**The University Of Edinburgh**

**Airborne GeoSciences Facility (UoE-AG)**

**Flight Reference Card**

***Aircraft Type***

**This FRC covers the following aircraft & purposes:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Type**  | **Class** | **Aerial Work** | **Private / Internal** |
|  |  |  |  |

ADD AIRCRAFT IMAGE

This document is a part of a combined Safety and Operations Manual for small enterprises that covers all of the appropriate aspects of UoE AG operations required to satisfy the requirements of the UK CAA Permission for Aerial Work using Small Unmanned Aircraft Systems (sUAS).

**Document Reference:**

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**This document is based on the FC template in:**

**Amendment Record**

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# Technical Data

|  |  |  |
| --- | --- | --- |
| Item |  |  |
| Operators Name |  |  |
| Registered Keeper |  |  |
| Manufacturer Name |  |  |
| Airframe Make |  |  |
| Airframe Model  |  |  |
| Serial Number |  |  |
| LUASSTM Registration Number |  |  |
| Registration Number |  |  |
| Airframe Type |  |  |
| Span / Diameter (metres) |  |  |
| Un-laden Weight (kg) |  |  |
| Maximum Take-Off Mass (kg) |  |  |
| Propulsion Type |  |  |
| Number of Motors / Engines |  |  |
| Motor / Engine Size |  |  |
| Motor KV |  |  |
| Flight Battery Type |  |  |
| Flight Battery Capacity |  |  |
| Propeller Size |  |  |
| Flight Control System |  |  |
| Flight Control Power Supply |  |  |
| Software / Firmware Version |  |  |
| GPS Unit |  |  |
| Transmitter Make and Model |  |  |
| Receiver Make and Model |  |  |
| Aircraft Control Frequency and Power |  |  |
| Ground Station Type |  |  |
| Ground Station Make and Model |  |  |
| Ground Station Software |  |  |
| Firmware / Software Version |  |  |
| Ground Station Link |  |  |
| Telemetry Link Make and Model |  |  |
| Telemetry Link Frequency and Power |  |  |
| Payload Link Make and Model |  |  |
| Payload Link Frequency and Power |  |  |

# Operating Limits and Conditions

|  |  |  |
| --- | --- | --- |
| Limitation |  |  |
| Operational Ceiling |  |  |
| Operational Endurance |  |  |
| Maximum Outside Air Temperature |  |  |
| Minimum Outside Air Temperature |  |  |
| Maximum Permissible Wind Speed Including Gusts |  |  |
| Maximum Permissible Precipitation |  |  |
| Broadcast Frequency Signal Strength |  |  |

# Types of Operation

|  |  |  |
| --- | --- | --- |
| Operation Type | Allowed? | Comments |
| Category: |  |  |
| VLOS – Day |  |  |
| VLOS – Night |  |  |
| EVLOS - Day |  |  |
| EVLOS – Night |  |  |
| Aerial Work |  |  |
| Internal - Training & Currency |  |  |
| Internal - Trials / Development  |  |  |
| Internal – Teaching |  |  |
| Internal – Research Grant Support |  |  |
|  |  |  |
| Data Acquisition: |  |  |
| Ortho-photography |  |  |
| Laser range-finding |  |  |
| Videography |  |  |
| Oblique Photography |  |  |
| Multi-Spectral Imaging |  |  |

# Performance Data

**Battery Endurance Vs Payload Performance**:

This section to be populated based on flight test data

**Battery Endurance Vs Wind-Speed Correction**

This section to be populated based on flight test data

# Flight Modes

|  |  |  |
| --- | --- | --- |
| Flight Mode | Switch Position(s) | Description |
|  |  |  |
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# Maintenance Procedures

**Full System Check:**

Add details

**Full Flight Test:**

Add details

**6 month / 20 Hr Checks:**

Add details

**Re and Post flight Actions:**

See Normal Procedures Section below.

