

**MAXI JOKER UAS  
OPERATING PROCEDURES**

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## **UTRC UAV Operating Procedures**

### **Introduction**

This document establishes operating procedures and includes a risk analysis and mitigation for safely performing radio control (R/C) and autonomous unmanned helicopter flight tests. This document identifies the roles, responsibilities, and procedures for test personnel in pre-test, test, and post-test operations.

### **General Guidelines:**

The general guidelines for flight operations are laid out in the FAA Interim Operational Approval Guidance 08-01. Specifically, all flight operations will be

- conducted in the class G airspace within visual line of sight.
- conducted at an off-airport, sparsely populated location
- conducted no further than 1 NM laterally from the UAS pilot and at an altitude of no more than 400 feet above ground level (AGL) at all times
- conducted during daylight hours only
- conducted no closer than 5 NM from any airport or heliport

### **Pre-test Notifications**

The Test Director and/or designated representative(s) will coordinate with the appropriate authority to gain access to facilities and surrounding airspace. The Test Director or Safety Officer will be responsible for coordinating with local air traffic control and with affected facility personnel.

## Pre-test Briefing

The Test Director or Safety Officer shall conduct a pre-test briefing immediately prior to the test reconfirming test objectives, procedures, and emergency procedures. The Ground Handlers will ensure that the batteries are fully charged. The Safety Officer will also verify critical phases of operations (i.e. verification of preflight checks) and ensure that personnel are properly trained for their given task(s).

## Weather & GPS Check

Upon arrival at the test site, the Test Director and test Safety Officer shall verify the weather conditions are within operational limits. Flight testing will only be done during day-time VFR, with wind limits 15 MPH on surface, 20 MPH measured >10' above ground. Maximum altitude and range boundaries must be followed. Intentional crosswind or downwind landings are discouraged.

In the case of autonomous flight operations, the Test Director and Safety Officer shall also verify that at least six satellites in the GPS constellation are visible and that signal quality is adequate to support autonomous flight.

## Test Area Visual Survey

The wind speeds and direction will be observed to be within the test limits. All personnel will be in the designated areas as specified by the Safety Officer and flying layout plan. When the Safety Officer determines test operations may commence, test team members may prepare the vehicle for flight testing.

## Procedures

The following procedures will be followed for the operation of the UAV

Verify Block	Sequence	Who	Action

**100.0 PRE-FLIGHT CHECKLIST**

100	1	GH	<p>Check batteries (Main drive batteries and auxiliary). Batteries should be checked at cell level. Cells should be around 4.15volts and shouldn't have a delta of more than .06 volts between cells.</p> <p>Connect two main batteries together to form a series connection. Check output voltage to be around 50v.</p> <p>Turn on the RC transmitter and verify that voltage is within specifications. (Futaba 12Z above 50%, Futaba 10C about 10v). Check for free movement of the main control sticks and all switches.</p> <p>Configure the transmitter to IDLE mode 1 and Throttle Cut On.</p>
100	2	GH	<p>Turn on the Ground Station equipment and check for operating parameters</p>
100	3	P	<p>Check the linkages on the head are secure with nothing loose.</p> <p>Check the tail rotor linkages.</p> <p>Check the main motor belts for wear and cracks.</p> <p>Check the gears for missing teeth, Check the alignment of gears.</p> <p>Rotate main blades by hand and check for smooth rotation without binding.</p> <p>Check main blades for cracks dents. Pay special attention to the area near the root of the blades.</p> <p>Check tail rotor blades for cracks and dents.</p>

**200.0 PRE-FLIGHT POWER UP**

200	1	P	Verify that RC transmitter is in ON, Throttle Cut On and IDLE 1 mode. Position Throttle pitch stick to the lowest position.
200	2	P	Connect the Auxiliary power battery.
200	3	P	Using the RC transmitter verify correct movement of all the servos.
200	4	GH	Verify Ground station link with the Helicopter. Check the parameters for correct values.

