whether a vessel complies with certain standards of safety and environmental protection.

Respondents: Owners and operators of vessels.

Frequency: On occasion.

Burden Estimate: The estimated burden is 443 hours a year.

2. Title: Advance Notice and Certification of Adequacy for Reception Facilities.

OMB Control Number: 2115–0543.

Summary: 33 U.S.C. 1905 gives the Coast Guard the authority to certify the adequacy of reception facilities in ports. Reception facilities receive waste from ships, which may not discharge at sea. Under these rules there are limits on discharges for oil and oily waste, noxious liquid substances, plastics, and garbage.

Need: This information collection is needed to evaluate the adequacy of reception facilities before issuance of a Certificate of Adequacy. Information for the advance notice ensures effective management of reception facilities and reduces the burden to facilities and ships .

Respondents: Owners and operators of reception facilities, and owners and operators of vessels.

Frequency: On occasion.

Burden Estimate: The estimated burden is 1,215 hours a year.

3. Title: Approval of Equivalent Equipment or Procedures Other Than Those Specified by Rule.

OMB Control Number: 2115–0553.

Summary: This information collection implements the concept of Best Available and Safety Technology provided for in Section 21 of the Outer-Continental-Shelf (OCS) Lands Act, as amended. The information allows owners and operators to propose, for approval by the Coast Guard, alternative equipment or procedures that would provide a comparable level of safety.

Need: The information helps the Coast Guard ensure that alternatives proposed would yield a level of safety at least equivalent to that of measures provided for in 33 CFR Subchapter N.

Respondents: Owners and operators of facilities in the OCS.

Frequency: On occasion.

Burden Estimate: The estimated burden is 50 hours a year.

4. Title: Application for Permit to Transport Municipal and Commercial Waste.

OMB Control Number: 2115–0579.

Summary: This information collection provides the basis for issuing or denying a permit for the transportation of municipal or commercial waste in the coastal waters of the United States.

Need: In accordance with 33 U.S.C. 2601, the U.S. Coast Guard issued rules requiring the owner or operator of a vessel to apply for a permit to transport municipal or commercial waste in the United States and to display an identification number or other marking on his vessel. This collection of information enables enforcement of those rules.

Respondents: Owners and operators of vessels.

Frequency: Every 18 months.

Burden Estimate: The estimated burden is 391 hours a year.

5. Title: Safety Approval of Cargo Containers.

OMB Control Number: 2115–0094.

Summary: This collection of information addresses the reporting and recordkeeping required for containers by 49 CFR Parts 450–453. These rules are necessary because the U.S. is signatory to the International Convention for Safe Containers (CSC), which requires that all containers be safety-approved before they are used in trade.

Need: This information collection requires owners and manufactures of cargo containers to submit information and keep records associated with the approval and inspection of those containers. This information is needed to ensure compliance with the CSC.

Respondents: Owners and manufacturers of containers, and organizations that the Coast Guard delegates to act as Approval Authorities.

Frequency: On occasion.

Burden Estimate: The estimated burden is 101,732 hours a year.

6. Title: Safety of Vessels in the Commercial Fishing Industry.

OMB Control Number: 2115–0582.

Summary: This information collection is intended to improve safety on board vessels in the commercial fishing industry. The requirements apply to those vessels and to seamen on them.

Need: Under the authority of 46 U.S.C. 6104, the Coast Guard has promulgated rules in 46 CFR Part 28 to reduce the unacceptably high level of fatalities and accidents in the commercial fishing industry. The rules allowing the collection also provide means of verifying compliance and enhancing safe operation of fishing vessels.

Respondents: Owners, agents, individuals-in-charge of vessels in the commercial fishing industry, and insurance underwriters.

Frequency: On occasion.

Burden: The estimated burden is 8,205 hours a year.

Dated: August 17, 2001.

V.S. Crea,

Director of Information and Technology.

[FR Doc. 01–21566 Filed 8–24–01; 8:45 am]

BILLING CODE 4910–15–P

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Aviation Rulemaking Advisory Committee Meeting on Transport Airplane and Engine Issues

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of public meeting.

SUMMARY: This notice announces a public meeting of the FAA's Aviation Rulemaking Advisory Committee (ARAC) to discuss transport airplane and engine (TAE) issues.

DATES: The meeting is scheduled for September 11–12, 2001, beginning at 8:30 a.m. on September 11. Arrange for oral presentations by September 5.

ADDRESSES: Doubletree Hotel Seattle Airport, 18740 International Boulevard, Cascade Rooms 5 and 6, Seattle, Washington.

FOR FURTHER INFORMATION CONTACT: Effie M. Upshaw, Office of Rulemaking, ARM–209, FAA, 800 Independence Avenue, SW., Washington, DC 20591, Telephone (202) 267–7626, FAX (202) 267–5076, or e-mail at effie.upshaw@faa.gov.

SUPPLEMENTARY INFORMATION: Pursuant to section 10(a)(2) of the Federal Advisory Committee Act (Pub. L. 92–463; 5 U.S.C. app. III), notice is given of an ARAC meeting to be held September 11–12, in Seattle Washington.

The agenda will include:

September 11, 2001

- Opening Remarks
- FAA Report
- Joint Aviation Authorities Report
- Executive Committee Report
- Harmonization Management Team Report
- Review of Proposed New Tasking List
- Continued Airworthiness Methodology Working Group Report and Approval
- Mechanical Systems HWG Report and Approval
- Design for Security HWG Report
- Ice Protection HWG Report
- Engine HWG Report
- Human Factors Harmonization Working Group (HWG) Report
- Powerplant Installation HWG Report
- Flight Test HWG Report
- Electromagnetic Effects HWG Report

Aviation Rulemaking Advisory Committee (ARAC)

Transport Airplane and Engine Issues

Meeting Minutes

DATE: September 11-12, 2001

TIME: 8:30 a.m.

Location: Doubletree Hotel Seattle Airport

18740 International Boulevard (Route 99)

Cascade Rooms 5 and 6

Seattle, Washington

Call to Order/Administrative Reporting

Craig Bolt, Assistant Chair, called the meeting to order. He acknowledged the morning's events and the families who had lost loved ones. Chuck Huber, Acting Assistant Executive Director, read the meeting procedures stated and updated attendees on information about the downed airplanes. He reported that the Seattle Regional Office had been closed, and that he expected building managers to meet later that day to decide how to proceed.

Mr. Bolt welcomed the attendees who, in turn, introduced themselves. (See attached sign-in sheet.). He reviewed the agenda (Handout 1), distributed the Open/Completed Taskings Chart (Handout 2), and requested that any changes be directed to him. From the Items of Interest Chart (Handout 3), he highlighted publication of three advisory circulars addressing §§ 25.723, 24.1435, and 25.3328; two new taskings (General Structures and Mechanical Systems Harmonization Working Groups (HWG), and a variety of correspondence to the FAA.

Mr. Bolt then reviewed the status of the June Action Items (Handout 4):

Item	Status
1	Most copies of FAA Policy book have been distributed; working group chairs should contact him if they need copies
2	Open
3	To be discussed during future taskings section
4	Closed
5	Closed

6	Closed
7	Closed
8	Cover during General Structures HWG report
9	Closed; search for additional guidance on economic analysis requirements unsuccessful
10	Closed; John Ackland looking for input from issues group
11	Closed
12	Open; to be covered during discussion of § 25.1309
13	Closed

FAA Report

Mr. Huber indicated that he was not providing a list of rulemaking projects because the Directorate was in the process of finalizing its business plan, and the computer program designed to determine the priority of projects has to be reviewed. The FAA has identified over 160 rulemaking projects for all the certification offices, and the number is too high to be realistic. Mr. Huber said that CAST recommendations would be given a higher priority and will not be incorporated into the 160+ project list.

Mr. Huber indicated that several position vacancies at the Directorate, including branch managers and an ARAC coordinator position, are considered a high priority for filling, but maybe affected by the FAA's current freeze on hiring policy. He indicated that a new technical writer is on board but cautioned that her performance would be impacted by a learning curve. Mr. Huber also indicated that the Directorate's budget had only been increased by 2 percent this year (3 percent less than previous years), and that the decreased budget allocation would most certainly impact travel plans for FAA representatives involved in harmonization working groups. He further indicated that the FAA would have to look at alternatives for doing rulemaking, such as certification programs. Mr. Huber did, however, reiterate that the agency is committed to completing Better Plan, fast track, category 1 projects, and that it would continue to work on some category 3 projects

Discussion items included providing the JAA advance information on the Directorate's business plan while still in proposal state, and providing ARAC with a copy of the Directorate business plan. Other items included putting a moratorium on taskings to working groups (approximately 52+ are assigned to the TAE working groups), determining a criterion for assessing what is in the rulemaking program and a criterion for establishing new projects, and looking at the definition of "harmonization." The committee also discussed having a new "sneak and peak" website that would allow the public to have an idea of what projects the FAA is contemplating.

Tony Fazio said that the FAA has overcommitted to ARAC, and that it is clear that the FAA cannot accommodate all the projects tasked to ARAC. He addressed the proportion of rules completed by ARAC to the actual number completed through the FAA process; the impact of projects tasked to ASTRAC; recommendations addressing the rulemaking process from the IG and GAO audits and the FAA Management Advisory Council. He indicated that requirements have increased with respect to the impact of rulemakings on small businesses and environment.

Mr. Fazio further indicated that the process for reviewing projects has changed under the new administration, and that all rulemaking projects are now considered "significant" since the Secretary must clear all proposed and final rulemakings before they can be published. He advised members that he does not see harmonization as the highest priority when weighted against safety issues. Mr. Fazio said that in the future, ARAC would only be tasked when FAA resources are guaranteed to be in place to process ARAC recommendations.

Both Jim Bettcher and Bob Kelley-Wickemeyer expressed concerns about better use of ARAC resources, using resources to complete economic evaluations, the need to look at and understand new technologies, and folding several projects into one rulemaking. Mr. Bettcher further recommended that the EXCOM address ARAC taskings.

Committee members criticized the FAA for its failure to identify issues early in the process before ARAC involvement, for not having realistic commitments, and for not being fiscally irresponsible with taskings that will not bear fruit.

Mr. Bolt provided the following points in summarizing the discussion: (1) so many ARAC recommendations have flooded the system; (2) look at taskings in system and determine where they are headed; (3) look at working groups in the middle of tasking and determine if they should continue; and (4) working groups may need to return tasks to ARAC.

JAA Report

Thaddee Sulocki indicated that the JAA has decided to publish all NPA’s. EASA will be in place in 2003, and the JAA has to clean house before the change. He indicated that the JAA has to take advantage of all the harmonization work and publish the rulemakings before EASA.

Discussion items included JAA’s publication of a final rule for JAR 25.1309, and use of JAA standards by FAA and industry.

Transport Canada

No report since Mr. Maher Khouzam was unable to attend the meeting.

EXCOM Report

Mr. Bolt indicated that the Fuel Tank Inerting working group had forwarded the EXOCOM a draft 250-report (with 650 pages of attachments) in CD-ROM format. The working groups expects to proceed with the following schedule: September 7—comments, specific questions, and clarifications due from EXCOM members; October 8-- working group to respond to EXCOM’s comments; November 7--final report to EXCOM; and mid December-- report with minority opinions due to FAA.

Mr. Bolt turned the floor over to Mr. Bettcher who wanted to express some concerns about ARAC. He began by stating that ALPA believes that ARAC is the "best thing going," even given the need for changes and improvements. He commended the efforts of Dorenda Baker and Kris Carpenter in showcasing the ability of ARAC. He criticized the process for squandering resources, for not having fully agreed-on products, and for allowing completed projects to languish because the FAA disagrees with the direction of a recommendation. He emphasized the need for more open discussion between ARAC and the FAA and the need for balanced leadership within the working groups. He also urged a longer period for ARAC members to review TOR’s and the need to address the readability and clarity of TORs.

Mr. Bettcher said that working groups should not be hampered with the cost of rulemaking, and that a tasking should not be driven by cost, but by whether it can be done. He told Mr. Fazio that he would forward his comments to him.

Mr. Kelley-Wickemeyer indicated that Boeing supports the concept of ARAC, but there is "too much going into the pipeline." He emphasized the need to find alternative solutions for some projects other than rulemaking. Philippe DeGouttes indicated that Airbus, and other industry representatives try to look at easy ways to harmonize.

Discussion items included inclusion of FAA's opinion in preamble language when there is disagreement, and having more dialogs between FAA and the working groups. Other items included the use of FAA representatives as chair for some working group especially when looking at controversial issues, having the FAA write rules of engagement in TORs, and the burden placed on working groups to do economic assessments.

Continued Airworthiness Assessment Methodology Working Group

Mr. Bolt summarized the task and indicated that the report (handouts 5 and 6) had been distributed to ARAC in August. Mr. Kelley-Wickemeyer raised the issue of the working group's recommendation that it be chartered, and questioned whether members could accept a portion of the report, rather than all of it. Mr. Bolt indicated that he would note the working group's recommendation in the transmittal letter. Members then voted unanimously to forward the recommendation to the FAA.

Loads and Dynamics HWG

Larry Hanson distributed a working group status report (Handout 7). Mr. Bolt indicated that the committee should take a hard look at the working group's tasking in view of earlier discussions.

Item	Discussion
25.865	--New material being used in engine mounts --Problem discerning what is fireproof? --Evaluation criteria with minimum cost to see if material is acceptable --Working group trying to set criteria to assure minimum cost of material is acceptable
TOR for Ground Handling, Towing	--Aimed at next generation of ultra large aircraft and current regulations applicability to those aircraft
TOR for Landing Descent Velocity	--What does increase rate of sink means to larger aircraft? --What is impact to design requirements?

	--Is it a data fishing expedition --Nature of landing gear sink rate incident problems? --Source of task determined to be JAA initiative. Mr. Sulocki to check out history
Work Plan for Flight Loads Measurement	--Current procedure is inadequate --Lack of consistency in manufacturers; no safety factor; no evidence of improper validation loads; essential element is variation of application rate --Supported by industry --Mr. Wickemeyer convinced that it is more appropriate in SAE issue rather than ARAC --Working group has draft advisory circular that can be cleaned up to address all issues --TAE member agreed to continue with tasking (handout 8); Mr. Wickemeyer dissented because of task and urgency implied in the work plan
NPRM Phase 4 Review	--Some tasks have been at FAA for 2 years --Economic evaluation form is an issue because working group members are not empowered to sign off on costs so letters have been sent to affected companies --About 2/3 manufacturers have responded; close to being completed --Manufacturer responses will be placed into FAA docket --Special conditions subject of coercion; doesn't justify Executive Order 12866 --Need to look at real life and see if additional costs are being incurred; compare regulation text --Mr. Hanson to send package to Mr. Bolt for transmittal to FAA (handouts 9 and 10)

Ice Protection HWG

Jim Hoppins, new chair, reported by telephone; a status report was distributed electronically (Handout 11). After summarizing the status report, Mr. Hoppins questioned the level of detail needed in the concept plan; Mr. Bolt indicated that a rough guideline of the working group's intent would be sufficient. Discussion items addressed insufficiency of US and Canadian data and disagreement within working group on icing phenomena in supercooled large droplets.

Design for Security HWG

Mark Allen distributed a status report (Handout 12), and indicated that the working group's taskings would be finished by the year's end. He provided the following updates:

Item	Discussion
Flight Deck Smoke Protection	--Airflow boost: changes certain amount of airflow into cockpit --MMEL requirement: currently fly with one air pack inoperative --No reduction of airflow to passenger compartment; working group reconsidering stance
Cabin Smoke Extraction	--Air pack MMEL: 4 minutes air change throughout cabin; will not occur with one air pack --Amount of air thrown out of cabin is arbitrary; doesn't seem to support requirement --Accounting for CO_2 allows two ways to meet intent of rule --Mr. Bettcher indicated that flying with 1 air pack is not unusual and that contacts for smoke concentration specialist have undergone reversal now
Systems Survivability	--Changed from requiring system separation to anywhere in compression system --Areas of special consideration include flight deck and e/e-bay; still need as much separation as possible
Cargo Compartment Fire Suppression	--How much deflection needs to be mandated? --Shielding on system
Least Risk Bomb Location	--No change expected --FAA has agreed to test proposed alternative --Concern if door not used. What is requirement? Working group can't agree on what requirement should be

	--Mr. Sulocki questioned the procedures for moving bomb; on JAA side, procedures are for not moving bomb
Design for Interior Search	--Minor changes from last report --More difficult to hide added; more areas to look at
Protection Resistance	--No further work
Flight Deck Intrusion	--Minor changes only --Expect to present report at December meeting --Coordination needs to be done through Electrical Systems HWG to Wiring system regarding separation of systems --Method of installing wire inside shielding --When is input to ICAO due? FAA International Group; Jeff Gardlin providing information for this and ICAO Annex 6

Powerplant Installation HWG

Andrew Lewis-Smith distributed a status report (Handout 13), and provided the following updates.

Section	Discussion
25.1187/863	--Safety related: how to protect broken fuel lines and pipelines from flames --Category 1
25.904, Appendix I	--Category 3 --Safety related: If you lose engine in critical flight would you be able to boost other engine? --Would be able to certify unique design requirement --No smoking hole if not installed --Addresses existing requirements --Mr. Sulocki expressed concern about the merits of the discussion because Better Plan is in place. Mr. Bolt

	responded that discussion was informational only for TAE members; would not be stopping any of the taskings in place
25.903(d)	--Evaluating path of fragments and mitigation --Original tasking closed; work being done in anticipation of future tasking
25.975	--Working group awaiting feedback from FAA representative
25.1309	--TOR being drafted

Mr. Sulocki requested clarification on tasking for §§ 25.1187 and 25.863; the difference is in how the sections are interpreted.

Engine HWG

Mr. Bolt indicated that two taskings had been recently sent to EXCOM—Bird Ingestion Phase II (§ 33.76) and Critical Parts Integrity Rule (handouts 14 and 15)). All other working group tasks are with the FAA.

Electrical System HWG

Mr. Bolt indicated that all the working group tasks are in phase 4 mode (Handout 16). ESHWG has been asked to support the Aging Transport Systems Rulemaking Advisory Committee, and, as a result is meeting with the Committee's Wiring System HWG. The working group appears to be on schedule, and is heavily focused on organizing part 25 and bringing all the little parts together. Mr. Sulocki indicated that there was good cooperation within the working groups. ATSRAC rulemaking will start in November.

Flight Tests

The working group has completed its taskings and has reviewed several projects under phase 4. The FAA is coordinating internally a TOR addressing § 25.177(c), but the TOR has not been coordinated with the harmonization management team.

Electromagnetic Effects HWG

No planned taskings. FAA Office of Policy is still working on the economic evaluation for HIRF.

Seat Test HWG

The working group has completed all its taskings.

ETOPS Tasking Update

Mr. Bolt indicated that the working group is running slightly behind schedule, and is taking certain actions to catch up (Handout 17).

Human Factors Report

No report provided, but Mr. Sulocki requested an update. Mr. Bolt indicated that he would followup with Curt Graeber for an update.

Airworthiness Assurance Working Group Report

Mr. Bolt indicated that the group's work plan for the multiple STC task would be sent electronically for members' approval.

Flight Control HWG Report

Mr. Bolt reminded participants of the committee's earlier decision to hold work product for § 25.671 pending a decision on § 25.1309.

Flight Guidance System HWG

A working group activity report was distributed electronically before the meeting (handouts 18 and 19). Mr. Bolt indicated that the working group is trying to wrap up everything by December. Discussion items included the working group's format for soliciting manufacturers' data to support economic considerations; the role of ARAC members in request for economic data, and the impact of the Changed Product rRule to the working group's task. The minority opinion addressing § 25.1329 (included in the handout) was also discussed;addressed; Mr. Huber indicated that the minority opinion might be eliminated with a caveat about the cost of the rule

Members further commented on giving the responsibility of economic assessments to working groups. Negative comments included the task being "extremely wasteful" of resources, and "working group members doing work without the proper background." Mr. Fazio indicated that the questions for collecting the data are general in nature, and that the intent is to collect data; working groups are not expected to conduct analysis. Mr. Hanson indicated that the format being used by the Loads and Dynamics HWG assessment is vastly different from the questions being used by the Flight Guidance SystemControl HWG. Mr. Kelley-Wickemeyer indicated that industry might be the proper place to look for data since FAA economist are often directed to industry for source of information that it uses.

Mr. Huber indicated that the FAA could customize the questions for each working group; he also took an action to address the differences in the formats being used by the FGSHWG and LDHWG,

Mr. Bettcher indicated that ALPA might have a minority position for § 25.1329. The position addresses overspeed protection during the altitude hold mode. He indicated that ALPA would work through its working group representative.

Mechanical Systems HWG

Steve Happenny presented the work plan addressing taskings related to §§ 25.831(g) and 25.841(a) (handout 20). Discussion items included industry concerns regarding § 25.831(g) (temperature/humidity vs. time and difference between FAA standard and NIOSH standards) and § 25.841(a) (cabin altitude resulting from cabin decompression can't be over 40,00025,000 feet and the FAA's near term position not to raise the limits).

Members approved the work plan unanimously following a discussion involving allocation of resources, certification of older planes to fly at 40,000-foot altitudes, having representatives from the medical community participate in the working group (look for representatives from NASA, U.S. Air Force, NIOSH, CAMMI CAMI, and academia), and participationinclusion of Engine HWG members in the MSHWG group,

Mr. Bolt indicated that the recommendation addressing the § 25.1438 tasking had been returned to the working group for a phase 4 review. He indicated that the FAA had changed the recommendation submitted by the working group but had not indicated the change in the preamble. Members debated the purpose of the phase 4 review, the lack of a FAA minority opinion in working group reports, and how the FAA should document its changes (working group should not have to ferret FAA changes).

The FAA's right to make changes to document submitted by working group was also discussed. Mr. Bettcher noted that the ARAC Procedures ("Green Book") should acknowledge the industry resources committed to recommendation/products and should express that no significant changes would be made without consulting with the working group.

Systems Design and Analysis

Mr. Bolt's provided a brief description of why the working group was meeting after having turned in a recommendation to the FAA over 2 years ago and why the FAA had requested the TAE to reform the group to discuss specific risk. Keith Barnett indicated that a mixture of people had attended the August Paris meeting, including members of the DandF study group and some of the original members of the § 25.1309 working group. Mr. Barnett indicated that meeting attendees agreed that there is "worth and value to having discussion with the FAA and a need to take the process further and develop something mutually acceptable.

Discussion items included addressing FAA legal revisions (some revisions change the working group's intent) and the possibility of the TAE overstepping 49 USC for part 25. Aircraft deviations under certain failure modes, and schedule for working group (phase 1 would take 6 months to 1 year) were also discussed. Other items included type of report that working group would generate, application of § 25.671, and components of Mr. Huber's briefing to FAA management. Mr. Sulocki indicated that the JAA planed to publish its final rule comments on 25.1309 in November; JAA plans to proceed along path laid out at the Paris meeting, i.e., 2-phase report to be completed in 6 months.

Members agreed on a two-phase form:

Phase 1	**Phase 1**
--will not need to be retasked --will address rulemaking issues --will stick to original ARAC recommendation with discussion on qualitative deviations	--will need to be tasked to ARAC --will include discussion on full blow deviation

Members agreed unanimously to positively encourage and support the two-phase approach.

Avionics Systems HWG

No report provided; the working has completed all its tasking, except for phase 4 review. Some 25.1322 issues are being coordinated with the HFHWG and JSIT activities.

Wrapup

Mr. Bettcher indicated that Jim Wallace would be replacing him as ALPA's ARAC representative. Mr. DeGouttes indicated that he would become the alternate ARAC representative, and that Rolf Greiner would become the primary ARAC representative.

The next TAE meeting will be held December 4-5 in Washington, DC.; location to be determined.

Mr. Bolt said that he would send the proposed meeting dates for 2002 out electronically. He also invited members to consider shortening number of yearly meetings to three.

Public Notification

The *Federal Register* published an announcement of the meeting on August 27 (Handout 21)..

Approval

I certify the above minutes are accurate.

Craig Bolt

Assistant Chair

Action Items

September 11-12, 2001

1. September 2001 Jim Bettcher to be sure ALPA representatives on Flight Guidance System HWG provide any potential minority opinions before September 24 FGSHWG meeting.
2. Chuck Huber to confirm which of the two economic evaluation forms that the working groups have should be used.
3. Chuck Huber to further investigate the FAA's technical rationale for changes to 25.1438 and recommend path forward. Additionally, need to insure preamble properly reflects rationale for any changes made to document.

4. FAA to review priority of any proposed new taskings and coordinate with JAA. FA to ask TAEIG support as needed.

Transport Airplane and Engine Issues Group Meeting

Doubletree Hotel Seattle Airport

18740 International Boulevard (Route 99)

Cascade Rooms 5 and 6

Seattle, Washington

DRESS: BUSINESS CASUAL

Tuesday, September 11, 2001 - 8:30 AM Call in number :202 493-2730

8:30	Call to Order, Reading of the Procedures Statement, Review of Agenda, Review of Minutes, Meeting Logistics, Review of Action Items, Items of Interest	C. Bolt/C. Huber
8:50	FAA Report	C. Huber

9:00	JAA Report	T. Sulocki
9:15	Transport Canada Report	No report scheduled
9:16	Excom Report	C. Bolt
9:30	Harmonization Management Team Report	T. Sulocki / C. Huber
9:45	**-- *BREAK* --**	
10:00	Review Proposed New Tasking List/ARAC Process Discussion	FAA / TAEIG/Tony Fazio
11:00	Continued Airworthiness Assessment Methodology WG Report	S. Knife

- Review and Agree HWG Report

11:30	***-- LUNCH --***	
12:30	Loads & Dynamics HWG Report • Review and Agree Work Plan for 25.301 (b) Task • Review FAA Economic Review Questionnaire for Various Tasks	L. Hanson
1:00	Design for Security HWG Report	M. Allen
1:30	Ice Protection HWG Report	J. Hoppins
2:00	Engine HWG Report	C. Bolt

2:15	-- ***BREAK*** --	
2:30	Human Factors HWG Report	No report scheduled
2:31	Powerplant Installation HWG Report	A. Lewis-Smith
3:00	Electrical Systems HWG Report • ATSRAC Update	FAA / B. Overhuls
3:30	Flight Test HWG Report	FAA
3:45	Electromagnetic Effects HWG Report	FAA
4:00	Seat Test HWG Report	FAA

4:15	ETOPS Tasking Update	C. Bolt
4:30	***-- ADJOURN --***	

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<u>Wednesday, September 12, 2001</u> ***Call in number :202 493-2723***

8:30	Call to Order/Approval of Minutes from June 2000 meeting	C. Bolt/J. McGraw
9:00	General Structures HWG Report	A. Hoggard
9:30	Airworthiness Assurance HWG Report • Review and Agree Work Plan for Multiple STC Task	A. Hoggard
10:00	***-- BREAK --***	

10:15	System Design and Analysis • Review Results of August Team Meeting	FAA / Keith Barnett
11:00	Mechanical Systems HWG Report • Review and Agree Work Plan for 25.841(a) and 25.831(g) Task	S. Happenny (FAA)
11:30	Flight Guidance System HWG Report	Written Report
12:00	-- ***LUNCH*** --	
1:30	Flight Control HWG Report	L. Schultz

1:45	Avionics Systems HWG Report	C. Badie
2:00	***-- BREAK --***	
2:15	Review Action Items/ Meeting Schedule	
2:30	***-- ADJOURN --***	

Working Groups Under TAEIG - Open Taskings

Transport Airplane and Engine Issues Group

FAA Part 21, 25, 33, 35
JAR 21, 25, E, P, Subpart J

Legend:

Presently Tasked: | **To be Tasked:**

Powerplant Installation Harmonization Working Group
F.A. Lewis-Smith - Boeing
O. Grimand- Airbus

- • 25.1187/25.863
- • 25.1193(e)
- App I
- Notice 84-17A
- 25.973
- 25.1181(b)
- 25.1305(a)(7), (d)(2)(1)
- 25.975
- 25.903(d)

Engine Harmonization Working Group
J. McRoberts - Allison
F. Fagegaltier - JAA

- • 33.17
- • 33.19
- 33.28
- • 33.75
- • 33.84
- • APU
- • OEI Shafts
- 33.27
- FAR 35/ JAR-P
- Bird Phase II
- Critical Parts

Design for Security Harmonization Working Group
M. Allen- Boeing

- ICAO Annex 8 Flight-Deck Intrusion

Loads & Dynamics Harmonization Working Group
L. Hanson - Gulfstream

- 25.415
- • 25.865
- 25.994
- 25.471/ 25.519
- 25.301

General Structures Harmonization Working Group
A. Hoggard - Boeing

- 25.603
- • 25.571
- • 25.631
- • 25.365(d)
- • 25.1529
- • Appendix H Part 25
- 25.776(b)
- 25.683

Electromagnetic Effects Harmonization Working Group
O. Spiller - Airbus
J. Cross - Raytheon

- • 25.1317
- • 25.1316

Flight Controls Harmonization Working Group
L. Schultz - Boeing
P. Traverse - Aerospatiale

- • 25.671
- • 25.671(c)/25.672

Continued Airworthiness Assessments Working Group
S. Knife - GE

- AC 39-XX

Human Factors Harmonization Working Group
R. Curtis Graeber - Boeing
D. Ronceray - Airbus

- 25.HF

Flight Test Harmonization Working Group
F. Iannarelli - Aerospatiale
R. Park- Boeing

- 25.1001
- 25.177
- 25.207
- Min.Maneuver Speeds

Systems Design & Analysis Harmonization Working Group
J. Ackland - Boeing
J-C. Rouquet - Aerospatiale

- 25.1301
- • 25.1309
- • 25.1310

Electrical Systems Harmonization Working Group
B. Overhuls - Boeing
R. Bewsey - JAA

Avionics Systems Harmonization Working Group
C. Badie - Honeywell
R. Lauta - Aerospatiale

- 25.1322
- AC 25-11

Mechanical Systems Harmonization Working Group
K. (Pat) Waters - Boeing
H. Asshauer - Airbus

- 25.831
- 25.841

Flight Guidance Harmonization Working Group
J. Ackland - Boeing
J. Beale - BAE

- • 25.1329
- • 25.1335

Ice Protection Harmonization Working Group
J. Hoppins - Cessna
C. Laburthe - Airbus

- • 25.1419
- • 25.1093
- • 25.929

Airworthiness Assurance Harmonization Working Group
A. Carter - Delta
G. Gopinath - Boeing

- Complex STC

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• *Indicates SBD items*

Legend:

FAA Actions Pending	FAA Actions Completed

Working Groups Under TAEIG - Completed Taskings

FAA Part 21, 25, 33, 35
JAR 21, 25, E, P, Subpart J

Transport Airplane and Engine Issues Group

Powerplant Installation Harmonization Working Group
F.A. Lewis-Smith - Boeing
O. Grimand - Airbus

FAA Actions Pending	FAA Actions Completed
• 25.901(c)(d) 25.903(d)(1) 25.903(e) • 25.905 • 25.933(a)(1) 25.934 25.943/25 x1315 25.1091 • 25.1093 (b)(1)(ii) 25.1141 • 25.1183(c) 25.1189(a) 25.1155 FAR 1	AC20-128A Phase I • 25.929 25.1103

Engine Harmonization Working Group
J. McRoberts - Allison
F. Fagegaltier - JAA

FAA Actions Pending	FAA Actions Completed
	33.64 • 33.76

Mechanical Systems Harmonization Working Group
K. (Pat) Waters - Boeing
H. Asshauer - Airbus

FAA Actions Pending	FAA Actions Completed
25X.1436 • 25.1438 25.1453 • 25.677(b) • 25.729 • 25.773(b)(2)(b)(4) • 25.1439 25.851(b)	

Seat Testing Harmonization Working Group
N. Calderone - Boeing
J.P. Deneuville - JAA/DGAC

FAA Actions Pending	FAA Actions Completed
• 25.562 • 25.785(b) (c)&(e)	AC25.562-1A

Loads & Dynamics Harmonization Working Group
L. Hanson - Gulfstream

FAA Actions Pending	FAA Actions Completed
25.305 25.34(b) 25.1517 25.371 25.721 25.775(b)(d) • 25.963(d) 25.331(c)(1) 25.302 25.331(c) 25.335 • 25.361/362 25.493(d) 25.723(a) AC25.491-1	25.335(b)(2) 25.341 25.345 25.561 25.629 25.351(a)(1) 25.371 25.427 25.473 25.479 25.483 25.493 AC25.629-1A

General Structures Harmonization Working Group
A. Hoggard - Boeing

FAA Actions Pending	FAA Actions Completed
AC25.775(d) 25.307(a) 25.603 25.613 25.621 25.683 25.783 25.963(e)(g)	AC25. 571

Electromagnetic Effects Harmonization Working Group
O. Spiller - Airbus
J. Cross - Raytheon

FAA Actions Pending	FAA Actions Completed
• 25.581	

Direct View Harmonization Working Group
D. Klippert- Boeing

FAA Actions Pending	FAA Actions Completed
Flight Attendant Direct View AC	

Hydraulic Test Harmonization Working Group
J. Draxler - Boeing

FAA Actions Pending	FAA Actions Completed
25.1435	

Flight Test Harmonization Working Group
F. Iannarelli - Aerospatiale
R. Park- Boeing

FAA Actions Pending	FAA Actions Completed
25.101(c)(2) 25.103 25.107(e) 25.111(c)(4) 25.121 25.125 • 25.1419 • 25.147(c) 25.161(c)(2)(e) 25.175(d) 25.177(a)(b) 25.177(c) 25.207 • 25.253(a)(3) • 25.253(a)(5) 25.1323(c) 25.1527 25.1583(c)(f) 25.1585 25.1587 25x1516	25.109(a) 25.113 25.143(c)&(f) 25.149 25.201 25.203 25.145(c) 25.1501 25.1583(k) 25X1591

Brake Systems Harmonization Working Group
R. Amberg - Boeing

FAA Actions Pending	FAA Actions Completed
• 25.735 25.731	

Electrical Systems Harmonization Working Group
B. Overhuls - Boeing
R. Bewsey - JAA

FAA Actions Pending	FAA Actions Completed
• 25.1351(b), (c)(d) 25.1353(a), (c)(5),(c)(6), (d) 25.1355(c) 25.1357 25X1360(a)(b) 25X1362 • 25.1431(d) • 25X.899 25.869(a) 25.1309 25.1310 • 25.1363	

Emergency Evacuation Issues Group
B. Glover

FAA Actions Pending	FAA Actions Completed
25.787 25.791(a) to(d) 25.810 25.811 25.819 • 25.813(c)	

Cargo Class B & Comp. Harmonization Working Group
D. Klippert(Retired) - Boeing

FAA Actions Pending	FAA Actions Completed
25.857(b)	

Avionics Systems Harmonization Working Group
C. Badie - Honeywell
R. Lauta - Aerospatiale

FAA Actions Pending	FAA Actions Completed
• 25.703(a)&(b) • 25.1333(b) 25.1423 25.1331 25X1328	

Airworthiness Assurance Harmonization Working Group
A. Carter - Delta
G. Gopinath - Boeing

FAA Actions Pending	FAA Actions Completed
Repairs WFD Report WFD	AC 91-56

For recordkeeping purposes:

Emergency Evacuation Issues Group still remains an active issues group

• *Indicates SRD items*

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Items of Interest Since June 2001 Meeting

1. Publication of AC 25.723-1 Shock Absorption Tests, May 25, 2001.
2. Publication of AC 25.1435-1, Hydraulic Systems Certification Tests and Analysis, May 21, 2001.
3. Publication of AC 33.28-1, Compliance Criteria for 14.CFR33.28, Aircraft Engines, Electrical and Electronic Engine Control Systems, June 29, 2001.
4. New Tasking to General Structures HWG, 25.603, Federal Register, August 7, 2001.
5. New Tasking to Mechanical Systems HWG, 25.831(g) + 25.841(a), Federal Register, July 26, 2001.
6. TAEIG Letter to FAA, Aging Aircraft Program (Widespread Fatigue Damage), June 29, 2001.
7. TAEIG Letter to FAA, Icing Task 1 Part 25 Rule Report, June 29, 2001.
8. TAEIG Letter to FAA/JAA/Transport Canada, Design for Security HWG, Future Enhancements in Design for Security Regulations, June 29, 2001.
9. TAEIG Letter to FAA, ARAC Report, FAR 25.851(b), Cargo Compartment Fire Suppression Systems, June 29, 2001.
10. TAEIG Letter to FAA, Proposed NPRM 25.1438, July 2, 2001.
11. TAEIG Letter to FAA, ARAC Recommendation Class B and F Cargo Compartments, July 2, 2001.
12. TAEIG Letter to FAA, ARAC Report, FAR 25.415, Ground Gust Conditions, July 18, 2001.

Handout 3

June 2001 TAEIG Action Items

1. Jill DeMarco to get copies of APO book on economic analysis needs to each WG.
2. Chuck Huber to send list of contacts in FAA to replace Kris Carpenter.
3. Chuck Huber to work to see if prioritized list of future tasks can be provided to TAEIG. Target Date – August 10
4. FAA to provide regular updates on status on backlog of items in FAA system and what may be done to improve process and reduce backlog.
5. C. Bolt to send Chuck Huber a letter requesting explanation of the changes FAA made to ARAC recommendations on 25.1438. – Closed
6. Design for Security WG to prepare briefing paper regarding logic of selection of min size aircraft selection of 60 passengers and 45,500 kg instead of ICAO proposed 30 passengers and 25,000 kg. C. Bolt to provide to Chuck Huber, Thaddée Sulocki, and Maher Khouzam. – Closed
7. C. Bolt to send copy of March 2000 Design for Security handout to Chuck Huber so it can be reviewed to determine if access to this document should be restricted.-Closed
8. Chuck Huber/Thaddée Sulocki to review proposed tasking for 25.603 and determine if this is a priority use of ARAC resources.
9. Brenda Courtney to look for examples of economic analysis requirements that could be provided to LDHWG as guidance for level of detail required.
10. C. Bolt to discuss with John Acklund the statement in the cost analysis questionnaire regarding the phrase "perceived vulnerabilities". After this is clarified, C. Bolt/ J. Acklund to send questionnaire, NPRM and AC to industry members of TAEIG to complete cost analysis form.
11. Keith Barnett to determine if one of the Bombardier nominees to the SDAHWG to act as temporary chair and organize first WG meeting prior to September TAEIG. Consider having in conjunction with August JAA D and F study group.
12. Bob Robesen to see if Cessna (Nick Andersen) can provide a member for SDAHWG.
13. C. Bolt to provide chair of SDAHWG the desired TAEIG agenda for first Working Group meeting.

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Subject: CAAWG Task Completion

Date: August 24th 2001

to: C Bolt

Dear Craig

I am happy to report that the Continued Airworthiness Assessment Working Group has completed the task of dispositioning the comments to draft AC39-XX. Consensus was reached on all points. I enclose a final status report and also our Task Group report, to be forwarded to TAEIG for their consideration.

I would request TAEIG, at their next meeting, to approve this report and forward it to the FAA.

Regards, Sarah

S Knife, PhD
CAAWG Chair

Handout 5

CAAWG Disposition of Public Comments to Draft AC 39-XX

Background

The Continued Airworthiness Assessment Working Group was tasked in December 2000 by the FAA, through ARAC, with the following:

> Reviewing the comments received to the Notice of Availability of proposed Advisory Circular AC 39.XX.
>
> Providing recommendations and advice on the task.
>
> Dispositioning comments considered inappropriate for incorporation into the AC.
>
> Making recommendations for revised language, in paragraph form, to address those comments with merit.

The following material completes this task.

General comments

GENERAL COMMENT 1

Several commenters indicate that the intended audience for this AC is not clear, as follows:

> "Who is this Advisory Circular aimed at, the ACO or Manufacturer/TC Holder (Applicant)? Typically, AC's are targeted to the applicant to aid in their demonstration of compliance to the regulations. Guidance to FAA is typically contained within policy or orders. This AC appears to be aimed at the FAA certification engineers, not at TC holders attempting to develop an acceptable continued airworthiness program with the FAA. Recommend developing guidance that is "party neutral"
>
> "Paragraph (b) states that the goal of this AC is to harmonize the continued airworthiness assessment policy between the two Directorates. However, the document itself seems to be intended for the whole aviation community . We believe the goals of the AC need to be defined with more clarity."
>
> "It is not clear what aspects of the process will be done by the regulatory authority and what will be done by the manufacturer"

The Working Group agrees that this rule and AC is unusual, since it does not involve an applicant requesting a finding of compliance from the FAA. The rule simply describes action which the FAA may take, and the AC gives guidance on the circumstances where this action would be appropriate. The AC is likely to be used by the type certificate holder, for instance in developing control programs to be proposed to the FAA, and by the FAA in the assessment of such control programs. Therefore guidance should be provided which is appropriate to the FAA as well as to the TC holder. The Working Group recommends clarifying wording be incorporated into the AC "Purpose" as follows:

Note that the descriptive level of the CAAM process contained in this AC is aimed at the individual, whether from the FAA or the manufacturer, who is without extensive risk analysis experience. Some of the material within this AC will therefore seem very basic to the experienced analyst. Additionally, this AC recognizes that an analysis must sometimes be performed without the benefit of readily-available information from the manufacturer. Typically, it is expected that more specific information will be available to the analyst, thus eliminating the need for some of the process steps which are described.

While information may be provided by and the assessment performed by the applicant, decisions as to whether an unsafe condition exists, and the appropriate responses to that unsafe condition, are exclusively the responsibility of the Administrator.

GENERAL COMMENT 2

Many commenters express concern over the separate guidance given for the E&PD and the TAD in appendices 4 and 5. It is strongly felt by the commenters that separate processes would lead to conflict between Directorates and that the processes would not result in the same standards of safety. A representative sample of comments is given; listing each comment would be unduly voluminous.

> "The proposed AC …suggests that the risk to passenger analysis will be used on Part 25 issues and the CAAM principles will continue to be used for Part 33 issues. However, there is no clear language to how conflicts between the two approaches will be resolved"
>
> "There is some confusion regarding the applicability of the two different methodologies for corrective actions carried out by or for the TAD or E&PD. It is clear that for conditions associated with installation items not part of an engine or propeller type design, that TAD guidance would apply. However, it is not clear whether, for items that are part of the engine or propeller design, E&PD guidance would apply to the item as certificated or whether TAD guidance would apply to the item as installed. To prevent confusion and possibly unnecessary duplication of work, additional clarification is requested."
>
> "The importance of the question between competing requirements between the TAD and E&PD cannot be understated. In the event of disagreement between the two Directorates, which Directorate has the final authority?"
>
> "There is also an important question regarding if actions are being performed under the two Directorates are in fact being performed to an equal standard. There is an appearance that the requirements of the E&PD are more severe but also more objective and uniform …."
>
> "It appears there is some potential for conflict between Directorates since appendices 4 and 5 prescribe different processes for the two Directorates. The two processes do not appear to result in the same levels of conservatism. The process for conflict resolution should be clarified."
>
> "As presented in the proposal two risk analyses (injury to passenger and CAAM) will need to be performed on Part 33 issues. It is recommended that this approach be removed from the proposed AC and CAAM-like approach be consistently be adopted for Part 33 and Part 25 issues."
>
> "the responsibilities of the FAA-Directorates need to be clearly defined"

The Working Group agrees that the AC should not have separate guidance for TAD and E&PD. The Working Group has developed an approach which will enable both Directorates to use the same guidance. This approach, and the rationale for the approach are given in attachment 1 to this report.

The Working Group has received instruction that wording on inter-Directorate coordination is not appropriate for inclusion in the AC. However, the Working Group strongly urges the FAA to pursue a robust process for coordination between Directorates on policy and continued airworthiness issues.

GENERAL COMMENT 3

Several commenters and Working Group members express concern over the difference in philosophy between Directorates when establishing safety standards.

> "A probable outcome of managing an unsafe condition to a single injury is to skew the overall level of safety for different size airplanes. In our opinion, this would not be an acceptable situation."
>
> "The risk to passenger methodology as presented is dependent on aircraft size (passenger capacity), configuration (wing or fuselage mounted powerplants) or application (passenger or cargo) It could be extrapolated that there could be multiple risk to passenger management plans required for an unsafe condition and that different aircraft sizes could be held to widely different safety standards."

It appears from Working Group discussions that TAD is attempting to minimize the number of persons injured in accidents each year, whereas E&PD is attempting to minimize the number of accidents involving injuries. This produces significant differences in approach for the largest and smallest airplanes. Both Directorates believe that their approach is sanctioned by Executive Order 12866, stating " *in choosing among alternative regulatory approaches, agencies should select those approaches that* ***maximize net benefits (including*** *potential economic, environmental,* ***public health and safety***...) "

The difference in goals makes it difficult to reach consensus when producing a common process to be used by both Directorates. The difference in philosophies between Directorates lies outside the scope of this task, but the Working Group recommends that the FAA develop a common approach on defining "safety".

GENERAL COMMENT 4

One commenter states that the sequence and flow of the document is extremely confusing, and recommended redrafting to streamline it.

The Working Group agrees that the document layout is confusing, especially the numbering sequence of sub-paragraphs. It is almost impossible to determine the correct identification for a sub-sub-paragraph. Moreover, the numbering system provides no means to distinguish between paragraphs appearing in the introductory material (above the signature block) and paragraphs appearing in the body of the AC (below the signature block), since paragraph numbers are duplicated in these separate areas. The Working Group proposes that, at a minimum, all sub-paragraphs be identified at their beginning by the full number – such as 2,5,d, 2, rather than the current practice of simply denoting the subparagraph as 2 and leaving the reader to determine how the sub-paragraph fits into the document. Paragraph numbers assigned above and below the signature block should be different. The Working Group also recommends that the FAA acquire the technological infrastructure and resources to translate the FARs, associated advisory material and interpretation, into linked html documents. Appropriate use of hotlinks will then greatly facilitate document organization and promote accessibility and comprehension by the reader.

GENERAL COMMENT 5

One commenter points out that valuable information appearing in the Federal Register Notice of Availability, regarding the fact that the FAA is not obligated to use this methodology or to accept manufacturers analyses performed in accordance with this AC, does not appear in the AC. The commenter asks that these statements of intent be added to the AC itself.

