U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

May 5, 2015

Exemption No. 11491
Regulatory Docket No. FAA–2015–0286

Mr. James Bianchin
President
Vertical Sciences, Inc.
2308 Lake Redding Drive
Redding, CA 96003

Dear Mr. Bianchin:

This letter is to inform you that we have granted your request for exemption. It transmits our decision, explains its basis, and gives you the conditions and limitations of the exemption, including the date it ends.

By letter dated February 3, 2015, you petitioned the Federal Aviation Administration (FAA) on behalf of Vertical Sciences, Inc. (hereinafter petitioner or operator) for an exemption. The petitioner requested to operate an unmanned aircraft system (UAS) to conduct mapping, geotechnical, and survey applications.

See Appendix A for the petition submitted to the FAA describing the proposed operations and the regulations that the petitioner seeks an exemption.

The FAA has determined that good cause exists for not publishing a summary of the petition in the Federal Register because the requested exemption would not set a precedent, and any delay in acting on this petition would be detrimental to the petitioner..]

Airworthiness Certification

The UAS proposed by the petitioner are the DJI S-1000+ and DJI Phantom 2 Vision+.

The petitioner requested relief from 14 CFR part 21, *Certification procedures for products and parts, Subpart H—Airworthiness Certificates*. In accordance with the statutory criteria provided in Section 333 of Public Law 112−95 in reference to 49 U.S.C. § 44704, and in consideration of the size, weight, speed, and limited operating area associated with the aircraft and its operation, the Secretary of Transportation has determined that this aircraft meets the conditions of Section 333. Therefore, the FAA finds that the requested relief from 14 CFR part 21, *Certification procedures for products and parts, Subpart H—Airworthiness Certificates*, and any associated noise certification and testing requirements of part 36, is not necessary.

The Basis for Our Decision

You have requested to use a UAS for aerial data collection[1]. The FAA has issued grants of exemption in circumstances similar in all material respects to those presented in your petition. In Grants of Exemption Nos. 11062 to Astraeus Aerial (*see* Docket No. FAA−2014−0352), 11109 to Clayco, Inc. (*see* Docket No. FAA−2014−0507), 11112 to VDOS Global, LLC (*see* Docket No. FAA−2014−0382), and 11213 to Aeryon Labs, Inc. (*see* Docket No. FAA−2014−0642), the FAA found that the enhanced safety achieved using an unmanned aircraft (UA) with the specifications described by the petitioner and carrying no passengers or crew, rather than a manned aircraft of significantly greater proportions, carrying crew in addition to flammable fuel, gives the FAA good cause to find that the UAS operation enabled by this exemption is in the public interest.

Having reviewed your reasons for requesting an exemption, I find that—

- They are similar in all material respects to relief previously requested in Grant of Exemption Nos. 11062, 11109, 11112, and 11213;
- The reasons stated by the FAA for granting Exemption Nos. 11062, 11109, 11112, and 11213 also apply to the situation you present; and
- A grant of exemption is in the public interest.

Our Decision

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. 106(f), 40113, and 44701, delegated to me by the Administrator, Vertical Sciences, Inc. is granted an exemption from 14 CFR §§ 61.23(a) and (c), 61.101(e)(4) and (5), 61.113(a), 61.315(a), 91.7(a), 91.119(c), 91.121, 91.151(a)(1), 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), and 91.417(a) and (b), to the extent necessary to allow the petitioner to operate a UAS to perform aerial data collection

[1] Aerial data collection includes any remote sensing and measuring by an instrument(s) aboard the UA. Examples include imagery (photography, video, infrared, etc.), electronic measurement (precision surveying, RF analysis, etc.), chemical measurement (particulate measurement, etc.), or any other gathering of data by instruments aboard the UA.

and/or closed set motion picture and filming. This exemption is subject to the conditions and limitations listed below.

Conditions and Limitations

In this grant of exemption, Vertical Sciences, Inc. is hereafter referred to as the operator.

Failure to comply with any of the conditions and limitations of this grant of exemption will be grounds for the immediate suspension or rescission of this exemption.

1. Operations authorized by this grant of exemption are limited to the DJI S-1000+ and DJI Phantom 2 Vision+ when weighing less than 55 pounds including payload. Proposed operations of any other aircraft will require a new petition or a petition to amend this exemption.

2. Operations for the purpose of closed-set motion picture and television filming are not permitted.

3. The UA may not be operated at a speed exceeding 87 knots (100 miles per hour). The exemption holder may use either groundspeed or calibrated airspeed to determine compliance with the 87 knot speed restriction. In no case will the UA be operated at airspeeds greater than the maximum UA operating airspeed recommended by the aircraft manufacturer.

4. The UA must be operated at an altitude of no more than 400 feet above ground level (AGL). Altitude must be reported in feet AGL.

5. The UA must be operated within visual line of sight (VLOS) of the PIC at all times. This requires the PIC to be able to use human vision unaided by any device other than corrective lenses, as specified on the PIC's FAA-issued airman medical certificate or U.S. driver's license.

6. All operations must utilize a visual observer (VO). The UA must be operated within the visual line of sight (VLOS) of the PIC and VO at all times. The VO may be used to satisfy the VLOS requirement as long as the PIC always maintains VLOS capability. The VO and PIC must be able to communicate verbally at all times; electronic messaging or texting is not permitted during flight operations. The PIC must be designated before the flight and cannot transfer his or her designation for the duration of the flight. The PIC must ensure that the VO can perform the duties required of the VO.

7. This exemption and all documents needed to operate the UAS and conduct its operations in accordance with the conditions and limitations stated in this grant of exemption, are hereinafter referred to as the operating documents. The operating

documents must be accessible during UAS operations and made available to the Administrator upon request. If a discrepancy exists between the conditions and limitations in this exemption and the procedures outlined in the operating documents, the conditions and limitations herein take precedence and must be followed. Otherwise, the operator must follow the procedures as outlined in its operating documents. The operator may update or revise its operating documents. It is the operator's responsibility to track such revisions and present updated and revised documents to the Administrator or any law enforcement official upon request. The operator must also present updated and revised documents if it petitions for extension or amendment to this grant of exemption. If the operator determines that any update or revision would affect the basis upon which the FAA granted this exemption, then the operator must petition for an amendment to its grant of exemption. The FAA's UAS Integration Office (AFS−80) may be contacted if questions arise regarding updates or revisions to the operating documents.

8. Any UAS that has undergone maintenance or alterations that affect the UAS operation or flight characteristics, e.g., replacement of a flight critical component, must undergo a functional test flight prior to conducting further operations under this exemption. Functional test flights may only be conducted by a PIC with a VO and must remain at least 500 feet from other people. The functional test flight must be conducted in such a manner so as to not pose an undue hazard to persons and property.

