Buyer agrees to comply with all applicable U.S. export controls laws and regulations, specifically including, but not limited to, the requirements of the International Traffic in Arms Regulations (ITAR), 22 C.F.R. §§ 120-130, and the Export Administration Regulations (EAR), 15 C.F.R. §§ 730-774, including the requirement for obtaining any export license or agreement, if applicable. Without limiting the foregoing, Buyer agrees that it will not transfer any export-controlled item, service, technology or technical data, to any non-U.S. person or entity, whether located within or outside the United States, without an applicable export license, agreement, exemption or exception.

Buyer further agrees that it shall immediately notify Seller’s authorized representative if Buyer is, or becomes, listed in any U.S. Government Denied Parties List or if Buyer’s export privileges are otherwise denied, suspended or revoked in whole or in part by any U.S. Government entity.
OWNER AND OPERATOR RESPONSIBLE FOR SAFE OPERATION OF UNMANNED AERIAL VEHICLE

Use of an unmanned aerial vehicle ("UAV") also known as an unmanned aerial system ("UAS") and known by some as a drone can cause risk of serious injury or death to people, animals and damage to property. Therefore, an operator (and an owner allowing others to use the UAV) has the obligation to act safely and responsibly at all times. In first learning to operate a drone or learning to operate a drone with which the operator is not familiar, the operator should seek instruction from someone knowledgeable and should learn in areas that are open and free of obstacles (for example, in a large field) and away from other people. Even once an operator is proficient in flying the UAV, the operator should always be flying on the assumption that the power could be lost without notice and the UAV could crash. A free-falling UAV, even weighing just a few pounds, dropping on someone’s head or other body parts or through a car windshield could cause serious injury or death.

At no point should a UAV be flown directly or even nearly overhead of people, animals or property that could be injured or damaged, if the UAV were to crash.

If the operator is flying near someone who is in motion, the operator must consider the path of that person (or the vehicle the person is in) to make sure that the UAV could not fall into the path of the person or vehicle. Further, in that same regard, flying a UAV low to the ground near a person who is moving on foot or in a vehicle could be distracting and cause that person to have an accident even if the UAV does not crash. Also, the moving rotors on a UAV can cause severe injury and the operator must not allow the rotors to come close to any person, animal or property that could be damaged. Thus, the operator of a UAV must at all times use common sense, act respectfully of others and always keep in mind that the UAV could stop flying without notice. Similarly, an operator should not fly a UAV over roadways and especially should not hover over one where the UAV could fall onto moving vehicles.

Unless the UAV operator has the permission of the persons in charge of an accident scene, disaster site, fire, etc., the operator should not fly the UAV. Even then, the operator is responsible for first learning whether the area is subject to a flight restriction imposed by the Federal Aviation Administration ("FAA"). Flying the UAV without permission of those in charge could cause risk to rescue or police helicopters, air ambulances,
news helicopters, and firefighting aircraft and could hamper the operations of those first responders.

It is also the responsibility of the owner and operator to learn about national, state and even local laws and ordinances concerning UAV flight. UAV-America LLC encourages owners and potential operators to hire a professional licensed flight instructor to learn how to read and interpret flight maps (for example, “Sectionals”) and to understand the national airspace system and airspace classifications. Persons flying recreationally are subject to some FAA safety rules and those rules must be learned. Persons wanting to fly a UAV commercially (which means anything other than for pure hobby use), must comply with additional FAA safety regulations and policies which may require the owner/operator to apply for a license or exemption and follow specific requirements of the FAA. Recreational users of UAV must register their aircraft with the FAA (can register several with the same number) and commercial operators must register each aircraft separately.

Even apart from the obligation to operate a UAV responsibly and safely, the owner and operator should be respectful of the privacy and property rights of individuals.

This safety warning and any others contained in the UAV-America LLC materials or website cannot teach the operator/owner everything he or she needs to know to safely operate a UAV or how to comply with the laws. Therefore, the owner and operator should not rely on these materials as the primary safely and legal guides by which a UAV is flown. Purchasing the UAV, reading all the instructional materials and learning how to fly the UAV is just the beginning of the UAV owner and operator’s responsibilities.

**LIMITED WARRANTY, EXCLUSIVE LIMITED REMEDY FOR DEFECT, TIME TO DISCOVER AND REPORT DEFECT. DISCLAIMER. CAUTION: LIMITED TIME TO DISCOVER AND REPORT ANY DEFECTS. READ IMMEDIATELY ON PURCHASE.**

*This limited warranty is valid only on products sold and used in the United States.*

UAV-America LLC warrants to the original purchaser that all goods sold by UAV-America LLC will be free from material defects at the time of delivery to the original owner only. Upon purchase, the owner shall inspect and test the UAV and related equipment for any defects and the owner must
notify UAV-America LLC in writing of the material defect within thirty days of purchase and delivery and make arrangements for the prompt return of the product to UAV-America.

UAV-America LLC will repair or replace, at its sole option, any defective components of its unmanned aerial vehicle that were defective at time of delivery and that are discovered and reported to UAV-America LLC within the thirty-day period. Repair or replacement is the sole and exclusive remedy for any covered defect. Defects not discovered and reported to UAV-America LLC in writing within the thirty-day period after purchase and delivery are not covered by any UAV-America LLC warranty. Damage caused during use of the unmanned aerial vehicle is not covered by this warranty. **Other than for this limited warranty and limited remedy, UAV-America LLC sells the products “as is.”**

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**THE OWNER SHOULD ALSO REFER TO AND COMPLY WITH ANY SEPARATE WARRANTY, IF ANY, OF THE MANUFACTURER OF ANY COMPONENT (for example, cameras, camcorders etc.) as, in some cases, that manufacturer’s warranty may exceed the UAV-America LLC warranty or remedy.**

The owner and operator assume all risk and liability for loss, damage or injury to themselves, their property (including but not limited to the unmanned aerial vehicle itself and any payload) and to others and their property arising out of the use or misuse or inability to use the product sold by UAV-America LLC.

