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Planning Prevents Conflict Between Cabin Service and Safety

Airlines must consider carefully the safety implications of operational changes or equipment changes in the aircraft cabin to improve passenger service. The U.K. Civil Aviation Authority believes that efforts to provide the best service sometimes conflict with safety objectives. Such conflicts can be resolved, in part, by the early inclusion of cabin-operations specialists and cabin-safety specialists in decision-making processes.

—
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U.K. Civil Aviation Authority

Civil aviation authorities recognize that cabin safety and passenger service are essential ingredients for the success of any airline. Cabin crewmembers routinely give significant attention to the service aspects of their duties, yet legally they are required to be on the aircraft in the interests of passenger safety. During the 1990s, the U.K. Civil Aviation Authority (CAA) has identified areas of cabin operations in which service can impinge on safety. Nevertheless, CAA believes that close liaison between the cabin-safety department and the marketing department — with mutual understanding of their respective importance — can and must enable airlines to achieve an acceptable level of safety.

High standards of passenger care and service need not undermine safety; but without careful balance, safety matters might be overshadowed by the level of cabin service that is provided. The proper balance can be more difficult to achieve when airlines restructure their management in such a way



that the cabin-safety department reports to the marketing department rather than to the operations department.

The paramount concept is that cabin crew safety procedures must not be overshadowed by commercial considerations. Thus, cabin crew managers should resist undue pressure from commercial departments, and cabin crewmembers should be encouraged to notify their managers of problems or concerns related to safety. Operators and regulatory authorities should monitor closely all conflicts of interest between service objectives and safety objectives.

On some flights, flight attendants distribute newspapers when they should be monitoring the correct stowage of baggage or conducting cabin-secure checks. There is often insufficient time — after the safety briefing and before takeoff — to conduct a thorough cabin-secure check, which includes, among

other tasks, the relocation of baggage from inappropriate areas to approved stowages.

After newspapers have been distributed, few passengers want to give their attention to the safety briefing. Such a focus on cabin service, however, does little to validate public-address-system announcements that suggest "Our airline takes passenger safety seriously."

During the past 10 years, 244 evacuations have occurred involving aircraft registered in the United Kingdom.¹ Most evacuations — 186 — were precautionary; 58 were full emergency evacuations and resulted in minor injuries. Many aircraft incidents and accidents occur at the gate and during taxi, takeoff, descent and landing.

From pushback to takeoff, and from landing to arriving at the gate, passengers and crew must be afforded the maximum level of protection. Passengers must be seated with seat belts fastened, and flight attendants should remain at their crew stations secured by a full harness during taxi, takeoff and landing, except to conduct safety-related duties.

CAA has found that during the taxi phase, however, many commercial considerations that are important to the operator can conflict with cabin safety. For example, drinks or hot towels often are provided prior to takeoff, resulting in the unacceptable practice of flight attendants walking in the cabin while the aircraft is taxiing. Airlines must ensure the security of cabin crews during the taxi phase and all other critical phases of flight.

To put the risks into perspective, the following accidents, for example, occurred during ground operations: the collision between two Boeing 747s at Tenerife, Canary Islands, in 1977;² the Boeing 737 and Fairchild Metroliner collision in Los Angeles, California, U.S., in 1991;³ and the collision in Detroit, Michigan, U.S., in 1990 involving a Boeing 727 and a McDonnell Douglas DC-9.⁴ Official reports of the two U.S. accidents contain references to the importance of flight attendants remaining secured at their crew stations during taxi and remaining secured during an accident until the aircraft stops moving.

'Passengers First' Must Include Safety Elements

CAA has identified a growing trend toward a philosophy of keeping passengers happy at all costs. Such a philosophy might be part of maintaining a marketing edge in a highly competitive business but also might create incentives to compromise safety. For example, excessive focus on service might cause flight attendants to be reluctant to enforce seat-belt discipline after the seat-belt signs have been switched on by the captain because of turbulence. Flight attendants also might be reluctant to remove sleeping infants from cots or seats so that the infants can be secured appropriately.

