**APPLICATION FOR BAROMETRIC VERTICAL NAVIGATION (BAROVNAV)**



**INSTRUCTIONS**

1. The applicant will tick (√) the appropriate yes/no boxes and as applicable insert references from the Aircraft Flight Manual (AFM) or Operations Manual (OM) with sample pages attached as appendix.

2. Applicant must obtain and submit manufacturer’s written confirmation with regard to continuing maintenance.

3. Operating policy and procedures, training syllabus and lesson plan must be submitted for approval before commencement of flight crew / dispatcher training.

**PARTICULARS**

**Operator : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_AOC No.\_\_\_\_\_\_\_\_\_\_\_ Rep’s Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Position\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Aircraft manufacturer,Type and series | Serial number | Registration  | No. of Altimetry system. Make and Type | No. of GNSS make and model | No. of FMS / FMGC make and model | No. of APV / BaroVNAV systems Make and model |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **AC AOC 38(0)** | **Title of Paragraph** | **Applicant’s Compliance Reference** |  |
| **9**9.1 | **AIRWORTHINESS CERTIFICATION****AIRCRAFT ELIGIBILITY**Operator must submit evidence attesting to the aircraft VNAV system capability by statement in AFM, TC, STC, TCDS or manufacture’s Service Letter. |  |  |
|  | **CONTINUING AIRWORTHINESS**Maintenance programme reference |  |  |
| **10**10.1 | **ALTIMETER SENSOR REQUIREMENTS**BaroVNAV approach operations are based on the RNAV system that automatically determines the aircraft FPA using inputs from any of the following equipment:(a) TSO-C106 / ETSO-C106 Air Data Computer; or(b) ARINC 706 Mark 5 or ARINC 738 Air Data and Inertial Reference system; or(c) Barometric altimeter compliant with RTCA DO-88 (Altimetry) and/or EUROCAE ED-26 (Minimum performance specifications for airborne altitude measurements and coding systems): or(d) Type certified integrated system providing an Air Data System capability comparable to (b)  |  |  |
| **11**11.111.1.111.211.2.111.311.3.111.411.4.111.511.5.1 | **SYSTEM ACCURACY****VNAV Equipment Error**For instrument approach operations, the VNAV equipment error, excluding altimetry, horizontal coupling and flight technical error on a 99.7% probability basis should be less than the following:

|  |  |  |
| --- | --- | --- |
|   | Level flight segments and climb/descent intercept altitude region of specified altitudes | Climb/Descent along specified vertical Profile (angle) |
| At or below 5000 ft (MSL) | 15m / 50ft | 30m / 100 ft |
| 5000 ft to 10000 ft (MSL) | 15m / 50ft | 45m / 150 ft |
| 10000 ft to 15000 ft (MSL) | 15m / 50ft | 67m / 220 ft |

**Horizontal Coupling Error (HCE)**HCE is a component of a vertical error component of along track position error and is assumed to be 24 ft on a 99.7% probability basis using longitudinal accuracy of 0.05nm at 95% and vertical path of 3 degrees.**Vertical Flight Technical Error (FTE)**The vertical FTE based on 99.7% probability should be less than:

|  |  |  |
| --- | --- | --- |
|  | Level flight segments and climb/descent intercept altitude region of specified altitudes | Climb/Descent along specified vertical Profile (angle) |
| At or below 5000 ft (MSL) | 45m / 150ft | 60m / 200 ft |
| 5000 ft to 10000 ft (MSL) | 73m / 240ft | 91m / 300 ft |
| 10000 ft to 15000 ft (MSL) | 73m / 240ft | 91m / 300 ft |

*Note: The above figures are promulgated in ICAO Doc 9613 and FAA AC 20-129. These figures are acceptable to the Authority provided flight director and autopilot are used to fly the profile.***Vertical Total System Error (TSE)**The vertical TSE made up the root-sum-square of all error components described this paragraph 11 on 99.7% probability is as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Altimeter System Error | VNAV Equipment Error | Horizontal coupling Error | Flight Technical Error | **Vertical Total Error** |
| At or below 5000 ft (MSL) | 80 ft | 100 ft | 24 ft | 150 ft | **199 ft** |
| 5000 to 10000 ft (MSL) | 106 ft | 150 ft | 24 ft | 150 ft | **238 ft** |
| 10000 to 15000 ft (MSL) | 127 ft | 220 ft | 24 ft | 150 ft | **296 ft** |

