December 31, 2014

U. S. Department of Transportation
Docket Management System
1200 New Jersey Ave.,
SE Washington, DC 20590

Subject: Exemption Request Section 333 of the FAA Reform Act and Part 11 of the Federal Aviation Regulations from 14 C.F.R. Part 21, 45.27(a), 45.29 (3) (c)(d)(e)(f)(g)(h), 61.113 (a) & (b), 91.103, 91.119, 91.121, 91.203, 91.151

Dear Sir/Madam:

Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 and 14 C.F.R. Part 11, I, Mark Ingle, would like to apply for an exemption from the following Code of Federal Regulations (C.F.R) to allow commercial operation of lightweight Unmanned Aircraft Systems (sUAS) for aerial imaging, video, and surveillance. This video and image data will be used for survey analysis, safety and/or damage inspection, aerial photography, as well as search and rescue. These are services that will be offered and safely executed to various clients or industries with these types of needs. The operations of the service(s) will only be carried out with the proper approval from property owners and any other agencies requiring approval. Safety will be top priority before, during, and after operations of the services. Described herein, along with request for exemption, are details on how my operations will be equal to, or more safe than use of traditional rotorcraft.

Part of my request, herein, for exemption will contain technical terms and components that make up the typical sUAS. These terms and definitions can be found at the end of this petition under the section *Terms and Definitions.*

My name and address:

Mark Ingle
325 Sand Paver Way
Fort Mill, South Carolina 29708
Cell Phone: 803.412.1958

I am requesting exemption from the following CFRs

14 C.F.R. Part 21 Subpart H
14 C.F.R. 45.27(a)
14 C.F.R. 45.29 (3) (c)(d)(e)(f)(g)(h)
14 C.F.R. 61.113 (a) & (b)
14 C.F.R. 91.103
14 C.F.R. 91.119

14 C.F.R. 91.121
14 C.F.R. 91.203
14 C.F.R 91.151

C.F.R. REGULATIONS - REQUEST SPECIFIC EXEMPTION.

14 C.F.R. Part 21, Subpart H: Airworthiness Certificates 14 CFR § 91.203

Due to the length and number of regulation with Part 21 Subpart H I am not listing all of the text but affirming that I have read all of the regulations in preparation for the request below.

I seek to request exemption from 14 C.F.R. Part 21, Subpart H Airworthiness Certificates 14 CFR to the extent of not requiring a traditional airworthiness certificate for the operation of a sUAS. The reason I am requesting the exemption is due to the fact the Form 8130-6 does not support applicable entry to provide data about my sUAS and is not applicable to sUAS characteristics. The information requested is based on a typical aircraft. The mechanical, electronic, and capacity characteristics for a sUAS are very different from a typical aircraft made for passenger or cargo transportation. As such, the current qualification process for the airworthiness certificate does not make sense at this time. Once a form or process is available to support sUAS airworthiness, I will be more than happy to submit one for processing and inspection of sUAS. I also encourage the FAA to develop an airworthiness certification process for sUAS. Until a formal FAA process is in place, the petitioner and pilot will follow the processes and procedures described herein to obtain the same level of safety expected under the current regulation of Part 21 Subpart H.

In addition, the proposed multi-rotor vehicle was built by the petitioner using proven parts available from the sUAV market. The sUAS weight is limited to 2.1Kg and the size is limited to 650mm. The sUAS maximum flight speed is 25 mph. In the event of communication failure, the sUAS will return to home position (established before flight). In the event of catastrophic failure, the onboard parachute will be deployed by pilot in command. The sUAS will be operated in an approved restricted environment under safety procedures described later in this petition. Because of the small size this sUAS is safer than the typical rotorcraft.

For 91.203, there is no cockpit or cabin, and a sUAS does not run on fuel. I would like to be exempt from all of 91.203 as well since this regulation is not applicable to a sUAS. However the intent of 91.203 is applicable to sUAS to the extent of proving airworthiness for battery, frame, and motor components. For this reason, recorded logs for sUAS inspection will always be in possession of the pilot in command. The operations of my sUAS will have a battery maintenance plan and a rotation plan along with current battery telemetry information provided to the pilot. Also any

documents that are required in the future will be with the sUAV pilot operating the sUAS.

