



Staying safe against in-flight turbulence

AR-2008-034

2nd edition, March 2014



What is turbulence?

High in the sky, as you are cruising to your destination, the seat belt sign goes on. As you look out the window, there are no clouds for kilometres. What could you possibly run into at this height? Turbulence – a frequently invisible problem for aircraft.

Turbulence is a weather phenomenon responsible for the abrupt sideways and vertical jolts that passengers often experience during flights, and is the leading cause of in-flight injuries to passengers and cabin crew.

Turbulence is caused by the irregular movement of air, and often cannot be seen. When air masses with different speeds, direction or temperatures meet each other – such as a warm or cold front, a thunderstorm, air flowing over or around mountains, or near jet streams – turbulence is likely to occur.



Where's the turbulence?

Photo: Core Lohse

Flying laptops in the cabin

In November 2013, on approach to Sydney Airport with the cabin seatbelt sign on, a Boeing 767 encountered moderate turbulence for about 2 minutes from an electrical storm the crew had earlier observed. After further descent, the crew elected to discontinue the approach, and conducted a missed approach. During the subsequent climb, the aircraft encountered severe turbulence. The crew needed full power to maintain altitude and speed, and they experienced difficulty controlling the aircraft.

In the cabin, one passenger sustained a serious head injury from a laptop computer that fell from an overhead locker. One other passenger sustained a minor rib injury and a third passenger sustained a minor injury from an iPad.

After orbiting for about 20 minutes, the crew recommenced an approach to Sydney Airport and again encountered severe turbulence and the aircraft was difficult to control. The aircraft was then diverted to Williamtown (Newcastle).

» ***Ensure heavy objects are secured in overhead cabins before takeoff and landing.***

How serious is turbulence?

While turbulence is normal and occurs frequently, it can be dangerous. Turbulence by its nature is unpredictable – occurring without warning, and ranging from a few minor bumps to a major shake-up.

Aircraft can handle even severe turbulence, and are designed to flex with the bumps and jolts. Turbulence is usually more severe in the cabin than in the cockpit.

» **Turbulence is rarely a threat to passenger aircraft or to pilot control of the aircraft.**

So why do you need to be prepared for turbulence? While your aircraft is designed to take turbulence, your body is not.

In a typical turbulence incident, 99 per cent of people on board receive no injuries. However, the bumpy ride can cause passengers and cabin crew who are not wearing their seat belts to be thrown around without warning. About 25 in-flight turbulence injuries are reported in Australia each year to the Australian Transport Safety Bureau (ATSB), and many more go unreported. Some of these injuries are serious, and have resulted in broken bones and head injuries.



Unrestrained passengers can sustain head injuries during turbulence by hitting overhead panels

» **An ATSB report found that passengers being thrown up and out of their seat during turbulence was the second most common type of head injury on aircraft.**

For the five-year period 2009 to 2013, there 677 turbulence occurrences on flights in, to or from Australia that were reported to the ATSB, with 197 minor injuries and 2 serious injuries to passengers and cabin crew. The United States Federal Aviation Administration (FAA) estimates that the cost to the worldwide aviation industry of turbulence injuries is over US\$100 million annually, and growing.

If you travel by air, you need to take turbulence seriously.

Bumpy approach

In 2000, a 60-seat turboprop aircraft encountered severe turbulence on approach to Sydney Airport.

One of the passengers attempted to tighten her seatbelt but inadvertently released it. As a result, she was thrown up out of her seat and struck her head on the overhead cabin fittings.

She suffered minor injuries, and was treated by ambulance staff when the aircraft landed.



Turbulence can affect aircraft of all sizes

Common types of turbulence

Thunderstorm turbulence

The Civil Aviation Safety Authority (CASA) requires pilots to avoid flying near storms and other sources of serious turbulence. Thunderstorm turbulence is displayed to pilots via on-board radar, making it avoidable.

Mountain wave turbulence

When air blows over a mountain range, it causes a series of turbulent updrafts and downdrafts.

Aircraft wake vortex turbulence

As objects move through the air, they disturb the air and generate vortices known as wake turbulence. To prevent wake turbulence affecting other aircraft, air traffic control apply wake vortex separation distances between aircraft.

Clear air turbulence (CAT)

Clear air turbulence (CAT) is the main culprit in surprise turbulence.

