This paper presents a new concept in developing instrument procedures. As a result of the complete misunderstanding of the development and application of minimum IFR altitudes in instrument procedures, especially non-precision instrument approach procedures, by the aviation industry at large, it is now necessary to rethink the way non-precision instrument approach procedures are developed, presented and flown. This paper suggests a solution to this problem.
INTRODUCTION

The Controlled Flight Into Terrain (CFIT) initiatives proposed by the aviation industry, and supported by ICAO, are severely critical of non-precision approach procedures. Study of world wide CFIT accidents reveals that 24.8% of these accidents occurred in the final approach phase of flight with the majority of this percentage occurring on non-precision approach procedures. It is, therefore, understandable that non-precision approach procedures have been singled-out as a major contributor to CFIT accidents.

Non-precision approach procedures such as NDB, VOR, NDB/DME, VOR/DME, LOC and LOC/DME have been the mainstay of IFR approaches worldwide for many, many years. These navigation systems are relatively cheap and generally relatively easy to place into operation. Associated aerodrome standards to support non-precision approach procedures are less demanding than for precision approaches thereby making the non-precision approach procedure more attractive to aerodrome operators. In addition, the requirement for precision approach procedures may not have been warranted at locations where the weather conditions did not dictate the need for precision approaches. These factors, and perhaps others, resulted in many non-precision approach procedures being placed into operation.

INITIAL APPROACH SEGMENT DEVELOPMENT

Criteria to develop the non-precision approach procedure are contained in ICAO PANS-OPS Volume II. The initial approach segment altitude selection is predicated upon minimum altitudes established in 100 ft or 50 m increments, as appropriate, and the altitude selection shall not be below the reversal or racetrack procedure altitude where such a procedure is required. Furthermore, altitudes specified in the initial approach segment must not be lower than any altitude specified for any portion of the intermediate or final approach segments. For obstacle clearance purposes, the prescribed minimum altitudes for either the racetrack or reversal procedure shall not be less than 300 m (984 ft) above all obstacles within the appropriate initial segment areas. The optimum descent gradient in the initial approach is 4.0% (243 ft/nm or 2.29°) with a maximum gradient of 8.0% (486 ft/nm or 4.58°).

INTERMEDIATE APPROACH SEGMENT DEVELOPMENT

The intermediate approach segment altitude selection is predicated upon minimum altitudes established and rounded upwards to the nearest 100 ft or 50 m increment, as appropriate, and shall provide a minimum of 150 m (492 ft) of obstacle clearance in the primary area of the intermediate segment. The intermediate segment should be flat but if a descent is necessary, the maximum permissible descent gradient is 5.0% (303.8 ft/nm or 2.9°).

FINAL APPROACH SEGMENT DEVELOPMENT

The final approach segment minimum altitudes are established based upon the use of an Obstacle Clearance Altitude/Height (OCA/H). The OCA/H for a non-precision approach shall provide the appropriate minimum obstacle clearance (MOC) over the obstacles in the final approach area. It shall also ensure that missed approach obstacle clearance is provided. A Minimum Descent Altitude/Height (MDA/H) is established above the OCA/H taking into account operational considerations such as ground/airborne equipment characteristics, crew qualifications, aircraft performance, meteorological conditions, aerodrome characteristics, location of guidance aid relative to the runway, etc. These considerations form a margin between the OCA/H and MDA/H. MOCs for the final segment vary with the procedure:

   a) 90 m (295 ft) without Final Approach Fix (FAF); and
   b) 75 m (246 ft) with FAF.

MINIMUM IFR ALTITUDES

In developing non-precision instrument approach procedures, the criteria allows the procedure designer to identify altitudes that will provide the segment required obstacle clearance under conditions of a standard atmosphere. Generally, it is these altitudes that are published as part of the procedure and are meant to be a
“DO NOT DESCEND BELOW” altitude. Unfortunately, the aviation industry at large, to include database providers, avionics manufacturers, operators and pilots, all have mis-interpreted the application of a minimum IFR altitude and have systemically placed aircraft operations at the minimum IFR altitude unnecessarily.

