AAIB
Air Accidents Investigation Branch

AAIB Bulletin 1/2017

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01252 512299

Air Accidents Investigation Branch
Farnborough House
Berkshire Copse Road
Aldershot
Hants GU11 2HH

Tel: 01252 510300
Fax: 01252 376999
Press enquiries: 0207 944 3118/4292
http://www.aaib.gov.uk

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A Field Investigation is an independent investigation in which AAIB investigators collect, record and analyse evidence.

The process may include, attending the scene of the accident or serious incident; interviewing witnesses; reviewing documents, procedures and practices; examining aircraft wreckage or components; and analysing recorded data.

The investigation, which can take a number of months to complete, will conclude with a published report.

SERIOUS INCIDENT

Aircraft Type and Registration:	Airbus A319-111, G-EZFJ
No & Type of Engines:	2 CFM CFM56-5B5/3 turbofan engines
Year of Manufacture:	2009 (Serial no: 4040)
Date & Time (UTC):	14 April 2016 at 0847 hrs
Location:	Malaga Airport, Spain
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 6 Passengers - 157
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	21,000 hours (of which 4,000 were on type) Last 90 days - 200 hours Last 28 days - 78 hours
Information Source:	AAIB Field Investigation

Synopsis

While calculating takeoff performance data, the flight crew elected to use the Multiple Runway Computation (MRC) function on their Electronic Flight Bag (EFB). Due to a software anomaly in the EFB, runway information for Runway 31 was displayed alongside takeoff performance data for Runway 13. The flight crew did not notice this during cross-checking and subsequently took off from Runway 31 using takeoff performance figures for Runway 13.

The manufacturer (of both the aircraft and the EFB), operator and flight crew were unaware of this anomaly at the time of the serious incident. The operator has since disabled this function in the EFB and the manufacturer has communicated this anomaly to all affected operators of this version of the EFB.

History of the flight

The aircraft was on scheduled flight from Malaga Airport, Spain to Liverpool International Airport. The flight crew consisted of the commander who was a Line Training Captain and a co-pilot who was under training. At the time, Runway 31 was in use and the wind was from 300° varying between 270° and 340° at 5 kt. The commander was the Pilot Flying (PF) and the co-pilot the Pilot Monitoring (PM) for the sector.

While calculating the takeoff performance figures using the Electronic Flight Bag (EFB), the co-pilot asked the commander if he could use the Multiple Runway Computation

(MRC) function in case the departure runway changed to Runway 13. Although it is not part of the line training syllabus, and as it was a training flight, the commander felt it would be beneficial for the co-pilot to look at this function. The operator's SOPs allow either the single runway calculation or MRC to be used, with the choice given to the crew.

After the performance figures had been calculated by the co-pilot, the commander cross-checked the 'Critical Data Entry' as PF in accordance with the operator's SOPs. He checked the aircraft configuration and that Runway 31 was displayed in the drop-down box on the top right of the EFB page. He also checked that the runway length was correct[1]; the takeoff speeds displayed on the EFB were then entered in the Flight Management Guidance Computer (FMGC). While he recognised the speeds were lower than his previous experience and the thrust reduction altitude was lower, he accepted the figures. He did this as he assumed that the operator had changed some of the aircraft's performance algorithms, as part of a number of other recent operational changes, which may not have been publicised to flight crew at the time. The subsequent takeoff was normal.

In the cruise, as a result of the commander's pre-takeoff observation regarding the speeds, he decided to check the calculations. He checked the co-pilot's EFB and noticed that with MRC selected, although Runway 31 was displayed with correct runway length and the correct engine out procedure, the takeoff performance figures displayed on the same screen were for Runway 13. The Runway 13 selection was in a small drop-down menu on the screen in a different place to where the runway was normally verified. He believes this was not noticed due to the subtle icon selection, the small text size and because the runway selection was normally verified in a different location on the screen. To help him to explain this upon his return he took photographs of the EFB screen (Figure 3).

Commander's comments

The commander commented that at a previous airline, takeoff performance figures were calculated with reference to paper documents. During the pre-flight preparation the crew could choose either normal speeds or "improved climb" speeds. He recognised that the EFB calculated speeds for Runway 31 would normally generate "improved climb" speeds but on this occasion the speeds seemed to be standard, ie lower. He added that he did not normally use the MRC function on the EFB.

Footnote

1 Runway 31 and 13 have identical lengths.

Operator's manual

The operator's Operations Manual Part B (OMB) contains the following:

> '**"CRITICAL DATA ENTRY"** **ANNOUNCE**
>
> *This announcement is made to ensure that both crew members understand that if they are distracted or disturbed when entering the take-off performance, then the whole process must be commenced from this point again.*
>
> ***TAKE-OFF DATA*** ***PREPARE AND CHECK/REVISE***
>
> *When the weight & balance data have been inserted, PM performs the Computation of the take-off data.'*

and:

> *'The PF checks and verbalises the following from the EFB in the* ***FRILS*** *format:*
>
> ***Flap*** *- Check the selected Flap setting.*
>
> ***Runway*** *- Check the selected runway.*
>
> ***Intersection*** *- State the selected intersection, if applicable.*
>
> ***Length*** *- State the displayed runway or intersection length.*
>
> ***Speeds*** *- State the V-Speeds, CONF* [configuration] *& Trim setting and Flex temperature, followed by the ENG OUT ACC ALT* [engine out acceleration altitude].
>
> *The PM inserts and verifies the data in the FMGS amending the THR RED* [thrust reduction] *altitude if necessary so that it is not less than the ENG OUT ACC altitude.*
>
> *The PM then calls out the green dot speed and the PF crosschecks this against the EFB as a gross error check.*
>
> ***WARNING: If any changes to the data in the EFB are made after the above process has been completed, the entire 'critical data entry' process shall be repeated.'***

The operator introduced EFBs and their associated SOPs to their specific operation requirements in 2003, which was accepted by the CAA. The SOP which referenced cross-checking involved the use of a single EFB but with cross-checking stages introduced throughout the data entry. Since then, the aircraft manufacturer introduced recommended SOPs, which involve each flight crew performing independent calculations of the takeoff performance data which are then cross-checked. These recommended SOPs were reviewed by the operator, but they did not incorporate them into their own SOPs as they felt their procedures were already more appropriate for their own operational requirements.

Airport information

Malaga Airport is located on the Costa del Sol on Spain's south-east coast. Takeoffs from Runway 13 track out to sea initially, whereas takeoffs from Runway 31 initially track inland towards rising terrain. To ensure appropriate terrain clearance, in the event of an engine failure after V_1, the operator's engine out procedure is to initially turn right at 3.3 nm from the Malaga VOR/DME[2] and to track 138°M, while flying less than 173 KIAS, and then to track out to sea. This information is displayed on the top half of the EFB between the runway information and the takeoff performance results (Figure 3).

Table 1 shows the declared lengths of Runway 13 and 31 at Malaga Airport.

Runway designator	Takeoff Run Available (TORA)	Takeoff Distance Available (TODA)	Accelerate-Stop Distance (ASDA)
13	3,200 m	3,450 m	3,200 m
31	3,200 m	3,419 m	3,030 m

Table 1

Declared Runway 13 and 31 lengths at Malaga Airport

Electronic Flight Bag (EFB)

The operator was using a ruggedised touchscreen PC with a Windows 7 operating system and Airbus FlySmart software as an EFB. The software version was L5.0.3 which was also assigned a version number by the operator of 1507. The operator used the EFBs for a number of functions including the calculation of takeoff and landing performance data and load sheet information.

To calculate takeoff performance data, the crew enter aircraft and environmental information into the 'CONDITIONS' area and then select the runway they wish to use at the chosen airport (Figure 1). There are two options for runway selection; single and multiple. The operator indicated that most takeoff performance calculations were performed using the single runway option. The multiple runway option calculates takeoff performance data for all the selected runways to allow comparison and also a ranking of the runways in order of the highest thrust derate.

Footnote

2 The Malaga VOR/DME is located at the airport.

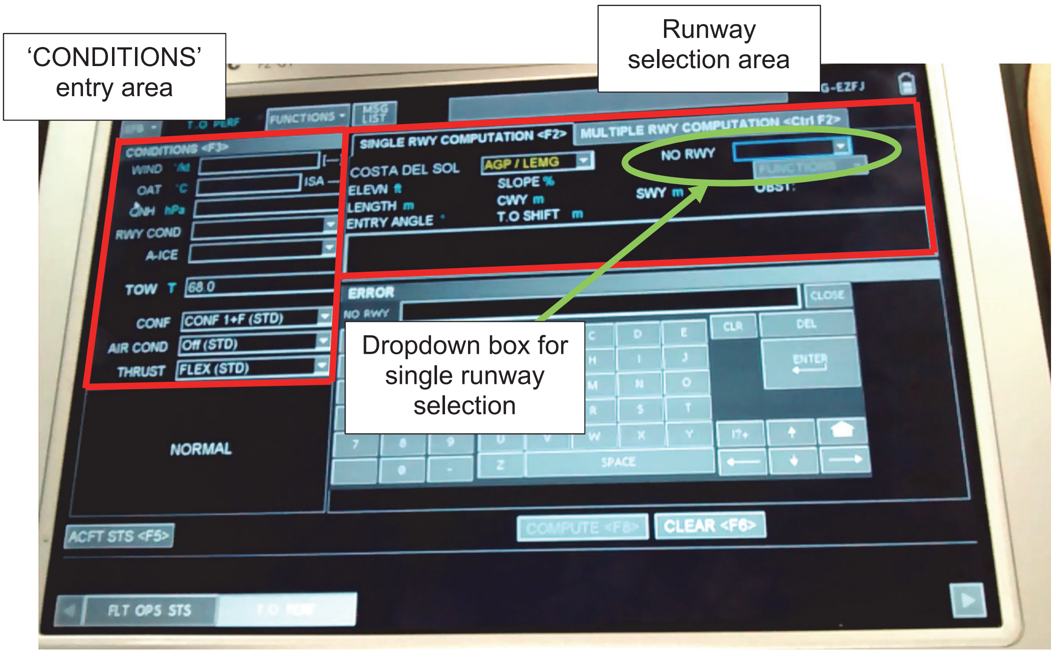


Figure 1

FlySmart takeoff performance screen

Multiple Runway Computations

For single runway computations, the runway number is selected using a single drop-down menu at the top right (Figure 1). For the Multiple Runways selection, the operator described a typical usage:

- Once the ‘CONDITIONS’ information has been entered, the ‘MULTIPLE RWY COMPUTATION’ tab is selected and a list of the available runways is presented in a table (Figure 2).

- Using a small checkbox located next to each runway, runways of interest can be selected, after which the user selects ‘COMPUTE’.

Takeoff performance data is then displayed in the ‘RESULTS’ section. The selected runway in the ‘RESULTS’ section will be that with the highest FLEX temperature for the chosen runways (Figure 2). Other chosen runways can then be selected using this drop-down menu.

At this stage, specific runway information such as length, elevation and engine-out information is not displayed. To retrieve this information, the user has to select ‘VIEW DETAILS’. The runway information will be selected but the ‘RESULTS’ screen will be obscured. The manufacturer commented that it should not be possible to display detailed runway information and the ‘RESULTS’ screen at the same time.

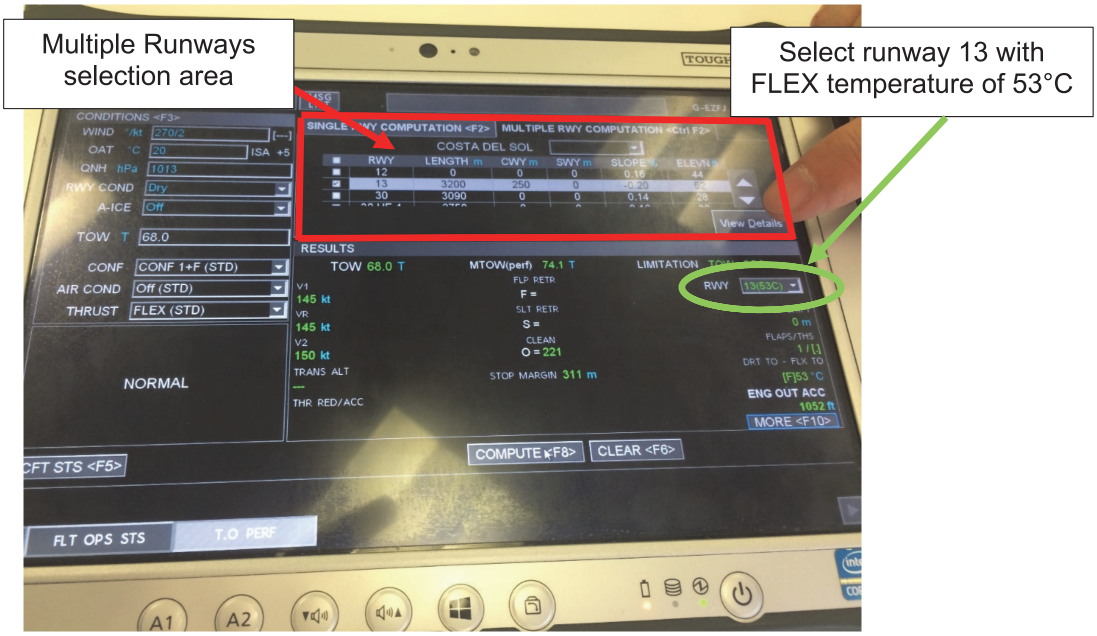


Figure 2

Results page for multiple runway computations

FlySmart anomaly during multiple runway computations

The sequence of events detailed by the flight crew suggested that the FlySmart software could display detailed information for one runway but with takeoff performance data for a different runway. Figure 3 shows a photo taken by the flight crew which confirmed this.

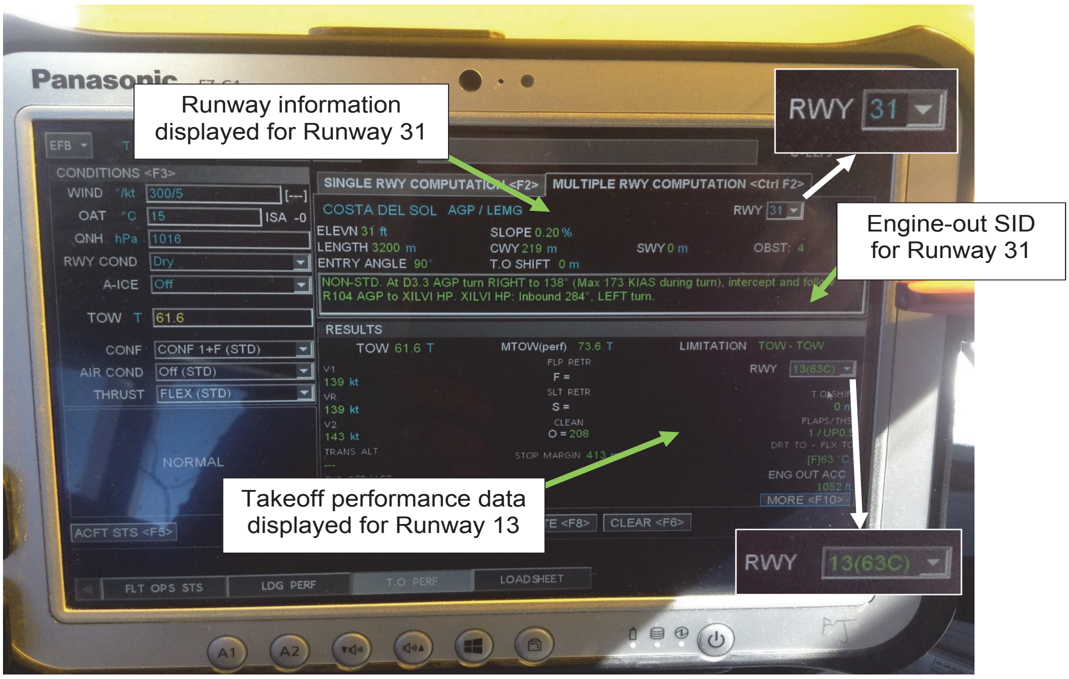


Figure 3

Photograph of EFB taken by G-EZFJ flight crew

A specific sequence of events discovered by the operator confirmed this was possible which was also reproduced by the AAIB and demonstrated to the manufacturer. This sequence of events differed from typical usage described by the operator in that, just prior to selecting 'COMPUTE', the crew switched to the load sheet screen to update it which ultimately updated the takeoff weight. Switching back to the takeoff performance screen and then selecting 'COMPUTE' allowed the display of detailed information for one runway but with takeoff performance data for a different runway to be reproduced.

EFB approval

The operator's EFB system[3] was granted approval by the CAA in 2003, based on the guidance material available at the time[4]. In 2014, the EASA published EASA AMC 20-25 *'Airworthiness and operational consideration for Electronic Flight Bags (EFBs)'* which is the most recent EU-specific guidance material. This AMC was issued to integrate TGL 36 into the structure of the Agency's rules and also to update the content. It is not currently linked to any Implementing Rule so the interpretation is open to the individual National Airworthiness Authorities (NAAs).

To enable NAAs to assess the detail of a new EFB software standard, the EASA can form an Operational Evaluation Board (OEB) to provide a consistent methodology for assessing a new EFB software standard. This is not a requirement and was not performed for this version of FlySmart. The CAA indicated that they do not have in-house experts for analysing EFB performance software but rely on operators to demonstrate the software suitability and accuracy. Part of this is the Human-Machine Interface (HMI) assessment which is addressed in AMC 20-25. The appropriate CAA Flight Operations Inspector then assesses the individual applications to the CAA by operators to use an EFB.

When referring to the HMI assessment guidance in AMC 20-25, the CAA indicated that:

> *'clear guidance on what analysis is required is a bit of a weak point in 20-25…'*

They also indicated that they have:

> *'…asked EASA to consider expanding its guidance when the EFB rules[5] are published at the end of this year'*

The FAA and Transport Canada provide an Advisory Circular for EFBs[6] and both provide checklists for the operational approval of a new EFB. In addition to the Advisory Circular, the FAA provides the '*Electronic Flight Bag Authorization for Use*'[7] document which contains detailed criteria for assessing an operator's request to use an EFB. However, the FAA differs from the EASA in that the FAA are also responsible for operational approvals.

Footnote

[3] The term 'EFB system' refers to all parts of the EFB operation which includes risk assessments, human-machine interface, flight crew operating procedures and training, EFB administration and quality assurance.
[4] JAA Temporary Guidance Leaflet (TGL) No 36 *'Approval of Electronic Flight Bags (EFBs)*, 2004.
[5] The reference to 'EFB rules' related to a current EASA Rulemaking Task which is discussed in the 'EASA activity' section below.
[6] FAA Advisory Circular No AC 120-76C, Transport Canada Advisory Circular AC 700-020.
[7] FAA Flight Standards Information Management System (FSIMS) 8900.1 Volume 4, Chapter 15.

Previous events

In the past 12 months, the AAIB has investigated four other takeoff performance events with the operator of G-EZFJ[8], only one of which involved a software issue with FlySmart. The FlySmart software version used was the same as that in the G-EZFJ incident. That issue involved use of a 'single runway computation' where the runway number, selectable in a drop-down menu, could be inadvertently modified. In that case, the flight crew did not notice the inadvertent change during cross-checking. Following this event, the operator highlighted this issue in their operations manual and the aircraft manufacturer issued a communication to operators.

Following the above four events, the operator introduced new cross-checking SOPs using the acronym FRILS (see the '*Operator's manual'* section).

Recorded information

The operator provided data from their Quick Access Recorder (QAR) which is part of their Flight Data Monitoring (FDM) programme. This recorded a similar set of parameters to the FDR. In addition, input and calculated data from the EFBs was recorded which was downloaded by the operator and provided to the AAIB.

The downloaded EFB data revealed that prior to takeoff, performance data had been computed for both Runway 13 and 31 which is shown in Table 2. The EFB did not record which of the multiple Runways was selected in the drop-down menu.

Runway	FLEX temperature (°C)	V_1 (kt)	V_R (kt)	V_2 (kt)	Engine out Acceleration Altitude (ft)
13	63	139	139	143	1,052
31	58	156	156	160	1,666

Table 2

G-EZFJ EFB data download

Just prior to takeoff, the QAR recorded a FLEX temperature of 63°C, V_1 of 139 and V_2 of 143. After FLEX/MCT takeoff power was set, the aircraft accelerated and the sidestick was pulled back as the Computed Airspeed (CAS) increased through 146 kt. The aircraft took off and appeared to climb away normally.

Footnote

[8] G-EZAA AAIB Bulletin 5/2016, G-EZUH AAIB Bulletin 1/2016, G-EZIV AAIB Bulletin 5/2016, G-EZFP – published in this Bulletin (AAIB Bulletin 1/2017).

EASA activity

In recent years NAAs have seen an increasing demand for EFB approvals and hence an increased demand in the required approval expertise. Recognising this, the EASA initiated a research program in August 2013 entitled *'Electronic Flight Bag (EFB) - Aircraft performance calculations and mass & balance - Best practices for evaluation and use of EFB'*. Specifically, it was highlighted that *'a requirement to establish standardised evaluation processes for flight data calculation software applications has been recognised'.* The project attempted to review NAA approval procedures with a view to select the best available evaluation practices. The final report was issued in October 2015[9] which stated that this was not feasible but, using the information gathered, guidance for EFB operational approval was provided. There were also a number of recommendations directed at NAAs and the EASA.

EASA currently have a Rulemaking Task (RMT)[10] which is studying the latest ICAO Standards and Recommended Practices (SARPS) and also possible updates to AMC 20-25. Part of this RMT will be transposing the operational provisions in AMC 20-25 into new Air OPS EFB implementing rules.

Analysis

Flight crew actions

The crew appeared to have conducted the initial flight preparation, with the relevant cross-checking of the performance figures on the EFB, in accordance with the operator's SOPs. While the MRC function is not in the line training syllabus, it was not unreasonable for the co-pilot to request to use it.

