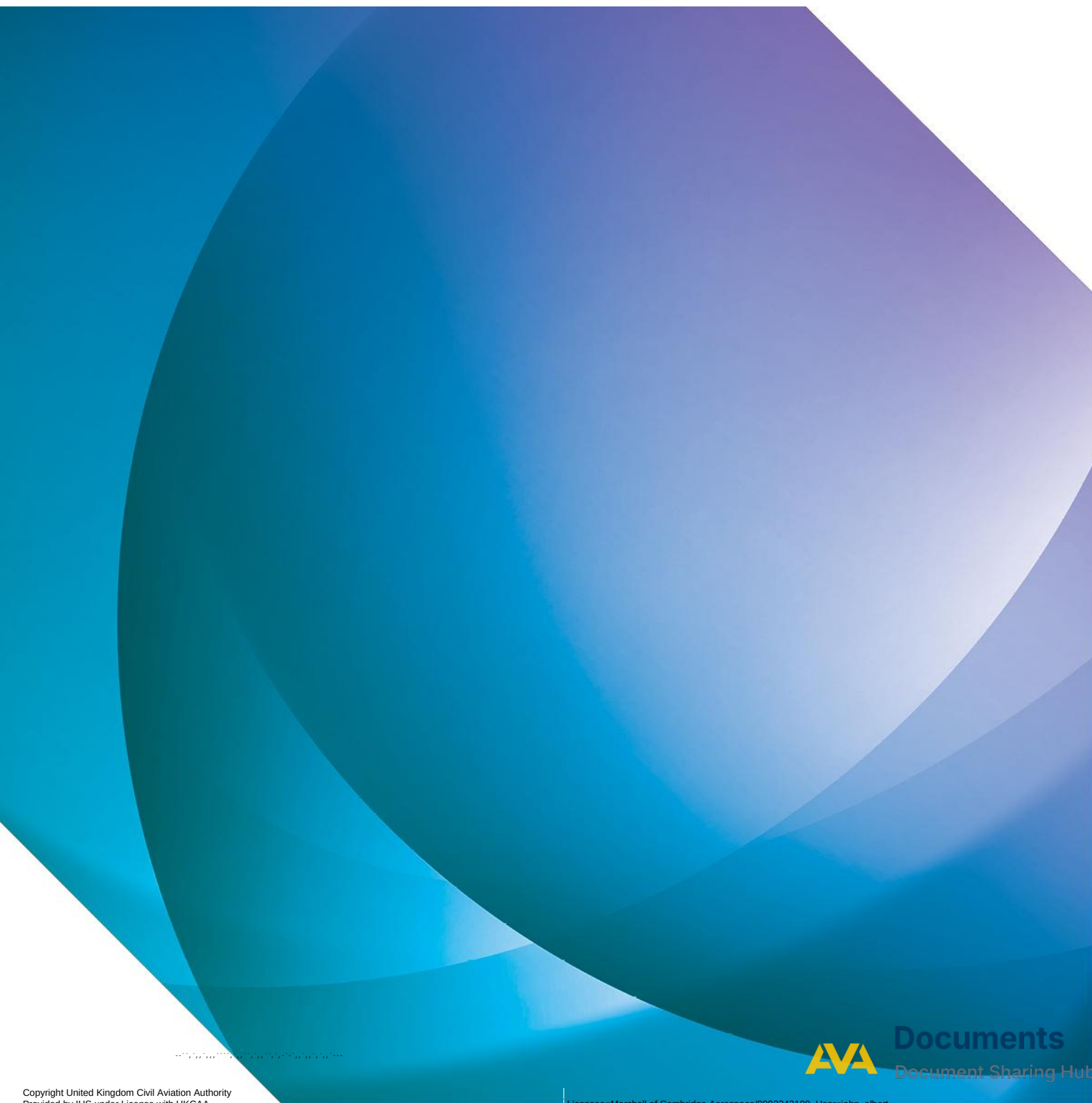


UK civil air display review: final report

CAP 1400



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Contents

Contents	3
Foreword	5
Executive summary	7
UK Civil Air Display Review timeline	10
Final report	11
Chapter 1.....	14
Introduction	14
Air display accidents.....	14
CAA response to the Shoreham accident	15
Summary of the Progress Report.....	16
Summary of the Action Report	17
Full list of actions.....	17
Progress since publication of the Action Report.....	19
Chapter 2.....	24
Permitted manoeuvres	24
Chapter 3.....	26
Distance between crowd lines and display lines	26
Chapter 4.....	30
Minimum heights at flying display.....	30
Chapter 5.....	32
Weather minima	32
Chapter 6.....	37
Post-display reporting.....	37
Chapter 7.....	40

Air display aircraft.....	40
UK civil air display 'fleet'	40
Focus of the review of air display aircraft	40
The criteria for accepting ex-military aircraft onto the UK civil register	41
Maintenance schedules.....	42
Ejection seats	43
Sharing of data	44
Chapter 8.....	45
Human factors.....	45
Increasing display pilots' awareness and understanding of the causes and impact of human error	45
Appendix A	48
CAA UK Civil Air Display Review terms of reference	48
Appendix B	56
Accident data from UK civil air displays and during aerobatic practice	56
Appendix C	58
Categories of aircraft, and some examples of different category of aircraft.....	58
Appendix D	59
CAA and UK civil air displays: commonly used terms and abbreviations	59

Foreword

By Dame Deirdre Hutton, Chair of the UK Civil Aviation Authority (CAA)

We commenced this Review of UK Civil Air Displays the morning after the tragic accident at Shoreham in August last year, but it is impossible to consider this Review without first thinking about the deaths of eleven people. For their families and friends it was a tragedy which has had, and will continue to have, a terrible impact on their lives and I want to extend my and the CAA Board and staff's deepest sympathy to them all.

I should first make clear that this has not been an investigation into the accident at Shoreham. That is being conducted by the AAIB and the police, who bring their independent expertise to bear on the analysis of the particular events and who will, in due course, make their findings public. What the CAA has done, is to conduct a very thorough review of its approach to regulation and develop a series of improvements which will