14 C.F.R. 45.27(a): Location of marks; non fixed-wing aircraft.

1. *Rotorcraft.* Each operator of a rotorcraft must display on that rotorcraft horizontally on both surfaces of the cabin, fuselage, boom, or tail the marks required by §45.23.

I request exemption from 14 CFR 45.27 (a) to the extent of not following this regulation since it is applicable to a typical aircraft. There is no fuselage, cabin, or boom on a multi-rotor sUAS. However the intent of assigning a unique identifier to a sUAS for the purposes of country and owner identification will be followed. The unique ID will be the owner's phone number until further direction from the FAA.

14 C.F.R. 45.29 (3) (c)(d)(e)(f)(h): Size of Marks

(3) *Rotorcraft,* must be at least 12 inches high, except that rotorcraft displaying before April 18, 1983, marks required by §45.29(b)(3) in effect on April 17, 1983, and rotorcraft manufactured on or after April 18, 1983, but before December 31, 1983, may display those marks until the aircraft is repainted or the marks are repainted, restored, or changed.

(c) Width. Characters must be two-thirds as wide as they are high, except the number "1", which must be one-sixth as wide as it is high, and the letters "M" and "W" which may be as wide as they are high.

(d) Thickness. Characters must be formed by solid lines one-sixth as thick as the character is high.

(e) Spacing. The space between each character may not be less than one-fourth of the character width.

(f) If either one of the surfaces authorized for displaying required marks under §45.25 is large enough for display of marks meeting the size requirements of this section and the other is not, full size marks must be placed on the larger surface. If neither surface is large enough for full-size marks, marks as large as practicable must be displayed on the larger of the two surfaces. If no surface authorized to be marked by §45.27 is large enough for full-size marks, marks as large as practicable must be placed on the largest of the authorized surfaces. However, powered parachutes and weight-shift-control aircraft must display marks at least 3 inches high.

(h) After March 7, 1988, each operator of an aircraft penetrating an ADIZ or DEWIZ must display on that aircraft temporary or permanent nationality and registration marks at least 12 inches high.

I request exemption from 14 CFR 45.29 (3) (c))(d)(e)(f)(g)(h) to the extent of not requiring identification marks of 12 inches and applicable width, spacing, and thickness. Identification (phone number or FAA unique ID requirement) will be displayed on the motor arms of all multi-rotor sUAS as large as possible without effecting performance of the sUAS. A rough estimate would be about ¾ inch font.

14 CFR 61.113 (a) & (b): Private pilot privileges and limitations: Pilot in command.

(a) Except as provided in paragraphs (b) through (h) of this section, no person who holds a private pilot certificate may act as pilot in command of an aircraft that is carrying passengers or property for compensation or hire; nor may that person, for compensation or hire, act as pilot in command of an aircraft.

(b) A private pilot may, for compensation or hire, act as pilot in command of an aircraft in connection with any business or employment if:

(1) The flight is only incidental to that business or employment; and

(2) The aircraft does not carry passengers or property for compensation or hire.

(c) A private pilot may not pay less than the pro rata share of the operating expenses of a flight with passengers, provided the expenses involve only fuel, oil, airport expenditures, or rental fees.

