



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: Preventing Injuries Caused by
Turbulence

Date: 11/19/07

AC No: 120-88A

Initiated by: AFS-200

Change: 1

1. PURPOSE. This advisory circular (AC) has been revised to remove information about Turbulence Auto-PIREP System (TAPS) and the Tropospheric Aircraft Meteorological Data Reporting (TAMDAR) weather reporting system due to product unavailability.

2. PRINCIPAL CHANGES. This change removes information from paragraphs 17, 18, and 19 and updates all references in the document.

PAGE CONTROL CHART

Remove Pages	Dated	Insert Pages	Dated
11 thru 12	1/19/06	8 thru 9	11/19/07

ORIGINAL SIGNED by
James J. Ballough
Director, Flight Standards Service



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: Preventing Injuries Caused by
Turbulence

Date: 1/19/06

AC No: 120-88A

Initiated by: AFS-200

Change:

1. PURPOSE. This advisory circular (AC) provides information and practices that can be used to prevent injuries caused by turbulence. This AC highlights the data-driven methods of the Federal Aviation Administration (FAA) and its government and industry partners in identifying practices known to be effective against injuries caused by turbulence. Practices identified in the AC are suggested for crewmembers, aircraft dispatchers, managers, trainers, and others associated with flight operations under Title 14 of the Code of Federal Regulations (14 CFR) part 121. Those practices are suggested components of standard operating procedures (SOP) that can be followed in daily flight operations and continually reinforced in training.

2. RELATED REGULATIONS. These regulations are available online at:
<http://www.gpoaccess.gov/cfr/index.html>.

a. 14 CFR part 121, §§ 121.311, 121.317, 121.417, 121.421, 121.427; part 125, §§ 125.211, 125.217, 125.287, 125.289, part 135, §§ 135.117, 135.128, 135.331, 135.349, and 135.351.

b. Title 49 of the Code of Federal Regulations (49 CFR) part 830, § 830.2.

3. DEFINITIONS. The following terms as they relate to this document are defined by the National Transportation Safety Board (NTSB).

a. Accident. An “accident” as in 49 CFR § 830.2 is “an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage.”

b. Fatal Injury. “A fatal injury is any injury that results in death within 30 days of the accident.”

c. Serious Injury. A serious injury is “any injury that (1) requires the individual to be hospitalized 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) causes severe hemorrhages, nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns, or any burns affecting more than 5 percent of the body surface.”

d. Minor Injury. Any injury that is neither fatal nor serious.

4. AUDIENCE. Managers, trainers, flightcrew (pilots and flight engineers), flight attendants (F/A), aircraft dispatchers, and others involved in flight operations under part 121 should be familiar with the contents of this AC. This AC may also be valuable to persons associated with operations under part 125, part 135, part 91, subpart K (fractional ownership programs).

5. RELATED READING MATERIAL (current editions). This AC provides suggested measures for preventing injuries caused by turbulence and expands upon existing guidance including:

- Airplane Upset Recovery Training Aid, available at http://www.faa.gov/other_visit/aviation_industry/airline_operators/training/index.cfm
- AC 00-30, Atmospheric Turbulence Avoidance, available at http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf
- FAA turbulence information at http://www.faa.gov/other_visit/aviation_industry/airline_operators/training/turbulence

6. BACKGROUND.

a. U.S. air carriers have a superb safety record that has improved over time and now ranks among the best in the world. Incidents are infrequent; accidents are rare; and the risk of injury or death associated with air travel is very low. In an effort to reduce the chance of injury during turbulence, government and industry partners in the Commercial Aviation Safety Team (CAST) developed the advisory material in this AC. Some of this material responds to investigative work and safety recommendations from the NTSB.

b. The CAST partners have committed to come to coming together, as recommended by the NTSB, to develop guidance to help aircraft operators avoid conditions that cause turbulence and minimize risks when aircraft encounter turbulence. Those organizations have also called for the FAA to consolidate strategies and procedures known to be effective in preventing injuries caused by turbulence and to issue guidance for implementation in the operations and training of air carrier flightcrews, F/A, aircraft dispatchers, and managers.

