

TERMINAL INSTRUMENT PROCEDURES TO IMPLEMENT VNAV FOR AIR CARRIER OPERATORS.

DRAFT -- August 15, 1996

1. Purpose. This NOTICE provides guidance and criteria for FAA to authorize air carriers to implement VNAV operations. It describes applicable procedures, operating criteria and revisions to the operators operations specifications. Obstacle assessments applicable to existing approaches and criteria to used by air carriers developing special instrument approach procedures are provided.

2. Background. Based on near-term safety benefits and a long-term goal of having a single approach training standard that includes vertical path, several carriers have indicated their intent to begin training to fly existing VOR, NDB, LOC, LOC-BC, LDA and SDF standard instrument approach procedures with VNAV. This desire was again stated in two key initiatives identified at the December 6-7, 1995, Aviation Safety Initiative Review held in New Orleans, Louisiana. Specifically, they were: 1/ eliminate 2-D approaches by providing VNAV guidance, and 2/ identify a process for air carrier operators to be designated certain procedure development responsibilities. In response to these initiatives, we've worked with the users and various regional FAA personnel in the development of this order.

Justification for such procedures may normally result from the scheduled/unscheduled outage of a ground-based navaid, to standardize operations for differing instrument approach types, incorporate VNAV guidance to enhance safety, or to provide for contingency planning for loss of other approach aid capability. Developing these FMS procedures may be of benefit to only a single operator, or to a group of operators with a common requirement.

The operating concepts herein are consistent with operations approved by United Kingdom's CAA for use by British Airways. New procedures being developed by FAA will incorporate the necessary obstacle assessments, data base specification and labeling for VNAV operations.

3. Related Documents.

Order 7100.11, FMS Procedures Program,
Order 8260.40, FMS Procedures

4. Operating Concept.

a. General. The operating concept is to fly existing lateral navigation (LNAV) approaches to the published minimum descent altitude (MDA) just like we fly an ILS approach to the decision altitude (height) DA(H). When this concept is provided for in training and utilized when flying eligible procedures a momentary descent below the MDA would be acceptable in the event of altitude loss while initiating a missed approach. These eligible procedures can easily be identified by specific charting

conventions such as a depiction of the vertical path angle and its depiction in the profile view. Sample charts are provided at Appendix 1.

Data base providers will calculate a vertical path accommodating step-down fix altitudes, if any, between the threshold crossing waypoint at 50-feet (preferred) and the final approach fix (FAF) altitude for existing eligible VOR, NDB, LOC, LOC-BC, LDA and SDF standard instrument approach procedures.

b. VNAV Equipped Aircraft. Operationally the aircraft will descend along this VNAV path to the current published minimum descent altitude MDA(H). When using this concept a decision to continue the approach or begin a missed approach must be made upon reaching MDA(H). This concept, however, does not modify any published missed approach point e.g., the runway threshold track. Although the missed approach maneuver may begin at the MDA(H), the published missed approach instructions for turns must not begin until the aircraft has passed the specified missed approach point. In most cases this will be the runway threshold.

c. Other Aircraft. For instrument approach procedures that include a including data base providers will calculate a vertical path, accommodating step-down fix altitudes if any, will be defined between the threshold crossing waypoint at 50-feet (preferred) and the final approach fix (FAF) altitude. Operationally the aircraft will descend along this VNAV path to the current published minimum descent altitude MDA(H) decision altitude (height) DA(H). When using this concept a decision to continue the approach or begin a missed approach must be made upon reaching DA(H). This concept, however, does not modify any published missed approach point e.g., the runway threshold track. Although the missed approach maneuver may begin at the DA(H), the published missed approach instructions for turns must not begin until the aircraft has passed the runway threshold missed approach point. Aircraft without a VNAV approach capability may use this operating concept using LNAV, or conventional navigation, provided a table providing the VNAV path angle and descent rates for a stabilized approach are depicted on the approach procedure.