The Working Group agrees. The Working Group proposes that the following wording be added to section 1 (Purpose):

> "*This proposed AC does not establish any requirement that the FAA must perform a risk assessment before issuing an AD, or that the FAA must wait to issue an AD until the design approval holder performs a risk assessment, or that the FAA must accept the findings of a risk assessment performed by the design approval holder. CAAM, as described in this proposed AC, assists the FAA in making decisions concerning the priority in which unsafe conditions should be addressed. The FAA may issue an AD for a particular unsafe condition before a risk assessment is performed, or without having an assessment performed at all.*".

GENERAL COMMENT 6

A number of comments advocate that the AC should be harmonized and that the scope of the AC should be expanded from propulsion systems to cover the whole airplane, or to cover multiple categories of aircraft.

The Working Group desires early publication of advisory material relating to propulsion systems and therefore supports a phased approach to developing advisory material of broader applicability. The Working Group is not tasked with harmonization and is tasked only to address Transport Category propulsion installations. The Working Group agrees that the next goal should be a harmonized, transport airplane-wide process, followed by development of a process applicable to multiple categories of aircraft. In order to provide a way forward to those objectives, the working group recommends that, upon completion of this task group's disposition of public comments to the draft AC, the FAA task ARAC with a project to develop an expanded, harmonized version of the current AC applicable to overall airplane continued airworthiness (airframe, systems, engines, propellers, appliances, parts, etc.) The Working Group is willing to accept the finalization and publication of the current AC with its limited applicability as a first step in completing an AC applicable to transport category airplanes with a target for completion of the broader harmonized AC as soon as possible.

GENERAL COMMENT 7

One commenter expresses concern that the AC process can not be used by other sectors of the industry, such as rotorcraft, since numerical data is not available to them on fleet exposure etc.

> "We have concerns that the FAA will use this same AD process on the General Aviation and Rotorcraft portion of the aviation industry.. Although the proposed AC 39-XX is noted as being applicable to Transport Category Airplanes, the FAA has in the past forced some of the same processes for Part 25 onto parts 23,27 and 29 aircraft. As an example, 25.1309 is being required on some rotorcraft certification.
>
> The processes being proposed are all based on having failure and exposure data available for analyses and decision making. These failure data relative to sections 21.3 are available for General Aviation and Rotorcraft, however, exposure data of flight hours, number of flights and number of passengers are not required to be reported on aircraft

operations other than those operations under part 121. These exposure data do not exist for the fleets of General Aviation and rotorcraft Aircraft since they do not operate under Part 121. The proposed AD process that requires determination of existing risk and predicted risk cannot be achieved for the General Aviation and Rotorcraft fleets without that data. Even the qualitative process described in the proposed AC 39XX is still based on the number of people at risk (data which is still lacking) if no AD is issued."

The Working Group agrees that this process would not be appropriate to rotorcraft or general aviation. The Rotorcraft Directorate uses other, existing methods to assess airworthiness. It is not intended that this AC be used for part 23, 27, or 29. Since the AC title specifically refers to Transport Category Airplanes, no change is recommended to the AC in response to this comment.

GENERAL COMMENT 8

One commenter requests that the FAA request ARAC undertake a project to further develop the AC and to disposition comments.

This task has been undertaken and completed by the Working Group.

Comments to Material above the Signature

COMMENTS TO 2. **RELATED REGULATIONS (CFR) AND READING MATERIAL.**

One commenter suggests that the basic certification/qualification requirements for aircraft, aircraft engines, propellers and appliances need to be listed as these are the basic Airworthiness Standards for the aeronautical products covered by FAR Part 39.

The Working Group does not agree. Referencing the basic Airworthiness standards as a group is not normal custom and practice, as they are assumed to be common knowledge. Furthermore the referenced regulations are those directly applicable to the AC.

One commenter questioned some of the references mentioned in "related reading material". This comment was subsequently withdrawn by the cognizant Working Group member.

COMMENT TO 3. **APPLICABILITY.**

Two commenters express concern that threats to persons outside the aircraft were to be considered. They point out that the environment outside the aircraft is impossible for the manufacturer to control and that mitigation of threats to persons outside the aircraft is in many cases impracticable. They also point out that the current Airworthiness Standards are silent on this point, and expressed concern that the continued airworthiness guidance should not hold products to a higher standard than that intended by initial certification.

The Working Group agrees that it may be impractical to mitigate certain threats to persons outside the aircraft. However, the Working Group notes that the scope of part 39 is not limited to conditions regulated by part 25. The Working Group is also aware of FAR 25 having been applied to certain hazards to persons outside the aircraft in the past. The Working Group recommends wording be added to the AC as follows:

"It is recognized that certain causes of serious injury to persons outside the aircraft cannot be mitigated by practicable changes to the type design. Examples, personnel (having disregarded cautions and warning markings/manual instructions) walking into turning propellers or being ingested.. Experience has been that many risks to persons outside the aircraft, such as the shedding of small components from the aircraft or engine, have been judged to be insignificant due to the low probability of persons being injured."

COMMENTS ON **DEFINITIONS.**

One commenter states that the proposed definition of continued airworthiness is vague and without adequate clarity to be understood by Authority or Certificate Holder. An alternative definition is proposed; "being in a state of continuous compliance with the applicable airworthiness standards appropriate to the certification basis for the product."

The Working Group concurs that the current definition does not clarify the role of continued airworthiness in relation to the product design standards. The Working Group does not agree with the definition proposed by the commenter . In some cases, the rules applying at the time of type certification were later found to be insufficient, and therefore the product may have complied with the letter of the rule while not meeting the intent. The Working Group proposes an amended definition which refers to the intent of the rule, rather than the actual rules used in the type certification basis, as follows:

> Continued airworthiness. *The ongoing activities associated with ensuring a product remains in compliance with the intent of the applicable product design standards.*

The Working Group also offers the following points for consideration on the relationship between initial certification and continued airworthiness: *It is normal and to be expected that the achieved level of safety of a product will vary throughout the lifetime of the fleet. This variation may result in some failure conditions occurring more frequently than permitted by initial certification requirements, in which case it is possible, but not necessarily the case that an unsafe condition exists. If the risk to the airplane, passengers or crew is very much greater than permitted by initial certification standards, an unsafe condition is likely to exist. In other words, there is an indeterminate area where a product no longer complies in some respects to certification standards, yet is not Unsafe. The product may, in this case, be returned to full compliance with the certification standards by normal product improvement programs, without the necessity to issue an Airworthiness Directive. Some assessment of the degree of risk is advisable if the failure condition rates significantly exceed those assumed or intended in the initial certification.*

One commenter questions the definition of "event", saying that the hazard level should be specified, since many in service events are well below the level of the CAAM guidelines.

The Working Group agrees that many of the events in service are low level. The hazard ratio is the tool for determining whether an event should be considered as potentially leading to an unsafe condition. The Working Group does not recommend a definition change in the AC as a result of this comment.

Several comments were made regarding the definition of the uncorrected event forecast, the corrected event forecast, the forecast event rate and the definition of serious injury. These comments were subsequently withdrawn by the cognizant Working Group member.

Two commenters disagree with the proposed definition of an unsafe condition; i.e., "A condition which, if not corrected, is reasonably expected to result in one or more serious injuries".

The Working Group considers the definition supports the intent that the appropriate assessment of risk is the threat to people.

One commenter proposes that "unsafe condition" be defined in FAR/JAR-1.

The Working Group notes that changes to FAR/JAR1 are outside the scope of the Working Group's task.

One commenter disagrees with the AC definition of an unsafe condition because it is not directly linked to the airworthiness standards for aeronautical products. The commenter is concerned that products might be held to a higher standard for continued airworthiness than for initial certification. The commenter states that the criteria for identification, prioritization and resolution of safety concerns should be consistent with the airworthiness standards.
The Working Group disagrees. While representing the "minimum acceptable level of safety" for certification, the certification regulations are also typically intended to provide the highest practicable standard of safety consistently attainable. Consequently, there is normally considerable margin between the standard of safety required for certification and the reduced level of safety associated with having an unsafe condition. Once the product enters service, problems may be encountered which will reduce the realized standard of safety over the short term, without an unsafe condition necessarily existing in the product. Control programs addressing these problems will, in due course, restore the product to the level of safety required for initial certification. Non-compliance with the initial airworthiness standards should not be presumed to imply that an Unsafe Condition exists. Further, unsafe conditions can be identified in service which were not adequately covered by the applicable airworthiness standards. In these instances changes to both existing airplanes and the airworthiness standards may be needed. However, the Working Group agrees that in general the continued airworthiness process should not be used to set a higher standard than that intended by initial certification.

Several commenters question the meaning of the phrase " reasonably expected" in the definition of an unsafe condition. They request clarification. One commenter questions whether the definition of "unsafe condition" addressed only severity or a combination of severity and probability.
The Working Group agrees that the term is subject to misinterpretation, and proposes that it be explicitly defined as follows:
Reasonably expected. A probability of occurrence acceptable to neither the long-term risk guidelines of this AC nor the intent of the applicable product design standards.

One commenter states that since turbofan engines have caused very few serious injuries, almost all future AD action could not be justified using this definition. The commenter cites the established FAA E&PD practice of controlling the potential for level 3 events which do not, inherently, involve injury.
The Working Group disagrees. The intent is that not only conditions which have actually caused serious injuries, but also those which are reasonably expected to do so, should be evaluated as unsafe conditions. "Reasonably expected " is defined above.

Several commenters note that the initial definition of an Unsafe condition does not appear to be maintained throughout the AC, but that broader and broader meanings of the term "unsafe condition " appeared to be used, to the point where the term becomes unbounded.
The Working Group agrees that this is a source of confusion. The intent is that the original definition of "Unsafe Condition" should be maintained throughout the AC. The Working Group recommends that elsewhere in the AC, the phrase "unsafe condition" be replaced by "potential unsafe condition" where it has not been determined that the condition is actually and in all cases Unsafe according to the definition.

COMMENTS ON **BACKGROUND.**

One commenter remembers the sequence of events differently from that stated in the background. The Working Group proposes a change in wording to accommodate different recollections regarding the CAAM committee process, as follows:
"It was decided to limit the scope of the effort to engines, propellers, and APUs installed on transport airplanes due to the availability of credible data."

One commenter requests redrafting of the following sentence, to clarify that the TAD certifies the installation but not the engine: *"Since the FAA TAD is responsible for the certification of engines, propellers and APUs as installed on transport category airplanes, identifying and responding to potential engine, propeller, or APU unsafe conditions often involves joint decision making by the two Directorates."*
The Working Group recognizes that the concept is a difficult one, but is unable to develop better wording.

Several commenters state that the listing of methods currently used to classify event severities is confusing, they appear to believe that this material offers four different approaches for use in continued airworthiness.
One commenter asks to have the methods used for initial certification removed, two commenters request that a "harmonized" common definition be developed. One commenter requests that existing (certification) methods be used so that continued airworthiness would be strongly linked to the Airworthiness Standards.
The Working Group disagrees. The listing of different methods appears in the section "Background", and offers perspective on the different approaches used to classify event severities. It is not intended that "continued airworthiness" should mean "remaining in compliance with all aspects of initial certification at all times", as has been discussed above, in the context of the definition of continued airworthiness. Initial certification is intended to mandate the highest possible safety standards for a new product; the intent of FAR 39 and this AC is to define how far, and for how long, a product may deviate from those high initial standards. It is therefore reasonable that a somewhat different approach be used for establishing event severities. The Working Group recommends that clarifying wording be added to the AC as follows: *"The reason certification classifications are not the focus of this AC is to avoid confusion as the acceptable levels of safety and risk assessment methods are different between certification and continued airworthiness."*

One commenter objects to the use of a disk burst example as an illustration of the application of Appendix 5, since a disk problem would be the province of FAA-E&PD. The commenter disagrees with the hypothetical event rate cited and the use of the term "catastrophic " when addressing an engine failure. The commenter expresses great concern over the potential for inconsistency between Directorates when addressing a given issue.
The Working Group agrees with the points made. The Working Group has developed a common process for use by both Directorates and all manufacturers, and therefore paragraph d), which is focused on the differences in event classification between Appendix 4 and Appendix 5, should be removed from the AC.

One commenter states that the flowchart does not add any value to the document . Another commenter remarks that although the AC goes into great detail on some aspects of an unsafe condition, it does not contain a concise and manageable methodology for determining when an unsafe condition exists.
The Working Group believes the flowchart is intended to perform this function. The Working Group notes that the flowchart was expressly requested by a significant portion of the prospective audience. However, the Working Group agrees that a succinct, high-level description of the process to be followed should be incorporated into the introduction. (See also General Comment 4.)

Comments to the main body of the AC

Comments to SECTION 1: ACQUIRE AND MONITOR AIRWORTHINESS INFORMATION
One commenter states that the audience for this section is not clear, since it does not reflect current business practice of manufacturers / operators working cooperatively, continually monitoring their fleets, identifying potential concerns and sharing the concerns with the authorities in both formal and informal reporting. Another commenter points out that TC holders are not obliged by regulation to perform any of the functions described in the AC, nor is it reasonable to create such an obligation without also requiring owners and operators of aeronautical products to share reports of failures, malfunctions and defects with the type certificate holder.
The Working Group agrees that the roles and responsibilities for exercising these functions are not clear. This material is intended primarily for ACO use; some steps may be performed by the manufacturer, in which case the process may vary to utilize the information/resources available. The Working Group proposes clarifying wording should be added to the AC (see general comment 1).

Two commenters question the practicability and value of monitoring component failures against the assumptions made in the initial certification analysis.
The Working Group notes that monitoring failure information, like any of the processes defined in this AC, is not mandatory. It is also noted that only a sample of failure data is likely to be available, either to the manufacturer or the FAA. However, it is likely that component failure rates which are orders of magnitude higher, or component failures with much more severe consequences, than assumed in the certification safety analysis will come to the attention of the analyst and may provide insight into the potential existence of an unsafe condition.
The following change in wording is therefore proposed to section 1:
"Monitoring the available data on failure conditions against the assumptions inherent in the original certification compliance, both for occurrence rates as well as outcome, allows for a proactive comparison of the safety-significant assumptions of certification with the actual situation in the fleet."

Comments to SECTION 2: IDENTIFY UNSAFE CONDITIONS
One commenter suggests a change in nomenclature, to distinguish between issues which may or may nor be unsafe conditions ("safety concerns"), issues which are unsafe conditions and merit an AD, and issues which were unsafe conditions but are now being controlled, by ADs, so that they are no longer unsafe.
The Working Group agrees that it is inappropriate to describe all three phases of an issue as an "unsafe condition". In response to this comment and in connection with the earlier comments on the "Definition of an unsafe condition", the Working Group recommends that this section be titled "IDENTIFY POTENTIAL UNSAFE CONDITIONS", and that all of the material in this section be reviewed, to distinguish between actual unsafe conditions and potential unsafe conditions. Specifically, sub section 2,2 should be reworded as follows:
"2. *There are at least three areas of information that can be used as a guide in identifying potential unsafe conditions. The first, and most visible, are the conditions which alone or in combination with other contributing factors have led to accidents. Such conditions or combinations have clearly been demonstrated to be unsafe. The second includes conditions that have significantly increased the probability of, but not directly caused, serious injuries. If such "contributing conditions" occur frequently enough, this too is an unsafe condition. In fact, the majority of ADs are intended to correct this type of unsafe condition. The third area of information involves hazards identified as part of the product's certification program.*"
The Working Group also agrees that once an acceptable control program has been instigated, the condition is no longer Unsafe.

One commenter questions the citation of human error as an example of an isolated event. Concern is expressed over human error which might be anticipated, as compared to gross negligence.
The Working Group considers that the example is intended to address extraordinary human error which could not be anticipated. The Working Group proposes a clarifying change in the wording, as follows:
"Recognizing the size and complexity of today's worldwide air transportation system, it would be unusual for an identified unsafe condition to be limited to a single airplane or engine. Examples of singular events where AD action would not be expected are those caused by gross negligence or a rare meteorological phenomenon."

One commenter expresses concern over the process of "assessing an unsafe condition against other products". This is felt to imply that each manufacturer would then be required to defend the reputation of each of their products with respect to an identified issue in a single product, and that this process would require disproportionate resources.
The Working Group agrees with the concern, and proposes a wording change as follows:
"Root cause problem assessments may identify concerns in other products of the same or similar type design or usage."

One commenter remarks that automated event, threshold level or trend alarms are not currently used for continued airworthiness.
The Working Group notes that these trend alarms are used by some organizations. No change is recommended.

One commenter asks that this section be removed as being redundant material.
The Working Group agrees that it is repetitive, but considers that it may be helpful to the inexperienced analyst. No change is recommended.

Several commenters note that the AC extends the scope of an unsafe condition to "conditions that can contribute to the probability of serious injuries". This would appear to promote ADs to remove all contributing conditions which could combine with an initiating malfunction to cause an injury. The commenters request guidelines or limitations on speculation as to what might contribute to an injury. The Working Group agrees, and recommends that the words "potentially unsafe condition" be used, and that phrasing be added to define the term "reasonably expected". (See comments under Definitions).

One commenter questions whether section 2,2 refers to all accidents or only to personal injury accidents. The Working Group notes that personal injury accidents are intended, as made clear by the initial definition of unsafe condition.

One commenter points out that not all hazardous effects may qualify as an unsafe condition.
The Working Group agrees, and reiterates the recommendation that section 2,2 refer to potential unsafe conditions rather than just unsafe conditions. This will eliminate the appearance that hazards identified as part of the certification program will necessarily turn out to be unsafe conditions.

Two commenters inquire how injuries resulting from turbulence or emergency egress should be addressed, since powerplant malfunction might have initiated the situation.
The Working Group notes that the means of addressing egress injuries might be divided between the TC holder of the initially malfunctioning equipment, the TC holder responsible for egress provision and the operator practices involved. It is therefore proposed that situations involving emergency egress injuries be negotiated on a case by case basis and the AC remain silent. The Working Group recommends that the ability to discriminate between life threatening and lesser injuries be provided by the following words:

> "*The risk guidelines are intended to cover exposures to the most severe of "serious injuries" (i.e., life-threatening injuries). Consequently, relaxation of these guidelines is acceptable in cases where the associated "serious injuries" are clearly not life threatening (e.g., simple fractures).*"

One commenter requests that the wording
"*For transport category airplanes in other types of service or with unconventional design features, these conditions may still be unsafe and should be assessed on a case by case basis.*" be replaced by "*For transport category airplanes engaged in missions not intended by design......*"
The Working Group does not agree. The proposed phrase does not reflect the intent of the AC. In order to reduce confusion, the Working Group recommends this subsection wording be changed to: "*For transport category airplanes, the FAA has defined certain specific conditions as potentially unsafe based upon previous service experience and relevant certification assessments*", dropping the second, confusing sentence.

One commenter states that the guidance on single failures in section 2,5 contradicts the definition of an unsafe condition.
The Working Group disagrees. The guidance is intended to remind the reader of certification standards, not to redefine the term "unsafe condition". However, the Working Group recommends a clarifying change in the wording as follows:
5a. Single failures. The type certification regulations limit the severity and frequency of single failures. Single failures that could result in a serious injury but are not expected to result in serious injuries to multiple persons are allowed by the regulations provided the frequency of occurrence is sufficiently low.

One commenter states that the guidance on single failures showed an unwarranted bias toward maintenance intervention, in the wording "*the results of the investigation may require AD action to implement more frequent monitoring...*" .The commenter points out the role of induced failure due to invasive on-wing inspections, and expresses concern that a forced inspection, if sufficiently frequent, might pose a greater risk of engine failure than the original subject of the AD.
The Working Group agrees, and recommends the wording be changed to "*more effective monitoring*".

One commenter states that the wording in this guidance on single failures is confusing.
The Working Group agrees and recommends the wording be changed to: "*When these failures or their precursors occur (e.g., a flaw is detected in a disk before the disk actually fails), the design of the component...*"

One commenter inquires whether an AD has ever actually been written to mandate a change in manufacturing method, as stated in the guidance.
One instance of such an AD is known to the Working Group, applied to a specific product. The Working Group agrees that referencing a change to a process is confusing and recommends deletion of the words: "*improved manufacturing methods*".

One commenter questions the realism of the statement that the installation design would be reviewed and considerations incorporated to minimize the effect of engine failures on the airplane.
The Working Group agrees that this would not be typical, and recommends the wording be changed to reflect a more general case: "*In addition, the design of the airplane is reviewed to ensure that the design covers the likelihood that these failures may continue to occur and the installation incorporates design considerations to minimize the impact of these failures on the airplane.*"

One commenter states that the material on latent failures, on cascading failures and on multiple failures deals only with certification standards and that the value of the paragraphs is not clear.
The Working Group considers that these paragraphs are intended to remind the analyst that single failures are not the only sources of unsafe conditions, and that the certification analysis may be helpful in identifying a potential unsafe condition for systems with complex architecture.

One commenter points out self-contradictory wording in the guidance on cascading failures, in that if the failure of one load path causes the failure of another, then they were not, by definition, redundant.
The Working Group agrees, and recommends the wording be changed to "*For example, in the structural design area, the failure of one load path should not result in loads that compromise the intended redundancy.*"

One commenter proposes that FAR 25.901 be cited as a source for safety assessment methods.
The Working Group disagrees, since FAR 25.901 does not contain guidance on such methods.

One commenter contends that engine overspeed is not a hazard, but that its consequences may be hazardous.
The Working Group concurs that engine overspeed is not of itself hazardous. The AC does not state that engine overspeed is hazardous, and so no change to the AC wording is recommended in this regard.

Several commenters question the appropriateness of the guidance given on In-Flight shutdowns, in the section addressing multiple failures and probability estimates. One commenter points out that there is no requirement during certification to demonstrate a low probability of multiple in-flight shutdown, and that the IFSD rate of "concern", 2E-4 IFSD/hour is well within historically acceptable norms. Another commenter points out that today's engines greatly exceed the reliability standard cited, and that therefore this guidance (of 2E-4 for an IFSD rate) is irrelevant to any realistic situation.
The Working Group notes that in the past there have been differences of opinion over whether a given IFSD rate is good, bad or the norm, and that citing a rate in this AC will be helpful in resolving such concerns. The Working Group recommends the wording be changed as follows: "*Engine shutdown rates below approximately 2E-4 failures/cycle should not be cause for concern.*"

One commenter expresses concern over the phrase " *it should be recognized that engine anomalies apparent to the crew in critical flight regimes may also lead to instances of inappropriate crew response due to increased stress and workload. Repeated exposure to these events increases the likelihood of an inappropriate response*" The commenter points out that both FAR 25 and FAR 33 assume or require that the failure of one engine in the most critical flight regime is a safe event.
The Working Group agrees with the concern. The AC is apparently attempting to address engine stall at V1, quiet autothrottle malfunctions and various other effects which have, in combination with inappropriate crew response, resulted in accidents in the past. The consistency of this wording with initial certification requirements is not clear, nor are the implications for continued airworthiness. The Working

Group recommends that if crew error is to be incorporated into the assessment of malfunctions, clear and specific guidance be given upon how to do so. The following wording change is recommended:
In addition, it should be recognized that certain engine anomalies during critical flight regimes have, on occasion, resulted in accidents due to lack of recognition or appropriate response to a single engine failure, especially in cases of very startling or very subtle failures. Excessive exposure to these events raises the possibility of an inappropriate response. Care should be taken in situations where certification assumptions of appropriate responses, and the timing of those responses, have been repeatedly called into question.

One commenter queries the definition of common mode failure, suggesting that "multiple dependent failures" is intended.
The Working Group disagrees. The intent is multiple otherwise independent failures occurring due to the same initiating event. The Working Group recommends the following clarifying change to the wording: "*multiple otherwise independent failures*".

One commenter queries the list of environmental factors in the causes of common mode failures. The commenter suggested that corrective action properly belongs at the source of the threat rather than by design action.
The Working Group agrees that volcanic ash concern is not likely to be remedied by design change and that "volcanic ash" should be replaced by "icing". The other environmental threats cited may be a concern in the event of a design deficiency, and the concern may also lead to a change in certification standards.

One commenter expressed concern over the identification of common cause maintenance error as a common mode concern, and the ability to address this concern by a fleet action plan.
The Working Group agrees that no clear means exists to address all instances of this threat. The Working Group recommends that the wording "currently" be deleted from the sentence "*There are currently no regulations specifying that any engine-related maintenance be conducted on only one engine at a time* …"

One commenter questions the validity of providing a list of structured methods and tools.
The Working Group recommends that the wording be changed to clarify that these tools are available, but need not always be used or usable. The Working Group recommends a wording change as follows: "tools that can aid in the process".

One commenter proposes that 25.901 be cited as well as 25.1309 in 5 d (1) of Section 2.
The Working Group agrees that 25.901 is directly applicable to propulsion systems, but it does not contain any safety assessment methods in the rule or AC. The Working Group recommends that the wording "the safety methods associated with 25.1309" is appropriate.

Comments on SECTION 3: DETERMINE APPROPRIATE RESPONSES TO IDENTIFIED UNSAFE CONDITIONS

One commenter asks for clarification of the circumstances under which the FAA would provide an exemption from the initial Basis of Certification. The commenter proposes a hypothetical situation in which only a small fleet is involved, so that the level 4 outcome is not anticipated to occur in the lifetime of the fleet (although the instantaneous probability may be higher than normally accepted). The cost of corrective action in these circumstances might not be economically reasonable.
The Working Group understands the concern, but believes that the reason for having a ceiling on the risk per flight is to protect any individual passenger from an unduly high risk. Small fleet size, therefore, does not automatically justify an exemption. However, the FAA may consider cost-benefit studies in determining the public interest.

One commenter asks for clarification of the meaning of the word "*outcomes*" in subsection 3.
The Working Group suggests that "outcomes" be replaced by "*airplane- level effects*."

One commenter asks for clarification regarding the validation of assumptions; the commenter suggests that data gathering would be one means to do this.
The Working Group agrees that data gathering to validate assumptions would be a normal part of the process. In the interim, action might be required based on more conservative assumptions.

One commenter remarks that the focus of the process must be quantitative. The comment supports the current wording of the AC in that respect, and so the Working Group does not recommend any change.

One commenter expresses concern at many points that the AC is heavily biased towards immediate and possibly ill-considered action.
The Working Group considers that this concern has been addressed by defining the term "reasonably expected" in the definition of an "unsafe condition". The Working Group also recommends that the title of the section be changed to "Develop and implement appropriate responses"

One commenter expresses concern over the example given for immediate action (thrust reverser deployment in flight). The comment was subsequently withdrawn by the cognizant member of the Working Group.

One commenter argues that the phrase "*Unsafe conditions that are not mitigated by contributing or conditional factors may require expedient action unless the root cause, failure distribution and risk can be confidently established*" places an unreasonable burden of proof upon the analyst at a very early stage in the process.
The Working Group agrees and proposes that the word "*confidently*" be replaced by "*reasonably*".

One commenter points out that the AC is incorrect in stating in this section "*The intent of these assessments is to ensure that an unsafe condition that represents the greater risk receives higher levels of attention and resources for its timely resolution than does one that represents a lower risk*". The wording describes the intent of the whole AC, rather than this sub-element of the process.
The Working Group agrees that it would be more appropriate in this section to say "*The intent of these assessments is to establish whether an unsafe condition exists and to ensure*".
The commenter also points out that the intent of the uncorrected risk forecast is mis-stated here. The Working Group agrees, and proposes that the following words be deleted from this section. "*Additionally, the intent is that the risk associated with each unsafe condition, during the time necessary to address it, are less than the applicable risk guidelines*".

One commenter maintains that elements of step 2 (Estimate the uncorrected event forecast) and 3 (Determine whether immediate action is necessary) duplicate each other, in the discussion of hazard ratios.
The Working Group agrees. The material on hazard ratios should be removed from paragraph 2, which was intended to address events, as opposed to the bottom line risk. The Working Group recommends a review of the whole AC for clarification and streamlining.

One commenter disagrees with the guidance regarding comparison of risks, since the risks should be compared to an objective standard.
The Working Group agrees, but acknowledges the need of the FAA to compare risks in order to prioritize activity. The Working Group therefore proposes the addition of wording as follows: "*Whatever exposure basis is used (flights or hours) it should be used consistently to allow the various risks being managed simultaneously to be compared to each other and the risk guidelines.*"

One commenter expresses concern that hazard ratios not be used inappropriately. One commenter requested that more specific material be provided on the development of hazard ratios.
The Working Group agrees, and proposes the following wording for incorporation into the AC:
"***HAZARD RATIO DEVELOPMENT.*** *Developing a hazard ratio will require considerable engineering judgment. The hazard ratio strongly influences the quantitative assessment results and, therefore, should have a sufficient validation basis or be assessed conservatively. Hazard levels are used for CAAM levels 3, 4 and/or 5, as is appropriate to establish the appropriate comparison of the risk of the unsafe condition to the CAAM guidelines.*

The following methods should be employed to establish the hazard ratio for a given CAAM level (X):

a. At least one level X or higher event has occurred.

1. Data. When at least one level X or higher event has occurred, use the value obtained by dividing the number of level X or higher events by the total number of events . If the latest event used in the calculation was not level X or higher, add one additional level X event, and one additional event to the totals (e.g., 1:4 becomes 2:5). The addition of another event is to provide an element of conservatism for the true value of the hazard ratio as estimated by the data to date. Alternatively, use the ratio obtained by counting only the events up to and including the most-recent level X event. This alternative should be used if the ratio of the number of level X events divided by the total number of events at the time when the last level X event occurred is lower than the ratio when one more level X event is assumed. For example, a history of 6 events, in the sequence 0 0 X 0 0 0, would result in a level X hazard ratio of 1:3 at the time the last level X occurred as opposed to assuming an additional event for a hazard ratio of 2:7.

2. Analysis. If analysis suggests the true hazard ratio, that ratio may be used. For example - for a particular airplane, a propeller blade will pass through the fuselage if it is released within a 90^o arc. The hazard ratio (assuming level 4 for serious injury to passengers seated in the plane of the propeller) would then be $90^o/360^o=0.25$ level 4 events given a blade release. This method has particular value where little data exists. Note: when the hazard ratio obtained by analysis is significantly different than what would be calculated from the observed data, it is strongly suggested that the observed data be used to establish the hazard ratio.

b. No level X or higher events have occurred.

1. Historical data. The Technical Report on Propulsion System and APU-Related Aircraft Safety Hazards provides hazard ratios for level 3 and 4 events. These historical hazard ratios should be used cautiously. The hazard ratio is installation dependent, and the historical hazard ratio may be skewed by the historical data available for the affected aircraft installation. Reading the summaries of the events from which the hazard ratios were developed will provide valuable insight into the applicability of the data. Some examples of the installation dependency of the hazard ratio are supplied here for illustration:

i. Engine separation. There are a large number of examples of engine separation in flight on older aircraft without adverse effects upon airplane control. More recent designs of aircraft, although designed with the same intent of allowing safe separation, have encountered difficulties after the separation of high bypass ratio engines. Separation of a wing-mounted engine may have very different consequences than separation of a tail-mounted engine.

ii. Uncontained rotor. The potential effect of an uncontained rotor depends largely upon the airplane systems in the plane of the rotor and their proximity to the engines. The effects may be very different for a wing-mounted installation and a fuselage-mounted installation.

2. Next event assumption. Where no level X or higher event has occurred, and no industry-wide data are available or suitable, a conservative hazard ratio may be established by assuming *the next event would be level X or higher (e.g., 0:4 becomes 1:5). There may be cases where this method is overly conservative.*

3. Analysis. As described above, engineering analysis may allow for accurate estimation of the hazard ratio.

Communication between the engine/propeller/APU manufacturer, installer, operators and the FAA is often necessary, especially if no appropriate historical hazard ratio is available. Additionally, it may be necessary to use engineering judgment to assess the impact of unique features of a specific powerplant or APU installation.

One commenter inquires whether step 5 (Estimate effects of candidate actions) should refer to injuries.
The Working Group agrees that the wording should be changed to: "*This is to consider their capacity to reduce the future risks to acceptable levels*".
The same commenter also remarks that the description of this step does not follow current business practice, in which the OEM will propose the candidate actions based upon data and FAA/operator input, with an assessment of risk reduction, to the FAA.
The Working Group disagrees; the AC does not specify who proposes the candidate actions and it is anticipated that the OEMs, FAA and operators will all cooperate in such an evaluation.

One commenter requests that the word "money" be removed from step 5b, due to legal sensitivities. The commenter also requests rephrasing to clarify that conducting a risk assessment is the expected norm.
The Working Group agrees, and proposes that the paragraph be reworded as follows: "*Resources are generally considered to be time, material (parts and inspection equipment), and labor. However, there are additional considerations such as shop capacity, parts distribution issues, operational disruptions and lost revenue. The extent of these required resources should be estimated to quantify the impact of the AD or other corrective action, such as improved training and interim non-AD actions, allow for timely provisioning, and aid in the determination of desirable tradeoffs between resources and risk. Depending on the analysis that has been performed, the number of replacement parts, shop visits, inspections, etc., may be available as output parameters. However, the results from the steps used to establish risk can likewise be used to estimate impact on resources. Data will often be required from the manufacturer(s), operators or both to aid in this process.*"

One commenter requests that "*replacement parts availability*" be explicitly listed as a consideration of resource requirements.
The Working Group considers that the concept is included in the term "*parts distribution*"

One commenter supports the AC guidance "*Prohibition of airplane operation based on an observed unsafe condition, pending determination of the root cause and appropriate corrective action, is typically an unnecessary level of conservatism.*" and asks that it be made stronger, since grounding airplanes is rarely appropriate or desired.
The Working Group agrees, and recommends the wording be changed to "*Prohibition of airplane operation based on an observed unsafe condition, pending determination of the root cause and appropriate corrective action, is rarely necessary...*"

The AC currently states; "*If a decision is made to not implement a candidate corrective action, the decision and its justification should be documented and filed for future reference.*" One commenter asks for clarification on the circumstances for which no corrective action would be taken for an unsafe condition.

The Working Group recommends a clarification to the wording as follows: "*If the FAA decides not to implement a particular candidate corrective action...*"

One commenter proposes that paragraphs d(1), d(2) and e should be replaced with two sentences: "*The process and results from the implementation of the corrective action plan should be monitored to ensure if it is effective. If the plan is not achieving acceptable results, then the plan should be modified to correct the deficiency*"
The Working Group considers that the current wording gives more detailed guidance, and should be retained.

One commenter suggests that the wording "*The FAA response to an unsafe condition should be based on a technical understanding of the problem and should require an appropriate implementation schedule ...*" have the word "*should*" replaced by "*will*".
The Working Group does not agree. The word "will" describes the optimum situation, but in some special circumstances, variation from the optimum will be unavoidable.

Two commenters raise concerns over the guidance on cumulative risk. They point out that there are no standards for an acceptable level of cumulative risk, that there would be difficulties in calculating such a parameter and that data does not support the contention that cumulative risk is an issue. One commenter asks whether the risk is to be assumed to accumulate through consecutive programs, and maintains that this approach would be statistically invalid.
The Working Group agrees that clarification is needed. The AC does not intend to suggest that consecutive programs increase risk, but to address the situation with many concurrent control programs. The Working Group proposes wording be added as follows: "*It is neither expected nor required to calculate cumulative risk nor track cumulative risk across the life of the fleet. The intent of this paragraph is only to provide recognition that acceptable risk levels should be regarded as upper limits*".

Several commenters request that section 3 be streamlined and clarified since it is currently very confusing.
The Working Group agrees, and recommends that this be done for the whole AC.

Comments on SECTION 4: LESSONS LEARNED.

One commenter states that the role of the manufacturers is not recognized in this section, and that it should be re-drafted.
The Working Group agrees that this section is written only from the FAA perspective, and proposes wording as follows: "*Centralized accessible repositories for CAAM "lessons learned" (e.g., risk models, hazard ratios, AD worksheets, etc.) are a valuable resource. As such centralized data repositories become available for general use, reference to these resources will be included in future revisions of this AC*".

One commenter suggests that additional material be included, as follows: "*Given that an unsafe condition is determined to exist, which is not adequately addressed by current Airworthiness Standards, an Airworthiness Directive will be issued and rulemaking action will be undertaken. In the interim, generic special conditions should be developed and imposed until such time as the new rulemaking actions are completed.*"
The Working Group agrees, and proposes this material be incorporated into the AC.

COMMENTS ON SECTION 5: ALTERNATIVE METHODS OF COMPLIANCE (AMOC)

One commenter asks for clarification of the term "*an equivalent level of safety*", including a formal definition and examples.
The Working Group notes that this term is widely used outside this AC and therefore feels it would be inappropriate to provide a definition which might then conflict with other equally valid usage.

One commenter questions the guidance on AMOCs. The comment was subsequently withdrawn by the cognizant member of the Working Group.

Comments on APPENDIX 1: HISTORICALLY UNSAFE CONDITIONS

Many commenters are concerned that the list of conditions in Appendix 1 appears to greatly expand the definition of an unsafe condition, effectively placing no bounds on what can be considered unsafe. Some of the examples are noted as being, in today's operating environment, much less unsafe than others. Concern is expressed that publication of such a list, without the accompanying hazard ratios, might be misleading; it is recommended by several commenters that the hazard ratios be developed and published with the list of conditions.
The Working Group agrees with the concern expressed. The Working Group recommends that the entire Appendix be removed from the AC. The Working Group recommends that an AIA/AECMA study group be tasked with collection of data to update the original CAAM data and also to develop hazard ratios for each condition cited in Appendix 1. The Working Group proposes that Appendix 1, with hazard ratios, be part of the report published by this AIA/AECMA group. The Working Group also recommends that Appendix 1 refer to a *potential* unsafe condition throughout.
If an updated CAAM report incorporating the Appendix 1 material is not available for reference by the time the AC is to be released, the Working Group recognizes that the FAA will proceed with inclusion of the best available information as Appendix 1.

Comments on APPENDIX 2: AIRWORTHINESS INFORMATION RESOURCES

One commenter explains that Appendix 2 does not reflect the business practice of OEMs, who may have much more detailed and accurate information relating to their own products than can be found in the cited databases. The commenter proposes that this appendix be removed.
The Working Group agrees that manufacturers may have other information, and recommends the following change: " ***PURPOSE***. *This Appendix provides a brief description of some airworthiness information resources that may be of use in supporting continued airworthiness assessments. More complete data may be available from the manufacturer.*"

Comments on APPENDIX 3: STRUCTURED ASSESSMENT METHODS AND TOOLS
One commenter is concerned that the material printed is too basic, to the point that anyone who needed this appendix would lack the necessary background to perform a risk analysis.
The Working Group notes that this AC is intended for a broad audience, and that much of the material will already be understood by an experienced analyst (see the note to this effect in the introduction).

One commenter requests that SAE ARP 5150 be cited in this appendix.
Since ARP 5150 is not yet published, the Working Group felt unable to evaluate its appropriateness. It is recommended that the citation of ARP 5150 be reconsidered once it is published in final form.

<u>Comments on APPENDIX 4</u>: ADDITIONAL ENGINE AND PROPELLER DIRECTORATE (E&PD) GUIDANCE

As stated in the general comments, the Working Group recommends that Appendix 4 be relocated to the main body of the AC, as explained in Attachment 1. Specific comments to the wording of Appendix 4 are, nevertheless, dispositioned here.

One commenter supports the guidance that the installer should be involved when assessing the hazard ratio (paragraph 6b) and asked that this guidance appear in the main AC.
The Working Group notes that similar guidance already appears in section 3.1(a)2.

One commenter asks for guidance on the calculation of flight exposure.
The Working Group agrees that clarification is required. The Working Group considers that the term "flight exposure" is intended to mean the number of flights that the fleet under assessment will accumulate in a given configuration. If the risk is reduced or eliminated from some part of the fleet, the flight exposure is reduced accordingly.

One commenter proposes that technical judgment play a major part in calculating hazard ratios.
The Working Group has prepared additional material on the calculation of hazard ratios.

One commenter questions the use of the wording " *Cumulative risk*" in section 8.
The Working Group agrees that this phrase should be replaced by "*aggregate risk*".

One commenter remarks, in the discussion of "reasonable risk", that the discussion of the relationship between CAAM levels and certification guidelines is technically incorrect.
The Working Group agrees and recommends that this material be removed. The Working Group also recommends a clarifying change to wording as follows: "*Event forecasts of 1.0 level 3 events in 100 million aircraft flights ($1x10^{-8}$) meet the long term acceptable risk target for part 33*".

One commenter asks for clarification of the sentence in section 9 "*These event guidelines should not be regarded as targets or typical values*".
The Working Group notes that it is explained earlier in the AC that the guidelines represent an upper boundary, and that it is not anticipated or desired that control programs will remain at the upper boundary.

One commenter is concerned about the guidance that "*critical failure modes should be managed to much lower level 4 event forecasts (risk factors) to minimize the cumulative effects of multiple unsafe conditions*" in that this does not provide a clear pass-fail criterion.
The Working Group agrees that each case is up to the discretion of the administrator, as explicitly stated in the introductory material.

One commenter requests that operators be involved early in the process of developing a model and Hazard Ratios.

The Working Group recognizes the concern of operators that they may be negatively impacted by a process into which they had no input. The Working Group recommends section 6 incorporate the following wording: "*agreement by consensus on critical assessment model inputs is essential, including validation of operational data by operators.*"

The Working Group also recommends the following wording be used in section 7: "*Communication between the engine/propeller/APU manufacturer, installer, operators and the FAA to determine the event hazard ratio assessment is necessary if no appropriate historical hazard ratio is available*".

Comments on APPENDIX 5 ADDITIONAL TRANSPORT AIRPLANE DIRECTORATE (TAD) GUIDANCE

As stated in the general comments, the Working Group recommends that Appendix 5 be removed from the main body of the AC, as explained in Attachment 1. The concerns expressed are, nevertheless, given here.

In addition to the concerns addressed earlier regarding different guidance between Directorates, many commenters believe that the approach proposed in Appendix 5, of forecasting the number of expected injuries, is completely unacceptable to industry. Commenters point out that this is unprecedented in current airworthiness standards and is equivalent to new rulemaking. Many commenters believe that this would lead to great difficulties in product liability lawsuits, that the FAA cannot protect this information under FOIA, and that OEMs do not enjoy the same immunity in this respect that Government bodies do. The FAA representatives to the Working Group did not have the same visibility of the concern.

The Working Group agrees with these concerns. The Working Group notes that FAA-TAD wishes to be able to distinguish between unsafe conditions involving local risks, involving a few passengers, and unsafe conditions involving whole-airplane risks. The Working Group has developed an approach which will accommodate the needs of industry and of both FAA-Directorates (see Attachment 1).

Detailed comments on Appendix 5 are also addressed below. Although it is recommended that appendix 5 be removed from the AC, these detailed comments and dispositions are recorded for historical completeness.

One commenter disagreed with the use of the example of a disk uncontainment in Appendix 5, since a disk problem would be addressed by E&PD. The Working Group disagrees. Although disk uncontainment would typically be addressed by corrective action to the engine, it might also involve corrective action at the airplane level if a design deficiency in mitigating the risk of an uncontained rotor were identified.

While the FAA Transport Airplane Directorate would prefer to retain the Appendix 5 approach in the AC, in consideration of the concerns of the majority and the recognition that (as with the proposed "Level 5") more experience with the expanded CAAM is needed to assure valid and effective Appendix 5 guidelines are established, they will agree to remove Appendix 5 provided:

1) a common event based assessment process, including a new Level 5, can be agreed and added to the main body as recommended by CAA Working Group;
2) the commitment to: 'develop valid and effective Level 5 event guidelines' is noted in the AC; and
3) an additional step is included in the common process which recognizes that: 'The FAA Transport Airplane Directorate will take the assessment one step beyond "event forecasts" and consider the number of persons expected to be seriously injured per event as required to allocate necessarily limited resources and determine what regulatory actions are justified.'

The Working Group notes that removing Appendix 5 from the AC and replacing it with the above reference to the associated considerations does not preclude the FAA Transport Airplane Directorate from further refinement and utilization of an Appendix 5 type process and guidelines for its internal use and standardization.

One commenter remarks on inconsistency between the results of using the level 4 risk boundary vs. the injury risk level boundary. The commenter requests that the acceptable risk levels be consistent with the percentage of level 4 events that result in serious injury.
The Working Group agrees that there is inconsistency. The Working Group considers that there is not necessarily a linear mapping between the guidelines for level 4 events and injuries. The Working Group proposes a methodology which uses a common process and will make this concern moot.

One commenter takes issue with the wording : "*Note that not all persons exposed to serious injury may be seriously injured* " The commenter states that this is both incorrect and inconsistent with the earlier text, since for a catastrophic condition, all exposed passengers will suffer the full effects of the event.
The Working Group disagrees. The historical record shows that accidents involving serious injuries do not always injure every individual on board. The Working Group agrees the wording appears to cause confusion.

One commenter disagrees with the value of 80% for the percentage of uncontained rotor failures which do not result in serious injuries and 20% resulting in serious injuries
The Working Group agrees numbers should be validated as a general principle. It is recommended the examples be reworked; a value of 90% is a non-specific generic number (based on SAE Uncontained reports).

One commenter alleged that the calculation of expected injuries would be difficult to substantiate. The comment was subsequently withdrawn by the cognizant member of the Working Group.

One commenter asks for clarification on the assumptions regarding load factor. The commenter questions the cited value of 90%, and inquires whether operators with higher load factors will be required to undergo more stringent corrective actions. The commenter also inquires whether cargo operators will therefore be allowed very lenient corrective action plans.
The Working Group agrees that a 70% load factor is more representative, and recommends the wording be changed accordingly. The Working Group interprets the AC as calculating risk values on a fleet-wide basis, rather than operator by operator; an operator with high load factors would not be required to have a more stringent corrective action plan. The Working Group recognizes that where resources are limited, priority is given to passenger aircraft types over cargo aircraft.

One commenter claims that the injury exposure calculations are too subjective and cannot be substantiated.
The Working Group disagrees. TAD considers that they have the appropriate information to generate these calculations. There is no expectation that others (OEMs, operators or FAA E&PD) would perform such calculations.

One commenter questions the mathematical process used to develop the injury exposure risk (use of a scalar factor), on the grounds that the calculations should not be adjusted to justify past agency actions.
The Working Group disagrees. Past TAD actions are not in dispute; it is reasonable when developing a new process to verify that it gives similar results to an existing, acceptable process. This may be considered as calibrating the mathematical model to good historical practice.