enhance public safety and that can be put in place before this year's season of air displays. If there are further changes that we should consider following the final publication of the AAIB report, we will of course do so. We will also conduct a full review of the impact of the changes and their effectiveness at the end of the 2016 display season, when all of the various stakeholders will be able to contribute their views.

Every time a regulator is faced with a tragic accident, they must consider the balance between further regulatory controls versus the constraints that might be placed on activities that people value. Air displays are no different. Every year almost six million people visit air displays at hundreds of locations across the UK – shows which raise millions of pounds for charity as well as, in the case of displays like Farnborough, providing a showcase for advanced British industry. Finding that balance is not easy.

The UK model of regulation, often copied around the world, seeks to engage the professionalism of those who make air displays happen; pilots, event organisers, aircraft owners. However, there are those in the air display community who have expressed concern about some of the actions the CAA has already publicised. They point to the excellent safety record where there have been no fatalities amongst spectators at air display events for over sixty years, and raise concerns that the

professionalism of this small community of practitioners should not be undermined. That is certainly not our intention and we will continue to work with those experts as we implement the actions that are outlined in this report. Equally, it is incumbent on the CAA to consider afresh its regulatory approach to air displays and continue to modify and improve regulation where this can be done effectively. We will continue to review this regulation to reflect changing conditions and will introduce further enhancements in the future just as we have done in the past.

I hope you will feel that the CAA has made a broadly correct judgement regarding the required regulation to enhance public safety while allowing air displays to continue to flourish. Above all, I hope that those families and friends with whom I started this foreword will feel that the CAA has approached this review determinedly and seriously. Thoughts of those eleven people who very sadly lost their lives have never been far from our minds as we undertook this work.