CAA believes that after the seat-belt sign is switched on, the regulatory criteria that require passengers to be secured by their seat belts are *mandatory*, not *advisory*. An accident involving a Boeing 747 that encountered severe turbulence over the Pacific Ocean in 1997 shows the importance of seat-belt utilization by passengers.⁵ In that accident, one fatality, 23 serious injuries and 166 minor injuries occurred.

Placating passengers also has affected flight attendants' response involving intoxicated passengers and disruptive passengers. Alcohol intoxication of passengers aboard an aircraft violates the U.K. Air Navigation Order (ANO). Gate agents, especially those at nondomestic airports, may board intoxicated passengers to avoid the problem of interacting with them. Crewmembers are reluctant to off-load such passengers because the process involves a delay while the passenger's baggage is identified and removed from the cargo hold.

Flight attendants also may be reluctant to interact with passengers and to refuse to serve alcohol to passengers during flight for similar reasons. Complicating the problem is a tendency among some flight attendants to offer passengers two drinks at a time to speed up cabin service. Passengers may not be aware of two factors that affect in-flight intoxication: Miniature bottles of liquor served by airlines are equal to two drinks; and the combination of alcohol and cabin pressure much higher than sea level increases the effects of alcohol on the brain.

In the United Kingdom, operators are required to report to CAA incidents of unruly behavior by intoxicated passengers. CAA has received reports of passengers throwing lighted cigarettes and matches around the cabin; passengers verbally and physically assaulting other passengers and flight attendants; and passengers entering the flight deck and distracting the flight crew. Many of the incidents have resulted in the arrest of the disruptive passenger on arrival at the destination. Some severe incidents have necessitated en route diversions of aircraft.

CAA has found that, despite the reporting requirement, operators appear reluctant to report incidents for fear of adverse publicity. But looking at the other side of the issue raises a question: "Are those passengers who do not drink [alcohol] to excess impressed by airlines that do not take action against the intoxicated passengers?"

Cabin-safety specialists in recent years have concluded that alcohol is only part of the problem and that incidents of "air rage" are a combination of other factors such as smoking restrictions, flight delays and other sources of stress. To learn more about the causes of such incidents, CAA is collating information from U.K. operators about incidents involving disruptive passengers. Detailed incident reports that are filed by U.K. operators are being studied by one of CAA's human-factors specialists. The United Kingdom also is amending the ANO to extend U.K. laws on civil public-order offenses into the aircraft cabin. Changes in the law also will increase the upper limit of monetary fines and the length of custodial sentences for in-flight offenses.

CAA also is aware of aircraft cabins in which, after landing, passengers frequently ignore the flight crew's instruction to remain in their seats with their seat belts fastened until the seat belt signs have been switched off.

This prohibited movement of passengers during ground operations, however, can be encouraged — rather than discouraged — when flight attendants move through the cabin returning coats and baggage that were stowed in locations away from their owners.

Such movement of flight attendants is unacceptable in terms of safety, but is encouraged by operators for customer-service reasons. One solution is to announce to passengers that both passengers and flight attendants must remain in their seats, but that as soon as the aircraft has stopped, the flight attendants will provide every assistance in returning any stowed possessions. For operators that follow these practices, the problem of passenger movement while the aircraft is taxiing nearly has been eliminated.

New Cabin Design Concepts Consider Operational Safety

Major aircraft manufacturers currently are marketing design concepts that include the use of lower-lobe areas of the aircraft for passenger services, such as sleeping areas and lavatory compartments. (Lower-lobe areas are optional lower-deck facilities.)

For example, an Airbus A330 has a lower-lobe facility capable of accommodating up to 18 people — 10 in five lavatory compartments and eight in a waiting area for the lavatories. While the facility meets the airworthiness, design and certification criteria in the Joint Aviation Requirements (JARs), CAA noted that there is no recent in-service experience of passenger use of lower-lobe compartments and that the potential operational problems are significant. Potential operational problems could include issues of passenger control and monitoring, fire watch, decompression, medical emergency response and turbulence.

With the advent of very large aircraft — for example, the Airbus A3XX — the possibilities for cabin design are unlimited. CAA believes that each concept must be evaluated, not only from the certification aspect and design aspect, but also from an operational point of view. Thus, the Joint Aviation Authorities have included cabin-safety specialists on the JAA Airbus 3XX Certification Team.