### 300.0 TAKEOFF PROCEDURES

300	1	P	Connect the Main Battery Pack. Attach the canopy and any external accessories that are needed for the flight.
300	2	P	Verify with GH that they have a good link.
300	3	GH	Start Flight timer.
300	4	P	Remove throttle hold, slowly add throttle to about 10%, and make sure to maintain positive yaw control. Using the right stick check that the rotor follows the stick movement.  Check for correct yaw movement.  Continue to power up to about 75% at which the helicopter should go into a hover.  Raise the helicopter to about 5ft AGL and switch to IDLE 2 mode.
300	4	P	If control is being handed over to Autonomous mode make the announcement. "Auto Control". If Switching to manual control announce "Manual Control"

### 400.0 LANDING PROCEDURES

400	1	P	If landing in manual control, announce "Manual Control". Bring the helicopter over the LZ,  At about 10ft AGL Switch to IDLE 1 mode, slowly land the helicopter, after touch down slowly brings the throttle down to 0%. Make sure to maintain full control of the helicopter while waiting for the rotor to slow down.
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			<b>Engage Throttle Hold mode.</b>
<b>400</b>	<b>2</b>	<b>GH</b>	<b>Stop Flight timer, record flight time in the log book.</b>

#### **500.0 POST LANDING PROCEDURES**

<b>500</b>	<b>1</b>	<b>P</b>	<b>Disconnect the main drive battery pack. Disconnect the auxiliary battery pack. Turn RC Remote off. Turn Ground Station off. Record battery cell voltages in the log book. (Flight time will need to be adjusted to make sure each cell doesn't drop below 3.6v no load voltage.</b>

#### **600.0 BATTERY RECHARGING**

<b>600</b>	<b>1</b>	<b>GH</b>	<b>Connect the charger to a power supply. (Car battery or 12-15vdc @ 20A)  Connect battery pack to charger, start a Balancing charge. Record mAh put back into the battery pack in the flight log. If battery pack was fully discharged, individual cells are near 3.4v and battery accepts less than 80% of rated mAh, pack may need to be replaced or checked for bad cells.</b>

### **Post-Test Activities**

Ground station will be disassembled. All equipment and test hardware will be transported back to transport vehicle/hanger. Inspect the test area for debris and be sure to gather all test equipment.

## 1.0 RISK ASSESSMENT AND MITIGATION

Detailed safety actions, training, and procedures are required to prevent injuries to test personnel. Due to the nature of this effort, specific detailed test procedures may change based on recent test experience, for specific measurement objectives, or to remedy urgent hazardous situations. Should modification of these specific safety plans be required, the Test Director (TD), with Safety Officer (SO) concurrence, has the authority to assess the test environment and implement modified test procedures in the field. All such modifications shall then be evaluated and this Risk Assessment plan may be revised to incorporate lessons learned. Thus, this risk assessment will anticipate hazards & mitigate their consequences and embody experience gained during tests. The TD and/or SO will evaluate the residual risk once the risk assessment has been completed to determine if the test can proceed.

## 2.0 SCOPE

These procedures apply to R/C and autonomous helicopter flight test operations carried out by UCONN personnel and external collaborators at authorized test facilities. Operations shall meet guidelines specified by current authorizations.

## 3.0 DEFINITIONS

**3.1 Test Coordinator/Director (TD) or the Pilot in Command (PIC):** The Test Director is primary supervisor for all tests. The TD must take any action not restricted by test rules to safeguard equipment & personnel. The TD has the responsibility to ensure that hazards have been appropriately mitigated and that operations are conducted safely. The TD has the authority to cancel any flight activity due to safety concerns.

**3.2 Pilot/Safety Pilot (P):** The Pilot manages the controls of a single UAV when operating in manual mode. The P must be proficient and may not be compelled to operate a vehicle in a manner which s/he believes is unsafe. Pilots are designated by the Test Director and/or the Safety Officer.

