UK civil air display review: final report

CAP 1400

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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 Report[1] published in October 2015 and the Action Report[2] 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 response[3] to the AAIB Special Bulletin S4/2015[4], which was published by the AAIB on 21 December 2015. The AAIB's Special Bulletin highlighted findings of the AAIB investigation

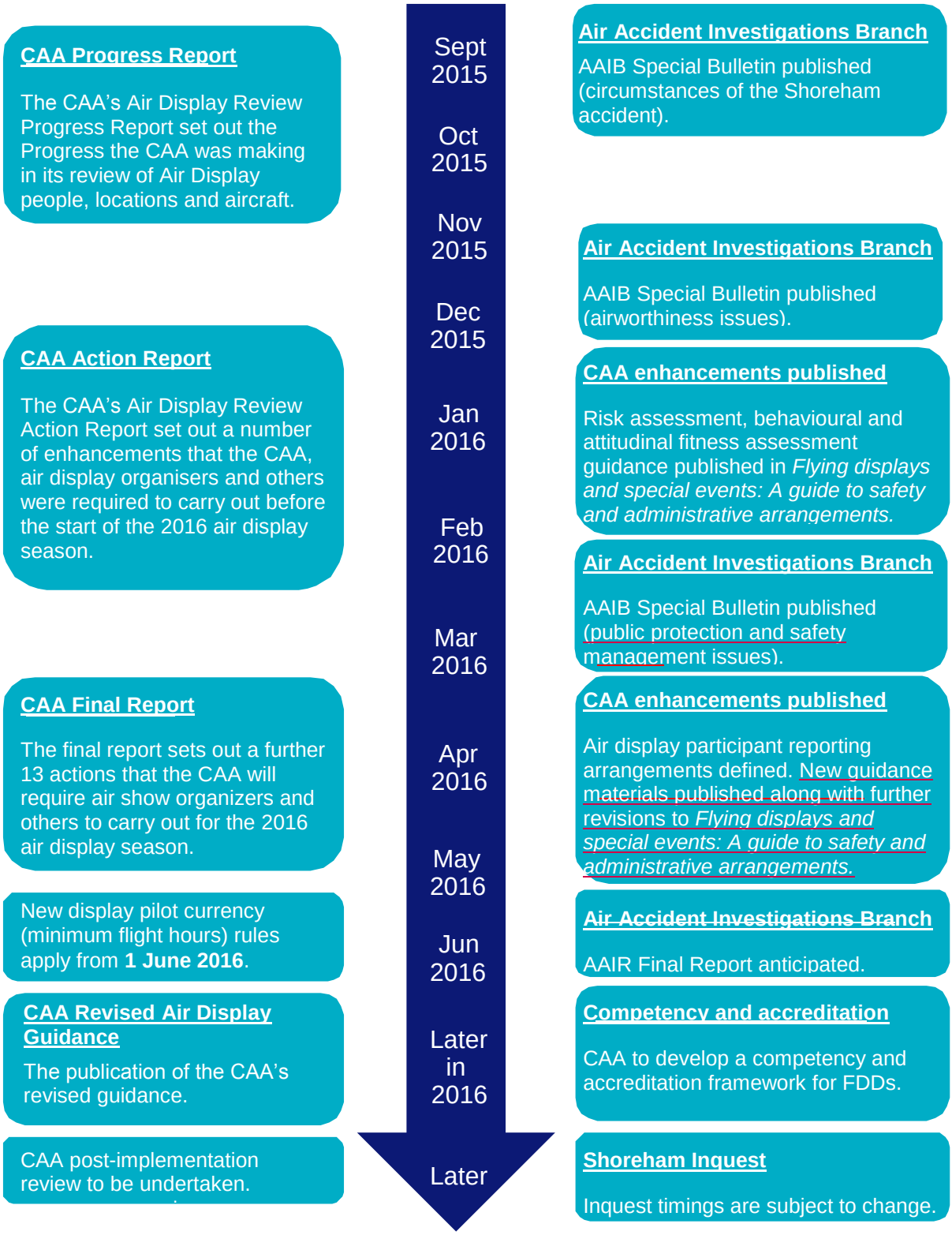
[3] http://publicapps.caa.co.uk/docs/33/Factor201601.pdf
[4] https://www.gov.uk/aaib-reports/aaib-investigation-to-hawker-hunter-t7-g-bxfi-special-bulletin-s4-2015

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

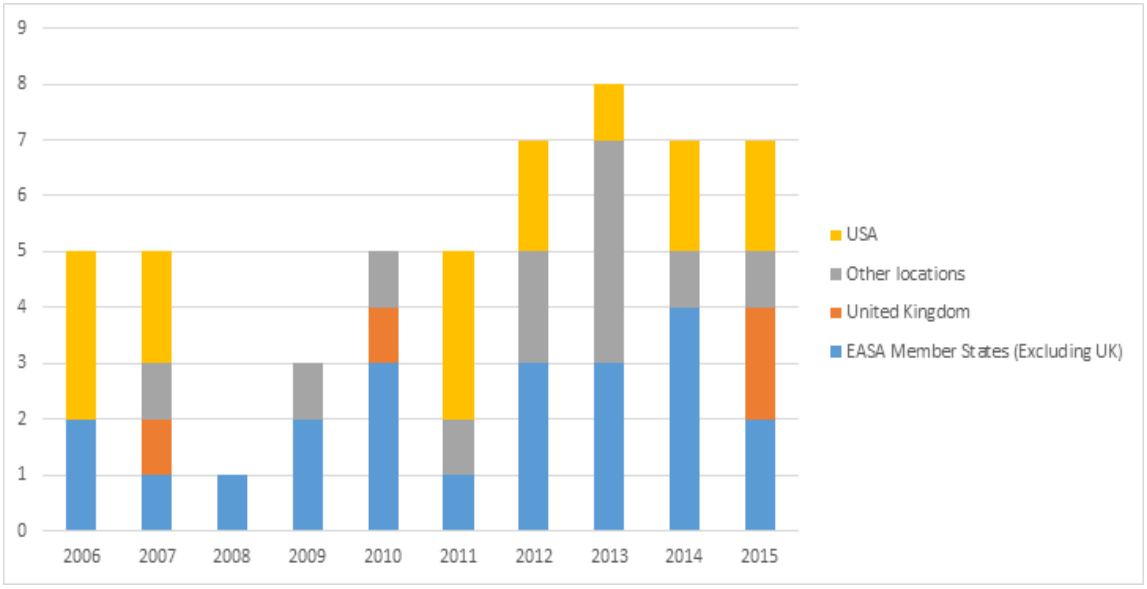
Introduction

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.