I request exemption from 14 CFR 61.113 (a) to the extent of not requiring a pilot's certificate at this time to operate a sUAS as pilot in command. I request the acceptance of Ground School Certificate and completing the petitioners training program (described in this document) as a means of meeting (61.113) (a). In combination to Ground School Certificate I request the acceptance of Academy of Model Aeronautics membership. This organization has a significant history with providing education for remote control devices including aircraft. Members have access to a centralized knowledge base for beginning and continuing education in aerodynamics. The membership number for Mark Ingle is 1063718. Academy of Model Aeronautics is located at:

5161 East Memorial Drive
Muncie IN 47302
Phone: 765.287.1256

In addition, I request that the acceptance of a completed and approved Federal Background Check be included as a means of granting pilot in command status. The latest background check for Mark Ingle is included in this document as an embedded file. Click the pdf icon below to view

FBI_Background_Check.pdf

I request exemption from 14 CFR 61.113 (b) to the extent of receiving some portion of payment for sUAS services but not to the extent of carrying passengers or cargo since it will be impossible for my sUAS to carry more than 6 kg without significantly effecting flight time. The reason I am seeking this relief is to offset operational expenses until the sUAS market matures to yield profit and final regulations. In addition, to the extent of using a remote controlled device, a secured area, and no passenger involvement, the risk of hazardous conditions and risk to life are significantly reduced. My sUAS operation will be equally or more safe than traditional rotorcraft. Before any services are rendered, the pilot will be required to complete a sUAS flight training program of 100 hours total (in the air) flight time - 60 hours in manual mode and 40 in self-leveling mode. The sUAS will be controlled remotely with a radio transmitter operating at 2.4 Ghz or 5.8 Ghz. For redundancy purposes, there will be two radio transmitters paired, in series, during operations – the pilot and co-pilot will each have one radio transmitter with the devices connected via the training port. The pilot will maintain control until verbally handing over control to the co-pilot, if needed. The certified sUAS pilot will also be required to pass a flight test demonstrated ability to fly the sUAS manually as well as self-level (autonomous) and show the ability to switch between flight modes at request. The certification test will include a flight course simulating typical flying challenges during service operations.

The exemption from this regulation will benefit the public by providing an opportunity for developing a market in sUAS services at a lower risks and lower startup costs than traditional rotorcraft services. And the same level of safety provided from pilot certification will be reached via the sUAS training program describe herein.

14 C.F.R. 91.103 (b)(1), (b)(2): Preflight Action

> Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight. This information must include—
>
> (a)…

(b) For any flight, runway lengths at airports of intended use, and the following takeoff and landing distance information:

(1) For civil aircraft for which an approved Airplane or Rotorcraft Flight Manual containing takeoff and landing distance data is required, the takeoff and landing distance data contained therein; and

(2) For civil aircraft other than those specified in paragraph (b)(1) of this section, other reliable information appropriate to the aircraft, relating to aircraft performance under expected values of airport elevation and runway slope, aircraft gross weight, and wind and temperature.

I request exemption from 14 CFR 91.103 (b)(1) and (b)(2) to the extent of not requiring landing and takeoff distance calculation since there is no runway required for a sUAS. However, for safety, preflight calculations do apply to the operation of a sUAS and will be adhered to:

Below is the current proposed preflight checklist for multi-rotor sUAS and includes preflight calculations: (Preflight Check list is carried out by co-pilot with pilot giving confirmation by the verbal response of "Check")

Preflight Checklist

1. Confirm weather conditions.
2. Check lock nuts on each prop.
3. Check each prop for damage or wear.
4. Check frame for cracks or loose screws.
5. Ensure motors are level.
6. Check landing gear is locked.
7. Secure battery with straps and connect/lock XT-60 power cord to power distribution board. Check for green indicator (LED) on electronic speed controllers while connecting.
8. Check voltage indication from flight controller and make note of current voltage and amperage.
9. Co-pilot determines Estimated Flight Time Capacity and compares to Required Flight Time from flight plan.
10. Check operating temperature of flight controller.
11. Check receiver and transmitter controller for yaw, pitch and roll.
12. Check sub-trims are set to zero.
13. Check low voltage alarm.
14. Check failsafe.
15. Pilot determines Estimated Flight Time Capacity and compares to Required Flight Time from flight plan. (This is separate from step 9. Both pilot and co-pilot calculations should match.)
16. Pilot compares flight time and route based on flight path
17. Note wind speed and direction. Wind must be <8 mph.

