AAIB
Air Accidents Investigation Branch

Annual Safety Review 2021

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Foreword

I am pleased to introduce this Annual Safety Review which includes information on occurrences notified to the AAIB in 2021, and the safety action taken or planned in response to AAIB investigations which concluded in 2021.

Although the coronavirus pandemic continued to have a profound effect on some categories of aviation activity in 2021, the AAIB still received 746 occurrence notifications (compared to 826 in 2019 and 553 in 2020) and opened 28 field investigations, 5 of which were into fatal accidents in the UK resulting in 7 deaths. A further 96 investigations were opened by correspondence.

In addition, the AAIB appointed an accredited representative to 46 overseas investigations in 2021 and these continue to be a very important part of our work. An article on how we collaborate internationally is included in this Review.

All the fatalities from air accidents in the UK in 2021 were associated with General Aviation (GA). Most involved loss of control, either at low speed close to the ground, or following an inadvertent entry into clouds by pilots without an IMC rating. The normal seasonal variations in GA activity were exaggerated somewhat by lockdowns in 2021 but the overall accident statistics and prevalent occurrence types were not unusual.

International travel restrictions continued to suppress Commercial Air Transport (CAT) activity, with a commensurate reduction in CAT occurrences. A few serious incidents were directly related to the return to flying, some due to aircraft system failures but also some associated with a lack of aircrew recency. The absence of a surge in incidents in 2021 perhaps reflected the success of the industry in managing the risks associated with the return to flying and also the slow pace of the recovery. That said, the destabilising effects of the pandemic on the entire aviation eco-system may continue for some time and there is no room for complacency with regard to aviation safety.

Unmanned aircraft systems (UAS) occurrences accounted for a quarter of the notifications received by the AAIB in 2021 and the increased levels of reporting from this sector is welcomed. The AAIB has been investigating selected UAS accidents since 2015 and an article on what we have learnt and fed back to the industry is included in this Review. Unfortunately, some of the hard lessons learnt in the development of manned aviation in the 20th century (such as the need to expect and train for failures) are having to be relearnt by the UAS sector in the 21st century. Our investigation of selected occurrences is helping to accelerate this process.

The sole objective of an AAIB investigation is the prevention of future accidents. In 2021 the AAIB issued 37 Safety Recommendations including 8 which were classified as safety recommendations of global concern (SRGC). Most of the recommendations related to

the regulation of aircraft operations or the regulation of aircraft design, production and manufacturing. In this Review there are full details of each recommendation, together with the response received and updates on the progress of the action taken.

The AAIB will always share information on safety issues as soon as possible during an investigation and this can often lead to safety action being taken by the operator, manufacturer or responsible authority while the investigation is still ongoing. The final section of this Review provides details of 188 significant actions to enhance safety taken proactively by the industry in 2021 as a direct result of AAIB investigations.

The 2021 Annual Safety Review brings together in one place a wealth of safety information which I trust you will find interesting and useful.

Contents

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AAIB Unmanned Aircraft Systems (UAS) Investigations Lessons Learnt

Background

The AAIB started investigating UAS accidents in 2015. Since then, we have published reports on 61 accidents involving UAS and published short 'Record Only' details on a further 164 UAS accidents. We have also recorded the details of 148 additional UAS events that have been reported to us but which did not warrant an investigation.

In the AAIB's Annual Safety Review 2018 we published an article on our UAS accident investigation process. We listed the following benefits to investigating UAS accidents:

- It increases AAIB knowledge of UAS and helps to prepare us for an accident involving a serious injury, fatality or a serious mid-air collision.
- It allows us to identify possible trends that might inform the regulations, change operational restrictions or training requirements.
- It enables us to inform UAS manufacturers of potential design issues.
- Unlike regulators and manufacturers, the AAIB can conduct a wholly independent investigation.
- The AAIB can make the investigation findings public and make safety recommendations intended to prevent recurrence.

We have deployed teams to investigate two accidents involving large UAS, a 180 kg Tekever AR5 Evoluation Mk 2 (G-TEKV) at Lydd Airport on 29 December 2020 (Figure 1) and a 95 kg Airspeeder at Goodwood Aerodrome on 4 July 2019 (Figure 2).

Figure 1
Tekever AR5 Evolution

UAS Safety Recommendations

The majority of UAS accident investigations are conducted via correspondence but occasionally some get upgraded to field investigations if they are particularly complex or involve safety recommendations. So far, the AAIB has made 21 Safety Recommendations related to UAS, of which 15 concerned the Airspeeder UAS accident (Figure 2). The remaining six were related to four different UAS investigations involving small quadcopter UAS. One of these recommendations was to a manufacturer to provide prompt technical support to Safety Investigation Authorities (SIA). The remaining five were to the CAA and concerned:

- Determining UAS failure rates to facilitate risk assessments of UAS operations
- Reviewing the rules on overflight of uninvolved persons
- Publishing a safety notice to advise operators of issues with moisture ingress regarding a specific UAS
- Requiring UAS operators in the Specific Category to routinely practice manual flying and emergency actions

A further four Safety Recommendations related to a UAS accident are currently at draft stage.

Figure 2
Alauda Airspeeder Mk II (exemplar model)

UAS accidents by Event Category

The AAIB has been categorising UAS accidents using the ICAO's 'Event Category' taxonomy. We have also added our own category for UAS which is 'UAS - Loss of Link'. The 'Fuel related' category covers battery issues.

Figure 3 shows the number of UAS accidents by event category. Some accidents have more than one category.

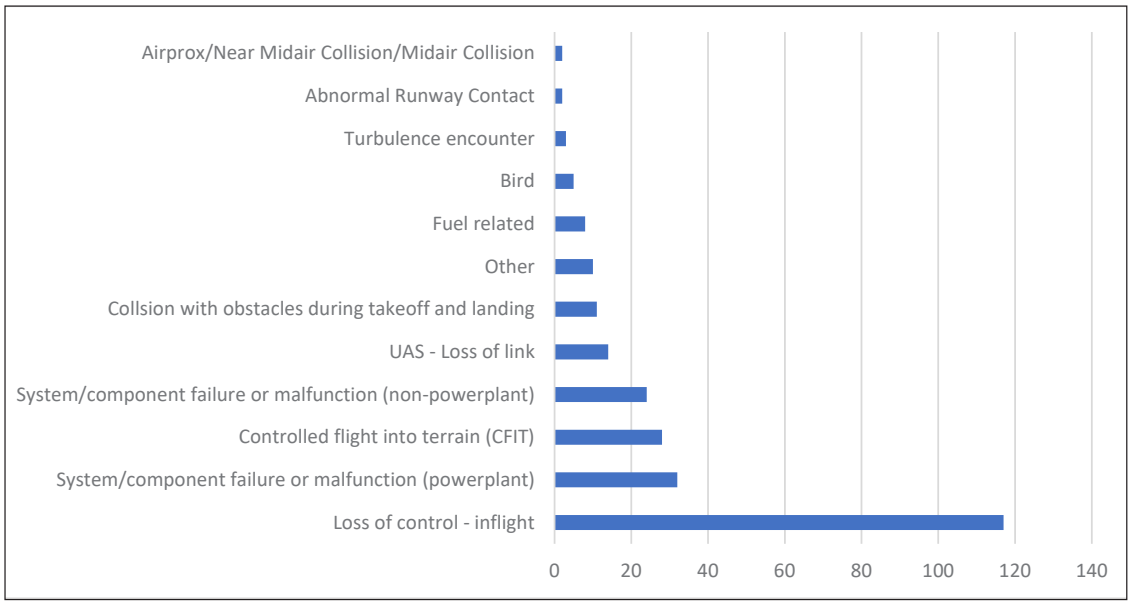


Figure 3

UAS accidents reported to the AAIB and categorised by Event Category

We have investigated two mid-air collisions, although these involved conventional radio controlled model gliders colliding with light aircraft. One of these occurred above 1,000 feet agl but that was six years ago before the 400 ft maximum height rule was introduced. The other accident occurred in the circuit. In both accidents the light aircraft were able to land safely.

System/component failure or malfunction feature highly for both non-powerplant and powerplant categories. The most common category is 'Loss of control – inflight', but 40 accidents involving this category have a secondary factor, of which 16 feature powerplant failure.

56% of the accidents categorised involved quadcopter type UAS manufactured by DJI, but this is primarily because DJI UAS make up a very large proportion of the market.

Serious injuries from UAS accidents

The AAIB is only aware of one UAS accident in the UK involving a serious injury which occurred in October 2015 when a quadcopter drone flew into an 18 month old child during a recreational flight. One of the propeller blades cut through the child's eyeball and the eye could not be saved. The French BEA has reported on an accident involving a DJI Inspire 2 quadcopter UAS which seriously injured three people in the audience of an outdoor concert on 14 July 2019. The UA struck a vertical structure on the side of the stage and then flew into the crowd where people were injured by the propeller blades.

UAS investigations lessons learnt

Some of the lessons we have learnt so far are:

- A 1.4 kg UA falling from 8 m could cause a fatal injury
- Quadcopter UA can fall from the sky for many different reasons:
  - Battery failure (hardware or firmware related)
  - Motor failure
  - Speed controller failure (sometimes due to moisture ingress)
  - Propeller failure/detachment

Figure 4

DJI M600 Pro after falling into a garden

- Compass interference results in many multi-rotor UA no longer being able to position-hold using GPS, leading to fly-away events.
- UAS pilots often use the 'return-to-home' button to get them out of trouble and find that it does not work, and then by the time they take manual control the UA is too far away to see.
- Sometimes there are no manuals for the 'app' used to control the UA.
- UAS manufacturers are not used to working with SIAs.
- Some in the UAS industry have little or no aviation background.
- Some are making the same mistakes that were made in the development of manned aviation a few decades ago such as:
    - Lack of redundancy in designs
    - Not considering all the possible failure mechanisms
    - Human factors not considered in design of controller
    - Operators not expecting or training for failures

We continue to learn new lessons as we investigate UAS accidents and we disseminate them in our reports in the hope that others will learn from them. All our reports on UAS accidents are available to read on our website at this link: AAIB UAS accident reports.

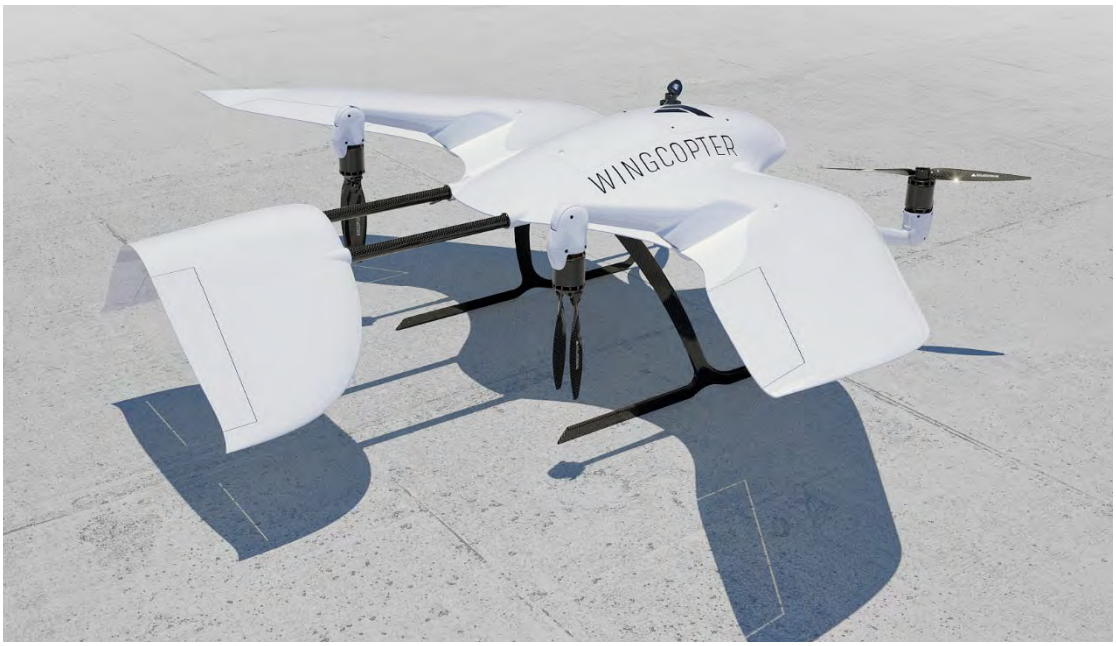


Figure 5

Wingcopter 178 Heavylift with propellers positioned in 'hover mode'

How the AAIB Fulfils its Worldwide Responsibility

Introduction

The AAIB is the UK State air accident investigation authority (AIA). Its role is familiar to the public and the AAIB is usually seen investigating and reporting on aircraft accidents and serious incidents in and around the UK. However, it is not quite so well known that the AAIB has a worldwide responsibility and participates in many aircraft accident investigations abroad. This article sets out how the AAIB participates and assists other States with their investigations.

Aviation safety is of international importance and the majority of States[1] have aircraft AIA working under International Civil Aviation Organisation (ICAO) Annex 13 Standards and Recommended Practices. These are the internationally agreed protocols by which aircraft accident investigation is carried out. They take effect in UK legislation through the Civil Aviation (Investigation of Aircraft Accidents and Incidents) Regulations 2018[2] and Retained Regulation (EU) 996/2010 (as amended)[3]. The international nature of aviation means the majority of aircraft accidents require cooperation and assistance from other States in one form or another.

What triggers AAIB involvement?

The State of Occurrence, ie where the accident took place, has an obligation to institute an investigation and notify any State that is entitled to participate in the investigation as defined in the international protocols.

The State of Occurrence must notify other interested States as follows.

- *State of Registry*

  The State on whose register the aircraft is entered. For the UK it is any aircraft that carries a 'G' registration, or an aircraft registered in one of the UK Overseas Territories or Crown Dependencies.

- *State of the Operator*

  The State in which the operator's principal place of business is located or, if there is no such place of business, the operator's permanent residence. These can be large or small airlines or companies. It does not include private individuals who own aircraft which are not used for commercial gain but are for private use only.

Footnotes

1 There are 193 ICAO contracting States that are requiured to have an independent AIA under ICAO Annex 13.
2 https://www.gov.uk/government/publications/the-civil-aviation-investigation-of-air-accidents-and-incidents-regulations-2018 [accessed February 2022].
3 https://www.gov.uk/government/publications/regulation-eu-no-9962010 [accessed Febraury 2022].

- *State of Design*

  The State having jurisdiction over the organisation responsible for the type design.

- *State of Manufacture*

  State having jurisdiction over the organisation responsible for the final assembly of the aircraft, engine or propeller. With multinational companies and internationally distributed aircraft and component manufacture this is perhaps the most complex requirement to apply.

In addition, the State conducting the investigation can also formally request assistance from any other State. Upon receipt of notification or request for assistance, a State is entitled to appoint an Accredited Representative (Acc Rep) under the agreed protocols and responsibilities.

How this is carried out in practice

In response, the notified States decide whether they wish to exercise the right to appoint an Acc Rep. This position is afforded rights and responsibilities within ICAO Annex 13, including the entitlement to appoint one or more advisers[4] to assist in the investigation.

The AAIB will appoint an Acc Rep from its pool of investigators, known as Inspectors of Air Accidents.

On appointment, a decision is made as to whether the Acc Rep will travel to the State of Occurrence or whether the support to the investigation can be carried out within the UK.

The decision as to whether the Acc Rep travels, or not, is made by an AAIB Duty Coordinator[5] and is agreed with the Chief or Deputy Chief Inspector of Aircraft Accidents (CIAA/DCIAA). Their decision generally takes the following into consideration:

- The nature of the event (accident or serious incident).
- The focus of activities for the Acc Rep ie at the accident site or in the UK gathering information, attending a manufacturing or maintenance facility or interviewing crew members.
- The location and the 'in-field' risks. For example, considerations may include the availability of timely transport, the local political situation, or the risks to personal safety. Advice may be sought from the Foreign, Commonwealth and Development Office (FCDO). Environmental conditions are also considered but Inspectors are trained and equipped for most conditions.

Footnotes

[4] An adviser is an individual who is asked to assist in an investigation because of their expertise or knowledge. They may, for example, be another AAIB investigator or a representative from a manufacturer or operator.

[5] The Duty Coordinator is an AAIB Principal Inspector charged with deciding and enacting the AAIB response to notifications. There is always a Duty Coordinator available on call.

- The ability to deploy an Acc Rep using available transport options in time to join the investigation and be able to make a meaningful contribution. For example, during the Covid 19 pandemic, international travel restrictions meant immediate departure was not always possible.

The AAIB will not normally deploy any Inspector overseas unless they can be accompanied by at least one other Inspector, normally from a different discipline[6]. One of this team (of 2 or more Inspectors) will be appointed as the Acc Rep and the remainder will be appointed as advisors to the Acc Rep. The focus, as understood in the initial phases of an investigation, will usually define whether the Acc Rep will be an operations, engineering, recorded data or human factors Inspector.

Role and privileges of the Accredited Representative

The Acc Rep is the UK State representative as defined in ICAO Annex 13 and as such acts as the primary interface with the State conducting the investigation. They are responsible for any UK advisers appointed in support. They are representing the UK in safety investigation matters and are not representing or acting as the champion for any UK commercial entity. That said they should ensure that the investigation is not biased in any way and that UK organisations are afforded the appropriate rights, recognition and participation in the investigation.

An Acc Rep has the following obligations:

- To provide the State conducting the investigation with all relevant information available to them.
- Not to divulge information on the progress and the findings of the investigation without the express consent of the State conducting the investigation.
- To provide pertinent information on any organisation whose activities may have directly or indirectly influenced the operation of the aircraft.
- To furnish the State conducting the investigation with the flight recorder records and, if necessary, the associated flight recorders when an aircraft involved in an accident or a serious incident lands in a State other than the State of Occurrence.
- To play an active part in the investigation and offer their area of expertise to the Investigator-in-Charge (IiC).

Footnote

6 There are four disciplines of AAIB Inspector: Operations, Engineering, Recorded Data and Human Factors.

The Acc Rep is entitled to:

- Visit the scene of the accident.
- Examine the wreckage.
- Obtain witness information and suggest areas of questioning.
- Have full access to all relevant evidence as soon as possible.
- Receive copies of all pertinent documents.
- Participate in read-outs of recorded media.
- Participate in off-scene investigative activities such as component examinations, technical briefings, tests and simulations.
- Make submissions in respect of the various elements of the investigation.

The Acc Rep fulfils a very important role that inevitably requires diplomacy and careful management. Accident investigations are often emotionally charged and move at a significant pace, particularly at the beginning in the 'field phase', with numerous different organisations involved. It is essential therefore, that the Acc Rep forms an amicable working relationship with the IiC appointed by the Foreign State.

It is often the case that investigators have met before and are acquainted. This may have been as a result of previous investigations or involvement in some of the many international forums and organisations in which the AAIB is involved. This is very advantageous in forming good relationships.

An Acc Rep is required to participate fully in the investigation and must be impartial and keep an open mind throughout the investigation. An Acc Rep is required to contribute and assist in all aspects of the investigation and be 'hands on' during the various processes. An example of this is shown in Figure 1. The AAIB Acc Rep in this case was assisting with preparations for cutting and disassembly prior to the removal of the wreckage of a UK manufactured aircraft from a challenging accident site in the US.

The Acc Rep responsibilities extend beyond the accident 'field' phase of the investigation. They must produce timely results from the tasks requested of them and keep up to date with the progress of the investigation. They must also keep track of the preparation of the draft final report and be prepared to assist with review and comment on specific aspects or matters of fact during its construction, if requested to do so by the IiC.

The UK Acc Rep will often remain in the UK and not travel to the accident site (referred to as a Non-travelling Acc Rep). In this case the Acc Rep and their advisers will provide the necessary assistance to the investigation from the UK, especially on those aspects which are UK based tasks.

Figure 1
Example of Acc Rep involvement at an accident site abroad

It is the responsibility of the Acc Rep to endeavour to comply with the task requested. An Acc Rep is required to use their authority within their own regulations to make all the necessary arrangements to oversee the task requested. This reduces the need for costly and time consuming travel by the State of Occurrence investigators. It also allows an IiC to concentrate on the overall investigation whilst the Acc Rep can focus on a specific aspect.

An Operations Inspector may be asked to interview a flight crew or passengers who have returned to the UK. They may also be asked to obtain training records and licencing documentation; interview flying instructors or listen to cockpit voice recording (CVR) with flight crews at the AAIB. The Acc Rep must ensure that all the international protocols on the protection of CVR recordings and witness confidentiality are rigidly adhered to.

Recorded Data Inspectors are often asked to recover data from damaged electronic devices and download and analyse flight data recordings from the FDR and cockpit audio recordings from the CVR.

Engineering Inspectors may be asked to obtain aircraft maintenance documents and either examine and report on them or arrange for despatch to the overseas IiC.

There is also a practical role for the Engineering Acc Rep which is often used by the AAIB and Foreign State investigators. When the aircraft or a component has been manufactured, maintained or overhauled in the UK or where a third party UK based organisation is best placed to offer a specific or unique expertise, the IiC may require that component to be tested and will ask the Acc Rep to do this on their behalf.

In practice, the item concerned, a component or a CVR/FDR will be packed and despatched to the UK by the IiC. It is clearly marked that it is subject to an ICAO Annex 13 investigation and that it should only be opened in the presence of the nominated State Acc Rep. It must be held in quarantine by the receiver until then.

In the case of an aircraft component, at a mutually agreed time, the Acc Rep will visit the third party, who will have been assigned as Advisers to the investigation. The Acc Rep will oversee the opening, examination and testing of the item as required for the investigation. Figure 2 shows an example of the sort of work an Acc Rep may be required to oversee.

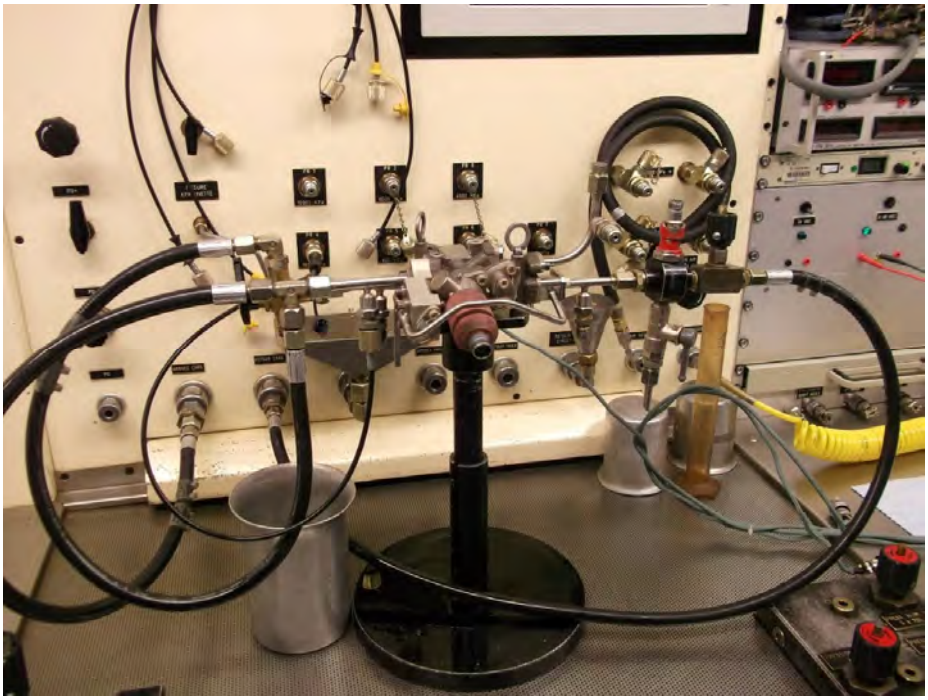


Figure 2

Fuel component bench test, an example typical of the work an Acc Rep may be required to oversee

The third-party adviser will report their findings on the examination and testing to the Acc Rep who will then forward it to the IiC with added comments, observations or analysis as required.

AAIB involvement by virtue of CVR and FDR data download capabilities

As the AAIB has world-leading facilities and the expertise to deal with damaged CVRs, FDRs and other devices containing recorded data, the AAIB often appoints Acc Reps to assist other States in this respect even though there may be no direct UK connection with the aircraft involved. Such recorders can be sent, or brought to the AAIB, where they are secured and dealt with in the AAIB laboratories. Figure 3 shows a CVR undergoing download and analysis.

Figure 3
CVR undergoing download and analysis at the AAIB

Completion of the case

The State of Occurrence must publish a final report. A copy of the draft report will normally be sent to the AAIB Acc Rep inviting 'significant and substantiated comments'. The Acc Rep's responsibility is then to coordinate comments from all the UK advisers and dispatch them to the IiC for consideration. It is very important that the AAIB Acc Rep ensures that the comments from UK organisations are discussed and supported by the AAIB before they are forwarded to the IiC. This is important because if there is any disagreement by the IiC with the comments, under the regulations the AAIB can request that these are appended to the final report. In practice though, this situation is rare.

Expert

Where a State has a special interest in an accident by virtue of fatalities or serious injuries to its citizens it is entitled to appoint an 'Expert'. Unlike the Acc Rep role, an Expert is not entitled to fully partake in an investigation. However, they are afforded modest rights under ICAO Annex 13 to:

- Visit the scene of the accident.
- Have access to the relevant factual information which is approved for public release by the State conducting the investigation, and information on the progress of the investigation.
- Receive a copy of the Final Report.

This will not preclude the State concerned from also assisting in the identification of victims or with meetings with survivors from that State.

However, the Expert has a very important responsibility to provide support to the victims and their families. An Expert will provide updates on the progress of the investigation and explain the protocols and how aspects of investigations are carried out.

A recent example was the accident to the Boeing 737 Max in Ethiopia in 2019. The AAIB sent three inspectors to offer assistance. The team were allowed to visit the accident site to make notes and take photographs in accordance with the protocols. The team assisted the Ethiopian based UK diplomatic staff at the accident site. Information was also provided to the families and to the Coroner as the investigation progressed. Figure 4 shows this in practice and is a general view of the accident site in Ethiopia.

Figure 4
General view of the accident site in Ethiopia

Inquests and Fatal Accident Inquiries

If accident victims are repatriated to the UK, the AAIB Acc Rep or Expert may be required to attend an Inquest (in England, Wales or Northern Ireland) or a Fatal Accident Inquiry (Scotland). In these cases, the AAIB Acc Rep or Expert may be called to explain aspects of the final report published by the State that carried out the investigation to assist with the court's understanding of it.

Observers

Occasionally the UK AAIB is invited to send Inspectors to observe or participate in major accident investigations in other states when there is no formal UK connection under the ICAO Annex 13 protocols. This is highly beneficial in developing Inspectors' skills, particularly for large investigations.

As a general rule, Inspectors invited to observe an investigation should not become directly involved with activities inside the wreckage cordon. However, AAIB Inspectors are often asked to contribute based on their experience and expertise. In these circumstances a formal Acc Rep request is then pursued.

Other considerations

High level diplomacy

The role of an Acc Rep should not be underestimated. There have been recent cases during investigations of worldwide significance, where the AAIB Acc Rep has interacted with UK and foreign dignitaries at the highest levels. Openness, impartiality and diplomacy are extremely important in these cases, whilst maintaining the independence of the aircraft accident investigation. Great care is taken by the AAIB to recruit and train investigators who are able to fulfil this demanding role.

Geographical considerations

Approximately 70% of the globe is covered by sea and in cases where an aircraft accident occurs in international waters, the State of Registration leads the investigation but the Annex 13 protocols regarding Acc Reps, advisors and Experts apply in the same way.

