Draganfly Heavy Lift

Operator’s Manual

Revision 1.1

Contents

1 Introduction

1.1 Procedural Terminology

Throughout this manual, a number of procedural terms have been used to describe processes and requirements associated with safe operation of the Draganfly Heavy Lift. For clarity, the specific meanings of these words (as used in this manual) is as follows:

Must and **shall** are used only when application of a procedure or direction is mandatory

Should is used when application of a procedure or direction is recommended

May is used when application of a procedure or direction is optional

Will is used only to indicate futurity, never to indicate a mandatory or imminent procedure

Warning is used when an operating procedure or practice could result in personal injury or loss of life if not strictly followed

Caution is used when an operating procedure or practice could result in damage to or destruction of equipment if not strictly followed

Note is used when an operating procedure or practice is essential to highlight

1.2 Danger, Warnings, and Cautions

The responsibility to operate the Draganfly Heavy Lift in a safe manner, prevent injury to persons, or damage to property, and to take not unnecessary risks fall solely upon the owner, and those whom the owner authorizes to pilot and operate the UAV system. Furthermore, the onus is upon each owner/operator/pilot to comply with all regulations pertinent to the use of the Draganfly Heavy Lift unmanned aerial vehicle and is associated components at the location of operation with regards to the use of airspace as well as radio communications. Draganfly Innovations Inc. Does not accept any responsibility for damages or financial compensations which may arise as a result of misuse of this product or the owner/operator/pilot failing to comply with any regulations which could lead to a claim against the user or manufacturer.

1.2.1 Warning

The Draganfly Heavy Lift is a precision machine that is vulnerable to misuse and can prove to be dangerous if not properly maintained or used in an inappropriate manner. Rotary wing aircraft by their nature or not inherently stable. Although the Heavy Lift can maintain an accurate attitude, and position relative to wind movement without pilot control input: operators should always be aware of its position, attitude, and orientation and be prepared to take immediate control of the UAV to recover from an unwanted position and avoid any mishaps. Please completely read and understand all Draganfly Heavy Lift instructional information before attempting to fly the aircraft.

To provide optimum performance, the Heavy Lift uses lithium polymer flight batteries. The same properties that make these batteries extremely powerful and lightweight also make them dangerous if handled incorrectly. Please read and understand all information pertaining to the flight batteries before attempting to charge or use them.

IF MISUSED THIS AIRCRAFT IS CAPABLE OF CAUSING SERIOUS BODILY HARM OR DEATH TO THE OPERATOR AND SPECTATORS AS WELL AS PROPERTY DAMAGE. ANY DAMAGE, INJURY, OR DEATH OCCURING DUE TO THE MISUSE OF THIS PRODUCT IS SOLELY THE RESPONSIBLITY OF THE OWNER/OPERATOR.

Do not place your hands or arms in close proximity to the rotors or attempt to stop spinning rotors with your hands as serious injury could result from contact.

1.2.2 Safety Precautions

As the pilot in command you are responsible for safety of yourself and others in the immediate vicinity as well as the general flight path area. Please take safety very seriously.

- Do not attempt to use batteries or any other components other than those specifically designed and manufactured for use with the Draganfly Heavy Lift. Doing so may cause erratic flight performance
- Understand and observe the Heavy Lift's environmental operating condition limitations
- Always operate within the limitations of your UAV flight operations permit or license

- Avoid operations while precipitation is present
- Do not operate when conditions are favorable for icing to occur
- Do not operate the Heavy Lift near or over people on the ground
- Be aware of potential obstacles and hazards within the flight area
- Avoid operations in areas where there is a high likelihood of radio frequency and/or electromagnetic interference such as electrical substation, high voltage power lines and communications structures
- When possible, perform flight operation with the support of a visual observer
- Understand and observe the operating performance limitations of the Heavy Lift UAV
- Never perform flight operations if there are apparent or suspected damaged or performance issues with the Heavy Lift UAV system or its components

1.3 Glossary

For brevity and specificity, this manual uses many abbreviations and technical terms, not all of which may be familiar to new pilots. These terms are explained below in alphabetical order.

AGL Above Ground Level - refers to an altitude referenced above the local terrain

ASL Above Sea Level - refers to an altitude reference above the global mean sea level (typically used for GPS)

BMS Battery Management System - the module installed in the end of each battery that reports state of charge and other info

GCS Ground Control Station - the combination of radios, antennas, power supplies, and interface devices on the ground that a pilot uses to communicate with the UAV

SDS Safety Data Sheet - lists information required to safely handle and use a material

UAV Uninhabited Aerial Vehicle - synonomous with "drone", this is the portion of the system that flies in the air

2 Heavy Lift Fundamentals

2.1 System Overview

The Draganfly Heavy Lift is an octacopter UAV designed to transport payloads up to 30 kg. It uses eight lithium polymer battery packs to power its onboard electronics as well as the brushless DC motors that spin its propellers. The Heavy Lift has eight folding arms, each equipeed with one motor and propeller, spaced evenly around its octagonal body. Each arm folds in two places: a shoulder joint where the arm attaches to the body and an elbox joint near the midpoint of the arm. All arm joints on the aircraft lock in both the folded and extended positions, with an extra security latch engaging for flight when the arm is extended and locked.

The Heavy Lift hosts a variety of sensors and avionics, mostly situated beneath the domed plastic cover in the center of its body. This included redundant barometers, accelerometers, and gyroscopes, as well as the computation hardware necessary for automated flight. The aircraft's GPS, vertical rangefinder, and downward-facing camera are all mounted on its arms, allowing larger payloads to be mounted underneath the aircraft without interference. Communications antennas for the onboard radio system are mounted on the underside of the aircraft's body in up to four locations (depending on the radio system selected).

The Heavy Lift aircraft, its removable landing gear, propellers, and most ground station options come packed into a single case for transport. The provided battery charger has its own case, providing the ability to charge up to four batteries at once. Aircraft batteries are cased separately, four batteries per case, to comply with battery transport regulations.

2.2 Specifications and Capabilities

2.2.1 Aircraft Dimensions

Unfolded Diameter (without propellers)	2165 mm
Unfolded Diameter (with propellers)	2980 mm
Propeller Diameter	812.8 mm
Unfolded Height	750 mm
Folded Diameter	910 mm
Folded Height	745 mm
Aircraft Weight (incl. batteries)	50 kg
Max. Payload Weight	30 kg
Max. Takeoff Weight	80 kg

2.2.2 Power System

Battery Chemistry	Lithium Polymer
Number of Batteries	8
Battery Capacity (each)	570 W h
Battery Configuration	4S2P
Primary Power Nominal Voltage	91.2 V
Primary Power Maximum Voltage	104.4 V
Primary Power Minimum Voltage	79.2 V
Maximum Payload Power Draw	1000 W

2.2.3 Travel Cases

Aircraft Case External Size (LxWxH)	978x978x530 mm (38.5x38.5x24.2 in)
Battery Case External Size (LxWxH)	328x330x366 mm (12.9x13x14.4 in)
Charger Case External Size (LxWxH)	533x448x274 mm (21x17.6x10.8 in)
Aircraft Case Packed Weight	65 kg (143 lbs)
Battery Case Packed Weight	16 kg (35 lbs)
Charger Case Packed Weight	16.5 kg (36 lbs)

Note that shipping of aircraft batteries for the Heavy Lift requires their UN 38.3 certification information, which is provided at the time of purchase or available from Draganfly at any time. Most ground control stations will also have a battery of some type; see the GCS manual for more details.