7. DATA ANALYSIS BY THE FAA: SIT DOWN AND BUCKLE UP. The data strongly suggests that having passengers and F/As seated with seatbelts fastened is an effective measure during a turbulence encounter. From 1980-2003, only four people who were seated with seatbelts fastened received serious injuries during turbulence, excluding cases of other people falling onto and injuring properly secured occupants. Graphical depictions of this data is contained in Appendix 3.

8. DESIGN EFFECTIVE TRAINING TO PREVENT OR MITIGATE INJURIES TO F/As CAUSED BY TURBULENCE.

a. Take Advantage of the Training Environment. The training environment presents an excellent opportunity to train crewmembers in an air carrier's SOP including standard

phraseology, and to introduce concepts that might promote crewmembers' adherence to those procedures during a turbulence encounter. The training environment for F/As and crewmembers afford a unique opportunity for lectures, scenarios and exercises designed to explore subjects such as evaluating risk, good and bad decisionmaking and the importance of crew coordination before, during and after a turbulence encounter.

b. Emphasize the Importance of F/A's Personal Safety. F/A injuries occur at a disproportionately high rate compared to other crewmembers and other cabin occupants because F/As spend more time in the passenger cabin unseated and, therefore, unbelted. Effective training emphasizes to F/As that:

(1) You are not invincible. The overlying objective throughout all crewmember training is to ensure that crewmembers are confident, competent, and in control while conducting their activities in the cabin. However, during a turbulence encounter, the most appropriate first response by a crewmember might be self preservation. Training courseware can make crewmembers aware of their vulnerability in moderate and extreme turbulence. Effective training can incorporate video/digital media, real world scenarios and interviews with crewmembers who have experienced moderate and severe turbulence as a way to demonstrate that "turbulence can be stronger than you are."

(2) You have tools available to increase your safety and the safety of your passengers. Effective training shows crewmembers how to increase personal safety and passenger safety by identifying tools available to them in a turbulence encounter. Training can include the effective use of the passenger address (PA) system and other methods of communicating with passengers; the location of handholds throughout the airplane (or equipment that could be used as a handhold); and how to secure a service cart or an entire galley in minimum time.

(3) You need to recognize and avoid a denial reflex. Crewmembers can be made aware of ways in which human psychology might play into a turbulence encounter, and might actually increase their risk of injury. For example, on a short flight, with little time to complete a cabin service, crewmembers might be less conservative regarding their personal safety than on a longer flight with no time constraints. crewmembers can also increase risk and compromise their personal safety by trying to adhere to routine procedures normally accomplished on every flight, such as completing seatbelt compliance checks, rather than by responding to the nonroutine situation that a turbulence encounter presents.

c. Promote Communication and Coordination. Crew Resource Management (CRM) training for crewmembers and dispatch resource management (DRM) training for aircraft dispatchers can emphasize that the individual is part of a team.

(1) Address turbulence response in CRM training. Communication and coordination among crewmembers is a critical component of an effective response to turbulence or a threat of turbulence. Air carriers can develop and implement CRM training in Initial and Recurrent crewmember training that encourages a coordinated crew response before, during and after a turbulence encounter.

(2) Subtopics supporting CRM and DRM training to counter turbulence. Effective and ineffective team performance can be made clearer by addressing topics such as:

(a) The importance of using standard phraseology so that meaning and intent are never in doubt.

(b) The importance of using SOPs so that all crewmembers know what to expect.

(c) The importance of an effective preflight briefing can include:

- Potential of turbulence encounters during each leg
- Emphasis on the importance of keeping the flight deck informed of the conditions in the cabin
- Commitment to using standard air carrier procedures and phraseology during a turbulence encounter

(d) The importance of maintaining communication during the flight, including communication with the aircraft dispatcher, as appropriate.

(e) The results of communication errors such as the use of vague, inaccurate descriptions and nonstandard phraseology regarding turbulence.

