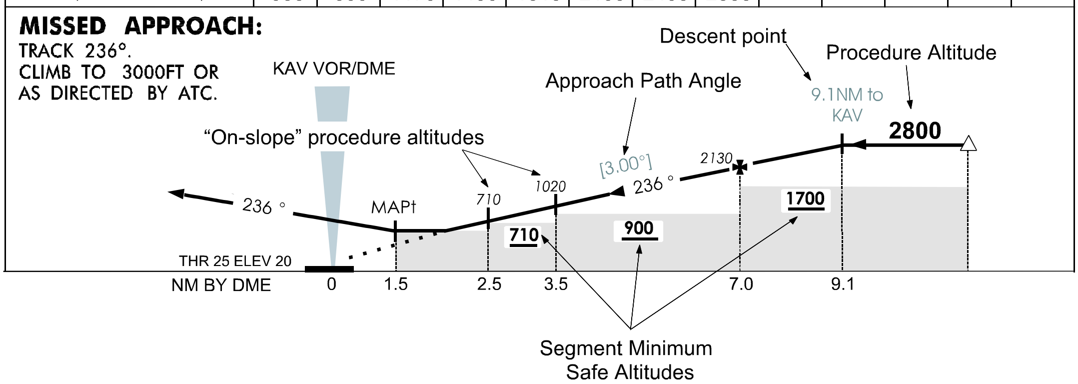

Figure 1 – Typical Constant Angle Approach Profile

4.5 What's a Procedure Altitude?

4.5.1 AIP defines procedure altitude as follows:

> ***Procedure Altitude****: A specified altitude, flown operationally at or above the minimum altitude and established to accommodate a stabilized descent at a prescribed descent gradient/angle in the intermediate/final approach segment.*

4.5.2 The term *procedure altitude* indicates that an altitude is promulgated to facilitate flying the procedure. This is in contrast to segment minimum safe altitudes that provide minimum obstacle clearance. The procedure altitude is therefore a recommended level, and an aircraft is not required to maintain the procedure altitude, unless instructed by ATC. A procedure altitude will always be at or above the minimum altitude for obstacle clearance.

4.5.3 Procedure altitudes are shown on the profile diagram at the commencement of the procedure and at each fix or significant point on the approach.

4.6 What are the shaded areas on the profile diagram of an NPA?

4.6.1 At each stage of an NPA a *segment minimum safe altitude*, depicted as a 'not below altitude' (e.g. **1700)** identifies the lowest altitude that provides the required obstacle clearance. ICAO has identified that many CFIT accidents have occurred because pilots were not aware of terrain beneath the approach flight path. Australian charts are shaded beneath the segment minimum safe altitude to graphically indicate the presence of obstacles or terrain to aid vertical situational awareness.

4.7 Can I descend to the segment minimum safe altitude instead of following the constant angle approach path?

4.7.1 Yes. Obstacle clearance is provided at or above the segment minimum safe altitude (shaded areas). The constant angle vertical approach path is the recommended flight path designed to enable a stabilised descent.

4.8 What is the Minimum Descent Altitude (MDA) and the Decision Altitude (DA)?

4.8.1 The MDA is the lowest altitude that can be used during an NPA in IMC. Flight below the MDA reduces the clearance above obstacles and is not permitted in IMC. (See AIP ENR1.5 Section1.8.2 ('Descent below the Straight-in MDA') for conditions associated with descent below MDA.)

4.8.2 The DA is the lowest altitude at which the pilot must decide to initiate a missed approach. The aircraft will descend below the DA prior to the start of climb, but this descent is allowed for in the design of the procedure.

4.8.3 The published MDA for an NPA may include an allowance for barometric error.

4.8.4 Where a 24-hour air traffic service is available the published MDA normally is based on the use of the local aerodrome QNH as reported by ATC and no barometric allowance is included.

4.8.5 At other aerodromes, an allowance of 100FT is included in the published MDA to provide for the accuracy of a forecast aerodrome QNH. If an actual aerodrome QNH is available (e.g. from an AWS) the 100FT tolerance for forecasting accuracy is not required and the MDA may be adjusted accordingly. Inclusion of the additional 100FT is indicated by shading of the minima box of the approach chart.

4.8.6 Where a forecast QNH (TAF) is not available and Area QNH is used the allowance of 100ft may be insufficient to take into account the forecasting tolerance and the pilot must add 50FT to the published MDA.