One commenter questions whether the examples were legitimate, whether failures actually exist which will always lead to a fuel tank explosion, and whether engine failures exist which will always lead to the injury of a single passenger.
The Working Group understands that there are actual failures which would always produce a fuel tank explosion. There are airplane systems which can only lead to injury of a single individual. The example is intended to illustrate the range of severities which may be considered, examples exist at each end of the range. The Working Group does not recommend a change to the AC wording.

One commenter inquires about the distinction between events which produce fatal injuries and those which produce fatalities, pointing out that the manufacturer will find it hard to discriminate between the two, since an element of chance determines the severity of the injury.
The Working Group agrees that events which seriously injure are similar to those which produce fatalities. The process outlined in the AC does not rely on a distinction between serious injury and fatality; serious injuries are considered to encompass fatalities.

COMMENTS ON APPENDIX 6: ASSESSMENT EXAMPLES
One commenter requests that the examples of calculating number of passenger injuries be removed.
The Working Group agrees, since this methodology is not anticipated to appear in the final AC.

One commenter requested that the examples be made more generic/less recognizable. The comment was subsequently withdrawn by the cognizant Working Group member.

One commenter posed many questions regarding the use of the compressor disk fracture example, inquiring why coordination with the airplane manufacturer and TAD might be necessary. The comments were subsequently withdrawn by the cognizant Working Group member.

Attachment 1: Common process for use by E&PD and TAD.

The Working Group proposes that E&PD and TAD use a common process, and that this should be based upon the material given in Appendix 4.
The Working Group acknowledges that TAD wishes to prioritize potential Unsafe Conditions into more discrete graduations of risk than sustained by the CAAM process, which defines risk levels 0 to 4. Since TAD may have hundreds of potential unsafe conditions to address on a single airplane model in one year, it wishes to assign graduations of risk within the CAAM level 4, so that its activities may focus on the most severe "level 4s" as a highest priority. The mechanism which TAD has proposed for this prioritization is calculation of the expected number of injuries for a given potential Unsafe Condition. The Working Group proposes that CAAM level 4 be split into two levels, a level 4 and a level 5, and that this will provide TAD with the desired ability to prioritize.

It is proposed by the Working Group that the new level 4 and 5 be defined as follows:
Level 4
4a. Serious injuries (Evacuation injuries excluded)
4b. Forced landing without serious injuries.

Level 5
Catastrophic outcome (ref Catastrophe as defined by AC 25.1309-B)

It was considered appropriate to remove hull loss from level 4, since it was felt that it represented an outcome less directly related to safety; this issue may require further exploration during the update to the CAAM database. A comment from a Working Group member regarding this recommendation was received after completion of the Working Group activity; this comment was not discussed by the Working Group but is given here without a Working Group disposition: "It was considered appropriate to remove hull loss from level 4, since it was felt that it represented an outcome less directly related to safety. One WG member disagrees with this view and this issue may require further exploration during the update to the CAAM database."

It is proposed that the acceptable risk upper boundaries for the new "level 4" events remain as in Appendix 4. It is also proposed that no upper boundaries be defined as yet for the new "level 5" events, since the industry and FAA lack experience in quantifying risks for this type of control program (the majority of risk calculation so far has been performed by Engine Manufacturers and the E&PD, who have very few potential Unsafe Conditions which might result in a level 5 event). The Working Group recommends that upper boundaries be developed for level 5 event risks as soon as is practicable, and incorporated into the AC. The Working Group also recommends that wording to this effect be incorporated into the AC.

It should be noted also that industry members that have worked with the CAAM levels 1 to 4 for many years have found that these levels are sufficient for their needs. When a safety concern with the potential to result in a level 4 event is identified, resolution of that concern is immediately assigned the highest priority. Corrective action is typically limited by the physical resources available such as the parts or inspection tooling which are available or can be made available within a reasonable time span. Since a potential level 4 already receives such prompt and vigorous corrective action, it may not be practicable to institute control programs which are more aggressive than those already existing for level 4.

The Working Group proposes that Appendix 4 (amended to incorporate level 5) be relocated into the main body of the AC. The Working Group proposes that appendix 5 be removed from the AC, since many comments were received expressing concern over the publication of the "injury count" methodology (see main report for detailed comments). In order to address the need of TAD to prioritize programs, the Working Group proposes that the AC incorporate wording to make it clear that TAD can and will use this injury count approach internally, as needed. The proposed wording is as follows: "The FAA Transport Airplane Directorate may take the assessment one step further and consider the number of persons expected to be seriously injured in an event when allocating necessarily limited resources and determining what regulatory actions are justified."

It should be noted that considerable discussion was required to develop the above recommendations. The Working Group considers it useful that the main points of discussion be recorded, to facilitate understanding of the consensus finally achieved. The main points are provided below.

Need to prioritize

Engine industry members have worked with the CAAM process for many years, and found that CAAM levels 1 – 4 provide sufficient discrimination to prioritize and manage control programs. There are comparatively few control programs controlling the risk of a level 4 outcome; most are directed towards issues which could result in a level 3 event. The TAD is faced with a different challenge, since they must write ADs against hundreds of issues a year on a single airplane model. They need to be able to discriminate between level 4s of different severities. The "injury count" approach of Appendix 5 was developed to provide a numerical continuum of severities and to enable rapid prioritization. The Working Group proposed that rather than a continuum, level 4 be separated into two levels, of different severity (levels 4 and 5). A review of the propulsion-related accident data (numbers of serious injuries per accident) for transport category aircraft supported the concept that two discrete levels were appropriate as a classification approach.

While the FAA Transport Airplane Directorate would prefer to retain the Appendix 5 approach in the AC, in consideration of the concerns of the majority and the recognition that (as with the proposed "Level 5") more experience with the expanded CAAM is needed to assure valid and effective Appendix 5 guidelines are established, they agreed to remove Appendix 5 provided:

4) a common event based assessment process, including a new Level 5, can be agreed and added to the main body as recommended by CAAWG;

5) the commitment to: 'develop valid and effective Level 5 event guidelines' is noted in the AC; and

6) an additional step is included in the common process which recognizes that: 'The FAA Transport Airplane Directorate will take the assessment one step beyond "event forecasts" and consider the number of persons expected to be seriously injured per event as required to allocate necessarily limited resources and determine what regulatory actions are justified.'

This agreement proved acceptable to the Working Group as a whole.

Precedent, custom and practice

Concern was expressed by OEMs that the methodology outlined in Appendix 5 has no precedent under current custom or practice and that no such requirement to make specific quantitative estimates of persons likely to be seriously injured exists under the applicable Airworthiness Standards for aeronautical products. Furthermore, it was pointed out that the philosophy advocated in Appendix 5, that resources are allocated according to the number of persons likely to be killed or seriously injured, rather than on the likelihood of such injuries regardless of the number, does not reflect current practice in the industry. Current practice among OEMs is to prevent accidents, rather than minimize the number of injuries. There was great concern expressed over this policy being advocated in the public domain. It was acknowledged that TAD standard practice includes a cost-benefit analysis which may include calculations of expected numbers of injuries; this does not present a problem provided industry does not perform such calculations or use their results.

The position of the FAA Transport Airplane Directorate is that they traditionally have, currently do and intend to continue to consider the number of persons expected to be injured in an event when allocating necessarily limited resources and determine what regulatory actions are justified. This activity is considered to be consistent with all applicable U.S. laws and standards regulating rulemaking. The following is part of the "Regulatory Evaluation" boilerplate for all FAA Rulemaking: "*Executive Order 12866, Regulatory Planning and Review, directs the FAA to assess both the costs and benefits of a regulatory change. We are not allowed to propose or adopt a regulation unless we make a reasoned determination that the benefits of the intended regulation justify the costs.*" This order also directs that in choosing among alternative regulatory approaches, agencies should select those approaches that maximize benefits. These costs and benefits are those to the public. TAD interpretation is that the costs and benefits are a direct function of the number of persons exposed to/protected from serious/fatal injuries by the regulatory change; an alternative interpretation might define the benefit as "preventing injury" without specifying the number of injuries – the difference is purely interpretive.

It was also pointed out that both the current AC25-1309-1A and the ARAC recommended AC25.1309-1B provide a precedent by allowing a greater probability of a failure condition considered "unsafe" by AC39-xx if the serious or fatal injures are limited to only "a relatively small number of persons other than the flight crew". This policy has been in the public domain for years and is an integral part of industry "initial airworthiness" practice.

Difficulty of estimating number of injuries

It was argued that it would not be possible to make estimates of the number of serious injuries to any degree of accuracy, consistency or repeatability. However, the member representing TAD, which has performed such estimates in the past, pointed out that once the probability of a level 4 or level 5 event was calculated, the only additional information required for such an estimate would be airplane capacity and load factor data. This is typically more readily available and analytically simpler to apply than the data and techniques required to produce the event forecasts in the first place.

Public perception

Concern was expressed that advocacy in the public domain of a methodology which implies that resources are allocated according to the number of persons likely to be killed or seriously injured, rather than on the likelihood of such injuries regardless of the number, could undermine the confidence of the flying public. It was pointed out that published "Regulatory Evaluations" may already include a formal numerical cost/benefit analysis wherein the standardized values prescribed for each injury or fatality avoided/allowed by the proposed rule change are summed and compared with the economic impacts of the rule change. The public does not appear to have difficulty with these regulatory evaluations.

Litigation exposure

Although TAD has traditionally performed estimates of numbers of injuries as part of cost-benefit analysis, this practice is not standardized across Directorates and it is not used by the industry. Concern was expressed that such calculations would have significant negative implications related to potential future litigation and the rights of plaintiffs under discovery procedures (as has been evidenced in other industries). It is noted that the FAA as a government agency enjoys special legal protection not shared by OEMs. It was suggested at one point that words could be added to Appendix 5 which would either absolve industry of any obligation to make such estimates or of any liability resulting from such estimates. Legal advice subsequently indicated that this is not possible.

There was general consensus that the FAA should not require industry to be exposed to unnecessary liability, and that the FAA should be able to follow its current practices internally without causing any problems. It was agreed that the formal numerical assessment called for within Appendix 5 should be removed, if it were replaced by an additional step within the main body which recognized that: "The FAA Transport Airplane Directorate may take the assessment one step further and consider the number of persons expected to be seriously injured in an event when allocating necessarily limited resources and determining what regulatory actions are justified." It was noted that removing Appendix 5 from the AC and replacing it with the above reference to the associated considerations does not preclude the FAA Transport Airplane Directorate from further refinement and utilization of an Appendix 5 type process and guidelines for their internal use and standardization.

Common safety across all models

A fundamental difference in philosophy was identified, which could not be resolved within the Working Group. The majority of the Working Group held that passengers flying in aircraft certified to a specific set of Airworthiness Standards (in this case CFR Parts 25 and 33) should expect to be afforded the same level of safety. For instance passengers in a Regional Jet would expect the same level of safety as passengers in a large transport aircraft. It was noted that the Directorates appear to be operating under different ground rules in this respect. It is the historical practice of TAD to prioritize resources based on the number of potential injuries, in other words, to hold large transport aircraft to a higher safety standard than commuter aircraft. This is considered to be consistent with historical AD practices for transport category airplanes and with their interpretation of the intent of Executive Order (E.O.) 12866, Regulatory Planning and Review (58 FR 51735, October 4, 1993) and DOT Order 2100.5, Policies and Procedures for Simplification, Analysis and Review of Regulations (May 22,1980).

Limited audience

The intended audience for the AC is the industry, the FAA E&PD and the FAA TAD. It was disclosed early in the discussions that no industry member intended to use the process outlined in Appendix 5, nor did the E&PD. It was then suggested that publication in an AC of guidance intended solely for internal use by one Directorate would be inappropriate. However, it was also argued that since the Transport Airplane Directorate makes the continued airworthiness decisions for transport category airplanes, it would be appropriate for the AC to accurately reflect all the technical considerations which go into those decisions. It was suggested that publication of Appendix 5 would provide useful visibility of the TAD decision process.

Attachment 5

1) Publication of the Federal Register Notice: Include date of publication. The announcement of task commences establishing the Working Group. Reference: Paragraph IV.B.(3)

2) Work Plan Approval: The work plan defines the task assignment, identifies the issues to be resolved, identifies individual assignments, develops a schedule, and establishes common ground rules by which the group will function. The work plan is developed and agreed upon by the HWG and must be approved by TAEIG. As the FAA Representative is a member of the HWG, the work plan should receive acceptance by FAA Legal. The legal review is primarily to determine workload and scheduling. Reference: Paragraph IV.C.

3) Concept Approval: The Concept is intended to provide a detailed discussion of the proposed recommendation and may include proposed regulatory language. FAA Legal review of the concept must occur prior to HWG approval of the concept. The FAA Legal review of the Concept is a cursory review of the HWG proposal and draft regulatory language. The working group presents the Concept to TAEIG for approval. The presentation of the Concept should be included in the agenda set forth in the *Federal Register* announcing the public meeting. When the Concept is approved by TAEIG, it will serve as the detailed outline for the proposed rulemaking document. Reference: Paragraph IV.D

4) Preliminary Tech Writer and Legal Support: After ARAC approves the Concept, the HWG may proceed with developing the actual recommendation document. The FAA can provide support to draft the working group's document to ensure that the recommendation is properly written, is in the required format complying with legal requirements, and is fully justified. If this support is not requested, a Final Draft submitted to the FAA is subject to change upon Formal Tech Writer and Legal review. Tech Writer review needs to occur prior to the Legal review. Preliminary reviews can be performed multiple times with the end goal of creating an ARAC package recommendation that meets all technical writing and legal requirements. To obtain FAA drafting support, the HWG Chair notifies the ARAC Assistant Executive Director, who in turn notifies the Office of Rulemaking or the Directorate writer/editor manager. Reference: Paragraph IV.E.(5)

5) Technical Approval in HWG: After the documents are drafted, the HWG must approve this final draft. Technical approval must include completion of the Preliminary Legal and Tech Writer support. FAA team and HWG approval must be included in the Technical Agreement. TAEIG must approve the package before submitting to FAA for Formal review. This constitutes "Technical Agreement" for purposes of the TAEIG work plan that was laid out in Dec 1997. Reference: Paragraph IV.E.(6)

6) and 7) Economic Evaluation and Formal T/W and Legal Review: After regulatory language and preamble material have been drafted, economist support and FAA Formal Legal review are requested. When TAEIG submits a package for Formal Review, the FAA economist performs an evaluation. Following completion of the economic evaluation, the FAA Tech Writers and Legal will make a last review for any possible changes due to the regulatory evaluation by the economist. Reference: Paragraph IV.E.(7) and (8)

8) Technical Agreement: When drafting of the final package is complete, including the preamble material, economic evaluation summary, regulatory language, and the full economic evaluation, the HWG should reach technical agreement on the completed package. This package will be the document that the HWG wants to submit to TAEIG for recommendation to the FAA. Technical Agreement is complete upon TAEIG approval. Reference: Paragraph IV.E.(9)

9) Recommendation to the FAA: TAEIG must approve the package submitted by the HWG, and submit to the FAA with a cover letter. The working group presents the recommended package to TAEIG for approval. The presentation of the recommendation should be included in the agenda set forth in the *Federal Register* announcing the public meeting. Reference: Paragraph IV.E.(10)

Note: All references refer to "Operating Procedures for the Aviation Rulemaking Advisory Committee (ARAC)" [Green Book] as revised 10/97.

WORKING GROUP ACTIVITY REPORT

Date:8/6/2001

- Transport Airplanes and Engines, Continued Airworthiness
- Continued Airworthiness Assessment Harmonization Working Group
- Comment Review for proposed AC 39-XX
- Review comments received on proposed AC 39-XX. Provide advice and recommendations on the task, provide recommendations for disposition of comments which are inappropriate to the AC and provide recommended revised language in paragraph form for the AC incorporating comments which have merit and warrant incorporation.
- Expected Product(s) NPRM o AC o Other X

Since the product is recommended language in paragraph form rather than a complete document, the work of the group is considered complete upon concept approval.

- Schedule:

	FAA Team	Working Group	TAEIG
1) Publication of the Federal Register Notice	12/21/2000		
2) Work Plan Approval	3/15/2001	2/28/2001	3/28/2001

3) Concept Approval	8/27/2001	8/6/2001	9/11/2001
4) Preliminary T/W and Legal Support	N/A	N/A	
5) Technical Approval in HWG	N/A	N/A	N/A
6) Economic Evaluation	N/A	N/A	
7) Formal T/W and Legal Review	N/A	N/A	
8) Technical Agreement	N/A	N/A	N/A
9) Recommendation to FAA			9/15/2001

- Status: All comments have been reviewed and dispositioned. The WG has written a formal report to the FAA. Work is now complete on this task. An AIA activity to update the CAAM database has been requested, as a follow-on activity.
- Bottlenecks; No bottlenecks. Agreement has been reached, eliminating minority positions.
- Next Action: Submission of report to FAA
- Future Meetings: None

- Request for TAEIG Action: Forward report to FAA

1) Publication of the Federal Register Notice: Include date of publication. The announcement of task commences establishing the Working Group. Reference: Paragraph IV.B.(3)

2) Work Plan Approval: The work plan defines the task assignment, identifies the issues to be resolved, identifies individual assignments, develops a schedule, and establishes common ground rules by which the group will function. The work plan is developed and agreed upon by the HWG and must be approved by TAEIG. As the FAA Representative is a member of the HWG, the work plan should receive acceptance by FAA Legal. The legal review is primarily to determine workload and scheduling. Reference: Paragraph IV.C.

3) Concept Approval: The Concept is intended to provide a detailed discussion of the proposed recommendation and may include proposed regulatory language. FAA Legal review of the concept must occur prior to HWG approval of the concept. The FAA Legal review of the Concept is a cursory review of the HWG proposal and draft regulatory language. The working group presents the Concept to TAEIG for approval. The presentation of the Concept should be included in the agenda set forth in the *Federal Register* announcing the public meeting. When the Concept is approved by TAEIG, it will serve as the detailed outline for the proposed rulemaking document. Reference: Paragraph IV.D

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Note: All references refer to "Operating Procedures for the Aviation Rulemaking Advisory Committee (ARAC)" [Green Book] as revised 10/97.

L&D HWG Status Report

11 September 2001 TAEIG Meeting

Discussion Items

- 25.865 Fire Protection of Flight Controls, Engine Mounts, and other Structure
- Ground Handling, Towing, & Landing Descent Velocity Tasks
- Work Plan for 25.301(b) Flight Loads Survey TOR
- NPRM Phase 4 review - Economic Evaluations

25.865 Fire Protection of Flight Controls, Engine Mounts, and other Structure

- Task group is meeting in Hoofddorp Oct 16-17 and will then report to the HWG on Oct 18
- Additional Task group meetings will be scheduled as needed to meet the 15 March 2002 completion date that was discussed at the 27 June TAEIG meeting

TOR for Ground Handling, Towing, & Landing Descent Velocity Tasks

(Assigned 28 Sept 2000)

- Ground Handling & Towing
  - FAA Special conditions and JAA CRIs for center/aux strut LG have been reviewed and are being used as the basis for draft regulations
  - Braked and unbraked center/aux LG have been considered.
  - Non-extended scenarios for center/aux LG have been considered
  - FAA reports for L-1011 and DC9 extended towing under review
  - Progress is on track per work plan approved by TAEIG in Dec.
  - Next HWG meeting for this task is 16-18 Oct.

TORs for Ground Handling, Towing, & Landing Descent Velocity

(TOR Assigned 28 Sept 2000)

- Landing Descent Velocity
  - The FAA Heathrow wide-body sink rate measurement tests were completed during July
  - The Heathrow data evaluation tasks have been planned and reviewed
  - The Airbus wide-body sink rate measurement and data evaluation tasks have been planned and reviewed
  - The work plan schedule approved by TAEIG in Dec for this task will not be achieved. The revised date for completion is now March 2003 for submittal of a final report to TAEIG
  - The next HWG meeting on this task is 16-18 Oct.

TOR for 25.301(b) Flight Loads Measurement

(TOR Assigned 11 June 2001)

- TOR was published after the June 5-7 L&D HWG meeting
- A work plan has been developed and is being submitted to TAEIG for approval at this meeting

NPRM Phase 4 Review

- The L&DHWG was asked by Craig Bolt on 3 June 01 to comply with an FAA Request to complete economic evaluation reports on draft NPRMs as follows:
  - Checked Pitch Maneuver 25.331 - NPRM
  - Gust and Continuous Turbulence 25.341 - NPRM & AC
  - Engine/APU Torque (25.361) & Engine Failure 25.362 - NPRM &AC
  - Interaction of Systems & Structures - NPRM
- Each of the above resulted from L&DHWG ARAC projects

NPRM Phase 4 Review

- The economic evaluation forms were completed by the U.S. members of the L&D HWG
- Each evaluation concluded “no significant cost”
- However the L&D HWG is not empowered to make cost evaluations without the formal concurrence of their companies

NPRM Phase 4 Review

- Letters were sent to the following US companies with a request to accept or reject the "no significant cost" evaluations :
  - Boeing
  - Cessna
  - Gulfstream
  - Learjet
  - Lockheed-Martin
  - Raytheon
  - General Electric (Engine related NPRM only)
  - Pratt & Whitney (Engine related NPRM only)
- The following table summarizes the responses

NPRM Phase 4 Review

Common Response

Company /Arac Project	Checked Pitch Maneuver FAR 25.331	Gust and Continuous Turbulence FAR 25.341	Engine Torque / Failure FAR 25.361/362	Interaction of Systems & Structures FAR 35.302
Boeing	Accept	Accept	Reject	Reject
Cessna	Accept	Accept	Accept	Accept
Gulfstream	Accept	Accept	Accept	Accept
Lear-jet	Accept	Accept	Accept	Accept
Lockheed-Martin	Accept	Accept	Accept	Accept
Raytheon	Accept	Accept	Qualified Accept	Qualified Accept
General Electric Jet Engines	Not Affected - not asked to respond	Not Affected - not asked to respond	Reject	Not Affected - not asked to respond
Pratt & Whitney Jet Engines	Not Affected - not asked to respond	Not Affected - not asked to respond	Accept	Not Affected - not asked to respond

NPRM Phase 4 Review

- The economic evaluation forms have been revised to reflect the results obtained from each company
- The revised forms are being presented for TAEIG approval to send to the FAA

Loads and Dynamics Harmonisation Working Group Work Plan

Flight Loads Survey Task

6 September 2001

The L&D HWG (Incorrectly stated as GSHWG) was tasked via FR Doc. 01-14659 as published 11 June 2001 to perform the following:

Specific Task

- Review 14 CFR Part 25, § 25.301 and JAR 25.301 for adequacy in addressing the issue of validation of flight load intensities and distribution. This review should include the consideration of:

1. FAA advisory circular (AC) 25-14, High Lift and Drag Devices;"
2. Relevant FAA issue papers and their implementation
3. JAA Certification Review Items

- Develop a report recommending the any revisions to the rules (including cost estimates) and any advisory materials needed to address the above issues.

Schedule: This task is to be completed no later than June 28, 2002 is.

Work Methods

The Loads and Dynamics Harmonization Working Group will comply with the procedures adopted by ARAC. As a part of the procedures, the Loads and Dynamics Harmonization Working Group is submitting to the TAEIG this work plan for completion of the tasks, including the rationale for the plan.

A status report on the tasks will be provided at each meeting of ARAC held to consider Transport Airplane and Engine Issues.

Detailed Work Plan

The chairman of the HWG has appointed a task group, with a chairman and co-chairman, to handle the tasks with the intent of expediting the completion of the assigned task. The membership of the task group is provided via Attachment 1. The membership of the group consists of selected members from the HWG.

TAE Sept 2001 Handout-8
Handout 8

The charter of the task group is to review and analyse the appropriate materials and data and to development the draft reports, advisory material, or any other collateral documents that are found to be appropriate. The draft report is to include an economic evaluation. The work of this task group is to be accomplished between the HWG meetings and brought forward at each L&D HWG meeting for review and comment. Most of the work will be accomplished by teleconference and email. However the chairman of the task group may call task group meetings if required.

1. Review

- 14 CFR Part 25, § 25.301 and JAR 25.301 for adequacy in addressing the issue of validation of flight load intensities and distribution. This review should include the consideration of:

  FAA advisory circular (AC) 25-14, High Lift and Drag Devices;"
  Relevant FAA issue papers and their implementation
  JAA Certification Review Items

- Existing airframe manufacturers practices and criteria for measuring flight loads magnitudes and distributions.

2. Identify issues

- What loads should be measured and how should they be measured
- How are measured flight loads currently used in the validation process
- How should they be used in the validation process
- When do differences in measured flight loads relative to certification design loads require evaluation require additional structural substantiation
- What is an appropriate error band for measured loads
- Under what circumstances can measured flight loads be used to show additional capability for increased maximum gross weights or design speed-altitude schedules

These are just some of the issues to be addressed.

3. Discuss and develop necessary rule changes / advisory material

Develop a Fast Track report that would provide the information for:

a) An NPRM
b) An AC
c) Cost Analysis

4. Schedule

a) Technical agreement 22 February 2002
b) Deliverables submitted to TAEIG by early March 2002 (TOR date due to FAA is 28 June 2002)

Identification of Affected Parties

The likely parties to be affected by the harmonization activity are the airframe manufacturers and the JAR Structures Study Group.

Expertise Required

The Group has determined that we have the needed expertise to proceed with the tasks.

Submitted to TAEIG by:

Larry Hanson
Chairman of L&D HWG

Flight Loads Survey Task Group

Name	Organization
Wim Doeland (Chairman)	RLD
Jack Grabowski	Transport Canada
Hank Offerman	FAA Transport Directorate
Tony Linsdell (Co-chairman)	Bombardier - Canadair
Gennaro Squeglia	Aerospatiale Matra-Airbus
Mark Ray	Gulfstream Aerospace
Mike Green	Boeing

ARAC L&DHWG Response Regarding the Costs and Benefits of the FAR 25 Harmonization Proposal for Checked Pitching Maneuver Requirement for Transport Airplanes

1. OVERVIEW

The FAA proposes to revise the checked pitching maneuver design load requirement of 14 CFR part 25 for transport category airplanes by incorporating changes developed in cooperation with the Joint Aviation Authorities (JAA) of Europe, Transport Canada and the U.S., European, and Canadian aviation industries through the Aviation Rulemaking Advisory Committee (ARAC). A checked pitching maneuver results when the cockpit pitch control is displaced to cause the airplane to pitch, but then the control is displaced in the opposite direction to arrest (check) the pitching motion. This rulemaking action concerns the design loads associated with the checked pitching maneuver and is necessary because differences between the current U.S. and European requirements impose unnecessary costs on airplane manufacturers. These proposals are intended to benefit the public interest by standardizing certain requirements, concepts, and procedures contained in the airworthiness standards without reducing, but potentially enhancing, the current level of safety.

- **Why are New Standards Needed?**

Section 25.331(c)(2) of part 25 prescribes a checked pitching maneuver in which the cockpit pitch control is first displaced in a nose up direction, then the control is displaced in the opposite direction sufficient to "check" the pitching motion. The control displacements must develop specified nose up and nose down pitching accelerations. The magnitude of these control inputs must be such that the positive limit maneuvering load factor prescribed in § 25.337 is achieved on the airplane, but not exceeded.

The corresponding requirement in JAR-25 is similar, however, there are no specific minimum pitching accelerations that must be achieved. Rather, JAR paragraph 25.331(c)(2) requires a rational motion. This rational motion is not defined in the rule but the associated advisory material, Advisory Circular Joint (ACJ) 25.331(c)(2), prescribes a control motion in the form of a sine wave. This control motion is applied with the initial movement in the nose-up direction so that the maximum positive limit maneuvering load factor is achieved. As a separate condition, the control motion is applied with the initial movement in the nose-down direction, so that a maneuvering load factor of 0g is reached. In both cases, the control motion is applied at a frequency related to the short-period rigid body mode of the airplane. The short-period rigid body mode is one of the two longitudinal stability modes that are inherent in every airplane and identified during the design phase.

(Handout 9)

The main criticism of the current FAR requirement is that the pitching accelerations are prescribed without any accounting for the size, configuration or characteristics of the airplane. In fact, the same pitching accelerations are applied to the smallest personal airplanes as to the largest jet transports. The JAR requirement, on the other hand, relates the frequency of the control motion to the frequency of the short-period rigid body mode of the airplane, thereby accounting for the characteristics of the particular airplane. Neither the FAR nor the JAR provide adequate criteria to fully account for the characteristics of advanced electronic flight control systems in which the achievable maneuvering load factors are governed by special computer control laws.

- **<u>What are the Proposed Standards?</u>**

The proposed standards are provided in the attached NPRM titled "Checked Pitching Maneuver Requirement for Transport Airplanes." The NPRM proposes to revise paragraph 25.333(c)(2).

2. Cost Discussion

The proposed harmonization standard will not impose additional significant cost on U.S. manufacturers of part 25 airplanes because:

1. There is no significant cost burden due to the changes to analysis requirements as the NPRM harmonizes both the FAA and JAA requirements. The NPRM is based upon the JAA requirements that most manufacturers have chosen to previously comply with.

2. Any changes to the loads requirements that result from this NRPM will not result in significant costs for certification or manufacturing. In addition there will be no significant increases in weight.

3. Benefits Discussion

A common set of standards will benefit the aviation industry economically due to meeting just one certification requirement rather than different standards for the United States and Europe. Airplane manufacturers already meet or expect to meet this standard as well as the existing Part 25 requirement.

The proposed standards will maintain the existing level of safety.

4. L&D HWG Recommendation

Six U.S. Part 25 airframe manufacturers having members on the L&D HWG were asked to respond to the Costs and Benefits sections of this economic evaluation which reflects the cost/benefits determination of the FAA Regulatory Evaluation Summary as contained in the proposed NPRM. The response letters received from the six manufacturers are attached.

All six of the companies accepted the cost/benefits. One company commented that:

"It should be noted that the economic assessment does not take into account the impacts this later certification requirement may have on aircraft certification programs subject to the new FAR 21.101 changed products rule requirement. The level of economic impact and impracticality of applying this rule to existing programs would have to be performed under the criteria defined by FAR 21.101 and AC 21.101-1."

The L&DHWG requests that in the next to the last paragraph of the Regulatory Evaluation Summary that the sentence:

"There was consensus within the ARAC members, comprised of representatives of the affected industry, that the requirements of the proposed rule will not impose additional costs on U.S. manufacturers of part 25 airplanes"

be changed to:

"There was consensus within the *U.S. members of the ARAC L&DHWG*, comprised of representatives of the affected industry, that the requirements of the proposed rule will not impose additional costs on U.S. manufacturers of part 25 airplanes"

The above change clarifies the fact that the U.S. members of the ARAC L&DHWG are the ones that have participated in the economic evaluation as opposed to all ARAC members.

In addition, it is requested that the previously discussed comment made by one company be discussed in the NPRM.

The U.S. members of the ARAC L&DHWG therefore recommend that the FAA proceed with this rulemaking with the changes as discussed above.

Loads and Dynamics Harmonisation Working Group Work Plan

Flight Loads Survey Task

6 September 2001

The L&D HWG (Incorrectly stated as GSHWG) was tasked via FR Doc. 01-14659 as published 11 June 2001 to perform the following:

Specific Task

- Review 14 CFR Part 25, § 25.301 and JAR 25.301 for adequacy in addressing the issue of validation of flight load intensities and distribution. This review should include the consideration of:

1. FAA advisory circular (AC) 25-14, High Lift and Drag Devices;"
2. Relevant FAA issue papers and their implementation
3. JAA Certification Review Items

- Develop a report recommending the any revisions to the rules (including cost estimates) and any advisory materials needed to address the above issues.

Schedule: This task is to be completed no later than June 28, 2002 is.

Work Methods

The Loads and Dynamics Harmonization Working Group will comply with the procedures adopted by ARAC. As a part of the procedures, the Loads and Dynamics Harmonization Working Group is submitting to the TAEIG this work plan for completion of the tasks, including the rationale for the plan.

A status report on the tasks will be provided at each meeting of ARAC held to consider Transport Airplane and Engine Issues.

Detailed Work Plan

The chairman of the HWG has appointed a task group, with a chairman and co-chairman, to handle the tasks with the intent of expediting the completion of the assigned task. The membership of the task group is provided via Attachment 1. The membership of the group consists of selected members from the HWG.

The charter of the task group is to review and analyse the appropriate materials and data and to development the draft reports, advisory material, or any other collateral documents that are found to be appropriate. The draft report is to include an economic evaluation. The work of this task group is to be accomplished between the HWG meetings and brought forward at each L&D HWG meeting for review and comment. Most of the work will be accomplished by teleconference and email. However the chairman of the task group may call task group meetings if required.

1. Review

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  Relevant FAA issue papers and their implementation
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- Existing airframe manufacturers practices and criteria for measuring flight loads magnitudes and distributions.

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- What loads should be measured and how should they be measured
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The likely parties to be affected by the harmonization activity are the airframe manufacturers and the JAR Structures Study Group.

Expertise Required

The Group has determined that we have the needed expertise to proceed with the tasks.

Submitted to TAEIG by:

Larry Hanson
Chairman of L&D HWG

Flight Loads Survey Task Group

Name	Organization
Wim Doeland (Chairman)	RLD
Jack Grabowski	Transport Canada
Hank Offerman	FAA Transport Directorate
Tony Linsdell (Co-chairman)	Bombardier - Canadair
Gennaro Squeglia	Aerospatiale Matra-Airbus
Mark Ray	Gulfstream Aerospace
Mike Green	Boeing

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Company		From TOM AVERY	Mailstop
Location		Company	
Fax No 912-965-3367	Telephone No.	Location	Bldg. No.
Comments		Fax No.	Telephone No.
		Original Disposition: ☐ Destroy ☐ Return ☐ Call for pickup	

Robert H. Kelley-Wickemeyer
Chief Engineer
Safety & Certification
A/P Performance & Propulsion

The Boeing Company
P.O. Box 3707 MC 67-WH
Seattle, WA 98124-2207

BOEING

September 7, 2001

Mr. Larry Hanson
Chairman L&D HWG
Gulfstream Aerospace Corporation, M/S D-04
500 Gulfstream Road or PO Box 2206
Savannah, Georgia 31402-2206

Dear Mr. Hanson:

Reference: Economic Evaluation of ARAC Proposed NPRMs and Advisory Circulars, dated August 27, 2001

The Boeing Company has been asked to respond to the Reference by accepting or rejecting the Loads and Dynamics Harmonization Working Group (L&D HWG) recommendations pertaining to qualitative economic evaluations of four proposed regulations which are in the NPRM stage. Two of the proposals are accepted and two rejected by Boeing.

The Boeing Company accepts the L&D HWG recommendations for both the Revised Requirements for Gust and Continuous Turbulence Design Loads, 25.341, and for the Checked Pitch Maneuver Requirement for Transport Airplanes, 25.331. Boeing believes that changes to the loads requirements that result from these NRPM's will not result in significant costs for certification or manufacturing. In addition, there should be no significant increases in weight.

However, Boeing cannot agree that replacing a special condition (that has not been through an economic evaluation) is an adequate justification for qualitatively saying that there will be no impact for these rules. Special Conditions are law, but they have not passed through the due process hurdles of an Economic analysis. For this reason, Boeing must reject the proposal for both Engine and Auxiliary Power Unit Load Conditions /Engine Failure 25.361 and 25.362, and for Interaction of Systems and Structures 25.302. Both of these proposals would drive additional costs onto an airplane if the special conditions did not exist.

Very truly yours,

RH Kelley-Wickemeyer

Robert H. Kelley-Wickemeyer
Chief Engineer - Safety and Airworthiness
Airplane Performance and Propulsion
Phone: 425-234-9984
robert.h.kelley-wickemeyer@boeing.com

Handout 10

Cessna
A Textron Company

September 4, 2001

Larry Hanson
Chairman L&DHWG
Gulfstream Aerospace Corporation M/S D-04
500 Gulfstream Rd
Savannah, GA 31402-2206

RE: Economic Evaluation of ARAC proposed NPRMs and Advisory Circlars

Dear Larry:

We have reviewed the economic evaluation questionnaires you forwarded to my attention on August 27, 2001.

We concur with the findings documented in those questionnaires.

Sincerely,

Robert L. Howes
Manager, Engineering
Member L&DHWG

Nick Anderson
Section Chief, Airworthiness

RLH:dgs

Cessna Aircraft Company One Cessna Boulevard, P.O. Box 7704, Wichita, Kansas 67277-7704 316/517-6000

Gulfstream
A GENERAL DYNAMICS COMPANY

Date: September 4, 2001

Larry Hanson
Chairman Loads &Dynamics HWG
Gulfstream Aerospace

A&C- FAA-01-220

Subject: Economic Evaluation of ARAC proposed NPRMs and Advisory Circulars
Reference: Your letter dated August 27,2001, same subject

Dear Larry:

Per your referenced letter, Gulfstream understands that the FAA has asked the L&D HWG to complete an economic evaluation of the proposed standards for four ARAC projects.

Gulfstream has reviewed and concurs with each of the economic evaluations for the four FAA projects as defined in the following ARAC L&DHWG responses.

1. Engine and Auxiliary Power Unit Load Conditions / Engine Failure 25.361 and 25.362 - NPRM and Advisory Circular.

2. Revised Requirements for Gust and Continuous Turbulence Design Loads 25.341 and associated paragraphs – NPRM and Advisory Circular

3. Interaction of Systems and Structures 25.302 – NPRM

4. Checked Pitch Maneuver Requirement for Transport Airplanes 25.331 – NPRM

It should be noted that these economic assessments do not take into account the impacts these later certification requirements may have on aircraft certification programs subject to the new FAR 21.101 changed products rule requirement. The level of economic impact and impracticality of applying these rules to existing programs would have to be performed under the criteria defined by FAR 21.101 and AC 21.101-1.

Sincerely,

Richard J. Trusis, Manager
Airworthiness, Certification, & Data Management

cc: R. Johnson, VP - Chief Engineer

Z2

Date: September 5, 2001

To: Loads & Dynamics HWG - Laurence C. Hanson, Chairman

Learjet Inc.
P.O. Box 7707
Wichita, KS 67277-7707 United States
Telephone 1(316) 946-2000
http://www.aerospace.bombardier.com

Subject: Checked Pitch Maneuver Requirement for Transport Airplanes 25.331 – NPRM

A review of the subject NPRM and economic evaluation questionnaire have been made by Learjet Loads and Dynamics resulting in the following conclusion:

For Learjet Designs the additional effort will not result in a large economic impact. This is due to that it replaces JAA special conditions and is harmonized with existing analysis methods.

Abe Jibril

Z2

Date: September 5, 2001

To: Loads & Dynamics HWG - Laurence C. Hanson, Chairman

Learjet Inc.
P.O. Box 7707
Wichita, KS 67277-7707 United States
Telephone 1(316) 946-2000
http://www.aerospace.bombardier.com

Subject: Revised Requirements for Gust and Continuous Turbulence Design

Loads 25.341 and

associated paragraphs – NPRM and Advisory Circular

A review Of the subject economic evaluation questionnaire has been made by Learjet Loads and Dynamics area and resulted in the following conclusion:

For Learjet Designs the additional effort will not result in a large economic impact. This is due to that it replaces existing JAA special conditions and existing analysis methods.

Abe Jibril

Z2

Date: September 5, 2001

To: Loads & Dynamics HWG - Laurence C. Hanson, Chairman

Learjet Inc.
P.O. Box 7707
Wichita, KS 67277-7707 United States
Telephone 1(316) 946-2000
http://www.aerospace.bombardier.com

Subject: Economic Evaluation 'Engine and Auxiliary Power Unit Load Conditions /Engine Failure 25.361 and 25.362 -NPRM and Advisory Circular.

A review of the subject economic evaluation questionnaire has been made by Learjet Loads and Dynamics area resulting in the following conclusion:

For Learjet Designs the additional effort will not result in a large economic impact. This is due to that it replaces existing special conditions and existing analysis methods.

Abe Jibril

Z2

Date: September 5,2001

Learjet Inc.
P.O. Box 7707
Wichita, KS 67277-7707 United States
Telephone 1(316) 946-2000
http://www.aerospace.bombardier.com

Subject: Interaction of Systems and Structures 25.302 – NPRM

A review of the subject NPRM and economic evaluation questionnaire
have been made by the appropriate structural areas resulting in the
following conclusions:

1. The additional effort needed to meet the system design, loads, flutter, static and residual strength requirement is significant (10 % to 15% increase).
2. For Learjet Designs the additional effort will not result in a large economic impact. This is due to the few fly by wire systems they contain.

Abe Jibril

Lockheed Martin Aeronautical Systems
86 South Cobb Drive Marietta, GA 30063

LOCKHEED MARTIN

September 5, 2001

Mr. Laurence Hanson, Chairman
ARAC Loads and Dynamics
Harmonization Working Group

Subject: Economic Evaluation of ARAC Proposed NPRMs and Advisory Circulars

The Economic Evaluation report and associated NPRM and Advisory Circular for the following proposed FAR 25 revisions have been reviewed by the Lockheed Martin Aeronautics Company C-130 Structures Office.

1. Engine and Auxiliary Power Unit Load Conditions/Engine Failure 25.361 and 25.362 – NPRM and Advisory Circular.
2. Revised Requirement for Gust and Continuous Turbulence Design Loads 25.341 and associated paragraphs – NPRM and Advisory Circular.
3. Interaction of Systems and Structures 25.302 – NPRM.
4. Checked Pitch Maneuver Requirement for Transport Airplanes 25.331 – NPRM.

The LM-Aero C-130 Structures Office concurs with the consensus of the ARAC Loads and Dynamics Harmonization Working Group that these revisions "will result in no significant change to manufacturer's cost".

W.E. Barron
C-130 Chief Structures Engineer

Raytheon

Raytheon Aircraft Company
9709 E. Central
P.O. Box 85
Wichita, Kansas
67201-0085 USA

General

September 5, 2001

In Reply Refer To: 940-2001-09-077

Mr. Larry Hanson
Chairman, ARAC Loads and Dynamics Harmonization Working Group
Gulfstream Aerospace Corporation, M/S D-04
500 Gulfstream Rd/P.O. Box 2206
Savannah, GA 31402-2206

Subject: Economic Evaluation of ARAC Proposed NPRMs and Advisory Circulars

Ref.: Your email of August 27, 2001 on the subject matter to Jagannath Giri.

Dear Mr. Hanson:

RAC has reviewed and evaluated the economic impacts of the ARAC proposed NPRM's and the Advisory Circulars transmitted through your email and listed below.

1. Engine and Auxiliary Power Unit Load Conditions /Engine Failure: 14 CFR Part 25.361 and 25.362 - NPRM and Advisory Circular (with a note that GE and Pratt & Whitney are separately being asked to comment on this engine-related material).

2. Revised requirements for Gust and Continuous Turbulence Design Loads 14 CFR Part 25.341 and associated paragraphs – NPRM and Advisory Circular.

3. Interaction of Systems and Structures 14 CFR Part 25.302 – NPRM.

4. Checked Pitch Maneuver Requirement for Transport Airplanes 14 CFR Part 25.331 – NPRM.

RAC accepts all the Economic Evaluation Questionnaires completed by the L&DHWG; however, RAC also offers the following comments:

1. For small business class airplane manufacturers like RAC, the burden and cost of meeting the added requirements, mainly to address the products and requirements of the large transport category aircraft makers, is considered significantly high. A point may be reached whereby the additional costs could increase the product price to a level that the market cannot sustain. This would lead to eliminating some smaller classes of aircraft from the market.

2. RAC reviewed the Revised Requirements for Gust and Continuous Turbulence Design Loads 14 CFR Part 25.341 with Associated Paragraphs – NPRM and AC, as well as the Checked Pitch Maneuver Requirements for Transport Airplanes 14 CFR Part 25.331 – NPRM, and the requirements are considered acceptable, as they indicate minimal cost increases.

3. For the Engine Failure Loads 14 CFR Part 25.361 and 25.362, the cost discussion states that the NPRM replaces the existing manufacturer's analysis and test techniques. For the type of aircraft that RAC manufactures, the added cost and weight penalty could be very high in comparison to the added safety considerations.

4. The requirements for the Interaction of Systems and Structures 14 CFR Part 25.302 – NPRM, as defined, will add significant new analysis, including non-linear analysis of control systems, inclusion of system effectiveness and system reliability, plus a consideration for the joint probability of structural failures. These additions will result in considerable added cost for RAC category and size of aircraft.

Sincerely yours,

RAYTHEON AIRCRAFT COMPANY

John Tigue, Acting Director
Product Design Assurance & FAA Liaison

JT:jg

GE Aircraft Engines
One Nuemann Way
Cincinnati, OH
45215-1988

Subject: Economic Evaluation of ARAC proposed NPRM and Advisory Circular FAR 25.361 Engine Torque & 25.362 Engine Failure Loads

Larry Hanson, Chairman L&D HWG
Gulfstream Aerospace Corporation M/S D-04
500 Gulfstream Rd or PO Box 2206
Savannah, GA 31402-2206

GEAE does not foresee any additional costs resulting from the proposed changes to FAR 25.361.

The major impact to GEAE will be from the proposed new Rule and AC 25.362. The proposed new rule and AC requires engine mount loads to be generated in conjunction with the airframes from a dynamic analysis using a validated, integrated dynamic airframe / engine model. We are already doing this for all new engine/airframe programs in order to comply with "issue papers" or "special conditions" imposed by regulators (FAA & others). This however does require considerable additional work and represents a significant cost when compared to what must be done to comply with the current FAR's.

GEAE "owns" the engine mounts for many of the application in which our engines are used. They are part of the engine and therefore must be designed and manufactured to support FAR 33 certification. Because the proposed new rule 25.362 requires that loads used for FAR 25 certification be obtained from a validated, integrated engine / airframe model, these loads are not likely to be available until after the mount hardware design is frozen and hardware manufactured for FAR33 certification and airframe compliance tests. This is particularly true where there is a new airframe and engine that relies on the FAR 33 engine fan blade out test to provide data for the model validation. This could potentially result in having to redesign the mount hardware in order to comply with the proposed new rule and AC at a significant cost to the program.

Although GEAE technically supports the proposed changes, for the reason's stated above, GEAE does not see the changes proposed as having "no significant change to manufacturer's cost", as stated in the Economic Evaluation Questionnaire, or that "the requirements of the proposed rule will not impose additional costs on U.S. manufacturers of part 25 airplanes", as stated in the NPRM, when comparing the cost of complying with FAR 25- as currently written to that required to comply with the introduction of the proposed new FAR & AC 25.362.

