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October 12, 2004
B-H300-04-JGD-074

Federal Aviation Administration
Transport Airplane Directorate
Attention: Gregg Bartley, ANM-111
1601 Lind Avenue SW.
Renton, Washington 98055-4056

FAA-2004-18775-10

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Subject: Comments to Proposed Advisory Circular (AC) 25.1329-1A, "Automatic Pilot Systems Approval"

Reference: (a) Notice of proposed advisory circular and request for comments, published in the Federal Register on August 13, 2004 (69 FR 50255)

(b) Notice of Proposed Rulemaking (NPRM), Docket No. FAA-2004-18775, Notice 04-11, "Safety Standards for Flight Guidance Systems," published in the Federal Register on August 13, 3004 (69 FR 50239)

Dear Mr. Bartley:

Enclosed are comments from Boeing Commercial Airplanes concerning the subject proposed advisory circular (AC). We have two significant concerns with the proposed document:

1. Even though substantial resources were expended by both government and industry to ensure harmonization between the parallel FAA and JAA documents, this proposed AC has been changed considerably prior to its publication and is no longer harmonized with the JAA Advisory Circular Joint (ACJ). It is disappointing that the FAA has elected in the end not to follow the strategy of FAA/JAA harmonization that was originally the cornerstone of this project. Consequently, use of the proposed AC (as well as the associated proposed rule) will pose significant difficulties to the applicants who comply with it. So that industry may better understand the objectives behind this change of direction, we request an opportunity for additional dialogue with the FAA as to why it has chosen not to promulgate harmonized documents.

2. As proposed, the terms of this AC would require substantial changes in airplane design in order to show compliance with §25.1329 using proposed AC 25.1329-1X as the guideline for establishing

compliance. In our enclosed detailed comments, we identify specific sections where design changes would be necessary and have asked for clarification and more explanation concerning their intent. Additionally, we request clarification on applicability particularly in conjunction with intent for the Change Product Rule.

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More detailed comments are included in the enclosure to this letter.

Please direct any comments or questions to Ms. Jill DeMarco of this office at (425) 965-3005.

Sincerely,

for Jim Draxler
Director, Airplane Certification and
Regulatory Affairs

Enclosure

cc: Dr. Michael Romanowski
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Boeing Commercial Airplanes
Comments on Proposed Advisory Circular 25.1329-1A, "Automatic Pilot Systems Approval"

GENERAL COMMENTS

1. Boeing Commercial Airplanes (Boeing), as well as many other stakeholders (including the FAA), invested a significant amount of time and effort, and incurred significant costs, in supporting the Flight Guidance System Harmonization Working Group (FGSHWG) activity that produced the basis for the proposed AC and the associated Notice of Proposed Rulemaking (NPRM). This activity occurred over approximately a five-year period and represented a significant company investment. The FGSHWG's product was provided to the FAA and JAA through the Aviation Rulemaking Advisory Committee (ARAC), Transport Aircraft and Engine Issues Group (TAEIG), with a recommendation for rulemaking/AC action.

   The JAA accepted the ARAC product with minimal changes (e.g., European spelling of certain words) and initiated a Notice of Proposed Amendment (NPA) action. The public comments from this process were addressed in a JAA hosted meeting that included industry and the FAA as participants, and minimal adjustments to its final rule and Advisory Circular Joint (ACJ) were made. The JAA product is now with the European Aviation Safety Agency (EASA) for finalization and official adoption.

   However, the FAA has made significant revisions to the ARAC product. The NPRM has been changed from the JAA NPA product, and inconsistencies exist between the NPRM and the AC. The AC format is significantly revised and is provided in a format that does not lend itself to software comparison tools to identify changes. Insufficient time was made available for the public comment period to make a comprehensive comparison of the proposed AC to the JAA ACJ and to the ARAC product. The comment period would have to be extended to provide sufficient time to complete this assessment.

   Given the time, effort, and costs expended in creating a harmonized product, Boeing requests that the FAA provide a justification for the changes made to the ARAC product to arrive at the current NPRM and AC. In the spirit of harmonization, Boeing suggests that the FAA make a positive effort to harmonize with the JAA product.

2. One of the difficulties in reviewing the proposed AC has to do with interpretation. The impact it may have on new derivatives of current production airplanes could be huge or none, based on interpretation of the requirement. We have elaborated on this issue in our comments that follow.

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SECTION 10.
FGS ENGAGEMENT, DISENGAGEMENT, INDICATIONS, AND OVERRIDE

Paragraph 10.A.1.b. - Multiple Autopilots:

For airplanes with more than one autopilot installed, each autopilot may be individually selected and should be so annunciated. It should not be possible for multiple autopilots to be engaged in different modes. For modes that use multiple autopilots, the additional autopilots may engage automatically at selection of the mode or after arming the mode. A means should be provided to determine that adequate autopilot capability exists to support the intended operation (e.g., "Land 2" and "Land 3" are used in some aircraft).

BOEING COMMENT: This requirement appears to be specific to one particular design strategy, one in which multiple autopilot channels are individually selected. We request that FAA provide clarification to identify the real requirement.

Paragraph 10.B.1.a.(3) - Multiple FDs:

If there are multiple flight directors and if necessary for crew awareness, indications should be provided to denote which flight director is engaged (e.g., FD1, FD2, HUD). For airplanes with multiple flight directors installed, both flight directors should always be in the same armed and active FGS modes. The selection status of each flight director should be clear and unambiguous for each pilot. In addition, indications should be provided to denote loss of flight director independence, (e.g., first officer selection of captain's flight director).