NOTE: It is highly desirable to conduct joint CRM training including flightcrew, F/As, and aircraft dispatchers. However, if joint training is not practical, each of these training populations can be made aware of the others' functions regarding turbulence through other training methods.

9. IMPLEMENT OPERATING PROCEDURES TO PREVENT INJURIES CAUSED BY TURBULENCE.

a. Crewmembers. Appendix 1, CAST's Turbulence Template, contains suggested procedures for crewmembers developed by a broad collaboration of government and industry representatives under CAST.

b. Passengers. Procedures promoting voluntary seatbelt use and compliance with the fasten seatbelt sign, can include the following:

(1) Flightcrew promptly and clearly communicate turbulence advisories including specific directions to F/As and to passengers. Those advisories can include directions to be seated with seatbelts fastened, and to secure cabin service equipment, as conditions may require.

(2) F/As effectively communicate directions to passengers to be seated with seatbelts fastened.

(3) Air carriers develop and implement practices to encourage the use of an approved child restraint system (CRS) to secure an infant or a small child that is appropriate for that child's size and weight.

(a) Parents and guardians can be encouraged to have children under two, occupy an approved CRS any time the fasten seatbelt sign is illuminated.

(b) F/As can verify that the CRS is secured properly in a forward facing seat and that the child appears to be properly secured in the CRS.

(4) Air carriers develop and implement practices to improve passenger compliance with seating and seatbelt instructions from crewmembers such as:

(a) Video presentations incorporated as part of a F/A's safety demonstration can illustrate the benefits of using effective turbulence practices.

(b) Articles in airline publications, pamphlets in seat back pockets or information on safety information cards can encourage passengers to engage in effective practices such as keeping seatbelts fastened at all times.

(c) Before descent, or early in the descent, depending on conditions, flightcrews may announce to passengers that the fasten seatbelt sign will be illuminated in 10-15 minutes, and that any personal needs requiring movement in the cabin should be met before that time. This practice emphasizes the requirement to comply with the fasten seatbelt sign.

(5) Air carriers can implement spoken and written advice to passengers that FAA regulations require them as individuals to comply with crewmember instructions regarding the fasten seatbelt sign.

(6) Air carriers can promote reasonable communication between F/As and the flightcrew regarding the use of the fasten seatbelt sign.

(a) The environment in the cabin may be very different from the environment in the flight deck during turbulence. F/As should feel free to request that the flightcrew illuminate the fasten seatbelt sign whenever they feel it is appropriate.

(b) Conversely, when the fasten seatbelt sign remains illuminated for prolonged periods of time for reasons other than protection from a turbulence encounter, its effectiveness can diminish for passenger and F/As. F/As should feel free to question the flightcrew on the need to continuously illuminate the fasten seatbelt sign.

10. OTHER WAYS TO PREVENT INJURIES CAUSED BY TURBULENCE.

a. Review its Own History of Turbulence Encounters and Injuries. Volunteers representing various stakeholder groups within an air carrier may work together as a highly competent team. The team can review the air carrier's own turbulence encounters and resulting injuries. That review might shed light on root causes of the encounters and the injuries, and, in turn, the way to effectively prevent them.

b. Gather Current Information on Turbulence Encounters and Injuries. Current information is generated in a variety of ways such as turbulence reports from crewmembers, injury reports from F/As, post-encounter interviews and other processes that provide information for review and analysis.

c. Useful Information for Analysis can Include:

- (1) Length of flight.
- (2) Route of flight.
- (3) Time of year.
- (4) Phase of flight.
- (5) Aircraft type.
- (6) Type of injuries received by passengers.
- (7) Type of injuries received by crewmembers.
- (8) Adequacy of crewmember communications.
- (9) Adequacy of air carrier procedures.