# Normal Procedures

|  |  |  |
| --- | --- | --- |
| Procedure | Responsibility Delegated to | Action Required |
| Embarkation Checks | PIC / GSC |  |
| On-Site Arrival Checks | PIC |  |
| GSC |  |
| GEC / Spotters |  |
| OPERTAING SITE SETUP |  |
| Radius: |  |
| Markings, Main Landing Zone: |  |
| Markings, Alternate Landing Zone: |  |
| Markings, obstacles / avoids:  |  |
| Telemetry / Wind Pole:  |  |
| Fire Extinguishers:  |  |
| First Aid Kit:  |  |
| Cordon procedure:  |  |

|  |  |  |
| --- | --- | --- |
| Procedure | Responsibility Delegated to | Action Required |
| CHECK ADaily check, upon move to new site, or payload change | PIC (specific tasks may be delegated to GSC) |  |  |
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| --- | --- | --- |
| Procedure | Responsibility Delegated to | Action Required |
| CHECK BCompleted prior to EACH flight. | PIC(specific tasks may be delegated to GSC) | **Part 1: General condition check and battery mounting** |
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| **Part 2: Mission Upload and Checking** |
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| **Part 3: Battery Installation** |  |
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| **Part 4: Vital Actions** |  |
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| Procedure | Responsibility Delegated to | Action Required |
| Take-Off | PIC |  |  |
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| GSC |  |  |
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| GEC/Spotters |  |

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| --- | --- | --- |
| Procedure | Responsibility Delegated to | Action Required |
| In-flight | PIC | * Maintain aircraft within Visual Line of Sight (max 500 metre horizontally, max 400 feet vertically). Maintain primary focus on the aircraft and immediate surroundings
* Monitor (via GSC where appropriate) basic telemetry from aircraft when safe and appropriate
* Maintain communications with the GSC at all times
 |
| GSC | * Monitor flight time elapsed, telemetry, flight battery voltage, satellites tracked, altitude etc. via the Ground Control Station (GSC)
* Relay the above to the pilot-in-command, when safe to do so, via verbal call-outs (in particular, regular updates on flight time elapsed, battery voltage and progress within the flight plan.
* Maintain visual lookout for public encroachments and airspace incursions
* Communicate with any additional spotters or the GEC (if appointed) to coordinate response to any public encroachment
 |
| GEC | * Maintain visual lookout for public encroachments and airspace incursions
* Reduce GSC workload by coordinating the response to any public encroachment, e.g. utilising additional spotters etc. where available
* Communicate any required information to the GSC (or PIC if very urgent)
 |
| Task Specialist (if present) | * Maintain visual lookout for public encroachments and airspace incursions
* Monitor any telemetry / read-outs from the payload to ensure correct function; inform the GSC (or PIC if very urgent) of any issues or malfunctions
* Provide any control of the payload, if applicable, or coordinate with the GSC for payload control
* Communicate any required information to the GSC (or PIC if very urgent)
 |
| Spotters | * Maintain visual lookout for public encroachments and airspace incursions
* Communicate any required information to the GEC/GSC (or PIC if very urgent)
* Act, as directed by the GEC / GSC or PIC, to prevent public encroachment of the operating site where possible (note the limitations regarding the right to stop members of the public against their will!)
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| Procedure | Responsibility Delegated to | Action Required |
| Landing & Shutdown | PIC  |  |  |
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| **When UA on Ground:** |  |
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| GSC |  |  |
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| **When UA on Ground:** |  |
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|  |  |
| GEC / Spotters | * Maintain visual lookout for public encroachments and airspace incursions
* Communicate any required information to the GEC/GSC (or PIC if very urgent)
* Act, as directed by the GEC / GSC or PIC, to prevent public encroachment of the operating site where possible (note the limitations regarding the right to stop members of the public against their will!)
 |

