with the same information as cabin crew, such as the location of handrails or handles to hold onto in case of sudden turbulence, lowering their posture and holding onto armrests when in the aisle, or sitting in an empty seat and fastening their seatbelt. These measures are crucial for preventing accidents.

- Additionally, when informing passengers, it is necessary to consider more effective methods that can reach as many passengers as possible.
- While procedures for responding to sudden turbulence are generally included in cabin crew manuals and communicated, practical training should be conducted to enhance cabin crew awareness and ensure they can apply these procedures effectively.
- Although cabin crew inherently face a much higher risk of injury than passengers due to the nature of their work, they must always remain aware of their role as safety personnel in the cabin. They should avoid prioritizing service to the extent that they become unable to fulfill their duties due to injury. Therefore, they should make every effort to remain seated whenever possible, especially in situations where turbulence is expected—but also in cases where it is not anticipated.
- Additionally, it is necessary to inform passengers that cabin crew seating is a safety measure and to seek their understanding and cooperation.
- Passengers should be continuously educated through in-flight announcements and other means to help them understand the importance of taking actions to ensure their own safety and to encourage their cooperation.

Column

“Efforts to reduce injury risks in the cabin”

Airlines are implementing various measures to prevent turbulence-related accidents. All Nippon Airways (ANA), for example, has introduced initiatives such as broadcasting educational videos to raise passenger awareness and conducting cabin crew training using a cabin simulator. The ANA Safety Promotion Center has contributed insights into their proactive measures for preventing turbulence-related accident.

"ANA's approach to turbulence countermeasures"

To reduce the risk of injuries caused by turbulence and maintain an acceptable level of safety, ANA is implementing and continuously improving the following measures.

1. Minimizing Turbulence

ANA is actively working on providing highly accurate turbulence forecast and real-time meteorological information to flight crew and flight dispatchers.

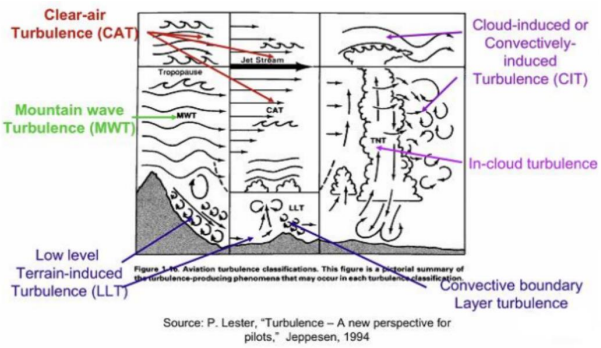
Regarding forecast data, conventional information was limited to VWS (Vertical Wind Shear), however, ANA now provides additional indicators such as CAT (Clear Air Turbulence), temperature changes, horizontal wind variations, stability, convective cloud effects, mountain waves, and real-time turbulence conditions. These factors are used to calculate and provide "Graphical Turbulence Guidance (GTG)" information.

For real-time turbulence data, in addition to the traditional PIREP (Pilot Report) transmitted via radio, ANA has joined IATA's (International Air Transport Association) Turbulence Aware platform, which enables the sharing of turbulence-related data among participating airlines worldwide. As part of this initiative, ANA has begun providing Eddy Dissipation Rate (EDR)*1 data.

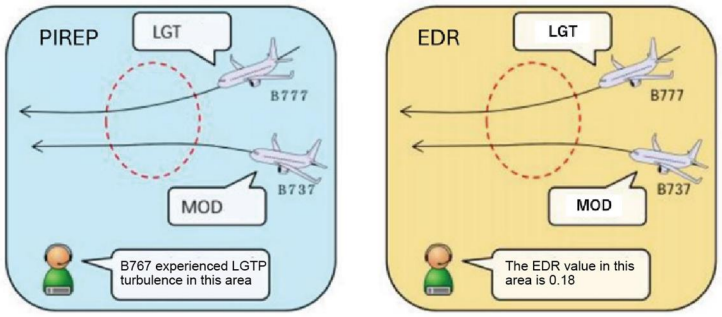
A major advantage of EDR is that turbulence data observed automatically by aircraft can be instantly collected, stored, and shared. Moreover, the data can be used across different aircraft types without distinction. The implementation of EDR is already progressing among international airlines, and ANA is expanding the number of aircraft equipped with this system.

At ANA, GTG and EDR data are accessible via tablet devices used by flight crew and ground-based dispatchers. Additionally, some international flights are equipped with in-flight Wi-Fi, allowing real-time access to the latest turbulence information. Moving forward, ANA plans to extend this capability to domestic flights as well. These initiatives enable improved turbulence forecasting and the selection of optimal flight routes.

*1: Eddy Dissipation Rate (EDR) – an index representing atmospheric turbulence intensity



GTG consideration factors



Source: Japan Meteorological Agency, "EDR (Eddy Dissipation Rate) and Automatic EDR Observation by Aircraft"