9. The operator is responsible for maintaining and inspecting the UAS to ensure that it is in a condition for safe operation.

10. Prior to each flight, the PIC must conduct a pre-flight inspection and determine the UAS is in a condition for safe flight. The pre-flight inspection must account for all potential discrepancies, e.g., inoperable components, items, or equipment. If the inspection reveals a condition that affects the safe operation of the UAS, the aircraft is prohibited from operating until the necessary maintenance has been performed and the UAS is found to be in a condition for safe flight.

11. The operator must follow the UAS manufacturer's maintenance, overhaul, replacement, inspection, and life limit requirements for the aircraft and aircraft components.

12. Each UAS operated under this exemption must comply with all manufacturer safety bulletins.

13. Under this grant of exemption, a PIC must hold either an airline transport, commercial, private, recreational, or sport pilot certificate. The PIC must also hold a current FAA airman medical certificate or a valid U.S. driver's license issued by a state, the District of Columbia, Puerto Rico, a territory, a possession, or the Federal

government. The PIC must also meet the flight review requirements specified in 14 CFR § 61.56 in an aircraft in which the PIC is rated on his or her pilot certificate.

14. The operator may not permit any PIC to operate unless the PIC demonstrates the ability to safely operate the UAS in a manner consistent with how the UAS will be operated under this exemption, including evasive and emergency maneuvers and maintaining appropriate distances from persons, vessels, vehicles and structures. PIC qualification flight hours and currency must be logged in a manner consistent with 14 CFR § 61.51(b). Flights for the purposes of training the operator's PICs and VOs (training, proficiency, and experience-building) and determining the PIC's ability to safely operate the UAS in a manner consistent with how the UAS will be operated under this exemption are permitted under the terms of this exemption. However, training operations may only be conducted during dedicated training sessions. During training, proficiency, and experience-building flights, all persons not essential for flight operations are considered nonparticipants, and the PIC must operate the UA with appropriate distance from nonparticipants in accordance with 14 CFR § 91.119.

15. UAS operations may not be conducted during night, as defined in 14 CFR § 1.1. All operations must be conducted under visual meteorological conditions (VMC). Flights under special visual flight rules (SVFR) are not authorized.

16. The UA may not operate within 5 nautical miles of an airport reference point (ARP) as denoted in the current FAA Airport/Facility Directory (AFD) or for airports not denoted with an ARP, the center of the airport symbol as denoted on the current FAA-published aeronautical chart, unless a letter of agreement with that airport's management is obtained or otherwise permitted by a COA issued to the exemption holder. The letter of agreement with the airport management must be made available to the Administrator or any law enforcement official upon request.

17. The UA may not be operated less than 500 feet below or less than 2,000 feet horizontally from a cloud or when visibility is less than 3 statute miles from the PIC.

18. If the UAS loses communications or loses its GPS signal, the UA must return to a pre-determined location within the private or controlled-access property.

19. The PIC must abort the flight in the event of unpredicted obstacles or emergencies.

20. The PIC is prohibited from beginning a flight unless (considering wind and forecast weather conditions) there is enough available power for the UA to conduct the intended operation and to operate after that for at least five minutes or with the reserve power recommended by the manufacturer if greater.

21. Air Traffic Organization (ATO) Certificate of Waiver or Authorization (COA). All operations shall be conducted in accordance with an ATO-issued COA. The

exemption holder may apply for a new or amended COA if it intends to conduct operations that cannot be conducted under the terms of the attached COA.

22. All aircraft operated in accordance with this exemption must be identified by serial number, registered in accordance with 14 CFR part 47, and have identification (N−Number) markings in accordance with 14 CFR part 45, Subpart C. Markings must be as large as practicable.

23. Documents used by the operator to ensure the safe operation and flight of the UAS and any documents required under 14 CFR §§ 91.9 and 91.203 must be available to the PIC at the Ground Control Station of the UAS any time the aircraft is operating. These documents must be made available to the Administrator or any law enforcement official upon request.

24. The UA must remain clear and give way to all manned aviation operations and activities at all times.

25. The UAS may not be operated by the PIC from any moving device or vehicle.

26. All Flight operations must be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures unless:
    a. Barriers or structures are present that sufficiently protect nonparticipating persons from the UA and/or debris in the event of an accident. The operator must ensure that nonparticipating persons remain under such protection. If a situation arises where nonparticipating persons leave such protection and are within 500 feet of the UA, flight operations must cease immediately in a manner ensuring the safety of nonparticipating persons; and
    b. The owner/controller of any vessels, vehicles or structures has granted permission for operating closer to those objects and the PIC has made a safety assessment of the risk of operating closer to those objects and determined that it does not present an undue hazard.

    The PIC, VO, operator trainees or essential persons are not considered nonparticipating persons under this exemption.

27. All operations shall be conducted over private or controlled-access property with permission from the property owner/controller or authorized representative. Permission from property owner/controller or authorized representative will be obtained for each flight to be conducted.

28. Any incident, accident, or flight operation that transgresses the lateral or vertical boundaries of the operational area as defined by the applicable COA must be reported to the FAA's UAS Integration Office (AFS−80) within 24 hours. Accidents must be

reported to the National Transportation Safety Board (NTSB) per instructions contained on the NTSB Web site: www.ntsb.gov.

If this exemption permits operations for the purpose of closed-set motion picture and television filming and production, the following additional conditions and limitations apply.

29. The operator must have a motion picture and television operations manual (MPTOM) as documented in this grant of exemption.

30. At least 3 days before aerial filming, the operator of the UAS affected by this exemption must submit a written Plan of Activities to the local Flight Standards District Office (FSDO) with jurisdiction over the area of proposed filming. The 3-day notification may be waived with the concurrence of the FSDO. The plan of activities must include at least the following:
    a. Dates and times for all flights;
    b. Name and phone number of the operator for the UAS aerial filming conducted under this grant of exemption;
    c. Name and phone number of the person responsible for the on-scene operation of the UAS;
    d. Make, model, and serial or N−Number of UAS to be used;
    e. Name and certificate number of UAS PICs involved in the aerial filming;
    f. A statement that the operator has obtained permission from property owners and/or local officials to conduct the filming production event; the list of those who gave permission must be made available to the inspector upon request;
    g. Signature of exemption holder or representative; and
    h. A description of the flight activity, including maps or diagrams of any area, city, town, county, and/or state over which filming will be conducted and the altitudes essential to accomplish the operation.

