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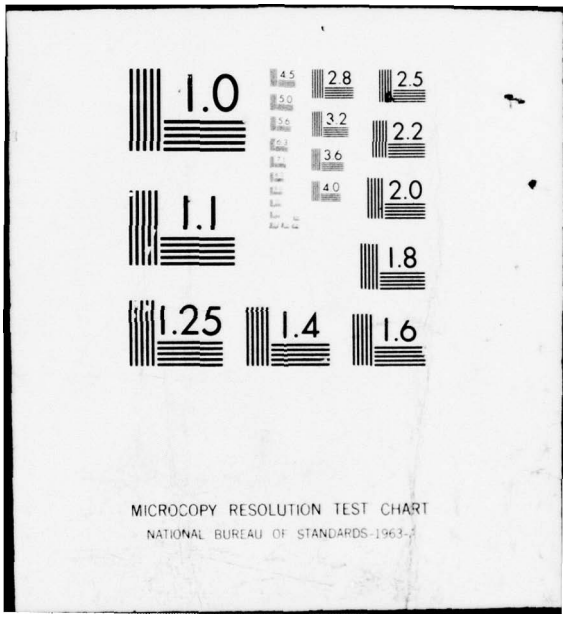
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Air Carrier Cabin Safety

A Survey

December 1976

Federal Aviation Administration
Office of Aviation Safety
Washington, D.C.

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16. Abstract

This is an overview report on the status and efficacy of the Federal Aviation Administration's air carrier cabin safety program. Up-to-date information on recurring cabin safety issues and problems was solicited from airplane manufacturers, air carriers, flight and cabin crews, associated organizations and others. The National Transportation Safety Board provided pertinent accident data and safety recommendations developed from aircraft accident investigation.

The survey identifies significant recurring cabin safety operational problems including flight attendant training and protection, flammability of cabin interiors, toxicity and smoke generation during post-crash fires, emergency evacuation, survivability. Seventeen recommendations are presented for instituting actions by the FAA's Flight Standards Service, Office of Aviation Medicine and Office of Aviation Safety to resolve recurring cabin safety problems and for continuing long-term improvement of cabin safety.

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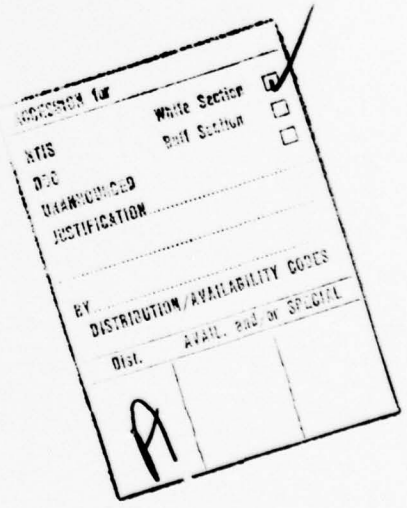
A SURVEY OF AIR CARRIER CABIN SAFETY

Conducted by

OFFICE OF AVIATION SAFETY
FEDERAL AVIATION ADMINISTRATION
July-September 1976



A SURVEY OF AIR CARRIER CABIN SAFETY

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INTRODUCTION

This is an overview report on the status and efficacy of the Federal Aviation Administration's air carrier cabin safety program based upon a survey conducted by the Office of Aviation Safety, July-September 1976.

The survey included interviews with representatives of aviation associations and unions as well as FAA regional and headquarters personnel, principal operations inspectors, airlines, and manufacturers' representatives. Thereafter an FAA-Industry Review of Cabin Safety in Air Carrier Operations was held in Oklahoma City on August 31, 1976. The FAA Administrator's Listening Session for Flight Attendants conducted at San Francisco on September 21, 1976, also provided further insight into cabin safety issues. The results of these two proceedings appear in the appendices. Cabin safety-related information obtained from FAA's Airworthiness and Operations Biennial Reviews are summarized in Appendices I and II.

The report highlights significant recurring cabin safety problems identified during the course of the survey. The status of the agency's cabin safety rule making and research projects as well as the status of 15 significant FAA cabin safety programs are described.

Seventeen recommendations are presented for instituting actions to resolve recurring cabin safety problems and for continuing long-term improvement of cabin safety.

A SURVEY OF AIR CARRIER CABIN SAFETY
BY
OFFICE OF AVIATION SAFETY
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D. C.

PURPOSE

This survey was conducted to provide to the Administrator of the Federal Aviation Administration an overview of the status of the agency's air carrier cabin safety programs and the efficacy thereof.

The survey identifies significant recurring cabin safety operational problems as perceived by FAA, manufacturing and operations representatives. It also contains recommendations formulated by the Office of Aviation Safety staff for improving the agency's program for carrying out its safety responsibilities with respect to occupants of airplanes used in U.S. air carrier passenger-carrying service.

SCOPE

This survey reviewed the agency's cabin safety programs pertaining to occupant injury protection and occupant survivability in mishaps occurring to transport category airplanes operated in air carrier passenger-carrying service under Part 121 of the Federal Aviation Regulations.

METHODOLOGY

Up-to-date information on recurring cabin safety issues and problems was solicited from airplane manufacturers, air carriers, flight and cabin crews, associated organizations, and others concerned with the certification and operation of transport category airplanes in U.S. air carrier passenger service. The National Transportation Safety Board provided pertinent accident data and safety recommendations developed from aircraft accident investigations. The data collection also drew heavily from the report on Aircraft Cabin Environment published by the Committee on Public Works and Transportation, House of Representatives, from the Hearing before the Subcommittee on Investigations and Review, February 3, 4 and 5, 1976. This report was a source of valuable background material as was documentation contained in the FAA Biennial Airworthiness and Operations Review records.

Follow-up meetings were held with many of the associations and unions as well as FAA regional and headquarters personnel, principal operations inspectors, airlines, and manufacturers to discuss the project and provide them with an opportunity to make additional inputs as the study proceeded.

On August 31, 1976, the Office of Aviation Safety sponsored a meeting on cabin safety at the Civil Aeromedical Institute in Oklahoma City, Oklahoma. Fifty-five participants representing various government agencies and industry organizations, including manufacturers, operators and crews, attended the meeting. Government organizations represented included professional staff representation from the Committee on Public Works and Transportation, House of Representatives; NASA; NTSB; and FAA.

Flight attendant representatives were provided further opportunity to make known their concerns related to cabin safety at the Administrator's Listening Session for Flight Attendants in San Francisco, California, on September 21, 1976.

NATURE OF THE CABIN SAFETY ISSUES

Considerable attention by the aviation community is focused on the crash protection of aircraft occupants and their evacuation following an accident. The aircraft manufacturers have expended large sums of money and many thousands of man-hours in research to improve the cabin interiors and escape systems. These improvements are reflected in the wide-bodied jet aircraft and some upgrading has been accomplished in refurbishing older aircraft that were certificated under regulations applicable at that time.

The flight attendants' unions have repeatedly recommended changes to the regulations applicable to cabin interiors, escape systems, emergency equipment, and training to improve the safety of the present and future aircraft fleet.

Last February the Committee on Public Works and Transportation of the House of Representatives held hearings on the "Aircraft Cabin Environment." During this hearing an opportunity was given to the government, operators, and the flight attendants' union representatives to testify.

A number of issues were raised during this hearing, including those associated with flight attendants' training, tie-down of large items in the cabin, protection for flight attendants during deceleration, flammability of cabin interiors and crew uniforms, toxicity and smoke generation during post-crash fires, and adequacy and availability of safety equipment provided for occupant protection.

The FAA has taken an active role in the improvement of cabin safety. Most of the problems presented by the flight attendants or those discussed during the Congressional Hearing in February were considered during the Biennial Airworthiness and Operations Reviews.

In December 1974, the FAA held a Biennial Airworthiness Review during which a number of provisions related to cabin safety were discussed. Following these discussions the FAA issued a number of NPRM's proposing amendments to the FAR's. Four of these NPRM's (75-10, 75-23, 75-26 and 75-31) contained proposed amendments affecting cabin safety. Appendix I contains a list of these proposals. Final amendments have not been promulgated.

During December 1975, discussions were held on the Biennial Operations Review. Appendix II contains a list of cabin safety items which were discussed during the December meeting. Issuance of NPRM's resulting from this review are pending.

A review of the NTSB's aircraft accident data was made to determine the injury potential to the aircraft occupants during various phases of flight. The records disclosed that 566 aircraft accidents occurred from 1966 through 1975 involving U.S. air carrier operations. Thirty-five percent of these accidents occurred in the approach and landing phase of flight. Approach and landing accidents accounted for 55 percent of the 2,262 occupants fatally injured during the 10-year period.

A computer run of the NTSB accident data for the years 1971 through 1975 disclosed that there were 69 accidents involving turbulence. One of these, a fatal accident in 1972, was a training accident involving a wake vortex encounter resulting in the deaths of the four crewmembers --the only occupants of the aircraft. Of the 342 cabin attendants exposed in the remaining 68 turbulence-related accidents, 35 sustained

serious injuries and 35 suffered minor injuries. In these same accidents, 6,601 passengers were aboard. Of these, 53 sustained serious injuries and 144 received minor injuries. This higher rate of flight attendant injuries (20 percent of those on board as compared to only three percent of the passengers exposed) is attributed to the flight attendants performing duties in the cabin or answering passengers' call bells. In these turbulence-related accidents, the statistics show that the seat belt sign was on in 48 cases; in 12, the seat belt sign was not on; and nine were unreported. In most of the 12 cases where the seat belt sign was not on, clear air turbulence was involved.

FAA CABIN SAFETY PROGRAMS

The FAA is engaged in a number of cabin safety programs, including both R&D and operational projects. The purpose of these programs is to enhance cabin safety through the development of improved procedures and standards.

1. Aircraft Cabin Fire Protection

Aircraft accident investigations have disclosed that post-crash fires limit the time available for the aircraft occupant to escape. The fire, smoke and toxic gases have such an incapacitating effect on the occupants that in many instances lives have been lost in an otherwise survivable accident. The complexity of this problem has led the FAA to increase its efforts in R&D projects in this area.

a. Cabin Materials Toxicity

Over the past years, considerable effort has been expended to reduce the flammability of cabin materials. About a year ago a cooperative study of 75 typical cabin materials was initiated by the National Aviation Facilities Experimental Center and the Civil Aeromedical Institute.

NAFEC conducted fire tests on each material to evaluate the products of combustion to determine the quantity of various toxic gases emitted. CAMI on the other hand measured the toxicity by subjecting animals directly to combustion products determining the time to incapacitation and death of the animals.

Efforts in toxicity conducted at NAFEC include:

(1) An in-depth statistical analysis of the comparison between NAFEC toxic measurements and CAMI animal toxicity data.

(2) Identification and quantification of toxic gases which have not previously been identified (the present tests identify and quantify nine selected gases).

(3) Support for the full-scale cabin fire tests.

Based upon previous work, CAMI has determined that the major toxic components in the pyrolysis gases are carbon monoxide (CO) and/or hydrogen cyanide (HCN). Its fiscal year 1977 work in toxicology will be to identify, if possible, those unknown components which may contribute significantly to the inhalation hazard of polymer pyrolysis gases.

b. Full-scale Tests

NAFEC will begin full-scale fire tests at Atlantic City, New Jersey, in fiscal year 1977 with an aircraft test fuselage of similar dimensions to the present wide-bodied jets configured with cabin materials presently installed in civil aircraft. The purpose of these tests is to evaluate compartmentation concepts, correlate the laboratory results with the full-scale fire tests, evaluate fire extinguishing systems, and increase the overall understanding of cabin fires.

c. Development of a Cabin Fire Model

Through contractual effort, FAA is developing a computerized cabin fire model to evaluate fire environment and distribution of gases. The model has now been completed and is being evaluated by the Systems Research and Development Service (ARD). It will be distributed by December 1976 to other FAA organizational units for their use and critique. Through additional contractual arrangements this model will be validated.

d. Development of a Combined Hazard Index

It is FAA's intention to develop a combined hazard index for cabin materials. Under contract, all pertinent research data available will be used to determine the fire characteristics of

various materials. Test methods will be evaluated to determine the various index components for the material.

A combined index, if successfully achieved, would include the flammability, heat flux, smoke and toxic gas emissions, and flashover characteristics of the material. The combination of these characteristics will determine if the material is acceptable. This index can be further developed to explore the feasibility of evaluating combinations of materials.

2. Investigation of Materials and Techniques to Reduce Crash Injury

CAMI is conducting a research program to evaluate the crashworthy performance of seats, restraint systems, and interior cabin configurations by dynamic and static testing to determine their potential for reducing crash injuries. Analytical models will be used in an attempt to analyze the performance demonstrated by these systems. Test methodology and equipment will be developed to enable reproducible test results to be used to evaluate the critical conditions for the systems.

3. Cabin Attendant Training for Air Carrier Operations Inspectors

In order to expose the principal operations inspectors (POI) to modern training methods in the area of cabin safety, a 3-1/2 day course was developed by an airline to provide them with the philosophies behind emergency evacuation procedures. FAA plans hands-on emergency evacuation drills utilizing cabin emergency equipment.

Sixty-four POI's have attended this course at the American Airlines training facilities. It is planned to have all of the air carrier inspectors go through an indoctrination or specialized course during the next three years. The plan is to rotate the courses to other air carrier facilities--not just use the facilities of one carrier.

4. Cabin Emergency Procedures: Problems, Coordination and Training

At CAMI there has been a continuing effort to gather and store human factor information from aircraft accidents, research activities, aircraft service experiences, training, etc. The purpose is to provide a repository for this type of information which is disseminated to air carriers, airplane manufacturers, flight attendant groups, training facilities and government organizations. The information gathered is disseminated through meetings, telephone contacts, letters and

technical papers and reports. The dissemination of this information should effect an overall for research in cabin procedures, improved training methods, and develop methods of informing passengers of regulations, use of equipment, and means of egress in case of an emergency.

5. Development of Flammability Standards for Flight Attendants' Uniforms

Allegations of serious injury and incapacitation have been made with regard to flammability characteristics of flight attendants' uniforms. Under contract with Systems Research and Development Service, the National Bureau of Standards has conducted fire tests on various items of apparel worn by flight attendants. Test results and recommended materials' criteria have been transmitted to Flight Standards Service for its consideration in rule-making action.

6. Development of an Experimental Flight Attendant Fire-protective Overgarment

FAA contracted for the development of a fire-protective overgarment with a protective breathing system capable of being donned in ten seconds. This garment could facilitate the flight attendants' performance of emergency duties during post-crash fire conditions. The prototype garment has been developed and tested. The final report of the test results and films are expected to be completed in early 1977.

This activity could be considered a first step from which further development can be initiated if the concept is found to have merit.

7. Protective Breathing Equipment

An apparent inadequacy was detected in the performance of flight-crew smoke and toxic gas protective equipment by the NTSB in its investigation of passenger and cargo air carrier accidents. An evaluation of all types of smoke goggles and oxygen masks was therefore warranted. CAMI developed a testing method and conducted tests of this equipment utilizing human subjects. From the information obtained in these tests standards were proposed at an FAA industry meeting in December 1975 for the upgrading of the applicable airworthiness and operating rules and the Technical Standard Order.

8. Infant/Child Restraint Systems

At the present time there are no standards for an infant restraint system. CAMI has concluded a series of tests of automotive restraint systems to develop specifications for such systems for civil aircraft. The results of the CAMI tests, which can be made applicable to civil aviation, are being included in a notice of proposed rule making (NPRM) expected to be issued within the next six months.

9. Emergency Evacuation Enhancement

A number of research projects are underway at CAMI to improve the emergency evacuations from civil transport category airplanes. A series of tests will be conducted to evaluate new emergency lighting systems with respect to their potential for guiding passengers to exits in low visibility cabin environmental conditions. Both black and light gray smoke will be utilized. Qualification of light transmissions in both types of smoke will be studied.

The effectiveness of directional auditory signals for emergency evacuations will be evaluated in fiscal year 1977. Comparisons will be made among all of the likely types of speech and nonspeech sounds in order to determine which will be localized successfully in emergency situations and which will be confounding to an untrained person who must select a direction to follow so that he will move quickly to a functional exit.

The escape slides' vulnerability to wind forces will be evaluated by subjecting the deployed slide to various wind velocities and angular directions. The results of these studies will be used to assist manufacturers to enhance slide tolerance to wind.

10. Simulation of Emergency Evacuations

The certification regulations require a demonstration that the transport category airplane can be evacuated in 90 seconds utilizing 50 percent of the available exits. Data has been gathered to develop a computer model to simulate these emergency evacuations without the necessity of using human subjects. When completed, the model will be checked against data obtained during full-scale evacuation demonstrations. This model is intended to serve as an analytical and design aid for emergency evacuation systems.

11. Evaluation and Testing of Single and Multiple Occupant Escape and Flotation Devices

An on-going research project is being conducted at CAMI to evaluate flotation devices. Support of regulatory development, testing, and evaluation of present and new design concepts in flotation devices will be conducted on a periodic basis. Through this effort support data has been developed to assist in the formulation of TSO's applicable to life rafts, slide/rafts, life preservers, and other flotation and sea survival equipment.

12. Seat/Man Dynamic Computer Model

A seat/man model has been developed to evaluate the dynamic seat responses and their effect on occupant injuries. This model is being evaluated by NAFEC. The model will provide an envelope of occupancy response for various types of restraint systems, i.e., seat belt alone and seat belt with various types of upper torso restraints. It will provide acceleration levels for various portions of the body. A follow-on program will be needed to establish physiological limits of accelerations for the various body components to determine human survival.

13. Mathematical Model for Airplane Crash Conditions

Two efforts are being conducted in the development of models for the airplane crash condition. One is for general aviation aircraft and the other is for transport category airplanes.

The general aviation airplane model employs a mass spring approach to determine the magnitude of deceleration forces in the occupiable section of the airplane from initial impact to rest. By interactive analysis techniques, the loads can be shifted to optimize the crashworthiness of the structure. The model and users' manual is now completed and is being reviewed. Evaluation of the model is being conducted by NASA through full-scale crash tests.

The second effort to develop a model for transport category crash conditions is now under development. This model will contain thousands of elements and be much more sophisticated than the one applicable to general aviation. This development is being jointly sponsored by NASA.

14. Air Transportation of Handicapped Persons

Handicapped persons have at times been denied air transportation due to the carriers' rules requiring them to be accompanied by an attendant. The determination as to the physical fitness of the individual to fly has been left to local airline personnel. Rule making has been initiated in this area to define "handicapped" in order to minimize arbitrariness. Evacuation tests have been conducted at CAMI to determine hinderances to passenger flow during evacuations resulting from impared mobility of handicapped passengers. Amendments to Parts 121 and 135, as well as an Advisory Circular to complement the amendments are nearing final development.

In addition, an R&D project has been initiated at CAMI to develop a prototype disabled-passenger seat for feasibility testing to facilitate emergency evacuation of the handicapped.

15. Flight Standards Projects in Cabin Safety

Although many of the aforementioned programs are sponsored by Flight Standards Service, the following projects in cabin safety have been undertaken directly by that Service:

a. Food/Beverage Service Carts in Air Carrier Operations

A project was established to identify specific problem areas with in-service food/beverage service carts relative to their retention/safe operation, including the service items contained therein. Consideration is being given to improved procedures, design and/or additional retention devices to improve their operational use and limit their potential for hazard under all phases of flight.

An initial project report with recommendations was prepared but found to be inconclusive and work is continuing.

b. Review/Evaluation of Air Carrier Flight Attendant Training Programs (Initial, Recurrent, Transition)

As a result of proceedings of Committee 9 of the Biennial Operations Review, and its recommendations, and an NTSB safety recommendation, a project was established to review and evaluate current flight attendant training programs.

Flight Standards Service has reviewed the FAA-approved flight attendant training programs being used by all scheduled air carriers. Although this review revealed compliance with current regulatory requirements, an on-site evaluation of these training programs utilizing three teams composed of headquarters and field air carrier operations inspectors will be accomplished in January 1977.

c. Consideration/Evaluation of Augmenting Amount and Manner of Presentation of Safety Information to Passengers

Accident investigation reports reveal that the majority of passengers are not paying full attention to or retaining safety information presented by flight attendants' briefings or reviewing passenger briefing cards. A concentrated effort is being made to improve the effectiveness of these presentations to the passengers through the use of advanced concepts, e.g., audio-visual means.

An evaluation of a video tape presentation for passengers on board aircraft has been made. It has been determined to be a good means of briefing but is not considered feasible for all carriers. An Advisory Circular on desirable, uniform contents for passenger briefing cards is under consideration.

d. Development of Inspection/Surveillance Procedures for Conducting En Route Cabin Safety Inspections

Background. Flight attendant associations have expressed the opinion that FAA inspectors are unconcerned with and gave minimal attention to cabin attendant en route activities.

Status. A notice has been prepared for early publication containing instructions to all flight standards personnel for observation and reporting on cabin safety matters. These instructions will require:

(1) Air carrier operations inspectors conducting en route inspections to also include a cabin safety inspection using a new report form; and

(2) Headquarters and regional inspector/specialist personnel who are ticketed passengers to note cabin safety items and send a written report of observations to the region having certificate responsibility for the air carrier concerned.

NON-FAA CABIN SAFETY R&D EFFORTS

The major non-FAA R&D effort supporting improved air carrier cabin safety is being carried out by NASA and the three major civilian transport manufacturers. The emphasis of this work is directed at improved crashworthiness and fireworthiness.

NASA is concentrating on developing an upgraded technology base for structural crashworthiness and understanding of fire and its control. It is a long-range program, expecting to yield new advanced fire-resistant materials of low toxicity and smoke emission which can be employed in aircraft interiors, accessory equipment, and crew uniforms. Assisted by NASA and FAA, the industry is looking to the near-term problem of evaluating fire-threat levels and employing optimum materials and extinguishing systems in cabin, galley, cargo bay, lavatory, and unoccupied sections of typical aircraft.

FAA representatives participated in a NASA Fire Research Steering Group to help guide research and technology efforts in practical directions supportive of standards improvement.

RECURRING, PERSISTENT CABIN SAFETY PROBLEMS

During this study organizations and associations representing the aircraft manufacturers and operators, and unions representing the flight-crews and flight attendants, as well as FAA regional offices, were invited to submit written comments and any background data regarding cabin safety problems identified through service or accident experience regarding emergency evacuations and post-crash survivability, cabin safety concerns in the area of aircraft certification and operation, and recommended solution of the identified problems. The testimony developed during the February 1976 Hearings on Aircraft Cabin Environment before the House Subcommittee on Investigations and Review of the Committee on Public Works was reviewed. Additionally, discussions were held with representatives of domestic and some foreign aircraft

manufacturers, air carrier safety and training personnel, and union and association representatives. During travel by personnel assigned to this study, in-flight observations were made of the cabin procedures and discussions pertaining to cabin safety functions were held with the flight attendants on these flights.

The most frequently identified recurring, persistent cabin safety problems as gleaned from the foregoing discussions, reviews and written responses are:

1. Cabin Fire, Smoke and Toxic Gases

   a. One means of reducing death and injuries following a survivable accident is to eliminate the post-crash fire. Methods of reducing the spillage of fuel and the ignition of spilled fuel should be developed.

      The FAA has an active research and development project to provide an additive which introduces anti-misting qualities in the fuel so that in the event of a ruptured fuel tank in the accident sequence the treated fuel will form a course spray which inhibits flame propagation. Due to the complexity of this problem, considerable research effort will be required to perfect this method of fire control.

   b. The predominant cause of death and injury in survivable accidents is from fire, and inhalation of smoke and toxic gases. The installation of improved cabin materials to reduce the flammability and the generation of smoke and toxic gases would result in additional time being available for evacuation of the aircraft in a post-crash fire. Research to improve fire, smoke and toxic gas characteristics of cabin materials should continue to be vigorously pursued.

      The certification requirements applicable to the cabin interior materials is contained in FAR 25.853. Generally, all materials used in the cabin interior are required to be self-extinguishing when subjected to a vertical burn test specified in Appendix F of Part 25.

The FAA, NASA, and industry are conducting investigations of cabin materials in terms of their flammability, smoke, toxicity, and flash propensity to develop technical data to support improved airworthiness regulations. This effort also includes the feasibility of controlling the spread of cabin fires by means of compartmentation curtains and fire extinguishing systems. FAA is also sponsoring a government-industry project which seeks to develop a Combined Fire Hazard Index. The index would consider the hazard contributions of materials flammability, heat flux, smoke, toxicity, and flash fire propensity.

c. Flammability standards for attendants' uniforms are needed so that rules requiring low-flammability material for these uniforms can be promulgated.

The FAA has sponsored an investigation into the flammability characteristics of flight attendants' uniforms. The fire tests were carried out at the National Bureau of Standards. These tests are now completed and the final report is being evaluated. As a result of this effort, flammability standards are being developed for rulemaking consideration.

2. Cabin Interiors

a. Interior seats, galleys, coat closets, and partitions should be dynamically tested as part of the certification process.

There is no requirement for dynamically testing seats, galleys, etc. The FAA has developed a man/seat model and a small aircraft model in order to calculate dynamic responses in the crash sequence. These models are presently being evaluated by FAA and NASA.

b. A method of egress into the cabin should be available to the flightcrew when cockpit doors are jammed.

FAR 121.313(f) requires a lockable door between passenger and pilot compartments to prevent passengers from

entering without the pilot's permission. Accident experience has disclosed that in some instances this door has become jammed thereby preventing the flightcrew access to the passenger compartment. During the 1975 Biennial Operations Review a proposed amendment to this requirement was discussed which would require a means of egress through the jammed door.

c. Improved methods of fire and smoke detection, fire extinguishment and smoke evacuation should be developed and implemented.

A number of accidents have occurred in which hazardous quantities of smoke and toxic gases have incapacitated flight crewmembers, cabin crewmembers and passengers. FAR 25.831(d) requires that if accumulations of hazardous quantities of smoke in the cockpit area are reasonably probable, smoke evacuation must be readily accomplished, starting with full pressurization and without decompressing beyond safe limits.

3. Emergency Equipment Locations

a. In some instances portable oxygen equipment is stored in coat closets and behind the last row of seats where they are covered with carry-on baggage and other articles.

FAR 121.303 specifies that required equipment be approved and installed in accordance with the airworthiness requirements applicable to them. Section 25.1411 requires that the stowage provisions for emergency equipment be such that the equipment is directly accessible, its location is obvious, and protected from inadvertant damage.

b. Megaphones are often stored in locations remote from the flight attendant's station necessitating the attendant to move against the flow of passengers to reach them.

FAR 121.309 requires a portable megaphone on airplanes with seating capacities of more than 60 and less than 100 passengers. Two megaphones are required for airplanes with passenger seating capacities of more than 99. When only one is required it must be in the most rearward location in the passenger cabin where it is readily accessible to the regularly designated flight attendant's seat. However, the Administrator may grant a deviation from this location requirement if he finds a different location more useful for the evacuation of passengers. When two megaphones are required, one is to be installed at the forward end and one at the rearward end of the passenger cabin and be similarly accessible.

4. Flight Attendants' Seating

a. The location of flight attendant seats should be more specifically defined, near floor level exits, with views of the cabin area and the external environment.

FAR 25.785(h) requires cabin attendants' seats to be in the passenger compartment near approved floor level emergency exits. As a result of the discussions at the 1974 Biennial Airworthiness Review, NPRM 75-31 proposed an amendment to this paragraph which, among other things, would require flight attendants' seats to be located to provide a view of the cabin area for which the flight attendant has assigned responsibility.

b. Seat belts and shoulder harnesses should be provided at all flight attendants' seats. The seat belt tie-downs should be so positioned on the flight attendant's jump seat to prevent "submarining" beneath the restraining harness during longitudinal and vertical loads.

Following an Eastern Air Lines B-727 accident at Raleigh-Durham Airport, the NTSB, on June 10, 1976, made two recommendations to the FAA intended to prevent "submarining" below the seat belt during deceleration and

turbulence. A-76-80 recommended that an Airworthiness Directive be issued to relocate the seat belt tie-downs on the forward jump seats on all B-727 airplanes so that the belt would be positioned across the occupant's pelvic girdle. A-76-81 recommended that the jump seats on all other air carrier aircraft be inspected to insure that the seat belt tie-downs are positioned properly and where improper installations are found, they be modified.

As a result of the 1974 Biennial Airworthiness Review, NPRM 75-31 was issued proposing amendments to FAR 25.785(h) and FAR 121.311(f) which would require a shoulder harness for all required flight attendants. The FAA responded to the aforementioned recommendation A-76-80 stating that it concluded that an unsafe condition did not exist and that an AD was not warranted. Additionally, with respect to A-76-81, it stated that the installations on all other airplanes were examined and that the tie-downs are properly positioned and, therefore, no additional action is contemplated.

c. The structural integrity of the flight attendants' seats, including bulkheads to which seats are attached, should exceed the design strength requirements of the structure to which the seat is attached.

FAR 25.785(a) requires that each seat, berth, safety belt, harness and adjacent part of the airplane at each station designated as occupiable during take-off and landing must be designed so that the person making proper use of this equipment will not suffer serious injury in an emergency landing as a result of the inertia forces specified in Section 25.561. No additional rule making addressing this problem is underway.

d. The ratio of passengers to flight attendants should be decreased to insure maximum safety in flight emergency conditions.

FAR 121.391 requires that the air carrier provide flight attendants on all passenger carrying airplanes with more than nine seats in the following proportions: 10 to 50, one flight attendant; 51 to 100, two flight attendants; more than 100 seats, two flight attendants, plus one additional flight attendant for each unit of 50 passenger seats, or part thereof, above 100. During the 1975 Biennial Operations Review it was proposed that the ratio be reduced.

e. The environment of the flight attendant's station should be injury free. All emergency equipment, galley equipment, magazines, etc., in proximity to the cabin attendant should be properly secured during take-offs and landings. Provision should be made to protect the head, neck, and spine while the flight attendant is seated in the seat designed as the assigned duty station.

Protection for the flight attendant while seated is covered in Section 25.785 (see 4c supra). Proposed amendments to 25.785 were discussed during the 1974 Biennial Airworthiness Review. A proposed amendment to 25.785 is contained in NPRM 75-31 to add a new paragraph which would require that each seat be located to minimize the probability of the occupant suffering injury during any operation by being struck by items dislodged in a galley, or from a stowage compartment or service cart. Additionally, NPRM 75-31 contains a proposed amendment to Section 25.785 to require that flight attendants' rearward facing seats have an energy absorbing rest that is designed to support the arms, shoulders, head, and spine.

5. Emergency Equipment

a. The present crash axes are inadequate in modern aircraft and should be replaced with an axe incorporating a pry-bar.

FAR 121.309(e) requires only that each airplane be equipped with a crash axe.

b. All aircraft should be equipped with slide rafts or quick detachable, inflatable slides since most aircraft ditchings or landings in water occur within five miles of the airport.

FAR 121.339 contains the requirements for emergency equipment for extended overwater operations. It requires, among other things, life preservers for each occupant and sufficient life rafts to accommodate all occupants. Section 121.340 requires flotation means within easy reach of each passenger if the airplane is operated over any water. There is no requirement that a slide/raft be installed on all airplanes nor is the inflatable slide required to be easily removable.

c. All aircraft operated over any area of water should be equipped with quick-donning life preservers for all occupants, and stored in a readily accessible location. Underseat locations are not practical due to the probability of blockage by carry-on baggage.

As indicated under b. above, a life preserver is required for each occupant in airplanes operating under FAR 121 in extended overwater operations and a flotation means on all aircraft operating overwater. There is no requirement for life preservers on all flights.

6. Crew Training

Flightcrews and flight attendants, in most instances, receive emergency procedures training separately. Crew coordination and performance would be enhanced if they attended the same emergency training classes and evaluation exercises. Crewmembers should know their respective duties as well as be aware of duties to be performed by others for optimum safety performance.

FAR 121.417 lists the subject which must be covered for each crewmember's emergency training. There are no requirements that the flightcrews and flight attendants receive emergency training together.

7. Galley Equipment

a. Concern was expressed regarding the security of the galley equipment. In many aircraft the latching systems are defective and will not hold the units in position during deceleration. Some secondary latches are as poorly designed or maintained as the primary latches.

FAR 25.787 requires that stowage compartments be designed to retain their contents up to the placarded maximum weight under maximum specified flight and ground loads and the emergency landing conditions specified in Section 25.561(b). There also must be a means to prevent the contents in the compartment from becoming a hazard by shifting under these same loads.

Following the 1974 Biennial Airworthiness Review it was proposed in NPRM 75-31 to clarify this latter provision of Section 25.787 to require that for internal storage compartments, if the means used for security is a latched door, it must be shown that the unwarranted opening of the door must be extremely improbable, taking into consideration the wear and deterioration expected in service. It was also proposed in NPRM 75-26 to amend FAR 25.789 which would require a means to prevent the hazardous shifting of items of mass in the galley, when subjected to the appropriate maximum load factors corresponding to the specified flight and ground load conditions and to the emergency landing conditions. Additionally, it would require the installation of a placard indicating its maximum load on galley compartments to avoid inadvertant overloading.

FAR 121.576 requires that means be provided to prevent each item of galley equipment and servicing carts, while not in use, from becoming a hazard by shifting under loads corresponding to the emergency landing conditions under which the airplane was certificated.

During the 1975 Biennial Operations Review extensive expansion of this provision was discussed. It was proposed, among other things, that the compartments be retained

under higher loads, the load capacity and distribution with the compartments be determined and so placarded, the strength of the structure to which the compartment is attached be increased, the compartment may not restrict access to emergency exits or obscure the seat belt sign from view.

b. Insufficient storage space is provided for the trash and disposable refuse. In many instances refuse is placed in bags and placed in front of emergency exits in the galley area. This could hamper the flow of passengers in an emergency evacuation.

There are no specific regulations dealing with this subject and no regulatory action is underway. There is, however, a general provision that all items of mass within the passenger compartment be secured for take-off and landing.

c. The galley floors are often slippery due to the spillage of beverages, ice cubes, leakage, and entry of rain during ground services.

Following discussions at the 1974 Biennial Airworthiness Review a recommendation was issued in NPRM 75-31 to add a new section 25.793 pertaining to floor surface. This section would require floor surface areas which are likely to become wet to have slip-resistant properties. If this proposal is adopted, it would apply only to newly type certificated airplanes. A similar provision has neither been proposed nor included in FAR Part 121.

8. Communications

a. There should be improved coordination between flightcrew and flight attendants. The flightcrew should be advised when all cabin pre-takeoff duties are complete; the flight attendants should be advised of the intended takeoff, or anticipated turbulence en route, and final approach for landing in sufficient time to enable them to properly secure themselves at the duty stations; and the flightcrew should be advised when the cabin is secured for landing.

There are no specific regulations applicable to crew coordination for these purposes. The crew communication practices vary among airlines and are a matter of individual air carrier operating procedure. FAR 121.319 provides for a crewmember interphone system on all airplanes with a capacity of more than 19 passengers. During the 1975 Biennial Operations Review, a proposal was discussed to require an interphone in all occupiable compartments to facilitate communications between flight and cabin crews.

b. Passengers are not attentive to the emergency oral briefing and demonstration conducted by the flight attendants prior to take-off.

FAR 121.571 and FAR 121.573 require that passengers be briefed before take-off and for extended overwater flight. During the 1975 Biennial Operations Review there were a number of recommended changes to these requirements which were intended to improve the overall passenger briefings. These are being considered for dissemination as an NPRM. Additionally, the FAA is evaluating an audio visual presentation of passenger briefings to determine its acceptance and the passengers' responsiveness.

c. Microphones and public address systems are not consistently of a quality to insure that the message is understandable by the passengers.

Public address systems are required by FAR 121.318 to be installed and be audible at each passenger's and flight attendant's seat and in each lavatory. FAA considers FAR 121.318 to be adequate.

d. On certain model aircraft the master minimum equipment lists (MMEL) do not require an operable public address system which negates the provisions of Section 121.318 of the FAR's. This was also pointed out in NTSB Recommendation A-76-120 issued on August 13, 1976. On October 6, 1976, the FAA replied to NTSB that it had taken action to standardize the MMEL's of those aircraft which the NTSB had identified as inconsistent with respect to public address system requirements.

9. Handicapped Passengers

Airline personnel have to make decisions with respect to the identification of the handicapped, since no standard definition has been established by the FAA.

The FAA has rule-making in progress regarding the carriage of the handicapped. Amendments to FAR 121 and 135, as well as an Advisory Circular to compliment the amendments, have been drafted and are in the final rule-making process.

10. Flight and Duty Time Limitations

Flight attendants contend that the FAA should establish and promulgate flight and duty time limitations regulations applicable to required flight attendants.

There are no requirements limiting the flight time or duty time permitted for flight attendants. During the 1975 Biennial Operations Review a number of recommendations were discussed pertaining to the establishment of such limitations.

11. Carry-on Baggage

a. Passengers often carry baggage and packages aboard aircraft which cannot be properly stowed under the seat or in the overhead compartment. The flight attendant is then faced with the problem of finding an acceptable place to stow the oversized carry-on baggage, or request that it be removed from the passenger compartment and handled as checked baggage.

FAR 121.589(a) requires the air carrier to stow carry-on baggage in a suitable baggage or cargo stowage compartment or under a passenger seat. During the 1975 Biennial Operations Review a proposal was made to amend this regulation to require preboarding surveillance of cabin baggage and restrict stowage in areas containing emergency equipment.

b. Stowage of carry-on baggage under the aisle seat is not restrained from lateral loads on most aircraft.

FAR 121.589(c) requires that each passenger seat, under which baggage is permitted to be stowed, be fitted with a means to prevent the baggage stowed under it from sliding forward under crash impacts severe enough to induce the ultimate inertia forces specified in Part 25 of the FAR's or in the emergency landing conditions specified in the regulations under which the aircraft was type certificated. During the Operations Biennial Review a proposed amendment was discussed to protect against side loads during crash impacts.

12. Limiting Alcoholic Beverage Service

Flight attendants support a limit of two drinks per passenger per flight segment and limiting the service on the ground to periods of at least one-hour duration.

FAR 121.575 restricts the service of alcoholic beverage to that served by the operator and forbids the service to persons appearing intoxicated, a prisoner or his escort, or a person who has a deadly or dangerous weapon accessible to him while aboard the airplane. Additionally, the air carrier may not allow any person on board any of its aircraft if that person appears to be intoxicated.

13. Passenger Service

Flight attendants are proponents of limiting alcoholic beverage service to flights exceeding 45 minutes. Also they advocate that food service on flights 45 minutes or less should consist of no more than a simple snack. Their contention is that on the shorter flights, passenger service workload demands upon flight attendants detracts substantially from their capacity to perform their routine safety duties notwithstanding the effect upon the safety performance in the event of an in-flight emergency or an emergency requiring evacuation as could occur during landing or the approach to a landing. On flights of 90 minutes or less, food service should be limited to a simple meal utilizing pre-set tray service. Furthermore, that beverage and meal service should be discontinued when such service or in-flight conditions may endanger the safety of the occupants.

FAR 121.577 is the only provision applicable to food and beverage service. This regulation restricts the food, beverage and tableware from being located at any passenger's seat during take-off or landing.

SUMMARY AND CONCLUSIONS

The in-flight safety of occupants of air carrier airplanes, provisions for their survivability in survivable accidents, and the capability, readiness, and performance of crewmembers to function effectively under the stress of emergency conditions in flight and after an accident has been and continues to be a safety issue. Different perspectives of cabin safety by the various, affected responsible organizations results in various contentions on the acceptability of the level of safety actually provided.

Nineteen selected survivable accidents investigated and reported by the NTSB, 1968-1975, have stressed the need for cabin safety improvements to minimize occupant injury and to maximize occupant survivability. This need has been further substantiated by three special studies conducted by the NTSB, 1972-1976, and by approximately 100 NTSB Safety Recommendations, 1962-1976.

Cabin safety in air carrier passenger carrying operations was the subject of numerous proposals considered at the FAA Airworthiness and Operations Biennial Reviews.

The flight attendant organizations have alleged that FAA has been deficient in fulfilling the agency's obligation for providing an adequate level of safety for air carrier airplane occupants during flight and for their survivability following an accident.

The foregoing was highlighted in hearings conducted on February 3, 4 and 5, 1976, by the Subcommittee on Investigations and Review of the Committee on Public Works and Transportation, House of Representatives, 94th Congress.

The FAA's cabin safety program and overall safety goals presented by the Administrator in testimony at the hearing were stated, in part, as follows:

> "The basic goal of the FAA is and has to continue to be the prevention of accidents. Unfortunately, in both experience and reason, they tell us that accidents will continue to happen. The FAA fully recognizes the complementary goal

of achieving aircraft crashworthiness, and by this term we mean increasing the ability of the aircraft and its passengers and crew to survive an accident and an accident's aftermath.

"The concept of crashworthiness has two basic components: First, the design of the aircraft itself, and second, the operational procedures utilized when we are involved in an accident. It is my intention as Administrator of the FAA to see that all of our activities in these two areas are vigorously pursued.

. . .

"We want to maintain a continuing dialogue in the common interest of flight safety. As stated before, proper answers come only from properly identified problems. Identification of problems can be one of the valuable products of this hearing.

". . . I am sure that this hearing will add to the FAA's knowledge and understanding of the problems associated with cabin safety.

". . . all suggestions we receive will be studied . . . and considered on their own merits. That is the only policy consistent with our statutory responsibility.

". . . Some of our actions have been slower in coming about than we might have wished, but we are working on speeding up our responsiveness and our process.

"When immediate action is necessary, we will take it. We know that when we have taken actions the actions have not always met with universal approval; but the FAA can not consider only a single point of view. Competing interests always affect our regulatory program. Technology, cost-effectiveness and the pure safety interests are always at odds. The FAA must balance these elements in arriving at our final product.

> "Applications of technology which do not substantially increase safety may not be warranted. Developing equipment that is prohibitively expensive is a poor use of our resources. We do not want to overregulate, but when Federal regulations are needed, we will not hesitate to issue them."

FAA was responsive to specific cabin safety issues of concern to the Committee (see Appendix VIII).

A broad range of regulatory proposals in the cabin safety area have been brought before the aviation industry and the public for discussion in the Airworthiness and Operations Biennial Review Conferences. Many of these proposals continue to be under study for a determination of their feasibility for resolution of the particular safety issue and for the appropriateness of implementation by rule making.

The FAA's safety-related engineering and development program includes 22 basic activity areas aimed at reducing fatal accidents; five for reducing fatalities after accidents, and three pertain to reducing chances of explosions and fires in flight. R&D projects for reducing fatalities after accidents seek improvement in chances of survival by developing methods and criteria to improve aircraft crashworthiness, reduce fatalities due to toxic fumes, improve fire extinguishing procedures, and modify fuel to reduce the chance of fire.