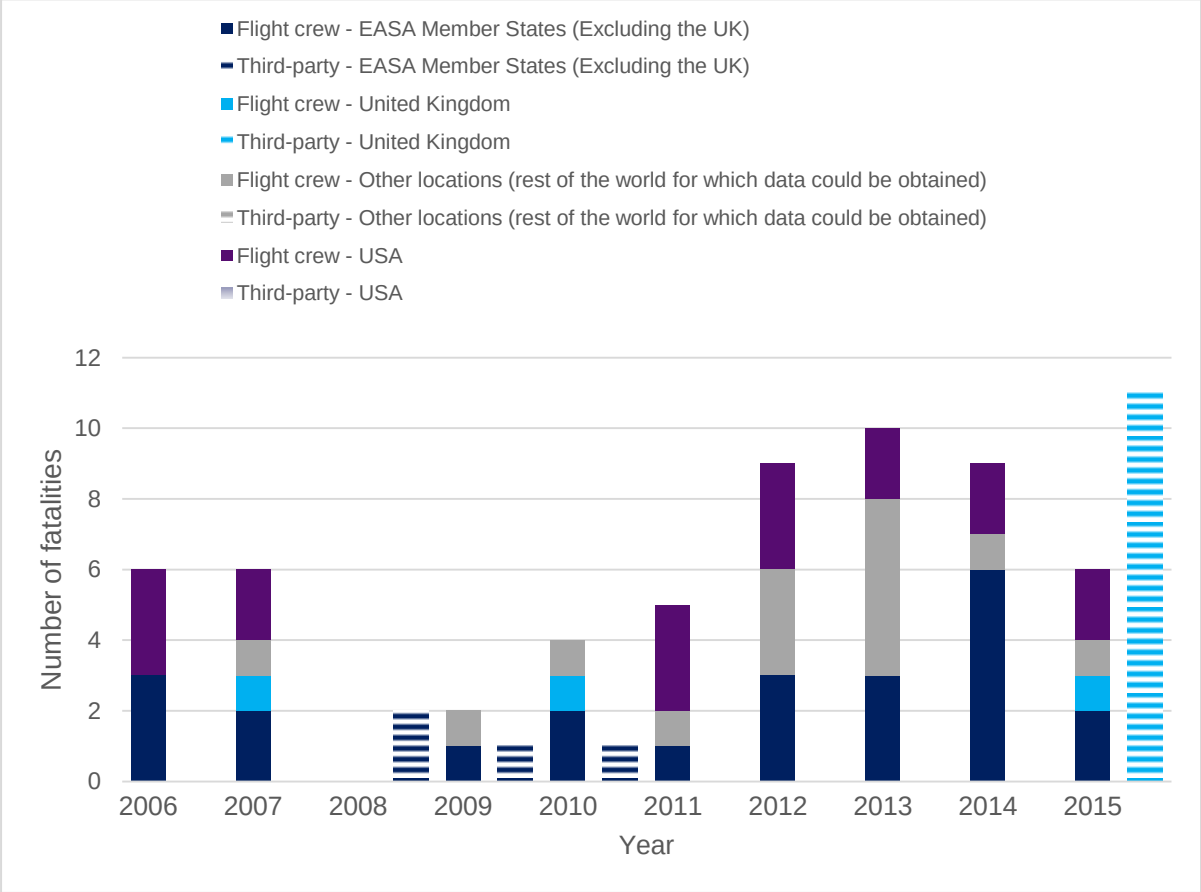
1.2 The tables below show the number of fatal accidents during air displays across the world from 2006 - 2015 (fixed wing aircraft only), and the number of fatalities, during air displays by locality from 2006 to 2015[5]. The data includes the deaths of pilots as well as members of the public.

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 Report[6]

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 Report[7]

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

- Action2: 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 is 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

the Action Report. It also formalised the fitness assessments that FDDs and display pilots must pass. Due to their urgent nature, these changes have been made ahead of a major revision to the guidance document, which is planned for later this year, and which will include the actions announced in this Final Report.

1.13 The changes to the display application requirements are detailed in:

- Chapter 3 Part A;
- Chapter 4 Part A; and
- Annex A - Risk Assessment.

The fitness assessments for FDDs and display pilots are detailed in Chapter 1 Part A[9].

1.14 The Action Report also stated that, with effect from 1 April 2016, a display authorisation will only remain valid for pilots of aircraft registered in the UK or abroad if they hold a European Union (EU) medical certificate issued by an Aeromedical Examiner (AME).

1.15 A number of pilots appearing at UK air shows come from outside of the EU, most commonly from the USA, where the pilot does not hold an EU licence or medical. We will require such pilots to demonstrate that they meet the same medical standards. For that purpose, an equivalent or higher International Civil Aviation Organisation (ICAO) medical certificate can be considered acceptable. We have therefore updated the action we announced in the Action Report, with the updated wording shown in italics below:

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.*

[9] www.caa.co.uk/General-aviation/Displays,-events-and-activities/Behavioural-and-attitudinal-fitness-assessment/

1.16 In the Action Report, we said that in our Final Report we would set out the increase in the minimum relevant hours required for a pilot to obtain a display authorisation (DA) for complex or high-performance aircraft, based on further CAA analysis and the engagement with industry.

1.17 We can now confirm that:

- all pilots requesting a DA for aircraft with 800HP or greater, 2730 kg mass or greater, jet powered or helicopter, must have a minimum of 500 hours total time, of which 300 hours must be as pilot in command (P1); and
- all pilots requesting a DA that does not include those display aircraft categories described above will continue to be required to have a minimum of 200 hours total time, of which 100 hours should be P1.

1.18 These requirements better reflect the experience a pilot needs on the more challenging characteristics of more complex aircraft. The requirements will be explained further in our next update to the CAA guidance document 'Flying Displays and special events: A guide to safety and administrative arrangements'.

1.19 We also said in our Action Report that in our Final Report we would publish new currency (recent flying experience) rules for display pilots. The aim of these is to ensure that display pilots not only have recent flying experience in display flying, but specifically that they have recent experience flying the kind of sequence they intend to fly in a public display.

1.20 We can now confirm that from 1 June 2016:

- Where the display aircraft is 800HP or greater, 2730 kg mass or greater, or jet powered a pilot must in that specific type of aircraft:
  - have flown or practised at least one display sequence within the 30 days preceding the date of the display, and

- have flown a minimum of three full display sequences within the 90 days preceding the date of the display.

- For all other types of display aircraft a pilot must:
  - have flown or practised at least one display sequence in the specific type of aircraft to be displayed within the 30 days preceding the date of the display, and
  - have flown a minimum of three full display sequences within the 90 days preceding the date of the display. This does not necessarily have to be in the specific type of aircraft.

1.21 These requirements will be explained further in our update to the CAA guidance document 'Flying Displays and special events: A guide to safety and administrative arrangements', which is being published alongside this report.

1.22 In our Action Report, we announced a strengthening of the requirements for display pilots wishing to renew their DA. Specifically, we stated that a display pilot authorised to perform above standard level aerobatics in more than one aircraft category will be required to renew their DA in each category. In the Action Report we set out the six categories for renewal purposes:

- Jet powered aircraft;
- Turboprop;
- Multi-engine piston (MEP);
- Single-engine piston (SEP);
- Helicopters; and
- Others.

1.23 Having reviewed the issue further we recognise the need also to strengthen requirements placed on display pilots authorised to perform standard level aerobatics. Taking into account the different risks at play and the impact of other restrictions placed on pilots operating at this level, we will now require that:

- 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.

1.24 We can further confirm that CAA retains the right to specify the type of aircraft within a category that a pilot is permitted to renew on.

1.25 We have updated Action 10 from the Action Report accordingly:

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.

Chapter 2

Permitted manoeuvres

2.1 Immediately following the accident at the Shoreham Air Show, the CAA restricted Hawker Hunter aircraft and other ex-military jet aircraft from performing certain manoeuvres at over-land air displays and limited such aircraft to flypasts. These restrictions only affect aircraft on the civil register, and not military-registered aircraft which are subject to their own restrictions.

2.2 As we stated earlier in the report, these restrictions will remain in place until the AAIB has published its final report. At that time we will reconsider these restrictions.

2.3 We have also considered whether to prohibit any specific manoeuvres in ex-military jet aircraft at civil air displays because of the potential risk that they pose to the public as well as to the pilot themselves.

2.4 There are four levels of manoeuvres that are permitted. These are:

- Standard;
- Intermediate;
- Advanced; and
- Unlimited.