Delegation of investigations

There are occasions when the location or resources required, can mean the State responsible for instituting an investigation may not be in a position to lead the investigation. A pragmatic solution is allowed for in the protocols whereby responsibility for the investigation can be formally delegated to another State. For example, in a recent case, a fatal accident occurred to an aircraft on the US register at sea near the Channel Islands and the US National Transportation Safety Board (NTSB) delegated the investigation to the AAIB.

Occasionally a State of Occurrence does not institute, conduct or delegate an investigation. Under ICAO Annex 13, the State of Registry or the State of Operator, Design, or Manufacture, in that order, are entitled to request the delegation of the investigation. If consent is given or there is no answer, the requesting State may undertake an investigation with the evidence available and publish a report.

International cooperation

The AAIB promotes cooperation in aircraft accident investigation and is an active member of many international organisations and committees. Aviation safety is of worldwide importance and transcends political differences. The AAIB is internationally seen as impartial and

independent, and on many occasions has assisted States with their investigation activiites, despite political differences with the UK, in order to further aviation safety.

Final thought

The AAIB has a worldwide role in aircraft accident investigation and aviation safety. To that end, AAIB Inspectors are regularly involved in investigations orchestrated by other States. As can be seen from the statistics, the AAIB travelling and non-travelling Acc Reps are involved with 40 investigations on average every year, this is a significant and important part of the overall workload of the AAIB.

Accident Timeline

The timeline illustrated here shows the various steps taken by the AAIB from the initiation of an investigation to the publication of a report. It shows a typical accident where the AAIB deploy a team to investigate the causes and contributory factors in a commercial air transport or general aviation accident or serious incident.

1 Notification

The AAIB are notified of an incident to an aircraft or unmanned air system (UAS). The notification is usually by telephone call or electronic media. Notifications are immediately acted upon; 24 hours a day 7 days a week.

2 Assessment

An AAIB Principal Inspector in the role of Duty Coordinator will assess the information received and if necessary, seek further clarification. A response decision is taken which can range from no further action to initiating a major deployment of an AAIB team.

Most accidents require a small team of three or four Inspectors. There are two teams available at any one time.

A team will prepare and depart to the scene of the accident as soon as possible. In the UK this is usually by road but further afield, such as Northern Ireland or Scotland, the team may use commercial flights.

3 Evidence Gathering

On arrival the Inspectors commence the investigation and gather evidence.

Depending on the nature of the accident, small aircraft wreckage will be recovered to the AAIB headquarters. Large commercial aircraft may require local hangarage or, if they are relatively undamaged, will be formally handed back to the owner or operator.

On average the work at the accident site takes three or four days.

4 Investigation

On return to the AAIB HQ, the evidence and initial findings are presented to the Chief Inspector of Aircraft Accidents (CIAA) and all the AAIB staff. A decision is then made on the scope of the investigation with agreed resources and timelines where possible.

Work continues using the evidence to establish the causal and contributory factors of the accident. This may require testing and research and additional witness interviews, data analysis as well as forensic examination of the aircraft and its components.

This work often takes several weeks if not months to complete.Throughout AAIB inspectors are mindful that they may find something which requires immediate safety action. If this should be the case, the AAIB will publish a Special Bulletin.

5 Report Review and Preparation

The investigation team prepares the report as the investigation progresses. The facts and evidence are analysed, with regular analysis reviews and in some cases with peer reviews too. During this analysis the casual and contributory factors, and safety issues are identified that may require a safety recommendation. These safety issues are discussed with the responsible authority and where action is being taken this will be reflected in the report. If a Safety Recommendation is proposed this is assessed under a specific peer review.

The time necessary to review and prepare the draft report is dependent on the complexity of the accident and the report can go through several iterations.

Accident Timeline cont

6 Consultation Period

A confidential draft report is prepared and provided to those States and authorities that have been involved in the investigation and anyone whose reputation is likely to be affected. The consultation is carried out under the relevant regulations with a response, containing any substantive representations, required within 28 days, which can be extended on request.

7 Response Review

When all the responses have been received from those that have been consulted the IIC will consider each response along with the investigation team and decide on whether there is a need to amend the report. It is also possible that new evidence may be presented by consultees that requires further investigative work and may result in a further consultation.

8 Approval for publication

The draft report is submitted by the IIC for final approval for publication, after which it is passed to the publications team for preparation for publication – including proof reading.

9 Pre-Publication

Prior to publication, the final report is provided to those involved in the accident and the relatives of the victims. The report is also provided to the other States involved, the relevant authorities and advisers, so that they are fully aware of the contents of the report and can prepare for any public or media enquiries. The pre-publication report is a protected document and cannot be disclosed until it is published.

10 Publication

The report is published either online as soon as it is ready for field and formal investigations or in the monthly bulletin for others. The publication is publicly available on the AAIB website. Letters are sent to the addressees of the safety recommendations in the report asking for their response within 90 days on the action they are likely to take or if no action is being taken as to the reason why.

11 Post-Publication

Following publication, the investigation team provide Statements to the Coroner or Procurator Fiscal and may subsequently appear in the Coroner's Inquest or Fatal Accident Inquiry.

Where a safety recommendation has been made the AAIB will assess responses and track proposed actions.

The investigation could be "reopened" if in the opinion of the Chief Inspector there is new and significant evidence which will require a return to step 4.

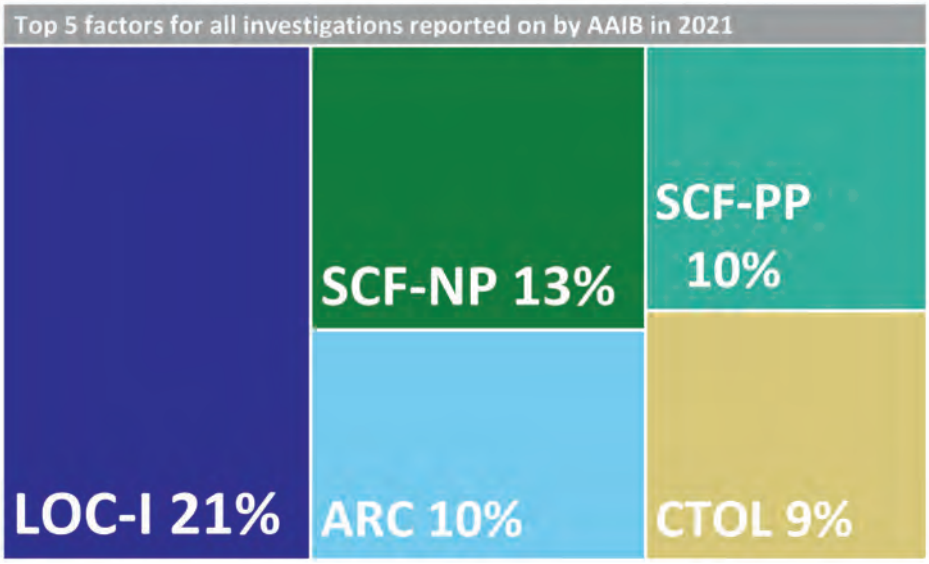
CICTT factors on investigations by the AAIB in 2021

Every occurrence in the UK is recorded and coded using the occurrence taxonomy defined by the CAST/ICAO Common Taxonomy Team (CICTT). This is a worldwide standard taxonomy to permit analysis of data in support of safety initiatives.

It should be noted that an investigation may find multiple causal or contributary factors, for example turbulence (TURB) leading to abnormal runway contact (ARC). Many of the causal or contributory factors feature as low percentages, between 1% and 4%. Therefore, unlike previous years, the AAIB has chosen only to show the top 5 percentage factors which featured during 2021 in the following set of graphics.

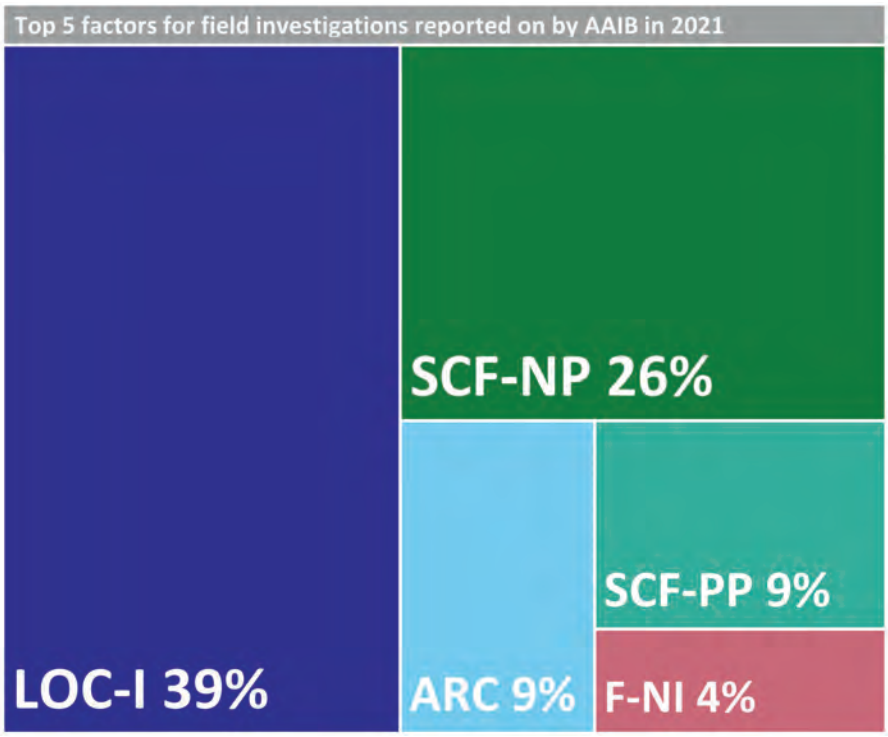
(The abbreviations can be found in Appendix 1.)

All Investigations



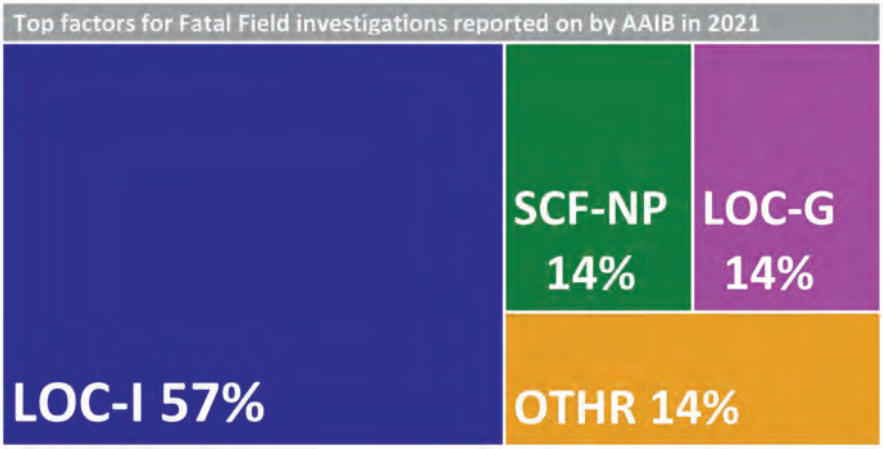
As in previous years, the overall predominant factor in aircraft accidents and serious incidents is loss of control in flight (LOC-I).

Field Investigations



In 2021 the AAIB published 24 field investigation reports, five were investigations into fatal GA accidents. There were 17 field investigations into non-fatal accidents or serious incidents to both GA and CAT aircraft. Two UAS field investigations were also published. LOC-I and SCF-NP were the predominant factors and have increased since 2020.

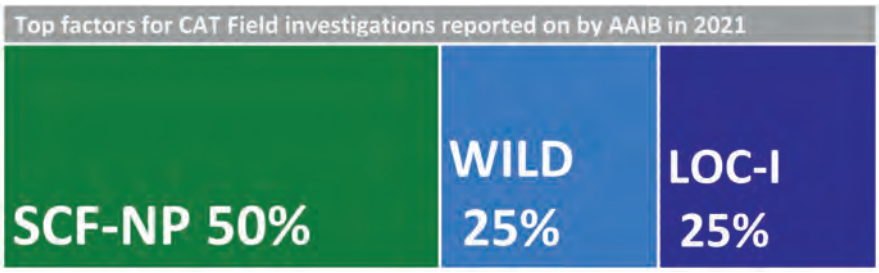
Field Investigations into Fatal Accidents



(All GA accidents, there were no fatal CAT accidents in 2021)

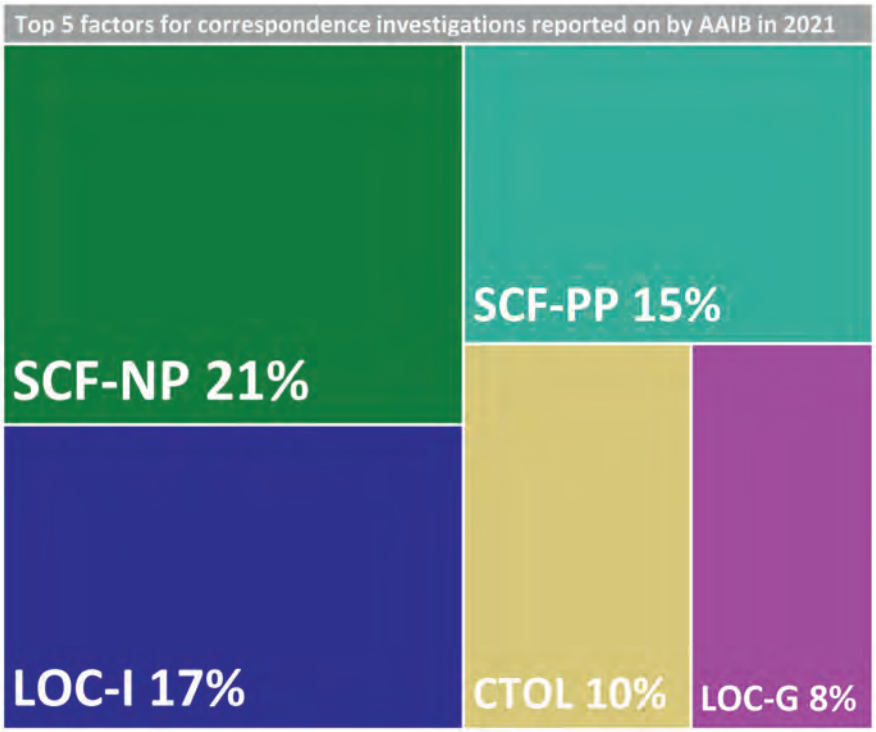
The predominant factor in fatal accidents was LOC-I. This usually results from low speed near to the ground and the aircraft stalling with an incipient or fully developed spin.

CAT Field Investigations



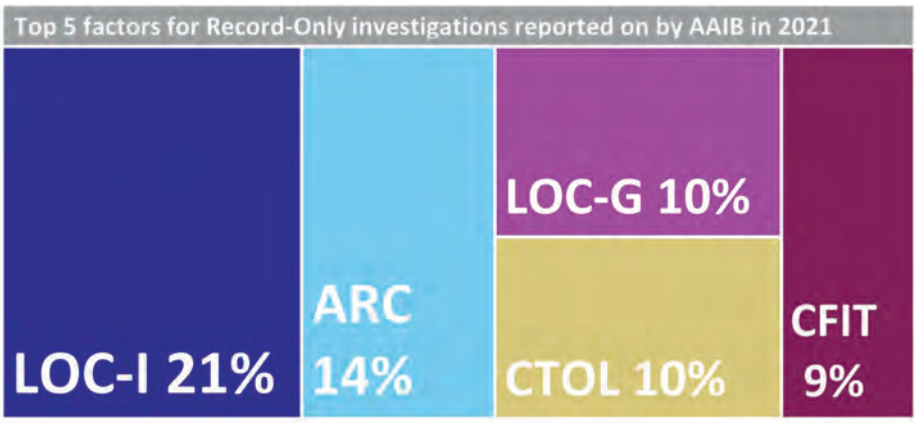
In contrast to GA, the predominant factor in CAT accident and serious incidents was system or component failure – non power plant (SCF-NP).

Correspondence (AARF) Investigations



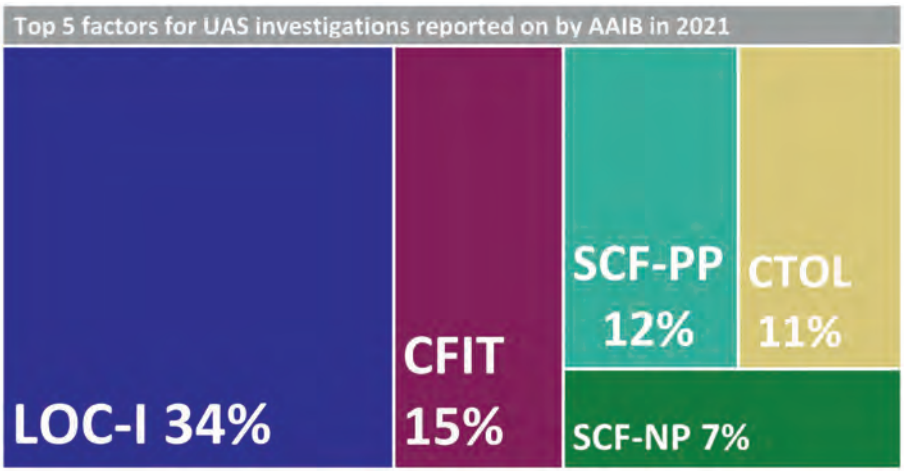
Correspondence investigations are usually conducted into non-fatal accidents and serious incidents on GA and CAT aircraft that do not warrant deployment of an AAIB team. They use the information provided by the pilot and in most cases with follow up enquiries by AAIB Inspectors. During 2021 the overall trend was slightly different in this category. SCF-NP was the predominant factor.

Record-Only Investigations



Record-only investigations are those where there were no serious injuries and the circumstances were such that there is little likelihood that a full investigation would identify any new safety lessons, the AAIB has the option to merely record the details for statistical purposes.

UAS Investigations



The predominant cause of UAS accidents, was LOC-I usually resulting from the UAS becoming unresponsive to control inputs or displaying an erratic uncommanded response in flight.

2021 Statistics

An overview of our involvement during 2021

This graphic shows the AAIB activity statistics for 2021. Of interest is that 2021 saw 746 notifications of an event or occurrence to the AAIB.

In 2020 this figure was 553 which reflected the effect of the pandemic on commercial, general and UAS aviation. Not since 2015 have we seen a figure that low. However, the 2021 figure is only 9.7% lower than the notifications received in 2019 and 5.7% higher than 2018.

746
Number of Notifications received by the AAIB

Investigations Opened

28 Field

96 Correspondence (AARF)

196 Record-only (RO)

Number of Notifications Year-on-Year Difference (%)

2021 vs 2020	2021 vs 2019	2021 vs 2018
↑ +34.9%	↓ -9.7%	↑ +5.7%

5
Number of UK Fatal Accidents

7
Number of Deaths

AAIB Activity Overseas

16 UK Registered Aircraft Overseas

30 Foreign Registered Aircraft Overseas

External Involvement

1 Military (AAIB assistance)

37 Sporting Associations informed

267
No Further AAIB Action

Continued over page

2021 Statistics cont

An overview of our involvement during 2021

Activity Associated with UAS

191

Of the 746 Notifications received by the AAIB involved UAS

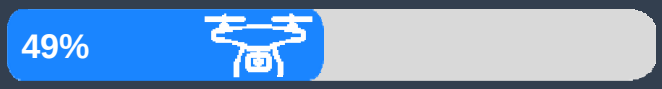
118

Of the 292 Correspondence (AARF) Investigations (incl RO) opened involved UAS

Safety Recommendations and Safety Actions

37

Number of Safety Recommendations made



Of those Safety Recommendations involved UAS

Action Status for Recommendations made in 2021

- Adequate - Planned Action Completed - Closed
- Partially Adequate - Planned Action Completed - Closed
- Not Adequate - No Planned Actions - Closed
- Adequate - Planned Action Ongoing Update Due - Open
- Partially Adequate - Planned Action Ongoing Update Due - Open
- Not Adequate - Planned Action Completed - Closed

188

Number of Safety Actions noted

Of those Safety Actions involved UAS

Publications

9 Number of UAS Correspondence Investigation Reports published

86 Number of Correspondence Investigation Reports published (incl UAS)
Average time to publication: 5.6 months

1 Formal Reports published
Average time to publication: 14.2 months

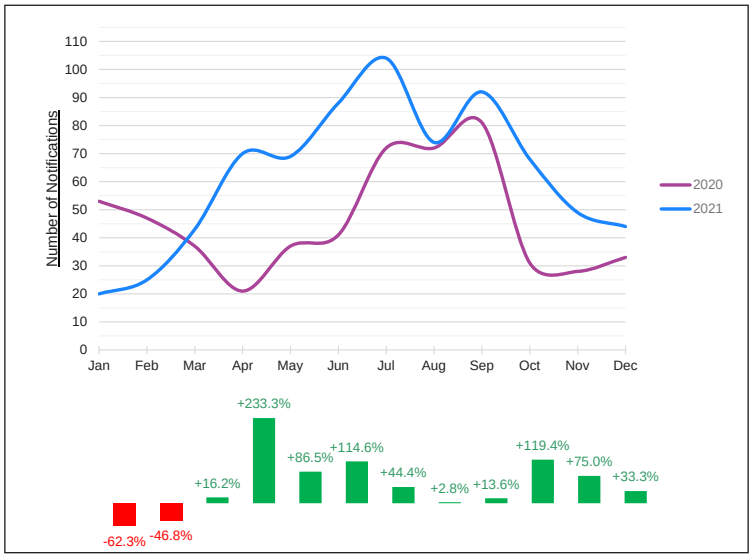
24 Field Reports published

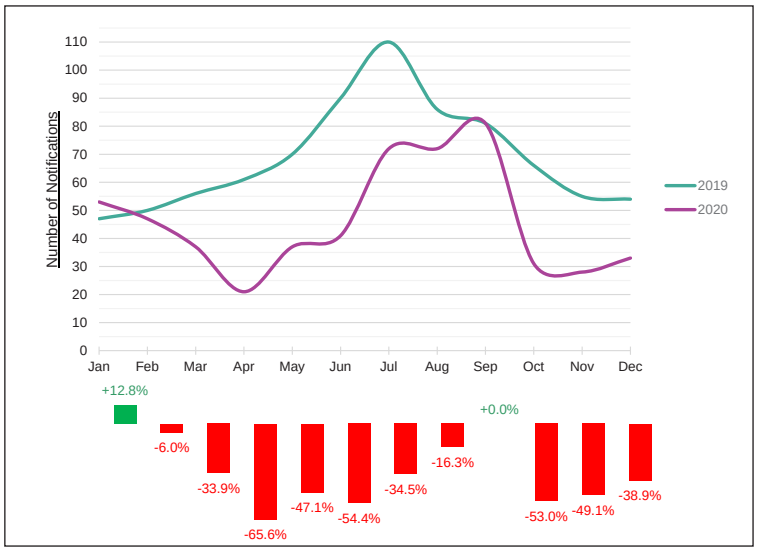
4 Of those Field Reports published involved UAS

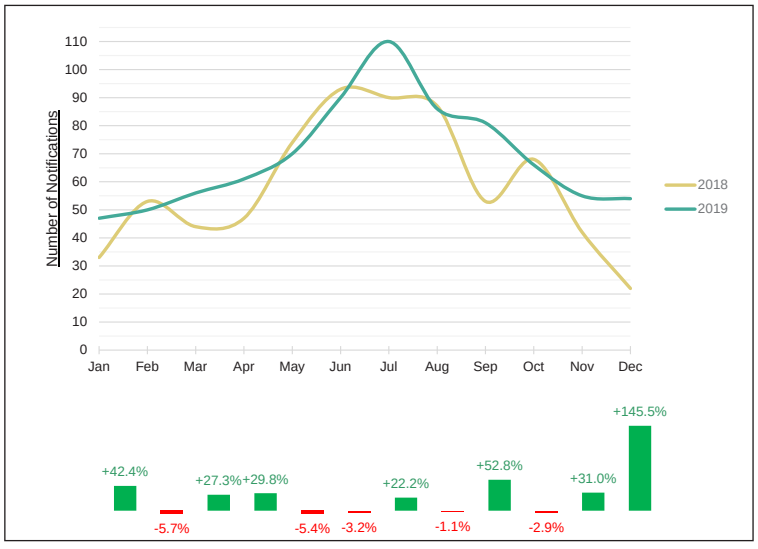
Average time to publication: 12 months

3 Special Bulletins published

Statistics Year on Year 2018-2021



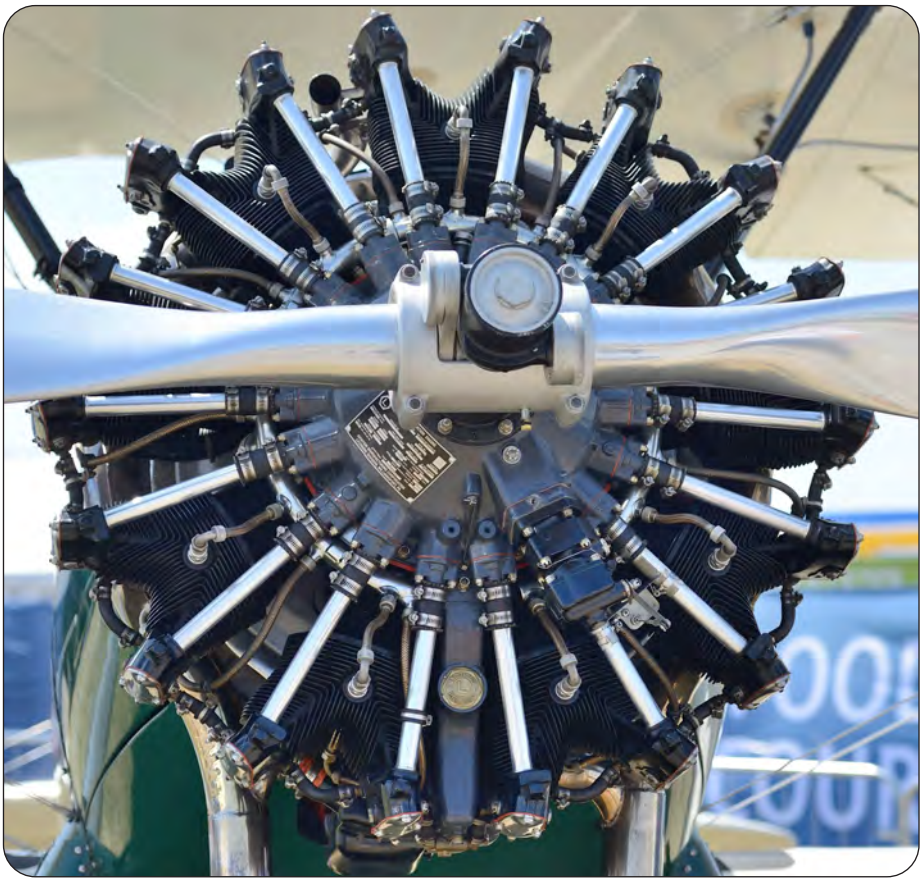




Notifications to the AAIB are calls and communications received daily which give information on an aviation related occurrence.

Information is received from a variety of sources and are assessed by AAIB staff to determine a response.

These graphs show the year on year notification rates since 2018



Safety Recommendations

Introduction

The AAIB will make Safety Recommendations based on the findings of an investigation and the need for action to be taken to maintain and improve aviation safety. Each Safety Recommendation made by the AAIB is given a unique reference number based on the year issued. For example, 2021-001 and so on.

The AAIB is responsible for assessing the responses to Safety Recommendations and monitoring the action subsequently taken. The AAIB carries out this function for the UK, its Overseas Territories and Crown Dependencies.

