Civil Aviation Safety Authority
of Papua New Guinea

Advisory Circular
AC173-2

Instrument Flight Procedure Design Criteria and Standards

Issue 2

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GENERAL

Civil Aviation Authority Advisory Circulars (AC) contain information about standards, practices and procedures that the Director has found to be an Acceptable Means of Compliance (AMC) with the associated rule.

An AMC is not intended to be the only means of compliance with a rule, and consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices or procedures are found to be acceptable, they will be added to the appropriate Advisory Circular.

PURPOSE

This Advisory Circular provides specific guidance acceptable to the Director, for showing compliance with Civil Aviation Rule 173 Subpart D - Design Criteria Instrument Flight Procedure requirements and explanatory material to assist in showing compliance.

RELATED CAR

This AC relates to Civil Aviation Rule Part 173, specifically rules:

- 173.55 Design of instrument flight procedures
- Rule 173 Subpart D — Design Criteria—Instrument Flight Procedure

CHANGE NOTICE

This AC replaces Revision 1, 18 July 2019.

APPROVAL

This AC has been approved for publication by the Director of Civil Aviation

Table of Content

General

Introduction

Civil Aviation Rule Part 173 in Papua New Guinea sets the standards for certifying and operating organizations that design instrument flight procedures (IFPs). It references ICAO Document 8168 for these procedures, but due to ambiguities in the document, an Advisory Circular clarifies its application to ensure consistency and safety in flight operations.

The following ICAO documentation form the requirements and basis for the design, validation and publication of Instrument Flight Procedures (IFPs);

ICAO Documents:

1. **Doc 8168**: Procedures for Air Navigation Services – Aircraft Operations (Volumes I & II)
2. **Doc 8697**: Aeronautical Chart Manual
3. **Doc 9365**: Manual of All-Weather Operations
4. **Doc 9613**: Performance Based Navigation Manual (Volumes I & II)
5. **Doc 9881**: Guidelines for Electronic Terrain, Obstacle, and Aerodrome Mapping Information
6. **Doc 9905**: Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual
7. **Doc 9906**: The Quality Assurance Manual for Flight Procedure Design

ICAO Annexes:

1. **Annex 4**: Aeronautical Charts
2. **Annex 6**: Operation of Aircraft
3. **Annex 11**: Air Traffic Services
4. **Annex 14**: Aerodromes (Volumes I & II)
5. **Annex 15**: Aeronautical Information Services

This AC ensures that Papua New Guinea meets both its domestic needs and international obligations by specifying any differences and limitations. If there is a conflict between the standards in this AC and those in the ICAO documents, the standards in this AC will take priority.

EM 173.55 Design of Instrument Flight Procedures

Key requirements for designing, verifying, and validating instrument flight procedures, ensuring they meet high safety and accuracy standards.

Design and Verification (Rule 173.55(a)):

- Instrument flight procedures must be designed to meet the standards in Subpart D.
- They must be independently verified by a qualified person not involved in the design.
- Procedures must be validated as per rule 173.205 and Appendix C.
- Flight validation is required to ensure safety, except in specific cases outlined in paragraph (b).

Exceptions to Flight Validation (Rule 173.55(b)):

- Certain en-route or arrival procedures may not need flight validation if obstacle data meets design requirements.
- Instrument departure procedures are exempt unless they limit aircraft performance.

- Amendments to previously validated procedures are exempt if design changes can be verified and a safety assessment confirms no additional risks.

Flight Validation Procedures (Rule 173.55(c) and (d)):

- Applicants must establish procedures for flight validation.
- Equipment used must be precise, accurate, and regularly checked.
- The equipment must record the actual flight path and be operated by competent personnel.

Justification and Data Standards (Rule 173.55(e) and (f)):

- Procedures must justify any exceptions to flight validation.
- Aeronautical data must comply with RTCA Inc. document standards and AIXM-5 standards acceptable to the Director.
  - RTCA Inc. Document Standards:
    - *Example: Aeronautical data must comply with standards specified in RTCA DO-200A, which outlines requirements for processing aeronautical data.*
  - Aeronautical Information Transfer Model (AIXM-5):
    - *Example: Data must be formatted and transferred according to AIXM-5 standards to ensure consistency and accuracy in aeronautical information.*
- Alternative equivalent standards may be used.

Subpart D — Design Criteria—Instrument Flight Procedure

EM 173.201(b) Design

If the IFP design organisation cannot meet the standards or recommended practices in the ICAO documents or this manual, they must apply to the Flying Operations Division for an exemption or deviation. The application should include:

1. *Reasons for the exemption or deviation.*
2. *Any safety assessments or studies conducted.*
3. *An estimated timeline for when they can comply with the current standards.*

If an exemption or deviation is granted, it must be documented in the operations manual, including:

1. *The reason for the exemption or deviation.*
2. *Any limitations or conditions imposed as a result.*

This ensures that any deviations are well-documented and justified, maintaining safety and regulatory compliance.

EM 173.202 Aerodrome Operating Minima

The Minimum Descent Altitude (MDA), Decision Altitude (DA), and Reference Height (RH) published on Instrument Approach Landing (IAL) charts must comply with ICAO Annex 6 Part 1. Operations cannot use MDA, DA, or RH values lower than those on the IAL charts. Unless otherwise noted, MDA and DA are equal to the Obstacle Clearance Altitude (OCA).

It is the responsibility of the holder of an instrument flight procedure service certificate to establish Aerodrome Operating Minima to be published in the PNG AIP for each instrument approach procedure and circling procedure developed at aerodromes as per the provision Rule 173.202.

Establishing Aircraft Landing Minima (ALM)

Operators must establish Aircraft Landing Minima (ALM) for each aerodrome, as per ICAO Annex 6 Part 1, Chapter 4. This involves:

1. **Considering Relevant Factors**: Operators must take into account various factors listed in Annex 6, such as aircraft performance, runway conditions, and environmental factors[1].
2. **Setting Higher ALM if Necessary**: After evaluating these factors, operators may determine that their ALM should be higher than the stated aerodrome operating minima[1].
3. **Adjusting DA for Pressure Error**: All Decision Altitudes (DA) must be adjusted to account for aircraft pressure error. This can be done by applying a specific correction or adding at least 50 feet to the published DA[2][3]. This adjustment ensures that the aircraft maintains a safe altitude during the approach.

Non-precision Approaches

For non-precision approaches, compensation for aircraft pressure error is not required when determining ALM[5][4]. Non-precision approaches typically use Minimum Descent Altitudes (MDA) to define how low a pilot may safely descend without the required visual reference[6].

Documentation and Compliance

All established ALM, including any adjustments for pressure error, must be documented in the operations manual. This documentation should include the reasons for any deviations and any resultant limitations or conditions imposed[2][3].

These procedures ensure that all instrument flight procedures (IFPs) are designed and executed safely, maintaining compliance with both domestic and international standards.