DISCUSSION

The Flight Safety Foundation initiated CFIT study reports, in part, the following:

“Most CFIT accidents occur during nonprecision approaches, specifically VOR and VOR/DME approaches. Inaccurate or poorly designed approach procedures coupled with a variety of depictions can be part of the problem. There are documented cases that the minimum terrain clearance on some published approach charts have contributed to both accidents and incidents. For more than a decade, a worldwide effort has been under way to both raise and standardize the descent gradient of nonprecision approaches. There are gradients as little as 0.7 deg in some VOR approach procedures.”

Included in the report are many diagrams to illustrate the notion of shallow approach gradients on nonprecision approach procedures. One of the graphics is repeated here.

This graphic clearly demonstrates the misunderstanding, mis-interpretation and mis-application of a nonprecision instrument approach procedure. This mis-understanding is further exemplified by the FSF CFIT supporting documentation which states, in part, “Many, if not most, nonprecision approaches provide crossing altitudes at the final approach fix (FAF) that would require a descent path of less than the standard three degrees. There is no minimum approach slope and some nonprecision approaches show a possible descent profile of less than one degree.” (CFIT Report, Appendix F, Taking the “Non” out of the Nonprecision Approach by Captain DE Walker.)

The above procedure has minimum IFR altitudes established as 1700 feet until crossing D14.0, 1200 feet until crossing the FAF “SHEA” and 760 feet (the MDA) until the MAP. These altitudes are established as “DO NOT DESCEND BELOW” altitudes and provide the requisite obstacle clearance for each segment of the procedure under ISA conditions. Below ISA altimeter source temperature errors need to be corrected in accordance with PANS-OPS Volume I to ensure that the requisite obstacle clearance requirements are not
violated. The CFIT report charges that this nonprecision approach procedure has a very low approach slope from SHEA (the FAF) of 1.37°. Herein lies a major mis-application of minimum IFR altitudes. The non-precision approach procedure like the one above was not developed to account for any particular approach slope angle. All that is provided is a MINIMUM IFR crossing altitude at the identified fixes that will, under ISA conditions, provide the aircraft with the requisite obstacle clearance. Unfortunately the aviation industry has interpreted these minimum IFR altitudes as defining the approach slope angle for these non-precision approach procedures.

The flight path of the aircraft, as illustrated above, placed the aircraft slightly above the minimum IFR altitude for the segment of the procedure prior to the D14.0 fix. This is a most unusual altitude for the aircraft to be in order to fly a stabilized approach. In fact, the illustration clearly shows that for a stabilized 3.0 degrees vertical path, that aircraft should have been in the vicinity of 4000 feet MSL! It is interesting to note that a flight management system navigation database would also place this aircraft at the minimum IFR altitudes because the ARINC Specification 424 requires minimum IFR altitudes to be coded as “at” or a “hard” altitude. The navigation database and the flight crew have mis-interpreted the minimum IFR altitudes. In actual fact, what should have occurred is that the navigation database should have been coded to provide the aircraft with a 3.0° vertical path angle by having an altitude at the D14.0 coded that is coincidental with the 3.0° path – not the minimum IFR altitude of 1700 feet!

Why did the flight crew accept being near 1700 feet, the minimum IFR altitude for that segment, so far back from the airport (another mis-application)? Possibly because they were trained that way. The aviation industry has trained its pilots to fly to PUBLISHED altitudes without regard to the fact that these “DO NOT DESCEND BELOW” altitudes are only MINIMUM and not REQUIRED. In fact, supporting documentation to the FSF CFIT report identifies training and conditioning of pilots to treat the non-precision profile as the procedure to be flown as being a system wide deficiency. (FSF CFIT Report, Chart design revision could enhance safety of non-precision approach and landing operations by RT Slatter, ICAO Secretariat).

The procedure can be very effectively flown at altitudes above the minimum IFR altitude. Very basic airmanship dictates that for a 3.0° vertical path angle, an aircraft 10 NM from the runway threshold must be at least 3200 feet above the runway and 1600 feet above the runway at 5 NM. All flight crews, with or without a flight management system can utilize this simple rule-of-thumb although it becomes difficult without some means of distance information to the landing runway threshold. Anything lower than these altitudes at these distances must raise a warning flag to the crew to question why the aircraft is lower than where it should be.