Sincerely,

T. Joseph 9/7/01

Tom Joseph
Mgr., Engine Mounts
Design Engineering
513-243-1388

Larry Bach
Mgr., Engine Dynamics
Structures Systems Analysis
513-243-2474

Andy May
FAA-DER Industry &
Regulatory Affairs Liaison
513-243-3878

Pratt & Whitney
400 Main Street
East Hartford, CT 06108

Pratt & Whitney
A United Technologies Company

August 31, 2001

Mr. Larry Hanson, Chairman L&D HWG
Gulfstream Aerospace Corporation M/S D-04
500 Gulfstream Road
Savannah, GA 31402-2206

Dear Larry:

Pratt & Whitney accepts the Economic Evaluation of the proposed NPRM and Advisory Circular for Engine and Auxiliary Power Units/Engine Failure that were developed and submitted to the FAA through the ARAC process.

Please feel free to contact me if there are any questions.

Sincerely,

Frank Stadmeyer
Assistant Manager
Flight Safety, Certification and Airworthiness

FS:jb

003/jb

cc: C. Bolt
N. Romanowski

ICE PROTECTION HWG STATUS

PRESENTATION TO ARAC TAEIG

SEPTEMBER 11, 2001

Exhibit 11

17TH IPHWG MEETING HELD AT MONTREAL, JUL 16-20, 2001

The purpose of the meeting was:

1) Task 2 - Review activities completed on Task 2, plan future activities

- Majority of the meeting was spent discussing the large droplet characterization and reviewing available data in an effort to bound the scope of the task.
- Agreed to separate the large droplet definition from the current Appendix C. May need to consider a small droplet environment to be used in conjunction with the large droplet definition.

2) Task 1- Discussion of Task 1 Certification Rule Proposal documents released to TAEIG

- No significant questions or discussion was raised regarding Task 1 report.

IPHWG - TASK 1

Task 1 - As a short-term project, consider the need for a regulation that requires installation of ice detectors, aerodynamic performance monitors, or another acceptable means to warn flight crews of ice accumulation on critical surfaces requiring crew action (regardless of whether the icing conditions are inside or outside of Appendix C of 14 CFR Part 25). Also consider the need for a Technical Standard Order for design and/or minimum performance specifications for an ice detector and aerodynamic performance monitors. Develop the appropriate regulation and applicable standards and advisory material if a consensus on the need for such devices is reached.

STATUS ON TASK 1 PRODUCTS

Proposed Part 121 Operations Rule and associated advisory materials

- FAA economic analysis in work. Assistance requested from manufacturers and RAA to develop costs with regard to ice detector installation.

Proposed Part 25 Certification rules and associated advisory materials

- At the June meeting TAEIG vote to submit the Task 1 report to the FAA with a recommendation for Option C. Option C proposed to withhold action on proposed §25.1420 until further progress is made on the Task 2 deliverables. The proposal to amend §25.1419 could proceed. FAA report at July meeting stated responses to the Task 1 report should be available by the October Meeting.

IPHWG - TASK 2

Until Task 1 material is returned to the group after FAA processing, the meetings will be devoted to task 2

Task 2 - Review National Transportation Safety Board recommendations A-96-54, A-96-56, and A-96-58, and advances in ice protection state-of-the-art. In light of this review, define an icing environment that includes supercooled large droplets (SLD), and devise requirements to assess the ability of aircraft to safely operate either for the period of time to exit or to operate without restriction in SLD aloft, in SLD at or near the surface, and in mixed phase conditions if such conditions are determined to be more hazardous than the liquid phase icing environment containing supercooled water droplets. Consider the effects of icing requirement changes on 14 CFR part 23 and part 25 and revise the regulations if necessary. In addition, consider the need for a regulation that requires installation of a means to discriminate between conditions within and outside the certification envelope.

IPHWG FUTURE MEETING ACTIVITIES

As stated in the previously submitted Task 2 report, the group recommends to TAEIG that IPHWG develop at least interim SLD certification standards

- May not be a complete revision of the Appendix C envelopes.
- Should be sufficient to permit generation of ice shapes for use in the remainder of Task 2

Prior to meeting 17, the IPHWG believed that interim standards could be completed to concept approval during first quarter of 2002. However, this target could be at risk depending on the level of detail required for concept approval.

- Detailed information on how the SLD envelopes should be presented could be challenging to reach consensus on.

IPHWG FUTURE MEETING ACTIVITIES (CONTINUED)

More detailed planning of the work required to complete Task 2 is required prior to establishing a credible schedule.

- A sub-group has been formed to address a detailed work plan and associated schedule.

Expect to have a more detailed work plan and schedule by the end of the next meeting (Oct. '01).

MEETING #18 OBJECTIVES

TASK 1

1. Review FAA response to Task 1 report

TASK 2

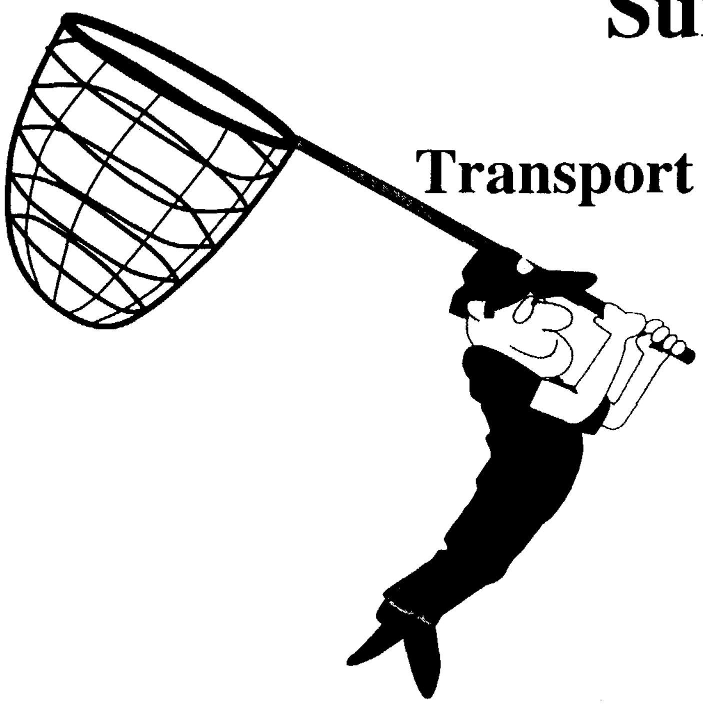
1. Review activities and action items completed on Task 2 since meeting #17
2. Deliberations on drop size and LWC characterization of SLD
3. Consideration of the sensitivity effects of drop size and LWC characterization on airfoils
4. Update of the SLD road map for engineering tools
5. Review milestones and develop schedule for Task 2

IPHWG Future Meeting Schedule

October 22 - 26, 2001	Linköping, Sweden (SAAB)
February 4 - 8, 2002	TBD, North America (Santa Fe or Dallas/Ft Worth)
May 20 - 24, 2002	Toulouse, France
Sep 9 - 13, 2002	TBD, North America (Santa Fe, Dallas/Ft Worth, Atlanta, Chicago, Sao Paulo Brazil (Embraer)
Dec 2 - 6, 2002	TBD (Brussels, Hoofddorp)

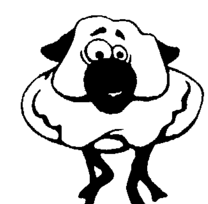
Design for Security HWG

Summary Update



Transport Airplane and Engine Issues Group

Seattle, Washington



Mark Allen - Chair
Boeing - Structures

Sept 11, 2001

Handout 12

Handout 12

ARAC Members

Mark Allen - Chair
Boeing - Structures

Dave Melberg
Boeing - Flight Deck

Steve Loukusa
Boeing - ECS

Michael Purwins
EADS Airbus - Certification

Keith Ayre
Bombardier - Systems

Joel Siqueira
Embraer - Design

Gale Meek
Cessna - Certification

Captain Peter Reiss
IFALPA / ALPA

Brian Wall
IATA - Security Services

Maurizio Molinari
Transport Canada
Structures Engineering

Jeff Gardlin
FAA - Cabin Safety & Airframe

Ed Kittel
FAA - Explosives

Rory Martin
JAA / CAA - Structures

Eric Duvivier
JAA / DGAC
Cabin Safety & ECS

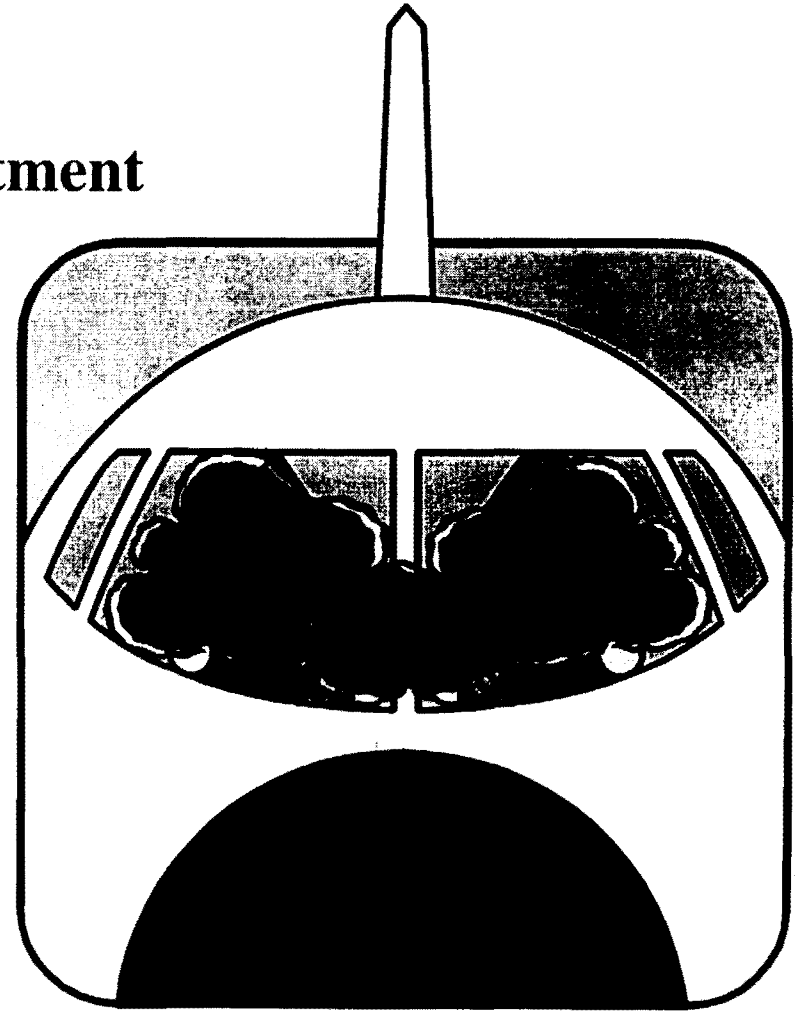
General

Working Group Tasked With Eight ICAO Rules:

(And One FAA Initiated Rule)

* Flight Deck Smoke Protection
* Cabin Smoke Extraction
* Cargo Compartment Fire Suppression
* Systems Survivability
* Least Risk Bomb Location (Identification)
* Least Risk Bomb Location (Design)
* Design for Interior Search
* Penetration Resistance
* ***Flight Deck Intrusion - June 11, 2001 Federal Register***

Flight-Deck Smoke Protection



Smoke Entry From any Compartment and any Flight Condition

No System Damage Assumed

Switch-Activated Airflow Boost
(TBD by FAA) Initial Smoke Entry Allowed

MMEL Requirement ???

No Recirculated air

No Airflow Reduction to Passenger Compartment???

-/

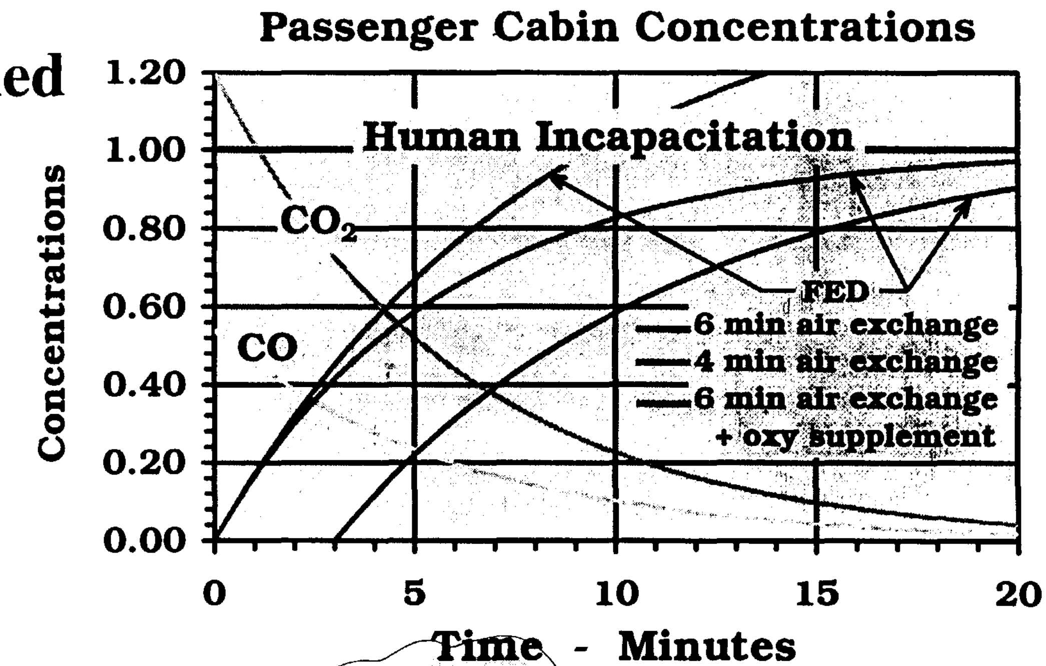
Cabin Smoke Extraction

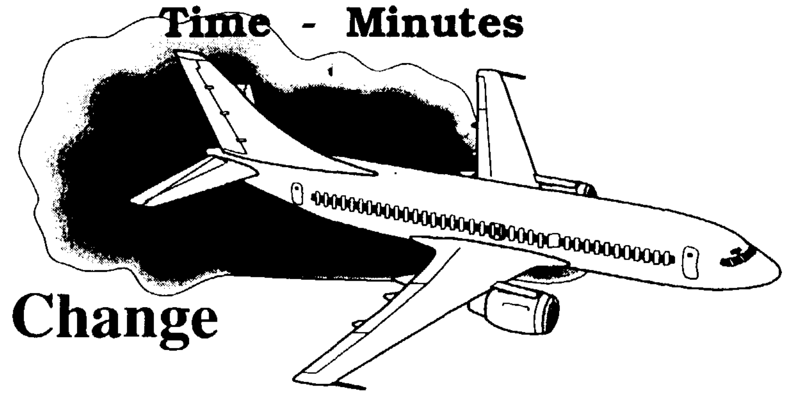
- Smoke Quantity Undefined

- Depressurization not Effective

- Air Pack MMEL???

- CO / CO_2 Ventilation Model





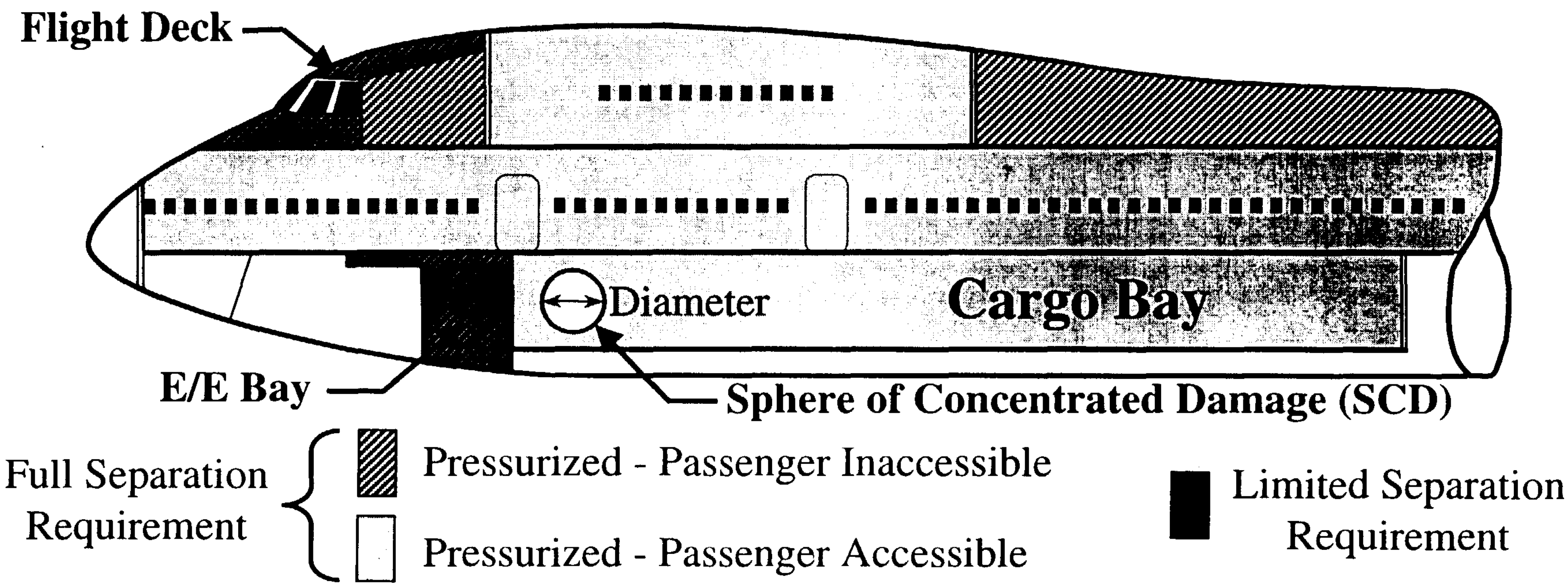
- Human Tolerance Related to Fractional Effective Dose (FED)

- Max Requirement : 4 Min per Air Change

- Supplemental Oxygen Acceptable (Hoods???)

Systems Survivability

Rule Will Resemble FAR 25.365(e) - "20 Square-Foot Hole Rule"
Circular Area Converted to a Spherical Diameter

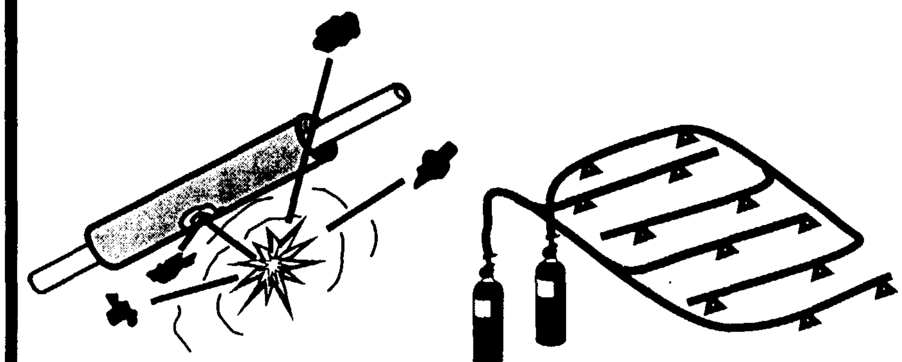


SCD Applied Anywhere Within Pressurized Compartment
Some Confined Areas may Have Limited Separation Requirement
SCD Does not Extend Beyond Inner Mold Line (IML)
Systems Protection Undefined if Separation is Unachievable

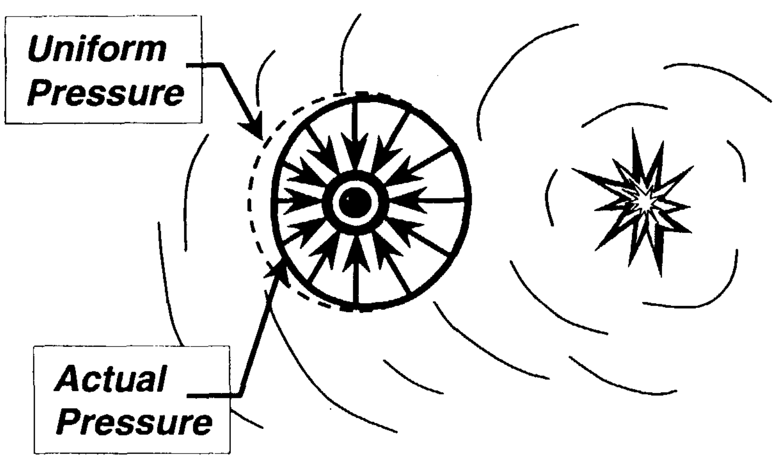
Cargo Compartment Fire Suppression

Fire Detection is Adequate

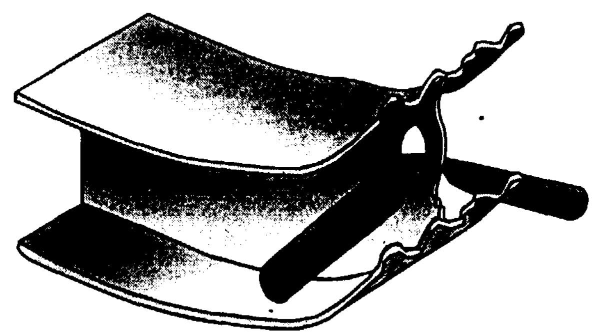
Shielding or Redundancy



Blast Effects Insignificant



Design for Large Deformations

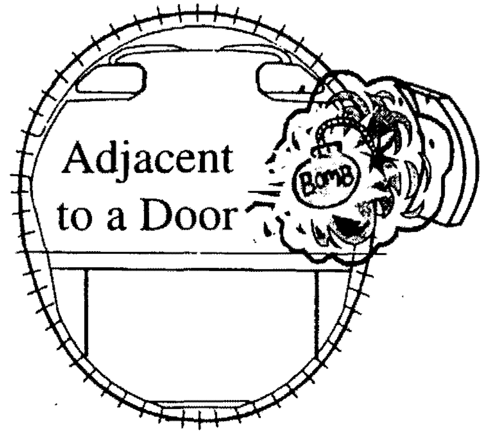


- Several Inch Displacements

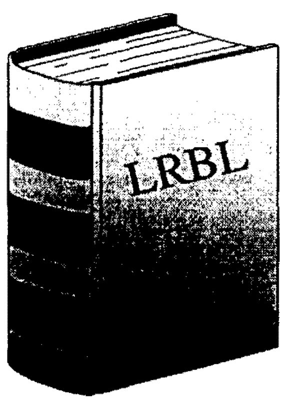
Least Risk Bomb Location
(Design & Identification)

- Specific Threat not Identified
- FAA may Specify Damage Size for Other Locations

FAA Preferred Location

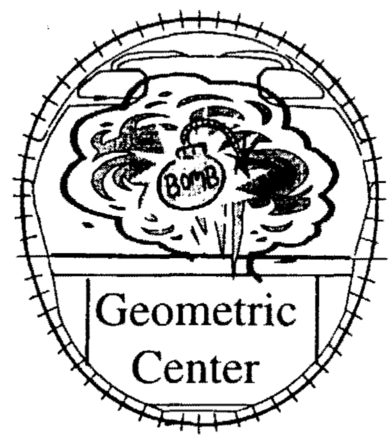


LRBL Procedures



- Manufacturer Creates
- FAA Distributes

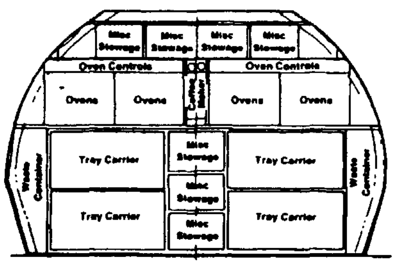
Proposed Alternative (Future Test)



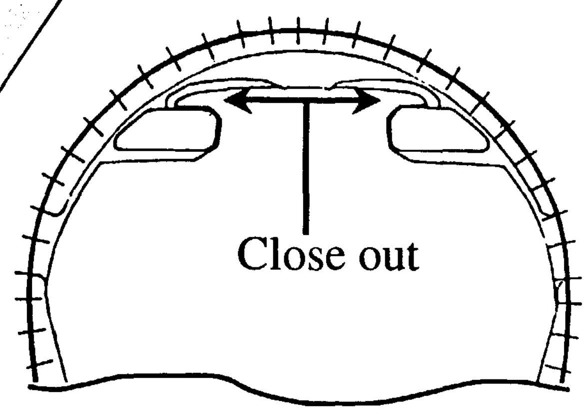
Design for Interior Search

Design for Ease of Inspection and Difficulty for Hiding

Specific Items / Regions Identified for Compliance



- Galleys / Lavatories
- Overhead Bins
- Life Vests
- Seats
- Paneling
- Crew-Rest Areas
- Closets & Lockers
- Flight Deck



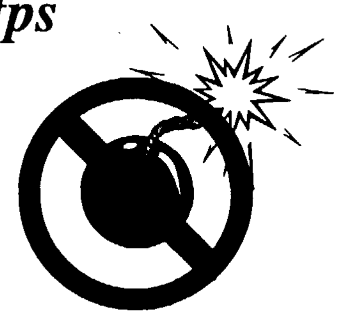
Penetration Resistance

Flight Deck Protection From all Passenger Compartments

No Acceptable Baseline Approved in AC

Protection Follows NIJ Standard 0101.04

- *.44 Magnum & 9mm @ 1400 fps*
- *Six Shots Each Bullet Type*
- *0º and 30º Impact Angles*
- *No Penetrations Allowed*



Enhanced Designs (by analyses) Need not be Tested

Flight Deck Intrusion

- Design for Entry Delay, not Impenetrable Barrier
- Protection Follows NILECJ Standard 0306.00
  - Medium Door Security
  - Based on Historical Break-Ins
  - Two Impacts Each (160 Joules)
    - Door Center
    - Door Latch
  - 250 lb. Pull on Doorknob
- Blow-out Panels Permitted
- Separate Doors for Each Test

Meeting Schedule

Paris, France — **24 - 26 July 2001**

[redacted] **This is our Last Meeting** [redacted]

Washin[redacted] D.C. — **1[redacted] - [redacted]4[redacted]ct 2001**

TAEIG
September 11/12
2001
Seattle, Washington

<u>PPIHWG Report</u>
<u>To</u>

11/12 September, 2001 Meeting

Of

TAEIG

Current Activities

- **25.1187/863---** **Flammable Fluid Fire Protection**
- **Appendix I--- Automatic Power Reserve**
- **25.903(d)--- Engine Rotor Burst**

- **25.975--- Fuel Tank Vent Fire Protection**

-
-
-

Current Activities (Cont.)

- **25.1187/863**

- **Proceeding per TAEIG enveloping direction**
- **Determined that task includes all areas of the airplane and all flammable fluids**
- **Working towards completion by December, 2001**

Current activities (Cont.)

- **25.904, Appendix I**
- **Task Group developed rule change and advisory material**
- **Flight Harmonization Study Group and Flight Test Harmonization Working Group have submitted proposal on CTI to Task Group (May 2001)**
- **Small PPIHWG review group headed by Hals Larsen (FAA) is evaluating the new material. Some significant issues identified.**

- **Goal is to have completion by next PPIHWG meeting, but may not be possible.**

Current activities (Cont.)

- **25.903(d)**

- **Group will start with AC20-128A as baseline**
- **Prescriptive design features will be scrubbed**
- **IORs to be revisited to determine which will be closed**
- **Group will work on failure models**
- **Working with China Lake Naval Weapons Center on 3-D visualizer program to evaluate fragment paths and practical mitigation means**

Current Activities (Cont.)

- **25.975**
  - **Task Group met in June**
  - **Reviewed draft rule and AC**
  - **Provided preliminary recommendations and comments to FAA Representative.**
  - **Next step- Feedback from FAA.**

-

Future Activities

- **25.1305 Powerplant Indications**
- **An AIA/AECMA Group met on this issue in June to prepare for tasking**

- **Group developed a work plan and schedule for completing work in 3 years.**
- **If tasking is completed, ARAC team will have first meeting in Cincinnati.**
- **Teams for 25.975, Fuel Tank Venting not meeting in Cincinnati due to SFAR 88 work.**
- **Work on 25.863/1187, 25.903(d) is continuing**
- **Appendix I – Conclusion to task in Cincinnati is goal**

Future Activities (Cont.)

- **Discussions were held on streamlining PPIHWG activities-all task groups bought into streamlining the work activities.**

- **Cowl Retention Task Team was to be formed for initial meeting in Cincinnati, however tasking is still not published.**
- **Next meetings of PPIHWG:**
- **October 9-11, 2001---Cincinnati, Ohio**
- **Spring, 2002---TBD, Europe**

ENGINE HARMONIZATION WORKING GROUP REPORT

Date: 11 Sept 01

ARAC Issue Group: Transport Airplane & Engines

Working Group: Bird Ingestion Phase II Task Group, Reporting to the Engine Harmonization Working Group (EHWG)

Task Title: Engine Bird Ingestion Requirements Phase II

Task Description: Define current bird threat and predictable changes. Determine if Phase I proposal is adequate. Consider high speed operations at low altitude. Recommend changes to Phase I rule and AC as appropriate. Assess effect of current threat on existing fleet and provide recommendations for areas of study other than engine certification requirements to mitigate risks.

Expected Product(s) NPRM ✓ AC ✓ Other ✓ (population control recommendation)

Schedule:

	FAA Team	Working Group	TAEIG
1) Publication of the Federal Register Notice			
2) Work Plan Approval			
3) Concept Approval			
4) Preliminary T/W and Legal Support			
5) Technical Approval in HWG		11/01 (goal)	12/01 (goal)
6) Economic Evaluation			
7) Formal T/W and Legal Review			
8) Technical Agreement			
9) Recommendation to FAA			

Status: Six meetings have been held. Safety target has been set at aircraft level. Tentative agreement has been reached on requirements for large flocking birds to address the threat up to 8#. Recommendations for controlling populations of large flocking birds being drafted. FAA provided issue paper regarding high speed operations.

Bottlenecks:. None at this time.

Next Action: Refine rule language, begin development of AC For large flocking birds.

Future Meetings: Task force meetings are scheduled for October 2001. Telecons are being conducted at scheduled intervals. Review with full EHWG will occur in October. Goal is submittal to TAEIG in Dec 01

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ENGINE HARMONIZATION WORKING GROUP ACTIVITY REPORT

Date: 11 Sept 01

ARAC Issue Group: Transport Airplane & Engines

Working Group: Critical Parts Task Group, Reporting to the Engine Harmonization Working Group (EHWG)

Task Title: Critical Part Integrity Rule Initiative

Task Description: Develop Harmonized Rule and AC for FAR 33.14 and JAR-E 515 for life management of critical parts. This will include declared lives, a process to address material, manufacturing, and usage induced anomalies as well as the process to achieve the rotor integrity throughout the lifetime of the product.

Expected Product(s) NPRM ✓ AC ✓ Other ☐

Schedule:

	FAA Team	Working Group	TAEIG
1) Publication of the Federal Register Notice			
2) Work Plan Approval			
3) Concept Approval			
4) Preliminary T/W and Legal Support			
5) Technical Approval in HWG		10/01 (goal)	12/01 (goal)
6) Economic Evaluation			
7) Formal T/W and Legal Review			
8) Technical Agreement			
9) Recommendation to FAA			

Status: Existing JAR-E 515 will be used as basis of the new rule. Changes will be made to encompass cradle to grave concept of control of critical parts. Schedule allows only consideration of rotating parts at this time (ref 33.14). FAR's for pressure vessels (ref 33.64) and static structure (ref 33.18) will not be developed at this time.

Bottlenecks: None at this time.

Next Action: Refine rule abd AC language.

Future Meetings: Next task force meeting will be held in October, followed by a review with EHWG. Goal is submittal to TAEIG in Dec 01.

ENGINE HARMONIZATION WORKING GROUP REPORT

Date: 11 Sept 01

ARAC Issue Group: Transport Airplane & Engines

Working Group: Bird Ingestion Phase II Task Group, Reporting to the Engine Harmonization Working Group (EHWG)

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Task Description: Define current bird threat and predictable changes. Determine if Phase I proposal is adequate. Consider high speed operations at low altitude. Recommend changes to Phase I rule and AC as appropriate. Assess effect of current threat on existing fleet and provide recommendations for areas of study other than engine certification requirements to mitigate risks.

Expected Product(s) NPRM ✔ AC ✔ Other ✔ (population control recommendation)

Schedule:

	FAA Team	Working Group	TAEIG
1) Publication of the Federal Register Notice			
2) Work Plan Approval			
3) Concept Approval			
4) Preliminary T/W and Legal Support			
5) Technical Approval in HWG		11/01 (goal)	12/01 (goal)
6) Economic Evaluation			
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8) Technical Agreement			
9) Recommendation to FAA			

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Bottlenecks:. None at this time.

Next Action: Refine rule language, begin development of AC For large flocking birds.

Future Meetings: Task force meetings are scheduled for October 2001. Telecons are being conducted at scheduled intervals. Review with full EHWG will occur in October. Goal is submittal to TAEIG in Dec 01

TAE Sept 2001 Handout 15
Handout 15

ENGINE HARMONIZATION WORKING GROUP ACTIVITY REPORT

Date: 11 Sept 01

ARAC Issue Group: Transport Airplane & Engines
Working Group: Critical Parts Task Group, Reporting to the Engine Harmonization Working Group (EHWG)

Task Title: Critical Part Integrity Rule Initiative

Task Description: Develop Harmonized Rule and AC for FAR 33.14 and JAR-E 515 for life management of critical parts. This will include declared lives, a process to address material, manufacturing, and usage induced anomalies as well as the process to achieve the rotor integrity throughout the lifetime of the product.

Expected Product(s) NPRM ✓ AC ✓ Other ☐

Schedule:

	FAA Team	Working Group	TAEIG
1) Publication of the Federal Register Notice			
2) Work Plan Approval			
3) Concept Approval			
4) Preliminary T/W and Legal Support			
5) Technical Approval in HWG		10/01 (goal)	12/01 (goal)
6) Economic Evaluation			
7) Formal T/W and Legal Review			
8) Technical Agreement			
9) Recommendation to FAA			

Status: Existing JAR-E 515 will be used as basis of the new rule. Changes will be made to encompass cradle to grave concept of control of critical parts. Schedule allows only consideration of rotating parts at this time (ref 33.14). FAR's for pressure vessels (ref 33.64) and static structure (ref 33.18) will not be developed at this time.
Bottlenecks: None at this time.
Next Action: Refine rule abd AC language.

Future Meetings: Next task force meeting will be held in October, followed by a review with EHWG. Goal is submittal to TAEIG in Dec 01.

WORKING GROUP ACTIVITY REPORT

- ARAC Issue: Transport Airplanes and Engines
- Working Group Name: Electrical Systems Harmonization Working Group
- Task Title: Task 1 – Electrical Generating and Distribution Systems
  Task 2 – Electrical Bonding and Protection Against Lightning and Static Electricity
- Task Description: The following differences between FAR 25 and JAR 25 and their associated guidance material have been identified as having a potentially significant impact on airplane design and cost. The ESHWG will develop recommendations to harmonize these FAR and JAR requirements.

Task 1 – Phase 1: FAR and JAR 25.1351(b) currently have different requirements relating to generating system power sources, distribution busses and cables, and associated control, regulation and protection devices. FAR and JAR 25.1351(c) define minimum requirements for connecting external power to the airplane electrical power system, with additional parameters for external power protection listed in the JAR. FAR and JAR 25.1351(d) address alternate/standby power systems. FAR 25.1351(d) defines minimum requirements to enable safe operation in VFR conditions for a period of not less than five minutes to enable engine relight. JAR 25.1351(d), with it's related ACJ, requires provision for a high integrity alternate/ standby power system with a duration for time limited systems compatible with JAR-OPS and ICAO Annex 8. This ACJ also provides Interpretive Material for non-time limited alternate/standby power sources and specifies services that must remain powered following loss of normal electric power.

Task 1 – Phase 2: The following FAR and JAR differences have been identified as having a lesser impact on airplane design and cost. FAR and JAR 25.1353(a) and 25.1431(d) address electrical interference on systems, with additional requirements contained in the JAR. FAR and JAR 25.1353(c) address control of storage battery charging. The JAR applies these requirements to all nickel-cadmium batteries, regardless of size or function, and adds requirements relating to maintenance of over-temperature sensing devices. FAR and JAR 25.1353(d) address electrical cable requirements, with the JAR containing additional requirements. FAR and JAR 25.1355(c) address electric power distribution. The JAR introduces Interpretive Material concerning segregation of electrical feeders to minimize the possibility of cascade or multiple failures. JAR 25X1360 addresses precautions against injury, with no equivalent FAR. JAR 25X1362 addresses emergency supplies for emergency conditions, with no equivalent FAR. FAR and JAR 25.1363 address testing criteria. The JAR contains additional criteria to be considered. The System Design and Analysis Harmonization Working Group (SD&A HWG) has proposed that the ESHWG harmonize and update 25.1310 (previously 25.1309(e) & (f)).

(Handout 6

The TAEIG added two new tasks at the meeting on September 14 -15, 1999, which are to be included in the Task 1, Phase 2. They are FAR/JAR 25.869(a), which addresses fire protection of electrical system components and FAR/JAR 25.1357, which addresses requirements for electrical circuit protection devices.

Task 2: JAR 25X899 and associated ACJ 25X899 provide for consideration of electrical bonding and protection against lightning and static electricity. An equivalent paragraph does not exist in the FAR.

- Expected Product(s) NPRM [x] AC [x] Other [x]
- Schedule:

Task 1, Phase 1 – (Category 1 Items) (3 Items)
FAR/JAR: 25.1351(b), 25.1351(c), 25.1351(d)

Task 1, Phase 2 – (Category 1 Items) (12 Items)
FAR/JAR: *25.869(a)*, 25.1309(b)(amj), 25.1310, *25.1353(a), 25.1353(c)(5), 25.1353(c)(6), 25.1353(d)*, 25.1355(c), 25.1357, 25X1360, 25.1363, *25.1431(d)*

Task 1, Phase 2 – (Category 3 Item) (1 Item)
FAR/JAR: 25X1362

Task 2 – (Category 1 Item) (1 Item)
FAR/JAR: 25X899

(NPRMs issued for FARs shown in Italics)

	FAA Team	Working Group	TAEIG
1) Publication of the Federal Register Notice	Sept. 11, 1998		
2) Working Group Report(s) Complete		May 25, 2000	
3) Phase 2 Complete (TAE Approves WG Report)			September 13, 2000
4) TAE Submits Report to FAA			September 18, 2000
5) Phase 3 Complete (FAA Drafts NPRM)	10 Complete 7 Remaining (Apr. 20, 2001)		
6) NPRM Back to HWG	10 Complete 7 Remaining (Apr. 20, 2001)		
7) Phase 4 Complete (WG and TAE Approve NPRM Report)		10 Complete (May 17, 2001) 7 TBD	6 NPRMs Issued (May 17, 2001) 11 TBD

WORKING GROUP ACTIVITY REPORT

(Considered "Technical Agreement")			

- Status – Convened nine meetings outlined below.

Meeting #1 – Long Beach, California; January 12-14, 1999
A. Established working group policies.
B. Drafted Work Plan defining task and working procedures.

Meeting #2 – London, England; March 30 – April 1, 1999
A. Gathered background data on JAR 25.1351 and 25X899
B. Drafted letter to TAEIG regarding categorization of assigned FAR/JAR paragraphs under "Fast Track".
C. Began "Fast Track" work group procedures.

Meeting #3 – Seattle, Washington; July 6-8, 1999
A. Began discussion on 25X899 with group divided into two positions.
B. Compromise position on 25X899 was to be worked out by next meeting.
C. Created first drafts of two Category 1 working group reports.

Meeting #4 – Hoofddorp, The Netherlands; October 19-21, 1999
A. Completed first drafts of remaining Category 1 working group reports.
B. Work group would review all report drafts to resolve any issues between fourth and fifth meetings.

Meeting #5 – Wichita, Kansas; November 30 - December 2, 1999
A. Completed final drafts of all Category 1 FAR/JAR paragraphs.
B. Submitted thirteen of sixteen reports to TAEIG at December meeting.
C. Held back three reports for further review of cost impact statement.

Meeting #6 – Paris, France; February 15-17, 2000
A. Finalized the remaining three Category 1 reports and submitted to TAEIG.
B. Began identification of issues for the Category 3 item, 25X1362.
C. Members would gather data on products from each company to help establish industry practice regarding subject addressed in 25X1362 in preparation for next meeting.

Meeting #7 – Ottawa, Canada; May 23-25, 2000
A. Discussed all issues relating to 25X1362 and completed final draft of the working group report.
B. Submitted final working group report to TAEIG.

Meeting #8 – Palm Coast, Florida; October 31 – November 2, 2000
A. Reviewed drafts of NPRMs from FAA, which resulted from six working group reports and approved with few comments.
B. Reviewed JAA draft of PNPA 25DF-317 which outlines JAA response to ESHWG working group reports.

C. Noted possible "deharmonization" of 25.1310 due to FAA delay in issuing NPRM.
D. Proposed three TORs for future ESHWG tasks and submitted to TAEIG for review and approval.

Meeting #9 – Bristol, England; May 15 – 17, 2001

A. Welcomed new member from Embraer and a new FAA focal to the working group.
B. Reviewed drafts from FAA, which resulted from four working group reports and approved with several comments.
C. Co-chairs from the Wire Systems Harmonization Working Group (WSHWG) established by ATSRAC joined our meeting for one-half day to familiarize ESHWG with ATSRAC Task 6 and to establish working relationship. Schedule for both groups to meet concurrently was agreed upon to allow maximum coordination for completion of ATSRAC tasks.
D. Began task of modifying draft AC 25.1351-1 to reflect proposed harmonization of FAR/JAR 25.1351 and associated ACJs. During discussion it was noted that in recent certification projects the FAA has written Issue Papers, Special Conditions, etc., that require compliance to standards even more stringent than the harmonized standards proposed by ESHWG for FAR/JAR 25.1351(d). Since the FAA has not completed the draft NPRM for FAR/JAR 25.1351(d), the ESHWG determined that further guidance on FAA policy regarding FAR 25.1351(d) is required.

Meeting #10 – Toulouse, France; August 21-24, 2001

A. No new draft NPRMs were available from the FAA for our review.
B. Continued review of FAA Policy Statement ANM-01-111-159 that relates to FAR 25.1333 and 25.1351(d). The impact of this on the ESHWG recommendation for the harmonized FAR/JAR 25.1351 is not yet clear.
C. One day was devoted to ESHWG business and the rest were the first combined meeting for the ESHWG and the WSHWG.
D. Combined meeting of ESHWG and WSHWG reviewed the six tasks from ATSRAC and began to create the plan for completion. WSHWG is working to provide the basic structure of the recommendations and the combined ESHWG/WSHWG meetings will fill in the details. There still are some questions regarding the scope of this task which must be addressed by ATSRAC.

- Bottlenecks – None

- Next Actions – Continue review of FAA drafted material relating to the remaining ESHWG harmonization proposals as they become available from the FAA. Continue review and update of Advisory Circulars AC 25-10, 25-16, and Draft AC 25.1351-1 to be compatible with newly harmonized FARs and recent FAA Policy Memos and Issue

Papers. Coordinate proposed FAR material coming from WSHWG to create new harmonized FARs and ACs.

- Future Meetings – Next meeting date has been set for November 6 – 8, 2001, in Seattle. This will include a joint meeting with WSHWG from ATSRAC. The next joint meeting date is planned for January 28 – 30, 2002, in Paris, France.

- Lessons Learned Discussion (at end of task) – (1) Improved instructions are needed to help working groups address question #16 in the Working Group Report regarding economic impact of the proposed rule or advisory material. (2) Feedback is needed when working group submits comments to FAA drafted material to indicate FAA acceptance or other disposition of working group comments.

- Request for TAEIG Action – The ESHWG has no requests for TAEIG action at this time.

ETOPS TASKING UPDATE

The separate working subgroups are tasked to draft Rule, Preamble, and Advisory Circular documents. Drafting groups within the subgroups were identified to accomplish (finish) this drafting. The following schedule was developed; the task descriptions are due on the date indicated:

August 31. The drafting groups will post a draft of the complete set of documents (Rule, Preamble, and Advisory Circular) pertaining to their area of responsibility on postdoc. In addition, an email should be sent with the documents as attachments to all members of the sub groups and the Working Group.

September 21. By this date, comments on the posted documents must be submitted to the Drafting group . These should be written comments, clearly labeled against the appropriate document, and sent via email to the drafting group.

October 12. The drafting group will re-post the complete set of drafts considering the comments, either incorporating comments received or providing a disposition of comments not incorporated.

Handout 17

Handout 17

ETOPS TASKING UPDATE (continued)

October 26. The Master Drafting Group will work during the preceding weeks to integrate the separate documents into a consolidated document package for review by the entire Working Group. The consolidated document package will be posted by this date on Postdoc.

November 27-30. The entire Working Group must review the drafted and revised material in preparation for the meeting scheduled November 27-30 in Washington, D.C. During this meeting, each subgroup will provide a complete briefing of the material they produced. This meeting will be the forum for final discussion prior to passing the completed package to the FAA. The meeting is scheduled for four full days, therefore participants should plan travel arrangements accordingly.

The package will be turned over to the FAA for final processing. It was originally planned to have the FAA lawyers and economists working with us so a final NPRM would be our finished product.

WORKING GROUP ACTIVITY REPORT

Date: September 12th, 2001

- ARAC Issue Group: Transport Airplanes and Engines
- Working Group Name: Flight Guidance System HWG
- Task Title:

  25.1329/25.1335 - Automatic Flight Control and Guidance System Requirements Harmonization and Technology Update

- Task Description

  Review 25.1329/1335, JAR paragraphs 25.1329/1335 plus material contained in NPA 25F-243 in addition to Sec. 121.579 and the associated Advisory Circular 25.1329-1 and ACJ 25.1329. Update and harmonize the Part 25 sections and the associated guidance material, in the light of the review of regulatory materials, current certification experience, and changes in technology and system design.

  Review recommendations that stem from recent transport aviation events and relate to crew error, cockpit automation and in particular, automatic flight control/guidance made by the NTSB, the FAA Human Factors Team, and the JAA Human Factors Steering Group. Make any proposed amendments to Sections. 25.1329/25.1335 and advisory materials that are needed to resolve these recommendations.