References

[1] Annex 6 - International Civil Aviation Organization (ICAO)

[2] Barometric Altimeter Errors and Setting Procedures

[3] Pressure Error - Airliners.net

[4] From Non-precision Approaches to Precision-Like Approaches: Methods and

[5] Precision vs. non-precision approaches | Pilots of America

[6] Minimum Descent Altitude/Height (MDA/MDH) - SKYbrary Aviation Safety

Category I Precision Approach Minima

A Category I operation is a precision instrument approach and landing using ILS (Instrument Landing System) or MLS (Microwave Landing System) with the following criteria:

- **Decision Height (DH)**: Not lower than 200 feet.
- **Runway Visual Range (RVR)**: Not less than 550 meters.

Decision Height and RVR Requirements

Decision Height (DH)	Full Facilities RVR	Intermediate Facilities RVR	Basic Facilities RVR	Nil Facilities RVR
200 ft	550 m	700 m	800 m	1,000 m
201–250 ft	600 m	700 m	800 m	1,000 m
251–300 ft	650 m	800 m	900 m	1,200 m
301 ft and above	800 m	900 m	1,000 m	1,200 m

Notes

1. **RVR or Meteorological Visibility**: These figures represent either the reported RVR or the meteorological visibility when RVR is not available.
2. **Full Facilities**: Comprise runway markings, 720 meters or more of high-intensity/medium-intensity (HI/MI) approach lights, runway edge lights, threshold lights, and runway end lights. All lights must be on.
3. **Intermediate Facilities**: Comprise runway markings, 420–719 meters of HI/MI approach lights, runway edge lights, threshold lights, and runway end lights. All lights must be on.
4. **Basic Facilities**: Comprise runway markings, less than 420 meters of HI/MI approach lights, any length of low-intensity (LI) approach lights, runway edge lights, threshold lights, and runway end lights. All lights must be on.
5. **Nil Facilities**: Comprise runway markings, runway edge lights, threshold lights, runway end lights, or no lights at all.
6. **Applicability**: The table is applicable to conventional approaches with a glide slope angle up to and including 4°.

Category II Precision Approach

Availability

- **All Engines Operating**: ILS CAT II Decision Altitude (DA), Radio Height (RH), and visibility minima are authorized for approved operators.

Operating Criteria

1. Ground Facilities:

- Precision approach runway CAT II.
- Transmissometer or other approved RVR measurement available from at least one touchdown and one rollout reading.

2. Airborne Equipment:

- An approved flight director system.
- An autopilot coupled approach system.
- An autoland system (for RVR less than 880 meters).
- An instrument failure warning system.

3. Environmental Conditions:

- Maximum headwind component including gusts: 25 knots.
- Maximum tailwind component including gusts: 10 knots.

- Maximum crosswind component including gusts: 10 knots.

Note: Operators are advised that the facilities required for Category II minima are currently not available at aerodromes in Papua New Guinea.

Category II Operation

A Category II operation is a precision instrument approach and landing using ILS or MLS with:

- **Decision Height (DH)**: Below 200 feet but not lower than 100 feet.
- **Runway Visual Range (RVR)**: Not less than 300 meters.

Category II Minima

Decision Height (DH)	RVR for Aeroplane Category A, B & C	RVR for Aeroplane Category D
100 ft – 120 ft	300 m	300 m / 350 m
121 ft – 140 ft	400 m	400 m
141 ft and above	450 m	450 m

Notes:

1. The values in the table represent the absolute minimum RVR under the most favorable operating conditions (e.g., auto-coupled flight to below DH).
2. If autoland operations are supported by the airport facilities, RVR for Category D can be reduced to 300 meters.

These criteria ensure that Category II operations are conducted safely and efficiently, taking into account the capabilities of both the aircraft and the ground-based navigation aids[1][2][3].

If you have any more questions or need further details, feel free to ask!

References

[1] CRITERIA FOR APPROVAL OF CATEGORY I AND CATEGORY II WEATHER MINIMA FOR

[2] Precision Approach - SKYbrary Aviation Safety

[3] IFR precision approach and minima - IVAO Documentation Library

Category III Precision Approach

Category III operations are subdivided into three main types: IIIA, IIIB, and IIIC.

(i) Category IIIA Operations

- **Decision Height (DH)**: Lower than 100 feet.
- **Runway Visual Range (RVR)**: Not less than 200 meters.

(ii) Category IIIB Operations

- **Decision Height (DH)**: Lower than 50 feet, or no decision height.
- **Runway Visual Range (RVR)**: Lower than 200 meters but not less than 75 meters.

Note: If the decision height (DH) and runway visual range (RVR) do not fall within the same category, the RVR will determine the category of the operation.

(iii) No Decision Height Operations

Operations with no decision height may only be conducted if:

- The operation with no decision height is authorized in the Aircraft Flight Manual.
- The approach aid and the aerodrome facilities can support operations with no decision height.
- The operator has approval for CAT III operations with no decision height.

Note: For a CAT III runway, it may be assumed that operations with no decision height can be supported unless specifically restricted as published in the AIP or NOTAM.

Category III Minima

Approach Category	Decision Height (ft)	RVR (m)
IIIA	Less than 100 ft	200 m
IIIB	Less than 100 ft	150 m
IIIB	Less than 50 ft	125 m
IIIB	Less than 50 ft or No Decision Height	75 m

Note: Reported RVR must be available at the aerodrome to conduct CAT II or CAT III operations[1][2][3].

These criteria ensure that Category III operations are conducted safely, taking into account the capabilities of both the aircraft and the ground-based navigation aids.

References

[1] Precision Approach - SKYbrary Aviation Safety
[2] Category I/II/III ILS Information - Federal Aviation Administration
[3] Guide to Aviation Approaches: Types and Technologies Explained

Non-Precision Approach (NPA) Minima

Non-Precision Approach (NPA) procedures have specific system minima based on the Minimum Descent Height (MDH). Here are the details:

System Minima

- **NPA with Final Approach Fix (FAF)**: Lowest MDH is 250 feet.
- **NPA without FAF**: Lowest MDH is 300 feet.

These minima apply to conventional approaches with a nominal descent slope of not greater than 4°. Greater descent slopes usually require visual glide slope guidance (e.g., PAPI) to be visible at the MDH.

RVR for Non-Precision Approach

Full Facilities

Full facilities include runway markings, 720 meters or more of high-intensity/medium-intensity (HI/MI) approach lights, runway edge lights, threshold lights, and runway end lights. All lights must be on.

MDH (ft)	RVR (m) / Aeroplane Category			
	A	B	C	D
250–299 ft	800 m	800 m	800 m	1,200 m
300–449 ft	900 m	1,000 m	1,000 m	1,400 m
450–649 ft	1,000 m	1,200 m	1,200 m	1,600 m
650 ft and above	1,200 m	1,400 m	1,400 m	1,800 m

Intermediate Facilities

Intermediate facilities include runway markings, 420–719 meters of HI/MI approach lights, runway edge lights, threshold lights, and runway end lights. All lights must be on.

