

# Human Factors in Flying Displays – Practical Guidance for Display Pilots & Flying Display Directors



**NATS**

Prepared by:  
COX, Martin  
Unmarked

# Human Factors in Flying Displays – Practical Guidance for Display Pilots & Flying Display Directors

# Table of contents

<b>1. Purpose of this Document</b>	<b>4</b>
1.1. Background	4
1.2. Purpose of this Document	5
1.3. Structure of the Document	5
<b>2. The Criticality of Human Factors to Flying Displays – General Guidance</b>	<b>6</b>
2.1. Human Factors and Flying Displays	6
<b>3. Personal Qualities and Characteristics of Display Directors and Display Pilots</b>	<b>7</b>
3.1. Personal Qualities & Characteristics	7
3.1.1. Professionalism	8
3.1.2. Motivation	9
3.2. Overview	10
3.3. Key Human Factors Requirements for the FDD	10
3.4. Human Factors Guidance for FDDs to Safeguard Displays	11
3.4.1. Use of Knowledge and Information	11
3.4.2. Planning and organising	12
3.4.3. Forming a Team	14
3.4.4. Communicating with Others	15
3.4.5. Awareness of Personal Limitations	17
<b>4. Human Factors for Flying Display Pilots</b>	<b>19</b>
4.1. Overview	19
4.2. Key Human Factors Requirements for the DP	19
4.3. Human Factors Guidance for DPs to Safeguard Displays	20
4.3.1. Use of Knowledge and Skill	20
4.3.2. Self-discipline	21
4.3.3. Awareness of Personal Limitations	23
4.3.4. Information Management and Situation Awareness	24
<b>5. Conclusion</b>	<b>26</b>
<b>Annex A- Flying Display Checklist for Flying Display Directors and Display Pilots</b>	<b>27</b>

# 1. Purpose of this Document

## 1.1. Background

Human Factors (HF) is concerned with the application of what we know about people, their abilities, characteristics, and limitations to the design and application of equipment they use, environments in which they function, and jobs they perform.

The extent to which HF influences impact on the attributes of system performance: quality, efficiency and safety can be related to the complexity of the system and the degree to which the effectiveness of peoples' interactions with it can be influenced by factors that regularly occur within that system.

The systems in place for the organisation, planning and performance of flying displays are complex and evidence shows that over half of air display accidents that occur in the UK can attributed to human error alone. This means that the potential impact of improved management of HF risk on flying display safety is significant.

While the influence of HF on aviation safety in general is becoming better understood, their impact on the safe flying display planning, organisation and performance is less known.

The purpose of developing HF knowledge is to make the relationship between humans and the system such that it minimises risks and in doing so increases safety and achieves and maximises "system" performance through good human performance.

Following the tragic accident at a flying display near Shoreham in 2015, the CAA conducted a review of flying display safety. The review recommended that CAA should commence a programme of work to better understand the impact of Human Factors on flying display safety and to help those involved in the display industry apply that knowledge to positive effect.

As a first step in this journey, CAA commissioned NATS to carry out an analysis of the psychological influences that are likely to impact Display Pilots and Flying Display Directors during the planning and performance of flying displays.

In order to inform the HF analysis and understand better the key HF issues and challenges that influence flying displays and display flying, NATS:

- Met with experts from within SARG, CAA;
- Conducted a series of one to one interviews with experienced Flying Display Directors and Display Pilots;
- Ran a one day workshop to explore Human Factor issues which was attended by a cross-section of Flying Display Directors and Display Pilots, active within the UK Air Display industry;
- Worked closely with Flying Display Directors and Display Pilots to refine the workshop's findings in the development of HF guidance material.

## 1.2. Purpose of this Document

The purpose of this document is to improve Flying Display safety and reduce the number and severity of accidents at Flying Displays.

It is based on the work commissioned from NATS by CAA to explore the impact of human factor influences on Flying Displays and how to control them and is intended for practical use by FDDs and pilots and any others who want to improve the safety of displays they are involved in.

Generally achieving good human performance depends on having:

- The right tools – what you work with
- The right capability – what gives you the skills you need
- The right environment – what impacts you at work

This document is intended as a tool for FDDs and display pilots to improve their performance.

There was, and still is, a common view that human error accidents are inevitable but CAA's firm view is that a better understanding of our human frailties will mean that more accidents can be avoided in future.

## 1.3. Structure of the Document

Our work revealed that a number of the HF issues that have the greatest impact on display safety are pertinent to both FDDs and DPs, though often they are expressed and can be controlled in different ways.

The influences that apply most commonly across the two roles are the personality characteristics and motivation of individuals doing them and a discussion of these in combination appears first. This is followed by an exploration of how HF apply specifically to the two roles in turn.

Each HF influence is set out with a statement of the issue and a description of how this relates to flying displays, quotes from pilots and FDDs to illustrate each issue, and guidance and awareness raising prompts to help tackle them.

