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NIST WUI Project - MLB SUPERBAT Unmanned Aerial Vehicle System User Manual

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NIST WUI PROJECT- MLB SUPERBAT

Unmanned Aerial Vehicle System User Manual

FOREWORD

1 PURPOSE

This manual presents the user with field level instructions for the deployment, basic operation and pre-flight processes of the NIST WUI Project MLB Superbat Unmanned Aerial Vehicle Systems. This manual does not supersede any manufacture instruction, publications or materials provided regarding operation of the MLB Superbat airframe, CloudCap software or third party developed applications and interfaces.

The NIST WUI UAV systems include five (5) MLB SuperBat airframes, one (1) UAV Command and Control trailer and its associated support equipment.
This equipment can be identified throughout this document and viewed in the Equipment Inventory list in the appendix following.

2 SCOPE

The complete manual covers set-up, operation and basic field level maintenance information for the NIST WUI Project MLB Superbat Systems.

3 MANUAL STRUCTURE

This manual consists of a Foreword, Safety Summary and information for the following components and procedures.

CHAPTER 1 – GROUND PREPARATION

CHAPTER 2 – FLIGHT PREPARATION

CHAPTER 3 – POST FLIGHT

Contents

SAFETY SUMMARY

1 INTRODUCTION

The following are general safety precautions and instructions that must be understood and applied during many phases of operation and maintenace to ensure personnel safety and health and protection of property. Portions of this SAFETY SUMMARY may be repeated elsewhere in this manual for emphasis. These highlighted precautions do not supersede any manufacturer recommendations for safe operation.

2 WARNINGS, CAUTIONS AND NOTES

WARNING and CAUTION statements have been placed throughout this manual prior to operating or maintenance procedures, practices, or cinditions considered essential to the protection of personnel (WARNING) or equipment and property (CAUTION).

NOTES do not replace a WARNING or CAUTION. The following definition are used for WARNINGS, CAUTIONS and NOTES throughout this manual.

2.1 WARNING

A WARNING highlights an operating or maintenance procedure, practice, condition or statement, which if not observed could result in injury or long term health hazard to personnel.

2.2 CAUTION

A CAUTION highlights an operating or maintenance procedure, practice, condition or statement, which if not observed could result in damage to equipment or loss of mission effectiveness.

2.3 NOTE

A NOTE describes an unusual procedure or condition to which special attention must be paid for a particular reason.

3 HAZARDOUS MATERIALS WARNINGS

3.1 HAZARDOUS MATERIAL ICONS

Icons are used in this manual to identify dangers associated with hazardous materials. The icons used and their definitions are as follows.

CHEMICAL

EYE PROTECTION

HEARING PROTECTION

PINCH HAZARD

FIRE

EXPLOSIVE

BATTERY

Lithium Polymer (LiPo)

Do not drop or expose to fire, battery may explode or ignite. Do not reverse polarity or short circuit positive and negative terminals. Do not store battery with other metal objects. Do not allow battery to get wet.

If damaged to the point of exposing the internal components of the battery, the lithium can be an irritant to skin, eyes and respiratory tract. Skin and eye protection are recommended. Do not breathe vapors if battery off gases. Keep off of skin, eyes and clothes.

4 SAFETY PRECAUTIONS

The following safety precautions shall be observed while performing procedures in this manual.

4.1 USE SAFETY APPROVED EQUIPMENT

When fueling the airframe, ensure that a properly rated fire extinguisher is readily available and in working order. When charging airframe batteries check for proper battery terminal connections and ensure that a properly rated fire extinguisher is readily available and in working order.

4.2 FOREIGN OBJECT DAMAGE

Foreign objects can enter compartments and airframe accessories during assembly, post-flight tear down or maintenance procedures. Always be aware for foreign objects entering any uncovered opening or port on the airframe. Always inspect compartments and accessories before assembly or storage.

4.3 PROTECTIVE COVERS

It is important to ensure that all protective covers on the airframe are sealed before flight operations and before airframe storage.

Fuel tank filler port cover on airframe is to be secured after fueling and following post flight de-fueling procedures to prohibit debri from entering into the fuel system. The airframe parachute bay is to be secured and checked during pre-flight procedures to prevent any flight failure from inadvertent parachute deployment and post flight to prevent any damage to the parachute.

HOW TO USE THIS MANUAL

This manual is to be used in conjunction with, or in addition to, direct, indirect manufacturer or manufacturer provided, certified, or endorsed training or training supplements.

Each chapter provides a basic overview, with illustrations or photographs outlining procedures regarding the safe deployment of the UAV trailer, associated UAV components and UAV airframe(s).

This manual does not provide training or operational recommendations for mission planning, use of mission planning software, use of flight control software, PIC flight operational procedures protocols or data collection processes and procedures.

Each illustration or photograph contains a brief caption to illustrate the relevant procedure being highlighted.

The appendix of this manual contains the following:

Flight Checklist utilized by the NIST PAC during Pre-Flight, Flight, Landing and Post Landing procedures. This Flight Checklist was developed based on the integrated PCC software Flight Checklist, airframe manufacture recommendations, and from numerous training and field deployment events.

PAC Flight Log developed for recording of all flight parameters during training and field deployment events. The material for the log was conceived based on the requirements identified by the NIST flight team.

Manufacture hardware specification reviews of the Airframe, Cloudcap Piccollo II autopilot system, and the Goodrich TASE DUO gimbal payload platforms.

MLB Superbat Vehicle

Cloudcap Ground Control Station (GCS)

Technical Support

Chapter 1 – Ground Preparation

TRAILER DEPLOYMENT

Site selection for trailer placement is based on Pilot in Command requirements for launch and recovery operations, accommodating minimum safety requirements for appropriate landing zone. Topographical and weather parameters need to be considered when determining placement of trailer.

SAFETY CAUTIONS:

NOTE: Trailer jacks and wheel chocks are effective and safe holding devices when used properly. The trailer jack needs to be fully extended to secure the trailer load. Wheel chocks must be used in pairs, positioned downhill and placed firmly and squarely against the tire tread. Select wheel chocks based on the gross vehicle operating weight and tire pressure. Refer to trailer specification safety label on trailer exterior for specifications.

Figure 1: When placing the trailer for field operations place the door of the trailer away from the operational area and the window (above the command and control workstation) to the catapult staging, launch and recovery area.

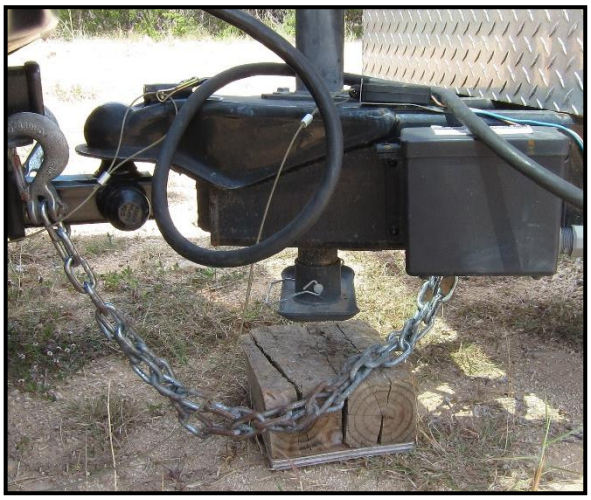

Figure 2: The trailer must be completely disconnected from the tow vehicle before lowering the support jack. These same connections must be in place before towing trailer from operation site.

Figure 3: Before lowering the trailer support jack (front tongue on trailer) place the tire chocks securely under wheels, one on each side of trailer. Then lower the support jack.

Figure 4: Following the placement of the tire chocks and lowering the support jack (front tongue on trailer), the rear support jacks can be lowered.

Figure 5: After the trailer is secured, the generator cover can be unlocked and the rubber secure straps unhooked.

