may present written statements to the executive committee at any time by providing 25 copies to the Executive Director, or by bringing the copies to the meeting.

If you are in need of assistance or require a reasonable accommodation for this meeting, please contact the person listed under the **FOR FURTHER INFORMATION CONTACT** section 10 calendar days before the meeting.

Issued in Washington, DC, on March 7, 2001.

Anthony F. Fazio,

Executive Director, Aviation Rulemaking Advisory Committee.

[FR Doc. 01–6232 Filed 3–12–01; 8:45 am]

BILLING CODE 4910–13–M

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 March 27–28, 2001, beginning at 8:30 a.m. on March 27. Arrange for oral presentations by March 16.

ADDRESSES: Department of Transportation, 400 7th Street SW., Washington, DC. The meeting will be held in room 3328 on March 27 and in rooms 6332–6336 on March 28.

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) 267–5075, 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 March 27–28, 2000, in Washington, DC.

The agenda will include:

March 27, 2001, Room 3328

- Opening Remarks
- FAA Report
- Joint Aviation Authorities Report
- Transport Canada Report
- Harmonization Management Team Report
- Executive Committee Report
- Human Factors Harmonization Working Group (HWG) Report
- Seat Test HWG Report
- Design for Security HWG Report
- Flight Guidance System HWG Report
- System Design and Analysis HWG Report
- Engine HWG Report
- Continued Airworthiness Assessment Methodology Working Group report
- Flight Test HWG Report
- Electromagnetic Effects HWG Report
- Powerplant systems HWG Report
- Mechanical Systems HWG Report

March 28, 2001, Rooms 6332–6236

- General Structures HWG Report
- Airworthiness Assurance Working Group Report
- Extended range with Two-Engine Aircraft (ETOPS) Tasking Update
- Ice Protection HWG Report
- Loads & Dynamics HWG Report
- Flight Controls HWG Report
- Avionics Systems HWG Report
- Electrical Systems HWG Report

The Continued Airworthiness Assessment Methodology Working group plans to seek approval of its work plan. The Flight Control and Loads and Dynamics HWG's plan to request ARAC approval of technical reports drafted under the Fast Track Process. The Ice Protection HWG plans to request approval of a proposed operating rule warning flight crews of ice accumulation requiring crew action.

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 March 19 by contacting the person listed in the **FOR FURTHER INFORMATION CONTACT** section. Callers outside the Washington metropolitan area will be responsible for paying long distance charges.

The public must make arrangements by March 16 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 March 7, 2001.

Tony F. Fazio,

Director, Office of Rulemaking.

[FR Doc. 01–6233 Filed 3–12–01; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Aviation Rulemaking Advisory Committee Meeting on Occupant Safety 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 occupant safety issues.

DATES: The meeting is scheduled for March 29, 2001, beginning at 8:30 a.m. Arrange for oral presentations by March 16.

ADDRESSES: Department of Transportation, 400 7th Street SW., Room 3328, Washington, DC.

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) 267–5075, 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 March 29 in Washington, DC.

The agenda will include:

- Opening Remarks
- FAA Report
- Joint Aviation Authorities Report
- Transport Canada Report
- Executive Committee Report
- Cabin Safety Harmonization Working Group Report

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 March 19 by contacting the person listed in the **FOR FURTHER INFORMATION CONTACT** section. Callers outside the Washington

Aviation Rulemaking Advisory Committee (ARAC)

Transport Airplane and Engine Issues

Meeting Minutes

DATE: March 27-28, 2001

TIME: 8:30 a.m.

LOCATION: Department of Transportation

400 7th Street, SW,

Rooms 3328 and 6322-6236

Washington, DC

Call to Order/Administrative Reporting

Craig Bolt, Assistant Chair, called the meeting to order and welcomed the attendees who in turn introduced themselves. (See attached sign-in sheet.) John McGraw, Acting Assistant Executive Director, read the required statement for governing the meeting. Mr. Bolt reviewed the agenda (handout 1). The December 2000 meeting minutes were circulated for review.

Members then reviewed the status of the December Actions Items:

Item	Status
1	Ongoing
2	Completed
3	--Completed --Appointment of non U.S. member as working group cochair not seen as a barrier; issues group, however, should contact T. Fazio when situation arises
4	Completed
5	Completed
6	Completed
7	Some connection; will be coordination w/ Loads and Dynamic and Mechanical Systems HWG
8	Completed
9	FAA working on doing 25.1310 as separate package

10	To be discussed during electrical system HWG
11	Open
12	Open
13	Open

Action item from the March 2000 meeting:

Item	Action
8	Resolved--JAA and FAA to continue to work together on differences (25.562)

Action item from June 2000 meeting:

Item	Action
15	FTHWG to draft TOR for follow-on work on § 25.177(c)

Action Item from September 2000 meeting:

	Thaddee Sulocki to review letter from Powerplant Study Group regarding concerns on LDHWG report for 25.963(d) and to determine path forward by next LDHWG meeting on 9/26/28

Mr. Bolt highlighted several items on the Items of Interest Since December 2000 **(handout 2)**, and requested that participants make revisions on the Open Taskings Charts **(handout 3)** and return to him.

FAA Report

- ***Status of FAA Rulemaking Projects*** (handout 4)**—**Kris Carpenter reported that the FAA is developing timelines for all the fast track rulemaking and advisory circular projects. ANM has developed timelines for about 50% of the projects (including categories 1, 2, and 3), and it is working with other FAA offices for scheduling purposes. Standard FAA guidelines are being used to develop the schedules. The Transport Airplanes Directorate (TAD) and the Office of Rulemaking are working to complete the timelines for each project.

- The TAD is working with the Office of Policy to develop boilerplate language for use by the working groups. In the future, the working groups will be responsible for preparing a

2-page document describing how harmonization will save resources; the FAA will summarize the cost benefits based on ARAC documentation. If comments are received during the comment period, they will be addressed in the final rule. Controversial fast track projects will be pulled from the fast track program and processed in the standard rulemaking program. The offices have agreed that the procedure will apply only to fast track projects.

- Ms. Carpenter will be looking at industry driven projects and those projects already submitted to the FAA to determine which projects will have to go back to the working group with a request for additional economic information.

- **Modified Working Group Report—**The FAA is expanding the applicability of the fast track process to other TAD-sponsored ARAC projects. The report uses the concepts of the fast track report format, although there are some differences, and it conforms to the parameters of the "Green Book" (handout 5).

- The FAA will be holding a Regulatory Course April 30-May 4, and the week of July 16. Those persons interested should contact Charlene Brown.

Electrical Systems HWG

Brian Overhuls, reporting by telephone, indicated that the working group is scheduled to meet in England in May. A representative of Embraer will join the working group at that meeting. Mr. Overhuls indicated that the working group would meet to review draft NPRMs received from the FAA, and the remaining portions of the group's original tasking that was put aside to accomplish harmonization by the fast track process. Other discussion items included TOR's developed by ESHWG at their last meeting addressing ACs previously tasked (25-10, 25-16, 25.1351-1 and the Mega AC), Aging Systems and Wiring, and Passenger In-Seat Power Supplies.

Ms. Carpenter discussed the structure of Aging Transport Systems Rulemaking Advisory Committee (ATSRAC) and its evolution from making recommendations to becoming more involved in rulemaking. Discussion items included separation of ATSRAC and ARAC, ATSRAC's mission, ATSRAC's broader setup for examining more than part 25 issues, limitations on what ATSRAC is reviewing, having routine ATSRAC updates at TAE meetings, and harmonization issues/lack of harmonization framework within ATSRAC.

JAA Report

Thaddee Sulocki indicated that he had no new business to report.

Transport Canada Report

Mr. Maher Khouzam indicated that he had no new business to report.

Harmonization Management Team Report

Mr. Sulocki indicated that the most important issue raised at the meeting was the Better Plan for Harmonization. Discussion items included industry frustration with FAA and JAA progress—pace and difficulty of harmonizing, and not being able to put new activity on table. Other items included a review of TORs, ATSRAC, rulemaking addressing tire burst threat, criteria for new activity based on safety-related issues, effect of § 25.1309 on other harmonization projects, and the FAA and JAA decision not to do any more unilateral rulemaking. The need to bring harmonization before EXCOM, differences in the JAA and FAA system of operation, and the likelihood of less participation by industry in future efforts were also discussed.

Executive Committee

Mr. Bolt indicated that a full ARAC meeting, followed by an EXCOM meeting was held February 7. Highlights of the ARAC meeting included the goal of ARAC to achieve consensus; revision of ARAC operating procedures (handout 6), sent to members via e-mail; comments should be mailed to Mr. Bolt); public accessibility to meetings and meeting locations; and the decision not to allow proxy voting. Participants were also briefed on the Federal Advisory Committee Act.

Mr. Bolt indicated that at the EXCOM meeting, the Fuel Tank Inerting HWG provided a status report. A special EXCOM meeting will be held April 4 at which time the HWG will be discussing design concepts (Mr. Bolt will try to provide TAE participants with an electronic copy of status report). The HWG plans to meet in May.

Human Factors HWG

Mr. Ed Kupcis, reporting for Curt Graeber, distributed a status report (handout 7 and handout 8). Mr. Graeber and Sharon Hecht had difficulty accessing the phone lines but joined the discussion later. Highlights Included: summary of the subgroups' activities; resolution of the issue of accessibility to FAA and JAA regulations; and the April HWG meeting in England. Embraer is expected to attend the next meeting and a decision to add the organization, as a member of the working group will be determined after the meeting.

Mr. Sulocki indicated that the JAA's A-NPA on Human Centred Design has been returned to the JAA steering group for additional work. Mr. Kupcis indicated that the HWG was concerned that some of the concepts in the JAA's document are different from the HWG.

Seat Test HWG

Ms. Carpenter reported that everything assigned to the working group has been turned in to the FAA. The FAA is working on the advisory circular, which may be returned to the working group in June. The FAA is looking at test criteria for 16g seats and installation issues. Also a report to Congress, which addresses seat issue, is being coordinated within the FAA.

Design for Security HWG

Mr. Mark Allen distributed a status report (handout 9). He indicated that there had been some fluctuation in the working group membership, which is comprised of representatives from the authorities, associations, and industries. In addition to the status report, discussion items included publication of the tasking addressing flight deck intrusion; use of differential pressure to insure that smoke does not get into cockpit; door designs; cabin and passenger carbon monoxide concentrations and human tolerance; air exchange rate in the cabin; meeting separation requirement in cargo and E/E bay; and requirement for advance design on cargo containers/fire extinguishers suppression system. Mr. Allen indicated that ICAO is looking at a possible structural rule but at this point the HWG has not been tasked to do so. He said that the working group had gone on a tour with an inspection group for British Airway; the inspection pointed out the obvious as well as the not so obvious places where security could be breached. Mr. Allen questioned when the task on flight deck intrusion would be issued since the HWG had done considerable work on the issue. The working group is scheduled to meet in April, July, and October.

Flight Guidance HWG

John Ackland reported by telephone; Mr. Bolt distributed a working group activity report

(handout 10). He indicated that the October completion date is being hampered by summer vacations/breaks and that the report probably will be completed by the end of October for the December 2001 meeting. He indicated the working group had received about 300 comments on the rule and AC/ACJ to resolve; the comments came mostly from working group members companies. TAE members reluctantly agreed to have the report for the December meeting.

Mr. Ackland indicated that the working group will try to flush out problems identified in the AC/ACJ wording and that there are wide majority/minority opinions. Discussion items revolved around a recent JSIT recommendation, which addresses one of the intervention strategies and its relationship to a Safety Board recommendation; Mr. McGraw indicated that he would provide Mr. Ackland with a copy of the JSIT recommendation.

System Design Analysis HWG

Ms. Carpenter indicated that that the FAA is working on a draft notice of proposed rulemaking and advisory circular and plans to return the documents (phase 4) to the HWG in May or June for review. She advised that there is a need to reconstitute the working group and establish co-chairs for the group. She indicated that the documents are based on the HWG's recommendations and the FAA addition of specific risk, as well as technical and legal reason. She further indicated that the rule might not have changed from the document submitted by the HWG but that the AC has changed substantially. Mr. Sulocki indicated that the JAA would like to see the recommendation published as step 1 and then provide specific risk. In addition, he indicated that the JAA would publish JAR 25.1309, on the basis of the 1998 Systems Design Analysis Study Group recommendation.

Mr. Bolt requested that TAE members provide nominees for the working group. Ms. Carpenter indicated that the FAA would provide a formal notification letter with time frames for the working group to complete the task. The letter would clearly indicate that the task is limited and not meant to reopen any doors. Mr. Bolt indicated that he would provide a letter to indicate the scope of the task.

Continued Airworthiness Assessment Working Group

Sara Knife reported by telephone; the working group activity report was distributed (handout 11) earlier. She provided an overview of the task and composition of the working group. Discussion items included contact for industry representatives, the need to complete the task for presentation at the September TAE meeting, why disposition of comments was not being done in a harmonization fashion, and where the JAA is in processing the disposition of comments. Other discussion items included disposition of AIA comments and airframer comments. TAE members approved the working group's work plan (handout 12) unanimously.

Engine HWG

Mr. Bolt indicated that all taskings for the HWG are in the FAA for formal legal and economic reviews. Discussion items included taskings for bird ingestion requirements, phase 2, and critical parts integrity (handout 13). The bird ingestion tasking will look at population of large flocking birds relative to high-speed operations; the critical parts integrity task is not expected to be as controversial as the bird ingestion tasking. Other discussion items included improving data collection efforts, mandatory reporting requirements, and quality of data in databases.

Flight Test HWG

Ms. Carpenter indicated that the FAA is developing a final rule, and that another bundled package delayed work on the rule. Section 25.177(c) had some dissenting opinions, which are being worked by the FAA. The NPRM for flight in icing is in preliminary legal review and is expected to be returned to the working group in May or June. The next meeting of the HWG is scheduled for October. The FAA plans to give the working group a task addressing operations retrofit/handling qualities in icing in early or late summer.

ETOPS Tasking Update

Mr. Bolt provided a paper describing the objectives, criteria for the AC and NPRM being formulated by the group (handout 14). He indicated that Tim Gallagher, working group chair, had indicated that the group was holding monthly meeting in addition to subgroup meetings. The working group does not expect to meet its July deadline. The Air Carriers Operations Issue Group approved the concept briefing (handout 12). Discussion items included compatibility of European equipment and involvement of ETOPS in harmonization.

Electromagnetic Effects HWG

Ms. Carpenter indicated that the HIRF project has been prioritized within the FAA and that the Office of Policy has given the regulatory evaluation a high priority. TAD is working on the advisory circulars pertaining to the HWG's Lightning packages; the FAA is looking at nonrulemaking avenues to address other changes proposed by the working group. Ms. Carpenter indicated that she would look further into the rulemaking package/FAA action and report back to the TAE.

Mr. Sulocki indicated that the JAA study group has proposed to wait a little longer to release its HIRF package since the FAA is working on its regulatory evaluation.

Mechanical Systems HWG

Ms. Carpenter provided an update of the items in the FAA--two are in the Office of Policy, one has been returned to the HWG for phase 4 review; and two are in early drafting stages. Taskings addressing sections 25.841(a) and 25.831(g) are in coordination and probably will be sent out in April.

Pat Waters indicated that the technical report addressing cargo compartment would be submitted to the TAE for approval at the June meeting. He also indicated he is looking to expand the representatives on the working group to work on 25.831(g) and 25.841(a). Draft TORs for landing gear retraction and tireburst will be presented to the TAE for review.

Ms. Carpenter indicated that two draft TORs are being generated for the MSHWG addressing 25X745 (on original list of differences) and landing gear retraction and tireburst (taken from the fast track report generated from section 25.729). Based on the March Harmonization Team Meeting, the tasks will probably be drafted for a new HWG comprised of representatives from the Loads and Dynamics and Mechanical Systems HWGs.

Powerplant Installation HWG

Mr. Bolt reviewed the status report (handout 15) provided by Andrew Lewis-Smith. Discussion items included slippage of submittal date for sections 25.1187 and 25.863 to December; the need for clarification of the critical time interval for go-around and involvement of JAA Flight Study Group, and the need for clarification of "management support" for other working group involvement (25.903(d). An invitation to hold a PPIHWG meeting in Moscow was also discussed.

December Meeting Minutes

Members provided comments and revisions. Mr. Bolt indicated that the meeting minutes would be distributed and approved electronically.

General Structures HWG

Amos Hoggard summarized the activity/status reports (handout 16 and handout 17). He provided an update of the task completed and the tasks still in the working group. He indicated that the working group had added two new members (Embraer and FAA). Mr. Hoggard indicated that the JAA representative has indicated that he can only support 3 ½- rather than 5-day meetings. Mr. Sulocki said that he would check with the JAA representative.

Mr. Hoggard further indicated that the FAA economist is questioning the accuracy of figures in a recommendation addressing section 25.613 (which the working group submitted 3 years ago) and threatening to stop work on the project if the HWG does not respond. Mr. Bolt indicated that he would write a letter to Tony Fazio regarding the economist's request.

The following discussion/actions were made:

Section	**Action**
25.365(d)	--Working group is working on a list of technical issues where agreement is needed --TAE unanimously approved work plan
25.571	--Working group has agreed to reopen harmonization effort based on Amendment 96 and desire to reinstate fail-safe requirements --Expects to complete June 2001, which is optimistic --Questioned if there will be ACJs
25.631 and 25.571	--Working group suffered setback and is awaiting results of FAA research and development on bird populations and probability of airplane/bird encounters
25.683	--Subteam proposed for the advisory circular --TAE approved approach unanimously with revisions

Airworthiness Assurance Working Group

Mr. Hoggard provided an overview of some of the issues that impacted delaying the recommendation on widespread fatigue damage, including obtainment of the economic assessment. He indicated that he expects to have the final document by the end of May for approval at the June TAE meeting. Mr. Hoggard further indicated that because the working group had just recently received the tasking on multiple complex supplemental type certificates, the working group did not have a full complement of members; he said that he would be better prepared to discuss the task at the June meeting.

Ice Protection HWG

Dennis Newton presented a status report (handout 18). With regard to task 1,operating rule (handout 19), Mr. Newton indicated that a vast majority of the document had been agreed on but there was concern about the two dissenting minority positions (BAE Systems and the FAA) that are documented in the report. BAE's position (supported by Cessna) deals with airplanes that have NPRMs that propose deicing airworthiness directives that, in some cases, have been withdrawn. The FAA's position (supported by the Air Line Pilots Association (ALPA)) supports having ice protection accumulations systems operating during all phases of flight. Mr. Newton indicated that because some dissents came after the working group meeting, e-mails had been sent to HWG member on whether to withhold the document until the next meeting. HWG members approved sending the request for formal legal economic reviews to the TAE meeting for approval.

Discussion items included consensus of other authorities, loss of RAA members' support of the document which will require part 135 airplanes to be certified to rules that have not been written; frustrations expressed by ALPA, GAMA, etc; desire for two ice protection systems (one for detection and one for ice sensors on unprotected areas); mechanical versus pilot skills; the lack of uniform policy among FAA personnel; and recording JAA's opinion. TAE members agreed to forward to FAA for regulatory and legal reviews with a notation on the cover letter citing issues addressing RAA and ALPA's concerns.

With regard to task 2, Mr. Newton presented a detailed report that cites the problems encountered by the working group for completing the task, i.e., lack of information, funding, and recommendations for future tasking (handout 20).

Loads and Dynamic HWG

Larry Hanson presented a status report that was distributed earlier (handout 21). The following items were discussed:

Section	**Discussion**
25.415	--Previously provided working group report and draft AC and NPRM at December TAE meeting --Request from Bombardier for extension of time --Suggestion to request FAA coordinate with another issues group --ALPA rep asked for further explanations regarding pilot restraint of the flight controls

	while gust locks disengaged and commented that such restraint is not common practice --Expects to complete technical report, AC and NPRM at June meeting; will revisit the pilot restraint issue and report to TAEIG in June
25.865	--Testing performed by Rolls Royce using 2-inch-diameter bar material indicated that temperatures did not stabilize and the need for additional testing which will be coordinated with FAA Tech Center --New schedule will be provided at TAE June meeting
TORs for Ground Handling, Towing, and Descent Velocity	--Task groups formed for ground handling, and chairs have been appointed --Clarification of task and status of Boeing's position on descent rate (10 feet per second, limit to 12 feet) --Taskings have not been published in *Federal Register*.
TOR for Flight Loads Measurements	--Awaiting task publication in *Federal Register* --JAA study group has been moving forward; HWG has been keeping abreast of their movement --Tasking is still being worked on within FAA, which is unsure if task will be published in time to have work plan for December TAE meeting

Mr. Hanson also requested the status of §§ 25.671(c)(2), 25.1309, and 25.671(c)(3) because the HWG needs to look at work required for loads based on jammed control position. Mr. Bolt and Ms. Carpenter drafted letter to Flight Controls group to authorize work in support of Flight Controls HWG. Mr. Hanson will submit a work plan at the December TAE meeting.

Todd Martin provided clarification regarding tasking relative to §§ 25.671(c)(2) and 25.1309. Sections have different combination of failure requirements. Once resolved, the new requirement will be able to use a combination of failure (will affect flutter). Mr. Sulocki indicated that the JAA Powerplant Study Group has raised concerns about section differences in JAR/FAR 25.963(d), which just addresses proximity of engines.

Flight Controls HWG

Larry Schultz, reporting by telephone, provided a working group activity report (handout 22) earlier. He indicated that the working group had no future meeting schedule unless something comes out addressing specific risk. With regard to the technical report on § 25.671 and the advisory circular (handout 23), discussion items included rationale for 15- to 25-knot crosswinds; definition of single failure; flight control jams; single vs. probable failure; the need for specific risk criteria; and minority opinions within the working group. Members also discussed having the FAA provide a discussion on § 25.1309 at the June TAE meeting. Members voted 6 to 2 not to forward report to FAA. They also voted 6 to 1 to hold, pending outcome of discussion. Members voted unanimously to forward the fast track report addressing § 25.672 (handout 24) to the FAA.

Avionics Systems HWG

Clarke Badie, reporting by telephone, requested the status of TORs addressing section § 25.1322 and AC 25-11. Ms. Carpenter indicated that one proposal is with the rulemaking council for approval and that for the other, an advanced tasking record is in coordination. The following items were discussed:

Section	Discussion/action
25.1333	--Current practice uses standby indicator; rule specifies instruments --Need to reword rule to reflect practice of use of whiskey compasses
25.1327	--No change; enveloping --Report will be available for June TAE meeting

Wrapup

Mr. Bolt reviewed the March action items.

The next TAE meeting will be held June 26-27 at Seattle Washington.

Public Notification

The *Federal Register* published an announcement of the meeting on March 11.

Approval

I certify the above minutes are accurate

/s/

Craig Bolt

Assistant Chair

Action Items

March 2001 TAEIG

1. Send out new WG report format to all WG's. -- C. Bolt
2. Kris Carpenter to see if ATSRAC group working Part 25 ICA can provide briefings to TAEIG.
3. John McGraw to provide John Ackland (FGHWG) with JSAT recommendation regarding 25.1329.
4. TAEIG to nominate members for SDHWG. C. Bolt to send letter to TAEIG calling for members to replace those no longer available. Reference Beth Ericksen letter.
5. Kris Carpenter to review if NWR can provide assistance in evaluation of lightning rule package.
6. Check with Bob Park/Andrew Lewis-Smith as to status of CTI understanding in support of Appendix I – Closed. Input has been received from FTHWG and is under review by PPIHWG.
7. Check PPHIWG for reason of date slip on 25.1187, 25.863. – Closed PPHIWG considers Dec TAEIG vote as best possible date
8. C. Bolt to circulate December 2000 meetings to TAEIG for e-mail vote.
9. Thaddee Sulocki to investigate how to assure that GSHWG receives JAA support (travel budget issues).
10. C. Bolt to draft letter to Tony Fazio expressing TAEIG displeasure at how economic analysis handled on 25.613.
11. Kris Carpenter to develop flow chart of Phases that goes along with report format for new taskings.
12. TAEIG to propose additional members for Multiple STC tasking assigned to AAWG.
13. Larry Hanson to provide new schedule for completion of 25.865 before June TAEIG meeting.
14. C Bolt to send WG membership list to TAEIG (Carryover from Dec 2000 action items)

TAEIG Action Items – December 5 & 6, 2000

1. Kris Carpenter to provide schedules to WG's as to expected Phase 4 activity by March TAEIG and entire schedule for IG.

2. Kris Carpenter to provide update on status of FAA implementation team for Seat Test Fast Track Reports. - CLOSED

3. Industry members of TAEIG to provide Tony Fazio with view of how non U.S. members act as co-chairs of Work Groups. C. Bolt to coordinate by 12/22.

4. Resend 25.903d proposed TOR to TAEIG. C. Bolt

5. Kris Carpenter/C. Bolt to get update on status/schedule of taskings of GSHWG.

6. C. Bolt/Larry Hansen to provide clarifying text for 25.415g2 and provide for email vote.

7. Kris Carpenter to insure proposed TOR for 25X745 is not in conflict with existing LDHWG task for 25.509.

8. Kris Carpenter to get update on status of Lightning package and provide to TAEIG.

9. Kris Carpenter/John McGraw to investigate if 25.1310 can be broken out of the 25.1309 package to maintain harmonization with upcoming JAA NPA.

10. FAA (Kris Carpenter) to compare Electrical System HWG proposed TOR's to outstanding taskings to determine what needs to be tasked versus what is covered by existing tasking plus what FAA wants to task. T/A 2/7/01

11. Kris Carpenter/Thaddée Sulocki to understand current status and plans for 25.1327 in both FAA and JAA systems.

12. C. Bolt to send WG membership lists to TAEIG.

13. Recommendations for SDAHWG co-chairs are still requested.

Handout 2

Open Items from March 2000 Meeting

T. Sulocki and Kris Carpenter to determine how JAA/FAA will address lack of harmony in 25.562 seats. (JAA rule does not include pilot or flight attendant seats, FAA rule does, but some exemptions have been granted for pilot seats regarding pitch and roll.)

Open Items from June 2000 Meeting

FTHWG to draft TOR for follow on work on 25.177(c).

Open Items from September 2000 Meeting

Thaddée Sulocki to review letter from Powerplant Study Group regarding concerns on LDHWG report for 25.963(d) and to determine path forward by next LDHWG meeting on September 26-28. – Open T/D 1/6/2001

Legend:

Presently Tasked: | To be Tasked:

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

Powerplant Installation Harmonization Working Group
F.A. Lewis-Smith - Boeing
O. Grimand- Airbus
Presently tasked:
- • 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

To be tasked:
- 25.903(d)

Engine Harmonization Working Group
J. McRoberts - Allison
F. Fagegaltier - JAA
Presently tasked:
- 33.27
- FAR 35/JAR-P
- • 33.17
- • 33.19
- 33.28
- • 33.75
- • 33.84
- • APU
- • OEI Shafts

To be tasked:
- Bird Phase II
- Critical Parts

Design for Security Harmonization Working Group
M. Allen- Boeing
Presently tasked:
- ICAO Annex 8

To be tasked:
- Flight-Deck Intrusion

Loads & Dynamics Harmonization Working Group
L. Hanson - Gulfstream
Presently tasked:
- 25.415
- • 25.865
- 25.994
- 25.471/ 25.519

General Structures Harmonization Working Group
A. Hoggard - Boeing
Presently tasked:
- • 25.571
- • 25.631
- • 25.365(d)
- • 25.1529
- • Appendix H Part 25
- 25.776(b)

To be tasked:
- 25.608/25.683

Electromagnetic Effects Harmonization Working Group
O. Spiller - Airbus
J. Cross - Raytheon
Presently tasked:
- • 25.1317
- • 25.1316

Flight Controls Harmonization Working Group
L. Schultz - Boeing
P. Traverse - Aerospatiale
Presently tasked:
- • 25.671
- • 25.671(c)/25.672

Continued Airworthiness Assessments Working Group
S. Knife - GE
Presently tasked:
- AC 39-XX

Human Factors Harmonization Working Group
R. Curtis Graeber - Boeing
D. Ronceray - Airbus
To be tasked:
- 25.HF

Flight Test Harmonization Working Group
F. Iannarelli - Aerospatiale
R. Park- Boeing
To be tasked:
- 25.1001
- 25.177
- 25.207
- Min.Maneuver Speeds

Systems Design & Analysis Harmonization Working Group
J. Ackland - Boeing
J-C. Rouquet - Aerospatiale
To be tasked:
- 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
To be tasked:
- 25.1322
- AC 25-11

Mechanical Systems Harmonization Working Group
K. (Pat) Waters - Boeing
R. Greiner - AECMA
Presently tasked:
- 25.851(b)

To be tasked:
- 25.831
- 25.841

Flight Guidance Harmonization Working Group
J. Ackland - Boeing
J. Beale - BAE
Presently tasked:
- • 25.1329
- • 25.1335

Ice Protection Harmonization Working Group
D. Newton - Boeing
C. Laburthe - Airbus
Presently tasked:
- • 25.1419
- • 25.1093
- • 25.929

Airworthiness Assurance Harmonization Working Group
A. Carter - Delta
G. Gopinath - Boeing
Presently tasked:
- Complex STC

Rev. March 2001

• *Indicates SRD items.*

Handout 3

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

- • 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

- 33.64
- • 33.76

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

- 25X.1436
- • 25.1438
- 25.1453
- • 25.677(b)
- • 25.729
- • 25.773(b)(2)(b)(4)
- • 25.1439

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

- • 25.562
- • 25.785(b) (c)&(e)

- AC25.562-1A

Loads & Dynamics Harmonization Working Group
L. Hanson - Gulfstream

- 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

- 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

- • 25.581

Direct View Harmonization Working Group
D. Klippert- Boeing

Flight Attendant Direct View AC

Hydraulic Test Harmonization Working Group
J. Draxler - Boeing

- 25.1435

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

- 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

- • 25.735
- 25.731

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

- • 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

- 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

- 25.857(b)

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

- • 25.703(a)&(b)
- • 25.1333(b)
- 25.1423
- 25.1331
- 25X1328

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

- Repairs
- WFD Report
- WFD

- AC 91-56

For recordkeeping purposes:

Emergency Evacuation Issues Group still remains an active issues group

• *Indicates SRD items.*

Rev. March 2001

Summary

HWG	Task ID	Category	SRD or PSRD	Report to TAE
AAWG	121-WFD		Non-FTA	12/00
AS	25.0703(a)(b)(c)	1	SRD	12/99 Accepted; 3/00 Revisions and AC Accepted
	25.1327/25X1328	1	PSRD	6/00 Accepted with note
	25.1331	1	PSRD	3/00 Accepted
	25.1333(b)	1	SRD	12/99 Accepted; 3/00 Revisions and AC Accepted
	25.1423(b)	1	PSRD	12/99 Accepted
BS	25.0731	2c	PSRD	NPRM 99-16; 6/00 submitted
	25.0735	2c	SRD	NPRM 99-16; 6/00 submitted
CAAWG	AC-39XX		New Task	
CS	25.0857(b)		Non-FTA	
DFS	ICAO Annex 8		New Task	6/00: Phase 1 report sumbitted
DV	25.0785		Non-FTA	
EE	25.0581	1	SRD	3/00 Accepted
	25.1316	2b	SRD	
	25.1317	2b	SRD	9/00 Accepted
EEIG	25.0787	1	PSRD	5/00 Accepted
	25.0791(a)to(d)	1	PSRD	5/00 Accepted
	25.0810	1	PSRD	3/01 Expected
	25.0811	1	PSRD	5/00 Accepted
	25.0812-1		Non-FTA	
	25.0813(c)	3	SRD	?
	25.0819	1	PSRD	5/00 Accepted
	25.1411-1		New Task	
ES	25.0869(a)	1	PSRD	2/00 Accepted
	25.1309/25.1365	1	PSRD	2/00 Accepted; 6/00 rev Accepted
	25.1310	1	PSRD	2/00 Accepted with Note
	25.1351(b)	1	SRD	2/00 Accepted
	25.1351(c),	1	SRD	2/00 Accepted
	25.1351(d)	1	SRD	3/00 Accepted

Handout 4

HWG	Task ID	Category	SRD or PSRD	Report to TAE
ES	25.1353(a), (c),	1	PSRD	2/00 Accepted; 6/00 Rev to (c)(6) Accepted
	25.1353(d)	1	PSRD	2/00 Accepted
	25.1355(c)	1	PSRD	2/00 Accepted
	25.1357	1	PSRD	2/00 Accepted
	25.1362	3	PSRD	6/00 Accepted as amended; 9/00 Accepted
	25.1363	1	PSRD	3/00 Accepted
	25.1431(d)	1	SRD	2/00 Accepted
	25X0899	1	SRD	2/00 Accepted; 6/00 Rev Accepted
	25X1360(a)(b)	1	PSRD	3/00 Accepted
FC	25.0671(c)	3	SRD/Non-FTA	3/01 expected
FGS	25.1329	3	SRD/Non-FTA	6/01 expected
	25.1335	3	SRD/Non-FTA	6/01 expected
FT	25.0101(c)(2)	3	PSRD	6/00 Accepted as amended
	25.0103	2c	Non-FTA	JAR Ch 15; NPRM 95-17
	25.0107(e)	3	SRD	3/00 Revisions Accepted
	25.0109(a)	2c	PSRD	JAR Ch 15
	25.0111(c)(4)	1	PSRD	12/99 Accepted
	25.0113	2c	PSRD	JAR Ch 15
	25.0121	2c	Non-FTA	JAR Ch 15; NPRM 95-17
	25.0125	2c	Non-FTA	JAR Ch 15; NPRM 95-17
	25.0147(c)	1	SRD	12/99 Accepted
	25.0161(c)(2),(e)	1	PSRD	12/99 Accepted
	25.0175(d)	1	PSRD	12/99 Accepted
	25.0177(a)(b)(d)	3	PSRD	(a),(b): 12/99 Accepted, (d): 6/00 Accepted
	25.0177(c)	3	PSRD	6/00 Accepted
	25.0207	2c	Non-FTA	JAR Ch 15, NPRM 95-17
	25.0253(a)(3),(a)(4)	1	SRD	12/99 Accepted
	25.0253(a)(5)	3	SRD	6/00 Accepted
	25.1323(c)	1	PSRD	12/99 Accepted
	25.1419	3	SRD/Non-FTA	

HWG	Task ID	Category	SRD or PSRD	Report to TAE
FT	25.1501	3	PSRD	3/00 Accepted-COMPLETE
	25.1516	1	PSRD	12/99 Accepted
	25.1527	1	PSRD	12/99 Accepted
	25.1583(c)	1	PSRD	12/99 Accepted
	25.1583(f)	1	PSRD	12/99 Accepted
	25.1583(k)	3	PSRD	3/00 Accepted-COMPLETE
	25.1585	1	PSRD	12/99 Accepted
	25.1587	1	PSRD	12/99 Accepted
	25X1591	3	PSRD	3/00 Accepted-COMPLETE
GS	25.0307(a)	2a	SRD	6/00 Accepted
	25.0365(d)(e)		New Task	na
	25.0571	2b	SRD/Non-FTA	In HWG
	25.0603	1	PSRD	6/00 Accepted-COMPLETE
	25.0613	2c	PSRD	In FAA
	25.0621	2a	SRD	6/00 Accepted
	25.0631	2a	SRD/Non-FTA	In HWG
	25.0683	1	PSRD	3/00 Accepted with note; 6/00 Accepted revs
	25.0775(b)	2a	SRD/Non-FTA	In HWG
	25.0775(d)	2a	SRD	In HWG
	25.0783	2a/3	SRD	3/00 Accepted
	25.0963(e)(g)	2a	SRD	3/00 Accepted
HF	25.HF		New Task	na
HT	25.1435	2c	PSRD	NPRM 96-6
IP	121-Ice		Non-FTA	
	25.1323(e)/25.1325(		Non-FTA	
	25.1419-1		Non-FTA	
	25.1419-2		Non-FTA	
	25.1419-6		Non-FTA	
L&D	25.0302	2b	PSRD	12/99 Accepted
	25.0305/341(b)/151	2a	PSRD	3/00 Accepted
	25.0331(c)	2a	SRD	In FAA
	25.0335	2a	PSRD	2/00 Accepted-COMPLETE
	25.0345	2c	PSRD	JAR Ch 15-COMPLETE

HWG	Task ID	Category	SRD or PSRD	Report to TAE
L&D	25.0351	2c	PSRD	JAR Ch 15-COMPLETE
	25.0361/362	2a	SRD	12/99 Accepted
	25.0371	2c	PSRD	JAR Ch 15-COMPLETE
	25.0415	3	PSRD	12/00 submitted
	25.0471 thru 25.051		New Task	
	25.0473	2c	PSRD	JAR Ch 15-COMPLETE
	25.0473-1		New Task	
	25.0479	2c	PSRD	JAR Ch 15-COMPLETE
	25.0483	2c	PSRD	JAR Ch 15-COMPLETE
	25.0493	2c	PSRD	JAR Ch 15-COMPLETE
	25.0509		New Task	
	25.0561	2c	PSRD	JAR Ch 15-COMPLETE
	25.0629	2c	PSRD	JAR Ch 15-COMPLETE
	25.0721	3	PSRD	6/00 Accepted
	25.0723	2c	PSRD	5/00 Accepted
	25.0865	3	SRD	12/00 expected
	25.0963(d)	2a	SRD	6/00 Accepted
MS	25.0677(b)	1	PSRD	5/00 Accepted
	25.0729	1	PSRD	6/00 Accepted
	25.0773(b)(2)(b)(4)	1	PSRD	5/00 Accepted
	25.0851(b)	3	PSRD	5/01 expected
	25.1438/25X1436	2a	SRD	12/99 Accepted
	25.1439	1	PSRD	6/00 Accepted
	25.1453	1	PSRD	12/00 Accepted
NEW	121 Icing		New Task	
	121, 125, 135		New Task	
	121.353(a)		New Task	
	25		New Task	
	25.0177		New Task	
	25.0207-1		New Task	
	25.0301-1		New Task	
	25.0562-1		New Task	
	25.0603-1		New Task	
	25.0729-1		New Task	

HWG	Task ID	Category	SRD or PSRD	Report to TAE
NEW	25.0745		New Task	
	25.0810-1		New Task	
	25.0811-1		New Task	
	25.0819-1		New Task	
	25.0831		New Task	
	25.0831/0841		New Task	
	25.0841		New Task	
	25.0857-1		New Task	
	25.0903(d)-1		New Task	
	25.0963(e)		New Task	
	25.1001		New Task	
	25.1193		New Task	
	25.1305		New Task	
	25.1322		New Task	
	25.1327-1		New Task	
	25.1333(b)-1		New Task	
	25.975		New Task	
	25.bizjet		New Task	
PPI	25.0901(c)	2a	SRD	In FAA
	25.0903(d)	3	SRD	6/00: COMPLETE
	25.0903(d)(1)	3	SRD	12/99 Accepted
	25.0903(e)	2a/3	PSRD	12/99 Accepted
	25.0905(d)	1	SRD	12/99 Accepted-COMPLETE
	25.0929	2c	SRD	In JAA
	25.0933(a)(1)	2a/3	SRD	12/99 Accepted
	25.0934	1	PSRD	12/99 Accepted
	25.0943/25X1315	1	PSRD	12/99 Accepted
	25.0945(b)(5)	3	PSRD	12/00 Accepted
	25.0973	1	PSRD	12/00 Accepted
	25.1091	1	PSRD	12/99 Accepted
	25.1093(b)(1)(ii)	2a/1	SRD	12/99 Accepted
	25.1103	1	PSRD	12/99 Accepted-COMPLETE
	25.1141	1	PSRD	12/99 Accepted
	25.1155	3	PSRD	5/00 Accepted with note
	25.1181(b)	1	PSRD	12/00 Accepted
	25.1183(c)	2a	SRD	12/99 Accepted-COMPLETE
	25.1187/25.863	1	SRD	9/01

HWG	Task ID	Category	SRD or PSRD	Report to TAE
PPI	25.1189(a)	2a/3	SRD	12/99 Accepted
	25.1193(e)	3	SRD	10/00 Accepted
	25.1305(a)(7), (d)(2	1	PSRD	12/00 Accepted
	App I	3	PSRD	3/01 expected
	App K/25.901(d)	2a/1	SRD	12/99 Accepted
	FAR 1	0	PSRD	12/99 Accepted
SDA	25.1301	2b	Non-FTA	In FAA
	25.1309/25.1310	2b	Non-FTA	In FAA
ST	25.0562	3	SRD	3/00 Accepted
	25.0785(e)(b)(c)	3	SRD	3/00 Accepted

Status

HWG	Task ID	Cat	SRD or PSRD	Report to TAE	Status
AAWG	121-WFD		Non-FTA	12/00	3/21/01: Expect econ eval back to wg by 5/01
AS	25.0703(a)(b)(c)	1	SRD	12/99 Accepted; 3/00 Revisions and AC Accepted	11/17/00 Legal returned NPRM draft w/o comment. Still in APO.
	25.1327/25X1328	1	PSRD	6/00 Accepted with note	11/7/00: Eng rqstd package be returned to wg: Phase 2 again. Plans to go "beyond scope" of current task.
	25.1331	1	PSRD	3/00 Accepted	3/16/01 WG concurred w/ draft, but feels that it now conflicts with work to be done on 1322. NPRM on hold until TAEIG/AVHWG determine appropriate action.
	25.1333(b)	1	SRD	12/99 Accepted; 3/00 Revisions and AC Accepted	11/17/00: Rep took back to WG based on ACO/Directorate comments
	25.1423(b)	1	PSRD	12/99 Accepted	3/16/01 WG concurred w/ draft
BS	25.0731	2c	PSRD	NPRM 99-16; 6/00 submitted	2/16/01: SNPRM comment period closed
	25.0735	2c	SRD	NPRM 99-16; 6/00 submitted	2/16/01: SNPRM comment period closed
CAAWG	AC-39XX		New Task		12/01/00: Tasked to ARAC
CS	25.0857(b)		Non-FTA		12/00: Draft w/ legal
DFS	ICAO Annex 8		New Task	6/00: Phase 1 report sumbitted	3/9/01: RMC agreed to add door intrusion task, ARM developing task
DV	25.0785		Non-FTA		1/31/01: TW preparing AC for interdirector review.
EE	25.0581	1	SRD	3/00 Accepted	12/1/00: Draft AC on hold waiting for rule with 25.899
	25.1316	2b	SRD		7/28/99: TAIG transmitted to FAA for formal legal and economic review.
	25.1317	2b	SRD	9/00 Accepted	1/11/01: HQ agreed to make this "like an A" for formal legal review, still needs APO rvw.
EEIG	25.0787	1	PSRD	5/00 Accepted	1/16/01: RPR in legal
	25.0791(a)to(d)	1	PSRD	5/00 Accepted	2/7/01: prelim NPRM to eng for review.
	25.0810	1	PSRD	3/01 Expected	FTA-2
	25.0811	1	PSRD	5/00 Accepted	1/26/01: RPR in interdirectorate coordination
	25.0812-1		Non-FTA		3/16/00: with engineering to decide on next action
	25.0813(c)	3	SRD	?	FTA-2
	25.0819	1	PSRD	5/00 Accepted	11/17/00 Legal returned draft NPRM w/o comment. Still in APO
	25.1411-1		New Task		

HWG	Task ID	Cat	SRD or PSRD	Report to TAE	Status
ES	25.0869(a)	1	PSRD	2/00 Accepted	1/20/01: NPRM waiting publication - on hold due
	25.1309/25.1365	1	PSRD	2/00 Accepted; 6/00 rev Accepted	1/12/01: NPRM in team coordination
	25.1310	1	PSRD	2/00 Accepted with Note	12/28/00: RPR in team coordination
	25.1351(b)	1	SRD	2/00 Accepted	2/27/01 Draft NPRM to engineer for review and additional information
	25.1351(c),	1	SRD	2/00 Accepted	2/9/01: NPRM in team review
	25.1351(d)	1	SRD	3/00 Accepted	12/20/00 Engineer reviewing comments from interdirectorate coordination
	25.1353(a), (c),	1	PSRD	2/00 Accepted; 6/00 Rev to (c)(6) Accepted	1/16/01 APO has last minute change, project on HOLD waiting for APO.
	25.1353(d)	1	PSRD	2/00 Accepted	2/22/01 ARM sent package to AGC for signoff on transmittal memo.
	25.1355(c)	1	PSRD	2/00 Accepted	2/8/01 Transferred project to Slotte
	25.1357	1	PSRD	2/00 Accepted	2/26/01 NPRM draft to Slotte for review/familiarization and input recost savings
	25.1362	3	PSRD	6/00 Accepted as amended; 9/00 Accepted	1/12/01: RPR to RMC, 3/9/01: Deferred until FAA discussion on FTA/APO
	25.1363	1	PSRD	3/00 Accepted	1/12/01: RPR to RMC
	25.1431(d)	1	SRD	2/00 Accepted	12/26/00: NPRM in final team conc.
	25X0899	1	SRD	2/00 Accepted; 6/00 Rev Accepted	11/16/00 Legal returned draft
	25X1360(a)(b)	1	PSRD	3/00 Accepted	3/15/01: Draft NPRM sent to WG
FC	25.0671(c)	3	SRD/Non-FTA	3/01 expected	1/31/01 Last WG meeting expected late February, expect to submit rec to TAEIG by March.
FGS	25.1329	3	SRD/Non-FTA	6/01 expected	12/7/00 Prelim draft rule and AC received for "preliminary TW and legal review". Want comments by January 26 for a February 6, 2001 meeting. WG is proposing to submit package to TAEIG (for formal review) by June 29, 2001
	25.1335	3	SRD/Non-FTA	6/01 expected	12/7/00 Prelim draft rule and AC received for "preliminary TW and legal review". Want comments by January 26 for a February 6, 2001 meeting. WG is proposing to submit package to TAEIG (for formal review) by June 29, 2001
FT	25.0101(c)(2)	3	PSRD	6/00 Accepted as amended	3/8/01 Clearance record AC revision, WG report to interdirectorate coordination, comments due 3/23/01.

HWG	Task ID	Cat	SRD or PSRD	Report to TAE	Status
FT	25.0103	2c	Non-FTA	JAR Ch 15; NPRM 95-17	
	25.0107(e)	3	SRD	3/00 Revisions Accepted	12/1/00 APO deferred prioritization until workload/time requirements on CAT 2 and 3 items is assessed by APO, 3/9/01; RMC deferred prioritization until FAA discussion on FTA/APO
	25.0109(a)	2c	PSRD	JAR Ch 15	
	25.0111(c)(4)	1	PSRD	12/99 Accepted	1/30/01 Waiting for APO reg evaluation.
	25.0113	2c	PSRD	JAR Ch 15	
	25.0121	2c	Non-FTA	JAR Ch 15; NPRM 95-17	
	25.0125	2c	Non-FTA	JAR Ch 15; NPRM 95-17	
	25.0147(c)	1	SRD	12/99 Accepted	1/30/01 Waiting for APO reg evaluation.
	25.0161(c)(2),(e)	1	PSRD	12/99 Accepted	1/30/01 Waiting for APO reg evaluation.
	25.0175(d)	1	PSRD	12/99 Accepted	1/30/01 Waiting for APO reg evaluation.
	25.0177(a)(b)(d)	3	PSRD	(a),(b): 12/99 Accepted, (d): 6/00 Accepted	1/23/01: Discussed CAD APO has questions
	25.0177(c)	3	PSRD	6/00 Accepted	7/12/00: To eng prior to tw
	25.0207	2c	Non-FTA	JAR Ch 15, NPRM 95-17	
	25.0253(a)(3),(a)(4)	1	SRD	12/99 Accepted	1/12/01: RPR put on hold by ARM, 3/9/01: Deferred until FAA discussion on FTA/APO
	25.0253(a)(5)	3	SRD	6/00 Accepted	1/12/01: RPR put on hold by ARM
	25.1323(c)	1	PSRD	12/99 Accepted	3/5/01 NPRM to ARM for headquarters coordination (APO final team concurrence and AOA approval to ANM to issue)
	25.1419	3	SRD/Non-FTA		2/12/01 To TW
	25.1501	3	PSRD	3/00 Accepted-COMPLETE	FTA task CLOSED per 5/17 ARM letter
	25.1516	1	PSRD	12/99 Accepted	12/18/00: NPRM published, 2/16/01: Comment Period Closed
	25.1527	1	PSRD	12/99 Accepted	12/18/00: NPRM published, 2/16/01: Comment Period Closed
	25.1583(c)	1	PSRD	12/99 Accepted	12/18/00: NPRM published, 2/16/01: Comment Period Closed
	25.1583(f)	1	PSRD	12/99 Accepted	12/18/00: NPRM published, 2/16/01: Comment Period Closed
	25.1583(k)	3	PSRD	3/00 Accepted-COMPLETE	FTA task CLOSED per 5/17 ARM letter
	25.1585	1	PSRD	12/99 Accepted	12/18/00: NPRM published, 2/16/01: Comment Period Closed

HWG	Task ID	Cat	SRD or PSRD	Report to TAE	Status
FT	25.1587	1	PSRD	12/99 Accepted	12/18/00: NPRM published, 2/16/01: Comment Period Closed
	25X1591	3	PSRD	3/00 Accepted-COMPLETE	FTA task CLOSED per 5/17 ARM letter
GS	25.0307(a)	2a	SRD	6/00 Accepted	1/26/01: RPR in team review
	25.0365(d)(e)		New Task	na	
	25.0571	2b	SRD/Non-FTA	In HWG	Phase 2: draft rule in ARAC for review
	25.0603	1	PSRD	6/00 Accepted-COMPLETE	to be CLOSED per ARM letter dtd ____
	25.0613	2c	PSRD	In FAA	3/21/01 APO advised on 2/15/01 that date for completion of updated reg evaluation has slipped to 3/30/01
	25.0621	2a	SRD	6/00 Accepted	12/2/00: ACO comments w/ engineer
	25.0631	2a	SRD/Non-FTA	In HWG	1/31/01 The working group is working w/ FAA on their sponsored R&D effort to assess bird strike damage.
	25.0683	1	PSRD	3/00 Accepted with note; 6/00 Accepted revs	12/13/00: NPRM being held to be worked w/ ac went back to wg-phase 2
	25.0775(b)	2a	SRD/Non-FTA	In HWG	1/31/01 The working group is working w/ FAA on their sponsored R&D effort to assess bird strike damage.
	25.0775(d)	2a	SRD	In HWG	2/22/01 AC sent out for interdirectorate coordination
	25.0783	2a/3	SRD	3/00 Accepted	3/21/01 reg evaluation expected by mid June
	25.0963(e)(g)	2a	SRD	3/00 Accepted	2/22/01 Engineer needs to address interdirectorate comments and will then send it to TW for continuation
HF	25.HF		New Task	na	
HT	25.1435	2c	PSRD	NPRM 96-6	1/31/01: Final Rule on OST list for sig/non-sig
IP	121-Ice		Non-FTA		
	25.1323(e)/25.1325(b)/2		Non-FTA		
	25.1419-1		Non-FTA		
	25.1419-2		Non-FTA		
	25.1419-6		Non-FTA		
L&D	25.0302	2b	PSRD	12/99 Accepted	1/11/01: assigned A priority by RMC for APO resources
	25.0305/341(b)/1517	2a	PSRD	3/00 Accepted	12/00 ARM requested RPR be resubmitted for March RMC, 3/9/01: deferred unitl FAA discussion of FTA/APO
	25.0331(c)	2a	SRD	In FAA	3/21/01 Still in APO
	25.0335	2a	PSRD	2/00 Accepted-COMPLETE	9/29/00: AC issued. CLOSED
	25.0345	2c	PSRD	JAR Ch 15-COMPLETE	
	25.0351	2c	PSRD	JAR Ch 15-COMPLETE	

HWG	Task ID	Cat	SRD or PSRD	Report to TAE	Status
L&D	25.0361/362	2a	SRD	12/99 Accepted	8/28/00 Legal completed review. Still waiting for APO
	25.0371	2c	PSRD	JAR Ch 15-COMPLETE	
	25.0415	3	PSRD	12/00 submitted	12/00 Submitted to TAE, deferred for some clarifications
	25.0471 thru 25.0519		New Task		
	25.0473	2c	PSRD	JAR Ch 15-COMPLETE	
	25.0473-1		New Task		
	25.0479	2c	PSRD	JAR Ch 15-COMPLETE	
	25.0483	2c	PSRD	JAR Ch 15-COMPLETE	
	25.0493	2c	PSRD	JAR Ch 15-COMPLETE	
	25.0509		New Task		
	25.0561	2c	PSRD	JAR Ch 15-COMPLETE	
	25.0629	2c	PSRD	JAR Ch 15-COMPLETE	
	25.0721	3	PSRD	6/00 Accepted	11/27/00: RPR to RMC - 1/11/01: defered to March RMC, 3/01: Deferred until FAA discussion of FTA/APO
	25.0723	2c	PSRD	5/00 Accepted	12/20/00: FR awaiting AST conc.
	25.0865	3	SRD	12/00 expected	
	25.0963(d)	2a	SRD	6/00 Accepted	11/27/00: RPR to RMC - 1/11/01: deferred to March RMC, 3/01: Deferred until FAA FTA/APO discussion
MS	25.0677(b)	1	PSRD	5/00 Accepted	1/17/01: NPRM to APO
	25.0729	1	PSRD	6/00 Accepted	1/23/01: RMC approved RPR, NPRM being drafted
	25.0773(b)(2)(b)(4)	1	PSRD	5/00 Accepted	2/27/01 RPR to JAA/Directorate coordination
	25.0851(b)	3	PSRD	5/01 expected	
	25.1438/25X1436	2a	SRD	12/99 Accepted	11/15/00 Legal returned draft NPRM
	25.1439	1	PSRD	6/00 Accepted	1/29/01: NPRM to APO
	25.1453	1	PSRD	12/00 Accepted	3/16/01 Engineer put project on HOLD until April to resolve WG reference
NEW	121 Icing		New Task		11/00: RMC assigned a B priority, eng drafting rule for ARAC
	121, 125, 135		New Task		1/01: ARM preparing tasking
	121.353(a)		New Task		
	25		New Task		12/00: ARM preparing tasking
	25.0177		New Task		
	25.0207-1		New Task		
	25.0301-1		New Task		1/01: ARM will task project
	25.0562-1		New Task		
	25.0603-1		New Task		3/01: RMC approve, ARM will prepare task

HWG	Task ID	Cat	SRD or PSRD	Report to TAE	Status
NEW	25.0729-1		New Task		12/00: TOR being coord btwn FAA/JAA
	25.0745		New Task		12/00: TOR being coordinated between FAA/JAA
	25.0810-1		New Task		
	25.0811-1		New Task		
	25.0819-1		New Task		
	25.0831		New Task		
	25.0831/0841		New Task		1/01: ARM preparing task
	25.0841		New Task		
	25.0857-1		New Task		3/01: Phaase II RPR to RMC, deferred to May council
	25.0903(d)-1		New Task		3/0/01: RMC approved, ARM will prepare task
	25.0963(e)		New Task		
	25.1001		New Task		
	25.1193		New Task		
	25.1305		New Task		
	25.1322		New Task		1/01: ARM preparing task
	25.1327-1		New Task		
	25.1333(b)-1		New Task		
	25.975		New Task		1/01: ARM preparing tasking
	25.bizjet		New Task		10/4/00: Rule to be drafted for ARAC, 3/01:TOR in coord betwn FAA/JAA
PPI	25.0901(c)	2a	SRD	In FAA	w/1309 package; FAA drafting NPRM and AC
	25.0903(d)	3	SRD	6/00: COMPLETE	Rules currently harmonized, CLOSED per ARM letter dtd 11/17/00
	25.0903(d)(1)	3	SRD	12/99 Accepted	3/6: Eng addressing interdir comments to AC draft
	25.0903(e)	2a/3	PSRD	12/99 Accepted	3/8/01 Received correct version on report from TAE, transferred to engineer
	25.0905(d)	1	SRD	12/99 Accepted-COMPLETE	9/27/00: Final AC issued. CLOSED
	25.0929	2c	SRD	In JAA	2/14/01 TW draft of AC to engineer
	25.0933(a)(1)	2a/3	SRD	12/99 Accepted	8/11/00: Eng reviewing interdirec comments
	25.0934	1	PSRD	12/99 Accepted	3/29/00 Memo sent to ANE to transfer any follow-on work to ANE
	25.0943/25X1315	1	PSRD	12/99 Accepted	1/21/01: RPR draft with engineer
	25.0945(b)(5)	3	PSRD	12/00 Accepted	2/27/01 TAD coordination completed. Put into interdirectorate coordination
	25.0973	1	PSRD	12/00 Accepted	3/5/01 RPR put into interdirectorate coordination
	25.1091	1	PSRD	12/99 Accepted	2/9/01 Still on hold waiting engineering decision

HWG	Task ID	Cat	SRD or PSRD	Report to TAE	Status
PPI	25.1093(b)(1)(ii)	2a/1	SRD	12/99 Accepted	2/14/00: TW draft (of AC) to eng
	25.1103	1	PSRD	12/99 Accepted-COMPLETE	CLOSED per ARM letter dated March 15, 2000
	25.1141	1	PSRD	12/99 Accepted	3/16/01 NPRM finalized for HWG review
	25.1155	3	PSRD	5/00 Accepted with note	1/11/01: RMC assigned project RPR an A priority, reg eval expected 5/15/01
	25.1181(b)	1	PSRD	12/00 Accepted	2/17/01 TAD coordination completed. Put into interdirectorate coordination
	25.1183(c)	2a	SRD	12/99 Accepted-COMPLETE	12/19/00: Published-COMPLETE
	25.1187/25.863	1	SRD	9/01	12/6/00 HWG will prepare report for TAEIG by 09/01
	25.1189(a)	2a/3	SRD	12/99 Accepted	10/4/00: WG decided to change project from AC only-back to phase 2
	25.1193(e)	3	SRD	10/00 Accepted	2/23/01 RPR put into interdirectorate/ACO coordination
	25.1305(a)(7), (d)(2)(I)	1	PSRD	12/00 Accepted	3/5/01 RPR put into interdirectorate coordination
	App I	3	PSRD	3/01 expected	12/6/00: TAEIG update-Task Group developed rule change and advisory material. All FAA inputs accepted with exception of fully understanding the Critical Time Interval for Go-Around. FTHWG has the task to reach agreement on and clarify CTI for Go-Around. On completion of this, Fast Track Report will be ready for vote.
	App K/25.901(d)	2a/1	SRD	12/99 Accepted	2/23/01: RPR put into Interdirectorate/ACO review. Comments due 3/19/01.
	FAR 1	0	PSRD	12/99 Accepted	12/15/00: RPR to legal
SDA	25.1301	2b	Non-FTA	In FAA	3/21/01: expect NPRM to HWG by 5/01
	25.1309/25.1310	2b	Non-FTA	In FAA	3/21/01: expect NPRM to HWG by 5/01
ST	25.0562	3	SRD	3/00 Accepted	1/31/01: Engineer changing original draft for TW
	25.0785(e)(b)(c)	3	SRD	3/00 Accepted	4/18/00: Report transmitted to FAA

Expected Actions

HWG	Task ID	Category	Report to TAE	Comments
EEIG	25.0810	1	3/01 Expected	Emergency Egress Assist Means: 25.810(a)(1)(i)-Visual means to determine girt bar engagement. Envelope means of compliance to the FAR issue papers already available (requires development of advisory material) 25.810(c)(2)-Deals with MOC for reflectance measurements for over wing escape route paint.- Rqrs JAR change only
FC	25.0671(c)	3	3/01 expected	Flight Control Systems: Includes 25.672; Needs C/W L&D Jammed Flight controls; NTSB driven; issue is definition of "normally encountered control positions"
FGS	25.1329	3	6/01 expected	Automatic Flight Control and Guidance Systems: Being included as part of 25.FGS. Includes AC 25-7X and Autopilot operating in icing.
	25.1335	3	6/01 expected	Automatic Flight Control and Guidance Systems: Being included as part of 25.FGS. Includes AC 25-7X and Autopilot operating in icing. Will probably be combined into 25.1329.
L&D	25.0865	3	12/00 expected	Fire Protection of Structures: Safety assessment criteria differ greatly. The originally tasked due date was 3/31/01. Decisions need to be made wrt PPI FAR/JAR 1 activity-done 4/00(WG decided to proceed as if there were going to be no changes to FAR/JAR1, which means this will be an AC only change).
MS	25.0851(b)	3	5/01 expected	Cargo Compartment Fire Extinguishing or Suppression Systems: 3/29/00: TAE agreed to make this cat 3 and add draft FAA AC cargo fire ext system matl to package. Need to check into FAA TC testing; will go beyond 6/00 (10/00?)
PPI	App I	3	3/01 expected	ATTCS: Automatic Reserve Performance System. Needs C/W FT, 12/99 report submitted to TAE. Industry (AIA-C) to present justification to recategorize as category 3. Justification received 1/12/2000. 3/00 HMT agreed to reclassify as Cat 3.