Dame Deirdre Hutton

April 2016

Executive summary

1. Protecting the public is at the heart of everything that the CAA does and we constantly work to enhance aviation safety standards. The purpose of our comprehensive review of UK civil air displays has been to assess whether it is possible to minimise further the risks at and around civil air displays in the UK.
2. The full terms of reference, including the governance structure, for the CAA's Review of UK Civil Air Displays can be found in Appendix A of this report as well as on the CAA website at www.caa.co.uk/Safety-initiatives-and-resources/Safety-projects/Airshow-review/CAA-review-of-public-air-display-arrangements-in-the-UK/. A timeline for the Review is on [page 10](#).
3. This is the Civil Aviation Authority's (CAA) third report from our review. This report follows the Progress Report¹ published in October 2015 and the Action Report² published in January this year. This report contains summaries of both those reports ([see pages 16-17](#)). Full copies of both reports can be found on the CAA website www.caa.co.uk.
4. This report sets out a further 13 actions that we require air show organisers and others to carry out for the 2016 display season ([see pages 11-13](#) for the full list). These actions build on those we announced in our Action Report. This report also provides detail of the longer-term programme of work to reduce risks relating to the airworthiness of ex-military jet aircraft that perform manoeuvres at UK civil air displays.
5. Additional requirements in this report include actions:
 - to strengthen the competency of pilots performing aerobatic manoeuvres in civil registered, ex-military jet aircraft;
 - to increase the distance between the display line and crowd line where high-energy manoeuvres are being carried out;

¹ www.caa.co.uk/CAP1351

² www.caa.co.uk/CAP1371

- to increase the minimum altitude at which high-energy manoeuvres must take place;
 - to revise flying display weather minima;
 - to strengthen post-display reporting requirements for FDDs, to reflect the importance of feedback and reporting from air displays; and
 - to strengthen the medical standards and the medical certification process for flying display pilots.
6. It also sets out our plans for increasing awareness and management of the inherent risks of human error in air display flying.
7. Our work on specific guidance for night air displays continues, as does our work on the additional risks that formation flying may pose. We plan to publish the results of this work as soon as possible. Flying displays are currently permitted up to 30 minutes past official sunset, which is the UK time definition of when night starts. We will continue to accept applications for displays up to 30 minutes past sunset, and approve them subject to other safety criteria being met. However, the risks associated with night displays are higher than those associated with daylight and dusk displays, and therefore require detailed analysis. Until that work is completed, and guidance is published in our publication '[Flying Displays and special events: A guide to safety and administrative arrangements](#)', we will not approve any requests for a permission to hold a night air display.
8. Though this is formally the final report of the review, it is not the end of the process. We will review all the actions we announced in January and those we are announcing in this report in the light of the recommendations made by the Air Accidents Investigation Branch (AAIB) in their Safety Bulletins.
9. On Friday 8 April we published our response³ to the AAIB Special Bulletin S4/2015⁴, which was published by the AAIB on 21 December 2015. The AAIB's Special Bulletin highlighted findings of the AAIB investigation