GENERATOR SET-UP

Begin preparations for powering up generator. Make sure generator is fueled and power cable from generator is plugged into trailer. The generator requires a warm up cycle of one to two minutes before switching to ECO mode.

SAFETY CAUTIONS:

Figure 6: Once the generator cover is removed, locate the generator power cord stored beneath the generator.

Figure 7: Plug the generator power cable in to the generator and the trailer.

Figure 8: Check that the generator is switched into the 'OFF' position in the ECO Throttle mode before starting. Allow the generator to run in the 'OFF' ECO mode for several minutes before switching into ECO mode before continuing trailer power up procedures.

25EXTERNAL TRAILER SET-UP, GENERAL

The external trailer set-up incorporates the following equipment deployment:

1) Mount external GoPro camera (external field operations observation)
    a. Unit is connected via HDMI cable to the trailer bulkhead.
    b. Unit is connected via USB power dongle to external trailer power.
2) Mount Ground Control Station telemetry antenna on trailer roof.
    a. Unit is connected via the antenna port on the trailer bulkhead.

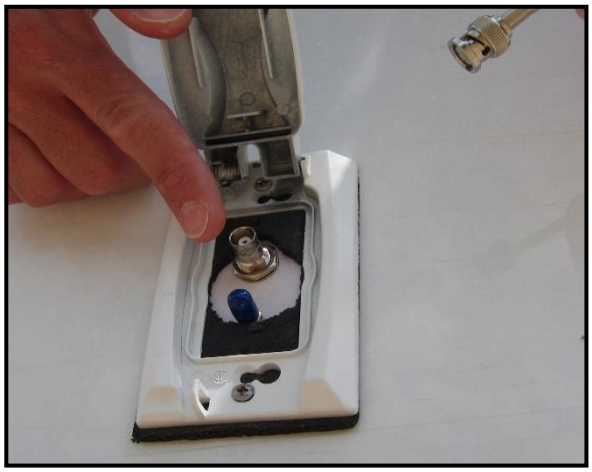

Figure 9: Locate the bulk head BNC connector on the exterior trailer to connect the external telemetry antenna cable.

3) Mount dual video tracking radome antennas on trailer roof.
    a. Units are connected via the bulkhead mounted in the trailer roof vent.

Figure 10: Locate the attachment point for the video tracking radome antennas on the trailer roof. NOTE: There are two different size attachment points (the mounting poles for the radome's are different diameters).

Figure 11: When placing the radome antennas insure that the NORTH label, on each radome, is facing true north.

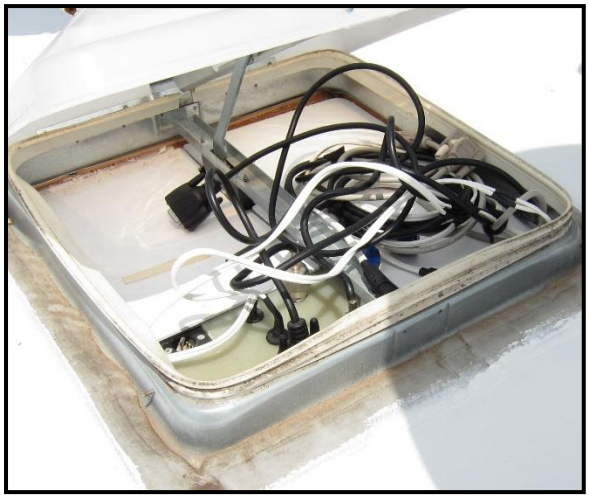

Figure 12: The cabling required to attach the dual radome tracking antennas can be found under trailer roof vent.

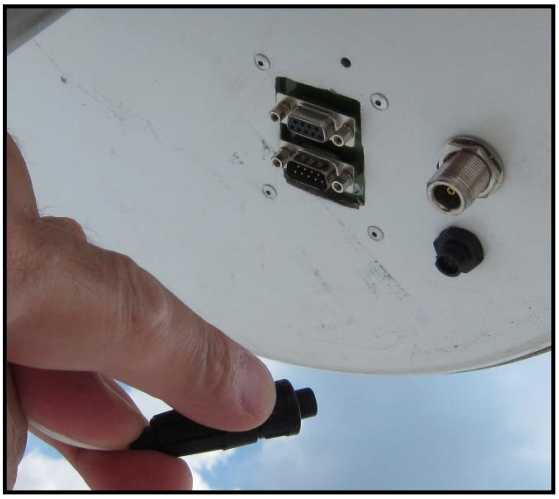

Figure 13: Attach the power cable to both units first.

Figure 14: Attach the N-type connector, video line, to each random unit.

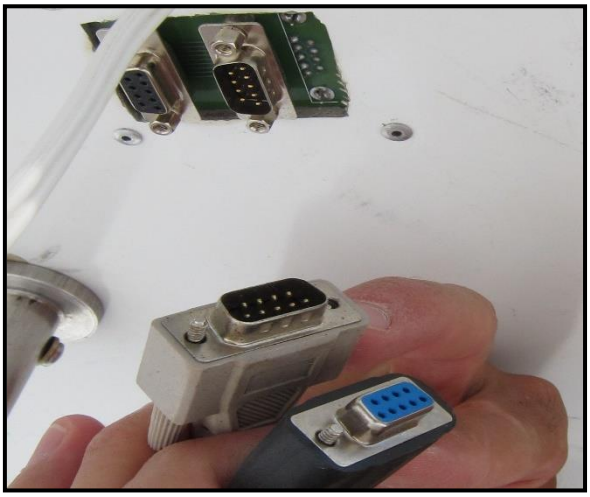

Figure 15: There are two serial connectors per radome. One is for primary tracking and the second cable attaches the units together.

Figure 16: The radome and telemetry antennas in place on the trailer roof.

INTERNAL TRAILER SET-UP, GENERAL

The internal trailer set-up incorporates the following equipment deployment:

1) Mount internal GoPro camera (internal flight operations BlackBox, if required)
    a. Unit is self-powered using the extended GoPro battery pack.

Pilot at Controls terminal -

1) Mount and connect HDMI and power cables to the external field operations view monitor to Pilot at Control's workstation.
2) Connect Pilot at Controls communication headset.
3) Connect power and USB comm. Cable from GCS (Ground Control Station) to laptop. (Laptop is utilized as a backup command and control terminal should the primary command and control desktop terminal fail).

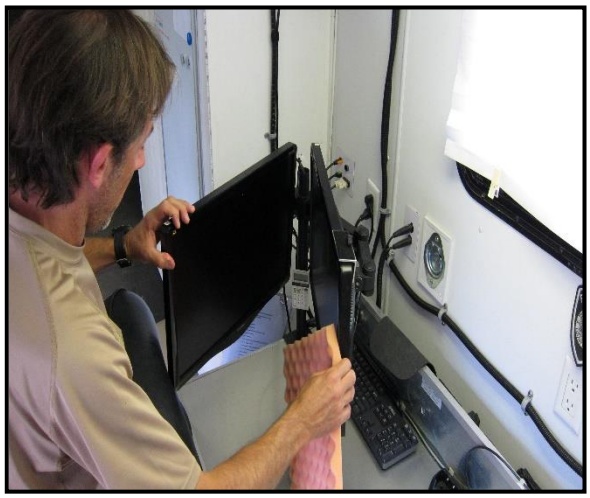

Figure 17: Remove transport padding and open PAC monitor mount

Figure 18: Secure the external field view monitor into the open tube of the PAC monitor mount.

