ACCIDENT

Aircraft Type and Registration:	Breezer B600E, D-ETDK
No & Type of Engines:	1 Rotax 912 ULS
Year of Manufacture:	2014
Date & Time (UTC):	2 August 2016 at 0933 hrs
Location:	2.5 nm NW of Oban Airport, Argyll
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Serious) Passengers - 1 (Serious)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Light Aircraft Pilot's Licence
Commander's Age:	63
Commander's Flying Experience:	2,500 hours (of which 1,200 hours were on type) Last 90 days - 30 hours Last 28 days - 15 hours
Information Source:	AAIB Field Investigation

Synopsis

The pilot of D-ETDK, who was flying in loose formation with a group of similar aircraft, slowed his aircraft to increase separation from the aircraft ahead. His aircraft then encountered an updraught from airflow over a ridge and stalled. He lost control of the aircraft and deployed the ballistic recovery system (BRS), but there was insufficient time for the aircraft to achieve a stabilised descent before it struck the ground.

The investigation concluded that the stall and subsequent loss of control were made more likely because: the aircraft was susceptible to turbulence and wind gradient because of its low inertia; the Centre of Gravity (CG) was probably behind the aft limit; and the aircraft's speed had been reduced to maintain separation from other aircraft joining the circuit.

History of the flight

D-ETDK departed Glenforsa Airfield on the Isle of Mull at 0918 hrs for a flight to Oban Airport in Argyll. The aircraft was the last of eight Breezer aircraft flying in a loose formation but operating as one speaking unit. The formation leader contacted Oban Information on the radio stating that there were eight Breezer aircraft approximately five minutes away. He was told that Runway 19 was in use with a right hand circuit, the wind was from 130° at 13 gusting 23 kt and the QNH was 1007 hPa. Figure 1 shows an extract of the Oban Aerodrome Chart contained in the UK AIP.

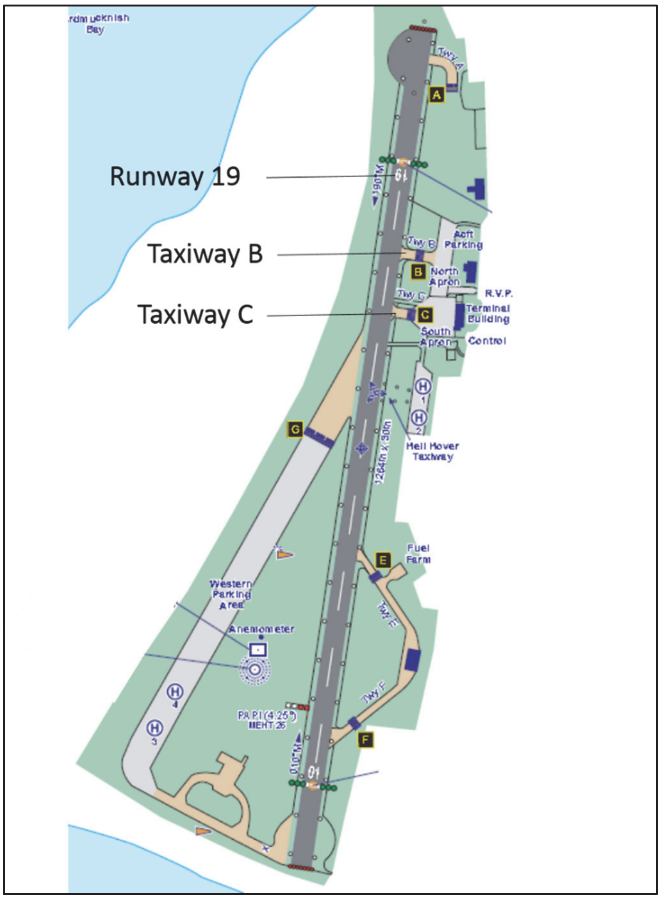

Figure 1

Extract of UK AIP entry for Oban Aerodrome

The formation leader said that there were pilots in the formation with "LANGUAGE DIFFERENCES" and asked the Flight Information Service Officer (FISO) to issue one clearance for the aircraft to land "SEQUENTIALLY, ONE AFTER ANOTHER". The FISO replied that he "WOULD LIKE EACH AIRCRAFT TO REPORT RIGHT BASE FOR ONE NINE AND LEAVE SPACE FOR A POSSIBLE BACKTRACK". He also warned the leader about the possibility of turbulence and windshear on short finals due to the wind.

