Unmanned Aircraft System Operations in UK Airspace – Guidance & Policy

CAP 722
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Revision History

Seventh Edition     July 2019

This amendment updates references and text in accordance with ANO 2016 and its subsequent amendments, changes to European regulations brought about by the publication of the New Basic Regulation in Autumn 2018, incorporates Guidance material that has been published in the interim, and brings terms, definitions and procedures/processes up to date as they have evolved, and a change to the structure of the document.

In addition, the opportunity has been taken to transfer the Appendices into two separate, but related, documents with CAP 722A covering the development of Operating Safety Cases, and CAP 722B covering the requirements for National Qualified Entities.

Sixth Edition March 2015

CAP 722 has been completely refreshed and restructured under this revision. Key changes to the document are:

- Complete restructure of the document.
- Updates to all Chapters (including Abbreviations and Glossary of Terms).
- Introduction of a Concept of Operations Approach (ConOps)
- Introduction of an Approval Requirements Map.
- Removal of Military Operations Chapters.
- Addition of Alternative Means of Compliance to demonstrate Operator Competency.
- Introduction of Restricted Category Qualified Entities.

Fifth Edition 10 August 2012

The changes at this edition primarily concentrate on updating areas where terms, definitions or procedures have evolved significantly and where details of chapter sponsors have also been changed. The specific areas to note are:

- Revised Abbreviations and Glossary (also reflected throughout the document), which reflect worldwide developments in UAS terminology.
Introduction of a Human Factors chapter.

A complete rewrite of the ‘Civil Operations, Approval to Operate’ chapter.

Amendments to civilian Incident/Accident Procedures.

A complete revision to Section 4 (Military Operations), which reflects the formation of the Military Aviation Authority (MAA) and the revised Military Aviation Regulatory Publications.

Fourth Edition  6 April 2010

This edition incorporates the changes to legislation introduced in Air Navigation Order 2009 (ANO 2009) regarding the requirement for operators of small unmanned aircraft to obtain a CAA permission when their aircraft are being used for aerial work, and also in some cases for surveillance or data acquisition purposes (now termed small unmanned surveillance aircraft).

Unmanned aircraft having a mass of less than 7 kg are now covered by this new legislation, which is intended to ensure public safety by applying appropriate operational constraints, dependent on the flying operation being conducted and the potential risks to third parties. In line with this change, some guidance on the additional details to be provided within an application for permission to operate small unmanned aircraft have also been included (Annex 1 to Section 3, Chapter 1).

Expanded guidance regarding the reporting of incidents/occurrences involving the operation of unmanned aircraft has also been included; such reporting is viewed as being a vital element in the successful development of the 'fledgling' civilian UAS industry.

Finally, in line with continued developments in UAS terminology, and the principle that unmanned aircraft are still to be treated as aircraft rather than as a separate entity. In line with this, the term 'pilot' (i.e. the person who operates the controls for the aircraft) is used more frequently. The term 'Remotely Piloted Aircraft' (RPA) is also emerging in some areas, although it has not yet been wholeheartedly accepted for use in the UK.

Third Edition  28 April 2008

Introduction

Following discussions at the CAA Unmanned Aircraft Systems (UAS) Working Group, held on 12 October 2006, it was considered that sufficient progress had been made in many areas of UAS work to warrant a substantial review of CAP 722. In particular, as an upsurge in UAS activity is envisaged over the coming years it is essential that both industry and the CAA, as the regulatory body, clearly recognize the way ahead in terms of policy and regulations and, more importantly, in safety standards.
With an ever-increasing number of manufacturers and operators, it is vital that the regulations keep pace with UAS developments, without losing sight of the safety issues involved in the simultaneous operation of manned and unmanned aircraft. As a living document, it is intended that CAP 722 will be under constant review and that it will be revised, where necessary, to take account of advances in technology, feedback from industry, recognised best practice and changes in regulations, which are developed to meet these demands. However, it is recognised that with continual rapid developments there will inevitably be times when Chapter sponsors will have to be approached directly for further guidance.

Revisions in this Edition

The layout of the document has been amended to more clearly separate Civil and Military guidance and as such the Chapters have changed in many areas. In addition, while there are many minor textual changes to the document, a significant revision has been made in many areas and as such it is recommended that those involved in UAS operations review the entire content of the document to ensure that they are fully cognisant with the update.

Impending Changes to Regulation

The CAA is in the process of a consultation with industry over a proposal to amend the Air Navigation Order which will require operators of UAS with a UAV component of less than 7 kg mass to obtain a CAA permission, as is currently the case for UAVs with a mass of 7-20 kg. This proposal intends to ensure public safety by applying operational constraints to UAVs of less than 7 kg mass, as deemed appropriate to the type of operation envisaged and the potential risk to members of the public.

If the consultation exercise approves the proposal, it is likely that the ANO Amendment will pass into law in December 2008. Potential operators of UAS with a UAV component of less than 7 kg must ascertain, before commencing operations, whether or not they are required to obtain a CAA permission.

Third Edition incorporating amendment 2009/01 14 April 2009

This amendment is published in order to update contact details and references throughout the document and make some editorial corrections.

Second Edition 12 November 2004

The major changes in this document are on legal, certification, spectrum and security issues.

Details of the CAA Policy on Model Aircraft/Light UAV have also been included.
Foreword

Aim

CAP 722, Unmanned Aircraft System Operations in UK Airspace – Guidance and Policy, is compiled by the Civil Aviation Authority's Unmanned Aircraft Systems Unit (UAS Unit). CAP 722 is intended to assist those who are involved with the development, manufacture or operation of UAS to identify the route to follow in order that the appropriate operational authorisation(s) may be obtained and to ensure that the required standards and practices are met. Its content is primarily intended for non-recreational UAS operators, but it is clearly recognised that there is a great deal of overlap with recreational use, particularly when the smaller (lower mass) unmanned aircraft are concerned; as a result, much of this guidance is also directly relevant to recreational uses.

Furthermore, the document highlights the safety requirements that have to be met, in terms of airworthiness and/or operational standards, before a UAS is allowed to operate in the UK.

In advance of further changes to this document, updated information is contained on the CAA website.

Content

The content of CAP 722 is wholly dependent on contributions from lead agencies; it does not replace civil regulations but provides guidance as to how civil UAS operations may be conducted in accordance with those regulations, and the associated policy. Wherever possible the guidance contained herein has been harmonised with any relevant emerging international UAS regulatory developments.

It is acknowledged that not all areas of UAS operations have been addressed fully. It is therefore important that operators, industry and government sectors remain engaged with the CAA and continue to provide comment on this document.

Availability

The primary method of obtaining a copy of the latest version of CAP 722 is via the CAA website under the publications section.

1. [www.caa.co.uk/uas](http://www.caa.co.uk/uas)
2. [www.caa.co.uk/CAP722](http://www.caa.co.uk/CAP722)
The CAA has a system for publishing further information, guidance and updates. This can be found within the ‘latest updates’ section of the CAA website’s UAS webpages. In addition, the CAA also provides a more general aviation update service via the SkyWise system.

Structure

The UAS Guidance documentation is structured as follows:

**CAP722**

Chapter 1  General
Chapter 2  Authorisations and Approvals
Chapter 3  Policy
Chapter 4  Airworthiness
Chapter 5  Operations

**CAP722 A Operating Safety Cases**

Section 1  UAS OSC Volume 1 – Operations Manual Template
Section 2  UAS OSC Volume 2 – UAS Systems Template
Section 3  UAS OSC Volume 3 – Safety and Risk Assessment Guidance and Template

**CAP722 B National Qualified Entity**
Point of Contact

Unless otherwise stated, all enquiries relating to CAP 722 must be made to:

For queries relating to the content of CAP 722:

UAS Unit
CAA
Safety and Airspace Regulation Group
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

E-mail: uavenquiries@caa.co.uk

For matters concerning operations or approvals:

Shared Service Centre (UAS)
CAA
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

Telephone: 03300 221908
E-mail: uavenquiries@caa.co.uk
Abbreviations and Glossary of Terms

The terminology relating to UAS operations continues to evolve and therefore the Abbreviations and Glossary of Terms sections are not exhaustive. The terms listed below are a combination of the emerging ICAO definitions and other ‘common use’ terms which are considered to be acceptable alternatives.

### Abbreviations

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<td>A</td>
<td>AAIB</td>
<td>Air Accidents Investigation Branch</td>
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<td>ACAS</td>
<td>Airborne Collision Avoidance System</td>
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<td>ADS-B</td>
<td>Automatic Dependent Surveillance Broadcast</td>
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<td>AIP</td>
<td>Aeronautical Information Publication</td>
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<td>ALARP</td>
<td>As Low As Reasonably Practicable</td>
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<td>ANO</td>
<td>Air Navigation Order</td>
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<td>Air Navigation Service Provider</td>
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<td>AOC</td>
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<td>API</td>
<td>Application Programmable Interface</td>
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<td>British Model Flying Association</td>
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<td>BVLOS</td>
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<tr>
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<td>Civil Aviation Authority</td>
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<td>CAT</td>
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<td>European Aviation Safety Agency</td>
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<td>Electronic Conspicuity</td>
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<td>ECCAIRS</td>
<td>European Co-ordination Centre for Accident and Incident Reporting Systems</td>
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<td>Emergency Restriction of Flying</td>
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<td>EVLOS</td>
<td>Extended Visual Line of Sight</td>
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<td>FIR</td>
<td>Flight Information Region</td>
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<td>FISO</td>
<td>Flight Information Service Officer</td>
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<td>FMC</td>
<td>Flight Management Computer</td>
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<td>FPV</td>
<td>First Person View</td>
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<td>FRTOL</td>
<td>Flight Radio Telephony Operators’ Licence</td>
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<td>FRZ</td>
<td>Flight Restriction Zone</td>
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<td>GCS</td>
<td>Ground Control Station</td>
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<td>HMI</td>
<td>Human-Machine Interface</td>
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<td>ICAO</td>
<td>International Civil Aviation Organisation</td>
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<td>IFR</td>
<td>Instrument Flight Rules</td>
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<td>IMC</td>
<td>Instrument Meteorological Condition</td>
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<td>Joint Authorities for Rulemaking on Unmanned Systems</td>
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<td>Maximum Take-off Mass</td>
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<td>NAA</td>
<td>National Aviation Authority</td>
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<td>NOTAM</td>
<td>Notice to Airmen</td>
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<tr>
<td>NQE</td>
<td>National Qualified Entity</td>
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<td>RA (T)</td>
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<td>Remotely Piloted Aircraft System</td>
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<td>Safety and Airspace Regulation Group</td>
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<td>SDK</td>
<td>Software Development Kit</td>
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<td>SERA</td>
<td>Standardised European Rules of the Air</td>
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<td>SMS</td>
<td>Safety Management System</td>
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<td>SSR</td>
<td>Secondary Surveillance Radar</td>
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<td>SUA</td>
<td>Small Unmanned Aircraft</td>
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<td>TCAS</td>
<td>Traffic Alert and Collision Avoidance System</td>
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<td>TDA</td>
<td>Temporary Danger Area</td>
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<td>TLOS</td>
<td>Target Level of Safety</td>
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<td>Upper Flight Information Region</td>
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Glossary of Terms

A

**Aircraft** - Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the Earth’s surface.

**Air Navigation Order (ANO)** – The legal document, established as a UK Statutory Instrument (SI) that is made for the purposes of regulating air navigation within the United Kingdom.

**Autonomous Aircraft** - An unmanned aircraft that does not allow pilot intervention in the management of the flight.

**Autonomous Operation** - An operation during which an unmanned aircraft is operating without pilot intervention in the management of flight.

B

**Beyond visual line-of-sight (BVLOS) operation.** An operation in which the remote pilot or RPA observer does not use visual reference to the unmanned aircraft in the conduct of flight.

C

**Continued Airworthiness** - The monitoring, reporting and corrective action processes used for in-service aircraft to assure they maintain the appropriate safety standard defined during the initial airworthiness processes throughout their operational life.

**Continuing Airworthiness** - The system of management of the aircraft and the scheduling and actioning of ongoing preventative and corrective maintenance to confirm correct functioning and to achieve safe, reliable and cost-effective operation.

**Command and Control (C2) Link** - The data link between the remotely-piloted aircraft and the remote pilot station for the purposes of managing the flight.

**Concept of Operations** - describes the characteristics of the organisation, system, operations and the objectives of the user.

**Controlled airspace** – airspace which has been notified as Class A airspace, Class B airspace, Class C airspace, Class D airspace or Class E airspace;

D

**Detect and Avoid** - The capability to see, sense or detect conflicting traffic or other hazards and take the appropriate action.
**E**

**Electronic Conspicuity** - Electronic Conspicuity (EC) is an umbrella term for a range of technologies that can help airspace users to be more aware of other aircraft in the same airspace.

**F**

**Flight Restriction Zone (FRZ)** - A zone around a protected aerodrome which prohibits the flight of UAS unless permission from relevant ATS unit is obtained.

**G**

**Ground Control Station (GCS)** - See ‘Remote Pilot Station’.

Note: RPS is the preferred term as it enables the consistent use of one term with the same meaning irrespective of its location (e.g. on a ship or in another aircraft).

**H**

**Handover** - The act of passing piloting control from one remote pilot station to another.

**High Authority** - those systems that can evaluate data, select a course of action and implement that action without the need for human input.

**Highly Automated** - those systems that still require inputs from a human operator (e.g. confirmation of a proposed action) but which can implement the action without further human interaction once the initial input has been provided.

**I**

**Initial Airworthiness** - The system used to determine the applicable requirements and establish that an aircraft design is demonstrated to be able to meet these requirements.

**L**

**Lost C2 Link** - The loss of command and control link with the remotely-piloted aircraft such that the remote pilot can no longer manage the aircraft’s flight.

**M**

**Model Aircraft** - Any small unmanned aircraft which is being used for sport or recreational purposes only.

**N**

**National Qualified Entity** – A person or organisation approved by the CAA to submit reports relating to pilot competence in operating a small unmanned aircraft.
O

**Operator** - A person, organisation or enterprise engaged in or offering to engage in an aircraft operation.

Note: In the context of remotely-piloted aircraft, an aircraft operation includes the remotely-piloted aircraft system.

**Operating Safety Case** – Methodology used to apply to the CAA for a Permission or Exemption to operate a UAS within the UK.

**Operational Authorisation** – A document issued by the CAA that authorises the operation of an unmanned aircraft system, subject to the conditions outlined within the authorisation, having taken into account the operational risks involved.

P

**Pilot** - The person in direct control of the UA - See also ‘Remote Pilot’.

**Permission** – Authorisation issued by the CAA to allow flights within the UK subject to the conditions and limitations specified.

R

**Radio Line-Of-Sight** (RLOS) - A direct radio link point-to-point contact between a transmitter and a receiver.

**Redundancy** - The presence of more than one independent means for accomplishing a given function or flight operation.

**Remote Pilot** - A natural person responsible for safely conducting the flight of an unmanned aircraft by operating its flight controls, either manually or, when the unmanned aircraft flies automatically, by monitoring its course and remaining able to intervene and change the course at any time. Regulation (EU) 2018/1139

Note: Within ANO 2016, article 94G the “remote pilot”, in relation to a small unmanned aircraft, is an individual who—

(i) operates the flight controls of the small unmanned aircraft by manual use of remote controls, or

(ii) when the small unmanned aircraft is flying automatically, monitors its course and is able to intervene and change its course by operating its flight controls

In this document, the term ‘remote pilot’ is used for all sizes of unmanned aircraft, hence the first definition is applicable.

**Remote Pilot Station** (RPS) - The component of the remotely-piloted aircraft system containing the equipment used to pilot the remotely-piloted aircraft.
**Remotely-Piloted Aircraft (RPA)** - An unmanned aircraft which is piloted from a remote pilot station.

**Remotely-Piloted Aircraft System (RPAS)** - A remotely piloted aircraft, its associated remote pilot station(s), the required command and control links and any other components as specified in the type design.

**RPA Observer** - A trained and competent person designated by the operator who, by visual observation of the remotely-piloted aircraft, assists the remote pilot in the safe conduct of the flight.

**Runway Protection Zone** – A zone, which comprises part of the UAS Flight Restriction Zone, defined and established for the protection of aircraft along the extended centreline of the runway.

**S**

**Safety** - The state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level.

**Safety Management System (SMS)** - A systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures.

**Sense and Avoid** - See ‘Detect and Avoid’.

**Small Unmanned Aircraft** - Any unmanned aircraft, other than a balloon or a kite, having a mass of not more than 20 kg without its fuel but including any articles or equipment installed in or attached to the aircraft at the commencement of its flight.

**Small Unmanned Surveillance Aircraft** - A small unmanned aircraft which is equipped to undertake any form of surveillance or data acquisition.

**Swarming** – Operation of more than one UAS, which are controlled collectively rather than individually.

**T**

**Tethered Unmanned Aircraft** – An unmanned aircraft that remains securely attached (tethered) via a physical link to a person, the ground or an object at all times while it is flying. The tether normally takes the form of a flexible wire or a cable and may also include the power supply to the aircraft as well.

**Transponder Mandatory Zone** - Airspace of defined dimensions wherein the carriage and operation of pressure-altitude reporting transponders is mandatory.
Unmanned Aircraft (UA) - Any aircraft operating or designed to operate autonomously or to be piloted remotely without a pilot on board.

Note: RPA is considered a subset of UA.

Unmanned Aircraft System (UAS) - An unmanned aircraft and the equipment to control it remotely.

Note: The UAS comprises individual 'System Elements' consisting of the Unmanned Aircraft (UA) and any other System Elements necessary to enable flight, such as a Remote Pilot Station, Communication Link and Launch and Recovery Element. There may be multiple UAs, RPS or Launch and Recovery Elements within a UAS.

Unmanned Aircraft System operator – Any legal or natural person operating or intending to operate one or more UAS.

Variation – Change of an operation or technical data that requires an application to the CAA.

Visual Line-Of-Sight (VLOS) Operation - An operation in which the remote pilot or RPA observer maintains direct unaided visual contact with the unmanned aircraft.
1. Introduction

1.1. Policy

It is CAA policy that UAS operating in the UK must meet at least the same safety and operational standards as manned aircraft. Thus, UAS operations must be as safe as manned aircraft insofar as they must not present or create a greater hazard to persons, property, vehicles or vessels, whilst in the air or on the ground, than that attributable to the operations of manned aircraft of equivalent class or category.

The CAA will supplement CAP 722 with further written guidance when required. For the purpose of UAS operations, the 'See and Avoid' principle employed in manned aircraft is referred to as 'Detect and Avoid'.

1.2. Scope

The guidance within CAP 722 concerns civilian unmanned aircraft and UAS as they are defined in the Glossary of Terms. It primarily focuses on the aspects connected with unmanned aircraft that are piloted remotely, whilst acknowledging the potential for autonomous operations in the future.

Military Systems are regulated by the Military Aviation Authority (MAA). All enquiries regarding military RPAS must be made to:

Military Aviation Authority
Juniper Building
Abbey Wood (North)
Bristol, BS34 8QW
Email: DSA-MAA-EnquiriesMailbox@mod.uk
website: www.gov.uk/government/organisations/military-aviation-authority

Similarly, the guidance for operating model aircraft for sporting and recreational purposes is not included; this guidance is published in CAP 658: Model Aircraft: A Guide to Safe Flying.
2. Legal Considerations

2.1. The Chicago Convention

As a signatory to the Chicago Convention and a member of ICAO, the United Kingdom undertakes to comply with the provisions of the Convention and Standards contained in Annexes to the Convention save where it has filed a Difference to any of those standards.

Article 3 of the Convention provides that the Convention applies only to civil aircraft and not to State aircraft. State aircraft are defined as being aircraft used in military, customs and police services. No State aircraft may fly over the territory of another State without authorisation. Contracting States undertake when issuing Regulations for their State aircraft that they will have due regard for the safety of navigation of civil aircraft.

Article 8 of the Convention provides that no aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a Contracting State without special authorisation by that State.

Article 8 of the Convention also requires that “each contracting State undertake to ensure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft”.

2.2. European Regulation

Regulation (EU) 2018/1139 (the EASA Basic Regulation - BR) sets out common rules for civil aviation and establishes the European Aviation Safety Agency (EASA). It makes provision for Implementing Rules, Implementing Acts or Delegated Acts dealing with airworthiness certification, continuing airworthiness, operations, pilot licensing, air traffic management and aerodromes.

Neither the BR nor the Implementing Rules apply to aircraft carrying out military, customs, police, search and rescue, firefighting, coastguard or similar activities or services (State aircraft). EU Member States must, however, ensure that such services have due regard as far as practicable to the objectives of the EASA Regulation.

Certain categories of civil aircraft are also exempt from the need to comply with the BR and its Implementing Rules. These exempt categories are listed in Annex I to the BR (Annex I aircraft) and primarily consist of manned aircraft categories. The exempt categories which are of relevance for UAS are:

- tethered aircraft with no propulsion system, where the maximum length of the tether is 50 m, and where:
• the MTOM of the aircraft, including its payload, is less than 25 kg, or
• in the case of a lighter-than-air aircraft, the maximum design volume of the aircraft is less than 40 m³;
• tethered aircraft with a MTOM of no more than 1 kg.

The essential requirements for unmanned aircraft are contained within Annex IX of the BR.

An aircraft which is not required to comply with the Basic EASA Regulation, either because it is a State aircraft or because it comes within one of the exempt categories, remains subject to national regulation so far as airworthiness certification and continuing airworthiness are concerned.

Implementing Rules for airworthiness certification and continuing airworthiness have been in force for some years. The Implementing Rules for pilot licensing, operations, aerodromes and air traffic management have more recently become applicable. The CAA’s website contains up to date information concerning these matters.

Implementing Rule (Regulation (EU) 923/2012) is also in force introducing Common Rules of the Air (the Standardised European Rules of the Air [SERA]). These are supplemented by the UK Rules of the Air 2015.

Specific EU regulations covering UAS are currently being developed. Until these regulations are in place and applicable, the national regulations of individual Member States must be followed.