4.8.7 Because of the requirement for access to aerodrome temperature during APVs, these procedures will not be published to locations that do not have access to actual weather condition (ATC or AWS).

4.9 What allowance should be made for wind?

4.9.1 Timing specified for holding and approach procedures includes an allowance for adverse winds. Pilots should not rely solely upon the design allowances and adjustment should be made for known or estimated winds to ensure that the aircraft remains within the design obstacle protection area, and to facilitate the successful completion of the approach within normal operating limits.

4.10 Can I fly an area navigation approach?

4.10.1 Yes. At present the only publically available area navigation instrument approach procedures available in Australia are based on GNSS. These procedures, previously referred to as a GPS/NPA, are identified on approach charts as $RNAV_{(GNSS)}$ approaches. Aircraft equipped with Technical Standard Order C129a, C145/146 or C196a or other approved GNSS systems may conduct $RNAV_{(GNSS)}$ approaches. Not all aircraft fitted with GNSS (including FMC equipped aircraft) are approved for approach operations and pilots should determine the operational approvals applicable to each aircraft type.

4.10.2 Although many aircraft fitted with modern FMC systems have the capability to fly approach procedures using area navigation based on other than GNSS, including procedures based on conventional navigation aids, the use of area navigation in this respect is not approved in Australia.

4.10.3 An area navigation system may also be used to assist in flying a conventional approach. However, it is necessary for the navigation system upon which the procedure is based to be monitored (NDB, VOR etc.) to ensure that the obstacle clearance requirements of the approach are met, and that the procedure is flown within the tolerances of the navigation system on which the procedure is based.

4.11 Clarification of Missed Approach Procedures

4.11.1 The expectation of the pilot during a missed approach procedure varies depending on whether it specifies lateral guidance and whether it is based on radio navaids or GNSS. In this context, the specification of lateral guidance means that the track nominated on the procedure charts also includes, or implies, reference to the navigation system that is to be used to achieve it.

4.11.2 AIP ENR1.5, Section 1.10.2 states that pilots must follow the missed approach procedure as published on the procedure chart and Section 1.11 (“Missed Approach Tracking’) outlines missed approach tracking procedures. The following paragraphs provide some background to these procedures.

4.11.3 **Missed Approach by reference to specified lateral guidance from a NAVAID**. Missed approach lateral guidance will be specified on the approach chart at locations where terrain is challenging. This type of missed approach procedure results in a smaller area used for the assessment of obstacles because the aircraft’s across-track error is more tightly constrained.

4.11.3.1 When lateral guidance is specified with reference to the radio navaid (ie, a VOR radial or an NDB bearing) the expectation is that the pilot will intercept the nominated track. Where an intercept is required it will be both stated in the missed approach procedure’s text and shown in the plan view on the procedure plate. The text will take the form of: *"At the NDB (or VOR or MAPt), Turn Left (or Right) to intercept xxx° (ZZ NDB or VOR). Climb to …"*

4.11.4 Missed Approached by reference to specified lateral guidance based on GNSS. GNSS procedures will specify the missed approach lateral guidance in one of two ways:

- For a straight missed approach or a turn at the MAPt the GNSS avionics will determine the track to the next waypoint. In these situations the expectation is that the pilot will track direct to the next waypoint after passing the MAPt and upon completion of the missed approach turn, if applicable. The text will take the form of: *"Turn Left (or Right), Track DCT XXXXX. Climb to …"*
- For a turn after the MAPt the procedure may not contain a subsequent waypoint. In these situations the expectation is that the pilot will make-good the nominated track using the GNSS for navigation. The text will take the form of: *"Turn Left (or Right), Track xxx°. Climb to …"*

4.11.5 Missed Approach without reference to lateral guidance (a DR track). When the instrument approach procedure is based on a radio navaid and lateral guidance is not specified for the missed approach, the expectation is that the pilot will use DR to achieve the nominated track. Allowance for wind must be made to make-good this nominated track. The radio navaid may be used to supplement track keeping during the missed approach when it is a straight continuation of the final track, however guidance is not mandatory. Most non-GNSS procedures in Australia that have been designed with a radio navaid utilise DR navigation in the missed approach segment. The missed approach procedure's text will take the form of: '*Turn Left (or Right), Track xxx°, climb to…'*

5. Straight-in Approaches

5.1 What is a straight-in approach?

5.1.1 An NPA that is aligned with a suitable runway may permit a pilot who becomes visual at or above the MDA to continue descent and land 'straight-in'. This is commonly referred to as a *straight-in* or *runway* approach.