When it came to the checking of the Critical Data Entry, while RWY 31 was checked in the drop-down box in the top right of the EFB, along with the runway length and aircraft configuration, it was not noticed that RWY 13 was present in the drop-down box in the 'RESULTS' section further down the page.

As most of the takeoff performance calculations were usually performed using the single runway option, the crew were familiar with verifying the selected runway only in one place; at the top right of the screen. Therefore, with a particular runway selected at this upper position on the screen, it is possible to make the assumption that the corresponding takeoff performance figures on the 'RESULTS' page are related to that runway. However, in MRC the takeoff performance figures can in fact relate to another runway selected in the lower section of the display. In this case, owing to this configuration on the screen, the flight crew cross-checking, using a single computation on one EFB in accordance with the operator's SOPs, did not identify that incorrect performance data was being used prior to takeoff.

Footnote

9 *Best Practices for approval of Performance and MB applications on EFBs, EASA_REP_RESEA_2014_1, October 2015.*

10 EASA RMT.0601 and RMT.0602.

Operator's procedures

The aircraft manufacturer has reiterated their recommendation for both flight crew to perform duplicate takeoff performance calculations, and then cross-check the results of the independent calculations. The operator has reviewed their SOPs on several occasions and are in the process of an additional review given this event.

EFB display of conflicting takeoff information

The software manufacturer indicated that, for Multiple Runway Computations, it should not have been possible to display detailed runway information and the takeoff performance data at the same time.

EFB approval

This investigation has highlighted a second FlySmart software anomaly to feature as part of an AAIB investigation within a year. Flight crew cross-checking has always been important for the purposes of checking for erroneous inputs and reasonability of the output. Software anomalies are not always detected during testing and this investigation highlights the value of cross-checking to also identify anomalies in the software which may not have been previously detected.

The CAA expects the operator to demonstrate software suitability and accuracy according to the guidance in AMC 20-25. However, the guidance in AMC 20-25 for HMI testing is generic and there is currently no other means to capture best practices in EFB approvals, such as testing for anomalies discovered during investigations. The FAA provide the '*Electronic Flight Bag Authorization for Use*' document which contains detailed criteria for assessing an operator's request to use an EFB. The CAA have requested that EASA update the HMI guidance in AMC 20-25 as part of RMT.0601 and RMT.0602.

Safety action taken

- The operator sent an email to all pilots on 22 April 2016 highlighting this specific anomaly.
- The MRC function was disabled across the operator's fleet in May 2016.
- The operator has reviewed and proposed further modification to their SOPs.
- In the L6.x versions of FlySmart, it has been verified by the manufacturer that the MRC function is not affected by this anomaly.
- The manufacturer has sent Flysmart Communication reference X46D16018565 to operators highlighting the anomaly discovered during this investigation and recommending that the affected operators disable the MRC option.
- The manufacturer sent Flight Operations Transmission (FOT) 999.0095/16 to all operators reminding them of the manufacturer's recommended procedures for EFB use. This involves each crew member performing their own independent calculations, the results of which are then cross-checked.

Conclusion

The flight crew took off from Runway 31 using the takeoff performance data for Runway 13 at Malaga Airport. This incorrect data was provided by the EFB which contained an anomaly that allowed detailed runway information for one runway to be displayed alongside takeoff performance data for another runway. The flight crew, operator and manufacturer were unaware of the anomaly at the time of the event.

The operator has disabled the MRC function and other affected operators have since been informed of this anomaly with a recommendation to disable the MRC function. The L6.x versions of the software do not exhibit this MRC function anomaly.

SERIOUS INCIDENT

Aircraft Type and Registration:	Saab 2000, G-LGNR
No & Type of Engines:	2 Allison AE 2100A turboprop engines
Year of Manufacture:	1995 (Serial no: 2000-004)
Date & Time (UTC):	6 November 2015 at 1700 hrs
Location:	On takeoff from Manchester Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 3 Passengers - 29
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	42 years
Commander's Flying Experience:	4,200 hours (of which 420 were on type) Last 90 days - 110 hours Last 28 days - 28 hours
Information Source:	AAIB Field Investigation

Synopsis

The pilots observed that the aircraft was flying in an unusual attitude. Shortly afterwards a roll mistrim indication illuminated to indicate that there were untrimmed forces in the aileron system. The pilots disconnected the autopilot and recovered the aircraft to straight and level flight. The roll mistrim indication ceased but the EICAS indicated that both ailerons were deflected up. The pilots decided to action a checklist which involved pulling a handle to separate the left and right ailerons. They found that having pulled this handle, aircraft controllability was reduced. The aircraft landed safely from its subsequent approach.

History of the flight

The aircraft was operating a commercial air transport flight from Manchester to Inverness. It departed at 1630 hrs, and the initial part of the flight was described by the crew as uneventful. The autopilot was engaged during the climb.

The aircraft levelled at FL090 and accelerated from 180 kt to 240 kt on a radar heading and in VMC. The pilot recalled that shortly afterwards the primary flight display (PFD) indicated that the aircraft had a nose-up attitude of 7° and 10° of roll to the left, an unusual attitude for straight and level flight. He also felt that the aircraft was not in balance. The PF alerted the pilot monitoring (PM) and together they cross-checked their instruments. A yellow 'R' MISTRIM indication then illuminated on the PFD, indicating there were untrimmed forces in the aileron system.

The PF decided to disconnect the autopilot, bracing the controls for the jolt he expected when doing so with an aileron mistrim. The jolt was more pronounced than usual and he had difficulty maintaining straight and level flight, finding that the aileron controls felt "sloppy" and unresponsive. He reduced airspeed to below 200 KIAS, and the PM viewed the Flight Control System (FCS) synoptic page on the Secondary EICAS Display (SED) (Figure 1). The pilots recalled that the FCS diagram indicated both of the aircraft's ailerons were deflected upwards, with the left aileron up 8° and the right aileron up 5°, and that whilst they were looking at the display both aileron depictions briefly deflected upwards to 17°.

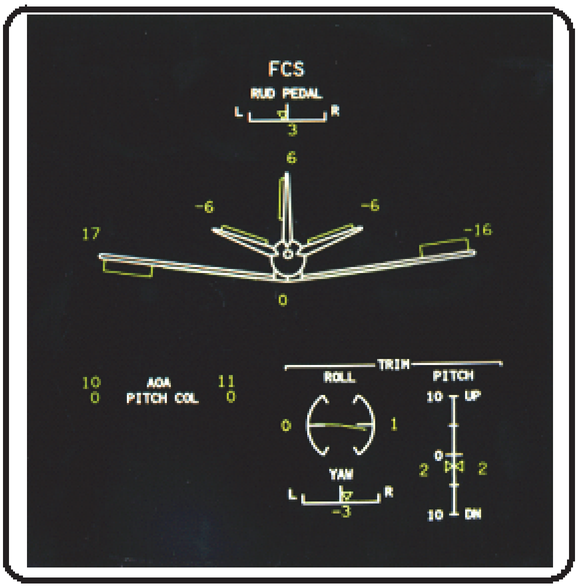


Figure 1

Example of FCS presentation on the SED Synoptic page

The pilots decided that there was a problem with the aircraft's aileron system, so the PM consulted the malfunction checklist kept in the cockpit. He read through the two aileron malfunction checklists it contained: *'Aileron system jammed'* and *'Aileron system open failure'*. Neither seemed to fit the symptoms, but the pilots remained under the impression that something was wrong with the ailerons, and as the controls were not jammed they decided to action the *'Aileron system open failure'* checklist (Figure 2). The pilots did not look outside the window to check the actual position of the ailerons, which can be seen from the cockpit if the ailerons are deflected up, and relied upon the SED synoptic page for indications of their deflection.

After pulling the ROLL handle (as directed by the checklist, to separate the left and right aileron control systems), both pilots flew the aircraft in turn to establish who had the most control. They determined that the left control wheel was more effective than the right, and so the commander remained as the PF. Initially a PAN call was transmitted to ATC but this was subsequently upgraded to a MAYDAY once it was clear that a landing would have to be made "with compromised flight controls."

SAAB 2000

MALFUNCTION CHECKLIST

AILERON SYSTEM OPEN FAILURE

*1. AUTOPILOT .... DISENGAGE
*2. Both pilots must act on the controls
*3. ROLL handle .... PULL
4. FLAPS .... UP
5. Target airspeed en route: 160 – 200 KIAS
6. DO NOT trim on failed side
7. Land at nearest suitable airport
8. LANDING TECHNIQUE .... REVIEW
 – Check controllability at safe altitude in the configuration and speed recommended below
 – Roll rate is reduced – use RUDDER to improve roll rate
 – Avoid turbulence and crosswind
 – GPWS FLAP .... OFF
9. For V_{REF} 0, see procedure ***M115***
10. End of procedure.

Land Flap	ICE ACC	M_i	M_i / W_i	LDF Flap 20
0	No	–	+W_i	1.3
	Yes	–	+W_i	1.3

Figure 2

Aileron System Open Failure Checklist

The pilots decided to return to Manchester and informed ATC that the aircraft had a reduced turning capability. The cabin crew were briefed and the PM set the navigation system for an ILS approach to Runway 23R at Manchester. Passing 4,000 ft, the PF requested the selection of Flap 15 in order to check controllability. When the flaps had extended to 7° the PF observed that the aircraft was more difficult to control, and when extended to 13° he requested they be reselected back up. The pilots then planned for a Flap 0 landing and reset the Vref of 152 kt accordingly. At approximately 200 ft agl on the approach the TAWS 'TOO LOW TERRAIN' and 'GLIDESLOPE' cautions sounded. The PF could see the runway and the PAPIs clearly, and the aircraft landed safely.

Recorded information

Incident flight

The operator provided Quick Access Recorder (QAR) flight data from the incident flight and the preceding sector. FDR data was not downloaded and by the time the event was notified to the AAIB the CVR recording had been overwritten.

The FDR and QAR record rudder pedal, trim actuator, rudder position, yaw damper and autotrim status. The position commanded by the flight control computer (FCC) is not recorded. Throughout the flight the yaw autotrim did not record any faults.

The takeoff was uneventful but, at 1,200 ft radio height as the aircraft accelerated through 150 kt, the recorded rudder trim position rapidly changed from approximately neutral to 22° right; rudder surface position remained unchanged at 2° right but both ailerons indicated a deflection of about 1.5° in a 'roll left' sense to maintain an essentially wings-level attitude. The autopilot was engaged at 1,600 ft radio height and, simultaneously, the data showed that the yaw damper disengaged. The aircraft manufacturer advised that the yaw damper is a condition for engagement of the autopilot and therefore it had remained engaged. It further advised that, in interpreting the recorded data, the yaw damper engagement status discrete parameter does not accurately reflect the actual engagement status under some circumstances. Twenty-two seconds later, the recorded rudder trim position value suddenly changed to 4° right. No changes of discrete status or warnings of autopilot roll mistrim, yaw autotrim, rudder or rudder control were recorded at this or any other point during the incident flight.

For the next four minutes, apart from during two heading changes, both ailerons showed 'roll left' deflections of about 2° from neutral and the rudder trim values constantly varied in the range 6° right to 22° right. The deflected ailerons, together with a relatively constant 0.05g lateral acceleration and a slight negative (left wing low) roll attitude, indicate that the aircraft was flying out of balance during this time. Pitch attitude varied between 4° and 6° nose-up.

The aircraft levelled at FL090 and accelerated to 245 kt; aileron deflection increased to 3° from neutral and lateral acceleration increased to 0.1g. As this change occurred, an aileron mistrim annunciation was recorded for ten seconds. At the end of this warning the autopilot disengaged and remained so for the rest of the flight[1]. The aircraft's roll attitude changed from -5° to wings level in just over a second but the aileron deflections and lateral acceleration imbalances remained; rudder trim position indicated 12° right at this point but very slowly trended towards being neutral.

Half a minute later, there was a marked 'jolt' observed in the lateral acceleration recording and, over the next 15 seconds, both ailerons progressively returned to neutral, lateral acceleration returned to zero and rudder trim position changed to a new steady value of 4° left. Rudder position also changed during this time from 2° right to about 4.5° left. Still at FL090, airspeed was reduced to between 190 kt and 200 kt.

Systems description

Flight Controls

General

The SAAB 2000 aircraft has conventional mechanical systems in roll, and fly-by-wire with hydraulic servos in pitch and yaw.

Footnote

[1] The autopilot may have been either manually or automatically disengaged, the data does not include a parameter to determine the method of disengagement.

Aileron control system

In manual control the ailerons are operated by the pilot through the control wheel, which uses a system of cables and pulleys that are directly connected to the ailerons and have a range of movement from +20˚ (±0.5˚) down to -24.2˚(±0.5˚) up. In the event of a control restriction, the pilot can manually operate the aileron disconnect (ROLL handle), which separates the left and right side of the aileron system. When the system is disconnected the left control wheel will control the left aileron and the right control wheel the right aileron. The aileron position is displayed on the SED.

The aileron trim system consists of a trim tab fitted to each aileron, each of which is operated by an electrical servomotor. The pilot can adjust the trim by using a trim switch located on the centre pedestal.

When the autopilot ROLL channel is engaged, movement of the ailerons is controlled by an electrical servomotor connected to the aileron control system. Manual trim can be used to reduce loads on the autopilot servomotor. High loads are annunciated by a yellow 'R' MISTRIM indication displayed on the PFD. If the high load remains for more than 10 seconds an AP ROLL AUTO MISTRIM caution will be displayed on the Primary EICAS Display (PED).

Rudder control system

The rudder control system consists of two independent systems. Each consists of a set of rudder pedals, a Linear Voltage Differential Transformer (LVDT), a Rudder Control Unit (RCU), and a rudder hydraulic servo actuator. The rudder control system also incorporates a yaw damper function, manual and auto trim, and a pedal feel unit.

In manual control the pilot operates the rudder pedals, which causes the mechanically connected LVDT to generate an analogue signal that is detected by the RCU. The RCU then commands the servo actuator to move the rudder to the position commanded by the pedals. The position of the rudder pedals, rudder, and rudder trim actuator are all displayed on the SED.

Yaw damper

The yaw damper should always be engaged during flight. With the yaw damper engaged, the RCU obtains accelerations from other systems on the aircraft and commands the servo actuator to move the rudder to a position to compensate for uncommanded yaw inputs. The yaw damper commands will automatically be set to zero by the FCC if the pedal force is greater than the breakout force[2] (16lb) of the trim and feel unit.

Rudder trim

The rudder trim system consists of a trim actuator and a pedal force cam unit, which is connected to both sets of rudder pedals. In manual flight the rudder trim is adjusted by

Footnote

[2] The pilot can overcome the automatic trim and yaw damper by applying a force of at least 16 lbs on the rudder pedals.

a manual trim switch, located on the centre pedestal, which operates the trim actuator that moves the rudder pedals through the pedal force cam unit. The FCC provides an autotrim function, which generates commands to eliminate steady state lateral accelerations. In autotrim, the FCC sends a signal, through RCU2, to the rudder servo and the trim actuator causing the rudder and rudder pedals to move to the commanded position. If the rudder pedals are constrained from moving, then the rudder will not move to the commanded position. Disengagement of the yaw autotrim will not generate any failure or fault warnings.

The rudder autotrim function is deactivated when rudder pedal deflection exceeds 5° from the trimmed position. Once deactivated, the deflection must be brought back to within 3° of the trimmed position before the autotrim function is reactivated. While a yaw trim failure will deactivate the autotrim function, the yaw damper will remain engaged and compensate for undemanded yaw inputs. Failure of the yaw autotrim generates an amber YAW AUTO TRIM INOP message on the EICAS.

Trim actuator position

The trim actuator position is obtained from two potentiometers. Potentiometer 1 sends an analogue signal to RCU1, which in turn provides data to Data Concentrator Unit 1(DCU). DCU1 provides the trim actuator position to the QAR. Potentiometer 2 provides the signal to DCU2, through RCU2, which is used by the FDR. DCU1 and DCU2 compare values and if there is invalid data, or a significant discrepancy in the values, it will display, when on the ground, a CONFIG TRIM red warning on the PED. If the signal from either, or both, potentiometers is lost in-flight, the FCC will command the yaw damper to disconnect.

Autopilot

The aircraft is equipped with an integrated two-channel autopilot and flight director consisting of two FCCs. The system provides dual flight directors, a 2-axis autopilot, automatic pitch trim control, independent yaw damping and yaw trim commands for the rudder control system. Continuous system monitoring is performed by the FCC for both the autopilot and yaw damper functions.

Aircraft Operations Manual

Flight Procedures Training

The flight procedures training section contains the following advice concerning aileron system faults:

> *'It is strongly recommended that these types of failures are trained during type rating in the simulator and repeated at regular intervals'*

And the warning:

> *'Do not trust the EFIS synoptic page indication!'*

Expanded Malfunction Checklist

This is a reference document normally held by the operator, as a part of its operations manual. This is not a part of the malfunctions checklist carried in the cockpit. The expanded checklist contained the warning:

> *'Before pulling the aileron disconnect in a suspected open failure case always verify an open failure by visually observing actual aileron movement'*

Malfunction checklist

The malfunction checklist is a document kept in the cockpit and used to assist pilots when dealing with a malfunction in flight. The advice that pilots should confirm the position of the aileron visually in these circumstances is not shown in this checklist.

Maintenance actions

Following the event the operator conducted a test of the RCU and rudder control system in accordance with the Aircraft Maintenance Manual[3]. It carried out a detailed inspection of all the connectors, connection beds, pins, and sockets on the RCU and trim actuator, and the control system was examined for evidence of an obstruction or control restriction. The only fault discovered was on the standby trim actuator which took 45 seconds to travel though its full range, instead of the required 16 to 20 seconds[4].

The operator replaced the RCU2, the rudder trim actuator and the left and right aileron position potentiometers. The operator stated that the RCU was referred to the OEM and no fault was found. As of 6 June 2016 the aircraft had flown 539 hours and 706 cycles since the event without a further incident involving the flying controls.

Manufacturer's flight trial

The manufacturer's test pilot conducted a flight trial to observe what would happen if the pedals were obstructed when the aircraft was climbing at 180 kt, then levelled at FL90 and accelerated to 240 kt. The test pilot obstructed the pedals by resting his feet on them. He observed that as the aircraft accelerated, the lateral acceleration increased and the bank angle increased to between 5° and 7°, then the 'R' MISTRIM indication illuminated, and ten seconds later the AP ROLL MISTRIM annunciator illuminated on the PED. The test pilot then removed his feet and the aircraft returned to normal flight. The test pilot commented that the force required to obstruct the pedals is low.

Analysis

The AAIB was unable to examine the aircraft prior to the flying control systems being disrupted and components changed, and the engineering analysis is based on QAR data and the examinations and system checks carried out by the operator.

Footnote

3 Chapter 27-21-00-710-801.
4 Chapter 27-12-00-720-001.

Throughout the event there had been no reported problems with either the flying control or autopilot/yaw damper systems. The QAR data also shows that the yaw autotrim remained engaged throughout the flight.

The QAR data from the previous flight shows that the output from the left aileron position transducer was on occasions erratic. At the start of the incident flight the output from the aileron position transducers appeared normal; however later in the flight the output from the left transducer was erratic and unreliable.

The autopilot and rudder control systems appeared to operate normally until the aircraft reached an altitude of 1,200 ft when the rudder trim position moved from -1.5 to -21.3º in six seconds. In manual mode the fastest the trim actuator can move through this range is 12 seconds, and in automatic mode the movement would be slower. While the rudder trim position recorded on the QAR was obtained from LVDT1 through DCU 1, the autotrim function is controlled by FCC 2, through RCU2, using positional data obtained from LVDT2 and DCU2 (the rudder trim position from LVDT2 is only recorded on the FDR). Following the replacement of RCU2 and the rudder trim actuator there were no further occurrences of erratic rudder trim positions recorded on the QAR or FDR. It is likely that as the autopilot, autotrim, and yaw damper all remained engaged, and no warnings or cautions were generated, that the signal from LVDT1 recorded on the QAR was erroneous. However, the evidence indicates that the signal from LVDT 2 which was used in the control of the trim actuator remained valid.

With the autopilot / yaw damper engaged, as aircraft speed increases, FCC2 will command RCU2 to move the rudder to maintain the aircraft in balance. RCU2 will also send a signal to the trim actuator to reposition the rudder pedals. The pilots' report that the aircraft became increasingly out of balance is consistent with the QAR data, which shows that lateral acceleration increased with aircraft speed. However, in comparing the QAR data with the previous flight, where the lateral acceleration remained around 0g, there is a noticeable difference in the position of the rudder pedals and rudder position between the two flights. On the previous flight as aircraft speed increased the rudder pedals and rudder moved close to the null position; whereas on the event flight the rudder pedals and rudder remained at 2° deflection to the right until the autopilot was disconnected, when they then moved to the null position over a 10 second period. After a further 25 seconds there was a rapid reduction in the lateral acceleration to the null position, both ailerons moved upwards by approximately 2° and the rudder pedals and rudder moved 3.7° to the left. This behaviour suggests that during the period that the autopilot was engaged there was a restriction that prevented movement of the rudder and rudder pedals.

Following the disengagement of the autopilot, and before the aileron disconnect (ROLL handle) was operated, the pilots reported that both ailerons moved upwards by several degrees. This was also seen on the QAR data. As the aircraft slowed for landing, both ailerons appeared to move upwards to approximately 17°, which discussion with the manufacturer indicates should have caused the aircraft to pitch nose-up. However, data from the QAR shows that there had been no impact on the flight path; moreover there was no corresponding change in the elevator position to counter the effect of the ailerons.

This suggests that at least one of the aileron position transducers was producing an erroneous signal.

The pilots were initially aware that the aircraft was flying "out of balance". This was probably caused by a restriction of the rudder pedals, perhaps inadvertently caused by one of the pilot's feet. On disconnecting the autopilot, the pilots were alerted by the jolt as the aircraft returned to balanced flight, and on checking the SED were presented with confusing information. They did not check the ailerons visually. The malfunction checklist in the aircraft did not highlight the importance of doing this.

The pilots, confused by the SED aileron indications and having made the decision to divert, omitted to complete the malfunction checklist. Subsequently they selected the flaps down, which was not appropriate in the circumstances, and were distracted late in the approach by TAWS warnings, which further added to their workload.

