

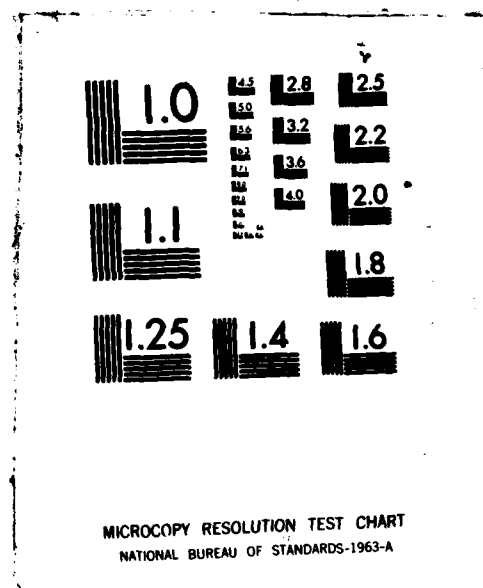
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TASK FORCE ON EMERGENCY EVACUATION OF TRANSPORT
AIRPLANES VOLUME 2 SUPPORTING DOCUMENTATION(U) FEDERAL
AVIATION ADMINISTRATION WASHINGTON DC OFFICE OF FLIGHT
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Associate Administrator for
Aviation Standards
Washington, D.C. 20591

Task Force on Emergency Evacuation of Transport Airplanes

2

Volume II — Supporting Documentation

AD-A172 256

Emergency Evacuation Task Force

Federal Aviation Administration
Washington, D.C. 20591

July 1986

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16. Abstract This is one of two volumes that report on the study of the emergency evacuation of transport airplanes that was sponsored by the Federal Aviation Administration (FAA). The study included the September 1985 Public Technical Conference and the public meetings of the three technical working groups formed during the conference as part of a task force effort. The working groups are: Design and Certification, Training and Operations, and Maintenance and Reliability. The task force program focused on the reassessment of existing Federal Aviation Regulations pertaining to emergency evacuation. Topics considered in the study include: evacuation demonstrations; emergency exits; evacuation slide certification, inspection and maintenance; emergency equipment; crewmember training and duties; passenger safety information; air carrier operations; and others. Volume I, Summary Report, summarizes the issues considered during the study and the outcome of those issues. Volume II, Supporting Documentation, contains meeting reports and other documents on which the summary report is based.			
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PREFACE

This is volume II of two volumes that report on the study of the emergency evacuation of transport airplanes that was sponsored by the Federal Aviation Administration (FAA). The study included the Public Technical Conference held by the FAA in September 1985 and the public meetings of the three technical working groups that were formed during the conference as part of a task force effort to coordinate the program. The working groups are: Design and Certification, Training and Operations, and Maintenance and Reliability.

The task force program focused on the reassessment of existing Federal Aviation Regulations pertaining to emergency evacuation of air carrier airplanes. The program was of special significance because it was the first such public forum held by the FAA exclusively on emergency evacuation during the recent years of certification and operational experience of the new generation of wide body and narrow body transports. Participants were of exceptional expertise and integrity, and expressed a wide range of views on important emergency evacuation issues.

The task force examined emergency evacuation concepts, problems, and experiences, some of which had not been previously aired in a public forum. These two volumes are the record of the task force proceedings which will have an impact on the regulations and practices pertaining to emergency evacuation for some time.

Volume II, Supporting Documentation, is a compilation of reports of the Public Technical Conference and working group meetings, and other documents on which Volume I, Summary Report, is based.

Copies of other public submittals, presentations, and correspondence are maintained in a file open to the public. The file can be reviewed in Room 915-G at the FAA Headquarters building, 800 Independence Avenue, S.W., Washington, D.C. 20591.



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VOLUME II -- SUPPORTING DOCUMENTATION

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SECTION 1

**LIST OF HEARINGS,
CONFERENCES, AND MEETINGS**

**LIST OF
HEARINGS AND MEETINGS**

- June 24-26, 1985 - Subcommittee on Investigations and Oversight, Committee on Public Works and Transportation, Hearing on Aviation Safety, Washington, D.C.
- September 3-6, 1985 - Public Technical Conference on Emergency Evacuation of Transport Airplanes, Seattle, Washington
- November 18-22, 1985 - First meeting of the Design and Certification Working Group, Seattle, Washington.
- December 3-4, 1985 - Meeting of the Training and Operations Working Group, Washington, D.C.
- December 4,5, 1985 - Meeting of the Maintenance and Reliability Working Group, Washington, D.C.
- February 4-6, 1986 - Second Meeting of the Design and Certification Working Group, Long Beach, California

SECTION 2

FEDERAL REGISTER ANNOUNCEMENT

Dated at Washington, DC, this 5th day of August 1985.

For the Nuclear Regulatory Commission.

Samuel J. Chalk,

Secretary of the Commission.

[FR Doc. 85-18834 Filed 8-7-85; 8:45 am]

BILLING CODE 7590-01-M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 25, 91, 121, and 125

Emergency Evacuation of Transport Airplanes

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of Public Technical Conference.

SUMMARY: This notice announces a public technical conference, which is being held by the Federal Aviation Administration (FAA) for the purpose of soliciting and reviewing information from the public on a variety of topics related to emergency evacuation of transport category airplanes. Interested parties are invited to make presentations or submit material for the record. Subjects will be considered relating to the design standards for and certification of transport airplanes, as well as their operation and maintenance in service, including: (1) Emergency exits, their number, size, distribution, and marking; (2) Escape slides, their design standards, certification, testing, maintenance, and reliability; and (3) Conduct of evacuation tests, when they should be required, how they should be conducted, and their validity as a reflection of actual accident scenarios. A more complete list appears later in this notice under the heading "Topics for Discussion." Topics not listed will be considered if their is sufficient interest and time permits.

DATES: The conference is scheduled for September 3-6, 1985. Registration will begin at 9 a.m. on September 3, 1985, and the conference will begin at 1 p.m. Persons planning to attend the conference are encouraged to pre-register by contacting the person identified later in this notice as the contact for further information. If necessary to complete the agenda, the conference may be extended into Saturday, September 7, 1985.

ADDRESS: The conference will be held at the Seattle Sheraton Hotel, 1400 Sixth Avenue, Seattle, WA. 98101, telephone (206) 621-9000.

FOR FURTHER INFORMATION CONTACT: Patricia Siegrist, Transport Standards

Staff, Aircraft Certification Division, FAA Northwest Mountain Region, 17900 Pacific Highway South, C-88968, Seattle, Washington 98168; telephone (206) 431-2128.

SUPPLEMENTARY INFORMATION:

Background

The FAA has initiated numerous regulatory changes to enhance the cabin safety of transport airplanes, particularly in the area of accident survivability. Completed rulemaking actions include: Flammability Requirements for Aircraft Seat Cushions, Amendment 25-59 (49 FR 43188; October 28, 1984); Floor Proximity Emergency Escape Path Marking, Amendments 25-58 and 121-183 (49 FR 43182; October 28, 1984); and Airplane Cabin Fire Protection, Amendment 121-185 (50 FR 12728, March 29, 1985). A proposed rule has been published for public comment: Improved Flammability Standards for Materials Used in the Interiors of Transport Category Airplane Cabins, Notice 85-10 (50 FR 15038; April 18, 1985). Proposed rules in development include Improved Seat Safety Standards and Improved Flight/Cabin Crew Emergency Communication.

A key aspect of occupant safety in a survivable impact aircraft accident is the ability to quickly and safely evacuate the airplane. This is a matter of great concern to the FAA, the aviation industry, and the flying public. In view of the high degree of interest in this area, the FAA considers it timely to hold an open public technical conference to provide a forum for the agency to gather information and for interested parties to express views and exchange information. The FAA anticipates and welcomes the participation of a wide spectrum of interested parties in this conference.

Parties are invited to express views concerning the existing regulations and their application, and to make recommendations for either regulatory or non-regulatory changes. Recommendations should include technical justification, service history, and supporting data expressing costs and benefits.

Topics for Discussion

The following list is not intended to be all-inclusive, but includes those topics which the agency considers to be of the greatest public interest. Topics listed in the miscellaneous category are not of a lesser importance, but do not fall clearly under any of the first three categories. Requests to present material on topics not listed will be granted if there is sufficient interest, and time permits.

I. Emergency Exits

- Number and capacity of exits
- Distribution of exits
- Distance between exits
- Deactivation of exits
- Means for marking and locating exits

II. Full Scale Evacuation Demonstrations

- When should they be required
- When should approvals be done by analysis rather than by full scale evacuation
- What kind of analysis should be accepted
- How should full scale evacuations be conducted
- Do the demonstrations properly account for carry-on baggage
- Is the 90-second criteria valid
- Should smoke be present during evacuation demonstrations
- Is the passenger mix valid
- Should there be handicapped, obese, or blind participants
- How should the distribution of blocked exits be determined
- Do the emergency evacuation tests presently required by the regulations reasonably reflect the survivable accident scenario
- Should the requirements of Parts 25 and 121 be better integrated
- Are mini-evacs a valid testing method

III. Escape Slides

- Are TSO C-89A design standards adequate
- Do the regulations adequately account for in-service deterioration
- Are the standards appropriate with respect to inflation times, girt strength, and heat resistance
- Is the 6-foot still height appropriate
- Is the 25-knot wind criterion appropriate
- Do the regulations adequately account for an adverse airplane attitude
- Are testing requirements adequate
- Are changes needed to improve slide reliability
- Is failure reporting adequate
- Is maintenance adequate
- Are the criteria for dispatching with inoperative slides appropriate

IV. Miscellaneous

- Floor Proximity Escape Path Marking
- Flight Attendant Seats
- Crew Training
- Passenger Briefing

Requests To Be Heard

Persons planning to present data or comments at the conference are requested to provide the FAA an abstract of their presentation by Monday August 26, 1985. The abstract should include an estimate of the time

needed to make the presentation, and should be mailed to the person identified earlier in this notice as the contact for further information. Following each presentation, a discussion period will be allowed and all persons will be given the opportunity to open discussions on the presentation. Following receipt of the abstracts, the FAA will prepare a detailed agenda which will be available at the registration desk prior to the conference.

Technical Conference Procedures

Hotel room reservations should be made in advance. A block of rooms has been reserved at the Sheraton Hotel. Persons wishing to attend the conference are encouraged to make reservations by August 21, by contacting the Sheraton Hotel directly at (206) 621-9000. Be sure to identify yourself as an FAA conference attendee.

Persons who plan to attend the conference should be aware of the following procedures which are established to facilitate the workings of the conference:

1. Sessions will be open on a space available basis to all persons registered. If necessary to complete the agenda, sessions may be extended into Saturday, September 7, 1985. If practicable, the conference may be accelerated to enable adjournment in less than the time scheduled.

2. All sessions will be recorded by a court reporter. Anyone interested in purchasing the transcript should contact the court reporter directly. A copy of the court reporter's transcript will be docketed. Additionally, the sessions may be tape recorded.

3. The FAA will consider all material presented at the conference by participants. Position papers or other handout material may be accepted at the discretion of the chairperson. Enough copies should be provided for distribution to all conference participants.

4. The FAA will have a panel of technical experts at the conference who will serve to facilitate discussions. Statements made by FAA participants at the conference should not be taken as expressing final FAA positions.

(Secs. 113(a), 601, and 603, of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421, and 1423), and 49 U.S.C. 100(g) (Revised Pub. L. 97-449, January 12, 1983))

Issued in Seattle, Washington, on August 2, 1985.

Wayne J. Barlow,

Acting Director, Northwest Mountain Region.

[FR Doc. 85-18831 Filed 8-7-85; 8:48 am]

BILLING CODE 4910-12-48

SECTION 3

**ATTENDANCE LIST FOR
PUBLIC TECHNICAL CONFERENCE**

ATTENDANCE LIST

EMERGENCY EVACUATION OF TRANSPORT AIRPLANES

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SECTION 4

**SUMMARY OF CONGRESSIONAL HEARING AND
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INTRODUCTION

The ability to evacuate an airplane safely and quickly during an emergency is a major concern to the FAA, the aviation industry, and the public. As part of an effort to collect information about and address these concerns, the FAA sponsored a technical conference in Seattle, Washington, from September 3-6, 1985, on topics related to emergency evacuation of transport category airplanes. Discussions covered emergency exits, including number and capacity, distribution, marking, etc.; full scale evacuation demonstrations, the validity of tests and test criteria, how the requirements of FAR Parts 25 and 121 are met, and testing methods; escape slides, design standards, testing requirements, maintenance and failure reporting; and other related topics.

During the conference, three working groups, Design and Certification, Training and Operations, and Maintenance and Reliability, were established to review and discuss existing regulations under Parts 25 and 121, and recommend regulatory and nonregulatory changes. An Emergency Evacuation Task Force was formed to coordinate actions of the three working groups. Each working group developed a preliminary list of key issues and met in November-December 1985 to discuss those issues and review alternative actions. The Design and Certification Group met also in February 1986.

In addition to FAA efforts in this area, there has also been legislative concern regarding the safe evacuation of aircraft. A congressional hearing was held by the Subcommittee on Investigations and Oversight of the House Committee on Public Works and Transportation, June 24-26, 1985. Representatives of the FAA, NTSB, airline pilots' and flight attendants' associations, as well as consumer interest groups testified.

In an effort to assist the Emergency Evacuation Task Force in its consideration of the issues raised during the Public Technical conference and the congressional hearings, the following summary was prepared. Its purpose is to summarize issues and identify recommendations and suggestions raised by conference/hearing participants.

The information is presented in two parts. The first section briefly catalogues the issues presented in the approximately 1400 pages of conference/hearing transcripts. The issues have been divided into the following general categories: Design and Certification, Maintenance and Reliability, Training and Operations, and Organizational Issues. They are presented in a narrative summary format without a specific attribution.

The second section lists the suggestions and recommendations offered by conference/hearing participants. They are repeated verbatim, along with the author's name and affiliation, as well as the page number in the Public Technical Conference (PTC) or congressional hearing (CH) transcript where they may be found. The suggestions and recommendations are categorized in the same manner as the issues summaries in the first section.

1.0 DESIGN AND CERTIFICATION

1.1 CERTIFICATION PROCESS

There were a number of criticisms of the certification, or recertification, process in general as well as the specific procedures involved in approving the removal of two emergency exits on the Boeing 747. Three United States Representatives, as well as airline employee and consumer interest organizations, complained about the closed nature of the process. The general consensus was that an aircraft modification of such significance as the removal of emergency exits should come under public scrutiny and there should be an opportunity for public comment.

Several congressmen thought it was inappropriate for exit removal to be handled under the Supplemental Type Certificate (STC) process. Two Congressmen felt that there should be some level of gradations of significance between STCs under review--a change in windshield wiper design should be treated differently than a removal of exits.

Another criticism was aimed at the concept of certification directorates. A Congressman and a consumer group leader felt that regionalism in regulation promotes too close a relationship between the regulator and the regulated, between an FAA region and the manufacturer. Aside from the potential conflict of interest issue, the Congressman also expressed surprise that a decision of such importance as emergency exit removal was not reviewed by FAA headquarters before becoming final.

Although most criticisms of the amended certification or recertification process generally focused on the notion of an unfair advantage for the aircraft manufacturer, the manufacturers had their own complaints. One representative from a commercial aircraft manufacturer stated that the restrictive definition of the exit ratings and arrangements as specified in Section 25.807(c)(1) can inhibit innovation that might enhance safety. Another industry representative echoed this opinion, stating that the regulations do not allow sufficient room to develop designs that may represent an improvement over the existing requirements of the regulations.

Regarding specific criticisms of the Boeing 747 exit removal STC, the major complaint was that there is no evidence that a review of the 747 evacuation history or service difficulty reports was conducted prior to granting the approval. According to a member of the pilot community, the removal approval was done without a regard for 747 accident evacuation history and despite a "dismal history of emergency exit assemblies" on the aircraft; however, unlike others, he agreed that the approval was properly within the scope of an STC. The complaint was that in deciding on whether or not to grant the STC, the FAA officials involved

did not avail themselves of all available relevant information. Flight attendant representatives as well as the National Transportation Safety Board (NTSB) agreed with this position.

Yet another criticism of the process was made by several participants in the Congressional hearings. They charged that the FAA failed to comply with its own regulation by not requiring a full-scale demonstration evacuation before approving the removal of the 747 exits. Several groups advocated the revocation of the 747 amended certificate pending a thorough investigation of all data that might impact the decision to remove exits.

1.2 DEMONSTRATIONS

1.2.1 Continued Use of Full-Scale Demonstrations

Participants generally agreed that full-scale evacuation demonstrations should be continued as part of the certification process. Several people specified circumstances under which such demonstrations should be required; these often pertained to the perceived purposes of conducting full-scale demonstrations and participants did not agree on what those circumstances should be. Only representatives from the aircraft manufacturing industry expressed reservations regarding the continued use of full-scale evacuation demonstrations.

A representative from a national safety group supported the continued use of full-scale evacuation demonstrations as the only means of proving the viability of equipment and training programs. Members of two flight attendant organizations expressed the need to test evacuation procedures and training by full-scale evacuation demonstrations. Criticism of full-scale demonstrations as a test of evacuation procedures was made by a representative from international associations of pilots. A spokesperson for an airline concluded that training for evacuations had not been successfully accomplished by full-scale demonstrations and that airlines had pursued other means of training personnel for evacuations. He did maintain that full-scale demonstrations are fundamental to the type certification process. This view was supported by representatives from a manufacturer, and partially by members of a European group of aircraft manufacturers. These participants assert that full-scale demonstrations should be conducted only to test unconventional aircraft configurations, and that this is only as a precaution for the authorities. Other methods of testing were cited as adequate for conventional designs, evacuation procedures, and crew training.

1.2.2 Full-Scale Demonstrations vs. Analysis

Several divergent positions were presented on the use of analysis in the certification process. The FAA permits a combination of analysis and test to demonstrate compliance with

emergency evacuation requirements. Participants at the conference raised concerns about the validity of the rule that permits analysis, the use and conduct of analysis, the data on which analysis is based, the criteria it validates, and the FAA's authority, specifically the Northwest-Mountain Region's authority, to determine when analysis can be used in lieu of a full-scale demonstration.

The regulatory history of emergency evacuation demonstrations and the evolution of analysis as a method of proving the evacuation capability of equipment was presented. The injuries sustained by demonstration participants were cited as the basis for changing the rules in 1978 to permit a combination of test and analysis. Industry representatives also testified that safety standards had not been adversely affected by allowing air carriers to use the results of another carrier's demonstrations. They concluded that a combination of test and analysis does not compromise safety, reduces the risk of injury to evacuation demonstration participants, and sufficiently proves compliance with certification criteria using a data base derived from system performance of past full-scale evacuation demonstrations. Representatives from the European manufacturing industry supported the use of analysis to confidently prove the design of conventional aircraft. They reaffirmed that alternate means of testing emergency procedures and crew training exist without the conduct of a full-scale demonstration.

Several participants objected to the use of analysis as a valid means of testing the full emergency evacuation system. Concerns were expressed that the data on which analysis has been based represents a sterile environment because it is taken from past evacuation demonstrations and not actual accidents. The exclusion of human factors, including both passenger and flight attendant behavior, the computation of flow rates, the factors considered in the computations, and reservations that adequate provisions might not exist for testing the other elements of an emergency evacuation system were aired by representatives from pilots' associations, passengers' associations, flight attendants' associations, and consumer interest groups.

There was support for the use of analysis if the FAA would clarify the conditions of its application, define the term, and limit its use. A flight attendant representative questioned the authority of the FAA to determine when analysis can be used, and suggested that a very literal interpretation of the preamble of the amendment to Section 25.803(d) be used.

1.2.3 Procedures and Simulated Conditions for Full-Scale Evacuation Demonstrations

Closely related to the use of analysis versus full-scale evacuation demonstrations are issues raised about the conditions under which full-scale demonstrations are conducted and procedures for those demonstrations and tests that are performed in conjunction with analysis. Fundamental to these concerns is

the realism of the simulated conditions for full-scale demonstrations. Some general criticism was made of the conditions outlined in the rules because not every accident scenario is reflected, especially those with smoke and/or fire. Representatives from aircraft manufacturers and governmental authorities reminded participants that the demonstrations are intended to test design criteria and that the demonstration reflected an accident scenario without smoke or fire, both of which would bring considerable risk of injury to demonstration participants if included in the simulated conditions.

The passenger mix by age, sex, and handicap is specified in the rules for evacuation demonstrations. Members of flight attendants' and pilots' associations, consumer groups, and the representative from Transport Canada commented that the passenger mix should reflect a typical mix of passengers and that exemptions to the requirement should not be permitted for demonstrations. Several suggested that the FAA revalidate the age range requirements, noting increases in the number of minors and elderly people on flights, and the criteria for selection of demonstration participants.

The criteria for selecting the exits to be blocked during a demonstration was presented as an issue by many conference attendees. Historically, manufacturers and air carriers have blocked exits on one side of the aircraft for demonstration purposes. Some participants, citing past accident information, suggested that simulated conditions could be more realistic if pairs of exits were blocked and those exits that have been used historically in accidents were used in the demonstrations.

Participants also mentioned the issues of carry-on baggage and other obstacles to evacuation, participation by the flight crew in the demonstration, and passenger seating, and made suggestions to improve the "reality" of the demonstrations. Representatives from aircraft manufacturers and regulatory authorities supported the concept of making demonstration conditions more realistic if design certification remained the primary purpose of the demonstration, if the economic burden related to demonstrations did not outweigh the potential benefits of improved test conditions, and if the risk of injury to participants did not exceed reasonable safety expectations.

1.2.4 Evacuation Demonstrations for Modified Aircraft

Compliance with emergency evacuation criteria must be demonstrated in an aircraft that is modified to increase the seating capacity beyond that for which it is certificated. A partial evacuation, or mini-evacuation, is required if an aircraft is entering operation; if the number, location, emergency evacuation duties or procedures of flight attendants change; and if the number, location, type of exits, or opening mechanism for emergency exits change.

Several participants felt that other changes to an aircraft warranted a full-scale evacuation demonstration to prove the evacuability of the modified aircraft. The representative from Transport Canada suggested that evacuation demonstration requirements be evaluated for a decrease in seating capacity with resulting deactivation of exits and deletion of flight attendant stations. Members of flight attendant associations supported the conduct of full-scale demonstrations when the duties, number, or locations of flight attendants were changed. They felt that a partial demonstration to prove the capability to open 50% of the exits within 15 seconds (required in mini-evacuations) was insufficient to prove the evacuability of the aircraft with such modifications. Particular concern was expressed about the removal of exits and the closely related issue of when a full-scale demonstration is required and when a combination of test and analysis can be used.

1.2.5 Data Collection and Use

Concerns were stated about the data that are used for the data base on which analysis is based, the availability of information about past accidents, typical passenger mixes, and other information pertinent to the conduct of full-scale demonstrations and test and analysis. Members of consumer groups, flight attendants' associations, pilots' organizations, and regulatory authorities asserted that accident data should be included in the data base used for analysis.

Representatives of aircraft manufacturers felt that the data they use are sufficient for analysis purposes. They and representatives of the FAA questioned the availability of such information and efficient methods of data collection. The same reservations were expressed about information on passenger mixes, although representatives of consumer groups declared that the FAA had published such information or that it could be easily supplied by the airlines from ticket sales.

Another issue raised by some participants was the FAA's failure to keep records of injuries to full-scale demonstration participants. Because the risk of injury has contributed to the use of analysis, the validity of such reasoning was questioned if no records on injuries are kept. No suggestions were made on this issue.

1.2.6 Economics

Several questions were raised on the costs of the demonstration, and costs that might result from improvements in training and hardware. Specific information was unavailable at the conference; consensus among representatives from manufacturers was that the cost of a full-scale demonstration was great, and that a combination of test and analysis, when appropriate, eased some of the economic burden. Members of consumer organizations remarked that these costs, and costs for improvements, were often passed along to consumers, regardless of

the impact. They also claimed that consumers would readily assume the costs if safety would be enhanced by additional or more comprehensive demonstrations and equipment and training improvements.

1.3 EMERGENCY EXITS

Differing views on the number and placement of exits were expressed by aircraft manufacturers and airline employees and passengers.

1.3.1 Criteria for Number of Exits

An aircraft manufacturer stated that the current FAA exit standards are conservative. A representative from another manufacturer stated that the exit rating criteria of Section 25.807(c)(1) do not take into account the higher egress rates made possible by modern aircraft and slide combinations. He stated that the time required for readiness of evacuation means has been reduced by 50%. A third member of the aircraft manufacturing industry suggested that manufacturers should receive credit for those Type B exits needed as passenger doors. He also suggested increases in passenger allowances for various types of exits. In addition, he noted that full credit for a Type A exit should be limited to those aircraft that carry over 200 passengers, in order to avoid the situation in which a 100 passenger aircraft could be certified with only one exit. He concluded that for a 500-passenger airplane, four pair of Type A exits would be required.

Contradicting these statements were the testimonies of the National Transportation Safety Board (NTSB) and a number of representatives from airline employee, passenger, and consumer organizations who generally agreed that the FAA standards that determine the number of required exits are invalid because they bear no relation to actual experiences. Numerous examples were cited where more than 50% of the emergency exits were unavailable for various reasons. This was true even in instances where the aircraft had sustained very little structural damage and no fires. One study that was cited concluded that past experience has shown that, for one reason or another, only 26.8% of doors are usable after a crash in civil air transport.

Furthermore, evacuation in such accidents, according to the testimony offered, was never completed in less than 90 seconds. Witnesses felt that the governing factor in determining how many exits are necessary should be a review of the adequacy of the current number of exits based on real accident experiences, rather than a theoretical model. Some suggested there should be more, rather than fewer, exits.

1.3.2 Elimination or Deactivation of Exits

A representative of the FAA asked whether or not air carriers should be allowed to take exits out of operating aircraft. Boeing responded that exits should be removed within the bounds of the regulations. Deactivation assessments should be made in the same manner as a new type applicant would make such assessments to configure an aircraft for new production.

A representative of airline pilots responded that in other cases cited, the number of exits that were eliminated reduced the total number of exits to those used in the FAR 25 certification of that particular aircraft. Reducing the number of 747 exits below 10 would result in a total number of exits below the number originally certified. He objected to this. During congressional testimony a number of airline labor, passenger, and consumer organizations protested the elimination of any exits, based on their experiences in real evacuations. Some cited the unreliability of slides and the reduced flexibility resulting from working with fewer slides. Others stated that on general principle a decrease in the number of exits by definition means a decrease in safety.

An aircraft industry spokesperson pointed out that if a certified aircraft can never operate with a reduced number of exits, aircraft manufacturers will be forced to design for the minimum number of doors. He stated that carriers should be permitted to remove doors as long as removal does not affect safety and is done in accordance with regulations (PTC, 467). A. FAA representative summarized the issue by stating that with the current number of extra exits and aircraft that are not operating at maximum capacity, a certain margin of safety is created. If, however, the fleet were to suddenly deactivate all excess doors, which they could do within the regulations, there would be a different set of statistics in crash survivability. Thus, the current margin of safety could disappear without any changes made in the regulation. In discussing the adequacy of the current standard, an aircraft manufacturing representative expressed reservations regarding the use of a new standard--what would form the basis of a new standard and what benefit would be gained from it.

1.3.3 Exit-to-exit, or Seat-to-exit Distance

A standard for the distance one has to travel to reach the nearest exit is not set in the Federal Aviation Regulations (FARs). A representative from an aircraft manufacturer discounted the effect of distance to exit as a critical factor in aircraft evacuation. He stated that queuing would occur at all available exits regardless of distance traveled to reach that exit. He cited FAA studies that concluded that evacuation times are determined by movement through exits following door preparation and that slide deployment and delays inside the aircraft are not a limiting factor. Another study cited concluded that changes in passenger cabin configuration, exit-to-exit

distance, seat pitch, and aisle width have no significant bearing on egress rates if the aircraft certification requirements for aisle width and exit accessibility are met.

An FAA representative stated that, although exit-to-exit distance may not be a factor in aircraft operating at maximum passenger capacity, it does become significant in those incidents where there are fewer passengers. Furthermore, the fact that distance to exit may not be a factor in evacuation exercises does not mean that the same is true in actual emergencies.

The National Transportation Safety Board (NTSB) representative noted that in 60% of survivable accidents there were failures in cabin furnishings that caused injuries, blocked exits and hampered egress. He concluded that the distance between exits is not strictly a function of time to travel that distance--it's a function of how many things you must climb over--seats, bodies, partitions, etc.

Airline employee and consumer interest organizations felt strongly that exit-to-exit distance was a major factor in aircraft evacuation. A pilot representative noted that distribution affects the order of evacuation. Another member of the airline pilot community could not accept queuing as a condition in real evacuations where self-preservation would be a strong factor determining the behavior of the person at the end of the line. Distance to exits was also cited by one FAA representative as a special concern for the elderly.

In response, an aircraft manufacturer denied that distance to exit is a significant factor in evacuation, but suggested that more studies in this area are needed. If the data support a change in the regulations, a change may be necessary.

It was the position of airline employee and consumer action organizations that there are sufficient crash investigation data to support their views. An article written by physicians and based on crash investigation data was cited in this regard as it concluded that "seat to exit distance is critically important, since survivors on the average sat closer to potentially usable exits than non-survivors" (CH, 167). Others stated that no new studies were needed because common sense dictates that seat-to-exit distance affects evacuation efficiency.

1.3.4 Placement of Exits

There were objections voiced not only to the removal of exits, but also to the removal of over-the-wing exits in particular. A representative from an international pilots' group noted that when an aircraft lands in shallow water, the use of over-wing exits may mean that exiting passengers may be able to avoid water contact by walking on the wing. In addition, a number of the cabin attendants who made presentations or testified regarding their emergency evacuation experiences cited

the over-wing exits as the means by which they and their fellow passengers exited the aircraft after other exits became inoperative.

An aircraft manufacturer asserted that the manufacturers should have the flexibility to place exits where they would be most useful and should not be required to include over-wing exits "just for ditching". Another manufacturer said that for an "unplanned water contact," door-mounted slides that are designed for flotation capabilities are better than over-wing exits with no flotation means. A member of the FAA panel added the observation that if the flaps are damaged, a life raft taken out over the over-wing exits may be damaged.

1.3.5 Standardization

A representative of flight attendants cited the usefulness of standardizing emergency exits but realized the problem this might create for aircraft manufacturers.

1.3.6 Exit Sill Height

A representative from another flight attendant group raised a concern that escape slides be designed to accommodate the changing attitudes of aircraft in emergencies. A slide manufacturer responded that slides are tested at maximum and minimum sill heights to demonstrate that the slides are usable in both conditions.

1.4 AIRCRAFT CONFIGURATION

1.4.1 Access Space

Concerns were stated about the access to exits and requirements for access to excess exits. A representative from a flight attendant organization expressed a concern about the accessibility to all exits and over-wing exits in particular. She supported the establishment of a minimum distance between rows at over-wing exits and between aft-facing flight attendant jump seats and forward-facing passenger seats.

A representative from Transport Canada recommended that seat cushions not protrude into the access space to an exit, citing a potential implication for flow rates (specifically, Type 3 exit rates) if the protrusions are eliminated. A further recommendation was offered by this participant to apply the same access requirements to excess exits that exist for required exits. The inability to predict whether an exit used in an evacuation will be a designated required exit or one in excess of the number mandated and therefore not required to meet the same evacuability standards was raised as a concern.

1.4.2 Aisles and Exit Passageways

A question was raised by a representative from Transport Canada about the intent of the cross-aisle requirements of Section 25.807(a)(7)(v). It was unclear to him whether the purpose of the requirement was to allow one line of passengers to use a serviceable Type A exit and its slides with minimum interference with another line of evacuees approaching from the main aisle. He suggested that if this is the correct intent, the regulations should be clarified and he offered alternatives to do so.

1.4.3 Other

A representative from a flight attendant association suggested that additional storage space should be provided for carry-on baggage.

1.5 CABIN FURNISHINGS AND EQUIPMENT

1.5.1 Passenger Seats, Jump Seats, and Seat Belts

Some general concerns were stated that seats should be made of non-toxic materials to reduce the risk of hazardous fumes in the event of a fire. More specific issues were raised by a flight attendant representative. The seat design, considerations of input from flight attendants in the design and review processes, the differences in seat strengths of primary and secondary jump seats, and some concerns about seat belts and shoulder harnesses were described. She suggested greater involvement of flight attendants with the manufacturers to resolve the deficiencies she explained. A concern that jump seats not be placed in galleys was also indicated and a recommendation was made that in-aisle jump seats that are attached to the galley bulkhead be banned.

1.5.2 Slide Designs

Several participants discussed slide design and the requirements that apply to slide design. Discussion focused on Technical Standard Order (TSO) C-69A, which specifies design requirements and tests for slides as evacuation devices and includes heat resistance requirements; the applicability of TSO C-69A; and the puncture and tear resistance requirements.

Representatives from the National Transportation Safety Board, flight attendant associations, and consumer organizations stated that the requirements of TSO C-69A should apply not only to slides on newly manufactured aircraft, but also to those currently in service. A slide manufacturer explained the process to upgrade slides for heat resistance, but said that some slides currently used cannot be treated to meet the standards.

The National Transportation Safety Association (NTSA) representative stated concern about the puncture and tear resistance of slides and remarked on the failures of new units. A representative from a flight attendant association, citing the failures of slides during evacuation, suggested that more stringent puncture requirements might be necessary to assure usability. An NTSB representative recommended strengthening the girt fabric of the 26 foot slide rafts.

Another flight attendant representative felt that slide rafts should be mounted at the doors. He viewed the slide rafts as an important way of getting people out of the aircraft and into the water while giving them some protection against hypothermia. He suggested that the slides be portable, so if an exit is jammed or there are high waves or a fire outside, the slide raft can be transported to another exit. He also thought that the wide-body slide rafts are too complicated to operate and that they should instead be like the more easily operated narrow-body aircraft slide rafts.

One of the pilot participants felt that a problem with the Boeing 747 slide raft is that it cannot be operated safely without previous hands-on experience. The problem centers on the detachment of the slide raft in the water. The end of the slide raft where it is detached from the aircraft drops very rapidly five or six feet into the water, and "would take off the operator's head if he were leaning back over the door sill."

The NTSA representative reported that consideration is being given to making slides usable as flotation platforms. The platform is being looked at as a new device, an adjunct of a small portable device for situations in which there would not be sufficient capacity on the evacuation slides to hold the occupants out of the water. Under review also are portable slides that use quick-detachable girts. A consumer safety group representative mentioned the NTSB recommendation that would have all floor-level slides designed to inflate automatically.

An airline industry representative stated that the airlines considered the current regulations for design to be adequate. Similar views were expressed by a representative from an aircraft manufacturer, who also described slide design requirements and efforts to improve the design of escape slides.

1.5.3 Communications Equipment

The NTSB representative referred to NTSB studies on emergency communications and cited a recommendation to have a public address system in aircraft that can operate independently of the main power supply. The NTSB representative, as well as representatives from flight attendant organizations, described incidents in which the loss of ability to communicate to passengers when the power was shut down resulted in difficulties in instructing passengers during emergency evacuations.

A flight attendant representative remarked on the importance of the communications equipment, stating that if passengers cannot hear crew commands there will be problems in attempting to secure an orderly evacuation. She urged further research into audio devices that would be automatically activated if an exit is opened in an emergency and that could attract passengers' attention.

1.5.4 Lighting

There were numerous comments regarding the difficulty encountered in seeing lights through a smoke-filled cabin. A representative of aircraft mechanics stated that a serious problem with the lighting scheme currently used is that if one light battery is lost, the lighting for one door and the aisles leading to that door are effectively lost.

An equipment manufacturer noted the various problems with the current aircraft incandescent lighting scheme: the system is heavy; the pinpoint source of light gives no sense of direction; and if one of the spotlights becomes covered or damaged, there is no other light near it. He suggested using electroluminescence for floor proximity escape path marking, claiming it is lightweight; uses a minimum of battery power; is virtually indestructible; is inexpensive to purchase, install, and maintain; provides an optimum level of light for viewing in a smoke-filled cabin; and offers a continuous strip of light to avoid the problem that occurs when a single light source is covered or damaged.

1.5.5 Alternative Equipment

A representative from a flight attendant organization noted that no alternate emergency evacuation means are available if escape slides should fail. She suggested that escape lines or ropes be available at all exits.

1.5.6 Standardization of Equipment

A flight attendant representative pointed out that flight crews fly on a variety of different aircraft, all with different configurations and locations for emergency equipment. She urged that, at least within the same airline, portable equipment and its location be standardized. A representative of an international pilots' association reiterated this suggestion.

2.0 MAINTENANCE AND RELIABILITY

2.1 RELIABILITY

A representative of an aircraft manufacturer stated that the manufacturer's testing of slides resulted in a 90 percent success rate. An airline pilot testified that his airline, from November 1980 through May 1985, had 17 emergency evacuations. In 16 of those evacuations, 100 percent of the slides that were activated were operable. Other airline pilots, cabin crew, and maintenance personnel presented a different view, referring to the general unreliability of slides. Maintenance personnel from an airline, using their testing procedures, achieved a 69 percent success rate. Six percent of the failures were due to the door power assist system; 10 percent were due to problems in slide design; 9 percent were attributable to some type of rigging, packing, or installation problem; 3 percent were associated with the gas generator; and 3 percent were for miscellaneous reasons. After the implementation of certain engineering modifications and changes in maintenance practices, the success rate improved. (No specific number appears in the oral transcript.)

2.2 MAINTENANCE

2.2.1 Maintenance Work

The Senior Aircraft Systems Engineer for an international airline noted problems in trying to maintain slide rafts and associated emergency equipment. He described engineering modifications made in the power assist rigging, Door 5 pack board, and the hoses in the slide packing. The changes not only resulted in a higher success rate with door operation, but they also made maintaining the equipment easier and reduced the likelihood of error. The airline has made a number of changes in maintenance manuals as a result of problems reported. In a discussion of what the manufacturers are doing in response to some of the problems noted, industry representatives stated that they had made some engineering changes and maintenance manual revisions. Slide maintenance and reliability problems were also examined during a conference held in June 1985.

An airline representative noted that his airline maintains a two-year service check on door-mounted slides and a one-year check on off-wing slides. The NTSB representative suggested that the U.S. maintenance interval on slides that extend out to five years be examined in relation to such experience.

2.2.2 Functional Testing

One foreign airline representative gave a detailed account of the airline's functional testing program. The slide and door to be tested cannot be prepared in any way. The slide must

deploy and inflate without manual assistance. It must be usable within 10 seconds of the start of the door's power assist operation. It must remain usable for 90 seconds and must be capable of maintaining pressure in the raft mode. Government officials are present for each slide deployment. A video recording is made to aid in the process of determining the cause of problems in deployment.

2.2.3 Training

Participants discussed training for maintenance crews in terms of provision of adequate training documents to airline maintenance crews by the manufacturers, development of training programs by airlines for FAA approval, and joint participation by manufacturers and airlines in training maintenance personnel. The responsibilities of airlines and manufacturers were described as was the role of the FAA in training maintenance personnel. The adequacy of training documents and their provision to maintenance personnel was questioned by some conference participants. A representative of the general public described an incident of slide failure due to poor packaging by a non-factory authorized packaging plant. He stated a concern that these type of facilities may not have the proper instruction manuals for maintaining slides. An aircraft manufacturer representative remarked that the manufacturers have a responsibility to provide airlines with suggested improved maintenance procedures in a timely manner. The representative also outlined the responsibilities of the airlines to incorporate revisions, maintain their own maintenance programs, and update maintenance training levels. An FAA representative asked the manufacturer to supply training programs or recommend training programs. Manufacturer representatives commented that FAA personnel often sat in on the development of training programs and during actual training sessions.

A flight attendant representative recommended that airline mechanics participate in hands-on training with slide manufacturers rather than refer to a manual for packing, servicing, repairing or replacing slides. This suggestion was supported by a representative from a slide manufacturer. Airlines do not consistently send maintenance personnel to vendors for this type of training.

2.2.4 Cost

There were general comments regarding the cost of maintenance and the willingness of the airlines to assume these costs. A representative from a passengers' association stated that, regardless of the expense, airlines passed maintenance costs to the passengers who were ultimately willing to assume the burden if safety was enhanced as a result. An airline representative indicated that his airline had voluntarily grounded its fleet to resolve a problem with bottle rubbing that

caused slide/raft leakage. He estimated that the airline lost \$6 million the first day. Information regarding the cost of maintenance, as well as other elements of air carrier operations, was solicited by the FAA.

2.3 INSPECTIONS

2.3.1 Inspection Intervals

A discussion was held on setting up inspection intervals based on calendar time versus hard time. A representative from a slide manufacturer explained that the inspection intervals recommended in their maintenance manuals are based on calendar time, on which most carriers operate. A maximum interval period of 3 years is recommended by that manufacturer. An FAA spokesman informed the conference that the FAA is studying overhaul periods in terms of both operational time and calendar time. Inspection intervals are established by manufacturers jointly with the FAA Maintenance Review Board upon the initiation into service of a new airplane model.

Additional concerns were expressed that the cycle of inspection deteriorated over time and extensions become prevalent in airlines' maintenance programs. Because these extensions are coordinated between the FAA Principal Inspectors and the airlines, some pertinent information may be missing that could be used by manufacturers and others in research and development work.

2.3.2 Required Inspection Items for Slides

An aircraft manufacturer representative described the items that are inspected for slides when it conducts an inspection. A mini-inspection procedure is used for emergency evacuation systems that identifies conditions that may affect successful slide deployment. Several participants discussed items they felt should be included in inspections. These items were discussed in conjunction with reporting requirements described in Section 2.4.

2.4 REPORTING AND INFORMATION

2.4.1 Equipment Malfunction and Defect Reporting

There were several comments about the reporting of slide and exit malfunctions. Discussion focused on the Service Difficulty Reports (SDR) system, the malfunctions and defects that are not reported, the collection and disposition of reports, and potential solutions to the problems discussed.

Members of flight attendant associations, the NTSB, and a consumer safety association stated their concerns that not all malfunctions of slides and exits are reported to the FAA, thus creating a vacuum of knowledge. The NTSB recommended in 1975

that all slide malfunctions, whether they occur during an inspection or test or happen inadvertently, be reported to the FAA. A flight attendants' association strongly urged the FAA to adopt this NTSB recommendation.

The process by which malfunctions are reported was criticized for excluding a large number of events. Slides that are deployed during demonstrations or maintenance checks and overhauls are not reported to the FAA. Representatives from the FAA and other organizations were concerned that events were taking place in the field that regulatory authorities were not aware of and that some of this information may be significant to safety. Some airline representatives pointed out that the information is available to inspectors at their request.

An FAA representative asked the participants for any information or comments on starting a rulemaking project to expand the data base for the maintenance reliability reporting (MRR) system. An airline industry association had formed a task force to study the system. The recommendations from the task force were summarized by a representative from the association and included making the MRR system a true mechanical alert reporting system that concentrates on safety-significant issues and eliminates repetitive reporting of non-critical occurrences. He indicated that airlines must rely on manufacturers for safety alert information. Representatives from airlines and manufacturers asserted that information is exchanged although it may not be reported to the FAA. The FAA has established a rulemaking project on the reporting requirements of Section 121.703. An FAA representative suggested that there are provisions in Section 121.703 to report events related to emergency slides and this would enable the FAA to respond quickly to significant items. An FAA representative asked participants for any other recommendations on mandatory reporting requirements for emergency systems. The FAA would like to enlarge the data base for reporting and make it available nationwide with input from airlines and manufacturers.

2.4.2 Information Loop--Manufacturer to Carrier

The exchange of information between manufacturers and airlines was discussed in conjunction with the reporting requirements. Airline and manufacturer representatives assured the conference attendees that when problems are found with equipment, the airlines report them to the manufacturers who provide remedies in a timely manner. A representative from an airline indicated that a representative of the aircraft manufacturer is normally present during tests of slides and is available to answer questions.

An airline industry association representative indicated that manufacturers provide updated maintenance manuals to the airlines and service bulletins to insure dissemination of information and product awareness. The airlines provide any information on malfunctions. Some information is maintained and

exchanged that is not required by the FAA. A manufacturer's representative described maintenance documents made available to operators; however, operators have the responsibility to develop their own approved maintenance programs.

As was mentioned in Section 2.4.1, Equipment Malfunction and Defect Reporting, several participants suggested that the information exchanged between airlines and manufacturers be made available through a national data base. An FAA representative inquired whether some of this information could be included as part of a rulemaking project.

2.5 SURVEILLANCE/ENFORCEMENT

The disparity in items and events reported to the FAA and the perceived lack of a coordinated effort to ensure that maintenance requirements are met were concerns of some conference participants. A representative from a flight attendant group suggested that a maintenance surveillance program could ensure the reliability of emergency evacuation systems. A similar conviction was voiced by an airline industry association representative who told the conference that the airlines must have continuing analysis and surveillance systems as required by the FARs to assure proper and immediate action is taken when malfunctions are reported. The airlines' surveillance systems must also cover work performed by repair stations.

3.0 TRAINING AND OPERATIONS

3.1 OPERATIONS

3.1.1 Reduction of Flight Attendant Complement

A representative from a flight attendant organization questioned the propriety of airlines that want to operate under an exemption to Section 121.391 (which requires one flight attendant for every 50 passengers) permitting them to have one less flight attendant. The airlines would compensate by blocking off two to four seats. She suggested that the exemptions are not justified as the aircraft configuration is virtually unchanged and recommended that seats be removed rather than blocked. She also inquired about the criteria by which exemptions are made. An FAA representative informed the conference attendees that no exemptions had been granted.

3.1.2 MEL Authorizations

A representative from the FAA solicited comments from conference participants about the minimum equipment list (MEL) authorizations for the L-1011, DC-10, and 747; the authorizations allow operation of an aircraft with an inoperable door or slide if seats are blocked. Representatives from the flight attendants' group expressed concern that seats next to the inoperable doors could be and had been occupied by passengers. They were unsure as to the adequacy of provisions for operating without an operable door or slide and for informing passengers of alternate safety procedures. A representative of aircraft mechanics questioned the reasoning of airlines that block a few seats and continue operations. He suggested that a great deal of analysis needs to be done, including examination of evacuation flows with seats blocked and the number of people affected. He wanted to know if members of the air carrier association would consider repairing inoperative doors and slides before taking off.

Representatives from an airline explained the Canadian procedures for operating with an MEL authorization. Seats are blocked based on the egress capacity of the inoperable door. Pilots are permitted to state objections to the operation and a flight attendant is required at the inoperative door and at the opposite exit.

3.1.3 Uniformity of Emergency Equipment

As mentioned previously, several airline employees suggested that the airlines standardize emergency equipment and its location.

3.1.4 Passenger Briefings and Information Cards

There were several comments regarding passenger briefings and information cards. Some expressed the view that deficiencies exist in the way information is conveyed and in the accuracy and content of information.

The NTSB representative informed the conference of NTSB recommendations made in 1983 to form a task force to study what type of safety information should be available, how to improve instructional concepts for conveying that information, and what operating requirement changes are necessary for oral briefings and briefing cards. He also summarized for the conference attendees the preliminary conclusions of an NTSB study on passenger briefings that support the position that the FAA should oversee research into passenger behavior and acceptance of safety information. He suggested that some of the variation in briefing cards and safety information and procedures could be eliminated.

Representatives from flight attendant organizations, airlines, pilots' associations, and consumer groups concurred with the view that deficiencies exist and several suggested alternate means of conveying the information through videos, pre-boarding briefings, incentive briefings, computer games, passenger simulators and media programs. Some encouraged a variety of elements in the oral delivery of passenger safety information, including humor and attention-getting devices, and some suggested that procedures be changed to announce the demonstrations before they are presented. A representative from a flight attendants' organization felt that some caution should be exercised for fear of overbriefing passengers and scaring them. She also mentioned the difficulty in eliciting passenger response when performing other duties, such as serving drinks.

Some participants suggested that briefing cards will be different because of differences in equipment. An airline representative suggested that variation could be eliminated if the manufacturers would review briefing cards rather than leave their development solely to operators.

3.1.5 Service vs. Safety

The issue of safety-related services vs. "inflight services" was raised by one of the FAA technical panel members. Representatives from several cabin crew associations stated that with deregulation the airlines are requiring more non-safety related services, such as the distribution of magazines and the sale of beverages and headsets, which take the attendants away from their emergency positions (PTC, 549-552). In addition, glasses, magazines, and headsets could present a safety hazard in the event of an emergency evacuation (PTC, 550-551).

3.1.6 Other

A flight attendant representative suggested that all flight attendants wear low-heeled shoes during takeoffs and landings.

3.2 TRAINING

3.2.1 Mini-Evacuations

Mini-evacuations are conducted to test the ability of the flight attendants to open 50% of the exits and deploy escape devices within 15 seconds. Representatives from flight attendant associations remarked that they are trained to operate the equipment, but no elements of decision-making and ability to deal with human behavior are incorporated into the mini-evacuation; consequently, no measure of the effectiveness of comprehensive emergency training is available except in full-scale demonstrations. And training emphasizes mechanical skills and not human factors since those are the only skills tested. No recommendations were offered on training and mini-evacuations.

3.2.2 Line Crewmember Training

Many of the cockpit crew and cabin attendants commented on various aspects of their training programs. One of the cabin attendant representatives complained that the airlines are required to have on board each flight a number of cabin crew trained in emergency procedures equal to that number certified for the aircraft. Thus, if the aircraft is certified for eight cabin attendants and the airline uses thirteen attendants for passenger service purposes, the five additional crew do not need to be trained in emergency procedures, even though they may be seated next to emergency exits. She suggested that every flight attendant seated next to an emergency exit have training in the operation of that exit.

There were differences of opinion regarding the amount and type of training necessary to prepare flight crews for emergency evacuations. Several cabin crew representatives were distressed at the trend toward classroom or home study training and away from hands-on training with simulators and actual equipment in realistic conditions. Several cabin crew association representatives called for more hands-on training. One advocated replacing written examinations with drills. There were also those who advocated the increased use of simulators. Reviewing past accidents through available photographs and videotapes and interviews with surviving crew was also suggested. Duplication of the conditions involved in past actual emergencies was identified as another useful training tool.

Different types of training were also discussed. One of the training areas mentioned specifically was wet ditching. An air carrier association representative felt that with proper classroom training flight attendants can be prepared for a

ditching. Others disagreed strongly. A crewmember from an airline described his airline's ocean ditching drills and said they were a good training exercise and presented a good opportunity for testing equipment. A member of a flight attendants' group said that a simulated ditching training conducted on a hangar floor was inadequate and no substitute for ocean conditions. A pilots' association representative concluded that there should be more emphasis on water ditching training by airlines. An NTSB representative also stated that the water ditching training of airlines is inefficient.

Several flight crew representatives stressed the need for joint training of cockpit and cabin crews. A flight attendant group member cited lack of coordination between crewmembers located at the forward and aft portions of the aircraft as a contributing factor to the problems experienced during several recent evacuations. A pilot association representative stated that the requirements for coordinated crew training are deficient and suggested that the airlines institute such training. The representative from an air carrier association disagreed with this position, stating that there is no need for coordinated crew training since everyone is trained from the same book.

An airline pilot and a representative from a flight attendant organization both raised the issue of joint training for flight crews and ground emergency fire and rescue crews.

A member of another flight attendant group discussed the need for full-scale evacuations under ideal, as well as adverse, conditions as a training tool. A pilot association representative noted that under Section 121.417(d)(3)(iii), emergency evacuation training should include the evacuation of persons needing assistance. The air carrier association representative discounted the need to take the handicapped, exceptionally obese, and blind into account in an emergency evacuation demonstration because "in an actual emergency, passengers with special needs will be pushed along at a satisfactory egress rate with the other passengers."

The need for consistent training by manufacturers and airlines for full-scale evacuation demonstrations was stressed by a flight attendant representative. He noted the discrepancies between the intensive training manufacturers give flight attendants and the normal emergency evacuation training provided by the airlines. Recommendations were made to eliminate the differences by upgrading the airlines' training or downgrading the manufacturers' training to reflect actual training performances.

An air carrier association representative cited the injuries sustained by crew in complying with a former FAA regulation that required them to exit the aircraft on an annual basis by sliding down an emergency evacuation slide as ample justification for its repeal. In light of the potential for injuries and his view that there is nothing to be learned from repeated exposure to slides,

he advocates initial, rather than recurrent, training on evacuation slides. The cabin crew attendants disagreed. They not only thought there should be recurrent training, but that it should be required on a semi-annual rather than annual basis. A member of a labor union stated that, in her opinion, it was worth the risk of injuries to have the actual experience. A flight attendant group member pointed out that the career of a cabin crewmember may extend 40 years. She thought that a cabin crewmember should have to undergo evacuation slide and wet ditch training more than once in a forty-year career.

Representatives from a passenger association and a flight attendant group proposed a standardization of airline emergency procedures training. The air carrier association responded that the airlines all comply with the basic requirements of the Federal Aviation Regulations, but need to tailor their training programs to their own individual needs.

A final training issue was raised by an FAA technical panel member who asked whether there should be a minimum number of hours required for emergency procedures training. The representative from a flight attendants' group responded affirmatively.

3.2.3 Effective Communications With Passengers

Comments regarding effective communication training related to concerns about methods of emergency communications and passenger briefings. General concerns were expressed by representatives from flight attendant associations about being able to use alternate means of communications in emergency situations. There was also some mention of the manner in which flight attendants delivered oral briefings. Recommendations did not specifically address training requirements.

4.0 ORGANIZATIONAL ISSUES

A recommendation was set forth by the representative from an international consumer group to establish a passenger safety unit within the FAA similar to the organizational entity established in Transport Canada.

**SUMMARY OF
SUGGESTIONS AND RECOMMENDATIONS**

The following presents a brief summary of specific suggestions and recommendations offered by participants in the Seattle Public Meeting and the Congressional Hearing. Some of these relate to proposed amendments to specific Federal Aviation Regulations, others are more general.

The summary is presented as excerpts from testimony. The exact wording of the party involved is presented to avoid any misinterpretation.

1.0 Design and Certification

1.1 Certification Process

Representative Newt Gingrich, R-GA

I think you should question the system which would permit significant modifications in large planes used by many people, with no public notice, and in fact, with sort of an assumption the public doesn't deserve-- does not have a role in that process (CH, 6/26/85, 121).

Representative James Oberstar, DFL-MN

... [are] there ... some gradations of significance among the STCs that you're reviewing ... the removal of an exit door is a whole lot different from a decision on changing the type of a windshield washer or a windshield wiper.

... there should be some alert system go off, and that's what I'm saying you ought to put into these regulations and review. So that a matter of this significance could have come to the attention on a national basis of user groups, of flight attendants, of the pilots, members of Congress (CH, 6/26/85, 159).

Oberstar, DFL-MN

With respect to the 747 overwing exit matter, I would hope and urge the FAA to review the guidelines that permitted someone within this agency to make a decision that a request of this kind could be handled through a supplemental type of certification process and not in the full open national view with all interested parties participating (CH, 6/26/85, 184-185).

Representative Norman Mineta, D-CA

It just seems to me that if it's bigger than a break [sic] basket and smaller than a house, somebody better take a look at this and treat it a little differently, instead of saying well, all of those things, regardless of size or significant [sic], get treated the same way (CH, 6/26/85, 160).

Steven Vincent Association of Flight Attendants

We would think that any changes to exit configuration, and any attempts to use analysis instead of a full-scale demonstration in compliance with 25.803(d), should be published in the Federal Register for comment. Government regulation works much better when it is conducted in the open (PTC, 221).

Werner Munster Association of Aircraft Manufacturers

And one of the last points I want to make is that the different life and health threats to inhabitants of an aircraft

cabin, they should be addressed with separate and individual rule-makings. One of these is now under way with the NPRM 85-10 that relates to the fire-hardening -- if, you know, that is the word I might use at this point -- fire-hardening of the cabins (PTC, 287).

Munster MBB Commercial Aircraft

The conclusion that we draw from that, on the basis of the presented material, is that the restrictive definition of the exit ratings and arrangements per FAR 25.807(c)(1) can cause conflict with the innovation to enhance safety, in using different combinations of exits, and should therefore be amended (PTC, 407).

1.2 Demonstrations

Munster Association of Aircraft Manufacturers

And one other point is that, with the definition of the evacuation demonstration performance, it would be a clearance of the aircraft based upon a single test for the life of the aircraft. It is our consideration that you could, and should more appropriately address this with, as addressed before, with singled-out sequences that be checked on a more frequent basis -- as, for instance, the mini-evac demonstrations, combined with the slide deployments on a more frequent basis (PTC, 287).

1.2.1 Continued Use of Full-Scale Demonstrations

Wolfgang Didszuhn Association of Aircraft Manufacturers

... it is the AECMA's point of view that full-scale demonstration should only be used to prove unusual, unconventional aircraft layout and exit arrangements. This fact has been acknowledged by European authorities (PTC, 271).

D. K. Lynch Transport Canada

In a case where exit distribution and/or flight attendant stations within the cabin area would be altered, a new emergency system, as compared to the original, is being proposed.

In this regard it is noted that in the preamble to Amendment 25-39 it is stated that the evacuation demonstration requirements are necessary to properly evaluate an entire emergency system. While this statement was made with respect to increases in passenger seating capacity, it is suggested that the same approach should be shown in the regulations where a decrease in seating capacity, based on exit deactivation in the cabin area to be occupied by passengers, is involved.

The need for this conservative approach is stressed where deactivation of exits is accompanied by deletion of associated crew stations (PTC, 176-177).

Lynch Transport Canada

Transport Canada endorses the intent indicated by the FAA in the foregoing references, and considers that to meet that intent, an evacuation demonstration should be performed in respect to each new airplane type, or when a new configuration -- excuse me; or when a configuration change makes a substantial difference to the evacuation system of a previously certificated airplane type (PTC, 178).

Werner Munster MBB Commercial Aircraft

Coming to the conclusions, we consider that when you design an aircraft to FAR 25 and 121 standards, you would not need to go through such a full-scale emergency evacuation demonstration (PTC, 286).

Joellen Thompson Joint Council of Flight Attendant Unions

In addition to the initial manufacturer's full-scale demonstration carried out under CFR 14, Part 25.803, each carrier utilizing any new, rebuilt, or modified aircraft should be compelled to perform a full-scale evacuation demonstration (PTC, 309).

1.2.2 Full-Scale Demonstrations vs. Analysis

Wayne Williams National Transportation Safety Association

On full-scale evacuation demonstrations, we believe that demonstrations are the only way to prove the viability of the hardware, the exits, and the slides, and the airline training programs (PTC, 42-43).

George Veryioglou Boeing Commercial Airplane Company

In conclusion, there are four points to be made. The current language of FAR 25.803(d) that allows a combination of analysis and tests to be used provides flexibility, as well as control, and need not be revised.

Risk of injury to demonstration participants can be reduced by applying the analysis method, when approved by the FAA.

It is incumbent on industry to utilize a combination of analysis and tests, as allowed by FAR 25.803(d), to prevent needless injury to demonstration participants, when available test data indicates conclusively that safety, as defined by the FARs, is not compromised by a new type configuration or derivative model.

Elimination of testing is not advocated. Conclusive testing on a reduced scale, combined with a rigorous analysis, attains the same objectives as live, full-scale evacuation demonstrations (PTC, 121-122).

D. K. Lynch Transport Canada

We feel that the present regulations regarding the demonstration are satisfactory, but also feel that the intent of the demonstration may be misconstrued in some quarters, leading to use of the analysis exception clause where the analysis may be based on factors not of the real world.

It is suggested therefore that the intent might be included in the regulation to better assure the desired interpretation of the requirements (PTC, 178-179).

Lynch Transport Canada

Considering what has been said previously in this presentation, it is likely obvious, and our view, that the conservative approach would be to accept analysis only where the data derives from evacuation demonstration of an aircraft type or types, having in comparison to the aircraft under consideration the same or very similar maximum passenger capacity, passenger seating distribution, exit types, location, and exit numbers, crew station numbers and locations, aisles, and cross-aisles (PTC, 179-180).

Steven Vincent Association of Flight Attendants

We therefore recommend, to avoid problems like the 747 exit removal, that the FAA should more closely follow the literal meaning of 25.803 and perform full-scale demonstrations when there are major changes to aircraft (PTC, 217).

1.2.3 Procedures and Simulated Conditions for Full-Scale Evacuation Demonstrations

Michael Oswald Airline Pilots Association

If we are injuring those test passengers, then something, somewhere, back a few years ago, or even now, we've devised something that's wrong, and it should be changed.

I want to see those evacs with human beings of all age groups coming out, and not being hurt in the tests. That's what I want. And I think that's what the passenger wants. And that's what we should want (PTC, 127).

Jennifer Colosimo Association of Flight Attendants

... no one is taking into account that air travel passengers have changed so much ... we no longer have only upper-middle class business people traveling... we are never without less than two or three or four people in wheelchairs, we are never without masses of children ... we have lots of unaccompanied children ... we have lots and lots of elderly people now ... that's just something that has to be taken into account (CH, 6/26/85, 27).

Lynch Transport Canada

Transport Canada is presently inclined to the view that smoke and floor proximity lighting systems should not be used in evacuation demonstration (PTC, 181).

Steven Vincent Association of Flight Attendants

[Suggests required use of a] standard airline mix, which is in the regulations -- not company employees and a few non-company employees sitting at floor level doors. I am referring to those who are younger and older than the mean population that they are tending to use (CH 152-153).

Vincent Association of Flight Attendants

If the training the manufacturers gave the flight attendants who are performing these evacuations was more reflective of what we actually receive at home on our airlines, then I think you would have [a] test that was more realistic of what a passenger would encounter in an emergency evacuation (CH, 6/25/85, 153).

Lynch Transport Canada

Handicapped passengers who might be endangered during an evacuation demonstration should not be included in the passengers for such demonstration (PTC, 183).

Steven Vincent Association of Flight Attendants

Our first recommendation is that flight attendants that are used in full-scale evacuations should receive training commensurate with what line flight attendants actually receive.

We would propose that the manufacturer invite the initiating operator to supply randomly selected crew members, and to have them trained by the carrier's approved transition training program.

In sum, we urge the FAA to do a brief survey of carriers to determine the average quality and quantity of initial and different training provided to flight attendants today. Training in full-scale evacuation demonstrations should be limited to that average. For modified aircraft, training should probably be limited to that of giving the flight attendants a manual revision (PTC, 228).

Steven Vincent Association of Flight Attendants

Our second suggestion for improving full-scale demonstrations is to block pairs of exits (PTC, 228-229).

Vincent Association of Flight Attendants

We believe that flight crew members who are used in full-scale evacuation should be instructed by the carrier's pilot training

instructions and only receive the approved training program's evacuation duties and responsibilities.

In addition, flight crews should not be allowed in the cabins for at least 30 seconds, to create a more realistic result (PTC, 232).

Vincent Association of Flight Attendants

Another way to improve full-scales is to develop a more realistic passenger mix. Current airline populations do not reflect the standard airline mix, as outlined in 25.803.

We at AFA do not want to unduly expose ourselves or others to undue risks. However, we do feel it's mandatory that the prescribed passenger mix in 25.803 be used. To be able to make a better judgment, we ask that the FAA make a full disclosure of the average number of injuries in full-scale evacuation demonstrations, and their severity (PTC, 232-233).

Wolfgang Didszuhn Association of Aircraft Manufacturers

... whether the distribution -- or how the distribution of blocked exits should be determined, is, at least in one item, not very clear. The requirements state that not more than 50 percent of the exits should be used. We are of the opinion that a clear definition should be given here -- that is, either using the left-hand or right-hand side of the airplane, or at least one door each of a pair of doors (PTC, 274).

Joellen Thompson Joint Council of Flight Attendant Unions

We recommend that all users participate in, not just observe, the Part 25 demonstration or the selected 121 full-scale demonstration. Since the basic content of all flight attendant training is dictated by the FAA, we feel there would be no problem using a mixed-carrier crew. Everyone would benefit by the comparison. We can learn from one another. The Joint Council advocates pilot and flight attendant emergency training be taken together (PTC, 310, 315).

Thompson Joint Council of Flight Attendant Unions

We believe that, seats should never be blocked on an aircraft; they should be removed entirely from an aircraft (PTC, 311).

Thompson Joint Council of Flight Attendant Unions

We urge the integration of the following items into 121, Appendix D:

One is smoke.

Two is a realistic carry-on: 100 percent pillows, blankets, newspapers, magazines, and a percentage of headphones. Delete, quote, "minor obstructions," unquote, from Appendix D(a)(10), and use flight attendants to ready the cabin, not the same flight attendants that will be participating in the demonstration.

Three, use an injured flight attendant, a simulated injured flight attendant, on one of the exits.

Four, weather -- use high-velocity exterior fans. It's been brought out before that several slides have been rendered unusable by wind, the latest being Honolulu, on the reef runway.

At least one flight attendant-occupied exit to be rendered inoperative.

At least one unoccupied exit to be operative, and not necessarily adjacent to the former.

And six, statistically inoperative, unusable exits to be blocked, as shown in the safety reports by the National Transportation Safety Board.

Demonstration participants should not include airline or manufacturer employees.

The passenger mix, as outlined in 121, Appendix D(a)(7), is realistic.

We recommend random seating, letting participants choose their seats.

All evacuation decisions should be made by the FAA.

We advocate an integration of the wording and requirements of Part 25 and 121, including Appendix D, as long as the contents remain in both parts. Our specific recommended changes are:

Part 25.7, 121.12 -- change to include use of integrated carriers crews.

Part 25.14, 121.14 -- delete the six-month qualification; participants to be used only once.

Part 25.17, 121.17 -- delete "carrier choice"; insert "FAA choice."

Part 25-D -- and after yesterday and the last two hours, define "analysis." (PTC, 311-312, 315)

1.2.4 Criteria for Recertification

Thompson Joint Council of Flight Attendant Unions

An evacuation demonstration should be performed under 121.291(b)(2), which is changing the number, location, or evacuation duties of flight attendants required by 121.391. We would like to know by what criteria the granting of exemptions is made (PTC, 311).

1.2.5 Data Collection

1.2.6 Economics

1.3 Emergency Exits

1.3.1 Criteria for Number of Exits

Representative James Oberstar, DFL-MN

I think the FAA needs to examine the validity of the issue of flow rates, by determining how they were established and verifying their accuracy (CH, 6/26/85, 185).

Wayne Williams National Transportation Safety Association

First of all, emergency exits. I won't go into detail there, but we feel the more, the better, because we know that some, perhaps several, will not function or be usable (PTC, 42).

Werner Munster MBB Commercial Aircraft

The next conclusion is that the ratings per 25.807(c)(2) do not reflect modern equipment, exits, and slides, particularly with regard to Type 1 exits. The improvements achieved in the area of quick availability of evacuation means should be regarded as a contribution by the industry to enhanced safety. However, it must be noted that regulations must be adaptive to innovation to prevent conflict, otherwise innovation will cease (PTC, 407).

Munster MBB Commercial Aircraft

... the ratings per 25.807(c)(1) and (c)(2), in our opinion, should correspond under the condition that, for instance, more than two pairs of exits are used per aircraft. This should also apply for possibly new added types of exits (PTC, 407).

Wolfgang Didszuhn Airbus Industrie

So the position of the AECMA members is that, in determining the size of exits and related passenger allowance, account should be taken of the current design practice and the known passenger flow data (PTC, 409).

Didszuhn Airbus Industrie

Therefore, we suggest that the Type A exits which do exist with certain dimensions, should be acceptable for 110 passengers -- that is no change to the actual situation -- but that, in addition, a Type B exit should be added to the rules, which should have a capacity of approximately 80 passengers, which is a well-proven figure. This is a type of exit which has been used in the past and adequate credit already given by the FAA on airplane models like DC-10 and 757.

The reason why we are promoting this type of exit is that, quite naturally, if you don't get any credit for this type of exit, you can have a situation where you have a Type B exit because you need it as a passenger entrance, but on the other side you have a very small exit...[in] these situations, no credit is given for the passenger entrance (PTC, 410).

Didszuhn Airbus Industrie

We would also suggest to increase the number of allowed passengers for a Type 1 exit; 55 passengers does seem, to us, a reasonable number. I think there is no reason to believe that a single-lane exit, an exit with a single-lane slide, is far worse than a Type A exit with a double-lane slide, which has 100

passengers. We think that 55 passengers, which is 50 percent, is an adequate figure.

We will also suggest slightly to increase the Type 2 exit allowance. We would suggest slightly to increase the Type 3 exit allowance, up to 40 passengers. One of the AECMA members, however, had some reluctance. He said 35 would be enough, and I would like to mention that. Type 4 exit, a 20 passenger exit (PTC, 411).

Didszuhn Airbus Industrie

... our proposal is to maintain the Type A rated capacity of the airplane at 110 passengers. So assuming that you have a 500-passenger airplane, you would need at least four pair of Type A exits, and add up another pair of Type B exits in order to be in line with this requirement, which would end up with five pairs of exits (PTC, 416).

Didszuhn Airbus Industrie

... additional constraints are considered on our side as a logic follow-up. These additional constraints should be presented in a different way than the 25.807(c)(1) table represents.

The further recommendations would be to simply state than [sic] an aircraft whose maximum passenger is nine or less must incorporate at least one Type 4 passenger exit per side. Aircraft whose capacity is 19 or less should incorporate at least one Type 3 exit, emergency exit per side. Airplanes above 19 passengers should incorporate at least two approved emergency exits per side. This is all still in line with the table as presented by 25.807(c)(1). And aircraft exceeding 39 rated passenger capacity should have two approved airplane exits per side, of which one must be at least a Type 1 exit. In excess of 109, we would suggest that there are three approved exits, of which one must be at least a Type 1 exit.

We would also consider that a credit for a Type A exit is limited to configuration -- that means, the full credit of 110 passengers is limited to configurations of airplanes having a capacity greater than 200 passengers.

Inconsistency or uncertainty is in the requirements as to passenger ventral or tail cone exits. So therefore, it is proposed that if a passenger ventral or tail cone exit is installed and can be shown to be usable following the collapse of one or more legs of the landing gear, an increase in passenger capacity may be allowed, based on the demonstrated capacity of the exit (PTC, 411-412).

Representative Newt Gingrich, R-GA

... we ought to look at how many after crash doors are available, because if we have a nonafter [sic] crash -- if we have a rule which works perfectly as long as the plane doesn't crash, except the rule is designed for planes that crash, we may have a problem (CH, 6/26/85, 120).

Gingrich, R-GA

... the 90 second rule ... may in fact require us to really rethink the next generation of airplanes, because, in fact, no one has testified to a serious crash in which they got out in 90 seconds. Now, we either need a lot more doors or we need to think about that (CH, 6/26/85, 120).

1.3.2 Elimination or Deactivation of Exits

Ellen Hill Joint Council of Flight Attendant Unions

One of our primary concerns is that there should be no reduction in exits and that future aircraft should be designed with a distance to the mid-points of the exits as equal as possible (PTC, 373).

Steven Vincent Association of Flight Attendants

For both public policy and safety reasons, we support an amendment to Part 121 that would prohibit the removal of existing exits on U.S. air carriers, unless you are going to a passenger/cargo configuration (PTC, 218).

1.3.3 Exit-to-Exit or Seat-to-Exit Distance

Ellen Hill Joint Council of Flight Attendant Unions

We also support the minimum standard distance set between rows for over-wing exits, as well as a minimum distance between an aft-facing flight attendant in a jump seat and the first row of forward-facing passengers (PTC 375).

Representative James Oberstar, DFL-MN

The FAA should identify the source of the comment that distance of a passenger from an exit has no bearing on the time required to reach that exit. That observation appears in the FAA document from the Office of Air worthiness summary report on the design change...

Distance plays a factor, a very significant one. Every one of the flight attendants involved in these tragedies -- take a hard look at that and reconsider it (CH, 6/26/85, 185-186).

Representative Newt Gingrich, R-GA

... distance for very large aircraft possibly should be apart of the criteria, not just number of seats per door (CH, 6/26/85, 120).

Barry Eberhardt Boeing

... we don't believe, in our past review of the history, that there is an exit-to-exit distance, even in the accident

scenario, where the distance becomes critical. That is something that should be taken up as an action out of this forum. It's obvious that the question has been raised repeatedly, but I don't think it can be stated right now categorically that it has been shown to have a distance factor.

I know of no studies, other than some review that we've made of accidents. That needs to be done some more, in light of the comments that other groups are making to us... and if the data is there, then the rules probably should be changed. But I think that's what has to happen in a working group (PTC, 453-454).

Bill Shook Douglas Aircraft

The question has come up on a data base. I would suggest that the committee review the work that was done in 1967 and '68 by AIA and FAA. That was a two-year study on evacuation and crashworthiness. And I further suggest that things haven't changed much in the succeeding years since that study was done. And if you want a good data base to start from, I would suggest that be reviewed (PTC, 458-459).

