

**AERONAUTICAL CHARTING FORUM**  
**Charting Group**  
**Meeting 13-01 – April 24-25, 2013**

**RECOMMENDATION DOCUMENT**

**FAA Control # ACF-CG RD 13-01-264**

**Subject:** Flight Path Angle (FPA) on STAR charts with published vertical profiles

**Background/Discussion:**

Within the past several months, the NAS has been experiencing an explosion of Optimized Profile Descent procedures. The profiles complexity and designs vary from airport to airport. Many of these procedures are leveraging “window” or “block” altitude constraints that further optimize aircraft performance by allowing more flexibility for aircraft operations and atmospheric conditions. Air traffic controllers are also discovering the window constraints can actually open up more airspace as a result of the predictability the constraints offer. They no longer must protect large chunks of airspace before allowing aircraft to descend.

The Regional Jet community has not realized the full benefit of the procedures. In fact, the window constraints can add a level of complexity that significantly increases pilot workload, and in some cases, requires both pilots to focus most of their attention on executing the procedures. This is due to a lack of VNAV automation and guidance on CRJs, E135/145 and some business aviation aircraft. The vast majority of regional aircraft in the system does not have coupled-VNAV capability, but can make up a large percentage of operations at major airport hubs that are implementing the OPDs. Combined with the lack of auto-throttles and other alerting capabilities that are standard in the VNAV fleet, OPDs are proving to be challenging.

However, there are some FMS capabilities that can be leveraged, and when appropriately applied, result in continuous descents with very little throttle adjustment and dramatically reduced workload and distractions. The FMS uses a calculated VNAV angle that is defaulted to 3.0 degrees, or more; but can be easily changed by the crew. Once programmed, the crew flies the profile using a “snowflake” as vertical guidance; much like a glideslope. The crew then adjusts vertical speed and thrust to stay on path.

Most pilots will not use the snowflake, because the default Flight Path Angle (FPA) in the FMS produces undesirable results. Using the FRDMM STAR at DCA as an example, the aircraft will command three different level-offs and vertical speed changes with a range of as much as 1100’ per minute in order to comply with the constraints. Multiple throttle adjustments were also required. PDARS data clearly shows many RJ pilots “dive and drive” to the next constraint to make certain they do not violate an altitude. This loses all fuel saving and efficiencies the procedures are designed to provide.

Using a spreadsheet tool that calculates vertical path angles based on existing procedures, it was determined the FRDMM is designed with a 2.2 degree angle. This angle was inserted in a CRJ-700 FMS and the procedure was flown with tremendous results. There were no level-offs, minimal throttle adjustment and the vertical speed changes required to stay on path varied by only 400’ per minute. Winds are not a factor in dictating the FPA.

This process has been validated with other operators and equipment. Many are beginning their training programs for the pilots. The increased safety potential is significant, as well as the added fuel savings.

**Recommendations:**

FAA order 7100.9D should be modified to put in place a process that results in the FPA's values to be calculated as part of the procedure design. Charting standards should be revised to permit publishing the "recommended" FPA's on the chart. This will easily permit pilots to select and input the appropriate angle in the FMS.

**Comments:**

A few examples of FPA's that have already been calculated and in use

DCA- FRDMM = 2.2°, TRUPS = 2.2°  
 IAD – GIBBZ = 2.9°  
 CLT – IVANE RW23 = 2.5°, RW36R = 1.8°  
 MEM – LTOWN RW36 = 2.4°, RW18 = 3.0°

**Submitted by: Kevin Allen**

**Organization: US Airways**

**Phone: 480-693-4637**

**FAX: 480-693-4936**

**E-mail: kevin.allen@usairways.com**

**Date: April 23, 2013**

**MEETING 13-01:** Darren Harris, PSA Airlines, [briefed the topic](#). Darren's recommendation is that the FAA calculate and publish a "recommended" flight path angle (FPA) for Arrivals that will allow aircraft to meet all published altitudes in order to fly an optimized profile descent. Optimal Profile Descent Procedures are currently published with the necessary altitudes, but no FPA is published. He stated that the majority of regional jet aircraft flown within the United States do not have coupled VNAV capability and are not able to take advantage of the fuel and workload savings these procedures have to offer.

Darren briefed that some Flight Management Systems (FMS) calculate a FPA – the default angle being 3.00 degrees, which can then be changed by the crew. This is not ideal, as level offs and vertical speed changes are required which significantly increase the workload to the operator. Many pilots resort to "dive and drive" tactics to insure that they comply with published altitudes during the descent.

Darren showed flight data from simulation work done by pilots at PSA flying the FRDMM One Arrival (RNAV) and TRUPS One Arrival (RNAV) into Ronald Reagan Washington National Airport (KDCA). The data showed that using the default 3 degree angle of descent, the workload of the pilot was significant as the pilot had to contend with vertical speed changes from 1100 feet per minute (fpm) to 2000 fpm along the arrival. There were three locations where the FMS advised the crew to level off. The pilot was required to adjust the throttle throughout the procedure.

