GOVERNMENT/INDUSTRY AERONAUTICAL CHARTING FORUM
Instrument Procedures Group
October 23, 2007
HISTORY RECORD

FAA Control # 07-02-278

Subject: Advanced RNAV (FMS/GPS) Performance of Holding Patterns Defined By Leg Length

Background/Discussion:

AIM para. 5-3-7(j)(5) describes use of DME or GPS Along-Track Distance (ATD) in lieu of time values that are necessary to ensure holding pattern airspace protection. When distance is used in lieu of time on a holding pattern, the distance value specified on the procedure chart or provided by ATC is applicable to the outbound leg of the holding pattern. When GPS is used for holding with a distance specified, the holding fix will be a waypoint in the database and the end of the outbound leg will be determined by the ATD (see fig. 1).

NBAA has recently learned the above AIM directive description of GPS holding operation differs markedly from the actual operation of modern FMS/GPS systems providing positive course guidance around the holding pattern. The ARINC 424 navigation database coding specification calls for coding any specified holding pattern leg distance on the inbound leg. FMS/GPS holding pattern logic will attempt to adjust the length of the holding pattern's outbound leg as necessary to make good this specified distance value when the aircraft completes the turn and rolls wings level on the inbound leg. A holding distance value for the inbound leg may be coded in the navigation database for published holds or manually entered into the FMS/GPS system by the pilot in response to an ATC request.

FMS/GPS holding pattern logic common to most systems can result in the outbound leg's ATD exceeding the charted value by a significant amount when the turn inbound is initiated. This is illustrated by an actual example of a holding pattern event over the RDU VOR at FL410, see Fig 2. While this example is based on a specific FMS system, many FMS/GPS systems currently in service share the same Nav-database coding specification and similar holding pattern logic. Therefore, it can be surmised that a similar result would occur using any FMS/GPS device that provides positive course guidance during holding operations.

NBAA is concerned that this demonstrated difference in holding pattern performance between the modern FMS/GPS navigation systems and that expected by FAA Order 7130.3A as amplified by the AIM directive on DME/GPS holding may result in an aircraft approaching or exceeding the limits of the holding pattern airspace area. This is especially worrisome with RNAV (GPS) procedures that have HIL and missed approach distance-limited holding patterns located in a non-radar environment, e.g. Alamosa, CO (KALS), see Fig 3.

Recommendations:

NBAA understands FAA reluctance to change existing holding pattern airspace containment criteria in FAA Order 7130.3A to accommodate current FMS/GPS holding pattern operation . Further, NBAA recognizes that the ARINC 424 coding specification document is beyond the FAA's control. However, FAA must recognize the inherent design logic of modern FMS/GPS systems and provide the necessary information to ensure that the performance of these systems is acceptable based on the FAA's existing holding pattern design criteria.

In support of that need, NBAA requests that the FAA develop and publish on Table 7 of FAA Order 7130.3A, "Holding Pattern Criteria", a corresponding maximum inbound leg distance value for each pattern type/ATD limit for use with electronic navigation database in coding the appropriate holding pattern. This inbound leg distance should be published on the holding data record form which should then be used by navigation database providers to properly code the inbound leg of the respective holding pattern. The FAA should notify electronic navigation database suppliers and avionics manufacturers of the necessity to code the appropriate inbound leg distance value on any en route, terminal, or instrument approach procedure holding pattern with a published outbound ATD leg distance value.

Since the described holding performance characteristics of FMS/GPS systems affects ad-hoc holding procedures as well (non-published holds issued by ATC in a radar environment), AIM guidance must be provided to pilots alerting them to the fact that holding pattern leg distances that are manually entered into the FMS/GPS system may result in the aircraft exceeding the specified outbound leg ATD. Pilot intervention or coordination with ATC may be necessary to remain within holding pattern airspace area.

FAA Order 7110.65R should be amended to alert controllers that the holding pattern performance characteristics of advanced RNAV equipped aircraft could result in flight path deviations from the holding pattern airspace area.

Comments: This recommendation affects

FAA Order 7130.3A, Holding Pattern Criteria
Aeronautical Information Manual
FAA Order 7110.65R, Air Traffic Control

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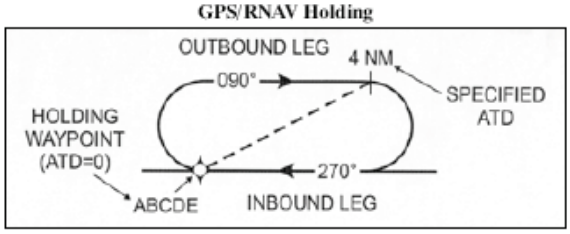
Fig 1: AIM pg. 5-3-13

FIG 5-3-7

GPS/RNAV Holding



NOTE-

The inbound course is always toward the waypoint and the ATD is zero at the waypoint. The end of the outbound leg of the holding pattern is reached when the ATD reads the specified distance.

Fig 2A: FMS Positive Course Guidance hold; 20 nm leg selection.