Approximately two minutes later, the FISO reiterated to the leader that the landing aircraft would be required to backtrack the runway before vacating it and asked him to ensure "WE GET ENOUGH SPACING BETWEEN AIRCRAFT". The leader asked whether the aircraft in the formation could "COLLECT AT THE END OF THE RUNWAY AND THEN BACKTRACK ALL TOGETHER?" but the FISO replied "NEGATIVE. FOR SAFETY WE REQUIRE – YOU WERE TOLD ON THE 'PHONE – TO LEAVE A COUPLE OF MINUTES' SPACING FOR THE SAFETY OF EACH AIRCRAFT AND FOR BACKTRACKING PURPOSES". The leader responded that "WITH EIGHT AIRCRAFT THIS COULD BE A LOT OF TIME AND WE HAVE A NUMBER OF AIRCRAFT WITH LOW FUEL. THIS IS NOT A GOOD SAFETY CONSIDERATION". The FISO asked for the leader to arrange to send the low-fuel aircraft ahead and for each pilot to call when on right base leg. The pilot of the aircraft which was number four in the formation transmitted that he could speak English and the FISO asked him to report when on right base leg.

The pilot of D-ETDK saw some of the aircraft ahead begin to fly “unusual” ground tracks to increase the separation between them before landing. The aircraft immediately ahead of his flew a 360° turn for spacing and the pilot of D-ETDK turned to track approximately 050°M and slowed his aircraft to create his own spacing from the rest of the formation (Figure 2). He flew along the north-western edge of a small inlet, parallel to a ridge which lay upwind to the southeast of him, and, as he reached the end of the inlet, he encountered turbulence and lost control of the aircraft. Aware that his aircraft was descending rapidly at low level, the pilot activated the aircraft’s BRS at what he estimated to be between 600 and 700 ft amsl and the aircraft struck the ground shortly afterwards. The pilot and passenger were seriously injured.

The pilot did not make an emergency transmission on the radio and the remaining members of the formation were unaware that he had crashed.

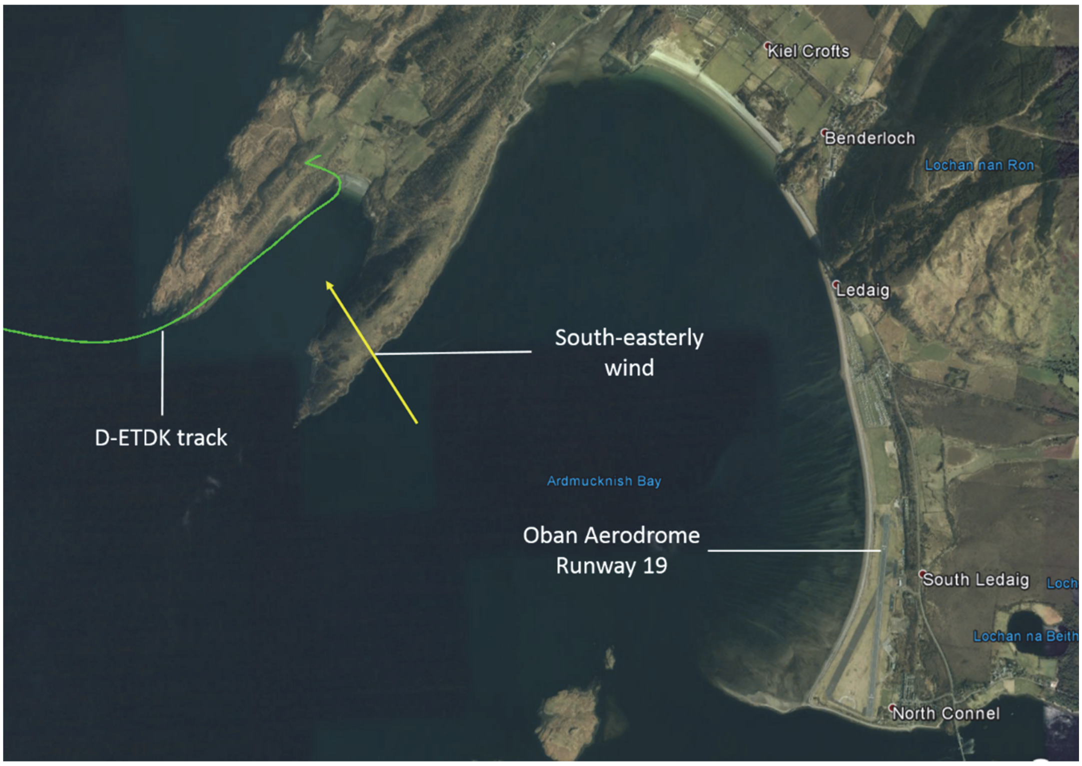

Figure 2

Final portion of the D-ETDK recorded track

The first three aircraft in the formation landed in order and vacated the runway at Taxiway B but the third did not vacate in time for the fourth to land and so the fourth went around. While the remaining aircraft were landing, radio communication between the FISO and aircraft included the following exchanges:

- FISO: "[callsign romeo] on final, just be aware we've got one aircraft on, i'm just getting him to backtrack. [callsign zulu], one eighty backtrack vacate charlie, caution one on finals".
- [Callsign Alpha]: "[callsign alpha] right base for runway one nine".
- FISO: "[callsign alpha], roger, that's copied, just be aware we do have now two aircraft on the runway, so the runway is occupied, you need to let each aircraft backtrack".
- [Callsign Alpha]: "ok, i watch out for the backtracking airplane and the one just landed if it could maintain to pass to the end of the runway".
- FISO: "[callsign alpha], there's limited space at the end of the runway as you've been informed we would have liked spacing for the safety of landings".

[Callsign Alpha] went around after which the FISO asked its pilot to inform the two aircraft at the south end of the runway that they should turn around, backtrack and vacate the runway at Taxiway C. The pilot passed on the instruction in German and then reported to the FISO that the pilots of the two aircraft would comply. After the last aircraft landed, the FISO asked the pilot whether he knew the location of the eighth aircraft (D-ETDK) but the pilot said he did not.

Further information about the flight

Before departure on the day of the accident, the formation leader telephoned Oban Airport's administrator and said that eight aircraft would be landing there to refuel. The airport administrator explained that the aircraft should be separated by five minutes on arrival because formation landings were not permitted at Oban Airport. The pilot of D-ETDK stated subsequently that members of the formation understood that the five-minute separation applied to takeoffs from Oban. "If we [had] understood 'for landing' we would have departed [Glenforsa Airfield] with five minutes separation."

One of the Breezer pilots reported that "there was nothing on the weather forecast to predict severe turbulence. I didn't experience any and neither did numbers five and six. The other aircraft did". Another Breezer pilot reported that his head hit the roof during the turbulence which he described as "remarkable". One pilot warned the others on the radio about strong winds and turbulence over Lismore Island (approximately 2.5 nm west of the accident site). Most pilots in the formation reported severe turbulence on final approach to land.

When interviewed after the flight, one of the Breezer pilots considered that "Oban has a unique management system. The tower's expectation of arriving aircraft is different from what a pilot would consider to be practical. We normally come in one after the other. Oban has a long runway and we only use a fraction of it and we can get a lot of planes on the ground rather than 'by-the-book' separation. Sometimes we come in three at the same time". After landing, the formation's pilots planned to re-group their aircraft in a holding area at the end of the runway before taxiing to the parking area together.

The FISO stated that only one aircraft is allowed on the runway at a time, and aircraft landing on Runway 19 often pass Taxiway Charlie before slowing to taxiing speed and have to backtrack before vacating the runway. He understood that the formation leader had been told on the telephone that the aircraft should arrive with sufficient spacing such that each landing aircraft had time to vacate the runway before the following aircraft touched down. He became concerned when two aircraft on short final were very close together causing one of the pilots to go around at a "very late stage". Only three of the seven pilots spoke to him on the radio and, at one point, he was unable to prevent there being two aircraft on the runway at the same time.

A locally-based pilot airborne at the time of the accident reported that conditions were "very choppy" below 2,000 ft and turbulence in the circuit area was "really horrible". He also said that, in a south-easterly wind, there is typically rotor turbulence to the leeward side of the ridge situated near to and upwind of the accident site.

Accident site

D-ETDK struck the ground in an area of grassland adjacent to woods, on the headland to the northeast of Ardmucknish Bay, opposite Oban Airport (Figure 2). The initial impact created ground marks and removed sections of grass. A second large ground mark, preceded by several 'slash' marks, contained sections of broken propeller blades and parts of the engine cowl. Further sections of propeller blade were found some 20 m away. A wreckage trail of small structural items then extended on a bearing of approximately 324° toward the wreckage of the fuselage. The grass along the wreckage trail had been flattened and further ground marks where the grass had been removed were visible at various points. The fuselage was resting inverted, with the nose of the aircraft pointing back along the wreckage trail, but offset by some 40°. The ballistic recovery parachute was still attached to the aircraft and extended out in a direction of approximately 285°.