5.1.2 Approaches where the final approach course is not suitably aligned with a landing runway, or where the runway does not meet the required standard, will terminate at a circling MDA from which some manoeuvring is normally required before the pilot can conduct further descent.

5.1.3 A straight-in approach is identified by the use of the runway direction in the title, e.g. NDB RWY14, and may be also be annotated in the minima box, e.g. by the letters S-I (straight-in), although this terminology will gradually be replaced by the term LNAV.

Note: *Refer also to special procedures applying to helicopter approaches in Section 9.*

5.1.4 The design criteria for APVs do not allow these procedures to be offset from the runway centreline.

5.2 What are the advantages of a straight-in approach?

5.2.1 It is commonly acknowledged that straight-in approaches are much safer than circling approaches. In Australia, instrument approach procedures are designed as straight-in approaches wherever possible.

5.3 Why aren't all approaches straight-in approaches?

5.3.1 In order for the aircraft to be able to safely land straight-in, the pilot needs to be able, at or before reaching the MDA, to sight the runway, align the aircraft with the centreline, and continue descent without significant changes to the descent rate, while visually avoiding any terrain in the runway approach area. In many cases a straight-in approach also permits a lower MDA but this also limits the amount of time and distance available to the pilot to complete the visual segment of the approach.

5.3.2 Therefore the approach alignment, descent gradient, runway dimensions and runway approach surfaces all need to meet appropriate standards. Where these standards can be met, a straight-in approach will be designed, but in those cases where it is not possible to comply with the standards only a circling approach is published.

5.4 What are the standards required for the publication of a straight-in approach?

5.4.1 Instrument approach procedures are designed to accommodate varying aircraft performance by the use of an Aircraft Performance Category based upon approach speed at the threshold. Approach procedures in Australia are designed for Category A, B, C & D. Category A applies to aircraft with low approach speeds (up to 90KT), and each successive category applies to aircraft with higher approach speed (Category B: 91KT to 120KT, Category C: 121KT to 140KT and Category D: 141KT to 165KT.). A separate Category H applies to approaches designed for use by helicopters only. Refer to AIP ENR 1.5 Section 1.2 ('Aircraft Performance Category') and Section 1.16 ('Handling Speeds').

5.4.2 **Alignment –** To avoid the necessity to conduct turns close to the ground, the alignment of the final approach course needs to be closely aligned to the runway centreline. PANS-OPS design rules permit the final approach course to intersect the extended runway centreline at an angle up to 30° for Category A/B procedures and at up to 15° for Category C/D. The final approach course also needs to intersect the extended runway centreline at a sufficient distance from the threshold to allow a turn onto the runway heading to be completed safely. The intersection distance is a minimum of 1400m.

5.4.3 **Descent Gradient –** For an approach to be safe the descent gradient should be neither too steep, nor too shallow. A steep approach requires high rates of descent which can result in inadvertent descent below critical altitudes. An approach that is too shallow can also increase risk. Straight-in approach procedures are normally designed with a 3° (5.24%/318FT per NM) gradient, but where necessary this may be increased to a maximum of 3.72° for Cat A/B procedures or 3.49° for Cat C/D. A descent gradient of less than 3° is not normally published.

5.4.4 **Runway Standards –** Runways serving straight-in approaches need to be of adequate dimensions to enable an aircraft to land after becoming visual at the MDA and must provide adequate clearance from obstacles on the visual segment of the approach path. Runways that conform to these standards are termed non-precision instrument runways. Runways that do not meet these standards may conform to a lesser standard suitable for VFR or circling IFR approaches and are referred to as non-instrument runways.

5.4.5 In Australia runway standards are contained in the Part 139 MOS. These standards are based on ICAO Annex 14 requirements modified to meet Australian circumstances.

5.4.6 **Obstacle Limitation Surfaces (OLS) –** Runway standards incorporate a set of surfaces surrounding an aerodrome referred to as the OLS. The surface immediately below the approach path is critical to the safe conduct of a straight-in approach. For straight-in NPA, the Australian standard specifies an applicable approach surface gradient between 2% and 3.33% along the final approach flight path and obstacles in this area should not be permitted above the approach surface. In cases where this is not possible and obstacles penetrate the approach surface a risk assessment is required. Where obstacles are assessed to constitute an unacceptable risk, they may be required to be removed unless the risk can be mitigated by other means such as lighting and marking. Where penetrating obstacles cannot be removed or the risk reduced to an acceptable level, a straight-in approach is not published. Also see Section 8.2.4 for a discussion about the closely related VSS.