- Expected Product(s) NPRM ✓ AC ✓ Other ✓

  - Proposal for revisions to the Flight Test Guide

- **Status & Schedule:**

Status

There has been an Editor's meeting and no Plenary meeting since the last report to TAEIG. The proposed 25.1329 Rule is complete. Draft 14 of the AC/ACJ was produced following the last plenary meeting held during the week of June 7th in Seattle. Thirty-four comments were received on this draft - primarily on the new sections. All of the comments were addressed during an Editor's meeting in August. The significant reduction in number of comments is interpreted to be an indicator of the maturity of the initial twelve sections of the AC/ACJ.

Section 14 (the last major section of the AC/ACJ to be worked), dealing with COMPLIANCE DEMONSTRATION USING FLIGHT TEST AND SIMULATION, has been further developed in Draft 15. Draft 15 was produced and distributed to the FGSHWG members on September 5th.

One Minority Opinion has been identified to date (Attached).

As reported at the last meeting, there has been dialog within the group relating to the need for data to support the economic assessment - but little feedback has been received to date. An Applicability Form has been developed (attached) to facilitate the generation of this data.

> **Action** - The group requests that the industry members of TAEIG consider whether transmitting this form, with the latest draft of the Rule and AC/ACJ to its members, would be a meaningful way of developing the necessary data from a representative cross-section of industry. **[Still open from last meeting]**
>
> -
>
> - Feedback requested from TAEIG on possible methods to get the necessary economic data to assess the potential significant cost to some constituents by this Rule and AC/ACJ

Future Plans

Draft 15 of the AC/ACJ and any associated comments will be reviewed and dispositioned by the Group at the next Plenary meeting during the week of September 24th. We hope to have the first draft of a Working Group Report available for review at that meeting. The FAA plans on providing a presentation/discussion/interpretation on the Change Product Rule at the meeting as the Rule may have a significant implication of the economic assessment. Minority Opinions will also be discussed.

The Group will attempt to reach technical agreement at the Plenary meeting in September. However, the maturity of Section 14 and the associated Flight Test Appendix may make this a low probability of occurrence. The Editing team's assessment is that it is likely that we will have to implement our contingency plan for a meeting in December

Schedule

Date	Meeting type	Location	Comment
April 9-11, 2001	Editors	Gatwick	Leading to Draft 13
April 23 week	Select editors	Seattle	Section 14
May 4, 2001			Draft 13 distributed to HWG & Tech editor
			Tech editor to prepare reformatted Draft 13 to begin Plenary as basis of draft 14
June 4-7, 2001	Plenary	SEA	Work to support preparation of Draft 14 • 95% Technical Agreement • Identify Minority Opinions • WG Report – discuss • Appendix X
June 8, 2001	Editors	SEA	Clean up material for Draft 14
June 11, 2001	John Ackland		Distribute Section 14
June 26-27, 2001			TAEIG meeting
June 29, 2001			Distribute ACJ Draft 14 to HWG
July 6, 2001	All members		Comments due on Section 14, MUH/MEA
August 10, 2001			Final Comments on due on Draft 14 Minority Opinions Documented
August 21-23, 2001	Editors	Williamsburg, VA	Leading to Draft 15
September 5th, 2001			Draft 15 distributed to HWG
September 24-27	Plenary	Rochester, UK	"Final" technical agreement?
September 28	Editors	Rochester, UK	Prepare Version 16
December 3-6	Plenary	PHX	Contingency - Final technical agreement

FGSHWG Minority Opinion

The Flight Guidance Harmonization Working Group [FGSHWG] was chartered to produce proposed revisions to FAR/JAR 25.1329 and the associated AC/ACJs. The FGSHWG has made a best effort attempt to reach consensus on all issues. This document identifies a Minority Opinion that has been expressed following the consensus building process.

Originator:

Chris Durkin

Affiliation:

Honeywell

Summary of Issue:

The new standards should consider the feasibility of compliance, including technological and practical limitations. The cost versus benefit of the new requirements for small FAR/JAR 25 airplane models and as applied to after-market modifications via STC/JSTC programs should be reevaluated.

Also, the imposition of new standards under FAR/JAR 25.1329 and the associated AC/ACJs should be aligned with the express intent of US Code Title 49, sections 44701 and 44702, where regulations or standards are classified appropriate to the differences between air transportation and other commerce.

Rule or AC/ACJ Reference(s):

FAR/JAR 25.1329(g); AC/ACJ sections 10.2.1, 14.2.2.1, and Appendix FT section FT.1.

FAR/JAR 25.1329(h); AC/ACJ sections 10.4, 10.4.1, 14.2.3.1, and Appendix FT section FT2.1.

FAR/JAR 25.1329(l); AC/ACJ sections 8.1.2.4, 8.4, and 14.2.5.

Discussion:

The new rule requires the flight guidance system to operate free of unacceptable loads and hazardous deviations under any condition of flight appropriate to its use. The AC/ACJ elaborates on the intent of the rule by stating that icing conditions are one of several rare normal conditions that must be considered. The AC/ACJ also states that the only logical assessment would be made during natural icing tests or with ice shapes affixed to the airplane's surfaces.

Our issue is with the difficulty in performing the suggested icing tests. Where a TC program is underway for a small FAR 25 airplane, considerable additional expense and program time could be expended to facilitate such tests. (The validation of the flight control system is normally performed on a different prototype airplane than the one being used for icing tests; this allows concurrent development and approval.) For STC programs in small FAR 25 airplanes, however, the icing test requirements virtually assure that no such after-market program would be undertaken. The STC applicant typically lacks the necessary resources, and the cost involved in working with the TC holder to develop icing shapes or to seek natural icing or to use a tanker aircraft would be prohibitive.

We also do not believe these requirements should apply to small FAR 25 airplanes as there is a lack of history of autopilot-related icing problems with this class aircraft. The accident that has been cited as prompting these new requirements appears to be unique, and related to an aircraft design characteristic that has no commonality with small FAR 25 airplanes. The basic issue centers on the need for an appropriate warning when the autopilot is holding a sustained out-of-trim condition, and that need is addressed elsewhere in the new AC/ACJ. This makes autopilot qualification tests in icing conditions or with icing shapes moot.

The rule and the AC/ACJ also specify the incorporation of low speed protection in the flight control system. While the AC/ACJ recognizes that existing FGS systems have no such protection, it nonetheless goes on to state the intent of the rule is to require the protection. A disconnect of the autopilot is not normally sufficient for the protection (it is one option during approach operations), rather, an anticipation of the low speed and corrective action is required.

Our opinion is that anticipatory low speed protection for small FAR 25 airplanes is not practical. The AC/ACJ focus heavily on the use of autothrust as a mitigating element to control speed excursions; most small FAR 25 airplanes have no such feature. Use of the pitch channel alone to control the flight path and protect against low speed excursions does not provide the optimum result. Indeed, section 10.4.1.1 of the AC/ACJ outlines the trade-off of parameters that is required during approach operations without autothrust. The main concern when implementing anticipatory low speed protection in small FAR 25 airplanes is that nuisance alerts or unwanted flight path deviations will result. The margin between a 1.3Vs approach and stall in these airplanes is relatively small in terms of absolute airspeed differential. This challenges the ability of the flight guidance system to maintain path control and speed control when no autothrust is available. The nuisance alerts and/or unwanted deviations from the intended flight path that result more than offset any benefit gained beyond the stall protection that already exists in these airplanes.

The rule also requires that an unsafe condition does not result when the flight crew overrides the primary flight controls. The AC/ACJ explains that the autopilot must disengage when the flight crew applies a significant force to the flight controls. It also states that autopilot automatic trim motion must be limited when an override force is applied so that no hazardous condition results.

Our experience is that implementation of this type design feature in a non-hydraulic, cable-driven aircraft is very difficult – and often impossible – to achieve. A force sensor is usually required in the flight crew's primary controls to determine the source of resistance to the autopilot. For STC programs, the design of this type system may be beyond the technical capability of the applicant and his resources, it may expand the scope of the project too far to be acceptable, or the expense may be prohibitive to the business case for the program. Because of these reasons, the imposition of the new protection requirement may eliminate a large number of STC after-market programs in small FAR 25 airplanes.

Our final issue, relevant to all three points above, concerns a need to recognize the distinction between the degree of safety required for air transportation and other commerce. US Code 49, section 44701 paragraphs (a) and (d), and section 44702 paragraph (b), expressly state that such a classification of regulations should be made. This allows the FGSHWG to stratify the rule and AC/ACJ in such a way that the current, high level of safety is maintained for air carrier operators, but that a lesser set of requirements could be constructed for small FAR 25 airplanes (less than 80,000 pounds gross weight) that are not operated under part 121.

Recommendation:

1. Stratify the rule and the AC/ACJ in the areas noted above under "discussion" to distinguish between requirements for those aircraft operated under part 121 versus all others. The highest level of safety would be required for the class that includes all part 121 operators, or for those airplanes above 80,000 pounds gross weight. A lower standard would be applied for the class that includes airplanes below 80,000 pounds gross weight and which are operated other than under part 121.

2. Reword the rule and AC/ACJ so that the requirements for icing considerations and for flight tests in natural icing conditions or with ice shapes do not apply to the lower class airplanes identified under recommendation 1.

3. Rewrite the rule and AC/ACJ to require anticipatory low speed protection for the higher class airplanes identified under recommendation 1. For the lower class airplanes, accept a desengagement of the flight control system at aircraft stall warning as an acceptable means of compliance.

4. Revise the rule and the AC/ACJ to provide further clarification of the autopilot override protection requirement. Retain the current guidance for the higher class airplanes, but eliminate the automatic disconnect feature as a need for the lower class airplanes. Where automatic trim motion is concerned, generate two levels of expected effects where larger excursions are acceptable for the lower class

airplanes following a flight crew override. Define the expected protocol for evaluation of an override, including the duration of the override prior to flight crew corrective action or control release.

Signature: Chris Durkin, Honeywell Date: 8-10-01

Applicability Considerations

The Flight Guidance Harmonization Working Group [FGSHWG] has produced proposed revisions to FAR/JAR 25.1329 and the associated AC/ACJs. These proposed revisions establish revised regulatory standards for Flight Guidance Systems and acceptable means of compliance with those standards. The applicability of the new standards is likely to have operational, manufacturing and economic impacts on operators, airplane manufacturers and equipment suppliers. The intent of this form is to collect various perspectives, opinions and data on the impact of introducing the revised Rule and AC/ACJ.

Applicability Scenarios:

Following regulatory promulgation of the Rule, it can be assumed that the Rule becomes applicable for:

1. An application for new airplane Type Certification (TC)
2. A Major Change to a current airplane type by STC or Amended Type Certification

Benefits:

The Benefits associated with the proposed rule change are primarily related to improvements in safety by addressing perceived vulnerabilities identified in service. The acceptable means of compliance criteria has been revised consistent with the changes in the Rule and attempts have been made to standardize on industry best practices. Some of these best practices are an attempt to minimize human error and confusion in operation of Flight Guidance Systems.

Costs:

As part of the Rule-making process, the costs associated with the Rule change need to be established. The remainder of this form is intended to provide a forum for end user's to document the impact of the Rule change on their business.

Company:

Type of Business:

General Comments on the Proposed Rule-making action:

General Comment on the Impact of the Rule Change:

- *What more-- or what less -- will have to be done if this rule is issued?*

Associated Costs:

What is the cost impact of complying with the proposed regulation? Consider:

- *The differences (in general terms) between current practice and the actions required by the new rule?*
- *Are new tests or designs are required, how much time and costs would be associated with them?*
- *If new equipment is required, what are projected purchase, installation, and maintenance costs?*
- *Does the proposed rule relieve industry of testing or any otherother costs, please provide an estimate of any such costs.*

  ***NOTE**: "Cost" does not have to be stated in terms of dollars; it can be stated in terms of work-hours, downtime, etc. Include as much detail as possible.)*

Other Considerations:

- Are small businesses affected?
  (In general terms, "small businesses" are those employing 1,500 people or less. This question relates to the Regulatory Flexibility Act of 1980 and the Small Business Regulatory Enforcement Fairness Act of 1996.]

- Will the proposed rule require any new or additional record keeping? If so, explain.
  [This question relates to the Paperwork Reduction Act of 1995.]

- Will the proposed rule create any unnecessary obstacles to the foreign commerce of the United States -- i.e., create barriers to international trade?
  [This question relates to the Trade Agreement Act of 1979.]

- Will the proposed rule result in spending by State, local, or tribal governments, or by the private sector, that will be $100 million or more in one year?
  [This question relates to the Unfunded Mandates Reform Act of 1995.]
  -
  -
  -
  -
- Other

JOINT ADVISORY CIRCULAR
AC/ACJ 25.1329

FLIGHT GUIDANCE SYSTEM APPROVAL

Draft 14

July 3rd, 2001

TABLE OF CONTENTS

1 PURPOSE

This AC/ACJ describes an acceptable means for showing compliance with the requirements of §/JAR 25.FGS of the Federal Aviation Regulations (FAR) and Joint Airworthiness Requirements (JAR). These means are intended to provide guidance to supplement the engineering and operational judgment that must form the basis of any compliance demonstration.

2 CANCELLATION/EFFECTIVE DATE

AC 25.1329-1A, dated July 8, 1968; and ACJ 25.1329, Change 15 (Amend. 96/1, Eff. 19.4.96); are hereby cancelled.

3 RELATED FAR/JAR SECTIONS AND ADVISORY MATERIAL.

FAR/JAR

The following are related FAR/JAR standards:

§ 25.671	Control systems, General
§ 25.672	Stability augmentation and automatic and power-operated systems
§ 25.677	Trim systems
§ 25.777	Cockpit controls
§ 25.779	Motion and effect of cockpit controls
§ 25.781	Cockpit control knob shape
§ 25.1301	Function and installation
§ 25.1309	Equipment, systems, and installations
§ 25.1322	Warning, caution, and advisory lights
JAR-OPS 1	Commercial Air Transportation - Aeroplanes
JAR-AWO	All Weather Operations

Advisory Circulars, Advisory Material Joint.

The following guidance and advisory materials are referenced in this AC:

AC 20-115B	Radio Technical Commission for Aeronautics Document RTCA/DO 178B
AC 20-129	Airworthiness Approval of Vertical Navigation (VNAV) Systems for use in the U.S. National Airspace System (NAS) and Alaska

AC 25-7A	Flight Test Guide for Certification of Transport Category Airplanes
AC 25-11	Transport Airplane Electronic Display Systems
AC 25-12	Airworthiness Criteria for the Approval of Airborne Windshear Warning Systems in Transport Category Airplanes
AC 25.1309-1A	System Design and Analysis
AC 25.1581-1	Airplane Flight Manual
AC 120-28D	Criteria for Approval of Category III Weather Minima for Takeoff, Landing, and Rollout
AC 120-29A	Criteria for Approving Category 1 and Category II Landing Minima for FAR 121 Operators
AC 120-41	Criteria for Operational Approval of Airborne Windshear Alerting and Flight Guidance Systems
AC for 25.671	(in work from FCHWG)
ACJ 25.1309	System Design Analysis
AMJ 25-11	Electronic Display systems
AMJ 25.1581	Airplane Flight Manual
AMJ 25.1322	Alerting Systems

4 RELATED DOCUMENTS

Industry documents.

The following are related Industry Standards that may be useful in the design process:

SAE ARP5366	Autopilot, Flight Director and Autothrust Systems
SAE ARP4754	Certification Considerations for Highly Integrated or Complex Aircraft Systems
SAE ARP4100	Flight Deck and Handling Qualities Standards for Transport Aircraft
SAE ARP4761	Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment
RTCA DO-178B/ EUROCAE ED-12B	Software Considerations in Airborne Systems and Equipment

RTCA DO-160D/ EUROCAE ED-14D	Environmental Conditions and Test Procedures for Airborne Equipment
RTCA DO-254/ EUROCAE ED	Design Assurance Guidance for Airborne Electronic Hardware
DOT/FAA/CT-96/1	Human Factors Design Guide for Acquisition of Commercial-Off-the-Shelf Subsystems, Non-Developmental Items, and Developmental Systems.

5 DEFINITIONS AND ACRONYMS

The following definitions apply to the requirements of §/JAR 25.1329 and the guidance material provided in this AC/ACJ. They should not be assumed to apply to the same or similar terms used in other regulations or AC's/ACJ's. Terms for which standard dictionary definitions apply are not defined in this AC.

5.1 Definitions

Abnormal Condition	See Non-normal
Advisory	Avionics HWG: An operational or airplane system condition that requires flight crew awareness. Compensatory or corrective action may be required. JAA: Crew awareness is required and subsequent crew action may be required.
Alert	A generic term used to describe a flight deck indication meant to attract the attention of the flight crew to a non-normal operational or airplane system condition without implying the degree or level of urgency for recognition and corrective action by the crew. Warnings, Cautions and Advisories are considered to be Alerts. JAA definition: A signal to the flight crew... Avionics group draft definition: A visual aural or tactile stimulus to the flight crew intended to draw their attention to the existence of an abnormality, system fault, or airplane condition.
Analysis	The terms "analysis" and "assessment" are used throughout. Each has a broad definition and the two terms are to some extent interchangeable. However, the term analysis generally implies a more specific, more detailed evaluation, while the term assessment may be a more general or broader evaluation but may include one or more types of analysis [AC/ACJ 25.1309].
Arm	A condition where the intent to transition to a new mode or state has been established but the criteria necessary to make that transition has not been satisfied.
Assessment	See the definition of analysis above [AC/ACJ 25.1309].

Autopilot	The autopilot function provides automatic control of the airplane, typically in pitch, roll, and yaw. The term includes the sensors, computers, power supplies, servo-motors/actuators and associated wiring, necessary for its function. It includes any indications and controllers necessary for the pilot to manage and supervise the system. Any part of the autopilot that remains connected to the primary flight controls when the autopilot is not in use is regarded as a part of the primary flight controls.
Autothrust	The autothrust function provides automatic control of the thrust of the airplane. The term includes the sensors, computers, power supplies, servo-motors/actuators and associated wiring, necessary for its function. It includes any indications and controllers necessary for the pilot to manage and supervise the system. Any part of the autothrust that remains connected to the engine controls when the autothrust is not in use is regarded as a part of the engine control system.
Caution	A flight deck indication that alerts the flight crew to a non-normal operational or airplane system condition that requires immediate crew awareness. Subsequent pilot corrective compensatory action will be required.
Cognitive Task Analysis	An analysis that focuses on the mental processes, skills, strategies, and use of information required for task performance.
Complex	A system is Complex when its operation, failure modes, or failure effects are difficult to comprehend without the aid of analytical methods [AC/ACJ 25.1309].
Conformal	Positioned and scaled with respect to the outside view
Control Wheel Steering (CWS)	A FGS function which, when engaged, enables the pilot/first officer to manually fly the airplane by positioning the flight control surfaces using the autopilot servos. The positions of the flight deck controls (e.g., control column, control wheel) are determined by the FCS, which converts them into autopilot servo commands. The autopilot servos, in turn, drive the appropriate flight control surfaces. CWS is, therefore, a rudimentary form of fly-by-wire control.
Conventional	A system is considered to be Conventional if its functionality, the technological means used to implement its functionality, and its intended usage are all the same as, or closely similar to, that of previously approved systems that are commonly-used [AC/ACJ 25.1309].

Engage	A steady state that exists when a flight crew request for mode or system functionality has been satisfied.
Error	An omission or incorrect action by a crewmember or maintenance personnel, or a mistake in requirements, design, or implementation [AC/ACJ 25.1309].
Failure	An occurrence which affects the operation of a component, part, or element such that it can no longer function as intended (this includes both loss of function and malfunction). NOTE: Errors may cause failures, but are not considered to be failures [AC/ACJ 25.1309].
Failure Condition	A condition having an effect on the airplane and/or its occupants, either direct or consequential, which is caused or contributed to by one or more failures or errors, considering flight phase and relevant adverse operational or environmental conditions, or external events [AC/ACJ 25.1309]
Fail Operational System	A system capable of completing an operation, following the failure of any single element or component of that system, without pilot action.
Fail Passive System	A system which, in the event of a failure, results in: (a) no significant deviation in the aircraft flight path or attitude and (b) no out-of-trim condition at disengagement that is not easily controlled by the pilot.
Flight Director	A visual cue or set of cues that are used during manual control of the airplane as command information to direct the pilot how to maneuver the airplane, usually in pitch, roll and/or yaw, to track a desired flight path. The flight director, displayed on the pilot's primary head down attitude indicator (ADI) or head up display (HUD), is a component of the flight guidance system and is integrated with airborne attitude, air data and navigation systems.
Flight Guidance System	A system consisting of one or more of the following elements: (a) autopilot, (b) flight director, (c) automatic thrust control,

	and any interactions with stability augmentation and trim systems.
Flight Management System	An aircraft area navigation system and associated displays and I/O device(s) having complex multi-waypoint lateral (LNAV) and vertical (VNAV) navigation capability (or equivalent), data entry capability, data base memory to store route and instrument flight procedure information, and display readout of navigation parameters. The Flight Management System provides guidance commands to the FGS for the purpose of automatic navigation and speed control when the FGS is engaged in an appropriate mode or modes (e.g., VNAV, LVAV, RNAV).
Head-Up Display (HUD)	A transparent optical display system located level with and between the pilot and the forward windscreen. The HUD displays a combination of control, performance, navigation, and command information superimposed on the external field of view. It includes the display element, sensors, computers and power supplies, indications and controls. It is integrated with airborne attitude, air data and navigation systems, and as a display of command information is considered a component of the light guidance system.
Inadvertent	A condition or action that was not planned or intended.
Intervention	A temporary modification to an FGS or Flight Management System function, such as FMS speed or altitude targets, without disengaging the autopilot or changing its engaged modes. An intervention is distinguished from an override in that an intervention normally utilizes a dedicated control that is used to command a change some particular behavior of the FGS while an override uses direct force to oppose the actions of the FGS.
Latent Failure	A failure is latent until it is made known to the flight crew or maintenance personnel. A significant latent failure is one, which would in combination with one or more specific failures, or events result in a Hazardous or Catastrophic Failure Condition [AC/ACJ 25.1309].
Limit Flight Envelope	This envelope is the most outside flight envelope, generally associated with airplane design limits
Mode	A mode is system configuration that corresponds to a single (or set of) FGS behavior(s).
Non-normal	A condition or configuration of the airplane that would not

Condition	normally be experienced during routine flight operations - usually due to failures.
Normal Condition	Any fault free condition typically experienced in normal flight operations. Operations typically well within the aircraft flight envelope, and with routine atmospheric and environmental conditions.
Normal Flight Envelope	The range of altitude and operating speeds that are defined by the airplane manufacturer as consistent with conducting flight operations for which the airplane is designed. This envelope is generally associated with practical, routine operation and/or prescribed conditions, whether all-engine or engine inoperative.
Override	An intervention by the flight crew to prevent or alter an operation being conducted by a flight guidance function.
Rare Normal Condition	A fault-free condition that is experienced infrequently by the airplane due to significant environmental conditions (e.g., significant wind, turbulence, or icing, etc) or non-routine operating conditions (e.g., out-of-trim due to fuel imbalance or under certain ferry configurations, or extremes of weight/c.g. combinations).
Redundancy	The presence of more than one independent means for accomplishing a given function or flight operation [AC/ACJ 25.1309].
Select	The flight crew action of requesting functionality or an end state condition
Significant transient	See "transient."
Stability Augmentation System (SAS)	Automatic systems which provide or enhance stability for specific aerodynamic characteristics of an airplane (e.g., Yaw Damper, Longitudinal Stability Augmentation System, Mach Trim).
System	A combination of components, parts, and elements that are inter-connected to perform one or more specific functions [AC/ACJ 25.1309].
Transient	A disturbance in the control or flight path of the airplane that is not consistent with response to flight crew inputs or environmental conditions. a. Minor transient: A transient that would not significantly reduce airplane safety, and which involves flight crew actions that are well within their capabilities

involving a slight increase in flight crew workload or some physical discomfort to passengers or cabin crew.

b. Significant transient: that would lead to a significant reduction in safety margins, an increase in flight crew workload, discomfort to the flight crew, or physical distress to passengers or cabin crew, possibly including non-fatal injuries.

NOTE: The flight crew should be able to respond to any significant transient without:

- exceptional piloting skill, alertness, or strength,
- forces greater than those given in FAR/JAR 25.143(c), and
- accelerations or attitudes in the airplane that might result in further hazard to secured or non-secured occupants.

Warning	A flight deck indication that alerts the flight crew to a non-normal operational or airplane system requiring immediate recognition. Immediate corrective or compensatory action by the flight crew is required.

5.2 Acronyms

AC	Advisory Circular
ACJ	Advisory Circular Joint
AFM	Airplane Flight Manual
AGL	Above Ground Level
ARP	Accepted and Recommended Practice
AWO	All Weather Operations
CWS	Control Wheel Steering
DA	Decision Altitude
DA(H)	Decision Altitude (Height)
DME	Distance Measuring Equipment
FCOM	Flight Crew Operations Manual
FD	Flight Director
FGS	Flight Guidance System

FLCH	Flight Level Change
FMA	Flight Mode Annunciator
FMS	Flight Management System
GLS	GNSS Landing System
GNSS	Global Navigation Satellite System
HUD	Head-Up Display
IAS	Indicated Air Speed
ILS	Instrument Landing System
LNAV	Lateral Navigation
MDA(H)	Minimum Descent Altitude (Height)
MEA	Minimum Engage Altitude
MEA(H)	Minimum Engage Altitude (Height)
MEH	Minimum Engage Height
MLS	Microwave Landing System
MSP	Mode Selector Panel
MUH	Minimum Use Height
NAV	Navigation
ND	Navigation Display
NPA	
PFD	Primary Flight Display
PNF	Pilot Not Flying
RNAV	Area Navigation
RNP	Required Navigation Performance
RVSM	Reduced Vertical Separation Margin
SAS	Stability Augmentation System (ed. Note: does this need a definition?)
SAE	Society of Automotive Engineering
TCAS	Traffic Collision Alert System
TCS	Touch Control System

VNAV	Vertical Navigation

6 BACKGROUND

This advisory material replaces material previously provided in AC/ACJ 25.1329 for autopilots. The automatic control and guidance systems in current aircraft have evolved to a level that dictates a revision to current advisory material.

There have been dramatic changes in technology and system design, which have resulted in much higher levels of integration, automation, and complexity. These changes have also redefined the allocation of functions and system interfaces between systems. Relatively simple, dedicated systems have been replaced with digital multi-function systems with more modes, and automatic changes in modes of operation. The introduction of fly-by-wire flight control systems has created new interface considerations for the FGS elements. These new systems are capable of providing better performance, increased safety and decreased workload. But if designed without consideration for the criteria in this AC, could also be confusing and not immediately intuitive for the flight crew. Significant operational experience has been gained on new generation systems and guidance material is provided herein based on that experience.

This advisory material is provided for Flight Guidance Systems, which include any autopilot functions, flight director functions, automatic thrust control functions and any interactions with stability augmentation and trim functions.

7 GENERAL

The FGS is primarily intended to assist the flight crew in the basic control and tactical guidance of the airplane. The system may also provide workload relief to the pilots and may provide a means to fly a flight path more accurately to support specific operational requirements (e.g. RVSM, RNP etc).

The applicant should establish, document and follow a design philosophy that supports the intended operational use regarding the FGS behavior; modes of operation; pilot interface with controls, indications, and alerts; and mode functionality.

Description of the FGS behavior and operation should be addressed from flight crew and maintenance perspectives in appropriate documentation and training material.

Subsequent sections of this advisory material provide acceptable means of compliance with §/JAR 25.1329 and the applicability of other Part 25 rules to FGS (e.g., §/JAR 25.1301, §/JAR 25.1309). The demonstrated means of compliance may include a combination of analysis, laboratory testing, flight testing, and simulator testing. The applicant should coordinate with the authorities early in the certification program, via a certification plan, to reach agreement on the methods to be used to demonstrate compliance.

7.1 Flight Guidance System Functions

The following functions, when considered separately and together, are considered elements of a Flight Guidance System:

- Flight guidance and control (e.g., autopilot, flight director displayed head-down or head-up);
- Autothrottle/autothrust systems;
- Interactions with stability augmentation and trim systems; and
- Alerting, status, mode annunciation, and situation information associated with flight guidance and control functions.

The FGS includes those functions necessary to provide guidance and control in conjunction with an approach and landing system, such as:

- the Instrument Landing System (ILS),
- the Microwave Landing System (MLS) or
- the Global Navigation Satellite System (GNSS) Landing System (GLS).

The FGS also includes those functions necessary to provide guidance and control in conjunction with a Flight Management System (FMS). The FGS does **not** include the flight planning and the generation of flight path and speed profiles tied to waypoints and other flight planning aspects of the Flight Management System (FMS). However, it does include the interface between the FMS and FGS necessary for the execution of flight path and speed commands.

7.2 FGS Components

For the purpose of this ACJ the term “FGS” includes all the equipment necessary to accomplish the FGS function, including the sensors, computers, power supplies, servo-motors/actuators, and associated wiring. It includes any indications and controllers necessary for the pilot to manage and supervise the system.

Any part of the FGS that remains connected to the primary flight controls when the autopilot is not in use is regarded as a part of the primary flight controls, and the provisions for such systems are applicable.

7.3 Compliance with §/JAR 25.1329

Table 7.3-A lists the relevant paragraphs of §/JAR 25.1329 and provides an indication where acceptable means of compliance with each paragraph may be found within this AC.

TABLE 7.3-A.
Where Means of Compliance Can Be Found in this AC

Section / Paragraph	Rule Text	Where Acceptable Means of Compliance Found in this AC
§ 25.1329 (a)	*Quick disengagement controls for the autopilot and autothrust functions must be provided for each pilot. The autopilot quick disengagement controls must be located on both control wheels (or equivalent). The autothrust quick disengagement controls must be located on the thrust control levers. Quick disengagement controls must be readily accessible to each pilot while operating the control wheel (or equivalent) and thrust control levers.*	Section 8.1, Autopilot Engagement/Disengagement Section 8.3, Autothrust Engagement/Disengagement and Indications
§ 25.1329(b)	*The effects of a failure of the system to disengage the autopilot or autothrust functions when manually commanded by the pilot must be assessed in accordance with the requirements of §25.1309.* .	Section 8.1, Autopilot Engagement/Disengagement Section 8.3, Autothrust Engagement/Disengagement and Indications **Section 13**, Safety Assessment
§ 25.1329(c)	*Engagement or switching of the flight guidance system, a mode, or a sensor must not produce a significant transient response affecting the control or flight path of the airplane.*	Section 8, FGS Engagement, Disengagement, and Override **Section 13**, Safety Assessment
§ 25.1329(d)	*Under normal conditions, the disengagement of any automatic control functions of a flight guidance system*	Section 8, FGS Engagement, Disengagement, and

	must not produce any significant transient response affecting the control or flight path of the airplane, nor require a significant force to be applied by the pilot to maintain the desired flight path.	Override Section 13, Safety Assessment
§ 25.1329(e)	*Under other than normal conditions, transients affecting the control or flight path of the airplane resulting from the disengagement of any automatic control functions of a flight guidance system must not require exceptional piloting skill or strength to remain within, or recover to, the normal flight envelope.*	Section 8, FGS Engagement, Disengagement, and Override
§ 25.1329(f)	*Command reference controls (e.g., heading select, vertical speed) must operate consistently with the criteria specified in §§ 25.777(b) and 25.779(a) for cockpit controls. The function and direction of motion of each control must be plainly indicated on, or adjacent to, each control if necessary to prevent inappropriate use or confusion.*	Section 8, FGS Engagement, Disengagement, and Override Section 9, Controls, Indications and Alerts
§ 25.1329(g)	*Under any condition of flight appropriate to its use, the Flight Guidance System must not:* • *produce unacceptable loads on the airplane (in accordance with § 25.302), or* • *create hazardous deviations in the flight path.* *This applies to both fault-free operation and in the event of a malfunction, and assumes that the pilot begins corrective action within a reasonable period of time.*	Section 10, Performance of Function Section 13, Safety Assessment
§ 25.1329(h)	*When the flight guidance system is in use, a means must be provided to avoid excursions beyond an acceptable margin from the speed range of the normal flight envelope. If the aircraft experiences an excursion outside this*	Section 10.4, Speed Protection

	range, the flight guidance system must not provide guidance or control to an unsafe speed.	
§ 25.1329(i)	*The FGS functions, controls, indications, and alerts must be designed to minimize flight crew errors and confusion concerning the behavior and operation of the FGS. Means must be provided to indicate the current mode of operation, including any armed modes, transitions, and reversions. Selector switch position is not an acceptable means of indication. The controls and indications must be grouped and presented in a logical and consistent manner. The indications must be visible to each pilot under all expected lighting conditions.*	Section 9, Controls Indications and Alerts
§ 25.1329(j)	*Following disengagement of the autopilot, a visual and aural warning must be provided to each pilot and be timely and distinct from all other cockpit warnings.*	Section 8.1.2.1, Autopilot Disengagement Alerts **Section 13**, Safety Assessment
§ 25.1329(k)	*Following disengagement of the autothrust function, a caution must be provided to each pilot.*	Section 8.3, Autothrust Engagement, Disengagement, and Indications **Section 13**, Safety Assessment
§ 25.1329(l)	*The autopilot must not create an unsafe condition when the flight crew applies an override force to the flight controls.*	Section 8.1.2.4, Flight Crew Override of the Autopilot
§ 25.1329(m)	*During autothrust operation, it must be possible for the flight crew to move the thrust levers without requiring excessive force. The autothrust response to flight crew override must not create an unsafe condition.*	Section 8.3, Autothrust Engagement, Disengagement, and Indications **Section 13**, Safety Assessment

8 Flight Guidance System Engagement, Disengagement and Override

The characteristics of the FGS during engagement, disengagement and override have caused some concern with systems on some airplanes. The following criteria should be addressed in the design of a FGS.

8.1 Autopilot Engagement/Disengagement

Autopilot engagement and disengagement should be accomplished in a manner consistent with other flight crew procedures and tasks, and should not require undue attention.

8.1.1 Autopilot Engagement

Each pilot should be able to select the autopilot function of the flight guidance system with a single switch action. The single switch action should engage pitch and roll axes. The autopilot system should provide positive indication to the flight crew that the system has been engaged. The selector switch position is not acceptable as a means of indication [reference § 25.1329(i)].

> **NOTE:** If a unique operational need is identified for split-axis engagement, then annunciation or indication should be provided for each axis.

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.

In non-maneuvering flight, the engagement of the autopilot should be free of perceptible transients. Under dynamic conditions, including maneuvering flight, minor transients are acceptable.

Without a flight director engaged, the initial lateral and vertical modes should be consistent with minimal disturbance from the flight path. For example, the lateral mode at engagement may roll the airplane to wings level and then hold the airplane heading/track or maintain the existing bank angle (if in a normal range). A heading/track preselect at engagement function may be provided if precautions are taken to ensure that selection reflects the current intent of the flight crew. The modes at engagement should be annunciated and any associated selected target values should be displayed.

With a flight director engaged, the autopilot should engage into a mode consistent (i.e., the same as, or if that is not possible, then compatible with) the active flight director mode of operation. Consideration should be given to the mode into which the autopilot will engage when large commands are present on either or both flight directors. For example, consideration should be given whether to retain the active flight director mode or engage the autopilot into the basic mode, and the implications for current flight path references and targets. The potential for flight crew confusion and unintended changes in flight path or modes should be considered.

Regardless of the method used, the engagement status (and changes in status) of the autopilot(s) should be clearly indicated and should not require undue attention or recall.

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 resources are available to support the intended operation (e.g., "Land 2" and "Land 3" are used in some aircraft).

> **NOTE:** The design should consider the possibility that the pilot may attempt to engage the autopilot outside of the normal flight envelope. It is not required that the autopilot should compensate for unusual attitudes or other situations outside the normal flight envelope, unless that is part of the autopilot's intended function.

8.1.2 Autopilot Disengagement

Under normal conditions, automatic or manual disengagement of the autopilot should be free of significant transients or out-of-trim forces that are not consistent with the maneuvers being conducted by the airplane at the time of disengagement. If multiple autopilots are engaged, any disengagement of an individual autopilot should be free of significant transients and should not adversely affect the operation of the remaining engaged autopilot(s).

In other than normal conditions (non-normal and rare normal conditions), disengagement of the autopilot may result in a significant transient. The flight crew should be able to respond to a significant transient without:

- exceptional piloting skill, alertness, or strength,
- forces greater than those given in FAR/JAR 25.143(c), and
- accelerations or attitudes in the airplane that might result in a hazard to secured or non-secured occupants.

The flight crew should be made aware (via a suitable alerting or other indication) of conditions or situations (e.g., continued out-of-trim) that could result in a significant transient at disengagement. [See Section 9.3.3 on Awareness of Potential Significant Transient Condition (“Bark before Bite”).]

8.1.2.1 Autopilot Disengagement Alerts

Since it is necessary for a pilot to immediately assume manual control following disengagement of the autopilot (whether manual or automatic), a visual and aural warning must be given. This warning must be given without delay, and must be distinct from all other cockpit warnings. It must sound for a minimum period, long enough to ensure that it is heard and recognized by that pilot and by other flight crew members, but not so persistent that it adversely affects communication between crew members or is a distraction. The warning should continue for at least this minimum period, until silenced by one of the pilots using an autopilot quick disengagement control, by reengagement of the autopilot, or by another acceptable means.

Disengagement of an autopilot within a multiple-autopilot system (e.g., downgraded capability), requiring immediate flight crew awareness and possible timely action, should cause a Caution level alert to be issued to the flight crew.

Disengagement of an autopilot within a multiple-autopilot system, requiring only flight crew awareness, should cause a suitable advisory to be issued to the flight crew.

8.1.2.2 Quick Disengagement Control

The purpose of the “Quick Disengagement Control” is to ensure the capability for each pilot to manually disengage the autopilot quickly with a minimum of pilot hand/limb movement. The “Quick Disengagement Control” should be located on each control wheel or equivalent within easy reach of one or more fingers/thumb of the pilot’s hand when the hand is in a position for normal use on the control wheel or equivalent. The “Quick Disengagement Control” should meet the following criteria:

(a) Be accessible and operable from a normal hands-on position without requiring a shift in hand position or grip on the control wheel or equivalent;

(b) Be operable with one hand on the control wheel or equivalent and the other hand on the thrust levers;

NOTE: When establishing location of the quick disengagement control, consideration should be given to:

- its accessibility with large displacements of, or forces on, the control wheel (or equivalent), and
- the possible need to operate the quick disengagement control with the other hand.

(c) Be easily located by the pilot without having to first locate the control visually;

(d) Be designed so that any action to operate the "Quick Disengagement Control" should not cause an unintended input to the control wheel or equivalent; and

(e) Be designed to minimize inadvertent operation and interference with other nearby control wheel (or equivalent) switches/devices (e.g., radio control, trim).

8.1.2.3 Alternative Means of Autopilot Disengagement

When a § 25.1309 assessment shows a need for an alternative means of disengagement, the following should be addressed:

- Independence,
- The alternate means should be readily accessible to each pilot,
- Latent failure/reliability of the alternate means.

The following means of providing an alternative disengagement have been found to be acceptable:

- Selection of the engagement control to the "off" position.
- Disconnect bar on mode selector panel.
- Trim switch on yoke.

NOTE: Use of circuit breakers as a means of disengagement is not considered to be acceptable.

8.1.2.4 Flight Crew Override of the Autopilot

The autopilot should disengage when the flight crew applies a significant override force to the controls, unless a safe alternative can be demonstrated. The applicant should interpret "significant" as a force level that is consistent with an intention to overpower the autopilot by either or both pilots. The autopilot should not disengage for minor application of force to the controls (e.g., a pilot gently bumping the control column while entering or exiting a pilot seat during cruise).

NOTE: 25 lbs. of force at the control column or wheel has been determined to be a significant override force level for other than approach operations on some aircraft types. To reduce nuisance disengagements, higher forces have been found acceptable for certain approach and landing operations on some aircraft types. The force to disengage an autopilot is not necessarily the force required at the column to oppose autopilot control (e.g., cause elevator movement). The corresponding forces for a sidestick or centerstick controller may be different.

A significant transient should not result from autopilot disengagement when the flight crew applies an override force to the controls.

Sustained application of force below the disengagement threshold should not result in an unsafe condition.

8.1.2.5 Flight Crew Pitch Trim Input

If the autopilot is engaged and the pilot applies manual pitch trim input, either the autopilot should disengage with no more than a minor transient, or pitch trim changes should be inhibited.

8.2 Flight Director Engagement/Disengagement and Indications

Engagement and disengagement should be accomplished consistent with other flight crew procedures and tasks and should not require undue attention.

8.2.1 Flight Director Engagement

A means maybe provided for each pilot to select (i.e., turn on) and deselect the flight director for display on their primary flight display (e.g., attitude display). The selection status of the flight director and the source of flight director guidance should be clear and unambiguous. Failure of a selected flight director should be clearly annunciated.

A flight director is considered “engaged” if it is selected and displaying guidance cues.

> Note: The distinction is made between “engaged” and “selected” because the flight director might be selected, but not displaying guidance cue(s) (e.g., the cue(s) are biased out of view).

If there are multiple flight directors, indications should be provided to denote which flight director is engaged (e.g., FD1, FD2). 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 (i.e., first officer selection of captain’s flight director).

A flight director should engage into the current modes and targets of an already engaged autopilot or flight director, if any. With no autopilot engaged, the basic modes at engagement of the flight director functions should be established consistent with typical flight operations.

> **NOTE:** The engagement of the pitch axis in Vertical Speed or Flight Path Angle, and engagement of the lateral axis in Heading Hold, Heading Select or Bank Angle Hold have been found to be acceptable.

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.

Engagement during maneuvering flight should be considered.

> **NOTE:** The design should consider the safety consequences if it is possible for the flight director to engage outside of the normal flight envelope. It is not required that the flight director should compensate for unusual attitudes or other situations outside the normal flight envelope, unless that is part of the flight director’s intended function.

8.2.1.1 Guidance Cue(s)

The flight director command guidance cue(s) will typically be displayed when the flight director is selected and valid command guidance is available or if it is automatically providing guidance as per paragraph 8.2.1.2 below. The flight director guidance cue(s) should be removed when guidance is determined to be invalid. The display of guidance cue(s) (e.g., flight director bars) is sufficient indication that the flight director is engaged.

8.2.1.2 Reactive Windshear Flight Director Engagement

For airplanes equipped with a flight director windshear guidance system, flight director engagement should be provided, consistent with the criteria contained in AC 25-12 and AC 120-41.

8.2.2 Flight Director Disengagement

There may be a means for each pilot to readily deselect his or her on-side flight director function. Flight crew awareness of disengagement and deselection is important. Removal of guidance cue(s) alone is not sufficient indication of deselection, because the guidance cue(s) may be removed from view for a number of reasons, including invalid guidance, autopilot engagement, etc. Therefore, the flight director function should provide clear and unambiguous indication (e.g., switch position or status) to the flight crew that the function has been deselected.

8.3 Autothrust Engagement/Disengagement and Indications

The autothrust function should be designed with engagement and disengagement characteristics that provide the flight crew positive indication that the system has been engaged or disengaged. Engagement and disengagement should be accomplished in a manner consistent with other flight crew procedures and tasks and should not require undue attention.

8.3.1 Autothrust Engagement

The autothrust engagement controls should be accessible to each pilot. The autothrust function should provide the flight crew positive indication that the system has been engaged.

The autothrust function should be designed to prevent inadvertent application of thrust during ground operations (e.g., provide separate arm and engage functions)**.**

The autothrust normally should be designed to preclude inadvertent engagement. However, intended modes such as a “wake up” mode to protect for unsafe speeds may be acceptable (see section 10.4.1 on Low Speed Protection). If such automatic engagement occurs, it should be clear to the flight crew that automatic engagement has occurred, the automatic engagement should not cause any unsafe condition (e.g., unsafe pitch attitudes or unsafe pitching moments) and the reason for automatic engagement should be clear and obvious to the flight crew.

> **NOTE:** The design should consider the possibility that the pilot may attempt to engage the autothrust function outside of the normal flight envelope or at excessive (or too low) enginethrust. It is not expected that the autothrust feature should compensate for situations outside the normal flight envelope or normal engine operation range, unless that is part of the authothrust's intended function.

8.3.2 Autothrust Disengagement

Autothrust disengagement should not cause any unsafe condition (e.g., pitch attitude or pitching moment) and the disengagement should not preclude or inhibit or interfere with timely and safe go-around.

The autothrust normally should be designed to preclude inadvertent disengagement during activation of autothrust modes of operation.

Following disengagement of the autothrust function, positive indication of disengagement should include at least a visual flight crew alert and deletion of autothrust 'engaged' status annunciations. For automatic disengagement, visual indications should persist until cancelled by flight crew action. For manual disengagement, if an aural is provided, visual indications should persist for some minimum period. If an aural is not provided, the visual indications should persist until cancelled by flight crew action. For aural indication, if provided, an aural alert of sufficient duration and volume should be provided to assure that the flight crew has been alerted that disengagement has occurred. An extended cycle of an aural alert is not acceptable following disengagement if such an alert can significantly interfere with flight crew coordination or radio communication. Disengagement of the autothrust function is considered a Caution alert.

8.3.2.1 Autothrust Quick Disengagement Control

Autothrust quick disengagement controls must be provided for each pilot on the respective thrust control (thrust lever or equivalent). A single-action, quick disengagement switch should be incorporated on the thrust control so that switch activation can be executed when the pilot's other hand is on the flight controls. The disengagement control should be positioned such that inadvertent disengagement of the autothrust function is unlikely. Positioning the control on the outboard side has been shown to be acceptable for multiengine aircraft. Thrust lever knob-end-mounted disengagement controls available on both sides to facilitate use by either pilot have been shown to be preferable to those positioned to be accessible by the pilot's palm.

8.3.2.2 Pilot Override of Autothrust Control

It should be possible for the pilot to readily override the autothrust function by moving the thrust levers (or equivalent) with one hand. FAR 25.1329(m) requires that the autothrust response to a flight crew override must not create an unsafe condition.

Autothrust functions may be designed to safely remain engaged during pilot intervention. Alternatively, autothrust functions may disengage as a result of pilot intervention, provided that the design prevents unintentional autothrust disengagement and adequately alerts the flight crew to ensure pilot awareness.

8.4 Automatic Pitch Trim Considerations

Application of force to the controls by a flight crewmember with the autopilot engaged should not produce automatic trim motion resulting in a hazardous condition.