## 2. The Criticality of Human Factors to Flying Displays – General Guidance

### 2.1. Human Factors and Flying Displays

Human Factors has been an influence in aviation since the very first attempts at flight. This is due to the fact that flying an aircraft of any kind safely requires considerable human expertise and skill. This is particularly the case when flying in “unusual”, “non-standard” or “challenging” situations, such as bad weather or with defective aircraft.

Flying displays serve a number of purposes, but from a human perspective, they allow pilots to:

- Display the flight capabilities of a particular aircraft. This may be a simple demonstration of its basic manoeuvres right through to a display that sometimes approaches the dynamic limits of the aircraft;
- Exhibit their own skills as a pilot. This may be for their own self-fulfilment but may also be to earn a living.

For a flying display to occur in front of an audience of any size, from a human perspective one or more skilled individuals must:

- Take responsibility for arranging the flying and support activities. The primary concern here is to ensure that the activity is safe for all involved.

In simple terms, flying displays to an audience do not occur without significant human input from pilots and Flying Display Directors (who are often current or former pilots) and in some cases, many others. They must for example:

- Plan and prepare a display programme;
- Plan and practice their routine to display an aircraft;
- Work together and communicate ideas, potential issues and ultimately bring about a safe outcome.

Whilst aviation has been the focus of HF analysis and input for many years, the specific area of flying displays appears to have received relatively little attention from Human Factors. Although to an extent, it is possible to apply general HF guidance to this particular area of aviation, flying displays have specific demands and idiosyncrasies that make a specific HF analysis and set of guidance very worthwhile. Discussion with FDDs and DPs suggest that around 80% - 90% of flying displays problems are likely to involve Human Factors – this in itself is broadly similar to ‘mainstream aviation’. However, the nature of the flying carried out in displays can increase the safety risks and place an even greater emphasis on sound understanding and practical application of HF for both those people that organise flying displays in the UK – the Flying Display Director (FDD) and those that fly in flying displays – the Display Pilot (DP).

## 3. Personal Qualities and Characteristics of Display Directors and Display Pilots

### 3.1. Personal Qualities & Characteristics

It is evident from the workshop activities carried out with FDDs and DPs that the type of individuals that fulfil these roles tend to share common features (e.g. a passion for aviation). In addition, it is apparent that to carry out their respective roles to the best of their abilities, they must have certain personal qualities and characteristics.

Discussions with FDDs and DPs indicated that both roles require a high degree of professionalism and motivation in order to be successful. This chapter sets out the HF aspects of Professionalism and Motivation.

### 3.1.1. Professionalism

i. Statement of the HF issue	Safe displays require high levels of professionalism from FDDs and DPs
ii. General description of psychological influences	Individual FDDs and DPs generally take a professional approach to their role and acknowledge the considerable responsibility that they have for safety. Regardless of the scale of the flying display or the nature of the display being flown, it is imperative that the FDD or DP exhibit consistently high levels of professional behaviour.
iii. Illustration of the issue in relation to flying displays	<ul style="list-style-type: none"> <li>• As an FDD, I work very hard to bring everything together on the day. To make this happen, I draw upon everything I know and have learnt from others, recognising that the final display programme will take time and effort to get right.</li> <li>• As a professional pilot, I seek out potential risks that can occur right from the planning stage and through every step until I land and taxi in after the display. If I have considered the risks, even if I can't prevent them all, I can be ready to act if necessary.</li> </ul>
iv. HF guidance	<p>HF behaviours that help control the sources of risk that arise from FDD/DP professionalism include:</p> <ul style="list-style-type: none"> <li>• Understand and exhibit what their industry would consider to be 'professional behaviours' when organising or conducting a flying display</li> <li>• Have the right education, knowledge and experience to feel properly competent and able to work within the prescribed rules and guidance</li> <li>• Have the right attitude to the role (e.g. taking responsibility, being accountable, exhibiting integrity)</li> <li>• Actively assess risks and seeking mitigation at all stages</li> </ul>
v. Questions to prompt awareness of the HF issue	<ul style="list-style-type: none"> <li>✓ Do I routinely act as a professional and exhibit behaviours my peers would expect of me?</li> <li>✓ Do I have the knowledge needed to carry out my role in the flying display in a professional manner?</li> <li>✓ Do I have the experience (either first hand or through others) that I can draw upon to help me manage my role effectively?</li> <li>✓ At what point might I want / need to draw upon the professional skills of others to make my display or flight a success?</li> </ul>