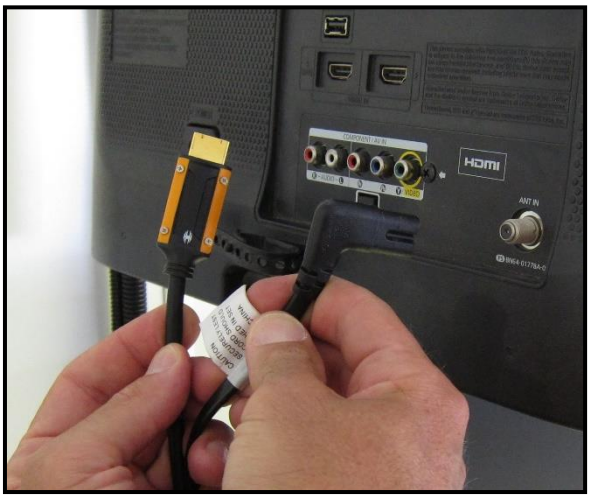

Figure 19: Connect the HDMI and power cable to the external field view monitor. The HDMI cable is attached to the internal bulkhead.

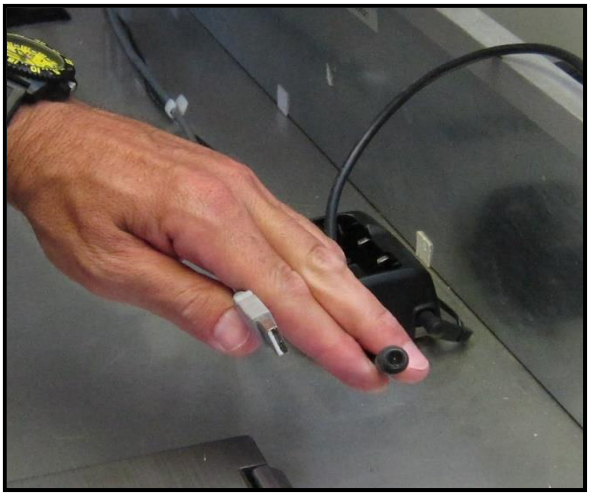

Figure 20: Attach the GCS port communication link USB cable and laptop power cable to the laptop, shown in Figure 21.

Figure 21: The laptop connected to GCS via the communications USB port and power, not viewable in image (rear of laptop).

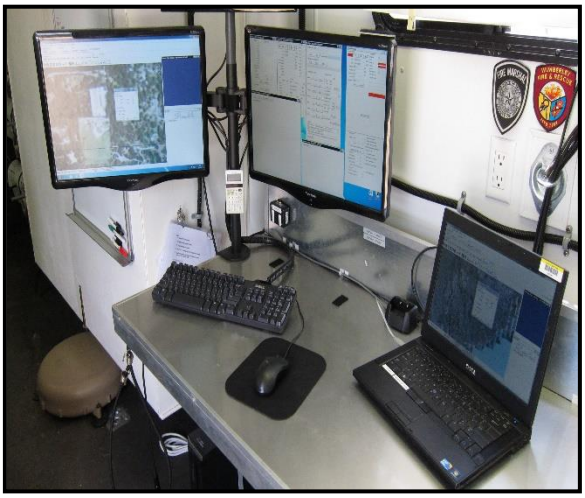

Figure 22: The PAC workstation fully connected and powered on.

Payload control terminal -

1) Connect Payload operator communication headset.
2) Connect video and power cables to Sony Video Decks 1 and Deck 2, respectively.
3) Confirm 2.4 GHz video receiver units' cables are secure.
4) Confirm dual radome cables are secure at the internal bulkhead.

Figure 23: Place the two Sony HDV decks on the command and control work area.

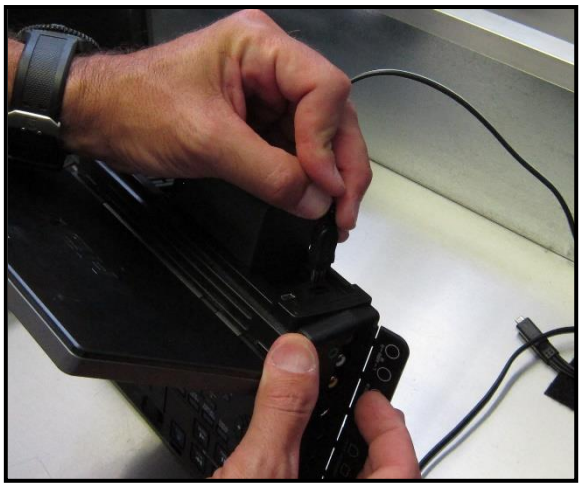

Figure 24: Connect the power cable, to both HDV decks. Power connection is on rear of the deck.

Figure 25: Connect the AV in and AV out cabling to each HDV deck.

Figure 26: The Payload workstation fully connected and powered on.

EXTERNAL TRAILER SET-UP, PILOT IN COMMAND

The following section pertains specifically to the equipment and connections for the external Pilot in Command.

The following equipment is required:

1) Reel spool with 100foot XLR audio cable for communications headsets and 100foot PIC transmitter interface cable.
2) Spool with 50foot XLR audio cable for communications headset for field support crew (if required)
3) Two communication headsets
4) Transmitter
5) 36-Piece Precision Screwdriver Set
6) Plastic baster (Used for Pitot tube check during Pre-Flight)
7) One copper tube, Pitot tube.
8) External large screen display. Used for external display of PAC (Pilot at Controls) terminal screen during flight or for Payload terminal screen during flight.
    a. Power cable, HDMI cable and DVI-D cable required for connection to trailer bulkhead.

Figure 27: The required equipment for PIC and ground support crew.

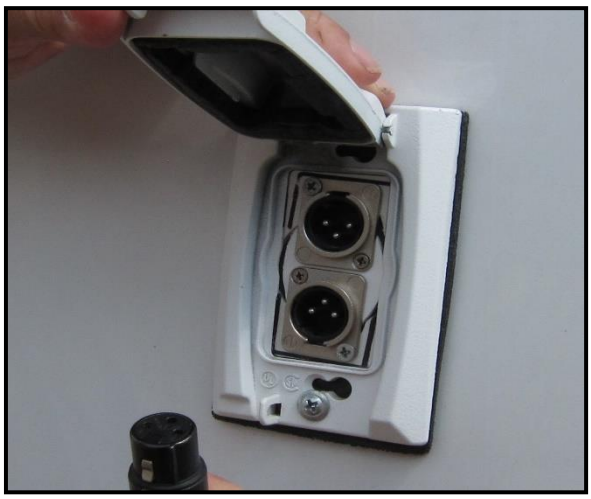

Figure 28: Locate the dual XLR bulkhead cable port on the trailer exterior.

Figure 29: Attach the male XLR from the headset to the female XLR extension that is connected into the bulkhead XLR bulkhead port.

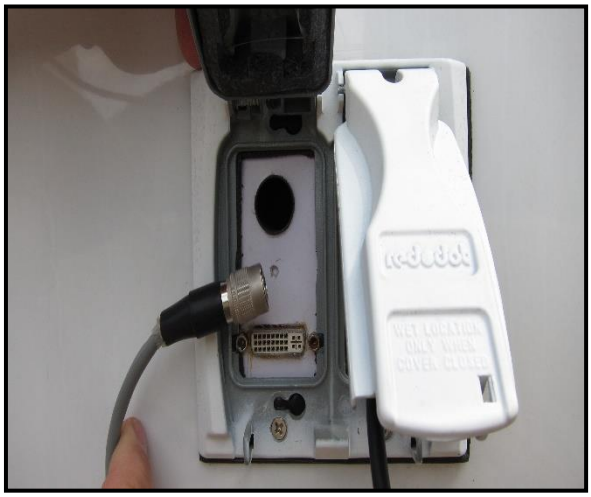

Figure 30: Insert the GCS connection side of the PIC transmitter control cable through the open port in the trailer bulkhead.