Note that although UAV-America LLC may voluntarily provide technical assistance via telephone, email or website. This assistance does not equate to or imply any warranty.
Some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages and so, the above limitations or exclusions may not apply to you. This warranty gives you specific rights and you may have other rights that vary from state to state.

To obtain warranty service, contact UAV-America LLC at:

240 Stage Road
Nottingham, NH 03290
603-389-6364
support@uavamerica.com
Thank you for your purchase of the Eagle XF UAS. The Eagle XF is manufactured and built in the United States by UAV-America. The fully autonomous Eagle XF is designed to meet the needs of professionals using UAS to solve real world aerial imagery challenges: infrastructure inspection, surveillance, mapping, surveying, precision agriculture, cinematography, photography and a range of other commercial applications. What separates the Eagle from other UAS?

- Long Flight Times - up to 60 minutes
- The Toughest Lightest Frame Available
- Uses Common 6 Cell Batteries
- Extremely Compact When Folded
- Accepts Most Common Gimbals
- High Level of Customer Support and Training
- Early Adopter Program Protects Your Investment
- Made in the U.S.A.

The Eagle XF Operations and Maintenance manual was produced by UAV-America, LLC. and contains information on the system and related subsystems as well as the procedures required for safe and effective operations. The information provided is intended to impart knowledge of the system characteristics as well as normal and emergency procedures. However, it is not a substitute for sound judgment. Situations affecting the lives and property of others may require deviation from the enclosed procedures.

The instructions and diagrams provided in this manual have been written specifically for personnel who have received training in the operation and maintenance of the Eagle XF UAS. This manual documents only those operations and/or procedures that will be routinely performed by experienced personnel under normal conditions. Owners and Operators are encouraged to read this manual cover to cover to ensure they have a detailed understanding of the contents. Unusual operations or non-standard configurations are prohibited.

UAV-AMERICA CUSTOMER SERVICE

240 Stage Road, Building 2
Nottingham, NH 0329
603-389-6364
Recommended changes to this manual shall be forwarded to UAV-America Customer Service at the following address:

support@uavamerica.com
240 Stage Road, Building 2
Nottingham, NH 03290
603-389-6364

UAV-America will evaluate recommended changes to determine if an immediate revision is required. Depending on the required change, immediate revisions may be transmitted to the Owner/Operator in the form of directions for “pen and ink” changes or electronic full-page replacements.

All change recommendations that are determined not to be immediate in nature will be considered during the routine periodic revision process.

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<td>January 4, 2016</td>
<td>Basic Issue</td>
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Within this manual, the following definitions are used:

**WARNING**

An operating procedure, or practice, which if not correctly followed, could result in personal injury or loss of life.

**CAUTION**

An operating procedure, or practice, which if not strictly observed, could result in damage or destruction of equipment.

**NOTE**

An operating procedure, practice, condition, etc., which is deemed essential to highlight.

The word “Shall” is used to indicate a mandatory requirement. The words “Should” and “May” are used to indicate non-mandatory but preferred methods of accomplishment. The word “Will” is used to express a declaration of purpose.
<table>
<thead>
<tr>
<th>Abbreviation</th>
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<td>AV</td>
<td>Air Vehicle</td>
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<td>ATC</td>
<td>Air Traffic Control</td>
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<tr>
<td>C2</td>
<td>Command and Control</td>
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<tr>
<td>COA</td>
<td>Certification of Waiver or Authorization</td>
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<tr>
<td>CG</td>
<td>Center of Gravity</td>
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<tr>
<td>EO/IR</td>
<td>Electro-Optic/Infrared</td>
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<td>FAA</td>
<td>Federal Aviation Administration</td>
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<tr>
<td>FBWA</td>
<td>Fly-By-Wire-A</td>
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<tr>
<td>GCS</td>
<td>Ground Control Station</td>
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<tr>
<td>GHz</td>
<td>Gigahertz</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<td>HDOP</td>
<td>Horizontal Dilution of Precision</td>
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<td>KTS</td>
<td>Knots</td>
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<tr>
<td>LiPo</td>
<td>Lithium Polymer (battery)</td>
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<td>LRU</td>
<td>Line Replaceable Unit</td>
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<tr>
<td>MHz</td>
<td>Megahertz</td>
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<td>MPH</td>
<td>Miles Per Hour</td>
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<td>MSL</td>
<td>Mean Sea Level</td>
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<td>NOTAM</td>
<td>Notice to Airmen</td>
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<td>OAT</td>
<td>Outside Air Temperature</td>
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<tr>
<td>OEM</td>
<td>Original Equipment Manufacturer</td>
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<tr>
<td>PIC</td>
<td>Pilot In Command</td>
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<td>PPE</td>
<td>Personal Protective Equipment</td>
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<td>PS</td>
<td>Payload Specialist</td>
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<td>R/C</td>
<td>Remote Control</td>
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<tr>
<td>RSSI</td>
<td>Received Signal Strength Indicator</td>
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<td>SE</td>
<td>Support Equipment</td>
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<td>UAS</td>
<td>Unmanned Aircraft System</td>
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CHAPTER I
GENERAL DESCRIPTION

1.0 Eagle XF Unmanned Aircraft System

The Eagle XF UAS manufactured by UAV-America is comprised of three major subsystems; The Air Vehicle (AV), a Command and Control System (CCS), and Support Equipment (SE) as described in figure 1. Each of these major subsystems is described in the chapters of Section I.
AIR VEHICLE (AV)

- Airframe center core
- Removable top cover
- Center frame joining bolts
- Arm hinges and removable pins
- 4 arms (motor mounts)
- Battery door
- Avionics rack
- Fixed or optional retractable landing gear
- Propulsion
- Electronic Speed Controller
- Electric Motor (x4)
- Propeller (x4)
- Flight Controls
- Pixhawk Autopilot
- Electrical System
- Power Connectors
- LiPo Batteries (x2)
- Wire Harness
- Battery Eliminator Circuit (power distribution)
- AV Antennas
- Optional Payloads (Grimsey H3 or other)