MDH (ft)	RVR (m) / Aeroplane Category			
	A	B	C	D
250–299 ft	1,000 m	1,100 m	1,200 m	1,400 m
300–449 ft	1,200 m	1,300 m	1,400 m	1,600 m
450–649 ft	1,400 m	1,500 m	1,600 m	1,800 m
650 ft and above	1,500 m	1,500 m	1,800 m	2,000 m

Basic Facilities

Basic facilities include runway markings, less than 420 meters of HI/MI approach lights, any length of low-intensity (LI) approach lights, runway edge lights, threshold lights, and runway end lights. All lights must be on.

MDH (ft)	RVR (m) / Aeroplane Category			
	A	B	C	D
250–299 ft	1,000 m	1,300 m	1,400 m	1,600 m
300–449 ft	1,300 m	1,400 m	1,600 m	1,800 m
450–649 ft	1,500 m	1,500 m	1,800 m	2,000 m
650 ft and above	1,500 m	1,500 m	2,000 m	2,000 m

Nil Approach Light Facilities

Nil approach light facilities include runway markings, runway edge lights, threshold lights, runway end lights, or no lights at all.

MDH (ft)	RVR (m) / Aeroplane Category			
	A	B	C	D
250–299 ft	1,500 m	1,500 m	1,600 m	1,800 m
300–449 ft	1,500 m	1,500 m	1,800 m	2,000 m
450–649 ft	1,500 m	1,500 m	2,000 m	2,000 m
650 ft and above	1,500 m	1,500 m	2,000 m	2,000 m

Standard Take-off Minima

Standard Take-off Minima apply at all aerodromes except where otherwise detailed on individual Aerodrome Charts. These minima are not applicable when, in the case of an engine failure in multi-engined aircraft, a return to land at the departure aerodrome is necessary. In such cases, meteorological conditions must be above IAL minima or allow for a visual approach.

Take-off Minima for Different Aircraft Categories

Aircraft Category	Ceiling	Visibility (Day)	Visibility (Night)
IFR Multi-Engined Aircraft Above 5700KG	0 ft	800 m	500 m
IFR Multi-Engined Aircraft Not Above 5700KG	0 ft	800 m	500 m
All Other IFR Aircraft at Aerodrome Without Approved Instrument Approach Procedure (Day)	500 ft	4000 m	Not permitted
All Other IFR Aircraft	300 ft	2000 m	2000 m
All Other IFR Aircraft at Aerodrome With or Without Approved Instrument Approach Procedure (Day)	VMC criteria	VMC criteria	Not permitted

Notes

1. **Obstacle Clearance**: Aircraft must comply with pertinent obstacle clearance requirements of CAR Parts 121, 125, 135, 136.
2. **Visibility Reduction**: Visibilities may be reduced by specific approval, which must be inserted in Company Operations Manuals.
3. **Engine Out Climb Gradient**:
   - Must be at least 0.3% greater than the obstacle-free gradient for the runway length required.
   - Published obstacle-free gradients can be used if surveyed to at least 7,500 meters from the end of TODA.
   - Operators can establish an obstacle-free gradient within 30 degrees of runway heading, with procedures involving not more than 15 degrees of bank to track within the splay.
4. **Pilot Responsibility**:
   - Ensure terrain clearance until reaching the applicable safety altitude.
   - Ensure compliance with engine failure procedures after V1 or lift-off.
   - Ensure aircraft performance and fuel availability for proceeding to a suitable aerodrome if a return to the departure aerodrome is not possible.
5. **Two Pilot Operations**:
   - Endorsed on type.
   - Multi-crew trained on type.
   - Multi-crew proficiency checked within the previous 13 months.
   - Instrument rated.

Publication of DA and MDA

State DA/MDA Requirements:

1. **OCA Compliance**: Must not be less than the Obstacle Clearance Altitude (OCA) as per ICAO PANS-OPS Vol II.
2. **Visual Segment Limitations**: Must adhere to visual segment limitations.
3. **Additional Margins**: Must include any necessary margin to account for poor ground equipment performance or local conditions.
4. **Threshold Elevation Adjustments**:
   - **Category I Operations**: Threshold elevation plus 200 ft.
   - **SA Category I Operations**: Threshold elevation plus 150 ft.
   - **Category II and SA Category II Operations**: Threshold elevation plus 100 ft.

RA Height:

- **SA Category I, SA Category II, and Category II**: A radio altimeter height must be determined and published for each procedure.
- **Category III**: A Decision Height (DH) or RA height is not required. If an operator's approval requires a DH for Category III operations, the flight crew will use the DH specified in the approval.

Different Aircraft Categories and Runway lengths.

1. **Combining Categories**: If the altitude difference between any two categories is less than 100 feet, they should be combined using the higher value of DA or MDA.
2. **Category E Aircraft**: Approach procedures are not typically provided for Category E aircraft. These aircraft may use approaches available to Category D but at the owner's and operator's risk. They must determine the suitability of the landing runway in advance.
3. **Runway Length Restrictions**: For runways less than 1,000 meters, approach procedures are usually restricted to Category A and B aircraft. The minima box must show a heading for Category C, but the relevant column should be greyed out with "Not Permitted" in the MDA row.
4. **Consistency in Procedures**: This requirement should be applied consistently, especially when a location is served by other procedures catering to higher performance categories. It ensures clarity and avoids confusion for chart users.

Alternate Criteria

Criteria for determining alternate airport minimums based on circling Minimum Descent Altitude (MDA) for each aircraft category.

1. Specification of Alternate Criteria:
   - The alternate criteria are specified for each chart and are based on the circling MDA for each aircraft category.
   - The criteria are expressed as a ceiling and visibility value, calculated as circling Minimum Descent Height (MDH) plus 500 feet and circling visibility plus 2000 meters.

2. Case Scenario:
   - If different procedures at the same location provide different circling MDAs, the alternate criteria must be based on the worst-case circling MDH and visibility.

- When creating a new approach at a location already served by other approaches, the alternate criteria must be reviewed to ensure the continued application of this policy.

EM 173.203 Use of Design Automation Tools

Utilization of Design Automation Tools

1. **Maximizing Use**: The holder of an instrument flight procedure service certificate is required to utilize design automation tools to the fullest extent possible. This is to minimize the potential for design errors, ensuring that the IFPs are accurate and reliable.
2. **Error Minimization**: By leveraging these tools, the design process becomes more efficient and less prone to human error. Automation tools can handle complex calculations and data processing, which enhances the overall safety and precision of the flight procedures.

Validation of Tools

1. **Pre-Use Validation**: Before any design automation tool is used, it must be validated. This means that the tool must be tested and confirmed to produce accurate and reliable results.
2. **Acceptable Methodology**: The validation process must follow a methodology that is acceptable to the Director. This ensures that the tools meet a standard of quality and reliability that is recognized by the regulatory authority.
3. **Continuous Monitoring**: Even after initial validation, there should be ongoing monitoring and periodic re-validation to ensure that the tools continue to perform correctly over time.