The AAIB monitors the progress of actions taken in response to a Safety Recommendation but does not undertake the role of the regulator nor to provide opinion on the efficacy of the action. The AAIB reports regularly to the Board of Accident Investigation Branches (BAIB) and the State Safety Board (SSB) on progress toward completion. It is for the SSB to decide on whether there is a need for any additional intervention.

This monitoring of actions is not only for Safety Recommendations issued by the AAIB but also those that have been issued to addresses in the UK from other Accident Investigation Authorities.

Response assessment

When the AAIB receives a response to a recommendation from the addressee it is assessed as to its adequacy under the requirements of Article 18 of retained Regulation (EU) 996/2010. The AAIB applies the following assessment criteria to the Safety Recommendation responses.

- **Adequate** means that the response fully meets the intent of the Safety Recommendation and the action is expected to address the safety issue.

- **Partially Adequate** means the response goes someway to meeting the intent of the Safety Recommendation and the action will address the safety issue to a certain extent, but further action would be required to fully address the issue identified.

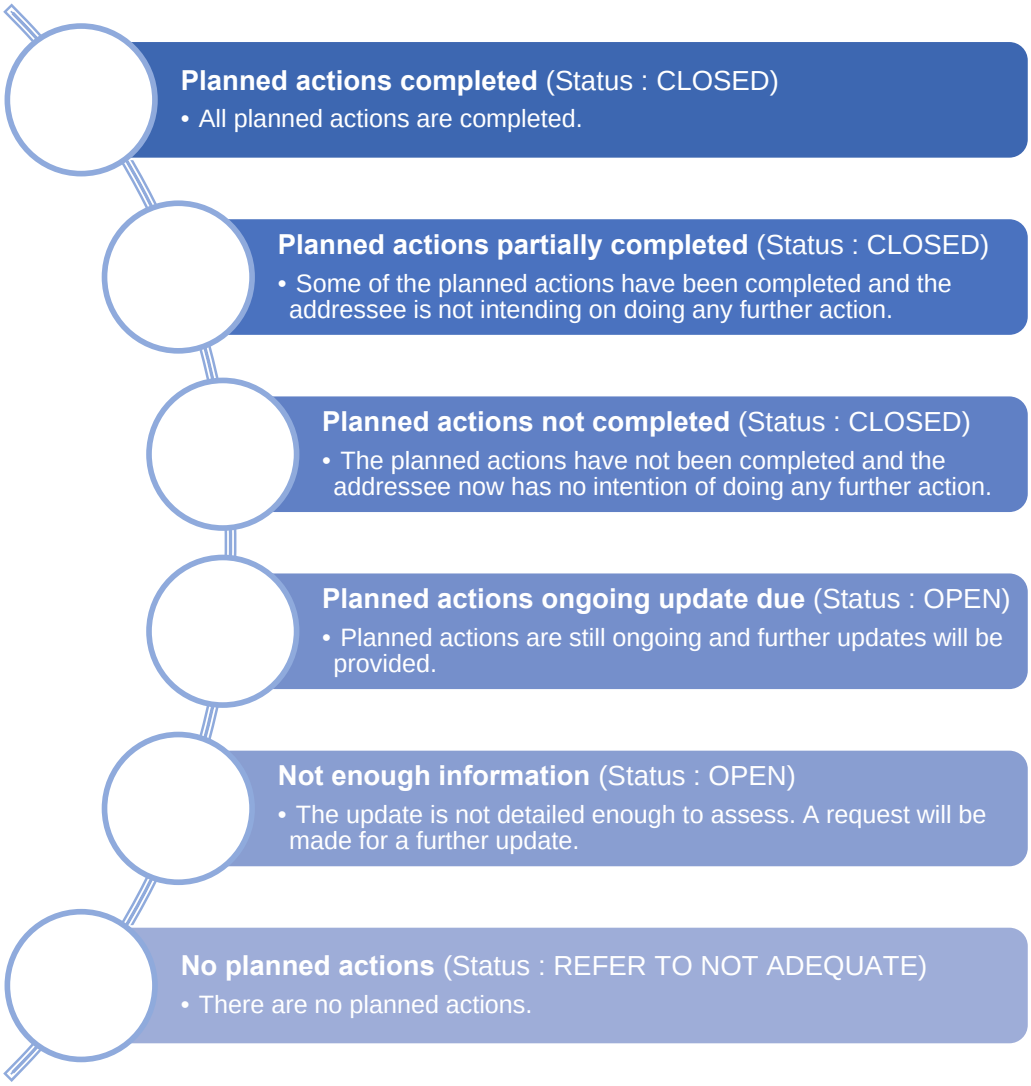
- **Not Adequate** means that the response does not address the intent of the Safety Recommendation, nor does it address the safety issue concerned. The AAIB will apply an open or closed status depending on the expectation of whether the addressee will reassess their response.

    - **Not Adequate - OPEN** The status of ‘open’ implies that AAIB still has concerns regarding the identified safety deficiency and that there is an expectation that the addressee will provide further responses.

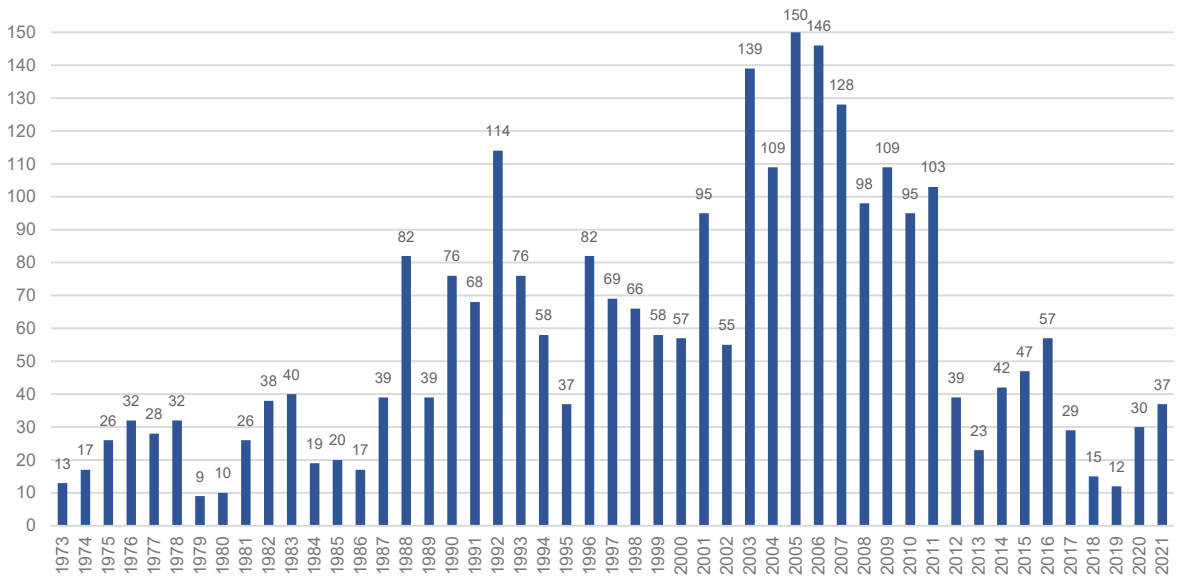
- **Not Adequate - CLOSED** The status 'closed' implies that there is a low likelihood that the addressee will act on the recommendation or provide any further responses.

- **Superseded** means the Safety Recommendation has been 'Superseded' either by a 'newer' and more comprehensive Safety Recommendation or actions have subsequently been taken by the addressee that have superseded the recommendation.

In reporting on the monitoring of the actions taken to a Safety Recommendation they are reported as meeting one of the following:



Number of Safety Recommendations made per year



The status of Safety Recommendations issued during 2021

Of the 37 Safety Recommendations issued in 2021, as of 25 May 2022, responses have been received for all 37 Safety Recommendations. The AAIB response assessment has classified those responses as follows:

- Thirteen are **Adequate**, with planned actions completed and are **Closed**.
- One is **Adequate**, with planned actions ongoing and remain **Open**.
- Nineteen are **Partially Adequate**, with planned actions ongoing and remain **Open**.
- Two are **Partially Adequate**, with planned actions completed and are **Closed**.
- One is **Not Adequate** and is **Closed**.
- One is **Not Adequate**, with no planned actions and remain **Open**.

Summary table

Number	Response Assessment	Action Status	Status
2021-001	Adequate	Planned Action Completed	Closed
2021-002	Partially Adequate	Planned Action Ongoing	Open
2021-003	Partially Adequate	Planned Action Ongoing	Open
2021-004	Partially Adequate	Planned Action Ongoing	Open
2021-005	Partially Adequate	Planned Action Ongoing	Open
2021-006	Partially Adequate	Planned Action Ongoing	Open
2021-007	Partially Adequate	Planned Action Ongoing	Open
2021-008	Partially Adequate	Planned Action Ongoing	Open
2021-009	Partially Adequate	Planned Action Ongoing	Open
2021-010	Partially Adequate	Planned Action Ongoing	Open
2021-011	Partially Adequate	Planned Action Completed	Closed
2021-012	Partially Adequate	Planned Action Completed	Closed
2021-013	Adequate	Planned Action Completed	Closed
2021-014	Partially Adequate	Planned Action Ongoing	Open
2021-015	Adequate	Planned Action Ongoing	Open
2021-016	Adequate	Planned Action Completed	Closed
2021-017	Not Adequate	No Planned Action	Open
2021-018	Partially Adequate	Planned Action Ongoing	Open
2021-019	Partially Adequate	Planned Action Ongoing	Open
2021-020	Partially Adequate	Planned Action Ongoing	Open
2021-021	Not Adequate	Planned Action Completed	Closed
2021-022	Adequate	Planned Action Completed	Closed
2021-023	Partially Adequate	Planned Action Ongoing	Open
2021-024	Adequate	Planned Action Completed	Closed
2021-025	Partially Adequate	Planned Action Ongoing	Open
2021-026	Partially Adequate	Planned Action Ongoing	Open
2021-027	Adequate	Planned Action Completed	Closed
2021-028	Partially Adequate	Planned Action Ongoing	Open
2021-029	Adequate	Planned Action Completed	Closed
2021-030	Partially Adequate	Planned Action Ongoing	Open
2021-031	Adequate	Planned Action Completed	Closed

Number	Response Assessment	Action Status	Status
2021-032[1]	Partially Adequate	Planned Action Ongoing	Open
2021-047	Adequate	Planned Action Completed	Closed
2021-048	Adequate	Planned Action Completed	Closed
2021-049	Adequate	Planned Action Completed	Closed
2021-050	Adequate	Planned Action Completed	Closed
2021-051	Adequate	Planned Action Completed	Closed

Safety Recommendations of Global Concern (SRGC)

A Safety Recommendation assessed to be SRGC is defined as:

> A safety recommendation regarding a systemic deficiency having a probability of recurrence, with significant consequences at a global level, and requiring timely action to improve safety.

SRGC provided to ICAO can be found on their website:

https://www.icao.int/safety/airnavigation/AIG/Pages/Safety-Recommendations-of-Global-Concern-(SRGC).aspx

Safety Recommendations issued to ICAO are also available on their website:

https://www.icao.int/safety/airnavigation/AIG/Lists/Safety%20recommendations%20to%20ICAO/Search1.aspx

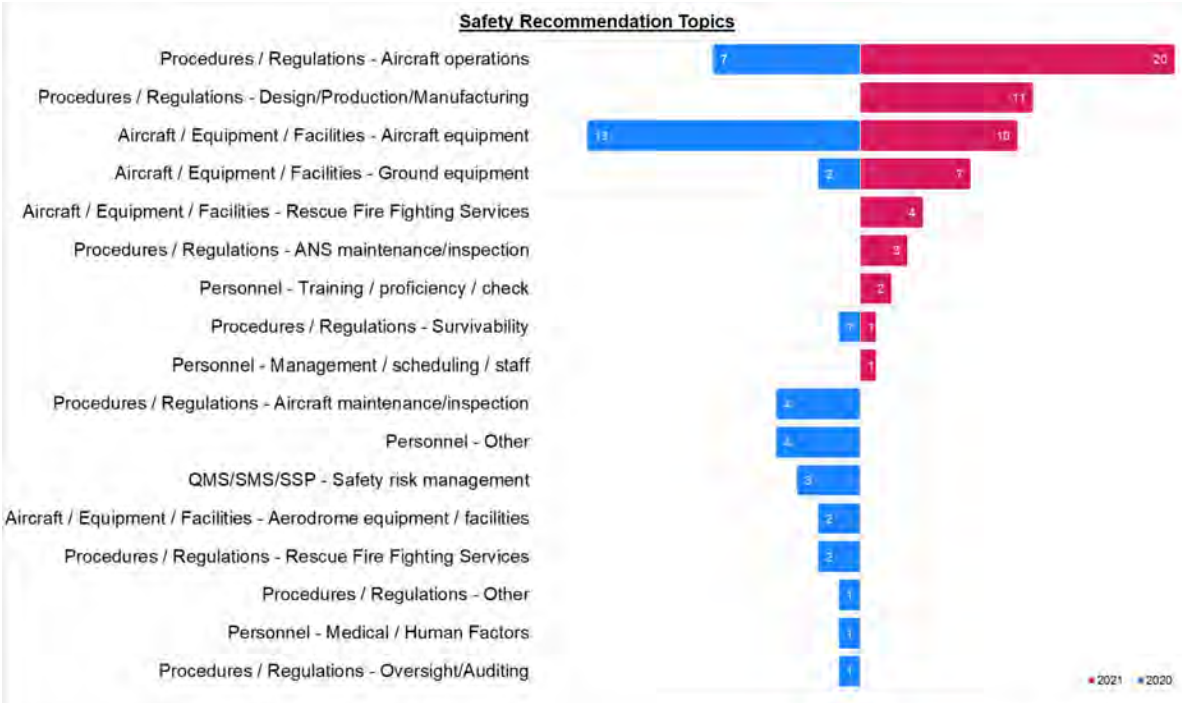
Of the 37 Safety Recommendations issued by the AAIB in 2021, eight were designated SRGC.

Note - The regulations and a link to ICAO Annex 13 can be found on the AAIB website:

https://www.gov.uk/government/collections/aaib-regulations-and-mous

Footnote

[1] Safety Recommendations 2021/33 to 2021/46 were originally issued against an ongoing major aircraft accident investigation that was unexpectedly delayed and could not be published during 2021. Therefore, these reference numbers will not be issued.



Alauda Airspeeder Prototype
4 July 2019 at Goodwood Aerodrome, West Sussex

Investigation Synopsis

Whilst performing a demonstration flight, the remote pilot lost control of the 95 kg Alauda Airspeeder Mk II scale demonstrator. After the loss of control had been confirmed by the remote pilot, the safety 'kill switch' was operated but had no effect. The Unmanned Aircraft then climbed to approximately 8,000 ft, entering controlled airspace at a holding point for flights arriving at Gatwick Airport, before its battery depleted and it fell to the ground. It crashed in a field of crops approximately 40 m from occupied houses and 700 m outside of its designated operating area. There were no injuries.

UA as found (inverted) at the accident site

The AAIB found that the Alauda Airspeeder Mk II was not designed, built or tested to any recognisable standards and that its design and build quality were of a poor standard. The operator's Operating Safety Case contained several statements that were shown to be untrue.

The Civil Aviation Authority's Unmanned Aircraft Systems (UAS) Unit had assessed the operator's application and, after clarification and amendment of some aspects, issued an exemption to the Air Navigation Order to allow flights in accordance with the operator's Operating Safety Case. The Civil Aviation Authority did not meet the operator or inspect the Alauda Airspeeder Mk II before the accident flight.

There have been many other similar events where control of an unmanned aircraft has been lost, resulting in either it falling to the ground or flying away. Even a small unmanned aircraft falling from a few metres could cause a fatal injury if it struck a person.

The Civil Aviation Authority and the organisation which designed and operated the Airspeeder Mk II have introduced measures to address a number of issues identified during the course of the investigation. In addition to the actions already taken this investigation report makes 15 Safety Recommendations regarding the operator's procedures, airworthiness standards and the regulatory oversight.

Safety Recommendation 2021-001

Justification

During the course of the investigation the operator demonstrated little knowledge or understanding of appropriate industry standards, in particular, those relating to airworthiness and for developing electronic hardware and software.

Therefore, the following Safety Recommendation was made:

Safety Recommendation 2021-001

It is recommended that Riotplan Proprietary Limited, trading as Alauda Racing, amends its processes to ensure that it designs, builds and tests unmanned and manned aircraft in accordance with appropriate standards to ensure the safety of those who may be affected by their operation.

Date Safety Recommendation made: 11 February 2021

Latest response received: 12 May 2021

Immediately following the incident, Alauda discontinued use of the Airspeeder MkII aircraft in all operations. To formally remove the aircraft from use, this included re-submission of manuals to the Australian Civil Aviation Safety Authority (CASA) and updating subsequent company approvals to remove the MkII from our Australian Remote Operating Certificate (ReOC). Alauda continues to develop the uncrewed Airspeeder Mk3, and has recently undertaken a comprehensive flight test with a Civil Aviation Safety Authority (CASA) RPAS inspector on 28 April 2021 that consisted of a formal assessment and acceptance by a Delegate of the Australian Director of Aviation Safety to include the Airspeeder Mk3 on the companies Remote Operating Certificate (ReOC) to commercially operate this Remotely Piloted Aircraft System (RPAS). At the time of sending this response we are awaiting the outcome of our formal assessment. Alauda has also implemented electronic reporting software (AVCRM) to ensure ongoing compliance with CASA Part 101 (Unmanned Aircraft and Rockets) Manual of Standards, Chapter 10. AVCRM software also supports the implementation of Alauda's Safety Management System (SMS).

Alauda has proactively introduced an aviation SMS. This exceeds the regulatory requirement and ensures safety is at the highest priority in development and operation of our aircraft and this system is under continuous improvement as the company continues to grow.

In addition, as set out in the Engineering Management Plan, which was previously shared with the AAIB, Alauda has employed key personnel to ensure ongoing compliance and safety, with experience in the aviation industry. In the design of the Airspeeder Mk3 and in all facets of the operation, Alauda has built processes and procedures with a total commitment to aviation safety and continuous improvement. Our processes have been redesigned to include the following measures:

Powertrain system architecture design and analysis processes to ensure redundancy of the system. This analysis includes failure modes and effect (FMEA) analysis and fault tree system safety analysis of the entire system and subsystems. This analysis takes into account the probability of failure of individual components and the effects of such failures.

AAIB Assessment:	**Adequate**
Action Status:	**Planned Action Completed**
Safety Recommendation Status:	**Closed**

Safety Recommendation 2021-002

Justification

The investigation identified that the operator identified 16 hazards with potentially catastrophic outcomes. Each was given a mitigation which reduced the likelihood and consequence to a level considered acceptable by the CAA. As these mitigation measures relied on airworthy systems, this could not be assured without detailed scrutiny of the design and manufacture of the aircraft. There was no requirement to carry out a detailed evaluation of such systems in CAP722.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-002**
>
> It is recommended that the Civil Aviation Authority update Civil Aviation Publication 722, Unmanned Aircraft System Operations in UK Airspace – Guidance & Policy, to require detailed evaluation of any Unmanned Aircraft Systems that use onboard systems to mitigate risks with Risk Severity Classifications of 'Major', 'Hazardous' or 'Catastrophic'.

Date Safety Recommendation made: 11 February 2021

Latest response received: 23 December 2021

A new edition of CAP722A is scheduled for publication in first quarter of 2022. This will address all the above recommendations.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 23 June 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB acknowledges the actions being undertaken and request an update by 23 June 2022.

Safety Recommendation 2021-003

Justification

To ensure that UAS operators carefully consider radio surveys as part of their pre-flight preparations, further emphasis should be included in CAP 722 to ensure UAS operators carefully consider radio surveys as part of pre-flight preparations.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-003**
>
> It is recommended that the Civil Aviation Authority update Civil Aviation Publication 722, Unmanned Aircraft System Operations in UK Airspace – Guidance & Policy, to provide guidance on the planning, completion and documenting of Radio Frequency surveys to reduce the risk of Radio Frequency interference or signal loss when operating Unmanned Aircraft Systems.

Date Safety Recommendation made: 11 February 2021

Latest response received: 23 December 2021

A new edition of CAP722A is scheduled for publication in first quarter of 2022. This will address all the above recommendations.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 23 June 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB acknowledges the actions being undertaken and request an update by 23 June 2022.

Safety Recommendation 2021-004

Justification

The investigation found that the failure of the only safety system installed in the Airspeeder Mk 2 was probably due to a loss of signal for 'poor signal'. If an RF survey has been stated as a mitigating factor to reduce the risk of a "poor signal" related failure, or to support the use of an RF-enabled safety system, then proof of example surveys should be provided as part of the approval process.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-004**
>
> It is recommended that the Civil Aviation Authority require Unmanned Aircraft System operators, that use unmanned aircraft which rely on a radio link to operate safety systems, to provide Radio Frequency survey reports to the Civil Aviation Authority for review, to ensure they are suitable and sufficient.

Date Safety Recommendation made: 11 February 2021

Latest response received: 23 December 2021

If an Operator relies on a technical safety feature which requires RF triggering, following the incident that generated these recommendations, it is unlikely to be accepted. Only systems that fail safe or activate in the event of a loss of link would be considered as acceptable.

If a loss of RF link, or an inability to establish a link, would result in an unsafe condition, then a comprehensive approach to RF surveys would be required and would be assessed. The RPAS Sector Team are producing an appropriate policy. An initial internal action has been identified to liaise with a spectrum specialist in the CNS team at the CAA to understand what a good RF survey may look like.

The likelihood of this type of requirement appearing is considered very small given the lessons learned from the Alauda Airspeeder incident.

AAIB Assessment	**Partially Adequate**
Action Status	**Planned Action Ongoing Update due 23 June 2022**
Safety Recommendation Status	**Open**

Feedback rationale

The AAIB acknowledges the work undertaken by the CAA and its approach to the requirements for a comprehensive approach to RF surveys where a loss of RF link would result in an unsafe condition and requests an update on the introduction of an appropriate policy by 23 June 2022.

Safety Recommendation 2021-005

Justification

The definition of UAS operational and safety areas relies on the use of accurate mapping or imagery together with trajectory calculations which take into account human or automated safety system reaction times and the UAS' maximum speed and altitude. CAP 722 does not contain any guidance on how operational and safety areas should be defined.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-005**
>
> It is recommended that the Civil Aviation Authority update Civil Aviation Publication 722, Unmanned Aircraft System Operations in UK Airspace – Guidance & Policy, with guidance on how to define an Unmanned Aircraft System's operational and safety areas, using up-to-date maps, accurate trajectory analysis and human or automated safety system reaction times, to ensure a safe operation.

Date Safety Recommendation made: 11 February 2021

Latest response received: 23 December 2021

A new edition of CAP722A is scheduled for publication in first quarter of 2022. This will address all the above recommendations.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 23 June 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB acknowledges the actions being undertaken and request an update by 23 June 2022.

Safety Recommendation 2021-006

Justification

CAP 722 does not require the installation of safety systems or detail any examples of safety systems. In addition, not all UAS operating with an exemption to the ANO or an Operational Authorisation are required to be fitted with safety systems. The use of such systems provides additional protection in the event of a malfunction of the UAS.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-006**
>
> It is recommended that the Civil Aviation Authority update Civil Aviation Publication 722, Unmanned Aircraft System Operations in UK Airspace – Guidance & Policy, to provide examples of Unmanned Aircraft System safety systems.

Date Safety Recommendation made: 11 February 2021

Latest response received: 23 December 2021

A new edition of CAP722A is scheduled for publication in first quarter of 2022. This will address all the above recommendations.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 23 June 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB acknowledges the actions being undertaken and request an update by 23 June 2022.

Safety Recommendation 2021-007

Justification

CAP 722 does not require the installation of safety systems or detail any examples of safety systems. In addition, not all UAS operating with an exemption to the ANO or an Operational Authorisation are required to be fitted with safety systems. The use of such systems provides additional protection in the event of a malfunction of the UAS.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-007**
>
> It is recommended that the Civil Aviation Authority introduce requirements to define a minimum standard for safety systems to be installed in Unmanned Aircraft Systems operating under an Operational Authorisation, to ensure adequate mitigation in the event of a malfunction.

Date Safety Recommendation made: 11 February 2021

Latest response received: 23 December 2021

Primary safety modes such as the use of lost link 'return to home' modes in system software are not yet subject to certification. Other systems such as ballistic recovery & parachute systems may adhere to standards such as ASTM F3322-18, but this is not mandatory and the number of available systems on the market that adhere to this is low.

The RPAS Sector Team have begun to request any evidence that any systems used on a UAS for safety purposes adhere to any standard and are building a library of relevant standards as cases begin to present them. This process is potentially complicated by the development of the Certified Category which may mandate standards for some systems, and the conflict between standards released by competing bodies such as EUROCAE, ASTM, ISO and BSi. Nevertheless, any standards that are produced and identified will be considered for inclusion in any guidance material.

The RPAS Sector Team already consider the robustness of any safety mitigation measure, in terms of its performance and integrity. All mitigations provided by technical systems are assessed to check:

- Performance relative to claimed reductions in severity
- Position and relevance in any bow ties or fault tree diagrams
- Integrity of function and assurance that the mitigation will function as claimed at all times or with an appropriate MTBF
- Its overall position within the Safety Risk Assurance Process, to understand how the applicant has formally assured the above, as well as how they selected the system as an appropriate mitigation.

As the Specific Category works on a case-by-case basis, every safety system is assessed individually for the use case described by the UAS Operator. Rather than a minimum performance requirement, each mitigation is checked to see if it achieves the claimed level of performance, and whether it can function as a mitigation as described.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 23 December 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB acknowledges that the RPAS Sector Team now consider the robustness of any safety mitigation measure and that each mitigation is now checked to see if it achieves the claimed level of performance, and as described. The AAIB also notes that the CAA are assessing a number of safety system but have not yet introduced a minimum standard of installed safety system for UAS operating under an Operational Authorisation and request and update by 23 December 2022.

Safety Recommendation 2021-008

Justification

Data recording systems provide significant benefits during the design and development of a UAS as well as to accident and incident investigation. In addition, recorded data could be used to demonstrate the maturity and suitability of the UAS for the operation and compliance with the conditions of an Operational Authorisation.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-008**
>
> It is recommended that the Civil Aviation Authority require Unmanned Aircraft System operations under an Operational Authorisation to be fitted with a data recording system which is capable of demonstrating: compliance with the Authorisation's conditions, safe operation and the logging of any failures which may affect the safe operation of the Unmanned Aircraft System.

Date Safety Recommendation made: 11 February 2021

Latest response received: 23 December 2021

A new edition of CAP722A is scheduled for publication in first quarter of 2022. This will address all the above recommendations.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 23 June 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB acknowledges the actions being undertaken and request an update by 23 June 2022.

Safety Recommendation 2021-009

Justification

The first responders to this accident were presented with the wreckage of a large UAS which had no external markings other than the sponsor's names. The damaged main battery was hazardous but there were no warnings of the risks of explosion or electric shock. There was also no battery self-monitoring system for temperature or voltage.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-009**
>
> It is recommended that the Civil Aviation Authority specify the minimum requirements for the monitoring of Unmanned Aircraft System high-voltage stored energy devices, to ensure safety of operation

Date Safety Recommendation made: 11 February 2021

Latest response received: 23 December 2021

A new edition of CAP722A is scheduled for publication in first quarter of 2022. This will address all the above recommendations.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 23 June 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB acknowledges the actions being undertaken and request an update by 23 June 2022.

Safety Recommendation 2021-010

Justification

The first responders to this accident were presented with the wreckage of a large UAS which had no external markings other than the sponsor's names. The damaged main battery was hazardous but there were no warnings of the risks of explosion or electric shock.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-010**
>
> It is recommended that the Civil Aviation Authority specify the minimum requirements for readily identifiable warnings and safety information on Unmanned Aircraft high-voltage stored energy devices to inform 3rd parties of the potential hazard.