WGTasks

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
AAWG	121-WFD	Non-FTA		Bandley	Yes	12/00	12/6/00: Draft NPRM and AC submitted to TAE, will go to FAA for formal legal/economic
AS	25.0703(a)(b)(c)	SRD	1	Baker, K.	Yes	12/99 Accepted; 3/00 Revisions and AC Accepted	Takeoff Warning System: 703(b) requires mod to JAR and ACJ also
	25.1327/25X1328	PSRD	1	Baker, K.	Yes	6/00 Accepted with note	Direction Indicator: 6/00 Submittal proposed by WG Note: TAE instructed wg to modify report showing adoption of JAR and clarification and adoption of ACJ material Requires mod to FAR and JAR and AC/ACJ WG proposes to incorporate 1328 into 1327
	25.1331	PSRD	1	Baker, K.	Yes	3/00 Accepted	Instruments Using Power Supply: Requires mod to JAR also
	25.1333(b)	SRD	1	Baker, K.	Yes	12/99 Accepted; 3/00 Revisions and AC Accepted	Cockpit Instrument System: Advisory material includes ACJ25.1333 and AC25-11; requires mod to JAR also
	25.1423(b)	PSRD	1	Baker, K.	Yes	12/99 Accepted	Public address system: Should review part 121.318

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
BS	25.0731	PSRD	2c	Wahi	No	NPRM 99-16; 6/00 submitted	Braking System: NPRM 99-16, SNPRM
	25.0735	SRD	2c	Wahi	No	NPRM 99-16; 6/00 submitted	Braking System: NPRM 99-16, SNPRM
CAAWG	AC-39XX	New Task			Yes		Review comments to FAA's Draft AC39xx
CS	25.0857(b)	Non-FTA		Wahi			Cargo Class B Compartments
DFS	ICAO Annex 8	New Task		Haynes	na	6/00: Phase 1 report sumbitted	ICAO Annex 8 amendment 97: NOT an FTA item. Amdt 97 issues (security into design) 12/6/00: TAE agreed to add flight deck door intrusion to this task. FAA preparing task.
DV	25.0785	Non-FTA		Gardlin			Direct View (Flight Attendant)
EE	25.0581	SRD	1	AIR130	Yes	3/00 Accepted	Protection from Lightning Strikes (Electrical Bonding): AIR 130 will work with WG to draft report. TAD will follow through with publishing the rule; Requires mod to JAR and ACJ; Needs coordination with ESHWG work on 25.899
	25.1316	SRD	2b	AIR130	No		AIR130 item. Lightning-WG activity complete. In preliminary t/w/legal. Consider transferring to phase 3.
	25.1317	SRD	2b	AIR130	No	9/00 Accepted	AIR130 item. HIRF-WG Activity complete. In formal legal/economic. Consider transferring to phase 5. 12/1/2000: FAA ltr to Craig stating ARAC activity COMPLETE and FAA will try to complete reg eval by 3/2001

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
EEIG	25.0787	PSRD	1	Claar	Yes	5/00 Accepted	Stowage Compartments: Rqrs mod to FAR and JAR
	25.0791(a) to(d)	PSRD	1	Claar	Yes	5/00 Accepted	Pax Info Signs: Rqrs mod to FAR and JAR
	25.0810	PSRD	1	Claar	Yes	3/01 Expected	Emergency Egress Assist Means: 25.810(a)(1)(i)-Visual means to determine girt bar engagement. Envelope means of compliance to the FAR issue papers already available (requires development of advisory material) 25.810(c)(2)-Deals with MOC for reflectance measurements for over wing escape route paint.- Rqrs JAR change only
	25.0811	PSRD	1	Claar	Yes	5/00 Accepted	Emergency Egress Markings: Requires location of word "OPEN" on emergency exit door opening handle. Rqrs mod to FAR and JAR
	25.0812-1	Non-FTA					Emergency Lighting/Slide Illumination. Rec forwarded to FAA 8/99 without consensus.
	25.0813(c)	SRD	3	Claar	Yes	?	Emergency Exit Access: Aisle width at over wing exit is the issue. NPA 25D-270 and NPRM 95-1, were issued, not harmonized. This item may go beyond 6/00 due to JAA comments of FAR Amdt 88 NPA
	25.0819	PSRD	1	Claar	Yes	5/00 Accepted	Service Compartments: Rqrs mod to ACJ also
	25.1411-1	New Task					Slide/Life Rafts. 12/00: EEIG suggested this as new rulemaking for the FAA. EEIG will forward a formal rec to the FAA
ES	25.0869(a)	PSRD	1	Sadeghi	Yes	2/00 Accepted	Fire Protection of Electrical Components: Aeroplane vs fuselage Rqrs mod to ACJ; no phase 4 requested

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
ES	25.1309/25.1365	PSRD	1	Sadeghi	Yes	2/00 Accepted; 6/00 rev Accepted	Electrical Appliances and Motors: Rqrs change to FAR/JAR/AC/ACJ
	25.1310	PSRD	1	Sadeghi	Yes	2/00 Accepted with Note	Power Supply/Essential Load: TAE recommend that this report be transferred internally in the FAA for consideration in the 25.1309 package. 12/00: TAE asked that the package be separated from 25.1309 and handled individually under FTA
	25.1351(b)	SRD	1	Sadeghi	Yes	2/00 Accepted	Electrical Generating System: (b) no phase 4, adopt JAR and ACJ
	25.1351(c),	SRD	1	Sadeghi	Yes	2/00 Accepted	External Power: (c) includes minor change to JAR; no AC matl
	25.1351(d)	SRD	1	Sadeghi	Yes	3/00 Accepted	Operations without normal electrical power: (d) adopt JAR and ACJ, boilerplate economic analysis is not acceptable for this project
	25.1353(a), (c),	PSRD	1	Sadeghi	Yes	2/00 Accepted; 6/00 Rev to (c)(6) Accepted	Electrical and Battery Installation: (a) adopt JAR and ACJ (c)(5) adopt JAR, no AC matl (c)(6) adopt JAR and ACJ, minor change to JAR
	25.1353(d)	PSRD	1	Sadeghi	Yes	2/00 Accepted	Electrical Cables: (d) adopt JAR, no AC matl
	25.1355(c)	PSRD	1	Sadeghi	Yes	2/00 Accepted	Electrical Distribution System: Modify FAR and JAR, adopt ACJ
	25.1357	PSRD	1	Sadeghi	Yes	2/00 Accepted	Circuit Protective Devices: Adopt JAR and ACJ

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
ES	25.1362	PSRD	3	Sadeghi	Yes	6/00 Accepted as amended; 9/00 Accepted	Electrical Supply for Emergency Service: Originally tasked 9/11/98. Rqrs mod to JAR and ACJ also
	25.1363	PSRD	1	Sadeghi	Yes	3/00 Accepted	Electrical System Test: Adopt JAR and ACJ
	25.1431(d)	SRD	1	Sadeghi	Yes	2/00 Accepted	Electronic Equipment: Related to 25.1353(a). Adopt JAR, no AC matl
	25X0899	SRD	1	Sadeghi	Yes	2/00 Accepted; 6/00 Rev Accepted	Electrical Bonding and Protection: Includes mods to JAR and ACJ, includes AC matl. Will provide a new 25.899 and 25.1353(e). Needs coord (for consistency) with 25.1360(a) and 25.1431(d) 3/15/00: WG revised report which received no TAE objections
	25X1360(a)(b)	PSRD	1	Sadeghi	Yes	3/00 Accepted	Electrical Shock and Burns: Adopt JAR and ACJ; Needs coord with 25.899
FC	25.0671(c)	SRD/Non-FTA	3	Martin	Yes	3/01 expected	Flight Control Systems: Includes 25.672; Needs C/W L&D Jammed Flight controls; NTSB driven; issue is definition of "normally encountered control positions"
FGS	25.1329	SRD/Non-FTA	3	Dunford	Yes	6/01 expected	Automatic Flight Control and Guidance Systems: Being included as part of 25.FGS. Includes AC 25-7X and Autopilot operating in icing.
	25.1335	SRD/Non-FTA	3	Dunford	Yes	6/01 expected	Automatic Flight Control and Guidance Systems: Being included as part of 25.FGS. Includes AC 25-7X and Autopilot operating in icing. Will probably be combined into 25.1329.

[redacted]

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
FT	25.0101(c)(2)	PSRD	3	Stimson	Yes	6/00 Accepted as amended	Thrust Performance: FT will c/w PPI; AC change to AC 25-7. Requires C/W PPI and EH. TAE accepted with a clarifying note to be added wrt level flight drag tests. AC only; Rqrs mod to ACJ also
	25.0103	Non-FTA	2c	Stimson	No	JAR Ch 15; NPRM 95-17	1G Stall Speed: Harmonization should be achieved with adoption of NPA 25B-215(JAR Ch.15) and NPRM 95-17. Editorial cleaning of several other sections is part of NPA/NPRM package. FAA needs to issue final rule.
	25.0107(e)	SRD	3	Stimson	Yes	3/00 Revisions Accepted	Harmonization of Airworthiness Standards: Flight Rules: T/O Speeds, VR. Includes AC 25-7 material. Modify JAR and ACJ also.
	25.0109(a)	PSRD	2c	Stimson	No	JAR Ch 15	ACJ 25.109(a) is the difference. The final RTO rule (Amdt 25-92 and NPA 25-B,D,G-244) and associated advisory material, which is nearly out, will complete harmonization.
	25.0111(c)(4)	PSRD	1	Stimson	Yes	12/99 Accepted	FT Package 1: Takeoff path. Includes AC 25-7 matl. Included in FSG NPA
	25.0113	PSRD	2c	Stimson	No	JAR Ch 15	Amdt 25-92, NPA 25-B,D,G,-244 (CH. 15)
	25.0121	Non-FTA	2c	Stimson	No	JAR Ch 15; NPRM 95-17	1G Stall Speed: Will be harmonized by NPA 25B-215 (Ch 15) and FAA Final Rule for 1g Stall Speed (NPRM 95-17).
	25.0125	Non-FTA	2c	Stimson	No	JAR Ch 15; NPRM 95-17	1G Stall Speed: Will be harmonized by NPA 25B-215 and FAA Final Rule for 1g Stall Speed (NPRM 95-17)
	25.0147(c)	SRD	1	Stimson	Yes	12/99 Accepted	FT Package 1: Lateral/OEI. Includes AC matl. Requires mod to JAR also
	25.0161(c)(2),(e)	PSRD	1	Stimson	Yes	12/99 Accepted	FT Package 1: Trim, Included in FSG NPA Both require mods to JAR also

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
FT	25.0175(d)	PSRD	1	Stimson	Yes	12/99 Accepted	FT Package 1: Demo Static Long Stab Prefer Deletion of 25.175(d)(4)(ii)
	25.0177(a)(b)(d)	PSRD	3	Stimson	Yes	(a),(b): 12/99 Accepted, (d): 6/00 Accepted	Static Directional Stability: (a) and (b); Includes minor AC 25-7 rev., Included in FSG NPA Requires mod to JAR also (d): Rqrs mod to JAR also
	25.0177(c)	PSRD	3	Stimson	Yes	6/00 Accepted	Directional Stability: (c):Mod to FAR/JAR, AC and ACJ, accepted with amendment for wg to add info regarding flight test accidents/incidents; also a TOR is to be developed for follow on action
	25.0207	Non-FTA	2c	Stimson	No	JAR Ch 15, NPRM 95-17	1G Stall Speed: Will be harmonized by NPA 25B-215 and FAA final rule for 1G stall speed (NPRM 95-17)
	25.0253(a)(3),(a)(4)	SRD	1	Stimson	Yes	12/99 Accepted	Speed increase and recovery characteristics: JAR contains recovery from laterally upset condition. Includes AC matl. Requires mod to JAR also
	25.0253(a)(5)	SRD	3	Stimson	Yes	6/00 Accepted	Trim Change due to airbrake selection: Includes AC matl. Rqrs mod to JAR and ACJ also
	25.1323(c)	PSRD	1	Stimson, D.	Yes	12/99 Accepted	Airspeed Indicating System: Report completed by FT and agreed upon by AS. Includes AC 25-7 matl. Requires mod to JAR also, NPA drafted
	25.1419	SRD/Non-FTA	3	Fender	Yes		Performance and Handling Qualities in Icing: (IPHWG incorporating SLD requirements which will be a harmonization project.) TAE agreed with report 3/00 recommending this not be Fast Track.

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
FT	25.1501	PSRD	3	Stimson	Yes	3/00 Accepted-COMPLETE	Contaminated Runway: issue subject to operations performance hwg activity. TAE accepted report recommending this FTA project be Closed. A follow on tasking to be developed when operations perf HWG activity is complete. FAA/ARAC action COMPLETE per 5/17 ARM letter
	25.1516	PSRD	1	Stimson	Yes	12/99 Accepted	FT Package 2: Other Speed Lims, NPA drafted
	25.1527	PSRD	1	Stimson	Yes	12/99 Accepted	FT Package 2: Alt/Temp environmental envelope, Also 25.1583©
	25.1583(c)	PSRD	1	Stimson	Yes	12/99 Accepted	FT Package 2: Weight and Loading Distribution; with 25.1527, NPA drafted
	25.1583(f)	PSRD	1	Stimson	Yes	12/99 Accepted	FT Package 2: Environmental Envelope; Ties in with 25.1527, NPA drafted Requires mod to JAR also
	25.1583(k)	PSRD	3	Stimson	Yes	3/00 Accepted-COMPLETE	Contaminated Runway: issue subject to operations performance hwg activity. TAE accepted report recommending this FTA project be Closed. A follow on tasking to be developed when operations perf HWG activity is complete. FAA/ARAC action COMPLETE per 5/17 ARM letter
	25.1585	PSRD	1	Stimson	Yes	12/99 Accepted	FT Package 2: Ops procedures to be in AFM, Included in FSG NPA Requires mod to JAR also
	25.1587	PSRD	1	Stimson	Yes	12/99 Accepted	FT Package 2: Performance info to be in AFM. Included in FSG NPA Requires mod to JAR also

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
FT	25X1591	PSRD	3	Stimson	Yes	3/00 Accepted-COMPLETE	Contaminated Runway: issue subject to airplane performance hwg activity. Possible retroactive application of Amdt 25-92/NPA 25-244 requirements. TAE accepted report recommending this FTA project be Closed. A follow on tasking to be developed when operations perf HWG activity is complete. FAA/ARAC action COMPLETE per 5/17 ARM letter
GS	25.0307(a)	SRD	2a	Yarges	Yes	6/00 Accepted	Proof of Structure: (Awaiting completion of APO eval) 3/00 report submitted, deferred to 6/00. Rqrs mod to FAR/JAR/AC/ACJ
	25.0365(d)(e)	New Task		Yarges	na	na	Pressurized Compartment Loads: Tasked 10/25/00 (d)Amdt 25-87/High Alt: Pressurized cabin loads (e) JAA guidance material requires hazard assessment
	25.0571	SRD/Non-FTA	2b	Yarges	No	In HWG	Damage Tolerance and Fatigue: not under FTA; associated with AAWG WFD; no report; (e) bird strike, no report; -AM96 and AAWG WFD report, rule and AC change expected EOY2000 1/5/01: Per discussion with Amos, WG still working on project to address three outstanding items- 1. Fail Safety which needs to get back into 571, 2. WFD (which has now been submitted for operating rules), 3. Harmonization (as current Amdt 25-96 is not harmonized with JAR)
	25.0603	PSRD	1	Yarges	Yes	6/00 Accepted-COMPLETE	Materials: 3/00 report submitted. WG proposes a future task to envelope NPA 25D-256. Current task will be closed pending ARM letter dated_____

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
GS	25.0613	PSRD	2c	Yarges	No	In FAA	Material Strength Properties/Dsn Vals: NPA 25D-286. Waiting for FAA publication of NPRM.
	25.0621	SRD	2a	Yarges	Yes	6/00 Accepted	Casting Factors: Technical agreement reached. Draft documents submitted to FAA 6/29/99 for legal/economic review (w/o preliminary eval) 3/00: report submitted. WG requested more time 6/00: Rqrs mod to FAR/JAR/AC/ACJ
	25.0631	SRD/Non-FTA	2a	Yarges	No	In HWG	Bird Strike: 10/00: Back to wg for deliberation
	25.0683	PSRD	1	Yarges	Yes	3/00 Accepted with note; 6/00 Accepted revs	Ops Tests: Requirements for stress analysis. WG proposes to maintain as FTA by enveloping JAR and proposes follow on task to develop advisory matl NOTE: will need an economic impact assessment 6/00: Revs state no substantial cost associated 12/00: WG will need to develop advisory matl to be included with reg change
	25.0775(b)	SRD/Non-FTA	2a	Yarges	No	In HWG	Bird Strike: 10/00: Back to WG for deliberation
	25.0775(d)	SRD	2a	Yarges	No	In HWG	Strength of Windshields and Windows: AC change only proposed. Rules the same. Proposed AC submitted to TAEIG 6/29/99. Requires mod to ACJ 3/00 A report was included for informational purposes
	25.0783	SRD	2a/3	Haynes	No	3/00 Accepted	Fuselage Doors: Will go forward as an FTA project per TAE request.
	25.0963(e)(g)	SRD	2a	Yarges	Yes	3/00 Accepted	Fuel Tank Access Covers: (e) in FAR, (g) in JAR Requires mod to FAR/JAR/AC/ACJ
HF	25.HF	New Task		Hecht	na	na	NOT an FTA item Workplan accepted 2/8/00
HT	25.1435	PSRD	2c	Wahi	No	NPRM 96-6	Hydraulic Test: NPA 25F-273 & NPRM 96-6 issued.

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
IP	121-Ice	Non-FTA		Ishimaru			Task 1-Installation of Ice Detectors Ops rule
	25.1323(e)/25.1325(b)/25.773(b)(1)(ii)	Non-FTA		Ishimaru	Yes		Task 5-Effects of Icing Environment
	25.1419-1	Non-FTA		Ishimaru			Task 1-Installation of Ice Detectors Cert Rule
	25.1419-2	Non-FTA		Ishimaru	Yes		Task 2. Define Icing Environment
	25.1419-6	Non-FTA		Ishimaru	Yes		Task 6-Ice Protection of Angle of Attack Probes
L&D	25.0302	PSRD	2b	Haynes	No	12/99 Accepted	Interaction of Systems and Structures: Includes 25.671, 25.1329, App New WG does not need to see package again (phase 4).
	25.0305/341(b)/1517	PSRD	2a	Haynes	Yes	3/00 Accepted	Continuous Turbulence Loads: Change to 25.305 should only be to remove ref to 341, if not already done. Not yet adopted by FAR or JAR. Also AC/ACJ mods. TAE wants to proceed as an FTA project for as long as possible.
	25.0331(c)	SRD	2a	Haynes	No	In FAA	Checked Pitch Maneuver: In formal Economic eval
	25.0335	PSRD	2a	Haynes	No	2/00 Accepted-COMPLETE	Design Dive Speeds: Amdt 25-86 and 91, NPA 25C-277, 260,282 (Ch 15). Needs Rev to AC, though Draft AC revs presented 12/99 to TAE, Accepted 2/8/00 9/29/00: AC rev issued-closing task
	25.0345	PSRD	2c	Haynes	No	JAR Ch 15-COMPLETE	Amdt 25-86 and 91, NPA 25C-260, 282 (Ch 15) Part of omnibus NPA (drafted)

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
L&D	25.0351	PSRD	2c	Haynes	No	JAR Ch 15- COMPLETE	Amdt 25-91, NPA 25C-260 (Ch 15)
	25.0361/362	SRD	2a	Haynes	No	12/99 Accepted	Engine Failure Loads: Ch 15 in JAA. WG will want a phase 4.
	25.0371	PSRD	2c	Haynes	No	JAR Ch 15- COMPLETE	Amdt 25-91, NPA 25C-260 (Ch 15)
	25.0415	PSRD	3	Haynes	Yes	12/00 submitted	Ground Gust Conditions: NPA 25C-284 to be harmonized. TAE agreed 12/8 to convert from cat 1 to cat 3 12/00 TAE deferred vote for further clarification of text, will anticipate an email vote later
	25.0471 thru 25.0519	New Task		Haynes	Yes		Ground Loads, tasked 9/28/00
	25.0473	PSRD	2c	Haynes	No	JAR Ch 15- COMPLETE	Amdt 25-91 and NPA 25C-260 (Ch 15)
	25.0473-1	New Task		Haynes	Yes		Landing Descent Velocity, tasked 9/28/00
	25.0479	PSRD	2c	Haynes	No	JAR Ch 15- COMPLETE	Amdt 25-91 and NPA 25C-260 (Ch 15)
	25.0483	PSRD	2c	Haynes	No	JAR Ch 15- COMPLETE	Amdt 25-91 and NPA 25C-260 (Ch 15)
	25.0493	PSRD	2c	Haynes	No	JAR Ch 15- COMPLETE	Amdt 25-97 and NPA 25C-276 (Ch 15) Part of onmibus NPA(drafted)

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
L&D	25.0509	New Task		Haynes	Yes		Towing Loads, tasked 9/28/00
	25.0561	PSRD	2c	Haynes	No	JAR Ch 15- COMPLETE	Structural Integrity of Fuel Tanks: Amdt 25-91 and NPA 25C-260 (Ch 15) Part of onmibus NPA (drafted) Associated with 25.963 package.
	25.0629	PSRD	2c	Haynes	No	JAR Ch 15- COMPLETE	New FAR rule in 1992, NPA 25B,C,D-236. AC 25.629 published July 98.
	25.0721	PSRD	3	Haynes	Yes	6/00 Accepted	Structural Integrity of Fuel Tanks: To be published with 25.963 package. Has several comments associated. Rqrs mod to FAR/JAR/AC/ACJ
	25.0723	PSRD	2c	Haynes	No	5/00 Accepted	Shock Absorption Test Requirements: NPRM 99-08; comments due 18Oct99 NPA 25C,D-279 (Ch 15)
	25.0865	SRD	3	Haynes	Yes	12/00 expected	Fire Protection of Structures: Safety assessment criteria differ greatly. The originally tasked due date was 3/31/01. Decisions need to be made wrt PPI FAR/JAR 1 activity-done 4/00(WG decided to proceed as if there were going to be no changes to FAR/JAR1, which means this will be an AC only change).
	25.0963(d)	SRD	2a	Haynes	Yes	6/00 Accepted	Fuel Tanks Outside the Fuselage: Done but being held to be done with 25.721 and 25.994. Has several comments associated. Rqrs mod to FAR/JAR/AC/ACJ
MS	25.0677(b)	PSRD	1	Frey	Yes	5/00 Accepted	Trim Systems: initially due 3/00 pure envelope
	25.0729	PSRD	1	Wahi	Yes	6/00 Accepted	Retracting Mechanisms: initially due 3/00; Mod to FAR/JAR/AC/ACJ WG proposes follow on action

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
MS	25.0773(b)(2)(b)(4)	PSRD	1	Wahi	Yes	5/00 Accepted	Pilot Compartment View: initially due 3/00. Ref. NPA 25D-269. Rqrs mod to FAR and JAR; and JAA adopt AC25.773
	25.0851(b)	PSRD	3	Happenny	Yes	5/01 expected	Cargo Compartment Fire Extinguishing or Suppression Systems: 3/29/00: TAE agreed to make this cat 3 and add draft FAA AC cargo fire ext system matl to package. Need to check into FAA TC testing; will go beyond 6/00 (10/00?)
	25.1438/25X1436	SRD	2a	Frey	Yes	12/99 Accepted	Pressurization and Pneumatic Systems: Requires mod to JAR also
	25.1439	PSRD	1	Ishimaru	Yes	6/00 Accepted	PBE: Protective Breathing equipment. Initially due 3/00. Rqrs mod to FAR/JAR/AC/ACJ
	25.1453	PSRD	1	Ishimaru	Yes	12/00 Accepted	Oxygen Systems: 3/00: HMT agreed to change category from "JAA adopt" to cat 1 Mod to FAR/JAR, eliminate ACJ
NEW	121 Icing	New Task		Fender	Yes		Minimum Maneuver Speeds for Flight in Icing Conditions-possible new task for FTHWG (follow-on to their 25.1419 acitivity)
	121, 125, 135	New Task		Dostert			Flame Arrestors/Fuel Vent, possible new task for PPIHWG
	121.353(a)	New Task					Pyrotechnic Signaling Devices. EEIG will submit as a recommendation to ARAC for new task.
	25	New Task		Brenneman	Yes		Significant Modifications/STCs on Transport Airplanes
	25.0177	New Task		Stimson	Yes		Stability. Possible new task for FTHWG as follow-on activity to FTA.
	25.0207-1	New Task		Stimson	Yes		Mandatory Artificial Stall Warning. Potential new task for FTHWG.

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
NEW	25.0301-1	New Task		Haynes	Yes		Flight Loads Validation. Possible new task for L&DHWG.
	25.0562-1	New Task		Gardlin	Yes		Possible new task for STHWG NOTE: rules are not harmonized, JAR does not include pilot and attendant seats (pax seats only); FAA/JAA to develop plan for harmonization, to be a New Task.
	25.0603-1	New Task		Yarges	Yes		Materials. Possible new task for GSHWG which proposed a future task from FTA activity to envelope NPA 25D-256.
	25.0729-1	New Task		Wahi			Retracting Mechanisms-possible follow on activity to FTA for MSHWG
	25.0745	New Task		Wahi	Yes		Nose Wheel Steering. Possible new task for MSHWG
	25.0810-1	New Task		Gardlin	Yes		Emergency Evac Exit Sill Height/Descent assist means. Possible new task for EEIG.
	25.0811-1	New Task			Yes		Symbolic Exit Signs. Possible new task for EEIG
	25.0819-1	New Task			Yes		Remote Occupied Compartments
	25.0831	New Task		Happenny	na		Ventilation: High Alt. Possible new task for MSHWG
	25.0831/0841	New Task		Happenny	Yes		Cabin Air Quality Issues. Possible new task for EEIG 12/00: EEIG provided further comment to draft TOR.
	25.0841	New Task		Happenny	na		Pressurized cabins: High Alt. Possible new task for MSHWG
	25.0857-1	New Task		Gordon	Yes		Light Transport Cargo Conversions. Possible new task

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
NEW	25.0903(d) -1	New Task		Dostert	Yes		Uncontained Engine Failures-Possible new task for PPIHWG 12/6/00: TOR accepted by TAEIG with concurrence that task will include engine case burn through in scope
	25.0963(e)	New Task		Yarges	Yes		Fuel tank and access cover protection. Possible new task for GSHWG
	25.1001	New Task		Stimson	No		Fuel Jettison: Possible new task for FTHWG
	25.1193	New Task		McRae	Yes		Engine Cowling Retention System. Possible new task for PPIHWG
	25.1305	New Task		McRae	Yes		Low Fuel Quantity Alerting/Engine Indicating System. Possible new task for PPIHWG
	25.1322	New Task		Baker, K.	Needs Tasking		New Task for ASHWG. Warning Systems: New task after FTA. Flight crew alerting, will include AC/ACJ 25-11.
	25.1327-1	New Task		Baker, K.	Yes		Possible follow-on to FTA activity for ASHWG. WG to draft a TOR.
	25.1333(b) -1	New Task		Baker, K.	Yes		Possible follow-on FTA activity for ASHWG. WG plans to draft a TOR.
	25.975	New Task		Dostert			Flame Arrestors/Fuel Vent, possible new task for PPIHWG
	25.bizjet	New Task		Gardlin	Yes		Standards for Private Use Jets TCA
PPI	25.0901(c)	SRD	2a	McRae	No	In FAA	Instl. Safety: Applicability of 25.1309(b) Being done with 1309 package. Goes into phase 3 with a TAE letter forthcoming asking to go straight to NPRM with 1301 package but deleting spec. risk.

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
PPI	25.0903(d)	SRD	3	Dostert	No	6/00: COMPLETE	Uncontained Engine Failures: AC 20-128A: WG will not pursue without additional tasking. Needs to be retasked as new rulemaking to address multiple fragments. Current task closed per ARM letter dated 11/17/00
	25.0903(d) (1)	SRD	3	Dostert	Yes	12/99 Accepted	Engine Case Burnthrough: Requires mod to JAR also
	25.0903(e)	PSRD	2a/3	Kaszycki	Yes	12/99 Accepted	Engine Restart Demonstration: TAE accepted report which included several dissenting positions. We will proceed with phases 3 and 4. At phase 5 it will probably be pulled out of FTA.
	25.0905(d)	SRD	1	Dostert	Yes	12/99 Accepted-COMPLETE	Prop Blade Release: Needs c/w L&D
	25.0929	SRD	2c	Kaszycki	No	In JAA	Propeller Deicing and Induction System Ice Protection: Related to 25.1093. WG and FAA action: COMPLETE -JAA Action only: to retract the propeller icing ACJ provision for demonstrating compliance on an engine test stand (NPA 299)
	25.0933(a) (1)	SRD	2a/3	McRae	No	12/99 Accepted	Thrust Reversing Systems: Draft NPRM and AC approved by PPI and presented to TAE 12/99. WG requests phase 4 only if there are substantive changes from FAA review.
	25.0934	PSRD	1	McRae	Yes	12/99 Accepted	Thrust Reversing Systems: Work completed in PPI Disharmony is in JARE/FAR33 3/29 Memo sent to ANE to transfer any follow-on work to ANE
	25.0943/25X1315	PSRD	1	Dostert	Yes	12/99 Accepted	Negative Acceleration: Needs C/W FT and GS Needed to go to engineer first

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
PPI	25.0945(b)(5)	PSRD	3	McRae	Yes	12/00 Accepted	Thrust or power augmentation system: 3/00: HMT agreed to reclassify from JAA Adopt to Cat 3. Mod to FAR only
	25.0973	PSRD	1	Dostert	Yes	12/00 Accepted	Fuel Filling Points: 3/00: HMT agreed to reclassify 25.973(d) from JAA adopt to cat 1 Mod to FAR only
	25.1091	PSRD	1	Kaszycki	Yes	12/99 Accepted	Water Ingestion
	25.1093(b)(1)(ii)	SRD	2a/1	Kaszycki	Yes	12/99 Accepted	Propeller Deicing and Induction System Ice Protection: In flight issues. Draft AC/ACJ. Related to 25.929.
	25.1103	PSRD	1	Kaszycki	Yes	12/99 Accepted-COMPLETE	Induction System Ducts: re piston engine instl NAR: No PPI or FAA action required Closed per ARM letter dated 3/15/00
	25.1141	PSRD	1	McRae	Yes	12/99 Accepted	Powerplant Controls-General: Needed to go to engineer first May require mod to JAR also
	25.1155	PSRD	3	Kaszycki	Yes	5/00 Accepted with note	Beta and thrust reverser in-flight deployment: Rqrs mod to FAR and JAR/ AC and ACJ
	25.1181(b)	PSRD	1	Dostert	Yes	12/00 Accepted	Designated Fire Zones: 3/00: HMT agreed to reclassify from JAA adopt to cat 1 (It is FAA practice to avoid cross referencing other paragraphs however since there is already a listing of other paragraphs leaving 25.869 out of the list of cross references could lead to confusion.) Mod to FAR/JAR

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
PPI	25.1183(c)	SRD	2a	McRae	No	12/99 Accepted-COMPLETE	Powerplant Installation Fire Protection Requirements: Flammable fluid carrying components. Used as an FTA econ eval/has been enveloped to JAR. 12/19/00: Amdt 25-101 Published
	25.1187/25.863	SRD	1	McRae	Yes	9/01	Flammable Fluid Drainage/Ventilation: Harmonize policy. Work started in WG in Oct/00 Report anticipated 9/01
	25.1189(a)	SRD	2a/3	McRae	Yes	12/99 Accepted	Flammable fluid Shut Off Means Requires mod to ACJ also
	25.1193(e)	SRD	3	McRae	Yes	10/00 Accepted	Fire Protection of Engine Cowling: Harmonize policy. Rqrs mod to FAR and JAR/ AC and ACJ
	25.1305(a)(7), (d)(2)(I)	PSRD	1	McRae	Yes	12/00 Accepted	Fire Wanring indicators and Powerplant Instruments: 3/00: HMT agreed to reclassify from JAA adopt to cat 1. (It is understood that it is traditional industry safety practice to comply with the JAR requirements.) Mod to FAR only
	App I	PSRD	3	Kaszycki	Yes	3/01 expected	ATTCS: Automatic Reserve Performance System. Needs C/W FT, 12/99 report submitted to TAE. Industry (AIA-C) to present justification to recategorize as category 3. Justification received 1/12/2000. 3/00 HMT agreed to reclassify as Cat 3.
	App K/25.901(d)	SRD	2a/1	Kaszycki	Yes	12/99 Accepted	APU Installations: (Was listed as 25.901(d)) Identify engine requirements applicable to APU and put into separate appendix. NPA and NPRM package same as an old package.
	FAR 1	PSRD	0	McRae	Yes	12/99 Accepted	Definitions of fireproof/fire resistant: Needed to go to engineer first

HWG	Task ID	SRD/PSRD	Category	FAA Rep	Report Required	Report to TAE	Comments
SDA	25.1301	Non-FTA	2b	Huber	No	In FAA	Being worked with 25.1309.
	25.1309/25.1310	Non-FTA	2b	Huber	No	In FAA	Includes 25.1301 and 25.1310(new) which relocates 25.1309 (e)&(f). TAE sent a ltr to FAA requesting specific risk be taken out and put into a second phase of activity. FAA responded by stating it would be added, but would go back for phase 4 review.
ST	25.0562	SRD	3	Gardlin	Yes	3/00 Accepted	Pax Seat Dynamic Testing: AC ONLY Mods to ACJ also
	25.0785(e)(b)(c)	SRD	3	Gardlin	Yes	3/00 Accepted	Seats, Berths, Safety Belt Harnesses: AC ONLY 25.785(e)&(b) Occupant protection-exposure to sharp edge interpretations cause compliance problems. Accepted with AFA comments to be included. Requires mod to ACJ also. 25.785(c) Seat restraints. Requires mod to ACJ matl Also. Accepted

Transport Airplane Directorate
<u>WG Report Format</u>
Harmonization and New Projects

1 - BACKGROUND:

- *This section "tells the story."*
- *It should include all the information necessary to provide context for the planned action. Only include information that is helpful in understanding the proposal -- no extraneous information (e.g., no "day-by-day" description of Working Group's activities).*
- *It should provide an answer for all of the following questions:*

a. <u>Safety Issue Addressed/Statement of the Problem</u>

(1) What prompted this rulemaking activity (e.g., accident, accident investigation, NTSB recommendation, new technology, service history, etc.)? What focused our attention on the issue?

(2) What is the underlying safety issue to be addressed in this proposal?

(3) What is the underlying safety rationale for the requirement?

(4) Why should the requirement exist?

Handout 5

b. Current Standards or Means to Address

(1) If regulations currently exist.

(a) What are the current regulations relative to this subject? (Include both the FAR's and JAR's.)

(b) How have the regulations been applied? (What are the current means of compliance?) If there are differences between the FAR and JAR, what are they and how has each been applied? (Include a discussion of any advisory material that currently exists.)

(c) What has occurred since those regulations were adopted that has caused us to conclude that additional or revised regulations are necessary? Why are those regulations now inadequate?

2. If no regulations currently exist.

(a) What means, if any, have been used in the past to ensure that this safety issue is addressed? Has the FAA relied on issue papers? Special Conditions? Policy statements? Certification action items? If so, reproduce the applicable text from these items that is relative to this issue.

(b) Why are those means inadequate? Why is rulemaking considered necessary (i.e., do we need a general standard instead of addressing the issue on a case-by-case basis?)

2. DISCUSSION

- *This section explains:*
  - → *what the proposal would require,*
  - → *what effect we intend the requirement to have, and*
  - → *how the proposal addresses the problems identified in Background.*
- *Discuss each requirement separately. Where two or more requirements are very closely related, discuss them together.*
- *This section also should discuss alternatives considered and why each was rejected.*

a. SECTION-BY-SECTION DESCRIPTION OF PROPOSED ACTION

(1) What is the proposed action? Is the proposed action to introduce a new regulation, revise the existing regulation, or to take some other action?

(2) If regulatory action is proposed, what is the text of the proposed regulation?

(3) If this text changes current regulations, what change does it make? For each change:

- What is the reason for the change?
- What is the effect of the change?

(4) If not answered already, how will the proposed action address (i.e., correct, eliminate) the underlying safety issue (identified previously)?

(5) Why is the proposed action superior to the current regulations?

b. <u>ALTERNATIVES CONSIDERED</u>

(1) What actions did the working group consider other than the action proposed? Explain alternative ideas and dissenting opinions.

(2) Why was each action rejected (e.g., cost/benefit? unacceptable decrease in the level of safety? lack of consensus? etc.)? Include the pros and cons associated with <u>each</u> alternative.

3. COSTS AND OTHER ISSUES THAT MUST BE CONSIDERED

The Working Group should answer these questions to the greatest extent possible. What information is supplied can be used in the economic evaluation that the FAA must accomplish for each regulation. The more quality information that is supplied, the quicker the evaluation can be completed.

a. Costs Associated with the Proposal

(1) Who would be affected by the proposed change? How? (Identify the parties that would be materially affected by the rule change – airplane manufacturers, airplane operators, etc.)

(2) What is the cost impact of complying with the proposed regulation? Provide any information that will assist in estimating the costs (either positive or negative) of the proposed rule.

(For example:

- *What are the differences (in general terms) between current practice and the actions required by the new rule?*
- *If new tests or designs are required, how much time and costs would be associated with them?*
- *If new equipment is required, what can be reported relative to purchase, installation, and maintenance costs?*
- *In contrast, if the proposed rule relieves industry of testing or other costs, please provide any known estimate of costs.*
- *What more-- or what less -- will affected parties have to do if this rule is issued?*

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.)*

b. **<u>Other Issues</u>**

(1) **Will small businesses be 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.]*

(2) Will the proposed rule require affected parties to do any new or additional recordkeeping? If so, explain. *[This question relates to the Paperwork Reduction Act of 1995.]*

(3) 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.]*

(4) 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.]*

4. ADVISORY MATERIAL

a. Is existing FAA advisory material adequate?

b. If not, what advisory material should be adopted? Should the existing material be revised, or should new material be provided?

c. Insert the text of the proposed advisory material here (or attach), or summarize the information it will contain, and indicate what form it will be in (e.g., Advisory Circular, policy statement, FAA Order, etc.)

Human Factors HWG

Curt Graeber

Report to the TAEIG

March 27, 2001

Washington, DC

Handout 7

HF HWG Status

- Sixth meeting: Jan. 9-11, 2001 Seattle
- Meeting accomplishments
  - *Subgroups finalized analytic processes and continued conducting reviews*
  - *Plan and process developed to integrate bottom-up (Subgrp C) and top-down (Subgrp B) results*
  - *Continued to refine and validate criteria*

HF HWG Subgroups

Four subgroups per the following objectives:

- Group A - Determine regulatory material to be reviewed
- Group B - Define and implement HF concept based analytic review processes (Top-Down)
- Group C - Define and implement experience (operational & regulatory) based analysis (Bottom-Up)
- Group D - Define success criteria

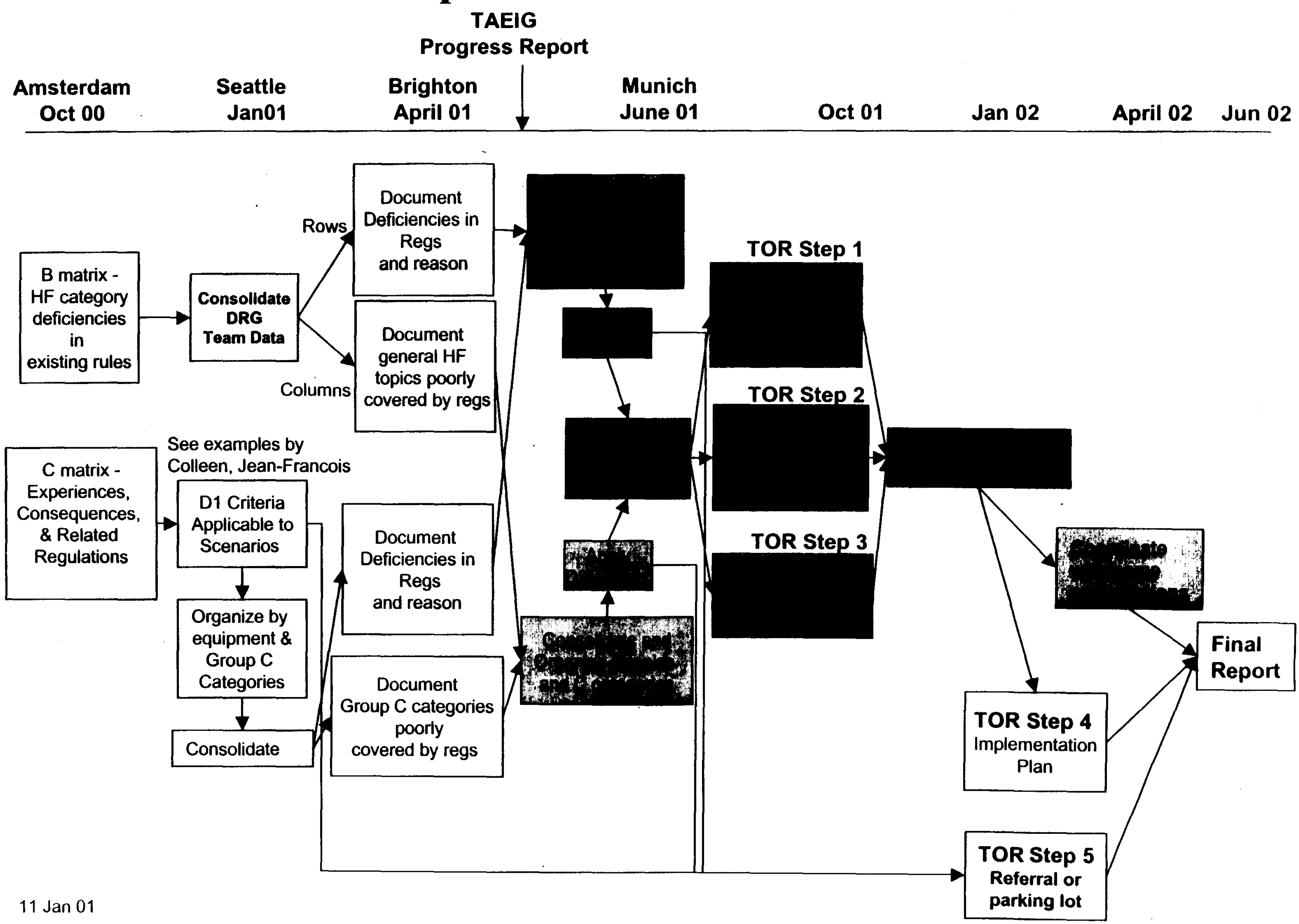
Review Material Finalized

- All FAR/JAR material made available on website
- Created lists of Advisory Circulars keyed to those sections of FAR 25 retained as relevant
  - *ACs in 20, 25, and 120/121 Series completed - each AC either included or excluded for cause*
  - *This work was used as model for selection of ACJs by JAA Subgroup A members*

Integration Focus Team

- Focus team developed a process for integrating Subgroup B&C results
  - *Scheme for organizing data into an integrated format*
  - *Recommend a process for applying criteria*
  - *Will become final analysis leading to Task 1 recommendations*
  - *Proposed HWG reorganization to accomplish this*
- Plan agreed to by total HWG.
- Beta test of the proposed process launched, to be completed by April 2001.

Proposed HFHWG Process



11 Jan 01

Applying Criteria

- Subgroup D refining general criteria:
  - *Validating current criteria*
  - *Developing decision guideline and conflict resolution method*
- Will base our approach on CAST JSAT-JSIT method for assessing intervention effectiveness
- All findings will be tracked regardless of their suitability for action as determined by the criteria

Progress and Concerns

- Progressing as planned
- Will deliver interim report on Tasks 1-3 by May
- Will complete Task 1 no later than October 2001
- Embraer contacted US co-chair requesting participation, will be attending next meeting as Observer with mutual decision to be made then regarding full membership.
- ATA representative quit,no replacement.
- No further status reported by JAA on A-NPA "Human Centred Design"

Future Meetings

Next meeting:

- Location: Brighton (UK CAA)
- Dates: Apr. 3-5, 2001

Summer meeting:

- Location: Munich (Dornier)
- Dates: June 19-21 , 2001

Fall meeting:

- Location: Boston (FAA)
- Dates: Oct. 16-18, 2001

Status Report : January - 2001

Including TAEIG Working Group Activity Report

For external distribution - Public

HF-HWG
Human Factors-Harmonization Working Group
Flight Crew Error / Flight Crew Performance
Considerations in the
Flight Deck Certification Process
Federal Aviation Administration – USA
Joint Aviation Authorities – Europe

Working Group		
Working Group Name	Flight Crew Error / Flight Crew Performance Considerations in the Flight Deck Certification Process (also known as Human Factors-Harmonization Working Group; HF-HWG)	
ARAC issue	Transport Airplanes and Engines	
Expected product(s)	NPRM ❑ AC ❑ Other ❑ To be decided	
Document		
Title	Status Report: January - 2001	
Version number	2.0	
Date initiated	January 15, 2001	
Date of this draft	March 20, 2001	
Deadline for review	January 26, 2001	
Date of public release by Co-chairs	March 21, 2001	
Number of pages	30	
Status	Approved by Co-chairs on March XX, 2001	
Distribution	TAEIG, HF-HWG, stakeholders, unrestricted public distribution	
Authors/Main Contributors		
Dr. R.C. Graeber – Co-Chair	Boeing	
Mr. D. Ronceray – Co-Chair	Airbus Industrie	
Mrs. S. Hecht - FAA focal point	FAA	
Ms. H. Courteney - JAA focal point	UK-CAA/JAA	
Mr. S. Boyd – HF-HWG Secretary	FAA	
Mr. R. Nibbelke – Subgroup Communication strategy	BAE SYSTEMS	

For contact details and information on how to obtain previous or future copies please refer to section 9.1.
This Status Report is part of a quarterly briefing to non-HF-HWG members.
This Status Report includes the information required in the TAEIG-Working Group Activity Report

Handout 8

Executive Summary

The Human Factors – Harmonization Working Group (HF-HWG) was established in 1999 following the ARAC[1]/JAA[2] tasking (FAA[3] Register Announcement 39553, Vol. 64, No. 140, July 22, 1999 / Notices). Previous initiatives have identified the importance of Human Factors of the Flight Deck Design in relation to Aircraft Safety.

The HF-HWG has 39 members. The aim of the HF-HWG is to provide ARAC and the JAA with advice and recommendations on the following harmonization task: *Flight Crew Error/Flight Crew Performance Considerations in the Flight Deck Certification Process.*

The 36-month task involves:

- reviewing existing material (FAR/JAR 25 regulations, advisory material, policy, and related references) and
- making recommendations about what regulatory standards and/or advisory material should be updated or developed to consistently address design-related flight crew performance vulnerabilities, and prevention and management (detection, tolerance, and recovery) of flight crew error.

Up until mid-January, 2001 six meetings have taken place. The most recent meeting was (see appendix B for details on previous meetings):

Meeting 6: January 9-11, 2001, Seattle, USA (hosted by BF Goodrich & Boeing)
Membership: 33

- *Types of organizations represented:*
  Regulatory agencies - 8 members
  Aircraft manufacturers - 14 members
  Avionics manufacturers - 5 members
  Research/consultant organizations - 4 members
  Pilot's associations representatives - 2 members
- *Mix of experience/skills/knowledge (some people in more than one category):*
  Human Factors – 22 members
  Certification – 18 members
  Operations 15 members
  Supplemental Type Certification – 6 members
  Pilots – 13 members
  Designers 21 members
  Training – 6 members
  Rulemaking – 6 members

Most of the meeting was spent in subgroup working sessions and their reports.

Subgroup A task: Identify regulatory/guidance materials to be reviewed
Subgroup A task is considered to be complete. At the meeting it was pointed out that Change 15 to JAR 25 incorporates JAA NPAs that have been proposed for review by the HWG. Change 15 was reviewed to ensure that all relevant NPAs have been identified. FARs and Advisory Circulars were reviewed for relevance and finalized.

Subgroup B task: Develop and test (validate) a set of theory-based processes and topics

- *Following the experience of using the review process, the five Document Review Groups (DRGs) exchanged experiences and refined the process.*

---

[1] Aviation Rulemaking Advisory Committee
[2] Joint Aviation Authorities - Europe
[3] Federal Aviation Administration - USA

- *The review process is intended to identify where the rules fail to deal with the key concepts. A discussion about the purpose of the different parts of the regulations clarified the 'adequacy of the regulations' in relation to the intended purpose.*

Subgroup C: Develop and test (validate) a set of experience-based processes and topics

- *This bottom-up approach reviews accident/incident data to identify human factors problems*
- *The relevant regulations and advisory material were reviewed to assess coverage of the human factors problems*
- *This process is identifying where the rules fail to prevent problematic designs*
- *Subgroup C was divided up into multiple teams*
- *The matrix that contains the data contains about 375 line items.*
- *One group is identifying specific FAR/JAR/AC deficiencies related to AC 25-11 and 25.1322 for a test case.*
- *Another group is doing preliminary work on issue-based deficiencies.*

Subgroup D: Develop a set of criteria for the future success to apply to the content of the Preliminary Report.

- *This group developed three high-level categories of criteria (aviation safety, effects on industry, industry/authority acceptance); which has been developed in more detail during the meeting.*
- *The application of the criteria to the findings (from the "regulation-based" and "topics-based" groups) will be in the form of filters.*
- *It was recommended that the highest priority be put on those findings that are supported by accident/incident data and expert judgment.*
- *Findings that are filtered out will not be "eliminated." Rather, they will be identified for referral to other groups or will be placed in a "parking lot," which will be documented in the final report.*
- *The application of the criteria to the recommendations will be in the form of a prioritization scheme. It was suggested that the intervention scoring method used in the JSAT/JSIT/JSSI process could be adapted for use. That scoring technique is dealing with similar issues and has been accepted on an international basis.*

In addition to the work being carried out in subgroups, there were plenary sessions on:

The Integration Team presented by Vic Riley

- *The output of Subgroups B&C will be restructured into two paths and then processed by two new subgroups*
  - *The regulation specific deficiencies will be collected*
  - *The conceptually based deficiencies will be collected*
- *Each of these subgroups will then produce recommendations*
- *The recommendations from the groups will then be combined and reconciled to form the main technical recommendations for Task 1.*
- *The process will need to be flexible – the later stages may need to be modified, based on what results we get from the earlier stages.*
- *The working group as a whole agreed to the process, as briefed.*
- *The process was modified so that the findings of the "regulation-based" groups and the "topics-based" group would be consolidated and then the work on the overall recommendations would be arranged and structured based on what those consolidated finding look like.*
- *This implies two places for applying group D criteria prior to forming the consolidated list of findings.*
- • *The two groups would then develop separate sets of recommendations which would subsequently be integrated, consolidated, organized and prioritized.*

The team decided that it would be advisable to test our processes, criteria, and outputs

- *A "beta test" team was established to work its way through a sample set of deficiencies identified by Subgroups B and C.*
- *The focus of the test would be on deficiencies related to FAR/JAR 25.1322 and AC 25-11, since the Avionics Systems HWG needs those inputs.*
- *The beta test team will be prepared to report on the testing and recommend any needed changes to the process at the next meeting.*

In addition, it was recommended that we test a sample of our identified deficiencies

- *It is important that the deficiencies are realistic and relevant to certification programs and problems*
- *A plan will be formulated for evaluating the validity and usefulness of the deficiencies in the context of realistic certification program scenarios.*

This status report provides some background, the tasking, the workplan, the processes developed, and information on progress, bottlenecks and future plans. The status reports will be published quarterly, for distribution to all relevant stakeholders.

Definitions of terms and abbreviations

AC	Advisory Circular
ARAC	Aviation Rulemaking Advisory Committee
CAA	Civil Aviation Authority
CRI	Certification Review Item
DRG	Document Review Group
FAA	Federal Aviation Administration – USA
FAR	Federal Aviation Regulations
HF-HWG	Human Factors – Harmonization Working Group
JAA	Joint Aviation Authorities – Europe
JAR	Joint Aviation Requirements
NPA	Notice Proposed Amendment
NPRM	Notice of Proposed Rulemaking
TAEIG	Transport Airplane and Engine Issues Group
TGL	Temporary Guidance Library
TSO	Technical Standard Order

Table of contents

1 Introduction

1.1 Brief history and background

The Human Factors – Harmonization Working Group (HF-HWG) was established in 1999 following the ARAC[4]/JAA[5] tasking (FAA[6] Register Announcement 39553, Vol. 64, No. 140, July 22, 1999 / Notices). Previous initiatives have identified the importance of Human Factors of the Flight Deck Design in relation to Aircraft Safety. For example, the FAA/JAA Human Factors Team (Abbott et al, 1996) investigated and confirmed this relation and included 4 recommendations on Human Factors in Regulatory Standards and Certifications.