**3.3 Ground Crew/Handler (GH):** The Ground Crew/Handlers include individuals who support the experiment other than as UAV Pilots. Activities of GH's include telemetry data logging and processing, UAV preparation and maintenance, documentation, and logistics.

**3.4 Safety Officer (SO):** The Safety Officer advises the TD of any observed hazardous situations and suggests corrective actions.

## **4.0 SAFETY**

**4.1 Spinning Blade Hazard** –The potential impact zone for debris from blade structural failure extends throughout the plane of the rotation disc and, to a lesser extent, above and below of the rotation disc.

4.1.1 Starting area will be cleared of personnel not associated with starting the UAV. The area will be clear of debris within 20 feet radius prior to spinning the blades.

4.1.2 Personnel in proximity to the rotor during startup shall wear eye protection.

4.1.3 All test personnel/observers shall stay clear of spinning rotor

4.1.4 At the end of a flight, the Pilot will shut off the rotor.

**4.2 Personnel & Equipment Impact Potential** - Aircraft loss of control represents an impact risk to test team and observers.

4.3.1 The AMA recommended flying site specifications will be used, as appropriate (subject to modification as approved by the Safety Officer)

4.3.2 Cars, trailers, tables etc should be positioned to serve as protective fencing, as appropriate.

## **5.0 UAV FLIGHT TESTING RULES**

### **5.1 Personnel Protection**

5.1.1 All ground test personnel not participating in the launch activities will remain in designated areas.

5.1.2 The wind speed seen by the R/C pilot will not exceed 15 mph as measured by a hand held wind speed gauge or 20 mph as measured by an anemometer mounted approximately 10 feet above the ground. Flight operations are prohibited if gust magnitudes exceed 5 mph within a 30 second period.

5.1.3 The test team shall have ready access to a first aid kit whenever flight operations are conducted.

5.1.4 The SO will carry an operable cellular phone and/or range control radio during all flight operations. The SO is responsible for verifying that these communication devices are fully charged and operational.

## 5.2 Test Commit Criteria

Flight test operations will be postponed or cease immediately for an evaluation/debugging period (to last at least 15 minutes) if:

5.2.1 Wind conditions exceed the following, determined either by a hand held wind gauge or a fixed anemometer:

5.2.1.1 Total wind speed greater than 15 mph as measured at 6 feet above the ground or 20 mph as measured 10 feet above the ground.

5.2.1.2 Wind gusts in excess of 5 mph.

5.2.2 Inclement weather is imminent (precipitation or lightning observed within 10 miles)

5.2.3 Either the primary or secondary control transceiver fails to establish link during the pre-flight range check or during flight.

## 6.0 EMERGENCY PROCEDURES

### 6.1 Emergency contact information is given below:

All personnel shall remain vigilant to the safe conduct of operations. The contact information for emergency services and fire department shall be determined prior to flight operations.

Be prepared to provide critical information:

Caller's Name: \_\_\_\_\_

Location: \_\_\_\_\_

Nature of the Emergency: \_\_\_\_\_

Name & Number of Victims: \_\_\_\_\_

Emergency Contacts and Phone Numbers:

\_\_\_\_\_

### 6.2 Personnel approaches the spinning rotor

6.2.1 TD Calls "SHUT OFF ROTOR".

6.2.2 P drops throttle to turn off rotor

6.2.3 All personnel help in securing medical attention, if necessary (see emergency contact information above).

### **6.3 UAV loses primary (900MHz) link in autonomous mode:**

6.3.1 P calls "LOSS of LINK"

6.3.2 TD notifies all Team Members and Observers of situation.

6.3.3 Autopilot automatically directs aircraft for "Safe Mode" operation.

6.3.4 If 900 MHz link is not re-established once UAV is within range for manual piloting, safety pilot takes control via secondary manual control link.

6.3.5 P lands the UAV (in a remote location if necessary)

6.3.6 GH and TD inspect for damage to UAV.

6.3.8 Testing is halted until UAV airworthiness and reliable 900MHz link are re-established.