8.5 FGS Engagement Mode Compatibility

The philosophy used for the mode at engagement of the autopilot, flight director, and autothrust functions should be provided in flight crew training material.

It must not be possible to select incompatible FGS command or guidance functions at the same time (e.g., commanding speed through elevator and autothrust at the same time).

9 Controls, Indications and Alerts

The human-machine interface with the FGS is key to ensuring safe, effective and consistent FGS operation. The manner in which FGS information is depicted to flight crews is essential to the flight crew awareness, and therefore, the safe operation of the FGS.

The controls, indications, and alerts should be so designed as to minimize flight crew errors and confusion. Indications and alerts should be presented in a manner compatible with the procedures and assigned tasks of the flight crew and provide the necessary information to perform those tasks. The indications should be grouped and presented in a logical and consistent manner and be visible from each pilot's station under all expected lighting conditions. The choice of colors, fonts, font size, location, orientation, movement, graphical layout and other characteristics such as steady or flashing should all contribute to the effectiveness of the system. Controls, indications, and alerts should be implemented in a consistent manner.

It is recommended that the applicant evaluate the adequacy and effectiveness of the information provided by the FGS interface (i.e., controls, indications, alerts, and displays) to ensure flight crew awareness of FGS behavior and operation. See **Section 14,** Flight Test and Simulator Demonstration, for more discussion of appropriate analyses (which may include, for example, cognitive task analysis as a basis for evaluation).

9.1 FGS Controls

The FGS controls should be designed and located to provide convenient operation to each crewmember and to prevent crew errors, confusion and inadvertent operation. To achieve this, §/JAR 25.1329 (f) requires that command reference controls to select target values (e.g., heading select, vertical speed) should operate as specified in §§/JAR 25.777(b) and 25.779(a) for cockpit controls. The function and direction of motion of each control should be readily apparent or plainly indicated on, or adjacent to, each control if needed to prevent inappropriate use or confusion. §/JAR 25.781 also provides requirements for the shapes of the knobs. The design of the FGS should address the following specific considerations:

- Differentiation of knob shape and position. (*Errors have included confusing speed and heading knobs on the mode selector panel.)*
- Design to support correct selection of target values. (*Use of a single control (e.g., concentric controls) for selecting multiple command reference targets has resulted in erroneous target value selection.)*
- Commonality of control design across different aircraft to prevent negative transfer of learning with respect to operation of the controls. *(Activation of the wrong thrust function has occurred due to variation of TOGA and autothrust disengagement function between airplane types- negative transfer of learning with respect to operation of the controls.)*
- Positioning of individual FGS controls, FMAs, and related primary flight display information so that, as far as reasonably practical, items of related function have similarly related positions. (*Misinterpretation and confusion have occurred due to the inconsistent arrangement of FGS controls with the annunciations on the FMA.)*
- Design to discourage or avoid inadvertent operation; e.g., engagement or disengagement.

9.2 Flight Guidance Mode Selection, Annunciation, and Indication

Engagement of the Flight Guidance System functions should be suitably annunciated to each pilot, as described in Section 8, FGS Engagement, Disengagement, and Override. The FGS mode annunciations should effectively and unambiguously indicate the active and armed modes of operation. The mode annunciation should convey explicitly, as simply as possible, what the FGS is doing (for active modes), what it will be doing (for armed modes), and target information (such as selected speed, heading, and altitude) for satisfactory flight crew awareness.

Mode annunciation should indicate the state of the system and not just switch position or selection. Mode annunciation should be presented in a manner compatible with flight crew procedures / tasks and consistent with the mode annunciation design for the specific aircraft type (i.e., compatible with other flight deck systems mode annunciations).

Operationally relevant mode changes and, in particular, mode reversions and sustained speed protection, should be clearly and positively annunciated to ensure flight crew awareness. Altitude capture is an example of an operationally relevant mode that should be annunciated because pilot actions may have different effects on the airplane. Annunciation of sustained speed protection should be clear and distinct to ensure flight crew awareness. It should be made clear to the pilot if a mode has failed to arm or engage (especially due to invalid sensor data). FGS sub-modes (e.g., sub-modes as the FGS transitions from heading hold to approach) that are not operationally relevant need not be annunciated.

In-service experience has shown that mode annunciation alone may be insufficient (unclear or not compelling enough) to communicate mode changes to the flight crew, especially in high workload situations. Therefore, the safety consequences of the flight crew not recognizing mode changes should be considered. If necessary, an appropriate alert should be used.

Mode annunciations should be located in the forward field of view (e.g., on the primary flight display). Mode selector switch position or status is not acceptable as the sole means of mode annunciation. Modes and mode changes should be depicted in a manner that achieves flight crew attention and awareness. Aural notification of mode changes should be limited to special considerations. Colors, font type, font size, location, highlighting, and symbol flashing have historical precedent as good discriminators, when implemented appropriately. The fonts and font size should be chosen so that annunciation of FGS mode and status information is readable and understandable, without eye strain, when viewed by the pilot seated at the design eye position.

Color should be used in a consistent manner and assure compatibility with the overall use of color on the flight deck. Specific colors should be used such that the FGS displays are consistent with other flight deck systems, such as a Flight Management System. The use of monochrome displays is not precluded, provided that the aspects of flight crew attention and awareness are satisfied. The use of graphical or symbolic (i.e., non-textual) indications is not precluded. Implementation of such discriminators should follow accepted guidelines as described in applicable international standards (e.g., AC/AMJ 25-11) and should be evaluated for their consistency with and integration with the flight deck design. Engaged modes should be annunciated at different locations and with different colors than armed modes to assist in mode recognition. The transition from an armed mode to an engaged mode should provide an additional attention-getting feature, such as boxing and flashing on an electronic display (per AC 25-11) for a suitable, but brief, period (e.g., ten seconds), to assist in flight crew awareness.

The failure of a mode to engage/arm when selected by the pilot should be apparent. Mode information provided to the pilot should be sufficiently detailed, so that the consequences of the interaction (e.g., ensuing mode or system configuration that has operational relevance) can be unambiguously determined. 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 between pilot-initiated commands (e.g., pilot engages positive vertical speed and then selects an altitude which is lower than the aircraft altitude). The default action taken by the FGS should be made apparent.

The operator should be provided with appropriate description of the FGS modes and their behavior.

9.3 Flight Guidance Alerting (Warning, Caution, Advisory, and Status)

Alerting information should follow the provisions of § 25.1322 and associated advisory material. Alerts for FGS engagement and disengagement are described in Section 8, FGS Engagement, Disengagement, and Override.

There should be some method for the flight crew to determine and monitor the availability or capability of the Flight Guidance System (e.g., for dispatch), where the intended operation is predicated on the use of the FGS. The method of monitoring provided should take account of the hazard resulting from the loss of the autopilot function for the intended operation.

9.3.1 Alerting for Speed Protection

To assure crew awareness, an alert should be provided when a sustained speed protection condition is detected. This is in addition to any annunciations associated with mode reversions that occur as a consequence of invoking speed protection (see Section 10.4, Speed Protection). Low speed protection alerting should include both an aural and a visual component. High-speed protection alerts need only include a visual alert component because of existing high-speed aural alert requirements, but does not preclude giving an earlier alert.

Alerting for speed protection should be consistent with the protection provided and with the other alerts in the flight deck. Care should be taken to set appropriate values for indicating speed protection that would not be considered a nuisance for the flight crew.

9.3.2 Loss of Autopilot Approach Mode

The loss of the approach mode requires immediate flight crew awareness. This may be accomplished through autopilot disengagement, as specified within AC 120-28D. If the autopilot remains engaged and reverts to a non-approach mode, an appropriate aural warning and/or visual alert should be provided.

9.3.3 Awareness of Potential Significant Transient Condition ("Bark before Bite")

There have been situations where an autopilot is engaged, operating normally, and controlling up to the limit of its authority for an extended period of time, and the flight crew was unaware of the situation. This service experience has shown that, without timely flight crew awareness and intervention, this situation can progress to a loss of control after autopilot disengagement, particularly in rare normal or non-normal conditions. However, with adequate flight crew awareness and intervention, loss of control may be prevented.

To help ensure crew awareness and timely intervention, appropriate alert(s) (generally caution or warning) should be provided to the flight crew for conditions that could require exceptional piloting skill or alertness for manual control following autopilot disengagement (e.g., significantly out of trim). The number and type of alerts required would be determined by the unique situations that are being detected and by the crew procedures required to address those situations. Any alert should be clear and unambiguous, and be consistent and compatible with other flight deck alerts. Care should be taken to set appropriate thresholds for these alerts such that they are not considered a nuisance for the flight crew.

Situations that should be considered for an alert include:

Sustained Lateral Control Command: If the autopilot is holding a sustained lateral control command, it could be indicative of an unusual operating condition (e.g., asymmetric lift due to icing, fuel imbalance, asymmetric thrust) for which the autopilot is compensating. In the worst case, the autopilot may be operating at or near its full authority in one direction. If the autopilot were to disengage while holding this lateral trim, the result would be that the airplane would undergo a rolling moment that could possibly take the pilot by surprise. Therefore, a timely alert should be considered to permit the crew to manually disconnect the autopilot and take control prior to any automatic disconnect which might result from the condition..

Sustained Longitudinal Out of Trim: If the autopilot is holding sustained longitudinal trim, it could be indicative of an unusual operating condition (e.g., an inoperative horizontal stabilizer) for which the autopilot is compensating. If the autopilot were to disengage while holding this longitudinal trim, the result would be that the airplane would undergo an abrupt change in pitch that could possibly take the pilot by surprise. Therefore a timely alert should be considered to permit the crew to manually disconnect the autopilot and take control prior to any automatic disconnect which might result from the condition.

Bank and Pitch Angles Beyond Those Intended for Autopilot Operations: Most autopilots are designed with operational limits in both the pitch and roll axes, such that those predetermined limits will not be purposely exceeded. If the airplane exceeds those limits, it could be indicative of a situation (which may not be covered by items 1. or 2.) that requires pilot intervention. Therefore, a timely alert should be considered to bring this condition to the attention of the flight crew to and permit the crew to manually disconnect the autopilot and take control prior to any automatic disconnect which might result.

It is preferable that the autopilot remains engaged during out-of-trim conditions. However, if there is an automatic disengagement feature due to excessive out-of-trim, an alert should be generated and must precede any automatic disengagement with sufficient margin to permit timely flight crew recognition and manual disengagement. See also Section 8.4, Automatic Trim Considerations, for related material.

> **NOTE:** This section is not intended require alerting for all instances of automatic autopilot disengagement. It is intended only for conditions which, if not addressed, would lead to such disengagement which could result in a significant transient for which the pilot may be unprepared. The intent is to provide crew awareness that would allow the flight crew to be prepared with hands on controls and take appropriate corrective action before the condition results in a potentially hazardous airplane configuration or state.

> **NOTE**: This section describes alerting requirements for conditions resulting in unintended out-of-trim operation. There are FGS functions that can intentionally produce out-of-trim operation (e.g. parallel rudder operation in align or engine failure compensation modes, pitch trim operation during the approach/landing to provide trim up/flare spring bias, or pitch trim operation for certain types of Speed/Mach trim systems). It is not the intent of this section to require alerts for functions producing intentional out-of-trim conditions. Other system indications (e.g., mode and status annunciations) should be provided to make the crew aware of the operation of these functions where appropriate.

[Note to FGS members: this text may need to be reviewed and revised. It is not intended to say an alert is only appropriate when there is an imminent automatic disengagement, so it may need clarification.]

9.4 FGS Considerations for Head-Up Displays (HUD)

Head-up displays (HUD) have unique characteristics compared to flight displays installed on the instrument panel. Most of these HUD differences are addressed during HUD certification whether or not the HUD provides flight guidance functions. The intent of this section is to address how such HUD differences may affect FGS functions.

9.4.1 Characteristics of HUD Guidance

If the HUD is designed as a supplemental use display system, it does not replace the requirement for standard Head Down Display (HDD) of flight instrument data. The HUD is intended for use during takeoff, climb, cruise, descent, approach and landing under day, night, VMC and IMC conditions. When it can be reasonably expected that the pilot will operate primarily by reference to the HUD, it should be shown that the HUD is satisfactory for manually controlling the airplane and for monitoring the performance of the FGS system.

During take off and landing during certain light and visibility conditions, HUD symbology can be extremely dominant in comparison to external visual references. When visual references are relatively dim, extremely active symbology dynamics and guidance cue gains can lead the pilot to make excessively strong corrections. It should be shown that if HUD guidance cues are followed, regardless of the appearance of external visual references, they do not cause the pilot to take unsafe actions.

Generally the criteria for the mechanization of guidance displayed on the HUD would be no different than guidance displayed on the head-down display. See **Section 10,** Performance of Function, for flight director performance criteria.

However, unlike head-down displays, HUD's are capable of displaying certain symbology conformal to the outside scene, including guidance cues. Consequently, the range of motion of this conformal symbology, including the guidance, can present certain challenges in rapidly changing and high crosswind conditions. In certain cases, the motion of the guidance and the primary reference cue may be limited by the field of view. It must be shown that, in such cases, the guidance remains usable and that there is a positive indication that it is no longer conformal with the outside scene. It must also be shown that there is no interference between the indications of primary flight information and the flight guidance cues. In take off, approach, and landing FGS modes, the flight guidance symbology should have priority.

Approach mode guidance, if provided, should be satisfactory throughout the intended range of conditions, including at the minimum approach speed and maximum crosswind, with expected gust components, for which approval is sought.

> [Note: The TAEIG report should say that the paragraph above should go into the flight test guide section of a future AC.HUD or in an issue paper]

Additionally, HUD guidance is often used in cases, like the low visibility approach, where the pilot will need to reference both the information displayed on the HUD and outside references. Consequently, it must be shown that the location and presentation of the HUD information does not distract the pilot or obscure the pilot's outside view. For example, it would be necessary for the pilot to track the guidance to the runway without having the view of runway references or hazards along the flight path obscured by the HUD symbology.

9.4.2 HUD Flight Guidance System Display

The HUD display should present flight guidance information in a clear and unambiguous manner. Display clutter shall be minimized. The HUD guidance symbology should not excessively interfere with pilots' forward view, ability to visually maneuver the airplane, acquire opposing traffic, and see the runway environment. Some flight guidance data elements are essential or critical and should not be removed by any declutter function.

9.4.3 Head-Up/Head-Down Display Compatibility

The HUD FGS symbology should be compatible and consistent with symbology on other FGS displays such as head-down EFIS instruments. The FGS-related display parameters should be consistent to avoid misinterpretation of similar information, but the display presentations need not be identical. The HUD and head-down primary flight display formats and data sources need to be compatible to ensure that the same FGS-related information presented on both displays have the same intended meaning.

While not all information displayed on the HUD is directly related to the FGS, the pilot is likely to use most of the displayed information while using the HUD-displayed guidance and FGS annunciations. Therefore, when applicable, the guidelines below for the presentation of FGS-related display information should be followed as much as possible. Certain deviations from these guidelines may be appropriate due to conflict with other information display characteristics or requirements unique to head-up displays. These may include minimization of display clutter, minimization of excessive symbol flashing, and the presentation of certain information conformal to the outside scene.

(a) Symbols should be the same format (e.g., a triangle-shaped pointer head-down appears as a triangle pointer head-up; however, some differences in HUD symbology such as the flight director "circle" versus head-down flight director "bars" or "wedge" have been found acceptable);

(b) Information (symbols) should appear approximately in the same general location relative to other information;

(c) Alphanumeric readouts should have the same resolution, units, and labeling (e.g., the command reference indication for "vertical speed" should be displayed in the same foot-per-minute increments and labeled with the same characters as the head-down displays);

(d) Analog scales or dials should have the same range and dynamic operation (e.g., a Glideslope Deviation Scale displayed head-up should have the same displayed range as the Glideslope Deviation Scale displayed head-down, and the direction of movement should be consistent);

(e) FGS modes (e.g. autopilot, flight director, autothrust) and status state transitions should be displayed on the HUD, and except for the use of color, should be displayed using consistent methods (e.g., the method used head-down to indicate a flight director mode transitioning from armed to captured should also be used head-up); and

(f) Information sources should be consistent between the HUD and the head-down displays used by the same pilot.

(g) When FGS command information (i.e., flight director commands) are displayed on the HUD in addition to the head-down displays, the HUD depiction and guidance cue deviation "scaling" needs to be consistent with that used on the head-down displays. This is intended to provide comparable pilot performance and workload when using either head-up or head-down displays.

(h) The same information concerning current HUD system mode, reference data, status state transitions, and alert information that is displayed to the pilot flying on the HUD, should also be displayed to the pilot not flying using consistent nomenclature to ensure unambiguous awareness of the HUD operation.

9.4.4 Alerting Issues

Although HUD's are typically not intended to be classified as integrated caution and warning systems, they may display warnings, cautions, and advisories as part of their FGS function. In this regard, HUDs should provide the equivalent alerting functionality as the head-down primary flight display(s). Warnings that require continued flight crew attention on the PFD also should be presented on the HUD (e.g., TCAS, Windshear, and Ground Proximity Warning annunciations). If master alerting indications are not provided within the peripheral field of view of the pilot while using the HUD, the HUD must provide annunciations that inform the pilot of Caution and/or warning conditions. [ARP-5288, V12]

For monochrome HUD's, appropriate use of attention-getting properties such as flashing, outline boxes, brightness, size, and/or location are necessary to adequately compensate for the lack of color normally assigned to distinguish and call attention to Cautions and warnings.

For multi-color HUD's, the use of red, amber, or yellow for symbols not related to Caution and warning functions should be minimized, so that the effectiveness of distinguishing characteristics of true warnings and cautions is not reduced.

Note: The TAEIG report should say the paragraph below should be moved to a future AC.HUD or an issue paper:

As for any color HUD, care must be taken that the interaction of the HUD colors and the background (i.e., out the window) color of lights and terrain does not create confusion for the pilot. Real world color shift should not be misleading.

Single HUD installations rely on the fact that the non-flying pilot will monitor of head-down instruments and alerting systems, for failures of systems, modes, and functions not associated with primary flight displays.

Dual HUD installations require special consideration for alerting systems. It must be assumed that both pilots will be head-up simultaneously, full, or part-time, especially when the HUD is being used as the primary flight reference, or when the HUD is required equipment for the operation being conducted.. If master alerting indications are not provided within the peripheral field of view of each pilot while using the HUD, then each HUD must provide annunciations that direct the pilot's attention to head-down alerting displays. The types of information that must trigger the HUD master alerting display are any Cautions or warnings not already duplicated on the HUD from head-down primary displays, as well as any Caution level or warning level engine indications or system alerts.

NOTE: The objective is to not redirect attention of the pilot flying to other display when an immediate maneuver is required (resolution advisory, windshear).

If a Ground Proximity Warning System (GPWS), wind shear detection system, a wind shear escape guidance system, or a Traffic alert and Collision Avoidance System (TCAS) are installed, then the guidance, warnings and annunciations required to be a part of these systems, and normally required to be in the pilot's primary field of view, should be displayed on the HUD.

9.4.5 Upset/Unusual Attitude Recovery Guidance

Upsets due to wake turbulence or other environmental conditions may result in near instantaneous excursions in pitch and bank angles and a subsequent unusual attitude.

If the HUD is designed to provide guidance for recovery from upsets or unusual attitudes, recovery steering guidance commands should be distinct from, and not confused with, orientation symbology such as horizon “pointers.” For example, a cue for left stick input should not be confused with a cue indicating direction to the nearest horizon. Guidance should be removed if cues become invalid at extreme attitudes, such as zenith, nadir, or inverted. For extreme attitudes it is acceptable to transition to the HDD, provided that the cues to transition from the HUD are clear and unambiguous.

If the HUD is designed to provide orientation only during upsets or unusual attitudes, cues must be designed to prevent them from being mistaken as flight control input commands.

10 PERFORMANCE OF FUNCTION

The FGS is expected to perform its intended function throughout the airplane's normal flight envelope. There are considerations for the FGS when operating at the limits of its performance capabilities and when operating under significant environmental conditions. The following sections provide acceptable means of compliance criteria and interpretive material for these considerations.

10.1 Normal Performance

The FGS should provide guidance or control, as appropriate, for the intended function of the active mode(s) in a safe and predictable manner within the airplane's normal flight envelope.

The FGS should be designed to operate in all airplane configurations for its intended use within the airplane's normal flight envelope to <u>provide acceptable</u> performance for the following types of environmental conditions::

- Winds (light and moderate)
- Wind gradients (light and moderate)

  <u>NOTE</u>: In the context of this AC, "wind gradient" is considered a variation in wind velocity as a function of altitude, position, or time.

- Gusts (light and moderate)
- Turbulence (light and moderate)
- Icing (trace, light, moderate)

  <u>NOTE</u>: Representative levels of the environmental effects should be established consistent with the airplane's intended operation.

Any performance characteristics that are operationally significant or operationally limiting should be identified with an appropriate statement or limitation in the Airplane Flight Manual (AFM).

The FGS should perform its intended function during routine airplane configuration or power changes, including the operation of secondary flight controls.

Evaluation of FGS performance for compliance should be based on the minimum level of performance needed for its intended functions. Subjective judgment may be applied to account for experience acquired from similar equipment and levels that have been established as operationally acceptable by the end-user.

There are certain operations that dictate a prescribed level of performance. When the FGS is intended for operations that require specific levels of performance, the use of FGS should be shown to meet those specific levels of performance (e.g., Low Visibility Operations – Category II and III operations, Reduced Vertical Separation Minimums (RVSM), Required Navigation Performance (RNP)).

The FGS performance of intended functions should at least be equivalent to that expected of a pilot for a similar task. The Flight Test Guide (AC 25-7A) and the Autopilot, Flight Director and Autothrust Systems SAE ARP 5366 may prove useful for establishing the general behavior of the FGS. When integrated with navigation sensors or flight management systems, the FGS should satisfy the flight technical error tolerances expected for the use of those systems in performing their intended functions.

The autopilot should provide smooth and accurate control without perceptible sustained nuisance oscillation.

The flight director, in each available display presentation (e.g., single cue, cross-pointer) should provide smooth and accurate guidance and be appropriately damped, so as to achieve satisfactory control task performance without pilot compensation or excessive workload.

The autothrust function should provide smooth and accurate control of thrust without significant or sustained oscillatory power changes or excessive overshoot of the required power setting.

The automatic trim function should operate at a rate sufficient to mitigate excessive control surface deflections or limitations of control authority without introducing adverse interactions with automatic control of the aircraft.

10.2 Performance in Rare Normal Conditions

The FGS will encounter a wide range of conditions in normal operations, some of which may be infrequent, but levy a greater than average demand on the FGS capabilities. Certain environmental conditions, as listed below, are prime examples. FGS performance during such rare normal conditions should be assessed. Such conditions may degrade FGS performance, but must be safe for FGS operation. The relative infrequency of such conditions may also be a factor in the flight crew's ability to detect and mitigate, in a timely manner, any limited capability of the FGS to cope with them. The FGS should be limited from operating in environmental conditions in which it cannot be safely operated.

This does not mean that the FGS must be disengaged when rare normal conditions, which may degrade its performance or capability, are encountered. Actually, the FGS may significantly help the flight crew during such conditions. However, the design should address the potential for the FGS to mask a condition from the flight crew or to otherwise delay appropriate flight crew intervention. See Section 9.3, Flight Guidance Alerting for discussion of alerting under such conditions.

Operations in rare normal environmental conditions may result in automatic or pilot-initiated autopilot disengagement close to the limit of autopilot authority. Autopilot disengagement in rare normal conditions should meet the safety criteria for autopilot disengagement found in Section 8.1, Autopilot Engagement/Disengagement and the criteria in Section 9.3 for flight guidance alerting.

For rare normal conditions, the FGS should provide guidance or control, as appropriate for the intended function of the active mode(s), in a safe and predictable manner, both within the normal flight envelope and for momentary excursions outside the normal flight envelope.

The following rare normal environmental conditions should be considered in the design of the FGS:

- Significant winds
- Significant wind gradients
- Windshear (e.g., microburst)

  NOTE: For the purpose of this AC, "windshear" is considered a wind gradient of such a magnitude that it may cause damage to the aircraft. Airplanes intended to meet § 121.358 for windshear warning and guidance need flight director windshear guidance. The FGS may also provide suitable autopilot control during windshear. Refer to Advisory Circulars AC 25-12 and AC 120-41 for windshear guidance system requirements.

- Large gusts (lateral, longitudinal, and vertical dimensions)
- Severe and greater turbulence (check AIM language)
- Severe or unusual types/effects of icing (e.g., airfoil contamination)

10.2.1 Icing Considerations

The FGS typically will be designed to provide acceptable performance in all standard airplane configurations. Operating an airplane in icing conditions can have significant implications on the aerodynamic characteristics of the airplane (e.g., ice accretion on wings, tail, and engines) and, consequently, on FGS performance. Ice accretion may be slow, rapid, symmetric, or asymmetric. During autopilot operation, the flight crew may not be aware of the gradual onset of icing conditions or the affect that the accumulation of ice is having on the handling qualities of the airplane.

Means should be provided to alert the flight crew as described in Section 9.3. The implication of icing conditions on speed protection should be assessed.

10.3 Performance in Non-Normal Conditions

The FGS will occasionally be operating when the airplane transitions outside of the normal flight envelope of the airplane, when other airplane systems experience failure conditions (e.g., inoperative engine, loss of hydraulics) or when the airplane experiences certain extraordinary conditions such as significant fuel imbalance, non-standard flap/slat or ferry configurations. Under such circumstances, the FGS characteristics and flight crew interaction with the FGS should be shown to be safe.

10.4 Speed Protection (25.1329(h))

The requirement for speed protection is based on the premise that reliance on flight crew attentiveness to airspeed indications, alone, during FGS operation is not adequate to avoid unacceptable speed excursions outside the speed range of the normal flight envelope. Many existing FGS systems have no provisions to avoid speed excursions outside the normal flight envelope. Some FGS systems will remain engaged until the aircraft slows to stall conditions and also to speeds well above Vmo/Mmo.

Standard stall warning and high-speed alerts are not always timely enough for flight crew intervention to prevent unacceptable speed excursions during FGS operation. The intent of the rule is for the FGS to provide a speed protection function for all operating modes, such that the airspeed can be safely maintained within an acceptable margin of the speed range of the normal flight envelope**[DD1]**.

For compliance with the intent of the rule, other systems, such as the primary Flight Control System or the FMS when in a VNAV mode, may be used to provide equivalent speed protection functionality.

If the FGS is providing speed protection function, the following are acceptable means to comply with this rule:

- The FGS may detect the speed protection condition, alert the flight crew and provide speed protection control or guidance.
- The FGS may detect the speed protection condition, alert the flight crew and then disengage the FGS.
- The FGS may detect the speed protection condition, alert the flight crew, and remain engaged in the active mode without providing speed protection control or guidance.

Note: If compliance with this requirement is based on use of alerting alone, the alerts should be shown to be appropriate and timely to ensure flight crew awareness and enable the pilot to keep the airplane within an acceptable margin from the speed range of the normal flight envelope. See Section 9.3.1 for additional discussion of speed protection alerting.

The design should consider how and when the speed protection is provided for combinations of autopilot, flight directors, and autothrust operation.

Care should be taken to set appropriate values for transitioning into and out of speed protection that the flight crew does not consider a nuisance.

The speed protection function should integrate pitch and thrust control. Consideration should be given to automatically activating the autothrust function (if armed) when speed protection is invoked. If an autothrust function is either not provided or is unavailable, speed protection should be provided through pitch control alone.

The role and interaction of autothrust with elements of the FMS and the primary flight control system, if applicable, should be accounted for in the design for speed protection.

[DD2]Consideration should be given to the effects of an engine inoperative condition on the performance of speed protection.

10.4.1 Low Speed Protection

When the FGS is engaged in any modes (with the possible exception of approach as discussed in 10.4.1.1) for which the available thrust is insufficient to maintain a safe operating speed, the low speed protection function should be invoked to avoid unsafe speed excursions.

Activation of speed protection should take into account the phase of flight, factors such as turbulence and gusty wind conditions, be compatible with the speed schedules. The low speed protection function should activate at a suitable margin to stall warning consistent with values that will not result in nuisance alerts. Consider the operational speeds, as specified in the Airplane Flight Manual (AFM), for all-engine and engine-inoperative cases during the following phases of flight:

- Takeoff. [DD3]
- During departure, climb, cruise, descent and terminal area operations airplanes are normally operated at or above the minimum maneuvering speed for the given flap configuration.

  Note: For high altitude operations, it may be desirable to incorporate low speed protection at the appropriate engine out driftdown speed schedule if the FGS (or other integrated sensors/systems) can determine that the cause of the thrust deficiency is due to an engine failure.[DD4]

- Approach. [DD5]

  Note: A low speed alert and a transition to the speed protection mode at approximately 1.25V_s, or an equivalent speed defined in terms of V_{SR}, for the landing flap configuration has been found to be acceptable.

- The transition from approach to go-around and go-around climb[DD6].

10.4.1.1 Low Speed Protection during Approach Operations

Speed protection should not interfere with the landing phase of flight.

It is assumed that with autothrust operating normally, the combination of thrust control and pitch control during the approach will be sufficient to maintain speed and desired vertical flight path. In cases where it is not, the FGS should provide an alert in time for the flight crew to take appropriate corrective action.

For approach operations with a defined vertical path (e.g., ILS, MLS, GLS, LNAV/VNAV), if autothrust is not being used for speed control and the thrust is insufficient to maintain both the desired flight path and the desired approach speed, there are several ways to meet the intent of low speed protection:

a) The FGS may maintain the defined vertical path as the airplane decelerates below the desired approach speed until the airspeed reaches the low speed protection value. At that time the FGS would provide guidance to maintain the low speed protection value as the airplane departs the defined vertical path. The FGS mode reversion and low speed alert should be activated to ensure pilot awareness.

Note: The pilot is expected to take corrective action to add thrust and return the airplane to the defined vertical path or go-around as necessary.

b) The FGS may maintain the defined vertical path as the airplane decelerates below the desired approach speed to the low speed protection value. The FGS will then provide a low speed alert while remaining in the existing FGS approach mode.

Note: The pilot is expected to take corrective action to add thrust to cause the airplane to accelerate back to the desired approach speed while maintaining the defined vertical path or go-around as necessary.

c) The FGS may maintain the defined vertical path as the airplane decelerates below the desired approach speed until the airspeed reaches the low speed protection value. The FGS will then provide a low speed alert and disengage.

Note: The pilot is expected to take corrective action when alerted to the low speed condition and the disengagement of the autopilot, to add thrust and manually return the airplane to the desired vertical path or go-around as necessary.

The FGS design may use any one or a combination of these ways, depending on the circumstances, to provide acceptable low speed protection.

If the speed protection is invoked during approach such that vertical flight path is not protected, the subsequent behavior of the FGS after speed protection should be carefully considered. Activation of low speed protection during the approach, resuming the approach mode and reacquiring the defined vertical path, may be an acceptable response if the activation is sufficiently brief and not accompanied by large speed or path deviations. This is considered consistent with criteria for Category III automatic landing systems, in JAR-AWO 107 and AC 120-28D, Appendix 3, Section 8.1 Automatic Flight Control Systems, which states that it must not be possible to change the flight path of the airplane with the automatic pilot(s) engaged, except by initiating an automatic go-around.

10.4.1.2 Windshear

The interaction between low speed protection and windshear recovery guidance is a special case. Windshear recovery guidance that meets the criteria found in Advisory Circulars AC 25-12 and AC 120-41 provides the necessary low speed protection when it is activated, and is considered to be acceptable for compliance with §/ACJ 25.1329(h). The autopilot must be disengaged when the windshear recovery guidance activates, unless autopilot operation has been shown to be safe in these conditions and provides effective automatic windshear recovery that meets the criteria found in the advisory circulars referenced above.

10.4.2 High Speed Protection

FAR 25.1329(h) states that the means must be provided to avoid excursions beyond an acceptable margin from the speed range of the normal flight envelope. V_{mo} and M_{mo} mark the upper speed limit of the normal flight envelope.

The following factors should be considered in the design of high-speed protection:

1. The duration of airspeed excursions, rate of airspeed change, turbulence, and gust characteristics.

a) Operations at or near V_{MO}/M_{MO} in routine atmospheric conditions (e.g., light turbulence) are safe. Small, brief excursions above V_{MO}/M_{MO}, by themselves, are not unsafe.

b) The FGS design should strive to strike a balance between providing adequate speed protection margin and avoiding nuisance activation of high-speed protection.

NOTE: The following factors apply only to designs that provide high-speed protection through FGS control of airspeed.

2. FGS in altitude hold mode:

a) Climbing to control airspeed is not desirable, because departing an assigned altitude can be disruptive to ATC and potentially hazardous. It is better that the FGS remain in altitude hold mode.

b) The autothrust function, if operating normally, should effect high-speed protection by limiting its speed reference to the normal speed envelope (i.e., at or below V_{MO}/M_{MO}).

c) If autothrust is not operating, the basic airplane high-speed alert is sufficient for the pilot to recognize the condition and take corrective action to reduce thrust as necessary. For this case, the FGS does not need to provide additional speed protection (e.g., alerts or guidance).

3. During climbs and descents:

   a) When the elevator channel of the FGS is not controlling airspeed, the autothrust function (if engaged) should reduce thrust, as needed to prevent sustained airspeed excursions beyond Vmo/Mmo (e.g., five knots), down to the minimum appropriate value.

   b) When thrust is already the minimum appropriate value, or the autothrust function is not operating, the FGS should begin using the elevator channel, as needed, for high-speed protection.

   c) If conditions are encountered that result in airspeed excursions above V_{MO}/M_{MO}, it is preferable for the FGS to smoothly and positively guide or control the airplane back to within the speed range of the normal flight envelope.

11 CHARACTERISTICS OF SPECIFIC MODES

There are certain operational modes of the FGS that have been implemented in different ways in different airplanes and systems. The following sections provide guidance and interpretative material that clarifies the operational intent for these modes and provide criteria that have been shown to be acceptable in current operations. The guidance in this section does not preclude other mode implementations.

Pilot understanding of the mode behavior is especially important to avoid potential confusion and should be clearly annunciated as described in Section 9.2, Flight Guidance Mode Selection, Annunciation, and Indication.

11.1 Lateral Modes

This section discusses modes that are implemented in many flight guidance systems that are used primarily for lateral/directional control of the airplane. The criteria below identify acceptable mode operation based on past operational experience gained from the use of these modes.

11.1.1 Heading or Track Hold

In the Heading or Track Hold mode, the FGS should maintain the airplane heading or track. For the situation when the airplane is in a bank when the Heading or Track Hold mode is engaged, the FGS should roll the airplane to a wings-level condition and maintain the heading or track when wings-level is achieved (typically less than five degrees of bank angle).

11.1.2 Heading or Track Select

In the Heading or Track Select mode, the FGS should expeditiously acquire and maintain a ‘selected’ heading or track value consistent with occupant comfort. When the mode is initially engaged, the FGS should turn the airplane in a direction that is the shortest heading (or track) change to acquire the new heading (or track). Once the heading/track select mode is active, changes in the selected value should result in changes in heading/track. The FGS should always turn the airplane in the same direction as the sense of the selected heading change (e.g., if the pilot turns the heading select knob clockwise, the airplane should turn to the right), even if the shortest heading (or track) change is in the opposite direction. Target heading or track value should be presented to the flight crew.

11.1.3 Lateral Navigation Mode (LNAV)

In the LNAV mode, the FGS should acquire and maintain the lateral flight path commanded by a flight management function (that is, FMS or equivalent).

If the airplane is not established on the desired lateral path or within the designed path capture criteria when LNAV is selected, the FGS LNAV mode should enter an armed state. The FGS should transition from the armed state to an engaged state at a point where the lateral flight path can be smoothly acquired and tracked.

For an FGS incorporating the LNAV mode during the takeoff or go-around phase, the design should specify maneuvering capability immediately after takeoff, and limits, should they exist. After takeoff or go-around, maneuveringshould be based upon aircraft performance with the objective to prevent excessive roll attitudes where wingtip / runway impact becomes probable, yet satisfy operational requirements where terrain and / or thrust limitations exist.

11.2 Vertical Modes

This section discusses modes that are implemented in many flight guidance systems that are used primarily for pitch control of the airplane. The criteria identified reflect operational experience gained from the use of these modes.

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.

11.2.1 Vertical Speed Mode

In the Vertical Speed mode, the FGS should smoothly acquire and maintain a selected vertical speed.

Consideration should be given to:

- the situation where the selected value is outside of the performance capability of the airplane, or
- use of vertical speed mode without autothrust,

potentially leading to a low-speed or high-speed condition, and corresponding pilot awareness vulnerabilities. See **Section 10.4**, Speed Protection, for discussion of acceptable means of compliance when dealing with such situations.

11.2.2 Flight Path Angle Mode

In the Flight Path Angle mode, the FGS should smoothly acquire and maintain the selected flight path angle.

Consideration should be given to:

- the situation where the selected value is outside of the performance capability of the airplane, or
- use of flight path angle mode without autothrust,

potentially leading to a low-speed or high-speed condition, and corresponding pilot awareness vulnerabilities. Acceptable means of compliance have included a reversion to an envelope protection mode or a timely annunciation of the situation.

11.2.3 Airspeed (IAS)/Mach Hold [Speed on elevator]

In the Airspeed/Mach Hold mode, the FGS should maintain the airspeed or Mach at the time of engagement.

11.2.4 Airspeed (IAS)/Mach Select Mode [Speed on elevator]

In the Airspeed/Mach Select mode, the FGS should acquire and maintain a selected airspeed or Mach. The selected airspeed or Mach may be either preselected or synchronized to the airspeed or Mach at the time of engagement.

11.2.5 Flight Level Change (FLCH) [Speed on elevator]

In the FLCH mode, the FGS should change altitude in a coordinated way with thrust control on the airplane. The autopilot/flight director will typically maintain speed control through elevator. The autothrust function, if engaged, will control thethrust to the appropriate value for climb or descent.

11.2.6 Altitude Capture Mode

The Altitude Capture mode should command the FGS to transition from a vertical mode to smoothly capture and maintain the selected target altitude with consideration of the rates of climb and descent experienced in service.

In-service experience has shown that certain implementations have the potential to cause pilot confusion that may lead to altitude violations. Accordingly, the following are guidelines for the Altitude Capture mode:

(a) The Altitude Capture mode should be armed at all times to capture the selected altitude. Note: assuming that it is armed at all times, then annunciation of the armed status is not required. If the FGS is in Altitude Capture, it should be annunciated.

(b) The Altitude Capture mode should engage from any vertical mode if the computed flight path will intercept the selected altitude and the altitude capture criteria are satisfied, except as specified during an approach (e.g., when the glidepath for approach mode is active).

(c) Changes in the climb/descent command references, with the exception of those made by the flight crew using the altitude select controller, should not prevent capture of the target altitude.

(d) The Altitude Capture mode should smoothly capture the selected altitude using an acceptable acceleration limit with consideration for occupant comfort.

(e) The acceleration limit may, under certain conditions, result in an overshoot. To minimize the altitude overshoot, the normal acceleration limit may be increased, consistent with occupant safety.

(f) During Altitude Capture, pilot selection of other vertical modes should not prevent or adversely affect the level off at the target altitude at the time of capture. One means of compliance is to inhibit transition to other pilot-selectable vertical modes (except altitude hold, go-around, and approach mode) during altitude capture, unless the target altitude is changed. If glidepath capture criteria are satisfied during altitude capture, then the FGS should transition to glidepath capture.

(g) The FGS should be designed to minimize flight crew confusion concerning the FGS operation when the target altitude is changed during altitude capture. It must be suitably annunciated and appropriate for the phase of flight.

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

(i) If the autothrust function is active during altitude capture the autopilot and autothrust functions should be designed such that the FGS maintains the reference airspeed during the level-off maneuver. For example, if the autopilot changes from speed mode to an altitude control or capture mode, then autothrust should transition to a speed mode to maintain the reference airspeed.

(j)

11.2.7 Altitude Hold Mode

The Altitude Hold mode may be entered either by flight crew selection or by transition from another vertical mode.

When initiated by an automatic transition from altitude capture the Altitude Hold mode should provide guidance or control to the selected altitude. The automatic transition should be clearly annunciated for flight crew awareness.

When initiated by pilot action in level flight, the Altitude Hold mode should provide guidance or control to maintain altitude at the time the mode is selected.

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., <200 feet/min) is reached. The intensity of the leveling maneuver should be consistent with occupant comfort and safety.

Automatic transition into the Altitude Hold mode from another vertical mode should be clearly annunciated for flight crew awareness.

11.2.8 Vertical Navigation Mode (VNAV)

In the VNAV mode, the FGS should acquire and maintain the vertical commands provided by a flight management function (that is, FMS or equivalent).

If the airplane is not on the desired FMS path when the VNAV mode is selected, the FGS VNAV mode should go into an armed state, or provide guidance to smoothly acquire the FMS path. The flight crew should establish the airplane on a flight profile to intercept the desired FMS path. The FGS should transition from the armed state to an engaged state at a point where the FGS can smoothly acquire and track the FMS path.

When VNAV is selected for climb or descent, the autothrust function (if installed) should maintain the appropriate thrust setting. When leveling after a VNAV climb or descent, the autothrust function should maintain the target speed.

If the aircraft is flying a vertical path (e.g., VNAV Path), then the deviation from that path must be displayed in the primary field of view (i.e., the PFD, ND, or other acceptable display).

The FGS should preclude a VNAV climb unless the Mode Selector Panel altitude window is set to an altitude above the current altitude.

Except when on a final approach segment to a runway:

- The FGS should preclude a VNAV descent unless the Mode Selector Panel altitude window is set to an altitude below the current altitude.
- The FGS should not allow the VNAV climb or descent to pass through a Mode Selector Panel altitude.

(See **Section11.5**, Special Considerations for VNAV Approach Operations related to selecting a Target Altitude.)

11.3 Multi-axis Modes

This section discusses modes that are implemented in many flight guidance systems that are used in an integrated manner for pitch, lateral/directional control and thrust management of the airplane. The criterion identified reflects operational experience gained from the use of these modes.

11.3.1 Takeoff Mode

In the take off mode, the vertical element of the FGS should provide vertical guidance to acquire and maintain a safe climb out speed after initial rotation for takeoff. If no rotation guidance is provided, the pitch command bars may be displayed during takeoff roll but should not be considered as providing rotation guidance unless it is part of the intended function.

If rotation guidance is provided, consideration should be given to the need to show that the use of the guidance does not result in a tail strike and should be consistent with takeoff methods necessary to meet takeoff performance requirements up to 35 feet AGL.

The Autothrust function should increase and maintain engine thrust to the selected thrust limits [e.g., full T/O, de-rate].

The FGS design should address all engine and engine-inoperative conditions consistent with the following takeoff system performance after liftoff:

(a) Takeoff system operation should be continuous and smooth through transition from the runway portion of the takeoff to the airborne portion and reconfiguration for en route climb. The pilot should be able to continue the use of the same primary display(s) for the airborne portion as for the runway portion. Changes in guidance modes and display formats should be automatic.

(b) The vertical axis guidance of the takeoff system during normal operation should result in the appropriate pitch attitude, and climb speed for the airplane considering the following factors:

- Normal rate rotation of the airplane to the commanded pitch attitude, at V_R-10 knots for all engines and V_R-5 knots for engine out, should not result in a tail-strike.

- The system should provide commands that lead the airplane to smoothly acquire a pitch attitude that results in capture and tracking of the All-Engine Takeoff Climb Speed, $V_2 + X$. X is the All-Engine Speed Additive from the AFM (normally 10 knots or higher). If pitch limited conditions are encountered, a higher climb airspeed may be used to achieve the required takeoff path without exceeding the pitch limit.

(c) For engine-out operation, the system should provide commands that lead the airplane to smoothly acquire a pitch attitude that results in capture and tracking of the following reference speeds:

- V_2, for engine failure at or below V_2. This speed should be attained by the time the airplane has reached 35-ft. altitude.

- Airspeed at engine failure, for failures between V_2 and $V_2 + X$.

- $V_2 + X$, for failures at or above $V_2 + X$. Alternatively, the airspeed at engine failure may be used, provided it has been shown that the minimum takeoff climb gradient can still be achieved at that speed.

If implemented, the lateral element of the takeoff mode should maintain runway heading/track or wings level after liftoff and a separate lateral mode annunciation should be provided.

11.3.2 Go-Around Mode

In the Go-Around mode, the vertical element of the FGS should initially rotate, or provide guidance to rotate, the airplane to arrest the rate of descent. The autothrust function should increase thrust and either maintain thrust to the thrust limits, or maintain thrust for an adequate, safe climb. The autothrust function should not exceed thrust limits (e.g., full go-around thrust or de-rated go-around thrust limits) nor reduce thrust, for winds, below the minimum value required for an adequate, safe climb or reduce thrust lever position below a point that would cause a warning system to activate. The initial go-around maneuver may require a significant change in pitch attitude. It is acceptable to reduce thrust to lower the pitch attitude for comfort of the occupants when a safe climb gradient has been established. It should be possible for the pilot to reselect the full thrust value if needed.

The go-around mode should engage even if the MSP altitude is at or below the go-around initiation point. The airplane should climb until another vertical mode is selected or the MSP altitude is adjusted to an altitude above the present aircraft altitude.

The FGS should acquire and maintain a safe speed during climbout and airplane configuration changes. Typically, a safe speed for go-around climb is V_2, but a different speed may be found safe for windshear recoveries (see FAA Advisory Circular AC 25-12). The lateral element of the FGS should maintain heading/track or wings level.

The FGS design should address all engine and engine-out operation. The design should consider an engine failure resulting in a go-around, and the engine failure occurring during an all engine go-around.

Characteristics of the go-around mode and resulting flight path should be consistent with manually flown go-around.

11.3.3 Approach Mode

In the Approach mode, the FGS should capture and track a final approach lateral and vertical path (if applicable) from a navigation or landing system (e.g., ILS, MLS, GLS, RNP RNAV – refer to AC 120-28D, AC 120-29A, JAR-AWO and JAR-OPS 1).

The FGS should annunciate all operationally relevant approach mode annunciations. Modes that are armed, waiting for capture criteria to be satisfied, should be indicated - in addition to the active pre-capture mode. A positive indication of the capture of the previously armed mode should be provided.