2.3 Assembly Procedure

2.3.1 Removal from Case

Removal of the Draganfly Heavy Lift from its case requires two people and should be done according to the following process:

1. Ensure the case is upright and on acceptably level ground, with enough clear space around to store the case lid and assemble the aircraft
2. Undo all external latches on the case (20 in total), twisting them counter-clockwise to release pressure on the hook mechanism before rotating the hook down and away from the case lid
3. With a partner, grab the case lid and lift it up and away from the bottom portion of the case. Set the lid down upside-down on the ground or lean it against a fixed object such that the propellers and landing gear contained in its foam are accessible and protected from impact
4. Undo the three hook-and-loop straps in the center of the case lid, allowing the four landing gear legs to be removed from the case foam
5. Install each landing gear leg on the aircraft:

(a) Remove a landing gear leg from the case foam, gently pulling it outwards

(b) Grip the leg near its black plastic foot, with the aluminum end cap downwards and away from you

(c) Locate an empty landing gear receiver on the aircraft. If the receiver's clamp is already fastened (flush with the aluminum surface), release it so the leg can be inserted (see Figure 1)

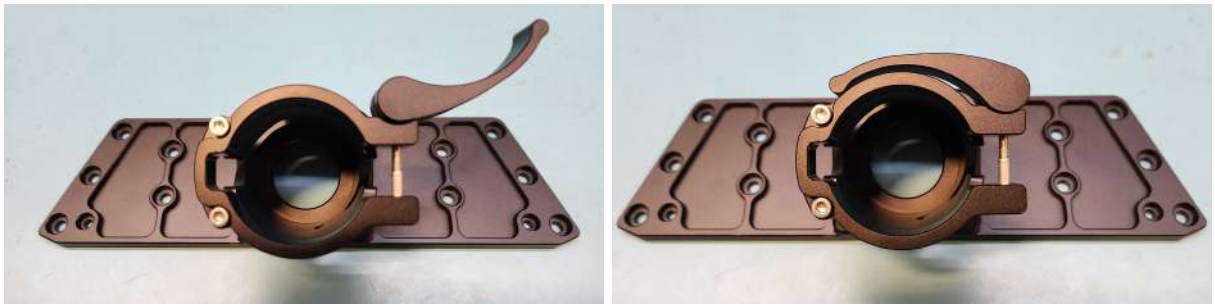


Figure 1: An empty landing gear receiver with clamp unlatched (left) and latched (right)

(d) Rotate the landing gear leg in your hand so that the blue screw head in the aluminum end cap is pointing to your left

(e) Facing the empty receiver, insert the landing gear leg into it, sliding the pin on the aluminum cap throug the notched section

(f) Rotate the landing gear leg clockwise until its foot is pointing outwards away from the aircraft. You should both hear and feel it click into this position, and it should be difficult (though not impossible) to rotate it back.

(g) Close the clamp, securing the leg in place. The end result should appear as shown in Figure 2

6. With all four legs installed, the Heavy Lift can be lifted out of its case, flipped over, and set upright on its landing gear. Warning: the aircraft is heavy, and can easily damage itself and anything it lands on if dropped. This step must be completed with two people. Take care to lift safely, and if unfamiliar with the process, having a third person available to help is ideal. When ready, carry out the following steps, depicted visually in Figure 3:

   (a) Stand facing your lifting partner, positioned along the sides of the aircraft case and with the case between you (Figure 3-i)

   (b) With your partner, decide which side of the case (left or right) you will set the upright aircraft down on. If this is to your right, use the directions as written below; if it is to your left, swap them left-to-right

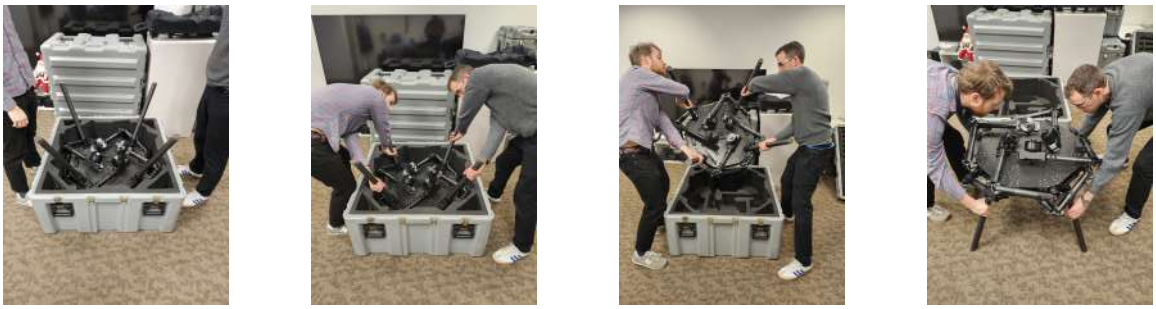
Figure 2: Fully assembled and latched landing gear receiver. Note the blue screw head showing on the upper surface - this confirms the leg is correctly oriented

(c) Grab the landing gear leg on your right with your left hand, twisting your arm counter-clockwise so that your thumb is oriented downward towards the aircraft body

(d) With your right hand, reach over top of your left arm and grab the landing gear leg on your left. As before, make sure your thumb is oriented downwards towards the aircraft body (Figure 3-ii)

(e) When both you and your partner are ready, use your legs to lift the aircraft directly upwards and out of the case foam. As soon as the body begins to clear the foam, flip the aircraft upright by un-crossing your arms (Figure 3-iii)

(f) Move sideways with our partner till past the edge of the case, then set the aircraft down onto its landing gear (Figure 3-iv)



(i) (ii) (iii) (iv)

Figure 3: Process for lifting the Heavy Lift out of its case

2.3.2 Unfolding

The arms of the Heavy Lift can be unfolded in any order, using the following process for each arm:

1. With the arm fully folded, locate the shoulder joint where it connects to the central body of the aircraft. Pull the clamp lever in the middle of this joint outwards slightly, away from the center of the arm, such that it bends away from the arm slightly (see Figure 4). If the clamp lever is straight or bent inwards at all, the arm is locked in place and unable to be unfolded.