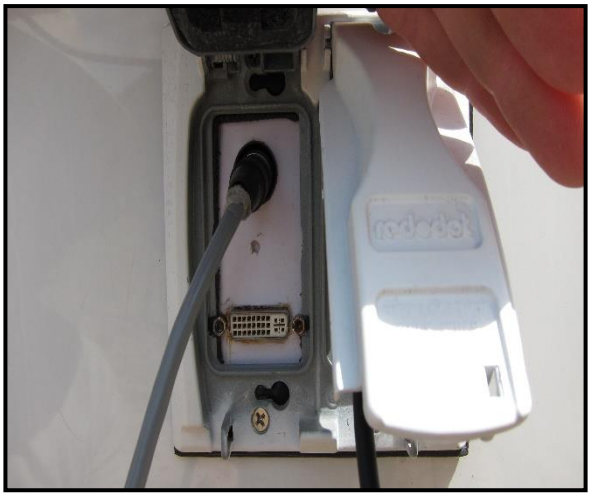

Figure 31: Insure the cable is inserted with enough slack to reach the GCS unit inside the trailer. Use caution when closing the bulkhead cover to prevent any damage to the cable.

Figure 32: Locate the PIC controller GCS cable and match the pin placement.

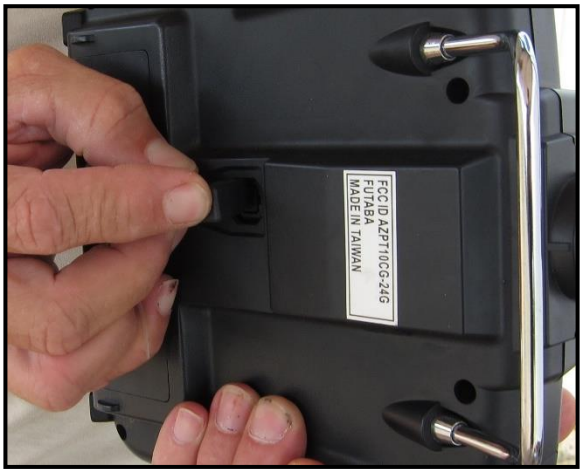

Figure 33: Firmly push the PIC GCS cable into the port of the PIC transmitter. Secure the cable to the transmitter via Velcro wrap or zip tie to insure cable does not disengage during flight operations.

Figure 34: Locate the exterior monitor mount on the exterior trailer. Align mounting brackets and confirm secure placement of monitor. It is advisable to attach the DVI-D, HDMI and monitor power cable before mounting.

Figure 35: Locate the DVI-D bulkhead port on the trailer exterior. Connect the exterior monitor cable.

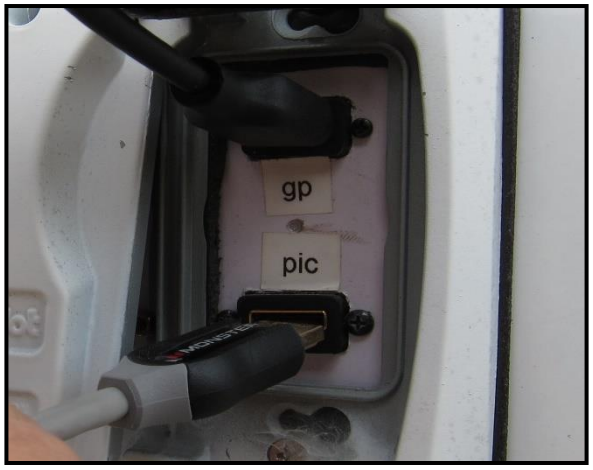

Figure 36: Locate the HDMI bulkhead port on the exterior trailer. Connect the exterior monitor HDMI cable.

Figure 37: The DVI-D and HDMI cable will be required along with monitor power cable for external mounting and proper operation of external monitor.

INTERNAL TRAILER SET-UP, POWER SEQUENCE

Command and Control -

The following procedures are recommended during the internal power-up sequence for the GCS Command and Control terminals.

1) Power up GCS. **Make sure** all internal cables are connected. Insure PIC transmitter interface cable is connected.

2) Power on the power block located behind the riser on the main workstation area.

3) Power on the APC units, below the main workstation area.

4) Power on PAC terminal. Default Windows password for log-on is "1234".

5) Launch the Piccolo Command application. Set the "Communications" window to the following, when prompted on screen:

Serial Settings: Port: COM1
Baud: 57600
Server Settings: (enable by checking box)
Port: 2000

6) Power up Payload terminal. Default Windows password for log-on is "1234".

7) Launch the View Point 2.2.0 application.

8) Power on the laptop for backup Command and Control. Default Windows password for log-on is "5678".

9) Launch the Piccolo Command application. Set the "Communications" window to the following, when prompted on screen:

Serial Settings: Port: COM10
Baud: 57600
Server Settings: (do not enable)

Port: 2000

10) DO NOT CLICK "**OK". Only do so if enabling the laptop for Command and Control due to main terminal failure or trailer power failure.**

Communications –

1) Connect PAC, Payload, PIC and Ground Crew male XLR cables to any open ports on the Eartec communication box.

2) Power on communications box. Check AC/DC switch (directly above Power witch) to insure either AC/DC setting.

3) Conduct audio check with all personnel to insure audio is functioning properly. **NOTE:** Do not leave the Eartec headsets exposed to direct sun when not in use.

Chapter 2 – Flight Preparations

PRE-FLIGHT

Catapult Launch Ring

Make sure that the catapult launch ring is place on firm, relatively level soil. Sand, loose soil, mud or other unstable surface may result in damage to the catapult, aircraft or personnel. Catapult placement form the Command and Control trailer should not exceed the distance of the PIC and Ground Crew audio headset cable lengths.

SAFETY CAUTIONS:

The following items are required for safe operational catapult assembly:

1) Catapult main ring.

2) Six (6) catapult mounting legs.

3) Six (6) catapult leg securing nails. Make sure the nails are not bent and do not show any additional signs that may indicate potential failure.

4) Adjustable, box or open-end wrench to secure catapult legs to main catapult ring. Secure the bolts firmly, **DO NOT OVERTIGHTEN**

5) Hammer for securing catapult nails. The nails pass through a guide hole on the base of each catapult leg.

Figure 38: The required items for the assembly of the catapult.

Figure 39: To assemble the legs to the main catapult place the ring upside down and insert each leg. Loosely tighten the attachment bolts on each leg by hand.

Figure 40: After all legs are in place, tighten all attachment bolts with a box or open end wrench.

Figure 41: After all legs are secured, rotate the catapult ring to its upright position.

Figure 42: Once the catapult is adjusted and sitting in a level position, anchor the catapult to the ground using large spikes. Drive the spikes at an angle into the ground.

Catapult

Use two persons for the safe placement of the catapult onto the catapult ring. Once the catapult is preliminarily set in the ring, it may require a slight rotation to firmly seat the catapult mounting base sections (front and rear) into the ring. Once seated loosely secure the mounting attachments to the ring. **DO NOT** tighten until launch direction is confirmed by PIC.

SAFETY CAUTIONS:

The following items are required for safe operational catapult placement:

1) Catapult in transport housing.

2) Catapult mounting base sections attached to bottom of catapult, front and rear. Confirm they are securely attached to catapult mechanism.

3) Mounting hardware for catapult mounting base sections, four (4) carriage bolts and four (4) wing nuts.

Figure 43: After the catapult, inside its transport housing, is in place; thread the support bracket carriage.

Figure 44: Once the support brackets are loosely secured, remove the transport housing.

Figure 46: After catapult housing is removed, check all mechanism cables, pulley systems and airframe attachment points as shown in figures 47 and 48.

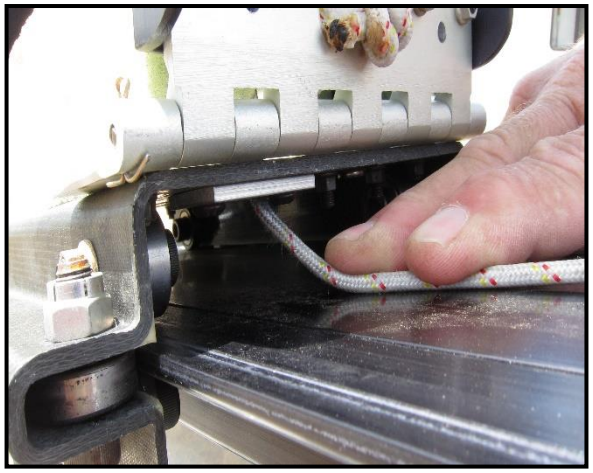

Figure 47: Check condition of pulley lines running from front of catapult to launch tray mechanism.