31. Flight operations may be conducted closer than 500 feet from participating persons consenting to be involved and necessary for the filming production, as specified in the exemption holder's MPTOM.

Unless otherwise specified in this grant of exemption, the UAS, the UAS PIC, and the UAS operations must comply with all applicable parts of 14 CFR including, but not limited to, parts 45, 47, 61, and 91.

This exemption terminates on May 31, 2017, unless sooner superseded or rescinded.

Sincerely,
/s/
John S. Duncan
Director, Flight Standards Service

Enclosures

February 3, 2015

VERTICAL SCIENCES, INC.

U.S. Department of Transportation
Docket Operations M-30
West Building Ground Floor, Room w12-140
1200 New Jersey Ave., SE
Washington, DC 20590

Re: Exemption Request Under Section 333 of the FAA Reform Act and Part 11 of the Federal Aviation Regulations

Dear Madam, Sir,

Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 (the "Reform Act") and 14 C.F.R. Part 11, Vertical Sciences, Inc. ("VSI"), an operator of the DJI S-1000+ Unmanned Aircraft System ("S-1000+") and a DJI Phantom 2 Vision+ ("Vision"), seeks an exemption from the Federal Aviation Regulations ("FARs") listed below:

- 14 C.F.R. 21
- 14 C.F.R. 45.23
- 14 C.F.R 45.29
- 14 C.F.R. 61.133(a)
- 14 C.F.R. 91.7(b)
- 14 C.F.R. 91.9(b)(2)
- 14 C.F.R. 91.109(a)
- 14 C.F.R. 91.119
- 14 C.F.R. 91.151(a)
- 14 C.F.R. 91.203(a) & (b)
- 14 CFR Subpart E (91.401 - 91.417)

VSI is comprised of licensed professional engineers, professional geologists, certified engineering geologists, private and commercial pilots, and software specialists trained in working in the civil and geotechnical engineering, surveying, environmental, and construction fields. Most of our professionals have over 30 years of experience and our pilots, over 5 years of experience that includes flying unmanned aircraft. The requested exemption would authorize commercial operations using the S-1000+ and Vision for mapping, geotechnical, and survey applications. These operations will be subject to strict operating requirements defined in the S-1000+ Pilot Operating Handbook and Vision Pilot Operating Handbook and conditions defined by the Safety Code of the Academy of Model Aeronautics (see Annex B), in order to ensure at least an equivalent level of safety to currently authorized operations using manned aircrafts.

The S-1000+ and Vision will be operated by an individual who fulfill the following requirements:

- Has successfully passed a manufacturer's training program for the S-1000+ and Vision;
- Has a Private Pilot license;

1. CHARACTERISTICS OF THE AIRCRAFT

The S-1000+ is a small (41 inches between rotors) and ultra-light (maximum take-off weight of 24 pounds) platform made of composite materials. The Vision is also a small (13.8 inches between rotors) and ultra-light (maximum take-off weight of 3.1 pounds) made of composite materials. Those aircraft perform pre-programmed precision aerial mapping missions thanks to on-board GPS and the related flight management software that allows the operator to plan safely and efficiently a mission in 3D, and then monitor it in real-time. With an attached camera, the S-1000+ takes a collection of high-definition still images that are used later to generate maps and contour lines of the surveyed area. The Vision takes high-definition video that is used later to generate maps, photographs, and contour lines of the surveyed area

The four main characteristics of the S-1000+ and Vision are:

a. Very light weight

The S-1000+ and Vision are so light that the operator can launch them by hand and let them land on almost any surface without requiring a parachute or landing net. Its low impact energy in case of a controlled emergency landing, also significantly reduces the risk of hazardous situations. Finally, the rotor arms of the S-1000+ are detachable and made of rounded composite materials with no sharp edges. The rotor arms of the Vision are rounded and made of plastic with no sharp edges.

b. Electric-powered

The S-1000+ and Vision are electric powered. The four and eight motors, respectively, are very quiet and reliable.

c. Semi-automatic flight

The artificial intelligence incorporated within the S-1000+ and Vision autopilot system continuously analyzes data from the Inertial Measurement Unit and from the onboard GPS and takes care of all the aspects of the flight under the supervision of the operator.

d. Option for Manual control

Additionally, the S-1000+ and Vision provide an override capability that allows the operator to take manual actions during the flight (Go to Home, Go Land, Hold and Resume the mission) and also suspend automated operations and take manual control of the aircraft should it become necessary to respond emergent circumstances, thanks to the remote controller provided with the system.

2. APPLICATIONS

The aircraft will be utilized for gathering geologic, geotechnical, environmental, and survey data for mining, public works, and construction-related studies and projects. These areas are typically

rural and will not include congested areas. Those data will be used for creating highly accurate maps and geo-rectified orthophotographs. In addition, the aircraft will allow gathering of geologic and geotechnical data in areas where previously, a geologist, engineer, or others would be required to repel down slopes or be situated at the base of rock and unstable slopes, thus reducing the danger to and increasing the safety for those professionals. Additionally, the use of the S-1000+ and Vision will negate the need for conventional manned helicopters to perform work where repelling and access is not possible, thus, reducing risk to pilot and passenger of the helicopter, and personnel on the ground. The use of UAV will also reduce the need for conventional aircraft in gathering photogrammetric data, thus improving public safety.

3. APPLICABLE LEGAL STANDARD UNDER SECTION 333

a. Operating requirements

Grant of the exemption to VSI for the S-1000+ and Vision will be subject to the following operating conditions, based on the operating conditions set forth by the Academy of Model Aeronautics (see Appendix B). The main restrictions are summarized below:

- Operations to be conducted over private or public controlled-access property where approved;
- Permission from the land owner/authority required before commencing any flight;
- Operations over congested areas shall be avoided;
- Operations must not interfere with manned aircraft operations, must yield the right of way to manned aircraft, and operators must See & Avoid other aircraft and obstacles at all times. Use of an ADS-B receiver by the VO will assist in monitoring the presence of other proximal aircraft;
- Operations limited to Visual Flight Rules Meteorological Conditions (VMC) and daylight hours;
- Aircraft operations must remain within Visual Line of Sight (VLOS) and will be visually monitored at all times;
- VLOS guaranteed with a GPS geo-fence around operator of 0.5 miles;
- Flight ceiling pre-programed at 400 feet;
- All operations conducted within 5 miles from an airport shall only be initiated after verbal coordination with the airport authority, or air traffic control when a control tower is present at the airport;
- All operations shall comply with required permissions and permits established by territorial, state, county or city jurisdictions; including local law enforcement, fire, or other appropriate governmental agencies;
- The S-1000+ and Vision operations will be compliant with existing safety procedures inherent to the activities of the related company.

b. Operator Requirements

The S-1000+ and Vision Pilot in Charge (PIC) will have a Private Pilot license. The PIC and Visual Observer (VO) will meet the requirements outlined in FAA Policy N 8900.227 Section 16 Personnel Qualifications. Additionally, the PIC and VO will perform maintenance on the system and will complete a course of maintenance instruction as part of their initial training. Due to the

simplicity of the system, we do not anticipate the need for a supplemental pilot in the field.