Conclusion

The investigation established that there had been two separate faults on the aircraft: one involved the rudder trim position recorded on the QAR and the second the output from the left aileron position transducer.

The first fault, with the rudder position, involved a restriction which prevented the rudder pedals from moving. The restriction ceased when the pilot disconnected the autopilot and flew the aircraft manually, and the investigation was unable to determine the cause of the restriction.

Safety actions

> The manufacturer stated that it intended to add the following to the *'Aileron system open failure'* section of the malfunction checklist at the next AOM revision: "NOTE: Verify an open failure by visually observing that one of the ailerons do not follow control wheel input."

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-161 Cherokee Warrior II, G-CDER
No & Type of Engines:	1 Lycoming O-320-D3G piston engine
Year of Manufacture:	1981 (Serial no: 28-8116222)
Date & Time (UTC):	6 August 2016 at 1600 hrs
Location:	English Channel, 1.2 nm from Winchelsea Beach, East Sussex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	44 years
Commander's Flying Experience:	98 hours (of which 48 were on type) Last 90 days - 5 hours Last 28 days - 1 hour
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was conducting a local flight over the sea when the pilot declared he had a problem with a rough running engine and high oil temperature; he flew a track towards his base airfield. Shortly after this, the pilot reported that he was unable to maintain altitude but, despite it being within glide range of land, the aircraft continued on a direct track, over the sea, towards the airfield visual reporting point (VRP). The aircraft ditched with a strong tailwind, and subsequently became inverted and sank. The pilot and aircraft were recovered from the seabed several days later. No mechanical defect was identified within the engine, but the aircraft was operating in the flight regime where severe carburettor icing could occur at any power setting. The investigation did identify a chafed wire in the engine oil temperature indication system which could explain the pilot reports of high oil temperature.

History of the flight

The aircraft, which belonged to a syndicate at Lydd Airport, was planned to make two flights that day with two different pilots; the accident occurred on the second of these flights. The first flight was of just under two hours duration with the landing at 1410 hrs. The pilot of this first flight described the flight as uneventful, with the aircraft, and its engine operating normally. After landing, when he completed the post-flight paperwork, the pilot of the accident flight was waiting to take the aircraft. They had a brief discussion about the weather, local air traffic information and that the aircraft would need to be refuelled before the next flight. The accident flight pilot, who was considered by the pilot of the first flight to have been in good spirits, explained that he didn't have a firm plan about where he was planning to fly, he was just going for a local flight on his own. He then walked out to refuel the aircraft.

The pilot called ATC at Lydd to request clearance to taxi at 1523 hrs and he took off from Runway 21 at Lydd at 1529 hrs. The aircraft climbed to 2,200 ft and, at 1533 hrs, the pilot reported that he was at Rye VRP; he was asked to call again when he was ready to re-join the airfield.

At 1558 hrs the pilot called Lydd ATC to report that he had a problem with his engine; he stated his position was 12 nm from Lydd. His next call, just over a minute later, was that he was unable to maintain altitude as the engine was failing and, at 1600 hrs, the pilot reported that he was ditching.

Several witnesses were on Winchelsea Beach; one of whom was a private pilot, who had been flying for 25 years. He described the weather conditions as good for flying, but with a strong south-westerly wind. Around 1600 hrs he saw an aircraft at what he estimated was 1,200 ft. He could hear no engine noise, and he described seeing the aircraft descending on a straight course of what he estimated to be 040° to 050°M. There was no change in the aircraft's heading and it went into the sea, downwind in a flat configuration. It appeared to the witness as though the flaps were up. He then ran to raise the alarm.

Other witnesses reported seeing what most of them initially believed was a boat, skipping across the water, when it suddenly flipped over and they could see it was actually an aircraft. The aircraft floated for around 30 seconds before it rolled and sank from their view.

The Search and Rescue (SAR) helicopter crew, who are based at Lydd airfield, heard the radio call of the pilot stating that he was ditching, and they scrambled. They were airborne at 1606 hrs and on scene shortly afterwards. They were able to locate an oil or fuel slick in a position close to where the witness on the beach indicated that the aircraft had last been, but there were no signs of the aircraft or any survivors.

Aircraft information

The PA-28-161 is a four-seat, low-winged light aircraft. The Pilot's Operating Handbook (POH) for the aircraft contains a glide performance chart. The chart predicts that, from a height of 2,200 ft, at 2,325 lbs weight, with the propeller windmilling and at an airspeed of 73 KIAS in still air, the aircraft would be able to glide for a distance of just over 4 nm.

The aircraft type has a single entry door on the right side of the fuselage which is secured by two latches; a lower latch which is operated by an external handle at the rear of the door and an internal handle in the lower forward section of the door, and an upper latch operated by external and internal handles on the top of the door.

G-CDER was fitted with a 160 hp carburetted engine. The aircraft was equipped with three instruments that enabled the pilot to monitor engine performance: the rpm gauge, an oil pressure gauge and an oil temperature gauge. The input to the rpm gauge is provided by a cable drive from the engine's accessory module. The oil pressure gauge is operated by a high pressure oil feed from the engine. Oil temperature is measured by a sensor mounted in the oil system. As the oil temperature increases, the resistance of the sensor decreases, allowing more electrical current to pass through the electrical gauge, which moves the needle to show the increased oil temperature.

Recorded information

Sources of recorded information

Recorded radar information (Mode A and C[1]) for the accident flight was available from ground-based sites located at London Gatwick and Pease Pottage. The radar provided an almost complete record of the accident flight, with the data starting just after the aircraft had taken off from Lydd and ending shortly before it struck the water. The most comprehensive record was provided by the radar at Pease Pottage, which was recorded once every six seconds.

RTF recordings relating to the accident flight were available from Lydd. These included the final radio transmissions from the pilot, who had been communicating with the controller on the Lydd Approach frequency since the start of the flight.

A tablet computer belonging to the pilot was recovered from his home and downloaded. This contained a record of four previous flights recorded by a navigation software application[2].

Summary of recorded data

Figure 1 shows the radar track of the flight from Lydd, Figure 2 shows the salient parameters during the final minutes of the flight and Figure 3 the final recorded radar positions.

The aircraft's track recorded by the radars correlated closely, corroborating the relative accuracy of the independent data sources. The aircraft's altitude amsl is derived from Mode C, corrected for a QNH pressure of 1028 hPa, with a tolerance of +/- 50 ft.

The first radar point was recorded at 1530 hrs, shortly after the aircraft had taken off from Runway 21. The initial route was towards the village of Rye, located 7.5 nm west of Lydd Airport. As the aircraft passed to the south of Rye the pilot transmitted a position report and confirmed the aircraft was at 2,200 ft amsl, which was the previously stated target altitude.

The aircraft then flew 1.2 nm off-shore before turning onto a south-westerly heading, to fly approximately parallel to the shore line. When the aircraft was abeam the village of Fairlight, it altered course towards the south whist maintaining an altitude of about 2,200 ft amsl. The aircraft continued to fly in a southerly direction until it was about

Footnote

1 Mode A refers to the four-digit 'squawk' code set on the transponder. Mode C refers to the aircraft's pressure altitude, referenced to 1013.25 hPa, which is transmitted with a resolution of 100 ft.

2 Skydemon.

12 nm off shore, where a left hand orbit was flown before it altered heading towards the west. Evaluation of ship movements in conjunction with the aircraft's track, indicates that the pilot may have flown out to sea to look at several vessels which were operating in the area.

At 1552 hrs, the aircraft turned onto a north-westerly course, before making a further turn onto a north-easterly track of about 040°; if maintained, this would position the aircraft back towards Rye VRP.

At 1558:47 hrs the pilot transmitted that he had a problem, stating "GOLF ECHO ROMEO LYDD LYDD (sic) APPROACH GOLF ECHO ROMEO I'VE GOT A EH A ENGINE PROBLEM HERE EH TEMPERATURES SKY HIGH AND I'VE OIL PRESSURE IS FALLING". The controller acknowledged and requested the aircraft's position (the ATS at Lydd do not operate a radar service). The pilot advised he was about 12 nm from the airport and approximately 4.6 nm east-south-east of Hastings. The nearest shoreline to the aircraft was 2.1 nm away, located between Hastings and Fairlight. This was within the glide range of the aircraft, which was at an altitude of about 2,200 ft amsl. The controller instructed the pilot to report when he was 4 nm from the airport, and provided the circuit direction and active runway, which were right-hand and Runway 21 respectively.

The aircraft proceeded to maintain its course towards the shoreline near Rye. At 1559:26 hrs, the aircraft started to descend at an average rate of 1,300 fpm and an estimated average airspeed (based on a wind from 230° at 17 kt[3]) of 99 KIAS. At 1559:53 hrs, the pilot transmitted "LYDD APPROACH I'M GOING TO NEED ASSISTANCE EH ENGINE NOW BEGINNING TO FAIL I'M LOSING ALTITUDE". This was acknowledged by the controller and the pilot provided a position report, advising he was 10 nm from Lydd and 3.5 nm south of Winchelsea "OVER THE SEA". He further added that he was unable to restart the engine stating that it was "POPPING". The aircraft was now at an altitude of about 1,600 ft amsl and 1.5 nm from the nearest shoreline which was near Fairlight. This was still within the glide range of the aircraft.

The aircraft maintained a track that was almost parallel to the shoreline whilst continuing to descend. At 1600:34 hrs the final radar return was recorded. The aircraft was at an altitude of 600 ft amsl, its estimated airspeed was about 100 KIAS, and 1.42 nm from the beach near Pett Level village (this was now beyond the glide range of the aircraft). Shortly after, at 1600:49 hrs the pilot made his last RTF transmission, when he stated that he was ditching the aircraft.

Based on the estimated glidepath of the aircraft, witness information and position of an "oil slick" observed on the surface of the sea shortly after the accident by a SAR helicopter, the aircraft struck the water approximately 1.2 nm from the shoreline of Winchelsea Beach.

Footnote

[3] Based on the Lydd Airport METAR timed at 1550 hrs UTC.

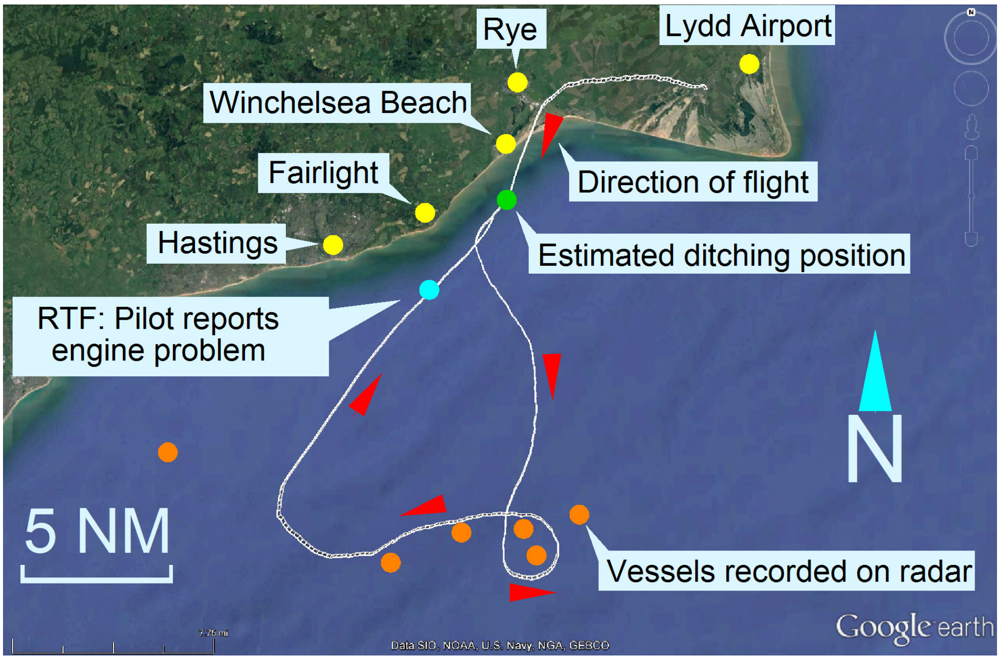


Figure 1

Flight from Lydd (Pease Pottage radar)

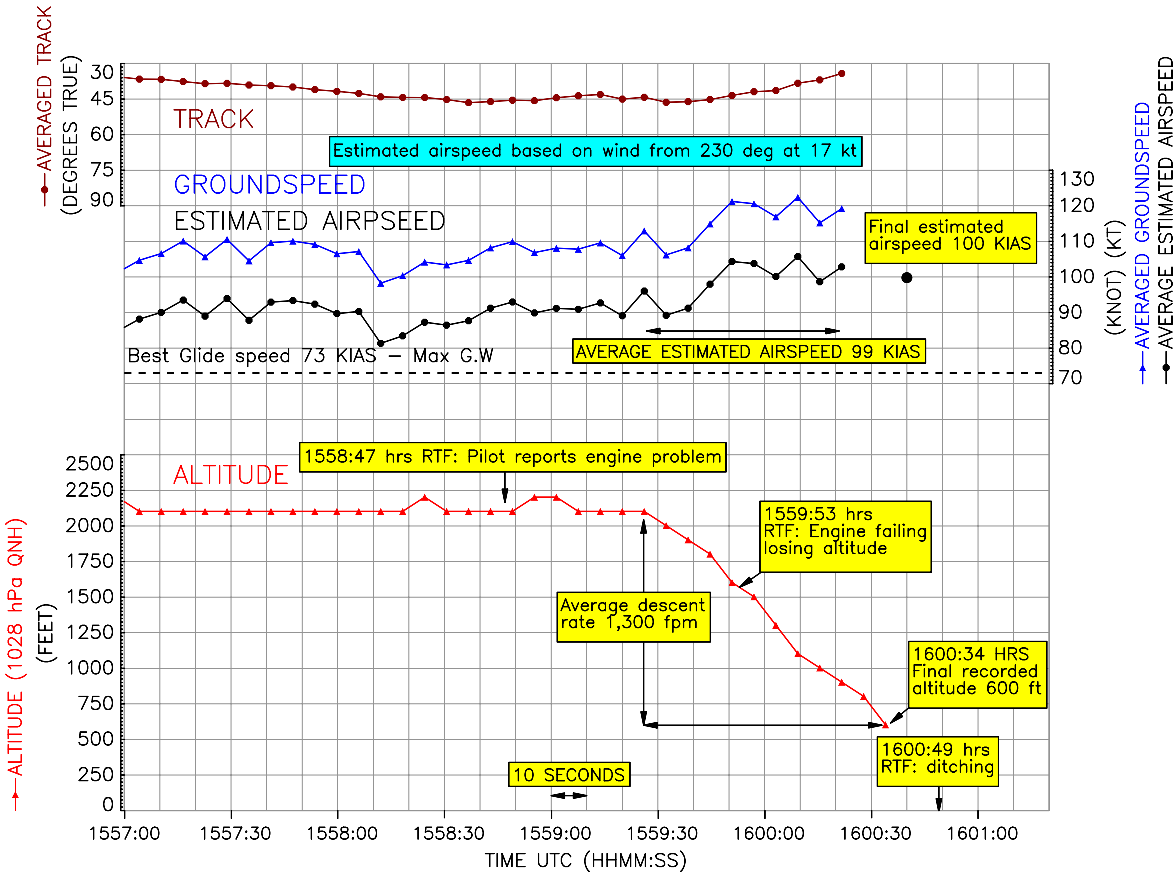


Figure 2

Accident flight data from Pease Pottage radar

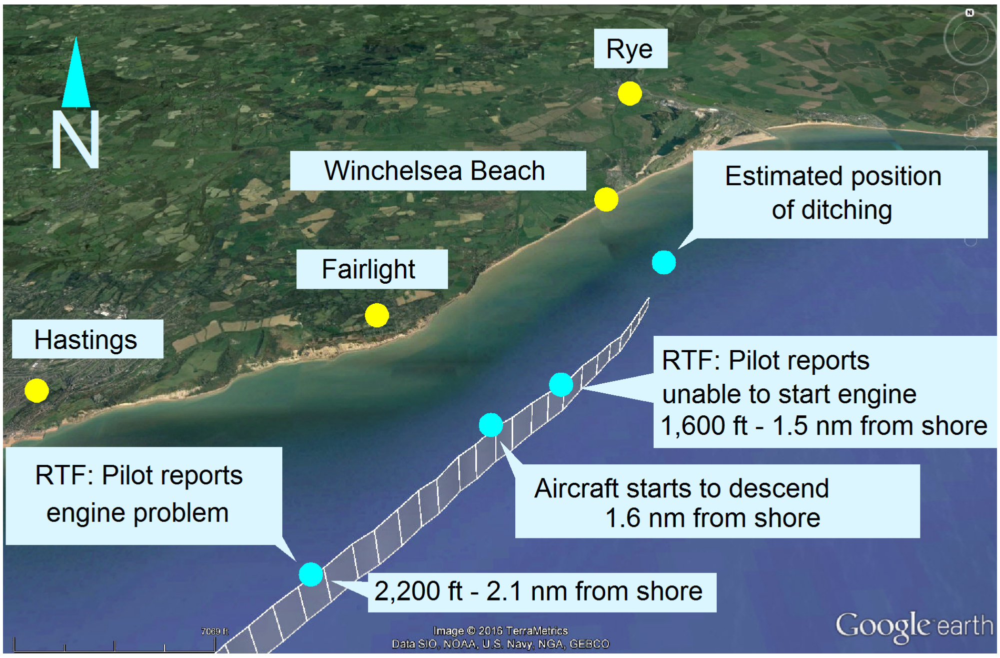


Figure 3

Final radar points (Pease Pottage radar)

Previous flight records

The pilot's tablet computer contained recordings of four flights made in 2015; two in August and two in September. Both of the flights in August were similar, with the aircraft flying along the coastline between Rye and Eastbourne, before returning to land at Lydd Airport. The aircraft was flown over the sea during periods of both flights, at distances of up to 2 nm from the shore and at an altitude of about 2,000 ft amsl.

The records from September contained an almost complete flight from Lydd to Bembridge on the Isle of Wight, and a partial record of the return flight back to Lydd. The aircraft was predominantly flown over the sea during both recordings, at similar distances and altitudes observed during the previous flights in August.

Recovery

During the SAR operation the RNLI lifeboat had placed a buoy at the location of the oil slick observed by the SAR helicopter. After discussion between the AAIB and SALMO[4] it was determined that the local sea conditions and knowledge of the aircraft's approximate location provided a high probability of a successful recovery operation. As a result a survey vessel, recovery vessel and dive team were chartered on the AAIB's behalf by SALMO.

Footnote

4 MOD Salvage and Maritime Operations.

On 10 August 2016 a side-scan sonar equipped survey vessel, with SALMO and AAIB personnel on board, located the aircraft on the sea bed at a depth of between 5 m and 9 m, close to the marker buoy. Sonar imagery showed that the aircraft appeared to be intact and was inverted (Figure 4).

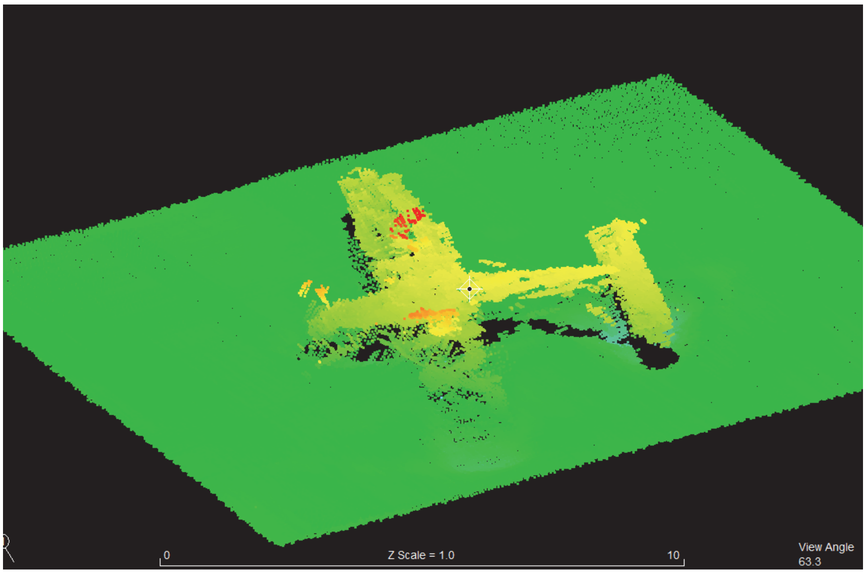


Figure 4
Sonar image of the aircraft

A recovery vessel arrived at the accident site on 13 August. After locating the aircraft, the dive team confirmed that it was intact and that the body of the pilot remained within the aircraft. During 13 August the aircraft was 'righted' on the sea bed and recovered to deck the following day. Initial examination of the aircraft identified that the flaps had been deployed to their first position (10°), that the pilot's seat belt was unfastened, the upper cockpit door latch was in the OPEN position and the lower door latch was in the LOCKED position. The body of the pilot was recovered and transported to shore by Sussex Police. The pilot was not wearing any form of flotation aid.

After bringing the aircraft to shore, approximately 2.5 litres of oil together with a large quantity of water was drained from the engine prior to filling it with de-watering fluid. Both fuel tanks were found to be intact and a large quantity of fuel, including some water was drained from the fuel tanks. The aircraft was subsequently transported to the AAIB for detailed examination.

Maintenance history

Examination of the aircraft's maintenance records confirmed that the aircraft had been maintained in accordance with its approved maintenance program and that there were no reported defects which could have had a bearing on the accident flight.

The engine log book showed that the engine had been fully overhauled in March 2014, approximately 235 flying hours prior to the accident.

When interviewed, the pilot who flew the aircraft immediately prior to the accident flight confirmed that there had been no observed abnormalities with either the aircraft's performance or its engine indications.

Aircraft examination

Examination of the aircraft's cockpit showed that the engine throttle was in the maximum power position, the mixture control was in the RICH position and that the carburettor heat control was in the OFF position. All the electrical circuit breakers were in the closed (on) position.