James Likes Boeing

... in a total evacuation system...the exit-to-exit distance parameter is adequately self-governed by the other parameters and by the current regulations, and should not be singularly regulated (PTC, 445-446).

1.3.4 Placement of Exit

Ellen Hill Joint Council of Flight Attendant Unions

One of our primary concerns is that there should be no reduction in exits and that future aircraft should be designed with a distance to the mid-points of the exits as equal as possible (PTC, 373).

D. K. Lynch Transport Canada

In regard to exit location, it is suggested that the sentence at FAR 25.807(c), which reads, "They must be distributed as uniformly as practical, taking into account passenger distribution," is capable of different interpretations. Further, "passenger distribution" is not defined and is not the only consideration, in our view.

Lynch Transport Canada

It is suggested that consideration be given for establishing a reasonable, practicable maximum distance that a passenger seat may be located from an exit, as a means of defining passenger distribution (PTC, 173, 175).

Barry Eberhardt Boeing

I think the industry, and we at Boeing feel the industry, should be left the flexibility -- no specific requirement for an exit over the wing just for ditching, but if it is there (the exit), have a means to get out onto the surface. And in the case of the one-piece slide, we have the means by deactivating the automatic deployment device (PTC, 450-451).

Werner Munster MBB Commercial Aircraft

So if this equipment be provided for ditchings, we consider that door-mounted slides that cater for flotation capabilities are a better type of equipment than solely having the over-wing exit with no immediate provisioning for flotation means.

You would have, immediately with the opening of the exit you would have the inflatable available right at the exit so that passengers could immediately board into the flotation means (PTC, 420).

1.3.5 Standardization

Karen Lantz Joint Council of Flight Attendant Unions

Another solution to this problem would be to insure that equipment standardization receives the attention it deserves. While exit standardization might create problems for the manufacturers, portable equipment and its location can certainly be standardized within a given airline (PTC, 519).

1.3.6 Exit Sill Height

1.4 Aircraft Configuration

D. K. Lynch Transport Canada

Further, to insure the availability of trained personnel to provide leadership in the event of an accident of an aircraft having Type 3 exits mid-cabin, it is recommended that at least one flight attendant station be required in the cabin area served by such exits (PTC, 175).

Steven Vincent Association of Flight Attendants

We would recommend that no new aircraft types be approved with a distance greater than 60 feet between exits, and that U.S. carriers be prohibited from acquiring aircraft with distances between exits greater than 60 feet -- and this would include existing aircraft (PTC, 220).

1.4.1 Access Space

D. K. Lynch Transport Canada

It is recommended that, in addition to the present requirements regarding seat backs, at least half of the exit width -- that is, at least 10 inches, should be free of seats from that exit to the main aisle -- or that the outboard seat should be removed and the access seat aisle should be at least 10 inches.

Further, it is suggested that the rationale that resulted in seat cushions extending into the projected opening of the exits be re-examined (PTC, 173).

Transport Canada recommends that 25.807(c)(6), access to excess emergency exits, be amended to require that excess exits meet the same access requirements as those for required exits. Good (PTC, 177-178).

1.4.2 Aisles and Exit Passageways

D. K. Lynch Transport Canada

In our view, the intent of the cross-aisle requirement is to allow passengers emerging from the cross-aisle to make use of the serviceable Type A exit and its evacuation slide with minimum interference with the line of evacuees approaching that exit from the main aisle.

If such an intent is agreed, it is recommended that the pertinent requirement be clarified.

One way to achieve this objective would be to have the extended center line of the cross-aisle meet each exit at its center point, or between its center point and the edge that is away from the main aisle leading to it (PTC, 172).

1.4.3 Other

Donald Brown Flight Attendant, PanAm

I think another improvement could be increased storage space on an aircraft for the carry-on luggage, if large carry-on luggage is going to be the wave of the future, as it seems to be now (CH, 6/26/85, 32).

1.5 Cabin Furnishings and Equipment

1.5.1 Passenger Seats, Jump Seats, and Seat Belts

Karen Lantz Joint Council of Flight Attendant Unions

Seat belts should be designed for quick entry and egress, and certainly should not inflict injury on the flight attendant (PTC, 740).

Lantz Joint Council of Flight Attendant Unions

In conclusion, we implore the FAA to move toward standardization of seat belts and shoulder harnesses. Standardization will not only cause a more safe environment through uniformity, but also protect the airlines and manufacturers who might hesitate to take the lead in improved flight attendant safety because of industry competition.

We also request that the manufacturers consider the input of flight attendants in design, with the flight attendant in mind (PTC, 746).

Lantz Joint Council of Flight Attendant Unions

In regard to the positioning of flight attendant jump seats, we never again want to see galley-mounted jump seats. The in-aisle jump seats which are attached to the galley bulkhead in some MD-80s and some 727s should also be banned, for the obvious safety hazards they pose, protruding into the aisle and having no headrests (PTC, 745).

1.5.2 Slide Design

Keith McGuire National Transportation Safety Board

We made the recommendation that the emergency evacuation slides on all floor-level exits be automatically inflated. And the FAA adopted a TSO relating to the slides and the fabrics involved, and the flammability of them (PTC, 59).

McGuire National Transportation Safety Board

In 1984, the Board followed up with a couple of recommendations, that only the new slides be acceptable for installation on newly manufactured aircraft, and that some reasonable time limit be placed on when they would be installed or retrofitted on the old aircraft -- either that, or that the slides themselves would be upgraded to meet the new TSO standards (PTC, 59).

McGuire National Transportation Safety Board

There were several other recommendations that came out of the Continental DC-10 accident in Los Angeles: strengthening the girt fabric of the 26-foot slide rafts. And the Technical Standard Order C-69A addresses the problem of additional asymmetrical load tests for slides. However, this pertains only to newly manufactured devices. And once again, the Board is concerned that many in-service evacuation devices may present an unsafe evacuation condition (PTC, 59-60).

Wayne Williams National Transportation Safety Association

In 1975 the Safety Board recommended that all slide deployments, failures, and malfunctions be reported to FAA, and

that all floor-level slides be designed to automatically inflate. The run I got the other day indicates that the action on that is still open.

In 1979 the Safety Board suggested further slide improvements. In '84 the Board recommended that TSO C-69A slides be installed on all newly manufactured airplanes, and that the FAA specify a date by which slides not meeting that standard be taken out of service, or upgraded to meet the standard. There is a way they can be upgraded by a coating.

In 1985 the Safety Board again recommended that all slides be modified to have quick-detachable girts to facilitate their use as emergency flotation.

Those recommendations concerning upgrading to meet increased heat resistance and quick release should be acted upon, we feel, at a very early date (PTC, 45-46).

Janna Harkrider Joint Council of Flight Attendant Unions

We would like to see an amendment to 14 CFT 121.310 to require, after a reasonable date, that all floor level slides be automatically inflatable (PTC, 698).

Steven Vincent Association of Flight Attendants

And we agree that most of the water contacts, from what we have seen, are at take-off and landing. We agree with the Airbus people that we'd like to see out slide rafts mounted at the doors (PTC, 423).

Wayne Williams National Transportation Safety Board

So we need to address, as Steve said, portability of the slides. That gets back to quick-detachable girts, for one thing (PTC, 424).

Vincent Association of Flight Attendants

In regards to portability, though, the current situation on most of our aircraft that do have slide-rafts or situations like that is unrealistic if we have a door that has high waves, a fuel fire outside, or is jammed for some reason. The portability, for example, on the DC-10 or our 747s -- I'd rather have an engineer or a maintenance person with me when I do it. I've seen a million films on it, but it's like 30 steps to do it.

And if it was something more realistic, like what we have on the narrow-bodied aircraft, where we can very quickly and easily retransport a slide or such to a usable exit, would be something that we'd like to see a lot more emphasis on, for manufacturers of slides and aircraft to look into, so that we do have a chance, on unplanned situations on take-off or landing, to have available means of flotation, or a survival platform, if you want to call it that, for our passengers and crew (PTC, 423).

Janna Harkrider Joint Council of Flight Attendant Unions

We do promote and support, as prescribed by the TSO-C69a, heat-resistant slides, and we would like to see them on all aircraft as soon as possible (PTC, 699).

Janna Harkrider Joint Council of Flight Attendant Unions

We encourage the manufacturers to continue with their fine designs of emergency slides, and to design slides with more thought given to the changing attitudes of aircraft in emergencies. The data support this fact, that very few emergencies are evacuated with the aircraft in a normal attitude (PTC, 699).

Janna Harkrider Joint Council of Flight Attendant Unions

We also feel that there should be extra care and precautions taken with slides located in galley areas and over wing areas. And with this data base, we feel there would be more information coming forth that we could check and see if these areas are as much of a problem statistically as the flight attendants feel that they are. Slides in the galley have coffee spilled on them -- on the 727 that comes to mind, the slide is affected with environmental factors more so than other doors. We have grease and food that's on the floor due to accident or my good cooking. And we try to be careful with these slides, but year after year it becomes a problem (PTC, 699-700).

1.5.3 Communications Equipment

Ellen Hill Joint Council of Flight Attendant Unions

We would like to urge some future research to be done on audio or sound devices which would automatically activate at an exit if opened in an emergency situation. This could greatly enhance the identification of exits unmanned by flight attendants and/or obscured by smoke and darkness. This sound device should not interfere with the flight attendants' commands (PTC, 374).

Keith McGuire National Transportation Safety Board

The Board's 1974 study of evacuations identified problems with emergency communications. Particularly now that we have larger, wide-body aircraft, this seems to be more applicable. And the board recommended that there be a public address system capable of operating on a power source independent from the main power supply. A similar recommendation was issued again in 1980 or '81, after the DC-8 accident in Phoenix (PTC, 60).

1.5.4 Lighting

Edward Scheu Luminescent Systems, Inc.

Basically, we believe that the solution to this problem of lighting on the cabin floor required, first, that it be lightweight; second, that it use a minimum of battery power; that it's virtually indestructible; that it has a low unit cost with a very easy installation and low maintenance, almost zero maintenance -- but most important of all, it provides an optimum level of light for viewing in a smoke-filled cabin environment. And we believe that electroluminescence, the systems that have been developed both by our company and others, will comfortably meet all of the important requirements of both new and existing aircraft (PTC, 479-480).

Scheu Luminescent Systems, Inc.

And it would be our recommendation that essentially a continuous strip with highlight strips every ten inches -- this type of system would be a high-intensity light every ten inches with a small connector ribbon of light in between, which truly provides a pathway of light to show the passenger a way out (PTC, 485).

1.5.5 Alternative Equipment

Ellen Hill Joint Council of Flight Attendant Unions

Based on the actual experiences of our members, we recommend that escape lines or ropes be available at all exits. In a situation where slides may be burned, punctured, or fail to inflate, ropes may be the only means of escape. These ropes could also be designed to be used to block an unusable exit (PTC, 374).

1.5.6 Standardization of Equipment

2.0 Maintenance and Reliability

2.1 Reliability

2.2 Maintenance

2.2.1 Maintenance Work

Werner Munster MBB commercial Aircraft

One more thing that I would like to fill in as a suggestion is that the use of these mini-evac demos, if combined with the routine checks on the inflatables, it could probably be used as a tool to check out the crew as well as the equipment (PTC, 279).

Wayne Williams National Transportation Safety Association

You asked for some information on maintenance the other day. As we explore this, I think we should explore the U.S. maintenance interval on slides that extend out to five years, and relate that to the success of the Qantas program (PTC, 583-584).

2.2.2 Functional Testing

Wayne Williams National Transportation Safety Association

I think as slides age they should be more stringently tested in ways that relate to actual use (PTC, 57).

Janna Harkrider Joint Council of Flight Attendant Unions

We would also like to see more in the area of puncture tests on slides. We know there's a tear strength and a tensile strength recommended, but we are not convinced that the puncture tests are adequate (PTC, 698).

Ellen Hill Teamsters Union

Is it possible and feasible, economically, that on service checks of slides, rather than taking them off an aircraft and taking them into a shop and checking them, to initially pop the slide in place where it is? I think you would get a lot more idea of if there are problems with them. And we would feel more comfortable that they are being checked in a realistic way. I just wonder. I don't see a big economic difference in doing -- actually inflating them on the aircraft, the way they've been riding, before taking them into check them the other ways (PTC, 715).

2.2.3 Training

Janna Harkrider Joint Council of Flight Attendant Unions

We also feel that mechanics should have a policy of having some type of hands-on training with the manufacturers of the slides, rather than referring to a manual that is sent to them by the manufacturers. If they are sent a manual and there are any questions, then they must take the time to -- and responsibly take the time to check out these questions. We have talked to some mechanics and they would like to have more hands-on training in the packing, the servicing, and repairing of slides or replacing slides (PTC, 699).

Lowell Roemke B. F. Goodrich

There were two items or recommendations that you made which I would just like to comment on.

One, I support your suggestion that there be more hands-on training for packing personnel on emergency slides. And I want to point out.

So those are good recommendations, and it's the type of thing that ought to be done on a recurring basis. If a person has attended the school and it's been a number of years past, it's good to have an update on that type of thing (PTC, 705-706).

2.2.4 Cost

2.3 Inspections

Representative Newt Gingrich, R-GA

... the flight attendants are ... your first line of defense scouts ... they ought to be your crash scouts in precisely the way that airline pilots are your scouts for midairs ... I think you need to rethink the role of flight inspectors and what they look for, and whether or not in fact safety procedures, safety regulations, attitude of flight attendants are [sic] part of their normal check list (CH, 6/26/85, 120-121).

Representative James Oberstar, DFL-MN

There is a maintenance problem, we've heard it again and again, on the 747 exit slides. And there ought to be some procedures set up for required inspections. If there is, they aren't being conducted. If they're being conducted, they aren't being done very effectively. And the FAA should look into that without delay (CH, 6/26/85, 187).

Oberstar, DFL-MN

... when a 13 year flight attendant can testify that she has never met an FAA inspector, other than to have him ask for another cup of coffee, someone is not carrying out the en route inspections, which are a part of the FAA procedure and which the Agency should be doing to insure the safety of airline passengers (CH, 6/26/85, 186).

2.3.1 Inspection Intervals

Janna Harkrider Joint Council of Flight Attendant Unions

We feel all slides should be checked by mechanics in a more frequent manner than they are at this point. This has been left up to the airlines individually. And some are very responsible, and some appear to be not as responsible in their checking and their manner of checking. We would like to see this standardized and the frequency improved (PTC, 698-699).

Werner Munster MBB commercial Aircraft

One more thing that I would like to fill in as a suggestion is that the use of these mini-evac demos, if combined with the routine checks on the inflatables, it could probably be used as a tool to check out the crew as well as the equipment (PTC, 279).

2.3.2 Required Inspection Items for Slides

2.4 Reporting and Information

2.4.1 Equipment Malfunction and Defect Reporting

Leroy Keith **FAA**

Just to be a little bit more direct, what about going with an NPRM right now, saying we can formalize, we can define some things we feel should be reported in the emergency systems, similar to what the Australian MOT is requiring, and actually formalize that in a Notice soon. I think that's what we're getting at (PTC, 682).

Ramesh Lutchmedial **British West Indian International**

Apparently there seems to be a lot of things that are happening in the field that the regulatory authorities are not aware of. And the rules are not plain. And we should probably bring the malfunction or the facts of emergency equipment under the mandatory reporting system.

And what I'm suggesting here is that if, for some reason, the door fails to open manually, just if there is no electrical power, and a mechanic wants to get out of the aircraft and he pulls the manual handle and the door fails to open, then that should come under the mandatory reporting system. So I'm not just talking about slides, but I'm talking about the operation of the emergency exits in the emergency mode (PTC 683).

Janna Harkrider **Joint Council of Flight Attendant Unions**

We feel the airlines should be required to report all emergency evacuation slide deployments, failures, and functions, to a data base that is central and accessible to all airlines in the world (PTC, 698).

Nora Marshall **National Transportation Safety Board**

Your suggestion for issuing an NPRM [to define things that the FAA feels should be reported regarding emergency systems] I just wanted to go on record that the Safety Board heartily supports that. We had made the recommendation in 1975. So we would welcome your issuing that NPRM (PTC, 684).

Mel Voltz **United Airlines**

[in reporting requirements] before you pattern whatever you're going to do after the Australians.... is the FAA willing to reorganize its Department of Aviation -- in Australia, where they give away, at least to a major degree, their enforcement action -- and look at it from a positive sense?

.... are you ready to dedicate the manpower, since there is the aviation authority in Australia that makes the decision as to whether or not it's a significant event? And that would require

one hell of a lot of people on your part, I think, to be available to us, not to interrupt the air transportation system of the United States while we're waiting for somebody to show up to tell us whether it's a major or significant item (PTC, 686).

Ray Ramakis **FAA**

What we're talking about is bringing information in to a central point, a central data base. Most of these airplanes are U.S.-registered. They fly all over the world. Everyone could share in the information that's received, if we had the reporting system specific to emergency equipment (PTC, 689).

Ramesh Lutchmedial **British West Indian International**

And the rules are not plain. And we should probably bring the malfunction or the facts of emergency equipment under the mandatory reporting system.

Also, perhaps, I want to suggest that emergency exits, malfunctions of emergency exits in the emergency mode if, for some reason, the door fails to open manually, just if there is no electrical power, and a mechanic wants to get out of the aircraft and then pulls the manual handle and the door fails to open, then that should come under the mandatory reporting system. So I'm not just talking about slides, but I'm talking about the operation of the emergency exits in the emergency mode (PTC, 683).

Joe Starkel **FAA**

I've heard a lot of different figures on reliability of the slides, from a 40 percent failure rate to 90 percent reliability. I would like, if possible, that the individual airlines which keep records of slide failures and slide successes, if they would provide the information for the record of their individual airline (PTC, 715-716).

Vern Ballenger **Air Transport Association**

"The following comments are submitted on behalf of ATA member airlines in response to FAA's inquiry. They were developed by an ATA task force which was formed in May of '84 to develop recommended changes to the FAA MRR/MISR" -- that is, the Mechanical Interruption Summary Reporting requirements. We did make recommendations.

And basically, what we said was -- let me read this one paragraph: "As noted in Attachment 1, the current FAA MRR/MISR requirements have resulted in the reporting of many items which have little relevance to safety. In addition, the item lag between submittal of the reports to the FAA and publication of weekly summaries makes the system essentially useless for alerting purposes. Consequently, the airlines must rely primarily on the manufacturers for dissemination of alert type information. In addition, the airlines often share safety information on an informal basis after occurrences or findings are reported to the manufacturers and the FAA." (PTC, 737)

Ballenger Air Transport Association

The FAA may have shot themselves in the foot with the recent final rule which changed the reporting time from 24 hours to 72 hours....ATA supported that rule-making action on the basis that, as long as the MRR system requires the reporting of a lot of information which is useless, 72 hours is fine -- as a matter of fact, 72 days would be fine. But in our recommendations back to the FAA on what we think the system should be like, we recommended that we go back to 24 hours. If you have an actual alerting system, the information needs to be disseminated fast (PTC, 738).

Ballenger Air Transport Association

Briefly, the ATA members recommended that the MRR system be made into a true mechanical alert reporting system which concentrates on safety-significant issues and eliminates the unnecessary repetitive reporting of non-critical occurrences. Presently, the volume of Service Difficulty Reports is so large that it is difficult to extract significant safety information. The volume of the reports also affects the ability of the FAA to disseminate such information quickly (PTC, 724).

Ellen Hill Joint Council of Flight Attendant Unions

We do support the NTSB's recommendation of compulsory reporting of all exits and slide failures (PTC, 374).

2.4.2 Information Loop--Manufacturer to Carrier

2.5 Enforcement/Surveillance

Janna Harkrider Joint Council of Flight Attendant Unions

We feel that a maintenance surveillance program to insure greater reliability of emergency evacuation slide systems is important (PTC, 698).

3.0 Operations and Training

3.1 Operations

3.1.1 Reduction of Flight Attendant Complement

3.1.2 MEL Authorizations

Janna Harkrider Joint Council of Flight Attendant Unions

Flight attendants feel that it is unacceptable to leave with an aircraft with an inoperative slide, and we would like to see this cease immediately (PTC, 699).

Menachem Levitan El Al Israel Airlines

We fail to follow the reasoning why on narrow-bodies or on 767s there is no allowance for MEL for one door inoperative, although 747 and other wide-body operators have it. And I'd like to ask the chairman, maybe, to include this subject in the working groups, or try to clarify the subject (PTC, 462-463).

3.1.3 Uniformity of Emergency Equipment

3.1.4 Passenger Briefings and Information Cards

Keith McGuire National Transportation Safety Board

The preliminary results of this safety study reinforce and strengthen the Safety Board's belief that the FAA should oversee research into passenger behavior, passengers' acceptance of safety information. More effective methods of conveying safety information to passengers should be a goal of both the FAA and the industry (PTC, 62-63).

McGuire National Transportation Safety Board

In 1983 the Safety Board again recommended to the FAA that it sponsor a government-industry task force, open to foreign participants, made up of representatives from the airplane manufacturers, air carriers and commuter operators, researchers, flight attendants, and consumers, to identify, first of all, the type of safety information that should be available; second, improved instructional concepts for conveying that information; and third, to recommend appropriate changes to the operating requirements regarding passenger oral briefings and information briefing cards (PTC, 62).

3.1.5 Service vs. Safety

3.1.6 Other

Ellen Hill Joint Council of Flight Attendant Unions

We recommend that the FAA require that less than agile passengers not be allowed to occupy seats in an exit row, as well as those seats one row forward and one row aft of exits (PTC, 374-375).

Janna Harkrider Joint Council of Flight Attendant Unions

We would also like to have a recommendation that flight attendants and crew members wear low-heeled shoes on take-off and landing (PTC, 698).

3.2 Training

3.2.1 Mini-Evacuations

Werner Munster MBB commercial Aircraft

One more thing that I would like to fill in as a suggestion is that the use of these mini-evac demos, if combined with the routine checks on the inflatables, it could probably be used as a tool to check out the crew as well as the equipment (PTC, 279).

3.2.2 Line Crewmember Training

Janna Harkrider Joint Council of Flight Attendant Unions

We also urge the FAA to incorporate the empirical evidence of past accidents and reporting systems, as well as testimony from crash-surviving crew members, when considering rule-making (PTC, 699).

Joellen Thompson Independent Union of Flight Attendants

Airline companies may come up to their staffing requirements for service with untrained flight attendants, flight attendants who have never been on the aircraft before, as long as the FAA-required minimum are on board. We find that totally unacceptable. We think that every flight attendant, as long as they are sitting in a flight attendant's seat, covering an exit, should have been trained in the operation of that exit and the emergency equipment on board (PTC, 497).

Thompson Independent Union of Flight Attendants

I am stating that I think that that should be changed in this particular process, that 121.391 should ... something should be inserted, amended, or whatever we can do to make sure that any time a flight attendant, either required by the FAA or by the carrier for service requirements, be trained in that equipment. It's highly unrealistic to say, "Well, this aircraft has the required number that were certified to evacuate this aircraft in a timely manner." Those flight attendants may be injured, dead, whatever (PTC, 516).

Steven Vincent Association of Flight Attendants

One complaint that we do have is that there seems to be a tendency going towards more home study courses with a reduction of actual classroom hours, and feeling that the home study does fulfill that. This would be a multiple question type of situation where the flight attendant has to fill in a workbook, bring it in to class, and take a test. While this may be appropriate for certain parts -- for understanding other performance of a flight attendant on an aircraft, we feel there should be more emphasis on the actual hands-on, with the operation of the equipment, not only for land use but water use (PTC, 533).

Karen Lantz Joint Council of Flight Attendant Unions

We've talked quite a bit about evacuation tests today, yesterday, and the day before. As to whether it's necessary, I think that it's the same type of a thing. Yes, you need to do it, a dry run. You need to do it under the ideal situation, which would be no waves, no elements, no weather. But you also need to do it under the adverse situations as well. You need to do an evacuation, a full-scale evacuation test under the ideal circumstances of everybody working normally, with the exits that are supposed to be working, working. But you also need to do it when the exits aren't working. And you also need to be doing it where things aren't going properly -- the same thing with wet ditching (PTC, 499-500).

Lantz Joint Council of Flight Attendant Unions

... again, the only time I have ever operated an actual aircraft door is during initial training. And I think that you should be operating actual doors rather than mock-ups, perhaps not every year, but at least every other year. And in fact, there have been times when our employer has said, "Since you've operated a door mock-up, you're now qualified on equipment." I don't believe that's adequate (PTC, 531).

Lantz Joint Council of Flight Attendant Unions

Most airlines are now making use of cabin simulators in their training programs. While we agree wholeheartedly with this method of training, we would like to stress the importance of making these sessions as realistic as possible. Hands-on training should replace written exams wherever feasible, and the simulator drills should be very real, perhaps even duplicating actual past emergencies (PTC, 520-521).

Lantz Joint Council of Flight Attendant Unions

Simulators now are more sophisticated today and even in those instances where new flight attendants are being trained in these simulators, those of us who are more senior and did not have the advantage of these more sophisticated simulators are not required to take recurrent training in these simulators. And we certainly believe that flight attendants who were not trained in these simulators should also go through these drills during recurrent, as well as the new hires going through during initial (PTC, 521).

Lantz Joint Council of Flight Attendant Unions

A review of past accidents is also an effective training tool, especially if photographs or videos can be used to emphasize the fact that accidents do happen and, as crew members, we must always be prepared (PTC, 521).

Wayne Williams National Transportation Safety Association

... one thing we should be addressing in these work groups in that kind of thing (ditching training) because the FAA over the last six years has come to recognize or acknowledge a number of things. One thing is that accidents happen very close to shore on approach/departure (PTC, 548).

Lantz Joint Council of Flight Attendant Unions

This need for change includes ... joint training with pilots and ground fire-fighting and emergency crews, increase the use of simulators, increase the frequency of training, as well as increased training in hijacking and terrorism procedures (PTC, 518).

Dale Istwan Airline Pilots Association

... requirements for training and crew coordination, I think, are deficient in the regulations, when it comes to the integration of the flight deck and cabin crew members. I think there's a general need for integrated training in the hands-on use of the equipment, where the cabin attendants and the flight deck crew members are there at the same time.

The crew coordination aspect of the training seems to be a weak part that's not covered by re-current hands-on training in emergency devices by either of those two groups (PTC, 504).

Michael Oswald Airline Pilots Association

... there should be more crew coordination training (PTC, 534).

Lantz Joint Council of Flight Attendant Unions

We ... suggest that members of the ground fire and rescue teams at our airports be invited to observe flight attendant training. They will certainly be better prepared to do their jobs outside the aircraft if they know what to expect from us inside the aircraft (PTC, 520).

Lantz Joint Council of Flight Attendant Unions

Over the past years many accident reports have cited communication between crews in the forward and aft portions of the aircraft as a contributing problem -- as a contributing factor to problems and disaster during emergency evacuation ... we suggest joint pilot/flight attendant training as a remedy to the problem (PTC, 519-520).

Lantz Joint Council of Flight Attendant Unions

Current regulations require cabin crew training of a given number of hours to be conducted once every 12 months. Some

airlines require training once every six months, and the Joint Council heartily approves of this approach (PTC, 521).

Lantz Joint Council of Flight Attendant Unions

And I think that I would like to see our emergency recurrent training, especially, broken down perhaps in two days and spread out over the year. I think doing it once a year really is not adequate (PTC, 531-532).

Lantz Joint Council of Flight Attendant Unions

We could bring forth a proposal on minimum hours on certain types of training. And yes, I do think that minimum training should be broken down by category, rather than by just a set number of hours, and whatever you stuff into that set number of hours is fine.

I believe that there should be a minimum number of hours of emergency evacuation, portable equipment, first aid, as well as the terrorism and security training that is already being required, and other areas as well (PTC, 547-548).

Lantz Joint Council of Flight Attendant Unions

I get on another carrier as a passenger, and although I am trained as a flight attendant and I am a flight attendant, and I certainly would be very useful in helping any flight attendants in emergency evacuation as an able-bodied person, their procedures are so completely different from mine that I really am none other than another passenger on board that airplane -- maybe a little bit more knowledgeable than other passengers, but certainly not as well prepared as I would like to be to be able to assist the flight attendants operating the emergency evacuation for that carrier.

I believe that there should be more standardization in our training (PTC, 549).

Lantz Joint Council of Flight Attendant Unions

The one concern that we do have ... is that the airlines are not giving the same amount of training to those people that they are training to replace us in the event of a work stoppage. And we feel that those people who will be working as flight attendants on board an aircraft are entitled to and should be receiving the same amount of training and the same type of training that those of us who are actually working for a carrier receive (PTC, 539).

3.2.3 Effective Communications with Passengers

4.0 Organizational Issues

Hans Krakauer International Airline Passenger Association

We are going to ask you, as you might know already, for the establishment of a passenger safety unit within the regulatory authority. This has been done by Transport Canada with great success. And I think the FAA is big enough to do that. And this would give the FAA a focal point for the evaluation and the future enunciation of policy changes. And we will submit a proper piece of paper to you before more than one week passes, on how we propose this might look (PTC, 398).

Chuck Foster FAA

And the suggestion that was brought up here, one of the things that has been mentioned at this conference -- the idea of someplace in the FAA creating a new unit or office or function for dealing with passenger safety. The Administrator has been informed of that, and we are going to look into the feasibility and determine whether or not, and where, such an organization should be formed within the Agency. And we should be getting some information on that out to everybody in the near future (PTC, 693).

SECTION 5

**FORMAL PRESENTATIONS OF THE
PUBLIC TECHNICAL CONFERENCE**

*Capt. J. Martin Vanotou
Incl. Federation of
Air Line Pilots Assn*

FHA Conference, Seattle, September 3 - 6 1985

EMERGENCY EVACUATION AND CABIN SAFETY

IFALPA Position and Policies

In view of recent tragic events, IFALPA's historic concern to achieve improvements in many areas related to cabin safety and emergency evacuation has become even more relevant. For many years the Federation has campaigned internationally (as have its individual Member Associations at national level) for improvements to give a greater degree of assurance that lives will not be lost in "survivable" accidents. Our policies have addressed the full range of issues, including seat and cabin furnishing restraint; provisions for fire and smoke detection and fire extinguishing equipment; the development and installation of non-toxic cabin furnishings; the elimination of materials which impede evacuation; the need for more rapid response by fire and rescue services; the provision of adequate quantities of extinguishing agents; and the elimination of alleviations from the requirement to provide rescue and firefighting equipment appropriate to the largest transport aircraft using an airport.

Many of these IFALPA policies have been in existence for years, and have been repeatedly expressed. Equally often they have been rejected on the grounds that the cost of implementing them is disproportionate to the benefit obtained. Airline pilots have been greatly disturbed by the growing tendency to equate the desired level of safety with the minimum permitted by regulation - a process which has culminated in the decision of some airlines actually to reduce the number of emergency exits provided on one major aircraft type, the B747.

IFALPA considers that in the light of present knowledge the adequacy of the provisions which determine the required number of exits, and in particular the conditions which prevail when compliance with these provisions is demonstrated, must be regarded as highly suspect. The Federation therefore hopes that the meeting now taking place will result in rapid and mandatory improvements in all the areas under discussion, and that they will be enforced with vigour in all countries which benefit from international civil aviation.

Public confidence in the international airline industry has been severely shaken over the last few months. Airframe and engine equipment which has been regarded by most as unquestionably safe and reliable has demonstrated itself to be vulnerable to unforeseen defects in their design

and maintenance, just as in the past many accidents have been attributed to the failure of flight crews to anticipate correctly the consequences of their actions in flight operations. There has been too much reliance on assumptions which do not reflect real world conditions, but which provide a comforting illusion that adequate protection has been given to the fare-paying public. IFALPA looks to this meeting to start to correct some of those assumptions.

The following is a brief outline of some of the IFALPA policies on Cabin Safety, Evacuation, Rescue and Firefighting. In all cases the full policies include proposed wording to amend existing ICAO Standards, Recommended Practices, or Guidance Material. The date of final adoption of the policy by IFALPA is shown in brackets.

Aircraft design requirements for improved detection, suppression and extinction of fires, including fuel system and tank ullage spaces, lavatories, galleys, and compartment ceilings (1975)

Elimination of cabin materials whose particle emissions can cause or accelerate flame propagation (1976)

Cabin Emergency lighting to be both above cabin window level and below seat level for smoke conditions. (1980)

Elimination of Cabin materials which can produce toxic gases or smoke in incapacitating quantities (1980)

Requirements for test criteria for such materials, and retroactive certification of existing aircraft (1980)

More stringent passenger and crew seat deceleration criteria (1977)

Cabin smoke generation to be insufficient to impede evacuation (1978)

Reduction of RFF Response Time to two minutes in all approved operational conditions. (1978)

Demonstration of RFF capability in low visibility before such operations are approved. (1978)

Amounts of required extinguishing agent to be determined by maximum aircraft size alone, not frequency of operation. (1977)

Requirement for all RFF vehicles and extinguishant to be immediately available (1978)

Improved manning, discharge rate, and range for RFF vehicles (1978)

These policies have been ratified by the Federation's Annual Conferences, and continuing discussion takes place within our Aircraft Design and Operations Committee, and our Airports and Ground Equipment Committee, on many other aspects of these problems. The adequacy of the existing 90 second evacuation criteria, and the necessity for demonstration under realistic emergency conditions, will remain subjects of high priority. Airline pilots worldwide believe that the industry must now pay serious attention to implementing improvements in these areas, and look forward to participating fully in that process.

- END -



INTERNATIONAL FEDERATION OF AIR LINE PILOTS ASSOCIATIONS

FAA PUBLIC TECHNICAL CONFERENCE

SEATTLE SHERATON HOTEL

SEATTLE, WASHINGTON

SEPTEMBER 3-6, 1985

IFALPA, the International Federation of Air Line Pilots Association, representing more than 50,000 pilots from over 60 countries, is very concerned over the removal of the overwing emergency exits on the B-747, which action has already been effected by several major airlines.

This concern is aggravated by the unfortunate series of accidents of recent months which have sadly illustrated that, for the evacuation after an accident, very little time is available for the occupants to escape. These accidents have once more underlined the necessity to review and reconsider the existing regulations. Not only in the recent past, but also for at least the last ten years, IFALPA has urged ICAO, and through our Member Associations their State Authorities, to review and amend the present regulations and requirements, freely offering our views.

IFALPA wishes to use the opportunity of this meeting to present once more our position on the topics which will be discussed.

Emergency Exits: The FAA approval by it's North-West Region of a Boeing modification to remove or deactivate the overwing exits (3L & 3R) on the B-747 will greatly reduce the chances of a successful evacuation. Limiting the number of passengers will not compensate for this deterioration of safety since it will necessitate those passengers near the inactive overwing exits to go further forward and/or aft, thereby reducing their survivability. IFALPA sees no justification for the removal of the exits other than commercial motives, and urges the companies which have deactivated these exits to restore them again.

Full Scale Evacuation Demonstrations: The existing demonstrations, as required for the certification process, are not very realistic. The people involved are not at all representative of a common load of passengers. They are trained, they know what is expected of them, and are not hindered in their movements by a typical load of excess handluggage and/or tax-free articles. The elements of surprise, shock, trauma, fright and panic are not present. Neither are there broken-down overhead bins or displaced seats. Instead there is absolute anticipation and preparation in a relatively sterile structure. These conditions are obviously going to produce an evacuation proficiency result that is far more idealistic than realistic. Although only half the exits are being used in such demonstrations,

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this condition should not be seen as compensating, for accident experience has shown it to be typical.

Escape Slides: After studying the accident and incident reports, IFALPA is alarmed at the great number of escape slides which fail to deploy or are otherwise unserviceable during emergency evacuation. In many cases escape slides could not be used because the slides were designed for use in unrealistic wind conditions. IFALPA insists in improvements in design, and better and more frequent maintenance of escape slides.

Fire Precaution: Since 1975, IFALPA policy has called for an amendment to the ICAO Standard with the addition that "No turbine powered public transport aeroplanes shall be certificated without positive fuel system fire protection". (IFALPA Annex 8 (Air) Part III, para. 4.1.6. e). IFALPA has repeatedly expressed this and other views for amendment to ICAO Standards and Recommended Practices to enhance flight safety and increase post-accidents survivability, but more than often found them turned down by the pressures of airline economy.

Cabin Safety: Since 1976, IFALPA has urged manufacturers and Authorities to use materials for cabin furnishings that would be heat resistant, have a very low flame propagation, and do not possess any characteristics to cause flash-fires. Furthermore, the cabin interior materials should not produce smoke or toxic gases in quantities sufficient to cause incapacitation to the passengers.

Passenger seats and cabin furnishings should be able to withstand high deceleration forces so as not to become dislodged during an accident.

Cabin emergency lighting should be installed both above cabin window level and below seat level to give guidance during heavy smoke conditions.

These views also have been expressed many times by IFALPA and are still actively pursued. IFALPA Annex 8 (AIR) Part III, para. 4.1.6 (f) and the Airworthiness Technical Manual Part 3, Section 4, Chapter 2.

Rescue and Fire Fighting: Use of the remission factors by the airlines to enable operations of aircraft on airports with inadequate facilities for those aircraft has been opposed by IFALPA for many years. The main purpose of Rescue and Fire Fighting is to enable the passengers and crew to escape safely from an accident, and to ensure this capability, it is essential to have sufficient equipment and facilities for the type of aircraft and number of passengers. The increasing amount of dangerous goods carried on-board passenger aircraft aggravate this serious situation

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and the use of a remission factor should be forbidden especially in this case. IFALPA Annex 14 (AGA) and IFALPA Annex 18 (DG).

IFALPA regrets that, in spite of our continuous effort to help increase aviation safety by offering our professional expertise, very little is implemented. IFALPA recognizes that airlines must be profitable to survive the present-day competition, but commercial motives must never be the cause for a deterioration of the achieved levels of safety, and airlines, manufacturers, authorities, and the professional aircrew associations should work together in unison to achieve even higher standards of safety.

IFALPA is seriously concerned that deregulation is beginning to show it's ill effects and that the natural strain between safety and economy is being biased in favour of economy, with a disturbingly low interest for the safety of operations. We sincerely hope this conference will result in an acknowledgement by the regulatory authorities and manufacturers of the need for more consideration for the safety of the travelling public. IFALPA remains available to provide the benefits of our extensive operational experience towards this goal.

Presented by:

Captain S.M. Vanstone, Vice Chairman
Aircraft Design and Operations (ADO) Committee
IFALPA

September, 1985.



Presentation by Wayne E. Williams, President, National Transportation Safety Association, at the FAA public technical conference on emergency evacuation of transport airplanes, Seattle, WA, Sept. 3, 1985.

First, I must express my appreciation to those who initiated and planned this conference. Our evacuation systems require this thorough examination.

But, as we discuss those systems, we cannot afford to ignore other serious problems that impact successful emergency egress. So, as I begin, I want to ask how many of you have studied this 1981 NTSB report, titled "Cabin Safety in Large Transport Aircraft"? Those who have not should, because it has a direct bearing on these discussions - although it does not specifically address aircraft evacuations.

The report covers 12 years of U.S. airline accidents. It reveals that 60% of the accidents that were survivable/partially survivable resulted in failures of cabin furnishings - and that almost 90% of the accident impacts were "survivable". Those failures, of seats, belts, overhead furnishings and bins, partitions, closets and galleys, killed, injured, trapped, and rendered occupants unconscious. Those cabin disruptions, often compounded by carry-on baggage litter, frequently created major evacuation obstacles for even conscious and mobile occupants, and were especially serious in those events - about 50% - where fire erupted. The NTSB recommended increased crash resistance for cabin furnishings in 1972 and again in this 1981 report.

As the NTSB also noted, rupture of the wing - the fuel tank - allows fuel to escape. That can cause catastrophic fires and explosions and those fuel fires have propagated into highly flammable cabin interiors, with disastrous results.

It is appropriate to mention these problems - that have such negative effects on both survivability and evacuation - because it appears that we will be affected by them for many more years. The FAA has indicated that sorely-needed new standards covering more crash-resistant seats - and other cabin furnishings - will apply only to future, newly-certificated, aircraft - not the current fleet that we'll be flying into the next century.

Similarly, while fire-blocking seat covers are now being installed, we fear that new overall cabin material flammability standards, when finally developed, will also be made applicable only to future-generation aircraft.

The hazards of the metal wing fuel tank will also continue, and claim many more lives, although we've had congressional hearings on that issue and strong protests by ALPA and independent safety advocates since the 1940's.

The things I've already mentioned tend to work against the ability to quickly and safely evacuate the airplane. I will now address some aspects of the evacuation system, following your agenda list, that are reasons for concern.

I. Emergency Exits: The more, the better, because we know that some, sometimes several, will not function - or be usable.

II. Full Scale Evacuation Demonstration:

A. This is the only way to prove the viability of the hardware - exits and evacuation slides - and the airline training programs. I do not believe that analysis should ever be substituted for this actual test. While injuries have been cited as the reason for backing away from such demonstrations, we've encountered a lot of difficulty in pinning that down. In letters from the FAA, last year, we were told that the agency does not maintain records on such injuries. In any event, I believe that with appropriate protective measures, the risk of injury would be negligible.

III. Escape Slides:

A. While most of the TSO C-69A standards seem to be adequate, there is cause for concern about the puncture and tear resistance of the sliding surface. These have failed, on fairly new units, and people have fallen through that surface. This problem is currently being discussed at SAE "Cabin Safety" committee meetings.

B. As concerns deterioration, reliability and maintenance: The slides are not being maintained often enough, well enough, and are - in some instances - being kept in service too long: some are almost 20 years old. A 1984 letter from the Northwest Mountain Region provided a summary of failure causes: 36% were attributed to design problems; 20% were due to inadequate crew training; 12% were due to age of the slides; 32% resulted from incorrect packing and/or crew operational problems.

C. We are especially concerned about slide performance in fire conditions - we estimate that less than 20% of the fleet is equipped with aluminized, heat resistant, units. We know that those in that other 80% virtually evaporate when exposed to radiant heat.

D. In 1975, the NTSB recommended that all slide deployments, failures and malfunctions be reported to FAA and that all floor-level slides be designed to automatically inflate; In 1979 the NTSB suggested further slide improvements; in 1984, the NTSB recommended that TSO C-69A slides be installed on all newly manufactured airplanes and that the FAA specify a date by which slides not meeting that standard be taken out of service, or upgraded to meet the standard; In 1985, the NTSB recommended that all slides be modified to have quick-detachable girts - to facilitate their use as emergency flotation.

Those recommendations concerning upgrading to meet increased heat resistance and quick release should be acted upon at a very early date.

As concerns "Floor proximity escape path marking": It took a lot of dead bodies to get that required. The airline industry did not take the requirement very seriously and without intervention would already be installing devices that would be useless in smoke conditions. It appears that this area is back on the intended track, but continued vigilance would be a good idea.

Crew training requires some attention, too, as noted in the aforementioned NW region letter. That is certainly true of training for water accidents. Again, the NTSB has long urged action in this area. In 1972, it recommended "wet drills" and that has again been urged in a recently-released study of water accidents. Yet, over the years, the industry, with FAA approval, has backed further away from that realistic requirement. So, while we once saw flight attendants dive down into a sunken aircraft and save lives by retrieving life vests for passengers, we now see internationally-qualified flight attendants who are so ill-prepared that they're afraid to step off a 3 foot platform into the water - while wearing an inflated vest.

The NTSB is about to release a report on passenger briefing. Some of us are addressing that problem, too. Only one thing is certain at this point - much needs to be done.

Last February, Administrator Engen made a surprising remark during a speech at an international cabin safety symposium. He told the audience of several hundred to, "Beware of self-appointed safety messiahs and their self-fulfilling prophecies". A subsequent comment by NTSB Chairman Burnett made it clear that he, at least, believed that the head of the FAA was referring to me.

Having been given the name, I'll assume the task and give you a prophecy: Over the next 10 years, thousands of airline passengers and crew members are going to be unnecessarily killed and injured in survivable accidents. Whether or not that becomes self-fulfilling depends on the FAA, the airlines, and the aircraft manufacturers. I would be very happy to be proven wrong.

In closing, I want to say that there are a lot of us spending large amounts of time educating the public about these problems. One of our messages is beginning to be heard: The cause of the accident and the causes of death and injury - as in the recent Manchester accident - are not the same. As more of them understand that, you'll hear from them.

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TASK FORCE ON EMERGENCY EVACUATION OF TRANSPORT

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AIRPLANES VOLUME 2 SUPPORTING DOCUMENTATION(U) FEDERAL

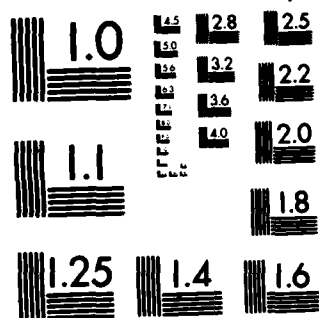
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

NTSB PRESENTATION
September 3, 1985

to be in the
Office

~~Good Morning!~~
^{Afternoon}
Good Morning! I would like to thank the FAA for allowing me to discuss some of the Safety Boards recommendations related to emergency evacuation of transport category airplanes.

The Safety Board has over the years expressed its concerns about the need to increase protection provided to aircraft occupants following a crash. The Safety Board has issued numerous recommendations to the FAA and the aviation industry, including recommendations concerning evacuation slides, emergency lighting, evacuation alarms, public address systems, crashworthiness standards, seat design and testing, crew training, cockpit cabin crew coordination, and passenger education. Time constraints prevent me from discussing all of these recommendations but I would like to review some of the recommendations that the Board remains concerned about.

In 1974, the Board adopted a special study of the Safety Aspects of Emergency Evacuation from Air Carrier Aircraft. The study examined ten air carrier accident case histories and identified factors which affected these emergency evacuations. The study revealed deficiencies that have had a detrimental effect on the success of emergency evacuations. The study indicated numerous slide failures and the Board was concerned that the reliability of evacuation slide systems could not be

properly evaluated. The Board recommended that the FAA require that emergency slide deployments, failures, and malfunctions be reported to the FAA. Also as a result of this study, a recommendation was made that emergency evacuation slides on all floor level exits be automatically inflated upon deployment. Both of these recommendations are in a ~~"Closed--Unacceptable Action"~~ status.

During the Continental Airlines DC-10 rejected takeoff accident at Los Angeles, in March of 1978, all of the passenger evacuation systems eventually failed because of flame impingements, radiant heat, and girt fabric overload. As a result the Safety Board issued a series of recommendations that called for the FAA to establish certification standards for fire-resistant fabrics, issue a TSO prescribing use of fire-resistant fabrics, and require that all passenger evacuation devices on air carrier airplanes, including those already in service, ultimately meet improved fire resistance standards.

The FAA issued TSO-C69a "Emergency Evacuation Slides, Ramps and Slide/Raft Combinations". The Safety Board is concerned that TSO-C69a allows current slides which do not meet the heat resistance requirements to be taken out of service only on an attrition basis and that ~~the TSO-C69~~ slides can still be installed on airplanes as long as they are available. Therefore

in 1984, the Safety Board issued two new recommendations urging that only TSO-C69a slides should be acceptable for installation on newly manufactured airplanes; and that a date be specified after which passenger evacuation devices which do not meet TSO-C69a must be taken out of service or upgraded to meet those standards

As a result of this same accident the Safety Board recommended that FAA issue an Airworthiness Directive to strengthen the girt fabric of the Pico 26-foot slide/raft. TSO C-69a addresses the problem of additional asymmetrical load tests for slides with sponsons, however this pertains to newly manufactured ~~slide/raft~~ devices. The Board remains concerned that many in-service evacuation devices may present an unsafe evacuation condition, therefore, the Safety Board reiterated to the FAA that an Airworthiness Directive be issued requiring the strengthening of the girt fabric of the 26-foot Pico slide/raft so that the unit's reliability is insured when it is deployed at its most critical angle.

The Safety Board's 1974 ~~Special Study of Evacuations~~ identified problems with emergency communications. ^{particularly with} The advent of larger, wide-bodied aircraft.

A recommendation resulting from this study called

for a public address system capable of operating on a power source independent of the main aircraft power supply. A similar recommendation was issued after a special investigation of a United Airlines DC-8 evacuation in Phoenix, December 29, 1980.

The ~~recent~~ investigation of a National Airlines 747^{evacuation} in Detroit, indicated^s that the senior flight attendant attempted to use the PA system to give evacuation instructions to people at the aft of the aircraft and was unsuccessful because the PA system was not ~~activated~~^{powered}.

In addition to these recommendations, the Safety Board has made several recommendations related to passenger education. The Safety Board considers the effective communication of safety information to passengers essential in order to assure that passengers react properly to an emergency situation. Federal aviation regulations require that oral briefings be given to passengers before all U.S. air carrier and air taxi flights and that passenger briefing cards be available to them. International Civil Aviation Organization Annex 6 standards extend these same requirements to international flights. However, based on information gathered during accident investigations, the Safety Board has found that current methods for instructing passengers about airplane safety features have

not always been effective in achieving their purpose of improving passenger survivability. The Safety Board, as a result of aircraft accident investigations and special studies, has found deficiencies in both the manner in which safety information is conveyed to passengers as well as the accuracy and content of the information. Since 1962, 27 recommendations which addressed deficiencies in safety information have been issued to the Federal Aviation Administration and to the Air Transportation Association. Two of these recommendations have requested that research be conducted to improve the format and substance of information given to passengers with the view toward improving the behavior of passengers in an emergency. For example, a 1972 special study of a DC-9 ditching resulted in a recommendation that the FAA "Collaborate with the Air Transport Association in the development of more effective methods of conveying safety information to passengers; research should be conducted in the application of communication techniques, behavioral sciences and optimum learning situations. (A-72-068 & --069).

In 1983, the Safety Board once again recommended to the FAA that it: "Sponsor a government/industry task force open to foreign participants made up of representatives from the airplane manufacturers, air carrier and commuter operators, researchers, flight attendants, and consumers (X) to identify the type of safety information that is most useful and needed by passengers,

(2-) to identify and develop improved instructional concepts for conveying the safety information, and (3-) to recommend appropriate changes to the operating requirements regarding passenger oral briefings and information briefing cards."

The Safety Board ~~authorized its~~ Bureau of Technology ~~to~~ ~~begin~~ a special study of the problems of passenger safety briefing ~~and~~ the staff is nearing completion of this study. The study addresses several major issues. It reviews previous efforts to improve the briefing methods; it examines current methods of conveying safety information; and it discusses human behavioral research into passenger acceptance of safety information.

The study discusses the evolution of the FARs with regard to passenger briefings, as well as, Advisory Circulars and Air Carrier Operations Bulletins. The Society of Automotive Engineers issued Aerospace Recommended Practice 1384 for passenger safety information cards in August 1976, and a revised ARP in September of 1983. This ARP was used as a basis for the FAA's Advisory Circular 121-24, issued on June 23, 1977.

The study focused on three methods used to convey safety information to passengers. The flight attendant oral briefing and accompanying demonstration; printed safety cards with pictorial and written safety instructions; and video taped safety briefings used in place of oral briefings and demonstrations.

The briefing methods ~~were~~ examined and compared against FAA regulations and guidelines as well as guidelines suggested by International Air Transport Association Safety Advisory Committee and Douglas Aircraft Company.

These comparisons indicated wide variance in the content and method of presenting the information. Some safety briefing cards included information that was ambiguous, unclear, or incorrect. While some cards presented information that went further than the FAA's guidelines, others did not even follow the guidance provided in the FAA's Advisory Circulars and Air Carrier Operations Bulletins. For example; ACOB 1-76-24 gives detailed guidance for brace for impact position. Seventeen cards from four airlines depicted brace positions not in accordance with this ACOB. Eighteen briefing cards did not comply with the FAA Advisory Circular 121-24 which advised that instructions for fastening, tightening, and unfastening of seat belts should be included on briefing cards.

The preliminary results of the study reinforce and strengthen the Safety Board's belief that the FAA should ~~provide leadership to~~ oversee research into passenger behavior, and passengers' acceptance of safety information. More effective methods of conveying safety information to passengers should be a goal of ~~both~~ the FAA and industry.

DISCUSSION OF EVACUATION DEMONSTRATION
CONDUCT ON TRANSPORT CATEGORY AIRPLANES

Presented by:

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Presented at:

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EMERGENCY EVACUATION DEMONSTRATIONS

INTRODUCTION

Ladies and gentlemen, my purpose in being here with you today is to discuss emergency evacuation demonstrations on commercial jet transport airplanes. This includes the evolution of such demonstrations, why they have been required in the past, how they are conducted, and some thoughts on how certification of evacuation capability might be handled in the future.

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The original rule proposal was worded to require a new demonstration upon any increase in passenger seating capacity. As stated in the preamble to the rule that was adopted, this was changed to require a new demonstration only when the new seating configuration exceeds that of the previous certification by five percent or more. At that time, no evacuation demonstration was required of the airplane manufacturer.

In 1966, the FAA issued two proposed rulemakings³ to extend the requirement for conduct of evacuation demonstrations on new type or model airplanes to manufacturers. As a result, the Aerospace Industry Association (AIA) formed a team of specialists representing all the major airframe manufacturers together with an FAA individual assigned as a liaison representative. This team established a Crashworthiness Development Program. Its objective was to find ways to increase passenger survivability following an aircraft accident through improvements in interior materials, fire suppression and smoke and fume protection systems, emergency lighting and exit awareness, and evacuation systems. Discussions here are limited to the latter -- evacuation systems, focusing specifically on evacuation demonstrations.

The evacuation system program study conducted by the AIA Evacuation Technical Group was divided into two major phases: In Phase I they evaluated the systems in use at that time, and in Phase II they proceeded with evacuation system research and development. The duration of the study was approximately one year. In brief, it was found that evacuation systems in use at that time had a good overall performance record, and that airline crews performed

3 NPRM's 66-26 and 66-26A.

commendably in achieving evacuations within reasonable times while providing calm and effective leadership. It was found that escape slides were the principal source of malfunctions or delays because of deployment and inflation functional complexity, and that the functions required to prepare the evacuation systems were too complicated on some aircraft and should, therefore, be simplified and automated on future aircraft. Principal evacuation flow constraints were identified as exit opening time plus slide deployment -- once inflated the slide was identified as the flow restriction. The need for integrated design of interior configurations, cabin doors, and escape device systems was identified -- that is, the interior/door/escape device interface would have to be designed as a system such that the escape device deploys and inflates automatically upon door opening when desired and the cabin interior must be designed to support a rapid flow of passengers to the exits. Several other major design concepts were developed from Boeing's involvement in the AIA working group's effort during this period -- among them the Type A door, double lane escape slides, dual longitudinal aisles, and off-wing escape slides.

With respect to evacuation demonstrations, the AIA working group recommended that the then present regulations be revised to eliminate the requirement for airline evacuation demonstrations beyond the point of evacuation system preparation and escape device deployment and inflation. It was further recommended that future research and development efforts be directed toward consideration of eliminating the requirement for the use of large numbers of people in both the manufacturers' and airlines' demonstrations. These recommendations were based upon the study of FAA records of airline evacuation tests conducted from 1964 through 1966 which showed that mechanical failures

and operational error were the major causes of evacuation system malfunctions, and that the egress capability of the cabin interior has not proved to be the main factor of rapid and safe evacuation. Development of highly reliable escape systems and thorough checking of crew proficiency in their use could achieve a high level of confidence and safety without using plane loads of people in test demonstrations. These recommendations and conclusions were documented in the AIA working group Report No. AIA CDP-4 published in July of 1968.

The FAA proceeded with adoption of new rules⁴ in late 1967. These rules retained the requirement for evacuation demonstrations by air carriers and extended the requirement for their conduct to the aircraft manufacturers. Relative to the manufacturer's demonstration the preamble⁵ states, "The FAA believes that since the evacuation capability of an airplane, as defined in this regulation, depends to a large degree on the design of that airplane, it is fundamental to the type certification process to ensure that the airplane has the necessary evacuation capability for the maximum passenger capacity for which certification is sought." In brief, these new rules required that aircraft manufacturers conduct an emergency evacuation demonstration on all new type or model airplanes produced. The time limit for completion of the demonstration by operator and manufacturer was reduced from 120 seconds to 90 seconds, using the exits on one side of the airplane. This decrease in evacuation time was felt to be justified by equipment advances, primarily the

4 FAR 25 Amendment 25-15 and FAR 121 Amendment 121-30.

5 Preamble to FAR 25 Amendment 25-15.

improved automatically deployed and inflated slides, which had occurred since the 120 second standard was adopted. Darkness of night was to be simulated, and a specific age/sex distribution of passengers was required to simulate the makeup of typical airline passenger loads. The demonstration was intended to simulate an aborted takeoff at night in which the aircraft stopped with all landing gear intact.

These rules⁶ also introduced the Type A exit and established its minimum opening size of 42" wide by 72" high, based upon tests conducted by Boeing, as a member of the AIA working group. The testing involved some 14,000 individual use cycles of various types of escape systems. The exit was rated by the FAA at 100 passengers per exit pair, although the AIA testing showed that rating to be extremely conservative. The working group report⁷ showed that the average dual lane escape slide rates achieved during the test program was 108 persons per minute, which corresponds to a 144 person evacuation capacity during a 90 second evacuation.

The next significant step in the evolution of evacuation demonstration regulations came in 1975 when the FAA issued several proposed rule changes⁸. Final regulations published from these notices⁹ adopted in 1978 for Part 25 are the regulations that exist today. The most significant changes put into effect by this rule change were (1) provision that one evacuation

6 FAR 25 Amendment 25-15.

7 Report Number AIA CDP-4 dated July, 1968.

8 NPRM's 75-10, 75-19, 75-23, 75-26 and 75-31.

9 FAR 25 Amendment 25-46.

demonstration may satisfy both Part 25 and Part 121 requirements, and (2) provision that a combination of analysis and test (subject to approval of the FAA Administrator) may be used to show that an airplane is capable of being evacuated within 90 seconds in lieu of requiring an actual evacuation demonstration. Numerous other changes were incorporated by this Amendment, primarily intended to make FAR Part 25 requirements consistent with FAR Part 121, such as requirement for clutter in the aisles, use of life size dolls to be carried by selected passengers, and (if the demonstration results are to be used by air carriers) use of regularly scheduled line crewmembers in conduct of the demonstration.

The provisions of these new regulations were extended to the air carriers by amending the operating rules in 1978¹⁰ to allow an airline to use the results of a successful emergency evacuation demonstration conducted either by a manufacturer or another airline (Part 121 certificate holder). Subsequent to this change the operating rules were amended again in 1981¹¹ requiring the certificate holder seeking to use the results of another party's demonstration to conduct a partial evacuation demonstration (referred to in the industry as a "mini-evac") by showing that their flight attendants are capable of opening half the exits and deploying their escape devices within a total elapsed time of 15 seconds. This was intended to preserve the training proficiency aspect of the earlier policy when air carriers were required to conduct their own evacuation demonstrations.

10 FAR 121 Amendment 121-149.

11 FAR 121 Amendment 121-176.

Simultaneously, the rule requiring that an evacuation demonstration be conducted if passenger capacity is increased by more than 5% was deleted on the grounds that repeating a demonstration because of increased seating capacity alone is not necessary unless the increase is more than the maximum number approved in the airplane type certificate.

The data used by the FAA to develop the new operating rule¹¹ (1981) was gathered during an FAA study of evacuation demonstrations conducted during the previous ten years. This study showed two significant findings: (1) many injuries are sustained by participants in evacuation demonstrations and, (2) allowing an air carrier to use the results of another party's demonstration under certain circumstances would not adversely affect safety standards. The study took into account data from 251 evacuation demonstrations conducted before 1967 when the allowable elapsed time was 120 seconds, 259 demonstrations under the current rule which requires evacuation completion in 90 seconds or less, and 90 partial demonstrations where flight attendants demonstrated their ability to ready 50% of the exits and slides within 15 seconds.

The impetus of these new rules which will minimize the need for full scale evacuations in the future is to minimize the risk of injury to people involved in these tests. In the preamble to the most recent (1981) operating rule change¹¹ the FAA states, "The risk of injury during repetitive emergency

¹¹ FAR 121 Amendment 121-176.

evacuations is very real and significant. For instance, two jumbo jet evacuations, each involving 345 passengers, resulted in 35 injuries in one demonstration and 46 injuries in the other."

By today's rules the certification of a new airplane type or model may be done either by actual evacuation test or by a combination of analysis and test. The important factor here is that any analysis/test presented must be found acceptable by the FAA in showing that the evacuation capability is equivalent to that which would be obtained by an actual test. This approach puts the burden on the industry to develop the necessary data to demonstrate compliance. If the test data are insufficient the FAA directs that more work be done.

HOW EVACUATION DEMONSTRATIONS ARE CONDUCTED

In order to fully understand the conduct of an evacuation demonstration, it is felt necessary to review the process involved in performing the test.

First, conduct of an evacuation demonstration requires the coordinated effort of every major engineering and manufacturing organization of a manufacturer. At Boeing, it involves the support of 18 organizations.

A production airplane must be taken out of its production sequence and is required on a full time occupancy basis for at least three days, with an additional shared occupancy of up to two weeks for installation of the interior arrangement. The airplane interior is reconfigured to accommodate the maximum passenger seating capacity for which approval is being sought by the manufacturer. This is usually as defined by the seating capacity limitation of the total exit complement or as determined by the FAA. This interior arrangement must include galley, lavatory, wind screen, and other interior installations to demonstrate the arrangement in terms of aisle widths, exit approachways, and other blockage features which could affect passenger evacuation. One-half of all exits are deactivated as directed by the FAA in a manner that is not apparent to flight attendants or passengers.

A test area is chosen that can be darkened to simulate night conditions. Safety equipment is brought in to reduce the possibility of injury. Large canvas covered foam pillows are placed around each exit to be used and carpeting is rolled out on the floor in the areas where the evacuees will land at the end of each slide. In the case of an overwing exit on airplanes for

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which no slide is required, a ramp is built from the wing area to the floor to avoid any injuries caused by sliding to the ground from the wing flaps. Medical stations are set up to administer aid if necessary. A video recording area is constructed and enclosed with light proof material to eliminate extra light from the test area. Infra-red lights are installed for video coverage to supplement the low-level emergency lighting and a significant number of video recorder views, both interior and exterior, are taken to be sure all evacuation exits will be video taped. Dummy cameras are also necessary at the inactive exits in the interior to assure that the crew and passengers do not suspect which doors are inoperative. A timer is included in the view screen of the video systems for evacuation time correlation.

The airplane windows are covered and a tunnel is constructed for passenger boarding to prevent viewing of the exterior test set-up prior to test.

Coordination with the airlines is carried out to obtain flight crews for the actual test. Two complete crews are necessary in case the test must be repeated for any reason. The flight crews must complete a training program witnessed and approved by the FAA for the type or model airplane being used for the demonstration. The training program is coordinated with the airlines to make sure "operator" inputs are addressed.

A major effort goes into obtaining passengers of the required age and sex distribution. In order to cover the possibility that the test may have to be repeated, two full-passenger complements plus extras must be recruited. For example, in the case of a 747 with a seating capacity of 550, approximately 1200 participants are required.

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The regulations were written to require the use of some test subjects under the age of 12 and some over the age of 60 years. This has presented problems to all manufacturers, particularly in obtaining the services of children in the under 12 age group, who are not of work force age. In January of 1971, McDonnell Douglas petitioned for relief from the under 12 age group requirement and submitted data collected during a study of a DC-10 evacuation demonstration conducted in 1968 which showed that the extreme age groups do not differ in evacuation behavior when compared to certain other age groups in the intermediate range. The chart that is now being shown presents the comparison of age grouping where evacuation performance was similar. Further justification for eliminating the under 12 age group was stated to be the greater likelihood of injury being sustained by this age group compared to adults. The petition proposed increasing the proportion of test subjects in the 50-59 year age group by five percent over the number normally used and requiring no children under 12 years of age to participate. The Douglas petition was granted and has been used as the basis for using no children in subsequent evacuation demonstrations. In 1974, exclusion of younger participants was extended to the under 18 year old age group by increasing the number of 50-59 year olds to 15% of the total passenger load.

In 1979, Boeing petitioned the FAA to eliminate participants in the over 60 age category by increasing the population of test people in the 50-60 year age group. This was done out of a concern for injury to the older age group participants. Results from the Douglas 1971 data were used in this petition

which the FAA granted prior to the conduct of the 767 evacuation demonstration. The next chart illustrates the age/sex distribution of the rules compared to the policy used for the 757, 767, and 737-300 demonstrations.

To return to the discussion of how evacuation demonstrations are conducted, once the test setup activities are complete, and the airplane is in all respects ready for test conduct, a final walk-through inspection with FAA representatives is conducted to verify that all test preparations have been satisfactorily completed. The flight crew is escorted aboard and take their assigned positions. The passenger participants are then escorted aboard and allowed to select seats in a generally random manner. Neither the passengers nor the crew are aware of which doors will be used for evacuation. Each passenger will have been issued a vest with a number on it. Once all passengers are boarded and seated each passenger location is recorded. At this point in time all support personnel except the FAA on-board observers are directed to vacate the airplane and the FAA distributes carry-on baggage, pillows, and blankets in the aisleways to simulate post crash debris. FAA observers are strategically located in the cabin to observe actions of the test participants, to assure that proper procedures are used, and to verify equipment operation. The flight attendants are then instructed by the pilot to arm the escape systems. Once arming is verified, the pilot directs a flight attendant to read verbatim a pre-flight briefing message similar to those required for present day commercial flights. The flight attendants simultaneously demonstrate the use of oxygen masks and seat belts. Emergency instruction cards like those found in seat back pockets of operational flights are provided for passengers. The passengers will have been given no other information except that they will be participating in a full scale evacuation.

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The exterior test area is then darkened and the infra-red lights are turned on.

When all above steps have been completed, the countdown starts, and cameras are turned on and upon reaching zero the external electrical power cord is disconnected from the airplane. This point in time constitutes "time zero". When the power cord is disconnected, the interior cabin lighting automatically switches from normal to emergency intensity which is the evacuation signal to the crew. Upon receiving this signal the airplane crew directs the evacuation in accordance with their training. Flight crew members go through the Emergency Shutdown Check List or simulate doing so by delaying five seconds before vacating the cockpit to aid in the evacuation exercise.

The evacuation completion time is when the last passenger or flight crew member has reached the ground. A post test conference is then conducted in which each participating crew member describes what they did and observed during the test, and preliminary elapsed times are reported.

I would now like to show a short video tape of typical interior and exterior scenes recorded during conduct of actual evacuation demonstrations. This video illustrates again the events that control the time of evacuation (exit preparation and the flow restriction involved in getting onto the slide). The FAA regulations relative to exit distribution are based on controlling aircraft configurations so that the 90 second standard is maintained. As a door is prepared for use, passengers anxious to get out move from their seats into the aisles and await slide readiness (queue up). Once evacuation starts

the rate of egress is controlled by the time it takes to transition to the slide. This is why on todays aircraft the distance between exits does not have an effect on the time of evacuation. During this process, passengers are able to move to the exits at a rate which is greater than the exits can flow.

EVACUATION DEMONSTRATION RELEVANCE TO ACTUAL EVACUATIONS

One question that is frequently asked is "Do evacuation demonstrations reflect the real world?" Do they really simulate actual in-service aircraft evacuation incidents? In our opinion, the evacuation demonstration is an accurate simulation of one type of in-service evacuation; namely one without smoke or fire involvement and with all landing gear intact. Data from Boeing files show that there have been a total of 583 known in-service incidents throughout the world in which jet transport airplanes have been evacuated. Of this number, 454 (78%) had all landing gear members intact. In 321 incidents (55%) there was some form of smoke or fire, either inside or outside the cabin, and in 40 incidents (6.9%) was there smoke, fire, and fatalities.

While smoke and other factors such as landing gear collapse or evacuating blind or handicapped passengers may increase the time required to evacuate an airplane, we believe that the potential for injury to participants does not warrant the technical benefit of including these factors in the test. This is not to say these factors should be ignored. We believe that the more responsible means of developing designs and procedures to account for these conditions is best done on specific, suitable test equipment such as door/slide test mockups or evacuation mockup facilities like that at the FAA's Civil Aeromedical Institute (CAMI) in Oklahoma City.

From the numerous full scale evacuation demonstrations that have been conducted to date by manufacturers (ten involving standard body airplanes with Type I/Type III exits and twelve involving larger dual aisle aircraft with Type A exits), a large data base has been established which allows

conservative forecasting of the performance of various design features such as aisles, exit approachways, exit types, and descent devices. The evacuation demonstration requires the performance of equipment and people to meet the 90-second standard. If either variable fails to perform well, the time can be exceeded. It is important to note that no design change has ever been necessary to meet the evacuation demonstration standards since the requirement for such demonstrations was first introduced.

BOEING'S POSITION ON CONDUCT OF EVACUATION DEMONSTRATIONS

I would like to conclude by stating the Boeing position regarding the need for evacuation demonstrations in the certification process for future airplanes or for future configuration changes to present airplanes. Evacuation demonstrations should be required only when unique changes such as new exit types or new concepts of interior arrangement or descent devices for which sufficient test data does not exist (compared to present-day aircraft) are introduced. Even with the introduction of unique design changes, consideration should be given to using relatively small scale demonstrations (such as evacuation of one section or zone or comparative performance tests (e.g., Latin Square) in lieu of a full scale demonstration). This proposal was made by Boeing when the Model 747 was first introduced, and it remains, in our minds, a viable approach to demonstrating evacuation capability today to be used in conjunction with analysis of the total airplane evacuation capability.

It is our desire to eliminate or, at least, to radically reduce the number of injuries sustained as a result of these demonstrations. Steps have been taken in that direction by allowing airline operators to use the demonstrations of other parties and by revising the rules to allow certification by analysis and test. We believe it is time to go the rest of the way by largely eliminating the requirement for evacuation demonstrations.

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Except for minor adjustments we feel that the current Federal Aviation Regulations which pertain to emergency evacuation provide the necessary safeguards in the interest of the flying public. One minor change is suggested: FAR 25.803(c)(8) should be revised to reflect the test subject age/sex distribution which is actually used; that is, allowing an adjustment in the number and sex of the over 50 age group in lieu of using individuals under 18 or over 60 years of age.

COMPARITIVE EVACUATION PERFORMANCE

BY AGE GROUP

<u>AGE GROUP</u>	<u>EQUIVALENT TO</u>
9-17 YEARS	50-59 YEARS
60-67 YEARS	50-59 YEARS
9-17 AND 60-67 YEARS COMBINED	50-59 YEARS

AGE/SEX DISTRIBUTION REQUIRED BY RULES Vs THAT USED DURING 757, 767, AND 737-300 DEMONSTRATIONS

REGULATORY AGE GROUP

ACTUALLY USED

5-10% UNDER 12 YEARS
OF AGE

NONE UNDER THE AGE
OF 18 YEARS

AT LEAST 5% OVER THE AGE
OF 60 YEARS

NONE OVER THE AGE
OF 60 YEARS

30% FEMALE OVERALL

MINIMUM OF 25% OVER
50 YEARS OF AGE WITH
40% OF THIS GROUP
FEMALE

REMAINING 75% 50 YEARS
OF YOUNGER WITH 25%
OF THIS GROUP FEMALE

**EMERGENCY EVACUATION SYSTEM CERTIFICATION
VIA
ANALYSIS AND TESTS**

Presented by:

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Airframe Systems Technology
Boeing Commercial Airplane Company**

Presented at:

**'FAA Technical Conference on
Emergency Evacuation of Transport Category Airplanes
September 3-6, 1985
Seattle, WA**

INTRODUCTION

Good morning (afternoon) Ladies and Gentlemen. My name is George Veryioglou. I am an engineer with Boeing Commercial Airplane Company. I will address my remarks today to the role of analysis in evacuation system certification. At the heart of this subject is an extremely important word in the airplane manufacturing industry. That word is safety --- an issue of major concern throughout the public transportation industry.

Safety, of course, is relative - not absolute. It is a quality or a condition that needs to be quantified for evaluation or judgment. In other words we need a yardstick so-to-speak. In the specific area of airplane emergency evacuation, safety provisions for timely escape of passengers and crewmembers must be designed, manufactured, tested and then certified as adequate to the task by the airframe manufacturer and properly maintained while in service by the airlines. The emergency evacuation "system" must satisfy performance standards that have been established by the Federal Aviation Administration (FAA) to ensure an acceptable, uniform level of safety to air travelers. Thus, safety is defined quantitatively by Federal Aviation Regulations (FARs) in the form of mandatory performance standards, our yardstick. The certification process must establish compliance with the regulations. The analysis approach to certification is justified by the fact that past full-scale evacuation demonstrations, conducted according to FAA regulations, have provided a database of system performance from which to prove compliance without risk of injury to those who participate as passengers.