Generally, in the past, non-precision approach procedures were developed by establishing minimum IFR altitudes for each segment. Because the aviation industry has mis-understood the non-precision approach procedure design, it appears necessary for the instrument procedure design to take into account this fact and establish procedures to dictate how an aircraft should be flown. In order to accomplish this, a major re-thinking of instrument procedure design must be done.

PROCEDURE ALTITUDES

This paper proposes amendments to PANS-OPS to include the notion of developing non-precision instrument approach procedures using what would be termed, “PROCEDURE ALTITUDES”. These altitudes would be developed and charted on the procedure to dictate (the use of the word “dictate” is intentional) to the pilot the appropriate altitudes to fly. These altitudes would never be lower than any minimum IFR altitude for the procedure and would ensure obstacle clearance even under identified conditions of altimeter source temperatures below ISA. It would be necessary to include the below ISA temperature these procedure altitudes would accommodate. The final, intermediate and initial approach segment of a non-precision approach procedure altitude would be developed based upon the premise of a 3.0° vertical path angle to a 50-foot TCH. The procedure altitudes would have a different depiction than the required minimum IFR altitude for each segment. It would be these PROCEDURE altitudes, and not the minimum IFR altitudes, that the data base suppliers must code into the navigation database.
MINIMUM IFR ALTITUDES

The non-precision instrument approach procedure would still require the establishment of minimum IFR altitudes for each segment of the instrument procedure. These minimum IFR altitudes would provide the pilot with the DO NOT DESCEND BELOW values and would be depicted on the instrument approach procedure chart very different to the procedural altitudes. The intent of including these minimum IFR altitudes is to ensure the pilot has the option to be able to utilise these altitudes should the need occur such as in icing conditions. These minimum IFR altitudes shall NOT be coded into the aircraft’s navigation database as part of the coded instrument procedure. Another Working Paper presented at this meeting addresses the Annex 4 chart depiction; however, the premise of the depiction would follow the concept presented in the figure below.

SINGAPORE MEETING

At the OCP Working Group meeting held in Singapore, 25 October to 05 November 1999, the WG had an opportunity to discuss the proposal above. Concern was expressed that having three types of profiles (procedural, minimum altitude and terrain) may cause too much clutter on the chart. To address this concern, this proposal does not include terrain profiling on the charts – only procedure and minimum altitudes. It is these altitudes that are critical information that must be presented to the pilot.

In the initial proposal at the Singapore meeting, the intermediate segment was indicated as a 3.00-degree descent path. In PANS-OPS, however, there is a requirement that this segment should be flat. It was argued that modern aircraft do not need such a horizontal segment. On the other hand, it was pointed out that the procedure should also be available to less sophisticated aircraft and therefore a need for a horizontal segment is existent. To address this concern, this proposal provides both a procedure and the minimum crossing altitude at the specific fixes thereby accommodating both applications. In general terms, a stabilized descent profile can also accommodate a level intermediate segment but this level segment should not be the minimum altitude associated with the intermediate segment.

One member explained the group that another group within ICAO had produced a State letter for amendment of Annex 4, dealing with the same charting issue. It was stressed that co-ordination should take place. The mentioned State letter did not address the issue of charting where most of the accidents occur – lined up with the runway from 10 nm to the threshold. This proposal will be supplemented with an Annex 4 amendment to establish Annex 4 charting specification for procedure and minimum crossing altitudes.

It was expressed that there should be a split in design philosophy between the segment from the FAF and the segments before the FAF. In essence, this split is already embedded within the proposed criteria. The final approach segment is restricted to a minimum descent path angle of no less than 3.00 degrees and a maximum of 3.77 degrees. These restrictions do not apply to the other segments.
Although there was some concern expressed at the Singapore meeting that there might be a potential problem concerning aircraft without a proper distance measuring equipment, this proposal was based on the recommendations of the CFIT Task Force and as such provided a viable change for those aircraft that need to fly a stabilized descent final approach segment.

In the end, there was general support for the concept of introducing procedure altitudes. With this in mind, this paper presents proposed amendments to PANS-OPS Volume I and II to accommodate this concept. The Meeting is invite to review and debate the proposed amendments.

RECOMMENDATION

Appropriate changes to PANS-OPS Volume I and II are presented. The members are invited to review and debate the proposed amendment to accommodate procedure altitudes.

