



Federal Aviation Administration

Memorandum

Date: MAY - 9 2008

To: Danny Hamilton, Manager, National Flight Procedures Group, AJW-32

From: *fw* John W. McGraw, Manager, Flight Technologies and Procedures Division, *LHS*
AFS-400

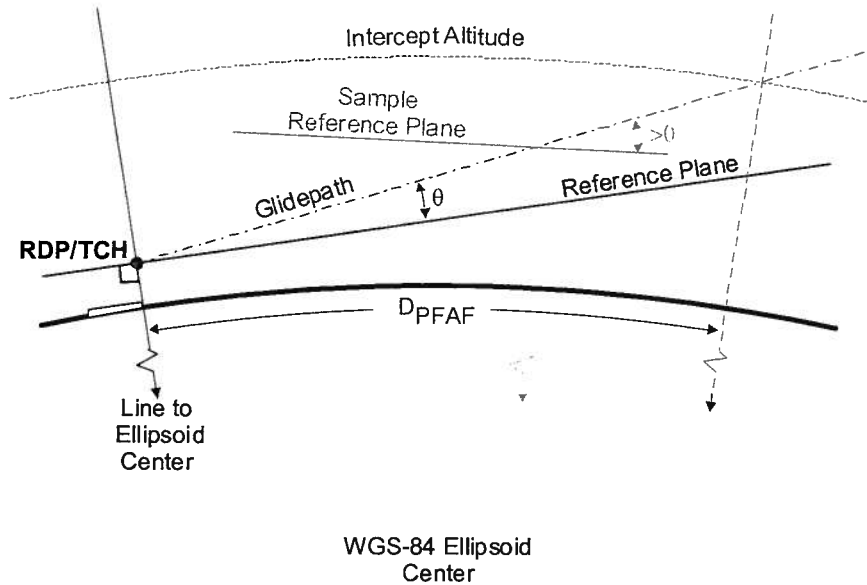
Subject: Clarification of Precise Final Approach Fix (PFAF) Location Policy

PURPOSE. This memorandum clarifies the formulas used to locate the PFAF for instrument approach procedures.

DISCUSSION. The National Airspace System (NAS) is evolving from a system based on ground navigational aids (conventional navigation) to one based on aircraft systems performance; i.e., performance-based navigation (PBN). Procedure design for conventional navigation used plane geometry to calculate distance and altitudes as if the earth were flat. PBN procedure design acknowledges the earth is a slightly flattened sphere, so the design guidance accommodates earth curvature. The change to PBN requires procedure design service providers to recognize the differences in the physical characteristics of the glidepaths that today's vertical guidance systems generate.

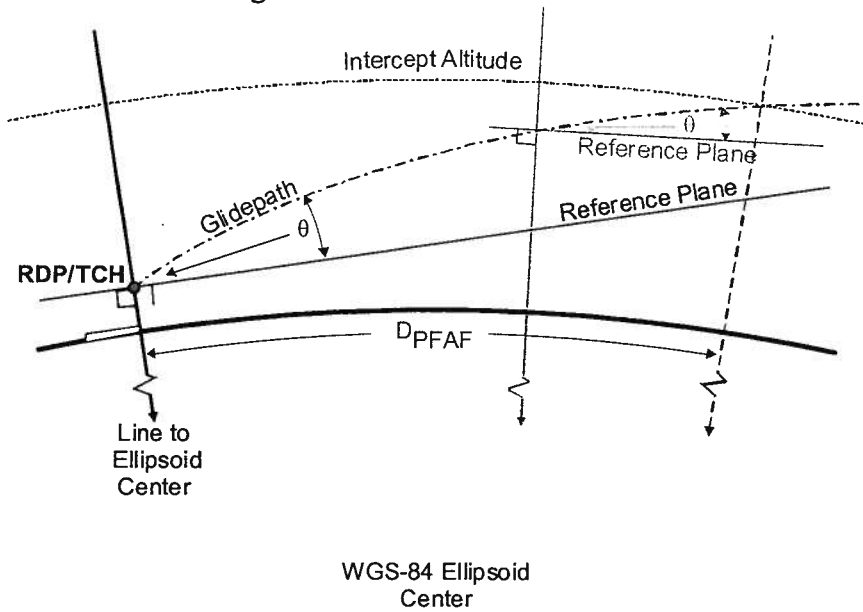
Straight line Vertical Path. The physical nature of ground-based electronically radiated glide slopes such as instrument landing system (ILS) and microwave landing system (MLS) and satellite-based calculated glidepaths such as local area augmentation system (LAAS) and localizer precision with vertical guidance (LPV) is a straight line in space. Order 8260.54A, formula 2-16a provides the formula for calculating PFAF locations for these systems. The glidepath angle value for these systems is not influenced by the location and altitude of the PFAF. The ILS/MLS/LPV/LAAS glidepath angle value is measured at the reference datum point (RDP) relative to a plane perpendicular to a line extending from the RDP to the center of the world geodetic system 1984 (WGS-84) ellipsoid. The glidepath angle measured at any point on the glidepath outside the RDP is larger because the glide slope is a straight line and the earth is curving away from it. See figure 1.

Figure 1. ILS/MLS/LPV



Curved Line Vertical Path. The calculated glidepath generated by Barometric Vertical Navigation (BaroVNAV) systems is a curved line in space consistent with the curvature of the earth so that the glidepath angle measured at any point on the glidepath will yield the same value. The glidepath angle value is dependent on the location and altitude of the PFAF relative to the RDP. See figure 2. Order 8260.54A, formula 2-16b provides the formula for calculating PFAF location for these systems.

Figure 2. *LNAV/VNAV* and *RNP*



POLICY CLARIFICATION

Locate a single PFAF to serve all approach procedures (both vertically and non-vertically guided) to a runway. Calculate the PFAF location using Order 8260.54A, formula 2-16b:

$$D_{\text{PFAF}} = \frac{\ln\left(\frac{20890537 + \text{PFAF altitude}}{20890537 + \text{LTP elevation} + \text{TCH}}\right) \cdot 20890537}{\tan\left(\text{Glidepath Angle} \cdot \frac{\pi}{180}\right)}$$

NOTE: When circumstances prohibit use of formula 2-16b (Air Traffic Control requires use of another fix location, etc.), determine the published LNAV/VNAV or RNP glidepath angle required by the fix location using 8260.54A, formula 2-16c:

$$\text{Glidepath Angle} = \text{atan}\left(\ln\left(\frac{20890537 + \text{PFAF altitude}}{20890537 + \text{LTP elevation} + \text{TCH}}\right) \cdot \frac{20890537}{D_{\text{PFAF}}}\right) \cdot \frac{180}{\pi}$$

4. Where fixes must be located in the intermediate/initial segments to achieve ILS glide slope intercept prior to the PFAF, locate the fixes using 8260.54A, formula 2-16a:

$$D_{\text{glidepath intercept}} = 20890537 \cdot \left(\frac{\pi}{2} - \text{Glidepath Angle} \cdot \frac{\pi}{180} - \text{asin}\left(\frac{\cos\left(\text{Glidepath Angle} \cdot \frac{\pi}{180}\right) \cdot (20890537 + \text{LTP elevation} + \text{TCH})}{20890537 + \text{Intercept Altitude}} \right) \right)$$

This application may result in intermediate segment descent gradients that exceed normal maximum values. This is a necessary artifact of using the ILS glide slope and may be ignored without waiver action.

If you have questions, contact Mr. Jack Corman, Flight Procedure Standards Branch, AFS-420, at (405) 954-0012.