This paper discusses motivational and regulatory aspects of using an analytical approach - coupled with, and dependent on a database of valid test data - to verify regulatory compliance.

A history of analyses in various forms, as applied for certification of airplane configurations dating back to 1967 is presented. The development of analysis as a more formal "methodology", initiated as early as 1972, will be traced to its present, and most recently applied form. Details of the analysis method will be presented. Evaluation of analysis as a viable and

conservative method of showing compliance with the regulations will be presented by citing formal analyses that were subsequently confirmed by full-scale, live demonstrations.

I will conclude my presentation with our position with respect to the adequacy of the existing FAA regulations on the subject of evacuation analysis.

MOTIVATION FOR "ANALYSIS AND TEST" APPROACH

There are several factors that should motivate the aggressive pursuit of applying a "combination of analysis and test" to the task of airplane emergency evacuation certification.

Passenger emergency exit "type" regulations as set forth in FAR 25.807(a) address the minimum size and physical installation requirements for each defined "standard" exit type found in today's transports. Egress performance data via most of these standard types have been generated for nearly three decades as a result of development, qualification and certification test programs conducted by airframe manufacturers and approved by the FAA. Egress performance data through standard exit openings designed to meet the regulations are known quantities. The Evacuation Systems Group of the Aerospace Industries Association (AIA) Crashworthiness Development Program (CDP) analyzed some of the early test data as well as available accident data, publishing their findings in mid-1968. One conclusion that was drawn from that study, in response to the FAA Notice of Proposed Rule Making (NPRM) 66-26 over seventeen years ago, was that "the egress capability of people plus the internal flow capability of the cabin interior have not proved to be the main requisites of rapid and safe evacuation." Egress performance per exit type is known. Performance data for improved exit mechanisms and external assist devices can be generated as the state-of-the-art advances, without the need to subject people to risk of injury in large scale evacuation tests.

FAR 25.807(c) states requirements for the numbers and types of exits that the manufacturer must design into the airframe in terms of the passenger seating configuration offered. As a result of the study conducted for responding to NPRM 66-26, the AIA concluded that the passenger capacity ratings established before 1967 were "unnecessarily conservative". Increased capacity ratings were proposed by the AIA study in excess of those ultimately granted by passage of FAR Amendment 25-15. These passenger capacity ratings, established by Amendment 25-15, remain in effect today with the exception of that for the Type 'A' exit. The Type 'A' rated capacity was subsequently increased from 100 to 110 passengers. At the time of adoption this rated capacity was established as still providing a significant time margin according to the 90-second FAR 25.803 requirement.

The history of full-scale evacuation demonstrations since October 1967 has provided a significant resource of performance data primarily under the conditions of FAR 25.803. A limited amount of data is also available as a result of operator demonstrations conducted under Part 121. These exercises should be deemed as credible data sources, as each has been witnessed by members of regulatory agencies. Of twenty-three complete full-scale evacuation sequences, four of them have been repeated trials which have been successful in attaining the test objectives without redesign of the emergency evacuation system. Application of the rated capacities in the FAA regulations in a "design guide" sense has resulted in configurations that can be readily demonstrated to comply with the evacuation performance requirements of FAR 25.803.

One extremely important motivation to apply analysis in lieu of full-scale evacuation demonstrations is the elimination of needless injury to those persons who participate in the tests as passengers. The process of rapidly moving large numbers of people of a variety of ages and physical capabilities has inherent dangers even under controlled test conditions. Supplementary information provided by the FAA as background to Amendment 121-176 indicates that "although there is no injury reporting requirement" associated with full-scale evacuation demonstrations, FAA records reveal that there were at least 169 injuries to participants in eight of the evacuation demonstrations conducted from 1972 through 1980. A breakdown of that total, published in

October 1981, reveals that one demonstration involving 345 passengers resulted in injury to 46 of them. This total equates to over 13% of the passenger count. The injuries sustained by those persons participating in the evacuation test were reported to range from simple abrasions to friction burns, lacerations, and fractures.

The issue of injury to test participants is a real issue. Though precautions are taken, the potential for injury will always accompany full-scale emergency evacuation demonstrations conducted in compliance with FAR 25.803. The role of analysis, with safeguards, as evidenced in the discretionary control of the FAA, can only help to reduce actual injury to the persons participating as passengers. Escape system components beyond the current state-of-the-art will always need to be tested to establish successful performance. Limited scale testing combined with analyses can provide proof of system performance with reduced injury potential.

REGULATORY AUTHORITY FOR ANALYTICAL APPROACH TO AIRPLANE EVACUATION SYSTEM CERTIFICATION

The regulatory authority that establishes the requirement to verify evacuation capability for certification of transport category aircraft is covered in Federal Aviation Regulations (FAR), Parts 25 and 121.

Regulatory changes in the form of Amendments to these Parts have updated the requirements since first imposed and have identified a role for analytical procedures in the certification process. I would like to highlight two major milestones in the evolution of the regulatory authority governing emergency evacuation system certification.

Amendments 25-46 and 121-149 revised evacuation demonstration requirements to permit FAR 25 demonstrations to satisfy the FAR 121.291 requirement. Further, FAR 25.803 was revised to allow evacuation certification to be substantiated by a combination of analysis and tests where the FAA determines that this method will provide data equivalent to that achieved by a full-scale evacuation demonstration.

Amendment 121-176 to FAR 121 requires, if an aircraft is certified to FAR 25.803 per Amendment 25-46, that the operator must demonstrate crew proficiency by showing that crewmembers can open half the exits and achieve usable egress assist devices within 15 seconds elapsed time.

The FAR 25 rule change set the stage for application of an analysis procedure in lieu of a full-scale demonstration when deemed appropriate by the FAA. The FAR 121 rule change is significant because it provides for conduct of crew proficiency "mini-demos" by operators. The real thrust of both rulings is to reduce the exposure of large numbers of people to the rigors of full-scale evacuation demonstrations.

The scope of applying a combination of analysis and tests as a means to show that an airplane is capable of being evacuated under the conditions contained in FAR 25.803(c) is governed by the enabling language of FAR 25.803(d). We agree with this regulation as stated. Control is provided by the review and judgment exercised by the FAA. The role of analysis is perceived by the manufacturers to be a broad role, bounded by the availability of test data. When conclusive data are available on the performance of the evacuation system components, the analysis approach is appropriate. When no performance data are available for components of the escape system, an analysis, of course, has no foundation. Testing is necessary. Tests must be conducted to conclusively determine performance characteristics of new, innovative system components. It is our opinion that meaningful and conclusive testing need not necessarily employ massive numbers of persons to be test "passengers".

ANALYSIS HISTORY (PRE-1978)

I would like now to focus my remarks on the development of analysis techniques. There are three precedents for a significant analysis role that I will now briefly describe in chronological order.

In May 1970, Boeing prepared an analysis to show that the actual evacuation demonstrations successfully conducted under FAR 25.803 on the 727-200 were equally applicable to the Model 720-025. The exit configurations in the side of the fuselage are identical in number and type, each airframe having two pairs of Type I exits and dual pairs of Type III exits. The longitudinal positions of the overwing exits, however, provide for differing distribution of passengers in the respective forward and aft cabin zones with respect to the overwing exits. The thrust of this analysis was based on similarity and a convincing analysis was presented. It should be noted that the objective of the analysis was to establish compliance for certification of the Model 720-025 with 170 passengers on the basis of two Model 727 demonstrations at payload levels of 180 and 189 passengers.

The second analysis prepared in November 1975 by Boeing was submitted for verification of 747SP evacuation capability. The premise of the analysis was that a full-scale evacuation demonstration was not necessary for assurance that evacuation could be successfully completed in accordance with FAR 25.803. Sufficient data and information were available from tests and previous demonstrations to assure that the requirements could be attained and far exceeded without conducting a full-scale 747SP passenger evacuation demonstration. The analysis approach provided a detailed comparison of emergency evacuation system elements with those already demonstrated as acceptable on the 747-100/-200 airplane. Physical features of the two airplanes were compared to show that the 747SP configuration was in fact comparable with regard to safe and efficient passenger evacuation. The analysis - a rigorous, systematic treatment - substantiated that the 747SP evacuation system is indeed in compliance with the regulations. It should be noted that a passenger limit of 400 was the objective of this analysis.

A third application of analysis was prepared by Lockheed in March of 1977. The objective of this analysis was to establish the ability to successfully evacuate 315 passengers from a L-1011-385-3 model airplane pursuant to FAR 25 requirements. The L-1011-385-3 airframe (currently known as the L-1011-500) includes 3 pairs of Type 'A' exits in a reduced length wide-body of the same cross-section as the L-1011-385-1. The analysis is based on the successful evacuation of two versions of the L-1011-385-1. One of the demonstrated "-1"

versions was equipped with three pairs of Type 'A' exits and a single pair of Type I exits, while the other was equipped with four pairs of Type 'A' exits. The analysis - also a rigorous and systematic treatment - detailed the pertinent similarities and differences between the "-3" and "-1" airplanes. The exit system performance data from actual demonstrations were presented and applied in concert with a passenger management strategy consistent with and based on the prior actual demonstrations.

It is evident that major historical precedents for an "analysis and test" approach do exist. Analysis is not a new approach. Each of these three analyses accomplished the intended objectives. Full-scale evacuation demonstrations were not required because of these analyses. The key to the analysis approach prior to the 1978 rule as embodied in Amendment 25-46 is apparent. It stands out as being a detailed, structured presentation with the pertinent and necessary performance data properly applied to the new configuration.

ANALYSIS METHODOLOGY DEVELOPMENT (SINCE 1972)

I would now like to direct your attention to the development of evacuation system certification by analysis and test as a methodology. In order to more fully develop this subject I will briefly comment regarding earlier work that was initiated within the FAA.

Computer-Based Evacuation Simulations:

Many of you may have noted that some computer programming activity has been devoted to simulate the airplane evacuation process or parts of that process. In a Research Project on Emergency Evacuations published by the Office of Aviation Safety in October of 1981 and an SAE Technical Paper prepared for the 1982 Aerospace Congress and Exposition in Anaheim, summary statistics are presented from 20 "runs" of an evacuation model, computed by the FAA Civil Aeromedical Institute (CAMI) in Oklahoma City.

FAA-CAM1 and the Engineering and Manufacturing Branch in Oklahoma City have developed two preliminary models of the evacuation process on an exploratory basis. These research and development activities recognized the long term potential of benefits to be gained by a reduction in the number of evacuation demonstrations necessary to achieve airplane certification by both manufacturers and airline operators. These FAA modeling efforts are indicative of that sustained desire within government.

Modeling of the evacuation process has also taken place within industry, and more specifically within the Engineering Department at Boeing, motivated by the FAA modeling activities and the new language of the regulations.

I want to clearly point out, however, that computer modeling of the evacuation process is still limited to research. No models have been proposed nor validated as certification tools. Let me stress that the analysis methodology that we are talking about today is not computer-based. The analysis technique we have applied to our new airplane products is a manual analysis and does not involve a computer model.

Manual Analysis:

Now we will discuss the development and key features of this manual analysis method. Commencing in 1982 there was increased interest within Boeing to pursue an analytical approach to the certification task. Boeing at that time was on the threshold of negotiating emergency evacuation requirements for certification with the FAA regarding the new model 757-200 and several derivative model products including the 767-200 at 290 passengers, a derivative of the 747-100/-200 with extended upper deck known as the 747-300 and the 737-300, a lengthened 737-200 airframe.

Boeing developed a unified analytical approach acceptable to the needs of each program. Historical records pertaining to evacuation demonstrations conducted under the conditions of FAR Part 25 were reviewed. Some of these demonstrations were also in accordance with Part 121 requirements. Review of film, video tape and test reports led to the formulation of an analytical

approach that was applied in draft form to anticipated configurations of the new products. The approach consists of a timeline summation of activities from exit preparation to last evacuee on ground. The initial approach was presented to the FAA - Seattle Aircraft Certification Office in the Fall of 1982.

FAA review of the initial analytical approach method resulted in some refinements that were incorporated in a follow-on review cycle. The next step in the process of review would follow during formal submittal of an analysis. Before recapping the chronology of the major analyses submitted to the FAA, let us turn to a brief description of the method.

Key features of the manual analysis approach that we have developed are as follows:

- o It depends on a database developed totally from FAA - witnessed tests and tests verifiable from video or film records.
- o All segments of the evacuation timeline, from the signal to evacuate, until all occupants are on ground, are based on these tests.
- o The analysis is straightforward.
- o The presentation of results is easy to follow.
- o The approach is conservative.

The manual analysis method is consistent with the scenario of FAR 25.803(c) in that not more than 50 percent of the emergency exits in the sides of the fuselage may be used, and those that are used must be representative of all exits on the airplane.

Assuming a candidate exit choice, subject to change during FAA review, the manual analysis method is a straightforward determination of the evacuation time via each exit tagged for use. The chart [Chart 1] which is now displayed before you indicates the expression that must be evaluated for each active exit. As you can see on the chart, a timeline is developed from the time of the signal to commence evacuation until flow ceases at the ground (T_T). This timeline accounts for exit preparation to a state of being ready for passengers (T_{EP}), hesitation of the initial evacuee (T_H), the initial transit

to ground of the first evacuee (T_{IT}), and finally, the entire flow period (T_{EF}) of the exit system from the time that the first evacuee attains an on-ground position until all subsequent evacuees are on ground. The time of exit flow, T_{EF} , of course depends on two very important factors, namely the rate of flow of the exit and the anticipated number of passengers and crewmembers that will evacuate through the exit. The other terms in the expression are given value by averaging pertinent and qualified data from the database of previous tests. A case for qualification of data must be established and presented in the text of the analysis.

Now let us focus on the buildup of the "exit flow" term, T_{EF} . Before discussing passenger "management" by crewmembers and the distribution of evacuees to exits, I would like to draw your attention to the chart [Chart 2] now before you. The subject here is "flow rate". In preparation for the analysis we submitted, we conducted a literature review in the area of exit egress performance. This review indicated that a standard method of describing egress flow rate had not been evolved. Several derivation techniques have been applied to the problem of characterizing flow of people. Boeing settled on a flow definition that is accurate, verifiable and can be universally applied, given that visual media records of tests are available or that key event times are recorded. As implied by the chart, a clear reference point is chosen within the field of view. The point of contact on the ground is a good reference if film or video tape coverage angle allows. The initial condition to the flow computation is the arrival of the first evacuee at the reference point. At this point in time, assuming N total evacuees will escape via the exit, there remain $N-1$ evacuees yet to arrive at the reference. Thus, the flow rate expression indicates $N-1$ evacuees will arrive at the reference during the time interval from the first arrival to the last. The database used in our analysis submittals was developed by reviewing all the applicable film or video data and recomputing the evacuation flow rates as defined. The data is therefore consistent.

The subject of passenger management and, therefore, the distribution of evacuees to exits is addressed in the analysis by considering three factors. One factor, obviously, is found in the distribution of passengers within the

total configuration relative to exit placement. A second factor is the relative performance capability (both preparation and egress) of the exits. The third factor is found in what has been accomplished in actual past full-scale evacuation demonstrations in terms of passenger management by airline crewmembers. The management plan of the analysis is supported by a logical development that cites precedents for plan elements. Such an element of a plan would perhaps be the time of travel to a key duty position by a crewmember. Graphic presentation of the plan in terms of numbers of passengers and crew allocated to exits is an important part of presenting an organized analysis for FAA review. It can act as backdrop for presenting the ultimate result, that of total evacuation time via each used exit.

I have just described the essence of the manual analysis method. There are many related topics that we do not have time to discuss today. I do not wish to minimize the significance of these topics by moving on at this point. I would like to emphasize that a conscientious job of describing the airplane configuration and escape system components and qualifying the use of database values is mandatory.

I would now like to quickly recap what we have done by way of applying analysis as a methodology. Formal analyses have been prepared and submitted to the FAA seeking to establish compliance with FAR 25.803 for five major configurations. I will briefly relate these events to you in chronological sequence.

- 1) The 747-300 configuration was submitted to seek certification for a maximum of 660 passengers, including 110 on the upper deck, in this extended upper-deck configuration that grew out of the 747-100/-200 technology as a derivative model. The 110 passenger upper deck, serviced by a pair of Type 'A' doors, was justified by a Latin Square test series per Order FS 8110.12 that established the upper deck doors as bonifide Type 'A' exits. The analysis was considered to satisfactorily demonstrate compliance with FAR 25.803(d) per Amendment 25-46 by the FAA.

- 2) An analysis was submitted concerning the 767-200 dual overwing hatch airplane configured for a maximum payload of 290 passengers. The analysis was found acceptable by the FAA.
- 3) Analyses were prepared and submitted for four 747 configurations that modified the 747-100/-200/-300 main deck to an 8 door system through deactivation of the Door #3 pair. This modification reduced maximum airplane occupancy by 110 passengers and included the 747-100/-200 and 747-300 models in all-passenger and 6 or 7 pallet combi configurations. These analyses were considered satisfactory by the FAA.
- 4) An analysis was submitted to seek approval of the 737-300 configured to carry 149 passengers in an extended 737 airframe. The complement of exits was the same as the 737-200 configuration. The analysis was initially considered by the FAA to satisfactorily demonstrate compliance with FAR 25.803(d). The decision was subsequently reversed by the Washington D.C. office because of the increased passenger capacity of the 737-300 and a full-scale evacuation certification demonstration was conducted. This demonstration resulted in only one "passenger" injury but two flight attendants were injured during crew training procedures in advance of the test.
- 5) The final submittal of an analysis was seeking approval of the 757-200 configured with dual overwing exit pairs replacing the Door #3 Type I pair of the previously certified version. The analysis document was considered to satisfactorily demonstrate compliance with FAR 25.803(d) as stated in FAA letter, but that acceptance was later reversed by the Washington D.C. office because of the change in exit configuration. A subsequent full-scale evacuation demonstration was conducted for certification. Eight "passenger" test participants and one flight attendant received injuries during the exercise.

CASE STUDIES:
MANUAL ANALYSIS VS SUBSEQUENT FULL-SCALE DEMONSTRATIONS

The last two analysis submittals we have just covered allow evaluation of the analysis method in light of subsequent full-scale evacuation demonstrations. The chart [Chart 3], now displayed, provides a comparison of the evacuation time results of the 757-200 demonstration conducted on October 20, 1984 with the results of the analysis submitted for approval nearly one year earlier. The chart provides the comparison of times for last-on-ground via each used exit system. Note the legend that indicates "analysis" bars to the left of the subsequent [green] demonstration result.

The net result of the evacuation time comparison is simply that the analysis indicated a total time of 82.9 seconds but the demonstration produced a 76.6 second result. This represents a 7.6% margin of conservatism in the analysis. The reason for the improved result is the extremely well balanced exit loading distribution that was achieved by effective passenger management exerted by the crew. The next chart [Chart 4] compares the evacuee distribution among the exit systems. Note the balanced loading of the 2R through 4R exits that resulted in a balance of "dry-up" times.

This chart [Chart 5] provides the same corresponding evacuation time treatment for the 737-300 analysis and subsequent full-scale demonstration on November 10, 1984. The 737-300 with one mid-cabin Type III exit pair presents a slightly different passenger management challenge to the airplane crewmembers. Note how the crew was able to direct the flow to yield a balanced time result at all exits. The evacuation time, T_T of 87.3 seconds derived by analysis was shown to include a 22.6% conservative margin when compared to the actual demonstration. The next chart [Chart 6] depicts the distribution of evacuees to the exits.

Both cases uphold the conservatism of the analysis approach with respect to demonstrated results. The indication is that analysis is a sound approach to showing compliance with FAR 25.803 without exposing many people to a test environment that necessarily involves some risk of injury to the participants.

CONCLUDING COMMENTS

My discussion today has included some of the motivation and regulatory background for use of analysis and test under FAR 25.803(d). We reviewed some history and presented a brief look at the method per se. Recent applications and two very strong cases demonstrating conservatism in the method have been illustrated.

In conclusion, there are four points to be made:

- 1) The current language of FAR 25.803(d) that allows a combination of analysis and tests to be used, provides flexibility as well as control and need not be revised.
- 2) Risk of injury to demonstration participants can be reduced by applying the analysis approach when approved by the FAA.
- 3) It is incumbent on industry to utilize "a combination of analysis and test" as allowed by FAR 25.803(d) to prevent needless injury to demonstration participants when available test data indicates conclusively that safety (as defined by the FARs) is not compromised by a new type configuration or derivative model.
- 4) Elimination of testing is not advocated - but conclusive testing on a reduced scale, combined with rigorous analysis attains the same objectives as live full-scale evacuation demonstrations.

Thank you very much for your attention.

EVACUATION TIMELINE SUMMATION

CHART 1

$T_T = T_{EP} + T_H + T_{IT} + T_{EF}$ WHERE.

T_T = TOTAL EVACUATION TIME

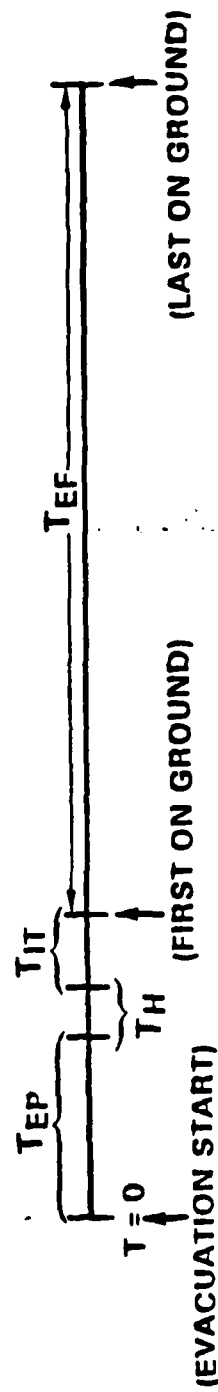
T_{EP} = TIME FOR EXIT PREPARATION (INCLUDING ATTENDANT REACTION TIME, DOOR OPENING, AND SLIDE DEPLOYED/INFLATED AND READY FOR USE)

T_H = FIRST EVACUEE HESITATION TIME, MEASURED FROM THE TIME THAT THE EXIT IS READY FOR USE UNTIL THE FIRST EVACUEE CONTACTS THE SLIDE SURFACE

T_{IT} = TIME FOR FIRST EVACUEE TO TRAVERSE SLIDE TO GROUND. THE TIME IS MEASURED FROM CONTACT WITH THE SLIDE (WITH IMPENDING MOTION) UNTIL TRANSITION OFF THE SLIDE

T_{EF} = TIME OF EXIT FLOW (TIME FROM FIRST EVACUEE ON GROUND TO LAST EVACUEE ON GROUND)

• T_{EP} , T_H , T_{IT} , AND T_{EF} CAN BE MEASURED DIRECTLY FROM FILM RECORDS OF PAST TESTS WITHOUT DIFFICULTY



RATE OF EVACUATION FLOW

CHART 2

$$\text{FLOW RATE (IN PPM)} = \frac{(N-1) \times 60}{(T_{\text{LAST}} - T_{\text{FIRST}})}$$

WHERE: N = NUMBER OF EVACUEES

T_{FIRST} = TIME IN SECONDS AT WHICH FIRST
EVACUEE PASSED THE REFERENCE POINT

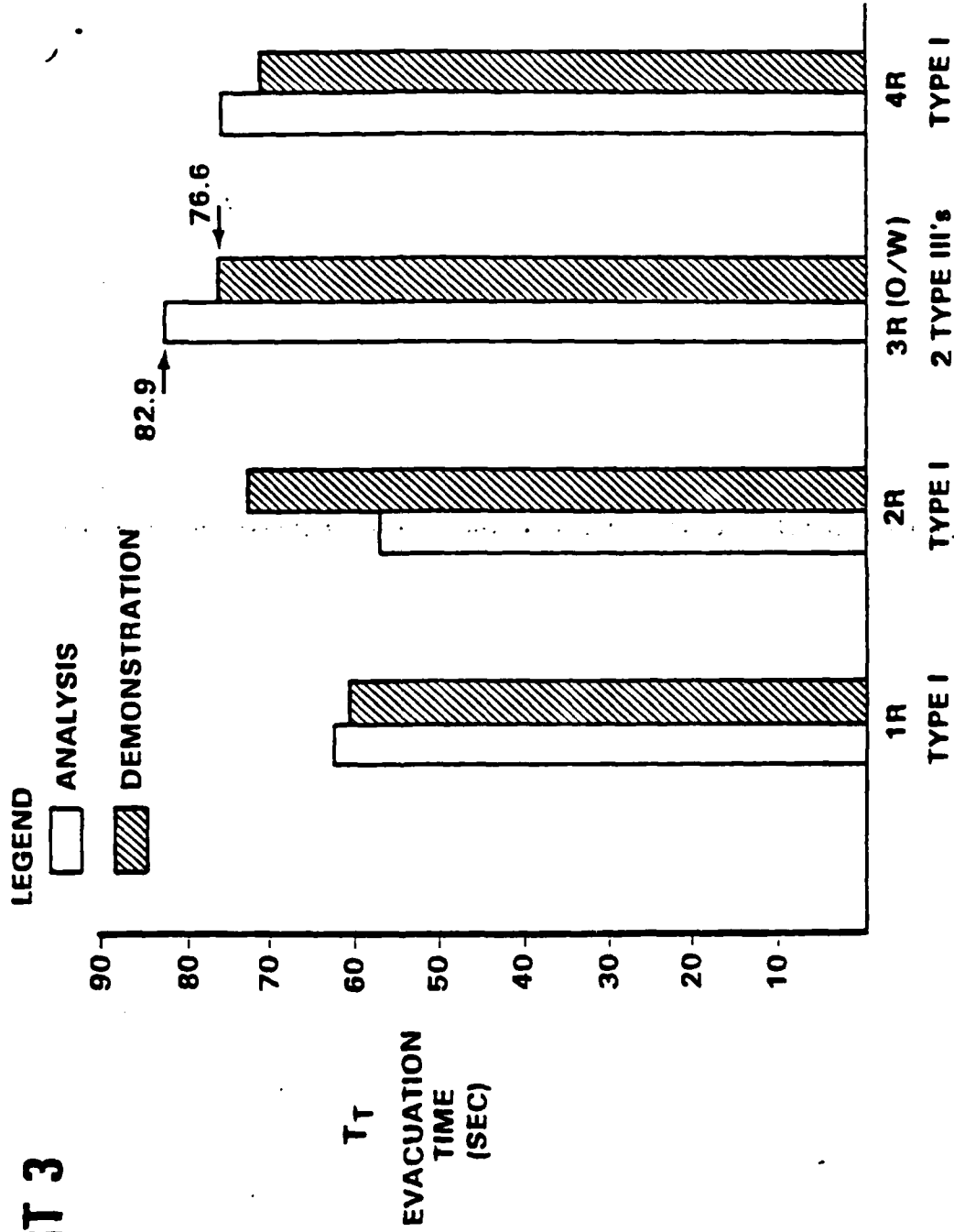
T_{LAST} = TIME IN SECONDS AT WHICH LAST EVACUEE
PASSED THE REFERENCE POINT

PPM = PERSONS PER MINUTE

757 EVACUATION TIME COMPARISON

ANALYSIS VS FULL SCALE DEMONSTRATION

CHART 3

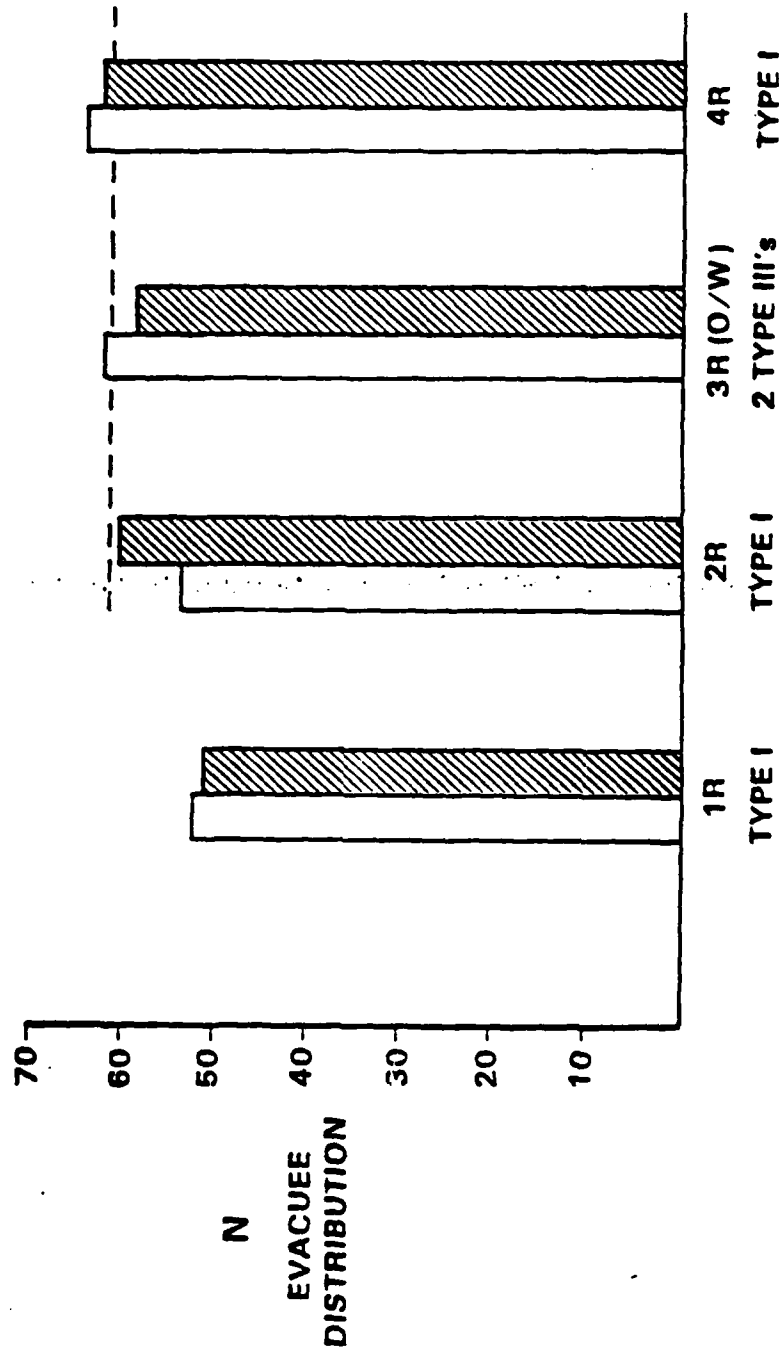


8-27-85
TE 31787

757 EVACUEE DISTRIBUTION COMPARISON

ANALYSIS Vs FULL SCALE DEMONSTRATION

CHART 4

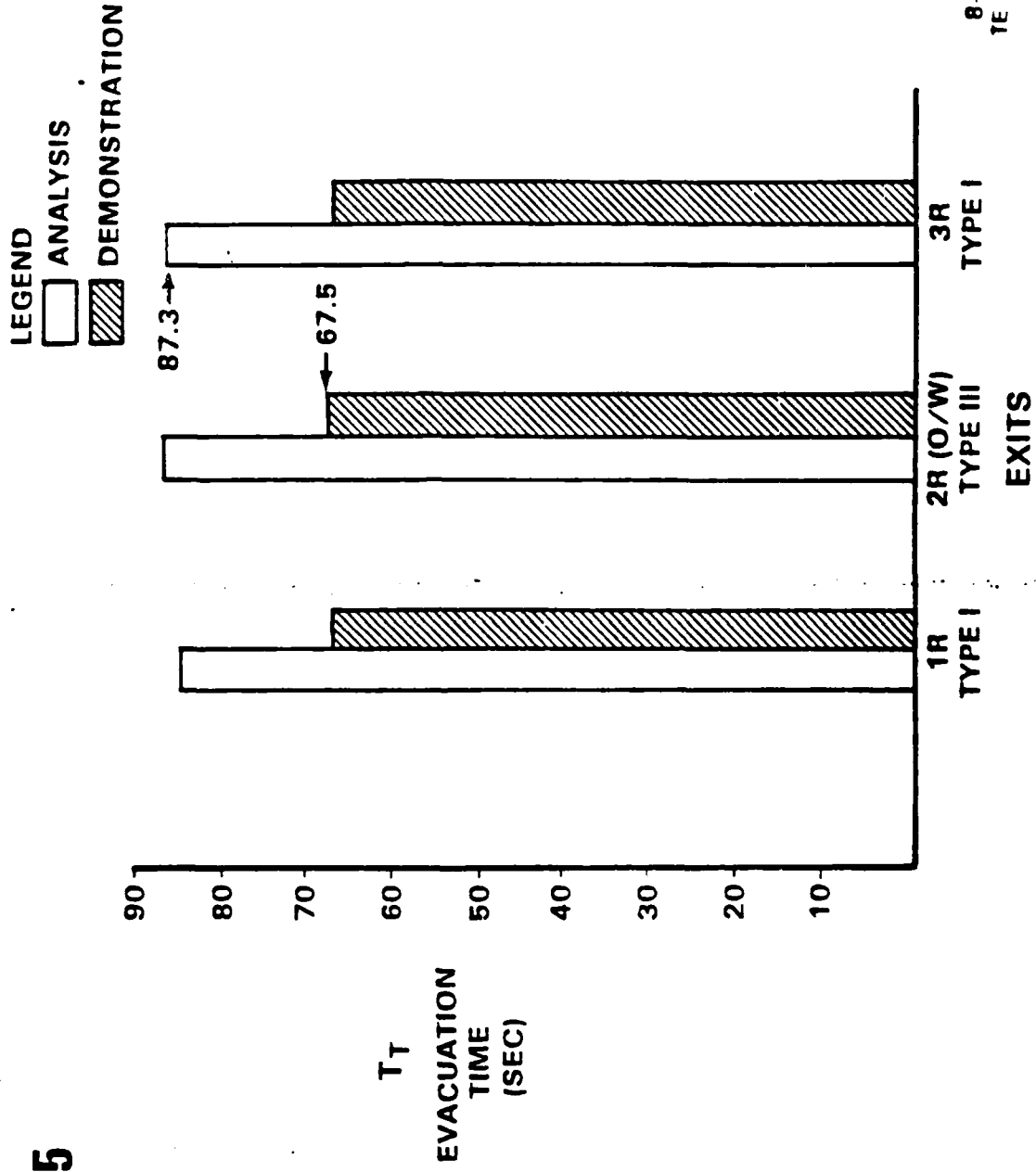


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737-300 EVACUATION TIME COMPARISON

ANALYSIS VS FULL SCALE DEMONSTRATION

CHART 5

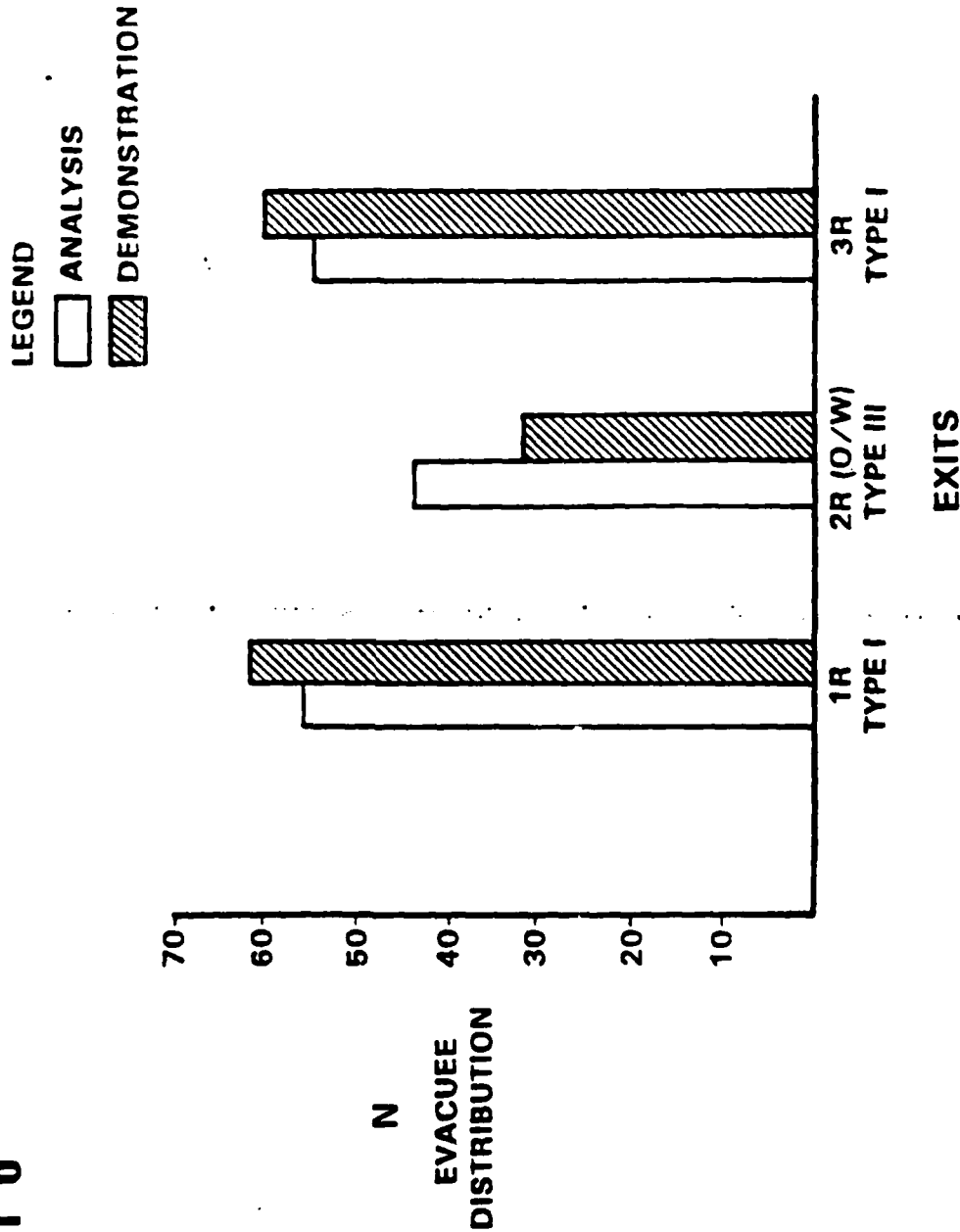


8-27-85
TE 31789

737-300 EVACUEE DISTRIBUTION COMPARISON

ANALYSIS Vs FULL SCALE DEMONSTRATION

CHART 6



8-27-85
TE 31790

THIS PRESENTATION IS MADE ON BEHALF OF THE CANADIAN AIR
TRANSPORTATION ADMINISTRATION.

THANKS TO MR. DONALD ENGEN'S THOUGHTFULNESS IN INVITING
TRANSPORT CANADA TO ATTEND THE AUGUST 6, 1985 CONFERENCE,
PRE-KNOWLEDGE OF THIS CONFERENCE WAS GAINED. EVEN WITH
THAT PRE-KNOWLEDGE, TIME AND RESOURCES DID NOT PERMIT THE
IN-DEPTH STUDY OF THE SUBJECT MATTER IT RIGHTLY DESERVES.

FAR PART 25 IS, BY REGULATION, THE BASIS OF CANADIAN
AIRWORTHINESS/CERTIFICATION STANDARDS FOR TRANSPORT CATEGORY
AIRPLANES. OUR INTENT IN MAKING THIS PRESENTATION IS TO
MAKE USEFUL COMMENT THAT MAY LEAD TO CLARIFICATION OF SOME
OF ITS PROVISIONS. NO COMMENT WILL BE MADE ABOUT FAR OPERATING
RULES.

I. EMERGENCY EXITS

A PAIR OF TYPE A EXITS HAS A PASSENGER SEATING LIMIT
OF 110. IN THE PREAMBLE TO AMENDMENT 25 DASH 15,
IT IS STATED THAT THE SIGNIFICANT FACTOR IN ACHIEVING
THE EGRESS RATE IS AN ADEQUATE FLOW OF PASSENGERS
TO THE EXIT, A STATEMENT WHICH CAN BE ACCEPTED AS
VALID TODAY FOR THE 110 SEATING LIMIT AS IT WAS AT
AMENDMENT 25 DASH 15 FOR THE 100 LIMIT. IN THE CASE
OF A SINGLE MAIN AISLE AIRCRAFT, THIS FACTOR IS REFLECTED
AT FAR 25-807(a)(7) BY REQUIRING A PASSENGER FLOW
FROM BOTH THE FORE AND AFT DIRECTIONS TO A TYPE A
EXIT, A REQUIREMENT WHICH WOULD ENSURE BEST USE OF
BOTH EVACUATION SLIDE CHANNELS. IN THE CASE OF 2
(OR MORE) MAIN AISLES, A PAIR OF TYPE A EXITS MAY
BE LOCATED AT ONE OR BOTH ENDS OF THE PASSENGER CABIN,
THUS HAVING A PASSENGER FLOW ALONG A MAIN AISLE TO
AN EXIT FROM ONE DIRECTION ONLY. AN ADEQUATE FLOW

OF PASSENGERS, IN THE EVENT OF FAILURE OF ONE OF THE EXITS, SHOULD RESULT FROM APPLICATION OF THE CROSS AISLE REQUIREMENT AT FAR 25.807(a)(7)(v). IN OUR VIEW, THE INTENT OF THE CROSS AISLE REQUIREMENT IS TO ENABLE PASSENGERS EMERGING FROM THE CROSS AISLE TO MAKE USE OF THE SERVICEABLE TYPE A EXIT AND ITS EVACUATION SLIDE WITH MINIMUM INTERFERENCE WITH THE LINE OF EVACUEES APPROACHING THAT EXIT FROM THE MAIN AISLE. IF SUCH INTENT IS AGREED, IT IS RECOMMENDED THAT THE PERTINENT REQUIREMENT BE CLARIFIED. ONE WAY TO ACHIEVE THIS OBJECTIVE WOULD BE TO HAVE THE EXTENDED CENTER LINE OF THE CROSS AISLE MEET EACH EXIT AT ITS CENTER POINT OR BETWEEN ITS CENTER POINT AND THE EDGE THAT IS AWAY FROM THE MAIN AISLE LEADING TO IT.

THE REGULATIONS FOR OVER-WING TYPE III EXITS AND INTERPRETATIONS OF THOSE REGULATIONS, PLUS THE TREND TOWARDS INCREASING PASSENGER SEATING DENSITY IN AIRCRAFT, HAS LED TO SEAT CUSHIONS PROTRUDING INTO THE PROJECTED OPENING OF THE EXITS, A ROW OF SEATS, BUT NOT SEAT-BACKS, PLACED IN THE DIRECT ACCESS TO THE EXITS, AND A SEAT AISLE NO WIDER THAN AT ANY OTHER SEAT ROW. WHILE THE RATE OF EVACUATION FLOW THROUGH A TYPE III OVER-WING EXIT IS LOW COMPARED TO THE RATE AT TYPE 1s AND TYPE A EXITS, TYPE III OVER-WING EXITS HAVE BEEN THE MAIN OR ONLY EXITS USED FOLLOWING AN ACCIDENT. IT IS RECOMMENDED THAT, IN ADDITION TO THE PRESENT REQUIREMENT REGARDING SEAT-BACKS, AT LEAST HALF OF THE EXIT WIDTH, THAT IS AT LEAST 10 INCHES, SHOULD BE FREE OF SEATS FROM THE EXIT TO THE MAIN AISLE; OR THAT THE OUTBOARD SEAT SHOULD BE REMOVED, AND THE ACCESS SEAT AISLE SHOULD BE AT LEAST 10 INCHES. FURTHER, IT IS SUGGESTED THAT THE RATIONALE THAT RESULTED IN SEAT CUSHIONS EXTENDING INTO THE PROJECTED OPENING OF THE EXIT, BE RE-EXAMINED.

IN REGARDS TO EXIT LOCATION, IT IS SUGGESTED THAT THE SENTENCE AT FAR 25.807(c) WHICH READS "THEY MUST BE DISTRIBUTED AS UNIFORMLY AS PRACTICABLE TAKING INTO ACCOUNT PASSENGER DISTRIBUTION" IS CAPABLE OF DIFFERENT INTERPPETATIONS. FURTHER, "PASSENGER DISTRIBUTION" IS NOT DEFINED, AND IS NOT THE ONLY CONSIDERATION, IN OUR VIEW. THE ROLE OF AN AIRCRAFT'S CREW IN ACHIEVING A SUCCESSFUL EVACUATION HAS LONG BEEN ACKNOWLEDGED. FOR EXAMPLE, IN HUMAN FACTORS OF EMERGENCY EVACUATION, AM 65-7, PUBLISHED IN 1964 BY THE FAA OFFICE OF AVIATION MEDICINE, WE FIND THE FOLLOWING:

"CREW KNOWLEDGE AND EFFECTIVE LEADERSHIP ARE THE MOST SIGNIFICANT FACTORS IDENTIFIED IN PRODUCING SUCCESSFUL ESCAPES." AND

"THE LARGER THE NUMBER OF PASSENGERS, THE MORE IMPORTANT IS THE ROLE OF THE CREW."

IN OUR VIEW, EVENTS OF THE PAST 20 YEARS GIVE STRONG SUPPORT TO THE FUNDAMENTAL "TRUTHS" OF THESE STATEMENTS.

AS FLIGHT ATTENDANT STATIONS ARE CO-LOCATED WITH EMERGENCY EXITS, IN PARTICULAR FLOOR LEVEL EXITS, THE DISTRIBUTION OF SUCH EXITS HAS A DIRECT BEARING ON THE DISTRIBUTION OF CABIN CREW MEMBERS, THAT IS TO SAY, ON THE DISTRIBUTION OF "LEADERSHIP" TO PASSENGERS IN THE EVENT OF AN ACCIDENT. IT IS BELIEVED THAT A SUGGESTION OR RECOMMENDATION WAS MADE SOME YEARS AGO BY A U.S. AGENCY THAT, AS A MATTER OF PRINCIPLE, NO PASSENGER SEAT SHOULD BE FARTHER LOCATED FROM AN EXIT THAN A GIVEN NUMBER OF FEET, THAT NUMBER, AS RECALLED, BEING ABOUT 30. IT IS SUGGESTED THAT CONSIDERATION BE GIVEN FOR ESTABLISHING

A REASONABLE PRACTICABLE MAXIMUM DISTANCE THAT A PASSENGER SEAT MAY BE LOCATED FROM AN EXIT, AS A MEANS OF DEFINING "PASSENGER DISTRIBUTION." FURTHER, TO ENSURE THE AVAILABILITY OF TRAINED PERSONNEL TO PROVIDE LEADERSHIP IN THE EVENT OF AN ACCIDENT OF AN AIRCRAFT HAVING TYPE III EXITS MID-CABIN, IT IS RECOMMENDED THAT AT LEAST ONE FLIGHT ATTENDANT STATION BE REQUIRED IN THE CABIN AREA SERVED BY SUCH EXITS.

DE-ACTIVATION OF EXITS

ON THE MATTER OF DE-ACTIVATION OF EXITS, THREE DIFFERENT SITUATIONS ARE APPARENT: 1) WHERE THE EXITS TO BE DE-ACTIVATED ARE IN EXCESS OF REQUIREMENTS AND WERE NOT USED DURING THE EVACUATION DEMONSTRATION "PROVING" THE MAXIMUM CERTIFICATED PASSENGER SEATING CAPACITY; 2) WHERE THE EXITS TO BE DE-ACTIVATED ARE IN EXCESS OF REQUIREMENTS FOR THE MAXIMUM CERTIFICATED PASSENGER SEATING CAPACITY AND WERE USED IN THE EVACUATION DEMONSTRATION "PROVING" THE MAXIMUM CERTIFICATED PASSENGER SEATING CAPACITY; AND 3) WHERE THE EXITS TO BE DE-ACTIVATED WERE REQUIRED FOR, AND USED IN THE EVACUATION DEMONSTRATION TO "PROVE" THE MAXIMUM CERTIFICATED PASSENGER SEATING CAPACITY.

SITUATION 1 IS ADEQUATELY DISCUSSED IN THE PREAMBLE TO AMENDMENT 25-20. SITUATION 2 IS MOST UNLIKELY; HOWEVER, IT IS OBVIOUS THAT THE CERTIFICATED MAXIMUM SEATING CAPACITY WOULD NEED TO BE "RE-PROVED" BY AN EVACUATION DEMONSTRATION OR BY OTHER ACCEPTABLE MEANS. SITUATION 3 DESCRIBES A CABIN CONFIGURATION CHANGE WITH THE NEED TO ESTABLISH AND "PROVE" A NEW MAXIMUM PASSENGER SEATING CAPACITY. WHERE THE CONFIGURATION CHANGE IS SIMPLE, SUCH AS CONVERTING TO A PASSENGER/FREIGHT

CONFIGURATION, ESTABLISHMENT AND "PROOF" OF THE MAXIMUM SEATING CAPACITY MAY ALSO BE RELATIVELY SIMPLE, A CASE OF DATA ANALYSIS, AS THE CABIN AREA, WHILE REDUCED IN SIZE, HAS HAD NO CHANGE IN THE EXITS, ETC. IN THAT AREA. IN A CASE WHERE EXIT DISTRIBUTION AND/OR FLIGHT ATTENDANT STATIONS WITHIN THE CABIN AREA WOULD BE ALTERED, A "NEW" EMERGENCY SYSTEM, AS COMPARED TO THE ORIGINAL, IS BEING PROPOSED. IN THIS REGARD, IT IS NOTED THAT IN THE PREAMBLE TO AMENDMENT 25 DASH 39 IT IS STATED THAT THE EVACUATION DEMONSTRATION REQUIREMENTS ARE NECESSARY TO PROPERLY EVALUATE AN ENTIRE EMERGENCY SYSTEM. WHILE THIS STATEMENT WAS MADE IN RESPECT OF INCREASES IN PASSENGER SEATING CAPACITY, IT IS SUGGESTED THAT THE SAME APPROACH SHOULD BE SHOWN IN THE REGULATIONS WHERE A DECREASE IN SEATING CAPACITY, BASED ON EXIT DEACTIVATION IN THE CABIN AREA TO BE OCCUPIED BY PASSENGERS, IS INVOLVED. THE NEED FOR THIS CONSERVATIVE APPROACH IS STRESSED WHERE DE-ACTIVATION OF EXITS IS ACCOMPANIED BY DELETION OF ASSOCIATED CREW STATIONS.

ACCESS TO EXCESS EXITS

WITH RESPECT TO ACCESS TO EMERGENCY EXITS, TRANSPORT CANADA CONSIDERS EXCESS EXITS (25.807(c)(6)) SHOULD AFFORD THE SAME EGRESS CAPABILITY AS THAT OF REQUIRED EXITS, AND SHOULD THUS COMPLY WITH THE SAME ACCESS REQUIREMENTS; THE BASIS BEING THAT PASSENGER 'CHOICE' OF EXIT IS DICTATED BY 'AVAILABILITY' AND CANNOT BE PREDICATED ON 'REQUIRED' DESIGNATION. TRANSPORT CANADA HAS ACCORDINGLY ISSUED A VARIATION TO FAR 25.807(c)(6) IN THE FORM OF AN ADDITIONAL AIRWORTHINESS REQUIREMENT (AAR) REQUIRING EXCESS EXITS COMPLY WITH 25.813. TRANSPORT CANADA RECOMMENDS THAT FAR 25.807(c)(6)

(ACCESS TO EXCESS EMERGENCY EXITS) BE AMENDED TO REQUIRE EXCESS EXITS MEET SAME ACCESS REQUIREMENTS AS THOSE FOR REQUIRED EXITS.

II. EVACUATION DEMONSTRATIONS

A. AN EVACUATION DEMONSTRATION, ACCORDING TO THE PREAMBLE TO AMENDMENT 25 DASH 15, "IS FUNDAMENTAL TO THE TYPE CERTIFICATION PROCESS TO ENSURE THAT THE AIRPLANE HAS THE NECESSARY EVACUATION CAPABILITY FOR THE MAXIMUM PASSENGER CAPACITY FOR WHICH CERTIFICATION IS SOUGHT." THE PREAMBLE GOES ON TO INDICATE THAT FOR AN EVACUATION DEMONSTRATION "A CRASH CONDITION WILL BE ASSUMED TO OCCUR DURING TAKE-OFF." THE PREAMBLE OF AMENDMENT 25 DASH 39 YIELDS A PHRASE, "DEMONSTRATIONS ARE MADE AS REALISTIC AS POSSIBLE... ." TRANSPORT CANADA ENDORSES THE INTENT INDICATED BY THE FAA IN THE FOREGOING REFERENCES, AND CONSIDERS THAT TO MEET THAT INTENT, AN EVACUATION DEMONSTRATION SHOULD BE PERFORMED IN RESPECT OF EACH NEW AIRPLANE TYPE, OR WHEN A CONFIGURATION CHANGE MAKES A SUBSTANTIAL DIFFERENCE TO THE EVACUATION SYSTEM OF A PREVIOUSLY CERTIFICATED AIRPLANE TYPE. WE FEEL THAT THE PRESENT REGULATIONS REGARDING THE DEMONSTRATION ARE SATISFACTORY BUT ALSO FEEL THAT THE INTENT OF THE DEMONSTRATION MAY BE MISCONSTRUED IN SOME QUARTERS, LEADING TO USE OF THE ANALYSES EXCEPTION CLAUSE WHERE THE ANALYSES MAY BE BASED ON FACTORS NOT OF THE "REAL WORLD". IT IS SUGGESTED, THEREFORE, THAT THE INTENT MIGHT BE INCLUDED IN THE REGULATION TO BETTER ASSURE THE DESIRED INTERPRETATION OF THE REQUIREMENTS.

B. ANALYSIS

SOME CYNIC ONCE SAID "THERE ARE LIES, DAMNED LIES, AND STATISTICS." WHILE WE ARE NOT, PERHAPS, THAT CYNICAL, WE DO REALIZE THAT IN ANY ANALYTICAL PROCESS, GREAT CARE MUST BE TAKEN TO ENSURE ONE IS COMPARING LIKE THINGS TO ONE ANOTHER, AND THAT DATA ARE SUFFICIENT TO YIELD A RELIABLE RESULT AT A GIVEN LEVEL OF PROBABILITY, PERCENTILE, OR WHATEVER. WHILE A FLOW RATE FOR GIVEN TYPES OF EXITS MAY BE REASONABLY ESTABLISHED BY DATA ANALYSIS, IT DOES NOT NECESSARILY FOLLOW THAT SUCH RATES IF APPLIED IN RESPECT OF ALL THE EXITS IN A NEW AIRCRAFT TYPE OR A NEW INTERIOR CONFIGURATION OF AN AIRCRAFT TYPE, WILL REASONABLY "PROVE" THE ACCEPTABILITY OF THAT AIRCRAFT'S ENTIRE EMERGENCY SYSTEM. CONSIDERING WHAT HAS BEEN SAID PREVIOUSLY IN THIS PRESENTATION, IT IS LIKELY OBVIOUS THAT IN OUR VIEW, THE CONSERVATIVE APPROACH WOULD BE TO ACCEPT ANALYSIS ONLY WHERE THE DATA DERIVES FROM EVACUATION DEMONSTRATIONS OF AN AIRCRAFT TYPE, OR TYPES, HAVING IN COMPARISON TO THE AIRCRAFT UNDER CONSIDERATION, THE SAME OR VERY SIMILAR:

- MAXIMUM PASSENGER CAPACITY
- PASSENGER SEATING DISTRIBUTION (DENSITY)
- EXIT TYPES, EXIT LOCATION, AND EXIT NUMBERS
- CREW STATION NUMBERS AND LOCATIONS.
- AISLES, CROSS AISLES (EXIT ACCESSIBILITY).

C. SELECTION OF EXITS

THE SELECTION OF EXITS MIGHT BE ON A "WORST CASE" BASIS. GIVEN THE RELATIVE UNIQUENESS OF EACH AIRCRAFT ACCIDENT, HOWEVER, SUCH A BASIS WOULD BE DIFFICULT,

OR PERHAPS IMPOSSIBLE TO ESTABLISH. THE EXITS THROUGH WHICH IT IS PERCEIVED TO BE THE MOST DIFFICULT TO ESTABLISH A GOOD PASSENGER FLOW RATE MIGHT BE SELECTED, BUT SUCH A CHOICE WOULD BE DIFFICULT TO SUBSTANTIATE. IT IS OUR VIEW, THEREFORE, THAT THE RANDOM SELECTION OF EXITS PRESENTLY PRACTISED; I.E. ONE OF EACH OPPOSITE PAIR OF EXITS; IS AS VALID AN APPROACH AS ANY OTHER.

D. SMOKE - FLOOR PROXIMITY LIGHTING

IN THE PREAMBLE TO AMENDMENT 25 DASH 1, IT IS NOTED THAT AT THAT TIME, IT WAS FELT THAT USE OF SMOKE IN EVACUATION DEMONSTRATIONS WOULD TEND TO EXCITE THE "PASSENGERS" USED, AND CREATE A HAZARDOUS CONDITION. TRANSPORT CANADA CONSIDERS THIS A VALID FEELING. WITH THE ADVENT OF FLOOR PROXIMITY LIGHTING REQUIREMENTS, TRANSPORT CANADA ALSO CONSIDERS THAT IT IS TIMELY TO EXAMINE THESE SUBJECTS.

THE APPLICATION OF PRESENT EVACUATION DEMONSTRATION CRITERIA HAS YIELDED RESULTS WHICH ARE MORE OR LESS COMPARABLE, ONE DEMONSTRATION TO ANOTHER. THE CRITERIA, AND THE STIPULATED TIME LIMIT HAVE GENERALLY BEEN ACCEPTED AS SUFFICIENT TO REASONABLY "PROVE" AN AIRPLANE'S EVACUABILITY. IGNORING THE TECHNICAL DIFFICULTIES INVOLVED, THE USE OF SMOKE, OR THE USE OF A FLOOR PROXIMITY LIGHTING SYSTEM WITH OR WITHOUT SMOKE, WOULD CONSTITUTE A MAJOR CHANGE TO THE CRITERIA, PERHAPS MAKING THE 90 SECOND TIME LIMIT INVALID.

TRANSPORT CANADA IS PRESENTLY INCLINED TO THE VIEW THAT SMOKE AND A FLOOR PROXIMITY LIGHTING SYSTEM SHOULD NOT BE USED IN AN EVACUATION DEMONSTRATION.

E. HANDICAPPED, OBESE, BLIND

WHILE SOME DATA ARE AVAILABLE WHICH INDICATE THE PERCENTAGE OF MALES AND FEMALES; THAT IS FULL-FARE PASSENGERS OVER 12 YEARS OF AGE; CHILDREN AND INFANTS ABOARD FLIGHTS, THERE IS NO KNOWN VALID DATA REGARDING THE BLIND, OBESE, PREGNANT WOMEN, LIMBS IN CAST, NON-AMBULATORY, AND OTHER CATEGORIES OF HANDICAPPED PASSENGERS. SOME CATEGORIES OF PASSENGERS IN OTHERWISE NORMAL PHYSICAL CONDITION, SUCH AS AN "OBESE" PERSON, MIGHT BE CONSIDERED FOR INCLUSION IN AN EVACUATION DEMONSTRATION, IF DATA INDICATED A HIGH PROBABILITY OF ONE OR MORE BEING ON A HIGH PERCENTAGE OF FLIGHTS. FOR MOST CATEGORIES OF HANDICAPPED PERSONS, THE RISK OF INJURY OR FURTHER INJURY IS A MATTER OF CONCERN. IN THE PREAMBLE TO AMENDMENT 25 DASH 1, IT IS NOTED THAT THE TESTS ARE TO BE AS REALISTIC AS POSSIBLE "BUT WITHOUT ENDANGERING THE PARTICIPANTS." IN OUR VIEW, THIS THOUGHT SHOULD BE THE GUIDELINE IN DECIDING UPON THE USE IN EVACUATION DEMONSTRATIONS OF TYPES OF HANDICAPPED PASSENGERS EVEN AFTER BEING IDENTIFIED BY SURVEY AS BEING ON MOST FLIGHTS.

TO SUMMARIZE, TRANSPORT CANADA:

- RECOMMENDS:

1. CROSS-AISLE REQUIREMENTS BE CLARIFIED.
2. ACCESS TO TYPE III OVER-WING EXITS BE IMPROVED.
3. AT LEAST 1 FLIGHT ATTENDANT STATION BE REQUIRED IN THE CABIN AREA SERVED BY TYPE III EXITS.
4. EXCESS EXITS HAVE SAME ACCESS REQUIREMENTS AS REQUIRED EXITS.
5. A MORE SPECIFIC REGULATION AS TO WHEN AN EVACUATION DEMONSTRATION MAY BE WAIVED IN FAVOUR OF ANALYSIS.

- SUGGESTS:

1. RATIONALE REGARDING SEAT CUSHION PROTRUSION INTO PROJECTED OPENING OF A TYPE III EXIT BE RE-EXAMINED.
2. ESTABLISHING A REASONABLE, PRACTICAL MAXIMUM DISTANCE THAT A PASSENGER SEAT MAY BE LOCATED FROM AN EXIT.
3. CHANGE IN REGULATIONS TO COVER DEACTIVATION OF EXITS.
4. CLARIFY INTENT OF APPLICATION OF EVACUATION DEMONSTRATION REQUIREMENTS.
5. CONTINUANCE OF PRESENT PRACTICE OF SELECTING EXITS TO BE USED IN AN EVACUATION DEMONSTRATION.
6. SMOKE AND/OR FLOOR PROXIMITY LIGHTING SYSTEMS NOT BE USED IN EVACUATION DEMONSTRATIONS.
7. HANDICAPPED PASSENGERS WHO MIGHT BE "ENDANGERED" DURING AN EVACUATION DEMONSTRATION, SHOULD NOT BE INCLUDED IN THE "PASSENGERS" FOR SUCH DEMONSTRATIONS.

THE PROBLEM OF THE B-747 OVERWING EXIT REMOVAL
AND HOW TO AVOID SIMILAR PROBLEMS IN THE FUTURE; AND HOW
TO IMPROVE FULL-SCALE EMERGENCY EVACUATION DEMONSTRATIONS

Presented Before the
FEDERAL AVIATION ADMINISTRATION PUBLIC TECHNICAL CONFERENCE ON
EMERGENCY EVACUATION OF TRANSPORT AIRPLANES

Seattle, Washington
September, 1985

Steven Vincent
Chairperson of the Aircraft Technical Committee
Association of Flight Attendants

Thank you for this opportunity to appear before you today. My name is Steven Vincent. I am the chairperson of the Association of Flight Attendant's Aircraft Technical Committee. I am here today representing the Association of Flight Attendants which is the largest flight attendant union in the world.

As you know, the Association of Flight Attendants has over the last year made every effort that it could to oppose the removal of the overwing exits from the Boeing 747 aircraft. Although we began this effort by ourselves, we have ended it in what we consider to be distinguished company -- the company of flight and cabin crewmember associations around the world, the company of a House oversight committee, the company of passenger groups, the company of the National Transportation Safety Board, and, above all, the company of the Federal Aviation Administration. All of these groups have said that from a safety standpoint, the removal of overwing exits is a mistake and should be avoided.

The FAA has stated that while removing the exits meets existing regulations, such removal would violate the standard of care set forth for carriers in the Federal Aviation Act. Moreover, the Administrator has written to U.S. carriers asking them to keep these exits and has stated that this letter in essence stops them from removing the exits. Given the unanimous views of so many major U.S. organizations involved with safety, it is not my purpose here today to argue that the removal of the 747 exits is a serious mistake from a safety standpoint. If there are any representatives of foreign carriers here today who are still considering such a move, we urge you to review the record before the Subcommittee on Investigation and Oversight of the House Public Works Committee. There was some very compelling testimony given there about the role that the overwing exits have played in past 747 evacuations. This testimony indicates that if you remove these exits, some of your passengers may be trapped and killed in a post-crash fire.

While the FAA has said that removing the exits may meet the regulations, we know that safety means more to you than meeting minimum regulations. That is what has made aviation a great industry, and what has made your airline a great airline. Don't throw that away.

I would like today to address two issues: (1) how to avoid problems of this type in the future and (2) how to better conduct full-scale demonstrations.

HOW TO AVOID B-747 PROBLEMS IN THE FUTURE

1. Conduct full-scale demonstrations when there are changes to exit configurations.

We believe that the 747 exit removal problem might have been avoided if a full-scale emergency evacuation demonstration had been performed. In our view, it

is unlikely that the aircraft could have been successfully evacuated with eight doors using a proper demonstration.

We have always been at a loss to explain why a full-scale demonstration was not performed. At issue is the meaning of the preamble to 25.803(d) which reads as follows:

Several commentators objected to the proposed amendment to §25.803(d) which would allow analysis in showing that the airplane is capable of being evacuated within 90 seconds. One commentator stated that analysis alone is an incomplete means of showing compliance and should not be allowed. Another commentator stated that extrapolations based on analytical testing have no practical relation to actual conditions which occur in accidents and in evacuation demonstrations. The FAA agrees that the limitations on the use of analytical procedures should be made clear. The requirement that the Administrator find the analysis data acceptable was intended to preclude approvals which might be based on insufficient test data, such as in the case of a completely new airplane model or a model which has major changes or a considerably larger passenger capacity than a previously approved model. Accordingly, 25.803(d) is revised to clarify the intent.

There are two possible interpretations of this preamble. The first is that the FAA, at the time it amended 25.803(d), realized that there were limits on the use of tests and analysis and spelled those out, for example, in the case of a major change. The other interpretation of this section is that there are no specified limits on the use of tests and analysis, and that the FAA can allow the use of tests and analysis whenever it feels that they are adequate. Thus, for example, tests and analysis could be used to double the maximum number of seats as long as the Northwest Mountain Region felt that the tests and analysis were sufficient.

The idea that the Northwest Region has unlimited discretion to determine when to use tests and analysis does not, in our opinion, correspond with the language of the preamble. The preamble states that, "The FAA agrees that the limitations on the use of analytical procedures should be made clear." To argue that there are no limits set out by this section seems to be beyond the language of the preamble.

Unfortunately, the Northwest Region has taken the position that it has unlimited discretion to determine when to allow the use of tests and analysis as a substitute for full-scale evacuations. According to their reading of the preamble, the examples of when full-scale are required are not really examples at all -- they are just "possible examples." This somewhat elusive characterization appears in a Northwest Region comment on a proposed policy for emergency evacuations which I have attached to my written submission. (Attachment 1)

This memo and others I have cited were obtained from the FAA under the Freedom of Information Act.

A more realistic interpretation of 25.803(d) is that the preamble sets out actual examples, and not possible examples, of when full-scale demonstrations are required. Such an interpretation appears in an Office of Airworthiness memo dated October 15, 1979. That memo states that "the pending type certification of new transport airplanes has prompted this letter, which regards analytical simulation of emergency evacuation and its relationship to current regulations." The memo discusses a prototype computer model under development by Flight Standards and states that the model is not intended to fulfill the provisions of 25.803(d). According to the memo:

The Preamble to Amendment 25-46 states clearly that there are limitations on analysis, and that the rule is intended to 'preclude approvals which might be based on insufficient test data, such as in the case of a completely new airplane model. . .' We have not seen an analysis method which has been validated and substantiated as being adequate to serve in lieu of the full-scale demonstration for certification of a completely new model. . . This is an important precedent setting area. If a manufacturer makes a proposal in this regard, please forward it to this office for evaluation and comment. (Attachment 2)

Although this point could be debated further, let us assume for a moment that full-scale evacuation demonstrations are required when you have a completely new model of aircraft, or a major change, or a significant increase in the number of seats. In other words, let us assume that the preamble in fact limits the discretion of the Northwest Region. The next question becomes whether or not the removal of the exits is a major change. We think that this is a rather obvious point. In fact, it is difficult to think of a change that would be more major in terms of aircraft evacuation.

Some history of the meaning of a major change can be found in the analogous FAR 121.291. Until §121.291 was changed on December 17, 1981, operators were on paper required to perform full-scale emergency evacuations when there was a major change to the aircraft. In a letter to Congress from FAA head Langhorne Bond in 1980, a major change under 121.291 was described as follows:

Guidelines as to what criteria constitute a "major change" is contained in paragraph 1188(e) of FAA Order 8430.6B... Examples of "major changes" that may affect the emergency evacuation of passengers are encroachments on access to exits, reduction in aisle width or seat spacing, and changes to the cargo configuration in a combination cargo/passenger version.

If an encroachment to an exit is a "major change", the removal of an exit must also be a "major change."

There are other reasons to believe that the removal of the overwing exits from the B-747 was a "major change". Rather than belabor the point, let me just mention one. The Administrator has indicated that removing the exits would violate the carriers duty to provide the highest possible degree of safety and that he would stop U.S. carriers from removing the exits. That sounds like a "major change" to us.

Let us make a completely different assumption at this point than the one we were operating under. Let us go along with the Northwest Region's interpretation of 25.803(d) and suppose that a full-scale is never required, regardless of how major the change is, as long as the Northwest Region believes that "tests and analysis" are available which can demonstrate the safety of a change. If we make this assumption, the question before us is whether there are tests and analysis which can adequately demonstrate that an exit removal is safe.

To answer this question, I would like to quote from a letter to Boeing dated October 2, 1984 from the Northwest Mountain Region. This letter had to do with a proposal by Boeing to delete two hatches on the B757-200 and substitute four window exits instead. The FAA made the following remarks with which we totally agree: "the case of an exit configuration change is not an appropriate subject for analysis, and a full-scale evacuation demonstration is necessary prior to FAA approval of the 224 passenger configuration." If, as the FAA states here, the case of an exit configuration change is not an appropriate subject for analysis, the removal of the overwing exits on the B-747 was approved illegally even if we agree with the Northwest Region's view that 25.803(d) allows analysis whenever it is appropriate. (Attachment 3)

Let's look specifically at the B-747 exit removal, instead of the 757. The precise question then is whether "tests and analysis" were performed that adequately demonstrate that the 747 can be evacuated without centrally located exits; without any means of escape for 72 feet; without exits that have been crucial in previous evacuations; and with two less exits on an aircraft with chronic slide problems.

To make a long story short, we think the answer is no. While it could be debated further whether such tests and analysis might theoretically be possible sometime in the future, and what kind of computer model you would have to have to take into consideration all the relevant factors, the Northwest Region apparently simply based its decision on flow rates from some very questionable past studies and 747 evacuations, and on the questionable assumption that distance to an exit does not affect evacuation time. It is my impression that ALPA will be

going into this is some detail, but I would like to give one example of our concerns about past 747 full-scale evacuation demonstrations.

When we made a Freedom of Information Act request for the results of the original 747 demonstration with 550 passengers in 1969, we were provided with documents which showed that the flight attendants were trained for three days and that they performed actual drills with passengers before the evacuation began. We were provided information that showed that some of the passengers were placed on platforms outside the plane because there were not enough seats. These passengers ran in through the right doors and exited through the left doors, which is not very realistic. But several pages were withheld from us because Boeing and the FAA considered them proprietary information. We filed an appeal, and as a result of some Congressional pressure the missing pages were finally provided to us. What the missing pages showed was that the evacuation did not take 90 seconds. It took 108 seconds. I think it is strange that this was considered proprietary information. And I think it was strange that this was considered a satisfactory full-scale evacuation demonstration.

The FAA has also suggested that distance to exits does not make a difference in flow rates as continuous lines are formed at available exits. This may be the case in an engineer's mind, but not in my mind.

When a cabin safety engineer thinks of flow rates, he pictures a portal flow rate. For example, an opening not less than 42 inches wide by 72 inches high and then you line up two lines of agile adults. On a given signal, you count the number of persons that pass through the portal in a prescribed time frame.

When I as a flight attendant think of flow rates, I see rows of passengers secured in seats that are spread from 20 inches to 65 feet in either direction of my portal. They are distributed from one to 13 seats across the cabin and on a prescribed signal, I count the number of persons that pass through the portal in a prescribed time frame.

Obviously the engineer's and the crewmembers' concept of flow rates is different. Continuous lines do not always form because this assumes every seat is occupied and that all occupants will be up and moving to the closest working exits in one to 15 seconds. This is assuming 50% of all exits are opened in a maximum of 15 seconds after the plane stops moving. This too assumes that passengers do go to the closest exit. Unfortunately, often passengers go to the door they entered the aircraft by or they choose too distant an exit. This also assumes said exits are not blocked by fire, smoke or debris. If the exits are blocked, they must then redirect their flow to another useable exit.

If every seat is not occupied, if the passengers are spread unequally in different zones, the time to reach their exits may take longer and thus, lines may not form.