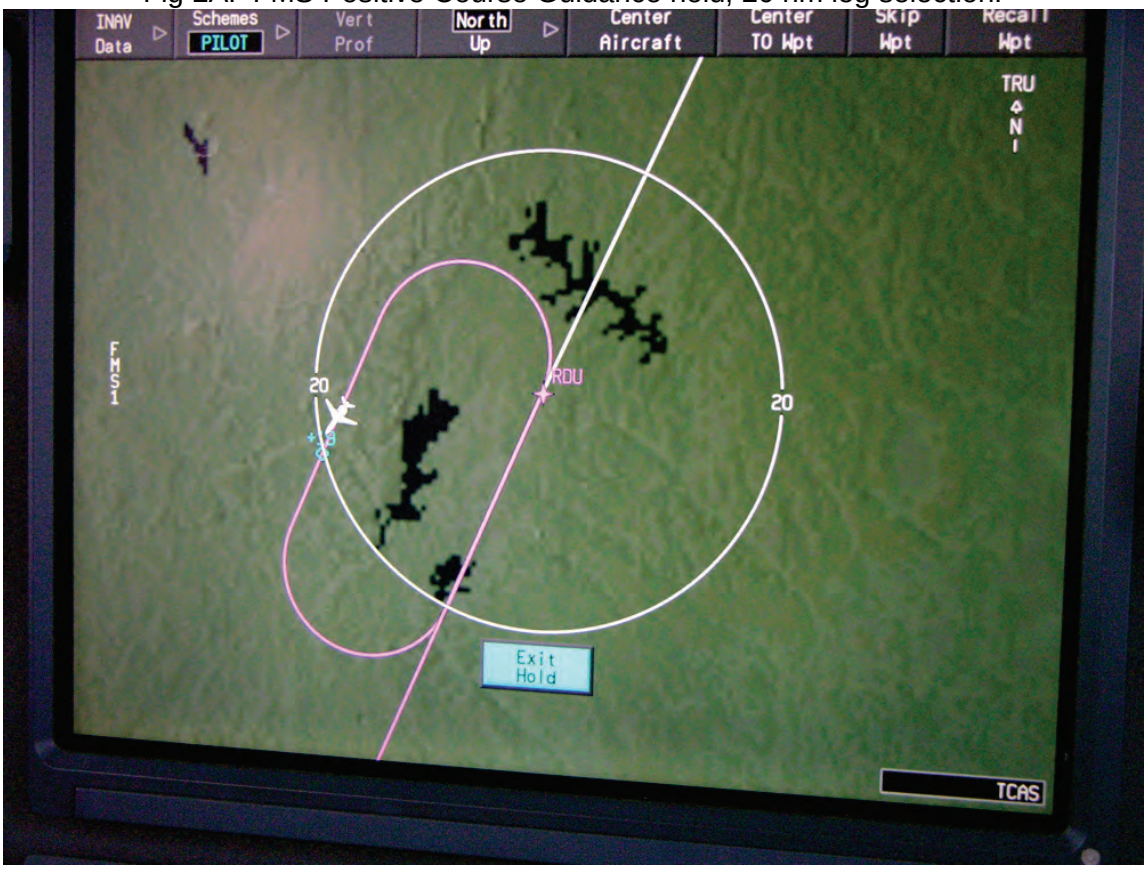
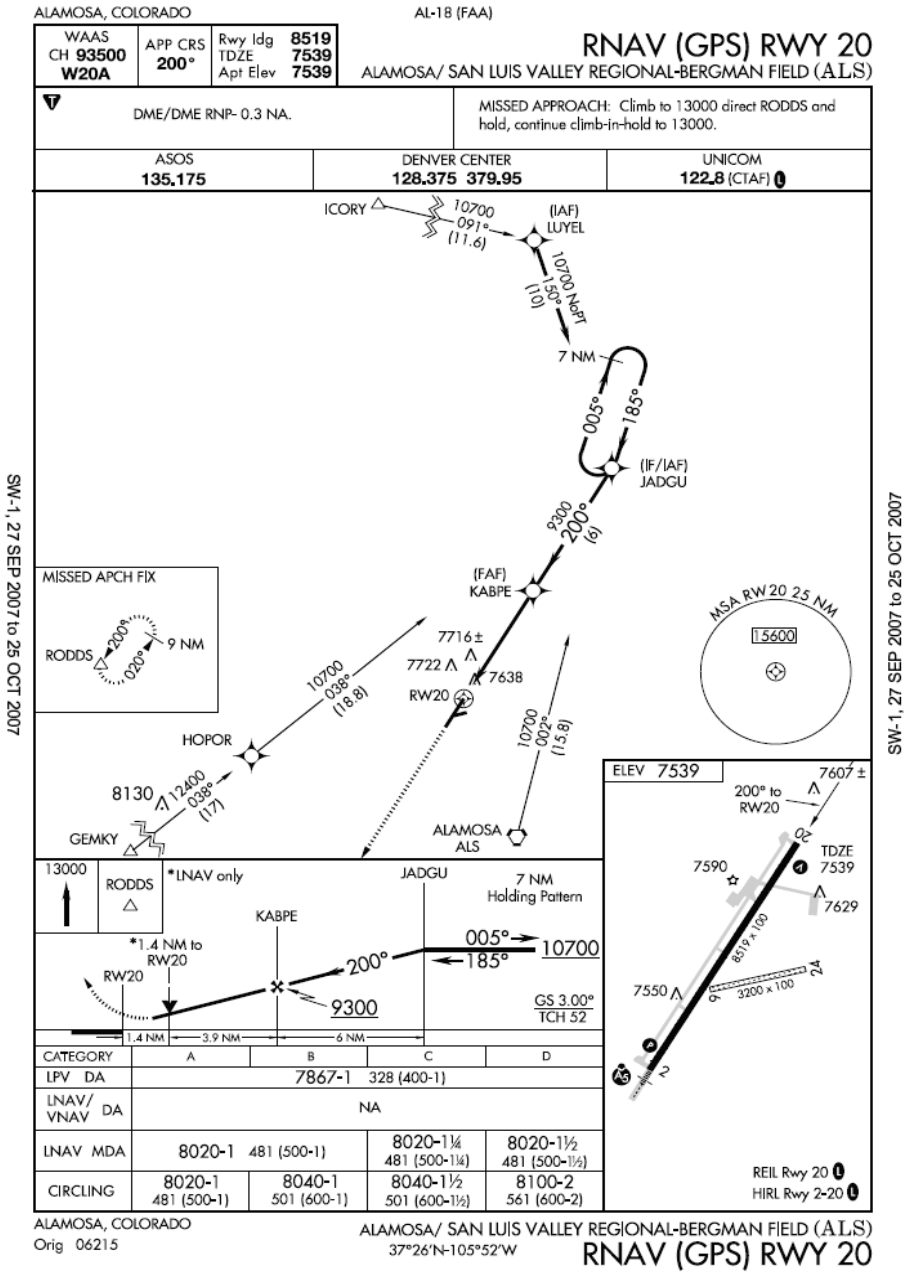