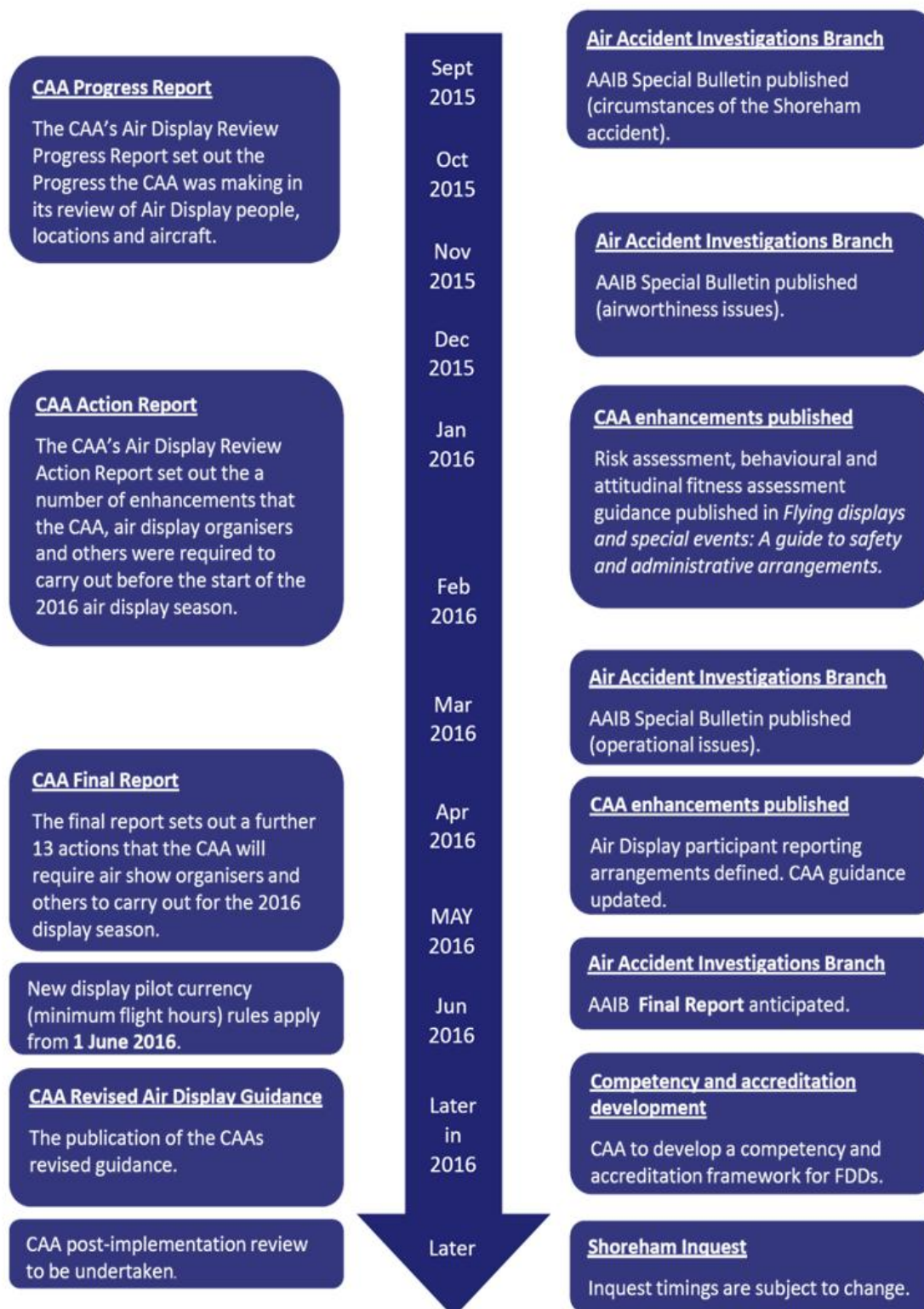
³ <http://publicapps.caa.co.uk/docs/33/Factor201601.pdf>

⁴ <https://www.gov.uk/aaib-reports/aaib-investigation-to-hawker-hunter-t7-g-bxfi-special-bulletin-s4-2015>

regarding ejection seat safety and the maintenance of ex-military jet aircraft.

10. We will also review any recommendations made by the AAIB in the Final Report into the causes of the tragic accident at the Shoreham Air Show on the 22 August 2015, and carefully consider the outcome of Sussex Police's ongoing investigation into the accident and the inquest opened by the West Sussex Coroner.
11. For ease of reference a list of CAA and UK civil air displays' commonly used terms and abbreviations is provided at Appendix D (pages 60-64).