> ***Note:*** *For details on OLS dimensions refer to the Part 139 MOS, Chapter 7.*

5.4.7 **Runway and Runway Strip Width –** A pilot conducting a straight-in NPA after sighting the runway has limited time and distance in which to align the aircraft for landing. For runways with strip width less than 300m the MDA or DA may be raised slightly to allow additional time and distance for manoeuvring to align the aircraft with the runway. However, the runway strip also provides a safe operating environment during landing and its width must be sufficient for this purpose. Obviously, raising the MDA or DA to counter a narrow strip width on the one hand has no benefit during the landing operation on the other. Where the strip width does not meet the minimum standard, a straight-in landing minimum is not published.

5.5 Approach Requirements - Wind Information

5.5.1 Automatic Weather Stations (AWS) have been installed by the Bureau of Meteorology at many aerodromes served by instrument approaches. When combined with a VHF broadcast facility they provide an acceptable source of wind and QNH information. Where the published minimum altitude is based on a forecast aerodrome QNH, an AWS capability enables the published minimum altitude to be reduced by 100FT.

5.5.2 Not all AWS have a broadcast facility. The cost of adding VHF capability is quite low and operators can arrange with the Bureau of Meteorology for a VHF broadcast facility to be installed. (Normally the cost of installation is borne by the aerodrome operator).

5.5.3 Windsocks are located in accordance with Civil Aviation Safety Regulation Part 139 either near the threshold and/or mid-field. However, the nature of their design can make them difficult to interpret until late on final approach especially in poor visibility or at night.

5.5.4 **If I don’t know what the wind is can I descend to the straight-in MDA?** Yes, but you need to consider the possibility that you might need to circle and it may be advisable to limit descent to the circling MDA. In most cases the straight-in MDA is lower than the circling MDA, and if descent is continued to the lower altitude a circling approach may not be possible. Pilots should not commit to a straight-in landing unless they can be satisfied that wind conditions are suitable.

5.6 Approach Requirements - Visibility

5.6.1 **Why is the visibility for a straight-in approach usually greater than for circling?** In order for a successful straight-in approach and landing to be conducted, the pilot of an aircraft conducting a runway approach must be able to see the runway prior to reaching the MAPt at an altitude no lower than the MDA or before reaching the DA of an APV. The visibility published on Australian charts is determined by calculating the distance from the runway threshold to the point on a normal 3° descent path at which the MDA is intercepted. A margin of 160m is added to that distance to allow visual reference to a reasonable amount of runway. Visibility for a straight-in approach therefore varies only with the height of the MDA or DA above the runway.

5.6.2 Visibility for circling operations varies with aircraft category. It is based on the radius of turn that an aircraft in each category would require in adverse wind conditions to manoeuvre from a downwind position to align with the landing runway.

6. Circling Approaches (General)

6.1 When is a circling approach published?

6.1.1 A circling MDA will normally be shown for a straight-in approach procedure to permit circling to other runways. However, where any of the requirements for a runway approach cannot be met, ***only*** a circling approach is published. These requirements are:

- Final approach course is not within the alignment criteria;

- Final approach gradient is too steep;
- Obstacles above the VSS (see Section 8.2.4); and
- Runway is not surveyed to the required standard.

6.2 How are circling-only approaches identified?

6.2.1 An NPA that only provides for a circling procedure is identified in the title by reference to the navigation system only (e.g. NDB). To provide additional clarification, a suffix is included in the procedure title using the letters from the beginning of the alphabet, e.g. NDB-A, VOR-A. Where confusion might exist between multiple circling procedures that share the same name, different suffixes are used; e.g. Moomba NDB-A and Moomba NDB-B.

6.2.2 For RNAV$_{(GNSS)}$ procedures only, the suffix is used to indicate the direction of the final leg to aid in pilot orientation. For example, RNAV-E$_{(GNSS)}$ indicates an approach from an easterly direction. The letters N, S, E, and W are used as the suffix in these cases.

6.3 Visual legs

6.3.1 In rare cases a procedure may specify descent to a position outside the circling area, and require that a visual leg be flown from that position to establish the aircraft within the circling area. In such cases obstacle clearance on the visual leg is the responsibility of the pilot and the visual leg must be flown clear of cloud and in sight of ground or water in conditions meeting altitude and visibility specified for circling.