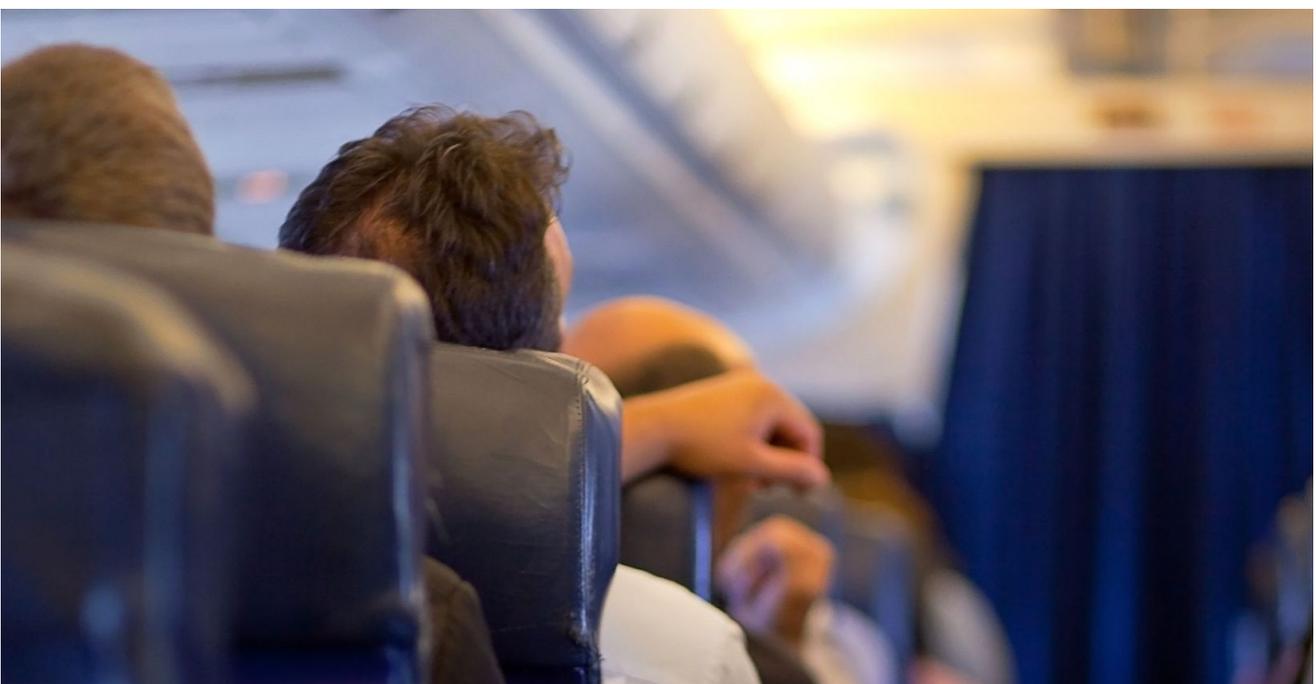
CAT strikes out of the blue, in dry clear air. CAT is particularly serious because:

- » It is hard for pilots, air traffic control and weather forecasters to detect – so there is often no warning until you fly into it.
- » It can occur when no clouds are visible.
- » It cannot be detected by aircraft radar.
- » It is common at the high altitudes which airliners cruise at, especially in the vicinity of jet streams.

All types of in-flight turbulence usually last for no more than a few minutes.

Injuries during cruise

In October 2013, a Boeing 737 departing from Sydney had just climbed above the clouds to 37,000 ft for the cruise to Auckland when the pilots noticed poor weather ahead. After a short delay in receiving clearance from air traffic control to deviate from their assigned flight path, the crew placed the seat belt sign on and began to make a right turn. Once established in the turn, the aircraft struck severe turbulence. Four passengers and cabin crew were injured, some needing to be taken to hospital. Injuries included a head injury, a fractured neck vertebra, and a sprained hand and a back injury.



What can you do to stay safe?

Almost all in-flight turbulence injuries can be avoided by using common sense.

1. Put your seatbelt on, and keep it fastened when you are seated

Your seat belt is the best defence against injuries. Keep it fastened low and tight around your waist.

Almost all turbulence injuries involve people who are not properly seated and do not have their seat belt fastened.

When the seat belt sign is on, you are required by law to have your seat belt fastened for your own safety. The pilots or cabin crew will not always have enough time to warn you to put your seat belt on before turbulence hits.

When the seat belt sign is off, you should continue to keep your seat belt fastened. When moving around the cabin to use the restroom facilities and to exercise during long flights, hold on to the seat backs as you walk. This will help secure you if the aircraft moves unexpectedly.

2. Pay attention to the safety demonstration and any instructions given by the cabin crew

In-flight turbulence injuries are mostly preventable. The safety announcements made by the cabin crew at various stages of the flight about wearing seatbelts when seated are designed to minimise the potential for these injuries to occur. Make sure you follow their instructions at all times.

Safely stow any carry-on baggage in the overhead locker or under the seat in front of you. These items can become projectiles during turbulence if not secured properly.

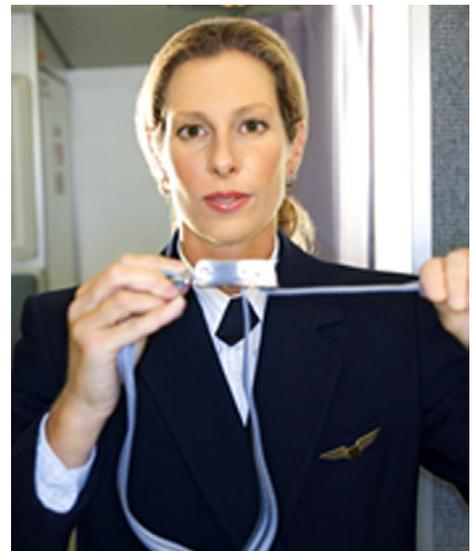
3. Read the safety information card in your seat pocket

A survey by the ATSB of 400 airline passengers found that 65 per cent did not read the safety card at all. This card is provided to all passengers because it contains important safety information specific to the aircraft type you are flying on - you need to read it every time you fly.