The FAA has established an Aviation Rulemaking Advisory Committee (ARAC) to provide advice and recommendations to the FAA Administrator, through the Associate Administrator for Regulation and Certification, on the full range of the FAA's rulemaking activities with respect to aviation-related issues. This includes obtaining advice and recommendations on the FAA's commitment to harmonize its Federal Aviation Regulations (FAR) and practices with its trading partners in Europe and Canada.

One area ARAC deals with is Transport Airplane and Engine Issues. These issues involve the airworthiness standards for transport category airplanes and engines in 14 CFR parts 25, 33, and 35 and parallel provisions in 14 CFR parts 121 and 135

The FAA requests that ARAC draft appropriate regulatory documents with supporting economic and other required analyses, and any other related guidance material or collateral documents to support its recommendations. If the resulting recommendation is one or more notices of proposed rulemaking (NPRM) published by the FAA, the FAA may ask ARAC to recommend disposition of any substantive comments the FAA receives.

An interim report is required within 18 months. The entire project shall be completed within 36 months of tasking.

The JAA supports this initiative and will consider the finding of the HF-HWG with respect to its implication for the JARs related to the above and the associated regulatory material.

1.2 Aim

To provide ARAC and the JAA with advice and recommendations on the following harmonization task:
Flight Crew Error/Flight Crew Performance Considerations in the Flight Deck Certification Process (see task description below; section 1.3).

1.3 The task

Task 1. Review relevant existing material (FAR/JAR 25 regulations, advisory material, policy, and related references) and make recommendations about what regulatory standards and/or advisory material should be updated or developed to consistently address design-related flight crew performance vulnerabilities, and prevention and management (detection, tolerance, and recovery) of flight crew error. This review should be accomplished in the context of both the Type Certification and Supplemental type Certification processes.

[4] Aviation Rulemaking Advisory Committee
[5] Joint Aviation Authorities - Europe
[6] Federal Aviation Administration - USA

Task 2. Based on results of the Task 1 review, recommend new advisory material to address design-related vulnerabilities of flight crew performance and the management of flight crew error.

Task 3. Recommend (or plan for the development of) new regulatory material to address design-related vulnerabilities of flight crew performance and the management of flight crew error. If rulemaking is not recommended, provide reasons and propose non-rulemaking alternatives.

Task 4. Recommend an implementation plan for products of Tasks 1–3, and develop Terms of Reference for fulfilling the plan.

Task 5. During accomplishment of these tasks, identify implications for qualification and operations for communication to appropriate groups.

1.4 Structure and organization of the working group

The Human Factors Harmonization Working Group is composed of 39 technical experts having an interest in the assigned task. The co-chairs and FAA & JAA focal points have taken special care to ensure to maintain a balance among members:

- Industry representatives 23 and representatives from the Regulatory Authorities (11), helped by human factors researchers or consultants (5).
- 26 have an expertise in Human Factors
- 16 Pilots
- 21 have an expertise in aircraft certification
- 23 have an expertise in cockpit design
- N. American (22) and European and other representatives (17)

All members have been made aware that they are representing their organization or company and need to disseminate and check information with their organization or company.

A full list of members is provided in appendix A.

Mr. R. C. Graeber (Boeing) and Mr. D. Ronceray (Airbus Industrie) are the co-chairs of the HF-HWG. The United States co-chair shall make periodic progress reports to TAE.

Mrs. S. Hecht (FAA, ANM-111) is the FAA focal point and Mrs. H. Courteney (UK-CAA) is the JAA focal point. Mr. S. Boyd (FAA, ANM-111) is the secretary of the HF-HWG. The FAA focal point will assist the United States co-chair in preparation of material in a form for submittal to ARAC. The JAA representative will be responsible for coordination with relevant JAA Study Groups, Steering Groups and Committees.

The Human Factors Harmonization Working Group will make use of a resource web site to document its work. Research Integrations, Inc. in the United States will host this site. There will be a public area for public information, e.g.:

- Quarterly status reports
- Names of members
- Publicly available information about our tasks (Federal Register Announcement)
- Points of contact information

The rest of the web site is password protected for use by the HF-HWG members only.

The Human Factors Harmonization Working Group meets alternately between Europe and the North America to the greatest extent practicable (2 meetings in the N. America, and 2 meetings in Europe per year).

The Human Factors Harmonization Working Group will comply with the procedures adopted by ARAC (Operating Procedures for the Aviation Rulemaking Advisory Committee, October 1997 Revision) and the harmonization procedures adopted by the JAA and FAA. As part of the procedures, the working group is expected to:

1. Recommend a work plan for completion of the task, including the rationale supporting such a plan, for consideration at the meeting of ARAC to consider transport airplane and engine issues held following publication of this notice.
2. Give a detailed conceptual presentation of the proposed recommendations, prior to proceeding with the work stated in task 3.
3. Draft recommendations for appropriate regulatory action with supporting economic and other required analyses, and/or any other related guidance material or collateral documents the working group determines to be appropriate; or, if new or revised requirements or compliance methods are not recommended, a draft report stating the rationale for not making such recommendations. If the resulting recommendation is one or more notices of proposed rulemaking (NPRM) published by the FAA, the FAA may ask ARAC to recommend disposition of any substantive comments the FAA receives.
4. Provide a status report at each meeting of ARAC held to consider transport airplane and engine issues.

2 Schedule

2.1 HF-HWG major task schedule

The following schedule is proposed for the major task activities. The working group will develop a detailed schedule to ensure that the tasks will be completed on time.

Date	Milestone
January 2000	• Define preliminary process for working group tasks • Select preliminary regulatory material for review
April 2000	• Determine if other material should be defined for review • Finalized list of regulatory material for review • Finalize the processes for working group tasks
July 2000	• Complete the preliminary review of regulatory material complete • Final adjustment and approval of processes
October 2000	• Prepare the outline of first report
January 2001	• Draft interim report complete
April 2001	• Finalize interim report
July 2002	• Draft Terms of Reference for follow-on activity
July 2002	• Work complete

2.2 TAEIG Working Group Activity table

	FAA Team	Working Group	TAEIG
1) Publication of the Federal Register Notice	July 22, 1999		
2) Work Plan Approval		Dec 15, 1999	Feb 8, 2000
3) Concept Approval			
4) Preliminary T/W and Legal Support			
5) Technical Approval in HWG			
6) Economic Evaluation			
7) Formal T/W and Legal Review			
8) Technical Agreement			
9) Recommendation to FAA			

3 Workplan

Task 1. Review relevant existing material (FAR/JAR 25 regulations, advisory material, policy, and related references) and make recommendations about what regulatory standards and/or advisory material should be updated to consistently address design-related flight crew performance vulnerabilities, and prevention and management (detection, tolerance, and recovery) of flight crew error. This review should be accomplished in the context of both the Type Certification and Supplemental Type Certification processes.

Subtask 1.a This task "should be accomplished in the context of both the Type Certification and Supplemental Type Certification processes".

- Understand relevant aspects of current and anticipated FAA and JAA Type Certification processes, including FAR/JAR 21 processes.
- Understand relevant aspects of current and anticipated FAA and JAA Supplemental Type Certification processes
- Determine whether to address TSOs and Field Approvals (to TAEIG)

Subtask 1.b The activity should "consistently address design-related flight crew performance vulnerabilities, and prevention and management (detection, tolerance, and recovery) of flight crew error".

- Define "design-related flight crew performance vulnerabilities"
- Define "prevention and management (detection, tolerance, and recovery) of design-related flight crew error"

Subtask 1.c Develop a review process methodology and preliminary adequacy criteria.

Subtask 1.d "Review relevant existing material"

- Identify and review the following existing and developing material relevant to Part 25 type certification:
    - Regulations
    - Policies
    - Advisory circulars
    - Industry standards

Subtask 1.e Critically evaluate reviewed materials for adequacy.

Subtask 1.f "Make recommendations about what regulatory standards and/or advisory material should be updated".

- Define criteria for determining the need for updated or new material
- Apply criteria to pertinent material
- List regulatory standards that should be updated or developed, including explanation/justification.
- List advisory material that should be updated or developed, including explanation/justification.

Task 2. Based on results of the Task 1 review, recommend new advisory material to address design-related vulnerabilities of flight crew performance and the management of flight crew error.

- Develop recommendations for new advisory material if required
- Consider the need for generic recommendations
- Consider the need for recommendations related to specific rules.
- Develop discussion paper to describe why advisory material is not recommended if necessary

<u>Task 3</u>. Recommend (or plan for the development of) new regulatory material to address design-related vulnerabilities of flight crew performance and the management of flight crew error. If rulemaking is not recommended, provide reasons and propose non-rulemaking alternatives.

- Develop recommendations for new regulatory material if required
- Consider the need for generic recommendations
- Consider the need for recommendations related to specific rules.
- Return to Task 2 to develop associated advisory material.
- Develop discussion paper to describe why regulatory material is not recommended if necessary

<u>Task 4</u>. Recommend an implementation plan for products of Tasks 1-3, and develop Terms of Reference for fulfilling the plan.

- Define tasks required for implementing recommendations
- Develop Terms of Reference for each task

<u>Task 5</u>. During accomplishment of these tasks, identify implications for qualification and operations for communication to appropriate groups.

- Develop a coordination plan
- Identify groups with whom coordination would be beneficial
- Develop points of contact for coordination
- Identify means for communicating with other groups
- Provide opportunities for other groups to present information
- Provide relevant information to other groups

4 Status against workplan

4.1 Introduction to Status January-2001

Up until mid-January 2001, the HF-HWG has concentrated on:

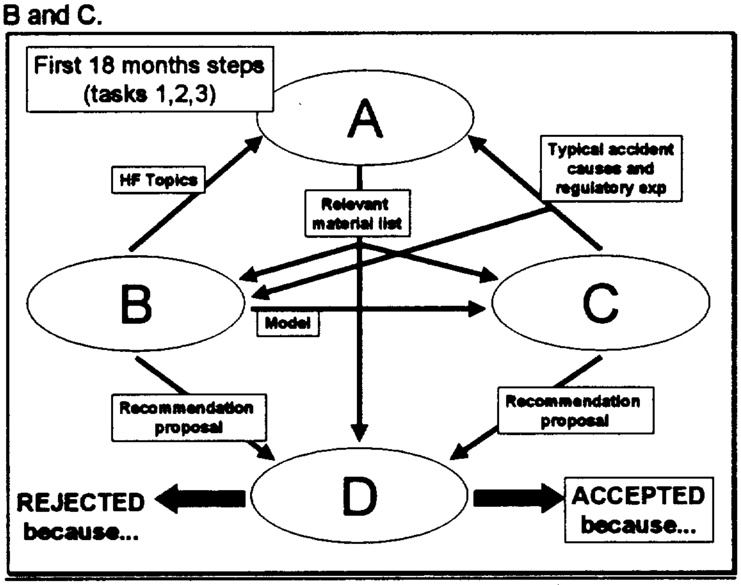
- Setting-up the working group
- Familiarization with the task and processes (including communication plan and the web-site)
- Development of workplan.
- Selecting the material to be reviewed
- Reviewing the regulations for inadequacies in the regulations and advisory material.
- Reviewing accidents, incidents and certification practice for inadequacies in the regulations and advisory material.
- Developing an analysis approach for processing the outcome of the reviews.

With respect to the workplan (up until mid-January 2001) the HF-HWG has mainly concentrated on Task 1[7] and the development of a process for reviewing the regulatory material. To work effectively, the HF-HWG was split into 4 subgroups (A, B, C and D) to address aspects of task 1 (also taking into account the other four HF-HWG tasks described in section 1.3):

- Subgroup A: Materials to be reviewed
- Subgroup B: Top-down/Concept-based process for reviewing the regulatory material
- Subgroup C: Bottom-up/Case-based process for reviewing the regulatory material
- Subgroup D: Criteria to assessing success of the product(s) of the working group

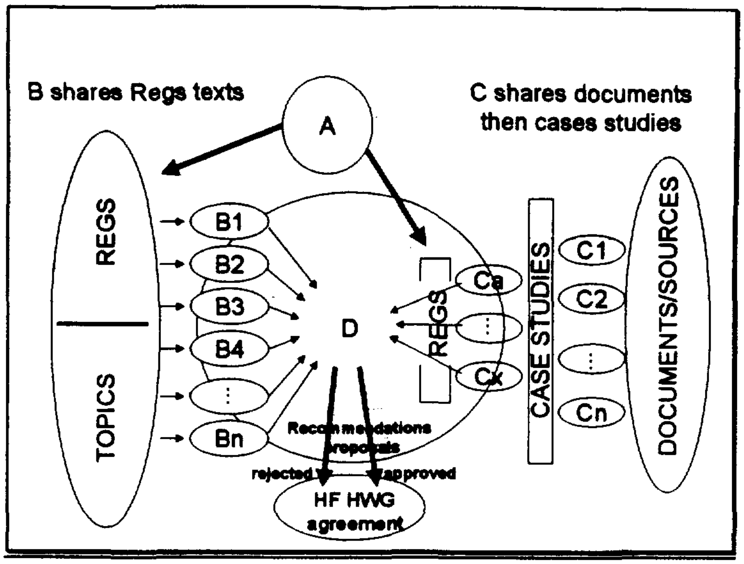
Subgroup B and C are reviewing the regulatory material and aim to complete this by April for analysis by the whole HF-HWG.

An integration team has developed an approach to analyze the review data from Subgroup B and C.



Initial model of task 1, 2 and 3 and the four processes developed by subgroup A, B, C and D.

[7] Review relevant existing material (FAR/JAR 25 regulations, advisory material, policy, and related references) and make recommendations about what regulatory standards and/or advisory material should be updated to consistently address design-related flight crew performance vulnerabilities, and prevention and management (detection, tolerance, and recovery) of flight crew error.



Further development of the model of task 1, 2 and 3 and the four processes developed by subgroup A, B, C and D

In addition, two further small working groups are working on organizational issues:

- Communication strategy and process subgroup
- Definitions subgroup

Members of these subgroups also take part in subgroup A, B, C or D.

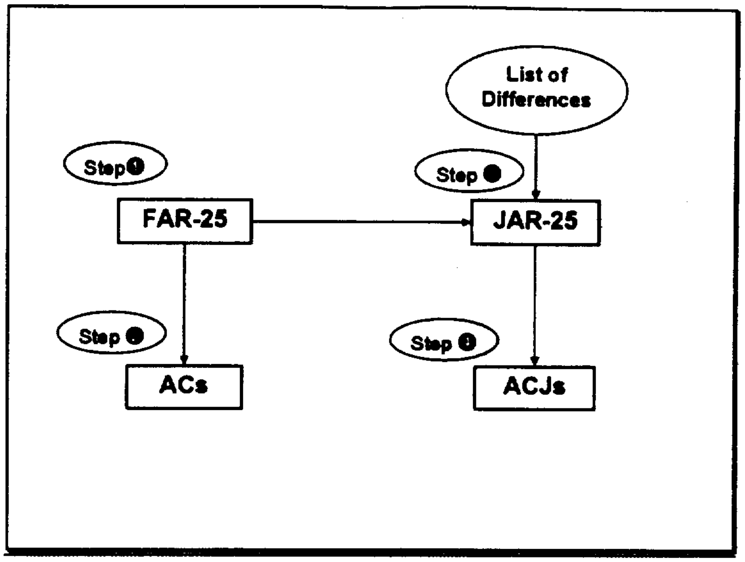
The activities and status of each subgroup will be described in more detail below.

4.2 Description of status by subgroup/process

4.2.1 Subgroup A: Materials to be reviews

Subgroup A tasks are complete.

Subgroup A has identified the relevant regulatory materials which need to be reviewed by the HF-HWG using the processes developed by subgroup B and C. The main scope focuses on both FAR 25 and JAR 25 (including Change 15) and associated advisory material. A four-step plan for reviewing both the FARs and JARs has been developed (see diagram below).



Proposals for amendments and historical information to establish the rationale for the original rules are also being considered. Subgroup A has also investigated ways of filtering the regulations for non-relevant sections by excluding parts that do not contain certain *'Human Factors Considerations'* key words. However, the rest of the HF-HWG prefers to work on the whole unfiltered material because there may be implicit Human Factors implications that would not be detected by filtering on keywords. The preliminary list for starting the review work has been completed. It has been acknowledged that the list of relevant regulatory materials may need to be updated and the subgroup will remain in place, while members can also take part in the FAR/JAR review process itself (subgroup B or C).

- Relevant NPAs have been identified and have been provided on the HF-HWG web site
- Relevant Temporary Guidance Leaflets have been identified and will be provided shortly after the October meeting.

4.2.2 Subgroup B: Top-down/Concept-based process for reviewing the regulatory material

Subgroup B developed a Top-down/Concept-based process for reviewing the regulatory material. The aim of this process is to perform a review against a list of key Human Factors/Human Error topics derived from a conceptual model of human information processing in a complex environment. This approach is complementary to the Bottom-up/Case-based process for reviewing the regulatory material as developed by subgroup C, ensuring a comprehensive review.

The Top-down/Concept-based has been used by five Document Review Groups (DRGs). Each DRG has reviewed a fifth of the regulatory material identified by subgroup A. Each DRG consists of a balanced mix of industry representatives and representatives from the regulatory authorities; Human Factors specialists and non-HF specialists; Pilots and non-pilots, US and non-US representatives. Internal cross-checking and co-ordination and comparison between DRGs has helped to ensure a consistent approach during the review.

The results from each DRG review has been captured in an EXCEL spreadsheet that represents the consensus of that DRG. These spreadsheets will be complete before the next meeting in April. Each of the five DRG spreadsheets will be reviewed by the other subgroup members and the results will be combined into a final subgroup spreadsheet that represents the regulations and advisory documents that have been identified with deficiencies along with the human factors topics that have been determined to be generally deficient in the material reviewed. It is the subgroup's goal to have this final spreadsheet product complete by the end of the April meeting.

4.2.3 Subgroup C: Bottom-up/Case-based process for reviewing the regulatory material

Subgroup C has developed a Bottom-up/Case-based process for reviewing the regulatory material. The aim of this process is to identify if the regulation addresses the Human Factors/Human Error issues that have been highlighted by:

- incidents,
- accidents,
- in-service experience,
- safety studies,
- certification experience and
- research.

This approach is complementary to the Top-down/Concept-based process for reviewing the regulatory material as developed by subgroup B, ensuring a comprehensive review.

Brief description of Bottom-up/Case-based process for reviewing the regulatory material

Step 1: Compile a list of Documents

- Summary reports: Accidents/Incidents
- In service experience (ASRS, Crew)
- Safety studies (e.g., Team Report)
- Regulatory experience
- Research (e.g., FANS)

Step 1 Filter:

- Part 25 issue
- Time/ Date (Is the problem/ issue a current certification problem? Or is it only an accident/incident of an issue on old out of production airplanes (design not being certified any more).

Step 2: Identify general topics, issues, or risk areas

- Take the document(s) to be reviewed, read them, and identify the general topics, issues, or risk areas

Examples of a topic, issue, or risk:

Example of a system that a regulator thought was unsafe and should not be approved (ex. Terrain Awareness Warning System installation in the pedestal).

Another example is a specific contributing factor (that may have caused) an accident: (ex. lack of a moving map display, or the fact that the waypoint list did not come in order of proximity to the aircraft).

A third example would be a more general item, like a general risk area (ex. lack of situation awareness). Some of these general issues that will come from things like Flight Safety Foundation reports (which contain summary data from the analysis reports of multiple accidents).
These examples could be flight deck features that could have contributed.

- Identify general topics, issues, or risk areas that- potential to lead to accidents
- Find specific case studies to support each risk area or topic.
- Cross check with subgroup B

Step 2 Filter

- Flight deck, pilot interaction, Human Factors (flight crew performance)
- Time/date (modern aircraft only?)
- Safety issue
- Design related (in a broad sense)
- Is another group working this specific issue?
- Modern design covers the issue?
- Part 25 (type operation)
- Cross check within team in Montreal
- Cross check with group B

Step 3: Development of Scenario

- Describe Scenario
- Document Source
- Assumptions
- Type of Information
- Safety Risks
- Compare to Group B Model
- Describe Aircraft/ Flight Deck/ System

Step 4: Identify the Specific Human Factors Safety Issues

- Compare to group B model
- Use model to cross check

Step 5: Run Scenarios against Regulatory/ Advisory Material

- Group A provides a full list of documents

- Pick from regulatory/ advisory material
- Identify "holes"
- Identify misunderstandings

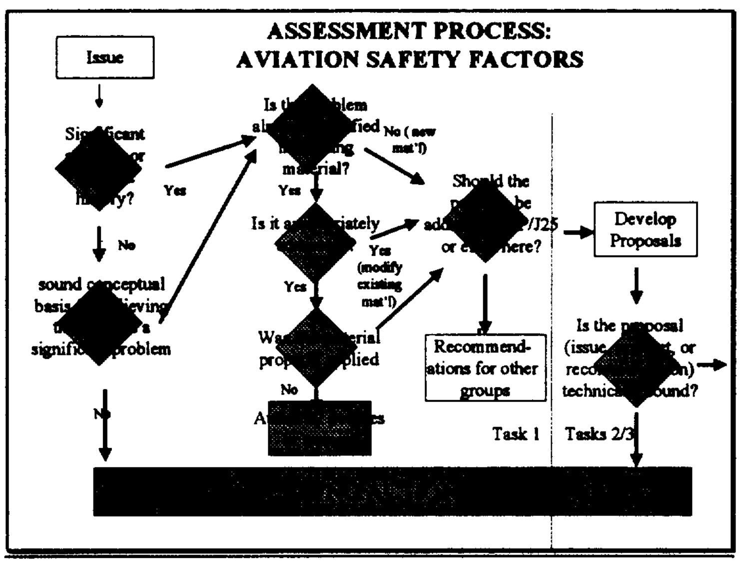
Step 6: Products/ Output

- Specific holes in the regulatory/ advisory material
- General issue that is not covered

4.2.4 Subgroup D: Criteria to assessing success of the product(s) of the working group

Subgroup D has developed a series of critical questions and success criteria and opertionalised these into a decision flow-chart. This will enable to HF-HWG to assess their final product(s) and provide rationale for inclusion or rejection of recommendations and advice to ARAC and the JAA. Another aim is to include some of the criteria into the review processes being developed by subgroup B and C.

The preliminary decision flow-chart will be completed prior to the Montreal meeting but work will continue. It has been acknowledged that the criteria and decision flow-chart may need to be updated and subgroup D will remain in place, while members can also take part in the FAR/JAR review process itself (subgroup B or C).



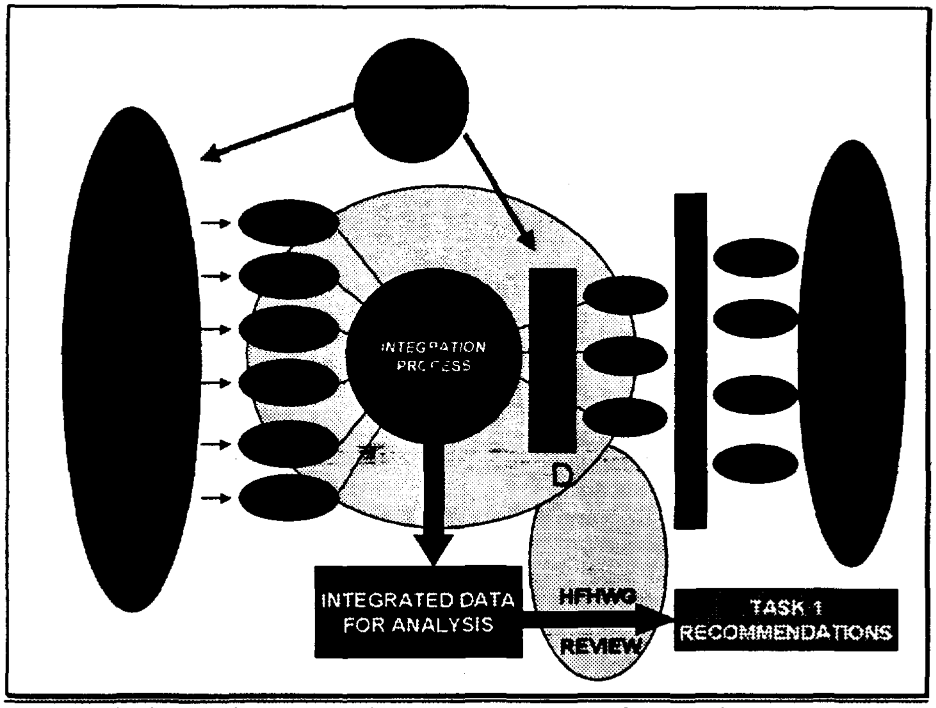
Initial version of the flow-chart developed by subgroup D

4.2.5 Integration Team

A small team representing subgroup B and C has produced an approach for integrating the two-directional data collection (as explained in section 4.2.2 and 4.2.3). The members of this Integration Team are

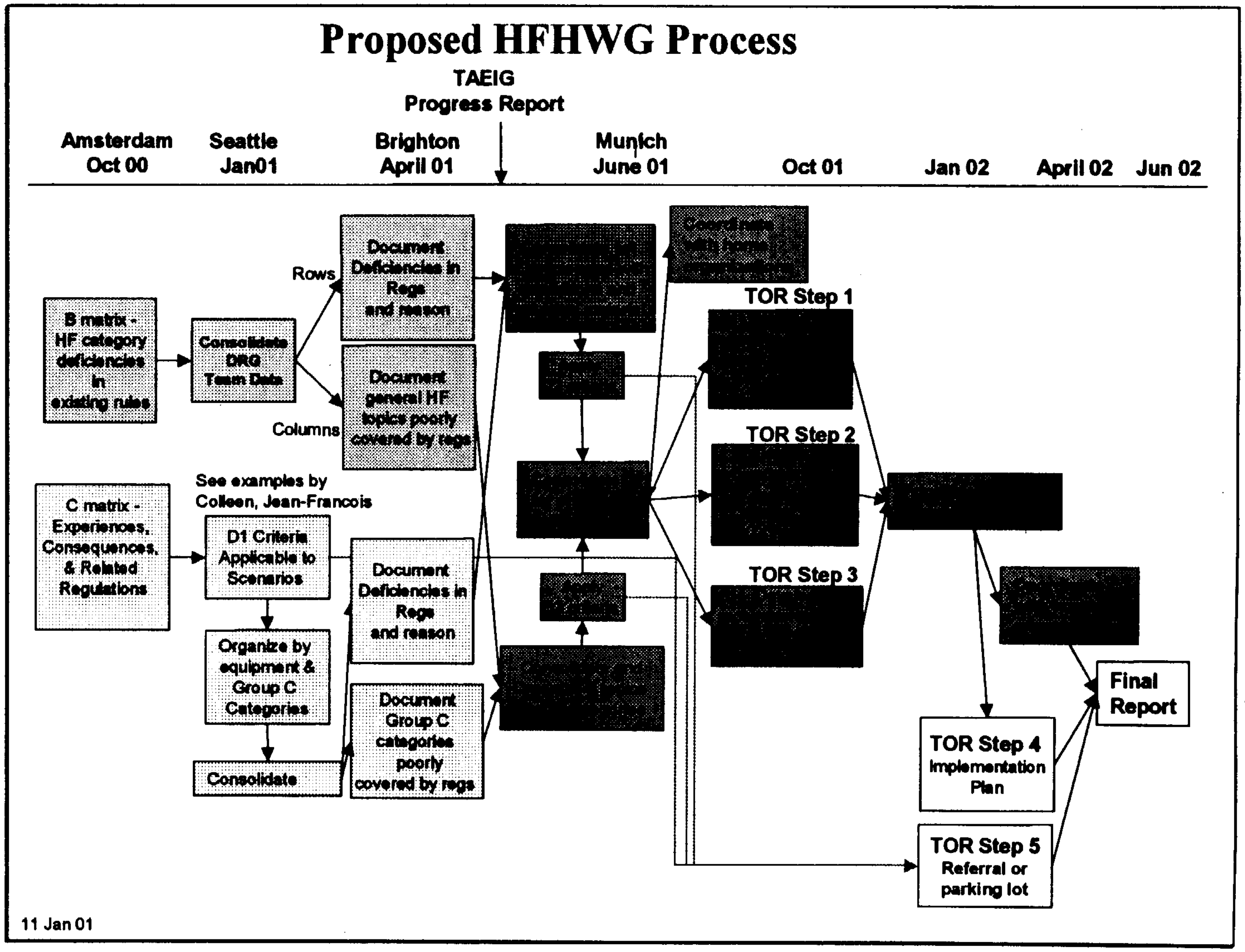
Subgroup B: V. Riley (chair), B. Kelly
Subgroup C: C. Donovan, J.F Bousquie (also a member of subgroup D)

- Develop recommended process for integrating Subgroup B & C results into a form that can be used by the entire HWG
- Recommend a scheme for organizing data into an integrated format
- Recommend an analysis process to apply Subgroup D criteria
- Propose how the HWG can best be organized to implement the scheme and conduct the final analysis



Role of the integration process in the overall process described on page 14.

The Integration Team Process



4.2.6 Beta test team

At the meeting in Seattle, January 2001, a small group was tasked with beta testing the integration proposed. The purpose was to try out the methodology proposed with it identify recommendations for improvement for the integration process and the subgroup D criteria. The team is composed of representatives for Subgroups B, C, and D and the Integration team.

The beta test team was given the following tasks:

- To initiate the use of D criteria and to evaluate the efficiency with which the integration of B and C products can de done
- To provide to the Avionics HWG a preliminary list of identified deficiencies with the supporting data to help them to progress on the rewriting (or updating) of the AC 25-11 and 25-1322
- To provide feedback and suggestions before Brighton on how to improve the D criteria and the integration process so that they are both ready when we come to integrate the entire B and C final products.

4.2.7 Organizational aspects

Small working groups have been working on organizational issues:

<u>Communication strategy and process subgroup</u>
The communication strategy and process subgroup has developed:

- Communication Plan: Strategy and Process for internal and external communication
- A web-site strategy (with assistance from Jennifer Wilson at Research Integration)
- Standardization of versions of software tools used
- A template for HF-HWG documents
- Development of this Status Report for external communication to relevant stakeholders.

<u>Definitions subgroup</u>
The definitions subgroup has developed:

- A process for developing and approving definitions
- A preliminary list of definitions
- A template form for proposing or changing definitions

5 Bottlenecks

Through regular process checks at the meetings the co-chairs are capturing, addressing and monitoring the bottlenecks/concerns. The HF-HWG secretary logs a list of issues.

- An issue was raised regarding the time needed to consult with different, geographically spread, civil flight deck groups within one large organization. The co-chairs acknowledged that during the HF-HWG meetings the technical specialists provide their expertise and not necessarily a corporately approved view on every detailed issue. However, ultimately a HF-HWG member represents his/her organization and needs to be able to approve outputs from the HF-HWG on behalf of the organization. The co-chairs appreciated that this approval needs consultation and that this will require a reasonable time between issuing a draft report and approval of such a report.

In future status reports, consideration will be given to bottlenecks. For example:

- Information availability (Materials to be reviewed, Internet access for members,...)
- Co-ordination with other working groups/organization
- Human resources required and available effort
- Scoping of the task
- Technical/Scientific bottlenecks

6 Actions

6.1 Request for TAEIG action

- TAEIG has determined that TSOs and Field Approvals are not within the current scope.
- TAEIG clarified how and when to consult with organizations not represented on the HF-HWG. TAEIG is aware of members no longer attending from organizations like ATA.

7 Meetings

7.1 Meetings to date

The following meetings were held to date:

Purpose	Date	Location	Participation
Introduction and education of the HF-HWG	6-7 Oct 1999	Boeing –Seattle US	25 HF-HWG members
Definition of working methods, review process and scope, and adequacy criteria	11-13 Jan 2000	Airbus – Toulouse FR	38 HF-HWG members
Finalization of HWG methods and processes, task sharing.	4-6 Apr 2000	Honeywell – Phoenix US	31 HF-HWG members
Subgroups work progress and report, cross subgroup coordination. Define contact with other HWGs	27-29 Jun 2000	Bombardier - Montreal	39 HF-HWG members
Continue Subgroup Analysis Activities Develop Interim Report Outline	3-5 Oct 2000	NLR – Amsterdam	35 HF-HWG members
Prepare draft Interim Report Agree on Integration Scheme	9-11 Jan 2001	BF Goodrich/ Boeing – Seattle US	33 HF-HWG members

7.2 Future meetings

Purpose	Date	Location	Participation
Finalize Interim Report, Complete Task 1, finalize integration process and reorganize the group accordingly.	3-5 April 2001	UK CAA - Brighton, UK	
State on how tasks 2 and 3 can be done according to the process and method chosen. Progress reports on these tasks.	19-21 June 2001	Dornier, Munich, Germany	

8 Lessons Learned

This section is to be completed at the end of the task. Some initial lessons learned can already be reported and will be explained in more detail at a later date, namely:

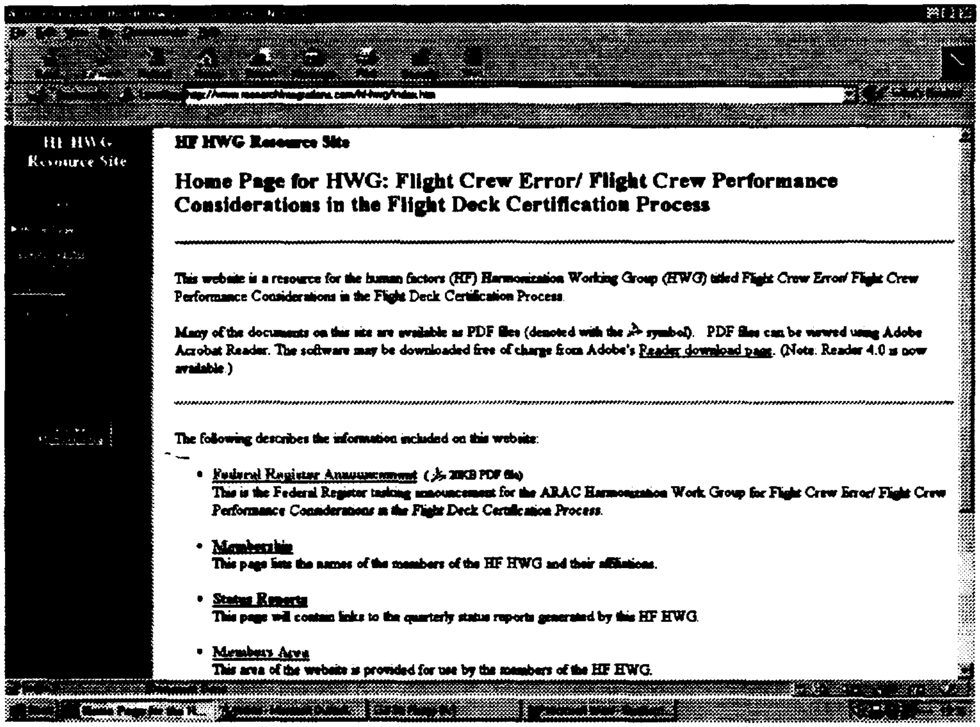
1. Composition of the working group: a good balance of expertise, backgrounds, nationalities was achieved (see section 1.4).
2. Processes for internal and external communication: Lessons will be learned regarding the use of a communication plan (incl. the use of the Web-site and a Status Report for external communication). The effectiveness of the plan is currently under review. See section 4.2.5.
3. Development of regulation review approaches. Lessons will be learned regarding the two approaches developed for reviewing the regulations (see section 4.2.2 and 4.2.3).
4. Definition of terms; Lessons will be learned regarding the use of a definition subgroup and a definitions process (see section 4.2.5).
5. In this group, two quite different kind of members are present: HF specialists and aviation sector professionals (design, certification, operations). If the subject involved is common, the approach and the words used are quite different leading to lack of mutual understanding. Time is needed for them to develop a "common language" for useful dialogue.
6. For about a third of our members, the native language is not English. As we need them to participate effectively, precautions have to be taken by the speakers to speak clearly, and slowly enough, and by the co-chairs to ensure that these members can effectively follow and take part in the discussions.

9 Further information

9.1 Point of contact

- Previous issues of the Status Report can be obtained from the HF-HWG Web-site:

  www.researchintegrations.com/hf-hwg/index.htm.



- To receive a the Status Report by email every quarter, please send an email to:

  Jennifer.Wilson@ResearchIntegrations.com

- For any questions or comments please send an email to HF-HWG central email address:

  9-ANM-111-HUMAN-FACTORS@faa.gov

  or write to:

  Mr. Steve Boyd, HF-HWG Secretary
  FAA – Transport Airplane Directorate
  ANM-111
  1601 Lind Ave, SW
  Renton, WA 98045
  United States of America

9.2 References

Abbott, K. et al (1996) FAA Human Factors Team Report on: The interfaces between flight crews and modern flight deck systems. Published on 18 June 1996.

FAA Register Announcement 39553 Vol. 64, No. 140 / Thursday, July 22, 1999 / Notices

Appendix B: Summary of previous meetings

Meeting 1: Oct 6-9, 1999, Seattle/Renton, Washington (hosted by Boeing)
Membership:
- *Types of organizations represented: 2 regulatory agencies; 8 Aircraft manufacturers ; 5 Avionics manufacturers; 2 Two Research/consultant organizations*
- *Mix of experience/skills/knowledge (some people in more than one category): Human Factors – 24; Certification – 25; Operations – 22; Supplemental Type Certification – 9; Pilots – 17; Designers – 22; Training – 4; Rule making – 7.*

Team processes were established
- *We will set goals for each meeting and measure our performance against them*
- *We will communicate between meetings via email and a dedicated website (http://www.researchintegrations.com/hf-hwg/, which was demonstrated during the meeting).*

Background briefings were provided
- *Current and planned human factors activities within the US and European regulatory agencies*
- *The FAA rulemaking process: ARAC history, purpose, and procedures.*
- *The components of a HF-HWG work plan*

The Tasking of the HF-HWG was reviewed and discussed. Relevant issues for each task were documented.
A draft Statement of Work was reviewed. Subgroups were formed to identify concerns and opportunities for the HF-HWG. There was a preliminary discussion of working process for the HF-HWG.
Subteams were formed for:
- Definition of terms
- Communications processes

Meeting 2: January 11-13, 2000, Toulouse, France (hosted by Airbus)
Membership (broadened, compared to first meeting):
- *Types of organizations represented: 4 regulatory agencies; 9 Aircraft manufacturers ; 6 Avionics manufacturers; 5 Research/consultant organizations; 2 pilot unions.*

There was a detailed discussion of the HF-HWG tasking with respect to the Statement of Work.
Temporary subgroups were formed to formulate ideas on HF-HWG work:
- *The processes we will use to perform Task 1*
- *The scope of the review process*

There was a briefing on the JAA rulemaking process
Four new subgroups were formed, balanced by skill, background, and N. America vs. Europe, to discuss and provide proposals for the following four subject areas:
- *Subgroup A: Identify regulatory/guidance materials to be reviewed*
- *Subgroup B: Develop and test (validate) a set of theory-based processes and topics*
- *Subgroup C: Develop and test (validate) a set of experience-based processes and topics*
- *Subgroup D: Develop a set of criteria for the future success to apply to the content of the Preliminary Report.*

Meeting 3: April 4-6, 2000, Phoenix, Arizona (hosted by Honeywell)
Most of the meeting was spent in subgroup working sessions and their reports.
Subgroup A: Identify regulatory/guidance materials to be reviewed
- *FARs and Advisory Circulars were reviewed for relevance*
- *Preliminary lists generated; to be finalized prior to next meeting*

Subgroup B: Develop and test (validate) a set of theory-based processes and topics

- *This top-down approach systematically reviews all regulations identified by Subgroup A.*
- *A set of key human factors concepts (e.g. input, response, control, environment) are evaluated against each regulation.*
- *This process is intended to identify where the rules fail to deal with the key concepts.*

Subgroup C: Develop and test (validate) a set of experience-based processes and topics

- *This bottom-up approach reviews accident/incident data to identify human factors problems*
- *The relevant regulations and advisory material are then reviewed to assess coverage of the human factors problems*
- *This process is intended to identify where the rules fail to prevent problematic designs*

Subgroup D: Develop a set of criteria for the future success to apply to the content of the Preliminary Report.

- *This group developed three high-level categories of criteria (aviation safety, effects on industry, industry/authority acceptance); these will be developed in more detail*
- *These criteria will be incorporated into a process by which the work of subgroups B and C can be evaluated.*
- *The criteria and process should be imbedded into the subgroups B and C processes*

The following agreements were reached:

- *Subgroup A would be dissolved when the review list is complete (prior to next meeting)*
- *Subgroup D would be dissolved when the process and criteria details are completed (prior to next meeting), but would reconvene to deal with any subsequent process or criteria issues.*
- *The concept-based and experience-based process (from Subgroups B and C) would be run in parallel. The differences in the approaches are likely to yield different and complementary insights.*

Meeting 4: June 27-29, 2000, Montreal, Canada (hosted by Bombardier)
Membership: 39

- *Types of organizations represented: 10 regulatory agencies; 16 Aircraft manufacturers; 6 Avionics manufacturers; 4 Research/consultant organizations; 3 Pilot's associations representatives.*
- *Mix of experience/skills/knowledge (some people in more than one category): 25 Human Factors; 19 Certification; 18 Operations; 9 Supplemental Type Certification; 16 Pilots; 22 Designers; 7 Training; 6 Rule making.*

Most of the meeting was spent in subgroup working sessions and their reports.
<u>Subgroup A:</u> Identify regulatory/guidance materials to be reviewed

- *FARs and Advisory Circulars were reviewed for relevance and finalized.*

<u>Subgroup B:</u> Develop and test (validate) a set of theory-based processes and topics

- *Following the experience of using the review process, the five Document Review Groups (DRGs) exchanged experiences and refined the process.*
- *The review process is intended to identify where the rules fail to deal with the key concepts. A discussion about the purpose of the different parts of the regulations clarified the 'adequacy of the regulations' in relation to the intended purpose.*

<u>Subgroup C:</u> Develop and test (validate) a set of experience-based processes and topics

- *This bottom-up approach reviews accident/incident data to identify human factors problems*
- *The relevant regulations and advisory material were reviewed to assess coverage of the human factors problems*
- *This process is identifying where the rules fail to prevent problematic designs*

Subgroup D: Develop a set of criteria for the future success to apply to the content of the Preliminary Report.

- *This group developed three high-level categories of criteria (aviation safety, effects on industry, industry/authority acceptance); which has been developed in more detail during the meeting.*
- *These criteria will be incorporated into a process by which the work of subgroups B and C can be evaluated.*
- *The criteria and process should be imbedded into the subgroups B and C processes*

In addition to the work being carried out in subgroups, there were plenary sessions on:

- Understanding the Avionics HWG activities and their HF needs (presentation by Kirk Baker and Clark Badie).
- Sharing information on the regulatory process, rules and supporting regulatory material, and the certification process (presentation by Hazel Courteney (CAA/JAA) and Tom Imrich (FAA))
- The definition of 'design-related' was discussed because it is an important concept in the Terms of Reference of the HF-HWG, which should be used to scope our activity. The definitions proposed are available to the members on the web-site.
- The draft table of contents for the interim 18-month report to the TAE.

The following agreements were reached:

- Definition of the working relationship between the HF HWG and the Avionics HWG include a proposal to have meetings at the same time and place.
- Interaction with other relevant HWGs was defined though nominated points of contact.
- A draft table of contents for the interim 18-month was agreed.

Meeting 5: October 3-5, 2000, Amsterdam, the Netherlands (hosted by NLR)
Membership: 35

- *Types of organizations represented: 9 regulatory agencies; 14 Aircraft manufacturers ; 5 Avionics manufacturers; 5 Research/consultant organizations ; 3 Pilot's associations representatives.*
- *Mix of experience/skills/knowledge (some people in more than one category): 25 Human Factors; 18 Certification; 14 Operations; 8 Supplemental Type Certification; 12 Pilots; 20 Designers; 5 Training; 5 Rule making.*

Most of the meeting was spent in subgroup working sessions and their reports. The work started in Montreal was continued, but in more detail.

- *Subgroup A and D met to discuss their tasks, but spent most of their time as part of subgroup B and C.*
- *At the end of the meeting group B had reviewed the majority of the regulatory material.*
- *Group C continued to work on reviewing accident/incident data to identify human factors problems. This process aims to identify where the rules fail to prevent problematic designs*

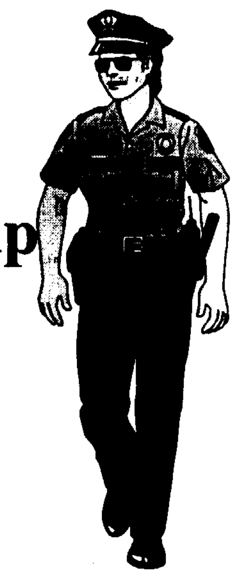
In addition to the work being carried out in subgroups, there were plenary sessions on:

- Understanding the Avionics HWG activities and their HF needs
- Discussion on the contents for the interim 18-month report to the TAE, including planning of the contributions of the different subgroups.
- An integration team was tasked to facilitate the process of integrating the outputs from subgroup B and C.

Design for Security HWG

Summary Update

Transport Airplane and Engine Issues Group



Washington D.C.

Mark Allen - Chair
Boeing - Structures

March 27 - 28, 2001

Handout 9

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

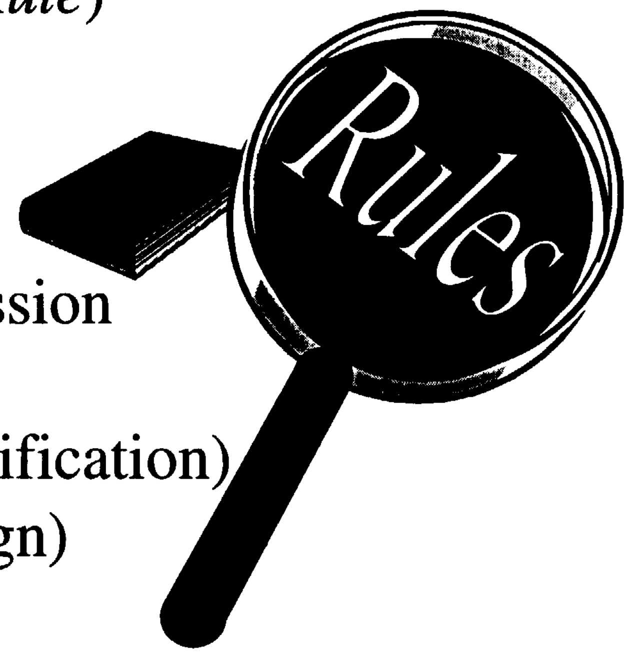
Rory Martin
JAA / CAA - Structures

Eric Duvivier
JAA / DGAC
Cabin Safety & ECS

General

Working Group Tasked With Eight ICAO Rules:

(*And Possibly One FAA Initiated Rule*)

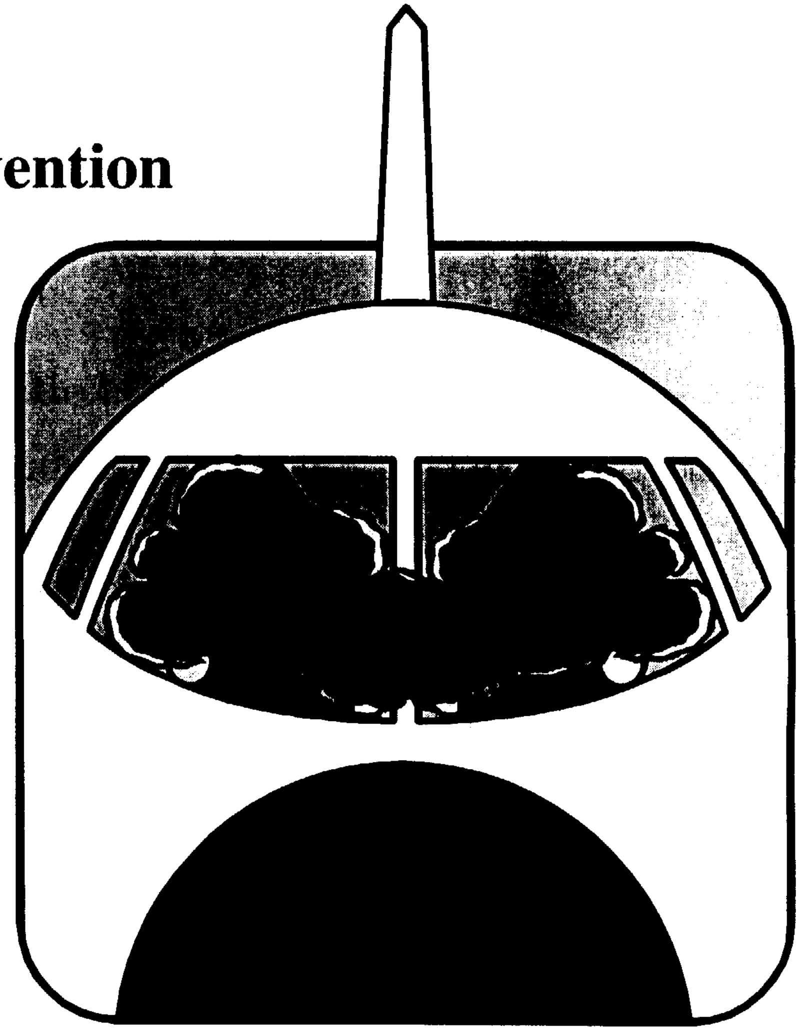


* Flight Deck Smoke Protection
* Cabin Smoke Extraction
* Cargo Compartment Fire Suppression
* Systems Survivability
* Least Risk Bomb Location (Identification)
* Least Risk Bomb Location (Design)
* Design for Interior Search
* Penetration Resistance
* *Flight Deck Intrusion* (FAA initiative)

Flight Deck Smoke Protection

Main Concern is Smoke Entry Prevention

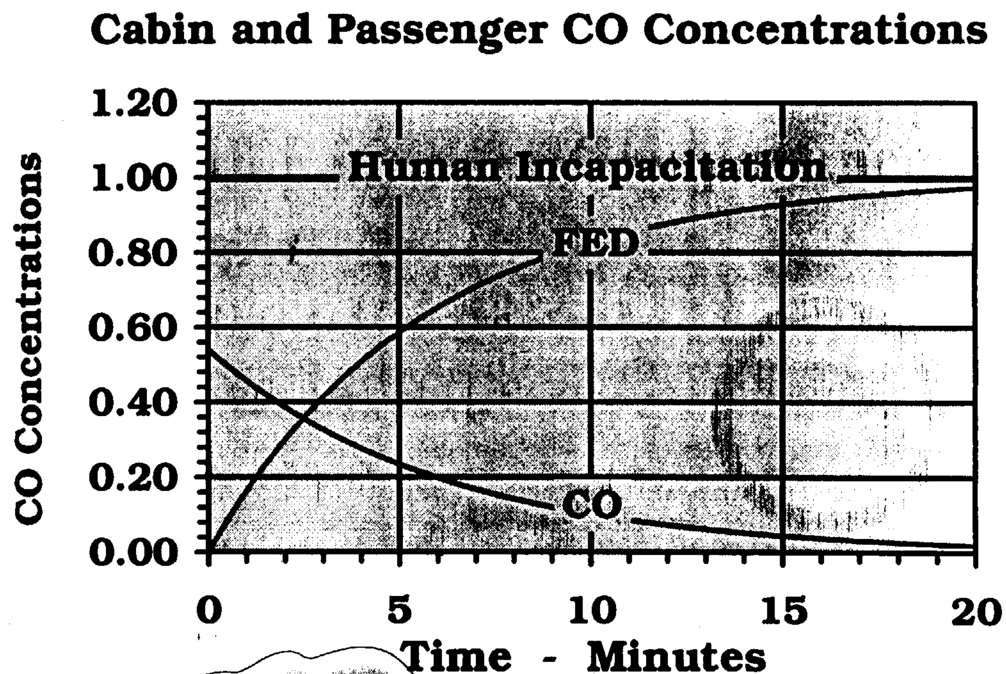
Absolute Sealing is not Viable
- **Smoke Particles are too Small**
- **Difficult to Maintain Seal**



Increased Airflow Only Option
- **Boost Switch Option**
- **Noise Levels Increase**
- **0.1 psi Delta Pressure High (230 lb. Door Load)**

AC 25-9A Requires Revision (Test Demonstration)

Cabin Smoke Extraction



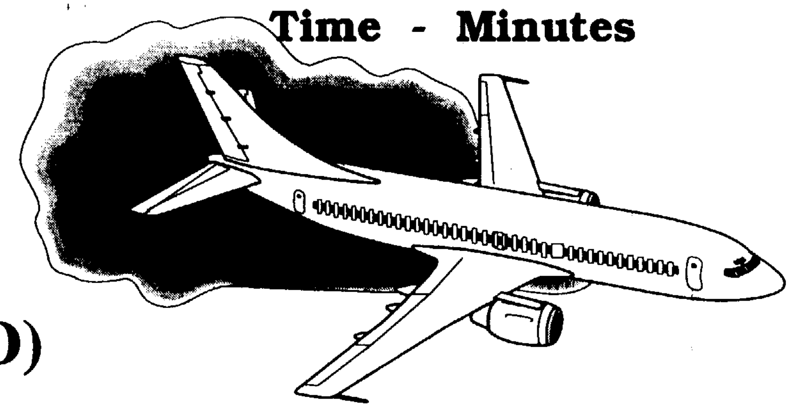
Assumptions

- Fire Contained
- Carbon Monoxide (CO) Highest Toxicity
- Continuous Mixing
- Ventilation Model:

$$C = C_0 e^{-t/\tau}$$

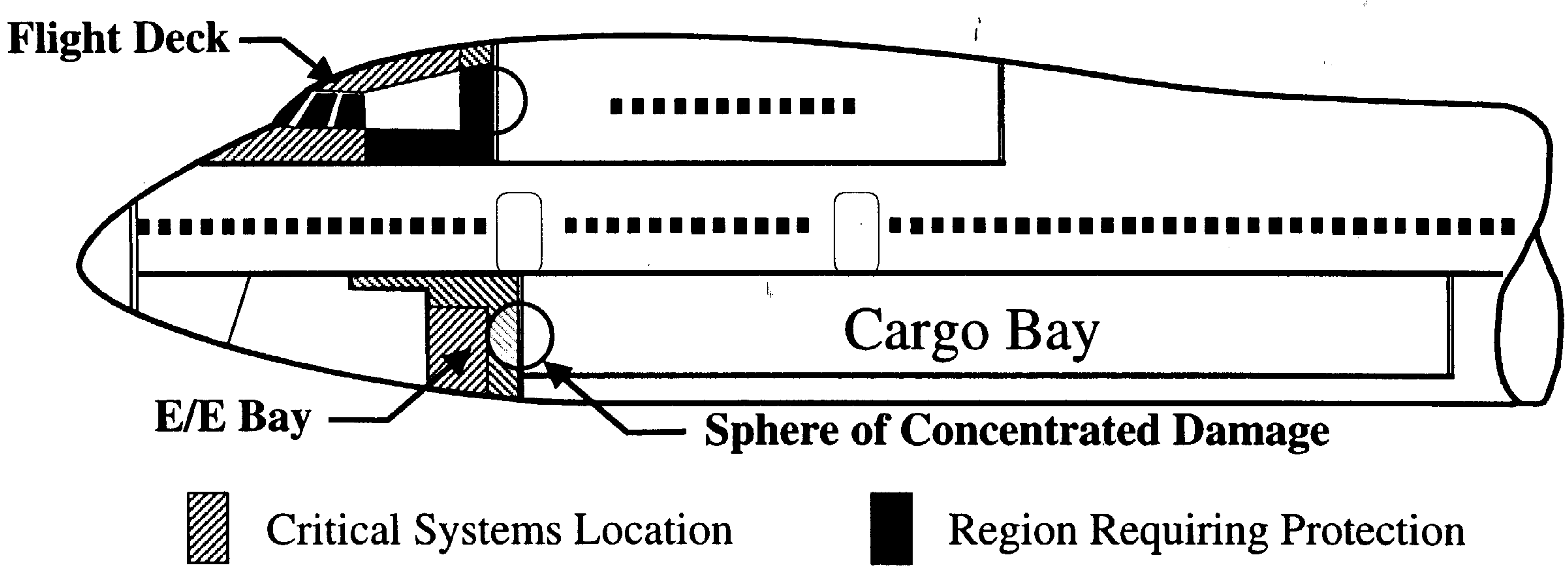
τ = Minutes per Air Change

- Human Tolerance Related to Fractional Effective Dose (FED)



Systems Survivability

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



Upper Limit of 20 Square Feet Maintained

Flight Critical Systems Only (Manufacturer Specified)

Fuel Tanks Excluded

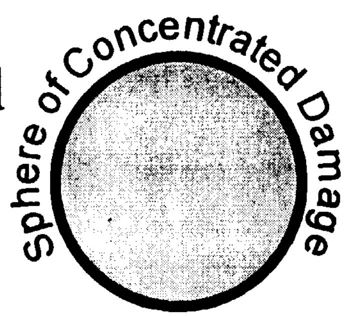
Cargo Compartment Fire Suppression

Areas of Concern	Action
Liner Rupture (blast overpressure)	None - Low Risk
Incendiary Devices (w/ self-contained oxygen)	None - Low Risk
Failed Detection System	Self-Test & Self Evident
Delivery Bottle Vulnerability	Bottle Separation or Protection
Delivery Line Failure	Flexible or Break-Free Attachments

Least Risk Bomb Location

(Design & Identification)

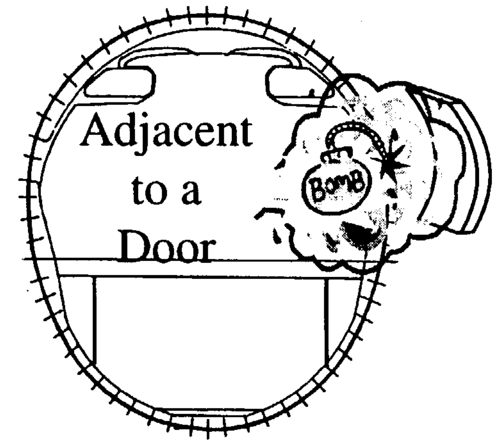
- Threat Never to be Identified
- Threat Size Related to 25.365(e) ???



