

# ARINC 424 NDB

Draft 1 of Supplement 23  
Discussion/Proposal

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## WORKING GROUP: XA TO 400 FT

V.32

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SUMMARY
Garmin took the action to follow up with the Data Suppliers and FMS Vendors to determine to full impact of the Airbus proposal to change the xA to 400 FT rule (Phoenix Working Paper 8).

## 1. INTRODUCTION/ BACKGROUND

At the 18-01 NDB Working in Phoenix, AZ Airbus submitted Working Paper #8 which proposed to change the Attachment 5 Rule 9.3.1.5 to remove some approaches from having the 'xA to 400 FT' added as the first leg of the missed approach.

424-22 text for Rule 9.3.1.5:

9.3.1.5 When an immediate turn is specified in an ILS, MLS, or GLS missed approach, or if the source describes a turn greater than 15 degrees from the final approach course, without an altitude specified before the turn, as the first leg of a missed approach, a course from or heading to an altitude (CA, FA, VA) leg must be coded as the first leg of the missed approach and must include a command to climb before the turning leg, using the final approach course for the leg heading or course. The altitude will be coded as a minimum altitude, at least 400 feet above the airport elevation and the leg will terminate at that altitude.

Airbus Working Paper 8 proposed changes:

**9.3.1.5 If the missed approach point is at the runway threshold and the final approach course aligned with runway centreline, w**When an immediate turn is specified ~~in an ILS, MLS, or GLS missed approach,~~ or if the source describes a turn greater than 15 degrees from the final approach course, without an altitude specified before the turn, ~~as the first leg of a missed approach,~~ a course from or heading to an altitude (CA, FA, VA) leg must be coded as the first leg of the missed approach and must include a command to climb before the turning leg, using the final approach course for the leg heading or course. The altitude will be coded as a minimum altitude, at least 400 feet above the airport elevation and the leg will terminate at that altitude.

**9.3.1.7 If the missed approach point is not at the runway threshold or the final approach course is not aligned with runway centerline, the necessity to code such an altitude leg and the leg heading or course value (if coded) shall be assessed by the data provider with respect to the published missed approach path, taking into account the go-around may be initiated either before or after the published missed approach point.**

The Phoenix NDB meeting notes reported the following on the Airbus Working Paper 8:

Julien Robin, Airbus, reported that Airbus raised awareness at last year's meeting in Florida on the operational impact of the rules for xA coding as the first leg of the missed approach. In cases where the runway axis is offset more than 15 degrees from the final approach course, the coding rules may induce misleading guidance commands.

In the dialogue that followed, the **FMS manufacturers requested test data from the data supplier, to ensure that it does not create a turn too close to the ground. Airbus withdrew the proposal and will resubmit at the next meeting. Data base suppliers accepted the action to provide test data and identify procedures.**

I think we should also investigate the **400 FT rule** that applies to the first leg of SIDs found in Attachment 5, Rule 4.1.

4.1 The following rules cover the altitude coding requirements of the initial leg of a departure:

If a published take-off requires a turn of greater than 15 degrees from the runway bearing, code a CA, VA or IF/FA leg on the runway bearing/heading to an altitude of 400 feet above the airport elevation (AFE).

If a published take-off is straight ahead or requires a turn of less than 15 degrees and is to a fix such as a waypoint, Navaid, or DME distance termination, code an altitude on that fix when included in the government source, otherwise no altitude is coded.

If a published take-off is straight ahead or requires a turn of less than 15 degrees and is to a specified altitude termination, code the appropriate leg type (VA, IF/FA, CA) to that altitude.

... (other unrelated text) ...

## 2. DISCUSSION and or ACTION

Garmin agreed to lead a sub-group to:

1. Identify the all the types of procedures impacted that need to be tested (see *Section 3* below)
2. Coordinate test ARINC 424 files from Data Suppliers
3. Report results back to the ARINC NDB Working Group at the Poland meeting in October

## 3. ~~Test Procedures~~ TEST PROCEDURES

I started the research by looking at cases where a xA leg to 400 FT was coded in the NavDB. I identified six unique cases that I think should be tested. The first test procedure is the approach to the LFKF airport in France that Airbus first reported as the problem. The other procedures are cases which I think will help further test the need for a safety xA leg to 400 FT.