Removal of the engine's carburettor confirmed that fuel was present in both the carburettor bowl and the carburettor acceleration pump. The carburettor heat valve had been jammed in the OFF position due to distortion of the valve casing. Tests conducted on fuel recovered from the aircraft's tanks confirmed that it met the required specification but had been contaminated with sea water.

The engine was removed and disassembled. There was no evidence of an external oil leak. No contamination or metallic debris was found in the oil filter, oil pump strainer, oil cooler or in the sump and the oil pump and oil pressure relief valve were in good condition. All the engine bearings were in good condition, with evidence of emulsified oil on all bearings. There was no evidence of bearing distress. All the oil galleries were free from obstruction and the pistons and cylinder liners were in good condition.

Tests carried out on the engine oil pressure indication system confirmed that the system operated normally. The oil temperature indicator and oil temperature sensor were removed and examined. The oil temperature indicator was contaminated with silt and corrosion. Tests confirmed that the gauge was inoperative. The oil pressure sensor was tested with a calibrated heat source and performed normally. Examination of the electrical wire which connected the oil temperature sensor and the oil temperature gauge identified an area of chafing in the insulation which had exposed the conductive core. The location of the chafe was in an area close to where the wire passed through the fuselage fire wall, adjacent to the engine mount and an earthing cable. Examination of the chafe under an optical microscope showed evidence of electrical arcing damage. Additional tests, using a serviceable oil temperature gauge, showed that if this wire to the oil temperature sensor became 'earthed' the gauge needle moved to its maximum deflection, indicating an engine oil temperature in excess of the maximum reading on the gauge. In this condition the maximum current measured though the indication circuit was 1.15 amps.

Pathology

The pathologist indicated that the pilot suffered severe multiple injuries which were probably caused when the aircraft struck the water.

There was no evidence of any significant pre-existing natural disease which could have caused or contributed to the accident. Toxicology revealed no evidence of alcohol or drugs in the pilot's body.

Weight and balance

The aircraft's weight and balance was calculated to have been within the normal operating range for the aircraft.

Meteorology

High pressure, centred over the Bay of Biscay was bringing settled weather conditions to the UK, with good visibility and virtually no cloud in the Hastings area. The surface wind at Hastings was 230° at 15 kt, the surface wind reported at Lydd was 230° at 17 kt, with a temperature of 20°C and a dew point of 15°C. The Met F214 spot wind chart indicated that the Environmental Lapse Rate[5] at the lower levels around the accident site was around 3°C per thousand feet, a steeper gradient than the ICAO standard lapse rate of 1.98°C per thousand feet. At 2,000 ft the wind was 260° at 20 kt, with the temperature likely to have been 14°C with a dew point of around 13°C.

Carburettor Icing

The CAA issues numerous Safety Sense Leaflets. Safety Sense Leaflet 14, covers piston engine icing and contains the following chart.

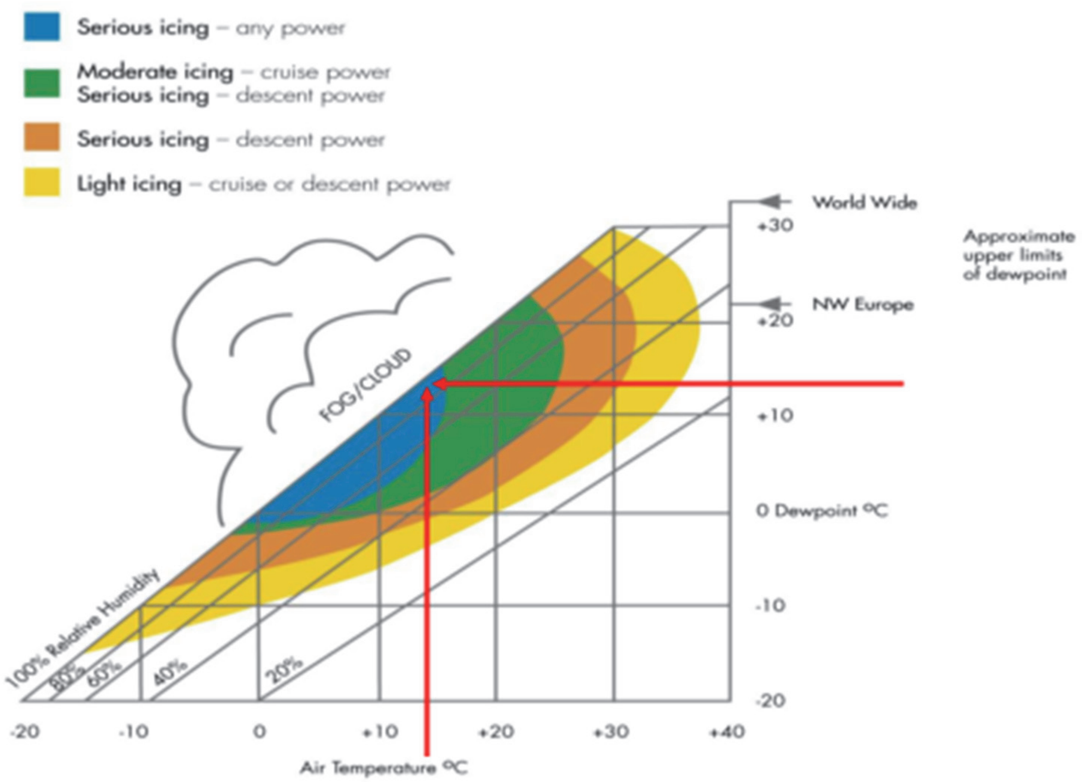


Figure 5
Carburettor Icing

Footnote

5 Temperature drop with altitude.

At a temperature of 14°C with a dewpoint of 13°C the aircraft is in the area where severe carburettor icing can occur at any power. In order to minimise the possibility of carburettor icing becoming a problem, pilots are taught to apply carburettor heat at routine intervals. In addition to applying carburettor heat the pilot would also check that all engine indications were normal.

Pilot's history

The pilot first started to fly in 2006, but the flying frequency was initially sporadic, until 2010, when he flew reasonably regularly until he gained his PPL in March 2013. He then started to fly G-CDER, and all but one of his flights since then were in this aircraft.

He flew two training sorties in March, with an instructor. The instructor confirmed that on those flights they covered Practice Forced Landings (PFLs) and the use of carburettor heat. The instructor recalled the pilot was very enthusiastic about aviation and generally flew to an above average standard, but he observed that on his first PFL, he allowed the aircraft's nose to go too far below the horizon, which resulted in a higher glide speed than the 75 KIAS his instructor recommended. This was corrected and subsequent PFL's were flown to a high standard. The instructor confirmed that ditching was discussed at the flying school, and their recommended technique for the PA-28 included opening the door, if possible, before impacting the water.

Other relevant incidents

On the weekend of the accident, the southern part of the UK was subject to a moist south-westerly airflow. The temperature and dewpoint of this air mass was such that aircraft flying around 2,000 ft were operating in the area of the carburettor icing forecast graph where severe carburettor icing could occur at any power.

The AAIB is aware of one other accident and several anecdotal reports of engine problems that occurred that weekend where carburettor icing was likely to have been a factor.

Analysis

Engineering

Examination and testing confirmed that the aircraft's fuel was not contaminated prior to the accident and the presence of fuel in the carburettor indicated that fuel was available to allow engine operation. The damage to the carburettor heat valve casing was consistent with impact forces so it was concluded that the carburettor heat valve was in the OFF position when the aircraft struck the sea.

Given the lack of evidence of an external oil leak from the engine, the low quantity of oil within the engine after recovery is thought to have been as a result of oil being purged from the engine breather system whilst the aircraft was submerged. This may have been the cause of the 'slick' observed by the SAR helicopter immediately after the aircraft sank.

Disassembly of the engine showed no evidence of a mechanical defect, the engine oil system was free from contamination and the oil pump and oil pressure relief valve were in good condition. There was no evidence of any deterioration which would be normally associated with a lubrication system failure.

The engine oil pressure indication system functioned normally. Tests showed that the chafed wire found in the oil temperature indication system could result in the gauge incorrectly reading oil temperature beyond the 245ºF maximum marking on the gauge. Testing also indicated that, in this condition, the current passing through the gauge would not be high enough to open, or trip, the relevant circuit breaker. This circuit breaker also provided power to a number of other aircraft electrical systems. The evidence of electrical arcing damage to the chaffed cable confirmed that the circuit had been earthed whilst power was applied.

The carburettor icing chart, Figure 5, indicated that the aircraft was operating in conditions where carburettor icing would be expected at any engine power setting. Other events, both reported and anecdotal, from aircraft operating in the same weather system confirmed that carburettor icing may have been prevalent.

Given the evidence from the examination of the aircraft, the pilot's report of "sky high oil temperature" was probably due to the oil temperature gauge reading in excess of 245ºF as a result of the effect of the chafed wire. In this situation, some pilots can become focussed on the abnormal indication to the detriment of other checks and actions. Given the atmospheric conditions, if carburettor heat was not routinely applied, ice would have built up in the barrel of the carburettor and the engine would begin to lose power and run roughly until eventually it would stop. It would not be possible to restart the engine until the ice had melted which could take several minutes. As the oil pump is driven by the engine's crankshaft, any reduction in engine rpm would produce a corresponding reduction in engine oil pressure. The combination of high oil temperature indication, a rough running engine and reducing oil pressure are usually symptomatic of a failure of the engine lubrication system. Therefore, it is not unreasonable to assume that the pilot, when confronted by this situation believed that the aircraft's engine was about to fail due to lack of lubrication.

Operations

The evidence suggests that the pilot suffered an engine malfunction, probably as a result of carburettor icing. The aircraft's position, when the pilot indicated he was unable to maintain altitude, was within glide range of land, but the pilot continued towards the Rye VRP. The aircraft was flown at an airspeed estimated to be at least 20 kt faster than the published best glide speed, which would have adversely affected its time in the air. The pilot did not attempt to turn the aircraft into the wind which would have reduced his groundspeed by around 34 kt, nor did he select full flap, to reduce the airspeed at which the aircraft ditched. The investigation considered that this was probably because of the pilot's relative inexperience, and becoming fixated on trying to return to the airfield. The investigation was unable to determine why the pilot's seatbelt was undone, but considered it probable that the door was unlatched by the pilot prior to the water impact in accordance with his training.

The CAA issue a number of Safety Sense Leaflets; Number 21(d) concerns ditching and contains useful advice for pilots on how best to survive a ditching. The General Aviation Safety Council (GASCo) publish some advice on forced landing[6]. In that advice they publish statistics which indicate the survivability of a forced landing is greater when the aircraft comes down on land rather than water.

Conclusion

The aircraft suffered an engine malfunction, with additional indications of high engine oil temperature and reducing oil pressure. This would have appeared to the pilot as though the engine was suffering a mechanical failure. The engineering investigation found no evidence of a mechanical defect with the engine but did identify a chafed wire which may have caused an erroneous indication that the oil temperature was extremely high.

The aircraft was within glide range of land, but the relatively inexperienced pilot, perhaps distracted by the abnormal engine indications, elected to return towards the airfield rather than the nearest land. The aircraft continued downwind and consequently ditched with a high groundspeed. The forces involved in the impact resulted in the pilot sustaining severe multiple injuries, and the aircraft then sank.

The cause of the engine malfunction was not positively determined, but the aircraft was operating in a regime of flight where severe carburettor icing was forecast and a number of other aircraft were involved in incidents which may also have been attributable to carburettor icing. The investigation noted that the Met F214 spot wind chart indicated that the Environmental Lapse Rate at the lower levels around the accident site was around 3° per thousand feet, a steeper gradient than the ICAO standard lapse rate of 1.98°C per thousand feet.

BULLETIN CORRECTION

There was a typographical error in the opening sentence of the last paragraph on page 25 of the Bulletin. The text should read:

> ‘The aircraft then flew 1.2 nm off-shore before turning onto a *south-westerly* heading, to fly approximately parallel to the shore line.’

The online version of this report was corrected on 12 January 2017.

Footnote

6 http://www.gasco.org.uk/safety-information/flight_safety_extra_june_16/forced-landings.aspx

ACCIDENT

Aircraft Type and Registration:	Ikarus C42 FB80 Ikarus, G-OJDS
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2004 (Serial no: 0411-6633)
Date & Time (UTC):	9 June 2016 at an unknown time after 1128 hrs
Location:	Near Cushendun, Northern Ireland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Missing)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	UK National Private Pilot's Licence (A)
Commander's Age:	68 years
Commander's Flying Experience:	Not known hours (of which n/k were on type) Last 90 days - Not known Last 28 days - Not known
Information Source:	AAIB Field Investigation

Synopsis

G-OJDS departed City of Derry Airport, Northern Ireland, at 1045 hrs on 9 June 2016 for a flight to Kirkbride aerodrome, Cumbria. The aircraft was last seen at approximately 1128 hrs near Cushendun, approximately 32 nm north of Belfast. The aircraft's tail section was spotted at 1342 hrs the following day (10 June) floating in the sea 6.9 nm south-east of Cushendun.

History of the flight

G-OJDS departed from City of Derry Airport, EGAE, at 1045 hrs on 9 June 2016 with two persons on board for a flight to Kirkbride aerodrome, Cumbria (approximately 9.5 nm west of Carlisle). The weather at the airport at 1050 hrs was wind from 030° at 4 kt with the direction varying between 350° and 070°; 7,000 m visibility with fog in the vicinity of the aerodrome; few clouds at 400 ft aal, scattered cloud at 800 ft aal and broken cloud at 2,300 ft aal; a temperature of 18° and a QNH of 1019 hPa.

Another aircraft (G-CDUS) took off at 1044 hrs with the same destination as G-OJDS and, although the pilot of that aircraft had planned the route with the occupants of G-OJDS, there was no intention for the two aircraft to fly the route in formation. G-OJDS routed towards the Coleraine Visual Reporting Point (VRP), 18 nm east-northeast of City of Derry Airport. At 1058 hrs, just before leaving the ATC frequency, the pilot reported his altitude as 1,200 ft, and said that he was routing towards Port Rush (approximately 4 nm north of Coleraine) and descending to maintain VMC[1].

At 1103 hrs the pilot of a commercial flight in contact with Scottish ATC on 127.275 MHz reported that an aircraft with callsign *Golf Juliet Sierra* was trying to make contact with Scottish ATC[2]. Just before he was transferred to Prestwick ATC, he said that he could still hear *Golf Juliet Sierra* trying to make contact. The Air Traffic Control Officer (ATCO) replied that he could not hear the aircraft's transmissions.

The pilot of G-CDUS reported that the plan was for the two aircraft to fly around the coast of Northern Ireland in a clockwise direction towards Larne before turning east towards Stranraer and then Kirkbride aerodrome. The last time he recalled seeing G-OJDS was at approximately 1128 hrs in the vicinity of Cushendun, on the coast approximately 32 nm north of Belfast, and he heard and saw nothing to indicate that there was a problem. He reported that, as he routed along the coast south of Cushendun, the visibility was approximately 3 to 5 km in haze with a poorly defined horizon, and there was fog over the sea. He climbed his aircraft above the haze, which extended to approximately 2,000 ft amsl, turned east towards Stranraer and called Scottish ATC at 1156 hrs.

G-OJDS was reported missing at approximately 1900 hrs when the pilot of G-CDUS called City of Derry Airport on the telephone to find out whether G-OJDS had returned.

Sections of the rear fuselage from G-OJDS were spotted at 1342 hrs the following day (10 June) floating in the sea 6.9 nm south-east of Cushendun .

Analysis

Examination of images of the recovered pieces of the aircraft confirmed that it had struck the sea with significant force. However, due to the limited amount of material recovered, and the lack of other substantive evidence relating to the accident, the AAIB was unable to determine the cause of the loss of this aircraft.

Footnote

1 Visual Meteorological Conditions.

2 The callsign for G-OJDS was *Golf Oscar Juliet Delta Sierra*, which might have been abbreviated to *Golf Delta Sierra*. It was not determined whether or not the transmission from *Golf Juliet Sierra* actually came from *Golf Delta Sierra*.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quantum 15, G-MZCR
No & Type of Engines:	1 Rotax 503-2V piston engine
Year of Manufacture:	1996 (Serial no: 7234)
Date & Time (UTC):	16 July 2016 at 1430 hrs
Location:	East Haxted Farm Airstrip, near Edenbridge, Kent
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Wing, trike and propeller damaged
Commander's Licence:	Private Pilot's Licence (A) Microlight aircraft
Commander's Age:	90 years
Commander's Flying Experience:	368 hours (of which 261 were on type) Last 90 days - 2 hours Last 28 days - 1 hour
Information Source:	AAIB Field Investigation

Synopsis

The pilot was landing on a grass runway at East Haxted Farm Airstrip after a local flight. Low to the ground he experienced some thermal activity and turbulence which caused the left wing to lift suddenly. He decided to abort the landing and applied power, using the foot throttle, to go around. The aircraft started to climb but he was unable to prevent it turning right and it struck a tree in a hedgerow adjacent to the runway. The pilot was seriously injured.

History of the flight

The pilot arrived at the East Haxted Farm club hangar facility in the morning. He was the owner of G-MZCR, a Pegasus Quantum flex-wing microlight, and had kept it at the club for a number of years. He was not able to rig or de-rig it alone because of the weight and awkwardness of fitting the wing to the trike, so the operator of the airstrip helped him to prepare the aircraft for flight. He also would always help him with de-rigging and putting the aircraft away afterwards.

The airstrip operator stated that it was the pilot's custom to fly either early in the morning or in the early evening when conditions were most likely to be calm and the air smooth. He departed on a planned flight himself that afternoon and, when he left, he believed that the pilot would not attempt to fly before he had returned.

In the early afternoon the pilot spoke with several people who were around the club hangar area; they reported that the conversations were routine. He then carried out all the normal pre-flight checks on his aircraft, started the engine and taxiied out towards the grass runway designated Strip 4 (Figure 1). He noticed the cloud cover had increased and suspected there might be thermic conditions. Strip 4 is 530 m in length and orientated 270°M (into wind on the day). It is located 1 km to the south-east of the club hangar (taxiing distance 1.6 km), from where it is out of sight.

The pilot reported that the takeoff was fine but, as he climbed, he realised that the conditions were quite bumpy. He flew around to the south-east for a while and then returned to East Haxted, descending gradually for an approach to Strip 4. As he neared the ground he encountered very rough air, the left wing lifted and the aircraft veered off course. He decided to go around but was unable to correct the direction of the aircraft which flew towards the trees and hedgerow on the north side of the runway.

Google Earth imagery date 6/6/13 - accessed 20 July 2016

Figure 1

East Haxted Farm layout, including Strip 4 (indicated by red arrow).
Circled numbers indicate strip designations.

At around 1430 hrs, a witness walking her dog in an easterly direction along Strip 4, saw what she thought was a microlight aircraft in the distance on approach to land. She moved about 30 m to the north of the runway to be clear. She watched the aircraft approaching to land and described it as appearing “too fast and at too acute an angle” and “a bit wobbly”. It came down to within four feet of the ground, rose up and dipped a couple of times before the landing was aborted and it started to climb. As it climbed it turned towards her and she became concerned that it might not clear the trees in the hedgerow. She watched as the aircraft flew into, and became entangled in, the branches of an oak tree at a height of around 15 feet.

The pilot only became aware of this witness when she called out to ask if he was alright. He replied that he was but that he would need the assistance of the Fire Service. She called the emergency services and remained with the pilot until they arrived. The emergency services personnel took several hours to release the pilot from the aircraft; he was subsequently airlifted to hospital suffering from injuries to his chest and right hand.

Accident site and wreckage examination

The aircraft crashed into a 20 m tall oak tree approximately halfway along Strip 4 at East Haxted Farm. The tree was part of a boundary hedge, displaced approximately 60 m to the north of the runway centreline (Figure 2).

Broken branches showed that the aircraft had struck the tree close to the top, at low speed, before then being arrested by the tree canopy. The progressive breakage of the tree branches beneath the aircraft's wing, coupled with the aircraft's low mass, resulted in relatively minor damage to the aircraft which was substantially intact and found resting in the tree canopy, about 5 m above ground level.

The aircraft was recovered to ground level and examined. The engine's crankshaft was free to rotate normally and fuel was present in both carburettor bowls. Tip damage to each of the propeller's three blades indicated that the engine had been running and producing power at impact. The hand and foot throttle controls were tested and found to function correctly. Forty litres of two-stroke fuel were recovered from the fuel tank, which has a capacity of 49 litres.

One of the left lower side rigging cables had failed in tensile overload and the second had been cut by the emergency services. The luff control wire, which controls the shape of the wing trailing edge for trimming purposes, had also failed in tensile overload. All other rigging cables were intact and were in good condition. The flying control bar had been bent, probably by contact with the pilot's body during the accident impact. The trim control was set to the takeoff position which is also appropriate for landing. The pilot's lap and shoulder straps were intact and had not failed at their attachments, although the shoulder strap had been cut by the emergency services.

The aircraft's keel beam had fractured at the main landing gear forward fitting, due to impact forces. All other damage to the aircraft was determined to have been caused by the accident impact and a thorough examination of the aircraft did not reveal any technical defect that may have caused a loss of control.

Aircraft information

The Pegasus Quantum 15 is a tandem two-seat flex-wing microlight aircraft controlled by weight-shift. G-MZCR was powered by a 50 hp Rotax 503 two-stroke piston engine, driving a three-bladed composite propeller. The aircraft's Permit to Fly maintenance inspection had been completed on 17 August 2015, and the Permit to Fly was valid when the accident occurred. The aircraft had accumulated 279 hours since manufacture, and 4.5 hours since the last maintenance inspection. The aircraft is flown solo from the front seat and a lap strap and shoulder harness are provided for both seat occupants. Separate hand and foot throttles are provided for the pilot and it is usual for the foot throttle, mounted on the right nosewheel steering pedal, to be used for takeoff and landing.