In the case of the United Kingdom, the national regulations are as described below.

2.3. National Regulation

This section describes UK national regulation applicable to unmanned aircraft.

2.3.1. Definition of a Small Unmanned Aircraft

Schedule 2 of the ANO defines a Small unmanned aircraft as follows:

“any unmanned aircraft, other than a balloon or a kite, having a mass of not more than 20 kg without its fuel but including any articles or equipment installed in or attached to the aircraft at the commencement of its flight;”

Although not specified in the ANO, the CAA adopts the following definitions:

‘unmanned aircraft’ means any aircraft operating or designed to operate autonomously or to be piloted remotely without a pilot on board;
‘aircraft’ means any machine that can derive support in the atmosphere from the reactions of the air other than reactions of the air against the earth's surface;

As such, the CAA considers the following as flying ‘objects’ rather than flying ‘machines’, and so do not fall within the definition of an unmanned aircraft, or a ‘small unmanned aircraft’:

- Paper aeroplane
- Hand launched glider, but only those with no moveable control surfaces or remote control link
- Frisbees, darts and other thrown toys.

2.3.2. Civil and Military Regulations

In the United Kingdom, there are two regulatory regimes: civil and military. Military requirements are a matter for the Ministry of Defence. A military aircraft for this purpose includes any aircraft which the Secretary of State for Defence has issued a certificate stating that it must be treated as a military aircraft.

Any aircraft which is not a military aircraft must, under United Kingdom aviation safety legislation, comply with civil requirements. There is no special provision for other types of non-military State aircraft such as those carrying out police, search and rescue, firefighting, coastguard or similar activities or services.

2.3.3. The Air Navigation Order 2016

The main civil requirements are set out in the ANO.

The provisions in the ANO concerning equipment requirements, operational rules, personnel licensing, aerodrome regulation and regulation of air traffic services apply to all non-military aircraft, organisations, individuals and facilities.

As explained above, insofar as these national requirements concern airworthiness certification or continuing airworthiness they will only apply to non-military State aircraft and Annex I aircraft. Such aircraft are exempt from the need to comply with the EASA Basic Regulation and Implementing Rules and thus remain subject to national regulation.

A non-military State aircraft or an Annex I aircraft registered in the United Kingdom which is outside the EASA Basic Regulation and Implementing Rules must have a certificate of airworthiness or a permit to fly issued by the CAA (or be operating under A or B Conditions) under the ANO, unless it is:
• an unmanned aircraft with an exemption from the ANO issued by the CAA (section 2.5); or
• a ‘small unmanned aircraft’ as defined in the ANO.

2.3.4. Applicability of the ANO to Small UAS

Small unmanned aircraft are exempted from the majority of the provisions of the ANO via article 23, and hence none of the above requirements apply. Instead, a set of conditions are included at articles 94, 94A, 94B, 94G and 95 of the ANO, which detail the specific requirements for the safe flight small unmanned aircraft and take the form of a proportionately ‘watered down’ version of the essential requirements of the full ANO. These conditions cover:

• a placement of responsibility on the remote pilot to only fly the aircraft if reasonable satisfied that it can be conducted safely (health, awareness and competence of the remote pilot, condition and serviceability of the aircraft, suitability of operating location etc).

• a requirement to only fly the aircraft within visual line of sight, for the purpose of avoiding collisions.

• specific airspace restrictions: a restriction of flights over or near aerodromes (FRZ).

• A maximum flying height of 400ft above the surface, unless permission to fly higher has been granted by the CAA, or by the aerodrome ATC/AFIS if within an FRZ.

• a prohibition on flight for the purposes of commercial operations without the specific permission of the CAA.

• specific restrictions on the use of small unmanned aircraft for surveillance or data gathering (minimum distances from congested areas, open-air crowds and third parties (persons of objects).

An additional set of articles (94C, 94D, 94E and 94F) have been created to cover future requirements regarding the operator registration and remote pilot competence aspects of small unmanned aircraft, but these elements do not become applicable until 30 November 2019.

In addition to articles 94, 94A, 94B, 94C, 94D, 94E, 94F, 94G and 95 a number of other articles also apply to small UAS as defined in article 23. Table 1 below shows a summary of these:
<table>
<thead>
<tr>
<th>Article Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Interpretation</td>
</tr>
<tr>
<td>91</td>
<td>Dropping articles for purposes of agriculture etc. and grant of aerial application certificates</td>
</tr>
<tr>
<td>92</td>
<td>Mooring, tethering, towing, use of cables, etc</td>
</tr>
<tr>
<td>93</td>
<td>Release of small balloons</td>
</tr>
<tr>
<td>239</td>
<td>Power to prohibit or restrict flying</td>
</tr>
<tr>
<td>241</td>
<td>Endangering safety of any person or property</td>
</tr>
<tr>
<td>257</td>
<td>CAA’s power to prevent aircraft flying (Except 257(2)(a))</td>
</tr>
<tr>
<td>253</td>
<td>Revocation, suspension and variation of certificates, licences and other documents</td>
</tr>
<tr>
<td>265</td>
<td>Offences and penalties</td>
</tr>
<tr>
<td>266</td>
<td>Exemption from Order (other than articles 179, 230, 247, 250, 251, 252, 255, and 267)</td>
</tr>
<tr>
<td>269</td>
<td>Certificates, authorisations, approvals and permissions</td>
</tr>
</tbody>
</table>

Table 1 – ANO applicability to small UAS

### 2.4. Exemptions and Permissions granted by the CAA

A UAS which is subject to national regulations and which weighs more than 20 kg is not a 'small unmanned aircraft' for the purposes of the ANO. Therefore, all of the requirements within the ANO (certificate of airworthiness or permit to fly, licensed flight crew etc) must be complied with. In such circumstances, the CAA may be prepared to issue an exemption to articles in the ANO (as prescribed in Article 266 of the ANO 2016), other than articles 179, 230, 247, 250, 251, 252, 255, and 267, or any regulations made under this Order, any aircraft or persons or classes of aircraft or persons, subject to such conditions it deems appropriate.

An exemption is used to allow an exception to the established law. Such an exception is usually only made subject to a number of additional conditions which still ensure adequate safety of the operation.

A permission is used where the established law prevents or restricts an activity but has set aside the possibility for the activity to take place under certain circumstances. As with an exemption, a permission would only be granted subject to any conditions which still ensure adequate safety is maintained.
Under ANO 2016, small unmanned aircraft operations require a permission from the CAA in the following circumstances:

- flights for the purposes of commercial operations - article 94(5)
- flights at a height of more than 400 ft above the surface - article 94A
- flights of small unmanned aircraft equipped to undertake any form of surveillance or data acquisition within the minimum distances set out in article 95. In summary, these are:
  - over or within 150 metres of any congested area or an organised open-air assembly of more than 1000 persons - article 95(2) (a) and (b)
  - flights within 50 metres of any person, vehicle, vessel or structure which is not under the control of the SUA operator or the remote pilot- article 95(2)(c) and (d)

A UAS with a mass greater than 20kg which is not certified can only be operated under the terms of an exemption issued by the CAA.

### 2.5. Insurance

Regulation (EC) 785/2004 came into force on 30 April 2005 requiring most operators of aircraft, irrespective of the purposes for which they fly, to hold adequate levels of insurance in order to meet their liabilities in the event of an accident. This EC Regulation specifies amongst other things the minimum levels of third-party accident and war risk insurance for aircraft operating into, over or within the EU (including UAS) depending on their Maximum Take-Off Mass (MTOM). Details of the insurance requirements can be found on the CAA website[^3] under “Mandatory Insurance Requirements”.

UK legislation which details insurance requirements is set out in Civil Aviation (Insurance) Regulations 2005[^4].

It is every operator’s responsibility to ensure they have appropriate insurance coverage. This is a condition of each permission, exemption or any other form of operational authorisation that is issued by the CAA.

Article 2(b) of EC 785/2004 states that the regulation does not apply to ‘model aircraft with an MTOM of less than 20kg’. In the absence of any definition of model aircraft within the regulation, the United Kingdom has interpreted ‘model aircraft’ to mean:

“Any small unmanned aircraft which is being used for sport or recreational purposes only”.

Therefore, for all other types of small unmanned aircraft flight, whether commercial or non-commercial, appropriate cover that meets the requirements of EC 785/2004 is required.

2.6. Enforcement

Our enforcement strategy has recently changed to better reflect the balance of capabilities between the CAA and local Police services.

The Police often have greater resources, response times and powers of investigation than the CAA. To support this, the CAA has now agreed with the Police, in a signed Memorandum of Understanding that the Police will take the lead in dealing with UAS misuse incidents, particularly at public events, that may contravene aviation safety legislation or other relevant criminal legislation. Please report any misuse of UAS offences to your local Police force.

The CAA’s remit is limited to safety and also to investigate where someone is operating commercially without a permission or not in accordance with their permission. This does not include concerns over privacy or broadcast rights.

Breaches of Aviation Regulation legislation must be reported directly to:

Investigation and Enforcement Team
Civil Aviation Authority
Room 505
CAA House
45-59 Kingsway
London
WC2B 6TE

E-mail: ietmailbox@caa.co.uk

Privacy issues are covered by the Information Commissioners Office (ICO) and will not be dealt with by the CAA.

If you have any concerns about UAS being used in your area, either from a safety or privacy perspective, contact your local police on 101.

CAA Enforcement guidance can be found in CAP 1074.

2.7. Lead Agency

- European Aviation Safety Agency – for civil aircraft which are not exempt from the EASA Regulation.
 Civil Aviation Authority – for civil aircraft which are subject to national regulation.
 Military Aviation Authority – for United Kingdom military aircraft.
 Department for Transport – for insurance matters.
1. UAS Classification System

1.1. Scope

This chapter gives guidance on the classification philosophy for UAS in the United Kingdom.

1.2. UAS Classifications

The current framework established and used by the CAA, and other NAAs, classifies aircraft based on simple discriminants or type (e.g. balloon, fixed or rotary wing) and mass. This reflects the historic developments in manned aviation – but is not necessarily fully appropriate for UAS hence the ConOps approach being taken by the UK. However, until such time as the alternative classification protocols defined in forthcoming EU regulations become applicable, this system is in place.

Working within this framework means we have very simple categorisations - Table 2 describes these.

<table>
<thead>
<tr>
<th>Mass Category</th>
<th>Mass (kg)</th>
<th>Responsible Regulatory Body</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small unmanned aircraft</td>
<td>0-20</td>
<td>National Aviation Authority</td>
</tr>
<tr>
<td>UAS</td>
<td>&gt; 20</td>
<td>National Aviation Authority or EASA (depending whether UAS is to be certificated)</td>
</tr>
</tbody>
</table>

Table 2 - Mass Categories Relating to UAS

Unmanned aircraft of any mass now fall within the remit of the EASA Basic Regulation, unless they are outside of this due to the exceptions defined in Annex I, or aircraft carrying out military, customs, police, search and rescue, firefighting, coastguard or similar activities or services (State aircraft). For non-military State unmanned aircraft and Annex I unmanned aircraft, the CAA has based the applicable certification requirements, organisation and operational approvals on those that would be applied by EASA as this provides maximum alignment and would offer potential operating benefits within Europe.

Specific EU regulations covering UAS are currently being developed. Until these regulations are in place and applicable, the national regulations contained within the ANO are to be followed.
1.3. Future Classification Development

Work is ongoing within ICAO, EASA and JARUS to formulate internationally recognised
categorisations for UAS. These categorisations are being developed along an operation
centric and risk-based approach, rather than the traditional aviation use of mass as a
discriminator. This approach follows the principle that UAS operations should be regulated
in a manner that is proportional to the risk of the specific operation and is very much in line
with the current UK ConOps approach that is described within this document.
2. Authorisation Requirements Map

2.1. Scope

This section gives guidance to UAS operators on the approach currently taken by the CAA to determine the level of assurance and assessment required prior to the issue of a permission or an exemption.

This section provides top level guidance only and is intended to give the community a starting point from which to develop understanding of the requirements. Chapter 2, Section 3 of this publication gives detailed policy and guidance on the approach to be taken when applying for a permission or an exemption.

2.2. Basic Requirements

The CAA ConOps philosophy underpins the authorisation process (and thus authorisation requirements) and aims to ensure that the public and other airspace users are not exposed to unacceptable risk introduced by UAS operations.

The CAA approach is to categorise UAS and the intended operations as detailed in Figure 1; all operations will fall into either the Low, Medium or High risk category.

The categories can be broken down in simple terms as follows:

- **Low risk category** – a low risk UAS operation that is conducted within the defined limitations of the law (ANO) and can take place without the need for any prior authorisation from the CAA.

- **Medium risk category** – a UAS operation where an operational authorisation from the CAA, based on a safety risk assessment, is required prior to the flight(s) taking place. This operational authorisation may be required because of the additional risks involved, or because one or more of the operational parameters do not comply with the defined limitations of the law. In some cases, the operational authorisation may be granted within a General Permission/Exemption, that details specific conditions that must be complied with.

- **High risk category** – a UAS operation that, due to the nature and risk of the operation or activity, requires a certification of the UAS, the UAS operator, and the remote pilots (i.e. the ‘traditional’ manned aviation approach).

Figure 1 below describes the change in Operational, Technical, Procedural and Pilot complexity/competence in relation to each other. The three categories described above...
are represented along the complexity axis. As the level of complexity of the operation increases, so too must either the pilot, technical or procedural complexity. After a point, no more pilot competence may be acquired, and no more procedural complexity may be acquired. At this point, a higher level of technical assurance is required in order to operate in this higher risk area.

There are scenarios that are not described, which will require differing levels of assessment (for example, a very light UAS operating in a complex environment with an extremely complex flight management system). It is therefore essential that operators contact the CAA early in the developmental process with any relevant permission or exemption applications to ensure that the correct approach is being taken.

Figure 1 - Simple UAS ConOps Authorisation Requirements Map
<table>
<thead>
<tr>
<th>Low Risk</th>
<th>Medium Risk</th>
<th>High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Airworthiness</strong></td>
<td>Airworthiness assessment based upon UAS Operating Safety Case (UAS OSC) submission (elements of design, production, continuing and continued airworthiness will be assessed) No design approval or production approval or TC or TCB</td>
<td>Type Certification Basis agreed Type Certificate required Design and Production approval required Continuing and continued airworthiness processes assessed</td>
</tr>
<tr>
<td>No formal Airworthiness Requirements</td>
<td><strong>Operational</strong></td>
<td>Authorisation based upon UAS OSC Volume 1, 2 and 3 submission or, for simpler operations, Authorisation based on UAS OSC Volume 1</td>
</tr>
<tr>
<td><strong>Pilot Competence</strong></td>
<td>Evidence of pilot competency required</td>
<td>Evidence of pilot competency equivalent to that of manned aviation required</td>
</tr>
<tr>
<td>Nil, or as set out in ANO</td>
<td><strong>Operating Environment</strong></td>
<td>Congested Areas Complex environment where third party risks are judged to be higher (e.g. within the prescribed minimum distances) VLOS, EVLOS, BVLOS</td>
</tr>
<tr>
<td><strong>Influencing Factors</strong></td>
<td>Low to medium complexity Congested areas or higher risk environment than ‘A’ Increased mass Swarming or multiple UAs under the control of one operator.</td>
<td>Highly complex; and/or high mass; and/or, Densely populated or high-risk environment Overflight of groups of people Complex flight profiles Carriage of Dangerous Goods</td>
</tr>
<tr>
<td>Low complexity, low mass, benign operating environment</td>
<td><strong>Visual Line of Sight</strong> Not in densely populated areas Not above 400 feet Very low risk environment</td>
<td>Congested Areas</td>
</tr>
<tr>
<td>Visual Line of Sight</td>
<td>Complex environment where third party risks are judged to be higher (e.g. within the prescribed minimum distances) VLOS, EVLOS, BVLOS</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 - UAS Authorisation Categories
3. Authorisation to Operate

3.1. Scope

This section gives guidance on the application requirements and processes to operate UAS in the UK.

3.2. Introduction

All civil aircraft fly subject to the legislation of the Air Navigation Order 2016 (ANO) and the associated Rules of the Air Regulations. However, in accordance with its powers under article 266 of the ANO, the CAA may exempt UAS operators from the provisions of the ANO and the Rules of the Air, depending on the UA’s potential to inflict damage or injury and the proposed area of operation. Small Unmanned Aircraft are exempted from most of the provisions of the ANO and Rules of the Air Regulations by the provisions of article 23, but in many cases, a permission from the CAA may still be required.

Changes, updates and further information are published on the CAA website5.

3.3. Operational Authorisations

The CAA may issue an exemption or permission for UA to operate if the applicability criteria detailed in Table 4 are met and the CAA is satisfied that the UA will be operated within the constraints stipulated. If a UA is intended for operation outside these constraints, the applicant must submit a UAS OSC and discuss these issues directly with the CAA.

<table>
<thead>
<tr>
<th>Aircraft Mass</th>
<th>Airworthiness Approval</th>
<th>Registration</th>
<th>Operational Authorisation</th>
<th>Pilot Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 kg or less</td>
<td>No</td>
<td>No (Note 1)</td>
<td>Yes (Note 2)</td>
<td>Yes (Notes 2, 3 &amp; 4)</td>
</tr>
<tr>
<td>Over 20 kg</td>
<td>Yes (Note 5)</td>
<td>Yes (Note 5)</td>
<td>Yes - Exemption</td>
<td>Yes (Note 4)</td>
</tr>
</tbody>
</table>

5 [www.caa.co.uk/uas](http://www.caa.co.uk/uas)
### Table 4 - Prerequisites for Operating a UA

<table>
<thead>
<tr>
<th>Aircraft Mass</th>
<th>Airworthiness Approval</th>
<th>Registration</th>
<th>Operational Authorisation</th>
<th>Pilot Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Mass – High risk category</td>
<td>EASA approval; or, CAA approval in certain cases (e.g. Annex I aircraft)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (Note 4)</td>
</tr>
</tbody>
</table>

**Notes:**

1. ANO 2016 article 94D introduces a requirement for registration of the SUA operator [for small unmanned aircraft of 250g or greater] from 30 November 2019.

2. Permission is required for:
   - aircraft used for Commercial Operations (article 94[5])
   - surveillance aircraft flown over or within 150m of a congested area or open-air assemblies (article 95)
   - surveillance aircraft flown close to people or property (article 95)
   - aircraft flown above 400ft (article 94A)
     Exemption required for aircraft flown beyond the direct unaided visual contact of the remote pilot. (article 94[3])

3. ANO 2016 article 94F introduces a requirement for remote pilots [of small unmanned aircraft of 250g or greater] to hold an acknowledgement of competency issued by the CAA from 30 November 2019.

4. Equivalent pilot experience will be considered on a case-by-case basis during application for an operating permission.

5. It may be possible to obtain certain exemptions from the airworthiness and registration requirements based on the mitigation within a safety case.

A summary of the permission and exemption framework is described in the figure below. The most basic regulations are set out in the Air Navigation Order and apply to everyone. Policy is then 'layered' on top of this, permitting or exempting more complex operations with a higher associated level of risk.
A CAA permission or exemption only addresses the flight safety aspects of the UAS operation and does not constitute permission to disregard the legitimate interests of other statutory bodies such as the Police and Emergency Services, the Highway Agency, Data Commission, Transport for London or local authorities.

The diagram below sets out the areas in which UAS may not be flown, without a permission. This diagram is repeated in the sections below and adjusted for each permission discussed.

Figure 2 – Schematic of areas normally prohibited for small UAS flight, without permissions and exemptions
3.3.1. ‘Standard Permission’

The CAA-issued ‘Standard Permission’ enables a person to conduct commercial operations with a small unmanned aircraft and also permits operations within a congested area. Potential operators are required to provide evidence of pilot competence and an Operations Manual which details how the flights will be conducted. The permission document no longer contains any division at the 7kg mass boundary. ‘Standard’ permissions will not list specific types (models) but will grant permission to fly any small unmanned aircraft (SUA) within one or both of the following classes:

- SUA multirotor with a maximum take-off mass (MTOM) not exceeding 20 kg.
- SUA fixed-wing with a MTOM not exceeding 20 Kg.

*Note: This classification includes hybrid or VTOL aircraft.*

Within each class, the applicant will be free to vary or add SUA as they wish without the requirement to undertake a practical flight assessment for each individual machine or when adding or changing to a new type (model). Both categories of NQE (Section 5 of this chapter) should make their recommendations to the CAA in one or both of the above classes. However, the applicant will be required to update all necessary manuals to reflect the models being used within the terms of their permission.

![Figure 3 – Schematic of areas normally prohibited for small UAS flight, with a standard permission](image)

With this permission, a UAS may now be flown within a congested area, but not within 50m of people, vessels, vehicles or structures within this area, and not over or within 150m of an open air assembly of more than 1000 people, and not above 400 ft.
Congested Area Operations

Article 95 of the ANO states that operations over or within 150m of a congested area are prohibited unless a permission has been issued by the CAA. As such, applicants who wish to undertake operations within a congested area must apply for a permission to do so. This permission is often referred to as the 'standard permission' and is combined with the permission to undertake commercial operations (article 94(5)). In this case, a safety case is not required, but the applicant must submit an operations manual (OSC Volume 1), evidence of pilot competency and evidence of appropriate insurance cover.

3.3.2. Reduced Distance Operations

Article 95 of the ANO states that operations within 50m of any vehicle vessel or structure, or uninvolved person are prohibited unless such a permission is held. Applicants who wish to undertake operations within these distances must therefore apply to the CAA for this permission. This must include a safety case including a risk assessment which demonstrates that the operation can be conducted in a safe manner. An operator may apply, utilising the UAS OSC, to the CAA to have their existing 'standard' permission varied in order to permit a reduction of the above operating distances- see CAP722A.

With this permission, on top of an existing ‘standard permission’, a UAS may be flown at a distance less than 50m to people, vessels, vehicle or structures, within a congested area and less than 150m from an open air assembly of more than 1000 people. The UAS may not be flown over the open air assembly of more than 1000 people, or above 400ft.