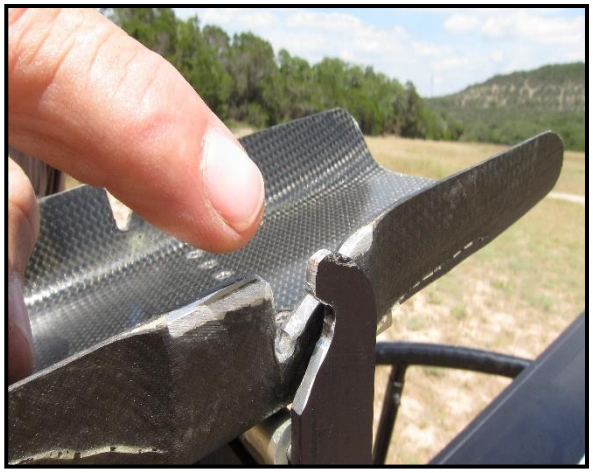

Figure 48: Observe condition of airframe pin locking mechanisms on launch tray of catapult. Look for signs of uneven wear, warping or other signs of fatigue.

Airframe

SAFETY CAUTIONS:

The following items are required to permit the safe assembly of the airframe:

1) Fuselage.

2) Matched wing set. Each wing set is numbered to match each individual fuselage:

2845, 3110, 3116, 3181 and 3195. **DO NOT** mix wing sets, it is important to use corresponding wing sets with its matched fuselage.

3) Fuselage matched tail booms.. Each tail boom set is numbered to match each individual fuselage:

2845, 3110, 3116, 3181 and 3195. **DO NOT** mix tail boom sets, it is important to use corresponding tail booms with its matched fuselage. **INSURE** right and left pair, labeled.

4) Matched cathedral tail. **DO NOT** mix cathedral tails, it is important to use corresponding cathedral tail with its matched fuselage.

5) ADDITIONAL ITEMS: One fully charged starter and the airframe container will be required for flight preparations once airframe is assembled. INSURE the fuel tank contains fresh properly mixed fuel. Oil gas mixture should be to manufacturer specifications for airframe operation

Figure 49: All airframes are secured in rear interior of trailer. Each is secured into the storage rack with Velcro straps. A retaining pin sits in a groove on each storage shelf. Use caution when removing airframe to insure no damage to airframe structure.

Figure 50: Locate the wing sets in the storage cabinet, trailer interior.

Figure 51: Insure the proper wing-set is used based on airframe selected. Match and confirm the identifier number.

Figure 52: Select the proper tail booms, also by identifier number. The booms are stored behind the wing sets in the storage cabinet.

Figure 53: Select the proper cathedral tail section, by identifier number, from the storage cabinet.

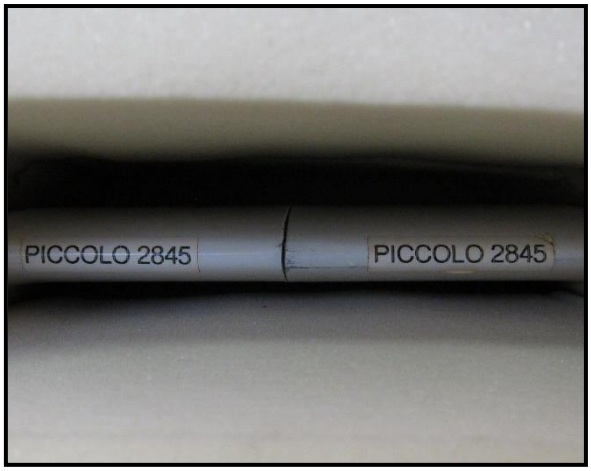

Figure 54: A close-up view of the cathedral tail showing the location of the identifier number

Airframe Assembly, Complete

1) Verify fuselage identifier matches wing set, tail booms and cathedral tail section.
2) Layout left and right wing sections and tail section.

Wings (Repeat this process for right and left wing sections)

1) Locate wing mounting pin access hole in wing section.
2) Place wing onto mounting guide on fuselage, slide partially on, **DO NOT** secure.
3) Gently connect the wing surface control wires to the ports on the fuselage.
4) After connections are secured, continue sliding the wind on to the guide. Confirm the pin mechanism has properly seated by accessing the mounting pin access hole on the wing section. Can also be confirmed by audible "click" when seated.

Figure 55: All required airframe components laid out for assembly

Figure 56: Identify the mounting pin access hole, on the bottom aspect of the wing.

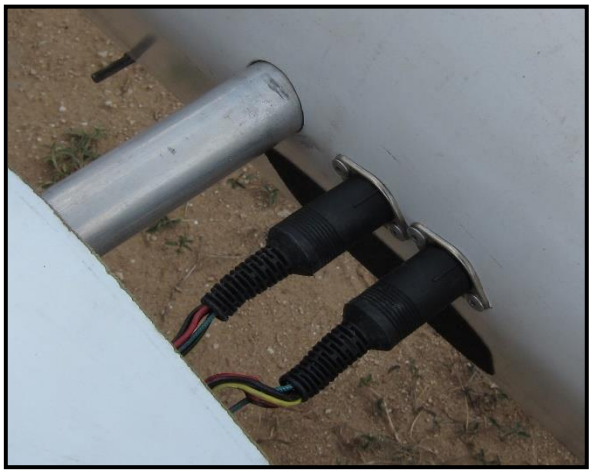

Figure 57: Connect both wing control cables to airframe. Confirm secure connection before continuing with wing assembly.

Figure 58: After wing is slid onto the mounting guide, place finger into hole to confirm mounting pin is secured.

Tail Booms (Repeat this process for right and left tail boom sections)

1) Locate the tail boom mounting pin access hole on the wing.

2) Place tail boom into the mounting guide on wing.

3) Slide the tail boom into the guide. Check that the pin mechanism has properly seated by visually confirming mounting pin access hole on the wing. Can also be confirmed by audible "click" when seated.

Figure 59: Identify not only the airframe identifier, but also the RIGHT and LEFT identifier before tail assembly.

Figure 60: Insert the tail boom into the mounting guide on each wing.

Figure 61: When the tail boom is secured an audible click will be heard. The deployment of the securing pin can also be visible.

Figure 62: Depress the securing pin while inserting the tail boom section in to the mounting guide on the wing.

Figure 63: Following the secure placement of the tail booms, slide the cathedral tail onto the booms.

Figure 64: Follow the same procedure for placement of the securing pin as the wing set and tail boom to wing set.

Figure 65: Visual confirmation of securing pin deployment, on LEFT tail boom.

Figure 66: Visual confirmation of the securing pin deployment, on RIGHT tail boom to cathedral tail mount.

Chute Inhibitor Pin

1) Restrain the parachute release cover and remove the retaining screw connecting the mechanism to the fuselage.

2) Carefully remove the parachute mechanism being cautious of the parachute servo control mechanism and wire.

3) Identify and remove the parachute inhibitor pin. **KEEP** the pin in a secure area, as it will be need to be replaced post flight.

4) Reseat the parachute mechanism into the fuselage and secure it to the fuselage with the retaining screw. **CAUTION:** Insure that the parachute servo release mechanism wire and the external parachute release cord are not pinched or obstructed in any manner when replacing the parachute mechanism and securing it.

Figure 67: After airframe is assembled, final flight preparations can begin.