UK Civil Air Display Review timeline



Final report

Full list of actions, and which follow on from the Action Report

- Updated Action 7: With effect from 1 April 2016, a display authorisation will only remain valid for pilots of all registered aircraft who hold *either* an EU medical certificate issued by an AME *or* an ICAO medical certificate that is of an equivalent or higher standard.
- Updated Action 10: Currency
 - display pilots authorised to perform at standard level aerobatics in multiple categories including jet powered and helicopter categories must renew in those categories at least every two years; and
 - where that authorisation also includes one or more of turboprop, multi-engine piston (MEP) or single-engine piston (SEP) categories they must rotate their renewal across those categories year on year.
- Action 17: Pilots authorised to perform standard level aerobatics will only be permitted to perform loops or barrel rolls in civil registered ex-military jet aircraft at civil air displays if they have received explicit approval from a suitably qualified DAE. Approval will be made clear on a pilot's DA.
- Action 18: FDDs must verify the DA of pilots wishing to perform standard level loops and barrel rolls in civil registered ex-military jet aircraft to confirm that they have the authorisation to perform the manoeuvres.
- Action 19: With immediate effect
 - where a display aircraft is performing aerobatics at a speed of between 200 and 300 kt IAS, the minimum distance between the crowd and the display line must be 230 metres;
 - where a display aircraft is performing at a speed in excess of 300 kt IAS, and the display includes any high speed manoeuvres towards the crowd, the minimum distance between the crowd and the display line must be 450 metres; and

- for light aircraft, with a maximum weight of less than 1200kg and operating speeds of less than 150 kt IAS throughout the display, the minimum separation is 150 metres.
- Action 20: From publication of this report, and until further notice, operators of civil registered ex-military jet aircraft must seek formal approval from the CAA to perform aerobatic manoeuvres below 500 feet.
- Action 21: With immediate effect the weather minima for flying displays by aircraft other than V/STOL aircraft operating in jet-borne flight/V/STOL mode, rotorcraft and other aircraft with a stalling speed below 50 knots, flying flat aerobatic displays, will be 500 ft cloud base BKN and OVC and 5 km visibility for both solo and formation displays.
- Action 22: From the 2016 display season onwards all event organisers and FDDs must submit a post-air display report to the CAA. Pilots must also report any aspect of their display that could have caused a significant safety risk.
- Action 23: FDDs will be responsible for reporting all breaches of safety at their display to the CAA. Where a 'stop' call is made during a display for reasons related to the fitness or competence of a pilot the circumstances leading to the 'stop' must be reported to the pilot concerned and to the CAA as soon as practicable. In such circumstances the CAA will issue a provisional suspension of the display authorisation to the pilot concerned.
- Action 24: We will review the criteria and requirements for the acceptance of ex-military aircraft onto the civil register. This work will be completed by early 2017.
- Action 25: We will require maintenance schedules for ex-military aircraft on the civil register to be provided to the CAA, so that we can harmonise schedules and improve the standard of these documents. This work will be completed by the end of 2016.
- Action 26: We will work closely with the MAA and the Ministry of Defence to enhance the CAA's understanding of the revision levels of key military

publications on which maintenance schedules for which ex-military aircraft are based. This work will be completed by the end of 2016.

- Action 27: We will conduct a review of all ex-military aircraft on the civil register that are required to have ejection seats fitted and active to ensure that they are necessary and appropriately maintained. This work should all be concluded by early 2017.
- Action 28: We will establish continued airworthiness boards for different types and classes of aircraft to facilitate regular exchange of airworthiness information of type- or class-specific best practice. We expect the first of these meetings to be held before the end of May this year.
- Action 29: The CAA will commence a programme of work to study and enhance understanding of human factor issues within the air display sector, starting with a full-day industry workshop on the causes and impact of human error for display pilots (date to be set).