7. DME or GNSS Arrivals

7.1 Is a DME or GNSS Arrival an NPA?

7.1.1 Yes. A *DME or GNSS Arrival* is a procedure unique to Australia that provides an NPA to a circling minimum. A *DME or GNSS Arrival* is designed using the same criteria as used in conventional NPA design.

7.2 What is different about a DME or GNSS Arrival?

7.2.1 *DME or GNSS Arrivals* are normally designed to permit descent from the en-route phase without the need to locate the aircraft overhead the navigation aid or to conduct a sector entry. Entry to the procedure is often available from any direction but commonly is limited to sectors or specific tracks. Where sectors are promulgated, an aircraft can be manoeuvred to intercept any particular track, provided this is done prior to reaching the FAF. This procedure enables an arriving aircraft to be positioned on a convenient track for subsequent circuit entry or a straight-in approach. However, prior to reaching the FAF the aircraft must be established on the final approach course and from the FAF the aircraft speed must be established within the range of speeds specified for the final leg.

7.3 Where is the FAF on a DME or GNSS Arrival?

7.3.1 The FAF is normally located 5NM prior to the MAPt. Its location is indicated on the approach chart.

7.4 How are DME or GNSS Arrivals charted?

7.4.1 The charting of *DME or GNSS Arrivals* varies between chart suppliers but in general they have usually been shown as series of descending steps on particular tracks or within a specified sector.

7.4.2 AIP/DAP *DME or GNSS Arrival* charts are in a similar format to normal NPA charts, and incorporate a constant approach path. The constant approach path is designed to provide a 3° constant angle approach where possible, and terminating at a circling MDA within the circling area (Refer Figure 2).

7.5 Can I use GNSS for track guidance on a GNSS arrival?

7.5.1 No. *GNSS Arrivals* are designed using the navigation tolerances applicable to the ground-based aid. The NDB across-track design tolerance at the navigation aid is ±1.25NM and splays at an angle of 10.3° and that for the VOR is ±1.0NM with a splay angle of 7.8°. Because the GNSS system is assumed to operate in the ‘terminal mode’ the design across-track tolerance at the reference point is ±2.5NM. Although the GNSS splay angle is zero, the NDB splay remains narrower than the GNSS splay within 6.8NM of the reference point and for VOR the distance is 11NM.

GPS ARRIVAL PROCEDURES

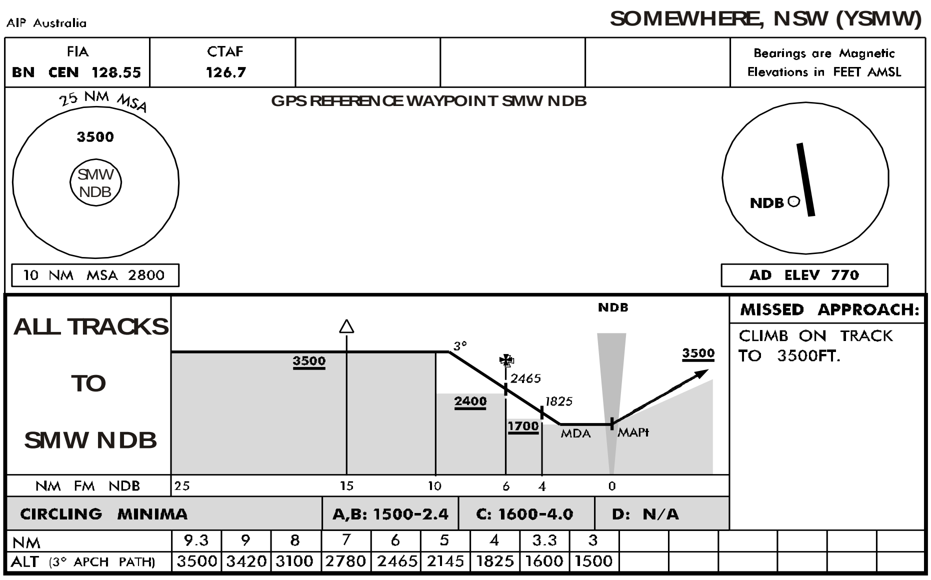

Figure 2 - Example of the Format DME or GNSS Arrival Chart

8. The Visual Segment

8.1 When may I descend below the MDA or DA?

8.1.1 Descent below the MDA or DA may be made when visual contact is made with the runway or runway environment (i.e. the runway threshold or approach lighting or other markings identifiable with the runway) and kept in sight during the subsequent approach and landing.