Aircraft information

The Breezer B600E is a general aviation aircraft certified with a restricted EASA Type Certificate under Certification Specifications for Light Sport Aeroplanes (CS-LSA). The aircraft is a conventional low wing, aluminium structure design with two seats, a traditional cruciform empennage and fixed tricycle landing gear. It is powered by a geared Rotax 912 engine and composite three blade propeller.

Aircraft examination

The nose section of the aircraft was badly damaged, the cowlings were broken off and the engine had almost completely detached from the firewall. The left wing had twisted vertically and bent backwards along the fuselage, with the left horizontal tailplane also bent vertically upwards. A large clump of grass was attached to the rear of the tail skid. The aircraft canopy had detached, and the cockpit area and instrument panel were significantly disrupted. The fuel tank had become detached and contained a small amount of fuel. The flaps on the intact right wing were extended to 15°. The ignition switch was selected to BOTH and the aircraft master switch was still in the ON position.

The BRS parachute was undamaged and its harness was attached to the aircraft at the four attachment points. The slip ring on the parachute suspension lines was in the fully deployed position.

Recorded information

General information

The aircraft was fitted with two digital displays, each of which recorded a number of flight parameters and the data was successfully downloaded. This data was not subject to the rigours that accompany a Flight Data Recorder but the aircraft manufacturer advised that, during the aircraft's development, the data recorded in these displays showed a good correlation to independent flight test instrumentation.

Included in the list of parameters recorded were: pressure altitude, fuel quantity in USG and alert information provided to the pilot on the display. Angle of attack, BRS parameters, control surface, control column and flap positions were not recorded.

Pressure altitude was recorded, based on a standard pressure setting of 1013 hPa. The 0920 METAR report from Oban was 1007 hPa so pressure altitudes in this report have been corrected, using 27 ft per hPa, to 1007 hPa by removing 162 ft from the recorded value. The recorded pressure setting recovered from the digital displays was 30.04 in Hg (1017 hPa) and, as a consequence, the pressure altitude on the pilot's display would have been over reading by 270 ft.

Accident flight recorded data

The data shows the aircraft took off with a recorded fuel quantity of 3.7 USG (14 litres) and climbed to the maximum recorded altitude for the flight of 1,325 ft amsl. Just over nine minutes later, a fuel MAIN LEVEL LOW alert was recorded, signifying that the fuel quantity had dropped below 12 litres.

At 0931:37 hrs the aircraft turned to track approximately 050°M. During this turn the engine rpm was reduced to 4,100 rpm[1], the aircraft began descending from 1,000 ft amsl and the speed reduced from 75 KIAS. One minute later, the engine rpm had increased to 5,200 rpm and the aircraft levelled at 700 ft amsl with airspeed fluctuating around 55 KIAS. The recorded wind[2] was 16 kt from 137° and 2 USG (7.5 litres) of fuel remained.

Over the next nine seconds, the airspeed fluctuated, reaching up to 58 KIAS but eventually reducing to 47 KIAS. At this point the aircraft's vertical speed and airspeed increased, while the engine rpm and pitch attitude remained constant. This is indicative of turbulent conditions including an updraught, which can have the effect of increasing the angle of attack.

Footnote

1 Maximum recorded rpm on takeoff was 5,750 rpm.
2 Wind speed and direction is that calculated by the on-board avionics which is recorded every two seconds.

One second later, at 0932:44 hrs, the aircraft rolled to the right by 9° and the airspeed began to reduce to 32 KIAS as the aircraft pitched up to 12.7°. The airspeed then increased to a maximum of 45 KIAS over the next few seconds.

Based on an assessment of the recorded data, the likely time of activation of the BRS was at 0932:51 hrs, with the aircraft at 770 ft amsl, an airspeed of 45 KIAS and the engine operating at 4,945 rpm. Airspeed then rapidly decreased and just over four seconds later a peak in the normal acceleration was recorded. The aircraft manufacturer stated that it takes approximately four seconds for the parachute to deploy. Engine rpm remained constant until the end of the recording.

Valid data ceased to be recorded approximately 10 seconds after the activation of the BRS and, with an accident site elevation of 70 ft, this suggests an average rate of descent of 4,200 ft/min.

