CIVIL AVIATION AUTHORITY
OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

Advisory Circular
AC173-1

Revision 0

Instrument Flight Procedure Design

31 August 2012

General

Civil Aviation Authority (CAA) Advisory Circulars (ACs) contain information about standards, practices, and procedures that the Director has found to be an **acceptable means of compliance** with the associated rule.

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 AC.

Purpose

This AC describes an acceptable means of compliance with Civil Aviation Rule Part 173 Subpart D *Design criteria-instrument flight procedure*.

Related Rules

This AC relates specifically to Civil Aviation Rule 173.201.

Change Notice

This is the initial issue of AC173-1.

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Introduction

Civil Aviation Rule Part 173 provides for the certification and operation of organisations undertaking instrument flight procedure design within New Zealand. It also includes the technical standards for design of an instrument flight procedure (IFP).

Civil Aviation Rule Part 173 Subpart D specifies the design criteria for instrument flight procedures in particular the relevant ICAO documents and standards. ICAO Document 8168, Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) – Volume I Flight Procedures, and Volume II Construction of Visual and Instrument Flight Procedures is the base instrument procedure document. The content of Document 8168 Volume II contains several requirements which can be ambiguous and interpreted in different ways. In order to ensure all Part 173 certificated organisations are working to the same criteria this Advisory Circular clarifies the application of ICAO Document 8168 requirements for New Zealand.

Maintenance of instrument flight procedures

Instrument Flight Procedure Review

Civil aviation rule 173.101 requires the holder of an instrument flight procedure service certificate to continue to meet the standards and comply with the requirements of Subpart B prescribed for certification under Part 173. In this regard, the certificate holder is required under rule 173.63, to review all instrument flight procedures on a periodic basis.

The purpose of the periodic review is to ensure continuous compliance with changing criteria, to confirm adequate obstacle clearance and ensure that the IFP continues to meet user requirements.

It is considered that the maximum acceptable period for an IFP review is 5 years.

Visual Segment Surface

PANS-OPS Volume II, Part I, Section 4, Chapter 5, paragraph 5.4.6 introduced the requirement for a Visual Segment Surface (VSS) for procedures designed after 15 March 2007. Paragraph 5.4.6.3 requires that straight-in instrument approach procedures published before 15 March 2007 shall be protected in the visual segment by means of the VSS after the periodic review of the procedure, but no later than 15 March 2012.

Due to the volume of instrument procedures to be reviewed the deadline for implementation of VSS on existing straight-in approaches for New Zealand is extended to 15 March 2015. An Aeronautical Information Circular (AIC) listing the aerodromes with VSS assessed and those where the VSS has not been assessed will be issued. The AIC will be regularly updated until the review programme and VSS implementation completed.

Base width

The base width of the VSS is detailed in paragraph 5.4.6.1 as 300 metres for Code 3 and 4 runways and 150 metres for Code 1 and 2. Many New Zealand certificated aerodromes do not have 150 or 300 metre strips and to meet this requirement would require additional survey and obstacle removal. The Australian Civil Aviation Safety Authority has allowed the use of the runway strip in lieu of the PANS-OPS criteria and proposed a change to ICAO. The ICAO Instrument Flight Procedures Panel have agreed to a proposed change to the PANS-OPS

criteria to make the VSS base width equal to the runway strip which should be updated in 2013.

The CAA accepts the base width of the VSS as the published and surveyed runway strip width.

VSS Penetration

If the VSS is penetrated in accordance with PANS-OPS Volume II, Part I, Section 4, Chapter 5, paragraph 5.4.6.4 an aeronautical study must be undertaken. The preferred mitigation options are to increase the nominal vertical path angle (VPA) or displace the runway threshold. To ensure a consistent application of aeronautical study mitigations the following are other acceptable mitigations to be applied:

Aircraft Track

When an approach is offset due to terrain the VSS area may be penetrated by the terrain which the approach is offset away from. For offset approaches the VSS area still diverges by 15% on the side opposite the offset to protect aircraft positioning along the extended runway centreline once visual. It may be possible to mitigate these situations by requiring aircraft to fly the published track until past the VSS penetration.