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| --- | --- | --- |
| Procedure | Responsibility Delegated to | Action Required |
| Site Departure Checks | PIC  | Provide any ATC end-of-action notificationsEnsure all UA and battery records updatedPack UAOversee packing and clear up processEnsure safe packing / handling of batteries**CONDUCT DEBRIEF** – Complete ‘After Action Report’ on On-Site Form |
| GEC / Spotters(PIC / GSC if none available) | Ensure area cleared of all markers, GCPs, litter, signage etcAssist PIC and GSC to pack / load UA and GCS hardware |
| GSC | Pack-up GCS hardwareAssist PIC packing UABack-up any retrieved logs/data if possible |

# ABNORMAL & EMERGENCY OPERATIONS

|  |  |  |
| --- | --- | --- |
| Emergency Type | Responsibility Delegated to | Action Required |
| Transmitter FailureFrequency Interference | PIC | 1. Call ***‘RC Failure’***
2. Confirm FAILSAFE RTL Activated (consult GSC if present)

 If **YES:**1. Call ***‘Fail Safe Activated, Aircraft Returning to Land*’**
2. Monitor aircraft progress visually and via telemetry

If **NO:**1. Attempt to activate RTL via telemetry (via GSC)
2. If successful, Call ***‘Fail Safe Activated Via Control Station, Aircraft Returning to Land*’**, proceed as above
3. If unsuccessful, commence ‘Fly-Away’ procedure
 |
| GSC  | 1. Upon hearing the call ***‘RC Failure’***, confirm FAILSAFE RTL Activated and advise PIC
2. Proceed as instructed by PIC
3. Once FAILSAFE RTL confirmed, ensure landing zone (i.e. point of arming) is clear of all persons

  |
| GSC / GEC / Spotters | 1. Upon hearing the call ***“Aircraft Returning to Land*”** ensure landing zone (i.e. point of arming) is clear of all persons
 |
| Loss of PropulsionMotor or Propeller FailureAircraft Battery Failure | PIC | 1. Call ***“Motor Failure”***
2. Assess if the aircraft is controllable

If sufficient control is maintained:1. Proceed directly to either the landing site or alternate landing site whichever is closest (take advice from GSC if available)
2. Call ***‘Returning to Land’*** or ***‘Returning to land, Alternate’*** as appropriate

 If control is compromised:1. Attempt a controlled descent and landing in current location
2. Call ***‘Emergency landing NOW’***
 |
| GSC | 1. Upon hearing the call ***“Motor Failure”*** identify the closest safe landing position to the aircraft and advise PIC
2. Clear any persons directly underneath or in the path of the aircraft to either the landing site or alternate landing as advised by the PIC landing call
3. Maintain visual contact with the aircraft once the area is clear.
 |
| GEC / Spotters | 1. Upon hearing the call ***“Motor Failure”*** immediately clear any persons directly underneath or in the path of the aircraft to either the landing site or alternate landing site as advised by the PIC landing call
2. Maintain visual contact with the aircraft once the area is clear.
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| Emergency Type | Responsibility Delegated to | Action Required |
| Ground Control Station Failure | PIC | 1. Call / confirm ***“GCS Failure – Returning to Land”***
2. Carry out the standard landing procedure.

NOTE: The aircraft is not in immediate danger but the ground station monitors crucial systems and therefore it is not advisable to fly without telemetry information. |
| GSC  | 1. Upon noticing GCS failure, inform PIC ***“GCS Failure”***
2. Attempt rectification, advise PIC if successful
3. Proceed as instructed by PIC (expect per normal landing procedure)
 |
| GSC / GEC / Spotters | 1. On hearing call ***“GCS Failure – Returning to Land”*** proceed as per normal landing procedure
 |
| Loss of GPS / GNSS Signal | PIC |  |
| GSC |  |
| GEC / Spotters |  |

