

# **Airworthiness assurance for RMAX flights at Kentland Farm**

## **VT Unmanned Systems Laboratory**

### **1.0 Essential Personnel**

#### **1.1 Mission Coordinator (MC)**

- 1.1.1 The MC is responsible for ensuring all necessary personnel and equipment is available and present for flight operations. The MC will make assignments, as necessary, for personnel to operate radios, video cameras and safety equipment such as fire extinguishers.
- 1.1.2 The MC will check weather conditions and confer with the pilot on acceptable / unacceptable conditions for flight.
- 1.1.3 The MC will monitor flight control frequencies during flight ops and will stand within 10 m of the pilot to communicate information.
- 1.1.4 The MC is responsible for the safe transit of the helicopter to the flight area.
- 1.1.5 The MC ensures that all necessary equipment for flight is transported to the flight area. The MC can delegate responsibility to others. A partial list includes:
  - 1.1.5.1 Computers
  - 1.1.5.2 Power (generator, power cords)
  - 1.1.5.3 Antennas
  - 1.1.5.4 Cameras

#### **1.2 Pilot**

- 1.2.1 The Pilot has primary responsibility for the operation, care and maintenance of the helicopter.
- 1.2.2 The Pilot is one of two responsible persons who will preflight the helicopter and complete a pre-flight check-list. The Pilot's pre-flight is conducted at the flying field just prior to engine start.
- 1.2.3 The Pilot will ensure that batteries are charged and ready for flight at the time agreed upon.
- 1.2.4 The Pilot will manage fuel for the helicopter.
- 1.2.5 The Pilot will maintain and update checklists as required – this particularly applies in the case of accidents leading to new items that must be checked to ensure airworthiness.

#### **1.3 Ground control station (GCS) operator(s)**

- 1.3.1 There will be a primary GCS person identified who will be responsible for equipment and operations set-up.

- 1.3.2 The GCS operator will set up the following equipment for flight:
  - 1.3.2.1 Tables and awnings
  - 1.3.2.2 Antennas
  - 1.3.2.3 Computers
  - 1.3.2.4 Generator and power distribution
- 2.0 Handling and transporting helicopter
  - 2.1 Whenever the helicopter or rotor blades are moved, two people must be present – no exceptions.
  - 2.2 Carriage of the helicopter should be a two-person carry on each side of the landing gear with the blades stowed.
  - 2.3 Before any action is taken to move the helicopter, the parties that are involved must confer with each other on the signals for pick-up, etc.
- 3.0 Flight procedures
  - 3.1 All necessary personnel will show up promptly to the lab at a time that allows 1 hour of preparation before departing the lab to fly.
  - 3.2 Before leaving the lab with the helicopter, the following are accomplished:
    - 3.2.1 One pre-flight will occur in the lab by a qualified inspector (not the pilot). Using the aircraft checklist, all items are checked off as either satisfactory or unsatisfactory.
    - 3.2.2 A briefing led by the MC will occur on how equipment will be set up and what the objectives of the mission are.
    - 3.2.3 The MC will collect the 1<sup>st</sup> pre-flight form and confirm from the pilot that the helicopter has full fuel and batteries are charged
  - 3.3 The MC will oversee the transportation of the helicopter and the set-up of the GCS. The MC will ensure that the helicopter is carried and configured by two people at all times. *At no time should one person move the helicopter and/or deploy the blades. This is always a two-person operation.*
  - 3.4 The following minimum equipment is required for flight operations:
    - 3.4.1 3 personnel (MC, GCS and Pilot) minimum, 4 preferred
    - 3.4.2 Ground control station equipment
    - 3.4.3 First aid kit
    - 3.4.4 Fire extinguisher
    - 3.4.5 Video camera
    - 3.4.6 All services and equipment to support the helicopter flight and data acquisition