Operators Need Cabin Crew Input on Configuration Options

When airlines are considering operating a new aircraft type, the primary considerations are commercial in nature. For

example, operators must consider the suitability of the aircraft to routes and airports, fuel efficiency, passenger loads and similar facts. In this process, cabin options offered by the aircraft manufacturers — such as configurations of seating, galleys, lavatories and bulkheads — are determined by airline marketing departments.

CAA rarely has observed at this stage of aircraft acquisition any input from cabin-safety specialists, for example, from flight attendants at each crew station in the cabin area for which they are responsible.

As a result, safety procedures are determined by restrictions that have been imposed by the choice of configuration. For example, evacuation drills and standard operating procedures (SOPs) in the cabin may be determined by the position of crew seats, which in turn have been restricted by the position of galley equipment.

Stowage areas do not always reflect the optimum positioning of safety equipment. CAA has found the problem particularly prevalent on aircraft with high-density seating. One result can be the stowage of safety equipment in locations that do not provide the ease of accessibility that is afforded by stowage at crew stations.

Crew Stations, Assist Spaces Must Not Be Obstructed

Aircraft certification criteria in the JARs require cabin crew stations to be located immediately adjacent to main-floor-level exits. Assist spaces are required to provide the crewmember a place to stand during an emergency evacuation and to assist passengers out of the aircraft after the exit has been opened. Assist space is an area not less than 20 inches by 12 inches (51 centimeters by 31 centimeters) that is immediately adjacent to the floor-level exits. CAA has seen attempts to encroach on crew stations and assist spaces with galleys, lavatory compartments and other installations. Crew stations and assist spaces, however, are essential for the safety of the aircraft and its occupants.

Attempts to negate or infringe upon the safety requirements of aircraft design and associated operational procedures are not acceptable. The cabin crew should be afforded the maximum means to effectively and expeditiously carry out their duties in the event of an emergency evacuation.

Movable passenger-class dividers often are used by operators to designate sections of the cabin to receive various standards of cabin service. The position of these dividers is determined by passenger demand for seats in a particular class of the cabin. CAA has seen dividers positioned improperly at the overwing self-help Type III exit rows.⁶

There also is evidence that dividers have become detached during various phases of flight. In an emergency evacuation, dividers could become detached and subsequently be pulled into the

exit seat row, obstructing access to the exit. Thus, CAA has prohibited the positioning of dividers at seat rows that form the border of the access routes from the aisle to the Type III exits. To maintain visibility throughout the length of the cabin, CAA requires that curtains — that is, curtains that are attached to dividers and that can be pulled across an aisle — must be fastened in the open position for taxi, takeoff and landing.

Airline Policies Affect Safety Of Passenger Carry-on Baggage

To meet passenger demands for service, some operators have adopted a flexible policy about acceptance of carry-on (cabin) baggage. Under such policies, if the aircraft load is low on a particular sector, passengers are permitted to take on board any number of items. (This would not be possible if the flight had a full passenger load.)

Problems arise from this policy when passengers make a return flight on a full aircraft or fly with another operator. In such cases, flight attendants must cope with the situation because the cabin crew has legal responsibility for securing carry-on baggage in approved stowages. Securing excessive amounts of carry-on items can be very time-consuming. This duty often occurs immediately before departure, when flight attendants are responsible for many safety duties. The demands of stowing excessive amounts of cabin baggage can detract from the accomplishment of other duties.

CAA also has seen desire by operators not to upset passengers who have excessive hand baggage, particularly passengers in business class or first class. Handling staff or gate agents should take control of carry-on baggage. Often, however, ground personnel do not wish to create conflict with passengers, so they leave the scrutiny of carry-on baggage to the cabin crew.

During routine inspections, CAA has observed excessive amounts of hand baggage being brought on board aircraft. This indicates a lack of operator monitoring of handling staff.

CAA's experience has been frequently that flight attendants are encouraged by the customer-service department not to confront passengers who have oversize baggage. There also have been situations in which the operator's management has not wholly supported flight attendants who have attempted to have passengers adhere to carry-on baggage restrictions.