FAA's aeromedical research activities include continuing studies on protection and survival of passengers and aircrew. The objectives are to increase the probability of survival and avoidance of injuries resulting from aircraft accidents.

Objectives of on-going aeromedical studies include:

> Development of criteria for the use of materials in aircraft cabins which would reduce toxic hazards in the event of fire.
>
> Development and evaluation of better crash protection equipment and structure.
>
> Development and evaluation of improved means of escape and survival after an accident.

The FAA cabin safety programs of the Flight Standards Service, Systems Research and Development Service, National Aviation Facilities Experimental Center, and the Civil Aeromedical Institute were reviewed at an FAA-Industry Meeting in Oklahoma City on August 31, 1976 (see Appendices III and IV).

These cabin safety programs and the regulatory considerations emanating from the Biennial Regulatory Reviews are comprehensive in scope with significant safety objectives.

The long-term outcome of the research and development projects and of the aeromedical projects and studies are promising of results that can be applied beneficially towards upgrading cabin safety.

Presently, however, there is a need to reassess the effectiveness of provisions for the safety of occupants aboard air carrier airplanes, the adequacy of procedures, emergency equipment, the crash protection provided flight attendants, the capability and readiness of flight attendants in coordination with the flightcrew to function effectively as a team in directing and conducting an evacuation of an aircraft in a survivable accident.

There are additional aeromedical areas in need of study and research relative to safety concerns that have been posed by flight attendants.

The current FAA cabin safety research, regulatory, and inspection programs notwithstanding, there are cabin safety issues of long standing that have not been fully reconciled. Although actions have been taken with the objective of controlling the problem or hazard involved, such actions have not fulfilled that objective. This aspect of the survey is discussed under Recurring, Persistent Cabin Safety Problems on page 14 of this report.

The role of the air carrier inspector is basically one of determining compliance with the regulations in force, a task performed with excellence. If compliance with the regulation is found to be satisfactory, usually the task is deemed to be completed.

But in the event of an accident or incident, his duty is broadened to include a determination of the adequacy of applicable regulations. It is that aspect of the inspector's role that should be stressed as an inherent element of the inspection function, that is, inspect for compliance but additionally, assess the adequacy of the regulation.

Flight attendants are required as crewmembers on air carrier passenger carrying flights although a majority of their time in flight is devoted to in-flight passenger service. Their safety function and performance should therefore receive FAA inspection attention in an equitable balance with that given to the flightcrew.

Flight attendants in the typical airline organization do not report organizationally to the Flight Operations Department; an exception to this was found during the survey wherein the flight attendants were organizationally under flight operations. In that instance, there was a reasonable communications channel for flight attendants to communicate their safety interests and concerns.

Cabin safety exhibits the greatest potential for safety productivity in reducing in-flight injuries and in increasing survivability following accidents wherein the impact forces, aircraft structural breakup, and fire that is likely to occur following the crash, permit passenger and crew evacuation.

Therefore, cabin safety should be distinguished as a separate safety program in headquarters and in the regions, supervised and carried out as an integral part of the FAA's total air carrier safety program. The FAA Central Region's Cabin Safety Inspection Program is designed and being carried out in a manner that achieves the intent of these objectives.

Similarly, air carrier management should bring greater distinction to cabin safety through improved communications between flight attendants and flight operations departments, through increased emphasis on the safety function and performance thereof by flight attendants and assuring that in-flight service functions do not detract from the safety duties and readiness to perform those duties assigned to flight attendants.

Passenger attitudes for their personal safety is a matter of concern to flight attendants and one deserving of more attention by FAA and industry if the optimum in injury minimization and maximization of passenger survival is to be realized.

During the course of the survey of cabin safety total crew coordination was of prime interest in the observations made of cabin safety from the passenger compartment of several air carriers.

Typically, the cabin crew was advised through the public address system to prepare for takeoff or landing. During these flights no turbulence of any consequence was encountered. Flight attendants were interviewed regarding whether or not in cases of turbulence encounters, while engaged with in-flight passenger services when the seat belt sign is "on," they are instructed by the Captain to discontinue service, secure equipment, and take seats and secure themselves with seat belts and shoulder harness as provided.

Flight attendants interviewed indicated that it was their responsibility to decide when to discontinue in-flight passenger service in the interest of their own personal safety. One flight attendant stated that on one occasion that option had been exercised. One flight attendant recalled an instance where the Captain had directed discontinuance of in-flight passenger service in the interest of safety for the cabin crew.

Another aspect of crew coordination reviewed with flight attendants was preflight coordination between the Captain and the lead cabin attendant when so designated. Observations and interviews indicated no common practice. In some instances the cabin crew performed their preflight duties without any communication with the flightcrew regarding readiness for the flight. In a few instances, the lead flight attendant reported to the Captain on the state of readiness of the cabin for the flight before the Captain initiated aircraft movement from the passenger loading position.

In view of the pilot-in-command responsibility, during flight time, for the safety of passengers and crewmembers, that pilot-in-command should assure that the cabin crew have completed their required safety duties as appropriate for each phase of flight, that the cabin is prepared and appropriately stationed for takeoff or landing, and should be continuously aware of and assess flight conditions with respect to the safety of the cabin crew as well as the passengers. When in the

judgment of the pilot-in-command, flight attendants should be seated and secured, he should exercise that responsibility with conservatism favoring the safety of the cabin crew.

Since the primary safety requirement for flight attendants is to provide for the most effective egress of passengers in the event of an emergency evacuation, it is imperative that they be protected from injury during flight and that they are continually available, capable, and ready to perform their assigned duties when and as required.

The demands of in-flight passenger service was observed on some flights of 1-1/2 hours or less to require flight attendants' attention during taxiing up to the point of beginning the take-off roll and during en route flight that involved them until the aircraft was on its final approach for landing. In some instances, flight attendants were hastily securing galley equipment during the final approach and were unable to become secured at their designated duty stations with ample time to assure proper security of seat belts and shoulder harnesses. In such circumstances, there was little or no time for the flight attendant to make a mental review of duties to be carried out in the event of an accident requiring an emergency evacuation of passengers.

NTSB aircraft accident files, reports, and computerized data were reviewed for the purpose of learning about problems associated with in-flight emergencies, passenger evacuation, and crashworthiness aspects of survivable accidents.

Accident investigations should produce an organized data source to facilitate the identification of cabin safety problems. However, the cases reviewed and data supplied by the NTSB were deficient for purposes of compiling a uniform mass of data common to cabin safety aspects of survivable accidents. A requirement for collecting specific cabin safety data from all investigations of accidents wherein cabin safety equipment, procedures, passenger evacuation, passenger and crew injuries or incapacitation, aircraft structural breakup, the occurrence of fire, in-flight or post-crash, and the conditions and surrounding circumstances could improve the understanding and more definitive description of cabin safety problems and thereby enable the formulation of definitive solutions to those more clearly defined problems.

Moreover, similarly organized data should be obtained from incidents in which it was necessary to evacuate passengers. For example, a passenger evacuation incident involving American Airlines Flight 463, Boeing 727, October 11, 1975, at Dulles International Airport occurred as a consequence of a jammed nose gear. The incident investigation files of NTSB and FAA were reviewed. Neither was useful other than to indicate that the evacuation was completed as required and without injuries to passengers or crew. The systematic investigation of such successes could be productive in evaluating equipment, procedures, and crew performance in more adverse but likely circumstances; to validate the adequacy of existing safety requirements; or to lead to further strengthening of requirements under different but likely conditions and circumstances.

Informing the air traveling public of the equipment, procedures and provisions for their safety when aboard U. S. air carrier aircraft is well publicized by most airlines in the company published magazines provided to passengers and also indicated on emergency briefing cards at each passenger's seat. Some airlines include summary information on passenger safety on ticket jackets. One topic is not adequately publicized is one of dangerous articles that are prohibited from carriage in passenger luggage. The FAA issued a news release June 22, 1976, advising that a new regulation (49 CFR 173.176(g)) prohibited, carrying of loose book matches in luggage, among other hazardous materials. The news release pointed out that a violator is subject to a fine of up to $10,000.00. FAA posters to caution passengers on these prohibitions distributed for airline display were seen at some ticket counters during this survey.

Flight attendant initial and recurrent training programs were reviewed at carriers' training facilities. The quality of facilities and skills of instructors vary upward to a high degree of excellence for the larger carriers. Some flight attendants interviewed expressed the view that recurrent training was elementary and was little more than a session to satisfy the regulatory requirement. One recurrent training session observed during this survey attested that point. In that instance, the instruction that was provided was presented by one of the flight attendants who did not exhibit the skills of a classroom instructor. All instruction required for initial as well as recurrent training should be presented by a person skilled in classroom instructing.

How to treat in-flight injuries and incapacitation of passengers or crew, how to cope with unruly passengers, and how to cope with passenger panic during emergencies were areas many of the flight attendants interviewed were desirous of becoming better informed and skilled so that they could meet such situations confidently and professionally. Increased training emphasis on these areas would be in keeping with the safety function that flight attendants are expected ro fulfill.

The secure stowage of carry-on baggage and overloading of overhead baggage storage bins continues to be a matter of concern to flight attendants.

Some airlines do an effective job of screening oversize carry-on items to avoid imposing the burden upon the flight attendant aboard the airplane. Otherwise the problem is left with the flight attendant to reject the carry-on items or to improvise for stowage in the passenger compartment. Better control of carry-on baggage before the passenger boards the airplane would reduce and could eliminate the hazard of scattered luggage and its impedance to passenger evacuation and the injury producing potential during in-flight turbulence, hard landings, and crashes.

Communication with passengers, whether for required pre-takeoff oral briefings during flight or preparation for and during an emergency evacuation, is essential to successful performance of flight attendants' safety role.

Several airplanes of the flights observed during this survey exhibited a low quality fidelity of public address system communications by flight attendants as well as from the flight deck. With large numbers of passengers that can be aboard wide-bodied jet airplanes, a means of clear, audible voice communication approaches the point of being a critical safety requirement to be satisfied and assured before flight.

Many of the foregoing topics were iterated by attendees at the Administrator's Flight Attendant Listening Session, September 21, 1976, in San Francisco (see Appendix IX).

The recommendations that follow are premised upon the results of this survey. These recommendations address areas for improving the FAA's fulfillment of its safety mission with respect to cabin safety.

RECOMMENDATIONS

1. Flight Standards Service identify pending regulatory projects pertaining to the Recurring, Persistent Cabin Safety Problems discussed in this report, pages 14-26, and proceed on a priority basis with rule-making action relative to those problems. Furthermore, concentrate inspection and surveillance on such of those problems not subject to regulatory action to prevent their recurrence.

2. Elevate agency priority to expedite the completion of FAA cabin safety and crashworthiness R&D projects identified in this report, pages 6-14. Systems Research and Development Service and Flight Standards Service should continue to jointly determine the priority and requirements of cabin safety/crashworthiness research projects to be carried out by Systems Research and Development Service.

3. Elevate agency priority to expedite the completion of FAA aeromedical cabin safety projects identified in this report, pages 6-14. Office of Aviation Medicine and Flight Standards Service should continue to jointly determine the priority and requirements of cabin safety research projects carried out by the Office of Aviation Medicine when these projects are programmed independently of Systems Research and Development Service.

4. Flight Standards Service review inspection and surveillance practices to assure that air carrier inspectors not only inspect for compliance but evaluate operating conditions for compatibility with safety objectives of regulations.

5. Flight Standards Service and its regional counterpart should provide program identity to cabin safety and assign responsibility for the execution of the program.

6. Flight Standards Service should encourage air carrier management to provide an organizational structure for flight attendants which takes cognizance of the relationship of the flight attendant safety function as an activity within the carrier's flight operations department.

7. Office of Aviation Medicine, in coordination with Flight Standards Service, undertake a project to determine a more effective means for enhancing passenger awareness to required before-takeoff briefings.

8. Flight Standards Service encourage air carrier pilots-in-command to be more aware of safety for flight attendants and to promote better coordination and communication between flight deck crewmembers and flight attendants.

9. Flight Standards Service require through regulation or operating specifications that flight attendants perform no passenger food and beverage service duties while the aircraft is taxiing and for a specified time period following take off and preceding landing.

10. Flight Standards Service, in coordination with the NTSB, develop a system for uniform data collection relative to cabin safety and crashworthiness in the investigation of accidents and incidents.

11. Flight Standards Service encourage airline management to publicize information that should be made known to passengers regarding articles that are prohibited by regulation from carriage in passenger luggage.

12. Flight Standards Service re-evaluate the adequacy of regulatory requirements for flight attendant recurrent training in terms of maintaining their proficiency level at or above that attained in initial training in addition to upgrading proficiency consistent with changing safety demands of their duties.

13. Flight Standards Service encourage all air carriers to be more effective in segregating carry-on baggage to ensure suitability for safe stowage on board the aircraft.

14. Flight Standards Service conduct an air carrier-wide campaign to assure that aircraft public address systems adequately serve all areas of the cabin occupiable by passengers taking into account ambient noise conditions.

15. Office of Aviation Medicine, in coordination with Flight Standards Service, conduct a cabin environmental study of air carrier aircraft regarding the hazards of cosmic radiation, ozone, humidity and noise as such pertains to passenger and crew safety and flight attendant performance.

16. Office of Aviation Medicine, in coordination with Flight Standards Service, develop guidance for air carriers on the scope and extent of first aid training for flight attendants.

17. Office of Aviation Safety be provided with one position for a human factors specialist/aerospace engineer to exercise an overview function for the agency's cabin safety program and other human engineering safety functions.

A SURVEY OF AIR CARRIER CABIN SAFETY

APPENDICES

A SUMMARY OF THE PROPOSED PARTS 25 AND 121 AMENDMENTS THAT DEAL WITH CABIN SAFETY IN AIRWORTHINESS REVIEW PROGRAM NOTICE NOS. 2(75-10), 5(75-23), 7-(75-26), AND 8(75-31)

Proposal Number	Source	FAR Section	FAR Section Title, and Substance of Proposal
2-60	FAA	25.785	Seats, berths, safety belts, and harnesses. The proposed amendment would correct a problem that has arisen because the intended use of forward observer seats was not taken into account during certification.
2-62	FAA	25.815	Width of aisle. The proposed amendment would recognize the FAA practice with regard to approving narrower aisles when tests satisfy the Administrator that they are safe.
2-63	FAA	25.831	Ventilation. The proposal would revise the current rule requiring independent controls on all transport aircraft to permit the use of common controls under the specified conditions.
2-64	NTSB AIA	25.841	Pressurized cabins. The proposed rule would require design considerations to account for possible significant differences in decompression ratio in separate occupied areas of airplanes.
2-91	FAA	25.1439	Protective breathing equipment. The proposed change would require protective breathing equipment for crewmembers expected in isolated areas.
2-212	AIA	121.331	Supplemental oxygen requirements for pressurized cabin airplanes: reciprocating engine powered airplanes.
		121.333	Supplemental oxygen for emergency descent and for first aid; turbine engine powered airplanes with pressurized cabins. The proposed amendment would clarify the required oxygen quantities.
2-213	NTSB	121.337	Protective breathing equipment for the flight crew. The proposed rule would require that certain airplanes operated under Part 121 have installed protective breathing equipment for crewmembers expected in isolated areas.

5-20	ALPA	25.831	Ventilation. The proposed amendment would require independent supply and control of ventilating air in crewmember compartments.
5-31	FAA	25.1421	Megaphones. The proposed amendment would require the installation of megaphones to withstand emergency landing loads, and would require the marking of megaphone stowage compartments.
5-34	AIA FAA	25.1447	Equipment standards for oxygen dispensing units The proposed amendment would establish the basis for approving oxygen dispensing units.
5-35	FAA	25.1450	Chemical Oxygen Generators - The proposed amendment would require that the chemical oxygen generators be disigned and installed in accordance with specified safety standards derived from service experience.
5-68	FAA AIA	121.337	Protective breathing equipment for the flight crew. The proposed amendment would require that protective breathing equipment be fitted to each crewmember for whom it must be provided under Section 121.337(a).
7-25	JAR Comm FAA	25.561	General. The purpose of the amendment is to establish needed structural crashworthiness requirements for airplanes having a passenger deck below main deck level that may be occupied during takeoff and landing.
7-26	FAA	25.563	Structural ditching provisions. The purpose of the amendment is to establish structural ditching capability requirements for airplanes with passenger deck located below main deck level that may be occupied during takeoff and landing.
7-38	ALPA S&S Div.	25.789	Retention of items of mass in passenger and crew compartment and galleys. The change would require placards on galley components so as to minimize their inadvertent overloading and failure.
7-39	NTSB	25.802	Evacuation alarm system. The proposed change would establish standards for evacuation alarm systems and to require their installation in airplanes operated under Part 121.
7-40	ATA	25.803	Emergency evacuation. The proposed amendment would allow means other than actual demonstration to be used to comply with emergency evacuation performance.

7-41	ALPA S&S Div FAA	25.807	Passenger emergency exits. The proposed amendment would establish the passenger emergency exit requirements for multi-deck airplanes.
7-42	FAA	25.809	Emergency exit arrangement. The proposed amendment would establish wind condition criteria to be accounted for in the evaluation of evacuation slide installation and to provide improved escape slide performance.
7-43	NTSB	25.812	Emergency exit marking. The proposed amendment would clarify the current rule for clear indication of how far the exit handle must be moved to release the locking mechanism and for self illumination of handle.
7-44	NTSB FAA	25.812	Emergency lighting. The proposed amendment would establish a requirement for all Part 25 airplanes that the emergency lighting system be operable from a point in passenger compartment.
7-45	FAA	25.813	Emergency exit access. The proposed amendment would clarify the rule with respect to whether the projected opening in the aircraft fuselage or the space through which the exit door passes in removing the door from the exit.
7-46	ALPA	25.831	Ventilation. The proposed amendment would amend the existing rule to extend the requirements of Sections 25.831(a) and (b) to galley and passenger areas.
7-49	ALPA S&S Div. FAA	25.1411	General. The proposed amendment would require that standard emergency equipment be readily accessible to the seated flight attendant.
7-50	FAA	25.1413	Safety belts. The proposal would broaden the rated strength requirements for safety belts and harnesses to include consideration of experted service loads as well as the ultimate load factors specified in Section 25.561(b).
7-51	FAA	25.1415	Ditching equipment. The proposal would require that rafts either be portable, a condition that now exists throughout the industry, or non-portable in which case additional rafts must be provided.
7-53	FAA	25.1423	Intercommunication equipment. The proposal would establish needed intercommunication equipment requirements for multi-deck airplanes.

7-54	ALPA S&S Div.	25.1561	Safety equipment. The proposed amendment would improve the removal of safety equipment.
7-78	AIA	121.291	Demonstration of emergency evacuation procedures. The purpose is to relocate the evacuation performance requirements. This would require the manufacturer to demonstrate the design in accordance with the similar evacuation conditions as the aircraft operators must now demonstrate their emergency procedures.
7-79	NTSB	121.292	Emergency alarm system. The proposed amendment would require an evacuation alarm system that meets the requirements of Section 25.802.
7-80	ATA	121.309	Emergency equipment. The proposed amendment would require that standard emergency equipment be readily accessible to the seated flight attendant.
7-81	NTSB	121.310	Additional emergency equipment. The proposed amendment would make the emergency evacuation slide requirements effective for existing aircraft two years after the date of the amendment.
7-82	ALPA	121.319	Crewmember interphone system. The proposal clarifies present rule by specifically requiring interphone terminals in all galleys and other flight attendant stations.
7-83	FAA	121.339	Emergency equipment for extended overwater operation. The proposed amendment would provide for the loss of one raft of the largest rated capacity, whereas the current rule only requires rafts of rated capacities to accommodate all occupants of the airplane.
7-84	ATA FAA	Part 25	Part 25 - Appendix D. The purpose is to relocate the evacuation performance requirements. This would erequire the manufacturer to demonstrate the design in accordance with the similar evacuation conditions as the aircraft operator must now demonstrate their emergency procedures.
8-30	NTSB ALPA FAA	25.365	Pressurized cabin loads. The proposed amendment would require the pressurized cabin structure to withstand explosive decompression.

8-31	FAA	25.633	Essential systems. The purpose of this proposal is to improve the aircraft's capability for safe flight and landing after the detonation of an explosive device.
8-35	NTSB	25.783	Doors. The proposed amendment would improve the reliability of non-plug type doors, and improve the standards for airplanes having such doors.
8-36	NTSB ALPA S&S Div. JAR Comm. FAA	25.785	Seats, berths, safety belts and harnesses. The proposed amendment would require a combination safety belt and shoulder harness at flight deck station and flight attendant seat in the passenger compartment.
8-37	FAA	25.787	Stowage compartments. The proposed amendment would clarify Section 25.787(b) to include all latched doors on internal stowage compartments.
8-38	NTSB	25.792	Passenger information signs: Lavatory occupancy. The proposal would require that a sign be provided to inform the passenger when lavatories are occupied.
8-39	FAA	25.793	Floor surfaces. The proposed amendment would improve the standards which may become wet in service.
8-40	FAA	25.819	Lower deck service compartments. The proposed amendment would establish the seating, communication, lighting, personnel safety, and emergency evacuation requirements.
8-41	AIA	25.851	Fire extinguishers. The proposed amendment would consolidate the hand fire extinguisher requirements in one section.
8-42	NTSB AIA FAA	25.853	Compartment interiors. The proposed amendment would require that all lavatories to be placarded against smoking.
8-51	AIA	25.1307	Miscellaneous equipment. The proposed amendment would make this section consistent with the proposed Section 25.851.
8-53	FAA	15.1421	Cargo compartment fire detection systems. The proposed amendment would define the requirements for cargo compartment fire detection systems.

8-54	NTSB	25.1439	Protective breathing equipment. The proposed amendment would relocate and clarify the portable oxygen requirement.
8-117	NTSB FAA	121.311	Seats, safety belts, and shoulder harnesses. The proposal would require after one year that each flight crewmember be able to perform his assigned duties with a confined safety belt and shoulder harness fastened. Since no shoulder harness is presently required, a new seat and combination safety belt and shoulder harness would be required.
8-118	ATA FAA	121.312	Materials for compartment interiors. The proposal would establish a date for compliance with the self-extinguishing and fireproof compartment interior material requirements.
8-120	NTSB	121.337	Protective breathing equipment for the crew. The proposal would require all airplanes operated under Part 121 to meet new standards proposed for Section 25.1439.

PROPOSALS SUBMITTED FOR BIENNIAL OPERATIONS REVIEW PROGRAM

Proposal No.	FAR	
1	25.772	Pilot Compartment Doors - Should provide egress if jammed so crew can assist passengers.
2	25.791	Seat and Safety Belts: Passenger Information - Amend present seat belt sign to read "Fasten Seat Belt While Seated." Passengers would have to have seat belt on except when going to rest room. They could not roam about cabin.
3	25.809	Emergency Exit Arrangement - Length of slide be sufficient so that angle to ground would be safe.
4	25.812	Emergency Lighting - Exterior emergency lighting must be activated upon operation of the emergency light system.
159	91	Shoulder Harness - Require that shoulder harness be installed and used on all light airplanes.
319	91.189	Survival Equipment for Overwater Operations - Additional requirements for liferafts in overwater operations.
320	91.189	Survival Equipment for Overwater Operations - Require lifeline even when operating under Part 91 as under 121.
322	91.193(d)	Emergency Equipment, Large and Turbine Powered Multiengine Airplanes - Require first-aid kits except in airplanes under 12,500 lb. G. W.

Proposal No.	FAR	
323	91.193(e)	Emergency Equipment - Each aircraft, regardless of size, be equipped with a fire axe.
324	91.201(g)	Underseat Baggage Restraint - Require that the restraint be of sufficient strength that baggage will not slide forward or sideward in a crash (25.561(b)).
325	91.201, 91.203	Carry-on Baggage and Carriage of Cargo - Not permit passenger to stow his own baggage oh any aircraft with a capacity of 5 or more.
782	135.117	Carriage Cargo - Require approved tie-down and restraints that meet FAA requirements.
783	135.117(c) (2) & (5)	Carriage of Cargo - Packaged or covered to avoid injury to passengers or crewmembers.
345	121 V	Emergency Evacuation Slide System - To require maintenance program to insure reliability of slides.
346	121 New	Require report on all evacuation slide deployments failures/malfunctions.
347	121	Consolidate all Part 121 rules pertaining to passengers.
389	121.163	Amend this part to exclude flight attendants on aircraft proving flights.
410	121.215	Cabin Interiors - To incorporate wording in 25.853(d) in Part 121.215.
411	121.215	Cabin Interiors - Test interior fabrics at specified intervals.
412	121.219	Ventilation - To meet the requirements of Part 25.813.
413	121.285(c)	Carriage of Cargo in Passenger Compartments - To consider flight attendants as passengers.

Proposal No.	FAR	
414	121.285(c)	Carriage of Cargo in Passenger Compartments - Covers carry-on baggage.
415	121.291	Demonstration of Emergency Evacuation Procedures - Would not require redemonstration if same seating capacity was proven by other certificate holders.
417	121.291	Demonstration of Emergency Evacuation - Revise evacuation procedures.
424	121.309	Emergency Equipment - Require a CO or dry chemical fire extinguisher near each lavatory or galley area and to require additional megaphone, one for each 100 passengers.
426	121.309(b)(4)	Emergency Equipment - Requires compartment or container to be marked with last inspection date and next due date.
427	121.309(f)	Megaphones - To designate a flight attendant the responsibility for use of the megaphones.
428	121.309(f)	Megaphones - To require a megaphone at each flight attendant's station.
429	121.310(a)	Emergency Evacuation Slide Systems - To require that slides be of such length to be useable after collapse of one leg.
430	121.310	Emergency Evacuation Slide System - To require floor level exit slides to inflate automatically on deployment.
431	121.310(a)	Emergency Evacuation - To provide a method to prevent slide deployment in the gate area.
432	121.310	Interior Emergency Exit Marking - To provide seat luminescent exit instructions.
434	121.310(n)	Exterior Emergency Lighting - To require exterior emergency lighting to activate automatically when exits are opened.

Proposal No.	FAR	
435	121.310(j)	Emergency Exits - To permit deactivation of excess emergency exits.
437	121.310	Emergency Equipment - To activate emergency light system when the assist means are erected.
439 450 451 588 686 688	121.311(b), 121.310(b), 121.317, 121.571, 127.109, 127.115	Seat and Safety Belts - To require passengers to keep safety belts secured at all times.
440	121.311	Seats and Safety Belts - To placard inoperative seats, require shoulder harnesses for flight attendants, and to standardize all seat belts.
444	121.313	Pilot Compartment Door - To provide a means to exit through jammed door.
448	121.317	Passenger Information - To require that passenger information signs are clearly visible to passengers and flight attendants.
449	121.317(d)	Passenger Information - No passenger or crewmember may smoke while sign is on.
452	121.318	Public Address System - To require independent power supply.
453	121.318	Public Address System - To require public address system in all occupiable compartments.
454	121.319	Crewmember Interphone Systems - To require interphone in all occupiable compartments.
461 463 464 465	121.327, 121.331, 121.333	Supplemental Oxygen - Require oxygen for all occupants.
467	121.339	Emergency Equipment for Extended Overwater Operations - To require equipment location be conspicuously marked.

Proposal No.	FAR	
493	121.391(a)	Flight Attendants - To use a 30 to 1 passenger to flight attendant ratio.
494	121.391	Flight Attendants - To include provisions for proper flight attendant seating and revise passenger to flight attendant ratio.
496	121.391(c)	Flight Attendants - All additional flight attendants shall be trained for that operation.
497	121.391	Flight Attendants - To allow a flight to continue to a domicile with an incapacitated flight attendant on board.
498	121.400	Applicability and Terms Used - Would establish an additional grouping of aircraft for training.
502	121.401	Training Program: General - To include provisions for flight attendant instructors.
505	121.403	Training Program - To assure that pictorial displays do not substitute for actual demonstration "Hands On" training.
510	121.412	Training Program - New. To include a training program for flight attendant supervisors and instructors.
512	121.414	New Check and Instructor Flight Attendant Training.
513	121.415	Crewmember and Dispatch Training Requirements - To require all persons serving as crewmembers aboard aircraft to be trained.
514	121.417	Crewmember Emergency Training - To expand the scope of training required of this section.
515	121.417	Crewmember Emergency Training - To require lavatory fire training.
516	121.417(c)(4)	Crewmember Emergency Training - To eliminate training by audio-visual means only. Dropped - Covered in Proposal No. 514.

Proposal No.	FAR	
518	121.421	Flight Attendants' Ground Training - To include provisions for training in the use of electrical equipment and eliminate the reduction of training hours.
519	121.421	Flight Attendants' Training - To require MEL training.
520	121.421	Flight Attendants' Training - Require flight attendants to take a written test and competence check on board each type aircraft assigned.
537	121.434	Flight Attendants' Operating Experience - To delete the 5-hour flight requirement.
555 558	121.472 New 121.482	Flight Time Limitation, Flight Attendants - To establish flight and duty time limitations for flight attendants.
566	121.544 New	Flight Attendants - That flight attendants to remain at their station while the aircraft is taxiing.
580	121.569	Equipment Interchange - To require differences training on operation and location of equipment.
581	121.571	Briefing Passengers Before Takeoff - To require passenger safety regulations be published as passenger information.
582	121.571	Passenger Briefing - To require carriers to brief passengers on the need to familiarize themselves with emergency exits.
583	121.571	Briefing Passengers Before Takeoff - To include the dissemination of pertinent information to passengers prior to take off.
585 586	121.571	Briefing Passengers Before Takeoff - To inform passengers on how to fasten and unfasten seat belts, and the location and use of flotation equipment.

Proposal No.	FAR	
587	121.571	Briefing Passengers Before Takeoff - To delete the oral briefing requirement when the seat belt sign is turned off.
588 589	121.571	Briefing Passengers Before Takeoff - To announce that passengers are required to keep seat belts fastened when the seat belt sign is off.
590	121.573(a)	Briefing Passengers: Extended Overwater Operations - To require briefing on all approved flotation means.
591	121.573	Briefing Passengers: Extended Overwater Operations - To include the dissemination of safety information to passengers prior to overwater takeoff.
592	121.574	Oxygen for Medical Use by Passengers - To include provisions for responsible able bodied assistants aboard to assist persons utilizing oxygen on a continual basis.
594	121.574	Oxygen for Medical Use by Passengers - To not allow any person to smoke in the row forward of aft of the row occupied by the oxygen user.
595 597	121.575	Alcoholic Beverages - To limit the amount of alcoholic beverages served aboard commercial aircraft.
597	121.575	Retention of Items of Mass - To add the words "and used" making it mandatory that retention devices be used.
598	121.576	Retention of Items of Mass - To provide specific limits on storage space in the cabin.
599	121.577	Food and Beverage Service - To allow passengers to retain beverage containers during takeoff and landing.
600	121.578 New	Food and Beverage Service In-flight - To add a new Federal regulation to include certain limitations on the service of food and beverages.

Proposal No.	FAR	
604	121.589	Carry-on Baggage - To require preboarding surveillance of cabin baggage and restrict stowage in areas containing emergency equipment.
648	121 Appendix A	First-aid Kits - To provide first-aid kits in the cabin, and to allow use of pneumatic splints.
649	121	Criteria Demonstration of Emergency Evacuation Procedures Under Section 121.291 - To simulate more realistic emergency evacuation demonstration.

FLIGHT STANDARDS SERVICE ACTIVITIES IN AIR CARRIER CABIN SAFETY

J. A. Ferrarese, Deputy Director, Flight Standards Service, gave a presentation covering the significant activities of Flight Standards Service in the cabin safety area over the past 15 years (see attachment).

Following the presentation, he gave a brief summary of the rulemaking procedures and pointed out that rulemaking usually takes too long. He pointed out that there are actually four steps which go into this procedure:

1. Identification of problem and rule to be made.

2. Receiving recommendations from interested parties.

3. NPRM sending comments and analyzing them.

4. Incorporation of this into FAR.

He again stated that this took a long time. He pointed out that most of the carriers will take action on an Air Carrier Operations Bulletin and other Safety Bulletins which are issued by the FAA. Mr. Roscoe pointed out that these bulletins are not regulatory and, therefore, not mandatory. Mr. Ferrarese stated that airlines do not like to have letters in their files asking them to comply with these safety bulletins (especially with all the legal ramifications now) and that issuing these bulletins was, in any case, better than waiting for rulemaking. There are some bulletins the carriers have no choice but to comply with; the only way they can keep from complying with them is to petition to the Administrator.

Mr. Roscoe told about visiting Frontier Air Lines with the POI and the Operations man at Frontier in reference to Air Carrier Operations Bulletins. The Operations man said Frontier would probably go along with the Operations Bulletin which refers to cabin mockups, but not at too much expenditure of money because new rules could be developed which would make the simulator out of date. Mr. Ferrarese stated that he seriously doubted that any simulator would ever be out of date.

Mr. McKay said a followup letter would be written about mockups and thinks that FAA Headquarters needs to get feedback about how Safety Bulletins are to be complied with.

FAA AND INDUSTRY REVIEW
OF
CABIN SAFETY IN AIR CARRIER OPERATIONS
AUGUST 31, 1976
CIVIL AVIATION MEDICAL INSTITUTE
FAA AERONAUTICAL CENTER
OKLAHOMA CITY

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FLIGHT STANDARDS SERVICE ACTIVITIES IN AIR CARRIER CABIN SAFETY

Ladies and Gentlemen -- Mr. Roscoe has asked me to review with you the significant accomplishments made during the past decade and a half by the Flight Standards Service in the area of air carrier cabin safety and crashworthiness and current programs.

Following a fatal accident in July of 1961, FAA's second Administrator, Najeeb Halaby, requested an indepth FAA/industry study of passenger evacuation problems associated with survivable accidents. Upon completion of these studies, he wrote (in April of 1962) to all airline presidents requesting that they take immediate action to ensure that initial and recurrent training programs for cabin and flight crewmember include the physical operation of escape slides, opening of emergency exits, placement of escape ropes, use of fire extinguishers, and deployment of liferafts. He also directed that FAA inspectors follow up with their assigned carriers to ensure that this action would be accomplished. Thus the 9-month period from July 1961 to April 1962 represents the beginning phase of FAA's primary emphasis on cabin safety which has continued until this day.

There are many requirements in our airworthiness and operating regulations that were not in the rules that were effective in 1961. To name a few:

1. Emergency evacuation demonstrations by air carriers and manufacturers.
2. Portable megaphones.
3. Passenger briefings on the location and operation of emergency exits.
4. Access to emergency exits.
5. Improved interior emergency exit lighting and marking.
6. Requirements for flotation devices for overwater operation.
7. Requirements for extra emergency exits.
8. Improved cabin interior fire protection requirements.
9. Isolation of main electrical power cables from flammable fluid lines.
10. Requirements for deploying escape slides automatically.
11. Improved exterior lighting to facilitate night evacuations.
12. Specific requirements for initial and recurrent flight attendant training.
13. Requirement for public address system and crewmember interphone.
14. Cabin announcement that passengers should keep safety belt on even though seatbelt sign is off.
15. Retention of items of mass such as galley equipment, serving carts, and crew baggage. This is in addition to the carry-on baggage requirements.
16. Improved landing gear design to minimize rupturing of fuel lines in the event of landing gear failure during a survivable accident.
17. Requirements for improved flight attendant seats.

In retrospect, we believe that considerable progress has been made during the past 15 years.

Not all of our actions are in the form of regulations. Because the rulemaking process, of necessity, is quite laborious, we must take timely action to: (1) correct safety deficiencies, (2) direct safety improvements, and (3) direct increased surveillance of suspect areas. For example, Flight Standards Service has issued numerous directives to its field inspectors concerning cabin safety. For the most part, these directives request that our inspectors follow up with their assigned carriers to either correct deficiencies or provide guidelines for improved cabin safety procedures. To better illustrate, I would like to capsulize some of the directives we have issued:

1. In 1969, we issued an air carrier operations bulletin directing our inspectors to be alert to the procedures used for handling serving carts and to request correction of observed deficiencies.

2. Another bulletin issued in 1969 requested our inspectors to brief their assigned carriers on the fire hazard of certain types of plastic and styrofoam cups used for beverage service.

3. In view of increasing injuries due to turbulence, a bulletin was issued in 1969 requesting inspectors to ask the carriers to undertake a program of educating passengers in the use of seatbelts. It also directed the inspectors to request the carriers to issue instructions to passengers to keep seatbelts fastened even though the seatbelt sign is off.

4. When it came to our attention that some carriers were blocking seats and reducing the number of flight attendants, we issued a bulletin in 1969 directing inspectors to ensure that their assigned carriers remove seats prior to operating with a reduced number of flight attendants.

5. In 1969, a bulletin was issued directing inspectors to review their assigned carriers' emergency evacuation procedures. This was issued following several incidents when passengers had been injured during evacuations not involving an emergency.

6. In 1970, we issued a bulletin requesting inspectors to assure that pre-ditching checklists include the item "warn passengers." This was issued following the ditching of an air carrier aircraft. This ditching was planned but passengers had not been warned to don lifevests.

7. Following the innovation of standup bars, we issued a bulletin in 1971 requesting inspectors to observe, during en route inspections, procedures for alerting passengers to resume their seats if turbulence is expected. The carriers, through their assigned inspectors, were requested to develop appropriate procedures.

8. A bulletin was issued in 1971 directing our inspectors to review carrier procedures pertaining to problems associated with lounge areas, such as lack of seatbelt discipline and inadequate training programs. Where appropriate, corrective action was initiated.

9. A bulletin was issued in 1972 requesting inspectors to conduct en route surveillance of carrier procedures regarding the serving of alcoholic beverages. The basis for the issuance of this bulletin was information received from flight attendants concerning incidents they had observed.

10. A bulletin was issued in 1973 following several survivable accidents which reflected deficiencies in training and performance of crewmembers in carrying out their evacuation duties. The bulletin stressed the need for high quality training and requested inspectors to emphasize this in reviewing training programs. It also requested that carriers, during initial training, require both flight and cabin crewmembers to actually operate each type emergency exit and at 2-year intervals in recurrent training.

11. Following several incidents involving in-flight fires in lavatories, a bulletin was issued in 1973 requesting inspectors to encourage carriers to:

    a. Place "No-Smoking" signs on the outside of lavatory doors.

    b. During cabin briefing, also announce that smoking is not permitted in lavatories.

    c. Require flight attendants to visually inspect lavatories prior to takeoff and periodically during flight (Items a. and b. adopted in AD 74-08-09).

12. As a result of information received from flight attendants concerning lower lobe galleys, a bulletin was issued in 1973 citing the following problem areas:

    a. Passengers in the lower lobe galleys.

    b. Too many flight attendants in lower lobe during training flights, resulting in an insufficient number of oxygen masks and seatbelts.

    c. Inadequate communications system.

d. Inadequate emergency equipment, procedures and training for combating fires in lower lobes.

e. Differing MEL procedures concerning inoperable cart lifts.

f. Inadequate stowage provisions for carts in cabin areas.

g. Inoperable mushrooms.

Inspectors were requested to review the procedures of their assigned carriers in the above areas and initiate appropriate corrective action. Inspectors were also requested to check these areas during en route surveillance.

13. In 1974, a bulletin was issued directing inspectors to:

a. Advise carriers of the need for procedures to assure that crewmembers can properly assess the damage following in-flight or ground emergencies, incidents, and fire or system malfunctions.

b. To train cabin crewmembers to report to the captain any significant damage relating to structures, life support equipment, cabin system malfunctions, and situations posing a potential threat to the safety of passengers and crew.

The basis of this bulletin was an accident involving structural damage in the cabin area following cabin decompression (fire and smoke in the cabin) wherein the flightcrew was not provided with an assessment of the situation.

14. In April of 1971, we initiated a directed safety investigation to assess the design, maintenance, and operational aspects of the flight attendants' working environment. The report of the investigation revealed that improvements were needed in areas such as, design criteria, maintenance practices, and flight attendant training.

Although some actions were taken as a result of this investigation, many of the recommendations are still awaiting final rulemaking action as an outcome of the Airworthiness Review. For example, Notice 75-31, issued in July 1975, contained proposed requirements for flight attendant seats that would correct problems identified in 1971. I must admit that the agency was not as responsive on this as we might have been. However, we did identify the problems contained in the investigative report to our regions in the form of a notice issued in August of 1971. We asked the regions to critically review the safety aspects of flight attendant seats on their assigned carriers and to submit to Headquarters recommendations for corrective action. Subsequently, the regions advised us of the corrective actions taken or initiated. Although some carriers took timely action, others did not. Accordingly, another investigation was conducted last year. One result of this investigation was the issuance of an airworthiness directive requiring the removal of side-facing flight attendant seats. Another was the issuance of Notice 75-31.

15. A bulletin was issued in 1975 requesting inspectors to review their assigned carrier training programs to ensure that:

    a. Flight attendants are fully aware that manual inflation of escape slides should be attempted if slide fails to inflate automatically.

    b. Prior to closing any door, inspect girt bar attach points for debris or ice accumulations that would interfere with slide deployment.

This bulletin was issued following several incidents involving these areas.

During the period June through October 1974, we directed our inspectors to conduct a special inspection on cabin safety. This inspection was generated by inspector reports and flight attendant complaints indicating a deterioration in flight attendant training, an increase in turbulence incidents and cabin safety equipment malfunctions. We requested that particular attention be given to the following areas:

1. Adequacy of training facilities and devices (mockups).

2. Compliance with regulations with emphasis on firefighting techniques, use of fire extinguishers, administering of first-aid oxygen, purpose and use of oxygen systems and smoking in lavatories (AD 74-08-09).

3. Quality of training.

4. Adequacy of training records.

5. Evaluation of carrier procedures by en route surveillance.

The results of this inspection generated FAA proposals for the regulatory reviews which are now under consideration.

To assure that our inspectors are knowledgeable concerning flight attendant responsibilities, we began in July a program to give our inspectors flight attendant training under contract to American Air Lines. This year some 60 air carrier operations inspectors will have received this training, and we hope to continue the program until all air carrier operations inspectors have received the course. Additionally, 18 air carrier maintenance inspectors have received training on the design, operation, and maintenance of escape slides. These inspectors are, thus, better able to monitor their assigned

carriers' maintenance/reliability programs. We are also developing a formal course for air carrier maintenance inspectors covering the maintenance aspects of all cabin safety equipment.

Some other ongoing programs in the area of cabin safety are:

1. A review by Headquarters personnel of flight attendant training programs with the objective of improving these programs through rulemaking or by followup action by our inspectors.

2. We are again looking at problems associated with food carts to pinpoint problem areas and initiate corrective action where needed, either by rulemaking or inspector followup.