### 3.1.2. Motivation

i. Statement of the HF issue	FDDs and DPs are motivated by positive personal factors to create safe and enjoyable displays
ii. General description of psychological influences	<p>Individual FDDs and DPs are motivated to get involved in the organisation or execution of flying displays for a number of positive personal reasons which may include:</p> <ul style="list-style-type: none"> <li>• The desire to spend time doing something they enjoy</li> <li>• Extending a career or involvement in aviation</li> <li>• Gain a feeling of ‘self-fulfilment’ by exhibiting professional skills and behaviours</li> <li>• Entertaining others</li> </ul> <p>Possible more negative personal motivators may exist, such as the desire to “show off” or test ones abilities.</p>
iii. Illustration of the issue in relation to flying displays	<ul style="list-style-type: none"> <li>• Although I no longer fly aircraft, I love aviation and want to give others the opportunity to share the passion I have for it – this is why I want to be a FDD.</li> <li>• I am aware of the audience when I fly a display and my desire is to give them lots of opportunities to take photos - something memorable, without scaring them.</li> </ul>
iv. HF guidance	<p>HF behaviours that help control the sources of risk that arise from FDD/DP motivations include:</p> <ul style="list-style-type: none"> <li>• Be introspective from time to time – think about what motivates you to be an FDD or DP</li> <li>• Be aware of the risks associated with more negative motivators, such as arrogance and rule breaking</li> <li>• Where possible, instil positive motivation in peers and colleagues and have the strength of character to challenge possible negative motivation in others</li> </ul>
v. Questions to prompt awareness of the HF issue	<ul style="list-style-type: none"> <li>✓ What really motivates me to get involved with flying displays?</li> <li>✓ Are all of the things that motivate me positive?</li> <li>✓ Is there something about any of my peers’ motivations that worry me?</li> <li>✓ How would I challenge a peer that appeared to be motivated by negative factors?</li> </ul>

## 3.2. Overview

The term “Flying Display Director” describes a single role but one that involves responsibilities that vary widely in terms of scale, detail and complexity. For example, an FDD may take responsibility for a small display, maybe in which they are also flying as a Display Pilot, doing all planning and preparation themselves. Alternatively they may take the lead for a large display with many aircraft displaying, forming a team of people to assist them in the organisation and running of the display. It is often the case that FDDs are current or former Display Pilots who make use of their knowledge of flying to consider the best way to display aircraft to an audience. The main remit of the FDD is to organise a safe, yet entertaining display.

FDDs typically ‘learn by doing’, often starting out by assisting one or more experienced peers in display organisation. They then gradually develop the knowledge and skills required in order to become competent as an FDD, drawing on their experiences to understand what makes a good display and what can cause difficulties and problems. More recently, FDDs are required to carry out professional training. Many FDDs build up a network of contacts that they can draw upon to either support them directly or obtain advice and guidance.

## 3.3. Key Human Factors Requirements for the FDD

It is apparent that a competent FDD requires a number of core skills and abilities related to HF. These are the ability to:

- i. Use knowledge and information appropriate to the safe organisation of a flying display;
- ii. Plan and organise a range of information within a timeframe;
- iii. Seek solutions with the help of others, maybe by forming a team and communicating with others;
- iv. Be aware of their own personal limitations and those of their peers and colleagues.

Each of these areas is explored further in the section that follows.

### 3.4. Human Factors Guidance for FDDs to Safeguard Displays

#### 3.4.1. Use of Knowledge and Information

i. Statement of the HF issue	Safe displays rely on FDDs using a wide range of knowledge and information effectively
ii. General description of psychological influences	<p>Making use of knowledge and information are core requirements for the FDD. Whilst certain knowledge and information is essential for all FDDs (e.g. the rules within CAP403), other knowledge needed will correspond to the size / scale of the display being organised. Larger displays typically require more information to be managed by the FDD and there comes a point where it is inappropriate for the FDD to carry out all information management tasks without help. FDDs need to make use of the knowledge and information available to them not just to organise the display but to make judgements. The key judgement is related to safety risk.</p>
iii. Illustration of the issue in relation to flying displays	<ul style="list-style-type: none"> <li>• I shadowed other FDDs a few times when I started out as a Display Director, which really helped me to pick up the subtle nuances of organising bigger shows.</li> <li>• I have a great deal of knowledge gained from running large displays but I certainly don't take any aspect of the information I need for granted when I occasionally take on a far smaller show. Complacency is something to be aware of.</li> <li>• If I become aware of new information on the day of a display, I check how this changes what I knew already.</li> </ul>
iv. HF guidance	<p>HF behaviours that help control the sources of risk that arise from the use of knowledge and information by FDDs include:</p> <ul style="list-style-type: none"> <li>• Make sure that all required training is done and so that knowledge is up-to-date</li> <li>• If gaps in knowledge become apparent, look for ways to fill them as soon as possible – if in doubt, ask</li> <li>• Seek out and build experience of displays to get exposure to the types of information that are needed</li> <li>• Organise information carefully rather than rely on memory</li> <li>• Use knowledge of what is information is more important to the organisation of the display to help avoid becoming overloaded by the volume and complexity of information</li> </ul>