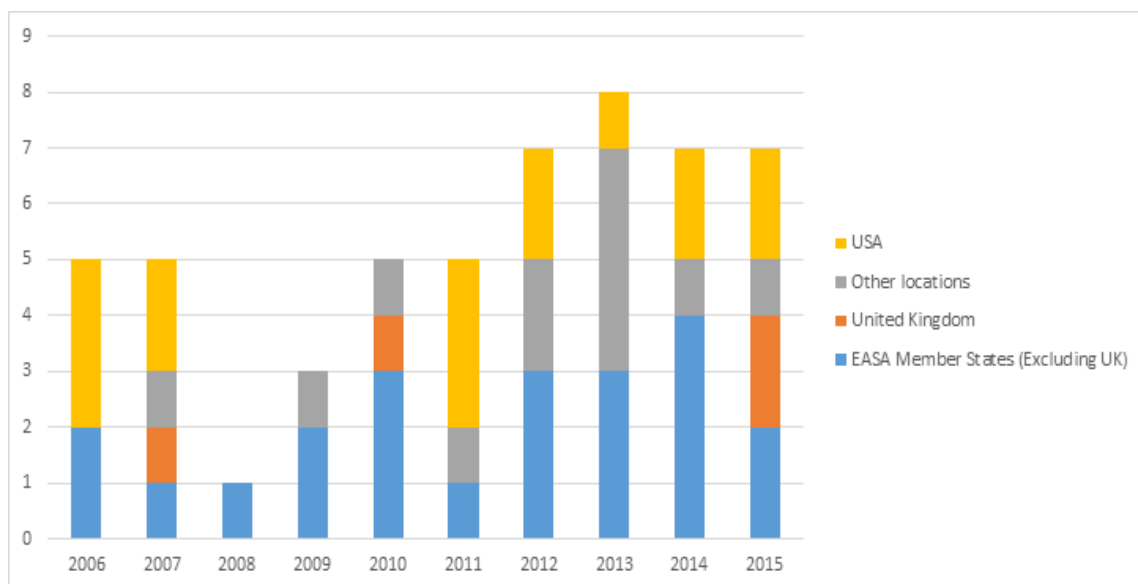
Chapter 1

Introduction

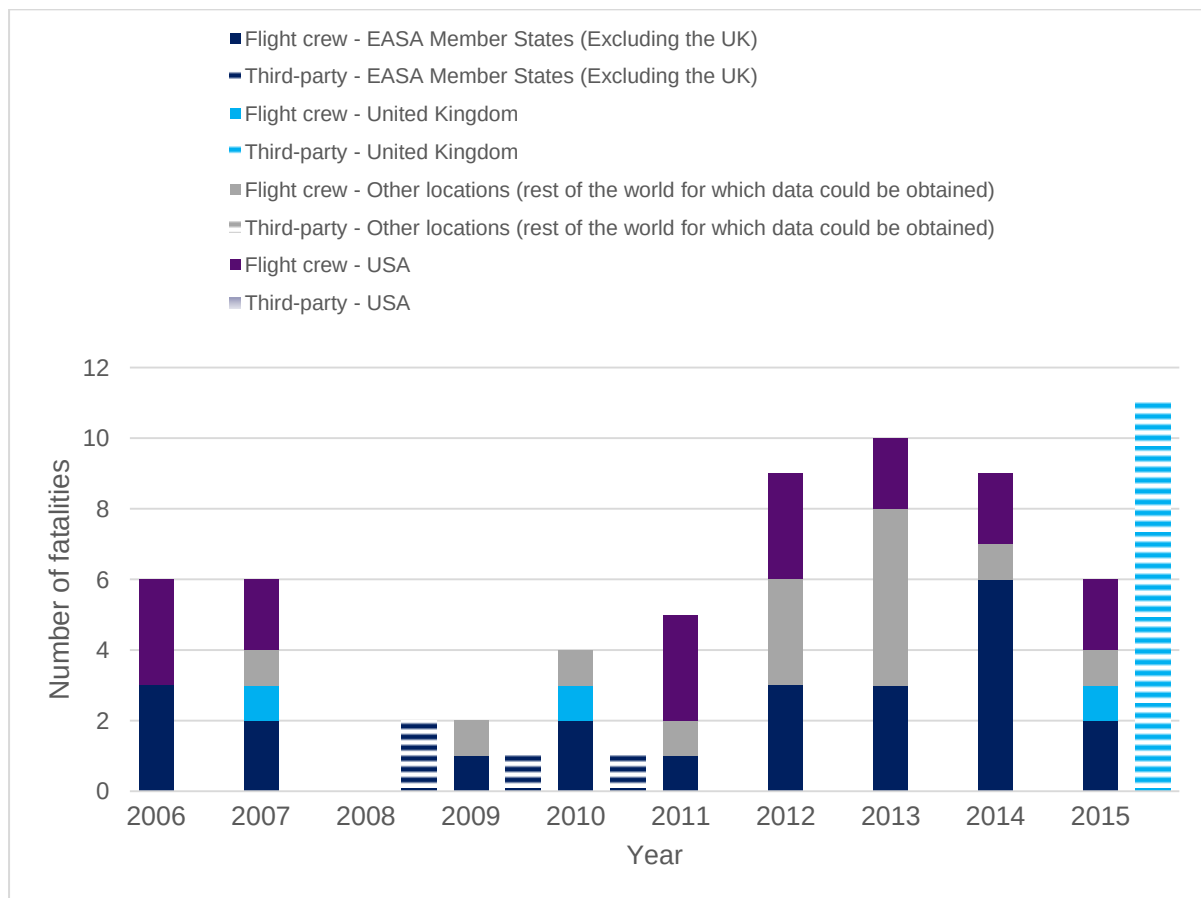
Air display accidents

- 1.1 Until the tragic accident involving a Hawker Hunter at Shoreham last year there had been no public fatalities at UK civil air displays in 60 years. This suggests safety at air displays in the UK compares very well with those of other countries.
- 1.2 The tables below show the number of fatal accidents during air displays across the world from 2006 - 2015 (fixed wing aircraft only), and the number of fatalities, during air displays by locality from 2006 to 2015⁵. The data includes the deaths of pilots as well as members of the public.

Table 1: Fatal accidents from 2006 to 2015 during air displays by location



⁵ Data for these graphs has been drawn from the AAIB, the National Transportation Safety Board (USA), the European Aviation Safety Agency and other aviation safety investigation and national aviation authorities.

Table 2: Number of fatalities during civil air displays from 2006 to 2015

- 1.3 The fact that there have been no public fatalities at UK civil air displays since 1952 makes the accident at Shoreham all the more alarming. It underlines why the CAA had to, and continues to, take decisive action to review and strengthen public safety at UK air displays.

CAA response to the Shoreham accident

- 1.4 In the immediate aftermath of the Shoreham accident, the CAA promptly introduced temporary precautionary measures to:
- ground all civil registered Hawker Hunter aircraft;
 - restrict what display manoeuvres similar jet aircraft are allowed to carry out over land; and
 - implement additional risk assessment criteria on all future civil air displays, some of which resulted in further precautionary measures being put in place.

