

**Area Navigation (RNAV)/Wide Area Augmentation
System (WAAS) Instrument Approach Procedures (IAP's)
and the New Charting Format.
[REVISED 1/5/00]**

PURPOSE.

Instrument procedures in the first half of the 21st century will be based on satellite navigation, also known as Global Navigation Satellite System (GNSS). Within the United States, the Global Positioning System (GPS), the Wide Area Augmentation system (WAAS), and the Local Area Augmentation System (LAAS) will comprise the primary components of the GNSS.

Air navigation is increasingly dependent upon RNAV systems - as exemplified by Flight Management System (FMS) and Global Positioning System (GPS) avionics. These systems navigate with reference to geographic positions called "waypoints" (WP) specified in latitude/longitude rather than to/from a specific ground-based navigation aid.

Reliance on RNAV systems for approach and departure operations will increase as new systems such as WAAS are developed and deployed. To foster and support full and optimal integration of RNAV into the National Airspace System (NAS), the FAA has developed a new procedure type for RNAV IAP's. This Notice serves to inform the flying public of the new concepts being implemented with the RNAV IAP's.

OPERATIONS.

In order to avoid unnecessary duplication and proliferation of instrument approach charts, Jeppesen will publish approach minimums for unaugmented GPS and WAAS (when operational) on the same chart. In addition, approach minimums will be established and published for LNAV/ VNAV - a new type of RNAV instrument approach with lateral and vertical navigation. The approach chart will be titled "RNAV RWY XX." The chart may contain as many as four columns of approach minimums: GLS; LNAV/VNAV; LNAV; and CIRCLING. Appropriately equipped aircraft may fly to the various published minimums described in paragraphs a through c below:

a. GLS. "GLS" is the acronym for GNSS Landing System; GNSS is the acronym for Global Navigation Satellite System. The minimums column labeled GLS will accommodate aircraft equipped with precision approach capable WAAS receivers operating to their fullest capability. WAAS, as its name implies, augments the basic GPS satellite constellation with additional ground stations and enhanced position/ integrity information transmitted from geostationary satellites. This capability of augmentation enhances both the accuracy and integrity of basic GPS, and may support precision approach minimums as low as 200' height above touchdown (HAT) and 1/2 statute mile (SM) visibility. In order to achieve lowest minimums, the requirements of an entire precision system including satellite availability; clear obstruction surfaces; AC

150/5300-13, Airport Design; and precision runway and airport requirements must be satisfied. Pilots will be informed that all the requirements of the precision system are satisfied by the notation "GLS PA" in the first column of minimums. Pilots will be informed that the precision system requirements are not met by the notation "GLS" without the letters "PA" in the first column of minimums. In this latter case, the airborne WAAS receiver may be operating in the most capable mode, but since the landing environment does not support the low visibility operations, minimums no lower than 300' HAT and 3/4 SM visibility will be published. Since computed glidepath guidance is provided to the pilot, procedure minimum altitude will be published as a Decision Altitude (DA).

LNAV/VNAV. Since LNAV/VNAV systems provide vertical guidance, the procedure minimum altitude will be published as a DA. The minimums column labeled as LNAV/VNAV may be used by the following systems:

(1) **Precision approach capable WAAS** equipment that has reverted to a less capable mode of operation. Conditions such as poor GPS satellite geometry or atmospheric interference may cause precision this reversion. Lateral and vertical navigation are still available to support an instrument approach but to a lesser degree of accuracy. If alerted to this condition by the on-board WAAS equipment, the pilot/crew shall use the LNAV/VNAV minimums.

(2) **WAAS lateral-only receiver** integrated with an IFR approach approved Barometric (BARO) VNAV system.

(3) **RNP-0.3 approved aircraft** with an IFR approach approved BARO-VNAV system.