18. Check throttle is set to idle.
19. Arm flight controller and check for errors or warnings.
20. Stand clear no less than 10 meters and throttle up props to 40%.
21. Check for any vibration or note abnormal prop noise.
22. Throttle down and disarm flight controller.
23. Request permission for takeoff from Safety Officer.

14 C.F. R. 91.119 (c) : Minimum Safe Altitudes

> Except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes:
>
> (a) Anywhere. An altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.
>
> (b) Over congested areas. Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft.
>
> (c) Over other than congested areas. An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure.
>
> (d) Helicopters, powered parachutes, and weight-shift-control aircraft. If the operation is conducted without hazard to persons or property on the surface—
>
> (1) A helicopter may be operated at less than the minimums prescribed in paragraph (b) or (c) of this section, provided each person operating the helicopter complies with any routes or altitudes specifically prescribed for helicopters by the FAA; and
>
> (2) A powered parachute or weight-shift-control aircraft may be operated at less than the minimums prescribed in paragraph (c) of this section.

14 CFR 91.119 (a)(b) and (d) – These regulations are applicable to the operation of a sUAS and will be part of the flight route planning between pilot and co-pilot to provide emergency landing area(s) and identifying restricted area(s). No flights will take place in restricted areas.

I request exemption from 14 CFR 91.119 (c) to the extent of requiring an altitude of less than 200 feet above the surface unless the pilot is flying with first person video enabled equipment. Any flight route 200 feet above the surface will increase the

risk of loss of sight orientation in which the sUAS pilot must recover. The pilot will comply with the flight route and altitude plans and no adjustments will be made to the route until the flight route is completed. People and property owners above flight route must also provide verbal or written permission before operations. All public safety regulations will also be followed. Normal operations for services provided will be at very low-altitude.

This exemption will provide for more safe operations of a sUAS since the visual line of sight limit will mitigate loss of control. The size and weight of sUAS makes this exemption safer than current regulation for typical rotorcraft.

14 C.F.R. 91.121: Altimeter Settings

> (a) Each person operating an aircraft shall maintain the cruising altitude or flight level of that aircraft, as the case may be, by reference to an altimeter that is set, when operating—
>
> (1) Below 18,000 feet MSL, to—
>
> (i) The current reported altimeter setting of a station along the route and within 100 nautical miles of the aircraft;
>
> (ii) If there is no station within the area prescribed in paragraph (a)(1)(i) of this section, the current reported altimeter setting of an appropriate available station; or
>
> (iii) In the case of an aircraft not equipped with a radio, the elevation of the departure airport or an appropriate altimeter setting available before departure; or
>
> (2) At or above 18,000 feet MSL, to 29.92″ Hg.
>
> (b) The lowest usable flight level is determined by the atmospheric pressure in the area of operation as shown in the following table:

Current altimeter setting	Lowest usable flight level
29.92 (or higher)	180
29.91 through 29.42	185
29.41 through 28.92	190
28.91 through 28.42	195
28.41 through 27.92	200
27.91 through 27.42	205
27.41 through 26.92	210

(c) To convert minimum altitude prescribed under §§91.119 and 91.177 to the minimum flight level, the pilot shall take the flight level equivalent of the minimum altitude in feet and add the appropriate number of feet specified below, according to the current reported altimeter setting:

Current altimeter setting	Adjustment factor
29.92 (or higher)	None
29.91 through 29.42	500
29.41 through 28.92	1,000
28.91 through 28.42	1,500
28.41 through 27.92	2,000
27.91 through 27.42	2,500
27.41 through 26.92	3,000

I request exemption from 14 CFR 91.121 to the extent of not following all of the regulations (91.121) as it is written due to the fact that these regulations are applicable to a typical aircraft. However the intent of the regulation does need to be followed for sUAS operations. The flight controller used on my sUAS will be equipped with a micro barometer to provide altitude information via telemetry to the pilot in command. This telemetry data will also be visible to the copilot. The barometer will also be integrated with the configuration and operation of the flight controller to provide a way for the pilot to maintain an "*altitude hold*" automatically. The "*altitude hold"* will be enabled by the pilot per the flight route plan that is established during pre-flight planning. GPS altitude information will be included in telemetry information but will not be integrated with the flight controller due to inherent risks with GPS signal loss.

