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Despite a briefing and illustrated safety cards, passengers on an Embraer 195 were unsure of what to do while using an overwing exit.

BY LINDA WERFELMAN

The U.K. Air Accidents Investigation Branch (AAIB) has recommended design reviews and modifications of emergency exits on public transport aircraft following an emergency landing in which passengers in an Embraer 195 became confused about how to use an overwing exit.

The AAIB issued the safety recommendations as a result of its investigation of the Aug. 1, 2008, incident that prompted the emergency landing at Ronaldsway Airport on the Isle of

Man. Five of the 95 people in the airplane received minor injuries during the evacuation.

About 10 minutes after takeoff on a scheduled passenger flight from Manchester, England, to Belfast, Northern Ireland, the no. 1 air cycle machine (ACM) failed, sending fumes onto the flight deck. The cabin crew reported an unusual odor and a haze in parts of the cabin.

The pilots donned oxygen masks and, because the commander was

concerned about the possibility of fire, declared an emergency and diverted to Ronaldsway. The fumes and smoke intensified during the surveillance radar approach, and the captain “considered that he would probably conduct an evacuation on landing,” the report said.

He did not notify the cabin crew or air traffic control because “he thought that to tell them anything at this late stage of the flight might cause confusion should he decide not to order an evacuation,” the report said.

# where's the **EXIT?**



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After completing the approach and landing on Runway 26, the commander turned the airplane into the wind and stopped at a runway intersection, telling the cabin crew first to stand by and, seconds later, to evacuate (Figure 1, p. 48).

Cabin crewmembers responded by opening their assigned doors. Passengers opened the left overwing exit door; the right overwing exit door could not be opened because the forward upper part of the door trim was jammed beneath the ceiling edge panel (Figure 2, p. 49).

The escape slides inflated automatically, but the slide at Door 1 Left had not fully inflated when the first passenger arrived at that exit, and, as a result, the senior cabin crewmember (SCCM) initially directed passengers away from that exit. After the slide inflated, the SCCM “had to push himself past the flow of passengers” to cross the aisle to Door 1 Right and open it, the report said.

Passengers said later that the slides were “very steep,” and they were “surprised by the speed at which they slid down them,” the report said. “The slides also ended without any round-out at the bottom, causing passengers to slide straight onto the ground at speed. This, and attempts by passengers to slow themselves on the slides, were the principal causes of injury reported.”

The report said that when the cabin crew became aware of the problems, they “tried to reduce injuries by instructing passengers to sit down as they got onto the slide and by controlling the flow of passengers down the slides.”

At the left overwing exit, passengers became confused about how to move from the wing to the ground.

“A 61-cm-wide [2-ft-wide] walkway was demarcated at the wing root in black paint, with arrows pointing towards the trailing edge,” the report said. “This was not noticed by some passengers; one passenger thought that the markings denoted an engineers’ walkway rather than an escape route. The overriding comment from passengers who evacuated onto the wing was that it was not obvious to them that they were meant to climb off the wing via the trailing edge.”

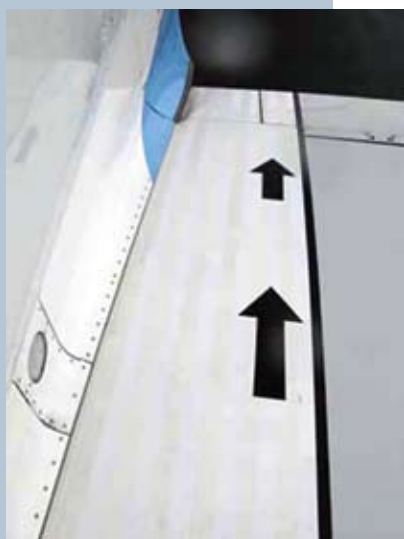
Two male passengers who used the overwing exit jumped from the rear of the wing to the ground — a “considerable drop” of about 1.7 m (5.6 ft), the report said — helped other passengers to the ground. They told investigators that, without their help, some passengers might have been seriously injured trying to climb down off the wing.

A review of each passenger’s seat position and his or her choice of exit showed that none of the passengers used Door 1 Right.<sup>1</sup> The report speculated that this was probably partly a result of the “staggered layout” of that exit and the Door 1 Left exit, which would have been the first exit that passengers reached as they moved forward from their seats.

The report also noted that a cabin crewmember was positioned next to Door 1 Left to assist passengers there, while Door 1 Right was unattended. “Passengers would have therefore had to find and use [Door 1 Right] at their own initiative,” the report said.

The cabin crew estimated that all passengers were evacuated within one minute. At that time, two cabin crewmembers checked that no

Passengers did not realize that the arrows on the wing denoted an evacuation route.



U.K. Air Accidents Investigation Branch

passengers remained in the airplane and evacuated through Door 2 Left.