2.5 Each level demands a different degree of skill, which will also depend on the aircraft to be flown. A DAE will evaluate the skills of a pilot and decide what level of skill he or she has demonstrated. Details of the manoeuvres permitted at each level are set out in the CAA's publication 'Flying Displays and special events: A guide to safety and administrative arrangements'.

2.6 In this review the CAA has looked specifically at civil registered ex-military aircraft[10] performing standard level manoeuvres and pilots authorised to fly standard level manoeuvres in such aircraft.

2.7 Accident data from UK civil air displays and during aerobatic practice for the period 1985 to 2015 is shown at Appendix D. The data shows that many more accidents have occurred during spins and loops than in other manoeuvres indicating that these inherently carry a greater risk. Though clearly pilot competency and practice can and should improve their ability to perform these manoeuvres successfully, when they do go wrong the outcome tends to be more serious and often fatal. Furthermore, when they are performed in civil registered ex-military jet aircraft, the impact and potential risk to the public of not completing these manoeuvres safely is also much greater. Having identified these elevated risks, we are taking steps to reduce them for pilots who have attained the standard aerobatic skill level.

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 air displays if they have received explicit approval from a suitably qualified DAE. Approval will be made clear on a pilot's DA.

2.8 We are not making any changes to the other skill levels for authorisation of aerobatic displays, so pilots who are authorised to perform above standard level aerobatics will not be affected.

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 competency to perform the manoeuvres.

[10] Aircraft that comply with the CAA's guidance 'Operation of 'Permit-to-Fly' ex-military aircraft on the UK register'

Chapter 3

Distance between crowd lines and display lines

3.1 The CAA's publication 'Flying Displays and special events: A guide to safety and administrative arrangements' sets out the distances that must be in place between the clearly identified display line, behind which displaying aircraft perform their manoeuvres, and the crowd line, behind which spectators are allowed to stand or sit. The distances differ according to the actual speed of the aircraft and the type of display. For aircraft flying in formation, the distance applies to aircraft performing nearest to the crowd.

3.2 The current minimum distances between the display line and crowd line are as follows:

All aircraft			
Aircraft display speed	**Type of display**		
	Flypast	Aerobatics	Vertical and/or short take-off and landing (V/STOL) aircraft only flypast or hovering
Less than 100 knots indicated air speed (kt IAS)	50 metres	100 metres	150 metres
100 – 200 kt IAS	100 metres	150 metres	150 metres
200 – 300 kt IAS	150 metres	200 metres	150 metres
Above 300 kt IAS	200 metres	230 metres	200 metres

3.3 For military air displays, the Military Aviation Authority's (MAA) guidance 'Flying Displays and Special Events[11]' (PDF) also sets out the distances between the display line and the crowd line, depending on the type of aircraft being flown and the manoeuvres being flown. The guidance states

[11] We understand that the MAA is due publish Issue 6 later in April 2016.

that the normal separation between the crowd line and aircraft displaying in flight, including helicopter displays that involve aerobatics, should be 230 metres.

3.4 The MAA's guidance also states that where the 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 should be increased to 450 metres. This also conforms to North Atlantic Treaty Organisation (NATO) requirements[12]. Military air displays that involve pilots from other countries as well as the UK typically apply NATO requirements regarding display lines to avoid confusion.

3.5 Before the accident at the Shoreham Air Show, the MAA commissioned independent research into crowd lines to ensure they remain fit for purpose. This research is ongoing and should report in 2017.

3.6 In its Special Bulletin published on 10 March 2016, as part of its investigation into the accident at the Shoreham Air Show[13], the AAIB recommended reviewing the required distances between the crowd line and display line at UK civil air displays. As the MAA research is ongoing, we have decided as an interim measure where current MAA distances are higher we are aligning with them.

[12] http://standards.globalspec.com/std/1641227/nato-afsp-5
[13] https://www.gov.uk/aaib-reports/aaib-investigation-to-hawker-hunter-t7-g-bxfi-special-bulletin-s1-2016

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 1200kg and operating speeds of less than 150 kt IAS throughout the display, the minimum separation is 150 metres.

3.7 The minimum distances are summarised below:

Type of Aircraft	Type of Display	Separation Distance
All aircraft	All aircraft including rotary-wing aerobatics	230 metres
All aircraft	Speed greater than 300KIAS with velocity vector towards crowd	450 metres

3.8 For the following aircraft and activities, reduced minimum separations are permitted:

Type of Aircraft	Type of Display	Separation Distance
Light aircraft	MTOM less than 1200kg and speed less than 150KIAS throughout the display	150 metres
Rotary-wing	Take-off, landing and transitional manoeuvres	150 metres

Rotary-wing	Non-aerobatic flight and underslung load operations	150 metres
V/STOL aircraft	Vertical take-off, landing and non wing borne flight at low speed	150 metres
V/STOL aircraft	Conventional wing borne flight	230 metres

3.9 We recognise that these changes are likely to cause some event organisers to have to make changes to display content and/or their risk assessments in advance of the 2016 display season. We have not found any evidence to suggest that there will be a significant impact on the number of displays happening but will be liaising with organisers on this point.

3.10 We will review these distances when the MAA's research reports. We have not aligned distances for the smaller, lighter end aircraft as this would have a disproportionate impact for air displays for negligible risk reduction benefits.

Chapter 4

Minimum heights at flying display

4.1 The general regulations regarding minimum heights are set out in UK law in the Rules of the Air Regulations 2015[14] and in the European Union's Standardised European Rules of the Air (SERA). The UK national regulations supplement the European Commission Regulation No 923/2012: Standardised European Rules of the Air. The latter govern all flights within the European Union. The Rules state that an aircraft must always comply with the following rules, unless it is granted an exemption by the national aviation regulator:

- **500 feet rule**
  An aircraft must not fly closer than 500 feet to any person, vessel, vehicle, building or structure.
- **1000 feet rule**
  If an aircraft is flying over a congested area (town, settlement, etc.) it must fly high enough so that, in the case of an engine failure, it is able to land clear without being a danger to people. It must therefore not fly less than 1000 feet above the highest fixed object within 600 metres of the aircraft.

4.2 The CAA is allowed to grant a general exemption against these regulations and does so in respect of display manoeuvres to be performed at air displays. The minimum heights to which a display pilot are set in their DA. These can vary according to their experience-level as well as the type and category of aircraft they fly.

4.3 In its investigation into the accident at the Shoreham Air Show, the AAIB has questioned whether this general exemption should remain. The CAA must respond to this challenge and consider whether the general exemption should remain. However, this consideration will take some time

[14] www.legislation.gov.uk/uksi/2015/840/contents/made

to conclude. As a precautionary measure in the interim, the CAA will not permit civil registered ex-military jet aircraft to perform aerobatic manoeuvres below 500 feet, unless a specific approval to do so has been issued to the pilot by the CAA. At all other times the pilot must comply with the normal rules of the air as set out in paragraph 5.1 above.

Action 20: From publication of this report, and until further notice, civil registered ex-military jet aircraft must seek formal approval from the CAA to perform aerobatic manoeuvres below 500 feet.

Chapter 5

Weather minima

5.1 All FDDs are required to:

- circulate a comprehensive written briefing to anyone flying in an air display, well in advance of the show; and
- hold a oral briefing on the day of the show with those flying in the display. This can be in person or by telephone.

5.2 The written briefing sets out the minimum acceptable weather conditions under which each element of the display can take place. They are known as the “weather minima”, and mean that under thick cloud or poor visibility, some aspects of a flying display may not be safe so must be removed from the display. The CAA has set recommended weather minima, which are published in ‘Flying Displays and special events: A guide to safety and administrative arrangements’ and summarised in the table below. It is then for the FDD to decide whether to follow these recommended minima, or increase them.