(4) **Aircraft equipped with other IFR RNAV systems** such as FMS and BARO-VNAV may also use LNAV/VNAV minimums. See paragraph d below.

c. LNAV. These minimums are for LNAV-only. Because vertical guidance is not provided, the procedure minimum altitude will be published as a minimum descent altitude (MDA). LNAV minimums support the equipment described below:

(1) **If the quality of the WAAS** navigation solution will not support vertical navigation at all, the WAAS receiver will revert to an LNAV mode. Again, the pilot/crew will be alerted to the loss of VNAV and shall revert to LNAV minimums.

(2) **WAAS equipment** approved only for nonprecision approaches.

(3) **RNP-0.3 approved aircraft.**

(4) **Navigation systems** using basic unaugmented GPS approved for approach operations in accordance with:

(a) AC 20-138, Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for Use as a VFR and IFR Supplemental Navigation system, for standalone TSO-C129 Class A(1) systems; or

(b) AC 20-130A, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors, for GPS as part of a multi-sensor system, qualify for these minimums.

d. Other Systems. Through a special authorization, aircraft equipped with other IFR approach approved RNAV systems may fly to the LNAV/VNAV and/or LNAV minimums described above. These systems may include aircraft equipped with an FMS that can file /E or /F. **Operational approval must also be obtained for BARO-VNAV systems to operate to the LNAV/VNAV minimums.** BARO-VNAV may not be authorized on some approaches due to other factors. Pilots are directed to their local Flight Standards District Office (FSDO) for additional information.

NOTE: RNAV and BARO-VNAV systems must have a manufacturer supplied electronic data base which shall include the waypoints, altitudes, and vertical data for the procedure to be flown. The system shall also be able to extract the procedure in its entirety, not just as a series of waypoints.

REQUIRED NAVIGATION PERFORMANCE (RNP).

With the widespread deployment of RNAV systems, the advent of GPS, and the imminent implementation of WAAS, greater flexibility in route, procedure, and airspace design is now possible, with an associated increase in navigation accuracy and flight safety. To capitalize on the potential of RNAV systems, the FAA and the International Civil Aviation Organization (ICAO) are effecting a shift toward a new standard of navigation and airspace management called RNP.

Navigation systems have typically been described as being sensor specific, such as VOR, NDB, and ILS systems. When RNP is specified, it does not matter what the underlying navigation system or combination of systems is used, provided the aircraft can achieve the required navigation performance. Typically, various sensor inputs are processed by the RNAV system to arrive at a position estimate having a high statistical degree of accuracy and confidence. RNP is intended to provide a single performance standard that can be used and applied to aircraft and aircraft equipment manufacturers, airspace, planners, aircraft certification and operations, pilots and controllers, and international aviation authorities. RNP can be related to obstacle clearance or aircraft separation requirements to ensure a consistent level of application.

An RNP level or type is applicable to a selected airspace, route, or procedure. The applicable RNP is expressed as a value that represents a distance in nautical miles from the intended position to the actual position of an aircraft. It is within this distance that an aircraft would normally be expected to operate. For general RNAV approach procedures, RNP-0.3 is required.

Aircraft meeting RNP criteria will have an appropriate entry, including special conditions and limitations, if any, in the Aircraft Flight Manual (AFM) or its

supplement. This will only occur when it has been determined that the aircraft complies with the appropriate provisions of certification.

Some aircraft have RNP approval in their AFM without a GPS sensor. The lowest level of sensors that the FAA will support for RNP service is DME/DME. However, necessary DME NAVAID ground infrastructure may or may not be available at the airport of intended operations. For those locations having an RNAV chart published with LNAV/VNAV minimums, a procedure note may be provided such as “DME/DME RNP-0.3 NA”; this means that RNP aircraft dependent on DME/DME to achieve RNP-0.3 are not authorized to conduct this approach. Where FAA flight inspection successfully determines the availability and geometry of DME facilities will support RNP-0.3 and that the DME signal meets inspection tolerances, a note such as "DME/DME RNP-0.3 Authorized" will appear on the chart. And where DME facility availability is a factor, the note may read “DME/DME RNP-0.3 Authorized; ABC and XYZ Required”; meaning that ABC and XYZ facilities have been determined by flight inspection to be required in the navigation solution to assure RNP-0.3.