Weather conditions

The forecast for Oban Airport, valid between 0900 and 1700 hrs on the day of the accident, was wind from 100° at 8 kt, more than 10 km visibility, and FEW clouds at 3,000 ft agl. The actual wind reported at 0920 hrs was from 130° at 19 kt.

The Met Office produced a report into the weather conditions that existed near Oban on the day of the accident. The surface pressure pattern suggested that the wind at 2,000 ft amsl was from the southeast at 20 kt. Information from the relevant radiosonde[3] ascent suggested that the air mass was slightly unstable and not conducive to the development of mountain waves. Mountain waves were not in the forecast valid at the time of the flight, and the satellite image valid at time of the accident showed no evidence of mountain wave activity in the vicinity.

Pilot's Operating Handbook

The Breezer Pilot's Operating Handbook (POH) contains the following statement in the introduction:

> *'…this aircraft possesses characteristics that are unique to light sport type aircraft. These characteristics include low inertia, [and] susceptibility to turbulence and wind gradient[4]'*

Footnote

[3] Radiosonde: Instrumentation for the measurement of atmospheric data, usually temperature, pressure and humidity, carried aloft by balloon, together with electronics for transmitting the data to a ground station.

[4] Gradient in this sense means the rate of change of wind speed and/or direction, either of which can suddenly affect the headwind experienced by the aircraft and, therefore, its indicated airspeed.

Section 2.6 of the POH, *Operating weights and loading,* includes the following limits (which are also on placards in the aircraft):

a. Maximum takeoff mass (MTOM): 600 kg

b. Maximum loading mass – baggage: 15 kg

Section 2.7 of the POH, *Structure and systems description*, contains the following caution:

> *'- Do not load more than 15 kg (33 lbs) into the baggage compartment. Before loading, check that the mass and balance values are within the limitations…*
>
> *It is important to place the baggage close behind the seats because of the W & B moment.'*

Section 7.12, Information on stalls, spins and any other useful pilot information, states:

> *'A stall during level flight with flaps retracted is preceded by slight buffeting. Usually the aircraft will pitch down; in gusty weather it may have a tendency to drop one wing. The wing can be easily brought back into the horizontal position using the rudder'*

and:

> *'Stall characteristics with flaps extended are exactly the same as those with flaps retracted and may be described as docile'*

and:

> *'Due to excellent slow flight characteristics of the Breezer, inadvertent spins are extremely unlikely to occur … as long as aircraft speed does not fall below stalling speed.'*

Aerodynamic stall

Aerodynamic stall is a condition leading to a loss of lift when the airflow over a conventional wing detaches and becomes turbulent. It occurs when the wing exceeds a given angle of attack (the angle between the relative airflow and the chord line of the wing[5]). The published stall conditions are normally defined with respect to airspeed because this is a parameter which is displayed to the pilot, but it is the angle of attack which predominantly defines when the wing will stall. In most flight conditions, angle of attack and airspeed are closely related, but there are conditions when the aircraft may stall at speeds above the published stall speed, such as when flying in turbulent updraught conditions and/or when the aircraft is overweight.

Footnote

[5] Chord line: a straight line joining the leading and trailing edges of an aerofoil.

Nominal stall recovery technique is to lower the aircraft's nose to reduce the angle of attack and increase airspeed, before applying power to minimise the altitude loss. Any correction in roll attitude during the recovery is normally achieved using the rudder pedals while avoiding aileron use.

Aircraft weight and balance

Breezer POH

Section 4 of the POH states that the acceptable operating CG range for the aircraft is from 258 mm to 448 mm aft of datum[6] (19% to 33% MAC[7]). The following warnings are stated:

> *'If the MTOM is exceeded, the Breezer aircraft will be overloaded. This in turn will lead to deterioration in flight characteristics and performance;'*

and:

> *'Exceeding the centre of gravity limits will detrimentally affect the controllability and stability of the aircraft.'*

Project Breezer B600 – Flight Test Report

The manufacturer produced a report in June 2015 which summarised the results of post-certification flight testing of Breezer aircraft. Although the testing led to a revised Type Certificate for later Breezer aircraft, it did not lead to amendments to the published POH for D-ETDK. However, because the additional testing determined stalling speeds more precisely than the original certification testing, the new speeds were used to assess the performance of D-ETDK on the day of the accident (power-off at MTOM):

a. Flaps up, V_{S1} = 63 km/h (34 kt)

b. Flaps 25°, V_{S0} = 59 km/h (32 kt).