In our view any analysis that is not affected by the distance between exits does not approximate the results of an actual crash or the results of a properly conducted full-scale demonstration. Whether analysis can even approximate the results of the type of full-scale evacuations conducted now is something that we have been wondering since the 767 evacuation when, as we understand it, the number actually evacuated differed from the number predicted by about 40 persons.

Given these problems with analysis, given the questions about past 747 full-scale evacuation demonstrations, and given the FAA's own statement that "the case of an exit configuration change is not an appropriate subject for analysis", we believe that the use of the tests and analysis was not in accordance with 25.803(d).

Let me summarize where we are so far. The Association of Flight Attendants believes that there should have been a full-scale evacuation demonstration before removing the overwing exits on the B-747 because that is what is required by 25.803(d). If 25.803(d) is interpreted to require a full-scale whenever there is a major change to an aircraft, a full-scale should have been done because an exit removal is a major change. If 25.803(d) is interpreted to require a full-scale when "tests and analysis" would be inadequate, a full-scale should have been done because the state-of-the-art in analysis is not advanced enough to demonstrate the safety of the exit removals.

We therefore recommend that to avoid future problems like the 747 exit removal, the FAA should more closely follow the literal meaning of 25.803, and perform full-scale demonstrations when there are any major changes to an aircraft. While we know that some people have an emotional aversion to full-scale demonstrations because they do not think they are worthwhile, we do not think that FAA regulatory action should be based on emotion. The FAA should instead focus on improving full-scale evacuation demonstrations and making them more worthwhile. Instead of looking for inappropriate ways to avoid them. The change we are suggesting here would not involve new regulations.

There are several other ways to avoid B-747 exit removal problems which I shall now briefly discuss.

2. Prohibit the removal of exits from existing aircraft

A second way of avoiding this kind of problem is to prohibit the removal of exits from existing aircraft. The Association of Flight Attendants does not

believe that exits should be removed from existing aircraft where they were required on the aircraft to begin with. Removal of required exits sends the public the wrong message, that safety is something that can be compromised to reduce costs. It reduces passenger confidence in our industry and ought to be avoided. Moreover, aircraft exits are generally installed on an aircraft in some kind of even physical distribution. Removing an existing exit, as opposed to designing a new aircraft with a new configuration of evenly distributed exits, creates an asymmetry that will make it difficult for some passengers to escape. This is precisely what happened in the B-747 case, and we note that one safety group has taken the position that an eight-exit B-747 might be acceptable to them if the exits were evenly distributed along the side of the fuselage. For both public policy and safety reasons, we support an amendment to Part 121 that would prohibit the removal of existing exits by U.S. air carriers unless you are going to a passenger/cargo combination.

3. Establish a minimum distance between exits

A third way of avoiding the B-747 type problem is to establish a minimum distance between exits. As you know, the 747 exit removal creates an enormous 72-foot space between exits. Although the FAA's position that distance to an exit has not made a difference in a full-scale demonstration as currently conducted may have some merit to it, the FAA's position that it does not make a difference in real crashes is a fanciful extrapolation.

On August 5, 1985 the Federal Aviation Administration held a conference in Washington, DC to reaffirm that it was legal to remove the overwing exits from the B-747. At that conference, the FAA released a review it had conducted of the issues involved, including the issue of distance between exits, and stated:

NPRM 66-26, from which Amendment 25-15 is derived, states, "It does not require any detailed research or accident investigations to show that there is a direct relationship between the proximity of an exit and a passenger and that passenger's chance for escape in an emergency situation.

We asked the FAA at that meeting if this was the agency's position, and the agency said that it was.

Assuming that distance to an exit affects evacuation time, it follows that passenger protection demands a maximum distance between exits. What distance should that be?

A 1964 CAMI study entitled "Human Factors of Emergency Evacuation" recommends that no passenger should be more than 22 feet from exits, and we were unable to find further FAA research in this area. This would obviously suggest a maximum distance of 44 feet between exits. In the June 1983 Air Canada fire, some passen-

gers died looking for exits in a 50-foot space between the forward doors and the window exits, and this would suggest that 50 feet may be too far in some cases. I don't think that this would have to be a rare case. For example, whenever you have thick clouds of smoke and gas or the complications of evacuating at night, 50 feet is going to be a problem.

To be realistic we would recommend that you take the current state-of-the-art for most aircraft and just put a lid on the distance between exits at that point. For example, if the agency were to set a limit of 60 feet between exits almost all aircraft types would fall within that limit except a few such as the B-747 with eight exits and the L-1011-500 with six exits. We would recommend that no new aircraft types could be approved with distances greater than 60 feet between exits, and that U.S. carriers would be prohibited from acquiring aircraft with distances between exits greater than 60 feet, and that would include existing aircraft.

It might be argued that more empirical evidence is needed before you place a limit at 60 feet. But what would any tests show? You could do some very wonderful tests and all that they would show is that 50 feet is better than 60 feet and 60 feet is better than 70 feet, which we already know. Once you find that out, there is no test that is going to tell you where to draw the line. We are saying that the line should be drawn at the existing distances between exits because the crashes we have today show that you have a great deal of trouble getting passengers out of exits. Our view is that we should therefore maintain the status quo and not allow the situation to deteriorate.

4. Publication in the Federal Register

A final method of avoiding 747 type controversies in the future is to let some sunshine in on the operations or the process of aircraft design certification. We think that any changes to exit configurations, and any attempts to use analysis instead of full-scale demonstrations in complying with 25.803(d), should be published in the Federal Register for comment.

Government regulation works much better when it is conducted in the open. For example, we seriously doubt that you would have the kind of confusion that exists today about when to conduct full-scale demonstrations if agency decisions on these matters had been subject to public review. We were shocked to find out at recent hearings before Congress, incidentally, that the Washington headquarters of the Federal Aviation Administration was unaware of the Northwest Region's approval of the 747 exit removal until a year after the approval. Even if the public does not know about these decisions, we hope that the FAA will conduct broader internal

reviews of important proposed regional decisions to insure consistency and accuracy in regulation interpretation.

To sum up this first part of my presentation, the Association of Flight Attendants urges the FAA: (1) to conduct full-scale evacuation demonstrations when there are changes to exit configuration; (2) to prohibit removal of existing exits; (3) to establish a maximum distance of 60 feet between exits; and (4) to subject decisions about exit configuration changes to comment in the Federal Register. Such regulatory and non-regulatory improvements would prevent unconscionable safety compromises such as the removal of the overwing exits from the 747.

HOW TO IMPROVE THE CONDUCT OF FULL-SCALE EVACUATION DEMONSTRATIONS

In the second half of my speech I would like to discuss some suggested improvements in conducting full-scale demonstrations to make them more realistic. We believe that more realistic evacuations would provide more useful information, and set a better objective standard, than simply reducing the 90 seconds requirement to some shorter time.

1. Flight attendant training should reflect what line flight attendants will actually receive.

Our first recommendation is that flight attendants used in full-scale evacuations should receive training commensurate with what line flight attendants will actually receive.

Although FAR 25.803 and FAR 121.291 originally required full-scale emergency evacuation demonstrations, the purpose of the demonstrations was different. As the Federal Register stated on July 29, 1966 in describing a 25.803 evacuation:

[S]ince a manufacturer will be demonstrating the basic capability of a new airplane type without regard to crewmember training, operator procedures and similar items that are of concern to an operator under part 121.291, the criteria to be prescribed under part 25 are not identical with those in part 121.

As a result, crew training for 25.803 demonstrations by the manufacturer did not resemble the operating airlines' evacuation training. The operator was separately tested by FAR 121.291/Appendix D to show that their approved transition or initial training programs and procedures could evacuate their maximum number of occupants in 90 seconds.

Historically, the manufacturer would utilize the initiating carriers flight attendants for their full-scale evacuation of a new production aircraft. The manufacturer would then extensively train these flight attendants solely on how to operate exits and command the evacuation.

The marathon, or should I say olympic training provided the flight attendants, was appropriate because the aircraft was being certified only for 25.800. It did not matter that the flight attendants who would actually use the aircraft would get much less training. The adequacy of their training would be tested by a full-scale under 121.291.

During the past ten years, the regulation has changed so that now the manufacturer's full-scale is the only one that is required to be conducted. For example, the MD-80 had one full-scale evacuation and over 20 mini-evacuations. The only test to prove that all occupants can in fact be evacuated is by the manufacturer.

Because this is the only test, the flight attendants should receive normal training. If this is not done, we will never know if a realistically trained crew can evacuate the aircraft in a reasonable amount of time. In addition, the use of hyper-trained crews dilutes the 90 seconds standard beyond recognition without the "back up" verification of an operator full-scale evacuation.

On October 20, 1984, I was one of several flight attendants from two carriers to participate in Boeing's training program for the 757 evacuation demonstration. The 757 we were to evacuate was the optional design with four window exits that replaced two jet escapes aft of the wing.

Our training consisted of three eight-hour days where we operated all exits in the normal, emergency, and malfunction modes. We jumped down slides and were timed on our drills. Later we ran drills on the aircraft simulating the evacuation with flight attendants initially seated for take-off. On a given signal, we were timed in running to our primary or secondary exit if the primary was inoperative. Drills were performed with our flight deck crews, which represented three airlines.

Currently, many airlines obtaining a new aircraft would provide a home study worth up to five hours credit, and approximately ten minutes per flight attendant on "hands-on operation", usually in a door mockup. The entire transition training will usually include: complete aircraft familiarization, operation and location of all emergency and cabin service equipment, oxygen systems, emergency and normal lighting systems, service flows, and emergency evacuation training particular to the new aircraft for land and water use. The entire program on an average is less than eight hours of home study and classroom with 15 minutes of "hands-on" training. This takes only one day.

Obviously, the 24 hours I received solely on the aircraft's evacuation systems differs so dramatically from what the line flight attendants receive that one must

question the possibility of equality in results of the manufacturer's evacuation and the one a crewmember will have to conduct under life-threatening situations. In our opinion the current "results" are not real life and are totally unreliable.

It is true that the operator upon initial introduction will conduct a mini-evacuation as required by 121.291(b), but this only tests the flight attendants' understanding of exit operation, slide readiness procedures and alternate assignments.

The mini-evacuation does not demonstrate the effectiveness of an operator's evacuation technique, directional control techniques, or the ability of the flight attendants' training to prepare them for dealing with passengers under adverse conditions.

All the "mini-evac" proves is the carriers training has been assimilated by the flight attendants to where they can prepare 50% of the exits in 15 seconds or less. This is an extremely easy task since there is no interference by passengers, and the only goal is to prepare the exits in less than 15 seconds. Our records indicate the majority of failures of the mini-evacs are attributed to door/slide problems and or improper maintenance to the evacuation systems.

We opposed the widespread use of "mini-evacs" instead of full-scale demonstrations when rule changes were proposed. But we are not here to re-argue that debate. Our point is that now that you only have "mini-evacs" at the carriers, the manufacturer's full-scale demonstration is the one basket with all the eggs. That full-scale must be done with a normally trained crew if we are to have any confidence that the plane can be evacuated safely.

We would propose that the manufacturer invite the initiating operator to supply randomly selected crewmembers, and to have them trained by the carriers' approved transition training program.

The difference between the training in full-scale demonstrations and what the line flight attendants receives is also enormous when there are alterations of an existing series of aircraft such as the 747SR or 737-300. The number of exits and their location has not been radically changed. The 747SR, for example, was a modified 747-100/200 with increased structure strength to compensate for the increased number of take-offs/landings and pressurization. In addition to the reinforced structure, the number of seats were increased to 527 with 511 on

the main deck and 16 on the upper deck. An evacuation demonstration was required because of an increase of seats over 5%.

For the demonstration, Boeing utilized airline instructors and union safety representatives who were at the time 747 qualified flight attendants. The flight attendants were given eight additional hours of hands-on training on exit usage, operation, and evacuation drills.

The odd part of this tale is that the line flight attendants would receive only a manual revision. There would be no extra eight hours of hands-on or practice sessions like the flight attendants Boeing used. The type of training Boeing gave for the full-scale training exists only for one day and vanishes.

In sum, we urge that the FAA do a brief survey of carriers to determine the average quality and quantity of initial and difference training provided to flight attendants today. Training in full-scale evacuation demonstrations should be limited to that average. For modified aircraft, training should probably be limited to giving a flight attendant a manual revision.

2. Block pairs of exits

Our second suggestion for improving full-scale demonstrations is to block pairs of exits.

In both "full-scale" and "mini-evacs", we must operate 50% of our exits. Traditionally, it has been conducted with one side blocked and the other side available for escape. However, it has been shown in actual accidents that rarely is only one side blocked and the other side available. Realistically, exit availability depends on aircraft attitudes, mechanical failures, ripped slides, or other problems which will cause a checker-board pattern and/or loss of the extreme ends of the cabin. According to our limited records, I cannot find any full-scale evacuation on a wide-bodied aircraft where two type A exits were used across from each other.

For example, if a full-scale was done on the eight door 747, I would not block the right side, but I would block 1L, 1R, 5L and 5R leaving me with 2L, 2R, 4L and 4R to evacuate my 440 passengers and crew of 12 from the main deck.

It would be even more interesting to test the aircraft by blocking 4L, 4R, 5L and 5R, thus leaving 1L, 1R, 2L and 2R to evacuate the occupants. What would the results be? They would certainly be more realistic.

3. Reduce flight crew involvement

A third suggestion for improving full-scales is to reduce flight crew involvement.

Current evacuation demonstration training for flight deck crewmembers is usually conducted jointly with the flight attendants. This involves both parties running evacuation drills together and develops coordination which enables both to complement the other which creates quicker evacuations. Most often the flight deck crews are assigned as cabin directors. Cabin directors are persons who divide areas of the cabin into blocs and direct passengers to set exits thereby assuring that all exits have an even distribution of occupants.

Unfortunately, it is our experience in the real world that minimal, if any, cabin evacuation techniques are taught by operators to their flight deck crews. I think it is a rarity if one finds an airline where both groups are trained together or by the same emergency instructor. It is my experience that pilots are not trained to shout commands, direct passenger flow in the cabin and are unaccustomed to assessing conditions, operating exits, inflating slides and carrying out malfunction procedures.

During the demonstration, the flight deck is instructed to count to 15 as a means to simulate shut down procedures and then proceed to the cabin. In reality, it will take longer than 15 seconds to minimally shut down the aircraft once it has come to a rest. With the increase of two person flight decks, there is that much more for a surviving person to shut down. Thirty to forty-five seconds is a more realistic time frame, and that is if everything goes well.

Although accident histories indicate that it is rare to find any member of a two person flight deck crew entering the passenger cabin in 15 seconds after an accident, the videos of the 767 evacuation demonstration indicate that the flight deck was the key to the success of the demonstration. Likewise, the flight deck crews on the 757 evacuation I trained for played the key roles of dividing the cabin into blocs and directing the flow to appropriate areas.

A recent review of different airline flight deck crew manuals shows that most often the first officer is supposed to assure 1R is operated and then proceed to the ground. He then encircles the aircraft and helps passengers away from the aircraft. The second officer was most often assigned to aid at 1L or in some cases the window exits. The captain was responsible for assuring all had in fact left the aircraft and to "assist where needed."

These duties differ greatly from the demonstration duties and responsibilities for flight deck crews. For example, on the 757 the captain is assigned the last row before exit 2L/2R and directs rows forward of 2L to 1L/1R. The first officer is assigned the area in front of the window exits and is to direct passengers forward to 2L/2R and keep others going out available window exits.

We believe that flight deck crews who are to be used in a full-scale evacuation should be instructed by the carrier's pilot training instructors in only the approved training program's evacuation duties and responsibilities. In addition, the flight crew should not be allowed in the cabin for 30 seconds. This will create more realistic results.

4. Redefine the passenger mix

Another way to improve "full-scales" is to develop a more realistic passenger mix.

The current airline passenger population does not reflect the "standard airline mix" as outlined in 25.803. With the deregulated environment, airlines are offering inexpensive fares which allow a greater cross-section of the population access to air travel. Every fall and summer we see the migration of more unaccompanied minors than ever -- children under the age of 12 are flying by themselves. It is not unusual to see greater than 10% of the cabin's mix under 12 years of age. Elderly and physically challenged passengers fly in ever increasing numbers, and during the summer months when tour groups flourish, the number of elderly exceeds 10%. In addition, we have a large number of non-english speaking passengers who travel throughout the United States year round.

Currently manufacturers have been granted relief from the "standard airline mix" required under 25.803 and 121.291. Therefore, no one is utilized during an evacuation demonstration under the age of 18 or over the age 60. During the 757 transition training, it was explained that the relief was given because of concerns of injuries to passengers in these age brackets, and that their absence would not effect flow rates or influence times. Real world experience shows that younger and older persons do make a difference in evacuation times and flow rates. Dr. Snow in his study of Survival in Emergency Escape from Passenger Aircraft, states:

In general, as age increases, agility and strength diminishes, reflexes slow, and quite often decisions are made with more hesitation. (p. 47)

Children under the age of 18 are not familiar with aircraft interiors and exit operations and children under 12 may not be capable of assimilating the predeparture briefing, safety instruction card, and flight attendant evacuation commands. We believe there should be robust debate about the passenger mix, but for the time being we would like to ask the panel why we do not see exemption petitions in the Federal Register since they appear to have been granted.

Another interesting aspect of this problem is the fact that most manufacturers utilize their own employees as the mix so the only "outsiders" are the few who sit

directly beside the exits. While there are limits in the regulations as to what kind of positions they can have in the company, all employees probably have an above-average knowledge of aircraft interiors.

When the "passengers" board the aircraft for the demonstration, they wear numbered vests, and the number is recorded on a cabin diagram. It takes about two hours to record all the occupant locations. Obviously, the employee who sits in an aircraft for two hours will be familiar with its layout and nearest exits by the time the evacuation command is given.

On the other hand, a normal passenger flight that has an accident on take-off finds passengers with only the preflight briefing to familiarize them with their nearest exit, and believe me, my passengers are a standard mix.

We at AFA do not want to unduly expose ourselves or others to undue risk; however, we do feel it is mandatory that the prescribed passenger mix in 25.803 be used. To be able to make a better judgment, we ask that the FAA make a full disclosure of the average number of injuries in full-scale evacuation demonstrations.

Rather than summarize our proposals for improving "full-scales", I would like to say a few words about slide problems. Nine months ago, we had a B-747 evacuation in Honolulu with multiple slide problems including one slide that fell off injuring the child who was on it critically. It is our understanding that for the last nine months, the FAA has had a priority project on slides. Yet, recently we had a 747 evacuation in Detroit with a 50% slide problem rate (three of six) and a 747 evacuation in Japan with a 40% problem rate (four of ten). Whatever project the FAA has, it is not yet producing results and if it does not produce results soon you may lose a lot of people on one of our 747's if it catches on fire. We think a thorough inspection of all 747 slides would be appropriate at this time.

Finally, I have not addressed several operational areas that are on the agenda, for example, flight attendant training and passenger briefings. We believe that these subjects deserve attention and we are in the process of raising our concerns with other parts of the FAA. I would be happy to answer any question you might have in these areas though.

Thank you again for allowing me to speak.

COMMENTS ON FOURTH DRAFT OF PROPOSED POLICY ON EMERGENCY EVACUATIONS

Attachment
1

The following are our comments on the fourth draft of the subject memo. There is only one "maximum seating capacity" for a model aircraft and that number is the number noted in the Type Certificate Data Sheet (TCDS). That number can not be exceeded. All other so-called "maximums" must be equal to or less than that number. The TCDS number is based on the maximum approved interior arrangement or, during the past approximately 15 years, the maximum evacuated per 25.803. Neither number could exceed that allowed by 25.807 or 4b.362. The use of the phrase "maximum seating capacity" in conjunction with any other number is misleading and confusing to the public. We suggest the memo be revised to reflect that the TCDS is the maximum seating capacity, quotes intentionally left off. Note that our definition of "maximum seating capacity" corresponds approximately with the second definition used in the memo, although slightly expanded. The first definition in the memo is perhaps best described as a "door limit capacity". The third definition in the memo is best described as an "airline operations maximum capacity".

In summary, the one and only maximum seating capacity is clearly published in the TCDS, is based on FAR 25 or CAR 4b and is the basis for all TC and STC approvals.

Even though this draft does not reflect a maximum of 5% passenger increase for 25.803(d) as amended by 25-46, tests and analysis, we are fully aware that some persons believe that "a considerably larger passenger capacity" means a maximum of 5%. We do not concur with that thinking. Amendment 25-46 specifically removed the 5% cap from the ^{rule}law. The cap, therefore, is no longer applicable and we can not agree that it should be interpreted as such. If the FAA had intended to retain the 5% cap, it would have kept the number in the ^{rule}law. The quoted preamble is responding to comments that analysis alone is not satisfactory and therefore states that the analysis must be based on sufficient test data. The examples are possible, not absolute, examples where there could be insufficient test data. Even the preamble does not state a 5% cap. It is our belief that a 5% or even 15% increase may not necessarily be "considerably larger passenger capacity".

RECEIVED

By our records, the following are corrections to the listing on maximum number of passenger seats approved on the Douglas and Lockheed models:

1) Douglas

- (a) Remove models DC-8-62 and DC-8-72 from "DC-8-F, 214 seats" listing and add these models to the "DC-8 Basic, 186 seats," listing.
- (b) Change demonstration date of "DC-10-10, 380 seats", from 6/26/71 to 6/4/72.

2) Lockheed

- (a) Change Model L-1011-385-1 designation to "includes Models L-1011-385-1-14 and -15."
- (b) Add after "345 - Lockheed", "with three type "A" exits and one type one exit per side"....
- (c) Add after above (same model designations) -- "400, Lockheed with four type "A" exits per side for Part 25 certification - 1/20/73".
- (d) Add after L-1011-385-3, "315, Lockheed by analysis from tests conducted on Model L-1011-385-1, 3/21/78".

10/27/79
AMS-120

FAR 25 Emergency Evacuation Demonstrations; Analysis Methods

Chief, Aircraft Engineering Division, AMS-100

All Regional Flight Standards Divisions

Attn: Chief, Engineering and Manufacturing Branch

Chief, Aircraft Engineering Division, AEE-100

Chief, Aircraft Certification Staff, AEU-100

The pending type certification of new transport airplanes has prompted this letter, which regards analytical simulation of emergency evacuation and its relationship to current regulations.

Several years ago, Flight Standards began a program to develop and validate a prototype computer model capable of simulating the emergency evacuation process for transport airplanes, and using statistical data derived from mini-tests of cabin interior sub-sections. While considerable progress has been made, the model has not been validated, and much work remains.

FAR 25.803 has required for some time, a full scale evacuation demonstration for aircraft certification. In 1978, Amendment 25-46 revised 25.803(d) to read, "A combination of analysis and tests may be used - - - if the Administrator finds - - - equivalent to that which would be obtained by actual demonstration."

The FAA model under development is not intended specifically to fulfill the analysis provision mentioned in 25.803(d). Primarily, it is to serve as a methodology for evaluating cabin design features bearing on the emergency evacuation process, and which industry can expand, and begin using as a tool for optimizing cabin design.

The Preamble to Amendment 25-46 states clearly that there are limitations on analysis, and that the rule is intended to "preclude approvals which might be based on insufficient test data, such as in the case of a completely new airplane model or a model which has major changes or a considerably larger passenger capacity than a previously approved model."

We have not seen an analysis method which has been validated and substantiated as being adequate to serve in lieu of the full scale demonstration for certification of a completely new model. This is an important precedent setting area. If a manufacturer makes a proposal in this regard, please forward it to this office for evaluation and comment.

Chapin

JERRY CHAPIN

CS: AMS-100/120
AMS-120/HORNBURG: R/L: 7/12/79

Attachment 3



U.S. Department
of Transportation
Federal Aviation
Administration

Northwest Mountain Region
Colorado Idaho Montana
Oregon Utah Washington
Wyoming

17900 Pacific Highway South
C-68966
Seattle Washington 98163

OCT 2 1984

Mr. D. R. Clifford
Chief Engineer Airworthiness
and Product Assurance
Boeing Commercial Airplane Company
P.O. Box 3707
Seattle, Washington 98124

Dear Mr. Clifford:

This is in further regard to the use of analysis, as opposed to full scale evacuation demonstration, and FAA approval of the B737-300 and the B757-200 airplanes, which were addressed in our letter of August 23, 1984.

Regarding the B737-300, the Britannia Airways demonstration on November 26, 1970, was not demonstrated to the requirements of FAR 121 and FAR 25.803, and remains an unacceptable basis for analysis. Furthermore, any analysis based on an acceptable test must be limited to an increase in passenger capacity of 5% or less. For these two reasons, a full scale evacuation demonstration is necessary, prior to issuance of the B737-300 type certificate.

Regarding the B757-200, the case of an exit configuration change is not an appropriate subject for analysis, and a full scale evacuation demonstration is necessary prior to FAA approval of the 224 passenger configuration. In view of the fact that near-future deliveries include arrangements of many fewer passengers than is presently approved on the basis of demonstration (i.e., 187 vs. 219), and in view of the expectation that the revised exit configuration is fully expected to accommodate an increase in passengers, we can accept the new configuration without testing, but limited to 187 passengers. To restore FAA approval of higher capacity, please forward your test proposal for a full evacuation demonstration. We suggest a schedule which will be completed within the next four months. This acceptance of the 187 passenger configuration prior to a full demonstration of the exit configuration has been coordinated with the Office of Flight Operations, and the airplanes involved may be placed in Part 121 service after the usual crew-only partial demonstration, which must be conducted in accordance with FAR 121.291c by the certificate holder.

Sincerely,

H. E. Waterman
Manager, Seattle Aircraft
Certification Office, ANM-100S



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C-68966 SEATTLE, Wash. 98168

Attn. Mrs Patricia SIEGRIST

O/Ref. : I/EA-A WD/MB N° 1403/85

Toulouse, August 28, 1985

SUBJECT : FAA CONFERENCE - SEPT. 3-6, 85 ON EMERGENCY
EVACUATION OF TRANSPORT AIRPLANES

Dear Mrs Siegrist,

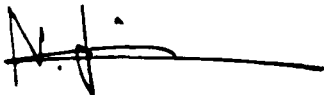
Enclosed is the abstract of AECMA views which we would like to present during the Public Technical Conference in Seattle. These positions are elaborated and coordinated between European Manufacturers including British Aerospace, Aerospaziale, Avions Dassault, Fokker and Airbus Industrie. Due to the short time available no further comments could be collected.

In addition we intend to provide specific informations and views based on experience with emergency evacuations of Airbus Industrie's wide-body airplanes. Supporting material will be available at the conference.

Participants will be :

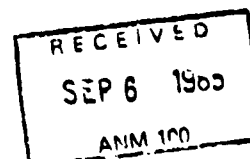
Werner MUNSTER, Manager Interior System (MBB-West Germany) and myself.

Best regards,



W. DIDSZUHN
Director, Office of Airworthiness

cc. : AECMA - MM. I. HERBST
RADFORD



SUBJECT : EMERGENCY EVACUATION OF TRANSPORT AIRPLANES - FAA PUBLIC TECHNICAL
CONFERENCE SEPTEMBER 3-6, 1985

THE FOLLOWING ABSTRACT REFLECTS THE COLLECTED VIEWS OF MEMBERS
OF AECMA. FURTHER INFORMATION WILL BE PROVIDED DURING THE FAA
PUBLIC TECHNICAL CONFERENCE IN SEATTLE.

TOULOUSE, AUGUST 26, 1985

AECMA = ASSOCIATION EUROPEENNE DES CONSTRUCTEURS DE MATERIAL AEROSPATIALE
(EUROPEAN ASSOCIATION OF AEROSPACE MANUFACTURERS)

I EMERGENCY EXITS

- NUMBER & CAPACITY OF EXITS

BACKGROUND

- CURRENTLY BOTH SINGLE AND TWIN AISLES AIRCRAFT UTILIZE EXITS SIZED BETWEEN TYPES "J" AND "A" WHICH HAVE SHOWN IMPROVED EVACUATION FLOW RATES OVER THE SMALLER EXITS OF JAR/FAR 25.807 (c) :

- SAE PAPER GIVES THE FOLLOWING FLOW RATES PER DOOR TYPE BASED ON DATA COLLECTED FROM EVACUATION EXPERIENCE :

TYPE A	128 PAX/90 SECS
TYPE I	78 PAX/90 SECS
TYPE III	59 PAX/90 SECS

- IN DETERMINING THE SIZE OF EXITS AND RELATED PASSENGER ALLOWANCE ACCOUNT SHOULD BE TAKEN OF :

- (1) CURRENT DESIGN PRACTISE
- (2) KNOWN PASSENGER FLOW RATE DATA

I EMERGENCY EXITS

NUMBER & CAPACITY OF EXITS

RECOMMENDATION

FAR 25-807 (c) SHOULD BE REVISED TO REFLECT THE FOLLOWING AND USED TO GIVE TYPICAL AND NOT MANDATORY STANDARD EXIT CRITERIA ENABLING MORE FLEXIBILITY OVER THE SELECTION OF TYPE AND NUMBER OF EXITS TO BE USED.

EMERGENCY EXIT	PASSENGER SEATING
EACH SIDE OF AIRCRAFT	CONFIGURATION ALLOWED

TYPE	HEIGHT	WIDTH		
A	72 "	X 42 "	)	110
B	72 "	X 32 "	)	80
I	48 "	X 24 "	)	55
II	44 "	X 20 "	)	45
III	36 "	X 20 "	)	40 (35)
IV	26 "	X 19 "	)	20

I EMERGENCY EXITS

RECOMMENDATION (CONT'D)

THE EXIT ALLOWANCES ARE FURTHER RESTRICTED AS FOLLOWS :

1. AIRCRAFT WHOSE MAX. PAX CAPACITY IS 9 OR LESS MUST INCORPORATE AT LEAST I TYPE IV
 EMERGENCY EXIT PER SIDE.
2. AIRCRAFT WHOSE MAX. PAX CAPACITY IS 19 OR LESS MUST INCORPORATE AT LEAST I TYPE III
 EMERGENCY EXIT PER SIDE.
3. AIRCRAFT WHOSE MAX. PAX CAPACITY EXCEEDS 19 MUST INCORPORATE AT LEAST TWO APPROVED
 EMERGENCY EXITS PER SIDE.
4. EXCEEDS 39 TWO APPROVED AT LEAST ONE OF WHICH MUST BE A TYPE I.
5. EXCEEDS 109 ... THREE APPROVED .. AT LEAST ONE OF WHICH MUST BE A TYPE I.
6. FULL CREDIT FOR A TYPE A EXIT IS LIMITED TO CONFIGURATION HAVING A PAX. CAPACITY
 GREATER THAN 200.

IF A PASSENGER VENTRAL OR TAIL CONE EXIT IS INSTALLED AND CAN BE SHOWN TO BE USABLE
FOLLOWING THE COLLAPSE OF ONE OR MORE LEGS OF THE LANDING GEAR, AN INCREASE IN
PASSENGER CAPACITY MAY BE ALLOWED BASED ON THE DEMONSTRATED CAPABILITY OF THE EXIT.
(NOTE : THE NUMBERS ABOVE DON'T INCLUDE CREWMEMBER SEATS).

II FULL SCALE EVACUATION DEMO

GENERAL

- BECAUSE OF THE DANGER TO PERSONNEL, THE PREDICTABLE RESULTS AND LARGE COST INVOLVED IN ROUTINE USE OF FULL SCALE DEMONSTRATIONS ARE NOT SUPPORTED FOR TYPICAL, CONVENTIONAL AIRCRAFT LAYOUTS & EXIT ARRANGEMENTS.
- IT IS CONSIDERED THAT FULLSCALE DEMO'S SHOULD ONLY BE USED TO PROVE UNUSUAL, UNCONVENTIONAL AIRCRAFT LAYOUTS & EXIT ARRANGEMENTS.
- ANALYSIS SHOULD BE USED TO PROVE CONVENTIONAL LAYOUTS ETC. BASED ON KNOWN FLOW RATES FOR TYPICAL DOOR SIZES AND SUPPORTED BY MINI EVACUATION ONLY WHERE IT IS CONSIDERED NECESSARY TO PROVE THE "READY TIME" FOR THE ASSIST MEANS OR ACCESSIBILITY.

11 FULL SCALE EVACUATION DEMO

GENERAL

- Do the demonstrations properly account for carry on baggage ?
 - . . . Yes - Experience shows this to be representative
- Is 90 - second criteria valid ?

Experience from actual evacuations shows that this time is valid.
- Should smoke be present during evacuations ?
 - . No - This introduces a further hazard to an already potential hazardous exercise.
- Is the passenger mix valid ?
 - . Yes - Experience shows this to be acceptable.
- Should there be handicapped, obese, or blind participants ?
 - . No - Because of the increase of hazard.

11 FULL SCALE EVACUATION DEMO

- HOW SHOULD THE DISTRIBUTION OF BLOCKED EXITS BE DETERMINED ?

CLARIFICATION OF 25-803 (c) (17) SHOULD BE PROVIDED WITH RESPECT TO :

"NOT MORE THAN 50 % OF EMERGENCY EXITS"

AS IT IS NOT CLEAR FROM THIS WHETHER THE INTENT IS STILL THE EXITS ON ONE SIDE OF THE AIRCRAFT AS
POST AMENDMENT 25-46.

- ARE TSO-C69A DESIGN STANDARDS ADEQUATE ?
- ARE TESTING REQUIREMENTS ADEQUATE ?

BACKGROUND

- . THERE ARE NUMEROUS INCIDENTS OF SLIDES FAILING BECAUSE OF TEARING BY EITHER DAMAGE FROM SHOES ON THE SLIDE WAY OR BY CONTACT WITH SHARP OBJECTS ON THE GROUND.
- . PROBLEMS HAVE BEEN ENCOUNTERED WITH EXPOSURE TO EXTREME ENVIRONMENTAL CONDITION - PRIMARILY DUE TO CONDENSATION CAUSING HYDROLYSIS.
- . CONTACT WITH HOT STRUCTURE OR HOT OBJECTS ON THE GROUND HAS BEEN THE CAUSE OF SLIDE NON AVAILABILITY.

- ARE TSO-C69A DESIGN STANDARDS ADEQUATE ?

- ARE TESTING REQUIREMENTS ADEQUATE ?

RECOMMENDATIONS

. TSO SHOULD INCLUDE PUNCTURE TESTS AND NAIL TESTS FOR BOTH SLIDING SURFACES AND THE GROUND CONTACT AREA.

. TSO SHOULD INCLUDE HYDROLYSIS TEST AND AIR RETENTION TESTS FOR ALL FABRICS AND ASSEMBLIES USED ON THE SLIDE.

. TSO SHOULD INCLUDE TESTS TO DEMONSTRATE RESISTANCE OF SLIDE FABRIC TO HOT METAL CONTACT (E.G. HOT FUSELAGE AFTER FIRE EXTINGUISHED, ETC.).

III ESCAPE SLIDES

- IS THE 25 KNOT WIND CRITERION APPROPRIATE ?

EXPERIENCE SHOWS THAT THIS GUST LEVEL IS A VALID AVERAGE VALUE.

III ESCAPE SLIDES

- Is FAILURE REPORTING ADEQUATE ?

GENERAL COMMENTS

IN ORDER TO IDENTIFY FAILURE TRENDS ADEQUATE INFORMATION NEEDS TO BE RECEIVED
FROM AIRLINES AS TO THE CAUSE OF THE PROBLEM.

A FORMAL INTERNATIONAL REPORTING SYSTEM WOULD OBVIOUSLY HELP TO ACHIEVE THIS DATA
BASE WHICH SHOULD ENABLE SLIDE RELIABILITY TO BE IMPROVED.

III ESCAPE SLIDES

- IS MAINTENANCE ADEQUATE ?

BACKGROUND

EVIDENCE SHOWS THAT PACKAGING ERRORS ARE A MAJOR CONTRIBUTORY FACTOR TO THE MAL-DEPLOYMENT OF SLIDES.

RECOMMENDATION

IT IS CONSIDERED IMPORTANT THAT STRICTER CONTROL OF MAINTENANCE PRACTICES IS INTRODUCED, PERHAPS BY WAY OF DUAL INSPECTION AT CRITICAL PACKING STAGES.

FAA PUBLIC HEARING

Sept. 3 thru 6

AIRBUS EXPERIENCE

related to

Emergency Exits

FULL SCALE EVAC DEMO'S

for Transport Category Aircraft

presentation by

W. MÜNSTER, MGR INTERIOR SYSTEMS

MESSERSCHMITT-BÖLKOW-BLOHM GMBH

ITEM 1 PASSENGER EMERGENCY EXITS AND THEIR ARRANGEMENT

- A - PRESENT REQUIREMENTS PER 25.807

A.1 HISTORY

- TABLE OF 25.807 (c) (1) WAS GENERATED IN OCT. 24. 1967 AND AMENDED MAY 1. 1972,

25.807 (c) (2) IN FEB. 08. 1972 AND AMENDED FEB. 10. 1977.

TECHNOLOGIES NON AVAILABLE AT THESE DATES ARE:

- FAST OPERATING EXITS ALSO FOR TYPE I EXITS
- FAST INFLATING EVACUATION/SLIDES

ACCORDINGLY THE TIME REQUIRED UNTIL READINESS OF EVACUATION MEANS HAS BEEN SIGNIFICANTLY REDUCED. E.G. FOR AIRBUS MAIN EXITS THE TIME SEQUENCE FROM START OF DOOR HANDLE OPERATION TO AVAILABILITY OF USEABLE EVACUATION SLIDES HAS BEEN REDUCED BY MORE THAN 50 PER CERT.

ITEM 1 CONTINUED

ON THESE EXITS IN RECENT AIRBUS EMERGENCY EVACUATION DEMONSTRATION PERFORMANCES FIRST PASSENGERS HAVE EXITED AFTER 11.5 SECONDS OR LESS.

- AS A RESULT 25.807 (C) (1) DOES NOT REFLECT
 - HIGHER EGRESS RATES FOR MODERN TYPE EXIT/SLIDES COMBINATIONS
 - REQUIREMENT OF INFLATABLE SLIDES WHEN OVERWING EXITS ARE USED WITH WING TRAILING EDGE MORE THAN 6 FT ABOVE GROUND LEVEL (WHICH APPLIES TO MOST MODERN NARROW BODY AIRLINERS ABOVE 140 PAX), I.E. USE OF THE COMBINATION OF TYPE 111 EXITS WITH OFF-WING SLIDES IS NOT REFLECTED.

AD-A172 256

TASK FORCE ON EMERGENCY EVACUATION OF TRANSPORT
AIRPLANES VOLUME 2 SUPPORTING DOCUMENTATION (U) FEDERAL
AVIATION ADMINISTRATION WASHINGTON DC OFFICE OF FLIGHT..

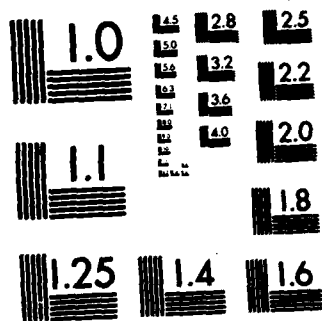
3/5

UNCLASSIFIED

JUL 86 DOT/FAR/US-86-1

F/G 1/2

NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

ITEM 1 CONTINUED

A.2 COMPARISON OF FAR 25.807 (C) (1) AND 25.807 (C) (2)

- TABLE OF 25.807 (C) (1) IS INCONSISTENT WITH VALUES PER 25.807 (C) (2). WHEN APPLYING VALUES PER 25.807 (C) (2) THE TABLE PER 25.807 (C) (1) WOULD READ

	25.807 (C) (1) OR	25.807 (C) (2)
1 X TYPE I + 2 X TYPE III =	MAX. 109 PAX	MAX. 115 PAX
2 X TYPE I + 1 X TYPE III =	MAX. 139 PAX	MAX. 125 PAX
2 X TYPE I + 2 X TYPE III =	MAX. 179 PAX	MAX. 160 PAX

- IT IS APPRECIATED THAT THE INCONSISTENCY PER ABOVE HAS A VALUED BACKGROUND ON FUSELAGE SHELLS WITH ONLY FEW EXITS BECAUSE NON AVAILABILITY OF A SINGLE EXIT MAY SIGNIFICANTLY IMPAIR THE EVACUATION FLOW.

ITEM 1 CONTINUED

- HOWEVER WITH THE USE OF 2 OR MORE PAIRS OF EXITS OF AN EQUAL DISTRIBUTION THE NOMINAL EVACUATION RATES FOR EXITS SHOULD BE APPLIED, BECAUSE COMPENSATION EXISTS BECAUSE SEATING CAPACITY IS BASED ON THE AIRCRAFT EVACUATION CAPABILITY WITH ONLY 50 PER CENT OF EXITS USED. THIS IS ALSO ENFORCED BY SAE TECHNICAL PAPER 821 486, "AN FAA ANALYSIS OF AIRCRAFT EMERGENCY EVACUATION DEMONSTRATIONS".

ITEM 1 CONTINUED

A.3 AIRBUS DECISIONS ON OVERWING EXIT TYPES FOR A310 AND A320

A.3.1 OVERWING EXIT TYPE FOR A310

- THE SELECTION OF THE TYPE OF EXIT(S) IN ADDITION TO THOSE PLACED IN THE FRONT AND AFT OF THE CABIN WAS FRAMED BY
 - SEATING CAPACITY OF AIRLINER WAS TO BE ABOVE 200 PAX THUS 25.807 (c) (1) WOULD NOT APPLY
 - EXITS SHOULD BE PLACED AROUND THE CENTER OF THE CABIN TO ACHIEVE EQUAL DISTRIBUTION
 - EVACUATION SLIDE INSTALLATION WAS DESIRED TO BE DOOR MOUNTED, LOCATED INSIDE THE PRESSURIZED CABIN AREA, IN ORDER TO REDUCE MAINTENANCE COSTS FOR OPERATORS AS WELL AS OPERATIONAL COMPLEXITY (AS E.G. WITH WING FAIRING MOUNTED SLIDES).
 - THE EVACUATION PATH SHOULD BE SUCH THAT POSITIVE GUIDANCE BE PROVIDED FROM THE EXIT ON TO THE SLIDE ENTRANCE IN ORDER TO PROVIDE MAX. SAFETY TO THE CABIN INHABITANTS.

ITEM 1 CONTINUED

- THE CONFIGURATION SELECTED AS CAN BE SEEN ON FIG. 1 IS IN COMPLIANCE WITH ALL ABOVE.
- THE EVACUATION RATES ACHIEVED CAN BE FOUND ON FIG. 2, 3 AND 4. PERFORMANCES WERE MADE IN ACCORDANCE WITH PROCEDURES PER FAR 121, APPENDIX D.

ITEM 1 CONTINUED

TOP VIEW

SIDE VIEW

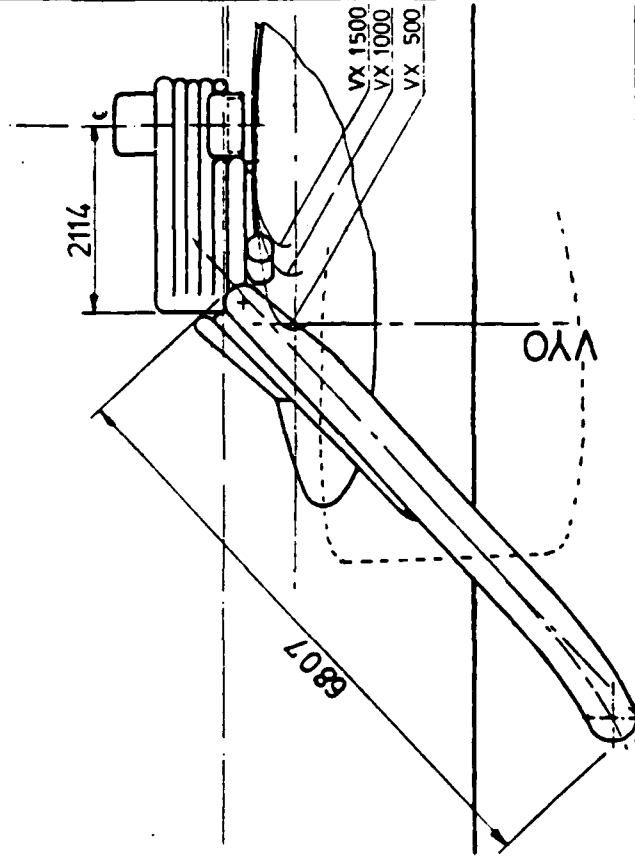
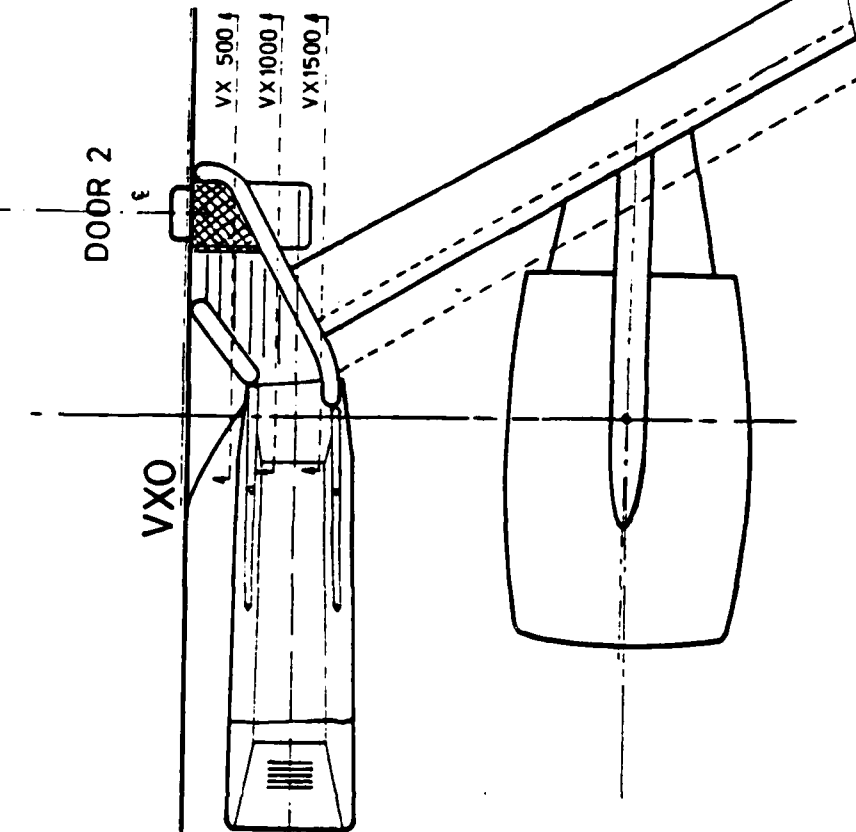
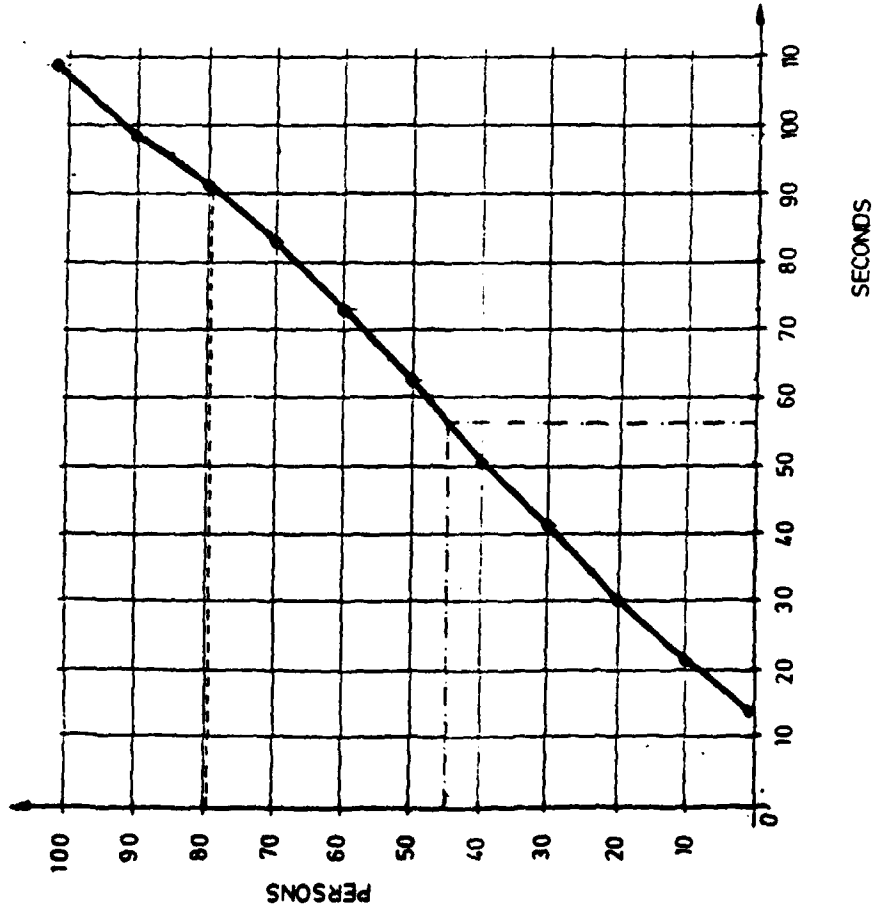


FIG. 1

ITEM 1 CONTINUED

100 PASSENGERS PLACED FORE AND AFT OVERWING EXITS,
1 EACH FLIGHT ATTENDANT PLACED AT EXIT



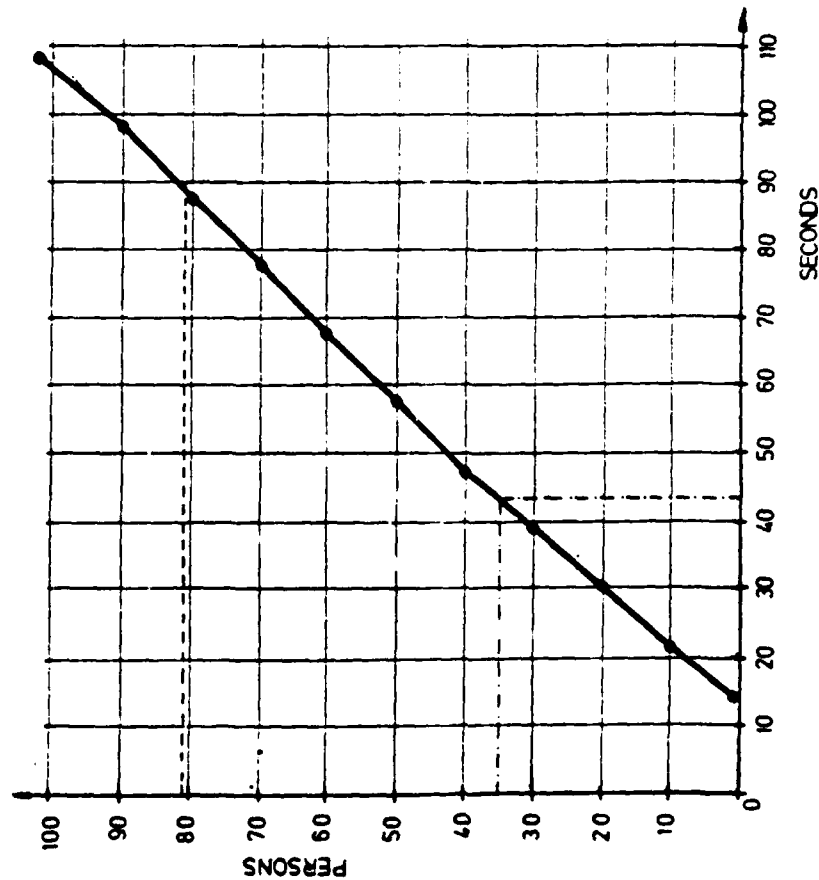
KEY EVENTS WERE:

ACTUATION OF SLIDE AFTER	5.6 SECONDS
SLIDE INFLATED AFTER	12 SECONDS
45 PERSONS EVACUATED IN	56 SECONDS
80 PERSONS EVACUATED IN	90 SECONDS
102 PERSONS EVACUATED IN	109 SECONDS

FIG. 2

ITEM 1 CONTINUED

100 PASSENGERS PLACED FORE AND AFT OF OVERWING EXITS, 1 EACH FLIGHT ATTENDANT PLACED AT FRONT AND AFT OF A310 CABIN, OVERWING EXITS NOT OCCUPIED BY FLIGHT ATTENDANTS



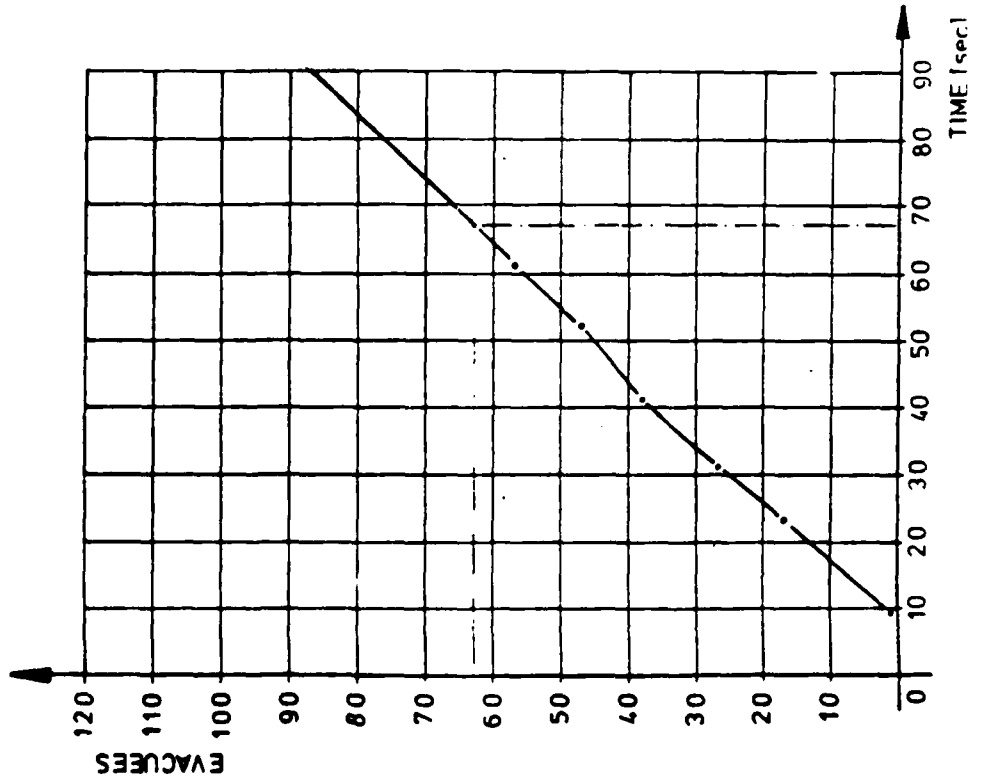
KEY EVENTS WERE:

ACTUATION OF SLIDE AFTER 5.2 SECONDS
 SLIDE INFLATED AFTER 11.8 SECONDS
 35 PERSONS EVACUATED IN 43.5 SECONDS
 81 PERSONS EVACUATED IN 90 SECONDS
 102 PERSONS EVACUATED IN 108.5 SECONDS

FIG. 3

ITEM 1 CONTINUED

FULL EVACUATION DEMONSTRATION PERFORMANCE



FIRST DOOR MOVEMENT	1:54 SEC.	ELAPSED TIME
SLIDE READY	8:76 SEC.	"
FIRST PAX JUMPS	9:15 SEC.	"
LAST PERSON ON THE GROUND	67:71 SEC.	"
ESCALATED CAPACITY 86 PERSONS	90:00 SEC.	"
61 PAX PLUS 2 CREW EVACUATED.		

FIG. 4

ITEM 1 CONTINUED

A.3.2 OVERWING EXIT TYPE FOR A320

- THE SELECTION OF THE TYPE OF EXIT(S) IN ADDITION TO THOSE PLACED IN THE FRONT AND AFT OF THE CABIN WAS FRAMED BY
 - SEATING CAPACITY OF AIRLINER WAS TO BE BELOW 180 PAX, THUS 25,807 (C) (1) APPLIES.
 - EXITS SHOULD BE PLACED AROUND THE CENTER OF THE CABIN TO ACHIEVE EQUAL DISTRIBUTION.
 - EVACUATION SLIDE INSTALLATION WAS DESIRED TO BE DOOR MOUNTED, LOCATED INSIDE THE PRESSURIZED CABIN AREA, IN ORDER TO REDUCE MAINTENANCE COSTS FOR OPERATORS AS WELL AS OPERATIONAL COMPLEXITY (AS E.G. WITH WING FAIRING MOUNTED SLIDES).
 - THE EVACUATION PATH SHOULD BE SUCH THAT POSITIVE GUIDANCE BE PROVIDED FROM THE EXIT TO THE SLIDE ENTRANCE IN ORDER TO PROVIDE MAX. SAFETY TO CABIN INHABITANTS.

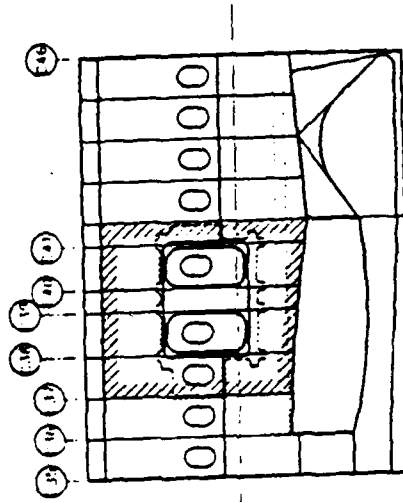
ITEM 1 CONTINUED

I.E. THE FRAMING CONDITIONS ARE IDENTICAL TO THOSE PER PARA. A.3.1
EXCEPT FOR APPLICABILITY OF 25.807 (c) (1).

- IN PRINCIPLE TWO POSSIBILITIES EXISTED WITH USE OF ONE PAIR OF TYPE I
EXIT/DOOR MOUNTED SLIDE SIMILAR TO A310 DESIGN OR USE OF TWO PAIRS OF
TYPE III EXITS/WING FAIRING MOUNTED SLIDE, SEE FIG. 5.

ITEM 1 CONTINUED

SELECTED CONFIGURATION



ALTERNATIVE CONFIGURATION

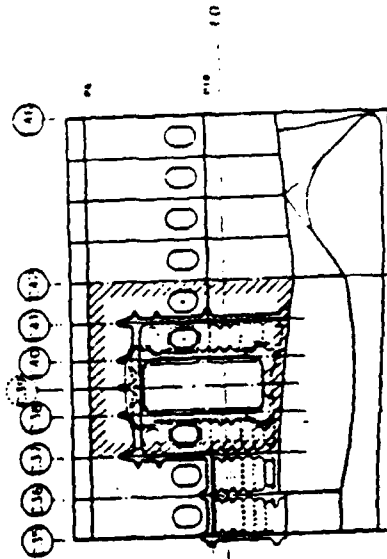


FIG. 5

ITEM 1 CONTINUED

- THE EVENTUALL DECISION MAKING TO USE TWO PAIRS OF TYPE III EXITS WAS SOLELY GOVERNED BY THE EXISTANCE OF FAR 25.807 (c)(1). THE MORE FAVOURED AIRBUS A310 OVERWING EXIT WITH ITS ASSOCIATED PROVEN ELEMENTS COULD NOT BE APPLIED BECAUSE THE INDUSTRIAL RISKS IN DESIGNING NOT TO STANDARDS COULD NOT BE DETERMINED.

THE RESULTANT DESIGN FEATURES CAN BE FOUND ON FIG. 6

MBB

Airbus Cabin Interior

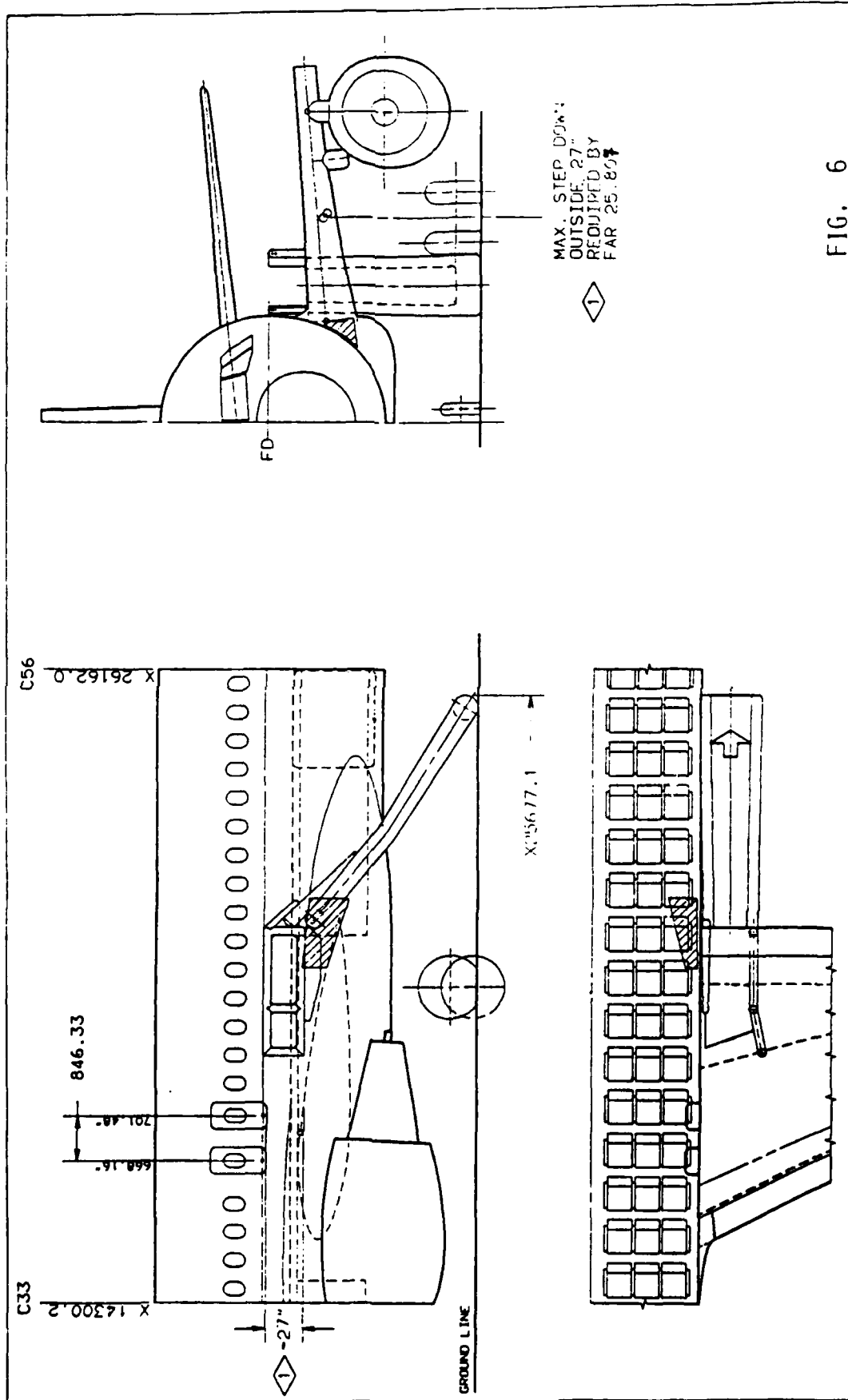


FIG. 6

ITEM 1 CONTINUED

A.4 CONCLUSION

ON THE BASIS OF THE MATERIAL PRESENTED ABOVE THE CONCLUSION IS
DRAWN THAT:

A.4.1 THE RESTRICTIVE DEFINITION OF EXIT RATINGS AND ARRANGEMENTS PER
FAR 25.807 (C) (1) CAN CAUSE CONFLICT WITH INNOVATION TO ENHANCE
SAFETY IN USING A DIFFERENT COMBINATION OF EXITS AND SHOULD THEREFORE
BE AMENDED.

ITEM 1 CONTINUED

A.4.2 THE PAX RATINGS PER FAR 25.807 (c) (2) DO NOT REFLECT MODERN EQUIPMENT (EXITS AND SLIDES), PARTICULARLY WITH REGARD TO TYPE 1 EXITS.

THE IMPROVEMENTS ACHIEVED IN THE AREA OF QUICKER AVAILABILITY OF EVACUATION MEANS SHOULD BE REGARDED AS A CONTRIBUTION BY THE INDUSTRY TO ENHANCE SAFETY. HOWEVER IT MUST BE NOTED THAT REGULATIONS MUST BE ADAPTIVE TO INNOVATION TO PREVENT CONFLICT.

OTHERWISE INNOVATION WILL CEASE.

ITEM 1 CONTINUED

A.4.3 RATINGS PER FAR 25.807 (C) (1) AND (C) (2) SHOULD CORRESPOND,
IF E.G. MORE THAN 2 PAIRS OF EXITS ARE USED PER AIRCRAFT.
THIS SHOULD ALSO APPLY FOR POSSIBLY NEWLY ADDED TYPES OF EXITS.

ITEM 2 FULL SCALE EMERGENCY EVACUATION DEMONSTRATION

- A - KEY ELEMENTS FOR EXECUTION OF EVACUATION PERFORMANCES AS PRESENTLY DEFINED
 - CREW MOTIVATION AND FUNCTIONS
 - FAST AVAILABILITY OF EVACUATION MEANS
 - EXIT ACCESSIBILITY
 - TEST PERSONELL MOTIVATION
 - DEFINITION OF THE TEST SCENARIO

A.1 CREW MOTIVATION

- A FULL SCALE EMERGENCY EVACUATION DEMONSTRATION IS NOT THE PROPPER MEANS TO EVALUATE CREW MOTIVATION
- CREW FUNCTIONS AND QUALIFICATION CAN MORE PROPPERLY ADRESSED AND DRILLED IN CREW TRAINING FACILITIES.

ITEM 2 CONTINUED

A.2 FAST AVAILABILITY OF EVACUATION MEANS

- THE TIME REQUIRED FOR THE FLIGHT ATTENDANTS TO

- RELEASE SEAT HARNESS

- MOVE TO EXIT

- OPERATE THE EXIT

- ACTIVATE THE SLIDE

CAN EQUALLY ADEQUATELY BE CHECKED BY MEANS OF THE SO CALLED "MINI-EVACUATION" PERFORMANCES.

- RELIABILITY ASPECTS WITH REGARD TO FAST AVAILABILITY OF THE EVACUATION MEANS ARE PRESENTLY ADRESSED BY SEPERATE TESTS ANYHOW.

ITEM 2 CONTINUED

A.3 EXIT ACCESSIBILITY
SUFFICIENT MATERIAL EXISTS TO PROVE APPROPRIATE EXIT ACCESSIBILITY
WHEN THE AIRCRAFT IS DESIGNED TO FAR 25 STANDARDS.
WITH REGARD TO LIMITATIONS AS A RESULT OF ACTUAL TYPE OF EMERGENCY
PLEASE REFER TO A.5 FURTHER BELOW.

ITEM 2 CONTINUED

A.4 TEST PERSONELL MOTIVATION

WHEN ASKED TO PARTICIPATE IN FULL SCALE EMERGENCY EVACUATION DEMONSTRATIONS AS PRESENTLY DEFINED BY FAR 25 AND FAR 121, TEST PERSONELL MOTIVATION IS NO PROBLEM. HOWEVER ANY INTRODUCTION OF A HARSHER TEST SCENARIO WILL LIMIT IF NOT PREVENT VOLUNTARY PARTICIPATION (ALSO SEE A.5 BELOW). EACH TEST PARTICIPANT CAN AND MUST EXPECT THAT THE RISK OF INJURIES AS A RESULT OF TEST PARTICIPATION IS REDUCED TO THE MINIMUM LEVEL POSSIBLE.

ITEM 2 CONTINUED

A.5 DEFINITION OF TEST SCENARIO

- THE PRESENT DEFINITION OF THE TEST SCENARIO PER FAR 25 AND FAR 121
ALREADY RESULTS IN INJURIES.
- ANY CHANGES TO FURTHER INCLUDE SPECIFIC "REAL" EMERGENCY SCENARIOS
WILL RESULT IN EVEN MORE THREATS TO THE HEALTH OF TEST PARTICIPANTS
AND AS A RESULT OF THAT WILL REDUCE IF NOT EXCLUDE VOLUNTARY TEST
PARTICIPATION. IN ADDITION NO INDIVIDUAL OR ORGANIZATION CAN ACCEPT
THE RESPONSIBILITY FOR THE EXECUTION OF TESTS WITH HIGH PROBABILITY
OF LIFE AND/OR HEALTH IMPAIRMENT.

ITEM 2 CONTINUED

A.6 CONCLUSION

- WHEN DESIGNED TO FAR 25 AND 121 STANDARDS, THERE IS NO NEED FOR THE EXECUTION OF A FULL SCALE EMERGENCY EVACUATION DEMONSTRATION, BECAUSE ITS RELEVANT ELEMENTS CAN BE CHECKED OUT INDIVIDUALLY.
- CONFIGURATIONS IN DEVIATION TO FAR 25 AND 121 STANDARDS MUST BECOME SUBJECT TO INDIVIDUAL REVIEW. A COMBINATION OF TESTS AND ANALYSIS MAY BE USED FOR PROOF OF COMPLIANCE.
- A MODIFICATION OF THE TEST SCENARIO IS NOT ACCEPTABLE DUE TO ITS ASSOCIATED RISKS.

ITEM 2 CONTINUED

- DIFFERENT LIFE AND HEALTH THREATS TO INHABITANTS OF AN AIRCRAFT CABIN SHOULD BE ADDRESSED WITH INDIVIDUAL RULE MAKINGS AS E.G. PRESENTLY UNDER WAY WITH REGARD TO FIRE HARDENING OF INTERIOR MATERIALS (SEE NPRM 85-10). SOLE INTEGRATION OF ABSTRACTS OF SUCH THREATS INTO AN EVACUATION DEMONSTRATION TEST SCENARIO WILL NEITHER ASSIST PASSENGERS NOR FLIGHT ATTENDANTS IN REAL ACCIDENTS BUT ONLY INCREASE THE OVERALL RISK OF INJURIES. FURTHER IT IS CONSIDERED THAT THERE IS NO TYPICAL ACCIDENT SCENARIO. FATAL AND/OR MAJOR INJURIES USUALLY ARE CAUSED BY DISTINCT HAZARDS FOR EACH INDIVIDUAL ACCIDENT.

APPENDIX TO MESSERSCHMITZ BÖLKOW BLOHM PRESENTATION titled

'AIRBUS EXPERIENCE related to Emergency Exits, FULL SCALE EVAC DEMOS ...'

NOTE 1, INSERT BETWEEN ITEM 1, P. 18 and ITEM 2, P. 1

Before entering into the presentation on the subject of full scale evacuation demonstration an answer shall be provided on the question of costs involved with evacuation tests. For recent tests costs range between .3 and .5 million DM in 1982 economical terms. The variation is largely due to difference in preparation as e.g. rework in interior arrangement, production aircraft availability and number of test persons.

Also Roger Brooks question shall be answered: Have ratings per the FAR 25.807 been achieved during evacuation demonstration? Test results achieved recently during which none of the test participants was company member:

Test 1, Fwd Door 109 persons in 66 seconds

Test 2, Aft Door 108 persons in 71 seconds

Test 2, Fwd Door 111 persons in 70.4 seconds

Test 2, Aft Door 114 persons in 70.5 seconds

This compares to a 110 passenger per type A exit pair rating. Tests mentioned above were run on same day, total available time for aircraft preparation and test execution was around 24 hours. The difference in results is largely a result of the crew for test 2 having already experience with the operation of the aircraft, whereas the crew for test 1 has been first time on board this aircraft type, having no experience with the aircraft.

Note 2 Insert below first subpara of A. 2, Item 2, page 2

The use of mini evacuation demonstrations could delete the need for slide operational checks and if performed at random e.g. with crew that has completed operational duties at end of day with aircraft might stop at maintenance base. Such performance would indicate performance levels for equipment as well as crews.

Note 3: Insert below line at page 2, item 2

As regards slide reliability Airbus have made a survey covering the time frame Jan 1980 thru October 1982. Our then 29 Airbus operators were addressed with requests to report on numbers of intended and inadvertent slide deployments. Out of these 29 operators contacted 19 operators reported representing 103 aircraft of A300 type. Reported deployments were as follows:

Doors	1+4	91	deployments
Doors	2	53	deployments
Doors	3	13	deployments
		47	unspecified doors deployments

Of those deployments problems were reported for:

Door 4, deployment with gusts above 30 knots wind, accordingly was not counted as failure although slide was L-shaped and rendered unusable corrective action was made

Door 2, During deployment attachment patch for release cable pulled off, resulting in unusable slide/exit.

Door 2, post deployment review showed partial separation of girt attachment to slide body. Was no functional problem, but precautionary measures were taken.