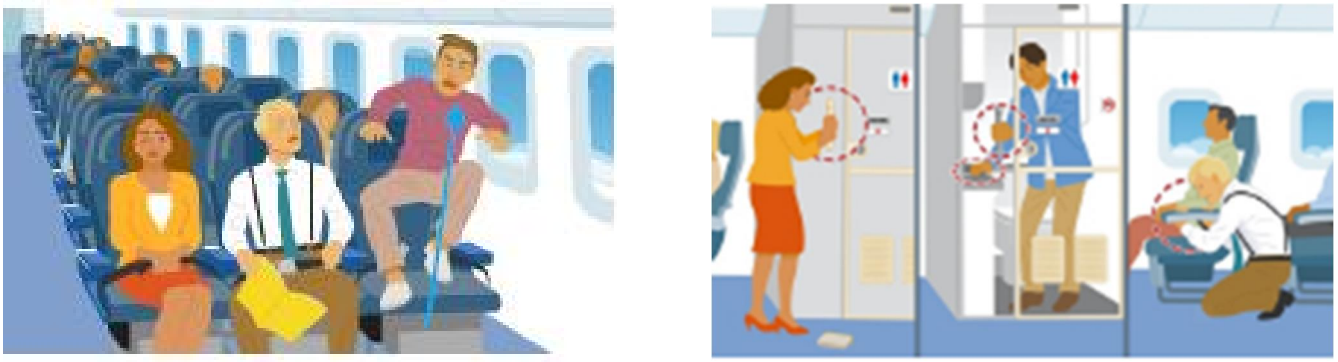
PIREP: Reports of turbulence from preceding aircraft allow the flight crew of following aircraft to anticipate turbulence severity based on their own aircraft's characteristics
EDR: The system calculates and provides turbulence intensity predictions to flight crew based on EDR values measured by preceding aircraft

Characteristics of PIREP and EDR

2. Preventing injuries & preparing for turbulence

Preventing injuries

Cabin crew issue announcements and provide verbal warnings to alert passengers when turbulence is expected or encountered. To further reduce injury risks, ANA introduced an in-flight educational video in September 2020. This video informs passengers about appropriate actions to take during turbulence, raising awareness and encouraging them to take proactive safety measures.



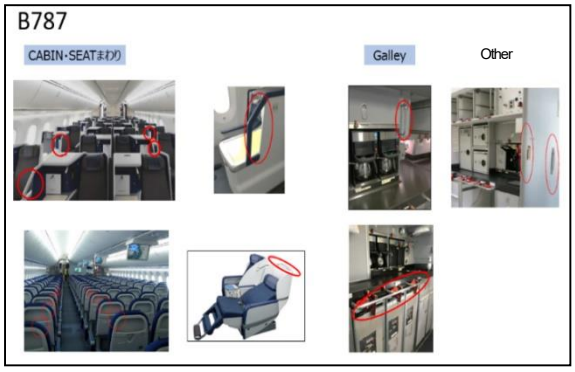
Passenger educational video

Preparing for Turbulence

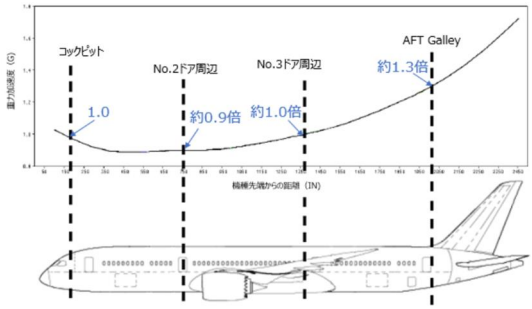
Effective crew communication is a crucial factor in reducing turbulence-related injury risks. Since flight crew are the primary source of information for both passengers and cabin crew, timely and accurate information sharing directly contributes to safety.

While different departments have individually implemented various measures, “turbulence-related injury prevention” should be addressed through cross-departmental collaboration. To facilitate this, ANA Group has published a Turbulence Prevention Pamphlet, outlining key factors and considerations for injury risk reduction. This initiative aims to enhance mutual understanding between flight and cabin crew, helping them identify and implement the appropriate actions necessary for safe operations.

Unexpected turbulence may be encountered, or actual turbulence conditions may differ from pre-flight information in terms of timing (earlier or later) and intensity (stronger or weaker). If safety measures are not in place beforehand, the risk of injury cannot be effectively reduced. To minimize the risk of being lifted off the ground during turbulence and to protect themselves, cabin crew are trained to familiarize themselves with available handholds on each aircraft type, identify secure handholds onboard before each flight, and experience turbulence response training using the Motion Mockup simulator, which replicates turbulence conditions, as part of new hire training. This ensures that crew members instinctively take protective actions in sudden turbulence situations.



B787 Secure handholds in the cabin



B787-9 Differences in turbulence intensity by aircraft position

According to Boeing data, turbulence experienced in the rear of the aircraft can be up to 1.5 times stronger than what is felt in the cockpit, though this varies by aircraft type. Based on this data, as well as ANA’s internal analysis of seatbelt sign activation during strong turbulence events, flight crews are encouraged to remain highly alert to the risk of severe turbulence and proactively activate the seatbelt sign without hesitation if turbulence is suspected.

3. Utilization of aircraft-mounted equipment (new technologies)

Utilization of onboard weather radar and meteorological information

- The most common cause of aircraft turbulence-related accidents is in-cloud turbulence. Since the development and dissipation of turbulence within clouds can be somewhat predicted by carefully monitoring the movement and intensity of observed radar echoes, it is crucial to make effective use of this information. To achieve this, flight crews must thoroughly understand the characteristics and limitations of weather radar and continuously practice proper operational techniques.
- Accurately assessing the development and dissipation of cumulonimbus clouds and thunderstorms allows for better turbulence avoidance strategies, such as horizontal course deviations or, depending on the situation, vertical avoidance by maintaining a sufficient altitude difference. When avoiding turbulence, it is important to recognize that certain types of airflow disturbances may not be easily detected by onboard weather radar. Therefore, pilots should ensure adequate time