- 3.5 The pilot performs the final pre-flight check before engine start. Only after the pre-flight checklist is turned in will the MC authorize engine start.
- 4.0 Development of pre-flight inspection checklists
  - 4.1 Pre-flight checklists are living documents. They will be revised and added to as reliability information becomes available. For instance, whenever a new failure mode is discovered, the system will be analyzed for the root cause of failure. If it is determined that the failure mode is traceable to an inspectable component, that item will be added to the checklist.
  - 4.2 The Pilot will be responsible for maintaining a current pre-flight checklist.
- 5.0 Safety
  - 5.1 Safety is a major concern for all stages of the flight operation. Risks of injury associated with the airframe principally relate to the engine and rotor. Lacerations, burns, fuel exposure, and blunt force injury are the major concerns; each of which are discussed below. Treatments for these injuries are described in Section xx.
  - 5.2 There are two phases of a flight operation that have unique risks which must be addressed: start-up and hover. During start-up, personnel are located close to the helicopter and are working with fuels, batteries and rotating equipment, all of which have unique hazards associated with them. During hover, the helicopter is operating at full RPM so flight loads will be at their maximum. A rotor blade that departs the aircraft can be thrown hundreds of feet, and so precautions to all ground personnel are necessary.
    - 5.2.1 Start-up safety procedures
      - 5.2.1.1 Ensure the helicopter is in a stable attitude (solid base) for start-up. Dynamic transients during start-up can cause a rocking motion that may potentially lead to a rotor strike.
      - 5.2.1.2 Personnel remain clear of moving parts, especially the rotor
      - 5.2.1.3 A fire extinguisher will be located and manned within 50' of the helicopter
      - 5.2.1.4 During normal operation, engine components become quite hot and can easily burn the user on contact. Precautions will be made to avoid contact with hot spots
      - 5.2.1.5 While the rotor is spinning up, the nearest person to the helicopter will be the pilot. The pilot should be at least 50' away from the helicopter during this phase of the operation. All other personnel should be at least 100' from the helicopter.
    - 5.2.2 Hover and in-flight safety procedures
      - 5.2.2.1 After the helicopter takes off, the major danger during flight operations is loss of control of the aircraft. All personnel will be vigilant of the helicopter flight path, and personnel will

communicate flight status on a regular basis to inform on the health of the aircraft.

5.2.2.2 In the event of loss of control, the Pilot or GCS operator will inform everyone of the condition, at which time personnel will seek safe shelter. Updated assessments by the Pilot and GCS operator will keep all personnel informed until helicopter control is regained, or the vehicle crashes.

### 5.3 Medical procedures

5.3.1 Lacerations. A laceration is any wound where the skin is broken. The following procedures are for all sizes of lacerations. If the wound is more than a half an inch long, is very deep, or is bleeding profusely, stitches might be required. The first step to treating a laceration is to stop the bleeding. Apply constant pressure to the wound using a clean cloth or bandage. If the bleeding does not stop and it is possible to do so, raise the body part above the level of the victim's heart. If bleeding continues seek medical assistance. To clean the wound, rinse it under cold water, however do not use soap directly on the wound. If there are debris in the wound, clean them out with a set of sterile tweezers. Apply an antibiotic such as Neosporin and then dress the wound with a bandage. The bandage will keep the wound clean and prevent infection. Replace the bandage daily until the wound has healed enough to prevent infection. Once the wound has healed enough, remove the bandage and expose the wound to air which will speed the healing process.

5.3.2 Burns. There are two kinds of burns that operators of UAVs should be aware of. Heat burns are caused by contact with a hot surface, such as the engine of a UAV. The second type of burn which may occur when operating a UAV is a chemical burn. This may occur if a victim comes in contact with a toxic chemical, such as the fuel used in most UAVs. If the toxic chemical comes in contact with the victim's eye, the eye should be thoroughly rinsed with water and medical attention should be sought. There are 3 degrees of heat burns. First degree burns are the least severe, leaving a red spot on the victim's skin. Second degree burns resemble first degree burns, but the victim will also have blisters on their skin. Third degree burns are the most severe and the victim will have a deep wound with charred skin. Although there is little or no pain with a third degree burn, such wounds are quite severe and require careful attention. The following procedures apply to chemical burns, first degree burns, and small (under 2 inch diameter) second degree burns. For a second degree heat burn that is larger than two inches or for a third degree heat burn, seek medical attention. If any of the victim's clothing is still smoldering or came in contact with the chemical, remove it. Cooling the burn will stop the burning process and remove chemicals left from contact. To cool the burn, run the affected area under cool water for fifteen minutes. Bandaging the burnt area will keep the air off the burn and lessen the pain. When bandaging the burn, wrap a sterile gauze strip around the affected

area. Do not use any cotton bandages, because these might stick and irritate the skin.

- 5.3.3 Vapor exposure. When operating a UAV it is possible to inhale harmful vapors from the engine or engine fuel. Symptoms of light vapor inhalation are drowsiness and inability to think clearly. More serious exposure may lead to vomiting or unconsciousness. For serious vapor exposures, seek medical assistance immediately. Information about the fuel being used should be on hand to aid emergency crews. The following procedures are appropriate for treating the symptoms of light vapor inhalation. Remove the victim from the vapor source as quickly as possible. Make sure the area is well ventilated so the victim can get fresh air. Keep the victim calm and have him or her lie down to reduce their breathing rate. Loosen tight clothing around the neck to aid breathing. If victim's condition does not improve, seek medical assistance.
- 5.3.4 Blunt Force Injuries. When operating a helicopter, there is a remote chance of being struck by a rotor blade. In blunt force injuries, the blood vessels under the skin are broken, resulting in a blue or black colored skin. If the skin is broken, follow the procedures for lacerations described in 5.3.1. Elevating the injured area will reduce blood flow to the wound and reduce pain. Apply ice or a cold pack to the injured area for twenty to thirty minutes at a time for a few days afterwards. This will reduce swelling and pain. Seek medical assistance if the pain is excessive or lasts for more than a few days.