8.2 Straight-in NPA or APV

8.2.1 During an NPA with a straight-in approach or during an APV and, at an altitude above the straight-in MDA or DA, you have the runway in sight and have the required visibility you may continue the descent. In so doing you must be sure that obstacles in the approach path are avoided. Protection from obstacles beneath the approach path is aided by aerodrome and instrument procedure design standards. Aerodrome standards, based on ICAO Annex 14 and modified to suit Australian operating conditions, are published in the Part 139 MOS.

8.2.2 Aerodrome standards supporting a straight-in NPA or APV provide for an OLS beneath the extended runway centreline. For example, an approach OLS of 3.33% provides a buffer to the published approach path which will be set at 3° (5.24%) or greater. Obstacles penetrating above the OLS that may be considered a hazard to an aircraft conducting a visual approach will be marked and/or lit, unless removed. (See Figure 3.)

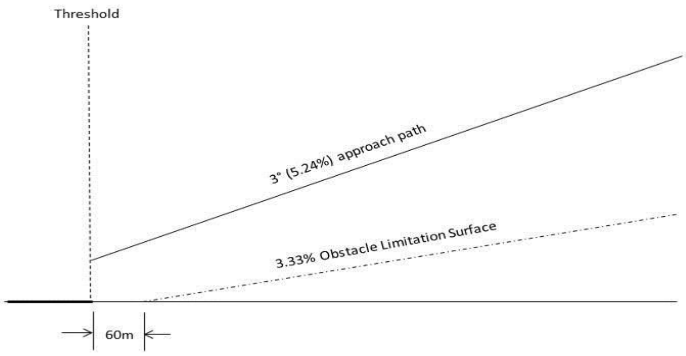

Figure 3 - Approach Obstacle Limitation Surface

8.2.3 The approach procedure design standards were modified in 2007 to include an area that lies below the final approach path for the purpose of identifying obstacles that need to be considered after descent below the MDA or DA. This area is called the VSS and is being progressively introduced into Australian procedures. The VSS is the same in concept and similar in dimensions to the OLS except that its angle is fixed at 1.12° below the published final approach path and it is coincident with the final approach track of the procedure rather than with the runway centreline. Penetration of the VSS is not permitted. The VSS angle (see Figure 4a), and/or its location (see Figure 4b) is adjusted to avoid any penetrations.