The manufacturer also provided amended moment arms for the fuel tank and pilots' seats which are included in the following weight and balance calculation.

Weight and balance calculation

The pilot provided the following information concerning the aircraft at takeoff:

a. Aircraft mass (empty): 385 kg

b. Occupants: Pilot 100 kg; Passenger 65 kg

Footnote

6 The reference datum for CG calculations is the wing leading edge.
7 MAC: Mean Aerodynamic Chord.

Several large bags and camping equipment were stowed in the luggage area behind the two seats, filling most of the baggage compartment. The pilot stated that the baggage weight "had been in the area of 28-30 kg". The baggage recovered from the wreckage was weighed by the AAIB one week after the accident (which gave time for it to dry out) and found to be 50 kg. Whilst there may have been some residual moisture remaining, this is unlikely to have accounted for a 20 kg discrepancy.

There was approximately 7.5 litres (5.4 kg[8]) of fuel on board the aircraft at the time of the accident.

Table 1 shows the calculation of aircraft mass and CG at the time of the accident using the POH, information provided by the manufacturer following the Project Breezer Flight Test Report, and a baggage mass of 30 kg (Table 1). The calculations place the CG at 442 mm aft of the datum (ie 6 mm ahead of the CG aft limit).

	Mass Kg	**Moment arm (mm)**	**Kg.mm**
Empty mass	385	278	107,030
Pilot	100	687	*68,700*
Pax	65	687	*44,655*
Fuel	5.4	-215	*-1,161*
Baggage	30	1,310	39,300
Total	***585.4***	***442***	***258,524***
Maximum	*600*	*448*	

Table 1

Aircraft mass and location of the CG at the time of the accident (30 kg baggage)

Note: As the baggage was distributed throughout the baggage compartment, the actual moment arm for the baggage is likely to have been greater than 1,310 mm. The effect of this would be to move the CG further aft.

Footnote

[8] A specific gravity of 0.72 kg/l was used for MOGAS.

The Rules of the Air Regulations 2015

General rules concerning landing and takeoff are contained in CAP 393 Section 2, *Rules of the Air Regulations 2015*. Rule10 states:

> *'(1) Subject to paragraph (4), a flying machine or glider must not land on a runway at an aerodrome if there are other aircraft on the runway'*

and:

> *'(4) Paragraph (1) … [does] not apply if the air traffic control unit at the aerodrome otherwise authorises the flying machine.'*

Oban Airport does not have an air traffic control unit.

CAP 797, *Flight Information Service Officer Manual*

Oban Airport offers a Flight Information Service (FIS) and CAP 797 contains instructions and guidance for Aerodrome FISOs providing a FIS. CAP 797 states in the Introduction:

> *'Nothing in this manual prevents FISOs from using their own discretion and initiative in response to unusual circumstances.'*

The following extracts from CAP 797 Section 1 are relevant:

> *'1.2 FISOs are not permitted to issue instructions except* [to aircraft on the ground] *or when relaying a clearance from an air traffic control unit'*

and:

> *'8.89 To facilitate the integration of arriving aircraft with existing circuit traffic … a FISO may provide advice on the published aerodrome joining procedure and/or a suggested course of action to the traffic situation'*

and:

> *'8.92 Pilots shall not land if there are other aircraft on the runway. FISOs shall provide relevant information on local traffic and aerodrome conditions to assist the pilot in deciding whether to land or go around'*

and:

> *'8.93 A landing aircraft shall not be informed 'land at your discretion' until the runway is unobstructed'*

and:

> *'8.99 Individual elements of a formation may be informed that they may land at their discretion, before the preceding element has reached the runway. The formation elements are responsible for their own separation on final but shall not land whilst the runway is occupied unless they have an exemption against the requirement.'*

Aircraft longitudinal stability with an aft Centre of Gravity

CAA Safety Sense Leaflet 9, *Weight and Balance,* explains that forward and aft CG limits, established as part of the aircraft certification process, define the range of CG positions within which longitudinal stability requirements can be met. The leaflet states that:

> *'Exceeding the aft CG usually results in … longitudinal instability, particularly in turbulence, with the possibility of reversal of control forces [and] degraded stall qualities to an unknown degree.'*

A small displacement in pitch changes the angle of attack of the wing and tailplane but, for positive static stability, the effect of the subsequent forces, and their resultant moment about the CG (the restoring moment), should be to return the aircraft towards its pre-displacement equilibrium state. Forward movement of the CG increases this positive stability, whereas aft movement of the CG reduces it. As the CG is moved further aft, it will eventually reach a position (the neutral point) where the restoring moment is zero and the aircraft is neutrally stable. The aft limit for the CG in the POH is set forward of the neutral point but, if loading limits are exceeded, it is possible to have the CG position on, or aft of, the neutral point. For a given elevator deflection there will be a small response in an aircraft with a forward CG (stable condition) and a large response in an aircraft with an aft CG (less stable condition).