Figure 4 – Schematic of areas normally prohibited for small UAS flight, with a ‘non standard’ (reduced distance) permissions
3.3.3. Operations above 400 ft

Operators who wish to fly a small unmanned aircraft at heights greater than 400ft above the surface outside an FRZ, are required to apply for a permission from the CAA in accordance with article 94A and must submit a safety case including a risk assessment which demonstrates that the operation can be conducted in a safe manner. If this operation is inside an FRZ, then permission only needs to be sought from the aerodrome, if the aerodrome has an ATC or AFIS unit. If the operation is inside controlled airspace, then notification of the flight to the relevant controlling authority may be necessary.

3.3.4. BVLOS and EVLOS Operations

Operators who intend to fly a small unmanned aircraft beyond the direct unaided visual line of sight of the remote pilot are required to apply for an exemption from article 94(3) and must submit a safety case including a risk assessment which demonstrates that the operation can be conducted in a safe manner.

3.3.5. +20Kg Operations

Operators of unmanned aircraft over 20 kg are required to apply for an exemption from the CAA. Any commercial operations aspects will also be covered within this exemption. The application must include a safety case including a risk assessment which demonstrates that the operation can be conducted in a safe manner.

3.4. Images and other Data Collection Requirements

The provision of images or other data solely for the use of controlling or monitoring the aircraft is not considered to be applicable to the meaning of 'Surveillance or Data Acquisition' in relation to ANO 2016 article 95.

UAS operators and remote pilots should be aware that the collection of images of identifiable individuals, even inadvertently, when using surveillance cameras mounted on an unmanned aircraft, may be subject to the General Data Protection Regulation and the Data Protection Act 2018. Further information about these regulations and the circumstances in which they apply can be obtained from the Information Commissioner’s Office and website: https://ico.org.uk/for-the-public/drones/

UAS operators must be aware of their responsibilities regarding operations from private land and any requirements to obtain the appropriate permission before operating from a
particular site. In particular, they must ensure that they observe the relevant trespass laws and do not unwittingly commit a trespass whilst conducting a flight.

3.5. Meaning of Commercial Operations

A commercial operation is defined in article 7 of ANO 2016 as:

‘a flight by a small unmanned aircraft except a flight for public transport, or any operation of any other aircraft except an operation for public transport;

- which is available to the public;

or

- which, when not made available to the public,

  (i) in the case of a flight by a small unmanned aircraft, is performed under a contract between the SUA operator and a customer, where the latter has no control over the remote pilot

  or

  (ii) in any other case, is performed under a contract between an operator and a customer, where the latter has no control over the operator,

in return for remuneration or other valuable consideration.’

This article must be carefully considered to determine if any flight will be considered as commercial operations. The key elements in understanding this term are ‘...any flight by a small unmanned aircraft...in return for remuneration or other valuable consideration...’

The term ‘available to the public’ should be interpreted as being a service or commodity that any member of the public can make use of, or actively choose to use, (e.g. because it has been advertised or offered to someone

Flying operations such as research or development flights conducted ‘in house’ are not normally considered as commercial operations provided there is no valuable consideration given or promised in respect of that particular flight.
3.6. Operations

3.6.1. Visual Line of Sight (VLOS)

Operating within Visual Line of Sight (VLOS) means that the remote pilot must be able to clearly see the unmanned aircraft and the surrounding airspace at all times while it is airborne. The key requirement of any flight is to avoid collisions and a VLOS operation ensures that the remote pilot is able to monitor the aircraft’s flight path and so manoeuvre it clear if anything that it might collide with. While corrective lenses may be used, the use of binoculars, telescopes, or any other forms of image enhancing devices are not permitted. Putting things in very simple terms, when operating VLOS, the aircraft must not be flown out of sight of the remote pilot’s eyes.

Within the UK, VLOS operations are normally accepted out to a maximum distance of 500 metres horizontally from the remote pilot, but only if the aircraft can still be seen at this distance. The ANO also limits the maximum distance from the earth’s surface to a height of 400 feet (see para 3.20 below). Operations at a greater distance from the remote pilot may be permitted if an acceptable safety case is submitted. For example, if the aircraft is large it may be justifiable that its flight path can be monitored visually at a greater distance than 500 metres. Conversely, for some small aircraft, operations out to a distance of 500 metres may mean it is not possible to assure or maintain adequate visual contact, and so the aircraft must obviously be kept closer to the remote pilot.

3.6.2. Operations in Congested Areas

Congested Areas
ANO 2016 Schedule 1 states that a ‘Congested Area’ means any area in relation to a city, town or settlement which is substantially used for residential, industrial, commercial or recreational purposes.

Operations of small unmanned aircraft over or within 150 metres of congested areas require a permission to be issued by the CAA in accordance with article 95(2)(a). Such a permission will normally be granted provided that the SUA operator is able to produce a suitable operations manual, evidence of remote pilot competency, and evidence of appropriate insurance cover. Separation distances from persons, vessels, vehicles and structures must still comply with the other requirements of article 95 (dependent on whether or not they are under the control of the remote pilot or the SUA operator).
Protection of Third Parties

Under ANO 2016 article 241, operators of small unmanned aircraft must not recklessly or negligently cause or permit their aircraft to endanger any person or property. This article does, of course, also apply to the endangerment of manned aircraft (because they are ‘property’) and the occupants of manned aircraft (because they are still ‘persons’).

Flights within the densely-populated urban environment have a higher probability of endangering persons or property unless conditions are put on their use so that they reduce the risk to third parties, i.e. the general public. Small unmanned aircraft do not currently have any recognised design, certification or other airworthiness standards and therefore operational restrictions have been established that limit the circumstances and locations at which the aircraft can be operated. Each specific limitation can only be varied or exempted in accordance with a permission or exemption granted by the CAA. An SUA operator will need to apply to the CAA for permission to fly a camera-equipped small unmanned aircraft:

- Over or within 150 metres of an organised open-air assembly of more than 1,000 persons.
- Within 50 metres of any person, vessel, vehicle or structure which is not under the control of the SUA operator or remote pilot (during take-off or landing, the distance from persons ‘not under control’ may be reduced to 30 metres).

Such a permission would be suitable for those SUA operators that find they are frequently engaged in towns and cities to carry out work for film and TV productions, advertising agencies, marketing or other publicity events, photographic work for large property developments or survey or infrastructure inspections at industrial sites, etc. There is no guarantee that a permission to reduce these distances can be granted.

Persons under the control of the SUA operator or remote pilot

Persons under the control of the SUA operator or remote pilot can generally be defined as:

- Persons solely present for the purpose of participating in the flight operation.
- Persons under the control of the event or site manager who can reasonably be expected to follow directions and safety precautions to avoid unplanned interactions with the small unmanned aircraft. Such persons could include building-site or other industrial workers, film and TV production staff and any other pre-briefed, nominated individuals with an essential task to perform in relation to the event.

Spectators or other persons gathered for sports or other mass public events that have not been specifically established for the purpose of the flying operation are not regarded as being ‘under the control’ of the of the SUA operator or remote pilot.

In principle, persons under the control of the SUA operator or remote pilot at a mass public
event must be able to:

- elect to participate or not to participate with the small unmanned aircraft flight operations;
- understand the risk posed to them inherent in the small unmanned aircraft flight operations;
- have reasonable safeguards instituted for them by the site manager and SUA operator during the period of any flight operations;
- not have restrictions placed on their engagement with the purpose of the event or activity for which they are present if they do not elect to participate with the small unmanned aircraft operation.

**Note:** As an example, it is not sufficient for persons at a public event to have been informed of the operations of the small unmanned aircraft via such means as public address systems, website publishing, e-mail, text and electronic or other means of ticketing, etc. without being also able to satisfy the points above. Permissions have, however, occasionally been granted for small unmanned aircraft flights at public events where these involved a segregated take-off site within the main event, with the aircraft operating only vertically within strict lateral limits that keep it directly overhead the take-off site. Such flights may also be limited by a height restriction and the tolerance of the aircraft to wind effects and battery endurance.

Further guidance on operational factors for small unmanned aircraft flights can be found in CAP 722A Annex A.

**Vehicles, Vessels and Structures under the control of the SUA operator or remote pilot**

Article 95(2)(c) makes reference vessels, vehicles and structures being under the control of a remote pilot or operator.

A vessel or vehicle could be said to be ‘under the control’ of a person if:

- That vehicle or vessel is present for the purpose of participating in the flight operation; and
- The operator of the vehicle or vessel (for example the driver of a car or captain of a ship) and any passengers are under the control of the remote pilot and can reasonably be expected to follow directions and safety precautions to avoid unplanned interactions with the small unmanned aircraft; and
- The owner or other person with an interest in the vessel or vehicle (such as a lessee) has granted permission for a UAS to operate within 50 metres of that vehicle or vessel.
A structure could be said to be ‘under the control’ of a person if:

- The owner or other person with an interest in the structure (such as a lessee) has granted permission for a UAS to operate within 50 metres of that structure; and
- Any occupants of the structure are under the control of the remote pilot.

### 3.6.3. Extended Visual Line of Sight (EVLOS)

EVLOS operations are operations, either within or beyond 500 metres / 400 feet, where the remote pilot is still able to comply with their collision avoidance responsibilities, but the requirement for the remote pilot to maintain direct visual contact with the UA is addressed via other methods or procedures. It is important to note, however, that collision avoidance is still achieved through the ‘visual observation’ of a human (by the remote pilot and/or competent Observers).

EVLOS operations may only be conducted under the terms of an exemption issued by the CAA. The operator must submit a safety case including a risk assessment for the operation. Factors taken into consideration must include:

- the procedures for avoiding collisions;
- aircraft size;
- aircraft colour and markings;
- aircraft aids to observation;
- meteorological conditions and visibility, including background conditions (cloud / blue sky);
- the use of deployed observers, including suitable communication methods within the team; and
- operating range limits - suitable radio equipment must be fitted in order to be able to effect positive control over the UA at all times.

### 3.6.4. Beyond Visual Line of Sight (BVLOS)

Operation of a UA beyond a distance where the remote pilot is able to respond to or avoid other airspace users by visual means is considered to be a BVLOS operation.

UA intended for BVLOS operations will require either:

- A technical capability which has been accepted as being at least equivalent to the ability of a pilot of a manned aircraft to ‘see and avoid’ potential conflicts. This is referred to as a Detect and Avoid (DAA) capability.
• Any DAA capability would be expected to ensure compliance with Regulation (EU) 923/2012 the Standardised European Rules of the Air (SERA) chapter 2 (avoidance of collisions), as adjusted by Rule 8 of the Rules of the Air Regulations 2015 (Rules for avoiding aerial collisions);

• a block of airspace to operate in which the unmanned aircraft is ‘segregated’ from other aircraft - because other aircraft are not permitted to enter this airspace block, the unmanned aircraft can operate without the risk of collision, or the need for other collision avoidance capabilities; or

• clear evidence that the intended operation will pose ‘no aviation threat’ and that the safety of persons and objects on the ground has been properly addressed

Note: the ultimate responsibility for avoiding collisions lies with the pilot-in-command of the aircraft, irrespective of the flight rules that the flight is being conducted under or any ATC clearances that may have been issued.

3.6.5. VLOS operating heights

Visual Line of Sight operations are limited to a maximum height restriction of 400 feet above the surface, however there is scope for the CAA to authorise flight at greater heights, via either a permission or exemption, if the CAA is satisfied that this can be achieved safely. Operations above 400 feet, within an aerodrome FRZ, may be approved by the Aerodrome Air Traffic Control service or Flight Information Service, without CAA approval.

This height limitation is intended to contribute to the safety of manned aircraft from the risk of collision with a small unmanned aircraft. With the obvious exception of take-off and landing, the majority of manned aircraft fly at heights greater than 500 ft from the surface. While there are some other exceptions where manned aircraft fly at ‘low level’ (such as Police, Air Ambulance and Search and Rescue helicopters, as well as military aircraft), flying a small unmanned aircraft below 400 ft significantly reduces the likelihood of an encounter with a manned aircraft. The height limitation is also identical to the one that is being introduced within the forthcoming European regulations for the operation of unmanned aircraft.

In aviation terms, ‘height’ means the vertical distance of an object (in this case the unmanned aircraft) from a specified point of datum (in this case above the surface of the earth). To cater for the few occasions where a small unmanned aircraft is being flown over hilly/undulating terrain or close to a cliff edge, the 400 ft height above the surface requirement may be interpreted as being a requirement to remain within a 400 ft distance

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6 In particular SERA 3201, SERA 3205, SERA 3210 and SERA 3215
from the surface, as shown in Figure 2 below. For the purposes of article 94A, this is considered to be an acceptable means of compliance with the legal requirement.

It should be noted that the 400ft limitation applies to ‘heights above/distances from’ the surface of the earth. It does not automatically apply to heights/distances from tall buildings or other structures: in such cases, an additional permission from the CAA will be required, which will invariably also require permission to operate within a congested area.

### 3.6.6. VLOS operations at night

There are no specific prohibitions to VLOS operations during night time. The basic VLOS principles still apply (i.e. you must be able to see the aircraft and the surrounding airspace). However, any applications for operational authorisations which include VLOS flight at night will be expected to include a ‘night operations’ section within the operations manual which details the operating procedures to be followed and should include items such as:

- daylight reconnaissance and site safety assessment of the surrounding area
- identification and recording of any hazards, restrictions and obstacles
- illumination of the launch site
- aircraft lighting/illumination requirements
3.6.7. **Tethered UAS operations**

A tethered UAS operation is one where the unmanned aircraft remains securely attached (tethered) via a physical link to a person, the ground or an object at all times while it is flying. The tether normally takes the form of a flexible wire or a cable and may also include the power supply to the aircraft as well.

Operations with a tethered UAS can be used as an efficient solution in a number of cases, for example where an operating area is restricted, or when the required flight time exceeds the normal endurance of a free flying battery powered aircraft.

Tethered UAS are subject to the same basic operating regulations as all other unmanned aircraft and, where necessary, are subject to the same authorisation process, but the fact that the operation is tethered can be used as a significant mitigation factor when applying for an operating authorisation, thus greatly simplifying the overall process.

3.7. **Insurance**

UAS Operators must comply with Regulation (EC) 785/2004 on Insurance Requirements for Air Carriers and Aircraft Operators. Further details regarding insurance are contained in Chapter 1, Section 2.5.

3.8. **UAS Operating Safety Case (OSC)**

The UAS Operating Safety Case (UAS OSC) has been devised using the ConOps methodology to give a flexible method by which the applicant can provide the CAA with a safety argument for intended operations. Each application for an exemption or a permission (other than for a ‘standard permission’ for commercial operations and/or for operations within a congested area) must be accompanied by a UAS OSC. Guidance and templates for the separate volumes of the UAS OSC are contained within CAP 722A.

Table 5 below provides UAS OSC requirements when applying for an exemption or permission.
<table>
<thead>
<tr>
<th>Mass (kg)</th>
<th>Operating examples</th>
<th>Volume 1</th>
<th>Volume 2</th>
<th>Volume 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>20kg or less</td>
<td>‘Standard Permission’ (commercial ops and/or &lt;150m in congested area)</td>
<td>Required</td>
<td>Recommended</td>
<td>Recommended</td>
</tr>
<tr>
<td></td>
<td>&lt;50m from uninvolved people/properties; &lt;150m from ‘organised open-air assemblies of more than 1000 persons’; &gt;400ft above the surface</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>over 20kg</td>
<td>Low Complexity UAS and/or Rural Environment</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td></td>
<td>Low Complexity UAS and/or Semi-rural(^7)</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td></td>
<td>High Complexity UAS and/or Complex Airspace(^8)/Congested Area</td>
<td>Required</td>
<td>Required</td>
<td>Required</td>
</tr>
</tbody>
</table>

Table 5 – UAS OSC Authorisation Requirements

Further details can be found in CAP722A.

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\(^7\) May require more formal airworthiness certification

\(^8\) May require more formal airworthiness certification within Category C (Certified)
4. Application Process

In order to ensure that sufficient safety measures have been put in place, operators that are required to apply for permission from the CAA will be asked to demonstrate that they have considered the safety implications and taken the steps necessary to ensure that the UA will not endanger anybody.

It is important to understand that it is the SUA operator (defined in ANO 2016 article 94G - i.e. the person having management of the UA, and not another person who may, for example, have contracted with the operator to have work done) who must apply for an exemption or permission.

Applications for an operational authorisation (exemption or permission) must be made using the application process listed in the UAS webpages of the CAA website www.caa.co.uk/uas.

The applicant is then able to apply through the NQE or directly to the CAA for the grant of a CAA 'standard' permission that will allow flights for commercial purposes and/or within congested areas. The operations manual (ideally in electronic PDF format) should accompany the formal application via the online portal along with electronic copies of the critical evidence of pilot competency and the correct fee as detailed in the published CAA Scheme of Charges. The online portal can be found here:

https://apply.caa.co.uk/CAAPortal/servlet/SmartForm.html?formCode=UAS

Please note that the CAA is unable to accept documents stored and hosted in third party cloud servers.

Applicants must submit all supporting documentation at time of application in support of this process. Failure to submit all required documentary evidence will delay the assessment process.

All applications for a permission, exemption or approval will require payment of the necessary fees as defined in the CAA Scheme of Charges. This can be found on the CAA website under the Publications Section, CAA Scheme of Charges (General Aviation). Any Service Level Agreements (SLA) are published on the CAA website and application forms.

Within the London Restricted Areas EG R157 (Hyde Park), EG R158 (City of London) and EG R159 (Isle of Dogs), SUA operators or remote pilots of any small unmanned aircraft are required to obtain an Enhanced Non-Standard Flight (ENSF) clearance. The procedures for processing these are set out on the NATS website https://www.nats.aero/do-it-online/non-standard-flight-nsf-applications/
Further details are published in the UK Aeronautical Information Publication (UK AIP) at ENR 1.1, section 4, paragraph 4.1.8 [www.ais.org.uk](http://www.ais.org.uk). This is mandatory for all flights within EGR 157, 158 or 159 and will involve authorisation by the Diplomatic Protection Group (DPG).

Other Airspace clearances may also be required for other types of operations. These should be addressed to [arops@caa.co.uk](mailto:arops@caa.co.uk)
5. National Qualified Entities

A National Qualified Entity (NQE) is approved by the CAA under the authority of Article 268 of the ANO 2016 and as such the approval is bounded by the limits of UK legislation. The CAA approves National Qualified Entities (NQEs) to conduct assessments of SUA operators and remote pilots and make recommendations to the CAA based upon these assessments. The NQE will validate the submission and then forward a recommendation for the granting of a 'standard' permission to the CAA. Further information regarding NQEs can be found in CAP722B.
6. Regulatory Enforcement

The CAA takes breaches of aviation legislation seriously and will seek to prosecute in cases where dangerous and illegal flying has taken place. However, the Police generally has greater resources, response times and powers of investigation than the CAA. To support this, the CAA has agreed with the Police, in a signed Memorandum of Understanding, that the Police will take the lead in dealing with UAS misuse incidents, particularly at public events, that may contravene aviation safety legislation or other relevant criminal legislation.

Privacy issues are covered by the Information Commissioners Office (ICO) and will not be dealt with by the CAA.

More information on the regulation of small unmanned aircraft, including a list of operators with permission to fly small unmanned aircraft for commercial purposes, is available at www.caa.co.uk/uas.

6.1. Source Documents

- CAP 393 Air Navigation: The Order and the Regulations.
- CAP 1074 Safety and Airspace Regulation Enforcement Guidance
7. Civil UAS Remote Pilot Competency

7.1. Scope

This section applies to all civil UAS operations in United Kingdom airspace. State (non-military) operated UAS are expected to comply with this section, unless otherwise directed by the CAA.

UAS operations conducted for the purposes of testing or are expected to comply with this section as far as is practicable. However, qualification requirements for remote pilots engaged in such operations will be assessed by the CAA at the point of submission for an operational authorisation.

7.2. Policy

The requirements for the licensing and training of United Kingdom civil remote pilots have not yet been fully developed. It is expected that United Kingdom requirements will ultimately be determined by ICAO Standards and Recommended Practices (SARPs) and EASA regulations.

ICAO has developed initial standards for a Remote Pilot's Licence (RPL), but these are part of a larger SARPS package that will not become applicable until 2022 at the earliest and will not necessarily apply to the Open and Specific operating categories. Until formal licensing requirements are in place the CAA will determine the relevant requirements on a case-by-case basis. In determining whether to permit a person to act as a remote pilot of a UAS, the CAA will consider a number of factors (based upon the ConOps approach) such as the type of operation being conducted, pilot experience, maximum aircraft mass, the system being operated, flight control mode, operational control and safety assessment.

7.3. Maximum Operating Mass

UAS are currently classified into two mass categories described below; the flight crew qualification requirements are related to these. Table 6 details the competency requirement for pilots of UAS in the relevant aircraft mass category.
### Table 6 Unmanned Aircraft Mass Related Pilot Competency and Licensing Requirements

<table>
<thead>
<tr>
<th>Operating Mass (maximum)</th>
<th>Pilot Competency / Licensing Requirements</th>
</tr>
</thead>
</table>
| 20 kg or less           | None, NQE competency assessment/ AMC , or additional competency dependent on the requirements of the operation (Operating Safety Case)  
Note: from 30 November 2019, ANO article 94F introduces new ‘basic’ competency requirements for remote pilots of small unmanned aircraft |
| More than 20 kg         | Dependent on requirements of the operation (Operating Safety Case), RPL, or equivalent |

#### 7.4. UAS Flight Control Mode

Remote Pilots will also be required to meet training and testing requirements for each class or type of UAS they will operate. This may be specific to each model of UAS (in the case of larger and certified platforms) or a more general ‘type’ of UAS – i.e. multi rotor, fixed wing etc, in the case of smaller UAS.
7.5. Alternative Means of Compliance

Table 7 describes the alternative means of compliance for the demonstration of pilot competency. NQEs are not under any obligation to accept candidates with these acceptable means of compliance, in such instances these candidates may present acceptable means of compliance described below to the CAA, with their practical flight assessment recommendation.