Skills for Cabin Emergencies Require Refresher Training

Before assignment to flying duties, flight attendants in the United Kingdom must complete extensive theoretical training and acquire practical experience. The training includes developing the skills to locate and operate all safety

equipment on board each type of aircraft to be operated; and learning procedures for evacuation, ditching, fire fighting, decompression, first aid and similar subjects.

Flight attendants also are required annually to take refresher training and to undergo testing. Every three years, practical training must be received in fire fighting, evacuation, exit operation and response to pilot incapacitation.

CAA recognizes that training is expensive and that, increasingly, operators are reviewing the amount of time allocated to mandatory safety training. To reduce the number of days allocated to such training, there appears to be a trend toward lengthy training sessions. CAA believes that reductions in training days are most prevalent in recurrent training, yet time allocations for courses on customer care, product knowledge and corporate image are on the increase.

CAA strongly recommends that wherever practicable, cabin safety training for flight crews and cabin crews should be conducted jointly. Joint training promotes crew communication and coordination, and provides all crewmembers a greater insight into their respective duties and areas of responsibilities — particularly in an emergency situation.

CAA's revised training requirements, published in 1992, facilitate combined training. Despite this emphasis, CAA has seen reluctance among operators to implement such training because of costs in time and effort that would be required to roster the crews — and costs of transportation for some operators. A number of airlines conduct cabin-safety training of flight crews and cabin crews not only using separate training departments, but also conducting training activities in different parts of the country.

Preflight Safety Briefing Focuses Crew's Attention

The work of the cabin crew is unique in the aviation industry. Under the ANO, flight attendants are required on aircraft "for the purposes of performing in the interests of the safety of passengers." This is their primary function.

Nevertheless, the routine duties of flight attendants reflect proportionately little of the safety training that they have received, and these crewmembers are required to practice few actions expected of them in an emergency situation.

In response to this problem, CAA requires that all flight attendants participate in a safety briefing before beginning their flying duties. This safety briefing is included in the duty time allocated to the cabin crew prior to boarding the aircraft.

The time that operators allocate to the preboarding period may be limited for economic reasons — that is, because crew allowances may be payable from the start of the report

time or flights for some crewmembers may be near duty-time limitations. An insufficient preflight briefing period can focus on cabin service and logistical issues. Moreover, if conducted by senior flight attendants who lack the necessary guidance, these briefings might be perceived as interrogations of other cabin crew, who then feel threatened by the process. CAA believes that preflight briefings of cabin crews frequently are considered a mandatory ordeal to be dispensed with as soon as possible — which negates the value and intent of the requirement.

Training has not always included appropriate instruction for flight attendants on how to conduct effective safety briefings. This deficiency is being addressed in Joint Aviation Requirements JAR-OPS 1, Commercial Air Transportation (Airplanes), which requires safety training for senior cabin crewmembers to include the preflight briefing of the cabin crew. CAA recommends that preflight briefings consist of a discussion of scenarios appropriate to the flight to be operated, with every flight attendant demonstrating competence.

Predeparture Tasks Combine Safety, Service Responsibilities

On-time departures are essential to every airline. All personnel involved in operational aspects of the company are trained to facilitate this goal. To encourage on-time performance, some operators have placed pictograms on the walls of the cabin crew-report area showing on-time targets and achievements; this does not pose a problem for CAA. Nevertheless, too much pressure to stay on schedule can result in a severe reduction in the turnaround time allocated to the aircraft.

Automatic boarding — a procedure in which passengers are released from the terminal area to the aircraft at a fixed interval of time prior to the takeoff slot time — has contributed to reduced turnaround time. This procedure does not consider how long the aircraft has been on the ground, or the amount of time the cabin crew has had to prepare for the flight. Thus, some tasks — including safety-equipment checks — are conducted sometimes in a perfunctory manner.

Safety-equipment checks are part of the essential safety-related duties that cabin crews must conduct prior to every flight. Equipment such as fire extinguishers, oxygen bottles and crew protective-breathing equipment must be inspected to ensure appropriate stowage in correct locations and full serviceability. The checks also may include evacuation slides, evacuation systems and smoke-alarm systems.

Preflight equipment checks also help to address infrequent practice for emergencies during routine flights and the safety awareness of the cabin crew is heightened by these checks.