*Note: An acceptable means of complying with the above accuracy requirements is to have the VNAV system approved for RNAV in accordance with FAA AC 20-129.***Vertical Path Error at FAP due to vertical fly-by transition**The error due to the capture of the vertical path starting from the FAP altitude causing momentary deviation below the published minimum procedure altitude is acceptable provided it is no more than 50 ft.  |  |  |
| **12**12.112.212.312.412.512.612.712.812.912.10 | **FUNCTIONAL CRITERIA****Continuity of Function** For operations predicated on use of BaroVNAV, at least one RNAV system must be serviceable.**Path definition** The navigation system must be capable of defining a vertical path angle to a fix. The system must also be capable of defining altitude constraints as follows:(a) “AT” altitude constraint, e.g. 2400(b) “AT or ABOVE” altitude constraint, e.g. 2400A (c) “AT or BELOW” altitude constraint, e.g. 2400B(d) “WINDOW” constraint, e.g. 2400A3400B**Vertical Constraints** All altitude and/or speeds associated with published procedures must be automatically extracted from the navigation database upon selecting the approach procedure.**Path Construction** The system must be able to construct a path to provide guidance from the current position to a vertically constrained fix.**Capability to load procedure from the navigation database** The navigation system must have the capability to load and modify the entire procedure(s) to be flown, based upon ATC instructions, into the RNAV system from the on-board navigation database. This includes the approach (including vertical angle), the missed approach and the approach transitions for the selected airport and runway. The navigation system should preclude modification of the procedure data contained in the navigation database.**Temperature limits** For aircraft using Barometric VNAV without temperature compensation to conduct the approach, low temperature limits are reflected in the procedure design and identified along with any high temperature limits on the charted procedure. Cold temperatures reduce the actual glide path angle, while high temperatures increase the actual glide path angle. Aircraft using Barometric VNAV with temperature compensation or aircraft using an alternate means for vertical guidance (e.g. SBAS) may disregard the temperature restrictions.**Guidance and control** For the vertical performance requirements, the path steering error budget must reflect altitude reference as well as other factors, such as roll compensation and speed protection, as applicable.**User Interface (Displays and Control)** The display readout and entry resolution for vertical navigation information shall be as follow:

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Display resolution (readout)** | **Entry resolution** |
| Altitude | Flight Level or (1 ft) | Flight Level or (1 ft) |
| Vertical Path Deviation | 10 feet | Not Applicable |
| Flight Path Angle | 0.1 degree (\*) | 0.1 degree |
| Temperature | 1 degree | 1 degree |