Importance of These Requirements

1. **Safety Assurance**: These requirements are crucial for maintaining high safety standards in aviation. Accurate IFPs are essential for safe navigation and landing, especially in challenging conditions.
2. **Regulatory Compliance**: Adhering to these guidelines ensures that the service providers comply with regulatory standards, which is necessary for maintaining their certification and operational approval.
3. **Operational Efficiency**: Using validated automation tools can significantly improve the efficiency of the design process, allowing for quicker updates and adaptations to flight procedures as needed.

Types of Approach Procedures with Specific Requirements

Procedures Based on Various Navaids

- **ILS, LOC/LLZ, VOR, NDB, and Locator Azimuth Navaids**: Procedures based on these navaids are published, with or without the use of Distance Measuring Equipment (DME).
- **GNSS Equipment**: Procedures also permit the use of distance information derived from approved GNSS equipment instead of DME for arrival and departure procedures.

Use of GPS in Lieu of DME

- **RAIM Study**: Following a successful RAIM (Receiver Autonomous Integrity Monitoring) study in PNG in 2002, research found that the fix tolerance for 1000 mHz DME can be applied to GPS distance.

- **Formal Approval**: This led to the formal approval for using GPS instead of DME in Instrument Approach Landing (IAL) procedures, with a specific notation on the chart identifying the GPS Reference Point.
- **Implementation**: These notations must appear on all new and revised procedures and be progressively implemented for existing procedures that can benefit from this flexibility.

Notation Format

- The specific notation format referred to in the guidelines must be clearly indicated on the charts.

Stand-Alone RNAV (GNSS) Procedures

- **Recognition**: Stand-alone RNAV (GNSS) procedures are recognized for both precision and non-precision approaches.
- **Design Criteria**: These procedures must strictly adhere to the design criteria published in PANS-OPS and, where necessary, to higher standards declared in the manual.

Non-Precision Approach Using DME

- **Approval**: A non-precision approach based on the use of DME as a stand-alone facility is approved by the Civil Aviation Authority (CAA).
- **Requirement**: This procedure was necessary to provide two independent approach aids for IFR RPT operations or to ensure a suitable alternate aerodrome.

RNAV (GNSS) NPA Implementation

- **Equipment Certification**: Implementation of stand-alone RNAV (GNSS) non-precision approaches (NPA) using equipment certified under TSO C129A.
- **Alternate Aerodrome Requirement**: If the destination is not equipped with a radio navigation aid, an alternate aerodrome served by such an aid is required.

Serviceability of Conventional Navaids

- **Challenges**: Serviceability of conventional navaids has been problematic in PNG.
- **Solution**: Non-precision approaches based on DME as a stand-alone aid have alleviated this issue, providing redundancy in case of azimuth navaid failure.

DME-Only Procedures

- **Uniqueness**: These procedures are unique to PNG but were once used in Australia.
- **Titles**: Known as "DME Homing and Descent" or "DME Descent," the naming differences arose from the implementation of PANS-OPS (1986) criteria.

Future Withdrawal of DME-Only Procedures

- **Redundancy**: It is expected that these DME-only procedures are currently withdrawn as RNAV (GNSS) NPA and conventional IALs provide sufficient redundancy.

Chart Accuracy and Digital Data

Guidelines on chart accuracy and digital data for flight procedures. Ensuring the accuracy of this data is indeed crucial for flight safety.

1. **Charting Accuracy**: Must be maintained by applying vertical and horizontal tolerances as per ICAO PANS-OPS DOC 8168. If these tolerances cause operational issues, additional survey data should be used.
2. **Preferred Data Source**: A site-specific survey of the aerodrome and surroundings, stored in digital format, is preferred. This data should be directly input into the CAD platform with appropriate tolerances applied.
3. **Data Handling**: Terrain and obstacle data must be handled by trained personnel and should not be modified unless absolutely necessary.
4. **Tolerance Levels**:
   - **Survey Data Report**: Horizontal 0-10m, Vertical 0m, Vegetation 0m
   - **SRTM Terrain Data**: Horizontal 25m, Vertical 10m, Vegetation 10m
   - **Google Earth Data**: Horizontal 25m, Vertical 10m, Vegetation 10m
   - **Map Digitized Data**: Horizontal 500m, Vertical 50m, Vegetation 10m (only to be used if no other data source is available)

Minimum Obstacle Clearance (MOC) Criteria

MOC Criteria: Based on PANS-OPS, considering altimeter errors due to high or steep terrain. Papua New Guinea (PNG) applies these criteria to all instrument flight procedures.

Primary Area MOC

1. **CAR 91.417 Criteria**: PNG uses a sliding scale for MOC based on terrain elevation:
   - **1,000FT** for terrain up to 5,000FT.
   - **1,500FT** for terrain between 5,000FT and 10,000FT.
   - **2,000FT** for terrain above 10,000FT.
2. **Assessment of AMA and LSALT**: Terrain elevations below 500FT are considered as 500FT.
3. **Design Specifications**: Modified values for design purposes:
   - **984FT** for terrain up to 5,000FT.
   - **1,476FT** for terrain between 5,000FT and 10,000FT.
   - **1,968FT** for terrain above 10,000FT.

Secondary Area MOC

4. **Determining Secondary Area MOC**: Based on the specifications of primary MOC, adjusted for obstacles in secondary protection areas.
5. **Calculation Example:**
   a. Distance from outer edge to obstacle: **1500m**
   b. Total area width in vicinity: **9270m**
   c. Result **(a/b)**: **0.16181** (or **16.18%**)
   d. Applicable primary MOC **(dxc)**: **1476FT**
   e. Required MOC: **239FT**

The distance units to be used may be metres, kilometres or nautical miles. Heights and elevations may be in metres or feet, but the result of each calculation must be shown in FEET in design documentation.

Terrain and Obstacle Assessment

1. **Contours**: When the controlling obstacle is a contour, the contour interval is added to the contour value shown on the map to avoid applying chart vertical error.
2. **Spot Features**: For spot heights, the applicable chart vertical error value is added.
3. **Spot Within Contour**: Spot heights within the highest depicted contour overrule the contour value, even if adding the contour interval results in a higher elevation. Only the chart vertical error is added to the spot height.
4. **Chart Vertical Error**: If not indicated, a value of 30 meters (100 feet) is used.
5. **Vegetation**: An additional 30 meters (100 feet) is added for vegetation, considering growth and logging activities.