Figure 4: An arm joint clamp in the locked-open (left), unlocked (centre), and locked-closed (right) positions. To release the joint from the locked-closed position, the button on the outer face of the clamp must be held

2. Grasp the arm by one of its carbon fibre tubes and rotate the shoulder joint closed, pushing the clamp lever down into place when the joint closes fully. Ensure that the security hook on the clamp lever latches fully
3. Repeat steps one and two on the elbow joint in the middle of the same arm, unfolding it and locking it into place

2.3.3 Propeller Installation

The Heavy Lift's propellers are fastened to its motors via a spring-loaded quick-release system and colour-coded according to directionality: counter-clockwise propellers belong on upright-facing motors and have bright silver quick-attach pieces (both propeller and motor sides), whereas clockwise propellers belong on downwards-facing motors and have gloss black quick-attach

pieces. Caution: the propellers have precisely-shaped surfaces and fine edges, and are both easily damaged and easily able to cause damage. Always take care to keep them away from obstacles.

To install each propeller onto its matching motor, complete the following steps:

1. Fully unscrew the T-handle in the center of the propeller, rotating it counter-clockwise by hand until it slides up and down freely over a small range (see Figure 5)

Figure 5: T-handle on the propeller quick-release in the fully-unscrewed position (left). It should be able to be pulled or pushed several millimetres further against spring tension, fully exposing the threads at its base (right)

2. Align the two protruding flanges opposite the T-handle on the propeller with the matching cutouts on the motor quick release (see Figure 6)
3. Holding the propeller in one hand, use the other hand to support the motor and hold it stationary. Push the propeller towards the motor, then as the two quick-release surfaces begin to touch, rotate the propeller. Continue rotating the propeller until an audible click is heard, then verify that the propeller and motor now spin together (see Figure 7)
4. Screw the T-handle on the propeller back in till finger-tight, locking the propeller and motor together. Caution: do not use tools on the T-handle or otherwise attempt to excessively tighten

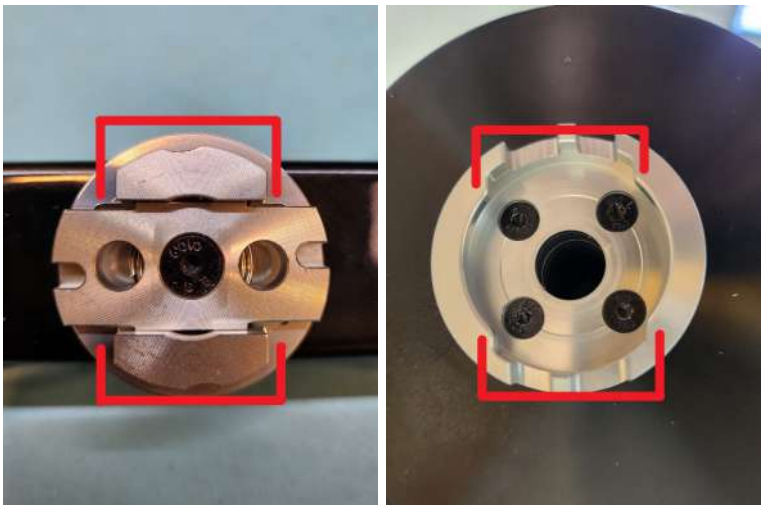


Figure 6: Flanges on the propeller quick-release (left) and matching cutouts they should be aligned with on the motor quick-release (right) for propeller installation

2.3.4 Battery Installation

Before installing batteries in the Heavy Lift, check the output voltage on the BMS for each battery. To be used together, the output voltage on all batteries must fall within 0.5 V of one another. If this is not the case, put the batteries back on the charger; it will automatically balance them as part of the charging routine. Whenever the Heavy Lift is flown, the flight session should be started with fully-charged batteries.

The Heavy Lift draws power from its batteries in two independent sets of four batteries, with each battery in a different set than either adjacent to it. A bright yellow start-up connector is provided with the Heavy Lift, which fits on the end of a battery (see Figure 8) and is used to power on the aircraft. Caution: if a complete set of batteries is connected without use of the start-up connector, internal sparking may occur, potentially rendering the battery connectors unusable. Warning: as the aircraft starts up, its motors will be used to emit status tones, moving the propellers slightly in the process. They will not spin, however the tips will change position and may present a snag or impalement hazard. Only people responsible for plugging in batteries should be within reach of the aircraft's propellers during the battery installation process, and they should each remain conscious of propeller tip positions as they move around the aircraft.

With eight fully-charged batteries ready, installation should be completed according to the following process:

Figure 7: Propeller quick-release fully rotated into place, with the locking bar clicking into place between the propeller and motor halves to prevent relative motion (left). Screwing down the T-handle locks the bar in place and finishes the installation process (right)

1. Select any two adjacent battery bays on the Heavy Lift. These will be the last two batteries to be installed.
2. Fill each of the other six battery bays with a full-charged battery:
   (a) Ensure the battery is upright (see Figure 9) and the battery locks are in the open (vertical) position
   (b) Slide the battery into the bay, pressing firmly till the locking surfaces are flush with the carbon plates on the outside of the body
   (c) Rotate both battery locks to their horizontal position, securing the battery in place
3. Install the start-up connector on a battery, then install that battery in one of the two remaining battery bays. Wait at least five seconds for the aircraft to power on fully. You must proceed to the next step within 30 seconds
4. Insert and lock the final unused battery into either of the empty battery bays
5. Remove the battery mated to the start-up connector, remove the start-up connector from the battery, and reinsert/lock the battery into the final empty battery bay

Figure 8: Battery with the start-up connector installed. The fabric band is wrapped around the end of the battery, ensuring the connector doesn't fall off

2.4 Pack-Away and Preparation for Transport

2.4.1 Battery Removal

The Heavy Lift will power off as soon as any two adjacent batteries are removed from it. Batteries are removed by rotating the battery locks back to the vertical position and gripping the handholds around their base, pulling directly outwards. Batteries should be placed directly into their case when possible to avoid contamination of their electrical connectors.

2.4.2 Propeller Removal

Removal of each propeller should be completed using the following steps:

1. Fully unscrew the T-handle in the center of the propeller, rotating it counter-clockwise by hand until it slides up and down freely over a small range
2. Using your fingers to brace against the center of the propeller, pull the T-handle outwards away from the propeller, lifting the locking bar that holds the propeller and motor together (shown in Figure 7). After aggressive manoeuvreing or heavily loaded flight, this may require strong force

Figure 9: Visual determination of battery orientation. Viewed from above (e.g. as it's being pushed into a battery bay), an upright battery has one large hole visible at its base (left), whereas an upside-down battery shows several small holes (right)

3. With the T-handle still pulled outwards, rotate the motor relative to the propeller, continuing to rotate until the propeller comes from from the motor
4. Store the propeller in the transport case

With all propellers placed make into the case the velco straps securing them must be fastened over top before the case is closed.

2.4.3 Stowing in Case

The aircraft can be packed back into the case by reversing the setup process. Ensure the case is free of debris, fold all arms, then have a partner help lift and rotate the aircraft back into the case. Once the aircraft is fully seated, remove its landing gear legs and store them back in the lid.

2.4.4 Special Considerations for Prolonged Transport or Storage

While the Heavy Lift is protected against minor water intrusion, the storage case does not provide means for any water sealed inside to escape. If the aircraft, its accessories, or the internal case foam are put away wet, make sure the case is re-opened and allowed to dry as soon as possible.

