

SAIT  
Unmanned Aerial Vehicle  
Operations Manual

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# Definitions

The following definitions apply:

1. **UAV:** Unmanned Aerial Vehicle a power-driven aircraft, other than a model aircraft, that is designed to fly without a human PIC onboard.
2. **Operation Manager** - is the person associated with the operation of the UAV system, responsible for taking safety related actions or making safety related decisions about the operation (i.e. UAV operator, pilots, maintainers and visual observers) and must be a minimum of 18 years of age (SI 623-001 Section 8.2).
3. **PIC:** Pilot-in-Charge, the pilot of the UAV. Also called Primary Pilot.
4. **Canadian Aviation Documents** – means any licence, permit, accreditation, certificate or other document issued by the Minister under Part I of the *Aeronautics Act* to or with respect to any person, or in respect of any aeronautical product, aerodrome, facility or service. An SFOC is a Canadian Aviation Document.
5. **Command and Control Link** – means the data link between the UAV and the control station for the purposes of managing the flight.
6. **Crew Member** – means a person assigned to duties essential to the operation of the unmanned air vehicle system during flight time.
7. **Owner** – in respect of an aircraft, means the person who has legal custody and control of the aircraft.
8. **Operator** – in respect of an aircraft, means the person that has possession of the aircraft or the UAV system, as owner, lessee or otherwise.
9. **Payload Operator** – means the person (s) trained to operate the payload system, and in some cases, manage the flight profile.
10. **Special Flight Operations Certificate (SFOC)** – is a Canadian aviation document required for operating an unmanned air vehicle system.
11. **Unmanned Air Vehicle (UAV)** – means a power-driven aircraft, other than a model aircraft, that is designed to fly without a human operator onboard.
12. **UAV Operator** – means the person that has possession of the UAV system, as owner, lessee or otherwise.
13. **Visual line-of-sight (VLOS)** – means unaided (corrective lenses and/or sunglasses exempted) visual contact with the UAV sufficient to be able to maintain operational control of the aircraft, know its location, and be able to scan the airspace in which it is operating to decisively see and avoid other air traffic or objects.
14. **Visual Observer** – means a trained crew member who keeps the UAV within visual line-of-sight and who assists the pilot in the duties associated with collision avoidance and complying with the applicable rules of flight.
15. **Flight Crew (Crew):** The persons who manage the UAV flight, at a minimum the PIC and visual observer. This could include a payload operator as well.

## **Protection of Rights and Privacy**

UAV PICs and observers ensure the protection of private individuals' civil rights and reasonable expectations of safety and privacy before deploying the UAV. UAV PICs and observers shall ensure that operations of the UAV intrude to a minimal extent upon private persons and businesses. To accomplish this primary goal, SAIT observes the following:

1. When the UAV is flown, the onboard cameras are turned so as to be facing away from occupied structures, etc. to minimize inadvertent video or still images of uninvolved persons or property.
2. SAIT does not conduct random surveillance activities. The use of the UAV in this regard is tightly controlled and regulated.
3. All authorized missions for SAIT UAV are for:
  4. Aerial Photography
  5. Photogrammetry
  6. Research
7. SAIT UAV shall operate strictly within the law and aviation regulations.

## **Operations Manual**

1. The policies and procedures contained in this manual are issued by SAIT. As such it is an official business document of SAIT.
2. This manual is not intended to be all-inclusive, but as a supplement to other company guidelines, Transport Canada (TC) regulations, pre-flight safety checklists, aircraft manufacturers' approved flight manual, etc.
3. This manual was written to address UAV operations as they existed when it was drafted. Equipment, personnel, environment (internal and external), etc., change over time. The management of change involves a systematic approach to monitoring organizational change and is a critical part of the risk management process. Given this, it is essential that this manual be continually updated as necessary. The entire manual must be reviewed, at a minimum, annually to assure it is up to date. Any changes to the manual will be communicated as currently dictated by company policy.
4. A copy of the manual (electronic and/or paper) is issued to every person having UAV responsibilities.

## **Organization**

1. The UAV unit is comprised of those personnel approved by SAIT and includes PICs, observers and others deemed necessary and have assignment as part of the UAV crew.

2. Assignment to the UAV crew is carefully controlled by SAIT from specially trained staff members of SAIT with knowledge of the intended airspace, best practices and UAV operation.