- 1.5 These restrictions have remained in place since the accident and will do so until we are able to review them in the light of the AAIB's Final Report.
- 1.6 After the accident, we also announced that we would conduct a robust evaluation of existing guidance, processes and all regulations relating to UK civil air displays. The Shoreham accident has not been the sole focus of this comprehensive review. The AAIB and Sussex Police investigations are ongoing, and it remains inappropriate for the CAA to speculate on the cause of the accident. However, we have supported both investigations fully and will continue to do so. Furthermore, we have taken the AAIB's investigation, and its preliminary Special Bulletins, into account in our work.

Summary of the Progress Report⁶

- 1.7 The Progress Report was published on 28 October 2015. It summarised the overarching regulatory framework and safety principles that govern the CAA's oversight of the development, organisation and performance of civil air displays and explained the three themes that would be used to structure the review: air display locations, air display aircraft and air display people. It also set out:
- what must be considered before an air display can be held at a specific location;
 - how the airworthiness of aircraft which participate in air displays is assessed and assured; and
 - the fitness (attitudes and behaviours), medical requirements, skills and competencies of those involved in air displays - display pilots, Flying Display Directors (FDDs) and Display Authorisation Evaluators (DAEs).
- 1.8 The detail set out in the Progress Report is not repeated in this Report.