5. Applicability. This guidance applies to existing straight-in approaches that deliver the aircraft to the runway threshold at a VNAV path angle not less than 2.75-degrees or greater than 3.77-degrees. Angles teeper than 3.77 degrees may be authorized on a case-by-case basis.

6. Action. Principal Operations Inspectors (POIs) for carriers intending to conduct instrument approaches using LNAV, LNAV/VNAV or LOC/VNAV as described above must ensure training, charting and the associated procedures are consistent with the aircraft flight manual and the following:

a. Training: Training material should include at least the following as applicable to the LNAV, LNAV/VNAV approach operations.

Autopilot Function -- Approvals and limitations.
Flight Management Function -- Approvals and limitations.
Approved Configurations -- Take off, climb, cruise, descent, approach.
Position Computation --How the FMS/FMGC computes its position from a mix
of IRS and radio position.
Navigation Modes -- IRS/DME/DME, IRS/DME,DME,LOC
Accuracy Checks -- From CDU pages and bearing/distance displays.
LNAV and VNAV including deviation indications and display scaling.
PF and PNF duties during: descent, initial approach, final approach,
reaching DA, go-around and landing.
Altitude Awareness -- GPWS operation and limitations, voice callouts, radio
altitude.

Note: LNAV only approach operations may continue to be authorized under current training. LNAV is considered to be basic and fundamental to the operation of the aircraft and consistent with those aircraft operations utilized when conducting a VOR approach with the FMS.

b. Data Base and Charting

All procedures, including the runway threshold waypoint and the VNAV path angle must be retrievable from the aircraft nav-database. Approach charts used by the flight crew must depict the DA(H) in the minima box and the VNAV path angle and it's associated vertical track from the FAF to the runway must be shown in the profile view. Sample charts are provided at Appendix 1.

c. Eligible Aircraft . This NOTICE is applicable to all “/E” or “/F” aircraft.

d. Eligible Procedures. General approval applies to existing VOR, NDB, LOC, LOC-BC, LDA and SDF standard instrument approach procedures. All procedures must be straight-in approaches that deliver the aircraft to the runway threshold at a VNAV path angle not less than 2.75-degrees or greater than 3.77-degrees. Steeper descent paths may be authorized on a case-by-case basis.

e. Authorization. Operations specifications (Opspec) paragraph C64 is required for any special approach authorization. Opspec paragraph C63 (x) must be issued to authorize the use of DA(H)?.

f. Navigation Sensor Updating. When specified in the navigation data base, the primary navaid must be operating. All procedures developed to emulate an inoperable ground facility must have signal coverage and navigation updating from at least two navigation sources providing DME information, or as specified for the procedure. DME/DME updating is accomplished when a suitable geometry exists between a pair of selected DME stations and they within range and above the acquisition horizon. A request may be made to AFS-400's Standards Development Branch to run it's

DME/DME prediction model to help assess whether suitable DME/DME geometry exists.

g. Validation Flights. Any procedures developed to emulate an inoperable ground facility must be validated by the certificate holder in-flight to ensure signal coverage, navigation-sensor updating, data base coordinates, accuracy of the LNAV, LNAV/VNAV path and the obstacle assessment. In-flight validation conducted by the lead carrier should consist of at least 4-approaches as listed below. Subsequent validation by follow-on operators should only require a single approach per aircraft type e.g., B737, A320.

A validation flight must consist of at least the following:

1. Fly the proposed approach with navigation sensor updating in the automatic mode. If the procedure is to emulate an out of service ground facility that is operating, it must be “black balled” or otherwise eliminated from the sensor updating.
2. Same as approach number 1. Observe repeatability and transition to missed approach.
3. Same as approaches 1 & 2, with one of the updating facilities noted during approaches 1 and 2 “black balled” or otherwise eliminated from the sensor updating.
4. Same as approach 3, with two of the updating facilities noted during approaches 1 and 2 “black balled” or otherwise eliminated from the sensor updating.