Visibility

When the VSS is penetrated the IFP minimum visibility must be 1600m.

Identify Obstacle on Chart

The obstacle or associated spot height must be displayed on the approach chart in the Aeronautical Information New Zealand (AIPNZ). A boxed warning can also be used to identify VSS penetrations.

Lighting

For approaches used at night VSS penetrations not otherwise mitigated must be lit. If the approach requires the obstacle to be lit then the lighting must have a monitoring system and a process established for when the lighting is not operational. If there is already lighting in the vicinity of the penetration that can be taken into account in assessing the necessity for other lighting.

Final Approach Segment

Straight-in approach criteria

PANS-OPS Volume II, Part I, Section 4, Chapter 5, paragraph 5.2.2 provides details on the criteria for the straight-in approach area in the final approach segment. This section needs clarification and expansion in regard to the New Zealand application. The following applies to straight-in approaches:

Minimum distance for intersect

In addition to PANS-OPS criteria in paragraph 5.2.2, the missed approach point (MAPt) for an approach with offset final approach track (FAT) must be located on or prior to the intersection with the runway extended centreline. Where this criteria cannot be met (VOR only or NDB only procedures) the FAT must be aligned to be within 150m laterally of the extended runway centre line at a distance of 1400m out from the runway threshold in order to be published as a straight-in approach.

A FAT can intersect the extended runway centreline at a distance less than 1400m provided the maximum FAT offset is 5° or less and the FAT is aligned to be within 150m laterally of the extended runway centre line at a distance of 1400m out from the runway threshold.

A FAT intersecting the extended runway centreline at a distance down to 900m is allowed for aircraft categories up to Cat C where operationally justified. The AIPNZ chart is to be annotated "Not in accordance with ICAO PANS-OPS straight-in criteria, FAT intersects RWY CL at *<xx>* M from RWY"

Maximum angle between final approach track and centreline

The maximum allowable offset angle between the FAT and the runway centreline is 30 degree for aircraft categories up to Category C in situations where operationally justified. The chart is to be annotated "Not in accordance with ICAO PANS-OPS straight-in criteria, FAT offset *<xx>* degrees"

The obstacle clearance altitude/height (OCA/H) adjustment as per PANS OPS Volume II, Part I, Section 4, Chapter 5, Appendix A applies. The actual value is be calculated rather than using a tabulated value.

Exceptions

An IFP published prior to January 2012 that do not meet expanded PANS-OPS criteria as detailed above can be approved for continued use subject to written approval from the CAA.

In some situations there may be procedures that do not meet the guidelines outlined in regard to the PANS OPS alignment requirements but an operator may request to have the procedure published as straight in. In this situation an aeronautical study must be carried out and if the procedure is published it will require aircraft and aircrew special authorisation by the CAA. Authorisation is only available to Part 121, Part 125 & Part 135 certificated operators.

Circling approach

Alignment of the FAT

In addition to the FAT alignment within 1NM of the usable landing surface detailed in PANS-OPS Volume II, Part I, Section 4, Chapter 5, paragraph 5.2.3 the MAPt is to be located within the area assessed for circling.

For example - The following distances apply for each aircraft category: CAT A 1.68NM, CAT B 2.66NM, CAT C 4.2NM, CAT D 5.28NM. If the procedure is to accommodate CAT A aircraft then the MAPt normally needs to be within 1.68NM of the runway. If the circling areas are combined for assessment then the larger value will apply e.g. CAT A & B circling.

Cloud-break procedures

Cloud-break procedures can be designed in cases where a straight-in approach is not possible and the circling approach criteria regarding final approach track alignment cannot be met, or the MAPt is not located within the circling area applicable to the aircraft category.

The following criteria must be met for cloud-break procedures:

- The procedure is only available to Category A and B aircraft
- The Obstacle Clearance Height (OCH) lower limit is 500ft
- The Final approach MOC is 150m.
- The Minimum visibility is 5km

- The MAPt for the procedure cannot be more than 10 NM from the destination aerodrome reference point.
- The procedure is available for day operations only.