Information provided in the aircraft manufacturer's Operator's Manual

The manufacturer provides a comprehensive Operator's Manual for the aircraft. There are a number of references to flight conditions including:

> *'Microlight flying is most enjoyable in the calm conditions found at the beginning or the end of the day, when the wind and thermals generally die away.'*

The manufacturer also provides weather limitations for wind and thermic activity (Table 1).

	EXPERIENCED	INTERMEDIATE	BEGINNER
Wind (mph)	20	10	5
Thermic activity	Moderate	Light	None
Cross wind	10	5	0
Taxiing	20	10	5

Experienced Pilots	100 + hours pilot in command
Intermediate Pilots	10 - 100 hours pilot in command
Beginners	0 - 10 solo hours pilot in command

Table 1

Wind and thermic activity limitations

Aircraft handling

Roll control in a flex-wing weight-shift microlight is achieved by the action of the pilot moving the A-frame control bar to the side away from the required direction of turn. Roll control becomes less effective at low airspeeds, so the bar needs to be pulled in slightly to increase airspeed before commencing a turn. At landing speeds a gust may catch one half of the wing leading to gust-induced rolling, requiring a corrective control input by the pilot.

Meteorology

The weather conditions were fine and warm with a westerly wind. The UK low-level significant weather chart (F215) for the region showed a slow moving cold front, from north to south, approaching the airstrip. East Haxted Farm is located 8.5 nm to the east of London Gatwick Airport (LGW) where the METAR recorded at 1420 hrs was surface wind from 260° at 8 kt, variable between 220° and 290°, visibility more than 10 km, scattered cloud at 3,200 ft and 4,400 ft, temperature 24°C, dewpoint 18°C and pressure 1024 hPa.

The south east area ballooning forecast for 16 July 2016, valid for the period 1600 hrs to 2100 hrs, indicated weak thermal activity locally at low level up to 4,000 ft amsl.

The airstrip operator returned from his flight at 1530 hrs. He landed on Strip 6, a different runway, about 800 m to the west of Strip 4. He reported that there was thermal activity with some low level turbulence and rotor effect when he landed.

Airfield information

East Haxted Farm is situated within the LGW Control Zone and is in Class D airspace. There is a letter of agreement with National Air Traffic Service for operations at the airstrip which is operated by a small flying club group. There is a booking out logsheet for planned landings away and a notice board on which pilots should record details of local flights.

A club hangar facility with an outdoor rigging area is available; aircraft were kept in the hangar de-rigged because of limited space. Four separate grass runways are located some distance away. Strip 4 is the furthest from the hangar and is out of sight on lower ground 1 km to the south-east (see Figure 1). The strip is level, orientated 270° / 090°M, 530 m in length and 10 m wide. Trees and hedgerows are in the vicinity of the strip and a public footpath crosses around the mid-point. At the time of the accident, hay was being made in the field in which Strip 4 is sited (see Figure 2). Walkers frequently use the mown grass area as a convenient pathway.

Figure 2

View of Strip 4 from east

Pilot information

The pilot had held a Private Pilot's Licence (Microlight) since 1997. He purchased the aircraft in 1998 and had flown it regularly, mainly in the summer months. The aircraft had been kept at East Haxted since 1999. He made one flight in the aircraft in the eight months prior to the accident, a forty minute local flight on 28 May 2016.

Analysis

The investigation did not identify any pre-existing technical defect with the aircraft that could have contributed to the loss of control.

The weather conditions were warm with a surface wind of probably between 5 kt to 10 kt and some thermal activity was forecast. The airstrip environment, with the grass runway surrounded by a patchwork of grass, trees and arable land, would have created conditions likely to give rise to thermal activity at low level. This may have been exacerbated by the drying hay on either side of the runway.

The Operator's Manual warns against flying in turbulent conditions, particularly for inexperienced flyers and, although the pilot was reasonably experienced, he was not in current flying practice.

The pilot made a decision to fly in the early afternoon, a time when conditions were more likely to be turbulent; his decision may have been influenced by the fact that, as he and the airfield operator had taken the time to get the aircraft rigged and ready, he may have felt some pressure to fly. The pilot also stated that, if he had set off later in the day, this would have kept the airstrip operator waiting after returning from his own flight, to help him with the derigging of G-MZCR. The warm weather, acting on the varied terrain around the airstrip, probably gave rise to rougher air conditions than he had anticipated and he may also have underestimated the significant control forces required to fly in such thermic conditions.

Conclusion

The pilot decided to go for a flight in the early afternoon but the conditions were rougher and more turbulent than he anticipated. He experienced some thermic activity at low level during landing and decided to go around but lost directional control and was not able to prevent the aircraft from crashing into a tree.

BULLETIN CORRECTION

The description of the accident site and wreckage examination (page 39) referred to "*lift control wires*" and "*flying control wires*", terms which may cause confusion as the cables in question are structural and not specifically for control. The relevant paragraph was amended and the terms have now been replaced by '*lower side rigging cables'* and '*rigging cables'*.

The online version of this report was corrected on 12 January 2017.

AAIB Correspondence Reports

These are reports on accidents and incidents which were not subject to a Field Investigation.

They are wholly, or largely, based on information provided by the aircraft commander in an Aircraft Accident Report Form (AARF) and in some cases additional information from other sources.

The accuracy of the information provided cannot be assured.

SERIOUS INCIDENT

Aircraft Type and Registration:	Airbus A319-111, G-EZFP
No & Type of Engines:	2 CFM56-5B5/3 turbofan engines
Year of Manufacture:	2009 (Serial no: 4087)
Date & Time (UTC):	9 May 2016 at 1530 hrs
Location:	Lille Airport, France
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 6 Passengers - 154
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot Licence
Commander's Age:	33 years
Commander's Flying Experience:	9,293 hours (of which 6,445 were on type) Last 90 days - 162 hours Last 28 days - 55 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

During pre-flight preparation performance figures were calculated for a departure from Lille Airport using the full length of Runway 08. The subsequent takeoff was from Intersection Tango 5, from which less than the full length was available. The error was not revealed by the crew's standard cross-check because they misread the runway length, possibly as a result of fatigue.

History of the flight

The aircraft was on a scheduled flight from Lille Airport to Toulouse Airport, France. The co-pilot was to be the Pilot Flying (PF) and the commander Pilot Monitoring (PM). Runway 08 was in use.

During the pre-flight preparation an Electronic Flight Bag (EFB) was used to calculate takeoff performance. Initially, upon opening the runway drop-down menu on the EFB the commander selected '08 T5' (indicating a departure from Intersection Tango 5 on Runway 08). He then saw that there was an option entitled '08 TMP' (Runway 08 Temporary[1]). He compared the

Footnote

[1] A 'Temporary' designator is added to the runway in the EFB when there are changes published by NOTAM that affect the takeoff performance. These might be changes related to runway length for maintenance work or other factors such as obstacles.

TORA[2] and the engine-out procedure for both options, focusing on obstacles and stopway because he recalled there was a NOTAM that mentioned cranes. Having not noticed any difference between the two TORA he computed the performance figures using the 08 TMP option; after the co-pilot had cross-checked them they were entered into the flight management guidance computer.

While taxing to the runway the PF briefed the departure in accordance with the operator's standard operating procedures, which include a review of takeoff speeds; these did not give either pilot cause for concern. The aircraft then took off using Runway 08 from Intersection Tango 5.

After takeoff the crew remarked to each other that the end of the runway seemed to be closer than normal as the aircraft became airborne, causing the commander to think a mistake may have been made. During the cruise he checked the EFB and noticed that there was a difference in runway length between 08 T5 and 08 TMP.

Airport information

The relevant distances are as follows:

Runway designator	TORA	ASDA[1]
08 TMP	2,825 m	2,162 m
08 - Takeoff from Intersection Tango 5	2,265 m	1,688 m

[1] ASDA – Accelerate Stop Distance Available.

Recorded data

The aircraft's flight data monitoring system captured the incident, showing that the aircraft departed using Runway 08 from Intersection Tango 5, at a takeoff weight of 59.735 tonnes.

Using this information the manufacture calculated that as the aircraft accelerated through V_1 of 139 KIAS there was about 920 m of runway remaining. When the aircraft became airborne there was approximately 800 m of runway remaining and the aircraft passed over the runway end at a height of 280 ft. Had an engine failed at V_1 there would have been 730 m of runway remaining as the aircraft got airborne, with the aircraft passing over the end of the runway at about 55 ft.

Commander's comments

The commander commented that while he and the co-pilot had cross-checked the distances between Runway 08 T5 and Runway 08 TMP they failed to spot the difference in length. Later he noted that three out of four digits were the same, but with the middle two swapped. As the V speeds seemed plausible it did not give him any cause for concern. He added that this was an "unintentional slip-up" that may have been caused by fatigue.

Footnote

[2] TORA – Take Off Run Available.

Other recent events involving takeoff from an intersection

G-EZAA

On 25 June 2015 an Airbus A319, registration G-EZAA, took off from Intersection Bravo on Runway 25 at Belfast International Airport with takeoff performance calculated using the full length of Runway 07. This report was published in AAIB Bulletin 05/2016 on 12 May 2016.

G-EZUH

On 16 July 2015 an Airbus A320, registration G-EZUH, took off from Intersection Bravo on Runway 08 at London Luton Airport with takeoff performance calculated using the full length. This report was published in AAIB Bulletin 01/2016 on 14 January 2016.

G-EZIV

On 16 October 2015 an Airbus A319, registration G-EZIV, took off from Intersection Uniform Five on Runway 21 at Lisbon Airport, Portugal with takeoff performance calculated using Intersection November Two of Runway 03. This report was published in AAIB Bulletin 05/2016 on 12 May 2016.

G-EZFJ

On 14 April 2016 an Airbus A319-111, registration G-EZFJ, took off from Runway 31 at Malaga Airport. Due to a software anomaly, information for Runway 31 was displayed alongside takeoff performance data for Runway 13. The flight crew did not notice this during cross-checking and subsequently took off from Runway 31 using takeoff performance figures for Runway 13. This report is published in this AAIB Bulletin (1/2017).

INCIDENT

Aircraft Type and Registration:	Cessna 750 Citation X, G-CEDK	
No & Type of Engines:	2 Rolls-Royce AE 3007C1 turbofan engines	
Year of Manufacture:	2006 (Serial no: 750-0252)	
Date & Time (UTC):	12 August 2016 at 0902 hrs	
Location:	Inverness Airport, Scotland	
Type of Flight:	Private	
Persons on Board:	Crew - 2	Passengers - 3
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	50 years	
Commander's Flying Experience:	6,960 hours (of which 1,850 were on type) Last 90 days - 60 hours Last 28 days - 40 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

Shortly after starting the left engine, the flight crew noticed a transient smell of burning rubber, which they described as being identical to that of tyre smoke from a landing aircraft. There were no visible indications of anything abnormal and, as the smell then disappeared, the aircraft was taxied for departure with the crew monitoring for any recurrence. Just after completing the turn onto Runway 11, the commander noticed a small amount of pale grey smoke, below the level of the instrument coaming, which was confirmed by the co-pilot. The aircraft was brought to a halt and the crew reviewed the situation, before deciding to carry out the Emergency Evacuation Drill. Air Traffic Control was informed and an evacuation was carried out through the aircraft main door, with the passengers being led upwind of the aircraft as the Airport Fire Service arrived.

A post-incident inspection by the operator's maintenance engineer identified that the cabin air cycle machine had failed, causing smoke to enter the cabin.

ACCIDENT

Aircraft Type and Registration:	Albatros DV.a, ZK-TGY
No & Type of Engines:	Mercedes D.111
Year of Manufacture:	2015
Date & Time (UTC):	15 September 2016 at 1320 hrs
Location:	Pimphurst Farm, Bethersden, Kent
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Structural damage to airframe and wings
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	69 years
Commander's Flying Experience:	23,830 hours (of which 4 were on type) Last 90 days - 9 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The Albatros DV.a was a German World War 1 fighter aircraft equipped with a Mercedes D.111 six-cylinder, liquid-cooled engine. ZK-TGY is a reproduction aircraft, manufactured in 2015 and operated by a historic warbird company in New Zealand. The engine is understood to be an original unit that has been overhauled.

The aircraft was on loan to an organisation in the UK and was returning from an event in France. The pilot reported that, approximately 4 miles short of the destination airfield, the engine began to run rough before stopping. He attempted a forced landing but clipped a hedge on final approach, resulting in the aircraft coming to rest inverted; he was uninjured.

The pilot reported that sufficient fuel remained in the tanks after the accident and water temperature and fuel pressure indications were normal throughout the flight. A landing incident three flights previously resulted in damage that required a replacement propeller and the aircraft was returned to flight after consulting the manufacturer.

The cause of the engine failure was not immediately apparent and the operator advised that the aircraft would be recovered to New Zealand for further examination.

ACCIDENT

Aircraft Type and Registration:	Beech B55 Baron, SE-EXW	
No & Type of Engines:	2 Continental IO-470 piston engines	
Year of Manufacture:	1969	
Date & Time (UTC):	29 August 2016 at 0800 hrs	
Location:	Abbotsley (Rectory Farm) Airfield, Cambridgeshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Damage to left wingtip, right wing and fuselage	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	49 years	
Commander's Flying Experience:	573 hours (of which 22 were on type) Last 90 days - 21 hours Last 28 days - 7 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

During a flight from Belgium to Northern Ireland, the pilot reported a rudder restriction and made a precautionary landing at Rectory Farm Airfield. However, the pilot was unable to stop the aircraft within the runway length available causing substantial damage to the aircraft.

ACCIDENT

Aircraft Type and Registration:	DHC-1 Chipmunk 22, G-BXCP
No & Type of Engines:	1 De Havilland Gipsy Major 10 MK.2 piston engine
Year of Manufacture:	1952 (Serial no: C1/0744)
Date & Time (UTC):	22 September 2016 at 1400 hrs
Location:	Bagby (Thirsk) Airfield, Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Right side of fuselage wrinkled and right wing and tailplane badly damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	70 years
Commander's Flying Experience:	14,578 hours (of which 22 were on type) Last 90 days - 7 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

There was no air/ground radio service at Bagby so, before landing, the pilot checked the surface wind at a nearby airfield; it was from 240º at 10 kt. He was very familiar with Bagby and had landed a Chipmunk there six times in the previous four days. On this occasion, he elected to take advantage of the 2.6% upslope on Runway 06 and land downwind. He knew the landing distance required was sufficient, given the grass surface was short and dry, but stated he would have used Runway 24 if he thought the wind was stronger than 10 kt.

A normal approach was flown to a three-point landing and the pilot held the control stick fully back as the aircraft slowed. He maintained directional control using differential braking until, at a speed of 20-25 kt, the aircraft swung left and would not respond to further application of right brake. It veered off the runway and the pilot was unable to halt it before the right wing and tailplane struck a hangar. He made the aircraft safe and vacated without assistance.

The pilot concluded that the swing to the left may have been due to the wind gusting or shifting direction.

ACCIDENT

Aircraft Type and Registration:	Diamond DA42 Twin Star, G-CTCB
No & Type of Engines:	2 Thielert TAE 125-02-99 piston engines
Year of Manufacture:	2005 (Serial no: 42.083)
Date & Time (UTC):	28 April 2016 at 1603 hrs
Location:	Bournemouth Airport, Dorset
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Failure of left landing gear drag brace rib
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	32 years
Commander's Flying Experience:	2,051 hours (of which 146 were on type) Last 90 days - 137 hours Last 28 days - 56 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

Following a practice asymmetric power approach and a normal but firm landing, the left main landing gear 'unsafe' light started flashing, with accompanying aural warning. After shutting down the aircraft on the nearest taxiway it was discovered that the left main landing gear leg had partially collapsed. The aircraft manufacturer determined that this was caused by an overload failure of the bonding between the composite drag brace rib and the composite centre wing section.

History of the flight

The accident occurred after landing at the end of a training flight. The student pilot was in control in the left seat and the instructor (commander) was in the right seat. Another student pilot was sitting in the back. The approach to Runway 26 was a practice asymmetric power approach with the left engine set to zero thrust (about 18% power). The wind was from 230° at 15 kt, providing a crosswind of 7.5 kt from the left. The instructor reported that the approach was stable and the speed well controlled by the student. A few feet before touchdown the student closed both power levers and corrected the drift using the rudder pedals. At touchdown the drift was almost fully corrected and the aircraft aligned with the runway. The instructor reported that the touchdown felt firm but not hard. The deceleration was normal and the aircraft maintained the runway centreline. At touchdown they heard a continuous beeping noise which they initially thought was the stall warner but then identified as the gear 'unsafe' warner. The left main gear green light was off and the red 'unsafe' light was flashing. The instructor took control and, after reaching a safe speed, vacated the runway by the nearest taxiway. The aircraft was still controllable but with increasing difficulty. He stopped the aircraft on the side of the taxiway and shut down the engines in order to inspect the landing gear. After noticing that the left main landing gear had partially collapsed, he asked the student pilot and student passenger to vacate the aircraft carefully.

Aircraft examination

The composite drag brace rib, which secures the left main landing gear drag brace to the centre wing section, had detached (Figure 1), causing the left main landing gear leg to partially collapse. The aircraft manufacturer examined the aircraft and removed the failed rib for further detailed examination. They determined that the failure pattern was typical for an overload failure of the bonding between the composite rib and the composite centre wing section. They concluded that some damage had occurred during a previous hard sideslip landing and then the final failure occurred on the day of the accident.

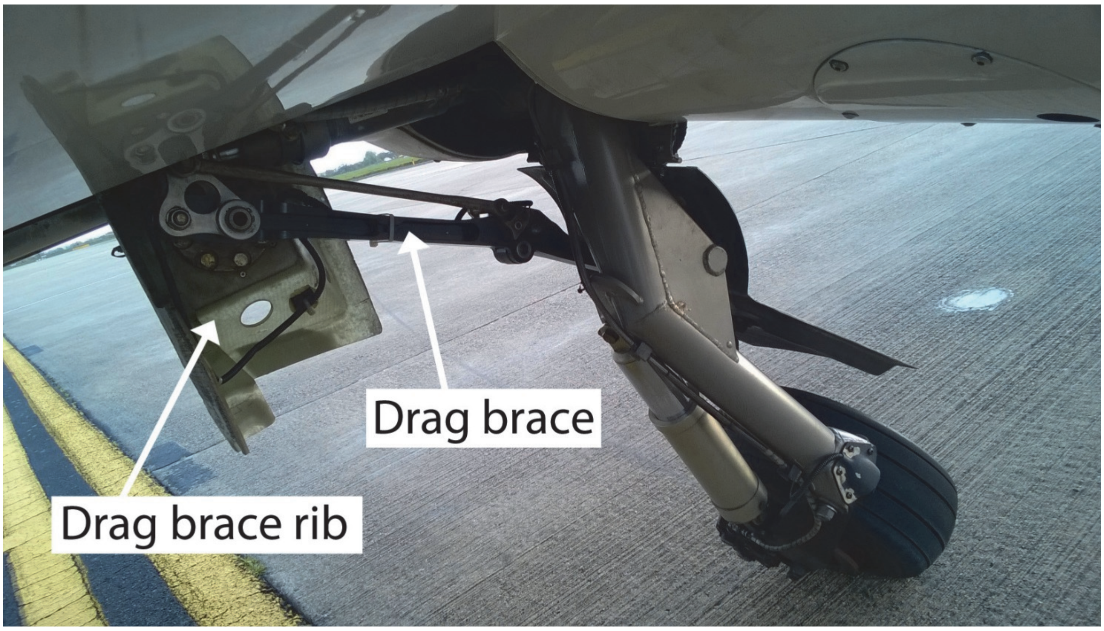


Figure 1

View of left main landing gear leg (looking aft) showing detached drag brace rib

Previous DA42 history of failures of the landing gear drag brace rib

The DA42 type has suffered a number of failures of the landing gear drag brace rib which were attributed to improper bonding of the rib to the centre wing section. This resulted in the aircraft manufacturer publishing a Mandatory Service Bulletin (MSB-42-031/1) in 2007 to perform an inspection of the bonding and carry out a repair if the bonding was inadequate. According to G-CTCB's airframe logbook this MSB had been carried out on 13 February 2007 and, according to the aircraft manufacturer, there was physical evidence that the MSB repair had been carried out correctly.

The aircraft manufacturer reported that since the MSB was issued they have received 11 reports of failures of the main landing gear drag brace rib. They determined that in four of these cases the MSB had not been carried out correctly and one was caused by a storm spinning the aircraft around while parked. The remaining cases were attributed to overload events.

ACCIDENT

Aircraft Type and Registration:	Evans VP-1 Series 2, G-TGJH
No & Type of Engines:	1 Volkswagen 1834 piston engine
Year of Manufacture:	2015 (Serial no: PFA 062-11933)
Date & Time (UTC):	27 August 2016 at 1000 hrs
Location:	Ewesley Farm, Northumberland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Substantial
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	76 years
Commander's Flying Experience:	1,029 hours (of which 17 were on type) Last 90 days - 4 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot reported that during takeoff from Runway 24 at Ewesley Farm airstrip, the right mainwheel entered long grass to the side of the runway, causing the aircraft to swing to the right and towards a fence. The aircraft cleared the fence but landed heavily on the rough ground beyond and was substantially damaged. The weather was good and the wind was light and from the south.

CAA Safety Sense Leaflet 12, '*Strip Sense*' contains useful information for operating at unlicenced aerodromes and private strips.

ACCIDENT

Aircraft Type and Registration:	Grob G115E Tutor, G-BYVE	
No & Type of Engines:	1 Lycoming AEIO-360-B1F piston engine	
Year of Manufacture:	2000 (Serial no: 82115/E)	
Date & Time (UTC):	24 August 2016 at 1145 hrs	
Location:	RAF Wittering, Cambridgeshire	
Type of Flight:	Training	
Persons on Board:	Crew - 2	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Propeller anti-erosion strip detached	
Commander's Licence:	Military	
Commander's Age:	Not known	
Commander's Flying Experience:	4,690 hours (of which 910 were on type) Last 90 days - 45 hours Last 28 days - 13 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

The pilot reported that during a formation takeoff, at approximately 400 ft agl, a loud "thud" was heard, followed by the onset of severe vibration. The aircraft was turned downwind immediately and a PAN declared. Once enough runway was available to complete a safe landing, a turn was made onto finals. A glide approach was flown and a successful landing completed.