#	apt_ident	proc_name (AIP link)	MAPt	Alignment	Path Term Combo	Test Condition
1	LFKF	<a href="#">VOR RWY 05</a>	FGI 1.6 DME	Straight-In	CF CA CF	Keep CA leg
2	KMIV	<a href="#">ILS or LOC RWY 10</a>	RW10	Precision Straight-In	CF CA DF	Remove CA leg
3	KSMN	<a href="#">RNAV (GPS) RWY 17</a>	AXLED	Straight-In	TF CA DF	Remove CA leg
4	KLUA	<a href="#">VOR/DME-B</a>	YIDUB	Circling Aligned RW22	CF CA CF	Remove CA Leg
5	KA AO	<a href="#">RNAV (GPS)-E</a>	NIYIC	Circling	TF CA DF	Keep CA Leg

Table 1: Approaches with xA to 400

I have included one SID that I think we should also test.

#	apt_ident	proc_name (FAA dTPP link)	Rwys	Alignment	Path Term Combo	Test Condition
6	KPSP	<a href="#">THERMAL SIX</a>	RW13B RW31B	n/a	VA VI	Remove VA Leg

Table 2: SIDs with xA to 400



### **4.3.1 Test ARINC 424 files from Data Suppliers**

NavBlue has offered to provide test data to the FMS Vendors who require it. Please contact Catriona Rose ASAP if you would like test data.

Catriona Rose  
[Catriona.Rose@navblue.aero](mailto:Catriona.Rose@navblue.aero)

### **5.3.2 Gather testing results for the ARINC NDB Working Group in Poland**

Test the Approaches by following these steps:

- a) Fly the aircraft past the DA/MDA on a course to a landing runway. For the circling approaches choose any runway.
- b) At a height of approximately 100 FT above the airport's elevation execute the TOGA
- c) Engage the FMS and activate LNAV
- d) Record the results.
  - a. Are turns below 400 FT above the airport elevation allowed?
  - b. Should the xA leg to 400 FT be added to this procedure?
  - c. What course would be the safest for an xA leg?

Test the SID by following these steps:

- a) Fly the aircraft to a height of approximately 100 FT above the airport's elevation
- b) Engage the FMS and activate LNAV
- c) Record the results.
  - a. Are turns below 400 FT above the airport elevation allowed?
  - b. Should the xA leg to 400 FT be added to this procedure?

#### 4. GARMIN FLIGHT TEST

A Garmin engineer flew the test procedures in a simulator and documented the results in the following table. He documented the airport’s elevation, if there was a potential for turns below 400 FT AGL, recommendation if he think the xA leg to 400 FT AGL should be added, and if so, what course he recommend for the xA leg. He also documented the results in the paragraphs provided below.

#	Airport	Proceduere	MAPt	Alignment	Path Term Combo	Test Condition	Arpt Elev	Potentia l Turns below 400'?	Should xA be added?	What course for xA?
1	LFKF	VOR RWY 05	FGI 1.6 DME	Straight-In	CF CA CF	Keep CA leg	0087'	No	Yes	045 (runway heading)
2	KMIV	ILS or LOC RWY 10	RW10	Precision Straight-In	CF CA DF	Remove CA leg	0085'	Yes	Yes	100 (rwy & final course)
3	KSMN	RNAV (GPS) RWY 17	AXLED	Straight-In	TF CA DF	Remove CA leg	4044'	No	No	N/A
4	KLUA	VOR/DME-B	YIDUB	Circling Aligned RW22	CF CA CF	Remove CA leg	0902'	Yes	Yes	224 (runway heading)
5	KAAO	RNAV (GPS)-E	NIYIC	Circling	TF CA DF	Keep CA leg	1421'	Yes	No	N/A
6a	KPSP	THERMAL SIX	RW13B	RW13L	VA VI	Remove VA Leg	476'	Yes	Yes	130 (runway heading)
6b	KPSP	THERMAL SIX	RW13B	RW31L	VA VI	Remove VA Leg	476'	Yes	Yes	310 (runway heading)

Table 3: Garmin Flight Test Results

##### 4.1 Summary from flight test:

ARINC 424-22 Rule 9.3.1.5 currently prescribes that a climb-to-altitude leg be coded as the first leg of a missed approach procedure when the missed approach procedure otherwise specifies an immediate turn and there is not another altitude leg provided by source data. To avoid low altitude turns after a go-around from less than 400 FT AGL, Airbus *Working Paper 8* proposes to modify that rule such that the altitude leg only be added to the procedure if the final approach course is aligned with the runway center line. The paper further proposes that climb-to-altitude legs be added to approaches where the final approach course does not align with the runway at the discretion of the data provider.