			Weather minima	
Type of aircraft	**Type of display**		**Cloud ceiling or significant cloud (4/8 or more)**	**Visibility**
V/STOL aircraft, rotorcraft and other aircraft with a stalling speed below 50 knots[15]	Flypasts	Solo aircraft	500 ft	1,500 m
		Formations	500 ft	3,000 m
	Full aerobatic displays	Solo aircraft	800 ft	3,000 m
		Formations	800 ft	5 km
Flying displays by other aircraft	Flypasts or flat aerobatic displays	Solo aircraft	500 ft	3,000 m
		Formations	800 ft	5 km
	Full aerobatic displays	Solo aircraft	1,000 ft	5 km
		Piston formations	1,000 ft	5 km
		Jet/turboprop formations	1,500 ft	8 km

5.3 In setting the minima, the FDD must carefully consider the operating characteristics of participating aircraft and may decide to increase the minima. To help the FDD do this, the CAA now requires that all pilots intending to fly a linked series of manoeuvres must notify the FDD of the series they intend to perform at least one day before the show[16]. With this information and knowing the weather conditions, the FDD may then ask the pilot to alter their display.

5.4 Throughout, it remains the pilot's responsibility to ensure that the display can be performed safely, taking into account the latest information available as to the route and location to be used, the weather reports and forecasts available, and any alternative course of action that will be

[15] This applies only to V/STOL aircraft operating in V/STOL mode.
[16] See Action 6 in the Action Report

adopted if the flight cannot be completed as planned. To help with this, the FDD's oral briefing should include details of the actual weather conditions at the time of the briefing, and the forecast conditions for the period of the display.

5.5 Pilots must also consider the potential effect of wind speed and direction on their display, particularly when experiencing a strong "on-crowd" wind. FDDs should emphasise the revised crowd separation display line minima in their pre-display briefing when such conditions are expected.

5.6 As part of our comprehensive review of all aspects of the guidance, processes and regulations relating to UK civil air displays, we have identified a lack of clarity relating to flat aerobatic displays by aircraft other than V/STOL aircraft, rotorcraft and other aircraft with a stalling speed below 50 knots. We have therefore updated the CAA's publication 'Flying Displays and special events: A guide to safety and administrative arrangements' to address this. The updated guidance is included below.

			Weather minima	
Type of aircraft	**Type of display**		**Cloud base broken (BKN) or overcast (OVC)**	**Visibility**
V/STOL aircraft, rotorcraft and other aircraft with a stalling speed below 50 knots	Flypasts	Solo aircraft	500 ft	1,500 m
		Formations	500 ft	3,000 m
	Full aerobatic displays	Solo aircraft	800 ft	3,000 m
		Formations	800 ft	5 km
Flying displays by other aircraft	Flypasts	Solo aircraft	500 ft	3,000 m
		Formations	800 ft	5 km
	Flat aerobatic displays	Solo aircraft	500 ft	5 km (current 3,000 m)
		Formations	800 ft	5km
	Full aerobatic displays	Solo aircraft	1,000 ft	5 km (current 3,000 m)
		Piston formations	1,000 ft	5km
		Jet/turboprop formations	1,500 ft	5 km

5.7 These changes will take immediate effect, and will be reflected in the CAA's publication 'Flying Displays and special events: A guide to safety and administrative arrangements' when it is next updated. There will be a dispensation for the Royal Air Force Aerobatic Team, the Red Arrows, which may allow them to perform at civil air displays under different conditions.

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.

Chapter 6

Post-display reporting

The role of FDDs, DAEs and display pilots

6.1 The CAA is keen to develop a positive reporting culture – a Just Culture[17] – within the air display sector as the most effective way to identify and address potential safety issues before they lead to accidents. This is something that has been instigated in other parts of the aviation sector and other sectors, from manufacturing to healthcare.

What is a Just Culture?	
Just	Errors and unsafe acts will not be punished if the error was unintentional. However, those who act recklessly or take deliberate and unjustifiable risks will still be subject to disciplinary action.
Reporting	Cultivating an atmosphere where people have the confidence to report safety concerns without fear or blame. Employees must know that confidentiality will be maintained and that the information they submit will be acted upon, otherwise they will decide that there is no benefit in their reporting.
Informed	Organisation – in this case the CAA and the airshow sector together – collects data and analyses relevant data, and actively disseminates safety information.
Learning	Organisation is able to learn from its mistakes and make changes. It will also ensure that people understand the Safety Management System processes at a personal level.
Flexible	Organisation and the people in it are capable of adapting effectively to changing demands.

6.2 Such a culture must involve all those who organise, participate and ensure safety at air displays. FDDs have a central role in planning and monitoring the safety of air displays. They are supported by DAEs who, if attending a display, should actively monitor display pilot standards throughout the displays. Pilots should also report any aspect of their

[17] http://www.caa.co.uk/News/New-reporting-rules-set-to-help-improve-aviation-safety/

display that could have caused a safety risk. The more these people engage in developing a Just Culture, reporting concerns and possible issues, the more information will be available to help further strengthen the safety of events.

6.3 In support of this, we will now require all event organisers and FDDs to submit, within seven days, a post-air display report to the CAA. This report should include what went well at the display, as well as information on any lapses and breaches from the required standards.

6.4 All this information will be collated by the CAA and help inform our review of the new rules. Important findings will be shared with the civil air display community through briefings, the pre- and post- season seminars held each year and the annual seminar that the CAA will organise for DAEs.

6.5 Where an FDD (or Flight Control Committee (FCC) member) perceives that the appropriate safety standards at a display were not being upheld the FDD must report that fact to the CAA.

6.6 Where safety is compromised during a display flight the FDD (or FCC member) should require the pilot to stop the display flight as soon as it is safe to do so by calling a ‘stop’. Any and all stop calls must be reported by the FDD to the CAA as soon as reasonably practicable and the FDD must explain his reasons for making a stop call.

6.7 Where such a stop call is made because an FDD (or FCC member) has reason to doubt the fitness or competence of a pilot based on what they witness during a display the circumstances must be reported to the pilot concerned and to the CAA as soon as practicable after the stop is called, or after the display has ended. Where it is known that the pilot concerned is due to appear in a subsequent display and, where possible, the FDD should also notify the FDD and event organisers of the next and subsequent displays that a stop has been called.

6.8 Where a stop is called because an FDD (or FCC member) has reason to doubt the fitness or competence of a pilot that pilot will also be subject to a provisional suspension of their display authorisation pending an

investigation by the CAA of the circumstances leading to the stop being called. A provisional suspension notice will be issued by the CAA once it has received the report from the FDD. Pending issue of the provisional suspension notice by the CAA, the pilot should not exercise the privileges of their display authorisation.

6.9 In its investigation, the CAA will determine whether the provisional suspension of the display authorisation should be withdrawn or further regulatory enforcement action should be taken against the pilot concerned.

6.10 All FDDs are required to hold a pre-briefing with those flying in a display on the day of the show. We have already enhanced this by requiring display pilots to notify the FDD of the series of linked manoeuvres that they intend to perform at least one day before the air show. As part of this, the pilot must now also confirm that their display complies with the air display permission granted by the CAA, well in advance of the display briefing. If the series of linked manoeuvres takes the aircraft outside the airfield boundary, the FDD will be able to take this into account in their risk assessment.

