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UNITED STATES STANDARD FOR TERMINAL INSTRUMENT PROCEDURES (TERPS)

VOLUME 3

Precision Approach (PA) and Barometric Vertical Navigation (Baro VNAV) Approach Procedure Construction

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

CHAPTER 1. GENERAL INFORMATION

1.0 PURPOSE.

This TERPS volume contains final and initial missed approach segment construction criteria applicable to instrument approach procedures that provide positive glidepath guidance. Apply this criteria to approaches based on instrument landing system (ILS), microwave landing system (MLS), precision approach radar (PAR), transponder landing system (TLS), wide area augmentation system (WAAS), local area augmentation system (LAAS), barometric vertical navigation (Baro-VNAV), and future 3-dimensional navigational systems.

1.1 BACKGROUND.

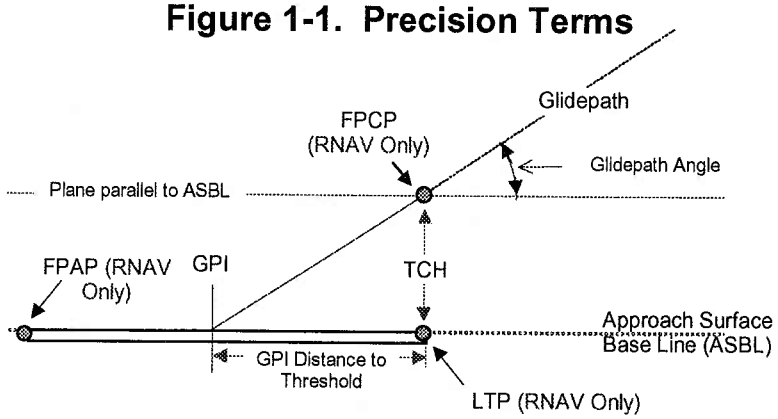
The ILS defined the navigational aid (NAVAID) performance standard for precision vertical and lateral guidance systems. Several different NAVAID's providing positive vertical guidance have evolved since the inception of ILS. NAVAID's capable of supporting Category I landing minimums are: ILS, PAR, MLS, TLS, WAAS, and LAAS. NAVAID's capable of providing Category II/III landing minimums are: ILS, MLS, and LAAS. A NAVAID capable of supporting Category I/II/III minimums does not qualify as a precision approach (PA) system without supporting ground infrastructure. Certain airport and obstruction clearance requirements are mandatory for the system to be considered a PA system and achieve the LOWEST minimums. These requirements are contained in AC 150/5300-13, Airport Design; and Order 8260.3, Volume 3, Precision Approach (PA), Barometric Vertical Navigation (Baro VNAV) Approach Procedure Construction, and appropriate military directives. When mandatory ground infrastructure requirements are not met, these NAVAID's may provide a vertically guided stabilized final approach descent, but command higher landing minimums. Additionally, some flight management system (FMS) avionics suites are equipped with Baro-VNAV systems that provide stabilized descent guidance.

1.2 DEFINITIONS.

1.2.1 Approach Surface Base Line (ASBL).

A horizontal line tangent to the surface of the earth at the runway threshold (RWT) point, aligned with the final approach course (see figure 1-1).

Figure 1-1. Precision Terms



1.2.2 Barometric Altitude).

Altitude above the orthometric Geoid surface; i.e., mean sea level (MSL), based on atmospheric pressure measured by an aneroid barometer. This is the most common method of determining aircraft altitude.

1.2.3 Barometric Vertical Navigation (Baro VNAV).

RNAV and Non-RNAV. Positive vertical guidance relative to a computed glidepath that is based on the difference between published altitudes at two specified points or fixes.

1.2.4 Decision Altitude (DA).

A specified altitude in reference to mean sea level in an approach with vertical guidance at which a missed approach must be initiated if the required visual references to continue the approach have not been established.

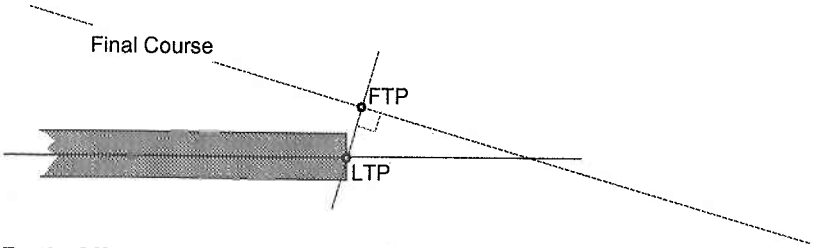
1.2.5 Departure End of Runway (DER).