3. CONCLUSION

We submit that the combination of the aircrafts' light weight, historically demonstrated flight performance, fully qualified flight crew and strict operation under the guidelines established in 8900.227, the FAA can have confidence that the operation will have an equivalent or greater level of safety of manned aircraft performing the same mission.

The name and contact information of the applicant are:

Vertical Sciences, Inc.
Attn: James Bianchin
2308 Lake Redding Drive
Redding, CA 96003
Phone: 530-949-6241
Email: jim.bianchin@gmail.com

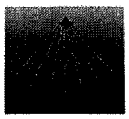
Respectfully Submitted,

VERTICAL SCIENCES, INC.

James A. Bianchin, PG, CEG
President

Appendices

A. Exemption Request and Equivalent Level of Safety
B. Academy of Model Aeronautics Safety Requirements
C. Privacy Issues
D. Safety Case
E. Maintenance Procedures
F. User Manual
G. Training Program
H. Aviation Experience



APPENDIX A: EXEMPTION REQUEST AND EQUIVALENT LEVEL OF SAFETY SHOWINGS UNDER APPLICABLE RULES SUBJECT TO EXEMPTION

VSI requests an exemption from the following regulations as well as any additional regulations that may technically apply to the operation of the S-1000+ and Vision:

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

This part establishes the procedures for the issuance of an airworthiness certificate. While the FAA continues to work to develop airworthiness standards for UAS, we request an experimental certificate be issued for the S-1000+ and Vision under either or both of the following provisions:

> 21.191 Experimental certificates.
> Experimental certificates are issued for the following purposes:
>
> **(a)** ***Research and development.*** Testing new aircraft design concepts, new aircraft equipment, new aircraft installations, new aircraft operating techniques, or new uses for aircraft.
>
> **(b)** ***Showing compliance with regulations.*** Conducting flight tests and other operations to show compliance with the airworthiness regulations including flights to show compliance for issuance of type and supplemental type certificates, flights to substantiate major design changes, and flights to show compliance with the function and reliability requirements of the regulations.

Since the experimental certificate can be used for commercial purposes such as market surveys, sales demonstrations, and customer crew training, we would expect that an experimental certificate would permit our commercial purpose as well.

The aircraft will not carry persons or property, will not carry fuel, and will only fly under strict operational requirements. Combined with the fact that the aircraft are lightweight, we propose that the S-1000+ and Vision will be at least as safe, if not safer, than a conventionally certificated aircraft performing the same mission.

If an experimental airworthiness certificate is not appropriate for this application, then we request an exemption of 14 CFR Part 21, Subpart H, and the requirement for an airworthiness certificate in general, citing the equivalent level of safety outlined in the previous paragraph.

14 CFR 91.203(a) & (b) Civil aircraft: Certifications required.

The regulation provides that an airworthiness certificate, with the registration number assigned to the aircraft and a registration certificate must be aboard the aircraft. Additionally, subparagraph (b) provides that the airworthiness certificate be "displayed at the cabin or cockpit entrance so that it is legible to passengers or crew." The S-1000+ and Vision are too small to carry documentation, do not have an entrance, and are not capable of carrying passengers or crew.

To obtain an equivalent level of safety and meet the intent of 91.203, we propose that documents deemed appropriate for these aircraft by the FAA will be co-located with the crew at

the ground control station and available for inspection upon request. In order to identify the aircraft, we propose that the information found on airworthiness and registration certificates be permanently affixed to the aircraft via placard:

Manufacturer: DJI
Model: "S-1000+" or "Phantom 2 Vision+"
Serial Number: 15-XXXX

Registered to:
Vertical Solutions, Inc.
123 Shasta Street
Anytown, CA 12345
If found please contact: (800)-222-1234.

14 C.F.R. § 45.23 & 14 C.F.R. § 45.29: Display of marks; size of marks

These regulations provide that each aircraft must display "N" and the aircraft's registration number in letters at least 3 inches high. Additionally, the aircraft must display the word "EXPERIMENTAL" in letters at least 2 inches high near the entrance to the cabin, cockpit, or pilot station.

Given the size of the S-1000+ and Vision (rotor to rotor distance of 41 and 13.8 inches, respectively), this requirement is impossible to match. We feel that the permanent placard discussed in the previous paragraph will provide the aircraft's registration information should it be found on the ground. We will also display at the ground station a high contrast flag or banner that contains the words "Unmanned Aircraft Ground Station" in letters 3 inches high or greater. Since the aircraft will operate within 1/2 NM of the ground station, the banner should be visible to anyone that observes the aircraft and chooses to investigate its point of origin.

14 C.F.R. § 91.7(a): Civil aircraft airworthiness

This regulation requires that no person may operate a civil aircraft unless it is in airworthy condition. Should the exemption be granted allowing commercial operation of the S-1000+ without an airworthiness certificate, no standard will exist for airworthiness of the S-1000+. An equivalent level of safety will be achieved by insuring compliance with the S-1000+ Pilot Operating Handbook (flight manual) prior to each flight.

14 C.F.R. § 91.9: Civil aircraft flight manual, marking, and placard requirements.

This regulation provides that no person may operate an aircraft unless a current, approved flight manual is in the aircraft. VSI assumes that the intent of this requirement is to ensure that flight manual information is available to the aircrew while operating the aircraft. VSI requests an exemption to this requirement since the aircraft is not only too small to carry documentation, that the documentation would not be available to the crew.

To obtain an equivalent level of safety and meet the intent of 91.9, we propose that a current,

approved Pilot Operating Handbook (Appendix F) must be available to the crew at the ground station anytime the aircraft is in, or preparing for, flight.

14 C.F.R. § 91.109(a) & 91.319(a)(1): Flight Instruction

The regulation provides that "No person may operate a civil aircraft that is being used for flight instruction unless that aircraft has fully functioning dual controls." The S-1000+ and Vision ground control stations are based on a small hand-held computer and while they do not offer a second set of "controls", both the student and instructor can, and will, operate the single set of controls simultaneously. Both the S-1000+ and Vision can be controlled from a ground station tablet or from the transmitter so, in essence, they have dual control capability and redundancy. With both student and instructor having "hands-on" the controls during flight, we feel that this technique meets the intent 91.109 and provides an equivalent level of safety.