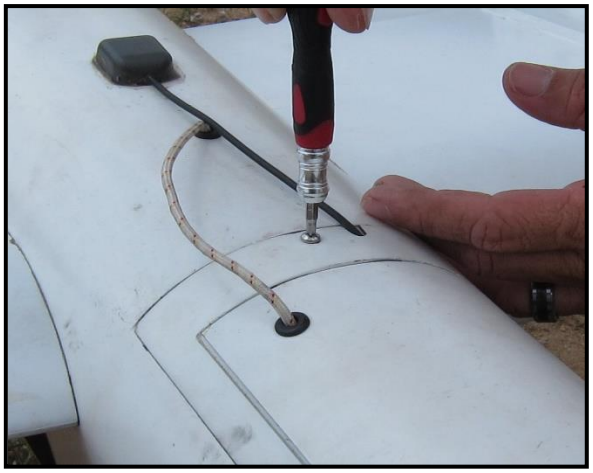

Figure 68: Locate the parachute bay securing screw on the top of the airframe, forward of the wing attachment area. Unscrew the retaining screw.

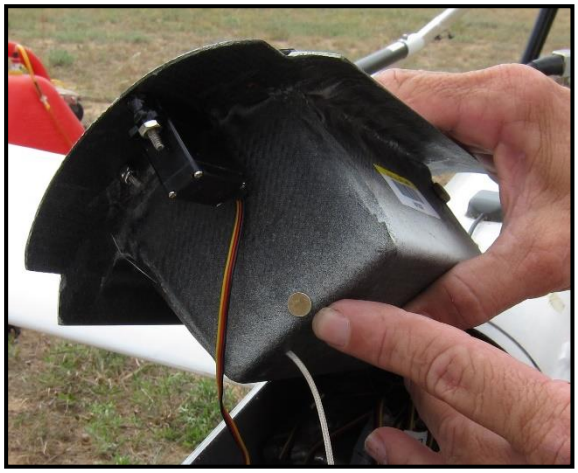

Figure 69: Gently remove the parachute bay mechanism and locate the parachute retaining pin.

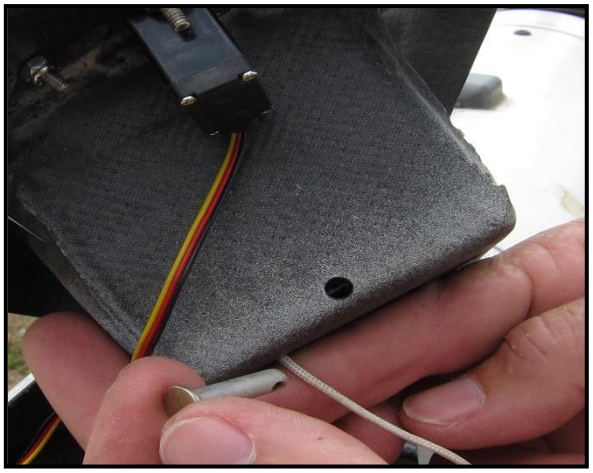

Figure 30: Remove the pin from the parachute bay mechanism and secure the pin in a safe location.

Figure 71: Re-insert the parachute by mechanism into the bay, using caution to avoid pinching or obstructing any of the parachute mechanism wires or cord.

Figure 72: Replace the parachute bay securing screw and tighten.

Sensor Cover

The sensor cover should be removed if flight profile includes the collection of applicable data.

1) Gently remove plastic cover, advised to hold the sensor base section (where sensor is mounted into fuselage) during removal of the cover.
2) **KEEP** the plastic cover in a secure area, as it will be need to be replaced post flight.

Figure 73: Locate the external sensor probe on aircraft left.

Figure 74: Gently remove the plastic sensor cover from the sensor. Use caution to not dislodge or rotate the sensor during removal of the cover.

Communications Antenna

1) Confirm integrity and condition of communication antenna.

2) Confirm secure fit of communication antenna on fuselage.

3) Adjust antenna so it is pointing straight up, place collar over antenna. This is to insure antenna does not fold down during induced G-forces during launch.

Figure 75: Place the carbon fiber collar over the telemetry antenna.

Figure 76: Confirm collar is sitting against the mounting base of the antenna and that the telemetry antenna is in an upright position.

Pitot Tube

1) Confirm integrity and condition of pitot tube.

2) Visually inspect that tube is clear of any obstructions.

3) Locate pitot tube attachment point on fuselage. Slide pitot tube into attachment point. **CAUTION:** Insure that the pitot tube extends slightly beyond the nose of the fuselage.

4) Once pitot tube is in place slide rubber tubing over attachment point where the tube is inserted into the fuselage section.

Figure77: Slide the pilot tube into the mounting point on the airframe.

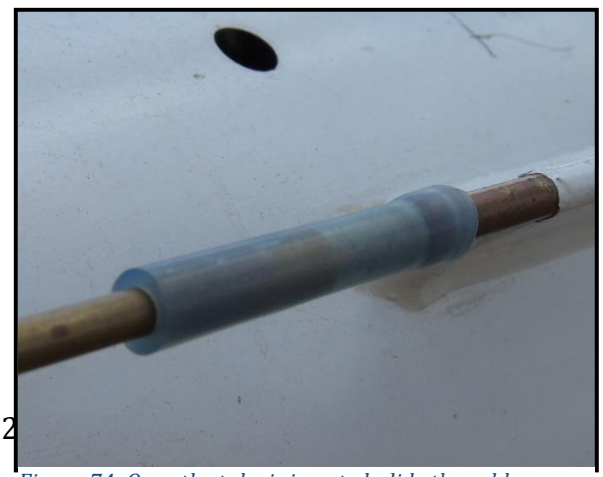

Figure 74: Once the tube is inserted, slide the rubber sheath over the mounting point and confirm the tube is secure.

Secondary Wing Camera

This section to be followed only if flying secondary still imager payload in wing bay.

1) Locate the removable panel on the left wing.
2) Place selected imager into open bay and secure as indicated based on imager used.
3) Confirm imager rests in appropriate position to allow for shutter activation by trigger servo. Placement will be confirmed during Pre-Flight procedures.
4) Secure the removable panel in place on the wing.

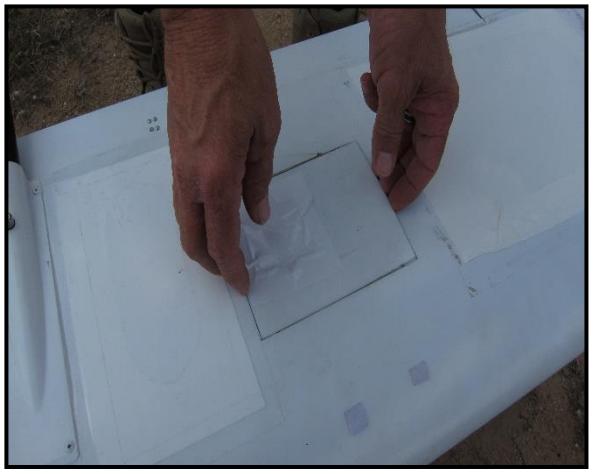

Figure 79: Locate and remove the wing camera bay cover.

Figure 80: Once the cover is removed the mounting bay is exposed.

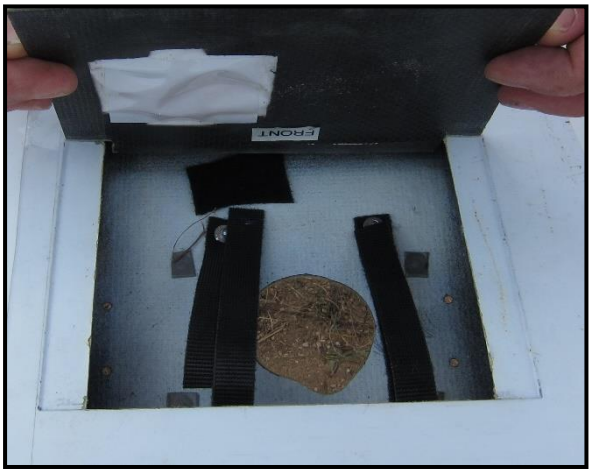

Figure 81: The bay can fit small point and shoot digital camera or a Tetracam unit.