The end of the runway that is opposite the landing threshold. It is sometimes referred to as the stop end of runway.

1.2.6 Fictitious Threshold Point (FTP).

The equivalent of the landing threshold point (LTP) when the final approach course is offset from runway centerline. It is the intersection of the final course and a line perpendicular to the final course that passes through the LTP. FTP elevation is the same as the LTP (see figure 1-2).

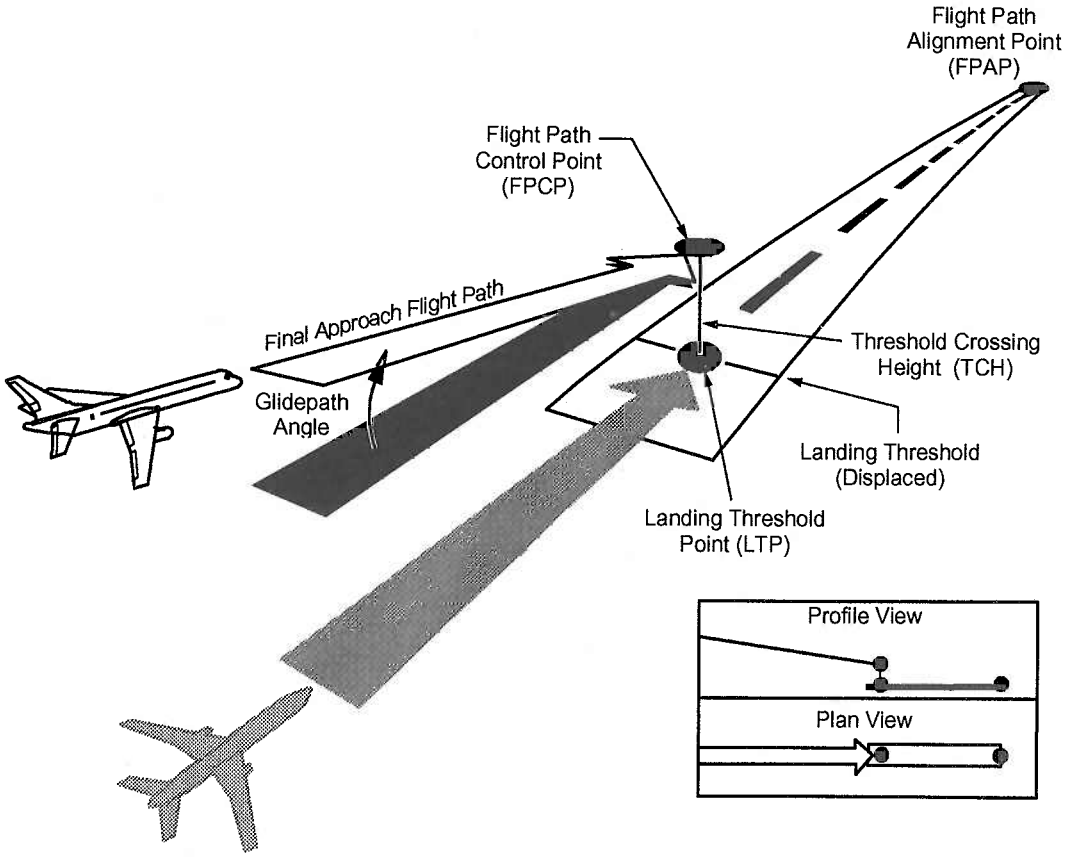
Figure 1-2. Fictitious Threshold Point



1.2.7 Flight Path Alignment Point (FPAP). [RNAV Only]

The FPAP is a 3D point defined by World Geodetic System (WGS)-84/North American Datum (NAD)-83 latitude, longitude, MSL elevation, (see figures 1-1 and 1-3). The FPAP is used in conjunction with the LTP and the geometric center of the WGS-84 ellipsoid to define the vertical plane of a PA RNAV final approach course. The approach course may be offset up to 3° by establishing the FPAP left or right of centerline along an arc centered on the LTP.

Figure 1-3. Precision Approach Path Points (Straight-In)



1.2.8 Flight Path Control Point (FPCP). [RNAV Only]

An imaginary point above the LTP from which the glidepath mathematically emanates. It is in a vertical plane containing the LTP and FPAP. The FPCP has the same geographic coordinates as the LTP. The elevation of the FPCP is the sum of LTP elevation and the TCH value (see figure 1-3).