Date Safety Recommendation made: 11 February 2021

Latest response received: 23 December 2021

A new edition of CAP722A is scheduled for publication in first quarter of 2022. This will address all the above recommendations.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 23 June 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB acknowledges the actions being undertaken and request an update by 23 June 2022.

Safety Recommendation 2021-011

Justification

The operator did not have a Safety Management System in place. Their lack of consideration for compliance, quality control and safety contributed to this accident. In addition, the absence of internal oversight, cross checking and management by accountable personnel were key factors and demonstrated that the organisation did not have an effective, proactive approach to managing safety. Safety management extends beyond compliance with regulations to a systemic approach to the identification and management of safety risks.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-011**
>
> It is recommended that the Civil Aviation Authority ensure that operators of Unmanned Aircraft Systems have an effective Safety Management System in place prior to issuing an Operational Authorisation.

Date Safety Recommendation made: 11 February 2021

Latest response received: 11 May 2021

The CAA partially accepts this recommendation:

CAP 722 already covers elements of SMS that operators could use for best practice and to manage safety risks.

The regulation only states a requirement for an SMS for Light UAS Certificate (LUC) approval holders under Part C UAS.LUC.030 of the Implementing Regulations for UAS. Due to the very wide range of possible operations within the Specific category for which an operational authorisation is required, it would not be practicable, nor indeed proportionate, to require every UAS operator to have a safety management system in place.

The RPASST exercise a proportional, performance based approach to applications, and required that elements of an SMS such as functional reporting and investigation processes are included as the complexity of the RPAS and operation increase.

AAIB Assessment: **Partially Adequate**

Action Status: **Planned Action Completed**

Safety Recommendation Status: **Closed**

Feedback rationale

The AAIB acknowledge that elements of SMS are included in CAP 722 to allow operators to manage safety risks and that the use of Performance Based Oversight should result in operators being required to adopt additional elements of SMS as the complexity and operation of UAS' increases. While this approach partially addresses the Safety Recommendation 2021-011, it does not ensure that operators of UAS have an effective SMS in place prior to receiving an Operational Authorisation therefore the response has been assessed as Partially Adequate - Closed.

Safety Recommendation 2021-012

Justification

Performance Based Oversight relies on previous experience of an operator or aircraft to allow an accurate assessment of the operational risk. As the CAA had not had previous experience with either the operator or the UAS, they did not have any information, other than that supplied by the operator, on which to assess the safety of the operation. A physical inspection of the UAS, prior to granting the exemption to the ANO, would have provided the opportunity to identify the shortcomings in the UA's build standard and that it was not compliant with the OSC. Had the CAA required a demonstration of the aircraft's operation, the operator may have been more vigilant in ensuring that they complied with their own procedures and the conditions of the exemption to the ANO.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-012**
>
> It is recommended that the Civil Aviation Authority, before issuing an Operational Authorisation to operate an Unmanned Aircraft System they have not previously had experience with, carry out a physical examination of the Unmanned Aircraft System to ensure that it is designed and built to suitable standards, and observe a test flight to confirm operation in accordance with the Operating Safety Case.

Date Safety Recommendation made: 11 February 2021

Latest response received: 11 May 2021

The CAA partially accepts this recommendation:

When considering larger, more bespoke RPAS types such as the subject of this accident, then this is the approach that will be taken. However, in other cases, dependent on the type of operation that is being authorised, such an approach may prove to be impractical. Where any features of design and construction have been included as mitigations in any risk assessment, then it would be appropriate for a pre-flight physical examination and an observation of an initial test flight to be conducted (bearing in mind that any test flight also requires an Operational Authorisation to be issued).

The RPASST will apply Performance Based Oversight (PBO) principles in order to target resource to risk. When a new platform is used that is likely to attract a high risk score, it will be prioritised for both physical direct inspection from an airworthiness Inspector and a flight test depending on the likely requirements. Even with COTS systems, the RPASST will use PBO to assess dynamically whether applications need a demonstration or test flight to show the requisite safety levels.

The RPASST also carry out sector-level reviews of risk metrics to help assess where PBO assets are best deployed.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Completed**
Safety Recommendation Status:	**Closed**

Feedback rationale

The AAIB acknowledges that the CAA will use Performance Based Oversight principles to assess the risk of new UAS and that those with a high risk score may be subject to a physical inspection and flight test. As a result this AAIB consider that the response to the Safety Recommendation as Partially Adequate - Closed

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Safety Recommendation 2021-013

Justification

CAP 722 and the CAA exemption documentation do not contain any information on the consequences of non-compliance and the action that organisations such as the CAA and Ofcom can take in the event of a breach of the regulations and requirements.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-013**
>
> It is recommended that the Civil Aviation Authority update Civil Aviation Publication 722, Unmanned Aircraft System Operations in UK Airspace – Guidance & Policy, to include reference to the consequences of not complying with the conditions of an Operational Authorisation to operate an Unmanned Aircraft System.

Date Safety Recommendation made: 11 February 2021

Latest response received: 11 May 2021

The CAA accepts this recommendation:

The Air Navigation (Amendment) Order 2020 (SI 2020/1555) introduced a number of new articles into the Air Navigation Order 2016. These create criminal offences, if the requirements of the UAS regulations that became applicable on 31 December 2020 are not complied with, along with the associated penalties.

This amendment was explained in guidance for UAS users within CAP 2013 (published 17 December 2020) and has been included in amendment 2021/01 to CAP 722 Chapter 4, Section 4.1.3 (March 2021).

AAIB Assessment:	**Adequate**
Action Status:	**Planned Action Completed**
Safety Recommendation Status:	**Closed**

Safety Recommendation 2021-014

Justification

The frequent reports of UAS loss of control and fly-away events indicates the potential hazard to uninvolved persons. The kinetic energy level of these impacts, even for a typical small UA, is likely to be well above the 80 joules of kinetic energy limit for a UAS operated intentionally over 'uninvolved people', set in EU Commission Implementing Regulation (IR) (EU) 2019/947, It would be prudent to take appropriate action to reduce the risk of this type of event to avoid a fatal accident.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-014**
>
> It is recommended that the Civil Aviation Authority adopt appropriate design, production, maintenance and reliability standards for all Unmanned Aircraft Systems with aircraft capable of imparting over 80 joules of energy.

Date Safety Recommendation made: 11 February 2021

Latest response received: 23 December 2021

There is currently no standard of this type agreed upon and accepted by the CAA. While some generic standards that could be utilised have been generated, such as ASTM F2910-14 (Standard Specification for Design and Construction of a Small Unmanned Aircraft System), ASTM F3002-14a (Standard Specification for Design of the Command and Control System for Small Unmanned Aircraft System), and ASTM F2909-19 (Standard Specification for Continued Airworthiness of Lightweight Unmanned Aircraft Systems), the decision to accept these into UK use and relevant publications would need to be managed in concert with the CAA's work on the development of the Certified Category.

In the Specific Category, procedures within the RPAS Sector Team have changed so that applicants are advised to demonstrate adherence to any relevant standards when able. No standards will be automatically accepted as proof of compliance with regulation, but conformance with any relevant standard shows a degree of safety assurance.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 23 December 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB acknowledges the introduction of additional procedures to ensure that applicants in the Specific Category demonstrate adherence to any relevant standards and notes that the adoption of generic standard for the design, construction and continued airworthiness of Small Unmanned Systems will need to be managed in conjunction work ongoing work relating to Certified UAS. The AAIB request an update on the progress of the adoption of these generic standard by 23 December 2022.

Safety Recommendation 2021-015

Justification

The frequent reports of UAS loss of control and fly-away events indicates the potential hazard to uninvolved persons. The kinetic energy level of these impacts, even for a typical small UA, is likely to be well above the 80 joules of kinetic energy limit for a UAS operated intentionally over 'uninvolved people', set in EU Commission Implementing Regulation (IR) (EU) 2019/947, It would be prudent to take appropriate action to reduce the risk of this type of event to avoid a fatal accident.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-015**
>
> It is recommended that the European Union Aviation Safety Agency adopt appropriate design, production, maintenance and reliability standards for all Unmanned Aircraft Systems with aircraft capable of imparting over 80 joules of energy.

Date Safety Recommendation made: 11 February 2021

Latest response received: 26 April 2021

Following European Union Aviation Safety Agency (EASA) Opinion 2018-01, the European Commission adopted Regulations (EU) 2019/945 and 2019/947 (from now on the 'UAS Regulations') on 1 July 2019 that establish the technical and operational requirements for Unmanned Aircraft Systems (UAS), respectively. The UAS Regulations became applicable on 31 December 2020, after the occurrence of this event.

The UAS Regulation defines the process for assessing the risk of UAS operations and contains instructions on how to define the technical (e.g. design, production and maintenance), operations and pilot competence requirements, proportionate to the level of risk of the operation. Notably, different sets of technical requirements are defined directly in the UAS Regulation (for UAS operated in the lower level of risk, the 'open' category) or derived by the definition of a certification basis for operations with higher risk (the 'specific' category). The operation causing the accident would be classified in the 'specific' category.

EASA also published a set of technical requirements in the form of a 'Special Condition - Light UAS' (published on the EASA website in December 2020). These technical requirements cover all UAS, including those transferring an energy lower than 80 joules to a human body. The UAS regulations identify this energy threshold as the one posing risk to people and it requires, for UAS exceeding this threshold, to meet appropriate design, production and maintenance requirements.

Lastly, EASA is supporting standards bodies in developing appropriate industry standards to meet the technical requirements defined in the UAS Regulation. The preliminary version of these industry standards is planned to be available by mid-2021, and the final version in early 2022.

AAIB Assessment:	**Adequate**
Action Status:	**Planned Action Ongoing Update due 31 December 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

It is recognised that EASA are supporting the development of appropriate industry standards to meet the technical requirements defined in the UAS Regulation and that the preliminary version of these industry standards is planned to be available by mid-2021. The AAIB request and update on the progress of the development of industry standards on or before 31st Dec 2021.

DJI Matrice 200 V1
21 September 2019 at Somme Crescent, Inverness

Investigation Synopsis

The DJI Matrice 200 Unmanned Aircraft System (UAS) was being operated on an automated flight plan to conduct an aerial survey. On the fifth flight of the day, while the aircraft was at a height of 100 m, the ballistic parachute recovery system fitted to the aircraft activated. The aircraft descended under the parachute and was subsequently found on the roof of a nearby house.

Aircraft after parachute deployment on 29 November 2019

Two months later, after having been repaired and fitted with a new parachute system, the aircraft experienced a second parachute deployment. On that occasion the aircraft was being manually flown in GPS mode at a height of 92 m over an area of open ground.

The first accident most likely occurred due to excessive vibration as a result of the parachute system not being securely attached to the airframe.

The investigation was unable to establish the cause of the second accident. There were several warnings in the recorded aircraft's flight log, but analysis of this data did not provide any insight into why the flight was abruptly terminated. However, the parachute manufacturer considered that the second event involved a valid activation of the parachute system in response to a total aircraft power failure.

The investigation was limited by the availability of recorded flight data for the first accident and a lack of information from the UAS manufacturer. It was therefore unable to establish if there were any common factors between the two accidents, which involved the same aircraft but different parachute units. One Safety Recommendation is made regarding technical support to accident investigations by the UAS manufacturer.

In response to the first accident, the parachute manufacturer and the operator amended their respective procedures for securely attaching the parachute system to the aircraft.

The operator also identified that further emphasis on wind speed and direction was required prior to launch, to provide greater understanding of the drift potential in the case of a parachute deployment.

Safety Recommendation 2021-016

Justification

Access to relevant technical information from aircraft manufacturers is often essential to assist investigators in understanding the causes of the accident and identifying areas which would benefit from safety improvement. The AAIB has experienced varying degrees of support from UAS manufacturers.

An absence of information from the UAS manufacturer impeded identification of a definitive cause during the investigation of a ballistic parachute deployment to a DJI Matrice 210, which is reported in AAIB report AAIB-26256, published in AAIB Bulletin 2/2021.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-016**
>
> It is recommended that DJI introduce an effective system for providing timely technical support to State safety investigations.

Date Safety Recommendation made: 19 March 2021

Latest response received: 30 June 2021

DJI has over the past 15 years developed and refined drone technology that has been widely adopted by professional and recreational users alike. Based on our user experience data, we estimate there are tens of millions of drone flights every year. Since no one in the world has ever died as a result of a drone flight, this means the accidental fatality rate for drones is zero – making it the safest form of aviation the world has ever known.

While this and other data reaffirms our conviction that our products are safe and reliable, we have long believed that incidents and accidents involving drone safety must be investigated to understand their causal factors. DJI routinely participates in regulatory efforts around the world to gather safety data on drone performance, study drone safety factors in academic experimentation, and investigate drone incidents.

AAIB is the only regulator in the world which has adopted an approach to investigate drone incidents with a similar level of scrutiny as for traditional aviation incidents, despite the aircraft being unoccupied and rarely operated over people. This intense attention to certain incidents has challenged our internal workflows in the past, as our engineering teams have not previously been expected to provide timely, high-quality input on incidents which did not result in obvious or significant threats to public safety.

As previously discussed, DJI has introduced a process for how to coordinate our different teams, gather information systematically under firm timelines, and ensure we can respond appropriately. DJI's main contact point for AAIB will remain our European Policy team, which will coordinate internal investigations and occasionally organize direct meetings or exchanges between AAIB and the expert engineering teams.

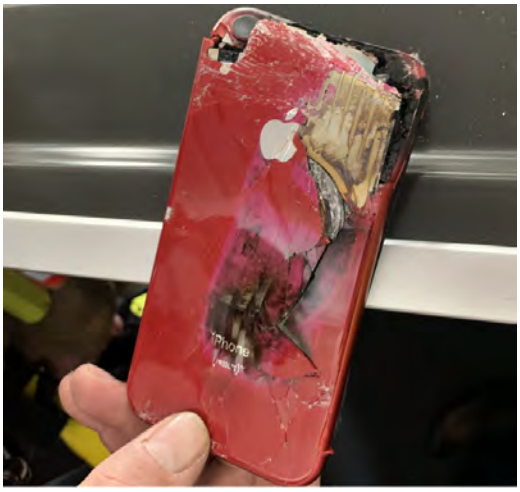
We remain committed to working with the AAIB and any other State safety investigators to ensure aviation accidents and incidents will be thoroughly investigated and understood.

AAIB Assessment:	**Adequate**
Action Status:	**Planned Action Completed**
Safety Recommendation Status:	**Closed**

Boeing 787-9, G-ZBKF
1 October 2020 at London Heathrow Airport

Investigation Synopsis

The aircraft was approaching the top of descent when the cabin crew saw smoke emanating from a passenger seat. It was discovered that a mobile phone had fallen down the side of the seat and had been crushed in the seat mechanism. The cabin crew extinguished the fire and the aircraft continued to its destination. There was no damage to the aircraft.



Mobile phone retrieved by the fire service after landing

There have been several reports of similar events occurring leading to smoke in the cabin. There are currently no seat design requirements to prevent electronic devices from becoming trapped in seats. Manufacturers and regulators are aware of this issue but it has proven challenging to find a workable solution. The EASA and the SAE International Seat Committee have taken safety action to develop new design standards and recommended practices. A Safety Recommendation is made to the CAA to improve seat design regulations.

Safety Recommendation 2021-017

Justification

Portable electronic devices becoming crushed in seat mechanisms are a fire hazard. There are currently no requirements to prevent this.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-017**
>
> It is recommended that the Civil Aviation Authority require that passenger seats in commercial air transport aircraft are designed to minimise the chance of portable electronic devices becoming crushed in mechanisms.

Date Safety Recommendation made: 8 April 2021

Latest response received: 8 February 2022

The CAA has continued to strengthen the UK State of Design capability recruiting Design Specialists who will be able to engage with other authorities and seek participation in the SAE International Seat Committee to the design of seats for commercial air transport aircraft and where appropriate to make recommendations to minimise the chance of portable electronic devices becoming crushed in mechanisms.

The evolution of seat design standards will only be effective when agreed on a global basis. The UK CAA will continue to work with other lead international regulatory authorities to review and support future amendments and updates to the Certification Specifications and /or recommended practices.

The CAA has continued to strengthen the UK State of Design capability recruiting Design Specialists who will be able to engage with other authorities and seek participation in the SAE International Seat Committee to the design of seats for commercial air transport aircraft and where appropriate to make recommendations to minimise the chance of portable electronic devices becoming crushed in mechanisms.

The evolution of seat design standards will only be effective when agreed on a global basis. The UK CAA will continue to work with other lead international regulatory authorities to review and support future amendments and updates to the Certification Specifications and /or recommended practices.

The CAA continue to monitor similar PED entrapment events through the requirements of CAA Regulation (EU) 376/2014 (as retained and amended in UK domestic Law under the European Union withdrawal Act 2018) and through its engagement in the SAE committee. Currently the CAA do not envisage an immediate change to the Certification Specifications or Recommended Practices to aircraft seat design. We will continue to monitor progress and changes through the SAE working group.

AAIB Assessment:	**Not Adequate**
Action Status:	**No Planned Actions, Update due 8 August 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB acknowledges the CAA's update on its response to this Safety Recommendation and recognises the international dimension of regulatory change. It remains the case that portable electronic devices becoming crushed in seat mechanisms are a fire hazard, and that there are currently no requirements to prevent this. The CAA is not precluded from taking action itself and the AAIB invites the CAA, in tandem with its international efforts, to consider a response to the Safety Recommendation that improves safety in this area as soon as practicable, and in any case to provide a further update by 8 August 2022.

AIRBUS A321-211, G-POWN
26 February 2020 at London Gatwick Airport

Investigation Synopsis

As part of scheduled maintenance overseas, G-POWN underwent a biocide shock treatment on its fuel system, using Kathon biocide, to treat microbial contamination. The aircraft returned to the UK on 24 February 2020, once the maintenance was complete.

In the 24 hours preceding this serious incident, there were abnormalities with the operation of both engines across four flights. On the flight before the fourth (event) flight, the crew reported momentary indications of a No 2 (right) engine stall. After the aircraft landed, this was investigated using an inappropriate procedure obtained from an aircraft troubleshooting manual not applicable to G-POWN, but no fault was found.

The aircraft took off from London Gatwick Airport Runway 26L at 0009 hrs on 26 February 2020 but, at around 500 ft agl, the No 1 (left) engine began to surge. The commander declared a MAYDAY and turned right downwind for an immediate return to the airport but, shortly afterwards, the crew received indications that the No 2 engine had stalled. The crew established that the engines were more stable at low thrust settings and the thrust available at those settings was sufficient to maintain a safe flightpath. They continued the approach and the aircraft landed at 0020 hrs.

The investigation identified the following causal factors:

1. G-POWN's fuel tanks were treated with approximately 38 times the recommended concentration of Kathon.

2. The excessive Kathon level in the aircraft's fuel system caused contamination of the engine Hydro Mechanical Units (HMU) resulting in a loss of correct HMU regulation of the aircraft's engines.

3. A troubleshooting procedure was used for the engine No 2 stall that applied to LEAP-1A32 engines, but G-POWN was fitted with CFM56-5B3/3 engines. The procedure for CFM56-5B3/3 engines required additional steps that would have precluded G-POWN's departure on the incident flight.

The investigation identified the following contributory factors:

1. The Aircraft Maintenance Manual (AMM) procedure did not provide enough information to enable maintenance engineers to reliably calculate the quantity of Kathon required, and the specific gravity value of Kathon was not readily available.

2. There were no independent checking procedures in place at the base maintenance Approved Maintenance Organisation (Base AMO) to prevent, or reduce the likelihood of, calculating and administering an incorrect quantity of biocide.

3. There were organisational factors at the Base AMO that contributed to the incorrect Kathon quantity calculations. In particular, the workload was high for the available facilities and personnel, and there was no internal technical support function for engineers to consult when they were uncertain.

4. The manufacturer's recommended method of searching the troubleshooting manual was not used to find the applicable procedure relating to the engine No 2 stall.

Following this serious incident, Safety Action was taken by regulators, the International Air Transport Association, the manufacturers of the aircraft, engines and biocide, the AMOs involved, and the operator. The specific action taken is detailed in Section 4.2 of this report.

Redundancy in safety critical systems is one of the principles supporting the safety of commercial air transport but fuel contamination undermines that redundancy because it can affect all engines simultaneously. It is essential that maintenance systems are resilient to errors that can lead to fuel system contamination. Therefore, five Safety Recommendations have been made in this report to promote the classification of biocide treatment of aircraft fuel systems as a critical maintenance task, which would ensure that an error-capturing method is included as part of the task.

Safety Recommendation 2021-018

Justification

As this serious incident and previous events have demonstrated, biocide treatment of aircraft fuel systems contains the potential to adversely affect the fuel quality supplied to, and therefore the thrust available from, all of an aircraft's engines. This fundamentally undermines the redundancy provided by multiple engines. It is clear, therefore, that the biocide treatment of aircraft fuel systems should be classified as a critical maintenance task because this classification would require an error-capturing method to be implemented. However, the existing EASA Part-145 and Part M regulations do not specifically require this classification and therefore the following Safety Recommendation was made.

Safety Recommendation 2021-018

It is recommended that the European Union Aviation Safety Agency amend the Acceptable Means of Compliance AMC2(a)(3) for regulation Part-145.A.48(b), Performance of Maintenance, to include the treatment of aircraft fuel systems with biocide additives as an example task that is to be considered as a critical maintenance task.

Date Safety Recommendation made: 27 April 2021

Latest response received: 31 July 2021

Paragraph 145.A.48 of Annex II (Part 145) of Commission Regulation (EU) No 1321/2014 intentionally allocates the responsibility for classification of tasks as “critical maintenance task” to the maintenance organisation for the following reasons.

First of all, regulation is never able to catch up with new technology and recent design, so any list of examples given in acceptable means of compliance (AMC) / guidance will always lack the latest ones and require constant updating. Therefore, not specific examples but a list of higher level criteria is given which is considered to apply to any new technology as well.

Secondly, the criticality of a task cannot fully be determined at such a high level, it is partly depending on the exact environment in which the task is performed and on the actual equipment used. In this specific example dosing and mixing the biocide manually makes the task much more critical than using a fuelling cart which has a biocide dosing capability. As such the decision whether a task is critical or not can only be appropriately taken at a level where the full information about how the task is performed and the equipment used is available.

Currently AMC2 145.A.48(b) does give a list of high level examples (e.g. “tasks that may affect the control of the aircraft”) which is not compatible with the very specific treatment of aircraft fuel systems with biocide additives.

The European Union Aviation Safety Agency (EASA) therefore disagrees that explicitly adding biocide treatment to AMC2 145.A.48(b) (a)(3) would be an appropriate action, and assumes that giving high level criteria and sources of information to identify critical maintenance tasks is more appropriate than giving specific examples.

EASA will however review the AMC2 145.A.48(b) (a)(3) wording for the possibility of amending it at a higher level.

EASA also recognizes that the list of data sources used to identify critical maintenance tasks in AMC2 145.A.48(b) (b) could be amended, to cover publications like EASA SIB 2020-06 dealing explicitly with biocide treatment.

EASA will include these considerations into the next updating exercise of the rules for Continuing Airworthiness.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 31 July 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The review of the AMC that EASA proposes has the potential (depending on the action taken following the review) to lead to an increased awareness within maintenance organisations of this safety issue. Therefore, although EASA disagrees with the Safety Recommendation, the response goes some way to meeting its intent. An update on progress is requested by the end of July 2022.

Safety Recommendation 2021-019

Justification

As this serious incident and previous events have demonstrated, biocide treatment of aircraft fuel systems contains the potential to adversely affect the fuel quality supplied to, and therefore the thrust available from, all of an aircraft's engines. This fundamentally undermines the redundancy provided by multiple engines. It is clear, therefore, that the biocide treatment of aircraft fuel systems should be classified as a critical maintenance task because this classification would require an error-capturing method to be implemented. However, the existing EASA Part-145 and Part M regulations do not specifically require this classification and therefore the following Safety Recommendation was made.

Safety Recommendation 2021-019

It is recommended that the European Union Aviation Safety Agency amend the Acceptable Means of Compliance AMC1(c) for regulation M.A.402(h), Performance of Maintenance, to include the treatment of aircraft fuel systems with biocide additives as an example task that is to be considered as a critical maintenance task.

Date Safety Recommendation made: 27 April 2021

Latest response received: 31 July 2021

Paragraph M.A.402 of Annex I (Part M) of Commission Regulation (EU) No 1321/2014 intentionally allocates the responsibility for classification of tasks as "critical maintenance task" mentioned under paragraph M.A.402(h) "performance of maintenance" to the maintenance organisation which ultimately performs the task, and not to the Continuing Airworthiness Management Organization (CAMO) which plans it.

Currently AMC1 M.A.402(h) does give a list of high-level examples (e.g. "tasks that may affect the control of the aircraft") which is not compatible with the very specific treatment of aircraft fuel systems with biocide additives.

EASA therefore disagrees that explicitly adding biocide treatment to M.A.402(h) (c) would be an appropriate action, and assumes that giving high level criteria and sources of information to identify critical maintenance tasks is more appropriate than giving specific

examples. EASA will however review the AMC1 M.A.402(h) (c) wording for the possibility of amending it at a higher level.

EASA also recognizes that the list of data sources used to identify critical maintenance tasks in AMC2 M.A.402(h) could be amended.

EASA will include these considerations into the next updating exercise of the rules for Continuing Airworthiness.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 31 July 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The review of the AMC that EASA proposes has the potential (depending on the action taken following the review) to lead to an increased awareness within maintenance organisations of this safety issue. Therefore, although EASA disagrees with the Safety Recommendation, the response goes some way to meeting its intent. An update on progress is requested by the end of July 2022.

Safety Recommendation 2021-020

Justification

As this serious incident and previous events have demonstrated, biocide treatment of aircraft fuel systems contains the potential to adversely affect the fuel quality supplied to, and therefore the thrust available from, all of an aircraft's engines. This fundamentally undermines the redundancy provided by multiple engines. It is clear, therefore, that the biocide treatment of aircraft fuel systems should be classified as a critical maintenance task because this classification would require an error-capturing method to be implemented. Since the NAAs of EASA Member States are responsible for performing safety oversight and audit of CAMOs and AMOs at the national level, the following Safety Recommendation was made.

Safety Recommendation 2021-020

It is recommended that the European Union Aviation Safety Agency (EASA) conduct safety promotion with the National Aviation Authorities (NAAs) of EASA Member States to promote the classification of biocide treatment of aircraft fuel systems as a critical maintenance task.

Date Safety Recommendation made: 27 April 2021

Latest response received: 31 July 2021

The European Union Aviation Safety Agency (EASA) is currently working on identifying the best way to promote the topic highlighted by the safety recommendation.

AAIB Assessment: **Partially Adequate**

Action Status: **Planned Action Ongoing Update due 31 January 2022**

Safety Recommendation Status: **Open**

Feedback rationale

The response is assessed as Partially Adequate pending notification of the method chosen by EASA to promote this safety issue. An update is requested by 31 January 2022.

Safety Recommendation 2021-021

Justification

As this serious incident and previous events have demonstrated, biocide treatment of aircraft fuel systems contains the potential to adversely affect the fuel quality supplied to, and therefore the thrust available from, all of an aircraft's engines. This fundamentally undermines the redundancy provided by multiple engines. It is clear, therefore, that the biocide treatment of aircraft fuel systems should be classified as a critical maintenance task because this classification would require an error-capturing method to be implemented. As the classification of critical maintenance tasks is defined at the organisation level by the planners, supervisors and certifying staff in an AMO or a CAMO, the following Safety Recommendation was made.

