



Aerospace Risk Consulting & Management Services Bulletin

Turbulence



Severe turbulence events in flight remain relatively uncommon, however, the aviation industry may need to consider changes in an effort to reduce the risk of injury onboard when a turbulence event does happen.

Turbulence events have always been a risk for the aviation industry. Turbulence is the irregular motion of air that can cause a change in the aircraft's altitude, speed, and direction. While turbulence can be uncomfortable for passengers, it is not usually dangerous for the aircraft.

There are several factors that can contribute to turbulence. One of the most common causes is air pockets, which are areas of air that differ in temperature and density from the surrounding air. When an aircraft encounters an air pocket, it can cause a sudden jolt or drop in altitude. Wind shear is another factor that can cause turbulence. Wind shear occurs when there is a sudden change in wind direction or speed, which can cause the aircraft to lose altitude or experience sudden changes in speed.

Geographical areas that regularly experience turbulence include:

- Transatlantic flights
- Areas around Iceland, the Azores and Indonesia due to the convergence of warm and cold air masses
- The equator, particularly during the summer months as it experiences a high level of convection, which can cause convective cells to form and move up and down through the atmosphere
- Flight routes connecting Southeast Asia to Australia experience intense tropical storms and monsoons, and
- The Intertropical Convergence Zone (ITCZ), which is located near the equator and where the northeast and southeast trade winds meet.

With respect to turbulence, both the regulator and the operator have a difficult balance to strike with respect to risk reduction for passengers and cabin crew, the onboard passenger experience and onboard health and wellbeing during flights.

Maintenance Inspections

Whilst the majority of turbulence events pose no structural threat to an aircraft, maintenance teams will routinely monitor the aircraft flight data to determine whether additional maintenance inspections are necessary after severe turbulence events.

Seatbelts

One change that could be introduced by the aviation industry is to mandate, rather than just recommend that passengers keep their seatbelts loosely fastened at all times whilst seated in case of unexpected turbulence.

Whilst this may help reduce risk it doesn't solve the problem completely; considerations around use of toilets, serving of food and drink and safety of cabin crew (who are at risk of injury) will be required. Conversely however, current health advice for long-haul passengers includes getting up regularly to stretch and go for a walk around the plane to help reduce the risks of conditions such as deep vein thrombosis (DVT).



Business Class and First Class Services

Many leading airlines pride themselves and indeed compete on Business Class or First Class passenger experience and some high-end aircraft suites have a 'walk-up' bar serving cocktails and snacks throughout the flight. These bar areas do have seats with seatbelts, but the cabin crew serving at the bar are not seated and the bottles and glassware is not always secured. Airlines will have invested large amounts of money in such luxury internal fits and further protocols may need to be introduced if such bar areas are to remain in use throughout the flight.

Upset Prevention and Recovery Training (UPRT)

As an additional mitigation for turbulence events, all operators might consider maintaining high levels of UPRT competence amongst their flight crews. Turbulence and extreme weather events in aviation should never be 'unexpected'; good situational awareness and rapid responses from aircrew are key mitigations. For example, illuminating fasten seatbelt signs the instant any minor turbulence is encountered can help to reduce the chances of passenger and cabin crew injury.

Trauma Support

Another factor that may not always be considered after a severe turbulence event is the possible psychological impact on traumatised crews and passengers. Flight crews, cabin crew and passengers may all suffer trauma, depending on the severity of the incident and any injuries suffered onboard as a result. Operators should consider these psychological factors and resist operational and commercial pressure to return potentially traumatised crews to flight operations too quickly. For flight crews, such trauma has the potential to adversely impact human performance and decision-making. Peer support systems and Aviation Medical Examiners (AMEs) may need to consider proactive interventions, rather than relying on reported events before they become involved.

Meteorological Forecasts

For all flight operations, risk mitigation for turbulence events should begin with meteorological forecasts and careful flight planning. Effective flight planning should always take into account the likelihood of adverse weather events en-route and considerations should be made about ‘what if’ scenarios, alternative routes, diversions and avoidance where possible. Of course, not all turbulence can be predicted and there will always be situations where Clear Air Turbulence (CAT) or other invisible and transient weather phenomenon might be encountered. Reporting of such events, ideally in real-time, can allow other aircraft to improve situational awareness and potentially to avoid areas of known turbulence where possible.

Future Technology

Weather and turbulence related Apps are already available and the use of expert systems is already helping operators to predict where turbulence events are likely to occur. Operators can use this new technology to assist in planning and decision-making during flight operations. Future technological development might include the introduction of in-flight stabilisation systems that actively counter turbulence (similar to stabilisation systems on large ships in rough seas), but such systems are still experimental and are years away from production.

In summary, turbulence events are an inherent risk for aviation operations. Regular extreme weather events and demand for air travel, together with crowded airspace, affect the frequency of turbulence events. Mitigations exist and should be applied when and wherever practical. However, the aviation industry may need to consider the introduction of further risk mitigation measures in order to minimise the potential for injury when severe turbulence events are experienced.

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