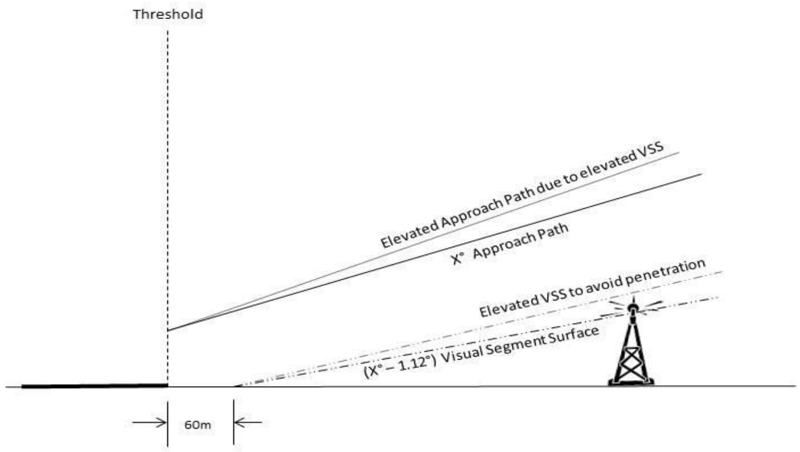

Figure 4a – Visual Segment Surface with approach angle adjustment

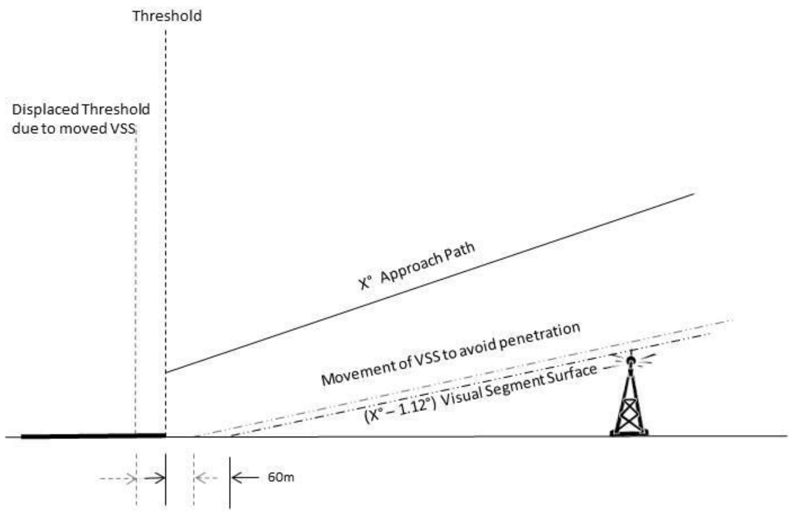

Figure 4b – Visual Segment Surface with longitudinal adjustment

8.2.4 Other precautions such as installing visual approach guidance (PAPI or T-VASIS) may also be used.

8.2.5 It will be safe to continue on a visual descent below the MDA or DA, provided the approach path of the aircraft is consistent with the protection afforded by runway and instrument standards. If an aircraft is flown below the published approach path then the safety margin between the aircraft and obstacles beneath the approach is reduced.

8.2.6 Instrument approaches that use distance measurement, either DME or GNSS, are provided with an altitude/distance table that enables a constant angle approach to be flown. Provided, on establishing visual contact, the aircraft continues a stabilised descent to the runway, a safe margin above the approach OLS and the VSS will be maintained.

8.2.7 In recognition of the added safety afforded by straight-in approaches, some NPAs without DME or GNSS have been published as straight-in approaches. (e.g. VOR RWY12). As an altitude/distance scale is not available in these cases, the distance and approach angle to the runway from the point at which the pilot becomes visual will vary.

In order to ensure clearance from obstacles beneath the approach path, descent should not be continued below the MDA until the aircraft is established on a safe path to the threshold. This may necessitate flying level at the MDA until a safe approach angle to the runway is intercepted.

8.3 Circling approach

8.3.1 Circling approaches normally require manoeuvring to align the aircraft with a suitable runway. Circling is a visual procedure that can be very hazardous if not executed correctly.

8.3.2 Circling rules are published in AIP ENR 1.5 Sections 1.7 ('Circling Approaches and Visual Circling') and 1.8. ('Visual Manoeuvring (non-Circling) subsequent to Non-Precision Approaches (NPA) and Approaches with Vertical Guidance (APV')). These rules have been developed as the result of many years' experience, and if followed, enable the safe termination of an instrument approach.

8.3.3 By day, and complying with the rules for circling, a pilot may elect to descend below the circling MDA, but in doing so must take responsibility for obstacle clearance. As spot heights on IAL charts do not necessarily indicate the highest terrain, or all obstacles in the circling area, pilots should only exercise this option when they are familiar with the terrain in the circling area. Without detailed local knowledge, it is a safer option to utilise the obstacle protection afforded by remaining at the circling MDA.

8.3.4 **What is the circling area?** The circling area is an area bounded by arcs drawn from the runway ends within which obstacle protection at the circling MDA of not less than 300FT for Category A/B and 400FT for Category C/D is provided. The size of the circling area is based on the maximum circling IAS permitted for each aircraft Category. In order to maintain obstacle protection the aircraft must be maintained within the circling area by visual reference to the runway. The maximum circling speeds are published in PANS-OPS and reproduced in the Australian AIP in AIP ENR 1.5, Section 1.16 Table 1.1

Category	KIAS
A	100
B	135
C	180
D	205

Table 1 - Maximum Circling IAS (from AIP ENR 1.5, Section 1.16, Table 1.1)

8.3.5 **What is the purpose of a no-circling area?** The circling MDA is calculated by adding a minimum obstacle clearance of 300FT (Category A/B) or 400FT (Category C/D) to the highest obstacle in the circling area. In order to permit a lower MDA, a no-circling area is sometimes published to eliminate obstacles in part of the circling area. Provided a pilot avoids the no-circling area, the required obstacle clearance applicable above all other obstacles is maintained.

8.3.5.1 Within the no-circling area, as the required obstacle clearance at the MDA is not provided, conditions need to be such that the pilot can see and avoid obstacles. For that reason, circling should not be conducted within the no-circling area unless by day and in VMC.