11. CABIN MODIFICATIONS. An air carrier can consider cabin modifications such as hand holds, restraints, or other devices to reduce injuries caused by turbulence. When an aircraft encounters unanticipated turbulence, there may not be time for preparation by crewmembers or passengers. In this situation, aircraft design is most likely to prevent or mitigate injuries caused by turbulence. Effective aircraft design features include:

- a.** Interior restraints and overhead bin doors can prevent equipment failures during turbulence.
- b.** Cabin structures with hard or angular surfaces, corners, or protrusions can be minimized.
- c.** Emergency handholds can be readily identifiable and usable in the cabin, galley and lavatories (such as handles, bars, or interior wall cut outs) by F/As and passengers who are not seated with seatbelts fastened.
- d.** Handrails and/or handgrips can be installed under the overhead compartments in the cabin.
- e.** Horizontal and vertical “grab bars” can be installed on the counters and stowage compartments in galleys.
- f.** In configurations where seats are distributed with a large pitch and the seat backs can be reclined to an almost flat position, air carriers can install supplemental handholds beside the seats or install partitions around the seats to provide a handhold if the seat is fully reclined.

g. Handholds can be installed outside the lavatories on the bulkhead walls for use by passengers who may be standing outside the lavatory at the onset of a turbulence encounter.

12. IMPLEMENT IMPROVEMENTS IN DISPATCH PROCEDURES TO PREVENT INJURIES CAUSED BY TURBULENCE.

a. **Keep Communication Channels Open Full-time.** Dispatchers can communicate with flightcrews, and vice versa before, during, and after a flight, and can be encouraged to do so whenever necessary. In the preflight planning phase, the dispatcher may use the “Remarks” section of the dispatch (flight) release to advise flightcrews of known or forecast turbulence. A “call dispatch” notation on the dispatch release may be included to indicate that the dispatcher believes a telephone conversation with the pilot is necessary. Communication may resume at any time during or after flight using an Aircraft Communication Addressing and Recording System (ACARS), company radio, or telephone – and should be encouraged by an air carrier’s management to improve the flow of real-time information regarding turbulence.

b. **Weather Briefings.** Preflight weather briefings, verbal or written, must include forecasts of turbulence and pilot reports of turbulence caused by thunderstorm activity, mountain wave activity, clear air turbulence, low altitude frontal windshear and low altitude convective windshear.

c. **Real-time Information Sharing.** During a flight, the pilot and dispatcher must communicate any changes in the forecast or actual turbulence conditions via voice or digital communication methods in order to pass real-time turbulence information along to other flights.

13. ELEMENTS TO INTEGRATE INTO AIRCRAFT DISPATCHER TRAINING TO PREVENT INJURIES CAUSED BY TURBULENCE. Dispatcher training can include new weather products and services available from private vendors as well as those provided by the National Weather Service (NWS). Continual reinforcement of the turbulence avoidance policy can be evident in theory, in on-the-job training, and in practice as follows:

- a. Assure pilot weather briefing includes known areas of turbulence.
- b. Discuss flight routing, including en route altitudes, with flightcrew prior to departure.
- c. Plan flights so they will not proceed through areas in which thunderstorms of more than moderate intensity are known to exist.
- d. Add remarks to dispatch/flight release or weather briefing to emphasize areas where turbulence may be expected.
- e. Plan flights to avoid areas of severe turbulence.
- f. Plan flights to avoid areas with severe thunderstorms.
- g. Add remarks to dispatch/flight release to emphasize areas of turbulence that can be avoided.

14. THREE FUNDAMENTALS OF EFFECTIVE PRACTICES AGAINST TURBULENCE.

a. Turbulence Avoidance as Corporate Culture. The first and most fundamental step in developing effective practices is for an air carrier to adopt a corporate culture of avoidance of turbulence as the first line of defense. Implementing a turbulence avoidance culture can include SOPs for dispatch and flight operations providing for rerouting around forecast and observed turbulence, and for observing standard clearances between thunderstorms and aircraft.

b. Rerouting. In the past the practice of rerouting has been met with limited air carrier acceptance, primarily because of the inaccuracy of first generation turbulence forecast products, the subjectivity inherent in Pilot Weather Reports (PIREP) (if available), and the operational costs of rerouting. However, recent advances in automation, atmospheric modeling, and data display have improved forecast accuracy, data delivery, and PIREP subjectivity, improving the odds that a well-chosen rerouting would in fact avoid turbulence.

c. Standard Clearances Between Thunderstorms and Aircraft. See Appendix 2.