3 Batteries

The Draganfly Heavy Lift uses eight separate six-cell (6S) 25000mAh Lithium Polymer flight battery assemblies for operations. These batteries do exceed 100Wh and require care when handling and transporting. Please carefully read the following safety guidance prior to charging or using the flight batteries. Battery SDS and UN 38.3 test reports are supplied separately when the battery is purchased and can be made available upon request. These supplemental documents are NOT incorporated into this operation manual.

Please read and fully understand all the instructions and warnings below before using or charging your lithium polymer batteries. Warning: Lithium Polymer (LiPo) batteries are volatile; improper use or failure to follow these instructions and warnings may result in fire, personal injury and/or damaged property. Draganfly Innovations and its affiliates assume no liability for the improper use of this battery, or failure to comply with these instructions and warnings.

3.1 Safety Guidelines Guidelines

- Flight batteries should not be fully charged for transport. After initial receipt, they will need to be fully charged prior to use
- Please only use the Lithium Polymer specific battery charger supplied with your Draganfly Heavy Lift package. Warning: use of any other charger may result in fire and property damage and/or personal injury
- Batteries should be kept in a flame-retardant location free of ignition sources
- Batteries should never be left unattended while charging
- If an any time a battery becomes swollen, immediately discontinue use or charging, disconnect the battery and place it in a safe observation area outdoors away from property, vehicles, and combustible materials. Observe the battery for a minimum of 15 minutes to monitor for changes including further swelling, visible gassing, smoke, or ignition
- Do not short-circuit flight batteries; doing so can cause a fire. Note: be cautious of potential shorts and burns that may occur due to jewelry contacting a battery's electrical terminals. The chemical reactions that occur inside batteries are not instantaneous and a damaged battery may not ignite or immediately - if a short occurs or the battery is involved in a crash,

place it in a safe observation area (as described above) for at least 15 minutes

3.2 Charging Flight Batteries

Batteries for the Draganfly Heavy Lift should only be charged using the included battery charging case, the electronics in which are preconfigured to safely charge Heavy Lift batteries. The charging case holds up to four batteries, connected to the charger in two independent groups (divided down the center of the case: the left two batteries are one group, and the right two are the other). Only batteries with similar states of charge should be conncted within the same group, and depending on the state of charge disparity between the two groups, they may be charged either in sequence or simulaneously (determined automatically by the charger).

The Heavy Lift battery charging case provides offers two main functions: charging batteries, either to a fully-charged or storage-ready state, and discharging batteries, used solely for batteries that will be stored and are currently above safe storage charge levels. Heavy Lift batteries should be charged at a current of no more than 30 A, taking slightly less than an hour for a depleted battery group to recharge fully (or approximately half an hour for storage-charged batteries). Discharging batteries takes significantly longer.

Before using the Heavy Lift battery charging case, review the charger manual provided with purchase for additional safety instructions as well as input voltage requirements and power output limitations.

3.3 Storage and Transport

The flight batteries supplied with the Draganfly Heavy Lift are classified as UN3480, Class 9 dangerous goods specific handling and transportation guidelines must be followed.

- Never transport, ship, travel with, charge, or use a damaged lithium battery.
- Batteries should be stored at room temperature (20C-25C)
- Do not store batteries in a vehicle even if in a flame-retardant container. Do not store batteries near a source of heat
- Exposure to temperature more than 65C may cause permanent damage and deteriorated performance

- Exposure to temperature more than 75C may cause ignition and fire
- If batteries are to be stored for more than one week, they should be discharged to a storage charge level of approximately 60% state of charge. This can be done automatically via the "Storage" setting on the charger
- Heavy Lift flight batteries cannot be transported on passenger carrying aircraft. Please refer to IATA Dangerous Goods Regulations and federal transportation of Dangerous Goods Regulations for safe packaging and transportation.

3.4 Disposal

Damaged or worn flight batteries shall be immediately removed from service and disposed of; never charge or use a worn or damaged battery. To properly dispose of a lithium battery fully submerge and soak the battery in saturated salt water for a minimum of 96 hours to discharge. In most locations discharged lithium batteries can be recycled at centers that accept household recycling materials or automotive materials. Please check with local waste and recycling programs to properly dispose of fully discharged batteries. Do NOT dispose of lithium batteries in fire.

4 Payloads

The Draganfly Heavy Lift supports three main styles of payload: small payloads up to 3 kg, attached via a single screw-on mechanism, large payloads up to 10 kg, attached via a pin-and-latch mechanism, and heavy payloads up to 30 kg, attached via a hook-and-bar mechanism. Small and large payloads interoperate with other products in the Draganfly line, allowing use of the same payloads on the Heavy Lift and other aircraft, where the heavy payload attachment system is unique to the Heavy Lift. For more information on payloads available off the shelf from Draganfly, consult the payload catalogue provided with your aircraft.

For all payloads, electrical connections are made via a circular quick-attach connector on the underside of the aircraft's body. This connector provides a variety of different interfaces including networking, servo control, serial, and USB into the onboard mission computer. Caution: never attempt to hot-swap any payload that makes an electrical connection to the aircraft. The aircraft must be powered off before any payload of this type is connected or disconnected.

4.1 Small Payloads

To install a payload using the small-payload system, complete the following process (shown on a Draganfly Commander 3XL, but identical on a Heavy Lift):

1. Align the payload with the aircraft, so that they're both facing the same way. This can be done using several different visual reference points (see Figure 10). Small payloads have a keyed connection, so they cannot be fully connected if they aren't aligned
2. Press the payload onto the aircraft until the coupling is fully seated. The payload will engage approximately 10 mm (3/8 in) with the aircraft
3. Tighten the payload coupling nut, spinning it clockwise by hand until it stops rotation (see Figure 11). Expect to hear several clicks from the locking mechanism before the nut tightens fully; if no clicks are heard, check that the payload is seated correctly. Do not stop tightening until the nut stops rotation by hand, and do not use tools
4. Attempt to wiggle the payload in all directions. If any motion is observed in the payload-to-aircraft coupling, the payload is not installed correctly, and must be removed to try again

