ARINC 424 NDB
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Discussion/Proposal

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VERTICAL ANGLE CODING AT THE FAF

V1.0

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| SUMMARY |
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| In 2003 during the Hanau meeting in Germany, Jeppesen proposed a working paper to recommend the coding of the FPA (Flight Path Angle) at the FAF when approach contains SDF (Step Down Fix) between the FAF and the FACF. This has been introduced in ARINC 424 supplemental 17 attachment 5 rule 8.9.9 and still present in supplemental 22. This rule may create situation where the FMS builds a vertical approach profile not in line with the published chart and therefore not expected by the crew.

This paper proposes to modify rule 8.9.9 of ARINC 424 attachment 5 so that the vertical angle is to be coded at the FAF only if requested by the source chart. Additional clarifications are proposed to enhance understanding of the rule. |

1.0   INTRODUCTION/ BACK GROUND

During tests performed in simulator in July 2020 by Airbus flight test department in order to validate changes made in the FMS' Navigation Database for FPA duplication at the FAF, Airbus found some occurrences at KPHL airport (Philadelphia US) where the vertical angle was still present at the FAF in the coding of the procedure. For instance, on RNAV(GPS)-27L at KPHL, the FAF TORNE has associated -3° vertical angle coded in the Navigation Database. As a result, the FMS builds a vertical approach profile with a -3° descent segment down to TORNE despite the AIP chart depicts a level-off at TORNE.

AIP FAA chart for RNAV(GPS)-27L at KPHL:
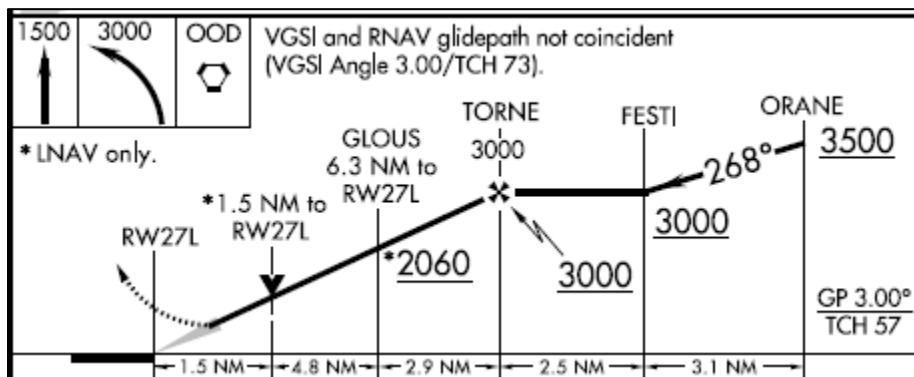
AIP FAA KPHL
RNAV27L.pdf

Corresponding vertical path built by the FMS (classic dive-and-drive approach):
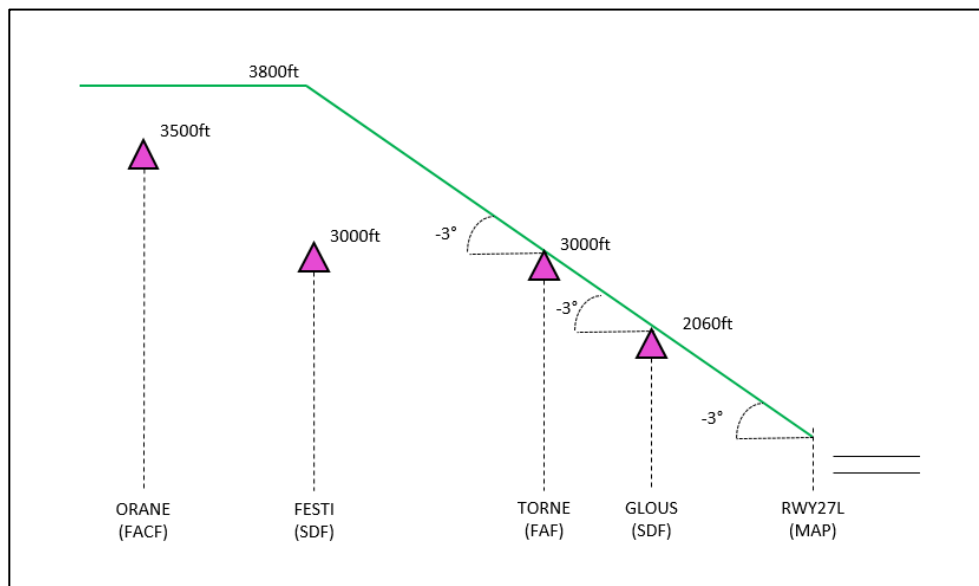
This discrepancy between published chart and automatic flight guidance performed by the A/C may create high confusion for the crew, calling into question the correct functioning of the FMS and the Navigation Database content.

