

Accident

Aircraft Type and Registration:	Diamond DA 40 NG, G-LDGB	
No & Type of Engines:	1 Austro E4-A piston engine	
Year of Manufacture:	2015 (Serial no: 40.N296)	
Date & Time (UTC):	16 May 2023 at 1445 hrs	
Location:	3 nm north-west of Oxford Airport	
Type of Flight:	Training	
Persons on Board:	Crew - 2	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Rear passenger door detached from airframe	
Commander's Licence:	Commercial Pilot's Licence	
Commander's Age:	33 years	
Commander's Flying Experience:	1,700 hours (of which 500 were on type) Last 90 days - 52 hours Last 28 days - 32 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further AAIB enquiries	

Synopsis

Whilst conducting an instrument flying training lesson the rear door detached from the aircraft. The instructor inadvertently disengaged the primary locking mechanism whilst pressing the rear door handle to demonstrate to students how to secure it in the event of an in-flight Primary Flying Display (PFD) door warning. The aircraft landed safely and there were no injuries. The Operator undertook a number of safety actions following the event.

History of flight

The flight was an instrument flight training lesson, there was also a passenger, another student, who was to observe for local area familiarity and lesson content. Part of the Operator's checklist for the Diamond DA40 NG requires that the rear door is to be confirmed closed before engine start and before take-off. On both occasions the student pilot and the instructor observed the student in the rear seat check that the handle mechanism of the rear door was in place and apply pressure to the door; all crew members were content the rear door was locked. Furthermore, the door warning light was confirmed to be OFF on the PFD as required the aircraft checklist.

Following a successful take-off and initial departure by the student, control was handed over to the instructor during climb out to enable the student to don the instrument flying hood¹, control was then returned to the student.

Prompted by a routine altitude warning and call out by the student pilot during the climb out, a discussion commenced with the instructor about visual and audio warnings on the PFD. The instructor demonstrated how selecting the pitot heat on would be displayed on the PFD. There then followed a discussion about the most common occurrence being door warnings and how these can be triggered by the door handle being open a small amount. At this point the instructor reached back and pushed on the rear door handle to demonstrate to the students how to secure the door following an in-flight PFD warning that would indicate the door was not closed. As the instructor interacted with the door handle it unexpectedly opened fully.

With the student pilot still flying, the instructor and rear seat student assessed the situation. The rear seat passenger could not reach the door to close it due to the seat restraint harnesses and shortly afterwards the door fully detached from the airframe. The instructor took control of the aircraft, contacted ATC to advise of the situation and was given clearance to land. The return to the airfield, landing and taxi were uneventful and there were no injuries to the occupants. The aircraft is shown below (Figure 1).



Figure 1

G-LDGB with rear door missing (image used with permission)

Footnote

¹ IFR Hoods or View Limiting Devices are used by pilots during flight training to simulate flying in the clouds or in poor visibility. It restricts their view so the student can only see the flight instruments, forcing them to fly without any external references to the ground or horizon.

Rear door description and operation

The rear passenger door is a carbon fibre reinforced plastic moulding with inner and outer frames bonded together. The door has an acrylic glass window. Two hinges attach the door to the top of the fuselage near the centreline. A gas strut attaches to the rear of the door and the fuselage which holds the door open on the ground. A handle on the left of the door operates two locking bolts located at the bottom front and rear corners of the door.

An additional safety latch is fitted (Figure 2). The function of this red safety latch is to hold the unlocked passenger door in a near closed position, whilst the aircraft is parked on the ground, protecting the passenger door from wind gusts. It also helps reduce the risk of a passenger door separation in case of an inadvertent opening of the door locking mechanism by a passenger during flight. Although it should be noted that the original design intent of the red safety latch was not to prevent a passenger door from separating from the aircraft because of a failure to lock the passenger door before flight.

The passenger door hinge design provides a predetermined breaking point, strong enough to comply with the certification specification but allowing a passenger door, which was closed, but improperly locked, to separate cleanly from the airframe with minimal damage. If the passenger door swung open and did not separate from the fuselage, reduced controllability of the aircraft would be the consequence.