<table>
<thead>
<tr>
<th>UAS Pilot Competency Alternative Means of Compliance</th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Aviation Qualification:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical Element: Theoretical Knowledge Requirement / General Airmanship (no requirement for annual renewal)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Nil</td>
<td>Completion of a Full Category NQE course</td>
<td>2 hours total flight experience logged within the last 3 calendar months on the class of SUA for which a Permission is sought.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Nil</td>
<td>Pilot flight skills assessment verified to the CAA by a Full or Restricted Category NQE in at least one of the</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Nil</td>
<td></td>
<td>It should be noted that these hours must be</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>UAS Pilot Competency Alternative Means of Compliance</th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>UK Military pilot / remote pilot or RPAS operator qualification</td>
<td>Nil</td>
<td>following two classes: a) SUA multirotor with a maximum take-off mass (MTOM) not exceeding 20 kg. b) SUA fixed-wing with a MTOM not exceeding 20 kg.</td>
<td>undertaken on a SUA, and not an SUA simulator. Pilots may self-certify through logbook entries (these can be hard copy or electronic).</td>
</tr>
<tr>
<td></td>
<td>(applicable where basic flight training has been carried out in non-segregated UK airspace)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAF VGS Instructor qualifications commencing at G1 Instructor level are also acceptable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>British Gliding Association (BGA) - Bronze ‘C’ and above (or EASA equivalent)</td>
<td>Nil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>BMFA ‘A’ or ‘B’ Certificates (or SAA/LMA equivalents)</td>
<td>Nil</td>
<td>Nil. Helicopter certificate accepted for multirotors</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Non-UK SUA/RPAS qualification/licence</td>
<td>Case-by-case CAA assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Other lapsed pilot licences or certificates</td>
<td>Licences that lapsed prior to 2010 will not be deemed acceptable for the issue of an authorisation.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7 - Pilot Competency Criteria for Small Unmanned Aircraft Permission under ANO articles 94 and 95
7.6. Granting of a small unmanned aircraft permission or exemption – Critical elements for remote pilot competency

In order to grant a permission or exemption, evidence of pilot competency must be demonstrated. This includes:

**Pilot Competency**

- Adequate theoretical knowledge/general airmanship;
- Successful completion of a practical flight assessment on the class of SUA that is being applied for;

**Operations Manual**

The CAA requires the submission and acceptance of an operations manual in each case before the Permission itself can be granted. The practical competency assessment will be based on the contents of the operations manual.

**Currency of competency**

A minimum amount of recent flying experience on the class of SUA that is being applied for, on renewal of the permission or exemption.

7.7. NQE Recommendations

The CAA accepts recommendations from approved NQEs in order to grant a ‘standard’ Permission. The traditional NQE route allows an individual with no formal pilot qualifications or experience to undertake a course which can lead to a recommendation to the CAA for a grant of a CAA Permission. The courses cover all of the critical elements mentioned in paragraph 4.7 plus an assessment of the student’s operational procedures as set out in their operations manual (Vol 1 of the UAS OSC). On successful completion of the course, the applicant will be granted a certificate or recommendation by the NQE. Recommendations from NQEs provide the CAA with an acceptable demonstration of remote pilot competence in order to operate a small unmanned aircraft. The recommendation can only be made once the NQE is satisfied that the individual has demonstrated appropriate knowledge of the applicable regulations, policy and/or the capability to fly the aircraft in accordance with his/her organisation’s operational procedures.

As the UAS industry has developed, the CAA has been increasingly asked to accept alternative qualifications and methods of demonstrating pilot competency other than those provided through the NQE route. Many recent applicants for a permission have formal
aviation qualifications, hobbyist certificates or recent flight experience that are highly relevant for fulfilling the critical elements set out in paragraph 4.7 above. An analysis of the critical elements points towards the practical flight assessment as being the single most essential of the elements as small unmanned multirotor and fixed-wing aircraft have unique flight and control systems and characteristics. Unless an applicant has already been objectively assessed by a third-party (such as through the British Model Flying Association (BMFA) certificate system), then there still exists a need for applicants to complete this critical element through an independent assessment.

The CAA therefore accepts alternative methods of satisfying the critical elements in addition to completing a full NQE course. Acceptable alternatives to fulfil the critical elements (evidence of pilot competency) are shown at Table 7.

7.8. Other Factors

Prior to the implementation of formal UAS Remote Pilot licensing requirements, the CAA will consider factors such as the arrangements for operational control of a UAS, and the safety risk assessment of a proposed UAS operation, when considering whether to permit an application for a person to act as a remote pilot.

7.9. Flight Radio Telephony Operators’ Licence

Remote Pilots wishing to use radiotelephony must ensure that they hold a Flight Radio Telephony Operators’ Licence (FRTOL) valid for the privileges intended to be exercised.

Further information can be found here:

https://www.caa.co.uk/General-aviation/Pilot-licences/EASA-requirements/General/Flight-radio-telephony-operator-licence/

The use of radiotelephony on aeronautical band radios for contact with air traffic control, for the operation of small unmanned aircraft, should be limited to exceptional circumstances, and as directed by the air traffic service unit with which the remote pilot needs to communicate. In the vast majority of circumstances, mobile telephone communication, or non-aeronautical radio communication is sufficient. Permission to access flight restriction zones should not be made by radiotelephony, unless directed to do so by the aerodrome.
CHAPTER 3 | Policy
1. CAA Policy on Detect and Avoid Capability

1.1. Scope

This Chapter offers guidance to industry on how to satisfy the requirements for a Detect and Avoid functions.

1.2. Introduction

A significant increase in both civil and military UAS flying is anticipated, most of which will require access to some if not all classes of airspace if it is to be both operationally effective and commercially viable. To achieve this, UAS will have to be able to display a capability that is equivalent to the existing safety standards applicable to manned aircraft types, appropriate to the class (or classes) of airspace within which they are intended to be operated.

1.3. Aim

The aim of this policy statement is to clarify the position of the CAA in respect of its role in assisting the UAS industry to find solutions to achieving a capability and level of safety which is equivalent to the existing 'see and avoid' concept. It is also recognised that the Detect and Avoid (DAA) capability is only one of a number of requirements that will need to be addressed for safe operation of UAS, particularly if not operating within segregated airspace.

1.4. General

Detect and Avoid is a generic expression which is used to describe a technical capability that is commensurate to the 'see and avoid' principle used in manned aviation. The overriding principle when assessing if proposed UAS DAA functions are acceptable is that they must not introduce a greater hazard than currently exists for manned aviation. Any proposed capabilities must, as a minimum, demonstrate an equivalence with those required for manned aircraft. The UAS must be operated in a way that enables it to comply with the rules and obligations that apply to manned aircraft, particularly those applicable to separation and collision avoidance. When operating outside controlled airspace, manned aircraft rely on ‘see and avoid’ to remain clear of other aircraft. UAS
must employ the same philosophy – i.e. it must detect other aircraft and avoid them particularly given the difference in size of most UAS compared to manned aircraft, and the associated difficulty for a manned aircraft in seeing a UAS with sufficient time to remain clear.

**1.5. Separation Assurance and Collision Avoidance Elements**

There are two distinct and potentially independent elements to a DAA capability, as described below. It must be noted that the remote pilot could act as an element within one or both of these elements, subject to being able to affect the desired outcome. Detect Function

The detect function is intended to identify potential hazards (other aircraft, terrain, weather etc.) and notify the appropriate mission management and navigation systems.

**1.5.1. Avoid Function**

The avoid function may be split down into two parts:

- **Separation Assurance/Traffic Avoidance:**
  
  This term is used to describe the routine procedures and actions that are applied to prevent aircraft getting into close proximity with each other. Any resolution manoeuvring conducted at this stage must be conducted in accordance with the Rules of the Air. When flying in airspace where the provision of separation is the responsibility of ATC, however, the remote pilot must manoeuvre the aircraft in accordance with ATC instructions, in the same fashion as is done for a manned aircraft.

- **Collision Avoidance:**
  
  This is the final layer of conflict management and is the term used to describe any emergency manoeuvre considered necessary to avoid a collision; such a manoeuvre may contradict the Rules of the Air or ATC instructions. While the Remote Pilot would normally be responsible for initiating a collision avoidance manoeuvre, an automatic function may be required in order to cater for collision avoidance scenarios where the Remote Pilot is unable to initiate the manoeuvre in sufficient time, e.g. due to command and control (C2) latency issues or lost link scenarios.

The DAA (separation and collision avoidance) capabilities must be able to:
Detect and avoid traffic (air and ground operations) in accordance with the Rules of the Air;

Detect and avoid all airborne objects, including gliders, hang-gliders, paragliders, microlights, balloons, parachutists etc.;

Enable the Remote Pilot to determine the in-flight meteorological conditions;

Avoid hazardous weather;

Detect and avoid terrain and other obstacles;

Perform equivalent functions, such as maintaining separation, spacing and sequencing that would be done visually in a manned aircraft.

### 1.6. Minimum DAA Requirements for Routine Operations

For routine BVLOS operations in non-segregated airspace a DAA capability will always be required unless the UAS operator is able to provide the CAA with clear evidence that the operation that is being proposed will pose no hazard to other aviation users.

The minimum level of DAA capability that is required may be adjusted in accordance with the flight rules under which the UA flight is being conducted and class of airspace that the UA is being flown in as follows:

**IFR flights within controlled airspace (Classes A to E)**

- A *Collision Avoidance* capability will be required
  - **ATC separates** from other traffic (although in Class D and E, the pilot of a conflicting VFR flight holds the separation responsibility)
  - As for manned aviation, a collision avoidance capability is required in case the ‘normal’ separation provision fails
  - If the flight is conducted wholly within controlled airspace where the operation of a transponder is mandatory, then a collision avoidance capability that is cooperative (e.g. ACAS) would be acceptable

- If there is any possibility that the UAS will/might leave controlled airspace and enter non-segregated Class G airspace during the flight (including in an emergency), then the collision avoidance capability would be required to be a non-cooperative one, unless there are other airspace measures in place that would still allow a non-cooperative system to be used; this includes airspace such as a Transponder Mandatory Zone, airspace above FL100 (where the operation of a transponder is required) etc

**VFR flights within controlled airspace, or any flight within Class G airspace**
A Separation Assurance/Traffic Avoidance capability and a Collision Avoidance capability will be required

- The remote pilot is the separator for all conflicts, with the same responsibilities as the pilot of a manned aircraft

### 1.7. Research and Development

It is not the role of the CAA to carry out research and development activities; this must be performed by the UAS industry. The research and development process will include full and open consultation with the CAA at appropriate stages so that the CAA can provide guidance on the interpretation of the applicable rules and regulations.

It is strongly recommended that developers of DAA technology for the use of UAS in non-segregated airspace set up a programme of regular discussion and review of their research and development activity with the CAA; early engagement is vital in the process. This will ensure that system developers will have access to the best advice on the applicable regulations, thereby increasing the likelihood of the ultimate acceptance of any DAA system by the civil authorities.

UAS designers will need to demonstrate equivalence to the regulatory and airworthiness standards that are set for manned aircraft.

To ensure that the DAA capability can provide the required level of safety they will be developed for the various component functions which include threat detection, assessment of the collision threat, selection of an appropriate avoidance manoeuvre and execution of a manoeuvre compatible with the aircraft’s performance capabilities and airspace environment. It is recommended that the System Safety Assessment process be followed (Chapter 4 Section 4) as this will support determination and classification of the various hazards and thus the level of integrity that may be required from particular system approaches.

### 1.8. Factors for consideration when developing a DAA capability

The CAA does not define the matters to be taken into account for the design of aircraft or their systems. However, for the guidance of those engaged in the development of DAA systems, some of the factors that may need to be considered are listed below:

- Ability to comply with the Rules of the Air;
- Airworthiness;
- Control method, controllability and manoeuvrability;
- Flight performance;
- Communications procedures and associated links.
- Security (physical and cyber);
- Emergency actions, reversionary or failure modes in the event of degradation of any part of the UAS and its associated Control and/or Relay Stations;
- Actions in the event of lost communications and/or failure of on-board DAA equipment;
- Ability to determine real-time meteorological conditions and type of terrain being overflown;
- Nature of task and/or payload;
- System Authority of operation and control;
- Method of sensing other airborne objects;
- Remote Pilot level of competence;
- Communications with ATS providers, procedures and links with control station;
- Means of launch/take-off and recovery/landing;
- Reaction logic to other airspace objects;
- Flight termination;
- Description of the operation and classification of the airspace in which it is planned to be flown;
- Transaction times (e.g. including delays introduced by satellite links);
- Address both cooperative and non-cooperative air traffic.

**Note:** This list above is not exhaustive.
2. CAA Policy on Human Factors in UAS Operations

2.1. Scope

This Chapter offers guidance to industry on how to address the human factors issues associated with the design, operation and maintenance of UAS.

2.2. Introduction

It is recognised by the CAA that Human Factors represent an important aspect of the design, operation and maintenance of UAS.

The fundamental concepts of Human Factors in aviation are covered by CAP 719. Additional guidance on human factors issues associated with aircraft maintenance is provided in CAP 716.

It is important to recognise that the human is an integral element of any UAS operation and, therefore, in addition to the standard Human Factors issues that relate to aviation development, operation and maintenance, a number of unique Human Factors issues associated with remote operation will also need to be addressed.

This guidance outlines a number of Human Factors recommendations related to the design, production operation and maintenance of UAS flown routinely in UK airspace.

2.3. General

A system of systems approach must be adopted in the analysis, design and development of the UAS. This approach deals with all the systems as a combined entity and addresses the interactions between those systems. Such an approach must involve a detailed analysis of the human requirements and encompass the Human Factors Integration domains:

- Manpower;
- Personnel;
- Training;
- Human Engineering;
- System Safety;
- Health Hazards;
• Social and Organisational;
• Ergonomics;
• Human-Machine Interface (HMI) Development and Assessment;
• Human Performance, including consideration of workload issues, situation awareness and distributed cognition of the system, teamwork and group dynamics and user acceptance and confidence in the system;
• Human Error and Resilience Assessment.

This approach must be applied to all the Human Factors issues identified in this Chapter.

2.4. Design Human Factors

There are two levels of Human Factors issues that need to be addressed for design:

• Human factors that affect design teams
• Design induced remote pilot or maintenance human factors issues

2.5. Human Factors That Affect Design Teams

The set of problems that can initiate Human Factors issues for design teams are not dissimilar to other environments. These include but are not limited to:

• Insufficient time to perform a task;
• Insufficient training and experience to perform a task;
• Inadequate, incomplete or ambiguous procedures, work instructions;
• Rapid and/or uncontrolled changes to requirements;
• Inappropriate working environments that can lead to distraction (e.g. noisy offices, multiple demands on individual’s time);
• Fatigue;
• Poor or non-existent working relationships with management and/or other teams.
• Group dynamics affecting group decision making (e.g. groupthink, risky and stingy shift in risk-based decisions).

Each of these issues can result in a design team making an error and failing to detect it before the aircraft or aircraft system enters service. These errors can result in operational or maintenance problems (system failures, inappropriate maintenance etc) and can even
drive additional human factors issues in other aviation domains such as the flight deck or maintenance.

Organisations that are developing UAS must ensure that the programme management aspects of their projects address potential Human Factors issues (e.g. provision of appropriate work spaces and instructions, effective control of the number of simultaneous demands made on individuals, effective control of the rate of requirement change, management of fatigue etc). The means by which this will be achieved must be described to the authority for any proposed certification project

2.6. Design Induced Remote Pilot Human Factors

The set of design induced remote pilot Human Factors issues includes but is not limited to:

- Non-optimal workspace layout which increases the likelihood of errors.
- Failure to present, late presentation or incomplete presentation of important information to the RPAS pilot.
  
  Too much or too little information provided to the RPAS pilot so that effective assimilation is not possible. Incorrect prioritisation of alerts;
- Insufficient notice of the need to perform a task (possibly related to data latency);
- Inadequate, incomplete or ambiguous procedures, work instructions;
- Lack of clarity regarding where to find the relevant control instructions (Standard Operating Procedures, Aircraft Flight Manuals etc);
- Non-obvious system mode changes or mode confusion.

Each of these issues can result in a remote pilot either making an error or failing to detect an aircraft safety issue.

Organisations that are developing UAS must ensure that any identified potential Human Factors issues (e.g. management of information to the pilot so that he/she can integrate this effectively, effective control of the number of simultaneous demands made on remote pilots etc) are addressed and mitigated as part of the UAS development processes. The means by which this will be achieved must be described to the authority for any proposed certification project.

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9 Alerts is a generic term that includes warnings, cautions and status messages.
2.7. Design Induced Maintenance Human Factors

The set of design induced maintenance Human Factors issues includes but is not limited to:

- Incomplete situation awareness (as a result of missing/inadequate information and/or data latency);
- Information overload/underload;
- Incorrect prioritisation of alerts\(^{10}\);
- Insufficient notice of the need to perform a task (possibly related to data latency);
- Inadequate, incomplete or ambiguous procedures, work instructions;
- Lack of clarity regarding where to find the relevant control instructions (Standard Operating Procedures, Aircraft Flight Manuals etc);
- Non-obvious system mode changes.

Each of these issues can result in a maintenance error which could result in an aircraft safety issue.

Organisations that are developing UASs must ensure that any identified potential maintenance Human Factors issues (e.g. provision of clear and unambiguous task instructions etc) are addressed and mitigated as part of the UAS development processes. The means by which this will be achieved must be described to the authority for any proposed certification project.

2.8. Outstanding Problem Reports

Any outstanding problem reports that are related to the interface between the system and the remote pilot or maintenance functions must be carefully evaluated in terms of any potential human factors issues. If the problem is likely to result in Human Factors issues and it cannot be rectified before the system enters service, then:

- The certification flight or maintenance teams must be informed of the problem and its likely consequences;
- Where applicable the relevant flight or maintenance documentation must be updated to ensure that the remote pilots or maintenance team are aware of both the problem and any action(s) they need to take in order to mitigate it;

\(^{10}\) Alerts is a generic term that includes warnings, cautions and status messages.
The certification team must be provided with an analysis of the problem, the necessary resolution and the plan for incorporating that resolution.

2.9. Production Human Factors

The set of problems that can initiate Human Factors issues for production teams is not dissimilar to other environments. These include but are not limited to:

- Insufficient time to perform a task;
- Insufficient training and experience to perform a task;
- Inadequate, incomplete or ambiguous procedures, work instructions;
- Uncontrolled changes to build specifications;
- Inappropriate working environments that can lead to distraction (e.g. noisy offices, multiple demands on individual’s time;
- Fatigue.

Organisations that are developing UASs must ensure that their production management processes address potential Human Factors issues (e.g. provision of appropriate work spaces and instructions, effective control of the number of simultaneous demands made on individuals, management of fatigue etc). The means by which this will be achieved will be described to the authority for any proposed certification project.

2.10. Operational Human Factors

In addition to the “standard” operational Human Factors issues, the physical separation of the Remote Pilot introduces a number of issues that need to be considered. These include but are not limited to:

- Degradation of situation awareness due to remote operation and associated lack of multi-sensory feedback;
- Temporal degradation resulting from data latency, pilot recognition, pilot response and pilot command latency over the data link requires consideration in the design of controls and displays;
- The Remote Pilot’s risk perception and behaviour are affected by the absence of sensory/perceptual cues and the sense of a shared fate with the vehicle;
- Bandwidth limitations and reliability of the data link compromising the amount and quality of information available to the Remote Pilot and thereby limiting his awareness of the RPA’s status and position.
It is therefore important to:

- Avoid presenting misleading cues and to consider alternative methods of representing the UAS data;
- Prioritise relevant data sent over the C2 link to satisfy the needs for all phases of the operation; and
- Ensure that data link characteristics and performance (such as latency and bandwidth) are taken account of within the relevant information and status displays in the Remote Pilot Station (RPS).

2.11. Authority and Control

The Remote Pilot is ultimately responsible for the safe conduct of the aircraft. They will, therefore, be required to sanction all actions undertaken by the aircraft whether that is during the planning stage (by acceptance of the flight plan) or during the execution of the mission via authorisation, re-plans or direct command. Though fully autonomous operation of a UAS is not currently envisaged, certain elements of a mission may be carried out without human intervention (but with prior authorisation). A good example of this is the Collision Avoidance System where, due to possible latency within the C2 link, the Remote Pilot may not have sufficient time to react and therefore the on-board systems may need to be given the authority to take control of the aircraft.

This level of independent capability, that must operate predictably and safely when required, can also be harnessed as a deliberative function throughout the flight. This supports a change in the piloting role from a low-level ‘hands-on’ type of control to an effective high-level decision maker. Due to the nature of remote operation, the RPS need no longer be constrained to follow a traditional cockpit design philosophy and must be designed to fit the new operator role. Account may be taken of enhanced system functionality allowing the pilot to control the systems as required via delegation of authority.

A clear understanding of the scope of any autonomous operation and its automated sub-systems is key to safe operations. Specific areas that need to be addressed are:

- User’s understanding of the system’s operation;
- Recovery of control after failure of an automated system;
- User’s expertise in manual reversion (they will not necessarily be pilots);
- Boredom and fatigue; and
- Design of the controls, including the design ‘model’, allowing the user to understand how the different levels of automation operate.
2.12. Ergonomics

The RPS will be the major interface between the Remote Pilot and the aircraft. The advice contained herein relates to the type of information and the nature of the tasks that would be undertaken at an RPS, it does not set the airworthiness, technical or security requirements. The ergonomic standards must ensure that the pilot works in an environment that is fit for purpose, does not create distractions and provides an environment that will allow pilots to maintain alertness throughout a shift period.

The ergonomic requirements of ‘hand held’ (VLOS) remote pilot stations must also be considered. Careful consideration must be given to the environmental conditions that will be encountered when operating outdoors (excesses in temperature, wet or windy conditions etc.). The potential for distraction to the pilot is also much greater in this environment.