TERMS/LANDING MINIMA DATA

IFR LANDING MINIMA

The United States Standard for Terminal Instrument procedures (TERPS) is the approved criteria for formulating instrument approach procedures. The standard format for RNAV minima and landing minima portrayal follows:

STRAIGHT-IN LANDING RWY 34								CIRCLE-TO-LAND	
GLS PA DA(H) 1473'(200')		LNAV/VNAV DA(H) 1580'(307')		LNAV MDA(H) 1640'(367')			Max Kts	MDA(H)	
FULL	RAIL or ALS out		RAIL or ALS out		RAIL out	ALS out			
A							90	1720'(433')-1	
B	RVR 24	RVR 40	RVR 40	RVR 50	RVR 24 or 1/2	RVR 40 or 3/4	120	1740'(453')-1	
C	or 1/2	or 3/4	or 3/4	or 1		or 1	140	1740'(453')-1 1/2	
D					RVR 50 or 1	RVR 60 or 1 1/4	165	1840'(553')-2	

AMEND 0

CHANGES: New procedure.

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RNAV minimums are dependant on navigational equipment capability, as stated in the applicable AFM or AFMS, and as outlined below.

GLS (Global Navigation Satellite System (GNSS) Landing System)

Must have WAAS (Wide Area Augmentation System) equipment approved for precision approach.

NOTE: “PA” indicates that the runway environment, i.e. runway markings, runway lights, parallel taxiways, etc., meets precision approach requirements. If the GLS minima

column does not contain “PA”, then the runway environment does not meet precision approach requirements.

LNAV/VNAV (Lateral Navigation/Vertical Navigation)

Must have WAAS equipment approved for precision approach, or RNP-0.3 system based on GPS or DME/DME, with an IFR approach approved Baro-VNAV system. Other RNAV approach systems require special approval. Use of Baro-VNAV systems is limited by temperature, i.e. “Baro-VNAV NA below -20°C(-4°F)”. (Not applicable if chart is annotated “Baro-VNAV NA”).

NOTE: DME/DME RNP-0.3 systems are not authorized unless a chart note indicates DME/DME availability, for example, “DME/DME RNP-0.3 authorized.” Specific DME facilities may be required, for example, “DME/DME RNP-0.3 authorized. ABC, XYZ required.”

LNAV (Lateral Navigation)

Must have IFR approach approved WAAS, GPS, GPS based FMS systems, or RNP-0.3 systems based on GPS or DME/DME. Other RNAV approach systems require special approval.

NOTE: DME/DME RNP-0.3 systems are not authorized unless a chart note indicates DME/DME availability, for example, “DME/DME RNP-0.3 authorized.” Specific DME facilities may be required, for example, “DME/DME RNP-0.3 authorized. ABC, XYZ required.”

PROCEDURE NAME.

After a transition period, unaugmented GPS IAP’s currently titled “GPS RWY XX” will be converted to the new RNAV plate and titled “**RNAV RWY XX.**” Where multiple RNAV procedures exist to the same runway, subsequent RNAV procedure titles will be “**RNAV Z RWY 22,**” “**RNAV Y RWY 22,**” etc. Pilot/controller communications should utilize phonetic phraseology; e.g., “RNAV ZULU Runway 22,” “RNAV YANKEE Runway 22,” etc. ATC clearance for the RNAV procedure will authorize the pilot to utilize any landing minimums for which the aircraft is capable, or the pilot and aircraft have been authorized. RNAV procedures, which incorporate a final approach stepdown, fix will be published as separate approach procedures. During the interim period when GPS procedures are undergoing revision to the new title, both “RNAV” and “GPS” approach charts will be published by Jeppesen.