This exemption allows for further development and integration of the "altitude hold" feature for other sUAS devices and understanding for certified pilots. In addition, this feature will provide another architecture layer supporting public and national airspace safety during sUAS operations. This specific technology, along with other advanced features, will foster other economic sector growth as a whole. Due to the small sUAS and ability to maintain consistent altitude, this exemption will provide a safer environment than current regulations for full sized rotorcraft.

14 CFR 91.151 (a) and (b): Fuel requirements for flight in VFR conditions

(a) No person may begin a flight in an airplane under VFR conditions unless (considering wind and forecast weather conditions) there is enough fuel to fly to the first point of intended landing and, assuming normal cruising speed—

(1) During the day, to fly after that for at least 30 minutes; or

(2) At night, to fly after that for at least 45 minutes.

(b) No person may begin a flight in a rotorcraft under VFR conditions unless (considering wind and forecast weather conditions) there is enough fuel to fly to the first point of intended landing and, assuming normal cruising speed, to fly after that for at least 20 minutes.

I request exemption from 14 CFR 91.151 (a) and (b) to the extent of not following these regulations (91.151) as it is written due to the fact that these regulations are applicable to a typical aircraft. However, the intent of the regulation (91.151) is to insure the safe operation of the powered aircraft while in flight and provide for extra fuel in case of emergencies. This same approach and intent will be followed for the operation of sUAS. Below is the calculation that will be used to determine flight time:

Flight Time Calculation

1. Determine the total weight of the sUAS during flight and divide weight by the number of motors – 4, 6, or 8. This will yield the thrust needed per motor.
2. Multiply the thrust needed by two to provide lift and hover of the sUAS.
3. Determine the amount of Watts needed to achieve hover thrust (Use manufactures specs if provided).
4. Divide power by nominal battery voltage to yield amps.
5. Divide Battery capacity (mah) by (Number of motors x amps)) and multiply this by 60 (minutes).
6. Multiply this number by 0.8 (20% loss of efficiency).
7. The result is your estimated flight time for hovering and lift.
8. The amount of power to reserve for RTH should be determined during flight planning between the pilot and copilot.

This same calculation can be used in reverse to determine the proper motor and/or battery configuration to achieve required flight times based on operational requirements per flight route. In some cases different video or image equipment maybe required.

Example:

Motor Specifications		
Max Watts	330	Watts
Working Current	16	Amps
Hover Thrust	19	Amps
Max current(10s)	22	Amps
No Load Current	0.03	Amps
Internal Resistence	0.091	ohm

Battery Specifications	
Battery Mah	5200
Battery Volts	14.8
Battery Amps	5.2
Battery Watts	76.96

Number of Poles	16			
Prop	12x3 12x6		Watts/Motor For Hover	71.25
Max Voltage	15	Volts	Amps/Motor	4.8

AUW	2100	grams		
Number of Motors	4			
Thrust Per Motor	525	grams	**Total Flight Time**	**16.2 min**
Thrust Needed Per Motor	1050	grams	**Less Eff. Loss (%20)**	**13.0 min**

Reserve battery power will be reviewed during flight planning and will be based on the distance from beginning location (take off) and the end location (landing and typically the home location). The percentage of battery reserve needed will be adjusted over time as the flight route is completed. This is due to external environmental factors that will affect the physics of lift and directly impact power consumption during flight – wind, humidity, and heat. The percentage of battery power remaining and the distance to the end location will be used in real time calculations built into the flight controller to determine when the sUAS should land at the end location. The percentage of battery power will be displayed in telemetry information to the pilot in command. While in manual mode the pilot must adhere to the telemetry warning and proceed to the end location

****

The following summary is provided for publication in the Federal Register:

Petitioner asks for an exemption from the following rules:

14 C.F.R. Part 21
14 C.F.R. 45.27(a)
14 C.F.R. 45.29 (3) (c)(d)(e)(f)(g)(h)
14 C.F.R. 61.113 (a) & (b)
14 C.F.R. 91.103
14 C.F.R. 91.119
14 C.F.R. 91.121
14 C.F.R. 91.203
14 C.F.R 91.151

The purpose of this request is to operate a small unmanned vehicle (10lbs or less) for aerial imaging, video, and surveillance services. Also search and rescue services will be offer to the South Carolina Search and Rescue Dog Association at no charge. For SAR services, all operations described herein will be followed in addition to following National Incident Management System protocol. No flight operations will take place during SAR services without the consent of the Incident Commander.

Exemption from the C.F.R. regulations will provide for safer operations than using traditional methods of rotorcraft.

Furthermore, a sUAS powered by batteries eliminates all risks associated with larger rotorcraft – fuselage, flight crew and fuel. sUAS do not require high-speed aerodynamics of large mechanical moving structure to achieve lift that is typical of rotorcraft thus reducing risk even further for society.

The operation of small sUAS, weighing less than 10 lbs., will be conducted under very strict rules and conditions outlined herein, will provide an equivalent or better level of safety supporting the grant of the exemptions requested herein, including exempting the applicant from the requirements of Part 21 and allowing commercial operations. The sUAS operate at slow speeds, close to the ground, and in a controlled environment and, as a result, are far safer than conventional operations conducted with rotorcraft operating in close proximity to the ground and people.

All flights will occur over private or controlled access property with the property owner's prior consent and knowledge. Images taken will be of individuals who have also consented to being filmed or otherwise have agreed to be in the area where aerial photography will take place.

Response to Section 333 (b) (1)

Section 333 (b) (1) ASSESSMENT OF UNMANNED AIRCRAFT SYSTEMS.—In making the determination under subsection:

> (b), the Secretary shall determine, at a minimum—
> (1) which types of unmanned aircraft systems, if any, as a result of their size, weight, speed, operational capability, proximity to airports and populated areas, and operation within visual line of sight do not create a hazard to users of the national airspace system or the public or pose a threat to national security;

I am addressing this mandate by designing a sUAS that has visual indicators to aid in determining flight orientation and enhance visual line of sight capabilities. The key design features are fluorescent orange props in front and fluorescent yellow in rear. In addition there will bright green LEDs in front and bright red LEDs in the rear. Focus of training will be centered toward sUAS control at long parallel distances.

Training plan for preparation of certification for piloting a UAS:

1. Pilot In Training will work along side a qualified or experience RC pilot for a total of 10 hours training. (These hours DO NOT count toward required flight time)
2. Pilot In Training will log 100 hours of computer simulated flight time before training can begin in the field. (These hours DO NOT count toward required flight time)
3. 60 hours of logged flight time manual mode for the quad sUAS
4. 40 hours of logged flight time self-leveling mode for the quad sUAS
5. Pilot will be able to safely switch between modes while in flight.
6. Each flight training session will consist of the following:
    a. Preflight checklist
    b. Successful take off and landing. Pilot must demonstrate understanding and recovery from Ground State Hover Effect on at least one landing per session.
    c. Recover from Vortex Ring State condition per session.
    d. Left and right turn circle of UAS.
    e. Recover from loss of visual line of sight (sUAS orientation) condition from north, east, south and west.
    f. Retrieval of object from a distance of 50 yards.
    g. Figure eight flight path for 5 minutes.
    h. Hover for no less than 5 minutes at 30, 50, 100, and 150 feet.