3. A project is underway to provide media for educating passengers regarding the cabin safety provisions of the regulations -- some of which apply to them. For instance, a draft advisory circular has been developed and is undergoing internal review. We are also exploring the feasibility of using visual/audio briefings in the terminals.

4. Additional instructions to our inspectors on how to conduct cabin safety surveillance will be issued soon.

In the areas of enforcement, you might be interested in the number of actions processed against scheduled air carriers or their passengers. During 1970 through 1975, we processed 68 enforcement actions against passengers involving the consumption of alcoholic beverages. In 39 cases, civil penalties totaling

$12,500 was collected. In the remaining 29 cases, administrative action was taken. During this period, 35 actions involving alcoholic beverages were processed against the carriers. In 18 cases, civil penalties totaling $35,000 was collected. In the remaining 17 cases, administrative action was taken.

As a result of the Operations and Airworthiness Reviews, numerous proposals are under consideration or have been issued as notices of proposed rule making for public comment.

Some of the notices issued cover areas such as:

1. Seats, belts, and harnesses.

2. Emergency equipment.

3. Slide installation.

4. Evacuation alarm system.

5. Stowage compartments.

6. Standards for multi-deck airplanes pertaining to structural requirements for ditching, passenger emergency exits, and location of flight attendant seats.

7. Standards for lower lobes, such as lighting, seats, and communications.

8. Improved performance for escape slides.

9. Standards for reducing hazards associated with cabin interior materials with respect to smoke, flame and toxicity.

Other proposals in the pre-notice stage under consideration pertain to:

1. Improved seatbelt signs ("Fasten belt when seated").

2. Means to inform passengers how to fasten and unfasten seatbelts.

3. Improved location of megaphones for flight attendant use.

4. Improved flight attendant training.

I should also mention that we issued in March of 1975 an advance notice of proposed rule making in an effort to develop flame retardant standards for flight attendant uniforms. A report is being drafted by our office of R&D which may form the basis for a notice proposing specific standards. We are also considering a notice of proposed rule making that would propose standards for children's seats.

The rulemaking process is not widely understood and it often appears that we are dragging our feet or are otherwise reluctant to change the regulations. Therefore, it might be helpful if I briefly describe the rulemaking procedure that we and other regulatory agencies must adhere to.

In developing regulations we are subject to the requirements of Public Law 89-554 entitled, "Administrative Procedure; Administrative Conference and Judicial Review." It is the requirement source for public notice of rule-making, the analysis of public comment and the requirement that adequate time be given for implementation between adoption and the effective date of the rule.

Those having general applicability, if not withdrawn or terminated, lead to issuance of a new regulation or the amendment of an existing one. These actions are normally initiated by petition from outside sources, such as the aviation industry, consumer groups, private citizens, etc., in accordance with FAR Part 11.25 or internally generated within FAA as a consequence of problem identification, NTSB recommendations, consumer complaints, internal FAA review, changing technology, court decisions, or Congressional mandate. The result of the project, if not withdrawn or terminated, will be to either issue a new or amend an existing part of the FAR's.

After a need for a rule has been established, a project is developed which outlines a proposed regulation to solve the problem in question. Either an advance notice of proposed rule making or a notice of proposed rule making is published in the Federal Register outlining the proposed rule and requesting public comment. Normally 60 to 90 days is allowed for such comment. During this comment period formal or informal hearings may also be held to allow all concerned to air their views. Quite frequently we receive comments that are not germane and, therefore, are outside the scope of the proposal and cannot be considered. Also, some comments opposing a proposed rule are subjective with no rationale as to why our proposal is wrong.

Our philosophy in rulemaking can be summed up as follows:

1. When we think about adopting a rule, we think of all citizens, not just the aviation community.

2. We respond to changing technology and circumstances.

3. We give top priority to changes having the greatest impact on safety.

4. Normally, rulemaking occurs only after we have explored other methods of obtaining comparable levels of safety.

5. In the development process we make a concentrated effort to obtain all the pertinent facts from all interested parties.

6. We endeavor to develop rules in a timely manner.

7. It is our intent to issue the minimum number of rules required to assure safety.

The latter two points have lately become quite important in the rulemaking process due to a myriad of external influences. These are inflationary, energy, environmental and consumer considerations and regulatory reform policies. Historically, the FAA has considered the impacts of a regulation on users, consumers and the environment and its economic effects. These have not always been explicitly stated, but the public has been quick to call our hand if proposed regulations would result in added costs, increased fuel usage or negative environmental effects. However, we now must not only consider these impacts but explicitly state them.

Executive Order 11821 of November 27, 1974, requires that major proposals for the promulgation of rules and regulations must be accompanied by a statement certifying that the inflationary impact of the proposal has been evaluated. The Office of Management and Budget Circular A-107 requires regulatory agencies to determine what is a major proposal and to develop procedures for evaluation of major proposals. Thus, in our development of any major proposal, we must consider its inflationary impact.

The Energy Policy and Conservation Act requires the FAA to include in any major regulatory action a statement of the probabl impact of such action on energy efficiency and energy conservation.

Pending definition of the term "major regulatory action" we are preparing energy impact analyses under interim agency guidelines. Not only is this being done for all current and new projects, but the requirement is retroactive to December 22, 1975, the effective date of the Energy Policy and Conservation Act.

The requirement for an environmental impact analysis began with the National Environmental Policy Act of 1969. Thus, the environmental impact of regulatory projects must be assessed at all stages of project development.

We must also consider consumer involvement in rulemaking based on a DOT study concluded in June 1974 and a proposed Consumer Representation Plan published in the Federal Register on November 26, 1975. The final plan, expected to be published in the Federal Register within the next month, will provide guidelines for assessing the impact of rulemaking actions on consumers.

Last, but by no means least, we have to incorporate Departmental Regulatory Reform Policy in our rulemaking process. This policy was published in the Federal Register on April 16, 1975, having the objective of improving the quality of analysis of regulatory proposals by considering their impacts on the private sector, consumers, and to all levels of Government. It also ensures that rulemaking is only undertaken when necessary.

Briefly, the policy calls for an evaluation of the impacts of proposed regulations, the use of the evaluation in assessing the desirability of the regulations, notification of the Secretary of Transportation when a proposed regulation is potentially costly or controversial and the establishment of a system by which those affected by the regulations are periodically provided an opportunity to offer comments through a structured process. The intent of this process is to assess whether existing regulations are effective or necessary, or need revision to accommodate changed circumstances and requirements.

In summary, I believe the record reflects significant progress in the area of cabin safety, but more needs to be done. Cabin safety, like all safety areas, needs continuing attention, and you can be assured that it will receive continued emphasis.

Mr. Dick Kirsch (SRDS) pointed out that the main mission was to provide Flight Standards with safety information; this is done by using:

1. In-house personnel
2. In cooperation with NAFEC
3. In cooperation with CAMI
4. Some very limited contracting (outside).

Fire safety is one of their major investigation areas:

1. Cabin fire safety -- gas analysis and toxicity
2. Crew uniform burn tests coming out in 45 days
3. Fuel fires -- tanks and fuel (antimisting to preclude fireball.

They are doing burn testing to try to settle overall fire problems. The major emphasis is on fuel fire prevention and trying to find out what a real fire is like.

There was some discussion about the crash-proof tanks used by the Army.

There was also discussion on the use of partitions in air transports to keep fire and fumes (presumably) from spreading. A representative from the AIA pointed out that there was a serious legal problem in placing a partition between passengers and a potential escape route. Mr. Kirsch pointed out that placing people in a location as to make them incapable of reaching escape routes such as is done in submarines was not what they had in mind. A representative of the AIA pointed out that extensive research has been done on partitioning and this experimentation was published. Mr. Kirsch said that he was aware of this and while research did not show that partitioning was promising accident data did show that it might be. The indication was that SRDS intended to continue looking into the matter.

Mr. Ralph Russell (NAFEC) pointed out that much research on fires in cabin materials has been conducted and that flash fire work has gone on for years. He reiterated what Mr. Kirsch had said about partitions giving some protection. He talked about the use of 1301 on internal fires and said that 5% by volume should be used as soon as possible before exits are opened. When there is an external fire, the discharging of 1301 in the cabin prevents entry of the fire through the exits if there is no wind; however, if there is as much as a 2 mile/hour wind, the fire can enter the cabin through the exits in 15 seconds.

Mr. Russell discussed the fact that a C-133, modified to represent a wide-bodied aircraft, will be used to study flow of heat and toxic gases through the cabin.

AIRCRAFT CABIN FIRE SAFETY PROGRAM

AT NAFEC

By: R. Russell (Presenter)
C. Sarkos

Prepared for:

FAA AND INDUSTRY REVIEW
OF
CABIN SAFETY IN AIR CARRIER OPERATIONS
AUGUST 31, 1976
CIVIL AVIATION MEDICAL INSTITUTE
FAA AERONAUTICAL CENTER

THE PRIMARY MISSION OF THE NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER (NAFEC) IS TO RESPOND AND CONTRIBUTE TO FAA RESEARCH AND DEVELOPMENT PROGRAMS.

THE FIRE PROTECTION BRANCH OF THE AIRCRAFT AND AIRPORTS SAFETY DIVISION AT NAFEC IS CHARGED WITH CARRYING OUT THE AIRPORT FIRE SAFETY AND THE AIRCRAFT SYSTEMS FIRE SAFETY PROGRAMS FOR THE FAA. OUR PRIMARY PRODUCT IS TO DEVELOP TECHNICAL CRITERIA WHICH CAN BE USED BY FLIGHT STANDARDS SERVICE THROUGH SRDS TO SUPPORT THE RULEMAKING PROCESS AND TO SUPPORT THE OFFICE OF AVIATION SAFETY. THE WORK IS SUBDIVIDED INTO TWO AREAS OF ENDEAVOR: (1) LABORATORY SCALE TESTS TO EVALUATE THE FIRE HAZARDS OF BURNING INTERIOR MATERIALS, AND (2) LARGE SCALE TESTS TO STUDY CABIN FIRE DYNAMICS AND EVALUATE PROSPECTIVE FIRE MANAGEMENT SYSTEMS.

SLIDE #1 - (LISTING OF LABORATORY FIRE TESTS FOR INTERIOR MATERIALS)

THE PERFORMANCE OF AN INTERIOR MATERIAL INVOLVED IN A CABIN FIRE HAS BEEN TRADITIONALLY EVALUATED USING SMALL-SCALE LABORATORY FIRE TESTS. GENERALLY, ANY FIRE TEST PROVIDES SOME INFORMATION RELATED TO ONE OR MORE OF THREE IMPORTANT FIRE HAZARD FACTORS: FLAMMABILITY, SMOKE EMISSIONS, AND TOXICITY OF COMBUSTION PRODUCTS. AT THIS TIME, ABOUT SIX TESTS ARE COMMONLY USED AT NAFEC, AND THESE TESTS RANGE CONSIDERABLY IN SIMPLICITY OF DESIGN, EASE OF OPERATION, COST OF EQUIPMENT, SPECIALIZATION OF TEST PERSONNEL, AND COMPLEXITY OF PERFORMING A TEST.

THE CURRENT FAA FLAMMABILITY TEST, WHICH CONSISTS OF SUBJECTING A VERTICAL SPECIMEN TO A BUNSEN BURNER FLAME, PRIMARILY ADDRESSES THE IGNITABILITY AND SELF-EXTINGUISHING FEATURE OF A MATERIAL. HOWEVER, IN AN

INTENSE CABIN FIRE FLAME SPREAD RATE AND HEAT EVOLUTION ARE PROBABLY EVEN MORE IMPORTANT FLAMMABILITY CHARACTERISTICS. THESE MAY BE READILY MEASURED WITH OTHER TEST METHODS: E.G., THE RADIANT PANEL OR THE OHIO STATE APPARATUS. THE LIMITING OXYGEN INDEX TEST FAVORED BY NASA ALSO ADDRESSES IGNITABILITY AND PROVIDES GREATER DISCRIMINATION THAN THE VERTICAL BUNSEN BURNER TEST FOR THE MORE FIRE RESISTANT CABIN MATERIALS AND ESPECIALLY ADVANCED POLYMERS. THIS UPCOMING FISCAL YEAR WE ARE SCHEDULED TO COMPARE THE PERFORMANCE OF VARIOUS CABIN MATERIALS, ALREADY TESTED WITH THE PRESENT FAA FLAMMABILITY TEST, WITH THEIR PERFORMANCE USING THE MORE PROGRESSIVE TEST METHODS JUST NOTED. BY COMPARING THESE DATA WITH ONE ANOTHER AND WITH FULL-SCALE TEST RESULTS, WE HOPE TO GET A BETTER GRASP OF THE NEED FOR IMPROVED FLAMMABILITY REGULATIONS AND THE AVAILABILITY OF TEST METHODS THAT SATISFY THESE NEEDS.

THE WORK ON FLASH FIRE HAS BEEN CONDUCTED INTERMITTENTLY OVER THE PAST 5 YEARS UNDER AN INTERAGENCY AGREEMENT AT THE BUREAU OF STANDARDS.

SLIDE #2 - (FLASH FIRE CELL)

A FLASH FIRE CELL WAS DEVELOPED AT NBS. THE 1-LITER, PYREX APPARATUS CONSISTS ESSENTIALLY OF A REMOVABLE SAMPLE HOLDER, ELECTRIC FURNACE, AND SPARK IGNITOR. IT HAS BEEN DETERMINED THAT THERE IS A CRITICAL SAMPLE WEIGHT AND FURNACE TEMPERATURE REQUIRED TO PRODUCE A FLASH FIRE. A FINAL REPORT DRAFT CONTAINING THE EVALUATION OF ABOUT 25 TYPICAL CABIN MATERIALS IN THE FLASH FIRE CELL AND MORE FUNDAMENTAL STUDIES CONDUCTED TO GAIN A BETTER UNDERSTANDING OF THE FLASH FIRE MECHANISM IS SCHEDULED FOR NEXT MONTH.

SLIDE #3 - (NBS SMOKE CHAMBER)

IN THE AREA OF SMOKE EMISSIONS, THE SITUATION IS NOT AS PRESSING AS IN FLAMMABILITY. WE FEEL THE NBS SMOKE CHAMBER IN ITS PRESENT DESGIN IS A GOOD TEST METHOD FOR SCREENING OUT ESPECIALLY SMOKY CABIN MATERIALS. THE CHAMBER BASICALLY CONSISTS OF A 18-CUBIC-FOOT CLOSED BOX, CONTROLLED SOURCE OF RADIANT HEAT AND FLAME, 3-INCH-SQUARE SPECIMEN HOLDER AND VERTICAL PHOTOMETER FOR CONTINUOUSLY MEASURING LIGHT OBSCURATION CREATED BY THE PRESENCE OF SMOKE. HOWEVER, WE PLAN TO TRY SOME IMPROVEMENTS NOTABLY A HIGH-RANGE RADIANT HEATER AND A HORIZONTAL SPECIMEN HOLDER, IN HOPES THAT THE CHANGES WILL IMPROVE THE CAPABILITY OF THE CHAMBER FOR PREDICTING SMOKE LEVELS IN FULL-SCALE FIRE.

OUR EFFORTS OVER THE LAST FEW YEARS HAVE BEEN CONCENTRATED IN THE AREA OF COMBUSTION TOXICITY. NAFEC WAS REQUESTED TO DEVELOP A SIMPLE, QUICK, AND INEXPENSIVE FIRE TEST FOR SCREENING MATERIALS PRODUCING COPIOUS AMOUNTS OF TOXIC GAS EMISSIONS. THE NBS SMOKE CHAMBER IN COMBINATION WITH COMMERCIAL GAS DETECTOR TUBES USED FOR INDUSTRIAL HYGIENE MEASUREMENTS SEEMED THE OBVIOUS SOLUTION. IT SHOULD BE EMPHASIZED THAT THERE IS NO STANDARD TEST METHOD IN THE U.S. FOR THE COMBUSTION TOXICITY OF SOLID MATERIALS. WE DEMONSTRATED THAT THIS APPROACH HAD SOME MERIT, BUT WE ALSO DISCOVERED PROHIBITIVE DEFICIENCIES.

ABOUT A YEAR AGO A COMBUSTION TUBE FURNACE IN COMBINATION WITH SPECIFIC GAS ANALYSIS PROCEDURES WAS DEMONSTRATED TO BE A MORE ACCURATE AND REPEATABLE TEST METHOD. FURTHERMORE, THE TUBE FURNACE COULD BE EASILY INCORPORATED INTO AN ANIMAL TOXICITY TEST, WHICH WE BECAME CONVINCED WOULD

HAVE TO BE AN ESSENTIAL PART OF ANY CREDIBLE TOXICITY REGULATION. ALSO, ABOUT A YEAR AGO, A COOPERATIVE STUDY WAS INITIATED AT NAFEC AND CAMI TO EVALUATE 75 CABIN MATERIALS USING A COMBUSTION TUBE FURNACE TO PYROLYZE THE MATERIAL. THE MAJOR DIFFERENCE BETWEEN THE TWO RECENTLY-COMPLETED EFFORTS WAS THE END PRODUCT: AT NAFEC TOXICITY WAS INDICATED IN TERMS OF THE QUANTITIES OF SELECTED TOXIC GASES, WHILE AT CAMI, TOXICITY WAS MEASURED BY EXPOSING ANIMALS DIRECTLY TO THE MATERIAL COMBUSTION PRODUCTS.

SLIDE #4 - (NAFEC COMBUSTION TUBE SETUP)

THE NEXT SLIDE IS A PHOTOGRAPH OF THE COMBUSTION TUBE SETUP AT NAFEC. THIS SYSTEM WAS DESIGNED TO FACILITATE THE COLLECTION OF GAS SAMPLES IN THE EFFLUENT STREAM FOR SUBSEQUENT QUANTITATIVE ANALYSIS. A 250 MG SAMPLE IS DECOMPOSED FOR 5 MINUTES IN THE TUBE FURNACE, WHICH IS PRESET AT A CONSTANT TEMPERATURE OF 600°C. AS THE SAMPLE IS DECOMPOSED, A STREAM OF AIR FLOWING AT 2 LITERS/MINUTE CARRIES THE COMBUSTION PRODUCTS INTO LIQUID-FILLED FRITTED IMPINGERS THAT COLLECT THE TOXIC GASES OF INTEREST. AFTER COMPLETION OF THE BURN, THE IMPINGERS ARE DISCONNECTED AND TAKEN INTO OUR CHEMISTRY LABORATORY AND THE CONTENTS ANALYZED IN ORDER TO QUANTITATE THE LEVEL OF TOXIC GASES. DATA ARE USUALLY REPORTED IN TERMS OF MILLIGRAMS OF GAS PER GRAM OF SAMPLE.

SLIDE #5 - (TOXIC GASES MEASURED AND METHODS OF ANALYSIS)

A LIST OF THE TOXIC GASES MEASURED AND THE METHODS OF ANALYSIS IS SHOWN ON THE NEXT SLIDE. THE METHODS OF ANALYSIS ARE SPECIFIC IN NATURE;

I.E., OTHER GASES PRESENT IN THE COMBUSTION MIXTURE DO NOT PRODUCE INTERFERENCE EFFECTS OR FALSE INDICATIONS. FROM PREVIOUS STUDIES AND A KNOWLEDGE OF THE CHEMICAL COMPOSITION OF THE VARIOUS CABIN MATERIALS, THE GASES SELECTED FOR ANALYSIS WERE EXPECTED TO BE THE MAJOR CONTRIBUTORS TO THE OVERALL TOXICITY OF ANY CABIN MATERIAL. CARBON MONOXIDE WAS SELECTED BECAUSE IT IS PRODUCED WHEN ANY ORGANIC MATERIAL IS BURNED AND IS USUALLY THE MOST ABUNDANT TOXIC SPECIES. HYDROGEN CYANIDE WAS SELECTED BECAUSE OF ITS EXTREMELY TOXIC NATURE AND PRESENCE IN THE DECOMPOSITION PRODUCTS OF SUCH COMMON NITROGEN-CONTAINING CABIN MATERIALS AS WOOL, NYLON, MODACRYLIC, AND URETHANE. HYDROGEN FLUORIDE IS A MAJOR DECOMPOSITION PRODUCT OF THE TEDIAR FILM FINISHES ON MOST PANELING USED IN CABIN INTERIORS. THE REMAINING GASES WERE SELECTED FOR SIMILAR REASONS.

IN ORDER TO ESTABLISH THE SIGNIFICANCE OF THE TOXIC GAS MEASUREMENTS, WE HAVE BEEN TRYING TO CORRELATE THESE DATA WITH ANIMAL TOXICITY DATA FROM CAMI. SINCE THE EXPERIMENTAL PROCEDURES ARE VERY SIMILAR, THIS EXERCISE IS BOTH NECESSARY AND VALID.

SLIDE #6 - (CORRELATION OF GAS ANALYSIS AND TOXICITY)

THIS SLIDE CONTAINS A PRELIMINARY CORRELATION FOR FABRICS BASED ON A NON-STATISTICAL APPROACH. THE ORDINATE IS THE RECIPROCAL OF THE TIME OF INCAPACITATION, OR TI, OF WHITE RATS MEASURED AT CAMI (DR. SMITH WILL HAVE MORE TO SAY ABOUT THIS END-POINT MEASUREMENT), AND THE ABSCISSA IS A DERIVED EQUATION CONTAINING THE QUANTITIES OF HCN, CO, AND HCl MEASURED AT NAFEC. NOTE THAT EACH GAS MUST BE WEIGHED DIFFERENTLY. BY ANALYZING THE DATA, DR. SPURGEON AT NAFEC HAS BEEN ABLE TO CORRELATE THE TOXICITY OF FABRICS

VARYING CONSIDERABLY IN CHEMICAL COMPOSITION IN TERMS OF ONLY THREE TOXIC GASES (OF THE HUNDREDS PRODUCED). SIMILAR CORRELATIONS FOR THE REMAINDER OF THE 75 MATERIALS HAVE YET TO BE ATTEMPTED.

TOXICITY EFFORTS AT NAFEC IN THE NEAR FUTURE INCLUDE: (1) AN IN-DEPTH STATISTICAL ANALYSIS OF THE COMPARISON BETWEEN NAFEC TOXIC GAS MEASUREMENTS AND CAMI ANIMAL TOXICITY DATA; (2) IDENTIFICATION AND QUANTIFICATION OF DOMINANT TOXIC GASES FOR MATERIALS WHOSE TOXICITY IS UNEXPLAINABLE IN TERMS OF THE NINE SELECTED TOXIC GASES: AND (3) SUPPORT FOR FULL-SCALE CABIN FIRE TESTS.

OUR POLICY IS ALSO TO ACCEPT REQUESTS FROM INDUSTRY AND OTHER GOVERNMENT AGENCIES TO PERFORM FLAMMABILITY, SMOKE, AND TOXICITY TESTS ON NEW MATERIALS THAT MIGHT FIND APPLICATION IN CABIN INTERIORS. IN THIS MANNER, NAFEC AND FAA CAN REMAIN ABREAST OF THE STATE-OF-THE-ART IN NEW POLYMERIC MATERIAL DEVELOPMENTS.

IN THE AREA OF FULL-SCALE CABIN FIRE TESTING, TEST PHASES HAVE RECENTLY BEEN COMPLETED ON TWO CONCEPTS DESIGNED TO INCREASE ESCAPE TIME FOR PASSENGERS DURING A POST-CRASH FIRE. THE FIRST CONCEPT STUDIED WAS THE USE OF CURTAINS AND/OR PARTITIONS FOR COMPARTMENTING THE SPREAD OF HEAT, SMOKE, AND TOXIC GASES IN THE AIRCRAFT CABIN, AND THE SECOND WAS THE USE OF A GASEOUS FIRE EXTINGUISHING AGENT, HALON 1301, IN COMBATING CABIN FIRES ORIGINATING EITHER WITHIN OR OUTSIDE THE AIRCRAFT. DC-7 FUSELAGES WERE USED AS TEST ARTICLES FOR THE TWO PROGRAMS.

THE COMPARTMENTATION WORK WAS CONDUCTED USING URETHANE SEAT FOAM FIRES WITH AND WITHOUT SIMULATED CABIN WIND DRAFTS AND INCORPORATING VARIOUS PARTITION/CURTAIN DESIGNS TO DIVIDE THE CABIN INTO TWO COMPARTMENTS HAVING EQUIVALENT 2200-CUBIC-FOOT VOLUMES. MEASUREMENTS OF TEMPERATURE, SMOKE (LIGHT REDUCTION), CARBON MONOXIDE, AND OXYGEN WERE TAKEN IN BOTH

COMPARTMENT. THIRTY-SEVEN TESTS WERE CONDUCTED RANGING FROM A FULLY OPEN CABIN TO A PARTITIONED CABIN WITH A FULLY CLOSED AND TAPED-SHUT CURTAIN.

TWO SLIDES -- SLIDES #7 AND 8 - (COMPARTMENTATION TESTS IN PROGRESS)

THE TEST RESULTS INDICATED THAT THE MORE TIGHTLY SEALED THE PARTITION AND/OR CURTAIN, THE GREATER WAS THE PROTECTION FROM THE SPREAD OF A GIVEN AMOUNT OF HEAT, SMOKE, CARBON MONOXIDE, AND DEPLETION OF OXYGEN. THE RESULTS ALSO INDICATED THAT THE USE OF COMPARTMENTATION MAY ALTER THE COMBUSTION CHARACTERISTICS OF A FIRE IN A SMALL ENCLOSED AREA, CREATING MORE PRODUCTS, OF COMBUSTION ON THE PROTECTED SIDE WHEN AIRFLOW IS INTRODUCED. HOWEVER, IN MOST CASES, THE CHANGE IN SURVIVABILITY CONDITIONS ON THE PROTECTED SIDE OF THE PARTITION BROUGHT ABOUT BY REDUCING THE OPENING USUALLY EXCEEDED ANY INCREASE IN SMOKE AND TOXICITY ON THE FIRE SIDE.

THE USE OF HALON 1301 WAS EVALUATED AGAINST AN INTERNAL CABIN FIRE AND AN EXTERNAL FUEL FIRE PENETRATING THROUGH A DOOR OPENING INTO THE FUSELAGE. AGAIN IT SHOULD BE EMPHASIZED THAT BOTH FIRE CONDITIONS RELATE TO POST-CRASH SITUATIONS. THE CABIN AGENT DISPENSING SYSTEM FOR HALON 1301 WAS OF A MODULAR, HIGH-RATE DISCHARGE DESIGN AND DEVELOPED AT NAFEC PRIOR TO THIS PROGRAM.

THE INSTRUMENTATION WAS SIMILAR TO THAT USED IN THE COMPARTMENTATION PROGRAM, WITH THE ADDITION OF INFRARED 1301 ANALYZERS AND SAMPLING PROBES FOR COLLECTING THE MAJOR DECOMPOSITION PRODUCTS OF 1301, NAMELY, HYDROGEN FLUORIDE AND HYDROGEN BROMIDE.

SLIDE #9 - (FIRE IN CABIN)

AGAIN URETHANE SEAT FOAM WAS USED AS THE FIRE LOAD. THE MAIN OBJECTIVE OF THE INTERNAL FIRE TESTS WAS TO DETERMINE HOW LATE THE AGENT COULD BE SAFELY USED DURING THE COURSE OF A FIRE AND STILL INCREASE ESCAPE TIME. THEREFORE, THE TESTS WERE RUN WITH VARIOUS FIRE BURN TIMES AND FUSELAGE CONFIGURATIONS, I.E., EXITS OPEN, EXITS CLOSED, AND EXITS CLOSED AND THEN OPENED AFTER AGENT DISCHARGE. A 5-PERCENT MIXTURE OF 1301 WAS USED IN ALL CASES. THIS WAS ADEQUATE TO SAFELY EXTINGUISH ALL INTERNAL FIRES UNDER ALL CONFIGURATIONS STUDIED WITHOUT EXCEEDING THE HAZARD LIMIT FOR HALON 1301 DECOMPOSITION.

THE RESULTS OF THE INTERNAL FIRE TEST PHASE SHOWED THAT IN ORDER TO MINIMIZE HF CONCENTRATIONS, THE FIRE SHOULD BE EXTINGUISHED WHEN ITS SIZE IS AS SMALL AS POSSIBLE AND PRIOR TO THE OPENING OF CABIN EXITS. IN ORDER TO REDUCE HF CONCENTRATIONS, THE CABIN EXITS SHOULD BE OPENED AS SOON AS THE FIRE IS EXTINGUISHED. THE ONLY ADVERSE TEST RESULTS OCCURRED WITH A SYSTEM MALFUNCTION, CAUSING HALON 1301 CONCENTRATIONS LESS THAN THOSE NEEDED TO EXTINGUISH A FIRE AND RESULTED IN DANGEROUS HF LEVELS.

SLIDE #10 - (EXTERNAL FUEL FIRE AT ENTRANCE DOOR)

THE EXTERNAL FIRE LOAD CONSISTED OF 3 GALLONS OF JP-4 IN A 30- BY 36-INCH PAN PLACED ADJACENT TO THE OPEN REAR ENTRANCE DOOR OF THE DC-7 FUSELAGE. AIRFLOWS BETWEEN 2 TO 10 MILES PER HOUR WERE DIRECTED ON THE BURNING FUEL TO CREATE FLAME BENDING INTO THE OPEN DOOR. THE RESULTS INDICATED THAT THE LENGTH OF PROTECTION TIME FROM FLAME PENETRATION THROUGH AN OPENING WAS STRONGLY DEPENDENT UPON EXTERNAL WIND CONDITIONS. FLAME PENETRATION WAS CONTROLLED FOR UP TO 3.5 MINUTES WITH ZERO WIND: BUT WITH A WIND OF AS LITTLE AS 2 MPH THE TIME WAS REDUCED TO LESS THAN 15 SECONDS. HF LEVELS

WERE RAPIDLY REACHED INSIDE THE CABIN: CONCENTRATIONS RANGED FROM 60 PPM WITH NO WIND TO 300 PPM WITH A 2-MPH WIND.

AN EFFORT THAT HAS BEEN IN PROGRESS CONCURRENTLY WITH THE WORK JUST DESCRIBED IS THE BUILDUP OF A FULL-SCALE FIRE TEST FACILITY.

SLIDE #11 - (C-133 AIRCRAFT)

SLIDE #12 - (AIRVIEW OF THE NAFEC R&D FACILITY)

THE FACILITY IS CENTERED AROUND THE MODIFICATION OF A C-133 FUSELAGE TO SIMULATE A WIDE-BODIED CABIN AND TO INSTRUMENT THIS AIRCRAFT SPECIFICALLY FOR CABIN FIRE TESTING. PROJECTS WITH THIS TEST ARTICLE WILL BE DESIGNED TO RELATE THE PERFORMANCE OF MATERIALS IN A REAL FIRE WITH WHAT IS MEASURED IN THE LABORATORY, AND TO INCREASE OUR UNDERSTANDING OF THE CHARACTERISTICS OF A CABIN FIRE. THE OVERALL VOLUME OF THIS TEST ARTICLE IS PRACTICALLY FOUR TIMES GREATER THAN ANY AIRCRAFT USED IN PREVIOUS FULL-SCALE CABIN FIRE STUDIES ANYWHERE AND WILL ALLOW PROPER EXAMINATION OF THE TRANSPORT AND DILUTION OF HEAT, SMOKE, AND TOXIC GASES IN THE LARGE CABIN SPACE UNDER REALISTIC FIRE CONDITIONS.

SLIDE #13 - (SKETCH COMPARING CABIN VOLUMES OF DC-10 WITH C-133)

SLIDE #14 - (FURNISHING MOCKUP IN C-133)

THE BULK OF NAFEC ACTIVITY RELATED TO CABIN FIRE SAFETY OVER THE NEXT SEVERAL YEARS IS EXPECTED TO CENTER AROUND THIS UNIQUE TEST FACILITY.

SLIDE #15 - (LIST OF FUTURE PROGRAMS)

THE NEXT SLIDE SHOWS A LIST OF FULL-SCALE FIRE TEST PROGRAMS PROPOSED FOR THIS FACILITY. AGAIN THE PROJECTS ARE RELATED TO THE POST-CRASH FIRE.

EXTENSIVE FUTURE REQUIREMENTS FOR FULL-SCALE FIRE TESTING WILL HOPEFULLY BE PERFORMED IN A FIRE TEST FACILITY PRESENTLY UNDERGOING AN ARCHITECTURAL AND ENGINEERING STUDY. THIS FACILITY WILL ELIMINATE RANDOM AMBIENT WIND CONDITIONS DURING TESTING AND PROVIDE A CAPABILITY OF MAINTAINING ABSOLUTE CONTROL OVER THE CHARACTERISTICS OF A FREE-BURNING POOL FIRE AND ALSO PERMIT THE PREPARATION AND CONDUCT OF CABIN FIRE AND CRASH-FIREFIGHTING STUDIES ON AN ALL-WEATHER, YEAR-ROUND BASIS.

DR. SMITH'S PRESENTATION

In November 1970 a charter aircraft crashed resulting in the death of 46 military personnel during the post-crash fire. AAC-114 received tissue from 19 of the victims and, for the first time, looked for the presence of HCN in the bodies. This resulted in extensive detective work because they found no traces of HCN, but a limited amount of CO was found in one of the bodies, which indicated that the victim died on impact. They found that one tissue sample was high in CO, but did not contain HCN which indicated that this person could not have died inside the aircraft, but probably died in the vicinity of burning fuel. What do these values mean? The presence of CO and HCN are targets of opportunity. When they are measured, we do not have to provide for background level.

A cooperative study with Wright-Patterson scientists to determine other gases which might be present during a fire was initiated; the results did not give much to go on.

Animal studies were initiated in which an attempt was made to measure time to incapacity rather than the more crude measurement of waiting a set length of time and then counting the number of dead animals. This has set a trend in the industry. There are two main facets of this experimentation: (1) CO and HCN are additives in toxicity and the results can be extrapolated for man by using a formula which takes into consideration body size and respiratory functions. Dr. Smith supplied charts with his presentation which further explain studies which have been done.

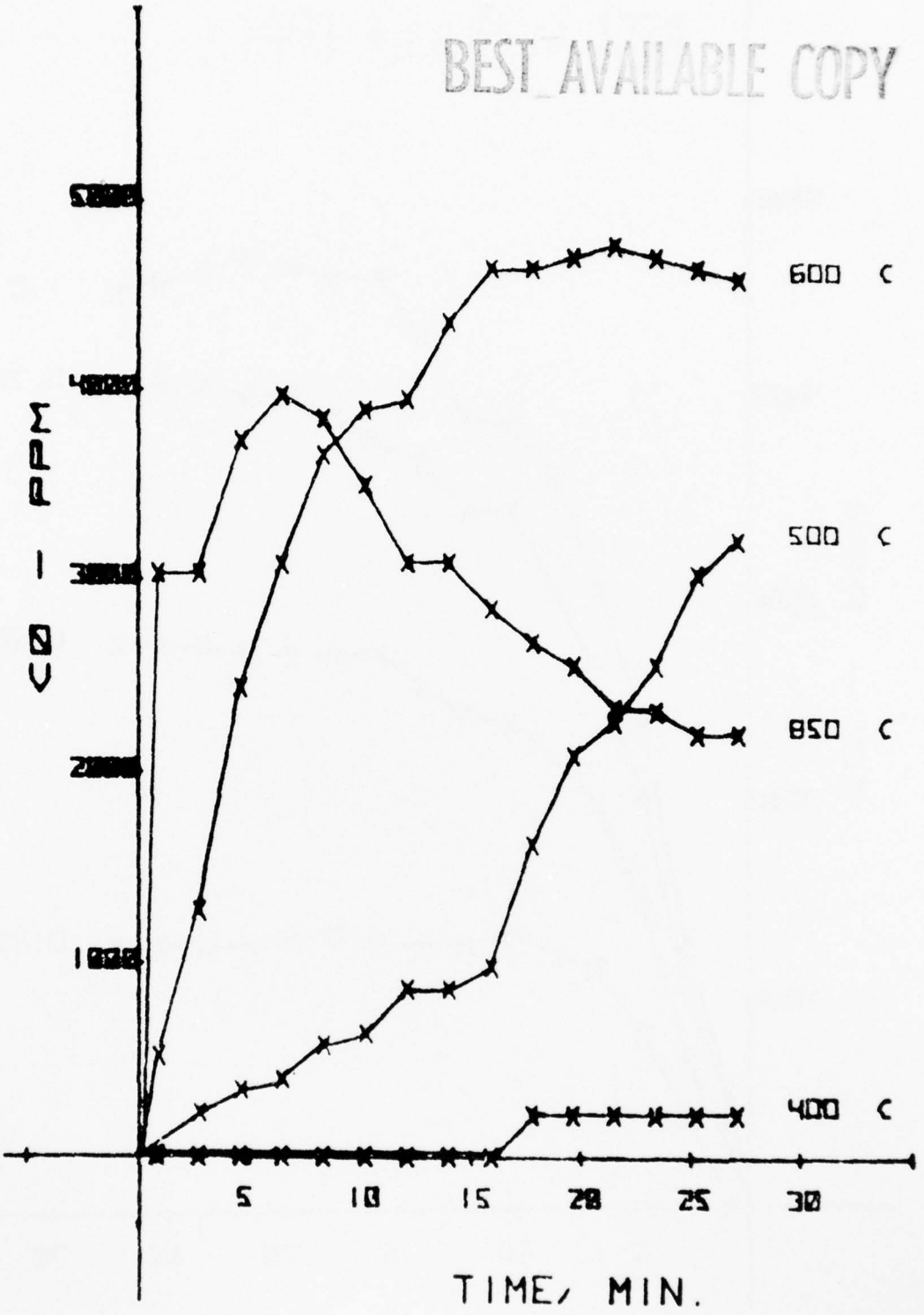


FIGURE II. Effect of temperature on evolution of carbon monoxide

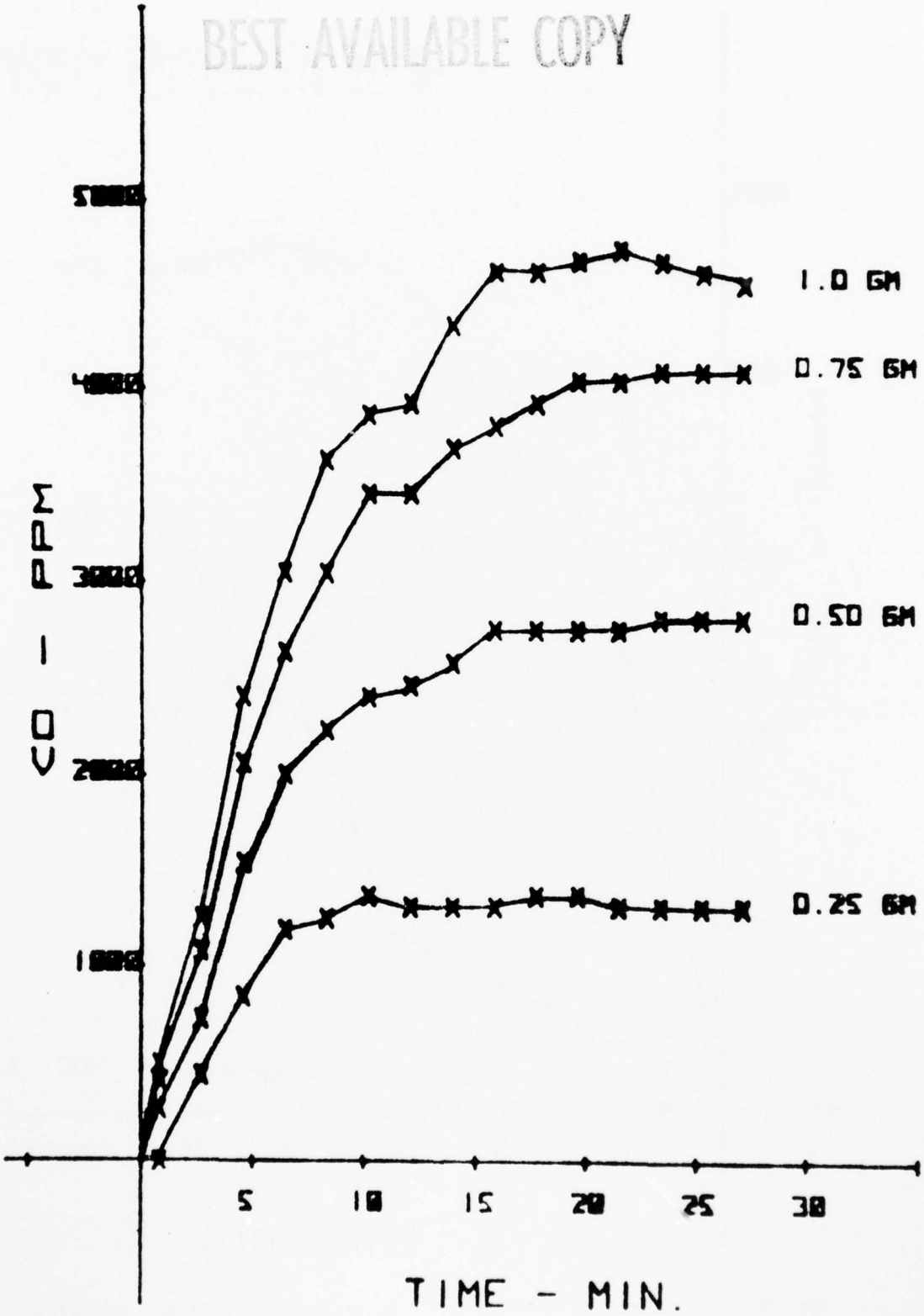
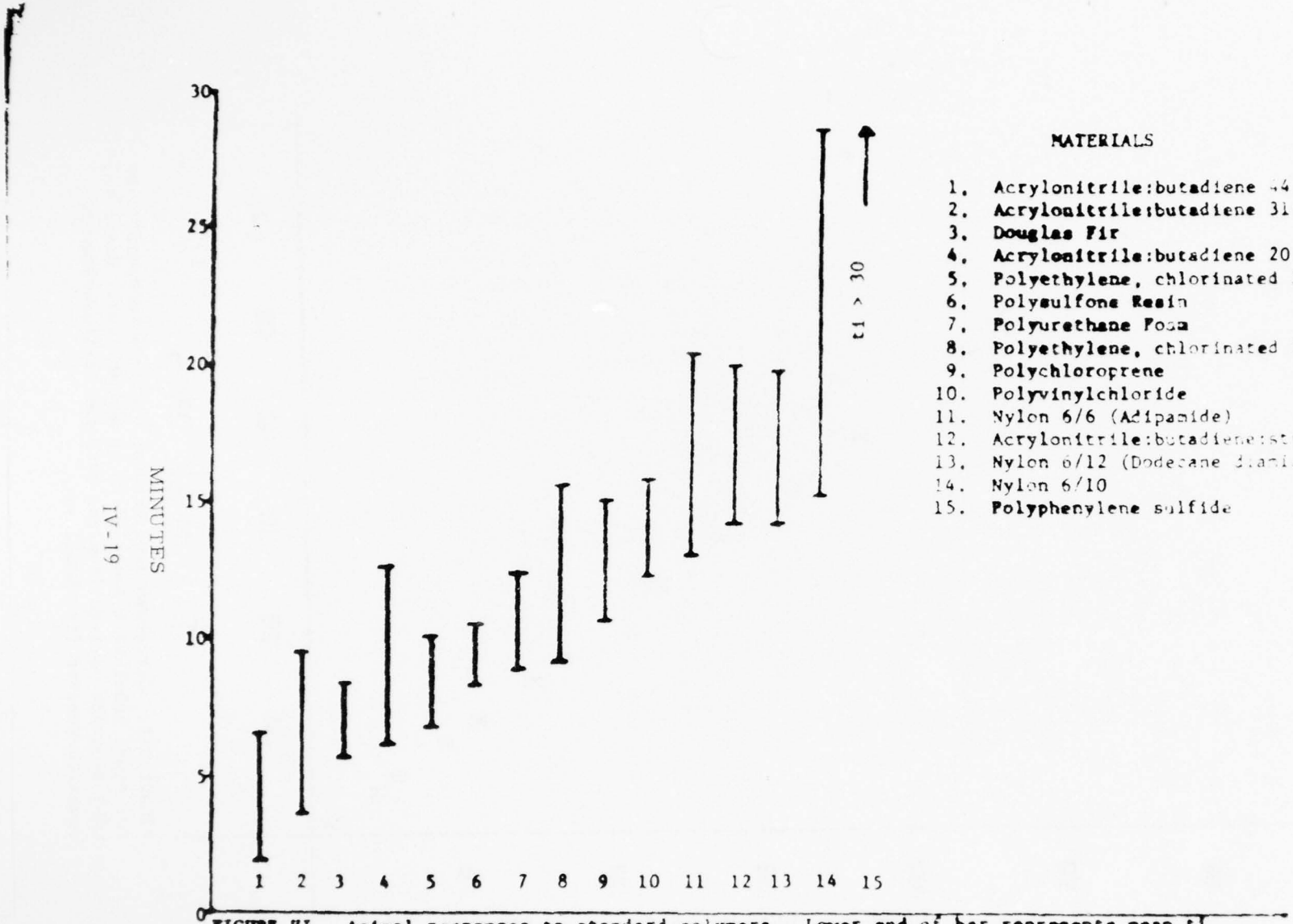


FIGURE IV. Effect of sample size on evolution of CO



MATERIALS

1. Acrylonitrile:butadiene 44:56
2. Acrylonitrile:butadiene 31:69
3. Douglas Fir
4. Acrylonitrile:butadiene 20:80
5. Polyethylene, chlorinated 25%
6. Polysulfone Resin
7. Polyurethane Foam
8. Polyethylene, chlorinated 36%
9. Polychloroprene
10. Polyvinylchloride
11. Nylon 6/6 (Adipamide)
12. Acrylonitrile:butadiene:styrene
13. Nylon 6/12 (Dodecane diamide)
14. Nylon 6/10
15. Polyphenylene sulfide

FIGURE VI. Animal responses to standard polymers. Lower end of bar represents mean t1, upper end represents mean td for a 200-gram rat, 1-gram fuel load, 585° C furnace temperature and a 6 l/min airflow.