Examination revealed that the anti-erosion sheath had separated from one of the propeller blades. As a precaution, the operator removed from service all propellers overhauled by their UK subcontractor; this included the incident propeller.

Specialist examination of the failure by the propeller manufacturer indicated that a combination of three defects had led to the loss of the anti-erosion sheath. Insufficient adhesive was present between the blade and the sheath, the layers of glass fibre on the inner portion of the sheath had been sanded excessively, and the sheath was not cleaned totally before refitting to the blade. Examination of the remaining two blades of the incident propeller and all three blades of another propeller overhauled by the same UK subcontractor showed the blades to be free from these defects.

ACCIDENT

Aircraft Type and Registration:	Klemm Kl35D, HB-UBK
No & Type of Engines:	Hirth Motoren KG HM 504 A2 piston engine
Year of Manufacture:	1940 (Serial no: 1918)
Date & Time (UTC):	6 July 2016 at 1355 hrs
Location:	Earls Lane, South Mimms, Hertfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Serious) Passengers - None
Nature of Damage:	Wings and landing gear broken away from fuselage, severe damage to engine
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	70 years
Commander's Flying Experience:	21,114 hours (of which n/k were on type) Last 90 days - n/k hours Last 28 days - 25 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

On the downwind leg of a forced landing into a field, the pilot made a 180° turn, at minimum speed, to avoid a line of trees ahead. On completing the turn, the pilot raised the nose to avoid hitting the ground nose first. This caused the aircraft to stall into the ground. During the impact sequence, both wings and the undercarriage became detached from the fuselage. The pilot and passenger were able to leave the aircraft's open cockpit by themselves; however, the pilot was later hospitalised.

History of the flight

On a flight from Southend to Old Warden, the pilot descended to between 1,500 and 2,000 ft with the intention to cross the approach sector of Luton Airport. Just as he was about to speak to Luton ATC the pilot noticed a change in the sound of the engine and immediately decided to declare an emergency and ask for directions to the nearest airport. He was advised that this (Elstree) was 6-8 nm away on a heading of 230°. As the engine was still operating, the pilot decided to turn onto this heading; however, after about five minutes the engine lost power. The pilot selected the one field into which he felt it was possible to make a forced landing and turned downwind. He quickly realised that there was a line of trees ahead that blocked his path so performed a 180° turn, at minimum speed, during which the aircraft lost the majority of its height. On completion of the turn the pilot raised the nose to avoid crashing nose first into the ground; however, at a height of about 10 ft, this caused the aircraft to stall and it impacted the ground right wing first. During the impact sequence, both wings and the undercarriage became detached from the fuselage.

The pilot and passenger, both wearing full harnesses, were able to leave the aircraft's open cockpit by themselves and within five minutes an air ambulance had arrived. The doctor from the air ambulance examined them both before allowing then walk over to an ambulance which had subsequently arrived. The pilot was later taken to hospital.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-180 Cherokee, G-AZDX
No & Type of Engines:	1 Lycoming O-360-A4A piston engine
Year of Manufacture:	1971 (Serial no: 28-7105186)
Date & Time (UTC):	26 August 2016 at 1000 hrs
Location:	Private Strip, Hundon, Suffolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 3
Injuries:	Crew - None Passengers - None
Nature of Damage:	Right wing severed, left wing and right tailplane severely damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	66 years
Commander's Flying Experience:	1,900 hours (of which 1,600 were on type) Last 90 days - 16 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft was about to carry out a private flight to St Omer (France) from Hundon (Suffolk) with four people on board. However, just after takeoff, the engine lost power and the aircraft failed to climb away. The pilot kept the wings level and carried out a forced landing through a hedge and into a field. The aircraft sustained serious damage to the wings and tailplane. The pilot and his passengers were uninjured. The cause of the power loss is unknown.

History of the flight

The aircraft was prepared for a flight from a private grass airfield near Hundon in Suffolk to St Omer with four people on board. The engine start and vital checks were uneventful with correct settings, pressures and temperatures throughout. After a normal takeoff run the aircraft became airborne and the pilot expected the aircraft to climb away normally. Then, without warning, there was a sudden reduction in power. The pilot kept the wings level and carried out a forced landing through a hedge and into a field at the end of the runway. During the landing the aircraft sustained the loss of the right wing, distortion to the right tailplane and severe damage to the left wing. The pilot and his passengers vacated the aircraft without injury.

Discussion

The aircraft had been refuelled earlier with sufficient fuel for the planned flight, with an allowance for diversion. The aircraft was below its maximum takeoff weight. The pilot was very familiar with the airfield and noted that the aircraft became airborne exactly where he had expected it to, as it had done on numerous occasions before. Based on the readings obtained during the power checks carried out prior to takeoff, there was no indication of an impending problem with the engine. At takeoff the fuel pump was running and the carburettor heat set to cold. At the time of writing the cause of the engine power loss is not known.

ACCIDENT

Aircraft Type and Registration:	Pitts S-2A Special, G-BTUL
No & Type of Engines:	1 Lycoming AEIO-360-A1A piston engine
Year of Manufacture:	1979 (Serial no: 2200)
Date & Time (UTC):	7 May 2016 at 1400 hrs
Location:	Sleap Airfield, Shropshire
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Lower wing, left landing gear, tail wheel and bottom of rudder damaged
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	59 years
Commander's Flying Experience:	1,671 hours (of which 361 were on type) Last 90 days - 40 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The landing was after a completion of the third of a series of aerobatic training flights. The pilot had taken control from the student for the landing and joined crosswind for a right hand circuit landing on Runway 05 at Sleap Airfield. The wind was reported as from 080º at 10 kt. During the approach onto final the pilot was aware that the aircraft was closer to the threshold than anticipated and adjusted the flight path accordingly. Flare and touchdown were normal, but during the ground roll the aircraft did not decelerate as expected. The left wing then dropped and the aircraft then ground looped to the right causing damage to the wing, tail wheel and rudder. The pilot and student evacuated the aircraft without injury.

Although the reported wind favoured Runway 05, the previous landing aircraft had made the decision to land on another runway as they felt there may have been a tailwind on Runway 05 and other observers at the airfield later reported to the pilot of G-BTUL that the wind at that time appeared to them to be from south-southwest, which would have resulted in a tailwind on Runway 05.

Examination of the aircraft shortly after the accident revealed that the left main landing gear had collapsed and that it was possible that this occurred during the landing roll precipitating the initial wing drop leading to the ground loop.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna F182P Skylane, G-DATG
No & Type of Engines:	1 Continental Motors Corp O-470-R piston engine
Year of Manufacture:	1976 (Serial no: 13)
Date & Time (UTC):	10 July 2016 at 1520 hrs
Location:	Near Westcott, Buckinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - 1 (Minor) Passengers - 1 (Minor)
Nature of Damage:	Damage to engine, propeller, fuselage, wings and landing gear
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	16,000 hours (of which 200 were on type) Last 90 days - 24 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, and other enquiries by AAIB

Synopsis

The aircraft overran the end of a grass airstrip during landing, sustaining substantial damage and causing minor injury to two of the three occupants. The landing performance calculated by the pilot did not fully account for the landing conditions and did not include a recommended safety factor. The approach itself was flown in a brisk crosswind, with a reduced flap setting from that on which the performance figures were based. Touchdown probably occurred at a higher airspeed than was required, resulting in the pilot being unable to stop the aircraft before the end of the airstrip.

History of the flight

The aircraft took off at 1400 hrs from Oxford Kidlington Airport with the pilot and two passengers on board. The pilot's intention was to land at a private grass airstrip about 13 nm east of Kidlington, an airstrip to which he had flown on three previous occasions. The weather was generally fine, with good visibility and scattered to broken cloud cover with a base of between 3,000 ft and 4,000 ft. There was an automated weather station at the airstrip, which the pilot checked before departure. This reported a wind from about 240° at 16 kt, similar to that at Kidlington. The airstrip was orientated 15/33, so was subject to a crosswind.

On arriving overhead the airstrip, the windsock indicated that the wind was blowing directly across the strip at an estimated 10 to 15 kt. The pilot commenced an approach to land in the 33 direction. He experienced what he described as a blustery crosswind, so flew the approach with flaps at 20° rather than 40°, believing it to be the recommended setting for the conditions. The approach was not fully stabilised, with airspeed varying by +/- 10 kt.

Touchdown occurred an estimated 30 m into the 540 m long strip. The pilot reported that wheel braking initially seemed effective but that overall deceleration was less than expected as he attempted to maintain maximum braking without locking the wheels.

As the aircraft approached the end of the strip, the pilot applied and maintained full braking but was unable to stop the aircraft. It overran the strip, passing through a hedge and over a small ditch onto a minor road where it came to rest heading in an approximately easterly direction. The aircraft suffered substantial damage, although damage to the cockpit and cabin area was minimal. The pilot and one of the passengers (all of whom were wearing shoulder and lap straps), sustained minor injuries in what the pilot described as a low speed impact. The aircraft occupants were able to vacate the aircraft using both main cabin doors.

In his report, the pilot considered that his decision to use flap 20 instead of flap 40 had been a mistake. The wind conditions had been such that he was unable to fully stabilise speed for the approach and he recognised that he should have made an early decision to go-around. He thought the apparent lack of brake effectiveness may have been due to a higher than ideal touchdown speed, possibly combined with some dampness of the grass. Although he considered rejecting the landing after touchdown, the risk associated with that course of action appeared greater than with a low speed overrun.

The pilot reported that he elected to raise the flaps to improve braking effectiveness during the landing roll (a recognised short field landing technique as described in the aircraft manufacturer's Pilot's Operating Handbook (POH)). However, this did not occur, as the aircraft came to rest with the flaps still in the 20° position.

Meteorological information

There was an area of low pressure to the west of Ireland, placing the bulk of England and Wales in a south-westerly or west-south-westerly airflow of about 15 kt. A weak occluded front was forecast to cross the area during the day.

Weather reports from Oxford Kidlington (13 nm to the west) showed that the wind was largely steady in direction, from 230° or 240°. The pilot assessed the wind at the strip to be similar. Luton Airport, 22 nm east of the airstrip, showed a surface wind from 210°, varying between about 150° and 240°. The wind direction veered slightly later in the afternoon, suggesting that the weak front crossed the general area during the afternoon.

Aircraft information

For a normal landing, the POH permitted a range of flap settings, from 0° to 40°. Power-on approach speeds were given as 70-80 kt (flaps 0°), and 60-70 kt (flaps down). Landing performance figures in the POH were based on the 'short field' landing technique, which required flap 40°, power off, and a speed of 60 kt. The POH stated that heavy wheel braking should be used after touchdown, and that flaps may be retracted to 0° to improve braking effectiveness. Concerning crosswinds, the POH advised using the minimum flap setting required for field length considerations.

Aircraft performance

The airstrip was 540 m (1,775 ft) long, with an average elevation of 270 ft amsl. The strip had an overall downslope in the 33 direction of approximately 1%. The temperature was 22°C and QNH 1006 hPa.

The group of pilots that operated the aircraft used a computer programme for mass, balance and performance calculations. As a matter of routine, the pilot used this programme (which was accessible on the group's internet site) to produce performance figures for the intended flight. Using this programme, and based on information supplied by the pilot, the landing mass of the aircraft was independently calculated at 2,732 lb (the units used by the programme), or 1,239 kg. This figure was approximately 92% of the maximum allowable landing mass.

The performance programme allowed input of certain variables and produced landing performance figures which were evidently based on the POH. The programme 'rounded up' altitude and temperature inputs, which in this case effectively accounted for the relatively low atmospheric pressure and high temperature of the day. As in the POH, all landing performance figures were based on the maximum landing mass, using flap 40°, power off, an approach speed of 60 kt and with heavy braking after touchdown.

The pilot calculated a landing ground roll of 645 ft (197 m) and an uncorrected *landing distance from 50 ft* of 1440 ft (439 m). The programme applied a 15% increment to the *landing distance from 50 ft* to allow for the grass surface, producing a *landing distance from 50 ft* of 1,656 ft (505 m).

Examination of the programme identified the following shortcomings:

- The 15% factor applied by the programme for a grass runway was in accordance with the recommendation contained in the CAA's publication, *Safety Sense Leaflet 7c*[1] and the UK Aeronautical Information Circular (AIC) 127/2006 (*Pink 110*)[2]. However it was less than the 20% factor recommended by the manufacturer in the POH. When the performance data was selected for printing, it included a cautionary note: '*It is the Pilot*

Footnote

1 Safety Sense Leaflet 7c: *Aircraft Performance* (www.caa.co.uk/publications).
2 AIC 127/2006: *Take-off, climb and landing performance of light aeroplanes.*

in Command's duty to ensure that the Pilot's Operating Handbook takes precedence over the above'.

- The programme did not allow for input of runway slope, although it advised users to '*add 10% factor for adverse runway slopes > 2%'.*

- The ground roll distance presented was that for a dry paved runway, irrespective of input of surface type or condition. Thus the distance given would be erroneous for anything other than a dry paved runway. The figure given was ambiguously titled *'landing distance'*, whereas the POH referred to this value as *'ground roll'*.

Had a grass runway factor of 20% been used, and the down slope accounted for (5%), the resulting figures would have shown a landing ground roll of 1,019 ft (310 m) and a *landing distance from 50 ft* of 1,814 ft (553 m). This was greater than the landing distance available of 540 m.

Supplementary information to pilots regarding the takeoff and landing performance of light aircraft has been published in Safety Sense Leaflet No 7c and AIC 127/2006. These documents stress that the performance figures given in the POH for most light aircraft are unfactored and achieved using a new aircraft and engine in ideal conditions, flown by a highly experienced pilot. Although not a mandatory requirement for a private flight, it was recommended that a safety factor of 1.43 (applicable to Public Transport flights) be applied. SSL 7c further recommended that pilots:

> *'always ensure that after applying all the relevant factors, including the safety factor, the Landing Distance Required (LDR) from a height of 50 ft does not exceed Landing Distance Available.'*

The performance programme automatically applied the recommended 1.43 safety factor, which gave a *landing distance from 50 ft of* 2,368 ft. This was the only figure also given in metres (722 m). Applying the same safety factor to the fully corrected landing figures given above would have produced a landing distance required of 2,594 ft (790 m).

Analysis

The shortcomings of the performance programme may not normally have been apparent for operations to reasonably long, paved runways, such as that at the aircraft's home airfield. However, the construction and presentation of the programme invited errors, which could prove significant in other cases. The factor applied to account for a grass runway was less than that stipulated in the POH, and the landing ground roll figure, which was ambiguously labelled, did not reflect the actual conditions selected. The absence of a runway slope input might lead to this aspect not being fully considered by the user, and the note concerning slope could be taken to mean that an adverse slope of 2% or less need not be considered at all.

Using the aircraft manufacturer's factor for the grass surface and taking into account the adverse slope, the resulting *landing distance from 50 ft* of 1,814 ft (553 m) exceeded the landing distance available, even before a safety factor was applied. Nevertheless, the figures produced by the programme would have indicated to the pilot that the airstrip was marginal in length in even optimum conditions and was not suitable for use with the recommended safety factor applied. It is possible that the pilot was misled by the erroneous landing groundroll figure in deciding whether to land at the strip, and may have considered the landing mass as being sufficiently below maximum to provide a safety margin, although he would not have been able to quantify this. The fact that he had previously visited the airstrip, presumably without incident, may also have been a factor in his decision to proceed.

An additional factor not considered in the calculations was a possible tailwind component. With the wind blowing directly across the airstrip, any variability could lead to a tailwind condition which is unlikely to have been detected once on the approach. The crosswind also had the effect of producing handling complications which had the potential to delay brake application and to interfere with it by producing directional control difficulties after landing.

The pilot would have been aware of the requirements for landing in terms of configuration, speed and techniques. However, he continued with an unstable approach in a non-standard configuration when an alternative was to discontinue the approach and divert elsewhere. In what would have been a high workload situation, it would appear that he became more concerned about the crosswind than the landing distance, to the extent that he prioritised the crosswind handling requirement for a reduced flap setting over the landing distance requirement for full flap and an accurate speed.

The pilot may well have been subject to a common cognitive bias known as plan continuation bias, in which there is an unconscious tendency to continue with a plan of action despite changing conditions that would otherwise be recognised as demanding a change of plan. This effect is stronger near the end of a task, such as during the approach and landing phase, when the desire to complete the task as originally planned can be difficult to overcome.

ACCIDENT

Aircraft Type and Registration:	Robinson R44 Raven, G-RFUN	
No & Type of Engines:	1 Lycoming O-540-F1B5 piston engine	
Year of Manufacture:	2002 (Serial no: 1239)	
Date & Time (UTC):	5 August 2016 at 1135 hrs	
Location:	Near Crowden, Glossop, Derbyshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 3
Injuries:	Crew - None	Passengers - 1 (Minor)
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	43 years	
Commander's Flying Experience:	87 hours (of which 9 were on type) Last 90 days - 1 hour Last 28 days - 1 hour	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

Synopsis

The helicopter took off at close to its maximum weight. It then flew to a hilly area, where the pilot made a downwind approach, with full carburettor heat applied, to an Out-of-Ground-Effect (OGE) hover. The manufacturer's performance figures show this to be outside the declared flight envelope of the helicopter. The helicopter was unable to sustain the hover and descended, probably entering a vortex ring state, before it landed heavily and rolled onto its side. The occupants escaped from the aircraft with one passenger sustaining a minor injury.

History of the flight

Following a successful start-up at the second attempt, the helicopter, with three passengers, lifted from Coal Aston Airfield (elevation 720 ft amsl), 5 nm south of Sheffield. The pilot reported that he flew a vertical takeoff, climbing to a height of around 50 ft, before he transitioned the helicopter into forward flight. Approximately 15 minutes later the helicopter arrived at a boar shooting ground where the pilot intended to hover, so they could wave at some friends. The boar shooting ground is in the Peak District National Park at approximately 1,000 ft amsl. The pilot flew over the selected site and circled whilst losing height. He then made an approach, with full carburettor heat applied, on an easterly heading, and reportedly came to a hover with 23 inches of power, at a height of 70 ft agl.

The pilot reported that after 2 or 3 seconds in the hover, he looked inside the helicopter to check the instruments; when he looked back outside, the helicopter was sinking. He raised the collective lever, but this had little effect and they continued to sink. Realising he was now too low to fly away, the pilot made the decision to try and land, on uneven ground to his right. He lowered the collective lever and yawed the helicopter to face into the hill, then pulled the collective back up to cushion the touchdown. The helicopter landed heavily on the front of its skids and then rolled onto its right-hand side before coming to a halt.

The pilot and his passengers, were able to vacate the helicopter by climbing through the left doors, although the passengers on the left (upper) side needed some assistance in undoing their seatbelts. The front seat passenger had a small cut to his head, but the rest of the occupants, though shaken, were unhurt. The pilot made the helicopter safe, by turning off the fuel and the electrics, and was then able to see ground marks which indicated to him that it had probably rolled onto its side when one of the main rotor blades had struck the ground.

Meteorology

The weather conditions were good with no significant cloud and good visibility. The Doncaster METAR at 1120 hrs showed the wind as 280°at 10 kt, the visibility was more than 10 km, the lowest clouds were at 4,000 ft, the temperature was 21°C and the QNH was 1020 hPa. At Manchester at 1150 hrs, the wind was 270° at 11 kt, more than 10 km visibility, the lowest cloud was 3,600 ft, the temperature was 19°C and the QNH was 1018 hPa.

Weight and balance

The loading calculations in the pilot's initial accident report show a pilot and passenger combined weight of 770 lbs which would have meant the helicopter was 29 lb above its maximum takeoff weight of 2,400 lbs. The pilot's calculations did not include an aircraft cover and several litres of oil, which were contained in one of the rear baggage compartments, and were reported to weigh 17 lb. The AAIB received a separate report that the weights used by the pilot for his loading calculation were incorrect, and detailed pilot and combined passenger weights of 182 lbs and 609 lb respectively; this would have made the aircraft's takeoff weight 2,467 lb.

The pilot was asked to reconfirm his weight and that of the passengers, and he provided new figures of 154 lb for himself and a combined weight of 574 lb for the passengers. The investigation also contacted the passengers individually for their weights, and established a combined weight of 595 lb, which would have placed the aircraft slightly above its maximum takeoff weight.

Aircraft performance

The pilot described the aircraft making a downwind transition to an OGE hover at the boar shooting ground (approximately 1,000 ft amsl). The performance section of the POH for the R44 shows at this altitude and temperature, in zero wind, the aircraft should be able to hover OGE at its max weight 2,400 lbs. There is a note in the performance section of the POH that all hover performance data is given with the carburettor heat off:

> *'Full carburettor heat reduces hover ceilings by up to 2400 feet.'*

With full carburettor heat applied, the maximum weight the aircraft should have been able to hover OGE at the boar shooting ground would be approximately 2,230 lbs.

Pilot's assessment of cause

The pilot reported he did not see or feel anything unusual in entering the hover, but that the aircraft lost power. When asked why he had used full carburettor heat, the pilot stated he had been taught "you can never have too much carb heat". He was unaware that carburettor heat had an adverse effect on the aircraft's performance.

Robinson Safety Tips

The Robinson R44 POH has a section containing safety tips and the following were considered relevant to this accident.

> *'10. Never make takeoffs or landings downwind, especially at high altitude. The resulting loss of translational lift can cause the aircraft to settle into the ground or obstacles.*
>
> *11. A vertical descent or steep approach downwind can result in "settling with power." This happens when the rotor is settling in its own downwash and additional power will not stop the descent. Should this occur, reduce collective and lower the nose to increase airspeed. Settling with power can be very dangerous near the ground as the recovery results in a substantial loss of altitude.'*

Analysis

The relatively inexperienced pilot flew the helicopter, at close to its maximum weight, downwind to an OGE hover, in hilly terrain with full carburettor heat applied. The performance figures in the POH show this was outside the declared flight envelope of the helicopter. Having reached the hover, it therefore started to descend, and probably entered a vortex ring state (settling with power) before landing heavily. As the helicopter had taken off and flown without incident for 15 minutes to its destination, the initial unsuccessful start-up attempt was considered to be unrelated to the accident.