Obstacle Data and Allowances

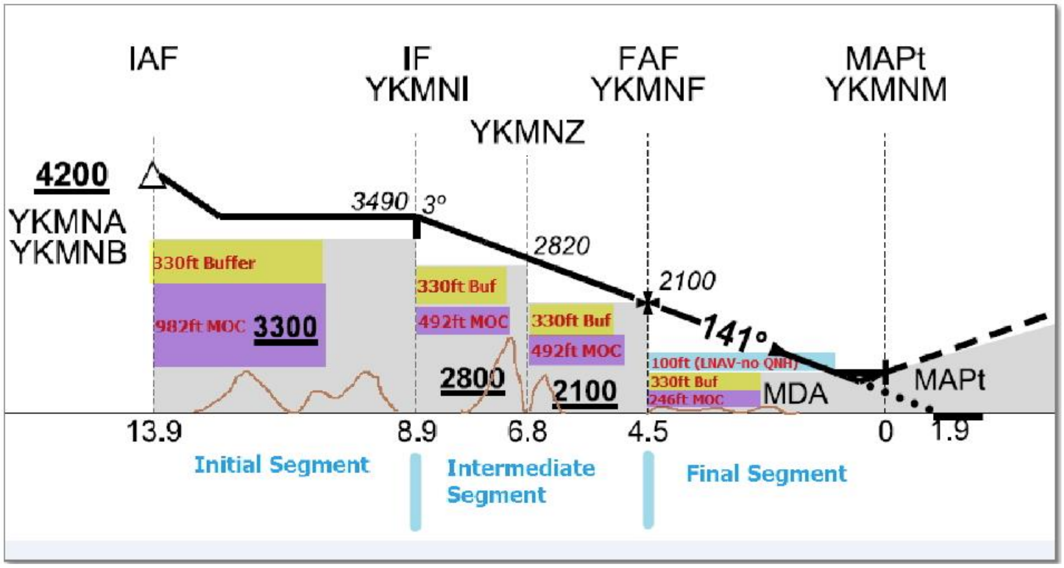
- All known terrain and obstacle data, including vegetation, must be accounted for.
- Allowances must be made for vegetation growth and new obstacles between surveys.

Tolerances for Different Obstacles

- **Surveyed Obstacles**: Horizontal tolerance of 0-10 meters, vertical tolerance of 0 meters, and vegetation tolerance of 0 meters.
- **Triangulation Points**: Horizontal tolerance of 0-10 meters, vertical tolerance of 0 meters, and vegetation tolerance of 30 meters.
- **Spot Heights**: Horizontal tolerance of 25 meters, vertical tolerance of 5 meters, and vegetation tolerance of 30 meters.
- **Contours**: Horizontal tolerance of 25 meters, vertical tolerance of 10 meters, and vegetation tolerance of 30 meters.
- **Shipping**: Vertical tolerance of 30 or 45 meters.

Obstacle Clearance Buffer Factor

- A 100-meter (330 feet) buffer is applied to all terrain data to mitigate obstacles not included in the provided data and to account for accuracy issues.
- This buffer is applied to every segment of an IFR flight procedure.



Application

- **Buffer Size**: A buffer of 100 meters (330 feet) is applied to all terrain data. This buffer helps mitigate the risk of obstacles that are not captured in the data provided.
- **Survey Specifications**: According to Annex 15 survey specifications, obstacles below 100 meters within area 2D (10-45 km from the aerodrome) are not required to be collected. However, within 10 km of the aerodrome, the threshold for obstacle collection is lower.
- **IFR Flight Procedures**: The buffer is applied to every segment of an IFR flight procedure to ensure that the flight path is free from obstacles.

Additional Buffer for Certificated Aerodromes

- **Part 139 Certificated Aerodromes**: For areas where obstacle monitoring and reporting are possible by Part 139 certificated aerodromes, an additional buffer of 133 feet is applied. This provides an extra layer of safety in regions where more precise obstacle data is available.

Importance

- **Safety**: The buffer factor is essential for maintaining a safe flight path, especially in areas where obstacle data may be incomplete or outdated.
- **Accuracy**: By applying this buffer, the procedure accounts for potential inaccuracies in the terrain and obstacle data, ensuring that the flight path remains clear of any unforeseen obstacles.

Adjustment for Remote Altimeter Setting

The adjustment for remote altimeter settings in non-precision approach procedures involves several key considerations:

1. **Altimeter Setting Adjustments**:
   - **24-hour TAF Availability**: At aerodromes with a 24-hour TAF (Terminal Aerodrome Forecast) and no 24-hour ATC tower service, add 100 ft (3 hPA) to the lowest Obstacle Clearance Altitude (OCA) in the Final Approach, and to the Minimum Obstacle Clearance Altitude (MOCA) in the Intermediate and Initial phases.

- **Limited TAF Availability**: At aerodromes where TAF is not available 24 hours, add 150 ft (5 hPA) to the lowest OCA in the Final Approach, and to the MOCA in the Intermediate and Initial phases.

2. **Minimum Descent Altitude (MDA)**:
   - The MDA box will be shaded to allow a reduction of 100 ft if local QNH (atmospheric pressure at sea level) is available from an approved source.

3. **Obstacle Considerations:**
   - All known obstacles, including vegetation, must be accounted for.
   - Allowances for vegetation growth and new obstacles between surveys must be made:
     - *100 ft over open country or water suitable for leisure boating.*
     - *200 ft over tropical rain forest, open water, or built-up areas.*
   - If known obstacles exceed these values, the greater value must be used, or Obstacle Clearance Buffers can be applied to account for local QNH inaccuracies.

These adjustments ensure that the approach procedures maintain safety margins despite variations in altimeter settings and potential obstacles.

Straight-in Non-Precision Approach Procedures

Specific guidelines for designing straight-in non-precision approach (NPA) procedures.

4. **Design Criteria**: NPAs should be designed as straight-in approaches following PANS-OPS Vol II alignment criteria.

5. **Additional Requirements**: To qualify as a straight-in NPA, the runway must meet more stringent requirements than those in PANS-OPS, including:
   - Compliance with Part 139 and Annex 14 for non-precision approach runways.
   - Obstacle Limitation Surfaces based on strip width.
   - Visual Segment Surfaces (VSS) obstacle clearance during the final approach segment
   - Runway edge lighting with a maximum spacing of 90 meters at night.
   - Wind direction indicator (WDI) near the threshold or acceptable alternatives like AWIS or an approved observer.

6. **Assessment and Validation**: If any requirements are not met, the procedure may be designed as Circling or Cloud-break. The adequacy of the WDI and other aspects must be assessed during flight validation. For domestic aerodromes, the acceptability of the procedure is assessed by Director in consultation with relevant Stakeholders.