Safety Recommendation 2021-021

It is recommended that the European Union Aviation Safety Agency, during future audits of Continued Airworthiness Management Organisations and Approved Maintenance Organisations for which it is the Competent Authority, include a check that consideration has been given to the classification of biocide treatment of aircraft fuel systems as a critical maintenance task.

Date Safety Recommendation made: 27 April 2021

Latest response received: 31 July 2021

The requirements for the performance of critical maintenance tasks, when dealing with complex motor-powered aircraft, are primarily addressed in point 145.A.48(b) of Annex II (Part-145) to Commission Regulation (EU) No 1321/2014.

The European Union Aviation Safety Agency (EASA) makes use of compliance check lists as part of its audit, reflecting the implementing regulation requirements and including a specific check on 145.A.48 (b) requiring the maintenance organisation to establish a procedure to ensure that an error capturing method is implemented after the performance of any critical maintenance task.

This check item covers the verification that the maintenance organisation has established a list of critical maintenance tasks as specified in the acceptable means of compliance (AMC) material "AMC 2 145.A.48(b) Performance of maintenance", the detail of which is fully the responsibility of the organisation and to be customised to the scope of the approval held. The safety recommendation addresses an expectation for an additional level of detail, to record evidence that the competent authority verifies that biocide treatment is classified as critical maintenance task. This approach has the potential to jeopardise the role of the competent authority, which is intended to verify that the organisation is compliant with regulatory requirements and has implemented a quality system able to monitor such compliance on continuous basis, rather than performing specific quality control activities as suggested in the safety recommendation.

In particular, EASA believes that the suggested level of detail would move the focus of the competent authority's inspection away from primary aspects of compliance verification thereby having a negative effect on safety.

EASA Status: Closed – Disagreement

AAIB Assessment:	**Not Adequate**
Action Status:	**Planned Action Completed**
Safety Recommendation Status:	**Closed**

Feedback rationale

The AAIB does not agree with the argument that the Safety Recommendation could potentially have a negative effect on safety. Nevertheless, in light of EASA's response, the recommendation is closed.

Safety Recommendation 2021-022

Justification

As this serious incident and previous events have demonstrated, biocide treatment of aircraft fuel systems contains the potential to adversely affect the fuel quality supplied to, and therefore the thrust available from, all of an aircraft's engines. This fundamentally undermines the redundancy provided by multiple engines. It is clear, therefore, that the biocide treatment of aircraft fuel systems should be classified as a critical maintenance task because this classification would require an error-capturing method to be implemented. As the classification of critical maintenance tasks is defined at the organisation level by the planners, supervisors and certifying staff in an AMO or a CAMO, the following Safety Recommendation was made.

Safety Recommendation 2021-022

It is recommended that the Civil Aviation Authority (CAA), during future audits of CAA-approved Continued Airworthiness Management Organisations and Approved Maintenance Organisations, include a check that consideration has been given to the classification of biocide treatment of aircraft fuel systems as a critical maintenance task.

Date Safety Recommendation made: 27 April 2021

Latest response received: 23 July 2021

The Civil Aviation Authority (CAA), as part of its future audit oversight programme for Continued Airworthiness Management Organisations and Approved Maintenance Organisations, will review the use of critical maintenance task methods and procedures highlighting to organisations, including the classification of biocide treatment of aircraft as indicated within the AAIB Report. This will include the need to follow the guidance material as set out in GM M.A.402(h) or AMC2 145.A.48(b) for data sources used for the identification of critical maintenance tasks which includes accident reports.

As an additional mitigation the CAA will amend its guidance material on the creation and amendment of Aircraft Maintenance Programmes to include additional guidance on identification of critical maintenance tasks highlighting the above mentioned regulatory references and the need to place additional focus on biocide treatment of aircraft.

As the regulatory framework within the UK is now separated from that of the EU, the CAA will also instigate a rulemaking task to amend the AMC as indicated in safety recommendation 2020-018 and 2020-019 for the UK legislation.

AAIB Assessment: **Adequate**

Action Status: **Planned Action Completed**

Safety Recommendation Status: **Closed**

UAS DJI Phantom 4 RTK
2 December 2020 at Newtongrange, Dalkeith, Midlothian

Investigation Synopsis

The UAS, a DJI Phantom 4 RTK, was being operated in an automated flight mode to survey a railway track and surrounding infrastructure when one of the four propellers detached whilst in-flight. The aircraft rapidly descended from a height of 70 m (230 ft) where it struck the ground in the rear garden of a house. No persons were injured.

Aircraft after being recovered from garden

This investigation has reviewed the new UAS regulations introduced on 31 December 2020 concerning the safe overflight of people and data available to assist in risk assessments. Two Safety Recommendations are made to the UK CAA.

Safety Recommendation 2021-023

Justification

Neither the operator in its risk assessment, nor the CAA in UKPDRA01, based mitigating actions on data published for UAS failure rates per flying hour. Whilst it is recognised that UAS manufacturers would be understandably reluctant to publish such information, large operators such as Network Rail are collating aircraft usage data, and UK operators are also now required to record usage data for each aircraft in addition to individual pilot flight hours to support annual applications to the CAA for the renewal of an operational authorisation. Collation and dissemination of such data would enable, in particular for operations involving overflight of people, the actual risk to uninvolved persons on the ground to be assessed with greater accuracy.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-023**
>
> It is recommended that the Civil Aviation Authority collate up to date information regarding the failure rates per flying hour for unmanned aircraft systems operating in the Specific category, or previously under a CAA Permission for Commercial Operations, to facilitate effective risk assessments.

Date Safety Recommendation made: 13 May 2021

Latest response received: 28 July 2021

The CAA partially accepts this recommendation. Most flying hours accumulated by smaller commercial off-the-shelf UAS in the UK are carried out in the Open Category, which the CAA does not have visibility of. The CAA accepts that Open Category products like this will be used under an Operational Authorisation (OA) in the Specific Category. Regulation (EU) No. 2019/945 as retained (and amended in UK domestic law) under the European Union (Withdrawal) Act 2018 requires that the Secretary of State nominates a Market Surveillance Authority (MSA) that will have responsibility for ensuring that manufacturers adhere to appropriate standards.

Part of the remit under UK Reg (EU) 2019/945 is that the MSA will engage with the CAA on safety matters and help ensure that products are suitably safe for market and use in the UK. This coupled with the C-marking standards defined in the regulation will assist in ensuring that equipment used in the UK is of high quality, and the MSA will assist in ensuring that manufacturers continually improve their products.

The collation of all flying hours across multiple product lines and manufacturers will not be feasible. The collection of hours flown by type in the Specific Category is difficult due to the temporary nature of many applications. An Operational Authorisation is typically valid for a year, and there is no compulsion on the applicant to renew. This means that following the issue of the OA, unless Performance Based Oversight (PBO) principles means there is a requirement identified to audit or examine the applicant, the CAA may have no further contact with them. The provision of full logs is not currently a requirement under any existing legislation; only a confirmation of currency within the 3 months preceding the application or renewal.

Under UK Reg (EU) 2019/947, point UAS.SPEC.090, any holder of an Operational Authorisation must make any records available to the CAA on request. The CAA will examine whether the application and audit processes could be expanded to use this privilege to retain logs by aircraft type at the point of renewal or expiry of a Specific Cat OA.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 31 March 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB notes the difficulties that the CAA would have in obtaining usage information from operators that do not renew an Operational Authorisation and the current limitations associated with those that do. However, the AAIB acknowledges the engagement of the CAA with the Market Surveillance Authority on matters of safety, and the intention of the CAA to explore whether a more complete set of usage information could be obtained through the exercise of the Regulator's privilege under UK Reg (EU) 2019/947, point UAS.SPEC.090. The AAIB requests an update on the progress of the latter on or before Q1/2022.

Safety Recommendation 2021-024

Justification

Since 2015, 73 accidents involving UAS aircraft have been reported to the AAIB where a loss of control occurred, of which 69 had a MTOM of less than 25 kg. It is unclear if the current mitigations intended to prevent injury to uninvolved persons are adequate or that it has been due to chance that a person has not been injured. This investigation indicates that UAS operations in the Specific category pose a risk to uninvolved people on the ground being struck by an aircraft relying solely upon its propulsion system for lift, following a failure of that propulsion system.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-024**
>
> It is recommended that, until an analysis of failure rates per flying hour has demonstrated an acceptable level of safety, the Civil Aviation Authority should consider prohibiting the overflight of uninvolved persons for those unmanned aircraft operating in the Specific category which rely solely upon their propulsion system for lift that would, following a failure of the propulsion system, impact the ground with a kinetic energy exceeding 80 Joules.

Date Safety Recommendation made: 13 May 2021

Latest response received: 28 July 2021

The ability to conduct a root cause analysis of the accident was frustrated by the rapid dispatch of the aircraft to the manufacturer for repair; important safety conclusions may have been missed. Neither Regulation (EU) No 376/2014 as retained (and amended in UK domestic law) under the European Union (Withdrawal) Act 2018, nor CAP722 specifically inform reporters that they should retain any material from the accident for potential investigations. The CAA will consider what advice should be added to a future draft of CAP722 regarding the preservation of evidence once suitable lines to take have been agreed with AAIB.

Overflight of people is permitted by regulation under UK Reg (EU) 2019/947. The CAA has not seen enough evidence that indicates that the prohibition of overflight of uninvolved people is a proportionate response to this accident. Authorisations to fly in congested areas have operating conditions and require a higher level of remote pilot competence to mitigate the safety risk it presents.

The CAA will conduct a trend analysis of occurrence reporting and will release an appropriate message to the regulated community to reinforce good practice on how to reattach propellers and remind operators to conduct root cause analysis to close MORs.

AAIB Assessment:	**Adequate**
Action Status:	**Planned Action Completed**
Safety Recommendation Status:	**Closed**

Feedback rationale

Although the cause of the loss of the propeller in this accident was not determined, the focus of Safety Recommendation 2021-024 is on the consequences of failures occurring to some types of UAS operating in the Specific category regardless of their cause. The CAA has considered the issue of overflight of uninvolved persons for these particular types of UAS but, in its response, has stated that the Authority has not seen enough evidence to warrant taking action.

The AAIB notes the CAA's intention to update CAP722 to regarding the preservation of evidence following an accident, which, if implemented, could enable the CAA, in conjunction with the Market Surveillance Authority (Safety Recommendation 2021-023 refers), to more effectively target specific areas of UAS design and operations to enhance safety.

SIKORSKY S-92A, G-LAWX
14 October 2019 at Shipston-on-Stour, Warwickshire

Investigation Synopsis

On approach to landing in reduced visibility just before night, a Sikorsky S-92A (G-LAWX) descended to within 28 ft of rising terrain close to a house. During the subsequent emergency climb at low indicated airspeed, engine torque increased to 131% and the pitch attitude was unstable.

View of LS to the West at 1720 hrs, 10 minutes before departure from Birmingham (used with permission)

Safety Recommendation 2021-025

Justification

The evidence of this serious incident, and the other occurrences to which CAP 1864 refers, indicates that the effect of the regulations when landing is not well understood, and may be causing pilots to act unsafely.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-025**
>
> It is recommended that the Civil Aviation Authority publish guidance on the meaning and intention of the phase of flight alleviations in UK SERA where detailed as “except for take-off and landing” to better enable pilots to plan and act on minimum height requirements for safe operations.

Date Safety Recommendation made: 11 June 2021

Latest response received: 23 December 2021

The date for the completion of the actions identified in our initial response is June 30th.

A progress update will be provided for all our actions associated with the G-LAWX safety recommendations by March 8th 2022.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 8 March 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB acknowledges the response to the Safety Recommendation and invites the CAA to update the AAIB on its progress by 8 March 2022.

Safety Recommendation 2021-026

Justification

The operator had not defined stabilised approach criteria in its OM.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-026**
>
> It is recommended that Starspeed Ltd specify in its operations manual stabilised approach criteria for visual approaches, including at off-aerodrome landing sites.

Date Safety Recommendation made: 11 June 2021

Latest response received: 13 September 2021

Summary

Taking the above into account, Starspeed cannot currently see a way of creating standard criteria for stabilised approach mandatory by day or by night that meet all the different safety and risk management needs. Crews will be instructed that where a landing site permits the use of the standard day gate criteria, (or prescribed stabilised night approaches) they will use them. At the very least, even if wings level cannot be achieved, by 500' agl with 0.5nm to run, landing checks will be complete and a steady, decelerative speed will be established to meet LDP, (wings level) at the appropriate point. This guidance will be written into the Part A, Section 8 of the OM.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 31 January 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The response does not completely satisfy the intent of the Safety Recommendation because it does not include action to specify in its operations manual stabilised approach criteria for visual approaches, including at off-aerodrome landing sites, except in the specific circumstances described. This does not appear consistent with the guidance to which

the AAIB report refers and which includes a consideration of onshore procedures. There appears to be more scope for defining practical stable approach criteria than envisaged by the operator's response.

The AAIB invites the operator to re-examine the issue and to advise the AAIB of progress in its response by 31 January 2022.

Safety Recommendation 2021-027

Justification

The existence of a PinS approach to the LS would have afforded the pilots a more robust alterative means to make an approach in the marginal conditions that were experienced. CAP 1864 identified that PinS approaches provide the opportunity to meet the needs of onshore helicopter IFR operations but did not propose any action to address the current lack of them.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-027**
>
> It is recommended that the Civil Aviation Authority encourage the development and deployment of Point-in-Space operations at landing sites.

Date Safety Recommendation made: 11 June 2021

Latest response received: 8 September 2021

The CAA accepts this recommendation. The CAA recognises safety and operational advantages are possible by developing Point-in-Space operations and will work with industry to encourage deployment through the Onshore Safety Leadership Group. However, the CAA is also cognisant that it is up to industry (operators and landing site owners) to identify most appropriate PinS applications, and that there is currently an industry cost burden in the development of such procedures which is an impediment to wider availability.

AAIB Assessment:	**Adequate**
Action Status:	**Planned Action Completed**
Safety Recommendation Status:	**Closed**

Safety Recommendation 2021-028

Justification

CAA Paper 2007/03, AIC Pink 137/2019, CAA Safety Notice SN-2019/007, CAP 1145 and CAP 1864 describe the broader hazards of operating in degraded visual conditions but do not offer guidance for managing them.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-028**
>
> It is recommended that the Civil Aviation Authority revise its guidance on helicopter flight in degraded visual conditions to include further information on managing the associated risks.

Date Safety Recommendation made: 11 June 2021

Latest response received: 8 September 2021

The CAA accepts this recommendation and will conduct a review of its current guidance on helicopter flight in degraded visual conditions with a view to providing enhanced information on the importance of the management of associated risks as exemplified through elements of this serious incident.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 8 March 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB acknowledges the response to this Safety Recommendation and invites the CAA to confirm by 8 March 2022 what further information it intends to publish on managing the risks associated with helicopter flight in degraded visual conditions, and its progress in doing so.

Safety Recommendation 2021-029

Justification

The S92 involved in this occurrence was fitted with a system to alert the pilots when the helicopter descended below a selected minimum barometric altitude. Not all helicopters are fitted with this system. No barometric altitude alerts were recorded during the flight, indicating that the barometric alert value was set above or below all the altitudes flown. There was no SOP for the value which should be set when operating under VFR. Setting alerts at pre-determined en route and approach minima for visual flight provides an additional barrier to inadvertent descent below those minima.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-029**
>
> It is recommended that Starspeed Ltd describe in its operations manual for the Sikorsky S92 helicopter the criteria for setting barometric altitude alert values at each stage of a flight.

Date Safety Recommendation made: 11 June 2021

Latest response received: 13 September 2021

For onshore rotary craft, the RADALT provides the only indication of actual terrain separation.

However, the Bar Alt, (on aircraft with the ability to set a Bar Alt alert) shall have the relevant MSA pre-set. When flying VFR or IFR in the cruise, the pre-setting of MSA will provide a known altitude by which the aircraft can fly to and achieve safe terrain separation.

This will be re-set in the event of an instrument approach when the applicable MDA will be used in accordance with Operations Manual Part A, Section 8, Table 8.14.9.

AAIB Assessment: **Adequate**

Action Status: **Planned Action Completed**

Safety Recommendation Status: **Closed**

Safety Recommendation 2021-030

Justification

The operator's external crew resource management training provider covered assertive communication and intervention using the PACE model, but the operator had not implemented the process in its OM. This occurrence indicates that the co-pilot had the greatest difficulty challenging the commander in those areas not covered by a formalised challenge procedure.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-030**
>
> It is recommended that Starspeed Ltd specify in its operations manual a formal process for crew members to monitor, escalate concerns and, if necessary, take control during a flight

Date Safety Recommendation made: 11 June 2021

Latest response received: 13 September 2021

The Ops Manual at Amendment 4 has been updated to better describe the procedure and requirements.

Section 8.14.8.5 – Go-Around process

Section 8.14.8.8 – Deviation calls

In addition, the training programme defined in Part D now includes specific training items relating to this incident. These changes have already successfully been incorporated in recent Simulator training sessions.

AAIB Assessment:	**Partially Adequate**
Action Status:	**Planned Action Ongoing Update due 31 January 2022**
Safety Recommendation Status:	**Open**

Feedback rationale

The AAIB acknowledges the action taken to by the operator. The changes to the operations manual described in the response do not completely satisfy the intent of the recommendation because they relate specifically to flight path deviations and not to how crewmembers might escalate concerns more generally. The AAIB invites the operator to explore how it might address the full intent of the Safety Recommendation and to advise the AAIB of its intentions by 31 January 2022.

Safety Recommendation 2021-031

Justification

CAP 1864 noted that pilots will often be subject to pressures – real or perceived – to complete a task, and that these pressures might lead pilots to continue with flights in circumstances where otherwise they would not. It recommended that operators show clear evidence of operational control as defined in AMC1 ORO.GEN.110 (c), ensuring that there is a clear tasking process separating the customer and the flight crew. The AAIB investigation of G-CRST amongst others, and its discussions with the CAA, indicate that this is a significant area of concern in the onshore helicopter industry requiring prompt safety action.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-031**
>
> it is recommended that the Civil Aviation Authority ensure that operators show clear evidence within their system for operational control as required by UK ORO.GEN.110 (c), of how the tasking process separates the customer from the flight crew.

Date Safety Recommendation made: 11 June 2021

Latest response received: 8 September 2021

The CAA accepts this recommendation. The CAA has conducted a Specific Objectives Check (SOC) relating to operational control as required by UK ORO.GEN.110 (c) and other associated Acceptable Means of Compliance and Guidance Materials, a number of observations have been raised with operators to address any shortcomings in their systems. As a result of this recommendation and the observations raised, the CAA is reviewing their guidance to operators. The CAA will also engage with relevant industry groups to promote awareness of, and compliance with, the relevant requirements.

AAIB Assessment: **Adequate**

Action Status: **Planned Action Completed**

Safety Recommendation Status: **Closed**

Safety Recommendation 2021-032

Justification

The Civil Aviation Authority recognises the benefits of Helicopter Flight Data Monitoring programs but CAP 1864 (Onshore Helicopter Review Report) does not propose action to implement them.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-032**
>
> It is recommended that the Civil Aviation Authority assess the safety benefits and feasibility of Helicopter Flight Data Monitoring programmes for onshore helicopter operators conducting commercial operations or non-commercial complex operations and publish its findings.

Date Safety Recommendation made: 11 June 2021

Latest response received: 1 March 2022

This item has been raised informally with industry, but more work is required to understand the potential benefits for small fleet sizes (typical with this sector) and the types of operation conducted. External subject matter experts are being considered to assist with this project.

AAIB Assessment: **Partially Adequate**

Action Status: **Planned Action Ongoing Update due 24 June 2022**

Safety Recommendation Status: **Open**

Feedback rationale

The AAIB acknowledges the CAA's response to the Safety Recommendation, which remains open pending a description of planned action. The AAIB requests an update by 24 June 2022.

Bell 407, N120HH
24 June 2020 at Long Marston, Stratford-upon-Avon, Warwickshire

Investigation Synopsis

Main wreckage

The pilot and passenger were returning to Thruxton Aerodrome following a short flight over the Malvern hills when the engine failed. The pilot executed an autorotation landing in a field near Long Marston, after which they were both able to exit the helicopter without injury. However, the tail boom was severed during the landing and the helicopter was destroyed by fire.The investigation found that the engine suffered an uncontained failure of the gas producing turbine disc due to insufficient oil reaching the bearings as a result of an oil leak. Due to the extensive damage to the helicopter it was not possible to determine the cause of the oil leak. Two Safety Recommendations were made regarding the Failure Mode and Effects Analysis for the engine, and the fire resistance and crashworthiness of aircraft components. The helicopter manufacturer undertook two Safety Actions regarding advice to pilots, and one Safety Action regarding analysis of the airframe fuel filter.

Safety Recommendation 2021-047

Justification

The accident sequence has shown that a loss of oil can lead to a burst of the GP2 rotor, the debris of which would not have been attenuated by the energy absorbing ring. Because the axial movement of the GP turbine is outside of the Rolls Royce design intent and certification criteria, the Failure Modes and Effects Analysis for the engine may not fully capture the linkage between loss of engine oil and uncontained bursting of the GP2 rotor.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-047**
>
> It is recommended that Rolls-Royce Corporation includes the scenario of a loss of engine oil leading to the uncontained failure of both Gas Producer Turbine Discs in the Failure Mode and Effects Analysis for the Rolls-Royce M250 Series 4 engines.

Date Safety Recommendation made: 23 September 2021

Latest response received: 29 November 2021

The M250-C47B FMECA was reviewed by Rolls Royce and found to contain two entries for insufficient oil supply to the No. 8 bearing; one which properly described the potential for T2 wheel burst and one with the highest level effect being in-flight shutdown. This FMECA was revised to eliminate the duplicate entry, maintaining the line with the proper description (i.e. T2 wheel burst). Additionally, the M250 Series IV Baseline FMECA was also reviewed and found to only describe in-flight shutdown as the highest level effect of insufficient oil supply to the No. 8 bearing. This FMECA was also revised to properly describe the potential for T2 wheel burst. These FMECAs have now been formally updated within Rolls-Royce and are live documents."

AAIB Assessment: **Adequate**

Action Status: **Planned Action Completed**

Safety Recommendation Status: **Closed**

Safety Recommendation 2021-048

Justification

The guidance for 14 CFR Part 27 does not appear to clearly articulate the need for components to be able to meet their crashworthiness requirements after exposure to fire and heat.

Therefore, the following Safety Recommendation was made:

> **Safety Recommendation 2021-048**
>
> It is recommended that Transport Canada assess its guidance material for 14 CFR Part 27 and Part 33 requirements on fire resistance and crashworthiness such that fuel system components certified to be fire resistant also retain sufficient residual material integrity to meet their crashworthiness requirements.

Date Safety Recommendation made: 23 September 2021

Latest response received: 18 October 2021

The conditions for fire resistance are addressed in the FAR part 1.1 definition, AC 20-135 Change 1 and AC 33.17-1A. Per FAA AC 33.17-1A, the intent of shielding per FAR 33.17(b) may be applied to engine fuel system components to minimize the possibility of leaking flammable fluid and also retain sufficient residual material integrity to meet their crashworthiness requirements in a fire situation. The fire resistant criteria has been applied to engine fuel system components because the 5 minute exposure

provides a reasonable time period for the flight crew to recognize a fire condition, close the appropriate fuel shutoff valve(s), and shutdown the engine, thereby cutting off the fuel source. At the aircraft level, per FAR 27.1183(a), fuel system components may have a fireproof shield or be located so as to safeguard against the ignition of leaking flammable fluid. The partial text of FAR 33.17(b) and 27.1183(a) read similar.

Per FAA AC 21-16G, the FAA encourages the use of RTCA DO-160 Environmental Conditions and Test Procedures for Airborne Equipment as one acceptable document for environmental qualifications to show compliance with certain airworthiness requirements. Specifically, DO-160 Section 7.0 Operational Shocks and Crash Safety contains requirements for a crash safety test of components to make sure they will not detach during an emergency landing. Aircraft fuel system components within the engine area (powerplant installation) may be subject to such DO-160 test and also to FAR 27.952 requirements, which considered the recommendations of report NTSB-AAS-80-2. The FAR section 27.952 is not specific to powerplant installation fuel components but it may be made to apply because, for example, a fuel filter located in the engine area, is an airframe mounted fuel system component. For future certification programs, TC and an Applicant may agree on a means to improve powerplant installation fuel components' crashworthiness.

The FAA AC 27-1B contains acceptable methods of compliance to each relevant FAR section 27.XXXX and are provided to guide the Applicant on how to retain sufficient residual material integrity to meet the crashworthiness requirements. During a certification program, a detailed review of the design is conducted to identify and quantify all fuel system components in areas subject to engine fire conditions such as engine compartments and other fire zones. Once these items are identified, the design means of fire protection and residual material integrity are selected and validated, as necessary, during the certification process and agreed by TC. For components that cannot be qualified as fire resistant by similarity or by known material standards, testing to severe fire conditions (see paragraph AC 27.859 definition and AC 20-135 for detailed requirements) are conducted on full-scale specimens or representative samples to establish their fire resistance capabilities and sufficient residual material integrity.

Transport Canada supports the TSB/AAIB Safety Recommendation 2021-048 objective of reducing post landing fires in small helicopters. TC has used the above FAA AC's as acceptable means of compliance in its regulatory system and deems that the current FAR standards in Table 1 (which are harmonized with Airworthiness Manual (AWM) Chapters 527 and 533) and means of compliance are sufficient to address the safety recommendation. TC will continue to monitor post landing fire events as part of on-going certification work. TC has no further activities planned at this time, is satisfied with measures taken and suggests this safety recommendation be closed.

AAIB Assessment :	**Adequate**
Action Status:	**Planned Action Completed**
Safety Recommendation Status:	**Closed**

ESCAPADE, G-CGNV
14 November 2021 at Breighton Airfield, Yorkshire

Investigation Synopsis

The aircraft was seen to takeoff and climb steeply while appearing to sideslip and drift off the runway centreline. It climbed to approximately 180 ft agl at which point the left wing dropped, the aircraft departed from controlled flight and it descended rapidly to the ground. The pilot was fatally injured. The evidence indicates that the seat moved rearwards leading to the pilot losing control of the aircraft. The cause of the seat movement is under investigation. Three Safety Recommendations were made.

Marks created on the pilot's seat adjustment rail by the pin

Safety Recommendation 2021-049

Justification

Given the possibility for a seat to not be properly locked in place and the secondary locking to not be secure on these and similar aircraft types the following Safety Recommendation was made.

Safety Recommendation 2021-049

It is recommended that the Light Aircraft Association remind owners of this aircraft type of the necessity, after every seat position adjustment, to:

- ensure that the seat pin is correctly locking the seat in position, and
- set the seat adjuster backup strap after the desired seat position has been selected.

Date Safety Recommendation made: 13 December 2021

Latest response received: 27 March 2022

The Light Aircraft Association (LAA) accepts this recommendation.

The LAA wrote to the owners of all Reality Escapade and Sherwood Scout aircraft on the LAA fleet in December 2021 advising them of AAIB Bulletin S3/2021, and advising: "... please ensure that after every seat position adjustment and prior to takeoff, that the seat locking pin is correctly locking the seat in position and that the seat adjuster backup strap has been set after the desired seat position has been selected.". The LAA Reality Escapade / Sherwood Scout Type Acceptance Data Sheet (TADS) was also revised to add a Special Inspection Point regarding the seat adjustment and referring to AAIB Bulletin S3/2021.

Subsequent to this initial action:

– In February 2022 the LAA issued LAA Technical Service Bulletin TSB-01-2022 to promulgate The Light Aircraft Company (TLAC) SB 01-2021 and CAA MPD 2022-004E. The LAA wrote to the owners of all Reality Escapade and Sherwood Scout aircraft on the LAA fleet advising them of these documents, and the LAA Reality Escapade / Sherwood Scout TADS has been up-issued to reference these documents.