Safety Message

The CAA issue a series of Safety Sense Leaflets; Number 17 concerns helicopter airmanship and contains a range of advice pertinent to the prevention of this type of accident.

ACCIDENT

Aircraft Type and Registration:	1) Robinson R44 II, G-SAIG 2) Spitfire IXT, G-CCCA
No & Type of Engines:	1) 1 Lycoming IO-540-AE1A5 piston engine 2) 1 Rolls-Royce Merlin 66 piston engine
Year of Manufacture:	1) 2006 (Serial no: 11364) 2) 1944 (Serial no: CBAF 9590)
Date & Time (UTC):	15 June 2016 at 1151 hrs
Location:	Lashenden (Headcorn) Aerodrome, Kent
Type of Flight:	1) Private 2) Safety Standards Acknowledgement and Consent
Persons on Board:	1) Crew - 1 Passengers - 1 2) Crew - 1 Passengers - 1
Injuries:	1) Crew - None Passengers - None 2) Crew - None Passengers - None
Nature of Damage:	1) Tail rotor guard, empennage and stabilizer 2) Propeller blade
Commander's Licence:	1) Private Pilot's Licence 2) Airline Transport Pilot's Licence
Commander's Age:	1) 56 years 2) 56 years
Commander's Flying Experience:	1) 208 hours (of which 131 were on type) Last 90 days - 2 hour Last 28 days - 2 hour 2) 20,000 hours (of which 101 were on type) Last 90 days - 34 hours Last 28 days - 16 hours
Information Source:	Aircraft Accident Report Form submitted by the R44 pilot, report from Spitfire pilot and further AAIB enquiries

Synopsis

The Robinson R44 helicopter hover taxied across Runway 28 as the Spitfire was completing its landing roll. The propeller of the Spitfire contacted the empennage of the helicopter but neither pilot was aware there had been contact, although a bump was felt in the R44. The helicopter returned to the apron for an inspection, where damage to its empennage and tail rotor guard was discovered.

History of the flight

The Spitfire

The Spitfire was carrying out a series of pleasure flights under the Safety Standards Acknowledgement and Consent regulations (explained later in this report). The weather conditions were reported as clear, with a Met Office weather observation at 1155 hrs at Frittenden, 4 km south west of Headcorn, recording the surface wind as being from the south-south-west at 7 kt, with gusts to 12 kt.

The pilot joined the circuit, reported "downwind" and then made a continuous left turn on to the final approach for Runway 28, a grass runway (Figure 1). He reported "final to land" during the turn, which was acknowledged by the Air/Ground (A/G) radio operator, and, in the turn, observed a helicopter hovering to the south of the runway, near the parking area. He maintained visual contact with the helicopter, until rolling wings level at about 100 ft agl on the final approach path. With the surface wind from the south-west, the nose of the aircraft was offset to the left as the pilot lined up with the runway, thereby obscuring his view of the parking apron.

After touching down and rolling along the runway centreline for approximately 200 m, the Spitfire pilot saw a helicopter pass, left to right, directly above his aircraft. He was not aware of any contact but on inspection after shutdown, minor damage to one propeller blade was discovered.

The Robinson helicopter

The helicopter pilot and his passenger, who was also a qualified pilot, had planned a private flight to the Isle of Wight. From the apron area to the south of Runway 28, the helicopter lifted into the hover, after the pilot had received approval on the A/G radio frequency, and hover taxied north towards the helicopter holding point on the north side of the airfield, near the Runway 03 threshold, which is used prior to departure from Runway 28. The pilot looked for other traffic and transmitted "crossing active" as he continued towards the threshold of Runway 03. Meanwhile, as the helicopter lifted in to the hover, the passenger had turned his attention to his iPad, on which he was plotting the route.

As they crossed the runway, the pilot and passenger both heard a noise and the passenger felt a slight bump. They saw the Spitfire to their left and after a short time decided to return to the apron. On inspection, damage to the empennage and tail rotor guard was discovered.

Witnesses

A tractor, moving from west to east, was mowing the grass to the south of Runway 28. The driver was wearing headphones and listening out for aircraft movements on the airband radio. He heard normal 'downwind', and 'finals' radio calls from the Spitfire, and heard the helicopter pilot advising they had two persons on board and were departing to the Isle of Wight. He saw the helicopter hover taxiing away from the apron, north towards the runway, at an estimated speed of 10 kt, and heard the pilot call "crossing active" but at a lower volume than on the previous transmissions. He realised that the helicopter was not going to stop and watched it cross the runway as the Spitfire was completing its landing roll. He thought an accident was about to occur but he did not see evidence of any contact between the two aircraft.

A second witness, the pilot of a light aircraft, had just landed on Runway 28 and was taxiing back to the parking area. He could see the Spitfire on final approach and stopped to watch it land. While he was watching, he noticed a helicopter hover taxiing north towards the runway. He assumed it would hold on the south side and turned his attention back to the Spitfire. He watched the landing and the ground roll and was surprised, then, to see the Spitfire pass to the rear of the helicopter, meaning that the helicopter was above or across the runway.

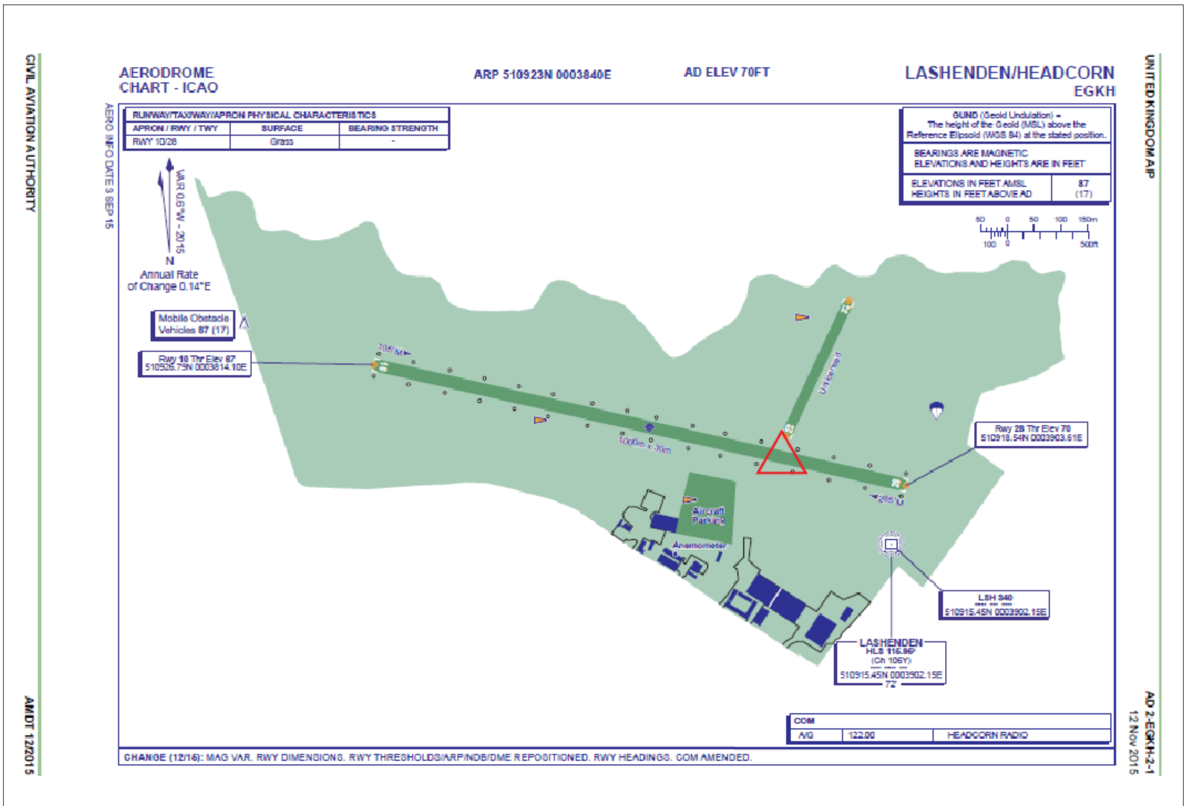


Figure 1

Lashenden/Headcorn Aerodrome
(red triangle indicates the location where contact between the two aircraft occurred)

Helicopter pilot

The helicopter pilot reported that he had stopped to look for traffic and made a radio call before crossing to the north side. He did not hear any other traffic on the frequency. As he crossed Runway 28, he heard a "whooshing" noise but did not feel any contact. He concluded that he had not seen the other aircraft because he was looking for aircraft on approach and not on the ground.

Airfield information

Lashenden/Headcorn Aerodrome operates an A/G Communication Service; non-radio aircraft being accepted with prior permission. A/G radio operators are not able to issue instructions to aircraft but rotorcraft are required to obtain a clearance prior to rotor engagement.

Organisational and guidance information

The CAA publications CAP 1395, '*Safety Standards Acknowledgement and Consent (SSAC)'* and CAP 1396, '*Framework for the evaluation of aviation activities for payment based on Safety Standards and Consent'* set out the requirements for the operation of flights where members of the public can pay to fly as a passenger in an aircraft not operated under an Air Operator's Certificate (AOC). This allows paid recreational flying, with the underlying principle of a consent-based activity. The following guidelines apply:

- *'The participants are informed of the risks involved with participating in the activity*
- *The participants are able and willing to consent to assume the risks involved with participating in the activity, and give such consent*
- *The level of risk to the public at large is not increased beyond a margin which is acceptable to the CAA and the public at large'*

The CAA publication Safety Sense Leaflet 13, *'Collision Avoidance',* provides advice for pilots on how to conduct an effective lookout. It also contains the following guidance:

> *'Encourage your passengers to assist in the look-out.'*

The CAA publication CAP 413, '*Radiotelephony Manual',* advises:

> *'Air/Ground Communication Service operators are not to pass instructions and must use the phraseology they would use for the movement of aircraft on the aerodrome.'*

When Spitfire operations were in progress at Headcorn, an additional sign board was placed at the light aircraft holding area for Runway 28, to caution pilots. A similar sign was not available for helicopter operations, because a sign board where the runway is crossed would create an obstruction.

Analysis

The Spitfire pilot flew a curved approach to maintain a view of the runway. However, once he was lined up with the runway, his view ahead and to the left was obscured by the nose of the aircraft. This approach pattern may have been unfamiliar to the helicopter pilot and, as a result, when he looked out before crossing the runway he did not see the Spitfire. The helicopter was hover taxiing in gusty tailwind conditions and, although the pilot reported that he had stopped to look, evidence from the other witnesses suggested that the helicopter continued moving forwards.

Safety action has since been taken by the aerodrome operator, to require helicopter pilots to stop and make an additional radio call before crossing the active runway.

The helicopter passenger, who would also have had an opportunity to see the Spitfire, was directing his attention elsewhere.

The Spitfire was operated under the terms of SSAC, whereby a passenger who has paid for the flight is made aware of the increased level of risk, relative to that for an AOC flight. However, it was concluded that this accident could equally have occurred during an AOC operation.

Conclusion

The helicopter pilot did not see the Spitfire on approach, probably because he looked in the wrong direction. The passenger did not participate in the lookout.

Safety action

After the accident, the Aerodrome Safety Manager issued a safety notice to the helicopter operator based at the airfield, requiring helicopters to hold short of the active runway and request clearance to cross. The A/G radio operator will then inform the helicopter pilot of any known traffic and the pilot, having checked it is safe to do so, may then cross the runway.

ACCIDENT

Aircraft Type and Registration:	Socata TB9, G-BTWX	
No & Type of Engines:	1 Lycoming O-320-D2A piston engine	
Year of Manufacture:	1991 (Serial no: 1401)	
Date & Time (UTC):	24 March 2016 at 1245 hrs	
Location:	Jericho Farm, Lambley, Nottinghamshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Damaged beyond economic repair	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	69 years	
Commander's Flying Experience:	839 hours (of which 168 were on type) Last 90 days - 0 hours Last 28 days - 0 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB	

Synopsis

Whilst taking off from a farm strip, the pilot believed the aircraft would collide with a van moving along a road that bounded the strip, and climbed the aircraft at a low speed soon after getting airborne. The aircraft's right wing dropped, struck the van and detached from the aircraft. The aircraft came to rest in a field on the other side of the road. There were no injuries.

The pilot used ground roll performance data to calculate the takeoff distance required (TODR), and determined that the distance available was sufficient. Using information about the total distance to clear a 50 ft obstacle would have indicated that the available distance was inadequate.

History of the flight

The pilot stated that he had been monitoring the weather and the farm strip's ground conditions for some weeks before the accident flight, to determine when conditions would be suitable to fly. He had last flown in November 2015, as previously the ground had been too soft or the wind too light.

On the day of the accident the pilot noted that the wind was forecast to be increasing to greater than 20 kt from the south-west after 1200 hrs. When he arrived at the farm strip the wind sock indicated a wind speed of less than 20 kt. He decided to attempt to take off, but aborted it when the aircraft did not achieve the desired 50 KIAS when half way along the runway. He delayed any further attempt by an hour in anticipation of the wind speed increasing.

At about 1230 hrs the windsock indicated wind from about 225° at more than 20 kt which the pilot equated to a 15 kt headwind component. He started the aircraft and taxied to the eastern end of the strip, lining up with 540 m of the 580 m available because the first 40 m of the westerly runway were soft. During the takeoff, the aircraft had reached the desired 50 KIAS about half way along the runway, so he committed to the takeoff. Shortly thereafter he felt the aircraft's acceleration slow but, at 55 kt, rotated the aircraft and flew it level to increase airspeed. At this point he spotted a van travelling in a southerly direction on the road that passes the end of the runway. Believing he might collide with it the pilot attempted to climb the aircraft, but as he did so the right wing dropped. He attempted to correct this with left rudder and by easing the control column forward, but without success. The right wing struck the van while banked approximately 90° right, and detached from the aircraft. Having crossed the road, the aircraft then slid to a halt in a field on the other side. The pilot vacated the aircraft; both he and the van driver were uninjured. The aircraft was damaged beyond economic repair.

One witness stated that the wind may have reduced at about the time the aircraft passed the halfway point of the runway (when the IAS was above 50 kt).

Airfield information

The farm strip is situated 4 nm north-east of Nottingham. It is approximately 1,902 ft (580 m) long and orientated 257/077°M. There is a hedge at the end of the westerly runway and a road beyond the boundary of the strip. There is no anemometer at the strip but it is equipped with a "20 kt wind sock"[1].

The pilot commented that due to the length of the strip he takes off with no passengers and no more than 5 US gallons of fuel in each tank; each tank has a capacity of 20.8 US gallons. He then flies to Nottingham Airport, 5 nm to the south, to refuel.

Meteorology

A Met Office aftercast for the period stated that the wind across the area was from the south-west at 10 kt increasing to 17 kt later in the day, the temperature was 7 to 9°C and the atmospheric pressure fell steadily through the period from around 1011 to 1007 hPa as surface fronts approached.

Nottingham/Watnall observatory, 6 nm west, reported that at 1200 hrs the wind was from 210° at 10 kt, temperature was 9°C and the QNH was falling from 1010 hPa.

East Midlands Airport, 12 nm south-west, reported at 1250 hrs, the wind was from 210° at 15 kt, temperature 8°C and QNH 1009 hPa.

Footnote

1 A 20 kt windsock is horizontal when the wind speed is 20 kt or more.

Aircraft performance

CAA guidance

Safety Sense Leaflet 7 – Aeroplane Performance states:

> *'The pilot in command has a legal obligation under EU Part-NCO and Article 87 of the Air Navigation Order 2009, which require the pilot to check that the aeroplane will have adequate performance for the proposed flight…*
>
> *Where data allows adjustment for wind, it is recommended that not more than 50% of the headwind component…of the reported wind be assumed.*
>
> *Safety Factors*
>
> *1. Take-off*
>
> *It is strongly recommended that the appropriate Public Transport factor, or one that at least meets that requirement,* ***should be applied for all flights*** [AAIB bold]. *For take-off this factor is x1.33 and applies to all single-engined aeroplanes…The table at the end of this leaflet* [See Figure 1] *gives guidance for pilots of aeroplanes for which there is only UNFACTORED data...*
>
> *Where several factors are relevant, they must be* ***multiplied****. The resulting Take-Off Distance Required to a height of 50 feet (TODR)* ***can become surprisingly high*** [AAIB bold].*'*

Pilot's calculations

The pilot reported that the aircraft's basic weight was 1,572 lb. He weighed 224 lb and there were approximately 60 lb of fuel aboard; about 19 litres (5 US gallons) in the left fuel tank and 6 litres (1.5 US gallons) in the right. These resulted in a takeoff weight of 1,856 lb.

Using takeoff performance data from the *Pilot's Information Manual* for the aircraft (shown in Figure 2) the pilot calculated that at a TOW of 1,874 lb, at 15°C and at sea level, the TODR would be 804 ft; which he rounded up to 900 ft. He then added 70% to this figure for the variables shown in Figure 3, as follows: 2% uphill slope (10%), soft ground (40%), increased humidity (10%) and engine wear (10%). This indicated that in still-air the TODR would be 1,530 ft. Using a personal 'rule of thumb' he reduced this by a further 1% for each knot of head wind, or a total of 15% (230 ft). This resulted in a calculated TODR of 1,300 ft (396 m).

The pilot commented that he expected the aircraft to be airborne in less than 1,300 ft (396 m) because he believed he had made a generous allowance for these variables.

The pilot was not aware that the CAA recommended applying a factor of 1.33 to takeoff distance calculations. Doing so would result in a calculated TODR of 1,729 ft. Alternatively, using the manufacturer's suggested 38% '*public transport safety factor*' would increase it to 1,794 ft (547 m).

FACTORS MUST BE MULTIPLIED e.g. 1.20 x 1.35

	TAKE-OFF		LANDING	
CONDITION	INCREASE IN TAKE-OFF DISTANCE TO HEIGHT 50 FEET	FACTOR	INCREASE IN LANDING DISTANCE FROM 50 FEET	FACTOR
A 10% increase in aeroplane weight, e.g. another passenger	20%	1.20	10%	1.10
An increase of 1,000 ft in aerodrome elevation	10%	1.10	5%	1.05
An increase of 10°C in ambient temperature	10%	1.10	5%	1.05
Dry grass* - Up to 20 cm (8 in) (on firm soil)	20%	1.20	15%⁺	1.15
Wet grass* - Up to 20 cm (8 in) (on firm soil)	30%	1.3	35%⁺ Very short grass may be slippery, distances may increase by up to 60%	1.35
Wet paved surface	-	-	15%	1.15
A 2% slope*	Uphill 10%	1.10	Downhill 10%	1.10
A tailwind component of 10% of lift-off speed	20%	1.20	20%	1.20
Soft ground or snow*	25% or more	1.25 +	25%⁺ or more	1.25 +
NOW USE ADDITIONAL SAFETY FACTORS (if data is unfactored)		**1.33**		**1.43**

Notes:

1. * Effect on Ground Run/Roll will be greater. Do not attempt to use the factors to reduce the distances required in the case of downslope on take-off or upslope on landing.
2. ⁺ For a few types of aeroplane (e.g. those without brakes) grass surfaces may decrease the landing roll. However, to be on the safe side, assume the INCREASE shown until you are thoroughly conversant with the aeroplane type.
3. Any deviation from normal operating techniques is likely to result in an increased distance.

If the distance required exceeds the distance available, changes will HAVE to be made.

Figure 1

CAA Safety Sense Leaflet additional factors

SOCATA
MODEL TB 9

SECTION 5
PERFORMANCE

TAKE-OFF PERFORMANCE

Conditions: IAS : Lift off : 60 KIAS – 69 MPH IAS
Clear 50 ft : 62 KIAS – 71 MPH IAS
Weight : 1874 lbs (850 kg)

Temperature	Distance	Pressure altitude (ft)				
		0	2000	4000	6000	8000
- 4ºF (- 20ºC)	Roll (ft)	574	705	853	1050	1230
	Clear 50 ft (ft)	902	1099	1345	1673	2100
+ 32ºF (0ºC)	Roll (ft)	689	804	1001	1181	1411
	Clear 50 ft (ft)	1066	1247	1558	1936	2526
+ 59ºF (+ 15ºC)	Roll (ft)	804	951	1083	1280	1558
	Clear 50 ft (ft)	1198	1427	1723	2182	2936
+ 86ºF (+ 30ºC)	Roll (ft)	869	1001	1198	1411	1706
	Clear 50 ft (ft)	1312	1542	1936	2494	3412
+ 104ºF (+ 40ºC)	Roll (ft)	951	1116	1280	1509	1887
	Clear 50 ft (ft)	1427	1690	2083	2690	4249

Fig 5.6 – TAKE-OFF PERFORMANCE (1874 lbs)

September 30, 1988 5.9

Figure 2

Aircraft takeoff performance table

SOCATA
MODEL TB 9 "U.K. Version"

SECTION 5
PERFORMANCE

NOTICE

Performance given in this Section are based on tests and interpolated to standard conditions (ICAO) and extrapolated from parameters : weight, altitude, temperature...

Factors relative to pilot's experience, to relative bad airplane's condition are not taken into account.

It is prudent to add safety factors :

A list of variables affecting performance together with guide line factor is shown hereafter, This table represents the increase in take-off distance to a height of 50 ft or the increase in landing distance from 50 ft.