The FGS may have sub-modes that become active without additional crew selection. An assessment of the significance of these sub-mode transitions to the flight crew should be made. If assessed to be significant (e.g., Flare), positive annunciation of the transition should be provided.

Glideslope capture mode engagement may occur prior to localizer capture. However, it is the flight crew's responsibility to ensure proper safe obstacle/terrain clearance when following vertical guidance when not established on the final lateral path.

Additional guidance and criteria is contained in AC 120-29, AC 120-28D and JAR-AWO.

11.4 Autothrust Modes

This section discusses modes that are implemented in many flight guidance systems that are used primarily for controlling the engines on the airplane. The criterion identified reflects operational experience gained from the use of these modes.

11.4.1 Thrust Mode

In the Thrust mode, the FGS should command the autothrust function to achieve a selected target thrust value.

11.4.2 Speed Mode

In the Speed mode, the FGS should command the autothrust function to acquire and maintain the selected target speed value - assuming that the selected speed is within the speed range of the normal flight envelope.

11.4.3 Retard Mode

If such a mode is installed on a specific aircraft, it should work in the same manner for both automatic and manual landings, when the autothrust function is engaged.

11.5 Special Considerations for VNAV Approach Operations related to selecting a Target Altitude

For approach operations, the FGS vertical modes should allow the pilot to set the target altitude to a missed approach value prior to capturing the final approach segment. This should be possible for capturing from both above and below the final approach segment

For VNAV Path operations, it should be possible to define a descent path to the final approach fix and another path from the final approach fix to the runway with the target altitude set for the missed approach altitude. Appropriate targets and descent points should be identified by the Flight Management System.

11.6 Control Wheel Steering (Control Steering through the Autopilot)

In the Control Wheel Steering (CWS) mode, the FGS allows the flight crew to maneuver the airplane through the autopilot. This has implications for control harmony, stability, and crew awareness that need to be thoroughly addressed.

If provided, a CWS mode should meet the following requirements:

(a) It should be possible for the pilot to maneuver the airplane using the normal flight controls with the CWS mode engaged and to achieve the maximum available control surface deflection without using forces so high that the controllability requirements of FAR/JAR 25.143(c) are not met.

(b) The maximum bank and pitch attitudes that can be achieved without overpowering the automatic pilot should be limited to those necessary for the normal operation of the airplane.

NOTE: Typically 35 degrees in roll and +20 degrees to -10 degrees in pitch

(c) It should be possible to perform all normal maneuvers smoothly and accurately without nuisance oscillation. It should be possible also to counter all normal changes of trim due to change of configuration or power, within the range of flight conditions in which control wheel steering may be used, without encountering excessive discontinuities in control force which might adversely affect the flight path.

(d) The stall and stall recovery characteristics of the airplane should remain acceptable. It should be assumed that recovery is made with CWS in use unless automatic disengagement of the automatic pilot is provided.

(e) In showing compliance with FAR/JAR 25.143(f), account should be taken of such adjustments to trim as may be carried out by the automatic pilot in the course of maneuvers that can reasonably be expected. Some alleviation may be acceptable in the case of unusually prolonged maneuvers, provided that the reduced control forces would not be hazardous.

(f) If the use of this mode for takeoff and landing is to be permitted, it should be shown that:

i) Sufficient control, both in amplitude and rate is available without encountering force discontinuities;

ii) Reasonable mishandling is not hazardous (e.g., engaging the automatic pilot while the elevators or ailerons are held in an out-of-trim position);

iii) Runaway rates and control forces are such that the pilot can readily overpower the automatic pilot with no significant deviation in flight path; and

iv) Any lag in aircraft response induced by the CWS mode is acceptable for the intended maneuver.

(g) It should not be possible to revert to the CWS mode by applying a force to the control column or wheel unless the autopilot is in a capture mode (e.g., altitude capture, localizer capture). When the force is released, the autopilot should return to the previously engaged capture mode or to the track mode.

NOTE: CWS, if it is provided, is considered to be an autopilot mode, as it is a specific function of the FGS. However, during CWS operation, it is the pilot and not the autopilot that is in control of the aircraft. Operationally, CWS is identical to the pilot flying the airplane during manual flight. In both cases, it is the pilot who is in actual control of the flight path and speed of the airplane. The only difference is the mechanization of how the actual flight control surfaces are moved. No "automatic" FGS commands are involved during CWS operation. Therefore, sections in this Advisory Circular such as those which discuss Speed Protection and performance objectives should be applied to only those autopilot modes with which the FGS is in control of the flight path of the airplane and should not be applied to CWS.

NOTE: The terminology "Control Wheel Steering" is currently used by industry to describe several different types of systems. This section is meant to be applied only toward those systems which are implemented in a manner as described above. For comparison, several other functions that are similar in nature, but functionally very different, to CWS are described below. This section does not apply to functions of these types.

- A Touch Control System (TCS) is a function that is available on many business and commuter aircraft. With a TCS system, a pilot is able to physically disengage the autopilot servos from the flight control system, usually by pushing and holding a button on the control wheel, without causing the autopilot system itself to disengage or lose its currently selected modes. The pilot may then maneuver the airplane as desired using the aircraft's flight control system (i.e., the autopilot servos are not part of the control loop). The pilot is then able to reconnect the autopilot servos to the flight control system by releasing the TCS button. Using the new orientation of the aircraft as a basis, the autopilot will then reassume control the airplane using the same mode selections as were present before the selection of TCS. This type of system on some aircraft is also sometimes referred to as Control Wheel Steering.

- Also different from CWS is what is referred to as a "supervisory override" of an engaged autopilot. With this function, a pilot is able to physically overpower an engaged autopilot servo by applying force to the flight deck controls. With a supervisory override, the autopilot does not automatically disengage due to the pilot input. This allows the pilot to position the airplane as desired using the flight deck controls without first disengaging the autopilot. When the pilot releases the controls, the autopilot reassumes control of the airplane using the same mode selections as were present before the supervisory override.

- The descriptions of TCS and of supervisory override are intended to be generic. Specific implementations on various aircraft may vary in some aspects.

11.7 Special Considerations for the Integration of Fly-By-Wire Flight Control Systems and FGS

Speed protection features may be implemented in the fly-by-wire flight control system. However, if speed protection is also implemented within the FGS, it should be compatible with the envelope protection features of the fly-by-wire flight control system. The FGS speed protection (normal flight envelope) should operate to or within the limits of the flight control system (limit flight envelope).

Information should be provided to the flight crew about implications on the FGS following degradation of the fly-by-wire flight control systems.

12 Flight Guidance System Integration

Throughout the preceding sections of the document, flight guidance systems and functions have been considered as being separate and distinct from other systems and functions on the aircraft. It is recognized that in complex aircraft designs, the flight guidance functions are closely integrated with other avionics functions, and that the physical integration of these systems, may have a bearing on how airplane level safety is assessed.The following paragraphs provide guidance on the likely FGS system integration issues found in more complex aircraft system designs, and the interfaces which should be considered within the bounds of demonstrating the intended function, performance and safety of the FGS.

12.1 System Integration Issues

Integration of other aircraft systems with the FGS has the potential of reducing the independence of failure effects and partitioning between functions. This is particularly the case where hardware and software resources are shared by different systems and functions (e.g., aircraft data highway and Integrated Modular Avionics (IMA) architectures). In addition to considering the reliability and integrity aspects of the FGS as a separate system, it may be necessary to address the effects of FGS failures with respect to fault propagation, detection, and isolation within other systems. The overall effect on the aircraft of a combination of individual system failure conditions occurring as a result of a common or cascade failure, may be more severe than the individual system effect. For example, failure conditions classified under §/JAR 25.1309 as Minor or Major by themselves may have Hazardous effects at the aircraft level, when considered in combination. With regard to isolation of failures, and particularly combination failures, the ability of the alerting system to provide clear and unambiguous information to the flight crew, becomes of significant importance. (See also **Section 13**, Safety Assessment.)

Complex and highly integrated avionics issues present greater risk for development error. With non-traditional human-machine interfaces, there is also the potential for operational flight crew errors. Moreover, integration of systems may result in a greater likelihood of undesirable and unintended effects.

Within the FGS, where credit is taken for shared resources or partitioning schemes, these should be justified and documented within the System Safety Analysis. When considering the functional failures of the system, where such partitioning schemes can not be shown to provide the necessary isolation, possible combination failure modes should be taken into account. An example of this type of failure would be multi-axis active failures, where the control algorithms for more than one axis are hosted on a single processing element. Further, the functional integration of control functions such as control surface trimming, yaw channel, and stability augmentation, while not strictly FGS, should be considered.

12.2 Functional Interfaces

In its simplest form, the FGS may be considered as interfacing with sensors that provide the necessary inputs to enable computation of its various functions. Typically, these sensors will include air and inertial data, engine control, and navigation sensors such as ILS, VOR, and DME. In the case of engine control, a feedback loop may also be provided. The FGS may also be considered as providing inner loop closure to outer loop commands. The most common interface is with the Flight Management System (FMS), which provides targets for lateral and vertical navigation in the form of steering orders.

In demonstrating the intended function and performance of both the FGS and systems providing outer loop commands, the applicant needs to address potential inconsistencies between limits of the two (e.g., with basic FGS pitch and bank angle limits). Failure to address these points can result in discontinuities, mode switching, and reversions, leading to erroneous navigation and other possible safety issues (e.g., buffet margin at high altitude). Similar issues arise in the inner loop, across the functional interface between FGS and flight controls. In fly-by-wire aircraft, the loss of synchronization between the two can result in mode anomalies and autopilot disengagement.

The applicant should demonstrate the intended function and performance of the FGS across all possible functional interfaces. The alerting system should also be assessed to ensure that accurate and adequate information is provided to the flight crew when dealing with failures across functional interfaces.

13 SAFETY ASSESSMENT

§/JAR 25.1309 defines the basic safety requirements for airworthiness approval of airplane systems and AC/ACJ 25.1309 provides an acceptable means of demonstrating compliance with this rule. This section provides additional guidance and interpretive material for the application of §/JAR 25.1309 to the approval of Flight Guidance Systems.

13.1 FGS Failure Conditions

General - one of the initial steps in establishing compliance with §/JAR 25.1309 for a system is to identify the Failure Conditions that are associated with that system. The Failure Conditions are typically characterized by an undesired change in the intended function of the system. The Failure Condition statements should identify the impacted functionality, the effect on the airplane and/or its occupants, specify any considerations relating to phase of flight and identify any flight crew action, or other means of mitigation, that are relevant.

Functionality - the primary functions of a Flight Guidance System may include:

- automatic control of the airplane's flight path utilizing the airplane's aerodynamic control surfaces,
- guidance provided to the flight crew to achieve a particular desired flight path or maneuver, through information presented on a head-down or head-up display system, and
- control of the thrust applied to the airplane.

Dependent upon the functionality provided in a specific FGS, the failure conditions could potentially impact the following:

- the control of the airplane in the pitch, roll and directional axes,
- the control of thrust,
- the integrity and availability of guidance provided to the flight crew,
- the structural integrity of the airplane,
- the ability of the flight crew to cope with adverse operating conditions,
- the flight crew's performance and workload,
- the safety of the occupants of the airplane.

NOTE: The safety assessment of a FGS for use in supporting takeoff, approach and landing operations in low visibility conditions are further addressed in AC 120-29A, AC 120-28D, and JAR-AWO.

13.2 Type and Severity of Failure Conditions

The type of the FGS Failure Conditions will depend, to a large extent, upon the architecture, design philosophy and implementation of the system. Typical types of Failure Conditions include:

- Loss of function – where a control or display element no longer provides control or guidance
- Malfunction – where a control or display element performs in an inappropriate manner which can include the following sub-types:
    a) Hardover – the control or display goes to full displacement in a brief period of time – the resultant effect on the flight path and occupants of the airplane are the primary concern.

b) Slow over - the control or display moves away from the correct control or display value over a relatively long period of time – the potential delay in recognizing the situation and the effect on the flight path are the primary concern.

c) Ramp - the control or display moves away from the correct control or display value fairly rapidly –the resultant effect and/or recognition, are the primary concerns.

d) Oscillatory - the control or display is replaced or augmented by an oscillatory element – there may be implications on structural integrity and occupant well being.

Failure Conditions can become apparent due to failures in sensors, primary FGS elements (e.g., autopilot, flight director, HUD), control and display elements (e.g., servos, primary flight displays), interfacing systems or basic services (e.g., electrical and hydraulic power).

The severity of the FGS Failure Conditions and their associated classifications will frequently depend on the phase of flight, airplane configuration and the type of operation being conducted. The severity of the Failure Conditions can also be mitigated by various design strategies (see Section 13.3).

Appendix A presents some considerations for use when assessing the type and severity of condition that results from functional failures. Classifications of failure conditions that have been identified on previous airplane certification programs are identified. The classifications of failure conditions should be agreed with the authority during the 25.1309 safety assessment process.

With exception of the Catastrophic failure condition, the classification of failure conditions leading to the imposition of airframe loads should be assessed in accordance with §/JAR 25.302. This requires that the structure be able to tolerate the limit load multiplied by a factor of safety associated with the probability of occurrence of the failure mode. The assessment needs to take into account loads occurring during the active malfunction, recovery or continuation of the flight with the system in the failed state.

Complex integrated systems may require that the total effect resulting from single failure be assessed. For example, some failures may result in a number of Failure Conditions occur which, if assessed individually may be considered a Major effects, but when considered in combination may be Hazardous. Special consideration concerning complex integration of systems can be found in **Section 12,**Flight Guidance System Integration.

13.3 Failure Condition – Mitigation

The propagation of potential Failure Conditions to their full effect may be nullified or mitigated by a number of methods. These methods could include, but are not limited to, the following:

- failure detection and monitoring,
- fault isolation and reconfiguration,
- redundancy,
- authority limiting, and
- flight crew intervention.

Means to assure continued performance of any system design mitigation methods should be identified. The mitigation methods should be described in the Safety Analysis/Assessment document or be available by reference to another document (e.g., a System Description document).

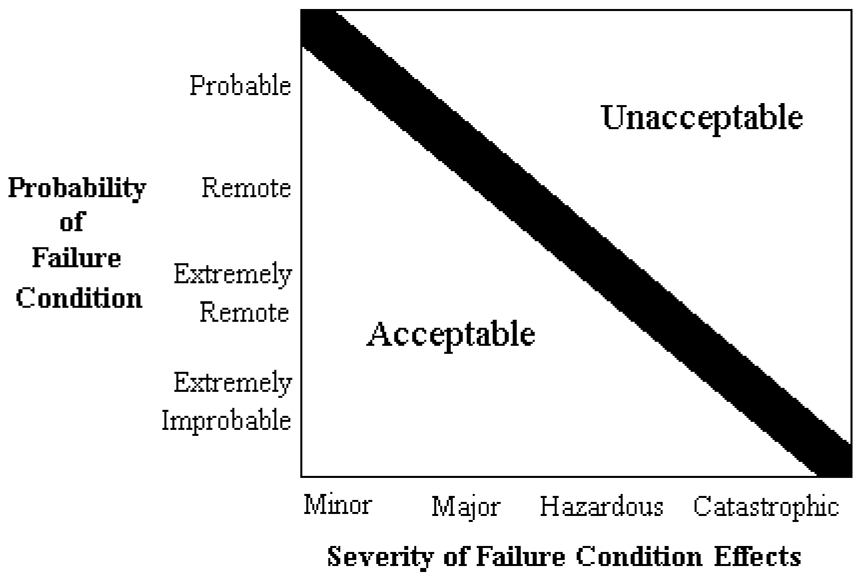
13.4 Validation of Failure Conditions

The method of validating of Failure Conditions will depend on the effect of the condition, assumptions made and any associated risk. The severity of some Failure Conditions may be obvious and other conditions may be somewhat subjective. If flight crew action is used to mitigate the propagation of the effect of a Failure Condition, the information available to the flight crew to initiate the intervention (e.g., motion, alerts, and displays) and the assumed flight crew response should be identified. It is recommended that there be early coordination with the regulatory authority to identify any program necessary to validate any of these assumptions.

The validation options for Failure Conditions include:

- Analysis
- Laboratory Testing
- Simulation
- Flight Test

It is anticipated that the majority of Failure Condition can be validated by analysis to support the probability aspect of the 25.1309 assessment:



The analysis will take account of architectural strategies (e.g., redundant channels, high integrity components, rate limit/magnitude limiting, etc.).

It may be necessary to substantiate the severity of a Failure Condition Effect by ground simulation or flight test. This is particularly true where pilot recognition of the failure condition requires justification or if there is some variability in the response of the airplane.

Section 14 – Compliance Methods using Flight Test and Simulation - provides guidance on the assessment of 'traditional' Failure Conditions. New and novel functionality may require additional assessment methods to be agreed with the authority.

13.5 Specific Considerations

The following paragraphs identify specific considerations that should be given to potential Failure Conditions for various phases of flight.

13.5.1 FGS Function during Ground Operations

The potential hazard that may result due to inappropriate autopilot, autothrust or other system control action during maintenance operations, while the airplane is parked at the gate or during taxi operations should be assessed. System interlocks or crew or maintenance procedures and placards may mitigate these hazards.

13.5.2 FGS Operations Close to the Ground

The response of the airplane to failures in an automatic flight control system could have implications on the safety of operations when the airplane is close to the ground. For the purpose of this advisory circular, close to the ground can be assumed to be less than 500 feet above the liftoff point or touchdown zone or a runway. A specific safety assessment is required if approval is sought for automatic flight control operation where the autopilot is engaged, or remains engaged in close proximity to the ground.

> NOTE: Operation in low visibility conditions require additional consideration and AC 120-29A, AC 120-28D, and JAR AWO Subparts should be used for those additional considerations.

13.5.2.1 Takeoff

If approval is sought for engagement of the autopilot below 500 feet after liftoff, an assessment of the effect of any significant FGS failure conditions on the net vertical flight path, the speed control and the bank angle of the airplane should be conducted. A Minimum Engage Altitude (MEA) or Minimum Engagement Height (MEH) on takeoff will be established based on the characteristics of the airplane in response to the failures and the acceptability of flight crew recognition of the condition.

Assessment of certain Failure Conditions may be required (see Section 14 – Compliance Methods using Flight Test and Simulation). The minimum engage altitude/height after liftoff, based upon the assessment, should be provided in the AFM.

13.5.2.1.1 Vertical Axis Assessment

The operational objective during the initial climb is to maintain an appropriate climb profile to assure obstacle clearance and to maintain an appropriate speed profile during climbout (refer to **Section 11**, Characteristics of Specific Modes).

FGS Failure Conditions should be assessed for the potential for:

- a significant reduction in the net takeoff flight path below 500 feet,
- a significant increase in pitch attitude that results in the airplane speed dropping to unacceptable values.

Failures Conditions with a probability greater than 1 x 10-7 per flight hour that have an effect requiring pilot intervention should be evaluated for a potential Airplane Flight Manual limitations or procedures.

13.5.2.1.2 Lateral Axis Assessment

The operational objective during the initial climb is to maintain an appropriate heading or track to provide separation from potential adjacent runway operations.

FGS failure conditions should be assessed for the potential for producing a bank angle that results in significant deviation from the runway track or intended track.

Failures Conditions with a probability greater than 1 x 10-7 per flight hour that have an effect requiring pilot intervention should be evaluated for a potential Airplane Flight Manual limitations or procedures.

13.5.2.2 Approach

If the autopilot is to remain engaged below 500 feet above the touchdown zone during approach, an assessment of the effect of any significant FGS failure conditions on the net vertical flight path, the speed control and the bank angle of the airplane should be conducted. The lowest point on the approach appropriate for the use of the autopilot will be established based on the characteristics of the airplane in response to the failure conditions and the acceptability of flight crew recognition of the condition.

A number of approach operations may be conducted using automatic flight control. These can include, but not be limited to, the following:

- ILS, MLS, GLS,
- RNAV (e.g., LNAV and VNAV),
- NAV (e.g., VOR, LOC, Backcourse),
- Open loop flight path management (e.g., Vertical Speed, Flight Path Angle, Track or Heading Select).

Some operations may be conducted with a single autopilot channel engaged and some operations may be conducted with multiple autopilots engaged. The engagement of multiple autopilots may have the effect of mitigating the effect of certain failure conditions. The effectiveness of these mitigation methods should be established.

The type of operation and the prevailing visibility conditions will determine the decision altitude/decision height (DA(H)), or minimum descent altitude or height (MDA(H)), for a particular flight operation. The operation may continue using automatic flight control if the visual requirements are met.

The lowest altitude at which the autopilot should remain engaged could vary with the type of operation being conducted. The resultant flight path deviation from any significant failure condition would impact the autopilot minimum operational use height.

Assessment of certain failure conditions may be required (see Section 14 – Compliance Methods using Flight Test and Simulation). The minimum use height for approach should be provided in the AFM.

13.5.2.2.1 Vertical Axis Assessment

The operational objective during the approach is to maintain an appropriate descent profile to assure obstacle clearance and to maintain an appropriate speed profile.

FGS Failure Conditions should be assessed for the potential for:

- a significant reduction in the approach flight path when below 500 feet above touchdown,
- a significant increase in pitch attitude that results in the airplane speed dropping to unacceptable values.

Failures Conditions with a probability greater than 1 x 10-7 per flight hour that have an effect requiring pilot intervention should be evaluated for a potential Airplane Flight Manual limitations or procedures.

13.5.2.2.2 Lateral Axis Assessment

The operational objective during the approach is to maintain an appropriate track to provide alignment with the runway centerline, or intended flight path, to support the landing.

FGS Failure Conditions should be assessed for the potential for producing a bank angle that results in significant deviation from the runway track or intended track.

Failures with a probability greater than 1 x 10-7 per flight hour that have an effect requiring pilot intervention should be evaluated for an appropriate Flight Manual limitations or procedures.

13.5.3 Cruise Operations

The primary concern during cruise operations is the effect the airplane response to Failure Conditions may have on the occupants. At a minimum, the accelerations and attitude resulting from any condition should be assessed. The mitigation of the effect of a Failure Condition by the flight crew may not be as immediate as during takeoff and landing operations. Section 14 provides guidance and considerations for this phase of flight.

13.5.4 Asymmetric Thrust during Autothrust Operation

During autothrust operation, it is possible that a failure (e.g., engine failure, throttle lever jam, or thrust control cable jam) could result in significant asymmetric thrust failure condition that may be aggravated by the continued use of the autothrust system. Because the FGS could potentially compensate for the asymmetric condition with roll (and possibly yaw) control, the pilot may not immediately be aware of the developing situation. Therefore, an alert should be considered as a means of mitigation to draw the pilot's attention to an asymmetric thrust condition during FGS operation.

13.6 Failure to Disengage the System via Quick Disconnect Controls [25.1329 (b)]

The requirement for quick disconnect for the autopilot and autothrust functions is intended to provide a routine and intuitive means for the flight crew to quickly disconnecting those functions. The implication of failures that preclude the quick disconnect from functioning should be assessed consistent with the guidelines of AC/ACJ 25.1309. An alternate positive means of disengagement is required to mitigate any significant Failure Condition effect.

13.7 Safety Analysis

A Safety Analysis document should be produced to identify the Failure Conditions, classify their hazard level according to the guidance of AC/ACJ 25.1309, and establish that the Failure Conditions occur with a probability corresponding to the hazard classification or are mitigated as intended. The safety assessment should include the rationale and coverage of the FGS protection and monitoring philosophies employed. The safety assessment should include an appropriate evaluation of each of the identified FGS Failure Conditions and an analysis of the exposure to common mode/cause or cascade failures in accordance with AC/ACJ 25.1309. Additionally, the safety assessment should include justification and description of any functional partitioning schemes employed to reduce the effect/likelihood of failures of integrated components or functions.

There may be situations where the severity of the effect of a failure condition identified in the safety analysis needs to be confirmed. Laboratory, simulator or flight test, as appropriate, may accomplish the confirmation.

It is recommended that the Safety Analysis plan is coordinated with the regulatory authority early in the certification program.

14 COMPLIANCE DEMONSTRATION USING FLIGHT TEST AND SIMULATION

14.1 Introduction

The validation of the operation of the FGS will typically be accomplished by a combination of the following methods:

- Analysis
- Laboratory Test
- Simulation
- Flight Test

The validation program will typically confirm acceptable performance of intended functions and the acceptability of failure scenarios. The type and extent of the various validation methods may vary dependent upon certification program, facilities, practicality and economic constraints. This section focuses on the validation considerations that would normally be expected to be accomplished by flight test or simulation with flight crew participation and evaluation.

Where Flight Test and Simulation is used as a means of showing FGS System compliance with FAR/JAR 25.1329, the assessment should address system intended function, safe operation, and the human-machine interface. Criteria and requirements for flight evaluation or simulation must consider the applicant's design and supporting engineering analysis and laboratory testing.

The certification flight test program should investigate representative phases of flight and aircraft configurations used by the FGS system under normal and failure conditions. The program should evaluate all of the FGS modes throughout appropriate maneuvers and representative environmental conditions, including turbulence.

A thorough investigation of the human-machine interface is required to ensure safe, effective, and consistent FGS operation. This investigation will principally be conducted on the integrated flight deck during actual flight test. However, certain simulation packages and some highly representative simulators can be used to accomplish human factors evaluations and workload studies.

The criteria used for compliance with FAR/JAR 25.1301, 1309 and 1329 may be found in Sections 8, 9, 10, 11, 12, and 13 of this document. In addition, AC 25-7A, Flight Test Guide For Certification of Transport Category Airplanes (Section 181, Automatic Pilot System), contains additional criteria and requirements to be used to show compliance.

14.2 Performance Demonstration (Fault Free) – 25.1301

The acceptability of the general performance of the FGS may be based on subjective pilot assessment, taking into account the experience acquired from similar equipment and the general behavior of the airplane. The acceptable performance may vary according to airplane type and model. The flight test and/or simulation demonstration program should include a representative range of airplane weight, center of gravity and operating envelope. Applicable airplane configurations should be assessed.

14.2.1 Normal Performance

The objective of the normal performance validation is to demonstrate acceptable performance over a range of conditions that may be experienced in operational use. The test program is intended to be representative but not exhaustive.

The performance demonstration should be conducted with the FGS operating at its normal authority levels.

The FGS should be evaluated to determine the acceptability of:

- The stability and tracking of automatic control elements
- The flyability and tracking of guidance elements
- The acquisition of flight paths for capture modes
- Consistency of integration of modes (Section 11)
-

Note:

If the FGS includes takeoff and/or approaches with guidance, then the following criteria needs to be considered for applicability in developing the overall flight test and simulation requirements:

- Advisory Circular 120-29A, "Criteria for Approving Category I and II Landing Minima for FAR 121 Operators"
- Advisory Circular 120-28D, "Criteria for Approval of Category III Landing Weather Minima" need to be included in the requirements to be tested.
- JAR AWO Subparts 1, 2, 3 and 4

14.2.2 Rare Normal Performance

The test program should explore possibility to expose the FGS to the more challenging operational environments, as the opportunity present itself (e.g., winds, wind gradients, various levels of turbulence, density altitude).

Rare environmental conditions may require the FGS to operate at the limits of its capabilities. Due to the severity of some environmental conditions, it is not recommended or required that the FGS evaluations include demonstrations in severe and extreme turbulence, or include flights into micro-bursts. The implications of any significant variability in control authority of the FGS in handling rare environmental should be assessed.

14.2.2.1 Icing Considerations

The implications of use of the automatic flight control elements of the FGS in icing conditions should be assessed. This assessment would logically be accomplished in conjunction with the evaluation of the basic airplane for operation in icing conditions.

Accumulation of ice on the airplane wings and surfaces has the effect of changing the aerodynamic characteristics of the airplane. The stability of the FGS may be impacted. The continued use of the FGS may be acceptable but its use may mask a developing situation which presents the pilot with a difficult handling quality task should the automatic control be relinquished.

The test program should assess the potential vulnerability of the FGS to icing conditions by evaluating autopilot performance during ice shape tests or during natural icing tests. Sufficient autopilot testing should be conducted to ensure that the autopilot's performance is acceptable. In general, it is not necessary to conduct an autopilot evaluation that encompasses all weights, center of gravity positions (including lateral asymmetry), autopilot servo authority, altitudes and deceleration device configurations. However if the autopilot performance with ice accretion shows a significant difference from the non-contaminated airplane, or testing indicates marginal performance, additional tests may be necessary. FGS performances and safety in icing conditions should be demonstrated by flight test and/or simulation tests, supported by analysis where necessary.

If significant automatic flight control inputs is required to compensate for the icing conditions, then the acceptability of the indication of a significant out of trim condition should be made and the subsequent response of the airplane when the automatic system is disengaged should be determined. (Refer to Section 9.3.3)

If applicable, the autopilot should demonstrate satisfactory performance during the shedding of ice from the airplane.

Where a degradation is noted which is not significant enough to require changes to the autopilot system or to deicing/anti-icing systems, appropriate limitations and procedures should be established and presented in the Airplane Flight Manual (AFM)."

Editorial Note - How do we handle the STC of an autopilot on an already TC'd airplane?

14.2.2.2 Windshear

The performance of the FGS in wind gradient and windshear conditions would typically be evaluated as part of design process. Opportunities to assess the performance in the presence of winds should be part of the flight test program. If the FGS provides windshear escape guidance, performance demonstration requirements should be conducted consistent with AC 25-12

14.2.2.3 Indication and Response to an Out of Trim Condition

An assessment should be performed to determine the acceptability of the out of trim annunciation and subsequent response to manual disengagement (Refer to Section 9.3.3).

14.2.3 Specific Performance Conditions

The functionality identified in previous section of this document will require some specific flight test or simulator evaluation, as appropriate, to confirm the performance of intended function.

14.2.3.1 Low Speed Protection

The FGS should be assessed for the acceptability of the low speed protection performance under the following conditions:

1. High Altitude Cruise.
2. Low Altitude Altitude Capture
3. High Vertical Speed
4. Approach

14.2.3.2 High-speed Protection

The FGS should be assessed for the acceptability of the high-speed protection performance under the following conditions:

1. High Altitude Level Flight Test with Autothrust function
2. High Altitude Level Flight Test without Autothrust function
3. High Altitude Descent Flight Test with Autothrust function

14.2.3.3 Go-around

The performance a go-around mode, if applicable, should be demonstrated. This assessment may be conducted in conjunction with the evaluation of the FGS to support low visibility operations using criteria in AC 120-28D, AC 120-29A and JAR AWO Subparts 2 or 3.

The flight evaluation should consider the following:

- The effect of airplane weight and CG
- Integrated autopilot and autothrust operation
- Speed performance during airplane reconfiguration and climbout (see Section 11.3.2)
- Implication of thrust de-rates
- Transition to Missed Approach Altitude
- Engine Failure at the initiation of Go-around
- Engine failure during GA – after go-around power is reached
- Initiation altitude

A typical go-around height loss number should be provided in the AFM:

14.2.3.4 Steep Approach [Special Authorization]

Typical approach operations are assumed to include glidepaths up to 3.77 degrees. Application for approval for operations greater than 3.77 degrees may require additional evaluation.

There may also be application on some types of airplanes for really steep approached (> 4.5 degrees)

This section describes the flight test and simulator assessment required to support a specific airworthiness approval for steep approach and really steep approach operations (Approach path > 4.5 degrees).

[Needs more work -to be integrated]

- Demonstration of go-around from steep approaches
- Words in 11.3.3 on Steep Approach

- Refer to para 6.8 AC 120-29A Appendix 2 (Cat 1) V23
- Worst case failures (deviation profile)

14.2.4 Flight Director / HUD Considerations

The purpose of these tests is to demonstrate compliance with the following:

- Paragraph 8.2 Flight Director Engagement/Disengagement and Indications, with its subparagraphs
- Paragraph 9.2.2 Flight Director Mode Annunciation
- Paragraph 9.4 FGS Considerations for Head-Up Displays (HUD), with its subparagraphs
- Paragraph 10.1 Normal Performance (specifically criteria for flight director guidance)

The Flight Director guidance cue(s) (e.g., single cue, cross-pointer) and the corresponding tracking reference, whether displayed on a head down primary flight display (PFD) or head-up display (HUD), should be demonstrated to provide smooth and accurate guidance and be appropriately damped, so as to achieve satisfactory control task performance without pilot compensation or excessive workload. The combination of display dynamics and airplane response to control inputs should be satisfactory when the pilot aggressively tracks the guidance.

The flight director guidance should be demonstrated to provide satisfactory performance when used in all normal airplane configurations intended for its use.

Flight director guidance demonstrations should include normal and non-normal conditions which are reasonably representative of actual expected conditions and cover the range of parameters affecting behavior of the airplane (e.g., wind, NAVAID characteristics, airplane configurations, weight, center of gravity, non-normal events).

The flight director guidance should be demonstrated in all degraded system modes that affect airplane control and in which the flight director is intended to be used. The flight director guidance should provide adequate performance with acceptable pilot compensation with:

- stability augmentation off
- alternate fly-by-wire control modes (e.g., direct law), if any
- engine inoperative.

Flight directors designed to work with a non-stationary tracking reference (such as a flight path angle or flight path vector which are commonly used with HUD guidance) should be evaluated in conditions which bring these guidance symbols to the field of view limits of the display. Crosswinds, and certain combinations of airspeed, gross weight, center of gravity and flap/slat/gear configurations might cause such conditions. At these limits, the dynamics of the guidance response to pilot control inputs can differ with potentially adverse affects on tracking performance, pilot compensation and workload.

Movement of the flight director and its tracking reference should also be demonstrated not to interfere with primary instrument references throughout their range of motion. The pilot's ability to interpret the guidance and essential flight information should not be adversely affected by the movement dynamics or range of motion.

14.2.4.1 Specific Demonstrations for Head-Up Display (HUD)

It should be demonstrated that the location and presentation of the HUD information (e.g., guidance, flight information and alerts/annunciations) does not distract the pilot or obscure the pilot's outside view. For example, the pilot should be able to track the guidance to the runway without having the view of runway references or hazards along the flight path obscured by the HUD symbology.

It should be demonstrated that pilot awareness of primary flight information, annunciations and alerts is satisfactory when using any HUD display mode. Some display modes which are designed to minimize "clutter" could degrade pilot awareness of essential information. For example, a "digital-only" display mode may not provide sufficient speed and altitude awareness during high speed descents.

It should be demonstrated that the pilot can immediately detect and recover from unusual attitudes when using the HUD. Specialized unusual attitude recovery symbology, if provided, should be shown to provide unequivocal indications of the attitude condition (e.g., sky/ground, pitch, roll, horizon) and to correctly guide the pilot to the nearest horizon.

It should be demonstrated that the pilot can positively detect cases when conformal symbology is field of view limited.

It should be demonstrated that visual cautions and warnings associated with the flight guidance system can be immediately detected by the pilot flying while using the HUD.

It should be demonstrated that the pilot flying can immediately respond to windshear warnings, ground proximity warnings, TCAS warnings, and other warnings requiring immediate flight control intervention, such as a go-around, while using the HUD without having to revert to a head down flight display.

It should also be demonstrated the pilot not flying can immediately detect visual cautions and warnings associated with the HUD.

14.2.5.2 Simulation Demonstration

If a pilot-in-the-loop flight simulation is used for some demonstrations, then a high fidelity, engineering quality facility is typically required. Results of the simulator demonstration should be correlated to flight test results.

Factors for validation of the simulation to be considered include the following:

- guidance and control system interfaces
- motion base suitability
- adequacy of stability derivative estimates used
- adequacy of any simplification assumptions used for the equations of motion;
- fidelity of flight controls and consequent simulated aircraft response to control inputs
- fidelity of the simulation of aircraft performance
- adequacy of flight deck instruments and displays
- adequacy of simulator and display transient response to disturbances or failures (e.g., engine failure, autofeather, electrical bus switching)
- visual reference availability, fidelity, and delays
- suitability of visibility restriction models such as appropriate calibration of visual references for the tests to be performed for day, night, and dusk conditions as necessary
- fidelity of any other significant factor or limitation relevant to the validity of the simulation.

AC 120-28D, Appendix 3, paragraph 7.1.2 also includes the following additional factors for manual low visibility landing systems:

- "ground effect" aerodynamic characteristics
- wind/turbulence model suitability and adequacy of interface with the simulation
- suitability of landing gear and ground handling dynamics
- suitability of the simulation for alignment, flare, and rollout control tasks for any normal or non-normal configurations or disturbance conditions to be assessed
- ability to simulate flight deck visual cutoff angles
- ability to simulate fog, rain, snow or patchy or intermittent conditions or external visual runway, lighting, marking or nearby terrain scenes as necessary

14.2.5 Flight Crew Override of the Flight Guidance System

The purpose of these tests are to demonstrate compliance with paragraph 8.1.2.4 Flight crew override of the autopilot and paragraph 8.4 Automatic Trim Considerations.

The initial tests to demonstrate compliance should be accomplished at an intermediate altitude and airspeed e.g. 15000 feet MSL and 250 knots. The FGS system should be engaged in altitude hold. The pilot should then apply a low force to the cockpit controller and verify that the automatic trim system does not make consistent with revisions in 8.4. After determining compliance with paragraph 8. 4, the pilot should gradually increase the applied force to the cockpit controller until the autopilot disconnects. When the autopilot disconnect occurs, observe the transient response of the airplane. Verify that the transient response is in compliance with FAR 25.1329(d).

Disconnect by caused by flight crew override should be verified applying a force on the cockpit controller (control column, or equivalent) to each axis for which the FGS is designed to disconnect., i.e. the pitch and roll yoke, or the rudder pedals (if applicable). The inputs by the pilot should build up to a point where they are sharp and forceful, so that the FGS can immediately be disconnected for the flight crew to assume manual control of the aircraft.

Note: During hardover testing that is listed in paragraph TBD of AC 25-7A there will be several opportunities throughout the flight envelope to conduct these tests. The evaluation of the manual disconnects would include the forces required for the disconnect, (not too light, but not to high,), the transients characteristics associated with each one (i.e. what type of motion and "g's" that are produced), and the warnings that are generated.

After the initial tests have been successfully completed, the above tests should be repeated at higher altitudes and airspeeds until reaching Mmo at high cruise altitudes.

[Additional work – integrate the following?]

- Pick up AC 120-28D words – Appendix 3 8.1
- Address single and multiple channels and appropriate force
- Autothrust – 8.3.2.2

14.3 Failure Conditions Requiring Validation – 25.1309

The Safety Assessment process identified in Section 13 may identify Failure Condition responses that require pilot evaluation to assess the severity of the effect, the validity of any assumptions used for pilot recognition and the viability of assumed pilot response to the condition. This section provides guidance on the test methods and recognition considerations for flight evaluation of these scenarios.

The implication of a Failure Condition can be significant in certain phases of flight. This section provides guidance on the application of the effect of certain Failure Conditions on flight operations.

The are certain probable failures that should be demonstrated to assess the performance of the FGS and the flight crew to routinely handle the condition in service

The Safety Assessment process should identify the need for a flight or simulation validation of a particular Failure Condition. Appendix FT provides guidance on test methods for particular types of Failure Condition that have been identified by the Safety Assessment. This section provides criteria that relate the effect of the Failure Conditions to operational use of the FGS.

14.3.1 Criteria for Determining the Use of the Autopilot

The validation criteria in this section are based on experience gained from certification programs and typical systems. FGS providing non-traditional functionality and using new and novel technology and implementation techniques may require additional criteria to be developed.

14.3.1.1 Autopilot Engagement after Take-Off - Minimum Engagement Altitude/Height

The potential deviation of the airplane from the desired flight path due to the effect of a Failure condition may necessitate delaying the engagement of an autopilot to an acceptable height. This height would provide for crew intervention and recovery without adversely affecting flight operations.

The operational minimum use height will be established based on the following considerations:

- the type of operations and the applicable vulnerabilities,
- the lowest altitude consistent with the response of the airplane to autopilot failure conditions (see **Section 14,** Flight Test and Simulator Assessment).

To support this determination, if a failure condition is identified that causes a significant transition below the intended vertical flight path, the worst case deviation profile should be provided in the AFM

Discuss the concept of having different obstacle surfaces against which the assessment is to be conducted.

The MEA/H will be established based on the following considerations:

a. the lowest altitude where the flight crew could reasonably be assumed to accomplish the selection of the autopilot with consideration given to normal flight crew tasks during rotation and liftoff (typically 100 feet or greater),

b. acceptability of the basic engagement/mode transition,

c. the lowest altitude consistent with the response of the airplane to autopilot failure conditionsFlight Test and Simulator Assessment).

If the response to the worst case failure condition causes a significant transition below the intended vertical flight path, the deviation profile should be provided in the AFM.

14.3.1.2 Climb, Cruise, Descent and Holding

[To be added]

14.3.1.3 Maneuvering

[To be added]

14.3.1.4 Approach

[To be added]

14.3.1.4.1 Approach without Vertical Guidance

[To be added]

14.3.1.4.2 Approach with Vertical Guidance

Approach with vertical guidance includes operations that have a definitive path on the final segment of the approach that connects with a known point on the runway or at the runway threshold (e.g. ILS, MLS, GLS, RNAV).

a) <u>xLS (ILS, MLS, GLS)</u>

[Needs more work – text pasted in for development purposes]

For ILS and MLS (ILS look-alike) coupled approaches the profile is the 1:29 slope. For GLS the surface will likely be different.

<u>Text taken from ACJ 1329 paragraph 5.3.4 Approach Coupled to an ILS Glide Path</u>

e. The MUH should be determined as the height of the aeroplane wheels at the point where recovery from the failure is initiated when the path of the aeroplane wheels during the recovery manoeuvre is tangent to the runway or to a 1:29 slope line drawn from a point 15 ft (4·57 m) above the runway threshold (See Figure 1). If there is no automatic landing capability, the MUH should not be less than 50 ft (15·24 m).

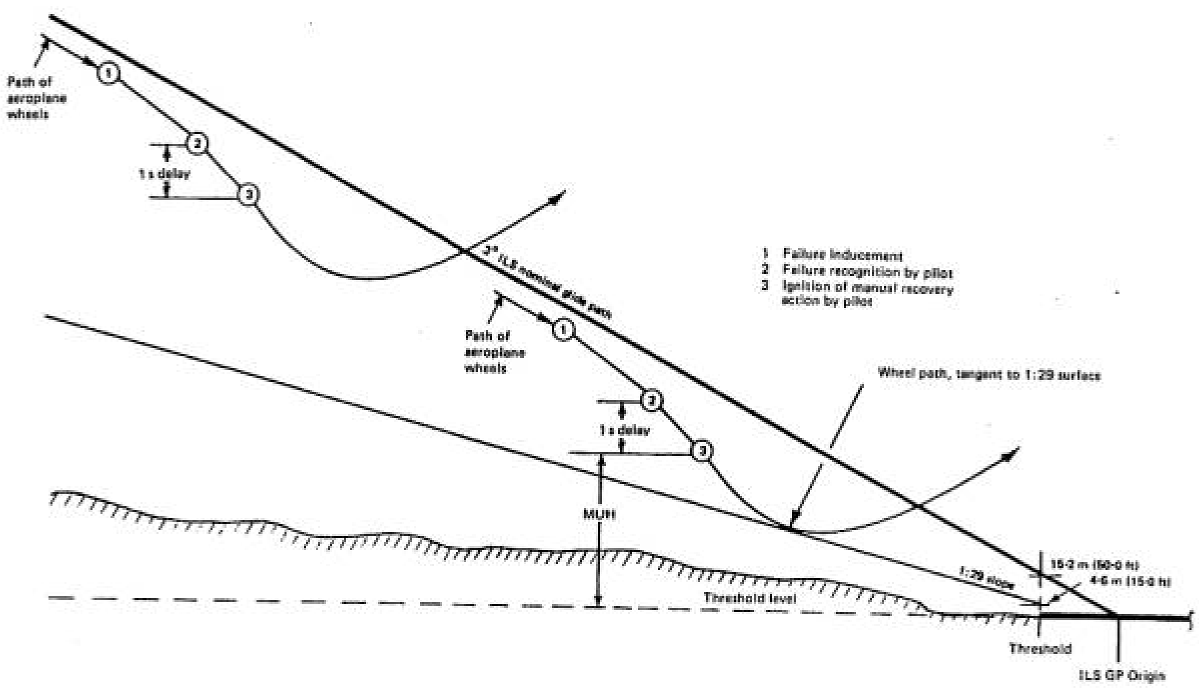


Figure 14-X Deviation Profile Method for Determining Minimum Height at which the Autopilot may be used on an xLS Coupled Approach

b) <u>RNAV</u>

For RNAV coupled approaches (e.g. Baro VNAV) the profile is determined from the height loss profile method described in Section 14.5.1.4.1 above. Take a slope parallel to the defined path and offer it up to the deviation profile. From the point on the deviation profile tangential to this slope, measure the vertical distance. This is the height loss. The Minimum Use Height is the greater of the height loss or 100 ft. 100 ft is chosen as a value which the operational community might be prepared to accept. Other considerations include the optimum height at which you wish to hand a trimmed aircraft back to the pilot, taking into account the imminent flare and possible adverse effects from crosswinds etc.

Note: The DA is based on the Required Obstacle Clearance (ROC) which typically is depicted as a slope parallel to the defined path, drawn 250 ft below it. The DA is given by taking the lateral point at which the ROC clips the highest obstacle, and then taking the point on the defined path vertically above it. The height of this point is the DA.