COMMAND & CONTROL SYSTEM (CCS)

- UAS Crew
- Ground Control Station (GCS)
- Mission Planning Software (Mission Planner)
- Futaba 14SGH 2.4 GHz Transmitter
- Command and Control Radios and antennas
- Telemetry Radios and antennas
- Optional equipment
  - Laptop
  - Power Supply
  - Dragonlink LRS 433 MHz long range control
  - HD Video downlink (CONNEX)
  - 5.8 GHz Video (HD)
  - 1.2 GHz or 5.8 GHz video (SD)
  - Communications (ICS if used)

RECOMMENDED SUPPORT EQUIPMENT (SE)

- Battery Charger (included with Eagle XF)
- Battery tester (included with Eagle XF)
- Optional/Customer-provided equipment
  - Generator (if required)
  - Battery Backup
  - USB sticks/Drives for Data XFER
  - Maintenance Equipment and tools
  - Personal Protection Equipment (PPE)
  - First Aid Kit
  - Fire Extinguisher

Figure 1 – EAGLE XF UAS Systems Summary
CHAPTER 2
AIR VEHICLE

2.0 Dimensions and Specifications

Air Vehicle
Type .................................................................................................................. Multi-Rotor
Diameter (AV without propellers installed) ................................................. 43.5 in.
Diameter (from propeller tip to propeller tip) ............................................. 71 in.
Height ........................................... 19.5in fixed gear or optional 28 in with retractable gear

Standard Empty Weight .............................................................................. 10.5 lbs.
Battery Weight .............................................................................................. 8.5 lbs.
Maximum Takeoff/Landing Weight ........................................................... 26.5 lbs.
Maximum Payload Weight (with Battery) .................................................. 7.5 lbs.

Autopilot ........................................................................................................... Pixhawk w/APM Copter V3.4.1
Propulsion ...................................................................................................... Electric, Multi-Rotor
Number of Motors .......................................................................................... 4
Motor Manufacturer/Model .............................................................................. KDE Direct / 7208
RPM/Volt .......................................................................................................... 110 KV
Propeller Manufacturer .................................................................................. KDE Direct
Propeller Model ............................................................................................. 27.5x8.9 (2 or 3 blade)
Propeller Type ............................................................................................... Folding foam filled carbon fiber
Battery ............................................................................................................... (2x) 22,000 mAh

Ground Control Station
Mission Planning Software .............................................................................. Mission Planner
Power Requirements .......................................................................................... 5VDC via USB port
Autopilot .......................................................................................................... Pixhawk w/APM Copter V3.4.1
Recommended Mission Computer ................................................................. Windows PC Or Android tablet w/OTG compatible USB port
Support Equipment

Battery Charger

Manufacturer............................................................................. Hyperion 720i duo
Power Required......................................................................................1200 W
Input Voltage....................................................................................... 110-240 VAC
Charge Rate ..............................................................................................1 C – 22 A

2.1 Air Vehicle (AV)

The Eagle XF is an extended endurance, molded carbon fiber, Ready-To-Fly (RTF) UAS that quickly and easily folds into a small footprint for storage, travel or shipping. The molded carbon fiber frame with stainless hardware is stronger and lighter than most other frames and designed with less hardware to keep weight down and flight time up. The frame integrates the AV’s propulsion, electrical, communications, and guidance components (figure 2). The fixed or optional retractable gear allow the camera payload to provide 30-degree or complete 360-degree unobstructed camera view. Numerous common gimbals and mounts are easily installed with pre-drilled access points. AV assembly is easily accomplished in minutes using the assembly procedures in chapter 10 of this manual.

Figure 2 – Major components of the Eagle XF UAS
2.2 Propulsion

The Eagle XF propulsion system has three primary elements: the electric motors, propellers, and speed controllers. These components operate using power from the onboard Lithium Polymer (LiPo) batteries to provide power for flight. The motors used on the Eagle XF are brushless electric KDE 7208 motors (figure 3).

**CAUTION**

The magnets in the motor attract ferrous materials and objects. Crews must be careful to prevent the motor from ingesting objects that can obstruct operation or short-circuit the electrical windings in the motor. Keep ferrous metal objects away from the motor and carefully inspect it prior to operation by rotating to check for roughness or binding.

The LiPo batteries provide power to the motors through Electronic Speed Controllers (ESCs) (figure 4) mounted in the AV housing.

![Figure 3 – KDE Electric Motor](image)

![Figure 4 – Castle Creations Phoenix edge lite HV 80A](image)
Throttle requests and commands from the flight control system send signals to the ESC’s to regulate the speeds of the four motors to maneuver the AV. The ESCs and motors are considered non-repairable and should be replaced if electrical problems are experienced. The propellers on the Eagle XF are two-bladed KDE 27.5 x 8.9 carbon fiber propellers (figure 5). This propeller-motor combination has been selected for its ability to provide the best performance under normal operating conditions. Modifications or replacements with similar parts is not recommended.

**WARNING**

The propeller operates at high speed and can inflict serious injury to anyone coming in contact. Propellers are subject to catastrophic failure. When this happens, debris can be propelled outward in the plane of the propeller arc. Operators and bystanders must keep clear of this area at all times. Always wear protective eye-wear when working around moving propellers since debris may be blown into the air. The propeller must be maintained in excellent operating condition, and be properly installed. Chips and nicks in the propeller may cause an imbalance that can lead to vibration and failure of on-board systems. If in doubt, replace a damaged propeller.

### 2.3 Flight Controller

The Eagle XF uses the Pixhawk APM Flight Controller. Other flight controller options are available based on the mission needs of the customer.
2.3.1 Pixhawk

The Pixhawk flight controller (figure 6) is an advanced autopilot designed by the PX4 open-hardware project. When coupled with the Mission Planner software, the Pixhawk provides advanced mission planning capability and fully autonomous operations. The Pixhawk is securely housed and protected in the equipment rack and includes an integrated microSD card for long-time high-rate logging.