Fig 2B: DME Distance from RDU VOR = 29 NM at start of inbound turn from the outbound holding leg.

ATD Mileage (38.3 NM) represents total miles from current position back to the holding fix

Fig 3: Alamosa, CO (ALS) RNAV (GPS) 20 Approach
Note: HIL ATD = 7 NM's
MAP Holding ATD = 9 NM's



<u>Initial Discussion - Meeting 07-02</u>: New issue introduced by Rich Boll, NBAA. An NBAA member, flying an advanced RNAV aircraft was assigned RNAV holding with 20 mile legs. Because the FMS was programmed to provide a wings-level rollout on a 20 NM inbound leg, the aircraft far exceeded the outbound holding airspace protected area (actually flew a 29

NM outbound leg). This programming logic is contrary to the guidance provided in AIM figure 5-3-7. Rich added that following conversations with various FMS manufacturers, the problem appears to be resulting from the application of the underlying ARINC holding pattern record (fix, inbound course, & leg length) within the FMS's holding pattern logic. Tom Schneider, AFS-420, stated the problem has been known to FAA Flight Standards for at least one year. It was identified during their work in re-evaluation holding pattern criteria. Ted Thompson, Jeppesen, noted that the problem extends beyond the United States. John Moore, AJW-351, added the subject is also being discussed in the ICAO IFPP. Tom concluded that this issue will be added to the AFS-450 holding pattern study. There was some disagreement; however, no one could recommend what other group would/should work the issue. It was noted during discussion that changing the AIRNC coding methodology would require changing all avionics boxes. Ted stressed that the issue needs to be fixed at the root cause, AIRNC Specifications, not various work-around. John Moore, AJW-351, briefed that the ICAO IFPP is considering publishing the diagonal distance where the turn inbound should be made. Brad Rush suggested that an easy solution would be to specify all RNAV holding be time-referenced. Tom will ensure the issue is included in the AFS-450 holding pattern study. Mark Steinbicker, AFS-470, stated they will also review the issue and provide comments/recommendations to AFS-450 for inclusion in the study. ACTION: AFS-420, AFS-470 and AFS-450.

MEETING 08-01: Sherri Avery, AFS-450, briefed that this issue has been included in the holding pattern study. Advanced FMS holding allows pilots to see exactly where they are flying but not whether they have containment in the holding protected area. Sherri further briefed that an initial review indicates that the containment areas are better than thought. She showed several examples where if the FMS flew the specified leg length as **inbound** vice **ATD outbound**, the aircraft would still be contained. Rich Boll, NBAA, questioned how this is possible when the avionics will fly whatever outbound is necessary to achieve the specified inbound leg length, Tom Schneider, AFS-420, questioned whether all FMS' are performing the same way. Rich responded that ARINC 424 only specifies coding of the inbound leg track and a length (distance). Adrienne Funk, AJW-352 reminded the group that this distance is not specific to either the outbound or inbound leg. Bill Hammett, AFS-420 (ISI), stated that this could be a serious safety issue, especially when holding in areas tightly constrained by terrain. Steve Barnes, AFS-450, re-iterated that if the correct template is used, it is not a safety factor. Either slant range or inbound leg length will provide containment. There is no indication that it is a significant safety issue; however, it will be assessed in the study. Tom added that as an interim measure, AFS policy terminated using smaller RNAV holding pattern templates and requires conventional criteria application for all holding. Ted Thompson, Jeppesen, briefed that this issue has been discussed at the Jeppesen Standards Group. At present there is no forum addressing this coding issue. Ted has recommended that it be considered by the ATA sub group designated to address FMS programming standardization. Mark Ingram, ALPA, stated that something needs to be done to study how FMS' are flying holding patterns especially on SIDs and STARs. Rich recommended something similar to the study MITRE accomplished on SID and STAR lateral flight tracks. Kevin Comstock, ALPA, recommended the issue be brought before ARINC. Tom stated that the AFS-420 representative on the ARINC 424 committee is aware of the