– February 2022's Light Aviation magazine contained an article based on AAIB Bulletin S3/2021 and highlighting the risks associated with adjustable seats. Also in February 2022, the LAA issued LAA Alert A-003-2022 to promulgate CAA SN-2022-001.

AAIB Assessment: **Adequate**

Action Status: **Planned Action Completed**

Safety Recommendation Status: **Closed**

Safety Recommendation 2021-050

Justification

Given the possibility for a seat to not be properly locked in place and the secondary locking to not be secure on these and similar aircraft types the following Safety Recommendation was made.

Safety Recommendation 2021-050

It is recommended that the British Microlight Aircraft Association remind owners of this aircraft type of the necessity, after every seat position adjustment, to:

- ensure that the seat pin is correctly locking the seat in position, and
- set the seat adjuster backup strap after the desired seat position has been selected.

Date Safety Recommendation made: 13 December 2021

Latest response received: 14 March 2022

The BMAA accepts the Safety Recommendation listed above and has carried out the following actions in response.

1. Copies of AAIB Special Bulletin S3/2921 on Escapade, G-CGNV were sent via e-mail to all BMAA Inspectors and owners of Escapade and Sherwood Scout aircraft under the airworthiness approval of the BMAA on 14th December 2021.

2. The Light Aircraft Company (TLAC) SB 01-2021 was sent via e-mail to all BMAA Inspectors and owners of Escapade and Sherwood Scout aircraft under the airworthiness approval of the BMAA on 31st January 2022.

3. An article regarding adjustable seats and with reference to this particular incident was published in the March 2022 edition of the BMAA Magazine Microlight Flying which is posted to all member of the BMAA. This article also included details about the CAA MPD 2022-004-E and also CAA Safety Notice SN-2022/001.

4. The Escapade Pilot Operators Manual has been up issued to include specific details about the seat pin and pre-flight checks. Similarly the Sherwood Scout Pilot Operators Manual has been up issued by The Light Aircraft Company to include additional details regarding the seat pin and pre-flight checks.

5. Homebuilt Aircraft Data Sheet (HADS) HM12 (Escapade) has been updated to include TLAC SB 01-2021 and also the CAA Mandatory Permit Directive CAA MPD 2022-004-E. The HADS also include details of the new Operators Manual reference, and in Annex E of the HADS Points for Special Attention include details about the seat pin, runner and backup straps.

6. Type Approval Data Sheet (TADS) BM84 (Sherwood Scout) has been similarly updated, and the same actions applied.

AAIB Assessment:	**Adequate**
Action Status:	**Planned Action Completed**
Safety Recommendation Status:	**Closed**

Safety Recommendation 2021-051

Justification

Given the possibility for a seat to not be properly locked in place and the secondary locking to not be secure on these and similar aircraft types the following Safety Recommendation was made.

> **Safety Recommendation 2021-051**
>
> It is recommended that the Civil Aviation Authority in conjunction with the Light Aircraft Association and British Microlight Aircraft Association, remind pilots of the importance of ensuring that seats are correctly locked and any secondary locking mechanisms are correctly used, particularly after any seat position adjustment.

Date Safety Recommendation made: 13 December 2021

Latest response received: 24 February 2022

The CAA accepts this Safety Recommendation.

The CAA issued general Safety Notice SN-2022/001 on February 17th 2022 to remind pilots of the importance of ensuring all occupied seats are correctly locked in position prior to departure and any secondary locking mechanisms are correctly used. Pilots are encouraged to be familiar with seat adjustment/locking mechanisms in their aircraft, including any backup locking systems and monitor them for wear and proper functioning, particularly following any heavy landing.

The CAA has also issued a Mandatory Permit Directive, MPD 2022-004, on February 10th, 2022 applicable to all Reality Escapades and Sherwood Scout aeroplanes (both kit and factory built). The MPD requires inspection of the seat locking and secondary locking means to ensure components are in good condition and working correctly.

The inspection is to be performed every 50 flight hours or Annual Inspection (whichever comes first) as well as after any heavy landing. The CAA has worked in conjunction with the Light Aircraft Association and the British Microlight Aircraft Association on mitigation activities for this safety risk. With the agreement and to the satisfaction of the CAA, both the LAA and BMAA have taken appropriate safety actions in relation to this accident and the general safety risk it has highlighted.

AAIB Assessment:	**Adequate**
Action Status:	**Planned Action Completed**
Safety Recommendation Status:	**Closed**

Safety Actions

Early in an investigation the AAIB will engage with authorities and organisations which are directly involved and have the ability to act upon any identified safety issues. The intention is to prevent recurrence and to that end to encourage proactive action whilst the investigation is ongoing and not for those involved to wait for the issue of official Safety Recommendations.

When safety action is taken, it means there is usually no need to raise a Safety Recommendation as the safety issue has been addressed. The published report details the safety issues and the safety action that has taken place. (By convention Safety Issues are published in the reports with a green highlight box).

Note: If the issue remains then a Safety Recommendation may be raised accordingly and this will then require a formal response by the addressee.

In 2021, 188 safety actions directly resulted from AAIB investigations. These arose from one Formal Investigation, one Special Bulletin, 18 Field Investigations and 23 Correspondence Investigations.

Index of Safety Actions Recorded in Field and Correspondence Investigations (Listed by aircraft weight)

Index of Safety Actions (by aircraft weight) cont

COMMERCIAL AIR TRANSPORT

FORMAL INVESTIGATION - AIRCRAFT ACCIDENT REPORT 1/2021

Airbus A321-211, G-POWN
26 February 2020, London Gatwick Airport

Summary

As part of scheduled maintenance overseas, G-POWN underwent a biocide shock treatment on its fuel system, using Kathon biocide, to treat microbial contamination. The aircraft returned to the UK on 24 February 2020, once the maintenance was complete.

In the 24 hours preceding this serious incident, there were abnormalities with the operation of both engines across four flights. On the flight before the fourth (event) flight, the crew reported momentary indications of a No 2 (right) engine stall. After the aircraft landed, this was investigated using an inappropriate procedure obtained from an aircraft troubleshooting manual not applicable to G-POWN, but no fault was found.

The aircraft took off from London Gatwick Airport Runway 26L at 0009 hrs on 26 February 2020 but, at around 500 ft agl, the No 1 (left) engine began to surge. The commander declared a MAYDAY and turned right downwind for an immediate return to the airport but, shortly afterwards, the crew received indications that the No 2 engine had stalled. The crew established that the engines were more stable at low thrust settings and the thrust available at those settings was sufficient to maintain a safe flightpath. They continued the approach and the aircraft landed at 0020 hrs.

The investigation identified the following causal factors:

1. G-POWN's fuel tanks were treated with approximately 38 times the recommended concentration of Kathon.
2. The excessive Kathon level in the aircraft's fuel system caused contamination of the engine Hydro Mechanical Units (HMU) resulting in a loss of correct HMU regulation of the aircraft's engines.
3. A troubleshooting procedure was used for the engine No 2 stall that applied to LEAP-1A32 engines, but G-POWN was fitted with CFM565B3/3 engines. The procedure for CFM56-5B3/3 engines required additional steps that would have precluded G-POWN's departure on the incident flight.

The investigation identified the following contributory factors:

1. The Aircraft Maintenance Manual (AMM) procedure did not provide enough information to enable maintenance engineers to reliably calculate the quantity of Kathon required, and the specific gravity value of Kathon was not readily available.

2. There were no independent checking procedures in place at the base maintenance Approved Maintenance Organisation (Base AMO) to prevent, or reduce the likelihood of, calculating and administering an incorrect quantity of biocide.

3. There were organisational factors at the Base AMO that contributed to the incorrect Kathon quantity calculations. In particular, the workload was high for the available facilities and personnel, and there was no internal technical support function for engineers to consult when they were uncertain.

4. The manufacturer's recommended method of searching the troubleshooting manual was not used to find the applicable procedure relating to the engine No 2 stall.

Following this serious incident, Safety Action was taken by regulators, the International Air Transport Association (IATA), the manufacturers of the aircraft, engines and biocide, the AMOs involved, and the operator.

Safety actions taken by regulators

- The EASA issued Safety Information Bulletin SIB 2020-06 on 20 March 2020, to notify affected stakeholders of recent air safety related events involving Kathon biocide and to remind aircraft owners and operators to ensure that the correct method and dosage is used for approved biocide treatment of aircraft fuel systems.

- The FAA issued Special Airworthiness Information Bulletin SAIB NE20-0417 on 25 March 2020 that contained similar regulatory guidance.

Safety action taken by IATA

IATA's Technical Fuel Group established an informal Biocide Task Force with the following tasks:

- Support the development of an equipment standard for biocide metered injection systems.

- Support research into alternative biocide products.

- Facilitate sharing of industry experience and best practices between airlines, AMOs and OEMs.

- Informing European airlines of news and developments relating to fuel biocide treatments.
- Lobbying the European Chemicals Agency in support of approval of Biobor JF and for unified REACH derogations in the interim period.

Safety actions taken by the manufacturers of the biocide and the engines

- The manufacturer of Kathon discontinued the use of its product for aviation fuel applications on 10 March 2020.
- On 16 March 2020, CFM, the manufacturer of G-POWN's engines, issued Alert Service Bulletin 73-A0296 recommending that operators of CFM56-5B engines suspend the use of Kathon during aircraft fuel system biocide treatments. Similar instructions were issued for other variants of the CFM56 engine family, as well as all General Electric turbofan engines.
- AMOs in the EU are continuing to use Biobor JF for biocide treatments, through the approval of temporary national derogations of the REACH regulations.

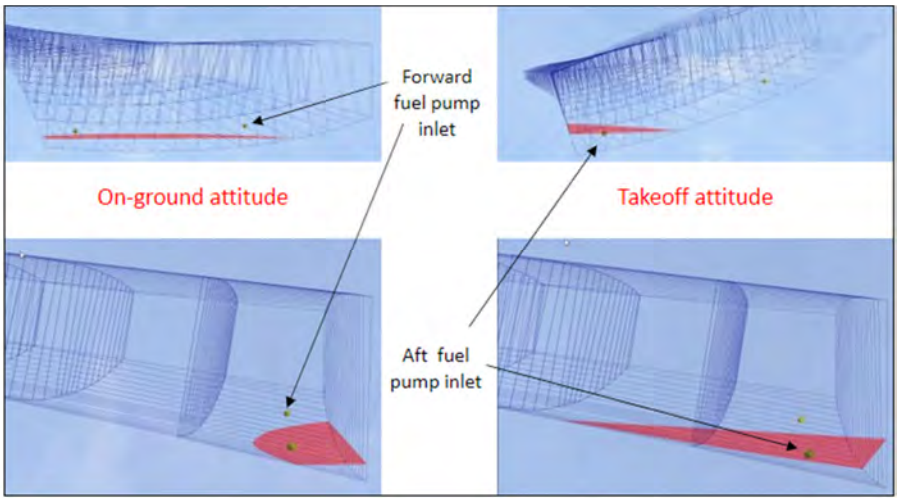
Safety actions taken by the aircraft manufacturer

- The aircraft manufacturer is revising the AMMs across their product range to replace 'ppm' with the term 'ml/1,000ltrs', and also plans to include a definition of ppm in the AMM glossary in cases where this term is used elsewhere.
- The AMM biocide dosing procedures are being revised to simplify the task instructions and to provide a step-by-step methodology. Explanatory notes will be added so that an operative understands why each step is being carried out. It is also planned to include a table giving the biocide volumes required for each fuel tank. The revised AMM procedures will include a check on the biocide dosing calculation, prior to the calculated biocide quantity being added to the fuel tanks.
- The aircraft manufacturer undertook to confirm the level of biocide to fuel mixing achieved when biocide is added to fuel prior to refuelling the aircraft, using the 'pre-mixing' method as currently defined in the AMM. This work would ensure that this dosing method achieves the same degree of biocide mixing as is the case with a metered injection rig. The manufacturer stated that if the testing revealed a lower level of mixing, the pre-mixing method could be removed from the AMM. A joint approach with Boeing would be taken to ensure consistency and best practice, in line with IATA guidance.

Safety actions taken by the Base AMO that performed the biocide treatment

- The AMO that performed the biocide treatment on G-POWN introduced a new role of 'technical engineer'. The technical engineer would be an EASA Part-66 B1 licensed engineer, outside of the management chain within the organisation, who would be available to assist other licensed engineers and mechanics with technical queries, such as calculations.

- The AMO undertook to introduce usage limits in stores so that staff would not be able to withdraw chemicals in quantities that significantly exceed the maximum permitted.
- The AMO increased the amount of office space available to the planning department and nominated a room dedicated to work pack compiling.
- The EASA SIB 2020-06 was included in the recurrent training syllabus for all AMO staff.
- The AMO undertook to write a procedure for biocide treatment, which would incorporate the following:
    - Two independent licensed engineers would make the calculation. Both calculations would be verified by the Technical Engineer against their own independent calculation.
    - A spreadsheet-based biocide calculator to allow the engineer to calculate the amount of biocide to be administered by entering the specific details of the fuel.
    - Biocide treatment would be considered as a "critical maintenance task" and would require duplicate/independent inspection of the calculations and the accomplishment of the task.
- The AMO would provide additional training on the differences between Airn@v[1], and Airnav[X].
- The AMO would provide additional training on using the TSM within each application.



View of the left wing fuel tank at the root with the fuel pump inlet positions in relation to approximately 30 kg of Kathon. Left – on-ground (0°).

Footnote

[1] Aircraft maintenance information is provided to the maintenance organisation by the manufacturer's online system known as AIRBUS World. This system includes two different applications: AirN@v and airnav[X]. AirnavX has been introduced to replace AirN@v using a gradual transition process.

Safety actions taken by the Line AMO

- The Line AMO liaised with the manufacturer and the operator for delegated access to airnav[x].
- A safety and compliance notice was issued to all staff concerning the use of AirN@v and the importance of filtering for the correct Fleet Serial Number.
- Station managers were reminded to perform competency assessments to an adequate standard.
- An additional check of competence was introduced using maintenance data in the certification authorisation interview.
- A safety and compliance notice was issued to disseminate the manufacturer's training material on using the AirN@v TSM. This was also added to their Airbus engineer type training courses and equivalent material for airnav[x].
- The Part-147 maintenance training organisation included a signoff task in their practical logbooks for engineers regarding the use of effectivity and troubleshooting manual for Airbus and other manufacturers' types.
- The G-POWN incident was included in continuation training and instructor awareness from September 2020 onwards.

Safety actions taken by the operator

- The operator undertook to maximise crew learning from the G-POWN serious incident, by incorporating it in its recurrent CRM training package for all aircrew, starting in September 2020.
- The operator incorporated into its engineer continuation training an exercise on communication and information management, based on this event, to enable duty engineers to maximise their awareness of the ongoing serviceability of an aircraft. It also added related detail to its Safety Management System.

AAIB SPECIAL BULLETIN - S1/2021

Boeing 787-8, G-ZBJB
18 June 2021, London Heathrow Airport Stand 583

Synopsis

Whilst the aircraft was being loaded with cargo in preparation for a flight to Frankfurt, and whilst carrying out a Dispatch Deviation Guide (DDG) procedure to clear maintenance messages relating to an existing Acceptable Deferred Defect (ADD), the Nose Landing Gear (NLG) retracted. This caused damage to the lower nose, NLG doors and engine cowlings. Door 2 left (Door 2L) struck the top of the mobile steps which resulted in the door separating from the fuselage and one person, operating the cargo loader positioned at the forward cargo hold, received minor injuries.

Pallet cargo loader positioned at the forward cargo door

The DDG procedure required the cockpit landing gear selection lever to be cycled with hydraulic power applied to the aircraft. To prevent the landing gear from retracting, the procedure required pins to be inserted in the nose and main landing gear downlocks. However, the NLG downlock pin was installed in the NLG downlock apex pin bore which was adjacent to the correct location to install the downlock pin. When the landing gear selector was cycled the NLG retracted.

An Airworthiness Directive (AD) 2019-23-07 had been issued, with a 36-month compliance from 16 January 2020, to install an insert over the apex pin bore to prevent incorrect installation of the downlock pin, but this had not yet been implemented on G-ZBJB.

The operator had issued a Technical News leaflet 10279007 – '*787 NLG Downlock Pin Installation'* on 9 April 2020 which showed the correct and incorrect position of the NLG downlock pin and referenced the FAA AD. The leaflet included the illustrations taken from AMM task B787-A-32-00-30-00A-720A-A – '*Landing gear downlock pin installation.'* The Technical News was re-issued on 9 December 2020 with an expiry date of 9 June 21.

Safety actions taken by the operator

- As a result of this accident the operator re-issued Technical News leaflet 10279007 on 19 June 2021. The operator is now planning to expedite the incorporation of AD 20192307.

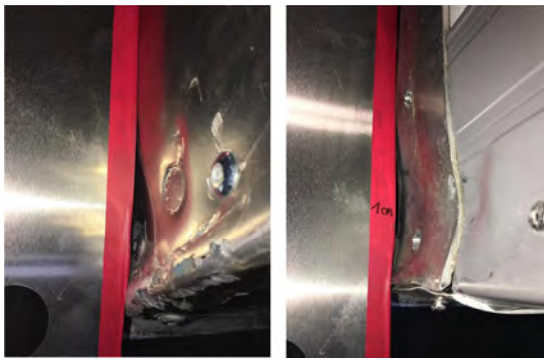
Commercial Air Transport (Fixed Wing)

Boeing 777-336ER, G-STBA
2 July 2021, London Heathrow Airport

Synopsis

A FIRE CARGO AFT warning illuminated during the pre-start procedures. Crew were advised by RFFS to conduct a rapid disembarkation via an airbridge. One cabin crew member suffered minor injuries during the disembarkation.

The fire warning was triggered when a short circuit in the battery pack of a refrigerated container in the aft cargo hold caused heating of cables and smoke.



Impact damage to container

Safety actions taken by the container manufacturer and the operator

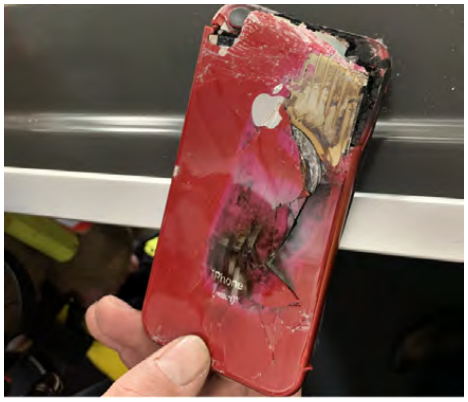
- The container manufacturer decided to consider reinforcing the battery attachment and, if necessary, make modifications to improve the functionality and safety of the container.
- The operator decided to consider introducing a comprehensive damage check on all similar containers before they are loaded onto aircraft.

Safety Actions

Boeing 787-9, G-ZBKF
1 October 2020, En route to London Heathrow Airport

Synopsis

The aircraft was approaching the top of descent when the cabin crew saw smoke emanating from a passenger seat. It was discovered that a mobile phone had fallen down the side of the seat and had been crushed in the seat mechanism. The cabin crew extinguished the fire and the aircraft continued to its destination. There was no damage to the aircraft.



Mobile phone retrieved by the fire service after landing

There have been several reports of similar events occurring leading to smoke in the cabin. There are currently no seat design requirements to prevent electronic devices from becoming trapped in seats. Manufacturers and regulators are aware of this issue but it has proven challenging to find a workable solution.

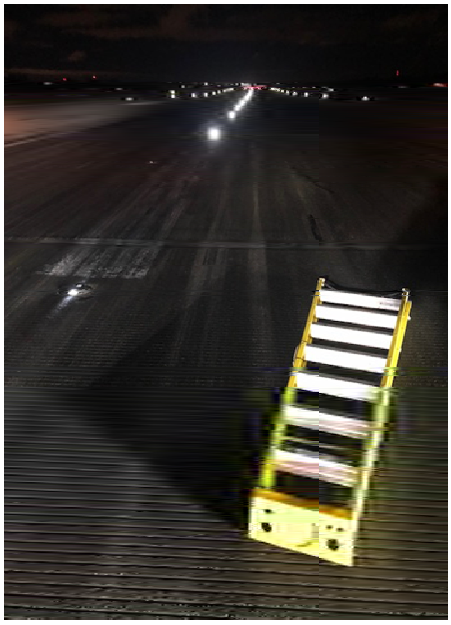
Safety action taken by EASA

- The EASA has requested that the SAE International Seat Committee develop design standards and/or recommended practices for the design of seats on commercial air transport aircraft to minimise the chance of portable electronic devices becoming crushed in mechanisms.

Boeing 757-28A, G-OOBA, Boeing 737-8AS, EI-DPC, Boeing and 737-8Z9, G-GDFR
8 September 2020, Birmingham Airport

Synopsis

After completing some routine maintenance on the approach lights to Runway 33 at Birmingham Airport, two airport engineering services technicians drove along the runway in an airport works pickup truck en route to their next task. In the back of the pickup truck (known as Work Vehicle 4 - WV4) was a step ladder that they had been using. As they drove through the touch down zone, the ladder came out of the vehicle and came to rest just to the right of the runway centreline. Three aircraft subsequently landed on Runway 33. The first two aircraft reported that they might have seen something on the runway during landing but could not be certain that it was not paint markings. Having been informed of the reports of the two preceding aircraft, the third aircraft elected to land, following which the flight crew notified ATC that they had seen a ladder on the runway. The ladder had been on the runway for 37 minutes before it was retrieved by the airport safety team.



View up Runway 33 with the ladder in the approximate position it was found

Safety actions taken by the airport operator

In parallel with the AAIB investigation the airport safety staff conducted an investigation and identified several safety actions to reduce the likelihood of this type of event reoccurring.

These are summarised under the various headings as follows:

Runway inspections and foreign object debris (FOD)

- Review the airport published procedures regarding runway Inspections.
- Review of ATCO immediate actions on receipt of FOD reports.
- Review the airport policy and local operating procedures regarding the FOD monitoring and alerting procedures.
- Define definitive actions to be taken when runway FOD is reported.

Airfield driving

- Undertake review of manoeuvring area and runway (M and R) permit course against the requirements of CAP 790.

- Splitting of the airfield driving permits to authorise M and/or R. This will include R permits issued annually and will include runway incursion awareness training.
- Undertake a review of airfield driving training and permit validity.

Airfield vehicles

- Working Instruction WI-EE-ES-AE-104 issued. Use of WV4. The load area must be kept sterile and clear of materials and tooling to avoid any FOD. Any exceptions to this must be pre-authorised by the Airfield Engineering Supervisor or Senior Airfield Technicians via email. Confirmation should be gained before proceeding with any use.
- Implement an airport vehicle management procedure for all users to include a vehicle FOD inspection procedure.
- Undertake a suitability assessment of all engineering services vehicles used to undertake tasks on the runway and manoeuvring area.

Tool control

- Collaboratively define a common standard of formal tool procedure to be adhered to by all airside users, which includes a tool control safety promotion plan and compliance and audit plan.

Training

- In order to support a Just Culture, identify training to improve knowledge/ improving skills of all airside users (all runway users) to include:
  - Define the Birmingham Airport Just Culture.
  - Increased task awareness.
  - Ensuring data and information is available.
  - Encouraging reporting.
- Review learnings at safety meetings including; Airside Safety Committee/ Local Runway Safety Team/Flight Safety Committee.
- Develop a training plan for the Engineering Services department to include performance objectives, competence checks and approval process.

Safety action taken by the CAA

The AAIB were concerned that airport ground staff may not have sight of AAIB reports and publications. Therefore, discussions were held with the CAA to explore how this incident might be brought to the attention of the wider aerodrome ground staff community.

Accordingly, the CAA issued a SkyWise notification under Aerodrome Safety Alerts section on 16 October 2020 as follows:

- Runway maintenance – equipment control.
- A recent incident at a UK aerodrome led to maintenance equipment being left on the runway. This incident is currently subject to AAIB investigation.
- It has become apparent that a lack of tool control, and security of equipment carried on aerodrome vehicles were contributory factors.
- Aerodrome operators should ensure that:
    1. Procedures for both routine maintenance and work in progress includes robust equipment control.
    2. Suitable vehicles are used for transporting equipment.
    3. Equipment is carried in/on vehicles securely.

Airbus A321-251NX, G-UZMI
3 January 2021, Bristol Airport

Synopsis

During the boarding process, the crew recognised that the passenger distribution was incorrect for their aircraft type. The commander subsequently filed a safety report that initiated an investigation by the operator. It was found that the previous sector might have been flown with the aircraft CG out of operating limits, and issues were identified with data transfer between the aircraft management and departure control systems.

EFB CG data produced in the operator's investigation using correct A321-NEO seating configuration for the Bristol to Edinburgh sector
(reproduced with permission)

Safety actions taken by the operator

The operator has;

- Introduced a procedure where an aircraft is changed, requiring the Network Control team in the Integrated Control Centre (ICC) to conduct a manual check between the IT systems used for planning and loading to ensure the correct aircraft type and registration are displayed in all systems.
- Introduced a requirement for the Chief Pilot, in coordination with the ICC, to notify the duty pilot of any aircraft type changes. The duty pilot will discuss the potential risk with the operating crew.
- Introduced a requirement for a manual bay count to be completed before departure for every flight to ensure the weight and balance calculations are accurate.
- Published a poster to all stations to highlight the requirements for data checks following an aircraft change to ensure that information extracted from the system is correct.
- Initiated a further investigation into their IT systems to determine how operational changes are managed and communicated between the relevant parts of the system in order for a permanent solution to be established.

Boeing 737-8K5, G-TAWG
21 July 2020, Birmingham Airport

Synopsis

Boeing Onboard Planning Tool performance data

The operator had suspended operations for several months due to Covid-19 restrictions, and prior to the incident flight the reservation system from which the load sheet was produced had been upgraded. There was a fault in the system which, when a female passenger checked in for the flight and used or was given the title 'Miss', caused the system checked her in as a child. The system allocated them a child's standard weight of 35 kg as opposed to the correct female standard weight of 69 kg. Consequently, with 38 females checked in incorrectly and misidentified as children, the G-TAWG takeoff mass from the load sheet was 1,244 kg below the actual mass of the aircraft.

Following this serious incident, the operator introduced a daily check to ensure adult females were referred to as Ms on the relevant documentation, with a secondary check by Operations staff against passenger loads. A more formal system of checks was introduced on 24 July 2020.

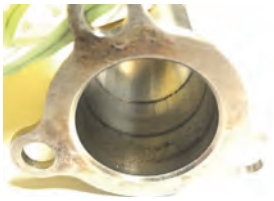
Safety actions taken by the operator

Following this serious incident, the operator took action to prevent re-occurrence:

- A member of the Systems team manually checked the flights daily to ensure that the title 'Miss' was amended to 'Ms'.
- A secondary check was instigated with the Operations department against the booked passenger loads.
- A reminder briefing was given to Ground Handling Agents to ask them to be alert at check-in or during boarding for any adult female passengers showing as Miss or a child.
- A formalised procedure for a Customer Care Executive to check bookings was instituted on 24 July 2020.

ATR 72-212 A, G-OATR and ATR 72-212 A, G-ORAI
29 June 2020 and 22 July 2020, Guernsey Airport, Guernsey

Synopsis



Corrosion found on piston and sleeve inner bore
(Images used with permission of the operator)

Two separate cabin smoke events were reported while starting the engines on different aircraft in the operator's fleet. The operator concluded that low utilisation of the aircraft and a high amount of airborne salinity resulted in corrosion forming on the P2.5/P3 engine air switching valve, sufficient to prevent it from fully closing. With the valve partially open, contaminated air from the engine was able to enter the cabin.