15. OTHER EFFECTIVE PRACTICES THAT CAN BE USED BY MANAGERS, TRAINERS, METEOROLOGISTS, AND AIRCRAFT DISPATCHERS. Effective practices can include:

a. Use all applicable weather data and products including alphanumeric weather information such as Aviation Routine Weather Reports (METARS), area forecasts and terminal area forecasts (TAF), wind and temperature forecasts, NWS in-flight advisories such as Significant Meteorological Advisories (SIGMETS), Convective SIGMETS and Airman's Meteorological Information (AIRMETS), upper air charts, graphical radar summaries or composites, and satellite imagery.

b. Use sophisticated product generation to merge diverse sources into graphical product to track turbulence.

c. Compile turbulence information, including PIREPs, making relevant information easily usable to dispatchers, flightcrews, and air traffic controllers (ATC).

16. NEW SYSTEMS OF TURBULENCE REPORTING AND FORECASTING. Since 1997, major advances in data processing and delivery have allowed graphical depictions of weather to be delivered in near real-time, even to the flight decks of suitably equipped aircraft. Advanced reporting, forecasting, and delivery of graphics have been promoted by government/industry partnerships and by the leadership of various organizations.

17. ADDITIONAL STEPS TO TAKE TO AVOID TURBULENCE AND THEREBY PREVENT CABIN INJURIES. Continued improvement in turbulence-related weather products requires better handling of real-time information on the state of the atmosphere at any given time. The most promising way to capture and convey this information is through a comprehensive program of reports from aircraft in flight. That program would be founded on automated turbulence reporting supplemented by human reports PIREPs. This system would generate real-time, automatic reports of hazardous turbulence events, and displays the

information for improved operations around turbulence. The report will quantify the severity of the loads experienced in the aircraft's cabin in accordance with the standard levels of light, moderate, severe, and extreme as described in the FAA's Aeronautical Information Manual (AIM). These downlinked reports would be displayed on dispatchers' flight-following display network, and could be scaled and used to predict and inform other aircraft of potential turbulence encounter severity. Reports only would be generated whenever significant turbulence events are encountered.

(1) Air carriers could improve the coverage and objectivity of atmospheric turbulence reports by installing automated aircraft turbulence downlink systems on all ACARS-equipped aircraft.

(2) Air carriers should encourage additional reporting of PIREPs by flightcrews through air carrier PIREPs awareness campaigns and by training flightcrews to follow established PIREPs procedures.

(3) Air carriers could establish communications links and encourage flightcrews to deliver air carrier PIREPs to the NWS and to the FAA.

18. EFFICIENT DELIVERY OF CURRENT INFORMATION. In conjunction with improved turbulence reporting, air carriers may join other industry groups and government organizations to develop faster processing and delivery of current turbulence information, e.g., develop a plan to integrate required improvements in conjunction with normal upgrade/replacement cycles for turbulence detection systems, and/or a cost-effective mix of Internet, Intranet, and other evolving communications systems.

19. ACTIONS TO TAKE TO SUPPORT EMERGING TECHNOLOGIES. Air carriers support development and implementation of emerging technologies when they work with organizations, and equipment manufacturers to develop industry standards for emerging turbulence technologies and weather formats for flight deck display systems.

James J. Ballough
Director, Flight Standards Service

APPENDIX 1. COMMERCIAL AVIATION SAFETY TEAM (CAST) TURBULENCE TEMPLATE STANDARD TERMINOLOGY FOR TURBULENCE

The following terminology is endorsed by the Commercial Aviation Safety Team, from the Aeronautical Information Manual (AIM) available at <http://www.faa.gov/atpubs/>.

1. DURATION OF TURBULENCE.

- a. **Occasional.** Less than 1/3 of the time.
- b. **Intermittent.** 1/3 to 2/3 of the time.
- c. **Continuous.** More than 2/3 of the time.