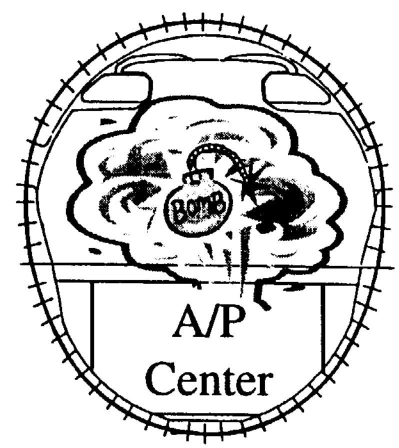
LRBL Procedures

- Manufacturer Creates
- FAA (Manufacturer?) Controls

FAA Preferred Location



Proposed Alternative

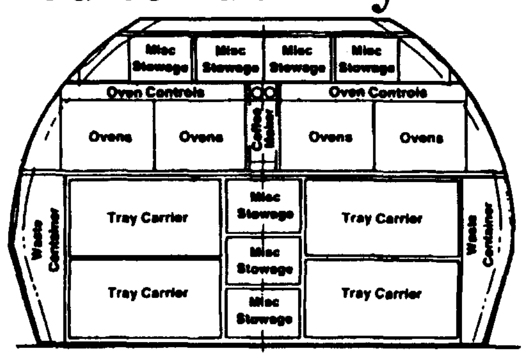


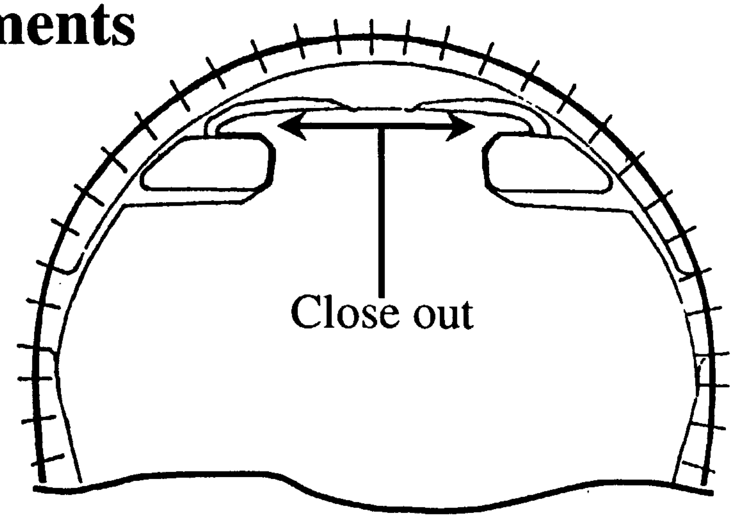
Design for Interior Search

Design for Ease of Inspection and Difficulty for Hiding

- Tamper Proof Life Jackets
- Fasteners Requiring Special Tools
- Avoid Empty Spaces and Loose Fitting Attachments
- Easily Removable / Replaceable Seat Cushions
- Locked Storage Compartments

Lacking Method to Identify Compliance





Penetration Resistance

Flight Deck Protection From all Passenger Compartments

Protection Follows NIJ Standard 0101.04

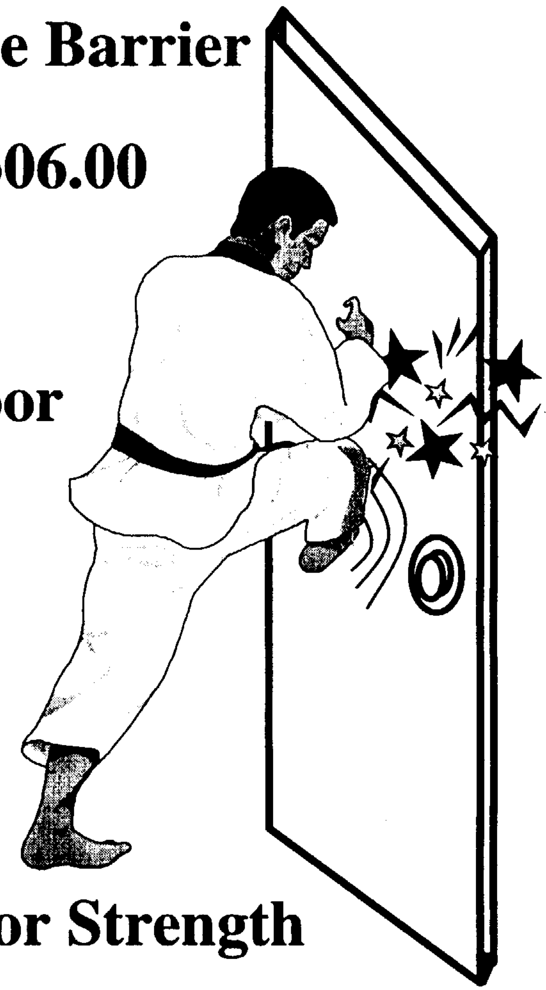
- .44 Magnum & 9mm @ 1400 fps
- Six Shots Each Bullet Type
- 0° and 30° Impact Angles
- No Penetration Allowed

Enhanced Designs (by analyses) Need not be Tested

Rule Essentially Complete

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) at Door Center and Latch (Equivalent to 220 lb @ 4 mph)



- Blow-out Panels Permitted
- Pull Test Might be Added
- Unresolved Whether to Demonstrate Door Strength After all Tests or After Each Test

Meeting Schedule

Gatwick, U.K.	23 - 25 Jan 2001
Seattle, Wa.	24 - 26 Apr 2001
Paris, France	24 - 26 July 2001
Washington D.C.	2 - 4 Oct 2001

WORKING GROUP ACTIVITY REPORT

Date: March 27th, 2000

- 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

Handout 10

• Status & Schedule:

Status

At the time of the last report to TAEIG, the Rule was considered 99% complete and the AC/ACJ was maturing at Draft 10. However, 27 comments were received on the Rule and 275 comments were received on the AC/ACJ.

An Editor's meeting was held in February and a significant number of the 300+ comments were addressed. A FAA Technical Editor participated in the Editor's meeting. The Editing Team produced an update to the Rule and AC/ACJ [Draft 11] based upon the comments received. The updated Rule and AC/ACJ was distributed to the FGSHWG members to support the Plenary meeting in March.

At the Plenary meeting, the Rule was adjusted slightly and is now considered 'complete'. Discussions at the Plenary meeting provided material to support a further update to the AC/ACJ. Draft 12 of the AC/ACJ was distributed to the FGSHWG on March 5.

The amount of work remaining and the schedule were reviewed by the Plenary. Two major sections of the AC/ACJ were discussed for the first time within the Plenary and the new Working Group format was reviewed with the Group for the first time. It was agreed that the remaining work could not be completed at the last meeting planned for Seattle in June.

Future Plans

Draft 12 of the AC/ACJ is being reviewed by the FGSHWG at this time. Comments are due by April 2nd. An Editors meeting is scheduled for April 9th – 11th. The Editors will address the comments received from the Group, will develop the two remaining immature sections and will work on the remaining administrative items.

A meeting is scheduled in Seattle for the week of June 4th and the final meeting is now scheduled for the week of October 1st in the UK.

Schedule

Date	Meeting type	Location	Comment
[redacted]			
April 9-11, 2001	Editors	Gatwick	Leading to Draft 13
April 27, 2001			Draft 13 distributed to HWG
June 4-8, 2001	Plenary	SEA	Work to support preparation of final draft [Draft 14]

			95% Technical Agreement
June 22, 2001			Draft 14 distributed to HWG with ballot
October 1-3	Plenary	UK	Disposition of ballot comments **Final technical agreement**
October 4-4	Editors	UK	Prepare final package
October 10	Co-chairs		Submit T AEIG package

The following Table contains the status and plan for the rest of the work for the FGSHWG

AC/ACJ and Working Group Report schedule

Section	Estimate % Complete	To be worked at:	Achieve technical agreement at:	Primary Responsibility:
1. Purpose	100			
2. Cancellation/Effective Date	100			
3. Related FAR/JAR Sections	100			
4. Related Documents	99	Gatwick	Seattle	Editors
5. Definitions and Acronyms	99	Gatwick	Seattle	Editors
6. Background	100			
7. General	100			
8. Controls, Indications And Alerts	98	Gatwick	Seattle	Editors
9. Characteristics at Engagement, Disengagement, and Override	95	Gatwick	Seattle	Editors
10. Performance Of Function	98	Gatwick	Seattle	Editors
11. Characteristics Of Specific Modes	95	Gatwick	Seattle	Editors
12. Functional Integration	95	Gatwick	Seattle	Editors
13. Safety Assessment	85	Gatwick	Seattle	JA,
14. Flight Test, Simulator Demonstration, And Analysis	60	Gatwick	Seattle	GB
15. Airplane Flight Manual	95	Gatwick	Seattle	TI, DD
Appendix A Safety Assessment	95	Gatwick	Seattle	JA
Appendix X (applicability considerations)	0	Gatwick	Seattle	All Members
• Working Group Report - • NTSB recommendations	10 0	Gatwick Seattle	Seattle UK	Editors Editors
Inputs to Flight Test Guide	0	Gatwick & Seattle	UK	Editors

WORKING GROUP ACTIVITY REPORT

Date:2/13/2001

- 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	6/15/2001	6/6/2001	6/27/2001
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			9/1/2001

- Status: Work plan to be submitted to TAEIG at next meeting. Concept in work.
- Bottlenecks
- Next Action: Comment review
- Future Meetings: April 24-26, June 5-7
- Lessons Learned Discussion (at end of task)
- Request for TAEIG Action: Approve work plan

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.

Work Plan for the Continued Airworthiness Assessment Working Group

February 13, 2001

I. Objective

The Continued Airworthiness Assessment Working Group will provide advice and recommendations related to continued airworthiness assessment in accordance with the tasking that the Aviation Rulemaking Advisory Committee has accepted from the FAA (reference FAA Notice FR December 21, 2000).

The working group members will have a complete understanding of the Task Statement. This objective should be met by providing each member with the tasking statement. The tasking will be reviewed at the first meeting to ensure that all members have a thorough understanding of their responsibilities.

Tasking Statements

Task 1. Review the comments received in the response to the Notice of Availability of proposed Advisory Circular (AC 39-XX) titled "Continued Airworthiness assessments of Powerplant and Auxiliary Power Unit Installation on Transport Category Airplanes".

Task 2. Provide advice and recommendations on the task

Task 3. Recommend disposition of the comments which are not appropriate for incorporation in the proposed AC. Provide recommended revised language in paragraph form to address those comments that have merit and warrant incorporation in the proposed AC.

II. Regulatory History or Related Rule and /or Guidance Material

A review of the proposed Advisory Circular 39-XX is part of the tasking statement.

III. Issues

The Continued Airworthiness Assessment Working Group will identify each issue for which public comments were received . All of the comments received will be grouped according to issue. Each issue and related comments will be documented, positions collected from the Continued Airworthiness Assessment Working Group members, actions will be identified and proposed comment disposition and rationale will be documented.

IV. Assignment of Tasks

In the process of addressing issues and conducting tasks, the Continued Airworthiness Assessment Working Group may form task subgroups to handle specific issues or tasks. Task subgroups will provide reports to the working group.

V. Work Methods

The Continued Airworthiness Assessment 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 task, including the rationale supporting such a plan, for consideration at the meeting of ARAC to consider transport airplane and engine issues held following publication of this notice.
2. Give a detailed conceptual presentation of the proposed recommendations.
3. Draft recommendations for revised wording to be incorporated into the AC and for disposition of comments, and/or any recommendations for further activity the working group determines to be appropriate
4. Provide a status report at each meeting of ARAC held to consider transport airplane and engine issues.

The following items describe the Continued Airworthiness Assessment Working Group work methods:

1. The Continued Airworthiness Assessment Working Group will be chaired by a United States industry member . The chair is Sarah Knife, General Electric.
2. The Continued Airworthiness Assessment Working Group will have designated FAA Representatives representing TAD and E&PD. The JAA is not intended to participate in this phase of the activity, but representatives of non-U.S. industry may participate
3. The Continued Airworthiness Assessment Working Group will meet in the United States.
4. The Continued Airworthiness Assessment Working Group will make use of a resource web site to document its work. TBD in the United States will host this site. This site will be password protected.
5. The Continued Airworthiness Assessment Working Group shall function as a Working Group under the ARAC Charter of the Transport Airplane and Engine (TAE) group.
6. The Chair shall make periodic progress report to TAE.

7. The FAA representatives will assist the chair in preparation of material in a form for submittal to ARAC.

VI. Statement of Work

1. Review the comments received in the response to the Notice of Availability of proposed Advisory Circular (AC 39-XX) titled "Continued Airworthiness assessments of Powerplant and Auxiliary Power Unit Installation on Transport Category Airplanes".

- Subtask 1.a The comments shall be grouped according to the issue they address.

- Subtask 1.b The issues shall be prioritized to allow those with broad implications for the conduct of the task to be addressed first.

-

Task 2. Provide advice and recommendations on the task

Task 3. Recommend disposition of the comments which are not appropriate for incorporation in the proposed AC. Provide recommended revised language in paragraph form to address those comments that have merit and warrant incorporation in the proposed AC.

VII. Schedule

A tentative schedule has been developed and will be reviewed by the HWG at the next meeting. Copy attached.

VIII. Membership

The Continued Airworthiness Assessment Working Group will be composed of technical experts having an interest in the assigned task. Only one member will be permitted to represent each organization.

ENGINE HARMONIZATION WORKING GROUP ACTIVITY REPORT

Date: 27 Mar 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. 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 X

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: Four meetings have been held. Safety target being set at aircraft level. Concepts for large flocking birds being discussed. Recommendations for controlling populations of large flocking birds being drafted. FAA to provide issue paper regarding high speed operations.
Bottlenecks: Problems in obtaining funding for data analysis. Problem solved, but analysis effort has been delayed.
Next Action: Refine rule language, begin development of AC.

Handout 13

Future Meetings: Task force meetings are scheduled for April, July, and October 2001. EHWG has scheduled a meeting for March for a detailed review of the material. Goal is submittal to TAEIG in Dec 01.

ENGINE HARMONIZATION WORKING GROUP ACTIVITY REPORT

Date: 27 March 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.

Bottlenecks: None at this time.

Next Action: Refine rule language, begin development of AC.

Future Meetings: Task force meetings are scheduled for May, August, and October 2001. EHWG has scheduled a meeting for March for a detailed review of the material. Goal is submittal to TAEIG in Dec 01.

ARAC ETOPS WORKING GROUP

Concept Briefing

December 13, 2000

Introduction

In accordance with the ARAC ETOPS Working Group task statement of June 14, 2000 (65FR37447), and the working group's work plan approved by the ARAC Air Carrier Operations Issues Group on August 15, 2000 (attached), the ETOPS WG has reviewed existing ETOPS documents and developed a risk assessment method for ETOPS and other long range flights. Our risk assessment method is comprised of three parts: a loss of thrust model; a system safety analysis using the FAR/JAR 25.1309 process; and an operational assessment assuring that pertinent operational considerations are taken into account.

General Concept

Underlying our proposals for new regulations and advisory material are the following general concepts:

- Special considerations for long range flights are designed to prevent the need for a diversion and to protect the diversion when it cannot be prevented
- Airplanes must be designed and built for the intended mission
- Airplanes so designed and built must be maintained at a level that preserves the original reliability
- At some level of engine reliability, as measured by the In Flight Shut Down (IFSD) rate (.01 per 1000 engine flight hours for twins), the risk of independent failures leading to loss of all thrust ceases to limit the operation, and other limiting factors come into play
- ETOPS will continue to be defined as flights more than 60 minutes up to 180 minutes from a suitable airport in FAR Part 121 operations, while LROPS (Long Range Operations) will be defined for all operations in excess of 180 minutes from a suitable airport
- Part 135 operations have unique considerations

Topics for Proposed Regulations and Guidance Material

Accordingly, the ETOPS Working Group will propose regulations and/or guidance material in three specific areas: Type Design (Parts 25 and 33); Part 121 Operations; and Part 135 Operations.

Handout 14

ARAC ETOPS – DFW **December 7, 2000**

121 Concept Briefing

Operational definitions will be developed.

ETOPS begins at 60 minutes.

- 75 minutes in Benign area concept will be retained.
- Criteria for exceptions, exclusive of MMEL, will be developed for up to 90 minutes for specified requirements.

ETOPS up to 180 minutes will be codified using the existing AC120-42A, and modified as appropriate.

- ETOPS diversion limits will be specified on the required flight documentation.
- Enroute alternate criteria will be reviewed to include passenger facilities appropriate to the operations.

LROPS applies to all airplanes (2, 3, & 4 engine) beyond 180 minutes and will be codified into regulations and advisory material.

- LROPS will be based on specific engine reliability standards to be developed.
- Human factors will be considered.
- Regulatory authority approval will be based on the operator, airplane equipment, and routes to be flown.
- Appropriate MMEL requirements will be developed for LROPS.
- Consideration will be given for previous operator experience.
- Current regulatory standards for operational validation will apply to LROPS.
- OPSPECS approval will be required.
- Current ETOPS maintenance practices will be carried over into LROPS for twins.
- Maintenance practices and standards for 3 & 4 engine LROPS will be developed using ETOPS maintenance practices and procedures as guidelines.
- LROPS areas of operations will be defined.
- Current ETOPS performance standards will be validated and refined. LROPS performance standards will be developed.
- Pilot and dispatcher training requirements for international operations will be established with appropriate advisory material developed.
- LROPS diversion limits will be specified on the required flight documentation.

- Enroute alternate criteria will be developed to include RFFS and passenger facilities appropriate to the operations.
- Develop or revise OPSPECS weather criteria for alternate airport selection.
- Current ETOPS operational control standards and procedures may be extended and will be reviewed for LROPS.
- Appropriate standards for fuel and oil supply for LROPS will be developed.
- Current communication and navigation standards will be reviewed and applied to the appropriate area of operation.

ETOPS/LROPS Type Design Rules and Advisory Material Concepts

- Basic Safety Objectives
  - Preclude Diversion
  - Protect Diversion
- Additional Safety Objectives
  - Preserve safety level of current ETOPS
  - Apply consistent safety objectives to all LROPS aircraft

ETOPS/LROPS Type Design Rules and Advisory Material Concepts

- Objectives
  - Risk Assessment Method
  - Codify ETOPS material
  - Define LROPS requirements
  - Provide adequate advisory material

ETOPS/LROPS Type Design Rules and Advisory Material Concepts

Risk Assessment Method

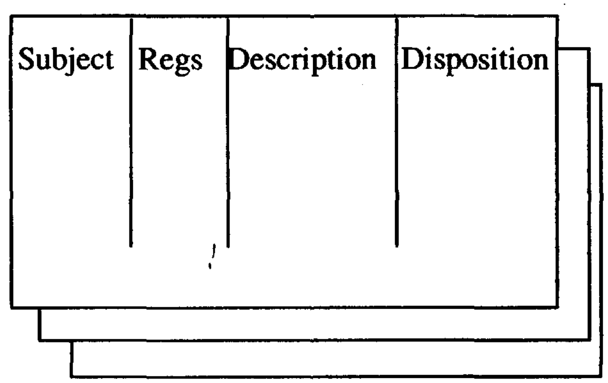
Elements:

- Review of multiple risk models concluded that an 0.01/1000 engine hours IFSD rate for twins effectively eliminates loss of thrust for independent causes as an operational limitation for LROPS.
- Review of common cause/cascading failures events being conducted to define LROPS design/maintenance/operational requirements
- System safety analyses (SSA) are adequate as long as the ETOPS/LROPS mission is considered. SSA must also consider various allowable dispatch configurations, separate criteria needs to be established.

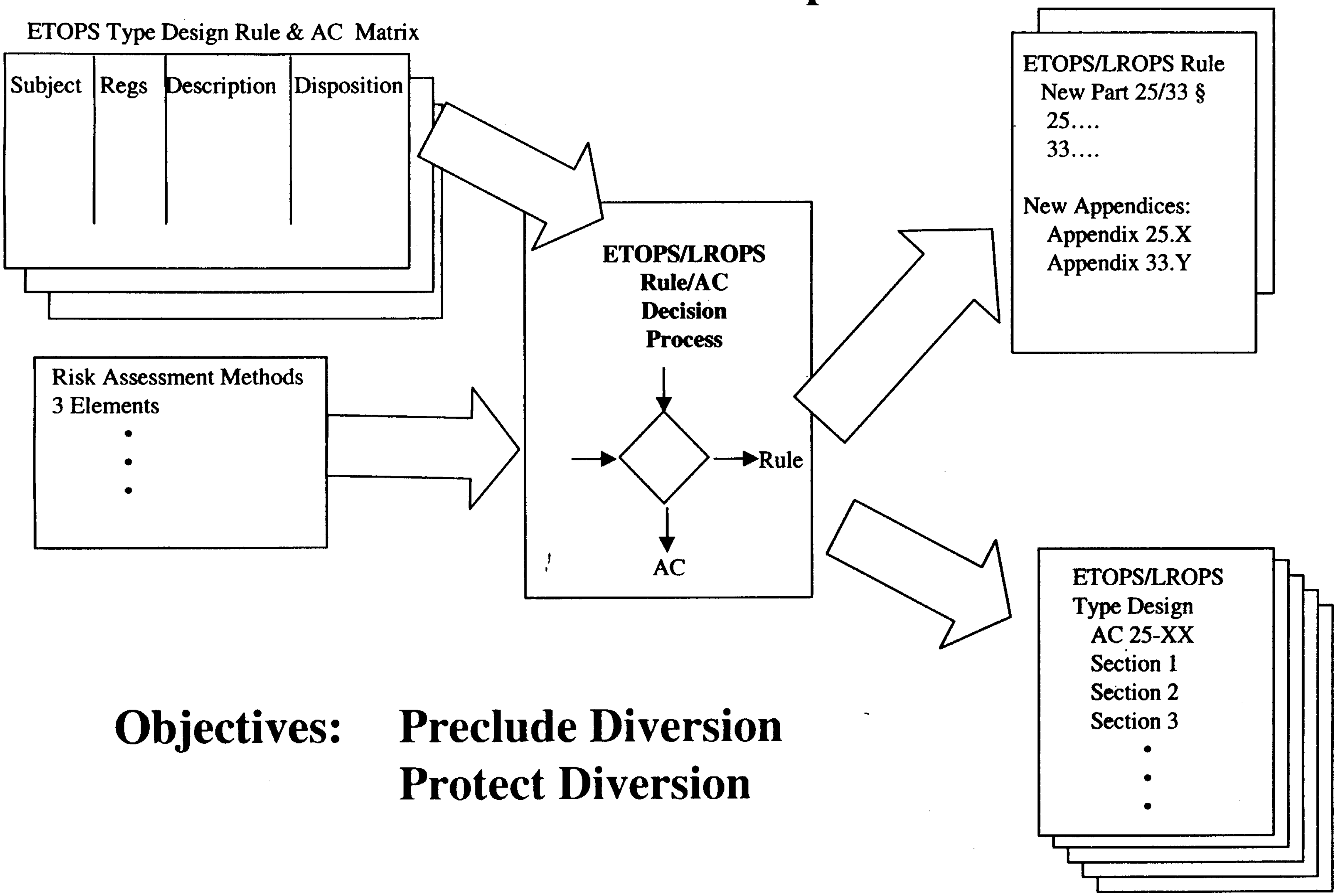
ETOPS/LROPS Type Design Rules and Advisory Material Concepts

- Codify ETOPS material

ETOPS Type Design Rules & AC Matrix



ETOPS/LROPS Type Design Rules and Advisory Material Concepts



Objectives: **Preclude Diversion**
Protect Diversion

ETOPS/LROPS Rule Decision Process

Rule Criteria

- Performance based

- Provide high level requirements that do not dictate one specific design

- Will stand the test of time

- Proposal structured similar to autoland or automatic take off thrust control system certification
    - Separate approval beyond basic Part 25 & 33 Certification
    - Requirements detailed in appendices to both Part 25 & 33

ETOPS/LROPS Advisory Circular Development

AC Criteria

- Provide acceptable means of compliance consistent with previously acceptable means

- Provide sufficient detail to ensure consistent compliance from applicant to applicant

- Address all relevant past ETOPS advisory material

- Provide historical perspective of requirements

- Provide rationale for granting LROPS approval

ETOPS/LROPS Rules and Advisory Circular Linkage

Part 25
Appendix 25.X:

X25.1 General
X25.2 Definitions
X25.3 Safety Assessment
- Propulsion
- Airplane Systems

X25.4 Design Validation
- In service experience
- Analysis and test
- Maint/Ops procedures

X25.5 Risk Management

Part 33
Appendix 33.X

AC 25/33.XX

1. Purpose
2. Cancellation
3. Applicability
4. Related Documents
5. Background
6. Safety Assessment
7. Design Validation
   7.a. Validation using in-service experience
   7.b. Validation using analysis and test
   7.c. Validation of Maint/Ops procedures
8. Risk Management
9. Type Design Certification

Appendix 1 Risk Model
Appendix 2 Propulsion Reliability
Appendix 3 ETOPS/LROPS Significant Systems

135 Concept Briefing
December 7, 2000

1. **NPRM Rule 135**:
    a. Require operations of turbine-powered airplanes within 180 minutes of an adequate airport,
    b. Specify a simple method for converting 180 minutes to a distance
    c. Require SMLROPS operators to report all power loss events, including instances when the engine is not shutdown.

2. **NPRM 135 Appendix** "K"– Rule describes the conditions & circumstances under which the Administrator would approve turbine-powered airplane operations beyond 180 minutes.

3. **Advisory Circular**
    a. Preamble/General
        i. Background
            1. This AC describes best practices for flying long distances
            - Acceptable means, but not the only means.
            2. Recommendations in this AC are SMLROPS
        ii. Philosophy
            1. Reducing risk arising from any cause – not limited to aircraft systems or engine failure
            2. Other considerations
        iii. Applicability
            1. Advisory material for Part 135 operations beyond 180 minutes
            2. Any airplane, regardless of number of engines

    b. Definitions:
        i. Unique name (SMLROPS) for Part 135 operation beyond 180 minutes (LROPS as used in 121 could be confusing)
        ii. Option – to have as a subset of LROPS with 135 specific issues

    c. Operator recommendations
        i. Previous experience with long-range operations
            1. New-aircraft considerations
                a. Flight crew training
                b. Gaining service experience
                c. Alternate proving method
            2. New-Operator considerations
                a. Flight crew training
                b. Additional management oversight
                c. Describe appropriate ways to gain operational experience

ii. Additional vigilance required
    1. Maintenance procedures
    2. Maintenance training
    3. Engine condition monitoring
    4. Critical system monitoring

d. Recommended aircraft configuration
    i. Systems – i.e. Communication
    ii. Equipment – i.e. SatCom

e. Fuel/Oil Recommendations
    i. Fuel/oil requirements at departure, including reserves for:
        1. Possible engine failure or depressurization at the most critical point,
        2. Uncertainty of longer-term terminal and enroute weather forecasts
        3. Uncertainty of enroute wind forecasts overwater
        4. Possible navigational inaccuracy

f. Additional oxygen requirements for crew and passengers
    i. Impact of oxygen availability on fuel planning
    ii.

g. Additional maintenance procedures
    i. Additional pre-departure checks
    ii. Unique procedures for scheduled/routine/recurring maintenance
    iii. Unique servicing procedures

h. Additional pilot procedures
    i. Additional flight-planning recommendations
        1. Enroute diversion airport requirements
        2. In-flight communication capabilities for WX/airfield updates
        3. Additional pre-departure checks

    ii. Inflight situational awareness
        1. Location of nearest enroute diversion (ETP) airport
        2. Redundant enroute checks of fuel use / fuel remaining

TAEIG

March 27/28
2001
Washington, DC

Andrew Lewis-Smith

Handout 15

PPIHWG Report

To

27/28 March, 2001 Meeting

Of

TAEIG

Current Activities

- **25.1187/863**
- **Appendix I**
- **25.903(d)**

Current Activities (Cont.)

- **25.1187/863** -
  - Group met in Palm Coast
  - Proceeding per TAEIG enveloping direction
  - Determined that task includes all areas of the airplane and all flammable fluids
  - Group will require team members with expertise in other areas, e.g. Hydraulic systems
  - Working towards completion by December

Current activities (Cont.)

- **25.904, Appendix I**

  - **Task Group developed rule change and advisory material**

  - **All FAA inputs accepted with exception of fully understanding the Critical Time Interval (CTI) for Go-Around.**

  - **Flight Harmonization Study Group has the task to reach agreement on and clarify CTI for Go-Around. On completion of this, Fast Track Report will be ready for vote.**

    need to clarify.

  - **Goal to have FRT ready for June meeting of PPIHWG**

Current activities (Cont.)

- 25.903(d)
  - Group met at Palm Coast
  - 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
  - Good progress made

Palm Coast Activities

- TORs for Cowl Retention and Powerplant indications reworked and submitted
- PPIHWG will require coordination and consultation with other Working Groups
- PPIHWG request that TAEIG provide management support to ensure other groups work with and support PPIHWG in timely manner
- Requests for team membership have been sent out
- Teams to start in Brighton

Future Activities

- Initiate work on Fuel Tank venting, Cowl Retention and Powerplant Instruments

- Next meetings of PPIHWG:

  - June 26-28, 2001---Brighton, England
  - October 9-11, 2001---Cincinnati, Ohio

- PPIHWG have received an invitation to hold a meeting of PPIHWG in Moscow, hosted by Aviation Register of Russia. Invitation is for Summer, 2003

General Structures HWG

Status Report

to ARAC-TAEIG
March 28, 2001

Amos Hoggard
Structures HWG Chair

Handout 16

ARAC General Structures Harmonization Working Group
Status Report to ARAC-TAEIG
March 2001

Meetings
The last meeting of the General Structures HWG was February 12-16, 2001 in Savannah GA. The next general meeting will be in Wichita KS. April 23-27, 2001.

Proof of Structure, 25.307
The completed NPRM and AC were submitted to the FAA through TAEIG for legal and economic evaluation on August 7, 1997. A Fast Track Report was submitted at the last meeting and the FAA is continuing to process the NPRM and AC. No further GSHWG action is planned at this point.

High Altitude Flight, 25.365(d)
This tasking was issued October 25, 2000. A detail work plan is to be presented at the March 2001 TAEIG meeting.

Scatter Factor, 25.571
AC 25.571-1B was published February 18, 1997 by the FAA. HWG work is complete for this task.

Fatigue and Damage Tolerance, 25.571
While the draft NPRM and AC were being prepared for submittal for legal and economic evaluation, the FAA published Amendment 25-96 (ref. NPRM 93-9) and an accompanying AC. It should be noted that the HWG considered the contents of NPRM 93-9 and the draft AC in their entirety during harmonization discussions. In addition, the AAWG has been given a significant task that will impact the results of any work by the HWG.

During the June TAEIG Meeting, it was recommended that the HWG Chair meeting with the FAA to discuss how this situation could be resolved. This meeting was held in late June 1999 and ground rules were developed on how this could go forward. This proposal was presented to the HWG in August 1999. The proposal establishes the base for harmonization as Amendment 96 with the task to establish a harmonized work against that document. The work would address the following elements as a minimum

- Harmonize JAR and Amendment 96 FAR
- Reintroduce Fail-safe requirements into the rule language
- Embody the work of the AAWG into the rule and AC language

It was further agreed that the wording of the rule can be changed as long as the change is justified in a way that none of the precepts are lost. The HWG agreed with the proposal and the concept that it needed to work closely with the AAWG to develop the final proposal.

At this point, the HWG is requesting that the Draft NPRM and AC submitted in the June 1999 meeting be withdrawn until the additional work is completed. The GSHWG work continues with a planned completion date of December 2001.

Materials, 25.603
This is a new Tasking under the Fast Track Process. The HWG considered this last year and found that there is no substantive differences between the FAR and JAR in either the rule or AC language. Since that time, there has been a change published to the JAR which embodied NPA25-256D regarding procedures to be

followed when a change in composite material is proposed. Now the rules are not harmonized and the HWG is requesting that an additional tasking be granted to incorporate the NPA into the FAR AC system. The fast track report and a proposed TOR has been submitted to do this. No further GSHWG action is planned pending tasking under the submitted TOR.

Material Strength Properties and Design Values, 25.613
The completed NPRM and AC were approved at the April 9, 1998 TAEIG meeting and forwarded to the FAA for publication. Still at FAA, not published. The FAA has requested a re-review of certain elements of the economic package. The GSHWG is reviewing these elements at the moment.

Casting Factors, 25.621
Draft NPRM and AC were submitted to the TAEIG in the June 2000 meeting for legal and economic evaluation. The FAA returned the document with both editorial and legal corrections. Those changes were reviewed and necessary corrections made. The Fast Track Report was updated and the package, with preliminary legal and economic review has been submitted and approved in September 2000. No further GSHWG action is planned at this time.

Birdstrike, 25.631, 25.775, 25.571
The draft NPRM and AC were submitted July, 1995 through the TAEIG for legal and economic evaluations. The Regulatory Branch and the ACOs have reviewed the drafts. The economic evaluation is in progress. The NPRM preamble material has been rewritten to provide improved justification for the rule change. The new draft has been circulated to HWG members for review and agreement. A new economist has been assigned. Additional cost data has been compiled and transmitted to the economist.

Received memo with rough estimate of the costs stating that it does not appear that the "reduction in safety" associated with this change is justified by the economic benefit. The HWG had made it very clear that it is obvious that the proposal is to lower the requirement but that the result still provides the necessary level of safety. It is very disappointing that the economists have formulated their own position on the required level of safety rather than working from the data and conclusions provided by the HWG after our many hours of deliberation.

Additional information was submitted to TAEIG in hopes of obtaining a resolution to this dilemma. Action was assigned to the FAA and JAA representatives to re-table the issue with the respective agencies. The result of this was that the FAA reaffirmed its position on the 8lb-bird and the JAA has published TGM removing the cut-back speeds. The FAA also acknowledged that they had contracted with the University of Illinois at Urbana-Champaign to study bird populations, and the probability of airplane/bird encounters. As a result, the working group has requested that the tasking remain open while the R&D studies are ongoing to assist the FAA with data and other support. It is hoped that the new data will provide a clear technical basis for future rule making.

Operational Tests, 25.683
This is a new tasking under the Fast Track Process. As such, the regulators provided a proposed fast track report for the HWG consideration. Following some discussion, it was decided that the appropriate path would be to envelope the requirements using the JAR text as recommended in the Fast Track report. Upon further review, the HWG found that additional advisory material was necessary to ensure uniform methods of compliance to the rule. Therefore the Fast Track report was revised to indicate that an additional task was required in the specific area of advisory material and a TOR was prepared for submittal. In the December TAEIG meeting, the

TAEIG decided that an additional tasking on this subject was not required and requested that the GSHWG produce and submit an AC on the subject under the authority of the existing Fast Track Report. The FAA would then review the AC for any additional rule making that was required. The GSHWG is active producing advisory material.

Windshields and Windows, 25.775(d)
It has been agreed that no change to the rule is required. An AC has been prepared and submitted to the ARAC with a fast track report September 2000. The AC subsequently received both a legal and a tech writer review. Changes as a result of these reviews were incorporated into the AC. The GSHWG plans no further activity at this time.

Doors, 25.783
The Doors Sub-team has completed their work and has submitted a complete package with Preliminary legal and economic assessment to the TAEIG at March 2000 meeting. No further GSHWG action is planned at this time

Fuel Tank Access Doors, 25.963(e)
Two alternate proposals for proceeding were submitted to TAEIG at the June meeting. The HWG recommended that Proposal 2 be submitted to the FAA for Legal and Economic Evaluation and the JAA Power Plant Study Group (PPSG) also endorse the proposal. On September 12, 1999, the HWG received word from the PPSG that Proposal 2 was acceptable. A Fast Track report has been prepared for this tasking as requested. Following the Paris accident and the ensuing investigation, the PPSSG and the FAA have proposed an additional tasking for the GSHWG to consider. The GSHWG plans no further activity unless directed by ARAC on this subject.

FUTURE WORK

The GSHWG expects to be tasked for 25.603.

Amos Hoggard
General Structures HWG Chair

General Structures HWG
Status Report
March 2001

Title	CFR Part 14	*Legal	*Economics	Fast Track Report	Status Since Last Report
Published:					
Scatter Factor	25.571	NR	NR	NR	HWG Work Complete
At FAA for Publication:					
Material Strength Properties and Design Values	25.613	Complete	Complete	NR	HWG Re-reviewing Economics
At FAA for Evaluation:					
Proof of Structure	25.307	Complete	Complete	Complete	HWG Work Complete
Materials	25.603	Complete	Complete	Complete	HWG Work Complete
Casting Factors	25.621	Complete	Complete	Complete	HWG Work Complete
Windshields and Windows	25.775 d	In Work	NR	Complete	HWG Work Complete
Doors	25.783	Complete	Complete	NR	HWG Work Complete
Fuel Tank Access Covers	25.963 e/g	Complete	Complete	Complete	HWG Work Complete**
To Be Submitted to FAA:					
In HWG:					
High Altitude Flight	25.365(d)	Not Started	Not Started	Not started	In Work
Birdstrike	25.631, 25.775 b, 25.571 e	Under review	Under review	NR	Reviewing FAA R&D Study
Fatigue and Damage Tolerance	25.571	In Work	In Work	NR	In Work
Operational Tests	25.683	In Work	NR	Complete	AC In Work

* Preliminary

** Additional considerations possible following recent Paris Accident.

AVIATION RULEMAKING ADVISORY COMMITTEE
WORKING GROUP STATUS FORM

Date: 3/28/01

Parent Issue Group **ARAC - Transport Airplane and Engines Issues Group**

Working Group Name **Structures General Harmonization Working Group**

Task Title **High Altitude Flight, 25.365(d), AC 25-20 Para 8**

Harmonization Number (If Applicable)

Task Description

Review 14 CFR 25.365(d), in particular the factors applied to the maximum relief value setting, which is used to set a limit structural design loan (load). Review FAA and Joint Aviation Authority (JAA) advisory material and paragraph 8 of Advisory Circular 25-20. In light of this review, develop a report recommending changes to harmonize this section and the corresponding JAR paragraphs, recommending new harmonization standards, and develop related or revised advisory material as well.

Product: NPRM ___X____ AC ___X___ Other _______

SCHEDULE	FORECAST	COMPLETE
TASKING PUBLISHED		October , 2000
WORK PLAN APPROVAL	March 2001	March 2001
TECHNICAL AGREEMENT- REQUEST DRAFTING SUPPORT	October, 2001	
DRAFT OF PRODUCT REVIEW- REQUEST ECON-LEGAL REVIEW	December 2001	
COMPLETION OF ECON-LEGAL REVIEW	May 2002	
RECOMMEND TO ARAC (ISSUE GROUP)	June 2002	
RECOMMEND TO FAA	July 2002	
PUBLISH NOTICE	2rd Qtr 2003	
PUBLISH FINAL	2rd Qtr 2004	

Status: **Working Group has developed a list of technical areas where agreement is needed. There is, in addition, a collateral tasking in 25.841 that affects this activity. Some of our work will depend on how that tasking is approached. The Mechanical Controls Working Group Chair has been approached to determine the best way to interface.**

Next Action: **TAEIG Acceptance of approach**

Future Meetings: **Wichita KS, April 2001**

AVIATION RULEMAKING ADVISORY COMMITTEE
WORKING GROUP STATUS FORM

Date: 3/28/01

Parent Issue Group **ARAC - Transport Airplane and Engines Issues Group**

Working Group Name **Structures General Harmonization Working Group**

Task Title **Fatigue and Damage Tolerance 25.571**

Harmonization Number (If Applicable)

Task Description: **Develop a harmonized 25.571 rule and advisory material.**

Product: NPRM __X__ AC __X__ Other ______

SCHEDULE	FORECAST	COMPLETE
WORK PLAN APPROVAL		**July 1995**
TECHNICAL AGREEMENT- REQUEST DRAFTING SUPPORT		**October 1997 Rev. March 1998**
Reopening due to Amdt 96 and AAWG	August 1999	**August 1999**
DRAFT OF PRODUCT REVIEW- REQUEST ECON-LEGAL REVIEW	2nd Quarter 2001	
COMPLETION OF ECON-LEGAL REVIEW	3rd Qtr 2001	
RECOMMEND TO ARAC (ISSUE GROUP)	December 2001	
RECOMMEND TO FAA	1st Qtr 2002	
PUBLISH NOTICE	2st Qtr 2002	
PUBLISH FINAL	3rd Qtr 2002	

Status: **HWG Technical Agreement was reached March 1998. FAA published Amendment 25-96 and AC in March 1998. The harmonized preamble has been revised in light of the new rule. HWG has reconsidered the status of it's work and has agreed to reopen the harmonization effort in light of Amdt 96 and the work of the AAWG and FAA/Industries desire to re-instate fail-safe requirements. Estimate of work package to be submitted is:**

1. **REVISED 25.571**
2. **REVISED AC 25.571**
3. **NEW RULE 25.6XX – FAIL-SAFE**
4. **NEW AC 25.6XX – FAIL-SAFE**
5. **REVISED 25.1529**

New Estimated completion date – 3nd quarter 2001.

Next Action: **TOGAA review of work product on Fail-Safety, continue to review rule and AC language.**

Future Meetings: **Wichita, April 2001**

AVIATION RULEMAKING ADVISORY COMMITTEE WORKING GROUP STATUS FORM

Date: 3/28/01

Parent Issue Group **ARAC - Transport Airplane and Engines Issues Group**

Working Group Name **Structures General Harmonization Working Group**

Task Title **Birdstrike Damage**

Harmonization Number (If Applicable) **17**

Task Description

Develop new or revised requirements for the evaluation of transport category airplane structure for in-flight collision with a bird, including the size of the bird and the location of impact on the airplane (FAR 25.571, 25. 631, 25.775, and other conforming changes).

Product: NPRM __X__ AC __X__ Other ______

SCHEDULE	FORECAST	COMPLETE
WORK PLAN APPROVAL		February 1994
TECHNICAL AGREEMENT-REQUEST DRAFTING SUPPORT		October 1994
DRAFT OF PRODUCT REVIEW-REQUEST ECON-LEGAL REVIEW		July 7, 1995
ASSIST FAA IN COMPLETION OF UIUC R&D PROGRAM	Jan 2002	
REASSESS TECHNICAL POSITION AND SET COURSE OF ACTION	April 2002	
SUBMIT REVISED DOCUMENTS FOR ECON-LEGAL REVIEW	June 2002	
COMPLETION OF ECON-LEGAL REVIEW	Sept 2002	
RECOMMEND TO ARAC (ISSUE GROUP)	December 2002	
RECOMMEND TO FAA	First Qtr 2003	
PUBLISH NOTICE	3rd Qtr 2003	
PUBLISH FINAL	3rd Qtr 2004	

Status: **FAA/JAA position on Bird Weight has been published, FAA is currently involved with UIUC in an R&D program to develop bird populations and probability of airplane/bird encounters. Industry has agreed to assist.**

Next Action: **Waiting for results of the FAA sponsored R&D program**

Future Meetings: **As necessary**

AVIATION RULEMAKING ADVISORY COMMITTEE
WORKING GROUP STATUS FORM

Date: 3/28/01

Parent Issue Group **ARAC - Transport Airplane and Engines Issues Group**

Working Group Name **Structures General Harmonization Working Group**

Task Title **Operational Tests, 25.683**

Harmonization Number (If Applicable)

Task Description: **Develop advisory material for enveloped per fast track report.**

Product: NPRM __X__ AC __X__ Other ______

SCHEDULE	FORECAST	COMPLETE
WORK PLAN APPROVAL		**December 2000**
ESTABLISH SPECIALIST SUB-TEAM	April 2001	
TECHNICAL AGREEMENT- REQUEST DRAFTING SUPPORT	October 2001	
DRAFT OF PRODUCT REVIEW- REQUEST LEGAL REVIEW	January 2002	
COMPLETION OF LEGAL REVIEW	2rd Qtr 2002	
RECOMMEND TO ARAC (ISSUE GROUP)	3rd Qtr 2002	
RECOMMEND TO FAA	3rd Qtr 2002	
PUBLISH NOTICE	4th Qtr 2002	
PUBLISH FINAL	4th Qtr 2003	

Status: **HWG has determined that a sub group of specialists is required to establish the advisory material. The HWG will assign the responsibility to this group of individuals to come up with the required AC material.**

Next Action: **TAEIG approval of approach**

Future Meetings: **Wichita, April 2001**

GSHWG and AAWG Report to ARAC

March 28, 2001

Amos Hoggard
Boeing Commercial Airplane Group

Handout 17

Discussion Issues

- GSHWG Membership
- GSHWG Status Report
- AAWG Membership
- AAWG Status Report

GSHWG Membership

Beaufils, J. Yves	EADS-Airbus	jean-yves.beaufils@airbus.aeromatra.com
Bayon de Noyer, P.	Dassault Aviation	33-5 56-13-92-51
Collins, Richard	BAE Systems	richard.collins@bae.co.uk
Comino, Giorgio	Transport Canada	cominog@tc.gc.ca
Doeland, Wim	RLD, Netherlands	wim.doeland@rld.minvenw.nl
Eastin, Bob	FAA US	Robert.eastin@faa.gov
Hoggard, Amos	Boeing (CHAIR)	amos.hoggardjr@west.boeing.com
Kasowski, Andy	Cessna	akasowski@cessna.textron.com
Martin, Rory	CAA, UK	rory.martin@srg.caa.co.uk
Newman, Philip	Bombardier Aerospace	philip.newman@eng.canadair.ca
Pereira, Humberto	Embraer	Humberto.pereira@embraer.com.br
Pinsard, Laurent	DGAC	pinsard_laurent@sfact.dgac.fr
Reid, Mike	Gulfstream	mike.reid@gulfaero.com
Schmidt, Hans	EADS Airbus GmbH	hans.schmidt@airbus.dasa.de
Simmons, Frank	Gulfstream	Frank.simmons.iii@gulfaero.com
Smith, Johnny	Raytheon Corp	johnny.smith@rac.ray.com
Yarges, Rich	FAA, US	rich.yarges@faa.gov

General Structures Harmonization Working Group

- General Status Report
- Administrative Issues
- FAR 25.365(d) Work Plan and Schedule
- FAR 25.571 - Status/Schedule
- FAR 25.631 - Status
- FAR 25.683 - Work Plan and Schedule

General Status Report

General Structures HWG
Status Report
March 2001

Title	CFR Part 14	*Legal	*Economics	Fast Track Report	Status Since Last Report
Published:					
Scatter Factor	25.571	NR	NR	NR	HWG Work Complete
At FAA for Publication:					
Material Strength Properties and Design Values	25.613	Complete	Complete	NR	HWG Re-reviewing Economics
At FAA for Evaluation:					
Proof of Structure	25.307	Complete	Complete	Complete	HWG Work Complete
Materials	25.603	Complete	Complete	Complete	HWG Work Complete
Casting Factors	25.621	Complete	Complete	Complete	HWG Work Complete
Windshields and Windows	25.775 d	In Work	NR	Complete	HWG Work Complete
Doors	25.783	Complete	Complete	NR	HWG Work Complete
Fuel Tank Access Covers	25.963 e/g	Complete	Complete	Complete	HWG Work Complete**
To Be Submitted to FAA:					
In HWG:					
High Altitude Flight	25.365(d)	Not Started	Not Started	Not started	In Work
Birdstrike	25.631, 25.775 b, 25.571 e	Under review	Under review	NR	Reviewing FAA R&D Study
Fatigue and Damage Tolerance	25.571	In Work	In Work	NR	In Work
Operational Tests	25.683	In Work	NR	Complete	AC In Work

* Preliminary

** Additional considerations possible following recent Paris Accident.

1 out of 8 tasked items

need copy? request

circulatory issues that need to be worked

assigned to ...

FAA held the ... unsure of status

FAA ... worked ...

Ames to Thodden JAA participation absolutely on this superb

Administrative Issues

- JAA Support of the GSHWG Activity
  - October 2000 Meeting, GSHWG 2001 Meeting Schedule set
    - Feb 12-16, 2001 Savannah GA
    - April 23-27, 2001 Wichita KS
    - June 18-22, 2001 Toulouse FR
    - October 8-12 Hamburg GR
    - December 10-14, 2001 Seattle WA
  - December 2000, GSHWG Agreed each meeting to last five days
  - February 2001, JAA changed position - now could support only a 3.5 day meeting. 68.2% of action items
    - Travel Budget
    - Family Issues

JAA reps — Thodden to check into it

fundamental issue

Administrative Issues Con't

- In 1998, the GSHWG submitted 25.613 for FAA review and publication.
- Last month we started receiving inquiries from the economist asking if our three year old numbers were still accurate.
- It's really tough to run a railroad like this!

HWG did not respond to e-mail the monday email said review would stop if HWG does not respond

write a letter to Fazio

FAR 25.365(d) - High Altitude Flight

AVIATION RULEMAKING ADVISORY COMMITTEE
WORKING GROUP STATUS FORM

Date: 3/28/01

Parent Issue Group	ARAC - Transport Airplane and Engines Issues Group
Working Group Name	Structures General Harmonization Working Group
Task Title	High Altitude Flight, 25.365(d), AC 25-20 Para 8

Harmonization Number (If Applicable)

Task Description

Review 14 CFR 25.365(d), in particular the factors applied to the maximum relief value setting, which is used to set a limit structural design loan (load). Review FAA and Joint Aviation Authority (JAA) advisory material and paragraph 8 of Advisory Circular 25-20. In light of this review, develop a report recommending changes to harmonize this section and the corresponding JAR paragraphs, recommending new harmonization standards, and develop related or revised advisory material as well.

Product: NPRM __X__ AC __X__ Other ______

SCHEDULE	FORECAST	COMPLETE
TASKING PUBLISHED		October , 2000
WORK PLAN APPROVAL	March 2001	March 2001
TECHNICAL AGREEMENT-REQUEST DRAFTING SUPPORT	October, 2001	
DRAFT OF PRODUCT REVIEW-REQUEST ECON-LEGAL REVIEW	December 2001	
COMPLETION OF ECON-LEGAL REVIEW	May 2002	
RECOMMEND TO ARAC (ISSUE GROUP)	June 2002	
RECOMMEND TO FAA	July 2002	
PUBLISH NOTICE	2rd Qtr 2003	
PUBLISH FINAL	2rd Qtr 2004	

unanimously

Status: Working Group has developed a list of technical areas where agreement is needed. There is, in addition, a collateral tasking in 25.841 that affects this activity. Some of our work will depend on how that tasking is approached. The Mechanical Controls Working Group Chair has been approached to determine the best way to interface.

Next Action: TAEIG Acceptance of approach

Future Meetings: Wichita KS, April 2001

FAR 25.571 Damage Tolerance

AVIATION RULEMAKING ADVISORY COMMITTEE
WORKING GROUP STATUS FORM

Date: 3/28/01

Parent Issue Group: **ARAC - Transport Airplane and Engines Issues Group**

Working Group Name: **Structures General Harmonization Working Group**

Task Title: **Fatigue and Damage Tolerance 25.571**

Harmonization Number (If Applicable)

Task Description: **Develop a harmonized 25.571 rule and advisory material.**

Product: NPRM __X__ AC __X__ Other ______

SCHEDULE	FORECAST	COMPLETE
WORK PLAN APPROVAL		July 1995
TECHNICAL AGREEMENT- REQUEST DRAFTING SUPPORT		October 1997 Rev. March 1998
Reopening due to Amdt 96 and AAWG	August 1999	August 1999
DRAFT OF PRODUCT REVIEW- REQUEST ECON-LEGAL REVIEW	2nd Quarter 2001	
COMPLETION OF ECON-LEGAL REVIEW	3rd Qtr 2001	
RECOMMEND TO ARAC (ISSUE GROUP)	December 2001	
RECOMMEND TO FAA	1st Qtr 2002	
PUBLISH NOTICE	2st Qtr 2002	
PUBLISH FINAL	3rd Qtr 2002	

Status: **HWG Technical Agreement was reached March 1998. FAA published Amendment 25-96 and AC in March 1998. The harmonized preamble has been revised in light of the new rule. HWG has reconsidered the status of it's work and has agreed to reopen the harmonization effort in light of Amdt 96 and the work of the AAWG and FAA/Industries desire to re-instate fail-safe requirements. Estimate of work package to be submitted is:**

1. **REVISED 25.571**
2. **REVISED AC 25.571**
3. **NEW RULE 25.6XX – FAIL-SAFE**
4. **NEW AC 25.6XX – FAIL-SAFE**
5. **REVISED 25.1529**

New Estimated completion date – 3nd quarter 2001. – very optimistic

Next Action: **TOGAA review of work product on Fail-Safety, continue to review rule and AC language.** – will then be ACJ's

Future Meetings: **Wichita, April 2001**

FAR 25.631 Bird Strike

AVIATION RULEMAKING ADVISORY COMMITTEE
WORKING GROUP STATUS FORM

Date: 3/28/01

Parent Issue Group **ARAC - Transport Airplane and Engines Issues Group**

Working Group Name **Structures General Harmonization Working Group**

Task Title **Birdstrike Damage**

Harmonization Number (If Applicable) **17**

Task Description
Develop new or revised requirements for the evaluation of transport category airplane structure for in-flight collision with a bird, including the size of the bird and the location of impact on the airplane (FAR 25.571, 25. 631, 25.775, and other conforming changes).