14 CFR § 91.119: Minimum Safe Altitudes

The regulation provides that over sparsely populated areas the aircraft cannot be operated closer than 500 feet to any person, vessel, vehicle, or structure. Since the aircraft will be operating at a maximum of 400 feet AGL, the S-1000+ cannot comply with this requirement.

The equivalent level of safety will be achieved because the S-1000+ and Vision will only fly over property with the permission of the landowner(s) or public agencies. The operator will define before every flight a working area radius and a flight area ceiling, preventing the S-1000+ to go beyond the flight area.

The landowner and the persons who may be on the ground in the flight area will be briefed of the expected route of flight and the associated risks to persons and property on the ground. Due to the small size of the S-1000+ and the material with which the S-1000+ is built, the hazard to persons, vessels, vehicles, and structures is not comparable to manned aircraft and should be considered in granting the exemption.

Moreover, the aircraft will not be operated over congested areas nor over any open-air assembly of persons. The aircraft will be operated at an altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.

14 CFR 91.121 – Altimeter Settings

This section requires that 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 below 18,000 feet MSL to:

- The current reported altimeter setting of a station along the route and within 100 nautical miles of the aircraft;
- 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;
- 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.

To provide an equivalent level of safety, the S-1000+ autopilot calculates the reference altitude (ground level) with the on-board GPS during the pre-flight tests. The GPS and barometer data are merged with respect to their respective precisions. The GPS provides reliable information to correct potential barometric bias, while rapid variations in altitude are detected through the barometer. Hence, barometric bias induced by environmental factors is rejected. The IOSD telemetry of the S-1000+ provides the CIP and VO real time flight data via the GPS and also performs flight recording.

14 C.F.R. § 91.151(a): Fuel Requirements for Flight in VFR Conditions

The regulation provides that no person may begin a flight in an airplane under day-VFR conditions unless there is enough fuel to fly to the first point of intended landing and to fly after that for at least 30 minutes.

Given the area of operation for the S-1000+ and Vision, VSI believes that an equivalent level of safety is already achieved with the specific procedure preventing the S-1000+ or Vision from accepting a take-off order if the battery level is below a given value. Moreover, VSI will monitor the battery levels of the S-1000+ and Vision during flight and return the aircraft to home when battery levels reach 25 to 30 percent capacity (depending on distance from home). DJI has integrated battery level warnings into controllers operated for these aircraft.

14 C.F.R. § 91.203 (a) & (b): Carrying Civil Aircraft Certification and Registration

This regulation provides as follows:

- No person may operate a civil aircraft unless it has an appropriate and current airworthiness certificate.
- No person may operate a civil aircraft unless the airworthiness certificate required by paragraph (a) of this section or a special flight authorization issued under §91.715 is displayed at the cabin or cockpit entrance so that it is legible to passengers or crew.

The S-1000+ and Vision weigh only 24 and 3.5 pounds (max take-off weight), respectively. As such, there is no ability or place to carry certification and registration documents or to display them on the UAS. In addition, there is no pilot or passengers on board the aircraft.

To obtain an equivalent level of safety and meet the intent of 91.203, VSI proposes that documents deemed appropriate for this aircraft by the FAA will be co-located with the operator at the ground control station in the S-1000+ and Vision box and available for inspection upon request

14 CFR Subpart E (91.401 - 91.417) - Maintenance, Preventive Maintenance, and Alterations

The regulation provides that the operator is primarily responsible for maintaining the aircraft in an airworthy condition, including compliance with Parts 39 and 43. Paragraphs 91.407 and 91.409 require that the aircraft be "approved for return to service by a person authorized under Part 43.7" after maintenance and inspection. Section 91.409(a)(2) requires an annual inspection for the issuance of an airworthiness certificate. Section 91.417(a) requires the owner or operator to keep records showing certain maintenance work that has been accomplished by certificated mechanics,

under Part 43, or licensed pilots and records of approval of the aircraft for return to service.

VSI proposes that the maintenance of the S-1000+ and Vision will be accomplished by the owner/operator according to the maintenance manual, provided by DJI. VSI requests the FAA treat the S-1000+ and Vision training programs as proprietary under 14 C.F.R. 11.35(b) and not include these documents in the public docket.

An equivalent level of safety will be achieved because the S-1000+ and Vision are small in size, they are not a complex mechanical device, and they will operate only in restricted predetermined areas. Moreover, the operator is the person most familiar with the aircraft and is best suited to maintain the aircraft in an airworthy condition and to ensure an equivalent level of safety.

APPENDIX B: ACADEMY OF MODEL AERONAUTICS SAFETY REQUIREMENTS

Academy of Model Aeronautics National Model Aircraft Safety Code

Effective January 1, 2014

A. **GENERAL:** A model aircraft is a non-human-carrying aircraft capable of sustained flight in the atmosphere. It may not exceed limitations of this code and is intended exclusively for sport, recreation, education and/or competition. All model flights must be conducted in accordance with this safety code and any additional rules specific to the flying site.

1. Model aircraft will not be flown:
   (a) In a careless or reckless manner.
   (b) At a location where model aircraft activities are prohibited.
2. Model aircraft pilots will:
   (a) Yield the right of way to all human-carrying aircraft.
   (b) See and avoid all aircraft and a spotter must be used when appropriate. (AMA Document #540-D.)
   (c) Not fly higher than approximately 400 feet above ground level within three (3) miles of an airport without notifying the airport operator.
   (d) Not interfere with operations and traffic patterns at any airport, heliport or seaplane base except where there is a mixed use agreement.
   (e) Not exceed a takeoff weight, including fuel, of 55 pounds unless in compliance with the AMA Large Model Airplane program. (AMA Document 520-A.)
   (f) Ensure the aircraft is identified with the name and address or AMA number of the owner on the inside or affixed to the outside of the model aircraft. (This does not apply to model aircraft flown indoors.)
   (g) Not operate aircraft with metal-blade propellers or with gaseous boosts except for helicopters operated under the provisions of AMA Document #555.
   (h) Not operate model aircraft while under the influence of alcohol or while using any drug that could adversely affect the pilot's ability to safely control the model.
   (i) Not operate model aircraft carrying pyrotechnic devices that explode or burn, or any device which propels a projectile or drops any object that creates a hazard to persons or property.
   Exceptions:
   - Free Flight fuses or devices that burn producing smoke and are securely attached to the model aircraft during flight.
   - Rocket motors (using solid propellant) up to a G-series size may be used provided they remain attached to the model during flight. Model rockets may be flown in accordance with the National Model Rocketry Safety Code but may not be launched from model aircraft.
   - Officially designated AMA Air Show Teams (AST) are authorized to use devices and practices as defined within the Team AMA Program Document. (AMA Document #718.)