- End -
PROPOSED AMENDMENTS TO PANS-OPS VOLUME II TO ACCOMMODATE PROCEDURE ALTITUDE CONSTRUCTION

PANS-OPS Volume II, PART 1 Chapter 1 Definitions:

Add the following definition:

*Procedure Altitude.* A specified altitude which is at or above the OCA, developed to accommodate a stabilized descent profile anchored on a 3-degree vertical flight path angle in the final approach segment and flown operationally instead of any minimum IFR altitude in the approach.

PANS-OPS Volume II, PART III – Introduction Page 3-1:

Add new paragraph at the end of the introduction as follows:

The aviation industry has identified that the majority of large aircraft accidents occur lined up with and within 19 km (10 NM) from the landing runway. To support the Controlled Flight Into Terrain (CFIT) prevention initiatives, instrument procedure design shall not only provide altitudes to ensure appropriate obstacle clearance but also procedure altitudes. Procedure altitudes are intended to place the aircraft above any minimum altitude associated with obstacle clearance and to support a stabilized 3 degree descent profile in the final segment.

PANS-OPS Volume II, PART III – General Criteria, Chapter 1 General Page 3-6:

Add new section 1.7 as follows:

1.17 Procedure Altitudes

Instrument procedure design in the past has been based upon the determination and publication of minimum altitudes associated with each segment of the instrument approach procedure. The operational application and use of these minimum altitudes has placed aircraft at minimum IFR altitudes unnecessarily. To support the CFIT prevention initiatives, all instrument approach procedures shall be developed to include not only the minimum altitudes to ensure obstacle clearance, but also procedure altitudes. Procedure altitudes shall be developed to place the aircraft at altitudes that would normally be flown to intercept and fly a minimum of a 3-degree vertical path angle in the final approach segment to a 15 m (50 ft) threshold crossing. In no case shall a procedure altitude be less that any OCA.

PANS-OPS Volume II, PART III – Chapter 2 Terminal Area Fixes, Page 3-15

Change figure to include procedure altitude depiction.
3.1.4 Procedure Altitude

**Procedure Altitude.** The procedure altitude shall not be less than the minimum altitude established by application of the MOC for the segment and shall be developed in co-ordination with Air Traffic Control requirements. The arrival segment procedure altitude should be established to allow the aircraft to intercept a 3-degree final approach segment descent path from the intermediate segment.

PANS-OPS Volume II, PART III – Chapter 4, 4-2 Altitude Selection, Page 3-18

Add new paragraph 4.2.3 as follows:

4.2.3. All initial approach segments shall have procedure altitudes established and published. Procedure altitudes shall not be less than the minimum altitude established by application of the MOC and shall be developed in co-ordination with Air Traffic Control requirements. The initial segment procedure altitude should be established to allow the aircraft to intercept a 3-degree final approach segment descent path from the intermediate segment.

PANS-OPS Volume II, PART III – Chapter 4, Page 3-19

Replace current paragraph 4.3.5 Descent Gradient with the following:

4.3.5 **Procedure Altitude/Descent Gradient.** Procedure altitudes shall be established to accommodate an optimum 5.24% gradient (3-degree vertical flight path descent). Where a higher descent gradient is necessary to avoid obstacles, the maximum permissible is 8.0 per cent. In this case, the procedure altitude would equal the minimum altitude established by the MOC.

PANS-OPS Volume II, PART III – Chapter 4, Page 3-27

Add new section, 4.9 Procedure Altitude as follows:

**4.9 PROCEDURE ALTITUDE**

Racetrack or reversal procedure altitudes shall not be less than the minimum altitude established by application of the MOC and shall be developed in co-ordination with Air Traffic Control requirements. The racetrack or reversal procedure altitude should be established to allow the aircraft to intercept a 3-degree final approach segment descent path from the intermediate segment.

PANS-OPS Volume II, PART III – Chapter 5 Intermediate Approach Segment, Page 3-28

Revise 5.6 DESCENT GRADIENT to read as follows:

**5.6 PROCEDURE ALTITUDE/DESCENT GRADIENT**

5.6.1 Because the intermediate approach segment is used to prepare the aircraft speed and configuration for entry into the final approach segment, this segment should be flat or at least have a flat section contain within the segment. If a descent is necessary the maximum permissible gradient shall be 5.24 per cent and a horizontal segment with a minimum length of 2.8 km (1.5 NM) should be provided prior to the final approach segment for Cat C and D aircraft. For specific procedures for Cat A and B aircraft, this minimum length may be reduced to 1.9 km (1.0
This should allow sufficient distance for aircraft to decelerate and carry out any configuration changes necessary before final approach segment.