Product: NPRM __X__ AC __X__ Other ______

SCHEDULE	FORECAST	COMPLETE
WORK PLAN APPROVAL		February 1994
TECHNICAL AGREEMENT-REQUEST DRAFTING SUPPORT		October 1994
DRAFT OF PRODUCT REVIEW-REQUEST ECON-LEGAL REVIEW		July 7, 1995
ASSIST FAA IN COMPLETION OF UIUC R&D PROGRAM	Jan 2002	
REASSESS TECHNICAL POSITION AND SET COURSE OF ACTION	April 2002	
SUBMIT REVISED DOCUMENTS FOR ECON-LEGAL REVIEW	June 2002	
COMPLETION OF ECON-LEGAL REVIEW	Sept 2002	
RECOMMEND TO ARAC (ISSUE GROUP)	December 2002	
RECOMMEND TO FAA	First Qtr 2003	
PUBLISH NOTICE	3rd Qtr 2003	
PUBLISH FINAL	3rd Qtr 2004	

Status: **FAA/JAA position on Bird Weight has been published, FAA is currently involved with UIUC in an R&D program to develop bird populations and probability of airplane/bird encounters. Industry has agreed to assist.**

Next Action: **Waiting for results of the FAA sponsored R&D program**

Future Meetings: **As necessary**

FAR 25.683 - Operational Tests

AVIATION RULEMAKING ADVISORY COMMITTEE
WORKING GROUP STATUS FORM

Date: 3/28/01

Parent Issue Group — **ARAC - Transport Airplane and Engines Issues Group**

Working Group Name — **Structures General Harmonization Working Group**

Task Title — **Operational Tests, 25.683**

Harmonization Number (If Applicable)

Task Description: **Develop advisory material for enveloped per fast track report.**

Product: NPRM __X__ AC __X__ Other ______

SCHEDULE	FORECAST	COMPLETE
WORK PLAN APPROVAL		**December 2000**
ESTABLISH SPECIALIST SUB-TEAM	April 2001	
TECHNICAL AGREEMENT-REQUEST DRAFTING SUPPORT	October 2001	
DRAFT OF PRODUCT REVIEW-REQUEST LEGAL REVIEW	January 2002	
COMPLETION OF LEGAL REVIEW	2rd Qtr 2002	
RECOMMEND TO ARAC (ISSUE GROUP)	3rd Qtr 2002	
RECOMMEND TO FAA	3rd Qtr 2002	
PUBLISH NOTICE	4th Qtr 2002	
PUBLISH FINAL	4th Qtr 2003	

Status: **HWG has determined that a sub group of specialists is required to establish the advisory material. The HWG will assign the responsibility to this group of individuals to come up with the required AC material.**

Next Action: **TAEIG approval of approach**

Future Meetings: **Wichita, April 2001**

Proposed Sub-Team Membership for AC 25.683

Cessna – Andy Kasowski
Airbus - Traverse
Boeing
Raytheon
CAA-UK
DGAC
CAA-NL
FAA - Greg Schneider
TC – John Melo

AAWG Membership

	NAME	Member	E-Mail Address
Baker	Dorenda	NO	dorenda.baker@faa.dot.gov
Bandley	Brent	YES	brent.bandley@faa.gov
Bristow	John	YES	john.bristow@srg.caa.co.uk
Carter	Aubrey(Co-Chair)	YES	aubrey.carter@delta-air.com
Coile	Mark	NO	
Collier	Don	YES	dcollier@air-transport.org
Fenwick	Linsay	YES	fenwickl@alpa.org
Foucault	Jim	YES	air2jf@air.ups.com
Gaillardon	Jean-Michel	YES	jean_michel.gaillardon@airbus.fr
Harrison	Bruce	YES	bruce.harrison@nwa.com
Heath	David	YES	david.heath@evergreenaviation.com
Petrakis	John	YES	john.petrakis@faa.gov
Hoggard	Amos	NO	amos.hoggardjr@west.boeing.com
Johnson	Brian	NO	brian.johnson6@PSS.boeing.com
Knegt	Martin	YES	martin.knegt@fokkerservices.storkgroup.com
Kuchiran	David	YES	dkuchi@coair.com
Goranson	Ulf	NO	ulf.goranson@PSS.boeing.com
Lewis	Austin	YES	austin.lewis@bae.co.uk
Lotterer	Dave	YES	david.lotterer@dc.sba.com
Martin	Gary	YES	gary.martin@americawest.com
Gopinath	Kyatsandra (Co-Chair)	YES	jack.mcguire@PSS.boeing.com
Tedford	Gareth	YES	Gareth.1.tedford@britiah-airways.com
Oberdick	Jon	YES	jober@usairways.com
Pervorse	John	NO	john.pervorse@west.boeing.com
Phillips	Randy	YES	randy_phillips@amrcorp.com
Ayers	Andy	YES	andy.k.ayers@lmco.com
Sesny	Paul	YES	paul.sesny@ual.com
Sobeck	Fred	YES	frederick.sobeck@faa.gov
Walder	Ray	YES	walderr@iata.org
Yerger	Mark	YES	mdyerger@fedex.com

Airworthiness Assurance Working Group

- Chairperson Changes
- December, 1999 Tasking – WFD
- March 22, 2001 Tasking RE: Multiple Complex STCs

Chairperson Changes

- In September 2000, the Chairpersons of the AAWG changed.
  - Kyatsandra Gopinath (Boeing) accepted the co-chair spot vacated by Jack McGuire (Boeing)
  - Aubrey Carter (Delta Air Lines) accepted the co-chair spot vacated by Jim Foucault (UPS)

December 1999 Tasking RE: WFD

- Status - At FAA for Final Legal/Economic Assessments
- Legal Assessment - All Reports Look Positive
- Economic Assessment
  - First two evaluations - failed Cost [illegible]
  - Third evaluation shows some promise

WFD Tasking Continued

- AAWG had hoped to present a final document at this meeting, Because of economic eval difficulties, this will be delayed until the June meeting.
- It is estimated that this will not affect the overall time line that the FAA/Industry has been working to.

March 22, 2001 Tasking RE: Multiple Complex STCs

- We will be much better prepared to talk about this at the next meeting.

does not have full engine complement

ICE PROTECTION HWG STATUS

PRESENTATION TO ARAC TAEIG

MARCH 28, 2001

Handout 18

15TH IPHWG MEETING HELD AT RENO, JAN 15 - 19, 2001

- Completed Task 1 Operations Rule Proposal documents to the point of release to TAEIG.
- Completed the report for TAEIG on status and recommendations for future plans on Task 2.

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.

15TH IPHWG MEETING

THE DRAFT OPERATING RULE AND AC WERE PROVIDED TO THE FAA TECHNICAL WRITERS BY THE IPHWG ON JUNE 5, 2000

THE DRAFT NPRM AND AC WERE RETURNED TO THE GROUP AFTER PRELIMINARY FAA TECHNICAL AND LEGAL REVIEW ON OCT 2, 2000

THE DOCUMENTS HAD MANY CHANGES AND COMMENTS INCLUDING A COMPLETE REWRITE OF THE PROPOSED RULE LANGUAGE

A REVIEW OF THE NPRM DOCUMENT WAS COMPLETED DURING THE 14^{TH} IPHWG MEETING

THE NPRM AND AC DRAFTS WERE COMPLETED DURING THE 15^{TH} MEETING AND TRANSMITTED TO TAEIG

- DISSENTING POSITIONS REMAIN ON TWO POINTS AND ARE DOCUMENTED

THE IPHWG REQUESTS THAT TAEIG TRANSMIT THE DOCUMENTS TO FAA FOR FORMAL LEGAL AND ECONOMIC REVIEW

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.

15TH IPHWG MEETING

THE DIFFICULTIES ENCOUNTERED WITH THIS TASK HAVE BEEN REPORTED AT PREVIOUS TAEIG MEETINGS

THE GROUP WAS GIVEN THE FOLLOWING ACTION ITEM AT THE MARCH 2000 TAEIG MEETING

> **ICE PROTECTION HWG TO PREPARE REPORT ON TASK 2 STATUS, LACK OF INFORMATION AVAILABLE, FUNDING, ETC., AND WHAT NEEDS TO BE DONE BEFORE THEY CAN FINISH TASK. THEY ARE TO MAKE A RECOMMENDATION TO TAEIG FOR FUTURE PLAN ON TASKING.**

THE TASK 2 REPORT WAS COMPLETED AND TRANSMITTED TO TAEIG

SUMMARY OF TASK 2 REPORT

FOR CLARITY, TASK 2 WAS DIVIDED INTO ITS ELEMENTS, AS FOLLOWS:

2a. 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.

2b. Define an icing environment that includes supercooled large droplets (SLD).

2c. Devise requirements to assess the ability of aircraft to safely operate either

- **i) for the period of time to exit or**
- **ii) to operate without restriction**

In SLD aloft and at or near the surface.

SUMMARY OF TASK 2 REPORT

2d. Devise requirements to assess the ability of aircraft to safely operate either

i) for the period of time to exit or
ii) to operate without restriction

In mixed phase conditions if such conditions are determined to be more hazardous than the liquid phase icing environment containing supercooled water droplets.

2e. Consider the effects of icing requirement changes on 14 CFR part 25 and revise the regulations if necessary.

2f. Consider the need for a regulation that requires installation of a means to discriminate between conditions within and outside the certification envelope.

SUMMARY OF TASK 2 REPORT

A REPORT CONTAINS THE STATUS AND IPHWG RECOMMENDATIONS FOR EACH OF THESE ELEMENTS

Task 2a is complete, except that the review of advances in ice protection state-of-the-art may be considered on-going if and as new developments emerge.

Task 2d may also be considered technically complete.

- With respect to airplane handling and performance, the IPHWG has not found evidence that mixed-phase conditions are more hazardous than the liquid-phase icing environment containing supercooled water droplets having the same total water content.
- No further activity related to mixed-phase conditions is planned in the IPHWG in connection with this task

SUMMARY OF TASK 2 REPORT

Task 2b: Definition of SLD icing environment

A master SLD database is being prepared by the FAA Technical Center

- Contains 1993 data miles as of end of year 2000

This database is considered sufficiently complete as of February, 2001, to proceed with development of an icing environment containing SLD

The group recommends to TAEIG that IPHWG develop at least interim SLD certification standards using the information from the database.

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

The IPHWG believes that interim standards could be completed to concept approval during first quarter of 2002

SUMMARY OF TASK 2 REPORT

Task 2c: Requirements to safely operate in SLD

Completion of this task depends upon:

- Development of SLD certification standards under task 2b and,
- Availability of acceptable engineering tools to demonstrate compliance.

Preliminary capability for simulating large-droplet conditions exists

- Rudimentary and not validated

SUMMARY OF TASK 2 REPORT

Task 2c:

The IPHWG recommends that NASA and the FAA, in collaboration with international partners and private industry, pursue sources of funding to adapt codes, tunnels, and tankers to supply manufacturers and regulatory authorities with validated tools

Recommendations are consistent with task 11c of the April, 1997, FAA in-flight icing plan

- IPHWG recommends activities from FAA icing plan task 11c be targeted to support the completion of IPHWG task 2c
- Should be carried on concurrently with IPHWG work on task 2b

SUMMARY OF TASK 2 REPORT

Task 2e: Consider the effects of icing requirement changes on 14 CFR part 25 and revise the regulations if necessary

- **Applies to determining whether other changes to 14 CFR Part 25 are needed as a result of the new SLD certification requirements developed under Tasks 2b and 2c**

- **Cannot be undertaken until any revision of requirements is at least drafted under Tasks 2b and 2c**

IPHWG recommends proceeding with Task 2e following development of Tasks 2b and 2c to a point sufficient to understand what is required under Task 2e

SUMMARY OF TASK 2 REPORT

Task 2f. Consider the need for a regulation that requires installation of a means to discriminate between conditions within and outside the certification envelope

Task 2f depends on two considerations:

- **Need - is there evidence that some cliff exists at the edges of the current or any future (to be defined) certification envelopes that will endanger an airplane**

- **Feasibility - is there an operationally feasible technology to accomplish this objective**

A technology has been identified which may be capable of detecting the presence of drops above a specified size; however, no mature products exist

SUMMARY OF TASK 2 REPORT

Task 2f.

Understanding these issues depends on the other parts of Task 2, particularly 2b and 2c

No recommendations made to by IPHWG to TAEIG at this time

16TH IPHWG MEETING

16TH IPHWG MEETING HELD AT CAPUA ITALY, MAR 19 - 22, 2001

IN ORDER TO EXPEDITE THE CERTIFICATION RULE PROPOSAL FOR TASK 1, THE FAA PREPARED A DRAFT NPRM AND AC

THE DRAFTS WERE EDITED IN THE GROUP TO CONSENSUS AS FAR AS POSSIBLE

REMAINING ISSUES WILL BE DOCUMENTED IN A REPORT TO TAEIG

THE DOCUMENTS AND THE REPORT ARE INTENDED TO BE SUBMITTED TO TAEIG BY MAY 26, 2001

A VOTE FOR TRANSMITTAL TO FAA WILL BE REQUESTED AT THE JUNE TAEIG MEETING

IPHWG FUTURE MEETING SCHEDULE

JULY 15 - 20, 2001	MONTREAL, QUEBEC, CANADA
OCTOBER 22 - 27, 2001	SWEDEN
FEBRUARY 4 - 8, 2002	TBD, NORTH AMERICA
MAY 20 - 24, 2002	TBD, EUROPE
SEP 9 - 13, 2002	TBD, NORTH AMERICA
DEC 2 - 6, 2002	TBD, EUROPE

EMBRAER HAS OFFERED TO HOST ONE OF THE 2002 IPHWG MEETINGS IN BRAZIL. IS THERE ANY REASON THIS CANNOT BE ACCEPTED IF THE WORKING GROUP AGREES TO IT?

OTHER BUSINESS

THE GROUP UNANIMOUSLY ENDORSES JIM HOPPINS OF CESSNA AIRCRAFT CO AS THE NEXT US CO-CHAIR OF THE IPHWG

CONFIRMATION OF MR. HOPPINS IS REQUESTED EFFECTIVE AT THE OCTOBER IPHWG MEETING

Op2_22_1.doc [4910-13]

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
14 CFR Part 121
[Docket No. FAA-2000-________; Notice No.____________]
RIN 2120-___________

Operations in Icing Conditions

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: This proposal would amend the regulations applicable to operators of certain airplanes used in air carrier service and certificated for flight in icing. The proposal would require either the installation of ice detection equipment or changes to the Airplane Flight Manual to ensure timely activation of the ice protection system. This proposal also would require certain actions applicable to airplanes with reversible flight controls for the pitch and/or roll axis. This proposed regulation is the result of information gathered from a review of icing accidents and incidents, and it is intended to improve the level of safety when airplanes are operated in icing conditions.

DATES: Send your comments on or before [*90 days after date of publication in the Federal Register.*]

ADDRESSES: Address your comments to the Docket Management System, U.S. Department of Transportation, Room Plaza 401, 400 Seventh Street, SW., Washington, DC 20590-0001. You must identify the docket number FAA-2000-__________ at the beginning of your comments, and you should submit two copies of your comments. If you wish to receive confirmation that FAA received your comments, include a self-addressed, stamped postcard.

You may also submit comments through the Internet to http://dms.dot.gov. You may review the public docket containing comments to these proposed regulations in person in the Dockets Office between 9:00 a.m. and 5:00 p.m., Monday through Friday, except Federal holidays. The Dockets Office is on the plaza level of the NASSIF Building at the Department of Transportation at the above address. Also, you may review public dockets on the Internet at http://dms.dot.gov.

FOR FURTHER INFORMATION CONTACT: Kathi Ishimaru, FAA, Propulsion/Mechanical Systems Branch, ANM-112, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, WA 98055-4056; telephone (425) 227-2674; facsimile (425) 227-1320, e-mail kathi.ishimaru@faa.gov.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in the making of the proposed action by submitting such written data, views, or arguments as they may desire. Comments relating to the environmental, energy, federalism, or economic impact that might result from adopting the proposals in this document also are invited. Substantive comments should be accompanied by cost estimates. Comments must identify the regulatory docket or notice number and be submitted in duplicate to the DOT Rules Docket address specified above.

Handout 19

All comments received, as well as a report summarizing each substantive public contact with FAA personnel concerning this proposed rulemaking, will be filed in the docket. The docket is available for public inspection before and after the comment closing date.

All comments received on or before the closing date will be considered by the Administrator before taking action on this proposed rulemaking. Comments filed late will be considered as far as possible without incurring expense or delay. The proposals in this document may be changed in light of the comments received.

Commenters wishing the FAA to acknowledge receipt of their comments submitted in response to this document must include a pre-addressed, stamped postcard with those comments on which the following statement is made: "Comments to Docket No. FAA-2000-___________." The postcard will be date stamped and mailed to the commenter.

Availability of NPRMs

Internet users may reach the FAA's web page at http://www.faa.gov/avr/arm/nprm/nprm.htm or the GPO's web page at http://www.access.gpo.gov/nara for access to recently published rulemaking documents.

Any person may obtain a copy of this document by submitting a request to the Federal Aviation Administration, Office of Rulemaking, ARM-1, 800 Independence Avenue SW., Washington, DC 20591, or by calling (202) 267-9680. Communications must identify the notice number or docket number of this NPRM.

Persons interested in being placed on the mailing list for future rulemaking documents should request from the above office a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

BACKGROUND

On October 31, 1994, an accident involving an Aerospatiale Model ATR72 series airplane occurred in which icing conditions, believed to include freezing drizzle droplets, were reported in the area. The FAA, Aerospatiale, the French Direction Générale de l'Aviation Civile, Bureau Enquete Accident, National Aeronautics and Space Administration (NASA), National Transportation Safety Board (NTSB), and others have conducted an extensive investigation of this accident. This investigation has led to the conclusion that freezing drizzle conditions created a ridge of ice aft of the deicing boots and forward of the ailerons, which resulted in uncommanded roll of the airplane.

Existing Regulations

Certification Regulations. The current regulations that are applicable to flight in icing conditions are contained in Title 14, Code of Federal Regulations (CFR) Part 23 (§ 23.1419, "Ice protection") for small airplanes, and Part 25 (§ 25.1419, "Ice protection") for transport category airplanes. Both of these regulations require that an airplane must be able to safely operate in the continuous maximum and intermittent maximum icing conditions of 14 CFR Part 25, Appendix C. Appendix C characterizes continuous maximum and intermittent maximum icing conditions within stratiform and cumuliform clouds. Freezing precipitation (freezing drizzle and freezing rain) are not included. Appendix C defines icing cloud characteristics (for both small and transport airplanes) in terms of mean effective drop diameters, liquid water content, temperature, horizontal extent, and altitude. Icing conditions containing freezing drizzle and freezing rain sometimes result in mean effective diameters that are larger than the mean effective drop diameters defined in Appendix C. Consequently, these icing conditions containing freezing drizzle and freezing rain are not considered during the certification of the airplane's ice protection system, and exposure to these conditions could result in hazardous ice accumulations.

Operating Regulations. 14 CFR Part 121.629(a) states:

> No person may dispatch or release an aircraft, continue to operate an aircraft enroute, or land an aircraft when in the opinion of the pilot in command or aircraft dispatcher (domestic and flag operations only), icing conditions are expected or met that might adversely affect the safety of the flight.

Also, 14 CFR Part 121.341 requires certain types of ice protection equipment and wing illumination equipment to be installed.

Neither the operating regulations nor the certification regulations require a means for the pilot in command to specifically identify that hazardous icing conditions have been met.

NTSB Safety Recommendations

The NTSB issued various safety recommendations to the FAA following the Model ATR72 accident. One of the recommendations, A-96-56, states in part that:

> If safe operations in certain icing conditions cannot be demonstrated by the manufacturer, operational limitations should be imposed to prohibit flight in such conditions and flight crews should be provided with the means to positively determine when they are in icing conditions that exceed the limits for aircraft certification.

In response to the latter portion of this safety recommendation, the FAA tasked the Aviation Rulemaking Advisory Committee (ARAC), by notice published in the Federal Register on December 8, 1997 (62 FR 64621), to:

> . . . 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).

The Aviation Rulemaking Advisory Committee (ARAC)

The ARAC was formally established by the FAA on January 22, 1991 (56 FR 2190), to provide advice and recommendations concerning the full range of the FAA's safety-related rulemaking activity. The FAA sought this advice to develop better rules in less overall time, using fewer FAA resources than are currently needed. The committee provides the opportunity for the FAA to obtain firsthand information and insight from interested parties regarding proposed new rules or revisions of existing rules.

There are 64 member organizations on the committee, representing a wide range of interests within the aviation community. Meetings of the committee are open to the public, except as authorized by section 10(d) of the Federal Advisory Committee Act.

The ARAC establishes working groups to develop proposals to recommend to the FAA for resolving specific issues. Tasks assigned to working groups are published in the Federal Register. Although working group meetings are not generally open to the public, all interested parties are invited to participate as working group members. Working groups report directly to the ARAC, and the ARAC must accept a working group proposal before that proposal can be presented to the FAA as an advisory committee recommendation.

The activities of the ARAC will not, however, circumvent the public rulemaking procedures. After an ARAC recommendation is received and found acceptable by the FAA, the agency proceeds with the normal public rulemaking procedures. Any ARAC participation in a rulemaking package will be fully disclosed in the public docket.

The rulemaking proposal contained in this notice is based on a recommendation developed by the Ice Protection Harmonization Working Group (IPHWG) of ARAC that ARAC approved and presented to the FAA as a recommendation.

DISCUSSION

Review Process

To address the task, the IPHWG followed a process consisting of the following five elements:

1. Review of the airplane icing related accident/incident history,
2. Identification of safety concerns,
3. Identification of the airplanes subject to the safety concerns (i.e., applicability),
4. Identification of various means to address the safety concerns, and
5. Review of the technology available to allow compliance with any proposed methods of addressing the safety concerns.

These five elements are discussed in more detail below.

1. Accident/Incident History Review

The IPHWG reviewed the airplane icing-related accident/incident history and developed a database of approximately 1,300 worldwide icing-related accidents and incidents. The IPHWG then refined the database by:

- Removing duplicate entries and reports with insufficient data.
- Removing elements that were not relevant to inflight airframe icing problems, such as reports related to ground deicing and carburetor icing.
- Excluding single-engine piston airplanes, because most of these airplanes are not certificated for flight in icing. (Although a few of these airplanes may be

certificated and equipped for flight in icing, the IPHWG considered that their exclusion would not affect the outcome of the review.)

- Removing reports involving multi-engine piston airplanes that were not certificated for flight in icing.
- Removing reports of events in which externally aggravating circumstances existed, such as operation of the airplane outside of its weight and balance limitations, descent below published minimums, or other reasons not related to airplane icing.

The IPHWG reviewed the remaining events and identified 96 events that contained adequate information to apply the following criteria:

- Was there ice accretion that was not known to the flight crew? and
- Would knowledge of this ice accretion have made a difference to the outcome of the accident or incident?

Based on these 96 events, the IPHWG concluded that in at least 61 events, there is substantive documented accident and incident history in which the existing level of flight crew cognizance of ice buildup on airframe surfaces was not adequate.

Once the group had concluded that flight crew cognizance of ice buildup on airframe surfaces was not adequate, an effort was undertaken to further analyze the data in order to identify factors which play a role in the flight crew's situational awareness as it pertains to icing. A parallel effort was undertaken to identify aerodynamic and system design factors which might play a role in the susceptibility of the airplane to icing effects, thus influencing the procedural vigilance required of the flight crew.

Both of these efforts required that the database be expanded. To do this, the same refinements described above were applied to the 1,300-event database, except that reports were included in which there was not sufficient information to positively determine whether flight crew knowledge of the ice accretion would have made a difference to the outcome of the accident or incident. This review yielded 234 events.

All 234 events were used to examine aerodynamic and system design factors. However, in order to look at issues regarding the flight crew's situational awareness, single-pilot operations were not considered relevant to multi-pilot aircrew cognizance. Therefore, events which were likely to have involved a single pilot were removed from the 234 events for this purpose. This left 119 events.

During the review of the 96-event data set, certain factors became apparent and these were evaluated more closely using the 119-event data set. In particular, factors which affect crew workload were considered, such as phase of flight and crew complement.

Crew complement was estimated based on the number of pilots required by the type certificate and/or the type of operation being conducted. Phase of flight was extracted from the narratives of the events.

This part of the analysis revealed that 49% of the 119 events had taken place during the approach and landing phases of flight, 38% had taken place during the cruise phase, 8% during the climb phase, and 2% during the go-around phase.

The phase-of-flight analysis was conducted again using only accidents. The pattern remains similar: 73% of the accidents had taken place during approach and landing, 17% during cruise, 7% during climb, and 2% during go-around.

Reported incidents represent a smaller portion of total incidents than reported accidents do of total accidents. However, if the proportion of reported incidents to total incidents is assumed to remain the same across all phases of flight, the relationship of accidents to incidents in each phase becomes of interest. It was found that in the case of approach and landing, there occurred just over 3 accidents for every reported incident. In the case of the cruise phase, there occurred 0.3 accidents for every reported incident; in the case of climb, 0.4 accidents for every reported incident.

This led the IPHWG to consider why the approach and landing phases were apparently much more likely to result in an event than the cruise and climb phases, and why that event was much more likely to be an accident.

The approach and landing phases of flight involve considerably higher degrees of pilot workload than do the cruise and climb phases. Thus, there is less attention available to manage the ice accretion problem. Further, these phases involve continuous changes in flight parameters such as airspeed, altitude, and bank angle. Therefore, indications of ice accretion other than visual cues, such as trim changes and drag increases, are much less visible to the crew. Finally, research was considered which suggests that the drag effects of ice accreted at low angles of attack can become very significant when the angle of attack is increased. Ice accreted early in the approach phase may not manifest its effects until the angle of attack is increased later in the approach or landing.

All of these factors influence the situation while the airplane is in close proximity to the ground.

The pilot workload required varies. In all cases, it requires that the ice accretion be detected. In some cases, it then requires that the ice accretion be evaluated prior to operation of the ice protection system (IPS).

With this data in hand, further work was undertaken to examine the crew response to knowledge of ice accretion. In 122 events out of 234, the narrative contained information that the flight crew knew that ice was accreting on the airframe. Yet in only 48 cases was there positive evidence that the crew had operated the IPS. This did not seem to be affected by crew complement, with 20 of the 48 cases involving a single pilot. In 16 of these cases, there was positive evidence that the crew had not operated the IPS; in the remainder, no information regarding IPS operation was available.

The IPHWG also considered extensively the significant air carrier accidents and incidents in recent years due to icing. These included the accidents at Roselawn, Indiana, in 1994 and at Monroe, Michigan, in 1997. It also included incidents involving Fokker F-27s at East Midlands, UK, and Copenhagen, Denmark; the British Aerospace ATP at Cowley, UK; Embraer EMB-120s at Tallahassee, Elko, Fort Smith, and Klamath Falls, US, and several Aerospatiale/Alenia ATR events during the 1980s. In nearly all of these cases, the flight crew was aware of ice accretion yet did not feel it warranted activation of the IPS. In other cases, notably the ATR at Mosinee, Wisconsin, the crew was completely unaware of clear ice accretion during approach.

2. Safety Concerns

Activation of Airframe IPS. The airplane icing-related accident/incident history review revealed accidents and incidents where the flight crew either:

- Was completely unaware of ice accumulation on the airframe, or

- Was aware of ice accumulation but judged that it was not significant enough to warrant operation of the IPS.

This led the IPHWG to conclude that flight crews must be provided with a clear means to know when to activate the IPS.

Exit Icing Conditions. The database contains accidents and incidents where the IPS was operated according to accepted procedures, yet the ice accretions still created degradations that led to an event. Therefore, the IPHWG concluded that the flight crew must be provided with a means to know if the airplane is in conditions conducive to ice accumulation that warrant the flight crew taking actions to exit icing conditions.

3. Applicability

The IPHWG examined the 234-event accident and incident history and found that discriminating factors exist that significantly reduce the risk of icing accidents and incidents. A wide range of factors was considered, including airplane size, type of flight control system, and wing chord length.

A limited analysis of the event database described above revealed that average wing chord length has a roughly inverse relationship to the event history. Of the data considered, the IPHWG noted that airplanes with average chord lengths in excess of ten feet had not experienced any accidents due to in-flight icing. Although some airplanes with shorter chords have no event history, many do.

Evidence is available to show that contamination on the upper wing surface results in an increasing deterioration in the wing's coefficient of lift and the coefficient of drag as the ratio of surface roughness height to chord length increases. This may sufficiently influence the contamination effects in a typical icing encounter such that a large chord experiences minimal aerodynamic effect, while a small chord may experience significant effects. Another contributing factor for the lack of accidents may be the fact that for any given icing encounter, droplets will impinge further aft and the resulting ice shape will be larger on a short chord wing than on a longer chord wing. Chord length, then, may be an appropriate discriminator for determining which airplanes have a higher risk of accidents and incidents without the flight crew having a clear means to know when to activate the IPS and when to exit icing conditions.

However, chord length is not a commonly known attribute of the airplane; therefore, the IPHWG sought a simple discriminator that could be readily understood by the aviation community. In the accident/incident database, those airplanes with a ten-foot average chord correspond quite well with airplanes with a weight of 60,000 pounds. Since the maximum certificated gross takeoff weight is simple and well-understood, it was recommended as the discriminating parameter.

4. Possible Means of Addressing the Safety Concerns

The FAA has issued Airworthiness Directives (AD's) to require activation of pneumatic deicing boots at the first signs of ice accumulation on several types of airplanes operated under 14 CFR Part 121. These AD's relieve the pilot of determining whether the amount of ice accumulated on the wing warrants activation of the IPS. However, the flight crew's observation of ice accumulations can be difficult during times of high workload, operations at night, or when clear ice has accumulated. Also, the difficulties of observing ice accumulations is applicable to any IPS which relies on this observation for activation of the system, not just pneumatic deicing boots.

The IPHWG concluded that an improved means to address these situations would be to require installation of a device that would alert the flight crew that the IPS should be activated. An advisory ice detection system in conjunction with substantiated visual cues will provide a much higher level of safety than visual cues alone. This device would mitigate the effects of high workload and of human sensory limitations in detecting ice and evaluating its thickness. When using such a device in conjunction with a manual ice protection system as required in 121.XXX (a)(2), the IPHWG considers it is not acceptable to use crew assessment of depth of ice as a discriminator in deciding when to operate the de-icing system. The intent is to permit current certified manual systems to be used in such a way that they replicate the effectiveness of an automatic system without the dependency on the crew to establish ice depths. There are several types of airplanes currently in operation which have primary ice detection systems installed, and the IPHWG considers that these airplanes already meet the desired level of safety.

An alternative to requiring the installation of such an ice detector would be to require that the IPS be operated continuously when the airplane is operating in conditions conducive to airframe icing: reference 121.XXX (b)(1). In this case, the flight crew would operate the ice protection system in response to a specific air temperature threshold and the presence of visible moisture. Temperature and visible moisture information is readily available and unambiguous. This approach has disadvantages with respect to increased maintenance due to increased time in operation. However, it presents large advantages with respect to flight crew workload and procedural reliability. It is consistent with systems used as anti-ice systems and is the procedure in use for many thermally anti-iced small jets. The IPHWG noted that small jets that used these procedures were absent from the incident data base. When a manual de-icing system is required to be operated as defined above, the IPHWG considers it is not acceptable to use crew assessment of depth of ice as a discriminator in deciding when to operate the de-icing system. The intent is to permit current certified manual systems to be used in such a way that they replicate the effectiveness of an automatic system without the dependency on the crew to establish ice depths. The IPHWG considered that this procedure could be used as an alternative to an ice detector.

Minority Position - BAE Systems (Supported by Cessna Aircraft Company)

The Part 121 Icing Ops rule proposed by the IPHWG has 3 options for demonstrating compliance with part (a) and (b) when flying in conditions conducive to airframe icing as follows:

(a) (1) Airplane must be equipped with a primary ice detection system or,
(2) Substantiated visual cues and an advisory ice detection system or,
(b) (1) & (2) Mandate continuous operation of the ice protection system at various phases of flight.

BAE Systems cannot support the proposed Part 121 Operational rule parts (a) and (b) due to the inability of a Part 121 rule to recognize compliance by an equivalent level of safety. The proposed rule has been developed to recognize that some aircraft types demonstrate unacceptable performance or handling characteristics in icing conditions. The incident and accident database was analyzed to determine a potential configuration that is susceptible to unsafe characteristics. The result of that analysis is that any aircraft of less than 60,000lbs would be affected by the introduction of this rule. There are a number of aircraft types within this criteria that have a good safety record which would now have to revise the operation procedures in icing from those developed during certification.

Prior to completion of this IPHWG operational rule making activity the FAA issued NPRM's proposing Airworthiness Directives to modify the procedures for operation of the airframe de-icing systems of the affected airplanes. The proposed ADs would require activation of the airframe ice protection system at the first sign of ice formation anywhere on the aircraft, and thereafter operation continuously to minimize ice accretions on the airframe. This requirement was not supported by BAE Systems and some other manufacturers since the recommended and approved use of the de-icing systems was as established during certification and currently presented in the AFM. The certified system operation requires the crew to establish when approximately ½ inch of ice has accreted prior to operation of the manually cycled de-icing system. This procedure was developed and agreed with the authorities. There appears to be no safety concern on the BAE Systems aircraft affected (or indeed some other aircraft) which would require such a change to system operating procedures, as evidenced by the withdrawal of the AD's.

The FAA decision to withdraw the proposed AD's on some aircraft types was based on evidence supplied by the respective manufacturers. Typically this included information on the certification testing, margin to stall warning, the susceptibility to adverse handling characteristics and the information presented in the AFM. On BAE Systems aircraft types this included information on ice accretions appropriate to normal de-icing system operation and to delayed activation or system failure. The FAA has thereby accepted that some aircraft can continue to operate the de-icing system as certified and have recognized that the crew have adequate means to determine the required level of ice has accreted and then cycle the boots accordingly. On these aircraft there is no justification to require the de-icing system operation to be amended by the introduction of the IPHWG proposed Part 121 rule.

The intent of parts (a) (1), (2) and (b) parts (1) & (2) of the proposed Part 121 Operating rule was not to require the current fleet to have primary ice detection systems fitted but also to allow installed systems to be able to demonstrate compliance. Compliance with options (a)(2) or (b) would require changes to the certification of the ice protection system on some Part 23 and Part 25 aircraft which the FAA have previously agreed, by withdrawing the proposed AD's, are not required. The withdrawal of the AD was not dependent on the aircraft having an ice detector fitted.

A list of aircraft that have had the de-icing AD's withdrawn is detailed below. As can be seen there is potential for a considerable number of aircraft types to be affected by the introduction of the Part 121 rule as currently written.

It is BAE Systems contention that some aircraft that fall within the applicable criteria do not have a flight safety issue in icing, and as such should be allowed to operate as certified. BAE Systems propose that, since the Part 121 rules do not have a mechanism for accepting equivalent level of safety, the most effective way to accommodate this position is to revise the IPHWG proposed rule such that it would not be applicable to any aircraft type that has had the proposed de-icing AD withdrawn. This will recognize that the FAA have already determined the operation of these specific aircraft types in icing conditions meets the required safety levels and therefore removes the need for amending system operation by the Part 121 Ops rule.

List of Aircraft Eligible for Part 121 Operations with AD withdrawal

Part 25 Airplane models	Docket No.
Cessna Aircraft Company, Models 550, and 560 Series Airplanes.	99-NM-136-AD
Jetstream, Model 4101 Airplanes	99-NM-146-AD

Part 23 Airplane Models	Docket No.
LET, a.s., Model L-420 Airplanes	99-CE-39-AD
British Aerospace, Jetstream Models 3101 and 3201 Airplanes	99-CE-40-AD
Raytheon Aircraft Company, 90, 99, 100, 200, 300, 1900 Series Airplanes	99-CE-46-AD
Short Brothers & Harland Ltd., Models SC-7 Series 2 and SC-7 Series 3 Airplanes	99-CE-48-AD

Majority Response

As described in the minority position, the FAA withdrew several notices of proposed rulemaking (NPRM's) which proposed that the airframe pneumatic deicing boots be activated at the first sign of ice accretion. Some of these withdrawals were based upon data that substantiated the airplanes could safely operate if the IPS was operated as certificated. However, the FAA states that during the evaluation of the data the FAA did not consider whether the flightcrew has a clear means to determine when the IPS should be activated. For example, if the certificated method of IPS operation is manual activation when ½ inch of ice has accumulated, the FAA did not evaluate whether the flightcrew could determine the ½ inch was present. The FAA evaluated whether the data substantiated that the airplane could safely operate with the ½ inch of ice. If the substantiation was found to be acceptable the FAA withdrew the NPRM. Consequently, an NPRM withdrawal does not equate to a determination by the FAA that there is a clear means to know when to activate the IPS. The visual cues to operate the ice protection systems are accepted during the initial known icing certification of aircraft. However, the IPHWG review of the accident and incident data indicates that the flightcrew's observation of these visual cues may be difficult on some models during times of high workload, operations at night, or when clear ice has accumulated.

The Jetstream 4101 is one case where the NPRM was withdrawn and is described in the Airworthiness Directive Final Rule. Handling and performance flight tests were accomplished which substantiated that the airplane could be safely operated with certain ice accretions on the airplane. The tests included: Normal Operation of the Deicing Boots, ½ to ¾ inch of ice on the protected wing leading edges and up to 3 inches of ice on unprotected leading edges; Simulated Failure of the Deicing Boots, approximately 1 to 1½ inches of ice on all leading edges; and Ice Accreted During the Take-off Phase, a thin rough layer of ice accreted during the initial take-off phase to 400 feet, prior to operation of deicing boots. It might appear from this information that there is a factor of safety due to the tests with 1 to 1½ inches of ice, which would compensate for not having a clear means to know when the IPS should be activated. However, for the normal condition of activating the boots with ½ to ¾ inch of ice the handling and performance criteria are more stringent than for the failure condition with 1 to 1½ inches. It cannot be concluded that the tests conducted with large ice accretions justifies a clear means to know when to operate the deicing boots during normal operations is not needed.

There are many events in the accident/incident data base in which the ice protection system was operated either late or not at all. This led the IPHWG to conclude that the flightcrew need a clear means to know when to activate the IPS. The proposed rule is intended to address that need. It is possible to have an aircraft that can safely operate in icing conditions provided the IPS is operated as certificated, however the certificated means to know when to operate the IPS may not be clear. Therefore, the proposed rule should not exclude aircraft that had the proposed deicing NPRM's withdrawn.

Nonetheless, the majority of the IPHWG requests that the FAA further consider the airplanes for which the proposed Airworthiness Directives were withdrawn prior to publication of the NPRM for this proposed operating rule to assure that operating them as required by the NPRM will not degrade their performance or adversely affect the safety of their operation. This consideration may need to include a review of the visual means used to determine when the IPS should be activated to evaluate whether they are in fact inadequate under some circumstances.

The information in the database revealed that the phases of flight that presented the greatest risk due to airframe icing were those that were associated with low speed and relatively high angle-of-attack operation (i.e., approach, landing, go-around, and holding). Takeoff was excluded because the accidents related to that phase of flight were caused by improper ground deicing/anti-icing procedures; this has been adequately addressed by amendment 121-253 to 14 CFR [§ 121.629(b) and (c), "Operating in icing conditions"]. This conclusion was based primarily on the preponderance of icing accidents taking place during those phases, particularly approach and landing.

The IPHWG considered an alternative requirement that would apply in any case where an ice detector was not operational and/or installed. This alternative would require that, when the airplane is operating in conditions conducive to airframe icing, the IPS must be operated continuously. The group then considered how this procedure would apply to each phase of flight.

The database lists ten accidents as originating during cruise. In six of the ten accidents, the flight crew was aware of the ice accretion. In the remaining four accidents, very little relevant data was available. These data were insufficient to draw meaningful conclusions and the IPHWG determined that the cruise accident history did not substantiate rulemaking.

The database also lists a number of incidents in the cruise phase, of which at least five were potential accidents. Further examination of the incidents where sufficient data was available led the IPHWG to conclude that the crews were aware that ice was accreting and that operation of the IPS at the first sign of ice accretion would have prevented the incidents. Examination of these incidents caused the IPHWG to conclude that the cruise phase should be included in the rule. However, the IPHWG did not believe that continuous operation of the IPS while in conditions conducive to icing was warranted. The IPHWG was reluctant to require continuous operation of manually cycled ice protection systems in conditions conducive to airframe icing due to considerations of crew workload and a concern that it would introduce a procedure possibly leading to substantial non-compliance. The IPHWG felt that continuous operation of the IPS at the first sign of ice accretion was more appropriate and alleviated the concern with procedural non-compliance.

With respect to the climb, approach, landing, holding and go-around phases of flight, the IPHWG determined that the following factors substantiated requiring the continuous operation of the IPS while in conditions conducive to icing:

- An overall majority of events which originated in these phases of flight;
- A sufficient number of events in which the flight crew was confirmed to be

unaware of ice accretion, supplemented by a substantial number of events in which the flight crew awareness of ice accretion was unknown;

- High cockpit workload resulting in low residual flight crew attention;
- Frequent maneuvering, resulting in little opportunity for the flight crew to detect aerodynamic degradations due to icing;
- Maneuvering at relatively high angles of attack.

Minority position: FAA

The flightcrew must be provided with a clear means to know when to activate the IPS both for the initial activation and on a continuing basis. It is the FAA's position that the preamble does not adequately justify the acceptability of using the flightcrew's observation of airframe ice accretions as the sole means of knowing when to activate the ice protection system during cruise.

Section 4 of the preamble states that the flightcrew's observation of ice accumulations can be difficult during times of high workload, operations at night, or when clear ice has accumulated. The preamble does not discuss the acceptability of flightcrew observation of airframe ice accretions during cruise if the operations are at night or if clear ice has accumulated.

The preamble states in section 2 that there were accidents and incidents where the flightcrew was completely unaware of ice accumulation on the airframe. It is the FAA's position that the flightcrew must have a clear means to know when to activate the ice protection system and that reliance on visual observation of ice accretions on the airframe during cruise is not acceptable when consideration is given to operations at night and if clear ice has accumulated.

The FAA is also concerned with the flightcrew workload created during cruise, by an IPS that must be manually cycled. An IPS that is automatically cycled or operates on a continuous basis (e.g. an anti-icing system) does not create this additional workload and is not a concern. It is the FAA's position that the following factors result in an unacceptable burden on the flightcrew during cruise:

a. the additional flightcrew workload if the IPS is cycled manually,
b. it may be necessary to operate the IPS during all of the cruise phase,
c. cruise is the longest phase of flight, and
d. workload during cruise varies, but can be high when operating in congested areas.

Therefore, the FAA proposes as follows:

1) When the airplane is operated in airframe icing conditions, the rule should require activation of the ice protection system during all phases of flight except first and second segment climb (0 to 400 feet). Take off climb prior to the completion of second segment

climb is exempted because the accidents during this phase of flight are attributed to improper ground deicing/anti-procedures and not to inactivation of the IPS.

2) The rule should require that the airplanes be equipped with a system which automatically cycles the ice protection system or the ice detection system must be effective for the initial activation of the IPS and subsequent cycles if the IPS operates in a cyclical manner.

Majority Response

During the cruise phase, the IPHWG proposed rule as written would allow the use of visual observation of ice formation anywhere on the aircraft as the means of knowing when to activate the ice protection system during cruise. The FAA minority position would require continuous operation of the system during cruise. The cruise phase of flight typically has limited exposure to actual airframe icing due to the limited horizontal extent of icing clouds. Per the FAA Technical Report DOT/FAA/CT-88/8-1 "Aircraft Icing Handbook" (March 1991), Figure 1-32, 90% of all icing clouds will have a horizontal extent of less than 50-statute miles. Typical Part 121 turboprop aircraft have cruise speeds on the order of 275 to 300 KTAS. Based on these figures, 90% of the icing clouds will be transited on the order of 9 minutes. Based on the proposed guidance of a 3-minute maximum time interval, the crew workload would typically consist of four manual activation cycles during the cruise phase of flight.

For most phases of flight, the rule as proposed requires the use of conditions conducive to airframe icing as a means to determine when to operate the ice protection systems. However, the probability of encountering the appropriate temperature and visible moisture conditions far exceeds the probability of actually accreting ice. Per the FAA Technical Report DOT/FAA/CT-88/8-1 "Aircraft Icing Handbook" (March 1991), Figure 1-37, icing will occur a maximum of approximately 40% of the time spent in clouds with temperatures below freezing. This implies that if the system is required to be operated during the cruise phase in conditions conducive to airframe icing, there will be no actual airframe ice accretions greater than 60% of the time the system is required to be operated. Were the FAA proposal of operating the ice protection system continuously during cruise in based on clouds and temperature to be adopted, this increase in the amount of time that the flight crew would be required to operate the ice protection systems could indeed lead to increased workload concerns, particularly with aircraft certified with manual pneumatic de-ice systems.

Manually operating a pneumatic de-ice system on temperature and moisture cues is considered acceptable for short durations or for periods of increased risk. The vertical climb and descent phases of flight are typically of limited duration with respect to proposed guidance of a 3-minute maximum time interval for ice protection system operation. These flight phases also tend to transition clouds vertically, which also limits the duration of the exposure. The additional flight crew workload for aircraft with manual pneumatic de-ice systems during these relatively limited exposures was accepted by the majority of the group IPHWG as compensating. However, directing flight crews to operate a manual pneumatic de-ice system in such a manner over prolonged periods of cruise in benign cloud conditions would create a situation where the motivation to comply would be greatly reduced due to the requirement to expend effort to remove airframe ice that is not present.

In addition, the FAA proposed Airworthiness Directives in 1999 and 2000 to require the operation of the de-ice boots on certain airplane types at the first sign of formation anywhere on the aircraft with continued operation to minimize ice accretions. The appropriateness of this method of operation is still a controversial issue (See BAE/Cessna minority position on the topic). However, the requirements of the Airworthiness Directives are similar to the requirements of the IPHWG proposal as written and no known issues regarding crew workload have surfaced. The issues raised in this document in the BAE/Cessna minority position are not workload related.

Based on the above considerations, the alternative of manually operating the boots during the cruise phase of flight based on temperature and moisture conditions was not considered by the IPHWG to be warranted (based on examination of the accident and incident history) or practical (based on frequent operation of the system with no actual ice accretions and the longer exposure of the cruise phase of flight). As stated in the preamble and generally acknowledged by the IPHWG, flightcrew observation of ice accumulations can be difficult under some circumstances. The majority of the IPHWG feel that allowing this as written in the proposal for the cruise phase is mitigated by the guidance provided in the proposed advisory circular for AFM language, as follows:

- If an automatic cycling mode is <u>not</u> available, the system must be operated at short intervals (not to exceed three minutes) to minimize ice accretions. In addition, the system must be operated for at least one complete cycle immediately prior to:

a. Decreasing airspeed for holding or for maneuvering for approach and landing;

b. Commencing a holding turn;

c. Commencing the turn intended to intercept the final approach course inbound, including the procedure turn; and

d. Selecting landing flaps.

These actions will remove any ice accumulated during cruise without the crew's knowledge.

With respect to the second part of the FAA proposal, the majority of the IPHWG believe that adoption of the FAA minority position requiring automatic cycling of the ice protection system or an ice detection system effective for each cycle of the ice protection system would in effect disallow the use of manually operated ice protection systems in Part 121 operations due to the complexity of the certification issues which would ensue.

It has never been the intention of the IPHWG to challenge the basic icing certification of any airplane to which this retrospective operating rule would apply. The proposal to require all aircraft to be equipped with a system that automatically cycles or the use of an ice detection system that is effective for the initial activation of the IPS and subsequent cycles would require the re-certification of aircraft with pneumatic manual de-ice systems.

For automatic cycles, the design change entails more than the addition of a timed control function to actuate the boots. The effectiveness of an existing manual pneumatic de-ice system to operate in an automatic cycle mode would need to be evaluated. The de-ice system effectiveness with thin ice accretions is largely dependent on whether the pneumatic system design can supply sufficient air to rapidly inflate the boots in an automatic cycle. An evaluation of the pneumatic characteristics of the system would be necessary. The failure monitoring strategy would likely require redesign and evaluation. The system reliability would need to be reassessed based on the increased number of operation cycles that typically occur with automatic systems. In addition, the residual and intercycle ice accretions handling qualities effects would need to be evaluated, typically both with simulated ice shapes and in natural icing conditions.

The alternate suggestion of using an ice detection system that is effective for the initial activation of the IPS and subsequent cycles if the IPS operates in a cyclic manner also would require reopening basic icing certification. While technology exists to operate a manual ice detection system in this manner, no Part 121 aircraft has been certificated with this technology. The technology that does exist is advisory only and has not been certified as a primary ice protection system activation means with the associated system safety implications. Certification of such technology would likely require a extensive program to mature the technology, design a system around it including both control architecture and failure monitoring. Extensive flight-testing to verify system function and any effects on the aircraft handling qualities with residual or intercycle ice accretions would be required. The magnitude of these types of design changes is believed to be beyond the scope of an operating rule.

The majority of the IPHWG believe that if a retrospective re-certification of an individual airplane type's ice protection system should be found necessary, it should be required through the Airworthiness Directive process, not in an operating rule. The majority also believes that the adoption of the rule language as proposed would not result in unacceptable increase in crew workload and is the most feasible means to address this issue.

In some cases, airframe manufacturers have specified definitions of icing conditions relative to given airplane types. In the absence of type-specific information, conditions conducive to airframe icing may be considered to exist in flight at an outside air temperature at or below +2 deg. C. in clouds or precipitation.

The safety concern of when to exit icing conditions was partially addressed in 1996 by a series of AD's issued by the FAA. [Amendment 39-9698, AD 96-09-22 (61 FR 20674, May 7, 1996) is typical of these AD's.] The AD's require certain airplanes to exit icing when the conditions exceed the capabilities of the ice protection equipment. Generally, the visual cues for determining that the flight crew must act to exit icing conditions are subjective and can result in varying interpretations. Terms such as "unusually extensive ice," ice that is "not normally observed," and ice that is "farther aft than normally observed" are used in the AD's. These are all variable terms that are largely dependent on flight crew experience. The IPHWG concluded that less subjective means of determining when the flight crew should exit icing conditions are needed.

5. Technology

To ensure that viable means exist for compliance with any proposed methods of addressing the safety concerns, the IPHWG reviewed the current state of technology with regard to ice detectors and aerodynamic performance monitors.

Ice detector technology is sufficiently mature that there currently are available several methods that can reliably alert the flight crew as to when the IPS should be activated. This type of technology already has been certificated on various airplanes as either an advisory or a primary means of determining when the IPS should be activated. However, an ice detection system with the capability to alert the flight crew when to exit icing conditions would have to be able to detect when:

a. The icing conditions encountered exceed the criteria to which the airplane was certificated; or

b. Ice is accreting on surfaces of the airplane where it could prove hazardous and that were not addressed in the airplane's icing certification.

Some ice detection systems currently installed on airplanes have the capability to detect and alert the flight crew that ice is accreting on sensor elements of the detector. Depending upon the intended application of these detectors, ice accretions of approximately 0.1 mm to 1 mm and larger are detectable. However, these detectors have not been proven to operationally perform either of the functions identified in paragraphs a and b above.

Due to the unproven capabilities of ice detectors for the above application and the immature development of aerodynamic performance monitors, the IPHWG considered additional means for the flight crew to know when they should exit icing conditions.

There is an accident and incident history caused by the uncommanded deflections of reversible flight controls in both pitch and roll axes in icing conditions. These uncommanded deflections were the result of ice accreting ahead of the control surfaces, either aft of the protected area or on the protected area when the IPS was not activated. This resulted in airflow separation over a control surface. Such a flow separation changes the pressure distribution on the control surface. The resulting control force change may be quite large, with significant difficulty for the flight crew to manage. In some cases, control of the airplane may not be regained.

In the database there is no history of accidents or incidents due to uncommanded rudder deflections. Normal operation of the airplane does not expose the vertical stabilizer to high sideslip angles (angles of attack) that could cause the vertical tail to stall and result in uncommanded movement of the rudder; there is a large stall margin for the vertical tail. Due to engine inoperative and crosswind landing requirements, the rudder is designed for operation at high sideslip angles without force reversal. The IPHWG found no grounds for including the yaw axis in the proposed rule.

For irreversible flight controls, the control surface actuators are sized to maintain the control surface in its commanded position throughout the airplane's flight envelope, including high-speed dive. This results in the design loads for the actuators being larger than the loads induced by flow separation caused by ice accretions aft of the airplane's protected areas. Therefore, airplanes with irreversible flight controls are not subject to uncommanded control surface deflection caused by ice accretions.

It is feasible for the current ice detector technology to identify the existence of ice aft of the protected areas. Based on the accident and incident history and the current state of ice detector technology, the IPHWG recommended that the regulations be revised to address the known safety concern of ice accumulations aft of the airframe's protected areas on airplanes with reversible flight controls in the pitch or roll axis.

The IPHWG also acknowledged that, in lieu of an ice detector, it might be possible to use the flight crew's observation of ice accretion on reference surfaces, provided that the visual cues are substantiated for the specific airplane.

The relevant icing accidents and incidents occurred on airplanes equipped with pneumatic deicing boots. However, the accumulation of ice aft of the protected areas due to large droplet icing conditions can occur on any airplane, regardless of the type of IPS installed on it. Therefore, the IPHWG maintained that any revision to the current regulations should be applicable regardless of the type of IPS.

Definition of Terms

For the purposes of this proposed rule, the following definitions are applicable:

a. **Advisory ice detection system**: An advisory system annunciates the presence of ice accretion or icing conditions. The cockpit crew is responsible for monitoring the icing as defined in the AFM, typically using total air temperature and visible moisture criteria, visible ice accretion, or specific airframe ice accretion thickness, and activation by the cockpit crew of the anti-icing or de-icing system(s) remains a requirement. The advisory system provides information to advise the cockpit crew of the presence of ice accretion or icing conditions but it can only be used in conjunction with other means to determine the need or timing of anti-icing or de-icing system activation.

b. **Airframe icing:** Ice accretions on portions of the airplane on which supercooled liquid droplets may impinge, with the exception of the propulsion system.

c. **Anti-Icing**: The prevention of ice formation or accumulation on a protected surface, either by evaporating the impinging water or by allowing it to run back and off the surface or freeze on non-critical areas.

d. **Automatic cycling mode:** A mode of airframe de-icing system operation that provides repetitive cycles of the system without pilot selection of each cycle. This is generally done with a timer and there may be more than one timing mode.

e. **Conditions conducive to airframe icing:** Visible moisture at or below a static air temperature of +2 deg. C., unless otherwise substantiated.

f. **Deicing**: Removal or the process of removal of an ice accretion after it has formed on a surface.

g. **Irreversible flight controls:** All of the force required to move the pitch, roll, or yaw control surfaces is provided by hydraulic or electric actuators, the motion of which is controlled by signals from the cockpit controls. Loads generated at the control surfaces themselves are reacted against the actuator and its mounting and cannot be transmitted directly back to the cockpit controls.

h. **Large droplet conditions conducive to ice accumulation aft of the airframe's protected area:** Conditions containing a population of supercooled droplets sufficiently larger than those provided for in Appendix C to cause ice accretions aft of the protected areas. The accumulation mechanism aft of the protected surface may be by direct impingement and accretion or delayed freezing of large droplets that impinge further forward. These conditions may be aircraft dependent as a consequence of airfoil geometry and limits of protected areas.

i. **Monitored Surface**: The surface of concern regarding ice hazard (e.g., the leading edge of the wing).

j. **Primary ice detection system**: The means used to determine when the IPS must be activated. The system annunciates the presence of ice accretion or icing conditions and may also provide information to other aircraft systems. A primary automatic system automatically activates anti-icing or de-icing systems. With a primary manual system, the cockpit crew activates the IPS upon indication from the system.

k. **Reference Surface**: The surface where an ice detection sensor is located or where a visual cue is located remotely from the surface of concern regarding ice hazard (e.g., a propeller spinner).

l. **Reversible flight controls:** The cockpit controls are connected to the pitch, roll, or yaw control surfaces by direct mechanical linkages, cables, or push-pull rods such that pilot effort produces motion or force about the hinge line. Conversely, force or motion originating at the control surface (through aerodynamic loads, static imbalance, or trim tab inputs, for example) is transmitted back to cockpit controls.

1. <u>Aerodynamically boosted flight controls</u>: Reversible flight control systems that employ a movable tab on the trailing edge of the main control surface linked to the pilot's controls or to the structure in such a way as to produce aerodynamic forces that move, or help to move, the surface. Among the various forms are flying tabs, geared or servo tabs, and spring tabs.

2. <u>Power-assisted flight controls</u>: Reversible flight control systems in which some means is provided, usually a hydraulic actuator, to apply force to a control surface in

addition to that supplied by the pilot to enable large surface deflections to be obtained at high speeds.

m. **Static air temperature:** The air temperature as would be measured by a temperature sensor not in motion with respect to that air. This temperature is also referred to in other documents as "outside air temperature," "true outside temperature," or "ambient temperature."

n. **Substantiated visual cues**: Ice accretion on a reference surface identified in the AFM which is observable by the flight crew. Visual cues used to identify Appendix C ice will differ from those used to identify large droplet ice.

<u>**NOTE**</u>: These definitions of terms are intended for use only with this rule.

Discussion of the Proposed Rule

The FAA has reviewed and accepted the recommendations that were developed by the IPHWG and were approved by ARAC. The FAA proposes to amend the current Part 121 regulations in two areas:

Activation of IPS

The first area addresses the possibility of the flight crew failing to recognize that the airframe ice protection procedures should be initiated. The proposed rule would be applicable to airplanes that have a maximum certified takeoff weight less than 60,000 pounds. As discussed previously in the Discussion section of this preamble, airplanes with takeoff weights less than 60,000 typically have wing chord lengths of the size that have been involved in relevant icing-related accidents and incidents. The proposed rule would require:

- A primary ice detection system and initiation of any other procedures for operation in icing conditions specified in the AFM; or
- Both substantiated visual cues and an advisory ice detection system, either of which enable the flight crew to determine that the ice protection system must be activated, and initiation of any other procedures for operating in icing conditions specified in the AFM; or
- That during climb, holding, maneuvering for approach and landing, and any other operation at approach or holding airspeeds, when in conditions conducive to airframe icing, the IPS must be activated and the approved procedures for operating in airframe icing conditions must be initiated, and
- That during any other phase of flight, the IPS must be activated and operated at the first sign of ice formation anywhere on the aircraft, except where the AFM specifies that the IPS should not be used.

Each of these methods provides a clear means for addressing the safety concern of when the IPS must be activated.