Longitudinal dynamic stability affects the longer-term manner in which an aircraft behaves following a displacement in pitch. A CG outside the aft limit adversely affects longitudinal dynamic stability by reducing the tendency of the aircraft to return towards the equilibrium point following each oscillation through it.

Ballistic Recovery System (BRS)

General information

The aircraft was fitted with a BRS-6™ Emergency Parachute System manufactured by BRS™. This system consists of a parachute, packed into a soft case and an explosive rocket deployment system, triggered by pulling a handle in the cockpit. When the system is activated, a rocket motor ignites and accelerates the rocket from its firing tube located under the nose cowl. The rocket body is attached to the parachute which deploys from its case. A slip ring, located on the suspension lines of the parachute, controls the rate at which the parachute opens relative to the aircraft's forward airspeed. This reduces the shock load as the aircraft begins to decelerate. The aircraft is initially pitched nose-up to assist in the reduction in forward speed, before stabilising in a predominantly level attitude once established under the parachute. The manufacturer quotes a descent rate, with a fully deployed parachute, of between 20 and 25 fps, resulting in a (vertical) touchdown speed of 17 to 20 mph. The manufacturer's manual includes a caution that following the deployment of the parachute a period of instability occurs, where the aircraft swings like a pendulum. Whilst this is normally damped out relatively quickly, if the parachute is deployed at low level, the aircraft may still be oscillating as it reaches the ground. This can result in an impact in an unusual attitude, increasing the risk of injury to the occupants.

The attitude and speed data recovered from the accident aircraft indicated that the pilot activated the BRS at approximately 770 ft amsl. Although the BRS functioned correctly, the aircraft did not achieve a stabilised descent before contacting the ground.

Limitations

The following information was taken from the *Owner's Manual and General Installation Guide for BRS-6™ Emergency Parachute Recovery Systems.*

The ballistic recovery system fitted to the accident aircraft was a BRS-6-1350. This has a gross maximum aircraft deployment weight of 612 kg, not including the parachute system, which weighs 13.2 kg. The procedure for deploying the parachute advises the pilot to shut the engine down prior to activation. This increases safety by stopping the rotation of the propeller blades, isolating the fuel supply and ensuring that the reduction in forward speed caused by the parachute is achieved as efficiently, and therefore as rapidly, as possible.

The following conditions (among others) aid rapid deployment of a correctly fitted BRS: aircraft surfaces intact; 'generous' forward speed; level flight; engine shutdown; and deployment handle operated quickly. The manual states that:

> *'If the situation is optimal, theoretical projections show deployment can be rapid enough to save the craft and occupant(s) from extremely low altitudes'*

and:

> *'When you use an emergency parachute system, you have entered a realm of flight where the unpredictable is the norm.'*

Commission Regulation (EU) No 1178/2011, *Part Flight Crew Licensing (FCL)*

Paragraph FCL.055 to Part FCL, Subpart A, *General Requirements,* gives details of language proficiency requirements for pilots. Pilots are required to have a language proficiency endorsement on their licence in either English or the language used for radio communications involved in the flight. Pilots must demonstrate at least an 'Operational Level'[9] of language proficiency which includes the ability to "*communicate effectively in voice-only … situations".*

Footnote

[9] Operational Level means ICAO Level 4.

Analysis

Aircraft technical condition

Neither data downloaded from aircraft avionics, nor engineering examination revealed any evidence that a technical fault with the aircraft contributed to this accident.

Turbulence

The Met Office report stated that mountain waves were not forecast for the area of the accident, and there was no evidence that they had actually occurred. It was evident from the turbulence experienced by pilots in the circuit, however, that the wind was strong enough to generate turbulence downwind of hilly terrain. A locally based pilot reported that a south-easterly wind often caused turbulence to the lee of the ridge near to, and upwind of the accident site. Recorded data showed that the aircraft experienced an increase in airspeed and vertical speed which was not accounted for by a change in engine power or pitch attitude, but which could be explained by an updraught.