**NOTE:**

**Operators must be thoroughly trained in the proper use of the Eagle XF operating system prior to undertaking any flights with the UAS.**

2.4 Electrical System

The Eagle XF electrical system consists of a LiPo battery, power distribution board, wiring harness and Avionics Rack (figure 7). Components are positioned in the main body of the AV with proper shielding where required to prevent interference. No changes to these components or their location is permitted.
2.4.1 Battery
Two 22,000 mAh LiPo batteries are used to power the Eagle XF (figure 8a). The batteries are housed in the integral battery tray on the AV and connected to the AV’s electrical system using a XT90S connector. The battery connectors include an anti-spark feature to protect against sudden power surges that could potentially damage the ESCs. Easy access to the batteries for charging and replacement is achieved through the integrated battery tray and access hatch (figure 8b).

The following battery voltages are used when operating the Eagle XF:

- 50.4 V – Fully Charged
- 43.2 V – Return to Land Voltage
- 40.8 V – Minimum Voltage at Hover

2.5 Antennas
The Eagle XF is equipped with; a 2.4 GHz antenna for command and control communications, 900 MHz antenna for telemetry, GPS antenna for the onboard navigation system (figure 9), and an optional 5 GHz antenna for the CONNEX video transmitter. Antennas are
pre-tuned to the required frequencies and connected to the respective components using shielded cables. Ground planes are positioned where needed to improve performance. Placement of the antennas is based on extensive testing by UAV America to provide the best reception and to minimize interference with other components. Relocation of the antennas can dramatically reduce performance therefore is not recommended.

2.6 Optional Payloads

The Eagle XF is offered with various payload options based on the customer’s required mission. Figure 10 shows the Eagle XF with the Optional Gremsy H3 gimbal and Sony NEX5 camera. Other payload options include:

- Gremsy H3 or H6 Gimbal
- Sony AX100 Camcorder or other Optical Imaging Camera
- FLIR VUE PRO or other multispectral or thermal/IR Sensor
Chapter 3 GROUND CONTROL STATIONS

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CHAPTER 3
GROUND CONTROL STATIONS

3.0 General Description of the Ground Control Station (GCS)

The Eagle XF GCS (figure 11) provides the user with command and control, mission planning, payload control, and real time video. UAV America recommends a Windows 7 or above equipped laptop computer, or android tablet for use as a GCS with the Eagle XF.

3.1 R/C Transmitter

The Eagle XF is provided with a 2.4 GHz Futaba 14SG hand-held R/C Transmitter (figure 12) to supplement the Flight Control System’s fully autonomous operating modes. The Futaba R/C transmitter is referred to simply as a “Transmitter” throughout this manual. The Flight Control System allows the operator to change between automated, manual, and Fly-By-Wire-A (FBWA) operation. This enables a trained operator to fly the system in the FBWA mode using the Transmitter. Only operators proficient in “R/C” flight should control the AV in the FBWA and manual mode.

3.2 Communications

GCS communications can be separated into Command and Control (C2) and Datalink communications. Hardware for these two subsystems consists of antennas, software, and equipment/cables.
3.2.1 Command and Control (C2) Communications

GCS Command and Control hardware consists of the antennas and communication equipment necessary to provide the Operator with the link required to maneuver and control the AV. C2 for the Eagle XF is accomplished using a 2.4 GHz link.

3.2.2 Telemetry and Video Downlink Communications

Datalink communications for the Eagle XF are provided by the 900 MHz telemetry radio, and the optional CONNEX wireless HD system (figure 13) which was designed for use under harsh conditions with minimal latency.

![Figure 13 – Optional CONNEX wireless HD system – GCS components](image)

The CONNEX transmits HD photos and video from the AV to the GCS on a 5.8 GHz digital link. The CONNEX system provides the following features:

- True 1080P HD at 60 fps
- Up to 1,000-meter range (line of sight)
- Automatic Frequency Selection (AFS)
- Encrypted and secure datalink
• Built-in OSD view with embedded MAVLink-based telemetry
• Gimbal control using a second Futaba Transmitter
• The AV portion of the CONNEX system includes two video downlink antennas (figure 14) to communicate to the GCS.

Figure 14 – CONNEX Video Downlink antenna (one of two shown)

3.3 Mission Planning

Effective planning is critical to achieving mission success. Mission planning with the Eagle XF UAS is accomplished through the Flight Control System via the GCS. This allows the Operator to define mission parameters including waypoints and route planning. Procedures for Mission Planning are provided in Chapter 11 of this manual.
CHAPTER 4
SUPPORT EQUIPMENT

4.0 Generator and Battery Backup

When power is not available, the generator is used to provide 120 VAC power to the GCS and other equipment. A gasoline-powered generator capable of producing at least 2000 W or an equivalent power inverter powered from 12 V batteries is optional to support the Eagle XF UAS.

4.1 Maintenance Equipment

A list of recommended maintenance equipment is provided in the Field Packing Checklist located in Chapter 15 of this manual.

4.1.1 Battery Tester or Multimeter

A Battery Tester (provided and shown in figure 15) or multimeter is required to check battery voltage prior to each flight.

![Figure 15 – Battery Tester connected to battery](image-url)
4.1.2 LiPo Battery Charger

The Hyperion 0720i Dual Battery Charger and external power supply is provided with the Eagle XF UAS (figure 16). The DC multi charging station includes a professional-grade balance charger and discharger. Directions for this battery charger are provided in the charger manual listed in Chapter 14.