issue and will pursue assurance that ARINC coding specifications are in consonance with holding pattern containment requirements. In the interim, AFS-450 will to continue to work the issue in conjunction with the holding study with input from AFS-470.
ACTION: AFS-420, AFS-470 and AFS-450.

MEETING 08-02: Tom Schneider, AFS-420, briefed the following update as received from Steve Barnes, Manager, AFS-450, which applies to all open issues relating to holding: "Numerous issues continued to arise from attempts to utilize the original holding tool for a broader application than it was originally intended. As a result, this past summer AFS-450 elected to take a new approach and have a new holding tool developed to better meet our present needs. The initial date for completion of this new holding tool was October. Due to other requirements during this time frame, that date was not met. We are anticipating something to look at and evaluate in December. As was presented/requested at the last meeting, AFS-450 is in search of the proper FMS logic to utilize in our modeling for appropriate simulations. Any support the ACF attendees can provide Dr. Sherri Avery in this matter would be appreciated" - also see related issues 03-01-247 and 06-02-267.
ACTION: AFS-450, with input from AFS-470.

MEETING 09-01: Tom Schneider, AFS-420, briefed the following from Dr Sherri Avery, AFS-450: "There has been no progress on the holding pattern study. AFS-450 has received information regarding holding pattern logic from Garmin and is awaiting the same from Honeywell." Tom thanked Rich Boll for soliciting information from FMS manufacturers. AFS-450 will continue to work the issue with input from AFS-470 and provide updates.
ACTION: AFS-450.

MEETING 09-02: Tom Schneider, AFS-420, briefed the following from Dr Sherri Avery, AFS-450: "AFS-450 is continuing analysis of FMS/GPS information. AFS-420 (Steve Jackson) has been assisting in obtaining problem statement information, including, to what extent does RNAV Holding exist? ACTION: AFS-450.

MEETING 10-01: Tom Schneider, AFS-420, briefed the following update from Dr Sherri Avery, AFS-450: "AFS-450 is continuing analysis of FMS/GPS information. Steve Jackson, AFS-420, has been assisting in obtaining problem statement information, including, to what extent does RNAV Holding exist?" ACTION: AFS-450.

MEETING 10-02: Tom Schneider, AFS-420, briefed that Steve Barnes, Manager of AFS-450, stated that AFS-450 is unclear as to exactly what the problem is and requested that AFS-420 provide a problem statement that would help his Branch understand what analysis and/or studies are required, if any. Steve Jackson, the AFS-420 holding criteria specialist, provided the following for the ACF: "I was able to have some discussion on this at the ICAO IFPP with Pedro Rivas, Delta, and some of the other PBN working group folks. The PBN

study group is now discussing a Navigation Specification (NavSpecs) for RNAV/RNP holding. Until then, there is no standard for RNAV holding for the equipment. The current implementations may or may not conform to the NavSpecs when it is written, some probably will not. There have been no changes to the operational guidance for holding in years. The only change was the addition of the ATD holding diagram in the AIM, based on the existing text, several years ago. I have been unable to find any other operational guidance for distance based holding other than turning at the charted distance. Bottom line is until there is an RNAV/RNP holding NavSpecs, I don't see that we will have sufficient guidance on how to model RNAV holding. Once the NavSpecs is written, there will need to be operational guidance written to support it." ACTION: AFS-450 and AFS-420.

MEETING 11-01: Tom Schneider, AFS-420, briefed the following from Steve Jackson, AFS-420, who is following the study: "Currently AFS has MITRE doing a survey of manufacturers to obtain and validate the assumptions to be used in the AFS-450 model. We also added several questions to a questionnaire going to helicopter avionics manufacturers concerning holding that will provide information for fixed-wing as well." No response was received from AFS-450. ACTION: AFS-450.

