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AIR PILOTS - COMMERCIAL AIR TRANSPORT SAFETY BRIEFING NOTE 10

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MINIMISING EN-ROUTE TURBULENCE INJURIES

The Context

Whilst turbulence injuries to both cabin crew and passengers cannot be eliminated, they continue to occur with no evidence that risk management is reducing the overall scale of the problem, especially but not only in long haul operations. Available occurrence data suggest that the serious injury risk for a member of cabin crew is greater than for an individual passenger. However, despite such serious injury events being included in the ICAO definition of an accident requiring independent investigation, far from full reporting and often cursory investigation have both militated against universal implementation of best practices. Whilst all occupants are vulnerable to turbulence injury if unsecured, the safety of cabin crew must remain paramount whilst still seeking to also protect passengers from similar injury. Turbulence sufficient to cause injury to unsecured occupants can occur at any altitude, but what follows focuses on the en-route risk to those in jet aircraft above an arbitrary 10,000 feet where encounters are not also a risk to the safety of the aircraft itself. The 'special case' of wake turbulence risk is not considered here.

Some examples of fully investigated turbulence injury events

[Note that all examples are wide body cases but this reflects investigation depth not event prevalence.]

- In 2021, just after beginning descent into Beirut from FL360 with the seat belt signs on, a Boeing 777-300 encountered unexpected jet stream-related CAT which prompted a 'cabin crew take your seats' PA. Turbulence almost immediately became severe with resulting injuries to unsecured passengers and cabin crew. ATC did not advise of a directly-related SIGMET and an operator IT fault prevented timely transmission of it to the aircraft by company flight watch.¹
- In 2019, a Boeing 787-8 descending at night into Beijing had its convective weather deviation track terminated due to restricted airspace and descent on the new track misjudged the turbulence risk. At 18,000 feet, severe turbulence occurred with the seat belt signs off and injuries, some serious, were sustained by both cabin crew and passengers.²
- In 2020, an Airbus A380 in the ITCZ over Mozambique at night entered unexpectedly severe in-cloud convective turbulence just eight seconds after the seat belt signs had been switched on without any accompanying PA or cabin crew interphone call. An unsecured passenger sustained serious injuries and several cabin crew were lifted off their feet but avoided injury. Better use of the weather radar could have prevented penetration of severe wet turbulence.³
- In 2015, a Boeing 777-300 crossed Alaska eastbound at FL330 aware of a SIGMET advising of occasional severe CAT with all cabin crew secured and the seat belt signs on. Two severe turbulence episodes followed and 21 unsecured passengers were injured, one seriously. The flight was third in a company sequence but its crew did not seek track deviation and turbulence reports from the flights ahead, an action which had helped the second in a sequence of three to avoid the worst turbulence.⁴
- In 2020, an Airbus A380 crossing the northern Rocky Mountains in night VMC at FL330 with the seat belt signs off suddenly encountered a very brief episode of completely unforecast severe CAT during which one passenger in a toilet compartment with no immediate access to a hand hold sustained a serious injury. It was likely to have been triggered by passage over a specific summit.⁵

¹see: <https://www.gcaa.gov.ae/en/departments/airaccidentinvestigation/Lists/Incidents%20Investigation%20Reports/Attachments/2/2021-1.Final%20Report%20AIFN-0002-2021-Emirates%20777%20EK957%20.pdf>

²see: https://www.mlit.go.jp/jtsb/eng-air_report/JA808A.pdf

³see: <https://www.gcaa.gov.ae/en/departments/airaccidentinvestigation/Lists/Incidents%20Investigation%20Reports/Attachments/128/2020-Final%20Report%20AIFN-0001-2020%20Emirates%20EK763.pdf>

⁴see: <http://www.tsb.gc.ca/eng/rapports-reports/aviation/2015/a15f0165/a15f0165.pdf>

⁵see: <https://www.gcaa.gov.ae/en/departments/airaccidentinvestigation/Lists/Incidents%20Investigation%20Reports/Attachments/125/2020-Final%20Report%20AIFN-0003-2020%20Emirates%20A380%20UAE216.pdf>