8.3.5.2 In some cases the MAPt is located within the no-circling area. In these circumstances a circling approach is not possible if the no-circling area is entered before reaching the MAPt. To avoid this limitation it is advisable to descend to the MDA as early as possible to achieve visual contact before entering the no-circling area.

8.3.6 **Why are the rules different for day and night?** At night it may not be possible to maintain visual clearance from obstacles even if those obstacles are lit or shown on instrument approach charts. For this reason the rules for circling at night require that the MDA is maintained until in a position where a normal descent can be conducted. In these circumstances the aerodrome OLS are intended to enable a safe approach to be conducted. However the responsibility for maintaining adequate obstacle clearance still remains with the pilot and caution should be exercised. Descent should not be commenced or continued until obstacles that may affect a safe visual approach from the MDA are identified or passed.

8.3.7 **Missed approach during circling**. If visual reference is lost during circling, a missed approach must be executed. However, as the position at which the missed approach is initiated can be anywhere within the circling area, the procedure designer has no means of designing a single procedure that will ensure obstacle clearance in all cases.

8.3.7.1 In executing a missed approach from within the circling area, the assumption is made that the area directly above the aerodrome is generally free of hazardous obstacles and a climbing turn should be made in that direction. A climb overhead the aerodrome should be continued while the aircraft is tracked to establish flight on the published missed approach.

8.3.8 **Why is only a circling MDA published at some locations when the final approach is runway aligned?** Final approach course alignment is only one of a number of criteria that need to be met for a straight-in approach. Unless all the requirements can be satisfied, only a circling MDA is published.

8.3.9 **Does that mean that a straight-in approach cannot be made in those cases?** No. It means that the instrument approach procedure and/or the runway approach surfaces do not meet all the associated safety standards. If, on becoming visual, the pilot assesses that the aircraft is in a suitable position to land straight-in, and the pilot considers that it is safe to do so, a straight-in approach can be conducted provided the rules for circling are followed. If the decision is made to ‘circle’ straight-in, the pilot should take into account that the runway and the runway approach area may not meet the standards for a straight-in approach and caution should be exercised. Additionally, a VSS will not be provided for a runway that has only a circling approach.

9. Helicopter Procedures

9.1 What approaches can I fly in a helicopter?

9.1.1 All fixed-wing Category A approaches can be flown by appropriately equipped helicopters, provided the speeds flown are within the Cat A range. The use of V_{at} is not applicable to helicopters.

9.2 Are helicopter approaches different to fixed wing approaches?

9.2.1 Yes. Approaches which are designated Category H are designed to different parameters and can only be flown by helicopters. Helicopter approach procedures are designed to criteria that are more appropriate to the flying speeds, performance, and handling characteristics of helicopters. Differences include increased maximum permissible approach gradients, shorter segment lengths, and may include increased missed approach gradients.

9.2.2 The PBN Manual provides for a unique helicopter specification which allows the use of RNP 0.3 throughout those approaches that are so designed.

9.3 Why do some helicopter approaches published in the AIP/DAP have a caveat?

9.3.1 Some helicopter procedures are designed to helicopter landing sites (HLS) specified for use by emergency medical services (EMS). Unlike aeroplane operations, which are designed to terminate in a standard aerodrome environment, EMS helicopter approaches deliver the aircraft to a point near an HLS from which specific procedures are needed for each approach to enable the visual segment to be negotiated safely. The Part 173 MOS requires a helicopter operator to publish in the company operations manual specific operational procedures for each approach and HLS. The caveat *'For CASA Approved Operators Only'* identifies those procedures to which these provisions apply.

9.4 What is the VAA-H?

9.4.1 The VAA-H is an Australian concept devised to facilitate the visual termination of a helicopter $RNAV_{(GNSS)}$ approach at an HLS, and performs a similar function to the circling area at an aerodrome.

9.4.2 The VAA-H provides obstacle clearance within an area 0.5 NM either side of the nominal track from the MAPt to the HLS, and relies upon visual navigation using key features or 'lead-in points' to navigate to the HLS so that continued flight past the MAPt to the HLS is possible in visibility that may be as low as 800m. Descent from the MDA is not permitted until the HLS is sighted and a normal approach can be completed.

9.4.3 A particular feature of the VAA-H is that missed approach obstacle protection is assured provided the missed approach is commenced at the MDA from a position within the VAA-H. This enables the helicopter to proceed past the MAPt in circumstances where the successful completion of the visual segment is not assured without compromising the safety of the missed approach.

Executive Manager
Standards Division

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