⁶ www.caa.co.uk/CAP1351

Summary of the Action Report⁷

- 1.9 The Action Report was published on 26 January 2016. Based on the same three core themes as the Progress Report (air display locations, air display aircraft and air display people), it set out a number of enhancements that the CAA, air display organisers and others have been required to carry out before the start of the 2016 air display season. It also gave all those involved in the 2016 air display season advance notice of the CAA's intentions as we seek to strengthen the safety provisions for UK civil air displays.
- 1.10 The Action Report introduced additional requirements or formalised existing requirements, including:
- the planning documentation that must be submitted to the CAA as part of the request for permission to hold a civil air display;
 - the competence and attitude of FDDs;
 - the experience, skill and health of display pilots; and
 - the role of DAEs.
- 1.11 In total, it set out 16 actions that together are designed to increase the skills and competencies of those who organise civil air displays, those who evaluate participants in civil air displays and, of course, the pilots. It recognised the crucial role these highly skilled personnel collectively contribute to delivering safe air displays. All the actions announced in January are listed below.

Full list of actions

Announced in the CAA publication 'UK Civil Air Display Review: Actions that impact on UK civil air displays in 2016'

- Action 1: The CAA will specify, for all future air displays, the risk assessment criteria that it requires event organisers and Flying Display Directors must use in planning and preparing for air displays of all sizes.

⁷ www.caa.co.uk/CAP1371

- Action 2: In their application for permission to hold an air display, an event organiser and/or FDD must provide their enhanced risk assessment and full details of how they propose to mitigate any risks they have identified. They must set out in their safety plans evidence of engagement with other authorities.
- Action 3: An event organiser must provide the CAA with written detail of how they, with input from the FDD, will communicate with the public about areas where they may be at greater risk.
- Action 4: The CAA will formalise its procedures for ensuring whether, in its opinion, an applicant has the right attitudes and behaviours to fulfil the role of an FDD. The CAA will develop similar procedures for display pilots and Display Authorisation Evaluators (DAE).
- Action 5: The CAA will accredit FDDs to meet a defined level of competence.
- Action 6: At least one day before an air show, any pilot intending to fly aerobatic sequences that flow directly from one manoeuvre into the next must notify the FDD of the series of linked manoeuvres that they intend to perform. If the information is not provided, the FDD must not allow the pilot to fly in the air show.
- Action 7: With effect from 1 April 2016, a display authorisation (DA) will only remain valid for pilots of aircraft registered in the UK or abroad who hold an EU (or ICAO equivalent) medical certificate issued by an AME. [This Action is updated in this Final Report]
- Action 8: The minimum relevant hours required for a pilot to obtain a DA for complex or high-performance aircraft will be increased.
- Action 9: The CAA will strengthen the display pilot's initial validation process by introducing an additional revalidation after the first six months and require that no display pilot has the same DAE conducting the revalidation for more than two consecutive years.

- Action 10: The CAA will publish new currency (flying experience) rules for display pilots that match better the time spent display flying to the type of display being flown. [This Action is updated in this Final Report]
- Action 11: A display pilot authorised to perform above standard level aerobatics and in more than one aircraft category will be required to renew their display authorisation in each category.
- Action 12: The CAA will strengthen the criteria for the nomination, appointment, induction and documentation for DAEs. These criteria will be in effect for all appointments from 31 March 2016 onwards, including reappointments.
- Action 13: The CAA will enhance the frequency and intensity of its oversight of DAEs to ensure that they are fulfilling their responsibilities to a satisfactory standard.
- Action 14: The CAA will assist DAEs to maintain their own competency and continuing professional development by organising an annual DAE seminar.
- Action 15: To obtain a display authorisation, pilots must be able to prove that they can plan and perform a series of linked manoeuvres.
- Action 16: With immediate effect, no member of CAA staff will be permitted to act or sit on a Flying Control Committee, or to act as a DAE. CAA Flying Standard Officers will oversee flying displays and the DAE system.

Additionally the CAA announced that it was increasing the minimum notification period to 42 days for air displays with seven or more 'items' participating.

Progress since publication of the Action Report

- 1.12 On 1 March 2016 we published an amended version of our guidance document '[Flying Displays and special events: A guide to safety and administrative arrangements](#)⁸'. The updated guidance document reflects the changes in display application requirements that were introduced in

⁸ www.caa.co.uk/CAP403