MEETING 11-02: Tom Schneider, AFS-420, briefed the following report as received from Steve Jackson, the newly assigned AFS-420 point person for holding issues: "This item is mislabeled as advanced performance of holding. A basic concept of distance based holding is to turn at the specified slant range distance. It is the only way to accomplish distance based holding with VOR/DME or basic GPS equipment. The pilot reads the slant range distance from the holding point and then starts a turn inbound. There is no operational guidance to adjust this distance for wind, like there is with timing. The distance the aircraft extends past the published distance is a function of tailwind on the inbound leg, and not related to the published distance and template size. Even if the large excursion past the specified turn point was acceptable in some holding template sizes, it would not be acceptable in the smaller templates. After some discussion, it appears that the recommendation to publish a maximum inbound leg distance, basically coding a shorter distance on the inbound leg than the published outbound leg length, is contradictory to the ACF item requesting that timing be allowed due to patterns being too short. The distance published is derived from the template being used and when there are conflicts with other operations, a shorter distance is specified and a portion of the template is not applied. Flying past the published distance is not only an obstacle issue if the aircraft exits the obstacle clearance area, but may also be an ATC issue if the area is being used to separate aircraft in holding from aircraft in adjacent holding or airways. Resolution of this issue is complex. Reevaluation of all the existing holding patterns to allow the anticipated excursion past the distance based on anticipated winds would take years. It could also have the unintended consequences of raising minima on approaches, having to move holding patterns further from the airport resulting in increased flight distance, and impacting airspace usage by ATC. One method to eliminate this issue is for crews to comply with existing operational guidance to turn when reaching the charted distance, manually if necessary. Additional operational guidance could be issued on this subject and is probably the most expeditious solution. Other solutions would involve changes to equipment that is also time consuming and expensive. This issue requires input from operational specialties and ATC." Rick Dunham, AFS-420, stated that an AFS-420 goal for 2012 is to publish a new holding

criteria order to include PBN holding. Al Herndon, MITRE, noted that during the MITRE holding test, it was noted that some government charts specified timed holding whereas the Jeppesen charts specified distance. Ted Thompson, Jeppesen, responded that this problem exists on older charts because Jeppesen formerly did not receive the complete Form 8260-2. It has been resolved, but will take time to correct all charts. AFS-420 will address the issue in the revised holding criteria Order. ACTION: AFS-420.

MEETING 12-01: Tom Schneider, AFS-420, provided attendees the following report as received from Steve Jackson, the AFS-420 point person for holding issues:

"Work is on-going to revise FAA Order 7130.3 as an 8260-series order (8260.Hold). Drawings are being redone with color, extraneous text is being removed, policy memos and letters are also being incorporated. Additionally the holding paragraphs from Order 8260.3 (TERPS) will be incorporated into draft '8260.hold' to provide one-stop shopping for holding patterns. The goal is to provide an updated manual that will form the basis for future additions of other holding material, while still providing the baseline criteria basis for the many thousands of existing holding patterns. Handbook 7130.8, *Development of Holding Pattern Criteria and Procedures*, has been archived as reference material, since today this document would be written as a test report, or a scientific finding paper based on modeling. Its only purpose was as background material for 7130.3 and to document how the areas sizes and shapes were derived. The existing holding areas are not inherently navigation system dependent. They were derived based on turn performance, with wind applied. Issues such as slant range, as well as the cone of confusion, are handled by the placement of the template, and VOR radial dispersion was handled by specifying which template is used based on distance from the NAVAID. The wind variable included in timed holding was not included in the DME holding since it assumes the aircraft will turn at the slant range distance from the facility providing DME.

The PBN Study Group definition of holding as, waypoint, inbound course, direction of turn and outbound distance, supports how we have done holding historically. No agreements could be reached on more advanced holding concepts due to the wide disparity in equipment capabilities. How outbound distance is defined, or more importantly interpreted, is still a source of concern since turning at the slant range distance from the waypoint, versus turning abeam a point on the inbound leg causes considerable variation in the turn point, especially on shorter holding patterns at higher TAS (wider pattern width). Differences of 2-3 NM are possible. There is also still concern with some aircraft “making good” the specified distance on the inbound leg by extending the outbound leg past the specified distance. Resolution of this issue will be a major factor in future revision of holding pattern size.

Part of the holding discussion at the new RTCA SC-227 working group was that the FMS would keep the aircraft inside the holding airspace, with the assumption that they could use all of the area. There is no realization that the entire holding area defined by the template may not be available due to the end reduction areas, which assume the aircraft turns at the specified distance or time. This further complicates the distance issue.

MITRE will hopefully be able to rerun last year's base line no-wind holding modeling on the manufacturer's bench top equipment this year, with wind. This information, if available in time, will be useful in SC-227 discussions of holding requirements, and in writing future NavSpecs on holding to support PBN criteria."

There was no further discussion, except that Rick Dunham, AFS-420, added that it is an AFS-420 goal to have draft PBN holding criteria developed by year's end.
ACTION: AFS-420

MEETING 12-02: Tom Schneider, AFS-420, briefed the following report as received from Steve Jackson, the AFS-420 point person for holding issues:

Work is progressing on the revision of 7130.3 into 8260.HOLD. PBN holding criteria can be included based on the DO-236 formulae; however, there is no NavSpec or operational guidance which covers this type of holding, so implementation is dependent on publication of the supporting documentation.