Pay particular attention to the brace positions that are right for you and the seat you are sitting in – most people who fly do not know how to brace themselves properly. Bracing your body against the seat in front of you or against your knees will help protect you in severe turbulence.



Keep your seat belt fastened when seated



Follow the instructions of cabin crew



Read your safety card carefully

Clear air surprise

In 2000, a Boeing 747-400 encountered clear air turbulence (CAT) en route from Sydney to Osaka, Japan. Although the weather forecast indicated thunderstorms within 200 km of the aircraft's route, no turbulence was forecast.

When the CAT struck, the seat belt sign was not illuminated, and people were moving about the cabin.

During the turbulence, two passengers sustained broken ankles. Both of those passengers had been out of their seats during the turbulence.

How is turbulence being avoided?

Pilots do their best to avoid turbulence by keeping abreast of the latest weather forecasts, and by communicating with other nearby aircraft to check the weather conditions up ahead. Airlines have standard operating procedures in place to ensure all crew members know what to expect and what to do when encountering in-flight turbulence. Cabin crew communicate regularly with the cockpit to ensure that pilots are aware of the conditions in the cabin.

Aircraft interiors are designed to minimise any sharp edges that might cause injuries. In many aircraft, handholds are provided in the cabin, galley and lavatories that can be used by passengers and cabin crew members who are not seated during turbulence.

Tea time turbulence

In 1996, a Boeing 747-200B encountered severe turbulence en route from Cairns to Tokyo, Japan. The aircraft was experiencing smooth flying conditions. Because the turbulence was not detectable by aircraft radar, the crew had no warning and were unable to take any avoiding action.

When the turbulence occurred, the cabin crew were just commencing a meal service. Passengers, cabin crew and meal trolleys hit the cabin ceiling, and then landed heavily back on the floor. Serious injuries were sustained, including bone fractures, lacerations, neck and back strains, a dislocated shoulder and shattered teeth.

In total, six cabin crew and 24 passengers sustained injuries. Almost all did not have their seat belts fastened. On arrival at Tokyo, 3 passengers and 1 flight attendant were admitted to hospital.

» In these accidents, injuries occurred because there was no warning of turbulence – it was too late for passengers to fasten their seat belts when the turbulence hit.

What are Australian airlines doing?

All major Australian airlines have procedures in place to ensure pilots avoid turbulent conditions wherever possible, and know how to respond if turbulence strikes.

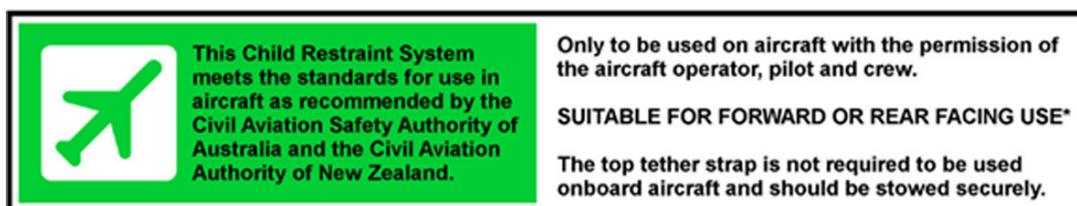
Your cabin crew are trained to ensure passengers are safe at all times, and are aware of the dangers of in-flight turbulence. All cabin crew are first-aid trained to look after passengers who are injured.

It is for this reason that you should follow any requests by cabin crew – including fastening your seat belt, securing carry-on baggage, or returning to your seat when asked.

What about children?

Although most airlines provide infant seat belts, research tests funded by the ATSB have showed that child seats (child restraint systems), as used in cars, provide much higher levels of safety and protection for children in normal and severe turbulence. This is because they include an integrated multi-point harness designed to restrain over a larger portion of a child's body. Parents should ensure children have their seat harness on as much as possible during flight.

Most child restraint seats for cars that meet the Australian Safety Standard are suitable for use in an aircraft. Some seats available from 2013 meet additional criteria relevant for use on aircraft, including installation with only the use of the aircraft seat belt. These seats have labelling similar to that below. Seats that do not contain this label are still acceptable for use on aircraft provided there is an approved means to attach the top tether strap.



Car booster seats (used by older children and do not have in-built harness) cannot be used on airline seats with only a lap belt.

Parents who choose to bring their own infant seats for their children are individually briefed by a cabin crew member to ensure they know what to do in turbulence. Contact the airline at least 24 hours before you fly to check that your infant seat is suitable.

In the absence of a child restraint seat, most major airlines will provide infant seat belts that are designed to loop into an adult's seat belt with the infant sitting on their lap. Although they do not offer the same level of protection as a child restraint, lap belts do provide considerably more protection in turbulence than just holding an infant. Parents should always ensure their children are buckled up when seated in an aircraft, even when the seat belt sign is off.