



**Federal Aviation
Administration**

RNAV (GPS) Approaches

In 2013, we will celebrate ten years of the Wide Area Augmentation System's (WAAS) availability to the public. Pilots are now benefiting from the proliferation of Area Navigation (RNAV) Global Positioning System (GPS) approaches and lower minimums provided by WAAS-enabled systems. As of July 2011, there were twice as many WAAS approaches as Instrument Landing Systems (ILS) approaches. Currently, there are over 3000 Localizer Performance without Vertical Guidance (LP) and Localizer Performance with Vertical Guidance (LPV) procedures.

With Vertical Guidance

Localizer Performance with Vertical Guidance (LPV)

LPV approaches take advantage of the refined accuracy of WAAS lateral and vertical guidance to provide an approach very similar to a Category I ILS. Like an ILS, an LPV has vertical guidance and is flown to a Decision Altitude (DA). The design of an LPV approach incorporates angular guidance with increasing sensitivity as an aircraft gets closer to the runway (or point in space (PinS) type approaches for helicopters). Sensitivities are nearly identical to those of the ILS at similar distances. This is intentional to aid pilots in transferring their ILS flying skills to LPV approaches.

Lateral Navigation/Vertical Navigation (LNAV/VNAV)

LNAV/VNAV approaches provide both horizontal and approved vertical approach guidance. Vertical Navigation (VNAV) utilizes an internally generated glideslope based on WAAS or baro-VNAV systems. Minimums are published as a DA. If baro-VNAV is used instead of WAAS, the pilot may have approach restrictions as a result of temperature limitations and must check predictive RAIM (Receiver Autonomous Integrity Monitoring).

See AIM 1-1-19, 5-1-16, and AC 90-105.

CATEGORY	A	B	C	D	E
LPV DA	393-½ 200 (200-½)				
LNAV/VNAV DA	610-⅞ 417 (400-⅞)				
LNAV MDA	580-½ 387 (400-½)	580-⅝ 387 (400-⅝)			
CIRCLING	700-1 479 (500-1)	700-1½ 479 (500-1½)	800-2 579 (600-2)		
MONTGOMERY RGNL (DANNELLY FIELD) (MGM)					

Without Vertical Guidance

Localizer Performance without Vertical Guidance (LP) and Lateral Navigation (LNAV)

LPs are non-precision approaches with WAAS lateral guidance. They are added in locations where terrain or obstructions do not allow publication of vertically guided LPV procedures. Lateral sensitivity increases as an aircraft gets closer to the runway (or PinS type approaches for helicopters). LP is not a fail-down mode for an LPV. LP and LPV are independent. LP minimums will not be published with lines of minima that contain approved vertical guidance (LNAV/VNAV or LPV).

LNAV approaches are non-precision approaches that provide lateral guidance. The pilot must check RAIM (Receiver Autonomous Integrity Monitoring) prior to the approach when not using WAAS equipment. See AIM 1-1-19, 5-1-16, and AC 90-105.

Both LP and LNAV lines of minima are Minimum Descent Altitudes (MDAs) rather than DAs. It is possible to have LP and LNAV published on the same approach chart. An LP is published if it provides lower minimums than the LNAV. See AIM 1-1-20.

CATEGORY	A	B	C	D
LP MDA	1660-1 295 (300-1)			NA
LNAV MDA	1800-1 435 (500-1)	1800-1¼ 435 (500-1¼)		NA
CIRCLING	1900-1 506 (600-1)	1900-1½ 506 (600-1½)		NA
MESA/FALCON FIELD (FFZ)				

Important Terms and Concepts

Advisory Vertical Guidance

Depending on the manufacturer, a few WAAS-enabled GPS units provide advisory vertical guidance in association with LP or LNAV approaches. Typically, the manufacturer will use the notation of LNAV+V. The system includes an artificially created advisory glide path from the final approach fix to the touchdown point on the runway. This may aid the pilot in flying constant descent to the MDA. LNAV+V is not the same as LNAV/VNAV or LPV. Pilots must use the barometric altimeter as the primary altitude reference to meet all altitude restrictions. Advisory vertical guidance is not required and is an optional capability. See AC 90-107.

Approved Vertical Guidance

Approved vertical guidance provides pilots with glide path information to meet altitude approach restrictions for LPV, LNAV/VNAV, and ILS lines of minima. An LPV approach can provide WAAS vertical guidance as low as 200 feet AGL. LNAV/VNAV approaches also provide approved vertical guidance and existed before the WAAS system was certified. At that time, only aircraft equipped with a flight management system (FMS) and certified baro-VNAV systems could use the LNAV/VNAV minimums. Today, LNAV/VNAV approaches may be flown using approved WAAS equipment. Barometric altimeter information remains the primary altitude reference for complying with any altitude restrictions. See AC 90-107.

Barometric Aiding (Baro-Aiding)

Barometric aiding is an integrity augmentation that allows a GPS system to use a non-satellite input source (e.g. the aircraft static system) to provide vertical reference and reduces the number of required satellites from five to four. Baro-aiding requires four satellites and a barometric altimeter to detect an integrity anomaly. The current altimeter setting may need to be entered into the receiver as described in the operating manual. Baro-aiding satisfies the RAIM requirement in lieu of a fifth satellite. See AIM 1-1-19.

Barometric Vertical Navigation (Baro-VNAV)

Baro-VNAV is an RNAV system which uses barometric altitude information from the aircraft's altimeter to compute vertical guidance for the pilot. The specified vertical path is typically computed between two waypoints or an angle from a single way point. When using baro-VNAV guidance, the pilots should check for any temperature limitations which may result in approach restrictions. See AIM 5-4-5.

For more information please refer to the following:

Aeronautical Information Manual (AIM) Paragraphs: 1-1-19, 1-1-20, 5-1-16, and 5-4-5

Advisory Circulars:

AC 90-105, Approval Guidance for RNP Operations and Barometric Vertical Navigation in the U.S. National Airspace System

AC 90-107, Guidance for Localizer Performance with Vertical Guidance and Localizer Performance without Vertical Guidance Approach Operations in the U.S. National Airspace System

. . . It is the pilot's responsibility to use the barometric altimeter to ensure compliance with altitude restrictions for all approach operations.