v. Questions to prompt awareness of the HF issue

- Actively review information periodically to ensure that it is up-to-date and complete
  - Look for conflicting or ambiguous information and try to resolve this as soon as possible
  - Make full use of the important information elements available to you to build up a picture of “what you know and what you don’t know”
  - If gaps in knowledge or information become apparent, never guess or make assumptions – seek assurance and evidence and record this
  - If information is given to you, check on receipt that you understand what you have been told, its importance and probable accuracy
- ✓ Is my knowledge of organising a display of this size really good enough or am I taking on too much?
  - ✓ Do I have all the main threads of information that I need to make good decisions?
  - ✓ Am I at risk of becoming overloaded by information and if so, how can I manage it better?
  - ✓ Does what I have just been told ‘make sense’ or does it contradict other information I have?

### 3.4.2. Planning and organising

i. Statement of the HF issue

Displays require FDDs to plan and organise complex activity within set timeframes

ii. General description of psychological influences

To make a display happen, FDDs must establish what their key objectives are and make a plan to achieve these within a certain time. The timeframe must be considered carefully and allow the FDD scope to review and re-plan.

Planning and organisation in advance of a flying display typically occurs over a number of months. During this time, plans evolve and crystallise. Up-front planning and organisation should as far as possible, minimise the need for further planning and organising on the day(s) of the flying display. In the interests of safety, planning and organisation should be fully informed by information and should afford sufficient time to permit careful consideration and decision making.

iii. Illustration of the issue in relation to flying displays

As far as possible, planning should take account of potential variability on the day of the display (e.g. unserviceable aircraft, delays, poor weather). FDDs should prepare for this contingency with table top exercises. Such planning removes the need for rapid planning or re-planning in all but exceptional circumstances.

- I know from experience that many aspects of planning a display take longer to achieve than you would first think. I now build in extra time as a result.
- For the main elements of the display, I will always consider what my fall-back 'Plan B' would be. This really helps me on the day of the display if something changes.
- When I look at the 'Big picture' I always ask myself if I know enough to predict what is going to happen on the day and more or less when.

iv. HF guidance

HF behaviours that help control the sources of risk that arise from planning and organising by FDDs include:

- Establish at the outset what the key objectives are – if necessary get these agreed with other parties
- If the plan is to be shared, describe the objectives in a manner which will be easy for others to understand
- Establish a workable timeline to achieve the objectives in advance of the display, building in time for reviewing and updating
- Benefit from the wisdom of experienced peers - share or discuss plans with other FDDs as a sense check
- Where possible, try to complete one task before starting another and if doing things in parallel develop checklists to keep track of matters – useful both in the planning stages for a display and on the actual day(s) of the event
- Periodically review plans – challenge all aspects to assess if the steps are still achievable within the timeframe.
- Where possible, develop fall-back plans, especially for aspects of the display that may be uncertain (such as implications of weather, delays, etc.)
- Where possible, avoid 'gold plating' plans – a straight forward, practical solution is likely to be the best option
- Take time to consider all consequences of re-planning on the day. It is usually far better to stick to something 'tried and tested' than introduce last minute changes

v. Questions to prompt awareness of the HF issue

- On the day of a display, as far as possible, use pre-planned fall-back ideas
  - Be aware of what others are doing / not doing to bring the plan to fruition
  - Look for possible problems – do not just seek confirmation that all is ok
  - Trust your ‘gut feelings’ – if there are any uncertainty or doubts in your mind about a plan or re-plan, then stick to what you know
- ✓ Do I have complete ‘big picture’ of the objectives I am working to?
  - ✓ Have I really been honest about how long it will take me to plan and organise the event?
  - ✓ Have I set aside enough time given the day-to-day distractions away from planning the display?
  - ✓ Do I know what my priorities are – is there are particular order that I need to get things done?
  - ✓ Can I predict with a good degree of certainty the outcome of a plan or decision?
  - ✓ Do I feel like I am losing track of the plan or that there is a deteriorating situation that I am not managing properly?

### 3.4.3. Forming a Team

i. Statement of the HF issue

Displays often require FDDs to form teams to deliver different activities

ii. General description of psychological influences

The FDD may recruit the help and input of others both in preparing and running a display. The support may be informal or deliberately recruited assistance. Regardless of experience, an FDD may benefit from seeking guidance, advice or feedback from peers or other ‘experts’, rather than attempting to take on all tasks. If the FDD decides to form a team, they need to consider who can help them and what role they need to play. This should then be agreed. Ongoing communication within a team needs to be managed by the FDD so that sufficient, two-way information sharing occurs that relates to the overall plan for the display.

iii. Illustration of the issue in relation to flying displays

- I seek out support from people I know I can rely on to deliver in a professional manner. So this means I usually keep in touch with the same group because I know from experience that we work well together.