Door 3, Unsatisfactory deployment due to false installation of inflation hose during packing

Door 3, unsatisfactory deployment due to improper engagement of inflation hose, quick disconnect. Both door 3 problems resulted in revision of manuals and tools

The conclusion is that there were 3 actual problems out of 204 deployments. That is to say there are other means than evacuation demonstrations to check hardware

Note 4, Insert below for subpara to A.5, Item 2 page.

As regards the seriousness of the test scenario note should also be given to

• Post test interviews to recent Airbus Evac Demo's revealed that many persons were very afraid of stepping into dark, passing the door sill but commented that positive flow of evacuees made them to exit

• One test subject refused to exit, attempted to return to cabin from exit area but was forced out by two flight attendants.

Also during a real accident an aircraft veered off the runway which led to a broken nose landing gear. 314 passengers, 10 crew members were on board of which 126 were children aged below 14 years. The children enjoyed sliding and motivated the rest of the passengers to quickly evacuate the aircraft.

Note 5 Insert below last line of A.6, Item 2, page 6

The clearance ~~into~~ of an aircraft into life time on the basis of a single full scale emergency evacuation test performance is considered less relevant than e.g. a repeating type of verification of performances for singled out elements contributing to a successful evacuation performances.

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6-12

Please insert the following: page one, FAA PUBLIC TECHNICAL CONFERENCE, FULL SCALE EVACUATION DEMONSTRATIONS, Jody Thompson (IUFA) for the Joint Council of Flight Attendant Unions.

I would like to preface this presentation by stating that it is not the intention of the Joint Council of Flight Attendant Unions to precipitate undue injury to participants or crew of full scale evacuation demonstrations. Our goals are safe, realistic certification procedures and a reevaluation of exemptions and "mini" demonstrations.

In addition to the initial manufacturers full scale demonstration, carried out under CFR 14 Part 25.803, each carrier utilizing any new, rebuilt or modified aircraft should be compelled to perform a full scale evacuation demonstration. We acknowledge the cost to the carriers; we feel that the experience gained justifies that cost. Carrier demonstrations assess crew performance, procedures, training and serve as equipment and maintenance checks.

If the determination is made to continue the present certification requirement of holding a Part 25 and one full scale 121 demonstration, such as Pan Am 747, Roswell, N.M., 1969, we recommend that all users participate in, not just observe, either the Part 25 demonstration or the selected 121 full scale demonstration. Since the basic content of all flight attendant training is dictated by the FAA we feel that there would be no problem using a mixed carrier crew. We would all benefit by comparison. The Joint Council also advocates joint flight attendant/pilot emergency training.

Since 1965 there have been "over 100 exemptions" from evacuation demonstrations (FAA Amendment 121-176). In the April 17, 1985 Federal Register two carriers applied for exemptions under CFR Part 11. Both carriers, Eastern and World, have petitioned to operate a specified aircraft with one less flight attendant as determined by Part 121.391 requiring one F/A per 50 passenger seats, by blocking off two and four seats respectively. We are not aware of the disposition of these petitions but, we feel that an exemption in either case is not justified. The required flight attendants for the World Airways DC-10 with 354 seats is 8. Blocking four seats would allow 7 flight attendants to be used on virtually the same configuration. We believe: 1. that seats should never be blocked; seats should be removed from the aircraft, and 2. that an evacuation demonstration should be performed under 121.291(b)(2): changing the number, location or evacuation duties of flight attendants required by 121.391. We would like to know by what criteria the granting of exemptions is made.

FAA Public Technical Conference: Full Scale Evacuation Demonstrations.

Good afternoon, I'm Jody Thompson, Independent Union of Flight Attendants (IUFA), Pan American.

Today I'm addressing full scale evacuation demonstrations for the Joint Council of Flight Attendant Unions.

Since I'm the first speaker for the Joint Council I'd like you to know who we are. Briefly, we represent 17 U.S. and Canadian Air Carriers totaling 37,000 Flight Attendants.

Before proceeding to our recommendations for changes to full scale evacuation demonstrations, I am reiterating that it is not the Joint Councils' intent to promote injury to demonstration participants; safety is our first and only concern.

A Part 121 full scale evacuation demonstration serves as a learning experience for real crash situations. Though each crash is unique, NTSB studies show the recurrence of certain problems. Problems such as aircraft attitude and failure of interior furnishings: seats, sidewalls, galleys and overhead bins. Unfortunately, these items cannot be easily or practically simulated.

We urge the integration of the following items into 121 Appendix D:

1. Smoke
2. Realistic carry-on, 100% pillows, blankets, magazines, some earphones and newspapers. Delete "minor obstructions" from Appendix D(a) (10). Use Flight Attendants to "ready" the aircraft.
3. Use "injured" Flight Attendants (simulated injury).
4. Use simulated weather conditions, Ex: high velocity exterior fans.
5. At least one Flight Attendant occupied exit inoperative and, at least one unoccupied exit to be operative and not necessarily adjacent to the former.
6. Statistically inoperative/unusable exit(s) to be blocked (as shown by the NTSB).

Demonstration participants should not include any airline (except selected demonstration crew members or manufacturer employees). "Passenger" mix as outlined in 121 Appendix D (a) (7) is realistic. We recommend random seating, I.E. Passenger Choice, changing seats only where existing or future FAR's are violated. All evacuation decisions should be made by the FAA.

The partial "mini" evacuation amendment, adopted in 1981, as reflected in 121.291 (b) (no passengers present, slides deployed in 15 seconds) is, in our opinion, inadequate and in no way reflects the realities of an actual aircraft evacuation. A "mini" evacuation is essentially an equipment check.

Flight Attendants are taught the mechanics of all carrier emergency equipment, hands-on training, oral review and written testing are frequent. The mechanics are important but, the ability to assess, reason and make sound decisions in a changing environment is critical to the survival of passengers and crew. Therefore, an evacuation with no passengers is unrealistic. Training philosophies vary with each carrier; with a full scale demonstration carrier observers would be able to assess their "human factors"

Page 2.

The FAA study in Amendment 121-176, page 509, shows that under pressure, with passengers, Flight Attendants took longer overall to initiate full scale evacuations than their counterparts initiating partial demonstrations, with no passengers. We need statistics on real evacuation times to assess the validity of partial demonstrations. On page 507 of the Amendment (121-176) the FAA states. . . an emergency demonstration is a final dress rehearsal for an emergency evacuation". We believe this to be a correct assessment of full scale evacuation demonstrations.

We advocate an integration of the wording and requirements of Parts 25 and 121 including Appendix D as long as the content remains in both Parts. We feel that in the certification process the equipment cannot be separated from it's intended use. Our recommended changes are:

Part 25(7), 121(12): change to include use of carrier crews.

Part 25(14), 121(14): delete 6 month qualification, insert participant to be used once.

Part 25(17), 121(17): delete carrier choice, insert FAA choice.

Part 25(d): define "analysis".

The progress of aviation safety is good, but we must not become complacent; we must not regress or let cost dictate safety. Full scale evacuation demonstrations are still needed; they need to be upgraded. We learn by doing.

The Joint Council wants to help, in any way we can, to enhance the safety of our industry. We thank the FAA in general and the Northwest Region for allowing us the forum to express our position on the topics discussed here.

Referenced Documents:

CFR 14 Parts 11, 25, 121, 121 Appendix D, NPRM 81-1 Proposal 11-3, Preamble Amendment 121-176, Federal Register April 17, 1985.

KL2JN86

AIRCRAFT EXITS

My name is Ellen Hill. I am a Health and Safety Representative from the International Brotherhood of Teamsters, Local 2707, Airline Division. In addition to representing our own members (at Northwest, PSA, World Airways, Cascade, and others) I am speaking on behalf of The Joint Council of Flight Attendant Unions. Besides the IBT, the members of The Joint Council include Association of Professional Flight Attendants - representing American Airlines Flight Attendants, Independent Federation of Flight Attendants-representing TWA Flight Attendants, Independent Union of Flight Attendants-representing Continental and Air Micronesia Flight Attendants and Canadian Airline Flight Attendant Association-representing all the major Canadian or Carriers Flight Attendants.

Some of the various aircrafts on which our members work include: 747-100, 200 & SPs, DC 10-30 and DC10-10, Airbus, L1011, DC8's, 767's, 727's, 737's, DC9's, and MD 80s.

I am speaking on behalf of The Joint Council of Flight Attendant Unions on the topic of Aircraft exits. We will not address each aircraft individually, but rather speak to areas which are a concern to all.

One of our primary concerns is there should be no reduction of exits and future aircraft should be designed with the distance at midpoint to an exit as equal as possible. Increased distance to an exit during an emergency evacuation could result in precious time lost due to difficulty of visual sighting of exits and/or hearing and understanding a Flight Attendant when one is available. Given the failure rate, reported by the NTSB, of emergency exits, can the FAA afford not to maintain the same number and capacity of exits? With regard to the recent decision to deactivate the 747 overwing (L 3 & R 3) exits the distance at midpoint between exits 2 and 4 we feel is extreme.

Based on actual experiences we recommend escape lines or ropes be available at all exits. In a situation where slides may be burned, punctured, or fail to inflate ropes may be the only means of escape. These ropes could also be designed to be used to block an unusable exit.

We also urge you to research an audio or sound device which would automatically activate when an exit is opened for use in an emergency. This could greatly enhance the identification of exits unmanned by a Flight Attendant and obscured by smoke or darkness. This sound device should not interfere with Flight Attendant commands.

Compulsory reporting of all exit and slide failure.

We recommend that the FAA require that less than agile passengers not be allowed to occupy seats in an exit row as well as those seats one row forward and aft of an exit.

We also support a minimum standard distance set between rows at overwing exits as well as a minimum distance between aft facing F/A jumpseats and the 1st. rows of forward facing passenger seats.

Cont'd. . .

Page 2.

All of our recommendations were developed and are supported by active Flight Attendants including some survivors of aircraft accidents, some of which serve on our Joint Council. We realize that some of these recommendations involve additional costs, which is a valid concern and one which we have considered. We are more than willing to work with the FAA and all others involved to minimize these costs. However, cost should not be an overriding factor when safety is involved.

The Joint Council members are very interested and willing to work with all parties involved to improve the safety of the environment in which our members work.

KL2JH87

TRAINING

My name is Karen Lantz and I am the Vice President of the Independent Federation of Flight Attendants. I am making this presentation for Barbara Dunn, the National Safety Chairperson for the Canadian Airline Flight Attendant Association on behalf of the Joint Council of Flight Attendant Unions.

Training of cabin crew members has gone through some major changes over the past few years.

However, there are still a few areas that the Joint Council of Flight Attendant Unions would like to see addressed. Most of our comments will not be new to any of you, but their repetition only confirms that the need for positive action to improve our training is great. This need for change includes, but is not limited to, the need to standardize exits and emergency equipment, include joint training with pilots and ground fire fighting and emergency crews, increase the use of simulators, increase the frequency of training as well as increased training in hijacking and terrorism procedures.

1. Standardization of Exits and Equipment:

Many flight attendants, especially those who work for larger carriers, are required to be qualified on several different aircraft types at one time. Not only are we required to learn 5 or 6 different types of aircraft, we must also be knowledgeable with different configurations within a given aircraft type. This means that we must be conversant with several types of exits, and even more types of portable equipment as well as their location. This becomes even more of a problem when a F/A flies multiple legs in a duty day with an equipment change each leg.

Some airlines have successfully overcome this problem by restricting the types of aircraft a flight attendants may fly during a given period of time similar to the restrictions applied to pilots. This procedure may, however, place an unacceptable scheduling burden on the airline. Another solution to this problem would be to ensure that equipment standardization receives the attention it deserves. While exit standardization might create problems for the manufacturers, portable equipment and its location can certainly be standardized within given airline.

2. Joint Training:

Over the past years many accident reports have cited communication between crews in the forward aft portions of the aircraft as a contributing factor to problems and disaster during an emergency evacuation. It should certainly be no surprise to anyone here when we suggest joint pilot/flight attendant training as a remedy to the problem.

eg. In-Flight Fire: 1983 - Cincinnati
- severity of fire

O-ring Miami - flt deck sent in charge out of flt deck with no information - w/o information regarding how much time the cabin crew had to prepare the cabin does not afford Flight Attendants the opportunity or the ability to secure the cabin and prepare the passengers in the time that may be available to them, thus allowing only minimum preparation for the ditching.

Cont'd. . .

It should certainly be no surprise to anyone here when we suggest joint Pilot/Flight Attendant training as a remedy to the problem. When an emergency situation rears its ugly head we are expected to react as a total crew and yet most of us have never gone through an evacuation drill with anyone from flight operations. We must be cognizant of each other's duties and responsibilities before we can react as a team. We would also like to suggest that members of the ground fire and rescue teams at the airport be invited to observe F/A training. They will certainly be better prepared to do their job outside the aircraft if they know what to expect from us.

3. Use of Simulators:

Most airlines are now making use of cabin simulators in their training programs. While we agree wholeheartedly with this method of training we would like to stress the importance in making these sessions as realistic as possible. "Hands-on" training should replace written exams wherever feasible and the simulation drills should be very real, perhaps even duplicating actual past emergencies. Simulators are more sophisticated today and even in those instances where new Flight Attendants are being trained in these simulators, those of us who are more senior are not required to take recurrent in these simulators. A review of past accidents is also an effective training tool especially if photographs or videos can be used to emphasize the fact that accidents do happen and as crew members we must always be prepared.

4. Frequency of Training:

Current regulations require cabin crew training of a given number of hours to be conducted once every twelve months. Some airlines require training once every 6 months and The Joint Council heartily approves of this approach.

Additionally, many of us have not been required to go down an emergency evacuation slide since initial training nor go through a wet ditch more than once in our career.

5. Hijacking & Terrorism:

The Joint Council would like to applaud the F.A.A. in their efforts to increase the amount of training regarding hijacking and terrorism. Certainly the events of the past few months clearly point out the need for improvements in this area and we would like to offer our full cooperation.

In closing we would like to emphasize that training is not something that only takes place once a year. It is a process that should be reinforced every day a Flight Attendant goes to work. The importance of crew safety briefings before every flight cannot be over looked. Nor should we ignore other methods of reinforcing our main role on board such as in-house safety programs, joint Union/Management safety committees and a good library of safety information at each Flight Attendant domicile to name just a few.

The Joint Council would like to thank the FAA for allowing us to present our views and we look forward to working with you on areas of common concern.

Thank you.

SLIDES

Good Afternoon ladies and gentlemen, my name is Janna Harkrider. I am the health and Safety Chairperson for the Union of Flight Attendants, Local No. 1.

One of the major points the Joint Council of Flight Attendant unions would like to present to the FAA today concerns the high percentage of slide failures during an evacuation.

The Joint Council decided to come up with the worst possible scenario for a survivable accident. This hypothetical case included a 747 with doors 3L and 3R removed, one slide was inoperative before takeoff, a collapsed main gear and fire were present on one side of the aircraft. Add to that the documented 40 percent fail rate of escape slides and you will have 3 or possibly only 2 slides to complete the evacuation.

As I was reviewing the hypothetical case, it immediately reminded me of a DC 10 accident in 1978 in which I was a working Flight Attendant. Following a rejected takeoff, the left main landing gear collapsed, puncturing the fuel tanks, and as a result, the entire left side of the aircraft was unusable due to fire. Of the four remaining slides on the right side of the aircraft, 4R failed because of an apparent overload when passengers went onto the slide faster than those at the bottom of the slide could leave it. This situation resulted from the combined effects of (1) the deployment angle of the slide, and (2) a design feature inherent with the slide/raft concept. (PICO 26). The overwing ramp for slide 3R malfunctioned. Slide 2R burned after approximately 35 passengers had evacuated. Slide 1R failed due to radiant heat damage.

All four of the slides failed before the evacuation was completed. Passengers and crewmembers who were still in the aircraft either jumped to the ground or slid down the escape rope from the first officer's window in the cockpit.

Seven passengers died that day or as a result of their injuries, 71 passengers and crewmembers were treated for burns, smoke inhalation, fractures, abrasions, contusions, and rope burns. All of the deaths and injuries occurred during the evacuation, none during the accident itself.

The Joint Council would like to make the following recommendations to the FAA that we believe will improve the reliability of slides and provide for safer evacuations in the future:

- (1) We feel airlines should be required to report all emergency evacuation slide deployments, failures, and functions.

- (2) Develop a maintenance surveillance program to insure greater reliability of emergency evacuation slide systems.

- (3) Amend 14 CFR 121.310 to require, after a reasonable date, that all floor-level slides be automatically inflatable.

- (4) Require a puncture test in addition to the tensile strength and tear strength and recommend low heeled shoes to be worn by crewmembers for takeoff and landing.

Cont'd. . .

Page 2.

(5) We feel all slides should be checked completely by mechanics once a year and replaced to meet the TSO-C69A standards.

(6) We think mechanics should be required to have hands-on training from the manufacturers for the installation, care and maintenance of slide/rafts.

(7) Extra care and precautions should be taken with slides located in galley areas. . . coffee, grease, food, and environmental exposure are prevalent due to the doors being opened for catering.

(8) Encourage manufacturers to design slides that will reach the ground in the case of aircraft attitude changes.

We do promote and support heat resistant slides and feel they should be installed as slides not meeting the TSO-C69A are due to be checked.

We urge the FAA to incorporate the empirical evidence of past accidents and reporting systems as well as testimony from crash surviving crewmembers when considering rulemaking.

The Joint Council wishes to express their willingness to work with everyone in the airline industry to change the grim statistics we are facing today.

And we thank you for providing this opportunity to speak to you on these matters.

KL2JN89

FLIGHT ATTENDANT JUMPSEATS

My name is Karen Lantz, Vice President of the Independent Federation of Flight Attendants, speaking on behalf of the Joint Council of Flight Attendant Unions. I am happy to be here today sharing with you Flight Attendant concerns regarding jumpseats.

This year, marks the 55 year history of Flight Attendants in the United States. In researching material for this Conference we found an old picture of one of the original Flight Attendant jumpseats. It looked like today's metal folding chairs that you might find around a card table; except this Flight Attendants jumpseat had its back attached to the interior of an airplane. Thankfully we no longer have to "live with" that old folding metal chair jumpseat, but today's Flight Attendant jumpseats still fail in many ways to consider the safety and security of their occupants, and the safety and security of our passengers.

Repeatedly, the Unions representing Flight Attendants hear these same questions:
Who designed these jumpseats?
Did they consult with Flight Attendants?
Did they even consider the dimensions of Flight Attendants in the design?

So today we are posing those same questions to you. We do not choose to single out any particular aircraft manufacturer. . . on the contrary, we have comments for Boeing, as well as Lockheed and Douglas.

We are tired of seat belt and shoulder harnesses that do not fit;
Seatbelts that hit mid-chest rather than across the lap;
Or as on some 747's where the shoulder harness attachment is placed so high that the harness crosses the sides of the face;

Or take the situation on some 767's where the shoulder harness does not retract after the Flight Attendant is no longer seated. A Flight Attendant must get up, face the seat and manually thread the harness into the housing as it is not possible to do so while seated. Or, the Flight Attendant might be one of those erroneously informed by their Airline that a loose shoulder harness is not unsafe as it will "catch" in an emergency. Unfortunately these loose 767 shoulder harnesses are not even hanging in format of the body.

Seatbelts should be designed for quick entry and egress. And certainly should not inflict injury on the Flight Attendant.

Consider the situation on some MD-80's, and the difficulties Flight Attendants have in getting problems resolved: The following is a report by a Flight Attendant to her Airline management outlining the safety problem of the forward jumpseat, which is adjacent to the forward left door on the MD-80;

" The stair extension handle and its protective padding protrudes into my left shoulder blade when I am strapped into F/A jumpseat "B". I am 5'9"

Cont'd. . .

Page 3.

sit with their legs on an angle due to limited space rather than on the floor. An angle which would enable them to sit with their feet flat on the floor.

In regard to positioning of Flight Attendant jumpseats; we never again want to see galley mounted jumpseats. The in-aisle jumpseats which are attached to the galley bulkhead on some MD-80's and some 727's should also be banned for the obvious safety hazards that they pose protruding into the aisle and having no headrests.

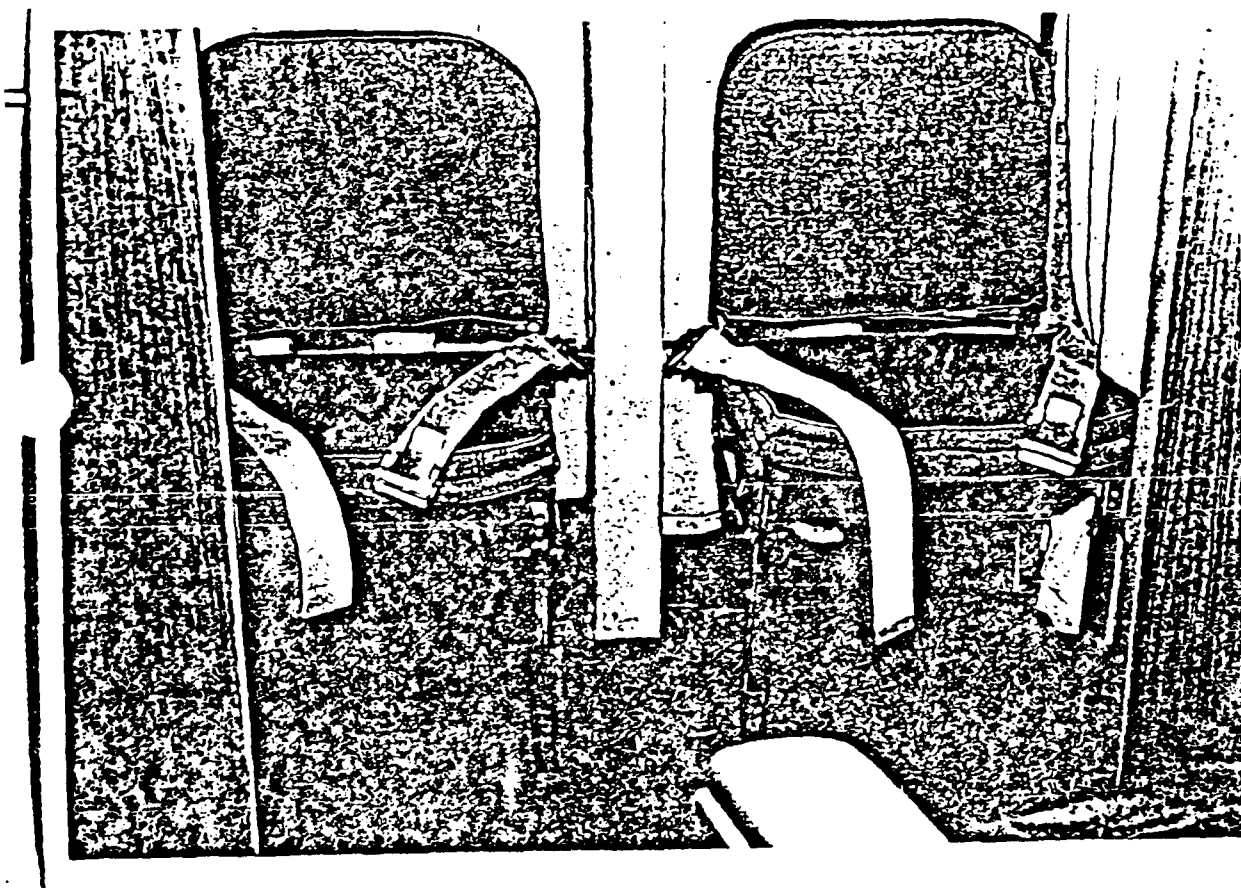
Other Flight Attendants are forced on some aircraft to sit with their knees up against aisle serving carts while seated in their jumpseats. Obviously bad planning when it came to positioning of jumpseats in conjunction with equipment.

Flight Attendants are already being injured on those L1011's which have allowed the stowage of aisle serving carts in cabin level service centers, rather than in the lower level galley, during take-off and landing. The carts, which have no secondary restraint systems are breaking loose and crashing into Flight Attendant jumpseats.

In conclusion, we implore the FAA to move toward standardization of seatbelts and shoulder harnesses. Standardization will not only cause a more safe environment through uniformity, but also protects the Airlines and manufacturers who might hesitate to take the lead in improved Flight Attendants safety because of industry competition.. We also request that the manufacturers consider the input of Flight Attendants and design with the Flight Attendant in mind.

Thank you for affording me this opportunity to speak on behalf of the Joint Council of Flight Attendant Unions. I will be happy to answer any questions you may have.

KL2JN90



SUMMARY

The Joint Council of Flight Attendant Unions was happy to be able to share with you our concerns on the variety of safety related issues that this Conference addressed.

Although all of us here at the Conference come from different perspectives on the issues, we do share the common goal of the safest possible environment for the occupants of an aircraft.

In this 55 year anniversary of Flight Attendants in the industry, we want to direct those responsible for the aircraft environment to place more emphasis on cabin safety and the Flight Attendant.

In researching for these presentations, the Joint Council found many old letters to former FAA Administrators and other officials, outlining Flight Attendant areas of concern. It is discouraging to note that many, if not most, of the areas of concern are the same as they were several years ago. One of those letters addressed a presentation during a September 2, 1976, "Listening Session With Flight Attendants". The FAA "listened" to Flight Attendants on some of the same concerns addressed at this Conference as well as the long overdue need for Duty Time limitations for Flight Attendants and restrictions on Carry-On Luggage. That was 1976. We must believe that through these "Listening Sessions" that the FAA and others have finally "heard" and that the 55 year anniversary of Flight Attendants will bring recognition of the Flight Attendant as the responsible safety professional that she or he is.

Few groups invite FAA scrutiny and inspection. We do and we would like to see the FAA appoint more Cabin Safety Inspectors.

The Joint Council of Flight Attendant Unions is prepared to work with the FAA, the manufacturers and the rest of the industry in any way possible. We enjoy the input of thousands of Flight Attendants at a majority of the carriers in the United States and Canada. Our members fly on virtually every type of equipment, and our Safety and Health Directors have experience as current or former Flight Attendants of, undoubtedly, every working situation that a Flight Attendant may endure. Included among our Directors are airline crash survivors.

We thank you for your attention and we know that together we will make this 55 year anniversary a year of progressive change, and truly the year of and for the Flight Attendant.

KL2JN91

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FEDERAL AVIATION ADMINISTRATION

NORTHWEST MOUNTAIN REGION

TECHNICAL CONFERENCE

SEATTLE, WASHINGTON

SEPTEMBER 3 - 6, 1985

TYPE CERTIFICATION DEFICIENCIES AND THEIR EFFECT
UPON ACCIDENT SURVIVAL

Presented by

Roger Brooks
Accident Survival Committee
Air Line Pilots Associations

SEP 11 1985

I am honored to be a speaker at this conference and honored to represent the views of the Air Line Pilots Association. I, like you have read and heard many judgments of ALPA. A common critical theme is that we are champions of our own interest and therefore are self-serving. It is as if we don't have the right, as does corporate america and all individuals in this country to protect and promote our own best interests.

Yet I am not here today to advocate better pay or working conditions or even greater safety for our 34,000 members. I stand before you voicing our memberships concern for the safety of over 235,000,000 American citizens. Those who are airline passengers and those who are potential airline passengers. It is well known in the aviation industry that ALPA, in the strongest terms, protests the unwise, callous and self-serving decision by some Boeing 747 series 100, 200, and 300 operators to remove existing emergency exits from their aircraft and to order new aircraft without these exits. To date, all aircraft modified to an 8 exit configuration are foreign registered. We commend the U.S. airlines who unanimously have resisted the temptations of avarice.

We have found no public records indicating that the Air Transport Association or any individual member airline has advocated or recommended the removal of emergency exit pair number 3, the overwing exits. Data provided by the FAA's Office of Airworthiness lists public comments on this issue. There are 17 letters by U.S. Senators and Representatives, 10 letters from industry trade groups, 2 from corporations, 20 from individuals along with the National Transportation Safety Board and Transport Canada. Every one of the above comments was in opposition to the deletion of the 747 overwing emergency exits.

It is interesting, even curious that only one public defender of this action exists, the Federal Aviation Administration. We have yet to receive an explanation from the manufacturer as to why exit pair 3 should be removed. We have yet to hear from an operator detailing the financial benefits of such a change. Surely we don't have a modification that has no benefits but only exists because it is labeled legal. It should not be necessary to purchase a 747 in order to obtain this information.

The FAA's March 1985 review of the 1984 design change stated that "This approval was not unprecedented, several previous approvals have been granted by the FAA to deactivate doors". The examples given are all narrow-body aircraft modified from cargo service or originally equipped with additional exits ordered at customer request. There exists no direct applicability between these examples and the amended type certificate granted Boeing. This argument is without foundation. This same review, written by the certificating region states that "...evacuation-test films clearly show that the time to reach an exit is dependent upon the number of people between the evacuee and the exit, not the distance". This may be true in evacuation tests but we cannot lose sight of the fact that these exits are not positioned for testing purposes out as escape routes in life threatening situations.

In the definitive joint FAA and NTSB effort titled *Survival In*

Emergency From Passenger Aircraft prepared by Dr. Clyde Snow and Mr. John Carroll; a correlation between distance to an exit and survivability is established. Some quotes from this study are as follows: "To some extent, the time that a given passenger is exposed to the lethal cabin environment will be a function of the distance he must travel to reach an exit. The hypothesis that probability of survival might be influenced by seat to exit distances, therefore appears a reasonable one" and "While such tests are valuable in establishing minimum evacuation times for a given configuration, the findings of the present study should encourage extreme caution in any attempt to extrapolate test results to actual emergencies".

The FAA's August 1985 review issued as a report to the Administrator concludes that public comment has failed to demonstrate that the modified aircraft design is not in compliance with all applicable airworthiness standards. ALPA challenges that opinion. The basis for last years overwing exit deletion is that a 10 exit Boeing 747 has been successfully tested to allow evacuation of 550 passengers. A 1969 test that did not evacuate 550 passengers within 90 seconds was declared successful. The slide at door 5 failed and by analysis it was determined that the evacuation would have been completed in 90 seconds if all slides functioned. At no time have 550 passengers been evacuated from a Boeing 747 in 90 seconds. From the information available to me, I find no instance when 550 passengers have simultaneously been inside a Boeing 747 series 100 or 200 nor have 550 seats ever been installed. In this 1969 full scale evacuation demonstration some "passengers" for whom seating was unavailable, waited outside an exit door on a ramp and entered after the evacuation had begun. This produced an enviable load factor of more than 100 percent. These people might be called "migratory test subjects" but they most certainly do not fit the dictionary definition of passengers nor were they complying with FAR 25:803 (C) 10 and 13 and FAR 121:311. No waivers, deviations or exemptions are known to have been granted for this full scale evacuation demonstration. An opportunity to validate the 550 passenger evacuation capability of the 747 existed in 1974 with the full scale evacuation demonstration of the SR high density model. For some reason a 527 seat configuration was used. If 23 more seats and passengers were on board and if Boeing had chosen to use the required passenger mix as defined in FAR 25:803 (D) 8 and if the crew training had approximated the best trained line crews required in FAR 121:291; then the 550 figure may have been validated. But it was not validated and is still not validated.

It is from this frail precedent that the 8 door configuration receives its legitimacy. Given that 550 people can be evacuated in a 10 exit configuration as demonstrated in the successful test that failed, it was concluded that an 8 exit configuration will evacuate 440 main deck passengers within the 90 second time limit. As in all deductive reasoning, the conclusion cannot be more accurate than the assumptions used. Although the 747 SP model sports a distance between exit door pair 2 and 3 of more than 60 feet, no full scale demonstration was conducted. Based upon design similarity, the 747 evacuation data base previously mentioned plus a World Airways full scale demonstration of a full size model which failed to exit 461 passengers in 90 seconds, this aircraft was by analysis only, approved to carry 400 passengers. The 747 series 300 with the lengthened upper deck is flying in

both the 8 and 10 exit configuration approved only by analysis. The maximum passenger loading is 660. Boeing now proposes the 747 model 400 with 8 main deck exits and featuring a 2,500 gallon fuel tank located in the tail. In the September 2, 1985 Newsweek, a Boeing spokesman was quoted "We still believe we build as safe an airplane as humanly possible". This claim remains unproven.

It is evident to me and I hope to others that some full scale evacuation testing must be done. Boeing has yet to prove that any 747 model can be evacuated with a maximum passenger load within the regulations and without analysis. No manufacturer has successfully conducted a full-scale evacuation demonstration with 110 passengers per Type A exit pair in compliance with then existing regulations. ALPA has noted that all evacuations by all U.S. manufacturers is done using either all right side or all left side exits. This is permissible under the regulations. It is true that occasionally an airplane is evacuated totally from one side but there is no correlation between this practice and accident experience. Evidently, an evacuation demonstration can be conducted more efficiently and faster using only one side. But how much more efficiently and how much faster? I don't know and neither do you. How great a problem is bunching when using opposing exits? What problems exist when all forward or all aft exits are used? What will happen if the flight deck crew is unable to assist in the evacuation? What effect does seat density, aisle width, dropped tray tables, smoke, unusual attitudes, and predictable passenger confusion and panic have on evacuation efficiency? Since the FAA's Northwest Mountain Region is charged with new aircraft certification, I suggest that they sponsor studies to provide these and other answers thus supplying a helpful base for aircraft designers.

A design goal of this conference is to provide input to the FAA for, and I quote Admiral Engen in a letter to ALPA, "a rigorous reassessment of the regulations governing the design of evacuation systems and the way transport airplanes intended for air carrier service are certificated". In a June 1985 letter to all U.S. airline presidents operating Boeing 747 aircraft, Admiral Engen explains his responsibility to establish minimum standards governing the design of aircraft. He then reminds these gentlemen that Title VI, Section 601 of the Federal Aviation Act obligates both him and the air carriers to "perform their services with the highest possible degree of safety in the public interest", then recommends that U.S. airlines do not delete emergency exits. We thus have on one hand an aircraft modification which "complies fully with all applicable safety regulations" yet in the opinion of the Administrator, is not consistent with his and the air carriers obligations under the Act. Thus a dichotomy of goals and standards may exist between Section 601 and Section 603 of the Federal Aviation Act. Evidence of this is our current squabble over the 747 exit deletion issue.

My overriding goal today is not to differ but to agree on methods to insure that our future as an industry is as noble as our past. As the part owner of a struggling airline, I am acutely aware of the necessity to remain both competitive and cost conscious. Since airline deregulation, all costs have come under scrutiny including the cost of operation above the minimum required safety level. We are challenged and time will reveal our character.

Nearly all of us in this room benefit from airline passengers. Some of our salaries are directly paid from ticket revenues and others of us are more remotely remunerated. While price elasticity exists, air travel is indispensable. The public will pay for what benefits them. Uniformly administered safety improvements will be passed on and paid by willing passengers while enabling individual airlines to maintain their cost competitiveness. We must protect those from whom we benefit. We must protect the integrity of this industry. We must.

EXITS

Presented by
James T. Likes
Senior Manager
Payload System Design
Boeing Commercial Airplane Company

Presented at
The FAA Technical Conference on Emergency
Evacuation of Transport Category Airplanes
September 3-6, 1985
Seattle, Washington

(J. T. Likes)

Good afternoon/morning ladies and gentlemen. I'm Jim Likes, Senior Manager of Payload System Design for the Everett Division of the Boeing Commercial Airplane Company. My purpose in being here today is to discuss the design of exits on commercial jet transport airplanes.

INTRODUCTION

There are three general categories of exits in the design evolution of an airplane. Passenger doors for boarding and deplaning passengers from a variety of airplane types and interior configurations. Service doors to allow for servicing galleys, interior housekeeping and maintenance and, in some cases to provide for crew boarding and deplaning. Then there are emergency exits. All doors in the airplane are, by definition, emergency exits and are a part of an emergency evacuation system which must meet all FAA requirements.

All emergency exits must satisfy the evacuation requirements of the airplane. The emergency evacuation system consists of the exit door itself, together with emergency descent devices, interior and exterior emergency lighting, markings and instructions, access via the aisles and passageways, exit path identification, and attendant assist space.

My remarks today will focus on the emergency exits used in the evacuation systems in the current Boeing family of airplanes. Included will be exit numbers, sizes and capacities, distribution and spacing, marking and location identification.

The current Boeing family of commercial airplanes includes models 747 and 767 (which are dual-aisle airplanes) and models 757 and 737 (which are single-aisle airplanes), and their respective variants.

Exit sizes in all Boeing models are represented on the following diagram.

NUMBER AND CAPACITY

- o Passenger emergency exit requirements are defined in FAR 25.807. Except for tailcone or aft ventral stair types of exits, all exits defined in this FAR are pairs. These exit pairs are Types A, I, II, III and IV in descending order of substantiated passenger capacities. This part of the regulation includes a table of various exit combinations of these exit pairs (exclusive of the Type A exit) to accommodate aircraft seating capacities up to 189 passengers. The standard provides maximum passenger totals based on combinations of exits but does not provide a specific rating for each exit type.

The standard is the result of evolution of very early airplane development prior to 1966 and is not directly suited to today's large jet aircraft without the help of the subsequent paragraphs in the FAR's. For airplane seating capacities continuing upward to 299 passengers, the regulation provides that additional pairs of exits must be added to the table combinations, with the exit pair types rated at 110 passengers for Type A, 45 for Type I, 40 for Type II and 35 for Type III. For airplanes exceeding 299 passenger seats, the current standard considers only Type I and Type A exit pairs.

Each Type I and Type A exit in the current Boeing family is an emergency escape system which includes an inflatable escape slide or slide/raft, emergency lighting and emergency markings. The most recent exit definition to be included in the FAR's is the Type A exit.

HISTORY AND DEVELOPMENT OF TYPE A EXIT

- o A brief history of the Type A exit seems in order here to help provide a basis for upcoming discussions. The Type A exit was proposed by Boeing during the early development of the 747 in 1965 and 1966 to accommodate the new generation of large jet aircraft. Previously all emergency exits defined in the FAR's had been single lane exits regardless of size, with passenger capacities on a per exit pair basis only inferred from the capacities allowed in the existing table of exit combinations. The Type A exit was to provide a dual lane exit with a dual lane slide. This provided a greatly improved level of evacuation capability, and kept the number of exit "holes" in the airplane structure of these large 2-aisled aircraft down to a practical number, based on airplane capacity, structural limitations and distribution requirements.

The 747 program was implemented in March of 1966 and by September of 1967 the FAR's had been amended to recognize the 747 and other similar types of large jet aircraft. At that time a rating of 100 passengers per pair of Type A exits was established based on a conservative demonstrated exit/slide system capacity using prototype slides and structural mockups of the new Type A exit.

As service experience accumulated, industry efforts continued toward up-rating the Type A exit from 100 to 110 passengers capacity per pair to more accurately reflect the real capacity of the Type A exit, including the conservatism built into the mass of accumulated data. The petitions requested a rating of 115 passengers per pair of Type A exits, although the data contained peaks of 145 passengers per exit/escape system with averages around 130+ passengers.

It was very apparent from the beginning that the Type A exit/evacuation system had much greater capacity based on testing, evacuations and analysis of the evolving exit/escape system than the regulation recognized. The exit/escape system capacities were typically verified using matured exit/evacuation systems. FAA continued to monitor the data and the service experience and the regulation was finally amended.

In December of 1976, the FAR's were amended to conservatively up-rate the Type A exit pair to 110 passengers based on responses to NPRM 75-40, on test data accumulated subsequent to establishing the original rating and on proven in-service reliability statistics of the Type A exits and their escape systems then in use in the industry.

DISTRIBUTION

- o Distribution of exits together with type and size are elements which have been considered in the development of all the Boeing family of airplanes and are the starting point for new designs.

Exit distribution requirements are defined in the FAR which states in part, the emergency exits must be distributed as uniformly as practicable taking into account passenger distribution. The application of this rule includes consideration of sufficient exits based on geometric airplane zones and passenger density, to meet the standard.

DISTANCE

Exit to exit distance is only one of many parameters involved in design and has been governed in the past by other more controlling parameters. The FAR's have never specified exit to exit distances. It has always been the emphasis of the FAA to regulate those parameters which have been shown, over years of data gathering, testing, hearings and the due process of regulatory reviews, to have an influence on the evacuation capability of airplanes. To date, exit to exit distance has not been shown to be one of those parameters.

The controlling parameter is time. Initially, in 1963 a time limit of 120 seconds was established for the completion of an evacuation demonstration by the operators under FAR 121, to show crew proficiency in the use of equipment, and to verify training procedures.

The 120 second standard was verified by FAA based on data available at that time regarding "survivable" accidents. In an effort to improve safety margins, the FAA and the industry worked to revise the time standard downward to 90 seconds. The 90 second plateau was established as an adequate reflection of the "real world" time available during "survivable" accidents.

In late 1967 the time limit was reduced from 120 to 90 seconds for completion of a successful evacuation demonstration and, in addition, evacuation demonstration requirements were extended to include manufacturers. With diligent work by the industry in equipment design and development of rapidly operating automatic doors and slide inflation systems, this standard was met. For manufacturers, the standard requires that within 90 seconds, an airplane must be fully evacuated commencing with an alert, then door preparation, assessment of conditions outside and around the exits, door opening, deployment and activation of the inflation system of slides, all prior to the first person leaving the cabin and entering the slide.

Another significant parameter is the nature of the evacuation process itself which was discussed earlier in this conference.

A further important parameter is Passenger Density. For every model in the current Boeing family analyses have been provided to the FAA relating exit distribution to passenger density.

Another parameter that influences the evacuation capability is the phenomenon of Queuing. Queuing is a function of other parameters in the airplane such as the ability of aisles, cross aisles and exit access from the aisles to feed airplane occupants to the exits at a rate faster than the door rate, regardless of distances in the current generation of approved airplanes.

What you are about to see will show that there is queuing at forward, overwing and aft exits of an airplane after about 20 seconds. This clearly demonstrates that exit to exit distance is not a factor, and that as exits begin to go "dry", passengers are re-directed from the queues to the more available or "dry" exits. The re-direction action is a standard procedure included in crew training.

(Video here)

- o Evacuation data. (including video/time tapes of full scale evacuations), computer models and FAA evaluations have all served to verify that the controlling factor in evacuations within the FAR requirement of 90 seconds, is not the distance between exit doors, but the nature of the exit/escape system installed. Passengers, regardless of their proximity to an exit, must still vacate their seats and enter into the flow to the available exits, with the flow rate out of the exit controlled by the door and the escape slide.

All available data show that queuing occurs at all available exits in an evacuation, negating the effect of distance from the exit, within the limits of today's regulations and designs.

The following excerpts further substantiate this conclusion:

From FAA Civil Aeromedical Institute (CAMI) Report No. FAA-AM-78-23 dated June 1978.

"Moreover, available data indicate that evacuation times are determined by movement through exits following door preparation and slide deployment and thus delays inside the aircraft are not a limiting factor."

From the FAA Study Material in the preamble to Amendment 121-176.

"Research tests and evacuation demonstrations show that passengers tend to form continuous lines at available exits when evacuating an airplane."

". . . the rates of passenger egress are not significantly different within each type of exit and that changes in the passenger cabin configuration" (exit to exit distance) ", seat pitch, and aisle width have no significant bearing on the egress rates if the aircraft certification requirements for minimum aisle width and exit accessibility are met."

DEACTIVATION

Before discussing deactivation, I believe it is appropriate to review the process of which airplanes and their exit configurations are developed. Because of the wide variation in the operational modes of airlines, the quantity of passenger seats varies substantially. The difference in the number of seats can vary by as much as 200 passengers. With the increased need to utilize air transportation for both passenger and cargo on the main cabin of airplanes, sufficient exits are placed in an airplane to accommodate all possible cargo/passenger combinations. Generally, airlines order airplanes that provide for the flexibility to handle operational changes. As their operational modes change airlines frequently find that the flexibility originally afforded to carry high density or cargo alternatives is not required for their current operations. If they continue to remain with exits placed in the airplane for entirely different operational configurations, they are placed at a disadvantage when directly competing with other airlines who utilize other aircraft that did not originally consider additional exits for airline flexibility. It is illogical to expect that 2 different aircraft carrying the same quantity of passengers would be expected to meet different exit standards.

Precedents exist for exit deactivations. All deactivations have been for exits in excess of the number required by the FAR's. In each case all FAA requirements had to be met, including distribution of the remaining exits, before the FAA approval was issued. Following is a summary of those FAA-approved exit deactivations constituting precedent:

1. Model 727-222, T. C. A3WE, STC No. SA4091WE--Deletion of a pair of excess Type I exits. Issued November 29, 1979. STC holder: United Airlines, San Francisco.
2. DC-8-61, T/C. 4A25, STC No. SA4063WE--Deletion of a pair of excess Type I exits. Issued January 22, 1980. STC holder: United Airlines, San Francisco.
3. 747, Malaysia Airline Systems (Modified by Boeing for British Airways prior to BA sale to MAS)--Deactivated excess Upper Deck L.H. Type I. March, 1982.
4. DC-8, STC No. SA2432NM--Deactivated two pair Type I and one pair Type III. STC holder: AiResearch.
5. 707, STC No. SA5600SW--Deactivated a Type II exit pair. STC holder: Buffalo Air.
6. 707, STC No. SA5706SW--Deactivated a Type II exit pair. STC holder: Premier Air.
7. 707, STC No. SA5784SW--Deactivated a Type II exit pair.
8. 707-323C, T.C. 4A26, STC No. SA655GL--Deactivation of a pair of excess window exits, at Station 990. Issued November 2, 1982. STC holder: American Trans Air, Indianapolis, Indiana.
9. On August 8, 1983, Boeing made formal application to the FAA by letter requesting approval of the deactivation of exit door No. 3 on the Model 747. Boeing received that approval from the FAA Northwest Mountain Region on September 2, 1983. Following this approval, the first production airplane to receive FAA certification with the deactivation of exit door No. 3 was certificated on June 1, 1984.

It should be emphasized that these nine precedents represent a significantly large number of airplanes in airline operation. Many of the precedents are for more than one airplane in the applicant's fleet.

To reiterate earlier remarks, the airlines served by Boeing exercise a significant participation in the design process. The deactivation of exit door No. 3 on the model 747 was developed as an option, to best serve their current operational requirements, yet still complying fully with industry standards for exit safety. There are various reasons for this option, but the german question is, why should there be a separate set of rules for a 747 with 8 doors and fewer than 440 passengers? What are the facts that would require changes to today's industry standards? To date, no facts have been brought to bear that would indicate a need or necessity to change. However, this conference should provide a basis for a working environment to allow those who have facts to come together in effective working groups that would result in positive improvements.

MEANS FOR MARKING AND LOCATING

- o There are several major areas of consideration in identifying and locating emergency exits in the cabin of an airplane. One is the marking of the routes to the exit and the exit itself; another is emergency lighting to allow the exit and markings and the route to be identified; and another more recent requirement is special path marking to supplement the first two areas of consideration and improve the evacuation process. Requirements covering these areas are all specified in the current FARs. Overall, the marking and locating of exits is a very detailed and complex subject with regard to the current FAR's and is indicative of the thoroughness of FAA in regulating these areas. Following is a summary of pertinent parts of the FARs.
- o The requirements for Emergency Exit Markings are defined in FAR 25.811. The current regulation requires that for each exit, its means of access and opening operation be clearly marked.

The identity of the exit and its location must be recognizable from a distance equal to the cabin width. The location of the exit must be identified by signs visible to passengers approaching along the aisle.

Signs must be located at the exit, in the aisle at the exit and on any cabin divider or bulkhead that prevents a view along the cabin.

Operating instructions for opening the exit from the inside must be provided which are readable at a 30 inch distance. Type A and Type I exit operating handles must be illuminated taking into account crowding. Illumination is also required for Type III exit handles and instructions. Types A, I and II exits must meet specific requirements for operating direction arrows and "OPEN" position for the handles.

Operating instructions and a 2 inch color band outlining the exit are required on the outside of the airplane, with very specific contrast requirements for the band, to assure ready identification of the exit by rescue personnel.

- o The requirements for emergency lighting are covered in FAR 25.812. The current regulation requires that the emergency lighting system be powered in an independent manner to assure its operation regardless of other power failures. This emergency lighting requirement includes exit marking and locating signs, aisle and exit area lighting, general cabin illumination required for emergency, floor escape path marking and exterior emergency lighting.

Included in the FAR's are detailed regulations regarding exit sign illumination and letter to background ratios and sizes, lighting for main aisles and, in the case of double aisle airplanes, lighting for the necessary cross aisles, exit area lighting both inside and outside the airplane, details on escape slide and wing area lighting and light levels for all of these areas. Also detailed are regulations related to duration of lighting and survival of the equipment and power sources taking into account crash loads and fuselage separation.

- o The FAA has recently revised the FAR's to address the problem of locating exits in conditions of dense smoke. This new requirement is referred to as Floor Proximity Emergency Escape Path Marking. It requires that emergency evacuation guidance must be provided for passengers when all sources of illumination over 4 feet above the cabin floor are totally obscured.

This change in the regulation is indicative of the continuing effort of FAA and the industry to improve airplane safety through the formal regulatory process, based on well founded, proven data and testing. The change is based on findings of the FAA, and several of their supporting groups, the SAFER (Special Aviation Fire and Explosion Reduction) Advisory Committee and The Civil Aeromedical Institute, and has had the benefit of both public and industry input prior to adoption as regulation.

SUMMARY

- o In summary, exit sizes, quantities and their performance factors as governed by the FAR's have been developed through sound and logical design processes. Exits must meet rigorous standards and are continually being analyzed and tested.
- o Time, the evacuation process, zone-by-zone passenger density, exit distribution, and queuing are the more meaningful parameters in a total evacuation system. The exit-to-exit distance parameter is adequately self-governed by the other parameters and by the current regulations, and should not be singularly regulated.
- o As in all rule making and criteria establishment, we must strive to provide a clear understanding of all that is required in achieving the highest safety standards. An improvement in the regulations as they deal with the performance factors leading to the various passenger ratings per exit requires an improvement of understanding by those within the air industry. Certain exits have been derived through policy evaluation against policy criteria. The current regulation in the area of exit distribution has required policy to clarify.

Consideration of adopting policy as rules and criteria should be considered. The industry will continue to evaluate and make recommendations to improve the evacuation system performance as noted in the recently adopted regulation dealing with floor proximity exit path markings.

- o As the airline industry continues to evolve and operational requirements change, a need exists for the flexibility to adjust airplane exit configuration to a sound and safe level commensurate with current operating airplane configurations.

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- **HISTORY AND DEVELOPMENT OF TYPE "A" DOOR**

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- FAR 25.811 EMERGENCY EXIT MARKING

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- AMEND. 121-183 (FAR 25.812 (E)) FLOOR PROXIMITY
EMERGENCY ESCAPE PATH MARKING

- **SUMMARY**

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BRIEF

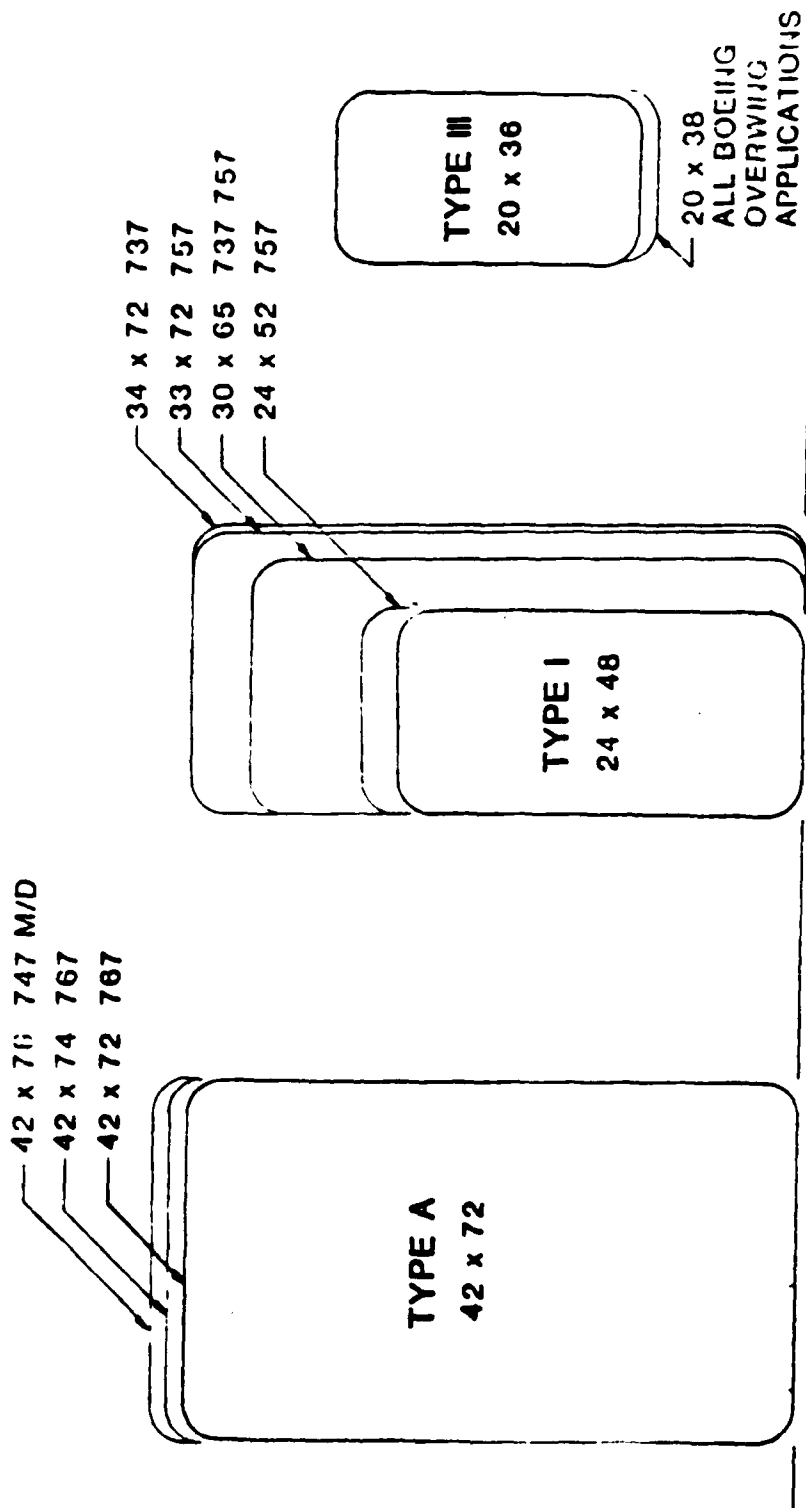
EXITS (J. LIKES)

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BOEING EXIT COMPARISON

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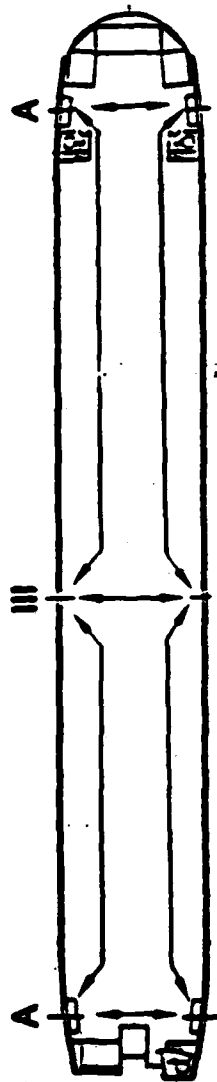
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PRECEDENTS FOR DEACTIVATION

1. MODEL 727-222, T.C. A3WE, STC NO. SA4091WE--DELETION OF A PAIR OF EXCESS TYPE I EXITS. ISSUED NOVEMBER 29, 1979. STC HOLDER: UNITED AIRLINES, SAN FRANCISCO.
2. DC-8-61, T/C. 4A25, STC NO. SA4063WE--DELETION OF A PAIR OF EXCESS TYPE I EXITS. ISSUED JANUARY 22, 1980. STC HOLDER: UNITED AIRLINES, SAN FRANCISCO.
3. 747, MALAYSIA AIRLINE SYSTEMS (MODIFIED BY BOEING FOR BRITISH AIRWAYS PRIOR TO BA SALE TO MAS)--DEACTIVATED EXCESS UPPER DECK L.H. TYPE I. MARCH 1982.
4. DC-8, STC NO. SA2432NM--DEACTIVATED TWO PAIR TYPE I AND ONE PAIR TYPE III. STC HOLDER: AIRESEARCH.
5. 707, STC NO. SA5600SW--DEACTIVATED A TYPE II EXIT PAIR. STC HOLDER: BUFFALO AIR.
6. 707, STC NO. SA5706SW--DEACTIVATED A TYPE II EXIT PAIR. STC HOLDER: PREMIER AIR.
7. 707, STC NO. SA5784SW--DEACTIVATED A TYPE II EXIT PAIR.
8. 707-323C, T.C. 4A26, STC NO. SA655GL--DEACTIVATION OF A PAIR OF EXCESS WINDOW EXITS. AT STATION 990. ISSUED NOVEMBER 2, 1982. STC HOLDER: AMERICAN TRANS AIR, INDIANAPOLIS, INDIANA.
9. ON AUGUST 8, 1983, BOEING MADE FORMAL APPLICATION TO THE FAA BY LETTER REQUESTING APPROVAL OF THE DEACTIVATION OF DOOR NO. 3 ON THE MODEL 747. BOEING RECEIVED THAT APPROVAL FROM THE FAA NORTHWEST MOUNTAIN REGION ON SEPTEMBER 2, 1983. FOLLOWING THIS APPROVAL, THE FIRST PRODUCTION AIRPLANE TO RECEIVE FAA CERTIFICATION WITH THE DEACTIVATION OF EXIT DOOR NO. 3 WAS CERTIFICATED ON JUNE 1, 1984.

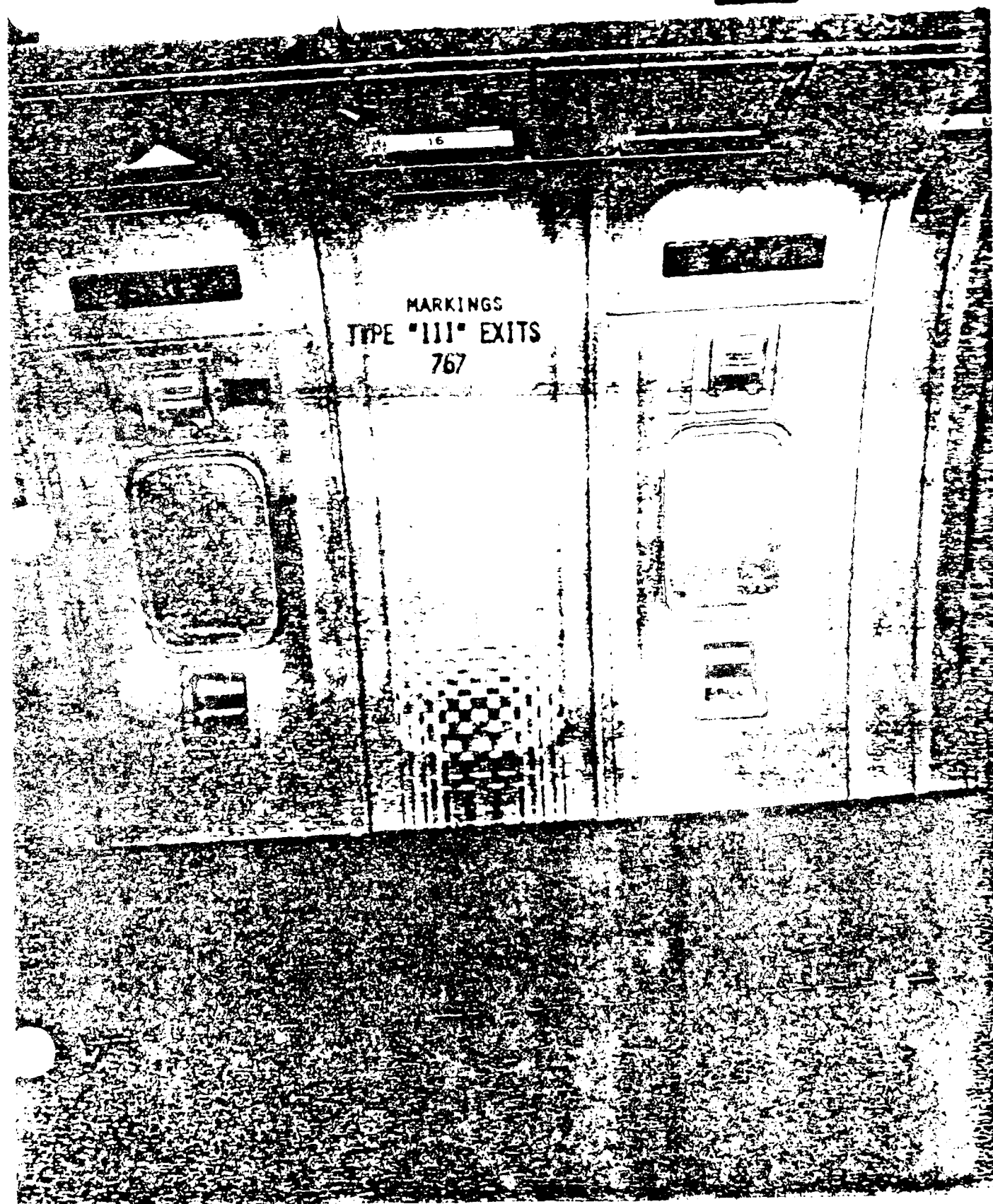
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BRIEF

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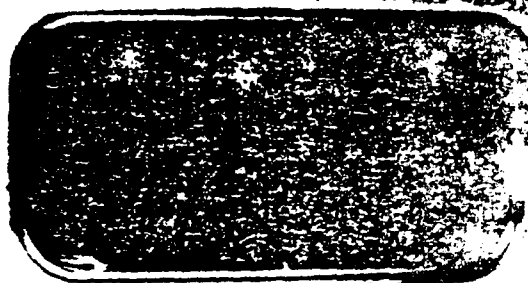
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MARKINGS
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TYPE "A" EXIT
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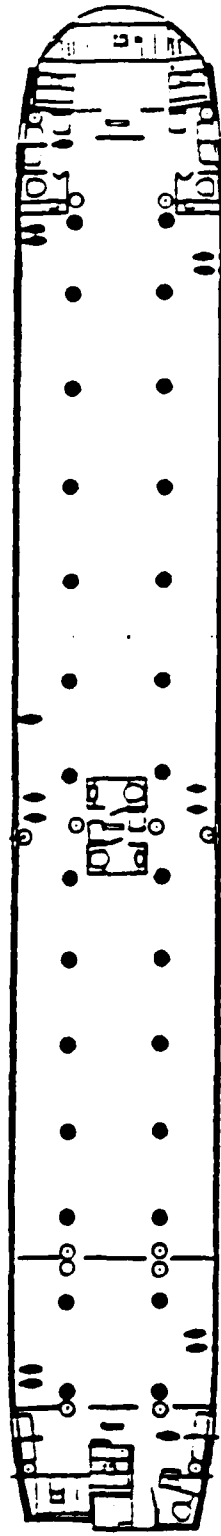
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EXIT

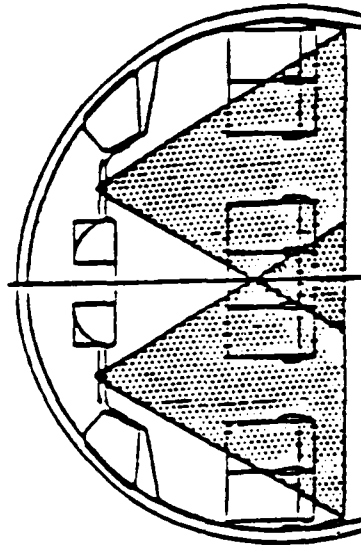
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LIGHTING EMERGENCY

767-200



- EMERGENCY LIGHT-UPPER DOOR SILL
- EMERGENCY LIGHT AISLEWAY
- ▲ BATTERY PACK
- ▮ EMERGENCY LIGHT-LOWERED CEILING
- EXIT SIGN



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 - AMEND. 121-183 (FAR 25.812 (E)) FLOOR PROXIMITY EMERGENCY ESCAPE PATH MARKING

• SUMMARY

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September 5, 1985

Emergency Evacuations, Crew Training and Passenger Briefings

Presented by Walter S. Coleman, Director - Operations
of the Air Transport Association
at the FAA Conference on Emergency Evacuation
September 3-6, 1985

Introduction

On behalf of our member airlines, ATA welcomes the opportunity to discuss subjects relating to emergency evacuation of transport aircraft. The safety of our passengers is our primary concern and it is our belief that technical conferences like this make important contributions to the regulatory process and safety.

In our participation in this conference we seek to be responsive and constructive as all of us work together to assure the continued safety of our nation's air transportation system.

An integral part of our commitment to safety is our continuing program of the reevaluation of certification procedures, emergency equipment, and crew training. As a part of this process, we would like to address the issues relating to evacuation demonstrations as a certification procedure, the emergency evacuation training of our flight and cabin crews, and passenger briefings.

Emergency Evacuation Demonstrations

In 1965, recognizing the need for rapid passenger and crew egress following a survivable crash, the FAA began requiring each airline to perform full scale demonstrations of aircraft evacuations under simulated emergency conditions. Transport aircraft are certificated under Part 25, but the FAA wanted to be assured that individual Part 121 operators, with their unique cabin configurations, and their own crewmembers, would be able to utilize to the fullest extent the safety capabilities of the aircraft.

Two years later, with airline support, the FAA reduced the time allowed for evacuation from 120 to 90 seconds in order to more accurately reflect the capabilities of the improved automatically deployed and inflated slides. Also with airline support, the FAA amended Part 25 to require the aircraft manufacturers to demonstrate the same full scale evacuations.

The use of smoke in the emergency evacuation demonstrations was thoroughly evaluated and subsequently rejected by the FAA in 1965. It was determined that the use of smoke would create an unnecessarily hazardous condition for passengers. It has been noted earlier that all emergency evacuation demonstrations are conducted either at night or under simulated nighttime conditions of restricted visibility.

The carry-on baggage provision, which requires that approximately one-half of the total amount of baggage, blankets and pillows should be distributed in the aisles and emergency exit access is notably stringent. It should be observed that this demonstration is one of an aircraft that is prepared for a takeoff. The baggage on the aircraft would, by regulation, be safely stowed. Recalling that we are considering a survivable crash, in which every passenger is expected to egress through an exit, it is entirely reasonable to assume that the cabin is basically intact. If 100% of all carry-on baggage and other stowed items broke loose, random distribution would suggest that it would be unlikely that more than 50% of this would be in the aisles or blocking access to emergency exits.

The passenger mix requirement does not set absolute percentages, but rather requires a representative passenger load of persons in normal health. The handicapped, exceptionally obese, and blind participants are not used, and with good reason. In a simulated emergency evacuation a major concern of the flight attendants and other participants is to avoid injury, although injuries do occur. In an actual emergency, passengers with special needs will be pushed along at a satisfactory egress rate with the other passengers. Abrasions, bruises, and even broken bones will naturally take a lower priority than the primary concern of saving lives. In 1977, the FAA announced the results of a Civil Aeromedical Institute study which examined the accident and incident reports of the previous 16 years. There was no recorded instance of a significant delay created by a handicapped passenger during an actual emergency evacuation. At this point, sufficient information has been collected on both actual and demonstration emergency evacuations to indicate that the participation of every possible type of airline passenger is not needed.

In 1982, after completion of an extensive 10 year study of both actual and demonstrated emergency evacuations, the FAA issued an amendment to Part 121 allowing a certificate holder to use the results of a successful demonstration conducted by either the manufacturer or another airline provided certain conditions are met. This provided the basis for the mini-evacuation. The regulations concerning the demonstration of a mini-evacuation are strict and fair. The justification for this procedure is simple. The FAA study concluded that any emergency evacuation, even under the controlled circumstances of a certification demonstration can be dangerous to the passengers. We believe that the regulation as written now provides, quoting from the FAA language of the 1982 amendment, "a reasonable standard which provides the highest level of passenger safety in air transportation".

Crew Training

We believe that our training programs ensure a safe and proficient crewmember, capable of performing his or her duties quickly and professionally. Each air carrier's training program must be individually evaluated and certified as being in compliance with the FAA requirements for initial and recurrent training.

Each crewmember must receive training specific to the type aircraft he or she will fly. Each crewmember is also required to be given individual instruction in the location, function, and operation of emergency equipment used in ditching and evacuation and emergency exits, with particular attention to the operation of the exits under adverse conditions.

The training regulations are flexible enough to allow changes, and even reversals when appropriate. An example is an FAA requirement, imposed in 1978, making it mandatory that crewmembers practice on an annual basis, exiting the aircraft by sliding down an emergency evacuation slide. The following year, after 23 confirmed cases of serious injury during training, (including a broken leg, a fractured coccyx, a broken ankle and a case of permanent paralysis from the waist down) the ruling was appealed, and the annual slide requirement was withdrawn.

We feel that the training programs as required by the FAA and conducted by the airlines are effective training methods and presentations are continually analyzed to see that training objectives are being met. The FAA and airline managements have demonstrated the flexibility and willingness to adapt as new information or needs reveal themselves.

Passenger Briefings

Passenger briefings offer a formidable challenge. There is no doubt regarding adequacy of briefings or the diagrammatic presentation of emergency information on seat cards. The accuracy and clarity with which passengers are instructed by flight attendants to utilize seat belts, oxygen masks, life vests, find exits or otherwise prepare and acquaint themselves for an emergency situation are not in question. What is in question is what degree of confidence do crewmembers and airline managements have that passengers, having been briefed and advised in compliance with appropriate regulations, actually understand the briefing and would take the actions expected of them in an emergency situation. It is the well trained crew providing guidance and assistance in an emergency situation that historically has ensured proper passenger utilization of safety equipment and safe evacuation.

Passenger briefings tread a narrow path between assuring the passenger of the unlikely need to utilize the emergency equipment while at the same time stressing the importance of being as knowledgeable and aware as possible of what emergency equipment is available, where it is and how to use it. Well prepared briefing material professionally delivered is, for now, the best alternative.

We are proud of the achievements of the U.S. air carriers, and we recognize and accept our responsibility to maintain the highest levels of passenger safety.

QANTAS EXPERIENCE WITH 747 SLIDE

TEST DEPLOYMENTS.

F.A.A. EMERGENCY EVACUATION MEETING.

SEATTLE . WASHINGTON.

SEPTEMBER. 1985.

INTRODUCTION

Qantas Airways has a slide maintenance and testing program. This program has been running since the introduction of the 747 in 1972.

This presentation describes the experience we have had with slide testing. It is not an attempt to level criticism at anyone but is merely a recounting of history.

Up till about 3 years ago, our slide reliability was not as good as we believe it should be. Over the last 3 years, it has improved significantly. This presentation shows some of the design and maintenance changes we have made to improve reliability.

Although this FAA conference is intended to address reliability and maintenance, it is not possible to separate either from design. So the presentation also discusses the design of the slide, the parts on the slide and the design of the door system.

FLEET

19 B747-200	ALL PASSENGER
3 B747-200	COMBI
<u>2</u> B747SP	ALL PASSENGER
24	

SLIDE TYPE

9 A/C HAVE COOL GAS GENERATOR SLIDES
15 A/C HAVE STORED GAS SLIDE/RAFTS

QANTAS

SLIDE TESTING

- SLIDES TESTED ARE DUE FOR OVERHAUL
- TESTS MONITERED BY:-

AERONAUTICAL & RELIABILTY ENGINEERING

FLIGHT LINE PERSONNEL

SAFETY & OPERATIONS DEPT

SLIDE OVERHAUL SHØP PERSONNEL

AUSTRALIAN DEPT. OF AVIATION

- VIDEO RECORDING.
- AIRCRAFT TESTS ARE IN ADDITION TO DEPLOYMENTS IN CABIN CREW TRAINING AREA

REQUIREMENTS

SLIDE TESTING

- DOORS OPENED SLOWLY FROM INSIDE
- DOOR POWER ASSIST MUST FUNCTION CORRECTLY
- SLIDE MUST DEPLOY AND INFLATE WITHOUT MANUAL ASSISTANCE OR BACK UP
- SLIDE MUST BE USEABLE WITHIN 10 SECONDS OF DOOR POWER ASSIST STARTING TO OPEN DOOR
- SLIDE MUST REMAIN USEABLE FOR AT LEAST 90 SECONDS
- SLIDE/RAFT MUST REMAIN USEABLE AS RAFT

IN SERVICE DEPLOYMENT

- ABOVE CONDITIONS ARE MORE RESTRICTIVE THAN REAL IN-SERVICE CONDITION

HOWEVER SLIDE IS DESIGNED TO WORK UNDER THESE CONDITIONS.

