

GOVERNMENT/INDUSTRY AERONAUTICAL CHARTING FORUM
Instrument Procedures Group
(Transcribed/Re-Formatted)
HISTORY RECORD

FAA Control # 95-01-143

SUBJECT: Establish and Publish Procedural Maximum Speeds for Terminal Instrument Procedures

BACKGROUND/DISCUSSION: Wally Roberts, ALPA led the discussion noting that the maximum airspeed for each segment of instrument approaches should be specified. ALPA's greatest concern was turns over the IAF from the en route structure. The discussion was expanded to include procedure turn maneuvers and maximum airspeeds for various type course reversals. ALPA also desires that the holding and teardrop course reversal maneuvers not be allowed. They believe that aircraft should be required to track outbound on the reciprocal of the inbound course then make a 45/180, 80/260, or 90/270 course reversal. None of the other participants were in favor of eliminating the holding and teardrop maneuvers. AFS-450 agreed to conduct ASAT modeling to determine maximum airspeeds and evaluate various course reversals against the TERPS procedure turn area. ALPA later forwarded to AFS-450 a specific example of a location where they felt the protected airspace might not be adequate at high entry airspeeds.

An initial, limited modeling effort gave the capability to look at a fixed bank entry turn back towards the inbound course. The altitude, airspeed, wind speed, wind direction and the aircraft heading relative to the entry course could be evaluated in a very time consuming and cumbersome manner. The initial test confirmed the ALPA simulator conclusion using Livingston, MT that with a precise set of entry parameters it is possible to exit the protected airspace, and is worst case scenario for entry heading and inbound course relationship.

More capabilities were added to the model to allow further evaluation, such as the ability to have multiple variations of several individual parameters to be accomplished on one run. This allows quicker modeling of multiple entry headings, multiple wind directions effect on a given entry heading, and multiple wind speeds on a given entry. It also allows a graphic comparison at the results of these multiple variations. Test cases at various airspeeds and altitudes were run with this revised model.

Since the last meeting, most of the advancement in the modeling has been in improving the fidelity of the aircraft model. For our 727 and 747 ASAT models, Boeing has approved the aerodynamic and propulsion characteristics and they have passed all tests to Boeing's satisfaction. The autopilot and flight control systems are still undergoing some changes. Modeling of holding pattern entries has been very recently been completed and will be applied to evaluating complete holding type procedure turns. We are planning to do a limited look at procedure turns in a simulator to compare the results with the ASAT model.

Additional discussion and modeling was done at various altitudes with the holding pattern airspeeds. In trying to stay with the altitude structure for holding patterns, modeling was done at 6000'/200 KIAS and 14,000'/230 and 210 K.IAS. The bank angle was nominally 25° with slight variations. With the TERPS wind velocities of 53 Knots at 6000', the worst case combination entry geometry and wind just touches the primary area boundary. At 14000'/210 KIAS and a 65 Knot wind, the worst combination geometry is tangent to the secondary

boundary. Winds above 65 Knots with the worst combination could place the aircraft outside the secondary area. At 14,000'/230 KIAS, with 65 Knot winds, two of the entries exit the secondary.

Assuming that the desire is to keep all entries inside the primary area with the TERPS wind value, approximately 165 KIAS at 14,000' with the worst case geometry and 65 Knot wind would be the maximum entry airspeed. All entries are contained in the primary area and all but two of the modeled entries are more than a mile from the boundary. Entries with winds over 100 KIAS with the worst geometry and wind direction are contained within the secondary.

While this speed appears to be workable for containment, the question of all aircraft being able to fly approaches at this speed at this altitude needs to be answered. Some of the questions are:

1. Since the aircraft is slowing for an approach and should be beginning configuration during the procedure turn would this speed be overly restrictive?
2. If the aircraft had to take a turn in holding prior to the PT could it be accomplished at this speed?

An additional problem with having different speeds at different altitudes is, how does the pilot determine which airspeed to use, since the maximum altitude to start the procedure turn is not published? (Also, what altitude does the procedure designer switch templates?) The only published number is generally the procedure turn completion altitude, which may be well below the altitude the approach is started from. If the airspeed is based on the last assigned altitude there might have to be a maximum altitude to commence the approach. ATC would have to get the aircraft to that altitude prior to the procedure turn fix.