One issue that has been identified through TARGETs modeling, with manual construction of DO-236 based tracks, is that conventional holding is based on 25 degrees of bank at all altitudes, but DO-236 is based on 15 degrees above FL195 for turns, and possibly FL245 for holding, based on an obscure paragraph that is not in the holding appendix. We have asked that MITRE do additional bench-top runs with the manufacturers to determine which altitude is actually used by the current equipment, since it seems unlikely that manufactures have implemented two changeover altitudes for bank angle. Use of the lower bank angle substantially increases the size of the pattern flown, so resolution of the altitude is critical to determine issues such as whether the fly by entry and the holding pattern fit inside the conventional holding pattern templates at higher altitudes.

We have also asked for holding pattern runs with wind (the previous runs were all no wind) to specifically address the issue of whether systems are flying past the specified turn point, and by how much. The difference between the slant range across the pattern and flying the specified outbound distance as an inbound distance is larger than originally thought, again based on limited modeling with TARGETs. At higher altitudes, this would account for much of the distance noted as being flown past the turn point.

It has also been identified that the source of some of the assumptions about using fly by entries on conventional holding patterns is due to an assumption that the holding fix is being coded as a fly by. The holding occurs prior to passage of the IAF, except for a hold-in-lieu-of-procedure-turn, even though the point is co-located. If the holding waypoint coding is not specified on government documents, it is assumed to be fly over based on the operational guidance.

These coding and guidance differences point to several implementation issues; e.g., aircraft that are flown manually, or are not fully DO-236 compliant, yet flying published PBN holding. Also, are there any additional issues with PBN aircraft flying conventional holding patterns, especially at higher altitudes above the bank angle transition point? Conventional holding criteria already has a provision for operations with slant range (VOR/DME) and without slant range (GPS and DME/DME) that could be applied to help accommodate PBN operations on conventionally defined holding patterns. This dual application of the template would of course increase the effective size of the area.

Status: AFS-420 to continue development of revised holding criteria. Item Open (AFS-420).

MEETING 13-01: Tom Schneider, AFS-420, briefed the following report as received from Steve Jackson, the AFS-420 staff specialist for holding issues: "Draft FAA Order 8260.HOLD is currently in internal AFS-400 coordination, with initial comments being resolved at this time. The Order updates the existing criteria with all the current memos and editorial updates, and brings the document under the 8260 series and compliance with current publication requirements. The criteria are divided into conventional, with slant range, and RNAV, without slant range, chapters, with a place holder for PBN holding. These three types of holding are recognized by the PBN Manual. It should also be noted that RNP (PBN) holding is being removed from PansOps. Several actions outside of the criteria arena are necessary before PBN holding can move forward." AFS-420 to continue development of revised holding criteria. ACTION: AFS-420.

MEETING 13-02: Tom Schneider, AFS-420, briefed the following report as received from Steve Jackson, the AFS-420 staff specialist for holding issues: "AFS-400 has made a decision to combine the planned Order 8260.HLD into a future version of Order 8260.3 (TERPS), probably as a separate volume. This does not really change any ongoing activity except that it ties any revisions to an 8260.3 publication date, most likely Jan 2015. A draft document was circulated within AFS-400 before the decision was made to change the publication. The ongoing effort at this time is to determine whether some of the non-obstacle clearance information published in Order 7130.3A (originally an Air Traffic document) such as end reduction areas, should be deleted, moved to some other document, or retained in some other form. Once that is determined and the document revised accordingly, further internal coordination will take place."

Rich Boll, NBAA, asked whether all the proposed holding order changes will be included in TERPS. Tom responded yes. Rich followed up asking which TERPS change will include this. Tom replied the plan is for inclusion in 8260.3C, since it will not make Change 26. Gary Fiske AJV-8, asked if this was discussed in a sub group of US-IFPP. Tom replied that he was not sure if Steve Jackson had a sub-group on this. Bruce DeCleene, AFS-400, added explanatory comments that Flight Standards is making a concerted effort to consolidate guidance. For example, Flight Standards has combined over 200 pieces of guidance for Aviation Safety Inspectors in Order 8900.1. A similar goal is to do the same in combining as much TERPS criteria as possible within a single document. Rather than produce a new holding document it makes sense to incorporate it into TERPS. Tom added that some items in the present holding order exist to support AT, and Steve Jackson is moving to resolve that. AFS-420 will continue development of revised holding criteria. ACTION: AFS-420.

> ***Editor's Note:*** *Following the meeting, there was a discussion within AFS-400 to reconsider and publish a separate holding order prior to consolidating holding criteria into FAA Order 8260.3C. A final decision will be made in Jan 2014 and the ACF will be advised.*