After analysis with the NDB Provider and the Data Services Provider (DSP), it appeared the vertical angle was coded at the FAF on the RNAV approach by the DSP in order to satisfy ARINC 424 rule 8.9.9. Additional review performed by Airbus showed that another DSP does not code such vertical angle at the FAF (in accordance with the chart).

ARINC 424 extracts:

Rule 8.1.2 for non-precision approach (not changed between A424-16 and A424-22):

8.1.2 A Vertical Angle must be coded in the Missed Approach Point, Runway Threshold or the Final End Point, which ever occurs first, for each approach procedure. Vertical Angles must be derived from the official government source or computed. This vertical angle will only be repeated on all step-down fixes after the FAF.

Rule 8.9.9 for non-precision approach created in A424-17 (discussed during Hanau meeting in 2003 based on Jeppesen paper Step-down Fix Prior to FAF, Altitudes and Angles):

8.9.9 If step-down fix is published in government source in the initial or intermediate segment, the fix and the appropriate altitude will be coded as part of the procedure. A vertical angle will be coded on the FAF waypoint that will ensure any step-down fix altitude in the intermediate segment FACF to FAF is cleared. Vertical angle information is not provided in the initial segment IAF to FACF. All step-down fixes will be coded with the appropriate altitude.

Rule 8.9.9 for non-precision approach modified in A424-19 and unchanged up to A424-22 (Airbus could not find the paper/meeting that introduced this change):

8.9.9 If one or more step-down fixes are published in the official government source in the intermediate approach segment of the procedure, and the intermediate approach segment can be included in the final approach coding, the fixes and the appropriate altitudes will be included as part of the Final Approach Coding. A vertical angle will be coded on the FAF waypoint that will ensure that any step-down fix altitude in the Final Approach Coding, FACF, to the FAF is cleared by that angle. Vertical angle information is not provided in Approach Transitions. However, any such fix will be included in the coding, along with the government source supplied altitudes.

Extract from Hanau meeting official report (ref. 03-226/NDT-116)):
QUOTE
John Kasten reported that ARINC 424 rules for altitudes on step down fixes are concise. However, ARINC 424 does not reference where the step-down fixes are located. John reported, Jeppesen has successfully applied those rules for step-down fixes, FAF inbound, but not between IF/FACF.
After a lengthy discussion, John provided a proposal that recommended the VNAV angle at the FAF when step-down fixes are coded. The proposal was supported (Reference N03-227/NDT-117, Attachment 11).
UNQUOTE

2.0 DISCUSSION and or ACTION

Airbus would like the rule 8.9.9 to be reviewed so that the coding of the vertical angle at the FAF is not to be performed unless clearly requested by the originator of the procedure (AIP source, chart, etc.). Indeed, there is a need that the coding of the procedure satisfies and correctly reflects what is published on the chart (both AIP source's chart and proprietary Data Provider's chart).

Additionally, Airbus would like the group to confirm FACF and Final Approach coding terms meaning in this rule.

Airbus' understanding is that:
- Initial approach segment starts at the IAF and ends at the IF. It is generally coded in the Approach transition (Approach Record with Route Type equal to 'A').
- Intermediate approach segment starts at the IF and ends at the FAF.
- Final approach segment starts at the FAF and ends at the MAP.
- Both Intermediate and Final approach segments are generally coded together in the Approach Record with Route Type different from 'A' and 'Z'.
- Missed approach starts at the MAP. It is coded in the Approach Record with Route Type equal to 'Z'.

Therefore in the section 8 of attachment 5 for non-precision approach, FACF should be generally understood as the IF (Intermediate Fix) of the approach, as defined in §6.2.5 of ARINC 424; and final approach coding should be understood as the coding of the Approach Record when Route Type is not A/Z (i.e. encompassing both the intermediate and final approach segments).

3.0 Changes as depicted (Track Changes is Helpful)

Modification for ARINC 424 supplemental 23 attachment 5 rule 8.9.9 (modifications in bold blue):

8.9.9 If one or more step-down fixes are published in the official government source in the intermediate approach segment of the procedure **(FACF to FAF)**, and the intermediate approach segment can be included in the ~~fF~~inal ~~aA~~pproach **Coding**, the fixes and the appropriate altitudes will be included as part of the Final Approach ~~Cc~~oding. **If the official government source requires a**~~A~~ vertical angle **to**~~will~~ be coded on the FAF waypoint**, the vertical angle value** ~~that~~ will ensure that any step-down fix altitude in the **intermediate approach segment (FACF to FAF)**~~Final Approach Coding, FACF, to the FAF~~ is cleared by that angle. Vertical angle information is not provided in Approach Transitions~~.~~ **(H**~~H~~however, any ~~such~~ fix **of the initial approach segment** will be included in the **Approach Transition** ~~c~~Coding, along with the government source supplied altitudes**)**.