NOTE: Duration may be based on time between two locations or over a single location. All locations should be readily identifiable.

2. TURBULENCE INTENSITY.

a. **Light Chop.** Slight, rapid, and somewhat rhythmic bumpiness without appreciable changes in altitude or attitude.

b. **Light Turbulence.** Slight, erratic changes in altitude and/or attitude. Occupants may feel a slight strain against seatbelts. Unsecured objects may be displaced slightly. Food service may be conducted and little to no difficulty walking.

c. **Moderate Chop.** Rapid bumps or jolts without appreciable changes in aircraft altitude or attitude.

d. **Moderate Turbulence.** Changes in altitude and/or attitude occur, but the aircraft remains in positive control at all times. It usually causes variations in indicated airspeed. Occupants feel definite strain against seatbelts, unsecured objects are dislodged, and food service and walking are difficult.

e. **Severe.** Large, abrupt changes in altitude and/or attitude. Usually causes large variations in indicated airspeed. Aircraft may be momentarily out of control. Occupants are forced violently against seatbelts, unsecured objects are tossed about, and food service and walking are impossible.

f. **Extreme.** Aircraft is violently tossed about and is practically impossible to control. May cause structural damage.

3. TURBULENCE TYPES.

a. **Thunderstorm Turbulence.** Turbulence associated within and in the vicinity of thunderstorms or cumulonimbus clouds. A cumulonimbus cloud with hanging protuberances is usually indicative of severe turbulence.

b. Clear Air Turbulence. High level turbulence (above 15,000') not normally associated with cumuliform cloudiness. Typically windshear turbulence even when in cirrus clouds.

c. Mountain Wave Turbulence. Turbulence as a result of air being blown over a mountain range or a sharp bluff causing a series of updrafts and downdrafts.

4. PROCEDURES KNOWN TO BE EFFECTIVE AGAINST TURBULENCE. The following procedures have been identified by the CAST and are suggested as standard operating procedures for voluntary implementation by U.S. air carriers. Maximize the information about your flight conditions as follows:

- a. Inform air traffic control (ATC) of turbulence at check in with new controller.
- b. Inform ATC when unforecasted turbulence is encountered en route.
- c. Inform company via ACARS or dispatch frequency so that following flights will be aware of the flight conditions or be planned on another route.
- d. Inform/query other aircraft operating in the area on a common frequency.
- e. Query ATC about "the rides" when you check in with a new controller/sector.

5. WHEN INFORMED OF TURBULENT FLIGHT CONDITIONS.

- a. Prior to departure, seek alternate routing to avoid the affected areas or delay departure until conditions improve.
- b. Change en route altitudes or routes to avoid the turbulence.
- c. Slow to the manufacturer's recommended turbulence penetration speed.
- d. Prior to descent, seek alternate routing to avoid the affected areas or, if severity dictates, hold or divert to alternate.
- e. Avoid any convective activity en route [at or above FL 230] by at least 20 nautical miles and 10 nautical miles below FL 230.

6. GENERAL TURBULENCE PROCEDURES.

- a. If flight into forecast turbulence is unavoidable, timely notification to the cabin crew is crucial to their safety.
- b. If turbulence is expected before the flight departs, the preflight briefing to the lead F/A must include turbulence considerations. The briefing can be the same as an in-flight briefing for expected turbulence including:
 - Actions the captain wants the cabin crew to undertake any time turbulence is expected,

- Intensity of turbulence expected,
 - Methodology for communicating to the cabin the onset or worsening of turbulence, e.g., cabin interphone or public address (PA),
 - Phraseology for the cabin crew to communicate the severity of turbulence, and
 - Expected duration of the turbulence and how an “all-clear” will be communicated.
- c. Utilize a positive signal of when cabin crew may commence their duties after takeoff and when they should be seated and secured prior to landing.
- d. Passengers will be informed of routine turbulence via the PA system. Do not rely on the seatbelt sign alone.
- e. Cabin crew will be informed of routine turbulence via the interphone.
- f. If at any time the cabin crew experiences uncomfortable turbulence without notice from the flight crew, they must immediately take their seats and inform the flightcrew.
- g. All service items must be properly stowed and secured when not in use.