   (j) Not operate a turbine-powered aircraft, unless in compliance with the AMA turbine regulations. (AMA Document #510-A.)
3. Model aircraft will not be flown in AMA sanctioned events, air shows or model demonstrations unless:
   (a) The aircraft, control system and pilot skills have successfully demonstrated all maneuvers intended or anticipated prior to the specific event.
   (b) An inexperienced pilot is assisted by an experienced pilot.
4. When and where required by rule, helmets must be properly worn and fastened. They must be OSHA, DOT, ANSI, SNELL or NOCSAE approved or comply with comparable standards.

B. **RADIO CONTROL (RC)**

1. All pilots shall avoid flying directly over unprotected people, vessels, vehicles or structures and shall avoid endangerment of life and property of others.
2. A successful radio equipment ground-range check in accordance with manufacturer's recommendations will be completed before the first flight of a new or repaired model aircraft.
3. At all flying sites a safety line(s) must be established in front of which all flying takes place. (AMA Document #706.)
   (a) Only personnel associated with flying the model aircraft are allowed at or in front of the safety line.
   (b) At air shows or demonstrations, a straight safety line must be established.
   (c) An area away from the safety line must be maintained for spectators.
   (d) Intentional flying behind the safety line is prohibited.
4. RC model aircraft must use the radio-control frequencies currently allowed by the Federal Communications Commission (FCC). Only individuals properly licensed by the FCC are authorized to operate equipment on Amateur Band frequencies.
5. RC model aircraft will not knowingly operate within three (3) miles of any pre-existing flying site without a frequency-management agreement. (AMA Documents #922 and #923.)
6. With the exception of events flown under official AMA Competition Regulations, excluding takeoff and landing, no powered model may be flown outdoors closer than 25 feet to any individual, except for the pilot and the pilot's helper(s) located at the flightline.
7. Under no circumstances may a pilot or other person touch an outdoor model aircraft in flight while it is still under power, except to divert it from striking an individual.
8. RC night flying requires a lighting system providing the pilot with a clear view of the model's attitude and orientation at all times. Hand-held illumination systems are inadequate for night flying operations.
9. The pilot of an RC model aircraft shall:
   (a) Maintain control during the entire flight, maintaining visual contact without enhancement other than by corrective lenses prescribed for the pilot.
   (b) Fly using the assistance of a camera or First-Person View (FPV) only in accordance with the procedures outlined in AMA Document #550.
   (c) Fly using the assistance of autopilot or stabilization system only in accordance with the procedures outlined in AMA Document #560.

C. **FREE FLIGHT**

1. Must be at least 100 feet downwind of spectators and automobile parking when the model aircraft is launched.
2. Launch area must be clear of all individuals except mechanics, officials, and other fliers.
3. An effective device will be used to extinguish any fuse on the model aircraft after the fuse has completed its function.

D. **CONTROL LINE**

1. The complete control system (including the safety thong where applicable) must have an inspection and pull test prior to flying.
2. The pull test will be in accordance with the current Competition Regulations for the applicable model aircraft category.
3. Model aircraft not fitting a specific category shall use those pull-test requirements as indicated for Control Line Precision Aerobatics.
4. The flying area must be clear of all utility wires or poles and a model aircraft will not be flown closer than 50 feet to any above-ground electric utility lines.
5. The flying area must be clear of all nonessential participants and spectators before the engine is started.

Academy of Model Aeronautics
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"SEE AND AVOID" GUIDANCE

A. General:

1. The primary means to avoid collisions between all aircraft flying within our National Airspace System (NAS) is "See and Avoid."

2. Vigilance must be maintained by each person operating an aircraft (whether model or manned) so as to "see and avoid" other aircraft.

3. Model aircraft must avoid manned aircraft. Our privilege to fly model aircraft in the NAS depends on our commitment to remain "well clear" of manned aircraft.

4. Simply avoiding an actual collision is not enough. A "near miss" is not acceptable.

5. Unless flying at a mixed-use site where manned and model aircraft routinely share airspace through their own site-specific rules, model aircraft must fly sufficiently far away from manned aircraft so as not to create a collision hazard.

6. Model aircraft flying must not only be safe, it must be perceived to be safe by the greater manned aviation community. Modelers must continually demonstrate their respect for the safety of manned aircraft by remaining vigilant and well clear.

7. Whenever a potential conflict arises between model aircraft and manned aircraft, the pilot of the model aircraft must always give way to the manned aircraft.

8. The pilot of a model aircraft must never assume the pilot of a manned aircraft can see the= model or will perform any maneuver to avoid the model's flight path.

9. Visual Line of Sight is required by the Safety Code. It means that visual contact with the aircraft must be maintained without enhancement other than by corrective lenses prescribed for the model aircraft pilot. All RC flying must remain clear of clouds smoke or any other obstruction to the line of sight.

10. "Blue Sky" is a term used to explain the method used to increase separation between a model and a manned aircraft in the same vicinity. The modeler should maneuver the aircraft in such a way as to increase the amount of blue sky perceived between the model and the manned aircraft. By increasing the blue sky separation, the question about depth perception is taken out of the equation and the modeler need not worry whether the model is closer to him than the manned aircraft or further away. Increasing the blue sky between the model and the manned aircraft automatically increases separation between them.

11. A modeler should never place any consideration for the well-being of the model aircraft above the safety of manned aircraft. Maneuvering to avoid the conflict may require that the model aircraft be sacrificed.

12. Free flight models should not be launched with relatively low altitude manned aircraft in sight and downwind or headed downwind from the launch site.

B. Spotters:

1. Before a flight, the pilot must insure that the spotter understands his/her duties and expectations.

2. A spotter should be used to assist in monitoring the surrounding airspace for manned aircraft whenever a flight is expected to exceed 400 feet above the ground and that operation is expected to be in proximity to known manned aircraft traffic such as at a mixed-use facility or within three miles of an airport. The spotter must have sufficient visual acuity and be mature enough to take this responsibility very seriously.

3. A spotter should also be prepared to assist his/her pilot in the event that another model aircraft or spectators become endangered or in turn are perceived to be a danger to the pilot or the pilot's model aircraft.