Indication of Ice Accumulation Aft of the Airframe's Protected Areas

The second area of the proposed rule addresses the possibility of ice accumulations on the airplane that could lead to hazardous operating conditions if the airplane is allowed to stay in icing conditions. For the same reason stated above, the proposed rule would be applicable to airplanes that have a maximum certified take-off weight less than 60,000 pounds. Further, the rule would be limited to airplanes equipped with reversible flight controls in the pitch or roll axis because these aircraft can be subject to uncommanded control surface deflections caused by ice accretions. The proposed rule would require that:

- Visual cues must be substantiated that enable the flight crew to determine that the airplane is in large droplet conditions conducive to ice accumulation aft of the airframe's protected areas; or
- The airplane must be equipped with a caution level alert and its associated visual or aural means to alert the flight crew that the airplane is in large droplet conditions conducive to ice accumulation aft of the airframe's protected areas.

These proposed requirements address the known problem of large droplet ice accretions aft of protected surfaces causing uncommanded pitch or roll control surface deflection that may result in loss of control of the airplane.

The determination that the airplane is operating in large droplet conditions conducive to ice accumulation aft of the airframe's protected areas could be based on:

- A <u>direct</u> measurement of ice accumulations on the airframe, or
- An <u>indirect</u> measurement of supercooled liquid droplet diameters, or
- Visual observation of ice accumulations on the airframe.

The intent of the proposed rule is to detect when the airplane is experiencing these icing conditions. Therefore, "forecast icing conditions" are not to be considered when complying with this proposed rule.

Direct measurement could be a surface-mounted ice detector located aft of the protected areas that detects the presence of ice. Indirect measurement could be a device that is remotely located and the detection of icing conditions at the device's location can be correlated to the presence of ice on the airfoil surface. Direct observation of ice accretion on substantiated locations on the airframe can be an acceptable means of compliance.

The proposed rule would require that the pilot in command must take action to immediately exit the conditions upon determining that the airplane is in large droplet conditions conducive to ice accumulation aft of the airframe's protected areas unless, in the opinion of the pilot in command, it is necessary to delay such action in the interest of safety.

Level of Approval

The modifications to airplanes that will be necessary to comply with the proposed rule will likely be complex and will require thorough testing and analysis to ensure that they perform their intended function when installed on the airplane. Therefore, the FAA proposes that the modifications and AFM procedures used to comply with this regulation would be required to be approved through an amended or supplemental type certificate in accordance with 14 CFR Part 21. As discussed in FAA Order 8110.4B ("Type

Certification"), an amended type certificate might not involve a physical alteration to the type certificate for some type design changes.

The proposed rule is not intended to disapprove an existing icing certification. Therefore, it is not necessary to re-certificate an airplane for flight in icing.

In the process of obtaining the amended or supplemental type certificate, the pertinent rules that apply to any modification are contained in § 23.1301 and § 25.1301 ("Equipment -- Function and installation"). Paragraph (a) of these rules requires that the equipment, "Be of a kind and design appropriate to its intended function." The applicant would be required to show that the modifications necessary for compliance with this proposed rule meet the "intended function" of the Part 121 rule. This is consistent with the FAA's practice of compliance findings for the digital flight data recorder requirements of Part 121. ***{Insert the DFDR rule amendment number and Fed. Register citation}***

Compliance

The notice proposes a two year compliance time from the effective date of the final rule.

Reasons for Proposing a Part 121 Operations Rule

Part 121 covers all scheduled operations of airplanes with ten or more passenger seats and scheduled operations of all turbojets regardless of size. In addition, the "hub and spoke" route network of the U.S. air traffic system can concentrate large numbers of Part 121 operations within a single weather system. With occasional exceptions under 121.590, Part 121 operators are constrained to use only airports certificated under FAR 139. A given Part 121 operator is generally further constrained to only those Part 139 airports listed in its Operations Specifications. The flight crews of Part 121 operators generally do not carry approach charts for airports not listed in their Operations Specifications. During busy traffic periods, lengthy vectoring or holding for landing sequencing is common at these airports. When this vectoring results in exposure to undesirable conditions such as icing, the flight crews' options (except in case of emergency) are generally limited to tolerating the exposure or diverting to a pre-planned Part 139 alternate airport listed in their Operations Specifications.

Consideration was also given to Part 91 and Part 135 operations. Most aircraft operated under Part 135 and Part 91 have been subjected to AD's discussed above regarding activation of their de-icing boots at first signs of accretion and also regarding exiting icing in severe icing environments. These AD's were proposed for all aircraft with pneumatic de-icing boots that are certified for known icing operations. The proposed AD's regarding boot activation resulted in an FAA review of operating procedures and certification basis on the affected aircraft. The severe icing AD's provide generic visual cues that can provide a means to identify conditions conducive to ice accumulations aft of protected areas and require exiting the conditions upon detection. As a result of this aircraft review and/or application of AD's, a level of safety relative to initial ice accretions and severe icing environments has been established. These procedures are relatively recent and the full impact of these safety improvements is not reflected in the reviewed event database.

In addition, Part 91 and 135 operators are not constrained to Part 139 airports, and in fact often avoid them in the first place due to the factors discussed above. Even when they plan to use them, they are free to divert to any suitable airport in the given terminal area, of which there are often several. The lower air traffic density in which Part 91 and 135 operators consequently often operate also results in fewer holding delays and significantly more routing options in icing conditions. Under Part 91 the tactical flexibility increases even more due to the inclusion of many small-scale general aviation aircraft. Moreover, Part 91 and Part 135 aircraft are typically smaller-scale aircraft than those operated under Part 121. This smaller scale provides easier monitoring of ice accretions, estimation of ice thickness, and identification of severe icing cues.

The level of safety provided by the combination of the AD's, the recent review of the operating procedures, the ability to more readily evaluate ice accretions, and tactical flexibility provide a comparable level of safety to other Part 91 and Part 135 operational requirements. The proposed Part 121 rule change will enhance the level of safety to the segment of the traveling public that has the greatest exposure and subsequent risk associated with flight in icing. Therefore, the IPHWG believes that a Part 91 and Part 135 rule is not required.

Applicability to Part 23 and Part 25 Airplanes

The icing accident and incident database developed by the IPHWG showed that all the relevant accidents and incidents occurred on aircraft with wing chord lengths less than 10 feet. Based on this finding, the FAA has proposed a Part 121 rule that is applicable to airplanes with a maximum certified takeoff weight of less than 60,000 pounds. Since the proposed rule addresses the safety concerns of flight in icing for smaller aircraft (i.e., maximum takeoff weight less than 60,000 pounds), the FAA proposes that the rule be applicable to both Part 23 and Part 25 airplanes that are operated under Part 121.

Applicable Airplane Models Eligible for Operation under 14CFR Part 121

The following is a list of currently certificated Part 23 and Part 25 airplanes under 60,000 pounds, equipped with reversible flight controls in the pitch or roll axis. Inclusion in this list does not necessarily mean the airplane is used in Part 121 operations, however.

- Aerospace Technologies of Australia Models N22B and N24A.
- Aerospatiale ModelsATR-42 and ATR-72 series.
- Beech Model 99, 200, and 1900 series.
- British Aerospace Model HS 748 series.
- CASA Models C-212 and CN-235 series.
- Cessna Models 500, 501, 550/560 series, and 650 series.
- de Havilland Models DHC-6, DHC-7, and DHC-8 series.
- Dornier Models 228, 328-100 and 328-300.
- EMBRAER Models EMB-110O1, EMB-110P2, and EMB-120 series.
- Fairchild Models F27 and FH227 series.
- Fairchild Aircraft Models SA226 and SA227 series.
- Fokker Model F27 Mark 100, 200, 300, 400, 500, 600, 700, and 050 series.
- Frakes Aviation Model G-73 (Mallard) and G-73T series.
- Gulfstream Aerospace Model G-159 series.

- Harbin Aircraft Mfg. Corporation Model Y12 IV.
- Jetstream Models 3101/3201, BAe ATP, and 4101.
- **Lear models**
- Lockheed Models L-14 and L-18 series.
- McDonnell Douglas Models DC-3 and DC-4 series.
- Mitsubishi Heavy Industires Model YS-11 and YS-11A series.
- Pilatus Britten-Norman Ltd. Models BN-2A, BN-2B, and BN-2T.
- Raytheon Aircraft Company (formerly known as Beech Aircraft Corporation) Models 100 series, 200 series, 300 series, B300 series, 400A, Hawker 800 and 1000.
- Reims F406
- Saab 340 series and SAAB 2000..
- Sabreliner Corporation Models 40, 60, 70, and 80 series.
- Short Brothers Models SD3-30, SD3-60, and SD3-SHERPA series.
- SIAI-Marchetti S.r.I (Augusta) Models SF600 and SF600A.

FAA Advisory Material

In addition to the amendment proposed in this notice, the FAA has developed an Advisory Circular (AC) that provides guidance as to acceptable means of demonstrating compliance with this proposed rule. Comments on the proposed AC are requested by separate notice published elsewhere in this issue of the Federal Register.

Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires that the FAA consider the impact of paperwork and other information collection burdens imposed on the public. We have determined that there are no new information collection requirements associated with this proposed rule.

International Compatibility

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to comply with International Civil Aviation Organization (ICAO) Standards and Recommended Practices to the maximum extent practicable. The FAA determined that there are no ICAO Standards and Recommended Practices that correspond to these proposed regulations.

Executive Order 12866 and DOT Regulatory Policies and Procedures

[APO is responsible for drafting the Regulatory Evaluation Summary. Summary of the economic evaluation prepared by APO will be inserted here.]

Economic Evaluation, Regulatory Flexibility Determination, International Trade Impact Assessment, and Unfunded Mandates Assessment

Proposed changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency propose or adopt a regulation only upon a determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (19 U.S.C. section 2531-2533) prohibits agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. In developing U.S. standards, this Trade Act also requires agencies to consider international standards and, where appropriate, use them as the basis of U.S. standards. And fourth, the Unfunded Mandates Reform Act of 1995 requires agencies to prepare a written assessment of the costs, benefits and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local or tribal governments, in the aggregate, or by the private sector, of $100 million or more annually (adjusted for inflation.)

In conducting these analyses, FAA has determined this rule 1) has benefits which do justify its costs, is not a "significant regulatory action" as defined in the Executive Order and is "significant" as defined in DOT's Regulatory Policies and Procedures; 2) will not have a significant impact on a substantial number of small entities; 3) reduces barriers to international trade; and 4) does not impose an unfunded mandate on state, local, or tribal governments, or on the private sector. These analyses, available in the docket, are summarized below.

Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) of 1980, (5 U.S.C. 601 et seq.) directs the FAA to fit regulatory requirements to the scale of the business, organizations, and governmental jurisdictions subject to the regulation. We are required whether a proposed or final action will have a significant impact on a substantial number of "small entities" as defined by the Act. If we find that the action will have a significant impact, we must do a "regulatory flexibility analysis."

International Trade

The Trade Agreement Act of 1979 prohibits Federal agencies from engaging in any standards or related activity that create unnecessary obstacles to the foreign commerce of the United States. Legitimate domestic objectives, such as safety, are not considered unnecessary obstacles. The statute also requires consideration of international standards and where appropriate, that they be the basis for U.S. standards. In addition, consistent with the Administration's belief in the general superiority and desirability of free trade, it is the policy of the Administration to remove or diminish, to the extent feasible, barriers to international trade, including both barriers affecting the export of American goods and services to foreign countries and barriers affecting the import of foreign goods and services to into the U.S.

In accordance with the above statute and policy, the FAA has assessed the potential effect of this proposed and has determined that it would have only a domestic impact and therefore no affect on any trade-sensitive activity.

Regulations Affecting Interstate Aviation in Alaska

Section 1205 of the FAA Reauthorization Act of 1996 (110 Stat. 3213) requires the Administrator, when modifying regulations in title 14 of the CFR in manner affecting interstate aviation in Alaska, to consider the extent to which Alaska is not served by transportation modes other than aviation, and to establish such regulatory distinctions as he or she considers appropriate. Because this proposed rule would apply to the certification of future designs of transport category airplanes and their subsequent operation, it could, if adopted, affect interstate aviation in Alaska. The FAA therefore specifically requests comments on whether there is justification for applying the proposed rule differently in interstate operations in Alaska.

Unfunded Mandates Reform Act

[APO is responsible for developing this analysis.]

The Unfunded Mandates reform Act of 1995 (2 U.S.C. §§ 1532-1538) requires the FAA to assess the effects of Federal Regulatory actions on state, local, and tribal governments, and on the private sector of proposed rules that contain a Federal intergovernmental or private sector mandate that exceeds $100 million in any one year. This action *[does or does not]* contain such a mandate.

Executive Order 13132, Federalism

The FAA has analyzed this proposed rule under the principles and criteria of Executive Order 13132, Federalism. We determined that this action would not have a substantial direct effect on the States, on the relationship between the national Government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, we determined that this notice of proposed rulemaking would not have federalism implications.

Plain Language

In response to the June 1, 1998, Presidential memorandum regarding the use of plain language, the FAA re-examined the writing style currently used in the development of regulations. The memorandum requires federal agencies to communicate clearly with the public. We are interested in your comments on whether the style of this document is clear, and in any other suggestions you might have to improve the clarity of FAA communications that affect you. You can get more information about the Presidential memorandum and the plain language initiative at http://www.plainlanguage.gov.

Environmental Analysis

FAA Order 1050.1D defines FAA actions that may be categorically excluded from preparation of a National Environmental Policy Act (NEPA) environmental impact statement. In accordance with FAA Order 1050.1D, appendix 4, paragraph 4(j), this proposed rulemaking action qualifies for a categorical exclusion.

Energy Impact

The energy impact of the notice has been assessed in accordance with the Energy Policy and Conservation Act (EPCA) Pub. L. 94-163, as amended (42 U.S.C. 6362) and FAA Order 1053.1. It has been determined that the notice is not a major regulatory action under the provisions of the EPCA.

List of Subjects in 14 CFR Part 121

Aircraft, Aviation safety, Reporting and record keeping requirements, Safety, Transportation.

The Proposed Amendment

In consideration of the foregoing, the Federal Aviation Administration proposes to amend Part 121 of Title 14, Code of Federal Regulations, as follows:

PART 121—OPERATING REQUIREMENTS: DOMESTIC, FLAG, AND SUPPLEMENTAL OPERATIONS

1. The authority citation for Part 121 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 40119, 44101, 44701-44702, 44705, 44709-44711, 44713, 44716-44717, 44722, 44901, 44903-44904, 44912, 46105.

2. Add a new section 121.XXX to read as follows:

§ 121.XXX [Title].

After [a date 24 months after the effective date of the final rule], no person may operate an airplane with a maximum certified takeoff weight less than 60,000 pounds in conditions conducive to airframe icing unless it complies with this section. Conditions conducive to airframe icing are considered as visible moisture at or below a static air temperature of +2 deg. C., unless the approved Airplane Flight Manual provides another definition.

(a) When operating in conditions conducive to airframe icing:

(1) The airplane must be equipped with a primary ice detection system; when the ice protection system is activated, any other procedures for operation in icing conditions specified in the Airplane Flight Manual must be initiated; or

(2) Both substantiated visual cues and an advisory ice detection system must be provided, either of which enable the flight crew to determine that the ice protection system must be activated; when the ice protection system is activated, any other procedures for operation in icing conditions specified in the Airplane Flight Manual must be initiated; or

(b) If the airplane is not equipped to comply with the provisions of paragraph (a)(1) or (a)(2), then the following will apply:

(1) When operating in conditions conducive to airframe icing, the ice protection system must be activated prior to and operated during the following phases of flight, and any additional procedures for operation in icing conditions specified in the Airplane Flight Manual must be initiated:

(i) Take off climb after second segment, en route climb, and go-around climb;

(ii) Holding;

(iii) Maneuvering for approach and landing; and

(iv) Any other operation at approach or holding airspeeds

(2) During any other phase of flight, the ice protection system must be activated and operated at the first sign of ice formation anywhere on the aircraft, except where the Airplane Flight Manual specifies that the ice protection system should not be used.

(c) If the procedures specified in paragraph (b)(1) of this section are specifically prohibited in the Airplane Flight Manual, compliance must be shown with the requirements of paragraph (a)(1) or (a)(2).

(d) For airplanes with reversible flight controls for the pitch and/or roll axis:

(1) Visual cues must be substantiated that enable the flight crew to determine that the airplane is in large droplet conditions conducive to ice accumulation aft of the airframe's protected areas; or

(2) The airplane must be equipped with a caution level alert and its associated visual or aural means to alert the flight crew that the airplane is in large droplet conditions conducive to ice accumulation aft of the airframe's protected areas.

(e) For airplanes with reversible flight controls for the pitch and/or roll axis, the pilot in command must take action to immediately exit the conditions in which any ice accretion is occurring, upon:

(1) Determining that the airplane is in large droplet conditions conducive to ice accumulation aft of the airframe's protected areas; or

(2) Activation of the caution level alert required by (d)(2);

unless, in the opinion of the pilot in command, it is necessary to delay such action in the interest of safety.

(f) All procedures necessary for compliance with this section must be set forth in the Airplane Flight Manual.

(g) System installations and AFM procedures used to comply with this section must be approved through an amended or supplemental type certificate in accordance with Part 21 of this subchapter.

Issued in Washington, DC, on

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: COMPLIANCE WITH REQUIREMENTS OF § 121.XXX, ______________	**Date:** Draft 2/21/01	**AC No: 121-XX**
	Initiated By: ANM-110	**Change:**

WORKING DRAFT -- NOT FOR PUBLIC RELEASE.

1. PURPOSE.

a. This Advisory Circular (AC) describes an acceptable means for showing compliance with the requirements of § 121.XXX, "______________," of Title 14, Code of Federal Regulations (CFR) Part 121, commonly referred to as Part 121 of the Federal Aviation Regulations (FAR). Part 121 contains the applicable aircraft operating requirements (for domestic, flag, and supplemental operations). The means of compliance described in this document is intended to provide guidance to supplement the engineering and operational judgment that must form the basis of any compliance findings relative to the requirements of § 121.XXX. Guidance includes considerations for:

- Installing a primary ice detection system; or
- Developing a method to alert the flight crew that the airframe ice protection system (IPS) must be activated, and revising the Airplane Flight Manual (AFM) concerning procedures for activating the airframe IPS; and
- A means for the flight crew to determine that they must exit icing conditions.

b. The guidance provided in this document is directed to airplane and engine manufacturers, modifiers, foreign regulatory authorities, and Federal Aviation Administration airplane type certification engineers and their designees.

c. Like all advisory circular material, this AC is not, in itself, mandatory, and does not constitute a regulation. It is issued to describe an acceptable means, but not the only means, for demonstrating compliance with the requirements for transport category airplanes.

Terms such as "shall" and "must" are used only in the sense of ensuring applicability of this particular method of compliance when the acceptable method of compliance described in this document is used. While these guidelines are not mandatory, they are derived from extensive Federal Aviation Administration and industry experience in determining compliance with the pertinent regulations.

d. This advisory circular does not change, create any additional, authorize changes in, or permit deviations from, regulatory requirements.

2. APPLICABILITY. The guidance provided in this AC applies to the operation, in conditions conducive to inflight airframe icing, of Part 23 (small) and Part 25 (transport category) airplanes with a maximum certified take-off weight less than 60,000 pounds and used in Part 121 operations.

3. RELATED DOCUMENTS.

a. **Regulations contained in Title 14, Code of Federal Regulations (CFR).**

§ 23.1301	Equipment - Function and installation
§ 23.1309	Equipment, systems, and installations
§ 23.1322	Warning, caution, and advisory lights
§ 23.1419	Ice protection
§ 23.1585(a)	Operating procedures
§ 25.1301	Equipment - Function and installation
§ 25.1309	Equipment, systems, and installations
§ 25.1316(b)	System lightning protection
§ 25.1321	Instruments Installation - Arrangement and visibility
§ 25.1322	Warning, caution, and advisory lights
§ 25.1333	Instrument systems
§ 25.1419	Ice protection
§ 25.1585(a)(6)	Operating procedures

Appendix C to Part 25

b. **Advisory Circulars (AC).** The AC's listed below may be obtained from the U.S. Department of Transportation, Subsequent Distribution Office, SVC-121.23, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785:

AC 20-73 Aircraft Ice Protection, dated April 21, 1971.

AC 20-117A	Hazards Following Ground Deicing and Ground Operations in Conditions Conducive to Aircraft Icing, dated December 17, 1982.
AC 20-115B	Radio Technical Commission for Aeronautics, Inc. (RTCA) Document RTCA/DO-178B, dated January 11, 1993.
AC 23.1309-1C	Equipment, Systems, and Installations in Part 23 Airplanes, dated March 12, 1999.
AC 23.1419-2A	Certification of Part 23 Airplanes for Flight in Icing Conditions, dated August 19, 1998.
AC 25-7A	Flight Test Guide for Certification of Transport Category Airplanes, dated March 31, 1998.
AC 25-11	Transport Category Airplane Electronic Display Systems, dated July 16, 1987
AC 25.1309-1A	System Design Analysis, dated June 21, 1988.
AC 25.1419-1	Certification of Transport Category Airplanes for Flight in Icing Conditions, dated August 18, 1999.

4. DEFINITION OF TERMS. For the purposes of this AC, the following definitions should be used.

a. **Advisory ice detection system**: An advisory system annunciates the presence of ice accretion or icing conditions. The cockpit crew is responsible for monitoring the icing as defined in the AFM, typically using total air temperature and visible moisture criteria, visible ice accretion, or specific airframe ice accretion thickness, and activation by the cockpit crew of the anti-icing or de-icing system(s) remains a requirement. The advisory system provides information to advise the cockpit crew of the presence of ice accretion or icing conditions but it can only be used in conjunction with other means to determine the need or timing of anti-icing or de-icing system activation.

b. **Airframe icing:** Ice accretions on portions of the airplane on which supercooled liquid droplets may impinge, with the exception of the propulsion system.

c. **Anti-Icing**: The prevention of ice formation or accumulation on a protected surface, either by evaporating the impinging water or by allowing it to run back and off the surface or freeze on non-critical areas.

d. **Automatic cycling mode:** A mode of airframe de-icing system operation that provides repetitive cycles of the system without pilot selection of each cycle. This is generally done with a timer and there may be more than one timing mode.

e. **Conditions conducive to airframe icing:** Visible moisture at or below a static air temperature of +2 deg. C., unless otherwise substantiated.

f. **Deicing**: Removal or the process of removal of an ice accretion after it has formed on a surface.

g. **Irreversible flight controls:** All of the force required to move the pitch, roll, or yaw control surfaces is provided by hydraulic or electric actuators, the motion of which is controlled by signals from the cockpit controls. Loads generated at the control surfaces themselves are reacted against the actuator and its mounting and cannot be transmitted directly back to the cockpit controls.

h. **Large droplet conditions conducive to ice accumulation aft of the airframe's protected area:** Conditions containing a population of supercooled droplets sufficiently larger than those provided for in Appendix C to cause ice accretions aft of the protected areas. The accumulation mechanism aft of the protected surface may be by direct impingement and accretion or delayed freezing of large droplets that impinge further forward. These conditions may be aircraft dependent as a consequence of airfoil geometry and limits of protected areas.

i. **Monitored Surface**: The surface of concern regarding ice hazard (e.g., the leading edge of the wing).

j. **Primary ice detection system**: The means used to determine when the IPS must be activated. The system annunciates the presence of ice accretion or icing conditions and may also provide information to other aircraft systems. A primary automatic system automatically activates anti-icing or de-icing systems. With a primary manual system, the cockpit crew activates the IPS upon indication from the system.

k. **Reference Surface**: The surface where an ice detection sensor is located or where a visual cue is located remotely from the surface of concern regarding ice hazard (e.g., a propeller spinner).

l. **Reversible flight controls:** The cockpit controls are connected to the pitch, roll, or yaw control surfaces by direct mechanical linkages, cables, or push-pull rods such that pilot effort produces motion or force about the hinge line. Conversely, force or motion originating at the control surface (through aerodynamic loads, static imbalance, or trim tab inputs, for example) is transmitted back to cockpit controls.

1. Aerodynamically boosted flight controls: Reversible flight control systems that employ a movable tab on the trailing edge of the main control surface linked to the pilot's

controls or to the structure in such a way as to produce aerodynamic forces that move, or help to move, the surface. Among the various forms are flying tabs, geared or servo tabs, and spring tabs.

2. Power-assisted flight controls: Reversible flight control systems in which some means is provided, usually a hydraulic actuator, to apply force to a control surface in addition to that supplied by the pilot to enable large surface deflections to be obtained at high speeds.

m. **Static air temperature:** The air temperature as would be measured by a temperature sensor not in motion with respect to that air. This temperature is also referred to in other documents as "outside air temperature," "true outside temperature," or "ambient temperature."

n. **Substantiated visual cues**: Ice accretion on a reference surface identified in the AFM which is observable by the flight crew. Visual cues used to identify Appendix C ice will differ from those used to identify large droplet ice.

> **NOTE:** These definitions of terms are intended for use only with respect to § 121.XXX.

5. COMPLIANCE WITH § 121.XXX: Determining static air temperature.

a. In the absence of more specific guidance provided by the manufacturer and approved by the FAA, § 121.XXX allows for the use of visible moisture and static air temperature at or below +2° C for determination of conditions conducive to airframe icing. If this provision is used, the flight crew should be able to easily determine the static air temperature.

b. The FAA anticipates that most types of airplanes to which § 121.XXX applies already incorporate a display of static air temperature available to the pilot. Existing displays that have been previously certificated need not be re-certificated. If the display is a new installation, the modification must be approved by the Aircraft Certification Service. If there is no such display, a placard can be provided showing corrections for temperature versus air speed to the nearest degree Centigrade in the region of interest (i.e., around 0 degrees).

c. Requiring the pilots to access hand-held charts or calculators in lieu of a placard is not an acceptable means.

6. COMPLIANCE WITH § 121.XXX(a)(1) and (2).

a. This section of the rule requires as an acceptable means of compliance:

1. For 121.xxx(a)(1), either a primary automatic or primary manual ice detection system.

2. For 121.xxx(a)(2), substantiated visual cues and an advisory ice detection system.

3. The applicant should present an ice detection system certification plan to the cognizant Aircraft Certification Office for an amended or supplemental type certificate. For Part 25 airplanes, the certification plan should cover compliance with §§ 25.1301, 25.1309, 25.1419, and any other applicable sections. For Part 23 airplanes, the certification plan should cover §§ 23.1301, 23.1309, 23.1419, and any other applicable sections.

b. **System Performance when Installed.** The applicant should accomplish a droplet impingement analysis and/or tests to ensure that the ice detector is properly located. The detector and its installation should minimize nuisance warnings, in accordance with §§ 23.1301 or 25.1301. The applicant must show that the modifications necessary for compliance with this proposed rule meet the "intended function" of the system required by this Part 121 rule.

c. **System Safety Considerations.** The applicant should consult AC 23.1309-1C or AC 25.1309-1A for guidance on compliance with § 23.1309 and § 25.1309, respectively. In accordance with those AC's, the applicant should accomplish a functional hazard assessment to determine the hazard level associated with failure of the ice detection system. The unannunciated failure of a primary ice detection system is assumed to be a catastrophic failure condition, unless the characteristics of the airplane in icing conditions without activation of the IPS are demonstrated to result in a less severe hazard category. The annunciated failure of a primary ice detection system is considered to be minor and requires the flight crew to avoid conditions considered to be conducive to icing or to conduct operations in accordance with FAR 121.XXX(a)(2), if substantiated visual cues and an advisory ice detector are available for the airplane; or FAR 121.XXX(b)(1). Failure of an advisory ice detection system is considered to be minor.

d. **Safe Operations in Icing Conditions.**

1. Both § 23.1419 and § 25.1419 require that the applicant demonstrate that the airplane is able to operate safely in the icing conditions defined in Appendix C to Part 25. It is not necessary to re-certificate the airplane for flight in icing to comply with § 121.XXX. However, the ice detection system should be shown to operate in the range of conditions defined by Appendix C.

2. Both § 23.1419 and § 25.1419 also require a combination of tests and analyses to demonstrate the performance of the ice detector and the system as installed on the airplane. This could include icing tunnel and icing tanker tests to evaluate the ice detector performance. Also required are analysis and flight tests in measured natural atmospheric conditions to demonstrate satisfactory performance of the system as installed on the

airplane. The approach used should result in activation of the IPS with the same amount of ice or less than would result from application of the approved existing AFM procedures. If this is not the case, the system may not be acceptable as a primary ice detection system for the purposes of § 121.XXX. Additional substantiation may be required to demonstrate that the airplane can safely operate with these larger ice accretions.

e. **Airplane Flight Manual (AFM).** The AFM should address the following:

- Operational use of the inflight ice detection system and any limitations; and
- Failure indications and appropriate crew procedures.

7. OPERATING PROCEDURES FOR § 121.XXX(a) & (b)

a. This section provides operating procedures to show compliance using various types of IPS's. Section 121.XXX (b) provides an option to the means defined in paragraphs 121.XXX(a)(1) and (a)(2). This alternative requires the operation of the IPS when the airplane is in conditions conducive to airframe icing during the following phases of flight:

- Take off climb after second segment, en route climb, and go-around climb;
- Holding;
- Maneuvering for approach and landing;
- Any other operation at approach and holding airspeeds;

In addition, during any other phase of flight, the IPS must be activated and operated at the first sign of ice formation anywhere on the aircraft, unless the AFM specifies that IPS should not be used.

It is not acceptable to use crew assessment of depth of ice as a discriminator in deciding when to operate a de-icing system. The intent is to permit current certified manual systems to be used in such a way that they replicate the effectiveness of an automatic system without the dependency on the crew to establish ice depths.

b. The following is an acceptable AFM change for compliance with paragraph 121.XXX (a)(2): With the approval of the FAA, the applicant may revise the Limitations Section of the FAA-approved AFM to include the following requirements for activation of the IPS:

When the flight crew determines from either the substantiated visual cues or the advisory ice detection system that the ice protection system must be activated:

- *For anti-icing systems:* The system must be operated continuously.

- *For de-icing systems:*
  - If an automatic cycling mode is available, it must be operated continuously at the available cycle rate most appropriate for the ice accretion rate.
  - If an automatic cycling mode is not available, the system must be operated at short intervals (not to exceed three minutes) to minimize ice accretions. In addition, the system must be operated for at least one complete cycle immediately prior to:
    a. Decreasing airspeed for holding or for maneuvering for approach and landing;
    b. Commencing a holding turn;
    c. Commencing the turn intended to intercept the final approach course inbound, including the procedure turn; and
    d. Selecting landing flaps.
    e. After gear and flap retraction on a go-around climb.

The airframe ice protection system may be selected off:

- *For anti-icing systems:* After the substantiated visual cues and the advisory ice detection system no longer indicate ice accretion or after leaving conditions conducive to airframe icing.
- *For deicing systems:* After completion of an entire deicing cycle after the substantiated visual cues and the advisory ice detection system no longer indicate ice accretion or after leaving conditions conducive to airframe icing.

c. The following is an acceptable AFM change for compliance with paragraph 121.XXX (b): With the approval of the FAA, the applicant may revise the Limitations Section of the FAA-approved AFM to include the following requirements for activation of the IPS:

When operating in visible moisture at or below a static air temperature of +2 deg. C unless a different condition is substantiated by test data.

During take off climb after second segment, en route climb, and go-around climb, holding, maneuvering for approach and landing, and any other operation at approach or holding speeds, the airframe ice protection system must be activated.

During any other phase of flight the ice protection system must be activated and operated at the first sign of ice formation anywhere on the aircraft except where the AFM specifies that the ice protection should not be used.

- *For anti-icing systems:* The system must be operated continuously.
- *For de-icing systems:*

- If an automatic cycling mode is available, it must be operated continuously at the available cycle rate most appropriate for the ice accretion rate.
- If an automatic cycling mode is not available, the system must be operated at short intervals (not to exceed three minutes) to minimize ice accretions. In addition, the system must be operated for at least one complete cycle immediately prior to:
  a. Decreasing airspeed for holding or for maneuvering for approach and landing;
  b. Commencing a holding turn;
  c. Commencing the turn intended to intercept the final approach course inbound, including the procedure turn; and
  d. Selecting landing flaps.
  e. After gear and flap retraction on a go-around climb.

The airframe ice protection system may be selected off:

- *For anti-icing systems:* After leaving conditions conducive to airframe icing.
- *For deicing systems:* Following completion of an entire deicing cycle after leaving conditions conducive to airframe icing.

8. COMPLIANCE WITH § 121.XXX(c)

a. **Requirement of the Rule.** Paragraph (d) of § 121.XXX is applicable to aircraft with a maximum certified takeoff weight less than 60,000 pounds and equipped with reversible flight controls in either the pitch or roll axis. The paragraph requires that:

- Visual cues must be substantiated to enable the flight crew to determine that the airplane is in large droplet conditions conducive to ice accumulation aft of the airframe's protected areas; or

- The airplane must be equipped with a caution level alert and its associated visual or aural means to alert the flight crew that the airplane is in large droplet conditions conducive to ice accumulation aft of the airframe's protected areas.

b. **Applicable Airplanes.** The applicable Part 23 and Part 25 airplanes have a maximum certified take-off weight of less than 60,000 pounds with reversible flight controls in the pitch and/or roll axis and are used in Part 121 operations. Consult with the aircraft manufacturer, cognizant certification office, and type data certificate to determine which model aircraft meet these criteria.

c. **Acceptable Means of Determining if Airplane is Operating in Large Droplet Icing Conditions Conducive to Ice Accumulation Aft of the Airframe's Protected Area.** There are several acceptable means for determining that the airplane is operating in large droplet conditions conducive to ice accumulation aft of the airframe's protected area. These include:

(1) <u>Direct or Remote Measurement on a Monitored Surface</u>:

(a) *Placement of Detectors.*

(i) For direct measurement, ice detectors are fitted directly onto the surface to be monitored. The detectors sense the presence and/or the thickness of ice that is accumulating aft of the protected area. They are usually flush-mounted (integrated on or within the skin). The monitored surface may vary from a spot of approximately one square inch to several square inches or larger.

(ii) For remote measurement, the sensing element is not directly fitted onto the surface to be monitored. An optical means (e.g., infrared or laser device) may be one means of compliance. The surface extent monitored by this system is usually larger than with direct measurements.

(b) *Ability to Sense Ice.* The applicant should demonstrate that the detector is able to detect ice accumulation aft of the protected area that requires crew action to exit icing conditions. (See paragraph 8.d. of this AC for an acceptable means of determining when the flight crew should exit icing conditions.)

(i) For direct measurement, an icing wind tunnel, icing tanker and/or a laboratory chamber may be used to evaluate the ability of the ice detector to detect ice.

(ii) For remote measurement, laboratory tests may be used to demonstrate the ability of the detector to detect ice on the monitored surface.

(c) *Detector Position.* The detector should be positioned such that it performs its intended function with considerations given to the following factors:

- Accretion characteristics of the monitored surface,
- Sensitivity of the airfoil to ice accretions,
- Thermal characteristic of the installation with respect to the generation of heat (direct measurement only),
- Physical damage from foreign objects,
- Early detection (response time),
- Not intrusive relative to ice accretion on the monitored surface (direct measurement only),

- Field of view relative to the monitored surface (remote measurement only),
- Obscuration due to atmospheric conditions (e.g. snow, clouds) (remote measurement only), and
- Any other appropriate factors.

(d) *Analysis, icing tankers, and icing wind tunnels* may provide information for location of the detector. In addition, laboratory tests may provide information for location of the remote detector.

(2) <u>Remote Measurement Correlated to Ice Accumulation on a Monitored Surface.</u> One method that could be used would be to provide indication of the conditions by discriminating droplet sizes. This method could provide an indication of conditions beyond those for which the airplane has been demonstrated.

(a) *Acceptable Settings.* Unless other acceptable means can be established, the device should be set to provide an indication when conditions exceed those specified in Appendix C, assuming a Langmuir E distribution for 50μm MVD droplets. The definition of a Langmuir E distribution may be found in the FAA Technical report DOT/FAA/CT-88/8-1, "Aircraft Icing Handbook" published March, 1991, updated September, 1993. The applicant should determine what droplet sizes might result in impingement aft of the protected surfaces. When the device detects conditions that exceed the Appendix C conditions, the "exit icing" signal should be activated.

(b) *Component Qualification.* The component level certification should verify that the device is capable of providing a reliable and repeatable signal. One method would be to perform testing in an icing tunnel. The droplet size distribution should bracket the signal point, with droplet distributions slightly below and slightly above the signal point. The test should be repeated at sufficient conditions of liquid water content and ambient temperature to ensure operation throughout the icing conditions defined by Appendix C and with droplet sizes up to 500 microns, or identify limitations as to the conditions where performance is degraded.

(3) <u>Visual Means.</u> This means can range from direct observation of ice accretions aft of the airplane's protected surfaces to observation of ice accretions on reference surfaces. Examples of visual means that could indicate to the flight crew that the airplane is operating in large droplet conditions conducive to ice accumulation aft of the airframe's protected areas include observations of:

- Accretions forming on unheated portions of side windows,
- Accretions forming on the aft portions of propeller spinners,
- Accretions forming on aft portions of radomes, and
- Water splashing on the windshields at static temperatures below freezing

Multiple cues may be required to meet the requirements of this rule.

(a) *Field of View.* Visual cues should be developed with the following considerations:

(i) Visual cues should be within the flight crew's vision scan area while seated and performing their normal duties.

(ii) Visual cues should be observable during all modes of operation (day, night, IMC).

(b) *Verification.* The applicant should verify the ability of the crew to observe the visual cues and reference surface. The visual cues should be evaluated from the most adverse flight crew seat locations during normal duties in combination with the range of flight crew heights. Consideration should be given to the difficulty of observing clear ice on the monitored or reference surface. If a reference surface is used, the applicant should verify that it correlates with conditions conducive to ice accumulation aft of the airframe's protected areas. Verification of the visual cues may be accomplished by testing in measured natural icing or simulated large droplet icing behind a calibrated water tanker aircraft.

d. **Acceptable Means of Determining When Flight Crew Should Exit Icing Conditions.** The flight crew should exit the icing conditions in which ice accretion is occurring if any amount of ice is detected, or correlated to ice accumulation, aft of the protected areas

e. **System Safety Considerations.** The applicant should consult either AC 25.1309-1A or AC 23.1309-1C, as appropriate, for guidance on compliance with §§ 25.1309 or 23.1309, respectively.

(1) Hazard classification. The following is a qualitative analysis that may be used for determining the hazard classification for compliance with this Part 121 regulation. Not all encounters with large droplet icing result in a catastrophic event. While definitive statistics are not available, given the volume of aircraft operations, and reported incidents that did not result in a catastrophe, a factor of around 1 in 100 is a reasonable assumption of the probability of a catastrophic event, if an airplane encounters large droplet conditions conducive to ice accumulation aft of the airframe's protected areas. Based on the above assumption, the hazard classification of an unannunciated encounter with "large droplet conditions conducive to ice accumulation aft of the airframe's protected areas" may be considered as *severe major* or hazardous (10^{-7}) in accordance with AC 25.1309-1A or AC 23.1309-1C, respectively.

(2) Frequency of occurrence. The Appendix C conditions were designed to include 99% of icing conditions. Evaluation of icing data has indicated that the

probability of encountering icing outside of Appendix C droplet conditions is on the order of 10^{-2}. The applicant may assume this probability for encountering the large droplet conditions conducive to ice accumulation aft of the airframe's protected areas. It should be considered as an average probability throughout the flight.

(3) Numerical safety analysis. For the purposes of a numerical safety analysis, the applicant may combine the probability of equipment failure with the probability, defined above, of encountering large droplet conditions conducive to ice accumulation aft of the airframe's protected areas. Therefore, if the applicant uses the above analysis for the hazard classification and the above probability of encountering the specified large droplet conditions (10^{-2}), it follows that the probability of an unannunciated equipment failure should be less than 10^{-5}.

f. **System Performance when Installed.**

(1) The ice detector system installed for compliance with § 121.XXX(c) is intended to detect ice that forms due to large supercooled droplets that exceed those specified in Appendix C. Flight tests in measured natural icing conditions (required by § 23.1419 and § 25.1419) should be conducted to ensure that the system does not produce nuisance warnings when operating in conditions defined by Appendix C.

(2) The low probability of finding conditions conducive to ice accumulation aft of the protected areas makes natural icing flight tests impractical as a means of demonstrating that the system functions in conditions exceeding Appendix C. The applicant may use flight tests of the airplane under simulated icing conditions (icing tanker) or icing wind tunnel tests of a representative airfoil section to demonstrate the proper functioning of the system and to correlate the signals provided by the detectors and the actual ice accretion on the surface.

NOTE: The measured natural icing flight tests required by § 25.1419 are only applicable for conditions that are defined by Appendix C.

g. **Software and Hardware Qualification.** For guidance on software and hardware qualification, the applicant should consult RTCA/DO-178, "Software Considerations in Airborne Systems and Equipment Certification," and RTCA/DO160D, "Environmental Conditions and Test Procedures for Airborne Equipment."

h. **Airplane Flight Manual**. For any changes to the limitations and normal procedures section of the AFM, the aircraft type certificate holder should be consulted to ensure compatibility with the flight characteristics of the particular model aircraft.

(1) For ice detection systems, the AFM should address:

(a) Operational use of the ice detection systems and any limitations of the system; and

(b) Failure indications and associated crew procedures.

(2) For visual means of compliance, the AFM should contain procedures that describe the visual means used to indicate that the airplane is operating in large droplet conditions that are conducive to ice accumulation aft of the airframe's protected areas.

(3) The following are acceptable AFM changes regarding actions the flight crew should take after there is an indication of ice aft of the protected areas. Changes to the Limitations Section of the AFM must be approved by the FAA.

(a) Revise the Limitations Section of the FAA-approved AFM to require the pilot in command to immediately take action to exit the conditions in which any ice accretion is occurring, unless in the opinion of the pilot in command, it is necessary to delay such action in the interest of safety.

(b) Revise the Normal Procedures Section of the FAA-approved AFM to include the following:

- In order to avoid extended exposure to flight conditions that result in ice accumulations aft of the protected areas, the pilot in command must immediately take action to exit the conditions in which any ice accretion is occurring, unless in the opinion of the pilot in command, it is necessary to delay such action in the interest of safety.
- Avoid abrupt and excessive maneuvering that may exacerbate control difficulties.
- Do not engage the autopilot.
- If the autopilot is engaged, hold the control wheel firmly and disengage the autopilot.
- If an unusual roll response or uncommanded roll control movement is observed, smoothly but positively reduce the angle-of-attack.
- Do not extend flaps during extended operation in icing conditions. Operation with flaps extended can result in a reduced wing angle-of-attack, with the possibility of ice forming on the upper surface further aft on the wing than normal, possible aft of the protected area.
- If the flaps are extended, do not retract them until the airframe is clear of ice.

- Report these weather conditions to Air Traffic Control.
- Maintain airspeed awareness and follow minimum speed guidelines per AFM procedures.
- Continue to follow these procedures until it can be determined that there are no ice accretions aft of the protected surface.

9. **FLIGHT CREW TRAINING.** Training in the use and procedures for the equipment required by § 121.XXX should be included in an operator's approved training program. Additionally, all pilots employed in operations under Part 121 should be given annual training in accordance with the approved methods in the operator's training program.

L&D HWG Status Report

28 March 2001 TAEIG Meeting

Handout 21

Discussion Items

- 25.415 Ground Gust
- 25.865 Fire Protection of Flight Controls, Engine Mounts, and other Structure
- Combinations of failure in 25.671(c)(2) and 25.1309
- 25.671(c)(3) - Jammed Flight Control Loads
- Ground Handling, Towing, and Landing Descent Velocity Tasks
- TOR for 25.301(b) Flight Loads Measurement

25.415 Ground Gust

- WG Report, AC & a draft NPRM
  - Submitted at the December 2000 TAEIG meeting
  - ALPA Rep Jim Bettcher asked for further explanations regarding pilot restraint of the flight controls while gust locks disengaged – not standard pilot practice
  - Discussed at March 6-8 L&DHWG meetings. Consensus was that the draft criteria are sufficiently conservative to cover
  - However it was agreed to do additional work – 3 manufactures w/ manual flight controls
  - ECD 15 June 2001

25.415 Ground Gust (cont.)

- Operational Issues
  - Some evidence that aircraft are being operated with ground gust peak velocities in excess of 65 KCAS
  - There is no requirement for the pilot to restrain the flight controls after gust locks are disengaged and while taxiing.
  - These issues can not be resolved by the L&D HWG (is not able to handle operational issues)
  - TAEIG guidance requested.

will document conclusions in working group report

make simple rec that FAA coordinate w/ another issues group

is aircraft design a limitation?

Could be placed in flight manual

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

- Status
  - Rolls-Royce tests using the draft AC methodology for lab determination of material temperatures has revealed that the selected test procedure is not adequate. Additional testing must be done. This is be coordinated with the FAA Tech Center
  - The initial consensus that the reference material could be addressed as "4000 series steel" is no longer supported. The FAA proposes "4130" steel.
  - Also, it is no felt that we can not proceed without a rule change to 25.865 as previously proposed.
  - The new L&DHWG FAA focal, Todd Martin is redirecting the Task Group. to resolve issues
  - The L&DHWG is working a new schedule for completion of this task; will not know until Tech Ctr testing is completed; will provide schedule at 10/01 mtg

Roll Royce testing
2 inch diameter bar - material temps did not stabilize
need for add testing coordinating / From tech ctr

Combinations of failure in 25.671(c)(2) and 25.1309

- Background
  - Progressed at Sept L&D HWG meeting
  - Airframe manufacturers are investigating the impact of the new rules in AC 25.1309 regarding peak risk and the new 25.671 requirement regarding latent failure together with the FAA issue paper
  - Former members of the flutter task team are to provide input on the flutter issues
- Status
  - This task has not been progressed since our FAA focal retired in Jan. New focal, Todd Martin is tasked with replanning.

25.671(c)(3) - Jammed Flight Control Loads

- Status report
  - Previous agreement reached on load conditions following flight control jam with the exception of the gust velocity for flaps extended conditions
  - Flaps extended gust velocity data from several sources were obtained and analyzed at March HWG meeting
  - Agreement on the flaps extended gust velocity was achieved.
  - Submittal to TAEIG at this meeting

671e only speaks to 66% of gust velocity

25.671(c)(3) - Jammed Flight Control Loads (cont'd)

Proposed text for AC 25.671

For clarity, it is proposed to separate the gust conditions for high lift devices retracted / extended as follows:

(iii) Structural Substantiation. The loads considered as ultimate should be derived from the following conditions at speeds up to the maximum speed allowed for the jammed position or for the failure condition:

(1) Balanced maneuver of the airplane between 0.25g and 1.75g with high lift devices fully retracted and in en-route configurations, and between 0.6g and 1.4g with high lift devices extended,

(2) Vertical and lateral gusts corresponding to 40% of the limit gust velocity specified at Vc in FAR/JAR 25.341 with high lift devices fully retracted,

(3) Vertical and head-on gust velocity of 17 fps with high lift devices extended.

risk that FAA will come back at 100% vertical + lateral gusts

TORs for Ground Handling, Towing, & Landing Descent Velocity (Assigned 28 Sept 2000)

- Ground Handling & Towing
  - The task group is collecting operational data to evaluate potential revisions to the requirements.
  - Details on existing and new gear configurations have been collected.
  - Progress is on track per work plan approved by TAEIG in Dec.

TORs for Ground Handling, Towing, & Landing Descent Velocity (Assigned 28 Sept 2000)

- Landing Descent Velocity
  - The task group is evaluating the full range of parameters that are applicable to defining loads as a function of descent velocity.
  - Details on existing and new gear configurations have been collected.
  - Additional FAA measured landing descent velocity data are required for Airbus wide-body and Boeing 777.
    - Heathrow airport has been selected. Data will be obtained in July of this year
  - Progress is on track per work plan approved by TAEIG in Dec.

- lot of energy absorption in trucks down main landing gear
- looking at a lot of (parameters) that contribute to peak loads

TOR for 25.301(b) Flight Loads Measurement

- Awaiting for this task to be published in the Federal Register, unofficial JAA Study Group has been moving forward L+D HWG has been keeping ~~abreast~~ abreast

IPHWG Task 2 Report for TAEIG

REPORT OBJECTIVE

This report is submitted in response to an action item from the March, 2000, TAEIG meeting, as follows:

> Ice Protection HWG to prepare report on Task 2 status, lack of information available, funding, etc., and what needs to be done before they can finish the task. They are to make a recommendation to TAEIG for future plan on tasking.

TASK STATEMENT

Task 2 of the IPHWG is as follows:

> 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.

For clarity, this task is subdivided into its parts, as follows, and then each is considered separately. References to FAR Part 23 are also removed per recent TAEIG action.

> **2a**. 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.
>
> **2b**. Define an icing environment that includes supercooled large droplets (SLD).

Handout 20

2c. Devise requirements to assess the ability of aircraft to safely operate either

- **i)** for the period of time to exit, or
- **ii)** to operate without restriction

in SLD aloft and at or near the surface.

2d. Devise requirements to assess the ability of aircraft to safely operate either

- **i)** for the period of time to exit, or
- **ii)** to operate without restriction

in mixed-phase conditions if such conditions are determined to be more hazardous than the liquid phase icing environment containing supercooled water droplets.

2e. Consider the effects of icing requirement changes on 14 CFR Part 25 and revise the regulations if necessary.

2f. Consider the need for a regulation that requires installation of a means to discriminate between conditions within and outside the certification envelope.

COMPLETED PARTS OF THE TASK

Task 2a is complete, except that the review of advances in ice protection state-of-the-art may be considered on-going if and as new developments emerge.

Task 2d may also be considered technically complete. Mixed-phase conditions were first discussed in detail at the 3rd IPHWG meeting in July, 1998. The sense of the group at this meeting was that mixed-phase icing is a common occurrence and probably existed during many icing tests but was not recognized as such because the instrumentation was not capable of detecting the solid-phase content until now. Recent measurements in Europe and North America have shown that a large percentage of clouds examined for SLD conditions contained ice crystals (over 40 percent in the Great Lakes area).

An FAA-sponsored 1964 report by D. T. Bowden and others, <u>Engineering Summary of Airframe Icing Technical Data</u>, Technical Report ADS-4, stated that flight through clouds of ice crystals, snow, or mixtures of ice crystals and liquid water is not uncommon. The report further commented that normally the aircraft ice protection system should not be turned on since the airframe and engine surfaces will remain clean; however, in "mixed" cloud conditions, ice may accumulate and require use of the ice protection equipment. The capacity of thermal systems may be exceeded and it may be necessary to escape the icing conditions as rapidly as possible. It has been speculated that reports of excessive icing might be the result of flight in mixed clouds with anti-icing systems overtaxed by the increased heat needed first to melt the ice crystals, then to warm and evaporate the water. However, documented evidence of severe airframe icing problems in clouds of ice crystals or mixed clouds is lacking. (The Report does reference a World Meteorological Organization Report by R.F. Jones, Ice Formation on Aircraft, WMO-No. 109, TO 47.) As long as the engine(s) continue to deliver the required thrust, operation in ice crystals is not likely to present severe problems.

The FAA Specialists Workshop on Mixed-Phase and Glaciated Icing Conditions was held in Atlantic City on December 2-3, 1998 — 34 years after the ADS-4 report. A report on the results of the Workshop was presented by the FAA Technical Center and discussed at the 9th IPHWG meeting in September, 1999. Existing JAA and UK requirements for consideration of mixed-phase icing were also presented and discussed. It was noted that these requirements generally refer to powerplant/engine installations, not to aerodynamic surfaces.

The FAA presentation to the IPHWG noted that the consensus among icing engineers and scientists dating back to the 1950's has been that airframe icing in mixed-phase conditions is not more hazardous than airframe icing in purely liquid water conditions, which are equivalent (in terms of total water content and collection efficiency) except for the absence of the ice crystals. The limited amount of relevant information in the public literature supports this consensus. Discussion at the FAA Specialists Workshop made it clear that it would be very difficult and expensive to design a study to fully address this issue, and there are no current plans for such an effort. Furthermore, by its very nature, it is extremely difficult to obtain operational data that bears upon the question of airframe icing in mixed-phase conditions; a pilot would not ordinarily be able to distinguish between mixed-phase and purely liquid conditions, nor would airframe ice accretions ordinarily permit this distinction to be made after the aircraft reached the ground. The FAA presentation concluded that, "the public literature does not provide evidence of mixed-phase environments that are more hazardous than comparable environments containing supercooled drops only."

However, a paper presented by Dr. Kamel Al-Khalil at the Workshop, Effect of Mixed Icing Conditions on Thermal Ice Protection Systems, concluded in part, ". . . that evaporative thermal [ice protection] systems are not significantly affected by the state of the water content [liquid or ice water content] but rather by its total content [liquid plus ice water content] in the atmosphere." The analytical work of Dr. Al-Khalil determined that running-wet thermal systems are significantly affected by the high ice content. This is typical of engine inlet ducts (e.g., helicopters and turboprop) and environmental control system scoops, especially where near-stagnant regions may exist.

Dr. Al-Khalil also made a presentation on this subject at the 13th IPHWG meeting. Subsequent to the presentation, the following points were discussed by the group:

- There is no data as to how the collection efficiency changes as the cloud changes phase from liquid to mixed to glaciated. Most comparisons conservatively assume that it remains the same.
- JAA has standards for mixed-phase environments which are applicable to powerplant/engine installations and pitot tubes, for which there are no equivalent FAA standards.
- There have been cases of ice concentration issues associated with the accretion of ice crystals in complex geometric configurations, such as some engine inlet ducts.
- Running-wet systems which vary power input to maintain a constant surface temperature behave differently than those which maintain a power input which is either constant or a function of engine power. Running-wet systems designed to the cold temperature extremes of Appendix C are less effected by ice crystals at a constant collection efficiency. The area of significant concern is for running-wet thermal ice protection systems whose design point is marginal relative to the freezing point.

This information examined by the IPHWG does not provide a compelling argument that these conditions are more hazardous than the liquid-phase icing environment. However, further examination of existing unpublished studies that address mixed-phase icing conditions and research on empirical work to clarify the effects of mixed-phase icing conditions on thermal anti-icing energy requirements appear warranted. This further work can be accomplished independently in parallel to IPHWG efforts to address defining the SLD icing environment.

Furthermore, there is some proprietary evidence that such environments may sometimes be hazardous because of their effects on engine installations and probes in certain designs. JAA and FAA practices with regard to engine installations and probes are not in harmony with respect to mixed-phase and glaciated conditions. Since power-plants/engines and their installations are not within the purview of the IPHWG, it is recommended that the ARAC leadership consider whether another ARAC Working Group should be tasked to seek out, examine, and evaluate such evidence.

REMAINING PARTS OF THE TASK

2b. Define an icing environment that includes supercooled large droplets (SLD).

and

2c. Devise requirements to assess the ability of aircraft to safely operate either

i) for the period of time to exit, or
ii) to operate without restriction

in SLD aloft and at or near the surface.

As briefed and agreed at the April, 1998, TAEIG meeting, "define an icing environment" (Task 2b) does not mean "revise Appendix C." A proposal for revision of Appendix C is FAA Icing Plan Task 9, scheduled for June, 2003 (attached as Appendix 1 for convenience). However, it was also stated that as IPHWG Task 2b was completed, the quality of the icing environment defined would nonetheless be evaluated to determine if it was adequate to propose new certification standards to replace or supplement Appendix C.

A master SLD database is being prepared by Dr. Richard Jeck of the FAA Technical Center. The table below lists the SLD flights that are contained in the Master Database as of December, 2000.

Flights Included in the Master SLD Database as of December 31, 2000

PROJECT	LOCATION	AGENCY	FLIGHTS	DATA MILES	SLD TYPE
SCPP (1985)	California	U. Wyoming	3	148	ZL
UND/FAA(1990)	Kansas City	U. North Dakota	3	350	ZR
WISP (1994)	Colorado	NCAR/U.Wyoming	3	419	ZL
NASA/FAA/ NCAR SLD (1997-98)	Great Lakes	NASA/GRC	13	722	ZL & ZR
Canadian CFDE-1 (1995)	Newfoundland	AES	1	273	ZL
Canadian CFDE-3 (1997)	So. Ontario	AES	1	81	ZL
				1,993 nmi	

With 9 more cases from past Canadian flights added in January and February, 2001, there remain about 36 more flights from 7 projects to be added to the database. This will ultimately take several years to complete. In order to avoid delaying Task 2 that long, the IPHWG decided last year that the addition of an adequate amount of data from the most readily available and reliable sources should provide an interim database sufficient for Task 2 purposes. About 56 SLD flights from NASA and Canadian SLD research flights from 1995 to 1998 were anticipated. These data were collected using the same types of research equipment and were processed using the same, well-understood procedures, so their validity for the database would not be in question. It turned out however, that only 24 of the available 56 flights had sufficient SLD content to merit inclusion in the Master SLD database. Nevertheless, with more than 2,000 nmi of select quality SLD data now in the Master SLD Database at the FAA Technical Center, the IPHWG is satisfied that this is sufficient for Task 2 deliberations to proceed.

The eventual addition of the remaining flight data is not expected to substantially change the results or conclusions derived from the interim database. Therefore, the interim database as of February 28, 2001, could be regarded as the completion of one aspect of Task 2b and is understood to not be a revision Appendix C.