Figure 16 – Dual Battery Charger included with the Eagle XF
CHAPTER 5
PERFORMANCE

Typical Operating Altitude ........................................................... 40 – 400 ft AGL
Recommended Min Alt for Extended Operations ....................... 200 ft AGL
Endurance ...................................................................................... 40-65 minutes
Transit Speed ................................................................................ 30 KTS
Radio range ................................................................................... up to 2 miles
(extended control available up to 10 miles)
CHAPTER 6
LIMITATIONS

Maximum Winds for GPS-dependent Operations ................................... 15 KTS (measured at ground level)

Temperature Limitations for Operations ......................................... 20 to 102 °F (measured at ground level)

Precipitation ............................................................................. Light fog and snow

Icing ...................................................................................... Flight into known icing conditions prohibited
CHAPTER 7
CREW REQUIREMENTS

7.0 Introduction

This chapter identifies the minimum requirements for training, qualification and currency of the Eagle XF UAS Crew.

7.1 UAS Crew Designations

FAA Notice 8900 (series) “UAS Operational Approval” provides the policies required for reviewing and evaluating the safety of UAS flight operations in the National Airspace System (NAS) and uses the titles of PIC and VO for UAS Operators. This manual for the Eagle XF UAS uses the same titles but it is recognized that some operations will occur outside of the NAS (e.g. segregated airspace). The minimum crew requirement for Eagle XF operations in the NAS is a Pilot in Command and a Visual Observer.

1. Pilot In Command (PIC)
2. Visual Observer (VO)
3. Payload Specialist (PS) - optional

For operations requiring dedicated/extended use of the payload/sensors, it is recommended that a Payload Specialist be added to assist the PIC. Depending on qualifications, the PS can oftentimes fill the role of a Maintenance Technician.

The following position descriptions are for reference only. Owner/Operators are responsible for ensuring compliance with applicable regulations.

7.1.1 Pilot in Command (PIC)

The PIC operates the UAS and ensures compliance with regulations and product specifications, and has ultimate responsibility for the safety of operations. PICs must be in compliance with FAA requirements. The following list summarizes the general responsibilities of the PIC. This list is not intended to be a comprehensive list of responsibilities. Owner/Operators must consult applicable regulations regarding their specific operations.
• PIC must be designated as PIC before the flight
• PIC is responsible for the UAS flight operations as described under 91.3 or FAA-recognized equivalent
• PIC is responsible for determining whether the UAS is in condition for safe flight.
• PIC must land the AV as soon as safety practical when any condition occurs that causes operations to be unsafe
• PIC may be augmented by supplemental pilots; however, the PIC retains complete and overall responsibility of the flight, regardless of who may be piloting the AV.
• PIC must have a thorough knowledge of the Certification of Authorization (COA) issued to the organization and must retain a copy to reference during flight.
• PIC must be trained and qualified on the specific UAS for the conduct of the flight.

7.1.2 Visual Observer (VO)

The VO may be positioned on the ground or in a dedicated chase aircraft but in any case must be in a position to provide assistance to the PIC to exercise the see-and-avoid responsibilities required by 91.111, 91.113 and 91.115 by constantly scanning the area around the AV for potential traffic conflicts. Additionally, the VO assists the PIC with navigational and situational awareness.

NOTE

Owner/Operators are required to comply with applicable regulations governing the use and operation of the UAS.

Figure 17 summarizes the crew certification and training requirements for the Eagle XF UAS.
Table: Crew Certification and Training Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Pilot in Command (PIC)</th>
<th>Visual Observer (VO)</th>
</tr>
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<tbody>
<tr>
<td>Designated in writing</td>
<td>X</td>
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<tr>
<td>Pilot Certificate (Note 1)</td>
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<td>Medical (Note 2)</td>
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<td>X</td>
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<tr>
<td>Currency</td>
<td>3 launches and recoveries within past 90 days</td>
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<tr>
<td>Specific training and testing in Eagle XF UAS operations</td>
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<td>X</td>
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<tr>
<td>FAA training (see FAA 8900 series) (Note 3)</td>
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</table>

Notes:

1. Owner/Operator is responsible for compliance with operational regulations.
2. Operations under an FAA approved “333 Exemption” currently permits a driver’s license or Class II Medical to satisfy the medical requirements for the PIC and does not require a medical for the Visual Observer.
3. FAA training requirements for the PIC are more stringent than for the VO; however, the VO is responsible for knowledge of the 14 CFR 91 including air traffic communications and the appropriate sections of the Aeronautical Information Manual (AIM).
SECTION IV - NORMAL PROCEDURES

CHAPTER 8
SAFETY

8.0 General Safety Requirements

The following are general safety requirements that are not related to a specific procedure, and therefore do not appear elsewhere in this publication. These are precautions that personnel must understand and apply during all applicable phases of Eagle XF system operation and maintenance activities. Personnel shall thoroughly understand and recognize all hazards associated with operating and maintaining the Eagle XF system, at all times. Personnel operating or maintaining the Eagle XF system covered by this manual shall become thoroughly familiar with all safety and accident precautions contained in this section.

**WARNING**

SAFETY REQUIREMENTS SHALL BE COMPLIED WITH AT ALL TIMES. THE SAFETY REQUIREMENTS IN THIS MANUAL ARE NOT A SUBSTITUTE FOR SOUND JUDGMENT BY THE OPERATOR/MAINTAINER. DILIGENCE BY OPERATOR/MAINTAINER PERSONNEL AND CONSCIENTIOUS APPLICATION OF SAFETY PROCEDURES ARE ESSENTIAL TO ENSURE PREVENTION OF INJURY OR DEATH, AND TO ENSURE PROPER OPERATION OF THE EAGLE XF.

8.1 Tools and Equipment

The Eagle XF system has been designed to utilize ordinary tools wherever possible. However, certain subsystems and/or maintenance procedures may require the use of specialized equipment items. Use of improper tools for these applications may result in injury to personnel or damage to system equipment. A substitute item may be used in place of any common tool if the use does not degrade the condition and reliability of the material or safety of operation.

8.2 Battery Safety

When properly stored, used, and maintained, the high energy and density (amp-hours/weight ratio) of LiPo batteries makes them a better choice over the alternatives. However, with improved performance comes a need to treat them with care to prevent fires that could cause personal injury...
and property damage.