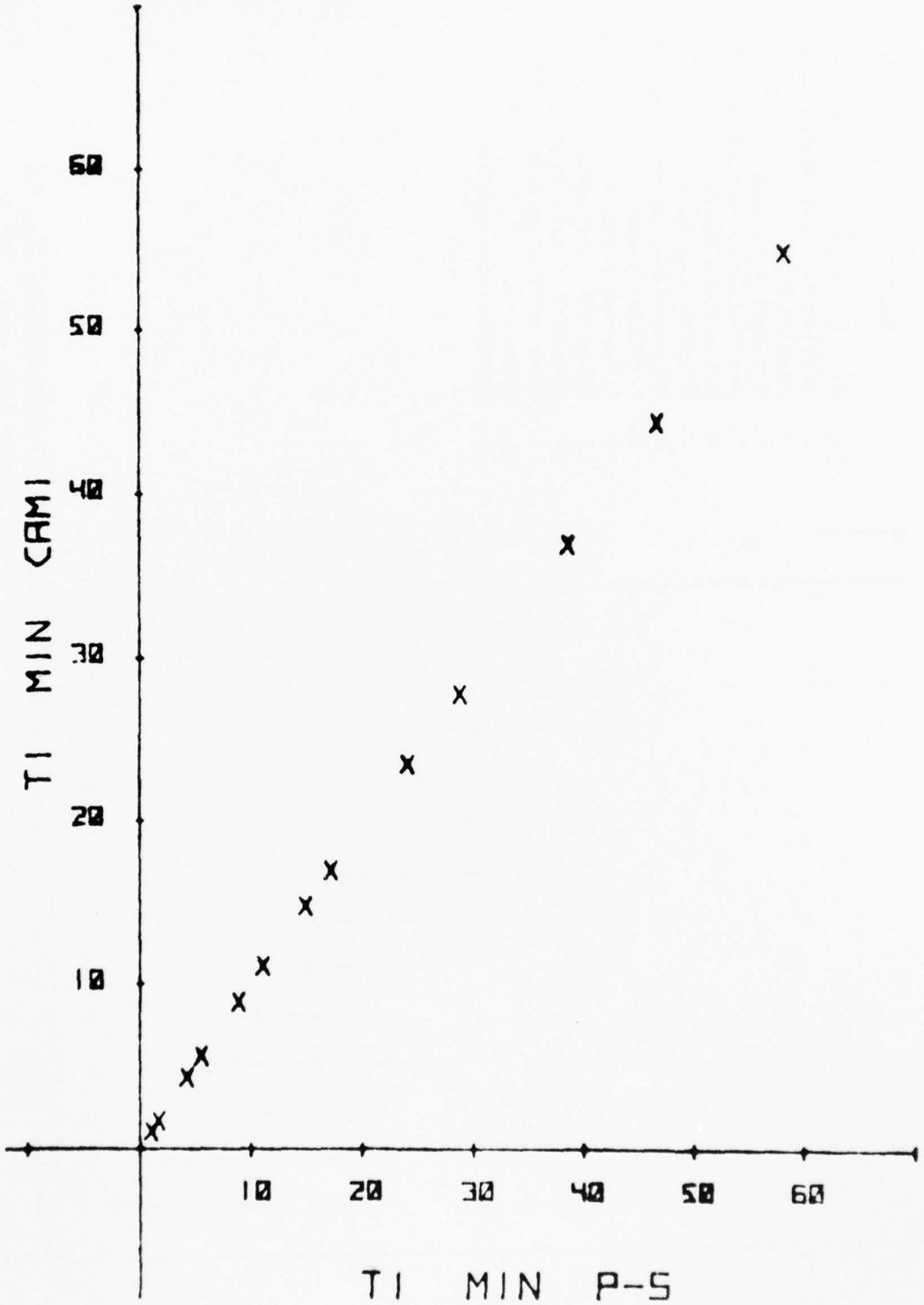


FIGURE VII. Correspondence between times-to-incapacitation for equal inhalation doses of CO in man and rat. Based on CAMI equation derived from rat data and Peterson-Stewart equation derived from human data.

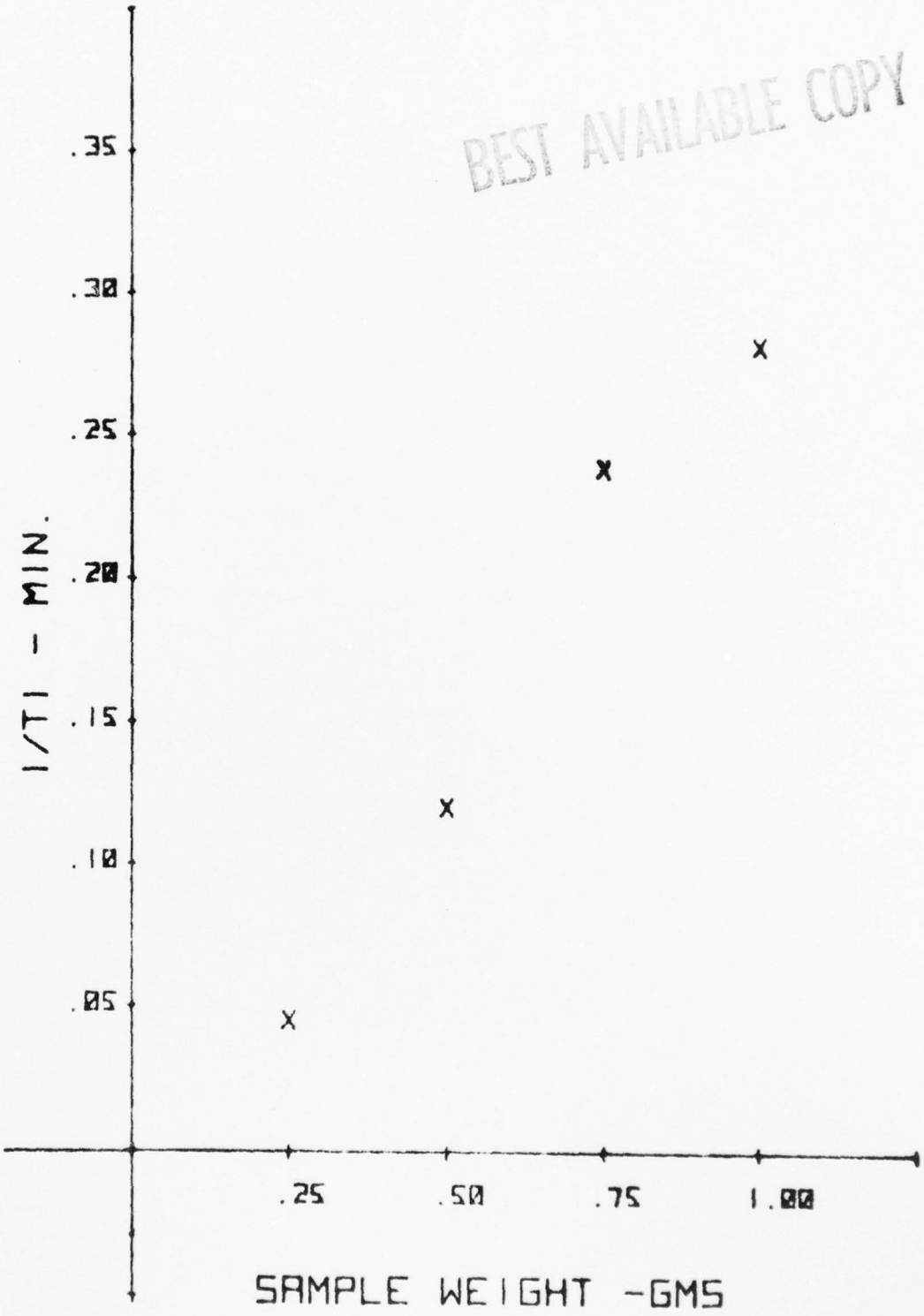


FIGURE VIII. Animal responses in relation to sample size

APPENDIX V

THE DESIGNER'S VIEW OF CABIN SAFETY

Prepared by the
Transport Airworthiness Committee
of the
Aerospace Industries Association

Presented by
Richard Ostlund

THE FAA, AND THE INDUSTRIES WHICH THE FAA REGULATE, HAVE COMBINED THEIR TALENTS THROUGHOUT THE YEARS TO ENSURE THAT THE SAFEST MODE OF TRANSPORTATION EVER DEVISED BY MAN IS AVAILABLE TO THE FLYING PUBLIC. THE EFFORTS OF THESE ORGANIZATIONS HAVE ALSO ASSURED A CONTINUOUS AND SIGNIFICANT SERIES OF IMPROVEMENTS IN THE AREA OF CABIN SAFETY. SOME SPECIAL INTEREST GROUPS CONTINUE TO COMPLAIN THAT NOT ENOUGH IS BEING DONE, AND IN THEIR COMPLAINTS SEEM TO IGNORE THE TREMENDOUS ADVANCES OF THE PAST FEW YEARS AND THE EXISTING ON-GOING PROGRAMS BEING CARRIED ON BY THE GOVERNMENT AND INDUSTRY GROUPS REPRESENTED HERE TODAY.

THESE SPECIAL INTEREST GROUPS SEEM TO CONSISTENTLY ADVOCATE CHANGE WITHOUT PROPER CONSIDERATION OF THE ECONOMIC IMPACT VERSUS DEGREE OF IMPROVEMENT.

ECONOMIC IMPACT MUST BE A CONSIDERATION IN RULE MAKING ACTIVITY. WE HAVE REVIEWED THE RULE MAKING OF THE PAST THIRTY YEARS IN THE AREA OF INCREASED CABIN SAFETY. IT IS INTERESTING TO NOTE THAT AMENDMENTS TO THE RULES ARE OCCURRING WITH INCREASING FREQUENCY. THE NUMBER OF RULE

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CHANGES PER YEAR IN THIS AREA DURING THE PAST 10 YEARS IS ELEVEN TIMES AS HIGH AS THE FREQUENCY OF CHANGES BETWEEN 1945 AND 1965. WHILE THIS TREND IS NOT ALARMING, AS IT SHOWS AN INCREASED AWARENESS OF THE NEED FOR IMPROVEMENTS THAT DID NOT EXIST 30 YEARS AGO, IT IS A MATTER OF SOME CONCERN WHEN WE CONSIDER THAT THE AIRLINES - DURING THIS SAME 10 YEARS - HAVE SUFFERED THE MOST SERIOUS DIFFICULTY IN THEIR HISTORY DUE TO FINANCIAL PRESSURES AND FOREIGN COMPETITION.

THE MANUFACTURERS, THE AIRLINES, AND THE PUBLIC ALL SHARE THE DIRECT BURDEN OF COSTLY RULE CHANGES. THE TRANSPORT CATEGORY AIRPLANES CURRENTLY IN PRODUCTION GENERALLY COMPLY WITH THE CURRENT FEDERAL AVIATION REGULATIONS THAT GOVERN THE MANUFACTURE AND INSTALLATION OF CABIN SAFETY RELATED ITEMS. THESE AIRCRAFT HAVE DEMONSTRATED COMPLIANCE WITH NEW FAR 25, AMENDMENT 15 WHICH REQUIRED A SIGNIFICANT REGULATORY INCREASE IN CABIN SAFETY. RULE CHANGES SUBSEQUENT TO AMENDMENT 25-15 HAVE ESTABLISHED ADDITIONAL REQUIREMENTS FOR SPECIFIC SEGMENTS OF THE AIRCRAFT MANUFACTURING INDUSTRY. COMPLIANCE WITH THE NEW ADDITIONAL REQUIREMENTS HAS BEEN DEMONSTRATED; IN MANY CASES, BY THE AIRCRAFT MANUFACTURER PRIOR TO ISSUANCE OF THE RULE.

THE EXPERIENCES OF THE PAST FEW YEARS HAVE SHOWN US THAT VERY CAREFUL CONSIDERATION IS REQUIRED PRIOR TO IMPLEMENTATION OF FUTURE CHANGES. FAILURE TO DO SO MAY RESULT IN THE GREATER BURDEN THAN OUR GREAT INDUSTRY CAN SUSTAIN.

OUR INDUSTRY HAS HISTORICALLY BEEN SELF-REGULATORY AND THROUGH ANALYSIS OF SERVICE PROBLEMS THIS SELF-REGULATION IS A CONTINUOUS WAY OF LIFE THAT ASSURES LOGICAL, ORDERLY IMPROVEMENTS IN THE PRODUCTS WE MANUFACTURE OR OPERATE. THIS PROCESS RESULTS IN A FIERCE COMPETITION FOR THOSE TWO RESOURCES OF WHICH WE ARE ALL LIMITED -- TIME AND MONEY. OUR FUTURE EFFORTS MUST UTILIZE THESE RESOURCES IN THE MOST EFFICIENT MANNER. ONE WAY IS TO FREE RESOURCES WHICH ARE NOT CURRENTLY BEING UTILIZED EFFECTIVELY. I SPEAK HERE OF A NEW APPROACH TO CERTIFICATION OF AN AIRPLANE UTILIZING ANALYSIS AND COMPUTER SUPPORTED PROGRAMS TO DEMONSTRATE THE EFFECTIVENESS OF THE AIRPLANE EVACUATION SYSTEMS, INSTEAD OF COSTLY TIME CONSUMING FULL SCALE DEMONSTRATIONS.

- o <u>EVACUATION BY ANALYSIS</u>

  WHEN THE RULE MAKING FOR NPRM 66-26 WAS PUBLISHED, NEW DOUBLE WIDTH DOOR DEFINITIONS AND THE RELATED REQUIREMENTS FOR DEMONSTRATIONS OF THE SYSTEM

EVACUATION CAPABILITY PROMPTED THE AIRFRAME MANUFACTURERS TO INITIATE INDEPENDENT BUT PARALLEL PROGRAMS THAT WOULD ASSURE THESE DEMONSTRATIONS FOR CERTIFICATION WOULD BE SUCCESSFUL. THESE DEVELOPMENTAL EFFORTS WERE INTENDED TO REDUCE PROGRAM RISK TO AN ACCEPTABLE LEVEL SINCE NO EXPERIENCE WAS AVAILABLE TO ENSURE THAT THE 90-SECOND EVACUATION REQUIREMENT WAS ACHIEVABLE AND FAILURE TO MEET THE RULE AFTER AVAILABILITY OF PRODUCTION AIRPLANES WOULD PROVE DISASTROUS TO BOTH THE MANUFACTURERS AND THE AIR CARRIERS. THESE DEVELOPMENT DEMONSTRATIONS, COMBINED WITH CERTIFICATION TESTINC THAT UTILIZED OVER 25,000 TEST SUBJECTS IN NUMEROUS TESTS OF PRE-PRODUCTION AND PRODUCTION HARDWARE, RESULTED IN A TREMENDOUS DATA BANK ON SYSTEMS AND HUMAN PERFORMANCE DURING CONDUCT OF EMERGENCY EVACUATIONS FROM WIDE BODY JET AIRCRAFT.

DATA FROM THESE TESTS WAS UTILIZED IN ESTABLISHMENT OF A COMPUTER PROGRAM BY THE FAA AT OKLAHOMA CITY TO PREDICT THE OUTCOME OF EMERGENCY EVACUATION EXERCISES FROM WIDE-BODIED JET LINERS. COMPARISONS OF THE COMPUTER OUTPUT TO ACTUAL TESTS

HAS SHOWN THAT THE TEST RESULTS ARE PREDICTABLE AND VARIABLES SUCH AS THE BEHAVIOR CHARACTERISTICS OF PASSENGERS AND CABIN ATTENDANTS CAN BE INPUT TO ESTABLISH A SPECTRUM OF ANTICIPATED RESULTS SHOULD AN EVACUATION EXERCISE BE CONDUCTED.

NPRM 75-26 WAS PUBLISHED JUNE 10, 1975, AND WOULD ALLOW COMPLIANCE WITH FAR PART 25.803 TO BE SHOWN BY DEMONSTRATION, ANALYSIS, OR A COMBINATION OF TEST AND ANALYSIS WHERE THE ADMINISTRATOR FINDS THAT THE ANALYSIS OR COMBINATION OF TEST AND ANALYSIS WOULD PROVIDE DATA EQUIVALENT TO *THAT WHICH WOULD BE OBTAINED* BY ACTUAL DEMONSTRATION.

THE AIA ENDORSES THIS PROPOSED CHANGE TO FAA PART 25.803 AS AN IMPROVEMENT TO AVIATION SAFETY. THE AVAILABLE DATA BANK FROM PAST EXPERIENCE CAN BE PUT TO EFFECTIVE USE, FEWER TEST SUBJECTS WILL BE EXPOSED TO INJURY DURING TEST EVACUATION, THE RULE CHANGE WILL ENCOURAGE COOPERATION AND UNDERSTANDING BETWEEN ALL PARTIES EARLY IN THE DEVELOPMENT PHASE OF A NEW AIRPLANE, AND THE

TOTAL INDUSTRY AND THE FLYING PUBLIC WILL BENEFIT AS WELL.

CABIN MATERIALS

IN THE AREA OF CABIN MATERIAL SELECTION, EFFECTIVE UTILIZATION OF INDUSTRY RESOURCES HAS NOT BEEN ACHIEVED. THE RESULT HAS BEEN DUPLICATION OF EFFORT AND THE PROPOSED APPLICATION OF RULES UPON RULE WITH DIFFERENT EFFECTIVE INCORPORATION POINTS FOR DIFFERENT CHARACTERISTICS OF THE SAME MATERIAL. FOR THIS REASON WE NEED AN OVERALL HAZARD INDEX FOR CABIN MATERIALS AS THE MEANS OF ENFORCING AN ORDERLY ECONOMIC APPROACH TO REGULATING CABIN MATERIALS CHARACTERISTICS.

TESTS PROMULGATED UNDER FAR 25.853 GREATLY REDUCED THE FLAME PROPAGATION CHARACTERISTICS FOR ACCEPTABLE MATERIALS. THIS INDUCED FABRICATORS TO MODIFY THEIR MATERIALS TO FURTHER IMPROVE SELF-EXTINGUISHING CHARACTERISTICS. THESE INHIBITING MATERIALS GENERALLY PRODUCE MORE SMOKE AND TOXIC GAS WHEN LOCATED IN A FIRE ENVIRONMENT THAN THEIR UNIMPROVED PREDECESSORS. DUE TO STATE-OF-THE-ART KNOWLEDGE, QUALIFYING TESTS HAVE BEEN PROPOSED AS A SERIES OF SEQUENTIALLY APPLIED "SCREENS" THAT WOULD ULTIMATELY RANK A MATERIAL FOR ITS COLLECTIVE ACCEPTABILITY. UNFORTUNATELY, THESE SEQUENTIAL TESTS

WOULD NOT CLEAR THE CONFUSION WITH REGARD TO THE RELATIVE HAZARDS OF FLAMMABILITY, SMOKE, AND TOXICITY. AN INTEGRATED TEST METHOD CAPABLE OF COMPARING A MATERIAL FOR ITS TOTAL COMBUSTION HAZARDS IS NOW TECHNICALLY FEASIBLE. RELATING THIS HAZARD INDEX TO A SPECIFIC FIRE SCENARIO IN A MODERN AIRCRAFT WOULD RESULT IN MATERIALS IMPROVEMENT WITH BALANCED HAZARD EMPHASIS (A BETTER INDEX WOULD BE A BETTER MATERIAL). THIS INDEX WOULD RESULT IN A SIMPLIFIED TEST METHOD SUITABLE FOR MATERIALS PROCUREMENT.

THE AIA IS INTERESTED IN THE PARTICIPATION IN A JOINT TASK FORCE LEADING TO DEVELOPMENT OF AN ACCEPTABLE HAZARD INDEX AND STANDARDIZATION OF TEST METHODS.

SMOKE PROTECTION

DISCUSSIONS IN THE RECENT PAST HAVE RESULTED IN THE PROPOSED REQUIREMENT FOR PROTECTIVE SMOKE HOODS FOR USE BY PASSENGERS AND CREWMEMBERS DURING AN EMERGENCY. WE HAVE SERIOUS CONCERNS THAT SUCH DEVICES WOULD RESULT IN AN OVERALL DECREASE IN THE CABIN SAFETY LEVEL INSTEAD OF AN INCREASE SUCH AS STATED BY PROPONENTS OF THE SYSTEM.

TYPICAL COMMENTS BY FAA RESEARCHERS IN THE PAST RELATIVE TO EMERGENCY EVACUATION HAVE INCLUDED:

- "ESCAPE FIRST --- LOOK FOR FIRE AFTERWARDS!"

- . . . "IN LAND EVACUATIONS NO DELAYS SHOULD BE IMPOSED BY REMOVAL AND TRANSPORT OF PARAPHENALIA DURING THE EVACUATION; WHILE, IN WATER EVACUATIONS, SURVIVAL DEPENDS UPON THE ACCOMPANYING EQUIPMENT."

WITH THE RELEASE OF NOTICE 69-2 THERE IS ACKNOWLEDGEMENT THAT AN EVACUATION TIME INCREASE UP TO 8 PERCENT IS ACCEPTABLE.

MOREOVER, THE NOTICE STATES THAT THE 8 PERCENT "ACCEPTABLE" TIME INCREASE IS THE RESULT OF "PRELIMINARY ANALYSIS" OF EVACUATION TESTS. IN ADDITION, THE TESTS WERE CONDUCTED WITH BRIGHT PHOTOFLOOD ILLUMINATION INSIDE AND OUTSIDE THE AIRPLANE AND WITH TELEVISION COVERAGE IN FULL VIEW OF THE FAA EMPLOYEES AND THEIR FAMILIES WHO WERE PARTICIPATING IN THE TESTS. HAD TESTS BEEN CONDUCTED UNDER MORE REALISTIC CONDITIONS THE INCREASE IN TIME REQUIRED WOULD PROBABLY HAVE BEEN MUCH GREATER.

COMBINING THESE FACTS WITH AIA TESTS RESULTS WHICH SHOW SUBSTANTIAL DECREASE IN EVACUATION RATE AND THE FACT THAT SUFFOCATION CAN OCCUR IN THE HOOD DESCRIBED IN NOTICE 69-2, IT APPEARS THAT THE PROPOSED RULE WAS NOT TECHNICALLY JUSTIFIED.

COMPARED HERE ARE SOME SIGNIFICANT ASPECTS OF FAA, CAMI - CONDUCTED EVACUATION DEMONSTRATIONS AND THE AIA TESTS CONDUCTED DURING THE AIS CRASHWORTHINESS DEVELOPMENT PROGRAM WHICH SUPPORT THIS CONCLUSION.

THE CAMI DEMONSTRATION DID NOT COMPLY WITH THE FEDERAL AIRCRAFT (sic) REGULATIONS IN WHICH SMOKE HOODS WERE PROPOSED TO BE MADE A REQUIREMENT.

- THEY WERE CONDUCTED IN EXTREMELY BRIGHT LIGHT; DARKNESS IS REQUIRED.
- CREW AND PASSENGERS KNEW WHERE ALL USABLE EXITS WERE; THEY COULD SEE OFF-WING DESCENT RAMPS OUT THE WINDOWS. REGULATIONS REQUIRE THAT WINDOWS BE COVERED.
- STEWARDESSES WERE STANDING AT USABLE EXITS AT THE EVACUATION START SIGNAL; REGULATIONS REQUIRE THEM TO BE SEATED WITH SEAT BELTS AND SHOULDER HARNESSES FASTENED.
- IN ONE DEMONSTRATION HOODS WERE PUT ON BEFORE THE EVACUATION START SIGNAL.
- PUBLIC TELEVISION COVERAGE WAS CARRIED OUT IN FULL VIEW OF PEOPLE PARTICIPATING IN THE DEMONSTRATIONS.

THE AIA - CONDUCTED TESTS COMPLIED WITH REGULATIONS WITH RESPECT TO THOSE ITEMS NOTED FOR THE CAMI TESTS. THEY DID, HOWEVER, DIFFER FROM STANDARD EVACUATION DEMONSTRATIONS AS FOLLOWS:

- o A FULL PASSENGER COMPLEMENT WAS NOT USED.
- o RECORDED CRASH NOISE AND SMOKE STIMULI WERE USED.
- o ESCAPE SLIDES (OUTSIDE CLOSED DOORS) WERE IN PLACE BEFORE TESTS.
- o THERE WAS NO CREW PARTICIPATION AFTER EXIT PREPARATION.
- o AUDITORY AND TACTILE EVACUATION AIDS AND EXIT SIGNS WERE EVALUATED DURING TESTS.

THE AIA TESTS WERE CAREFULLY CONTROLLED AND DESIGNED TO LIMIT HUMAN FACTOR VARIABLES TO ISOLATE TRENDS OF HUMAN ACTION. EIGHT GROUPS OF SUBJECTS INEXPERIENCED IN EVACUATION TECHNIQUES WERE OBTAINED THROUGH AN OUTSIDE CONTRACTOR. LIGHT INSIDE COMPARISON OF RESULTS OF EVACUATION TESTS WITH AND WITHOUT SMOKE HOODS SHOWED THAT IN THE AIA TESTS SMOKE HOODS SLOWED EVACUATION RATES 30 PERCENT UNDER EMERGENCY ILLUMINATION IN EXCESS OF FAA MINIMUMS.

ALTHOUGH HUNDREDS OF BILLIONS OF PASSENGER-MILES HAVE BEEN FLOWN SAFELY, THERE HAVE BEEN ACCIDENTS AND FATALITIES. ALL OF THESE MUST BE EXAMINED TO DETERMINE THE NEED OR ADVISABILITY OF EQUIPMENT TO BE USED FOLLOWING AN ACCIDENT. NEW DEVICES PROPOSED IN THE NAME OF SAFETY MUST NOT CREATE A HAZARD IN THEIR USE AND MUST BE SHOWN BENEFICIAL IN FATALITY REDUCTION.

THERE WERE 35 ACCIDENTS WITHOUT SURVIVORS WHICH WERE, AS FAR AS KNOWN, NOT IMPACT SURVIVABLE. THESE, THEREFORE, ARE NOT PERTINENT TO THE QUESTION OF SMOKE HOODS USE. IMPACT-SURVIVABLE ACCIDENTS WHICH HAVE ALMOST ALWAYS OCCURRED AT TAKEOFF OR LANDING ARE RELEVANT. THERE HAVE BEEN 16 OF THESE ACCIDENTS IN OVER 17 MILLION AIRPORT OPERATIONS. THERE ARE 119 KNOWN OCCASIONS WHEN FIRE DID OR COULD HAVE BROKEN OUT, BUT THERE WERE NO FATALITIES. THESE ALSO ARE RELEVANT TO THE QUESTION OF SMOKE HOOD USE.

IN THESE RELEVANT ACCIDENTS THERE WERE 542 FATALITIES AND MORE THAN 8,900 SURVIVORS. IF PASSENGER SMOKE HOODS HAD BEEN REQUIRED EQUIPMENT ON THE AIRPLANES IN THESE ACCIDENTS, THE SIGNIFICANT QUESTION IS, "WHICH OF THESE NUMBERS WOULD HAVE DECREASED?"

CONSIDERING THE HISTORICAL FACTS OF JET TRANSPORT ACCIDENTS AND THE EVIDENCE OF THE AIA EXPERIMENTAL PROGRAM, IT APPEARS THAT THERE IS CONSIDERABLY LESS THAN TECHNICAL JUSTIFICATION FOR SMOKE HOODS. THERE IS SIGNIFICANT EVIDENCE THAT SMOKE HOODS COULD DETRACT RATHER THAN CONTRIBUTE TO SAFETY FOLLOWING AN AIRCRAFT ACCIDENT.

CONCLUSION:

A PROGRAM OF SMOKE HOOD RESEARCH WAS RECOMMENDED BY THE AIA IN JULY, 1968. THE WORK REQUIRED TO OBTAIN FURTHER DATA UPON WHICH FIRM CONCLUSIONS MIGHT BE BASED WAS DESCRIBED. AN ESSENTIAL PART OF THIS WORK WAS GROUP EVACUATION TESTS IN A DENSE, IRRITATIONAL SMOKE ENVIRONMENT. LATEST SMOKE HOOD MODELS DO INCORPORATE IMPROVEMENTS IN INDIVIDUAL PROTECTION FEATURES THAT WERE FOUND DEFICIENT BY THE AIA. HOWEVER, INFORMATION AVAILABLE TO THE AIA INDICATES THAT ESSENTIAL TESTS THAT HAVE NOT BEEN CONDUCTED INCLUDE THE NECESSARY GROUP EVACUATION TESTS IN A REALISTIC SMOKE ENVIRONMENT.

CONSIDERING ALL EXPERIMENTAL AND ANALYTICAL DATA AVAILABLE AT THIS TIME, SMOKE HOODS COULD ENDANGER THE LIVES OF AIRLINE PASSENGERS. IT MUST BE NOTED THAT, AS THE HOODS ARE IMPROVED, THEIR WEIGHT, BULK, AND COST SEEM TO INCREASE ACCORDINGLY. UNFORTUNATELY, THE ECONOMIC BURDEN DUE

TO INITIAL COST AND INSTALLATION AND THE ANTICIPATED HIGH REPLACEMENT COST DUE TO SOUVENIR REMOVALS, MAY MAKE CONSIDERATION PROHIBITIVE. IT REMAINS TO BE SHOWN THAT THE USE OF THE HOODS MAY SAVE LIVES BUT WILL NOT CONTRIBUTE TO LOSS OF LIFE.

IN THESE SAME AREAS OF CABIN SAFETY, WE ALL HAVE THE SAME OBJECTIVES. WE ALL STRIVE FOR NECESSARY IMPROVEMENTS AND HIGHER STANDARDS. IN THIS VEIN, THE AIA RECOGNIZES AND SUPPORTS THE EFFORTS OF THE ATA, AND THE FLIGHT AND CABIN CREW ORGANIZATIONS IN WORKING DILIGENTLY TOWARD IMPROVEMENTS IN CREW TRAINING, PASSENGER PREFLIGHT BRIEFINGS, AND BETTER PASSENGER INFORMATION LITERATURE.

THE FAA IS RECEIVING MANY RECOMMENDATIONS FROM VARIOUS SOURCES THAT PURPORT TO INCREASE THE SAFETY OF AIR TRANSPORTATION. BECAUSE INCREASED SAFETY IS SOMETHING WE ALL DESIRE TO ACHIEVE, THESE RECOMMENDATIONS QUICKLY GET ATTENTION AND ARE THRUST UPON THE FAA, OFTEN POORLY CONCEIVED AND OF DOUBTFUL WORTH BUT WITH STRONG BACKING. EVEN CONGRESS HAS TAKEN JURISDICTION AND PASSED LAWS WITHOUT PROPER INVESTIGATION SUCH AS THE EMERGENCY LOCATOR TRANSMITTER (ELT). IN ORDER TO PREVENT RULE CHANGES THAT HAVE LITTLE OR NO POSITIVE EFFECT ON THE SAFETY OF AIR TRANSPORTATION BUT DO INCREASE THE COST AND COMPLEXITY

OF THE SYSTEM, A CRITERIA MUST BE APPLIED TO THESE RECOMMENDATIONS, NO MATTER WHAT THE SOURCE, SO THAT THE WHEAT CAN BE SIFTED FROM THE CHAFF BEFORE MUCH TIME AND MONEY IS EXPENDED.

DR. MC LUCAS, FAA ADMINISTRATOR, IN HIS SPEECH AT THE COMMENCEMENT OF THE BIENNIAL OPERATIONS CONFERENCE, DECEMBER 4, 1975, PROPOSED CRITERIA TO BE APPLIED TO PROPOSED REGULATIONS. THIS SAME CRITERIA SHOULD BE APPLIED HERE TO RECOMMENDATIONS IN THE CABIN SAFETY SEMINAR.

1. IS IT REALLY REQUIRED?

   CAN THE PROBLEM BE SOLVED BY BETTER TRAINING OR BETTER MAINTENANCE?

2. WHAT PROBLEM IS IT SOLVING?

   THE PROBLEM MUST BE CLEARLY DEFINED, NOT JUST SUSPECTED OR EMOTIONALLY CONCEIVED.

3. WHAT IS THE ECONOMIC IMPACT?

   THE AIR TRANSPORTATION INDUSTRY IS IN A TIGHT MONEY SQUEEZE. THE AIRLINES PROVIDE THE SAFEST TRANSPORTATION AVAILABLE AT A PRICE THAT IS IN REACH OF A HIGH NUMBER OF PEOPLE, BUT THE

ECONOMIC IMPACT OF SOME RECOMMENDATIONS IS SO STAGGERING AS TO THREATEN THE INDUSTRY'S SURVIVAL WITH LITTLE OR NO INCREASE IN SAFETY.

4. WHAT IS THE WORKLOAD ON THOSE THAT WILL BE REQUIRED TO RESPOND?

MANY THOUSANDS OF MAN/HOURS HAVE BEEN SPENT JUST CONSIDERING THE BIANNUAL AIRWORTHINESS & OPERATIONS REVIEWS. EVERY RECOMMENDATION THAT IS PROPOSED REQUIRES TIME TO RESPOND TO. THEREFORE, THESE RECOMMENDATIONS SHOULD BE SCREENED THROUGH THIS CRITERIA AND THOSE THAT DO NOT MEET IT SUMMARILY DROPPED SO THAT THE AVAILABLE EFFORT CAN BE USED ON THOSE THAT HAVE MERIT.

CHANGES CREATE GREAT WORKLOAD PROBLEMS FOR THE AIRLINES IN COMPLYING WITH THESE CHANGES. AIRPLANES MUST BE PULLED OUT OF SERVICE, IN MOST CASES, AND REVENUE - SO BADLY NEEDED - IS LOST. EVERY EFFORT SHOULD BE MADE TO ASSURE THE LEAST DISRUPTION POSSIBLE.

IN ADDITION, THE POLICY STATEMENT REGARDING RULE MAKING FROM THE OFFICE OF W. T. COLEMAN, JR., SECRETARY, DEPARTMENT OF TRANSPORTATION, DATED APRIL 13, 1976, MUST

BE ADHERED TO SO THAT THE AIR TRANSPORTATION INDUSTRY WILL CONTINUE TO IMPROVE IN THE MOST COST-EFFECTIVE MANNER.

APPENDIX VI

NATIONAL TRANSPORTATION SAFETY BOARD PRESENTATION

Mr. Walhout reviewed the Continental Airlines accident, Denver, Colorado, August 7, 1975; and the Ketchikan, Alaska, accident on April 5, 1976. He pointed out that both accidents were survivable and had several things in common. He listed five things which could be learned from these accidents:

1. Flight attendant protection is inadequate,
2. Restraint system installations are inadequate,
3. Galley security is inadequate,
4. Seat restraint is marginal, and
5. Manufacturers should not be required to design for equipment failures caused by fuselage damage.

He also pointed out that a recent study (as yet unpublished) by the Safety Board concerning fire-involved air carrier accidents over a 5-year period from 1965 to 1974 shows that occupants have a 37% better chance of safely egressing a burning aircraft than was found during a previous 10-year study period on the same subject from 1955 to 1964. This is in spite of the fact that the potential of fire being a factor in accidents has increased from 18% to 25% in these two studied periods.

LIMITING FACTORS IN CABIN SAFETY IN CIVIL AIR CARRIER ACCIDENTS
(A review of two survivable accidents)

PRESENTED AT FAA AND INDUSTRY REVIEW OF CABIN SAFETY
IN AIR CARRIER OPERATIONS SEMINAR AUGUST 31, 1976

by

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The subject of cabin safety and the emphasis on injury prevention and survival in air carrier operations was given considerable impetus during 1960's. At this time the FAA issued several NPRMs and the subsequent enactment of most of these rules resulted in a comprehensive and detailed set of Federal Aviation Regulations (FARs) regarding the number, type, arrangement, lighting and accessibility of emergency exits and evacuation slides and which required demonstrated rapid passenger evacuation as part of the aircraft certification process. These improvements have paid off. A recent study (as yet unpublished) by the Safety Board concerning fire-involved air carrier accidents over a ten-year period from 1965 to 1974 showed that occupants have a 65 percent better chance of safely egressing a burning aircraft than what was found during a previous ten-year study period on the same subject from 1955 to 1964. This is despite the fact that the potential of fire being a factor in accidents has increased from 18 percent to 25 percent in these two studied periods.

Occupant survival in an aircraft accident depends on many factors. In broad and simple terms, survival, first of all, is a function of

the intactness of the occupiable area (that is, living space must be provided throughout the accident sequence); secondly, it is a function of the forces generated by the aircraft decelerative processes which must remain within the limits that can be endured by the occupants; and thirdly, it is a function of the occupant's participation in the decelerative processes (that is, they must be restrained in their seats and their seats must remain secured to the airframe structure).

When these conditions are met, theoretically we have a survivable accident. However, conditions can become intolerable rapidly after surviving the impact, mainly because of fire and in the case of a ditching, the threat of drowning. Thus, post-crash conditions also become vital factors in the survival picture. Survival therefore, also is a function of the availability of adequate exit provisions; availability of unobstructed pathways to these exits; and knowledge by the occupants of their escape routes. But the vital factor in post-crash survival is time. While there are many other factors (such as adequate lighting), the importance of the time factor is reflected in the 90 second evacuation demonstration requirement of the FAR's.

To illustrate some of the limiting factors involving cabin safety that pertain to survival, I will review two recent survivable accidents with you. The first one occurred on the Stapleton International Airport at Denver, Colorado on August 7, 1975. There were 124 passengers, four flight attendants and three cockpit crewmembers on board this Boeing 727. The accident resulted when the aircraft, immediately after lift off, encountered a severe down draft which caused it to settle

back to the ground. The aircraft crashed within the boundaries of the airport on relatively level terrain. The aircraft hit tail first, causing a circumferential fracture of the aft fuselage at the two rear exits. Subsequently, the aircraft slid to a stop causing another circumferential break of the fuselage which extended from just aft of the main forward entry door to the forward lavatory which is located aft of the cockpit bulkhead. The entire crash sequence involved about 2,000 feet of aircraft travel. There was no fuel spillage and a fire did not occur. Of the 52 occupants taken to hospitals in the area, seven crewmembers and 19 passengers were admitted for treatment and observation. Of these occupants, the captain, four flight attendants and 10 passengers received serious injuries involving spinal fractures, rib fractures, and fractures of the extremities.

The evacuation was started almost immediately when the aircraft came to a stop and it was passenger initiated. The reason for this was twofold: the two forward flight attendants seated on a rearward-facing jumpseat were rendered unconscious during the crash sequence when their heads were repeatedly thrown against the unpadded cockpit bulkhead to which their seat was attached. Aggravating the situation was the failure of the coat closet facing them. This closet moved forward and the upper part slipped forward against the cockpit bulkhead, effectively trapping both flight attendants in their seat. The failure of the coat closet most likely was caused by a fracture

of the cabin floor structure directly underneath the closet. The closet moved forward, striking the evacuation slide pack on the forward entry door. This rotated the closet slightly outboard after which it struck the inboard edge of the flight attendant's jump seat with sufficient force to fail the seat downward. This particular sequence probably saved the life of the flight attendant seated on the inboard side of the jumpseat. Had the closet not caused the failure of the jumpseat, allowing her to move downward and toward the aisle, she would have received serious if not fatal head injuries considering that only 3 inches of clearance remained at the normal head position. Furthermove, the coat closet now blocked effectively access to the forward main entry door.