## **Personnel**

1. Detailed description of the duties of the individual flight crew members will comprise those duties as defined in any of SAIT's approved UAV flight training courses.
2. The Operations Manager, PIC and visual observer are jointly and individually responsible for the overall direction and performance of the UAV unit and exercises command and control over it. Each have individual authority to terminate a mission that is judged to be unsafe.

## **PICs:**

3. To be approved for selection as an PIC, applicants must meet the requirements for and successfully pass a SAIT approved UAV PICs Course. PIC must additionally meet the qualifications as stated in the SFOC application.
4. PICs interacting with Air Traffic Control (ATC) or Terminal Radar Approach Control Facilities (TRACON) shall have sufficient expertise to perform that task readily. PICs must have an understanding of, and comply with TC Regulations applicable to the airspace where the UAV operates.
5. A PIC's primary duty is the safe and effective operation of the UAV in accordance with the manufacturers' approved flight manual, TC regulations and company policy and procedures. PICs must remain knowledgeable of all TC regulations; UAV manufacturer's flight manual and bulletins and company policy and procedures.
6. PICs may be temporarily removed from flight status at any time by the OM, for reasons including performance, proficiency, physical condition, etc. Should this become necessary, the PIC will be notified verbally and in writing of the reason, further action to be taken and expected duration of such removal.
7. The OM shall maintain a file for each PIC which shall include copies of training records, flight incidents, etc. This file is reviewed in accordance with current company policy and procedures.

## **Visual Observers:**

1. Visual observers must have been provided with sufficient training to communicate clearly to the PIC any turning instructions required to stay clear of conflicting traffic and obstacles. Observers receive training on rules and qualifications described in SI 623-001(4)(1)(3)(f), Operating Near Other Aircraft, Right-of-Way Rules, cloud clearance, in-flight visibility, and the pilot controller glossary including standard ATC phraseology and communication.
2. The OM maintains a file for each observer, which includes copies of training records, UAV incidents, etc.

## **Facilities**

1. See the Site Security document.
2. UAV operations are housed and maintained at a facility designated by SAIT.

3. Personnel must not leave the designated facility without making sure the UAV equipment is secured.
4. All personnel are equally responsible for maintaining the facility in a neat, clean and orderly fashion.

## **Miscellaneous**

1. Requests for support from third-parties will be responded to by the OM. Should the request involve an immediate threat to life, or property, the PIC is authorized to accept or decline the request. Proper policy and procedure, as well as TC regulations must be followed when accepting mutual aid support for the UAV.
2. Complaints or inquiries regarding UAV operations must be referred to the OM.

## **Safety**

1. Specific UAV safety procedures are found in the UAV safety plan found in SAIT SFOC application.
2. In addition to UAV safety SAIT has a complete set of safety documentation that may be found at <http://www.saitnow.ca/health-safety-environment-management-system.html>
3. Any safety hazard, whether procedural, operational, or maintenance related must be identified as soon as possible after, if not before, an incident occurs. Any suggestions in the interest of safety should be made to the OM.
4. If any member observes, or has knowledge of an unsafe or dangerous act committed by another member, the OM is to be notified immediately so that corrective action may be taken.

## **UAV Incident Reporting**

Information on SAIT's incident reporting procedure may be found here:

<http://www.saitnow.ca/health-safety-environment-management-system.html#incident>

1. Occurrences are unplanned safety related events, including accidents and incidents that could impact safety. A hazard is something that has the potential to cause harm. The systematic identification and control of all major hazards is foundational to safety.
2. The OHOR concept provides a mechanism to report hazards and occurrences, real and perceived, to those responsible for UAV operations.
3. Every hazard and/or occurrence is investigated, with the results and corrective action taken communicated to all members. The investigation will be conducted by the OM or any other member of the company who has the technical skill necessary to do it. The services of an independent subject matter expert may be necessary in some cases to assure a thorough and complete investigation.
4. Hazards requiring immediate attention will be brought to the attention of the OM, verbally, without delay.
5. ALL MEMBERS ARE AUTHORIZED TO TAKE ACTION TO CORRECT A HAZARD if in that member's opinion delay will result in accident or injury. The OM will be notified immediately in such situations.