Documentation including, but not limited to, the following must be recorded for each approach in order to establish appropriate condition/limitations, if any:

- a. Final approach course alignment and VNAV path. Note approximate lateral offset from runway centerline at DA.
- b. Note facilities being used for position updating.
- c. Note acceptable transition from DA to landing.
- d. Note acceptable transition to missed approach.
- e. Note that VNAV path clears all stepdown altitudes, if any, between the FAF and DA.

7. OBSTACLE ASSESSMENT.

a. General. This section provides specific obstacle assessment requirement to implement VNAV operations. . In order to be consistent with FAR’s 91.175 and 121.651, the VNAV function and operating concept allows a momentary descent below DA during the execution of a missed approach. It is the operator’s responsibility to ensure the appropriate obstacle assessment has been conducted for visual portion of the final approach. The obstacle assessments and methods of establishing minimums are applicable to air carrier procedures developed to emulate, or otherwise overlay, existing FAA Part-97 instrument procedures. The obstacle

assessment area described herein for the visual portion of an approach is applicable to all aircraft utilizing VNAV guidance to an existing MDA or DA(H).

b. Visual portion of the final approach segment. The visual portion begins at the decision altitude point (DAP) and ends at the runway threshold. The DAP is a defined point on the final approach course of a computer generated vertical path of a straight-in approach from which normal descent from the DA to the runway touchdown point may be commenced, provided visual reference is established.. Airline personnel experienced with performing obstacle assessments for compliance with FAR 121.189, or equivalent applications, may conduct this obstacle assessment.

1. Location. The DAP is located at a point on the vertical path to the runway at the altitude specified by the published DA(H).

2. Alignment. The visual descent area (VDA) is centered on the runway centerline extended

3. Area. The VDA is determined as follows:

(a) The area shall begin at a point 1,000 feet upwind from the runway threshold and splay 10-degrees either side of the runway centerline. Figure 1 depicts the VDA.

(b) Where the 10 degree splay does not encompass the width of the runway at the threshold, the area shall begin at the threshold at a width equal to the runway width and splay 10-degrees from the runway edges.

(c) The area shall terminate at the DAP, or where the obstacle clearance surface elevation is equal to the DA minus the ROC, whichever occurs first.

4. Surface. The surface is inclined upward from the runway and extends outward to the DAP at an angle 1-degree lower than the published angle from DA to the runway threshold. Figure 2 depicts the surface.

5. Obstacle Clearance. No obstacle shall penetrate the surface overlying the area. If obstacles penetrate this surface it should be brought to the attention of the regional Flight Standards Division. The regional flight standards personnel may need to take action to amend the underlying procedure, chart the obstacle, or coordinate with AFS-400, as appropriate.