The two flight attendants located in the rear of the cabin were seated on their jumpseat which is attached to the door leading to the air stair. While the flight attendants stated that they had their restraint system adjusted snugly, they tightened it at the first sign of turbulence shortly after take off. During the crash sequence one of the flight attendants, in an attempt to steady herself, grabbed the door handle and caused the door to open. To aggravate matters, the tightening of the shoulder harnesses caused the lap belt to move upward to just below the rib cage. Having the lap belt this high on the body, causes inadequate restraint of the lower torso. Both flight attendants consequently submarined out from under the seatbelts. The swinging door then closed on the shoulder of one of the flight attendants causing a serious injury to the shoulder joint. The other flight attendant managed to release her restraint harness, unfastened her partner's belt and moved over seatbacks to the left overwing exits

where the evacuation was already in progress. The injured flight attendant managed to extract herself from her harness and directed the evacuation from the rear of the cabin.

While all galley units in the forward and aft cabin remained attached to the aircraft's structure, failure of the upper tie down pins of the most forward galley unit caused this unit to tilt inboard. However, it didn't block the aisle appreciably. While there was some debris reported in the forward galley door pathway, these two units remained intact as far as the individual compartments and their contents is concerned. Much more debris was released from the aft galley units, from which several tray carriers, waste containers and other miscellaneous items were released. Both these units remained firmly attached to the aircraft structure, but the flooring was disrupted extensively by the break in the fuselage at this location. The galley door was made inoperable because of this break; however, the opposite exit could have been used.

While considerable debris littered the aisles because the overhead bins opened and spilled their contents, these were reported to be minor or not obstructions to egress. However, ceiling panels had fallen down throughout the cabin and they were reported as hindering free movement to exits.

To summarize, this accident was entirely survivable by definition. The forces were well within the tolerance of both man and machine; the fuselage remained relatively intact to provide a protective container; there were no restraint system failures as such and there was no fire.

The limiting factors in this accident were the incapacitation of the flight attendants, two because of unconsciousness and two because of the failure of their restraint system to give adequate protection. In the final analysis, only one flight attendant was able to give effective aid. Secondly, the coat closet failed because of structural fuselage failure, blocking a primary exit. Thirdly, another structural failure of the fuselage partially blocked another primary exit and caused the opposite exit to be entirely inoperable. Fourthly, while the galleys remained attached to primary structures, some of their contents were spilled and contributed to obstructions to egress. Five of the nine exits in the cabin were used during the evacuation.

The next accident I would like to discuss occurred at the Ketchikan Airport in Alaska on April 5, 1976. There were 43 passengers and four flight attendants and three cockpit crewmembers on board this Boeing 727. The accident resulted when the aircraft, after conducting a visual approach, overshot the end of the runway and crashed into a ravine 41 feet below the runway elevation and 700 feet from the departure end of the runway. The aircraft broke in three places; just behind the cockpit, just forward of the wing root and near the ventral stairs exit.

Of the 50 occupants there was one fatality and eight were seriously injured although three more were hospitalized for observation. All three cockpit crewmembers, one flight attendant and four passengers were listed as serious which included spinal fractures, rib fractures, a skull fracture and fractures of the extremities. The fatality involved a massive skull fracture combined with a seat failure (and thus loss of restraint).

A fire started almost immediately around the engines at the tail of the aircraft and a flash fire occurred on the right side of the aircraft when the right wing broke away. The aircraft came to rest on numerous tree stumps in the area, destroying the belly of the aircraft. This is also believed to have caused some of the numerous seat failures which occurred in the cabin.

The evacuation, again, was passenger initiated. The four flight attendants did not have a chance to proceed to their stations because the signal that landing was eminent was given on short final. This also caused the landing announcement via the public address system to be incomplete. The four flight attendants (FA) were seated in 6C, 8C, 22C, and 22D, respectively. The FA in 6C, after the aircraft came to rest, got up shouting to release seatbelts and to follow her and made her way to the galley but she was blocked by something she could not identify. She then worked her way to the forward door where she helped a woman exit through the crack in the forward left door. She followed the woman out. The flight attendant in 8C found herself hanging upside down in her seat near or at row 5. Someone lifted her seat and she released her belt and crawled free. She then crawled over the aux galley and possibly some loose seats and proceeded to the first class section where she found the aisle unobstructed. She also made her escape through the crack in the main door. The FA in 22C thought his seat moved upward and forward on impact but he found himself upright. He did not recall releasing his seatbelt and heard the "D" FA say that

she was stuck in her seat. He proceeded to the rear stair door and opened it without difficulty. He then attempted to lower the ventral stairs without success. He stepped forward and saw daylight through a break in the tail, through which he exited. While exiting, he heard the "D" FA shout to come this way, and shortly thereafter she exited through the same break.

The FA in 22D was thrown forward and she found her foot caught between the seat and the armrest in front of her. Her seatbelt also was difficult to release. The cabin in front of her was blocked by debris, wires and seats from floor to ceiling. She recalled that she and the "C" FA did not have a sufficient room to stand up straight near their seats. She exited through the break in the fuselage behind the airstair door.

Of the three galley units in the cabin, the No. 2 galley was destroyed and its contents scattered forward into the cabin. The other two units were found intact. No one remembered seeing emergency lights in the cabin. The cabin was dark and illuminated only by the fire outside the aircraft. Of the seven exits in the cabin three were used in the evacuation while breaks in the fuselage at two locations also were used as escape routes. The main cabin door was jammed; fortunately it had been forced partially open during the crash, allowing a 1 foot opening for egress of about fourteen occupants from the first nine rows of seats. One passenger escaped through a break at the No. 2 galley, two passengers went through

a break at about row 8. All other passengers (about 27) escaped through the left overwing exits.

In summary, then, this accident also is classifiable as survivable, although not entirely by definition. While the crash forces were within tolerance, they probably approached the limits of both men and machine because of the predominantly vertical forces generated in this accident. The fuselage provided a protective shell around the occupants, although, again, the limits probably were approached in view of the damage incurred by the floor and ceiling in several places and the impending breakup of the fuselage. Thirdly, restraint was lost by many of the occupants, involving at least ten seat units. Fortunately, however, the longitudinal forces were not of a sufficient magnitude to give these occupants appreciable velocity within the cabin. Nevertheless, the one fatality experienced in this accident can be attributed directly to the loss of restraint because of the seat failure.

The limiting factors in this accident were the inability of the flight attendants to aid passengers in any significant way. This was because of the damage incurred in the cabin and because of injuries sustained by them, including shock trauma. Secondly, the ventral stairs and the main forward cabin door were inoperable, although the main door was partially open and used. Furthermore, the right side overwing exits were not used nor was the galley service door. The overwing exits probably were not used because there was a residual fire on that side from the separation of the right wing, while the galley service door might not have been visible or reachable because of galley debris. Thirdly, the failure of many seats caused obstructions to

egress as well as probable disorientation of the occupants as to the location of the emergency exits.

Well, what is to be learned from these two accidents with regard to cabin safety? Let me touch on just a few. While one of these accidents was relatively low on a severity scale, the other approached the limits of survivability. Yet both accidents have much in common regarding cabin safety. These commonalities are as follows:

1. Flight Attendant protection is inadequate.

   The Safety Board has always maintained that the most important function of the flight attendant is to provide for the safety of the passenger in case of a mishap. Consequently, the flight attendant must be protected from injuries more so than anyone else on the aircraft in order to be able to fulfill the functions of leadership after an accident. In one of these accidents two flight attendants were knocked unconscious simply because there was no head protection available. Materials to provide the proper protection have been successfully used in protective head gear for fighter pilots and motorcyclists.

2. Restraint system installations are inadequate.

   Only recently the Safety Board has been successful, through repeated recommendations, to require the installation and the wearing of shoulder harnesses for aircraft crew, both pilots and flight attendants. We have noticed lately, however, that while cockpit crew restraint installations are generally adequate and well engineered, those for the

flight attendants oftenleave much to be desired, especially those systems which may have been retroactively installed. Seatbelts which span the abdomen instead of the hips; one piece shoulder harness/seatbelt combinations which are difficult if not impossible to adjust properly; even a seatbelt which does not afford restraint at all if improperly fastened. The engineering technology of seatbelt shoulder harness installations have been with us for many many years. Much authoritive literature has been written and many tests have been conducted to establish optimum restraint systems for all modes of transportation, yet sometimes it seems we have started from scratch.

3. Galley Security is inadequate.

Just the other day we got a request for the number of galley failures that had occurred in air carrier accidents over a number of years. While we couldn't some up with an answer because this information is unfortunately not at our fingertips, I would venture a pretty educated guess that in survivable accidents, the number is very small in modern jet aircraft. Our problem is with the security of the galley's contents. There is a real problem in keeping the various drawers, compartments, etc., closed during the severe, repetative shocks imposed on the locks of these compartments. About 5 years ago or so, the Board called for the requirement of secondary locking devices on galleys because of the

abuse that galleys receive in service over the years. While some airlines have recognized the hazard to evacuation because of this problem and have installed bars across galley doors, no requirement exists to do something similar for all operators.

4. Seat Restraint is marginal.

As far as the Safety Board is concerned, there is no reason why passenger seats should fail when the fuselage remains relatively intact and the floor or other structure to which the seat is attached is not compromised significantly. The Safety Board has called for increased strength of seats and seat attachments and has suggested that a requirement to test seats dynamically to the present strength requirements of the FAR's would significantly improve the situation. It is true that we do not encounter so many seat failures in investigations of survivable modern jet aircraft accidents as we did during the reciprocating engine days. But we do encounter them. Side loads are inadequate as are the absence of rearward load factor requirements. In the latter accident I presented, the downward load factor requirement is suspect although we couldn't inspect any of the seat failure modes in detail because of the fire. Before some of the industry representatives start protesting, I should add that we are quite aware that industry designs

their seats well in excess of the minimum requirements and that they do conduct dynamic tests of their products. My point is that there are novel ideas in industry to increase seat security without appreciably increasing weight. I am, for instance, reminded of the EAL L-1011 accident near Miami, I believe in 1971 or '72. This accident, by every aspect of a definition, was unsurvivable since the aircraft came apart completely and restraint was lost for most of the occupants. Yet, many occupants survived this accident. I was struck by the seat installation in this aircraft where sets of seat units were installed on pallets. While the aircraft structure to which these pallets were attached was destroyed completely, the seats remained firmly anchored to the pallets and the pallets remained intact. I attributed the unusual survival rate to this seat installation.

In closing, I believe that we are well on the way toward increased emphasis by the FAA on cabin safety. We have seen considerable improvements in the recent past. My one observation is that, in establishing certain rules in this area, increased emphasis must be given to the details of implementation of such rules. Because, while the FAA can rule for instance, that a shoulder harness is required, the individual implementation may be worse than no rule at all if certain guidelines for installlation are not given.

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Mr. Ed Nelms - NTSB

Mr. Nelms gave a presentation on the recent Allegheny Airlines accident at the Philadelphis International Airport (PHL). During this accident, the pilot initiated a "go around" and, perhaps because of turbulence associated with a squall line, crashed on the runway. The tail and both engines came off the DC-9. The 4 crewmembers and 32 of the passengers were severely injured; the Captain sustained multiple fractures of the spine. Most of these injuries were attributed to the downward loading on the aircraft. Mr. Nelms also discussed the Trans World Airlines Milan accident. He showed slides which demonstrated the debris in the aisle. He expressed the hope that there were reasonable ways to improve the galleys of the older airplanes. Mr. Nelms pointed out that the closed overhead bins, which are considered safe by a lot of people, opened and spilled contents in the aisle. Slides also depicted the floor deformation. The fire and rescue people arrived at the aircraft at the PHL accident in an extremely short time, but took almost 20 minutes getting to the aircraft at the Milan accident (this was probably due to the fog, and the distance from the fire station to the site of the aircraft). Everyone agreed that the fact there was no fire in these accidents resulted in fewer tragedies than there could easily have been.

FILE NO. 1-0011

EXHIBIT NO. 6-A

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

HUMAN FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

NATIONAL TRANSPORTATION SAFETY BOARD
Bureau of Aviation Safety
Washington, D. C. 20594

HUMAN FACTORS GROUP FACTUAL REPORT

A. ACCIDENT DCA76A-ZØ29

Location : Philadelphia International Airport, Philadelphia, PA

Date/Time : June 23, 1976, about 1712 EDT 1/

Aircraft/Carrier: DC-9-30, Allegheny Airlines, Flight 121, N994VJ

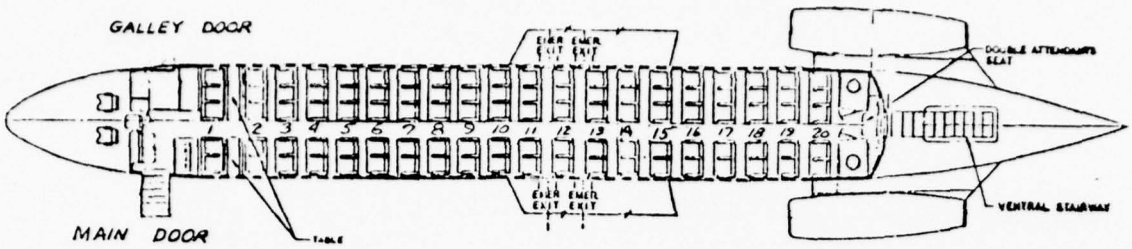
B. HUMAN FACTORS GROUP

Chairman: Matthew M. McCormick, National Transportation Safety Board
Members : Gary Bedford, Air Line Pilots Association
Nanci McQuade, Association of Flight Attendants
Peter Coppolino, FAA - Air Carrier District Office
James Simpson, FAA - Civil Aeromedical Institute
Jack Stephan, American Association of Airport Executives
Sgt. Edward Funk, Philadelphia Police Department
Tom Whited, Allegheny Airlines
Marvin Kahn, Allegheny Airlines

C. SUMMARY

Flight 121 crashed while attempting a go-around maneuver during an approach to runway 27R at Philadelphia International Airport. The tail and engines separated from the aircraft and were found on the infield grass about four hundred feet from the cabin. The cabin with both wings attached also came to rest on the grass and at a heading of about 90° to the runway. The grass infield was covered with from 2 to 5 inches of standing water. There was no fire. There were one hundred and six occupants on board, including four crew members, three children under two years old, one three-year old child, 76 and 83 year-old men, and a pregnant woman. The forward flight attendant jump seat failed and only 8 of the 100 passenger seats exhibited no damage or failures. Some passengers were transported to the airport dispensary prior to being transported to area hospitals. The two pilots, the two flight attendants and from three to 12 passengers were either assisted or extricated from the aircraft by volunteers and firemen. The captain was removed from the cockpit about 45 minutes after the accident. Passengers and flight attendants recalled hearing engine noise increase, and the nose come up prior to impact. City fire department units based at the airport and off the airport and City Police units responded to the accident. The crash alarm was sounded at about 1712.

1/ All times herein are Eastern Daylight Time based on the 24-hour clock.



D. DETAILS OF THE INVESTIGATION

1. Aircraft Configuration

The cockpit was configured in the standard captain and first officer arrangement. The 5-point seat restraint systems were manufactured by Pacific Scientific Company to TSO C-22. A bi-fold door separated the cockpit from the cabin.

The main boarding door was located on the left side of the forward cabin. A double occupancy aft facing flight attendant jumpseat was attached to the cockpit-to-cabin bulkhead inboard of the boarding door. A coat closet was installed aft of the boarding door. A manually inflatable evacuation slide was installed at the boarding door.

The galley was located on the right side of the forward cabin. The galley service door was located between the forward and aft galley units. A manually inflated evacuation slide was installed at the door.

The cabin contained no first class section. There were twenty rows of passenger seats; the left side of the cabin contained double occupancy seat units. A table was located between rows 1 and 2 on both sides of the aisle. Row one was rearward facing.

Overwing exits were located on both sides of the cabin between rows 11 and 12 and between rows 12 and 13.

A rear cabin stairway was located behind the rear cabin pressure bulkhead. Access to the stairs was via the door in the bulkhead. A double occupancy flight attendant seat was attached to the bulkhead door.

The flight attendant restraint systems were manufactured by American Safety Flight Systems to TSO C-22.F.

2. Exterior Examination of Aircraft

The captain's sliding window was found open. The main door was found locked open with its handle in the "open" position. The door was operated with no difficulty. No deformation was seen at the door or the door frame. The evacuation slide was found on the ground to the rear of the door and the girt bar was attached to the slide. The slide was deflated and the air bottle showed no pressure. The slide was punctured. The slide was manufactured by Sargent Industries to TSO C-69, in July 1969. It was last packed and tested on November 22, 1974. The slide had part number 11331DG and serial number 598. The air bottle was last tested in October 1971.

Both left overwing exit hatches were found on the ground outside the aircraft aft of the left wing. No deformation was seen at the exit openings in the fuselage. The hatch from row 12 had its interior handle out of the stowed position and its exterior handle stowed. The hatch from row 13 had both of its release handles in the stowed position. The trailing edge of the wing's inboard flap was displaced upward for a distance of about 5 feet along the inboard flap.

No deformation was seen of the rear stair door and its handle was in the "open" position. No deformation was seen at the door frame.

No deformation was seen at the frames around the two right overwing exits. One exit hatch was found inside the cabin in seat row 12 and lodged between the seatbacks at 12 D and E. Both release handles were in the stowed position. A second exit hatch was found in seat row 11; the seatbacks at 11 C,D,E were all full forward and the hatch was on top of the seatbacks. The hatch's interior handle was not stowed and its external handle was stowed.

The leading edge flap was torn in two places: one tear was about 2 feet from the inboard edge and the second tear was about 3 feet from the same edge.

The evacuation slide from the galley service door was seen inflated at about 2200 on June 23, 1976, and was partially inflated the next morning. The girt bar and the fabric to which the girt bar is normally attached were found inside the forward cabin closet on a shelf. The fabric had the appearance of having been cut with a sharp object

at the surface which had been attached to the slide. The slide's pressure bottle showed zero pressure. The slide cover was found on the ground under the right wing with fire extinguishing foam agent on top of it; there was no foam under the cover. The slide was manufactured by Sargent Industries to TSO C-69 in March 1969. It was last packed and tested on November 19, 1974. The slide had part number 11331DG and serial number 6804. The air bottle was last tested in October 1973.

The galley service door was found locked open with its handle in the "open" position. No deformation was seen at the door or at the door frame.

3. Interior Examination of Cockpit and Cabin

The captain's oxygen mask was found on top of the captain's flight bag and under the nose wheel steering wheel. The oxygen mask's hose was disconnected at the oxygen bottle. A floor access panel aft of the captain's seat was open. A pair of black frame eye glasses was found folded on top of the flight bag. The bag was in place in its floor container . A pair of sunglasses was found in a pocket of a uniform jacket which was hanging in the closet; the jacket sleeves had four stripes.

The left seat's shoulder harness was found retracted with no hardware deformation. When the inertia take up reel was tested it retracted and operated with no difficulty and locked. The seatbelt buckle released with no difficulty. During these operations, the insert end (male end) of the seatbelt often would not lock into the buckle; the insert had to be manipulated on occasion in order for it to lock into the buckle.

The seat arm rests were found in the down position and the seat was in its most forward position and about four adjustment notches from the full down position.

The outboard edge of the seat pan structure was displaced inboard and the inboard edge was displaced outboard. The metal pan was cracked above the forward lateral seat pan support tube and the support tube was separated at the outboard edge of the pan frame. The seat pan was displaced downward and rivets which secured the pan to the support showed evidence of having been sheared in a downward direction.

The forward left portion of the seat had failed in an upward and inboard direction. The center cockpit console was dented on its outboard surface (which was adjacent to the inboard surface of the seat pan frame) and the dent closely matched the shape of the inboard side of the seat frame. The distance between the seat frame and the console was 4 inches. The seat was firmly attached to its floor track. The floor beneath the seat's forward pair of seat tracks was displaced upward about 4 inches and the floor under the rudder pedals was displaced upward about 8 inches. The manner of the displacement at the rudder pedals on the right side of the cockpit was essentially similar, but the displacement was less on the right side. The electrical (left side) relay panel beneath this portion of the floor was displaced upward about 8 inches. The distortion of the floor under the seat's forward outboard track prevented the seat from being slid aft on its tracks.

Blood stains were found: under the captain's sliding window with no evidence seen of impact with the surfaces on and near the window; on the instruments forward of the captain's yoke; on the right grip of the yoke and on the forward surface of the control column; on the outboard side of the console; and randomly on the glare shield in front of the captain. Blood-like stains were seen on the captain's seatbelt and on the seatbelt release; no similar stains were seen on the shoulder harness straps. The "Master Warning" light was removed from the glare shield and a small amount of blood was found on the forward surface of the light assembly which was inside the glare shield.

The right cockpit seat had failed in a downward direction with a small fracture at the side about 4 inches from the front edge. The inboard side of the seat pan support was wrinkled at its lower surface. The outboard side of the seat pan support was deformed slightly. Rivets at the inboard frame were separated in a downward direction. The seat could not be slid aft. The floor was not damaged at the rear legs. The seatback was free to move and would not lock into any recline position. Shoulder harness straps were found retracted. The straps when tested locked at various lengths and retracted with no difficulty. No deformation was seen of the restraint system hardware and the seatbelt release operated without difficulty. No blood was seen on the restraint system or elsewhere on the right side of the cockpit.

The large oxygen bottle was missing from behind the first officer's seat; it had been removed during the rescue activity and was found in the cabin.

The first officer's flight bag was tipped out of its storage location. Numerous pages from manuals were scattered on the floor on the right side of the cockpit.

The center console was free from its floor attachment bolts at the forward right edge.

No damage was seen on the instrument panel or its displays. Only the weather radar display glass was fractured; the display was located on the lower pedestal.

The rudder pedals on the left side of the cockpit showed the left pedal full forward and on the right side of the cockpit the right pedal was full forward.

The cockpit door was found full open. The pin at the top of the door was out of its track and resting against the ceiling; the pin was not imbedded in the ceiling. The door was tested and it closed and opened with no difficulty. The door's two side by side kick out panels (located in the bottom of the door) were tested by kicking them toward the cockpit from the cabin. The right panel released following one kick. The left panel released following three moderate kicks.

b. Galleys

The following items are number coded to the illustrations of the Nr. 1 and Nr. 2 galley in Attachment 1.

Nr. 1 Galley

Top compartment (#1) contained paper cups. The door was found closed and latched. The cabin ceiling hung down about one-half inch and prevented the compartment door from being opened. When the ceiling was pushed up during the investigation, the compartment door was opened with no difficulty.

The set up board (#2) was attached to the galley with no failure of the hinge. The retaining pin which secured the bottom of the board was not engaged and the bottom of the board was free to swing aft and up.

The coffee pot compartment (#3) door was closed and latched; three coffee pots were found inside the compartment.

The service counter (#4) drain screen was loose and two full beer cans were lying on the counter.

Drawer (#5) was closed and latched; the drawer contained tea, sugar, coffee, and stirrers.

The ice drawer (#6) was closed and latched; the drawer contained water and a plastic bag.

The beer chest drawer (#7) was found on the counter at Nr. 2 galley. The drawer had a series of "V" shaped dents at three locations on the bottom surface of the drawer. Starting at the latch end of the drawer the dents were located at 2, 14, and 15 inches from that end. The size and shape of the three dents and scratches on the bottom of the drawer closely matched the top surface of the metal support frame between drawers #7 and #8.

The frame between drawers #7 and #8 was separated at its outboard fasteners and was bent forward (into the galley) about 5 inches. During the investigation, drawer #7 was inserted into the galley and because of the distorted support frame, the drawer fell down and and inside the galley. In this position, the latch to #7 drawer would not engage. The secondary lock (an over center one-quarter turn fastener) was not found in the locked position at drawer #7.

No secondary latches were found in the locked position. All secondary latches exhibited resistance to turning except for the secondary latch at drawer #8; it could be turned with little resistance.

The beer compartment, drawer #8, was found latched and empty. The set up drawer (#9) was open about one-half inch; it contained coffee cans and soft drink cans. The top surface of the drawer at its latch was bent forward about 1 inch. The support frame between compartments #9 and #10 was distorted downward causing compartment #10 to jam in the closed position. Compartment #10 contained cans of apple juice.

Compartment #11 was closed and latched; the coffee makers at #12 were intact.

Nr. 2 Galley

Compartments #1 and #2 were latched closed and keys were found in the locks at both compartments.

The trash cart (#3) was found out of its storage compartment and lying on its side on the table between seat rows 1-A, B and 2-A, B. The cover to the cart's compartment was bent; the top portion of the cover was bent forward. The bend was at the approximate location where the cart restraint strap passed over the cover. During the investigation, the cart was installed into the Nr. 2 galley compartment and its cover was installed in the galley. The cover's latch engaged only after the cover was forcibly pushed into place. The cart compartment secondary restraint, a fabric strap was found fastened at its outboard anchor. The other end of the strap, the end which contained a clip-type fastener, was free and the fastener had pulled out of the strap fitting. The fastener was attached to its "D" ring on the inboard surface of the galley. The clip-type fastener was not deformed. The wheels on the trash cart were not equipped with brakes.

The two liquor kit compartments (#4) were closed, latched and had secondary latches in the locked position.

The two tray storage compartments (#5) were closed, latched, and had secondary latches in the locked position.

Compartments #6-#9 were closed and latched.

c. Forward Closet

The forward closet floor and the aisle contained full soft drink and beer cans and miniature liquor bottles. A CO_2 fire extinguisher was on the floor of the closet. The beverage cart was inside the closet; its center and bottom fasteners for the webbing (fabric) restraints were not fastened to the cart. The top fabric cart restraint strap was fastened; the bottom cart restraint strap was not fastened. The galley door's slide girt bar and the slide fabric which the bar passed through were found on the bottom closet shelf. A walk around oxygen bottle was in place on the top closet shelf.

d. Forward Jumpseat

The seat pan was free at the top outboard support brace. When the seat pan was pulled down to its full travel the seat pan was tilted outboard about 26 degrees and about 10 degrees up at the outboard edge. No failures of plastic straps used to support the seat pan cushion were seen. There was no obvious evidence of body impact marks on the seat, floor, wall or other environmental surfaces near the seat.

With regard to the damage, the following was observed: The circular pin fastener which secured the seat pan frame to the seat pan support brace was pulled out of its anchor nut on the inboard portion of the seat pan frame. The pin was bent about one-half inch in what appeared to be a downward and aftward direction. The seat pan brace was bent outboard in the area of the hole for the fastener pin. Attached to the pin was a washer, collar/spacer, and the anchor nut. The seat pan frame in the vicinity of where the pin had pulled out was bent in an outboard and upward direction.

The seat restraint system was manufactured by American Safety Flight Systems, Inc., with a part number of 500635 and a model number HT 1003-11. The seatbelts were manufactured to FAA TSO C-22.F.

The flight attendant's telephone was found stowed in its cradle.

e. Cabin Damage

(1) Seat damage

Each passenger seat was examined and the damage is contained in Attachment 2.

Passenger seats were manufactured by Burns Aero Seat Company, TSO-C-29, and were rated to 7.5g down and 4.5g up.

(2) Other Cabin Damage

The tables between rows 1 and 2 showed no damage; the two leaves were folded on top of the tables. The rack for stowage of the passenger safety cards had come off the bulkhead and was under the table. A seatbelt extension was also under a table. The trash container from No. 2 galley was found on top of the table between rows 1-A B and 2-A B.

Paper napkins were in the overhead rack above seats 1-CDE. The overhead rack above seats 1-AB and 2-AB was intact but hung down over row 2 about 2 inches. The magazine rack installed in the overhead rack over seat 1-B was damaged but was in place. The oxygen compartment was open

over row one and the masks were not deployed. The no smoking sign was attached to the side wall panel over the left table but the forward end of its cover was displaced about 3 inches.

The overhead rack above seats 2 CDE was free of its ceiling support tube and it had dropped about 8 inches. The megaphone installed in the overhead rack above the left table was in place and its retaining clamps were fastened. From row 2 the rack gradually resumed its normal position until at seats 6-CDE it was in its normal position. At seats 8-AB, the rack was displaced down about 6 inches where the two sections of the rack met. The metal grill cover over the side wall lights hung down from seats 6-A to 11-A. A pillow was in the overhead rack above seat 7-A. The oxygen compartment door was open above seats 5-CDE; one mask was deployed fully, one mask was hung down to the full length of its lanyard, and two masks were attached to the door.

The overhead rack above rows 11&12- AB was intact but the section above 11 & 12 -CDE hung down about 6 inches. The support tube above 12-CDE failed. The speaker which had been installed in the overhead service unit was found between rows 12 & 13 -CDE. The plastic cover to a cove light was hanging down and fractured.

The forward edge of the overhead rack above seats 13&14 -AB was displaced downward about 1 inch. Above seats 13&14-CDE, the rack's support tube was fractured at the ceiling. The forward section of the rack was displaced about 6 inches toward the aisle and hung down about 8 inches. The plastic cover to the cove light was hanging down and was fractured.

The oxygen compartment door above seat 14-E was open; only one mask was deployed. The cover over the cove light at row 15 & 16 -AB was hanging down. The overhead rack supports above seats 17 & 18 -AB failed. The forward portion of the rack was displaced aft about 18 inches toward the aisle and extended into the aisle about 10 inches; the clearance between the rack and the seatbacks was about 10 inches. The rack's rear support failed at seats 17 -CDE and the rack hung down about 5 inches.

The overhead rack above seats 19 & 20 AB had failed at its forward support. The rack had dropped about 18 inches at the aisle side. The aft end of the rack dropped about 6 inches and its support tube was distorted. The megaphone located above seats 20-AB was in place and its retaining clamp fastened. The magazine rack which was installed inside the overhead rack over seat 20-B had failed. The plastic cover over the cove light was open and fractured. The first aid kit, located above seat 20-C in the overhead rack was intact and its retaining clamps were fastened.

The cabin floor at seat row 4-CDE was displaced upward about 1 inch under 4-D. The floor raised about 1 inch and then became almost level at row 7-CDE. The floor under 5-D was displaced upward about 6 inches and was buckled. The floor under seat 10-C was displaced upward as was the floor at seat 13-B. Aft of seats 13 -C, E the floor was displaced upward. The floor under 14-B was displaced upward about 12 inches and became almost level at 15-AB. At seats 16-CDE, the aisle floor was depressed slightly. The floor panel at row 20-CDE was removed to gain access to the CVR.

A piece of a magazine rack was found in the aisle at seat 16-B.

Two pieces of a magazine rack were found in the aisle at seats 18-B & C. The tray holder behind seats 20-CDE was loose.

The cabin floor panel forward of the rear stair door was loose, The CO_2 and water fire extinguishers fastened to the rear bulkhead behind row 20-AB/20-CDE were in place and their retaining clamps fastened.

The cabin floor panel forward of the rear stair door was loose, moved forward 1 to 1½ inches, and was displaced about 2 inches upward. The door was found open and the floor distortion prevented it from being closed. The door was subsequently closed and no damage was seen at the rear flight attendant jumpseat. The seat's restraint straps were intact and the release mechanisms operated with no difficulty. The exterior surface of the door had grass, soil, and mud adhering to it. The ceiling panel forward of the door hung down about 2 inches.

All passenger seatbelts were intact, none failed, and all were found open. All releases operated with no difficulty.

f. Main Landing Gear

The left main landing gear wheel well was pushed upward and was fractured in three places. There was an impression of the wheel in the top surface of the well. The right main landing gear wheel well was also pushed upward and fractured in one place. There was no impression of the wheel seen in the top surface of the wheel well.

4. Aircraft Occupants

a. Flight Crew

Captain Carl W. Boyer, age 49
First Officer John R. Spencer, age 38

b. Flight Attendants

Ildiko Tovolgyi, age 34 (the "A" attendant)
Marsha Morris, age 25 (the "B" attendant)

c. Passengers

The 102 passengers included 84 adult males (including 76 and 83 year-old men), 14 adult females, (including a 73 year old woman and a 26 year old pregnant woman) and four children. The childrens' ages were 3 years, 2 years, 21 months, and 6 months; the latter three were not ticketed passengers as they were considered as "infants in arms" and were intended to be held during flight.
There were no handicapped passengers or passengers who required special handling because of age or illness.

5. Crew Information

a. Flight Crew

Captain Carl W. Boyer, born August 23, 1926, was examined on February 5, 1976 for his First Class medical certificate by FAA Medical Examiner No. 02482-1: John S. Cunnick, M. D., of Port Isabel, Texas. Captain Boyer's medical certificate contains the limitation: "Holder shall have available a pair of correcting glasses while exercising the privileges of his airman certificate." Captain Boyer's most recent electrocardiogram was performed on February 5, 1976.

First Officer John R. Spencer, Jr., born August 4, 1937, was examined on April 12, 1976, for his First Class medical certificate by FAA Medical Examiner No. 02194-1: Otto F. Swegal, M. D., of Pittsburg, Pennsylvania. First Officer Spencer's medical certificate contains no limitations.

b. Flight Attendant Information

Ildiko Tovolgyi, the "A" flight attendant, was born on December 22, 1941. She completed her initial training on May 27, 1964. Her most recent recurrent emergency training was completed on February 16, 1976 and she received a score of 88 on the written test. Her most recent observation flight was on May 18, 1976, with no adverse comments made by the reviewer.

Marsha Morris, the "B" flight attendant, was born on August 29, 1950. She completed her 80 hour initial training on June 16, 1976. When she completed her training her qualification and operating experience on Allegheny aircraft were: DC-9, 11:02; BAC-111, 13:08, and CV 580, 1:44.

Both flight attendants were qualified on the DC-9-30, -50, BAC-111, and the CV-580.

Allegheny Airlines recurrent flight attendant emergency training, which takes 8½ hours, includes both classroom and "hands on training." A written test is administered prior to the attendants going to an aircraft to demonstrate their knowledge of the aircraft's emergency equipment which is conducted at night using normal cabin lights for illumination. All aircraft exits are opened including cockpit windows by each flight attendant in the presence of an instructor. Evacuation slide girt bars are not attached to the aircraft floor when the cabin doors are opened. Each attendant must physically locate each piece of emergency equipment in the presence of an instructor. Beginning in 1976, the recurrent training included using smoke for realism. The flight attendants are given a set of emergency circumstances by their instructor while inside a darkened cabin which has been filled with theatrical smoke. They are then instructed to open the appropriate exit after they assess the situation. This exercise could be conducted on DC-9-30, -50, BAS-111, or CV-580 aircraft.

6. Medical and Pathology

a. Flight Crew

The captain and the first officer sustained multiple spinal fractures and contusions. The captain also sustained lacerations to the forehead, the left temple, and rib fractures. The first officer also sustained a lacerated tongue and abrasions to both legs.

b. Flight Attendants

The "A" flight attendant sustained a compression type of spinal fracture.

The "B" flight attendant sustained a contusion to her left ankle and left leg, acute lumbosacral and cervical strains, and a lacerated tongue.

c. Passengers

Thirty-two of the 102 passengers sustained serious injuries [2/]. These injuries included 7 cervical fractures, 8 thorasic fractures, 11 lumbar fractures, 1 ankle fracture and 2 arm fractures. Minor injuries sustained by 50 passengers, as well as passengers who sustained serious injuries, included cervical and lumbosacral strains and sprains, wiplash, facial lacerations, anterior chest contusions, tongue lacerations, broken teeth, and multiple contusions and abrasions to head/face and to extremities. Twenty passengers, including the four children, had no reported injuries.

d. Others

A city policeman sustained a sprained back when he slipped from a wing while he was assisting in removing injured passengers.

e. Injury Table

	Flt Crew	Flt Attend	Adult Pax	Children	Others	Total
Fatal	0	0	0	0	0	0
Serious	2	2	32	0	0	36
Minor	0	0	50	0	1	51
None	0	0	16	4	-	20
Totals	2	2	98	4	1	107

[2/] 14CFR830.2 defines serious injury as: "any injury which (1) requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) involves lacerations which cause severe hemorrhages, nerve, muscle, or tendon damage; (4) involves injury to any internal organ; or (5) involves second- or third-degree burns, or any burns affecting more than 5% of the body surface."

7. Medical Assistance

a. Airport Dispensary - Affiliated with St. Luke's Hospital

According to the two Registered Nurses on duty the dispensary was alerted by telephone of the accident. The nurses stood by for transportation to the scene; instead, about 27 persons were brought to the dispensary in Eastern Airline vans and police vehicles. All persons were ambulatory. The more severely injured persons were transferred to area hospitals by ambulance, police vehicles, and rescue squads.

The physician who was scheduled to be on duty at the airport later in the evening learned of the accident on his automobile radio and he proceeded to the airport arriving at about 1800. He examined several of the passengers.

Common injuries to persons included chest pain, whiplash, back pain, and lacerations.

b. Area Hospitals

Six area hospitals received and treated the injured.

Taylor Hospital in Ridley Park was notified by telephone between 1730 and 1735. The first person arrived at 1745 and the last at 1805. Eighteen persons were brought to the hospital and 9 were admitted. The hospital's disaster plan was not implemented because enough staff was on duty. Persons were brought to the hospital in a camper, a minibus and van type vehicles.

Methodist Hospital in Philadelphia was notified by telephone through the hospital's switchboard at 1720. The first person arrived at 1742 and the last at 1837. Fifty-one persons were brought to the hospital and 13 were admitted. The hospital's disaster plan was implemented. Police and fire department vehicles transported persons to the hospital.

St. Agnes Hospital in Philadelphia, was notified at 1730 by the Police Department radio and the first person arrived at about 1800 and the last at about 1830. Twenty-one persons were brought to the hospital and six were admitted. The hospital's disaster plan was initiated and the staff reported to the hospital and the burn unit was prepared to receive patients. Persons arrived at the hospital in police and fire department units.

Misericordia Hospital in Philadelphia was notified at 1810 and the only person to be brought to the hospital arrived at about 1845. The patient was admitted. The staff was placed on alert but it was not necessary to implement the disaster plan.

Fitzgerald Hospital in Darby contacted Misericordia and reported that that hospital had a number of beds available and that their staff was standing by.

The University of Pennsylvania Hospital was notified at 1730 and the first person arrived at 1845 and the last shortly thereafter. No persons were admitted. The hospital's disaster plan was partially implemented. Persons were brought to the hospital via police vehicles.

A City police officer was brought to Philadelphia General Hospital for treatment of a back injury he sustained when he slipped from a wing.

8. Survivability

The following is summarized from interviews and statements from flight attendants, passengers, and ground witnesses:

a. The Approach and the Accident

Three passengers recalled that the approach to BDL appeared faster than normal and two said the landing was hard. One of these passengers stated the approach to PHL seemed fast and as soon as the aircraft's nose was raised for a go-around, the aircraft dropped and struck the ground. A second of these passengers saw that the streets were wet near the Philadelphia Navy Yard. The aircraft immediately went into clouds and the visibility went to zero. The engines then went to full power and they came out of the clouds and the passenger saw the ground and saw that they were descending; the aircraft then struck the ground.

One passenger stated that just after passing Veterans Stadium they encountered turbulence. They encountered heavy rain while over the airport property and the visibility went to zero, the engine noise increased and the aircraft fell to the ground.

According to another passenger, as the aircraft approached a highway, which was perpendicular to the runway, and close to the runway, it entered a violent storm with high wind and rain. As they passed the highway the visibility decreased and it became almost dark. The aircraft then

gained altitude but fell almost vertically to the ground. This passenger did not recall if the engine noise increased.

A passenger who saw the ship yard clearly, stated that the weather changed to rain with gusty winds as they neared the airport. The aircraft shook and then went up followed by the nose rising. The nose remained up and the aircraft fell vertically until the impact.

One passenger stated that while over the Delaware River it began to rain very hard and the rain intensity increased as they got closer to the runway. A second passenger stated that after encountering the rain, the wings shook from turbulence. Another passenger described the rain as a sheet of water on the windows. This passenger also recalled that the aircraft nose went up at a sharp angle and the engines accelerated. Another passenger estimated that at about 100 feet the aircraft's nose went up after encountering the rain; he did not recall turbulence. Another passenger estimated the altitude at 200 - 400 feet when the nose came up.

A passenger saw vehicles on Industrial Boulevard during the approach and shortly thereafter the aircraft went into clouds and the visibility went to zero. The engine power increased and he thought that they struck the ground and bounced back into the air before the final impact.

One passenger believed that the wheels touched the runway briefly and the engines accelerated and the aircraft took off and was airborne briefly before finally striking the runway.

According to another passenger, the aircraft shook violently, the nose went up and they struck the ground. One passenger estimated that the nose came up about 25 degrees.

One passenger saw rain at the end of the runway and thought that the aircraft was too high and too fast to land. He then heard the landing gear come up and the engines accelerate shortly before the impact. A second passenger stated the aircraft encountered large rain drops and wind gusts while the landing gear was down. The aircraft then climbed, the gear was retracted, and it got very dark outside. The rear of the aircraft was then pushed down and they impacted.

Passengers recalled seeing streets wet from rain, trees being blown by wind, and the water in the river being disturbed by wind.

Passengers agreed that the aircraft dropped to the ground suddenly in a slightly nose up or almost level altitude; some described it as if the tail was pushed down while the nose was up. The aircraft slid along the ground briefly on its initial heading until it slid broadside past the terminal (the nose turned to its left) until coming to rest on the grass.

At impact most seats failed causing passengers to be thrown into adjacent seats and pinning some passengers between seats, the floor and seats, and between seats and side walls. (See Attachment 2 for description of seat damage). One 21-month old child reportedly was thrown vertically from its seat. Overhead storage racks failed, spilling their contents toward the floor. Some passengers sustained leg injuries when seats collapsed on their legs.

b. <u>The Evacuation</u>

The "A" flight attendant stated that she was standing in the area between the cockpit door and her jumpseat at impact. She was thrown to the floor and was immobilized because of her back injury. When the aircraft stopped, a male passenger came forward and in the process of opening the main cabin door, he inflated the escape slide; the flight attendant was partially covered by the slide. (Photographs taken by a passenger shortly after the passenger evacuated show that the main door was not open). The "A" attendant then directed the passenger and another passenger to open the galley service door and to inflate its slide which they did with no difficulty. Two ground witnesses saw the door open and the slide inflate; however, the slide was held horizontally by the wind. They saw two men attempt to hold the slide down but did not see anyone exit from the galley door.

Passengers opened the four overwing exits; about 40 passengers used these exits.

The rear cabin door, leading to the rear stairs, was open about 2 inches at impact and was prevented from opening

further by the raised floor forward of the door. The entire airframe section aft of the rear cabin pressure bulkhead was missing and there was about a 4-foot drop from the rear door sill to the ground. The "B" flight attendant could not open the rear door and called for assistance. Three male passengers took less than 10 seconds to force the door open far enough for the exit to be used. It is believed that the majority of passengers used this exit.