Darren then showed the data for both arrival procedures when the flight path angle was re-calculated and flown at 2.2 degrees. The workload for the pilot was reduced, throttle changes were minimized, there were no level offs and vertical speed changes were limited to only 1400 fpm to 1800 fpm along the arrival.

Darren reiterated that currently the regional jet community calculates these angles and requests that the FAA calculate and publish useable flight path angles for these procedures. Ted Thompson, Jeppesen, asked whether FPAs should be calculated for RNAV arrivals only, or for conventional procedures also.

Darren replied that he would like to see it done for all arrival procedures.

Valerie Watson, AJV-3B, stated that the charting offices cannot calculate this angle, but could certainly chart it if provided on the 7100-series procedure source document. She asked if the FPA should be depicted as "recommended". Darren replied that yes, this is a recommended angle of flight; it is 'advisory' only and would not be coded.

Gary McMullin, Southwest Airlines, expressed his support for the FPA to be calculated and published by the FAA. Gary suggested that if the FPA was published, that it be as an "advisory" angle.

Catherine Majauskas, AFS-470, stated that the Performance Based Aviation Rulemaking Committee (PARC) is currently discussing the broader subject of "Vertical Navigation on Arrivals" to which this subject could be incorporated. She offered to take this recommendation to the PARC, where it can be discussed within that group. She will report at the next ACF on decisions/recommendations made.

**STATUS: OPEN**

**ACTION:** Kel Christianson/Catherine Majauskas, AFS-470, to report back at next ACF regarding progress made within the PARC regarding this issue.

**MEETING 13-02:**

Kel Christianson, AFS-470, reviewed the topic. Kel stated that the PARC VNAV Action Team would have an interim product/guidance out in January 2014.

Al Herndon, MITRE, reported that MITRE is conducting research to determine whether current avionics can support depiction of a FPA. A discussion ensued during which it was agreed that if the angle is only depicted on charts, but is not contained in the FMS, it may be of limited value. Rich Boll, NBAA, commented that the Business Aviation community has not been included in the discussions and studies, but that many of the same FMS systems that are utilized by the regional airlines are found in business aircraft as well. Rich stated that many business aircraft have the ability to depict FPA and wish to see its publication implemented.

Valerie Watson, AJV-3, stated her previous position on behalf of the charting offices that the FPA be clearly listed on the FAA Form 7100-4 arrival procedure source document. She then asked whether there might be different angles for different transitions on a single Arrival. Kel responded that details are still being worked out. Valerie asked whether the angle was to be

considered “advisory” or not. If it is to be charted as “advisory”, she would like to see it indicated as such on the source.

Lev Prichard, APA, expressed support for the publication of the advisory flight path angle on charts regardless of other variables. He believes that publication of this information would assist pilots in flying VNAV arrivals much more smoothly and efficiently.

**STATUS: OPEN**

**ACTION:** Kel Christianson, AFS-470, will report on progress made by the PARC VNAV Action Team.

**MEETING 14-01:**

Kel Christianson, AFS-470, shared a statement from Mark Steinbicker, AFS-470, regarding discussions in the PARC on the subject of FPAs. No decision has been made yet. However, Mark’s statement indicated that there should not be an expectation that the angles will be charted.

There was general disappointment in the room at the news that FPAs may not be published. Discussion followed as to whether the FPA would be useful only for specific operators and whether or not the FAA could make this data available so that those operators who can use it would have it.

Bob Lamond, NBAA, stated that the FPA would not have limited use and that many FMS systems can use FPAs. Kevin Allen, US Airways, reiterated his recommendation that the angle be presented as “suggested” or “advisory”.

Jim Arrighi, AJV-141, commented on the possibility that the data could be made available for specific operators that are equipped use it. Ted Thompson, Jeppesen, stated that Jeppesen would not add FPAs to the charts or to the data unless it was included on the FAA procedure source document. He also commented that there are chart/database compatibility issues that need to be considered. There should not be items that are databased that are not also depicted on the chart and vice versa.

Brad Rush, AJV-3, stated that there is currently nothing in the criteria to support charting FPAs. In order to get the FPA published on a chart, a policy decision will have to be made. Kevin reiterated that he would like to see a change in the policy so “advisory” FPAs can be charted.

Kel reported that Mark Steinbicker will continue to work this issue in the PARC, taking into consideration the strong support from ACF attendees regarding the continued desire have FPAs calculated and published.

**STATUS: OPEN**

**ACTION:** Kel Christianson, AFS-470, will report on progress made by the PARC VNAV Action Team.

**MEETING 14-02**

Trent Bigler, AFS-470, briefed the issue and stated that the final recommendation from the PARC VNAV Action team was not to publish FPAs on STAR Charts.

Valerie Watson, AJV-344, expressed surprise at this decision as there was very strong pilot support at the previous ACF for published FPAs on Arrivals. Trent stated that the angle will be calculated as part of the criteria, but will not be published on the chart.

**STATUS: CLOSED**