### Passenger Briefings

The investigation found that before departure, cabin crewmembers had briefed the passengers seated next to the overwing exits on their operation. Similar instructions — including “the depiction of an arrow apparently guiding passengers towards the trailing edge of the

wing” — were on the seatbacks in front of these passengers, and each passenger had a safety card that contained a diagram depicting passengers “climbing off the trailing edge of the wing onto the ground,” the report said.

After the incident, the operator modified the safety briefing for passengers seated next to the overwing exits “to make them aware that the arrows on the wing indicate direction of evacuation (i.e., aft over trailing edge of the wing),” the report said.

### Previous Incident

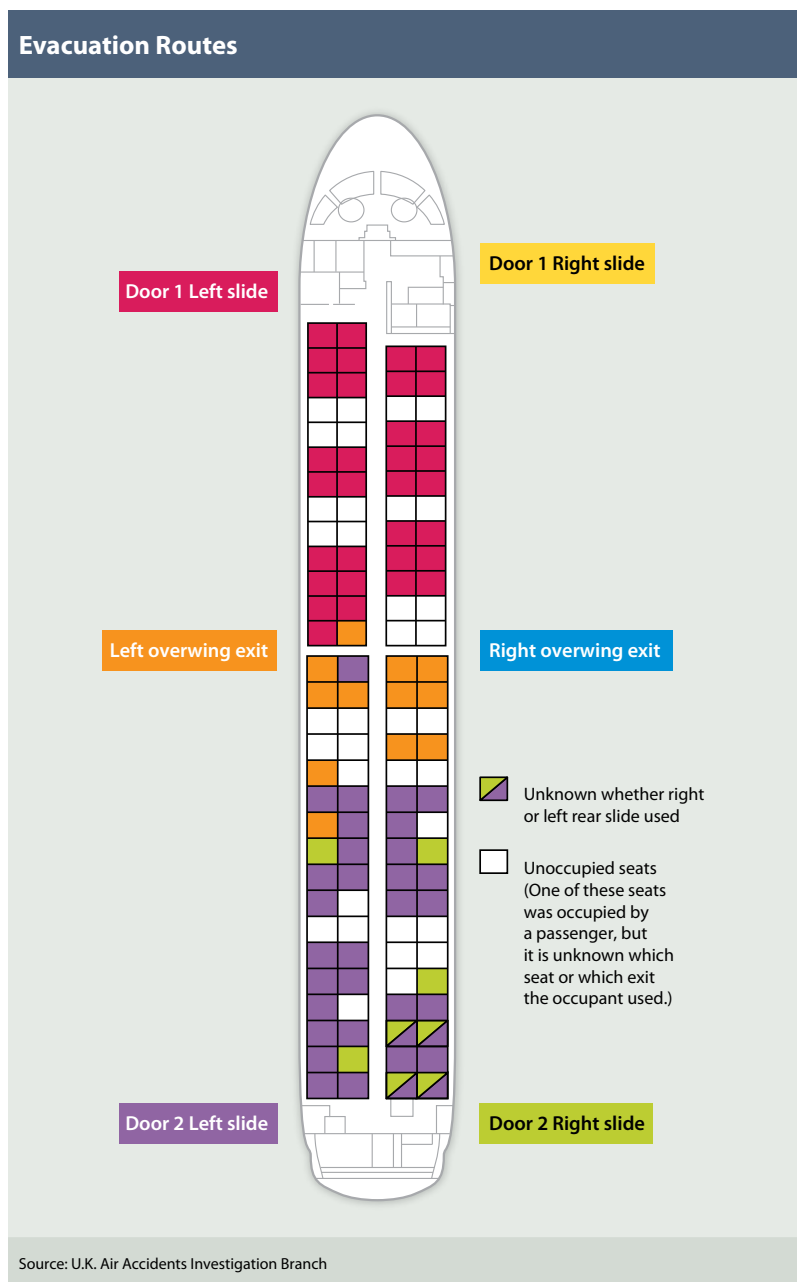
The report noted the previous AAIB investigation of an April 1, 2002, incident in which passengers in a Fokker F28 experienced similar problems using overwing exits during an emergency evacuation after the cabin filled with smoke while the airplane was taxiing for takeoff from Manchester International Airport.<sup>2</sup>

The final AAIB report on the 2002 incident said that passengers using the left overwing exit “congregated on the wing looking for a way down” and that some passengers eventually “slid or jumped from the wing tip and leading edge (a drop of some 7 to 8 ft), instead of sliding off the wing trailing edge down the extended flaps.”

As a result of its investigation of the Fokker incident, the AAIB recommended that the U.K. Civil Aviation Authority (CAA) and the European Joint Aviation Authorities (JAA) review “the design, contrast and conspicuity of wing surface markings associated with emergency exits on public transport aircraft with the aim of ensuring that the route to be taken from wing to ground is marked unambiguously.”