4. If a model aircraft pilot experiences what he or she considers a near miss with a manned aircraft, that model aircraft pilot should notify AMA Headquarters with a written report of the incident, including action taken by the model aircraft pilot to avoid the manned aircraft. This report is intended to help the modeler, the club, and the AMA capture as much detail as possible so that it may be used to assist all parties in recalling the particulars of the incident at a later time. Call 1-800-435-9262 (1-800-IFLYAMA) extension 230 or 251 for assistance with this report.

Academy of Model Aeronautics
AMA Advanced Flight Systems Committee
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Radio Controlled Model Aircraft Operation Utilizing Failsafe, Stabilization and Autopilot Systems

1. DEFINITION OF TERMS:

Please refer to Page 3, section 7 which contains an alphabetical listing of the definitions of the terms in italics that are used in this document.

2. GENERAL:

All model aircraft flights utilizing *stabilization* and *autopilot* control systems must be conducted in accordance with AMA's current National Model Aircraft Safety Code and any additional rules specific to a flying site/location.

3. OPERATIONS – REQUIREMENTS – LIMITATIONS:

a) AMA members flying radio controlled model aircraft equipped with flight *stabilization* and *autopilot* systems must maintain *VLOS* with the aircraft at all times including programmed autopilot waypoint flight.

b) *AMA Pilots* must be able to instantaneously deactivate programmed flight of *autopilot systems* at any time during flight and resume manual control of the model aircraft.

c) *AMA Pilots* must perform an *R/C Test Flight* of a model aircraft before activating a newly installed *autopilot* or *stabilization system* and/or after any repairs or replacement of model aircraft *essential flight systems*.

d) Model aircraft exceeding 15lbs and/or 70mph may only use an *autopilot* for a programmed "return to launch" (RTL) flight and not for programmed waypoint flying of a predetermined course.

e) STABILIZATION & AUTOPILOT SYSTEMS MAY BE USED FOR/TO:

- Stabilization/automatically stabilize aircraft to level flight when control sticks are centered.
- Recovery/activate TRX switch to recover an out of control aircraft to level flight.
- Heading/activate TRX switch to hold a model aircraft's heading for precision flight path.
- Altitude/activate TRX switch to maintain fixed aircraft altitude while allowing directional control.
- Return GPS/activate TRX switch to return aircraft via GPS to launch point.
- Return FSS/failsafe activated from radio signal loss to return aircraft via GPS to launch point.
- Fixed circle/activate TRX switch to circle aircraft at point of activation at fixed altitude.
- Waypoint/activate TRX switch to initiate an autopilot programmed flight path via waypoints.
- Fencing/autopilot programed to display site unique boundaries on video monitor/goggles.

4. RANGE – ALTITUDE – WEIGHT – SPEED:

a) One of the requirements in Federal Law (Public Law 112-95 Sec 336 (c) (2) February 14, 2012) for model aircraft to be excluded from FAA regulations is that model aircraft be flown within *VLOS* of the operator.

b) Model aircraft must be flown at or below 400 feet AGL when within 3 miles of an airport as stated in the AMA Safety Code.

c) Model aircraft utilizing an *autopilot* for waypoint flying are limited to a maximum weight (including fuel, batteries, and onboard *autopilot systems*) of 15lbs and a speed of 70mph.

5. RECOMMENDATIONS & INFORMATION:

a) If your radio system lacks *failsafe* capability, consider using programmable digital servos or auxiliary *failsafe* modules. In the event of a radio signal failure these components will activate desired safe servo settings or an *autopilot* for return to base/launch (RTL).

b) When using an *autopilot system* the "return to launch" (RTL) feature should be programmed to return the aircraft to a safe location and safely terminate the flight should manual control of the aircraft be lost. When using RTL, pay particular attention to the manufacturer's throttle recommendations to prevent stalling.

c) The use of *stabilization systems* is recommended when flying FPV to improve flight stability and video quality.

d) Pilots usually choose to incorporate *stabilization* and *autopilot systems* for model aircraft flying to enhance flight performance, correct bad tendencies of the model aircraft, maintain stability in windy weather, establish precision heading holds for takeoffs/landings, flight training for novice pilots, create a steady flight platform for cameras, and generally just to make an airplane easier and safer to fly.

e) When purchasing *stabilization* and *autopilot systems*, always try to select quality equipment from reputable dealers, ensure for compatibility with other onboard systems, and install components according to manufacturers' instructions.

6. PRIVACY PROTECTION SAFEGUARDS:

The use of imaging technology for aerial surveillance with radio control model aircraft having the capability of obtaining high-resolution photographs and/or video, or using any types of sensors, for the collection, retention, or dissemination of surveillance data or information on individuals, homes, businesses, or property at locations where there is a reasonable expectation of privacy is strictly prohibited by the AMA unless written expressed permission is obtained from the individual property owners or managers.

7. DEFINITIONS OF TERMS:

AMA Pilot is an AMA member who is capable of manually operating an R/C transmitter to control a model aircraft's flight path within its safe intended *flight envelope* without losing control or having a collision.

Autopilot Systems incorporate programmable flight *stabilization* with an altitude sensor and a GPS receiver for accurate positioning and to navigate/control a radio controlled model aircraft's flight path. Advanced systems offer software for entering navigable waypoints. The flight data waypoints may be saved to autopilot's/GPS memory for programmed flight.

Essential Flight Systems are any systems or components necessary to maintain stable flight within a model aircraft's *flight envelope*. (This includes primary R/C systems and any *stabilization* or gyros required to maintain stability and heading in certain types of model aircraft that would be uncontrollable/unstable without their use).

Failsafe Systems are designed to minimize or prevent damage and safely terminate a flight when a radio controlled model aircraft loses radio signal. Modern radio systems can be programmed to position servos to a desired control setting in the event of radio signal failure.

First Person View (FPV) refers to the operation of a radio controlled (R/C) model aircraft using an onboard camera's cockpit view to orient and control the aircraft. (AMA Document #550).

Flight Envelope is defined as the range of airspeeds, attitudes and flight maneuvers which a model aircraft can safely perform/operate for its intended use.

Non-Essential Flight Systems are any systems or components that are not necessary to maintain stable flight within the model aircraft's intended flight envelope. (This includes *autopilot* or *stabilization systems* that can be activated and deactivated in flight by the pilot without affecting manually controlled stable flight).

R/C Test Flight requires an AMA Pilot to manually operate an R/C transmitter to control a model aircraft's flight path and determine if the aircraft is capable of maintaining stable flight within its safe intended *flight envelope.*

Stabilization Systems are designed to maintain intended model aircraft flight attitudes. The pilot can install, program and/or activate a system to stabilize yaw, pitch, or roll or any one attitude or combination of attitudes. Systems are often based on rate/heading hold gyros or inertial motion sensors utilizing multi-axis gyros and accelerometers for attitude stabilization.