5.6.2 Procedure altitudes in the intermediate segment shall be established to allow the aircraft to intercept an optimum final approach segment 5.24% gradient (3-degree vertical flight path descent). Where a higher descent gradient is necessary to avoid obstacles, the maximum permissible is 6.12 per cent. In this case, the procedure altitude would equal the minimum altitude established by the MOC.

**PANS-OPS Volume II, PART III – Chapter 6 Final Approach Segment, Page 3-33**

Amend last paragraph in 6.2.1 as follows:

For nominal descent gradients above 5.24 per cent, increase by 18 per cent the values of the table for each per cent of gradient above 5.24 per cent.

**PANS-OPS Volume II, PART III – Chapter 6 Final Approach Segment, Page 3-37B**

Add new section as follows:

**6.5 FINAL APPROACH DESCENT PATH ANGLES TO SUPPORT VERTICAL NAVIGATION (VNAV)**

6.6 To support VNAV operations in modern navigation systems, the final approach segment of all non-precision approach procedures shall include a descent path angle published in degrees to the nearest one-hundredth of a degree. Descent path angles shall be no less than 3.00 degrees and shall originate at a point 15 m (50 ft) above the landing runway threshold. Earth curvature shall not be considered in determining this descent path angle. Descent path angles shall not exceed 3.77 degrees.

6.7 A 3.00 degree descent path angle originating at a height of 15 m (50 ft) above the landing runway threshold and extending back to the FAF establishes the procedure altitude at the FAF (earth curvature is not applied). This procedure altitude shall not be less that the FAF minimum altitude established by application of the MOC. Because VNAV systems anticipate a descent in order to avoid overshooting the VNAV path, the FAF published procedure altitude shall be 15 m (50 ft) below calculated procedure altitude. See Figure III-6-6.

![Diagram](image)

**Figure III-6-6. Procedure Altitude vs Descent Path Angle**

6.8 Both the procedure altitude and the minimum altitude for obstacle clearance shall be published. In no case shall the procedure altitude be lower than the minimum altitude for obstacle clearance.
6.9 In cases where a 3.00 degree descent path angle does not clear a final approach segment stepdown fix minimum obstacle clearance altitude, the descent path angle shall be increased by raising the procedure altitude at the FAF to a point where the descent path angle clears. Where this option cannot be effected, the FAF shall be moved toward the landing runway to a point where the descent path angle clears all final approach segment stepdown fix altitudes.

PANS-OPS Volume II, PART III – Chapter 21 ILS, Page 3-70

Add new paragraph as follows:

21.2.4 Procedure altitude. Chapter 4, 4.9 applies.

PANS-OPS Volume II, PART III – Chapter 21 ILS, Page 3-71

Add new paragraph as follows:

21.3.6 Procedure altitude and descent path angle. Chapter 5, 5.6 applies.

PANS-OPS Volume II, PART III – Chapter 23 LOCALIZER ONLY, Page 3-96

Delete the current paragraph 23.3.5 and replace with the following:

23.3.5 Procedure altitude and descent gradient for an ILS procedure with glide path inoperative. Chapter 6, section 6.5 applies.

Revise Figure III-23-2 as indicated below:

![Diagram of Localizer-only procedure - obstacle clearance and procedure altitude]

PANS-OPS Volume II, PART III – Chapter 26, Page 3-110

Revise current section 26.5 Profile Descent with DME to read as follows:

26.5 PROCEDURE ALTITUDE AND DESCENT PATH ANGLES

26.5.1 Chapter 6, 6.5 applies. In addition, where a DME is suitable located, it may be used to define the distance/height relationship for the descent path angle required. This information shall be published on the appropriate chart, preferably in increments of 2 km (1 NM).

PANS-OPS Volume II, PART III – Chapter 28, Page 3-116

Add new section as follows:

28.3 PROCEDURE ALTITUDE AND DESCENT PATH ANGLES
26.6 Chapter 6, 6.5 applies. In addition, where a DME is suitable located, it may be used to define the distance/height relationship for the descent path angle required. This information shall be published on the appropriate chart, preferably in increments of 2 km (1 NM).