## iv. HF guidance

- I agree deadlines when I delegate tasks – that way we both know who is doing what and when it will be done by. If problems come up, I expect to be told about them.
- I have never organised a display on my own. There have always been times even with small events when I have asked for help in some way. I think it's a good quality never to be too proud to ask for help.

HF behaviours that help control the sources of risk that arise from FDDs forming a team with others include:

- A good leader 'sets the standard' and is 'highly credible' such that they are respected by those giving help and assistance
- Two-way trust is essential within the team, which requires openness and honesty
- Acknowledge when '2 heads are better than 1' and seek out appropriate advice, input or assistance
- Clearly describe what help or input is needed and any timeframe - agree this upfront to form a 'contract'
- With a larger team, make sure that the main contributors are aware of what the roles are within the team
- Always start from the standpoint that 'others won't know this' rather than make assumptions – ask team members to work in this way with each other

## v. Questions to prompt awareness of the HF issue

- ✓ Do I need to get some advice or guidance from someone else?
- ✓ Am I taking on too much, rather than sharing and delegating tasks?
- ✓ Do I come across as a strong team leader, being kind to those helping me yet sufficiently assertive?
- ✓ Does everyone know exactly what I need them to do and by when?
- ✓ Will my team tell me immediately if there are problems that they cannot circumvent or rectify?
- ✓ Are my team members assuming that I already know something, rather than checking this with me?

## 3.4.4. Communicating with Others

## vi. Statement of the HF issue

A safe display depends on effective communication between everyone involved in it

vii. General description of psychological influences

A great deal of communication is required within the FDD role. Regardless of the size of the display, the FDD will need to communicate effectively with a number of stakeholders, which may include the Regulator, DPs, emergency services, etc. In all cases, the nature, clarity and consistency of the communication that takes place is important to the success of the working relationship. Excellent two-way communication is imperative if the FDD is supported by a team.

viii. Illustration of the issue in relation to flying displays

- I make sure I know the entire set of 'stakeholders' that I need to get information from or give information to.
- As part of organising the display, I plan out who I need to communicate with and when this needs to happen.
- I appreciate that communication is a two-way mechanism, meaning that I need to ensure that I give information clearly and check that I understand what I receive.
- On the day of the display, communication is probably one of the most important things I have to do - so I always build in time for it.

ix. HF guidance

HF behaviours that help control the sources of risk that arise from FDDs communicating with others include:

- If giving an instruction, seek feedback to check it has been received and understood properly
- If clarification is requested, repeat the whole message
- Be succinct and very clear in all communication - both verbal and written – if the task is very important, use written communication and ask for agreement
- Consider breaking complex instructions or messages down in to smaller 'chunks'
- In all communication, always start from the standpoint that 'others won't know this' rather than make assumptions
- If a particular part of planning the display relies on a shared goal between two or more people, communicate clearly who is doing what to avoid elements 'falling down the cracks'

x. Questions to prompt awareness of the HF issue

- ✓ Do I have some kind of plan for communication as part of my overall planning for the display?
- ✓ For key pieces of information, have I got a proper audit trail of communication and where necessary, written confirmation?
- ✓ Do I think about the best way to communicate something before starting to do so?

- ✓ Do I sometimes interpret information or make assumptions, rather than check my understanding is sound?
- ✓ If I give an instruction on the day of the display, have I checked that it has been fully understood?
- ✓ Are people communicating with me adequately, helping me to maintain my situation awareness of the display as it progresses?
- ✓ Are my team members assuming that I already know something, rather than checking this with me?

### 3.4.5. Awareness of Personal Limitations

i. Statement of the HF issue	FDDs need to be aware of their own personal limitations and those of their peers and colleagues
ii. General description of psychological influences	The FDD role carries responsibility and is not without pressures. Both when planning the event and on the day, the FDD will sometimes need to make difficult decisions, not ‘cut corners’ and they must have good attention to detail. An FDD may well have to show courage and say ‘no’ or ‘stop’ in order to safeguard safety, this may be to the completion of an individual display or of an entire event. It is therefore essential that the FDD has an awareness not only of their strengths but of their limitations. They should seek support to mitigate their personal limitations.
iii. Illustration of the issue in relation to flying displays	<ul style="list-style-type: none"> <li>• Whilst ideally an FDD should have flown as a pilot, if they haven’t they need to seek input they can trust from someone who does fly.</li> <li>• On the day of a display, even with the best organisation, I find I sometimes have to think fast whilst under pressure. But if this causes me any doubts, I am not scared about making hard decisions and saying ‘no’.</li> <li>• I may at times be involving more than one display at a time. But I’ll only do this if I know I can give it the time and effort it requires.</li> </ul>
iv. HF guidance	<p>HF behaviours that help control the sources of risk that arise from FDDs’ awareness of their personal limitations include:</p> <ul style="list-style-type: none"> <li>• Watch for symptoms or warning signs of pressure, stress &amp; fatigue in yourself and others</li> </ul>