2.13. Flight Crew Awareness

A number of sub-systems associated with the operation of a UAS are likely to be complex in their operation and therefore may very well be automated. The system must provide the operator with appropriate information to monitor and control its operation. Provision must be made for the operator to be able to intervene and override the system (e.g. abort take-off, go around).

2.14. Transfer of Control between Remote Pilots

UAS operations may require the transfer of control to another pilot. This operation needs to be carefully designed to ensure that the handover is accomplished in a safe and consistent manner and would be expected to include the following elements:

- Offer of control;
- Exchange of relevant information;
- Acceptance of control; and
- Confirmation of successful handover.

The exchange of information between Remote Pilots (co-located or remotely located) will require procedures that ensure that the receiving pilot has complete knowledge of the following:

- Flight Mode;
- UAS flight parameters and aircraft status;
- UAS sub-system status (fuel system, engine, communications, autopilot etc);
- Aircraft position, flight plan and other airspace related information (relevant NOTAMs etc.);
- Weather;
- The current ATC clearance and frequency in use;
- Positions of any relevant RPS control settings in order to ensure that those of the accepting RPS are correctly aligned with the transferring RPS.

The transferring pilot will remain in control of the RPA until the handover is complete and the accepting pilot has confirmed that he is ready to assume control. In addition:

- Procedures to cater for the recovery of control in the event of a failure during the transfer process will be required; and
- Special attention will be required when designing handover procedures involving a significant change in the control interface, for example between a VLOS 'Launch and Recovery Element' RPS and a BVLOS 'En-Route' RPS.

### 2.15. Crew Resource Management

Workload and Crew Resource Management play an equally important role in the ground station as they do on a manned flight deck. The allocation and delineation of roles must ensure a balanced workload and shared situation awareness of the UAS status and proximity to other aircraft and flight paths to ensure that:

- The display design provides clear and rapid information retrieval matched to the human needs; and
- The Remote Crew Station design promotes good team co-ordination.

### 2.16. Fatigue and Stress

Fatigue and stress are contributory factors which are likely to increase the propensity for human error. Therefore, in order to ensure that vigilance is maintained at a satisfactory level in terms of safety, consideration must be given to the following:

- Crew duty times;
- Regular breaks;
- Rest periods and opportunity for napping during circadian low periods;
- Health and Safety requirements;
- Handover/Take Over procedures;
- The crew responsibility and workload;
- Ability to mitigate the effects of stress from non-work areas (e.g. financial pressure causing anxiety).

The work regime across the crew must take this into account.

### 2.17. Degradation and Failure

Degradation of performance and failures will require a philosophy for dealing with situations to ensure consistent and appropriate application of warnings, both visual and auditory. The philosophy must ensure that:

- The design provides good error detection and recovery;
- The design is fail-safe and protects against inadvertent operator actions that could instigate a catastrophic failure;
- In the event of degraded or total breakdown in the communication link the status of the lost link will be displayed to the operator. Ideally the expected planned reactions of the UA to the situation will also be displayed to the operator;
- Operating procedures are designed to be intuitive, not ambiguous and reinforced by training as required.

### 2.18. Maintenance Human Factors

The set of problems that can initiate Human Factors issues for maintenance teams is not dissimilar to other environments. These include but are not limited to:

- Insufficient time to perform a task;
- Insufficient training and experience to perform a task;
- Inadequate, incomplete or ambiguous procedures, work instructions;
- Inappropriate working environments that can lead to distraction (e.g. noisy offices, multiple demands on individual’s time);
- Fatigue;
- Poor or non-existent working relationships with management and/or other teams.

Each of these issues can result in a maintenance team making an error and failing to
detect it before the aircraft or aircraft system enters service. These errors can result in operational or maintenance problems (system failures, inappropriate maintenance etc.) and can even drive additional Human Factors issues in other aviation domains such as the flight deck or maintenance.

Organisations that are developing UASs must ensure that any maintenance Human Factors issues (e.g. provision of clear and unambiguous instructions) are addressed. The means by which this will be achieved must be described to the authority for any proposed certification project.

### 2.19. Future Trends

Future developments in UAS are moving more towards mitigating Remote Pilot workload through advanced decision support systems. Human Factors expertise will be central to such developments to produce a system that is not only safe but also ensures the correct level of crew workload for all mission tasks and phases of flight.

### 2.20. Source Documents

- CAP 719 Fundamental Human Factors Concepts
- CAP 716 Aviation Maintenance Human Factors (EASA/JAR145 Approved Organisations)
- CAP 737 Crew Resource Management (CRM) Training
- CAP 789 Requirements and Guidance Material for Operators
- ISO 9241
- ISO 13407
3. CAA Policy on UAS Autonomy

3.1. Scope

This guidance relates to the regulatory interpretation of the term “autonomous” and provides clarification on the use of high authority automated systems in civil UAS.

3.2. Introduction

The dictionary definition of autonomy is “freedom from external control or influence”. The need to meet the safety requirements, defined in the various Certification Specifications under CS XX.1309, for "Equipment, Systems and Installations" means that at this point in time all UAS systems are required to perform deterministically. This means that their response to any set of inputs must be the result of a pre-designed data evaluation output activation process. As a result, there are currently no UAS related systems that meet the definition of autonomous.

In general, UAS systems fall in to two categories:

- Highly automated – those systems that still require inputs from a human operator (e.g. confirmation of a proposed action) but which can implement the action without further human interaction once the initial input has been provided.

- High authority automated systems – those systems that can evaluate data, select a course of action and implement that action without the need for human input. Good examples of these systems are flight control systems and engine control systems that are designed to control certain aspects of aircraft behaviour without input from the flight crew.

The concept of an "autonomous" UAS is a system that will do everything for itself using high authority automated systems. It will be able to follow the planned route, communicate with Aircraft Controllers and other airspace users, detect, diagnose and recover from faults and operate at least as safely as a system with continuous human involvement. In essence, an autonomous UAS will be equipped with high authority control systems that can act without input from a human.
3.3. **What is the Difference between Automation and Authority?**

Automation is the capability of a system to act using a set of pre-designed functions without human interaction (e.g. robotic manufacturing).

The level of authority a system has is defined by the results that the system can achieve. For example, a flight control computer may only be able to command a shallow roll angle, whereas the human flight crew will be able to demand a much higher angle of roll. A full authority system will be able to achieve the same results as a human operator.

3.4. **Use of High Authority Automatic Systems**

High authority automatic systems have the capability to take actions based on an evaluation of a given dataset that represents the current situation including the status of all the relevant systems, geographical data and environmental data.

Although these systems will take actions based on an evaluation of a given dataset they are required to be deterministic in that the system must always respond in the same way to the same set of data. This means that the designs of the associated monitoring and control systems need to be carefully considered such that the actions related to any given dataset are appropriate and will not hazard either the aircraft or any third parties in the same area.

High authority automatic systems are usually composed of a number of sub-systems used to gather data, evaluate data, select an appropriate set of actions and issue commands to related control systems. These systems can include flight management systems, detect and avoid systems, power management systems, etc.

In an UAS a system can have authority over two types of function: general control system functions (e.g. flight control computers) and navigational commands.

3.5. **Delegation to a High Authority Automatic System**

The concept of high authority automatic systems covers a range of varying degrees of system authority ranging from full authority where the systems are capable of operating without human control or oversight to lesser levels of authority where the system is dependent upon some degree of human input (e.g. confirmation of proposed actions).

The level of authority a system can have with respect to navigational commands may vary during any flight, dependent upon the hazards the aircraft is faced with (e.g. terrain or potential airborne conflict with other aircraft) and the time available for the human operator to effectively intervene. If the aircraft is flying in clear airspace with no nearby terrain the
system may be designed such that any flight instructions (e.g. amendment to a flight plan) are instigated by a human operator. However, if the aircraft is faced with an immediate hazard (terrain/other aircraft) and there is insufficient time for a human operator to intervene (based on signal latency etc.) the UAS will need to be able to mitigate that risk. These mitigations may include the use of full authority automatic systems.

Although it is anticipated that most systems will be operated using a lesser level of authority, the design of the overall system (control station, air vehicle and related operational procedures) will need to take account of the failure conditions associated with loss of the command and control communications link between the control station and the air vehicle and this may drive a need for the use of full authority systems.

3.6. Potential Future Developments

3.6.1. Learning/Self Modifying Systems

A learning, or self-modifying system is one that uses data related to previous actions to modify its outputs such that their results are closer to a previously defined desired outcome. Although learning systems do have the potential to be used in UAS, the overall safety requirements (for example the need to comply with CS XX.1309) still apply. This means that it may not be possible to use these systems to their full potential.

It is also important to note that these systems have the potential to be more susceptible to the effects of emergent behaviour and, as such, the evaluation of such systems would out of necessity need to be very detailed.

3.6.2. Other Potential Developments

It is possible that, at some point in the future, the aviation industry may consider the use of non-deterministic systems to improve overall system flexibility and performance.

Whilst there are no regulations that specifically prohibit this, the use of non-deterministic systems will drive a number of system and operational safety assessment issues that will need to be addressed before the use of this type of technology could be accepted for use in aviation.

3.7. General
All past and current civil aircraft operations and standards have an inherent assumption that a competent human is able to intervene and take direct control within a few seconds at any stage, and that the human will be been presented with enough information to have continuous situational awareness. It is to be expected that, for the foreseeable future, the civil aviation authorities would require this human intervention facility to be available for all UAS regardless of their level of autonomy.

### 3.8. Human Authority over Autonomous UAS

CAA policy is that all UAS must be under the command of a Remote Pilot. Dependent upon the level of autonomy, a Remote Pilot may simultaneously assume responsibility for more than one aircraft, particularly when this can be accomplished safely whilst directing the activities of one or more other Remote Pilots. However, if this option is to be facilitated the applicant will need to demonstrate that the associated human factors issues (displayed information, communication protocols, etc) have been fully considered and mitigated.

### 3.9. Safe Operation with Other Airspace Users

Autonomous UAS must demonstrate an equivalent level of compliance with the rules and procedures that apply to manned aircraft. It is expected that this will require the inclusion of an approved Detect and Avoid capability when UAS are operating outside segregated airspace.

### 3.10. Compliance with Air Traffic Management Requirements

Autonomous UAS operation is expected to be transparent to ATM providers and other airspace users. The autonomous UAS will be required to comply with any valid ATC instruction or a request for information made by an ATM unit in the same way and within the same timeframe that the pilot of a manned aircraft would. These instructions may take a variety of forms and, for example, may be to follow another aircraft or to confirm that another aircraft is in visual sight.

### 3.11. Emergencies

The decision-making function(s) of any autonomous UAS must be capable of handling the same range of exceptional and emergency conditions as manned aircraft, as well as ensuring that malfunction or loss of the decision-making function(s) itself does not cause a reduction in safety.
3.12. Factors for Consideration when Applying for Certification of Autonomous Systems

3.12.1. Data Integrity

Autonomous systems select particular actions based on the data they receive from sensors related to the aircraft environment (airspeed, altitude, met data etc), system status indicators (fault flags, etc), navigational data (programmed flight plans, GPS, etc.) and command and control data received from control stations. As such, UAS developers will need to ensure that any data related to autonomous control has a sufficient level of integrity such that the ability to comply with basic safety requirements is maintained. This will require the development of appropriately robust communication and data validation systems.

3.12.2. Security

An autonomous system must be demonstrated to be protected from accepting unauthorised commands, or from being “spoofed” by false or misleading data. Consequently, UAS will have a high degree of dependence upon secure communications, even if they are designed to be capable of detecting and rejecting false or misleading commands. Section 3 below covers security issues in more detail.
4. CAA Policy on Security Issues for UAS Operations

4.1. Scope

This section offers guidance to industry on how to implement and satisfy the requirements for security through all UAS lifecycle activities (i.e. initial concept, development, operation and maintenance and decommissioning). In this context, security refers to the security of the Unmanned aircraft, including both physical and cyber elements.

4.2. Policy

It is CAA Policy that any UAS operating outside of a UK Danger Area will not increase the risk to existing airspace users and will not deny airspace to them. This policy requires a level of safety and security equivalent to that of manned aviation.

A UAS must have adequate security to protect the system from unauthorised modification, interference, corruption or control/command action.

4.3. Factors for Consideration when Developing Security for UAS

4.3.1. Holistic Approach

When considering security for the UAS it is important to take a holistic approach, paying equal cognisance to technical, policy and physical security for the UAS as a whole. Utilising this approach will help ensure that issues are not overlooked that may affect security and ultimately safety.

By utilising proven industry approaches to the protection of Confidentiality, Integrity and Availability (CIA), security measures applied can benefit the UAS operator by assuring availability of service and the integrity and confidentiality of both data and operations.

4.3.2. Security Aspects to be Addressed

Security aspects are required to address particular potential weaknesses to UAS such as employees, location, accessibility, technology, management structure and governance.

Such security aspects include but are not limited to:
The availability of system assets, e.g. ensuring that system assets and information are accessible to authorised personnel or processes without undue delay;

Physical security of system elements and assets, e.g. ensuring adequate physical protection is afforded to system assets;

Procedural security for the secure and safe operation of the system, e.g. ensuring adequate policies such as Security Operating Procedures are drafted, applied, reviewed and maintained;

Data exchange between system elements, e.g. ensuring the confidentiality and integrity of critical assets is maintained during exchanges within the system, over communication channels and by other means such as physical media;

Accuracy and integrity of system assets, e.g. ensuring threats to system assets caused by inaccuracies in data, misrouting of messages and software/hardware corruption are minimised, and actual errors are detected;

Access control to system elements, e.g. ensuring access to system assets is restricted to persons or processes with the appropriate authority and ‘need-to-know’;

Authentication and identification to system assets, e.g. ensuring all individuals and processes requiring access to system assets can be reliably identified and their authorisation established;

Accounting of system assets, e.g. ensuring that individual accountability for system assets is enforced so as to impede and deter any person or process, having gained access to system assets, from adversely affecting the system availability, integrity and confidentiality;

Auditing and Accountability of system assets e.g. ensure that attempted breaches of security are impeded, and that actual breaches of security are revealed. All such attempted and actual security incidents must be investigated by dedicated investigation staff and reports produced;

Object Reuse of system assets, e.g. ensure that any system resources re-usage, such as processes, transitory storage areas and areas of disk archive storage, maintains availability, integrity and confidentiality of assets;

Asset Retention, e.g. ensuring that system assets are securely retained and stored whilst maintaining availability, integrity and confidentiality.

Identified and derived requirements would then sit within each identified security aspect and be applied (where necessary) to parts of the UAS, e.g. ground based system (including the communications link) and the UA itself. The requirements must be ultimately traced to the overall policy requirements.
4.3.3. **Security Process**

Any agreed security design, evaluation and accreditation process will be integrated (where necessary) with the existing certification, approval and licensing processes utilised for manned aircraft.

The security design, evaluation and accreditation process will be considered as a factor to the operational scenario, including but not limited to:

- Applicable flight rules;
- Aircraft capabilities and performance including kinetic energy and lethal area;
- Operating environment (type of airspace, overflown population density);
- Opportunities for attack and desirability.

The operational scenarios, along with other applicable factors, must be combined with possible weaknesses to the system to determine a measure of perceived risk. A possible security lifecycle for the UAS is shown in Figure 1 and this particular phase is referred to as the risk assessment phase of the process.

Risk management techniques must then be utilised to reduce the perceived risk to an acceptable level of residual risk. As shown in Figure 1 this phase is referred to as the risk mitigation phase of the process.

The risk management techniques implemented are verified and evaluated for effectiveness in a regular cycle of ‘action and review’ ensuring optimum effectiveness is maintained throughout the lifecycle. As shown in Figure 1 this phase is referred to as the validation and verification phase of the process.

Although the approach above is directly applicable to technical security it must be borne in mind that this process must be supported by the application of both good physical security and procedural security and these could be drawn up by interactions between industry, the CAA and Government agencies.

4.4. **Current UAS Security Work**

The current security research work draws on sector experience and recognised security standards. Through liaison with Government agencies, system security policies are formed that are not only thorough due to their holistic approach but also achievable due to the recognition that systems will have varying operational roles.
Figure 6 – Security assessment process
5. CAA Policy on UAS Spectrum Issues

5.1. Scope

This section provides:

- CAA policy on the use of frequencies to support UAS operations;
- Frequencies bands potentially available to support UAS command & control and detect & avoid systems, their limitations and required authorisation of their use.

5.2. Introduction

The provision of communication, navigation and surveillance is essential to the safe and expeditious operation of UAS. Whilst there are many existing aeronautical systems that operate in suitably allocated and protected spectrum that support safety critical applications, these are often not suitable for UAS operations.

UAS safety critical applications generally do not conform to a flight profile that is consistent with that assumed for existing aeronautical systems and hence there is a requirement for the provision of UAS specific systems that will require spectrum support.

However, the identification of suitable spectrum for those UAS safety-critical applications that cannot be addressed by existing aeronautical systems. In 2012 the allocations in the frequency band 5 030 – 5 091 MHz were suitably modified to allow for terrestrial and satellite support for UAS. Additionally, in 2015 some frequency bands were identified that might be able to provide further satellite support for UAS operations for which studies are still on-going to identify the conditions under which these frequency bands could be used.

5.3. Aim

The aim of this policy statement is to clarify the position of the CAA in respect to the spectrum currently available, the limitations on and the application process for its use by the UAS industry as well as the process for seeking access to alternative spectrum

5.4. Policy

The CAA policy is:
to ensure that frequencies used to support safety-critical UAS functionality meet both international and national regulations/legislation;

- to ensure that all frequencies used to support safety-critical UAS functionality have been co-ordinated and licensed in accordance with the appropriate licensing regime;

- to ensure that any such licence obtained provides suitable protection to the use of that frequency appropriate to the functionality and safety criticality of the systems being supported and the area of operation;

- to assist in the identification of suitable dedicated spectrum to support UAS safety-critical functionality.

5.5. Radio Regulatory Framework

The International Telecommunication Union (ITU), a sister UN agency to ICAO, is responsible for the global management of the radio frequency spectrum whose prime objective is to ensure interference free operation of radiocommunication systems. This is achieved through the implementation of the Radio Regulations and regional agreements. Within the UK, management of spectrum is the responsibility of Ofcom.

The availability of spectrum and the licencing regime under which it operates will vary dependent on the operational requirement (e.g. within or beyond visual line of sight etc), environment (e.g. urban/rural etc,) and the safety criticality (e.g. separation, kinetic energy etc) of the function being supported.

5.6. Spectrum Availability

The following frequency bands are appropriately allocated within the Radio Regulations to support UAS Command & Control and/or Sense & Avoid systems. However, their potential use to support such systems will be subject to compatibility with incumbent and known future systems operating or intended to operate in the relevant frequency band.

<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>Potential Use</th>
<th>Protected / Unprotected</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>255 - 526.5 kHz</td>
<td>Detect &amp; Avoid</td>
<td>Protected</td>
<td>Aeronautical use: for Non-Directional Beacons with 0.5 kHz channelization</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Other Information</strong> None</td>
</tr>
<tr>
<td>34.945 – 35.305 MHz</td>
<td>Detect &amp; Avoid</td>
<td>Unprotected</td>
<td><strong>Other Information</strong> Power limited to 100mW, 10 kHz channelization</td>
</tr>
<tr>
<td>74.8 – 75.2 MHz</td>
<td>Detect &amp; Avoid</td>
<td>Protected</td>
<td><strong>Aeronautical use</strong>: Marker beacons with a fixed centre frequency of 75 MHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Other Information</strong>: None</td>
</tr>
<tr>
<td>Frequency Band</td>
<td>Potential Use</td>
<td>Protected / Unprotected</td>
<td>Comment</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------</td>
<td>-------------------------</td>
<td>---------</td>
</tr>
</tbody>
</table>
| 108 – 117.975 MHz | Command & Control and/or Detect & Avoid | Protected | Aeronautical use: Instrument Land System with 50 kHz channelization, VHF Omni-Ranging with 50 kHz channelization, Ground Based Augmentation System with 25 kHz channelization & VHF Data Link Mode 4 with 25 kHz channelization.  
Other Information: None |
| 117.975 – 137 MHz | Command and Control | Protected | Aeronautical use: analogue voice communications with 8.33 kHz channelization, VHF Data Link Modes 2 & 4 with 25 kHz channelization  
Other Information: None |
| 328.6 – 335.4 MHz | Detect & Avoid | Protected | Aeronautical use: Instrument Landing System with 150 kHz channelization.  
Other Information: None |
| 960 – 1 165 MHz | Command & Control and/or Detect & Avoid | Protected | Aeronautical use: Distance Measurement Equipment with 1 MHz channelization, Secondary Surveillance Radar on 1030 & 1090 MHz, Automated Collision Avoidance System on 1030& 1090 MHz, Automatic Dependent Surveillance – Broadcast on 1090 MHz and Universal Access Transceiver on 978 MHz Potential future use for a new air ground communication system as well as UAS Command & Control  
Other Information: Shared with MoD’s Joint Tactical Information Distribution System |
| 1 165 – 1 215 MHz | Detect & Avoid | Protected | Aeronautical use: Distance Measurement Equipment with 1 MHz channelization  
Other Information: Planned use by high precision/integrity Global Navigation Satellite Systems and shared with MoD’s Joint Tactical Information Distribution System |
| 1 215 – 1 350 MHz | Detect & Avoid | Protected | Aeronautical use: En-route primary radar above 1260 MHz  
Other Information: Global Navigation Satellite Systems below 1260 MHz |
| 2 400 – 2 500 MHz | Command & Control and/or Detect & Avoid | Unprotected | Aeronautical use: None  
Other Information: Power limited to 100mW with a requirement for “listen before talk” or “detect and avoid” mitigation and a maximum power spectral density of 10mW/MHz |
| 2 700 – 3 100 MHz | Detect & Avoid | Protected | Aeronautical use: Airport approach and windfarm mitigation radar  
Other Information: None |
| 4 200 – 4 400 MHz | Command & Control and/or Detect & Avoid | Protected | Aeronautical use: radio altimeters that sweep across the whole frequency band and wireless avionic intra-communication  
Other Information: None |
| 5 000 – 5 030 MHz | Command & Control and/or Detect & Avoid | Protected | Aeronautical use: None currently but is available for aeronautical satellite communication  
Other Information: None |
| 5 030 – 5 091 MHz | Command & Control and/or Detect & Avoid | Protected | Aeronautical use: Microwave Landing System at Heathrow and reserved for co-ordinated use by both terrestrial/satellite UAS communication systems  
Other Information: None |
<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>Potential Use</th>
<th>Protected / Unprotected</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 091 – 5 150 MHz</td>
<td>Command &amp; Control and/or Detect &amp; Avoid</td>
<td>Protected</td>
<td>Aeronautical use: Aeronautical mobile airport communication system&lt;br&gt;Other Information: MoD use for telemetry</td>
</tr>
<tr>
<td>5 150 – 5 250 MHz</td>
<td>Detect &amp; Avoid</td>
<td>Protected</td>
<td>Aeronautical use: None&lt;br&gt;Other Information: None</td>
</tr>
<tr>
<td>5 350 – 5 470 MHz</td>
<td>Detect &amp; Avoid</td>
<td>Protected</td>
<td>Aeronautical use: None&lt;br&gt;Other Information: None</td>
</tr>
<tr>
<td>5 725 – 5 875 MHz</td>
<td>Command &amp; Control and/or Detect &amp; Avoid</td>
<td>Unprotected</td>
<td>Aeronautical use: None&lt;br&gt;Other Information: Power limited to 25mW</td>
</tr>
<tr>
<td>8 750 – 8 850 MHz</td>
<td>Detect &amp; Avoid</td>
<td>Protected</td>
<td>Aeronautical use: none&lt;br&gt;Other Information: None</td>
</tr>
<tr>
<td>9 000 – 9 200 MHz</td>
<td>Detect &amp; Avoid</td>
<td>Protected</td>
<td>Aeronautical use: Airport surface movement radar&lt;br&gt;Other Information: None</td>
</tr>
<tr>
<td>9 300 – 9 500 MHz</td>
<td>Detect &amp; Avoid</td>
<td>Protected</td>
<td>Aeronautical use: Airport surface movement radar &amp; airborne weather radar&lt;br&gt;Other Information: Used for maritime radar</td>
</tr>
<tr>
<td>13.25 – 13.4 GHz</td>
<td>Detect &amp; Avoid</td>
<td>Protected</td>
<td>Aeronautical use: None&lt;br&gt;Other Information: None</td>
</tr>
<tr>
<td>15.4 – 15.7 GHz</td>
<td>Detect &amp; Avoid</td>
<td>Protected</td>
<td>Aeronautical use: None&lt;br&gt;Other Information: None</td>
</tr>
<tr>
<td>66 – 71 GHz</td>
<td>Detect &amp; Avoid</td>
<td>Protected</td>
<td>Aeronautical use: None&lt;br&gt;Other Information: None</td>
</tr>
<tr>
<td>76 – 81 GHz</td>
<td>Detect &amp; Avoid</td>
<td>Unprotected</td>
<td>Aeronautical use: None&lt;br&gt;Other Information: Use of the frequency band 76 – 77.5 GHz is restricted to ground use only</td>
</tr>
<tr>
<td>95 – 100 GHz</td>
<td>Detect &amp; Avoid</td>
<td>Protected</td>
<td>Aeronautical use: None&lt;br&gt;Other Information: None</td>
</tr>
</tbody>
</table>