6.11 If a pilot does not provide the FDD with the list of manoeuvres to which they will confine their display, the FDD must not allow the pilot to fly in the air show.

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.

Chapter 7

Air display aircraft

UK civil air display 'fleet'

7.1 The UK civil air display show fleet includes a wide range of aircraft from microlights and balloons to large ex-military aircraft. In between are many diverse aircraft types and classes of type. Some air displays also include large transport aeroplanes. The capabilities of these aircraft range from very old aircraft with limited flight capabilities, through specialist aerobatic aircraft, to extremely capable high speed ex-military jets.

7.2 Across this range, the airworthiness of aircraft that appear at air displays is overseen either by the European Aviation Safety Agency (EASA) or nationally by the CAA. Some aircraft will have a Certificate of Airworthiness (CofA), an approval issued either by EASA or the CAA for aircraft that adhere to the International Civil Aviation Organisation's (ICAO) standards. However, a large proportion will have Permit to Fly (PtF), issued according to alternative published criteria that include conditions and limitations under which the aircraft may be flown and maintenance requirements that must be met.

Focus of the review of air display aircraft

7.3 To obtain a CofA, an aircraft must already have an internationally acceptable level of support, which in turn means an internationally acceptable level of airworthiness assurance. For this reason, the use of CofA aircraft in air displays was not considered further by the CAA as part of this review. Nor has the review considered amateur-built PtF aircraft used for display flying because of their low complexity and relatively low speed and kinetic energy. Instead, our review has focussed on ex-military aircraft with a PtF.

The criteria for accepting ex-military aircraft onto the UK civil register

7.4 The CAA established a number of criteria for accepting ex-military aircraft (particularly the jet fleet) on to the UK civil register following discussion with the Airworthiness Requirements Board[18] (ARB) in 1991 and 1992. Amongst these were requirements for the restoration and maintenance of ex-military aircraft by an Approved Organisation.

7.5 Under these criteria, ex-military aircraft were classified as:

- simple, for example the Spitfire and Hurricane;
- intermediate, for example the Blenheim, de Havilland Vampire and any small-medium helicopters; or
- complex, for example the Buccaneer and Vulcan.

7.6 These classifications are still in use, as they reflect differences in size, technology, operational equipment and the flying and handling characteristics of the aircraft concerned. Under the criteria agreed with the ARB, the more complex an aircraft is, the greater the level of organisational and operational support required.

7.7 A relatively small number of ex-military aircraft were approved for civil use before these classes were established. These aircraft were retrospectively classified using the above criteria.

7.8 As part of the review, we have looked again at the acceptance criteria. While we do not believe that there are any grounds for immediate or interim action, we are now in a position where we can carry out a more comprehensive review, studying the safety data gathered since the criteria were last considered.

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.

[18] http://discovery.nationalarchives.gov.uk/details/r/C6280

Maintenance schedules

7.9 Any aircraft in military service is, and would have been, maintained in accordance with well-defined and regularly updated Maintenance Schedules that took into account the operational environment and the way the aircraft were used. The schedule may have included specialised checks such as non-destructive testing. It is important that all of these requirements continue to be complied with during the civil operation. However, they may need to be carefully modified both to account for the difference in their operations as display aircraft, and to allow for the effects of ageing. For maintenance schedules to be both applicable and effective there clearly needs to be a balance between the required inspections, the time between inspection events and the intensity of use.

7.10 For ex-military PtF aircraft, the Continuing Airworthiness requirements are outlined in the CAA Airworthiness Approval Note (AAN). This makes reference to the original military servicing manuals, which were based upon manufacturer's inspection criteria, operational experience of the user and much higher levels of annual utilisation. In many cases, ex-military aircraft used for displays fly fewer than fifty hours per year and spend a considerable amount of time parked or stored. This will not reflect the expected utilisation upon which a manufacturer may have developed a schedule of inspections. In practice, there is a danger that, if critical inspections were based on a certain number of hours being flown, such inspections may not be carried out for a number of years. It is therefore essential that maintenance schedules reflect this lower utilisation, and where necessary the relevant military hours-based maintenance cycle is translated into calendar checks.

7.11 We know there are differences in approach between individual operators and their Maintenance Organisations and Continuing Airworthiness Management Organisations (CAMO) when producing such schedules for ex-military aircraft. We are currently reviewing a wide range of schedules, with a view to harmonise them and so reducing risks. This may result in additional guidance being developed.

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.

7.12 There is some variation in the amendment status of the military publications on which maintenance schedules for ex-military aircraft are based. As part of our work to improve the standard of these schedules, we will investigate this variation to ensure that it does not affect the airworthiness of the ex-military aircraft fleet.

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 ex-military aircraft are based. This work will be completed by the end of 2016.

Ejection seats

7.13 We are currently conducting research into a wide range of issues related to ejection seats. Once this is complete we will formulate a policy for the future use of ejection seats in UK ex-military jet aircraft. Issues under consideration include:

- the use of ejection seats over the years and availability of overhaul facilities and maintenance information;
- the use of pyrotechnics - in particular those that are operating on extended lives;
- access to continuing support for ejection seats, including the availability of spares; and
- whether ex-military aircraft should be permitted to fly with ejection seats disabled.

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.

7.14 Ejection seats which contain a pyrotechnic device that has not detonated in an accident could be a risk to the emergency services. In our Action Report, we stated that FDDs should inform emergency services arriving at the scene of an accident of any potential or known safety risks and hazards related to the incident: this includes pyrotechnic devices that may be fitted on the aircraft. This information should already be included in the safety plan produced as part of the preparations for the event and shared with the emergency services ahead of the event.

Sharing of data

7.15 The airworthiness of each ex-military aircraft is assessed on an individual basis, meaning each aircraft has its own Airworthiness Approval Note (AAN) to record this assessment and approve the aircraft for the issue of its PtF. We do not plan to change this process.

7.16 However, because each aircraft is assessed individually, potentially valuable airworthiness data is often not shared. Harmonising the content of schedules and adopting ‘best practice’ should have a positive effect on the airworthiness of these aircraft in the future; however, we wish to go further and create dedicated forums for sharing relevant information.

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.

Chapter 8

Human factors

Increasing display pilots' awareness and understanding of the causes and impact of human error

8.1 Over the years, there have been a number of fatal accidents involving highly experienced air display pilots, where extensive investigation has found no clear root cause beyond human error. While some argue that accidents – in any field – caused by human error are inevitable, the CAA believes that, with a better understanding of the impact of 'human factors', many such accidents could be avoided or recovered.

8.2 The term 'human factors' encompasses errors, lapses, failures and poor decision-making of individuals and groups. These can be caused by issues such as stress, anxiety, fatigue, distraction, peer pressure, an individual's physical fitness or significant personal problems.

8.3 The CAA's publication 'Flightcrew human factors handbook[19]' cites research that shows that even though air display pilots perform many more practice flights than flights in front of an audience, they were considerably more likely to crash when flying at an audience event. This could be seen to indicate the additional stress or anxiety that comes from performing in front of an audience and could potentially have a particular impact on display pilots.

8.4 The same research found that when in the presence of an audience, display pilots' attitudes to safety can subtly change – when their role appears to shift towards their airshow-pilot 'persona'[20].

8.5 The list below sets out a number of issues which, if they are not identified or are poorly managed, may cause accidents. The likelihood of an

[19] www.caa.co.uk/CAP737
[20] Jarvis, 2010

accident due to such risks is of course magnified by performing aerobatics in high-performance aircraft while close to the ground.