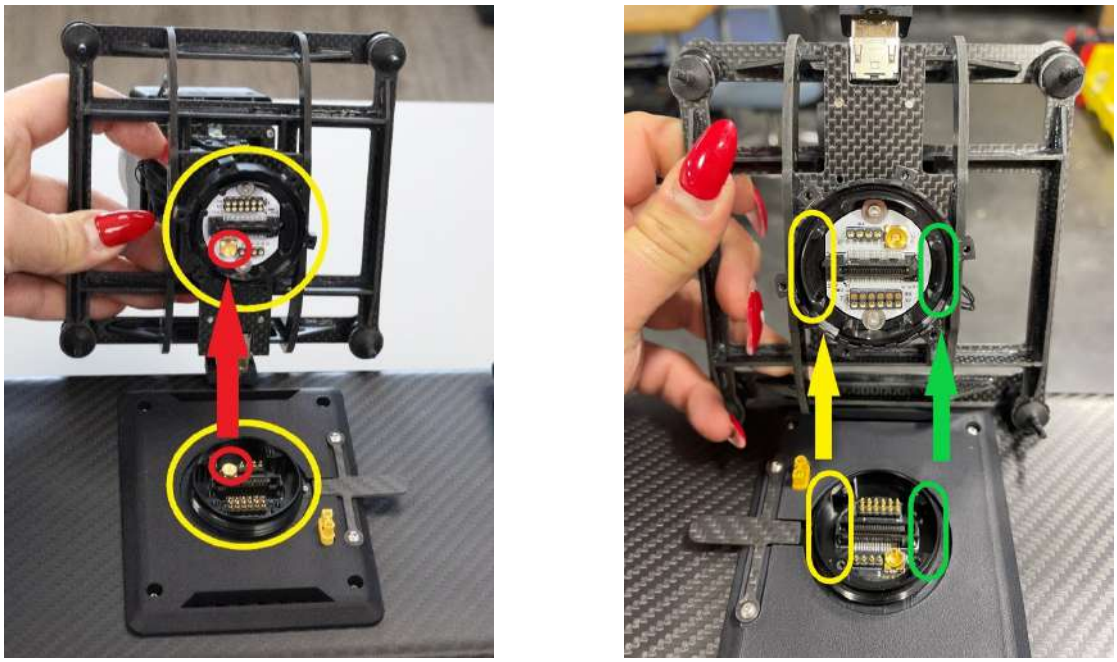


Figure 10: Alignment features used to line up small payloads with the quick-attach payload connector: location of the large brass antenna connector (left) and relative size of the locating tabs (right)

To remove a small payload, the process is similar:

1. Locate the payload release latch (see Figure 12) and bend it approximately 6 mm (1/4 in) away from the aircraft body
2. Holding the payload release latch bent, unscrew the payload coupling nut completely
3. Pull the payload directly away from the aircraft

4.2 Large Payloads

To install a payload using the large-payload system, complete the process (shown on a Draganfly Commander 3XL, but identical on a Heavy Lift). Note that four of the large payload bars are present on the underside of the Heavy Lift; most payloads will use either the outer two alone or inner two alone, though some may use all four simultaneously. Regardless of which set of bars is being used, the same process applies.

1. Prepare the payload by rotation all payload lock levers to their open position (see Figure 13)

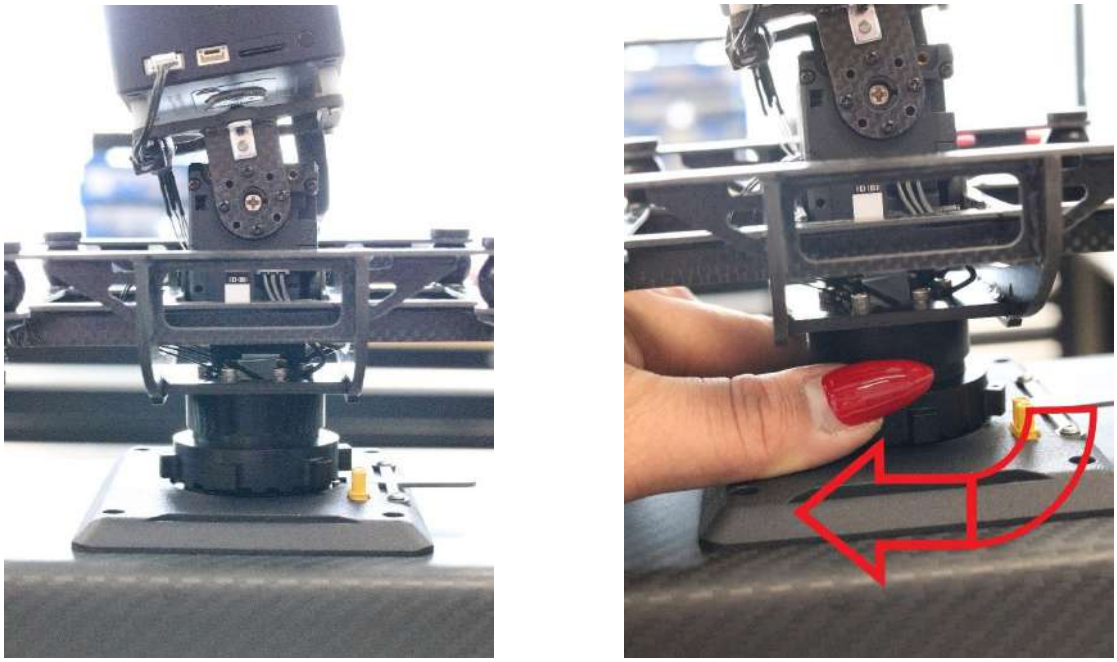


Figure 11: A fully-seated payload (left) and the process for tightening the payload coupling nut (right) to lock the payload in place

2. Ensure the payload and aircraft are facing the same direction (see Figure 14) - alignment principles from small payloads (Figure 10) can be used as well

3. Lift the payload flat against the aircraft, checking and correcting alignment on the payload guide pins (Figure 15). Once the guide pins are fully aligned, press the button on the bottom side of each to allow them to fully engage with the aircraft

4. Release the guide pin buttons and verify there is no gap between the aircraft's payload recieving bars and the top plate on the payload. Figure 16 shows an example of both correctly and incorrectly-inserted guide pins; if the pin is not correctly inserted, it must be removed to try again

5. Once all guide pins are inserted correctly, rotate all the payload lock levers to their closed position 17. A lock symbol should be visible on the exposed outer surface of each lock lever

4.3 Heavy Payloads

Before carrying payloads that use the Heavy Lift's heavy payload mounting system, its two heavy payload adapter plates must be installed. Each plate is installed via the same process used for large payloads, with one plate supported

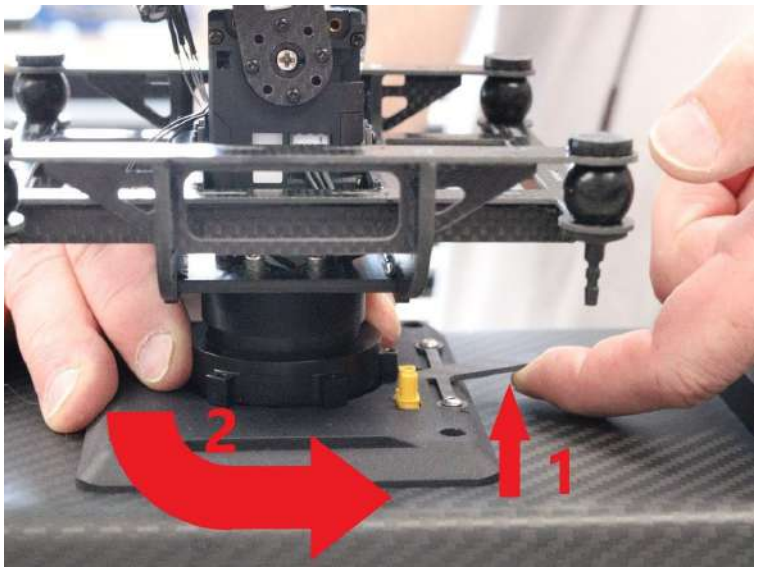


Figure 12: Removal process for small payloads connected to the quick-attach payload connector

by the front two large payload bars and the other by the rear two (see Figure 18). Ensure that the payload release handles are oriented towards the outside of the aircraft.