Table 8 – Spectrum availability

**Note:** Any proposed use that does not conform to the regulatory limits applicable within a frequency band will need to be shown to be compatible with incumbent systems and approved/ licenced by Ofcom.

Applications for the assignment of frequencies within the bands identified or otherwise must be addressed to OFCOM. Of additional note is that any aircraft system transmitting on 1030 MHz, as may typically be used in collision warning or sense-and-avoid systems, must not be operated without an approval from the National IFF and SSR Committee (NISC) (see CAP 761).
5.7. Allocation of Spectrum

The CAA supports OFCOM by providing the UK lead on issues related to aeronautical spectrum, including UAS. For information on how to participate in the process for the identification and allocation of spectrum that can be used to support UAS operations contact the CAA.

Licencing of frequency allocations is the responsibility of Ofcom and hence, where required, all applications for a frequency assignment should be directed in the first instance to Ofcom. In frequency bands where the CAA is the assigning authority, then the application will be passed to the CAA by Ofcom so that the CAA can conduct the technical work, but Ofcom still remains the licencing authority.

Where a frequency licence is required (e.g. in protected frequency bands or where powers exceed the current regulatory limits) the CAA will not be able to issue a permission or exemption.

5.8. Use of 35 MHz, 2.4 GHz and 5.8GHz

There are no specific frequencies allocated for use by UAS in the UK. However, the most commonly found are 35 MHz, 2.4 GHz and 5.8 GHz.

35 MHz is a frequency designated for Model Aircraft use only, with the assumption that clubs and individuals will be operating in a known environment to strict channel allocation rules. It is therefore not considered to be a suitable frequency for UAS operations where the whereabouts of other users is usually difficult to assess.

2.4 GHz is a licence free band used for car wireless keys, household internet and a wide range of other applications. Although this is considered to be far more robust to interference than 35 MHz, operators must act with appropriate caution in areas where it is expected that there will be a high degree of 2.4 GHz activity.

In addition, operations close to any facility that could cause interference (such as a radar station) could potentially disrupt communications with the UAS, whatever the frequency in use.

It is the responsibility of the operator to ensure that the radio spectrum used for the command and control link and for any payload communications complies with the relevant Ofcom requirements and that any licenses required for its operation have been obtained. It is also the responsibility of the operator to ensure that the appropriate aircraft radio licence has been obtained for any transmitting radio equipment that is installed or carried on the aircraft, or that is used in connection with the conduct of the flight and that operates in an aeronautical band.
6. CAA Policy on UAS Registration

6.1. Scope

The registration requirements for civil UAS are contained within Regulation (EU) 2018/1139, the EASA Basic Regulation, and in the ANO, and are in line with the requirements of ICAO Annex 7.

6.2. Policy

The registration requirements for unmanned aircraft differ from those required for other aircraft in that they are dependent on the category of UAS operation. While some specific details are still to be clarified, the following basic principles apply:

- UAS operated within the Certified category (i.e. the design is subject to certification) – each individual UA must be registered
- UAS operated within the Specific category (from 1st July 2020) – the UAS operator will require to be registered
- Small unmanned aircraft (from 30 November 2019) – the SUA operator must be registered if the UA has a mass of 250g or more

UA whose design is subject to certification are required to be registered in accordance with articles 24 to 32 of ANO 2016 unless they are flying under an exemption or under the provisions of a 'B Conditions' approval issued to an organisation under BCAR A8-9 (see www.caa.co.uk/cap553). Once the CAA has processed the application, the aircraft will be issued with a registration ID consisting of five characters starting 'G-' (e.g. G-ABCD) and the details will be entered into the aircraft register. The registration must be displayed permanently on the aircraft in accordance with article 32 of ANO 2016.

Operators of UA over 20kg mass that are not subject to design certification (i.e. those being operated within the Specific category under an exemption) do not currently fall into any formal registration system, however the process of obtaining the exemption is currently considered sufficient to satisfy the UAS operator registration requirements. The requirements will be addressed at a later date, either within EU UAS regulation or within UK only regulation, as appropriate.

With effect from 30 November 2019, operators of small unmanned aircraft will be required to be registered in accordance with article 94D of ANO 2016.

EC Regulation 785/2004 requires most operators of aircraft, irrespective of the purposes
for which they fly, to hold adequate levels of insurance in order to meet their liabilities in the event of an accident. This EC Regulation specifies amongst other things the minimum levels of third-party accident and war risk insurance for aircraft operating into, over or within the EU (including UAS) depending on their MTOM.

Compliance monitoring of the insurance regulation is carried out by the CAA Aircraft Registration Section. Details of the insurance requirements can be found on the CAA website\(^{11}\) under “Mandatory Insurance Requirements”.

### 6.3. Source Documents

Air Navigation Order 2016, articles 24 to 32 and 94D.

Other guidance material is available at [www.caa.co.uk/aircrafteregister](http://www.caa.co.uk/aircrafteregister).

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11 [www.caa.co.uk/default.aspx?catid=122&pagetype=90&pageid=4510](http://www.caa.co.uk/default.aspx?catid=122&pagetype=90&pageid=4510)
7. CAA Policy on Radar Surveillance

7.1. Scope

There have been no previous CAA regulations governing the surveillance requirements for civil registered UAS in UK airspace. All civil aircraft fly subject to the legislation of the ANO. However, in accordance with its powers under Article 266 of the ANO 2016, the CAA may exempt UAS operators from the provisions of the ANO and the Rules of the Air, dependent upon the aircraft’s potential to inflict damage and injury. This policy is applicable to all civil UAS operating within the UK Flight Information Region (FIR) and Upper Flight Information Region (UIR), regardless of origin.

7.2. Policy

This surveillance policy is complementary to the Detect and Avoid guidance contained in Chapter 3, Section 1. In broad terms, UAS must be able to interact with all other airspace users, regardless of the airspace or aircraft’s flight profile, in a manner that is transparent to all other airspace users and Air Navigation Service Providers (ANSPs), when compared to manned aircraft. Unmanned aircraft must be interoperable with all surveillance systems without any additional workload for ATCOs, surveillance systems, manned aircraft pilots or other Remote Pilots. UAS must carry suitable equipment so as to be interoperable with aircraft equipped with mandated Airborne Collision Avoidance System (ACAS) such as TCAS II. It must be noted that, where a UAS employs a collision avoidance system with reactive logic, any manoeuvre resulting from a perceived threat from another aircraft must not reduce the effectiveness of a TCAS II resolution advisory manoeuvre from that aircraft.

It is recognised that the Radar Cross Section (RCS) and size of certain categories of aircraft will make detection by non-cooperative surveillance systems difficult, especially at low-level. Consequently, cooperative ground and/or air-based surveillance systems are traditionally deployed by ANSPs to complement coverage of non-cooperative systems, especially in controlled airspace.

The primary means of cooperative surveillance within the UK is SSR Mode Select Elementary Surveillance (Mode S ELS). However, within certain areas of UK airspace, the carriage of an SSR transponder is not mandatory (see UK AIP Gen 1.5). In such airspace, where an Air Traffic Radar service is not mandatory, non-transponder equipped aircraft will

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12 Primary Surveillance Radar (PSR).
not be 'visible' to ACAS. Consequently, in these areas 'see and avoid' is often the primary means of separation of aircraft. Until it is possible to equip unmanned aircraft with 'Detect and Avoid' capabilities\(^\text{14}\) that comply with appropriate future requirements and the SSR carriage policy for Unmanned Aircraft can be reviewed, any Unmanned Aircraft operating outside visual line of sight in non-segregated airspace must be equipped with a functioning SSR Mode S transponder, unless operating within the terms of an exemption from this requirement.

Electronic Conspicuity (EC) devices offer an alternative, low cost option for cooperative airborne surveillance that can effectively signal an aircraft's presence to other similarly equipped airspace users, thereby enhancing situational awareness for those users. EC has been available to certain General Aviation users since 2016 and some UAS operators also employ it where appropriate. EC devices can also alert pilots to the presence of other aircraft, which assists General Aviation pilots in the visual acquisition of those aircraft and allow avoiding action to be taken as necessary. Similarly, EC may assist remote pilots in remaining clear of other aircraft when operating beyond visual line of sight. EC devices use ADS-B transmitters and receivers and it must be recognised that these have certain technical limitations and are not interoperable with transponders or ACAS. They offer limited ground surveillance capability at present but may be ideally suited to areas with multilateration radar coverage. ADS-B receivers can be a valuable tool for UAS operators since they have the potential to receive transmissions from surveillance systems of all aircraft, thereby providing enhanced situational awareness.

EC devices are becoming increasingly available to UAS operators and manufacturers offer the ability to integrate them with an unmanned aircraft using software development kits (SDKs) and application programmable interfaces (APIs) that provide control and display capability at the remote pilot's station. UAS operators should be aware that they must observe certain obligations prior to and when using EC devices, which are as follows:

- the EC device must have an equipment approval acceptable to the CAA;
- the operator must obtain an Aircraft Address and programme it into the device;
- the operator must obtain an aircraft radio licence from Ofcom.

Full details on these aspects and acquiring and using EC devices can be found in CAP 1391 Electronic conspicuity devices.

\(^{14}\) Described in Chapter 2, Section 2.
7.3. **Source Documents**

- UK AIP GEN 1.5
- ANO 2016
- ICAO Annex 10 SARPs
- CAP 1391
1. Certification

1.1. Scope

This chapter offers guidance to industry on what aircraft certification is and how the activities associated with aircraft certification interrelate with the activities associated with continuing and continued airworthiness.

1.2. Lead Agency

Within Europe the regulatory framework is defined by the European Commission (EC) and enacted by the European Aviation Safety Agency (EASA) and National Airworthiness Authorities (NAA). The regulatory framework responsibilities are therefore shared between EASA and NAAs and address:

- Initial Airworthiness (certification and production)
- Continued and Continuing Airworthiness
- Operations
- Air Traffic Management

The regulatory framework and sharing of roles and responsibilities is described within the EASA Basic Regulation (Commission Regulations 2018/1139). EASA is the primary agency for all rulemaking activities and conducting initial and continued airworthiness aspects.

It must be noted that within the Basic Regulation certain aircraft categories are currently defined to be outside of scope and hence these aircraft remain subject to national regulation. This applies to aircraft carrying out military, customs, police, search and rescue, firefighting, coastguard or similar activities or services (State aircraft).

A number of exceptions to this are also defined – these are commonly referred to as Annex I aircraft. These are defined within Annex I of the EASA Basic Regulation.

1.3. Policy

The following text provides an overview of the objectives of the airworthiness and certification processes and is intended to give a general understanding of the various aspects of civil certification and the related organisational oversight activities. It is not a
complete or detailed explanation of this complex subject.

The principles outlined in this Chapter apply only to Certified UAS platforms.

1.4. Certification Objectives

Under the International Civil Aviation Organisation (ICAO) and the Convention on International Civil Aviation (commonly referred to as the “Chicago Convention” (ICAO Doc. 7300. Annex 8 contains the SARPS for Airworthiness)) there is a system of internationally agreed standards and recommended practices by which each contracting state can establish a means to ensure a minimum level of safety is established and achieved, thus enabling mutual recognition of individual aircraft operating within each other's airspace.

As not all types of aviation require routine international operating capability, each state can define and establish their own standards and practices for these national activities. Within Europe this has, for most aircraft types, been harmonised across states through the EU Commission and the EASA, as described above.

Therefore, it is important to recognise that the headline title of airworthiness/certification is a means by which an NAA can establish and attest to compliance with an agreed set of standards. These standards cover the necessary range of aircraft types and the activities to be undertaken; typically, the standards applied can be, and usually are, different for varying classes of aircraft and their intended use. For example:

- To comply with the ICAO international requirements aircraft must be operated under cover of an Operational Approval; each aircraft must have a valid Certificate of Airworthiness (which is underpinned by an approved Type Design) and be flown by appropriately qualified and licensed flight crew.

At the other end of manned aviation small personal use (recreational) aircraft may have a Permit to Fly, which as a National approval, limits use to that country and could include limitations and conditions on where and when it can be flown (e.g. class of airspace, weather conditions, etc). It must also be noted that a National approval is just that, so precludes automatic rights of use/operation in another country; this does not prevent use or operation in another country, but it does mean each NAA will need to determine how and what it will allow by separate process.

Thus, certification is a process by which the capability and operational limits of an aircraft are determined.
1.5. Initial, Continuing and Continued Airworthiness

Within the certification and airworthiness system there are three basic processes to set and maintain required standards. These processes determine and maintain the intended level of safety:

- Initial airworthiness processes;
- Continuing airworthiness processes;
- Continued airworthiness processes.

The initial airworthiness processes are those used to determine the applicable requirements and establish that an aircraft design is demonstrated to be able to meet these requirements. This includes the safety targets and the development of instructions for use and ongoing care/maintenance. Within the EASA framework, which is adopted in the UK, it would also cover the elements of production, i.e. those aspects of taking the approved design and manufacturing the end product to the point of a useable aircraft. This phase is therefore complete prior to an aircraft entering into service.

The continuing airworthiness process refers to the system of management of the aircraft and the scheduling and actioning of ongoing preventative and corrective maintenance to confirm correct functioning and to achieve safe, reliable and cost-effective operation.

Continued airworthiness refers to the monitoring, reporting and corrective action processes used for in-service aircraft to assure they maintain the appropriate safety standard defined during the initial airworthiness processes throughout their operational life.

In parallel with each of these processes, there are schemes that require or provide for organisation approvals, e.g. design, production, maintenance and organisation approvals. These approvals enable the NAAs to recognise capability within a company system; this limits the level of investigation and oversight that may be necessary to establish compliance against the regulatory standards applicable to individual products.

1.6. Initial Airworthiness Processes

The initial airworthiness process is intended to establish a desired level of airworthiness integrity for an aircraft and to demonstrate that this level of integrity can be achieved. In this case, integrity can be taken to include all aspects of the design (structurally and systemically) to cover safety, reliability, availability, capability, etc. When the desired level of airworthiness integrity is met and consistently shown to be achieved, the aircraft can be considered to provide an acceptable level of safety; this covers both the vehicle (and any person(s) on board, if applicable) and, by inference from continued safe flight, to persons and property on the ground.
The initial airworthiness processes have the following basic elements for design and production:

- Establishment of the design/certification requirements (certification specifications) which define the high-level design criteria and showing that these are met.
- The design organisation aspects which cover the capability and competence of the company for the design of the complete aircraft, systems or individual parts.
- The production organisation aspects which cover the capability and competence for the manufacture and assembly of the complete aircraft, systems or individual parts in accordance with the approved design and testing of the aircraft prior to delivery.

The design organisation is charged with demonstrating to the certification authority that the proposed design is compliant with the established and agreed certification specifications or other requirements. Similarly, the production organisation is responsible to show the end product is in conformance to the design.

For current categories of manned aircraft there are already established design/certification requirements, such as the EASA Certification Specifications (e.g. Large Aeroplanes (CS-25), Large Rotorcraft (CS-29), Very Light Aircraft (CS-VLA), and Very Light Rotorcraft (CS-VLR)). These also provide guidance material on the intent of the requirement and methods of showing compliance that have been found to be acceptable. However, it is recognised that these do not fully address the range of aircraft potentially possible, how the technology elements pertinent to UAS may cross the boundaries between the categories of the requirements.

Except for the very smallest aircraft, where the safety aspect is controlled by separation and operational management, each class of aircraft will have some level of safety requirement. At the highest end, where a formal certification approval is necessary, this safety assessment requirement for "Equipment, Systems and Installations" and the associated guidance material is already defined in the Certification Specifications under paragraph CSXX.1309. However, once again this may not be wholly appropriate for all categories of aircraft.

1.7. Continuing airworthiness processes

The continuing airworthiness processes are intended to assure that in–service aircraft are managed and maintained and that these actions are performed correctly, by appropriately capable persons, in accordance with the instructions developed by the design organisation so that assumptions and considerations made during the design, particularly in respect of safety, remain valid. As a result, these processes also need effective communication
between the operator, maintenance organisations and the design organisations to ensure that necessary information is shared and if necessary corrective actions taken.

The continuing airworthiness process will support any modifications, repair or component replacement once an aircraft has entered service. This is achieved by not only undertaking the incorporation of the changes, but also in the management of configuration records, updating of maintenance instructions, etc.

### 1.8. Continued airworthiness processes

The continued airworthiness processes are intended to provide a closed loop monitor and corrective action cycle for in-service aircraft to assure that the intended level of safety is maintained. The process starts with activity within the certification work (for example the development of the maintenance schedules and instructions on how to perform this activity). Thereafter, it includes the monitoring of experience of in-service aircraft and, when necessary, the definition and promulgation of corrective action instructions.

The development of maintenance schedules typically considers and uses information from the aircraft design and safety assessment processes to determine what maintenance activities are required and how frequently they will be performed to maintain the appropriate level of aircraft integrity (for example replacing parts before they would typically wear out or fail will prevent the consequence of this and hence aid both safety and commercial costs).

The monitoring and reporting processes support the collection and analysis of in-service information and enable the design organisation to be satisfied that the overall level of safety is being achieved, or if necessary, to determine and promulgate corrective actions to address problem areas.

If these programmes are run correctly, they have the potential to save organisations money – it is usually cheaper in terms of both money and time to fix a minor problem before it becomes a serious problem.
2. General Certification Requirements

2.1. Scope

This section offers guidance on the general certification requirements for UAS, where this is applicable.

2.2. Policy

The approach taken by CAA for certification is, in principle, the same as that followed by EASA and is described below. Within this process, the actual requirements that make up the certification basis, which must be shown to be met, may well be different for each NAA due to the views, experience and concerns of each country.

2.3. Applicability

UAS ‘whose design is subject to certification’ i.e. aircraft that meet the conditions specified in Regulation (EU) 2018/1139 (the Basic Regulation) – Annex IX, need to be certificated by EASA and hence reference to them must be made.

2.4. Certification Process

The initial airworthiness or “Type Certification” process can be considered to follow a simple flowline, albeit there may be parallel paths in obtaining Design Organisation Approval (DOA) and Production Organisation Approval (POA), where these are necessary, which must come together at key cross-contact points.

The following describes the typical process for aircraft.

- **Phase 0**: Company develops idea to point of maturity where certification is considered appropriate or necessary. During this phase the company will need to consider both functional requirements (to derive a product that is capable of performing what is intended) and also the external requirements that may need to be met (certification, operational, legislative, environmental etc.). It may also include the building and testing of initial developmental and prototype machines.

- **Phase 1**: Application is made to the competent authority for design to begin the certification process. At this point the formal process begins which enables two things:
• The applicable certification requirements are defined as those published at this date. Compliance with these requirements must be demonstrated within five years. If this is not achieved, later published revisions to the requirements may be introduced.