Because the type and location of equipment can vary according to aircraft type and configuration, adequate time for preflight

checks is particularly important if flight attendants fly on different aircraft types or at a variety of crew stations. The effectiveness of such checks can be negated by reduced cabin crew-report times, in which flight attendants arrive at the aircraft shortly before passenger embarkation begins.

Crew Attitudes Affect Quality Of Passenger Preflight Briefing

Data show that 90 percent of all aircraft accidents are survivable.⁷ Seventy percent of all passengers in aircraft accidents are involved in accidents in which there are no fatalities. Ten percent of passengers survive accidents in which some fatalities occur. These data underscore the importance of evacuations in saving lives.

A report by the Cranfield University Applied Psychology Unit on behalf of CAA shows that emphasis on the importance of passengers understanding safety information is likely to lead to improvements in their ability to carry out safety procedures correctly.⁸ The ANO requires that passengers receive safety information such as the position and operation of emergency exits, seat belts, oxygen and life jackets.⁹

The Cranfield report said that the majority of passengers are not aware of the importance of the safety briefing and that stronger safety messages could help passengers to be more attentive. But, for commercial reasons, some operators treat their main predeparture-safety briefing in a dismissive manner, frequently saying to passengers “safety regulations require us to ... ” provide the information. This statement has been shown to have a negative effect on passenger attention because of the operator’s apparent lack of endorsement of the briefing.

The report said, “Operators should adopt a more positive [method for] the preflight briefing of passengers. Briefings should not be introduced with the statement that operators are required to provide such information. The serving of drinks, and the handing out of newspapers, magazines, menus, headsets, etc. should not take place during the safety briefing.”¹⁰

“Operators should actively promote ways to encourage passengers to pay attention to the safety briefing and to study safety cards. Passengers’ attention should be drawn to the fact that their understanding of safety briefings and cards may enable them successfully to carry out safety-related actions, in differing emergency situations, requiring for example, exit operation resulting in their safe evacuation from the aircraft.

“Operators should actively promote methods for enhancing passengers’ safety awareness. This may be possible to achieve by emphasizing the importance of all passengers understanding the safety procedures or by clarification of the reasons for safety regulations.”

The Cranfield report said that passengers are not as safety-shy as airline marketing departments might believe. About 80 percent of the passengers who were surveyed said that operators should encourage passengers to be more safety conscious.¹¹ A variety of suggestions were made in the report, indicating that passengers are concerned about safety issues such as safety briefings and safety information, passenger education, the quantity and correct stowage of hand baggage, and restrictions on smoking, alcohol, use of electronic devices and the carriage of duty-free goods.

CAA has found some operators reluctant to draw attention to safety. Such operators have been unwilling to introduce a procedure that complies with a CAA recommendation to provide a special briefing to passengers seated in rows in which there are self-help emergency exits (Type III exits and Type IV exits). These exits — often located in the mid-cabin area away from cabin crew stations — usually have a removable hatch and a design for operation by passengers.

Although Type III exits and Type IV exits are not necessarily difficult to open, their successful operation requires lifting of the hatch and correct disposal of the hatch. These tasks — because of the equipment's weight and handling characteristics — can be very difficult for the untrained passenger.

CAA and Cranfield University are conducting research to investigate the advantages of providing a more detailed briefing to passengers who occupy the seat rows of self-help exits.

Excessive Short-sector Services Can Reduce Margin of Safety

CAA encourages operators to consider carefully whether attempting to provide too much service with the minimum required number of flight attendants on short sectors — safety issues notwithstanding — actually enhances passenger service. Elaborate and extensive cabin service on short sectors can mean that flight attendants must rush to complete their tasks from the moment the seat-belt signs are switched off after takeoff until the seat-belt signs are switched on prior to landing.

Operators should ask themselves, “Are passengers impressed by harassed cabin crewmembers rushing up and down the aisles, invariably knocking passengers’ knees and elbows, whisking meal trays away and having no time for them as individuals?”

For example, the emphasis on passenger service on short sectors can result in a lack of awareness of passengers standing or walking in the cabin while smoking, or neglecting the required checks of the lavatories for fire or smoke-detector deactivation.