MEETING 14-01: Tom Schneider, AFS-420, presented a slide provided by Steve Jackson, AFS-420, (View) on the issue. John Moore, Jeppesen, inquired about the implementation references on the slides. Ted Thompson, Jeppesen, inquired if still a work in progress. Tom said yes, this is being worked to incorporate into TERPs. Tom pointed out Steve's question on the slides about what is the objective and asked for group input for Steve. John expressed concern with the bullet that stated not all aircraft can hold in these patterns and that additional waypoints (or even dual points) may be required on a single procedure. Ted pointed out that this issue has become convoluted with the combining of several issues, making it hard to define a single objective. Gary Fiske, AJV-8, commented AT has aircraft holding on all the present fixes with no issues. ATC expects a pilot to hit the fix and hold as instructed, which they successfully do now. Ted said it would be regrettable if more holding patterns were developed, since it would introduce more complexity into the cockpit. Kevin Bridges, AIR-130, pointed out that equipment-wise, RNAV holding is an advanced RNP function, meaning it is a special qualification and not every aircraft can accomplish it. Gary said that ATC will assign holding and does not expect to ever ask aircraft for specific capabilities. Kevin added this will be part of RNP airspace (dependent function) limiting where some aircraft can operate. Tom added that this is becoming more complicated, and will include the NavSpec issue. Bob Lamond, NBAA, stated they would be against any LOA requirements. A group discussion followed about functionality, PBN specific examples, aircraft limitations for certain airspace uses, original issue as presented by NBAA, etc. Tom restated that AFS-420 is just taking the old document and converting into an 8260 series Order, updating for the conventional aspect without changing pattern sizes. NBAA (original submitter) was asked how they would like this ACF issue to proceed; i.e., do we keep open to provide updates to the order? (Which will not include specific requirements from original submission). Bob requested that the issue remain open, and said he will take back and regroup, with some FAA off-line conversations on direction. Mark Steinbicker, AFS-470, stated he was not sure of the accuracy of all facts submitted and that the issue is becoming very convoluted. He is not aware of any strategy document or implementation for NextGen or RNP holding. Holding will be like it is today, whether associated with conventional or RNAV fixes, and he would be hesitant to say patterns will be expanded to account for RNAV. On the OPS side, we allow pilots to use RNAV to hold and they do quite well under most conditions, with the underlying assumption the pilot will be complying with restrictions. Mark is concerned that we are trying to tackle something with criteria that should be worked somewhere else. His recommendation is to leave criteria, pattern size and ops policy "as-is" and work other aspects of the issue. It was agreed to keep this issue open for one more ACF cycle and discuss off line.

Status: Bob Lamond (NBAA) will take back and discuss issue, to include off line discussions with FAA. Item Open (NBAA).

MEETING 14-02: Tom Schneider, AFS-420, briefed that Bob Lamond, NBAA, had sent Steve Jackson, AFS-420, correspondence as agreed upon, and here is Steve's response (View). Tom advised there will be no NavSpec changing current RNAV holding practices as described in the AIM/AIP. Rick Dunham, AFS-420, asked Rich Boll, NBAA, to explain the purpose of this agenda item. ICAO is revising their RNAV holding guidance and there is no NavSpec specifically defining RNAV holding. Rich

said AIM guidance is insufficient. His concern is that as long as both ATC and pilots knows aircraft may fly outbound more than prescribed before turning back to achieve desired leg length NBAA is satisfied. Tom indicated Steve is saying pilot must follow AIM guidance regardless of what the box does. Rich said that the current Nav system would require pilot initiate turn and re-intercept pattern, which is too much leg work for the pilot. He would recommend a return to timed holding, and AIR-130 would have to go to manufacturers and have them fix their systems. Kevin Bridges, AIR-130, said there is no NavSpec for automated RNAV holding. Current MOPS define it, but it is not a required function. The pilot needs to fly what the procedure says, regardless of what the box manufacturers have programmed into their systems. Group discussion followed on box functionality and differences, and the fact that this is not a coding issue. Rick Dunham, AFS-420, said AFS-420 will take another look at the language in AIM/AIP and IPH, in conjunction with AFS-470, to ensure pilots know to stay inside airspace. Joshua Fenwick, AeroNavData, said this would be a good issue for the ARINC NDB group to take up, and he will forward it to Sam Buckwalter to discuss. The group meets in June 2015. Tom added we could see if RTCA or ARINC 424 group can take, since there is nothing more the ACF can do at this point.
Status: AFS-420/470 will look at AIM and IPH language. Joshua Fenwick, AeroNavData, will bring issue up with ARINC 424 committee. **Item Open:** AFS-420/470 and Joshua Fenwick, AeroNavData

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MEETING 15-01: Joshua Fenwick, AeroNav Data, was not present to brief on ARINC 424 meeting. Tom Schneider, AFS-420, briefed (View) using a slide provided by Steve Jackson, AFS-420, consisting of proposed AIM language. This proposed AIM language was provided to NBAA in advance for feedback. Rick Dunham, AFS-420, stated that the slide was mislabeled since we have no RNP holding. Rich Boll, NBAA, provided (View) a short history on this item specifically that observed RNAV performance in holding is different than current AIM guidance. The equipment extends the outbound leg to achieve the desired inbound leg programmed length. AIM paragraph 5-3-8 holding guidance is not representative with regard to bank angles and says holding distance is applied to outbound leg, whereas the RNAV systems extend the outbound leg to make distance good on the inbound leg. Kevin Bridges, AIR-131, confirmed that different boxes are designed to different standards depending on type/usage. Rich discussed his review of Steve's proposed AIM language and inquired if there was a shift toward requiring stronger language (perhaps new information). Rick advised there has been no shift, and this is AFS-420's first draft at what AIM holding language should be, showing how pilots interpret it and how it is to be used. Rich stated that this proposed language is overly complex and hard to understand. Rich would like the ACF to form an ad-hoc workgroup to look at holding operations, certification, criteria, and query OEM's for recommendations on revised AIM guidance specific to the issue. Topics would be: Is this an issue (altitude)? When is it an issue? When should it be considered? And what are viable alternatives? Tom inquired how to move this issue forward. Rick said he was not against a group forming to address this, but does not want this ACF issue expanding and commented that no protected airspace risk based data has been presented on this issue by anyone. Revised AIM language can raise awareness to all groups and his office is also looking at IPH language on how holding is flown, but there are questions on the training aspect. Group discussion followed on if there is actually a problem with what aircraft are doing. Gary Fiske, AJV-82, stated that in light of the