With the heavy payload adapter plates installed, complete the following steps to fasten a heavy payload to the aircraft. A team of at least two people should work together to fasten the payload to the aircraft, which is what these steps assume.

- Position the payload underneath the aircraft. Depending on the specific payload and situation, this may be accomplished by either sliding the payload underneath the assembled aircraft or lifting and placing the aircraft over top of the payload
- With one person at each end of the payload, grasp its metal handles and lift together, keeping the top plate of the payload level
- Using the payload alignment pins as a guide (see Figure 19), lift it fully into place, pulling the load-bearing bar at each end up and into the hooks on the heavy payload adapter plates. Ensure the payload does not press on either of the payload release handles, and they are still both in their fully closed positions (see Figure 20)
- Once the hooks at both ends of the payload have engaged, slowly release pressure on the payload, checking that it does not droop as it becomes fully supported by the aircraft. Any sagging or significant movement may

Figure 13: Payload lock levers oriented correctly to begin payload installation: flat sides inwards towards the aircraft centerline

indicate that the payload is not properly connected - in this case, the payload must be removed before installation is re-attempted

To remove a payload, a team of two should stand at either end, lift the metal payload handles together, then pull the payload release handles upwards while slowly lowering the payload to the ground.

4.4 Custom Payload Integration

For use cases requiring custom payload integration, Draganfly offers both off-the-shelf integration kits and integration consulting services. Integration kits break out the interfaces provided in the quick-attach payload connector, allowing easy access for end users who know exactly what they need. Up to 1000 W of power can be drawn through the high-power payload connector adjacent to the quick-attach connector, with ranging in voltage from approximately 80 V to 100 V depending on battery state of charge. Caution: this is a direct connection to battery power, and offers enough power to significantly affect the flight time and payload capacity of the aircraft. Ensure pilots are conscious of any high-power payloads connected to the aircraft and their potential effects on system performance.

Figure 14: Alignment between large payloads and the aircraft: the pins circled in yellow will go into the yellow-circled holes on the aircraft's large payload bars. Circled in red, position of the large brass antenna connector and its receiver can be used to confirm that the payload and aircraft are both facing the same way

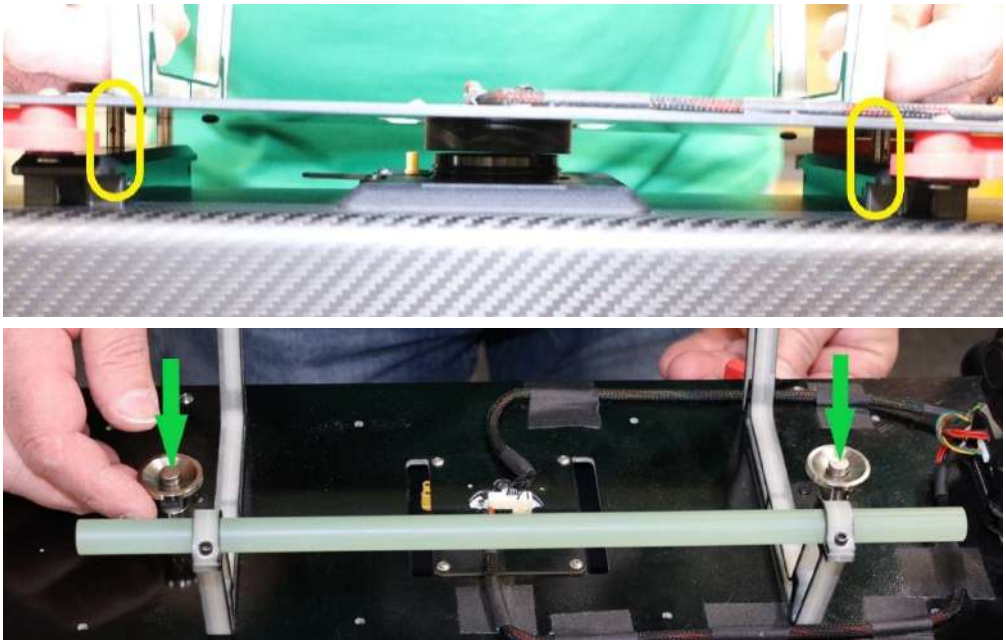


Figure 15: Large payload in place near the aircraft's receiver bars, with pins properly aligned and ready to push in (top). To insert the pins fully, press the buttons indicated with the green arrows (bottom), pushing upwards towards the underside of the aircraft

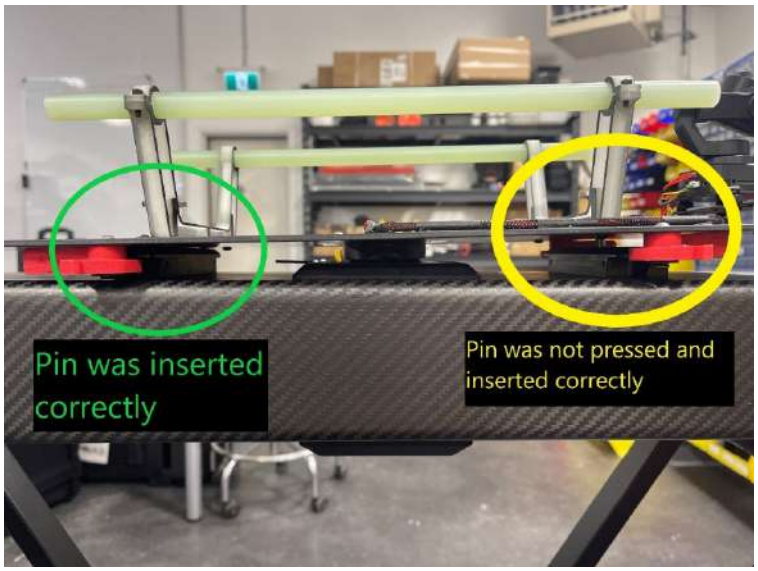


Figure 16: Correct and incorrect pin insertion for large payloads

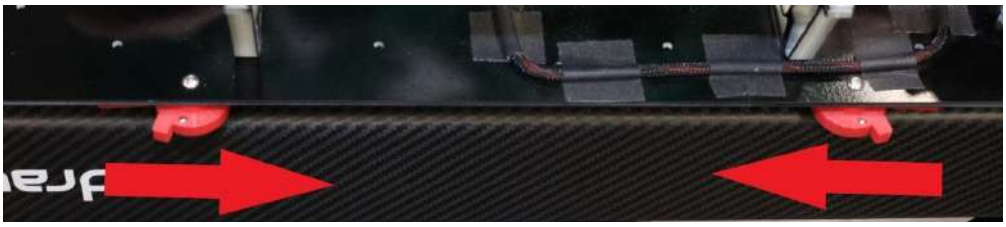


Figure 17: Rotation of payload locking levers to secure the payload completely to the aircraft