The procedure is to be published using the naming convention for circling approach. The approach chart shall be annotated:

"This procedure is specified to enable aircraft to establish required visual reference for continuation of visual approach to the landing RWY."

Cloud-break procedures should only be designed in exceptional cases when all other design options have been assessed as inadequate and it is an imperative to enable IFR operations at an aerodrome.

Descent gradient

Gradient/angle limits

For New Zealand the minimum/optimum descent gradient is 5.0% for the final approach segment of a non-precision approach with a final approach fix (FAF) (3° for a precision approach or approach with vertical guidance). This differs slightly from PANS-OPS Volume II, Part I, Section 4, Chapter 5, paragraph 5.3.1.1 which stipulates 5.2 per cent.

Determination of descent gradient for a non-precision approach with FAF

The descent gradient (g) for a non-precision approach with a FAF is computed using the equation: g = h/d. The values to be used are:

For a circling approach:

d = the lesser of the horizontal distance from the FAF to the MAPt, or the distance from FAF to the first usable portion of the landing surface, and

h = the vertical distance between the altitude/height over the FAF and the lowest circling OCA/H.

For cloud-break procedures use:

d = the horizontal distance from the FAF to 1NM before the MAPt (this to enable sufficient time for assessment of meteorological conditions for continuation of flight under VFR beyond MAPt)

h = the vertical distance between the altitude/height over the FAF and the OCA/H.

Approach Naming Conventions

ICAO Doc 8168 – PANS-OPS approach naming principles are to be used including the following:

Circling only approaches

For annotation of the circling-only approach procedures (i.e. not aligned with a specific RWY for straight-in landing). Example: VOR A
If more than one circling approach exists at an aerodrome, or at adjacent aerodromes managed by the same approach unit, each approach is to have a different suffix assigned to it, starting with the letter A.
(e.g. VOR A, VOR B, NDB C).

Two same type approaches

To differentiate between two separate approaches of the same type (e.g. VOR, NDB or RNAV), to the same RWY, suffixes are assigned starting from the letter Z. Any subsequent suffixes follow the inverse alphabetic order.
Example: RNAV (GNSS) Z RWY 16, RNAV (RNP) Y RWY 16

Helicopter approaches

A helicopter approach to a point in space or a helipad is to include the final approach track in the approach name.
Example: RNAV (GNSS) 027 or VOR 027

Aerodrome Operating Minima

Take-off and landing minima requirements are detailed in Civil Aviation Rule Parts 91, 121, 125 and 135. Aerodrome Operating Minima is published in the AIPNZ and is to be established in accordance with Appendix A to this Advisory Circular.

This minima is based on the European Joint Aviation Authorities Joint Aviation Requirement for the operation of commercial air transport (JAA JAR-OPS 1). The methodology is applicable to all new procedures from 30 June 2012 and for existing procedures as they come up for review.

Appendix A –Aerodrome operating minima

Landing

Category I Precision Approach

A Category I operation is a precision instrument approach and landing using ILS, MLS with a decision height not lower than 200 ft and with a runway visual range not less than 550 m.

Category I minima				
Decision height	**Facilities/RVR[1]**			
	Full[2&6]	**Intermediate[3&6]**	**Basic[4&6]**	**Nil[5&6]**
200 ft	550m	700m	800m	1,000m
201–250 ft	600m	700m	800m	1,000m
251–300 ft	650m	800m	900m	1,200m
301 ft and above	800m	900m	1,000m	1,200m

Note 1: These figures are either the reported RVR or the meteorological visibility when reported RVR not available.

Note 2: Full facilities comprise runway markings, 720 m or more of HI/MI approach lights, runway edge lights, threshold lights and runway end lights. Lights must be on.

Note 3: Intermediate facilities comprise runway markings, 420–719 m of HI/MI approach lights, runway edge lights, threshold lights and runway end lights. Lights must be on.

Note 4: Basic facilities comprise runway markings, <420 m of HI/MI approach lights, any length of LI approach lights, runway edge lights, threshold lights and runway end lights. Lights must be on.