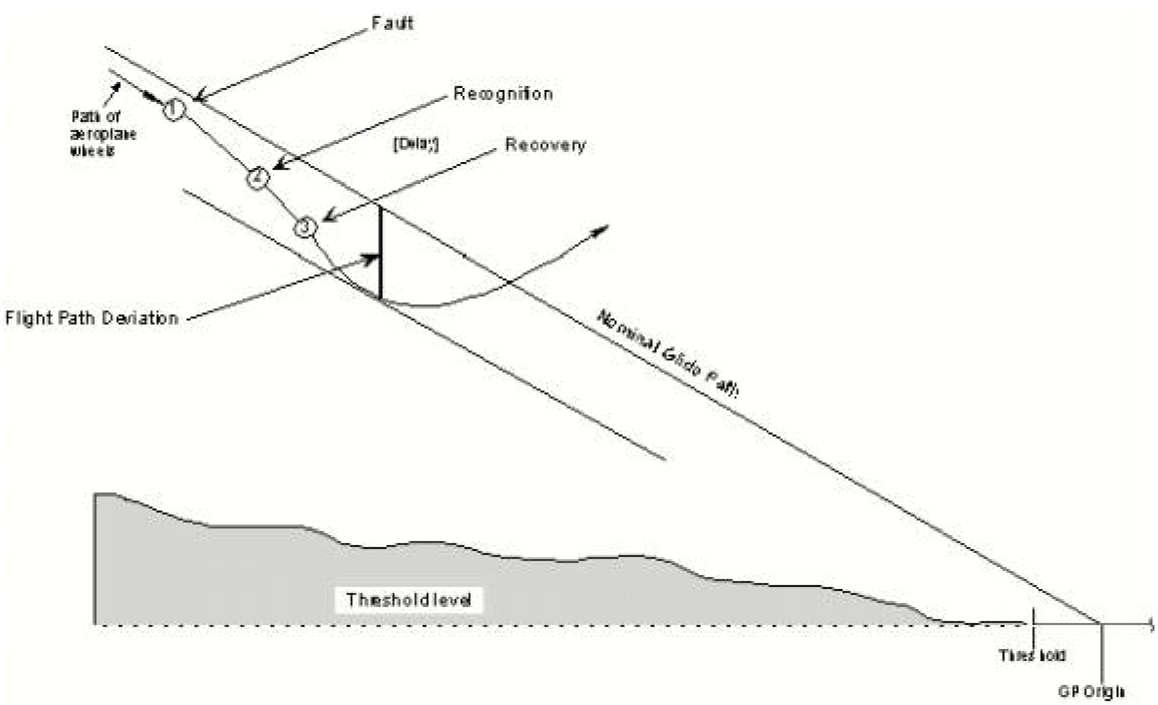


Figure 14-Y Deviation Profile Method for Determining Minimum Height at which the Autopilot may be used on an RNAV Coupled Approach

14.3.2 Specific Conditions

The following are failure conditions which should be considered as part of the FGS evaluation program:

- Engine Failure during approach - continue approach to DA/MDA

- The effect of potential fuel imbalance
- Airplane System Failures (as necessary – requiring specific flight evaluation), e.g.,
  - Hydraulics
  - Electrical
  - Flight Controls
  - FGS related Sensors

14.4 Automatic Disengagement of the Autopilot

The automatic disengagement characteristics of the FGS should be investigated throughout the flight envelope. Automatic disengagement of the FGS system will occur for several reasons such as system failures, sensor failures, unusual accelerations, etc. These disengagement cases should be analyzed to determine the ones that can safely be demonstrated during the test program. The use of simulation is recommended for all conditions that are expected to result in significant transients. For each disengagement the transients, warnings, and pilot workload for recovery should be evaluated and compliance with FAR 25.1329(d)and (e) should be verified.

14.5 Human Factors Assessment

In keeping with Interim Policy being promulgated by both the FAA and JAA, we need some words here to tie in the man-machine-interface assessment for FGS. Also, need to identify the possibility of future techniques that might be applied to assess workload

[Needs more work - put in cross references to JAA TGM and FAA certification Plan and Compliance Interim Policies.}

(Asaf had some words from an earlier comment?)

15 AIRPLANE FLIGHT MANUAL (AFM)

The following sections provide guidance on material to be provided in the Airplane Flight Manual (AFM) to ensure that the appropriate information related to FGS operation is translated into air carrier operations. For additional guidance, note that AC 25.1581-1/AMJ 25.1581 addresses requirements of the AFM for transport category aircraft and distinguishes between those aircraft that are used in air carrier operations and those not in air carrier service.

The terminology used in the AFM should be consistent with the intended operational use.

Appropriate AFM information related to low-visibility operations is addressed in AC120-28D, AC 120-29A, and JAR-AWO Subparts 1-4.

15.1 Limitations

The Limitations section of the AFM presents those FGS operating limitations appropriate to the airplane model as established in the course of the type certification process, and as necessary. FGS operational limitations (should any exist) should specify, but not be limited to, the following:

(a) Minimum engagement altitude(s) or height(s), if and when necessary.

NOTE: If minimum engagement altitude(s) or height(s) are not specified, then "maximum displacement deviation" information from a pertinent takeoff flight path and approach profile should be provided in the AFM Normal Procedures section, or in the associated FCOM.

(b) Mandatory disengagement requirements, if necessary.

(c) Configuration/envelope restrictions, if and as applicable.

15.2 Abnormal/Emergency Procedures

Any FGS anomaly that is addressed to the flight crew by a non-normal procedure must be included in the AFM.

15.3 Normal Procedures

The normal procedures for use of the FGS should be documented in the AFM or Flight Crew Operation Manuals (FCOM), as appropriate. These procedures should be demonstrated during the type certification process.

In lieu of specification of minimum engagement altitude(s) or height(s) (see **Section 15.1,** above)], the AFM may alternately specify "maximum displacement deviations" from a specified takeoff flight path, or from a specified approach profile. This information may be based on typical departure or approach flight paths suited for the aircraft type and for failure conditions that are determined applicable to the type of FGS system and modes suitable for use.

The flight manual should include any necessary procedures for the use of the flight guidance system in icing conditions (including severe icing conditions). In particular the procedures should include any necessary changes in operating speeds required either operationally or as a result of relevant design features of the speed protection function of the FGS; e.g., variations in minimum speeds as a function of de/anti-icing system selection.

15.3.1 Aircraft with Published Flight Crew Operation Manuals (FCOM)

The AFMs for aircraft for which the manufacturer has published an FCOM should contain essential information on normal operating procedures that are considered “peculiar” to the operation of the FGS for the aircraft type or are otherwise necessary for safe operation. System description, specification and operational procedures that are normally associated with flight guidance systems may be described in the FCOM.

If applicable, an FCOM may contain the “maximum displacement deviation” information described in **Section 15.1,** , above, in either numeric or graphic form.

15.3.2 Aircraft without Published FCOM’s

For aircraft that rely on the AFM as the sole operating manual, the AFM should contain operating information sufficient for flight crew reference. System description, operation, checklists, and normal operating procedures should be amplified in sufficient detail so that an appropriately trained flight crew may operate the FGS under normal conditions.

<u>Appendix A - SAFETY ASSESSMENT</u>

A1 General

This section provides material that may be useful in supporting the safety assessment activities identified in **Section 13**.

A2 Identification of Failure Conditions

The following "failures" should be considered for applicability when establishing Failure Conditions as indicated in **Section 13**:

- Loss of autopilot in single or multiple axes;
- Loss of guidance in single or multiple axes;
- Loss of thrust control;
- Partial loss or degradation of autopilot function;
- A failure resulting in unintended autopilot commands in a single axis or multiple axes simultaneously (e.g., hardover, slowover, and oscillatory failure modes);
- A failure resulting in unintended guidance commands in a single axis or multiple axes;
- A failure resulting in unintended thrust control;
- A sustained out-of-trim condition with the autopilot engaged without a warning;
- An autopilot disengagement in an out-of-trim condition;
- Autopilot disengagement without a warning;
- Inability to disengage the autopilot or autothrust functions;
- Un-commanded engagement of an autopilot or autothrust; and
- Jamming or loading of primary flight controls.
- Un-intended thrust asymmetry

A typical Failure Condition statement may be of the form:

'[Failure]' during ***'[Phase of Flight]'*** that ***'[Effect]'*** when ***'[Mitigation Consideration]'***

Failure Conditions may result from failures within the FGS or from failure associated with aircraft interfacing systems or components (e.g., navigation receivers, attitude heading reference systems, flight management systems, hydraulics, electrical systems, etc.).

A3 Considerations when Assessing the Severity of Failure Condition Effects

The Failure Condition definition is complete (as defined in AC/ACJ 25.1309) when the effects resulting from "failure" are identified. A complete definition of the Failure Condition and its effect will then support the subsequent Failure Condition classification.

When assessing the effect that results from a failure, the following items should be considered for various phases of flight:

- The impact of the loss of control, or unintended control, on the structural integrity of the airplane as a result of simple loading or as a result of excitation of aerodynamic or structural modes, both at the time of occurrence and while the flight continues,
- Implications of the airplane response in terms of attitude, speed, accelerations, flight path, and the impact on the occupants and on flight crew performance,
- Degradation in the stability or other flying qualities of the airplane;
- The duration of the condition;
- The aircraft configuration.
- The aircraft motion cues that will be used by the flight crew for recognition;
- Availability, level, and type of alerting provided to the flight crew;
- Expected flight crew corrective action on detection of the failure.

Failure Conditions may include the following characteristics:

- "Hardover" effects - typically considered to significant and are readily detectable by the flight crew based on the resulting aircraft motion or guidance cues.
- "Slowover" effects - typically not readily detected by the flight crew. The effect may involve departures from intended flight path that are not initially detectable by aircraft motion alone, and may only be detectable by motion cues when a significant flight path deviation has occurred or by the provision of an appropriate flight crew alert.
- "Oscillatory" effects – typically a repetitive motion or guidance condition not related to intended guidance or control. The magnitude, period and duration of the condition and any mitigation considerations will determine the final effect.
- "Loss of" effects – typically the removal of control, guidance or functionality that may have an immediate effect or may not be immediately apparent to the flight crew.

Section 14 provides guidance on crew recognition considerations.

A4 Failure Condition Classification

The following are examples of the type of Failure Condition effects that have been identified in previous airplane certification programs. The specific number and type of Failure Condition may vary with airplane type, airplane system architecture and FGS system design philosophy (e.g., failure detection, redundancy management, failure annunciation, etc.).

A4.1 Catastrophic Failure Conditions

The following effects have been assessed Catastrophic in previous airplane certification programs:

- A load on any part of the primary structure sufficient to cause a structural failure preventing safe flight and landing (Refer to §/JAR 25.302);
- Unrecoverable loss of flight path control;
- Exceedance of V_{DF}/M_{DF};
- Flutter or vibration that causes a structural failure preventing safe flight and landing (Refer to §/JAR 25.302);
- A temporary loss of control (e.g., stall) where the flight crew is unable to prevent contact with obstacles or terrain;
- A deviation in flight path from which the flight crew are unable to prevent contact with obstacles, terrain, or other aircraft.

A4.2 Hazardous Failure Conditions

The following effects have been assessed Hazardous in previous airplane certification programs:

- Exceedance of an airspeed halfway between V_{MO} and V_{DF} or a Mach number halfway between M_{MO} and M_{DF};
- A stall, even if the flight crew is able to recover safe flight path control;
- A normal acceleration less than a value of 0 g;
- Bank angles of more than 60 degrees en route or more than 30 degrees below a height of 1000 ft. (304.8 m above an applicable airport elevation);
- Degradation of the flying qualities of the airplane that excessively increases flight crew workload;
- A flight path deviation that requires a severe maneuver to prevent contact with obstacle, terrain or other aircraft.

  NOTE: Severe maneuver includes risk of serious injury or death of a small number of occupants

A4.3 Major Failure Conditions

The following effects have been assessed Major in previous airplane certification programs:

- A flight path deviation, a required recovery maneuver, which may result in passenger injuries (e.g., consideration should be given to phases of flight where the occupants may reasonably be moving about the airplane or be serving or consuming hot drinks).

- Degradation of the flying qualities of the airplane that significantly increase flight crew workload.

APPENDIX FT - Flight Test Procedures for inclusion in update to AC 25 7A

FT.1 Icing

The following represents a minimum test program for evaluating general autopilot performance under 'icing conditions':

(a) "Holding ice"

(b) Medium to light weight, symmetric fuel loading

(1) High lift devices retracted configuration:

Slow down at 1 knott/sec to automatic autopilot disconnect or to stall warning. Recovery should be initiated a reasonable period after the onset of stall warning or other appropriate warning. The airplane should exhibit no hazardous characteristics.

(2) Full Instrument Approach:

If the autopilot has the ability to fly a coupled instrument approach and go-around. It should demonstrate the following:

(i) Instrument approach using all normal flap selections.

(ii) Go-around using all normal flap selections.

(iii) Glideslope capture from above the glidepath.

(3) If the airplane accretes or sheds ice asymmetrically it should be possible to disengage the autopilot at any time without unacceptable out of trim forces.

(4) General maneuverability including normal turns, maximum commandable AOB in one direction and then instant reversal to maximum commandable AOB in the other direction.

Autopilot (Natural Icing) - the autopilot should demonstrate satisfactory performance during the shedding of the ice.

Use of Vertical Speed and Pitch Modes

Inattention to speed management when climbing in Vertical Speed or Pitch modes has been the cause of icing accidents and incidents. A more appropriate autopilot mode to use is IAS mode. Use of this mode should prevent inadvertent speed decrease. Hence the following operational guidance is proposed:

> "When climbing in icing conditions, use of Vertical Speed or Pitch autopilot modes is not recommended due to the possibility of drag increase, undetected speed decrease and airplane stall.
>
> During Altitude Hold autopilot operation in icing conditions, including a descent and Altitude Capture, airspeed must be closely monitored and thrust used to maintain the minimum recommended airspeed for flight in icing with the autopilot engaged."

FT.2 Speed Protection

FT2.1 Low Speed Protection

There are four cases that should be evaluated when the FGS engages in the Low Speed Protection mode. They are as follows:

1. High Altitude Cruise Test.

    a) At high altitude at normal cruise speed, engage the FGS into a Heading or LNAV mode and the A/T into a speed mode

    b) Manually reduce one engine to idle thrust

    c) As the airspeed decreases, observe the A/P behavior to maintain altitude and heading/course

    d) When the Low Speed Protection mode engages, note the airspeed and all the associated aural and visual alerts and mode change annunciations.

2. Low Altitude Altitude Capture Test.

    a) At about 3000 feet MSL and 250 knots, engage the A/P into a Heading or LNAV mode, and Altitude Hold, and A/T into a speed mode

    b) Set the Altitude Pre-selector to 8000 feet MSL. Select the FLCH mode to begin a 250 knot climb at maximum climb power.

    c) When the FGS first enters the altitude capture mode, retard an engine to idle power.

    d) As the airspeed decreases, observe the A/P trajectory and behavior.

    e) When the Low Speed Protection mode engages, , note the airspeed and all the associated aural and visual alerts and mode change annunciations.

3. High Vertical Speed Test.

    a) Engage the A/P in Vertical Speed Mode with a very high rate of climb.

    b) Set the thrust to a value that will cause the airplane to decelerate at about 1 knot per second.

    c) As the airspeed decreases, observe the A/P trajectory and behavior.

    d) When the Low Speed Protection mode engages, note the airspeed and all the associated aural and visual alerts and mode change annunciations.

4. Approach Test.

    a) Conduct an instrument approach with vertical guidance.

    b) Engage the A/P in LOC and GS capture.(or LNAV/VNAV etc).

    c) Cross the FAF/OM at a high-speed (approximately Vref + 40 knots) with the throttles at idle power until low speed protection activates.

    d) As the airspeed decreases, observe the A/P trajectory and behavior.

    e) When the Low Speed Protection mode engages, note the airspeed and all the associated aural and visual alerts and mode change annunciation.

f) Note the pilot response to the alert and the recovery actions taken to recover to the desired vertical path and the re-capture to that path and the acceleration back to the desired approach speed.

g) Note: If the FGS remains in the existing mode with reversion to Low Speed Protection, the FGS must provide a suitable alert to annunciate the low speed condition. In this case, note the pilot response to the alert and the recovery actions taken to maintain the desired vertical path and to accelerate back to the desired approach speed.

FT.2.2 High-speed Protection

There are three cases that should be evaluated for High-speed protection. They are as follows:

1. High Altitude Level Flight Test with Autothrust function

   a) Select Autothrust Off (with automatic wake-up function; otherwise, select Autothrust on) with FGS in altitude hold

   b) Select a thrust that will result in acceleration beyond Vmo/Mmo

   c) As the airspeed increases, observe High-speed protection mode engages as evidenced by autothrust reactivation and thrust reduction as necessary to control the airspeed to Vmo/Mmo.

2. High Altitude Level Flight Test without Autothrust function

   a) Select a thrust value that will result in an acceleration beyond Vmo/Mmo.

   b) As the airspeed increases, observe the basic airplane overspeed warning activate between Vmo + 1 and Vmo + 6 knots.

   c) Observe the high-speed protection mode engage as evidenced by the unique visual alert and the FGS mode change.

   d) Maintain the existing thrust level and observe the airplane depart the selected altitude.

   e) After sufficient time has elapsed to verify and record FGS behavior has elapsed, reduce the thrust as necessary to cause the airplane to begin a descent.

   f) Observe the FGS behavior during the descent and subsequent altitude capture at the original selected altitude.

3. High Altitude Descent Flight Test with Autothrust function

   a) Select Autothrust Off (with automatic wake-up function) with thrust set to maintain an airspeed 10%below Vmo/Mmo with the FGS in altitude hold

   b) Select vertical speed mode that will result in acceleration beyond Vmo/Mmo

   c) As the airspeed increases observe the autothrust function reactivate and reduce thrust towards idle

   d) Observe the FGS mode reversion to high-speed protection

e) Observe the reduction in pitch

FT.3 Failure Conditions

This section contains criteria relating to airplane system failure and Failure Conditions identified for validation by a Safety Assessment.

FT.3.1 Test Methods

The test method for most Failure Conditions will require some type a fault simulation technique with controls that provide for controlled insertion and removal of the type of fault identified as vulnerability. The insertion point will typically be at a major control or guidance point on the airplane (e.g., control surface command, guidance command, thrust command).

The implication of the effect of the Failure Condition on various flight phases should be assessed and the demonstration condition established. This assessment should identify the parameters that need to measures and appropriate instrumentation provided in the airplane.

The role of any monitoring and alerting in the evaluation should be identified.

The alertness of the crew to certain airplane response cues may vary with phase of flight and other considerations. Guidance on this is provided below.

The 'success criteria' or operational implications should be identified and agreed with the regulatory authority prior to the conduct of the test. Guidance on this is provided below.

-

FT.3.2 Fault Recognition and Intervention

The Safety Assessment process may identify a vulnerability to the following types of Failure Condition:

- hardover
- slowover
- ramp failures
- oscillatory

The various types of effect will cause differing response in the airplane and resultant motion and other cues to the flight crew to alert them to the condition. The flight crew attention may be gained by additional alerting provided by systems on the airplane. The recognition is then followed by appropriate intervention and recovery action.

The assessment of the acceptability of the Failure Condition and the validation of the Safety Assessment assumptions are complete when a stable state is reached as determined by the test pilot.

The following paragraphs provide guidance for specific phases of flight.

FT.3.2.1 Takeoff

This material addresses the use of a FGS after rotation for takeoff. Section 13 identified the key considerations for this phase of flight to be the effect on the net flight path and the speed control after liftoff. Automatic control is not typically provided for the takeoff roll. It may however be selected soon after liftoff. Failure Conditions may be introduced with this engagement.

For the initial liftoff through flap retraction, it can be assumed that the flight crew is closely monitoring the airplane movements and a maximum crew response time after recognition would be one second.

FT.3.2.2 Climb, Cruise, Descent and Holding

[To be added]

FT.3.2.3 Maneuvering

[To be added]

FT.3.2.4 Climb, Cruise, Descent and Holding

[To be added]

FT.3.2.5 Maneuvering

[To be added]

FT.3.2.6 Approach

[To be added]

As originally worded, the rule was interpreted to mean that FGS must maintain a safe speed. This contradicts the group's conclusion that the FGS speed protection may include alerting with automatic speed control, alerting without disengagement, or alerting with disengagement. The revised wording clarifies that FGS provides speed protection without who/what maintains the speed. This, in part, addresses Steve Stowe's comment that automatic FGS speed control should be clearly preferred - a position I think FGSHWG did not take.

This sentence should be moved to 10.4.1.1 Speed Protection during Approach Operations.

AFM specification is sufficient.

AFM specification is sufficient.

AFM specification is sufficient.

AFM specification is sufficient.

Sept. 7, 2001

Statement of Work for the Mechanical Systems Harmonization Working Group (MSHWG)

I. Task Assignment

IA. Objectives

The Mechanical Systems Harmonization Working Group (MSHWG) will develop and recommend appropriate changes to the FARs, JARs, and any associated advisory material, related to mechanical systems features in transport category airplanes, in accordance with the following Harmonization Task that the Aviation Rulemaking Advisory Committee (ARAC) has accepted from the FAA (reference FAA Notice FR July 26, 2001, pages 39074 to 39075):

The MSHWG will have a complete understanding of the Task Statement and will aim to achieve fully harmonized regulations and advisory materials with an objective of the text adopted by the FAA and JAA being identical to the greatest practical extent.

The MSHWG will also strive to establish common interpretations of the regulations and advisory material such that the work required by industry to achieve certification by one authority would be equally acceptable to all authorities.

The MSHWG will have an objective to produce material which supports acceptance of one State's operational approval by other States. The group will coordinate with other groups responsible for operational regulations to support this objective.

The MSHWG will develop and recommend appropriate changes to both 25.831(g) and 25.841(a,2&3) that achieve an acceptable level of safety without precluding flight at cruise altitudes in higher, less congested airspace.

IB. Tasking Statements

Part 1; Temperature and Humidity (25.831(g))

A. Review the current airworthiness standards for transport category airplanes regarding airplane cabin and flight deck temperature and humidity environment.

B. Determine if revisions are needed to ensure the ventilation system, following system failures, will provide a suitable temperature and humidity environment for crew and passengers. The assessment should consider:

1. The types of airplane system failure conditions that should be addressed.

2. Setting the appropriate limiting values of cabin and flight-deck temperature, humidity levels, and exposure times to eliminate any unacceptable impact on flight crews and cabin crew performance, disabling any passengers, or creating long-term health problems to passengers or crews.

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3. Any relevant National Aeronautics and Space Administration (NASA), United States (US) Armed Forces, National Institute of Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), Federal Aviation Administration (FAA), academia and industry standards for pressure, temperature and humidity.

C. Develop a report based on the review, and recommend any revisions to the rules (including cost estimates) and advisory materials needed to address the above issues.

D. If as a result of the recommendations in this report, the FAA publishes a notice of proposed rulemaking and/or notice of availability of proposed advisory circular for public comment, ARAC may be further tasked to review all comments received and provide the FAA with a recommendation for disposition of those comments.

Part 2: Cabin Pressurization (25.841(a))

A. Review the current airworthiness standards for transport category airplanes regarding airplane cabin altitudes resulting from cabin decompression.

B. Determine if revisions are needed to ensure that during certain failure conditions the cabin environment is suitable for crew and passengers. The assessment should consider:

1. The types of airplane system, structure, and/or propulsion failure conditions that should be addressed.

2. The factors that impact the level of severity of the threat, airplane design features, and operation procedures that could be used to moderate the severity of the threat.

3. The recommendation of appropriate cabin pressure standards that would govern cabin air quality following certain failure conditions. These standards should ensure that exposure time to a reduced oxygen partial pressure in the airplane does not reach a level that would:

   a. Negatively impact the flight-deck crew's performance to the extent that the flight crew could not safely control the airplane during an emergency descent,

   b. Disable any cabin crew member or passenger to the degree that resuscitation techniques would be needed to revive, or

   c. Create long term health problems for the crew or passengers.

4. Any relevant NASA, US Armed Forces, NIOSH, OSHA, FAA, Academia and industry standards.

C. Develop a report based on the review, and recommend any revisions to the rules (including cost estimates) and advisory materials needed to address the above issues. It is required that the recommendations be substantiated with corroborating material and that all dissenting positions be reported and thoroughly documented.

D. If as a result of the recommendations the FAA publishes a notice of proposed rulemaking and/or notice of availability of proposed advisory circular, ARAC may be further tasked to review all comments received and provide the FAA with recommendation for disposition of those comments.

II. Issues

IIA. Identification and Tracking of Issues

The MSHWG will identify all issues associated with this task. It will be the responsibility of the working group co-chairs to document each issue, collect positions from the MSHWG members, identify actions, track developments, and document resolution.

IIB. Identification of Issues Affecting Other HWGs and Issues Groups

The MSHWG will coordinate with other harmonization working groups, organizations, and specialists as appropriate. Other affected groups, organizations, and specialists may include but not be limited to the Powerplant Installation Harmonization Working Group, Engine Harmonization Working Group General Structures Harmonization Working Group (GSHWG), Loads & Dynamics Harmonization Working Group (LDHWG), Flight Test Harmonization Working Group (FTHWG), Flight Controls Harmonization Working Group (FCHWG), Emergency Evacuation Issues Group (EEIG), Human Factors Harmonization Working Group (HFHWG), United States Armed Forces, National Aeronautics and Space Administration (NASA), National Institute of Occupational Safety and Health (NIOSH), Occupational Safety and Health Administrations (OSHA) and various academia experts.

IV. Assignment of Tasks

In the process of addressing issues, the MSHWG may form a Task Group to handle a specific issue. The Task Group must provide reports to the working group. A Task Group is disbanded when all of its assignments are completed.

The MSHWG may request ARAC assignment of tasks to existing working groups if necessary. The MSHWG will identify to ARAC the need for additional new working groups when existing groups do not have the appropriate expertise to address certain tasks.

V. Work Methods

The Mechanical Systems Harmonization Working Group will comply with the procedures adopted by ARAC (Operating Procedures For The Aviation Rulemaking Advisory Committee, October 1997 Revision). As part of the procedures, the working group is expected to:

1. Recommend a Work Plan for completion of the tasks, including the rationale supporting such a plan, for consideration at the next meeting of ARAC to consider Transport Airplane and Engine Issues held following tasking (FAA Notice FR July 26, 2001, pages 39074 to 39075).

2. Give a detailed conceptual presentation of the proposed recommendations, prior to proceeding with the work stated in item 3 below.

3. Draft the appropriate documents and required analyses and/or any other related materials or documents.

4. Provide a status report at each meeting of ARAC held to consider Transport Airplane and Engine Issues.

The following items describe the MSHWG work methods:

1. The MSHWG will be co-chaired by European and United States Industry members (Hartwig Asshauer, representing Airbus and European Association of Aerospace Industries, and Kenneth (Pat) Waters representing The Boeing Company and AIA).
2. The role of Secretary for the MSHWG will be a rotational assignment between the members.
3. FAA and JAA will each provide a designated representative to the MSHWG (Stephen Happenny - FAA Transport Airplane Directorate and Eric Duvivier - JAA)
4. The MSHWG meetings shall alternate between Europe and the United States to the greatest practical extent and, between meetings, progress using electronic media as much as practical.
5. The Co-chairmen will rely on the industry organizations and regulatory agencies to provide appropriate specialists to support the harmonization process and to conduct the dissemination of information within their organizations (e.g. Working Group Report, Draft Rule revisions, Draft Advisory Material, etc.). The organizations should also assume the responsibility for ensuring the development of their member's position and providing that information to the designated person for inclusion in the Working Group Report.
6. Individuals can request membership of the MSHWG by written request to one of the Co-chairmen accompanied by a statement of their experience and interest in the Mechanical Systems Harmonization activity. Members will not be added or substituted without the approval of the assistant chair, the assistant executive director, and the working group co-chairs.
7. The MSHWG shall function as a Working Group under the ARAC Charter, and will report to the Transport Airplane and Engine Issues Group (TAEIG).
8. The United States Co-chairman shall make periodic progress reports to the TAEIG.
9. The FAA Designated Representative shall assist the United States Co-chairman in preparing material in a form for submittal to ARAC for transmittal to the FAA for NPRM action.
10. The JAA designated member shall be responsible for coordination with relevant JAA Study Groups, Steering Groups and Committees, and for progressing NPA material with the JAA Secretariat.
11. Meetings of the MSHWG will not be open to the public, except to the extent that individuals with an interest and expertise are selected to participate. There will be no public announcements of working group meetings.

VI. Membership

The MSHWG shall be made up of members who have an interest and expertise in human respon to rapid decompression, low oxygen partial pressure, temperature extremes and humidity extreme as well as other areas of expertise as deemed necessary by the group. Because of the wide range or issues and disciplines, it is the objective of the Co-chairmen to work through established industry and government organizations to the greatest extent possible. The principal affiliations and the nominated representatives are identified below.

The members of the MSHWG will be drawn primarily from individuals representing the Regulatory Authorities, government agencies and various Industry Associations. The MSHWG will be supplemented with additional technical experts as necessary. Individuals may request membership by contacting the Co-chairmen and indicating their qualification and rationale for participation.

AFFILIATIONS	VOTING MEMBERS
FAA	Stephen Happenny
JAA	Eric Duvivier (prime) & Mark Shortman (second)
Airbus & European Association of Aerospace Industries	Hartwig Asshauer, European Co-Chair (prime) & Stefan Repp (second)
Boeing & AIA	Pat Waters, U.S. Co-Chair (prime) & Mark Lord (second)
Cessna	Roy Shelinbarger
Honeywell	Stan Pollit
Gulfstream	Mehdi Motlagh
Fairchild/Donier	Ms. Anna Katysheva
Embraer	Pedro Seiti Endo (prime) & Edwardo Borges (second)
Bombardier	Keith Ayre
British Airlines & Association of European Airlines	Dr. Michael Bagshaw
ATA	Charlie Bautz
CAMI	Dr. Noel May
academia	Dr. Ivo Martinac (Univ. of Sweden, Dr. Stanley Mohler (Wright State University)
ALPA	Captain Bernie Sanders
NASA	Dr. Michael Powell
U.S. Air Force	Lt. Co. Thomas Morgan
Transport Canada	Jim Marko

VII. Schedule

The Federal Register tasking requires that the Working Group Report be submitted no later than 24 months after the task is published by the FAA in the Federal Register. That date would be July 26, 2003. However, the Co-Chairs of the MSWHG believe that the Working Group Report can be produced and submitted using the more optimistic schedule below.

Meeting schedule

MSHWG MEETINGS	Tasks	Dates
#1 – Seattle	Stat. of Work	4th qtr, 2001
#2 - Paris	Concept	1st qtr, 2002
#3 – East Coast	Tech Agreement	2nd qtr, 2002
#4 - Seattle	WGReport	3rd qtr, 2002
#5 - Europe	TBD	4th qtr, 2002

Schedule - General

Activity	Date(s)
MSHWG Tasked	July 26, 2001
European Co-chair Approved	Aug. 15, 2001
Identify Working Group Members	Aug. 24, 2001
Work Plan to TAEIG	Sept. 12, 2001
TAEIG Approve Work Plan	Sept. 12, 2001
MSHWG Technical Agreement	April , 2002
Final Draft, WGReport	Aug., 2002
Final Draft to TAEIG	Sept., 2002
TAEIG Approval	Sept, 2002

whether a vessel complies with certain standards of safety and environmental protection.

Respondents: Owners and operators of vessels.

Frequency: On occasion.

Burden Estimate: The estimated burden is 443 hours a year.

2. *Title:* Advance Notice and Certification of Adequacy for Reception Facilities.

OMB Control Number: 2115–0543.

Summary: 33 U.S.C. 1905 gives the Coast Guard the authority to certify the adequacy of reception facilities in ports. Reception facilities receive waste from ships, which may not discharge at sea. Under these rules there are limits on discharges for oil and oily waste, noxious liquid substances, plastics, and garbage.

Need: This information collection is needed to evaluate the adequacy of reception facilities before issuance of a Certificate of Adequacy. Information for the advance notice ensures effective management of reception facilities and reduces the burden to facilities and ships .

Respondents: Owners and operators of reception facilities, and owners and operators of vessels.

Frequency: On occasion.

Burden Estimate: The estimated burden is 1,215 hours a year.

3. *Title:* Approval of Equivalent Equipment or Procedures Other Than Those Specified by Rule.

OMB Control Number: 2115–0553.

Summary: This information collection implements the concept of Best Available and Safety Technology provided for in Section 21 of the Outer-Continental-Shelf (OCS) Lands Act, as amended. The information allows owners and operators to propose, for approval by the Coast Guard, alternative equipment or procedures that would provide a comparable level of safety.

Need: The information helps the Coast Guard ensure that alternatives proposed would yield a level of safety at least equivalent to that of measures provided for in 33 CFR Subchapter N.

Respondents: Owners and operators of facilities in the OCS.

Frequency: On occasion.

Burden Estimate: The estimated burden is 50 hours a year.

4. *Title:* Application for Permit to Transport Municipal and Commercial Waste.

OMB Control Number: 2115–0579.

Summary: This information collection provides the basis for issuing or denying a permit for the transportation of municipal or commercial waste in the coastal waters of the United States.

Need: In accordance with 33 U.S.C. 2601, the U.S. Coast Guard issued rules requiring the owner or operator of a vessel to apply for a permit to transport municipal or commercial waste in the United States and to display an identification number or other marking on his vessel. This collection of information enables enforcement of those rules.

Respondents: Owners and operators of vessels.

Frequency: Every 18 months.

Burden Estimate: The estimated burden is 391 hours a year.

5. *Title:* Safety Approval of Cargo Containers.

OMB Control Number: 2115–0094.

Summary: This collection of information addresses the reporting and recordkeeping required for containers by 49 CFR Parts 450–453. These rules are necessary because the U.S. is signatory to the International Convention for Safe Containers (CSC), which requires that all containers be safety-approved before they are used in trade.

Need: This information collection requires owners and manufactures of cargo containers to submit information and keep records associated with the approval and inspection of those containers. This information is needed to ensure compliance with the CSC.

Respondents: Owners and manufacturers of containers, and organizations that the Coast Guard delegates to act as Approval Authorities.

Frequency: On occasion.

Burden Estimate: The estimated burden is 101,732 hours a year.

6. *Title:* Safety of Vessels in the Commercial Fishing Industry.

OMB Control Number: 2115–0582.

Summary: This information collection is intended to improve safety on board vessels in the commercial fishing industry. The requirements apply to those vessels and to seamen on them.

Need: Under the authority of 46 U.S.C. 6104, the Coast Guard has promulgated rules in 46 CFR Part 28 to reduce the unacceptably high level of fatalities and accidents in the commercial fishing industry. The rules allowing the collection also provide means of verifying compliance and enhancing safe operation of fishing vessels.

Respondents: Owners, agents, individuals-in-charge of vessels in the commercial fishing industry, and insurance underwriters.

Frequency: On occasion.

Burden: The estimated burden is 8,205 hours a year.

Dated: August 17, 2001.

V.S. Crea,

Director of Information and Technology.

[FR Doc. 01–21566 Filed 8–24–01; 8:45 am]

BILLING CODE 4910–15–P

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Aviation Rulemaking Advisory Committee Meeting on Transport Airplane and Engine Issues

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of public meeting.

SUMMARY: This notice announces a public meeting of the FAA's Aviation Rulemaking Advisory Committee (ARAC) to discuss transport airplane and engine (TAE) issues.

DATES: The meeting is scheduled for September 11–12, 2001, beginning at 8:30 a.m. on September 11. Arrange for oral presentations by September 5.

ADDRESSES: Doubletree Hotel Seattle Airport, 18740 International Boulevard, Cascade Rooms 5 and 6, Seattle, Washington.

FOR FURTHER INFORMATION CONTACT: Effie M. Upshaw, Office of Rulemaking, ARM–209, FAA, 800 Independence Avenue, SW., Washington, DC 20591, Telephone (202) 267–7626, FAX (202) 267–5076, or e-mail at effie.upshaw@faa.gov.

SUPPLEMENTARY INFORMATION: Pursuant to section 10(a)(2) of the Federal Advisory Committee Act (Pub. L. 92–463; 5 U.S.C. app. III), notice is given of an ARAC meeting to be held September 11–12, in Seattle Washington.

The agenda will include:

September 11, 2001

- Opening Remarks
- FAA Report
- Joint Aviation Authorities Report
- Executive Committee Report
- Harmonization Management Team Report
- Review of Proposed New Tasking List
- Continued Airworthiness Methodology Working Group Report and Approval
- Mechanical Systems HWG Report and Approval
- Design for Security HWG Report
- Ice Protection HWG Report
- Engine HWG Report
- Human Factors Harmonization Working Group (HWG) Report
- Powerplant Installation HWG Report
- Flight Test HWG Report
- Electromagnetic Effects HWG Report

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• Seat Test HWG Report

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• General Structures HWG Report
• Airworthiness Assurance Working Group Report and Approval
• System Design and Analysis HWG Report
• Flight Guidance System HWG Report
• Extended Range with Two-Engine Aircraft (ETOPS) Tasking Update
• Loads & Dynamics HWG Report and Approval
• Flight Controls HWG Report
• Avionics Systems HWG Report
• Electrical Systems HWG Report

The Continued Airworthiness Assessment Methodology Working Group plans to seek approval of a technical report that it drafted under the fast track process. Three HWG's will be seeking approval of work plans: The Mechanical Systems HWG will be addressing taskings associated with §§ 25.841(a) and 25.831(g), the Airworthiness Assurance Working Group will be addressing a tasking associated with multiple supplemental type certificates, and the Loads and Dynamics HWG will be addressing a tasking associated with § 25.301(b).

Attendance is open to the public, but will be limited to the availability of meeting room space and telephone lines. Details for participating in the teleconference will be available after September 4 on the ARAC calendar at *http://www.faa.gov/avr/arm/araccal/htm*, or by contacting the person listed in the **FOR FURTHER INFORMATION CONTACT** section. Persons participating by telephone will be responsible for paying long distance charges.

The public must make arrangements by September 5 to present oral statements at the meeting. Written statements may be presented to the committee at any time by providing 25 copies to the Assistant Executive Director for Transport Airplane and Engine issues or by providing copies at the meeting. Copies of the documents to be presented to ARAC for decision or as recommendations to the FAA may be made available by contacting the person listed under the heading **FOR FURTHER INFORMATION CONTACT**.

If you are in need of assistance or require a reasonable accommodation for the meeting or meeting documents, please contact the person listed under the heading **FOR FURTHER INFORMATION CONTACT**. Sign and oral interpretation, as well as a listening device, can be made available if requested 10 calendar days before the meeting.

Issued in Washington, DC, on August 21, 2001.

Tony F. Fazio,

Director, Office of Rulemaking.

[FR Doc. 01–21616 Filed 8–24–01; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

User Input to the Aviation Weather Technology Transfer (AWTT) Board

AGENCY: Federal Aviation Administration (FAA), Department of Transportation (DOT).

ACTION: Notice of public meeting.

SUMMARY: The FAA will hold an informal public meeting to seek aviation weather user input. Details: September 18, 2001; Ernest N. Morial Convention Center, 900 Convention Center Blvd., New Orleans, Louisiana; 1:00 pm to 5:00 pm in room 291. The objective of this meeting is to provide an opportunity for interested aviation weather users to provide input on FAA's plans for implementing new weather products.

DATES: The meeting will be held at 1:00–5:00 PM, on September 18, 2001.

ADDRESSES: The meeting will be held in Room 291 at the Ernest N. Morial Convention Center, 900 Convention Center Blvd, New Orleans, LA 70130 in conjunction with the National Business Aviation Association, Inc. (NBAA) annual convention.

FOR FURTHER INFORMATION CONTACT: Debi Bacon, Aerospace Weather Policy Division, ARS–100, Federal Aviation Administration, 800 Independence Ave., SW., Washington, DC 20591; telephone number (202) 385–7705; Fax: (202) 385–7701; email: *debi.bacon@faa.gov*. Internet address: http:www.debi.bacon@faa.gov.

SUPPLEMENTARY INFORMATION:

History

In 1999, the FAA established an Aviation Weather Technology Transfer (AWTT) Board to manage the orderly transfer of weather capabilities and products from research and development into operations. The Director of the Aerospace Weather Policy and Standards Staff, ARS–20, chairs the AWTT Board. The Board is composed of stakeholders in Air Traffic Services, ATS; Regulation and Certification, AVR; and Research and Acquisitions, ARA in the Federal Aviation Administration and the Office of Meteorology in the National Weather Service.

The AWTT Board will meet semi-annually or as needed, to determine the readiness of weather research and development (R&D) products for experimental use, full operational use for meteorologists or full operational use for end users. The Board's determinations will be based upon criteria in the following areas: users needs; benefits; costs; risks; technical readiness; operational readiness and budget requirements.

The user interface process is designed to allow FAA to both report progress and receive feedback from industry users. Each AWTT Board meeting will be preceded by a half-day industry review session approximately one month prior to each Board meeting. These industry review sessions will be announced in the **Federal Register** and open to all interested parties.

This meeting is the second industry review session and is intended to receive feedback on weather R&D products that will be presented for consideration at the November 2001 AWTT Board meeting. The products to be considered are the Integrated Icing Diagnosis Algorithm (IIDA) and the Integrated Icing Forecast Algorithm k(IIFA).

Meeting Procedures

(a) The meeting will be informal in nature and will be conducted by representatives of the FAA Headquarters.

(b) The meeting be open to all persons on a space-available basis. Every effort was made to provide a meeting site with sufficient seating capacity for the expected participation. There will be neither admission fee nor other charge to attend and participate. This meeting is being held in conjunction with the NBAA annual conference. There is a charge to attend the NBAA conference; however, any person attending this informal meeting only will be admitted by NBAA conference officials to this meeting only at no charge.

(c) FAA personnel present will conduct a briefing on how the AWTT system works and changes to the process made in the last year. Any person will be allowed to ask questions during the presentation and FAA personnel will clarify any part of the process that is not clear.

(d) FAA personnel will present a briefing on the specific products to be reviewed at the November 2001 AWTT Board Meeting. Any person will be allowed to ask questions during the presentation and FAA personnel will clarify any part of the presentation that is not clear.

- Seat Test HWG Report

September 12, 2001

- General Structures HWG Report
- Airworthiness Assurance Working Group Report and Approval
- System Design and Analysis HWG Report
- Flight Guidance System HWG Report
- Extended Range with Two-Engine Aircraft (ETOPS) Tasking Update
- Loads & Dynamics HWG Report and Approval
- Flight Controls HWG Report
- Avionics Systems HWG Report
- Electrical Systems HWG Report

The Continued Airworthiness Assessment Methodology Working Group plans to seek approval of a technical report that it drafted under the fast track process. Three HWG's will be seeking approval of work plans: The Mechanical Systems HWG will be addressing taskings associated with §§ 25.841(a) and 25.831(g), the Airworthiness Assurance Working Group will be addressing a tasking associated with multiple supplemental type certificates, and the Loads and Dynamics HWG will be addressing a tasking associated with § 25.301(b).

Attendance is open to the public, but will be limited to the availability of meeting room space and telephone lines. Details for participating in the teleconference will be available after September 4 on the ARAC calendar at *http://www.faa.gov/avr/arm/araccal/htm*, or by contacting the person listed in the FOR FURTHER INFORMATION CONTACT section. Persons participating by telephone will be responsible for paying long distance charges.

The public must make arrangements by September 5 to present oral statements at the meeting. Written statements may be presented to the committee at any time by providing 25 copies to the Assistant Executive Director for Transport Airplane and Engine issues or by providing copies at the meeting. Copies of the documents to be presented to ARAC for decision or as recommendations to the FAA may be made available by contacting the person listed under the heading FOR FURTHER INFORMATION CONTACT.

If you are in need of assistance or require a reasonable accommodation for the meeting or meeting documents, please contact the person listed under the heading FOR FURTHER INFORMATION CONTACT. Sign and oral interpretation, as well as a listening device, can be made available if requested 10 calendar days before the meeting.

Issued in Washington, DC, on August 21, 2001.

Tony F. Fazio,

Director, Office of Rulemaking.

[FR Doc. 01–21616 Filed 8–24–01; 8:45 am]

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

User Input to the Aviation Weather Technology Transfer (AWTT) Board

AGENCY: Federal Aviation Administration (FAA), Department of Transportation (DOT).

ACTION: Notice of public meeting.

SUMMARY: The FAA will hold an informal public meeting to seek aviation weather user input. Details: September 18, 2001; Ernest N. Morial Convention Center, 900 Convention Center Blvd., New Orleans, Louisiana; 1:00 pm to 5:00 pm in room 291. The objective of this meeting is to provide an opportunity for interested aviation weather users to provide input on FAA's plans for implementing new weather products.

DATES: The meeting will be held at 1:00–5:00 PM, on September 18, 2001.

ADDRESSES: The meeting will be held in Room 291 at the Ernest N. Morial Convention Center, 900 Convention Center Blvd, New Orleans, LA 70130 in conjunction with the National Business Aviation Association, Inc. (NBAA) annual convention.

FOR FURTHER INFORMATION CONTACT: Debi Bacon, Aerospace Weather Policy Division, ARS–100, Federal Aviation Administration, 800 Independence Ave., SW., Washington, DC 20591; telephone number (202) 385–7705; Fax: (202) 385–7701; email: *debi.bacon@faa.gov.* Internet address: http:www.debi.bacon@faa.gov.

SUPPLEMENTARY INFORMATION:

History

In 1999, the FAA established an Aviation Weather Technology Transfer (AWTT) Board to manage the orderly transfer of weather capabilities and products from research and development into operations. The Director of the Aerospace Weather Policy and Standards Staff, ARS–20, chairs the AWTT Board. The Board is composed of stakeholders in Air Traffic Services, ATS; Regulation and Certification, AVR; and Research and Acquisitions, ARA in the Federal Aviation Administration and the Office of Meteorology in the National Weather Service.

The AWTT Board will meet semi-annually or as needed, to determine the readiness of weather research and development (R&D) products for experimental use, full operational use for meteorologists or full operational use for end users. The Board's determinations will be based upon criteria in the following areas: users needs; benefits; costs; risks; technical readiness; operational readiness and budget requirements.

The user interface process is designed to allow FAA to both report progress and receive feedback from industry users. Each AWTT Board meeting will be preceded by a half-day industry review session approximately one month prior to each Board meeting. These industry review sessions will be announced in the **Federal Register** and open to all interested parties.

This meeting is the second industry review session and is intended to receive feedback on weather R&D products that will be presented for consideration at the November 2001 AWTT Board meeting. The products to be considered are the Integrated Icing Diagnosis Algorithm (IIDA) and the Integrated Icing Forecast Algorithm k(IIFA).

Meeting Procedures

(a) The meeting will be informal in nature and will be conducted by representatives of the FAA Headquarters.

(b) The meeting be open to all persons on a space-available basis. Every effort was made to provide a meeting site with sufficient seating capacity for the expected participation. There will be neither admission fee nor other charge to attend and participate. This meeting is being held in conjunction with the NBAA annual conference. There is a charge to attend the NBAA conference; however, any person attending this informal meeting only will be admitted by NBAA conference officials to this meeting only at no charge.

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(d) FAA personnel will present a briefing on the specific products to be reviewed at the November 2001 AWTT Board Meeting. Any person will be allowed to ask questions during the presentation and FAA personnel will clarify any part of the presentation that is not clear.