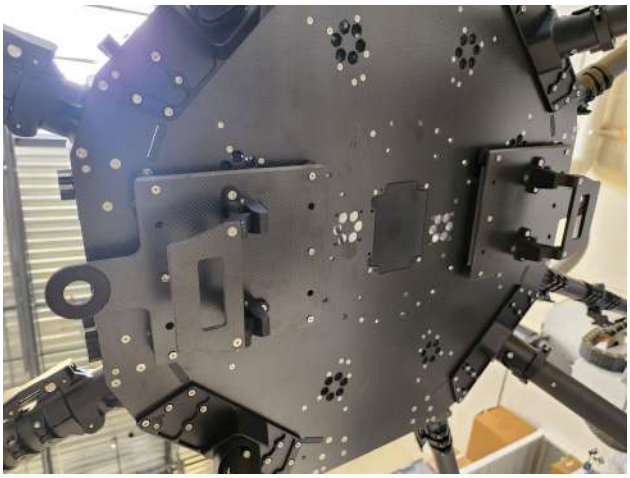


Figure 18: Heavy payload adapter plates installed on the underside of the Heavy Lift

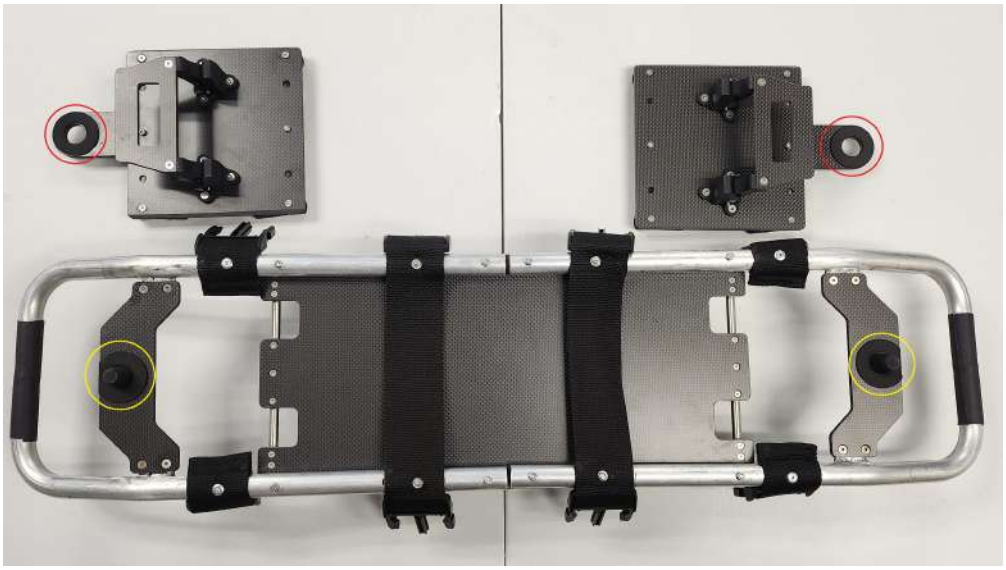


Figure 19: Correct orientation of load-bearing plate on heavy payload relative to the heavy payload adapter plate. Alignment pins on the payload (circled in yellow) are pulled upwards and through alignment holes on the adapter plates (circled in red) as the payload is installed.

Figure 20: Position of the release lever on each payload adapter plate once the payload is securely latched.

5 Communications and Ground Control

The Heavy Lift can be ordered with a number of different radio configurations according to the intended operator, use case, and operating conditions. Except on special request each Heavy Lift is packaged from the factory with an appropriate ground station station for its equipped radios; an operator's manual specific to each GCS is provided with that hardware. In all cases, Draganfly recommends DGroundControl as ground control software for piloting the Heavy Lift. DGroundControl comes pre-installed on all factory-supplied GCS options and is available to download for Windows and Android from the Draganfly website.

6 System Maintenance

The Draganfly Heavy Lift has minimal required maintenance or user serviceable components. The PIC and operator shall be responsible to conduct and keep records for all applicable maintenance and service performed. Should the UAV system fail any maintenance procedure or inspection, flight operations shall be suspended until the UAV has been properly serviced and issues resolved.

6.1 Scheduled Maintenance

The maintenance schedule below is recommended to be observed to keep your Heavy Lift in operating condition. Milestones are based on either the number of accumulated flight hours or calendar days: whichever is reached first.

6.1.1 Every Flight Session

- Propeller check - Section 6.2.1
- Visual inspection - Section 6.2.2
- Compass calibration - Section 6.2.3
- Back up flight logs - Section 6.2.4

6.1.2 Every Month or 25 Flight Hours

All items from the every-flight-session check plus:

- Exterior cleaning - Section 6.2.6
- Physical inspection - Section 6.2.5

6.1.3 Every Three Months or 75 Flight Hours

All items from the monthly check plus:

- Motor test - Section 6.2.7
- Arm tension adjustment - Section 6.2.10
- Cycle batteries (if not being regularly used) - Section 6.2.11
- Contact Draganfly to check for software updates or service bulletins

6.1.4 Every Year (or 300 Flight Hours)

Major system maintenance is recommended annually or after 300 flight hours. These maintenance items require advanced knowledge of the UAV system as well as specialized tools. It is recommended that annual maintenance should only performed by factory-trained personnel. Procedures to be completed include:

- Inspect and clean all electrical connections
- Inspect all moving components for wear, replace as needed
- Recalibrate handheld controller (if required)
- Inspect motor assemblies for wear, replace as required
- Re-torque critical fasteners
- Inspect all vibration isolation components, replace as needed
- Inspect structural components for fatigue or damage
- Effect any outstanding service bulletins

6.1.5 After Prolonged Storage

Before using the Heavy Lift after prolonged storage, these extra checks should be completed.

- Avionics functionality check - Section 6.2.8
- Motor test - Section 6.2.7

6.1.6 After Abnormal Occurrence

If the system behaves in an unexpected or atypical way, especially during a flight, these extra checks should be completed.

- Physical inspection - Section 6.2.5
- Avionics functionality check - Section 6.2.8
- Back up flight logs - Section 6.2.4
- Contact Draganfly support and share the ten most recent flight data logs for help diagnosing any issues

6.2 Inspection/Maintenance Procedures

6.2.1 Propeller Check

Propeller checks should be performed with the propeller installed on on a motor, tightened down with the arm extended and ready to fly. Position the propeller so it rests at a right angle to the arm, then perform the following three actions:

1. Place one hand near each end of the propeller, then push down gently with in an alternating fashion to rock the propeller back and forth. Use enough only enough force to slightly move the motor the propeller is attached to. Motion of the propeller should be observed to cause corresponding of the motor bell, motor base, and very slight twisting of the carbon fiber tube at the end of the arm.