Figure 82: After camera system is secured into the bay, replace the cover. Insure cover is secure.

Chapter 3 – Pre-Flight

PRE-FLIGHT

Pre-flight preparation includes the following procedures:

1) Verification of airframe assembly.
2) Placement of aircraft in a level position.
3) Aircraft power-up.
4) Confirmation of aircraft communication and selection of airframe within PCC at the PAC terminal, once communication is established between the GCS and airframe.
5) Launching of the MLB third-party software application to monitor fuel level and sensor data. This is required to observe fuel loading to level determined by PIC to accomplish mission parameters. **Maximum fuel levels may also be dictated by parameters laid out by the Federal Aviation Administration Certificate of Authority for operation. It is recommended that the PIC review any such advisements with in the operational COA.**
6) Specific mission planning, payload operation and data collection procedures will be unique to each mission with the operational guidelines established by the field operation team, in accordance with the flight profile of any established COA the airframes are flown under. Specifics for use of PCC, Viewpoint and all other procedures should be covered during manufacture training and operational protocols established by the field operation team following their training on the safe use of the airframes.

SAFETY CAUTIONS:

During airframe fueling procedures it is advised that cell phones and any ignition type source be clear from the designated fueling area.

AIRFRAME ASSEMBLY

A visual and physical check should be conducted to insure that the airframe is securely assembled and all locking pins, retaining screws; collars, tubes and any additional materials are secure and accounted for.

The visual inspection should also assess general airframe integrity; cracks, peeling of wing surfaces, loose connections or other damage or suspected damage.

AIRCRAFT POWER-UP

The airframe is powered up by the switching the power switch located on the fuselage to the ON position. The switch is located aircraft left beneath a hinged door.

CAUTION: The powering of the airframe powers all systems of the aircraft. Be cautious of power drain during pre-flight preparations. If any delays occur; hazards or operational issues, the PIC should determine if the airframe should be powered down until delays are clear.

AIRCRAFT COMMUNICATIONS

On power up the aircraft will establish communications with the GCS, confirmed by a pop-up window on the PAC terminal showing the aircraft identifier. The PAC will confirm this pop-up window by clicking 'OK' within the PCC application.

AIRCRAFT FUELING

1) With the aircraft placed in a level position (nose elevated by use of wood block or other material to insure aircraft is sitting in a level aspect), the fueling tube from the gas container can be attached to the aircraft fueling port.

2) The electric pump on the gas container should be switch to the 'ON' position for fueling to commence.

3) Fueling should continue until the pre-selected fuel percentage is reached, as indicated on the MLB plug-in application fuel gauge.

NOTE: There is communication delay between the actual fuel level of the airframe and the readout of the MLB plug-in application on the PAC terminal. It is recommended that fueling should be terminated when the displayed reading is approximately ten percent (10%) below the pre-determined level. For example: 50% fuel load, fueling should terminate when the MLB plug-in reads at 40%).

4) When the pre-determined level is reached the electric pump on the gas container should be switched to 'OFF' to stop the flow of fuel.

NOTE: Watch for fuel leaks at the fuel connection port on the airframe as well as from the tubing running from the gas container. The airframe is equipped with an overflow in the event of over filling. If fuel is seen leaking from the port, hosing or the overflow port (bottom of airframe) immediately terminate fueling procedure, disconnect and remove gas container from the vicinity of the airframe.

5) Once the fueling procedure is complete, disconnect the fuel hose from airframe and secure fuel port cover on airframe. Remove the gas container to a pre-designated fuel safety zone away from the launch and recovery area.

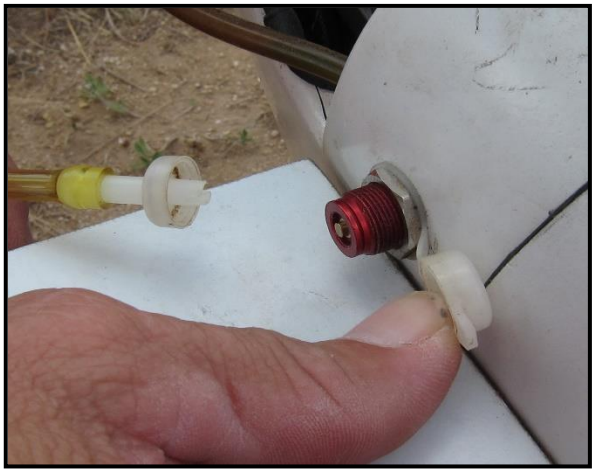

Figure 83: Locate the fueling port on the airframe and remove the safety cover.

Figure 84: Attach the fueling line from the fuel canister to the fueling port on the airframe.

Figure 85: Once a secure connection is confirmed, commence fueling procedures.

MISSION PLANNING

Mission planning will be based upon the unique mission requirements and COA parameters established for each operational area.

Training in the use of the command and control software, third-party applications and aircraft specific procedures should be completed under the guidance of the airframe manufacturer or other recommended training provider per the airframe manufacturer.

APPENDIX

FLIGHT CHECKLIST

PILOT AT CONTROLS (internal pilot)

UAV Checklist

Pilot At Controls

- Confirm TFR (if in place)
- Cellphones to operations mode
- Visual inspection of Catapult
- Set PCC to enable server:port 2000 [Communications]
- Laptop on standby, secondary Command and Control Com Port 10 / Link 2 on GCS

********AIRFRAME********

- Fuselage assembled
- Pitot tube assembled
- Verify chute inhibitor pin removed, hatch secure
- Sensor cover removed
- Power up airframe
- Verify proper AP is set to Active and Pilot, then “Remove All”
- Set Log file path on PCC
- Verify operation of User Buttons (EXCEPT chute)
- Verify Chute operation: restrain hatch, deploy and retract chute
- Re-Enable engine
- Verify manual control, including “AP off” indication
- Verify trims reset on PIC controller
- Wing camera on
- Launch MLB wind estimator app
- Fuel aircraft

********AUTO-PILOT********

- Check and record fuel gauge reading [MLB plug-in window]
- Check and record initial battery voltage (16.5V full / 13.5V empty) [System]
- Set auxiliary input sample rates (0.1 is minimum) [Payload I/O Settings]
- Verify RSSI (-50) and Link % (100) [System]
- Set telemetry rates (<5Hz for gimbal operation) [System]
- Verify “control to GPS” and control to DGPS” are NOT enabled [Pre-Flight]

- Set altimeter to local base pressure (barometer), send to AP [Pre-Flight]
- Enter actual altitude ("Elev" of AP from map NOT "Alt") [Pre-Flight]
- Set initial fuel weight (full at 6.8lb) [Pre-Flight]
- Set payload weight [Pre-Flight]
- Validate controller settings with aircraft configuration file [Pre-Flight]
- Check pitot tube for airspeed response
    - (Should "Climb Out" for 15s then return to "Prelaunch")
- Cup pitot tube, "Zero Air Data" [Pre-Flight]

- Verify altitude limits for mission [Mission Limits]
- Verify aircraft GPS (>6) and PDOP (<3) [Telemetry]
- Verify auto land waypoint (90), lost comm waypoint (99) [Mission Limits]
    - (verify lost comm plan terminates within comm range)
- Verify auto land plan loaded (created with CC BAT Landing Planner)

********PRE-LAUNCH********

- Set flaps command loop to ON, hold at 0 degrees [Command Loops]
- Check all other command loops in AUTO, except TRACKER [Command Loops]
- Confirm aircraft "GOING TO" (not tracking) launch mission waypoint
- Manual Mode, engine warm up, verify RPM range (3500 to 8800)
- Kill engine, Re-enable engine
- Check air data for drift. Cup pitot and zero air data (if required) [Pre-Flight]
- Final checks: Launch waypoint, battery voltage, telemetry, link and RSSI
- Check PCAS for air traffic, advise other personnel of launch
- Check catapult tray is locked and latched, safety pin in place
- Load vehicle onto catapult
- Check catapult tray mechanism and airframe locking pins
- Check landing gear clearance
- Clear to tension catapult
- Pull safety on catapult
- Verify "Engine On"
- Verify Pre-Launch mode
- Go to Manual Mode, start engine
- Verify RPM ranges
- Advise Pilot in Command ready for launch; confirm auto or manual launch