Note 5: Nil approach light facilities comprise runway markings, runway edge lights, threshold lights, runway end lights or no lights at all.

Note 6: The Table is applicable to conventional approaches with a glide slope angle up to and including 4°.

Category II Precision Approach

A Category II operation is a precision instrument approach and landing using ILS or MLS with a decision height below 200 ft but not lower than 100 ft and a runway visual range of not less than 300 m.

Category II minima		
Decision height	**RVR[1]**	
	Aeroplane Category A, B & C	**Aeroplane Category D**
100 ft–120 ft	300m	300m[2]/350m
121 ft–140 f t	400m	400m
141 ft and above	450m	450m

Note 1: The values in the table represent the absolute minimum RVR under the most favourable operating conditions (e.g auto-coupled flight to below DH).

Note 2: If autoland operations supported by the airport facilities, RVR for cat D can be reduced to 300m

Category III Precision Approach

Category III operations are subdivided as follows:

(i) A operations. A precision instrument approach and landing using ILS or MLS with:

a) A decision height lower than 100 ft; and

b) A runway visual range not less than 200 m.

(ii) B operations. A precision instrument approach and landing using ILS or MLS with:

a) A decision height lower than 50 ft, or no decision height; and

b) A runway visual range lower than 200 m but not less than 75m.

Note: Where the decision height (DH) and runway visual range (RVR) do not fall within the same Category, the RVR will determine in which Category the operation is to be considered.

(iii) No Decision Height Operations. Operations with no decision height may only be conducted if:

a) The operation with no decision height is authorised in the Aircraft Flight Manual;

b) The approach aid and the aerodrome facilities can support operations with no decision height; and

c) The operator has an approval for CAT III operations with no decision height.

Note: In the case of 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)[1]
IIIA	Less than 100 ft	200m
IIIB	Less than 100 ft	150m
IIIB	Less than 50 ft	125m
IIIB	Less than 50 ft or No Decision Height	75m

Note1: Reported RVR must be available at the aerodrome in order to conduct Cat II or Cat III operations

Non-Precision Approach

The system minima for non-precision approach (NPA) procedures are not lower than the minimum descent height (MDH) values below.

System minima	
Facility	**Lowest MDH**
NPA with FAF	250 ft
NPA without FAF	300 ft

The following four tables are only applicable to conventional approaches with a nominal descent slope of not greater than 4°. Greater descent slopes will usually require that visual glide slope guidance (e.g. PAPI) is also visible at the Minimum Descent Height. The distance figures are either reported RVR or meteorological visibility.

RVR for non-precision approach – full facilities

Full facilities comprise runway markings, 720 m or more of HI/MI approach lights, runway edge lights, threshold lights and runway end lights. Lights must be on.

Non-precision approach minima - Full facilities				
MDH	**RVR/Aeroplane Category**			
	A	**B**	**C**	**D**
250–299 ft	800m	800m	800m	1,200m
300–449 ft	900m	1,000m	1,000m	1,400m
450–649 ft	1,000m	1,200m	1,200m	1,600m
650 ft and above	1,200m	1,400m	1,400m	1,800m

RVR for non-precision approach – intermediate facilities

Intermediate facilities comprise runway markings, 420–719 m of HI/MI approach lights, runway edge lights, threshold lights and runway end lights. Lights must be on.

Non-precision approach minima - Intermediate facilities				
MDH	**RVR/Aeroplane Category**			
	A	**B**	**C**	**D**
250–299 ft	1,000m	1,100m	1,200m	1,400m
300–449 ft	1,200m	1,300m	1,400m	1,600m
450–649 ft	1,400m	1,500m	1,600m	1,800m
650 ft and above	1,500m	1,500m	1,800m	2,000m

RVR for non-precision approach – basic facilities

Basic facilities comprise runway markings, <420 m of HI/MI approach lights, any length of LI approach lights, runway edge lights, threshold lights and runway end lights. Lights must be on.