- Poor decision making caused by:
  - Lack of information or slower information processing
  - Complacency
  - Incorrect assumptions
- Poor risk assessment and increased risk-taking (e.g. pressure of flying from A to B if the weather changes)
- Pressure to deliver the flight (commercial – no payment if no flight for personal reasons)
- Culture, individual personality, team work, authority gradients and group decisions
- Fatigue due to excess flying/working hours
- Mixed flying, for example multi-pilot vs. solo aerobatics leading to higher levels of workload
- High total hours but low hours on type, (particularly low currency in ex-military jets)
- Poor supervision and support for the individual
- Poor situational awareness within the dynamic environment (such as changes to the display site/weather/runway etc.)
- Unexpected information or events leading to surprise or startled behaviours

8.6 In the Civil Air Display Action Report published in January 2016, the CAA set out its plans to develop an accreditation scheme for FDDs. This new accreditation scheme is not yet complete but it will include a requirement to demonstrate knowledge of key human factor issues. In time for the start of the 2016 display season, the CAA required FDDs wishing to organise air shows with seven or more display 'items' to attend a pre-season seminar jointly organised by the British Air Display Association (BADA), the MAA and the CAA where these matters were considered. This conference took place on 10/11 February 2016.

8.7 During the Pre-Season Air Display Conference on 10/11 February 2016, the CAA gave a presentation on ‘Air display safety and the human in the system’, which generated a very productive debate and confirmed that this is an issue to which we must return.

8.8 Similarly, the Action Report committed the CAA to strengthen the criteria for the nomination, appointment, induction and documentation for DAEs. The CAA also set out a requirement for an annual DAE seminar designed to maintain their professional competence. This seminar will cover human factor issues training.

8.9 Action 22 detailed in this report requires FDDs to submit a post-air display report to the CAA. This report will provide key insight into human factors issues which arise at UK civil air displays and will help inform targeted training events at these seminars.

8.10 The CAA will continue human factor discussions with the air display industry and we will look to develop jointly an enhanced curriculum for display pilots on human performance and limitations, and more formalised testing and documentation of these issues, as part of the display authorisation process.

8.11 It will only be possible to achieve meaningful outcomes with the support of the air display sector and we look forward to this engagement.

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: the causes and impact of human error for display pilots (date to be set).

Appendix A

CAA UK Civil Air Display Review terms of reference

Introduction

Following the tragic accident at the Shoreham Air Show on Saturday 22 August 2015 that resulted in the loss of life of eleven members of the public, and which left the pilot critically ill in hospital (as of 4 September 2015), the UK's Civil Aviation Authority (CAA) is reviewing the arrangements for public flying displays in the UK.

The CAA's guidance 'Flying Displays and Special Events: A Guide to Safety and Administrative Arrangements' (CAP 403)[21] was reviewed and updated earlier this year. The CAA believes however that it is right to go further and to carry out a comprehensive review to ensure that proportionate, risk-based measures are in place to reassure the public, the aviation community and the CAA Board that all is being done to ensure public air displays in the UK operate to the very highest safety standards and that air shows remain safe.

The Military Aviation Authority (MAA) will support this Review and ensure that any lessons for military air displays are read across into military regulations[22], which were also reviewed and updated in parallel with the earlier CAA work.

The Review is supported by UK Department for Transport Ministers.

The Review Sponsor will be Mark Swan, the CAA's Group Director for Safety and Airspace Regulation (SARG). An independent, external panel of experts – the Independent Challenge Panel – chaired by Geoffrey Podger CB, will oversee the review and critically challenge the CAA's recommendations.

[21] www.caa.co.uk/CAP403
[22] www.gov.uk/government/publications/regulatory-article-ra-2335-flying-displays-and-special-events

Scope of the review

The Review will evaluate existing civil guidance on flying displays and special events, and the danger they may pose to the public. To do this the Review will consider the following issues:

- the competency and experience of pilots flying at air displays;
- the attitudes of pilots and organisations to safety standards;
- the skill levels pilots flying at air displays must have to perform different aerobatic manoeuvres;
- the physiological challenges of, and medical fitness to perform aerobatic, high performance and display flying;
- the age, condition and performance, as well as the regulatory framework that governs aircraft used at air displays;
- the range of permitted manoeuvres, in particular for high performance or vintage jet aircraft;
- the content of the air display; and
- location and characteristics of the air display venue, including displays not over a recognised aerodrome, coastal locations, and the surrounding area/infrastructure.

Other issues may arise during the course of the Review.

The Review will also consider what lessons can be learnt from any other air display incidents both in the UK and other countries, as well as how other countries authorise air displays. It will also consider any forthcoming European legislation that may impact on this activity. The Review will consider the CAA's internal procedures for assessing and approving flying displays and participants, the relationship that the CAA has with display organisers, such as the British Air Display Association (BADA) as well as others present at air shows also responsible for public safety, such as the Health and Safety Executive and emergency services.

Emerging information from the Air Accidents Investigation Branch (AAIB) will be considered promptly by the Review which will identify any further actions that it determines to be immediately necessary to protect the public in relation to air displays.

Independent Challenge Panel

The Review will have an Independent Challenge Panel for the Review. The Panel's Chair is independent of the CAA and the aviation display community but has knowledge of public safety issues. Membership of the Challenge Panel includes a consumer/public representative as well as representatives from the flying display community and the MAA. The CAA will provide support to the Challenge Panel.

The Panel's role is to provide constructive challenge to the thinking of the Review. It will advise on the efficacy and applicability of any recommendations that might result from the review for both the general public and the flying display community, as well as provide guidance on the priority of any recommendations. The Panel will ensure that any proposals meet the overarching objective of the project to ensure that all is being done to ensure public air displays in the UK operate to the very highest levels and safety standards and that air shows remain safe.

The Panel is free to comment publicly on the work that has been carried out by the CAA. This may mean communicating with the aviation industry, the media, the CAA and others as appropriate.

Engagement

The Review will engage fully with the air display community, including organisers and pilots, as well, where feasible those who attend or are in the vicinity of air displays.

Governance

The Review is overseen by a Steering Board, chaired by Mark Swan, Group Director Safety and Airspace Regulation Group.

There is a Project Board, chaired by Tony Rapson, Head of the General Aviation Unit (GAU). The Project Board will guide and direct the project to a successful conclusion in terms of timeliness and meeting objectives. Tony Rapson is responsible for reporting direct to the Steering Board.

The work of the Project Board will be informed by Working Groups. The Project Board, with the agreement of the Steering Group, will decide on the number and make-up of the Working Groups as the Review progresses.

The Project Board will:

- manage the Review's relationship with stakeholders, including the public, and the broader aviation community;
- ensure that recommendations are fit for purpose and then, beyond the final report, consider how to ensure they are fully implemented; and
- ensure that the project has the resources it needs to be successful.

Philip Clarke, Manager, Safety Policy, Intelligence, Strategy and Policy Team (ISP), the Safety and Airspace Regulation Group, is the Review Business Manager.

Dan McCafferty is the Review Project Manager.

Challenge to the CAA's work will be carried out by an Independent Challenge Panel, as detailed above.

Monthly updates will be provided to the CAA Board and to the Department of Transport (DfT). The European Aviation Safety Authority (EASA) will also be kept informed of the progress of the Review as it progresses.

Membership of the governance groups

Steering Board members	
Mark Swan	Chair
Tony Rapson	Chair, Project Board
Philip Clarke	Review Business Manager
David Oastler	Consumer Policy Group (CPG) and Review Deputy Business Manager
Padhraic Kelleher	SARG ISP
Mark Shortman	GAU and AAIB Advisor
Sarah Doherty	Deputy Head of CAA Policy Programmes Team (PPT); International Directorate (ID) from 1 April 2016
Rear Admiral Paul Chivers	MAA
Dan McCafferty	Project Manager

Others colleagues, for example, from the CAA's Legal Team and Communications Team, may be co-opted onto the Steering Board at the request of the Steering Board Chair as the Review dictates.