QANTAS

DOOR 3 SLIDE REQUIREMENTS

SAME AS ENTRY DOORS, BUT IN ADDITION. .

- PULL DITCHING LEVER AND CHECK DOOR AND RAMP SYSTEM ONLY
- REMOVE RAMP, CLOSE DOOR AND REOPEN TO CHECK OFF WING SLIDE
- EACH PART TO BE INFLATED WITHIN 10 SECONDS

QANTAS

NUMBER AND LOCATION OF SLIDES TESTED

COOL GAS GENERATOR POWERED SLIDES

DOORS 1, 2 OR 4	LEFT OR RIGHT	2 PER YEAR
DOOR 5	LEFT OR RIGHT	1
DOOR 3	LEFT	2
	RIGHT	2
UPPER DECK		1

STORED GAS SLIDE RAFT

DOORS 1, 2 OR 4	LEFT OR RIGHT	2 PER YEAR
DOOR 5	LEFT OR RIGHT	1
DOOR 3	LEFT	2
	RIGHT	2
UPPER DECK		2

QANTAS

FAILURES PER YEAR

	1976	1977	1978	1979	1980	1981	1982
SLIDE							
FIRING	4	5	8	7	5	9	8
FAILURE	-	1	-	1	1	3	3
%	0	20%	0	14%	20%	33%	38%

SLIDE/RAFT							
FIRING	5	5	7	4	10	8	12
FAILURE	-	3	3	-	3	4	5
%	0	60%	43%	0%	30%	50%	42%

QANTAS

FAILURES PER DOOR POSITIONS

SLIDES

SLIDE RAFTS

DOOR	FIRINGS	FAILURES	RATE
1	4	1	25%
2	9	1	11%
3	17	5	29%
4	3	-	-
5	6	-	-
U/DECK	7	2	29%

8	2	25%
2	-	-
17	8	47%
3	1	33%
8	2	25%
8	4	50%

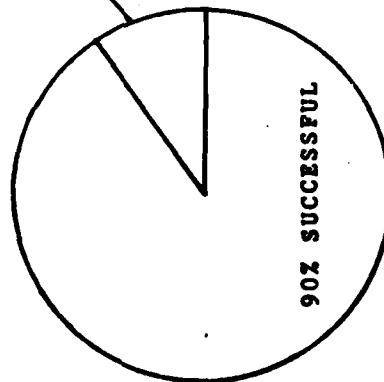
QANTAS

10% UNSUCCESSFUL

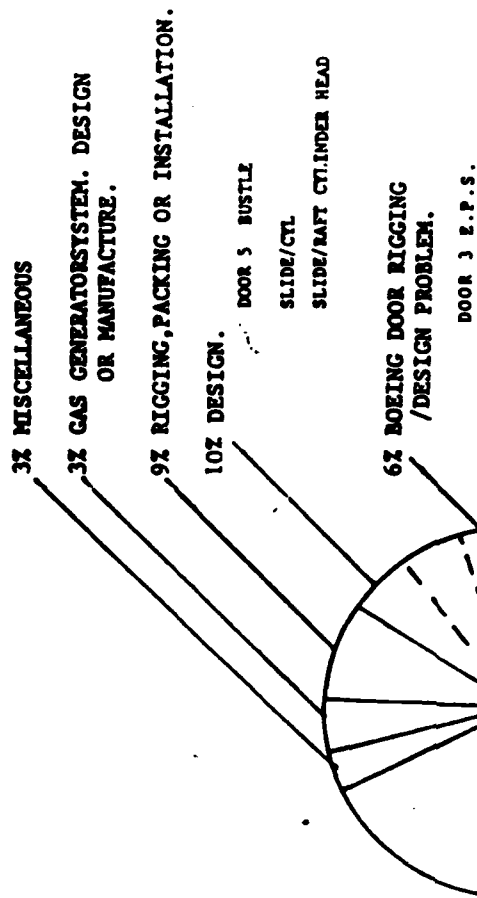
IMPROPER
INSTALLATION OR
MAINTENANCE 7%

INEXPERIENCED
OPERATOR 1%

MISCELLANEOUS 2%



BOEING AIRLINER
JAN/MARCH 1982



QANTAS EXPERIENCE

QANTAS

IN 6 YEARS QANTAS ISSUED:-

53 MAJOR DEFECT NOTICES

39 FLEETWIDE INSPECTIONS

12 IN HOUSE MODIFICATIONS

9 MAINTENANCE MEMOS

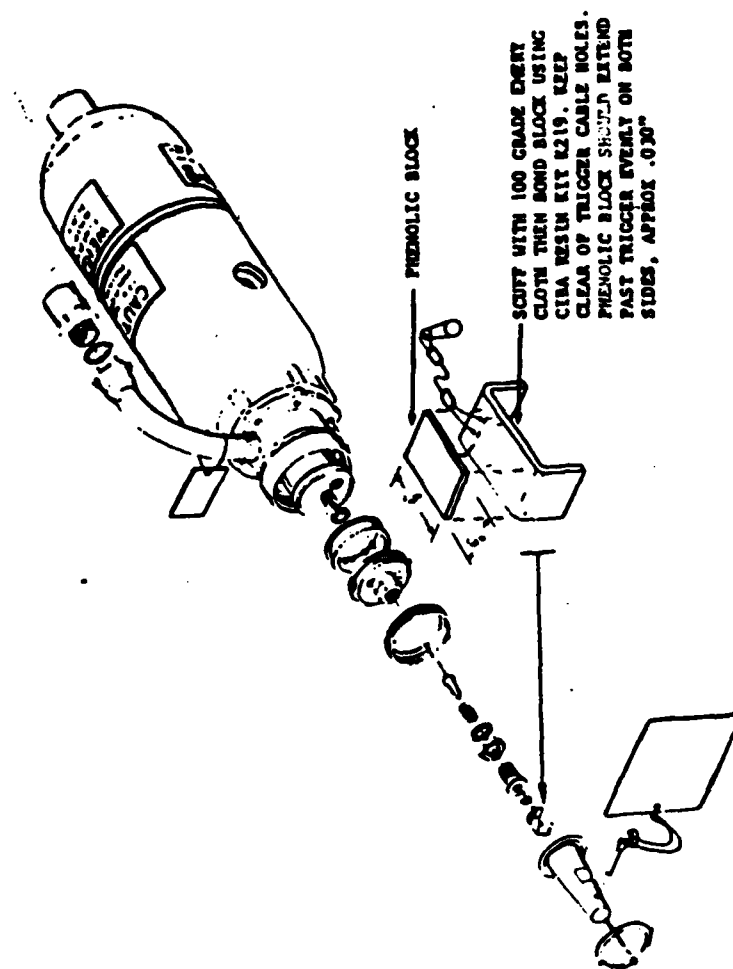
**AN UNKNOWN NUMBER OF BOEING & COMPONENT MANUAL
AMENDMENTS**

QANTAS

IMPROVEMENT to SLIDES MODIFICATION of COOL GAS GENERATOR HEAD

PROBLEM. ROTATION of TRIGGER ALLOWS DISENGAGEMENT of FIRING PIN

SOLUTION. BOND $3/32$ " PHENOLIC SHEET to TRIGGER.

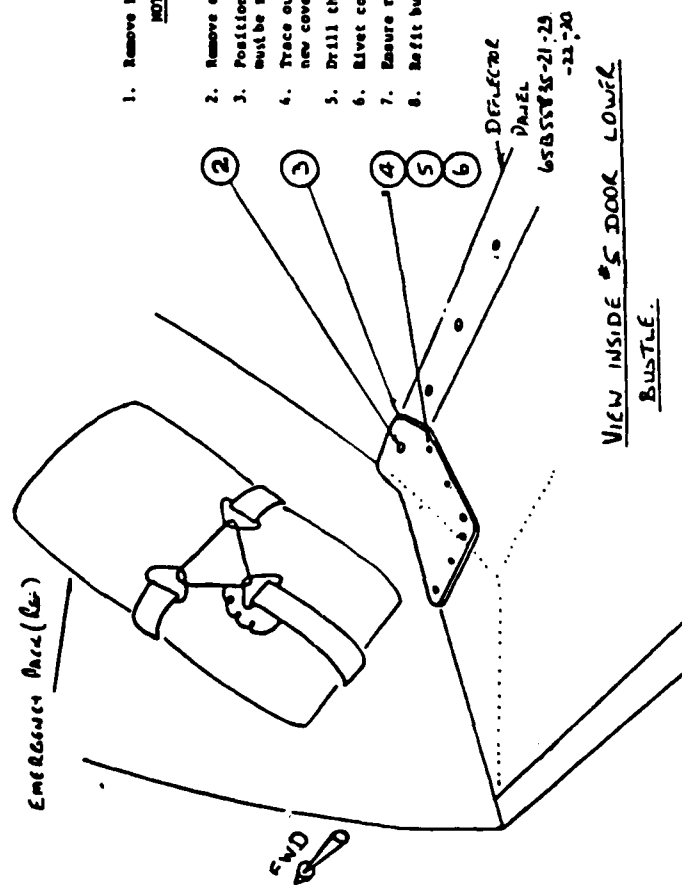


QANTAS

IMPROVEMENT to SLIDES MODIFICATION to DOOR 5 SLIDE RAFT BUSTLE

PROBLEM. EMERGENCY PACK LANYARD JAMS IN BUSTLE CUT OUT.

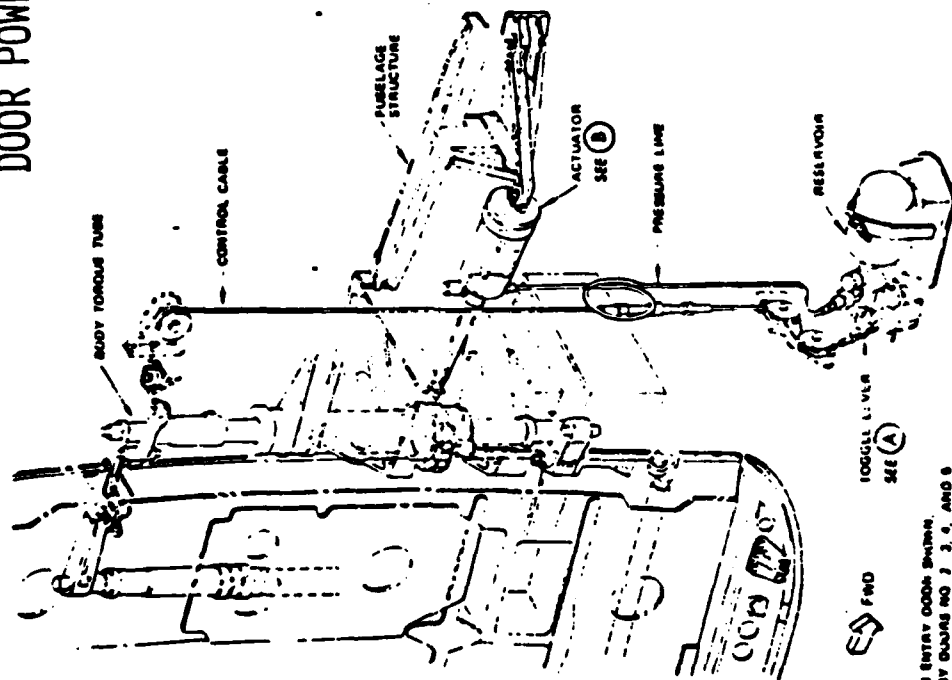
SOLUTION. FIT COVER PLATE OVER CUT OUT.



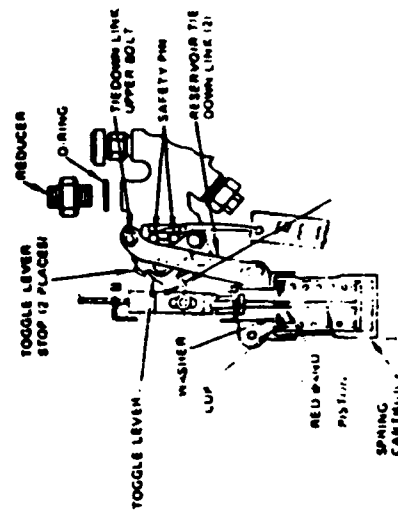
1. Remove No. 5 door bustle.
- NOTE: Emergency pack will need to be detached from door to allow complete bustle removal.
2. Remove existing screw.
3. Position Cover -1 (LM) or -2 (RM) as shown aligning screw hole. Screw must be refitted to hold cover in position.
4. Trace outline of cover & cut away teflon lining of deflector panel to allow new cover to sit down on metal part of deflector panel.
5. Drill through deflector panel 1/8" dia using holes in cover as a guide.
6. Rivet cover to deflector panel using rivets NAS 1399 D4-2.
7. Ensure rivet heads are flush with cover.
8. Refit bustle & restore emergency pack in accordance with normal procedure.

QANTAS

DOOR POWER ASSIST SYSTEM



NOTE: NO. 1 ENTRY OODN SWIRN.
ENTRY OODN NO. 2, 3, 4, AND 5
SIMILAR



QANTAS

DOOR POWER ASSIST RIGGING

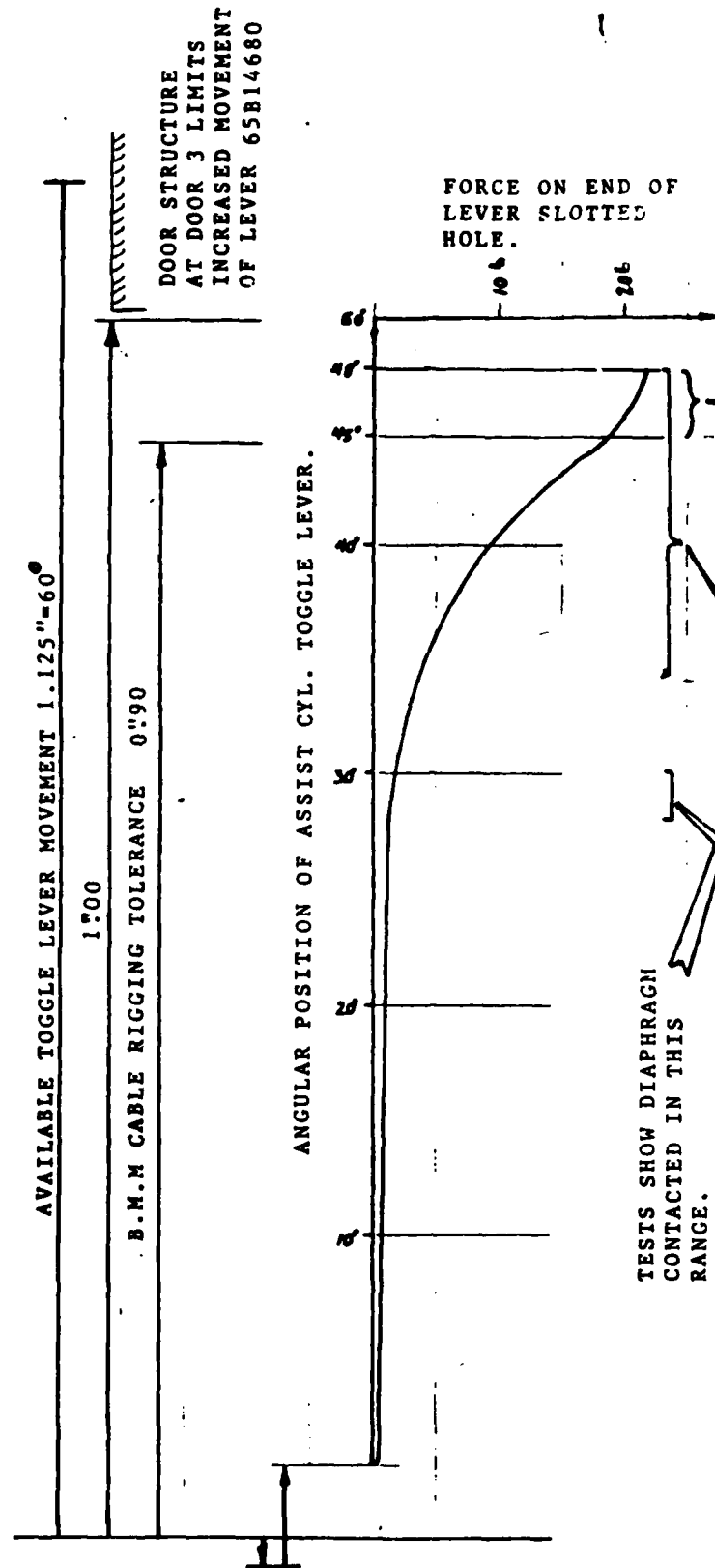
5 CASES OF POWER ASSIST NOT WORKING
INVESTIGATION SHOWED.

- DIAPHRAGM 803322 VERY DUCTILE
- DIAPHRAGM ORIGINALLY COATED WITH TEFLON ONE SIDE ONLY.
NOW COATED BOTH SIDES.
- CUTTER 803308 VARIES IN LENGTH BY ".013.
- LINKS 69B14281 - () NEED TO BE SELECTIVELY INSTALLED TO ACHIEVE CORRECT
INSTALLATION

POSSIBLE TO ASSEMBLE SYSTEM WITH INDIVIDUAL PARTS ON THEIR TOLERANCE LIMIT.
THIS ASSEMBLY WILL NOT WORK.

QANTAS

PENETRATION OF DIAPHRAGM IN DOOR POWER ASSIST CYLINDER

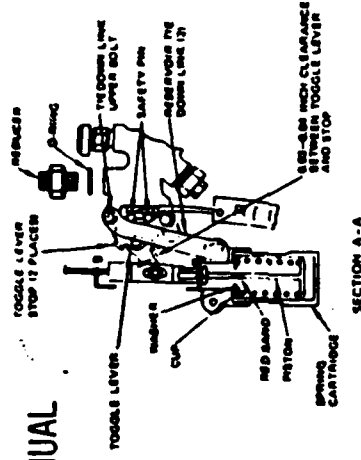


QANTAS

SOLUTIONS TO DOOR POWER ASSIST RIGGING

QANTAS

- REDUCE RIGGING TOLERANCE IN BOEING MAINTENANCE MANUAL
- TIGHTEN MAINTENANCE MANUAL PROCEDURES



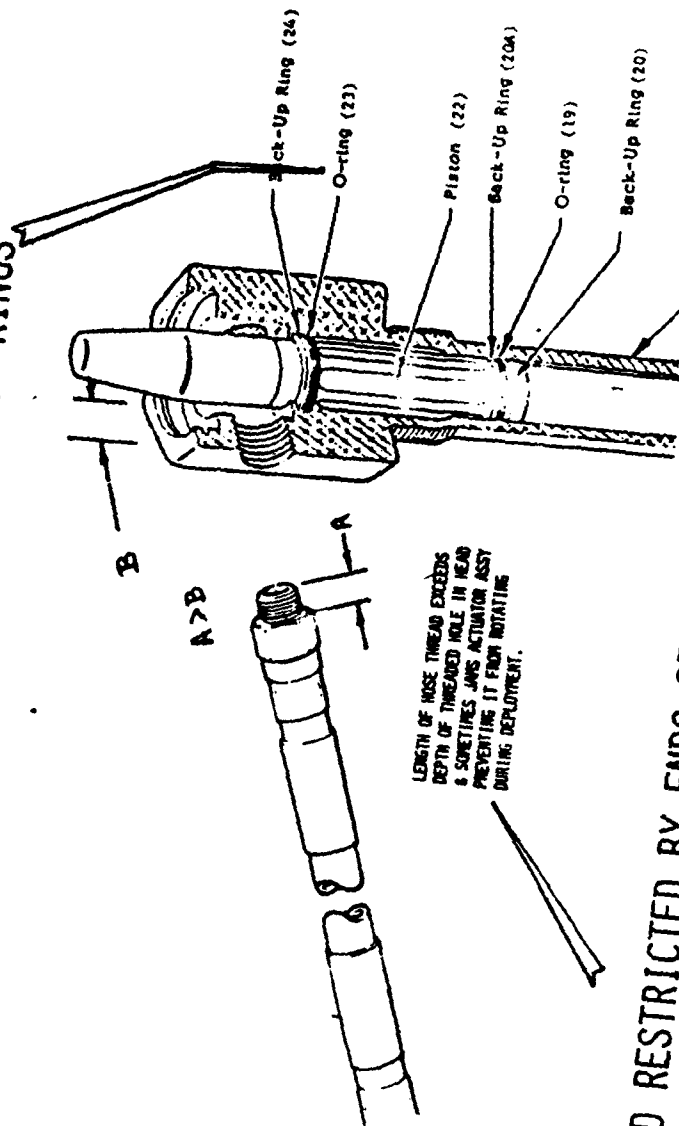
ACTION THAT COULD BE TAKEN BY MANUFACTURERS

- CHANGE DIAPHRAGM 803311 TO REQUIRE LESS PENETRATION BEFORE FAILURE
- CHANGE PROFILE OF CAM 803309 TO GIVE MORE MOVEMENT BETWEEN TOGGLE LEVER ANGLES OF 18° AND 25°

QANTAS

SLIDE/RAFT INFLATION PROBLEMS

- STUCK PISTON IN REGULATOR, SEIZED 'O' RINGS



- ROTATION OF HEAD RESTRICTED BY ENDS OF INFLATION HOSES. — HOSES SHOULD BE CUT OFF.

QANTAS

AD-A172 256

TASK FORCE ON EMERGENCY EVACUATION OF TRANSPORT
AIRPLANES VOLUME 2 SUPPORTING DOCUMENTATION(U) FEDERAL
AVIATION ADMINISTRATION WASHINGTON DC OFFICE OF FLIGHT...

4/5

UNCLASSIFIED

JUL 86 DOT/FAA/US-86-1

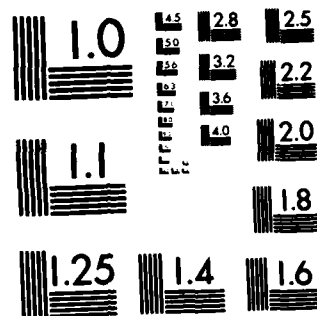
F/G 172

NL

Slide/Raft Design

(Work began during the last half of the 1960s to combine the functions of the inflatable slide and the inflatable raft for airplanes requiring

regulations. The FAA regulations provide design requirements which ensure the design of safe, reliable evacuation equipment. Some of the design requirements are:



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

SLIDE/RAFT INFLATION CYLINDER TESTING

- DIFFICULT TO ACHIEVE SAME POST OVERHAUL PRESSURE/TIME TRACE FOR REGULATOR
THAT MANUFACTURE ACHIEVED

- IMMERSION OF CYLINDER IN WATER TO CHECK FOR LEAKS

UNDESIRABLE

INTEGRITY DESTROYED BY REMOVING GAUGE

MANUFACTURE SPECIFIES SUBSEQUENT 24 HOUR BENCH CHECK ANYWAY

QANTAS

SLIDE RELIABILITY IN LAST 2 YEARS

SLIDES

14 SUCCESSFUL DEPLOYMENTS

1 RAMP SLOW TO INFLATE. RESTRAINT STRAP OBSTRUCTION.

15

93% SUCCESS

SLIDE/RAFT

21 SUCCESSFUL DEPLOYMENTS

1 STUCK PISTON IN REGULATOR

1 DOOR ASSIST BOTTLE WITH SAFETY PINS LEFT IN

23

91% SUCCESS

QANTAS

"ROUGH EDGES" STILL IN SLIDE SYSTEM

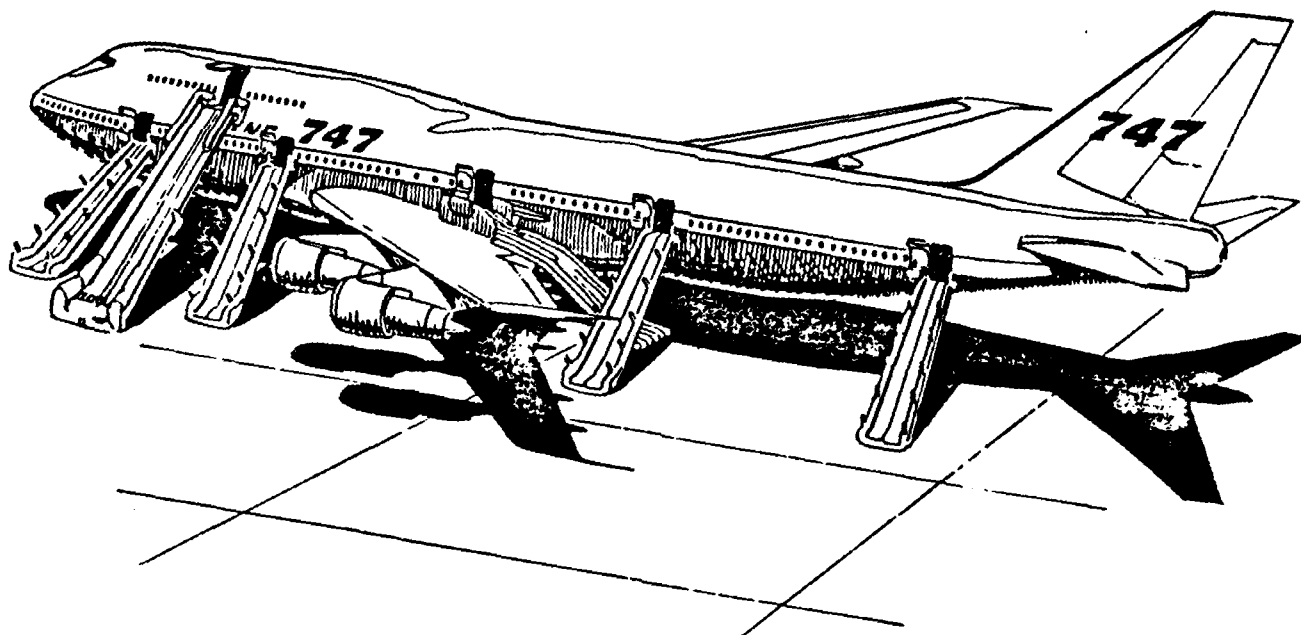
- DOOR POWER ASSIST RIGGING
- PACK BOARD CORROSION
- HAND PUMP AND VALVE
- CYLINDER TESTING

QANTAS

Thank you for your attention and I thank FAA, and all those associated with the meeting for the opportunity to participate and address the meeting.

Emergency Escape Slides

Emergency Evacuation of Transport Airplanes
Public Technical Conference
Federal Aviation Administration
Seattle, Washington
September 3-6, 1985



Russell G. Welker
Senior Manager
Payload Systems
Renton Division
Boeing Commercial Airplane Company

Emergency Escape Slides R. G. Welker

Introduction

This paper addresses the escape slides used for emergency evacuation of occupants from commercial jet aircraft. The information is based primarily on experience with Boeing aircraft. The discussion will deal with the following topics:

- Early configuration escape slide systems
- Modern escape slide design
- Off-wing escape slide design
- Slide/raft design
- Escape slide design requirements
- Escape slide testing
- Escape slide reliability and maintenance

In the design of escape slide systems, the objective is complete success in having all escape slides on an airplane available to safely and rapidly evacuate passengers and crew from an airplane.

Early Configuration Escape Slide Systems

Early commercial aircraft were relatively small and close to the ground. Figure 1 shows the hand-held chute that came into use in the forties. When needed, the chute was removed from its compartment in the ceiling, attached to support points on the floor, and then dropped out the open door. The first two people to leave the airplane had to climb down the chute. These two people then had to hold the lower end of the chute so the remaining people could escape by sliding down the chute.

Inflatable escape slides became available just as the early U.S. jet-powered aircraft were entering the final design stages in 1957. Introduction of this technology served to greatly advance safety standards.

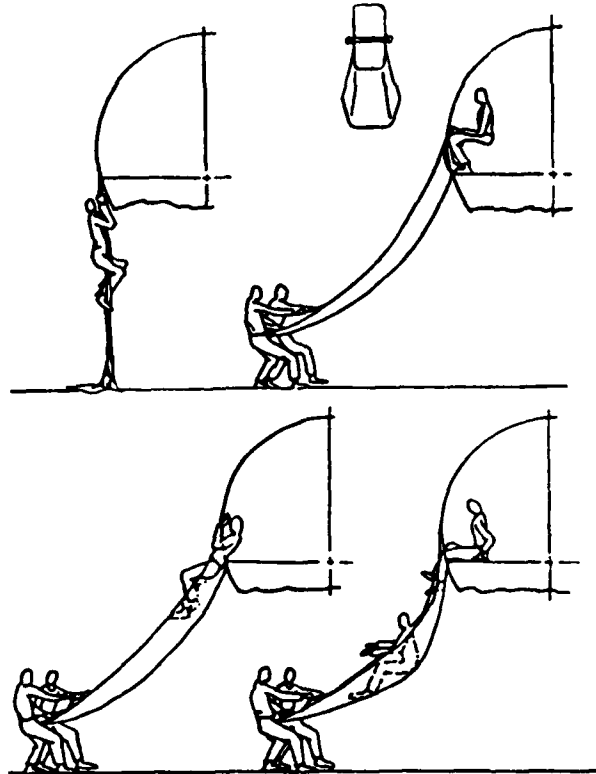


Figure 1. Noninflatable Hand-Held Chute

Figure 2 shows the early inflatable slide design. The slide consisted of a 24-in.-diameter main tube, with two 8-in.-diameter side tubes. The small tubes served to guide slide occupants down the entire length of the slide.

The inflation system consisted of a cylinder filled with high-pressure compressed gas, an inflation valve, two aspirators, and a flexible inflation hose. Aspirators, as shown in Figure 3, are venturi devices which use high-velocity gas from the cylinder to entrain air into the slide at low pressure. The compressed gas is then used to top off the inflatable side at the required working pressure of two to three lb/in². Aspirators minimize the size and weight of the gas cylinder.

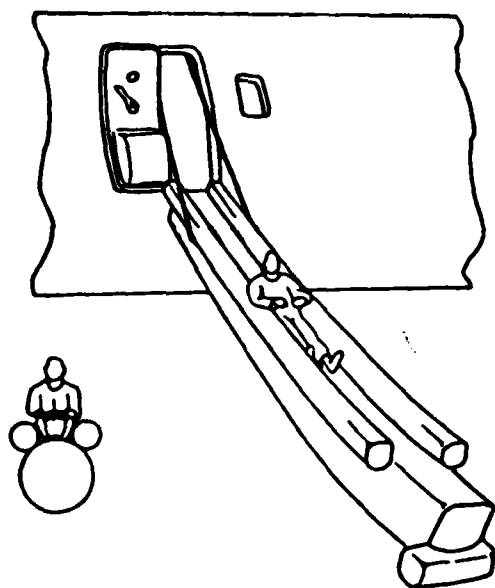


Figure 2. Early Slide Design

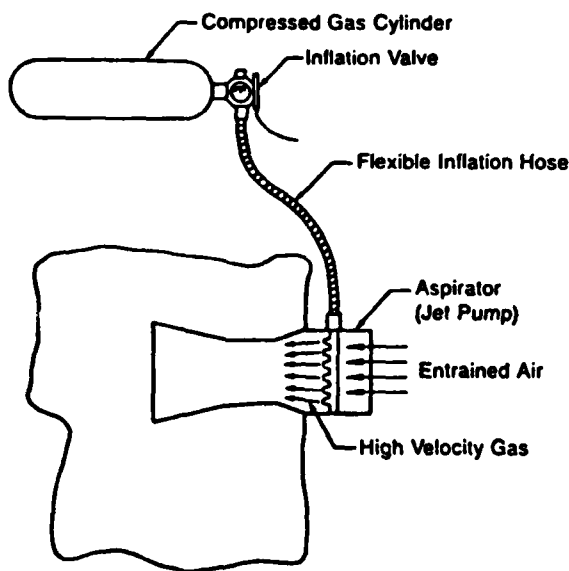


Figure 3. Aspirator Function

Because of the physical bulk of the slide system, it was not practical to locate the equipment anywhere other than above the ceiling, as shown in Figure 4.

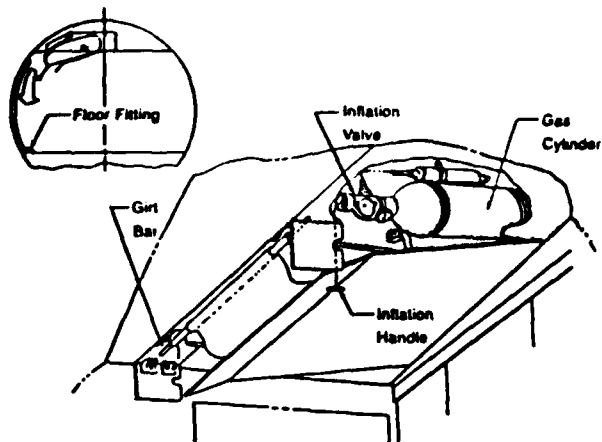


Figure 4. Typical Ceiling-Mounted Slide Installation

Deployment of these early slides was relatively difficult. Figure 5 shows the steps required to operate the ceiling-mounted slide after first opening the aircraft door:

1. Unlatch the overhead slide compartment door.
2. Withdraw the slide pack and allow it to fall to the floor.
3. Kick the girt bar into the floor brackets.
4. Push the slide pack out the door opening and pull the rip cord.
5. Pull the overhead bottle release cord to inflate the slide.

Ten to 20 seconds were required to deploy the slide, and 15 to 18 seconds were required to inflate the slide, for a total of 25 to 38 seconds.

The next major change, in approximately 1960, was to introduce a slide with two parallel tube members, as shown in Figure 6, with the sliding surface suspended between the tubes. A head tube at the top provided support and stability at the upper end of the slide, a toe end tube provided ground support, and a cross tube maintained side-tube separation. Other items associated with the escape slide include:

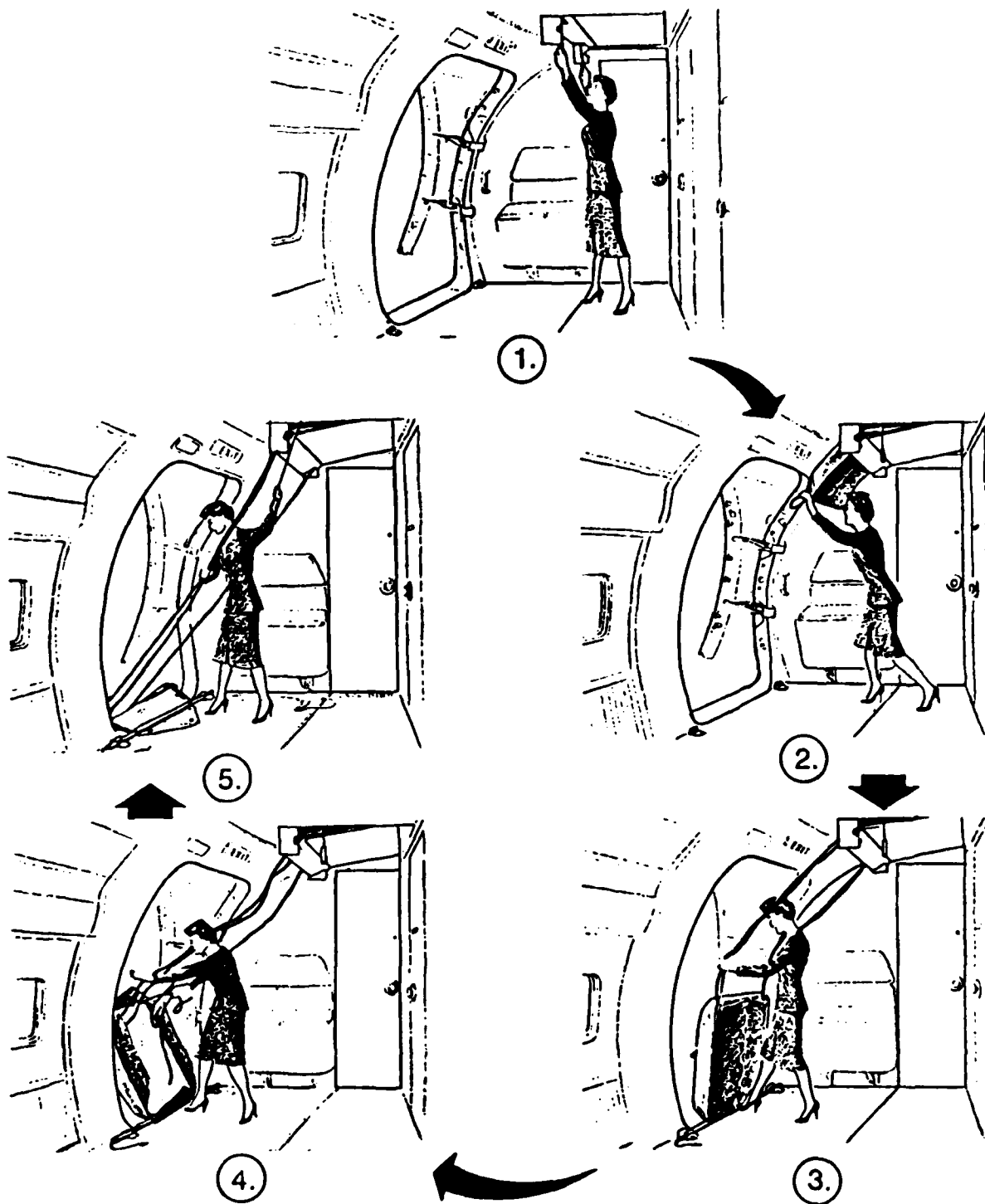


Figure 5. Operation of the Ceiling-Mounted Escape Slide

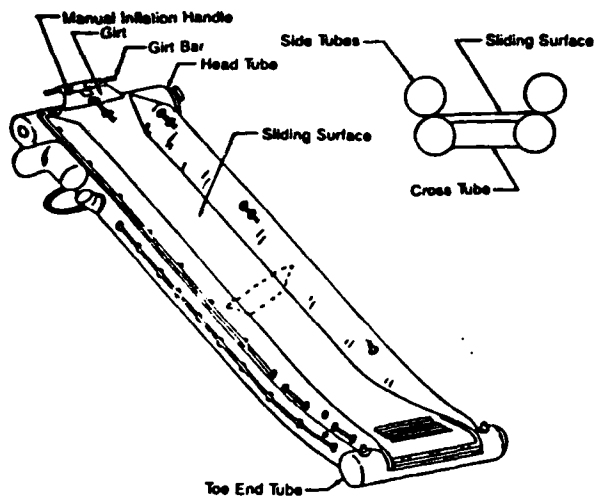


Figure 6. Escape Slide Terminology

- The girt bar, a metal bar which attaches the slide assembly to brackets located on the airplane floor.
- The girt, a fabric panel between the girt bar and the head tube. The girt and girt bar secure the slide to the airplane.
- The manual inflation handle on the girt, used to manually inflate the escape slide.

By 1963, improvements in materials and inflation systems reduced the weight and bulk of the slide system, making it practical to move the slides out of the ceilings to the lower inboard face of the doors. Figure 7 shows a 737 door-mounted slide enclosed in a bustle with the inflation system located inside the slide pack. This location resulted in a still more efficient system, reducing the time needed to ready an escape slide from between 30 and 50 sec to between 18 and 24 sec, including door-opening time. Girt bars were stowed on the slide compartment until needed for an emergency evacuation.

By 1966, further improvements to the efficiency of the aspirators had reduced slide inflation time to as few as six seconds.

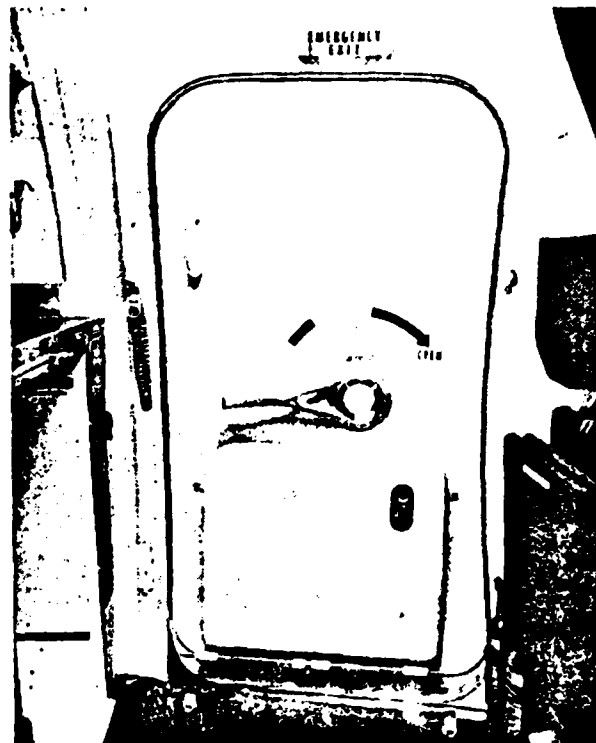


Figure 7. Typical Door-Mounted Escape Slide Enclosed in a Bustle

Detachable girts were developed which made it possible to detach the inflated escape slide from the aircraft in a ditching situation. The slides then could serve as supplemental flotation devices.

Automatic inflation of escape slides was introduced at the same time as the bottom-hinging floor level exit, as shown by the typical installation illustrated in Figure 8. The automatically inflatable escape slide provided yet another increment of added safety. Untrained passengers could open the door and inflate the slide during an emergency. Automatically inflatable slides have since become a requirement at all floor-level exits for new design aircraft.

Modern Escape Slide Design

The safety of passengers in an emergency is, of course, the reason for providing emergency equipment such as escape slides. In addition to

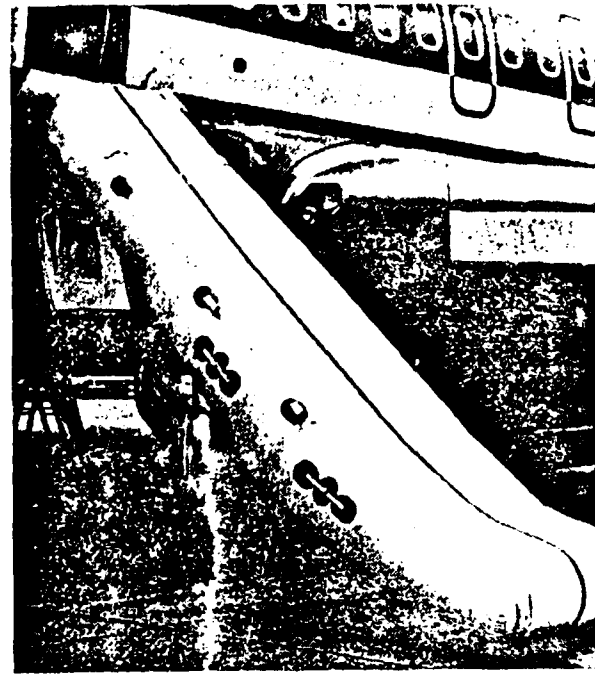
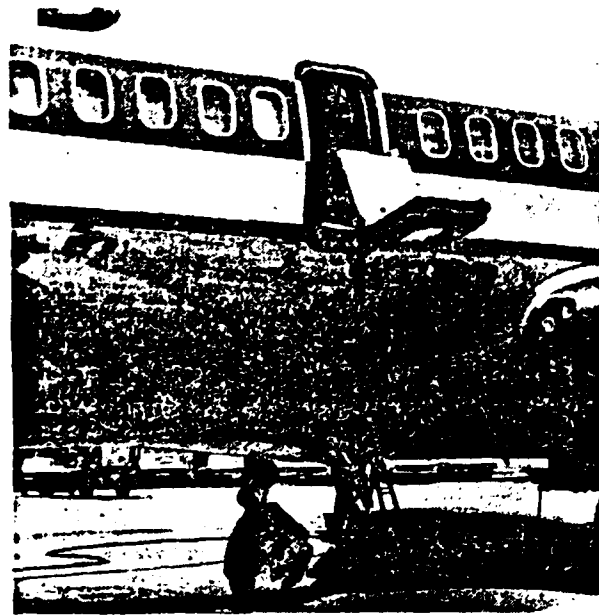
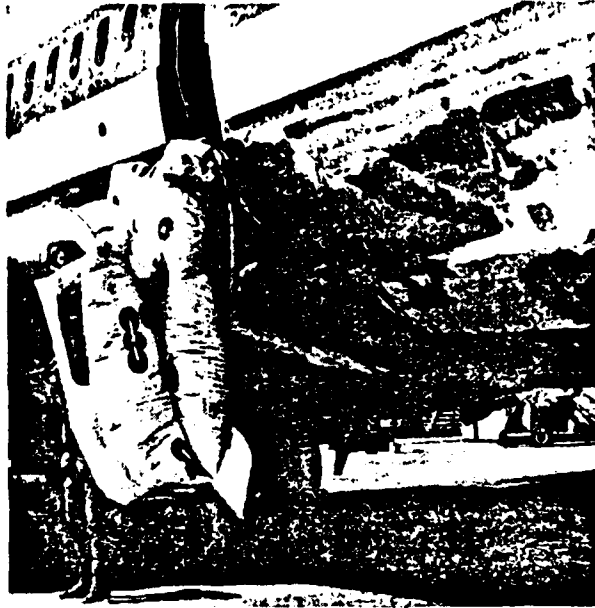
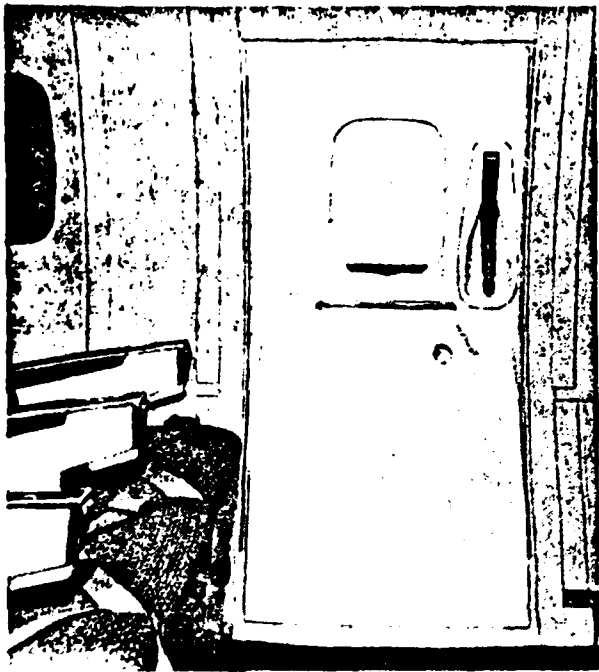


Figure 8. Typical Early Bottom-Hinging Floor Level Exit

providing the basic means of escape from an aircraft, this equipment must be safe to use. The objective is to restrict the number and severity of injuries to an absolute minimum.

With the advent of wide-body aircraft, new elements were again introduced into escape system design. Wide-body aircraft have higher door-sill-to-ground heights and carry more passengers. Figure 9 shows door-sill heights at normal aircraft attitude for various models of Boeing aircraft. Given this large variation in sill height, the escape slide must be designed to suit each particular model.

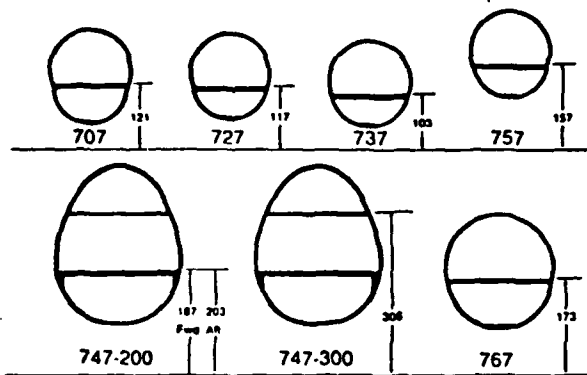


Figure 9. Door Sill Heights at Normal Airplane Attitude (in.)

What came to be called "Type A" doors were developed to achieve higher evacuation rates at each door. The Type A door allows two people to exit the aircraft side-by-side. Figure 10 shows the escape slides developed for these higher and wider doors on the 747. Figure 11 shows one of these slides with two separate lanes and a divider between them. This allowed twice the flow rate of the single lane slides. The wider doors, together with the heavier and larger escape slides, required development of a powered assist for opening the doors in an emergency.

Other improvements which came into being with the introduction of the wide-body escape systems and with later slide designs included:

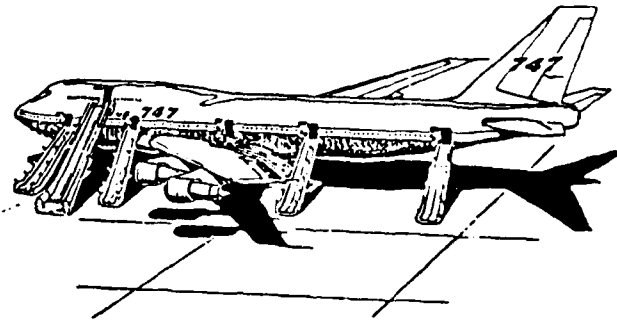


Figure 10 747 Wide-Body Escape Slides

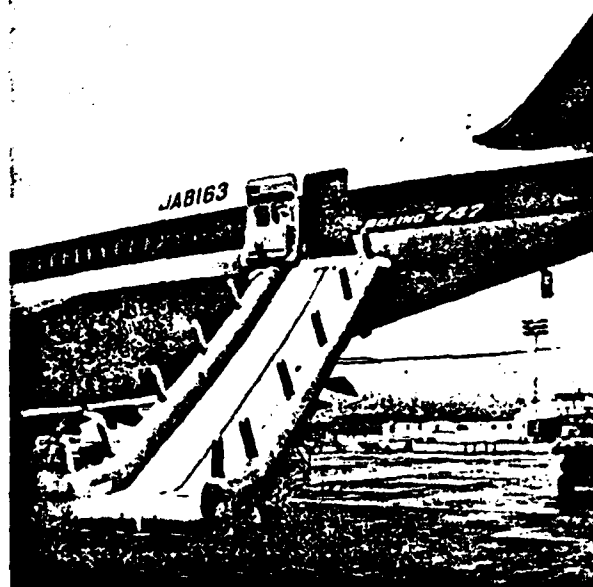


Figure 11. Typical Escape Slide Developed for Wide-Body Airplanes

- The means to arm and disarm the slide system by controls located on or near the door, rather than having to stoop and manually place the girt bars in the floor brackets before taxi and takeoff and then reversing the process to disarm the slides after arrival. Figure 12 shows the arm/disarm system used on the 757 door. Moving the lever to the "Engage" position automatically locks the girt bar into the floor brackets.

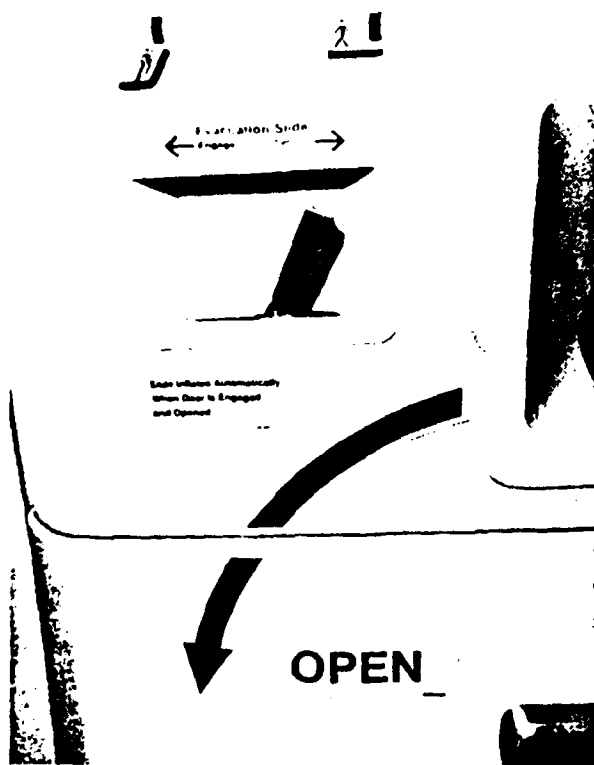


Figure 12. Arm and Disarm System — 757 Aircraft

- New, lighter weight, higher strength fabrics provided improved resistance to punctures and tears as well as allowing for improved designs.
- New fabric coatings were developed to protect the slide from the effects of radiant heat, thereby lengthening the time that a slide would be usable when exposed to the effects of an external fire.
- More efficient aspirator designs made the inflation of standard body aircraft slides possible in as little as one or two seconds.
- A cool gas generator provided a lightweight way to inflate the new, larger, wide-body airplane slides. Hot gas from combustion of a solid propellant was mixed with vaporized Freon to cool the gas used to drive the aspirators and inflate the slides.

- Improved tube designs provided more resistance to buckling and provided better ways to keep occupants on the sliding surface.
- Slides capable of being deployed in 25-kn winds blowing from any direction were developed.
- Reliability of escape system components such as aspirators, pressure bottles, and inflation valves was improved.

Off-Wing Escape Slide Design

Off-wing slides were first introduced with the wide-body aircraft and are now also provided on some standard-body models. Figure 13 shows a typical off-wing escape slide as installed on the 757. By current regulations, off-wing escape slides must be provided when the wing-to-ground height (with the wing flaps in the most adverse position) exceeds six feet. Off-wing systems are more complex than door-mounted slide systems because the escape slide and inflation systems must be located in body fairings or wheel well areas away from exits. Off-wing slide systems have used combinations of electrical, mechanical, pyrotechnic, and pneumatic devices to deploy and initiate inflation of the slides.

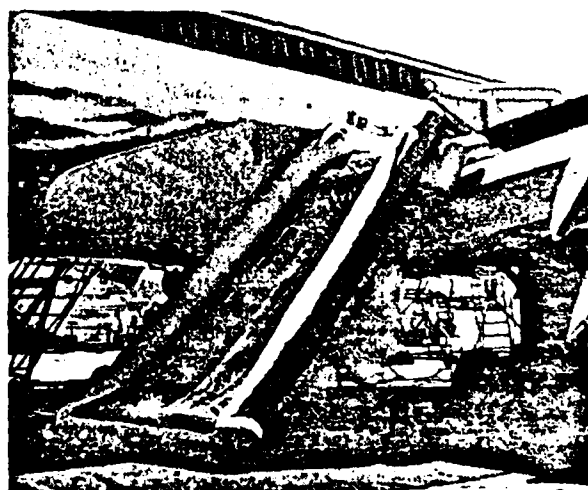


Figure 13. Typical 757 Off-Wing Escape Slide

Slide/Raft Design

Work began during the last half of the 1960s to combine the functions of the inflatable slide and the inflatable raft for airplanes requiring over-water equipment. The combination device would have to meet all the requirements for use as an escape slide on land as well as meet all the requirements for use as a raft at sea. The first such units were put into operation in 1971. Figure 14 shows a typical 767 slide/raft deployed as a slide. Figure 15 shows a typical 757 slide/raft being used as a raft. Figure 16 shows the 757 slide/raft in the water, with a canopy erected over it to protect the evacuees from the elements. This technology provided further improvements in passenger safety and did away with the need to carry and maintain separate rafts, unless they were needed to supplement the aircraft's slide/rafts.

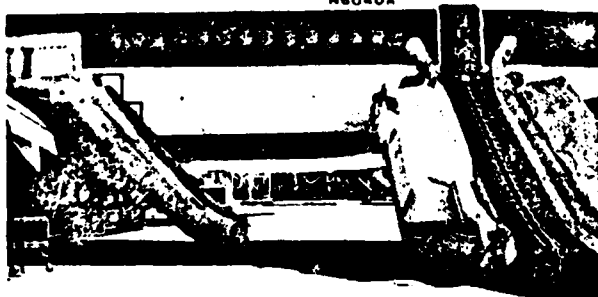


Figure 14. Typical 767 Slide/Raft Deployed as a Slide

Escape Slide Design Requirements

The prime purpose of the emergency evacuation system is to provide fast, safe evacuation of passengers and crew on land or in water. Systems and equipment must be safe and simple to use, perform reliably, and be easy to maintain.

Design of all emergency evacuation systems must meet Federal Aviation Administration

regulations. The FAA regulations provide design requirements which ensure the design of safe, reliable evacuation equipment. Some of the design requirements are:

- The escape system must accommodate all aircraft attitudes, taking into account all combinations of landing gear position or loss of any gear.
- The materials used in escape systems must meet specified strengths that provide protection against tears and punctures.
- Materials must resist burning.
- Materials must be resistant to fluids, food contamination, and exposure to the sun.



Figure 15. Typical 757 Slide/Raft Used as a Raft



Figure 16. Typical 757 Slide/Raft in the Water With Canopy Erected

- Escape slides must inflate within 10 seconds after initiation of deployment. Off-wing slides must inflate within 15 seconds.
- Escape slides must be capable of supporting at least 60 persons per sliding lane per minute.

Effective June 3, 1983, new escape slide designs approved under Technical Standard Order TSO-C69a were required to meet the following requirements:

- The escape slide system must be capable of deployment into 25-kn winds from any direction.
- Materials must be resistant to radiant heat from fire.

Escape Slide Testing

An extensive test program is carried out by both the escape slide manufacturer and the airframe manufacturer to ensure that the escape slide system will meet all performance requirements. For example, the 747 airplane slide development program for the main and upper decks involved over 6,300 inflations and 40,000 live subjects.

On recent aircraft programs, modules simulating airplane structure, with a working door, were used for development and testing of the escape slide system. These modules were used for hundreds of tests and retests of prototype escape slides. In some cases a second set of door modules was built, with actual production hardware, for continued testing of escape slides prior to the availability of the first production airplane.

The door modules were used to deploy escape slides at various sill heights into 25-kn winds and to deploy slide/rafts into the water. Changes to the escape slide and slide/raft designs took place throughout this period of development and testing. Production escape slide units were also tested on the door modules before being tested on production airplanes.

Some of the tests the slide manufacturers conduct to show compliance with today's FAR and TSO requirements are:

- Tensile and tear strength tests for slide fabrics. These tests are conducted with fabric samples that have been exposed to various fluids and have undergone accelerated aging.
- Permeability tests in which the fabric used in the inflatable tubes is tested to verify that the allowable leakage rates are not exceeded.
- Seam and adhesive peel and shear strength tests which are conducted before and after accelerated aging.
- Tests confirming the slide fabric's resistance to fungus, beverages, foods and fluids (including fuel), and cleaning fluids.
- Tests that prove resistance to salt spray, sand and dust, humidity, and atmospheric pressure changes.
- Tests conducted under simulated rainfall to ensure that the sliding characteristics of a wet slide are adequate and safe.
- Tests to burst pressures of at least twice maximum operating pressure to ensure that the slide would still operate even if the pressure relief valves were to fail.
- Wind tests to confirm that the slide would deploy in wind from any direction. Wind testing requires the greatest number of tests and the most redesign.
- Life cycle testing in which one unit is subjected to 40 cycles of packing and deployment with no maintenance.
- Beam strength tests which confirm the maximum number of occupants that could be supported by the slide without buckling.
- Environmental tests to account for the environmental extremes of high and low temperatures the aircraft will be subjected to.

- Inflation system tests to proof and burst pressures and dynamic inflation loads. The systems are put through drop tests to simulate accidental dropping with a charged bottle.
- Lighting system tests to ensure that adequate light levels are provided.
- Testing conducted to establish evacuation rates at all pressure combinations. Tests are also conducted to demonstrate the use of a slide as a hand-held chute.

Following these tests the slide supplier normally obtains a TSO-C69a approval. As an option, the slide can be certificated as part of the airplane design by verifying that the slide meets the requirements of TSO-C69a.

In addition to the testing performed by the slide manufacturer, the airframe manufacturer conducts several tests, such as:

- Tests that show the slide can be deployed from an airplane at all expected landing gear conditions.
- Repeatability tests from door modules representative of the actual aircraft door, and then from the aircraft itself.
- Large-scale tests that are beyond the capability of the slide supplier.

These tests must all be conducted to the satisfaction of both the slide manufacturer and the airframe manufacturer before the escape system is presented for certification. A series of demonstrations are then conducted for the FAA for certification approval. The FAA demonstrations include wind tests, hot and cold soak tests, repeatability tests, and low- and high-sill height tests.

The foregoing development, qualification, and certification test programs, however, are by no means the end of escape slide testing. The slide manufacturer conducts performance verification tests on every production assembly. The airframe manufacturer deploys every slide, at

every door, on every airplane well into the production program until the quality control department and the FAA agree that the escape slide performance justifies the establishment of a sampling test plan.

Escape Slide Reliability and Maintenance

The initial maintenance requirements for a new Boeing airplane are jointly developed by a committee of Boeing and airline technical specialists known as a Maintenance Steering Group. This group's activities are observed by FAA specialists. The Steering Group develops requirements through application of a logical decision process, outlined in the Maintenance Steering Group handbook and referenced in FAA Advisory Circular 121-22. Results of this cooperative activity are issued by the FAA as a Maintenance Review Board report, outlining the minimum airworthiness maintenance requirements for that airplane model.

Concurrently with the release of this FAA Maintenance Review Board report, the airframe manufacturer releases a Maintenance Planning Data document that outlines its recommendations for establishing an initial scheduled maintenance program. The Maintenance Planning Document thus contains not only all of the FAA Maintenance Review Board requirements, but also those maintenance tasks suggested by the airframe manufacturer. This document is not, however, an FAA-approved document. Each operator has the final responsibility for developing and obtaining regulatory approval of its own maintenance program.

Because the FAA Maintenance Review Board report is issued primarily to support the start of a new airplane model in service, it is not regularly revised. The Boeing Maintenance Planning Document, on the other hand, is revised annually to include significant design changes in the airplane and changes in maintenance procedures. Maintenance recommendations based on airline service are also included.

Maintenance programs are generally approved by the airline's local regulatory agency well

before the arrival of a new-model airplane in an operator's fleet.

An operator with an established maintenance program continually revises his program based on industry and his own real in-service experience.

At delivery, the customer receives a fully certified and FAA-approved airplane with the latest improvements incorporated. While the airframe manufacturer's hands-on responsibility and involvement cease at this time, the airline is by no means left to its own resources in maintaining the airplane.

The Boeing customer services organization provides complete support to assist the airline customer in these activities. Onsite Boeing field service representatives help the airline identify and resolve in-service problems. The field service representatives work closely with the airline's technical staffs to provide technical details of in-service problems and needed product improvements. These details in turn are communicated to the appropriate Boeing organization for resolution. This two-way communication results in:

- Service bulletins and service letters which provide the technical details for incorporation of changes to the airplanes.
- Revisions of formal publications such as maintenance manuals, structural repair manuals, illustrated tool and equipment manuals, and so on. Periodic revisions to these documents provide the latest technical data and procedures for maintenance of the airplane.
- Revisions to the illustrated parts catalog which lists the latest components and parts, either from Boeing or the various Boeing suppliers and vendors.

A prime example of the benefits of the operator/Boeing information loop has been the recent development of the mini-inspection/check procedure for the 747 emergency evacuation system. This is essentially a simplified checklist which identifies conditions that

might prevent successful deployment and inflation of the 747 emergency escape systems. While the procedure itself is new, it is basically a compilation of existing data and information located throughout the various and separate ATA subchapter sections of the maintenance manual.

Beginning with the 767, a mini-inspection/check procedure was developed for the 767 doors after a number of difficulties were encountered in rigging the doors on early delivery airplanes. Implementation of this procedure in production and in the maintenance manual reduced door problems significantly. Next was a similar approach for the 747 in an effort to improve its escape system reliability. As a result, a 747 mini-inspection checklist was developed.

This checklist has now been field-tested at three major airlines. Feedback is being incorporated in the final version of this procedure, which is to be included in the October 1985 revision of the maintenance manual.

An experienced mechanic can complete the checklist within two and a half hours per door. Use of the mini-inspection/check procedure, as verified by the field tests, will produce a significant increase in escape system reliability.

The responsibility of ensuring a consistently reliable emergency escape slide system rests with both the airframe manufacturer and the airlines as monitored by the appropriate regulatory agency. The airframe manufacturer's responsibility is to ensure that in-service problem resolutions, product improvements, and revised maintenance procedures are provided in a timely manner. The airline's responsibility is to:

- Incorporate fixes generated by in-service problem resolutions and production improvements.
- Maintain their own maintenance program and update it as necessary.

- Maintain satisfactory training levels of their maintenance and cabin crews.

Conclusion

Emergency escape systems have been instrumental in saving many lives by providing a way to rapidly and safely leave aircraft under emergency conditions.

Emergency escape systems have been significantly improved over the years. Current designs afford measurable improvements in safety. Inflation times have been reduced as equipment and techniques continue to become more efficient. Materials now have greater strength and improved fire resistance coupled with lighter weights.

Escape slides now deploy automatically. Arming of the system is simple and ensures that the escape slide has been prepared in the event of an emergency.

System reliability has increased as a result of both extensive development and qualification programs which closely simulate actual service experience.

When in-service difficulties are reported, the industry responds to identify causes and to take prompt corrective action.

In spite of all the improvements that have already been made, the industry must maintain a high level of reliability and continue to seek improvements so that vital emergency escape systems will be there when needed to minimize injury and to save lives.

Ballenger

**The Airline Engineering and Maintenance Aspects
of Emergency Evacuation Hardware**

**Presented by the Air Transport Association
at the FAA Conference on Emergency Evacuation
September 3-6, 1985**

The Air Transport Association is pleased to participate in this conference and to present a brief overview of the airline Engineering and Maintenance aspects of emergency evacuation hardware.

Effective emergency evacuation of aircraft obviously requires that equipment such as exit doors and escape slides or slide rafts and emergency lighting systems operate to a high level of reliability. Earlier narrow-body jet aircraft, by the nature of their design, were equipped with smaller and simpler doors and slides. Because of the lower floor heights and lower passenger capacities, these aircraft presented less of a design challenge to fit slides into compact packages. Doors and slides for the narrow-body aircraft have been relatively trouble free except for the small number of inevitable design and human errors which are experienced with all new hardware.

Design of the wide-body jets starting in the late 1960's and the early 1970's presented a more difficult design challenge because of larger doors and greater floor to ground heights. The larger doors required the use of counterbalancing, power assist or full power which made them more complicated.

The increased complexity of the wide-body aircraft doors and slides produced a number of "teething" problems during the early 1970's. These problems were solved by design and maintenance program changes. In recent years some airlines replaced the original main deck cool gas generator inflated slides on Boeing 747 aircraft to improve reliability. The new stored gas inflated slides also generated their own unique teething problems which we believe are now solved.

The routine operation of aircraft passenger doors is in itself a check of door hardware. At each departure and arrival, flight attendants arm and disarm the equipment which provides for a functional test of this part of the system and a visual awareness of general condition. It is obvious, however, that the complete emergency actuation of doors and slides cannot be checked at each routine door operation and by each flight attendant check. Therefore, to maintain door and slide emergency systems to a high degree of reliability, the operators rely upon periodic maintenance checks and overhauls. This includes the periodic removal of the slides/slide rafts for shop testing as well as several scheduled levels of inspections and functional checks conducted with the equipment installed on the aircraft. All such inspections and equipment checks are accomplished in accordance with an FAA approved airline maintenance program and in accordance with specified maintenance manuals.

The intervals for slide/slide raft removal and overhaul vary according to equipment design, modification status and the airline's operating experience. Shop testing and inspection frequency are either controlled by a computerized time control program or are implemented automatically at specified major maintenance visits. This assures that no equipment is used beyond its approved time period.

At certain times, sample deployments of slides are performed to assure that the equipment performs its intended function. Inadvertant deployments also provide valid door and slide reliability data. Malfunctions experienced during any type of deployment can be grounds for fleet campaigns to assure that other doors or slides do not have the same problem. Each airline must have a continuing analysis and surveillance system as required by FAR 121.373 to assure that malfunction information is acted upon. The airlines maintain extensive engineering and quality control staff to determine the cause of malfunctions and execute appropriate corrective action programs.

When appropriate, malfunction information is provided to the equipment manufacturer and aircraft manufacturer so that necessary design changes can be developed to improve function and reliability throughout the life of the equipment. The manufacturers issue information letters and service bulletins to all operators of the equipment to insure that proper

dissemination of information and product improvement awareness exists with all operators of the equipment involved. This system has been in place for years and has been demonstrated as extremely effective for problem-solving and product improvement.

Most of the larger airlines have extensive facilities for overhaul and modification of slides. However, some airlines contract with FAA approved repair stations to overhaul their slides. Overhauls conducted by repair stations must be accomplished in accordance with each airline's maintenance manual for the specific slide type. Each airline is required by FAR 121.363(b) to exercise quality surveillance over the work of repair stations as well as for work the airline accomplishes in-house. In addition, the airline's continuing analysis and surveillance system must cover the work performed by repair stations.

The basic objectives of all airline maintenance programs, including those for doors and slides, are well stated in the ATA airline/manufacturer Maintenance Planning Document MSG-3 as follows.

- (1) To ensure realization of the inherent safety and reliability levels of the equipment
- (2) To restore safety and reliability to their inherent levels when deterioration has occurred.

- (3) To obtain the information necessary for design improvement of those items whose inherent reliability is inadequate

MSG-3 is internationally recognized by airworthiness authorities, airlines, manufacturers and military organizations as the keystone for development of aircraft maintenance programs.

The continuing improvements of current transport category airplanes in conjunction with the reliability monitoring maintenance programs of the operators assure that airline emergency evacuation equipment will continue to perform to a high degree of reliability.

In the judgment of the airlines, the current FAR's for the design and maintenance of aircraft emergency evacuation equipment are sound and need no major revision. However, FAR's 121.703 and 121.705 which contain the Mechanical Reliability Reporting and Mechanical Interruption Summary Reporting requirements should be revised. ATA's recommendation on these requirements were sent to the FAA in response to a request for public comment in the July 16, 1984 Federal Register.

Briefly the ATA members recommended that the MRR system be made into a true mechanical alert reporting system which concentrates on safety significant issues and eliminates the unnecessary repetitive reporting of non-critical occurrences.

Presently the volume of Service Difficulty Reports is so large that its difficult to extract significant safety information. The volume of reports also affects the ability of the FAA to disseminate such information quickly. Because of the shortcomings of the SDR system the airlines now rely primarily on the manufacturers to alert them to safety type information.

In closing I would like to point out a couple of observations regarding the discussions during this conference:

The first observation - There seems to be a number of people at this Conference who are having difficulty understanding the aircraft certification process. This is probably understandable. Those of us who are engineers perhaps take the certification process for granted and we do a poor job of explaining how it works. There are in fact hundreds and maybe thousands of certification requirements or airworthiness qualities which must be substantiated for a new aircraft and engine combination certification program. Examples of these airworthiness qualities are structural integrity, aircraft performance, engine durability, hydraulic system performance and automatic flight control systems integrity as well as emergency evacuation system performance. It is just not on to expect a manufacturer to spend 10 years doing tests for endless operating scenarios. A \$2 billion certification program would become a \$20 billion program which would, of course, be uneconomic. It is a fact that all certification requirements provide margins

for in-service variations. If a need for additional margins is identified, then rulemaking action may be appropriate. The purpose of this Conference is to identify any need for additional safety margin.

The second observation - As noted by Barry Eberhardt and others, the airframe manufacturers have been designing, building and demonstrating jet transport emergency evacuation systems for 27 years. As Barry said, no redesign of any airplane was required as a result of full scale evacuation demonstrations. In other words, the emergency evacuation analysis performed by the designers before the airplane was built has always been successful. The 27 year record of success substantiates the validity of analysis used in conjunction with appropriate tests. There is a good reason for this record. The manufacturer must guarantee the maximum certificated passenger capacity of a new airplane long before it is built and certificated. If he misses the capacity as a result of a full scale emergency evacuation failure, he would be in deep financial trouble. If a 500 passenger capacity aircraft suddenly became 450 passengers, heads would roll at Boeing, Douglas or Airbus.


PR/TEXAS

September 3, 1985

Ms. Patricia Siegrist
Transports Standards Staff
Aircraft Certification Division
Federal Aviation Administration
North West Mountain Region
17900 Pacific Highway S (C-68966)
Seattle, Washington 98168

Dear Ms. Siegrist:

As the developer of the first floor-proximity emergency egress lighting system to demonstrate compliance with 25.812E, change 19, Plumly Airborne Products naturally has much to contribute to the discussion of cabin safety and transport aircraft accident survivability.

The Plumly Advanced Incandescent Emergency Egress Lighting System substantially raises the standards for floor proximity lighting systems, as documented in the enclosed material. This advanced system is so effective that it warrants adoption by the Federal Aviation Administration as the design standard by which all such systems can effectively be measured.

We are enclosing with this letter material which should be incorporated into the permanent record of the proceedings of the seminar now being conducted by the Northwest Mountain Region of the Federal Aviation Administration. We request that this material also be made available to each participant at the seminar as well as to other interested parties. These documents include:

- *Performance Standards for Floor-Proximity Emergency Lighting Systems, dated Sept. 1, 1985.
- *Developing An Effective Floor Proximity Escape Path Lighting System for Commercial Aircraft: A Technical and Historical Perspective, dated June 3, 1985.