v. Questions to prompt awareness of the HF issue

- Don't ignore any feelings of pressure & stress - seek help from others and ask for guidance from other FDDs
  - Get the balance right between planning the flying display and other aspects of life and work
  - Take opportunities to rest & recharge
  - Relieve perceived pressures by re-assessing objectives – make sure they are achievable or consider finding more time or support
  - Be the best you can be but don't push on beyond your personal limitations of knowledge and experience
  - Know the limitations of people you recruit to help and don't ask them to do something beyond their abilities
- 
- ✓ Can I really do everything I have set out to do for this display?
  - ✓ Should I ask for some help early on, rather than have to try to get help later on?
  - ✓ Am I taking on too much, rather than sharing and delegating tasks?
  - ✓ Am I feeling more and more overwhelmed but what still needs to be done?
  - ✓ I've been told not to worry as 'This is the way we always do things...' but this feels like complacency – how should I challenge this?

## 4. Human Factors for Flying Display Pilots

### 4.1. Overview

Pilots participating in flying displays have a range of backgrounds and only a relatively small number of pilots in the UK choose to seek a Display Authorisation to allow them to perform at flying displays. Whilst the motivations for display flying may be primarily to show off the capabilities of a particular aircraft, all DPs will gain a degree of satisfaction when displaying. Another possible reason for becoming a DP may be ability, either in general or relating to a particular aircraft type.

Display Pilots use their knowledge of aircraft and flying skills to conceptualise and develop a series of linked manoeuvres that allow them to display the aircraft to an audience. The DP will then have to rehearse the manoeuvres so that they become well practiced. The degree of display complexity depends on a wide range of factors, including the age of the aircraft, its manoeuvrability, the space available to display in, the skill and experience level of the pilot.

DPs are required to revalidate their Display Authorisations in different categories by being evaluated by Display Authorisation Evaluators (DAEs) appointed by the CAA. DAE evaluations include both a verbal component and an assessment of a display routine by the pilot.

### 4.2. Key Human Factors Requirements for the DP

It is apparent from discussions carried out with DPs in preparing this HF guidance that a competent DP requires a number of core skills and abilities related to HF. These are the ability to:

- v. Use knowledge and skill appropriate to the safe development of a flying display;
- vi. Exhibit a high level of self-discipline when flying a display routine;
- vii. Be aware of their own personal limitations when planning and flying a display.

Each of these areas will be considered in turn in the following section.

### 4.3. Human Factors Guidance for DPs to Safeguard Displays

#### 4.3.1. Use of Knowledge and Skill

i. Statement of the HF issue	Safe display flying requires high levels of skill and knowledge
ii. General description of psychological influences	To devise a flying display, DPs must have good knowledge of the flying characteristics for the displayed aircraft (this may be as specific as knowledge of a specific airframe). The DP must then match their own ability and experience level with that aircraft to make sound decisions regarding the choice of safe, entertaining manoeuvres to be flown. The DP must select a series of manoeuvres that can be flown consistently in a safe manner once practiced sufficiently. The development of the flying display should embody a degree of flexibility so that the DP is able to adapt his routine to suit a range of weather conditions, etc. A display flown alongside other aircraft must take into consideration the knowledge and skills of all pilots involved.
iii. Illustration of the issue in relation to flying displays	<ul style="list-style-type: none"> <li>• I take a great deal of care when planning my display routine, making sure that it all fits together seamlessly, without putting me at any risk at all.</li> <li>• Although I will have a well rehearsed display that I put to the FDD, if the need to adapt it comes up during the display for whatever reason, I reserve the right to focus on flying my aircraft safely and not stick rigidly to what was planned.</li> <li>• You have to know your aircraft intimately. When you fly the display, you become part of it.</li> </ul>
iv. HF guidance	<p>HF behaviours that help control the sources of risk that arise from the use of knowledge and skill by DPs include:</p> <ul style="list-style-type: none"> <li>• Establish at the outset clear bounds to the display in terms of complexity</li> <li>• Use knowledge of the aircraft's handling characteristics to guide the selection of safe manoeuvres</li> <li>• Develop a display that makes full use of skills that are sound and well developed, avoiding as far as possible newly learned skills until they are highly developed by practice</li> <li>• Ensure that the sequence / order of manoeuvres is easy to remember / recall</li> <li>• As far as possible, plan in contingency within the routine, such as extra room or height</li> </ul>

v. Questions to prompt awareness of the HF issue

- Use skill to foresee potential problems that could occur during the display and take steps to remove or mitigate these by adapting the display
  - During a display, use knowledge and skill to detect when something is wrong
  - Rehearse the display in a manner that consolidates knowledge of the aircraft by using practice time to test out ideas
- ✓ Is any part of the display that I am developing taking me beyond what I am comfortable the aircraft can do?
  - ✓ Is the aircraft performing just as I anticipated?
  - ✓ Where are the potential difficulties and risks within the display I'm considering and how can I get rid of these?
  - ✓ Is there any risk that I might confuse the order to the display sequence?
  - ✓ Am I certain that I possess the skill level needed to fly as part of a formation as part of the display proposed by my colleague?