It is determined that the SLD icing environment as defined by the completed database will be adequate for proposing certification standards to supplement Appendix C. Preparation of proposed SLD-inclusive revisions to Appendix C, under Task 2b, and the development of requirements for assessing operational safety during flight in SLD conditions, per Task 2c, are discussed below.

The IPHWG member organizations have done a great deal of work with the partial SLD database which presently exists to understand what is involved in completing Tasks 2b and 2c. Various statistics have been compiled from the data. Several relevant papers have been published in the open literature (see Appendix 2 for references). Calculation of ice shapes using existing icing codes, such as LEWICE, has been done to investigate the suitability of these codes in conjunction with SLD. These investigations have resulted in the following conclusions:

(1) Given an engineering standard, the requirements for accomplishing Task 2c are essentially contained in the proposals that have been submitted by the Flight Test Harmonization Working Group (FTHWG). Such an engineering standard, at least an interim standard, can be developed by the IPHWG from the information compiled under Task 2b. A proposal for inclusion of this engineering standard in FAR Part 25 Appendix C will be made by the IPHWG under Task 2b.

There remains the issue of means of compliance with these new standards. The engineering tools do not presently exist at current certification confidence levels to get from a certification standard specifying an SLD environment (or environments) to the ice shapes that would be necessary to determine whether a given airplane would be able to operate under these conditions or would have to exit.

Completion of Task 2c requires the capability to determine the properties of ice accretions on airframe components resulting from SLD encounters, particularly their shape, location, and extent. The effects of these accretions on the airplane stall speeds, handling qualities, and performance can then be determined.

(2) Although a definition of SLD exists, it is neither useful nor meaningful in characterizing SLD environments. The existing definition was arrived at during the FAA International Conference on Aircraft Inflight Icing in May, 1996, and merely defines SLD as any droplet larger than 50 microns diameter. However, the current FAR Part 25 Appendix C envelopes specify median volume diameters (not maximum diameters) up to 50 microns. Droplets larger than 50 microns therefore are already required by the present rule in order to achieve 50 micron MVDs. Under the current requirements, use of a Langmuir E spectrum with a 50 micron MVD results in the presence of drops of up to 135 microns diameter. In the research flight data analyzed to date, which was strongly biased toward large drops by deliberately seeking such conditions, more than half of the encounters have MVDs within the existing Appendix C envelopes despite the presence of much larger drops.

The SAE paper cited in Appendix 2 as Reference No. 1 addresses these issues. However, it does not address horizontal extent, vertical extent, nor duration of the conditions. FAA Technical Center research has revealed that there is no consensus on the meaning of the term "horizontal extent" and, depending on its definition, it may be nearly impossible to measure. No definition of horizontal extent has been found anywhere in the icing literature. It will be necessary to address extent and duration in development of new certification standards.

(3) Development of candidate icing envelopes that include SLD requires that all of the above shortcomings of the current icing environment definitions be addressed. In addition, it requires consideration of what may constitute the most critical conditions. At this point, it is doubtful if anyone can say what a most critical condition is when related to airplane design; for example, is it high liquid water content with moderate-size drops, or low liquid water content but mostly in very large drops, or a lengthy case with large drops but low liquid water content, or something else? It is also necessary to consider whether any SLD condition which may be defined can be applied in isolation or whether it needs to be considered simultaneously with conventional Appendix C conditions. Critical conditions may also well turn out to be airplane specific and therefore variable.

(4) The existing computer codes are not presently adapted for generation of large-drop ice shapes. Shortcomings to the current methods when applied to SLD include:

- Droplet Thermodynamics
- Droplet breakup
- Droplet drag
- Gravitational Effects
- Splash
- Ice shape growth aft of the protected areas

The codes will need to be revised and validated to address these issues.

(5) Adequate representations of SLD conditions in icing research tunnels do not presently exist, in part due to lack of definition of these conditions and in part due to limitations of the current water-spray systems.

NASA has provided a road map of actions required to address these short-comings, pertinent pages of which are attached as Appendix 3. Some actions have already been taken. A meeting of a sub-group of the IPHWG was held at NASA Glenn Research Center in March, 2000, during which these matters were discussed and clarified. An outcome of the meeting was the selection of several representative flight data sets from the research flights for use during the recalibration of the Icing Research Tunnel currently in progress. It is not expected that the tunnel will be able to reproduce these conditions; rather, it is expected that the use of these conditions as models will allow the tunnel to generate conditions which can then be used to validate computer codes in the general physical conditions of interest. Once in hand, the codes can be used to calculate ice accretions for any SLD condition specified.

No technical breakthroughs appear to be required to do this work. The recalibration of the Tunnel is funded and in progress. Funding and resources are available to do work which will be required to complete Tasks 2b and 2c. Specific tasks have been defined, with scheduled activities to address current tunnel and code SLD limitations. NASA expects the work to take approximately 2 to 3 years to address many of the issues cited above.

2e. Consider the effects of icing requirement changes on 14 CFR part 25 and revise the regulations if necessary.

This task is applicable to determining whether other changes to 14 CFR Part 25 are needed as a result of the new SLD certification requirements developed under Tasks 2b and 2c. Task 2e cannot be undertaken until any revision of requirements is at least drafted under Tasks 2b and 2c.

> **2f.** Consider the need for a regulation that requires installation of a means to discriminate between conditions within and outside the certification envelope.

This part of Task 2 depends on two considerations. The first is need, which depends on whether there is evidence that some cliff exists at the edges of the current or any future (to be defined) certification envelopes that will endanger an airplane. The second consideration is whether there exists an operationally feasible technology to accomplish this objective. A technology has been identified which may be capable of detecting the presence of drops above a specified size; however, no mature products exist.

Understanding these issues depends on the other parts of Task 2, particularly 2b and 2c, as detailed above.

CONCLUSIONS AND RECOMMENDATIONS

Task 2a: Complete; no recommendations.

Task 2b: The FAA Technical Center SLD database is considered sufficiently complete as of February, 2001, to proceed with the task. It is recommended that the IPHWG proceed with the development of at least interim SLD certification standards using the information from the database. The expected product may not, and should not (per FAA Icing Plan Task 9), be a complete revision of the Appendix C envelopes but should be sufficient to permit the generation of ice shapes for use in Task 2c. The group feels that these interim standards could be completed to the point of concept approval during the first quarter of 2002.

Task 2c: As discussed above, completion of this task is dependent upon the development of SLD certification standards under Task 2b and, possibly (see below), upon the availability of acceptable engineering tools to demonstrate compliance. Preliminary capability for simulating large-droplet conditions exists but it is rudimentary and not validated. Therefore, it is recommended that NASA and the FAA, in collaboration with international partners and private industry, pursue sources of funding to adapt codes, tunnels, and tankers to supply manufacturers and regulatory authorities with validated tools. These recommendations are consistent with Task 11c of the April, 1997, FAA In-flight Icing Plan (attached as Appendix 4 for convenience). These activities should be carried on concurrently with the IPHWG work on Task 2b. The recommendations from Icing Plan Task 11c and resulting activities should be targeted to support the completion of IPHWG Task 2c.

Task 2d: With respect to airplane handling and performance, the IPHWG has not found evidence that mixed-phase conditions are more hazardous than the liquid-phase icing environment containing supercooled water droplets having the same total water content. No further work should be scheduled on this subject in the IPHWG. The group may revisit mixed-phase conditions in Tasks 5 and 6.

JAA and FAA practices with regard to engine installations and probes are not in harmony with respect to mixed-phase and glaciated conditions. Since power-plants/engines and their installations are not within the purview of the IPHWG, it is recommended that the ARAC leadership consider whether another ARAC Working Group should be tasked to seek out, examine, and evaluate such evidence.

Task 2e: It is recommended that the IPHWG proceed with Task 2e following development of Tasks 2b and 2c to a point sufficient to understand what is required under Task 2e.

Task 2f: Understanding the issues of this task depends on the other parts of Task 2, particularly 2b and 2c, as detailed above. No recommendations can be made to TAEIG at this time.

In summary, the various elements of Task 2 can be accomplished without requiring any technical breakthroughs. A master SLD database will soon be available from the FAA Technical Center that will permit the definition of an icing environment. Engineering standards can then be derived from this icing environment. Given these engineering standards, the FTHWG's proposed in-flight icing certification rules will provide requirements to assess the ability of aircraft to operate safely.

The major difficulty will be defining acceptable means of compliance with the requirements. This issue has been discussed in detail within this document relative to Task 2c. The engineering tools do not presently exist at current certification confidence levels to get from a certification standard specifying an SLD environment (or environments) to the ice shapes that would be necessary to determine whether a given airplane would be able to operate under these conditions or would have to exit.

The majority of the group feels that the issuance of a final rule will be dependent upon the availability of acceptable means of compliance and that guidance material cannot be written until these means of compliance have been established. The FAA and ALPA, however, believe that completion of the final rule should not be contingent upon completion of the tool-development process described in the section of this report entitled, "Remaining Parts of the Task." They maintain that such a precondition is neither necessary nor prudent. Their position is based on both historical and current practices for icing certification. When the ice protection regulation, 14 CFR Part 25.1419, was issued in 1965, the capabilities for simulating icing conditions in laboratories and in flight, as well as the analyses used to predict ice shapes, were rudimentary or did not exist; thus, reliance was placed upon conservative use of then-existing icing simulation methods, engineering judgement, and flight testing in natural icing conditions to demonstrate compliance with icing requirements. Over time, engineering tools used to simulate icing conditions and predict ice shapes have improved and permitted a reduction in the amount of costly and time-consuming flight testing in natural icing conditions. Nevertheless, the engineering tools currently in use have not been fully validated by quantitative means. Current ice protection system certification practices permit use of the engineering tools based on engineering judgment, using the tools in a conservative manner, and qualitative verification of the tools during flight in measured natural icing conditions. The FAA believes that a similar means of compliance for SLD icing conditions could be developed that utilizes existing tools in combination with engineering judgment and conservative assumptions. The NASA representative believes that substantial improvements in the engineering tools will be seen within the next two years. It is NASA's opinion that the current tunnel, tanker, and code capabilities do provide a limited but, if properly used, conservative measure of ice shape characterization and performance for SLD conditions. NASA believes that these engineering tools, along with other design experience, can supply interim capability to address SLD certification issues. The group will continue to work Task 2 and attempt to resolve these differences to consensus as quickly as possible.

Appendix 1

FAA Aircraft Inflight Icing Plan, Task 9

Task 9. The FAA, in concert with airworthiness authorities throughout the world, will consider a comprehensive redefinition of certification envelopes (such as those that appear currently in Appendix C) for the global atmospheric icing environment when sufficient information is available worldwide on SLD, mixed phase conditions, and other icing conditions, and when adequate simulation tools are available to simulate and/or model these conditions.

PLAN DETAILS, TASK 9:

The lack of information to support a comprehensive redefinition of certification envelopes for the global atmospheric icing environment was emphasized by numerous participants at the May 1996 FAA-sponsored International Conference on Aircraft Inflight Icing. Additionally, as the number of aircraft increase, the probability of encountering intense icing conditions that were previously considered rare increases. As available icing cloud information and technologies improve, the FAA will consider a comprehensive change to the icing certification envelopes. This task is extremely complex--it requires information from around the globe and cooperation of aviation authorities around the world. In the interim, the FAA will work with ARAC to improve the safety of airplanes exposed to icing conditions that exceed the current Appendix C icing envelopes (see task 5 of this plan).

Responsible Party: FAA Icing Steering Committee.

Schedule:

June 2003: If appropriate, the FAA will propose a change to the envelope.

Appendix 2

References of SLD Literature

1. Shah, Patnoe, and Berg (The Boeing Company). Engineering Analysis of the Atmospheric Icing Environment Including Large Droplet Conditions. SAE Technical Paper 2000-01-2115.

2. Addy, H.E., D.R. Miller, and R.F. Ide. A Study of Large Droplet Ice Accretions in the NASA-Lewis IRT at Near-Freezing Conditions; Part 2. NASA TM-107424, 1998.

3. Miller, D.R., T.P. Ratvasky, B.C. Bernstein, F. McDonough, and J.W. Strapp. NASA/FAA/NCAR Supercooled Large Droplet Icing Flight Research: Summary of Winter 96-97 Flight Operations. NASA TM 1998-206620, AIAA-98-0577, 1998.

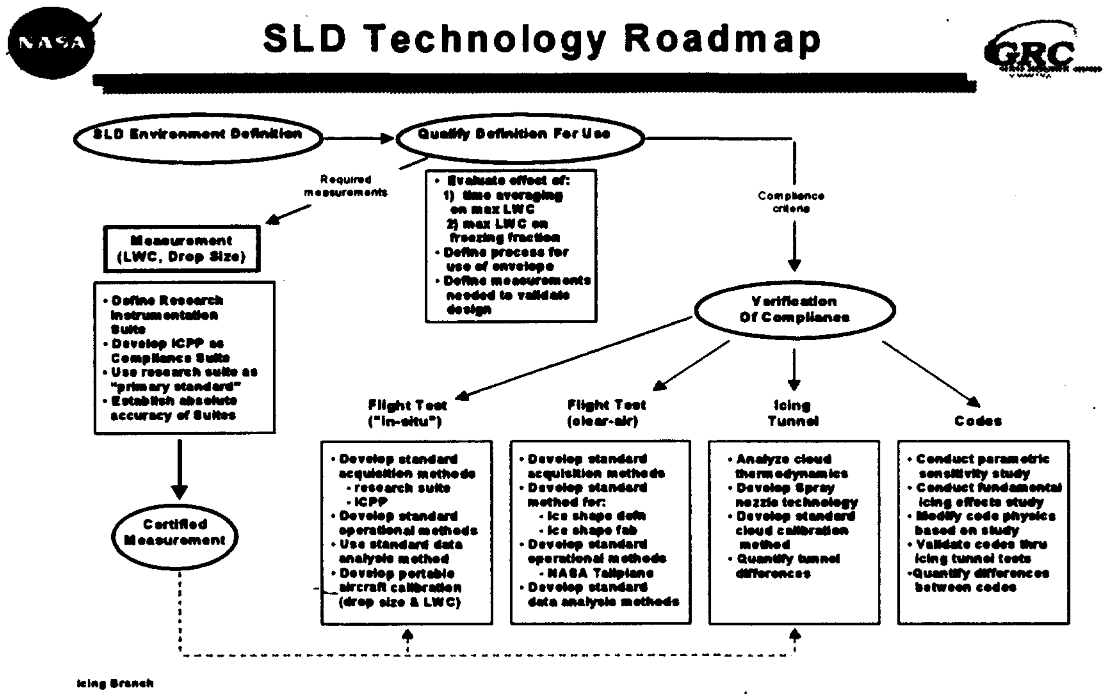
4. Wright, W.B. and M.G. Potapczuk. Computational Simulation of Large Droplet Icing. Cleveland: NASA Contractor Report, NASA Glenn Research Center, 1998. 11pp.

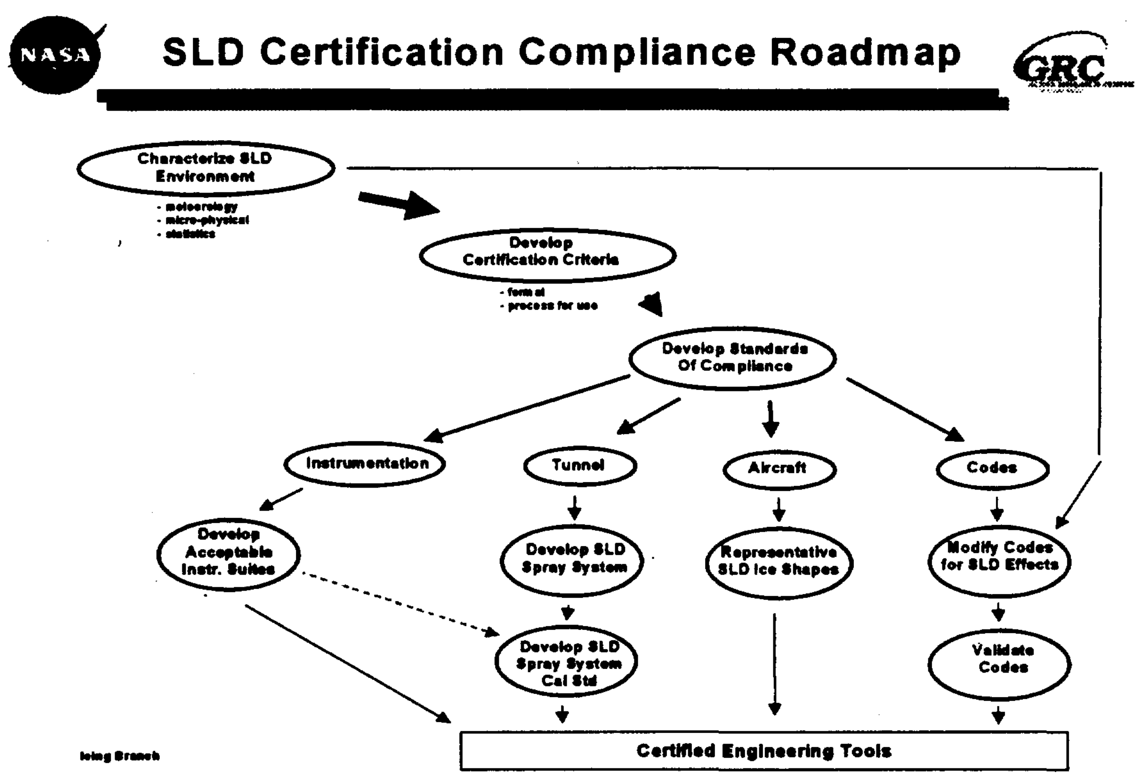
5. Cober, S.G. and G.A. Isaac. Characterizations of Aircraft Icing Environments that Include Supercooled Large Drops. Submitted to J. Appl. Meteor., 2000.

6. Isaac, G.A., S.G. Cober, A.V. Korolev, J.W. Strapp, A. Tremblay, and D.L. Marcotte. Canadian Freezing Drizzle Experiment. 37th Aerospace Sci. Meeting, 11-14 January. Reno: 1999.

IPHWG Task 2 Report for TAEIG

Appendix 3





Appendix 4

FAA Aircraft Inflight Icing Plan, Task 11

Task 11. Develop validation criteria and data for simulation methods used to determine ice shapes on aircraft, including icing tunnel, ice accretion computer codes, and icing tankers.

A. *VALIDATION REQUIREMENTS.* A working group will be formed to identify validation requirements for icing facilities (tunnels and tankers), and droplet impingement and ice accretion computer codes. The validation requirements will be appropriate for use in certification. The working group will develop information describing validation criteria (including specification of limitations) for icing simulation facilities, including instrumentation and data processing methodologies as they relate to facility calibrations, and for impingement and ice accretion codes. This will be a coordinated effort among research organizations, industry, and regulatory authorities. This material will be evaluated by the FAA for adoption as guidance material.

PLAN DETAILS, TASK 11.A:

The working group will establish a plan for development of validation criteria for experimental icing simulation facilities (tankers and tunnels) and icing simulation codes. The working group will develop level-of-acceptance criteria for validation comparisons. The group will examine correlation of ice shapes (including impingement) from icing facilities with those from flight in natural icing conditions. In addition, the group will examine correlation of ice shapes (including impingement) from ice accretion codes with those from both simulation facilities and natural conditions. The fidelity of artificial ice shapes needed to represent a natural event will be reviewed. Methods will be examined to provide quantifiable information on cloud characteristics, ice accretion shapes, and aero-performance measurements in natural icing to determine the comparison criteria for simulation. Methods for processing time-averaged flight data will be evaluated to support replicating natural icing events in ground-based facilities.

The working group also will address methods for defining tunnel/tanker cloud characteristics and their calibration and accuracy. This will include instrumentation employed in the establishment of those calibrations and methods to determine the facility's envelope. A set of equivalent icing conditions along with a standard model(s) will be identified for use in comparing icing simulation facilities. Means of comparison to cross reference individual facility results will be developed.

Issues related to the simulation of freezing drizzle, freezing rain, and mixed phase conditions either by a facility or a computer code also will be examined.

Responsible Parties: NASA LeRC, FAA Technical Center, and Aircraft Certification Service.

Schedule:

- August 1997: Develop interim recommendations on validation criteria.
- June 2001: Develop final recommendations on validation criteria.

B. *VALIDATION DATA.* The FAA shall support research aimed at developing ice accretion data and associated aerodynamic effects that can be used for the validation of ice accretion codes and analysis of aerodynamic performance degradation due to icing. This research also can be used to form the basis of an evaluation of ice shape features resulting in critical performance loss.

<u>PLAN DETAILS, TASK 11.B.</u>:

The NASA LeRC Modern Airfoils Ice Accretions Program receives funding support from the FAA. This program encompasses the development of ice accretions in icing tunnels on modern airfoils (2D) and wings (3D) of interest to industry and the FAA. It includes the acquisition of aerodynamic data using icing tunnel accretion models in high quality aerodynamic tunnels.

Responsible Parties: NASA LeRC, FAA Technical Center.

Schedule:

September 1998: Report on ice accretions for modern airfoils (2D), including C_d, $C_{l,max}$, and stall angles.

C. *SIMULATION IMPROVEMENT.* The FAA will support research on the development and improvement of ice simulation methods such as ice accretions codes, icing tunnels, and icing tankers. This research will be directed at understanding the physical processes underlying the ice accretion process, including phenomena associated with SLD ice accretion.

<u>PLAN DETAILS, TASK 11.C.</u>:

A working group will be formed to publish a research plan that addresses how the FAA can most cost effectively improve the simulation capabilities of industry and research facilities.

Responsible Parties: FAA Technical Center, Aircraft Certification Service.

Schedule:

February 1998: Publish a Simulation Improvement Research Plan.

Working Group Activity Report – 03/28/2001

ARAC Issue

Transport Airplanes and Engines

Working Group Name

Flight Controls Harmonization Working Group

Task Title

Flight Control Systems

Organization

Co-Chairs: Larry Schultz (Boeing), Pascal Traverse (Aerospatiale)

Focals: FAA –Todd Martin JAA – Richard Ward

- Participants: FAA, JAA, Boeing, Aerospatiale/Airbus, Cessna, Fairchild/Dornier, Embraer, Transport Canada, Raytheon, ALPA, Bombardier, Gulfstream

Task Description

Review the current §§ 25.671 and 25.672 standards and corresponding JAR 25.671 and 25.672 standards pertaining to flight control systems, taking into account the requirements in §§ 25.1309 and 25.1329. Also review current policy including that established by special conditions issued for fly-by-wire control systems and active flight controls, and any related advisory material. Examine accumulated transport airplane service history to validate assumptions made on the probability of occurrence of system failure and consider any NTSB recommendation. In light of this review, recommend new harmonized standards, and develop related advisory material as necessary.

Expected Products : NPRM, Advisory Material

Handout 22

Status

- Broad Agreement on 25.671 Rule and Advisory Material
- Final Draft of Material Forwarded to TAEIG
- See Enclosure for Team Member Alternate Proposals
- Team Unanimously Accepted FAA Recent Response to NTSB
- 25.672 Addressed. Recommendation: Eliminate FAA and JAA advisory material as being covered by 25.302 and 25.1309 and 25.672 will be harmonized.

No Plans for Next Meeting

- Address any 25.1309 Specific Risk Issues if Necessary
- Possibly Review NPRM

Future Meetings – None Planned

- Not Planned Pending 1309 Specific Risk Issue

Overview of 25.671 Harmonisation & Revision Activity

25.671(a)	Includes material from recent fly by wire certifications requiring operation in any attitude.
25.671(b)	Revised to discourage marking alone as a desired means of ensuring correct assembly.
25.671(c)	Negligible change.
25.671(c)(1)	Clarifies which jamming to be excluded from "any single failure".
25.671(c)(2)	Added 1/1000 specific risk to numerical analysis. Clarifies which jamming to be excluded.
25.671(c)(3)	Provides (c)(3) jam definition. Adds recognition of limitations on jam failure alleviation just prior to landing. Adds 1/1000 specific risk analysis on additional failure conditions.
25.671(c)(4)	Highlights requirement to address runaway. Requires addressing single failure regardless of probability.
25.671(d)	Clarifies all engine-out flight to be considered at any point in the flight. Requires flare capability.
New-25.671(e)	Adds requirement for alerting the crew if control means nears limit authority from recent fly by wire certifications.
New-25.671(f)	Adds requirement for mode annunciation from recent fly by wire certifications.

AC/AMJ Material:

- Includes Current ACJs
- Provides Advisory Material for All Paragraphs of 25.671
- Defines "Normally Encountered Positions"
- Defines Criteria for "Continued Safe Flight & Landing"
- Provides Examples of Compliance for 1/1000 Specific Risk Criteria

Team Member Alternate Proposals

- Raytheon, Bombardier, Airbus, Boeing, Cessna, & Transport Canada recommend using 15 kt instead of 25 kt crosswind in determination of roll and yaw control jam positions.

- Boeing recommends allowing use of other handling quality rating methods as means of compliance for Continued Safe Flight & Landing if acceptable to the certification authority.

- Bombardier & Boeing recommend an alternate definition of "single failure" which allows consideration of the likelihood of a fault propagating.

- Transport Canada recommends using more conservative "safe flight and landing" criteria to address the wide range of failure probabilities that might exist.

- Raytheon & Cessna recommend considering an exclusion for flight control disconnect failures similar to a jam failure just prior to landing.

FAR/JAR 25.671 FCHWG - ARAC Report

(Includes Rule, Advisory Material, & Alternate Recommendations)

12/03/01 DRAFT

1. What is the underlying safety issue addressed by the FAR/JAR? [Explain the underlying safety rationale for the requirement. Why should the requirement exist? What prompted this rulemaking activity (e.g., new technology, service history, etc.)?]

This requirement ensures the basic integrity and availability of flight control systems, and further ensures that any failure experienced in service is manageable by the aircrew and will not prevent continued safe flight and landing. This rulemaking activity was prompted by efforts to harmonize the FARs and JARs, recommendations from the NTSB as a result of accident investigation, and the need to update the rule to address recent Special Conditions applied to fly-by-wire control systems.

2. What are the current FAR and JAR standards? [Reproduce the FAR and JAR rules text as indicated below.]

Current FAR Text:

FAR 25.671 General.

(a) Each control and control system must operate with the ease, smoothness, and positiveness appropriate to its function.

(b) Each element of each flight control system must be designed, or distinctively and permanently marked, to minimize the probability of incorrect assembly that could result in the malfunctioning of the system.

(c) The airplane must be shown by analysis, tests, or both, to be capable of continued safe flight and landing after any of the following failures or jamming in the flight control system and surfaces (including trim, lift, drag, and feel systems), within the normal flight envelope, without requiring exceptional piloting skill or strength. Probable malfunctions must have only minor effects on control system operation and must be capable of being readily counteracted by the pilot.

(1) Any single failure, excluding jamming (for example, disconnection or failure of mechanical elements, or structural failure of hydraulic components, such as actuators, control spool housing, and valves).

(2) Any combination of failures not shown to be extremely improbable, excluding jamming (for example, dual electrical or hydraulic system failures, or any single failure in combination with any probable hydraulic or electrical failure).

1. Any jam in a control position normally encountered during takeoff, climb, cruise, normal turns, descent, and landing unless the jam is shown to be extremely improbable, or can be alleviated. A runaway of a flight control to an adverse position and jam must be accounted for if such runaway and subsequent jamming is not extremely improbable.

(d) The airplane must be designed so that it is controllable if all engines fail. Compliance with this requirement may be shown by analysis where that method has been shown to be reliable.

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-23, 35 FR 5674, Apr. 8, 1970]

Current JAR Text:

JAR 25.671 General

(a) Each control and control system must operate with the ease, smoothness, and positiveness appropriate to its function (See ACJ 25.671 (a).)

(b) Each element of each flight control system must be designed or distinctively and permanently marked, to minimise the probability of incorrect assembly that could result in the malfunctioning of the system. (See ACJ 25.671 (b).)

(c) The aeroplane must be shown by analysis, test, or both, to be capable of continued safe flight and landing after any of the following failures or jamming in the flight control system and surfaces (including trim, lift, drag, and feel systems) within the normal flight envelope, without requiring exceptional piloting skill or strength. Probable malfunctions must have only minor effects on control system operation and must be capable of being readily counteracted by the pilot.

(1) Any single failure not shown to be extremely improbable, excluding jamming, (for example, disconnection or failure of mechanical elements, or structural failure of hydraulic components, such as

actuators, control spool housing, and valves). (See ACJ 25.671(c)(1).)

(2) Any combination of failures not shown to be extremely improbable, excluding jamming (for example, dual electrical or hydraulic system failures, or any single failure in combination with any probable hydraulic or electrical failure).

(3) Any jam in a control position normally encountered during take-off, climb, cruise, normal turns, descent and landing unless the jam is shown to be extremely improbable, or can be alleviated. A runaway of a flight control to an adverse position and jam must be accounted for if such runaway and subsequent jamming is not extremely improbable.

(d) The aeroplane must be designed so that it is controllable if all engines fail. Compliance with this requirement may be shown by analysis where that method has been shown to be reliable.

3. What are the differences in the standards? [Explain the differences in the standards or policy, and what these differences result in relative to (as applicable) design features/capability, safety margins, cost, stringency, etc.]

The JAR allows for the demonstration of single failures to be shown extremely improbable and also includes ACJ advisory material for paragraphs (a), (b), and (c)(1). Due to their similarity, there has been little effect on cost or safety to comply with one standard or the other.

4. What, if any, are the differences in required means of compliance? [Provide a brief explanation of any differences in the current compliance criteria or methodology (e.g., issue papers), including any differences in either criteria, methodology, or application that result in a difference in stringency between the standards.]

In practical terms, there has been little difference in the means of compliance between JAR and FAR. The FAA in specific instances has also allowed certain single failures to be shown to be extremely improbable.

Another area of difference is that in compliance demonstration, the FAA has allowed use of the Handling Qualities Rating Method of AC 25-7, which is not recognized by the JAA.

Also an issue has been the term "extremely improbable" as used in FAR/JAR 25.671(c)(2). Both the FAR and JAR paragraphs identify examples of "any combination of failures not shown to be extremely improbable." One of these examples is any single failure in combination with any probable failure. The FAA has considered this example to be a requirement, while the JAA has considered it to be just an example which is not specifically required.

In regard to 25.671, the greatest issue is a need for basic rule clarification and advisory material to produce more consistent demonstration of compliance for jam failure conditions from one airplane program to the next. This is reflected in recent FAA Issue Papers (which were not harmonized) and policy letters regarding Jam Failure Conditions, such as Issue Paper F-2 (applied to 737NG).

5. What is the proposed action? [Describe the new proposed requirement, or the proposed change to the existing requirement, as applicable. Is the proposed action to introduce a new standard, or to take some other action? Explain what action is being proposed (not the regulatory text, but the underlying rationale) and why that direction was chosen for each proposed action.]

Harmonized revisions are proposed to the rule acompanied by advisory material to achieve greater consistency in demonstration of compliance for flight control jam failures. This includes definition of "normally encountered position" and "continued safe flight and landing". A summary of changes is listed below.

25.671(a) Includes material from recent fly by wire certifications requiring operation in any attitude.

25.671(b) Revised to discourage marking alone as a desired means of ensuring correct assembly.

25.671(c) Negligible change.

25.671(c)(1) Clarifies which jamming to be excluded from "any single failure". Removes "extremely improbable" as a means of compliance.

25.671(c)(2) Added 1/1000 specific risk to numerical analysis. Clarifies which jamming to be excluded.

25.671(c)(3) Provides (c)(3) jam definition. Removes "extremely improbable" as a means of compliance. Adds 1/1000 specific risk analysis on additional failure conditions. Adds recognition of the difficulty in covering the time period just before landing.

25.671(c)(4) Highlights requirement to address runaway. Requires addressing single failure regardless of probability.

25.671(d) Clarifies all engine-out flight to be considered at any point in the flight. Requires flare capability.

New-25.671(e) Adds requirement for recognition of control means at the limits of authority from recent fly by wire certifications.

New-25.671(f) Adds requirement for mode annunciation from recent fly by wire certifications.

AC/AMJ Material:

- Includes Current ACJs
- Provides Advisory Material for All Paragraphs of 25.671
- Defines "Normally Encountered Positions"
- Defines Criteria for "Continued Safe Flight & Landing"
- Provides Examples of Compliance for 1/1000 Specific Risk Criteria

6. What should the harmonized standard be? [Insert the proposed text of the harmonized standard here]

See the rule changes and advisory material in Enclosures 1 and 2.

7. How does this proposed standard address the underlying safety issue identified in #1? [Explain how the proposed standard ensures that the underlying safety issue is taken care of.]

This standard requires the use of "Fail Safe" compliance methods and analysis techniques common to 25.1309 to ensure safety following single failures and combination of failures not extremely improbable. This includes consideration of the effect of dormant failures and specific demonstration of acceptable operation following flight control failure conditions. A 1/1000 probability requirement is used to ensure a minimum residual level of safety following a single failure or jam and replace the "single plus probable" material included in the parentheses of the current 25.671(c)(2). Definitions of "normally encountered position" and "continued safe flight and landing" are included in the advisory material. Use of advisory material is appropriate for these definitions since some variation can be expected due to the characteristics of individual flight control systems.

8. Relative to the current FAR, does the proposed standard increase, decrease, or maintain the same level of safety? [Explain how each element of the proposed change to the standards affects the level of safety relative to the current FAR. It is possible that some portions of the proposal may reduce the level of safety even though the proposal as a whole may increase the level of safety.]

The proposed standard will increase the level of safety through expansion of the flight envelope in which jams are demonstrated and through specific criteria which defines "continued safe flight and landing". Safety is also increased by requiring a specific residual level of safety following a single failure. Comments on the effect of each change on safety are included below.

25.671(a) Includes material from recent fly by wire certifications requiring operation in any attitude. This change will increase the level of safety by providing coverage absent in the current FAR/JAR.

25.671(b) Revised to discourage marking alone as a desired means of ensuring correct assembly. This change will increase safety by promoting greater use of design features that ensure correct assembly.

25.671(c) Negligible change.

25.671(c)(1) Clarifies which jamming to be excluded from "any single failure". Removes "extremely improbable" as a means of compliance. This change will increase safety since all single failures must now be considered.

25.671(c)(2) Added 1/1000 specific risk to numerical analysis. Clarifies which jamming to be excluded. The FCHWG proposal removes the single plus probable failure combination from 25.671(c)(2) which is somewhat ambiguous and has been inconsistently applied, and replaces it with the 1/1000 specific risk criteria. The proposed criteria is both more conservative and less conservative than the current standard. In addition to a single failure, the current standard requires the inclusion of any probable failure, using a 10^{-5} failure rate as the determining factor. The new standard would require, in addition to any single failure, the inclusion of any failures which have combined probability of greater than 1/1000. The new standard thus prescribes a more moderate residual failure probability, but it applies to all possible failure conditions, including dormant failures. The new standard also has the advantage of being more clear than the existing requirement.

25.671(c)(3) Provides (c)(3) jam definition. Removes "extremely improbable" as a means of compliance. Adds 1/1000 specific risk analysis on additional failure conditions. These changes will result in an increase in safety by requiring consideration of all jams, ensuring a minimum level of safety after the jam condition, and by clarifying the type of jam to be covered under (c)(3). Adds recognition of limitations in compliance achievable in the landing phase. This reduces the coverage in the rule, but it is an exclusion that has been allowed as a matter of practicality under the existing rule.

25.671(c)(4) Highlights requirement to address runaway. Requires addressing single failure regardless of probability. This change will result in an increase in safety by highlighting the need to address all single failures that could cause a runaway.

25.671(d) Clarifies all engine-out flight to be considered at any point in the flight. Requires flare capability. This change will improve the level of safety by clarifying that the capability must provided throughout the flight regime and be sufficient for a flare to a landing.

New-25.671(e) Adds requirement for recognition of control means at the limit of authority from recent fly by wire certifications. . This change will increase the level of safety by providing coverage absent in the current FAR/JAR.

New-25.671(f) Adds requirement for mode annunciation from recent fly by wire certifications. . This change will increase the level of safety by providing coverage absent in the current FAR/JAR.

9. Relative to current industry practice, does the proposed standard increase, decrease, or maintains the same level of safety? [Since industry practice may be different than what is required by the FAR (e.g., general industry practice may be more restrictive), explain how each element of the proposed change to the standards affects the level of safety relative to current industry practice. Explain whether current industry practice is in compliance with the proposed standard.]

Tthe proposed standard will increase the level of safety for the same reasons as described in #8.

10. What other options have been considered and why were they not selected? [Explain what other options were considered, and why they were not selected (e.g., cost/benefit, unacceptable decrease in the level of safety, lack of consensus, etc.) Include the pros and cons associated with each alternative.]

There was consideration to simply reference 25.1309 and its corresponding advisory material and use AC25-7A to address handling quality criteria with flight control failures. However, it was determined that material does not contain sufficient guidance to address jam failure conditions and accompanying demonstration. In addition, the intent of the material in the parentheses of 25.671(c)(2) is captured by the 1/1000 "specific risk" criteria that is not addressed in 25.1309. The Handling Quality Rating Method was not used because it is not harmonized with the JARs.

11. Who would be affected by the proposed change? [Identify the parties that would be materially affected by the rule change – airplane manufacturers, airplane operators, etc.]

It is intended that this new rule material be applied in new certification programs. Manufacturers of transport category airplanes would be affected by the change. Operators using newly certified airplanes may be affected through additional non-normal procedures and operator training may be required to address jam failure conditions. Additional operator maintenance requirements may be driven by the 1 in 1000 residual safety requirement.

Note that this material introduces some extensive additions to the rule interpretation and new criteria. The full impact of such a change on the manufacturers cannot be predicted without applicaton to an actual flight control certification program.

12. To ensure harmonization, what current advisory material (e.g. ACJ, AMJ, AC, policy letters) need to be included in the rule text or preamble? ? [Does any existing advisory material include substantive requirements that should be contained in the regulation? This may occur because the regulation itself is vague, or if the advisory material is interpreted as providing the only acceptable means of compliance.]

See enclosed rule and advisory material. A part of one JAR ACJ has been added to 25.671(a) because it was determined to be rule material.

13. Is existing FAA advisory material adequate? If not, what advisory material should be adopted? [Indicate whether the existing advisory material (if any) is adequate. If the current advisory material is not adequate, indicate whether the existing material should be revised, or new material provided. Also, either insert the text of the proposed advisory material here, or summarize the information it will contain, and indicate what form it will be in (e.g., Advisory Circular, policy, Order, etc.)]

There is no existing FAA advisory material for 25.671. See the enclosure 2 for proposed advisory material. Advisory Circular 25-7 does contain a method for assessing flight control failures that affect handling qualities that is acceptable to the FAA but not accepted by the JAA. Advisory Circular 25.672 relates to flight controls and is being addressed by the

Loads & Dynamics Harmonization Working Group. See also the separate recommendation for 25.672.

14. How does the proposed standard affect the current ICAO standard? [Indicate whether the proposed standard complies with or does not comply with the applicable ICAO standards (if any)]

The proposed standard does not conflict with the current ICAO standard shown below. Compliance with 25.1309 using "Common Cause Analysis" provides coverage for the criteria in the ICAO standard.

ICAO change to Annex 8, effective March 12, 2000 :

"4.1.6(b) Aeroplane systems shall be designed, arranged and physically separated to maximize the potential for continued safe flight and landing after any event resulting in damage to the aeroplane structure or systems."

15. How does the proposed standard affect other HWG's? [Indicate whether the proposed standard should be reviewed by other harmonization working groups and why.]

This proposed standard contains criteria and requires compliance for flight controls beyond that contained in 25.1309 and the Handling Qualities Rating Method in Appendix 7 of AC25-7A. In addition, since a primarily qualitative approach is used in the proposed 25.671 advisory material, there may be some inconsistencies with the numerical approach used in those two standards. It also must be compatible with the Structures standards developed for 25.302.

The FAA agrees that the 1/1000 criteria added to the rule text in 25.671(c)(2) is an acceptable replacement of the current "single plus probable" requirement, as described in #8 of this report. However, there is currently a review of alternative "specific risk" criteria under FAR/JAR 25.1309. The FAA believes that it is imperative that 25.1309 and 25.671 be fully compatible with regard to any specific risk criteria. Furthermore, the LDHWG has been requested to evaluate these specific risk criteria in regards to the possible implications to flutter prevention.

Another FAA concern relative to compatibility between guidance material is the interchangeable use of the term "dormant" in 25.671 and "latent" in 25.1309. The FAA believes it is important to use a common term to avoid confusion.

16. What is the cost impact of complying with the proposed standard? [Please provide information that will assist in estimating the change in cost (either positive or negative) of the proposed rule. For example, if

new tests or designs are required, what is known with respect to the testing or engineering costs? If new equipment is required, what can be reported relative to purchase, installation, and maintenance costs? In contrast, if the proposed rule relieves industry of testing or other costs, please provide any known estimate of costs.]

The new standard will increase the amount of evaluation for certification of flight controls, both in analysis and testing. Depending on the airplane architecture, system changes may be required in new certification programs for greater use of jam override devices or split control surfaces. Some duplicate analysis or testing may be avoided through FAR/JAR harmonization.

17. If advisory or interpretive material is to be submitted, document the advisory or interpretive guidelines. If disagreement exists, document the disagreement.

See the Enclosure 3.

18. Does the HWG wish to answer any supplementary questions specific to this project? [If the HWG can think of customized questions or concerns relevant to this project, please present the questions and the HWG answers and comments here.]

The working will be able to answer questions arising during the process of NPRM development. The HWG has no supplementary questions to provide.

19. Does the HWG want to review the draft NPRM at Phase 4 prior to publication in the Federal Register?

Yes.

20. In light of information provided in this report, does the HWG consider that the "Fast Track" process is appropriate for this rulemaking project, or is the project too complex or controversial for the "Fast Track" process? [A negative answer to this question will prompt the FAA to pull the project out of the Fast Track process and forward the issues to the FAA's Rulemaking Management Council for consideration as a "significant" project.]

The HWG considers this project too complex for the "Fast Track" process.

25.671 General

(a) Each control and control system must operate with the ease, smoothness, and positiveness appropriate to its function. The flight control system shall be designed to continue to operate and must not hinder aircraft recovery from any attitude.

(b) Each element of each flight control system must be designed to minimize the probability of incorrect assembly that could result in failure of the system to perform its intended function. Distinctive and permanent marking may be used only where design means are impractical.

(c) The airplane must be shown by analysis, test, or both, to be capable of continued safe flight and landing after any of the following failures, including jamming, in the flight control system and surfaces (including trim, lift, drag, and feel systems) within the normal flight envelope, without requiring exceptional piloting skill or strength. Probable failures must have only minor effects and must be capable of being readily counteracted by the pilot.

> (1) Any single failure, excluding failures of the type defined in (c)(3).
>
> (2) Any combination of failures not shown to be extremely improbable. Furthermore, in the presence of any single failure in the flight control system, any additional failure states that could prevent continued safe flight and landing shall have a combined probability of less than 1 in 1000. This paragraph excludes failures of the type defined in (c)(3).
>
> (3) Any failure or event that results in a jam of a flight control surface or pilot control that is fixed in position due to a physical interference. The jam must be evaluated as follows:
>
> > (i) The jam must be considered at any normally encountered position.
> >
> > (ii) The causal failure or failures must be assumed to occur anywhere within the normal flight envelope except during the time immediately before landing where recovery may not be achievable when considering time delays in initiating recovery.
> >
> > (iii) In the presence of a jam considered under this sub-paragraph, any additional failure states that could prevent continued safe flight and landing shall have a combined probability of less than 1 in 1000.

(4) Any runaway of a flight control to an adverse position if such runaway could be due to a single failure, or due to a combination of failures that is not extremely improbable.

(d) The airplane must be designed so that it is controllable and an approach and flare to a landing possible if all engines fail at any point in the flight. Compliance with this requirement may be shown by analysis where that method has been shown to be reliable.

(e) The system design must ensure that the flight crew is made suitably aware whenever the primary control means nears the limit of control authority.

(f) If the design of the flight control system has multiple modes of operation, a means must be provided to indicate to the crew any mode that significantly changes or degrades the normal handling or operational characteristics of the airplane.

Advisory Advisory Circular Material Joint

Subject: Control Systems- General	**Date:** 19 March 2001	**AC/AMJ No:** 25.671
	Initiated By: FCHWG	**Change:** Final Draft

Table of Contents:

-

1. PURPOSE.

a. This AC/AMJ provides an acceptable means, but not the only means, of showing compliance with the control system requirements of 14 CFR 25.671 (referred to as FAR/JAR 25.671 in this AC/AMJ) of the Federal Aviation Requirements (FAR)/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.

b. The means described in this AC/AMJ are neither mandatory nor regulatory in nature and do not constitute a regulation. These means are issued, in the interest of standardization, for guidance purposes and to outline a method that has been found acceptable in showing compliance with the standards set forth in the rule. Because this AC/AMJ is not mandatory, terms "shall" and "must" used in this AC/AMJ only apply to those applicants who choose to demonstrate compliance using this particular method.

c. Other, alternate means of compliance that an applicant may propose should be given due consideration, provided they meet the intent of the regulation. In the absence of a rational analysis substantiated by data supporting alternative criteria, the criteria listed in this AC/AMJ may be used to show compliance with FAR/JAR 25.671.

2. CANCELLATION.

The following material is cancelled by this AC/AMJ:

a. ACJ 25.671(a), Control Systems – General (Interpretive Material)

b. ACJ 25.671(b), Control Systems – General (Interpretive Material)

c. ACJ 25.671(c)(1), Control Systems – General (Interpretive Material)

3. RELATED DOCUMENTS.

The following regulatory and advisory materials are related information:

a. Regulations.

(1) FAR/JAR 25.21(e), General - Proof of Compliance.

(2) FAR/JAR 25.143, Controllability and Maneuverability - General.

(3) FAR/JAR 25.302, Interaction of Systems and Structures.

(4) FAR/JAR Part 25 -- Appendix K, Interaction of Systems and Structures.

(5) FAR/JAR 25.331, Symmetric Maneuvering Conditions.

(6) FAR/JAR 25.571, Damage-Tolerance and Fatigue Evaluation of Structure.

(7) FAR/JAR 25.629, Aeroelastic Stability Requirements.

(8) FAR/JAR 25.671, Control Systems – General.

(9) FAR/JAR 25.672 (FCHWG Draft), Stability Augmentation and Automatic and Power-Operated Systems.

(10) FAR/JAR 25.683, Operation Tests.

(11) FAR/JAR 25.701, Flap and Slat Interconnection.

(12) FAR/JAR 25.1309 (SDAHWG Draft), Equipment, Systems, and Installations.

(13) FAR/JAR 25.1322, Warning, Caution, and Advisory Lights.

(14) FAR/JAR 25.1329, Automatic Pilot Systems.

(15) FAR/JAR 25.1435, Hydraulic Systems.

(16) FAR/JAR 25.1581(a)(2), Airplane Flight Manual - General.

(17) FAR/JAR 25.1583, Operating Limitations.

b. Advisory Circulars, Advisory Material Joint.

(1) AC 25-7A, Flight Test Guide for Certification of Transport Category Airplanes.

(2) AC/AMJ 25.1309 (SDAHWG Diamond Draft), System Design and Analysis.

c. Industry Documents.

(1) RTCA/DO-178B/EUROCAE ED12B, Software Considerations in Airborne Systems and Equipment Certification.

(2) SAE ARP 4754, Certification Considerations for Highly Integrated or Complex Aircraft Systems.

(3) SAE ARP 4761, Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment.

4. APPLICABILITY OF 14 CFR 25.671 AND ADVISORY MATERIAL.

14 CFR 25.671 (referred to as FAR/JAR 25.671 in this AC/AMJ) applies to all flight control system installations (including primary, secondary, trim, lift, drag, feel, and stability augmentation systems) regardless of implementation technique (manual, powered, fly-by-wire, or other means).

5. DEFINITIONS.

The following definitions apply to the requirements of FAR/JAR 25.671 and the guidance material provided in this AC/AMJ. Unless otherwise stated, they should not be assumed to apply to the same or similar terms used in other regulations or ACs/AMJs. Terms for which standard dictionary definitions apply are not defined herein.

a. At Risk Time. The period of time during which an item must fail in order to cause the failure effect in question. This is usually associated with the final fault in a fault sequence leading to a specific failure condition. See also SAE ARP 4761.

b. Catastrophic Condition. As used in AC/AMJ 25.1309 (reference 3.b.2).

c. Continued Safe Flight and Landing. The capability for continued controlled flight and landing at an airport without requiring exceptional pilot skill or strength.

d. Dormant Failure. A dormant failure is defined as one that has already occurred, but has not become evident to the flight crew or maintenance personnel. (The advisory material to 25.1309 uses the term "latent" in this application.)

e. Dormancy Period. The duration between actions necessary to check for the existence of a failure – the action may be a pre-flight flight crew check, periodic maintenance check, or periodic maintenance inspection (including component overhaul). See also "Exposure Time."

f. Error. An omission or incorrect action by a crewmember or maintenance personnel, or a mistake in requirements, design, or implementation. See also AC/AMJ 25.1309 and SAE ARP 4761.

g. Event. An occurrence that has its origins distinct from the airplane, such as atmospheric conditions (e.g., gusts, temperature variations, icing, and lightning strikes) and runway conditions, but is not intended to cover sabotage. See also AC/AMJ 25.1309 and SAE ARP 4761.

h. Exposure Time. The period of time between when an item was last known to be operating properly and when it will be known to be operating properly again. See also SAE ARP 4761.

i. Extremely Improbable. As used in AC/AMJ 25.1309 (reference 3.b.2).

j. Extremely Remote. As used in AC/AMJ 25.1309 (reference 3.b.2).

k. Failure. An occurrence that 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 operation outside specified limits). Note: Errors may cause Failures, but are not considered to be Failures. See also "failure" and "malfunction" in AC/AMJ 25.1309 and SAE ARP 4761.

The following are some of the types of failures to be considered in showing compliance with FAR/JAR 25.671(c). Since the type of failure and the failure's effect will depend on system architecture this list is not all-inclusive, but serves as a general guideline.

(1) Jam. A failure or event such that a control surface, pilot control, or component is fixed in one position.

(i) If the control surface or pilot control is fixed in position due to a physical interference, it is addressed under FAR/JAR 25.671(c)(3). Causes may include corroded bearings, interference with a foreign or loose object, control system icing, seizure of an actuator, or a disconnect that results in a jam by creating an interference. Jams of this type must be assumed to occur and should be evaluated at positions up to and including the normally encountered positions defined in Section 9.b.

(ii) All other failures that result in a fixed control surface, pilot control, or component are addressed under FAR/JAR 25.671(c)(1), 25.671(c)(2), and 25.671(c)(4), as appropriate. Depending on system architecture and the location of the failure, some jam failures may not always result in a fixed surface or pilot control; for example, a jammed valve could result in a surface runaway.

2Loss of Control of Surface. A failure such that a surface does not respond to commands. Failure sources include control cable disconnection, actuator disconnection, or loss of hydraulic power. In these conditions, the position of the surface(s) or controls can be determined by analyzing the system architecture and airplane aerodynamic characteristics; common positions include surface centered (0°) or zero hinge-moment position (surface float).

(3) Oscillatory Failure. A failure that results in undue surface oscillation. Failure sources include control loop destabilization, oscillatory sensor failure, oscillatory computer or actuator electronics failure. The duration of the oscillation, its frequency, and amplitude depend on the control loop, monitors, limiters, and other system features.

(4) Restricted Control. A failure that results in the achievable surface deflection being limited. Failure sources include foreign object interference or travel limiter malfunctioning. This failure is considered under FAR/JAR 25.671(c)(1) and 25.671(c)(2), as the system/surface can still be operated.

(5) Runaway or Hardover. A failure that results in uncommanded control surface movement. Failure sources include servo valve jamming, computer or actuator

electronics malfunctioning. The speed of the runaway, the duration of the runaway (permanent or transient) and the resulting surface position (full or partial deflection) depend on the available monitoring, limiters and other system features. This type of failure is specifically addressed in FAR/JAR 25.671(c)(4).

(6) Stiff or Binding Controls. A failure that results in a significant increase in control forces. Failure sources include failures of artificial feel systems, corroded bearings, jammed pulleys, and failures causing high friction. This failure is considered under FAR/JAR 25.671(c)(1) and 25.671(c)(2), as the system/surface can still be operated. In some architectures, the higher friction may result in reduced centering of the controls.

l. Failure States. As used in 25.671(c), this term refers to the sum of all failures and failure combinations contributing to a hazard, apart from the single failure being considered, and including the effect of exposure time.

m. Flight Control System. Flight control system refers to the following: primary flight controls from the pilots' controllers to the primary control surfaces, trim systems from the pilots' trim input devices to the trim surfaces (incl. stabilizer trim), speedbrake/spoiler (drag devices) systems from the pilots' control lever to the spoiler panels or other drag/lift-dumping devices, high lift systems from the pilots' controls to the high lift surfaces, feel systems, and stability augmentation systems. Supporting systems (i.e., hydraulic systems, electrical power systems, avionics, etc.) should also be included if failures in these systems have an impact on the function of the flight control system.

n.Probable. As used in AC/AMJ 25.1309 (reference 3.b.2).

o. Probability vs. Failure Rate. Failure rate is typically expressed in terms of average probability of occurrence per flight hour. In cases where the failure condition is associated with a certain flight condition that occurs only once per flight, the failure rate is typically expressed as average probability of occurrence per flight (or per takeoff, or per landing). Failure rates are usually the "root" numbers used in a fault tree analysis prior to factoring in dormancy periods, exposure time, or at risk time. Probability is non-dimensional and expresses the likelihood of encountering or being in a failed state. Probability is obtained by multiplying a failure rate by the appropriate exposure time.

p. Remote. As used in AC/AMJ 25.1309 (reference 3.b.2).

q. Single Failure Considerations. As used in AC/AMJ 25.1309 (reference 3.b.2).

6. BACKGROUND.

Two sets of requirements exist for flight control systems: FAR/JAR 25.671 and FAR/JAR 25.1309. Both are aimed at ensuring an adequate level of safety. FAR/JAR 25.1309 has the advantage of being associated with structured assessment methods and guidelines. While useful as a general guide for analysis and a complement to the requirements of FAR/JAR 25.671, FAR/JAR 25.1309 does not specifically address (1) minimum residual airplane capabilities following single failures, nor (2) the concept of control jams in normally encountered positions. FAR/JAR 25.671 specifically addresses these two areas.

This advisory material was developed to harmonize FAA and JAA requirements and provide guidance in showing compliance to FAR/JAR 25.671. This material addresses the existing JAA ACJ guidance as well as the following regulatory areas:

a. FAR/JAR 25.671(c) prescribes the failure conditions that must be considered in a control system design. While the failure conditions in FAR/JAR 25.671(c) are similar to those to be considered under FAR/JAR 25.1309, there are differences between the rules that lead to confusion and inconsistent application of FAR/JAR 25.671(c). In addition, JAR 25.671(c)(1) allows the exclusion of single failures that can be shown to be extremely improbable; FAR 25.671(c)(1) requires all single failures, regardless of failure probability, to be considered. FAR 25.671(c)(1) and JAR 25.671(c)(1) need to be harmonized. A uniform means of compliance to FAR/JAR 25.671(c) needs to be developed. It is expected that considerable elaboration would be made as to how the various mechanical, hydraulic, and electrical failures should be handled. Consideration should be given to dormant failures and the relationship of the flight control failures with the occurrence of engine failures.

b. Using the rate of control jams experienced in the transport fleet to date, and in service experience as an indicator of types control system malfunctions that may be safety concerns, the following aspects of 25.671 were also addressed:

(1) Defined the meaning of the terms "normal flight envelope", "without exceptional piloting skill or strength", "minor effects", and " position normally encountered" as used in § 25.671(c).

(2) Determined to what extent basic skills and reasonable pilot response and action may be used to alleviate the resulting airplane control problems. Determined the

applicability of crosswind to the landing situation with a jammed flight control.

(3) Identified acceptable methodology by which judge the controllability/maneuverability of an airplane with a jammed control system (e.g. Handling Qualities Rating System --HQRM).

(4) Reviewed & responded to NTSB Recommendation A-96-108 & A-99-23.

(5) Considered comments in AIA-GAMA letter dated January 23, 1997 and the input received at the December 3, 1996, public meeting conducted by the FAA.

(6) Addressed structural loading conditions following the jammed failure condition required for continued safe flight and landing.

c. Provided advisory material that addresses all engine failure condition defined in FAR/JAR 25.671(d).

d. The confusion of two different interpretations and inconsistent application of prior FAR/JAR 25.671(c)(2) was clarified with new wording and advisory material.