BOEING COMMENT: As written, this requirement would preclude certain current normal operations, such as flying with the Captain's flight director in a localizer mode, and with the First Officer's flight director in a VOR mode. We suggest it be clarified or revised.

Paragraph 10.B.1.a.(5) - Heads Up Display (HUD):

Since the HUD can display flight guidance, the HUD guidance mode should be indicated to both pilots and should be compatible with the active head–down flight director mode.

BOEING COMMENT: This requirement appears impractical. We request clarification on how the non-HUD crew member gets the mode information.

Paragraph 10.B.1.a.(2) - No significant transients:

> *In normal operating conditions, a significant transient should not result from autopilot disengagement when the flightcrew applies an override force to the controls (see §25.1329 (d)).*

BOEING COMMENT: This appears to be a new design requirement. No current production Boeing airplanes comply with this requirement. We request more clarification, especially on how compliance could be shown.

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SECTION 11.
CONTROLS, INDICATIONS, AND ALERTS

Paragraphs 11.C.4.a, 11.D.2, [and Section 12, paragraph 12.F.1.b.(1)]:

BOEING COMMENT: Each of these paragraphs use the terms "reversions" and/or "sustained speed protection," but the meaning of the terms is unclear. We request that the FAA provide more information on what their interpretation of these terms is intended to be.

Paragraph 11.C.5. - Failure to Engage or Arm:

> *It should be made clear to the pilot that a mode selected by the pilot has failed to arm or engage, especially due to invalid sensor data.*

BOEING COMMENT: It is not clear as to whether a specific annunciation would be required, or if normal annunciation of the armed and engaged modes would be sufficient to comply with this requirement. We request that this paragraph be clarified to discern exactly what is meant by the text.

Paragraph 11.C.6 - FGS Mode Display and Indications:

> *Mode information provided to the pilot should be sufficiently detailed, so that the consequences of the interaction can be determined unambiguously. Examples of the consequences are ensuing mode or system configurations that have operational relevance. The FGS interface should provide timely and positive indication when the flight guidance system deviates from the pilot's direct commands (e.g., a target altitude or speed setting) or from the pilot's pre-programmed set of commands (e.g., waypoint crossing). The interface should also provide clear indication when there is a difference or conflict between pilot-initiated commands. An example would be when a pilot engages positive vertical speed and then selects an altitude that is lower than the aircraft altitude. The default action taken by the FGS should be made apparent.*

BOEING COMMENT: This paragraph is specific to one particular design strategy. Some designs do not allow the vertical mode to be selected before setting the target altitude. Some designs do allow the altitude target to be in one direction and the vertical speed or flight path angle, climb or descent, to be in the other direction. We request clarification whether the intent of this requirement is to preclude this type of operation. (This same comment applies to Section 13, paragraph 13.C.2.)

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SECTION 13.
CHARACTERISTICS OF SPECIFIC MODES

Paragraph 13.C.2 - Target Altitude Selection:

To avoid unconstrained climbs or descents for any altitude transitions when using applicable vertical modes, the altitude select controller should be set to a new target altitude before the vertical mode can be selected. If the design allows the vertical mode to be selected before setting the target altitude, then consideration should be given to the potential vulnerability of unconstrained climb or descent leading to an altitude violation or Controlled Flight into Terrain. Consideration should also be given to appropriate annunciation of the deviation from previously selected altitude and / or subsequent required pilot action to reset the selected altitude.

BOEING COMMENT: The current FAA-approved design of Boeing airplanes does allow the vertical mode (V/S) to be selected before setting the target altitude. It appears that the intent of the proposed paragraph is aimed at preventing unrestrained climb or descent that could lead to an altitude violation or controlled flight into terrain. However, the system is designed for pilot-in-the-loop monitoring; the pilot needs to be aware of what the airplane is doing. A design change would be required to alert or indicate to the crew that the airplane is traveling away from the target altitude. We question whether this is truly going to make flying safer, and request that the FAA provide more information/clarification as to the intent of this paragraph.

Paragraph 13.C.8.b.(8) - Adjusting datum pressure:

Adjusting the datum pressure at any time during altitude capture should not result in loss of the capture mode. The transition to the pressure altitude should be accomplished smoothly.

BOEING COMMENT: The text of this proposed paragraph seems to imply that, during the altitude capture, the autopilot should adjust the target altitude to account for changes in the altimeter setting and smoothly complete the capture to the target altitude based on the new altimeter setting. The current FAA-approved autopilot design (of Boeing Models 747-400/757/767/777) does not work this way. At entry into altitude mode, the existing filtered baro altitude (based on the altimeter setting existing at ALT mode entry) is the altitude reference (target). A design change would be required to meet the intent of the above text. We request that FAA provide more clarification and information as to the reasoning behind this specific proposed implementation requirement.

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Paragraph 13.C.9.b.(2) - Climbing or descending:

> *When initiated by pilot action when the airplane is either climbing or descending, the FGS should immediately initiate a pitch change to arrest the climb or descent and maintain the altitude when level flight (e.g., less than 200 feet per minute) is reached. The intensity of the leveling maneuver should be consistent with occupant comfort and safety.*

BOEING COMMENT: The current FAA-approved design of Boeing models does not operate the way described in the proposed paragraph. The current design will cause the autopilot to fly back to the altitude existing when the ALT HOLD mode button was pushed. A design change would be required to meet the intent of the above text. We request that FAA provide more clarification and information as to the reasoning behind this specific proposed implementation requirement.