CAA also has observed on short sectors operational problems caused by the improper stowage of catering items and cabin-service items. Often, because of aircraft configuration, these items are not stowed in the most accessible places. To achieve the required service in the time available, flight attendants sometimes relocate such items away from their approved stowages.

Some airlines place high emphasis on the sale of duty-free goods, which can place the cabin crew under pressure to complete services in the time available. Flight attendants may have revenue targets to meet or they may have personal incentives to sell — that is, commission on sales can provide part of their regular income.

Remaining stocks of duty-free goods have to be recorded for customs or handover purposes. This typically is achieved by a manual count of the items or by downloading the sales computers prior to the disembarkation of passengers. CAA has observed that this is a time-consuming process — usually achieved before landing — and sometimes is conducted at the expense of thorough cabin-secure checks. CAA found that this particular activity often is conducted during the final phases of flight — just at the time that the cabin crew should be concentrating on the possibility of an emergency during landing.

CAA expects flight attendants to be secured at their stations in time for landing. During the final phase of descent, there have been instances of serious injuries to flight attendants caused by unexpected turbulence attributable to the wake vortices of another aircraft.

In summary, airlines invest in advertising campaigns that persuade the public to fly, and marketing departments develop creative ideas to differentiate each airline's service. Yet safety is featured rarely. Perhaps this indicates a belief that the safety of air travel may be taken for granted, but behind the scenes, operators must be vigilant for situations in which service innovations must be balanced with operational safety in the aircraft cabin.♦

About the Authors

Sue Knight and Nick Butcher jointly wrote a paper about cabin safety and service while Knight was cabin safety officer for the U.K. Civil Aviation Authority (CAA). Knight, currently assistant flight safety officer at Monarch Airlines in the United Kingdom, participated in updating the information for this article.