CHART TERMINOLOGY.

a. DA is the acronym for “Decision Altitude”. At some point, DA will be published for all future instrument approach procedures with vertical guidance.

b. MDA, the acronym for “minimum descent altitude,” has been in use for many years, and will continue to be used for the LNAV and circling procedures.

c. GLS identifies minimums developed to accommodate aircraft equipped with augmented GPS equipment.

d. **LNAV/VNAV** identifies minimums developed to accommodate an RNAV IAP with vertical guidance. **LNAV** is the acronym for lateral navigation, **VNAV** for vertical navigation. Aircraft using LNAV/VNAV minimums will descend to landing via an internally generated descent path based on satellite or other approved VNAV systems.

MINIMUMS FORMAT.

a. **Each column of minimums on an RNAV chart** will be titled to reflect the associated RNAV system applicable; e.g., **GLS, LNAV/VNAV, and LNAV. CIRCLING** minimums will also be provided when authorized.

b. **The minimums title box** will also indicate the nature of the minimum altitude for the procedure. For example:

(1) **DA** will be published where the minimums column reflects vertical guidance such as for GLS or LNAV/VNAV.

NOTE: DA indicates to the pilot that the published descent profile is flown to the Decision Altitude, where a missed approach will be initiated if visual references for landing are not established. Obstacle clearance has been provided to allow a momentary descent below DA while transitioning from the final approach segment to the missed approach.

(2) **MDA** will be published where the minimums column reflects only lateral guidance. Descent below the MDA is not authorized unless the visual conditions stated in 14 CFR Part 91.175 exist.

DESCENT ANGLE.

a. **It is FAA policy to design IAP's** with minimum altitudes established at fixes/waypoints to achieve optimum stabilized (constant rate) descents within each procedure segment. This design can enhance the safety of the operations and contribute toward reduction in the occurrence of controlled flight into terrain (CFIT) accidents. Additionally, the National Transportation Safety Board (NTSB) recently emphasized that pilots could benefit from publication of the appropriate IAP descent angle for a stabilized descent on final approach. The new RNAV charts will, therefore, include the descent angle to the hundredth of a degree; e.g., **3.00°**. The angle will be provided in the graphically depicted descent profile as well as in the conversion table.

b. **The stabilized approach** may be performed by reference to vertical navigation information provided by WAAS or LNAV/VNAV systems; or for LNAV-only systems, by the pilot determining the appropriate aircraft attitude/ground speed combination to attain a constant rate descent which best emulates the published angle. To aid the pilot, rates of descent are shown in the conversion table for use in planning and executing descents under known or approximate ground speed conditions.

TCH.

a. Most pilots are aware of this acronym for “Threshold Crossing Height.” It is a term traditionally used in “precision” approaches as the height of the glide slope above threshold. Now, with publication of LNAV/VNAV minimums and RNAV descent angles, including graphically depicted descent profiles, TCH will also apply to the height of the “descent angle,” or glidepath, where it crosses above the threshold.

b. Unless otherwise required for larger type aircraft, which may be using the procedure, the typical TCH will be 30-50 feet.

CHART SYMBOLOGY.

a. Descent Profile. The published descent profile and a graphical depiction of the vertical path to the runway will be shown. Graphical depiction of an RNAV descent angle will differ from the traditional depiction of an ILS glide slope (feather) through the use of a simple vertical track.

b. Visual Descent Point (VDP). A VDP will be published on most RNAV procedures. When published, VDP’s will pertain only to aircraft utilizing LNAV minimums - not GLS or LNAV/VNAV. A ball-flag will be affixed to the VDP depiction in the profile view, with an accompanying procedure note “**LNAV only** “ also located in the profile view.