**Path deviation and monitoring** The navigation system must provide the capability to continuously display to the pilot flying, on the primary flight instruments for navigation of the aircraft, the aircraft position relative to the vertically defined path. The display must allow the pilot to readily distinguish if the vertical deviation exceeds +30 m/–15 m (+100 ft/–50 ft). The deviation should be monitored, and action taken to minimise errors.(a) It is recommended that an appropriately-scaled non-numeric deviation display (i.e. vertical deviation indicator) be located in the pilot’s primary optimum field of view. A fixed-scale deviation indicator is acceptable as long as it demonstrates appropriate scaling and sensitivity for the intended operation. Any alerting and annunciation limits must also match the scaling values.*Note Existing systems provide for vertical deviation scaling with a range of* ±*500 ft. Such deviation scaling should be assessed consistent with the above requirement on discernability.*(b) In lieu of appropriately scaled vertical deviation indicators in the pilot’s primary optimum field of view, a numeric display of deviation may be acceptable depending on the flight crew workload and the numeric display characteristics. A numeric display may require additional initial and recurrent flight crew training.(c) Since vertical deviation scaling and sensitivity varies widely, eligible aircraft must also be equipped with and operationally using either a flight director or autopilot capable of following the vertical path.**Barometric altitude** The aircraft must display barometric altitude from two independent altimetry sources, one in each pilot’s primary optimum field of view. Operator procedures should ensure current altimeter settings for the selected instrument procedure and runway. |  |  |
| **13**13.113.213.313.4 | **OPERATING PROCEDURES****Manufacturer’s instructions or procedures** The operator must ensure that the flight crew comply with all instructions or procedures identified by the manufacturer as necessary for safe operation.**Altimeter Setting** The operator must ensure that the flight crew pay particularly attention when reading back to ATC as well as setting of aircraft altimeters, especially during period of high workload.**Cold Temperature** The flight crew must be aware of the limiting temperature for the use of BaroVNAV. During cold weather operations the flight crew must check for temperature limit and temperature correction on the instrument approach chart. If the airborne system contains a temperature compensation capability, the manufacturer’s instructions shall be followed.**Contingency procedures** The operator must ensure that the flight crew are aware that where the contingency procedure requires reversion to a conventional procedure, the necessary preparations should be completed before commencing the RNAV procedure. |  |  |
| **14**14.114.214.3 | **PILOT KNOWLEDGE AND TRAINING** The list below describes the scope of training necessary for proficiency of VNAV operations. Subject to the Authority’s discretion, operators who are RNAV experienced may submit a truncated version for approval.(a) the concept of PBN operation and contents of this BaroVNAV AC;(b) the meaning and proper use of aircraft systems;(c) ICAO Doc 8168 Vol 1 Chapter 1 Table I-4-1-2 Speeds for procedures calculations. (d) procedure characteristics, as determined from chart depiction and textual description: (1) depiction of waypoint types (flyover and fly-by) and path terminators used by the operator) as well as associated aircraft flight paths;(2) RNAV system-specific information;(3) levels of automation, mode annunciations, changes, alerts, interactions, reversion (4) functional integration with other aircraft systems;(5) the meaning and appropriateness of vertical path discontinuities as well as related flight crew procedures;(6) monitoring procedures for each phase of flight (e.g.monitor “PROGRESS” or “LEGS” page);(7) turn anticipation with consideration to speed and altitude effects; and(8) Interpretation of electronic displays and symbols. Procedures for operating VNAV equipment including the following actions: (a) adhere to speed and/or altitude constraints associated with an approach procedure;(b) verify waypoints and flight plan programming;(c) fly direct to a waypoint;(d) determine vertical-track error/deviation;(e) insert and delete route discontinuity;(f) change arrival airport and alternate airport;(g) contingency procedures for VNAV failures;(h) crew requirements for altimeter cross-checks, checking for temperature limitations and procedures for altimeter settings for approach; and(i) discontinuation of a procedure based upon loss of systems or performance and flight conditions, e.g. inability to maintain required path tracking or loss of required guidance, etc.Additional operations guidance related to the considerations reflected in the procedure design are included in PANS-OPS, (Doc 8168), Volume I. |  |  |
| **15**15.115.2 | **NAVIGATION DATABASE INTEGRITY**The navigation database integrity must comply with RTCA DO-200A / EUROCAE ED-76 standards. The operator must ensure that the navigation database supplier or vendor to the operator hold valid Type LOA (Letter of Approval) issued in accordance with FAA AC 90–153 or EASA IR 21(G) / EASA Nr 01/2005.The operator should also conduct additional navdata check of any new or changed procedure. Reports on navigation error must be acted upon promptly. Repeated navigation error occurrences attributed to a specific piece of navigation equipment may result in cancellation of the approval for use of that equipment. |  |  |
| □yes □no | **MEL** Minimum equipment list showing LRNS provisions |  |  |
| □yes □no | **HMI** Human / Machine Interface review. |  |  |
| □yes □no | **QSRA** Qualitative Safety Risk Assessment |  |  |

**Warning: Notice is given that the operator shall accept full responsibility for all information given in this application form. Any attempt to provide distorted or false information will result in rejection of the application and, if already granted, the**

 **withdrawal of the Operational Approval under paragraph 60 of the ANO. Additionally, for the offence, the operator may render himself to prosecution under paragraph 61 of the ANO.**

**I have read the above Warning and declare that the information given is true and accurate.**

**Signature / Name of person representing the operator:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Signature / Name of A/FO Officer accepting this form :\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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| Revision History |
| Version | Date | Paragraph(s) | Details |
| 1.0 | 1 October 2015 | Title & various | Minor editorial |
| 2.0 |  |  |  |

**REFERENCES**

Regulatory: (1) AOCR, Chapter 2 Paragraphs 21 (2) ANO, Paragraphs 60 and 61

Compliance: (1) CAAS AC AOC 38(0) (2) ICAO Doc 9613 AN/937 (3) EASA AMC 20-27 (4) FAA AC 20-129