Discussion

Management of turbulence injury risk can be divided into recognition of the risk and the response to such recognition. Repetition of similar scenarios and injury consequences shows that both are not always addressed optimally. Recognition of turbulence risk is the first priority and it must occur with sufficient time to mitigate the consequences. For passengers, this means an audible PA from either cabin or flight crew instructing them to be seated with their seat belts secured. For Cabin Crew, this means an interphone message from the flight deck which clearly gives the time available before they must be secured in their full harness seats. Late identification of such a risk may require all occupants to be instructed of an imminent risk and to immediately secure themselves in their seats. Whilst certainty that significant turbulence lies ahead is not required, it is equally important not to employ excessive caution.

The risk of serious CAT can be difficult to assess unless up to date information is available but every effort to access it must be made. There are significant differences in both the usefulness of available forecast and current weather information and the extent to which both aircraft equipment and (if available) flight watch capability can contribute to crew risk awareness. If more than one CAT origin is involved (jet stream, mountain wave, proximity to storm cells or flight over mountainous terrain), the risk of a severe encounter may be increased. There are also significant differences in the extent to which aircraft operators seek to raise pilots' meteorological understanding above relatively low licence-holding thresholds. From a passenger safety perspective, a perennial challenge which is not always managed effectively is the threshold for use of seat belt signs during the period when they are normally off. If this leads to their use when there is no likelihood of a meaningful risk to passenger safety and/or when no reason for their precautionary use is offered by an audible PA, compliance may be poor when it matters.

Safety Recommendations

To Aircraft Operators

- Effective management of en-route turbulence injury risk needs procedures and guidance which support cabin crew safety as an absolute priority relative to passengers and customer service.
- Pilots' meteorological understanding must enable the making of informed decisions en-route including at high altitude and their competence in weather radar use must be explicitly validated.
- Departure fuel must take account of potential track deviation if significant turbulence is forecast.
- Robust procedures must exist for flight crew to proactively communicate by interphone with their cabin crew lead ahead of any intended ad hoc en-route use of the seat belt signs.
- If cabin crew need to be secured in their crew seats, this must be specifically stated by the flight crew with advice on the time available so they can decide if a passenger seat belt compliance check is practicable - such a check must not be a requirement, a PA may have to suffice.
- If an imminent risk of previously unanticipated turbulence is identified, the flight crew should be expected to make a PA. This must automatically mean no passenger seat belt compliance check.
- Passenger pictorial safety self-briefing cards must adequately cover seat belt signage and use.

To Pilots

- Update your en-route weather information as close to departure as possible - relatively simple if you use an EFB but still worth aiming for if it's rather more difficult. Some EFBs now offer very accurate turbulence pictorials presented relative to aircraft route which can be updated en-route.
 - Be certain you know how to use the available weather radar. If manual GAIN/TILT selection is required, set it up appropriately, monitor prevailing wind velocity and regularly vary range to detect any active cells obscured by closer returns. If manual or automatic status is available, taking manual 'slices' at different altitudes will help avoid the highest precipitation intensity. Be capable of obtaining the maximum benefit from relevant pre-flight and in-flight weather information which is or could be relevant to your intended flight.
 - Note that increasing TAT can sometimes provide an early indication of an increased risk of CAT.
 - Experience of uneventful similar en-route sectors must not lead to complacency - the likelihood of severe turbulence encounters is low but regionally and sometimes seasonally variable.
 - Overuse of seat belt signs for relatively minor turbulence may cause passengers to take them less seriously when a real turbulence risk exists and if signs have been on for turbulence which does not then occur, an explanatory PA when they are switched off may aid future compliance.
 - Remaining clear of convective cloud is not enough, associated CAT must be avoided too. 'Rules of Thumb' for minimum lateral distance and overflight margin are often provided in Operations or Training Manuals and should be followed - with care on dark nights. The autopilot should be kept engaged in turbulence provided it is performing normally unless this is explicitly prohibited.
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