********HOME ORBIT FLIGHT CHECK********

- Verify stable flight

- Switch flaps command loop to AUTO [Command Loops]
- Verify RSSI (-50) and Link% (100)
- Verify battery voltage, telemetry GPS, fuel, RPM
- Verify altitude and airspace of mission flight plan
- Advise PIC of aircraft behavior
- Open nose shield

********LANDING PROCEDURE********

- On mission completion return to lost-comm orbit
- Check battery voltage, telemetry GPS, comms and fuel
- Set gimbal to stow, close nose shield
- Verify all command loops to "AUTO", Tracker "On" [Command Loops]
- Verify auto-landing plan correct
- Confirm PIC is ready for landing sequence
- **If manual landing**, call out airspeed, altitude, RPM (as needed)
- **If auto landing**, command autopilot to go-around point or downwind point
    - (Flght Plan 90 or 91)
- **If auto landing**, call out aircraft entry to each leg to PIC
    - (Crosswind, Downwind, Base, Approach)
- **If auto landing**, at decision point (94) call out "Commit" or "Abort" (as indicated)

- ********POSTFLIGHT********

- Immediately after landing "Kill" engine, re-enable if re-launching
- Set mode to PreLaunch
- Record flight time, fuel and battery levels
- Open nose shield
- Close Nose shield
- Turn aircraft off
- Close PCC
- Copy .windout files to aircraft log files
- Defuel and disassemble aircraft
- Confirm all flight logs, .windout files saved
- Copy all flight logs, .windout, and Payload data to back-up drive

FLIGHT LOG

PILOT AT CONTROLS (internal pilot)

Date :
Local time :
UTC time :

Flight location :

Purpose of flight :

_ _ _ _ _ _ _ _
Air Density :
Airframe #
Airframe power up time :
Battery (pre-flight voltage) :
Fuel (pre-flight %) :

Launch time :
Landing time :

Total flight time (flight timer) :

Battery (post-flight voltage) :
Fuel (post-flight %) :

Airframe power down time :

Flight Notes : (continued on back if required)

_ _ _ _ _ _ _ _
Burn ignition time :

Visual confirmation of targets :
Number of visible targets :

Completed by :

SPECIFICATIONS

AIRFRAME

Aircraft Type	**MLB SuperBat**
Wing Span (ft)	8.5
Length (ft)	5.0
Gross Take Off Weight (lbs)	35 with payload
Propulsion	26cc internal combustion
Fuel on Board (lbs)	6.9 lbs (gas/oil mix)
Duration (typical)	10 hours/ 400 miles
Take Off Type	Catapult launch
On board electrical	3 X 5Ah Lithium Polymer
Electrical Duration (typical)	10 hours
Guidance/Avionics	Cloud Cap Piccolo II
Pilot-In-Loop/Manual Over ride	Yes
Launch Type	Catapult
Landing Type	Conventional/Skid
Failover Recovery	Parachute
Aircraft Performance	----------
Max Climb (fpm)	1000
Max Descent (fpm)	800
Airspeed (max, kts)	60
Airspeed (cruise, kts)	39
Max Altitude (ft)	10,000
Active Frequencies (Transmitted)	**----------**
Primary Command & Control Frequency	900 Mhz Spread Spectrum/Microhard
Telemetry Frequency	900 Mhz Spread Spectrum/Microhard
Secondary Frequency	N/A
Range (typical)	3-6 miles VLOS
Payload Frequency	1 watt, 2.4 Ghz (consumer)
Range (typical)	Up to 10 miles VLOS
Passive Frequencies (Received)	----------
L1 (1575.42 Mhz) and L2 (1227.60 MHz)	GPS navigation

AUTOPILOT

CLOUDCAP PICOLLO II (auto-pilot system on unmanned aerial vehicle)

AutoPilot - Piccolo II	
Aircraft Type	MLB SuperBat III
AutoPilot	Piccolo II
Radio Frequency	900 MHz for ground control station, telemetry feeds. 2.4ghz for all video transmission
User Interface	Piccolo Command Center
	Dockable windows, context menus for common functions
	Complete support for all Piccolo controlled vehicles
	Primary Flight Display and graphical EFIS with the ability to change airspeed, altitude and heading
	Real-time flight planning. Flexible drag and drop flight plan generation and updates
	Integration with web mapping servers for elevation imagery data
	Terrain aware flight planning and warning system. 3-D views, high performance mapping with the profile viewer. Terrain database supporting DTED and SRTM
	Geo-Fence: Airspace boundary definition and warning system
	PCC Software supports a growing number of plug-in applications that can be purchased separately
	TASE Gimbal plug-in for TASE or servo pan/tilt cameras
	Strip Chart displays plug-in adds graphical display of telemetry data
Advanced Software Features	Advanced flight planning: updates during flight, drag and drop, lost com and landing plans
	Supported by full HW in Loop and Software Simulators
	Support of TASE stabilized gimbal
	Support for DGPS and WAAS corrections for built in GPS
	Gimbal stabilization control for servo based pan-tilt cameras
	Magnetometer, payload pass-through, etc.
Ground Station Kit	Ground control station is secured inside of the command and control trailer.
Aircraft Integration Accessories	

PAYLOAD

GOODRICH CLOUDCAP TASE DUO 200

TASE 200 Duo -Gimbal System Configuration	
Aircraft Type	MLB SuperBat III
Gimbal Mounting Type	Nose mounted, fixed environmentally sealed gimbal payload- Goodrich **TASE 200 Duo** series camera.
User Interface	**ViewPoint, Version 2.x.x (to be provided)**
	Geo Point: Click map or video to autonomously point gimbal at specific GPS location on the ground
	Moving Map: Interactive map displays location and gimbal sensor footprint on ground. Satellite, streets and maps, or any user supplied map supported
	SD Video Capture & Display: Analog NTSC or PAL video supported
	Record & Replay: NTSC or PAL recording. Playback includes video, GPS time, plus gimbal and sensor footprint GPS locations
	Make Video Files: Create video file (AVI output or MPEG2 encoded) from digitally recorded files
	Plug-in Support: Supports CCT plug-ins and 3rd party plug-in architecture
	MJPEG Axis Client: Supports IP connection and web serving using MJPEG compression
Advanced Software Options	Path Track, or breadcrumb trail, can be viewed during flight. ViewPoint based screen captures acquired by a manual user interface keystroke during flight. Extracted frames are mosaiced over loaded map base layer within Viewpoint.
Developers Kit	
Onboard GP/IN	

Camera Configurations Summary	Camera format: NTSC or PAL capability. Standard used in North America is NTSC 29.97 frames per second, comprised of 525 individual scan lines.
IR Camera (Long wave):	Goodrich TASE Duo 200 series
	Image Resolution : 640x480
	HFOV : 10.5 degrees
Standard electro-optical	Goodrich TASE Duo 200 series
	Image Resolution : 1280x720
	HFOV : 55.7 to 1.94 degrees
Aircraft altitude	1500 feet above ground level
Aircraft loiter	300 meter loiter radius
Slant range	?
Image resolution (pixels)	Reflected in camera specifications of what sensor provides.
Ground sample distance	?

MATERIAL SAFETY DATA SHEETS (MSDS)

MSDS information should be provided for the following items:

1. Lithium-Polymer Ion Batteries: as these change and different manufactures are used there may be different MSDS

2. Gasoline

3. 2 Stroke Oil: Brand dependent