The passengers encountered baggage and garments in the aisle during the evacuation. Some passengers retrieved their carry-on articles (attache cases, garment bags, cameras, tote bags, etc.) before they egressed. The flow of passengers to exits was hampered by seats which came to rest in the aisle and seats which failed and came to rest against other seats. At least three and possibly as many as 12 passengers were immobilized by injuries or trapped by failed seats and were still in the cabin when firemen arrived.

Few passengers reported difficulties releasing their seatbelts; one passenger said that his seatbelt loosened at impact.

The passengers praised the efforts of a Philadelphia Fire Department Captain who was a passenger for issuing evacuation instructions and assisting injured passengers from the cabin. He remained in the aircraft during the removal of passengers who could not egress by themselves.

Many passengers remarked that after leaving the aircraft there appeared to be no organized manner for taking care of them and to assure that they were kept together. Some recalled that it seemed to be a long time before they saw fire trucks arrive.

Passengers were in agreement that when they exited from the aircraft and while they were standing outside the aircraft that it was raining very hard and the wind was very strong and that from 2 to 5 inches of standing water covered the grass around the aircraft.

c. Ground Assistance

Numerous Eastern, Trans World, and Allegheny Airlines ground personnel went to the scene of the accident by foot and by miscellaneous vehicles. When these personnel arrived some passengers were still egressing. Eastern Airlines personnel drove passengers to the airport dispensary and to Taylor Hospital. Airline personnel also entered the aircraft and assisted in freeing passengers and in moving the "A" flight attendant's feet from near the main cabin door in order to open the door. A TWA employee punctured the evacuation slide which was inside the forward cabin at the main door to gain access to the door.

9. Crash Fire Rescue - The following is summarized from Fire Department Reports and interviews with Fire Department personnel:

a. Notification

The crash alarm was activated by the Control Tower at 1712 and was received at both airport fire stations Nos. 77 and 78. This alarm was initiated by a tower controller who picked up the crash phone which rang the alarm bell, opened the fire house doors and opened the airport access gate at station 77 for approximately eight minutes. (Only the Tower and the fire stations can transmit on this telephone. When this phone rings it can be monitored at 12 other locations on the airport.) Within 48 seconds of the arrival of the first airport fire truck, a second alarm was struck; this was at about 1714:36.

b. Firefighting Effort

Firemen who arrived at the scene shortly after the accident described the weather as severe due to heavy rain and strong gusty winds from the west and southwest. Some but not all, depending on their location, observed passengers exiting from both right and left overwing exits and rear door. Although no firemen recall anyone exiting from the front of the aircraft, they thought some passengers might have prior to arrival of crash equipment. The captain on F-3, the first vehicle on the scene, recalled that approximately twelve passengers and three crewmembers were still inside the aircraft when they arrived. Trucks from Station 78 applied foam (protein) to the fuselage and wings of the aircraft to reduce the possibility of fire; no fire existed at the time nor did any occur thereafter. Foam was also applied onto pools of standing water in the event that the pools contained standing fuel.

About 12,500 pounds of Jet-A fuel was on board the aircraft.

c. Rescue

Area hospitals were alerted to receive patients via the fire department notification plan. Some firemen entered the aircraft upon arrival and assisted in the evacuation of remaining passengers. Firemen removed seats and other objects so that 5 or 6 passengers could egress. Three passengers had to be removed via stretchers. It is estimated that from the arrival of CFR equipment to the exit of all mobile passengers and the "B" flight attendant took about 4 or 5 minutes. The "A" attendant plus the captain and first officer were removed later.

Because there was no fire, much caution was exercised in removing the injured passengers and crewmembers to prevent additional injuries. Firemen saw no visible injuries to the passengers and crew with the exception of the captain who sustained head lacerations. The physician from St. Luke's Hospital, which operates the airport dispensary, sent others on to area hospitals, and released others. He later went to the accident site to determine if further medical assistance was needed. However, none was required; he was assisted by two nurses.

Firemen also noted on arrival that some of the passengers were sitting and lying on the pavement and the grassy areas near the aircraft and had to exercise caution so as not to run over them in the poor visibility conditions.

Five rescue units responded to the scene. The men from Unit 19 and Station 77 removed the "A" flight attendant; she was removed first to gain better access to the cockpit. She complained of back pain and was removed in a stretcher.

Unit 11 was a mobile intensive care unit. This unit, along with the PFD captain from Station 77, removed the pilots. Both pilots were conscious when the firemen and Eastern Airlines employees entered the cockpit. The captain was bleeding from head lacerations and both pilots complained of back pain. The first officer was removed while the captain was being treated for lacerations. The captain was removed at about 1750 E.d.t.

d. Equipment

A total of eight firefighting vehicles from the two airport stations responded to the first alarm; the first unit arrived at 1:48 after the alarm (or at 1713:48). This was a quick crash vehicle identified as F-3 equipped with 300 gallons of water and 38 gallons of AFFF. It also had 1500 lbs. of dry chemical. The second unit to arrive was a major firefighting unit identified as F-2 equipped with 3,000 gallons of water and 500 gallons of protein foam concentrate. The remaining airport equipment, arrived within two minutes from the first alarm. In addition to the above, several off-airport units responded to the airport, including one fireboat.

The off airport units not used at the crash scene were held on the ramp by the Battalion Chief. Only off airport unit E-69 was used at the foot of Concourse "B" at a hydrant as a nurse truck. Off-airport units gained access to airport at Station 78.

Capacity of Airport Trucks

Truck Number	Water Capacity	Foam Concentrate Capacity	Dry Chemical	Fire Station #
F-1	3000	500		78
F-2	3000	500		77
F-3	300	38	1500 lbs.	77 (quick response truck)
F-4	2600	400		77
F-5	2300	300		77
F-6	1500	300		77
F-7			1000 lbs.	78
F-9	300	700		78
	13,000gal	2,738 gal.	2500 lbs.	

Three-hundred and seventy gallons of foam concentrate and 11,300 gallons water (approximately) were expended. Water, from hydrant on concourse B, was used to replenish trucks F-2, F-6 and F-9. A total of 18 firemen were on the scene from Stations 77 and 78 within 1½ minutes after the alarm.

e. Response of Equipment

(1) First Alarm at 1712 -

Station 77: First unit on scene at 1:48 from alarm. Requested that a second alarm be sounded at 1714:32. Firemen entered cabin and saw passengers lying on floor. They lifted seats to free passengers, check the condition of the "A" attendant and the pilots and assisted passengers from the aircraft via the left overwing exits. Assisted in removing the pilots from the cockpit. Firemen observed persons walking and running from the aircraft, as well as sitting and lying on the ground as they arrived at the scene.

Station 78 arrived within 2 minutes of the alarm. The Fire Department captain attempted to shut off the aircraft's electrical power in the cockpit but was unable to do so. Equipment applied foam agent to fuselage, wings, and ground. Failed to find any fuel leaks on the aircraft. Firemen entered cabin and assisted personnel from Station 77. Equipment remained at the scene until 0330 on June 24th.

The following off-airport units responded to the first alarm:

Engine 69 - on scene in 3 minutes. Personnel saw police and firemen helping persons from aircraft. E-69 provided hydrant supply to E-78 foam truck.

Engine 60 - on scene in 5 minutes.
Engine 49 - on scene in 8 minutes.
Engine 26 - on scene in 3 minutes.

Ladder 4 - on scene in 4 minutes. Towed the airport first aid wagon from station 78. (A converted baggage cart which carried various trauma supplies.)

Boat M-32 - on scene at Hog Island Terminal in 35 minutes.

Rescue R-19 - on scene in 5 minutes. Removed "A" flight attendant and departed scene at 1734 and arrived Methodist Hospital at 1742.

Chem.3 - on scene in 10 minutes.

(2) Second Alarm at 1714:32

Engine 47 - arrived in 6 minutes
Engine 53 - arrived in 10 minutes
Engine 10 - arrived in 12 minutes
Engine 57 - arrived in 8 minutes
Engine 5 - arrived in 8 minutes
Ladder 19 - arrived in 4 minutes
Chemical 2 - arrived in 44 minutes
LW - 2 - arrived in 15 minutes
R - 3 - arrived in 6 minutes. Transported the captain to St. Agnes Hospital. Departed scene at 1752 and arrived at the hospital at 1809.

R-14 - Arrived in 6 minutes. Departed the scene at 1742 with the first officer and arrived at Methodist Hospital at 1758.

R-7 - arrived in 7 minutes. Assisted R-11 removing a passenger from the terminal building.

R-11 - arrived in 6 minutes. Assisted an elderly male passenger in the cabin (passenger transported to a hospital by police). Assisted three passengers in terminal building who were later transported to hospitals by police. Assisted male passenger in terminal and departed terminal at 1814 with the passenger and arrived at St. Agnes Hospital at 1830.

Numerous Fire Department officials, including officals from the Fire Marshall's office, responded to the alarms. One Battalion Chief stated that he encountered heavy rain in the vicinity of Island Avenue and Lindberg Boulevard en route to the airport.

10. Security

a. Philadelphia Police Department

The Philadelphia Police operations desk notified the following hospitals: Philadelphia General at 1728; University of Pennsylvania at 1725; Fitzgerald Mercy at 1723; Miserecordia at 1725; and St. Agnes, Einstein Southern, Chester Crozier, Presbyterian, and Methodist shortly after learning of the accident.

According to the police report, the airport was closed at 1730, and at 1930 Runways 27L and 17 were re-opened.

The Police Department dispatched their Mobile Communications Unit, two buses, 59 patrol cars, 11 foot traffic vehicles, 8 highway patrol cars, 4 tow trucks, 2 crime lab units, and 11 detective cars.

Detectives from the Homicide Bureau visited each hospital and interviewed those aircraft occupants who were less seriously injured.

b. Airport Security

Airport security personnel were reponsible for manning gates and other access points on the airport and at the terminal building.

11. Other

Douglas Aircraft Company was requested to examine the damage to the forward flight attendant seat. The results of that examination will be included in the accident file.

Burns Aero Seat Company was requested to provide information from their representative's inspection of the passenger seats.

Matthew M. McCormick
Human Factors Group Chairman

Attachment 1

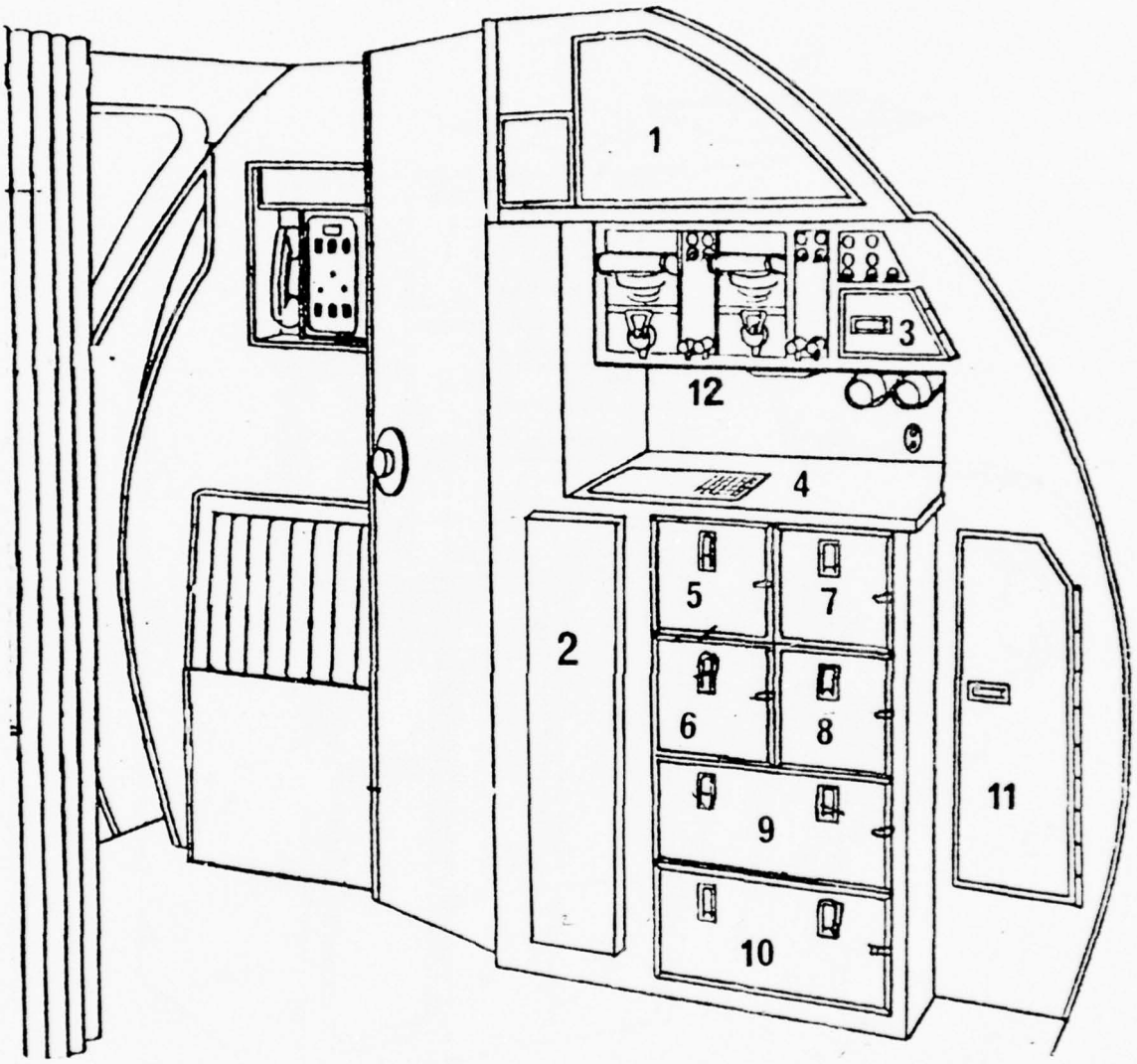
to APPENDIX VI

File No. 1-0011

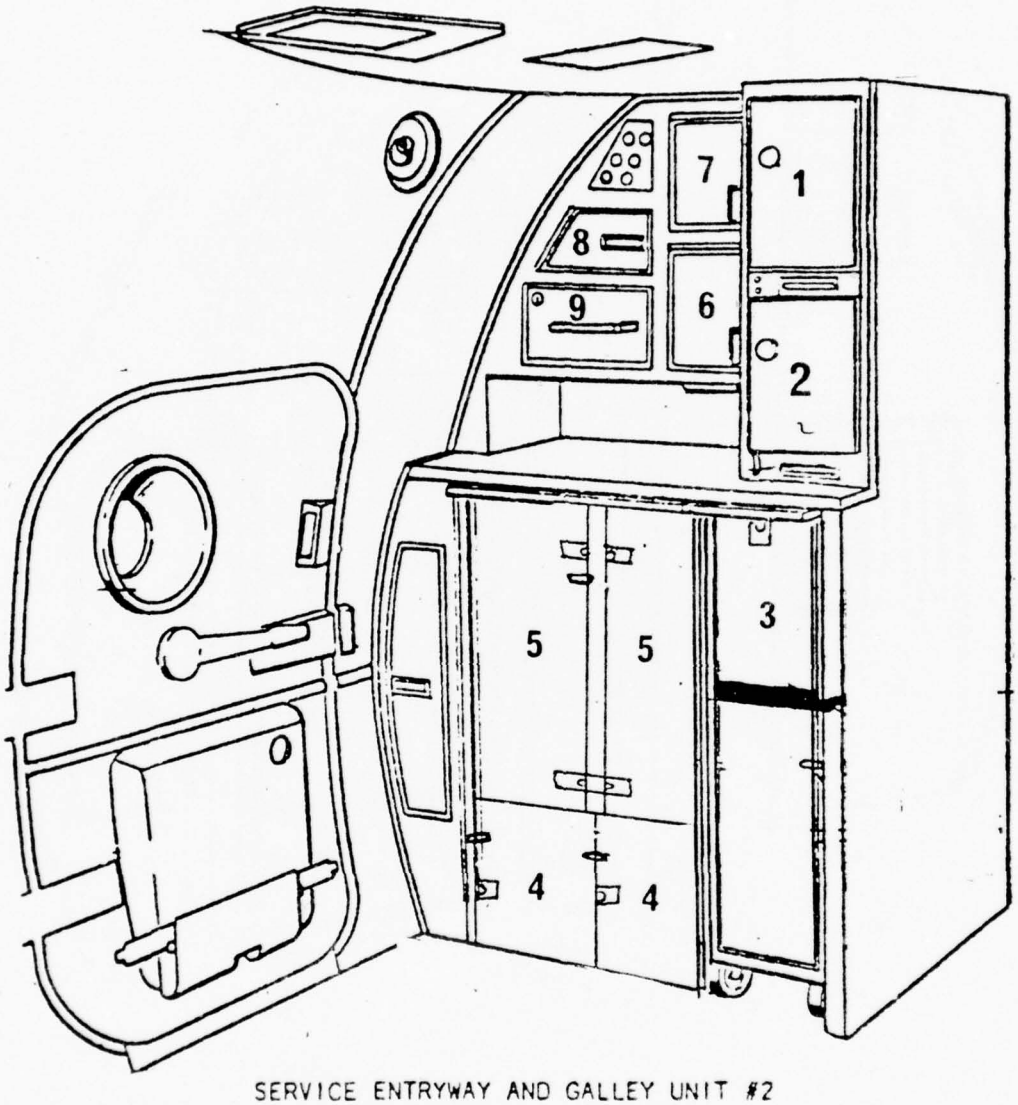
DCA 76-A-Z029

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

GALLEYS NOS. 1 AND 2



FORWARD PASSENGER ENTRYWAY, COATROOM AND GALLEY UNIT #1
(LOOKING FORWARD)



SERVICE ENTRYWAY AND GALLEY UNIT #2
(RIGHT SIDE, LOOKING AFT)

Attachment 2
to APPENDIX VI

File No. 1-0011

DCA 76-A-Z029

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

DESCRIPTION OF DAMAGE TO PASSENGER SEATS

Row/Seat	Seat Pan Fabric	Seat Legs	Lateral Fwd Support Tube	Lateral Rear Support Tube	Miscellaneous
1A	Partially separated from rear support tube		Bent downward	Bent downward 3" at wall end	
1B	Torn about 2" at rear tube				Arm rest cover missing
1C	Separated at aft tube aisle side				Seat back displaced forward; coffee pot under seat; baggage restraint bar bent
1D	not damaged	All bent downward and toward aisle			1-D,E,F leaning 3-6" toward aisle; wire beverage cart basket in seat
1E	not damaged	Distorted downward and toward aisle		Deformed downward about 4"; fractured under 1E	
2A	not damaged	Forward leg fractured; rear leg distorted down and toward aisle	Bent downward about 6" at wall end	Bent downward about 6" at wall end	
2B	Separated at rear tube	Forward leg fractured	Bent downward and outboard		Arm rest raised;
2C	Completely detached from rear tube	Forward and rear legs between 2-C, D buckled and bent downward 2"			

Row/Seat	Seat Pan Fabric	Seat Legs	Lateral Fwd Support Tube	Lateral Rear Support Tube	Miscellaneous
2D	Completely detached from rear tube	Forward and rear legs between 2-C, D buckled and bent downward 2"			
2E	not damaged	Rear leg buckled downward about 4"; forward legs buckled same amount; legs attached to floor track			Arm rest raised; liquor kit lid on seat
3A	not damaged			Deformed downward and separated	
3B	Detached at rear tube; rivets pulled out	Rear aisle leg bent downward and toward aisle about 1"			Tray table on 3B deployed
3 C, D, E					Underseat baggage restraint bar loose laterally only; entire row displaced downward and outboard about 1½"
3C	not damaged				Aisle baggage restraint bar under 3C bent inboard. About 2" clearance between bar and floor.
3D	Detached at rear tube				Forward edge of seat pan is about 6" above floor

Row/Seat	Seat Pan Fabric	Seat Legs	Lateral Fwd Support Tube	Lateral Rear Support Tube	Miscellaneous
3E	not damaged				
4A	not damaged	Rear leg under 4A deformed downward and inboard		Tube fractured at leg	Tray table deployed; Row 4-A, B displaced downward and toward aisle about 1"
4B	not damaged				
4C	Completely separated from rear tube				Aisle baggage restraint bar bent under seat pan and about 3" from floor
4D	not damaged		Wrinkles on both sides of 4D (seats 4-C, E are cantilevered from the two legs to either side of 4D)		Floor raised about 1" under 4D and increases slightly until floor levels again at 7-C,D,E
4E	not damaged	Rear leg is fractured and separated from floor track			
4-C,D,E		All legs bent downward and inboard			Entire row is bent downward and toward aisle
5-A,B					Entire row is displaced downward and toward aisle
5A	not damaged				

Row/Seat	Seat Pan Fabric	Seat Legs	Lateral Fwd Support Tube	Lateral Rear Support Tube	Miscellaneous
5B	not damaged				
5C	not damaged				Aisle baggage restraint bar bent upward and inboard (typical of many seen)
5D	Separated at rear tube	Both legs deformed downward about 1" and inboard at floor			5-D,E displaced downward; floor under 5D buckled and pushed upward about 6"
5E	not damaged				Outboard arm rest moved upward
6A	not damaged	Legs between 6-A,B displaced downward and inboard			
6B	Separated at rear tube and free end on floor	Rear aisle side leg displaced downward and toward aisle			Tray table deployed
6C	Separated at rear tube and free end on floor				Aisle baggage restraint bar bent under seat pan
6D	Separated at reat tube and free end on floor				Empty beer can in seat back pocket
6E	not damaged			Cracked and displaced downward	6C and E displaced downward about 1½"

Row/Seat	Seat Pan Fabric	Seat Legs	Lateral Fwd Support Tube	Lateral Rear Support Tube	Miscellaneous
5-C,D 6-C,D					Tilted toward aisle
7A	not damaged	Leg between 7-A,B deformed downward; no lateral displacement of leg			
7B	not damaged				
7-C,D,E		Leg between 7-C,D free of floor tie down; also bent downward and toward aisle with some forward displacement			Row held up by leg between 7-D,E; Row failed completely and was resting on floor
7C	not damaged				Tray table deployed; aisle baggage restraint bar bent up and snagged on bottom cushion
7D 7E	not damaged not damaged			Bent downward outboard of leg between 7-D,E	
8A	Separated at inboard edge of rear tube. Rivets did not pull out				Arm rest stowed up
8B	not damaged				
8-C,D,E					8-C,D tilted toward aisle

Row/Seat	Seat Pan Fabric	Seat Legs	Lateral Fwd Support Tube	Lateral Rear Support Tube	Miscellaneous
8C	Separated at rear tube				
8D	Separated at rear tube				
8E	not damaged			Crack at leg between 8-D,E	Seat displaced down about 2"
9A	not damaged				
9B	not damaged				
9-C,D,E					Row displaced slightly inboard and downward
9C	Separated at rear tube				
9D	not damaged		Compression wrinkle outboard of leg between 9-D,E	Compression wrinkle outboard of leg between 9-D,E; crack located in wrinkle	Crack located near weld in outboard lateral brace at seat pan frame
9E	Torn - no rivets pulled out - at rear tube				Aisle side of seat frame bent downward
10A	Partially separated at outboard edge	Forward leg fractured and distorted downward		Cracked	
10B	not damaged			Bent downward	
10-C,D,E					Row displaced downward, forward, and toward aisle about 4"

Row/Seat	Seat Pan Fabric	Seat Legs	Lateral Fwd Support Tube	Lateral Rear Support Tube	Miscellaneous
10C	not damaged	Forward and rear legs fractured and compressed downward			Aisle baggage restraint bar folded upward under seat; seat resting on floor on aisle side
10D	not damaged	Forward and rear legs fractured and compressed downward			
10E	not damaged			Cracked	
11A	not damaged				Seatback displaced forward
11B	not damaged				Seat back displaced forward
11C	Separated and fabric torn	Rear leg compressed about 1"		Fractured	11-C,D depressed about 2" downward
11D	Separated at rear tube	Forward leg compressed about 1"			
11E	Separated from rear tube			Fractured	
12A	not damaged	Rear leg compressed 1"			
12B	not damaged	Rear leg compressed			

Row/Seat	Seat Pan Fabric	Seat Legs	Lateral Fwd Support Tube	Lateral Rear Support Tube	Miscellaneous
12C	not damaged	Forward and rear legs fractured and compressed about 1"			
12D	Separated from rear tube			Wrinkled	Forward edge of seat resting on floor
12E	not damaged		Wrinkled	Fractured and bent downward	Seat tie down rail f actured; seat back folded rearward
13A	not damaged	Forward and rear legs fractured and compressed about 4"			
13B	not damaged	Forward and rear legs wrinkled downward	Wrinkled	Wrinkled	Flooring between seat tracks raised; outboard seat track fractured
13-C,D,E					Row resting on floor
13C	not damaged	Rear leg fractured at top and bottom; forward leg bent forward about 6"			Aisle baggage restraint compressed; seat back displaced full forward
13D	not damaged	Rear leg fractured at floor; forward leg compressed about 4" and bent forward about 6"	Fractured	Fractured	
13E	not damaged				Cover missing from seat cushion

Row/Seat	Seat Pan Fabric	Seat Legs	Lateral Fwd Support Tube	Lateral Rear Support Tube	Miscellaneous
14-A,B		All legs fractured			Seats turned about 45° in outboard direction
14A	not damaged	Forward and rear legs free of floor track			Outboard floor track fractured in three places; floor raised and buckled; Blood on wall next to seat
14B	not damaged	Rear leg attached to floor track; forward leg free from floor track			2 shelves from magazine rack under 14B
14-C,D,E					Row turned 60° to aisle and extended in to aisle about 12"
14C	not damaged	Both legs fractured at floor and bent forward about 12"			Tray table deployed; blood on tray table
14D	not damaged	Rear leg fractured; forward leg compressed and twisted			Seat back displaced forward; Side support tube on pan compressed 1"
14E	Partially separated from rear tube		Compressed	Fractured	
15A		Rear leg fractured and compressed; forward leg compressed and bent about 4" toward aisle			

Row/Seat	Seat Pan Fabric	Seat Legs	Lateral Fwd Support Tube	Lateral Rear Support Tube	Miscellaneous
15B	Partially separated at rear tube	Forward and rear legs compressed			
15C	Separated from rear tube	Forward leg compressed slightly; rear leg fractured at top and at floor; also compressed about 1"			Tray table deployed; seat pan side tube fractured at forward end; baggage aisle restraint bar folded under seat
15-D,E					Seat backs displaced rearward 8-10"
15D	Separated at rear tube	Forward leg compressed slightly; rear leg fractured at floor and compressed about 1"	Buckled		Tray table deployed; seat pan side tube fractured at rear
15E		Rear leg fractured and compressed about 4"			Seat pan side tube fractured at forward end
16A	not damaged	Forward leg compressed about 2" and fractured; rear leg compressed about 3" and fractured at floor end.			Wallet with identification of R. Berryman found at seat. Tray table down and its latch was missing
16B	Separated from rear tube	Forward leg compressed about 1". Rear leg compressed about 3" and fractured at floor end			Tray table down
16C	Separated from rear tube	Forward leg compressed about 2". Rear leg compressed about 1"			Tray table down; aisle baggage restraint bar folded upward

Row/Seat	Seat Pan Fabric	Seat Legs	Lateral Fwd Support Tube	Lateral Rear Support Tube	Miscellaneous
16D	not damaged		Buckled	Buckled	
16E	not damaged			Fractured and outboard portion bent down about 2"	Side support fractured at forward end allowing seat back to be displaced rearward about 6"
17A	not damaged			Fractured and compressed at outboard end	
17B	Separated at rear tube				The contoured back of the magazine rack was found in front of seat
17-C,D,E					Entire row compressed downward and about 4" above floor
17C	Partially separated in center of tube				Seat back displaced forward; Coupon for C.R. Cowan found under seat
17D	Partially separated	Forward leg fractured at floor	Buckled		Seat back displaced forward; seat displaced downward about 6-8"
17E	not damaged			Buckled and compressed at side outboard	Seat back displaced forward; seat cushion on floor

Row/Seat	Seat Pan Fabric	Seat Legs	Lateral Fwd Support Tube	Lateral Rear Support Tube	Miscellaneous
19D	not damaged				
19E	not damaged			Fractured at outboard side and compressed about 2"	
20-A,B					Row moved outboard about 2"
20A	not damaged	Forward leg fractured at floor; rear leg fractured at floor			Seat compressed about 6"
20B	Separated at rear tube	Forward leg compressed about 6" down and about 2" toward aisle; rear leg compressed about 2" down and about 2" toward aisle			
20-C,D,E		Forward legs free of floor tracks; rear legs compressed downward			All legs fractured;rear portion of seat row resting on floor and displaced rearward about 45°; row moved into aisle about 8-10"; baggage restraint bar loose
20C					
20D					Seat pan side tube compressed
20E		Forward leg fittings pulled out of track		Fractured	Seat pan side tube fractured
20D					Blood like stain on aft bottom edge of trim below seat back

Row/Seat	Seat Pan Fabric	Seat Legs	Lateral Fwd Support Tube	Lateral Rear Support Tube	Miscellaneous
18A	not damaged	Forward leg fractured at floor; rear leg fractured at floor; both legs compressed about 4"	Buckled near outboard end about 2"	Buckled and end penetrated wall about 2"	
18B	Separated at rear tube	Forward leg compressed about 1" at top of leg; rear leg compressed about 2" at floor end of leg			Plastic bag containing hand soap on seat; blood like stain on rear tube under bottom cushion; no stain on cushion or elsewhere on seat or on floor
18-C,D,E					All seat backs displaced forward. All legs collapsed and resting on floor
18C	Partially separated				
18D	not damaged				Bottom cushion on floor
18E	not damaged				
19A	not damaged	Forward leg fractured at floor end and compressed; rear leg compressed			Tray table deployed
19B	not damaged	Both legs compressed			Tray table deployed
19-C,D,E		Rear legs fractured and compressed down; legs attached to floor			Row resting on floor
19C	not damaged				Small portable radio in seat

Mr. Richard Chandler, Chief of the Protection and Survival Laboratory, Civil Aeromedical Institute (CAMI), showed the following slides to illustrate their research in areas pertaining to cabin safety.

Slide	Description
1	CAMI evacuation simulator with two-deck housing for stairs on the front. The simulator is in a 7-degree nose down and 12-degree right roll attitude. This facility is the primary tool used in evacuation systems research. The purpose of this research is to quantify delays which could occur in an evacuation due to factors of door width, floor angle, seat spacing and configuration, smoke, lighting, debris, aisle width, etc. These factors are then considered in a computer model which is being developed to enable statistically significant predictions of aircraft evacuation times under realistic conditions to be made.
2	CAMI evacuation simulator with the slide out, showing a simulated handicapped passenger jumping into the slide. A recent use of the evacuation simulator was to investigate problems of handicapped passengers in an emergency evacuation. Tests used simulated handicapped passengers in evacuations to avoid uncontrollable potential for injuries to truly handicapped subjects.
3	Inside of the evacuation simulator showing one of the evacuation of handicapped tests in which one of the passengers is carrying the female dummy in his arms. Internal factors such as the number of handicapped on board and their seating locations were considered in this work. The results of this study were furnished the Flight Standards Service for possible use in rulemaking activity.
4	Inside the evacuation simulator showing the industrial spiral stairs and the straight segmented stairs which rotate the same way that the industrial spiral stairs rotate. The B-747 stairs, which have railings on both sides and rotate the opposite direction, were also tested. The results of these tests indicated considerable relative difficulty in using the spiral stairs, particularly when the simulator was oriented at an angle and

Chandler (continued)

vision was limited due to smoke and thus supported the recent rulemaking which limits the use of spiral staircases on board aircraft.

5 Slide showing cockpit of aircraft in the survival tank with men evacuating out the top hatch of the cockpit. This early study demonstrates a continuing interest in evacuation survival research.

6 Slide raft undergoing seaworthiness tests. This test evaluated a slide/raft configuration with high-density occupant loading under partially inflated raft configuration.

7 Individual flotation device which shows that person wearing it would wind up with face in the water. Recent efforts have been directed to work with industry to upgrade the industry standard for individual flotation devices to provide improved flotation characteristics.

8 Smoke hood with subject demonstrating heat resistance by having flame impingement on either side. Although no recent efforts have been made to further develop the smoke hood, several industry sources are now marketing smoke hoods which incorporate supplies of breathing gas to increase usage time.

9 Smoke goggle/oxygen mask combination showing that smoke could leak in under eyeglasses worn by the subject. Recent studies in the laboratory indicated that no device in use on flight decks would provide smoke protection when the user was wearing glasses. These tests are being used by the Flight Standards Service to upgrade the requirements. Current tests of prototype systems show that protection can be provided.

10 Full-face smoke mask which demonstrates visual distortion with person with bifocals. Both full-face smoke masks and goggles can push eyeglasses out of their normal position, so that vision is impaired.

11 Slide depicting a subject under workload preparing for a decompression. This study, conducted by Dr. Busby, evaluated the effect of physical workload on the time of useful consciousness. As a result of this study, consideration is being given to establishing more stringent guidelines to prevent loss of consciousness of flight attendants after a decompression.

Chandler (continued)

12 Slide showing testing of passenger mask being evaluated at altitude with exercise. A frequent task is to accomplish physiological evaluation of the performance of new concepts in oxygen masks.

13 Slide depicting flight attendant strength tests. Recent studies have been conducted to define cabin attendant anthropometry for use in seat, restraint, and work station design, and to define basic strength capability in work-related tasks.

14 Elderly handicapped subject applying force to operate push-button-type restraint system buckle. In measuring characteristics of the population which use civil aircraft, efforts must be made to include the full range of variables, including in this case both elderly and the young.

15 Little girl applying force to a push-button-type restraint system buckle. This study showed that the average force which could be exerted to release a push-button release was only 14 pounds.

16 GM infant seat with 6-month dummy. Tests have recently been completed to evaluate the effectiveness of child restraint systems for providing protection in crashes and in turbulence. Results of this work have been furnished the Flight Standards Service for use in rulemaking.

17 Shows inertia reel restraint system with the dummy submarining. This system, with inertia reels at all anchorage points, was to be used in cabin attendant seats on a wide-bodied jet. Although it met the requirements of the FARs, the manufacturer submitted it for dynamic testing. When it demonstrated major problems (submarining), it was withdrawn from service.

18 Exterior of the Continental Airlines B-727 aircraft in the accident at Denver. The CAMI participants in the investigation of aircraft accidents obtain data to guide our research. This work is now under the leadership of Dr. William Kirkham.

19 Interior of the Continental Airlines B-727 aircraft in the accident at Denver, Colorado, showing the debris toward the front of the cabin. The main aisle of the aircraft, a primary exit route in most accidents, is partially blocked by debris and damaged structure.

Chandler (continued)

20 Galley-mounted seat with flight attendant in it, located in main aisle, the primary exit route.

21 Galley-mounted seat with flight attendant in it slumped to the side with head contacting unpadded, hard structure. If the flight attendant were injured in the crash, the aisle could be blocked. The restraint system design, lack of padding, and low seat back increase the probability of injury.

22 Galley-mounted seat showing the return spring detached and the restraint system and lack of head restraint. The return spring is easily detached by the occupant, probably to make the seat easier to use, since with the spring in place the seat tends to fold up as you are sitting down. However, with the spring detached, the seat does not automatically fold against the galley. Thus, the aisle is blocked unless the cabin attendant takes time to manually fold the seat. This could create a hazard during a serious accident.

23 Galley-mounted seat showing how if the spring is connected it might not retract because of the restraint system getting in the way. Even if the return spring is properly connected, the restraint system must be carefully stowed to avoid interference with the seat retracting completely against the galley. Again, the aisle could be blocked in an emergency. This installation is an example of problems which can exist with cabin attendant seating systems on civil aircraft.

Mr. Chandler then showed a short film showing dynamic impact tests and evacuation tests.

Scene

1 The first series of film scenes is of selected aircraft restraint system tests conducted in CAMI's impact facility. The test platform is being stopped in a distance of about 4 feet from a velocity of 30 miles per hour. Impact events are being recorded with high-speed cameras operating at 1,000 frames per second. These events are occurring in less than 1/4 second.

In this test, a 170-pound anthropomorphic dummy is restrained by a certificated (9-g) lapbelt and shoulder harness in an aircraft seat. The impact force averages 6-1/2 g. The single diagonal

shoulder harness, or upper torso restraint, is attached to an inertia reel located in the seat back. Due to the forward pull of the harness on the upper seat back, breakage occurs in the rear portion of the seat pan frame. No guidance is provided in the FARs to specify the force acting on the seat back by the upper torso restraint.

2 In the next two scenes, 170-pound dummies are restrained by lapbelts and shoulder harnesses in identical aircraft seats. The impact force is averaging 10 g in this first test. Both dummies rotate out of their shoulder harnesses. From analysis of this film, CAMI scientists concluded that this separation from restraint was due to the harness' passing below the center of mass of the upper torso. This test was repeated after relocating the inboard anchorage point of the harness 5 inches to the rear and shortening the common leg of the restraint system by 3 inches to raise the position of the shoulder harness.

3 With the harness now located above the center of mass of the torso, the dummies are adequately restrained even under an impact force 3 times greater than that of the previous test. Accelerometers located in the dummies provided data indicating that only minor injuries would be sustained by a human in this impact situation.

4 This scene illustrates the consequences of being exposed to impact forces without the benefit of upper torso restraint and also problems with firm seat attachment to the aircraft. This 105-pound dummy in the rear seat, being decelerated at an average of 9 g, jackknifes over the lapbelt to strike her face on the forward seat back. Her rebound then causes the forward anchorage point of her seat to break, allowing her seat to tilt back, so that her head then strikes the rear crossbar. A human head could sustain serious or fatal injuries in this impact situation.

5 This test evaluates an aircraft seat designed specifically for protection from high vertical impact forces. This rear, overhead camera view shows the energy absorbers in the seat effectively control seat movement toward the floor. The 45-peak-g impact forces were reduced to 25 g in the 210-pound dummy occupying the seat. The rebound seen after the initial impact is not considered severe enough to produce injuries.

6 CAMI has conducted a series of tests of various infant and child restraint systems to provide information relevant to their use in air carrier aircraft. This 6-month-old-infant dummy, restrained by a lap belt in an air carrier seat, is being decelerated at an average of 26 g. The dummy jackknifes over the belt, striking its head on the forward edge of the seat pan. A loose seatbelt would probably allow ejection of the dummy from the seat. Protection of the relatively large head of the infant and prevention of excessive neck strain are critical features in impact protection for infants.

7 Under the same impact conditions, this commercially available infant seat allows the dummy to ride up the restraint and severely extend its neck over the seat back.

8 Again under the same impact conditions, this seat prevents neck extension and provides good initial impact protection. Rebound forces are not considered significant enough here to injure the infant.

9 The next series shows selected aircraft evacuation tests conducted with CAMI's evacuation simulator. This simulator is an aircraft fuselage mounted on a platform that can be raised 17 feet from the ground and tilted 20 degrees in both pitch and roll axes. The arrangement of airline seats in the simulator is similar to that of the coach section in a B-727 aircraft.

This test is the first of a sequence in which evacuation times are determined for 25 passengers by using floor-level exits of various widths. This exit is 24 inches wide. These data are being used in developing a computer model to predict aircraft evacuation times with consideration of factors such as number of passengers, type and width of slide, and positions of the aircraft and slide.

10 In another research program with the evacuation simulator, CAMI scientists have been attempting to determine where handicapped passengers should be seated in air carrier aircraft so that in the event of an emergency evacuation, they can leave the aircraft by the most expeditious, safest route without slowing the evacuation process. In this test, 50 "passengers" are being evacuated through a hatch type of exit onto an area that would be the aircraft wing. The initial delay represents the time necessary to open the hatch. Included in this group are four "passengers" who are simulating lower-limb mobility problems. Evacuation delays due to these problems led to the conclusion that passengers with these problems should be seated where they would leave the aircraft through a door-type, nonoverwing exit.

Chandler (continued)

11 This scene taken by an overhead camera demonstrates how an immediate attempt to lift a nonambulatory person into the passenger flow can slow the evacuation process. A number of handicapped persons visited CAMI to have their mobility in the air carrier cabin environment assessed. They have provided valuable information related to assuring their safety in aircraft evacuations.

12 The evacuation simulator has also been used to compare rates of passenger movement up and down spiral and straight-segment stairways. This research stems from air carrier requests to seat passengers above or below the main decks of wide-bodied aircraft during takeoff and landing. We were concerned for the type of stairway that would allow passengers to leave the aircraft most expeditiously and safely. In this test, recorded under low light with a special image-intensifying camera, the passengers are moving down a spiral staircase as quickly as they can. The simulator is pitched forward 7 degrees and rolled to the right 12 degrees. The lighting level is reduced to that required at armrest level (0.05 foot-candle) under air carrier aircraft emergency lighting conditions. The subjects are wearing goggles that simulate vision in a smoke-filled environment. We concluded that the straight stairway had measurable advantages over the spiral stairway.

The Protection and Survival Laboratory of the Civil Aeromedical Institute (CAMI) has conducted a continuing program of investigation into problems affecting air carrier cabin safety since its beginning in the late 1940's. The early work of this group in areas of the effects of rapid decompression, dynamic testing of seats and restraint systems, strength capabilities for actuating emergency exits, escape and survival techniques, passenger oxygen systems, etc., are considered milestones in developing safe air travel. This effort has continued in recent years and now forms a major portion of the total workload for the Laboratory. The following listing gives the more significant accomplishments of the years 1966 through 1975.

1966

Discovered failure mode of water-activated survivor locator lights. As a result, units in airline inventory were withdrawn.

Evaluated children's life preservers to determine flotation angles, self-righting capability and retention systems. Conceived a new flotation device for children to improve system performance and provide thermal protection against cold.

Evaluated miniaturized ballistic rescue flares with respect to visibility and trajectory as related to Technical Standard Order (TSO) C24.

Designed first smoke hood to protect passengers after investigation of United Air Lines (UAL) Salt Lake City crash.

Evaluated proposed B-727 passenger mask using human subjects decompressed to 40,000 feet. Approval was denied after performance was found to be inadequate.

Completed dynamic tests to investigate varying anchorage location and restraint configuration on kinematic effectiveness of restraint systems.

Determined exterior light necessary for night aircraft evacuation using slides and overwing exits. Results coordinated with the Society of Automotive Engineers (SAE) and were incorporated in the Federal Aviation Regulations (FAR) 25.812(f) and 121.310 in 1969.

