



U.S. Department  
of Transportation

**Federal Aviation  
Administration**

# Advisory Circular

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**SUBJECT:** Use of Barometric Vertical  
Navigation (VNAV) for Instrument Approach  
Operations Using Decision Altitude

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**Date:** 10/19/00

**AC No:** 90-97

**Initiated by:** AFS-420

**Change:**

**1. PURPOSE.** This document provides guidance for the operational use of barometric vertical navigation (VNAV) equipment to perform 14 CFR Part 97 area navigation (RNAV) instrument approach procedures published with a VNAV Decision Altitude (DA). This document identifies the types of equipment that the Federal Aviation Administration (FAA) has determined to be acceptable for barometric VNAV approach operations.

**2. RELATED TITLE 14, CODE OF FEDERAL REGULATIONS (14 CFR) PARTS.**

- a. **Part 91**, General Operating and Flight Rules, sections 91.175 and 91.205.
- b. **Part 97**, Standard Instrument Approach Procedures.
- c. **Part 121**, Certification and Operations: Domestic, Flag, and Supplemental Air Carriers and Commercial Operators of Large Aircraft, section 121.567.
- d. **Part 125**, Certification and Operations: Airplanes Having a Seating Capacity of 20 or More Passengers or a Maximum Payload Capacity of 6,000 Pounds or More, sections 125.287 and 125.325.
- e. **Part 129**, Operations: Foreign Air Carriers and Foreign Operators of U.S. - Registered Aircraft Engaged in Common Carriage.
- f. **Part 135**, Air Taxi Operators and Commercial Operators, section 135.165.

**3. RELATED PUBLICATIONS.**

**a. Advisory Circulars (AC).**

(1) **AC 20-129**, Airworthiness Approval of Vertical Navigation (VNAV) Systems for Use in the U.S. NAS and Alaska.

(2) **AC 20-130**, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors, latest edition.

(3) **AC 20-138**, Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for Use as a VFR and IFR Supplemental Navigation System, latest edition.

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(4) **AC 120-29**, Criteria for Approving Category I and Category II Landing Minima for FAR 121 Operators.

**b. FAA Orders.**

(1) **FAA Order 8400.10**, Air Transportation Operations Inspector's Handbook.

(2) **FAA Order 8700.1**, General Aviation Operations Inspector's Handbook.

**4. DEFINITIONS.**

**a. Area Navigation (RNAV).** This is a method which permits aircraft navigation along any desired flightpath within the coverage of the associated navigation aids or within the limits of the capability of self-contained aids, or a combination of these methods.

**b. Barometric Vertical Navigation (VNAV).** A function of certain RNAV equipment which presents computed vertical guidance to the pilot referenced to a specified vertical path. The computed vertical guidance is based on barometric altitude and is typically computed as a geometric path between two waypoints or an angle based on a single waypoint.

NOTE: The GPS augmentation system known as the Wide Area Augmentation System (WAAS) will also possess a VNAV capability and may be capable of performing to the lateral navigation (LNAV)/VNAV minima, however, this document only addresses barometric VNAV.

**c. Decision Altitude (DA).** In an approach with vertical guidance, DA is a specified altitude in mean sea level at which a missed approach must be initiated if the required visual references to continue the approach have not been established.

**d. Lateral Navigation (LNAV).** The function of RNAV equipment that computes, displays, and provides lateral guidance to a profile or path.

**e. Required Navigational Performance (RNP).** A statement of the navigational performance necessary for operation within a defined airspace.

**f. RNP Level or Type (RNP-X).** A value, in nautical miles (NM), from the intended horizontal position within which an aircraft would be at least 95 percent of the total flying time.

**5. BACKGROUND.** Controlled flight into terrain (CFIT) is a major cause of aircraft accidents during the approach phase of flight. Instrument approaches, without the vertical guidance, are particularly prone to CFIT. Various forums, including the United States Secretary of Transportation Safety Summit and the FAA Administrator's Safer Skies Initiative, have recommended that whenever and wherever possible vertical guidance should be provided on all instrument approaches. A timely and cost-effective solution is to make use of the instrument flight rule (IFR) approved barometric VNAV capability of certain aircraft to perform guided, stabilized descent paths on instrument approach procedures which otherwise have no vertical guidance. In order to support these

initiatives, the FAA will publish Part 97, i.e., public RNAV Instrument Approach Procedures (IAP), which provides for VNAV operations to a decision altitude.