The Steering Board will be quorate with four members attending, including the Chair or his nominated deputy, and at least one non-SARG member.

Project Board members	
Tony Rapson	Chair, Project Board (with Padhraic Kelleher as deputy)
Philip Clarke	Review Business Manager
David Oastler	CPG and Review Deputy Business Manager
Mark Shortman	GAU and AAIB Advisor
John Romain	Aircraft Restoration Co.
Ed Bellamy	GAU
Dom Marino	PPT

Stuart Mitchell	CAA Medical Department
Matthew Bennett	CAA Legal Team
Sqn Ldr Rich Thornton	MAA (to November 2015)
Lt. Com Marc Cornford	MAA (from December 2016)
Mike Alcock	DfT
Dan McCafferty	Project Manager

Chairs of Working Groups as required.

Others colleagues, for example, from the CAA's Communications Team, may be co-opted onto the Project Board at the request of the Project Board Chair as the Review dictates.

The Project Board will be quorate with five members attending, including the Chair or his nominated deputy, and at least one non-SARG member.

Independent Challenge Panel members	
Geoffrey Podger CB	Chair
John Turner	BADA
Keith Richards	Chair, CAA Consumer Panel
AVM Gary Waterfall CBE	MAA and Ministry of Defence
Barbara Cooper	Kent County Council
As required at the Independent Challenge Panel	
Philip Clarke	Review Business Manager
David Oastler	CPG and Review Deputy Business Manager
Dan McCafferty	Project Manager

Working Groups

The Working Groups, in line with but not limited to the tasks set out above, will be asked to go back to first principles and:

- Assess the adequacy of the current provisions to aircraft in scope of the review;
- Assess the adequacy of current provisions to pilots in scope of the review;
- Assess the safety objective of each provision;
- Assess the impact location may have on an air display;
- Assess whether this safety objective remains sufficient in the light of the Shoreham and other disasters;
- Assess whether there is additional evidence to amend the provision;
- Make recommendations to the Project Board for changing current provisions, with an indication of the likely impact, both on public safety and the aviation community.

Meeting frequency

The Steering Board will meet monthly throughout the life of the Review, and the Project Board will be updated weekly and meet as necessary for the same period. Frequency of meetings after publication of the final report will be assessed at the time.

The Independent Challenge Panel will meet three or four times during the course of the Review. It will meet on its own to form its own views on the interim and final reports, and then with the Chairs of the Steering and Project Boards to challenge the findings, conclusions and recommendations of the CAA. The Chair of the Independent Challenge Panel may ask or be invited to address the CAA Board.

Resources

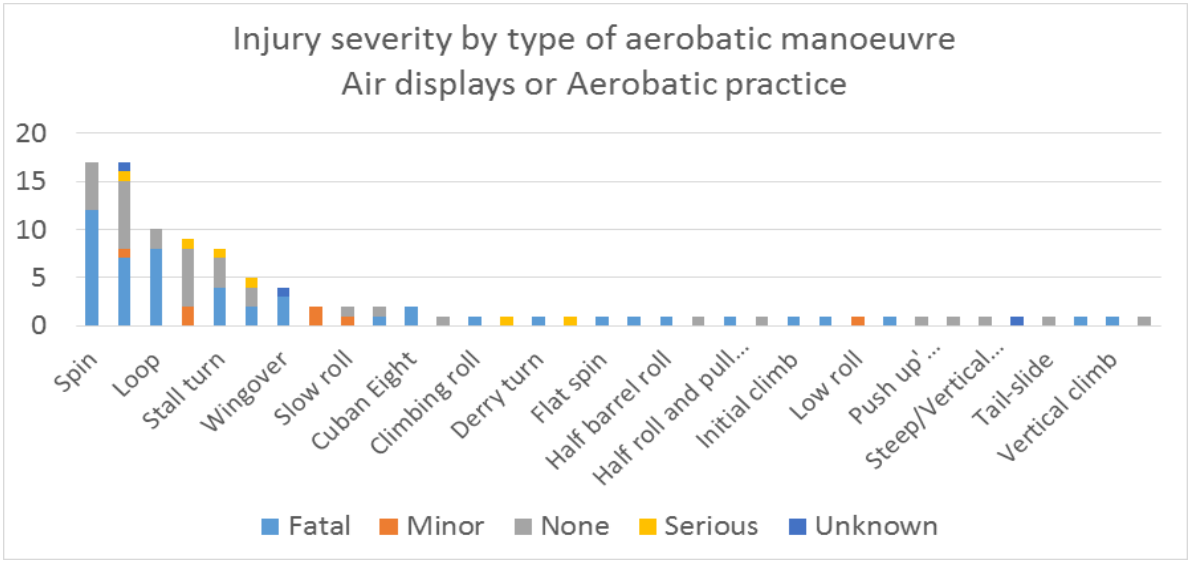
The Review will be fully resourced by the CAA except where people resources are provided by the MAA and DfT. Reasonable travel costs of non-CAA staff will be covered by the CAA. The CAA will cover the cost of Independent Challenge Panel.