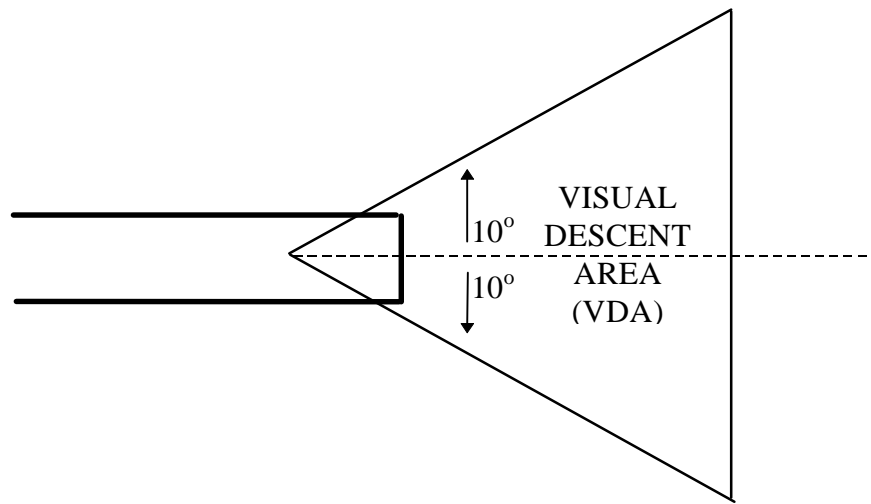


Figure 1

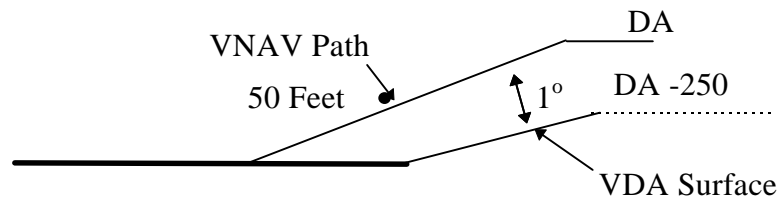


Figure 2

Note: FAA has completed the VDA obstacle assessment for the following approaches:

1. Approaches with a published visual descent point (VDP).
2. ILS, GPS or RNAV approaches with a published glide slope or computed VNAV glide slope.
3. Approaches served with a VASI or PAPI vertical visual guidance system.

c. Obstacle assessment for FMS overlay of the final approach segment. Air carrier procedures developed to cover scheduled/unscheduled outage of a ground based navaid, standardize operations or provide for contingency planning must emulate, or otherwise overlay, existing FAA Part-97 instrument procedures. When an instrument approach procedure is being developed for LNAV or LNAV/VNAV operations, Order 8260.40A, paragraph 10 (Approach Criteria) will apply.

d. Obstacle assessment for RNP overlay of the final approach segment. When RNP minimums are to be established use Order 8260.40A, paragraph 10 as follows:

1. Secondary area(s) identified at 10a (4), (5), (6); 10b (4); 10c (3)(b); 10d (4)(b) and 10d (5)(a) do not apply;

2. The width of the Intermediate Approach Segment at 10c (3) will taper from the width of the primary area at the IWP to a width of 0.6NM each side of centerline at the FAWP;

3. The width of the Final Approach Segment at 10d (4) will be 0.6NM each side of centerline from the FAF to the runway threshold, and;

4. Identify minimums using 250-feet of ROC specified at 10d (5)(a) as a DA(H). In no case will a visibility minima less than 1/2 sm (RVR2400) be authorized.

5. Applicable lighting credit may be applied

The RNP minimums will only be authorized for airborne equipment providing vertical path guidance about the published flight path angle throughout the final approach segment. Airborne equipment operated in any other VNAV mode during the final approach segment will be limited to published LNAV minimums. Specific airborne equipment, crew training and operating conditions/limitation, if any, will be provided as air carrier notes associated with the FAA Form 8260 for the underlying approach.

e. VNAV Obstacle assessment criteria. Baro VNAV criteria is being developed for order 8260.40. Pending completion of the final criteria, the following criteria may be used.

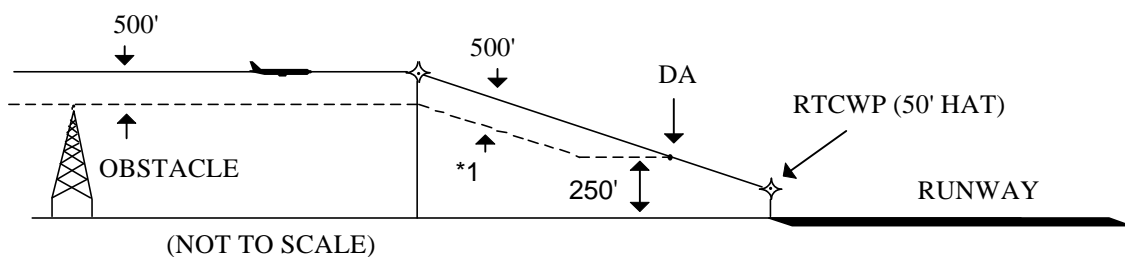
1. Location. The VNAV obstacle assessment area begins at the FAF or at the minimum crossing altitude or where the FAF altitude intersects the VNAV path angle and ends at the altitude specified by the published DA(H).