Gradients Overview:

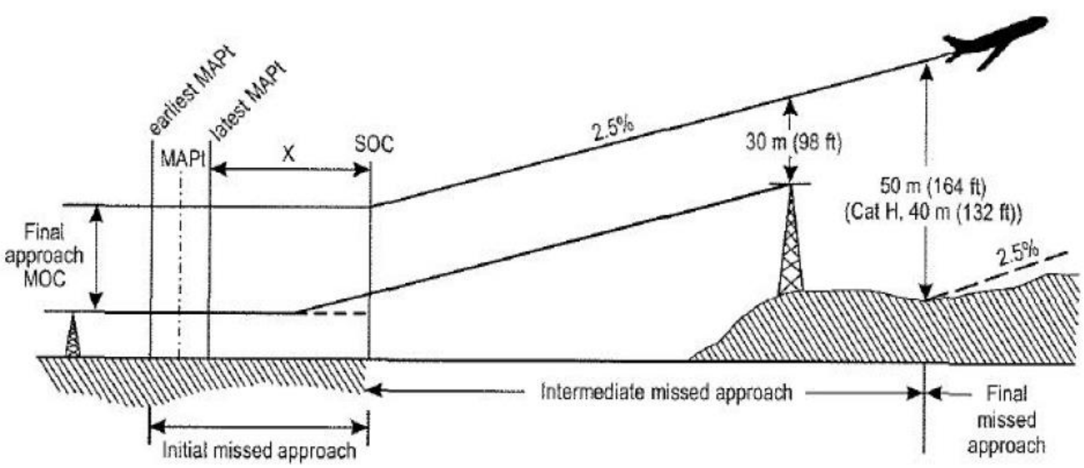
Definition: Gradient is the slope of climb/descent in the segment concerned, expressed as a percentage or in degrees (e.g., 5%, 4%, 3°, 3.5°).

Climb/Descent Gradients:

1. **Optimum and Maximum Gradients**:
   - Calculated according to PANS-OPS Doc. 8168, Vol-II.
   - The optimum gradient is preferred operationally and should only be exceeded if necessary for obstacle clearance.
   - The maximum gradient must not be exceeded.
2. **Optimum Descent Gradient**:
   - Equates to a 3° glide path.
   - Maximum permitted gradients:
     1. **CAT A and B aircraft**: 6.5% (≈ 400 FT/NM), equivalent to a 3.8° glide path.
     2. **CAT C, D, and E aircraft**: 6.1% (≈ 370 FT/NM), equivalent to a 3.5° glide path.
   - Steeper gradients (>5.24%) are used only in exceptional circumstances and require consultation with Flight Operations Inspectors (FOIs) and relevant operators.

Missed Approach Gradients:

1. **Nominal Climb Gradient**:
   - 2.5% (≈ 152 FT/NM) is standard.
   - Provides a minimum obstacle clearance of 30m (98 ft).
   - Can be adjusted (2.0% to 5%) based on operational needs and must be published on the approach chart.
2. **Special Considerations**:
   - If the climb gradient cannot be achieved due to degraded performance (e.g., engine inoperative), the DA/H or MDA/H should be increased or other actions taken to ensure obstacle clearance.
   - Gradients used in the final approach segment for non-precision approaches, and preferably other segments, should be published.



Additional Notes:

No Descent During Turns: Maximum descents are calculated without considering any descent during turns.

Missed Approach Procedures:

To clarify the procedures and considerations for missed approaches as follows;

1. **Track Guidance Avoidance:**
    - Missed approaches should ideally not rely on track guidance from navaids or GNSS due to potential failures.
    - However, guidance may be specified once a turn back to the navaid can be made with a minimum obstacle clearance (MOC) of 164 feet.

2. **Critical Terrain Considerations:**
    - For terrain above 5,000 feet, the MOC of 164 feet must be multiplied by 1.5.
    - For terrain above 10,000 feet, the MOC must be multiplied by 2.

3. **Manual Protection Area:**
    - If software cannot produce a non-track-guidance template, the protection area must be manually drawn.
    - Guidance for constructing a “dead reckoning” (DR) missed approach segment is provided in PANS-OPS.

4. **Essential Track Guidance:**
    - If track guidance is essential due to adjacent terrain, charts must alert pilots.
    - An alternative approach without track guidance must be provided, even if it results in a higher minimum descent altitude (MDA).

5. **GNSS Approach Considerations:**
    - Track guidance is not assumed after a GNSS approach due to potential RAIM loss.
    - Guidance may be assumed from the first point where continuous MOC of 164 feet is available.
    - Continuous RAIM availability may be considered if the approach is designed for GPS receivers meeting specific standards (TSO-145a or TSO-146a).

6. **DME-only Approaches:**
    - No track guidance is available during a DME-only approach.
    - An altitude must be specified from which an aircraft can home to the DME, ensuring continuous MOC of 164 feet.

7. **Chart Annotations:**
    - Charts must state whether track guidance is needed.
    - If not required, the term “DR Track” follows the track specification.
    - If required, the term “from (navaid ident)” follows the track specification.

8. Secondary Areas:

- If track guidance is used, secondary areas specified in PANS-OPS may be applied.
- If a turn is required at the missed approach point (MAPt), secondary areas may be applied to the outside of the turn.

Visibility Criteria

Basic Value Determination

The basic value for runway approach procedures, other than Category 2 or Category 3, shall be determined as follows:

(a) Required Visibility (Basic value) = $\sqrt{(A^2+DH^2)}$ (in metres)

Where A = horizontal visibility (in metres)

DH = decision height (in metres).

To determine A:

(1). <u>For Runways with Approach Lights.</u>

A = C + 160
Where A = horizontal visibility (in metres)
Where C = the greater of:
horizontal distance DH point to lights, or
DH (in metres) / tan(cockpit cut-off angle)

(2). <u>For Runways without Approach Lights.</u>

A = D + 160
Where A = horizontal visibility (in metres)
Where D = the greater of:
(a) horizontal distance DH point to threshold, or
(b) DH (in metres) / tan(cockpit cut-off angle)

Alternatively:

(b) Required Visibility (Basic value) = √(A2+DH2) (in metres)

Where A = horizontal visibility (in metres)

DH = decision height (in metres).

To determine A:

(3). <u>For Runways with Approach Lights.</u>

A = C + 160
Where A = horizontal visibility (in metres)
Where C = the greater of:

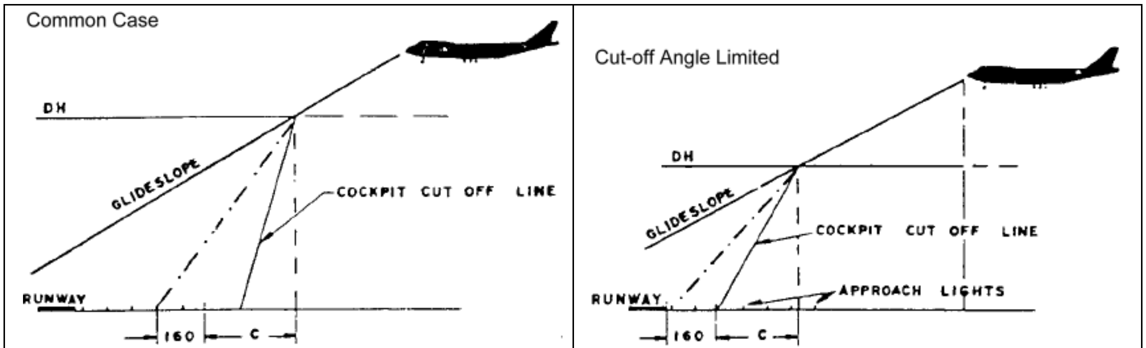
(a) ((DH - TCH) in metres / tan (Glide slope angle)) - APLL, or
(b) DH (in metres) / tan(cockpit cut-off angle)

Where DH = decision height TCH =

threshold crossing height APLL =
approach lighting length

(1). <u>For Runways without Approach Lights.</u>

As for (1) above except APLL equals zero.