PANS-OPS Volume II, PART III – Chapter 30, Page 3-123

Add new section as follows:

30.2.4 Procedure altitude. Chapter 4, 4.9 applies.

PANS-OPS Volume II, PART III – Chapter 30, Page 3-124

Add new paragraph as follows:

30.3.6 Procedure altitude and descent path angle. Chapter 5, 5.6 applies.

PANS-OPS Volume II, PART III – Chapter 30B, Page 3-149

Replace existing 30B.3.5 with the following:

30B.3.5 Procedure altitude and descent gradient for an MLS procedure with glide path inoperative. Chapter 6, section 6.5 applies.

PANS-OPS Volume II, PART III – Chapter 30B, Page 3-150

Replace existing Figure III-030B-2 with figure below:

![Figure III-30B-2. Azimuth-only procedure – obstacle clearance and procedure altitude](image)

PANS-OPS Volume II, PART III – Chapter 31, Page 3-153

Add new paragraphs as follows:

31.4.3 Procedure altitude. Chapter 4, 4.9 applies.

31.5.5 Procedure altitude and descent path angle. Chapter 5, 5.6 applies.

31.6.6 Final approach segment path angles to support vertical navigation (VNAV). Chapter 6, 6.5 applies.

PANS-OPS Volume II, PART III – Chapter 33, Page 3-172
Add new paragraphs as follows:

33.4.6 *Procedure altitude.* Chapter 4, 4.9 applies.

33.5.4 *Procedure altitude and descent path angle.* Chapter 5, 5.6 applies.

33.6.4 *Final approach segment path angles to support vertical navigation (VNAV).* Chapter 6, 6.5 applies.

**PANS-OPS Volume II, PART III – Appendix A to Chapter 33, Page 3-175**

Replace existing paragraph 3.6 with the following:

3.6 *Procedure altitude.* Chapter 4, 4.9 applies.

Add paragraph as follows:

4.6 *Procedure altitude and descent path angle.* Chapter 5, 5.6 applies.

**PANS-OPS Volume II, PART III – Appendix A to Chapter 33, Page 3-177**

Add following paragraph:

5.6 *Final approach segment path angles to support vertical navigation (VNAV).* Chapter 6, 6.5 applies.
PROPOSED AMENDMENTS TO PANS-OPS VOLUME I TO ACCOMMODATE PROCEDURE ALTITUDE CONSTRUCTION

PANS-OPS VOLUME I, PART I, Chapter 1, Page 1-3

Add the following definition:

Procedure Altitude. A specified altitude which is at or above the OCA, developed to accommodate a stabilized descent profile anchored on a 3-degree vertical flight path angle in the final approach segment and flown operationally instead of any minimum IFR altitude in the approach.

PANS-OPS VOLUME I, PART III, Chapter 1, Page 3-2

Add new section 1.6 as follows:

1.6.1 PROCEDURE ALTITUDES AND FINAL APPROACH DESCENT PATH ANGLES TO SUPPORT VERTICAL NAVIGATION (VNAV)

1.6.2 To support VNAV operations in modern navigation systems, the final approach segment of all non-precision approach procedures will include a descent path angle published in degrees to the nearest one-hundredth of a degree. Descent path angles will be no less than 3.00 degrees and originate at a point 15 m (50 ft) above the landing runway threshold. Earth curvature shall not be considered in determining this descent path angle. Descent path angles will not exceed 3.77 degrees.

1.6.3 A 3.00 degree descent path angle originating at a height of 15 m (50 ft) above the landing runway threshold and extending back to the FAF establishes a procedure altitude at the FAF (earth curvature is not applied). This procedure altitude will not be less than the FAF minimum altitude established by application of the MOC. See Figure III-1-1.

![Diagram showing descent path angles and procedure altitude](image)

Figure III-1-1. Procedure Altitude vs Minimum Altitudes with Step-Down Fix

1.6.4 Both the procedure altitude and the minimum altitude for obstacle clearance will be published. In no case will the procedure altitude be lower than any minimum crossing altitude for obstacle clearance.
1.6.5 Database suppliers shall only code procedure altitudes in the airborne navigation database and not the minimum crossing altitudes. Pilots should expect to see these procedure altitudes in the Flight Management System.