## 6. APPLICABILITY.

**a. The guidance** contained herein applies to all operators conducting operations under Parts 91, 121, 125, 129, and 135 within the United States National Airspace System (NAS) and Alaska.

**b. Use of barometric VNAV**, as described in this document, applies to Part 97 RNAV IAP's which are published with separate minima identified for VNAV equipment and shown on the IAP as a DA. For ease of reference, these approaches will be referred to as VNAV approaches in this document. Operators with barometric VNAV equipment identified in this AC may utilize this equipment to fly LNAV/VNAV minima.

## 7. AIRCRAFT ELIGIBILITY AND APPROVAL PROCESS.

**a. RNAV Capability.** VNAV approach operations to a published DA will be conducted as part of an RNAV instrument approach procedure and as such the VNAV equipment must be part of an integrated RNAV system approved for IFR instrument approach operations. Eligible aircraft are those with an Aircraft Flight Manual (AFM) or AFM Supplement which explicitly states that the RNAV system is approved for operations in accordance with paragraphs 7a(1), 7a(2), or 7a(3).

**(1) Global Positioning System (GPS)** Class A1 navigation equipment approved under AC 20-138.

**(2) Multi-Sensor Navigation System** or Flight Management System (FMS) incorporating a Class B1, B3, C1, or C3 GPS sensor approved under AC 20-130. For a particular approach, GPS must be an active component of the aircraft's navigation solution.

**(3) RNP Systems Approved for RNP 0.3 NM Operations or Less.** Any limitation or specific requirement needed to maintain RNP 0.3 shall be adhered to. Unless otherwise noted on the procedure, the use of RNP systems requires GPS or DME/DME to be an active component of the aircraft's navigation solution. If RNP .3 based on DME/DME is not authorized, it will be noted on the procedure.

**b. Barometric VNAV Capability.** Eligible aircraft are those with an AFM or AFM Supplement which explicitly states that the VNAV system is approved for approach operations in accordance with AC 20-129. In addition, for a VNAV system to be approved for approach operations under AC 20-129, it must have a vertical deviation indicator (VDI). Since VDI scaling/sensitivity values vary widely, eligible aircraft must also be equipped with and operationally using either a flight director or autopilot capable of following the vertical path. Pilot deviation of +100/-50 feet is considered acceptable for adherence to the depicted VNAV path

**c. Data Base Requirement.** The RNAV system must include a manufacturer supplied electronic data base, which contains the waypoints and associated VNAV

information, i.e., altitudes and vertical angles, for the procedure to be flown. Pilot/crew modification of the LNAV/VNAV approach information is prohibited. If manual adjustments to stored altitude information are necessary, e.g., cold temperature adjustments, the crew should make appropriate adjustments to procedure altitudes and revert to use of the temperature adjusted LNAV minimum descent altitude (MDA).

**d. Part 91 Operator/Aircraft Approval.** Part 91 operators should review their AFM or AFM Supplement to establish that it shows navigation system eligibility as detailed in paragraphs 7a, 7b, and 7c. Once the operator has established system eligibility, the operator should take steps to ensure that barometric VNAV approach operations are conducted in accordance with the guidance in paragraphs 8 and 9. After these actions have been completed, the operator may begin to conduct barometric VNAV approach operations to a published DA as shown on Part 97 RNAV IAP's which are published with separate minima identified for VNAV equipment. A Letter of Authorization (LOA) is not required when eligibility is based on the AFM and provisions of this AC. See paragraph 7f for actions to take if the operator is not able to determine VNAV approach eligibility from the AFM or AFM Supplement.

**e. Air Carrier Aircraft/Commercial Operator Approval.** Part 121, 125, 129, or 135 operators should present the following documentation to their Certificate Holding District Office (CHDO): sections of the AFM or AFM Supplement which document RNAV/VNAV airworthiness approval for approach operations in accordance with paragraphs 7a, 7b, and 7c and sections of the training and operations manuals which reflect the operating policies of paragraphs 8 and 9. Once the operator has addressed the guidance in these paragraphs to the satisfaction of the CHDO, the operator may begin using this barometric VNAV equipment to fly to the LNAV/VNAV DA as published on the IAP. See paragraph 7f for guidance on actions to take if the operator is unable to determine eligibility from the AFM or AFM Supplement.