#### 4.3.2. Self-discipline

i. Statement of the HF issue

Display pilots needs to remain highly self-disciplined when flying a display routine

ii. General description of psychological influences

The DP must maintain a high degree of self-discipline which is embodied by acute self-awareness and ability to self-critique honestly. The DP must fly a display which is entertaining to the audience but does not engender concern or fear in those watching. The DP must remember that they are primarily demonstrating the aircraft, rather than their own skills.

The DP should attempt as far as possible to fly the display as planned and practiced but have the awareness to know when to deviate from the routine to maintain safety.

The DP should fly well within their abilities, allowing spare capacity to cope with unexpected issues or problems in a calm and measured manner.

iii. Illustration of the issue in relation to flying displays

When flying a display alongside others, the DP must constantly be aware of any deviations by other pilots from what was planned and take account of this to ensure safety.

- Although I am aware of the audience during my display, I am not thinking about them – I am thinking about myself and getting through each element of the display safely.
- A little bit of natural caution is never a bad thing. I'd rather be slightly under confident than over confident.
- Even if I am aware that I have made a mistake during the display, I put it out of my mind and focus on flying the aircraft. I can analyse it far better when I am safely on the ground.
- Complacency can be lethal. Just because it worked last time doesn't mean it will always work like I planned.

iv. HF guidance

HF behaviours that help control the sources of risk that arise from DP self discipline include:

- Use practice sessions to develop and consolidate skills – never try new things out during the actual display
- Assess a practice display honestly and consider seeking feedback from peers
- If an element of the planned display proves very hard to get right consistently, consider replacing the manoeuvre with something more reliable
- Stick to a display as closely as possible but know when to deviate from the plan to maintain safety
- Never attempt anything novel at a display
- Situation awareness during the display must include awareness of your own performance
- Do not assume that a routine will go exactly as rehearsed – build in capacity to adapt the routine as it is flown to ensure safety
- Do not allow a small mistake to become a distraction – think about on the ground
- Don't attempt to stretch a performance that is already going well enough
- If things are beginning to go wrong, have the courage (and desire for self-preservation) to end terminate the display early and land. Resist any temptation to press on.

v. Questions to prompt awareness of the HF issue

- ✓ Am I looking at my mistakes in a constructive manner, so that I learn from them?
- ✓ Can I really fly the display safely I am feeling angry about something when I taxi out prior to the display?
- ✓ Would I have the courage to stop the display early if I was struggling to get through it?

✓ Am I adapting my own routine to take account of how my colleague is flying?

### 4.3.3. Awareness of Personal Limitations

i. Statement of the HF issue	DPs need to be aware of their own personal limitations when planning and performing their display
ii. General description of psychological influences	<p>The DP role carries responsibility for safety. It is therefore essential that the DP has an awareness not only of their strengths but of their limitations. On the basis that there is no such thing as a perfect pilot, DPs should use flying practice to reinforce their strengths, address their weaknesses and test their skills.</p> <p>DP limitations can include aspects such as physical resilience: they should recognise that they can succumb to fatigue both when transiting to or from a display, as well as during the day of the display. In addition, psychological factors such as mood disturbances can influence the DPs ability to concentrate fully during a display when this is essential.</p> <p>There is also benefit for DPs learning from colleagues – both in terms of positive practical skills and techniques and learning from the mistakes of others.</p>
iii. Illustration of the issue in relation to flying displays	<ul style="list-style-type: none"> <li>• You cannot be totally fearless as a display pilot – you should always retain a healthy dose of self-doubt.</li> <li>• I try to be open and honest with the FDD and have no problem saying ‘No’ if I asked to include something I am not comfortable with in my display.</li> <li>• I am not happy doing too many displays in quick succession, as I know from experience that this makes me tired. And tiredness causes mistakes.</li> </ul>
iv. HF guidance	<p>HF behaviours that help control the sources of risk that arise from DPs’ awareness of their personal limitations include:</p> <ul style="list-style-type: none"> <li>• Be very aware of personal limitations – be honest about your flying skills</li> <li>• Plan a display that is well within your limits and therefore leave room to deal with problems</li> <li>• Don’t make assumptions about skills and abilities based on a previous career (e.g. “I used to be a Harrier pilot...”) – focus on the skills you have now for the aircraft you are flying today</li> <li>• Recognise that your personal performance may well vary between different aircraft types that you display in</li> <li>• Watch for symptoms or warning signs of pressure, stress &amp; fatigue</li> <li>• Don’t ignore any feelings of pressure &amp; stress – try to avoid the causes of these in the first place</li> </ul>