One interpretation of prior FAR/JAR 25.671(c)(2) focused on "combination of failures not shown to be extremely improbable" and considered this requirement essentially equivalent with the analysis required by AC/AMJ 25.1309. The examples in the parenthetical expression of prior FAR/JAR 25.671(c)(2) were viewed as examples only and not the main intent of the rule. Therefore, all combinations of failures that were not extremely improbable (1×10^{-9}/FH) were considered.

A different interpretation of prior FAR/JAR 25.671(c)(2) focused on the parenthetical expression and considered the failure combinations listed as the kinds of failures not considered to be extremely improbable, regardless numerical probability. Further, the phrase "any single failure in combination with any probable hydraulic or electrical failure" had been expanded to a more generic form of "any single failure in combination with any probable failure." Therefore, "single+probable" failures were not considered extremely improbable (regardless of probability) and therefore were to be considered for compliance.

7. EVALUATION OF CONTROL SYSTEM OPERATION -- 25.671(a).

a. Control systems for essential services should be so designed that when a movement to one position has been selected, a different position can be selected without waiting for the completion of the initially selected movement, and the system should arrive at the finally selected position without further attention. The movements that follow and the time taken by the system to allow the required sequence of selection should not be such as to adversely affect the airworthiness of the airplane.

b. Compliance should be shown by evaluation of the closed loop flight control system. This evaluation is intended to ensure that there are no features or unique characteristics (including numerical singularities) which would restrict the pilot's ability to recover from any attitude. It is not the intent of this rule or guidance material to limit the use of envelope protection features or other systems that augment the control characteristics of the aircraft.

8. EVALUATION OF CONTROL SYSTEM ASSEMBLY – 25.671(b).

This rule is intended to ensure the parts applicable to the type design are correctly assembled and is not intended to address parts control (ref. 25.1301(b), 45.14, & 45.15).

a. For control systems, the design intent should be such that it is impossible to assemble elements of the system so as to prevent its intended function. Examples of the consequences of incorrect assembly include the following:

(1) an out-of-phase action, or

(2) reversal in the sense of the control, or

(3) interconnection of the controls between two systems where this is not intended, or

(4) loss of function.

b. Adequate precaution should be taken in the design process and adequate procedures should be specified in the maintenance manual to prevent the incorrect installation, connection, or adjustment of parts of the flight control system.

9. EVALUATION OF CONTROL SYSTEM FAILURES – 25.671(c).

The guidance provided in this advisory material for 25.671(c) is not intended to address requirement errors, design errors, software errors, or implementation errors. These are typically managed through development processes or system architecture, and are adequately addressed by SAE ARP 4754, DO-178B, and AC/AMJ 25.1309.

FAR/JAR 25.671(c) requires that the airplane be shown by analysis, tests, or both, to be capable of continued safe flight and landing following failures in the flight control system and surfaces (including trim, lift, drag, and feel systems) within the normal flight envelope, without requiring exceptional piloting skill or strength.

Subparagraph (c)(1) requires the evaluation of any single failure, excluding the types of jams addressed in subparagraph (c)(3). Subparagraph (c)(1) requires that any single failure be considered, suggesting that an alternative means of controlling the airplane or an alternative load path be provided in the case of a single failure. All single failures must be considered, even if they can be shown to be extremely improbable. The single failure considerations of AC/AMJ 25.1309 apply.

Subparagraph (c)(2) requires the evaluation of any combination of failures, excluding the types of jams addressed in subparagraph (c)(3), not shown to be extremely improbable. For this application, extremely improbable is defined based on the criteria established in AC/AMJ 25.1309. In addition, subparagraph (c)(2) states that after any single failure in the flight control system, additional failure states that could prevent continued safe flight and landing shall have a combined probability of less than 1 in 1000. A probability of less than 1 in 1000 is not a failure rate but a time based probabilistic parameter intended to provide a required minimum residual airplane capability following a single flight control system failure.

Subparagraph (c)(3) requires the evaluation of any failure or event that results in a jam of a flight control surface or pilot control. This subparagraph is intended to address failure modes that would result in the surface or pilot’s control being fixed at the position commanded at the time of the failure due to some physical interference. The position at the time of the jam should be at any normally encountered control position encountered during takeoff, climb, cruise, normal turns, descent, and landing. In some architectures, component jams within the system may result in failure modes other than a fixed surface or pilot control; those types of jams are considered under subparagraphs (c)(1), (c)(2), and (c)(4).

In the past, determining a consistent and reasonable definition of normally encountered control positions has been difficult. A review of in-service fleet experience, to date, showed that the overall failure rate for a control surface jam is approximately 10^{-6} to 10^{-7} per flight hour. Considering this in-service data, a reasonable definition of normally encountered positions represents the range of control surface deflections (from neutral to the largest deflection) expected to occur in 1000 random operational flights, without considering other failures, for each of the flight segments identified in the rule.

One method of establishing acceptable control surface deflections is the performance-based criteria outlined in this AC which were established to eliminate any differences between aircraft types. The performance-based criteria prescribe environmental and operational maneuver conditions, and the resulting deflections may be considered normally encountered positions for compliance with FAR/JAR 25.671(c)(3).

Alleviation means may be used to show compliance with subparagraph (c)(3). For this purpose, alleviation means include system reconfigurations, jam prevention design features, or any other features that eliminate or reduce the consequences of a jam or permit continued safe flight and landing.

Subparagraph (c)(3) also states that in the presence of a jam that results in a fixed position of a flight control surface or pilot control, additional failure conditions that could prevent continued safe flight and landing shall have a combined probability of less than 1 in 1000 of existing. As with subparagraph (c)(2), a probability of less than 1 in 1000 is not a failure rate but a time based probabilistic parameter intend to provide a required minimum residual airplane capability following this type of jam.

Subparagraph (c)(4) requires that any runaway of a flight control to an adverse position be accounted for if such a runaway is due to a single failure or due to a combination of failures not shown to be extremely improbable. Means to alleviate the runaway may be used to show compliance by reconfiguring the control system, deactivating the system (or a failed portion thereof), overriding the runaway by movement of the flight controls in the normal sense, eliminating the consequences of a runaway in order to ensure continued safe flight and landing following a runaway, or using a means of preventing a runaway. Without a suitable means to alleviate or prevent the runaway, an adverse position would represent any position for which they are approved to operate.

All approved aircraft gross weights and cg locations should be considered. However, only critical combinations of gross weight and cg need to be demonstrated.

a. <u>Compliance with FAR/JAR 25.671(c)(2).</u> In showing compliance with the multiple failure requirements of FAR/JAR 25.671(c)(2), two different types of analysis/assessment are necessary.

(1) The first analysis/assessment requires that the airplane be capable of continued safe flight and landing following any combination of failures not shown to be extremely improbable. To satisfy this initial requirement, a safety analysis according to the techniques of AC/AMJ 25.1309 should be used.

(2) To comply with the second part of FAR/JAR 25.671(c)(2), the applicant is required to show that in the presence of any single failure in the flight control system (regardless of probability), any additional failure state (subsequent or pre-existing) that could prevent continued safe flight and landing when combined with the single failure must have a probability of less than 1 in 1000 of existing. This additional requirement ensures that a minimum level of safety exists should the single failure occur. As such, it establishes a minimum required

reliability for systems that provide a backup function to a primary system even though the primary system may have a very low failure probability (e.g., a 10^{-1} backup system to a 10^{-8} primary system would not be allowed).

Jams of the type addressed in (c)(3) are excluded from consideration under FAR/JAR 25.671(c)(2).

Given the current state of technology, some failure combinations such as dual electrical system or dual hydraulic system losses are not generally accepted as being extremely improbable.

The following is a general outline of the steps to perform the additional analysis for FAR/JAR 25.671(c)(2), following the safety analysis per AC/AMJ 25.1309:

> (i) Systematically work through the flight control system and impose a single failure on each single component or element of the flight control system. The single failure is assumed to have happened, regardless of its calculated failure rate or probability.
>
> (ii) With each single failure, identify any additional failure state(s) that would preclude continued safe flight and landing.
>
> (iii) Accounting for dormancy period (check/inspection interval), exposure time, or at risk time, calculate the risk probability of encountering the additional failure state(s) that would preclude continued safe flight and landing. The risk probability of encountering any of these additional failure states(s) on the same flight as the single failure shall be less than 1 in 1000.
>
> (iv) Repeat the above steps for each single failure in the flight control system.

Or viewed in another way, in showing compliance with the additional analysis of FAR/JAR 25.671(c)(2), for every numerical analysis that demonstrates a flight control failure condition that prevents continued safe flight and landing is extremely improbable, it shall be possible to substitute a probability of 1.0 at any individual gate or condition that represents a single failure, and the fault tree result due to the remainder of the analysis shall not be greater than 1 in 1000.

Appendix 2 gives simplified examples explaining how the 1 in 1000 analysis might be applied.

b. Determination of Control System Jam Positions – FAR/JAR 25.671(c)(3). The flight phases required by FAR/JAR 25.671 can be encompassed by three flight phases: takeoff, in-flight (climb, cruise, normal turns, descent, and approach), and landing.

Takeoff is considered to be the time period between brake release and 35 ft. In-flight is considered to be from 35 ft following a takeoff to 50 ft prior to landing including climb, cruise, normal turns, descent, and approach.

25.671(c)(3) requires that the airplane be capable of landing with a flight control jam and that the airplane be evaluated for jams in the landing configuration. However, for the evaluation of jams which occur just prior to landing, proximity to the ground need not be considered for the transient condition. Given that some amount of time and altitude is necessary in order to recover from any significant flight control jam, there is no practical means by which such a recovery could be demonstrated all the way to touchdown. The potential delay in accomplishing a recovery could be on the order of 5 seconds as described in section 9.e. For a jam at a control deflection corresponding to .8 g, a recovery may not be possible below approximately 200' even with a state of the art control system. While it is recognized that this means that a specific hazard is not addressed(a control jam that occurs, or is recognized, just before landing), this hazard is mitigated for the following reasons. First, the landing phase represents a limited exposure window in which a jam could occur. Second, successful operation of the controls throughout the flight minimizes the likelihood of a jam suddenly appearing during the landing phase. Also, some sources of jamming such as icing are not prevalent in the landing phase. Third, a certain level of recovery capability will be ensured through compliance with this AC such that if a jam does occur during landing, the crew will have a reasonable chance of landing safely.

Only the airplane rigid body modes need to be considered when evaluating the aircraft response to maneuvers and continued safe flight to landing.

It is assumed that if the jam is detected prior to V_1, the takeoff will be rejected.

The jam positions to be considered in showing compliance include any position up to the maximum position determined by the following maneuvers. The maneuvers and conditions described in this section are only to provide the control surface deflection to evaluate continued safe flight and landing capability, and are not to represent flight test maneuvers for such an evaluation; see section 9.e."

(1) Jammed Lateral Control Positions.

(i) Takeoff: The lateral control position for wings-level at V1 in a steady crosswind of the lesser of 25 knots (at a height of 10 meters above the takeoff surface) or the maximum demonstrated crosswind. Variations in wind speed from a 10 meter height can be obtained using the following relationship:

$$V_{alt} = V_{10meters} * (H_{desired}/10.0)^{1/7}$$

Where: $V_{10meters}$= Wind Speed at 10 meters AGL (knots) V_{alt} = Wind Speed at desired altitude (knots) $H_{desired}$ = Desired altitude for which Wind Speed is Sought

(Meters AGL), but not lower than 1.5m (5 ft)

(ii) In-flight: The lateral control position to sustain a 12 deg/sec steady roll rate from $1.23V_{SR1}(1.3V_S)$ to VMO/MMO or V_{fe}, as appropriate, but not greater than 50% of the control input.

Note: If the flight control system augments the pilot's input, then the maximum surface deflection to achieve the above maneuvers should be considered.

(2) Jammed Longitudinal Control Positions.

(i) Takeoff: Three longitudinal control positions should be considered:

(1) Any control position from that which the controls naturally assume without pilot input at the start of the takeoff roll to that which occurs at V1 using the manufacturer's recommended procedures.

Note: It may not be necessary to consider this case if it can be demonstrated that the pilot is aware of the jam before reaching V_1 (for example, through a manufacturer's recommended AFM procedure).

(2) The longitudinal control position at V_1 based on the manufacturers recommended procedures including consideration for any runway condition for which the aircraft is approved to operate.

(3) Using the manufacturers recommended procedures, the peak longitudinal control position to achieve a steady aircraft pitch rate of the lesser of 5 deg/sec or the pitch rate necessary to achieve the speed used for all-engines-operating initial climb procedures (V_2+XX) at 35 ft.

(ii) In-flight: The maximum longitudinal control position is the greater of :

(1) The longitudinal control position required to achieve steady state normal accelerations from 0.8g to 1.3g at speeds from $1.23V_{SR1}(1.3V_S)$ to V_{MO}/M_{MO} or $V_{fe,}$ as appropriate.

(2) The peak longitudinal control position commanded by the stability

augmentation or other automatic system in response to atmospheric discrete vertical gust defined by 15 fps from sea level to 20,000 ft.

(3) <u>Jammed Directional Control Positions.</u>

(i) <u>Takeoff:</u> The directional control position for takeoff at V1 in a steady crosswind of to the lesser of 25 knots (at a height of 10 meters above the takeoff surface) or the maximum demonstrated crosswind. Variations in wind speed from a height of 10 meters can be obtained using the following relationship:

$$V_{alt} = V_{10meters} * (H_{desired}/10.0)^{1/7}$$

Where: $V_{10meters}$ = Wind Speed at 10 meters AGL (knots) V_{alt} = Wind Speed at desired altitude (knots) $H_{desired}$ = Desired altitude for which Wind Speed is Sought

(Meters AGL), but not lower than 1.5m (5 ft)

(ii) <u>In-flight</u>: The directional control position is the greater of:

(1) The peak directional control position commanded by the stability augmentation or other automatic system in response to atmospheric discrete lateral gust defined by 15 fps from sea level to 20,000 ft.

(2) Maximum rudder angle required for lateral/directional trim from $1.23V_{SR1}(1.3V_S)$ to the maximum all engines operating airspeed in level flight with climb power, but not to exceed V_{MO}/M_{MO} or V_{fe} as appropriate. While more commonly a characteristic of propeller aircraft, this addresses any lateral/directional asymmetry that can occur

in flight with symmetric power.(4) Control Tabs, Trim Tabs, and Trimming Stabilizers. Any tabs installed on control surfaces are assumed jammed in the position associated with the normal deflection of the control surface on which they are installed.

Trim tabs and trimming stabilizers are assumed jammed in the positions associated with the manufacturer's recommended procedures for takeoff and that are normally used throughout the flight to trim the aircraft from $1.23V_{SR1}(1.3V_S)$ to V_{MO}/M_{MO} or $V_{fe,}$ as appropriate.

(5) Speed Brakes. Speed brakes are assumed jammed in any position for which they are approved to operate during flight at any speed from $1.23V_{SR1}(1.3V_S)$ to V_{MO}/M_{MO} or $V_{fe,}$ as appropriate. Asymmetric extension and retraction of the speed brakes should be considered. Roll spoiler jamming (asymmetric spoiler panel) is addressed in Section 9.b.1.

(6) High Lift Devices. Leading edge and trailing edge high lift devices are assumed to jam in any position for takeoff, climb, cruise, approach, and landing. Skew of high lift devices or asymmetric extension and retraction should be considered; FAR/JAR 25.701 contains a requirement for flap mechanical interconnection unless the aircraft has safe flight characteristics with the asymmetric flap positions not shown to be extremely improbable.

(7) Load Alleviation Systems.

(i) Gust Load Alleviation Systems. At any airspeed between $1.23V_{SR1}(1.3V_S)$ to V_{MO}/M_{MO} or $V_{fe,}$ as appropriate, the control surfaces are assumed to jam in the maximum position commanded by the gust load alleviation system in response to a discrete atmospheric gust with the following reference velocities:

(1) 15 fps (EAS) from sea level to 20,000 ft (vertical gust),

(2) 15 fps (EAS) from sea level to 20,000 ft (lateral gust).

(ii) Maneuver Load Alleviation Systems. At any airspeed between $1.23V_{Sr1}(1.3V_{Smin})/V_{ref}$ to $V_{MO}/M_{MO}/V_{fe}$ the control surfaces are assumed to jam in the maximum position commanded by the maneuver load alleviation system during a pull-up maneuver to 1.3g or a pushover maneuver to 0.8g.

c. Jam Combination Failures – FAR/JAR 25.671(c)(3). In addition to demonstration of jams at "normally encountered position," compliance with FAR/JAR 25.671(c)(3) should include an analysis that shows a minimum level of safety exists should the jam occur. This additional analysis should show that in the presence of a jam considered under 25.671(c)(3), any additional failure state that could prevent continued safe flight and landing when combined with the jam must have a probability of less than 1 in 1000 of existing. (This analysis uses the same methods for demonstration of compliance with 25.671(c)(2), where the jam is the single failure.) As a minimum, this should include analysis of such elements as a jam breakout or override, disconnect means, alternate surface control, alternate electrical or hydraulic sources, or alternate cable paths. This analysis should help determine intervals for scheduled maintenance activity or operational checks that ensure the availability of alleviation or compensation means.

d. Runaway to an Adverse Position – FAR/JAR 25.671(c)(4). Consideration of a control runaway will be specific to each application and a general interpretation of an adverse position cannot be given. Where applicable, the applicant is required to assess the resulting surface position after a runaway, if the failure condition is not extremely improbable or can occur due to a single failure. This applies to all controls discussed in Section 9.b.

e. Assessment of Continued Safe Flight and Landing – FAR/JAR 25.671(c). Following a flight control system failure of the types discussed in Sections 9.a, 9.b, 9.c, and 9.d, the maneuverability and structural strength criteria defined in the following sections should be considered to determine the airplane's capability for continued safe flight and landing.

(1) Flight Characteristics.

(i) General. Following control system failure, appropriate procedures may be used including system reconfiguration, flight limitations, and crew resource management. The procedures for safe flight and landing should not require exceptional piloting skill or strength.

Additional means of control, such as trim system, may be used if it can be shown that the systems are available and effective. Credit should not be given for use of differential engine thrust to maneuver the aircraft. However, differential thrust may be used following the recovery to maintain lateral/directional trim following the flight control system failure.

For the longitudinal control surface jam during takeoff prior to rotation, it is necessary to show that the aircraft can be safely rotated for liftoff without consideration of field length available.

(ii) Transient Response. There should be no unsafe conditions during the transient condition following a flight control system failure. The evaluation of failures, or maneuvers leading to jamming, is intended to be initiated at 1g wings-level flight. For this purpose, continued safe flight and landing is generally defined as not exceeding any one of the following:

(1) A load on any part of the primary structure sufficient to cause a catastrophic structural failure

(2) Catastrophic loss of flight path control

(3) Exceedance of Vdf/Mdf

(4) Catastrophic Flutter or vibration

(5) Bank angle in excess of 90 degrees

In connection with the transient response, compliance should be shown to the requirements of FAR/JAR 25.302. While V_F is normally an appropriate airspeed limit to be considered regarding continued safe flight and landing, temporary exceedence of V_F may be acceptable as long as the requirements of FAR/JAR 25.302 are met.

Paragraph 9.b. provides a means of determining control surface deflections for the evaluation of flight control jams. In some cases, aircraft roll or pitch rate or normal acceleration is used as a basis to determine these deflections. The roll or pitch rate and/or normal acceleration used to determine the control surface deflection need not be included in the evaluation of the transient condition. For example, the in-flight lateral control position determined in paragraph 9.b.(1)(ii) is based on a steady roll rate of 12 degrees per second. When evaluating this condition, whether by analysis, simulation or in-flight demonstration, the resulting control surface deflection is simply input while the airplane is in wings-level flight, at the appropriate speed, altitude, etc. During this evaluation, the airplane's actual roll or pitch rate may or may not be the same as the roll or pitch rate used to determine the jammed control surface position

(iii) <u>Delay Times.</u> Due consideration should be given to the delays involved in pilot recognition, reaction, and operation of any disconnect systems, if applicable.

Delay = Recognition + Reaction + Operation of Disconnect

Recognition is defined as the time from the failure condition to the point at which a pilot in service operation may be expected to recognize the need to take action. Recognition of the malfunction may be through the behavior of the airplane or a reliable failure warning system, and the recognition point should be identified but should not normally be less than 1 second. For flight control system failures, except the type of jams addressed in (c)(3), control column or wheel movements alone should not be used for recognition.

The following reaction times should be used:

Flight Condition	Reaction Time
On Ground	1 sec (**)
In Air, (<1000 ft AGL)	1 sec (**)
Manual Flight (>1000 ft AGL)	1 sec (**)
Automatic Flight (>1000 ft AGL)	3 sec
(**) 3 sec if control must be transferred between pilots.	

The time required to operate any disconnect system should be measured either through ground tests or during flight testing. This value should be used during all analysis efforts. However, flight testing or manned simulation that requires the pilot to operate the disconnect includes this extra time; therefore, no additional delay time would be needed for these demonstrations.

(iv) Maneuver Capability for Continued Safe Flight and Landing. If, using the manufacturer's recommended procedures, the following maneuvers can be performed following the failure, it will generally be considered that continued safe flight and landing has been shown.

(1) A steady 30° banked turn to the left or right,

(2) A roll from a steady 30° banked turn through an angle of 60° so as to reverse the direction of the turn in not more than 11 seconds (in this maneuver the rudder may be used to the extent necessary to minimize sideslip, and the maneuver may be unchecked),

(3) A pushover maneuver to 0.8g, and a pull-up maneuver to 1.3g,

(4) A wings level landing flare in a 90° crosswind of up to 10 knots (measured at 10 meters above the ground).

Note: For the case of control surface jams during takeoff that are detected by the flight crew, it may be assumed that the aircraft is returned to a suitable runway, including consideration of crosswind. As a result, it can be assumed that the aircraft is returned to a runway with a favorable crosswind no more than 15 knots less than the crosswind at the time of the jam.

(v) Control Forces. The short and long term control forces should not be greater than 1.5 times the short and long term control forces allowed by FAR/JAR 25.143(c).

Short term forces have typically been interpreted to mean the time required to accomplish a configuration or trim change. However, taking into account the capability of the crew to share the workload, the short term forces of 25.143(c) may be appropriate for a longer duration, such as the evaluation of a jam on takeoff and return to landing.

During the recovery following the failure, transient control forces may exceed these criteria to a limited extent. Acceptability of any exceedances will be evaluated on a case by case basis.

(2) Structural Strength for Flight Control System Failures.

(i) Failure Conditions per FAR/JAR 25.671(c)(1), (c)(2), and (c)(4). It should be shown that the aircraft maintains structural integrity for continued safe flight and landing. This should be accomplished by showing compliance with FAR/JAR 25.302 (Interaction with Systems and Structures). In FAR/JAR 25.302, a failure is declared extremely improbable based solely on a quantitative probability. However, some failures may exhibit failure rates that are less than 10^{-9} per flight hour and not be classified as extremely improbable (some single failures may fall into this category). The level of structural strength assessment should be according to the probability of the failure as defined below:

Failure Probability **(Quantitative Assessment)**	**Failure Probability** **(Qualitative Assessment)**	**Structural** **Substantiation**
$>10^{-9}$ per flight hour	Not Extremely Improbable	As per FAR/JAR 25.302, Appendix K25.1(c)
$<10^{-9}$ per flight hour	Not Extremely Improbable	As per Section 9.e.2.iii
$<10^{-9}$ per flight hour	Extremely Improbable	None

(ii) Jam Conditions per FAR/JAR 25.671(c)(3). It should be shown that the aircraft maintains structural integrity for continued safe flight and landing. Recognizing that jams are infrequent occurrences and that margins have been taken in the definition of normally encountered positions of this Advisory Circular, criteria other than those specified in FAR/JAR 25.302 Appendix K25.1(c) may be used for structural substantiation to show continued safe flight and landing.

This structural substantiation should be per Section 9.e.2.iii

(iii) Structural Substantiation. The loads considered as ultimate should be derived from the following conditions at speeds up to the maximum speed allowed for the jammed position or for the failure condition:

(1) Balanced maneuver of the airplane between 0.25g and 1.75g with high lift devices fully retracted and in enroute configurations, and between 0.6g and 1.4g with high lift devices extended,

(2) Vertical and lateral discrete gusts corresponding to 40% of the limit gust velocity specified at Vc in FAR/JAR 25.341(a) with high lift devices fully retracted, and a 17 fps vertical and 17 fps head-on gust with high lift devices extended.

10. EVALUATION OF ALL-ENGINES FAILED CONDITION – 25.671(d).

a. Explanation. FAR/JAR 25.671(d) states that, "The airplane must be designed so that it is controllable and an approach and flare to a landing possible if all engines fail at any point in the flight. Compliance with the requirement may be shown by analysis where that method has been shown to be reliable."

The intent of FAR/JAR 25.671(d) is to assure that in the event of failure of all engines and given the availability of an adequate runway, the airplane will be controllable and an approach and flare to a landing possible. In this context, "flare to a landing" refers to the time until touchdown. Although the rule refers to "flare to a landing" with the implication of being on a runway, it is recognized that with all engines inoperative it may not be possible to reach an adequate runway or landing surface; in this case the aircraft must still be able to make a flare to landing attitude.

FAR/JAR 25.671(d) effectively requires airplanes with fully powered or electronic flight control systems to have a source for emergency power, such as an air driven generator, wind-milling engines, batteries, or other power source capable of providing adequate power to the flight control system.

Analysis, simulation, or any combination thereof may be used to show compliance where the methods are shown to be reliable.

b. Procedures.

(1) The airplane should be evaluated to determine that it is possible, without requiring exceptional piloting skill or strength, to maintain control following the failure of all engines, including the time it takes for activating any backup systems. The airplane should also remain controllable during restart of the most critical engine,

whilst following the AFM recommended engine restart procedures.

(2) The most critical flight phases, especially for airplanes with emergency power systems dependent on airspeed, are likely to be takeoff and landing. Credit may be taken for hydraulic pressure/electrical power produced while the engines are spinning down and any residual hydraulic pressure remaining in the system. Sufficient power must be available to complete a wings level approach and flare to a landing.

Analyses or tests may be used to demonstrate the capability of the control systems to maintain adequate hydraulic pressure/electrical power during the time between the failure of the engines and the activation of any backup systems. If any of the backup systems rely on aerodynamic means to generate power, then a flight test demonstration should be performed to demonstrate that the backup system could supply adequate electrical and hydraulic power to the flight control systems. The flight test should be conducted at the minimum practical airspeed required to perform an approach and flare to a safe landing attitude.

(3) The maneuver capability following the failure of all engines should be sufficient to complete an approach and flare to a landing. Note that the aircraft weight could be extremely low (e.g., the engine failures could be due to fuel exhaustion). The maximum speeds for approach and landing may be limited by other Part 25 requirements (e.g., ditching, tire speeds, flap or landing gear speeds, etc.) or by an evaluation of the average pilot's ability to conduct a safe landing. At an operational weight determined for this case and for any other critical weights and c.g.'s identified by the applicant, at speeds down to the approach speeds appropriate to the aircraft configuration, the aircraft should be capable of:

(i) A steady 30° banked turn to the left or right,

(ii) A roll from a steady 30° banked turn through an angle of 60° so as to reverse the direction of the turn in not more than 11 seconds (in this maneuver the rudder may be used to the extent necessary to minimize sideslip, and the maneuver may be unchecked),

(iii) A pushover maneuver to 0.8g, and a pull-up maneuver to 1.3g,

(iv) A wings level landing flare in a 90° crosswind of up to 10 knots (measured at 10 meters above the ground).

Note: If the loss of all engines has no effect on the control authority of the aircraft (e.g., manual controls) then the results of the basic handling qualities flight tests with all engines operating may be used to demonstrate the satisfactory handling qualities of the airplane with all engines failed.

(4) It should be possible to perform a flare to a safe landing attitude, in the most critical configuration, from a stabilized approach using the recommended approach speeds and the appropriate AFM procedures, without requiring exceptional piloting skill or strength. For transient maneuvers, forces are allowed up to 1.5 times those specified in FAR/JAR 25.143(c) for temporary application with two hands available for control.

11. EVALUATION OF CONTROL AUTHORITY AWARENESS – 25.671(e).

a. FAR/JAR 25.671(e) requires suitable annunciation to be provided to the flight crew when a flight condition exists in which near-full control authority (not pilot-commanded) is being used. Suitability of such a display must take into account that some pilot-demanded maneuvers (e.g., rapid roll) are necessarily associated with intended full performance, which may saturate the surface. Therefore, simple alerting systems, which would function in both intended and unexpected control-limiting situations, must be properly balanced between needed crew-awareness and nuisance alerting. Nuisance alerting should be minimized. The term suitable indicates an appropriate balance between nuisance and necessary operation.

b. Depending on the application, suitable annunciations may include cockpit control position, annunciator light, or surface position indicators. Furthermore, this requirement applies at limits of control authority, not necessarily at limits of any individual surface travel.

12. EVALUATION OF FLIGHT CONTROL SYSTEM SUBMODES – 25.671(f).

Some systems, EFCS in particular, may have submodes of operation not restricted to being either on or off. The means provided to the crew to indicate the current submode of operation may be different from the classic "failure warning."

13. ACCEPTABLE MEANS OF COMPLIANCE DEMONSTRATION.

It is recognized that it may be neither practical nor appropriate to demonstrate compliance by flight test for all of the failure conditions noted herein. Compliance may be shown by analysis, simulation, a piloted engineering simulator, flight test, or combination of these methods as agreed with the certification authority. Simulation methods should include an accurate representation of the aircraft characteristics and of the pilot response, including time delays as specified in Section 9.e.1.iii.

Efforts to show compliance with this regulation may result in flight manual abnormal procedures. Verification of these procedures may be accomplished in-flight or, with the agreement of the certification authority, using a piloted simulator.

a. Acceptable Use of Simulations. It is generally difficult to define the types of simulations that might be acceptable in lieu of flight testing without identifying specific conditions or issues. However, the following general principles can be used as guidance for making this kind of decision:

(1) In general, flight test demonstrations are the preferred method to show compliance.

(2) Simulation may be an acceptable alternative to flight demonstrations, especially when:

(i) A flight demonstration would be too risky even after attempts to mitigate these risks (e.g., "simulated" takeoffs/landings at high altitude),

(ii) The required environmental conditions are too difficult to attain (e.g., windshear, high crosswinds),

(iii) The simulation is used to augment a reasonably broad flight test program,

(iv) The simulation is used to demonstrate repeatability.

b. Simulation Requirements. Where it is agreed that a simulation will be used to establish compliance, to be acceptable for use in showing compliance with the performance and handling qualities requirements the simulation should:

(1) Be suitably validated by flight test data for the conditions of interest.

(i) This does not mean that there must be flight test data at the exact conditions of interest; the reason simulation is being used may be that it is too difficult or risky to obtain flight test data at the conditions of interest.

(ii) The level of substantiation of the simulator to flight correlation should be commensurate with the level of compliance (i.e., unless it is determined that the simulation is conservative, the closer the case is to being non-compliant, the higher the required quality of the simulation).

(2) Be conducted in a manner appropriate to the case and conditions of interest.

(i) If closed-loop responses are important, the simulation should be piloted by a human pilot.

(ii) For piloted simulations, the controls/displays/cues should be substantially equivalent to what would be available in the real airplane (unless it is determined that not doing so would provide added conservatism).

APPENDIX 1. FAILURE RATE AND PROBABILITY CONSIDERATIONS.

a. Failure Rates.

An important aspect in performing the analyses to show compliance with both multiple failure requirements of FAR/JAR 25.671(c)(2) is the determination of failure rates. The failure rates are used in the fault tree analysis per FAR/JAR 25.1309 to determine the overall probability of failure combinations to ensure the probability is commensurate with the failure effects. Failure rates are also used to calculate the probability (i.e., risk) of additional failures, or of being in a failed state, that may preclude continued safe flight and landing following the single failure.

Failure rates should be conservative and adequately substantiated to yield an acceptable level of confidence. In order of preference, the following sources should be considered for calculating conservative/substantiated failure rates: manufacturer/vendor in-service data of like or similar components used in a similar application and similar environment, vendor prediction, industry standard (i.e., NPRD data), and engineering judgement based on prior experience with similar components. The methods of obtaining failure rates should be explained and traceability to sources should be maintained. Built-in conservatism in the analysis should also be explained. The certification agencies have the opportunity to question or discuss any failure rates in the course of reviewing safety analysis materials. Following certification, the manufacturer should monitor for in-service deviations from safety analysis assumed failure rates.

In some cases, manufacturers use published company design standards as one means to promote consistency and improvement of component failure rates. These standards typically specify environments, design features, and other considerations that the manufacturer’s past design and service experience has shown provides acceptable service reliability. Generally, future components that adhere to these standards are expected to achieve reliabilities similar to predecessor components.

To aid in providing confidence in the analysis, sensitivity analyses should be conducted on the failure rates used in the fault tree analysis for 25.1309 to show the top failure condition probability still allows compliance to be shown.

b. Failure Rate vs. Probability.

In the analysis required by the second sentence of FAR/JAR 25.671(c)(2), it is important to note that the "probability of less than 1 in 1000" for the additional failure state(s) that would preclude continued safe flight and landing is not to be confused with a failure rate of 10^{-3} per flight hour. Failure rates are expressed in "per flight hour" or "per flight" terms. The "probability" in the requirement is unitless and represents the "risk" of encountering those additional failure(s) during the same flight. For example, after the failure of the primary system, a backup system that is monitored with a failure rate of $1x10^{-5}$ per flight hour (active failure) would have a probability of encountering that additional failure during the same flight of $1x10^{-5}$ for a 1 hour flight, $3x10^{-5}$ for a 3 hour flight, and $1x10^{-4}$ for a 10 hour flight.

Dormancy periods also factor into the calculation of the 1 in 1000 probability. In the example of the $1x10^{-5}$/FH backup system, if this were a dormant failure, then a check for the presence of the dormant failure must be performed every 100 hours to comply with the 1 in 1000 probability.

The above examples assume that the airplane is "at risk" of the additional failure for the duration of the flight. For cases where the airplane is at risk of the additional failure only during a limited portion of the flight, at risk time is used to determine the risk probability.

Flight time, dormancy period, exposure time, and at risk time all combine to contribute to the risk probability of the additional failures.

APPENDIX 2. EXAMPLES OF 25.671(c)(2)'s 1 in 1000 REQUIREMENT.

The following simplified examples explain how the additional 1 in 1000 requirement in FAR/JAR 25.671(c)(2) might be applied. Since many other factors influence the acceptability and certificability of a design, inclusion of a design as an example does not imply the design will always be acceptable; the examples below are only included to illustrate the additional investigation required under FAR/JAR 25.671(c)(2).

a. Example #1 – Dual Load-Path.

Although there are other requirements that govern such a design, consider a simplified case of a dual load-path design where two pushrods connect actuators to an unbalanced surface. Assume that a free-floating surface could preclude continued safe flight and landing in any flight phase and therefore must be guarded against.

For this example each pushrod is designed to carry the full load in the absence of the other, the pushrods are independent of one another, and they are readily inspectable. However, since the failure of one pushrod (one load-path) would not be readily apparent to the crew, that failure would be dormant.

(1) FAR/JAR 25.1309 Considerations -- Suppose the manufacturer has sufficient service history data to justify a failure of a pushrod is $1x10^{-7}$/FH. Under a strict FAR/JAR 25.1309 approach and taking into account the dormancy of the failure, the failure of both pushrods in combination has a probability of occurrence per flight hour of...

$\{ [(1x10^{-7}/FH \text{ Pushrod Failure}) \bullet (t_{insp} \text{ hr dormancy period})]$
$\bullet$

$[(1x10^{-7}/FH \text{ Pushrod Failure}) \bullet (t_{flight} \text{ hr avg flight})] \} /$
$(t_{flight} \text{ hr avg flight})$

$< 1x10^{-9}/FH$

Since the "t_{flight} avg flight" term cancels out of the equation, solving for the maximum acceptable dormancy period that still satisfies the $1x10^{-9}$/FH criteria yields a dormancy period (i.e., inspection interval) of 100,000 FH.

(2) FAR/JAR 25.671(c)(2) Considerations -- Now look at the additional multiple failure requirement in the second sentence of FAR/JAR 25.671(c)(2). The single failure is assumed to have occurred, regardless of probability; in this example the failure of one pushrod is the single failure. The additional failure that could preclude continued safe flight and landing is identified as the failure of the other pushrod. Now look to see if the probability of encountering the additional failure is less than 1 in 1000.

Since the additional failure is dormant, to calculate the probability that the additional failure has already occurred (or will occur) the full dormancy period is applied first using the inspection interval established for compliance with FAR/JAR 25.1309.

$$(1\text{x}10^{-7}/\text{FH Pushrod Failure}) \bullet (100{,}000 \text{ hr check}) = 4\text{x}10^{-2}$$
$$(\text{or 1 in 25})$$

Since the inspection interval for compliance with FAR/JAR 25.1309 does not satisfy the 1 in 1000 criteria in the second part of FAR/JAR 25.671(c)(2), the inspection interval is recalculated to comply with the 1 in 1000 criteria.

$$(1\text{x}10^{-7}/\text{FH Pushrod Failure}) \bullet (t_{insp} \text{ hr dormancy period}) < 1\text{x}10^{-3} \text{ (or 1 in 1000)}$$

Solving for the inspection interval to satisfy 1 in 1000 yields an inspection interval (dormancy period) of no more than 10,000 hrs. In this case, the 1 in 1000 criteria in FAR/JAR 25.671(c)(2) would be more restrictive than 25.1309.

b. Example #2 – Flap System and Asymmetry Detection.

Although there are other requirements that govern such a design, consider the simplified flap drive system shown. Assume that excessive asymmetry could preclude continued safe flight and landing in any flight phase; therefore, excessive asymmetry must be sufficiently guarded against throughout the flight (i.e., at risk time could not be used in this case).

In this example a central power drive unit drives, through drive shafts, irreversible actuators at the flap surface. In the absence of the asymmetry monitor, a severance of the drive shaft just outside the PDU results in one flap being driven and the other flap remaining in its last commanded position – excessive asymmetry could develop. Since this excessive asymmetry is not extremely improbable, an electronic flap asymmetry monitor checks the position of each flap and shuts down the power drive unit should excessive asymmetry start to develop. The asymmetry monitor is passive; it only shuts down the PDU when it detects an excessive asymmetry.

(1) FAR/JAR 25.1309 Considerations -- Suppose the manufacturer has sufficient service history data to justify the probability of either drive shaft severance is approximately $1x10^{-7}$/FH. Under a strict FAR/JAR 25.1309 approach, to ensure that excessive flap asymmetry is extremely improbable the likelihood of either drive shaft severance combined with the likelihood of an asymmetry monitor failure would need to be less than $1x10^{-9}$/FH.

Suppose the manufacturer has sufficient service experience with similar electronic monitor systems to justify a failure rate (fail to inoperative status) of $1x10^{-5}$/FH. In the example, the failure of the monitor is dormant since the monitor takes no action until it detects the asymmetry; therefore, a periodic check is established to satisfy the required minimum reliability for 25.1309.

{ [($1x10^{-5}$/FH Monitor Failure) • (t_{insp} hr dormancy period)] •

[($0.5x10^{-7}$/FH Either Drive Shaft Severance) • (t_{flight} hr avg flight)] }

/ (t_{flight} hr avg flight) < $1x10^{-9}$/FH

Since the "t_{flight} avg flight" term cancels out of the equation, solving for the maximum acceptable dormancy period that still satisfies the $1x10^{-9}$/FH criteria yields a dormancy period (i.e., inspection interval) of 2,000 FH.

(2) FAR/JAR 25.671(c)(2) Considerations -- Now look at the additional multiple failure requirement in the second sentence of FAR/JAR 25.671(c)(2). The single failure is assumed to have occurred, regardless of probability. If the assumed single failure is the failure of the asymmetry monitor, the additional failure(s) that could preclude continued safe flight and landing is the failure of the drive shaft. Now look to see if the probability of encountering the additional failure(s) is less than 1 in 1000.

($1x10^{-7}$/FH Either Drive Shaft Sev.) • (t_{flight} hr avg flight) < $1x10^{-3}$ (or 1 in 1000)

Since the probability of encountering the drive shaft failure is on the order of 1 in 10,000,000 (depending on the duration of the average flight) compared to a 1 in 1000 requirement, compliance with the multiple failure requirements of FAR/JAR 25.671(c)(2) is shown for this single failure condition.

If the assumed single failure is the failure of the drive shaft, the additional failure(s) that could preclude continued safe flight and landing is the failure of the asymmetry monitor. Now look to see if the probability of encountering the additional failure(s) is less than 1 in 1000. Since the additional failure is dormant, the full dormancy period is applied first using the inspection interval established for compliance with FAR/JAR 25.1309.

($1x10^{-5}$/FH Monitor failure) • (2000 hr check) = $2x10^{-2}$ (or 1 in 50)

Since the 2000 hr inspection interval for compliance with FAR/JAR 25.1309 does not satisfy the 1 in 1000 criteria in the second part of FAR/JAR 25.671(c)(2), a design change would be necessary. Options available include: (1) change the monitor to self-check so it is no longer a dormant failure, (2) change to a redundant drive path or redundant monitor path, (3) improve the reliability of the monitor, or (4) reduce the check interval on the monitor. For this example, let's recalculate the inspection interval to comply with the 1 in 1000 criteria.

($1x10^{-5}$/FH Monitor Failure) • (t_{insp} hr dormancy period) < $1x10^{-3}$ (or 1 in 1000)

Solving for the inspection interval to satisfy 1 in 1000 yields an inspection interval (dormancy period) of no more than 100 hrs. In this case, the 1 in 1000 criteria in FAR/JAR 25.671(c)(2) would be more restrictive than 25.1309.

Team Member Alternate Recommendations

1. Proposal to use 15 knots crosswind in Lateral Directional Takeoff Conditions [Raytheon, Bombardier, Airbus, Boeing, Cessna, Transport Canada]

One proposal for AC/AMJ 25.671 Section 9b(1) and (3) to determine jammed roll and yaw control positions, used during demonstration of continued safe flight and landing, establishes a crosswind level for a jam occurring during takeoff as the lesser of 25 knots or maximum demonstrated crosswind. The FAA Generic Issue Paper for flight control mechanical jam conditions and jam Issue Papers being used for current FAA certification programs establish roll and yaw control jam positions to be considered as that required for takeoff in a steady crosswind up to 15 knots. Transport Canada has indicated that recent Canadian certification programs have used a 14 knot crosswind to determine control positions for jams occurring during takeoff. It is proposed that the determination be based on crosswinds up to 15 knots for the following reasons:

- The group has not identified a safety issue with the current means of compliance, which establishes a crosswind of 15 knots for determination of normally encountered roll and yaw control jam positions. The increase in crosswind to the lesser of 25 knots or maximum demonstrated capability is unwarranted.
- The probability of a mechanical control jam occurring between V_1 and lift-off is Extremely Improbable by numerical evaluation. ($1x10^{-7}$/flt-hr jam failure rate

with less than a 5 sec. or 0.0014 hr. exposure time results in a $1.4x10^{-10}$ probability of jam during this critical period per flight.) The released FAA Flight Test Guide AC25-7A, Appendix 7 defines the probability of encountering a crosswind up to 25 knots as 1 in 1000 flights. Therefore, the probability of encountering a crosswind of 25 knots on the same flight as a mechanical control jam which occurs during the critical 5 second time period during takeoff is approximately $1x10^{-12}$ to $1x10^{-13}$.

- If the 25 knot crosswind criterion is adopted, more complicated control systems may be required to ensure that continued safe flight and landing characteristics are provided. For example, an aileron-only lateral control system may no longer be certificable, multiple rudder panels may be necessary, and redundant means for lateral trim may be necessary. These complications to proven control surface configurations would have a negative impact on the viability of new aircraft and may have a negative overall impact on airplane safety.

To be added in Section 9(b) of Draft B following:

It is assumed that if the jam is detected prior to V_1, the takeoff will be rejected.

Although 1 in 1000 operational takeoffs is expected to include crosswinds up to 25 knots, the short exposure time associated with a control surface jam occurring between V_1 and V_{LOF} allows usage of a less conservative crosswind magnitude when determining normally encountered lateral and directional control positions. Given that lateral and directional controls are continuously used to maintain runway centerline in a crosswind takeoff, and control inputs greater than that necessary at V_1 will occur at speeds below V_1, any jam in these control axes during a crosswind takeoff will normally be detected prior to V_1. Considering the control jam failure rate of approximately 10^{-6} to 10^{-7} per flight hour combined with the short exposure time between V_1 and V_{LOF}, a reasonable crosswind level for determination of jammed lateral or directional control positions during takeoff is 15 knots.

........[existing paragraph]......

(1) Jammed Lateral Control Positions.

(i) Takeoff: The lateral control position for wings-level at V_1 in a steady crosswind of 15 knots (at a height of 10 meters above the takeoff surface). Variations in wind speed from a 10 meter height can be obtained using the following relationship:

$$V_{alt} = V_{10meters} * (H_{desired}/10.0)^{1/7}$$

Where: $V_{10meters}$= Wind speed at 10 meters AGL (knots) V_{alt} = Wind speed at desired altitude (knots) $H_{desired}$ = Desired altitude for which wind speed is sought

(Meters AGL), but not lower than 1.5m (5 ft)

(ii) In-flight: The lateral control position to sustain a 12 deg/sec steady roll rate from $1.23V_{SR1}(1.3V_S)$ to V_{MO}/M_{MO} or V_{fe}, as appropriate, but not greater than 50% of the control input.

Note: If the flight control system augments the pilot's input, then the maximum surface deflection to achieve the above maneuvers should be considered.

(2) Jammed Longitudinal Control Positions.

(i) Takeoff: Three longitudinal control positions should be considered:

(1) Any control position from that which the controls naturally assume without pilot input at the start of the takeoff roll to that which occurs at V_1 using the manufacturer's recommended procedures.

Note: It may not be necessary to consider this case if it can be demonstrated that the pilot is aware of the jam before reaching V_1 (for example, through a manufacturer's recommended AFM procedure).

(2) The longitudinal control position at V_1 based on the manufacturers recommended procedures including consideration for any runway

condition for which the aircraft is approved to operate.

(3) Using the manufacturers recommended procedures, the peak longitudinal control position to achieve a steady aircraft pitch rate of the lesser of 5 deg/sec or the pitch rate necessary to achieve the speed used for all-engines-operating initial climb procedures (V_2+XX) at 35 ft.

(ii) In-flight: The maximum longitudinal control position is the greater of :

(1) The longitudinal control position required to achieve steady state normal accelerations from 0.8g to 1.3g at speeds from $1.23V_{SR1}(1.3V_S)$ to V_{MO}/M_{MO} or $V_{fe,}$ as appropriate.

(2) The peak longitudinal control position commanded by the autopilot and/or stability augmentation system in response to atmospheric discrete vertical gust defined by 15 fps from sea level to 20,000 ft.

(3) Jammed Directional Control Positions.

(i) Takeoff: The directional control position for takeoff at V_1 in a steady crosswind of 15 knots (at a height of 10 meters above the takeoff surface). Variations in wind speed from a height of 10 meters can be obtained using the following relationship:

$$V_{alt} = V_{10meters} * (H_{desired}/10.0)^{1/7}$$

Where: $V_{10meters}$ = Wind speed at 10 meters AGL (knots) V_{alt} = Wind speed at desired altitude (knots)

$H_{desired}$ = Desired altitude for which wind speed is sought

(Meters AGL), but not lower than 1.5m (5 ft)

(ii) In-flight: The directional control position is the greater of:

(1) The peak directional control position commanded by the autopilot and/or stability augmentation system in response to atmospheric discrete lateral gust defined by 15 fps from sea level to 20,000 ft.

(2) Maximum rudder angle required for lateral/directional trim from $1.23V_{SR1}(1.3V_S)$ to the maximum all engines operating airspeed in level flight with climb power, but not to exceed V_{MO}/M_{MO} or V_{fe} as appropriate. While more commonly a characteristic of propeller aircraft, this addresses any lateral/directional asymmetry that can occur in flight with symmetric power.

Replace the Note in Section 9(e)(1)(iv) of Draft B with:

Note: For the case of a lateral or directional control system jam during takeoff that is described in Section 9(b)(1) or 9(b)(3), it should be shown that the aircraft can safely land on a suitable runway with any crosswind from 0 kt to the crosswind level and direction at which the jam was established.

Response to Proposal: The team has discussed at great length the levels used to determine jam positions and generally settled on flight conditions somewhat larger than typically used in past certifications. The strictly numerical approach would simply "AND" the probability of a crosswind and the probability of a jam in a short exposure time. There is evidence to say that jam failures do not necessarily occur in a purely probabilistic fashion. They may occur as a result of external events or be connected to maneuvering or specific positioning of the controls. For *this reason, the determination of "normally encountered position" has been conservative and has given careful consideration to pilot recommendations regarding conditions regularly seen in-service.*

This determination is also consistent with the existing AC 25.1309 guidance for use of probabilities described in paragraph 8.e, "A probability of 1 should usually be used for encountering a discrete condition for which the airplane is designed," and "When combining the probability of such a random condition with that of a system failure, care should be taken to ensure that the condition and the system failure are independent of one another…." The 1 in 1000 flights description is only a general statement regarding the intent of the conditions to be covered.

The value of a 25 knot crosswind as representing a 1 in 1000 occurrence is consistent with both AC 25-7 and AC 20-57A.

2. Proposal to allow use of a handling qualities rating method acceptable to the certification authority in lieu of the criteria in this advisory material. [Boeing]

It is recommended that other handling qualities rating methods such as presented in Appendix 7 to AC 25-7 be allowed as alternate means of compliance for demonstrating continued safe flight and landing if it is agreeable to the certification authority. The proposed advisory material uses arbitrary static control capability and does not account for measures of control including dynamic stability or capability for controlling flight path to accomplish a specific task(eg. glide path control). The process in AC 25-7 is consistent with the principles of analysis in 25.1309, addresses both transient conditions and continued flight, and provides an orderly approach to evaluating handling qualities after failures. It has also been used successfully on previous certification programs. In prior certification efforts, airplanes have been determined to have enough maneuvering capability for continued safe flight and landing at maneuvering levels below that defined in the 25.671 proposed advisory material. It is proposed that a statement be included at the beginning of Section 9.e of the advisory material that allows the use of other handling quality rating methods that are agreeable to the certification authority.

Response to Proposal: Use of the other handling qualities rating methods has been discussed during team development of criteria for continued safe flight and landing. Since there is not a harmonized method accepted by all *the certification agencies, criteria were developed which were generally agreeable to the team as a whole.*

3. Proposal to clarify the definition of single failure to allow consideration of the probability of subsequent fault propagation. [Bombardier, Boeing]

The following change is recommended to the single failure definition:

5. <u>DEFINITIONS</u>

q. <u>Single Failure : </u>A single failure includes any set of failures or effects that are certain to occur as a direct consequence of the initial failure.

<u>9. EVALUATION OF CONTROL SYSTEM FAILURES – 25.671(C)</u>

Subparagraph (c)(1) requires the evaluation of any single failure, excluding the types of jams addressed in subparagraph (c)(3). Subparagraph (c)(1) requires that any single failure be considered, suggesting that an alternative means of controlling the airplane or an alternative control path be provided in the case of failure of a single component, part or element of a system. All single failures must be considered, even if they can be shown to be extremely improbable. Any failure condition or effects that are certain to occur as a direct consequence of a single failure must be considered. Cascading failures or collateral damages that are not certain to occur in connection with an initial single failure, need not be considered under subparagraph (c)(1), instead such combination of events must be shown to comply with subparagraph (c)(2). Failure containment should be provided by the system design to limit propagation of the effect of any single failure to preclude catastrophic failure conditions. In addition, there must be no common cause failure that could affect both the single component, part or element, and its failure containment provisions. Failure containment techniques available to establish independence may include partitioning, separation, and isolation.

While single failures must normally be assumed to occur, there are cases where it is obvious that, from a realistic and practical viewpoint, any knowledgeable, experienced person, would unequivocally conclude that a failure mode simply would not occur, unless it is associated with a wholly unrelated failure condition that would itself be catastrophic. Once identified and accepted, such cases need not be considered failures in the context of FAR/JAR 25.671(c)(1). For example, with simply loaded static elements, any single failure mode resulting from fatigue fracture can be assumed to be prevented if this element is shown to meet the damage tolerance requirements of FAR/JAR 25.571.

Rationale

Since the proposed new wording deletes the reference to AC/AMJ 25.1309, the above is a repeat of AC/AMJ 25.1309 except for the underlined paragraphs.

This recommendation is based on the following:

AC/AMJ 25.1309 does not provide a definition of single failure. It does describe single failure considerations in section 11 Assessment of failure condition probabilities and analysis, but a real definition is lacking. Since 25.671 has a specific requirement addressing single failures, it should also provide a definition of single failure in the AC/AMJ 25.671.

The words used in AC/AMJ 25.1309 to describe single failure considerations; "A single failure includes any set of failures which cannot be shown to be independent from each other" are too all encompassing. Using this description, one could be asked to include all cascading effects or collateral damages regardless of how remote the combined probability of these effects or damages and the single failure is.

There is precedence for limiting the effects that need to be considered to those that are certain to occur as a direct consequence from a single failure. For example, the Boeing 777 Special Condition A-9 "Reliance on Retained Stiffness with Dual Hydraulic Actuators In stead of Mass Balance" provided the following definition: "Multiple failures will be considered as a single failure if they are certain to occur as a direct consequence of a single event". The implication here is that if the effects were not certain to occur as a direct consequence of a single event, they were considered as multiple failures. This interpretation was followed throughout the certification of the 777 Flight Control System.

If the probability of the cascading failures or collateral damages is high the combined probability would not satisfy the proposed FAR/JAR 25.671(c)(2). In particular, the second part of (c)(2), less than 1 in 1000 probability, would be very difficult to meet for likely effects. Obviously, if the numerical probability analysis shows that the combined probability is not extremely improbable, the applicant must show that the combination is not catastrophic.

Response to Proposal: The team did not choose to include a definition for single failure. The advisory material currently points to the 25.1309 use of "single failure". The team recognizes the shortcomings of how the term is used in 25.1309 but generally feels it is conservative and still allows use of engineering judgement in determining "independence".

4. Proposed revision to "continued safe flight and landing" criteria. [Transport Canada]

It is noted that para 9(e)(1)(ii) Transient Response applies to all flight control failures not shown to be extremely improbable including jams. The appropriate level of response for these failures should be no greater than the hazardous category and it is not reasonable to attempt to define a boundary right at the limit of being catastrophic. The hazardous level is consistent with the criteria originally proposed in the Transport Canada guidance material, which was tabled at the first Working Group meeting.

Transport Canada concedes that the hazardous criteria of the draft ACJ 25.1329 which was used as a basis in the working group discussions is not entirely appropriate to the flight control failure case, and proposes the following wording for para 9(e)(1)(ii):

".......For this purpose, continued safe flight and landing is defined as

not encountering any one of the following:

(1) Exceedence of Limit loads

(2) Stall

(3) Speeds greater than Vdf/Mdf

(4) Buffet or vibration severe enough to interfere with control of the airplane or to cause structural damage

(5) Bank angles in excess of 67 degrees flaps up and 60 degrees flaps down

(6) Pitch angles greater than +30 degrees or lower than -20 degrees."

Response to Proposal: In developing the 25.671 criteria for safe flight and landing, the team recognized that there was an area of compliance to 25.1309 that was not specifically being addressed. That is, if a jam with a probability of 1E-06 occurred, to be consistent with 25.1309, the effects should not be Hazardous. This is an area not specifically covered by the 25.671 advisory material. The general view of the team was if a system is designed to achieve continued safe flight and landing (not Catastrophic) at the large deflections we have defined, it is likely that more probable *jams at lesser deflections would have correspondingly less effect and also be acceptable.*

5. Proposed revision to landing exposure criteria. [Raytheon, Cessna]

The proposed change to 25.671(c)(3) for flight control jams excludes from consideration the time immediately prior to landing. The background and intent of this exclusion should be clearly stated in the preamble to the NPRM. However, the reasons for this exclusion raise similar issues of compliance with the proposed 25.671(c)(1) for single mechanical flight control disconnects. Expansion of the landing exclusion to include single mechanical flight control system disconnects covered by 25.671(c)(1), should be considered by the FCHWG and coordinated with other committees involved in the harmonization of other affected regulations and advisory material. A possible revision to the rule could be:

"25.671(d) Mechanical flight control system disconnects considered under (c)(1) and jams considered under (c)(3) need not be assumed to occur immediately prior to landing during a reasonable time necessary for the crew to recognize the failure, react and recover."

Response to Proposal: The team recognized the similarity of some disconnect failure modes to the jam scenarios at low altitude for which an exclusion was defined. However, it was generally felt that allowing an exclusion for all disconnect failure modes in a short exposure time before landing was far too broad a criteria and that there were more feasible options to deal with disconnects than with jam failures. Addressing areas other than jams in such a unique fashion also generates a conflict with 25.1309, which the team had accepted as a basic analysis approach for all failure conditions except jamming.