2. Alignment. The VNAV obstacle assessment area is centered on the final approach

3. Area. The VNAV obstacle assessment area is determined as described in Order 8260.40A, paragraph 10, as specified at paragraphs 7c or 7d above, as appropriate.

4. Surface. The surface is inclined from the FAF altitude minus 500-feet and extends parallel to, and 500-feet below the VNAV path angle to the DA. Figure 3 depicts the VNAV surface.

5. Obstacle Clearance. No obstacle shall penetrate the surface overlying the area.



*1 NOTE: Descent gradient for obstacle clearance surface equals

8. RESPONSIBILITIES:

a. Operator: The operator is responsible for the overall coordination and development of the requested flight operation/procedure for approaches developed for use during scheduled/unscheduled facility outages., including:

1. Coordination with the affected Air Traffic Facility.
2. Ensuring an obstacle analysis of the final approach and missed approach or visual segment, as appropriate, using obstacle assessment areas using the guidance specified in this NOTICE has been completed.
3. The operator is responsible for conducted appropriate simulation and/or flight trials to ensure waypoint integrity and /procedure flyability.
4. Providing a copy of the procedure to the affected Air Traffic Facilities.
5. Naming a point-of contact for all matters related to the procedure.
6. Obtain OpSpec C64 approval.
7. Completion of FAA Form 8260-7 to document the procedure.

b. Air Carrier Personnel Knowledge Requirements. Air carrier personnel conducting obstacle assessments described in paragraphs 6c, 6d, 6e or 6F of this order must be knowledgeable in the following areas:

1. Sections of this order and related documents specified herein as they relate to obstacle assessment and flight procedures development.
2. Sections of FAR Parts 77,91, 97 (including Terminal Instrument Procedures (TERPS), 121, 135, 139 and 171 as they apply to flight procedures requirements.
3. ARINC Specification 424, Navigation Data Base.
4. RTCA Document DO-187, Minimum Performance Standards for Airborne Equipment Using Multi-Sensor Inputs.

c. Regional AFS-200, All Weather Operations: The regional All Weather Operations representative is responsible for ensuring the proponent has correctly

applied its obstacle assessment and determined the appropriate minimums for approach operations developed in accordance with paragraph 6c, 6d, 6e or 6f of this NOTICE, and:

1. Ensuring coordination with the affected Air Traffic Facility
2. Ensure all of the Air Traffic Facilities conditions/limitations, if any, are satisfied.
3. Ensure the proponent's procedure(s) are developed using direction and guidance provided by this NOTICE and the Flight Standards Service's Technical Programs Division (AFS-400)
4. Forward a signed 8260-7 form (recommended by) with proposed minima to AFS-400, for approval and issuance.

d. Technical Programs Division, AFS-400: The Technical Programs Division will provide general policy and guidance for procedures developed by air carriers. AFS-400 will also maintain a file for each air carrier developed procedure developed in accordance with paragraphs 6 of this NOTICE. Supply a copy of the appropriate 8260 forms to the controlling region of each follow-on operator requesting the procedure. Conduct DME/DME assessments as requested. Develop standard criteria implementing barometric VNAV criteria for inclusion in TERPS.

e. Principal Operation Inspector (POI): The POI is responsible for ensuring the carrier has developed and validated its procedure(s) in accordance with the applicable portions of paragraph 5 of this NOTICE. The POI will also issue appropriate operations specifications paragraph C63 or C64, and FAA Form 8260-7, if any, authorizing VNAV operations.

9. Inquires. This NOTICE was developed by the Technical Programs Division inquires should be directed to AFS-400 at (202) 267-8452

James H. Enias
cc: AFS-200/200N
AFS-400/410/420/430