Variable	Increase in take-off distance to height 50 ft	Increase in landing distance from 50 ft
Dry grass (*) – Short (under 5 in) – Long (between 5 & 10 in)	20 % 25 %	20 % 30 %
Wet grass (*) – Short – Long	25 % 30 %	30 % 40 %
A 2 % slope (*)	uphill 10 %	downhill 10 %
Soft ground or snow (*)	25 % or more	25 % or more
Public transport safety factor	38 %	43 %

(*) Effect on ground run / roll will be greater

NOTE :
For higher humidity conditions, such as those found in the United Kingdom and Northern Europe, the scheduled figures should be amended as follows:

Take-off ground runs and total distance to clear
50 ft obstacle : Increase by 10 %
Rate of climb : Reduce by 10 %

September 30, 1989 5.7

Figure 3

Takeoff variables

AAIB calculations

The manufacturer's publication advised that safety factors should be added. Accordingly, the AAIB calculated that at a TOW of 1,874 lb, at 8°C and at 300 ft amsl, with a pressure of 1009 hPa (412 ft pressure altitude) the basic TODR to clear 50 ft would be 1,178 ft. When increased by the pilot's chosen variables of 70%, plus 20% for short dry grass, the resulting still-air TODR was 2,238 ft. The AAIB was not aware of a documented basis for applying the pilot's 'rule of thumb' for this aircraft, but doing so would produce a TODR of 1,903 ft (580 m). Adding the manufacturer's public transport safety factor this rises to 2,626 ft (800 m).

Using the same factors, but multiplying them as recommended by the CAA, would result in a TODR of 3,090 ft (942 m).

Discussion

The pilot calculated the TODA was adequate by calculating the TODR using the ground roll from the aircraft's take off performance tables. Given the hedge at the end of the farm strip and traffic passing on the road, the distance to clear 50 ft would have been more appropriate. He also did not include the factor for short dry grass. Had the pilot used this distance the calculated TODR would have been 590 m, 50 m in excess of the TODA and the takeoff should not have been attempted. Using the conditions on the day the TODR was also greater than the TODA. When the manufacturer's safety factor is added the TODRs are increased to a greater degree.

The wind reports at Nottingham and East Midlands indicated that the wind speed was less than 20 kt at these locations. If at the time of the accident this was the case at the strip, or the wind reduced as one of the witnesses noted, the takeoff run would have been further extended.

ACCIDENT

Aircraft Type and Registration:	Tecnam P2002-JF Sierra, G-TECI
No & Type of Engines:	1 Rotax 912-S2 piston engine
Year of Manufacture:	2010 (Serial no: 127)
Date & Time (UTC):	15 September 2016 at 1415 hrs
Location:	Haverfordwest Airfield, Pembrokeshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Collapsed nosewheel, damage to propeller, left wingtip and pitot tube
Commander's Licence:	Light Aircraft Pilot's Licence
Commander's Age:	75 years
Commander's Flying Experience:	337 hours (of which 20 were on type) Last 90 days - 5 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional enquiries made by the AAIB

The pilot applied full power to take off from asphalt Runway 03; the wind was northerly at about 8 to 9 kt. At approximately 45 kt, in accordance with the manufacturer's flight manual, he began to raise the nose. However, the nose rose more abruptly than expected and he released the back pressure he was applying on the control stick. The nose then dropped and, at the same time, the aircraft adopted a left wing-down attitude and veered to the left. The aircraft, which had briefly become airborne, struck the ground and came to rest in the long grass adjacent to the runway. The pilot and passenger were able to vacate the aircraft without difficulty and were uninjured. The pilot considered that gusty wind conditions may have contributed to the loss of control.

Although it was not possible to determine whether it was a contributing factor to this accident, the AAIB is aware of a number of runway excursions to the left featuring this class of aircraft which have relatively high power-to-weight ratios; the tendency to swing to the left at high power is more pronounced at low airspeeds and an appropriate application of right rudder is required to control it.

ACCIDENT

Aircraft Type and Registration:	Fournier RF5, G-AZPF
No & Type of Engines:	1 Sportavia-Limbach SL 1700-E piston engine
Year of Manufacture:	1968 (Serial no: 5001)
Date & Time (UTC):	2 October 2016 at 1241 hrs
Location:	Manchester Barton Aerodrome
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to fuselage and wing
Commander's Licence:	Private Pilot's Licence
Commander's Age:	78 years
Commander's Flying Experience:	338 hours (of which 29 were on type) Last 90 days - 5 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot had carried out a local area flight and returned to land on grass Runway 26R. The weather was good, with calm wind conditions, CAVOK, an OAT of 16°C, dew point 09°C and QNH 1016 hPa. He had previously flown Cessna aircraft and had experienced difficulty judging the round out in the Fournier. On final approach, which he described as "stable", he thought he was too high and, at a speed of 60 kt, closed the throttle and fully opened the airbrakes. This corrected his approach path and he commenced the flare in the correct place but too high. As he was maintaining back pressure on the control stick, the airspeed decayed and the aircraft stalled from an estimated height of 5 to 10 feet. The aircraft landed heavily on the grass runway and veered off to the right, suffering damage to its fuselage and wing. The pilot, who was wearing a full harness, was uninjured and exited the aircraft unassisted, as normal.

The pilot considered that, when it was apparent that he had rounded out too high, he should have carried out a go-around.

ACCIDENT

Aircraft Type and Registration:	Ikarus C42 FB80, G-SARM	
No & Type of Engines:	1 Rotax 912-UL piston engine	
Year of Manufacture:	2005 (Serial no: 0504-6674)	
Date & Time (UTC):	22 July 2016 at 1930 hrs	
Location:	Redlands Airfield, Wiltshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - 1 (Minor)	Passengers - N/A
Nature of Damage:	Moderate damage to engine cowling and propeller, nose landing gear detached	
Commander's Licence:	National Private Pilot's Licence	
Commander's Age:	41 years	
Commander's Flying Experience:	126 hours (of which 16 were on type) Last 90 days - 7 hours Last 28 days - 5 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

Synopsis

The pilot reported that the aircraft was on base leg to land at Redlands Airfield when he realised there were cattle near the runway. He extended his base leg to land on a parallel but shorter runway. Whilst on finals he decided to touch down as near to the threshold as possible to make full use of the runway available. As he got nearer to the threshold his sink rate was higher than expected and the aircraft landed and bounced. The aircraft then hit the runway heavily on the nose landing gear which then detached. The pilot vacated the aircraft unaided but had sustained minor injuries in the accident.

History of the flight

The aircraft was returning to Redlands Airfield and joined downwind to use Runway 24 North. The pilot reported that, on turning to base leg, he noticed cattle close to the runway. He extended his base leg to use the parallel but shorter Runway 24 South and during finals he made the decision to land as near to the threshold as possible in order to make use of all the available runway. As the aircraft approached the threshold the pilot felt the aircraft sink more quickly than expected and prepared for a hard landing. He tried to 'hold off' by bringing the aircraft nose up but the aircraft touched down and bounced. The nose then dropped and hit the runway, overloading the nose landing gear which detached and the aircraft came to a stop. The pilot vacated the aircraft unaided but had sustained minor injuries in the accident.

Discussion

In the pilot's own analysis after the accident he considered the cause to be that he did not react to the increased sink rate in time. He also felt that the application of full throttle to go around, rather than attempting to correct the bounce, might have prevented the nose-hard landing.

ACCIDENT

Aircraft Type and Registration:	Mainair Blade 912, G-BYHS
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	1999 (Serial no: 1187-0299-7-W990)
Date & Time (UTC):	21 October 2016 at 1103 hrs
Location:	Shobdon Airfield, Herefordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Rear right top and bottom suspension arms, drag link, spat, propeller blades and petrol tank
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	135 hours (of which 135 were on type) Last 90 days - 5 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Shortly after having landed on asphalt Runway 27, the pilot applied the brakes but, rather than providing a progressive braking action, the brakes began to "snatch" and the pilot released them. A few seconds later the right undercarriage collapsed and the pilot lost directional control. The aircraft departed the right side of the runway before coming to a stop having turned through 180°. The pilot was uninjured and vacated the aircraft unaided.

Inspection of the aircraft showed that the right drag link had failed, causing the right undercarriage to collapse and move aft into the path of the propeller. The pilot considered that the drag link had broken due to an excessive load being placed upon it when the brakes were applied.

ACCIDENT

Aircraft Type and Registration:	Zenair CH 601UL Zodiac, G-CBUR
No & Type of Engines:	1 Rotax 912-S piston engine
Year of Manufacture:	2002 (Serial no: PFA 162A-13891)
Date & Time (UTC):	22 July 2016 at 1000 hrs
Location:	Headon Microlight Strip, near Gamston, Nottinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damaged beyond economic repair
Commander's Licence:	Private Pilot's Licence
Commander's Age:	59 years
Commander's Flying Experience:	187 hours (of which 59 were on type) Last 90 days - 22 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Runway 14 was used for takeoff as the pilot believed this offered sufficient downslope to compensate for a possible 3 kt tailwind. The temperature was 26ºC and the aircraft was close to maximum weight but the pilot knew the airstrip well and did not calculate the required takeoff run. He anticipated being airborne before reaching a prominent dip in the grass surface, approximately two-thirds of the way along the 600 m strip.

Figure 1

Zenair CH 601UL Zodiac, G-CBUR

(photograph courtesy of Mr Steve Barnes)

The takeoff roll was longer than expected and, although the pilot rotated just before the 'dip', he believed, in retrospect, that he probably rotated at a slightly lower airspeed than normal. At this stage the controls felt "heavy" and, when only a few feet above the ground, the left wing dropped. The pilot was unable to regain control and the aircraft veered into a hedge and span around its left wingtip. Although the aircraft was severely damaged, the canopy opened normally and the two occupants vacated without assistance. They had been wearing lap and diagonal harnesses and were uninjured.

In future, the pilot intends to calculate his aircraft's takeoff performance, with appropriate allowance for the ambient conditions. He believes he was caught out, on this occasion, by the combined effects of a tailwind and the low atmospheric density.

Miscellaneous

This section contains Addenda, Corrections and a list of the ten most recent Aircraft Accident ('Formal') Reports published by the AAIB.

The complete reports can be downloaded from the AAIB website (www.aaib.gov.uk).

BULLETIN CORRECTION

Aircraft Type and Registration:	Piper PA-46-350P Malibu Mirage, N186CB
Date & Time (UTC):	14 November 2015 at 1134 hrs
Location:	Buttles Farm, Churchinford, Somerset
Information Source:	AAIB Field Investigation

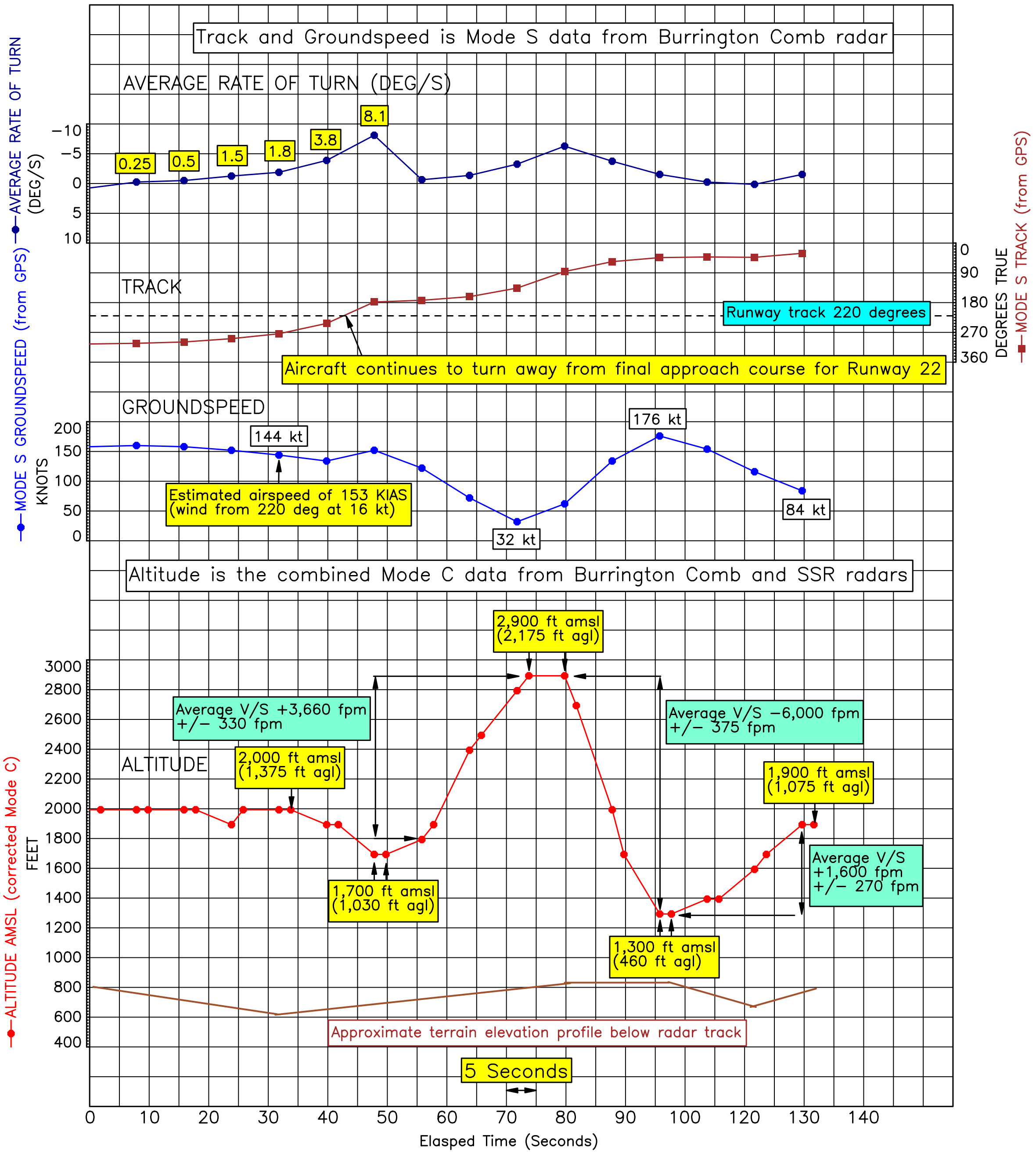
AAIB Bulletin No 11/2016, page 11 refers

The report published in AAIB Bulletin 11/2016 included a plot of recorded radar data for the accident flight (see Figure 3 on page 11).

In the middle of Figure 3, under the altitude ‘2,900 ft amsl’, the height should have been ‘***2,175 ft agl***’, not ‘1,175 ft agl’. The supporting text, analysis and conclusions were unaffected by this error.

The corrected version of Figure 3 appears on the next page.

The online version of this report was corrected on 22 November 2016.


Track and Groundspeed is Mode S data from Burrington Comb radar
AVERAGE RATE OF TURN (DEG/S)
0.25
0.5
1.5
1.8
3.8
8.1
TRACK
Runway track 220 degrees
Aircraft continues to turn away from final approach course for Runway 22
GROUNDSPEED
144 kt
176 kt
Estimated airspeed of 153 KIAS (wind from 220 deg at 16 kt)
32 kt
84 kt
Altitude is the combined Mode C data from Burrington Comb and SSR radars
2,900 ft amsl (2,175 ft agl)
Average V/S +3,660 fpm +/− 330 fpm
Average V/S −6,000 fpm +/− 375 fpm
ALTITUDE
2,000 ft amsl (1,375 ft agl)
1,900 ft amsl (1,075 ft agl)
Average V/S +1,600 fpm +/− 270 fpm
1,700 ft amsl (1,030 ft agl)
1,300 ft amsl (460 ft agl)
Approximate terrain elevation profile below radar track
5 Seconds
Elasped Time (Seconds)
AVERAGE RATE OF TURN (DEG/S)
MODE S GROUNDSPEED (from GPS) KNOTS
ALTITUDE AMSL (corrected Mode C) FEET
DEGREES TRUE
MODE S TRACK (from GPS)

BULLETIN CORRECTION

Aircraft Type and Registration:	Zenair CH 601XL Zodiac, G-EXXL
Date & Time (UTC):	19 June 2016 at 1110 hrs
Location:	Pilling Sands, Morecambe, Heysham, Lancashire
Information Source:	Aircraft Accident Report Form submitted by the pilot

AAIB Bulletin No 11/2016, page 93 refers:

The final paragraph under the heading ‘Safety Action’ should read as follows:

> For conspicuity at night, all Permissions for night operations will state (and detail) that the kite should be lit in the manner previously required by Rule 52.

The online version of the Bulletin was amended on 11 November 2016.

TEN MOST RECENTLY PUBLISHED FORMAL REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

1/2011 Eurocopter EC225 LP Super Puma, G-REDU
near the Eastern Trough Area Project Central Production Facility Platform in the North Sea
on 18 February 2009.

Published September 2011.

2/2011 Aerospatiale (Eurocopter) AS332 L2 Super Puma, G-REDL
11 nm NE of Peterhead, Scotland
on 1 April 2009.

Published November 2011.

1/2014 Airbus A330-343, G-VSXY
at London Gatwick Airport
on 16 April 2012.

Published February 2014.

2/2014 Eurocopter EC225 LP Super Puma
G-REDW, 34 nm east of Aberdeen, Scotland on 10 May 2012
and
G-CHCN, 32 nm south-west of Sumburgh, Shetland Islands
on 22 October 2012.

Published June 2014.

3/2014 Agusta A109E, G-CRST
Near Vauxhall Bridge, Central London
on 16 January 2013.

Published September 2014.

1/2015 Airbus A319-131, G-EUOE
London Heathrow Airport
on 24 May 2013.

Published July 2015.

2/2015 Boeing B787-8, ET-AOP
London Heathrow Airport
on 12 July 2013.

Published August 2015.

3/2015 Eurocopter (Deutschland) EC135 T2+, G-SPAO
Glasgow City Centre, Scotland
on 29 November 2013.

Published October 2015.

1/2016 AS332 L2 Super Puma, G-WNSB
on approach to Sumburgh Airport
on 23 August 2013.

Published March 2016.

2/2016 Saab 2000, G-LGNO
approximately 7 nm east of Sumburgh Airport, Shetland
on 15 December 2014

Published September 2016.

Unabridged versions of all AAIB Formal Reports, published back to and including 1971, are available in full on the AAIB Website

http://www.aaib.gov.uk

GLOSSARY OF ABBREVIATIONS

aal	above airfield level
ACAS	Airborne Collision Avoidance System
ACARS	Automatic Communications And Reporting System
ADF	Automatic Direction Finding equipment
AFIS(O)	Aerodrome Flight Information Service (Officer)
agl	above ground level
AIC	Aeronautical Information Circular
amsl	above mean sea level
AOM	Aerodrome Operating Minima
APU	Auxiliary Power Unit
ASI	airspeed indicator
ATC(C)(O)	Air Traffic Control (Centre)(Officer)
ATIS	Automatic Terminal Information System
ATPL	Airline Transport Pilot's Licence
BMAA	British Microlight Aircraft Association
BGA	British Gliding Association
BBAC	British Balloon and Airship Club
BHPA	British Hang Gliding & Paragliding Association
CAA	Civil Aviation Authority
CAVOK	Ceiling And Visibility OK (for VFR flight)
CAS	calibrated airspeed
cc	cubic centimetres
CG	Centre of Gravity
cm	centimetre(s)
CPL	Commercial Pilot's Licence
°C,F,M,T	Celsius, Fahrenheit, magnetic, true
CVR	Cockpit Voice Recorder
DME	Distance Measuring Equipment
EAS	equivalent airspeed
EASA	European Aviation Safety Agency
ECAM	Electronic Centralised Aircraft Monitoring
EGPWS	Enhanced GPWS
EGT	Exhaust Gas Temperature
EICAS	Engine Indication and Crew Alerting System
EPR	Engine Pressure Ratio
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
FAA	Federal Aviation Administration (USA)
FDR	Flight Data Recorder
FIR	Flight Information Region
FL	Flight Level
ft	feet
ft/min	feet per minute
g	acceleration due to Earth's gravity
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
hrs	hours (clock time as in 1200 hrs)
HP	high pressure
hPa	hectopascal (equivalent unit to mb)
IAS	indicated airspeed
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IP	Intermediate Pressure
IR	Instrument Rating
ISA	International Standard Atmosphere
kg	kilogram(s)
KCAS	knots calibrated airspeed
KIAS	knots indicated airspeed
KTAS	knots true airspeed
km	kilometre(s)
kt	knot(s)
lb	pound(s)
LP	low pressure
LAA	Light Aircraft Association
LDA	Landing Distance Available
LPC	Licence Proficiency Check
m	metre(s)
mb	millibar(s)
MDA	Minimum Descent Altitude
METAR	a timed aerodrome meteorological report
min	minutes
mm	millimetre(s)
mph	miles per hour
MTWA	Maximum Total Weight Authorised
N	Newtons
N_R	Main rotor rotation speed (rotorcraft)
N_g	Gas generator rotation speed (rotorcraft)
N_1	engine fan or LP compressor speed
NDB	Non-Directional radio Beacon
nm	nautical mile(s)
NOTAM	Notice to Airmen
OAT	Outside Air Temperature
OPC	Operator Proficiency Check
PAPI	Precision Approach Path Indicator
PF	Pilot Flying
PIC	Pilot in Command
PNF	Pilot Not Flying
POH	Pilot's Operating Handbook
PPL	Private Pilot's Licence
psi	pounds per square inch
QFE	altimeter pressure setting to indicate height above aerodrome
QNH	altimeter pressure setting to indicate elevation amsl
RA	Resolution Advisory
RFFS	Rescue and Fire Fighting Service
rpm	revolutions per minute
RTF	radiotelephony
RVR	Runway Visual Range
SAR	Search and Rescue
SB	Service Bulletin
SSR	Secondary Surveillance Radar
TA	Traffic Advisory
TAF	Terminal Aerodrome Forecast
TAS	true airspeed
TAWS	Terrain Awareness and Warning System
TCAS	Traffic Collision Avoidance System
TGT	Turbine Gas Temperature
TODA	Takeoff Distance Available
UHF	Ultra High Frequency
USG	US gallons
UTC	Co-ordinated Universal Time (GMT)
V	Volt(s)
V_1	Takeoff decision speed
V_2	Takeoff safety speed
V_R	Rotation speed
V_{REF}	Reference airspeed (approach)
V_{NE}	Never Exceed airspeed
VASI	Visual Approach Slope Indicator
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	VHF Omnidirectional radio Range

AAIB Air Accidents Investigation Branch