Demonstrated no difference in evacuation times through 24-inch-wide Type I exits having 48-inch and 60-inch heights, allowing deletion of 60-inch height requirement in Notice of Proposed Rulemaking (NPRM) 66-26A.

Evaluated the effectiveness of overhead hatches vs. cockpit windows in DC-7, CL-44, and L-1049 aircraft. No increase in effectiveness was found when the hatch was used, except for the L-1049 in which rapid escape was not possible without an overhead hatch.

1966 (continued)

Cooperated in development and testing of zenon discharge survivor locator lights.

Designed and tested first tritium liferaft configuration identifying lights.

Investigated buoyancy of aircraft seat cushions under dynamic conditions with human test subjects. Results of these tests served as a basis for rewriting TSO C72.

1967

Conducted dynamic tests to evaluate "brace for impact" positions. Findings resulted in Air Carrier Operations Bulletin No. 69-16, Brace for Impact Positions.

Studied the effect of color contrast on exterior exit location markings for aircraft. Recognition of markings was accomplished under as little as .01 candelas for high-contrast combinations to as much as 2 candelas for low-contrast combinations.

Evaluated exit lights, voice recordings, and warbler sounds as locator aids in a test chamber filled with black smoke. Twenty-six subjects averaged 31.5 seconds to locate the exit light, 12.2 seconds to locate the voice, and 8.4 seconds to locate the warbler sound.

Evacuation tests conducted using supersonic transport mockup. Comparison of times for Types I, II, and III exits (70.4 seconds to evacuate the aircraft) with three Type A exits (47.4 seconds to evacuate the aircraft) demonstrated the advantages of the larger, Type A, exits.

Constructed and evaluated polyimide film smoke hoods using human subjects in smoke irritant and under black smoke conditions for mobility tests. Investigated feasibility of small high-pressure breathing gas cylinders to extend useful duration of the smoke hood.

Evaluated first mask-mounted crew oxygen regulator. Discovered functional problems associated with voice communication. The mask was redesigned by the manufacturer to eliminate this problem.

1967 (continued)

Established oxygen utilization efficiency for open-port dilution masks, port-restricted dilution masks, and phase-dilution masks.

Conducted dynamic test program to establish the injury effect of crash impact loads on restrained pregnant occupants.

Completed dynamic tests to demonstrate the injury mechanism of side-facing restraint systems.

1968

Conducted evacuation tests using B-720 aircraft and 258 test subjects to investigate the possibility of evacuation delays due to use of the smoke hood. Impartial evaluation of data did not indicate a statistically significant difference between use of the hood and nonuse of the hood. Demonstrated no effect on hearing and speaking due to the smoke hood.

Completed evaluation of prototype child flotation device to provide extended open-water survival for children.

Conducted lower-leg fracture tests. Determined that loads encountered in producing lower-leg fractures could exceed tie-down strength of passenger seats in an aircraft.

Completed dynamic tests to establish injury potential of various construction methods and materials for possible use in B-747 bulkheads and tables.

Conducted evaluation of head injury potential of the door-mounted slide cover for the 727-200 aircraft. As a result of these tests, energy-absorbing padding was added to the cover.

Conducted dynamic evaluation of the five-point rotary release buckle used on many crew restraint systems. As a result of these tests, weaknesses in the buckle were identified and strengthened by the manufacturer, increasing restraint capability from 9.5 to 24.0 g.

1968 (continued)

Determined efficiency of angled, rearward-facing seats in preventing "roll" off of seat back.

Conducted dynamic evaluation of polyester pillow head cover in reducing head impact deceleration.

1969

Determined protective efficiency of the smoke hood under exercise and rest conditions. Completed multidisciplinary study of the smoke hood regarding vision, sound attenuation, communication, toxic protection, and psychological acceptance.

Completed evaluation of a new phase-dilution conical passenger oxygen mask for use on wide-bodied jet aircraft. Human tests proved the physiological adequacy of the system, which was subsequently approved.

Demonstrated effectiveness of energy-absorbing headrest in reducing cabin attendant head impact against a bulkhead in a rearward-facing seat. (Reduction from 180 to 25 g was demonstrated.)

Completed evaluation of improved five-point crew restraint system buckle at up to 29-g impact.

Conducted head impact tests on B-747 slide cover and window trim.

1970

Evaluated adequacy of five configurations of flotation seat cushions with regard to buoyancy, cushion integrity and effect of restraint system modifications. One configuration demonstrated unfavorable flotation orientation (head down) for some naive subjects. This configuration was removed from service.

Demonstrated the efficiency of the automatic ventilation system of the child flotation device, through use of animal subjects.

1970 (continued)

Investigated behavior of sharks related to attacks on flotation devices. Demonstrated that sharks are attracted to bright (standard yellow) devices, but ignore dull (black) devices.

Completed a study of DC-8, B-727, and B-707 aircraft crashes which presented detailed human factors analysis of evacuation crashes.

Demonstrated inadequate performance of prototype air carrier passenger seat with built-in energy absorbers.

1971

Investigated potential functional or physiological impairments which could result from high-density loading of liferafts. Although circulatory stress of the lower limbs was found to be present after extended duration of occupancy, it did not prevent physical activity on the part of the subjects in a final survival event. Evaluation of a DC-10 slide/raft in open water with waves indicated sufficient flotation capability, although partial body immersion occurred under the more severe test conditions. These data were provided for use in certification.

Completed a study of 48 cabin attendant seating and restraint systems in 13 aircraft to determine possible deficiencies in impact protection.

Completed cooperative program with the National Aeronautics and Space Administration (NASA), Ames Research Center, to investigate dynamic impact protection properties of air carrier passenger seats using two shell concepts with energy absorbers.

Conducted dynamic tests of head impact injury potential of the DC-10 door-mounted slide/raft cover.

Conducted measurements of the ability of the flying population to achieve strength levels to release button-type restraint system buckles.

1972

Completed physiological evaluations of 5-man A-300B oxygen systems, Sabreliner and Jet Commander (FAA) flight crew oxygen systems and demonstrated the inflight smoke protection performance of a smoke hood used in conjunction with a passenger oxygen mask. This combination readily provided protection for 1 hour at normal cabin altitudes.

Completed studies of cold protection provided by a specially designed lifecraft and by "wet suits" used by divers. The wet suits provided little protection when used in the dry state.

Evaluated current aircraft life preservers relative to Technical Standard Order (TSO) C13C. Determined that test procedures in the TSO allowed approval of life preservers providing only 17.7 pounds of buoyant force, although the specified design intent was 23 pounds. This study initiated an effort to upgrade the industry standard for life preservers, completed in 1976.

Accomplished initial evaluations to demonstrate the feasibility of using automotive child seats in an air carrier aircraft.

Developed initial computer model to simulate aircraft emergency evacuation.

Conducted comparative studies of audible guidance techniques (voice vs. bell) for aircraft evacuation at night with a smoke-filled aircraft cabin. Voice direction was significantly preferred; the bell was of little assistance.

Documentation of maximum velocities obtained by users of a standard 29-foot-long evacuation slide indicates speeds of 18 feet per second, sufficient to cause serious injury.

Completed dynamic tests of cabin attendant restraint systems using all inertia reel anchorages installed in the L-1011 aircraft. Due to poor performance in these tests, restraint systems were recalled by the manufacturer and replaced.

1973

Evaluated physiological adequacy of chemical oxygen generators used for first aid application on aircraft. Demonstrated the importance of mask efficiency in the overall performance of the system.

Completed reevaluation of A-300B crew oxygen system redesign indicated by prior testing. Information subsequently aided certification.

Investigated concepts of using existing passenger oxygen systems and aspirator techniques for removing CO_2 in hoods to provide protection against smoke. The concept of an aspirator CO_2 scrubber was adopted by the industry and resulted in competitive marketing of smoke hood protection systems with breathing gas supply and extended duration of use.

Conducted dynamic tests of prototype five-point crew restraint buckle. Tests indicated buckle could fail even though it had met TSO test requirements. System subsequently was removed from the market.

Completed dynamic test evaluation of prototype lateral restraint system. System was found to provide inadequate restraint and could cause injury. Subsequently the system was withdrawn by the manufacturer.

1974

Developed concepts for potential applications of passenger oxygen masks for inflight smoke protection.

Accomplished preliminary evaluation of flight deck smoke protective equipment using subjective techniques. Concluded that these techniques, which were prevalent in the industry, could not provide consistent results.

Developed infant dummy for evaluation of child restraint systems for aircraft. (The dummy was subsequently adopted by the National Highway Traffic Safety Administration (NHTSA) for compliance testing.)

1974 (continued)

Measured properties of air carrier seats for construction of a seat for dynamic testing.

Completed static tests of restraint systems (combined lap belt and shoulder belts) to demonstrate static test alternative procedures relative to the TSO requirements.

Conducted a comparative demonstration of all available emergency light systems in a smoke-filled cabin mockup for the SAE A20 Committee. This was the first opportunity for industry to observe and compare systems under simulated emergency conditions. An important observation was the significance of brightness in determining visibility of the signs.

1975

In cooperation with the Air Line Pilots Association (ALPA) Steward and Stewardess Division, the National Transportation Safety Board (NTSB), and FAA AFS-50, a compilation of biomedical data pertaining to air carrier accidents and incidents in 1970, 1971, 1972, and 1973 was completed and distributed. (This compilation is updated with more recent data as data become available.) Data from this compilation were used to define injuries related to emergency evacuations.

Initiated a direct effort to improve communications with the industry relative to problems of cabin safety and applications of research conducted by the Protection and Survival Laboratory. This program began with a seminar attended by 46 representatives of ALPA, the Association of Flight Attendants (AFA), the Transport Workers Union (TWU), various air carriers, NTSB, and other offices of the FAA. It has been followed by a series of "workshops" for small groups (3 to 4 participants) in which individual attention is given to the specific concerns of the attendees.

Developed objective techniques for evaluating the protection offered by flight deck smoke protective equipment. Completed over 1,000 tests on 124 combinations of oxygen masks and smoke goggles, fullface masks and hoods. It was found that equipment in service did not achieve the minimum performance levels established for these

1975 (continued)

tests. As a result of this effort, revisions to the regulatory requirements were undertaken and manufacturers initiated a product improvement program.

Completed dynamic tests of automotive child restraint systems in an aircraft seating configuration to demonstrate protection offered in crashes and turbulent flight.

Initiated a cooperative program with the U.S. Army to dynamically test and develop a lightweight crew seat incorporating energy absorbers to limit crash loads acting on the occupant in the forward, rearward, and vertical directions.

Measured light output of survivor locating lights. Measurements indicated light distribution variations not considered by TSO-C85. Modifications were undertaken by the manufacturer and data were furnished the Flight Standards Service of FAA for possible revision of the TSO.

Comparison of passenger movement on spiral and straight segmented stairways showed inefficiencies of spiral stairways, especially when rapid movement between decks is desired under smoke conditions or nonlevel orientation. Data supported recommendations prohibiting future installations of spiral stairways in aircraft.

Compared performance of seven currently used exit lights to determine relative ability to penetrate black smoke. No significant variation in existing lights was detected, but an experimental light with greater initial brightness was also superior in smoke penetration.

Completed a study of the problems of handicapped passengers in aircraft emergency evacuations. Conclusions were reached regarding preferential seating areas in the aircraft to avoid injury to the handicapped passenger or delay for other passengers.

Completed 72 standard anthropometric and functional measurements of 423 stewardess trainees to provide adequate criteria for improving the emergency equipment availability and workspace design for the stewardess.

1975 (continued)

Completed a study of the maximum strength capabilities of on-line airline stewardesses. Measurements obtained provide appropriate data for the design engineer to make the stewardess-machine interface compatible with their duty requirements.

FAA'S AUGUST 31, 1976, RESPONSE TO INQUIRY OF MAY 10, 1976, FROM SUBCOMMITTEE ON INVESTIGATIONS AND REVIEW, HOUSE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION CONCERNING AIRCRAFT SAFETY ENVIRONMENT

In his letter of May 10, 1976, to Dr. McLucas, Chairman Jim Wright of the Subcommittee on Investigations and Review, House Committee on Public Works and Transportation, specified 21 subject areas for which members of the Committee had expressed special interest or concern as the result of recent aviation safety oversight hearings. Among these were eight subjects related to the February 1976 hearings on Aircraft Cabin Environment:

(13) Training, testing, retraining, and certification of flight attendants.

(14) Anchoring of major internal structures aboard commercial aircraft.

(15) FAA Bulletin requiring flight attendants to be seated during taxi, takeoff, and landing being regularly violated.

(16) In FAA's cargo loading regulations for stowage in the passenger compartment, the word "passenger" should be changed to "occupant."

(17) Need for dynamic testing of seats as well as other cabin components.

(18) Continued research required on flammability of materials for cabin interiors and flight attendants' uniforms as well as on toxic emissions, escape devices in flaming cabins, fire suppressants, and emergency breath filtration devices.

(19) Improve availability and insure proper functioning of emergency oxygen systems for all crewmembers and passengers.

(20) AD 76-05-02 indicates that side facing seats may no longer be used by flight attendants but could be used for passengers.

In his August 31, 1976, response to Chairman Wright, Dr. McLucas indicated the current status and plans for each of the above-mentioned items. A copy of that portion of the response is attached.

Attachment

Item No. 13: Training, testing, retraining, and certification of flight attendants are areas of concern to the Subcommittee, and we feel FAA may want to address these areas more carefully.

Response: Increased emphasis is currently being placed on flight attendant training programs, including initial, recurrent, and transition training. More specifically, this emphasis relates to emergency training involving emergency equipment and procedures and in particular the operation of exits in the emergency mode. These efforts include a complete evaluation of all flight attendant training programs with respect to the above. After completion of this evaluation, follow-up action will be initiated, as required.

The air carriers are also being encouraged to use the "hands-on" training concept through the use of training mockups and simulators to more realistically illustrate emergency equipment and procedures.

Significant proposals were submitted to the First Biennial Operations Review dealing directly with expanding the scope of flight attendant initial and recurrent emergency training programs to include actual "hands-on" demonstrations on particular drills. Several of these proposals are presently being considered for inclusion in a Notice of Proposed Rule Making which is under development.

Regarding the certification of flight attendants, this issue was included in the discussions of proposals submitted to the First Biennial Operations Review. The proposal on the subject of certification sets forth objectives to ensure an equal/adequate level of training and enforcement by the agency to establish standards applicable to all airlines and to culminate in Federal certification after completion of training and testing.

We are not aware of reasons why the certification of flight attendants would be significantly advantageous over the present system. There are over 40,000 flight attendants in the U.S. To certificate these flight attendants would impose an extremely heavy workload on the agency without a concomitant increase in the level of qualifications and performance of flight attendants.

Federal Aviation Regulations presently require each air carrier to have a flight attendant training program and appropriate instructions in its manual to enable flight attendants to accomplish their assigned duties

in an effective manner. The FAA reviews and approves the training program. These training programs are monitored by the agency to ensure the effectiveness of the training given.

Based on the above, it is believed that certification would not significantly improve the high standards of performance presently required.

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Item No. 14: The anchoring of major internal structures aboard commercial aircraft, such as closets and galleys, to prevent breakaway on impact in a crash, is a subject on which testimony seems to justify new research and attention.

Response: The FAA presently has underway a research project to study the effects which dynamic crash landing loads have on the overall cabin structure, including structures such as closets and galleys. If the results of this study indicate that a revision of design standards is in order, appropriate action will be taken.

Additionally, we should note that Notice No. 8 of the First Biennial Airworthiness Review contains a proposed new standard for FAR 25 intended to improve the security of contents stowed in various compartments in the cabin. This proposes that if latches are used on compartment doors for securing the contents, unwanted opening of the doors must be shown to be extremely improbable, taking into consideration the wear and deterioration expected in service. Comments received from the public in response to this proposal are under consideration.

****

Item No. 15: According to testimony before the Subcommittee, the FAA Bulletin requiring flight attendants to be seated during taxi, takeoff, and landing, is being regularly violated by many air carriers.

Response: Air Carrier Operations Bulletins (ACOB) are not regulatory in nature and thus are not mandatory. They are issued to provide needed guidance to FAA field inspection personnel, as well as to establish the direction that each carrier should follow in numerous operational matters.

The intent of ACOB 70-9 was to correct a specific problem that came to our attention in which a flight attendant was unable to perform emergency duties during an emergency evacuation because during the time the aircraft was taxiing (1) passengers were allowed to leave their seats, thus blocking the passageway, and (2) the flight attendant left her duty station to return personal effects to passengers. Federal Aviation Regulation 121.311(b) which requires each person on board to be seated during takeoff and landing with safety belt properly secured, is not being regularly violated to our knowledge.

We are currently preparing a revision to this bulletin to emphasize the importance of passengers and flight attendants remaining seated while the aircraft is taxiing. This would not prohibit flight attendants from leaving their duty stations to perform duties associated with safety.

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Item No. 16: It is the general feeling of the Committee that in FAA's Cargo Loading Regulations for stowage in the passenger compartment, the word "passenger" should be changed to "occupant" so as not to permit flight attendants to be seated forward of items which could become lethal loose cargo in a crash situation.

Response: Two proposals were submitted to the agency's First Biennial Operations Review which proposed changing the language in FAR 121.285 from "passenger" to "occupant," in order to provide the same protection to passengers and flight attendants alike with respect to their sitting forward of cargo and cabin baggage. These proposals have been combined and are being considered for issuance in a Notice of Proposed Rule Making which is currently under development.

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Item No. 17: The present system of static testing on seats and seat anchoring appears to us to be inadequate. Testimony before the Subcommittee by FAA scientists makes plain the fact that dynamic testing gives a much more accurate picture of what stresses can be handled by various seating components in a crash. FAA seems to need a more clear official position with regard to dynamic testing of seats as well as other cabin components.

Response: Regarding the dynamic testing of seats, it is necessary that the criteria for such tests include input pulse shapes, and response characteristics of seat/occupant systems when subjected to crash environments. Such data are now being obtained by full-scale controlled crash tests being conducted at Langley Research Center. After these results are obtained and evaluated, the FAA will determine whether dynamic testing is necessary to predict seat performance in a crash.

In addition, we are conducting seat/occupant tests at the National Aviation Facilities Experimental Center in Atlantic City in order to establish a mathematical model of the seat and occupant behavior in crash conditions. It may be feasible to mathematically predict performance rather than having to test for crashworthiness.

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Item No. 18: It was emphasized in our hearings that much testing had been done to determine flammability of materials used in cabin interiors and flight attendant uniforms. The Subcommittee needs to be kept fully informed of your continued research in this area as well as in the broader field of toxic emissions, escape devices in flaming cabins, fire suppressants. and emergency breath filtration devices.

Response: We will be pleased to keep the Subcommittee fully informed of our research efforts in these areas. In this regard, we note that considerable research remains to be completed in the areas of cabin materials, toxic gas emission, emergency breathing filtration, escape devices, and fire suppressants.

Because of the complex, inter-relationship of the flammability and smoke and toxic gas emission qualities of cabin interior material, it is apparent that considerable research remains to be done. We expect to conduct, in about one year, a comprehensive review of the overall area of cabin interior materials, after some of the ongoing research and development is completed and results are available for evaluation. The need for comprehensive rather than piecemeal standards may be indicated. In this connection, the FAA presently has under careful review comments received in response to several outstanding rulemaking notices (Notice Numbers 74-38, 39 F.R. 45044; 75-3, 40 F.R. 6506; and Proposal 8-118 of Notice 75-31, 40 F.R. 29410) with a view toward determining whether final rulemaking based on these notices is practicable at this time. Since this review is in its final stages, we will advise the Subcommittee of our determination when a final course of action has been decided on.

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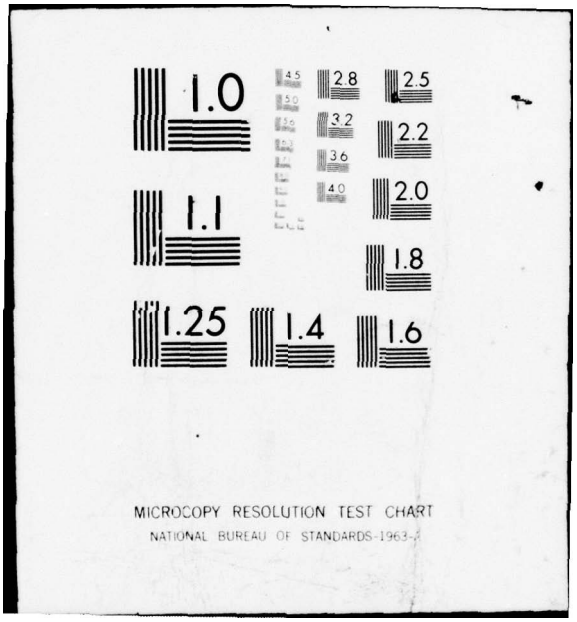
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Regarding flight attendant uniforms, we expect to complete a research and development project this year. After evaluation of the results of this project, we will determine what action is appropriate.

Please be assured that these areas of concern to the Subcommittee are also receiving careful attention by the FAA. In discharge of its mission to promote aviation safety, the FAA is directing significant research efforts toward these problems as well as maintaining close liaison with the aviation community in an attempt to find viable solutions to them.

It is the FAA's intent to promulgate comprehensive and complete regulatory standards in these areas when viable solutions are developed.

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Item No. 19: Much concern was voiced during hearings over the availability of, and the failure percentage rate, of emergency oxygen systems. We do not feel this was addressed fully by the FAA, particularly with regard to corrective actions which might be taken to improve availability and to insure that emergency oxygen systems for all crewmembers and passengers actuate and function precisely as designed.

Response: We have reviewed the various actions taken or contemplated by the major manufacturers to upgrade and to increase the reliability of passenger and crew emergency oxygen systems.

Our review indicates that neither Lockheed Aircraft Corporation nor the Boeing Company have found it necessary to modify or to provide other corrective action on emergency oxygen systems installed on their aircraft; nor have any Airworthiness Directives (AD) been issued pertaining to emergency oxygen systems on these aircraft.

With respect to McDonnell Douglas Corporation aircraft, the following applies to corrective actions taken after the DC-10 accident at Albuquerque, New Mexico.

DC-10

1. All oxygen masks failed to deploy in the left aft section of the cabin.

Failure of the No. 3 (right wing) engine resulted in isolation of the No. 3 AC electrical bus which serves the left aft cabin. Power could have been restored if the bus tie switch on the flight engineer's panel had been

returned to the normal position. On March 11, 1974, a note was added to the Airplane Flight Manual (AFM): "If power to any bus is interrupted, recycle passenger OXY MASK switch after power is restored."

2. Seven oxygen compartments failed to open in the remainder of the cabin.

Prior to the accident, on March 9, 1973, FAA Maintenance Bulletin (M/B) 8340.1 was issued, requesting surveillance to prevent passenger seat upholstery from interfering with opening of oxygen compartment doors. On January 10, 1974, DC-10 Principal Maintenance Inspectors (PMI's) were reminded of M/B 8340.1. On July 5, 1974, Airworthiness Directive (AD) 74-15-04 was issued, requiring upholstery modification. On January 29, 1975, AD 75-04-03 was issued, requiring installation of improved oxygen compartment door latches.

3. Three oxygen cannister (generators) were pulled out of oxygen compartments.

It is believed the cannisters were pulled out of nearby seats by passengers whose own masks did not deploy, or because they thought their own masks were not dispensing oxygen. On December 26, 1973, the PMI's were requested to assure that operators followed Douglas oxygen installation procedures. On March 28, 1974, M/B 8340.1A was issued, requesting PMI's to assure adequate inspection in this area. On April 24, 1974, AD 74-10-2 was issued, requiring installation of improved cannister retention clips.

4. No warning that oxygen cannisters can be extremely hot.

If the cannisters are properly installed, a heat shield will prevent passengers from touching the cannisters. As a precautionary measure, however, on January 29, 1975, AD 75-04-03 was issued, requiring installation of a "HOT" placard.

5. Some oxygen cannister heat shields were dislodged.

This problem was corrected in association with proper cannister-retention (Item 3) and mask and hose packing (Items 6 and 8).

6. Oxygen masks improperly packed and stowed.

On December 26, 1973, the PMI's were requested to see that oxygen masks were properly packed and stowed in accordance with the Douglas maintenance manual. On March 28, 1974, M/B 8340.1A was issued, recommending PMI assurance that proper packing procedures were being followed. On January 29, 1975, AD 75-04-03 was issued, requiring modified oxygen hose routing and mask holders.

7. One reservoir (breather) bag separated from the oxygen mask.

On June 8, 1974, AD 74-14-07 was issued, requiring installation of reservoir retaining discs.

8. Some oxygen mask hoses and reservoir bags were found fused (welded) to the cannisters.

If the masks are properly packed and stowed, there is no way for the hoses and reservoir bags to become wedged between the cannister and heat shield. On December 26, 1973, PMI's were instructed to see that the operators stowed masks properly in accordance with the Douglas maintenance manual. On January 29, 1975, AD 75-04-03 was issued, requiring rerouting of oxygen hoses and installation of additional hose clips.

9. Eight oxygen masks lanyards snagged on mask holders.

On August 19, 1974, Douglas issued Service Bulletin (S/B) 35-16, providing means to prevent the lanyards from snagging on the mask holders. On January 29, 1975, AD 75-04-03 was issued requiring compliance with S/B 35-16.

10. Lack of indication of passenger oxygen flow.

This problem is complicated by the fact that at lower cabin altitudes, oxygen flow is less apparent, which was the case in the ABQ accident. On December 10, 1973, Douglas issued All Operators Letter (AOL) 10-529, bringing the above condition to the attention of the operators. This was followed in April 1975 by a Douglas booklet "DC-10 Passenger Emergency Oxygen System" for flight personnel familiarization. Work is continuing on development of an oxygen flow indicator that would be understood by passengers.

11. A few bulkhead oxygen compartment doors would not open 180 degrees.

To insure 180 degree opening (to provide unrestricted passenger flow during evacuation), on June 11, 1974, Douglas issued S/B 25-163, providing modified door hinges. On January 29, 1975, AD 75-04-03 was issued, requiring compliance with S/B 25-163.

12. Oxygen masks were not connected to portable oxygen cylinders.

On January 28, 1974, PMI's were directed to advise operators of Douglas maintenance manual provisions indicating that masks should be connected to oxygen cylinders and be ready for use. On March 28, 1974, M/B 8340.1A was issued, reiterating the above. On August 9, 1974, Douglas S/B 35-17 was issued, covering the same subject and detailing the method of attachment.

13. Confusion with oxygen masks and life vest stowed in alternate seat backs.

This confusion resulted from passengers trying to force open oxygen compartment doors that failed to deploy. Although placarded LIFE VEST, the life vest door is similar in appearance to the oxygen door. Improved oxygen compartment door opening reliability, covered by other items on this list, is considered to alleviate this problem.

14. Exposure to open oxygen compartments when passengers assume emergency landing brace position.

This condition was not contemplated during the type certification program. Since the doors cannot be readily relatched, studies are continuing on ways to hold the doors closed or provide other protection for the passengers.

15. Lower galley portable oxygen cylinders difficult to reach.

Reevaluation of the location of the portable oxygen cylinders on the forward bulkhead outboard of the escape ladder has been completed. The FAA has issued AD 76-13-04 requiring the relocation of the lower lobe galley portable oxygen units in all Douglas DC-10 airplanes.

The following action has been taken with regard to the DC-8:

DC-8

1. AD 74-12-03 effective April 15, 1975
   Inspection and modification of oxygen system plumbing.

Three Maintenance Bulletins have been issued by the FAA, Air Carrier Airworthiness Branch, to provide data to our principal inspectors and to the air carrier industry regarding specific problems and corrective procedures. These are as follows:

(1) Maintenance Bulletin 35-1, Passenger Service Unit Oxygen Mask Doors. Provides information regarding door opening failures due to accumulations of dirt and nicotine.

(2) Maintenance Bulletin 35-4, Oxygen Valve and Manifold Seal Deterioration. Provides information regarding seal life and recommends principal inspectors determine that their assigned operator is aware of problem and has adequate provisions in his approved maintenance program.

(3) Maintenance Bulletin 35-5, Emergency Oxygen System Problems. Provides details on a specific DC-10 accident in which certain emergency oxygen system problems were encountered. Principal inspectors are requested to determine the adequacy of their assigned operator's inspection program with respect to specified areas.

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Item No. 20: It has been brought to the Subcommittee's attention that the FAA, in written communication, has indicated that while side facing seats may no longer be used by flight attendants, they may in fact be used for passengers under the provisions of AD 76-05-02. This administrative interpretation seems to obviate the increased safety of cabin occupants for which the AD was designed.

Response: Airworthiness Directive (AD) 76-05-02 was issued to prohibit the use of flight attendant side facing seats by flight attendants. The AD was issued in recognition of the crucial role of flight attendants during emergency situations. Compliance with AD 76-05-02 could be achieved by removal of these seats or by the addition of a placard to prevent their

use by flight attendants during takeoff and landing. In the event an operator elected the option of placarding a side facing seat against use by a flight attendant, the seat could conceivably be assigned to a passenger. However, we do not believe that an operator would choose to do this since this would likely be considered a significant change in the particular cabin configuration in question which would require re-evaluation from an emergency evacuation standpoint, including consideration of the requirement in the regulations for a full scale emergency evacuation demonstration. The FAA is currently surveying this area to determine whether side facing flight attendant seats have been placarded allowing use by passengers.

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APPENDIX IX

SUMMARY REPORT OF
LISTENING SESSION WITH FLIGHT ATTENDANTS
SAN FRANCISCO, CALIFORNIA
SEPTEMBER 21, 1976

U.S. DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration

Listening Session with Flight Attendants

Opening Remarks

FAA Administrator John McLucas welcomed the participants and expressed his appreciation for their attending this session. He then briefly described the purpose of listening sessions and other consultative planning meetings, stating that since he was new to the FAA such meetings were helpful to him in getting a better view of the problems which face the people in the aviation industry.

Dr. McLucas pointed out that some of the items which might be raised at the meeting could already be in rulemaking status which would by law prohibit discussion of those items. He said that while FAA would not hide behind the fact that some items were in rulemaking, they could sometimes not give as specific an answer as would normally be the case. Following this, the discussion began with Dr. McLucas acting as moderator.

Proceedings

Ms. Joan Fuetsch, serving as the principal spokesperson for the Transport Workers Union (TWU), had a number questions and inquiries regarding the status of matters of concern to TWU:

Lack of Flight Attendant Representation within FAA

Ms. Fuetsch stated that many of the flight attendants who are working in the area of cabin safety have developed good relationships with principal inspectors involved with their airlines, many of whom are just as frustrated as they are about the lack of action from Flight Standards Service on cabin safety problems. She asked Dr. McLucas if he didn't feel that a person with flight attendant experience in the twelve regional offices might help decrease the workload of principal inspectors.

Dr. McLucas said he felt it was an interesting suggestion--one which he had heard before--and he was neither for it nor against it at this time, except that he believes there is a useful function which could be performed by such a person. At the same time, however, it runs up the overhead. Dr. McLucas said that if FAA was to enter into that perhaps it would be better to begin with just a few rather than throughout the regions.

Ms. Fuetsch asked whether FAA had anyone with cabin safety expertise and any crashworthiness background go over the cabin equipment when an aircraft is certificated, to which Mr. Skully, FAA Director of Flight Standards, replied yes.

Ms. Fuetsch then mentioned the Civil Aeromedical Institute (CAMI) program and the educational efforts which have been put forth there for both company representatives as well as union safety representatives. She asked if there was some way to establish direct communication between the Office of the Administrator and the Protection and Survival Laboratory, suggesting that perhaps Ms. Donell Pollard of CAMI would be the person to do that, that she should be the one to contact flight attendants, principal inspectors, and CAMI researchers.

Dr. McLucas responded by stating that if the flight attendants felt that the Protection and Survival Laboratory was too far down the structure for its recommendations to reach his office or that if they felt someone at an intermediate level was suppressing that unit's recommendations he would explore the situation. Dr. McLucas also pointed out that Dr. Busby's recent appointment to Deputy Federal Air Surgeon at FAA Headquarters should improve the flow of communications, since Dr. Busby was formerly Chief of the Aeromedical Research Branch at CAMI and is quite familiar with CAMI's activities in the cabin safety area.

Another question was received regarding how many people with flight attendant experience are presently employed by FAA, in what capacities, and why they were not present at this listening session.

There are two persons presently employed by FAA who have flight attendant experience: (1) Ms. Donell Pollard, Human Factors Specialist, Protection and Survival Laboratary, Civil Aeromedical Institute, and (2) Ms. Carolyn Johnson, Air Carrier Cabin Safety Inspector, Flight Standards Division, FAA Central Region, Kansas City, Missouri.

The above-mentioned FAA personnel were not invited to the listening session because the purpose of the listening session is to give a representative group of flight attendants an opportunity to present their views to the top-level FAA officials in a face-to-face exchange. However, they will receive copies of all materials pertaining to this meeting.

Comments were received from many of the flight attendants on the termination of Ms. Jeanne Koreltz in the position of Air Carrier Cabin Safety Specialist in FAA's Flight Standards Service. Specifically, the flight attendants wanted to know why she was terminated and why the position was abolished.

Mr. Skully responded by stating that Ms. Koreltz was terminated because of a sex discrimination grievance filed by one of the flight attendants. Moreover, the position was a Schedule A position which was approved by the Civil Service Commission not to exceed 24 months. This was the easiest way to hire a person with flight attendant experience who was perhaps not on the Civil Service Register. Thus, it was not a career position.

Ms. Fuetsch stated that the basic problem troubling the Transport Workers Union is the fact that because of lack of representation by flight attendants within the FAA they feel that they are not getting responsive action.

Dr. McLucas said that this point came through during the discussion, and he does not have a closed mind on it. He said he believes the idea of hiring flight attendants is an interesting one and he is forming an opinion on the subject based on the pros and cons presented by his staff. Flight Standards recommended that we try an alternative which was to hire a number of flight attendant consultants who would be recommended by their industry for a certain period of time. Once we see how that approach works, it can be determined whether it is preferable to have the flight attendant consultants or a flight attendant on the headquarters staff. And while the flight attendants at this meeting had certainly pinpointed very real problems, hiring a flight attendant does not solve those problems. One of the perennial complaints about the FAA regulatory process is that it usually takes longer than two years. However, the burden of proof is on the FAA to show that it does provide an adequate response to the flight attendants.

The flight attendants wanted to know for what period of time would FAA use each consultant and how long would it take for FAA to decide which is the better technique--consultants or a staff individual.

Mr. Skully replied that it would probably be similar to the time frame used about a year and a half ago when FAA hired six ex-airline captains as consultants for approximately 90 days. He went on to say that some of the flight attendant representation at this meeting had been quite negative relative to recommending names. Dr. McLucas added that FAA should make a decision within a few months as to whether this is a viable approach, depending on what kind of response he receives.

Another question asked of Mr. Skully was what was the GS rating originally attached to the Cabin Safety Specialist position.

Mr. Skully replied that the Civil Service Commision had originally tried to classify the position at the GS-9 level but that Flight Standards was able to justify a GS-11 rating.

Recurrent Training

Ms. Fuetsch commented on the statement made by Mr. Joseph Ferrarese of FAA's Flight Standards Service at an August 31 meeting at CAMI in which he referred to Mr. Halaby's (former FAA Administrator) 1961 finding that flight attendant training was inadequate and his subsequent request to the airlines that recurrent training include drills in the use of slides, opening of exits and other cabin equipment. She asked if Mr. Skully would care to comment on the fact that in 1975 the National Transportation Safety Board (NTSB) issued at least one recommendation, A75-84, citing inadequate flight attendant training as a factor in a recent accident investigation and that many carriers still have not implemented hands-on training. Mr. Skully said he had no comment but accepted the statement.

Other questions were raised regarding how many airlines still require that flight attendants spend twelve hours in the classroom and whether FAA felt that the present recurrent training programs were adequate.

Mr. Skully responded that he does not feel that the present program is inadequate.

One of the participants wanted to know why principal inspectors had recently gone through flight attendant training at American Airlines and whether this program would be continued or perhaps expanded so that the principal inspectors go through the training of their own carrier.

Mr. Skully stated that the plan is to have all of the air carrier inspectors go through an indoctrination or specialized course during the next three years. The one cited is the first effort. FAA plans to rotate it--not just focus on American Airlines--to see the latest state of the art of training and some of the other carriers' performances. Mr. Skully added that this would give the inspectors a better appreciation of the duties of flight attendants.

The flight attendants wanted to know how closely recurrent training is monitored and if FAA felt that training might be better monitored by a person with flight attendant experience. Additionally, is there a standard for monitoring right now?

Mr. Skully said he could not describe how closely recurrent training is being monitored. Continuing, he said he did not see the need for a person with flight attendant experience to monitor recurrent training because he thinks that the people already located can adequately monitor the program, just as they monitor the various ground schools being taught to the flight crew members. Mr. Skully pointed out that perhaps "monitor" was not the correct word because what we are actually looking for is compliance with the training program. And monitor doesn't mean staying in the classroom on a day-to-day basis.

Ms. Fuetsch also wanted to know whether the FAA has a requirement for first-aid training in the recurrent training curriculum, to which Mr. Skully replied that he did not know. (Note: This as well as other questions which were not answered will be listed in the follow-up appendix to this report where the latest information available will be presented).

Ms. Sandra Campbell, independent researcher at UCLA, on leave from Pan Am, stated that she understood that the cabin attendant training for air carrier operations inspectors that was being conducted by American Airlines was designed to focus on Principal Operations Inspectors in modern training methods in the area of cabin safety. They developed a three and a half day course of training. This course will present the philosphies behind the development of emergency evacuation procedures by one airline and will offer an opportunity for the inspectors to participate in a hands-on drill utilizing emergency equipment. It will also acquaint them with firsthand training as conducted by this airline. It doesn't mention anything about evaluation of American Airlines' training but more or less an opportunity for operations inspectors to be more aware of what is going on. Ms. Campbell wanted to know if the training was designed to evaluate or just to familiarize.

Mr. Skully replied that the course was for the purpose of familiarization.

Continuing, Ms. Campbell said that it was her understanding that each training program is approved by the regional office. She suggested that consideration be given to having one area reevaluate all of the training programs in order to have a more standardized program throughout the United States and more standardized evaluation procedures of the requirements of the training program. She pointed out that she had evaluated training programs on the air carriers in the United States and did not feel that a mock-up that uses

wooden handles was adequate. Using wood handles and latches on a so-called mock-up is not helping the matter but making it more confusing. Thus, she would like to see a regular, organized evaluation of the training program which could be done in a manner such as a university evaluates a high school program.

Many of the flight attendant participants expressed concerns regarding training related to emergency situations on board the aircraft involving heart attack victims, allergic reactions to some of the food served, asthmatics and other persons requiring immediate first aid. They believe that they are not sufficiently trained to handle these emergencies and asked how many hours the FAA requires for first-aid training, initially and in recurrent training programs.

Dr. Busby responded that FAA does not have a requirement regarding the number of hours of first-aid training. He said he believes there is a requirement for training in first-aid equipment and its proper use and handling of emergency situations including illnesses, injuries, and other abnormal situations.

He said that many suggestions for improved medical provisions and expanded training are received each year from physicians who fly the airlines and encounter medical problems. In fact, he said, in December 1975 he had an opportunity to see this situation firsthand with a heart attack victim on board a Continental Airlines flight. Dr. Busby said he did not really feel frustrated with the fact that he didn't have the equipment to diagnose whether the person was suffering from anything other than a heart attack. Dr. Busby stated that they could discuss for hours the philosophy of requiring cardio-pulmonary resuscitation (CPR); but as any physician or critical care nurse will tell you, you've got to practice all the time in order to maintain proficiency in CPR. Since heart attacks occur so rarely on the airlines, all they can do is give the rudiments of the training. He pointed out that some of the flight attendants at the meeting may have had the complete series of training in CPR only to have their airlines drop it. Some airlines have dropped closed chest compression and have gone only to mouth-to-mouth respiration as an emergency measure because it is so difficult to maintain the ability to conduct efficient CPR; that is, closed chest as well as the ventilation. This relates to how far do you want to take it in terms of procedures taught in medical management as well as for the equipment on board. Again, there is no FAA regulation specifically concerning this. Dr. Busby said he has discussed many times with the airline medical directors the matter of just how far to go in the flight attendant first-aid training programs. And one of the problems, of course, is just how far do you take the diagnosis and treatment of medical problems by flight attendants.

Dr. Busby went on to say that FAA recognizes the need to review what is available in the medical kit and that this is being conducted by a committee of the Aerospace Medical Association under Dr. Stanley Mohler of the Office of Aviation Medicine. Dr. Busby said he had seen the report which contains a number of suggestions and that the report is going out for review by the airline medical directors. He said that perhaps some of the participants might recall the expanded medical kits put on board the 747's. The kits were eventually deleted from stock because they weren't being used enough. However, he understands KLM and a number of other European airlines carry medical kits for more serious medical problems on board international flights--eleven or twelve hours flights--where their medical directors feel they might be used.

Duty Limitations and Occupational Safety and Health

Does the FAA feel that a flight attendant who is fatigued because he or she has been on duty for over fourteen hours can adequately carry out his or her required duties should an emergency occur?

Dr. Douglas Busby responded by saying that this would depend upon the circumstances on which the flight attendant would be mobilized in an emergency situation. He said he knew from extensive research in the past that people have been able to mobilize their resources, after 24 to 36 hours, to an optimum level of proficiency. There are some subtle deteriorations in performance after 24 hours.

Ms. Fuetsch asked if any emergency evacuation demonstrations required for aircraft certification had been carried out using actual flight attendants at the end of a lengthy duty day. Dr. Busby replied that he was not aware of any.

In view of the FAA's statement in the Federal Register of July 1975 discussing the responsibility for the occupational safety and health of the flight attendant, the Transport Workers Union wanted to know what testing has been done, what standards have been established, what programs have been initiated, and who is directly responsible.

Dr. Busby replied that there is an impasse between the Occupational Safety and Health Administration (OSHA) and the Department of Transportation (DOT) at the present time. A decision pertinent to FAA responsibilities in the occupational health and safety of flight attendants is being held in abeyance until further discussion with the Department of Labor.

Ms. Fuetsch asked if he had any idea how long this will be held in abeyance. Dr. Busby stated that it is an action item which is expected to be resolved within the next few months.

Another flight attendant participant joined the discussion regarding departmental responsibility for the flight attendants' occupational health. She said she would like better answers regarding why it is taking so long, why there is no government agency responsible for flight attendants. If pilots are covered by FAA, why should flight attendants be covered by OSHA? There was unanimous agreement by the flight attendants regarding this point.