   Fail if: Propeller moves independently of motor bell, motor bell independently of motor base, or motor base independently of the arm

2. Run your fingertips along both the leading and trailing edges of each propeller blade, feeling for roughness or imperfections

   Fail if: Gouging or cracking is found on either the leading or trailing edge, excessive surface roughness on the leading edge

3. Grasp one of the two propeller blades with both hands, one near the tip and the other at the widest point. Twist the propeller blade downwards away from its leading edge slightly, looking for any cracks or separation along the trailing edge.

   Fail if: Any discontinuity (crack, gap, etc.) is observed in the trailing edge

6.2.2 Visual Inspection

To conduct a visual inspection, remove the Heavy Lift from its case and unfold its arms, then verify the following:

1. Fasteners on the top and bottom plates of the aircraft are all present and appear flush with or slightly recessed into the carbon fibre
2. Center dome of the aircraft is intact and seated flat against the carbon fibre top plate
3. Security latches on all elbow and shoulder joints are fully engaged
4. No cracking, gouging, or deep scratching is visible on any of the carbon fibre tubes (arms and landing gear)

6.2.3 Compass Calibration

The Heavy Lift's compass is responsible for providing heading information to the flight controller. This data is needed for stable and controlled flight. Occasionally the compass will need to be calibrated to ensure optimum performance. Calibrations should be completed in the following scenarios:

- DGCS flight management software is giving an alarm or message indicating the compass needs calibration
- The flight location is more than 500km away from the location of the last compass calibration
- The aircraft heading is not reporting correctly
- The aircraft is exhibiting abnormal flight behaviour
- The aircraft has been involved in a tip over, crash, or impact

For instructions on the calibration process, see your GCS manual.

6.2.4 Data Log Backup

Flight data logs should be backed up by downloading logs wirelessly to a connected GCS, from which they can be distributed on to backup drives as

needed. The precise steps in this process may differ depending on the GCS being used - consult the pilot's manual provided with the GCS for more information.

6.2.5 Physical Inspection

To physically inspect the aircraft, remove the aircraft from its case and unfold its arms, then complete the following:

1. Check for play in the arm joints by supporting the arm underneath the motor and lifting up slightly. The arm should flex, but no demonstrate significant movement without much force applied.

   Fails if: Motor can be moved upwards more than 3 mm (1/8 in) before the arm begins to flex

   Corrective action: Adjust arm tension - Section 6.2.10

2. Check for exposed or pinched wires inside all folding arm joints. If any exposed, undamged wires are found, tuck them back inside their black protective sheath. If any exposed wires show signs of pinching or other damage, contact Draganfly service
3. Check for tightness on all M4 fasteners (2.5 mm driver) on the aircraft's top and bottom plates. If any are loose, re-torque to 2.8 N m (25 in-lbs)
4. Slowly rotate each motor by hand for at least 1 full rotation. The movement should be smooth with consistent resistance throughout full rotation
5. Ensure payload attachment points are secure and have no missing or loose fasteners. Inspect electrical connections and ensure they are clean and free of debris. Once the payload in connected verify the attachment mechanisms are latched and fully secure, ensure there is no freedom of movement or play in the attachment points
6. Check that the antennas on the underside of the aircraft are securely threaded onto their mounts and show no signs of damage

6.2.6 Exterior Cleaning

6.2.7 Motor Test

The motor test feature included on the Heavy Lift requires that the aircraft be fully assembled and powered on, but it must not have its propellers installed.

Warning: the motors will spin once the motor test feature is activated, and must be verified to be clear of entanglement hazards before beginning. Starting a motor test with propellers installed may cause the aircraft to move and inflict damage upon itself or its surroundings.

Once prepared for a motor test, follow the instructions in your GCS manual to set all motors to approximately 50% throttle. Run the motors for two minutes, then stop them and power down the aircraft. The appearance of any of the following characteristics shall be indicative of damages or wear:

- Any specific motor is consistently slow to start or fails to start
- Any one motor premature stops running during the test
- Any specific motor sounds excessively rough and presents a grinding or squealing noise
- Any motor is hot to the touch after running for 2 minutes

If any motor presents one or more of these symptoms, flight operations shall be suspended until the UAV has been serviced and the issue has been rectified.

6.2.8 Avionics Functionality Check

Functionality of the avionics system shall be completed prior to each take-off as well as during the post delivery acceptance inspection or as a result of any abnormal operating behaviour being observed.

- **Compass Orientation:** Observe reported compass heading via GCS and verify it is correct relative to a hand held compass. Ideally check for North, East, South, and West orientations, ensure the reported value is within +/- 5 degrees of the true heading. If reported compass heading is incorrect by more than 5 degrees perform a compass calibration and verify it is reporting correctly prior to flight

  Fail if: Reported compass heading with a deviation exceeding +/-5 degrees of actual heading

  Corrective action: perform compass calibration, if failure persists contact Draganfly tech support

- **AHRS:** Physically manipulate the aircraft through pitch and roll movements in both + and – directions, ensure the AHRS artificial horizon indicator in DGCS responds in correct direction and magnitude

  Failure State: attitude indication in the wrong direction, wrong orientation or with an apparent magnitude deviation greater than +/-5 degrees when aircraft is sitting level and stationary

  Corrective action: perform accelerometer calibration, if failure persists contact Draganfly tech support

- **Flight Mode:** Verify that the aircraft responds to changes to the flight mode switch on the HHC

  Failure state: aircraft does not emit appropriate tone and GCS does not report correct flight mode

  Corrective action: contact Draganfly tech support

- **Cooling Fans:** Verify that the cooling fans on the bottom of the aircraft can be heard running

6.2.9 Software Update

There are several electronic components on the Heavy Lift which may require updating. None of these components include an auto-updating mechanism, and Draganfly will not force software updates. When updates are available, the relevant files will be supplied with instructions on how to apply them. For safety-critical updates, Draganfly will reach out to owners of affected systems; for performance and other non-critical enhancements, system maintainers should contact Draganfly periodically to check for updates.

6.2.10 Adjust Arm Tension

Each of the Heavy Lift's folding arm joints has a screw-adjustable tension mechanism, designed to take up any slack that develops in the joint over time. To check for slack in the joints, the aircraft must be assembled with arms extended and locked. Place a finger over the seam on an arm joint, then press upwards firmly on the underside of the motor on the same arm. If the joint can be felt slipping slightly as the arm is loaded, follow the steps below to increase tension on it:

1. Unlock and fold the joint, locking it in the folded position

2. Locate the two adjustment screws, positioned on the outer side of the joint on either side of the main hinge
3. Use a 2.5 mm driver to rotate each screw one quarter of a turn counter-clockwise
4. Unload the joint and re-extend the arm, locking it back into the open position once more. Test for slack in the joint again, repeating the steps above if it is still present

6.2.11 Cycle Batteries

Batteries stored without being used for long periods of time should be periodically returned to a storage charge level to combat self-discharge that might otherwise take them outside an acceptable voltage range. To do so, simply connect each battery to a charger and run the charger's storage routine, allowing it to bring the batteries back to an ideal charge level for long-term storage.