Safety actions taken by the operator

- Introduced a requirement for engine ground runs to be carried out on aircraft that have not flown for three days to ensure the correct operation of the bleed air system and ECS.
- Introduced an inspection of the P2.5/P3 air switching valves every 42 days and replacement of the piston ring every 100 days.
- Issued a 'Notice to Crew' to require flight crews and maintenance personnel to start the engines with the bleed air system and ECS selected OFF.

Safety actions taken by the engine manufacturer

- Updated the EMM to include an inspection of the P2.5/P3 air switching valves following a period of storage, irrespective of duration and environment.
- Issued a requirement to replace the P2.5/P3 air switching valves during engine overhaul.
- Initiated a redesign of the P2.5/P3 air switching valve, which will consider the materials used in the valve assembly.

BAe ATP, SE-MAO
22 May 2020, Birmingham Airport

Synopsis

SE-MAO leaves the paved surface

In windy conditions the crew of SE-MAO performed a go-around from their first approach to Runway 33 at Birmingham Airport. On the second approach the aircraft departed the runway to the left after touching down. The crew had not applied or maintained into-wind aileron during the landing or landing roll and, despite the application of full rudder, could not keep the aircraft on the runway. The aircraft was off the paved surface for approximately 450 m. There was no damage to the aircraft or the airfield, and the crew were uninjured.

Safety action taken by the operator

- Recurrent simulator sessions across all the operator's fleet were amended to include crosswind training.
- A crosswind limit would be introduced for new co-pilots during their first year of operation on type. This limit would be removed once the co-pilot had completed their first year of operations and successfully demonstrated the correct technique in their recurrent simulator.

BAe ATP, SE-MAO
18 August 2020, After departure from Jersey Airport, Channel Islands

Synopsis

During a short flight from Jersey Airport to Guernsey Airport, Channel Islands, the flight crew experienced difficult, but manageable, issues with roll control. The aircraft landed safely.

Despite extensive testing, no faults were identified that could have caused the event. However, the investigation did identify two minor issues with autopilot computer maintenance and testing. These have been addressed through safety action taken by the operator.

trim light and associated pitch and roll out-of-trim indicators (highlighted in the orange box)

Safety actions taken by the operator

- The operator has amended their processes to ensure that component operating hours are only set to zero if an item is accompanied by a release certificate that states that the item has been overhauled.
- The operator has implemented a maintenance contract for its autopilot computers.

Safety Actions

Reims Cessna F406, G-RVLW
6 March 2021, North Sea

Synopsis

The pilot was operating a cargo flight from Göteborg Landvetter Airport, Sweden to East Midlands Airport. The aircraft was at FL 180 when the pilot began to experience a headache. He then noted that his cognitive ability was declining. Realising that he may be suffering the effects of hypoxia, he checked his equipment, before noting that his oxygen saturation as displayed on his finger pulse oximeter was low. He immediately switched oxygen bottles and the symptoms resolved. The pilot was able to continue the flight to East Midlands without further incident.

Safety action taken by the operator

The operator began a retrofit programme to install/reactivate all Cessna F406 aircraft operating above FL100 with a fully integrated oxygen system utilising oxygen masks rather than cannulas.

Reims Cessna F406, G-FIND
4 April 2021, Near St Neots, Cambridgeshire

Synopsis

During an unpressurised aerial photography flight at 12,000 ft the task specialist lost consciousness. The pilot commenced a rapid descent and diverted to London Luton (Luton) Airport. During the descent the task specialist regained consciousness. The aircraft landed normally.

The pilot was using supplementary oxygen during the flight whereas the task specialist was not. It could not be determined what caused the loss of consciousness.

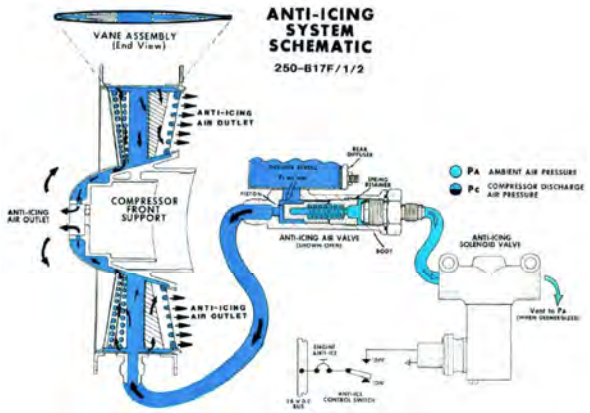
Safety action taken by the operator

The operator has updated its Operations Manual to require Task Specialists and Survey Operators to use supplementary oxygen at all times during unpressurised flights above 10,000 ft.

BN2T-4S Islander, G-CGTC
12 November 2020, City of Derry Airport, Eglinton, Londonderry

Synopsis

The aircraft suffered a double engine failure, likely due to intake icing, while operating in IMC at approximately 7,000 ft amsl. After an initial glide descent both engines were successfully restarted and the aircraft made a powered landing at Eglinton. The operator has taken safety action related to winter operations, use of anti-icing systems and pilot wellbeing.



Schematic of the engine anti-ice bleed air system

Safety actions taken by the operator

The operator has

- Introduced a standard system of icing conditions briefing and checks for all the operator's flights. This includes pre-flight briefing of icing conditions along with actions required and the impact of any aircraft system unserviceabilities. Inflight use of a standard response to any change of altitude such as "Levelling FL70, temperature 2°C, engine anti-icing is on."
    - Along with;
        - Emphasis on 'Standard' climb and descent checks.
        - Secured funding to provide an update to the TAWS database on the incident aircraft.
        - Introduced icing checklists that can be called for by either the pilot or the observers.
        - Introduced biannual ground training days for all pilots.
        - Re-issued a winter operations briefing to all pilots.
        - Enhanced training for individuals based on examiner, management pilot and individual input.
        - Produced cockpit aide memoires to cover icing related issues.
        - Increased communications with pilots relating to mental wellbeing and access to a specific aviation-focused peer support programme within the flying operation in addition to the confidential counselling service already available within the parent organisation.

Cessna C208B Super Cargomaster, N967FE

23 September 2020, Terrance B Lettsome International Airport, Tortola, British Virgin Islands

Synopsis

The pilot was operating a cargo flight from San Juan, Puerto Rico to Tortola, British Virgin Islands. He discontinued the first approach due to poor weather. Following the second approach the aircraft made a hard landing that was 795 m beyond the threshold of the 1,206 m runway. During the landing roll the aircraft veered off the runway damaging the wheels, landing gear and baggage pod.

Damage to right wheel assembly

Data from the aircraft showed that the approach did not meet the operator's stable approach criteria. It also showed that the engine was running below the normal flight idle speed during the last few moments of the flight. Examination and testing found no evidence of anomalies with the engine. It was not possible to determine why the engine was operating below the normal idle speed whilst in flight.

It is likely that the pilot was experiencing high workload due to the unstable approach and poor weather and this may have limited his ability to deal with the situation.

Safety action taken by the operator

The operator intends to update its operations manual to state explicitly the altitude by which stable approach criteria must be achieved for all types of approach.

Commercial Air Transport (Rotary Wing)

Sikorsky S-92A, G-LAWX
14 October 2019, Near Shipston-on-Stour, Warwickshire

Synopsis

On an approach to a private landing site in conditions of reduced visibility shortly before night, the pilots became uncertain of their position and the helicopter descended to within 28 ft of rising terrain close to a house. During the subsequent emergency climb at low indicated airspeed, engine torque increased to 131% and the pitch attitude of the helicopter was unstable. The helicopter made another approach to the landing site and landed without damage or injury to the occupants.

View of LS to the West at 1720 hrs, 10 minutes before departure from Birmingham
(used with permission)

The investigation identified the following factors:

- Standard operating procedures for altitude alert setting, stabilised approach criteria and crew communication were either absent or not effective,
- a strong desire as a customer-facing director not to inconvenience the client, which was potentially in tension with his obligation as the commander to ensure a safe flight,
- uncertainty about the Rules of the Air when landing, and
- attitudes, behavioural traps and biases likely to have contributed to the occurrence.

The circumstances of this serious incident indicate the need for greater awareness of the hazards of operating in degraded visual conditions and highlight the potential safety benefits of Point-in-Space approaches at landing sites.

Safety actions taken by the operator

The operator has:

- Conducted a training day focussing on the occurrence.
- Gained approval from the client to install cloud base and visibility monitoring equipment at the LS.
- Transferred the role of Safety Manager from the commander to the Compliance Manager and has begun the process of delegating responsibilities for the SMS from the Accountable Manager to the Compliance Manager.

- Added the following note to the front page of the GL3 procedure on the EFB:

  'Note: The GL3 is NOT an aid for poor or marginal visual conditions. To be used as Visual Approach Aid in VMC ONLY.';

- Included "Inadvertent IMC at Low Level / Low IAS" as an additional training requirement to be delivered during simulator training.
- Issued a Flying Staff Instruction (FSI) updating the OM Part A Section to address operations in marginal weather conditions. The FSI covered the following areas:

  Definition of 'marginal conditions' by day and night.

  Departure at night in VMC.

  Airspeeds to be flown.

  Indicated airspeeds to be flown.

  Assessment of cloud base at off airfield landing sites.

  Light levels and time of year.

  Planning and briefing of approach and departure routes.

  Use of the GL3.

  The requirement for an alternate plan.

  Operational control and supervision of the go/no go decision in marginal conditions.

  Operational control and supervision of management post holders when flying.

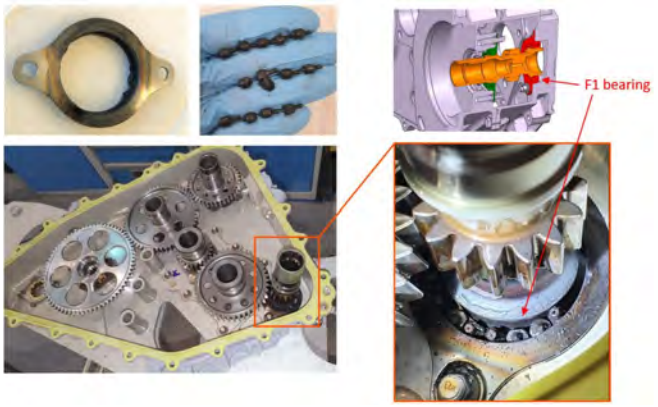
- Revised the OM Parts A, B and D and included an SOP on deviation calls in multi-pilot operations.

The operator stated that it intends to:

- Develop pilot intervention training.
- Explore the feasibility to install Cloud Base and visibility equipment at other landing sites.

Airbus Helicopters EC175B, G-EMEB
23 September 2020, Aberdeen Airport

Synopsis



Failed F1 bearing in the LAGB
(image used with permission of Airbus Helicopters)

A failure of an alternator pinion roller bearing in the left accessory gearbox (LAGB) occurred during a post-maintenance ground run following a scheduled replacement of the main gearbox. The investigation identified that the roller bearing was subjected to an excessive axial load during operation, caused by compression of grease and air within the alternator shaft link during installation by the operator of a 10 kVA alternator to the LAGB. The cause of the incident was identified as the application of an excessive quantity of grease to the alternator pinion cavity, as required by the aircraft maintenance manual instructions. The method used by the operator to attach the alternator to the left accessory gearbox was identified as a contributory factor in the incident.

Safety actions taken by the manufacturer

- In response to this incident the manufacturer released Safety Information Notice (SIN) 3599-S-63, alerting EC175 operators to the potential hazard of excessive grease within the alternator shaft link cavity. The manufacturer has also revised the content of AMM tasks 24-21-00, 4-1 (Removal/Installation – Left Alternator 10 kVA) and 24-21-00, 4-2 (Removal/Installation – Blank or Left Alternator 10 kVA Equipment on LAGB), requiring that any excess grease is removed from the shaft link cavity prior to installation of the alternator on the LAGB. The SIN also highlighted the need to follow the published AMM procedure when installing the alternator, by attaching it using the V-band clamp.

- As the mounting of the DC generator on the RAGB has a similar design to the 10 kVA alternator, the manufacturer also revised the related AMM installation procedures for the DC generator.

AgustaWestland AW109SP, G-TAAS
22 April 2021, Carsington Water, Derbyshire

Synopsis

At about 1,000 ft agl and 140 kt, as the helicopter was descending and turning towards East Midlands Airport on return from a HEMS mission, a bird struck the left windshield. The windshield shattered and the bird entered the cockpit striking the technical crew member (TCM) on the left side of their helmet. The TCM and pilot were unhurt. Debris from the windshield also entered the main rotor disk, making a hole in the trailing edge of one of the rotor blades.

Damage to the left windshield

The AgustaWestland AW109 windshield is not designed to withstand bird strikes and the design certification requirements do not require it to do so. Proposed amendments, specifically to the certification of Small Rotorcraft were published in EASA NPA 2021-02 to change this for newly designed rotorcraft. A rule making group is also considering the retrospective application to existing fleets and/or to future production of already typecertified rotorcraft.

Safety action taken by EASA

The EASA are considering amendments to CS-27 regarding windshield penetration by bird strikes and will publish a decision in 2022.

General Aviation (Fixed Wing)

Beech B200, G-YVIP
23 October 2020, Bournemouth Airport, Dorset

Synopsis

The aircraft landed safely after an electrical fire a approach. The operator's investigation found that the commander's circuit breaker (CB) panel showed evidence of moisture ingress and the back-lighting circuit board was burned. They concluded that the most likely scenario is that rainwater entered the cockpit through the storm window, which is above the CB panel.

CB panel showing evidence of moisture ingress and overheating

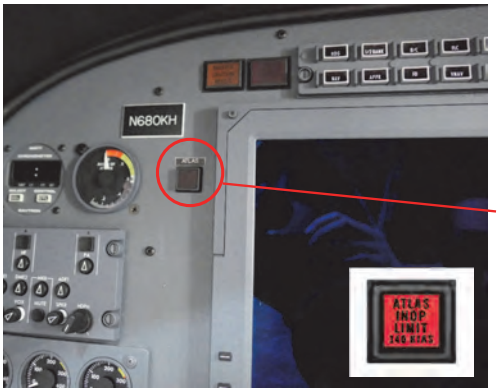
Safety actions taken by the operator

The operator has installed the improved window seal across their fleet of King Air aircraft, and whenever possible, their aircraft will be parked inside the hangar and only towed outside when required.

Safety Actions

Cessna Citation CJ1+, N680KH
13 April 2019 Bournemouth Airport

The aircraft had been modified with a system intended to enhance its performance, which included supplementary control surfaces designed to deflect symmetrically and automatically to alleviate gust loads. Shortly after takeoff, an electrical failure in this system caused one of these control surfaces to deploy separately, causing an uncommanded roll. The resulting aircraft upset caused the pilot significant surprise and difficulty in controlling the aircraft.



ATLAS INOP button in N680KH, inset representation of button when illuminated

The pilot was not aware of supplementary procedures associated with the modification. The procedures did not adequately characterise the significance of the system failure, nor address the failure in all anticipated flight conditions. Certification flight tests of the system did not reveal the severity of possible outcomes. The *'Aircraft Safety and Certification Reform Act 2020'* underway in the USA will review existing assumptions on pilot recognition and response.

Safety actions have been taken or are intended in the areas of training and the information to be provided, both for this system and for other supplementary systems capable of influencing the flight path of an aircraft.

Safety actions taken by the manufacturer

The winglet manufacturer has taken, or intends to take, the following safety actions:

- It intends to include aileron trim in the Active Technology Load Alleviation System (ATLAS) inoperative in flight procedure.
- It has added a signature page to the ATLAS winglets delivery checklist to identify who has conducted a particular handoff briefing. It intends to incorporate that checklist into its document control process.
- It intends to add an item to the ATLAS winglets delivery checklist requiring the Aircraft Flight Manual Supplement (AFMS) to be installed in the (AFM) and the log of approved supplements to be updated during the handoff briefing.
- It intends to promote awareness of the AFMS to ATLAS pilots and improve its overall availability, for example, by making it easier to find and download on its website.
- It will ensure that the information it provides in its manuals, marketing material and other media, is clear about the consequences of ATLAS fault conditions.

- It has published a laminated single-page informal abbreviated ATLAS checklist, which it provides to ATLAS purchasers. The checklist includes the actions from the AFMS ATLAS inoperative in flight procedure. It intends to include that checklist in its document control process.
- It intends to create a page on its website containing advisory information about likely failure modes, including relevant cockpit video, and the related emergency procedure using excerpts of the AFMS. It plans to promote awareness of the webpage to ATLAS pilots, and to create a mechanism for pilots to contact them with queries relating to the ATLAS inoperative procedure.
- Intends to include the ATLAS as a knowledge topic in the FAA's 'WINGS – Pilot Proficiency Programme'.

Safety actions taken by EASA, FAA and CAA

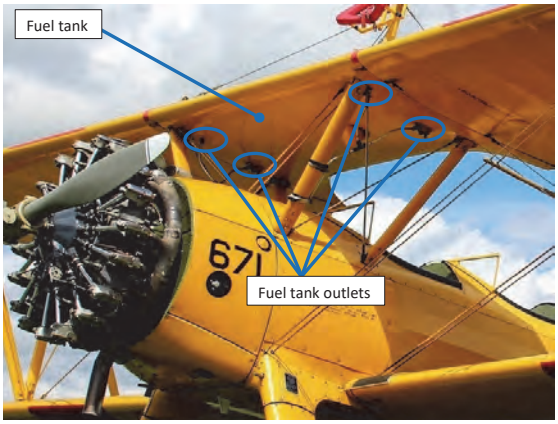
- The EASA and the FAA issued Airworthiness Directives (ADs) restricting the operation of aircraft with ATLAS installed. The closing action and alternative means of compiance for the ADs and Service Bulletin (SB) CAS/SB1480 mandated the embodiment of SBs CAS/SB1467 and CAS/SB1475, ensuring that the Tamarack Control Units (TCUs) were the latest standard and that centering strips had been installed on the trailing edge of each Tamarack Active Camber Surface (TACS).
- The UK CAA has taken an action to create data validation rules in ECCAIRS to identify occurrence reports that should be shared with external authorities based on State of Occurrence, Registration and Design. It also intends to agree with the EASA any additional criteria that will be included in validation rules.

Boeing A75L300 'Stearman', G-CGPY
23 June 2020, Culmhead, Somerset

Synopsis

After performing several wing-walking experience flights at Chiltern Park Aerodrome, Oxfordshire, the aircraft was returning to Dunkeswell Airport, Devon, when its engine stopped producing power. The pilot performed a forced landing in a field.

The investigation revealed inconsistencies in fuel planning assumptions, and it is likely that insufficient fuel reserves were onboard for the accident flight.



Fuel tank and fuel pipes from tank of G-CGPY
(image used with permission)

Safety actions taken by the operator

- Mandated a refuel stop for its aircraft, after a maximum of 1.5 hours of flight time.
- Introduced a requirement for cross-country flights to depart with a full fuel tank.
- Introduced a requirement for its pilots to check and record an aircraft's fuel quantity every second wing walking flight using a calibrated fuel tank dipstick.
- Revised its aircraft technical log pages to include 'engine start' to 'engine stop' times, for accurate monitoring of fuel use and engine parameter trends.
- Introduced an annual technical questionnaire for its pilots, to refresh significant aspects of their safety knowledge.
- Introduced an SSAC Pilot Manager, in addition to the Chief Pilot role already in place, to share decision making for the operation – each post holder having equal right to prevent a flight taking place if there were safety concerns.

Piper PA-28-161, G-BZDA
13 September 2020, White Waltham, Berkshire

Synopsis

Climbing through 100 ft after takeoff from Runway 29R at White Waltham Airfield, G-BZDA's engine abruptly ran down. The instructor took control from the student, lowered the aircraft's nose and looked for a suitable landing area ahead. As the nose was lowered, the engine recovered to full power, so the instructor raised the nose to climb away again but the engine ran down a second time and stopped. The instructor turned the aircraft left towards open ground and carried out a forced landing. The student and instructor were unhurt and vacated the aircraft without assistance.

Gascolator and drain removed from G-BZDA after the accident

The loss of power resulted from the gascolator drain being inadvertently locked open leading to partial fuel starvation.

Safety action taken by the CAA

- Safety Notice SN-2021/005 was released, highlighting to owners, operators and pilots, the risks associated with lockable gascolator drains and recommending replacement with 'suitable, non-locking alternatives.' This was later amended to include a recommendation that aircraft be checked for appropriate placarding at the next scheduled maintenance event.
- Due to the lack of documentary evidence available to them regarding the decision not to replace EAD001-02-90, the CAA undertook to review the issue of lockable gascolator drains against current AD criteria.

Piper PA-28-161 Warrior II, G-BTRY
13 September 2020, Enstone Airfield, Oxfordshire

Synopsis

Whilst on final approach to land on Runway 26 at Enstone Airfield the pilot allowed the aircraft to descend too low and the aircraft struck a pile of gravel, causing the left main landing gear to detach from the aircraft. The pilot went around and diverted to Oxford Airport which had better fire and rescue services than Enstone Airfield. The aircraft departed the runway on landing at Oxford Airport, damaging the left wing and tailplane.

G-BTRY after landing at Oxford Airport

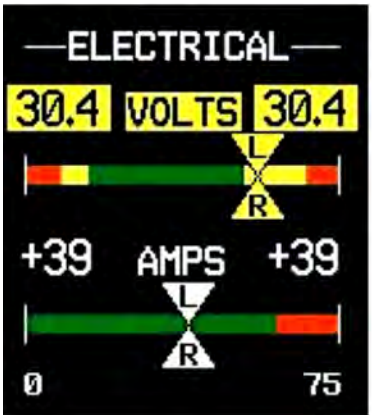
Safety action taken by the airfield operator

The airfield operator commented that following the accident the landowner of the disused portion of the airfield had reduced the height of the gravel piles and ensured that subsequent gravel storage occurred further away from the airfield boundary, to remove the hazard to aircraft.

DA 42 NG, G-HAKA
8 December 2020, Leeds Bradford Airport, West Yorkshire

Synopsis

The aircraft lost electrical power shortly after takeoff because the alternators had not been switched ON. The pilot did not notice the incorrect switch setting before takeoff, or when carrying out the abnormal checklists in flight. The engines continued to operate, and the pilot returned to the departure airport with the aid of the standby artificial horizon and a mobile phone based flight planning application.



Schematic showing the voltmeter and ammeter displays on the G1000 (Schematic from the manufacturer's AFM)

Safety actions taken by the operator

The operator issued an Operational Crew Instruction to:

- Require pilots to complete the before engine start checklist as a read-and-do checklist instead of from memory.
- Highlight the fact that the Garmin 1000 does not show if an alternator is switched ON or OFF.
- Highlight the requirements of the low voltage abnormal checklist and require pilots to study it prior to their next flight in a DA 42.
- Remind pilots that the Aircraft Flight Manual (AFM) does not permit flight with a discharged battery under IFR or night VFR conditions.

Cirrus SR22, G-CTAM
31 May 2020, Calshot Spit, Hampshire

Synopsis

Passing 1,400 ft in a descent towards an airfield the engine started to run roughly and subsequently lost power. The pilot turned the aircraft parallel to the shore and deployed the aircraft's Ballistic Parachute Recovery System. The parachute descent was successful and both occupants escaped from the aircraft uninjured. The loss of power was probably caused by fuel starvation to the engine, but the cause of the starvation could not be determined.

Fuel selector valve, fuel gauge and fuel pump switch

Safety action taken by the manufacturer

The aircraft manufacturer stated that it would convene a panel to discuss updating the Cirrus Airframe Parachute System (CAPS) guidance in the POH to reflect the guidance in the CAPS online training programme.

Rockwell Commander 112, G-LITE
23 September 2020, Perranporth Airfield, Cornwall

Synopsis

The aircraft stalled onto the runway during takeoff and overran the end. The aircraft was probably over its maximum takeoff weight and may have been affected by windshear due to the proximity of cliffs at the end of the runway.

Safety actions taken by the airfield operator

- Runway 09/27 has now been removed from normal operations. Whilst the runway may still be used, pilots can only do so after having received specific information on the associated limitations.
- Both the airfield owner and resident flying club will also be reviewing their websites to incorporate this new information.

Vans RV-7, G-CDME
28 February 2021, Farm strip near Goose Green, West Sussex

Synopsis

Approximately 140 m into its landing roll on a grass runway, the aircraft encountered an area of soft ground. The wheels and spats sank in and caused a rapid deceleration during which the tail rose, the propeller dug in and the aircraft over-ended onto its back. The pilot was tightly strapped in but was able to exit the aircraft uninjured. The cause of this accident was the sudden increase in drag created by the wheel and spats clogging with soil.

Contamination and damage to one of the wheel spats (pictures courtesy of the pilot)

Safety actions taken by the CAA

As a result of this accident wheel spat contamination was discussed with the CAA. Accordingly, the CAA has taken several actions to ensure General Aviation (GA) pilots aware of the risks. These safety actions are as follows:

- CAA Safety Sense Leaflet 12 – 'Strip Flying' includes a note to remind pilots to ensure that the wheel spats are clear of mud and grass and that temporary removal of the wheel spats must be agreed with the CAA regional office.
- As part of the safety promotion and safety education service to pilots across GA, there will be reminders to pilots to inspect wheel spats and to consider ground conditions at grass strips as part of the aircraft loss of control focus.
- CAA GA Unit Communications will share on social media the request to inspect spats for mud accumulation using the pictures supplied by the AAIB.
- The CAA will raise the matter at the GA Safety Council meeting as part of the safety information exchange.

Reims Cessna F152, G-BHFI
8 September 2020, Wards Stone, Forest of Bowland, Lancashire

Synopsis

A student pilot had been briefed to carry out a planned navigation exercise from Blackpool Airport (EGNH) around the local area before returning to Blackpool. About halfway around the route, the pilot attempted to avoid cloud but inadvertently entered IMC and became disorientated. During his attempts to maintain controlled flight, he briefly contacted the ground, but he was able to climb away and, with the assistance of ATC and another aircraft relaying messages, land back at Blackpool.

Aircraft damage caused by the impact with the ground

A report into the event concluded that it was made more likely by: the inexperience of the student pilot; flying below MSA; the pilot not recognising a general deterioration in the weather conditions; and the pilot expecting the weather to improve because it had done so earlier.

Safety actions taken by the training organisation

The Declared Training Organisation proposed to introduce the following Safety Actions:

- The club would reinforce / refresh the required approach to reviewing weather data prior to departure to ensure consistency across the PPL, Instructor and Student populations.
- An MSA and Maximum Elevation Figure (MEF) refresher training pack would be developed and issued to all club members. Training would be given to all students in a ground-based environment prior to the navigation phase of the PPL course. This would supplement the normal PPL training and navigation exam.
- Selection of MSA and MEF would be more diligently reviewed by instructors, any errors would be discussed in detail between the pilot and instructor, corrections would be clear and re-enforced, and the planned altitudes would be adjusted accordingly.
- The Club would consider the construction of a standard example map for use as a training aid.
- Unconscious bias (confirmation bias). Human Performance and Limitations (HPL) and Human Factors (HF) refresher pack would be updated to include a section on the effect of unconscious bias and how to mitigate against it. A case study of this event would be included in the club HPL and HF refresher pack.

- Feedback would be given to Blackpool ATC on the visibility of the green 'cleared to land' light. A note would be issued to all members on the meaning of the lights and where to look in the event of radio failures or difficulties.
- The Club would undertake a ground based one-hour review for each student, led by the safety manager, briefing the content of this event as part of a ground school activity.