Ms. Patricia Siegrist
September 3, 1985
Page 2

We regret that we are unable to attend the seminar. We are devoting our energy and resources to completing steps necessary to put the Plumly system on the market with sufficient time to allow the airlines to retrofit their existing fleets by the compliance deadline of Nov. 26, 1986.

However, we respectfully request a complete list of participants in the seminar in order that we may send them more detailed information about this innovative emergency lighting system in the near future. Please provide the list of participants and their addresses as soon as possible.

Sincerely,


David Lindsey

DL/meg

cc: Thomas E. McSweeney

**PERFORMANCE STANDARDS
FOR FLOOR-PROXIMITY
EMERGENCY ESCAPE PATH LIGHTING**

SEPTEMBER 1, 1985

**Plumly Airborne Products, Inc.
P.O. Box 26868
Fort Worth, TX 76126-0868
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INTRODUCTION.

The American free enterprise system is based on one fundamental concept: entrepreneurs risking their own financial resources, ingenuity and capability to provide needed products and services at a competitive price.

The antithesis is monopoly, unfair restraint of trade and under-the-table anticompetitive agreements.

As an entrepreneurial company embodying the best of the American approach to business, Plumly Airborne Products, Inc., has set out to develop, build and market a superior floor-proximity emergency egress lighting system. Throughout the research and development process -- which has spanned more than a decade of extensive research in smoke-filled aircraft cabins -- Plumly Airborne Products has diligently worked to solve the problem of getting people out of smoke-filled aircraft cabins; the system was not designed just to meet minimal regulations.

The resulting floor-proximity lighting system is a state-of-the-art engineering achievement that represents a significant leap forward in aircraft cabin safety equipment.

In adopting new floor-proximity egress lighting regulations, the Federal Aviation Administration itself said in the preamble to the rule that it was seeking systems that "represent a significant improvement in aircraft cabin safety."

The Plumly system has passed all applicable tests and the appropriate Special Type Certificate has been issued, the first system to demonstrate compliance with the floor-proximity emergency escape path marking regulations published in the Federal Register Friday, Oct. 26, 1985, and requiring Parts 25 and 121 aircraft to be equipped with effective systems by Nov. 26, 1986.

As part of the development process and amply verified in the STC approval process, the Plumly system has been demonstrated conclusively to establish new, significantly higher standards for emergency egress lighting. These standards now stand as an effective measure of any competitive floor proximity lighting systems which may be offered to the airlines, and thus indirectly to the airlines' passengers.

The rule specifically indicates that the new floor-proximity lighting systems should enable passengers to:

- 1) leave the passenger seat or seat row and enter the walkway area immediately adjacent;
- 2) identify from visual reference to the floor proximity marking system the direction(s) of the first exit or pair of exits forward and aft;
- 3) traverse to those exits without significant hesitation, delay or evidence of confusion;
- 4) make positive identification of the exits by visual reference to features not more than four feet above the cabin floor.

In its justification for the rule, the Federal Aviation Administration said the historical fire fatalities for the period 1965 through 1983 were 712. Extrapolating this fire fatality rate over the next 10 years, the expected life of the lighting system, the FAA estimates that about 10 percent of that number will have to be saved to justify the cost. The FAA's judgment is that a sufficient number of persons will be saved to justify the cost.

The Plumly system not only technically meets the standards, it raises the standards substantially in all applicable categories as demonstrated by the following report.

SYSTEMS DESIGN.

In essence, the Plumly Advanced Incandescent Emergency Egress Lighting System is a state-of-the-art approach to floor proximity lighting.

Its lights are incorporated into the aircraft carpet, the ideal location for enhancing passenger evacuation rates in smoke-filled aircraft cabins. Bright incandescent bulbs are placed in highly durable LEXAN tracks at 20" alternating intervals on either side of the cabin aisle. Exits are indicated in the aisle by red strips which indicate the location of an exit on that side of the aircraft. The exits themselves are further identified by new lighted EXIT signs that spell out the word EXIT with 25 tiny, brilliant lamps.

The unique Plumly design identifies the escape path along the cabin floor in an unmistakable, natural geometric pattern similar to runway lighting. Even if the next bulbs in the escape path are

obscured temporarily by dense smoke, they appear at such regular intervals that all passengers will have the security of knowing where to look for the next guidepost along the escape path.

The red strips, incorporated into the aisle, are the next key feature in the Plumly system. Because they are centered with the nearest exit, it will be virtually impossible for passengers to pass by the exits unaware that an exit is nearby. As demonstrated in the Air Canada fire and forced landing in June 1983, and acknowledged by the FAA itself in its Advisory Circular regarding compliance with the new floor-proximity rules, this feature is essential in new lighting systems. Two of the passengers who died on the Air Canada plane were proven to have been in front of the wings when the plane landed. However, because their bodies were found aft of the wings, it is axiomatic that they passed all four overwing exits simply because they could not see them.

The third dramatic breakthrough in the Plumly system is the new exit lights. Present exit signs are required to provide 25 foot-lamberts of light and a 3 - 1 contrast ratio. The Plumly exit sign, however, produces 400 foot-lamberts of light and an infinite contrast ratio. These lights are so effective that they can be seen in 90 percent dense smoke for 100 feet.

Further, the Plumly Advanced Incandescent Egress Lighting System consistently produces a minimum of 7.5 times the light required of existing overhead emergency lighting at the floor and armrest levels when measured at standard 40" intervals.

WHY THE PLUMLY SYSTEM REPRESENTS A 'SIGNIFICANT IMPROVEMENT IN AIRCRAFT SAFETY.'

The Plumly Advanced Incandescent Emergency Egress Lighting System is so clearly superior to all other emergency lighting systems that it alone warrants adoption by the Federal Aviation Administration. At the very least, the Plumly system should set the standard by which all lighting systems are approved, if only because its performance level is so demonstrably more effective than any other potential floor-proximity lighting approach.

Here is a summary of the reasons why the Plumly system represents such a significant improvement in cabin safety that it raises the applicable standards.

- 1) It is the only system that has been tested and proven effective in smoke. Even in 90 percent dense smoke, the system is visible for more than half the length of the ship's cabin. The Plumly exit signs are visible for more than 100 feet in 90 percent dense smoke.

- 2) The Plumly system operates indefinitely on the aircraft's 115 essential AC power until that power source is inoperable or depleted. Current emergency systems, on the other hand, rely solely on battery power. In the Air Canada scenario, for example, the plane was in the air 10 - 12 minutes before landing. Although the emergency lighting system had been switched on, no survivors recall seeing any light whatsoever. Additionally, current systems are only required to provide 10 minutes worth of emergency light -- which clearly is inadequate because the batteries can be depleted in that period of time before the aircraft even makes it to the ground.
- 3) Once the 115 essential AC power is depleted, the Plumly system provides more than 30 minutes worth of full power -- again, representing a significant improvement in passenger safety.
- 4) Whenever the ship's primary electrical system is activated, all of the filaments in the Plumly lamps are heated thermally to increase their resistance to shock and vibration which significantly extends the rated life of the bulbs by minimizing the adverse effect of thermal shock, again representing a significant improvement in aircraft safety.
- 5) The system is built on a continuous loop from the front end to the rear end of the aircraft. This continuous loop provides two distinct advantages: a) if one side of the loop is severed, there is no loss of lighting; b) if both sides of the loop are severed as in an aircraft separation, both sections of the aircraft will continue to be lit as there are two battery sources, each capable of running the full 100 percent of the lamps approximately 15+ minutes. This assures that even in subzero temperatures, lighting is available to both sections regardless of where the separation takes place. This represents a significant improvement in aircraft safety.
- 6) A switch is provided at the flight attendant's panel, allowing the system to be activated at approximately 50 percent voltage which performs a complete systems check each time the lights are demonstrated during the passengers' safety briefing.
- 7) The flight attendant's switch also allows, through a momentary switch, the batteries to be checked at full power. The Plumly system provides a visual indication that the batteries are at least 80 percent charged. Under the existing system, flight crews have virtually no way to check the

charging on the emergency lighting batteries without removing them from the aircraft. Thus the Plumly system again represents a significant improvement in cabin safety.

- 8) The system provides a new and unique integrated circuit which accelerates battery charging when needed, provides only a trickle of charge when the batteries are approaching full charge, and only a minimal charge thereafter. This assures that batteries will get a very fast charge during the boarding time when auxiliary power is being used and assures the maximum amount of energy and reliability of the batteries after take-off, especially in extreme cold climatic conditions, another significant improvement in cabin safety.
- 9) The Plumly batteries are completely sealed and exhaust no liquids and only gas when the internal pressures exceed 40 psi (which can only occur with a runaway charge, inhibited by the electronic circuitry in the system.) This assures that upon extreme decompressions, the reliability of the Plumly batteries will not be adversely affected.
- 10) The system requires no structural changes whatsoever to the aircraft, ensuring that the system can be economically and easily installed. Because the system is integrated into the carpet, it is not affected by expansion or contraction of the aircraft, and is therefore not affected by shrinkage, twisting or movement of the aircraft interior structure.
- 11) The system is turned off, armed and activated by the switching system already installed in the aircraft, and requires only minor changes to the flight attendant's panel and interfacing with the present power and signaling systems.
- 12) The system's arming approach assures that the Plumly system can not be misused or abused, thus ensuring its use only in a bona fide emergency. This ensures that the system will be fully charged when called upon in the case of authentic emergencies, another significant improvement in cabin safety.
- 13) Because the system is powered by the ship's 115 essential AC power, it can be used for emplaning, deplaning and night lighting, allowing passengers to be consciously and unconsciously made aware of the emergency escape path and every exit on the aircraft.

- 14) The system makes exits so visually obvious -- by the red strips in the aisle and the new 400 foot-lambert exit signs -- that historically underutilized exits such as the galleys and overwing exits will be immediately seen by passengers who might otherwise tend to be led by these available escape routes, a dramatic improvement in cabin safety.
- 15) Federal Aviation Administration demonstrations prove that the Plumly system provides more than 30+ minutes of burn time with both batteries operable, and more than 15+ minutes of burn time when powered by only one of the power sources. This represents a significant improvement in cabin safety, particularly in the event of an in-flight fire such as the Air Canada disaster when persons should have had sufficient time to identify the exits nearest them and plan the escape strategy.

CONCLUSION.

The Federal Aviation Administration, whose duty it is to ensure that the airlines "operate at the highest possible degree of safety" has an opportunity to translate these words into action with the Plumly Advanced Incandescent Emergency Egress Lighting System. This state-of-the-art lighting system represents American ingenuity, problem-solving and entrepreneurial spirit at its best.

It sets the standards by which all other potential floor-proximity emergency egress lighting systems should be measured.

**DEVELOPING AN EFFECTIVE FLOOR PROXIMITY
ESCAPE PATH LIGHTING SYSTEM FOR COMMERCIAL AIRCRAFT:
A TECHNICAL AND HISTORICAL PERSPECTIVE**

**By: David Lindsey
June 3, 1985**

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EXECUTIVE SUMMARY

Airlines, as prime carriers of the public, are charged with maintaining the highest order of duty regarding state-of-the-art safety equipment. To do anything less constitutes gross negligence.

The Federal Aviation Administration similarly is charged with promulgating effective safety standards to ensure that the airlines provide maximum protection for the public. It should not be necessary to point out that the public -- not the airlines -- is the FAA's chief constituency and, therefore, its primary concern.

According to industry estimates, 350 million people board aircraft annually. Given that FAA safety standards normally stand relatively unchanged for 15 years, it becomes evident that as many as 5.2 billion people will board aircraft under the new "floor proximity emergency escape path marking" regulations published in The Federal Register in October 1984, and requiring compliance by November 1986.

Therefore, it is the duty of the FAA to ensure that the safety systems adopted by the airlines in response to these new regulations are effective, and that they actually represent "a significant improvement in aircraft cabin safety" as stated in the preamble to the regulations.

In summary, the regulations require new safety systems to provide visual guidance for emergency cabin evacuation when all sources of cabin lighting more than 4 feet above the aisle floor are totally obscured by smoke.

The systems must enable each passenger to:

- 1) Visually identify the emergency escape path along the aisle of the cabin floor after leaving a cabin seat; and
- 2) Readily identify each exit from the emergency escape path by reference only to markings and visual features not more than 4 feet above the cabin floor.

INTRODUCTION

For years, safety experts both inside and out of the Federal Aviation Administration have recognized that emergency escape lighting systems on commercial aircraft have been grossly inadequate.

It is an undeniable fact that many people have died in otherwise survivable airline disasters from smoke inhalation -- primarily because they have not been able to see to get out of smoke-filled aircraft. Consequently, the FAA Civil Aeromedical Institute in Oklahoma City asked Fort Worth inventor George Plumly more than a decade ago to use his extensive expertise in human factors lighting to develop an effective lighting system that would dramatically improve passenger evacuation rates in air disasters involving smoke-filled airliners.

The FAA specified that a satisfactory system would penetrate 90 percent dense smoke at 6 feet.

Plumly agreed to take on this important research task at no cost to the government. In addition to his proven ability as an engineer and inventor, Plumly brought an essential ingredient to the effort: his independence. He was under no obligation to anyone in the airline industry, nor did he have a product he wished to adapt for sale. Plumly's original research was intended solely to examine alternatives and to develop a workable, effective emergency egress lighting system that would enable significantly higher percentages of passengers to survive.

The FAA/Plumly research involved extensive study of every major lighting technology that had potential as life-saving equipment. These included:

- *Electroluminescent strips
- *Spotlights
- *Strobe lights
- *Floodlights
- *Fluorescent lights
- *Incandescent lights

Tests conducted over a two-year period demonstrated the impracticality and ineffectiveness of all systems except fluorescent and incandescent lights. Plumly pursued both of these approaches simultaneously, and the results were impressive. In a report made by the Flight Standards Technical Division of the Civil Aeromedical Institute referring to Project No. 207-75A (01551) dated September 1975, authorities noted:

"It is significant that two exit lights, the Plumly-F and Plumly-FX, produced more light in 90 percent smoke than the other lights did in no smoke."

At the time of the research, FAA officials told Plumly that the airlines were reluctant to mounting any system on the floor; Plumly then concentrated on installing the lights on the arm rests of the seats. This arm rest system had tremendous smoke penetrating capabilities because of a unique lens system developed by Plumly that incorporated more than one million prismatic surfaces on both the front and back of the lens.

However, the fluorescent arm rest system, despite its effectiveness, was later abandoned because the fixtures were not adaptable to floor lighting -- proven to be the ideal location for egress lighting in smoke conditions by FAA studies -- and because the costs associated with the system were unusually high. The fluorescent system also had a critical problem regarding starting reliability under all environmental conditions possible when an emergency could occur.

FAA researchers and others have recognized that floor placement of the lights is ideal for three obvious reasons:

- 1) The concentration of smoke that causes restriction to vision is apt to be the least at floor level.
- 2) Unless the floor is lit, the average person has extreme difficulty in moving even on a flat, unobstructed and level floor, as attested to by firefighting experts for years.
- 3) In a crash scenario involving failed landing gear, where either the latitudinal or longitudinal axis are tilted, it is almost impossible for any passenger to evacuate the aircraft within the FAA standard of 90 seconds without the floor being lighted.

SPOTLIGHTS, STROBE LIGHTS AND SELF-ILLUMINATING MARKERS

The FAA and Plumly researchers also have investigated spotlights, strobe lights, floor lights, indirect fluorescent lights and self-illuminating markers. None of these technologies proved effective in smoke-filled conditions.

By definition, spotlights and/or floodlights are lights which use an incandescent light source intensified by reflective materials which direct light into beams.

When high intensity lighting hits suspended carbon particles such as in a smoke-filled cabin, the suspended particles stop this light almost immediately. Therefore, this lighting technology simply does not work in smoke. Additionally, light from reflective instruments has a tendency to blind people either in clear or smoke-filled air, thus having a tendency to negatively impact the time necessary to evacuate the aircraft.

Early in the investigation, it was determined that no type of indirect light had any value in penetrating smoke and lighting the floor in a manner that would facilitate prompt evacuation. For example, in a demonstration comparing the various technologies earlier in 1985 at the FAA facility in Oklahoma City, strong high-powered fluorescent lights were placed under each seat in the simulated aircraft. Subjects in the evacuation simulator were unable to see the light source; only the light on the floor was visible. Only one subject out of 10 even knew the lights were on.

Plumly also tested a similar system using incandescent spotlights. This test proved without question that any type of indirect light of an intensity compatible with an aircraft egress system was of little or no value in smoke.

New floor proximity escape path lighting regulations were based in part on M. Teal's report, Improved Interior Emergency Lighting Study, DOT/FAA/CT-83/81. In that report, Teal compared 11 candidate systems including spot lights, self-illuminating markers and floor strip lights.

It is significant that of the 11 systems studied, only the floor-based lighting models -- including floor strip lights -- were deemed capable of providing 90 seconds of visibility in dense smoke. Spotlights, on the other hand, add "approximately 30 seconds of visibility in dense smoke conditions."

If we use the Air Canada scenario, we must assume that the moment the aircraft came to rest, it was already filled with smoke. When smoke enters an aircraft at some point after it has come to rest, it is obvious that there may be a period of time when smoke is not an issue in the egress progress. Therefore, it could be argued that other systems promising less visibility than 90 seconds may be adequate for evacuation.

However, given that the intent of Congress and the FAA regarding the current floor proximity regulations was to significantly improve passenger safety, it is difficult to justify considering any system that promises less than 90 second egress capability.

FAA document Amendment 25-59 entitled "Flammability Requirements for Aircraft Seat Cushions", page 404, paragraph 3, notes that the benefit effectiveness of fire blocking layers is basically a function of the increased time that is made available for aircraft evacuation. Quoting the report, "This time is varied, ranging between 20 seconds and 60 seconds." In looking at the economic studies of implementing this to a commercial airline fleet, the report indicates the cost to be more than \$28 million -- and yet the report shows that the evacuation benefit of this regulation only extends the evacuation times 20 - 60 seconds. The Plumly system adds a full 90 seconds -- and the Plumly system works in dense smoke conditions.

Self-illuminating markers, such as the paste-on tritium markers cited in Teal's lighting study -- which allegedly add 45 seconds of visibility -- make absolutely no promises of visibility in dense smoke. In fact, these markers have been demonstrated to be completely ineffective in smoke. These markers:

- *Produce no useable light.
- *Are one-third the brightness of the average firefly.
- *Are virtually impossible to see even in clear air.
- *Do not in any way define the escape path or adequately indicate exits.

QUESTION: WHAT WILL WORK?

After 10 years of research and development, it is abundantly clear that people in smoke can only see the source of the light -- not the ambient light the lamp produces. No amount of ambient light can penetrate carbon black particles.

The single most important fact learned in the research is that under dense smoke conditions, the only light that is visible is the unreflected light from a filament.

Incandescent bulbs require heating tungsten filaments. All tungsten filaments produce an equal amount of light for an equal amount of mass dependent on the Kelvin temperature of the filament.

In developing the Advanced Incandescent Egress Lighting System, Plumly has taken an approach designed to maximize the number of lighting sources in the aircraft cabin. Rather than place a few high powered spotlights in the cabin, the Plumly system installs 80 - 100 lamps with small filaments with brightness and/or Kelvin temperatures almost identical to larger tungsten-filament lighting units. The only difference in the lamps themselves is the length of the filaments, not the brightness of the filaments.

By dividing approximately the same amount of light into a considerably greater number of packages, the Plumly system allows the filaments to be placed in such a manner to form a pathway on the floor which automatically will guide people to every exit on the aircraft.

In the Plumly system, the lights are incorporated as an integral part of the floor covering itself. This covering has an average thickness of .2 and a crushed thickness of .1. Because the lights are incorporated into the carpet, the major part of the entire wiring and fixture mounting can be accomplished before the system is placed in the aircraft. Aircraft carpeting is pre-cut to fill the space between the seating rails, so installation is quite simple and inexpensive.

Because every type of lighting element deteriorates, any cost-effective system must be designed for maximum lamp life. Every time an incandescent bulb, for example, is used at its rated voltage, the filament is deteriorating at a relatively fixed rate and has a finite life. Over voltage or under voltage increases or decreases the life of the lamp by the 12th power. That means that if the lamp is operating at 50 percent of rated voltage, the life is theoretically more than 4,000 times the rated life of the lamp. Conversely, when operating the lamps at 50 percent over the rated voltage, the life is only 7/1,000 of the rated life of the lamp.

In the Plumly system, the lamps are specially designed to exacting specifications and are based on military and aircraft standards. Under the Plumly design and voltage requirements, each lamp will have approximately 2,000 hours of life.

Any emergency lighting system that does not work properly under the high probability of adverse conditions encountered in crash scenarios would be useless. The most delicate part of any system is the lighting element itself. In the Plumly system, two lighting intensities are built in. One level is set at approximately 50 percent brilliance for functional testing of the system and for pre-flight passenger briefing. The full-power intensity is only used in an actual emergency and/or power failure.

The Plumly system also involves continuous thermal heating of the filaments from the aircraft's normal power sources to ensure maximum flexibility of the otherwise brittle tungsten filaments. By incorporating thermal heating of the filaments, the Plumly system minimizes the effects of aircraft vibration and shock, thus extending the theoretical life of the bulbs by a factor of two.

One of the most demanding criteria for designing an effective emergency system is the requirement that it be adaptable to as wide a range of aircraft as possible. The system must also educate the passengers so that regardless of the type of aircraft, they can be familiar with the mechanics of fast, efficient evacuations.

In the Plumly system, the entire egress pathway from the front of the plane to the back is lit with white lights. In the case of multiple aisle aircraft, the system also will light the cross-aisles. Each exit on the plane is clearly marked with red and/or colored filters that precisely indicate the path off the main aisles to the exits.

In smoke, lineal vision is restricted to less than the aisle length. Because the Plumly lights are geometrically placed throughout the length of the cabin, new lights come in to vision in repetitive and predictable locations as passengers move down the aisle. This allows passengers to move rapidly and easily to the exits even though vision is restricted. The lighting pattern is similar to the way a pilot safely lands his aircraft when visibility is less than the length of the runway.

The light along the aisles in the Plumly system is even from one end of the cabin to the other, which allows the Plumly system to provide more than 10 times the light now provided by existing emergency lighting approaches.

In other words, this means that the Plumly system meets both the intent and objectives of the floor proximity lighting regulations as well as the existing requirements for emergency lighting with one compact, lightweight system.

AIR CANADA: LESSONS LEARNED

Longtime FAA official J. D. Garner, with whom Plumly worked in the original research, has said that if the exact scenario of each crash could be predicted, then evacuation plans would be drafted that would get most, if not all, of the passengers out of the aircraft.

In reality, however, actual crashes over the last 10 years have seldom, if ever been in accordance with the script. One FAA scenario states that if the optical density at 4 feet above the floor is .5, then the temperature in the aircraft at 4 feet is 400 degrees -- requiring that passengers be evacuated within 90 seconds.

However, in the Air Canada forced landing on June 2, 1983, survivors said the smoke was far more concentrated than .5, and that the smoke was at times thicker at the floor than at the ceiling. Survivors of the disaster do not recall even noticing the temperature inside the plane.

This is because Air Canada involved a slow-burning interior fire which produced a much greater amount of smoke than a normal faster burning fire. Passengers were confined in the dense, black smoke for as long as 13 minutes.

By assuming that the densest smoke is confined to the upper part of the cabin, the new regulations ignore the realities of smoke distribution. For the purposes of the regulations, it is assumed that there is no smoke below 4 feet. This certainly was not the case in the Air Canada disaster, and it is not the case in most other crashes investigated.

Although smoke normally does stratify, once there is movement in the cabin, or once any door or window is open, the smoke swirls. In the Air Canada example, survivors reported that the black smoke was much more severe when the doors were opened.

SURVIVORS

Another scenario heard frequently is that after a forced landing, passengers line up in the aisle, and are assisted by cabin attendants in making a safe and speedy exit. Again, the Air Canada disaster demonstrates that this scenario is overly optimistic.

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Referring to Figure 1 (based on the Bartholmess Human Factors study of the Air Canada forced landing), the first four passengers out of the two prime exits, R1 and L1, were passengers #3, #4, #8 and #11. Three of these first four people off the plane were flight attendants. Consequently there was no help by cabin attendants to assist the non-airline passengers.

If a disaster could be considered ideal in terms of potential survivability, the Air Canada forced landing at the Greater Cincinnati Airport was it. The aircraft landed normally, no one was injured or jostled about on impact; the cabin itself was only one-third full, and passengers had as many as 12 or 13 minutes to determine which exits they would use.

Yet only 18 non-airline passengers survived out of a total of 46 people aboard the aircraft. Why?

Most people are born with five senses:

- *The ability to see.
- *The ability to feel (tactile).
- *The ability to hear.
- *The ability to smell.
- *The ability to taste.

In an emergency such as Air Canada, only three of these senses are helpful in escaping the aircraft: seeing, touching and hearing. If there had been a forced landing with no smoke, no restricted vision, and all main and overwing exits open, it is probable that no one would have died aboard Air Canada Flight 797. Evacuation rates would have been normal and in accordance with the original evacuation rates set forth in the original certification of the Air Canada DC-9.

It is clear that a majority, if not all, the fatalities were caused by a lack of the ability to see. Evacuation rates were not adequate for survival.

When vision is highly restricted, and a person is forced to rely on tactile sense alone, the person must be thoroughly familiar with a structure in order to be able to quickly evacuate. Therefore, only those persons (flight attendants, pilot and first officer) who knew the aircraft structure intimately and passengers who familiarized themselves with the nearest escape routes were able to evacuate the aircraft using only their sense of feel.

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The least effective of the three available senses is the ability to hear. Passengers #18 and #19 escaped only because they heard the overwing exits being opened.

It is helpful to analyze the escape routes of the 23 survivors of the Air Canada catastrophe in detail. All but two of the passengers who survived relied on their luck in having been located close enough to the exits to feel their way out of the aircraft.

Referring again to Fig.1:

#1 and #2 (pilot and co-pilot) used the flight deck window exit immediately adjacent to their positions.

#3 and #4 were Flight Attendant 1 and a passenger seated next to him adjacent to prime exit L1 and the slide.

#22 and #23 had been told to move forward, but refused to do so because they felt safer sitting next to the overwing exit. Therefore, their unique position did not require vision to escape.

Flight Attendant 2 (#8 on Fig. 1) was sitting in seat 3C. Because she knew the aircraft, she proceeded directly to exit L1. Flight attendant 3 (passenger #11 on the illustration) used her tactile sense and knowledge of the aircraft to make her way through the aisle and galley, where she opened exit R1 (with slide). It is interesting to note that F/A 3 was the only person who escaped out of that prime exit.

The following passengers were briefed by the flight attendants or who were relatively close to the exits. Again, their survival was directly related to their familiarity with the exits, and they, too, did not need to see to get out of the aircraft.

#14 was instructed by a flight attendant and knew where exit R3 was located.

#16 was instructed as to the location of exit L2. #17, sitting next to passenger #16, got out by holding on to the other's trouser belt.

#15 was only two seats from exit R2.

#18 heard the overwing exit being opened and proceeded to exit L2, one row from his seat.

#19 heard the overwing exit being opened and proceeded to exit R2, again just one row away.

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#13 planned to exit R3 at row 13, but opted to exit out of L2 because it was closer and the smoke was not as dense.

#20 and #21 escaped via exit L2, one row from where they were seated on landing. #9 exited L1, knowing she was just one row from the front bulkhead.

#7 was an ex-airline employee familiar with the plane. He exited from L1.

#6 was closest to the two main front exits and had the most advantageous position.

The final two survivors, #10 and #12 on the illustration, were not in advantageous locations and were not necessarily familiar with the aircraft.

Had the Plumly system been installed in the Air Canada DC-9, there would have been semi-continuous lighting elements placed in the carpet from the flight deck to the rear of the plane. The bright red strip lights opposite L1 and R1 exits would have been visible by all passengers from their seat locations as shown by the dotted lines on Fig. 2.

In addition, four bright red lighted strips would have defined the exits at rows 12/13 and 13/14.

In the case of the Air Canada fire, the Plumly system would have been activated at the first indication of smoke. At that time, probably all the passengers could have oriented themselves in relation to the nearest exit. (The system is powered by the 110v 400 cycle main power supply until that power is exhausted. Because that power supply did not fail in the Air Canada disaster until after the engines were turned off after landing, the Plumly system would have operated continuously throughout the evacuation process. The system would have provided an additional 15 - 25 minutes of power from its designated battery sources after the plane landed.)

As demonstrated by Fig. 2, two fatalities were aft of an overwing exit. They were forward of the exit during landing. This means that they traveled past four exits WITHOUT SEEING THEM. Their bodies were found near seat row 14 and 16. Had the Plumly system been installed, with the bright red indicators at the overwing exits, there would have been no way that these passengers would have failed to recognize the escape exits.

Six people were found in the aisle. Their evacuation rate was not adequate for survival. The bottleneck at the front of the plane undoubtedly played a role in their deaths, coupled with the fact that there was no light in the forward section of the aircraft. Row 1 had been removed to add a coat closet from floor to ceiling. What little lighting did exist on the aircraft was around a corner and almost eight feet down the corridor.

Crew members clearly intended to use the primary exits to evacuate many of those passengers who died. If the Plumly system had been aboard the craft, there would have been a lighted path from the coat closet to both exits R1 and L1, which again would have been marked with lighted red strips, one on each side of the aisle. These strips would have been visible to all or most of the passengers from their positions at the time of the landing.

SYSTEM SPECIFICATIONS

To recap the design specifications of the Plumly Advanced Incandescent Egress Lighting System, the system:

- *Locates 80 - 100 low-powered incandescent lights alternately under the seats on either side of the aircraft, thus providing a clear indication of the egress pathway.

- *Incorporates the lights as an integral part of the carpet, and requires no structural changes whatsoever to the aircraft.

- *Operates from the airliner's own 110v, 400 cycle power, and is controlled by the already installed 28v DC controls.

- *Charges batteries and thermally heats the lighting filaments automatically each time the ground power or APU is activated.

- *Ensures that each battery will be fully charged under any type of environment or temperature condition.

- *Is based on a loop so that any discontinuity on any part of the loop results only in the loss of one light.

- *Is powered by two lightweight battery packs, one at the aft of the plane and the other on the flight deck, both mounted above the floor of the plane.

- *Provides 40 minutes at room temperature with both battery packs. If one battery is inoperable, the system will be powered for 23 minutes under these conditions.

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*Provides 19 minutes of power on one battery at sub-zero takeoff conditions.

*Does not interfere in any way with inspections because the system is integrated into the carpet itself.

*Is powered by new, revolutionary sealed lead-acid batteries which are used by NASA in the space program and are virtually standard equipment in buildings.

*Is unconditionally warranted for three years, with an additional two-year warranty available for a flat fee of \$250 per airplane.

CONCLUSION

A decade of research by human factors lighting expert George Plumly has resulted in a revolutionary emergency escape path lighting system that meets and exceeds the new floor proximity emergency escape path marking regulations of the Federal Aviation Administration.

The Plumly Advanced Egress Lighting System outperforms any system now being developed, and can, in fact, provide total compliance for emergency lighting under any conditions.

This system is adaptable to virtually any aircraft in the existing fleet as well as to aircraft now on the drawing board -- and it can save lives.

SECTION 6

**WORKING GROUP INTERIM REPORTS
AND BACKGROUND INFORMATION**

CHARTER

FEDERAL AVIATION ADMINISTRATION

EMERGENCY EVACUATION DESIGN & CERTIFICATION WORKING GROUP

OCTOBER 28, 1985

I. PURPOSE

The function of this working group is to develop specific recommendations in the areas of aircraft design and certification, as a follow-up to the Public Technical Conference on Emergency Evacuation of Transport Airplanes. The types of actions which may be recommended include rulemaking, development of advisory material, or changes to methods of finding compliance with existing rules.

II. BACKGROUND

On September 3, 1985, the FAA convened a public technical conference in Seattle, Washington for the purpose of soliciting and reviewing information from the public on a variety of topics related to the emergency evacuation of transport category airplanes. The items discussed at this conference covered four general categories: (1) emergency exits, (2) full scale evacuation demonstrations, (3) escape slides, and (4) other concerns which are of no lesser importance than the topics of the first three categories, but rather do not fall clearly under any of the first three. The conference provided a forum for the FAA to gather information and for interested parties to express views and exchange information. At the conference the FAA established three working groups to further study the concerns raised and to review the information presented. Each of the three groups will be concerned with one of the following general subject areas: (1) Design/Certification, (2) Operations/Training, and (3) Maintenance/Reliability.

III. OBJECTIVES

The working group is charged with several objectives. The end product of this effort is expected to be a set of recommendations which will specifically detail the activities the FAA pursue. The types of actions which may be recommended include rulemaking, development of advisory material, or changes to methods of finding compliance with existing rules.

To achieve this result, the work group will to review the concerns and information aired at the technical conference in Seattle. As part of its review, the group will need to validate the problems and concerns, (ie., separate fact from opinion), which have been raised.

Secondly, in preparing its recommendations, the group will have to decide which action on the part of the FAA would be the most effective and the most responsive to the concerns which the group validates.

Finally, the group will have to be able to achieve some sort of a consensus of position on a variety of controversial issues. Any recommendations which receive the consensus of the group will be forwarded to the cognizant FAA office as soon as possible so that the appropriate action may be initiated. In the event a consensus cannot be reached, coalitions of differing opinions should be willing to prepare their positions in writing for the FAA to consider.

IV. SCOPE

A. Schedule

It is anticipated that the group's objectives will be accomplished through one or more meetings of up to one week in duration. The first meeting is to be held in Seattle, November 19-22. Additional meetings, as necessary, will be scheduled at a later date, although, a second meeting is proposed for mid-December. A final report of the group's work will be forwarded to the Administrator within thirty days after the final meeting.

B. Agenda

The proposed agenda for the first meeting is shown in Attachment 2. This agenda is considered to be flexible and subject to the progress made during the first meeting.

C. Participants

During the technical conference in Seattle, approximately twenty people representing fifteen organizations, both national and international, indicated an interest in participating in the work group. A list of the work group members is shown in Attachment 3.

D. Resources

Each member will be responsible for making a commitment to achieving the goals and objectives of this charter. Each member will be responsible for providing his/her own resources necessary to attend the working group meetings. The FAA will be responsible for making the necessary arrangements for meeting rooms, administrative support, and logistic support related to conducting the meetings.

E. Discussion Items

An outline of the specific discussion items is shown in Attachment 1. This list will be open to amendment by the work group. Discussion items will not be limited to the controversial items that were discussed at the public hearing, but will be limited to those subjects contained in the public notice.

F. Discussions

1. Current Regulations

The current airworthiness standards applicable to emergency evacuation will be reviewed by the working group. Cognizant FAA personnel will be participating in the work group so that a knowledge of the interpretation and application of the current standards will be available to the working group. The adequacy of the current standards will be the prime concern of this discussion. In addition to providing recommendations for needed changes, the work group will also provide a positive indication as to which standards/advisory materials are acceptable as currently written.

2. Consolidation of Views

After reviewing the current airworthiness standards, the views and comments raised at the conference and those raised by the work group members will be consolidated for each discussion item. Relationships between the consolidated views and the current airworthiness standards will be developed. The primary concern of this discussion will be to establish what should be the objective of the current airworthiness standards.

3. Development of Recommendations

With the results of Items D.1. and D.2., the work group will develop specific recommendations as to the actions the FAA should take. The primary objective of this discussion is to provide specific and relatively detailed proposed draft regulatory and advisory material.

G. Substantiating Data

It will be the responsibility of each work group member to assure that the data which they will use to substantiate their views is made available to the rest of the work group. The FAA will be responsible for providing copies of the applicable regulations, advisory material, and policy statements. The FAA will make every effort to consolidate these data and to disseminate it to the work group members.

H. Minutes

The discussion items may be divided into specific groups. Work group members will then be solicited to keep minutes of the discussions pertaining to these specific groups. The minutes need to be prepared for dissemination to the rest of the group for comments on completeness and accuracy. Once the minutes receive the concurrence of the group, they will become part of the record of the group's work and will be included in the group's final report.

V. EXPECTED RESULTS

The product of this working group is expected to be a set of specific and detailed recommendations for changes to the airworthiness standards, Technical Standard Orders, and Advisory Circulars which are applicable to emergency evacuation. If appropriate, recommendations which can be implemented in a relatively short period will be segregated from other longer term recommendations. Whenever a recommendation receives the consensus of the group, it will be forwarded to the cognizant FAA office as soon as possible so that the appropriate action may be initiated. In addition to providing recommendations for needed changes, the work group will also provide a positive indication as to which standards/advisory materials are acceptable as currently written.

#

ATTACHMENT 1

DISCUSSION ITEMS

I. Evacuation Demonstrations - FAR 25.803

- A. Should FAR 25 and 121 Full scale evacuation demonstrations be conducted?
 - 1. What do they accomplish?
- B. Should full, mini evacuations, or a combination of both be used?
- C. When should full scale evacuations be required? [803 (d)]
- D. When should analyses be accepted in lieu of demonstrations? [803 (d)]
- E. Should there be limitations on the use of analyses for:
 - 1. Exit deactivation?
 - 2. Exit configuration changes?
 - 3. Passenger capacity changes?
- F. What kinds of analyses are acceptable? [803 (d)]
- G. How realistic should demonstrations be?
 - 1. How should they be conducted?
 - 2. Is carry on baggage properly accounted for? [803 (c)(11)]
 - 3. Is the 90 second criteria valid? [803 (c); (d)]
 - 4. Is the 50% blocked exit criteria valid? [803 (c)(17)]
 - 5. Is the passenger mix (ie., age/sex) valid? [803 (c)(8)]
 - 6. Is the experience of people used for demonstrations appropriate? [803 (c)(14)]
 - 7. Should handicapped, obese, etc., passengers be included?
 - 8. Should smoke or other anxiety factors be used?
 - 9. Is the distribution of blocked exits appropriate? [803 (c)(17)]
 - 10. Do the current demonstrations reasonably reflect the survivable accident scenario?
 - 11. Should FAR 25 and FAR 121 requirements be better integrated?
 - 12. Is crew training prior to the test appropriate? [803 (c)]
 - 13. Is the use of the cockpit crew appropriate? [803 (c)]
 - 14. Should off-wing ramps be used during demonstrations? [803 (c)(3)]
 - 15. Should adverse attitudes be accounted for? [803 (c)(2)]
 - 16. What use of emergency lighting during the test is appropriate? [803 (c)(4)]
- H. Should evacuations be required for airplanes with less than 44 passengers?

II. Emergency Exits - FAR 25.807, .809, .811, .812, .813, .815

- A. Is the number required and the capacity appropriate? [807 (c)]
 - 1. Should there be a rating criteria other than passenger/exit ratio?
- B. Is the distribution of exits appropriate (eg., should it be uniform)? [807 (c)]
- C. What should be the maximum distance between exits? [807 (c)]
- D. Under what circumstances should excess exits be deactivated on:
 - 1. New model airplanes?
 - 2. Airplanes already in service?
- E. Is the means for marking and locating exits adequate? [811, 812]
- F. Are aisle widths adequate? [807, 815]
- G. Is access to exits adequate for: [807, 813]
 - 1. Cross aisles?
 - 2. Seats at Type III exits?
 - 3. Excess exits?
- H. Is the criteria for escape path marking adequate? [812 (e)]
- I. Are the current emergency lighting standards adequate? [812]
- J. Is the current exit/slide ready time adequate? [807 (a)(7)(ix), 809 (b)(2), 809 (f)(1)(i)]
- K. Should adverse airplane attitude be a criteria for requiring a slide? [809 (f)]
- L. Could exit markings/placards be better standardized? [811]

III. Escape Slides - FAR 25.809

- A. Are the TSO C-69A design standards adequate?
 - 1. Is the standard for inflation time adequate?
 - 2. Is the standard for girt/material strength adequate?
 - 3. Is the standard for heat resistance adequate?
- B. Do the regulations adequately account for in-service deterioration?
- C. Is the six foot height criteria appropriate? [809 (f), (h)]
- D. Is the twenty five knot wind criteria adequate? [809 (f)(1)(iv)]

- E. Are adverse airplane attitudes acceptably accounted for? [809 (f)(1)(iii), (h)]
- F. Are testing requirements adequate? [809 (f)(1)(v)]
- G. Are changes in design or testing needed to improve slide reliability?
 - 1. Is the current reliability testing adequate?
- H. With the recent amendment of TSO C-69A, should a schedule for replacement of slides approved in accordance with earlier versions of the TSO be made mandatory?
- I. In order to account for possible deterioration with age, should a life limit be established for slides?

IV. Miscellaneous

- A. Should folding flight attendant seats be allowed at aisle or exit locations?
- B. Should flight attendants be seated in galley areas such that they may be impaired in performing their duties if items of mass were to come free of their restraint?
- C. Are restraint designs for galley carts and other items of mass sufficient to prevent either injury to flight attendants or impairment to the evacuation of the airplane?

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SOME SUGGESTED RECOMMENDATIONS

1. CLARIFY THE INTENT OF THE CROSS AISLE REQUIREMENTS OF 25.807 (a) (7) - LYNCH
2. REEXAMINE THE THE RATIONALE FOR ALLOWING SEAT COUSHINS TO PROTRUDE INTO AN EXIT AREA (TYPE III) - LYNCH
3. DEFINE WHAT A UNIFORM PASSENGER DISTRIBUTION IS - LYNCH
4. DEFINE A MAXIMUM DISTANCE FROM ANY PASSENGER SEAT TO AN EXIT - LYNCH
5. STATION A FLIGHT ATTENDENT AT THE TYPE III'S - LYNCH
6. AMEND 25.807 TO INCLUDE REFERENCE TO 25.813 - LYNCH
7. PROHIBIT REMOVAL OF EXITS - VINCENT
8. DEFINE THE MAXIMUM DISTANCE BETWEEN EXITS AS 60 FEET - VINCENT
9. CREW TRAINING FOR EVAC DEMOS SHOULD BE SAME AS WHAT CREWS REALLY GET FOR INTRODUCTION OF NEW EQUIPMENT - VINCENT
10. BLOCK PAIRS OF EXITS FOR EVAC DEMOS - VINCENT
11. COCKPIT CREW SHOULD WAIT 30 SEC. AT THE BEGINNING OF AN EVAC DEMO, 15 SEC. IS NOT REALISTIC - VINCENT
12. TEAR/PUNCTURE RESISTANCE OF SLIDES IS NOT ADEQUATE - WILLIAMS
13. THE RATINGS PER 25.807 (C) (1) & (C) (2) CORRESPOND UNDER THE CONDITION THAT MORE THAN TWO PAIRS OF EXITS ARE USED PER AIRCRAFT AND POSSIBLY FOR NEW ADDED TYPES OF EXITS - MUENSTER
14. ADD A TYPE B EXIT WHICH SHOULD HAVE A CAPACITY OF 80 PASSENGERS - DIDSZUHN
15. INCREASE TYPE I TO 55 PASSENGERS - DIDSZUHN
16. INCREASE TYPE II - DIDSZUHN
17. INCREASE TYPE III TO 40 PASSENGERS - DIDSZUHN
18. TYPE IV, A 20 PASSENGER EXIT - DIDSZUHN
19. PROPOSE THE FOLLOWING REQUIREMENTS:
9 OR LESS-AT LEAST ONE TYPE IV
19 OR LESS- AT LEAST ONE TYPE III
MORE THAN 19 -AT LEAST TWO APPROVED EXITS PER SIDE
MORE THAN 39-AT LEAST TWO APPROVED EXITS OF WHICH ONE MUST

BE A TYPE I.

MORE THAN 109-THREE APPROVED EXITS WITH AT LEAST ONE A TYPE I.

FOR A TYPE A-FULL CREDIT GRANTED ONLY TO CONFIGURATIONS OF MORE THAN 200 PASSENGERS - DIDZSUHN

20. REQUIREMENT TO REPORT ALL SLIDE DEPLOYMENTS, FAILURES, AND FUNCTIONS TO A CENTRAL DATA BASE - HARKRIDER

21. MAINTENANCE SURVEILLANCE PROGRAMS TO INSURE GREATER RELIABILITY - HARKRIDER

22. REQUIRE ALL (PAST, PRESENT, FUTURE) FLOOR LEVEL SLIDES BE AUTOMATICALLY INFLATABLE - HARKRIDER

23. REVIEW OF THE PUNCTURE TESTS REQUIRED FOR SLIDES - HARKRIDER

24. REQUIRE CREW MEMBERS TO WEAR LOW HEeled SHOES - HARKRIDER

25. REQUIRE A MORE FREQUENT MAINTENANCE CHECK SCHEDULE FOR SLIDES - HARKRIDER

26. MECHANICS SHOULD HAVE HANDS ON TRAINING BY THE MANUFACTURE OF THE SLIDES TO COVER PACKING, REPAIRING, AND REPLACING SLIDES - HARKRIDER

27. REQUIRE A GREATER CONCERN FOR THE SAFETY AND SECURITY OF FLIGHT ATTENDANTS IN DESIGNING AND LOCATING F/A SEATS - LANTZ

28. PROHIBIT GALLEY/AISLE MOUNTED F/A SEATS AS BASICALLY UNSAFE TO THE F/A AND AS A POSSIBLE HAZARD TO EVACUATION - LANTZ

30. REQUIRE SECONDARY RESTRAINTS ON UNSTOWED CARTS - LANTZ

31. BETTER STANDARDIZATION OF ERGONOMETRIC DESIGN OF F/A SEATING, SEATS, AND SHOULDER HARNESSSES - LANTZ

32. PILOT AND F/A EMERGENCY TRAINING BE TAKEN TOGETHER - THOMPSON

33. REQUIRE THE REMOVAL, NOT JUST BLOCKING OF SEATS - THOMPSON

34. REQUIRE SMOKE DURING EVAC DEMOS - THOMPSON

35. REQUIRE 100 % USE OF PILLOWS, BLANKETS, ETC., WITH A PERCENTAGE OF HEADPHONES - THOMPSON

36. DELETE "MINOR OBSTRUCTIONS" FROM APPENDIX D (a)(10) - THOMPSON

37. USE F/A'S TO READY THE EVAC DEMO CABIN - THOMPSON

38. SIMULATE AN INJURED F/A AT ONE EXIT - THOMPSON

39. REQUIRE AT LEAST ONE OPERATIVE EXIT TO BE UNMANNED - THOMPSON

40. USE NTSB STATISTICS TO DETERMINE INOPERATIVE EXITS - THOMPSON
41. PROHIBIT USE OF AIRLINE OR MANUFACTURER EMPLOYEES FOR DEMO PARTICIPANTS - THOMPSON
42. LET PARTICIPANTS SELECT SEATS FOR TEST - THOMPSON
43. INTEGRATE THE WORDING OF FAR 25 AND 121 INCLUDING APPENDIX D - THOMPSON
44. CHANGE 25.7, 121.12 TO INCLUDE THE USE OF INTEGRATED CREWS - THOMPSON
45. CHANGE 25.14, 121.14 TO USE PARTICIPANTS ONLY ONCE - THOMPSON
46. CHANGE 25.17, 121.17 TO INSERT FAA CHOICE IN STEAD OF CARRIER CHOICE - THOMPSON
47. WITH RESPECT TO EVACUATIONS, DEFINE ANALYSIS - THOMPSON
48. REQUIRE LINES OR ROPES AT EXITS - HILL
49. PROPOSE RESEARCH ON AUDIO DEVICES FOR LOCATING OPEN EMERGENCY EXITS - HILL
50. RESTRICT SEATING AT EXITS TO ABLE BODIED PERSON - HILL
51. ESTABLISH A MINIMUM DISTANCE BETWEEN SEAT ROWS AT OVER WING EXITS - HILL
52. ESTABLISH A MINIMUM DISTANCE BETWEEN AN AFT FACING F/A AND THE FIRST ROW OF FORWARD FACING PASSENGERS - HILL

#

DESIGN AND CERTIFICATION WORKING GROUP

Minutes - November 19 - 22¹⁹⁸⁵ Meeting

Seattle, Washington

MINUTES

~~RECEIVED~~ 1985
NOVEMBER 1985 MEETING

Items Discussed by the Full-Scale Emergency Evacuation Working Group

II. Discussion Items A thru F.

There was a consensus on the need for full scale demonstrations under certain circumstances but a criteria for requiring a full scale demonstration could not be decided on.

Full scale demonstrations are a validation of the total design including crew training and passenger management.

Full scale and mini evacuations should continue to be required.

Draft position papers on when to require a full scale or use analysis are attached.

Action:

Position papers are to be submitted by December 20 on when to allow analysis in lieu of a demonstration and what data base is acceptable for analysis. These items will be discussed at a follow-up meeting.

Discussion Item G:

It was agreed that the demonstration does not reflect an accident scenario and that the demonstration cannot and should not reflect actual accident scenarios.

Discussion Item G.1:

FAR 25.803(c) was discussed in detail with the individual items listed below. An Advisory Circular should be developed with the FAR 121 team to define how a demonstration should be conducted.

Discussion Item G.2:

The amount of baggage used should be defined as one item per seat row per aisle in an Advisory Circular.

Discussion Item G.3:

It was agreed that 90 seconds is a good ball park time. The NTSB has reviewed accident data and feels that 90 seconds does correlate somewhat with accidents.

Discussion Item G.4:

It was agreed that the 50% blocked exit criteria is valid for a demonstration. It appears to be a good percentage and other percentages may be unworkable.

AGE/SEX

Discussion Item G.5

At this time the group does not have data for this item. Assuming the current rule accurately reflects the current mix the current rule is satisfactory.

ACTION:

ATA agreed to provide data on the average passenger mix by December 20. Advisory Circular material should be developed to define a criteria for accepting other passenger mixes. The Boeing and Douglas position is expressed in their requests for equivalency.

Discussion Item G.6:

There is a proposal to change the rule to prohibit participants from being used more than once. The manufacturers desented stating that this will only make it harder to meet the age/sex mix requirements and that it rarely happens.

ACTION:

The manufacturers will review their records on whether people have been used more than once and present their position.

Discussion Item G.7:

The group decided that the normal health requirement be maintained and that handicapped, obese, etc. people not be used. However, the CAMI should develop an analytical method of predicting how these people affect evacuations.

Discussion Item G.8:

The concenses is that smoke should not be used. It is not possible to control smoke density for a demonstration nor is it possible to determine what smoke density would be appropriate.

Discussion Item G.9:

There was no agreement on how to select the exits for a demonstration. One view is that it should be a random selection, the other is that it should be one of ~~the end~~ pair.
EACH

The group does not have data to determine the effect of using a criteria other than the one of each pair currently being used. It was apparent that selecting an end of cabin configuration would be slower.

The following change to the regulation was discussed: The applicant should submit an analysis of all the variations of 50% of the exits blocked and one floor level exit usable and the FAA would choose which configuration would be tested by full scale demonstration. The 90 second criteria would be applied to the one of each pair test. Other time limits may be used for other configurations. Time limits would be set, and a change to the 90 second criteria reviewed after the manufacturers data is reviewed. It was also proposed that a limit be placed on the time variation between different exit configurations (i.e.: If 90 seconds is the time limit for one of each exit pair test than the time limit for the other configurations could not vary by more than a percentage yet to be determined.) This regulation would apply to new type design only.

ACTION:

The airplane manufacturers were asked to provide an analysis of each airplane except the 707 and DC-8 considering any 50% of the exits blocked with at least one floor level exit useable. Since considering any combination of 50% would be a difficult task the manufactur'rs were asked to present the critical configurations. The Manufacturers agreed to present a plan for presenting the requested data by December 20.

Discussion Item G.10:

See Item G.

Discussion Item G.11:

The flight attendant training requirements should be better integrated. This will be discussed at the Operators Working Group and an Advisory Circular defining the training for a demonstration should be considered by both working groups.

ACTION:

Discuss this item after the Operators Working Group meeting.

Discussion Item G.12:

See item G.11 and discussion of 25.803(c)(7)(i).

Discussion Item G.13:

There was one descending view to the proposal that the flight deck crew should have no assigned role in the demonstration.

ACTION:

Boeing will provide a minority opinion.

Discussion Item G.14:

25.803(c)(3) does not need revision.

Discussion Item G.15:

25.803(c)(2) does not need revision.

Discussion Item G.16

25.803(c)(4) does not need revision. The total emergency lighting system should be used.

Discussion Item H:

25.803(c) does not need revision. The 44 passenger limit for evacuation demonstration should be retained.

DISCUSSION OF SUGGESTED RECOMMENDATION:

Items 9, 10, 11, 34, 35, 36, 41, 43, 44, 45, 46, and 47 are covered by other discussion items.

Item 37. It was explained that current FAA policy is that the weight of the baggage, etc. This policy is considered acceptable.

Item 38. The ^{consensus} ~~conclusion~~ is that the minimum number of flight attendants required by Part 121 be used. The Part 121 one flight attendant per 50 passengers rule will be discussed at the Operators Working Group.

Item 39. It was explained that current FAA policy is to distribute flight attendants as required by Part 121 some at useable exits and others at inoperative exits. This was considered satisfactory.

Item 40. The NTSB representative stated that such statistics do not exist.

Item 42. Except for assignments made by the FAA per 25.803(c)(9) this is generally done.

Discussions of FAR.25.803 paragraphs not already discussed.

Item 1. FAR 25.803(a), (b), (c), (c)(1), (c)(2), (c)(3), (c)(4), (c)(5), (c)(6), (c)(10), (c)(12), (c)(13), (c)(15), (c)(16), (c)(18), (c)(19), (c)(20) are satisfactory and do not require change.

Item 2. FAR 25.803(c)(7)(i). Advisory material should be developed with the Operators Working Group to define "regularly scheduled line crew." The following item was suggested:

- (1) Airline training department personnel should not be used.
- (2) An FAA approved training plan for the demonstration must be used, ~~for~~ ~~training~~ (not necessarily a Part 121 plan).

Item 3. FAR 25.803(c)(8)(iv) should be clarified that the life size dolls should also be of appropriate weight.

Item 4. FAR 25.803(c)(9). It was proposed that an Advisory Circular be developed defining what type of company employee should not be used and that the rule be changed to prohibit company employees from each exit row.

ACTION:

Proposed Advisory Circular wording will be submitted by December 20.

Additional Items of Discussion:

- 1. The FAA should define how much information may be given to participants considering they must give informed consent.

ACTION:

FAA legal will be asked for an opinion to be included in an Advisory Circular. The Manufacturers will also give their position.

2. Limit the number of times a failed demonstration can be repeated and conditions for repeat tests.

THERE WAS A CONSENSUS THAT DEMONSTRATION FAILURES DUE TO HARDWARE ACTION: (bombs, smoke, etc) COULD BE REPEATED

AFA, Joint Union of Flight Attendants, and AIA will provide their position.

3. The publishing of equivalency findings, FAA issue papers, notification of design changes were discussed.

ACTION:

The FAA will review its policy on these matters

DISCUSSION ITEMS FOR FOLLOW-UP MEETING:

- 1. Use of analysis vs. full scale demonstration. 23.107(2)
- 2. Distribution of Exits to be used for full scale demonstrations. (C)(17)
- 3. Define "Regularly Scheduled Line Crew." KX(1)(1) - OPS
- 4. Discuss age/sex mix after ATA input and methods for equivalency. (C)(18)
- 5. Restrict use of certain types of company employees. (C)(18)
- 6. Discuss proposal not to use participants more than once. (C)(14)
- 7. Discuss crew training for the demonstration. OPS
- 8. A follow-up meeting will consider exact wording for an Advisory Circular and regulation changes.

ACTION ITEMS:

- 1. ATA to submit average age/sex mix by December 20.
- 2. Submittals for proposed Advisory Circular that will be developed to describe more precisely the conditions for a full scale demonstration.
- 3. The manufacturers will submit a plan by December 20 for submission of the requested evacuation analysis.

DICK JOHNSON
ACT-330
DECEMBER 2, 1985

EMERGENCY EVACUATION DESIGN

- CERTIFICATION WORKING GROUP MEETING

NOVEMBER 18-22, 1985

EMERGENCY EXIT GROUP MINUTES - F. JENKINS

II. Emergency Exits - FAR 25.807/.809/.811/.812/.813/.815 (November 19, 1985)

A. Is the number required and the capacity appropriate?

MBB - 25.807(c)1--Not adequate, we presently obtain approval for ratings based upon "equivalency" - see "suggested changes" items 13-19--justification: Desire new designs to reflect different configuration needs than current table allows--new table proposed.

FAA (JENKINS) - We will prepare draft proposal of suggested changes to current tables by MBB -

	A	110
	B	80
	I	55
Not supported	II	45
by current data*	III	40
	IV	20

MBB - Evacuation of AIRBUS * supports above table except Types II/III.

UNITED - Need added data to support table.

MBB - See FAA Report (SAE 1982) and also AIA Report 1968 for "rating data" for II/III exits.

FAA (JOHNSON) - In view of the proposed table, shouldn't we consider an adverse gear condition which may relate to useable exits other than one side being available - Recent industry study indicates majority of survivable accidents in which "gear damage" is involved.

DGAC - Also, shouldn't exit rating in table be based upon known scenarios, aircraft exit sensitivity, etc?

MBB - Disagree with "adverse gear" or other actual conditions for table because of the variance of crash scenarios (and available exits) - Also, what would it prove--that it would take longer than 90 seconds to evacuate?

FAA (BRANTING) - Along with the proposed table other considerations must be made as follows:

- (1) Total exit size and number vs PAX performance
- (2) Minimum exit number vs PAX performance
- (3) Distribution
- (4) Verification (Tests/Analysis)
- (5) Flow analysis

B. Is the distribution of exits appropriate? uniformly?

C. What should be the maximum distance between exits?

FAA (BRANTING) - We must address distance between exits and consider PAX's at less than full airplane load--less than 100% load factor.

BOEING - Don't see why--the maximum load is the most significant--if you look at less load, you cannot maintain the rating per exit that is required.

UNITED - What the FAA means is letting the aisle by the limit.

FAA (BRANTING) - Yes, distance must be addressed.

FAA (JOHNSON) - Perhaps distance and distribution should be identified more thoroughly under a Advisory Circular.

FAA (BRANTING) - No, we need more than that--regulation.

BOEING - Distances may vary with number of aisles while door/exit is limiting factor.

CAA - Not necessarily true.

FAA (JOHNSON) - What the FAA is talking about is the case in which an exit is not "stacked" with occupants and the closer a person is to that exit the quicker he can escape (a person sitting next to a removed No. 3 exit of new 4 exit B-747 does not have same benefit as sitting on a 5 exit B-747).

FAA (BRANTING) - Perhaps if distribution were administered correctly, distance would not be problem.

ALL - Agreed.

BAC - Distance could be established together with Table--like exits less sensitive, particularly in case of losing a PAIR.

BOEING - Current design case assumes failure of one of each pair--typical of accidents.

CAA - 25.1309 should readily be applied.

FAA (JOHNSON) - Since current evacuation requirements are based upon "time" (exit/slide ready time, etc.) perhaps one approach would be to establish a maximum " Δt " from occupant seat to primary and/or secondary exits rather than distance between exits--this would supplement rule and allow for a more meaningful configuration assessment considering uniform distribution, various load factors, etc.

FAA (BRANTING) - The more exits the better--if you had (4) Type I or (2) Type A, the loss favors more exits--also, different size exits positioned axially on an aircraft--result in varied egress rate based upon location. Distance must be addressed, but don't know how, desire indication from Boeing on why distance is not effective.

UNITED - Distance should be considered on basis of flow rates, etc.

FAA (JOHNSON) - Past CAMI reports (SNOW 1970, MCFADDEN 1964) on suggested exit distances should be reviewed by everyone--will have copies sent to each. Also, consideration should be given to looking at time(Δt) rather than Distance.

IAPA - Should a scenario (to support distance) be identified based upon real-life conditions?

CAA - Computer analysis methods are available and could be applied.

FAA (JOHNSON) - Such analysis methods like Boeing's EVAC model are available but additional input data (specifically related to interior flow, fire, smoke, etc.) is needed to support their effectiveness. At present, passenger flow rates thru exits of different sizes and different aircraft configuration can be simulated to some degree with repeatable results, however, further research in the verification of these models should be pursued to determine their feasibility and use.

FAA (JENKINS) - We have 2 positions here; one favoring distance and, one not favoring distance. Let's have everyone submit their position on both "distribution" and "distance" by December 20 to each other. We will discuss further at next meeting.

CAA - We should review conference data and other data by experts which provides "rational basis"--CAMI reports should be reviewed as they indicate distance to be important.

FAA (JENKINS) - Volunteers needed to provide data (on distance/distribution) next meeting and submit to working group by December 20--Joint F/A Council, AIA, AIA, MBB/CAA/BAC, IATA and FAA Technical Center/CAMI.

D. Under what circumstances should excess exits be deactivated?

MBB - If operator uses de-rated aircraft, why should not it be allowed?

UNITED - It would not have been problem if Boeing increased exits (from 4 to 5) but from 5 to 4, yes a problem.

FAA (JENKINS) - United is only one having excess exits.

MBB - If you apply to one aircraft, you should apply equally to any aircraft.

CAA - Distribution differs in recent deactivations (B-747 and L1011) and that represents the problem in terms of distance.

BOEING - The problem is that the margin above the "minimum level" was reduced.

FAA/CAA - Agreed, distribution is problem.

FAA (JOHNSON) - If excess exit meets rule, it should be allowed to be deactivated, but should meet "uniform distribution" (perhaps further advisory material is in order).

AFA - Exit removal is no problem if failure rate of slides, etc., wasn't so bad. The Boeing 550 configuration also was bad because of adverse severe experience.

MBB - If we determine that such approvals are political, then we should get word to the public--educational problem.

UNITED - Agency approval (B-747) meets the numbers, but if not, could result in "Increases".

BAC - Was excess exit allowance (B-747) to allow for improved in MDT procedures?

FAA (JENKINS) - Will check info from other (maintenance) groups--request that all views be presented (December 20) in regard to "removal or deactivation of exits--all present will have (2) views; (1) to allow if it meets "distribution" and (2) to not allow because of adverse experience.

(NOVEMBER 20)

E. Is the means for marking and locating exits adequate?

CAA - Under Amendment 25-32, the FAA indicated that the illumination of handles on Type II and IV overwing exit would be considered under subsequent rulemaking--we recommend it.

FAA (JENKINS) - Should we be concerned and initiate action to illuminate these handles?

ALL - Yes, implement CAA recommendations.

F. Are aisle widths adequate?

CAA - Passenger evacuation may be adversely effected because of "Floor-to-ceiling galleys" which effect "access" to exit from "over seat tops" and visually effects seeing exit.

UNITED - These issues were discussed in NTSB study AS-74-3, 1974, covering visual access and movement between galleys and/or dividers.

FAA (JENKINS) - Any options to problem?

BOEING - Too costly to increase aisle width.

FAA (JENKINS) - Long term item for review or should we discuss at next meeting?

MBB - Lets provide data for December 20 submittal and discuss later as appropriate--if problem is safety related and we are concerned, lets recommend a retrofit.

CAA - We are really talking about a retrofit.

ALL - Agreed.

BAC - Cross aisle represents a bonus on wide bodies during an evacuation.

CAA - We need to do more work.

FAA (JOHNSON) - Will check with CAMI to see what work was done--where did the "20 aisle" come from--is 15 and 20 adequate?

G. Is access to exits adequate (cross-aisle, seats at Type III exits, and Excess exits)?

FAA (JENKINS) - Question concerns whether cross-aisles should lead directly to exit.

CAA - Intent should be clarified--Canadian DOT suggests cross-aisle centerline extending to center point of exit to prevent or eliminate interference co-mingling from main aisle.

UNITED - Reflects possible need for AC material and expand on "leading to an exit" criteria.

FAA (JENKINS) - Approvals vary while exit "view" from aisle should apply--except for "stagger" which exists on L1011 also, back door near circular stair on B747--volunteer needed to write "AC material" for cross-aisle.

UNITED - We will volunteer.

FAA (JENKINS) - With respect to seats at Type III exits, rules state that "no obstructions" shall be allowed on "projected opening."

CAA - Original wording better - "may not obstruct" and "effectiveness of opening including operation and accessibility."

FAA (JENKINS) - We are not concerned with operation or what to do with it.

BOEING - In one test, the seat blocked the exit.

ALPA - Question concerns what to do with exit--"out" or "in" problem.

CAA - We are reviewing the design, operation and access to overwing exits. Our findings are: (1) must be operated by PAX--difficult--no space to operate--card instructions vary; (2) more reliable than other exits, can be seen--readily available; (3) most adverse--exit stays in airplane (need space); (4) vertical displacement of 12-1/2 inches is needed; and (5) delete outboard seat movement (existing pitch 31").

UNITED - Our B737 has outboard seat removed.

FAA (JENKINS) - What should be recommended for Type III exit?

MBB - Don't agree with CAA that there is a problem.

CAA - Advisory Circular on rule interpretation is needed to tell how to apply--at least 10 inches of the exit width is needed to be free from obstruction--also, FAR 25.813 should apply to ALL (3) seats and better marking of handle is needed.

BOEING - The 2 inch allowance is not allowed on B767 because exit is bigger than Type III.

FAA (BRANTING) - There should be FAR change to accommodate exit access depending on size.

FAA (JENKINS) - Do we have enough information now to do anything?

BOEING - There is no problem during evacuation demonstration.

FAA (JENKINS) - Should change be considered to improve accessibility through design or operation.

CAA - We are considering the issue of an "AD" on all aircraft with Type III (or IV) exit--will know such changes tomorrow.

FAA (JENKINS) - We have (2) positions to be recommended: (1) rule should be changed to reflect improved accessibility to overwing exits; (2) review Manchester accident results and determine if rule change is warranted.

FAA (JENKINS) - Excess exit needs to be addressed--it's an exit which is in addition to Table listing.

FAA (BRANTING)/UNITED - Lets drop it--not applicable to today's configuration.

ALL - Agreed.

H. Is the criteria for escape path marking adequate?

I. Is the current emergency lighting standards adequate?

CAA - Clarification of "floor illumination" needs to be addressed (and changed) under current Advisory Circular supporting Amendment 25-58 in view of current FAA findings of compliance.

MBB - Agree, particularly to prevent misinterpretation by European manufacturers.

FAA (JENKINS)-- We will revise either by policy letter or change to Advisory Circular.

ALL - Agreed.

J. Is the current exit/slide ready time adequate?

FAA (JENKINS) - Under the "Slide Group" consideration are being given to change (reduce) time? Is door ready time (25.809(b)2) of 10 seconds satisfactory?

BAC - Conflict exist with 121.291.

MBB - Should we combine time?

BAC - Recommend that all numbers be consistent--no problem if they all meet 15 second per 69-33.

FAA (JENKINS) - We will recommend change, (after talk with Slide Group)--should be consistent (25/121/TSO) and start with door motion.

K. Should adverse airplane attitude be a criteria for requiring a slide?

FAA (JENKINS) - Slide Group is looking at needs less than 4 feet--if you have a sill height of 5 feet (normal gear) and 10 feet (adverse gear) it's OK--no slide or "evac means" are needed.

CAA - Amendment 25-15 indicated study of overwing exit under adverse gear collapse--do we need further study?

FAA (JOHNSON) - CAMI is studying needs relative to less than six feet--will work with CAMI and provide findings to group.

(NOVEMBER 21)

L. Could exit markings/placards be better standardized?

FAA (JENKINS) - Not aware of any problem.

CAA - More important is PAX information cards, video, display, etc., currently being looked at by SAE S-9.

FAA (JENKINS) - Doesn't appear to be any need for change.

ALL - Agreed.

**EMERGENCY EVACUATION DESIGN AND CERTIFICATION
WORKING GROUP**

III. Escape Slides - FAR 25.809

A. TSO C-69a Design Standards

1. Inflation Time

Recommend reduction of the inflation time standard from the current requirements of 10 seconds after deployment is begun to 6 seconds for a door exit and 15 seconds for an overwing exit system. This change to be incorporated in a revision to the TSO and FAR 25 for new aircraft designs.

2. Girt Strength

At present there is not sufficient evidence available to this group to indicate that stronger girt fabric is required.

3. Heat Resistance

The radiant heat testing requirement is considered adequate. We recommend not to extend this requirement to existing slides and slide/rafts not qualified to TSO C69a.

4. Puncture and Tear Resistance Tests

Incorporate puncture and tear resistance tests as specified in ARP 495c into the TSO for new aircraft designs.

5. Hydrolysis Tests

Revise TSO to include a requirement for a hydrolysis tests as specified in ARP495c for new aircraft designs.

6. Slide/Raft Back Support Requirement

We recommend that Paragraph's 4.1.1.1 and 4.1.1.2.2 be revised to remove the requirement for back support in slide/raft for the following reasons: (1) It restricts the design of the slide raft, i.e. forces the design to incorporate sponsons which adversely effects the performance of the slide in 25 knot winds. (2) the 8" back support appears to provide a comfort factor for extended at-sea periods. Today's search and rescue operations preclude extended periods at sea before rescue is made. Therefore the back support requirement does not appear warranted.

B. In-service Deterioration

Aging tests incorporated in TSO C69a adequately anticipate in-service deterioration. However, the following maintenance items are pertinent in establishing in-service deterioration as well as slide and slide/raft system reliability.

1. It should be considered that the repairman who is authorized to pack slides and/or slide rafts be required to attend the slide/slideraft manufactures course and is appropriately certified.
2. Make slide/slideraft packing and installation procedures on aircraft a required inspection item. (RII)
3. Require emergency exit door opening and slide inflation tests be accomplished on the aircraft.
4. Mandatory reporting fall slide/slideraft deployment/inflations. We suggest that it is important to establish a central data base of slide deployments, successful and unsuccessful, to determine slide reliability and problem areas involving design and use. Since it is difficult to obtain facts on deployments, we recommend a review of FAR 121.703 for the possible requirement of mandatory reporting of all slide/slideraft deployments (evacuations, testing, maintenance checks, inadvertent deployments, etc.)

C. Six Foot Height Criteria FAR 25.809 (f) and(h)

It is recommended that the six foot sill/flap height requirements be reviewed to determine the origin and appropriateness of these regulations. It is suggested that consideration be given to adverse aircraft altitudes in applying this regulation. We propose that CAMI provide the needed information/research to define the possible need to revise these requirements.

D. 25 Knot Wind Criteria

It was the opinion of the group that the 25 knot wind criteria is an adequate requirement and that aircraft cross-wind capability should not dictate escape system performance.

E. Adverse Aircraft Altitudes FAR 25.809(f)(1)(iii), (h)

Adverse aircraft attitudes are acceptably accounted for as long as the slides are demonstrated to be acceptable under the prescribed conditions.

F. Testing Requirements FAR 25.809(f)(1)(v)

It was the opinion of the group that the present slide testing requirements incorporated in the TSO and certification requirements are adequate design standards. However, see item (B) for consideration of in-service testing for continued airworthiness.

G. Reliability Testing

Covered under item F.

H. Replacement of Slides not conforming to TSO C69a

TSO C69a main differences are to incorporate radiant heat standard and 25 knot wind requirement. It was the consensus of the group not to require replacement of all slides not meeting TSO C69a because it is not considered cost effective.

I. Life Limits on Slides

It was the consensus of the group that if proper overhaul test and inspection procedures are adhered to, that slide deterioration will be identified and those units will be removed from service prior to degradation becoming a factor. Therefore no finite life should be specified for slides.

J. Requirement for Automatic Inflation Slides

The possible requirement for mandatory replacement of all non-auto inflating slides with auto-inflating slides was discussed. We were unable to agree on this requirement. One faction disagreed with the requirement, stating that it would result in additional inadvertent slide deployment. The opposing faction cited the availability of retrofit service information to incorporate the modification, the improvement in evacuation efficiency and proposes an FAR 121 requirement specifying that the slides be replaced considering a 1 year delay in effectivity with three years for incorporation.

K. Quick-Detachable Girts

Recommendation for aircraft with no life rafts or slide rafts and for door exits anticipated to be useable in ditching, require all slides to have quick-detachable girts so that the slides may be effectively used in a ditching. Revise FAR 121 to specify the above requirement considering a 1 year delay in effectivity with 3 years for incorporation.

L. Secondary Means for Egress from an Exit

Use of escape ropes in some cases have proved useful in some accidents wherein escape slides have failed. In other cases they have proved to be a detriment to egress. CAMI to study situation and provide guidance, to either support the recommendation or not support a secondary means for egress in new aircraft designs.