## **Safety Officer - PIC/Observer/Coordinator**

1. In regards to safety, all members of the UAV flight crew are responsible for the following:
  - a. Ensuring all flight operations personnel understand applicable regulatory requirements, standards and organizational safety policies and procedures.
  - b. Observe and control safety systems by monitoring all operations.
  - c. Review standards and the practices of company personnel as they impact operational safety.
  - d. Communicate all reported safety related problems and the corrective action taken. If there were any in-flight problems (or learned experiences), the proper procedures for handling that problem should be discussed.
  - e. Copy and circulate pertinent safety information.
  - f. Copy and circulate emergency safety bulletins.
  - g. Place any electronic copies of safety information or bulletins in a conspicuous location for all employees to access.
  - h. It is emphasized again that safety is the responsibility of ALL members of the UAV unit.

## **Safety Training**

1. SAIT employees have access to general safety training and orientation outlined in :  
<http://www.saitnow.ca/training-and-orientation.html#newhireorientation>
2. In addition to the safety training procedures that all SAIT employees require. All UAV crew members shall receive training in the following subjects prior to operating the UAV:
  - a. Specific UAV hazard analysis.
  - b. Special certificates for hazardous environments
  - c. Special certificates for compliance with research partner safety requirements.

## **Human Factors**

1. PIC and Observers shall only deploy the UAV when rested and emotionally prepared for the tasks at hand.
2. Physical illness, exhaustion, emotional problems, etc., seriously impair judgment, memory and alertness. The safest rule is not to act as an PIC or observer when suffering from any of the above. Members are expected to "stand down" when these problems could reasonably be expected to affect their ability to perform flight duties.
3. A self-assessment of physical condition shall be made by all members during pre-flight activities.



4. Performance can be seriously hampered by prescription and over-the-counter drugs. The OM must be advised anytime such drugs that impair the performance of the are being taken. If it is determined that the medication being taken could hamper an PIC or observer, that member shall be prohibited from the deployment or exercise.
5. No member shall act as an PIC or observer within eight hours after consumption of any alcoholic beverage, or while under the influence of alcohol.

## **Training**

### **Objective**

1. The key to continued safe operations is by maintaining a professional level of competency. The first step in this process is establishing minimum qualifications for selecting UAV crew members, and the second step involves training those personnel. Preliminary qualifications for the PIC

### **Instructors**

1. If any members are TC certified flight instructors, they are given instructor duties. Such duties can include developing training courses, provide training, and student evaluation and documentation.
2. Duties of instructing new members shall fall upon those who have the most flight time and knowledge of UAV operations. Instructors are designated by those within the unit and approved by the OM.

### **Training Plans**

1. The approved training plan is developed by the OM.
2. All deployments or exercises are documented and count toward a member's training.
3. It is the member's responsibility to verify their training file contains all pertinent information.

### **Initial Training**

1. Observers and PICs must have completed sufficient training to communicate to the pilot any instructions required to remain clear of conflicting traffic. This training, at a minimum, shall include knowledge of the rules and responsibilities described in [Staff Instruction \(SI\) No. 623-001 - Transport Canada](#); Basic VFR Weather Minimums; knowledge of air traffic and radio communications, including the use of approved ATC/pilot phraseology; and knowledge of appropriate sections of the Aeronautical Information Manual. In conjunction with fulfilling all training requirements for PIC/observer duties, the new member must also become familiar with UAV operations, the aircraft and its equipment.
2. Any new member who fails to successfully complete the initial training may be denied as a member of the UAV flight crew.

## **Recurrent Training**

1. All members within the unit shall maintain proficiency in their PIC/observer abilities. Members who do not have any documented training or flight time within a span of 90 days will have to show proficiency before being an PIC/observer during a deployment or exercise.
2. Recurrent training is not limited to actual operating/observer skills but includes knowledge of all pertinent UAV/aviation matters.
3. Failure to prove proficiency can result in removal from UAV responsibilities.

## **Miscellaneous**

1. Depending on the nature of the training request, all efforts are made to accommodate the hours of training so as little impact is made to staffing levels.
2. All requests for training shall be approved through the member's chain of command and timekeeping during those training hours are marked by the OM.
3. Members are encouraged to attend, and forward information on TC sponsored safety seminars.
4. Training shall only be conducted at approved locations and follow the provisions within the approved TC regulations.

## **General Operating Procedures**

### **Request for UAV Support**

UAV support is defined as support for SAIT personnel who require the services of a UAV but do not have access to such resources. A request may be submitted to the OM for support from departments within SAIT that have the required equipment and capabilities.

1. Requests for UAV support shall be made through the OM who has the most current list of UAV PICs and observers to contact.
2. Requests for UAV support can be made at any time during the day or night.

