OBSTACLE CLEARANCE PANEL (OCP)

PANS-OPS IMPLEMENTATION

MADRID, SPAIN

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ANNEX 4, AERONAUTICAL CHART MANUAL AND PANS-OPS AMENDMENTS TO SUPPORT BARO-VNAV PROCEDURES

WORKING PAPER

Presented by

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SUMMARY

OCP 12 introduced criteria called RNAV/BAROMETRIC VERTICAL NAVIGATION (BARO-VNAV) as a new Chapter 34 to PANS-OPS Volume II. Within these criteria, paragraph 34.5 detailed the requirements of promulgation of the procedure. This paper proposes to amend paragraph 34.5 to include a vertical path deviation chart identifying what vertical path angle the flight crew can expect based upon varying altimeter source temperatures. This paper also proposed appropriate amendments to PANS-OPS Volume I, Volume II, Annex 4 and the Aeronautical Chart Manual to accommodate this deviation chart.

INTRODUCTION

OCP 12 introduced criteria called RNAV/BAROMETRIC VERTICAL NAVIGATION (BARO-VNAV) as a new Chapter 34 to PANS-OPS Volume II. Within these criteria, paragraph 34.5 detailed the requirements of promulgation of the procedure. With the experience gained by Canada in introducing BARO-VNAV criteria that spawned the PANS-OPS version, it was discovered that very few operators clearly understood the effects of temperatures on the on-board derived BARO-VNAV vertical path angle (VPA). In order to combat that lack of knowledge, Canada introduced a Vertical Path Deviation (VPA) chart that was published on the appropriate BARO-VNAV instrument approach chart.

DISCUSSION

Modern aircraft avionics has made rapid advances in functionality; some of which has contributed significantly to ease the workload of the flight crew. On the other hand, some of this functionality has evolved rather than being specifically designed to accomplish a given task. BARO-VNAV is one of these functionalities. Vertical Navigation (VNAV) was developed to aid the flight crew in establishing a Top-of-Descent point in order to effect a more fuel-efficient descent. This functionality naturally then got extended into the final approach segment of an instrument approach procedure.

Many aircraft currently in operation have the ability, through an appropriate navigation database, to provide the flight crew with vertical guidance in the final approach segment of the instrument approach procedure. Flight crews have embraced this functionality by liking it to an ILS glide path. Standard Operating Procedures (SOPs) of many operators include the use of this functionality as a CFIT preventative measure supporting a stabilized approach.

While the final approach VNAV functionality has many advantages, it also has disadvantages and these disadvantages are not widely known by flight crews. One of the major disadvantages of the BARO-VNAV functionality in today's aircraft avionics is that the system that derives the vertical path angle on an approach does not accommodate the effects of altimeter source temperatures on this vertical path. In other words, for a promulgated 3.00° final approach vertical descent angle, the aircraft's avionics system will present information on this vertical path angle to the flight crew as 3.00°, in all temperature conditions even though the actual vertical path will be more, or less, then the promulgated 3.00° when ISA conditions are not present. Nothing in the aircraft's flight manual or any other document presented to the flight crew addresses this difference between what vertical path the aircraft is actually flying and the information presented to the flight crew. The result of this misleading information presented to the flight crew is confusion, questions and perhaps, unstablized approaches. In extreme cases, the variation from a promulgated 3.00° vertical path angle could be as low as 2.5°, or lower, and as high as 4.0°, or higher. These vertical path angle variations are not enunciated to the flight crew by the aircraft systems.

The technical know-how is available to the industry to incorporate a temperature corrected vertical path angles derived by BARO-VNAV, however, only one avionics manufacturer to date has developed this functionality into their Flight Management System (FMS). An attempt to require the development of new FMSs with the temperature compensated functionality through RTCA DO-236A, Minimum Aviation System Performance Standards: Required Navigation Performance for Area Navigation was unsuccessful. Therefore, avionics systems that present misleading information to the flight crew regarding the baro-derived vertical path angle will be in operation for many, many years.