## 6.0 Kentland Farm Procedures.

- 6.1 A grass airfield for small research aircraft has been established at the university's Kentland Farm agricultural research facility. This airfield was made possible by the effort of Dwight Paulette, Jr. (College Farm Coordinator), David Schmale, III (PPWS), Shawn Askew (PPWS), and several others within the College of Agriculture and Life Sciences (CALS). The airfield's primary purpose is to enable experimental research involving small flight vehicles, however the facility is also available to the university community for educational or outreach purposes. If you wish to have access to the site, please e-mail David Schmale, III ([dschmale@vt.edu](mailto:dschmale@vt.edu)) or Craig Woolsey ([cwoolsey@vt.edu](mailto:cwoolsey@vt.edu)).
- 6.2 Following is a brief list of procedures to follow when using the Kentland Airfield:
  - 6.2.1 An online calendar has been established to enable users to to notify others of their planned experimental activities. The URL is <http://www.unmanned.vt.edu/kentlandfarm/index.html>. Users *must* announce their activity in advance using this calendar program.
  - 6.2.2 Bring supplies. The Kentland Farm has few amenities. Use the bathroom before you go. Bring water, food, sunscreen, bug spray, etc., as necessary. Also bring a small medical kit in case of minor accidents. Power and wireless internet are available at the site.

- 6.2.3 Sign in and post warning signs. A logbook and two yellow safety signs are located on the porch of the building at the main entrance of Kentland Farm (5250 Whitethorne Road). When you enter the facility, sign the logbook, post the smaller sign near the gate at the main entrance, and post the larger sign beside the road at the airfield. Please return the signs after you finish. If you need to use the airfield after hours, you may contact Craig Woolsey directly to borrow a key to the gate.
- 6.2.4 Use gravel parking area. Please park in the gravel area adjacent to the barn by the airfield.
- 6.2.5 Fly safely. Follow established policies and procedures in this document and the FAA Certificate of Authorization (COA).

## Mission coordinator checklist

Mission Coordinator: \_\_\_\_\_

Date: \_\_\_\_\_

<u>Item</u>	<u>Accomplished?</u>
1. Weather check (231-4837)	Winds: _____ Temperature: _____ Barometric Pressure: _____
2. All essential personnel present for briefing?	Yes / No
3. Briefing completed?	Yes / No
4. First pre-flight check has been completed?	Yes / No (collect)
5. Pilot has charged batteries?	Yes / No
6. Pilot has fueled helicopter?	Yes / No
7. All equipment loaded, transported and set up?	Yes / No
8. GCS is set up and operational?	Yes / No
9. Pilot has completed the 2 <sup>nd</sup> pre-flight inspection?	Yes / No (collect)
10. Frequency monitor shows no interfering signals?	Yes / No
11. Cameras are set up for video?	Yes / No
12. Start time of mission: _____	
13. End time of mission: _____	

Notes on flight:

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# RMAX Flight Checklist

Date	
Time	
Weather	
Temperature	
Altitude	

Starting Flight Time	
Finishing Flight Time	
Length of Flight	
Total Flight Hours on Helicopter	
Location	
Pilot	

Preflight Check		
Item	Check	Initial
Engine Seals	Leaks	
Carburetor	Clean	
Air Filter	Clean	
	Condition	
Main Rotor Head	Ball Links	
	Play	
	Condition	
Main Rotor Blade Fastener	Proper torque	
Main Rotor Blades	Condition	
Stabilizer	Play	
	Condition	
Stabilizer Blades	Condition	
Tail Rotor Head	Play	
	Condition	
Tail Rotor Blade Fastener	Proper torque	
Tail Rotor Blades	Condition	
Tail Rotor Drive Belt	Condition	
	Tension	
	Lubrication	
Main Gear	Condition	
	Play	
Fuel Tank	Mixture	
	Level	
Servo Batteries	Voltage Level	
	Battery Condition	

Flight Controls Check		
Item	Check	Initial
Cyclic Roll	Direction	
Cyclic Pitch	Direction	
Collective	Direction	
Throttle	Play	
	Direction	
	Return	
Rudder	Direction	
Gyro	Direction	
Servos	Noise	
	Smooth Operation	
Range Check(50m)	Distance	

On First Flight	
Item	Initial
Tracking	
Trim	
Performance/Sound	

Post Flight	
Item	Initial
Receive Off	
Transmitter Off	
Wipe Down Inspection	