Figure 2

Rear passenger door handle configuration (image used with permission)

There is a DOOR OPEN warning that activates on the PFD if the primary locking mechanism is not properly located. However, there is no way of demonstrating this warning on the PFD without opening the doors. This warning can be demonstrated in the DA 40 simulator, but the operator did not have this facility.

Operators Investigation

The operator of the aircraft conducted an investigation into the occurrence. This concluded that the instructor wanted to show a common warning annunciation (door not fully closed) to the student whilst in-flight and to do this he intentionally manipulated the handle. The instructor refuted this conclusion and maintained that his intention had been to show the students how to deal with an erroneous door open warning by pushing the door handle to ensure it was secure. The operator's investigation also found that it was likely that the red safety latch was either not fully engaged or was not able to retain the door, resulting in the door opening into the airflow and detaching from the aircraft.

A check of the airframe and the recovered detached door was undertaken by the Continuing Airworthiness Management Organisation (CAMO) which concluded the following: there was no fault with the primary or secondary door locking mechanisms, the door hinges were damaged where the door had been torn away in-flight and there was no evidence of impact damage to the rest of the airframe from the door detaching in-flight.

The operator provided photographs and videos of the detached door and surrounding airframe which showed the locking mechanisms operating correctly and the safety latch retaining block intact. There were witness marks on the top of this block, although these were assessed by the Continuing Airworthiness Organisation as being due to normal wear and tear.

Tests and Research

Research conducted by the Design Organisation (DO) showed that since 2004, there were approximately 80 reports of DA 42 series and DA 40 series airplanes that experienced an in-flight passenger door separation. The investigations into these incidents could not establish a technical reason that would cause door separation. The possibility of pilots not correctly closing doors could not be discounted in many of these investigations and the DO concluded this to be the most likely cause of in-flight passenger door separations.

Nevertheless, over time the design of the involved components, such as the door locking mechanism, safety hook, retaining block on the fuselage, and the composite hinges have continued to be improved to minimize the risk of a technical failure. Although there was no proof that the red safety latch had ever disengaged spontaneously, the DO has also improved the design of the black retaining block on the fuselage, which was introduced to airplanes in the field under a Service Bulletin in July 2010², preventing the red safety latch from slipping past the black retaining block (Figure 3). Furthermore, the geometry of the red safety latch and the black retaining block on the fuselage was improved for aircraft in serial production. Built in 2015, G-LDGB would have benefitted from these improvements.

An investigation in 2011 conducted by the Dutch Safety Board into a rear door separation incident on a DA 40 found that excessive free play on the rear door forward hinge bracket combined with an unlocked door could move the door up at the top front position. This was

Footnote

² This Service Bulletin was covered by EASA Airworthiness Directive 2010-0235 and FAA Airworthiness Directive 2010-25-01 in November 2010.

causing a de-activation of the red safety latch and the door separated from the aircraft. The Aircraft Maintenance Manual now requires hinges to be inspected as part of a scheduled maintenance check and this was carried out on G-LDGB on 17 April 2023.



Figure 3

Red safety latch in engaged position (Image used with permission)

Analysis

Whilst this investigation could not determine the instructor's intent when interacting with the door handle during flight, the instructor's action inadvertently disengaged the primary locking mechanism for the rear door. This allowed the door leading edge to open sufficiently to be pulled open by the airflow and torn off its hinges. There was no evidence found on the recovered door of a technical fault with the primary door locking mechanism. From the evidence available it was also not possible to determine why the red safety latch did not retain the door once the primary locking mechanism was disengaged. The door hinges had been inspected recently so excessive free play of the forward hinge was unlikely to be a factor and the instructor and crew were confident the door was closed properly. However, the red safety latch is not the primary mechanism for securing the door.

Conclusion

The passenger door detached from the aircraft because the primary locking mechanism for the door was inadvertently disengaged by the instructor whilst demonstrating to the student pilot how to respond to potential door warnings in flight. The reason why the secondary mechanism that was designed to help prevent door opening in-flight did not retain the door could not be positively determined.

Safety actions

Following the accident, the operator undertook a number of safety actions:

- Providing clear guidance to crews on the use of the rear door and latches.
- Amendments to the pre-flight check list to include additional testing of the secondary latch during pre-flight checks and a reminder of the importance of reporting any faulty secondary latches as a defect.