Maintenance Plan for sUAS:

1. Preventative maintenance will be required after 20 hours of total flight time for each registered sUAS.
2. Detailed records will be kept for unplanned and planned maintenance as well as auxiliary equipment that is added or removed.
3. Equipment that is rotated from the sUAS will undergo inspection and testing by an approved inspector who will sign off on each inspected part and component.
4. All records will be retained for the life of the sUAS while in service.
5. All parts and components will be uniquely identified for tracking purposes during inspection and rotation of parts.
6. Preventative Maintenance Tasks:
    a. Check and tighten all mechanical screws. Lock tight glue should be used on all screws. Record inspection with digital picture and date of inspection.
    b. Replace all carbon fiber motor arms with new or inspected carbon fiber arms. Record replacement part and date.
    c. Replace landing gear carbon fiber rods with new or inspected carbon fiber rods. Record replacement part and date.
    d. Remove all propellers and inspect for cracks or damage. Replace propellers with new props. Record replacement part and date.

e. Replace electronic speed controllers with new or inspected controllers. Confirm all controllers are operating with the latest firmware from the manufacture. Record replacement part and date.
f. Inspect all wiring and insure all wiring has the appropriate twist proportion to reduce magnetic fields.
g. Replace all motors with new or inspected motors. Record replacement part and date.
h. Replace flight controller with new or inspected flight controller. Confirm the flight controller has the latest firmware from the manufacture. Record replacement part and date.
i. Replace all worn anti-vibration material.
j. Any part of component found defective will be removed and replaced. The defective part of component will be record.

Required components for safe operation of sUAS

1. Flight Controller must have the following integrated components:
    a. Inertia Measuring Unit
        i. 3 Axis Gyro
        ii. 3 Axis Accelerometer
        iii. 3 Axis Magnetometer
    b. Barometric pressure sensor
    c. LED status indicator
    d. Low voltage alarm capabilities

2. Electronic Speed Controller (ESC) must have the following:
    a. LED status indicator
    b. Input Frequency > 1Khz
    c. Purpose built multi-rotor ESC!!!!

3. Propellers will be attached to threaded axil attached to motor by lock nut design. No other type of nut will be used.

4. Radio controlled deployable parachute.

5. Power distribution board with gold connectors

6. Radio Transmitter with the following:
    a. 2.4 or 5.8 ghz communication frequency.
    b. Battery capacity of one hour with low voltage indicator and auditable alarm.
    c. No less than 9 channels for control and monitoring sUAS
    d. Training port for redundancy during flight and training sessions.
    e. Telemetry display with the following:
        i. Battery Mah
        ii. Battery voltage
        iii. Radio Signal Strength Indicator (RSSI)

iv. Active Acquired Satellite Count

Operational Procedures

Mark Ingle will abide by the following limitations, restrictions, and procedures when conducting its sUAS operations under an FAA issued exemption:

1. The sUAS will be less than 10 pounds.
2. Operations will only be conducted during daylight hours.
3. Flight operations will not occur within 5 miles of any public or private airport.
4. Flights will be operated within visual line of sight of a pilot (PIC) as well as a Co-pilot to aid in navigation while surveying or inspecting. For safety the PIC must be focused on flying 100%.
5. Maximum total flight time for each operational flight will be 30 minutes. The flight controller used on my lightweight UAS will maintain battery life calculation and alert the pilot to return to home(RTH) when 15% of battery life is remaining.
6. Flights will normally be operated at an altitude less than 175 feet AGL, never exceeding 250 feet. The maximum airspeed will not be more than 25 mph.
7. Based on the service provided a flight area will be determined ahead of operations via ground survey. The flight area will contain the flight route and a risk assessment will be determined before proceeding with planning and operations.
8. The flight area will be defined by no less that four longitudinal/latitudinal coordinates using approved geo spatial software. The coordinates will be known as the geo-fencing coordinates.
9. The flight route will have a begin location (takeoff) and end location (landing) identified in the flight plan.
10. All involved in the sUAS "services" transaction will agree to the flight area and restrictions.
11. The owner of the property where operations are taking place must give permission via signed wavier for the flight area.
12. Any unauthorized persons entering the flight area will require the pilot in command to abort the flight operation landing the sUAS in a predetermined location.
13. A briefing will take place with all roles involved in the operations prior to beginning operations.
14. Roles for each flight operation will consist of:
    a. Pilot (PIC) using either FPV or VLOS. Pilot will be in control of sUAS.
    b. Co-Pilot assists with navigation and maintaining a safe flight area as well as assist with Preflight Checklist.
    c. Safety Officer will inspect all areas in the flight area as well as continually assess weather conditions. The Safety Officer will mark flight area appropriately for public awareness when needed. Safety

Officer will maintain visual contact with sUAS at all times and maintain awareness of surroundings in flight area. The Safety Officer purpose is to serve as an "Air Traffic Control" function.