v. Questions to prompt awareness of the HF issue

- Get the balance right between practicing the display and other aspects of life and work
  - Take opportunities to rest & recharge
  - Be the best you can be but don't push on beyond your personal limitations
  - Know the limitations of people you fly alongside and don't encourage them to do something beyond their abilities
- ✓ Can I really do everything I have planned for this display?
  - ✓ Am I going to the edge of my limits if I use a similar display for the other aircraft type |I display in?
  - ✓ Have I scared myself when practicing the display?
  - ✓ I'm keen to do the kind of display that the FDD was discussing me, but I'm not sure I'm quite that good – should I speak up?

#### 4.3.4. Information Management and Situation Awareness

vi. Statement of the HF issue

DPs need to use all information available to them in order to maintain excellent situation awareness during a display routine

vi. General description of psychological influences

The DP must manage all information available carefully during the display routine to maintain situation awareness of their own performance, the performance of the aircraft and possibly the performance of other aircraft (if not flying solo).

The DP should be aware in advance of the display exactly what information and cues need to be monitored. They should use their expertise and experience from practice to understand exactly the parameters of performance that is 'safe' and those that indicate a problem.

During the display routine, the DP should continuously match the characteristics of the planned routine with the actual display being flown. Where anomalies are apparent, the DP must know how to respond to maintain safety.

When flying a display alongside others, the DP must constantly be aware of any deviations by other pilots from what was planned and take account of this to ensure safety.

vii. Illustration of the issue in relation to flying displays

- I am aware of what constitutes a good display routine and use key bits of information to make sure that I am comfortably within the bounds of a 'safe display'
- Complacency can be lethal. Just because it worked last time doesn't mean it will always work like I planned.
- I know exactly what I need to do at any point in my display should something not be going as expected.

viii. HF guidance

HF behaviours that help control the sources of risk that arise from DP information management and situation awareness include:

- Use practice sessions to develop and consolidate skills – never try new things out during the actual display
- If an element of the planned display proves very hard to get right consistently, consider replacing the manoeuvre with something more reliable
- Stick to a display as closely as possible but know when to deviate from the plan to maintain safety
- Situation awareness during the display must include awareness of your own performance
- Do not assume that a routine will go exactly as rehearsed – build in capacity to adapt the routine as it is flown to ensure safety
- If things are beginning to go wrong, have the courage (and desire for self-preservation) to end terminate the display early and land. Resist any temptation to press on.

ix. Questions to prompt awareness of the HF issue

- ✓ Do I know exactly what information and parameters are critical to a safe display?
- ✓ Am I monitoring things closely enough during my routine or allowing myself to get distracted by the audience?
- ✓ Would I have the courage to stop the display early if I was struggling to get through it?
- ✓ Am I adapting my own routine to take account of how my colleague is flying?

## 5. Conclusion

This guidance sets out the Human Factor issues that have the greatest potential to impact on Flying Display Director and Display Pilot decision making alongside best practice about how to control those issues to improve flying display safety.

The guidance was developed and refined from the insights of individuals active within the UK display industry and is intended for practical use by FDDs and pilots and any others who have an interest in ensuring a safe and vibrant display industry.

As Human Factors is a broad, varied and developing field, the guidance focusses on the issues of particular concern to the planning and performance of flying displays. Production of this guidance is the first element of the CAA's programme of work on Human Factors and flying displays and is recommended as a good starting point for FDDs and display pilots to better understand how those factors can influence the safety of their displays and how to mitigate their negative impacts.

# Annex A- Flying Display Checklist for Flying Display Directors and Display Pilots

## FLIPPER

- **Fitness (F)** - Am I physically and mentally fit for the tasks ahead of me?
- **Lessons (L)** - Have I taken sufficient time to consider previous displays and to apply lessons learnt to the current display?
- **Information (I)** - Do I have all of the information and knowledge that I need to undertake this display successfully? Does everyone in the wider team understand their roles and have the information and knowledge needed to be effective?
- **Planning (P)** – Do I have a plan for the display which clearly identifies actions, owners and timescales? Do I have a back-up plan for when things change?
- **Professionalism (P)** - Have I reminded myself of the professional behaviours that are expected of me in this role? Am I motivated by positive personal factors to create a safe and enjoyable display? Do I have the skills and knowledge necessary for my role?
- **Effectiveness (E)** – Am I fully aware of my personal limitations? Do I have the awareness and self-discipline to recognise and act when I am approaching these limitations? Do I have an appropriate team around me to help me to deliver the different activities? Am I fully aware of their limitations?
- **Risks (R)** - Have I fully considered all of the risks associated with this display? Do I have an effective plan for mitigating them?