In order to provide the flight crew the information that is not provided elsewhere, Canada has introduced a simple chart on all RNAV BARO-VNAV instrument approach procedures. A sample chart is provided below.

VPA Deviations	
A/D Temp	Actual VPA
+30°C	3.2°
+15°C	3.0°
0°C	2.8°
-31°C	2.5°

This simple chart clearly describes the effects of non-ISA temperatures on the baro-derived vertical path angle. Knowing this information, the flight crews can brief and prepare for these effects thus resulting a safer flight operation.

RECOMMENDATION

This paper proposes to amend paragraph 34.5 of PANS-OPS Volume II, add new material to paragraph 9.4.1.1 of PANS-OPS Volume I, add new material for inclusion in the Annex 4, new paragraph 11.10.8.6 and accompanying changes to page 7-11-20 of the Aeronautical Chart manual Doc 8697-AN/889/2 to include a vertical path deviation chart identifying what vertical path angle the flight crew can expect based upon varying altimeter source temperatures. The Working Group is invited to review the proposals presented in this paper and debate the issue.

-End-

PROPOSED AMENDMENT TO PANS-OPS VOLUME I

PART III, Chapter 9

Add the new paragraph 9.3.6 as follows:

9.3.6 In order to advise flight crews of the effects of non-standard temperatures on RNAV BARO-VNAV instrument approach final approach segment vertical path angle, a chart will be published detailing an aerodrome temperature with an associated true vertical path angle. Therefore, although the aircraft's avionics system may be indicating the promulgated final approach vertical path angle, the flight crew can now be aware of, brief and prepare for an actual vertical path angle different from the information presented to the crew by the system. A sample of that chart is provided in Figure III-9-1 below.

VPA Deviations	
A/D Temp	Actual VPA
+30°C	3.2°
+15°C	3.0°
0°C	2.8°
-31°C	2.5°

Figure III-9-1. VPA Deviation Chart

-End-

PROPOSED AMENDMENT TO PANS-OPS VOLUME II

PART III, Chapter 34

Add the following to paragraph 34.5.2:

d) a Vertical Path Angle (VPA) deviation chart. This chart shall be developed indicating the aerodrome elevation (altimeter source) ISA temperature and the promulgated vertical path angle, and at least one ISA plus aerodrome temperature with the corresponding increased VPA and at least two ISA minus aerodrome temperatures with the corresponding decreased VPA. See Annex 4 for publication details and Figure III-34-4 for an example. A VPA chart shall be calculated and published for each aerodrome. To calculate the VPA and the associated aerodrome temperature, the following equation is used:

VPA = atan (tan VP x [273 + t]) / 288
Where
VP = nominal vertical path angle
t = aerodrome temperature in degrees C

For aerodrome elevations exceeding 1000 feet the following equation may be used

VPA = atan (tan VP x [273 + t]) / 288 – [0.00198 x h])

Where
H = aerodrome elevation in feet above sea level.

VPA Deviations	
A/D Temp	Actual VPA
+30°C	3.2°
+15°C	3.0°
0°C	2.8°
-31°C	2.5°

Figure III-34-4. VPA Deviation Chart

-End-

PROPOSED AMENDMENT TO ANNEX 4

Chapter 11

Add the following new paragraph 11.10.8.6:

11.10.8.6.1 On charts depicting RNAV BARO-VNAV procedures, a Vertical Path Angle (VPA) Deviations charts shall be published to indicate the effects of non-ISA temperatures on the procedure established VPA. In addition to the aerodrome ISA temperature and the designed VPA, at least one ISA plus aerodrome temperature with the corresponding increased VPA and at least two ISA minus aerodrome temperatures with the corresponding decreased VPA shall be included. VPAs shall be published in degrees and tenths of degrees.

-End-

PROPOSED AMENDMENT TO Doc 8697-AN/889/2 AERONAUTICAL CHART MANUAL

Add the following information at Page 7-11-20:

<table>
<tr><th>ANNEX 4
REFERENCE</th><th>DETAILS</th><th>DRAUGHTING
ILLUSTRATION</th></tr>
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