1.6.6 In cases where a 3.00 degree descent path angle does not clear a final approach segment stepdown fix minimum crossing altitude, the descent path angle shall be increased by raising the procedure altitude at the FAF to a point where the descent path angle clears. Where this option cannot be effected, the FAF shall be moved toward the landing runway to a point where the descent path angle clears all final approach segment stepdown fix crossing altitudes.

Renumber subsequent paragraphs and subsequent figures accordingly.

PANS-OPS VOLUME I, PART III, Chapter 2, Page 3-7

Add new paragraph 2.1.4 as follows:

2.1.4 Instrument procedure design in the past has been based upon the determination and publication of minimum altitudes associated with each segment of the instrument approach procedure. The operational application and use of these minimum altitudes has placed aircraft at minimum crossing altitudes unnecessarily. To support the CFIT prevention initiatives, all instrument approach procedures will be developed to include not only the minimum altitudes to ensure obstacle clearance, but also procedure altitudes. Procedure altitudes will be developed to place the aircraft at altitudes that would normally be flown to intercept and fly a minimum of a 3-degree vertical path angle in the final approach segment to a 15 m (50 ft) threshold crossing. In no case will a procedure altitude be less than any OCA.

PANS-OPS VOLUME I, PART III, Chapter 2, Page 3-10

Add new paragraph 2.4.4 as follows:

2.4.4 When procedure altitudes are developed and promulgated as part of a non-precision approach procedure, the descent angle established by the procedure altitude will not be less than 3.00 degrees in the final segment of the procedure. Any descent angle established by the procedure altitudes will clear, under ISA conditions, all step-down fix minimum crossing altitudes within any segment and for the final will not be in excess of 3.77 degrees.

PANS-OPS VOLUME I, PART III, Chapter 3, Page 3-13

Add new paragraph 3.1.3 as follows:

3.1.3 In addition to minimum IFR altitudes established for each segment of the procedure, procedure altitudes will also be provided. Procedure altitudes will, in all cases, be at or above any minimum crossing altitude associated with the segment. Procedure altitude will be established taking into account the Air Traffic Control needs for that phase of flight.

PANS-OPS VOLUME I, PART III, Chapter 3, Page 3-16

Change paragraph 3.3.3.4 to read as follows:

3.3.3.4 *Descent.* The aircraft shall cross the fix or facility and fly outbound on the specified track descending as necessary to the procedure altitude, if one is provided, but no lower than the minimum crossing altitude associated with that segment. ....
PANS-OPS VOLUME I, PART III, Chapter 3, Page 3-18

Change paragraph 3.5.2.2 to read as follows:

3.5.2.2 The FAF is crossed at the procedure altitude in descent but no lower that the minimum crossing altitude associated with FAF under ISA conditions. The descent is normally initiated prior to the FAF in order to achieve a stabilized 3.00-degree descent path. Delaying the descent until the reaching the FAF at the procedure altitude will cause a descent path to be greater than 3.00 degrees. The descent gradient, the descent path in 1/100th of a degree, and where range information is available, descent profile information are provided.

PANS-OPS VOLUME I, PART III, Chapter 3, Page 3-19

Amend paragraph 3.5.3.2 as follows:

3.5.3.2 These procedures will indicate a minimum altitude/height for a reversal procedure or racetrack, and an OCA/H for final approach. In the absence of a FAF, descent to MDA/H is made once the aircraft is established inbound on the final approach course. Procedure altitudes will not be developed for non-precision approach procedures without a FAF.

PANS-OPS VOLUME I, PART III, Chapter 3, Page 3-23

In view of the fact that the introduction of procedure altitudes will be published as well as minimum fix crossing altitudes, it is critical that any temperature correction application be limited to only the minimum crossing altitude and not applied to any procedure altitude. The only case where temperature corrections will need to be applied to a procedure altitude is when the procedure altitude and the minimum fix crossing altitude are the same. Therefore, the table headings should be amended as follows:

Table III-3-2. Values to be added by the pilot to published minimum crossing altitudes (meters).

Table III-3-3. Values to be added by the pilot to published minimum crossing altitudes (feet).