### **Call-out Procedure**

1. The OM will screen all initial requests to use a UAV.
2. The OM will then contact the PIC to request the deployment of the UAV.
3. The OM will also contact the UAV flight crew who will screen the request using the following factors:
  - a. Is the proposed use of UAV within the capabilities of the UAV equipment and personnel to perform?
  - b. Does the proposed use of the UAV fall within the TC and department policies and regulations for UAV usage?

- c. Can the UAV be deployed safely given current weather conditions?
  - d. If the UAV deployment requires a warrant has one been requested and approved?
  - e. Are sufficient trained and qualified personnel available to safely operate the UAV?
4. The UAV flight crew will either accept or decline the request for UAV support. If the request is denied the UAV flight crew will provide a reason for declining the support request to the OM who will provide the requestor this information along with the reason for declining. If the OM accepts the support request they will contact a UAV PIC who will be provided all available mission information.
5. The UAV PIC will contact a certified observer from the list of available trained observers. The UAV PIC is responsible for transporting the UAV and all required equipment to the scene. Upon arriving at the requested location the UAV PIC will contact the requestor to check in and receive a briefing on the mission requested. The UAV PIC will make an on scene determination of the ability of the UAV to perform the requested mission safely and within company and TC policies and procedures.
6. If the UAV PIC determines that the use of the UAV would violate company policy or directives then the UAV PIC will inform the requestor of the potential conflict along with recommendations for modifying the requested mission to conform to company policies and procedures. As this is a change from the original approved mission the UAV PIC will contact the OM for direction on how to proceed. As soon as possible after the completion of the mission, the UAV PIC will make a full report of the circumstances and their concern through the OM.
7. UAV PICs will have sole discretion for declaring safety or violation of TC rules. If the UAV PIC determines that a requested mission would violate TC rules or endanger person or property, then the UAV PIC will respectfully inform the requestor of the reasons for refusing to operate the UAV and contact the OM immediately. The UAV will not be flown in this circumstance and the authority of the UAV PIC is absolute.
8. If the UAV PIC determines that the requested mission will potentially damage the UAV or its associated equipment the UAV PIC will inform the requestor of their concerns. The UAV PIC will fully document and send a report to the OM.

### **Flight Boundaries**

1. At no time shall UAV support be granted inside restricted airspace without first obtaining permission from the local TC and approval by local authorities.
2. Maximum altitude shall not be set more than 400 feet per the TC regulatory standards.
3. The PIC will obtain the consent of all persons involved in the mission and ensure that only consenting persons will be allowed within 100 feet of the flight operation, and this radius may be reduced to 30 feet based upon an equivalent level of safety determination.

### **Minimum Personnel Requirements**

The minimum personnel required on ALL missions will be a PIC and visual observer. Under no circumstances will a PIC attempt to complete a deployment alone.

### **Personnel Responsibilities for Deployments**

1. Pilot in Charge (PIC)
  - a. The PIC is directly responsible for, and is the final authority over the actual flight of the UAV.
  - b. PIC have absolute authority to reject a flight based on personnel safety or violation of TC regulations. No member of SAIT, regardless of status, shall order an PIC to undertake a flight when, in the opinion of the PIC, it poses a risk to personnel or is in violation of TC regulations.
  - c. PICs are responsible for compliance with this manual, company policy and procedure and TC regulations.
  - d. The PIC's main duty during the deployment of the UAV is to operate the UAV safely while accomplishing the goals of the deployment.
  - e. PICs shall see-and-avoid any obstacle that will lessen safety during the mission.
  - f. PICs shall be responsive to the requests of the observer in order to accomplish the deployment.
  - g. PICs shall be responsible for documentation for mission training and updating of flight books.
2. Observer
  - a. Observers shall see-and-avoid any obstacle that will lessen safety during the mission.
  - b. Observers are responsible for the operational aspect of the deployment.
  - c. Observers shall operate any attachments to the UAV, allowing the PIC to maintain complete focus on the operation of the UAV.
  - d. Observers shall remain alert for suspicious persons or activities on the ground and coordinate response by other UAV flight crewmembers.
  - e. Observers shall assist the PIC in the main objective of safe operations of the UAV.
  - f. Observers shall be responsible for documentation for mission training and updating of flight books.