There are three possible solutions to prevent exiting the protected airspace:

1. Reduce the maximum airspeed for procedure turns to remain within the present procedure turn template. AIM already specifies that maximum holding pattern airspeeds apply to holding in lieu of procedure turns. Applying holding speeds to procedure turns 6000' and below appears to be viable. Procedure turns above 6000' appear to need lower airspeeds than holding if the area is not enlarged. The primary area of the number 10 holding template for 14,000', is larger than the primary area of the PT template, and includes most of the PT secondary area in the entry area. Above 6000', lower airspeeds should not be as much of an impact for procedure turns as they are for holding, since the aircraft is configuring for the approach and will have to continue to slow down anyway. The net result is probably to cause high speed aircraft to slow a few miles earlier, just prior to the procedure turn fix rather than after it.
2. Use the present PT template and 200KIAS at or below 6000' and increase the size of the procedure turn template above 6000' to accommodate 210 or even 230 KIAS. This could result in increases in the minimum descent altitude or even in the elimination of some approaches. The primary PT area for 210 KIAS would be approximately the same size as the present secondary area. The time required to implement a revision of all of the existing procedure turn approaches above 6000' with a new template size could be considerable but

the number of approaches involved is unknown at this time. With GPS scheduled to eliminate procedure turns, this is may not be a viable option.

3. Use the present PT template and 200 KIAS at or below 6000' and replace procedure turns with holding-pattern-in-lieu-of-procedure-turn type approaches above 6000'. Again the time required to implement could be considerable and a different template shape and size could result in MDA increases or elimination of some approaches. The amount of descent allowed in a Hold-in-lieu is less than in a procedure turn and many of the approaches that would be most affected might not be possible.

Additional modeling and software revisions have been completed. Entry speeds have been evaluated at various altitudes, wind speeds, and directions through the entry turn. Near term expansion of the model's capabilities will allow evaluation of the entire procedure turn with intercepting the outbound, teardrop and holding type entry maneuvers as well as provide more refinements and ensure there are no problems outside the entry phase of the procedure turn.

RECOMMENDATION:

COMMENT: Analysis of higher speed military aircraft must be considered.

Submitted by: ALPA (assumed)

INITIAL DISCUSSION (MEETING 95-01): Mr. Tom Young, ALPA, discussed how instrument Approach and Departure Procedure criteria assume certain maximum aircraft speed in order to assure containment within protected airspace. It is essential that pilots not exceed these implicit speeds in order to make containment assumptions valid. This will become more critical with GPS procedures because siting flexibility will tend to place procedural segments in closer proximity to higher terrain. Also, emerging, tighter RNP concepts will only be valid within certain speed limits. ALPA recommended evaluation of all existing and future terminal instrument procedure criteria to determine maximum allowable ground speeds for each procedural segment. Convert these values to conservative indicated airspeed values and notify the aviation community on a continuing and effective basis of the limits. In the case of air carrier operations, this should include positive directive material to the air carrier operations inspectors. This also affects Handbook 8260.19C "Flight procedure and Airspace", the Airman's Information Manual, Handbook 8400.10, Air transport Operations Inspector's handbook," and possibly the charting of terminal instrument procedures, per se. AFS-420/800 will evaluate and report next ACF. **Action: Item Open (AFS-420/800).**

MEETING 95-02: No action was taken to update this issue. AFS-420 and AFS-800 will evaluate this item and report at next meeting. **Action: Item Open (AFS-420 and AFS-800)**