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1. U.K. Civil Aviation Authority (CAA). Safety Data Analysis Unit Database.
2. Accidents Commission, General Air Transport Authority, Civil Aviation Subsecretariat, Ministry of Transport and Communications, Spain. *Aircraft Collision of KLM [Royal Dutch Airlines] Boeing 747 PH-BUF and [Pan American World Airways (Pan Am)] Boeing 747 N736PA at Los Rodeos (Tenerife) on March 27, 1977*. Joint Report, July 12, 1978. The report said that during takeoff, the KLM B-747 collided with the Pan Am B-747 on the runway in weather conditions of light rain and fog. Both aircraft were destroyed by the collision and postimpact fire. Fourteen crewmembers and 234 passengers were killed on the KLM airplane. Nine crewmembers and 326 passengers were killed on the Pan Am airplane (including nine passengers who subsequently died of injuries received); seven crewmembers, two employees and 52 passengers were injured on the Pan Am airplane. Spanish accident investigation authorities said, "The fundamental cause of this accident was the fact that the KLM captain: took off without clearance; did not obey the 'stand by for takeoff' from the tower; did not interrupt takeoff when [the] Pan Am [crew] reported that they were still on the runway; [and,] in reply to the flight engineer's query as to whether the Pan Am [aircraft] had already left the runway, replied emphatically in the affirmative."
3. U.S. National Transportation Safety Board (NTSB). *Runway Collision of USAir Flight 1493, Boeing 737, and Skywest Flight 5569, Fairchild Metroliner, Los Angeles International Airport, Los Angeles, California [U.S.], Feb. 1, 1991*. NTSB/AAR-91/08. Oct. 22, 1991. NTSB said in its final report that the Boeing 737 (B-737) collided with the Fairchild Metroliner while the B-737 was landing on Runway 24L. The Metroliner was positioned on the same runway, awaiting clearance for takeoff at intersection 45. Both airplanes were destroyed. All 10 passengers and two crewmembers aboard the Metroliner and 20 passengers and two crewmembers aboard the B-737 were killed. NTSB said: "The probable cause of this accident was the failure of the Los Angeles Air Traffic Facility Management to implement procedures that provided redundancy comparable to the requirements contained in the National Operational Position Standards and the failure of the FAA Air Traffic Service to provide adequate policy direction and oversight to its air traffic control facility managers. These failures created an environment in the Los Angeles Air Traffic Control tower that ultimately led to the failure of the local controller 2 (LC2) to maintain an awareness of the traffic situation, culminating in the inappropriate clearances and subsequent collision of the USAir and Skywest aircraft. Contributing to the cause of the accident was the failure of the FAA to provide effective quality assurance of the [air traffic control] system."
4. NTSB. *Aircraft Accident Report: Northwest Airlines, Inc. Flights 1482 and 299 Runway Incursion and Collision, Detroit Metropolitan/Wayne County Airport, Romulus, Michigan [U.S.], December 3, 1990*. NTSB/AAR-91/05. June 25, 1991. NTSB said in its final report that Northwest Airlines Flight 1482, a McDonnell Douglas DC-9, and Northwest Airlines Flight 299, a Boeing 727, collided near the intersection of Runway 9/27 and Runway 3C/21C in dense fog. The B-727 was substantially damaged and the DC-9 was destroyed. Eight of the 39 passengers and four crewmembers aboard the DC-9 received fatal injuries. None of the 146 passengers and 10 crewmembers aboard the B-727 was injured. At the time of the collision, the B-727 was on its takeoff roll, and the DC-9 had just taxied onto the active runway. NTSB said that the probable cause of the accident was "a lack of proper crew coordination, including a virtual reversal of roles by the DC-9 pilots, which led to their failure to stop taxiing their airplane and alert the ground controller of their positional uncertainty in a timely manner before and after intruding onto the active runway." The report said, "Contributing to the cause of the accident were (1) deficiencies in the air traffic control services provided by the Detroit tower, including failure of the ground controller to take timely action to alert the local controller to the possible runway incursion, inadequate visibility observations, failure to use progressive taxi instructions in low-visibility conditions, and issuance of inappropriate and confusing taxi instructions compounded by inadequate backup supervision for the level of experience of the staff on duty; (2) deficiencies in the surface markings, signage and lighting at the airport and the failure of [U.S.] Federal Aviation Administration surveillance to detect or correct any of these deficiencies; and (3) failure of Northwest Airlines, Inc., to provide adequate cockpit resource management training to their line aircrews. Contributing to the fatalities in the accident was the inoperability of the DC-9 internal tailcone release mechanism. Contributing to the number and severity of injuries was the failure of the crew of the DC-9 to properly execute the passenger evacuation."
5. According to Airclaims information, a United Airlines Boeing 747 encountered severe turbulence Dec. 28, 1997, while at Flight Level 310 en route from Tokyo, Japan, to Honolulu, Hawaii, U.S. The report said that the turbulence was encountered during meal service and that the "fasten seat belts" signs had been illuminated moments before the turbulence.
6. Joint Aviation Requirements 25.807 define a Type III exit as a rectangular opening of not less than 20 inches (508 millimeters [mm]) wide by 36 inches (914.4 mm) high

with corner radii not greater than one-third the width of the exit, and with a step-up inside the airplane of not more than 20 inches. If the exit is located over the wing, the step-down outside the airplane may not exceed 27 inches (685.8 mm). A Type IV exit is a rectangular opening of not less than 19 inches (482.6 mm) wide by 26 inches (660.4 mm) high, with corner radii not greater than one-third the width of the exit, located over the wing, with a step-up inside the airplane of not more than 29 inches (736.6 mm) and a step-down outside the airplane of not more than 36 inches.

7. Statistics used in this paragraph are from Fennell, P.J.; Muir, H.C. *Passenger Attitudes Towards Airline Safety Information and Comprehension of Safety Briefings and Cards*. U.K. Civil Aviation Authority (CAA) Paper 92015, December 1992. Citing Taylor, A.F. "Fire, Fuel and Survival: A Study of Transport Aircraft Accidents, 1955-1975." Advisory Group for Aerospace Research and Development, AGARD-CP-166, Conference Proceedings, 1975, and Taylor, A.F. "Aircraft Fires: A Study of Transport Accidents from 1975 to the Present." Advisory Group for Aerospace Research and Development, AGARD-CP-467, Aircraft Fire Safety Conference Proceedings, October 1989.

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9. CAA. *Air Navigation: The Order and the Regulations*. Civil Aviation Publication 393.

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