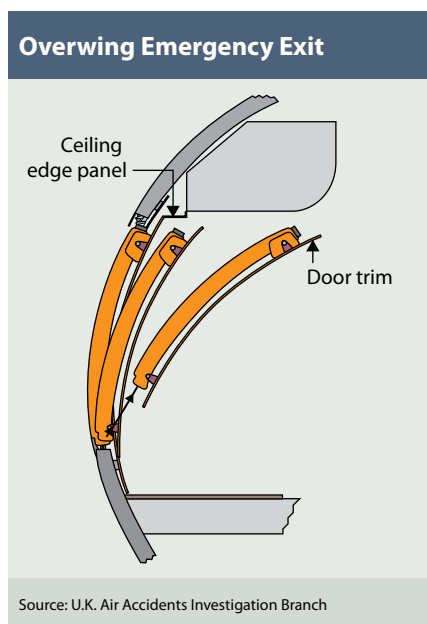
The report said that the CAA accepted the recommendation, but there was no response from the JAA.

As a result of the more recent Embraer incident, the AAIB re-issued the safety recommendation, directing it this time to the European Aviation Safety Agency (EASA), which now has responsibility for aircraft certification throughout Europe.



Source: U.K. Air Accidents Investigation Branch

Figure 1



**Figure 2**

“It is apparent from this incident that the issue of ambiguous overwing escape route markings ... still exists,” the AAIB said. “It is therefore appropriate that this matter is re-examined.”

### Door Jam

A post-incident examination of the right overwing emergency exit door found insufficient clearance between the top edge of the door trim and the ceiling edge panel. “Over most of its length, the clearance was just sufficient to accommodate insertion of a credit card, but near the forward corner of the door, where the door trim had jammed, the clearance was only 0.003 in [0.076 mm],” the report said.

No clearance had been specified, but after the AAIB informed the manufacturer of the incident, Embraer issued Service Bulletin (SB) 190-25-0092, calling for inspections and replacement of the ceiling edge panel if the clearance is less than 2.00 mm (0.08 in). Similar inspections were introduced during manufacturing to ensure a minimum 2-mm clearance.

The AAIB’s subsequent evaluation of the SB’s effectiveness found that a 2-mm clearance was insufficient to prevent jamming of the door trim behind the ceiling edge panel “if the door was lifted during the initial stages of opening or if it was opened energetically, such as might be the case in an actual emergency,” the report said. “It was concluded that [although] the SB reduced the probability of a jam, the potential for a jam had not been eliminated.”

The report traced the problem to the EASA’s certification of the Embraer 195 — “largely on the basis of its similarity to the Embraer 190.”

However, the report added, “during Embraer 195 development, the ceiling edge panel manufacturer introduced changes to the configuration and dimensions of the cutouts around the overwing exit aperture, reducing the clearance between the ceiling panel and the door trim. These changes were not notified to the aircraft manufacturer.”

Current aircraft certification requirements do not discuss the potential for jamming, “except that there must be provisions ‘to minimize the probability of jamming of emergency exits resulting from fuselage deformation in a minor crash landing,’” the report said.

The AAIB recommended that the manufacturer “modify the overwing emergency exits ... to eliminate the possibility of the exit door jamming due to interference between the door trim panel and the ceiling edge panel.”

### Source of Trouble

The report traced the airplane’s problems to the no. 1 air conditioning pack; investigators determined that the no. 1 ACM rotor had seized. At the time of the incident, the no. 2 air conditioning pack was inoperative, and the airplane was being operated without it in accor-

dance with the minimum equipment list. It had been damaged four days before the incident in another event that involved smoke in the cabin.

Examination of both ACMs revealed that Stage 2 turbine blade failures had occurred in each unit, causing the turbine blade tips to come in contact with the ACM casings; this produced fine metallic particles, which were released into the cabin air system, “creating the reported symptoms of smoke and fumes inside the aircraft,” the report said.

The report quoted the airplane manufacturer as saying that this incident was “the only known case of the failure of an ACM Stage 2 turbine during single-pack operation on the Embraer 190/195 fleet.”

In addition, the manufacturer said that modifications and maintenance had “significantly improved” the reliability of the Embraer 190/195 air conditioning packs. As a result, the AAIB said no further safety recommendations were needed. 🌀

*This article is based on AAIB Serious Incident Report EW/C2008/08/01, included in the AAIB Bulletin published in June 2010 and available online at <[www.aaib.gov.uk/publications/bulletins/june\\_2010.cfm](http://www.aaib.gov.uk/publications/bulletins/june_2010.cfm)>.*

### Notes

1. Investigators were unable to determine which of several seats was occupied by one passenger, as well as the exit used by that passenger.
2. AAIB. Accident Report EW/C2002/4/1. <[www.aaib.gov.uk/cms\\_resources.cfm?file=/dft\\_avsafety\\_pdf\\_507773.pdf](http://www.aaib.gov.uk/cms_resources.cfm?file=/dft_avsafety_pdf_507773.pdf)>. Six of the 94 people in the airplane received minor injuries. The report said the manufacturer attributed the problem to a failure of the auxiliary power unit (APU) compressor oil seal, “which had allowed APU oil to leak into the APU bleed air supply and thus to enter the air conditioning system.”