It was concluded that the aircraft was struck by an updraught in turbulence caused by the south-easterly wind flowing over the ridge upwind of the accident site.

Aircraft reaction to the turbulence

The data showed that the aircraft was flying below 50 kt in the two seconds prior to the updraught and evidence from the accident site showed that the flaps were extended to 15°. By interpolation, the power-off stall speed with flaps extended to 15° would have been approximately 33 kt[10], although the actual stall speed might have been marginally lower because the engine was producing more than idle power.

The POH stated that the aircraft is susceptible to turbulence and wind gradient because of its low inertia. It also warned that overloading the aircraft would lead to a deterioration in flight characteristics and performance, and exceeding the CG limits would detrimentally affect controllability and stability.

The actual location of the aircraft CG at the time of the accident was not determined precisely, but using the 30 kg baggage weight provided by the pilot gave a CG position of 442 mm aft of datum, where the limit given in the POH is 448 mm. The AAIB recorded a baggage weight of 50 kg, with the baggage in a slightly damp condition. The moisture is unlikely to have accounted for a 20 kg discrepancy in the weight and so it is probable that baggage weight was in excess of 30 kg. In addition, the distribution of the baggage within the baggage compartment was likely to have moved the CG further aft than the weight and balance calculation suggested. It was considered that this probably placed the aircraft's CG aft of the limit as it approached the updraught and the aircraft's handling qualities might have been compromised.

Footnote

[10] Stalling speeds: flaps up = 34 kt; flaps 25° = 32 kt.

The updraught would have increased the wing's angle of attack by adding a vertical component to the relative airflow and it was concluded that the increase was sufficient to cause the wing to reach or exceed its stalling angle of attack. Recorded data showed that, following this updraught, the aircraft pitched nose-up, dropped a wing and the airspeed reduced to 32 KIAS. There appeared to be no stall recovery action taken because no significant increase in engine power was observed in the data and there was no nose-down attitude change. Had the aircraft CG been located behind the aft limit, however, this might have compromised the effectiveness of any nose-down control input.

Survivability

The BRS owner's manual states that, in optimal conditions, successful deployment of the BRS should be possible from '*extremely'* low altitudes. Optimal deployment conditions include '*generous'* forward speed, level flight, engine shutdown, and deployment handle operated quickly. In this accident, only the last condition was met and, from the evidence available, it appeared likely that the BRS was deployed in circumstances that did not allow enough time for the aircraft to stabilise beneath the parachute before striking the ground. This resulted in extensive damage to the aircraft and the serious injuries sustained by the pilot and passenger.

Planning for the flight

During a telephone briefing before the flight, the leader of the formation was advised that the aircraft should arrive at Oban Airport separated by five minutes to enable each landing aircraft to vacate the runway before the following aircraft touched down. The pilots, however, did not appreciate that the requested separation was to satisfy a mandatory runway occupancy requirement on landing; they believed, incorrectly, that the separation applied to their subsequent departure. Consequently, they did not change their plan, which was to remain closely-spaced as one speaking unit and ask to land sequentially and re-group at the upwind end of the runway.

The leader reported to the FISO that some pilots had "language differences", and the FISO was only able to make radio contact with three of the seven pilots who landed. It is therefore likely that some of the remaining four pilots did not understand fully what was being said on the radio, and that the wish to help those pilots contributed to the original decision to remain as one speaking unit.

The plan to land sequentially and re-group at the end of the runway reflected what the formation normally did. This, along with pilot language difficulties and concern about fuel, probably contributed to the leader's reluctance to change a plan which was incompatible with landing requirements at Oban, and led to there being more than one aircraft on the runway at one point in time.

Conclusion

It was concluded that D-ETDK stalled and departed from controlled flight after encountering an updraught due to wind flowing over a ridge. The stall and subsequent loss of control were made more likely by the fact that:

a. The aircraft is of a type susceptible to turbulence and wind gradient because of its low inertia.

b. The aircraft's CG was probably behind the aft limit.

c. The aircraft's speed had been reduced to maintain separation from other aircraft joining the circuit.

The pilots departed for Oban Airport with the intention of remaining in a closely-spaced formation, landing sequentially and re-grouping at the end of the runway before taxiing together to the parking area. Their plan, formed on the ground after misunderstanding a telephone briefing, was incompatible with landing requirements at Oban but their options to re-plan while airborne were compromised by language difficulties and a concern that some aircraft were short of fuel.