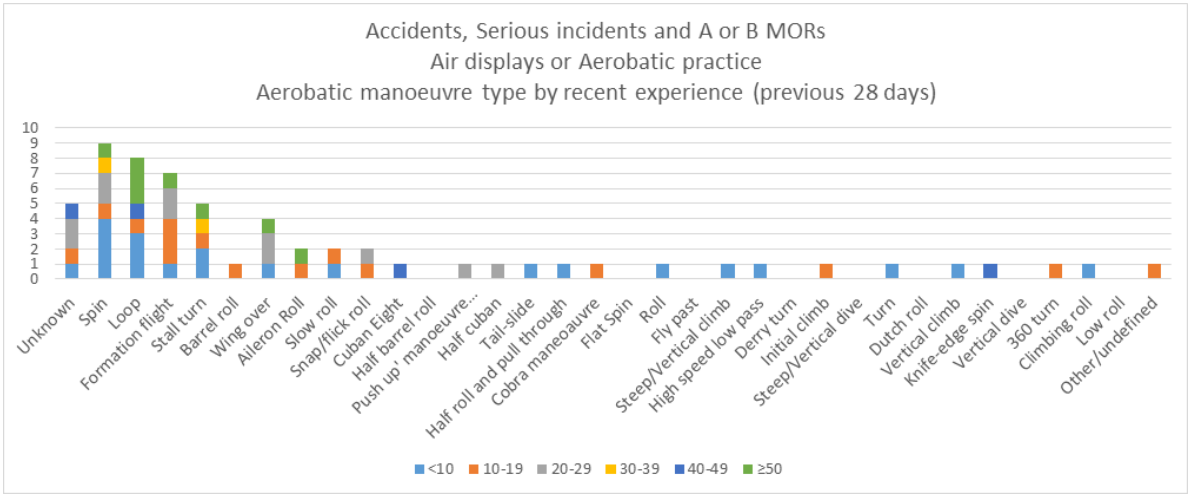
Timescale

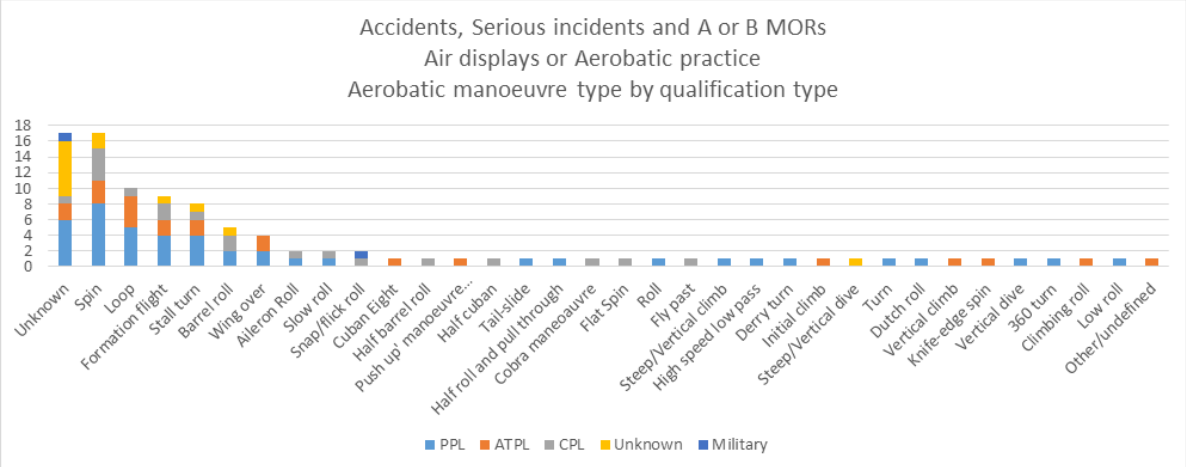
The Review will produce an interim report by the end of October and its final report early in the New Year.

Appendix B

Accident data from UK civil air displays and during aerobatic practice






Accidents, Serious incidents and A or B MORs
Air displays or Aerobatic practice
Aerobatic manoeuvre type by qualification type
18
16
14
12
10
8
6
4
2
0
Unknown
Spin
Loop
Formation flight
Stall turn
Barrel roll
Wing over
Aileron Roll
Slow roll
Snap/flick roll
Cuban Eight
Half barrel roll
Push up' manoeuvre...
Half cuban
Tail-slide
Half roll and pull through
Cobra maneoauvre
Flat Spin
Roll
Fly past
Steep/Vertical climb
High speed low pass
Derry turn
Initial climb
Steep/Vertical dive
Turn
Dutch roll
Vertical climb
Knife-edge spin
Vertical dive
360 turn
Climbing roll
Low roll
Other/undefined
PPL
ATPL
CPL
Unknown
Military

Appendix C

Categories of aircraft, and some examples of different category of aircraft

Single–engined piston aeroplanes **A** Less than 200 hp **B** Between 200 and 600 hp **C** Exceeding 600 hp	**Helicopters and Gyroplanes** **L** Helicopters specified by type **M** Gyroplanes specified by type
Multi–engined piston aeroplanes **D** Less than 300 hp total **E** Between 300 and 600 hp total **F** Single Pilot Exceeding 600 hp total, specified by type **Z** Multi-crew Exceeding 600 hp total, specified by type	**Gliders, Hang Gliders and Paragliders** **N** Gliders of all types **O** Hang Gliders of all types **Y** Paragliders of all types
Jet powered aeroplanes **G** Single jet aeroplanes specified by type **H** Multi jet aeroplanes specified by type	**Microlight Aeroplanes** **T** Microlight aeroplanes of all types with weight shift control **U** Microlight aeroplanes of all types with three axis control **V** Microlight aeroplanes of all types with hybrid control
Turbo-prop powered aeroplanes **I** Single turbo-prop aeroplanes specified by type **J** Multi turbo-prop aeroplanes specified by type	**Powered Parachutes, Powered Paragliders and Powered Hang Gliders** **W1** All types of Trike Unit Powered Parachutes **W2** All types of foot launched Powered Paragliders **W3** All types of foot launched Powered Hang Gliders

Appendix D

CAA and UK civil air displays: commonly used terms and abbreviations

List of commonly used terms	
Flying display	any flying activity deliberately performed for the purpose of providing an exhibition or entertainments at an advertised event open to the public
Special event	any flying activity during which aircraft may not necessarily comply with the Rules of the Air and normal air traffic control rules and which requires consideration of one or more of the following: • The issue of special procedures; • The level of an 'air traffic service' to be provided; • The establishment of Restriction of Flying Regulations.
Crowd line	the forward edge of the areas intended for spectators and any car park to which the public has access during a Flying Display
Display line	a line defining the closest a display aircraft should approach the crowd line
Event organiser	the organiser of an event which includes a flying display
Flying Display Director	the person responsible to the CAA for the safe conduct of a flying display
Display item	a single aircraft, or formation of aircraft, flying as one display 'act'
Display pilot	a pilot who holds a display authorisation or exemption, issued by their appropriate national authority, which allows the pilot to take part in a flying display

Spectator	a person attending a flying display and remaining in the areas set aside by the organiser for the public
Display Authorisation	a national document detailing the types or groups of aircraft in which a pilot is authorised to display, together with any limitations and other specific endorsements
Display Authorisation Evaluator	a CAA authorised person qualified to conduct examinations and tests for the award of the display authorisation
Skill levels for authorisation of aerobatic displays	The skill levels used on display authorisations are: • Standard; • Intermediate; • Advanced; and • Unlimited.
Pleasure flights	any passenger flight starting from, or arriving at, the display site purely for the purpose of commercial air transport pleasure flying
Static Aircraft Park	a park for aircraft to which the public has access at all times
Aircraft parking area	a park for aircraft to which the public has no access during the period of the display
Car parks	car parks to which the public has access during the flying display and as such are considered the same as the spectator area

List of common abbreviations	
A	
AAIB	Air Accidents Investigation Branch
AAN	Airworthiness Approval Notice

AME	Aeromedical Examiner
ANO	Air Navigation Order
ARB	Airworthiness Requirements Board
B	
BADA	British Air Display Association
BKN	Cloud base broken
C	
C of A	Certificate of Airworthiness
CAA	Civil Aviation Authority
CAMO	Continuing Airworthiness Management Organisations
CAP	Civil Aviation Publication
CPG	Consumer Policy Group
D	
DA	Display Authorisation
DAE	Display Authorisation Evaluator
DfT	Department of Transport
E	
EASA	European Aviation Safety Agency
EO	Event Organiser
EU	European Union
F	
FCC	Flight Control Committee
FD	Flying Display
FDD	Flying Display Director
G	
GA	General Aviation

GAU	General Aviation Unit
GP	General Practitioner
H	
HE	Highways England
HP/hp	Horse Power
HSE	Health and Safety Executive
I	
ICAO	International Civil Aviation Organisation
ID	International Directorate (CAA)
ISP	Intelligence, Strategy and Policy team (CAA)
K	
Kt IAS	Knots indicated air speed
L	
LA	Local Authority
M	
MAA	Military Aviation Authority
MCA	Maritime and Coastguard Agency
MEP	Multi-engine Piston
MoD	Ministry of Defence
MoR	Mandatory Occurrence Report
N	
NAA/s	National Aviation Authority/Authorities
NATO	North Atlantic Treaty Organization
O	
OVC	Overcast
P	

P1	Pilot in Command
PPT	Policy Programmes Team (CAA)
PtF	Permit to Fly
R	
RA(T)	Restricted Area (Temporary)
S	
SAG	Safety Advisory Group
SARG	Safety and Airspace Regulation Group
SEP	Single-engine Piston
SERA	Standardised European Rules of the Air
U	
UK	United Kingdom
V	
V/STOL	Vertical and/or short take-off and landing