|  |  |  |
| --- | --- | --- |
| Emergency Type | Responsibility Delegated to | Action Required |
| Public Encroachment | GEC / Spotter  | 1. Call *“****Public Incursion, (location)”***
2. Approach the member of the public asking them to follow you to safety as they are currently in an extremely dangerous situation.
 |
| GSC | 1. Upon identifying an encroachment from a member of the public or hearing the call *“Public incursion (location)”* advise the Pilot-In-Command.
2. Identify the nearest available landing site away from the encroachment and advise the PIC.
3. Once the PIC confirms they understand, if there is no spotter present dealing with the situation approach the member of the public asking them to follow you to safety as they are currently in an extremely dangerous situation.
 |
| PIC | 1. Immediately hold position and wait for further information.
2. The GSC will advise which the safest area to land
3. Confirm landing site selection
4. Proceed to confirmed landing site
 |
| Aircraft Incursions | GSC / GEC / Spotter | 1. Upon identifying an imminent aircraft incursion into the operating area call ***“Aircraft Incursion (relative location by clock code, using the line between PIC and the UA as the 12 o’clock reference), (relative height)’***
2. Maintain visual contact with the approaching aircraft

If PIC confirms visual contact:1. Monitor aircraft, UA and check ground environment below UA
2. Advise PIC of any immediate hazards below if present

If PIC does NOT make visual contact:1. Advise on de-confliction action required (normally ‘***Descend NOW’***)
 |
| PIC | 1. Upon hearing call ‘Aircraft ….’, immediately search in direction indicated

**If visual contact made:**1. Call ***‘Contact Aircraft…’***
2. )
 |
| **Warning**RAPID DESCENTS MAY INDUCE VRS AND LOSS OF CONTROL**DO NOT** EXCEED MAXIMUM DESCENT RATE AS PER LIMITATIONS SECTION ABOVE UNLESS SITUATION CRITICAL AND AREA BELOW IS CONFIRMED TO BE CLEAR |
| **If visual contact NOT made**1. Call ***‘Looking’***
2. Take avoiding action as advised by GSC / GEC / Spotter with visual contact
 |

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| --- | --- | --- |
| Emergency Type | Responsibility Delegated to | Action Required |
| Fly Away Actions | PIC | 1. Call ***“Fly Away*”** so that the crew understand the situation.
2. Activate RETURN TO LAND mode via RC and telemetry (instruct GSC if applicable) in case communication is re-established
3. Maintain direct visual contact with the aircraft for as long as possible.
4. Note (or instruct GSC to note) last known altitude, speed, remaining battery endurance and heading / track from GCS or visual estimation if telemetry not available

**If visual contact with UA is lost, or if airspace / congested area incursion imminent:**1. Contact the local air traffic control and local police using the contact numbers found on the SSA form within the job file to advise them of the situation.

**If the aircraft is seen to make contact with the ground or a structure:**1. Execute the shutdown procedure and walk over to the crash site taking a fire extinguisher and camera.
2. Take photographs at the crash site, contact details and statements from anyone present and recover the aircraft.
3. Leave contact details for any property damaged as a result.
 |
| GSC | 1. Upon hearing ***“Fly Away”*** immediately monitor the aircraft telemetry data and make a note of the aircraft’s actual heading, speed and altitude.
2. On instruction from PIC, activate the RETURN TO LAND mode via telemetry.
3. Continue to monitor the telemetry data for as long as the connection remains and advise the PIC of the available information
 |
| GEC / Spotter | 1. Upon hearing ***“Fly Away”*** maintain direct visual contact with the aircraft for as long as possible and advise the Pilot-In-Command of an estimated heading.
2. If practical, check area under UA and attempt to keep public well clear
 |

|  |  |  |
| --- | --- | --- |
| Emergency Type | Responsibility Delegated to | Action Required |
| Pilot Incapacitation | PIC | **If possible:**1. Upon feeling as though incapacitation is imminent activate RETURN TO LAND mode
2. Call ***‘Pilot Incapacitated – Returning to Land’***
 |
| GSC | 1. Upon noticing the PIC has become incapacitated activate RETURN TO LAND mode via telemetry
2. Call ***‘Pilot Incapacitated – Returning to Land’***
3. Ensure that the PIC is not in any imminent danger from a returning aircraft
4. Ensure that the landing site (where aircraft was armed) is clear of all persons; instruct GEC / spotters to assist as required
5. Call for the emergency services if required, or instruct GEC / spotters to do so if available
6. Once the aircraft lands and shuts down disconnect the flight battery.
 |
| GEC / Spotters | 1. Upon hearing call ***‘Pilot Incapacitated – Returning to Land’*** check primary landing site (RTL location) is clear of persons
2. Assist GSC as instructed