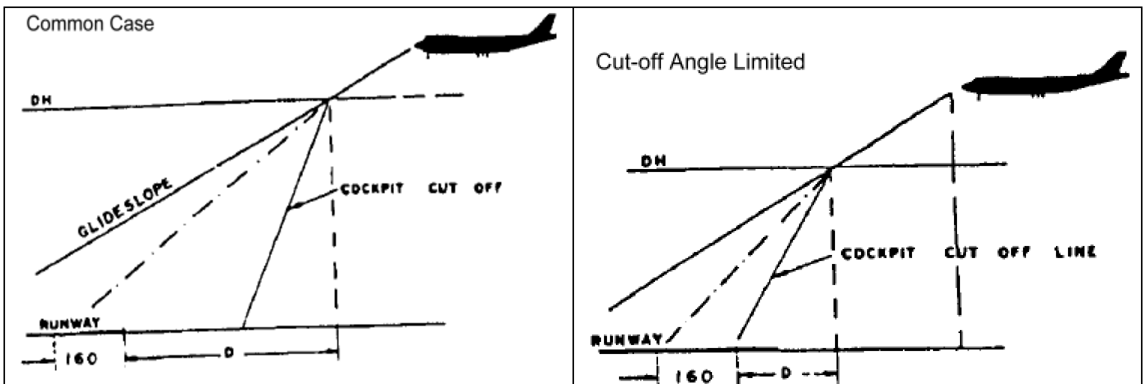


The line marked as -.-. indicates the required slant visibility.

Runways with Approach Lighting

Note:

1. *Cockpit cut-off angles of 14° or greater do not become significant until DH/MDA is reduced below 250 ft.*
2. *If cockpit cut-off angle cannot be determined a value of 14° shall be used.*
3. *Non precision procedure calculations shall assume a 3° glide path and a 50 FT TCH.*



The line marked as -.-. indicates the required slant visibility.

Runways without Approach Lighting

Category 2 Procedures:

- No provision is made for the determination of basic visibility for Category 2 procedures.
- The only type of ILS procedure to be approved in PNG is Category 1, and the design of any other type of ILS procedure will not be accepted.

Circling Visibility:

- The basic circling visibility ensures the pilot can see the runway from the downwind position.

- Formula: V=0.9DV=0.9D, where VV is circling visibility and DD is the distance for turn at the average maneuvering speed.
- Minimum circling visibility values are provided for different aircraft categories:
  1. Category A: 2400 meters
  2. Category B: 2400 meters
  3. Category C: 4000 meters
  4. Category D: 5000 meters
  5. Category E: 7000 meters
- The formula is applied if the circling altitude exceeds 2,000 feet AMSL. Default values are used otherwise.

Calculation Details:

- TAS and turn radius are rounded up to the next whole number.
- Wind-affected turns through the first and second 90º of heading change are calculated and rounded to three decimal places.
- The resultant visibility value is expressed in meters, rounded up to the next whole 100 meters.
- Calculations can be formulated in a spreadsheet or dedicated computer program, with results included in the procedure design record.

Cloud break

The same general principles are applied to a Cloudbreak, to determine minimum visibility. Calculations assume that a pilot will execute a course reversal in the visual segment, as an escape manoeuvre, with visual reference equivalent to the radius of turn. Calculation criteria is as follows: -

1. **Speed**: Use the maximum final approach speed for the aircraft category.
2. **Altitude**: Take the highest procedure MDA, add 500 feet, and round up to the next higher whole 500 feet.
3. **Conditions**: No adjustments for temperature, wind velocity, or bank angle.
4. **Visual Turn Initiation**: Allow for 6 seconds of flight at TAS plus tailwind (3 seconds for pilot recognition and 3 seconds for aircraft reaction). Add this distance to the radius of turn to calculate visibility.
5. **Radius of Turn**: Calculate with drift allowance according to PANS-OPS for the first 90 degrees of turn at a 20º bank angle.
6. **Obstacle Reaction Time**: Allow another 6 seconds for the pilot to see and react to obstacles not covered by the procedure's protection areas.
7. **Distance Calculation**: Convert the total distance to meters and round up to the next whole 100 meters.

A full explanation and justification is provided at ***Cloud-Break Visibility Criteria below***

Side Step Procedure

A Side Step Procedure allows a pilot to perform a visual maneuver at the end of an instrument approach to land on a parallel runway within 1,200 feet of the original runway.

1. **Glide Slope and Threshold Crossing Height (TCH)**: Assume a 3° glide slope and a 50-foot TCH for both the visual segment and the instrument procedure, unless otherwise specified.
2. **Approach Lighting**: No reduction in calculations is allowed due to the availability of approach lighting.

The basic value for sidestep procedures is calculated from the start of the visual segment to the threshold of the landing runway

Minimum visibility requirements and limitations for landing:

1. **Visibility Values**: Quoted in meters to allow easy comparison with the visibility shown on a TAF (Terminal Aerodrome Forecast).
2. **Landing Visibility Calculation**:
   - Calculated using the Visibility Criteria Determination.
   - If the calculated visibility exceeds the minimum visibility for circling for a specific aircraft category, the circling value is applied unless it falls within the following ranges:

Visibility Range by Aircraft Category:

- **Categories A + B**: Basic + 500 meters
- **Category C**: Basic + 200 meters
- **Category D**: Basic + 400 meters

3. **Basic Value**: Derived according to the Visibility Criteria Determination. If the calculated result is within the specified range for any aircraft category, that value is used, and the required circling visibility is increased according to the table above.

Minimum Visibility for Straight-In Procedures (Category I)

Lighting and Marking	DH (ft)	RVR (m)	VIS (m)
High intensity approach lighting (HIAL) (900 m length), high intensity runway lighting (HIRL), and runway markings, as for a precision approach runway Category I	200-250	550	800
	>250	1,000	1,200
Short HIAL or approved approach lighting system, HIRL, and runway marking as above			
HIAL <900 m and >740 m	200-250	800	800
For other HIAL length or other approved approach lighting systems	>250	1,000	1,200
Approved lighting and marking not mentioned above	>250	1,500	1,500

Limitations on Visibility Values

- Minimum values may not be reduced by credit for cockpit cut-off angle.
- RVR values of less than 800 meters must be determined by transmissometer measurement or a system of similar accuracy.