Non-precision approach minima - Basic facilities				
MDH	**RVR/Aeroplane Category**			
	A	**B**	**C**	**D**
250–299 ft	1,000m	1,300m	1,400m	1,600m
300–449 ft	1,300m	1,400m	1,600m	1,800m
450–649 ft	1,500m	1,500m	1,800m	2,000m
650 ft and above	1,500m	1,500m	2,000m	2,000m

RVR for non-precision approach– Nil approach light facilities

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

Non-precision approach minima - Nil approach light facilities				
MDH	**RVR/Aeroplane Category**			
	A	**B**	**C**	**D**
250–299 ft	1,500m	1,500m	1,600m	1,800m
300–449 ft	1,500m	1,500m	1,800m	2,000m
450–649 ft	1,500m	1,500m	2,000m	2,000m
650 ft and above	1,500m	1,500m	2,000m	2,000m

Circling

PANS OPS provided minimum visibility values for circling procedures are used in New Zealand.

Visibility for circling vs. aeroplane category

	Aeroplane Category			
	A	**B**	**C**	**D**
Minimum meteorological visibility	1,900m	2,800m	3,700m	4,600m

Take-off minima

- Civil Aviation Rule 91.413(g) prescribes the default take-off minima for any aerodrome in New Zealand as 300ft ceiling and 1500m visibility unless otherwise prescribed in the AIPNZ.
- Specific lower take-off minima will only be published in the AIPNZ if:
    - the facilities at the aerodrome support lower minima than the default 300ft-1500m value; and
    - there is an evaluated instrument departure procedure promulgated for the RWY; and
    - the OIS (obstacle identification surface) for the instrument departure procedure is not penetrated.
- 300ft ceiling and 1500m visibility will apply at locations where close-in obstacles penetrating the departure OIS have not been considered in the calculation of instrument departure procedure design gradient. Information regarding such obstacles (description, position and height) will be promulgated on the SID chart. (Refer PANS-OPS Doc 8168 Vol II)
- Minima of 0ft–800m can be prescribed at an aerodrome provided conditions in the Table 1 below are met. Minima below 0ft-800m is only available to operators certificated under Civil Aviation Rule Parts 121, 125 or 129.
- An air traffic control service is a prerequisite for operations in visibilities 800m or below.

Table 1 - RVR/Visibility for take-off

Take-off RVR/Visibility		
Facilities	**RVR/Visibility[1]**	**Reference**
Nil	1500m[2]	CAR 91.413
RWY centreline marking, ATC on watch	800m[2]	CAR 91.413
Minima for certificated 121, 125 & 135 operators only:		
RWY CL markings, RWY edge lights, secondary power with automatic switch-over, ATC	550m	Annex 14
RWY CL markings, RWY edge lights, secondary power with automatic switch-over, ATC, TWY lights or other means of guiding aircraft, stopbars or LVP	400m	Annex 14
RWY CL lights, RWY edge lights, secondary power with automatic switch-over, ATC, TWY CL lights, stopbars or LVP	200/250m[3]	Annex 14, JAR-OPS1
RWY CL lights, RWY edge lights, secondary power with automatic switch-over, ATC,	150/200m [3,4]	Annex 14, JAR-OPS1

TWY CL lights, stopbars, LVP , multiple RVR information		
All of the above + HI RWY CL spacing 15m or less, HI RWY edge lights spacing 60m or less	125/150m [3]	Annex 14, JAR-OPS1
All of the above + Category III LOC guidance available for take-off	75m	Annex 14, JAR-OPS1

Note 1 The reported RVR/Visibility value representative of the initial part of the take-off run can be replaced by pilot assessment.

Note 2 For night operations at least runway edge and runway end lights are required.

Note 3 The higher values apply to Category D aeroplanes.

Note 4: The required RVR value must be achieved for all of the relevant RVR reporting points with the exception given in Note 3 above.

AIPNZ Publication notes

Take-off RVR	**Note**
800 m	Available during TWR HR
Less than 800m	OPS below 800m visibility available to operators authorised by CAA New Zealand only and subject to availability of serviceable secondary power supply and automatic switch-over