radar environment in the U.S., ATC monitors flights and adjusts as necessary. Rich indicated that the ultimate solution of the group may be the AIM guidance and this may be all that is needed. Tom discussed holding templates are 60+ years old and wondered if FMSs are keeping aircraft inside these areas, and if so, do we care how? Rick said his goal would be for the ad-hoc group to take the AFS-420 draft AIM language and adjust as necessary to meet industry needs. Lev Prichard, Allied Pilots Association, added that he feels there is not a large technical issue, but rather a need to renew AIM/IPH guidance. Rick said the Holding Order 7130.3A will be absorbed by Order 8260.3C; the criteria updated, and will be out for coordination soon. Brian Townsend, American Airlines, said the answer may be as simple as a cautionary statement that if you are doing FMS holding, you may not be getting your desired results. Tom stressed the need for generic language such as desired distance on legs. Rich volunteered to chair an ad-hoc holding group since he has already reached out to industry on this topic. They will look at AIM language, review draft Order 8260.3C language, and look at including information that ATC is monitoring the aircraft flight pattern. Rick volunteered any assistance to the group as required from AFS-420.The sign up list is included (View).

Status: Rich Boll volunteered to chair an ad-hoc holding group. **Item Open:** NBAA (Rich Boll), Ad-Hoc sub group

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MEETING 15-02: Rich Boll, NBAA, formed a Working Group (WG) after ACF 15-01 to look at issues with holding. The group has representatives from the FAA, manufacturers/industry. There have been eight telecons and members now have a good understanding on how RNAV systems work with holding. Rich provided (View) a presentation covering topics including: list of WG participants; proposed guidance materials; OEM provided information; principal recommendations for the AIM (e.g., speeds, entry procedures, substitution, etc.); recommendations for ATC and Pilot/Controller Glossary; and future actions. The WG determined that entry speed into the pattern (including slowing to pattern speed before the holding fix) is needed for containment, and some of the more advanced RNAV equipment will calculate the deceleration point for the pilot. Rich reminded all that the FMS will calculate the holding pattern size based on the speed you cross the holding fix at and to not use a turn bank limiting mode (i.e., criteria is based on 25 dg bank at all altitudes). FB vs. FO turns at the holding fix were discussed. Changes to FAA Order JO 7110.65 (ATC) & holding criteria were not the focus of the WG, but ATC agreed to process changes into their orders. Mike Stromberg, Air Wisconsin, inquired if FMS manufacturers will change their equipment going forward to fly these correctly. Rich said that he thinks more equipment manufacturers will incorporate RTCA DO-283, but it is not a requirement. Kevin Bridges, AIR-131, added that DO-283B (new MOPs) will be out soon with a two class system, and will contain the “Advanced RNP” function (which includes holding). Proposed AIM language (View) is included and was sent separately to all ACF roster email addresses. Rich requested that all interested parties review the proposal and submit comments NLT 11-15-2015 for consideration. This will allow for final consolidation, review by AFS-420, and publication in the summer 2016 AIM revision.

Status: Provide update on work being done by sub-group. **Item Open:** NBAA (Rich Boll), Ad-Hoc sub group/AFS-420.

MEETING 16-01: Tom Schneider (AFS-420) briefed that Rich Boll (NBAA) has done extensive work on the issue with multiple work group meetings formed after ACF meeting 15-02. Bob Lamond (NBAA) briefed from the attached slides (View). Recommendations have been completed and were provided to the ATO in October 2015. These DCPs have gone out for coordination with comments due back no later than May 5, 2016. Tom provided the DCPs for those interested in seeing them; one changes RNAV holding information and the other changes the definition for Along-Track-Distance (ATD). (Hold DCP) (ATD DCP).

Status: NBAA requests item remain open one more cycle to ensure completion and will plan on closing this agenda item at ACF 16-02 **Item Open:** AFS-420

MEETING 16-02: Rich Boll (NBAA) briefed (VIEW) the rewrite work was completed for AIM holding guidance and submitted to the ATO, but a corresponding guidance change for the AIP was not done. Andy Duda (AJV-83) informed Rich that a DCP is now in progress, no issues are expected, and a November 10th publication is projected for both. Gary Fiske (AJV-82) concurred.

Status: **Item Open:** AJV-83