c. Waypoints. Most pilots are familiar with the waypoint (WP) symbol. Symbology used on new RNAV IAP’s is intended to inform the pilot of the distinction between a “fly-over (FO) WP” and a “fly-by (FB) WP.” As depicted on the planview of the approach procedure: the “fly-by WP” will use the standard WP symbol. However, the “fly-over WP” will enclose the WP symbol inside a circle. If flown manually, pilots should anticipate the turn at a FB WP to ensure a smooth transition from one segment to the next. Alternatively, for a FO WP, no turn is accomplished until the aircraft passes the WP. All RNAV or GPS stand-alone IAP’s are flown using data pertaining to the particular IAP obtained from an onboard database, including the sequence of all WP’s used for the approach and missed approach. Included in the database is coding that informs the navigation system of which WP’s are FB or FO. The navigation system may provide guidance appropriately - including leading the turn prior to a FB WP; or causing overflight of a FO WP. Chart symbology for the FB WP will provide pilot awareness of expected actions.

TERMINAL ARRIVAL AREAS (TAA).

TAA’s are currently described in the Aeronautical Information Manual (AIM) in Chapter 1 under GPS. When published, the new RNAV plate will depict the TAA areas through the use of “icons” representing each TAA area associated with the RNAV procedure. These icons will be depicted in the planview of the approach plate, generally arranged on the plate in accordance with their position relative to the aircraft’s arrival from the en route structure. The WP, to which navigation is appropriate and expected within each specific TAA area, will be named and depicted on the associated TAA icon. Each depicted named WP is the IAF for arrivals from within that area. TAA’s may not be

depicted on all RNAV procedures because of the inability for ATC to accommodate the TAA due to airspace congestion.

PILOT BRIEFING.

Now included in the Briefing Strip™ are WAAS and BARO-VNAV information.

a. Cold Temperature Limitations. Considering the pronounced effect of non-standard temperature on BARO-VNAV operations, a minimum temperature limitation will be published for each procedure for which BARO-VNAV operations are eligible. This temperature represents the airport temperature below which use of the BARO-VNAV will not be authorized to the LNAV/VNAV minimums. An example limitation will read: “**BARO-VNAV NA below -20°C(-4°F).**” This information will be found in the notes section of the Briefing Strip™.

b. WAAS Channel Number/Approach ID. The WAAS Channel Number is an equipment optional capability that allows the use of a 5-digit number to select a specific instrument approach procedure. The Approach ID is a unique 4-letter combination for verifying selection of the correct procedure. The WAAS Channel Number and Approach ID will be displayed prominently in the Briefing Strip™.

c. Approach Procedure Selection. The WAAS Channel Number and Approach ID provide one method available to the pilot for selecting and verifying the approach procedure for the runway of intended landing from the on-board databases. Some equipment may utilize a menu selection method.

(1) The “menu” method. In general, although the steps may vary among equipment types, the pilot first selects the airport of intended landing using the airborne equipment control panel. From a menu that is presented for this airport, the pilot then selects the approach runway. Selecting, from the menu, the Approach ID that matches the Approach ID printed on the approach chart then makes selection of the specific approach procedure. Finally, the pilot activates the procedure by selecting the IAF with which to begin the approach.

(2) 5-Digit Channel Number Method. The pilot enters the unique 5-digit number provided for the approach chart, and the receiver recalls a specific approach procedure from the aircraft data base. A list of information including the “Approach ID” and available IAF’s is displayed. The pilot confirms the correct procedure is selected by comparing the Approach ID listed with that printed on the approach plate. Finally, the pilot activates the procedure by selecting the appropriate IAF with which to begin the approach.

SCHEDULE FOR TRANSITION TO RNAV PROCEDURES.

FAA development of RNAV procedures will be according to the following priority scheme:

- a. Runways not served by an ILS at Title 14 CFR Part 139 airports. Part 139 airports are those supporting scheduled passenger operation of an air carrier using aircraft having a seating capacity of more than 30 passengers.
- b. Runways not served by an ILS and greater than or equal to 5,000' in length.
- c. All other runways.