Pitts S-2A Pitts Special, G-ODDS
24 August 2019, Stonor, Oxfordshire

During an aerobatics training flight, the aircraft struck the ground whilst in a spin. The aircraft was destroyed and both pilots were fatally injured. A definitive cause could not be determined, but it is likely that the commander became incapacitated during a spin and the student was unable to recover the aircraft in time. The aircraft had a Centre of Gravity (C of G) position that was out of limits aft, which would have reduced the capability of the aircraft to recover and extended the time to do so. Unapproved devices, which adjusted the rudder pedal positions, were found on the rudder cables but were unlikely to have been a contributory factor.

Elevator and rudder damage (circled)

Safety actions taken by the operator

Safety action has been taken by the operator regarding aircraft weight and balance to ensure accurate weights are used.

- The use of spreadsheets has been discontinued and Aircraft Flight Manual (AFM) weight and balance charts are used instead. A current weight and balance report is now included in the aircraft technical log.
- The operator has circulated the AFM weight and balance charts together with current weight and balance reports to all instructors.
- Scales are now provided so pilots can weigh themselves. The operator has found large discrepancies between given and actual weights among its pilots and no longer accepts assumed or estimated weights.
- The operator has encouraged pilots and instructors to continue to take notice of weight and balance placards in the aircraft, which require confirmation that the weight and balance has been checked before flight.
- Electronic copies of flight manuals have been circulated to all instructors (and are available for students) to provide reference material on weight and balance.

Ikarus C42 FB80, G-CFHP
13 September 2020, Porthtowan, Cornwall

Synopsis

During the latter stages of a practice forced landing (PFL), the right landing gear wheel spat struck the perimeter fence of the airstrip. The aircraft turned sharply right and struck the ground, causing extensive damage. Both those on board were uninjured and were able to exit the aircraft unaided. Safety action was taken to stress the importance of going around should it appear that a PFL would be unsuccessful.

Power cables from approximately where the aircraft came to rest

Safety action taken by the British Microlight Aircraft Association

The BMAA will review the advice to instructors regarding the conduct of PFLs, with particular emphasis on early initiation of a go-around if the plan is not working as expected.

Druine D.31 Turbulent, G-ARNZ
18 October 2020, Damyns Hall Aerodrome, Upminster

Synopsis

When approaching the airfield to rejoin the circuit, the aircraft's engine began to run rough then lost power completely. During the subsequent forced landing the aircraft came to rest inverted and the pilot sustained minor injuries. A post-accident inspection of the engine revealed a crack on the plastic rocker arm in the fuel pump.

Plastic fuel pump rocker arm

Safety action taken by the Light Aircraft Association (LAA)

The LAA issued the following Airworthiness Information Leaflet(AIL):

LAA Airworthiness Information Leaflet (AIL) LAA/MOD/ENG/VW/001 Issue 1, applicable to all LAA aircraft operating with Volkswagen (VW) derivative engines states:

'mechanical fuel pumps using a plastic rocker arm must not be used on VW derivative engines operating under an LAA administered Permit to Fly'

'it must be established beyond doubt whether or not the mechanical fuel pump fitted to the engine uses a plastic rocker arm'

This AIL requires inspections to be carried out within five flying hours of its issue and must be signed off by a suitable LAA Inspector.

Pelican PL, G-MPAC
30 August 2020, Stoke Golding Airfield, Warwickshire

Synopsis

The aircraft had flown from Oxenhope Airfield in Yorkshire and, with a northerly breeze, its pilot positioned to land on Runway 08 at Stoke Golding Airfield. He reported being slightly fast on the approach which resulted in a protracted flare and deep landing approximately halfway along the runway. Despite applying maximum braking, the pilot could not stop the aircraft, which overran the runway at an estimated 15 kt. It entered the boundary hedge and tipped nose-first into a deep ditch where it came to an abrupt halt. The pilot attributed the accident to accepting an excessively deep landing rather than going around.

Front spar carry-through tube crossing behind G-MPAC's windscreen (image © Leicestershire Police)

The passenger was uninjured, but the pilot sustained severe injuries having struck his head on a metal bar running across the top of the cockpit. He put the severity of his injuries down to only having a 3-point harness and not bracing for impact. A post-accident field trial by the Light Aircraft Association showed that a slack shoulder strap would allow enough body movement for a seat occupant's head to strike the metal bar during a rapid deceleration.

Safety actions taken by the Light Aircraft Association

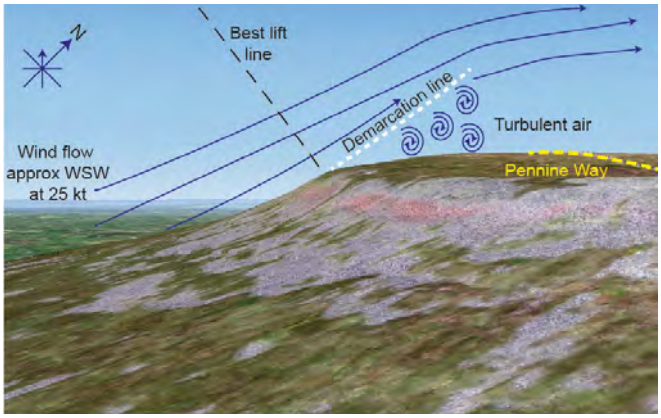
- It alerted the only other owner of a G-registered Pelican aircraft to the potential for head injury in an accident if the harness shoulder strap is not tight.
- It used this accident as a case study to emphasise to its members the importance of the 'Hatches and Harnesses' pre-landing check.

General Aviation (Gliders)

SB-5E glider, G-DEJH
7 August 2019, Summit of Cross Fell, Pennines, Cumbria

Synopsis

The 15 year old pilot, who was part of a private group visiting a gliding club near Penrith, was flying low behind the ridge at Cross Fell in the Pennines when the tail section of the glider began to oscillate rapidly before breaking away from the glider. The glider pitched nose down and was heavily disrupted when it struck the surface. The pilot was seriously injured. The cause of the failure was flutter, which was driven by the ruddervators and likely occurred when the glider was flying between the Rough Air speed limit and V_{NE}.



Likely effect of the wind on the summit of Cross Fell where the accident occurred

A number of safety actions have been taken to improve the supervision of young glider pilots, maintenance of training records and the introduction of a national syllabus for hill soaring (ridge flying).

Safety actions taken by the gliding club

- Amended their Flying Orders such that for junior pilots under the age of 18 years wishing to fly on the ridge:
  - They may only fly on the ridge when the conditions for the day have been deemed suitable.
  - A check flight may be required at the discretion of the Duty Instructor.
  - A specific pre-flight briefing by the Duty Instructor must be obtained prior to launching.
- Reviewed the Check Level requirements and the guidance to Duty Instructors for setting the day's Check Level.
- The pilot's home club has reviewed its requirements for completion of pilot logbooks and training cards to ensure robust records of a pilot's training are kept.

Safety actions taken by the British Gliding Association (BGA)

- Initiated a review of their Form 276 Airworthiness Review Checklist to ensure the section relating to Airworthiness Directives specifically refers to a check of

the glider logbook and the BGA Form 280. The BGA is expected to submit their proposed amendment to the CAA, for approval in November 2020.

- Highlighted in the September 2020 edition of their Technical News Sheet, the importance of always referring to source documents when reissuing limitation placards or annotating ASIs.
- Reminded all BGA Club chairmen and Chief Flying Instructors on the guidance in place for the supervision of young solo pilots and pilots under training.
- Reviewed their Operations Regulations to clarify:
    - That passenger flying is only to be undertaken by qualified glider pilots aged 16 years or over and who have been authorised by the Chief Flying Instructor.
    - The need for a qualified instructor to exercise appropriate supervision during training, including solo flying of unqualified pilots and paid passenger flying.
- Updated their document Managing Flying Risk – Guidance for Pilots and Clubs to include:
    - The requirement for home clubs to provide information on their pilots to the CFI of the club that they intend to visit.
    - References on soaring techniques and Safety in Mountain Flying.
    - Guidance on the knowledge and training required to safely conduct ridge flying.
    - Guidance on the permission for gliders to fly lower than 500 ft when hill soaring.
    - A template for clubs to use when assessing the hazards and risks when hosting visiting pilots.
- Initiated a review of the requirement for training record-keeping in preparation for the implementation of EASA Part-DTO.
- Revised the BGA training syllabus to comply with EASA Part-SFCL, which includes the theoretical knowledge and practical techniques to be taught for ridge flying.

Schleicher ASH 25 E, G-CFST
26 August 2020, Cheltenham, Gloucestershire

Synopsis

G-CFST launched behind an aerotow tug from Aston Down Airfield with the intention of soaring along the Cotswold Ridge between Dursley and Broadway. The soaring conditions proved challenging and the glider became too low as it followed the ridge to the east of Cheltenham, an area with few options for a successful field landing. The glider collided with the top of a line of trees while the pilot was attempting to start the glider's sustainer engine and trying to find a suitable place to land. After colliding with the trees, the glider struck the ground nose-first imparting fatal injuries to the pilot. The rear seat passenger received only minor injuries.

Trees struck by the right wing from above

The investigation found that the accident occurred because the glider was flown over an area where the combination of the terrain and the glider's altitude meant a successful field landing could not be assured. While the pilot had been flying under an informal age-related 'dual-only' limitation imposed by his gliding club, the investigation was not able to determine to what degree age was a factor in the pilot's decision making on the accident flight.

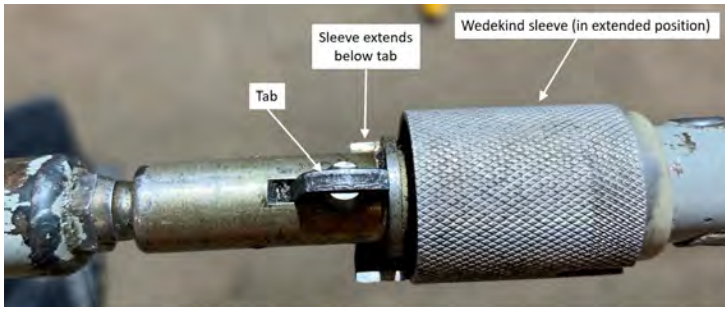
Safety actions taken by the British Gliding Association (BGA)

Following this accident, the BGA:

- Began a consultation process with its member clubs with the aim of developing formal guidance to support the management of pilots of any age who might benefit from flying with a safety pilot or relinquishing PIC status.
- Undertook to write to all BGA Inspectors and owners of gliders with engines that are no longer supported by the engine manufacturer, to remind them of the maintenance requirements and the need to document any deviations from recommended maintenance in the aircraft's SDMP.

Grob G102 Astir CS, G-CJSK
23 June 2021, Gibett Hill, Brentor, near Tavistock, Devon

Synopsis



L'Hotellier control connection with Wedekind sleeve correctly fitted (image courtesy of the BGA)

The right aileron L'Hotellier control connection in the fuselage became disconnected in flight, causing the pilot to abandon the glider by parachute. The control connection was equipped with a secondary Wedekind sleeve locking device, and the pilot had conducted a positive control check to his satisfaction prior to the accident flight. The investigation demonstrated that it is possible to partially assemble this type of control connection such that the connection is not secure, despite appearing to be so during a positive control check.

Safety actions taken by the British Gliding Association (BGA)

- The BGA has informed all owners of UK-registered sailplanes equipped with L'Hotellier control connections of the findings of its safety investigation. The safety information included guidance on how to physically check that Wedekind sleeves, where installed, are correctly locked by the application of a gentle pulling force on the socket, away from the ball. The BGA also published a video[2] containing similar safety information.
- Further safety information relating to the security of sailplane control connections is contained in EASA Safety Information Bulletin 2019-07[3].

Safety Actions

Footnote

2 https://www.youtube.com/watch?v=ydUy2Jx097o, *Understanding how Wedekind connections work* [accessed 2 July 2021].
3 EASA Safety Information Bulletin 2019-07, *Sailplane Rigging – Procedures, Inspections and Training*, 30 April 2019.

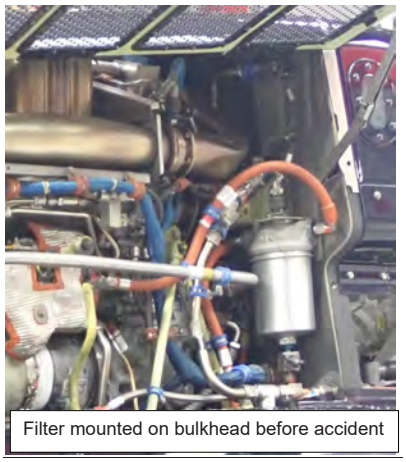
General Aviation (Rotary WIng)

Bell 407, N120HH
24 June 2020, Long Marston, Stratford-upon-Avon, Warwickshire

Synopsis

The pilot and passenger were returning to Thruxton Aerodrome following a short flight over the Malvern hills when the engine failed. The pilot executed an autorotation landing in a field near Long Marston, after which they were both able to exit the helicopter without injury. However, the tail boom was severed during the landing and the helicopter was destroyed by fire.

The investigation found that the engine suffered an uncontained failure of the gas producing turbine disc due to insufficient oil reaching the bearings as a result of an oil leak. Due to the extensive damage to the helicopter it was not possible to determine the cause of the oil leak.



Damage to airframe mounted fuel filter

Safety actions taken by the manufacturer

The helicopter manufacturer has:

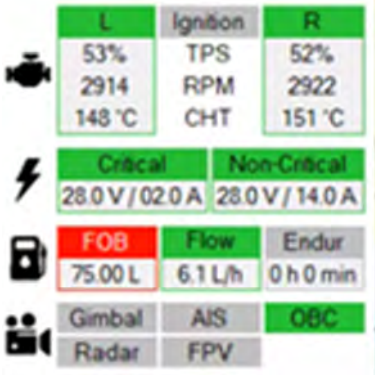
- Made a revision of the data section of the Bell 407 Rotary Flight Manual to add the following clarification in section 1-25-D for the Fuel Shutoff Valve: 'Shutoff valves isolate fuel from the engine compartment during shutdown or in the event of an engine fire'.
- Conducted an analysis of the failure of the Bell 407 airframe mounted fuel filter to show that it retains sufficient crashworthiness properties whilst meeting the applicable fire resistance requirements laid out in 14 CFR Part 27.1183 for the component.
- Added information to the supplementary material to the Bell 407 Rotorcraft Flight Manual to inform pilots that unusual torque indications might be the result of a loss of engine oil.

Unmanned Air Systems

Tekever AR5 Evolution Mk 2, G-TEKV
29 December 2020, Lydd Airport, Kent

Synopsis

While orbiting south of the runway in preparation for landing, both the unmanned aircraft's engines shut down unexpectedly. The External Pilot on the ground, who was visual with the aircraft, took control and landed it without further incident. The dual engine shutdown was likely to have been caused by an on-aircraft data error. Various safety actions, including improvements to the aircraft's hardware and software, and the Ground Control Station software, have been taken to reduce the risk of a reoccurrence.



Revised flight information bar extract

Safety actions taken by the operator

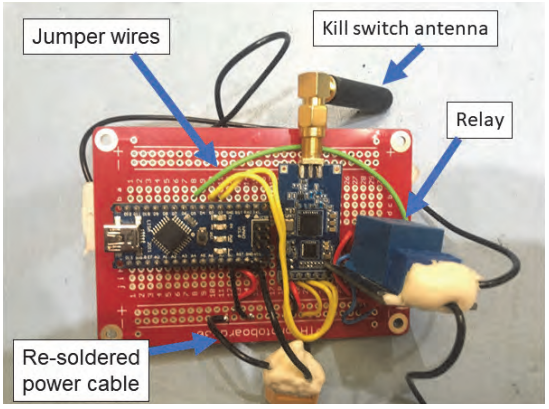
Since the June 2020 and December 2020 events, the operator has:

- Redesigned the GPU to reduce emissions and is installing these on the AR5 aircraft fleet.
- Changed the design of the radio command channel used by the EP and bypassed the multiplexer.
- Embodied an autopilot firmware update on the AR5 fleet of aircraft so that 'Ignition OFF' must be asserted for 10 consecutive commands to trigger engine shutdown.
- Introduced an additional procedural control measure to disable the 'Ignition OFF' command unless the aircraft is within 500 m of the EP.
- Implemented a revision to the alerting system within the GCS software to improve its effectiveness.
- Revised its internal documentation to include modification design and embodiment processes and to ensure that consideration is given to EMC for the integration of new equipment.

Alauda Airspeeder Mk II, (UAS, registration n/a)
4 July 2019, Goodwood Aerodrome, West Sussex

Synopsis

Whilst performing a demonstration flight, the remote pilot lost control of the 95 kg Alauda Airspeeder Mk II scale demonstrator. After the loss of control had been confirmed by the remote pilot, the safety 'kill switch' was operated but had no effect. The Unmanned Aircraft then climbed to approximately 8,000 ft, entering controlled airspace at a holding point for flights arriving at Gatwick Airport, before its battery depleted and it fell to the ground. It crashed in a field of crops approximately 40 m from occupied houses and 700 m outside of its designated operating area. There were no injuries.



Kill switch on-board circuit board

The AAIB found that the Alauda Airspeeder Mk II was not designed, built or tested to any recognisable standards and that its design and build quality were of a poor standard. The operator's Operating Safety Case contained several statements that were shown to be untrue.

The Civil Aviation Authority's Unmanned Aircraft Systems (UAS) Unit had assessed the operator's application and, after clarification and amendment of some aspects, issued an exemption to the Air Navigation Order to allow flights in accordance with the operator's Operating Safety Case. The Civil Aviation Authority did not meet the operator or inspect the Alauda Airspeeder Mk II before the accident flight.

There have been many other similar events where control of an unmanned aircraft has been lost, resulting in either it falling to the ground or flying away. Even a small unmanned aircraft falling from a few metres could cause a fatal injury if it struck a person.

The Civil Aviation Authority and the organisation which designed and operated the Airspeeder Mk II have introduced measures to address a number of issues identified during the course of the investigation.

Safety actions by the operator and the CAA

Both the CAA and the operator have sought to learn from this accident and have implemented a number of measures:

Operator's safety action

- The operator conducted their own investigation into the accident which included a detailed review of its processes and procedures. As part of this process, they

generated 53 recommendations for improvement and, as of December 2020, all actions had either been completed or were being in the process of implementation.

- The operator is continuing its plans to further develop the Airspeeder aircraft but has now discontinued operation and production of the Airspeeder Mk II to allow design and development of a new, larger Mk III platform. They stated that they have recruited additional, experienced staff and implemented a Safety Management System.

CAA safety action

- As a result of this investigation the CAA have conducted a review of the OSC audit process and introduced changes to the oversight process. All audits have inbuilt peer review and are conducted by audit teams. A 'Knowledge Base' has been developed to capture best practice and share knowledge and new audit checklists have been developed within the audit software to capture all the current regulatory requirements. Inspectors and Surveyors have taken on a new, qualitative and subjective approach to auditing, removing the quantitative, checklist-based approach that was used before. Analysis of the competence, value and performance of parts of the OSC are emphasised, as opposed to a 'tick box' approach to checking whether paragraphs or sections are included. An onsite audit procedure is also in development to more accurately target time when face to face with an applicant, focusing on elements that cannot be reviewed remotely.
- Additional, experienced resource has been recruited to the UAS Sector Team and mechanisms to include other capability within the CAA have been proposed.
- A new format of Operational Authorisation template has been introduced in line with the new regulations that came into force on 31 December 2020 with a view to being clearer and simpler, with a tabular, consistent approach.

UAVE Prion Mk 3 (UAS, registration n/a)
3 February 2021, MoD Area 7, Salisbury Plain, Chitterne, Wiltshire

Synopsis

During a training flight at a height of 400 ft agl the engine lost some power and the aircraft started to descend. The operator sent a command to limit the throttle but this did not resolve the issue. The autopilot was in a mode whereby the throttle was used to control airspeed and elevator used to control altitude. The loss of altitude caused the autopilot to pitch the unmanned aircraft nose-up until it stalled, entered a spin, and then hit the ground.

UAVE Prion Mk 3

Safety actions taken by the manufacturer and operator

- The UAS manufacturer has modified the engine on the fleet of Prion Mk3 aircraft with a safety feature which provides additional security that the spark plug cap is fitted correctly.
- The operator has also changed their training and operational procedures to help mitigate the risk of recurrence.

DJI Matrice 210 (UAS, registration n/a)
6 October 2019, Danbury, Essex

Synopsis

The DJI Matrice 210 unmanned aircraft system was being operated in a manual flight mode over a nature reserve in support of emergency service operations. Whilst the aircraft was hovering at a height of about 54 m, the ballistic recovery parachute system fitted to the aircraft activated unexpectedly. The aircraft descended under the parachute and became lodged in a tree.

Parazero SafeAir M200 installed on a DJI Matrice 210 RTK unmanned aircraft (Source: Parazero)

Testing of the parachute system did not identify any evidence of a system malfunction which could have triggered an erroneous parachute deployment, but a false-positive activation of the parachute system could not be ruled out.

Analysis of the aircraft recorded on-board data did not provide any insight into why the flight was abruptly terminated, although several possibilities were identified. It was not established whether the parachute system activated first, cutting power to the aircraft motors or whether the aircraft experienced an inflight failure which triggered the parachute deployment.

Safety action taken by the manufacturer

The parachute system manufacturer is aware of the log alignment issues between its system and the DJI Matrice 200 series of aircraft. As such, the latest parachute system that is being designed for the DJI Matrice 300 series aircraft will communicate directly with the aircraft to cut power to the motors, leaving power on the aircraft to continue logging data, and enable more accurate syncing of the aircraft and parachute system log files.

DJI Matrice 200 V1, (UAS, registration n/a)
1) 21 September 2019, near Raigmore Hospital, Inverness
2) 29 November 2019, Montrose, Angus

Synopsis

The DJI Matrice 200 Unmanned Aircraft System (UAS) was being operated on an automated flight plan to conduct an aerial survey. On the fifth flight of the day, while the aircraft was at a height of 100 m, the ballistic parachute recovery system fitted to the aircraft activated. The aircraft descended under the parachute and was subsequently found on the roof of a nearby house.

Aircraft after parachute deployment on 29 November 2019

Two months later, after having been repaired and fitted with a new parachute system, the aircraft experienced a second parachute deployment. On that occasion the aircraft was being manually flown in GPS mode at a height of 92 m over an area of open ground.

The first accident most likely occurred due to excessive vibration as a result of the parachute system not being securely attached to the airframe.

The investigation was unable to establish the cause of the second accident. There were several warnings in the recorded aircraft's flight log, but analysis of this data did not provide any insight into why the flight was abruptly terminated. However, the parachute manufacturer considered that the second event involved a valid activation of the parachute system in response to a total aircraft power failure.

The investigation was limited by the availability of recorded flight data for the first accident and a lack of information from the UAS manufacturer. It was therefore unable to establish if there were any common factors between the two accidents, which involved the same aircraft but different parachute units.

Safety action by the manufacturer

In response to the first accident, the parachute manufacturer amended the pre-flight checks in the SafeAir M200 installation guide to check the security of the mounting leg attachment screws.

Safety actions by the operator

In response to the first accident the operator:

- added a thread-locking compound to the screw threads of the parachute mounting leg attachment screws.
- amended its pre-flight procedures to check the security of mounting leg screws and correct fitment of washers.

- updated its maintenance procedures to document when the parachute mounting legs were fitted to and removed from the aircraft.
- identified that further emphasis on wind speed and direction was required prior to launch, to provide greater understanding of the drift potential in the case of a parachute deployment.

DJI Phantom 4 RTK (UAS, registration n/a)
2 December 2020, Newtongrange, Dalkeith, Midlothian

Synopsis

The UAS, a DJI Phantom 4 RTK, was being operated in an automated flight mode to survey a railway track and surrounding infrastructure when one of the four propellers detached whilst in-flight. The aircraft rapidly descended from a height of 70 m (230 ft) where it struck the ground in the rear garden of a house. No persons were injured.

Aircraft after being recovered from garden

Safety action taken by the operator

In January 2021, Network Rail precluded the use of DJI Phantom 4s in support of its survey activities. Furthermore, they advised that they intend to carry out trials using a UAS with a MTOM of less than 25 grams for when there is a need for UAS operations over uninvolved persons. The FMS is also being updated to provide a 'risk map' to include information on areas having known hazards, such as transmission masts that could affect UAS communications.

Aeryon SkyRanger R60 (UAS, registration n/a)
17 June 2020, Maidenbower Pond, Crawley, West Sussex

The UA fell from a height of about 70 ft into a pond when the emergency cut-out was accidentally operated by the pilot. The pilot stated he had not recognised the emergency cut-out function icon which had appeared on the flight controller screen. In attempting to clear it he unintentionally activated the function, stopping the UA motors.

Safety action taken by operators

The police forces involved had been increasingly investing in the training and assessment of those officers using UAS. They were already in the process of introducing a new system of pilot assessment which will require pilots to undergo an assessment every six months, incorporating an annual day's training. Since the accident they have also allocated an officer working full time in the training role to compliment the assessors already in place.

Parrot Anafi USA, (UAS, registration n/a)
3 April 2021, Quarry Span Hill, Henley on Thames, Oxfordshire

Synopsis

While conducting a flight in support of police search operations, the pilot became concerned about losing visual line of sight with the unmanned aircraft (UA) and attempted to activate the return-to-home (RTH) function. The UA had not acquired a GPS signal prior to the flight and therefore did not record its takeoff point, rendering the RTH function ineffective. The UA lost connection with the controller and drifted in the wind. It was located undamaged the next day approximately 5 km away, having performed an automatic landing.

Safety actions taken by the operator

- Following the accident, the operator amended its In-Flight Checklist to include an action to confirm the home point is locked, and if time permits, to check the RTH function.
- It also intends to fit additional LED lighting to its UAs, to assist in maintaining line of sight at night.

Appendix 1

Commercial Avistion Safety Team (CAST) / ICAO Common Taxonomy Team (CICTT) Occurrence Categories

CODE	DESCRIPTION
ARC	ABNORMAL RUNWAY CONTACT
AMAN	ABRUPT MANEUVER
ADRM	AERODROME
MAC	AIRPROX/TCAS ALERT/LOSS OF SEPARATION/NEAR MIDAIR COLLISIONS/ MIDAIR COLLISIONS
ATM	ATM/CNS
BIRD	BIRD
CABIN	CABIN SAFETY EVENTS
CTOL	COLLISION WITH OBSTACLE(S) DURING TAKEOFF AND LANDING
CFIT	CONTROLLED FLIGHT INTO OR TOWARD TERRAIN
EVAC	EVACUATION
EXTL	EXTERNAL LOAD RELATED OCCURRENCES
F–NI	FIRE/SMOKE (NON-IMPACT)
F–POST	FIRE/SMOKE (POST-IMPACT)
FUEL	FUEL RELATED
GTOW	GLIDER TOWING RELATED EVENTS
GCOL	GROUND COLLISION
RAMP	GROUND HANDLING
ICE	ICING
LOC–G	LOSS OF CONTROL–GROUND
LOC–I	LOSS OF CONTROL–INFLIGHT
LOLI	LOSS OF LIFTING CONDITIONS EN ROUTE
LALT	LOW ALTITUDE OPERATIONS
MED	MEDICAL
NAV	NAVIGATION ERRORS
OTHR	OTHER
RE	RUNWAY EXCURSION
RI	RUNWAY INCURSION
SEC	SECURITY RELATED
SCF–NP	SYSTEM/COMPONENT FAILURE OR MALFUNCTION (NON-POWERPLANT)
SCF–PP	SYSTEM/COMPONENT FAILURE OR MALFUNCTION (POWERPLANT)
TURB	TURBULENCE ENCOUNTER
USOS	UNDERSHOOT/OVERSHOOT
UIMC	UNINTENDED FLIGHT IN IMC
UNK	UNKNOWN OR UNDETERMINED
WILD	WILDLIFE
WSTRW	WIND SHEAR OR THUNDERSTORM

Air Accidents Investigation Branch

Annual Safety Review 2021