If an altitude leg is not encoded prior to an immediate turn in the missed approach procedure, FMS guidance may command a turn at low altitude in cases such as 2 and 6. In these cases where the final approach course is aligned with the runway, Rule 9.3.1.5 still serves to prevent a low altitude turn, and an xA leg should be included.

In other cases where the final approach course is not aligned with the runway, such as cases 1, 4, and 5, the inclusion of an xA leg along the final approach may cause a low-level turn. In these scenarios a go-around executed from a point 100 FT AGL and aligned with the runway will result in the new active leg being on a different course. While case 1 did not result in a low-level turn, there could be combinations of aircraft position and configuration and path definition that will result in an immediate turn away from the runway to the final approach course upon activation of the missed approach procedure. In these cases, a climb leg is helpful to provide a minimum altitude prior to following the missed approach procedure. Defining the climb leg with a course that does not align with the runway may create the situation it is trying to prevent. In these cases, Garmin recommends an xA leg should be included, but should be along the runway heading. If there is no runway, such as in case 5, the leg should not be included.

Test Case 3 represents a final set of scenarios where the automatic inclusion of a climb leg for use below the approach MDA can result in path guidance that seems to disagree with the way the original missed approach procedure was designed by the FAA. In these cases, the missed approach point is not close to the airport, and the aircraft has diverged from the intended missed approach path by the time a go-around is initiated. In these situations, an xA leg should not be included.

Our testing demonstrates that the proposed rule changes from Airbus *Working Paper 8* may allow some turns at low altitude. These turns may be prevented if the data provider is also given the latitude under the proposed rule 9.3.1.7 to align the xA leg with the runway if it is to be included. This acknowledges that the xA leg inserted into these procedures is not part of the missed approach procedure, which is defined to begin from the missed approach point at the minimum approach altitude. Given the assumption that an aircraft operating below 400 FT AGL is aligned with a landing runway, the xA leg is a go-around maneuver, which defines a de facto departure procedure intended to assist in safely maneuvering the aircraft back to a position from which the missed approach procedure can be joined.

## 5. Changes as depicted (Track Changes is Helpful)

### 5.1 Proposed change to Attachment 5 Rule 4.1 (SID Runway Transition xA Rule):

No change should be made to Attachment 5 Rule 4.1 which indicates when the data suppliers should add an xA leg to 400 FT AGL as the initial leg of a departure.

### 5.2 Proposed updated Attachment 5 Rule 9.3.1.5 (Missed Approach xA Rule):

I propose changing Rule 9.3.1.5 to keep the xA leg in most of the current cases. The proposed rewording should only remove the xA leg for those approaches which are circle-to-land and do not meet straight-in alignment criteria (KAAO RNVE), and those where a TF is intended as the first leg of the missed approach instructions (KSMN R17). We are also proposing the course on the xA leg be changed from the final approach course to the runway bearing/heading. We are also proposing that the xA altitude be 400 FT above the airport elevation or the lowest MDA/DA.

9.3.1.5 When an immediate turn is specified in an ~~IIS, MLS, or GLS missed~~ approach **that (1) meets straight-in alignment criteria, (2), or if** the source describes a turn greater than 15 degrees from the final approach course, **(3) the first path on the missed approach is not intended to be a track (TF leg) between the MAP and the first missed approach fix, and (4) without there is not a climb to** an altitude **leg (xA)** specified before the turn, ~~as the first leg of a missed approach~~, a course from or heading to an altitude (CA, FA, VA) leg must be coded as the first leg of the missed approach and must include a command to climb before the turning leg, using the ~~final approach course~~ **runway bearing/heading** for the leg's ~~heading or~~ course. The altitude will be coded as a minimum **(At/Above)** altitude, ~~at least of~~ 400 feet above the airport elevation **(AFE), or the lowest DA/MDA,** and the leg will terminate at that altitude.