## **Personal Protective Equipment (PPE)**

1. Flight crew shall wear eye protection at all times while the UAV is in flight.
2. Although there is no specific uniform for the UAV unit or required for proper operation of the UAV, the PIC/observer should take necessary measures to deploy in a professional manner, wear Hi-Visible vests when appropriate, and take into consideration that all deployments are subject to media requests.
3. Flight crew will take into consideration the current weather conditions when planning to deploy, and wear appropriate clothing to deploy comfortably.
4. There are no documented issues with the use of the radio or cellular phones during the deployment of the UAV, but the PIC/observer should at all times take into consideration safe operation of the UAV when using a radio or another device (use of the radio or other device is strictly prohibited by the PIC during flight).
5. Flight crew shall wear clothing that easily identifies them as SAIT UAV Flight Crew members.
- 6.

# **Pre-Flight/Post-Flight Actions**

## **Inspections**

1. Flight crew are responsible for a thorough preflight inspection of the UAV.
2. Before and after each deployment (whether a mission or training), the PIC and observer shall conduct a thorough inspection of the UAV in accordance with the instructions contained in the manufacturer's user's manual.
3. Any issues found that jeopardize the safe operation of the UAV shall be documented and resolved immediately prior to flight.
4. It has been recognized that the use of a checklist is a significant method to combat UAV accidents. A pre-flight checklist is contained with each UAV Base Station and is utilized prior to each flight.
5. Any physical equipment that cannot be resolved on-site, and which have an impact on safety or the mission, will override the deployment. These issues will be resolved before flight.

## **Weather**

1. Before each deployment the PIC/observer will ensure that he/she gathers enough information to make themselves familiar with the weather situation existing throughout the area of deployment. The PIC shall utilize TC approved weather resources to obtain the latest and most current weather conditions.
2. An anemometer should be utilized in order to better estimate the wind speed and determine if it is within the capabilities of the airframe being flown.
3. Flight crew should use the Beaufort Scale when making deployment decisions in regards to wind conditions.
4. The weather conditions reported for the operation shall be recorded in the pre-flight checklist.
5. The PIC shall ensure that the flight will occur within TC VFR weather requirements.

## **Documentation**

1. Inspection and weather will be documented prior to flight within the log book.
2. After each flight, the PIC will complete a statement documenting the UAV operations.

## **Planning**

1. The PIC/observer shall familiarize themselves with all available information concerning the deployment including, but not limited to, the weather conditions, hazards, description of the incident, deployment goals, etc.
2. PICs will ensure that the location for take-off and emergency landing is adequate for a safe deployment.
  - a. The take-off/landing area should be clearly marked and identifiable with short cones.

- b. At least one emergency landing area should be identified per deployment.
3. PICs will ensure that they are aware of their surroundings in the event that an emergency landing is necessary. This includes the ability to recover the UAV.

## **Checklists**

1. PICs shall utilize pre-flight checklists to ensure the highest level of safety for deployment.
2. Prior to flight, the flight log shall be initiated.

## **Control Station**

1. Control method (e.g. manual flight, pre-programmed, tethered, auto-land, etc.); Flights will be operated using manual and pre-programmed methods. The PIC will be able to switch to return to home and possesses a failsafe option. Flight Instrumentation (e.g. attitude, altitude, airspeed, heading, present position, navigation etc., and method of displaying the information): Normally, flight instrumentation readings are displayed on a mobile device (i.e. iPad, iPhone) using a specific application or equivalent. Data is updated real-time and displays attitude, altitude, airspeed, heading and the present position of the UAV.
2. Systems diagnostic and monitoring information (e.g. low battery, fuel status, critical systems failure, visual and audio warnings, etc.);
3. Normally system diagnostic and monitoring information is displayed on a mobile device (i.e. iPad, iPhone) using the UAV specific software application or equivalent. Data is updated real-time and displays battery status from the controller and UAV (Low, Critical), estimated remaining flight time, warnings and critical system failures. All information is described by visual and audio warnings. The application also displays a warning message when a damaged battery cell is detected.
4. Visual warnings may include: include Fast Yellow Flashing (Remote Controller's Signal Lost), Slow Red Flashing (Low Battery Warning), Fast Red Flashing (Critical Battery Warning), Red Flashing Alternatively (IMU Error), Solid Red (Critical Error), Red and Yellow Flash Alternatively (Compass Calibration Required). Other warnings include Low Battery Warning, Power Required to Return Home, Power Required to Land, Critical Battery Warning and Remaining Flight Time. The primary pilot shall be familiar with any visual warnings that the UAV may transmit.
5. Environmental warnings (e.g. icing, rain, terrain, etc.); All UAV flights will be conducted within the specified environmental limits from the manufacturer. Typically UAV will not be flown in conditions of rain or icing. The UAVs will receive a "Low Battery Level Warning" in low temperature environments. In addition, warnings are displayed when reaching the maximum flight altitude, No-Fly zones and Warning Zones.
6. Redundant systems (e.g. back-up computer displays, back-up power supply); There will be at least one backup tablet or smart phone for every operation. The UAVs and controllers will have multiple batteries and a charging system on site. Every mission will