8.2.1 Inspection prior to Charging or Discharging a LiPo Battery

1. Inspect the battery for damage. Damage could include physical damage (cuts, deformation, etc.), swelling, fluid leaks. DO NOT CHARGE A DAMAGED, SWOLLEN, OR LEAKING BATTERY.

2. Measure the voltage of each battery cell (when multiple cells installed). If the cell voltage is significantly lower than the normal voltage (3.3 V per cell) or there is a significant difference in voltages amongst cells (more than 0.1 volts), the battery may be defective. DO NOT CHARGE THE BATTERY.

3. Ensure wire connection polarity is correct to avoid short circuiting the battery.

4. Verify the LiPo charger is in good condition.

8.2.2 Handling, Charging and Discharging the Battery

**WARNING**

Exercise caution when handling the LiPo Battery. Failure to follow battery handling, charging/discharging, and storage procedures may cause a fire which could result in serious personal injury and property damage.

**WARNING**

Do not allow fluids from a leaking battery to get into eyes or on skin. Wash affected areas immediately.

1. Use an appropriate container for housing the battery during charge such as a fireproof cement container.

2. Use only the charger supplied with the Eagle XF UAS or one approved by UAV-America.

3. Put the charger on concrete floor.
4. Place charger and battery at least 5 feet horizontally and 10 feet vertically from other objects.

5. Keep combustibles (including generator when used) at least 10 feet from charging operation.

6. When possible, cover the charging container with a fireproof cover.

7. The charging rate should not exceed 1 C (one times the capacity of the battery. For example, charge a 22000 mAh battery at or below 22 A. Excessive charging rates may damage the battery and cause a fire.

8. Never leave charging operation unattended.

9. If battery starts to swell or balloon during the charging or discharging process, discontinue the charging/discharging process immediately. Disconnect the battery from the charger and place in a safe observation area for approximately 30 minutes.

10. In case of fire, unplug the charger immediately.

8.2.3 Battery Storage

1. Use a fireproof cement storage container to store the batteries when not in use.

2. Put the storage container on a concrete floor.

3. Batteries should be stored at room temperature (40° to 70° F).

4. Ensure batteries are in good condition prior to placing in storage.

5. Cover the storage container with a fireproof material cover.

6. Check the condition of the stored batteries at least once per week.

7. Keep combustible materials away from the storage container.
CHAPTER 9
SITE SELECTION AND PREPARATION

9.0 Site Selection

Proper site selection is critical for safe and proper operation of the Eagle XF. Site selection is normally driven by the range conditions or the area available for operations. The site should be relatively flat terrain and be free of obstacles within a 100 by 100-foot box. Additionally, Operators must consider the influence of obstacles between the Transmitter and the AV.

Consideration must be given to visual observation during critical portions of the operations such as during launch and recovery. Communications for both visual and non-visual flight must be evaluated during site selection. Safety considerations must be evaluated to accommodate emergency operations during normal launch and recovery as well as for contingency conditions.

9.1 Weather

The Operator is required to check current and forecast weather conditions before flying the Eagle XF. The Eagle XF has been tested in winds up to 16 mph but these winds can significantly reduce the performance of the AV. Winds aloft at 1000 feet can be many times the wind speed measured on the ground. In windy conditions, Operators must consider the impact the winds have in returning the UAS to the recovery site. Gimbal performance will be degraded in winds above 6-8 mph. Most multirotors will fly in winds well above this, however the likelihood of a crash increases. Takeoff and landing in windy conditions will require a decisive flying style. Tip over accidents are most common when landing leg is in contact with uneven ground.

9.2 NOTAMS

Current COA requirements state that a Notice to Airmen (NOTAM) must be filed for all UAS flights in the National Airspace System (NAS). NOTAMS can be filed by calling 877-487-6867.
CHAPTER 10
SYSTEM ASSEMBLY AND SETUP

10.0 General Information on System Setup and Preflight

This chapter provides detailed procedures and photos to illustrate the setup and preflight of the Eagle XF. The operational checklist in chapter 15 represents a summary of these procedures.

10.1 Air Vehicle Assembly

1. Remove the AV from case. Unfold and lock each arm into flight position by installing the pin through attachment hole (figure 18). Install landing legs by gently pushing each leg into mount. Leg will “click” into position.

![Figure 18 – Hinge arm shown with locking pin properly installed](image)

2. Unpack GCS and AV radios
3. Unpack CONNEX video receiver and mount to tripod.
4. Mount flight battery to battery tray and secure Velcro straps. Battery wires should face the rear of the craft. Do not connect battery at this point.
5. Preform a nut and bolt check of the motor bolts, arm bolts, frame plate bolts, and landing gear bolts. Verify that all fasteners are in good condition and tight. Loose fasteners should be tightened snug. Any replacement bolts should have Loctite Blue 242 applied sparingly.
6. Inspect propellers to ensure no chips or cracks.

7. Visually inspect the landing gear or optional retract mechanism and tension springs. Check for side-to-side slop in the retract mechanism. Springs must be tensioned evenly.

8. Perform a visual inspection of the motors. Check the end play (up and down play check). Motors with excessive end play should be inspected closely and replaced if bearings are worn.

9. Check propeller fastener torque by checking prop folding resistance. This might take experience to determine the correct stiffness of the propellers. Additionally, check the paint mark on the propeller retaining bolt to be sure it has not loosened (figure 19). If the lines do not match up DO NOT LAUNCH. Bolt must be checked for proper torque before operation. Do not tighten or loosen prop bolts unless appropriate maintenance training has been completed.

10. Check balance on all four arm “pairs”. Fore and aft balance can be adjusted by sliding the battery or gimbal to achieve perfect balance. Max imbalance: 3mm in any direction.

11. Move the AV to the home point.

12. Power up AV by plugging in connector the two connectors. Listen for Pixhawk and ESC startup tones. Keep aircraft absolutely still after plugging in battery while red/blue LED flashes on Pixhawk. While Gyros are initializing, zero movement is critical.