1.2.9 Geoid Height (GH). [RNAV Only]

The height of the Geoid (reference surface for orthometric or MSL heights) relative to the WGS-84 ellipsoid. It is a positive value when the Geoid is above the WGS-84 ellipsoid and negative when it is below. The value is used to convert an MSL elevation to an ellipsoidal or geodetic height - the height above ellipsoid.

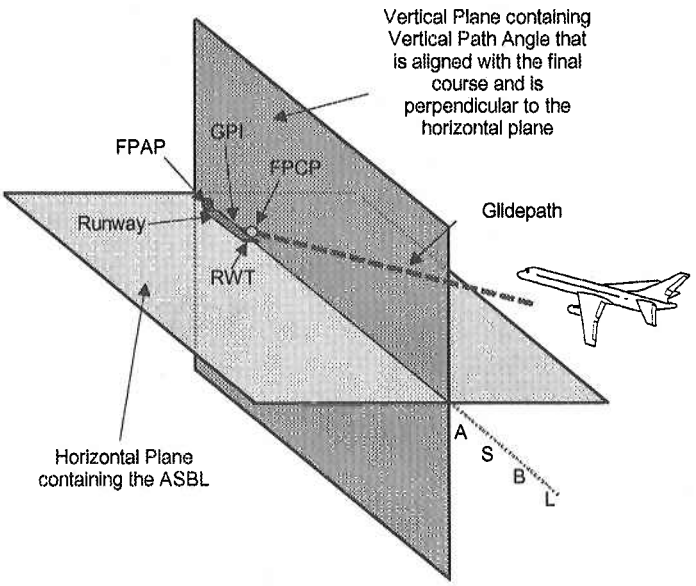
1.2.10 Glidepath Angle (GPA).

The angular displacement of the glidepath from a horizontal plane that passes through the LTP/FTP. This angle is published on approach charts (e.g., 3.00°, 3.20°, etc.).

1.2.11 Ground Point of Intercept (GPI).

A point in the vertical plane containing the glidepath where the vertical path intercepts the ASBL. GPI is expressed as a distance from RWT (see figure 1-4).

Figure 1-4. 3D Path & Course



1.2.12 Height Above Ellipsoid (HAE). [RNAV Only]

A height expressed in feet above the WGS-84 ellipsoid. This value differs from a height expressed in feet above the geoid (essentially MSL) because the reference surfaces (WGS-84 Ellipsoid and the Geoid) do not coincide. To convert an MSL height to an HAE height, algebraically add the geoid height value to the MSL value. HAE elevations are not used for instrument procedure construction, but are documented for inclusion in airborne receiver databases.

EXAMPLE:	Given:	KOUN RWY 35	Runway ID
		N 35 14 31.65	Latitude
		W 97 28 22.84	Longitude
		1177.00	MSL Elevation
		-87.29 feet (-26.606 m)	Geoid Height (GH)

HAE = MSL + GH

HAE = 1177 + (-87.29)

HAE = 1089.71

1.2.13 Height Above Touchdown (HAT).

The HAT is the height of the DA above touchdown zone elevation (TDZE).

1.2.14 Inner-Approach Obstacle Free Zone (OFZ).

The airspace above a surface centered on the extended runway centerline. It applies to runways with an approach lighting system.

1.2.15 Inner-Transitional OFZ.

The airspace above the surfaces located on the outer edges of the runway OFZ and the inner-approach OFZ. It applies to runways with approach visibility minimums less than ¾ statute mile.

1.2.16 Landing Threshold Point (LTP).

The LTP is a 3D point at the intersection of the runway centerline and the runway threshold. It is defined by WGS-84/NAD-83 latitude, longitude, MSL elevation, and geoid height (see figure 1-1). It is used in conjunction with the FPAP and the geometric center of the WGS-84 ellipsoid to define the vertical plane of an RNAV final approach course. LTP elevation applies to the FTP when the final approach course is offset from runway centerline.

1.2.17 Lateral Navigation (LNAV). [RNAV Only]

Azimuth navigation without positive vertical guidance. This type of navigation is associated with nonprecision approach procedures.