• The initial or general familiarisation of the product begins, this enables the competent authority for design to begin to review the applicable specific requirements set and notify/confirm this to the company and to determine the technical areas that will require specialist involvement in the project.

• **Phase 2**: Detail or technical familiarisation leading to the agreement of the certification requirements set – the certification basis. In this phase the company briefs the competent authority for design specialists on the detailed design, the requirements that they have considered applicable and how these are planned to be demonstrated as being met – the means or method of compliance. The competent authority for design specialist team considers these proposals and, following further discussion with the applicant, an agreed certification basis is documented. This basis will usually start from one (or more) of the existing Certification Specifications from which unnecessary items will be deleted. Additions may be introduced to cover where the requirement is inadequate or there are no suitable requirements due to the new or novel technologies used. For simple designs these phases can be covered as one.

• **Phase 3**: The Company works to demonstrate compliance with the Certification Basis in the agreed way. If necessary further dialogue is held to ensure that the most effective ways of working are used to agree changes in the means/methods of compliance, or indeed to revise the requirements if changes to the original design are made and warrant this.

• **Phase 4**: Compliance has been shown. The competent authority for design team will complete their report and recommend issuance of the aircraft type design approval, which is recorded by the Type Certificate (TC) and the associated Type Certificate Data Sheet (TCDS). These define the aircraft type, high level features, the certification basis met, applicable maintenance, inspection and operational instructions, key limitations, restrictions and conditions and other necessary information that form the approved design.

The current CAA policy is not to mandate airworthiness certification as outlined above but to make use of the UAS Operating Safety Case process. However, it is considered worth noting that elements of the safety case must reflect similar information to that which would be developed within the certification process. It is therefore considered that a level of understanding of the certification requirements may therefore be useful, and maybe beneficial in designing the aircraft, even though not required by the regulatory system.
2.5. Certification Basis

From the above processes the derivation of the applicable requirements is clearly a key aspect. However, it is clear that the current requirements set do not align with the types/size/mass of aircraft that are being developed as UAS.

Unfortunately, the timeline for developing requirements is likely always to be behind the rate of technological advancement. The current approach is therefore to identify the category that fits as best as possible to the type/classification of the aircraft – and subtract what is not necessary and add to fill the gaps where required. The gaps can be filled by parts of other requirement sets, where practicable, and/or by developing new material where necessary.

- For example: a simple fixed wing aeroplane design may align well with the VLA (Very Light Aeroplanes) category with respect to structure and control surface actuation etc. However, because of the remote pilot aspects, the design may have a sophisticated command and flight control system, which is not addressed in CS-VLA. Use of the relevant sections of CS-23 or even CS-25 may be applicable.

The main difficulty with this approach, apart from the commercial risk prior to agreement with the competent authority for design, is the potential lack of cohesion between the safety target levels from the different standards.

2.6. Interrelationship between the Three Stages of Airworthiness Oversight

2.6.1. Initial and Continued Airworthiness

During the initial certification of an aircraft the initial and continued airworthiness processes may be considered to run concurrently, as the information developed within the initial airworthiness processes feeds into the continued airworthiness processes to develop the “instructions for continued airworthiness”, i.e. the maintenance schedules and tasks which need to reflect the assumptions and considerations of use of the aircraft.

In principle, the intent is that once it has been demonstrated both the initial airworthiness and continued airworthiness requirements have been met, an aircraft type will be issued with a Type Certificate.
Type Certificates are only issued to the following:

- Aircraft
- Engines
- APUs
- Propellers

The development of all other types of aircraft system is required to be overseen by the Type Certificate applicant.

Once an aircraft, engine, APU or propeller holds a Type Certificate any changes will fall into the following categories:

- **Major Change** – This is a significant change to the design of an aircraft, engine, propeller or related system that is designed and implemented by the holder of the Type Certificate.

- **Supplemental Type Certificate** – This is a significant change to the design of an aircraft, engine or propeller that is not designed and implemented by the holder of the relevant Type Certificate.

- **Minor Change** – This is a non-significant change to the design of an aircraft, engine, propeller or related system which is not permitted to affect the extant aircraft, engine or propeller level safety assumptions.

- **Change in Operational Use** – This is a change to the operational use of an aircraft, engine or propeller that falls outside the agreed scope of use defined during the initial and continued airworthiness processes. In principle this must be discussed and agreed with the relevant TC holder, but this is not actually mandated.

Clearly any change to a certificated system that does not involve the TC holder has potential implications for aviation safety.

### 2.6.2. Continuing Airworthiness

The continuing airworthiness process begins with an evaluation of an organisation to determine whether or not it meets the basic requirements to be allowed to perform initial and/or continued airworthiness functions.

This process seeks to determine compliance against one or more of a number of organisational approval requirements documents:

- **Part 21** – “Certification of Aircraft and Related Products, Parts and Appliances, and of Design and Production Organisation”. In simple terms this document applies to organisations involved in initial airworthiness.
Part M – “Continuing Airworthiness Requirements”. This relates to organisations that are responsible for managing and overseeing maintenance tasks and maintenance scheduling.

Part 145 – “Approved Maintenance Organisations”. This applies to organisations that perform continued airworthiness related tasks under the management of an organisation approved to Part M.

Part 147 – “Maintenance Training Organisational Approvals”. This applies to organisations that are responsible for the provision of aviation related training.

Part 66 – “Certifying Staff”. This documents the competency requirements for personnel that are responsible for signing off aircraft or aircraft systems as serviceable.

Further information on these regulations and requirements may be found on the EASA website: https://www.easa.europa.eu/regulations

No organisation is permitted to work within the aviation industry unless they either have the relevant approvals, as dictated by the continuing airworthiness processes or they are overseen by an organisation that holds the relevant approval. This is intended to ensure that any aviation work is performed with a degree of integrity commensurate to the risk associated with that activity. Once an approval has been granted, the continuing airworthiness process runs concurrently with the initial and continued airworthiness processes to ensure that an appropriate level of organisational integrity is maintained to support the individual project/aircraft level tasks overseen by the initial and continued airworthiness processes.

If the initial and/or continued airworthiness processes identify organisational risks, this information is passed back in to the continuing airworthiness processes to ensure that these risks are managed appropriately.
3. What Level of Certification Do I Need?

3.1. Scope

This section offers guidance to industry on the level of certification required for each UAS type. Where no formal airworthiness certification is required guidance is given on the approach to take.

3.2. Policy

The level of certification required for an aircraft or UAS is based upon the intended use.

As described in section 2 of this chapter, at the highest level there are aircraft that have a Certificate of Airworthiness underpinned by Type Certification, continued and continuing airworthiness processes and design and production organisation approvals. These aircraft are flown by rated and licensed pilots under the procedures of an approved operator and thus are capable for international operations under the mutual recognition arrangements from ICAO and the International Convention.

At the opposite end of the spectrum, we have aircraft that are not required to hold any airworthiness approvals but can be operated commercially under cover of an operating permission provided they are suitably separated from third parties and property.

Compliance with the most demanding requirements provides for a widest range of operational privileges, whereas a lack of demonstrable airworthiness can still be accommodated – but with significant restrictions on the operations where appropriate.

This approach is intended to provide a reasonable and proportionate level of regulation. This is based on the scale and level of risk each category of aircraft and its use could pose to both the general public and their property, whether on the ground or in an aircraft. The challenge therefore is to match the operational aspirations, and the risk this could pose, with proportionate airworthiness requirements that provide adequate management of this risk.

3.3. Aircraft Classification

The current framework established and used by the CAA, and other NAAs, classifies aircraft based on simple discriminates or type (e.g. balloon, fixed or rotary wing) and mass. This reflects the historic developments in manned aviation – but is not necessarily fully
appropriate for UAS. However, until such time as alternative classification protocols are agreed this system is in place. Working within this means we have very simple categorisations.

UAS fall within the remit of the EASA Basic Regulation 2018/ 1139 Annex IX, unless they are State aircraft or fall within the exceptions defined in Annex I.

4. General Safety Assessment Points

4.1. Scope

This section offers guidance on some general safety assessment issues for UAS Certification.

4.2. Policy

The intent of a Safety Assessment is to demonstrate that the aircraft is safe enough for the manner and type of operation it is intended to perform. It is not intended here to describe any of the many different types of assessment or analyses that can be undertaken, but to outline the basic aspects to be considered.

It is important however to recognise that Safety Assessments, if conducted as a fundamental and iterative design process, can provide benefits in terms of the level of safety achievable. This also achieves a degree of reliability or availability possible and even minimise the cost of ownership through effective maintenance schedules.

If the Safety Assessment is considered simply as a retrospective analysis the result can only reflect the frozen design. Whilst this could be sufficient, it does also carry the risk that any shortfall can only be addressed by redesign or by limitations or restrictions on the use - which could be significant enough to preclude viable operation.

4.3. Assessment Steps

A Safety Assessment may be considered in simple steps:

- Determination of the set of aircraft level threats/hazards related to functional failures are identified;
- The severity of the consequence for each of these failure conditions is determined/classified;
- This classification could be different for differing scenarios, e.g. during different phases of flight;
- The target level of safety (TLOS) is assigned for each failure condition;
- The systems and component failures that could contribute to each of these failure conditions is assessed or analysed to establish if the individual TLOS is met;
Compliance with each individual failure condition and the overall aircraft level target is shown.

Within the airworthiness requirements set, as discussed below, the large aircraft certification specifications contain specific requirements and levels of safety defined in probability terms. For smaller classes of aircraft, the airworthiness requirements may not define levels of safety to this detail – hence the method of demonstrating compliance is open for discussion and may be able to be based on judgement and justified arguments rather than detailed probabilistic analysis. This is clearly important as with lower levels of robust component reliability data the more challenging is the task of developing probability analyses.

4.4. Safety Assessment Considerations

Each of the UAS design requirement sets will include system safety requirements. These are often referred to by the applicable paragraph number of CS-XX.1309. This requires that the probability of a failure is inversely proportional to the severity of its effect at aircraft level, i.e. high criticality systems are required to have an extremely low probability of failure.

These certification requirements were established many years ago based on in-service experience (accident data etc) and a desire to set a standard that would drive improvements in what was then being achieved. For each class of passenger transport aircraft (large and small fixed wing aircraft, rotorcraft, etc.), an acceptable fatal accident rate was defined, e.g. 1 accident in 10 million flight hours (10^-7 per flight hour), for a large fixed wing aircraft.

Then based on simple assumptions regarding the number of aircraft systems and potentially critical failures in each of these, a target level of safety was defined for each critical failure. This is described in detail within the advisory material that goes with the requirement.

The validity of using these probability targets for UAS is currently a debated subject. Clearly, they relate to passenger transport aircraft and the safety of passengers carried. However, it must be noted that by protecting persons on board an aircraft, third parties on the ground will also be protected.

There is also some discussion that the types of operation undertaken by passenger aircraft are quite different to the range of operations undertaken by UAS, hence once again the probability targets are inappropriate. In respect to this, it must be noted that the safety assessment process already accounts for this to some extent, as due to these differences the consequence or severity of effect could be quite different thus giving a different target level of safety.
For UAS, the safety assessment and any analysis or justification to demonstrate compliance with the level of safety target is primarily based on the aircraft system and its associated failure mechanisms. The aircraft system is the total system required for safe flight and landing, e.g. the aircraft, control station, command and control datalinks and any launch or landing/recovery systems.

In principle, it does not place reliance on external factors that may mitigate the failure – these are the safety nets that could prevent the worst-case scenario.

It must also be noted that where the simple assumptions made in the certification safety assessment requirements are not valid, e.g. independent versus integrated systems, simple versus complex and the number of critical failure conditions, it may be necessary to impose more stringent targets to individual failure conditions in order to meet the aircraft target level of safety.

For UAS the proportionate approach taken does not require a safety assessment to the level described above. However, the safety case approach does still require consideration of the hazards (including those that could be due to aircraft system failures), their severity, and justification of how these will be mitigated and managed. It is therefore envisaged that some level of assessment and justification of how and why hazards are suitably managed will be necessary, albeit not to the level that uses detail probability-based analyses.

### 4.5. Other Considerations

The value of the safety assessment process in the development of maintenance programmes, e.g. the type and frequency of maintenance actions, must also be recognised. The outputs of the processes provide useful data to determine what maintenance activities are required and how frequently they will be performed to maintain the appropriate level of aircraft integrity. These maintenance actions can prevent critical failures, e.g. by replacing items before they are likely to fail, or by detecting problems before operation of the aircraft. Not only does this support safety but it has the potential to save money – it is usually cheaper in terms of both money and time to fix a minor problem before it becomes a serious problem.
1. Airspace Principles

1.1. Introduction

The purpose of this chapter is to outline the policies, constraints and regulations that are to be adhered to when conducting UAS operations within UK airspace.

The legal constraints on flying operations, including UAS, within UK airspace are contained within the ANO and it must be noted that the use of Danger Areas (DAs) for the segregation of RPAS activities might be subject to specific regulations pertinent to the DA. Information on airspace regulation within DAs must therefore be sought from the relevant DA authority. SARG Airspace Regulation will assist in identifying the appropriate authority if required.

Whilst the segregation of UAS from other airspace users provides a safe operating environment, the process for establishing such airspace reduces the flexibility of operation sought by the user community. This chapter does not cover reactions to unplanned/emergency situations, as these are already catered for by the use of Restricted Area (Temporary) (RA(T)) and Emergency Restriction of Flying (ERF) procedures.

1.2. Scope

The guidance below details the operating principles associated with UAS flights both in segregated and non-segregated airspace. Specific guidance for model aircraft is detailed in CAP 658, Model Aircraft: A Guide to Safe Flying.

1.3. Policy

Regulation (EC) 2018/1139 (the EASA Basic Regulation) applies to all unmanned aircraft, other than certain types of tethered aircraft. However, at present, the European Commission Implementing Regulations associated with UAS operations are not yet applicable (applicability date will be 1st July 2020). Therefore, until these Implementing Regulations become applicable, the national legislation laid out in the ANO will still apply.

There is no lower weight limit below which the ANO does not apply; however, the extent to which the regulations apply depends upon the mass of the aircraft. ANO 2016 articles 94,

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15 This includes, but is not limited to, instructions laid down in SARG Policy Statements regarding Danger Areas and Special Use Airspace Safety Buffer.
94A to G and 95 define constraints that are unique to small unmanned aircraft and small unmanned surveillance aircraft. Some of these constraints are dependent on how, or where, the aircraft is used. ANO 2016 article 241 applies to all weight categories and stipulates that *any* person must not recklessly or negligently cause or permit an aircraft (manned or unmanned) to endanger any person or property (which includes other aircraft and their occupants). If the CAA believes that danger may be caused, then the CAA may direct that the aircraft must not be flown (ANO 2016 article 257 - CAA’s power to prevent aircraft flying).

### 1.4. Airspace Principles for UAS Operations in the UK

UK aviation legislation is designed to enable the safe and efficient operation of all aircraft in all classes of airspace. UAS operators must work within this same regulatory framework.

UAS do not have an automatic right to airspace if safety provision cannot be made or if such operations would have an unreasonably negative impact on other airspace users. In order to integrate with other airspace users, UAS operators must ensure that their aircraft can demonstrate an equivalent level of compliance with the rules and procedures that apply to manned aircraft.

Until UAS can comply with the requirements for flight in non-segregated airspace, one-off or occasional BVLOS UAS flights outside permanently established segregated airspace (I.e. DAs) may be accommodated through the establishment of Temporary Danger Areas (TDAs). TDAs must not be considered to be a convenient ‘catch all’ for short notice UAS activities that can simply be requested, and implemented, without due consideration for other airspace users. TDAs will mainly be used for longer term measures, where activities have been properly planned and prepared, and adequate time is available for full consideration by SARG Airspace Regulation along with full promulgation. TDAs are covered more fully below.

Unless special provision is made with the Air Traffic Service Unit (ATSU) handling the UAS activity, the provision of an Air Traffic Service (ATS) to an unmanned aircraft must be transparent to the controller. In other words, the controller must not have to do anything different using radiotelephony or landlines than he or she would for other aircraft under his or her control, nor must the controller have to apply different rules or work to different criteria. The following points are of note:

- UAS must be able to comply with instructions from the ATS provider and with equipment requirements applicable to the class of airspace within which they intend to operate. ATS instructions must also be complied with in a timescale comparable with that of a manned aircraft.
All UAS callsigns must include the word "UNMANNED", on first contact with the ATS provider, to ensure that air traffic controllers are fully aware that they are dealing with a UAS flight.

If “special provisions” are made with the associated ATSU, it is essential that these do not reduce the situational awareness of other airspace users.

1.5. General Principles for UAS Operations within Segregated Airspace

Unless able to comply with the current requirements of the ANO, including the Rules of the Air, UAS flights which are operated beyond the visual line of sight of the remote pilot are required to be contained within segregated airspace. The UK uses DAs as the primary method of airspace segregation for UAS operations.

For flights within segregated airspace, whilst some restrictions may still apply, an unmanned aircraft will generally be given freedom of operation within the bounds of the allocated airspace, subject to any agreed procedures and safety requirements. An authorisation to operate will take into account the risks associated with any unintended excursion from the allocated airspace and it will also consider the possibility of airspace infringements. In addition, measures that may be put in place to enhance the safety of UAS activities will also be considered in the authorisation process.

While segregated airspace, by its nature, provides exclusive use of that airspace to the UAS activity, boundaries are not impervious to aircraft infringements. In order to enhance the safety of UAS operations, the following constraints may be imposed:

- Where available, the remote pilot is to make use of an ATS provider to monitor UAS flights and to provide a service to them and to other aircraft operating in the vicinity of the segregated airspace;
- Communications are to be maintained between the ATS provider and the remote pilot;
- Procedures are to be put in place for, amongst others, emergency recovery, loss of control link and the avoidance of infringing aircraft.

1.6. General Principles for UAS Operations in Non-Segregated Airspace

For all flights being conducted in airspace that is not segregated, the aircraft performance and all communications with the ATS provider must be continuously monitored by its remote pilot. To comply with ATS instructions in a timescale comparable with that of a manned aircraft, it is imperative that the remote pilot is capable of taking immediate active
control of the aircraft at all times.

Special equipment (e.g. Secondary Surveillance Radar (SSR) Transponder) mandated for manned aircraft in certain classifications of airspace\textsuperscript{16} must also be considered a minimum requirement for UAS intending to fly in the same airspace.

An approved method of assuring terrain clearance is also required.

Standard Operating Procedures are required, and these would normally be contained within an organisation’s UAS Operations Manual. As a minimum, the following procedures must be covered:

- Take-off and landing procedures;
- En-route procedures;
- Loss of control data link; and
- Abort procedures following critical system failure.

UAS must be able to comply with the Instrument or Visual Flight Rules (IFR or VFR) as appropriate to the class of airspace and the weather conditions.

Additional safety requirements that will be considered under permissions and exemptions may include that the aircraft must not be flown:

- Unless it is equipped with a mechanism that will cause the aircraft to land in the event of disruption to or a failure of any of its control systems, including the radio link, and the remote pilot has satisfied himself that such mechanism is in working order before the aircraft commences its flight;
- Unless the remote pilot has reasonably satisfied himself that any load carried by the aircraft is properly secured, that the aircraft is in an airworthy condition and that the flight can safely be made. Operators and manufacturers who are in any doubt as to the airworthiness of their system must seek independent assessment from either the CAA or an appropriate CAA-approved qualified entity.

1.7. **Detect and Avoid**

In order to maintain the appropriate levels of safety, a suitable method of aerial collision avoidance is required for all UAS operations. Because of this, UAS operations will not normally be permitted within non-segregated airspace, beyond the direct unaided visual line-of-sight of the remote pilot, without an acceptable DAA capability.

Note: The use of ‘First Person View R/C’ equipment (see CAP 658) is not considered to be

\textsuperscript{16} For example, flight above 10,000ft within Class G airspace or flight within a Transponder Mandatory Zone.
acceptable for use as a DAA solution.

The minimum DAA requirements for routine BVLOS UAS operations to be conducted within non-segregated airspace are set out in Chapter 3, Section 1.

### 1.8. Temporary Danger Areas

It is recognised that there may be occasions when UAS flights are planned to take place outside an established DA; in these cases, one or more TDAs could be established to provide the appropriate segregation.

#### 1.8.1. Maximum Duration

Although the use of TDAs offers a flexible tool for segregating specific portions of airspace on a temporary basis, it is important to emphasise that segregation effectively denies airspace to otherwise legitimate users.

Due to their ‘temporary’ nature, TDAs will normally only be established to cover UAS activities up to a maximum period of 90 days. The formation of a TDA must not be viewed as a convenient means of establishing segregated airspace for routine, repetitive and/or long-term activities however; such requests will require the establishment of a permanent segregated airspace structure, and so will be subject to the Airspace Change Process, as detailed in CAP 1616. TDAs will not be routinely ‘reissued’ to cover periods beyond their original lifespan.

#### 1.8.2. Application Requirements

Requests for the establishment of TDAs to support UAS operations are to be forwarded to SARG Airspace Regulation via the following email address:

aroops@caa.co.uk

Any queries relating to TDAs should also be directed to this address.

In order to allow time for the appropriate approval and notification to take place, a minimum of 90 days’ notice is required. In cases where larger volumes of segregated airspace are required, particularly when the airspace extends to higher altitudes, an extended notification period of up to 120 days is more appropriate. Applications with less than 90 days’ notice may be considered, but will be taken on a case-by-case basis and any approval/rejection decision will be largely biased towards the likely potential for impact on other airspace users. Applications must contain the following information:
- A clear description of the requirement for the TDA;
- Details of the volume of airspace required, including coordinates;
- Details of the required hours of operation;
- Details of the airspace management procedures that will be employed (ATC, DACS/DAAIS, Flexible Use of Airspace practices, NOTAM procedures, etc.);
- Details of the TDA Sponsor, including contact details for multiple on-site contacts;
- Details and evidence of the consultation and engagement (including potential affected stakeholders) that has taken place. In addition, details and evidence of the responses from the above process must be provided. Please note the 90 days’ notice will only commence after full consultation and engagement evidence is provided;
- Details of the type(s) of Remotely Piloted Aircraft that will be flown within the airspace, in particular the status of any airworthiness approvals/exemptions.