Visual Line of Sight (VLOS) is the distance at which the pilot is able to maintain visual contact with the aircraft and determine its orientation and attitude without enhancements other than corrective lenses.

APPENDIX C: PRIVACY ISSUES

The S-1000+ and Vision are proposed to be flown over sterile, unpopulated to lightly populated areas. In addition, we propose to obtain landowner permission to fly over properties as part of our services and to notify and obtain waivers of consent from non-landowners over which we will be flying. Finally, most of our flights will be 300 to 400 feet above ground surface, making visual recognition of people on the ground difficult. Because of the sterile environment and the pre-notification of landowners and personnel on the ground, privacy compromises due to VSI activities are anticipated to be alleviated. Under no circumstances will VSI's aircraft be utilized to purposefully invade the privacy of peoples or properties in areas within our studies or outside of our study boundaries.

APPENDIX D: SAFETY CASE

Safety of our flight crew, other aircraft, people on the ground, and public and private properties is of utmost importance to VSI. VSI's Pilot in Command (PIC) will be responsible for all safety procedures and protocols while on the ground. The Visual Observer (VO) will assist the PIC in maintaining safety procedures throughout the course of a project. Safety procedures to be utilized in the filed include the following:

- A full diagnostic check of the aircraft by the PIC and VO using a pre-flight checklist will be performed on the ground prior to commencement of each project;
- High visibility (day-glow orange or green) will be worn by the flight crew during each project. In addition, at the ground station, a high contrast flag or banner that contains the words "Unmanned Aircraft Ground Station" will be placed prior to any flights;
- Operations to be conducted over private or public controlled-access property where approved;
- Permission from the land owner/authority required before commencing any flight;
- Operations over congested areas shall be avoided;
- Operations will not interfere with manned aircraft operations, will yield the right of way to manned aircraft, and operators must See & Avoid other aircraft and obstacles at all times. Use of an ADS-B receiver by the VO will assist in monitoring the presence of other proximal aircraft;
- Operations limited to Visual Flight Rules Meteorological Conditions (VMC) and daylight hours
- Aircraft operations will remain within Visual Line of Sight (VLOS) and will be visually monitored at all times;
- Use of a high-definition first-person view from the aircraft will assist the PIC and VO identify potential flight conflicts and terminate or alter the pre-programmed flight plan;
- VLOS guaranteed with a GPS geo-fence around operator of 0.5 miles
- Flight ceiling pre-programed at 400 feet;
- All operations conducted within 5 miles from an airport shall only be initiated after verbal coordination with the airport authority, or air traffic control when a control tower is present at the airport;
- All operations will comply with required permissions and permits established by territorial, state, county or city jurisdictions; including local law enforcement, fire, or other appropriate governmental agencies;
- In areas where the aircraft will operate over sensitive structures or habitat, the use of a deployable drop-safe parachute affixed to the aircraft will be utilized;
- Post-flight inspection of the aircraft will be performed by the PIC and VO utilizing a post-flight checklist;
- The S-1000+ and Vision operations will be compliant with existing safety procedures inherent to the activities of the related company.

APPENDIX E: MAINTENANCE PROCEDURES

VSI's maintenance procedures for our rotor-powered aircraft are as follows:

- PROPELLER CARE
  - Propellers must be checked each flight for nicks or cracks
  - Propellers are designed to last indefinitely if they do not impact dust, dirt or more.

- BATTERY CARE AND USE

Refer to instruction sheet included from the battery manufacturer. Typical information follows:

- Batteries are highly flammable and can explode, especially when fully charged. Improper charging, vibration, impact, high discharge, etc. can lead to explosion and fire. Batteries must be charged under constant supervision and using proper precautions.
- Batteries fully charged must be handled with extreme care.
- Any battery that puffs up is considered damaged and must not be used. It is in a dangerous state. Never charge a puffed up battery.
- Any battery which holds less than 80% of its rated capacity should be discarded.
- Cycle test each battery after every 50 cycles or if a battery is suspected to have lost as significant amount of its capacity to determine the current capacity.
- Properly dispose of batteries. First discharge the battery fully using a battery cycler. Bring to a recycler such as a home improvement store.
- Always charge flight batteries under "balance" mode.
- Flight Battery Recommended Charge Rate: 1C which takes approximately 1 hour to charge
- Flight Battery Maximum Charge Rate: May exceed 5C. Charge rates higher than 1C will decrease life cycles. Maximum charge rating per the manufacturer will provide 300+ cycles. Use the lowest charge rate which is practical.
- Battery Rest Time between discharging and charging: 30 minutes minimum, 1 hour maximum.
- Do not charge if the battery is more than 2°C warmer than ambient, especially if the temperature is above 20°C. The outer surface is cooler than the inner core after use. Damage will occur when charging a warm battery.
- Recommended Battery Discharge Amount: 80%. Using more of the capacity of the battery will decrease the life cycles
- As battery temperature approaches freezing the capacity of Lithium Polymer batteries decrease. Keep warmer than 5°C before installing into the UV (unmanned vehicle).
- Battery capacity decreases at higher discharge rates. Using more batteries decreases the discharge rate of each battery thereby extending individual battery capacity slightly.
- Lower discharge rates improve the life cycles.
- Batteries are rated at greater than 300 life cycles. 1,000+ life cycles are possible.
- Batteries must not be stored above 60% charged state for extended periods.
- Batteries should be stored below 25°C for extended periods

- Store batteries between 40% - 60% charged state. Fully charge just before use.
- Fully charged batteries which are not to be used within 24 hours should be discharged to 40% - 60% charged state using the battery discharger.
- Using more than one battery at a time requires the proper wiring harness so that the voltage is no more than 25.2V. Over voltage will cause serious damage to electrical equipment.

- PREVENTATIVE MAINTENANCE
  - ANNUAL INSPECTION (SUGGESTED)
    - If the airframe has in excess of 300 hours in a one year period, an annual inspection must be completed by an approved technician.
    - An approved technician should disassemble the AV and inspect all components for wear and replace any components as required.
    - Test all batteries for capacity.
    - Upgrade firmware and software to latest revisions

  - 500 HOUR PM (SUGGESTED)
    - An approved technician should disassemble the AV and inspect all components for wear and replace any components as required.
    - Replace all 8 motors.
    - Test all batteries for capacity.
    - Upgrade firmware and software to latest revisions.

APPENDIX F: USER MANUALS & HANDBOOK

User manuals for the DJI S-1000+ and Vision are included in this appendix. The Pilot's Operating Handbook prepared for the S-1000+ is also included within this appendix.