7. TURBULENCE ONSET CATEGORIES AND INJURY AVOIDANCE ACTIONS.

a. **Expected Turbulence.** Advance notice exists for the captain to brief the cabin crew either prior to the flight or in-flight via the interphone.

(1) The captain can thoroughly brief the cabin crew on the expected turbulence level and its duration.

(2) Clearly articulate expectations from the cabin crew and request confirmation of completed actions.

(3) Instruct the cabin crew to immediately and plainly report any deviations from the expected turbulence level.

(4) Develop a method to inform the cabin crew of the completion of the turbulence event.

b. **Little Warning.** Sufficient warning exists to seat the passengers and for the cabin crew to perform their duties.

(1) The captain turns on seatbelt sign and makes a PA announcement, “F/As stow your service items and take your seats. Passengers please remain seated until this area of turbulence has passed and I have cleared you to move about the cabin.”

(2) Cabin crew stows all applicable service items, performs cabin compliance check, and secures themselves in their jump seats.

(3) Lead F/A informs captain of the completion of these items.

(4) When conditions improve, captain uses the PA system to advise the cabin crew that they may resume their duties and whether or not the passengers may move about the cabin.

c. Imminent Turbulence or Turbulence Occurring. Sudden, unexpected or imminent turbulence requiring immediate action to protect cabin crew and passengers.

(1) Captain turns on seatbelt sign and makes a PA announcement, "F/As and passengers be seated immediately. Passengers please remain seated until this area of turbulence has passed and I have cleared you to move about the cabin."

(2) Cabin crew take first available seat and secure themselves.

(3) No compliance checks are performed and items are secured only if they present no delay in securing a person in a seat.

(4) When conditions improve, captain makes PA announcement advising the cabin crew that they may resume their duties and whether or not the passengers may move about the cabin.

APPENDIX 2. USAF PRACTICES TO AVOID THUNDERSTORMS AND ATTENDANT TURBULENCE

1. The practices shown below are excerpted from the United States Air Force Flight Publications for pilots of the Air Mobility Command (AMC).
2. Many of the airplanes operated by the AMC compare closely to the transport category airplanes operated by U.S. air carriers under 14 CFR part 121 in respect to size, weight, and other characteristics. Practices effective in AMC operations are often effective in commercial (air carrier) operations, and vice versa.
3. The following practices have been developed by the Air Force for the AMC pilots as measures to prevent thunderstorm penetrations and to mitigate effects of proximate thunderstorms, especially loss of control and turbulence that might cause injuries.
4. These practices are reprinted here for reference by managers and trainers of pilots operating transport category airplanes in commercial aviation, especially those carrying passengers and F/As under 14 CFR part 121. These practices are comprised of clear and objective criteria to facilitate recognition of cues associated with severe convective activity and guidance to improve flightcrew decisionmaking.

During flight, use any means available to avoid thunderstorms by at least:

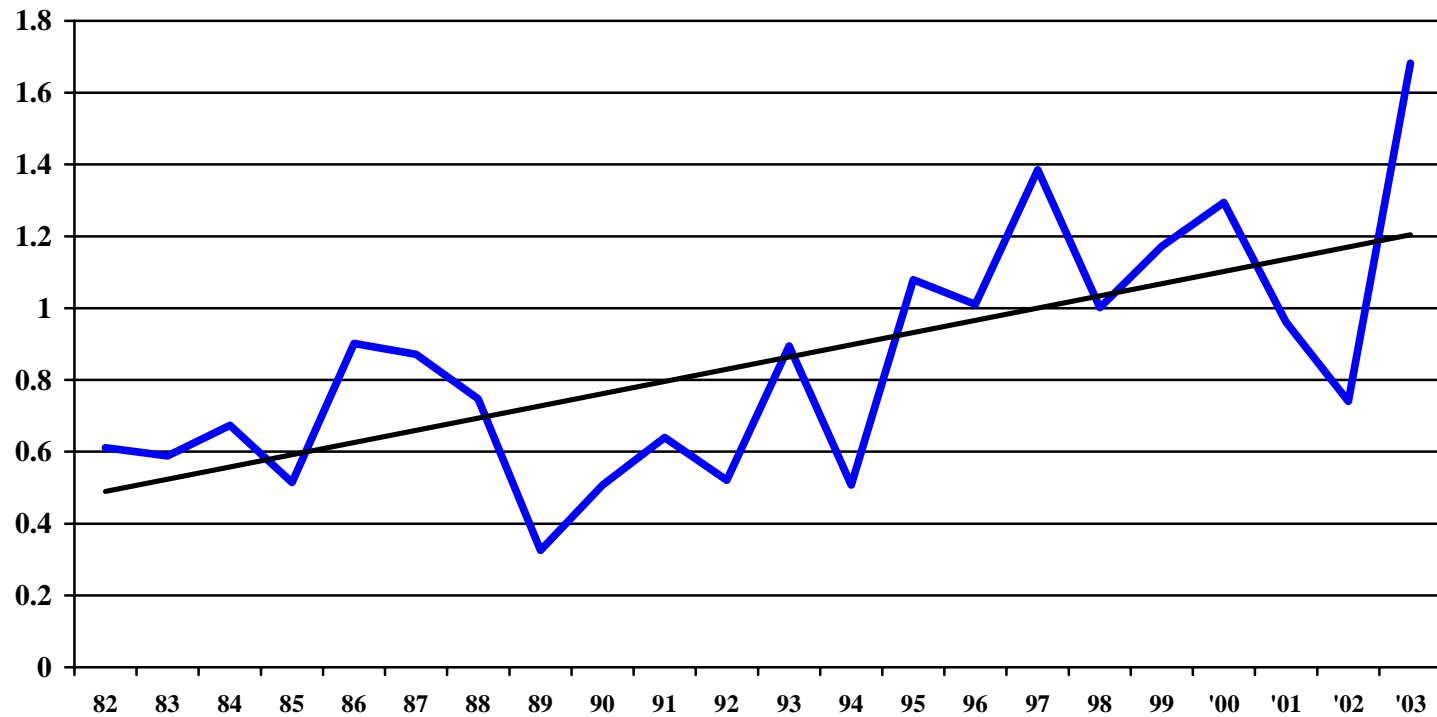
- 20 nautical miles [at or above flight level (FL) 230]
- 10 nautical miles below FL 230, in order to minimize exposure to thunderstorm hazards when approaching or departing an airport in an area where thunderstorms are occurring or are forecast
- Attempt to maintain visual meteorological conditions (VMC)
- Maintain at least 5 nautical miles separation from heavy rain showers
- Avoid areas of high lightning potential, i.e., clouds within $\pm 5,000$ feet of the freezing level

NOTE: Approaches or departures may be accomplished when thunderstorms are within 10 nautical miles. The thunderstorms must not be producing hazardous conditions (such as hail, lightning, strong winds, gust fronts, heavy rain wind shear, or microburst) at the airport, and must not be forecast or observed to be moving in the direction of the route of flight (to include the planned missed approach corridor, if applicable).

**APPENDIX 3. GRAPHICAL DEPICTION OF SOME OF THE DATA
USED IN THIS AC**

**Turbulence Accidents Per Million Departures
U.S. Air Carriers, 1982-2003**

**The increase in accidents and injuries cannot be explained only by volume.
The controlling factor might be load factors.**



**APPENDIX 3. GRAPHICAL DEPICTION OF SOME OF THE DATA
USED IN THIS AC (Continued)**

**Turbulence Accidents Per Million Departures
U.S. Air Carriers, 1982-2003**

**The increase in accidents and injuries cannot be explained only by volume.
The controlling factor might be load factors.**