  |
| Fire (Ground Equipment) | All Crew | 1. Upon noticing fire call ***“Ground Fire”***
2. If the fire is a Lithium Polymer battery fire do not try to extinguish, allow the battery to burn out and then extinguish any additional fires.
3. If the fire cannot easily be extinguished and increases in size call the emergency services.
 |
| Fire (Aircraft in Flight) | PIC | 1. Upon noticing / being made aware of an aircraft fire call / confirm *“****Aircraft Fire”***
2. **I**dentify nearest safe landing site (take advice from GSC if available).
3. Proceed directly to nearest safe landing point. Call ***‘Emergency Landing’***, ***‘Emergency Landing, Alternate’***, or ***‘Emergency Landing NOW’***, etc. as appropriate
4. Upon landing shut down the motors.
5. Approach the aircraft (or instruct crew as appropriate) with a fire extinguisher and continue as per the Fire (Ground Equipment) procedure
 |
| GSC | 1. Upon identifying an aircraft fire call *“****Aircraft Fire”.***
2. Immediately identify the nearest safe landing point and advise the PIC.
3. Once landed, approach the aircraft with a fire extinguisher and continue as per the Fire (Ground Equipment) procedure
 |
| GEC / Spotters | 1. Upon identifying an aircraft fire call *“****Aircraft Fire”.***
2. Upon hearing *“****Aircraft Fire”*** *c*heck landing areas are clear of persons (PIC will call where aircraft will be landed)
3. Once landed treat the emergency as per the Fire (Ground Equipment) procedure.
 |

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| --- | --- | --- |
| Emergency Type | Responsibility Delegated to | Action Required |
| UA exhibits poor or limited controlUA appears ‘bouncy’ or high unexpected vertical thrust(Probable excessive vibration affecting accelerometers) | PIC | 1. Set Flight Mode to STABILISE
2. Call ***‘Limited Control’***
3. Identify nearest safe landing site
4. Call ***‘Emergency landing’, ‘Emergency landing, Alternate’***, or ***‘Emergency Landing NOW’*** as appropriate
5. Proceed to land in STABILISE mode
 |
| GSC  | 1. Upon hearing call *‘Limited Control’* check nearest safe landing site; advise PIC.
2. Once PIC has confirmed landing site, ensure that the landing site is clear of all persons; instruct GEC / spotters to assist as required
 |
| GEC / Spotters | 1. Once PIC has confirmed landing site, ensure that the landing site is clear of all persons; instruct GEC / spotters to assist as required
2. Assist PIC / GSC as instructed

  |
| UA ‘toilet bowling’ around waypoints or in LOITER(probable magnetometer failure / interference) | PIC | 1. Set Flight Mode ALT HOLD
2. Call ***‘Navigation Failure’***
3. Identify safe landing site (consult GSC if applicable)
4. Call ***‘Emergency landing’, ‘Emergency landing, Alternate’***, or ***‘Emergency Landing NOW’*** as appropriate
5. Proceed to land in STABILISE mode
 |
| GSC  | 1. Upon hearing call *‘Navigation failure’* check nearest safe landing site; advise PIC.
2. Once PIC has confirmed landing site, ensure that the landing site is clear of all persons; instruct GEC / spotters to assist as required
 |
| GEC / Spotters | 1. Once PIC has confirmed landing site, ensure that the landing site is clear of all persons; instruct GEC / spotters to assist as required
2. Assist PIC / GSC as instructed

  |