### 1.8.3. TDA Sponsorship

The requirement for sponsorship of a TDA is identical to that required for any other DA. Details regarding DA sponsorship, including Terms of Reference, are contained in the SARG Airspace Regulation Policy Statement ‘Danger Areas’.

### 1.8.4. Decision/Approval

The decision on whether or not to approve the establishment of a TDA rests with the CAA’s Group Director, Safety and Airspace Regulation. In some circumstances, this authority may be devolved to another member of the CAA’s Airspace Regulation Team.

### 1.8.5. Implementation

Planned TDAs will normally be implemented and promulgated to airspace users via UK Aeronautical Information Circulars (AIC). In cases where there is insufficient time left to promulgate a TDA via the normal AIC method, full details of the TDA will be issued via a detailed Notice to Airman (NOTAM). In addition, a document containing text and a diagram in a similar format to the AIC will be placed within the ‘News’ section on the Home page of the NATS AIS website.

Planned TDAs will be activated via NOTAM and should be done so at least 24 hours before the activation time of the TDA. This is crucial to allow other airspace users, and air navigation service providers the opportunity to plan accordingly.
1.9. UAS Operating in Controlled Airspace and Flight Restriction Zones

Whilst permission is not required for a small UAS to operate in controlled airspace (if outside an FRZ, and in compliance with the applicable articles of the ANO), there are still a number of considerations that must be taken into account when operating in such areas.

Major airports exert a major influence over the characteristics of the overall airspace structure and often require that any pilots operating at low-level under VFR adhere to notified routes and procedures to avoid traffic conflict. This is particularly true of VFR helicopter flights in and around London, which are often under active control and confined to a route-structure with changing altitude limitations. Information on such low-level VFR helicopter route structures is provided in the Aeronautical Information Publication (AIP) and portrayed on Helicopter Route VFR charts, for example the London Control Zone chart (Scale 1: 50,000, Series GSGS 5542). Operators are strongly advised to have a current copy of these charts when operating nearby.

Due to their small size and ability to operate out of small sites in towns and cities, SUA are particularly difficult to see against an urban backdrop versus the relatively much larger size of a manned aircraft. The majority of SUA do not have an anti-collision beacon (although they may have other lights of lesser illumination - typically LEDs) and they are not currently required to be fitted with a transponder. The small size and the open-framework, symmetrical structure of a multi-rotor SUA means that it may not be clearly visible until at a much closer distance than would be the case between two manned aircraft, particularly when the SUA is hovering or moving slowly. Sighting of a SUA from another aircraft is likely to be a ‘late sighting’ with reduced time to alter course.

Therefore, in addition to maintaining direct VLOS and, where required, keeping to a height of no more than 400 feet above the surface, operators of SUA of any weight must avoid other airspace users at all times. This is particularly relevant when operating near the London helicopter routes due to the higher density of low level traffic; remote pilots should operate no higher than strictly necessary for the operation.

Many unlicensed helicopter landing sites also exist, including hospital helipads, as well as numerous Police helicopter and air ambulance flights. Such aircraft may loiter at low-level or land and take off unexpectedly. All of these types of helicopter operations may therefore be affected by SUA operations particularly when approaching to land or departing from a site; SUA operators must take active precautionary measures to avoid affecting the safety of other airspace users. Such measures should involve keeping sufficiently clear to avoid any avoiding action being necessary by either party, or any distraction or change in mission to the other party, i.e. aborting an air ambulance landing due to a UAS sighting.

It should also be noted that ANO Article 94 states that a person in charge of a SUA ‘may only fly the aircraft if reasonably satisfied that the flight can safely be made’ and that they
'must maintain direct, unaided visual contact with the aircraft for the purpose of avoiding collisions'. In practical terms, SUA of any mass could present a particular hazard when operating near any aerodrome or other landing site due to the presence of manned aircraft taking off and landing.

NOTAM action at each site is generally not required due to the typically small scale, duration and operating limitations of SUA operations. Such a requirement must, however, form part of the operator’s risk assessment process, particularly outside of controlled airspace and when several SUA will be operating together (‘swarming’).

1.9.1. Flight Restriction Zones

Flight Restriction Zones are implemented at a the majority of UK aerodromes (a complete list can be found in the AIP, and on the DroneSafe Website) the purpose of which is to enhance safety for other airspace users within the vicinity of an aerodrome. In order to operate within these areas, permission must be sought from the appropriate authority. Currently, the NATS AUP (aup.nats.aero) provides an online platform to submit requests to operate within FRZs around some NATS aerodromes, other NATS aerodromes may require an NSF submission (www.nats.aero/nsf). Other aerodromes may simply require a telephone call. An approval in principle will generally be issued before, which must normally be followed by an on the day approval from the appropriate air traffic service unit, or aerodrome operator. In some cases, a standing agreement may be appropriate, and agreed by both parties, which grants permission on a standing basis for a specific operation.

FRZs are defined in article 94 of the ANO and comprise two sections:

- The Aerodrome ATZ
- Runway Protection Zones (RPZs)

The ATZ is an existing airspace structure, which applies to manned aircraft, and is a 2 or 2.5 NM radius cylinder which extends to 2000 ft above aerodrome level, centred around the centre point of the longest runway.
The RPZs are rectangular blocks, starting at the runway threshold and extending out 5km along the extended runway centreline, which are 1km wide and extend to 2000 ft above aerodrome level.

Figure 7 – Gatwick airport Flight Restriction Zone

These two areas make up the overall FRZ, for which permission to fly within must be obtained from the ATC or AFIS unit or from the aerodrome operator if no ATC/AFIS is present.

Permission to fly above 400 ft within the FRZ may be granted by the ATC or AFIS unit, without requiring further permission from the CAA, providing the flight remains entirely within the FRZ. If no AFIS or ATC unit is present, then the aerodrome may not permit a UAS flight above 400 ft within the FRZ, and a CAA permission is required.

All FRZs are published graphically on www.dronesafe.uk, and in raw data formats within the AIS.

1.9.2. London Restricted Areas EG R157, R158 and R159

The Air Navigation (Restriction of Flying) (Hyde Park) Regulations 2017, Air Navigation (Restriction of Flying) (City of London) Regulations 2004 and Air Navigation (Restriction of Flying) (Isle of Dogs) Regulations 2004 lay down restrictions on aircraft operations (which
include SUA) within three defined airspace areas:

- EG R157 (vicinity of Hyde Park),
- EG R158 (vicinity of the City of London) and
- EG R159 (vicinity of the Isle of Dogs).

These Restricted Areas are described in the AIP in ENR 5.1 and are marked on current VFR charts. The restrictions require, with certain exceptions, that no aircraft fly below 1,400 feet Above Means Sea Level (AMSL) within these areas unless in accordance with an ENSF clearance issued by the appropriate ATC unit.

The procedure for gaining an ENSF clearance for these Restricted Areas is described in AIP ENR 1.1 and the procedure to obtain the clearance is facilitated by NATS. Operators can utilise the web-based application process at the NATS website as above and will then need to comply with any conditions imposed by the clearance. Operators must note that the ENSF process also involves security considerations that would apply to any flight by a SUA whether or not engaged in aerial work or equipped for surveillance or data acquisition. The ENSF process may take up to 28 days before the grant of an approval.

1.10. Source Documents

- CAP 393 Air Navigation: The Order and the Regulations17.
- UK AIP Aeronautical Information Publication.
- Regulation (EU) 923/2012 (Standardised European Rules of the Air).
- EASA Decision 2013/013/R of 17 July 2013 (Acceptable Means of Compliance (AMC) and Guidance Material (GM) for Implementing Regulation (EU) 923/2012 of 26 September 2012)

17 CAP393 sets out the provisions of the Air Navigation Order as amended together with Regulations made under the Order. These Regulations are The Rules of the Air Regulations, The Air Navigation (General) Regulations, the Air Navigation (Cosmic Radiation) (Keeping of Records) Regulations, the Air Navigation (Dangerous Goods) Regulations and a number of permanent Air Navigation (Restriction of Flying) Regulations. It also contains the provisions of the Civil Aviation Authority Regulations.
2. Cross Border Operations

2.1. Scope

For the purposes of this guidance, international boundaries are considered to be coincident with lateral FIR/UIR boundaries.

2.2. Policy

UK UAS operators planning to operate beyond an international FIR/UIR boundary must comply with the regulatory and ATM requirements applicable to the territories over which the UAS is flown; these may differ from UK requirements. Whilst the CAA will provide guidance on cross border ATC procedures, including detailing the arrangements for those areas of airspace where ATS provision is delegated either to or by the UK. Guidance on foreign national procedures is to be sought from the appropriate State National Aviation Authority (NAA), and any permissions or authorisations are to be sought directly from that NAA in this regard. This requirement stems from Article 8 of the Convention on International Civil Aviation (‘Chicago Convention’), which states that:

- "No aircraft capable of being flown without a pilot shall be flown over the territory of a contracting State without special authorisation by that State and in accordance with the terms of such an authorisation. Each contracting State undertakes to insure that the flight of such an aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft".

For the purposes of the Convention the territory of a State shall be deemed to be the land areas and territorial waters adjacent thereto under the sovereignty, suzerainty, protection or mandate of such state (Chicago Convention Article 2).

ICAO requirements concerning the authorisation of UAS flight across the territory of another State are published at Appendix 4 to ICAO Annex 2, Rules of the Air.

3rd Country operators wishing to operate within the UK, outside the normal provisions of the ANO, must make an application to the UK CAA in this regard. They will have to demonstrate to the CAA using suitable evidence that they can safely comply with the applicable UK regulations in this regard. These applications to the CAA will be assessed on a case by case basis for suitability.

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18 ICAO use of “insure” should read “ensure”
3. ATM Procedures

3.1. Scope

Air Traffic Services (ATS) in the UK are provided by personnel who are suitably trained and qualified to provide services at one or more of the three levels of provision: Air Traffic Control, UK Flight Information Services and Air/Ground Communication Service. It is not possible to anticipate all of the issues and queries relating to ATS integration that will inevitably arise during the future development of UAS and their operational procedures. Any enquiries for further guidance or to establish the UK policy on a particular issue must be made to the CAA.

This section provides guidance on the policy associated with the provision of Air Traffic Services within UK airspace.

3.2. Policy

Individual ATS units may provide services within clearly defined geographic boundaries (such as a specific portion of airspace) or may provide services within a general area (for example, in the vicinity of an aerodrome).

The rules pertaining to aircraft flight and to the ATS provided will be determined by a number of factors (including airspace categorisation, weather conditions, aircraft flight rules and type of ATSU).

Not all aircraft within the same geographic area will necessarily be in communication with the same ATSU or operating under the same rules.

It is important that those managing UAS operations are familiar with the relevant rules and procedures applicable within any airspace through which the aircraft will be flown.

UAS operation is expected to be transparent to ATS providers. The pilot will be required to respond to ATS guidance or requests for information, and comply with any ATC instruction, in the same way and within the same timeframe that the pilot of a manned aircraft would. These instructions may take a variety of forms, for example, to follow another aircraft or to confirm that another aircraft is in sight.

International regulations and standards require that any new system, procedure or operation that has an impact on the safety of aerodrome operations or ATS shall be subject to a risk assessment and mitigation process to support its safe introduction and operation. Where an agency intends to operate a UAS in UK airspace it will be required to provide with a safety assessment demonstrating that associated hazards to other airspace
users have been identified, that the risks have been assessed and either eliminated or reduced to a level which is at least tolerable and is as low as reasonably practicable through ATS and/or other measures.

Where it is intended to operate a UAS in segregated airspace such a safety assessment must reflect measures intended to reduce the risk of mid-air collision between UAS and between UAS and manned aircraft. The safety assessment (which may also be presented in the form of a safety case or ATS sub-section of a broader UAS OSC) would be expected to include safety arguments concerning ATS and/or other measures to reduce the risk of accidents resulting from unplanned incursions into the segregated airspace by manned aircraft and unplanned excursions from the segregated airspace by the UAS.

3.3. Source Documents

Further information about the various levels of ATS and the services available from

- ATS units can be found in the following documents:
- CAP 797 Flight Information Service Officer Manual.
- CAP 452 Aeronautical Radio Station Operator’s Guide.
- CAP 774 UK Flight Information Services.

Further information about the classification of airspace and flight rules can be found in CAP 32 UK Aeronautical Information Publication.

Further information about radiotelephony procedures can be found in CAP 413 Radiotelephony Manual.

Further guidance on the conduct of safety assessments relating to ATS aspects of UAS operations can be found in CAP 760 Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases: For Aerodrome Operators and Air Traffic Service Providers.
4. Emergency ATM Procedures

4.1. Scope

The guidance below outlines the requirements for an operator of a UAS in UK airspace to include robust provision for ATM aspects of the efficient handling of relevant UAS emergencies.

Pre-planned arrangements for emergency manoeuvring of UAS, including manoeuvre into emergency orbit areas, emergency landing areas, ‘cut-down’ points and ditching areas, must be developed in consultation with CAA Airspace Regulation, who will coordinate with associated ANSPs and other elements within the CAA Safety and Airspace Regulation Group (SARG).

4.2. Policy

In accordance with the overarching principle that UAS operation is expected to be transparent to ATS providers, the ATM handling of emergencies involving UAS will be expected to follow the same process as that for manned aircraft with the air traffic controller/Flight Information Service Officer / Air-Ground radio operator providing assistance to the Remote Pilot in order to recover and/or land the UAS without injury to life and, where possible, without damage to property. However, the absolutely overriding objective in any emergency situation is the safety of human life. ATM procedures for dealing with UAS emergencies must, therefore, focus on assisting the Remote Pilot to resolve the situation without endangering other airspace users or people on the ground. Although the ATS provider can offer assistance, ultimate responsibility for concluding a UAS emergency safely must rest with the Remote Pilot.

UAS operators must, as a minimum, develop procedures which provide for the emergency notification of the relevant ATM agencies in the event that guidance of a UAS is lost or significantly restricted. Such notification must include the last known position, altitude and speed of the aircraft and sufficient additional information, such as endurance, which would enable other airspace users and aerodrome operators to be alerted to the hazard. Such notification arrangements must be reflected in the UAS operator’s safety assessment.
4.3. **Source Documents**

Further information about ATS arrangements for dealing with aircraft emergencies can be found in the following documents:

- CAP 797 Flight Information Service Officer Manual.
- CAP 452 Aeronautical Radio Station Operator's Guide.
- CAP 774 UK Flight Information Services.

Further guidance on the conduct of safety assessments relating to ATS aspects of UAS operations can be found in CAP 760 Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases: For Aerodrome Operators and Air Traffic Service Providers.
5. Aerodrome Operating Procedures

5.1. Scope

The ANO does not require UAS operations to take place from aerodromes licensed by the CAA. This section applies to those UAS operations that take place at licensed aerodromes.

It is not possible to anticipate all of the issues and queries relating to aerodrome operations that will inevitably arise during the future development and operation of UAS. Any enquiries for further guidance or to establish the UK policy on a particular issue must be made to the CAA.

5.2. Policy

The aerodrome licence holder is required to demonstrate how the safety of those aircraft requiring the use of a licensed aerodrome will be assured when UAS operations are permitted at the aerodrome.

The operation of UAS at a licensed aerodrome must be conducted in accordance with safety management requirements set out in the Aerodrome Manual of the aerodrome. This Manual, which forms a core element of the aerodrome’s Safety Management System (SMS), contains the safety policies, accountabilities, responsibilities and procedures to facilitate the safe operation of the aerodrome.

It is essential that those managing UAS operations are familiar with the relevant rules and procedures applicable at the aerodrome from which they operate. The aerodrome licence holder must provide an operating manual or other documents pertaining to the operation of UAS at that aerodrome, to ensure that risks from all aspects of the intended UAS operation are assessed and mitigated.

Aerodrome and UAS operating procedures may be subject to audit by the CAA.

5.3. Source Documents

Information about the licensing and operation of aerodromes can be found in the following documents:

- CAP 168 Licensing of Aerodromes.
- CAP 738 Safeguarding of Aerodromes.
6. Incident and Accident Procedures

6.1. Scope

The safe operation of UAS is as important as that of manned aircraft, and third-party injury and damage to property can be just as severe when caused by either type of aircraft. Proper investigation of each accident, serious incident or other occurrence is absolutely necessary in order to identify causal factors and to prevent repetition. Similarly, the sharing of safety related information is critical in reducing the number of occurrences. The limited operational experience with UAS in civil applications makes such investigation particularly relevant.

This section outlines the principles that must be employed with regard to the reporting and further investigation of occurrences involving the operation of all civilian unmanned aircraft within UK airspace; it also covers occurrences involving UK-registered unmanned aircraft that take place within the airspace of other nations.

6.2. Definitions

The current UK definitions of 'Accident' and 'Serious Incident' originate from Regulation (EU) No. 996/2010, which in turn are directly linked to the ICAO Annex 13 definitions.

An Accident is defined as: 'An occurrence associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked or, in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down, in which:

a) a person is fatally or seriously injured as a result of:

- being in the aircraft, or,
- direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or,
- direct exposure to jet blast, except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or
b) the aircraft sustains damage or structural failure which adversely affects the structural strength, performance or flight characteristics of the aircraft, and would normally require major repair or replacement of the affected component, except for engine failure or damage, when the damage is limited to a single engine (including its cowlings or accessories), to propellers, wing tips, antennas, probes, vanes, tires, brakes, wheels, fairings, panels, landing gear doors, windscreen, the aircraft skin (such as small dents or puncture holes) or minor damages to main rotor blades, tail rotor blades, landing gear, and those resulting from hail or bird strike (including holes in the radome); or

c) the aircraft is missing or is completely inaccessible.

A Serious Incident is defined as: 'An incident involving circumstances indicating that there was a high probability of an accident and associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked or, in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down.'

NOTE: The difference between an accident and a serious incident lies only in the result.

A Reportable Occurrence is defined as: 'Any incident which endangers or which, if not corrected, would endanger an aircraft, its occupants or any other person.'

6.3. Policy

Any person involved (as defined under Regulation (EU) No. 996/2010) who has knowledge of the occurrence of an accident or serious incident in UK airspace must report it to the AAIB. Such persons include (but are not limited to) the owner, operator and remote pilot of a UAS.

All other occurrences must be reported under the CAA Occurrence Reporting Scheme (MOR Scheme – details are published on the CAA website as CAP 382).

www.caa.co.uk/cap382

The following aircraft categories are specifically covered by the MOR Scheme (i.e. all occurrences must be reported):

- any aircraft operated under an Air Operator's Certificate granted by the CAA;
- any turbine-powered aircraft which has a Certificate of Airworthiness issued by the CAA.

Although these categories would appear to exclude the vast majority of UAS applications, all occurrences related to UAS operations which are considered to have endangered, or
might have endangered, any aircraft (including the subject unmanned aircraft) or any
person or property, must still be reported to the CAA via the MOR Scheme. This applies
equally to all UAS categories, regardless of the aircraft's mass or certification state. It also
includes UK registered UAS operating outside UK airspace.

UAS Operators should report any event in line with Regulation (EU) 376/2014 and IR
2015/1018. Whilst some of the listed occurrences would clearly only apply to manned
aviation, many will apply equally to UAS, in particular those associated with the operation
of the aircraft; there are also failure modes that are UAS specific. In addition to those listed
in CAP 382, other, more UAS-specific, reportable occurrences include events such as:

- Loss of control/datalink – where that loss resulted in an event that was potentially
  prejudicial to the safety of other airspace users or third parties.
- Navigation failures;
- Pilot station configuration changes/errors:
  - between Pilot Stations;
  - transfer to/from launch control / mission control stations;
  - display failures.
- Crew Resource Management (CRM) failures/confusion;
- Structural damage/heavy landings;
- Flight programming errors (e.g. incorrect speed programmed);
- Any incident that injures a third party.
- Additional guidance on MORs (Mandatory Occurrence Reports) and VORs
  (Voluntary Occurrence Reports) can be found on the CAA website:
  https://www.caa.co.uk/Our-work/Make-a-report-or-complaint/MOR/The-MORs-code/

### 6.3.1. Occurrence Analysis and Follow-up

Occurrences identified by UAS operators as potential safety risk as a result of its
investigation and analysis should be transmitted within 30 days form the initial date of
notification of the occurrence. Included in the update should be preliminary analysis
performed and, if any; action to be taken due to the outcome of the analysis. Furthermore,
the UAS operator should submit the final results of their analysis no later than three
months form the date of initial notification of the occurrence.

UAS operators should consider the size and complexity of their operation when selecting a
reporting system. For smaller less complex UAS operators the CAA recommends UAS
operators submit reports using the EU Aviation Reporting Portal. For larger more complex
operators the CAA recommends UAS operators use a reporting software solution that meets the requirements found on the CAA website. https://www.caa.co.uk/Our-work/Make-a-report-or-complaint/MOR/Reporting-Software-Solution/

Guidance on reporting via the EU Aviation Reporting Portal can be found in CAP1496.

6.4. Source Documents

The Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996.
Regulation (EU) 376/2014 on the reporting, analysis and follow-up of occurrences in civil aviation.
ICAO Annex 13 – Aircraft Accident and Incident Investigation.

6.5. Points of Contact

6.5.1. Accident / Serious Incident:

Air Accidents Investigation Branch
Farnborough House
Berkshire Copse Road
Aldershot
HANTS
GU11 2HH
24-hour Accident/Incident reporting line: +44 (0) 1252 512299
(Administration/general enquiries)
Tel: +44 (0) 1252 510300
Fax: +44 (0) 1252 376999
E-mail: enquires@aaib.gov.uk
6.5.2. Mandatory Occurrence Reporting:

Safety Data
Civil Aviation Authority
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR

E-mail: sdd@caa.co.uk with copy to mor@aaib.gov.uk

Reporting Portal: www.aviationreporting.eu or via the MOR Reporting pages on the CAA website