Minimum Values for Precision Approach Categories II and III

Approach Type	Minimum RVR (m)	Runway Capability
Precision approach Category II	350	Precision approach runway Category II. Precision approach Category II and III lighting system. Touchdown Zone (TDZ) Runway Visual Range (RVR) sensor and at least 1 RVR sensor at either the MID point or END zone.
	300	In addition to the runway capability requirements for operations with a minimum RVR of 350 m, the runway has: (a) runway centreline lighting with a longitudinal spacing that applies to a runway intended for use in RVR conditions less than a value of 350 m; and (b) either: (i) an ILS classified at least II/D/2; or (ii) taking into account any associated operating limitation, a precision approach facility that has performance characteristics at least equivalent to an ILS classified at least II/D/2.
Precision approach Category IIIA	175	Precision approach runway Category III. Precision approach Category II and III lighting system.
Precision approach Category IIIB	75	RVR sensors at all zones.
Precision approach Category IIIC	Not applicable	

Cloud-Break Visibility Criteria

1. Background

- **Purpose**: Develop Cloud-break approach procedures for situations where the Missed Approach Point (MAPt) must be outside the circling area due to terrain proximity.
- **Previous Method**: Applied circling visibility criteria, suitable for sea-level locations but problematic at higher altitudes due to increased True Air Speed (TAS) and larger turn radius.

2. Circling Criteria Application

- **Factors Considered**:
  1. Circling IAS as specified in PANS-OPS.
  2. TAS based on IAS at aerodrome elevation plus 1,000 feet at ISA +15 degrees.
  3. Omni-directional wind velocity of 25 knots.
  4. Average achieved bank angle of 20 degrees.
- **Formula**: ($V = 0.9D$), where (V) is minimum circling visibility and (D) is the distance for turn at the average maneuvering speed for the category.
- **Minimum Visibility**: If the calculated result is less than 2,400 meters, the minimum visibility value to be applied is 2,400 meters.

3. Cloud-break Procedures Application

- **Standard Criteria**: Suitable for aerodromes with ARP elevation not exceeding 1,000 feet or MDA not above 2,000 feet.

- **Higher Altitudes**: Requires consideration of aircraft configuration beyond the circling area and differences between visual and instrument-based maneuvers.

4. New Methodology

- **Airspeed**: Uses final approach IAS instead of circling IAS.
- **Altitude**: Highest procedure MDA plus 500 feet, rounded up to the next higher whole 500 feet.
- **Conditions**: Temperature ISA +15, wind velocity 25 knots, and bank angle 20°.
- **Turn Initiation Area**: Includes 6 seconds of flight at TAS plus tailwind for pilot recognition and reaction.
- **Turn Radius Calculation**: Based on PANS-OPS formula, including drift allowance.
- **Visibility Calculation**: Adds distance for obstacle reaction time, resulting in a total distance converted to meters and rounded up to the next whole 100 meters.

Example Calculations

- **Visibility Values**: Provided for various airports and aircraft categories, showing the impact of the new methodology.

5. Limitations

- **Visibility Minima**: Criteria for design altitudes not exceeding 2,000 feet continue to be based on standard circling visibility minima.

Tables

Table 5 A-1: Previously Published Values

Airport	Category A	Category B	Category C
Mendi	3100 m	3100 m	4900 m
Moro	3900 m	3900 m	4700 m
Tabubil	2900 m	2900 m	4200 m
Tari	2900 m	2900 m	4900 m

Table 5 A-2: Visibility Values Based on Standard Circling Criteria

Airport	Category A	Category B	Category C
Mendi	2700 m	4400 m	7000 m
Moro	2400 m	4000 m	6600 m
Tabubil	2400 m	3900 m	6400 m
Tari	2600 m	4200 m	7000 m

Table 5 A-3: Cloud-break Visibility Values (Justified)

Airport	Category A	Category B	Category C
Mendi	3400 m	3400 m	4600 m
Moro	3100 m	3100 m	4200 m
Tabubil	3100 m	3100 m	4200 m
Tari	3300 m	3300 m	4500 m

The new methodology provides a more conservative and operationally justified approach to determining visibility minima for Cloud-break procedures, especially at higher altitudes. It ensures that pilots have sufficient visibility to maintain visual reference and react to obstacles during the approach and potential course reversal.

Containment of Procedure

Primary MOC Areas

- **Primary MOC areas** (Minimum Obstacle Clearance areas) associated with each segment of an approach must be entirely within any controlled airspace around the airport.
- There must be a **clear area of at least 1NM** between the boundaries of the primary MOC areas and the relevant airspace boundary to ensure safety and separation.

Controlled Airspace

- For the purposes of these guidelines, **controlled airspace** includes:
  - **TMA** (Terminal Control Area)
  - **CTR** (Control Zone)
  - **ATZ** (Aerodrome Traffic Zone)
  - **MBZ** (Mandatory Broadcast Zone)
- Other types of airspace, such as **special airspace** (defined in CAR Part 73, including Prohibited, Restricted, and Danger areas) and broader airspace areas like **FIR** (Flight Information Region), **FIA** (Flight Information Area), and **sub-FIA**, must also be considered in the design of an Instrument Approach Procedure (IAP).

Communication and Separation

- Ensuring that all air traffic in the vicinity of each IAP is on the same frequency is crucial for communication, traffic information, and separation purposes.

Missed Approach Segment

- The primary MOC areas for missed approach segments may extend beyond all boundaries except the FIR. This acknowledges the potential need for significant length in design, though it is rarely used in practice.
- To determine this containment, calculate the distance in the climb using a gradient of **5% (304 feet/NM)**.

Procedures Outside Controlled Airspace

- Procedures should be designed to avoid controlled airspace, restricted/danger/prohibited areas, or other hazardous areas like glider or blasting areas.
- If procedures overlap these areas, the primary area of the procedure must remain clear, and the secondary area should also remain clear if possible.

Separation

- It is recommended to apply suitable horizontal and vertical separation between the procedure protection areas and the surrounding airspace to ensure safety.

Safety Assessment

- A safety assessment case must be conducted and submitted with the Procedure Design Package (PDP) if procedures do not comply with this standard.

Consultation

Consultation with ATS Specialists

- **Early Consultation**: Procedures for use within controlled airspace require early consultation with Air Traffic Services (ATS) specialists.
- **Prior Authorization**: Relevant ATS staff must be consulted before authorizing the publication of an Instrument Approach Procedure (IAP) involving controlled airspace.

Consultation for Navaid Installation or Relocation

- **Essential Consultation**: If an IAP is needed due to the installation or relocation of a conventional navaid, consultation with installation specialists is essential.
- **Information Availability**: This ensures that all necessary information, including navaid flight test documentation, is available to the designer.
- **Commissioning Certificate**: An IAP must not be used until the Commissioning Certificate for the navaid is issued.

Consultation with the Aviation Industry

- **Industry Consultation**: Development of new procedures requires consultation with the aviation industry to ensure the procedure is needed and beneficial.
- **Expedited Matters**: Lack of response by the due date is considered acceptance to expedite the process.