**f. Eligibility Not Based on the AFM or AFM Supplement (Special Approval).**

**(1) The operator** may not be able to determine VNAV approach eligibility from the AFM or AFM Supplement. In this case, a Part 91 operator should request that the local Flight Standards District Office (FSDO) assess the equipment for VNAV approach eligibility while a Part 121, 125, 129, or 135 operator should request that the CHDO make the eligibility assessment. The operator should provide the FSDO or CHDO with the RNAV/VNAV system make, model and part number, any evidence of IFR RNAV/VNAV approval, and pertinent information from crew operating procedures. If the FSDO or CHDO is unable to determine equipment eligibility, it should forward the request and supporting data through the appropriate FAA Flight Standards Regional Division to the appropriate Aircraft Evaluation Group (AEG). The AEG will verify that the aircraft and RNAV system meet the criteria for VNAV, and that the system can safely fly specified VNAV vertical paths associated with instrument approach procedures applying a DA rather than an MDA. The AEG will provide written documentation (i.e., amend Flight Standards Bulletin Report or other official documentation) to verify the eligibility of that equipment.

**(2) For Part 91 operators,** if the FAA determines that the navigation equipment is eligible for barometric VNAV instrument approach operations to a published DA, the

FSDO will provide documentation that the aircraft equipment is approved for these VNAV operations.

**(3) For Parts 121, 125, 129, and 135 operators,** the FAA will attempt to establish system eligibility and ensure that the operator's training and operations manuals reflect the operating policies of paragraphs 8 and 9. Once these steps are successfully completed, the operator may begin using this VNAV equipment to fly to the LNAV/VNAV DA as published on the IAP.

**8. VNAV OPERATING PROCEDURES (GENERAL).** For barometric VNAV approach operations, the flightcrew should be familiar with the operating procedures detailed below.

**a. Actions at DA.** The pilot/crew is expected to fly the aircraft along the published vertical path and execute a missed approach procedure upon reaching DA, unless the visual references specified in Part 91.175 for continuing the approach are present.

**b. Temperature Limitation.** Because of the pronounced effect of nonstandard temperature on barometric VNAV operations, VNAV approaches will contain a temperature limitation below which use of the VNAV DA, based on barometric VNAV, is not authorized. If the temperature on a given day is lower than the VNAV temperature limitation, the pilot/crew may continue use of the barometric VNAV function but only to the published LNAV MDA. The temperature limitation will be shown as a note on the IAP.

**c. VNAV Path Mode Selection.** Crews should be knowledgeable on selection of the appropriate vertical mode(s) that command vertical navigation via the published vertical path. Other vertical modes such as vertical speed are not applicable to barometric VNAV approach operations.

**d. Remote Altimeter Setting Restriction.** Use of barometric VNAV DA is not authorized with a remote altimeter setting. A current altimeter setting for the landing airport is required. Where remote altimeter minima are shown, the VNAV function may be used but only to the published MDA.

**9. PILOT KNOWLEDGE.** Pilots/crews should be knowledgeable in the following areas:

**a. Charting.** The aeronautical instrument approach chart that will promulgate LNAV/VNAV procedures including, but not limited to, temperature and altimeter source limitations for barometric VNAV operations.

**b. Nonstandard Temperature Effect on Barometric VNAV Operations.** Barometric altimeters are calibrated to indicate true altitude under International Standard Atmosphere (ISA) conditions. If on a given day the temperature is warmer than ISA, the true altitude will be higher than indicated altitude. Conversely, on a day colder than ISA, the true altitude will be lower than indicated altitude. These errors increase in magnitude as the altitude above the altimeter setting source increases.

**c. VNAV Failure Modes and Mode Reversions.** The pilot/crew should be knowledgeable of failures and mode reversions, which adversely impact the aircraft's ability to conduct VNAV approach operations. In addition, pilots/crews should be aware of contingency actions, i.e., reverting to LNAV MDA, following VNAV failures.

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Service