15. All of the roles involved during a flight operation will review the flight route and photo/video capture plans before taking flight.
16. The sUAS will not travel outside the flight area and will be enforced by:
    a. Pilot and co-pilot adherence during manual flight modes.
    b. Autonomous flight control using ground station software.
17. No other personnel will be allowed in the flight area without verbal or written consent. Operations of the flight should stop if unauthorized personnel entry flight area.
18. Roles will have appropriate safety equipment.
19. The Pilot will be trained in manual and self-leveling flight modes for each sUAS in use. Autonomous flight training will take place as well.
20. Pilot will have been trained in manual flight modes and require 60 hours of flight time before certified for operations. Self-leveling certification will require 40 hours of flight time.
21. In the event of an emergency while in manual mode, the Co-Pilot will have a second controller ready to take over flight of the sUAS.
22. In the event of system or component failure while in self-leveling or autonomous flight, the pilot or co-pilot will take over in manual mode. sUAS will also have a failsafe return to home.
23. A battery maintenance plan will be established that includes logging of the following:
    a. Date and number of Charges with beginning and ending voltage
    b. Date and number of Balance Charges with beginning and ending voltage
    c. Proper disposal procedures when battery reaches end of rotation life.

Terms and Definitions

Flight Controller – Used to aid the pilot in flying and steering the UAS via software program executing on a microprocessor. This device also contains an Inertia Measuring Unit (IMU).

IMU – Accelerometer, Gyroscope, and Magnetometer

Return to Home (RTH) – This is a setting performed before flight using GPS to record the longitude and latitude of the start location.

First Person View (FPV) – Transmitted video from the sUAS giving a forward view of the UAS in real time either on a monitor of FPV goggles.

Visual Line of Sight – The view of the UAS in clear plain sight of the operator while having 100% control.

Ground Station Software – Software integrated with flight controller over radio frequency using modem to modem communication between the controller and a computer. The sUAS is flown via GPS coordinates sent to the flight controller.

Current Federal Background Check:

1-787 (Rev. 05-25-2012)

U.S. Department of Justice

Federal Bureau of Investigation

Clarksburg, WV 26306

11/6/2013 6754

MARK BRADY INGLE
325 SAND PAVER WAY
FORT MILL SC 29708

The Criminal Justice Information Services (CJIS) Division of the Federal Bureau of Investigation has completed the following fingerprint submission:

Subject Name	Search Completed	Result
MARK BRADY INGLE	11/6/2013	A SEARCH OF THE FINGERPRINTS PROVIDED BY THIS INDIVIDUAL HAS REVEALED NO PRIOR ARREST DATA AT THE FBI.

Social Security number: XXX-XX-5706

The result of the above response is only effective for the date the submission was originally completed. For more updated information, please submit new fingerprints of the subject.

In order to protect Personally Identifiable Information, as of August 17, 2009, FBI policy has changed to no longer return the fingerprint cards. This form will serve as the FBI's official response.

Any questions may be addressed to the Customer Service Group at (304) 625-5590. You may also visit the Web site at www.fbi.gov for further instructions.

This Criminal History Record Information (CHRI) is provided pursuant to 28 CFR 16.30-16.34 solely for you to conduct a personal review and/or obtain a change, correction, or updating of your record. This CHRI is not provided for the purpose of licensing or employment or any other purpose enumerated in 28 CFR 20.33.

Kimberly J. Del Greco
Section Chief
Biometric Services Section
Criminal Justice Information
Services Division