MEETING 96-01: Wally Roberts, ALPA led the discussion noting that the maximum airspeed for each segment of instrument approaches should be specified. Their greatest

concern is turns over the IAF from the en route structure. PANS-OPS specifies speed tables for each procedure segment and ALPA believes this information could be useful to pilots using U.S. criteria and should be published in the AIM. Don Pate, AFS-450, noted that maximum airspeeds were considered in FMS criteria (Order 8260.40A). The discussion was expanded to include procedure turn maneuvers and maximum airspeeds for various type course reversals. ALPA desires that the holding and teardrop course reversal maneuvers not be allowed unless they have been specifically charted on the procedure and specific course guidance is provided. They believe that aircraft should be required to track outbound on the reciprocal of the inbound course then make a 45/180, 80/260, 90/270 course reversal maneuver. None of the other participants were in favor of eliminating the holding and teardrop maneuvers. AFS-450 stated that they would conduct ASAT modeling to determine maximum airspeeds and evaluate various course reversals against the TERPS procedure turn area. AFS-450 will report the test results when complete. **Action: Item Open (AFS-450)**

MEETING 96-02: Don Pate, AFS-450, presented a briefing demonstrating the ASAT test results for specific PT entry maneuvers at Livingston, MT. The test results, using different aircraft speeds/altitudes and varying 60 kt wind directions, indicate that there are instances where an aircraft will depart the TERPS obstacle clearance area (Note: A T-NOTAM raising the IAF altitude has been issued to correct the Livingston problem). Additional testing is required to develop new criteria and/or flight procedures that will assure obstacle clearance in all instances. Discussion prompted several possible solutions, including using holding pattern vice PT criteria, limiting airspeed, etc. AFS-440/450 took an IOU to prepare an AIM item which will outline the conditions under which the current TERPS protected airspace is exceeded. AFS-40/450 will continue testing and criteria/procedural development and report progress at the next meeting. Additionally, AFS-440/450 will jointly prepare an item for the AIM. **Action: Item Open (AFS-440/450).**

MEETING 97-01: Don Pate, AFS-450 briefed FAA analysis results thus far. His staff has concluded that the existing Procedure Turn (PT) area will only accommodate a maximum airspeed of 200 Kts through 6000 MSL in extreme adverse wind condition. Above 6000 MSL, the area will only accommodate airspeeds up to 165Kts (See the attached status report for further details). The question was put to the forum as to the direction to proceed. Wally Roberts, ALPA recommended specifying a 200 Kt maximum airspeed as an immediate safety improvement pending completion of the study. If additional airspace must be consumed, then publish the maximum speed on the chart to maintain containment. The group consensus favors a two phased approach: First, publish pilot guidance restricting airspeed to 200 Kts for PT maneuvers as an interim safety measure (documents include the AIM, AIP, IAP booklets and the Instrument Flying Handbook). Bill Hammett, AFS-420 and Wally will jointly take on this task. Second, AFS-450 will continue assessing the airspace required for PTs above 6000 MSL and make a determination whether or not new criteria development is warranted. AFS-420/ALPA will prepare a change for the AIM/AIP. AFS-450 will continue testing and report progress at the next meeting. **Action: Item Open (AFS-420/ALPA & AFS-450).**

MEETING 97-02: Don Pate, AFS-450 briefed FAA analysis results thus far. His staff has concluded that the existing Procedure Turn (PT) area will only accommodate a maximum airspeed of 200 Kts through 6000 MSL in extreme adverse wind conditions. Above 6000 MSL, the area will only accommodate airspeeds up to 165 Kts (See the attached status report for further details). The question was put to the forum as to the direction to proceed. Wally Roberts, ALPA recommended specifying a 200 Kt maximum airspeed as an immediate safety improvement pending completion of the study. If additional airspace must be consumed, then publish the maximum speed on the chart to maintain containment. The group consensus favors a two phased approach: First, publish pilot guidance restricting airspeed to 200 Kts for PT maneuvers as an interim safety measure (documents include the AIM, AIP, IAP booklets and the Instrument Flying Handbook). The AIM/AIP changes have been submitted for publication, and will appear in the Feb 98 print. Second, AFS-450 will continue assessing the airspace required for PTs above 6000 MSL and make a determination whether or not new criteria development is warranted. AFS-450 will continue testing and report progress at the next meeting. **Action:** Item Open (AFS-450)

MEETING 98-01: Howard Swaney, AFS-420 briefed that the AIM change recommended at the previous meeting has been published. The change specifies a 200 KIAS maximum for PT entry maneuvers as an interim safety measure pending new criteria development. New criteria are under development within AFS-420. The group agreed that this issue could be closed. **Status:** Item Closed.