Dr. Busby stated that when the Occupational Health and Safety Act was put into effect in 1970, it required that occupational safety and health provisions be made for occupational groups containing a certain number or more employees. In the past few months, there have been extensive discussions between the Department of Transportation, of which FAA is a part, and the Occupational Health and Safety Administration which comes under the Department of Labor. At this particular time, there is an impasse regarding who has jurisdictional responsibility for occupational health and safety in DOT modes. The Federal Railroad Administration, which is also under the Department of Transportation, is a focal point in this discussion. The matter is under review by both administrations and will be decided on in the next couple of months.

Mr. Bruce Selfon of the Office of the Chief Counsel, FAA, joined the discussion to point out that there is no ambiguity with respect to FAA's position and that is that the FAA and not OSHA should be responsible for the flight attendants. That, however, does not solve the problem since a competing department (Labor) has intervened at the departmental level with FAA's parent organization, the Department of Transportation. In the interim, Mr. Selfon said, the FAA is doing what is has always been doing before OSHA came along and that is trying its best efforts to take care of the occupational health and safety problems of the flight attendants.

Another participant asked where were the complaint forms which she could fill out and send into the FAA when one of her union members has suffered a partial hearing loss. Where could she go? She said she had never seen a form nor did she know with whom to communicate.

Then Ms. Mya Shelton, Association of Flight Attendants (AFA), asked for clarification of two statements made earlier. First, in talking about the dispute between OSHA and FAA as to who has jurisdiction over the flight attendants' health, there was a comment made that the railways were also involved. She said she was curious about what the railways would have to do with aviation people. Secondly, the comment was made that until this jurisdictional dispute is resolved, the FAA is trying to take care of the flight attendant as they have always taken care of them. Ms. Shelton said she would like to know how they have been taken care of; that is, what has the FAA done for them in the area of health?

Mr. Selfon said he would try to explain. When the statute for OSHA was drafted,it stated they would have responsibility for occupational health and safety for certain classes of occupations. However, if there are occupations for which there is adequate statutory authority already vested in the Federal agencies, then OSHA will step back and allow those agencies to perform the OSHA function. The FAA has indicated that it has that authority. But the Department of Labor, working with the Department of Transportation, said that they would only grant exemption if it covered the entire Department of Transportation family. The Federal Railroad Administration, according to OSHA, does not have adequate statutory authority to enforce for railway employees the safety and health standards that OSHA feels are necessary. As a result, this dispute has now been raised to the level of the Deputy Secretary, as recently as three weeks prior to this meeting, who has been asked to step in to try to resolve the matter so that a clear decision can be made.

Continuing, Mr. Selfon stated that what he had purported to say earlier was that prior to OSHA he assumed that occupational health and safety problems involved with the flight attendants' job function came within the purview of the FAA--Flight Standards Service, Office of Aviation Medicine, and others--and that as these problems are highlighted, appropriate regulatory or other response is being made.

Mr. Joe Kovacich, United Airlines flight attendant, commented on an approach pattern called the expedited approach in which he said the aircraft, in a noise abatement procedure, flies in high and then dives in for the landing. He explained that this is a very unsafe atmosphere for flight attendants who are not told about this and are geared for a gradual approach. He wanted to know what is being done about situations like this.

Mr. Kovacich also commented on the competition between the airlines in providing services to the passengers. He mentioned a time when they were in contract negotiations and had a concept called up-wheels down, where the flight attendants did not want any services on flights in which they did not have more than 45 minutes of actual flying time. But there are some flights with only 20 minutes of flight time--from Vancouver to Seattle, for example--where coffee and tea are being served. Mr. Kovacich stated he does not feel that is a safe environment. Those are the flight where the flight attendants are running crazily around trying to get a ridiculous service like this done. Thus, he wanted to know whether FAA

is aware of things like this; and if FAA gets responsibility for the flight attendants rather than OSHA, will it be able to do something about situations like this? Does FAA care to something about situations like this?

Dr. McLucas replied that FAA obviously cares to do something about any situation that is compromising safety. And since Mr. Kovacich states there is not sufficient time to perform those services in a safe environment, the matter should be looked into. If it is proven to be unsafe, then certainly the FAA should be prepared to step in and say flight attendants should not serve food and/or beverages on flights of less than X minutes. Usually though there are at least two sides to questions of this type. And if FAA is to take action on it, it would have to deal with all of the inputs rather than act unilaterally.

Ms. Campbell commented on an FAA report which she had obtained that said some operators attempt food and/or beverage service on short haul flights (30 minutes or less) which does not allow sufficient time for the performance of safety items such as briefing and picking up service trays and beverage containers before landing. It further states that regulatory limitations are too difficult to enact or enforce; however, FAA believes an effort should be made on the national level to encourage operators to curb this activity and obtain cooperation from the public. Ms. Campbell asked what was the difficulty referred to regarding enforcing this.

Mr. Skully responded that the situation now is such that with every regulation with which they come forth, consideration must be given to the economic impact as well as the inflationary impact versus the environmental impact of the regulation. Mr. Skully said that it is about three times more difficult to get a regulatory action through today than it was three years ago. Now, in order to issue a regulation in which there may be controversy, it has to be sent to the Secretary of Transportation for thirty days for review. Thus, the FAA has been issuing Operations Bullentins which, of course, do not have the force of law and hopefully the carriers will conform with what FAA is trying to establish as a standard. But, he concluded, trying to get every regulation out is extremely difficult.

Ms. Fuetsch questioned why the FAA imposes duty limitations on pilots. She stated that the fatigue findings relating to pilots ought to relate to flight attendants as well. Therefore, why shouldn't pilots and flight attendants have the same duty limitations?

Dr. Busby asked if the flight attendants were equating their task load and task ability to that of a pilot. Ms. Fuetsch answered yes, in an emergency situation, because once the emergency has occurred, the pilots are finished with their duties and then the flight attendants take over. Ms. Campbell added that very often pilots, in taking the fullest impact, are disabled and unable to help out.

Dr. Busby then said he wanted to clarify a point. He said what he was talking about was not necessarily an emergency in the flight environment but potential for the pilot getting into difficulty. He said the FAA has not given consideration in setting pilot flight duty times whether or not the pilot could respond appropriately in an emergency situation. He said he wanted to make sure that is absolutely clear. What he was talking about was the ability of an individual over a prolonged period of time to monitor a number of highly complex instruments. As an individual becomes fatigued, he channels his attention particulary to some types of monitoring and controlling tasks required on the flight deck. And what we are dealing with particularly is the potential for deterioration, over a period of time, in monitoring a series of engine instruments and various other flight instruments.

Ms. Fuetsch asked, "What about the flight attendant's ability to monitor an emergency situation and to act accordingly? Are they not monitoring nine-tenths of that aircraft?" She said that the point she is trying to make is that the fatigue factor is a human problem. Pilots have these duty limitations because they are human. And flight attendants want duty limitations because they are human. She said they don't want to have to work an 18 hour day, bypassing eight to twelve time zones, because emergency or no emergency, this affects their health.

The next question asked of Dr. Busby was who, in his opinion, does more physical labor, the flight attendant or the pilot. Dr. Busby responded that certainly it is the flight attendant.

Other questions asked were what is the reason for not imposing duty limitations on flight attendants and whether or not the FAA at the Operations Review proposed duty limitations for flight attendants.

Mr. Skully replied affirmatively and stated that the proposal is in rulemaking status.

Toxic Gases and Survivable Accidents

Ms. Fuetsch commented that FAA is continuing to certificate aircraft, the interiors of which release toxic gases in post-crash fire situations which to date have caused hundreds of deaths in accidents termed survivable by the NTSB. For instance, in the Pan American Pago Pago accident, which was termed survivable by the NTSB, four people survived out of over 100. The cause of death in most cases was inhalation of toxic gases.

Dr. McLucas stated that the textile industry does not offer to the aircraft manufacturers materials that have proven to be nontoxic. FAA has run many tests at CAMI and NAFEC (National Aviation Facilities Experimental Center) on how to reduce the flammability of materials but has not found any materials that will burn without producing toxic gases. If there were materials available which the FAA knew of, then certainly the FAA would do something.

Dr. Busby added that he became familiar with materials toxicology several years back during NASA's search for relatively toxic free materials following the fires involving the three Apollo astronauts. He said it is important to emphasize that we are dealing with the state-of-the-art situation in the various types of materials that are placed particularly in a closed environment such as the aircraft cabin. The fact is that in order for aircraft to fly and to be able to carry passengers, light-weight materials had to be used; and unfortunately many of these materials are lethal when burned under certain circumstances. The particular temperature at which they are burned, whether or not they are actually burned in the presence of oxygen or are burned with a decreased oxygen atmosphere, are determinants of how toxic they are.

Other critical factors are related to how much nitrogen and carbon the various polymers have in them. Nitrogen-containing materials produce cyanide; carbon-containing materials, carbon monoxide. It was not until the Chicago accidents that we realized how much cyanide really evolved from burning cabin materials.

Continuing, Dr. Busby said that FAA has an extensive program being conducted at CAMI and NAFEC--one which the textile industry is watching very closely--in the area of reducing the potential for not only fires but also for toxic gases from these materials. This is a priority item in the FAA research program.

Another question received was whether the FAA believes the loss of lives might have been reduced in recent survivable accidents if the FAA had a requirement for fire prevention measures such as fuel tanks of crash-resistant material or fire suppressant additives in the fuel.

Mr. Skully responded that the Continental Airlines accident is indicative of the Airworthiness Directive (AD) which FAA issued on 727's following the accident in Salt Lake City where the fuel lines were not severed and there was no fire. In fact, the problem was shutting the engines off after the accident. Mr. Skully stated he believes the FAA has, where possible, taken corrective action on production aircraft.

Galley Restraint Devices

Ms. Fuetsch also asked if FAA did not feel that there was sufficient evidence at this time to warrant a requirement for some sort of galley restraining devices on all galleys. The response was that FAR Part 25 requires restraining devices on all galleys. The flight attendants also wanted to know what testing standards are applied to those restraint devices and why the galleys and related components are not included in the original aircraft certification. Mr. Skully stated that he could not answer that specifically at the time, and Dr. McLucas promised the flight attendants a response in the near future as part of the follow-up resulting from this meeting.

Jumpseats and Shoulder Harnesses

Ms. Mya Shelton, Association of Flight Attendants (AFA), referring to the February 1976 congressional hearing on cabin safety, commented that as the FAA is aware, flight attendants have been seriously injured, killed, incapacitated or rendered incapable of performing their duties during emergency situations while in their assigned jumpseats. The FAA claims the flight attendants' jumpseats have been properly certificated and these seats have met all applicable regulations; however, it is known that after several aircraft accidents it was determined that either (1) a deficiency was existent in the seat itself or within the hardware or the components, or (2) the seat never met the criteria under which the aircraft was certificated. The FAA, in their written answers to the congressional subcommittee, stated that static testing is an accepted method of insuring that a component or assembly can meet structural load criteria as identified in the regulations. FAA says that flight attendant seats are statically tested, not dynamically tested.

Further, FAA states that static tests cannot relate results to injury protection for the occupant. FAA goes on to state that crash injury protection is the basic purpose of dynamic testing of seat and restraint systems and that structural adequacy is of secondary concern. Ms. Shelton asked when can they expect the FAA to seriously consider giving crash injury protection to the flight attendant in present and future flight attendant seats.

Dr. Busby replied that at the present time there is no dynamic testing of flight attendant seats being conducted or planned by the Office of Aviation Medicine at CAMI. Ms. Shelton asked if the Office of Aviation Medicine would be the only branch of the FAA that would be considering this type of testing.

NAFEC has been working on a manned seat mathematical model program. The math model is being made available for use by industry and NASA. The NASA crash test results, to be partially available in late 1976, will be used along with NAFEC tests to further validate the math model. The math model does not differentiate between flight attendant seats and other seats, and will provide a powerful tool for the design of all seats for occupant protection in crash environments.

Ms. Shelton asked if FAA does dynamic testing on passenger seats and whether any dynamic testing had been conducted in the past.

In response, Mr. Skully stated that FAA does not do dynamic testing of passengers seats. FAA requires the manufacturer to demonstrate it, if they change from static to dynamic. Mr. Skully said he is aware of the opinions expressed that FAA should do dynamic testing. And the fact that it hasn't been done in FAA in 35 years doesn't mean that it never will be. He said he does not know the exact status of this, but obviously it is more complex to test dynamically than statically. He said he was referring to passenger seats and well as flight attendant seats.

Another flight attendant had a question in regard to cabin jumpseats--formerly passenger seats which have been designated flight attendant jumpseats--as opposed to the type that are fitted on walls or doors. She wondered why forward facing jumpseats are required to have shoulder harnesses while the cabin forward facing jumpseats do not have shoulder harnesses for the flight attendant. It was pointed out that

quite a number of these cabin jumpseats did not allow the flight attendant enough space to get over into a brace position without banging his or her head on the seat in front. Some of the other participants voiced their agreement that all flight attendant jumpseats should have shoulder harnesses and padding behind the head. This, they said, is one of their top priorities.

Carry-on Baggage

One of the participants said she would like to bring to FAA's attention the problem flight attendants have in enforcing regulations pertaining to carry-on baggage. She explained that they feel like they are in a tug-of-war. On one hand, they are enforcing an FAR; and on the other hand, they are reprimanded and disciplined by their airline management because passengers continually report them because the flight attendants have had to take it upon themselves to have the baggage checked when the bags should not have even been allowed through the door of the jetway to get onto the aircraft.

She suggested that FAA require all airlines to place mock-up passenger seats at either ticket counters or security areas and that all luggage that does not fit underneath one of these mock-up passenger seats or the approved storage areas be checked at that point, thus eliminating the problem of having the passenger put the luggage on the aircraft only to have the flight attendant take it off. This might eliminate their having to go to their supervisors to defend themselves against management that they were not in the wrong. Management tries to make it appear as if this is an attitude problem, when all the flight attendant is trying to do is enforce the FAR.

Another flight attendant added that this is very much a problem but said that the ticket agents "pass the buck" by stating that they are too busy checking people in or that when the passengers come up to the podium the bags are behind the podium so they cannot see them.

Mr. Skully pointed out that some of the carriers have "no-go bag racks" and that if the bag did not fit, it had to be checked. However, one of the Continental Airlines flight attendants said this doesn't work because her airline has one of those racks. But it is placed right by the gate where the passenger boards the aircraft. This means the passenger has carried the bag through security and all the way to the gate. Then there is the mock-up seat where the passenger can check to see if the bag fits. She said once

a passenger gets on the airplane, you cannot imagine the problems flight attendants have trying to get that bag away from the passengers who create a scene, threaten their jobs, or even strike them with the bag. She recommended that this problem be eliminated before the passenger gets through the security area. Another participant recommended an actual measurement device right where the baggage is being checked in. If it doesn't fit that device, then it must be checked.

This is another one of the areas requiring follow-up action by the FAA.

Another question directed to Mr. Skully relevant to the February 1976 congressional hearings at which Mr. Skully stated that a proposal in the Operations Review in December of 1975 spoke to amending FAR 121.285(c) to restrict baggage in the cabin which might be placed forward of the foremost seated passenger, because the regulation only protected the passenger, and not the flight attendant. Mr. Skully had stated that the proposal was under consideration for a rule change. The participant wanted to know the status of this rule change.

Mr. Skully said he would have to look this up and would provide them with an answer.

Other Problems Relating to Safety

One of the Association of Flight Attendants (AFA) representatives referred to the February 1976 congressional hearing on cabin safety at which Mr. Skully stated that an Air Carrier Operations Bulletin was in draft form to clarify whether flight attendants should be moving about in the aircraft during taxi other than to perform duties associated with safety. At that hearing, Mr. Skully's response to Representative Clausen was that, "It shall state that passengers should remain seated during the landing roll and while taxiing. Flight attendants should remain seated during the landing roll and until the aircraft has cleared the runway. Consideration is being given to including language to state that flight attendants should remain at assigned duty stations unless required to perform safety related duties." Her question then was when could they expect to have conclusive action on the matter of flight attendants moving about the aircraft serving drinks, passing out personal belongings, garment bags, etc., which jeopardize the safety of the aircraft, passengers, and flight attendants.

Mr. Skully responded that the bulletin to which she referred is Proposal 494 which has not been finalized, but that proposal does state that FAA would require that flight attendants remain at their duty stations during taxi unless performing duties associated with the safety of the aircraft. Mr. Skully said the bulletin has not come out yet and he did not know when it would be out but that it is an active project.

One of the Transport Workers Union representatives asked why an exemption was signed for Pan Am to the regulations that require pilots to wear their oxygen masks at flight levels above 41,000 feet.

Mr. Skully responded that he believed the experience over the last ten years indicated that there have been no occasions of explosive decompression at those flight levels.

Ms. Shelton said she had two other questions for which she would like answers. As FAA is aware, the DC-10 has only one cabin altitude sensor, located forward in the forward cabin on the main deck. An investigation following a National Airlines DC-10 Albuquerque accident revealed that a decompression occurring in an occupiable compartment on the lower deck would not necessarily be registered on the main deck; therefore, oxygen would not be presented to be used in the lower compartment. The NTSB subsequently issued recommendations regarding this accident. One recommendation was to locate a cabin altitude sensor so that decompression occurring on the lower deck would be read at the same time as decompressions on the main deck. This accident occurred in 1973, and it is now 1976. Ms. Shelton wanted to know what is being done to implement the recommendation, and how soon could they see some implementation.

Secondly, official input to the formulation of the Master Minimum Equipment List (MMEL) is provided by the FAA, the airline operators, and the aircraft manufacturers. Requests for change are routed through either the aircraft manufacturer or the FAA Principal Operations Inspectors for individual air carriers. As the FAA is also aware, crew members have no means of official submission to the MMEL. Requests have been made to the FAA in Washington, D.C., to establish a means by which crew members have official input; but to date, they have no action on this subject. Ms. Shelton asked whether FAA is considering action so that crew members can have official input to the MMEL, and if so, when can they expect this action.

Mr. Skully said he did not know the status of these items but would provide a response in the follow-up to this meeting.

One of the Western Airlines representatives pointed out that when Western got its DC-10's it was found that the tubing on the oxygen was three to four feet too short to reach the jumpseats for the ninth and tenth flight attendants. This was reported to Western's safety people, to the company, and to the FAA several years ago; and to this date, the tubing is still three or four feet too short. Neither the FAA nor the company has done anything. And their ninth and tenth flight attendants still don't have any oxygen throughout rapid decompression. It was also pointed out that this was not just a problem on Western Airlines' DC-10's but a problem which is common to the basic DC-10. Any DC-10 which has a seating configuration of this type has this particular problem.

Dr. McLucas stated that this is a good example of something on which action should be taken.

Concluding Discussions

Mr. Barney Spera, International Representative, Transport Workers Union, stated that he wanted to thank FAA for the opportunity for this listening session but felt that the time allotted was insufficient. He said we were really discussing a matter of life and death and the health and safety of everyone involved. Mr. Spera went on to say that in 1960 the average turnover rate for flight attendants was 18 months. The people really didn't care that much about their job--they didn't get involved. The latest figure is eight years, and a lot of these people will be working for a good many years to come. And they are concerned about their health.

The airlines, he continued, up until the last couple of years treated flight attendants as second-class citizens. He said the FAA is still treating flight attendants as second-class citizens. He said from some of the answers he heard at this meeting he didn't believe FAA really understood their problems, and that is why TWU is insisting that FAA have flight service input into the FAA of full-time people.

He said that TWU, and probably AFA and the Teamster Airline Division as well, would present a brief to FAA of questions and the problems they are experiencing. They would like a positive response to those questions, and Mr. Spera said he was happy to hear that FAA would provide such a response within a month or two. He said TWU would ask for FAA to seriously consider full-time flight people in the FAA and that TWU is prepared to give FAA a couple of people and to even pay their salaries in order for them to work with the FAA, if they can serve a function and be effective. Otherwise, it would be a waste of money.

Mr. Spera concluded by stating that they would meet FAA far more than fifty percent of the way if they can get a positive response.

It was suggested that for the purpose of this listening session the flight attendant participants agree on a list of approximately ten priority items or ten major areas on which FAA should focus immediate attention. There was much disagreement over this point with AFA representatives pointing out that FAA has already received voluminous documentation regarding problem areas. Ms. Mya Shelton stated that AFA could not contribute to such a list because they feel that there are considerably more than ten important areas that need attention. She further stated that AFA did not want to be limited to ten items and they did not feel they could place those kinds of priorities.

It was pointed out by FAA representatives that it was not their intent that such a list of the priorities identified at this listening session would obviate any of the previous documentation submitted to the FAA. It was agreed that the flight attendant representations would send in writing their priorities, but some would not agree on them at this meeting. However, Ms. Joan Fuetsch of TWU did name several items which she considered priorities which were flight attendant seating problems, duty limitations, and lack of representation from flight attendants within the FAA.

Ms. Joan Fuetsch, referring to the subject of flight attendant representation within FAA, asked Dr. McLucas if he would clarify before the meeting adjourned exactly what the future of the Cabin Safety Specialist is at the present time.

Dr. McLucas replied that it had been established that the Cabin Safety Specialist position had not been abolished. As he stated earlier, the Flight Standards Service had recommended that FAA try a different approach--the use of cabin safety consultants--because they felt that it had worked in the case involving airline pilots. Now if that approach does not work, Dr,. McLucas said, they would use full-time people.

Ms. Fuetsch asked if this program had been implemented by retaining Mr. Bernard Doyle as a consultant or whether it was yet to be implemented. Dr. McLucas replied that the program was yet to be implemented.

One of the flight attendants pointed out that Dr. McLucas had earlier stated that listening sessions have an impact on the FAA in terms of focusing more attention to the problems of flight attendants. Therefore, she wanted to know when and where FAA was anticipating having the next flight attendant listening session.

Mr. Stuart Jamison of the Office of Aviation System Plans replied that FAA responds to the user organizations' written requests to hold these meetings. The fact is that it was the FAA who proposed having this particular meeting because they felt it was an appropriate time to have another one and thus contacted the three unions represented. However, there seems to be little point in having these meetings too frequently when there are no new problems to discuss. Rather, FAA tries to keep the participants informed regarding the status of items already brought to FAA's attention.

Dr. McLucas agreed that it seemed to him a good idea to schedule a listening session with this group either annually or biennially because if the meetings were scheduled too frequently enough time would not elapse to allow for the regulatory process and much of the meeting time would be taken up with questions or comments regarding items in rulemaking.

Many of the participants felt it was desirable to hold the listening sessions approximately every six months.

Before closing the meeting, Dr. McLucas said he wanted to give Mr. Marion Roscoe, Assistant Administrator for Aviation Safety, an opportunity to comment. Mr. Roscoe said he found the session very interesting and believed there was a great need for these meetings to convene more frequently so that there could be better communication on the problems that otherwise seem to build up over a period of time with the apparent feeling evidenced by this group that nothing is happening to solve those problems. He said he takes exception to a couple of comments, particularly with the one from the TWU International representative who criticized the Administrator for not allowing more time for this meeting.

Mr. Roscoe went on to say that Dr. McLucas has shown his concern for cabin safety problems by expressly asking him to look at and review the cabin safety program within the FAA. Mr. Roscoe said he has been diligently involved in this task since the latter part of July. He said that Mr. Bernard Doyle is working as a consultant to the Aviation Safety Office to assist in its cabin safety review. Mr. Roscoe reported that he had corresponded with the Association of Flight Attendants, Transport Workers Union, the Teamsters Union, as well as a number of other organizations concerned with cabin safety, to let them know that FAA was conducting this study and asked for any input they would care to provide. Mr. Roscoe remarked that some

of the organizations seemed to believe that everything had already been said. This listening session indicated to him that everything had not been said.

Continuing, Mr. Roscoe said that FAA held a one-day meeting at CAMI in Oklahoma City on August 31 and that they could have held a two or three day meeting had there been more interest. That is why he takes exception to the criticism of the Administrator for not having this listening session for a longer period of time. (Note: The listening sesion began a 2:30 p.m. and ended at approximately 6:30 p.m.)

Mr. Roscoe explained how he is carrying out the cabin safety review. First, his office is taking stock of the concerns of different organizations, flight attendant unions, the concerns of the Congress, the concerns of the airline industry and manufacturers. His working group has visited a number of air carriers, talked with air carrier management, reviewed flight attendant programs, initial training programs, recurrent training programs, and visited a number of FAA regional offices to talk about cabin safety problems. He and those working with him have also observed safety performance in the cabin; he feels that he is well familiarized with cabin safety conditions.

The end result of his cabin safety review, said Mr. Roscoe, is to make a report to the Administrator about mid-October, which will contain recommendations on what might be done toward bettering the FAA's procedures and methodology by which it is taking care of its cabin safety program.

Dr. McLucas thanked the participants for attending the meeting. As he pointed out earlier, FAA intends to provide complete responses to all questions raised which were not fully answered during the meeting--either in the follow-up appendix to this summary report or in supplemental follow-up reports.

APPENDIX

FOLLOWUP ACTION RESULTING FROM

LISTENING SESSION WITH FLIGHT ATTENDANTS

In an effort to be responsive to the issues raised at the listening session, which were not fully covered at the time, the individual offices and services within the Federal Aviation Administration have prepared the following additional information.

Flight Standards Service

Monitoring of Recurrent Training Programs

A number of the flight attendants wanted to know how closely recurrent training is monitored, whether there is presently a standard for monitoring, and whether FAA felt that this training might be better monitored by a person with flight attendant experience.

FAA Response

The FAA surveillance procedures call for recurrent training to be monitored in its entirety at least once a year. Each change to an established program is monitored for a full cycle. No standard norms are established but an inspector will ensure that the training program authorized by the principal inspector is followed and will report his judgment as to effectiveness of the training. Flight attendant experience might be desirable but would be specializing in too narrow a field for an inspector who would be observing flight attendant training for only a small percentage of his duty time. The training of inspectors, as is being done at the American Airlines' training complex at Ft. Worth, will help the inspector to determine effectiveness of recurrent training.

First-aid Training

A participant inquired whether FAA has a requirement for first-aid training in the recurrent training curriculum.

FAA Response

There is a requirement for first-aid training for all crewmembers. However, first-aid training is only given as it pertains to the first-aid equipment on the airplane. Also, if flying above 25,000 feet, flight attendants must receive instructions on problems connected with decompression.

Standardized Flight Attendant Training Program

It was suggested that, rather than having each region approve training programs, consideration be given to having one area reevaluate all of the training programs in order to have a more standardized program throughout the United States as well as more standardized evaluation procedures of the requirements of the training program.

FAA Response

Training programs are approved at the district office by the principal inspector with input from the air carrier inspector concerned. A standardized program for all carriers would negate the progress some carriers have made with more sophisticated training mockups and better training facilities. This has allowed them to shorten the time spent in the classroom and at the same time achieve a higher degree of transfer of learning. Also, the different route structure, different aircraft in the carrier fleet and varied geographic areas of operation make a national standardized program unrealistic. FAA agrees that training mockups must be realistic, even to the point of having the right pressures on handles that operate mockup doors and exits. However, the use of wooden handles for training may serve a purpose if it is later adequately reinforced by the real item. This is done all the time for flight crewmembers by use of cockpit procedures trainers.

Food and Beverage Service on Short-Haul Flights

It was pointed out that some carriers attempt food and/or beverage service on short-haul flights (30 minutes or less) which does not allow sufficient time to retrieve the trays and containers and perform other safety duties prior to landing.

FAA Response

Present regulatory requirements are considered adequate in this area. Flights that are too short to allow food and beverage service should be recognized by the carriers. If service is required that results in violations of FAR 121.577, then regulatory action should and must be taken. Putting an arbitrary time on a definition of a "short flight" would, in FAA's opinion, be unrealistic. There is a proposal being formulated at this time that would allow carriers to serve beverages in crushable containers that could be retained by the passengers during takeoff and landing. This would ease the problem somewhat. This proposal does not include so-called "finger foods." More frequent en route inspections in the passenger cabins should help minimize unrealistic requirements for food and beverage service.

Testing Standards for Galley Restraint Devices

Some of the flight attendants wanted to know what testing standards are applied to galley restraint devices and why the galleys and related components are not included in the original aircraft certification.

FAA Response

All galley restraining devices are tested to critical crash loads in accordance with CAR 4b.260 or FAR 25.561. Static tests are conducted with FAA witnesses. All galleys and related components are included in either original aircraft certification, or in supplemental type certificates, which utilize the same standards.

Cabin Forward Facing Jumpseats

The participants wanted to know why forward facing jumpseats are required to have shoulder harnesses while the cabin forward facing jumpseats are not.

FAA Response

Airworthiness Review Notice No. 8, Proposal 8-36, is based in part on AFA's Proposal 236. It would require a combination belt and shoulder harness at each flight deck station seat and at each flight attendant seat in the passenger compartment. Final action is expected in early 1977. The proposal had a retrofit for older aircraft.

Carry-on Baggage Storage Problems

The problems the flight attendants face regarding enforcing regulations pertaining to carry-on baggage was discussed by many of the participants.

FAA Response

This matter is the subject of an item in the Operations Review and is being considered for rulemaking. Different size bins, racks and closets on different carriers' aircraft preclude a standard for all carry-on baggage. Proposed rule should alleviate the problem to some extent since it will make agent accountable and liable to enforcement action.

Proposal to Restrict Baggage Placement in Cabin

One participant wanted to know the status of the proposal in the Operations Review to amend FAR 121.285(c) to restrict baggage in the cabin which might be placed forward of the foremost seated passenger because the regulation only protected the passenger and not the flight attendant.

FAA Response

Operations Review Proposal 413 covers this and is being prepared for publication as a Notice of Proposed Rule Making (NPRM).

Proposal which Would Require Flight Attendants to Remain at Duty Stations During Taxi

The flight attendants asked when they could expect conclusive action on the matter of flight attendants moving about in the aircraft during taxi to perform duties other than those associated with safety.

FAA Response

Air Carrier Operations Bulletin No. 70-9 is being canceled. Operations Review Proposal 494 covers this item and is being prepared for an NPRM.

Cabin Altitude Sensor Location

One of the participants wanted to know what is being done to implement the NTSB recommendation to locate a cabin altitude sensor so that decompression occurring on the lower deck would be read at the same time as decompressions on the main deck.

FAA Response

In response to the referenced NTSB recommendation (No. A-74-10), McDonnell Douglas, with the cognizance of the FAA Western Region (AWE-100), performed calculations to determine the need for a lower lobe altitude sensor. McDonnell Douglas found, and AWE-100 concurred in their findings, that the main cabin will lag the lower lobe by only 1 second in a decompression of the nature discussed. AWE-100 considered the present design satisfactory, and NTSB was so advised in a letter of June 13, 1974.

Crew Member Input to MMEL

A question was raised as to whether FAA is considering action to enable crew members to have official input to the Master Minimum Equipment List (MMEL).

FAA Response

Due to the complex problems associated with compiling MMEL items, the basic input for changes is limited to those groups referred to. Any item considered appropriate by a flight attendant or AFA may be submitted to the appropriate principal operations inspector who will review the proposal, comment and forward to the FOEB concerned.

Problems with Deployed Oxygen Masks on DC-10's

It was pointed out by a Western Airlines flight attendant that the tubing on the oxygen was three to four feet too short to reach the jumpseats for the ninth and tenth flight attendants on DC-10's.

FAA Response

Airworthiness Directive 76-13-04, effective August 3, 1976, requires relocation of the portable oxygen units in the DC-10 lower lobe to a place adjacent to the attendants' seats. The AD has a 3,000-hour compliance time, so Western Airlines as well as some other carriers may not have complied yet.

Air Carrier Cabin Safety Specialist Position

One participant wanted to know the current status of the efforts which were underway when Ms. Jeanne Koreltz was terminated.

FAA Response

Ms. Koreltz left with her supervisor a list of 16 projects or special studies with which she was involved at the time of her departure from the FAA. All of these projects were reassigned to operations inspectors within the Training and Technical Standards Section of the Air Carrier Operations Branch, Flight Standards Service.

Of the 16 projects, four have been completed; three are being prepared for NPRM; four are awaiting R&D or engineering action prior to being prepared for NPRM; one is a continuing project which has shown results (coordinative efforts with field personnel to communicate with the flight attendants and air carrier management); one has been dropped; and three have shown initial action to be inconclusive and additional action is being contemplated.

Evaluation of Safety Aspects of Flight Attendants Occupying Lower Galley During Takeoff Operation

It was suggested that FAA evaluate the safety aspects of flight attendants occupying the lower galley during takeoff.

FAA Response

At present, the AFM on aircraft equipped with lower lobe galleys prohibits occupancy of the lower lobe during takeoff. There are at present no proposals to change this requirement.

NTSB Recommendations on Restraint Attachments at Flight Attendant Seats

One of the participants wanted to know the present status of NTSB recommendations on restraint attachments at flight attendant seats.

FAA Response

FAA action on NTSB Recommendations A-76-80 and 81 is closed. On September 8, 1976, the Administrator signed a letter to the NTSB with the following comments concerning these recommendations:

> "The usual practice employed in design of passenger restraint systems is to position the seatbelt tiedowns such that the belt centerline is at a 45 degree angle relative to the seat pan. Normally, the seatbelt tiedowns are located on the seat structure; however, for other seats--such as flight attendants' seats--this is not practical, and basic aircraft structure is utilized to anchor the tiedowns. This is the situation with many of the flight attendant automatic retractable jumpseats installed on the narrow-body transport category--such as the Boeing Model 727 airplane in question. In those cases, the effect of seat adjustment and possible seat deformation in a crash has been considered and seatbelts which subtend a slightly reduced angle with the seat pan have been approved. In evaluating these installations during original type design certification, this aspect was not found to be detrimental to the safety of the seat occupant.

"Our investigation revealed there was no record of medical test data which substantiates that detrimental effects would be sustained by occupants using seatbelts at angles representative of the Boeing 727. We are not aware of any accident injuries that can be attributed to the use of seatbelts of which the angle with the seat pan is outside the range recommended by the NTSB, and we have no record of adverse service experience.

"Flight attendant seat restraint systems on all other air carrier aircraft were examined, including those of the wide-body jumbo jets. Results of this examination and supporting service history indicate that the tiedowns are properly positioned; therefore, no further action is contemplated."

National Bureau of Standards' Proposed Standards on Flight Attendant Uniforms

A question was raised regarding whether the FAA plans to accept the National Bureau of Standards' proposed standards for flight attendant uniforms.

FAA Response

The final report prepared for the FAA Systems Research and Development Service has been completed and is being prepared for publication. The proposed flammability standard for flight attendant uniforms contained in this report will be considered for inclusion in a Notice of Proposed Rule Making.

Office of Aviation Medicine

Exploration of Present Communication Methods Between CAMI and the Administrator to Determine Whether Modification is Required

One of the participants suggested that there was no direct communication between the Protection and Survival Laboratory at CAMI and the Office of the Administrator and asked if perhaps Ms. Donell Pollard of that office would not be the person to provide such communication.

FAA Response

The Federal Air Surgeon has reviewed the various methods of communication between CAMI and the Administrator and is confident that they not only are effective but also warrant no modification at this time. From the standpoint of personal familiarization with CAMI research activities, the Administrator was briefed on these activities by research personnel at CAMI shortly after his appointment and by the CAMI director and laboratory chiefs at Headquarters in October 1976. The Federal Air Surgeon is kept apprised of all CAMI research activities and achievements, and has an opportunity to transmit significant information to the Administrator at least twice weekly in staff meetings, and at any other time, as indicated.

Study of Hearing Loss Being Experienced by Flight Attendants

One of the participants stated that some flight attendants experience partial hearing loss and that she did not know with whom to communicate in order to register such a complaint.

FAA Response

This question was unsubstantiated. Noise surveys on air carrier aircraft have not identified a significant noise hazard in the cabin environment. Most of the major air carriers conduct audiometry as part of their periodic medical examination of flight attendants. The Federal Air Surgeon stated that to his knowledge hearing loss attributable to noise in the cabin environment had not been identified as a health problem in flight attendants.

Air Carrier Medical Information Availability to FAA

It was recommended by one of the participants that medical information on the flight attendants which is obtained by the air carriers be made available to the FAA.

FAA Response

Medical information obtained in periodic medical examinations and non-occupational medical care of flight attendants is held in doctor-patient confidence by most of the major air carriers.

The Office of Aviation Medicine can see no justification for monitoring the incidence and treatment of occupational injuries in the flight attendant group over and above the excellent services in this respect provided by the air carriers, their respective insurance carriers, and state workman's compensation boards.

The Office of Aviation Medicine does obtain medical data on specific incidents involving flight attendant injuries.

NOTE: At the conclusion of the listening session, a representative of the Association of Flight Attendants submitted a list of questions which addressed subjects such as the February 1976 Congressional Hearing on Cabin Safety, the 1975 FAA Operations Review, NTSB reports, regulatory actions and various other FAA actions and documents. Many of these questions duplicated the questions and inquiries that were raised at the listening session and are covered in this report. Others concerned items which are in rulemaking status or are under study by the agency; thus specific answers cannot be given at the present time. These questions have been referred to the appropriate FAA offices and services for action, and answers to such questions will be covered in supplemental reports.

AIR CARRIER CABIN SAFETY REFERENCE DOCUMENTS

1. Aviation Safety, Volume II, Aircraft Cabin Environment, report on Hearings, Feb. 3, 4, 5, 1976, before the Subcommittee on Investigations and Review of the Committee on Public Works and Transportation, House of Representatives, Ninety-fourth Congress, 2nd Session.

2. Aircraft Crashworthiness, edited by Kenneth Saczalski, George T. Singley III, Walter D. Pilkey, and Ronald L. Houston, published 1975, University Press of Virginia, Charlottesville, Va.

3. Advanced Techniques in Crash Impact Protection and Emergency Egress from Air Transport Aircraft, by R. G. Synder, AGARD-AG No. 221, June 1976.

4. In-flight Safety of Passengers and Flight Attendants Aboard Air Carrier Aircraft, National Transportation Safety Board Specia Study, NTSB-AAS-73-1.

5. Chemically Generated Supplemental Oxygen Systems in DC-10 and L-1011 Aircraft, National Transportation Safety Board Special Study, NTSB-AAS-76-1.

6. Passenger Survival in Turbojet Ditchings, National Transportation Safety Board Special Study, NTSB-AAS-72-2.

7. Aircraft Accident Reports issued by the National Transportation Safety Board.

   a. Ozark Airlines, DC-9, Sioux City, Iowa, December 27, 1968, Report No. NTSB-AAR-70-20.

   b. Overseas National Airways, DC-9, near St. Croix, V. I., May 2, 1970, Report No. NTSB-AAR-71-8.

   c. Capital International Airways, DC-8, Anchorage, Alaska, November 27, 1970, Report No. NTSB-AAR-72-12.

   d. Allegheny Airlines, CV-340/440, New Haven, Connecticut, June 7, 1971, Report No. NTSB-AAR-72-20.

e. Pan American World Airways, Boeing 747, San Francisco, California, July 30, 1971, Report No. NTSB-AAR-72-17.

f. National Airlines, Boeing 747, near Lake Charles, Louisiana, January 4, 1972, Report No. NTSB-AAR-72-21.

g. North Central Airlines, DC-9, O'Hare International Airport, Chicago, Illinois, December 20, 1972, Report No. NTSB-AAR-73-15.

h. Ozark Air Lines, FH-227B, St. Louis, Missouri, July 23, 1973, Report No. NTSB-AAR-74-5.

i. Trans World Airlines, Boeing 707, Los Angeles, California, August 28, 1973, Report No. NTSB-AAR-74-8.

j. Piedmont Airlines, Boeing 737, Greensboro, North Carolina, October 28, 1973, Report No. NTSB-AAR-74-7.

k. National Airlines, DC-10, near Albuquerque, New Mexico, November 3, 1973, Report No. NTSB-AAR-75-2.

l. Eastern Air Lines, DC-9, North Canton, Ohio, November 27, 1973, Report No. NTSB-AAR-74-12.

m. Delta Air Lines, DC-9, Chattanooga, Tennessee, November 27, 1973, Report No. NTSB-AAR-74-13.

n. Iberian Airlines, DC-10, Boston, Massachusetts, December 17, 1973, Report No. NTSB-AAR-74-14.

o. Pan American World Airways, Boeing 707, Pago Pago, American Samoa, January 30, 1974, Report No. NTSB-AAR-74-15.

p. Eastern Air Lines, DC-9, Charlotte, North Carolina, September 11, 1974, Report No. NTSB-AAR-75-9.

q. Western Airlines, Boeing 737, Casper, Wyoming, March 31, 1975, Report No. NTSB-AAR-75-15.

r. Continental Airlines, Boeing B-727, Denver, Colorado, August 7, 1975, Report No. NTSB-AAR-76-14.

s. Eastern Air Lines, Boeing 727, Raleigh, North Carolina, November 12, 1975, Report No. NTSB-AAR-76-15.

8. Aircraft Incident Investigations, National Transportation Safety Board:

a. American Airlines Boeing 727, Flight 463, LaGuardia to Washington National, October 11, 1975. (In-flight emergency from inoperative nose gear; diverted to Dulles Airport; evacuation successful for 80 passengers in 20 seconds.)

9. Safety Recommendations (approximately 100) pertaining to cabin safety and occupant survivibility, 1962-1976, National Transportation Safety Board.

10. Professional papers and articles.

a. 12th Annual SAFE Conference, September, 1974.

(1) New FAR Programs (passenger safety), James W. Danaher, Chief, Human Factors Branch, National Transportation Safety Board.

(2) Aircraft Interiors, (The Question of Fire and Smoke), James W. Danaher, Chief, Human Factors Branch, National Transportation Safety Board.

b. 11th Annual SAFE Conference, October 1973.

(1) Lifevest Problems and Passenger Experience in Ditching Preparations, G. J. Walhout, Air Safety Investigator, National Transportation Safety Board.

c. 6th Annual Air Safety Forum, Airline Pilots Association, Steward and Stewardess Division, July 1968.

(1) Ditching and Evacuation, Bernard C. Doyle, Chief, Human Factors Branch, National Transportation Safety Board.

d. USAF-Industry Life Support Conference, November, 1967.

(1) Civil Air Carrier Crash Experience--Limiting Factors in Crash Survival and Escape, Bernard C. Doyle, Chief, Human Factors Branch, National Transportation Safety Board.

11. Special Air Safety Advisory Group Report to the Federal Aviation Administration, July 30, 1975.

12. Safety-Related Engineering and Development Activities of the Federal Aviation Administration, FAA-EM-75-2, March 1975.

13. An Analysis of Aircraft Accidents Involving Fires, G. V. Lucha, et al, NASA CR 137690, May 1975.

14. A Crashworthiness Analysis With Emphasis on the Fire Hazard: U.S. and Selected Foreign Turbine Aircraft Accidents, 1964-1974, Thomas G. Horeff, FAA-RD-75-156, July, 1976.