13. Perform a gimbal and camera signal system test. Power up camera and gimbal. Gimbal will initialize, be sure nothing can contact gimbal during initialization. Power up cameraman monitor and CONNEX HD video receiver.

14. Proceed to chapter 11 to prepare the GCS for flight operations.
CHAPTER 11
FLIGHT OPERATIONS

11.0 Launching the Eagle XF

UAV-America provides the Eagle XF with the Pixhawk Flight Controller. In order to operate the system safely, Operators must ensure familiarity with the mission planning software (Mission Planner) and the control modes available.

11.1 Pixhawk Operations with the Eagle XF

The following procedures assume completion of the AV assembly in chapter 10 and that the AV has been powered.

1. Connect to Mission Planner. Note that artificial horizon matches reality. If horizon is not level, perform accelerometer calibration. If still out of level, this indicates a problem with the internal IMU sensor on Pixhawk. Contact UAV America for further instructions.

2. Note battery voltage greater than 25 V for each battery

3. Verify altitude close to zero, and GPS status. GPS status will vary depending on conditions. A GPS HDOP less than 2.0 is recommended for accurate GPS positioning.

4. Cycle the pilot control radio mode switch and verify Mission Planner reports the expected mode for each switch position.

5. Perform a test of the Ground station video Receiver and OSD by verifying video feed on the monitor and that the OSD data matches Mission Planner HUD.

6. The communication connection options are available in the upper right hand corner of the Mission Planner screen (figure 20). Make sure the appropriate comm port is selected and that the baud rate is set to 57600.

7. Verify Arming Button on back of AV is blinking.
8. Verify good link by checking the RSSI lights are solid green and not flashing. If using the optional CONNEX video downlink, verify the link lights are illuminated on both the air and ground receivers.

9. Connect AV to Mission Planner by opening Flight Data Tab and clicking “Connect”. When the ground station has successfully connected, the status of the vehicle will be updated under the “Flight Data” tab on the mission planner in which the HUD will respond to physical pitch, roll and yaw movements of the vehicle (figure 21).

10. Check the link quality in the Link Status Window by selecting the “Link Stats” icon in the Flight Data tab of Mission Planner. The “Quality” percentage should be monitored to ensure that link to the air vehicle is adequate. A value of 100% is equivalent to excellent link status (figure 22).

11. Verify correct heading against a known direction (such as runway heading if operating from an airport) or using a hand-held compass.

12. Check the fail-safes to ensure Low Voltage set at 21.5 V.

13. Perform Preflight Calibration under Flight Data Tab then Actions Tab – Select “Do-Action”.

14. Set Home Point under Flight Plan Tab, then Home Location on bottom right.

15. All mission planning and uploading is performed in the “Flight Plan” tab of mission planner. Care must be taken to ensure that the vehicle’s location displayed on the map is an accurate representation of its location referencing any available physical surroundings...
16. Waypoint missions can be planned by using the waypoints bar located at the bottom of the “Flight Plan” tab. To add waypoints left click on the map. Waypoints can be placed more accurately by clicking and dragging them to where you would like the AV to fly.

17. Waypoint missions can be programmed for altitude and for the AV to perform predetermined tasks by modifying the mission in the “Waypoints” bar (figure 24).

18. WayPoint files can be saved and referenced later by clicking “Save WP File” and specifying a file path.

19. Push the Arming button (figure 25) on the AV and verify the light in the button goes solid.

20. Make sure that the throttle control is down or that the system is set to loiter mode. The AV is now ready for launch.
CHAPTER 12
EMERGENCY PROCEDURES

12.0 Emergency Procedures

Crews operating the Eagle XF UAS must be familiar with the following emergency procedures. These procedures will be taught during initial training.

12.1 General Discussion on Loss of Link

The likelihood of a loss of radio control (loss of link) can be reduced through range check/analysis as part of a thorough preflight. In the event of a loss of link event, after 5 seconds the AV will return to the home point and land.

If all fail-safe features fail, the Air Vehicle should be tracked from the ground and every possible measure taken to keep it in sight until the batteries are depleted and the vehicle lands.

Observer Comes in Contact with Flight Vehicle or Propeller

1. Pilot—immediately terminate flight operations and land/move vehicle to a safe position (depending upon the situation).
2. Disarm the system and disconnect battery.
3. Crew—seek emergency medical attention and provide basic first aid to those in need.

Propeller or Motor Failure During Launch

1. Crew—signal the Pilot to cancel the launch
2. Pilot—If Air Vehicle becomes airborne – Switch to FBWA and land immediately.
Loss of Control of Air Vehicle

1. Pilot—notify all observers of the situation.
2. Crew—move to a safe location away from flight operations and the AV’s flight path.
3. Pilot—attempt to regain control of AV and perform emergency landing.

Lost Link

NOTE:
Lost link procedures must be determined and reviewed as part of the mission planning process. The procedures should be based on airspace restrictions and the surrounding obstacles, terrain, and infrastructure. If communications cannot be established, the vehicle will track to the predetermined landing position.

1. Pilot—monitor Air Vehicle flight path and attempt to regain link to the AV.
2. Crew—contact local law enforcement and local air traffic authorities as necessary.

Loss of GPS

1. Pilot—If the loss of GPS occurs:
   a. Select FBWA mode
   b. Find a suitable/safe area to land if the intended recovery site cannot be made.
3. Pilot—Once recovered, inspect the GPS for faults prior to conducting another flight.
CHAPTER 13
SERVICING AND MAINTENANCE

13.0 Servicing and Maintenance

Maintenance on the Eagle XF is limited to items described in the following sections.

13.1 Air Vehicle

The AV should be inspected before and after each flight to ensure no damage has been sustained. Special attention should be given to the condition of the propellers, motors, electrical connections, and any structural components.

13.2 Batteries

Batteries should be tested for voltage after being charged and immediately prior to launching the AV. If a battery does not properly charge or does not hold sufficient charge, it should be replaced. Check battery packs for damage and dispose of properly (see chapter 8 for more information on battery safety).