1.2.18 Microwave Landing System/Mobile Microwave Landing System (MLS/MMLS). [DOD Only)

MLS/MMLS can be configured in two ways; "Split Site" where the azimuth and elevation antennas are sited the same as an ILS, or "Collocated Site" where the azimuth and elevation antennas are located together along side the runway. "Split Site" is the normal configuration for "fixed" MLS locations to meet the capability of standard MLS avionics receiver equipment. Aircraft that will use MLS/MMLS procedures configured as a "Collocated Site" must have a special MLS avionics receiver capable of computing the offset runway centerline location. These procedures will have the following caveat: "COMPUTED APPROACH: FOR USE BY AIRCRAFT CAPABLE OF COMPUTING OFFSET RUNWAY CENTERLINE ONLY." Since the MMLS has a selectable azimuth and glide slope, procedures will be published with the caveat: "FLYING OTHER THAN PUBLISHED AZIMUTH AND/OR GS ANGLE RENDERS THE PROCEDURE UNUSABLE." MMLS equipment computing capability for "collocated" configuration requires that all system components (DME/P, AZ, and EL) must be operating, thus the following caveat must be published: "ALL SYSTEM COMPONENTS MUST BE OPERATIONAL."

1.2.19 Object Free Area (OFA).

An area on the ground centered on a runway, taxiway, or taxilane centerline provided to enhance the safety of aircraft operations by having the area free of objects, except for objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes.

1.2.20 Obstacle Clearance Surface (OCS).

An inclined obstacle evaluation surface associated with a glidepath. The separation between this surface and the glidepath angle at any given distance from GPI defines the MINIMUM required obstruction clearance at that point.

1.2.21 Positive Vertical/Horizontal Guidance.

Glidepath or course guidance based on instrumentation indicating magnitude and direction of deviation from the prescribed glidepath or course on which obstruction clearance is based.

1.2.22 Precision Approach (PA).

An approach based on a navigation system that provides positive course and vertical path guidance conforming to ILS or MLS system performance standards contained in ICAO Annex 10. To achieve lowest minimums, the ground infrastructure must meet requirements contained in AC 150/5300-13 and TERPS Volume 3.

1.2.23 Precision Approach Radar (PAR).

A ground radar system displaying an aircraft on final approach in plan and profile views in relation to glidepath and course centerlines. Air traffic controllers issue course line and glidepath information to the pilot. The pilot alters course and rate of descent in response to gain course and glidepath alignment. Military pilots may achieve 100′ HAT and 1/4 mile visibility minimums with PAR.

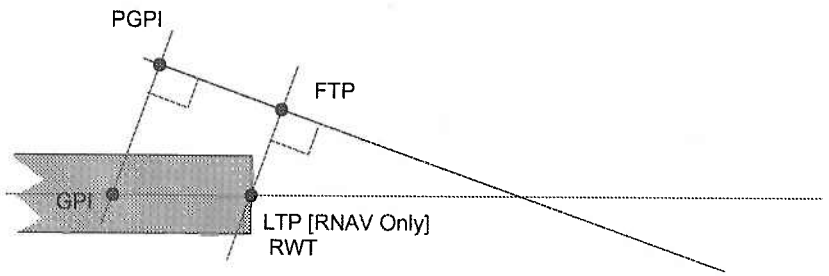
1.2.24 Precision Final Approach Fix (PFAF). Applicable to all PA approach procedures.

A 2D point located on the final approach course at a distance from LTP/FTP where the GPA intercepts the intermediate segment altitude (glidepath intercept altitude). The PFAF marks the outer end of the PA final segment.

1.2.25 Pseudo Ground Point of Intercept (PGPI).

Phantom location abeam the GPI when the approach course is offset. PGPI elevation is the same as ASBL (see figure 1-5).

Figure 1-5. PGPI and FTP Locations



1.2.26 Radio Altimeter Height (RA).

An indication of the vertical distance between a point on the nominal glidepath at DA and the terrain directly beneath this point.

1.2.27 Required Navigation Performance (RNP).

A statement of the navigation performance accuracy necessary for operation within a defined airspace. Note that there are additional requirements, beyond accuracy, applied to a particular RNP type.

1.2.28 Runway Threshold (RWT).

The RWT marks the beginning of that part of the runway usable for landing (see figure 1-6). It extends the full width of the runway. The RWT geographic coordinates identify the point the runway centerline crosses the RWT.

Figure 1-6. Threshold

1.2.29 Three-Dimensional (3D) Point/Waypoint. [RNAV Only]

A waypoint defined by WGS-84 latitude and longitude coordinates, MSL elevation, and GH.

1.2.30 Touchdown Zone Elevation (TDZE).

The highest elevation in the first 3,000 feet of the landing surface.

1.2.31 Two-Dimensional (2D) Point/Waypoint. [RNAV Only]

A waypoint defined by WGS-84 latitude and longitude coordinates.

1.2.32 Wide Area Augmentation System (WAAS). [RNAV Only]

A method of navigation based on the GPS. Ground correction stations transmit position corrections that enhance system accuracy and add VNAV features.