also have a fully charged laptop with the UAV software for any required troubleshooting, if required.

7. Equipment in the control station (e.g. lights for night operations, fire extinguisher); and Illumination of the take-off and landing site will be provided for night flights. A method for fire suppressant (i.e. fire extinguisher) will be on site during all missions.
8. Control station security (e.g. capable of being locked). All UAVs, systems and equipment shall be kept in in a secure, locked location at all times to prevent accidental or intentional tampering and damage. The control station will not be left unattended during any mission.

## **Command and Control Links**

1. Lost Link indications (e.g. "off flags", signal strength indicators, etc.); In the event of a failure of the ground control station or remote control, the flight mission shall be aborted by directing the UAV to return to launch site with the remote control or through telemetry with the ground station. The Pilot shall maintain a visual siting of the UAV while the Ground Support person attempts to restore the failed ground stations component. In any event the UAV shall be landed as soon and as safely as possible. Aircraft status indicator will provide a warning (i.e. fast yellow flashing) when the remote controller's signal is lost.
2. Measures for preventing or mitigating radio frequency interference; and Missions will be flown by minimizing exposure to high levels of electromagnetism, including base stations and radio transmission towers. Prior to any flight, a radio frequency interference check will be performed by a spectrum analyzer. Depending on the results, the mission will be re-located to minimize risk.
3. Single or dual redundant control links. All UAVs use a single control link but the UAVs possess built-in redundancies such as dual compass module and dual inertial measurement units (IMUs) that greatly increase reliability.

## **Voice Communications**

1. Primary method of communicating with ATC/ATS and other airspace users (e.g. radio relay through the air vehicle, fixed based transmitter, etc.); Normally communications with ATC and other airspace users will be via telephone or NOTAMS. If VHF communication with ATC and other airspace users is required it will be with approved VHF hand-held radio(s) operated by persons holding a valid Radio Operators Certificate (Restricted Certificate (Aeronautical)). VFR will be constantly monitored during each flight.
2. Backup communication capability (e.g. landline, cell phone, etc.); Transport Canada shall be provided a means to immediately contact the flight crew for every flight. This shall include one or more of the following means, a Cellular phone, a Satellite phone, a nearby landline.

3. Communication latencies (e.g. able to perform ATC/ATS directed actions without delay, etc.); and
4. Communications devices shall be located onsite with the Ground Supervisor who shall be in direct contact with the Pilot in a form that there will be very little or no communication latencies so that any actions directed by Air Traffic Control or Transport Canada can be performed without delay.
5. Communication system used for the pilots, ground support personnel and observers to communicate with each other.
6. In the event that ground support personal and observers are utilized for the flight and that the persons are beyond voice communication range with the pilot or ground supervisor, communication shall be made with handheld radios or other means so that the communications are immediate.

## **Payloads**

1. Payload limitations (e.g. impact on flight envelope, how conflicts are managed when aircraft and payload operational limits differ, etc.); The combined weight UAV and payload may not exceed the specified MTOW. If the UAV is over MTOW or out of balance, the following changes to the loading of the aircraft may bring the aircraft within allowable limits: changing the payload, changing the battery, securing small weights to adjust balance, moving and re-securing the battery and/or payload ensuring that the items are adequately secured.
2. Payload Directed flight (e.g. camera controls the flight path of the UAV, etc.): Normally the payload device will not control the flight path of the UAV.
3. Abnormal Crew Duty (e.g. pilot operating UAV and payload, etc.):The PIC responsibilities will not include ancillary duties, which in any way may detract from maintaining visual contact with the UAV. Payload manipulation and control shall not be the responsibility of the PIC. Whenever possible the Ground Supervisor shall be responsible for radio communications.