13.3 Flight Controls

There are no repairable items within the flight control system. Remove the defective component and replace after consulting with a factory representative from UAV America.

13.4 Maintenance Schedule

The table in figure 26 outlines the maintenance inspection and replacement schedule for the Eagle XF UAS based on Air Vehicle flight hours. If the material condition of any item is ever in question, replace it. Contact UAV-America with any questions or comments.
### Chapter 13 SERVICING AND MAINTENANCE

#### Every Flight
- Preflight Inspection: Refer to Preflight Checklist
- Propellers: Inspect for damage, replace blades as required
- Propeller Blade Screws: Check propeller for proper resistance and paint marks are aligned
- Motor (Inspection): Check mounting screws and bearing play
- Motor (Replacement): Replace motor
- ESC (Inspection): Check connections, inspect wiring harness
- ESC (Replacement): Replace ESC
- Flight Battery: Cycle battery, replace if capacity is below 80%
- Flight Battery (Replacement): Replace battery pack

---

#### 13.5 Pixhawk Color Codes and Safety Switch Indications

The status of the Pixhawk is determined using both audio and light signals. Below is a list of the various patterns:

- **Flash Red and Blue**: initializing. Do not move AV while gyros initializing.
- **Double Flashing Yellow**: error. System refuses to arm - connect to Mission Planner to see error.
- **Flash Blue**: disarmed, searching for GPS. Autopilot, loiter, and return to launch modes require GPS lock.
- **Flash Green**: Disarmed, GPS lock acquired. Ready to arm.
• **Solid Green** - Armed with GPS lock. Ready to fly.
• **Flashing Yellow** - RC failsafe activated.
• **Flashing Yellow** - Battery failsafe activated.
• **Flashing Yellow and Blue** - GPS glitch or GPS failsafe activated.

Pixhawk safety switch indications (Red LED)

• **Quick, Constant Blinking**: performing system check. Please wait.
• **Intermittent Blinking**: system ready. Press the safety button to activate.
• **Solid**: ready to arm. Proceed to the arming procedure.
CHAPTER 14
SUPPLEMENTS

14.0 Supplements

The following publications are required OEM supplements to the Eagle XF UAS Operations and Maintenance Manual. Portions of the supplements may be included in the preceding chapters, however the owner/operator must reference the OEM supplements for details regarding equipment use.

1. Pixhawk quick start guide
2. Futaba 14SGH Instruction Manual
3. Hyperion 0720i Dual Battery Charger Manual
4. CONNEX User Guide
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CHAPTER 15
CHECKLISTS AND FORMS

15.0 Use of the Appropriate Checklists

The checklists provided in this chapter are recommended to be used by the Owner/Operator in operating and maintaining the Eagle XF UAS.

1. **Field Packing List** – This list is used to ensure all items needed for operations are included prior to heading to the field. UAV-America recommends that the Owner/Operator customize this checklist to include additional items specific to their operation.

2. **Eagle XF UAS Abbreviated Checklist**.

3. **Fight Hour Log** – used to document flight times on a specific UAS to support periodic maintenance.

4. **Maintenance Logbook** – used to document scheduled and unscheduled maintenance on the system including preflight inspections.
Chapter 15 CHECKLISTS AND FORMS

FIELD PACKING LIST

**Eagle XF UAS**
- Eagle XF User Manual
- Eagle XF AV
- Camera/Payload
- QTY 4 Propellers
- GCS Laptop
- Ground Control Station (GCS)
- GCS Antennas, cables, etc.
- Futaba Transmitter
- Camera/Payload
- Additional Batteries
- Spare Hardware
- Spare components (ESCs, motors, etc.)
- Antennas

**Support Equipment**
- Battery Charger
- Battery Tester or Voltmeter
- Generator or backup power source
- Fuel for Generator
- Antenna Tripod
- Pixhawk Micro USB cord
- Personal Protective Equipment (PPE)
- Table and chairs
- Fire Extinguisher
- Extension cords
- Power Strips
- Tools and repair items

**Personal Items**
- First Aid Kit
- Safety Glasses
- Water and food
- Bug spray and sun lotion
Preflight Checklist
- NOTAM Filed?
- Check NOTAMS
- Check Weather and winds aloft
- Check Solar Flare (CME) activity for impact on GPS
- Assemble AV and check for balance
- Mount CONNEX receiver to tripod
- Check voltage of flight batteries and Transmitter
- Install batteries in AV but do not connect power
- Check that all bolts, pins, and screws are secure
- Inspect propellers for damage and verify security

Takeoff Checklist
- Connect battery power to AV
- Cameras on, charged, and gimbal operation checked
- Verify video downlink
- Verify Flight battery voltage
- Mission uploaded and waypoint altitudes and obstructions verified
- Timer set for less than 80% max battery capacity.
- Select desired flight mode. If GPS HDOP below 2.0 you can take off in Pos Hold. Otherwise it is recommended to take off in stabilize or alt hold.
- Clear the flight area. Bystanders and obstacles should be at least 100 feet away.
- Press and hold safety button until ESCs arm (they will stop beeping)
- Loudly announce your intentions to take off.
- Arm the craft and slightly increase throttle. Note propeller RPM, noise or anything out of the ordinary. STOP and DISARM if anything out of the ordinary noted.
- Takeoff into the wind and be ready to correct for wind related turbulence.
- Increase throttle to 100% and climb to your desired altitude. Reducing the throttle after takeoff will make for a more efficient climb. Getting away from the ground and out of ground effect is critical, take off decisively.

Post Flight Checklist
- Disarm
- Carefully press safety button until ESCs beep and safety button flashes red
- Unplug both flight batteries
- Turn off Gimbal
- Turn off Monitor
- Stow aircraft and associated equipment
UAS Model: ____________________________________________________________
System ID/Serial Number: _____________________________________________

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**General Description**

**Performance & Limitations**

**Crew Requirements**

**Normal Procedures**

**Emergency Procedures**

**Servicing & Maintenance**

**Supplements & Checklists**
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