IV. Miscellaneous

A. Folding Flight Attendant Seats

Flight attendants contend that folding F/A seats constitute a safety problem. They propose that:

- (1) Aisle jumpseats should be removed from all aircraft and the F/A should use a passenger seats equipped with shoulder harnesses in its

place. (2) All F/A folding seats placed at an exit, for new aircraft designs, should be designed so that adequate egress be maintained to the exit if the jumpseat fails in the extended position. The opposition to these recommendations contend that the folding seats if properly designed and maintained should be retained. No consensus was reached by the working group.

B. Flight Attendant Seating in Gallery areas of Mass Stowage

Should F/A be seated in galley areas and other areas where items of mass are stored, such that F/A's may be impaired from performing their duties if the items of mass come free from their restraints? F/A position: Retrofit present latch systems to include double latches on galleys and mass stowage facilities which are in the vicinity of F/A seating locations.

Opposing position: The cost to redesign and retrofit all galleys and other stowage areas would be prohibitive. No consensus was reached by the working group.

C. Same as B.

D. Flight Attendant Restraint Systems

It was stated that some restraint systems do not fit; seat belts that hit the mid-chest rather than across the lap; or as on some 747's where shoulder harness attachment is placed so high that the harness crosses the sides of the neck or face.

The proponents for corrective action should identify alleged unsatisfactory installations. After review by the cognizent FAA office, appropriate corrective action if deemed warranted, will be conducted. CAMI to provide data on acceptable installation criteria for restraints systems. This information will be provided in an Advisory Circular.

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DESIGN AND CERTIFICATION WORKING GROUP

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DESIGN AND CERTIFICATION WORKING GROUP

Minutes - February 4 - 7 Meeting
✓ 1986

Long Beach, California

**FEDERAL AVIATION ADMINISTRATION
FAA WORKING GROUP ON
EVACUATION SYSTEM DESIGN AND CERTIFICATION
EMERGENCY EXIT SUB-GROUP**

FEBRUARY 4-5, 1986
LONG BEACH, CALIFORNIA

- II. EMERGENCY EXITS - FAR 25.807, .809, .811, .812, .813, .815.
A. Is the number required and the capacity appropriate? FAR 25.807(c).
1. Should there be a rating criteria other than passenger/exit ratio?

Discussion:

AIA-Passenger/exit rating criteria should be continued. Exit ratings to replace the existing tables was proposed which would establish an exit rating for each exit type. Will review the supporting data for the new table when such data is available. If a Type I rating of 45 is proposed, it is believed the data will show this to be conservative.

AFA-Should remain constant if not reduced; would like to see data to substantiate exit ratings.

JCU-Concerned about only using optimum conditions being used for testing. "Pairs of exits" should be defined.

Note: The question was raised as to the need to revise the existing tables. It was acknowledged that the tables provide convenient guidelines for the manufacturers; provide for better requirements in the design stage; make it easier to interpret the rules.

EXIT RATINGS:	EXIT TYPE	RATING
	A	110
	B	80
	I	45-55
	II	40
	III	35
	IV	10

Type A - Group concurs (can be used in a single-aisle aircraft).

Type B - Group concurs (same aisle constraints as for a Type A)

Type I - No group concurrence (JCU suggests 45, AIA says 45 is conservative)

Type II - Concur

Type III - Concur

Type IV - Concur

Conclusion: Reference Exit Rating Handout-A wording change: "20-80 passengers..." for two exits and an explanation of 'pairs of exits.' will be incorporated into the document. Additional submittals will be accepted until February 21, 1986.

II.B. Is the distribution of exits appropriate (eg., should it be uniform)? FAR 25.807(c).

Discussion:

AIA-Supports the current FAR requirements relative to exit distribution. Current fleet is satisfactory. Manufacturers need flexibility.

Serviceability is a consideration.

BRITISH AIRWAYS-Supports an Advisory Circular or possibly rule change.

FAA-(Braden)Supports a possible rule change.

Conclusion: It is recommended that the FAA publish an AC and/or NPRM.

II.C. What should be the maximum distance between exits? FAR 25.807(c).

Discussion:

AIA-FAR's need not specify a maximum distance. The exit-to-exit distance is adequately self-governed by other parameters and by the current regulations. It is not good to base a rule on just two accidents.

AFA-Recommend 60 feet. The vast majority of the current fleet meet this and it is satisfactory.

BRITISH AIRWAYS-No recommendation at this time, based on a review of the Snow Report.

CAMI-Establishing a distance between exits may not be enough. Unique situations occur with each and every accident.

FAA-It is difficult to arrive at a specific distance, but it should be established. No firm data is available to establish a distance figure. Passenger distance from exit may be a key factor. More studies may be necessary.

Conclusion: A recommendation of 60 feet has been submitted by AFA. This item will be left open for additional recommendations for a period of two weeks. We cannot arrive at a conclusion at this time. Deadline for additional submittals is February 21, 1986, to Don Gonder, FAA, Seattle.

II.D. Under what circumstances should excess exits be deactivated on:
1) New model airplanes or 2) airplanes already in service?

Discussion:

AIA-For both new model airplanes and airplanes already in service, excess exit deactivation should continue to be allowed when certain criteria are satisfied (reference AIA input to Working Group). Analysis should still be allowed. Airplane design has the capability of getting the passengers out; it's the performance of the crew that is the deciding factor.

AFA-No exits should be deleted under any circumstances. A full-scale demonstration is always necessary.

FAA-FAA's proposal is Enclosure #1, mailed to the Working Group previously.

JCU-Opposed to removal of excess exits. We must give passengers the maximum standards under which to evacuate (optimum not minimum). Exit

removal should be accomplished with a full-scale evacuation. Analysis alone is not valid due to unpredictable human behavior. A computer has yet to predict human behavioral deviation.

AFA/JCU-If there is a change in exit configuration (model number aircraft) then a full-scale evacuation demonstration should be conducted (not analysis/test) for certification.

IATA-Is a full-scale evacuation demonstration always necessary? Why not analysis?

MBB-Human behavior is not the purpose of the tests.

Conclusion: It is satisfactory to delete exits if the airplane is recertificated and an evacuation demonstration is conducted.

II.E. Is the means for marking and locating exits adequate? FAR 25.811, .812.

Discussion:

It was agreed that the current requirements are adequate.

Conclusion: No change is recommended.

II.F. Are aisle widths adequate? FAR 25.807, .813.

Discussion:

AIA-Current requirements are adequate. If the aisle is too wide it could cause confusion and slow down the flow.

CAA-Have not yet conducted tests to evaluate persons traversing seat backs and forced to merge into aisle at bulkheads on both sides of aisle.

CAMI-Tests show that smooth walls improve flow as compared to between seats.

Conclusion: Insufficient data at this time to warrant rule change.

II.G. Is access to exits adequate for 1) Cross aisles; 2) Seats at Type III exits; 3) Excess exits?

Discussion:

1) Cross aisles:

FAA-(Jenkins)Enclosure #1 is proposed to be incorporated in an Advisory Circular.

BRITISH AIRWAYS-Should allow a second feed into a wide exit "two flows to the same door," which is not addressed at this time.

BOEING-Is there a need for design change criteria? Cross aisles should be so located so that a flow of 2-abreast can be maintained. Determine minimum dimensions that have to be held at the junction to the main aisle exit to obtain 2-abreast flow.

MBB-Additional access is available through the rows, so a 20" access is not critical. Not aware of any accessibility problem. Suggests that an equivalent safety finding can always be used.

CAMI-We need to define "double flow."

AIA-Agrees, no problems reported.

Conclusion: This item is cancelled. It can be added to the Crashworthiness Handbook at a later date if policy material is necessary.

2) Seats at Type III exits:

MBB-Assure that opening is kept throughout evacuation; i.e., seat aft of opening would not break into aisle, prevent trapping of passenger in seat. Present rules are adequate.

CAA-Provide a full 20" aisle on new aircraft certification. AN 79 was presented for comment and would like thoughts on what should be permanent, improved requirement.

AFA-Concurs with CAA.

JCU-Concurs with CAA.

Conclusion: No conclusion will be made by the working group. Please address comments as to how AN 79 type requirements can be incorporated into Part 121 and Part 25. Comments to be submitted to Don Gonder, FAA by February 21, 1986.

3) Excess exits:

Conclusion: These rules are adequate. No change recommended.

II.H. Is the criteria for escape path marking adequate? FAR 25.812(e).

Discussion:

CAA-Requirements for floor proximity lighting needs to be more clearly stated to the public.

Conclusion: FAA (Jenkins/Branting) will contact S. Wallace, ANM-100, to get a clarification out to the public.

II.I. Is the current emergency lighting standards adequate? FAR 25.812.

Discussion:

FAA-(Young) Suggests to make all handles meet the same requirements. This gives two options for all handles; include Type II and IV.

MBB-Concurs with FAA.

AIA-Concurs with FAA.

Conclusion: FAA(Jenkins) will redraft with recommendations to FAA for an NPRM.

II.J. Is the current exit/slide ready time adequate? FAR 25.807(a)(7)(ix), .809(b)(2), .809(f)(1)(i).

Discussion: None.

Conclusion: This item will be handled by the Slide Working Group.

II.K. Should adverse airplane attitude be a criteria for requiring a slide? FAR 25.809(f).

Discussion:

FAA-(Branting) Suggest this item be dropped. Few, if any commercial carriers, use small aircraft anymore.

MBB-Concurs with FAA.

CAA-Concurs with FAA.

CAMI-Concurs with FAA.

Conclusion: The rules are satisfactory and need not be changed.

II.L. Could exit marking/placards be better standardized? FAR 25.811.

Discussion: None.

Conclusion: Current requirements are satisfactory and no change is recommended.

SOME SUGGESTED RECOMMENDATIONS

2. Reexamine the rationale for allowing seat cushions to protrude into an exit area (Type III)- Lynch.

Discussion: It was generally expressed that the draft Crashworthiness Handbook Advisory Circular was not clear as to what policy applied to what version of the rules.

Conclusion: FAA (Jenkins) has revised the introduction to clarify and expects the advisory circular to be out for public comment in June 1986.

22. Require all (past, present, future) floor level slides be automatically inflatable - Harkrider.

Discussion: None.

Conclusion: This item will be handled by the Slide Sub-group.

52. Establish a minimum distance between an aft facing F/A and the first row of forward facing passengers - Hill.

Discussion:

CAMI-Anthropomorphic data has been distributed to sub-group. Expressed comfort and convenience go hand-in-hand. If the seat is not comfortable, then it probably won't be utilized. Suggests that Advisory Circular delineate those dimensions that were discussed and FAA ask CAMI for assistance.

AFA/JCU-Supports rule change. Concerned about 25.785(c); reiterated concern in regards to "close quarters" seating. Possible suggestion: Shoulder harnesses for passengers. Would like further investigation into this matter (i.e., testing with different sized passengers). Complaints of F/A jumpseat being too small and uncomfortable. Some examples-B727, MD-80 rear door. Asked to consider placement as well as dimension of seats (possibly offset F/A seat from passenger seat).
 ATA-Doesn't believe the airlines would go along with a rule change. This would mean an extension of the fuselage.
 IATA-Asked about the number of instances, justification for rule change?
 CAA-Supports rule change to Part 25.
 FAA-(Braden) Pointed out the danger of dual F/A seating. This is a more critical problem if two F/A's were eliminated at the same time.

MBB-Mentioned that this group may not be the appropriate group to decide on details of seat design.

FAA-Assured, this group will not get deeply into the details.

DAC-Does not support rule change; agrees with CAMI. AC 25.785 already specifies F/A seat requirements.

Conclusion: FAA will review AC 25.785-1 to incorporate more design criteria and encourage manufacturers to separate F/A seats.

Gilbert Thompson, Systems & Equipment, ANM-130L, gave an informal briefing on Floor Level Emergency Escape Path Marking Systems.

1.1 Capacity. Include acceptance criteria from non-standard exits, based upon FAA Order FS 8110.12, possibly as appendix material like NPRM 84-21 proposal for full-scale evacuation procedure.

Discussion:

FAA-The order is incorporated in the Crashworthiness Handbook AC.

BOEING-Asked that 8110.12 be described.

BRITISH AIRWAYS-Expressed concern about the Latin Square method of testing. Supports employee being used in evacuation demonstrations but not employee families (legal problems).

CAA-Suggest that the age/sex requirement be deleted and the number of participants in each group be changed to match the JAR.

Conclusion: FAA will look into changing the Crashworthiness Handbook.

1.4 Accessibility. Consideration should be given to include specific data on the location and size of the assist space adjacent to each floor level exit. Should the assist space be located in an optimum location rather than only at a position adjacent to the exit.

Discussion:

CAA-The F/A should, if possible, be able to look down aircraft aisle and assist the passengers while next to the exit. Keep F/A station location 'general' rather than a particular spot.

FAA-(Braden) Asked if there were any written requirements as to where the F/A must stand.

AFA-Stated F/A must stand facing the main flow of traffic.

IAMAW-Suggested manual exit handles (main door mechanism) in new aircraft to be all on the same side of the door; uniformity.

Conclusion: Current policy is satisfactory. No change recommended.

ADDITIONAL ITEMS

Audio Evacuation Alarm System. Should it be required? From where should it be initiatable/silenceable?

Discussion:

AFA-Prefers independent public address (P/A) system.

FAA-(Young)There is already an NPRM to make the P/A system have an independent power source.

BRITISH AIRWAYS-Should this signal be pilot activated only?

AFA-No, it should be at each F/A station, with anyone being able to activate the alarm.

BOEING-The manufacturers already offer alarm systems to the operators. Leave this up to the individual operator.

FAA-(Young)The problem of crew coordination should be examined.

MBB-Is this Part 25 material? This is actually individual airline operations procedures.

DAC-Agrees with MBB.

ALPA-Agrees with DAC and MBB.

IAMAW-FAA should have some test data regarding the alarm system before regulating.

Conclusion: Part 25 rule change is not in order. This must be left up to the individual operator.

Multi-Deck Regulations:

Discussion:

Copies of the 747 upper deck special conditions were distributed to the sub-group members prior to the meeting. It was readily decided and agreed that these special conditions should be the basis for rule-making action.

Conclusion: It is recommended that the FAA publish an NPRM as noted in the discussion.

**FEDERAL AVIATION ADMINISTRATION
FAA WORKING GROUP ON
EVACUATION SYSTEM DESIGN AND CERTIFICATION
EMERGENCY EVACUATION EXIT SUB-GROUP**

DATE: FEBRUARY 4-5, 1986
LONG BEACH, CALIFORNIA

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EVACUATION DEMONSTRATION SUB-GROUP

FEBRUARY 6-7, 1986
LONG BEACH, CALIFORNIA

The meeting began with an introduction of attendees. (See attached Attendee List). The agenda used for the meeting was the Enclosure mailed out to the Working Group entitled Items Discussed by the Full-Scale Emergency Evacuation Working Group.

Items A through F.

Summation from previous meeting:

Mr. Roger Young (FAA) reiterated, there was a consensus on the need for full-scale demonstrations under certain circumstances but a criteria for requiring a full-scale demonstration could not be decided.

Discussion:

Mr. Young stated that he had received two separate views regarding the subject. One group supported running a full-scale evacuation test each and every time. The other group wanted a full-scale test only under unique situations.

Conclusion: FAA is unable to reach a decision at this time and will continue to accept additional submittals concerning this subject. The deadline for comment is February 21, 1986. Comments are to be submitted to Roger Young, FAA.

Item G. How realistic should demonstrations be?

Summation from previous meeting:

It was agreed that the demonstration does not reflect an accident scenario and that the demonstration cannot and should not reflect actual accident scenarios.

Discussion: None

Conclusion: As agreed previously, emergency evacuation demonstrations are not realistic nor could they be.

Item G.1. How should they be conducted?

Summation from previous meeting:

FAR 25.803(c) was discussed in detail with the individual items listed below. An Advisory Circular should be developed with the FAR 121 team to define how a demonstration should be conducted.

Discussion: See each individual item below.

Conclusion: See each individual item below.

Item G.2. Is carryon baggage properly accounted for? [803(c)(11)]

Summation of previous meeting:

The amount of baggage used should be defined as one item per seat row per aisle in an Advisory Circular.

Discussion: None

Conclusion: Working group agrees, baggage should be defined as one item per seat per aisle.

Item G.3. Is the 90 second criteria valid? [803(c);(d)]

Summation from previous meeting:

It was agreed that 90 seconds is a good ball park time. The NTSB has reviewed accident data and feels that 90 seconds does correlate somewhat with accidents.

Discussion:

Mr. Young asked, should the 90-second criteria be maintained and that at this time no other figure has been proposed.

Conclusion: No other figure was proposed. FAA will stay with 90-second evacuation time unless new data becomes available. Comments/analysis requested. Deadline February 21, 1986. Comments to Roger Young, FAA.

Item G.4. Is the 50% blocked exit criteria valid? [803(c)(17)]

Summation from previous meeting:

It was agreed that the 50% blocked exit criteria is valid for a demonstration. It appears to be a good percentage and other percentages may be unworkable.

Discussion: None

Conclusion: Working Group agrees, 50% blocked exit is a good figure.

Item G.5. Is the passenger mix (ie., age/sex) valid? [803(c)(8)]

Summation from previous meeting:

Age/Sex Distribution--At this time the group does not have data for this item. Assuming the current rule accurately reflects the current mix, the current rule is satisfactory.

Discussion:

ATA- (Reference ATA letter to Roger for explanation) The reason for a disclaimer, input was from only a few sources, not conclusive.
 CAA-asked if the demonstrations were based on full-scale evacuations.
 FAA-replied. It was based on passenger profile of the traveling public (Reference R. Young handout during meeting).
 MBB-asked the origin of identification for over 60's.
 ATA-stated 'unknown.'
 MBB-stated that the basis for the data should be required.
 ATA-acknowledged the data came from several sources with different basis' used (i.e. rounded-off figures, estimates, etc.)
 FAA-concluded that a more thorough investigation should be done.
 MBB-suggested CAA's figures on the chart should be identified as British Airways' chart because the data is from them.
 FAA-mentioned that 25.803 is only slightly different for ATA's figure.
 CAA-stated that the 'over 60's is significant.
 ATA-added that over/under ages tend to fluctuate with time of year and fare specials offered.
 FAA-agreed. But..there is still a need to represent them in the figures for evacuation demonstration purposes.

Discussion of using children under 18 years of age for evacuation demonstrations, possibly using other factors instead was raised.
 JCU-asked about the legal department findings in regards to this subject.
 FAA-stated that the legal aspect depends upon the child-labor laws in which state the demonstration is being conducted.
 FAA-suggested a way to compensate for using children or making it easier to recruit children might be to change the time of the evacuation demonstration so that more children would be available to participate (i.e. after school hours) or use more 'over 60's' passengers to compensate for the children passengers.
 ALPA-said they were of the opinion that if children are passengers then the evacuation demonstrations should provide testing for such.
 FAA-one thought about using children is that children may perceive the demonstration as a game, not taking the exercise seriously.
 MBB-there are no legal ramifications from using minors in Germany.
 ALPA-expressed a concern about handicapped/disabled passengers. A question of the pilot's responsibility to make sure all passengers have evacuated before pilot evacuates (problem: if it takes 15 minutes to board a handicapped/disabled passenger should the pilot be expected to spend the 15 minutes to evacuate the passenger, what happens to the 90-second evacuation time.)

FAA-this item should be addressed by the Operations Group.
 ALPA-possibly handicapped/disabled could be factored in to the demonstration.

DAC-manufacturers are governed by law as to the use of handicapped volunteers during evacuation testing.
 JCU-agreed, possible analysis could be used to compensate for handicapped/disabled.
 FAA-stated the main goal of the meeting was to get the public to propose some new regulations.

NTSB-recognized, but are we not asking the public to rerate what is not familiar to them.

FAA-No, just to propose a concept, that might be used. If no proposal is received then 25.803 will be left as is.

ALPA-could we possibly add an addendum citing that the problem of handicapped passengers is acknowledged and does indeed exist. What about addressing this issue in Part 121.

ATA-are there any statistical data on how frequent a handicapped passenger is assisted on board an aircraft?

JCU-flight attendants receive a computer printout of the handicapped passengers for each flight.

CAMI-mentioned the possibility of employing anthropomorphic dummies in place of the handicapped/disabled.

Conclusion: Part 25.803 will remain as is. Advisory Circular material will be published for those who wish to deviate.

Item G.6. Is the experience of people used for demonstrations appropriate?
[803(c)(14)]

Summation from previous meeting:

There is a proposal to change the rule to prohibit participants from being used more than once. The manufacturers desecrated stating that this will only make it harder to meet the age/sex mix requirements and that it rarely happens.

Discussion:

FAA-we will be receiving the manufacturers' position on February 15, 1986.
DAC-no data available.

BOEING-out of the last 4 demonstrations, 847 volunteers used, 25 volunteers were repeats. Females over age 50 are hard to recruit. Supports retaining the 6 month criteria.

ALPA-objects. Repeats make a difference in testing (i.e. cueing, awareness).

CAMI-what about establishing a maximum percentage of used passengers.

NTSB-this may not work because who/how to determine at what percentage will become significant.

JCU-use a time limit. Suggests 36-48 months.

MBB-it is difficult to track volunteer passengers. They could have been used in other airline companies' demonstrations. Must rely on volunteer's written statement.

FAA-inquired, is it a problem recruiting volunteers for evacuation demonstrations.

BOEING-yes, somewhat but not a real problem.

DAC-agreed with Boeing.

FAA-this is such a small percentage (4%) it does not appear to be a major problem.

Conclusion: The FAA will consider the suggestions brought up at this meeting and will accept additional submittals until February 21, 1986. Comments to R. Young, FAA, Seattle.

Item G.7. Should handicapped, obese, etc., passengers be included?

Summation from previous meeting:

The group decided that the normal health requirement be maintained and that handicapped, obese, etc. people not be used. However, CAMI should develop an analytical method of predicting how these people affect evacuations.

Discussion:

This item was discussed to some degree in Item G.5.

Conclusion: It was generally decided to continue to use the 25.803 verbage, "good health", etc. However, FAA requested additional comments, position papers in regard to this subject. Deadline: February 21, 1986. Submittals to R. Young, FAA, Seattle.

Item G.8. Should smoke or other anxiety factors be used?

Summation from previous meeting:

The consensus is that smoke should not be used. It is not possible to control smoke density for a demonstration nor is it possible to determine what smoke density would be appropriate.

Discussion:

FAA-has received position papers supporting smoke introduction into evacuation environment. FAA states there is a technical problem with introducing the smoke into the cabin. Regulating smoke density is difficult and how much smoke obtains a valid test.

CAA-evacuation is an arbitrary test. We strongly maintain, there is no justification for smoke introduction into the evacuation.

NTSB-asked if smoke was used during testing for the crew.

JCU-smoke was previously used, but no longer.

NTSB-adverse affects?

JCU-no, but there was no significant results either.

AFA-in answer to the same question, it varies from airline to airline.

Conclusion:

Again, FAA emphasized the impossibility to control smoke introduction.

Item G.9. Is the distribution of blocked exits appropriate? [803(c)(17)]

Summation from previous meeting:

There was no agreement on how to select the exits for a demonstration.

Discussion:

FAA-stressed, this data is a transport matter for rule change for future aircraft. FAA does not know how far to go until more data is received.
 DAC-position paper to be submitted by February 15, 1986.
 AIA-position paper to be submitted by February 15, 1986.
 FAA-FAA proposal was mailed out to working group for review and request for comments was made.
 DAC-warned that if a rule change is in order then other already existing rules may be affected as well (i.e., exits).
 ALPA-agrees with FAA proposal verbage.
 DAC-has a problem with the last sentence "...new type design only."
 JCU-satisfactory, reasonable.
 NTSB-leave 90-second rule as is, reasonable.
 FAA-a question of what times to use for the different exit types.
 AFA-would like to see "checkerboard" pattern of random selection used.
 FAA-(ASF-300) would like to see all evacuation times be cut down to 90 seconds.
 ATA-warned, not to rely solely on an arbitrary number.
 WPAFB-uses a 60-second evacuation time for all aircraft, all exits.
 FAA-not sure of the applicability to commercial, passenger carrying aircraft.
 CAA-agrees 90-second evacuation is reasonable.
 FAA-brought up the question, by using random doors are we using a true 50% of each type of exit.
 MBB-we should consider "50% of exit capacity", not 50% of exits.
 BOEING-warned, that this concept may penalize the aircraft with exits all alike. There could be no random selection of door, the test results would be the same.

Conclusion: FAA will wait for manufacturers's data and determine course of action. Comments/modifications due to R. Young, FAA, Seattle, by February 2, 1986.

Item G.10. Do the current demonstrations reasonable reflect the survivable accident scenario?

See Item G

Item G.11. Should FAR 25 and FAR 121 requirements be better integrated?

Summation from previous meeting:

Integration of flight attendant training requirements.

Discussion: None

Conclusion: This item will be gotten from the Operations Working Group and will be included in the Advisory Circular.

Item G.12. Is crew training prior to the test appropriate? [803(c)]

See Item G.11 and discussion of 25.803(c)(7)(i).

Item G.13. Is the use of the cockpit crew appropriate? [803(c)]

Summation from previous meeting:

There was a descending view to the proposal that the flight deck crew should have no assigned role in the demonstration.

Discussion:

FAA-has received several inputs from appropriate parties.

CAA-states that the flight deck crew have been assigned evacuation roles in the past.

FAA-(Young)Suggest not to use flight deck crew at all.

JCU-stress the need for consistency whatever was decided.

FAA-agrees that Part 121 should be consistent with Part 25.

JCU-suggest possibly having them there but not actually assisting in evacuation procedure.

IFALPA-supports no flight deck crew used in evacuation procedure.

Conclusion: FAA will recommend no flight deck crew be used during evacuation

NOTE: All other items on the agenda were skipped, down to: SUGGESTED RECOMMENDATIONS

Item 37. Use F/A's to ready the evacuation demonstration cabin.

Summation from previous meeting:

It was explained that current FAA policy is that the FAA distributes the baggage, etc. This policy is considered acceptable.

Discussion: None.

Conclusion: Accepted as stated.

Item 38. Simulate an injured F/A at one exit.

Summation from previous meeting:

The consensus is that the minimum number of flight attendants required by Part 121 be used. The Part 121 one flight attendant per 50 passengers rule will be discussed at the Operators Working Group.

Discussion: None.

Conclusion: Accepted as stated.

Item 39. Require at least one operative exit to be unmanned.

Summation from previous meeting:

It was explained that the current FAA policy is to distribute the flight attendants as required by Part 121 some at useable exits and others at inoperative exits. This was considered satisfactory.

Discussion: None.

Conclusion: Accepted as stated.

Item 40. Use NTSB statistics to determine inoperative exits.

Summation from previous meeting:

The NTSB representative stated that such statistics do not exist.

Discussion: None.

Conclusion: Accepted as stated.

Item 42. Let participants select seats for test.

Summation from previous meeting:

Except for assignments made by the FAA per 25.803(c)(9) this is generally done.

Discussion: None.

Conclusion: No action required.

DISCUSSION OF FAR 25.803 PARAGRAPHS NOT ALREADY DISCUSSED

Item 1. FAR 25.803(a), (b), (c), (c)(1), (c)(2), (c)(3), (c)(4), (c)(5), (c)(6), (c)(10), (c)(12), (c)(13), (c)(15), (c)(16), (c)(18), (c)(19), (c)(20).

Discussion: None.

Conclusion: No change.

Item 2: FAR 25.803(c)(7)(i). Advisory material should be developed with the Operators Working Group to define "regularly scheduled line crew."

Discussion: None.

Conclusion:

This information will come from the Operations Working Group.

Item 3: FAR 25.803(c)(8)(iv). Should be clarified that the life-size dolls should also be of appropriate weight.

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TASK FORCE ON EMERGENCY EVACUATION OF TRANSPORT
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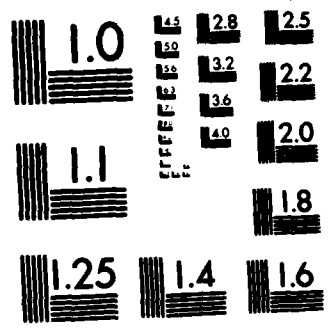
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MICROCOPY RESOLUTION TEST CHART
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Discussion: None.

Conclusion: Working Group agrees on doll being appropriate weight.

Item 4: FAR 25.803(c)(9). Proposal that Advisory Circular be developed defining what type of company employee should not be used and that the rule be change to prohibit company employees from each exit row.

Discussion:

AIA-reference AIA document, page 4.

BOEING-stated that they currently use assembly employees for evacuation demonstrations

JCU-refer to submittal.

DAC-JCU is being too restrictive.

MBB-why does it matter. There is no correlation between each individual component and final product.

JCU-does not want anyone involved who might be readily familiar with the aircraft interior/evacuation testing environment.

Conclusion: FAA will publish an Advisory Circular for comment.

ADDITIONAL ITEMS FOR COMMENT

Item 1. The FAA should define how much information may be given to participants considering they must give informed consent.

Discussion:

FAA-quotes CFR, no conflict. FAA states there is no technical objection but possibly a legal question involved. The test should be discussed enough to obtain a legal consent.

BOEING-stated this is a legal issue and that this working group could not make an informed decision.

Conclusion: None.

Item 2. Limiting the number of times a failed demonstration can be repeated and conditions for repeat tests.

Discussion:

FAA-(Crenshaw) noted that all failed demonstrations would require proper documentation of discrepancies of failures.

BOEING-(Reading from AIA input) pointed out that there is only one opportunity to pass the demonstration except for mechanical failure(s), as discussed at the last meeting.

AFA-would like to review AIA's input further before making comment.

Item 3. FAA procedures on publishing of equivalency findings, FAA issue papers, notification of design changes.

Discussion: None.

Conclusion: FAA is not prepared to discuss this item. This is a nation-wide policy, not a technical issue.

With the conclusion of this last item Mr. Young thanked all attendees for their participation and adjourned the meeting.

FEDERAL AVIATION ADMINISTRATION WORKING GROUP ON EVACUATION SYSTEM DESIGN AND CERTIFICATION, EVACUATION DEMONSTRATION SUB-GROUP

DATE: FEBRUARY 6-7, 1986
CALIFORNIA

LONG BEACH,

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Report of the Training and Operation Working Group Meeting

December 3-4, 1985

Washington, D.C.

On September 3, 1985, the FAA convened the Public Technical Conference in Seattle, Washington, for the purpose of soliciting and reviewing information from the public on a variety of topics related to the Emergency Evacuation of Transport Category Aircraft. At the conference, three working groups were formed. They were the Design and Certification Working Group, the Maintenance and Reliability Working Group, and the Training and Operations Working Group.

The Training and Operations Working Group was given the task of reviewing issues concerned with: 1) crew member training; 2) location and duties of flight attendants; 3) passenger safety information; and 4) air carrier operations. The Training and Operations Working Group met on December 3-4, 1985, and discussed pertinent Technical Conference issues and other issues which had been submitted in writing.

During the meeting, some time was spent discussing evacuation demonstrations; however, it was decided that the subject should be handled by the Design and Certification Working Group. The Office of Flight Standards would assist in the preparation of the Advisory Circular (AC) regarding evaluation demonstrations; and Flight Standards will prepare the part of the AC pertinent to training of crew members to be used in evacuation demonstrations, use of flight crewmembers, and definition of line crewmember.

The major part of the agenda consisted of four major categories of issues. These were: 1) crewmember training; 2) number, location, and duties of flight attendants; 3) passenger safety information; and 4) air carrier operations.

TRAINING

During the Technical Conference, the Training and Operations Working Group meeting and in written submissions, the groups representing the crewmembers and the passengers expressed some concern over the quality and quantity of emergency training given to crewmembers. They also expressed the need for clarification of some of the terms used in the regulations pertaining to emergency training. The Airline Transport Association indicated during the Technical Conference and the Training and Operations Group meeting that they felt that crew emergency training was sufficient and no changes were needed.

The Association of Flight Attendants provided a written submission requesting a clarification of the meaning of "Each crewmember must perform...", "individual instruction," "competence check," "performed emergency drills," and "actually operate." The Association also requested that Section 121.417(c) be clarified to actually require putting out a fire or at a minimum to require the deployment of fire extinguishers.

These issues were submitted in writing and not discussed at length during the Training and Operations Working Group meeting. However, the Working Group asked if the FAA could provide guidance in these areas and the FAA responded by saying they

could be covered in an Advisory Circular being prepared by the Office of Flight Standards that will address crewmember emergency training. Additional guidance will be given the principal Operations.

The Association of Flight Attendants submitted written recommendations suggesting that the FAA issue a directive to its inspectors prohibiting them from approving less than 12 hours of recurrent classroom training at airlines operating three or more aircraft types and programs providing less than nine hours of classroom recurrent training. The Association further recommended that the FAA should not approve transition training unless it provided for a minimum of four classroom hours, including hands-on training on each type of exit in the normal and emergency mode aboard the acquired aircraft. The Association also recommended that the FAA should amend its regulations to ensure that flight attendants moving from one airline to another undergo the regular, approved training program of the receiving airline without reductions in hours, according to one view.

The Training and Operations Working Group did not reach a consensus on these issues; however, the FAA will provide additional guidance regarding training program approval in the inspector handbook being prepared as part of project SAFE.

The Association of Flight Attendants recommended that flight attendants receive the recurrent training required under Section 121.417(c) on an annual basis instead of once every 24 months.

Section 121.417(c) addresses drills required every 24 months. Recurrent training of flight attendants is required every 12 months under Section 121.433(c)(ii) with pictorial

displays, discussions, lectures and other training techniques supplementing the drills required every 24 months. The FAA has not been given data to indicate this training is not sufficient.

The Association of Flight Attendants submitted a written recommendation requesting that the FAA should, through rulemaking, develop a minimum number of hours of training for first aid in consultation with appropriate emergency care groups. This training should be separate from current recurrent training requirements.

During the Training and Operations Working Group meeting, some of the participants indicated they would provide additional information regarding the need for additional first aid training and that they would submit suggestions for the joint flight/cabin crew training in specific areas. These participants have not submitted written recommendations.

No data was introduced during any of the meetings nor was any submitted in writing which would indicate the first aid training is not adequate. Further, all evidence indicates that since present first aid training (as opposed to emergency medical technician training) is adequate, no regulatory activity is anticipated. However, the inspector handbook and proposed flight attendant training advisory circular will provide additional guidance to inspectors regarding the approval of training programs including that part devoted to first aid training.

The Association of Flight Attendants recommended that the FAA ensure that any increase in recurrent security training is not implemented at the expense of classroom training on regular subjects.

The Security Training program of an airline is approved by the Principal Operations Inspector (POI); however, the Principal Security Inspector will work closely with the POI and the airline in the development of these programs. It is incumbent upon the POI assigned to a certificate to approve the total training program. The nature of the operation and equipment must be taken into consideration when approval is granted. The inspector handbook being prepared as part of project SAFE will provide additional guidance in this area.

Some of the additional recommendations regarding emergency training concerned take-home tests/material; hands on training replacing written exams; making drills more realistic; actual removal of emergency equipment from the holders; actual instruction in the location, operation and use of each type of oxygen system; elimination of any provisions that permit carriers to use demonstrations for certain emergency situations; and the sequence and procedures for an anticipated practice emergency should be identical to that which is to be used in an actual emergency.

As stated before it is the duty of the Principal Operations Inspector assigned to a certificate to approve a training program. This approval must be based on, among other things, an assessment of that operator's procedures, routes, equipment, physical plant and experience. It appears that some of the recommendations have already been addressed in the Federal Aviation Regulations (specifically Sub-Part N of Part 121). Additional guidance will be provided in the inspectors handbook being prepared as part of project SAFE.

An additional recommendation regarding emergency training program subject matter was that air carriers operating applicable Boeing 727 aircraft should include emergency procedures for operation of the ventral airstair door in their training programs for cabin crews.

Section 121.417(c)(1) requires each type of emergency exit to be opened in normal and emergency modes. The certificate holder should make use of all available exits when formulating evacuation procedures. Therefore, all crewmembers should be drilled on the use of these exits.

One of the recommendations suggested that flight attendants should have actual experience in "smoke-filled" cabins for initial training.

The proposed Advisory Circular of Flight Attendant training will address the use of smoke or smoke simulating goggles during flight attendant training.

Further recommendations included having Principal Operations Inspectors review training programs and, if necessary, specify they be amended to emphasize the flight crews take immediate and aggressive action to determine the source and severity of any reported cabin fire and to begin an emergency descent for landing or ditching if the source and severity of the fire are not positively and quickly determined, or if immediate extinction is not assured, flight attendants should be trained to recognize the urgency of informing the flight crews of the location, source, severity of any fire or smoke within the cabin and for all crewmembers to be knowledgeable of the proper methods of

agressively attacking a cabin fire by including hands-on training in the donning of protective breathing equipment, the use of the fire axe to gain access to the sources of the fire through the interior panels which can be penetrated without risk to essential aircraft components, and the discharge of an appropriate hand fire extinguisher on an actual fire.

The protective breathing equipment in the cabin regulatory project will address the actual requirements for the use of a fire extinguisher during crewmember emergency training.

The Airline Pilots Association submitted a recommendation to expand the provisions in Part 121 to include demonstrated minimum proficiency in the operation of water survival equipment by all crewmembers on carriers conducting passenger service in extended overwater operations. This training would be conducted in a deep water environment and contain provisions for instruction in directing passenger evacuation in a ditching situation; donning of life preservers both in and out of the water; deployment of raft, slide/raft combinations (would include removing life rafts from storage compartments); directing and marshalling survivors; demonstrating proficiency in boarding rafts from the water and getting passengers aboard the raft; and demonstrating proficiency in operation of any survival equipment carried, with emphasis on emergency locator transmitter operation in rough water conditions and operation of flare signalling devices.

Another group also recommended additional water survival training and recommended that the regulations be expanded to include basic water survival training as part of initial and recurrent training for all flight crews. This training should

emphasize coordination between flight and cabin crews with little or no pre-water contact preparation time. It should provide for post-crash survival training including, but not limited to, operation of all water survival equipment on board the aircraft, prevention of hypothermia, and crew leadership.

Regarding the frequency of this type of training, one suggestion was to require proficiency in actual water conditions on a one-time basis in initial training. For current crewmembers, this one time water survival training would be required during recurrent training. Another recommendation was to require a wet ditching drill for each crewmember every five years.

The FAA will consider initiating a regulatory project in the area of in-water emergency training. The regulation to be amended would be Section 121.417.

One of the flight attendant groups recommended that Section 121.417 be amended to include megaphones as one of the items of emergency equipment that crewmembers must actually operate during initial and recurrent training. Also, recurrent training programs should contain instructions on the use of the public address system.

Another recommendation was to require airlines to include, during initial and recurrent flight attendant training programs, information on how personality and behavior of passengers can be manifested in non-routine and emergency situations; and to provide instruction on how flight attendants can compensate for their interpersonal dynamics when they must assign duties to

passengers in emergencies. Training should also be given to flight attendants on how to improve the motivation of passengers to pay attention to the oral briefings and to the demonstrations regarding safety features of the aircraft.

There is an Advisory Circular being prepared on passenger information systems. Section 121.417 requires training of crewmembers regarding abnormal situations involving passengers and crew. Section 121.421 requires flight attendants, during initial and transition training, to have training on handling passengers. Inspectors receive training on cabin safety, including passenger information. In view of the increase in passenger initiated unwarranted evacuations, many people are questioning the desirability of providing additional information to passengers.

Additional recommendations regarded pilots receiving training on cabin FARS to ensure cockpit/cabin crew coordination. Further, joint training between pilots and ground fire fighting emergency crews should be given. Also, the FAA should establish requirements for intercarrier crew compositions to assure that adequate training and standardization of emergency procedures have been accomplished in all facets of the operation.

Guidelines to inspectors will emphasize the need to ensure that emergency procedures training for cabin crew and flight crew are coordinated. There is a logistics problem with training every cockpit and cabin crewmember together.

One recommendation was to establish a procedure to require air carrier management to create and implement a system that would provide a method for continual assessment of the pilot-in-

command's performance in executing management's operational control responsibility. In addition, the FAA should review and revise, where necessary, the operations manuals of air carriers to clearly state management's operational control procedures with regard to the pilot-in-command and other crewmembers, and the manner in which each crewmember is expected to execute his duty.

Guidance for the acceptance of manuals will be contained in the inspector handbook being prepared as part of project SAFE.

FLIGHT ATTENDANTS: NUMBER, DUTIES, LOCATION

The flight attendant organizations made recommendations regarding the minimum number of flight attendants. One of the recommendations was that under no circumstances should an airline be allowed to reduce the number of flight attendants on an aircraft by blocking passenger seats. The number of flight attendants used to certify a particular type and model aircraft should be the required number of flight attendants to operate the aircraft regardless of number of passengers aboard.

A related recommendation was that the FAA should enforce its interpretation requiring all flight attendants to be on board the aircraft during boarding and deplaning.

An additional recommendation came from the NTSB, which recommended that previously effective Section 121.391, requiring two flight attendants for more than 44 passengers, be reinstated without any waivers, exemptions or deviations (as allowed under Exemption 1108B). As the agency has previously noted, the Board did not recommend a permanent rule change but rather that the

partial exemption be extended for a period of time during which a program for collection of appropriate data can be accomplished. The exemption allowed certain carriers to operate a 50-passenger aircraft with one flight attendant for a 44-passenger seating capacity and two flight attendants for a 44 to 99 passenger seating capacity.

The Training and Operations Working Group did not reach a consensus of opinion on this matter; however, the FAA pointed out that present interpretations do not allow the blocking of passenger seats in order to reduce the number of flight attendants. There is a regulatory project in this area. In addition, the FAA is not aware of any empirical evidence that indicates the need for two flight attendants in aircraft operating with less than 50 passenger seats.

An additional recommendation regarding the location of flight attendant seats stated that flight attendant seats should be located as close as possible to floor level exists. However, in instances where there are sufficient flight attendants covering each floor level exit, it would be permissible to have flight attendant seats at other emergency exits.

The Training and Operations Working Group did not reach a consensus of opinion on this issue; however, the FAA pointed out that present regulations (Section 121.311) require designated flight attendant seats to be evenly distributed at floor level exits. A further determination for the location of required flight attendants during takeoff and landing is established during the evacuation demonstrations required under Section 121.291. In addition, Advisory Circular 25.785-1 provides

additional information regarding the location of flight attendant seats. This subject was extensively discussed during the operations review, and at that time an amendment to Section 121.311 was issued. At this time it was the general consensus of opinion in the aviation community that the passenger flow rate was so much greater at floor level exits. This remains the best location for required flight attendant seats.

One of the recommendations received stated that the FAA should require that the air carriers designate the flight attendant(s) who will be responsible for use of the megaphone(s) during an evacuation, and relocate the megaphone(s) so they are within easy reach of that flight attendant's seat. Consideration should be given to the installation of new light and compact megaphones to facilitate stowage and use.

The Training and Operations Working Group did not reach a consensus of opinion on this area. However, the FAA has reviewed official NTSB and FAA accident/incident files and found they do not reveal use of megaphones during these occurrences. Airlines assign crewmember evacuation duties in accordance with Section 121.397. FAA inspectors will receive guidance regarding these duties in the handbook presently being prepared as part of project SAFE. Megaphones are discussed in Advisor Circular 121-6.

EQUIPMENT

During the Technical Training Conference and the Working Group meetings there was a good deal of discussion about

equipment issues such as flight attendant seats, minimum equipment lists, slides, and standardization of equipment.

The Joint Council of Flight Attendants felt that flight attendant seats should be located as closely as possible to floor level exits. Both of the flight attendant groups felt that flight attendant seats should not be located in or across from galleys, that there was a need to address the size of flight attendant seats, and that flight attendant seats should not be located so there was a danger of flight attendants striking their heads on something in the area. It was also recommended that if the present NPRM does not include flight attendant seats, they should be included and should therefore provide a standard for dynamic testing. The Joint Council and some of the passenger advocate groups expressed concern regarding the location of "non-required" flight attendant seats.

During the discussions regarding flight attendant seats it was pointed out to the Working Group Participants that Advisory Circular 25.785-1 provides information regarding the location, design and other standards of flight attendant seats. It was further pointed out that this subject was extensively discussed during the operations review, and following that exercise, amendments to Sections 121.311 and 25.785 were issued. This amendment and Advisory Circular 25.785-1 provide guidance regarding additional protection for flight attendants seated in designated flight attendant seats.

Both of the flight attendant groups expressed concern about flight attendant seats and restraint systems fitting flight attendants. They stated that there was a problem with flight

attendant seats being large enough for the larger flight attendants. Throughout the various meetings, the flight attendants expressed concern about the ease of donning, fitting and releasing their restraint systems. Some of these problems appear to be related to the size of flight attendants, since crowding on the seats contributed to some of the difficulties. The flight attendants also recommend that restraint systems be standardized throughout the airline's fleet.

This item is basically in the Design and Certification Working Group area; however, the FAA pointed out that FAA's Protection and Survival Laboratory and the restraint manufacturers are continuously conducting research to improve restraint systems. Ease of donning and quick release features are among the variables considered.

The flight attendant groups expressed concern that the flight attendant seats would be left out of the proposed NPRM on seats.

It is believed that the NPRM will address all occupant seats and thus provide for dynamic testing of seats.

During the Technical Conference the flight attendant groups mentioned the problem of operating with one door inoperative. This was briefly discussed during the Training and Operations Group meeting at which time the Airline Pilots Association indicated that they would provide a written submission regarding this matter. Their written submission requests the withdrawal of any conditions under which an aircraft being operated under Part 121 can be dispatched with one of the required exits being inoperative.

The Office of Flight Standards is studying the one door inoperative MEL practice and anticipates providing additional guidance regarding this matter in the near future.

During the Technical Conference, the Training and Operations Working Group meeting, and in written submissions, the Association of Flight Attendants made recommendations regarding evacuation slides. They recommended that all slides in Part 121 operations be automatically inflatable, that all narrow-body slides be readily detachable from the aircraft for use as flotation devices, and that upper deck exits be provided with inertial reel egress systems as back-up for the maximum seating capacity of flight attendants on the upper deck.

The Training and Operations Working Group discussed these issues and decided they would be more properly handled by the Design and Certification and Slide Maintenance Working Groups.

During the Technical Conference, the Training and Operations Working Group meeting, and in written submissions, the Association of Flight Attendants, the Joint Council of Flight Attendants, and some of the consumer advocate groups recommended standardization of equipment. Some of the passenger advocate groups felt this standardization should be inter-airline in order to help knowledgeable passengers in emergency situations. The flight attendant groups were basically concerned with having standardization of equipment on one airline.

There was no consensus of opinion among the group members. The Airline Transport Association maintained that the airline should have the final option regarding the type and location of

equipment. While there was no formal consensus of opinion regarding this matter, it appeared that there was general agreement among the Working Group participants that this subject would be more properly handled by the Design and Certification Working Group.

PASSENGER SAFETY INFORMATION

A number of comments, suggestions, and recommendations were made regarding passenger safety briefings. Proposals were made that would require some sort of testing for passenger comprehension to ensure that the briefings were conveying their message properly by determining whether these persons are able to perform the actions described, such as using the supplemental oxygen system, life preservers, and exit doors.

Several recommendations on changes in the content of the briefing were also made. One proposal was to revise the Advisory Circular "Passenger Safety Information Briefing and Briefing Cards" (AC-121-24 dated June 23, 1977, and AC-135-12 dated October 9, 1984) to include guidelines covering the following items in briefings and demonstrations: adults donning oxygen masks before placing masks on accompanying children; fastening an adult size life preserver or personal flotation device on a child; and brace positions for children. As an interim measure, the FAA will issue an Air Carrier Operations Bulletin to assist FAA inspectors in providing better guidance to airlines.

Another proposal was to amend Part 121 to require, on airplanes that are equipped with life preservers, that the safety briefings include demonstrations of how to open the life

preserver's sealed protective pouch. In addition, a recommendation was set forth to amend Section 121.571 to state that the appropriate crewmember must physically point out the location of all emergency exits on each aircraft prior to takeoff.

Also included in these recommendations was a requirement to amend Part 121 to require pre-landing safety announcements to reinforce the pre-takeoff briefings on release of seatbelts, the location of exits, the location and operation of life preservers (in the case of overwater landings), and to urge passengers to refer to safety cards prior to landing. Yet another suggestion was to generally "toughen" the language used in passenger safety briefings.

Along with various suggestions on briefing content, there were also recommendations on briefing method. A suggestion was made to conduct research in the application of communication techniques, behavioral sciences, and optimum learning situations. Another suggestion was made to incorporate audio-visual materials in the briefing. Another was to develop a program to test feasibility, effectiveness, and passenger acceptance of providing safety briefing information in airport terminal gate areas, and of providing printed safety information on or inside the ticket envelopes. Another recommendation was that the emergency instructions for the individual airplane should be displayed on the back of the seats at the passenger's eye level to provide added assurance that the passenger is fully aware of vital safety and survival information.

A proposal was made to require that automatically activated safety messages be used for explaining the operation of the supplemental oxygen systems following loss of cabin pressurization in all newly manufactured air carrier airplanes and, after a specified date, in all other air carrier airplanes that operate under 14 CFR 121. Furthermore, the FAA should, according to one proposal, explore the feasibility of providing public service messages in the media that acquaint air travelers with safety features aboard air carrier aircraft.

Also, it is recommended that the FAA revise, based on the results of testing passenger comprehension of safety information and performance of emergency procedures, Air Carrier Operations Handbooks and Bulletins and air carrier inspector training programs to include instruction to prepare FAA inspectors to provide better guidance to airlines when assisting them in improving the content and presentation of passenger safety information to their passengers.

In response to these various suggestions, it should be noted that no empirical or objective evidence exists that documents either a passenger fatality or serious injury resulting from deficiencies within the passenger information system. The number of passenger-initiated unwarranted evacuations may in fact indicate that additional passenger training could have a negative effect on overall passenger safety. Also, we have reported cases of passenger interference with crew. Perhaps it would be better to address most of our resources to improvements in crew emergency training.

Motivating passengers to read cards or pay attention to announcements is complex and difficult. Motivating people is very difficult and usually considered long term. These problems are also experienced by professional educators and trainers when they seek to motivate people in 'required' classes. People who have studied motivation regarding safety practices know that one sure way to motivate people is to show them the consequences of a failure to follow safety practices. For example, in the case of encouraging people to wear their seatbelts, states have shown scenes of anthropomorphic dummies going through windshields and cars following accidents. In the case of aviation safety, similar attempts at motivation could consist of pictures of accident victims, crashes, etc., posted in strategic places at airport boarding gates or on airplanes. This would get attention, and would probably cause more people to pay attention to the briefings and briefing cards. Would the airlines and traveling public accept this method of passenger motivation?

Development of tests and standards to measure comprehension and performance would be quite difficult and costly. For example, most of the results would be based on the 'typical' passenger. It would be necessary to define the typical passenger, which would be difficult. In addition, there is ample evidence that indicates that passengers have been able to open exits and doors in accidents. While they may have difficulty donning life vests, this could be more of a design deficiency than lack of education and information.

Passenger information cards are almost too cluttered right now. Adding pictures of children in brace positions and children

in lifevests would only add to the clutter and possible confusion. Furthermore, depicting a brace position for children on cards would be difficult since any protective position varies according to the size of the child. In any case, in the event of any anticipated evacuation, there should be ample time for the flight attendants to show the adult accompanying the child the correct position. In the event of an unanticipated evacuation, it is doubtful there will be enough time for the adult to do more than assume the brace for impact position himself. This may be the most important thing the adult can do, since it is important for the adult to survive in order to help the child get out of the airplane.

In the event of a ditching (anticipated water landing), there would be ample time for the crewmembers to instruct children and the adults accompanying them in the donning and wearing of lifevests. In the event of an unanticipated water landing, the most important thing would be for the adult to get his lifevest on, and then perhaps he and other adults would be able to hold up the child. The chances of being able to assist anyone in donning a lifevest in an unanticipated water landing are minimal unless lifevests that are much easier to don are developed.

Airlines with operations that may indicate that it is important to depict infant/child brace positions or infant/child procedures for donning and wearing lifevests are free to do so as long as the depiction is accurate.

There is an Air Carrier Operations Bulletin that was jointly prepared by Flight Standards and the Protection and Survival Laboratory at CAMI, which provides all the information available on brace for impact positions.

Furthermore, it was proposed that the FAA amend Part 129 to include the safety provisions of Subpart T of Part 121 governing the briefing of passengers, or include these provisions in the operations specifications issued to foreign air carriers by the Administrator; and require that approved wording for such briefings be included in the appropriate flight/operations manuals of the applicable crewmembers.

The FAA feels that a joint industry-government task force might be productive if there were specific, objective, documentable information about the types of problems (as evidenced by official NTSB accident/incident reports) caused by passengers not receiving safety information.

Part 129 applies to foreign air carriers operating into the United States. The FAA has only limited authority over a Part 129 operator. This authority is valid only when operating within the United States and is limited to certain air traffic regulations. The FAA does not have any authority over passenger safety issues.

Finally, a suggestion was made to amend the regulations so that each operator and/or producer of aircraft passenger briefing materials submits a documentary report to the FAA/POI containing substantive data on the instructional effectiveness of the briefing material and/or method.

As stated, the FAA plans to address the passenger information system in an Advisory Circular that will be specially directed toward that subject. The subject will also be addressed in the flight attendant training Advisory Circular and also in the new inspector handbook.

TRAINING AND OPERATIONS WORKING GROUP MEETING

DECEMBER 3-4, 1985

<u>NAME</u>	<u>AFFILIATION/ORGANIZATION</u>
Ms. Connie Stevens	Association of Professional Flight Attendants, Homewood, CA
Mr. Dan Smith	International Airline Passengers Association, Dallas, TX
Mr. Thomas L. Anderson	B.F. Goodrich, Akron, OH
Mr. Ray Walder	International Air Transport Association, Montreal, Canada
Mr. John Reese	Aerospace Industries Association Washington, DC
Mr. Roger Brooks	Air Line Pilots Association Aurora, CO
Mr. Walt Coleman	Air Transport Association Washington, DC
Ms. Janna Harkrider	Union of Flight Attendants Pasadena, CA
Ms. Barbara Dunn	Canadian Airline Flight Attendants Association, Vancouver, Canada
Mr. Hector Berrera	Frontier Airlines, Denver, CO
Mr. Wayne Williams	National Transportation Safety Association, Dania, FL
Mr. Al Hastings	Arlington, TX
Ms. Ellen Hill	Teamsters Local 2707, Berkeley, CA
Mr. Steve Johnson	Flight Engineers Independent Association, Washington, D.C.
Ms. Karen Lantz	Independent Federation of Flight Attendants, New York, NY
Ms. Terry Singleton	Indepdent Union of Flight Attendants Honolulu, HI

<u>NAME</u>	<u>AFFILIATION/ORGANIZATION</u>
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Ms. Donell Pollard	FAA, AAM-119, Oklahoma City, OK
Ms. Marcia Bryars	Pacific Southwest Airlines, San Diego, CA
Mr. Steve Huntley	DOT/Transportation System Center, DTS-45, Cambridge, MA
Mr. Edmond Boullay	French Embassy, Washington, DC
Mr. Bill Weeks	Air Line Pilots Association Aurora, CO
Mr. Dan Johnson	Interaction Research Corporation Olympia, WA
Mr. Lawson C. White	International Air Transportation Association, Montreal, Canada
Mr. William H. Shook	Douglas Aircraft Company Long Beach, CA
Ms. Toni F. Ketchell	Association of Professional Flight Attendants, Euless, TX
Mr. George Veryiougrou	Boeing Commercial Airplane Company Seattle, WA
Ms. Joellen M. Thompson	Independent Union of Flight Attendants, El Segundo, CA
Mr. Anthony Adamski	Chrysler, Pentastar, Ypsilanti, MI
Mr. H. Beau Altman	Chrysler, Pentastar, Olympia, WA
Mr. Roger Vesely	Frontier Airlines, Denver, CO
Ms. Allison Johnson	Delta Airlines, Atlanta, GA
Mr. Mark Storm	Eastern Airlines, Miami, FL
Ms. Kay Avery	American Airlines, Dallas, TX
Mr. Jim Danaher	National Transportation Safety Board Washington, DC

<u>NAME</u>	<u>AFFILIATION/ORGANIZATION</u>
Ms. Nora Marshall	National Transportation Safety Board Washington, DC
Mr. Steven Vincent	Association of Flight Attendants Seattle, WA
Ms. Sandy Noller	Pan American World Airways, Miami, Fl
Mr. R.E. Livingston	Washington, DC
Captain John Mimpriss	Civil Aviation Authority London, England
Mr. E.E. Campbell	The Boeing Company, Seattle, WA
Mr. Paul Robinson	Air Line Pilots Association Marietta, GA
Mr. W.S. Weeks	Air Line Pilots Association Winston-Salem, NC
Mr. William A. Gill, Jr.	Flight Engineers International Association, Washington, DC
Ms. Isabell Burgess	Air Line Pilots Association Washington, DC
Mr. Ian Goodyear	Douglas Aircraft, Long Beach, CA
Mr. Gale Braden	FAA, ASF-300, Washington, D.C.
Mr. William Hendrix	FAA, AVS-2, Washington, D.C.

ATTENDANCE LIST

TRAINING AND OPERATIONS WORKING GROUP MEETING

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Mr. Gale Braden	FAA, ASF-300, Washington, D.C.
Mr. William Hendrix	FAA, AVS-2, Washington, D.C.
Mr. Rick Cremer	FAA, AFS-200, Washington, D.C.

FEDERAL AVIATION ADMINISTRATION (FAA)/INDUSTRY EVACUATION SLIDE
AND SLIDE/RAFT MAINTENANCE/RELIABILITY WORKING GROUP MEETING,
DECEMBER 4-5, 1985, CONDUCTED AT FAA HEADQUARTERS,
WASHINGTON, D.C.

FAA Participants:

Chairman - Fred W. Crenshaw, Aviation Safety Inspector (AW)
Acting Manager, Air Transportation Branch, AFS-330

Angelo R. Mastrullo, Aviation Safety Inspector (AW)
General Aviation Branch, AFS-340

Gary N. Goodwin, Aviation Safety Inspector (AW)
Aircraft Evaluation Group, ANM-270S

Winslow Lim, Aviation Safety Inspector (AW)
Principal Maintenance Inspector, AWP-FSDO-14

Anthony L. Pennybaker, Aerospace Engineer
Regulatory Support Division, AVN-100

Lorraine B. Parker, Secretary, AFS-330

Industry Participants - PLEASE SEE ATTACHED LIST

BACKGROUND:

The Federal Aviation Administration (FAA) sponsored a technical conference at Seattle Washington, September 3-6, 1985, concerning the emergency evacuation of transport category aircraft. The attendees included FAA personnel and 200 representatives from the airline and aerospace industries.

Three technical working groups were formed to address (1) the design and certification; (2) operations and training; (3) maintenance and reliability of aircraft evacuation systems. Conference attendees were invited to participate as members of the working groups. It was decided that each group would address appropriate issues, and make recommendations that would affect future FAA and industry actions concerning evacuation systems.

MAINTENANCE/RELIABILITY WORKING GROUP:

This was the first meeting of the Maintenance/Reliability Working Group. There were 42 attendees representing the national and international aviation communities. We appreciate the interest and participation of everyone who attended.

Raymond E. Ramakis, Manager, Aircraft Maintenance Division, AFS-300 in his opening remarks explained the significant roll that maintenance must play to assure the reliability of aircraft evacuation systems.

A review of the September meeting transcript revealed the following maintenance issues concerning evacuation system reliability. These issues were discussed at this meeting.

MAINTENANCE ISSUES AND RECOMMENDATIONS DISCUSSED:

1. Improper Maintenance.

Discussion:

This includes improper packing of slides and slide/rafts by repair facilities and improper installation of units on the aircraft by the operator. Malfunction and failure of equipment due to improper maintenance has been experienced during actual emergencies, evacuation demonstrations and functional testing.

Recommendations:

Improper maintenance can be addressed by proper training, current and adequate procedures, adequate facilities and equipment, and quality control. All of which should be addressed in the operators maintenance program. Also good communications between the operator and the manufacturer for purposes of training and current maintenance instructions. The FAA role is to continue to emphasize surveillance and enforcement activities.

2. Training/Qualifications.

Discussion:

Personnel involved in the inspection, packing and installation of slides on aircraft should be properly trained and qualified and must always follow current procedures.

Recommendations:

Initial training should be received from the slide manufacturer. The air carrier should have periodic recurrent training as part of its program. FAA inspectors should receive hands-on training. This would be an aid for monitoring operator and repair facility maintenance and training programs.

3. Mandatory Reporting of Malfunctions, Defects and Failures of Evacuation Systems.

Discussion:

This would require reporting by an air carrier under Section 121.703, Mechanical Reliability Reports (MRR) and a repair facility under Section 145.63, Reports of Defects or Unairworthy Conditions.

Recommendations:

Initiate a rule change project to incorporate reporting requirements that include corrective actions that would provide the FAA and Aviation Industry a total picture concerning problems. Such an action would greatly improve the reliability of evacuation systems. Even though malfunctions are being reported voluntarily, the MRR system does not reflect the total picture.

4. Required Inspection Items (RII).

Discussion:

There have been incidents involving slide malfunctions due to improper packing and improper installation of slides on the aircraft. Failure of a slide in an emergency situation could result in occupants not being able to evacuate an aircraft.

Recommendations:

What is needed is the assurance that the slide has been properly packed and properly installed on the aircraft. Two sets of eyes during these maintenance processes would provide that assurance. The manufacturer should identify in its overhaul manual the critical tasks during the packing process that could effect proper deployment; and the critical tasks to be observed during installation of the slide on the aircraft. All of those tasks should be identified in the air carrier's manual as RII. The Air Transport Association of America promised to survey its members for acceptability of RII for evacuation systems.

5. Functional Testing of Evacuation Systems on the Aircraft.

Discussion:

Functional deployment testing of the slide on the aircraft would test the total evacuation system. This would include operation of door systems with the slide engaged, and slide pack deployment and inflation.

Recommendations:

a. Proper documentation of functional tests would be necessary to account for evacuation system reliability. Functional tests could be accomplished when a slide is due for a shop visit or whatever method an operator chooses to include in its program and be accepted by the assigned principal maintenance inspector.

b. An added benefit to scheduled functional testing could be in conjunction with hands-on flight attendant training. This suggestion was presented to the Operations and Training Group.

6. Inspection Intervals.

Discussion:

The manufacturer initially establishes the inspection intervals for its product. The air carrier incorporates the evacuation system equipment into its own program and establishes inspections intervals based on its experience and evaluation, which are approved by the assigned FAA principal maintenance inspector. In some cases those inspection intervals may not be adequate.

Recommendations:

a. When inspection intervals are considered, the manufacturers with the operators should determine life limits for materials. Tests should be established to check for deterioration, age vs. fabric integrity and in service environmental conditions.

b. This issue was also given to the Design and Certification Group for consideration.

OTHER ISSUES:

Visual Indication of Proper Girt Bar Position: This issue was given to the Design/Certification Group and is being addressed by them.

There were some disagreements on how these issues should be addressed however, the majority of participants in the meeting agreed that the issues are valid and that recommended corrective measures should be considered.

The tasks identified in the above issues to be completed by industry participants are follows:

ATA Member Survey of Slide Packing, Installation and Testing Practices and Policies.

Questions Directed By ATA to its Members:

1. Do you currently designate critical slide packing tasks and slide installation tasks as Required Inspection Items (RII's)?
2. Would you object to an FAA requirement that such items be designated RII's?
3. If you object, please describe the grounds for objection and the impact you would expect from such a requirement.
4. Do you presently perform sample slide deployments on the airplane and/or rely upon inadvertent deployments to evaluate slide and door reliability?
5. Would you object, if inadvertent deployments were too infrequent to establish reliability trends, to an FAA requirement for on-airplane sample deployments?
6. If you object, please describe the grounds for objection and the impact you would expect from such a requirement.

The twelve ATA members were split in their responses to the questions. Some designate critical slide packing tasks and slide installation tasks as Required Inspection Items (RII) and others do not. Some are opposed to such a requirement. Approximately the same responses we received concerning functional testing of evacuation systems with slides installed on the aircraft. Some of the members believed that RII and functional testing should not be considered for narrow body aircraft.

INTERNATIONAL ASSOCIATION OF MACHINISTS (IAM) SUBMITTAL ON MAINTENANCE AND RELIABILITY OF EVACUATION SYSTEMS by Wayne Gallimore

This was an all inclusive submittal for all working groups. The following apply to the Maintenance/Reliability Working Group.

1. Door Failure Reporting.

Discussion:

During the last several months, it has become apparent that the FAA does not have a sufficient data base to make sound judgements on door failures in the automatic mode, and the repairs or modifications required to insure a reliable escape system.

Recommendations:

Include failure of an exit door functioning in irregular reporting system.

2. In-Service Deterioration Slides, Rafts and Life Vests.

Discussion:

It has been the experience of members of the IAM working on and testing slides, life rafts and life vests that too many of these items deteriorate to the point of being unairworthy. It should be stated that all our carriers' maintenance programs are not the same. Some have outstanding programs while others are lacking in regards to inspection and testing of emergency equipment. Some carriers use a time change system with varying times between inspections and test, while others use a survey method. A survey of our membership working on slide, raft and life vest inspection and testing indicates a vast majority supports the time change system with the following times: slides inspect and test a maximum of once every three years; slide/rafts once every three years; rafts once every four years; life vests once every five years. We are totally opposed to the survey system. On one aircraft we found numerous life vests over twelve years old. This is unsatisfactory.

Recommendations:

Institute an Advisory Circular deleting the survey system of inspection and testing. Require maximum times be set on all slides, rafts and life vest inspection and testing.

3. Slide Failure Reporting.

Discussion:

It appears to us that the FAA does not have a data base to assess the reliability of slides or slide/rafts. We believe if the FAA should require all deployments to be reported to the FAA, the data would be inaccurate. A more realistic approach would be to activate the automatic door opening and slide deployment system at the required time change of slides and a report to be filed with the FAA listing discrepancies found. This would provide an accurate data base and improve the serviceability of emergency escape systems at a convenient time at which repairs could be made.

Recommendations:

The FAA, through an Advisory Circular, require evaluation of the automatic door opening and slide deployment systems at required time change of evacuation slides and a report be made to the FAA listing discrepancies found.

French Civil Aviation Authority (DGAC) Comment.

The DGAC has created 3 working groups for Aircraft Cabin safety. Mr. Kim N'Guyan, head of the "Maintenance" Bureau of DGAC/SFACT and responsible for the French Maintenance Working Group will represent France at the FAA Working group meetings.

The Netherlands Department of Civil Aviation (RLD) Comment.

Maintenance of escape slides, as organized by KLM, Martinair and Transavia:

KLM

Maintenance of escape slides is carried out by the Section "Emergency Equipment" of the Repairshop. Time Before Removal = 18 months. The result of a recently held audit by the RLD shows that this section meets a satisfying quality standard. The Department Inspection and Quality of the KLM is surveying the section "Emergency Equipment" rather frequently and periodically.

A deployment test of escape slides, installed in an aircraft takes place on a basis of "each year all slides on one aircraft of a type". That means a frequency of 1 test every 3 weeks. Each test is photographed. Since the beginning of these tests in 1974 a considerable improvement of the test results has been achieved.

Martinair

Escape slides A-310, DC-10 and F-28
Maintenance by KLM (see above).

Escape slides DC-9-80 maintenance by Swissair.
(Maintenance-and engineering responsibility by Swissair).

Transavia

Escape slides B-737 maintenance by KLM (see above).

Scheduled deployment tests by KLM August 15, 1974 to November 30, 1977 produced a failure rate of 39%. This rate decreased to 12% during the last reporting period, March 27, 1984 to February 18, 1985.

Action To Be Taken By FAA:

The FAA has considered the recommendations for corrective action and has in progress a project to develop an Advisory Circular that will address

the issues concerning the maintenance/reliability of aircraft evacuation systems. Those issues will also be included in the Airworthiness Inspector's Handbook which is presently being revised.

A regulatory project has been approved to amend Section 121.703, Mechanical Reliability Reports (MRR) to require the reporting of malfunctions, defects and failures of evacuation systems during demonstrations, testing or actual emergency situations. It will also require corrective action documentation.

The Advisory Circular and proposed regulation change will be published in the Federal Register for review and comment.

A summary report of the activities of all 3 working groups is being prepared and should be available in the next few months. I will send a copy of that report to everyone on the Maintenance/Reliability Working Group mailing list.

Again, we appreciate your participation and support in this important safety effort.

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December 5, 1985

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**EVACUATION SLIDE AND SLIDE/RAFT MAINTENANCE/RELIABILITY
WORKING GROUP MEETING, DECEMBER 4-5, 1985**

**Federal Aviation Administration Headquarters
800 Independence Avenue, S.W.
Washington, D.C. 20591**

Conference Rooms 9A/B/C

**Chairman - Fred W. Crenshaw
Air Transportation Branch, AFS-330A**

AGENDA

WEDNESDAY DECEMBER 4

- 9:00 - Opening Remarks Raymond E. Ramakis, Manager, Aircraft Maintenance Division, AFS-300**
- 9:30 - Introductions and Announcements - Fred Crenshaw**
- 9:45 - Background and Presentation of issues concerning The Maintenance/Reliability of Slides and Slide/rafts - Fred Crenshaw**
- 10:15 - Break**
- 10:30 - Discussion of Issues**
- 11:30 - Lunch**
- 1:00 - Discussion of Issues**
- 2:15 - Break**
- 4:00 - Break for the Day**

THURSDAY DECEMBER 5

- 9:00 - Continue Discussion of Issues**
- 10:15 - Break**
- 11:30 - Lunch**
- 1:00 - Action Plan and Recommendations**
- 2:15 - Break**
- 2:30 - Action Plan and Recommendations**
- 3:30 - Future meetings and Closing Remarks**
- 4:00 - Completion of the First Meeting for the Maintenance/
Reliability Working Group**

**Evacuation Slide and Slide/Raft Maintenance Reliability
Working Group Meeting**

**Opening Remarks - Raymond E Ramakis
Manager, Aircraft Maintenance Division, AFS-330**

Good morning and welcome to the Federal Aviation Administration (FAA) Headquarters. I hope that everyone had a good trip and your're enjoying your stay in Washinton, DC. If all of that is true, then I'm sure we're going to have a smooth running meeting.

I was at the September evacuation slide meeting in Seattle and I recognize several of you who were also there. That was an interesting meeting and I'm sure this one will also be interesting.

Evacuation Slide and Slide/Raft Maintenance/Reliability is what this meeting is all about. We have several issues to discuss concerning slide maintenance. Your input to the discussions will have a definate bearing on how the issues will be resolved.

The other working groups; Certification and Design, and Operations and Training, are addressing issues respective to their areas of responsibility. We are hopeful that all of our efforts will contribute to safety.

As you know, safety is a responsibility that we all share. I want you to know that our efforts have support at the highest levels of the FAA and we intend to be productive.

Fred Crenshaw, Chairman of the Maintenance/Reliability Group will direct the meeting and provide further details.

Thank you for your participation.

**Evacuation Slide and Slide/Raft Maintenance/Reliability
Working Group**

The Federal Aviation Administration (FAA) sponsored a technical conference at Seattle Washington, September 3-6, 1985, concerning the emergency evacuation of transport category aircraft. The attendees included FAA personnel and 200 representatives from the airline and aerospace industries.

Three technical working groups were formed to address (1) the design and certification; (2) operations and training; (3) maintenance and reliability of aircraft evacuation systems. Conference attendees were invited to participate as members of the working groups. Each group will meet, discuss appropriate issues, and make recommendations that will affect future FAA and industry actions concerning evacuation systems.

This is the first meeting of the Maintenance/Reliability Working Group. We extend our appreciation to those of you who signed up for this group. We have a cross section of the national and international aviation maintenance community here. With good communication and a good exchange of information and ideas, I am certain that we will be able to adequately handle the task before us.

In reviewing the transcript of the September meeting, we have identified the following issues that affect the Maintenance/Reliability of slide and slide/raft systems.

1. Improper Maintenance. This includes improper packing and improper installation of slides and slide/raft assemblies in the aircraft.

2. The need for proper training and instructions for inspection, repair, and overhaul of units in repair facilities, and for the installation of slide and slide/raft assemblies in the aircraft.

3. Make mandatory the requirement for reporting of all malfunctions, defects and failures of slide and slide/raft systems by repair facilities and air carriers.

4. Make mandatory required inspection items (RII) for the packing, and installation of slides and slide/rafts on the aircraft.

5. Require periodic testing of installed evacuation slide and slide/raft systems, to include operation of the door and power assist systems with girt bars connected.

6. Adequacy of Maintenance/Inspection intervals for slides and slide/rafts.

You may have other issues to add to this list.

We want to discuss these issues, consider all possible solutions, and arrive at the best possible solutions.

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