## **Maintenance**

### **Maintenance Schedule**

The flight crew shall carefully inspect the UAV before and after each flight using a checklist based on the manufactures recommendations and created by the System Maintainer. Any damage shall be noted. If a defect is discovered on the UAV making it unsafe to fly, a red colored tag indicating the defect and that that aircraft should not be flown until rectified shall be attached to the UAV. The System Maintainer shall hold the records except when the UAV is conducting flights in which case they will be with the UAV on site.

### **Before & After Every Flight:**

1. Update the firmware for batteries and flight controller immediately before every flight.
2. Check condition of props (run finger along leading and trailing edges, flex both blades to check for hairline cracks)



3. Check motor shafts have no “play” (missing E clip? Loose bell housing screw? Bad bearings?).
4. Check condition of battery spade connectors and data pins (level, free movement, clean)
5. When powered up and idling confirm no unusual noise or vibration from motors.
6. Check over the UAV’s body and check to cracks, out of place seams.
7. Spin the motors to make sure they move freely, listen for any abnormal noise.
8. Check the landing gear and make sure there is no damage to the antennas or compass.
9. Check the rubber dampers for damage and that they are seated correctly. Verify that the anti-drop pins are fitted.
10. Check gimbal for full range of movement. Listen for any unusual noise.

### **The Sooner of Every Week Ten Flights**

1. Visual inspection of shell and other plastic components for cracking/damage (landing skids, camera mounting plates, etc.) Check tightness of motor retaining screws and shell retaining screws (both 2.0mm hex)
2. Clean data spring pins and battery contact pads with alcohol and swab or proprietary electrical contact cleaner and cycle spring pins several times to check for spring weakness and full unimpeded travel
3. Check radio and inertial measurement system (IMU) calibration state and all battery cells have good balance (repeat for all batteries).
4. Check batteries for number of cycles and discharge per manufacturers recommendations.

### **The Sooner of Every Month or Forty Flights**

1. Remove upper shell and check state of all wiring - plugs fully seated, condition of all solder joints, condition of visible circuit boards and wiring runs, internals generally clean and no debris/loose items.
2. Remove motors and check security of ESC clips, condition of bearings and general visual inspection.
3. Remove rubber cover from camera servo mounting point and check tightness of the small cross-head screw.

### **Smart Flight Battery Maintenance**

1. Always comply with the guidelines set out the UAV manual in the “Intelligent Flight Battery Safety Guidelines” or similar wording.
2. Before and after flight visually inspect the battery for any damage or swelling. If damage is found discharge it and dispose of it properly. Do not pierce or disassemble the battery as it could catch fire.
3. Visually inspect the contact pins on the battery and corresponding power connectors on the UAV.
4. Check the cell voltage of the battery and ensure they are similar.
5. Variations in the cell voltage of a battery can signify cell damage and the battery should not be used. A 0.2v variance above or below could mean a problem.

## **LiPo Battery Use**

1. Do not allow batteries to come into contact with any liquid. Do not leave batteries out in the rain or near a source of moisture.
2. Never use batteries other than those specified by the manufacturer.
3. Never use or charge swollen, leaky or damaged batteries.
4. Never install or remove a battery from the aircraft while it's powered on.
5. LiPo batteries should only be used in temperatures ranging from -10° to 40° C. Temperature in excess of 50° C can lead to a fire or explosion. Using the battery at temperatures below -10° C can lead to permanent damage.
6. Never disassemble or pierce the battery in any way.
7. Before use, be certain that intelligent batteries are updated with the latest version of the firmware.

## **Manuals and Records**

The following documents shall be retained and made available to crews and Transport Canada:

1. Aeronautical Information Manual (AIM)
2. Canada Flight Supplement (CFI)
3. Appropriate VFR Charts
4. SAIT SOP, Check Lists and Worksheets
5. UAV Flight Manuals

## **Mission Records**

The following records shall be retained by the PIC and crews as applicable:

1. Completed Pre-Flight checklist worksheets for each mission
2. Pre-Flight communications with aerodrome controlling authorities
3. Any other pre-flight graphics, maps and material created for the flight
4. Completed Post-Flight Worksheet for each mission.
5. Any Completed Incident Reports

## **Mission Logs**

1. The following logs shall be retained by the Operations Manager and crews as applicable:
  - a. Date and time.
  - b. Pilot and crew.
  - c. Aircraft logbook
2. Company Logbook containing date, times, crew and aircraft.
3. Pilot's Logbook containing flight hours per day, month and year.